



# TECHNICAL SPECIFICATIONS HAMMAM, DURRËS





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REPUBLIKA E SHQIPËRISË  
MINISTRIA E KULTURËS

22644-001\_ALB\_EU4C\_RFP\_01 - "Provision of Consultancy for Design services for EU4CULTURE Project - Support for revitalization of cultural heritage sites and monuments affected by Earthquake in Albania."

22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



## INDEX

### PREAMBLES

<b>1.</b>	<b>GENERAL REQUIREMENTS.....</b>	<b>7</b>
1.1	SCOPE OF WORK.....	7
1.2	UNITS OF MEASUREMENTS.....	8
1.3	DISCREPANCIES.....	8
1.4	EXECUTION REQUIREMENTS.....	8
1.4.1	DEGREE OF SKILL, CARE AND DILIGENCE.....	8
1.4.2	FAULTY WORKS.....	9
1.4.3	MATERIALS.....	9
1.4.4	PERSONNEL.....	9
1.4.5	INFORMATION TO BE SUPPLIED TO THE SUPERVISOR.....	9
1.4.6	APPROVAL BY SUPERVISOR OF METHOD STATEMENTS.....	10
1.4.7	ADDITIONAL WORK.....	10
1.4.8	CONFIRMATION OF SUBMISSIONS.....	10
1.4.9	AS BUILT DRAWINGS.....	10
1.4.10	ROAD CLEANING.....	10
1.4.11	PROTECTION OF TREES.....	10
1.5	HEALTH AND SAFETY.....	10
<b>2.</b>	<b>SITE CONSTRUCTION.....</b>	<b>11</b>
2.1	MOBILISATION.....	11
2.1.1	OBTAINING NECESSARY IMPLEMENTATION WORKS PERMITS.....	11
2.1.2	STATEMENTS.....	11
2.1.3	CONDITION SURVEYS.....	12
2.2	REQUIREMENTS AND PRODUCTS.....	12
2.2.1	SITE CONSTRUCTION FENCE.....	12
2.2.2	SITE INFORMATION BOARD.....	12
2.2.3	SITE OFFICE FOR SUPERVISOR.....	12
2.2.4	ATTENDANCE UPON THE SUPERVISOR'S REQUEST.....	13
2.2.5	PROTECTIVE EQUIPMENT.....	13
2.2.6	FIRST AID PACKS.....	13
2.2.7	GARBAGE PLACE FOR DISPOSAL.....	13



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22644-001\_ALB\_EU4C\_RFP\_01 - "Provision of Consultancy for Design services for EU4CULTURE Project - Support for revitalization of cultural heritage sites and monuments affected by Earthquake in Albania."

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2.2.8	SANITARY FACILITIES .....	14
2.2.9	INDIVIDUAL POWER GENERATOR.....	14
2.2.10	SAFEGUARDING .....	14
2.3	SITE PREPARATION .....	15
2.3.1	EARTH WORKS .....	15
2.3.2	SITE CLEARING, HERBAL REMOVAL, WASTE DISPOSAL .....	17
2.4	SCAFFOLDING .....	18
<b>3.</b>	<b>STRUCTURAL CONSERVATION.....</b>	<b>18</b>
3.1	SURFACE RESTORATION .....	19
3.1.1	EXECUTION .....	19
3.2	THE CONSOLIDATION OF THE DOME .....	20
3.3	RESTORATION OF BRICK MASONRY WITH THE STICHING METHOD.....	21
3.4	LOCAL LIME MORTAR INJECTION .....	22
3.5	REPAIR OF JOINTS WITH LIME MORTAR .....	22
3.6	MECHANICAL PROPERTIES.....	23
3.6.1	MORTAR.....	23
3.6.2	STEEL.....	24
<b>4.</b>	<b>MASONRY .....</b>	<b>24</b>
4.1	PLANT REMOVAL .....	24
4.1.1	EXECUTION .....	25
4.2	REMOVAL OF CEMENT MORTAR .....	25
4.2.1	EXECUTION .....	25
4.3	STONE CLEANING .....	26
4.3.1	EXECUTION .....	26
4.4	STONE REINSTALLATION .....	28
4.4.1	EXECUTION .....	29
4.5	LIME MORTAR CHARACTERISTICS .....	29
4.5.1	EXECUTION .....	31
<b>5.</b>	<b>MOISTURE PROTECTION AND THE ROOF.....</b>	<b>32</b>
5.1	REMOVAL OF THE EXISTING LAYERS .....	32
5.2	CUPOLA AND ROOF RESTORATION .....	33
5.2.1	LIMECRETE LEVELLING LAYER.....	33
5.2.2	WATERPROOF AND VAPOR MEMBRANE .....	33



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MINISTRIA E KULTURËS

22644-001\_ALB\_EU4C\_RFP\_01 - "Provision of Consultancy for Design services for EU4CULTURE Project - Support for revitalization of cultural heritage sites and monuments affected by Earthquake in Albania."

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5.2.3	GUTTERS .....	41
6.	PAINTING .....	42
6.1	LIME WASH.....	42
6.1.1	EXCECUTION .....	43
7.	FIXTURES RESTORATION .....	45
7.1	DOORS AND WINDOWS .....	45
7.1.1	EXCECUTION .....	45



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MINISTRIA E KULTURËS

22644-001\_ALB\_EU4C\_RFP\_01 - "Provision of Consultancy for Design services for EU4CULTURE Project - Support for revitalization of cultural heritage sites and monuments affected by Earthquake in Albania."

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*VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE AND REPORT ANY DISCREPANCIES BEFORE PROCEEDING WITH THE IMPLEMENTATION WORKS.*



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## PREAMBLE

The information provided herein are drawn up to specify works and installations to exactly match the standards required to achieve the objectives of the project.

The Contractor shall certify the conformity of offered products with the specifications as requested below and shall furnish the Contracting Authority and the Supervisor with further certifications that prove the conformity of the goods with the standards as required.

General comprehension shall be achieved for the following:

Technical Specifications, Tables in the Technical Specifications or in the Bill of Quantity, Photos or Drawings do not imply a specific product or a specific manufacturer.

Works, products or installations proposed by the contractor which represent a higher degree of standard or a newer version shall be accepted whenever proven by the contractor.

Tables and enumerative descriptions in these specifications indicate a range for the contractor to propose the respective product; the above mentioned tolerances shall apply unless explicitly restricted.

The approval of an offered product is given by the Supervisor at building site only after presentation of an acceptable sample of each type.

All supplies, materials and products purchased must originate from an EU member state, a country that is a beneficiary of the European Neighbourhood and Partnership Instrument or a Member State of the European Economic Area or a country which has established reciprocal access to their external assistance with the EU. Please also refer to Article 19, paragraph 5 of the "EC Council Regulation No 1085/2006" (IPA regulations).



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Not every situation can be foreseen, therefore these specifications give an outline to the work and set a standard that is to be met. In cases where local practice overrides these specifications then it is up to the discretion and prudence of the Conservation Architect or Engineer in situ.

There are two technical parts to the project design.

The first pillar is this Technical Specifications Report, ordered as per common conservation trades and it is more oriented toward the materials, standards, and execution of the implementation works.

The second technical pillar is the Technical Report which includes the description of the site's conditions, structural systems and overview of conditions.

They are to be used in combination. They are, as in all complex conservation projects, interconnected and refer to one another as well as the Drawings and Bill of Quantities.

Locally available sizes for all elements described in this document can be used with the permission of the conservation architect or engineer. These documents are intended give an outline and standard of the work to be performed.

It is the responsibility of the contracted party carrying out the conservation works to request clarification to this, or any subsequent document, to the Conservation Architect or Engineer should there be any questions or misinterpretation.

All materials, sizes and installation listed in the drawings and specifications must be submitted to the Conservation Architect or Engineer for approval.

The project design required work interventions are based on these Technical Specifications, Drawings, and the Bill of Quantities. These three documents are linked to give the best possible description of each intervention.



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## 1. GENERAL REQUIREMENTS

### 1.1 SCOPE OF WORK

The main objective of the design for this site is to provide the restoration and rehabilitation of the Hammam of Durrës.

The detailed design works include, but are not limited to, Architectural and Structural Works of Conservation.

The intervention on the heritage site consists in the:

- Full conservation, structural stabilization and a full restoration
- Revitalizing the function of the building by identifying the materials and functions of the hammam, to bring a museum of hammam to the public, through the functional internal spaces and the new digital technologies.

All of these measures are outlined graphically in the **Drawings** and fiscally in the **Bill of Quantities**. The Bill of Quantities includes a basic outline for each section.

**Note:** If there are any elements that cause structural instability that are uncovered or observed during the works then these are also included in the scope of work.

If these areas are found, then they must be brought to the immediate attention of the conservation architect or engineer.

The intent of these documents (General Conditions, Technical Specifications, Drawings, and Bill of Quantity), along with other investigations and preliminary reports is to describe the work that the contractor will undertake. The contractor shall perform all of the work specified in these documents in good faith and execute the contract and such additional, extra, collateral and incidental work as required and necessary for the proper execution and completion of the work reasonably inferable from the contract. Contractor shall provide and pay for all labour, materials, equipment, tools, temporary water, light, power, transportation, shop drawings, and incidentals and other facilities and services necessary for proper execution and completion of the work, whether or not they are incorporated into the work.

The detailed design reports explain the order of the works as there are many elements that must be stabilized or removed before other work can be conducted. Therefore, the drawings and reports contain details concerning the conservation steps, what must be stabilized and structurally consolidated or removed before other work commence.

However, these priorities do not infringe on the staging and other works that can be prepared off-site or in conjunction with these important factors. It is the responsibility of the contracted party to conduct the works in the most efficient, cost effective, and time saving manner.



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## 1.2 UNITS OF MEASUREMENTS

In general, the units of measurements to be used in connection with this contract are metric units of mm, cm, m Km, N (Newton), Mg (1000 kg) and degrees Celsius (Co). Decimal points are written as ",". The units to which the contractor shall refer to for measurements are indicated in the respective Bill of Quantities for each individual item separately.

## 1.3 DISCREPANCIES

Before the contractor begins any work, they shall carefully review the all documents, drawings and specifications, inspect the site, and compare the documents comprising the contract with each other and with any additional information furnished by the Contracting Authority with the objective of discovering any errors, inconsistencies or omissions.

Should any of the above-described errors, discrepancies or omissions be found in the contract or should any discrepancy be found between the contract and the physical conditions at the site or in any subsequent drawings or addenda that may be provided thereafter, the contractor shall notify the Contracting Authority in writing, immediately.

Any work done after such discovery, unless authorized in writing by the Contracting Authority will be done at the contractor's expense. The contractor will not be allowed to take advantage of any error, omission, or discrepancy in the contract.

## 1.4 EXECUTION REQUIREMENTS

Particular attention is drawn to the fact that certain works require traditional and / or other professional expertise in conservation design and installation; the Contractor has to consider that the mentioned specifications and subsequent expenses are borne with the Contractor and are thus, to be included in the unit prices.

The Contractor shall in accordance to his own design, also propose and submit a methodology how to implement his design. The design shall be in accordance to the detailed design drawings and the material specified. All design, methodology and purchase shall be approved by the Supervisor. Only especially skilled and licensed technicians shall be authorized to install the system. The contractor shall provide to the Supervisor evidence of the qualifications of the nominated staff before commencement of works.

