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TECHNICAL REPORTS

THE WORLD BANK

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1 GENERAL REPORT

1.1 HISTORICAL NOTES [1]

The Besac Fortress, or as the people usually calls it, "the town of Besac", is located on the hill, at the altitude of approximately 50 m, which rises from Virsko Polje and Kruseva Bara, right above the Virpazar community. The strategic importance of Beasc is based on the fact that from its observation posts and towers one gets a complete view of the surrounding area, especially from Virsko polje on the northwest and the Skadar Lake on the northeast. The fortress can be reached by a gravel road that can be used by vehicles, that is connected to the road Vir-Ostros, along one side of the lake for approximately 200 m.

The Besac fortress represents a fortification complex that consists of an external defensive wall, with the gate on the southern side and observation points on the northeast and southwest corners, and the inside buildings: rectangular fortification with circular towers on the northern and southern side, the building used as a military barrack in the central part, and the remnants of the supporting buildings along the southern wall. The buildings inside the walls of the fortress are distributed harmoniously and have good communication between them, in the form of cobble paved paths at various levels. Because it is abandoned and neglected for many years, the Fortress is a ruin nowadays.

Having in mind that the Besac Fortress originates from the Turkish times, the second half of the 15th century, and it is also assumed to have a younger fortification with towers inside the walls – from the period of medieval Zeta it represented a border between the Montenegrin and the Turkish territories of the time, and thus, it has historic value.

A characteristic example of the successive creation of the fortification – defense architecture, from the period of medieval Zeta (early 15th century), and the Turkish period (second half of 15th century), the Besac Fortress has an important military-engineering architectural value.

Having in mind that the contours of the external walls of the Besac Fortress and the main buildings inside of it dominate the Virsko Polje and the Skadar Llake, thus providing for very attractive views of Virpazar and especially of the Skadar Lake, from the east side of the Godinje bay, the hill with the fortress has exceptional ambiance and aesthetic values.

Virpazar together with the National Park Skadar Lake, based on its natural and cultural resources, has a great tourism potential. An important element for the tourism valorization of the Fortress is its position, i.e. easy access and serviceability – the crossing point of the roads from the north-south direction (Podgorica-Bar) and east-west (Cetinje-Skadar.) Besides, the vicinity of Virpazar and Vranjina, the two main touristic points on the Skadar Lake are important. Virpazar is one of the biggest communities on the Montenegrin side of the lake, with the biggest tourist offer and infrastructure, with the pier used by the ships as a starting point for the lake cruises. As the other islands on the southern side of the lake are further away

[1] Text by: Regional Programme for Cultural and Natural Heritage in South East Europe 2003 – 2010. PRELIMINARY TECHNICAL ASSESSMENT OF THE ARCHITECTURAL AND ARCHAEOLOGICAL HERITAGE IN SOUTH EAST EUROPE. BESAC FORTRESS. Virpazar, Bar Montenegro.

from Virpazar, Vranjina hosts the Visitors' Center of the PI National Parks of Montenegro, and a pier used by cruise ships.

As the organization of organic food fairs is becoming more and more interesting, and the territory of the Crmnica region is the most productive center of producers of the autochthonous wine type "Vranac", honey, cheese, smoked fish – carp and bleak, and other products, the Virpazar community, together with the Besac Fortress could have a significant economic potential. Production of organic food, in combination with the tourist offer of this region represents an important resource.

The Besac fortress, based on its cultural and historic values is important at the national level, but based on its geographic position and natural potential of the surrounding area, it is also important at the regional level. Due to the fact that the fortress was built by the Turks, and that it is situated on the Lake shared between two countries, it also has a wider international importance.

The aim of this project is the rehabilitation of the architectural heritage in support of sustainable development, in this case – protection of the cultural resource with new purpose "touristic-hospitality point for excursions and fair activities of the local population".

The preliminary intention is to reconstruct the existing buildings, with the possibility to introduce new ones, in support of the infrastructure necessities, e.g. along the southern wall, where the supporting facilities were located before, or outside the external, defensive wall, along the southern side.

The above mentioned project to restore the Besac fortress will undoubtedly be useful, too, to strengthen the sustainable development of the communities of Virpazar and Vrajina, and their population.

Fig 1: FORT WITH TOWER SEEN BY NORTH

Fig 2: GENERAL VIEW OF THE FORTRESS SEEN BY SOUTH

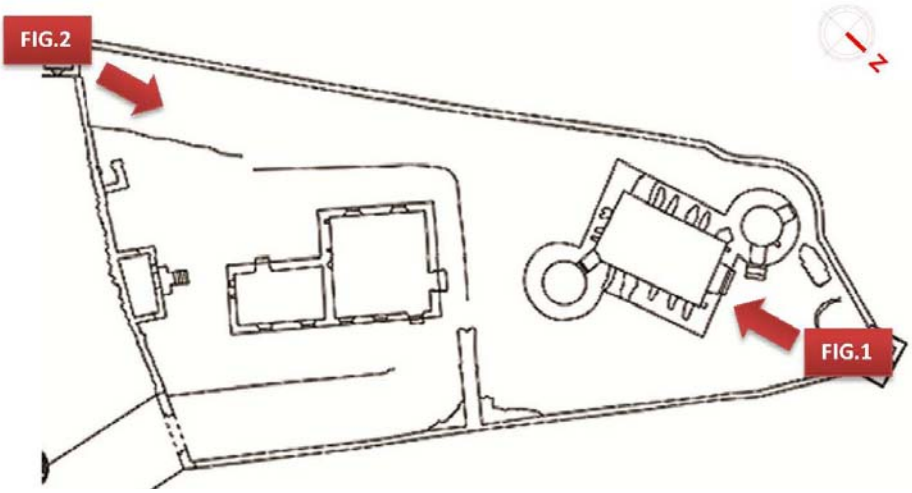


Fig 3: FORT-INTERNAL VIEW

Fig 4: BARRACKS

1.2 STATUTORY PROTECTION/CONSTRAINTS[2]

The Besac fortress is entered into the Central Register of Cultural Monuments of Montenegro (Decision no. 1,217 dated 27.11.1957), as a monument of culture of Category III[3], and it is subject to limitations regarding the interventions on the immovable cultural resource (Law on Protection of Cultural Monuments, Official Gazette of Republic of Montenegro no. 47/1991).

The direct surroundings of the Besac fortress are the Virpazar community and Skadar Lake on the east side. The Lake was proclaimed a National park in 1983. Besides, in 1995, Skadar Lake was entered into the Ramsar list as a swamp of international importance, primarily because of the birds.

The activities regarding the future purpose and use of space are defined in the planning documentation of the state (Spatial plan for the special purpose area of the National Park Skadar Lake) and local authorities (Plan for development of the small community of Virpazar). All the interventions on the cultural resource must be planned in accordance with the conservation requirements and executed under strict supervision by the authority for protection within the responsible State Institute for the protection of cultural monuments. The approval for works on the cultural resource is issued by the Ministry for Economic Development, with the previous consent of the relevant Institute for the protection of cultural monuments.

1.3 ARCHEOLOGICAL REPORT

Last July 2011, the Ministry of Culture has carried out sounding archaeological researches of the Besac Fortress (for further details, refer to the attached professional illustrated archaeological report.) Ms. Snjezana Simovic, from the Ministry of Culture, has stated the following conclusions:

"… It can be concluded that there are no moving archaeological finds, only buttons from the German military uniform were found in the probes 5 and 9.

*Also, it has confirmed that Besac fortress lies on a natural rock, which makes its substrate structure (*supstrukciju*). All probes were placed at the key locations within the fortress, where the primarily findings could be expected. However, excavation*

[2] The present chapter (apart the next notes) is taken by: Regional Programme for Cultural and Natural Heritage in South East Europe 2003 – 2010. PRELIMINARY TECHNICAL ASSESSMENT OF THE ARCHITECTURAL AND ARCHAEOLOGICAL HERITAGE IN SOUTH EAST EUROPE. BESAC FORTRESS. Virpazar, Bar Montenegro.

[3] Under the previous law for conservation of cultural monuments (Official Gazette No. 47/1991, 27/1994), the monuments in Montenegro, according their cultural value, are classified in the following three categories:

- monuments of great importance (Category I),
- monuments of great significance (Category II), and
- important monuments (Category III.)

The Article 32 this states: "Significant cultural monuments are monuments that do not belong to the first or second category, and by their cultural and historical or other value they are of reduced/narrower regional or local significance (Category III)"
From August 2010 a new law that treats the cultural heritage of the Protection of Cultural Property Act is in force (Official Gazette no. 2010/49). Under this new law, cultural property can be:

- a cultural property of international significance,
- cultural property of national significance, or
- cultural property of local significance.

The new classification of cultural monuments in accordance with the new law has not been performed yet.

layers in probes suggest that they have already been treated, or, that in the area of the fortification, earthworks have been carried out at its base.

Use of the fortress and the fact that its prime use has been converted many times since its establishment - until the mid '40 of the XX century is enough long period during which the original cultural layer was eroded. Researches show that the natural rock of the fortress Besac, descends from west to east, which is confirmed by the fortress look, which western wall and the ground are much higher than the east one.

In any of probes traces of architecture were not found, although they were expected especially in the probes in and near the fort. Based on this it can be assumed that the castle with the circular towers is the oldest building of the fortification complex from the medieval period of Zeta. It can be conclude that the Turks, as well as in other cases, have taken over the fortress and tailor it to their needs.

The optimal archaeological researches have been undertaken for a relatively short period. The archaeological researches were not carried out in eastern tower in the fortress due to obstacle of physically reaching it as well as relatively short time frame. Therefore, the presence of an archaeologist will be necessary during the revitalization of mentioned tower of the Besac fortress.

The most important finding regarding the dating of buildings within the complex refers to the fact that the remains of earlier buildings were not found in. Also, during the analysis of wall screens [note: plaster] *and other elements that are visible on the external and internal surfaces of walls, it was concluded that the most imposing element of the complex, the fort with round towers, seems to represent an object that was created in one phase, and, because of the material and construction methods it could be argued that this fortress was existing during the Turks time, and in that time it suffered only minor alterations.*

Further, it could be concluded that the interventions which were carried out in Turkish time were related to the construction of the defensive walls, upgrading or rebuilding the guards, and possibly building on the site of today's auxiliary building, which has no cultural value.

During the analysis of insides of the objects the data which represents the starting point for the formation of stone floors in the main fortresses were found. An accurate data about the position of the original wooden staircase in the central part, and the recent circular staircase in one of the towers, also were found. Data which were previously reported about the exact position of the roof on the building barracks, as well as positions in the ceiling guards A were also confirmed. An underground connection between the fortress and the guards were not found.

During the analysis of building facades, it was concluded that all facilities were constructed as buildings with visible stone facades and access to plastering [note: the plastering of the facades] *have occurred in the later stage (probably between the two world wars). That is why, all facades of all buildings located within the complex should be presented as a stones one. Additional clarification, regarding the results of researches works relates to the following:*

- → *The level of work which is necessary to consolidate the entire complex should be determined after assessing the structural condition of the complex and all its parts. Even though it is possible to apply modern materials for the remediation in the constructive sense, the final processing of all walls should be carried out using current materials;*
- → *this means the rehabilitation of defensive walls, fortification and the auxiliary facilities, as provided within the appropriate guidelines - previously issued conditions of conservation, where the following is stated: It is necessary to thoroughly evaluate the structural condition of the entire complex and provide the necessary static consolidation, in the way that new elements of static reinforcements are not visible on the buildings facades;*
- → *as the buildings have no roofs on and no relevant data about the authentic look of the roof of fortress with circular towers have found, it is not possible to predict the performance of the subject roof. The walls of the upper floors of the fortress need to be preserved, with a cap conservation set. The roof of the barrack should be restored while keeping all the elements of the roof which have been determined on the site and recorded with the conservation project which has prepared by the Republic Institute for Monuments Protection. This refers to the height of the ridge and cornice, and the height and slope of roof planes;*

- → *as the fortress with round towers is the building with the most prominent cultural values, essential to the authenticity and integrity of cultural property, during its rehabilitation is necessary to comply with all the existing data. It is necessary to keep the shape, size, number and arrangement of all holes on the buildings facades, and - as a rule, all stages from the period of the complex creation should be shown, which includes the presentation and glazing of all openings in accordance with guidance provided by local consultants, with minor repairs, and accordance with the suggestions that were previously imposed. It is not possible to predict the early stages of reconstruction of the facility and eliminated recent holes, but it is necessary to preserve the elements which were formed between the two world wars, when the larger windows sizes were made;*
- → *in accordance with the findings of the research works, all exterior walls of facilities with circular towers and other facilities should be planned as a stone ones, which means that it is necessary to provide the removal of all parties of plaster from all sites and provide a finishing technique of grouting, called* dersovanje *(It is technique which means filling joints between the blocks and leveling the entire surface of the plaster). Recipe for the plaster needs to be adapted to the present state;*
- → *the floors in the fort with round towers, in accordance with the findings on the spot, are necessary to be predicted as stone ones (in the central area, as well as round towers). First it is necessary to predict the return (reappearing) of the stone panel which was caught up on the spot. The dimensions and shape of the new, missing stone panels should be adapted to the present state, and it is necessary to provide more accurate and finer finish, as the difference between new and caught up elements should be indicate. In particular, it is necessary to keep all the existing floor elevations;*
- → *the same principles-retention of existing floor coverings must be applied in the process of rehabilitation of the access road and footpaths within the fortifications. It is not possible to introduce new material for this purpose but is necessary to provide cobbling (set of stone panels of irregular size - all modeled on the existing floors);*
- → *the rehabilitation of other facilities within the complex is necessary to predict in the way to make the consolidation and reconstruction of all elements that could be perceived on the spot, using the original, current materials, while the missing elements needs to be aligned with the existing state;*
- → *inside of all buildings modern intervention could be performed in order to adjust the planned use of the facilities. In order to achieve the corresponding functionality, and improve building energy efficiency modern materials could be used, but in a way that their use could be confined to the interior of buildings or modern materials that are not visible on the facades."*

Fig 5: ARCHEOLOGICAL SOUND

1.4 METHODOLOGICAL APPROACH

1.4.1 CONSERVATION AND RESTORATION CRITERIA

Conservation and rehabilitation of a building or of a monument needs to go through identification of general and shared tasks, capable to maintain the historical material providing new vital lymph, throughout facilities, consolidation intervention, infrastructures and innovation of the surrounding environment. Tasks are established by the community who's in charge for the custody of the property, on the base of cultural, economical and social options, but must rely on a common share idea, based on the experiences and the culture of subjects that may be even geographically quite remote. Such a common shared base is represented by the Restoration Chart that, starting in 1931, came to our days in a continuously sequence. The following methodological guidelines take into account both needs: the local ones, based on the potentially attractiveness location by a cultural and touristic point of view, and the more general ones, focusing on the need to provide technical instruments for a correct intervention on conservation.

On the base of such a premise, the general tasks will be the following:

→ respect to the structural identity: having in mind the integral safeguard of such a cultural heritage site, the structural consolidation interventions will have the aim to enhance its performances; it will be reached through the use of the historic structures as far as still working by a structural point of view, and their replacement only in case of their end of performance;
→ integrated conservation: further the specific design for the site and the buildings, it has to be foreseen a broad design, able to allow the site to "survive" in the actual social, territorial, naturalistic framework.
→ building materials restoration: all the historical surfaces are considered important and to be safeguarded. An operative protocol for any surface typology will be provided, in order to detect strategies and products to tackle deterioration causes.
→ "readability" of any intervention, in order to let better understand the users the historic and actual development of the building / site;
→ any intervention has the potentiality to be removed, if in the future the former conditions could be reached through further technologic advancements;
→ compatibility: all the chosen materials and technologies must have an elevate compatibility grade, in order to not distort the building / site identity, by a physical, chemical, mechanic point a view.

Furthermore, any intervention will have the aim to detect not only optimal solutions for the building / site, but also for the environment.

1.4.2 CONSERVATION CONDITIONS

The design will be carried out taking in strict and mandatory consideration what described by the *Conservation Conditions* document issued by the Republic Institute for Monuments Protection on 20 June 2011 (no 02-920/1). Particularly, we will adhere to all the stated conditions, that are above recalled (translation in English from the original in Montenegrin):

→ the reconstruction and revitalization of Besac Fort is approved in line with the principle of the profession and respecting the technical norms and legislation;

- → the function of all parts of the complex needs to be specified in accordance with the ToR;
- → prior to developing the design it is necessary to examine the encountered condition in details, to record all the findings, which includes all the elements necessary for the proper architectural analysis of the complex;
- → it is necessary to make a detailed assessment of the structural condition of the entire complex and to envisage the necessary static consolidation in the manner that new elements of static reinforcement are not visible on the facades of the structures;
- → it is necessary to ensure the preservation of the original spatial relationships and to envisage the maintaining of the horizontal and vertical overall dimensions of the structures within the complex, as well as the maintaining of the encountered number of floors, and all the elements of architectural plastic;
- → it is necessary to retain all the elements of the roofs – ridge and cornice height and the height and the inclination of the roof planes (considering that in any case the roof planes inclinations are certain);
- → it is necessary to retain the form, size and the number and distribution of all the openings on the facades of the structures, and, as a rule, present all the stages from the time of the origin of the complex;
- → for the construction of the windows and doors, it is necessary to foresee the use of high quality timber, and all the elements of the woodwork need to be made according to the traditional details of this area;
- → it is particularly necessary to envisage the mounting of the entrance gate which should be made of high quality timber with massive ironwork;
- → in the process of remedying the principal fort, it is necessary to respect the encountered state as much as this is possible. The remedying of the walls and the floors and of all the architectural elements needs to be planned so as to reflect the original form. It is also necessary to envisage the insulation to be applied on the upper floor so as to preserve the original vault of the ground floor and the articulated space with niches;
- → the guardhouses need to be reconstructed and their floors restored according to the pattern of the encountered remains, and depending on the results in the field, it is desirable to activate the underground connection between the guardhouse and the principal fort[4];
- → since the outer walls of the structures were made as massive walls up to 100 cm thick, it is necessary to keep them in entirety and possible measures of additional thermal insulation of the outer walls need to be limited to repairs and the interventions on possible thermal bridges;
- → with the purpose of achieving appropriate functionality and the improvement of energy efficiency of the structure, it is possible to use contemporary materials, but in such a way that their application be restricted to the interior of the structure and that the materials are not visible on the facades;
- → all stone walls need to be thoroughly cleaned, which comprises the removal of vegetation, of the unstable parts of the walls, stripping off the plaster and the removal of the unstable joints. New construction works and repointing should be adjusted to the encountered state with maximum use of the encountered material;

[4] It has to be noted that during the archaeological researches already carried out, no evidence of the said underground connection has been found. In any case, further possible surveys during the works could reach for more deepened results.

→ landscape design of the complex should be covered by a special addendum to the Main Design. The remedying of the existing footpaths should be envisaged by using mostly the encountered materials, at the same time reducing new pedestrian communications to minimum;
→ the unstable parts of the access road abutment wall need to be consolidated by using the existing material and the access road itself needs to have paved finish;
→ all the earthworks within the complex, but also in its immediate vicinity, need to be extremely carefully undertaken, since it is possible to uncover the remains of the older structure – in which case it is necessary to envisage their conservation and presentation;
→ the mounting of electrical installations needs to be planned in such a way that the encountered values and the integrity of the cultural property are not harmed.

1.4.3 PLANT INTEGRATION

The life of a architectonic complex, of any kind, is strictly linked to its physic conservation. This existence has been possible through times because of its design, based on the parameters of his time (living comfort, technologies, use, social class, etc.); it remains possible if, while going through transformation and changes even radical, such parameters are kept. Restoring a building is not only an intervention of consolidation and protection, but also giving back the monument to a user, after a careful "reading" of its functional and typological features. It is, so, necessary to provide with the same efficiency the protection of an historical building and its "reutilization", intended as the use of a fabric for a specific task, even if different from the original one; in this idea falls the problem of the choice and the design of technological plants. The approach of the inserting of plants in an historical building is quite difficult, because it doesn't exist a standard which will provide systematic solutions and matching of two needs that often seem contradictory:

→ Respect of the architectonic and physical constraints of the building;
→ Envisage advanced plant solutions and appropriate to the new intended use of the fabric.

Often, if the intervention is not well studied, the same intervention results not well integrated, unbalanced though a merely conservative point of view or through an unacceptable impact of plants on the historic-artistic peculiarity. The restoration design, architectonic and plant, must not, therefore, regardless a careful survey of the existing situations and of the analysis of possible intervention, compatible both from the point of view of the protection of the history of the fabric, and from the point of view of efficiency of function delegated to plants. Main constraints to take into account are of two types:

→ Architectonic:
- ✓ Protection of the most remarkable characters of the building (façade, frescos, decorations and stucco, vaulted ceilings, etc.);
- ✓ Protection of masonry from inappropriate intervention (break-in, holes, tracks);
- ✓ Minimization of the impact of plants in the most important halls;
- ✓ Reuse of traditional equipment (chandeliers, radiators, sinks, etc.);

→ Plants:
- ✓ Integral conformity to the laws, general and specific in the intended function (hospital, schools. Library, etc);

- ✓ Existence and suitability of volumes and rooms to assign to technological areas (thermal power plants, elevator space, dumping, etc.);
- ✓ Search for horizontal space for the main distribution (loose stone foundation, etc.) and at the floors (false ceilings, garrets, etc.);
- ✓ Functional requirements: appropriate lightning, environmental comfort (cooling/heating), security system, alarm and monitoring, etc.

Usually, except eventually for the reuse of terminal equipment, restoring an existing building involves a radical remake of the plants or a new insert, in case plants does not exist; therefore the necessity to study plants so that one can:

→ Reduce impact on fabric;
→ Use rooms and volumes existing;
→ Design properly the plants, fallowing the technical regulations.

The main problems to undertake for the proper design of specific plants are the following:

→ Heating and air conditioning:
- ✓ Search for the space for thermal power plant for the refrigeration unit and substations;
- ✓ Tracks for the air exchange system (sent and recovery)
- ✓ Tracks for the distributions pipelines (generally under the floor);
- ✓ Placement of the thermal unities.

→ Water and sanitation facilities and discharges:
- ✓ Proper placement of water in relation with discharges;
- ✓ Supply pipes and secondary ventilations ducts;
- ✓ Rooms ventilation systems.

→ Lifting equipment:
- ✓ Identification of the shafts; accessibility, structural compatibility and appropriate volumes;
- ✓ Machinery spaces (high or low)

→ Lightning:
- ✓ Research for the more appropriate lightning solutions;
- ✓ Minimization of tracks and backgrounds for lights, lights control, etc:
- ✓ Continuous lightning systems (profiles, frames, etc.) rather than point.

→ Electric plants, communication and security:
- ✓ Vertical distribution: in atrium or pipelines dedicated;
- ✓ Horizontal distribution: in false ceiling, inside conduits in the wall or in skirting
- ✓ Problems of coexistence of plants with different voltage and of connection to final utilities.

→ Fire prevention system:
- ✓ Escape routes dimensioned to the use of the building and to the crowds;
- ✓ Survey of compartmentalization, of filters (aired), of stairs (smoke control, protected, etc.)
- ✓ Sizing of the water – fire prevention system and of other safety equipment (lights and safety signals, fire detection and extinguishing system, etc.).

1.5 GREEN SUSTAINABILITY SOLUTIONS

The Besac Fotification is located in a very remarkable environmental context, with a important flora and fauna heritage to be protected. Reuse and consequently the touristic flows that it could attract must not alter such balance. Therefore, also design must be oriented to the environment protection, reducing the waste of resources and the use of pollution material.

Some of the basic design principles are:

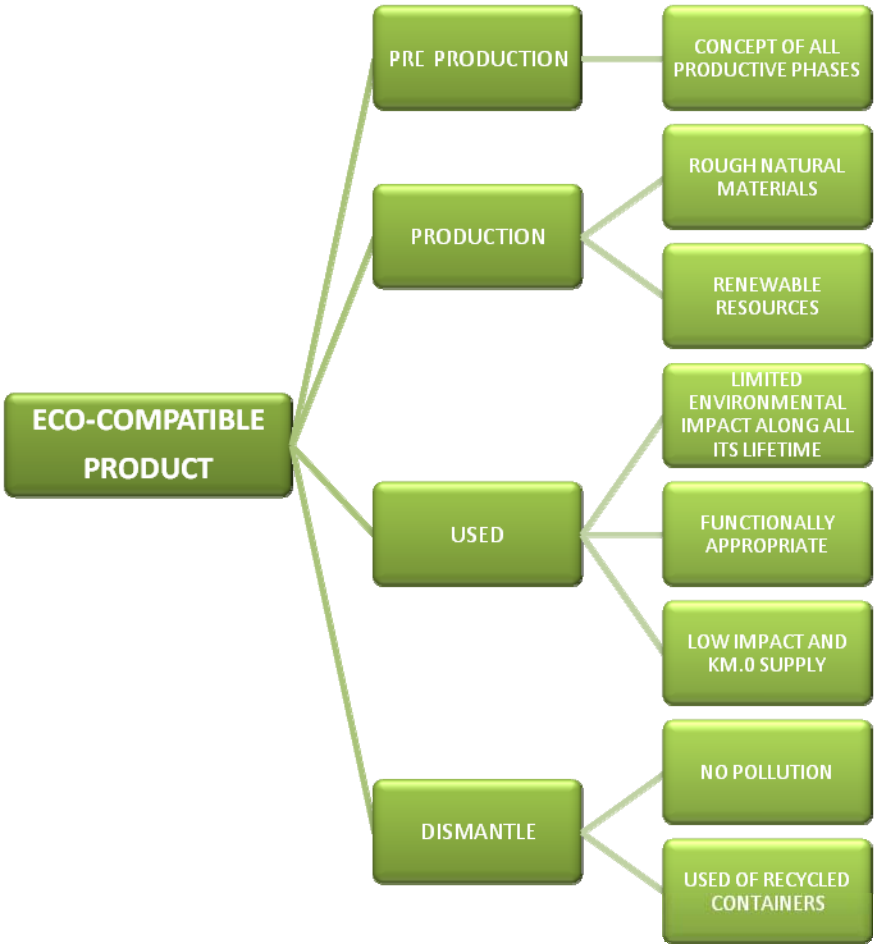
→ Optimize the relation between the building and the context in which it is located;
→ Privilege quality of life and wellbeing of human being;
→ Protect the ecosystem;
→ Use natural resources (water, vegetation, climate);
→ Reduce harmful emission (smoke, gas, wastewater, waste);
→ Conceive flexible solutions and eventual removals, substitutions or integration of plants, and possible enlargement or change of intended use;
→ Provide a large scale use of renewable energy;
→ Use of eco-sustainable material and techniques, preferably belonging to the local material culture;
→ Evaluate which material to be use, giving preference to the natural ones and locally produced, beside being less polluting in the phases of production and disposal:
→ Design electric plant that reduce as much as possible the presence of EMF;
→ Chose building typologies that allow a proper transpiration and ventilation of the building;
→ Use of plants that will reduce electrical consumption and apply all necessary measures to reduce heat loss.

Therefore, starting with the preliminary phase, it will be necessary to identify strategies and implementation measures, capable to satisfy such requirements. You may identify two main lines of action:

→ Material options;
→ Low impact plant solution.

The options on material must imply a less consumption of non-renewable and polluting resources and must satisfy requirement of the attached scheme. Regarding plants, instead, it is necessary to provide the possibility to install high efficiency machinery, so to reduce consumption, solutions aimed to deliver facilities only in the presence of users, exploitation of the natural thermal inertia of historical masonry therefore to limit the use of air conditioning plants, use of lighting with low consumption led.

Such basic indications will allow a rational use of resources and will assure the compliance with the most modern and innovative regulations of the sector.


ECO-COMPATIBLE PRODUCT
PRE PRODUCTION
CONCEPT OF ALL PRODUCTIVE PHASES
PRODUCTION
ROUGH NATURAL MATERIALS
RENEWABLE RESOURCES
USED
LIMITED ENVIRONMENTAL IMPACT ALONG ALL ITS LIFETIME
FUNCTIONALLY APPROPRIATE
LOW IMPACT AND KM.0 SUPPLY
DISMANTLE
NO POLLUTION
USED OF RECYCLED CONTAINERS

1.6 USE OF FORTRESS

The intended use and the content/facilities are below resumed:

→ within the larger structure of the barracks: polyvalent hall having as a primary function the art gallery with the library, research station and video-beam;
→ within the smaller structure of the barracks, the museum hall;
→ fort with towers: wine boutique (Montenegrin wines) – tavern, with belvedere on the upper store;
→ the observatory posts: make them usable and equipped them with adequate equipment for viewing the panorama;
→ ancillary premises: small structure should be planned for a souvenir shop, while the large structure (sentry post) should be equipped in adequate manner in order to look like sentry post from the time when it was in use;
→ the area within the walls should be arranged as landscaped area with amphitheatre, with the possibility of showing video projections outdoors as well as for holding of other outdoors events;
→ the area outside the fortification should be planned for accommodation capacities (examine the possibility of using the nearby structures and placing camping tents) for an artists' colony (artists' club), researchers' colony (considering that the aetiological site Mijela is located nearby); These proposed new constructions should not affect the visual effect of the Fortification and existing vegetation;
→ adequate lighting for the Fortification, i.e. for the interiors, exterior, walls, and access road*;*
→ vehicular access road with arranged parking spaces that would not affect the visual effect of the Fortification and existing*;*
→ adequate access road for disabled persons.

2 TECHNICAL REPORTS

2.1 THE SURVEY PROVIDED BY THE CLIENT

In order to carry out the present assignment within the contractual due time, during the time the Clients have provided different survey regarding both the fortress and the surrounding areas. They consist in:

- a first survey (provided in raster format) of all the fortress, carried out some years ago, has been provided as first survey; it has allowed us to start our site assessment and first design conceptual ideas;
- a digitalized survey has been provided within the contractual time, accompanying the archaeological survey carried out directly by the Ministry of Culture;
- further, we have received another digitalized survey describing the path connecting the fortress with the road to Virpazar – Ostros – Stari Grad;
- finally, we have received the survey regarding the tree taxonomy of site opposite the fortress entrance.

All the above mentioned surveys are listed within the first section of the drawings, named within the section “BS” (Basic Surveys.)

Annex 1. ***Taxation of micro-location Besac***

Current state

Area of Besac is located in the protection zone II of the National Park "Skadar Lake". This high ground is located near the village Virpazar. Fortress Besac can be reached by a narrow road leading from local road Virpazar-Ostros.

In 1950s the area of Besac was reforested with seedlings of cypress (Cupressus sempervires L.) and black pine (Pinus nigra Arnold). We must emphasize that these species are autochthonous in this area. In these area some invasive types were identified as well, such as acacia (Robinia pseudoacacia L.) and sour wood (Ailantus glandilosa).

So, along macadam to Besac fortress woody species of cypress and black pine were recorded. We emphasize that there is more presence of cypress than black pine. This species form avenue along the road (photo 1).

Since building smaller object near the entrance into fortress is planned by the project, taxation of woody species was done in this micro-location. Taxation was done on the right side area of the road fortress-Virpazar, from entrance into fortress in lenght of 30m and in width of 15m from the road (fig. 1).

We note that in this area 33 trees were stated, of which there are 29 cypresses, 3 black pines and 1 acacia.

Health condition of these trees is not the best. Since these species were entered by afforestation (except acacia), their vitality is on very low level. There are certain trees with dry top or which are completely dry (7 trees) (photo 4) or mechanically damaged (2 trees).

Photos of this location are given further in the text

Photo 1a

Photo 1b

Foto 2

Foto 3

Dry top trees:

Photo 4.

Photo 5

Photo 6

Photo 7

Black pine (Pinus nigra L.)

Photo 8.

Acacia (Robinia pseudoacacia L.)

Taxation of micro-location Besac

The method of grading the state of tree flora

The table indicates current state of autochthonous tree flora and the following indicators are rcesssed/described:

1. Tree height;

2. Pelvic diameter of the trunk;

3. Width of crown;

4. Rating vitality;

5. Rating decoration;

1. Tree height is determined by the altimeter (Haga & Nounberg);

2. The diameters of trees on the chest height (1.30 m) were calculated from the measured volume of trees.

3. Crown width was determined by measuring the projection of the crown on the ground, identifying the mean of two perpendicular diameter tree crown projections.

4. Vitality score estimated in the range of 1 to 5 and characterized in the following way:

1	*Dry the affected tree with no possibility of recovery*
2	*Sick tree with the possibility of recovery, by application of effective measures*
3	*Tree with mechanical damage and a number of staple and broken branch*
4	*A tree with less intensity of damaged branches*
5	*A tree without damage*

5. The decorative rating is expressed in the range of 1 to 5. It is of crucial importance for the decorative assessment beside the health status the morphological characteristics of the crown and trunk, as well as the appearance of the individual as a whole. In relation to the presence and the effect of the listed factors, decorative score are established as follows:

1	*The tree of the lowest level of decoration*
2	*Very low level of tree decoration - required significant measures rehabilitation*
3	*Tree of Intermediate Level of decoration - the necessary rehabilitation measures small-scale*

4	Tree of high level of decoration - the application of rehabilitation measures minimum
5	Tree of highest level of decoration

Taxation table

No.	Name of species	H (m)	D (cm)	W. c. (m)	Vitality rating	Decoration ration rating	Remark
1	Cupressus sempervires	13,5	23	2	4	3	
2	Cupressus sempervires	12	25	1,8	1	1	Dry top
3	Cupressus sempervires	13	20	1,8	1	1	Dry top
4	Cupressus sempervires	13	22	1,8	4	3	
5	Cupressus sempervires	12	17	1,5	3	3	
6	Cupressus sempervires	13	19	1,5	1	1	Dry
7	Cupressus sempervires	11,5	19	1,5	1	1	Dry top
8	Cupressus sempervires	9	13	2	3	3	
9	Cupressus sempervires	12	20	2	1	1	Dry top
10	Cupressus sempervires	11,5	23	1,5	4	3	
11	Cupressus sempervires	11,5	24	1,5	4	3	
12	Cupressus sempervires	10	14	1,2	4	3	
13	Cupressus sempervires	13,5	20	1,5	3	3	
14	Cupressus sempervires	14	22	1,5	3	2	
15	Cupressus sempervires	11,5	25	2	1	1	Dry top
16	Cupressus sempervires	14,5	22	2	5	3	
17	Cupressus sempervires	14	33	1,8	5	3	
18	Robinia pseudoacacia	10,5	21	3,8	3	2	
19	Cupressus sempervires	10	16	1,5	5	3	
20	Cupressus sempervires	11	18	1,5	5	3	
21	Cupressus sempervires	10,5	19	1,2	5	3	
22	Cupressus sempervires	10	19	1,8	5	3	
23	Cupressus sempervires	15	24	1,5	4	3	
24	Cupressus sempervires	14,5	27	1,8	4	3	
25	Cupressus sempervires	13	24	2	1	1	Dry top
26	Cupressus sempervires	14	25	1,8	4	3	
27	Cupressus sempervires	15	22	1,8	2	2	Mech. damage
28	Pinus nigra	14,5	31	7,2	2	2	Mech. damage
29	Pinus nigra	15	37	5,8	3	3	
30	Pinus nigra	15,5	40	6,5	3	3	
31	Cupressus sempervires	11	19	1,2	4	3	
32	Cupressus sempervires	10	21	1,2	4	3	
33	Cupressus sempervires	10,5	18	1,5	4	2	

Proposed measures for arrangement of micro-location

Based on the Law on National Parks of Montenegro (Official Gazette RCG No. 56/09), forests in national parks are special-purpose forests, suggesting that these forests are managed in a way which emphasize its ecological and social functions.

