



Contract No. / Nr. i Kontratës

CONTRACT NO. C36576

“Full design preparation of façade mosaic restoration of Albania’s National Museum of History”

KONTRATA NR. C36576

“Restaurimi i mozaikut "Shqiptarët" në fasadën e Muzeut Historik Kombëtar”

Client / Klienti



Trans Adriatic Pipeline AG

Beneficiary / Përfituesi



**Republic of Albania, Ministry of Culture, Institute of Monuments of Culture
Republika e Shqipërisë, Ministria e Kulturës, Instituti i Monumenteve të Kulturës**

Design team / Grupi i projektimit



ATELIER 4
ARCHITECTURE & CONSULTING STUDIO

Rr. e "Kosovarëve", Ndërtesa 35, Hyrja 6, Ap.4/1,
Njësia Administrative Nr. 5, 1019, Tiranë, Shqipëri
tel: +355 4 24 30 195 / 4 22 22 804
fax: +355 4 24 30 194
mobile: +355 69 20 38 958
e-mail: info@atelier4.al
web: www.atelier4.al

ATELIER 4
ARCH. ALBAN EFTHIMI

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Revision / Rishikim	Date / Data	Project phase / Faza e projektit

Table of contents

1.	GENERAL DESCRIPTION AND OBJECTIVES	3
1.1.	Short Introduction	3
1.2.	General Objectives	3
1.3.	Project Goals	3
1.4.	Legal framework.....	4
1.5.	Legal Status	4
2.	MOSAIC CONSERVATION STATE	5
2.1.	The history of the Historical National Museum building	5
2.2.	The building of the Mosaic in the Historical National Museum façade	5
2.3.	Mosaic scenes interpretation.....	8
2.4.	Interventions / modifications performed at the mosaic during its lifetime.....	4
2.5.	Structural links - Mosaic retaining structure.....	6
2.5.1.	General structural system of the "National Museum of History"	6
2.5.2.	Mosaic's retaining structure calculations, as part of section "C" of the NHM	8
2.5.3.	Mosaic structural elements	19
2.6.	Analysis of rainwater drainage system and the influence on causes of degradation of mosaic.....	25
3.	DETERIORATION ANALYSIS	29
3.1.	Deterioration analysis of the mosaic.....	29
3.2.	Deterioration analysis of retaining structure	33
3.2.1.	Deteriorations of the general structure.....	33
3.2.2.	Deteriorations of the Mosaic's structural elements	36
3.3.	The analysis of the deterioration of the rainwater discharge system.....	39
4.	RESTORATION INTERVENTIONS.....	44
4.1.	Restoration - rehabilitation interventions in the rainwater drainage system	44
4.1.1.	Proposed interventions for rainwater and humidity regulations	44
4.1.2.	Waste water discharge system - Technical specifications	48

4.1.3.	Roof layers	51
4.1.4.	Roof layers – Technical specifications.....	51
4.1.5.	Skylights	52
4.2.	Restoration intervention- Retaining structure	54
4.2.1.	Proposed interventions in the general structural system.....	54
4.2.2.	Proposed interventions in mosaic support panels.....	54
4.2.3.	Retrofitting of the support panels - Technical specifications	56
4.3.	Restoration interventions – the mosaic	60
4.3.1.	The mosaic - Detailed phases of restoration work	60
4.3.2.	The mosaic - Technical specifications	65
5.	MOSAIC MAINTENANCE PROGRAM	72
6.	SITE WORKS SCHEDULE	73
7.	HEALTH AND SECURITY ENVIRONMENT (HSE)	75
7.1.	General considerations	75
7.2.	Scaffolding.....	78
7.2.1.	Scaffolding possible problems	79
7.2.2.	Choosing the proper scaffolding type.....	79
7.2.3.	Scaffold overload	80
7.2.4.	Dangers while working on scaffolds	81
7.2.5.	How we should be protected?.....	81
8.	IMPLEMENTATION BILL OF QUANTITIES	Error! Bookmark not defined.
9.	TECHNICAL ANALYSIS OF PRICES	82

1. GENERAL DESCRIPTION AND OBJECTIVES

This technical report, regarding the Conservation State of the "Shqiptarët" Mosaic, and respective needed restoration interventions, has been compiled due to the common investigation work of all the Experts, in order to clearly identify the main issues that the Mosaic faces actually. This technical report is fully based on the ToR document, issued from the Institute of Monuments of Culture.