### 1.4.1 Degree of Skill, Care and Diligence

The contractor shall perform, or cause to be performed, all the work required of it under the terms and conditions of the contract with that degree of skill, care, and diligence normally exercised in performing that type of work in projects of a scope and magnitude comparable to the project. The contractor shall use their best efforts to assure timely and satisfactory completion of the work. The



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contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the work under the contract, unless the contract gives other specific instructions concerning those matters.

The contractor has an obligation when directed by the Contracting Authority, shall promptly correct, or remove all work identified to be defective or incomplete. The contractor shall bear all costs.

Unauthorized work done without permission from the Contracting Authority as shown on the drawings or specifications will be considered as unauthorized.

#### 1.4.2 Faulty Works

Any work, which fails to comply with these Specifications, shall be rejected and the Contractor shall, at his own expense, repair any defects, as directed by Supervisor satisfaction.

#### 1.4.3 Materials

There will be no substitutions of materials on this project without written authorization of the conservation architect or engineer.

The materials shall comply with the specifications and used throughout the work. In the absence of a defined specification then the contractor will submit in writing a report of any required new materials. Testing of all materials including mortar, stone, sand, and other materials shall be conducted and approved by the conservation architect or engineer. All data sheets and materials identification and literature including product description, samples, and test along with the name of the manufacturer will be submitted to the Contracting Authority.

The conservation architect or engineer has the right to inspect any and all materials used to ensure quality and standards, at any time.

#### 1.4.4 Personnel

The Contractor shall provide the name and identification documents of all persons or subcontractors expected to work on the project to ADF prior to commencement of work. If any changes are required, then the Contractor shall submit in writing proposed changes.

#### 1.4.5 Information to be supplied to the Supervisor

The information to be supplied to the Supervisor shall include drawings showing the general arrangement of the temporary offices and any other temporary buildings or structures which he proposes to use, together with details of the constructional plant and temporary works, and all other devices which he proposes to adopt for the construction and completion of the whole of the works and, in addition, details of the labour strength, skilled and unskilled, and supervision arrangements.



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#### 1.4.6 Approval by Supervisor of Method Statements

The manner and the order in which it is proposed to execute the permanent works as described in the Contractor's method statements is subject to adjustment and approval by the Supervisor, and the Contract price shall be held to include any necessary adjustment required by the Supervisor during the course of the work.

#### 1.4.7 Additional Work

The contractor should submit to the Supervisor every additional work; a detailed drawing and the work should begin only after the Supervisor's approval.

#### 1.4.8 Confirmation of submissions

The contractor should sign proposals, details, sketches, accounts, information, materials, test certificate, whenever required by the Supervisor. The Supervisor will accept every submission and if appropriate will be answered to the contractor in accordance to any proper clause of contract conditions. Every submission should be done due to dates agree with the Supervisor and referring to the approved program and necessary time that the Supervisor needs to submit those works.

#### 1.4.9 As Built Drawings

This material should contain the complete set of drawings of the implemented works, including any additional drawings made during work implementation approved by the Supervisor, and the measurement handbook per each work volume.

#### 1.4.10 Road cleaning

Streets adjacent to the site shall be kept clean on a daily basis. The Contractor shall take necessary precautions to prevent excessive spoiling of streets such as wheel washing and covering of open lorries and containers leaving the site.

#### 1.4.11 Protection of Trees

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

### 1.5 HEALTH AND SAFETY

The Contractor shall implement all works in accordance with current European and Albanian Health and Safety at Work Standards.



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He shall develop and maintain a proactive approach to safety on site with providing the following:

- A site safety plan
- Nomination of a safety inspector
- Carrying out regular staff safety briefings
- Performing regular safety tours of the site with the Supervisor and
- Maintenance of accident statistics for presentation to the Supervisor each month.

## 2. SITE CONSTRUCTION

### 2.1 MOBILISATION

It is the contractor's responsibility to become familiar with these documents and contact the Contracting Authority or the conservation architect or engineer should there be any questions, concerns, or discrepancies. It is also the contractor's responsibility to visit the site and become familiar with the unique situations present at the site before beginning the works on the project.

The project is complicated; therefore, the scope / limits is also outlined in this document as well as clearly delineated on the drawings. Should there be any questions before, during, or after the work concerning scope the Contracting Authority must be contacted.

#### 2.1.1 Obtaining necessary implementation works permits

It the contractor's responsibilities to obtain the necessary implementation works permits, insurance, bonding, right-of-way, etc. It is also the contractor's responsibility to obtain all the necessary permissions to conduct the work outlined in these General Conditions, Technical Specification, and Drawings. No work shall commence until these permissions are obtained and a copy submitted to the Contracting Authority. It is the contractor's responsibility to obtain all permissions required to execute this scope of work. If the permissions have a time requirement this must also be respected and if reapplication is required, this is also the contractor's responsibility. All expenses for obtaining these permissions are the contractor's responsibility. The contractor must always maintain the work site in accordance with the requirements of these work permissions.

#### 2.1.2 Statements

Submit proposed transport, placement and connection procedures to the Supervisor for approval before work is started. Procedures shall provide for adjusted placement and coordination with other works in progress, a connection schedule of utility services, all necessary permits from utility supply companies, a detailed description of methods and equipment to be used for each operation and sequence of operations.



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### 2.1.3 Condition Surveys

In cases where neighbouring property could be touched or damaged by the container placement or the storage placement or the site board, then the Contractor shall carry out at his expense a detailed condition survey of the neighbouring property including photographic documentation a copy of which shall be presented to and approved by the Supervisor prior to commencement of the works.

## 2.2 REQUIREMENTS AND PRODUCTS

All products and items as described in the following have to be included within the scope of work by the contractor.

### 2.2.1 Site construction fence

For purposes of safeguarding and protection, if needed, the contractor has to erect a fence surrounding the construction site, to prevent unauthorized access.

The Contractor shall install a fence surrounding the construction that is made from steel or solid wooden panels or similar material. The height of the fence shall be not less than 2.80 m. The support of the fence shall be stable and solid as to the direction of the Supervisor.

### 2.2.2 Site Information Board

The contractor shall construct one board, carrying information supplied by and erected in the location specified by the Contracting Authority. The wording shall be presented in such a way as to be legible from a distance.

### 2.2.3 Site Office for Supervisor

Where itemised in the Bill of Quantities the Contractor shall provide appropriate office facilities for the exclusive use of the Supervisor and his staff for the duration of the Contract. Such offices shall have an area of min 25 sq.m. and shall be configured to provide, as a minimum, two offices, toilet facilities and a store room.

The office container shall be ready-made from steel panels. Container should have windows on 2 sides. The container shall be burglar proof. The door of the container shall be lockable. All office containers should be equipped with the required furniture, computers and ancillaries, internet connection and heating.

The contractor has to cover the running and maintenance costs for the complete contract time.



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#### 2.2.4 Attendance upon the Supervisor's request

The Contractor shall provide to Supervisor all required attendance and , all equipment, tools and protective clothing, plastic bags for sampling, and survey assistants, chainmen and labourers, delivery personnel and transport, wooden pegs, iron pins and pickets, water, cement and aggregate for concreting, transport for labourers and materials, as may be required by the Supervisor and his staff for carrying out the sampling and laboratory testing activities and for checking, setting out, surveying, measuring or testing the work The Contractor shall provide all cleaners, labour, equipment, consumables and material which may be necessary for keeping all the buildings in a neat and clean condition, and any repairs shall be made immediately at the request of the Supervisor. The Contractor shall include in his rates in the Bill of Quantities, the cost of all attendance upon the Supervisor and his staff. No other payment shall be made in respect of attendance, except where a specific item is provided for in the Bill of Quantities.

#### 2.2.5 Protective Equipment

The contractor shall at commencement of the Works provide the Supervisor with protective clothing and equipment, as follows, and, as the Supervisor considers necessary, provide replacement items under the provisions for maintenance of the Supervisor's facilities. Prior to making this provision, the Contractor shall obtain a list of appropriate sizes from the Supervisor. as and where the Contractor's methodology, activities or planned testing programme may require additional protective equipment (such as gloves, ear plugs, goggles, torches etc.), the Contractor shall make these available to the Supervisors and when the need arises.

#### 2.2.6 First Aid Packs

The Contractor shall provide, to the Supervisor's satisfaction and compatible with current legislation, and maintain, two first aid packs. Each vehicle working within the site borders shall be provided with a first aid pack in accordance with the regulations in force and will be replenished, as necessary, together with the office supplies.

#### 2.2.7 Garbage Place for disposal

The work includes the preparation of a garbage place for construction waste and debris.

The storage place for disposals and garbage shall be located close to the work site in order to allow easy access and transport from the work site; the garbage place shall be emptied each evening at closure of the construction site. The garbage storage shall include the provision of 4 movable garbage bins on rolls with lockable covers.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIE  
MINISTRIA E KULTURËS



## 2.2.8 Sanitary facilities

The Contractor shall avail sanitary facilities in relation to the number of workers and staff on site, but at minimum 2 separate toilet cabins shall be provided.

All sanitary facilities shall be provided, installed, operated and maintenance by the contractor. The number of toilets has to be approved by the Supervisor.

## 2.2.9 Individual Power Generator

For the use of the Supervisor, the Contractor shall provide, install, operate and maintain a diesel power generator.

The power generator shall be equipped with a diesel engine and be of at least 4 kVA capacity.

## 2.2.10 Safeguarding

The Contractor has to provide services for safeguarding the object over 24 hours a day and 7 days per week.

A service for safeguarding the construction site shall be provided. The service providers shall be properly equipped with uniforms and mobile phones to connect to the next police station. A cabin with windows for surround view at the entrance of the construction site shall be provided, equipped with heating device and spotlight.

The construction site is an archaeological site therefore due care must be taken to work on this site. For this reason, the site should be inspected and if any elements are found, they should be placed in the attention of the conservation architect. They should not be moved without permission.

If archaeological elements are found during the works above or below the surface, the works in the vicinity should be stopped immediately and the restoration architect should be notified together with the Ministry of Culture. Work can only continue after approval under the supervision of an archaeologist.

In cases where there is planned work under the surface for drainage system, for the removal of vegetation, it is not expected to have chances for finding archaeological elements, however great care should be taken with any surface or sub-surface work.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rrijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



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## 2.3 SITE PREPARATION

### 2.3.1 Earth works

These works consist of excavation, transportation, disposal, placement and impact of all materials encountered within the boundaries of the work, including construction of drainage, support, as well as excavation of ditches and canals necessary for the construction of the workplace in accordance with the purpose of the work. All excavations will be defined as, unclassified excavations, extraction, removal of unsuitable materials, rock excavations, borrowings or landfills.

Removal of Unsuitable Material should consist of removing soil and / or mixing soil with organic materials identified in the planned Contract or as directed by the Engineer, which would be detrimental to the road or embankment if left in place in the condition its existing. Rock excavations. Rock excavations consist of igneous, metamorphic and sedimentary rock which cannot be excavated without exploding or with the use of an excavator, including all rocks or other detached rocks.