Based on the status of micro-location, legal and spatial planning documents, it is needed to comply with the following standards:

- prohibited deforestation;

- prohibited introduction (planting) foreign plant species, except for the purpose of preventing erosion and landslides;

- prohibited pulling out rare, endemic and sparse plant species, except for purposes of scientific research;

- prohibited cutting surface vegetation due to the wealth of endemic and species protected by law.

Based on state of terrain, legal and spatial planning documents, it is allowed to implement specific activities as follows:

- obligatory removal of dry top trees;

- obligatory removal of dry trees;

- it is allowed to remove mechanically damaged trees or trees with no future (depressed, poor physiological condition, etc.)

- as woody flora, of treated micro-location, has allochthonous origin in the ares, it is allowed to remove smaller groups of trees for the purpose of carrying out the project

Removing certain woody species should contribute to improvement of sanitation conditions and improve visual and aesthetic values, of this micro-location, and the entire area around the fortress as well.

REFERENCES

1) Special Purpose Spatial Plan for the National Park "Skadar Lake"

2) The Law on National Parks of Montenegro (56/09)

3) The Law on Nature Protection (51/08)

4) The Law on Forests (Official Gazette of RM no. 74/10)

5) Base studies for area of NP "Skadar Lake"

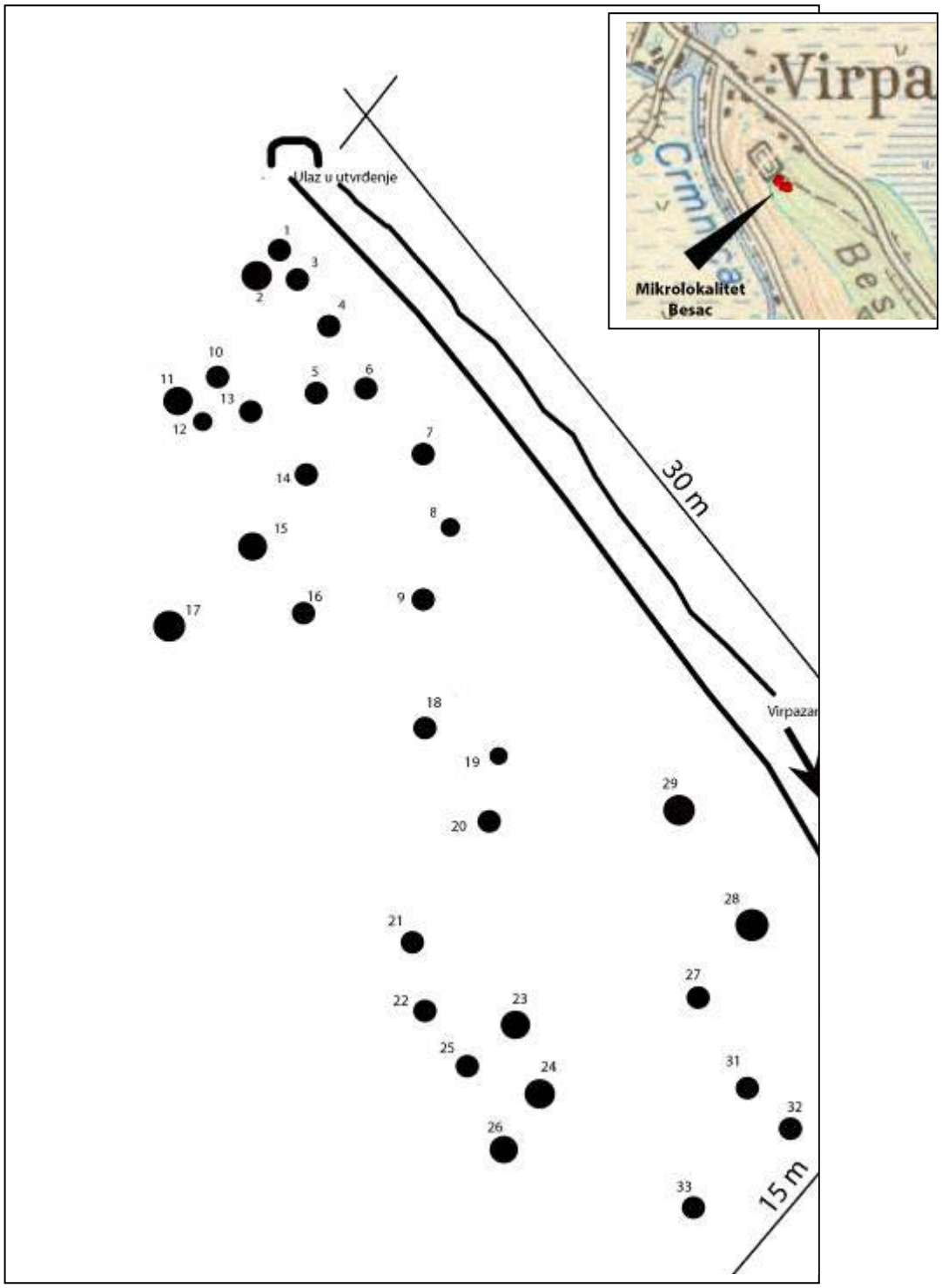
6) Management Plan for National Park "Skadar Lake" (2010-2015)

Podgorica,

30. 08. 2011. *Mr. Slobodan Stijepović, forestry engineer*

Appendix

Figure of terrain of location of Besac



2.2 THE ACTUAL CONDITIONS: DECAY ANALYSIS

The fortress, actually not in use, is constituted by two main buildings, flanked by secondary service structures. The compound is enclosed by defensive walls, with a unique opening represented by the entrance. The most used materials are: local stone for the walls, mortar plaster based on the fracturing of the same stones; furthermore, it is supposed the wood was used for the floors. The fortress is not served by any facility, such as water and electricity. Due to the neglected state, the decay is very notable and involves both the materials and the structures.

2.2.1 SITE DECAY

The decay analysis starts observing the present site usability conditions. The path leading to the fortress is usable, but trees and bushes often overrun somewhere. Also the portions outside the buildings are infested by bushes and grass, freely grown due to the abandonment.

2.2.2 STRUCTURAL DECAY

The analysis of the present structures and a first evaluation of their static conditions, lead to some preliminary considerations, useful to address the recovery intervention. In general, that structures are not affected by instability. It is due to the relative small size of the buildings and to the presence of compact rock foundations, that have not allowed structural failures. Only few structural damages are sign of the still good health of the walls.

External walls. They are built with stone blocks roughly cut, with the traditional technology of “sack wall”; they show localized collapses along the whole perimeter, sometimes only on the crown. The collapses are due not only to lack of maintenance, but also by the presence of bushes. All the crowns are lost, thus it is very hard verify both the former dimensions, and how they were built.

Fig. 1: DEFENSIVE WALLS-LOCAL COLLAPSE

2.2.2.1 Guard posts

They show extensive collapses, involving both the roof, totally lost, and portion of perimeter walls, built in the same way of the external one, being their extension. Also in this case it is not possible establish the former height dimensions; in the north-western guard post we assume a wooden ridge roof; furthermore, the eastern one shows the former existence of two levels, divide by a lost floor.

Fig. 2: SOUTH SENTRY POST

2.2.2.2 Service buildings

They show the same situation of the guard posts (same building materials, masonry technology, and collapse of roofs and portion of the walls.) Only the smallest building still conserves in good conditions the former vault.

Fig. 3: NORTH SENTRY POST

Fig. 4: SERVICE BUILDING FOR SOUVENIR SHOP

Fig. 5. SENTRY BOX

2.2.2.3 Barracks

The building shows two regular rectangular portions, with different dimensions. The former wooden ridge roofs, have been lost. The collapses are localized at the openings and on the crown where the wooden roof was built. No specific lesions have been noted: it means the foundations still conserve a good performance. The walls have been built with stone cut in a more refined way, maybe due to the different use of the building.

Fig. 6: BARRACKS

Fig. 7: BARRACKS

2.2.2.4 Fort and towers

Undoubtedly, it is the more representative building and the more challenging one by a structural point of view. It is composed by an almost rectangular main hall flanked by two cylindrical towers. The towers shows extensive collapses in the upper portions, without roof and part of the walls, consequently it is not possible understand the shape of the former roofs, even though we could assume, through ancient photos, they were wooden sloping roofs. The main hall, accessible through stone steps, shows localized collapses of the external facade and some closures that do not allow the access to the towers. The roof is a vault built with cut stones. It is assumed that the existing level formerly had an upper level, accessible by the eastern tower, but actually there is no evidence of it, except and old photo apparently showing it.

Fig. 8: FORT WITH TOWER

2.2.3 MATERIAL DECAY

It is mainly due to the lack of maintenance and not to their quality, that is good, or their incorrect in place disposition.

Stone decay. The stone is white-colour compact limestone, with some red signs in correspondance of iron devices. Its decay is typical of the limestone exposed to the action of rain, wind, snow. The main alterations are the following:

- ✓ colour changes;
- ✓ crusts having limited extension, dark colour;
- ✓ cracks in correspondence of blocks under-dimensioned or over-stressed;
- ✓ surface layer composed by extraneous material;
- ✓ delamination;
- ✓ biologic “patina”, green colour in almost the cases.

Fig. 9: EXAMPLE OF STONE DECAY

2.2.4 PLASTER DECAY

The plaster is applied on the external surfaces of both the fort and the towers; further, it is applied on the external and inner surfaces of the barracks. It is double-layered. Formerly it had light brown colour, but actually has grey colour, with large lacks. The main alterations, that are spread everywhere, are the following:

- ✓ colour changes;
- ✓ craquelure;
- ✓ surface crusts;
- ✓ surface layer composed by extraneous material;
- ✓ lacks of parts of the plaster and stone blocks;
- ✓ biologic “patina”, green colour in almost the cases;
- ✓ dustering.

Fig. 10: EXAMPLE OF PLASTER DECAY

2.3 ARCHITECTURAL RESTORATION DESIGN

2.3.1 INTRODUCTION

The architectural design aims to give back to the citizens the Besac fortress, through its valorization and public use. In order to achieve such a result, the design aims to optimize the site receptivity, focusing on the recovery and the conservation of all the existing structures, and giving to any portion of the fortress a specific use in accordance with the Client.

2.3.2 ACCESS ROAD

The access road will be partially restored through the road flooring and the supporting wall. The road will be cleaned, and any infesting natural element will be removed. It will be given as a carriageway only for emergency cars or for disabled persons to be carried, and it will be paved with cobbles, natural massive stone or compressed earth. The road will be usable also by night, thank to the presence, on both the banks, of spotlights on the ground marking the path.

2.3.3 FORT WITH TOWER

2.3.3.1 DESCRIPTION OF THE INTERVENTION

The fort will be used as a wine-museum, with possibility to taste local wines. The connections with the towers will be restored through the re-opening of the closed doors, and the terrace will also become usable, through the insertion of a mechanical scale in the north tower. All the present slots that are at present walled will be reopened and infilled with a sash. The South tower will be endowed with a new floor, in order to make the ground floor usable with a tasting place.

2.3.3.2 INTERVENTIONS ON THE SURFACES

All the external surfaces of the fort and the internal ones of the towers will be accurately cleaned, with the double purpose to eliminate the existing deteriorated plaster and the superficial layer of dirt accumulated on the rock walls. The removal of plasters will be made with manual means, on order not to damage the support, while the cleaning will be made with low pressure water washing, in order to remove the superficial layer of dirt and not damage the rock blocks.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

The internal surfaces of the port will be subject to a milder cleaning, given the better preserving condition, also based on washing with low pressure water.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.3.3 PAVEMENTS

The presence of paving stones inside the fort makes us believe that the original pavement was made by rock. The project idea is to re-propose the pavement with the same original material, but with a different

pattern, in order to emphasize the integration with the new material. The pattern to be used will be chosen by the Client directly during the works, by the direct comparison of at least three examples of new pattern with the on ground situation.

The North tower has a cement pavement, under which studies will be made to check the presence of original paving stones. Also for these environments the project idea is to offer again flooring with pavement stones.

The terrace and the South tower, after structural interventions, will be paved with an architectural concrete, made with a mixture based on local aggregates, whose color and granulometry will be chosen based on particular demands and taste.

2.3.3.4 FRAMES

At present no frames are present. However, thanks to the traditional frames researches and the traces left in the masonry, the project proposes a typology of wooden frames that match with the local tradition as well as with the site subject to the intervention

The fort door will be made of wood, with a metallic sheet cover and studs. The windows will be made of solid wood, except for the ones that correspond to the loopholes that cannot be opened and with metallic structure. All windows will have insulating double glazing, in order to guarantee minor heat dispersions.

2.3.3.5 CONNECTIONS

The connection between ground floor and terrace will be guaranteed by a mechanic staircase made in the North tower, with a simple design, corten effect. Such staircase will also allow the access to the fort directly from the tower.

2.3.3.6 PLANT INSERTION

The project of the plant is based on the idea of being as little invasive as possible. For this purpose, no plant will mean partial masonry demolitions, as everything will be moved under the floor. Because of this the electric plant will feed the fitted totems that will have ordinary and emergency lights, outlets for the power, signal, screens, etc.

The air condition plant will be established by build-in machines inside central furnishing elements, with special grids. In this manner all masonries will be preserved and exposed.

2.3.4 BARRACKS

The barracks will be used as multi-purpose hall and museum. The usability will be made possible thanks to the drainage from the site of weeds and the plant endowment necessary to the use of the project.

2.3.4.1 INTERVENTIONS ON THE SURFACES

All internal and external surfaces will be cleaned accurately, with the double purpose to eliminate the existent deteriorated plaster and the superficial layer of dirt accumulated on the visible rocks. The removal of plasters will be made with manual means, in order not to damage the support, while the cleaning of the parameters will be made with low pressure water, in order to avoid the damage of the rock blocks and take away the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.4.2 PAVING

As far as we know, there's no trace of the original pavement of the barracks. The only hypothesis is that it was in paving stones, as the one of the fort, but no support elements exist. For this reason, the choice of the new pavement is architectural cement that will be made with local castings.

2.3.4.3 FRAMES

At present there are no frames present. However, thanks to the traditional frames research and to the traces left in the masonry, the project proposes a typology of wooden frames that are according to the local tradition as well as to the site subject to the intervention.

The access doors are made of solid wood, without transparent panel plants.

The windows have shutters whose trace has been found on the masonry. The windows will be insulating double glazing.

2.3.4.4 PLANT INSERTION

The project of the plant is based on the idea of being as little invasive as possible. For this purpose, no plant will mean partial masonry demolitions, as everything will be moved under the floor. Because of this the electric plant will feed the fitted totems that will have ordinary and emergency lights, power outlets, signal, screens, etc.

The air condition plant will be established by build-in machines inside central furnishing elements, with special grids. In this manner all masonries will be preserved and exposed.

2.3.4.5 ROOFING

All roofing will be re-built, similarly to the existent ones, based on the remaining traces and on the local building tradition. For this reason, it will be double-pitched, with tiles roof covering. The solid wood structure will be similar to the traditional ones, with wooden sleeper on perimeter masonry and protruding rock sheet that form a sort of eaves. The waterspouts are not provided.

2.3.5 SOUVENIR SHOP

The structure that will be used as a souvenir shop was subject to a recovery project of the existent masonry and reconstruction of new walls with modern materials.

2.3.5.1 INTERVENTION ON THE SURFACES

All internal and external surfaces will be subject to accurate cleaning, with the purpose to eliminate the superficial layer of dirt accumulated on the visible stone facing. The cleaning of the parameters will be performed with low pressure water, in order not to damage the blocks or rock and remove the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.5.2 NEW STRUCTURE

The new structure will be performed through bearing walls, with flat roof and false ceiling. The form, clean and simple, will be used to distinguish the intervention and at the same time not to make it too impacting. The covering of local limestone will instead make the building more suitable to be entered in the surrounding environment.

2.3.5.3 FLOORINGS

As far as we know now, there is no trace of the original flooring. For this reason, the choice of the new flooring was the architectural cement that will be made with local castings.

2.3.6 SENTRY BOX

The little building will be designed to make visible to the public a sentry box. For this purpose, the interventions are minimum, limited to the preservation of the state of fact.

2.3.6.1 INTERVENTIONS ON THE SURFACES

All internal and external surfaces will be subject to accurate cleaning, with the purpose to eliminate the superficial layer of dirt accumulated on the visible stone facing. The cleaning of the parameters will be performed with low pressure water, in order not to damage the blocks or rock and remove the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.6.2 FLOORINGS

As far as we know now, there is no trace of the original flooring. For this reason, the choice of the new flooring was the architectural cement that will be made with local castings.

2.3.6.3 FRAMES

The frames will be limited to the entrance gate and to the grating of the little existent window. The gate and the grating, of painted metal, will have a simple design, with corten effect.

2.3.6.4 EXTERNAL CAP OF THE ARCH

As the structure of the arch does not provide further roofing, it will remain visible. For this, roofing with a mortar and local stones layer is provided, in order to give the cap an aspect more appropriate to the place in order to give an additional protection layer to the arch itself.

2.3.7 SENTRY POST A

The place assigned to the observance on behalf of the guards will be an observation post again, this time for the landscape. The intervention has the objective to conserve the state of fact, allowing the safe access and usability.

2.3.7.1 INTERVENTIONS ON SURFACES

All internal and external surfaces will be subject to accurate cleaning, with the purpose to eliminate the superficial layer of dirt accumulated on the visible stone facing. The cleaning of the parameters will be performed with low pressure water, in order not to damage the blocks or rock and remove the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.7.2 FLOORING

As far as we know actually, there is no trace of the original flooring. For this reason, the choice of the new flooring was the architectural cement that will be made with local castings. The new foundation is foreseen with use of plastic dome aerated system flooring. Considering the very little inner dimension of the sentry post A (2,93 x 2,50 m) and its future use (simply an observation post), the carrying of such foundation, up to 400 kgs./sq. m., is estimated largely sufficient.

2.3.7.3 ACCESS

The access, considering the difference in level of the land, will be guaranteed by a simple metal stair corten effect, made by almond-pattern sheet and endowed with special holes for the outflow of rainwater.

2.3.8 SENTRY POST B

Also in this case, the intended use is panoramic observation point.

2.3.8.1 INTERVENTIONS ON SURFACES

All internal and external surfaces will be subject to accurate cleaning, with the purpose to eliminate the superficial layer of dirt accumulated on the visible stone facing. The cleaning of the parameters will be performed with low pressure water, in order not to damage the blocks or rock and remove the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.8.2 NEW ATTIC

The collapse of the existent floor made the observation post unusable. The traces left by the beams in the masonry give us an idea about their number and dimensions. The design idea is to make the post usable trough a transparent floor, of steel and glass that will allow the view of the part below. It is at the same level of the acceding ground (or just few centimeters below), such as neither stairs nor steps are needed. The dimensions of such a floor are calculated to support a minimum load of 400 kg./sq.m.

The narrow size of the Sentry Box, and the lack of any evidence, does not allow the creation of a not-disturbing stair for the access to the lower part. Consequently, the access to this portion of the fabric will be allowed only for maintenance (i.e. cleaning vegetal growth), through the temporary removal of portion of the designed glass floor.

2.3.9 DEFENSIVE WALLS

The intervention on the defensive walls aims to freeze the present situation, through consolidation and protection.

2.3.9.1 INTERVENTIONS ON SURFACES

All internal and external surfaces will be subject to accurate cleaning, with the purpose to eliminate the superficial layer of dirt accumulated on the visible stone facing. The cleaning of the parameters will be performed with low pressure water, in order not to damage the blocks or rock and remove the superficial layer.

All the existing vegetal weed elements will be eradicated and a biocide intervention with the double purpose to eliminate the present weeds and avoid new ones from growing will be performed.

All surfaces will be protected by a water-repellent treatment, in order to be protected a determined number of years by the attacks of the weather, especially rain.

2.3.9.2 RECONSTRUCTION OF MISSING PORTIONS

The reconstructions will be reduced to minimum and will be considered only where strictly necessary for the consolidation. In this case they will be performed with local material or with lime based mortars.

2.3.9.3 SAFETY MEASURES OF THE ROUTE

Because of the collapses, some areas of the route result dangerous because of the risk of falling in the surrounding precipice. For this purpose, the use of metallic railings with simple design is suggested, only in the critical points, performed in the same way as the ones of the fort terrace.

2.3.9.4 MASONRY CROWNS

In order to protect the wall and surface integrity of the masonry, a capping intervention is suggested, that will allow rainwater to flow correctly and not allow the growth of vegetal weed elements.

2.3.10 SERVICE BUILDING

The new building to be foreseen outside is necessary because of the lack of rooms to be used for sanitary and technical use. Constructive typology adopted has little impact and reveals to be functional for the overall usability of the site.

2.3.10.1 ARCHITECTURAL FEATURES

The external coating of the building will be part local stone and part simply plaster. Instead, inside, given the intended use, no precious materials will be present, but simple covering ceramic tiles, that will allow the hygiene and decoration of the place.

2.3.10.2 EXTERNAL AREA

The external area can become the receiving area. For this purpose, preserving as much as possible the existent trees, we propose the creation of a pavement similar to the one at the entrance paths.

2.3.11 LANDSCAPED AREA

The external area will be equipped in order to become usable. Such interventions consist in draining the vegetal weeds and repaving the whole surface with the same material used for the access path.

Also, the back part of the fort will be equipped with fixed benches that will allow stops for visitors and also projection on the walls of the fort as well as small theatre representations or product presentations, etc.

The whole area will have ground illumination, in order to allow a safety use, without light pollution phenomena.

2.4 STRUCTURAL DESIGN

2.4.1 REPORTS

2.4.1.1 FORT WITH TOWER

2.4.1.1.1 Ground interventions

At the bottom we provide the performance of an reinforced slab, in order to guarantee most of all the possibility to reassemble the old and new paving stones and allow the passage of plant tubes inside an intermediate casting. Such slab will then allow the perimeter binding of the masonry due to a bond plant type *gripp-round* and namely trough round metal anchoring with intervals of about 60 cm one from the other and then entered in the above-described reinforced concrete cast. The thickness of such slab will not exceed a total of 5 cm. Considering that the building rests on a consistent stone layer no further interventions such as curbs or others are provided.

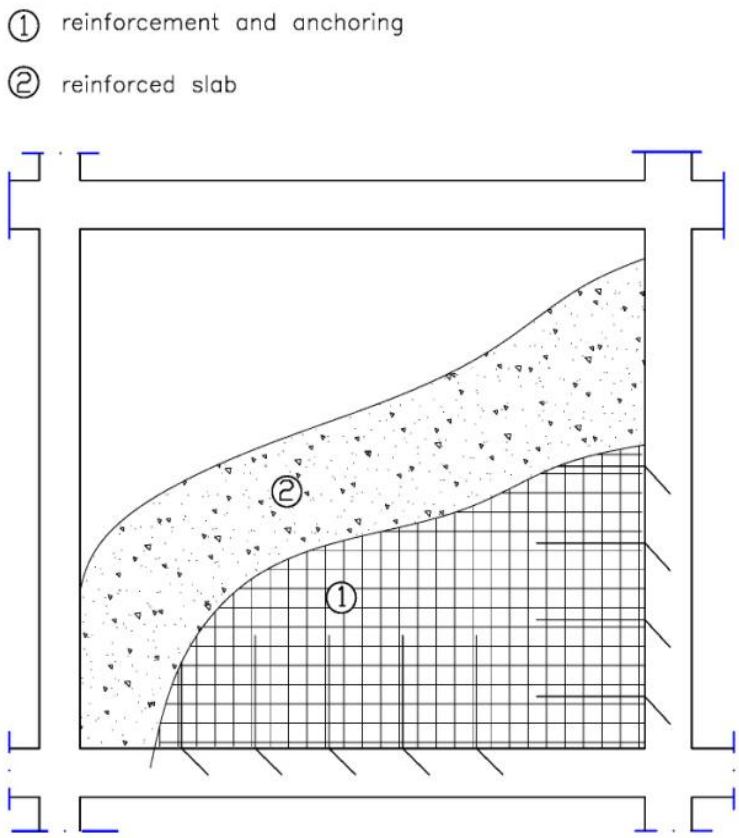


Image 11: REINFORCED SLAB

2.4.1.1.2 Wall interventions

The masonry will be interested by consolidation intervention through the rake-out of all joints and the next pointing of all open joints, with lime based mortar, without cement. Also, the restoration of the collapsed areas is provided with the re-use of stone blocks found on place or new ones with the characteristics similar to the present.

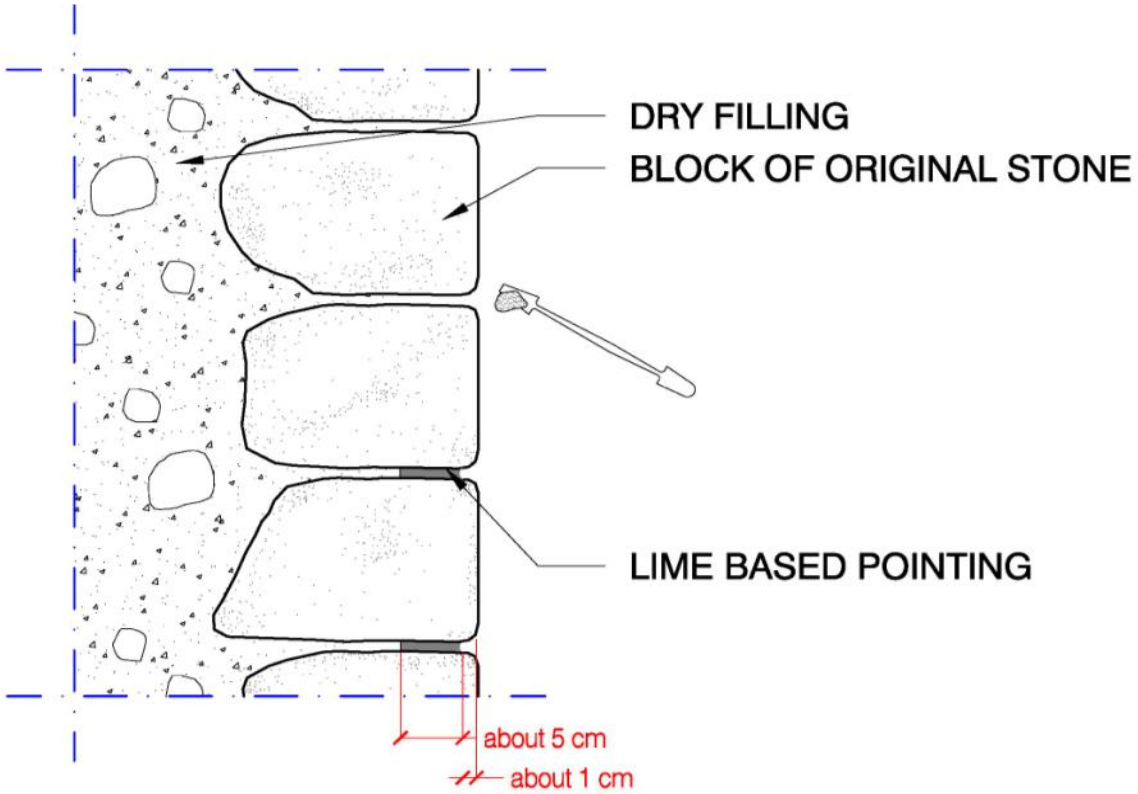


Image 12: MASONRY INTERVENTIONS

2.4.1.1.3 Roofing interventions

On the roofing we expect the strengthening of the existing vault by emptying the existent part of land, the performance of a reinforced lime based canopy with concrete reinforcement rods and dissolved mesh net fixed to the old structure through metal anchoring. We expect filling the sides of the vault with anchoring efficiently connected to the masonry by a steel shake rod B450C Ø16mm every 60cm. of perimeter. After the consolidation, the vault will be filled with lightened elements such as loose pumice or expanded clay and filling lightened cast. The casings will be premixed with natural elements such as coak or perlite.

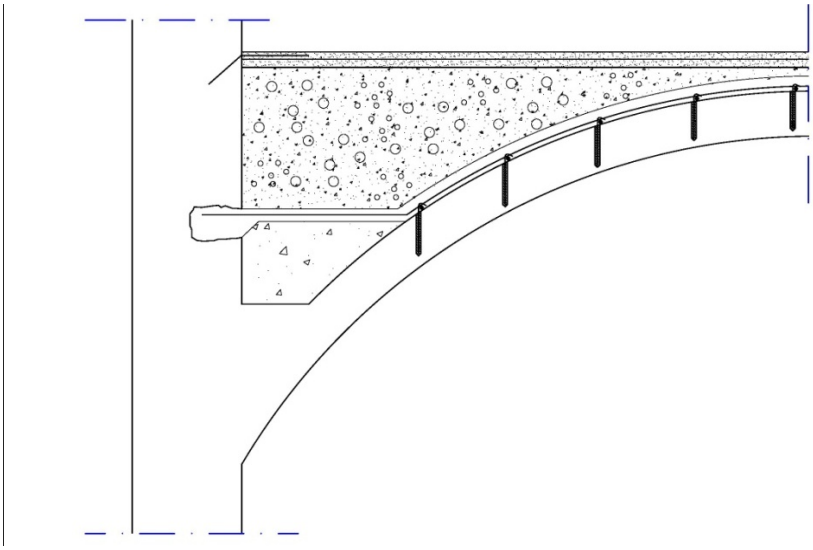


Image 13: VAULT STRENGTHENING

The roofing of the North tower will be made through timber primary frame, wooden planking and surrounding reinforced concrete cast and it will be completed by a perimeter binding riddle to the existent masonry through anchoring with special anchoring mortars. For specification please refer to the attached execution projects.

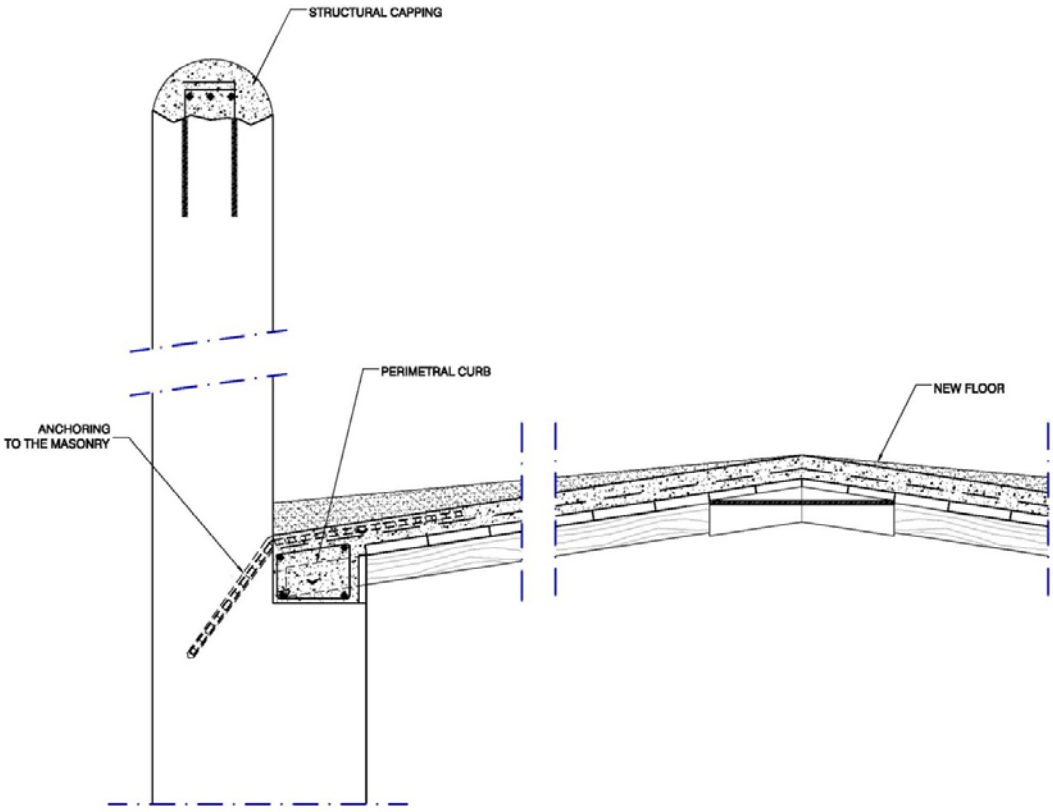


Image 14: NEW NORTH TOWER FLOOR

2.4.1.2 BARRACKS

2.4.1.2.1 Ground interventions

At the bottom we provide the performance of a reinforced slab, in order to guarantee most of all the possibility to perform the pavement provided by the project and allow the passage of pipe plants inside and intermediate cast. Such floor will then allow the perimeter binding of the masonry due to a bond plant type *gripp-round* and namely trough round metal anchoring with intervals of about 60 cm one from the other and then entered in the above-described reinforced concrete cast. The thickness of such floor will not exceed a total of 5 cm. Considering that the building rests on a consistent stone layer no further interventions such as curbs or others are provided.