1.1. Short Introduction

The Historical National Museum, is located at the main square in the very city center, at the "Skënderbej" square. It is the main museum institution in Albania. It has been constructed in 1981, according the project that has been compiled by a group of experts from the fields of history, linguistic, archaeology, ethnography, architecture and art. It has been three years of strictly organized work between these experts in their respective sections; from the beginning of the construction until the museum opening to the public.

The Historical National Museum, including its Mosaic on the southern facade, has been declared as Cultural Monument of the II Category, by the Decision no. 122, date t. 05.03.2007 of the Ministry of Tourism, Culture, Youth and Sports.

1.2. General Objectives

The aim of this project is the restoration of the "Shqiptarët" mosaic, in the main facade of the Historic National Museum, in order to preserve and consolidate a Cultural Monument of outstanding values. This project will address all the needed interventions all over the mosaic, it will address also the cause of its deteriorations, in order to re-highlight the Mosaic Values and prolong its life.

1.3. Project Goals

The main goal of this project is the restoration of the "Shqiptarët" Mosaic at the southern facade of the Historical National Museum and the rehabilitation of the roof drainage system. The implementation of this project is expected to qualitatively improve the "Shqiptarët" mosaic. This project's aims are:

- Restoration and Conservation of the Mosaic;
- Improvement of the rainwater roof drainage system (mainly at the rooftop and vertical rainwater downpipes);
- Upgrade the main facade, the Mosaic.

1.4. Legal framework

The project for the Restoration of the mosaic at the Historical National Museum facade will be complied in full accordance to:

- Law No.27/2018, "For Cultural Heritage and Museums";
- Principles of the "Albanian Restoration Charter", DCM No.426, 13.07. 2007;
- DCM No. 582, date 3.10.2018" *For the definition of the Historical center of Tirana, definition of its buffer zone and approval of its protection, preservation and administration"*

1.5. Legal Status

The Historical National Museum, including its Mosaic on the southern facade, has been declared as **Cultural Monument of the II Category**, by the Decision no. 122, date. 05.03.2007 of the Ministry of Tourism, Culture, Youth and Sports.

Beside the Status of Cultural Monument, the Historical National Museum is also part of the Historical Center of Tirana.