Provide satisfactory soil materials for filling and refilling, free of mud, rock or stones larger than 100 mm in any dimension, litter, debris, vegetation and other harmful substances and use excavated or borrowed material sampled, tested and approved as accepted soil material. The material excavated in the borrowing pits has been selected and approved by the Engineers.

#### 2.3.1.1 Execution

Inspect the areas before excavation with the conservation architect or engineer outline the extent of excavation, limits, probable depth, and access.

EXCAVATION - consists of the removal of all materials encountered above the required grade elevations, setting aside satisfactory soil materials for reuse in backfilling (in trenches, around structures) and filling (for general grading and other purposes) and disposal of unsatisfactory and excess material. Unauthorized excavation consists of removal of materials beyond indicated elevations or lateral limits without the specific direction of the Engineer. Unauthorized excavation shall be replaced by backfilling and compacting as specified for authorized excavations unless otherwise directed by the Engineer.

When excavation has reached the required trench bottom or grade elevations, notify the Engineer for the inspection of conditions. If unsuitable bearing materials are encountered at these elevations, carry excavations deeper and replace the excavated material, as directed by the Engineer.

Slope the sides of excavation to the angle of repose of the in -situ material excavated, or provide shores, timbering, struts and sheeting, as required, and brace where sloping is not possible either because of space restrictions or is to be avoided because of the trenching requirements described later. Maintain sides slopes of excavations in a safe condition until completion of backfilling. Take prior precautions to prevent slides or cave-ins in excavation.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



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Prevent surface water and subsurface or ground water from flowing into excavations and flooding the work site and surrounding area. If water is encountered in excavation, it shall be removed without allowing it to accumulate, in order to prevent soil changes detrimental to the stability of subgrades. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey the water away from the site. Drain the water from excavations and rainwater to collecting or run-off areas. Trench excavations for utilities shall not be used as temporary drainage ditches.

**COMPACTION** - Control soil compaction during construction, as to provide at least the minimum percentage of density or the minimum relative density, if applicable, specified for each area.

Soil compaction for backfill in trenches around associated structures, for subgrade below equipment bases and for fill elsewhere shall not be less than the percentages of maximum dry density given below in sub-paragraphs (a) and (b) for soils which exhibit a well defined density, and not less than the relative densities in percent values given in the same sub-paragraphs determined, for soils which do not exhibit a well-defined moisture- density relationship.

Where the moisture content of a layer of the subgrade or other soil must be increased before compaction, water shall be applied uniformly to its surface and in such a manner that free water is prevented from appearing on the surface during the compaction operation. Soil which is too wet to permit compaction to specified density shall either be removed and replaced, or scarified and dried. Soil material, which has been removed because it is too wet to permit compaction may be stockpiled or spread in approved locations and permitted to dry. Drying shall be assisted by harrowing or pulverizing, until the moisture content is reduced to a satisfactory value.

**BACKFILLING** - Provide satisfactory soil materials for backfill and fill, free of clay, rock or boulders larger than 50 mm in any direction, debris, garbage, vegetable matter, and other deleterious matter. Only such excavated or borrow material shall be used in fills and backfills, as have been sampled, tested and approved by the Engineer.

### 2.3.1.2 Drainage system

It is necessary to remove water from the surrounding structure, as excess moisture often leads to serious deterioration of the stone and plaster. This section involves installing a drainage system to remove water from the site. The drawings contain the location of canals, catchment ponds, outlets and dimensions. Collection ponds should be installed at each turn in the direction of the drainage pipes. Inlet and outlet pipes should be 10 cm minimum, but should contain enough space to work in case cleaning is required. Put leaf guards on all entrances to prevent debris from entering the system.

Gravel should be 1cm - 3 cm evenly washed and clean and free of salt and dirt. Geotextile to be a non-woven synthetic polymer with various small holes with a minimum size of .211 mm # 70 with an open surface of 4% and a tensile strength of 100 kg. Be from an ISO 9001: 2008 certified



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



manufacturer and be resistant to ultraviolet degradation and biological, chemical and salt environments.

The installation of the drainage pipe will start from a collection pond at the top of the collection system in the direction of the slope. The tubes will come out in the collection boxes according to the drawing details. The pipes will be placed on a slope of 1.5% - 2%. The catchment basins will be positioned at all direction changes in the drainage system. The locations of these collection ponds are shown in the drawings.

### 2.3.2 Site clearing, herbal removal, waste disposal

This process includes the protection of all existing trees and terrestrial vegetation, or other necessary protective species to prevent damage to existing elements that will not be removed, and all elements on neighboring properties or adjacent to the project site. This includes the aqueduct, the surrounding wall, the spring and especially the historic olive groves or any other element that is not included within the project scope. Protect existing trees and other vegetation that will remain as it is, from cutting, breaking or rooting, bark decay, smoking of trees from accumulation of building materials or excavations within marked lines, from excessive pedestrian traffic or vehicles, or parking vehicles within the marked line. Provide temporary fences, barricades or surroundings as required, to protect trees and vegetation, to be left as is.

Removal and disposal of shrubs, their roots, grass, wild plants, surface debris, fallen organic material and rotten trees, clearing the site and preparing for further activities. This includes cleaning and removing debris and disposing of off-site or storage as directed. The work should be limited to the area shown in the drawings. All cleaning should be done with hand tools or small mechanical gasoline cutters and chainsaws.

Note: only small hand tools for mechanical cleaning are allowed. Large machines towed by tractors are not allowed. Large tree trunks should not be removed. Mechanical cutters are not allowed to be used within 2 meters of any stone wall or object.

Large shrubs should be removed from this area carefully given the archaeological nature of the site. Work to remove shrub roots can not progress beyond 0.5 m (1 / 2M) below the surface. Trees will NOT be removed and must be protected at all times. All communal installations must be protected and not damaged.

Remove all debris material from the site including all barbed wire free from old fences. Remove debris from the facility in such a way as to prevent field losses. Keep at all times the whole building and the area near the building, clean and free from mud, dirt, debris. Clean the waste generated by cleaning the facility continuously according to the progress of the works.

Caution: Waste incineration is not allowed and all material should be removed according to the orientation of the restoration architect. Avoid the accumulation of cut material near any building to eliminate the risk of fire.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIE  
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## 2.4 SCAFFOLDING

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

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

Steel scaffolding of trestle type, in accordance with local standards and regulations, including the supply of supports, maintenance, assembly, anchorage, dismantling etc. 15 cm toe boards shall be provided on all levels. Weatherproof sheeting or at least protective netting shall be provided on the outside of the scaffolding.

## 3. STRUCTURAL CONSERVATION

As determined in the structural analysis, recovering the integrity of the masonry walls is crucial for guaranteeing the stability of the walls. Additionally, cracks are a way for water to easily penetrate into the wall section, causing future decay. For these reasons, it is necessary to stitch the cracks. The proposed solution is to use stone units and mortar to match existing in material properties and appearance. When necessary, fiber glass bars might be inserted in order to provide additional connection, especially in particularly thick walls, heavily cracked walls or corners.

1. Careful recording
2. Monitoring
3. Characterization and recording of masonry and mortar (core and facing) – see below.
4. Stitching. Removing facework and core to form slots across the fracture. Introducing shaped long stones and fiber glass bars grouted with hydraulic lime (NHL)
5. Completing lost masonry and repointing. Under archaeological supervision.

Stone replacements, where necessary, will be carried out following these steps:

1. Careful recording
2. Petrographic identification. Provenance.
3. Rule of "stitching" appropriate for identification. Matching color, grain size and texture.
4. Respect courses and mortar color and texture



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rihetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



Selection of mortar for repointing will be carried out following these steps:

1. Characterization. Lab analysis.
2. If inappropriate Portland cement-based mortar, remove
3. Remove decayed joint mortar
4. Design a lime-based mortar, taking into account original aggregates
5. Repoint / replace mortar with "stiching" technique.

Before any works begins the permission and observation of the conservation architect or engineer is required and an inspection must be conducted

### 3.1 SURFACE RESTORATION

This chapter deals with surface cleaning, surface preparation and application of new materials to existing surfaces. This work must be carried out after all other work has been installed and completed, including the water control elements.

A sample of the geotextile to be used, a sample of the aggregate base and the final material.

#### 3.1.1 Execution

- 1) Preparation of surface beds - all weeds and plant materials and loose clay should be removed by hand from the space. All dust and debris should be kept to a minimum during this process. Loose clay should be removed according to the detail drawings. There are loose stones that need to be removed before this work. The stones must be stored for possible reuse.
- 2) Install the steel separator between the modified parts on the surface material. Place the geotextiles on the trail and overlap backwards by 0.5m. Overlap each adjacent section of geotextiles by 1 meter. Obtain approval from the restoration architect or engineer before filling with gravel.
- 3) After removing the mud, fill the remaining area which should be firmly compacted and compacted and there should be no large stones or any plant material. The surface should be sloping downwards towards the drainage pipes and away from the building. This slope should be between 1.5 - 2%. The existing surface should be easily glued with hand tools and all soft areas should be compacted, filled and leveled to ensure a uniform base. Treat the area according to the drawings.
- 4) Create a mixture of lime mortar by thoroughly mixing the dry ingredients with a ratio of 5% white colorless lime-based cement (65% lime + pozzolanic additives) and 95%. After compaction, but before applying the material, lightly spray the surface with clean, salt-free water until wet. Apply a light coat over the mortar mixing area / Water spray of the lime mortar mix.

Apply in the erection stages No more than 10 cm compaction after the new material is deposited. Provide at least a uniform material depth of 20 cm.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRISË  
MINISTRIA E KULTURËS



Do not work in an area that may end up before the subsoil is completely dry. Sprinkle the finished path and compact one last time and cover with a damp bag to protect from the sun. Keep covered for a minimum of 48 hours, periodically wetting the cover. Ensure a smooth transition between all areas. There should be no evidence of shredding, cracking or falling pieces. The cured and compacted path should be strong across the profile, with no spongy areas. Free material should not be present on the surface after installation. Any surface irregularities in the path will be fixed to the uniformity of the entire installation.

If surface cracks appear, a small amount of loose material may seep into the cracks and get wet. If wet aggregate appears on the surface to depth, apply additional and compact material. This process can be repeated as needed.

NOTE: do not allow any movement on the finished track until the material has hardened for a week. The final layer should be clean. It should be in accordance with the size and color, be clean, washed and free of small stones, sand or any organic material. It should match in color and texture. Before applying the subfloor should be lightly sprayed with water. The material should be tightly compacted in stages or layers until it reaches the right thickness as described in the drawings. Note: The color should be consistent all the time and match the color and quality.

### 3.2 THE CONSOLIDATION OF THE DOME

The mortar of the joints of the stone/brick masonry must be ejected up to a depth of 5 cm, throughout the entire size of the joints.

1. In case the joint size (width/height) is less than 8 mm, the stones and the bricks next to that joint must be cut as specified in the previous note and the size of the joint should be no less than 8 mm.
2. The joints must be polished with pressurized air and must be cured with water.
3. Set the first layer of mortar in the prepared joint.
4. Set the helicoidally stainless steel rebar of diameter  $d=8\text{mm}$  and length  $l=100\text{ cm}$ .
5. Set the second layer of the mortar.
6. Set the closing layer of the joint with original mortar.