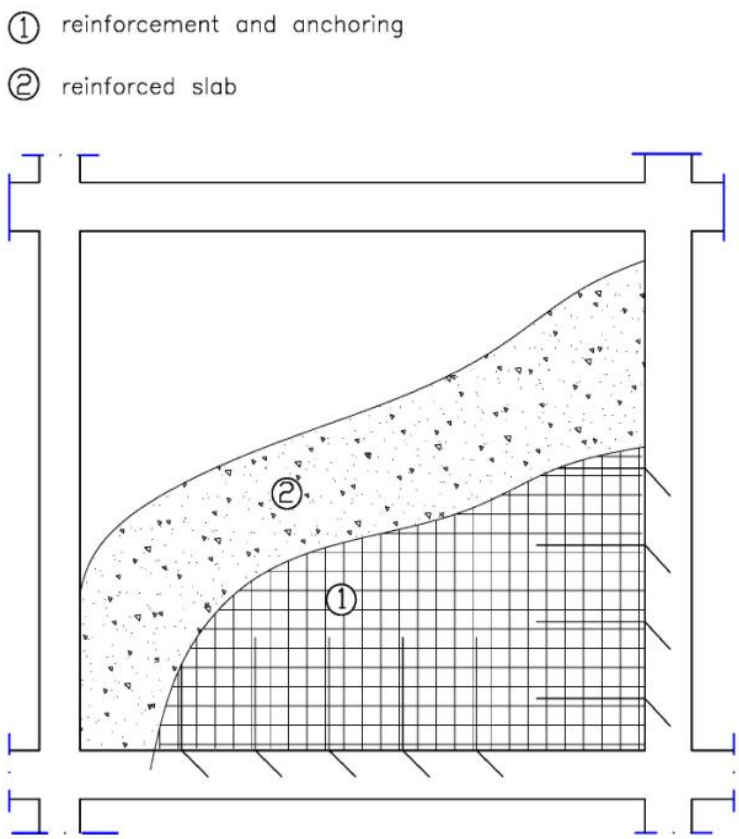


Image 15: REINFORCED SLAB

2.4.1.2.2 Wall interventions

The masonry will be subject to consolidation interventions trough the rake-out of all joints and the pointing of all open joints, with lime based mortar, cement free.

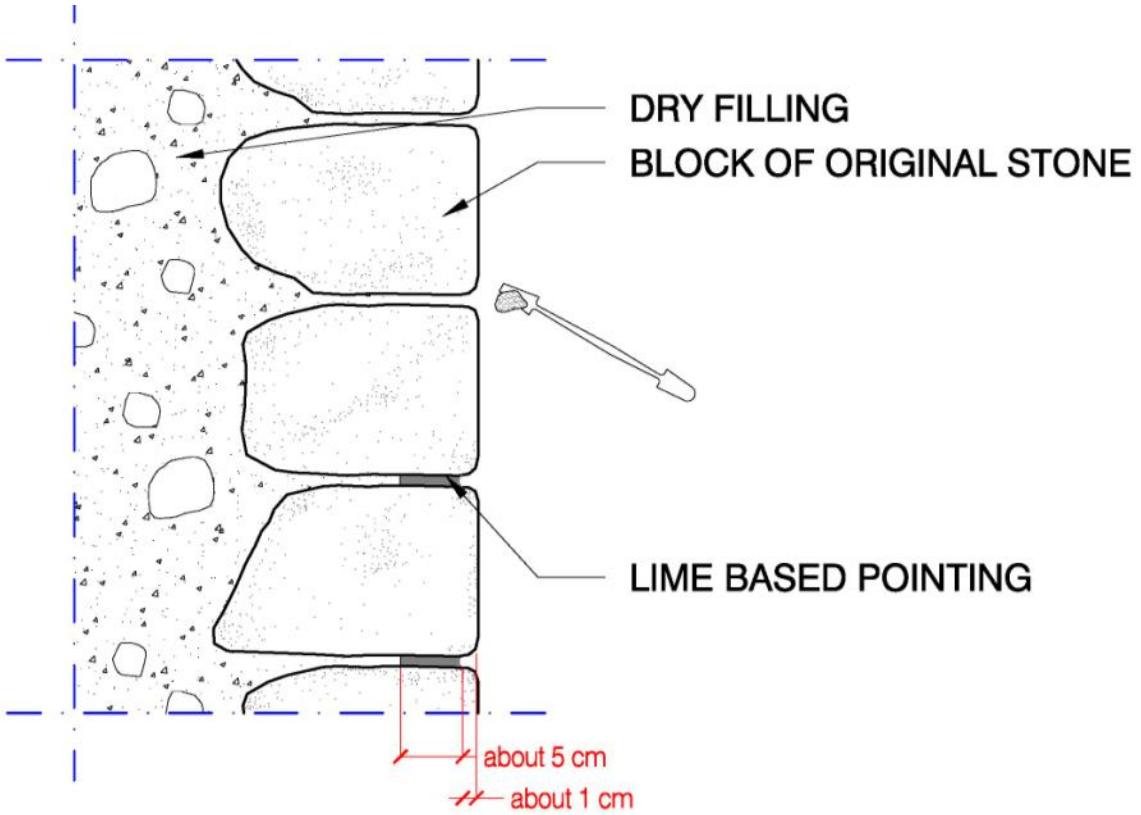


Image 16: MASONRY INTERVENTIONS

2.4.1.2.3 Roofing interventions

The roofing, completely absent, will be reconstructed in wood, according to the model of the existent one, that can be inferable from the history researches and from the traces left on the beam masonry.

The general configuration will be gabled, with sloped double layer, made by roof ceramic tiles, sustained by a structure performed as following:

→ ridge beams (28x28 cm for the smaller room, 50x40 for the bigger room);
→ secondary roof frame of wooden beams 10x13 cm, with a center distance of about 50 cm;
→ wall plate rested on the perimeter masonry of 15x15 cm;
→ double timber planking fixed on the structure below by wood self-anchoring screws extended type (hilti or similar) to guarantee enough rigidity to remedy the flowage phenomena;
→ insulating layer to guarantee a higher yield from the energy point of vie (smaller heat diffusion in winter, more resistance to insulation in summer);
→ waterproof payer.

At perimeter level the masonry will be subject to the performance of a mortar lime curb, reinforced with longitudinal plates connected to the bearing masonry face with a series of metal rod anchoring fixed with anchoring mortar entered in alternate position.

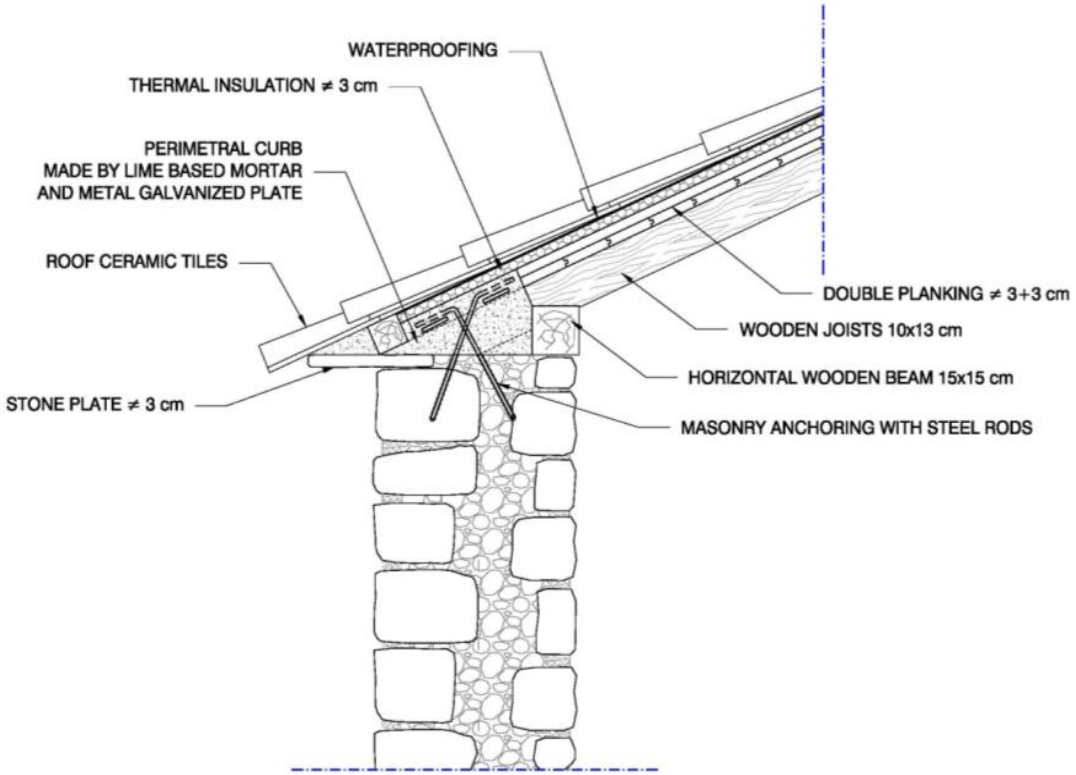


Image 17: ROOF STRUCTURE

2.4.1.3 SENTRY POST A

2.4.1.3.1 Ground intervention

For the ground we foresee the performance of aerated flooring plant formed with plastic domes type “IGLOO” or similar, 20 cm high or higher, completed with superior reinforced cast of about 5 cm thickness. We recommend the provision of a ventilation plant made of PVC tubes every 2 ml to guarantee the healthiness of the ventilation space and hence of the newly performed structures above ground.

Such new level will be connected to the vertical wall elements with perimeter curbs, sometimes with flooring function for the ground, efficiently connected to the masonry through a molded steel bar B450C Ø16mm every 60cm of perimeter.

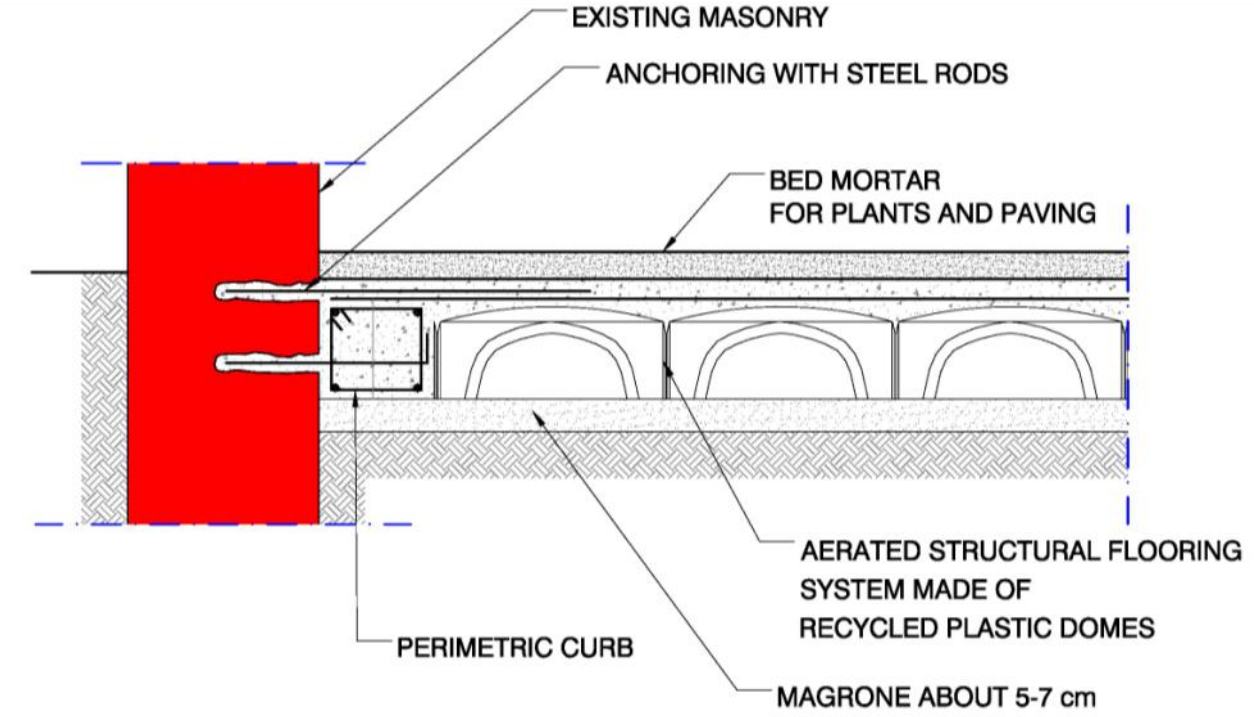


Image 18: FOUNDATIONS

2.4.1.3.2 Wall interventions

The masonry will be subject to consolidation interventions through the rake-out of all joints and the pointing of all open joints, with lime based mortar, cement free.

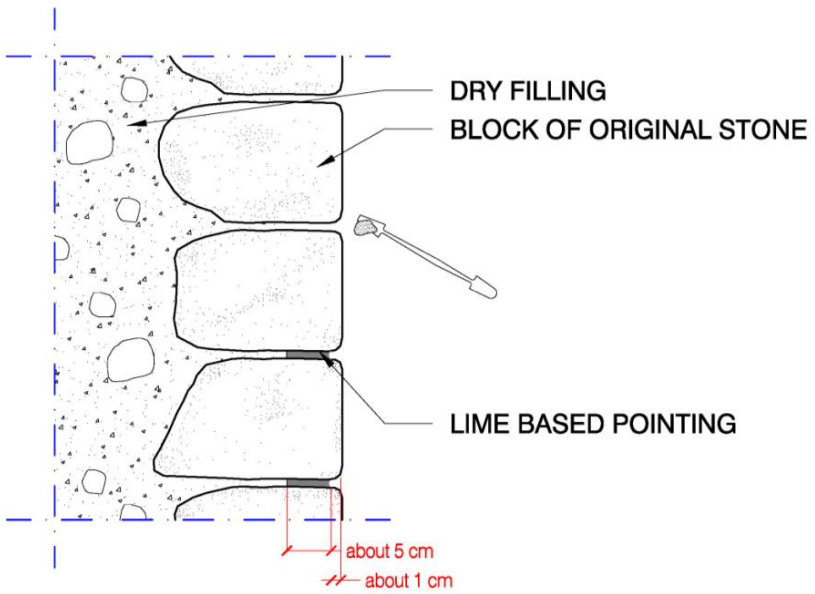


Image 19: MASONRY INTERVENTIONS

2.4.1.3.3 Roofing interventions

For the roofing we provide the construction of a structural capping. The barrel will be reinforced with longitudinal galvanized steel concrete reinforcement rods or metal plates of similar section anchored to the below masonry with anchoring mortar.

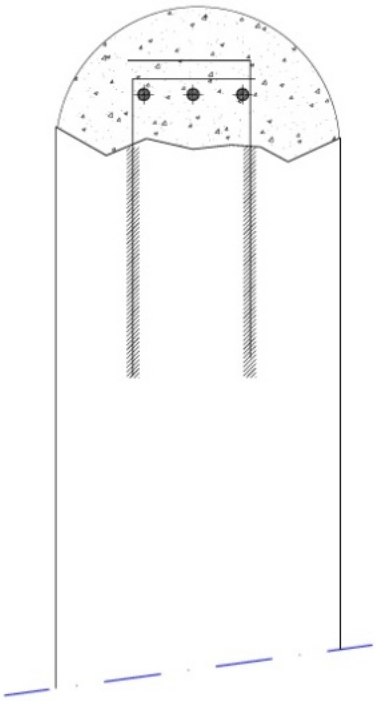


Image 20: STRUCTURAL CAPPING

2.4.1.4 SENTRY POST B

2.4.1.4.1 Ground intervention

No ground interventions are expected but we expect the construction of a new floor at the middle of the height formed by the tubular metal frame overcome by pavement slabs made of transparent glass to allow the view below. The structure will be bi-directional to guarantee more rigidity and thus less deformability to remedy possible breakdowns of the underneath glass. We expect anchoring the existent masonry through chemical Hilti type anchorage or similar with threaded rods and support profile Gripp round type with an “L” section to guarantee a homogeneous distribution of the loads of the same floor.

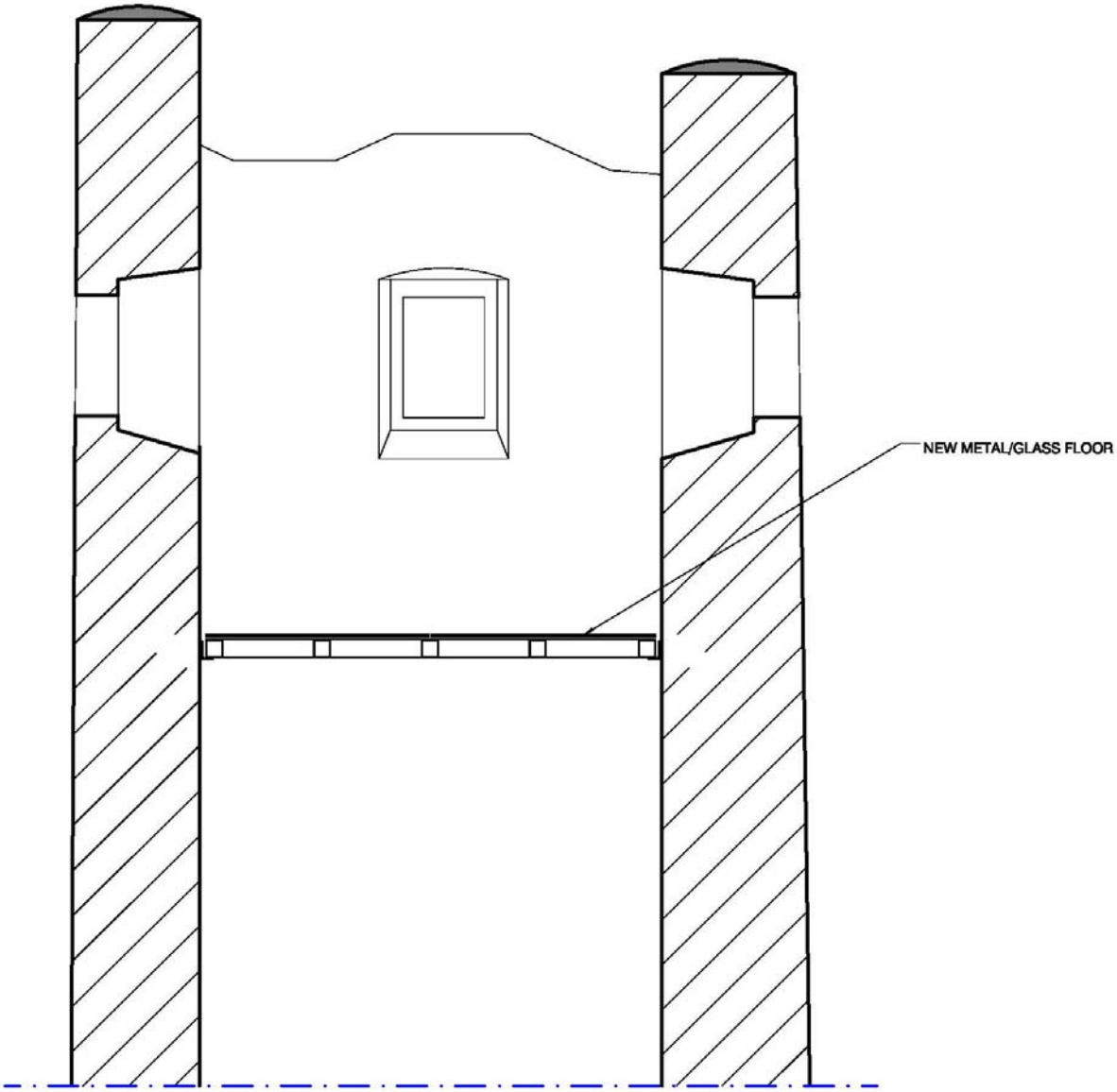


Image 21: NEW METAL/GLASS FLOOR

2.4.1.4.2 Wall interventions

The masonry will be subject to consolidation interventions through the rake-out of all joints and the pointing of all open joints, with lime based mortar, cement free. Also, the restoration of the collapsed areas with the reuse of stone blocks found on the spot or of new ones with similar characteristics to the present ones is provided.

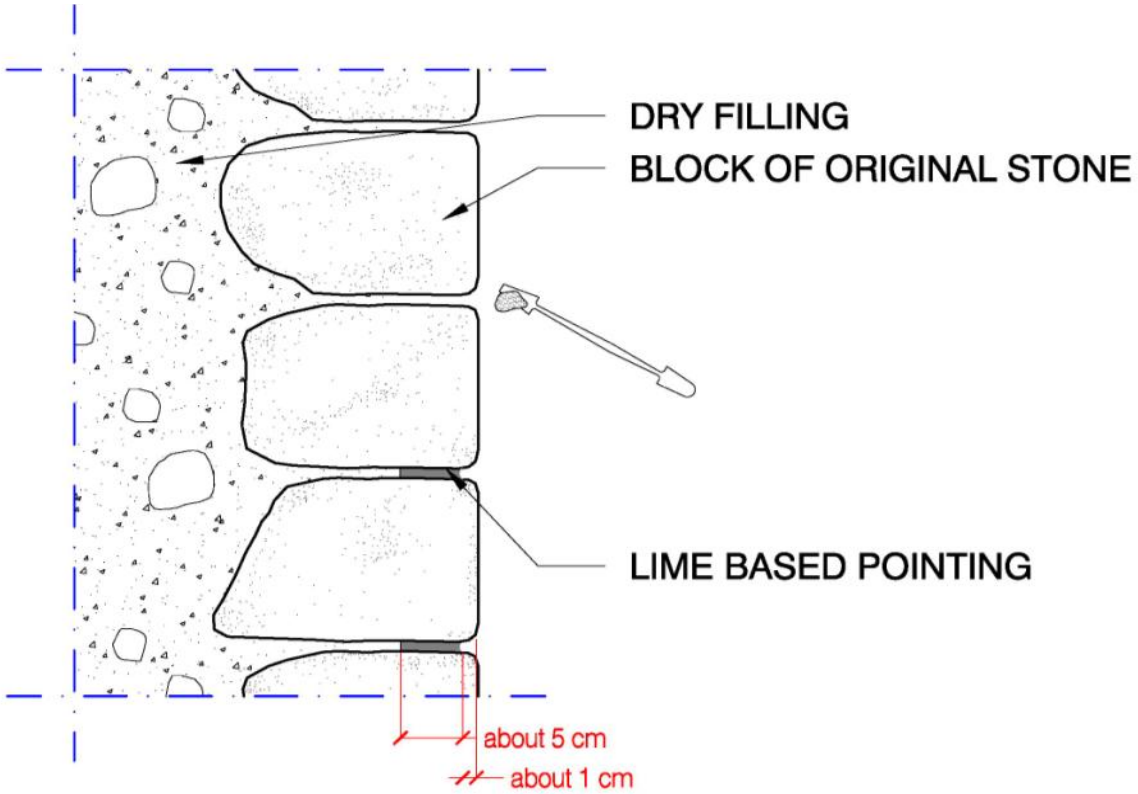


Image 22: MASONRY INTERVENTIONS

2.4.1.4.3 Roofing interventions

For the roofing we provide the construction of a structural capping. The barrel will be reinforced with longitudinal galvanized steel concrete reinforcement rods or metal plates of similar section anchored to the below masonry with anchoring mortar.

2.4.1.5 SENTRY BOX

2.4.1.5.1 Wall interventions

The masonry will be subject to consolidation interventions through the rake-out of all joints and the pointing of all open joints, with lime based mortar, cement free. Also, the restoration of the collapsed areas with the reuse of stone blocks found on the spot or of new ones with similar characteristics to the present ones is provided.

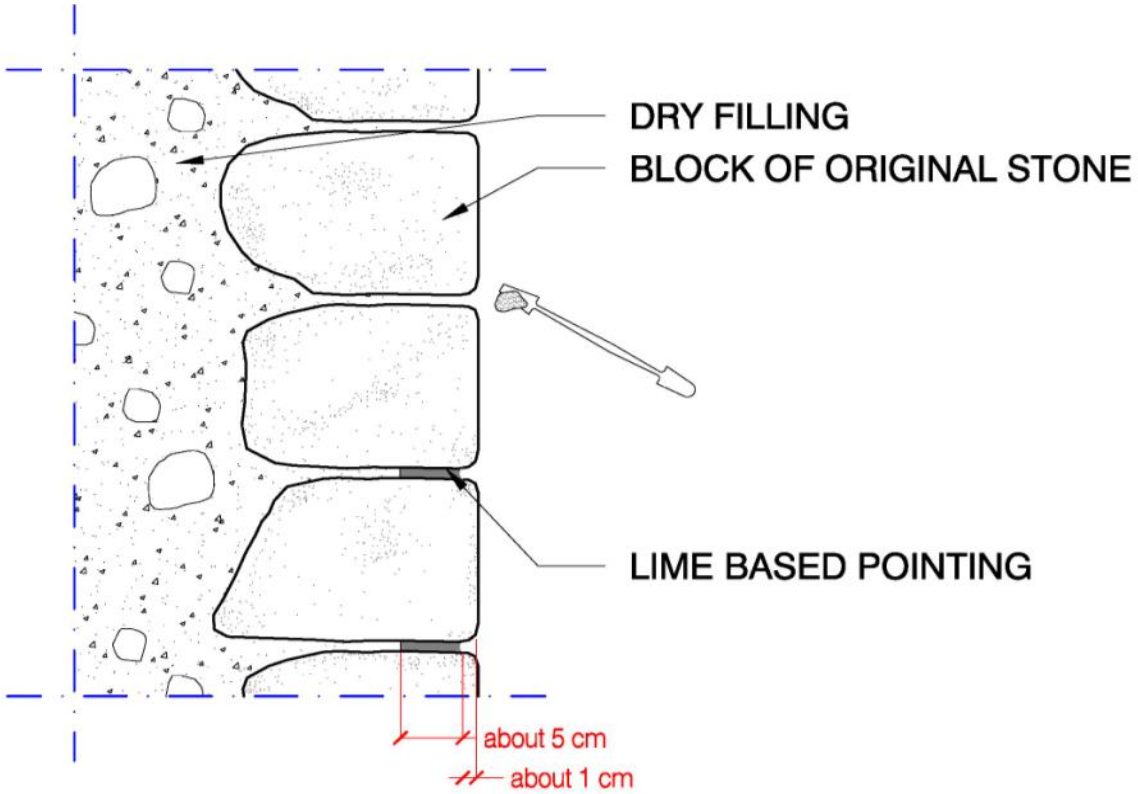


Image 23: MASONRY INTERVENTIONS

2.4.1.5.2 Roofing interventions

For the roofing we expect the consolidation of the existent arch by emptying the part of existent land, the performance of a reinforced plating cast with ordinary rods and loose grid fixed to the old structure with metal anchoring and the restoration of the collapsed areas with the reuse of wall parts found on the spot or new ones with similar characteristics to the present. The arch will then be covered with local stone over the consolidation cast.

2.4.1.6 SOUVENIR SHOP

2.4.1.6.1 Ground intervention

For the ground we foresee the performance of aerated flooring plant formed with plastic domes type “IGLOO” or similar, 20 cm high or higher, completed with superior reinforced cast of about 5 cm thickness. We recommend the provision of a ventilation plant made of PVC tubes every 2 ml to guarantee the healthiness of the ventilation space and hence of the newly performed structures above ground. Such new level will be connected to the vertical wall elements with perimeter curbs, sometimes with flooring function for the ground, efficiently connected to the masonry through a molded steel bar B450C Ø16mm every 60cm of perimeter.

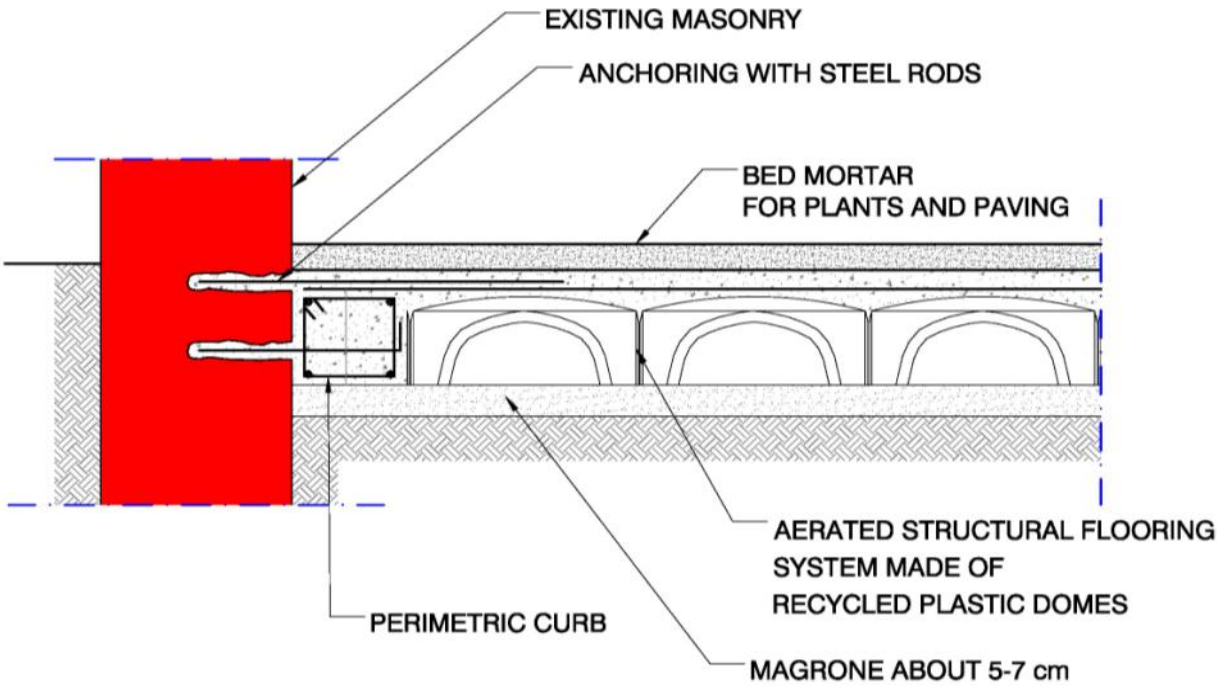


Image 24: FOUNDATIONS

2.4.1.6.2 Wall interventions

The new masonry will be made with half-full supporting block of antiseismic type considering the seismic characteristic of the intervention area of at least 20 cm thickness with traditional cement mortars. We recommend plastering the walls with adhesive plasters, with possible wired portions, especially on the contact discontinuities between the new masonry and the lintels or the housing for plants. The lintels will be precast or reinforced concrete.

2.4.1.6.3 Roofing interventions

The roofing will be built with slabs of brick-concrete: composed of trellis rafters H=16cm with center distance of 50cm and hollow clayblocks infill with concrete upper cast with a thickness of 4 cm, reinforced with welded mesh Ø10mm. The perimeter anchoring of the existent masonry will be performed with a concrete board with the dimensions 20x20cm, above the new porothon masonry.

2.4.1.7 SERVICE BUILDING

2.4.1.7.1 Ground intervention

For the ground we expect the performance of a continuous foundation plinth where the porothon masonry will be integrated by ventilated flooring plant formed with modular plastic domes type “IGLOO” or similar, with a height of 20 cm or more, completed with superior reinforced cast of about 5cm thickness. We recommend you provide a ventilation plant with PVC tube every 2 ml to guarantee the healthiness of the ventilation space and hence of the newly performed structures above ground.

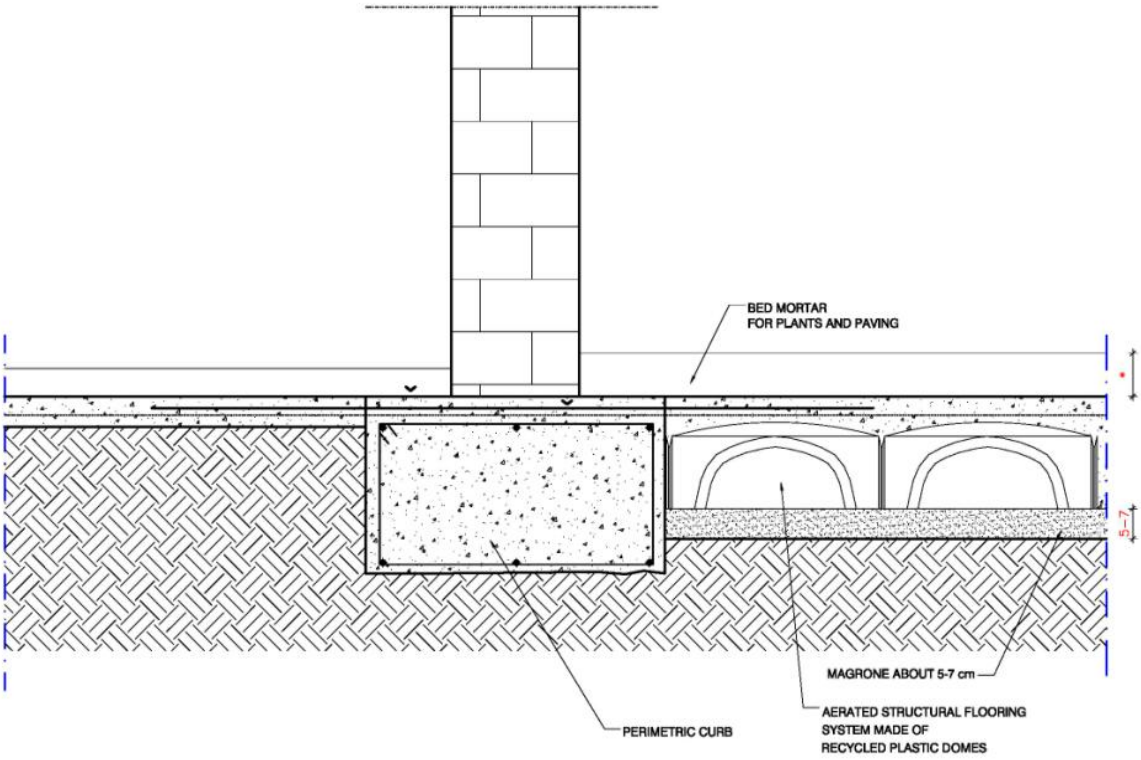


Image 25: FOUNDATIONS

2.4.1.7.2 Wall interventions

The new masonry will be performed with antiseismic semi-solid blocks, considering the seismic characteristics of the intervention area, of at least 30 cm thickness walled with cement plasters or mortar. We recommend you to plaster the walls with adhesive plasters, with possible wired portions, particularly on the contact discontinuities between the new masonry and lintels or housing for plants. The lintels will be precast of reinforced concrete.

2.4.1.7.3 Roofing interventions

The roofing will be made by slabs composed by lattice joists H=16cm with center distance of 50cm and pots with above concrete cast 4cm thick, reinforced with welded mesh Ø10mm. The perimeter anchoring to the existent masonry will be performed with a concrete perimeter curb with dimensions of 30x20cm, above the new one.

2.5 ELECTRICAL PLANT DESIGN

2.5.1 LAWS AND RULES

The plants designed will have to be carried out observing the actual Laws and Rules, under the responsibility of the installer company to carry out them in a workmanlike, and they will have to work perfectly and correctly.

2.5.2 CONTENT OF THE PRESENT TECHNICAL REPORT

The present technical report describes the provision and the works needed to carry out the electrical and special plants to serve the Besac fortress.

2.5.3 ELECTRIC AND DISTRIBUTION PANELS

The electric plant will be powered by a three-phase energy. The position of the delivery point shown in the drawings is approximate; it will be shared with the utility company at the beginning of the works.

Near the delivery point we will install a supply panel, named “QEN”, fitted for an electrical power)capacity of 50kW, containing the differential circuit breaker with general activity function and 3 breakers located for the protection of the power lines of the general panel, called “QGE”, of the mechanical loads panel, called “QUM” and external area panel, called “QEX”. The above-named switch with the general activity function will be equipped with opening coil to shunt able to switch off the whole plant in case of emergency by pressing the release emergency button located inside the room used as a souvenir shop; such button will be included in a red box with frangible glass and will be equipped with a signaling lamp with the purpose to check the efficiency of the trip circuit. The “QEN” panel will be made with a carpentry of external PVC.

The general panel “QGE” will be installed inside the totem located in the room used as museum and will supply the protection and sectioning of all power lines of the users; it will also supply the derivatives switchboards: panel Souvenir Shop, called “QSS”, panel Multipurpose Room “QSP” and panel Wine Boutique, called “QWB”. The electric panels “QSP” and “QWB” will be recessed installed in the relative totem an the electric panel “QSS” will be installed recessed in the room of the souvenir shop.

All panels will have DIN rail for snap mounting of modular equipment. All terminal power lines will be commanded and protected by differential circuit breakers with instantaneous intervention.

The following accessory materials for the panel will be provided:

→ Input and output cable terminals supplied with lugs or pre-insulated end sleeves or covered with self-extinguishing insulating layer.
→ Section cables fit for the internal cabling to the panel, type NO7V-K, insulated with thermoplastic material, that doesn’t spread fires.
→ Terminal board of thermosetting material with High dielectric strength and mechanical resistance
→ Pre-insulated lug and wire marking numbered for all incoming and outcoming lines of the panel.
→ Pantographed plates to indicate various starting circuits.

The distribution inside the technical room will be made with external rigid PVC tubes, while inside all the other rooms will be made with corrugated built in PVC pipes located under the floor and finally outside will be made by heavy corrugated PVC tubes with internal smooth double layer directly underground.

The secondary distribution inside the rooms used for sanitary services and a souvenir shop will be made with corrugated PVC tubes located under plaster. More details can be detected from the graphic technical specifications of the project.

Inside the external main distribution single-core cable lines will be located and multipolar double insulated type FG7(OR)R, while inside the PVC tubes and channels will be located in single-core lines with sole insulation type N07V-K.

The external distribution will be made with heavy corrugated PVC tubes with internal smooth double layer diameter 63/110mm directly underground inside which the cable lines type FG7(OR)R will be located.

The junction boxes will be made with self-extinguishing plastic or metal material, built in or external, endowed with closing cap fixed with screws. The special structured cabling plants, fire alarm, intrusion alarm, sound distribution and TV/Sat) will always be separated by the light and F.M. ones, with special junction boxes or separators.

2.5.4 LIGHT PLANTS

The lighting inside the rooms in subject will be made with the following types of devices:

→ Aluminum light fixture fitted for the recessed installation in the false ceiling, with white aluminum spot, equipped with no. 3 LED with power P=2,5 W each. Degree of protection IP23.
→ Aluminum light fixture fitted for the recessed installation in the false ceiling, with white aluminum spot, equipped with no. 1 LED CREE with power P=30 W. Degree of protection) IP23.
→ Ceiling light fixture made of unbreakable and self-extinguishing polycarbonate, with galvanized steel spot and diffuser made of transparent polycarbonate. Equipped with no. 2 linear fluorescent lamps with power P=58W. Degree of protection IP65.
→ Unbreakable polycarbonate light fixture, spot made of polished aluminum and polycarbonate diffuser. Equipped with 2 compact fluorescent lamps with power P=9W. Degree of protection IP65.
→ Light fixture of unbreakable nylon with cast aluminum frame and tempered glass diffuser. Equipped with 1 LED with power P=2,5W. Degree of protection IP67.

The illumination emergency will be made with powered ceiling lights able to guarantee in the passages, hallways and in the escape routes an illumination level not lower than 5 Lux and a minimum autonomy of 1 hour. The recharge time of all accumulators that serve the emergency lighting cannot be more than 12 hours. The light fixtures used for the emergency illumination will be:

→ Emergency “always open” ceiling lamp indicating the escape path, self-extinguishing polycarbonate body and disperser, with fluorescent lamp capacity P=24W. Autonomy 1h, loading period 12h, Degree of protection IP65.

The outside illumination of the building will be made with the following types of equipments:

→ Nylon illuminating body with stainless steel frame, tempered glass disperser. Equipped with n°1 LED lamp with power P=3,3W. Degree of protection IP67.
→ Nylon illuminating body with stainless steel frame, tempered glass disperser. Equipped with n°1 LED lamp with power P=3,3W and light strip with angle 60°. Degree of protection IP67.
→ Die cast aluminum light fixture, transparent tempered glass disperser. Equipped with n°1metal halide lamp with power P=70W. Degree of protection IP67.
→ LED Strip fitted for the recessed installation in profiles and/or false ceilings with power P=9W/13,5W. Degree of protection IP65.
→ The raising of light fixtures installed inside rooms will be punctuals, type on/off, and the controlling units will have inside totem, in the rooms used as museums, the Multipurpose Room and wine boutique, and recessed in the room used as souvenir shop.

→ The raising of the external light fixtures will be controlled with a programmer watch and a twilight switch.

More details can be taken from the project planimetries.

2.5.5 DRIVING FORCE PLANTS

The distribution of the driving force inside the rooms in subject will be performed with service outlets 2P+T-10/16A type "bypass" (two step) and type "P30" in built in execution installed in the totem.

In the external area of the fortress, close to the area use to project films and slides and in the position that can be taken by the project graphical plans, 3 floor towers will be installed, equipped with sockets 2P+T-10/16A type "bypass" and type "P30".

Inside the room used as Multipurpose Room we will also install 2 retractable turrets equipped with sockets 2P+T-10/16A type "bypass" and type "P30".

All power circuits will be derived from the area panels.

Some electric users will also be fed directly from the area panels with special power points mono and/or three-phase, constructed build-in or external. According to the type of user supplied, the supply points will have a special bipolar switch and/or square pole.

Inside the technical room we will install also groups of sockets for supply performed with type CEE mono-phase and three-phase with fuse and isolator block; the socket groups mentioned will be fed by panel "QUM". More details can be found in the project plans.

2.5.6 SPECIAL PLANTS

In this category classify, the structured cabling plant, the detection plant and fire alarm, the anti-intrusion plant, the sound diffusion plant) and the TV/Sat plant.

→ *Structured cabling plant:*

Inside the wine boutique room, especially under the stairs, a data transmission rack cabinet will be installed. From the rack cabinet mentioned we will continue with a star type cabling and the data transmission lines with UTP Cat. 6 cable from the connection of the data points sockets type RJ45 and of the supply points type Access-Point located in a position that can be seen in the project graphic plans. To the mentioned structured cabling plant finally we will connect a telephone exchange (not supplied).

→ *The detection plant and fire alarm:*

The detection plant and fire alarm will be according to the regulation Uni 9795 and will have a central unit alarm, completely autonomous as function, to which will be connected the fire detection plants and signaling of the different areas of the fortress. Such unit will be able to control two ring lines (class A loop die), meant for the actual detection, to which smoke detectors can be connected, input and output modules, manual alarm calls), etc.

The central unit will command the appropriate optical and acoustic signals installed in the various rooms. The sensors will be connected to the central unit with interfaces connected to the ring lines (class A loop).

The distribution of the smoke detectors will be according to the provisions of the UNI 9795 regulation, meaning that smoke detectors have to be present in every environment (except the bathrooms) and in the false ceilings.

All fire detectors that cannot be seen directly, like the ones installed inside the false ceilings, will have a repetition of the light alarm signaling, located in a visible area.

The central unit can be programmed with keyboard on the central unit itself, either by PC, with a software included in the supply of such unit.

→ *Burglar alarm plant:*

Will be mainly established by infrared volumetric detectors, installed inside every room and administered by a special *burglar alarm unit* located inside the technical room. The plant will be integrated by installing magnetic perimeter contacts that correspond t some frames of the ground floor. The plant in subject can be activated and deactivated with special number keys, that can be used from the outside, installed in the souvenir shop room and in the technical room. Outside the technical room we will install the panel for the optical and acoustic signaling.

→ *Sound diffusion plant:*

The sound diffusion plant will be formed by an amplification unit and by n°1 microphone post able to distribute the audio signals and/or the calls in the different areas of the fortress with loudspeakers whose position can be established with the graphic project plans. In the external area, close to the area used for video projections and/or slides, we will installed floor towers for the connection of a sound diffusion plant.

→ *TV/Sat Plant:*

We well create a SAT antenna centralized plant to receive satellite networks composed of an aluminum satellite dish, an amplifier, a splitter, a micro switch and terminating resistors and a centralized TV antenna plant will be created for receiving the irradiating issuers of the area, composed of: channel VHF antenna with 12 element, UHF channels antenna with 91 channel, an amplifier, mixers, pre-selection modules) a stabilized power, selective filters for channel with adjustable actuator for each channel), splitters, double separator, taps with one or two ways, terminating resistors. Also we will install in the TV/Sat sockets in the rooms used as Multipurpose Room, museum, wine boutique and in the area used for projection of films and slides. The installed plant will have to guarantee, for every socket, a signal level not less than 60dB.

The sanitary services will have and optical/acoustic signaling located at the entrance that can be started with tie rod buttons located close to the sanitary services for handicapped people.

The distribution of the special plant connections will take place with different tubes of types already described for the light and F.M. Plants. The tubes and the derivation boxes for the special plants will be always different from the ones provided for the light and F.M.

More details can be found in the project plans.

2.5.7 ELECTRICAL PLANTS FOR MECHANICAL PLANTS

The overload protection of each mechanic user will be ensured by motor protection switches of adjustable type regulated for the necessary range installed inside the electric panel "QUM".

Inside the technical rooms, a minimum degree of protection of IP44 has to be guaranteed. The connections to be performed to the various actuators and sensors present on the field will be defined in detail during the mounting, in function for the equipments pre-chosen by the buyer. Anyway it will be the duty of the performing company to perform according to the indications of the constructor the electrical connections of the machined present on the field.

The cables will have to be type fire retardant located in pre-arranged channels and/or tubes; including cabling accessories, deadlifts with tubes or channels fir the camp elements that establish the regulation system (example substations, switches, thermostats, temperature sensors, actuators, etc.), with accessories for the perfect operation of the plant.

2.5.8 EARTHING AND EQUIPOTENTIAL PLANT

A new earthing plant will be built. It will be made by ten modular with coupling copper-plated steel coupling, 3 m length, contained within PVC inspectable wells and connected one to each other with nude copper rope 50 sq. mm. section. The grounded general collector will be built inside the "QGE" general panel; this element will collect both the protective conductors and the earth conductor coming from one of the foreseen earthings.

The main equipotential connections and the additional ones for the masses and the present foreign masses present have to be built. The minimum section of the protection conductor that performs the equipotentiality of the metallic masses will be 6 sq. mm. The conductors used for the equipotential connections will be included in sub track tubes.

The general earth plant, located within the service room, will be connected with the following types:

→ all metallic tubes systems for adduction, distribution and water drainage,
→ all accessible tubes for the heating plant, and
→ all metallic accessible masses with remarkable extension that exist in the area of the electric plant of the user.

2.5.9 LIGHTING PROTECTION SYSTEM (LPS)

A Lighting Protection System (LPS) level III (net distance 15 m) will be established. Within the cabinet, i twill be associated with a Surge Protection System (for further details, refer to the drawings.) The LPS will have a round copper wire (8 sq. mm. section), laid down along the roof perimeter of the buildings to be used as museum / multi-purpose hall and wine boutique, installed with stirrups at least 1 m distance. Furthermore, four picking up shafts (on the roofs of the Sentry Posts A and B, the museum / multipurpose hall, and the wine boutique), 2 m high, will be mounted. The round copper wire and the picking up shafts will be connected with the before described earthing plant through columns.

2.5.9.1 ENVIRONMENT SUSTAINABILITY

The electric plant will be formed by machines that will allow energy saving,. We will especially use mainly light fixtures equipped with LED lamps that will allow the substantial reduction of the electric power consumption. Another advantage of the use of LED sources is the reduced maintenance needed and the high time duration.

2.5.10 SIZING CRITERIA AND CALCULATION REPORT

2.5.10.1 PREMISE

In the present annex we present the main project criteria used for the sizing and the choice of the parts used.

2.5.10.2 SIZING CRITERIA

2.5.10.2.1 CLASSIFICATION OF THE ELECTRIC SYSTEM IN RELATION TO THE GROUND CONNECTION AND TO THE STATE OF THE NEUTRAL

The supply is provided in BT (low Voltage) by the distributor and the plant has his own earthing plant (TT system).

2.5.10.2.2 PLACE IDENTIFICATION

The environment can be classified as high risk environment in case of fires based on the prescriptions of the regulations CEI 64.8/7.

2.5.10.2.3 DISTRIBUTION LINES

a) Circuits

The electric plant has a mainly radial development with power grids and different circuits in function for the use of the different environments (illumination, F.M.). The panels are located in the rooms and environments indicated in the project.

b) Maximum voltage drop

Where not otherwise specified the following project values have been considered:

light circuits 3%

F.M. circuits 4%.

c) Conductor Range

According to the laying conditions derivable from UNEL and the related CEI regulation.

d) Minimum conductors section

- 1,5 mmq for the derivations on lighting circuits

- 2,5 mmq for F.M. lines connected to only one socket or user

and) Rated insulation voltage conductors:

e1) terminal circuits

for mounting pvc or metal tubes and channels:

Uo/U = 450/750 V

Conductor without sheath type N07V-K or similar fire retardant

Double-insulated conductors type FROR fire retardant

e2) distribution circuits for mounting metallic tubes and channels where required by a major degree of insulation, more exactly in case of connection or air on sight (where allowed):

Uo/U = 0.6/1kV

Double insulation type FG7R or similar fire retardant with toxic and corrosive gases contained emission

f) Packed coefficients

· cables with sheath in the tubes:

diameter of the contained tube equal to 1,5 times external diameter of the contained cable (including the sheath thickness)

· cables without sheath located in the tubes:

diameter of the contained tube equal to 1,4 times the diameter outside the bundle of conductors.

· cables located in the channels:

straight section < 50% of the useful section of the channel.

g) Minimum curving radii

Equal to 9(D+d) for unipolar shielded cables or with concentric conductors.

Equal to 8(D+d) for all other types of cables.

Where :

D = external diameter of the cable.

d = diameter(s) of the conductor(s).

h)(Measures against the spread of fire.

Group 3 pipelines are used (N.CEI 64.8; art 751.04.1 point m) established by fire retardant cables, in casing with degree of protection even less than IP 4X but protected with RCD sensitivity not more than 0,5A, installed in beams with the quantity of non-metallic material less than provided by the Regulation CEI 20.22

2.5.10.2.4 PROTECTION AGAINST OVER CURRENT

DIMENSIONS OF CONDUCTORS AND THE CHOICE OF THE PROTECTION DEVICE AGAINST THE SHORT CIRCUIT:

- The protection is entrusted to circuit breakers with intervention features type limiting let-through energy with breaking capacity ≥ 6 kA.

- In every section of the circuit the report will be valid:

$I^2t \leq K^2 S^2$

Where the minimum power or short circuit present in correspondence to the terminal line of the protected pipeline is assessed according to the report:

$$Icc = \frac{15\ U\ S}{L}$$

DIMENSIONING OF CONDUCTORS AND CHOICE OF THE PROTECTION CIRCUIT AGAINST OVERLOAD

At the beginning of every line there is a protection device with intervention features that comply with the following reports:

$Ib \leq In \leq Iz$

$If \leq 1{,}45\ Iz$

where:

Ib = power employment

In = nominal power and adjustment of the protection device

Iz = reach of the cable

If = conventional intervention power of protection device

In case of deriving circuits formed of conductors that have an inferior section to the one of the main line and have no further protections, the previous reports are satisfied also for conductors with smaller section. Al lines except the ones for the safety services are protected against overload.

2.5.10.2.5 PROTECTION AGAINST INDIRECT CONTACTS

For TN systems the report is always valid:

Zs Ia ≤ Uo

where :

Zs = impedance of the fault in ohm

I = value in amperes of the intervention power of the protection device:

in 5 s for the distribution circuits.

Within 0,4 s for the TERMINAL circuits.

Uo = nominal voltage) in c.a. effective value phase and earth

For the TT systems the report is always valid:

$R_a I_a \leq 50V$ (25V for construction, local and medical use sites etc.)

where:

R_a = sum of the resistance of the earth and of the protective conductors of the masses in ohm

I_a = value in amperes, for the intervention power of the protection device:

within 1 s for the distribution circuits.

Within 0,4 s for the TERMINAL circuits.

2.6 MECHANICAL PLANT DESIGN

2.6.1 OBJECT AND TECHNICAL REGULATION

The present technical report describes the provision and the works needed to carry out the following mechanic plants to serve the Besac fortress:

→ Summer and winter air conditioning plan with variable refrigerant volume
→ Waterworks and drains
→ Sewage and waste water treatment plant

2.6.2 TECHNICAL DATA OF THE PROJECT

The design of the plants, the inspections during the work and the testing operations will be made with reference to the requirements below.

2.6.3 NOISE

In relation to the noise of the plants against the building environments and third party environments are in force the provisions of the Law and what is specified below.

In relation to the *noise issued towards the rooms of the building* the Regulation UNI CTI 8199 November 1998 are applied "Sound testing for the air conditioning and ventilation plants"

In relation to the *noise issued towards properties and third parties environments* the Law provisions are applied, among which the Law n. 447 of October 26, 1995, "Panel law for the sound pollution" DPCM November 14, 1997 "Determining of the limit value of the sound sources" and the DPCM December 5, 1997 "Determining the passive sound requirements for buildings"

The company will adopt the necessary devices and will make the necessary supplies and performances to obtain rumor levels prescribed by the above regulations.

2.6.4 AIR CONDITIONING

The plants will be designed and performed relating to the project conditions below; the parameters referring to ventilation are reported to the volume of the rooms measured up to the floor intrados for the rooms without false ceiling and to the intrados of the false ceiling when it is provided.

In relation to everything not indicated the Regulations UNI CTI 10339 are applied:

		Summer	*Winter*
	External Temperature (°c)	34	-4
	External Relative Humidity (%)	50	80
	Internal Temperature (°c)	26	20
	Internal Relative Humidity (%)	50	50
Tolerance	Temperature (°c)		+1/-1
	Relative humidity (%)		+5/-5
Ventilation	Natural (vol./h)		0,5
	Input of external air (mc/h*person)5		
	Spoiled air extraction (vol./h)6		
Room crowding	(persons/sqm)		0,2
Internal loads	All rooms (W/sqm)		30

2.6.5 SANITARY AND WATER PLANT

The distribution plants for hot and cold water will be dimensioned so as to include the speed under 2 mt/sec. and installed in order to obtain the performances indicated below:

EQUIPMENT	*CAPACITY (LT/SEC.)*		*MINIMUM PRESSURE*
	A.C.	*A.F.*	*(KPA)*
WASHBASIN	0,10	0,10	50
BIDET	0,10	0,10	50
WC WITH CISTERN	--	0,10	50
WC WITH FLOW METER	--	1,50	150
BATHTUB	0,10	0,10	50
SHOWER	0,10	0,10	50
SINK	0,20	0,20	50
WASHING MACHINE	0,10	--	50
URINAL	0,10	--	50
SMALL HYDRANT OF 1/2"	0,40	--	100
SMALL HYDRANT OF 3/4"	0,60	--	100
HYDRANT UNI 45	2,00	--	200

The simultaneous loads adopted for the dimensioning of plants will be the ones from the Regulations Assistal curve n° 1 or n°2 in relation to the intended use of the buildings; the drainage plant) for the waters will be made with rigid polyethylene tube fitted according to the above norms, table n°3.

[5]In the air plants with A.E. socket
[6]For the sanitary services

2.6.6 DESCRIPTION OF THE PLANTS

The plants installed are essentially:

→ VRV Plant conditioning rooms
→ Electric forced air plant for the sanitary services
→ Water and sanitary plant and drains
→ Air extraction plant for bathrooms
→ Plant for the purification of waste water
→ Sewing for rainwater and used water

2.6.6.1 VRVPlant

The VRV Plant (Variable Refrigerant Volume) serves the rooms:

→ Souvenir shop
→ Museum
→ Multipurpose Room
→ Wine tasting
→ Wine boutique

The external unit (composted by two machines) is located adjacent to the service room for the public complying with the wall distances necessary to guarantee the correct functioning.

The machine is fitted to provide the winter performance for an external temperature of -4°C and the summer performances for + 34°C and is composed by one or more coupled modules, according to the supplier.

From the machine the gas and liquid tubes start towards the terminal units

The tubes and the communication bus will be earthed in corrugated PVC tubes and signaled with tape before the backfilling.

We will take care to enter the buildings through the doors and not through the walls.

The branch joints were located in order to be compatible with the maximum lengths accepted for such plant typology.

The internal units will be vertical type without furniture and will be located inside furnishing structures including also the input and air recovery vent.

Only the machine of the souvenir shop will be horizontal, also without furniture

The condensation generated by the internal units will be alleged to non returnable wells without bottom located on the sand bed

The entrance tubes for the wells will be protected by micro grid against insects.

2.6.6.2 THERMO ELECTRIC FAN SERVICE ROOM

The sanitary services room, newly built, is external in relation to the fortress. We need electric fan service with equipments wall mounted with power 2 KWe each with their own thermostat. Such solution releases the building from testing the heat pump and also makes compatible the maximum distances of the cooler tubes for other buildings

The high position of the machine holds a functional safety against the water sprays from the sinks and is also measure against vandalism.

2.6.6.3 Water sanitary plant, drainage and bath extraction

The water supply plant and drainage serves the sanitary rooms and the wine tasting rooms.

The wine tasting room is very far away from the sanitary services. The cold water is connected to the room with multilayer grounded tubes. With an electric boiler we produce sanitary hot water. The drainage network is over-dimensioned in relation to the real needs as we cannot bring a covering ventilation.

The increase of the diameter functions as auto-ventilation as the drainage not blocking ever the whole section allows the course of the air reverse without creating pressures or drops of pressures.

Given the high gradient of the land between the use and the delivery a series of quote sink wells are placed to hold the gradient of the sewer within 2%

For the service room, as is newly built there are no problems that lead to the vent for the covering

2.6.6.4 Extraction plant for the bathroom area

For the extraction of the bathrooms we provided a multiple attacks box and rook exit. To allow the circulation of the air renewal the doors must be raised 2 cm from the pavement. In the bathroom there are only the air intake valves while the box is located in the technical room to be protected from vandals.

2.6.6.5 USED WATER TREATMENT PLANT

The solution proposed is a degreaser well and an active sludge plant. A grilling to separate the bulky waste is made in a little well upstream from the sewage treatment plant; it receives the sewage waters as well as the clarified water that goes out of the degreaser.

The active sludge plant is fitted for the equivalent of 5 inhabitants and is composed of:

→ Blower located in the technical room
→ Membrane diffuser in epdm
→ air lift
→ oxidation tank
→ sedimentation tank
→ sampling well

2.6.6.6 RAINWATER AND WASTEWATER SEWERAGE

No street traps are provided and also the Barrack building (Museum and Multipurpose Room) has no waterspouts

We provide wells for rain, pvc tubes and dissipater quote wells as previously mentioned to stop the gradient of the discharge tubes.

An analogous solution is adopted for the sewing of the used water.

2.6.7 ENVIRONMENTAL SUSTAINABILITY

The choice of a hot air high efficiency heat pump for the air conditioning makes the plant highly sustainable from an environment point of view.

In energetic terms the energy issued as thermal energy is much higher than the primary chemical energy introduced to generate electrical energy to supply the machine.

The energy surplus made for the heated environment is taken by the external air machine.

From the point of view of emissions it has zero emissions as it does not work with electric energy.

The freezing gas R410A is an ecologic gas and also at the time of disposal of the plant there are no environment emissions as it is aspirated and put in cylinders before cutting the tubes.

2.6.8 MAINTENANCE COSTS

2.6.8.1 VRV Plant

The VRV (Volume of Variable Refrigerant) plant will serve the following rooms: Souvenir shop, Museum, Multipurpose hall, Wine tasting, and Wine boutique.

2.6.8.2 Winter Consumes of the VRV plant

We have evaluated the winter consumes (month by month, and consequently the whole winter season) through the *Easyclima* calculation programme. For the calculation we have considered a period of 180 days/year (E zone) with functioning ten hours per days 7 days a week (refer to the attached calculations.)

For the heat pump winter functioning we have made reference to an Energy Class A machine (cop > 3.6) with a cop of 4.17. Consequently, the winter thermic need of 40,406 KWh to satisfy asks for the compressors of the heat pump an electric need of 9,690 Kwh.

2.6.8.3 Summer Consumes of the VRV plant

We have evaluated the summer consumes (month by month, and consequently the whole winter season) through the *Easyclima* calculation programme. For the calculation we have considered a period of 91 days/year (15 June – 15 September) with functioning 7 days a week, 9:00 to 20:00 (refer to the attached calculations.)

For the heat pump winter functioning we have made reference to the same machine estimated for winter functioning. Consequently, the summer thermic need of 14,647 KWh to satisfy asks for the compressors of the heat pump an electric need of 3,850 Kwh.

2.6.8.4 Summer Consumes of the VRV plant

Based on what above calculated, the annual need of electric energy is up to 13,540 KWh.

2.6.8.5 Calculaton of primary Energy needs

SUMMARY PRIMARY ENERGY MONTH BY MONTH
Project: F:\10000\12056_CALCOLI\EASYCLIMA\12421 – Besac Fortress

Zone: heated/cooled zone

2.6.8.5.1 Energy needs

Mese	Qh	Qh'	$\eta_{e,corr}$	Qout,rg	$\eta_{rg,corr}$	Qout,d	$\eta_{d,corr}$	Qin,d
October	3,230	3,230	0.950	3,400	0.807	4,212	0.957	4,401
November	9,027	9,027	0.950	9,502	0.881	10,784	0.957	11,267
December	13,214	13,214	0.950	13,909	0.920	15,117	0.957	15,794
January	14,444	14,444	0.950	15,204	0.918	16,556	0.957	17,298
February	11,515	11,515	0.950	12,121	0.896	13,521	0.957	14,127
March	9,323	9,323	0.950	9,814	0.846	11,597	0.957	12,116
April	3,151	3,151	0.950	3,317	0.794	4,178	0.957	4,365

2.6.8.5.2 Zone efficiencies of the heating plant sub-systems used for the losses calculation

Mese	η_e	η_{rg}	η_d
October	0.95	0.807	0.947
November	0.95	0.881	0.947
December	0.95	0.920	0.947
January	0.95	0.918	0.947
February	0.95	0.896	0.947
March	0.95	0.846	0.947
April	0.95	0.794	0.947

2.6.8.6 GENERAL TOTAL (Building)

2.6.8.6.1 Energy Needs

Month	Qh	Qh'	$\eta_{e,corr}$	Qout,rg	$\eta_{rg,corr}$	Qout,d	$\eta_{d,corr}$	Qin,d
October	3,230	3,230	0.95	3,400	0.807	4,212	0.957	4,401
November	9,027	9,027	0.95	9,502	0.881	10,784	0.957	11,267
December	13,214	13,214	0.95	13,909	0.920	15,117	0.957	15,794
January	14,444	14,444	0.95	15,204	0.918	16,556	0.957	17,298
February	11,515	11,515	0.95	12,121	0.896	13,521	0.957	14,127
March	9,323	9,323	0.95	9,814	0.846	11,597	0.957	12,116
April	3,151	3,151	0.95	3,317	0.794	4,178	0.957	4,365
Total	**63,904**	**63,904**	**0.95**	**67,268**	**0.885**	**75,966**	**0.957**	**79,367**

Month	Qout,s	$\eta_{s,corr}$	Qout,gn	$\eta_{gn,corr}$	Qin,gn	$\eta_{gn+aux,corr}$	Qin+aux,gn	QH,aux	Qp,H	$\eta_{p,H}$
October	0	1	4,401	2.315	1,901	2.315	1,901	0	1,901	1.699
November	0	1	11,267	2.137	5,273	2.137	5,273	0	5,273	1.712
December	0	1	15,794	1.898	8,321	1.898	8,321	0	8,321	1.588
January	0	1	17,298	1.793	9,648	1.793	9,648	0	9,648	1.497
February	0	1	14,127	1.887	7,488	1.887	7,488	0	7,488	1.538
March	0	1	12,116	2.079	5,827	2.079	5,827	0	5,827	1.600
April	0	1	4,365	2.242	1,947	2.242	1,947	0	1,947	1.619
Total	**0**	**1**	**79,367**	**1.964**	**40,406**	**1.964**	**40,406**	**0**	**40,406**	**1.582**

2.6.8.6.2 Building efficiency of the heat plant sub-systems used for the losses calculation

Month	η_d	η_{gn}	η_{gn+aux}
October	0.947	2.315	2.315
November	0.947	2.137	2.137
December	0.947	1.898	1.898
January	0.947	1.793	1.793
February	0.947	1.887	1.887
March	0.947	2.079	2.079
April	0.947	2.242	2.242

Legenda:

Symbol used	Dimension	Measurement Unit
Qh	Ideal need of thermic energy for heating	[kWh]
Qh'	Net ideal need for heating	[kWh]
$\eta_{e,corr}$	Emission efficiency	-
Qout,rg	Need of energy output from the regulating system	[kWh]
$\eta_{rg,corr}$	Regulating efficiency	-
Qout,d	Need of energy output from the distribution system	[kWh]
$\eta_{d,corr}$	Distribution efficiency	-
Qout,s = Qin,d	Need of energy input in the distribution system	[kWh]
$\eta_{s,corr}$	Accumulation system efficiency	-
Qout,gn	Need of energy output from the generating system	[kWh]
$\eta_{gn,corr}$	Generating efficiency without electric auxiliaries to the generator	-
Qin,gn	Need of energy input in the generating system without electric auxiliaries to the generator	[kWh]
$\eta_{gn+aux,corr}$	Generating efficiency with electric auxiliaries to the generator	-
Qin+aux,gn	Need of energy input in the generating system with electric auxiliaries to the generator	[kWh]
QH,aux	Electric energy need of the auxiliaries (excluding the generator)	[kWh]
Qp,H	Primary energy need for heating	[kWh]
$\eta_{p,H}$	Average seasonal efficiency of the heating plant	-
Note: the "corrected" efficiency of the plant sub-systems takes into account possible recovery		

2.6.9 CALCULATION SUMMARY

Calculation of the winter dispersions

SUMMARY OF THE CENTRAL HEATING PLANT:

Project :	F:\10000\12056_CALCOLI\EASYCLIMA\12421 - besec fortress

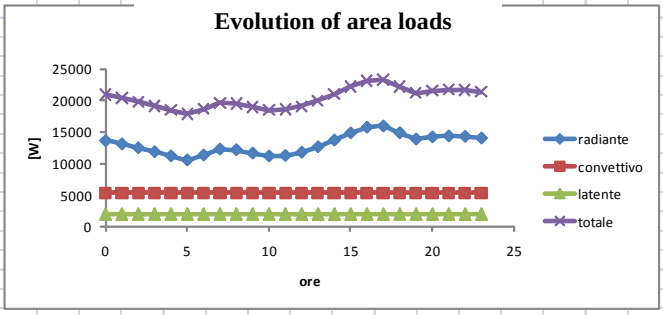
Building/Apartment :	**Central heating/cooling plant**	
Gross surface (S)	742,3	m^2
Gross volume (V)	767,2	m^3
Report S/V	0,90	1/m
Calculated Cd	1,63	W/m^3*K
Cd law	----	W/m^3*K
Net volume	531,60	m^3
Total dispersions	33428	W

Room	**Area**	**Floor**	**S [m^2]**	**V net [m^3]**	**T [°C]**	**Dispersions [W]**		
						Trans.	**Inf.**	**Total**
1 Souvenir	Danger area	Ground floor	9,33	21	20	2844	89	2933
3 Wine boutique	Danger area	Ground floor	60	135	20	6208	574	6781
2 Museum	Danger area	Ground floor	33,33	105	20	4553	446	4999
4 Multi-purpose room	Danger area	Ground floor	70,67	223	20	9731	946	10677
5 Tasting	Danger area	Ground floor	12	27	20	3327	115	3442
6 Museum de	Danger area	Ground floor	9,33	21	20	4506	89	4595
			194,66	**532**		**31169**	**2259**	**33427**

Easy Clima - Estate

Cooling loads **Progett F:\10000\12056_CALCOLI\EASYCLIMA\12421 - fo** **besec fortress. Pri**

Area
building Heating/Cooling unit
Area Heated/cooled area
maximum load al 17 hours in August
surfacace 194.7 m^2
volume 532 m^2
number of inhabitants 27 persons at the maximum load hour
infiltrations 133 m^2/h
external temperature 30.2 C at the maximum load hour
maximum thermal load sensitive 31258
latent 1951
total 23309



LOAD SITUATION IN 24 hours [W]

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
	radiant	13638	13107	12497	11850	11187	10536	11327	12274	12176	11636	11179	11257	11770	12657	13717	14885	15788	15986	14894	13888	14230	14392	14325	14058
	connective	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372	5372
	latent	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951	1951
	total	20961	20430	19820	19172	18510	17858	18650	19597	19499	18959	18502	18580	19092	19980	21040	22208	23110	23309	22217	21211	21553	21715	21648	21381
ripartizione dei carichi																									
load division		1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752
Lights [W]	radiant	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752	1752
	connective																								
		1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336	1336
People [W]	radiant	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714	2714
	connective	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970	2970
	latent																								
		3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
Other loads [W]	radiant	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
	connective	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	latent																								
		-253	-297	-340	-374	-400	-409	-391	-348	-271	-158	-29	118	256	359	428	454	428	368	273	161	49	-46	-133	-202
Infiltrations [W]	sensitive	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029	1029
	latent																								
		15943	15040	13944	12729	11447	10140	8837	7573	6455	5674	5370	5557	6152	7044	8135	9358	10671	12041	13422	14731	15834	16562	16800	16563
External walls [W]	sensitive																								
Windows [W]	connection	1446	1359	1278	1201	1129	1244	4969	7319	7844	7287	6337	5863	5951	6641	7630	8765	9348	8736	6126	2148	1852	1741	1637	1538
	radiant	-408	-478	-548	-603	-645	-659	-631	-561	-436	-255	-47	190	412	579	690	732	690	593	440	259	78	-75	-214	-325
Internal walls [W]	sensitive																								
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

3 WORK PHASES

Considering the strong economic efforts that has to be faced, the works for the restoration / reuse of the Besac fortress will carried out in two phases. In great synthesis, such phases have been subdivided between architectural and structural restoration works, and plant establishments.