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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



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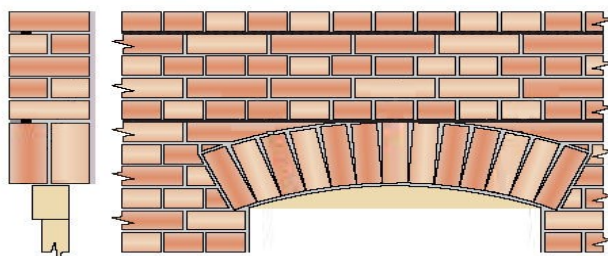
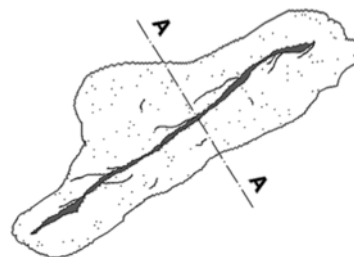


Fig. Set the helicoidal stainless steel rebar.

### 3.3 RESTORATION OF BRICK MASONRY WITH THE STICHING METHOD

PRERJA A-A PARA RESTAURIMIT



PRERJA A-A PAS RESTAURIMIT

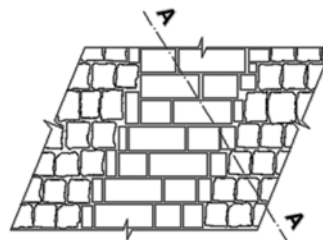


Fig. Repairing masonry through "stitching" method.

The steps for the strengthening are:

- Demolition of existing plaster and drawing out masonry.
- Removing the elements of masonry affected by splitting and some other elements, to form a sufficient space for the introduction of new elements to the masonry, taking care to form a perimeter suitable for the connection old masonry with the new one and to create indentations and fugues which do not fall over each other.
- The introduction of new elements of masonry (stone or bricks), after cleaning and washing the cavities created with water, taking care in the formation of so-called



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notches. Must be used light expansive bond materials, composed of aggregates similar to what constitutes existing bonding material.

### 3.4 LOCAL LIME MORTAR INJECTION

Mortar injection will be realized according to the following steps:

1. In case when that the pipe of injection cannot penetrate directly to the crack, is necessary to use a drilling rotary machine (of 14 mm diameter) at the route of the blast. If the cracking lies on both sides, the holes will be made on both sides of masonry. The holes will have the depth depending to the thickness of masonry, while their minimum depth is 20 cm. The maximum distance between the injection holes shall be taken 40 cm.
2. Insert the pipe in each of the holes, to a depth of about 5 cm.
3. The filling of cracks or degraded joints from outside, will be with the same injection mortar, or when this is not possible must be used a rapid drying mortar.
4. Prepare the mixture to be injected with the drill rotary machine and brush. Injection of mixture must start from the bottom holes of the masonry continuing in the upper ones.
5. If the walls inside are filled with non-cohesive material and gaps, then for the purpose of saving materials and avoidance of over-strengthening local of masonry, mortar must be not-very fluid.

Crack Width	Raccomended procedure
< 0.1mm	Injection with epoxy
0.3m to 3mm	Injection with lime mortar that contains shrinkage reducing admixture
>10mm	Reconstruction of damaged area with new units. Cracks may sealed with mortar if the wall thickness is relatively small

Tab. Injetion According to Crack Width

### 3.5 REPAIR OF JOINTS WITH LIME MORTAR

To realize the repair of masonry surface, the following steps should be followed:

1. Initially, the part of the masonry that needs intervention will be carefully identified, ie the parts where the mortar in the masonry joints are degraded and the part where the mortar in the joint is missing.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



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2. Once the problem has been identified, the joints should be carefully cleaned mechanically from debris and unconsolidated mortar.
3. Once the joints have been mechanically cleaned, they will be washed with running water.
4. Once they have been washed with running water, the mortar filling will start (when the problem is superficial). In case the damaged existing mortar goes deep in the masonry, then the new mortar will be injected to that depth. The mortar recipe should be designed according to the original masonry mortar, ie according to the in-situ materials.
5. If the masonry is non-plastered (which depends on the typology of the building) after the joints have been filled with mortar, the mortar will be cleaned from the surface of the stones so that it is not visibly invasive for the surface of the masonry units.

### 3.6 MECHANICAL PROPERTIES

#### 3.6.1 Mortar

Mechanical properties of lime mortar should be in conformity to the Albanian standard STASH 510-81. The mortar test methodology is given in STASH 543-83. The mortar resistance will be determined testing cubes with dimensions 7.07x7.07x7.07cm, in wet conditions. The mortar must withstand at least 15 freeze-thaw cycles.

Mortar type	Proportion of volumes (Lime:Sand)	Mortar class (strength) (daN/cm <sup>2</sup> )	Lime wash (l)	Cement (kg)	Sand (m <sup>3</sup> )	Gypsum (kg)	Water (l)
Lime mortar, lime having consistence of 12 cm	1:3	4	350	-	0.99	-	120

Tab. Mechanical properties of lime mortar

Important notes:

1. The above recipe has an orienting character, as in advance the mortar that must be placed in the site, has to be verified with laboratory tests to meet the requirements of mechanical resistance and durability as described above. In case the test results do not meet the technical requirements, then notify the structural engineer, for the review of the recipe.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rihetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRISË  
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2. Mortar components should be obtained from the nearest quarries, in order to identify as far as possible the constituent materials of the original mortar.

2. Do not use, for any reason, lime mortar combined with stainless steel elements.

### 3.6.2 Steel

Mechanical properties of steel used in the project is given in the table below.

Material	Density (kg/m <sup>3</sup> )	Brinell Hardness Number	Modulus of Elasticity (x10 <sup>3</sup> MPa)	Yielding stress (MPa)	Tensile strength (MPa)	Ultimate strain (%)	Coefficient of thermal expansion (x10 <sup>-6</sup> °C)
Iron / Steel for RC elements							
Iron and mild steel	7870	115	196	195	390	35	12
Ductile stainless steel (Hot rolled)	7970	150	196	295	590	10	17
Steel for high strength cables							
High-strength stainless steel (Cold rolled)	7970	300	206	785	980	5	17
Iron / Steel for tie rods, profiles and accessories: Class S275							
Iron and mild steel	7870	115	200	265	410	23	12

Tab. Mechanical properties of steel

## 4. MASONRY

### 4.1 PLANT REMOVAL

All plants should be removed from all structures. Small shrubs and other plants that grow in the structure cause physical damage. Their roots penetrate into the spaces between the stones and into the gaps in the stone. However, they must be removed very carefully to avoid further damage and displacement of the original materials. Below is the procedure for removing this plant material.



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#### 4.1.1 Execution

Vegetation should not be removed until the structural consolidation of the area is ready to continue. The team and materials should be ready to stabilize and consolidate the area immediately after vegetation removal. Under no circumstances should the vegetation be removed and the area left overnight or over a weekend without stabilizing.

Vegetation should be removed slowly and a field assessment should be made as to whether it can be safely removed without damaging workers or the structure. If the plant supports a stone block or any other material, then the area should be stabilized before complete removal.

The plant should be completely removed with no roots left.

All loose and brittle materials should be removed in accordance with structural consolidation guidelines

The area should be carefully inspected to ensure that there are no residual plant materials that can germinate again. The area should be treated with an approved biocidal before it is consolidated and allowed to dry. In areas where large plants exist, a small amount of ammonium salts should be injected into the stem and roots of the plant so that when the plant dries it is removed without damaging the skin. All herbicides should be used with caution and all precautions should be taken regarding the health and safety of workers. Follow the manufacturer's instructions.

All plant materials removed from the building should be removed from the site and disposed of properly. Organic material cannot be left on the site. Organic materials can be temporarily stored in place during removal, but only for one-week periods. Every Friday the place should be cleaned of organic plant materials.

## 4.2 REMOVAL OF CEMENT MORTAR

During various interventions in time, the patching of degraded surfaces or damaged joints with cement has started to be applied in historic buildings, which is a material that does not match traditional materials and original construction techniques of the building.

They must be removed very carefully to avoid further damage and displacement of the original materials.

#### 4.2.1 Execution

A small test area should be selected for removal to determine the difficulty of removing this mortar. Only hand tools should be used and only on the Portland cement mortar – not on the original stone. Care must be taken in these areas as the mortar joints are not large and work must proceed from the centre of the joint using a pointed hand chisel creating a groove up the centre of the joint



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REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



working upward. This groove can then be expanded inward until the original lime mortar is encountered and outward toward the stone. Chiselling upward in the centre of the joint prevents slips and damages to the original stone. After this initial cut the groove can be expanded. If the mortar breaks away freely without harming the original stone then work may proceed.

If the mortar breaks away with large pieces (3-4cm) of original stone, then the work must be stopped and the conservation architect notified. In this case that the mortar cannot be removed then additional instructions will be issued.

If the mortar is easy to remove, then work should progress around the area to be consolidated. Areas of urgent consolidation must be addressed first and the Portland cement mortar must be removed from the back and sides of all original stone if that stone is removed. The Portland cement mortar must be removed from an area larger than the consolidation zone in order that the new lime mortar may be 'blended' into the surrounding area. This is to prevent obvious visual 'patches' of work.

Once the mortar is removed the area must be cleaned of loose material and disposed of with water. High pressure water hoses may not be used nor an excessive amount of water.

### 4.3 STONE CLEANING

The stone is very porous and prone to collect dirt, dust, oils and fats from direct contact and from the atmosphere. Inhalation of these types of pollutants can cause surface staining and promote biological growth.

Biological growths such as lichens, algae, mosses and fungi that grow on stone walls is usually an indication that there is excess moisture in or around the stone. These growths need to be removed, as they attract moisture to the surface of the stone and keep it there, which can lead to more serious problems. Lichens and mosses in particular, produce oxalic acid which can damage certain types of historic stone.

Pure, salt-free drinking water should be used in hand-sprayed bottles and used sparingly. Only soft bristles with natural bristles are allowed along with wooden spatulas or small trowels.

Dry cleaners, bleaches and high pressure washers are not allowed. Generally, this work should be performed by an experienced contractor.

#### 4.3.1 Execution

Examine the conditions of the area to determine that the actual area to be cleared has already been structurally stabilized, re-emphasized, and all vegetation removed. Try to clean a small, invisible area to check for side effects and damage to the material. Surface preparation: Before proceeding with cleaning operations, remove all various metal materials, sinks and bird droppings from the surface to prevent any discoloration.



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REPUBLIKA E SHQIPËRISË  
MINISTRIA E KULTURËS



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Note: Cleaning will be performed by testing a small area to determine the effectiveness of cleaning methods, materials, equipment before proceeding with cleaning operations in larger areas.

The cleaning process should be slow enough to allow the operator to control the effects. The method used should not generate harmful products for stone preservation.

The cleaning method should not produce large scratches, micro fractures or changes in the stone surface. Do not aggressively clean the stone as this will cause premature breakage of the binding agents inside the stone. Do not use steel wire brushes as they can leave pieces of iron behind, which can rust and leave stains on the surface.

Given the nature of the stone and its storage status, buildings should be cleaned slowly only by hand with a threaded brush. This prevents the appearance of mould. Only a small amount of water with a hand pump can be used. The remnants of the crust can be eliminated with a brush. The amount of water to be used should be the minimum possible. Rinse the surface thoroughly with clean water using a hand pump and continue rinsing the entire surface with water. While the surface is still wet, lightly clean it with a soft, natural bristle brush. If the surface has started to dry, moisten again before proceeding and rinse the stone with clean water. Cover all areas to ensure even cleaning of the stone. Start at the top of the structure and continue to the bottom. Before applying any of the methods in general, it is necessary to test the suitability of the method in local areas. The implementation of the cleaning method should be performed by a technical specialist and monitored by the restorer.

Rolling brushes should not be used, which are rough and can severely abrasive the surface. Abrasive cleaning methods should not be used. Acid or alkali chemical cleaners should not be used. Always use the mildest cleaning tools possible.

For crushed surfaces: Remove the composition using a wooden scraper. Be careful not to corrode or damage the stone. Remove as much as possible using a stiff brush. Small amounts of waste sealing compound may remain on the surface and should be left.

Dirty and loose dust: Wash the surface with water using a sprayer with a thin spray. Clean gently as needed with a damp natural bristle brush.

Avoid soaking the stone. Rinse the surface thoroughly to prevent foggy or invisible debris which may attract dirt.

Dirt and loose dust: Wash the surface with water using a sprayer with a thin spray. Clean gently as needed with a damp natural bristle brush.

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Mould, mildew and algae: Fungal / algae growth is promoted in humid environments. This, combined with the lack of sunlight, creates favourable conditions for this type of surface staining. Eliminate excess moisture conditions. Carefully clean the surface with a natural water brush.

Mould and surface salts: Carefully clean the surface salts with a dry brush using a natural bristle brush or rinse with water. If mould comes back, carefully examine the surrounding areas to determine the possibility of leaks or water sources causing excessive moisture penetration. Eliminate sources of excess moisture and repeat.

#### 4.4 STONE REINSTALLATION

Replacing, or re-setting loose stone units - this procedure includes guidance on stabilizing or setting loose stones. Note: This procedure must be performed by an experienced mason.

Prior to delivery, submit certificates attesting to compliance with applicable specifications for grades, types and classes.

Joint Raking: Prior to raking out all areas, cut back joints at location selected by conservation architect, until an acceptable sample is achieved. This area will serve as standard for joint raking for the entire job. It will be marked and left un-pointed until all other pointing is complete. Re-point when directed by the conservation architect. It is necessary to provide detailed quality control of the materials used on site while the work is ongoing. The tests must be carried out by specialized laboratories and the assessment of the results should be done by technical experts. Therefore, samples of the stones and location from which they were taken must be submitted to the conservation architect for testing. This must be done at least three weeks in advance for determining if the stone selected is the same as stone identified in the preliminary investigations.

Sample Stone Pointing and Repair: re-point joints, re- attach stone fragments and repair stone using materials and methods specified at a location(s) selected by the conservation architect. The samples accepted by the conservation architect will serve as a standard for the entire job. They will be marked and left undisturbed. To obtain sand/aggregate that matches historic materials, have a sample analysed. Colour and texture should be closely matched to eliminate need for pigment additives which can fade and reduce strength of mortar. Environmental Requirements: No stone pointing or repair shall be performed when the air temperature or stone surface temperature is 20C and falling during and for 48 hours subsequent to laying or above 30 c.

Supply and installation of masonry of the same characteristics and size as the existing to create new buttresses, matching with the existing in the curtains and using NHL 3,5 lime mortar and aggregates in 1:2,5 ratios. Following courses of the existing wall and selecting the pieces to fit and river sand and filling the joints with the same mortar.



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An appropriate stone material that matches the present properties that are as similar as possible to the original material, such as chemical composition, colour, density, porosity, hydraulic and mechanical characteristics. With regard to the mechanical properties, it especially worth noting that a more appropriate stone material will present a modulus of elasticity that is equal or less than that of the original material.

#### 4.4.1 Execution

- 1) For Small Stones: Carefully remove small shifted and/or loose stone units. Clean of dirt, mortar, and loose debris. Retain for re-use.
- 2) Re-build support masonry and lay new bedding material.
- 3) Remove loose debris from cavity, and rinse with water to remove dust.
- 4) Pre wet adjacent surfaces with clean potable water. Re-set stone in an evenly filled bed of mortar, with full mortar coverage on horizontal and vertical joints. Maximum tolerances from plumb and level new work, not to exceed variation from plumb and level of adjacent existing work. Match existing placement, pattern and location. Note: If replacement units are required, they should match original stone in color, texture, and size, and be free from salts and other contaminants.
- 5) Construct uniform joints. Shove vertical joints tight. Adjust stone to final position while mortar is soft/ plastic. Set stone with joints tooled back 1cm.
- 6) Point remaining depth as the rest of the stone is pointed. Keep mortar and stone damp (80-90% RH) for 72 hours or until mortar is cured. For Large Stones: DO NOT REMOVE. Tightly secure large stones using wooden wedges soaked in water.
- 7) Carefully clean joints of loose mortar and other debris and re-point in place. Refer to conservation architect for guidance on re-pointing stone.
- 8) Adjusting / cleaning -At the time of repairing, patching, pointing and re- setting of the stone, immediately remove mortar, grout and adhesives from the face of the masonry. Clean stone only with fiber bristle brushes and water. Note: Use no acids, detergents or other cleaning products.

#### 4.5 LIME MORTAR CHARACTERISTICS

Must be performed by a mason having not less than five years successful experience in comparable masonry restoration projects and employing personnel skilled in the restoration processes and operations indicated. All technicians planned for use on the job will be required to successfully complete 1m of cutting and raking of mortar joints in the presence of the conservation architect



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prior to working on the job. Unsuccessful performance in this test area will be grounds for rejection of this technician for this job.

Tools: Trowels, chisels: Joint chisels or a standard mason's chisel with a 4cm blade and a long narrow handle Hammers: 5# stone dressing hammer 2# striking hammer. No-Bounce" hammer, Full size and one half size brick hammers, Joint Tools: raised beaded tool, beaded striking tool, raised beaded tool with offset handle, flat joint iron. Pointing tool should be narrower than the joint being filled to achieve good compaction. Plywood or steel mortar board, Natural bristle brushes, Stiff bristle brushes no wire brushes are to be used, Spray bottle. Water: Clean and free of deleterious amounts of oil, acid, alkalis and organic matter.

Premixed aggregates - Use of a commercial mortar with aggregates incorporated in the commercial dosage

Lime based mortar approved by conservation architect or engineer. This is a lime-based and metakaolin mortar of a whitish color indicated for the repair of masonry walls and mortar joint filling. This mortar already contains pre-mixed aggregate and it only has to be mixed with water following the instructions in the technical sheet. Its salt content will therefore remain below 100  $\mu\text{S. cm}^{-1}$ . With regard to the mechanical and hydraulic properties, the following table provides a comparison of the data from the technical sheet:

Property	Commercial Mortar	Mortar
Density	15.4 KN/m <sup>3</sup>	15.4 KN/m <sup>3</sup> (mean average)
Salts-conductivity	86 $\mu\text{S. cm}^{-1}$	907—7692 $\mu\text{S. cm}^{-1}$ (stone)
Capillary absorption	--	28.5 %
Compressive strength	7.5 MPa	1.6 MPa (mean average rejecting a high value of 7.1 Mpa)

In view of the above technical specifications, it appears that the mortar is compatible with the masonry materials, such that its use is therefore recommended. Nevertheless, it was recommended that certain tests be conducted during the works, to ensure compliance with the specifications on the technical sheet. The following tests are recommended:

Conductivity measurement once mixed. It should have a conductivity of below 100  $\mu\text{S. cm}^{-1}$ . Color. The question of color should be validated by conservation architect.



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Note: the question of color is very important in both options and must be adjusted by an experienced mason with the oversight and approval of the conservation architect or engineer.

#### 4.5.1 Execution

- The mix of the mortar

Bedding Mortar Mix Proportions: Mix by Volume.

Mixing Procedures: Measure materials by volume or equivalent weight.

Do not apply or mix mortar on outside surfaces with standing water or outside during rain. Mortar mixing should be done only in the shade; Cover mortar in hot weather to reduce evaporation.

Note: Use a known measure. Do not measure by shovel.

Mix ingredients in clean mechanical batcher for 5-10 minutes. Measure mortar and aggregate material in a dry condition by volume or equivalent weight. Do not measure by shovel, use known measure. Mix materials in a clean mechanical batch mixer.

Consistently and accurately measure materials for each batch.

Mix for at least five minutes in a mechanical batch mixer or mortar box. Mix trowel workable consistency for unit masonry setting and resetting.

Thoroughly mix mortar and aggregate materials together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix which will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 1-to-2 hours. Add remaining water in small portions until mortar of desired consistency is reached. Use mortar within 30 minutes of final mixing; do not re-temper or use partially hardened material.

- Let mortar sit for 1 hour prior to use to allow for initial shrinkage. Remix mortar to workable consistency. Use mortar within 1.5 hours of initial remixing. Discard left-over mortar. Do not remix.

Discard mortar not used within two hours after mixing; do not re-temper at mixer.

Dispose of waste mortar and cleaning water in approved manner; do not contaminate the site, adjoining property, or waste to sewers.

- Colored Mortar: Produce mortar of color required by use of selected ingredients. Do not adjust proportions without CONSERVATION ARCHITECT's approval.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRISË  
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**Color Pigmented Mortar:** Where colored mortar pigments are indicated, do not exceed pigment-to-cement ratio of 1-to-10, by weight.

Match original color and texture for each kind of mortar and masonry work. Match to inner mortar color which has been protected from weathering and soiling, not face color.

Do not use admixtures of any kind in mortar, unless otherwise indicated.

- **Field Samples:** Prior to start of general masonry restoration, prepare the following sample panels on building where directed by conservation architect. obtain conservation architect's acceptance of visual qualities before proceeding with the work. Retain acceptable panels in undisturbed condition, suitable designated during construction as a standard for judging completed work
- **Delivery, storage and handling**

**Storage and Protection:** Protect masonry restoration materials during storage and construction from wetting by rain, snow or ground water, and from staining or intermixture with earth or other type materials. Protect grout, mortar, and other materials from deterioration by moisture and temperature. Store in a dry location or on waterproof containers. Keep containers tightly closed and away from open flames. Protect liquid components from freezing. Comply with manufacturer's recommendations for minimum and maximum temperature requirements for storage.

- **Project/site conditions**

**Existing Conditions:** No stonework will be performed when the air temperature is 10 C and falling or when stone surface temperature is 10 C or below. do mix or apply in temperatures exceeding 35 degrees or when anticipated to be higher. In warmer temperatures over 25 degrees apply in the afternoon and cover with damp cloth and keep moist

## 5. MOISTURE PROTECTION AND THE ROOF

### 5.1 REMOVAL OF THE EXISTING LAYERS

One of the most important pathologies in historic buildings is, almost always, water. The presence of water is one of the most harmful factors for the constituent materials of a building, which appears in various forms, starting from the damaged roof, existing drainage systems placed incorrectly or insufficient to remove excess groundwater, near or around walls, leading to capillary action and subsequent problems.