For such a purpose, we provide the following documents:

- *Drawings*, one packet for the whole work, and two different packages, one for phase 1 and another one for phase 2;
- *Bill of Quantities,* one packet for the whole work, and two different packages, one for phase 1 and another one for phase.

In the following lines the different works to be carried out within any phase are listed.

3.1 PHASE 01

FORT WITH TOWER

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

BARRACKS

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *New Roof*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

SENTRY POST A

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

SENTRY POST B

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *New Floor*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

SENTRY BOX

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

SOUVENIR SHOP

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *Building of new Masonry Box*
- ✓ *Structural Strengthening*
- ✓ *Paving Works*
- ✓ *Preparation for Plants*

3.2 PHASE 02

ENTRANCE ARCH

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *New metal gate*

LANDSCAPED AREA

- ✓ *Paving Works*
- ✓ *Amphitheatre*

DEFENSIVE WALLS

- ✓ *Removal of Vegetation*
- ✓ *Surface Cleaning*
- ✓ *Structural Strengthening*

SERVICE BUILDING

- ✓ *Building of New Construction*

ACCESS ROAD

- ✓ *Removal of Vegetation*
- ✓ *Paving Works*

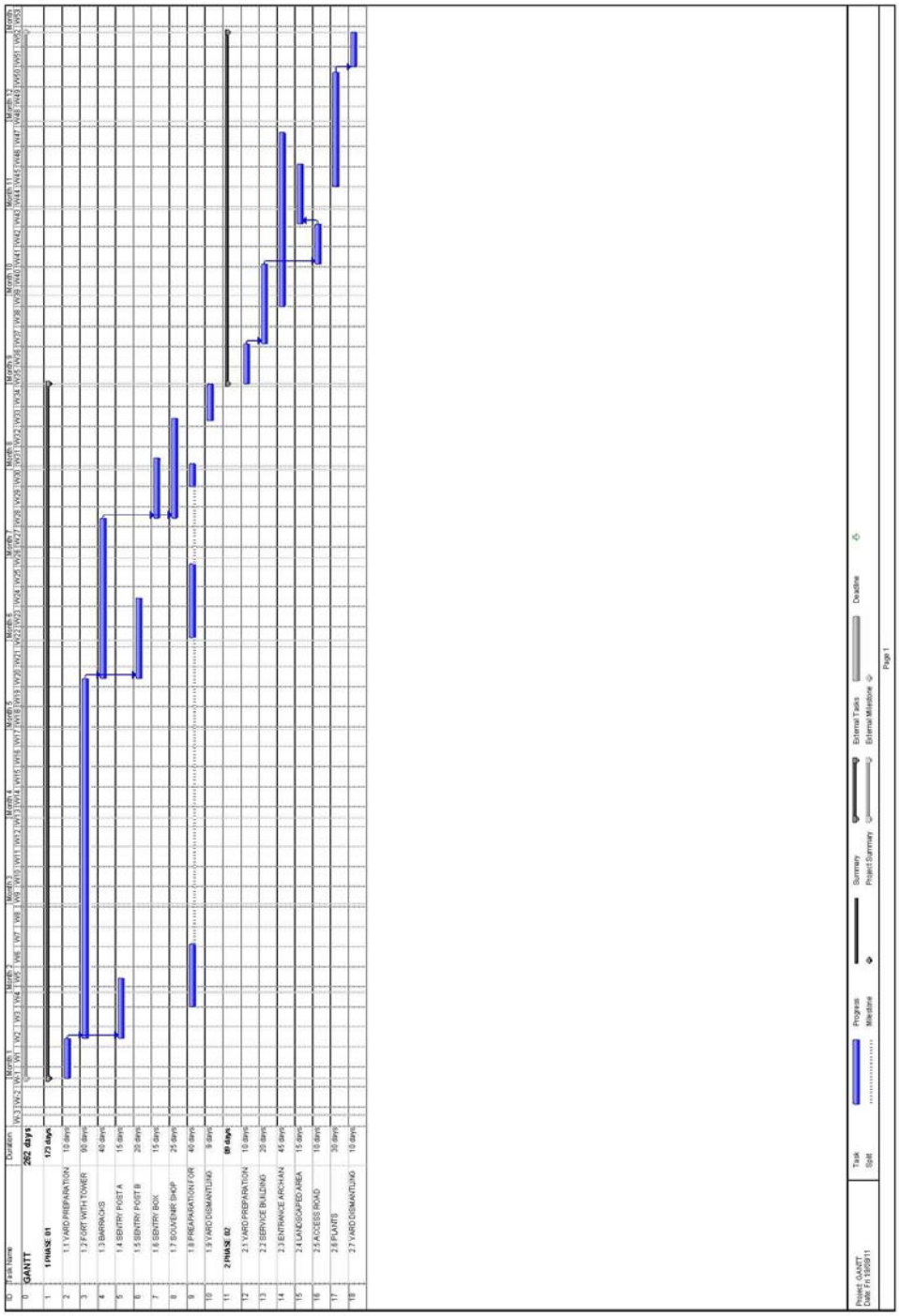
ELECTRICAL PLANTS

MECHANICAL PLANTS

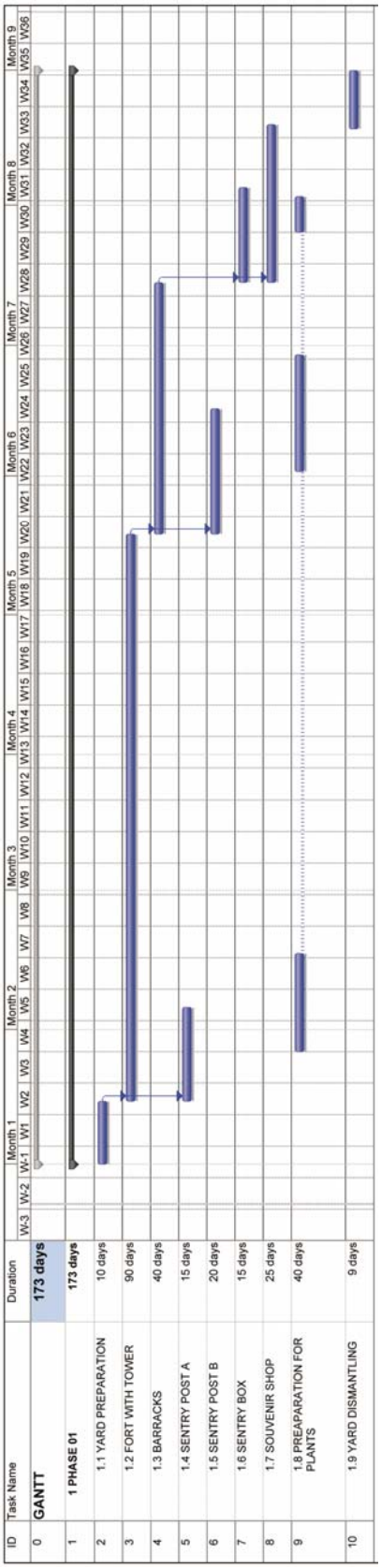
4 GANTT CHART

The following GANTT chart shows the timetable related the whole works to be carried out. Furthermore, we provide also two more GANTT charts, related the two different phase 1 and phase 2.

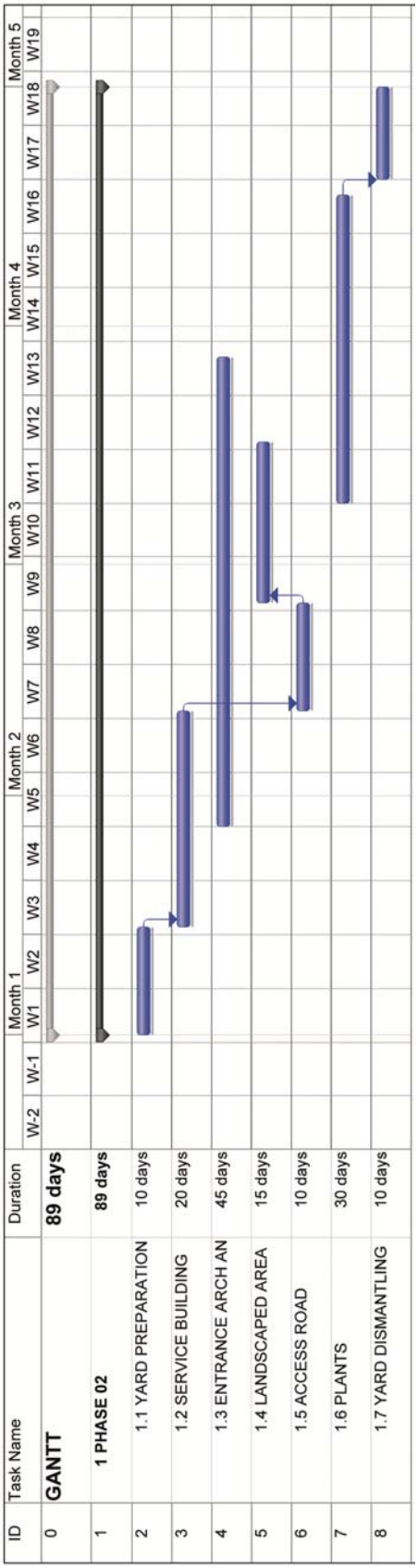
GANTT chart #1 – the whole works



GANTT chart #2 – the works to be carried out during phase 1



GANTT chart #3 – the works to be carried out during phase 2



5 LIST OF PAPERS

The documents provided here are the following:

- Technical report (the present document),
- Bill of Quantities (BoQs), and
- Drawings, divided in

    01 - Basic Survey,

    02 - Architectural Design, and

    03 - Plants.

ANNEX 1 – TECHNICAL SPECIFICATION

1 PRELIMINARIES

1.1 AIMS & OBJECTIVES

→ The principle underlining the approach of restoration is to restore the remains as a ruin. The policy of minimum intervention must be adopted wherever possible, subject to instructions by the Architect in charge. Missing pieces, for example, should not be replaced unless the damage is a hazard to the remains, or unless otherwise specified by the Architect in charge.

→ Photographic Records: Photographic records are required of all historic features that may be uncovered and exposed during the restoration works. Surveying and recording of the investigatory works herein described will serve to supplement the existing information.

1.2 SCOPE OF WORKS

→ The objective of the Work is to restore the Besac Fortress, as described in the introduction and project policy. The works primarily include the restoration of deteriorated masonry fabric and removal of any biological growth and cleaning. No replacement of missing pieces shall be carried out unless otherwise specified.

→ All works shall be carried out with care and sensitivity

→ When tendering, the contractor shall be aware that he shall take all necessary precautions for the safeguarding of the ruins, and shall assume responsibility for the protection of the ruins on site during ongoing works.

→ Prior to commencement of works and when required so by the Architect, the successful contractor shall be required to produce a detailed method statement outlining the proposed procedure of intervention and specifying materials to be employed for the restoration intervention.

→ The method statement shall be submitted to the Architect for approval, and prior to the commencement of works. In addition to this, the contractor is to conform with the Construction Management Plan as prepared by the project manager of the Project, in order to be able to establish how to access the site and handle building materials and waste on site to ensure minimum impact.

1.3 FACTUAL REPORTING

→ The Contractor shall submit weekly factual reports of site operations describing the interventions, works uncovered, findings and instructions received. The report shall be presented in PDF format and shall contain, but not be limited to the following information:

- ✓ Introduction
- ✓ Site location & Description
- ✓ Description of procurement
- ✓ Findings
- ✓ Photographs of Works
- ✓ Instructions received.

→ All the above shall be accompanied by a full measurement survey together with a photographic report summarizing the findings.

2 RESTORATION AND STRUCTURAL INTERVENTIONS

2.1 EXTENT OF WORKS

Prior to the commencement of works, the building shall be inspected together with the Architect to confirm the extent of work and restoration methodology employed, making sure the method statements requested are submitted by the tenderer and comply.

2.2 REMOVAL OF CEMENT RENDERS/LIME WASH RENDERS/WATER BASED PAINTS

Where identified by the Architect, concrete/ cement renders/ lime wash renders/ water based paints shall be carefully remove by hand tools using manual methods so as to contain damages to the underlying masonry work. Electrical tools as well as tipped metallic instruments with sharp edges or corners, power tools (such as rotating disk cleaners) and sand blasting (dry or wet) shall not be permitted, unless otherwise instructed by the Architect.

2.3 REMOVAL OF ADDITIONS/ACCRETIONS

The Contractor shall ensure the careful removal of all accretions from the facades of the building. The methodology employed for this removal shall be approved by the Architect prior to commencement of works. Care shall be taken to remove all metallic inserts, (especially iron and steel fixings) from the stonework.

Corroding metal fixings shall be carefully cut so as to cause the least possible disturbance to the surrounding masonry; the associated rust debris shall also be carefully removed. Resulting holes shall be filled-in using a suitable lime-based mortar when the break is small or by piecing-in stone, if the gap is large, as per specification.

2.4 DISMANTLING OF MASONRY STRUCTURES

→ All dismantling of masonry sections for subsequent reconstruction shall be carried out carefully by experienced personnel, care shall be taken to ensure that during the dismantling procedure each stone block is numbered and referenced to a drawing, specified image, photograph etc as directed by the Architect and Civil Engineer in charge.

→ The masonry blocks/sections shall be removed in their entirety. Each unit shall be identified clearly and indelibly on concealed faces. The methodology to be employed shall be discussed with and approved by the Architect and Civil Engineer in charge prior to the commencement of works.

→ All masonry units shall be cleaned from old mortar, soil etc and stored in a manner such as not to cause any damage.

2.5 RECONSTRUCTION OF PREVIOUSLY DISMANTLED STRUCTURES

→ Reconstruction shall be carried out by experienced personnel who shall ensure that the original face and joint lines, joint widths etc. are respected to ensure that the final work matches the original in all respects. Care shall be taken to ensure adequate bonding at junctions with the retained original structure.

→ The bedding surfaces of the masonry blocks shall be dampened with de-ionized water having conductivity inferior to 60 µS to control suction. The masonry blocks shall be laid on an evenly buttered bed of mortar prepared from a mixture of suitably slaked airline, and stone dust. Care shall be taken to ensure that the exposed surfaces of the masonry blocks are kept clean.

The Architect and Civil Engineer in charge shall indicate and approve which of the original masonry units shall be replaced.

2.6 REMOVAL OF VEGETATION

Every effort shall be made to remove all parts of biological growth including roots and stubs. Plants/ weeds shall be removed by carefully cutting the plant at the base of the stem and then by the introduction of a suitable biocide to kill off the remaining part of the plant.

The product to be used should result in the desiccation of the plant after it has been absorbed; the dead parts will then be easily removed by hand, without risking re-growth.

The following factors shall determine which chemicals will be used:

→ Chemicals which do not cause damage, chemically or otherwise, to the stone;

→ Chemicals which do not create any risk to man or other life forms , apart from the ones treated, taking into account their toxicity;

→ Their activity period and residual effects;

→ Do not contain harmful salts or other substance which can instigate or accelerate the deterioration of the stone.

1.1.1 Choice of Herbicide

The removal of vegetation must be made with products compatible with the surface to be coated and with a lasting and safe effect far as possible. In succession are shown the characteristics of three products that can be applied and that have acceptable technical characteristics having been tried in other yards. The choice is based both on their availability and on their effectiveness.

Product	Manufacturer
RODEO GOLD	MONSANTO
GOAL* 480 SC	DOW AGROSCIENCES ITALIA s.r.l.
CHIKARA 25 WG	BELCHIM

All the operations of weed will have to be made within the period autumn/ winter to exploit the favourable phenological moment. All operations will be performed by properly trained staff and supervised by a qualified and skilled technician.

1.1.2 Characteristics of RODEO GOLD

Active ingredient: Glyphosate pure g 41 - (g/l 480)

The RODEO GOLD (whose active ingredient is N-fosfometilglicina) is a herbicide, broad-spectrum of activity, for effective and targeted control of any weeds and / or shrub.

From the biological point of view the mode of action of the RODEO GOLD is very specific in respect of higher forms of plant: it interacts with the mechanism of protein synthesis and in particular with the synthesis of aromatic amino acids. This biochemical process is present only in plants and is not found in similar form in any other living being. Such action specificity gives back reason for the very high herbicide activity and the harmlessness to humans, animals, both terrestrial and aquatic microorganisms at a time.

The RODEO GOLD is only absorbed by the leaves and all the green parts of the plant (and, therefore, not from the roots or trunks of shrubs), once absorbed, the active ingredient is transported by the sap in the tissues to the roots and reproductive organs of the plant. Although the 'RODEO GOLD action occurs after a few days after treatment (7 to 15 days) with a yellowing of the plant which then gradually becomes brown, the plant ceases to grow from the time of treatment.

RODEO GOLD is used for the control of the weeds in all that environments where however it must be to avoided that the grass infesting, with their growth and colonization of the territory, creates problems of stability to the structures, hinders the accessibility from the citizen, prevents the collection of waste or forms an organic substratum where irritating insects and animals can develop and proliferate.

THE RODEO GOLD is a product for the control of weeds, annual and pluriannual, on roads, sidewalks, parks and gardens, cemeteries, bike paths, urban squares, dock yards, parking lots, hollows of trees, walls, monuments, archaeological areas, forest areas, airports, railways, railway stations, tree-lined streets, wetlands, settlements and handicraft industry

1.1.3 Characteristics of GOAL 480 SC

Active ingredient. OXIFLUORFEN pure 480 g /l

Goal 480 SC is a selective herbicide in concentrated suspension for the weed control of the arboreal cultures and crops in open field, of forest and ornamental hatcheries, of uncultivated areas, industrial and civil areas, road edges, banks and railway centers

Goal 480 SC at pre emergence, at maximum usable doses, is effective against grasses and dicotyledonsGoal 480 SC acts on weeds on contact and its effectiveness and persistence are enhanced during the autumn and spring. Depending on the type of treatment adopted is necessary to treat the complete wetting of the soil and weeds. Goal 480 SC is compatible with the total herbicides post-emergency, such as Glyphosate.

1.1.4 Characteristics of Chikara 25 WG

Active ingredient. 25% p/p Flazasulfuron

This product is also registered for the non-agricultural areas. The product, can be used in pre or early post-emergence weed control, is characterized by very low dosages, toxicological and environmental prophile and residual action

Chikara 25 WG presents an excellent herbicidal activity against the most common annual weeds mono and dicotyledons, as well as to almost all of the ruderal and replacement species.

It is particularly suitable for "difficult" weed pest, especially where glyphosate does not produce satisfactory results, and it shows its best work in tank mix with glyphosate after an early weed emergence. The mixture with glyphosate at reduced doses, in fact, supplements and improves the action spectrum of both products having synergistic and complementary activity.

1.1.5 Maintenance

The use of the products previously described, applied in the correct way according to the instructions of the manufacturer, allows to obtain excellent results. To ensure that these results are permanent, a periodic maintenance must be serviced on a regular basis, performed by non-specialized, but trained operators.

Additionally, the use of the products described does not preclude the eventual seeding a meadow after treatment.

Even for maintenance, such products are applicable, because they affect the weed both at seedling stage (pre-emergence), cancelling the development of fact, both during the post-emergence, eliminating the weed already developed.

The effectiveness of these products is 6 months. At regular intervals, twice a year, you must repeat the treatment in order to avoid the development of weeds and hit them at the seedling stage. In this case, in fact, it is not necessary to provide for mowing and harvesting, significantly reducing the maintenance costs.

2.7 RAKE OUT JOINTS

Power tools may not be used for the removal of renders, mortars and opening of joints unless explicitly requested in writing by the Architect. Hand held tools to be used.

2.8 POINTING

The repointing of masonry will be necessary in cases where the existing mortar has weathered out, consists of cement or where it has become friable or loose. Mortar tests were carried out by an independent laboratory and these were analyzed by a Stone Conservator. Refer to this document for the conclusions on the types of mortar as necessary.

Due the variation of the existing mortar colour the new pointing should be similar in colour to the adjacent original pointing mortar. The difference in colour should be brought about by adding a colour additive. Various on-site trial/samples should be carried out in areas were these different mortar types are used for approval by the Architect.

The following will apply in the pointing procedure:

→ Where the wall is tight-jointed, no raking out of joints shall take place unless otherwise indicated by the Architect.
→ Small mason hand tools, including hacksaw blades and narrow screwdrivers shall be used.
→ Portland cement mixes will not be permitted, unless otherwise instructed by the Architect.
→ All mixes shall be lime-based, and will also be as close as possible in colour, texture to the original mortars.
→ Pozzolanic or similar additives shall be preferred alternatives to give strength and durability to a lime-based mix, unless instructed otherwise.

The properties of the mix shall be improved if hydraulic lime is used as an alternative to both hydrated lime and pozzolana. In the former case only aggregate shall be added; no cement or other pozzolanic additives shall be necessary.

2.9 PREPARATION OF MASONRY STRUCTURE FOR POINTING

→ The existing mortar shall be carefully removed without damaging the adjacent masonry or widening the joints using small hand-held chisels to a minimum depth of 25mm and never to a depth less than their width. Impact tools shall not be used. Power tools such as rotary discs (chasers) will not be allowed.
→ If mortar has failed to such an extent that the joints are largely empty, then the joints will be deep tamped and, if necessary, hand grouted to fill the voids up to the distance required for pointing.
→ Prior to pointing/re-pointing, all open joints shall be cleaned from dust and loose materials, and the surrounding stones adequately wetted by water as specified in this document
→ The work shall commence at the top of the wall moving downwards.
→ If joints exhibit biological soiling, a biocide should be applied prior to flushing out.

2.10 POINTING METHODOLOGY

→ Where pointing is considered necessary, subject to the Architect, the Contractor shall clean and dampen the joints with clean water as specified in this document
→ The mortar face shall be kept as far back as required to achieve the original joint width.
→ If the stones have retained sharp edges, joints shall be filled flush unless the original joint face was profiled in some other way. In the case of weathered edges, or where the stone has spalled off, the face of the new mortar shall be kept back such that the apparent joint width does not increase.
→ The Contractor shall ensure that all pointing is built up in layers not exceeding 10mm in thickness
→ The mortar shall be built up and firmly applied in layers until the specified thickness is reached; the Contractor shall ensure good adhesion with no voids. A mechanical key shall be formed to the undercoat/s by combing or scratching so as to produce evenly spaced lines.

- Each layer shall be allowed to achieve an initial set prior to the application of subsequent coats (minimum 24hrs), and prevented from drying out too rapidly by covering immediately with plastic sheeting and/or dampening intermittently with clean water. All pointing shall be left shy from the surface, however, all pointing shall be such as to inhibit any water during the cleaning process from lodging into the structure.
- When using lime mortars, the fresh mortar shall be kept as humid as long as possible to slow down setting rate and hence avoid cracking. Ready-mixed lime mortar shall only be used if approved by the Architect.
- After application, but prior to setting, the area around the joint will be sponged down with water to remove the residue from the adjacent stone
- After the initial set has taken place, the Contractor shall stipple the joints with a stiff brush to remove laitance/excess fines and achieve a coarse texture.
- All pointing shall be carried out in moist, warm conditions
- Fresh pointing shall be allowed to dry slowly and be adequately protected from excessive heat and direct sunshine by a tarpaulin, and should occasionally be wetted to avoid cracking.
- A minimum of 24 hours shall be permitted between the applications of each layer of pointing.
- When laying new stonework, all vertical and horizontal joints shall be adequately buttered with mortar.

2.11 PLASTIC REPAIR

- Plastic repair as specified in this document shall be used in areas indicated by the Architect.
- Any deteriorated, flaking, powdering etc masonry shall be carefully removed to expose a sound background. In the process care shall be taken not to weaken the structure or damage the adjacent masonry.
- The top and vertical edges of the repair area shall be undercut to provide sufficient bonding and reduce the formation of visible shrinkage joints.
- Suitable non-ferrous reinforcement approved by the Architect shall be used for all plastic repair interventions which have a projection of more than 40mm from the stone surface or an area which exceeds 50mm by 50mm.
- Pre-fabricated glass reinforced polyester, or epoxy rods having a diameter of not less than 6mm shall be used. Holes shall be drilled with the background to form a grid of dowels fixed not more than 40mm apart. Dowels shall have a minimum anchorage in stone of 60mm, and the Architect may request that this bedding depth be increased. All dowels shall be adequately bonded to the masonry fabric with an approved epoxy resin.
- Adequately gauged stainless steel wire shall be used to form a mesh between the dowels. This mesh shall be secured to the resin dowels.
- When preparing the reinforcement, allowances shall be made to ensure a minimum cover of 20mm.
- The plastic repair mortar shall be based on a lime binder and it can be premixed.
- Aggregates used shall vary from coralline sand, to pozzolanic additives, as agreed with the Architect.
- The mixes shall approximate a 1:3 binder to aggregate ratio, unless otherwise agreed the Architect. In the mortar preparation, the Contractor shall ensure that the grains of sand and stone dust are adequately coated with the binder paste.

- Slaked lime shall be used as a binder, with the putty mixed wet with the aggregate and stored in an airtight container as far in advance as possible.
- Hydraulic lime may be used to substitute completely the slaked lime, as per the Architect instructions.
- The mortar shall be built up in layers where necessary, each layer not exceeding 12mm.
- The finishing coat shall match the existing surfaces and approved sample/s.
- The Contractor shall ensure that repair mortar is not stronger than the adjacent fabric.
- When plastic repair is used to fill alveoli then the extent of filling shall be determined on site by the Architect and shall reflect the physiognomy of the deteriorated masonry fabric. All plastic repair shall be formed such as to match the adjoining stonework in colour, texture and final profile.

2.12 ADVERSE WEATHER

- Wet methods of surface intervention (including re-pointing) will be suspended, or suitable protection provided. The Contractor shall protect works against damage by rain and necessary precautions shall be taken by the Contractor to prevent the masonry bedding from drying out too rapidly in hot conditions and in drying winds.

2.13 REPLACEMENT OF DETERIORATED MASONRY

- Every effort shall be made to retain as much as possible of the original masonry structure. To this effect no stone shall be replaced without the prior approval of the Architect.
- Stone replacement will be limited to individual badly deteriorated stone blocks and the total number of stone replaced shall be kept to the minimum possible.
- All new stone work used shall be similar in material, colour, size and configuration to the original and shall match with the existing course height.
- Methodology employed for the cutting away of the deteriorated masonry sections may vary depending on the particularities of every individual case. Nonetheless, care shall be taken to ensure that only hand held tools and small power tools which do not cause damage to the structure and/or immediate stone blocks will be used. The methodology employed shall be discussed with and approved by the Architect prior to the commencement of works.
- The cutting of perimeter joints may be carried out with a masonry saw. If stone is to be retained, the cut shall be made by a purpose-made fine saw blade or with a plugging chisel in the case of a wide joint. Where stone is to be replaced, the stone shall be chiseled away starting from the centre and moving towards the edges.
- The extent of additional replacement, to that indicated in attached drawings, shall be established with the Architect.

Furthermore, the work is to recover the walls by means of a partial substitution of the materials; walls or part of walls particularly decayed so not to be recoverable and which cannot respond to their static function any more, will be substituted with new stone blocks compatible for nature and dimensions. The choice of the recovering materials must be very carefully done and the new structures must satisfy different issues: historic, aesthetic and most of all technical; the new materials must be compatible with the old ones in dimensions (so to avoid differences in the frame of the wall which can cause ungluing between the old and the new parts) and in nature (a different hardness could provoke different absorbing

and the coming off of stains. The demolition of the stone to be substituted must be done with manual tools (hammers, points, levers…) being careful not to stress the structure and to avoid new damages; when the stone is taken out the hole must be cleaned with brushes, scrapers and aspirators to remove dust and debris. The bonding mortar could be a natural hydraulic lime grout with siliceous sand, brick dust, pozzolan, cleaned and wasted.

2.14 STRUCTURAL STABILITY

The contractor shall ensure that the stability of the masonry structure is maintained throughout the work.

Any defects, including signs of movement that develop or become apparent during the course of the works shall be immediately reported to the Architect.

2.15 GROUTING JOINTS

Grout mix shall be based on lime and local sand.

Joints around replacement masonry units shall be thoroughly grouted wherever joints cannot be fully filled with bedding mortar.

The grout shall be kept back from the exposed face to allow for the depth of pointing specified; this shall be achieved using an approved temporary sealing material. The Contractor will ensure that the grout does not stain the exposed face.

The Contractor shall not point replacement masonry until all the work has settled-in. The pointing of the outer 25mm (as a minimum) shall be left until all bedding work has settled.

2.16 JOINTING OF MASONRY WORKS

Replacement stone shall be cut and shaped with such a manner as to ensure the minimum loss of the original material, yet provide a firm seating for the replacement.

All existing joint widths shall be respected and bridging of joints will not be permitted.

The pockets to receive inserts shall be accurately cut with small, sharp chisels and small saw blades to a neat, square profile. The sides of pockets shall be undercut, where necessary, to provide space for specified bonding material.

Where so directed by the Architect, the contractor shall dove-tail the new insert with the original to ensure adequate bonding.

The pocket shall be cleaned out thoroughly and the inserts installed accurately and securely. The Contractor shall ensure that no bonding material encroaches upon the exposed faces.

Piecing-in may also be carried out in larger areas, in which a piece of stone is added to fill in a missing area or replace a part of a deteriorated stone by the insertion of an appropriately cut stone piece, attached using structural adhesives (e.g. epoxy or polyester adhesives), as approved by the Architect.

2.17 BONDED DOWELS

The Contractor shall submit samples/ method statements for the use of stainless steel, glass reinforced or epoxy resin dowels used in conjunction with polyester or epoxy resin adhesives shall be used, and as approved by the Engineer.

Suitably sized holes shall be drilled in the background and rear of the replacement/insert to receive dowels and adhesive. The Contractor shall ensure that the holes are aligned to allow accurate positioning of the replacement/insert and that enough depth is allowed for sound anchorage.

The holes shall be cleaned, all dust removed and adequately flushed with water; adequate drying time shall be allowed. Smaller holes may also be cleaned by blowing out with a small tube.

The dowels shall be secured into clean, dry holes with adhesive. No adhesive shall be used to bond stones at joints unless agreed otherwise with Engineer. The pins shall be cut to size prior to the injection of the resin and shall not be closer than 6mm to the surface for small diameters and 12mm for large diameters.

The resulting holes shall then be filled with matching mortar.

2.18 NUMBERING OF STONEWORK THAT IS TEMPORARILY REMOVED

Using methods and materials approved by the Architect, number existing unstable stone cladding/facing as directed by the Architect, and to the specifications listed below. The numbering methodology to be employed shall be determined by the Architect. Copies of photos and photographic records shall be handed to the Architect as part of the building file to be compiled by the contractor for this project as detailed in this document.

Carefully dismantle sections of the outer leaf, previously numbered one area at a time, taking care to adequately prop surrounding stone work. Extents of masonry work to be dismantled shall be determined by the Architect.

Carefully, taking care not to damage the stonework by chipping, etc., store dismantled outer leaf on timber palettes. Care should be taken to ensure that dismantled stonework is not damaged and the original patina of the stone shall be respected. Expanded polystyrene sheets or any other similar material approved by the Architect shall be used to pack dismantled stone work on timber palettes for future use.

Following the dismantling of the outer wall any unstable stone, material etc shall be removed and the exposed surface shall be prepared for the re-instatement of the previously removed outer leaf. The dismantled stone work will then be reinstated in their original location and with the same orientation as was originally. Any deteriorated stonework will be replaced with new stone having similar dimensions and configuration. The masonry to be replaced must be approved by the Architect.

Where necessary, joints at the back of the stone work shall be prepared ready to receive chemical anchors/ties. An average of two ties/ anchors per meter run shall be introduced in every course, or as otherwise directed by the Architect. While carefully taking care to propagate the minimum vibration possible, drill holes in stonework ready to receive chemical ties/anchors. Ties/anchors shall be sunk to a minimum of 150mm or as specified by the manufacturer into a sound stone fabric. Grout ties/anchor using

a suitable epoxy resin, or any other material as directed by architect and civil engineer on site. When inserting ties/anchors, care should be taken to ensure that these are fixed at a suitable inclination as directed by the Architect to ensure that the newly re-instated stonework is well anchored in the backing material.

The bedding surfaces of the masonry blocks shall be dampened with water as specified in this document. The masonry blocks shall be laid on an evenly buttered bed of mortar prepared from a mixture of suitably slaked air lime and stone dust. Care should be taken to ensure that the exposed surfaces of the masonry blocks are kept clean

Tie stone blocks together by forming joints, as detailed by the Architect, and grout using a suitable hydraulic lime based mix, or otherwise, as directed by the Architect.

Using a hydraulic lime-based grout, grout any interstices between newly re-instated leaf and the original fabric. Grouting should be carried out at course height intervals.

2.19 CLEANING: GENERAL CONSIDERATIONS

The cleaning method adopted should, as far as possible;

→ Be effective in removing the deleterious substances from the stone surface.

→ Not produce any substances which will encourage any future deterioration of the stone.

→ Be slow enough such as to allow good control by the operator.

→ Must not cause any micro-fractures or any other discontinuities of the stone surface, as these may initiate or encourage new deterioration processes.

Abrasives, chemicals, or high pressure water jetting will not be permitted. A controlled nebulous pulsating water spray system should preferably be used. The process must ensure that no over saturation and softening of the stone occurs. In those areas where this system is not sufficient to reach the required level of cleanliness, controlled micro-blasting on plain, non-decorative areas may be considered. Systems adopting sand, gravel, or water blasting techniques will not be considered.

Micro-blasting systems used shall be such as to function effectively at low pressure, and use low quantities of water. The abrasive material used shall be calcium carbonate having size and configuration which will not damage the surface texture of the stone fabric.

It is important that any water used throughout the cleaning operation be free from salts. No chemical agents will be permitted. The use of tap water will NOT be permitted.

The aim of the cleaning exercise should primarily be that of cleaning the face of the stone and removing all accumulation of carbon, sulphurous compounds, and other contaminants, but should retain the patina of time. On completion of works, the stone is to be brought to its natural patina, texture and profile. All discoloration is to be removed from the face of the stone. No original carved relief arises or surface textures are to be damaged or altered.

Contractor shall ensure that all electrical supplies serving external equipment have been disconnected and that, unless specified otherwise, fittings and associated cable have been removed.

2.20 TESTS TO BE CARRIED OUT DURING THE CLEANING PROCEDURE

The Contractor might be asked to carry out tests to determine the extent of salts within the masonry fabric during and after the cleaning process has been completed. The contractor shall furnish the Architect with the results of the tests.

2.21 TRIAL CLEANING

The Contractor is to prepare trial samples for all cleaning methods in locations agreed with the Architect.

The Contractor shall inform the Architect before carrying out each trial cleaning method to enable the Architect to approve of selected testing area and be present during the preparation and execution of trial samples. The period of notice shall be agreed with the Architect.

The time, date, location, details of the all products and procedures for each sample shall be submitted in writing to the Architect. The contractor shall provide the Architect with a copy of trial sample records.

2.22 MONITORING

The Contractor shall regularly monitor effects of each cleaning procedure against the degree of cleaning established by approved trial sample/s.

The Contractor shall seek instructions immediately wherever:

→ Disruption to the surface occurs;
→ Discoloration or stains are revealed by cleaning;
→ Anticipated level of surface cleaning is not being achieved.

2.23 BRUSHING BY HAND

Prior to commencing any cleaning method, the Contractor shall remove loosely adhered deposits and growths using suitable corrosion resistant brushes and micro scalpels that do not damage the stone surface.

The use of brushes with steel bristles shall not be permitted. Nylon brushes will be preferred.

Carefully dry brush, one section at a time, using a stiff bristle/nylon brush, dirt from stonework and lime renders to be retained. Care should be taken to ensure that no damage is caused to friable, delaminated stonework. If so deemed necessary such areas shall be pre-consolidated adopting procedures outlined hereunder.

2.24 WATER CLEANING BY HAND HELD SYSTEMS

General cleaning shall be carried out by means of low pressure washing (less than 2 bar) using and hand held mineral/nylon fibre brushes as directed and approved by the Architect.

Chlorinated mains water shall not be used.

In the process, care shall be taken to ensure no damage is caused to mortar joints.

Stubborn deposits shall be removed first. Softened deposits shall be removed with suitable brushes that do not damage the surface. Any debris shall be thoroughly rinsed.

The Contractor shall seek the prior approval of the Architect prior to making any changes to the agreed cleaning process.

2.25 LOW PRESSURE CLEANING

→ Low pressure micro blasting cleaning with pressures not exceeding 3 Bar. The water used shall be free of salts and as specified in this document.

→ High pressure blasting or washing using pressures in excess of 3 Bar will not be allowed.

→ The Contractor shall ensure that any water resulting from this cleaning process is not allowed to flow in the streets.

→ The Contractor shall take all the necessary measures to ensure that cleaning agent or residues are not allowed to stray onto adjacent or protected surfaces.

→ The Contractor shall ensure that the grit used in the cleaning process is weaker than the stone being cleaned. No cleaning shall commence prior to the approval of the Architect.

→ The Contractor shall clean, collect and safely dispose of all debris from scaffolding, ledges, etc at the end of each day.

→ The Contractor shall prevent marking of cleaned areas from dirt and debris splashing up from scaffold boards.

→ All cleaning shall commence at the uppermost section of the structure to avoid washing dirt onto previously cleaned surfaces.

→ Approved cleaning procedures or materials shall not be modified without approval of the Architect. The Contractor shall seek approval from the Architect should it be necessary to take additional measures for cleaning.

2.26 WATER SPRAY CLEANING WITH MOUNTED NOZZLES

→ Water spray cleaning with mounted nozzles shall be used in areas which require a prolonged period of wetting, as approved by the Architect. The wetting shall last for a period sufficient to produce swelling

of the layer of dirt and in combination with small brushes to cut down the saturation period, and shall be attached to a length of pipe connected to the approved water supply. Water to be used must be according to that specified in this document

→ The spray shall be atomised from fine nozzles situated at least 300mm away from the masonry. Enough water pressure and small enough orifices shall be required to atomise the water.

→ The equipment shall be of a type which allows the position and direction of nozzles to be readily adjusted relative to existent surfaces and profiles.

→ For each surface, the nozzle positions and spraying cycles that enable deposits to be removed/ softened whilst keeping the water running off the surface to a minimum shall be established.

→ The nozzle positions and spraying cycles that enable deposits to be removed/ softened whilst keeping the water running off the surface to a minimum shall be established. The flows will be directed from the top downwards so that the trickling of water softens the lower areas of the dirt build up.

→ Regular monitoring and adjustment of the washing cycle and nozzle positions shall be ensured by the Contractor as work proceeds; in addition, water spray/ mist shall be controlled by adequate sheeting which shall reduce the effect of draughts of air blowing away the water from the building, since the effectiveness depends on how successfully the mist can be contained.

→ The heaviest deposits shall be removed first; softened deposits shall be removed with suitable brushes that do not abrade the surfaces. Any debris shall be thoroughly rinsed.

→ The water spray technique shall not be allowed in severely damaged areas.

2.27 CLEANING OF ORGANIC GROWTH

Surface soiling, by organic growth, shall be initially removed by simple dry bristle knife blades and spatulas, provided that the substrate is sound enough, without damaging or abrading the surface and as approved by the Architect. If the surface below the growth is delicate or liable to be marked or scoured in any way, this preparation must be limited to removal of higher plants only, and approved by the Architect.

The application of mild biocides that have a long-term inhibiting effect on re-colonisation shall follow the initial removal of organic growth.

Products to be used shall be neutral products belonging to the chemical class of compounds methoxytriazine, acting by being absorbed both through the roots and the leaves and have a wide spectrum of action; other products include quaternary-ammonium compounds, or as per the Architect's approval.

The biocides shall be applied in strict accordance with the manufacturer's recommendations for safety and protection of the workers and the environment. Treated areas shall be brushed with a suitable nylon brush after a period of 7 days or as recommended by manufacturer, following the application of the biocide to remove the dead growth. Procedure shall be repeated to affected areas until biological growth has been

removed. Where so deemed necessary, thick layers of biological growth shall be removed using delicate manual methods and hand tools, primarily scalpels prior to the application of the specified biocide.

The general removal of organic growth such as fungus, lichens and the like will be limited to places where these are possibly causing harm and as approved by the Architect.

In an exceptionally dry period, and in areas where it is recommended to remove the organic growth, dormant dry lichens shall be revived with light water spraying prior to the application of the biocide. Application of biocide treatments will not be undertaken during wet weather or when windy conditions lead to excessive drift of spray.

The Contractor shall protect all surfaces that are excluded from chemical cleaning. All chemical agents shall be contained within each treatment area.

2.28 REMOVAL OF HIGHER FORMS OF VEGETATION

→ The Contractor shall cut out a metre section of the main stem, around 300mm to 1m above ground level; care must be taken not to damage the adjacent masonry.
→ After the removal of almost all aerial parts of bushes and trees, chemical spot spraying shall be carried out on cut ends of stems and branches for perennial woody plants and on new buds and leaves in deciduous trees.
→ Systemic herbicides will be used with absorption through leaves or barks.
→ A procedure combining mechanical and cleaning means will follow to remove the plants completely.

2.29 CLEANING OF PAINT

Oil Based paints may be removed by a neutral paint remover certified to contain no salts or any other deleterious agent. Repeated applications in paste form may be necessary to remove persistent stains. The pasteous, solvent free remover for mineral surfaces will be applied in a thick layer left in contact with the paint for long enough to cause softening and to enable scraping and brushing to take place successfully: the layer will be covered by a thin layer of plastic (as per manufacture's recommended procedure).

Following this application the surface will then be washed thoroughly with warm water and neutral pH soap.

2.30 CHEMICAL CLEANING BY LIQUID GELS

For each area/surface, the lowest possible concentration of agent/s and the shortest dwell times are established. The Contractor is to keep written records of concentrations, dwell times, number of applications, ambient temperatures and rinsing water temperatures.

The Contractor shall ensure that the chemical agents and rinsing water/sprays are contained within each treatment area and, agents or rinsing water/sprays, do not come in contact with surfaces that are either excluded from the cleaning or that have already been cleaned. It is important to prevent wind drift.

Before each application of agent, the surface and adjacent areas are wetted using clean water applied by a low-pressure spray. The wet surface is also tested for pH. The cleaning agent is then applied evenly over the surface and is not allowed to dry out.

The treated surfaces are then rinsed thoroughly and evenly with clean water working from the top of each area downwards. Water spray pressures that will drive cleaning agent into, or cause disruption of, the surface material and joints, will not be used.

PH testing and neutralisation procedures will then follow.

2.31 POULTICES: GENERAL CONSIDERATIONS

The principle behind poultice treatment is that once soiling is dissolved, dirt is held in contact with the pack, rather than dissolved and permitted to fill the pores. The intimate and extended contact of the cleaning materials means that smaller quantities and lower concentrations of chemicals need be used.

The use of the AB57 (Mora Pack) with paper pulp/ cellulose and/ or sepiolite clay is being requested.

The Mora Pack is a mild chemical pack containing agents which facilitate the dissolution of calcium salts. The poultice shall be prepared by mixing

→ 60g sodium bicarbonate;

→ 60g ammonium bicarbonate;

→ 25g ethylene diamine tetra acetic acid (EDTA);

→ 10g surfactant disinfectant (neutral);

→ 60g sepiolite clay/ paper pulp/ carboxymethylcellulose (CMC).

The above-mentioned ratios may be revised/ adapted by the Architect as so deemed necessary. The mix is then suitably ironed to a thickness of 4 to 5mm on the pre-wetted soiled surface, and covered with a polyethylene film to prevent the poultice from drying up. The poultice is left in place for a contact period as considered necessary by the Architect, after which it is gently removed and the treated area rinsed with water as specified in this document and brushed with a suitable nylon brush.

2.32 CHEMICAL CLEANING – POULTICES REMOVERS FOR IRON STAINS

The clay pack for iron stains shall consist of Sepiolite clay and / or paper pulp added to a solution of glycerine, generally sodium citrate. The paste shall then be applied to the stain surface and left to dry.

The paste shall then be removed with wooden or other non-metallic spatula. Several coatings might be necessary to lighten the stain; for stubborn stains, the surfaces shall be wetted. When lifted off, the surface is washed with copious amounts of water.

Given the nature of the crust, this process shall be repeated for as many times as so deemed necessary, until the black crust formation has been removed, and a satisfactory level of cleaning is obtained.

2.33 CHEMICAL CLEANING – REMOVERS FOR GRAFFITI / AEROSOL PAINT

The pasteous, solvent-free remover for mineral surfaces shall be applied in a thick layer left in contact with the paint for long enough to cause softening and to enable scraping and brushing to take place successfully; the layer shall be covered by a thin layer of plastic (as per manufacturer's recommended procedure).

Following this application, the surface shall then be washed thoroughly with warm water and neutral pH soap.

Given the nature of the crust, this process shall be repeated for as many times as so deemed necessary, until the black crust formation has been removed, and a satisfactory level of cleaning is obtained.

2.34 CHEMICAL CLEANING – SOAP / DETERGENTS

The Contractor shall apply a non-foaming soap blend for water rinsing and completion of the cleaning.

The lowest possible concentration of agent and the shortest dwell times shall be established for all areas and surfaces.

The Contractor shall keep written records of concentrations, dwell times, thickness and number of applications. Powdered detergents shall not be used.

Given the nature of the crust, this process shall be repeated for as many times as so deemed necessary, until the black crust formation has been removed, and a satisfactory level of cleaning is obtained.

2.35 CONSOLIDATION

→ Stone consolidants are applied to the stone fabric as liquids, depositing a solid material within the pore structure of the material.

→ The main function of a stone consolidant should be that of restoring the cohesion, physical properties and appearance of the deteriorated stone. It is thus important that the choice of a suitable consolidant should be based on the following parameters:

- ✓ Consolidating value, whereby the treated deteriorated stone recovers its original properties, mainly strength, surface hardness and abrasion resistance.
- ✓ Durability
- ✓ Depth of penetration, affected mainly by the viscosity and surface tension, rate of gel or precipitation formation, method and conditions of application, and rate of evaporation.
- ✓ Stone porosity. As the proportion of fine pores increases, the stone becomes more susceptible to salt attack. The consolidant should, ideally not alter the pore size distribution of the original material.
- ✓ Moisture transfer
- ✓ Compatibility. Cured stone should have three-dimensional properties similar to that of the original stone. Consolidants should not form by-products containing harmful salts that can cause further damage to the stone.
- ✓ Appearance of the consolidated stone.

→ The consolidants to be used shall be non toxic and of a one component system, having a silicium organic compound base (70 to 80%). They shall be thin, and have a low viscosity of 3.3c ST at 25oC or better, certified to penetrate deep into fine capillaries. They shall not impair the breathability of the stone structure, be durable and resistant to local weather. The consolidant used shall be colourless, have a density in the region of 0.96 to 0.98 g/ cm3, or better, and cure without any salt formation. The consolidant shall be catalysed by atmospheric humidity. The consolidant shall be applied to specifications detailed by the manufacturer. It shall not be applied to stone subjected to high moisture content, or characterised by an elevated salt content. Ideally, the stone is to be consolidated by flooding either by a coarse-droplet, or preferably by a long-bristled brush.

→ The consolidant shall be applied generously and uniformly to the stone surface, until the stone surface is saturated.

→ The consolidant shall not be applied in windy or elevated climatic temperature conditions which would impair the penetration of the same material. Consolidated areas should be protected from water, wind, and other natural/ man-invoked adverse conditions for a minimum of 30 days, or more if so specified by manufacturer.

2.36 CONSOLIDATION: DELAMINATED STONEWORK

In cases where the extent of delamination is such that the layers of stone have become detached, the space resulting between the layers shall be suitably cleaned prior to the application of the consolidant. Cleaning shall be carried out by low pressure air, conveyed through pipes adequately sized to reach the interstices followed by the liberal application of an approved volatile solvent such as acetone. Using suitable methods designed to ensure deep penetration, apply a consolidant within the interstices and cure for a minimum of thirty (30) days, ready to receive lime injection.

The consolidant shall not be applied in windy or elevated climatic temperature conditions which would impair the penetration of the same material. Consolidated areas should be protected from water, wind, and other natural/ man-invoked adverse conditions for a minimum of 30 days, or more if so specified by manufacturer.

Using a fluid lime mortar, suitably prepared to specifications listed in this document, inject in interstices previously consolidated. When injecting, care shall be taken to ensure pressure exerted on delaminated stone sections does not cause shearing of the same material. In cases where the detached material is of considerate dimension, carbon fibre rods, bridging the weaker layers with the strong fabric, and grouted with the same fluid lime-based mortar shall be introduced. Glass reinforced polyester resin and/or carbon fibre rods shall be inserted such as to be least intrusive.

Using epoxy resins a specified hereunder, having suitable characteristics and viscosity, inject, under pressure, cracked masonry sections previously consolidated. Epoxy Injection will be resorted to only for areas where injected fluid lime mortar would be inadequate.

2.37 MORTAR REPAIR OF CRACKS

Mortar injection of cracks shall be carried out with proprietary fluid lime based mortar as specified in this document.

When injecting, care shall be taken to ensure pressure exerted on delaminated stone sections does not cause the shearing of the same material.

In cases where the detached material is of considerate dimension, carbon fibre rods, bridging the weaker layers with the stronger fabric, and grouted with the same fluid lime-based mortar shall be introduced. Carbon fibre rods shall be inserted such as to be least obtrusive.

2.38 LIME INJECTION MORTARS

The injection mortars used shall be suitably prepared from good quality and chemically stable hydraulic lime, free from salts, pozzolans and other inert additives, mixed into a consistent thixotropic, injectable putty.

Prior to injection, all stone surfaces should be desalinated, adequately consolidated, cleaned from any accumulated dirt/dust and suitably wetted with water as specified in this document. Mortar shall be injected into the crevices using suitably sized syringes. Application should not be permitted in ambient temperatures exceeding 30ºC.

The injection mortar used shall have a specific weight of 1200kg/m^3, an initial set of an average of six (6) hours, and a final set of approximately ten (10) hours, attaining a mean compressive strength of 26 N/mm^2, and an average flexural resistance of 7N/mm^2 after 28 days. The set mortar shall attain an elastic modulus of 15 (+/- 1.5) N/mm^2, and a change in dimension not exceeding 1.60µm.

2.39 EPOXY RESIN INJECTION

Epoxy resins as specified in this document, having suitable characteristics and viscosity, shall be used for the injection, under pressure, of cracked masonry sections previously consolidated.

Epoxy injection will be resorted to only for areas where injected fluid lime mortar would be inadequate

The epoxy resin used shall be a solvent-free resin-based product supplied in two packs (resin + hardener), having a low viscosity, and certified by manufacturer to suitably fill cracks in the region of 1mm or more as so required. The resin shall be certified by manufacturer to have a suitable bonding to masonry, be colourless (or have a stone colour), be resistant to chemicals, and have an effective adhesion even on moist masonry surfaces. The material shall be easily injected into the crack structure using proprietary methods and tools, including suitably sized non-return injection valves. It shall have a compressive strength greater than 60N/mm^2, and a flexural tensile strength of more than 30N/mm^2.

All masonry surfaces to be treated with epoxy resins shall be clean, free from any loose material, greasy substances, etc. Cracks should be superficially sealed with an epoxy resin having suitable viscosity, and proprietary injection nozzles fixed. Following the injection of the epoxy resin, and after allowing sufficient time to ensure that the structural stability of the delaminated or otherwise masonry structure is restored, the masonry is carefully cleaned from the superficial epoxy resin applied previously to seal cracks.

2.40 GROUTING

The Architect may request grouting of voids resulting between new and old masonry, displaced masonry, etc with an organic material such as hydrated or hydraulic lime. The lime grout shall be prepared with or without filler depending on the size of the gap.

Glass reinforced polyester, epoxy or stainless steel ties shall be used as and where directed by the Architect.

Grouting holes shall be formed in joints at suitable horizontal and vertical centres to suit coursing and achieve an effective distribution of grout and fill all voids, as per the Architect's approval.

The maximum length of each lift between pours shall be established to prevent any disturbance of the masonry.

Unless re-pointing precedes grouting, the joint shall be sealed as necessary on either side of the grouting holes with an approved temporary material to prevent leaking of grout. The temporary seal shall be kept back from the face work to allow for specified re-pointing.

Before grouting, the delivery holes shall be thoroughly flushed with clean water.

Site trials, in all areas indicated by the Architect , shall be carried out for the different methods of grouting so as to establish the parameters required to achieve uniform grouting.

2.41 GROUTING BY HAND

The grout material shall be poured under gravity into the interstices formed by the masonry structure.

2.42 GROUTING BY GRAVITY INJECTION

The approved equipment shall include a control of grout flow at the head of the hose (plug) and at the delivery nozzle (stop valve).

The height of the pan above delivery nozzle (subject to site trials) shall be sufficient to ensure an adequate flow, usually around 4.5m.

2.43 PUMPED INJECTION GROUTING

The delivery pressure shall be established after site trials.

2.44 CAPPING (WHERE APPLICABLE)

From a mere visual inspection it results that the exposed topmost face of the exterior walls, are well sealed off by the type of construction methodology employed. In the latter case the issue of sealing off the exposed top level will be vital, as water ingress into the infill layer can cause bulging of the wall and overall destabilization.

The top of the ruins are to be capped where indicated by the Architect. The capping mix will consist of a mix 2 parts of brick dust, 1 part hydraulic lime and 1 part sand. The *brick dust* used will be a pre-mix. The hydraulic lime will be either white or brown in colour, depending on the colour to be achieved on site. A sample patch should be made for the Architect to establish the adequate colour.

Method of application:

→ Wet the area of application thoroughly beforehand. If this is applied during the summer months, special care should be given in keeping the area thoroughly wet during application.

→ Put a layer of sand over the said area. The use of sand depends on the density required.

→ Compact this layer properly with hand held tools.

→ Wet the sand.

→ Place the brick dust pre-mix.

→ Compact thoroughly with hand held tools

→ Fresh areas of *brick dust* shall be shaded from direct sunshine and/or sheltered from continuous rain and cured adequately.

Since the compaction will occur on the topside of the wall and within a restricted width, any compaction will be carried out with hand held tools/equipment and no excessive vibrations shall be caused that will disturb the stability of the wall.

2.45 WATER REPELLENT

The specific nature of the rocky material and the adverse climatic conditions, determine the need for cyclic waterproof treatments, therefore to prevent the persistence of big quantities of humidity and, at the same time, guarantee the regular gas exchanges with the atmosphere.

Water penetration inside the material is one of the main degradation reasons, producing many decay effects, such as:

- ✓ cracking due to expansion, caused by freezing/thawing of the absorbed water;
- ✓ saline efflorescence and damage caused by hydration and crystallization of soluble salts;
- ✓ infiltration of humidity inside the internal walls;
- ✓ fungi and mildew rooting in the material;
- ✓ penetration of polluting substances carried by the water, such as SO2 and NO2 , acid gases, which may cause deterioration of the material;
- ✓ aesthetic damage due to the appearance of stains, rust and the effects of washing.

Typology of AvailableProducts

To reduce the absorption of water and, therefore, the inevitable deterioration of natural-finish dressings, a hydrophobic impregnation treatment must be carried out to make the substrate water-repellent. The hydrophobic treatment, however, must not disable the porosity of the material, so that the transpiration capacity of the substrate shall still be guaranteed. In so doing, capillary penetration is considerably reduced and humidity present in the substrate is eliminated under the form of water steam.

The treatment must guarantee waterproof performance and permeability to steam. Besides, it must not imply chromatic changes, making of film, yellowing due to exposition to air. There are many water repellent products that can be purchased, but testing on the technical features brings to limit the range of the choice.

Selected products are the ones based on silane, siloxane and polisiloxane, that interact with the holder throughout a chemical reaction (Si – O – Si bonds) which creates an intimate bond with the substrate without forming a film, and directing the hydrophobic groups towards the outside. The internal surface of the capillaries are thus coated with a water-repellent layer which prevents the water from percolating. However, since the pores are not blocked, they allow the steam to pass through.

Choise of Products

Prodotto	*Casa Produttrice*
ANTIPLUVIOL S	MAPEI
SILO 111	CTS
PROTETTIVO IDROREPELLENTE S	CALCHERA SAN GIORGIO

ANTIPLUVIOL S: Characteristics

Colourless protection against rain for exposed concrete structures, cement renders, cellular cement, facebricks, exposed concrete blocks, natural and artificial stone, non-glazed ceramic tiles, etc.

Antipluviol S is a colourless liquid made from silanes and siloxanes in solvent, characterized by its capacity to penetrate deeply into all absorbent mineral-based materials used in the building industry. Applied to a porous surface, Antipluviol S penetrates deeply and reacts with natural humidity to form a water-repellent layer inside pores and capillaries. Without altering appearance, Antipluviol S provides efficient protection against aggressive atmospheric agents that penetrate structures. The Antipluviol S water repellent treatment also improves the self-cleaning effect of facades and reduces the adhesion of moss and weeds. Antipluviol S does not form a skin and, therefore, does not substantially modify permeability to water vapour. Antipluviol S has excellent resistance to the alkalis present in cementitious materials and to UV rays and maintains its water-repellent properties for a very long time. Antipluviol S meets the main requirements of EN 1504-9 ("Products and systems for protecting and repairing concrete structures: definitions, requirements, quality control and conformity assessment. General principles for the use and application of systems"), and the requirements of EN 1504-2 ("Protection systems for concrete surfaces") for class: products for protecting surfaces – hydrophobing impregnation, H) – protection against the risk of

penetration (1.1) (protection against ingress, PI) + control of humidity (2.1) (moisture control, MC) and increase in resistivity (8.1) (increasing resistivity, IR) (ZA.1a).

SILO 111: Characteristics

The SILO 111 is a ready-to-use water repellent protective, based on organosiloxane oligomers, with an excellent capacity for penetration. It is formulated in 10% dearomatized mineral solvent.

Once the reticulation reaction is completed (thanks to atmospheric humidity), they impart excellent waterproofness to the treated surfaces. They do not form any superficial film impervious to water vapour, nor cause chromatic alterations or glossy effects. It can be applied to marble, stone, plasters, bricks. The product ownes the following properties-characteristics**:**

- ✓ an excellent water vapour permeability,
- ✓ the absence of chromatic alterations or filming effects, and
- ✓ a very good resistance to atmospheric agents and to efflorescence.
- ✓ appearance: colourless liquid
- ✓ active material content: 10%
- ✓ density: 0.9 kg/l at 20°C
- ✓ boiling point: 145°C
- ✓ flash point: 40°C.

3 CONCRETE WORKS

3.1 GENERAL OUTLINE OF WORKS

The grade of the concrete shall be as specified by the Architect and Civil Engineer in charge.

3.2 CEMENT

Portland cement conforming to EN 197-1:2000 or equivalent shall be used.

Stacked cement shall be stored in a dry, well ventilated place with boarded floors. Cement shall moreover be of the brand approved by the Architect and Civil Engineer in charge. Tests of cement shall be made at the discretion of the Architect in charge and any cement below the standard required will have to be replaced by the contractor. Partially set or damaged cement shall not be used in concrete works.

3.3 AGGREGATES

Coarse aggregates shall consist of first quality crushed hard stone passing a 19.05mm mesh sieve, graded according to EN 12620:2002 or equivalent and EN 933 or equivalent.

Sand or fine aggregate are to be clean, sharp and gritted and free from loamy matter and other deleterious substance. They shall pass a 9.5mm mesh sieve and be graded according to EN 12620:2002 or equivalent and EN 933 or equivalent. The sand is to be washed and screened when so directed by the Architect in charge at the expense of the Contractor.

3.4 WATER

Clean, fresh water, entirely free from organic matter shall be used. The necessary quantities of water shall be provided by the Contractor at his own expense.

3.5 REINFORCEMENT

3.5.1 Generally

All steel reinforcement for reinforced concrete works supplied and paid for by the Contractor and shall be cut, bent, tied, hoisted and placed in position and kept firmly in place as shown on drawings and/or as indicated by the Architect in charge. All steel fabric reinforcement shall be in sheets.

Rods showing signs of cracking or brittleness following bending shall not be used in the works. No welding of rods will be permitted, except tack or positional welding between plain mild steel rods crossing approximately at right angles so as to fix them in position. Such welding of high tensile or work-hardened mild steel rods will not be allowed except in fabric to BS 4483:2005 or the equivalent.

Care is to be taken to ensure that the overall depth of slab rods and the overall size of links are accurate, and that the rods are not unwinding after they are bent. All steel reinforcement is to be free from scales and any appreciable rust, oil, paint, mild scale, or coating of any character which would tend to destroy its' adhesive bond with the concrete. All steel is to conform in all respects to the requirements specified in MSA EN 10080:2005 or equivalent. Mesh reinforcement is to comply with BS 4483:2005 or equivalent. All rods shall be bent cold in accordance with BS 8666:2005 or equivalent. The Architect shall have the authority to order tests on any steel prior to its being used on the works. Any steel not of the required standard shall be rejected and will have to be replaced by other of approved quality at the Contractor's expense.

When required to do so by the Engineer, the contractor shall provide:

a) the manufacturer's name,

b) the manufacturer's routine work test certificate,

c) ladle analysis

for all the reinforcement supplied.

3.5.2 Bar Reinforcement

Mild steel bar reinforcement shall conform to BS 4449:2005 or the equivalent and shall have a specified characteristic strength of 250 N/mm2.

High yield steel bar reinforcement shall conform in all respects to BS 4449:2005 or the equivalent and shall have a minimum specified characteristic strength of 460 N/mm2.

3.5.3 Fabric Reinforcement

Steel mesh fabric reinforcement shall conform to BS 4483:2005 or equivalent. It shall be used only in sheets and is to be lapped a minimum of 400mm all round.

3.6 FORMWORK

The contractor shall be entirely responsible for the design, erection and safe removal of all necessary shuttering.

Formwork or centring shall be true to line and sufficiently strong to carry the dead weight of wet concrete plus any incidental loading without noticeable deflection. It shall be sufficiently rigid to guard against movement or vibration whilst concrete is being placed and tamped into position. Sheeting shall be close together to prevent leakage of the fine stuff and shall be 'treated' in a way to facilitate striking and obtain a clean release. Formwork for slabs shall be laid with an upward camber to ensure a level ceiling.

All formwork must be carefully cleaned out before any concreting takes place. Faces in contact with concrete shall be free from adhering grout, projecting nails, splits or other defects. The Contractor must make sure that formwork is such to give a reasonable smooth finished face to concrete placed against it.

All formwork must be adequately braced and strutted during the maturing period of the concrete.

3.7 POSITION OF REINFORCEMENT

All fabric reinforcement is to be in sheets and fixed in the required position by metal chairs or some suitable method approved by the Architect and Civil Engineer in Charge.

Adequate and effective precautions should be taken to leave all reinforcement undisturbed during concreting, planking elevated on low trestles for the passage of wheel-barrows being provided by the Contractor. Wheel-barrows shall under no circumstances be allowed to transit directly over the reinforcement. All reinforcement shall be placed strictly as directed. Nothing shall be allowed to interfere with the required disposition of the reinforcement. The Contractor shall ensure that all parts of

the reinforcement are placed correctly in every respect, and are temporarily fixed where necessary to prevent displacement before or during the process of tamping and ramming the concrete in place.

3.8 FIXING OF REINFORCEMENT

Adequate temporary spacers, chairs and binding wire shall be provided to maintain the steel in correct position. Binding wire is to be thoroughly annealed 1.5mm diameter soft wire. These items shall be deemed to be included in the rates for fixing.

Covers to the steel reinforcement shall be properly maintained. Fabric reinforcement shall be lapped 400mm in each direction and tied at 300 mm centres along each joint or as shown on drawings.

On no account is any reinforcement to be left out for inserting into wet concrete during the progress of concreting, and in no case may any portion of the concrete be put in position and allowed to set in order to act as a base upon which to set up any of the reinforcement for the member.

3.9 INSPECTION OF FIXED REINFORCEMENT

When the reinforcement is in position for concreting, the contractor must notify the Architect in charge who is to arrange for it to be checked before any of it is covered up with concrete. Such checking will not relieve the contractor from any of his/her responsibilities under the contract.

3.10 CONCRETING

All concrete and constituent materials shall comply with the requirements of MSA EN 8500-2:2006 or equivalent.

The materials for the concrete are to be carefully measured in the proper proportions, measuring containers of suitable sizes being provided by the contractor and used for the purpose. The contractor is to obey all directives by the Architect in Charge concerning the mix.

The mixing of concrete, unless otherwise authorised by the Architect in Charge, shall be done by batch of approved type, which will ensure a uniform distribution of the materials throughout the mass so that the mixture is of uniform colour and homogeneous. The entire contents of the drum shall be discharged before recharging. The mixer shall be cleaned at frequent intervals while in use.

The volume of mixed materials shall not exceed the manufacturer's rated capacity of the mixer. The mixing of each batch shall not be less than 1 minute or exceed 10 minutes under normal conditions.

Immediately after mixing, concrete shall be transported to the site and carefully placed around reinforcement bars and thoroughly tamped as to exclude any voids. No more than 30 (thirty) minutes shall elapse between mixing and final placing of the concrete. The concrete shall be discharged from the mixer and transported to the works by means which shall prevent adulteration, segregation or loss of ingredients and so as to ensure that the concrete is of the required workability at the points and time of placing. Segregated concrete will be rejected.

A mechanical vibrator shall be used throughout all Concrete Works.

The re-tampering of the concrete which has commenced to set and re-mixing with or without additional cement, aggregate or water shall not be permitted. Before placing any new concrete against an existing face, this face shall be roughened, cleaned and brushed over with a thick grout of cement. All concrete shall be well cured with water and protected from the sun for four days after placing. The quantity of water used shall be the minimum necessary to produce concrete of the workability required by the Architect and Civil Engineer. The consistency of the concrete when required by the Architect shall be measured by the slump test which in no case shall be more than 100mm.

3.11 PLACING OF CONCRETE

The methods of placing concrete shall be to the approval of the engineer in charge. Concrete shall be so placed that contamination, segregation or loss of the constituent materials does not occur.

Concrete is not to be distributed to its final position by means of vibration. Shaking of reinforcement to assist the placing of concrete will not be permitted.

Care must be taken to ensure that any rods which project from set or partially set concrete are not moved or jarred.

Concreting must be carried on continuously up to construction joints. Any construction joints must be carefully arranged in approved positions where they will have the least effect upon the strength of the structure.

3.12 COMPACTION OF CONCRETE

All concrete is to be consolidated by vibration to ensure that the concrete is worked into every interstice between and around the reinforcement so as to ensure a compact mass without voids and of the greatest possible density throughout.

Wherever possible, vibration is to be carried out with immersion vibrators which are to be applied for short duration sufficiently frequent to consolidate the concrete effectively. Points of vibration are in no case to be further apart than 500mm. Immersion vibrators are to be totally immersed in the concrete and withdrawn slowly. The maximum speed of withdrawal is not to exceed 75mm per second. Vibrators are not to be allowed to rest against, or come into contact with reinforcement or the faces of the formwork.

3.13 REMOVAL OF FORMWORK

Forms or struts for concrete shall not be removed before 15 days or any such period as specified by the Architect in charge until the concrete is sufficiently strong to safely carry the loads, dead or temporary. The responsibility for the safety of the concrete will rest entirely on the contractor and he will be held liable for any damage. He will, moreover, be bound to make good same at his own expense.

Immediately after striking formwork, all air holes and other irregularities in the exposed surfaces are to be stopped or otherwise made good with cement and sand mortar mixed in the proportions of 1:3 respectively. The whole finished surface shall be of a reasonably smooth appearance free from voids, holes and bulges.

3.14 CUBE TESTING OF CONCRETE

Any cube tests shall be made in approved 150mm moulds from samples taken in accordance with MSA EN 12390:2000 or equivalent. Samples shall be from every individual pour of concrete irrespective of the volume of concrete pours. A pour being defined as one continuous concreting operation, i.e. not necessarily one lorry load of concrete.

Each cube shall be marked on its surface without any etching of the surface with a distinguishing number and the date, and a record shall be kept on site giving the following:

→ Cube number
→ Date made
→ Location of work within the site
→ Design mix
→ Name of person taking sample
→ Crushing tests results
→ Date
→ Strength
→ Density
→ In the Case of Ready Mix Concrete, the Delivery Note Number.