Therefore, all water should be controlled and removed from the monument, addressing all the causes that give it the opportunity, repairing the cover, cleaning the moisture from the walls and providing a convenient drainage system that disciplines groundwater and rainwater.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRISË  
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Therefore, the existing building cover layer will be removed including all missing bitumen sheets, accumulated mud, stones or any other dirt. Existing debris should be removed from the surface by disposing of it properly.

## 5.2 CUPOLA AND ROOF RESTORATION

The steps for the implementation of restoration works are as follows:

- Realization of a levelling layer of lime mortar on the dome
- Installation of a waterproofing and evaporating membrane
- Laying the protective layer of geotextile
- Laying the cover with place tiles, with wooden slats
- Placement of gutters

### 5.2.1 Limecrete levelling layer

On the cleaned dome and on the cover of the hammam cleaned from the layers, a levelling layer of 4 cm of lime-based mortar is applied, for a surface in contact with water.

This levelling layer is applied with the mixture as: 5 Brick Powder + 4 Lime, Thickness 4 cm.

Mortar parameters as above.

### 5.2.2 Waterproof and vapor membrane

Approval of all materials is required prior to purchase, delivery and application. This includes all product data sheets and calculations, and samples of asphalt, pavement, base sheet, bitumen sheets, ignition membranes, fixing elements, primers and rolling materials. Warranty samples are important and a sample must be submitted along with certification. Sample guarantees and certificates must be submitted. Any test reports, instructions and manufacturer documentation must also be provided.

The coverage system applicant must be approved, authorized or licensed in writing by the coverage system manufacturer and must have a minimum of 3 years experience as an approved, authorized or licensed applicant with the manufacturer and be approved in a level capable of providing the specified warranty.

Wind-generated Rise Resistance - Provide a complete fitting of the roofing system that has been evaluated and installed to withstand wind loads [shown] [calculated in accordance with ASCE 7-16] and verified by wind resistance testing set-up, in accordance with the Reciprocal Factory (FM) test



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procedures. Do not install systems not rated other than those approved by the Official Contractor. Submit Wind Rise Calculations from a licensed engineer and data to test any unappreciated cover system. Base wind rise measurements at a design wind speed of 70 m / s in accordance with ASCE 7-16 and other applicable building code requirements. For the center of the roof, the pressure coefficient is  $GC_p = 1.0$ , perimeter  $GC_p = 1.8$  and angle  $GC_p = 2.8$ .

Delivery, Warehousing, and Handling - Deliver materials in original unopened containers of manufacturers and catalogs with manufacturer labels intact and legible. Mark and remove wet or damaged materials from the object. When materials have a reference specification on them, the container should have the specification number, type and grade, as appropriate. Indicate on the labels or bill of lading for the greenhouse cover, the type of greenhouse, the final swelling temperature (FBT), the flash point (FP), and the equivalent temperature (EVT). Deliver materials in sufficient quantities to allow work to continue uninterrupted.

Protect materials against moisture absorption, contamination or other damage. Avoid crushing or shredding packaged materials. Store end-packed materials on clean raised platforms in dry, enclosed spaces or towed rooms with adequate ventilation. Do not store packaged materials in changing facilities until the concrete, mortar and plaster work is complete and dry. Do not store materials outside unless approved by the Official Contractor. Fully cover the protected belts outside, above and outside the cover, with waterproof canvas protective cover. Do not use polyethylene sheet as a cover. Attach the secure covers to the pallet to make them completely waterproof and at the same time provide sufficient ventilation to prevent condensation. Maintain packaged materials at temperatures above 10 degrees C for a period of 24 hours immediately before application. Keep aggregates dry as defined by ASTM D1863 / D1863M.

Put only those materials that will be used during a working day on the cover. Remove unused materials from the cover at the end of each day's work. Immediately remove wet, contaminated or damaged or unsuitable materials from the monument. Damaged materials must be marked by the Official Contractor

Handling - Prevent damage to edges and ends of packaged materials. Do not install damaged materials at work. Select and use materials handling equipment in such a way that it does not damage the materials or coating applied.

Environmental conditions - Do not install roofing during precipitation, or fog, or when air temperature is below 4 degrees C, or when there is ice, frost, moisture or visible dampness on roof deck. Environmental conditions - Do not install roofing during rainfall or fog, or when the air temperature is below 4 degrees C, or when there is ice, frost, dampness or visible humidity on the roof deck.

Coordinate work with other professions to ensure that components to be secured or inserted into the coverage system are available and that permanent igniters and counter-igniters are installed as the work progresses. Make sure temporary protective measures are in place to prevent moisture



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



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intrusion or damage to installed materials. Install the cover immediately after applying the insulation as a continuous operation.

Warranty - Provide roof system material and workmanships that meet specified requirements. Provide revision or modification of the diaphragm manufacturer's standard warranty according to specified requirements. The roofing system installer must guarantee for a minimum period of two years that the roofing system, as it is installed, has no defects in the installation work, including roofing membrane, ignition, insulation, accessories, attachments and installation of integral foil. as a whole complete assembly of the waterproof cover system. Write the guarantee directly to the Government. The roofing system installer is responsible for correcting work defects and replacing damaged or affected materials. The roofing system installer is responsible for all costs associated with repair or replacement work.

Fall protection - Provide fall protection as defined in the contractor's safety presentation document. Seek at all times all precautions to prevent the risk of falling.

Base ignition membrane - Standard membrane manufacturer system, minimum two-layer modified bitumen membrane ignition in accordance with the constructed roof membrane and as recommended in the published literature of the membrane manufacturer. Provide a minimum base layer of ignition membrane with a thickness of 1.8 mm 70 miles. Provide a modified bitumen igniter cap sheet on the grain surface with a thickness of 3 mm 120 miles to the edge of the stream.

Belt with triangular section material - Provide standard perlite strips, wood fibers treated with bituminous impregnation, size or wax lubrication and fabricated to ensure maximum 45 degree change in membrane direction. Provide strips with a minimum thickness of 38 mm and provide minimum heights of 125 mm and 89 mm vertically when installed at a 45-degree angle to the face, unless space limits the height to a smaller dimension.

Bonds and plates- Coated, corrosion-resistant joints compatible with the components being joined and the contact surfaces. Comply with the applicable standards for fasteners for connection to the deck substrate of the Class I roof deck structure for the specified wind resistance. Use strong copper connectors in contact with copper; aluminum or stainless steel connectors in contact with aluminum; and stainless steel connectors in contact with stainless steel. For fastening, use only roof fasteners, use fixing elements directed through metal discs, or joining elements consisting of a head piece with a diameter of not less than 25 mm or square 25 mm with rounded angles or 45 degrees.

Vertical masonry surfaces - Provide rigid nails or steel screws with flat heads, diamond-shaped points and mechanically deformed straws not less than 25 mm long to secure seats, metal objects and accessories. Use power-driven fasteners only when approved in writing by the Contracting Officer.

Walkway - Provide polyester-reinforced roof supports, modified bitumen membrane material with a granular surface, with a minimum thickness of 5 mm or 200 miles, compatible with the roof membrane and as recommended by the roof membrane manufacturer. Do not exceed 1.2 meters by 4 meters in length for each panel.



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MINISTRIA E KULTURËS



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## Execution

1) Condition verification - Before placing roofing materials, make sure the following are present: Do not install items that show visual evidence of biological growth. Make sure all pastures, curbs, cans, control joints, expansion joints, etc. Surfaces are solid, clean, dry, smooth and without cracks, holes and sharp changes in height. The joints in the substrate are closed to prevent bitumen from dripping into the building or down the exterior walls. Check surfaces and approve immediately before roof application and ignition. Place roofs and burners on a smooth and firm surface, free of ice, frost, visible moisture, dirt, projections and foreign materials.

Make sure that the substrate plane does not change more than 6 mm within an area of 3 by 3 meters when checked with a straight edge of 3 meters placed anywhere on the substrate. The substrate should be sloping as shown to ensure proper drainage. Vertical walls and surfaces are built to withstand ignition and will allow mechanical fixation of the base ignition materials. The treated wood nails are in place on non-valid surfaces, to allow the base burn to be nailed to a minimum height of 20 cm above the finished roofing surface.

The strips are securely fastened in place at angles formed by walls and other vertical surfaces. The angle of the bar is approximately 45 degrees and the height of the vertical leg is not less than the nominal 89 mm. Lay the strips on a stiff asphalt cloth or asphalt cement layer just before laying the roof piles.

Any exposed nail head on wood or concrete substrate should be placed properly. Any deformed and split plank or sheet should be replaced. Make sure there are no cracks or end joints 6 mm wide or larger. Slab contraction joints should intersect at the openings for columns and should intersect at the openings for columns. There should be no moisture during start-up.

2) Preparation - Verify that the roof deck is prepared to receive coverage with the architect or conservation engineer. Check deck surfaces for inadequate anchorage, foreign material, moisture and unevenness that would prevent execution and application quality. Install protective coverings on the sidewalk and construction walls next to the risers and bins before starting work. Grasp protective covers not less than 20 cm, secure against the wind and blow to prevent moisture accumulation on the covered surfaces. Keep protective covers in place throughout the cover work.

Install bitumen stops or other means to prevent bitumen dripping at the edges of the roof, openings and vertical projections before hot application of the roofing membrane. Form two-strip bitumen stops 300 mm wide. Laminate and lay strips on a layer of asphalt half the width exceeding the edge of the roof or opening

Continue applying coverage only after defects have been corrected. Commencement of work determines the acceptance of the surfaces by the Contractor.

3) SAFETY - Flammable equipment. Do not place hot appliances on the roof. Use only open flame devices recommended by the roofing material manufacturer. Do not switch on open flame devices when left unattended.



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REPUBLIKA E SHQIPËRIE  
MINISTRIA E KULTURËS



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Provide and maintain a fire extinguisher adjacent to other rooftop fire extinguishers - at all times.

4) Surface primer - Prime the primer in the amount of 3 liters per 10 square meters or as recommended by the manufacturer of the roof membrane manufacturer to promote the adhesion of the membrane materials. Allow the primer to dry before using the membrane materials on the painted surface. Avoid flammable primer material conditions in torch membrane base ignition applications.

Filling concrete and masonry surfaces - Once the surface drying requirements have been met, coat with concrete and masonry surfaces which will get the roof and base evenly heated with primer. Allow the primer to dry before using the roofing and ignition materials.

5) Asphalt Heating - Destroy solid asphalt on a surface free of dirt and debris. Boiler heat asphalt designed to prevent flame contact with surfaces in contact with asphalt. Provide visible working thermometer and thermostatic controls located at temperature limits. Keep controls in working order and calibrated. Use a diving thermometer, accurate within a tolerance of plus or minus one degree Celsius, to frequently check asphalt temperatures. When the temperatures exceed the specified maximum, remove the asphalt from the site. Do not allow asphalt to be cut, forged or flushed.