At least four, preferably six, test cubes from each sample shall be made in approved 150mm moulds, two, preferably three, to be tested at 7 days, and two, preferably three to be tested at 28 days. In each case, the average of the two or three results shall be taken as the test result.

All cubes shall be stored on site in their mould for at least 24 hours, in a place free from vibration, under damp matting and completely covered with polythene. When the concrete has achieve sufficient strength, the cubes shall be de-moulded and immediately submerged in a tank of water until they are taken to the approved independent testing laboratory. No cube shall be dispatched before it is 3 days old. The testing laboratory shall be approved by the Engineer in charge before the commencement of the concreting operations. One copy of all test cube results shall be forwarded to the Engineer in charge. The concrete in each grade will be considered acceptable if the average of any four consecutive 28 day test results exceeds the specified grade by 3N/sq.mm, and if no individual 28 day test result is less than the specified grade by 3N/sq.mm. The 7 - day test result will be compared to the 7 - day result obtained in the trial mixes, and the Contractor advised of the potential problems in any instances where the test result is more than 2N/sq.mm less than the trial mixes.

The Contractor shall also allow in his rates for concrete, for all expenses in connection with the preparation, conveying to the testing laboratory, and for the testing of the test cubes.

3.15 CURING OF CONCRETE

All reinforced concrete work shall be designed, mixed, placed, compacted and cured in accordance with EN 1992-1-1:2004 or equivalent to the approval of the Architect in Charge.

Minimum period of curing shall be as indicated in EN 1992-1-1:2004 or equivalent.

Concrete must be protected during hardening from the harmful effects of the weather or running water. The protection shall be applied immediately after completion of placing, by one or more of the following methods:

→ by covering with a layer of sand, sacking, canvas, hessian, straw mats or similar absorbent materials and keeping constantly wet for 72 hours.
→ by thoroughly wetting and then covering with a layer of approved waterproofing paper or plastic sheet or insulated mats kept close to the concrete for 72 hours.

3.16 ADMIXTURES

Any admixtures to the concrete mix are to be approved by the Architect and used strictly in accordance with the manufacturer's instructions.

4 MATERIALS

4.1 WATER

Water to be used shall have conductivity inferior to 60 µS. The contractor is to give a proposal of methodology of testing the water on site. Therefore, a trial should be tried and tested on site on each consignment brought on site. Chlorinated water or tap water shall not be used.

4.2 SAND FOR LIME MORTARS

Sharp, well graded and conforming to the methods of sampling and testing and quality requirements of statutory EN regulations and in particular EN 1097, unless specified otherwise.

4.3 LIME (HYDRAULIC AND AIR LIMES)

Unslaked Lime (quicklime), shall be prepared from suitable, good quality upper coralline limestone. The quicklime should preferably be prepared in a wood-fired kiln in a temperature not exceeding 900ºC. The stone matter should be suitably cooked to prevent under burning, over burning, or sintering of the stone, keeping the contents of any inert residue to the minimum as permitted by established International standards. The quicklime shall be crushed to a fine powder, sieved, packed, and delivered to site in dry conditions, and soon after baking. When testing sample of lime using Hydrochloric acid, the CO2 content of lime supplied shall be in the region of 3%. All lime shall conform to the statutory EN regulations and in particular EN 459.

The hydraulic lime should be natural, free from any additions such as Portland cement, etc., or any other material, which contains any quantity of deleterious salts such as sulphates, chlorides, nitrates, etc. The hydraulic lime offered should be that defined by standard norms as eminently hydraulic lime C3/ XHN 60,

though natural cements, class D/ XHN 100 (roman cements), may be used subject to the approval of the Architect. The hydraulic lime offered shall have an initial putty setting time in water of 2-4 days, acquiring a stone-like consistency following 12months curing in water. Composition of CaO and MgO shall be over 50%, while SiO2, Al2O3, and Fe2O3 shall amount to approximately 12%-25% of active clays. Crushing strength at 28 days of a mixture of 1:3 lime: sand, shall be in the region of 6.00N/mm2. For natural cements, class D, crushing strength at 28 days of a mixture of 1:1 lime: sand, shall be in the region of 10N/mm2. Hydraulic lime used shall have a stone colour, and shall be certified to have been produced at a temperature inferior to 1100ºC. It shall be ground to a fine powder having a specific area of 8000cm^2/g.

4.4 LIME (PREPARATION OF AIR LIMES)

Quicklime (unslaked lime) shall be slaked soon after it has been produced.

The slaking shall be carried out in a container of suitable shape and material which will not permit the material to overheat during the slaking process.

Soon after slaking the lime shall be sieved through a 5mm gauge sieve to remove any uncreative material.

The slaked lime putty shall be allowed to mature under water for a minimum period of 4 weeks before being used.

The slaked putty shall then be mixed with the aggregate specified above in ratio of 1 part lime to 3 parts sand is as specified and approved by the Architect.

4.5 LIMEWASH

→ Prior to the application of the limewash, the background shall be washed to remove dust and grime, then allowed to dry to a damp state. Any organic growth shall be treated with a suitable biocide as directed by Architect and Civil Engineer in charge, and dead material brushed off before applying limewash.

→ Apply the limewash to the substrate with a long-haired bristle brush, using horizontal, vertical, and diagonal strokes, ensuring the lime wash is applied as thinly and evenly as possible, and is burnished into the surface. Overly heavy coats will craze and crack when they harden and dry. If this occurs, wash off with hot water and a stiff bristle brush and ensure that the new covering is properly applied.

→ Containers of lime wash should be constantly stirred during application to ensure even distribution of lime and pigment. Allow the first to dry fully before applying the second coat, and so on, lightly dampening the background before applying the next coat. Damping shall ideally be carried out by spraying water to an area of approximately 2 sq. m. at a time. Protect from strong winds and direct sunlight during the drying out period. Limewash shall be produced from mature lime putty mixed with water to a suitable consistency. The mix shall be sieved into a bucket, working through any lumps, but leaving any grit in the sieve. Add colour as directed by Architect and Civil Engineer in charge, mix well and sieve again prior to use. It is difficult to match lime colour batches. It is thus ideal that all lime wash provision required be prepared in one batch.

4.6 LIME MORTAR

Lime mortars shall be free from cement and produced in conformity to standards set out in the statutory EN regulation and in particular EN 998 and EN 1015. The density of the lime putty shall range between 1.3 and 1.4kg/l and shall not contain any salts (nitrates, chlorides, sulphates, etc) which contribute towards the deterioration if the stone.

4.7 POZZOLANIC MORTARS

The use of pozzolanic additives such as brick dust, pozzolanic etc to enable air limes to set hydraulically will be permitted. However care shall be taken to ensure that pozzolanic (natural or artificial) added are not toxic and do not contribute towards the deteriorations of stone. Pozzolanic such as polverised fuel ash or others which contain salts detrimental to the stone will not be allowed.

Any pozzolana shall be added to the mortar before use.

4.8 BRICK DUST

Brick dust used shall be prepared from good quality red (terracotta) clay baked to a temperature between 850ºC and 900ºC. Clay baked at higher or lower temperatures **shall not** be used for the production of brick dust.

The brick dust used shall be clean and free from deleterious substances, etc., The baked clay shall be crushed and adequately graded for use as specified in this document.

The use of glazed ware for the production of brick dust will not be permitted.

4.9 HIGH LOAD DAMP PROOFING MEMBRANE

→ The high load damp proof membrane shall be a pitch polymer DPC ideal for damp proofing of walls in stone and bricks, capable of taking high loadings.
→ It shall be capable of being used both in vertical, horizontal and cavity tray positions.
→ It shall have a nominal thickness of not less than 1.25mm.

4.10 LIQUID MEMBRANE

→ The liquid membrane shall consist of a thixotropic polymer based high resistance liquid, resistant to UV rays, to take foot traffic and with excellent adhesion to concrete and masonry surfaces.
→ The liquid membrane used shall be stone colour unless otherwise requested by the Architect and Civil Engineer in charge.
→ Application shall comply strictly with manufacturer's instructions.

4.11 STAINLESS STEEL

All stainless steel used for this project shall, unless otherwise instructed by the Architect to be Grade 316, or better, certified for use in marine environments as specified in EN 10088-1:2005, or its updated version.

4.12 MICRO FIBRE STRANDS

Fibre strands used to reinforce concrete shall be polymer-based, certified by the manufacturer as suitable for the nature of works described in tender document. They shall be such as to prevent shrinkage crack formation, withstand corrosion and be resistant to alkalis and acids. Fiber diameter shall be in the range of 17 to 20 microns, and having a specific density ranging between 870 and 930kg/ cu.mj. They shall have a tensile strength in the region of 390 to 500Mpa. Max elongation at break point shall not exceed 14%. A minimum of 0.85kg of these fibre strands or as recommended by manufacturer shall be mixed with one cu.m of mortar mixed.

4.13 EPOXY RESINS

→ The epoxy resin used shall be a solvent-free resin-based product supplied in two packs (resin + hardener), having a low viscosity, and certified by manufacturer to suitably fill cracks in the region of 1mm or more as so required. The resin shall be certified by manufacturer to have a suitable bonding to masonry, be colourless (or have a stone colour), be resistant to chemicals, and have an effective adhesion even on moist masonry surfaces. The material shall be easily injected into the crack structure using proprietary methods and tools, including suitably sized non-return injection valves. It shall have a compressive strength greater than 60N/mm2, and a flexural tensile strength of more than 30N/mm2.

→ All masonry surfaces to be treated with epoxy resins shall be clean, free from any loose material, greasy substances, etc. Cracks should be superficially sealed with an epoxy resin having suitable viscosity, and proprietary injection nozzles fixed. Following the injection of the epoxy resin, and after allowing sufficient time to ensure that the structural stability of the delaminated or otherwise masonry structure is restored, the masonry is carefully cleaned from the superficial epoxy resin applied previously to seal cracks.

5 MONITORING AND DOCUMENTATION

5.1 INSPECTION BY THE ARCHITECT

Prior to the dismantling of any scaffolding, the contractor shall give the Architect sufficient time to inspect all the works. The contractor shall give the Architect at least one week notice to allow for a final inspection.

The contractor shall be responsible for the clearing of all apertures, ledges, window sills, etc from any material resulting from any of the processes outlined with this document.

5.2 DEFECTIVE WORK AND MATERIALS

All rejected work shall be removed and replaced using new materials at the Contractor's expense. The Contractor shall also be bound to replace any defective materials in all or parts of the existing Works by

proper materials and/or workmanship as directed by the Architect. The Contractor is liable for the restoration works and restoration interventions specified in this tender document.

5.3 DOCUMENTATION OF RESTORATION INTERVENTIONS

The contractor shall, on completion of works on each section, and prior to certification of works, submit to the Architect a drawing accurately indicating all interventions carried out. This documentation shall form part of the building file to be submitted to the Architect on completion of works.

The contractor shall be responsible to map every intervention carried out so as to provide a detailed record of works. Distinct interventions (stone replacement, consolidation, etc) shall be mapped on a separate layer allowing the user to view each intervention separately. The mapping shall be carried on a stone-by- stone basis and the exact demarcation of each intervention shall be denoted by a closed polygon and hatched as detailed by the Architect.

Prior to the certification of works the contractor shall submit to the Architect two printed copies (in colour) in scale 1:100 or as requested by the Architect and a digital copy (AUTOCAD 2006 compatible). The drawings and mapping indicated shall be certified by a warranted architect and civil engineer specialized in restoration, as exactly representing the works (type and extent) carried out.

5.4 PHOTOGRAPHIC RECORD OF RESTORATION INTERVENTIONS

The contractor shall, on completion of works on each section, and prior to certification of works, submit to the Architect a set of photographs indicating all interventions carried out. This documentation shall form part of the building file to be submitted to the Architect on completion of works.

The photographs shall clearly illustrate the interventions carried out as well as the state of the structures to be restored prior to the commencement of works. Any archaeological, historical, etc. evidence such as masons marks, particular construction details, etc. discovered on site during the progress of works shall also be documented.

The photographs shall be submitted to the Architect prior to the certification of works. The photographs shall be submitted in digital format saved on a CD (Compact Disk) or DVD as directed and approved by the Architect.

The photographs shall be taken with a high resolution colour digital camera, saved in .jpg format and not less than 3.2Mb in size.

All photographs shall be taken with adequate lighting (flash light should as far as practicable be avoided) and should be of a good quality free from blurs and colour bleedin

6 SAMPLES AND TESTS

6.1 TESTS TO BE CARRIED OUT

Prior to commencement of works the contractor shall carry out the following samples as directed by the Architect:

→ Cleaning technique decided upon by the Architect;

→ Pointing;

→ Pumped injection grouting;

→ Biocide;

→ Micro Blasting (if necessary);

6.2 CHEMICAL ANALYSIS OF WATER

The Contractor shall test the pH value of clean water used for all techniques used within this contract, and all chemical agents to be used in the cleaning processes before application.

All solutions shall be thoroughly mixed before taking a sample for pH measurement.

All readings shall be carried out at the same temperature, or compensated for if taken at different temperatures. All data shall be submitted in writing to the Architect.

6.3 STONE SAMPLES TO BE PROVIDED

Also prior to stone/stair replacement the contractor will be asked to provide the following:

→ Local stone for flooring.

A minimum of three test samples per test is required. After samples are prepared and cured they will be tested (7days and 28days) for the above tests.

6.4 PRELIMINARY INVESTIGATIONS BEFORE RESTORATION AND CONSERVATION WORKS

6.4.1 General Issues

The preliminary investigations before restoration and conservation works will have the aim to acquire a more extensive knowledge regarding the construction former characters of the building on which the works have to be carried out. Such investigations will aim to the analytical and scientific acquiring of data and information regarding the real nature of the material used and its state of conservation, in order to complete and check the knowledge framework of the decay considered as base for the design.

Any type of investigation, also the ones already foreseen during the design phase, will be discussed and approved by the responsible of the works. The Contractor will carry out the shared cycle of survey following the arrangements received, respecting the building characteristics, and prior the authorization of the authorities charged.

Before starting any type of works, the Contractor will carry out the knowledge investigation always preferring that ones that do not destroy the materials and/or the building elements, in order to make no prejudice to the building conservation, having particular care to not alter the former conditions.

6.5 INVESTIGATION TYPOLOGIES

The investigations could interest various materials, such as stones, plasters and mortars, woods, metals, concrete and coverings; and could be carried out according to various deepening levels, such as:

→ direct visual inspection;
→ chemical analysis;
→ physical analysis;
→ biologic analysis;
→ mechanical analysis.

6.5.1 Not Destructive Tests

The not destructive tests will be carried out "in situ" without any material withdrawal. Some examples are: direct survey, photographic and topographic tele-survey, termography, magnetometry, colorimetry, sonic and ultrasonic survey, lightning survey, radar and geo-radar survey, etc.

6.5.2 Light Destructive Tests

They will be carried out by the withdrawal of small material fragments taken from decaying portions or making small holes.

6.5.3 Destructive Tests

In some case they are needed in order to monitor the inner state of some building elements and their resistance.

6.6 PROCEDURES TO EXECUTE THE INVESTIGATIONS

In order to execute the investigations, the Contractor will use tools and devices able to guarantee the perfect desirable result.

The investigations have to be executed by specialised personnel and, if considered needed, the Contractor can be supported by specialized and recognised institutions or laboratories.

After finishing the investigation works, the Contractor will restore and clean the site, eliminating any not convenient working residual.

The photogrammetric and topographic surveys and all the surface tele-survey systems will be carried out through suitable devices; furthermore, they will be comprehensive of the processing, the graphic drawings and the analytic and photographic description, including also comments on the results acquired in order to create a correct interpretation of the information related the on-site state.

7 UNITS OF MEASUREMENT

The units of measurement used in the annexed technical documentation are those of the International System of Units (SI). No other unit may be used for measurements, pricing, detail drawings etc. (any unit not mentioned in the technical documentation must also be expressed in terms of the SI.) Abbreviations used in the bill of quantities are to be interpreted as follows:

mm	*means millimetre*
m/ lm	*means metre*
mm²/ sq.mm	*means square millimetre*
m²/ sq. m	*means square metre*
m³/ cu. m	*means cubic metre*
kg	*means kilogram*
to	*means tonne (1000 kg)*
pcs	*means pieces*
h	*means hour*
km	*means kilometre*
L.s./ LS	*means Lump sum*
l	*means litre*
%	*means per cent*
N.d	*means nominal diameter*
m/m	*means man-month*
m/d	*means man-day*
No./nr/ in no.	*means numbe*

ANNEX 2 – GUIDELINES FOR DRAFTING THE HEALTH AND SAFETY PLAN

1.1 INTRODUCTION

In the following pages the guidelines for the Health and Safety Plan are provided. The awarded bidder, in preparing the specific Health and Safety Plan for carrying out the works has to take into consideration the following requirements.

1.2 GENERAL SITE MANAGEMENT PRACTICE

1.2.1 LIAISON

The contractor shall liaise and co-operate with the appropriate Authorities and occupiers of adjoining land and buildings likely to be affected by the works, for all matters regarding access, monitoring, third party rights, and similar.

1.2.2 CO-ORDINATION OF SERVICES

The contractor shall be responsible for locating existing drains and services, and underground cables and pipes, for seeking instructions from the appropriate authorities as to how to deal with such services, and for carrying out any necessary work relating to deviations or protection, or any other works deemed necessary by the respective Utility authority.

1.2.3 ACCESS

The contractor shall take all the necessary steps to ensure that the external areas and access roads are left clean and tidy during all stages of the work, to the satisfaction of the Architect and Civil Engineer in charge.

1.2.4 METHOD STATEMENT AND PROGRAMME OF WORKS

Apart from the preliminary Method Statement and the Programme of Works to be submitted by the bidder with the tender document, the successful bidder (the contractor) shall be required to submit a detailed Method Statement together with a Programme of Works, and Construction Management Plan prior to commencement of works. The Method Statement shall include a Risk Assessment, as referred to in this document. It shall also detail site logistics and plant locations. The Contractor shall take into account the problems of access into the site, and in particular the needs to maintain access open to the sites for both visitors as well as other contractors.

The detailed Programme of Works, (Gantt chart) shall identify each activity, indicating the dates when works in their various phases would be undertaken, for approval of the Architect and Civil Engineer in charge.

The Programme shall be updated monthly or whenever required by the Architect, to be in line with the progress of the actual Works. The Programme shall be accompanied by sufficient data and information together with all the necessary details of constructional plant, required labour force, etc. Should the Architect consider any alteration in or addition to the Programme as submitted, the Contractor shall conform therewith without additional cost to the Director General (Works).

The submission to and approval by the Architect of such Programme or the furnishing of such particulars shall not relieve the Contractor of any of his/her duties or responsibilities under the Contract.

1.2.5 HOUSEKEEPING

→ Storage areas for materials, plant and construction waste shall be enclosed with secure hoarding; the different areas for materials, waste and staff facilities will also be fenced in for security, for the protection of the public, as well as to reduce, visual impact. Construction waste shall not be allowed to accumulate on site and should be removed periodically. The contractor shall endeavour to locate the storage and stockpile areas in the areas from where there will not be a significant visual impact on views of the fortifications.

→ The disposal of hazardous waste shall be carried out in accordance with procedures approved by the Local Authority of Environment Protection. Any hazardous material shall be notified to the Local Authority of Environment Protection, and shall be transported in accordance with the relevant Montenegrine Legislation. Relevant hazardous wastes include, but are not limited to, petroleum tank bottom sludges, waste acidic of alkaline solutions, wastes containing metals, waste hydraulic, engine, or bilge oils, degreasing agents or solvents, discarded equipment containing PCBs or asbestos. Waste explosives, batteries and accumulators, soil, stone or construction and demolition waste containing dangerous substances, and insulation material containing asbestos.

→ Sanitary waste during the construction phase shall be disposed of chemically.

→ Burning of waste plastics, wood or any other material on site shall not be allowed.

→ All activities producing dust shall be controlled, and measures such as spraying with water shall be used to ensure that the emitted dust is minimised. Dust-laden materials shall be removed from the site, and transported through public thoroughfares, only after thorough watering before leaving the site. Dust covers, of appropriate material, properly secured along all sides, shall be used on all open-topped vehicles used for the transportation of rubbish or debris from the site.

→ Wash-down facilities may need to be installed at the designated exit of the site of the works, to minimize any dust carried by construction vehicles on the public roads, unless it can be shown that the contractor can otherwise control the dust carried by his vehicles. Wash-down facilities shall normally consist of a power washer, surface gutters and a system of interconnected reservoirs underlying the washing area, so as to allow construction vehicles, leaving the site, to be washed-down. The water from the wash-down should flow through the gutters into the underground reservoirs, and clear water will overflow from one compartment into the next, depositing the silt load. A submersible pump will recycle the water form the last compartment and feed it to the power washer. Sludge will be collected regularly using mobile suction pump, mixed with the excavated debris to remove excess water, and disposed of with the same excavated material.

→ All plant shall be operated with any relevant doors closed, and shall be fitted with silencers and noise suppressors. All plant and site operations will be required to conform to local legislation, and in particular EN ISO 11690, EN 12096, EN 28662, EN ISO 10819, EN ISO 8662. The contractor shall select and utilise methods of working, and items of plant, so that the maximum measured ground vibrations do not exceed a peak particle velocity of 3mm per second at any occupied property, and 5mm per second at other properties, or any other values indicated by the relevant Authorities. Noise levels at the perimeter of the site shall not exceed 70dB, or the value indicated by the relevant Authorities.

→ Any chemical drums that may need to be on site shall be stored on impervious surfaces in designated bunded areas. Oil tanks shall be similarly stored. The bunds shall have a capacity equal to 110% of the volume of the largest drum. In view of the fact that the bunds are meant to cater for operational leakages and spills, this is considered as sufficient. The bunds shall have no drains, and provision shall be made for pumping out rainwater. Filling and vent pipe-work shall be located inside the bund. The bunds shall be available for inspection. Empty drums shall be stored in a similar fashion, in separate areas, and shall be safely disposed of in accordance with the arrangements made with the Local Authority of Environment Protection.

→ Oil drip trays shall be used under small static plant, such as pumps and compressors. These trays shall be open to inspection and spent oil shall be disposed of in accordance with the arrangements made with the Local Authority of Environment Protection. Maintenance areas for the construction plant shall be indicated in the Contractor's Construction Management Plan. Disposal procedures shall be as instructed by the Local Authority of Environment Protection. The contractor shall be required to install settling ponds to stop oil-contaminated, or silt-laden, waste water, (including rain-water), from finding its way into the surrounding cultivated agricultural areas.

→ The contractor shall take all necessary procedures to control energy use on site. Site lighting shall be, as much as possible, low energy, or energy-efficient, light fixtures, and shall be downward pointing and shielded to avoid unnecessary light loss and light pollution.

→ The Contractor shall comply with and fulfil all obligations imposed by Local Laws and shall give all notices, obtain all permits; pay all fees that may be lawfully demanded by Public Officers in respect of works and comply with all requirements of the Law and any Lawful Authority.

1.2.6 SAMPLES AND TESTS

During the course of works, Architect and Civil Engineer in charge reserves the right to take samples or carry out specialised tests on site. In specific cases, analysis/tests on samples elevated may take significant time to be completed, in which case, Architect and Civil Engineer in charge may request suspension of all or part of the activities being carried out by the contractor. Unless such tests/ analysis are being carried out due to any negligence, bad workmanship, etc. from the contractor's side, the Director General (Works) or his/ her representative may opt to prolong the completion period as detailed in tender document. Should, however, the need for such tests arise due to any negligence, bad workmanship, etc. by the contractor, expenses incurred in the carrying of such tests will be deducted from payments due to the contractor. In the Period of Execution of the work the Contractor will have to factor in such tests.

1.2.7 CLEARANCE OF SITE

→ Each trade is to make good after itself and provision for such work shall be made in respective rates.

→ During the execution of the works, the Contractor shall keep the site reasonably free from all unnecessary obstruction, and shall store or dispose of any Contractor's equipment and surplus materials and clear away and remove from the site any wreckage, rubbish or temporary works no longer required.

→ On completion of the Works, the Contractor shall clear away and remove from site all Contractor's equipment, surplus material, rubbish and temporary works of every kind, and leave such part of the

site and works clean and in a workmanlike condition to the satisfaction of the Architect and Civil Engineer in charge.

1.2.8 CONSTRUCTION MANAGEMENT PLAN

The Construction Management Plan shall be compiled to show how access to the site will be managed, how security and safety of the buildings will be guaranteed, and how building material and building waste will be handled to ensure minimum impact. It will also detail site logistics and plant locations, and equipment etc. to be used in the execution of works indicating how the contractor endeavours to carry out the works requested by the Architect and Civil Engineer in charge. The Contractor shall take into account the problems of access into the site, and the existing physical site constraints in particular the needs to maintain access open to the sites for both visitors as well as other contractors. It shall show in particular:

→ The Access Plan - All site access points for workers, plant and machinery.
→ Storage areas for materials and plant.
→ A detailed Program of Works (Gantt chart), indicating the dates when works in their various phases would be undertaken and broken down into more detail for each activity of each phase, for approval of the Architect in Charge.
→ Adequate and suitable provision to reduce dust nuisance during all phases of the works.
→ Protection measures for overlying and adjoining retained buildings, structures and landscapes.
→ Measures for the safety and continued operation of overlying existing activities.
→ The location of disposal sites for material from demolition and excavation, and the means and routing of transport to disposal sites (i.e. the possibility to use chutes for disposing of debris from a height).

The submission to and approval by the Architect and Civil Engineer in charge of such Programme or the furnishing of such particulars shall not relieve the Contractor of any of his/her duties or responsibilities under the Contract.

1.3 HEALTH AND SAFETY PROVISIONS

1.3.1 HEALTH AND SAFETY OFFICER

The contractor shall be required to appoint an Occupational Health and Safety Competent Person, appointed in accordance with the Health and Safety Authority Local Act. The Health and Safety Competent Person shall be responsible for the preparation of a Risk Assessment of the Site and the proposed works, for the preparation and administration of the Health & Safety Plan, and for the co-ordination of the construction/ restoration process/es in order to achieve the objectives of the Health and Safety Plan. It may be required that the Health and Safety Plan be submitted for approval by the Occupational Health and Safety Authority, in which case any comments, for amendments, that the Authority may deem necessary, shall be taken on board without additional cost to the Employer.

The appointed Health and Safety Competent Person is to fulfill the role of Project Supervisor for the Design and Construction/Execution stage. He/She will have the following responsibilities:

- ✓ verifies the application of the disposals of the safety measures, and of the correspondent work procedures, through coordination and control actions;
- ✓ verifies the suitability of the safety measures, and adapt them to the evolution of the works and to the possible changes occurred, assessing the proposals of the working companies aimed to improve la safety within the construction site;
- ✓ organizes the cooperation among the working companies and the coordination of the activities, further their reciprocal information;
- ✓ signals to the Client and to the engineer/architect in charge the noncompliance to the given measures, and, if considered needed, proposes the suspension of the works, the ousting by the construction site of the working companies, or the contract resolution;
- ✓ in case of directly found serious and imminent danger, suspends the individual works up to the verification of the needed adaptation carried out by the working companies.

1.3.2 GENERAL HAZARDS

The following hazards have been identified:

- → Electrocution from buried/overhead electricity services and by electrically powered equipment/machinery used on site of works;
- → Workers falling from scaffolding, or from heights on existing buildings;
- → Noise and dust production as a result of the works outlined in this document;
- → Workers crushed by collapse of structures and/or scaffolding;
- → Inhalation of fumes resulting from restoration processes.

1.3.3 RISK MITIGATION MEASURES

The following measures are recommended to minimise risks on site:

- → Clear delineation of plant movement areas;
- → Provision of sturdy work platforms/ scaffolding, and guide rails at unprotected edges of existing buildings;
- → Use of plant with limited noise emission;
- → Periodic wetting of demolition area to reduce dust emission;
- → Establishing clear procedural rules during overhead material handling to;
- → Enforcement of hard hats.

1.3.4 PROVISIONS FOR SAFE PRACTICE

The following provisions shall be made, without limiting, in any way, other provisions that the Contractor may deem necessary in order to render the Site and the Work safe:

- → Where there is an imminent danger to the safety of workers, the Contractor shall take immediate steps to stop the operation and evacuate workers as appropriate;
- → Secure fencing, to prevent unauthorised access to the active work areas;

- A Notice, giving information on the specific hazards, and on the availability of emergency assistance, shall be clearly displayed in a position such that those working on site can read it as well as those affected by the Site;
- Routes for the movement of vehicular traffic around the work of place shall be clearly delineated. These routes shall be separated from the areas subject to overhead movements;
- Escape routes and means of escape shall be kept clear at all times;
- Existing services, both overhead and underground, within the work site and immediately surrounding the work site, shall be identified, the respective utility companies contacted for information and disconnected/made safe;
- Special attention shall be given to lifting, slewing and overhead handling operations to avoid public access areas;
- The Contractor shall take appropriate measures, or shall use the appropriate means, in particular mechanical equipment, in order to avoid the need for the manual handling of loads by workers;
- All openings through which workers are liable to fall shall be kept effectively covered or fenced and marked in the most appropriate manner;
- Where natural lighting is not adequate to ensure safe working conditions, the Contractor shall provide adequate and suitable lighting, including portable lighting when appropriate, at the Site of work;
- Guard-rails and toe-boards shall be provided to protect workers from falling from elevated workplaces; alternatively, adequate safety nets or safety sheets shall be erected, made fast and maintained, or adequate safety harnesses shall be provided and used;
- Hoist shafts shall be enclosed with rigid panels or adequate fencing at ground level on all sides;
- The contractor shall be responsible for ensuring that all persons on the Site, whether the Contractor's employees or otherwise, wear the necessary personal protective clothing at all stages;
- The Engineer shall have the right to send away any of the Contractor's employees, or of his Sub-Contractors, or otherwise doing work on the site, if they do not comply with these requirements.

1.3.5 FIRE OUTBREAK

The Contractor shall take all appropriate measures to:

- Avoid the risk of fire;
- Control quickly and efficiently any outbreak of fire;
- Bring about a quick and safe evacuation of persons.

1.3.6 PROTECTIVE CLOTHING AND EQUIPMENT

- Safety helmets or hard hats to protect the head from injury resulting from falling or flying objects, or from striking against objects or structures;
- Goggles, a screen, a face shield or other suitable device when likely to be exposed to eye or face injury from airborne dusts or flying particles, dangerous substances, harmful heat, light or other radiation, and in particular during welding, flame cutting, or other hazardous work;
- Protective gloves and suitable protective clothing to protect hands or the whole body when exposed to heat radiation or while handling hot, hazardous or other substances such as poultice packs which might cause injury to the skin;

- Footwear of an appropriate type when employed at places where there is the likelihood of exposure to adverse conditions, or of injury from falling or crushing objects, hot or hazardous substances, sharp-edged tools or nails;
- Respiratory protective equipment, suitable for the particular environment when workers cannot be protected against airborne dust, vapours or gases by ventilation or other means;
- Waterproof clothing and head coverings when working in adverse weather conditions;
- Safety harnesses with independently secured lifelines where protection against falls cannot be provided by other appropriate means.

1.3.7 STORAGE OF MATERIALS

- The Contractor shall provide safe, sufficient and suitable storage for flammable liquids, solids and gases such as ethyl silicates and/ or fuels.
- Storage areas for flammable liquids, solids and gases shall be rendered secure against trespassers.
- Smoking shall be prohibited and "No Smoking" notices or appropriate design and shape shall be prominently displayed in all spaces containing readily combustible or flammable materials.
- Combustible material such as scrap wood or plastics, oily/greasy waste, sawdust or packing material shall not be allowed to accumulate in places of work, but should be kept in closed metal containers in a safe place.

1.3.8 SCAFFOLDING / SUPPORT SYSTEMS

- All work shall be carried out in accordance with local Occupational Health and Safety Regulations the statutory EN regulations and in particular EN 12810, EN 12811, EN 12812.
- Adequate precautions shall be taken to protect persons from injury by the fall of materials, tools or equipment being raised or lowered. Such precautions will include fencing, barriers and the like. Safety nets or sheets should be tied at every intersection of the scaffolding tubing and able to withstand rupture from the above mentioned loads; otherwise barriers (in the form of inclined overhangs) will be introduced at a distance of 4 to 6m above ground level followed by ones at 12m intervals. Fencing, barriers, or the appropriate utilization of lookout men.
- The Contractor shall provide competent supervision to ensure that all scaffolds are used appropriately, and only for the purpose for which they are designed or erected.
- Where work at the face of a building or other structure is done from a working platform, the space between such face and the working platform shall be as small as practicable, provided that, where workmen sit at the edge of the platform to work, such space may be up to a maximum of 30cms.
- In transferring heavy loads on to a scaffold, a sudden shock not be transmitted to the scaffold.
- When hoisting loads on to scaffolds, the loads shall be controlled by a hand rope (tag line), so that they cannot strike against the scaffold. The load on the scaffold shall be evenly distributed, as far as practicable, and in any case shall be so distributed as to avoid disturbance of the stability of the scaffold. Scaffolds shall not be used for the storage of material except that required for immediate use.
- Workers shall not be employed on external scaffolds in weather conditions that threaten their safety.

- → Guys, stays or supports shall be used where required to prevent danger; alternatively other effective precautions shall be taken to prevent the collapse of structures or parts of structures that are being erected, maintained, repaired, dismantled or demolished.
- → No scaffold shall be partly dismantled and left so that it is capable of being used, unless it continues to be safe for use
- → Working platforms, gangways and stairways of the scaffolds shall be provided with overhead screens of adequate strength and dimensions to prevent danger from falling objects. Materials shall not be thrown from scaffolds; exceptions shall be made only where the landing area has been designated, protected, appropriate notices displayed and are under supervision of a person at landing level.
- → Scaffolding materials shall not be thrown from scaffolds or from heights. Other materials shall only be thrown from scaffolds or heights where the landing area has been designated, protected, appropriate notices displayed and is under the supervision of a person on a landing level.
- → Openings between the scaffolding and the structure, which exceed 20cm, should be adequately protected by the installation of handrails. Wherever the above hinders operations to be carried out, workers shall be provided with safety harnesses with independently secured lifelines.
- → Any timber used in the construction of scaffolds shall be straight-grained, sound and free from large knots, dry rot, worm holes and other defects likely to affect its strength. Where necessary, boards and planks used for scaffolds shall be protected against splitting. Ladders, boards and planks used in scaffolds shall not be painted, so that any defects remain visible. All tubes, couplers and fittings used in metal scaffolding shall be free from damage and distortion, and shall be maintained in a lubricated condition. Couplers shall not cause deformation in tubes. Couplers shall be made of drop forged steel or equivalent material. Tubes shall be cut cleanly square with the tube axis. Alloy and steel tubing shall not be intermixed on the same scaffold.
- → Tower scaffolds shall be designed and built in such a manner that the ratio of height to the base width is not more than 3.5:1, in the case of static towers used outdoors, and in a ratio of 4:1, in the case of static towers used indoors; in any case, the height of free-standing static towers should not exceed 12m. Mobile towers shall not be moved while persons or materials are on the top platform. The ratio of height to base width in the case of mobile towers used outdoors shall be of 3:1, but should not in any case exceed 9.6m in the case of free-standing mobile towers.
- → In the case of prefabricated scaffold systems, the manufacturers' instructions shall be strictly adhered to. Prefabricated scaffolds shall have adequate arrangements for fixing bracing. Frames of different types shall not be intermingled in a single scaffold.
- → In addition to the requirements for scaffolds in general as regards soundness, stability and protection against the risk of falls, suspended scaffolds shall have a safe cabin, with full protection from weather and adverse climatic conditions, and designed and constructed in accordance with ergonomic principles; a clear and unrestricted view of the area of operation; safe access to, and egress, from the cabin, including for situations where the operator is taken ill.
- → The scaffolding shall be tied to the building at suitable vertical and horizontal distances without causing irreversible damage/ alterations to the fabric of the building being restored. Preferably, scaffolding shall be secured by utilising existing openings/ holes. If not possible, a predetermined minimum number of perforations for tying the scaffolding to the historic structures will be allowed. The latter will make use of a bolting system inserted in the joints between the blocks for minimum damage possible to the masonry.

1.3.9 LIFTING EQUIPMENT

- → Any lifting gear or equipment intended for lifting shall not be loaded beyond its safe working load or loads as specified by the manufacturer.
- → No person shall be raised, lowered or carried by a lifting appliance unless it is constructed, installed and used for that purpose, except in an emergency situation
- → Every platform or receptacle used for hoisting any loose material shall be so enclosed as to prevent the fall of any of the material.
- → Any equipment with wheels, placed directly on a platform for raising or lowering, shall be so secured so that they cannot move, and the platform shall be enclosed as necessary to prevent the fall of the contents.

1.3.10 'HOUSEKEEPING' PROGRAM

- → A suitable "housekeeping" programme shall be established, and be continuously implemented on the Site.
- → Areas within the Site, which are liable to become slippery, because of oil or other causes, shall be regularly cleaned up, or strewn with sand or sawdust.
- → It shall include provisions for the proper storage of materials and equipment, and for the removal of scrap, waste and debris at appropriate intervals.
- → Loose materials that are not required for use shall not be placed or allowed to accumulate on the site, so as to obstruct means of access to, and egress from, places of work and passageways.

1.3.11 MACHINERY AND EQUIPMENT

- → All manual tools, pneumatic tools, electrical tools, etc. shall be suitable for the work to be carried out, shall conform to approved standards and regulations, shall be safe and such that they can be operated without risk to health.
- → They shall be provided with protective guards, shields or other devices as appropriate, which shall be maintained regularly, which shall be equipped, where applicable, with an extraction system which shall be as close as possible to any source of the dust, and which sucks away from the breathing zone, not through it, shall be fitted with shock absorbing materials, and be fitted with noise control protection devices at source to reduce as much as possible noise exposure.
- → Only insulated or non-conducting tools shall be used on or near live electrical installations if there is any risk of electrical shock. Only non-sparking tools shall be used near or in the presence of flammable or explosive dust or vapour.
- → Operating triggers on portable pneumatic tools shall be so placed as to minimize the risk of accidental starting of the machine, and so arranged as to close the air inlet valve automatically when the pressure of the operator's hand is removed. Hose and hose connections for compressed-air supply to portable pneumatic tools shall be designed for the pressure and service for which they are intended, fastened securely to the pipe outlet, and equipped with a safety chain, as appropriate. Pneumatic shock tools shall be equipped with safety clips or retainers to prevent dies and tools from being accidentally expelled from the barrel. Pneumatic tools shall be

- → disconnected from power and the pressure in hose lines released before any adjustments or repairs are made.
- → Portable electric tools shall generally be used on reduced voltage to avoid as far as possible the risk of lethal shock. All electrical tools shall be earthed, unless they are "all insulated" or "double insulated" tools which do not require an earth. Earthing shall be incorporated in metallic cases, and as a safeguard against damaged cables, where wires enter the tool. Electric tools shall be fitted with protection guards that are regularly maintained for their effectiveness. Power cables to electrical tools shall be armoured and/or covered in thick flexible rubber, and socket outlets shall be of special design for outdoor use, and protected by a residual current circuit breaker.
- → All electrical tools shall receive inspection and maintenance on a regular basis by a competent electrician, and complete records kept.
- → The cables of portable electrical lighting equipment shall be of adequate size and characteristics for the power requirements and of adequate mechanical strength to withstand severe conditions in construction operations.
- → All vehicles shall be of good design and construction, taking into account established ergonomic principles, particularly with reference to the seat; they shall be maintained in good working order, shall be used with due regard to health and safety, by workers who have received appropriate training.
- → Where appropriate, earth-moving or materials-handling equipment shall be fitted with structures designed to protect the operator from being crushed should the machine overturn, and from falling material.
- → All vehicles and earth-moving or materials-handling equipment shall be fitted with a plate indicating the gross laden weight; the maximum axle weight or, in the case of caterpillar equipment, ground pressure.
- → Plant, machinery and equipment shall be switched off when not in use and isolated before any major adjustment, cleaning or maintenance is performed. Where trailing cables or hose pipes are used they shall be kept as short as practicable, be mechanically protected and not be allowed to create a safety hazard.
- → Mobile high pressure compressor plants and equipment shall be examined, tested and certified annually by a mechanical Engineer having a warrant to practice his profession.
- → Portable compressors shall be fitted with a double adjustable tow-bar and jockey wheel. When the plant/equipment is in operation, wheel chocks shall be installed. The wheels must be fitted with brakes that are operated automatically via a handbrake for parking purposes.
- → Only competent persons shall operate and maintain such plant and equipment.

1.3.12 PERSONNEL

- → The Contractor shall assign workers only to employment for which they are suited by level of training, age, state of health and skill, and having ensured that the workers are fully aware of any risks to health or hazards connected with the work, and that they are trained in the precautions necessary to avoid accidents or injury to health. Such training shall be given in a language that is understandable to the workers. The training shall be sustained periodically and shall take into account any new or changed risks to the health and safety of the employees concerned.

→ When the use of equipment is likely to involve a specific risk to the health or safety of workers, the Contractor shall take the measures necessary to ensure that:

- ✓ the use of equipment is restricted to those persons given the task of using it, and who have been adequately trained for the specific task;
- ✓ in the case of repairs, modifications, maintenance or servicing, only competent workers are specifically designated to carry out such work.
- ✓ All operators of construction equipment shall receive basic training as per Code of Practice provisions.
- ✓ Drivers of heavy machinery shall have followed an approved course in relation to the equipment to be used or driven and be in possession of a valid license.

1.3.13 MAINTENANCE

All equipment/ plant shall be certified to be in a proper working order, and shall be operated by trained personnel.

1.3.14 NOISE EMISSIONS

→ Noise emission levels from the plant/ equipment must conform to approved local standards, and in particular EN ISO 11690.

→ The exhaust system from any engine used on site must be fitted with a residual silencer.

1.3.15 CRANES

→ All lifting equipment used on site shall be certified by a warranted Mechanical Engineer every 6 months, in accordance with the regulations issued by the Occupational Health and Safety Authority.

→ Copies of the certificates shall be sent to the Architect and Civil Engineer in charge/ Project Manager.

→ Failure to comply or to update these certificates will lead to an automatic penalty.

→ Further measures shall be taken to protect cranes against the effects of bad weather and lighting.

1.3.16 TEMPORARY ELECTRICAL INSTALLATION

→ Any temporary electrical installation on the Site shall meet the requirements of local legislation.

→ Any temporary electrical installation shall be certified by an independent warranted electrical Engineer, every 3 months, and the certificate shall be affixed in a prominent position next to the Main Temporary Switchboard.

ANNEX 3 - DESIGN OF THE ACCESS TO DISABLED PERSONS

1.1 FOREWORD

The monumental complexes often are only partially accessible to the disabled persons. In fact, due to their inner nature, they do not allow notable interventions on their construction system aimed to eliminate architectural barriers.

Since the design preliminary activities, it is necessary check the possibility to make accessible all the spaces of a monument, assuring to the disabled persons to autonomously satisfy their needs through:

- ✓ the physical possibility to reach for the monument and move within its various zones, and
- ✓ adequate systems able to facilitate the comprehension of the spaces where the persons are.

1.2 DEFINITIONS

In order to deal with the issue of the accessibility to the fortress by disabled persons, we have considered the Italian technical legislation, due to the lack of a general framework at European level. It is composed by:

- ✓ the Law no. 13 dated 9 January 1989 (Law no. 12/89)**,** *"Measures to facilitate the clearing and the elimination of the architectural barriers",* that sets the terms and the modalities to assure the accessibility, with a particular focus on the public sites, and

- ✓ the Decree of the Ministry of Public Works no. 236 dated 14 June 1989 (D.M. no. 236/89), *"technical prescriptions to assure the accessibility, the adaptability and the capacity-to-be-visited to private and public buildings, with the aim to clear and eliminate the architectural barriers",* that deepens the technical aspects. In particular, the D.M. detects three different levels:

  - *accessibility*: possibility to persons with partial or no moving capacity to reach for the building and its single parts, with adequate security and autonomy;
  - *capacity-to-be-visited*: possibility to access to relation spaces, such living rooms and working areas, and at least one toilette facility;
  - *adaptability*: possibility to modify the built environment in the future with limited costs, in order to make it totally accessible by a disabled person.

Any new construction has to respect such rules, while the old buildings have to be fitted top the rules as much as it is possible, when are restructured.

1.3 THE RESTORATION PROJECT

1.3.1 The accessibility state-of-art

Actually, both the path acceding to fortress and the inner areas do not assure to the disabled persons the possibility to access and visit the fortress autonomously; in fact, they are composed by ramps with strong slopes and altitude jumps, sometimes notable. Most of the buildings are accessible through steps, and the size of the doors do not allow the access to a wheelchair.

1.3.2 The accessibility to the external areas

The accessing path, due to its slope and paving, remains a strong architectural barrier that does not allow the access to the disabled persons, who can reach for the fortress only by car/shuttle. When reached the entrance, the restoration design foresees only a partial accessibility of the fortress.

The whole fortress external area will be visitable even though, due to the ground level irregularity and the impossibility of notable modifications, they will have to be assisted. The inner paths will be paved with aggregated gravel, easily practicable also with wheelchairs. The fortress buildings are reachable by the disabled persons, but they will not have capacity to be visited, due to strong physical barriers than can be eliminated only through interventions compromising the original structures.

Fort with Towers – It is accessible only through stairs. Thus, the disabled persons cannot access to it; the only way would be the creation of a ramp (that would be too much long for the spaces available, and it would be in contrast with the general aspect of the fortress) or a stairlift (that needs a mechanical system non acceptable.) The access to the terrace is not allowed, as well, due to the obligated dimensions of the stair in the tower and the impossibility to install a lift or a stairlift.

Barracks – The barracks inner spaces, too, are accessible only through steps and only one entrance is sufficiently large to allow the access to a wheelchair. In order to let a disabled enter, the installation of a ramp where are the steps would be necessary, thus completely hiding them and creating a discrepancy with the whole fortress shape.

Sentry Post A and B – They are accessible in a very difficult way: the Sentry Post A has a stair really demanding while the Sentry Post B, even though it has no steps, has a very narrow access. Also in this case, there is no way to allow the access to the structures.

Sentry Box – The building is reachable, but it has no capacity to be visited due to the narrow dimensions of the access.

Souvenir Shop – The building is reachable, but it is not accessible, due to a notable stair which slope gives us no way to create a ramp.

Toilette Facilities – The fortress will be given with an external new building for toilette facilities. That building will be perfectly accessible by disabled persons.

Attached to the present report, you can find a table showing how any part of the fortress can be reached by disabled persons.

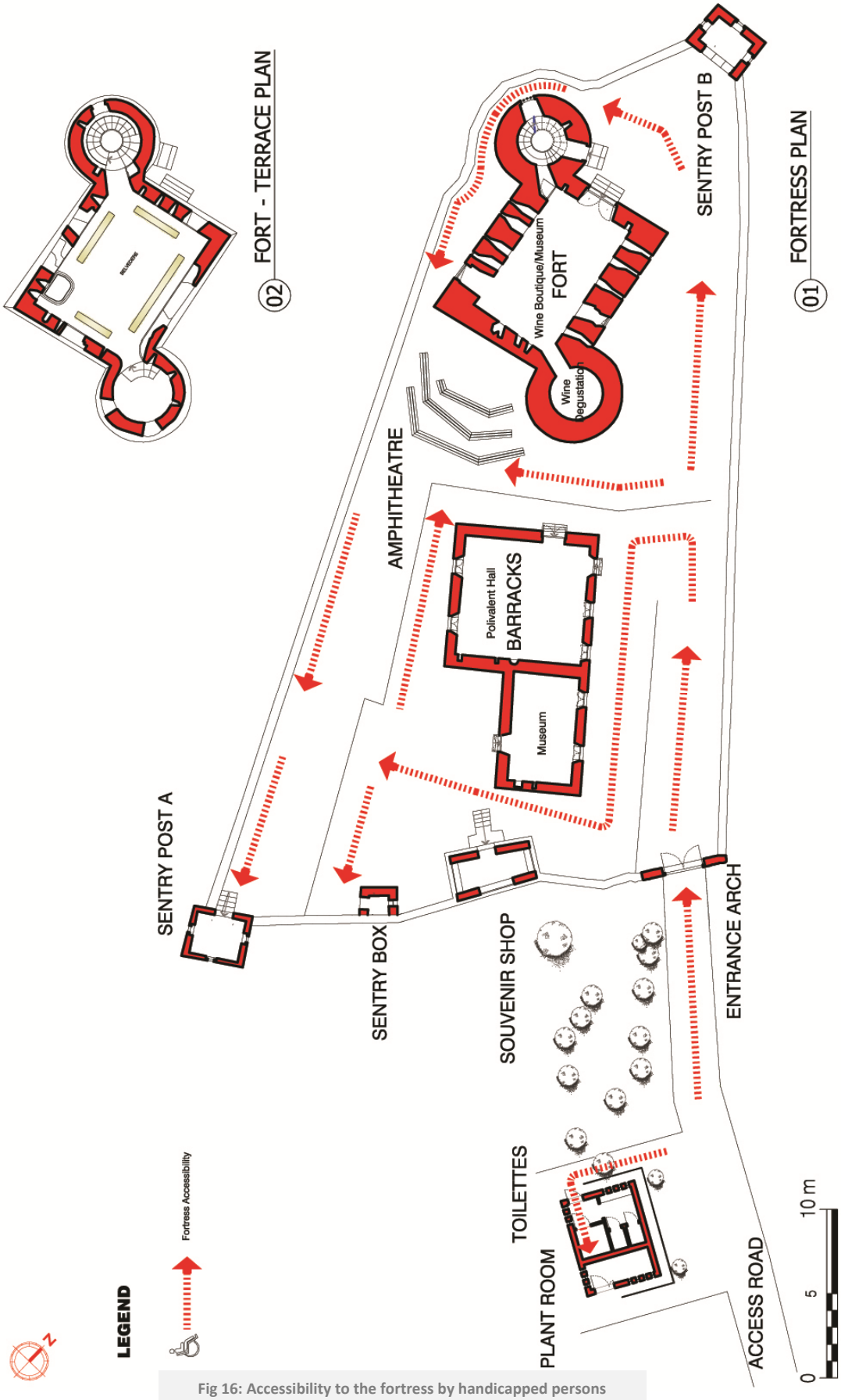


Fig 16: Accessibility to the fortress by handicapped persons

ANNEX 4 - CARRYING CAPACITY

The potential hospitality of a site is measured by factors which take in consideration different aspects, such:

- users security;
- user wellness;
- site safeguard.

Such fun of criteria defines a maximum number of users that can stay at the same time within the site, and a maximum number of daily presences.

1.4 USERS SECURITY

The *carrying capacity* of a site detects the numbers of persons that can be hosted at the same time in security conditions and that in case of emergency have the possibility to reach in a short time a *safe site*.

1.5 DEFINITIONS

- ✓ *emergency*: situation that occurs without or with short notice and can cause damage to persons, property or services;
- ✓ *emergency procedures*: activation of human resources and technical established procedures to eliminate, modify or mitigate the consequences of risky situations;
- ✓ *management of emergencies employees*: units which provide to carry out the measures of alarm, extinguishing or restriction of the start of fire, as well as the evacuation of the structure;
- ✓ *safe site*: place where people can be considered safe from the effect of the event (such as a fire), as the areas outside the building;
- ✓ *emergency exit*: passage that leads to a safe place;
- ✓ *escape route* obstacle-free route that allows an easy flow allowing people to reach a safe place in the shortest possible time;
- ✓ *safety lighting*: lighting automatic intervention in case of mains failure, which provides for at least 30 minutes brightness levels adequate in the passages of escape routes;
- ✓ *safety signs*: signs that refers to an object or situation, transmits visually, graphically, or with synthetic message, security informations (such as the location of fire extinguishers, escape direction or how to behave);
- ✓ *fire compartment*: part of a building delimited by fire resistance construction elements predetermined and organized to meet the needs of the fire prevention;
- ✓ *flow or evacuation capacity*: maximum number of people who, in a system of exit routes, it is assumed can flow out through an output of "module one". This data, established by rule, takes into account the time needed for the orderly evacuation of a compartment;
- ✓ *density of crowding*: maximum number of persons assumed per unit of gross floor area;
- ✓ *maximum hypothetical crowding*: number of persons allowed in a compartment. It is determined by the product of the density of crowding for the gross surface area of the floor.
- ✓ *exit module:* unit of measurement of the width of the exits. The "module one", which is assumed equal to 0.60 m, expresses the average width occupied by a person;
- ✓ *safe place*: open space, or fire compartment, separated from other areas through open space or smoke-proof filters, having characteristics suitable to receive and contain a predetermined number of persons (static safe place), or ensure the orderly movement (dynamic safe place) .

1.5.1 Calculation of the density of crowding

Maximum number of persons assumed per unit of gross floor area. The density of crowding of the site under study was calculated according to the parameters set by relevant legislation, intended for museums and galleries of historic interest.

The reference standards are the following:

- ✓ **MINISTERIAL DECREE 16 February 1982- Amendments to Ministerial Decree of 27 September 1965, concerning the determination of the activities subject to fire prevention visits.** (Paragraph 87 - Rooms used for display and / or wholesale and retail with a gross floor area exceeding 400 m2 including services and deposits);
- ✓ **Circular No. 36 of 11 December 1985 - Fire prevention: explanations of existing provisions and judgments made by the Central Committee for technical and scientific issues of fire prevention and fire prevention issues.**
  Paragraph 11 - Ministerial Decree of 16 February 1982, paragraph 87): Rooms used for display and / or wholesale and retail with a gross floor area exceeding 400 m2 including services and deposits. Clarification: Part of the activities referred to in paragraph 87 of Ministerial Decree,16 February 1982, the museums, galleries and similar open to the public when the respective gross floor areas exceed 400 m2.
- ✓ CIRCULAR M.I. No. 5210/4118/4 of February 17, 1975- **Clarifications regarding the application of paragraph 97 of the list annexed to the Ministerial Decree n. 1973 September 27, 1965 - partial changes to the Circular. 75, July 3, 1967.**

The following parameters are deduced, according to relevant regulations,:

Reference floor	*N °of people/m2 of gross floor area*
Basement / Ground Floor	0,1 people/m2
Upper floors	0,05 people/m2
Areas used for offices and services	0,05people/m2
Landscaped area	Number of people not defined by legislation. Is assumed equal to 0.1 people/m2

Consequently, the density of crowding for each room within the fortress is shown in the following table:

Reference room	*N° of people/m2*	*Gross Floor Area*	*Crowding*
FORT WITH TOWERS-GROUNDFLOOR	0,1 people/m2	45 m2	**5**
FORT WITH TOWERS-TERRACE	0,05 people /m2	70 m2	**4**
SOUTH TOWER	0,1 people /m2	8,00 m2	**1**
BARRACKS - MUSEUM	0,1 people /m2	25,00 m2	**3**
BARRACKS – POLIVALENT HALL	0,1 people /m2	53,00	**5**
SOUVENIR SHOP	0,1 people /m2	6,6 m2	**1**

SENTRY BOX	0,1 people /m2	1,3 m2	**1**
SENTRY POST A	0,1 people /m2	7,3 m2	**1**
SENTRY POST B	0,1 people /m2	4,3 m2	**1**
LANDSCAPED AREA	0,1 people /m2	793 m2	**80**
		TOTAL crowding	**102**

1.5.2 Outflow Capacity Calculation

Maximum number of people who, in a system of ways out, it is assumed can flow out through an exit of " module one". Such datum, established by the norm, takes into account the time needed for the orderly evacuation of a compartment. it keeps in mind of the required time for the orderly dispersion of a compartment.

The flow capacity is calculated using the following mathematical formula:

$$a = \frac{d \times L}{0,6}$$

- ✓ a: flow;
- ✓ d: value of the flow capacity (value imposed by legislation: 50 for the ground floor; 37,5 for the basements; 33 for the upper floors of buildings over three storeys; 37,5 for the upper floors of buildings with three floors above ground). Indicates the maximum number of people who, in a system of evacuation routes can flow through an exit of “module one” (60 cm);
- ✓ L= exit width in meters;
- ✓ 0,6: width in meters of an exit module.

The coefficient can be reduced at the discretion of the designer, according to a more or less easily escape from the safety exits identified. A key factor, for example, may be the presence of stairs or other obstacles (for which we need to estimate a range shorter than normal module for the evacuation "on level ground"), which may also slow the exodus. For this reason, hereinafter, in the calculation table, it is indicated a reduction factor, which takes account of this aspect which tends to further decrease the maximum number of the people, to the advantage of safety.

Reference ambient	*L Emerency Exit*	*D value*	*Reduction Factor*	*Outflow*
FORT-GROUNDFLOOR AND SOUTH TOWER	1,88 m	50	0,2	**31**
FORT WITH TOWERS-TERRACE	1,24 m	37,5	0,15	**11**
BARRACKS - MUSEUM	1,00 m	50	0,2	**16**
BARRACKS – POLIVALENT HALL	1,32 m	50	0,2	**22**
SOUVENIR SHOP	1,05 m	50	0,2	**17**
SENTRY BOX	0,72 m	50	0,2	**12**

SENTRY POST A	1,09 m	50	0,2	**18**
SENTRY POST B	0,71 m	50	0,2	**11**
			TOTAL CAPACITY OF OUTFLOW	**138**

The values determined on the basis of the calculation shown in the table represent the maximum number of people who could safely visit the rooms of the fortress. However, at the discretion of the designer, these values can be decreased according to further subjective considerations. They cant, however, be increased, if not in the discretionary portion of the reduction factor.

1.6 WELLFARE OF USERS

The visit to a monument site should make your stay pleasant, able to allow a visit with acceptable temperature-humidity conditions. The installation of plants for the air-conditioning and humidity control play a decisive role and are dimensioned according to the volume of the environments. Consequently, once given the volume and the ability of air conditioning installations, it is possible to obtain a given ideal of crowding. This calculation is set by the UNI 10339, which establish, according to the size and intended use of rooms, the amount of people present at the same time that they can stop under ideal conditions in each rooms. This calculation, then, was carried out in extreme weather conditions both hot and cold, coherently with the climate zone in which the fortress lies. Consequently, these values can be reasonably increased and represent the limit values.

Reference room	*number of Occupants*
FORT-GROUNDFLOOR	**9**
FORT WITH TOWERS - SOUTH TOWER	**2**
BARRACKS - MUSEUM	**5**
BARRACKS – POLIVALENT HALL	**10**
SOUVENIR SHOP	**1**

1.7 PROTECTION OF PROPERTY

The capacity of a site to accept a certain number of visitors can not be assigned to a mathematical formula or a rule. The simultaneous presence of a high number of visitors may involve, for example, the stop in points not dedicated to it, the lack of precise control by management workers, the greater probability of vandalism events, etc.

For all these reasons, we believe that we should take into account the data obtained by the maximum crowding of the site, reducing it by a factor of safety equal to 0.5 and excluding service and surveillance staff. The number thus calculated is deemed to satisfy the instances of conservation of the site.

Crowding	*Reduction Factor*	*Carrying Capacity*
122	0,5	**61**

1.8 CONCLUSIONS

The considerations and analysis expressed in previous chapters are meant to give an idea of the different parameters that should be examined to assess the carrying capacity of users for a monumental site. Some of these considerations derive from strict parameters (from normative values), others are derived, instead, by the discretion of the designer. However, it can be stated that all are limit values which may be changed to the advantage of safety.

Below a summary table:

Criterion	*No of Visitors*
USERS SAFETY -CROWDING	**122**
USERS SAFETY-FLOW CAPACITY	**138**
WELFARE OF USERS (air conditioned rooms)	**27**
PROTECTION OF PROPERTY	**61**

In conclusion, it can be said that the optimum loading capacity is estimated at 61 users simultaneously, excluding service and surveillance staff.

Fire protection: Building Regulations are generally directed to functional or performance-related criteria, rather than being prescriptive. In Europe, the development has been accelerated by the Construction Products Directive (CPD), which was adopted in 1988. The CPD provides six essential requirements, one of which is safety in case of fire The requirements relating to fire state that buildings should be designed and constructed so that in case of fire:

- it can be assumed the bearing capacity for a given period of time
- the generation and propagation of flame and smoke are limited
- the spread of fire to the surrounding buildings is limited
- occupants can leave the building or can be saved in other ways
- take into consideration the safety of rescue teams.

European standards on safety in case of fire in buildings comprise mainly harmonized methods for verification. These standards are at a technical level but security in case of a fire at the political level is regulated by national legislation. National or local authorities will set the level of requirements to maintain current levels of national security.

Classification for reaction to fire properties of products for the construction of buildings was introduced in Europe by the Commission Decision (2000/147/EC) on 8 February 2000 implementing Council Directive 89/106/EEC.

In conclusion, I would say that the European Union has standards for plants and for the classification of materials, but the determination of flow capacity, crowding, etc. remains a national responsibility Regarding your email requesting for clarification on the number of people in the table, I inform you that:

- This number is the sum of the crowding of each room;
- This crowding is drawn on the basis of the square meters of the room and its destination;
- Crowding conforms to specified standards UNI10339 establishing, according to square meters and the intended use of rooms, the amount of people in single rooms.

Attached calculations of each rooms where I highlighted the people considered.

The sum of people in each individual room is 27 as in the previously sent file

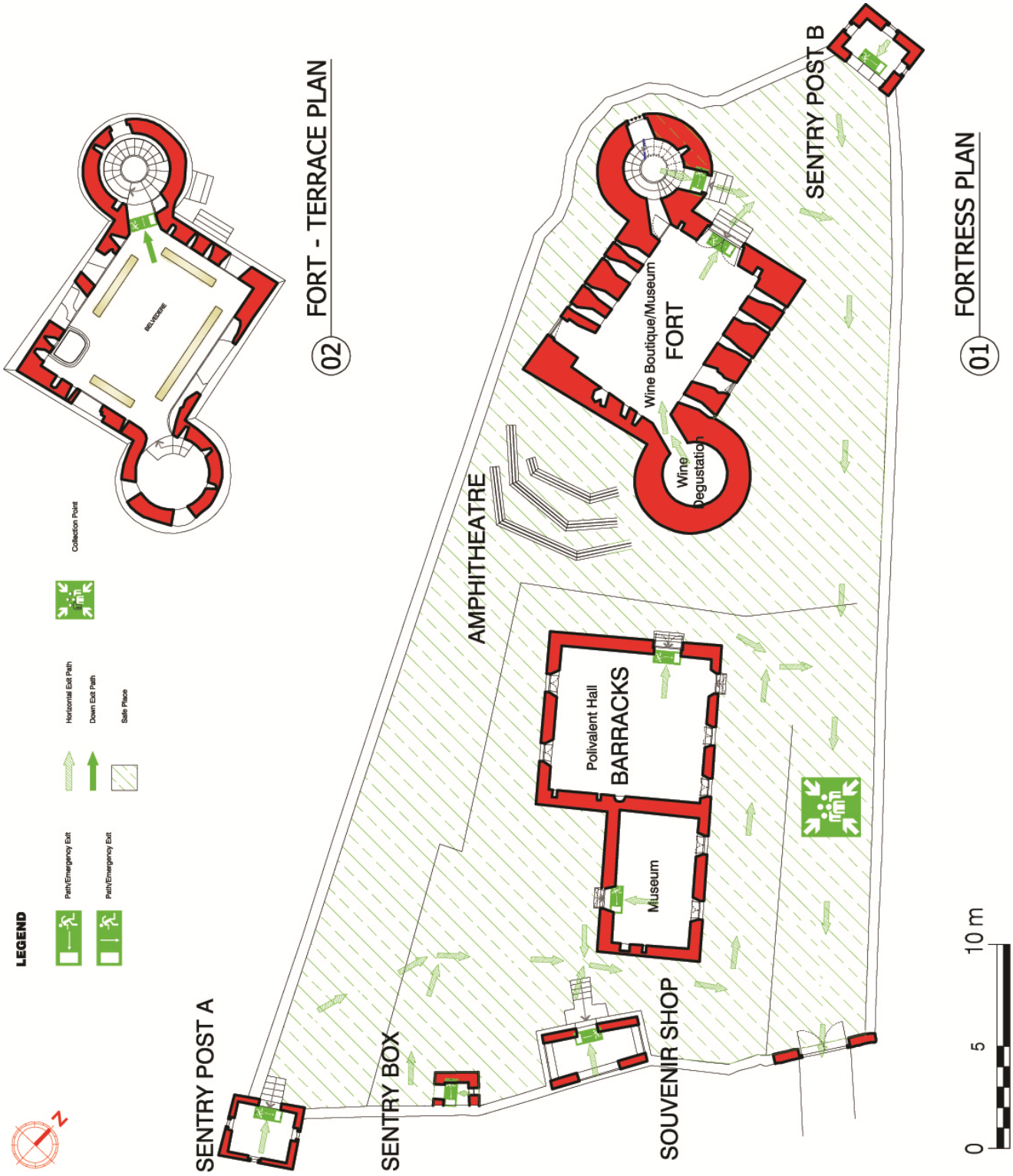


Fig 27: Escape paths

ANNEX 5 – MAINTENANCE COSTS

1.1 MAINTENANCE COSTS

1.1.1 ARCHITECTURAL/STRUCTURAL WORKS

EXISTING BUILDINGS		
Elements	*Tipology*	*Frequency*
MASONRY	Inspection Restoration of crackings, detachments, disaggregation	Annual
EXISTING VAULT COVER	Inspection Restoration of crackings, detachments, disaggregation	Annual
CROWNING OF THE WALLS	Inspection	Annual
	Water-repellent	Every five years
WOODEN DOORS/WINDOWS	Inspection Cleaning Protective Coating	Annual Every three months Every five years
SKYLIGHT	Inspection Cleaning	Every three months
METAL WORKS	Inspection Cleaning	Annual Every three months
NEW PITCHED ROOF/ NEW TOWER ROOF/ NEW SOUVENIR SHOP ROOF	Inspection	Annual
	Cleaning	Every six months
LIFE LINES	Verification of integrity	Annual
GUTTERS/PLUVIALS	Cleaning	Every six months
NEW METAL/GLASS FLOOR	Inspection/Cleaning	Every three months
NEW STONE FAÇADE COVERING (Souvenir Shop)	Inspection Restoration of crackings, detachments, disaggregation	Annual
ACCESS ROAD/LANDSCAPED AREA	Inspection Apply biocide	Annual
	Pruning of vegetation	Annual/ to occurrence
NEW SERVICE BUILDING		
Elements	*Tipology*	*Frequency*
PLASTER	Inspection	Annual
PAINTING (Internal/External)	Inspection New Painting	Annual Every five years
INDOOR TILES	Inspection	Annual
ROOF	Inspection Cleaning	Annual Every six months

METAL DOORS/WINDOWS	Inspection	Annual
	Cleaning	Every three months
GREEN COURTAIN	Inspection	Annual
	COST FOR 1 YEAR	**€ 5,100.00**

NOTE: INSPECTION be carried out annually and possibly with greater frequency in the event of exceptional weather events and / or significant changes in climate (eg winter frost).

Please note that the assumed annual costs can vary depending on the mode of execution:

- ✓ own staff;
- ✓ agreements with specialized companies in recovery and restoration of works;
- ✓ maintenance entrusted the management institution.

It is expected an increase in annual costs by 5%.

COSTS PROJECTION IN TEN YEARS

Years	*Annual costs*
1st	€ 5,100.00
2nd	€ 5,355.00
3th	€ 5,622.75
4 th	€ 5,903.89
5 th	€ 6,199.08
6 th	€ 6,509.04
7 th	€ 6,834.50
8 th	€ 7,176.23
9 th	€ 7,535.04
10 th	€ 7,911.80
SUM	**€ 64,147.33**

1.1.2 PLANTS

ELECTRICAL PLANTS

Annual agreement with a maintenance company that provide an maintenance worker on call if needed

COST FOR 1 YEAR	**€ 15,000.00**

MECHANICAL PLANTS

The variable refrigerant flow system is highly reliable and virtually maintenance-free. Maintenance work will focus primarily on the monthly cleaning of the filters of the indoor units and two times/year cleaning machine primary condenser.

Over the years costs may still arise wear and especially exposure to the public such as the remote wire or replacement of any electricity meter.

COST FOR 1 YEAR	**€ 2,120.00**

It is expected an increase in annual costs by 5%.

COSTS PROJECTION IN TEN YEARS FOR BOTH PLANTS

Years	*Annual costs*
1st	€ 17,120.00
2nd	€ 17,976.00
3th	€ 18,874.80
4 th	€ 19,818.54
5 th	€ 20,809.47
6 th	€ 21,849.94
7 th	€ 22,942.44
8 th	€ 24,089.56
9 th	€ 25,294.04
10 th	€ 26,558.74

SUM	**€ 215,333.53**

1.1.3 SUMMARY

COSTS PROJECTION IN TEN YEARS

ARCHITECTURAL/STRUCTURAL WORKS	**€ 64,147.33**
PLANTS	**€ 215,333.53**
SUM	**€ 279,480.86**