Temperature restrictions for asphalt - Heat and placement of asphalt at the temperatures specified below, unless otherwise specified by the manufacturer's printed instructions. Use a thermometer to check the temperature during heating and application. Have the boiler constantly monitored during the heating process to ensure that the set temperatures are maintained. Do not heat the asphalt above its finished blow temperature (FBT). Do not heat asphalt between 260 and 274 degrees C for more than four consecutive hours. Do not heat the asphalt at the ignition point (FP). Lay the asphalt sheets and embedded membrane when the asphalt temperature is within plus or minus 14 degrees C equivalent temperature (EVT). Before heating and applying the asphalt refer to the label or load of the asphalt manufacturer for the FP, FBT and EVT of the asphalt used.

6) APPLICATION - Place roofing materials as specified unless otherwise approved by the Contracting Officer. Keep roofing materials dry before and during application. Except for the total surface area, complete application of the coating in a continuous operation. Start and apply only as many roofs in a day as can be completed that same day. Maintain the specified temperature for asphalt. Do not apply the total surface until the other roof application procedures specified here are completed.

Application of the base sheet - Fully glue the base sheets according to the printed instructions of the membrane manufacturer. Roll and wipe on the base sheet to ensure full contact with hot asphalt application. Apply the sheets in a continuous action.

Set side-turn sheets to a minimum of 80 mm unless a larger side bump is recommended by the manufacturer's standard application instructions. Provide end laps of not less than 150 mm and staggered a minimum of 1 meter. Place the sheets at right angles to the slope of the roof so that the direction of water flow is over and not against the turns. Extend the base sheets approximately



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REPUBLIKA E SHQIPËRIË  
MINISTRIA E KULTURËS



ATELIER 4  
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50 mm above the top of the strips on a vertical surface and on top of the strips in other places. Trim the base sheet into a clean fit around the ventilation pipes, roof drains and other projections through the roof.

The application must be free of ridges, wrinkles and fixations

**Top Textile Layer Application** - Ensure proper textile alignment before installation. Set the textile, shingle fashion perpendicular to the slope of the roof, including application to areas of conical insulation that change the direction of the slope. Drainage or wastewater parts are prohibited. Apply the textile continuously. Secure the initial sheets of textile to maintain the specified number of layers, along the cover. Place the textile, with side rolls in accordance with the printed instructions of the material manufacturer for the number of layers to be installed and in a uniform order. Lap ends not less than 150 mm and rolls at least one meter. Apply the full width of each layer to the hot bitumen immediately after the bitumen applicator. Lay layers without wrinkles, creases, ridges or cavities. Spread the fabric approximately 50 mm above the top of the strips on the vertical surfaces and on top of the strips elsewhere. Trim the layers in a neat fit around ventilation pipes, roof drains and other projections. Avoid movements on smoothed surfaces when the bitumen is liquid and for a minimum of one hour after applying the coating.

**Heat of textile layers** - Connect the layers to each other and to the base sheet or hot asphalt substrate. Lay the textile immediately after applying the asphalt. Do not work forward with asphalt. Instantly, the textiles come in contact with the asphalt, the asphalt must be completely liquid, with asphalt temperatures within the specified EVT interval. Lay the asphalt evenly on a full, continuous, tightly bonded film. Lay asphalt at the rate of approximately 13 kg per 10 square meters plus or minus 25 percent. While the textiles are wrapped in hot asphalt, immediately clean, roll or wipe down to eliminate trapped air and ensure tight and smooth laminates. smooth without wrinkles, buttons, clamps or cavities. Bitumen must be visible beyond all edges of each layer as it is installed. Install the individual layers and the finished roof membrane system without air pockets, textile removal, ridges, creases, cavities, dry laps or bubbles. Do not place dry textiles or turn them over to remove pieces between them.

**Membrane Ignition** - Provide two coats of modified bitumen membrane strip pulses and sheet ignites at angles formed where the roof deck supports walls, curbs, fans, pipes and other vertical surfaces, and when necessary for them made waterproof work. The main ignition layer should be modified bitumen membrane with granular surface. Install the ignition after the coating surface has been applied. Cut at an angle of 45 degrees to the entire end-to-end area of the lid membrane before applying the adjacent lid membrane membrane.

Press the ignition in place to ensure full adhesion and to avoid overtaking. Provide full throughput seal in all throughput areas. Mechanically fasten the upper edge of the base by pushing 150 mm in the center through tin caps with a minimum diameter of 25 mm with fixing elements of sufficient length to insert a minimum of 25 mm into the bonding substrate. Place the membrane lining on top of the exposed nails and lock and overlap the upper edge of the base ignition installation on



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REPUBLIKA E SHQIPËRIE  
MINISTRIA E KULTURËS



ATELIER 4  
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the curbs, parapet walls, expansion joints and as otherwise indicated to serve as a waterproof lining under the ignition components of the sheet.

**Strip ignition** - Place the first flanges of the foil burners to be included in the roofing system in a uniform layer of asphalt roof cement no less than the thickness applied over the textile layers. Stripping with a smooth surface of the modified bitumen membrane and cap with the modified bitumen membrane on the granular surface. Place the strip that ignites on the hot asphalt on the tops of the flanges, the cover membrane and each other. Use asphalt cement coating no less than thick for felt in the coating. Use hot asphalt or modified bitumen cement for modified bitumen sheets. Extend the first strip of stripping not less than 100 mm beyond the outer edge of the flange to the roof membrane. Extend each additional layer 100 mm beyond the edge of the previous layer.

**Membrane ignition in roof drain** - Extend the cover plates to the edge of the drain bowl opening in the roof drain deck flange. Fit neatly and press the primary roof drain by heating on the heavy layer of asphalt roof cement applied on top of the roofing tiles. Strip and completely cover the ignition with two coats of modified bitumen sheet, extending the first sheet 150 mm to the roof beyond the edge of the ignition. Extend the cover sheet 150 mm beyond the previous ignition layer. Connect the two layers with the ignition metal and with each other with hot asphalt. Securely fasten the diaphragm, metal ignition and ignition strip to the ignition fixing ring. Grasp the safety so that the ignition of the bar and the ignition of the metals are free from wrinkles and folds. Trim the membrane, ignition and undress with the inside of the tightening ring.

**Lightning protection** - Flash or attach lightning protection system components to the roof membrane in a manner acceptable to your roof membrane manufacturer.

7) **Roof access roads** - Install access roads at roof entry points and where otherwise indicated for movement areas and access to mechanical equipment, in accordance with the modified bitumen roof manufacturer's printed instructions. Provide a minimum separation of 150 mm between the adhesive walkways to accommodate drainage. Secure the passage block under the prefabricated concrete blocks to protect the cover.

8) **Granules** - Modified bitumen cover sheet - Inspect the applied base membrane and repair without damage, holes, punctures, cracks, scratches and any other defects, and without moisture, loose materials, debris, sediment, dust and any condition other required by the membrane manufacturer prior to installation of the cover sheet. Provide artificial cleaning and drying with fan or hot torches to ensure a clean, dry surface before applying the lid sheet. When delays in the installation of the cover sheet may have occurred, do not apply the cover sheet if the base materials have been exposed to rain or frozen precipitation within the previous 24 hours. Move the cover sheet membrane and allow it to relax for at least 1 hour before installation and as otherwise recommended by the membrane manufacturer. Apply the lid sheet in the same direction as the base felt creases. Align the cover membrane and apply with a minimum lateral turn of 75 mm and a final turn of a minimum of 150 mm and as otherwise required by the membrane manufacturer. Place the lid sheet on the hot asphalt. The cork sheet may be applied with the approval of the Contracting Officer and the written approval of the manufacturer of the felt membrane, and as



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REPUBLIKA E SHQIPËRISË  
MINISTRIA E KULTURËS



ATELIER 4  
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recommended by the modified manufacturer of the bitumen membrane. Cut at an angle of 45 degrees to the entire edge of the lid membrane stream to overlap the end areas of the lap before placing the overlapping lid membrane. Minimize traffic to the newly installed cover sheet membrane.

9) Correction of deficiencies - Where any form of deficiency is found, take additional measures to determine the extent of the deficiency and perform corrective actions as instructed by the architect or conservation engineer. Where cross-linking is very easy, apply two coats and proceed with the asphalt password. Apply with side and end laps 100 mm. When free water, excesses, excess voids, dry laps or any form of delamination are detected between the layer, remove and rebuild the affected area. Correction of inadequate layer number, inappropriate lane width, or non-uniform or excessive asphalt removal should be done as directed by the architect or storage engineer.

10) Cleaning - Remove debris, debris, containers and debris and other debris resulting from installing the roofing system from the workplace every day.

Applied cover protection - Do not allow storage, walking, rolling and transporting vehicles directly on the applied roofing materials. Provide temporary wooden walkways, runways and platforms, runways or clean smooth planks, as necessary to avoid damage to the applied roofing materials, and to distribute the weight in accordance with the living load load limits of the building. roof. Use tired rubber fittings for roof work.

11) Field quality control - Perform field tests in the presence of the architect or conservation engineer. Notify the Contracting Officer one day before the tests are performed. As the cat work progresses, perform visual inspections to ensure compliance with the specified parameters. Furthermore, verify the following: The equipment is in working order. The measuring devices are accurate. The materials are not installed in adverse weather conditions. Substrates are in acceptable condition, in accordance with the specifications, before the application of subsequent materials. Nails and locking are provided where and as needed. Proper number, type and space of fasteners are installed. The materials comply with the specified requirements. All materials are properly stored, treated and protected from moisture or other damage. Asphalt is heated and applied within the specified temperature parameters. Hot asphalt application is provided uniformly for void coverage and as needed to ensure complete adhesion of materials. The materials are laid in place while the asphalt is within the specified temperature range. The appropriate number and types of installations are installed, with the specified overlaps. The applied membrane surface is inspected, cleaned, dried and repaired as needed before installing the cover sheet. The membrane is free of ridges, wrinkles, cramps, cavities, or other voids or layer removal. The installer adheres to the specified and detailed application parameters. Associated violations and foil are installed in a timely manner, in accordance with the specified requirements.

12) Gutter Test - Once the cover system except the surface has been completed, perform the following gutter and roof test for moisture. Place the gutter and fill with water at the edge of the drain pipe for 8 hours. Do not close the overload secondary gutter at the same time as the adjacent primary gutter. To ensure a little drainage from the roof, do not try all the drains at once. Measure



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MINISTRIA E KULTURËS



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the water at the beginning and end of the trial period. When precipitation occurs during the test period, repeat the test. When the water level drops, remove the water, dry it thoroughly and inspect the installation. Repair or replace the drain cover to ensure a properly installed waterproof seal. Repeat the test until there is no water leakage.

12 months after the completion of the roofing system, the Contractor must inspect the roof surface for any leaks. When IR inspection indicates moisture interference, replace any damaged or defective material or construction in a way that ensures waterproof construction and maintains the specified roof system warranties.

### 5.2.3 Gutters

The water drainage system will be dug horizontally and then down vertically.

This will be made possible through a system of gutters, sheds, collection boxes, pins or nets to prevent the leaves as well as the discharge hole. this section will describe the specifications for these elements.

Accumulation of materials to prevent deflection, bending, and corrosion, and to provide ventilation. Slope materials and components to ensure drainage. Avoid contact with materials that cause staining or staining.

Do not place gutters or spill materials during inclement weather. do not place gutters or spill materials on wet or frozen surfaces.

Perform works to industry standard. Verify field measurements before fabrication. Supply of metal components against corrosion with a 5-year production warranty and with an additional warranty for installers for 5 years against the failure of the fixer, water penetration into the joints or non-drainage.

Vertical cast iron gutters, galvanized ignition, anchors, partition bolts and clamps. The downstream is to have a catch bucket at the top to get water from the horizontal under the ladder and a cast iron boot at the bottom to divert the water force to the catchment basin. Under this a spray block will be installed and the soil will be removed.

Form sections as shown in the Drawings, with the correct size, square and without distortions or defects. Limiters, profiles and other metal components of the same material as the metal gutter parts. Provide exposed metal surfaces with the same finish as the exposed face of the metal roof panels. Produce belts of compatible material such as gutters, to join the gutter. Create expansion joints / clamps from the same material as the gutter that is interlocked with the gutter by mechanical fixing or welding. Form gutter and flow sections into the longest practical lengths or on single-length sheets when possible.



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MINISTRIA E KULTURËS



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Provide expansion joints (sliding joints) in gutters exceeding 20 m in length. The flange of the side roof channel should extend continuously upwards into the bandage or wall and terminate below the edge of the drainage point or gravel stop. When this is not possible, the flange should be wrapped with flat foil starting below the edge of the roof wrapper or drip edge and rotating over the sloping flange of the rear channel. The rear gutter flange should be flat, when placed on the vertical stand, glued with silicone. The joint layer of corners is sewn for rigidity, sealed with glue.

Install the gutter connections according to the manufacturer's warranty requirements. Bonds can be: Joined or closed with adhesive. The bottom spout joints of the gutter should be joined or tightened with bolts and should be closed with adhesive.

### 5.2.3.1 Execution

- a. Roll-shaped gutter: Join the lengths with the formed closed layers AND fasten them mechanically so that they are waterproof. Mark and seal gutters on spills and accessories.
- b. Install according to the manufacturer's instructions. If there is a conflict between the subcontract documents and the manufacturer's instructions, comply with the strictest requirements.
- c. Slopes gutters minimum 1/8 inch per foot, preferably 1/4 inch per foot.
- d. Connect the leaks to the gutter element [boots] or [shoes] at 20 cm above the ladder, attach the waterproof connection.
- e. Install gutters 10 cm below the slope of the roof at the outer edge. Attach the gutters to the structure via straps and by direct fixing through the profile. Fasteners and belt ties should be placed a maximum of 30 cm in the center. Connect the leaks to the gutter elements [boots] or [shoes] at 20 cm above SCALE, join the waterproof adhesive.
- f. Find spills in drawings or as directed by RESTAURANT ARCHITECT or ENGINEERING. Fastening strap in leaks with a maximum of 40 cm in the center. Do not localize backwater runoff by creating a traffic problem at pedestrian crossings
- g. Place drainage blocks under the estuary or at the water collector on a flat roof or one step below where applicable. Make sure in place. Place spray blocks under the spout and secure with earth or pegs. Scale the flowing soil in the drainage area. provide barriers to downstream spills, stones with a nominal diameter of 20 cm secured at the site where the adjacent soil rate exceeds 5 percent, or where the volume and velocity of the outlet will cause.

## 6. PAINTING

### 6.1 LIME WASH



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Lime wash is a compatible and effective material for surface covering of historic buildings. It allows the building materials to breathe and can be applied in a number of coats. Several coats allow a natural depth of finish that can cover a variety of substrates. It can be colored through the use of pigments and is materially inexpensive.

As per the lime mortar specifications. Submit sample of lime wash and color pigment. Pigment to be submitted for color and type and mixed in accordance with the manufacturer's instructions. conservation architect to select and approve final colour.

### 6.1.1 Execution

- 1) All surfaces must be sound, clean, dry and free from dirt, grease and other contamination. Flaking or peeling may occur if painting over weak paint layers. If mold is present, the surface must be cleaned. Cracking or loose subsurface material must be repaired and filled with a lime-based mortar and filler. New plaster application must be significantly cured.
- 2) New substrates the lime wash can be applied directly. Unsound surfaces- any loose particles, dust, dirt, lichen, and grease must be brushed or washed off. Fungal or algal contaminated surfaces must be cleaned
- 3) Create a test area 5 square meters to verify color and application for approval by the conservation architect.
- 4) Pigments in powder form are best mixed with hot water to aid dispersal. The amount of pigment needed depends on the required intensity of color, with an average ratio of 20:1. Verify with manufacturer with approval of conservation architect.
- 5) Mix Lime Putty. Use a trowel to make sure the pre-mixed lime putty is sufficiently mixed to a thick, creamy consistency. Transfer to a clean bucket
- 6) Add water slowly to the lime putty. The ratio of water to putty may be 50:50, or even greater depending on its original consistency – verify after tests and with conservation architect. Mix the lime putty and water with a stirring paddle until the mixture is thin and creamy in consistency. Flaxseed oil maybe added, especially for exterior use (the oil aids adhesion and durability). As a guide, use a ratio of 12:1 This dilution of lime wash with water must suit site conditions. It could be between 10 – 30% but could be up to 100% depending on the surface.
- 7) Add pigment mix. Pour the mixture through a sieve and into a second bucket (image 1). Add the colored pigment at this stage, again mixing it together with a stirring paddle. Mix thoroughly and frequently during application.
- 8) Spray with water an area of approximately 3m<sup>2</sup> at a time until the surface is damp but not running with water. Lime wash must be applied to a freshly dampened surface. Lime wash should never be applied to a dry surface, as this will cause rapid drying out of the lime wash and result in dusting. Old lime wash, cob, and lime plaster will need more dampening down than harder surfaces.



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MINISTRIA E KULTURËS



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9) The lime wash should be applied in several thin coats. Apply with a long haired or masonry paint brush. Apply beginning at the top of the wall in a criss-cross pattern working down vertically. Ensure the lime wash is applied as evenly as possible and is well worked into any cracks and joins, but not allowing it to build up too thickly at any point or it will craze on drying out. Avoid losing a wet edge as you move to the next area, damping as applied. Even out using a criss-cross pattern working from the top to the bottom. Do not apply lime wash in very damp or wet, windy conditions, direct sunlight, or if there is danger of frost for several weeks after the lime wash has been applied.

Do not apply too much to cause drips

10) Do not apply in temperatures below 10°C or ABOVE 25°C. Colors in Lime wash vary according to the surface they are applied to. Certain colors may appear up to 10 shades darker when wet. Ensure the right colour is selected prior to application. When more than one tin of the same colour is to be used ensure that batch numbers are identical or intermix before use. Stir well before and often during application. Dampening down is very important for a good finish.

11) For subsequent coats allow the previous coat to dry out completely overnight. Lightly dampen down with water the previous coat before applying the next. A minimum of three coats should be applied: more on new external surfaces or when changing colour. After the initial drying out, lime wash will continue to harden and strengthen for several weeks.

12) Clean up: Clean brushes and rollers with warm soapy water. Lime Putty made from slaking fine quality quicklime, water and colored pigments.

13) Storage: This product is caustic but not flammable. It must be protected from frost and kept in a cool dry place between 5-20°C. It will settle out if left standing. Stir to reconstitute.

14) Disposal: Though water based, please do not dispose of into watercourse. Waste materials must be disposed of properly.

15) Final finish to be approved by conservation architect. Additional coats may be required to make a more uniform surface.

Note that colors in Lime wash vary according to the surface they are applied to. Certain colors may appear up to 10 shades darker when wet. Lime renders can vary dramatically in porosity, leading to patching, this is more pronounced when using darker colors. Therefore, lime wash requires a MINIMUM OF THREE COATS to build up opacity and even out irregularities in tone.

This product is irritating to the skin (R38). Ensure good ventilation during application and drying. Avoid contact with skin and eyes. In case of contact with eyes, immediately bathe the eye with running water for 15 minutes and seek medical advice. After contact with skin wash immediately with plenty of soap and water. Keep out of reach of children.



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22644-001\_ALB\_EU4C\_RFP\_01 - "Sigurimi i Konsulencës për Shërbimet e Projektimit për Projektin EU4CULTURE - Mbështetje për rijetëzimin e siteve dhe monumenteve të trashëgimisë kulturore të prekura nga Tërmeti në Shqipëri."



REPUBLIKA E SHQIPËRIE  
MINISTRIA E KULTURËS



ATELIER 4  
ARCHITECTURE • ENGINEERING • CONSULTING

## 7. FIXTURES RESTORATION

### 7.1 DOORS AND WINDOWS

Provide shop drawings for each type of window, including scale wall elevations, typical unit elevations, glazing details, and full-size details of typical composite members, include window rehabilitation, steel hardware, double re-glazing details and weather stripping. The conservation architect or engineer reserves the right to require additional samples that show fabrication techniques and construction and design of hardware and accessories.

Installation of windows shall be completed after historic masonry wall conservation to allow the evaporation of excess moisture. BUT before doing any interior final finish work to insure weather-tight integrity of interior spaces.

Air Infiltration Resistance: When tested in accordance with ASTM E 283: a. Operable Windows: Maximum of 0.37 cfm/ft of crack length, with pressure differential across the window unit of 6.24 psf (50 mph). b. Fixed Windows: Maximum of 0.06 cfm/sq ft. 2. Water Penetration Resistance: No uncontrolled leakage when tested in accordance with ASTM E 331 using a differential static pressure of not less than 6-24 psf. 3. Load Bearing Strength: Capable of withstanding minimum uniform inward and outward pressure of 30 psf when tested in accordance with ASTM E 330.

Fabricated by a firm or individual with more than 10 years' experience in the custom manufacturer of similar types.

Restoration, fabricator to protect windows and doors during shipment or on site fabrication. Store in a secure, dry place until installation.

#### 7.1.1 Execution

- 1) Inspections of all openings for door and window as shown in the drawings. Conduct an opening-by-opening survey to determine existing conditions, sizes, and identify the specific work needs of each window. For each window type, the survey should include color photographs which show design details for comparison to new work, and existing conditions. Full frame views, both interior and exterior. Close-up views of typical details, both interior and exterior.
- 2) Cleaning of the openings may be necessary depending upon the scheduling of other aspects of the work.
- 3) Submit sample materials to conservation architect for approval. Fabricate a mock up window and door of each type.
- 4) Thresholds to be treated for masonry consolidation, moisture protection, and positive drainage away from the window. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with treated wood, cementitious, or dissimilar materials.



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- A) Install doors, windows, test operation and oil hardware. Repair any damages since transportation from workshop. Reinstall windows and doors in their original location. Inspect proper operation pull chains and weights at. Lubricate all working parts to assure smooth operation. Doors and windows to be hung plumb and level. Provide weather stripping as required.
- B) Set windows plumb, level and true to line, without warp or rack of frames or ventilators. Anchor units securely to surrounding construction with approved fasteners. Install glass in accordance with Section 08800, to glazing method required to achieve performance criteria. Install thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier. Coordinate attachment and seal of perimeter air and vapor barrier materials. Seal exterior joints between the windows, trim and mullions.
- C) Adjust hinges, sets, hardware, locksets, lubricate all hinges.
- D) Maintain protection and other precaution required through the remainder of construction period to ensure that newly rehabilitated window units will not be damaged throughout the remainder of any restoration or rehabilitation work.