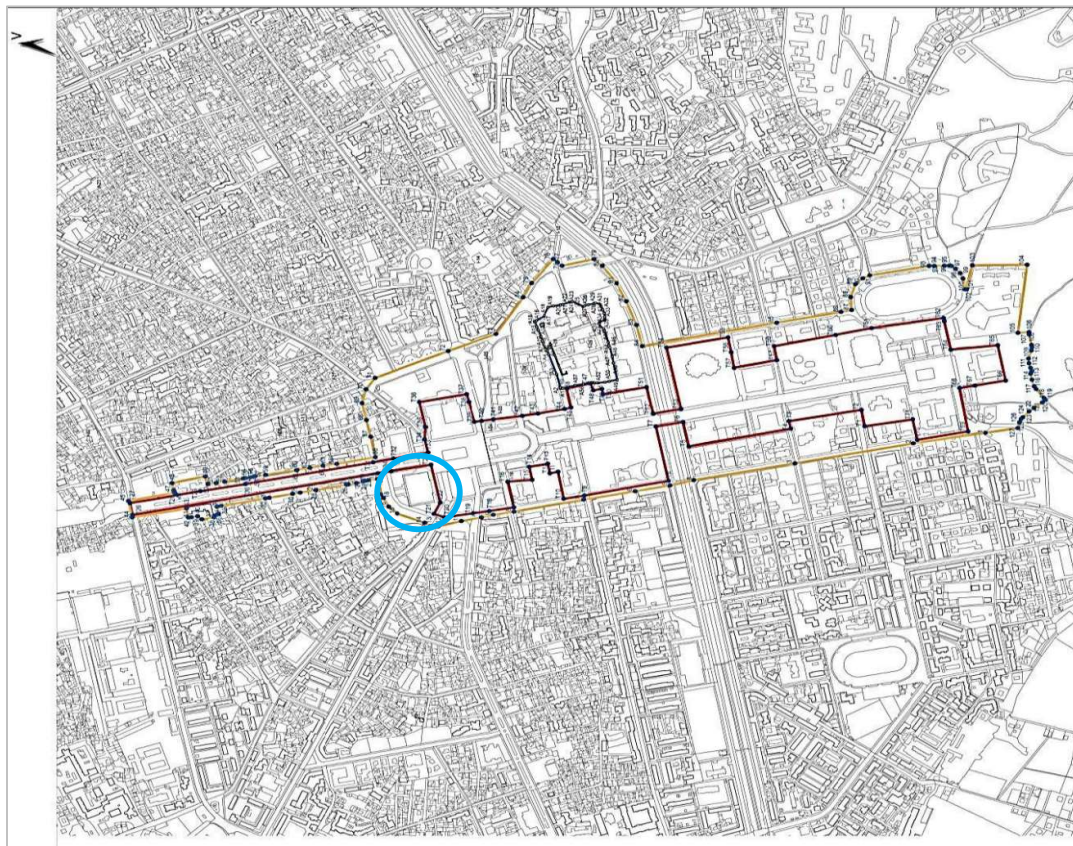


Fig. 1 – Historical Center of Tirana and its Buffer Zone Boundaries

2. MOSAIC CONSERVATION STATE

2.1. The history of the Historical National Museum building

The building of the Historical National Museum has been built on 1981, according to a project prepared from a group of specialist from a wide range of fields. The working group has been directed from eminent personalities as: Aleks Buda, Stefanaq Pollo, Selami Pulaha, Skënder Anamali, Emin Riza, Burhan Çiraku, Kleanthi Dedi, Iljaz Goga, Rrok Zojzi, Abaz Dojaka, Ramadan Sokoli, Enver Faja, Nina Shehu, Vilson Kilica, Fatmir Haxhiu, Myrteza Fushekati, Met Deliu, Aleksander Meksi etc. The location of the Historical National Museum has been decided in accordance of an urban plan of the City Center, prepared in 1976 from the Institution of Urban and Architectural Design Studies, which later has been approved from the Political Bureau of the political Party-State. Built in the communist regime style, the museum line has been foreseen based on the isolation of Albania, manifesting its liberation and its multiple battles during the centuries. The political message that the Historical National Museum aimed to spread, was one of the most successful decision which was in total accordance of the Enver Hoxha's aim for the "defense of a country surrounded by the enemies".

Nowadays, in 2019, the Historical National Museum should reflect and tell the history of our country in a new perspective, by highlighting the Albania's wide diversity in geography, habitat and its cultural achievement, including everyday aspects, its people's values and life lessons.



Fig. 2 – Full frame of the mosaic in the Facade of the Historical National Museum

2.2. The building of the Mosaic in the Historical National Museum façade

The "Shqiptarët" Mosaic, has been installed on the main facade of the Historical National Museum, at its southern facade precisely, which is faced toward the "Skënderbej" square.

After the construction of the Historical National Museum building, begun the works for the executing of the Mosaic. The authors were: Vilson Kilica, Josif Droboniku, Agim Nebiu, Anastas Kostandini, Aleksandër Filipi.



Fig. 3 - The authors initials

At the upper part of the columns of the southern facade colonnade, starting from the highest level, 21.30m and going down toward the ground level, there are mounted the armed concrete panels, which would serve as the main support of the mosaic. There are 15 concrete panels, 11x2.5x0.2 m large. These panels have been preliminarily produced at the "Josif Pashko" construction factory, in Tirana, and from there they have been transported to be mounted in the Historical National Museum facade. They are mounted at the HNM facade by welding them at some specific points (metallic tiles), the position of which had been preliminarily designated spots at the columns of the southern facade colonnade. After the installation of each concrete panel, there had been applied a flattening layer of cement +river sand plaster. This layer filled the joint gaps between every two panels and also made possible a flat surface, over which latter would be placed the Mosaic.

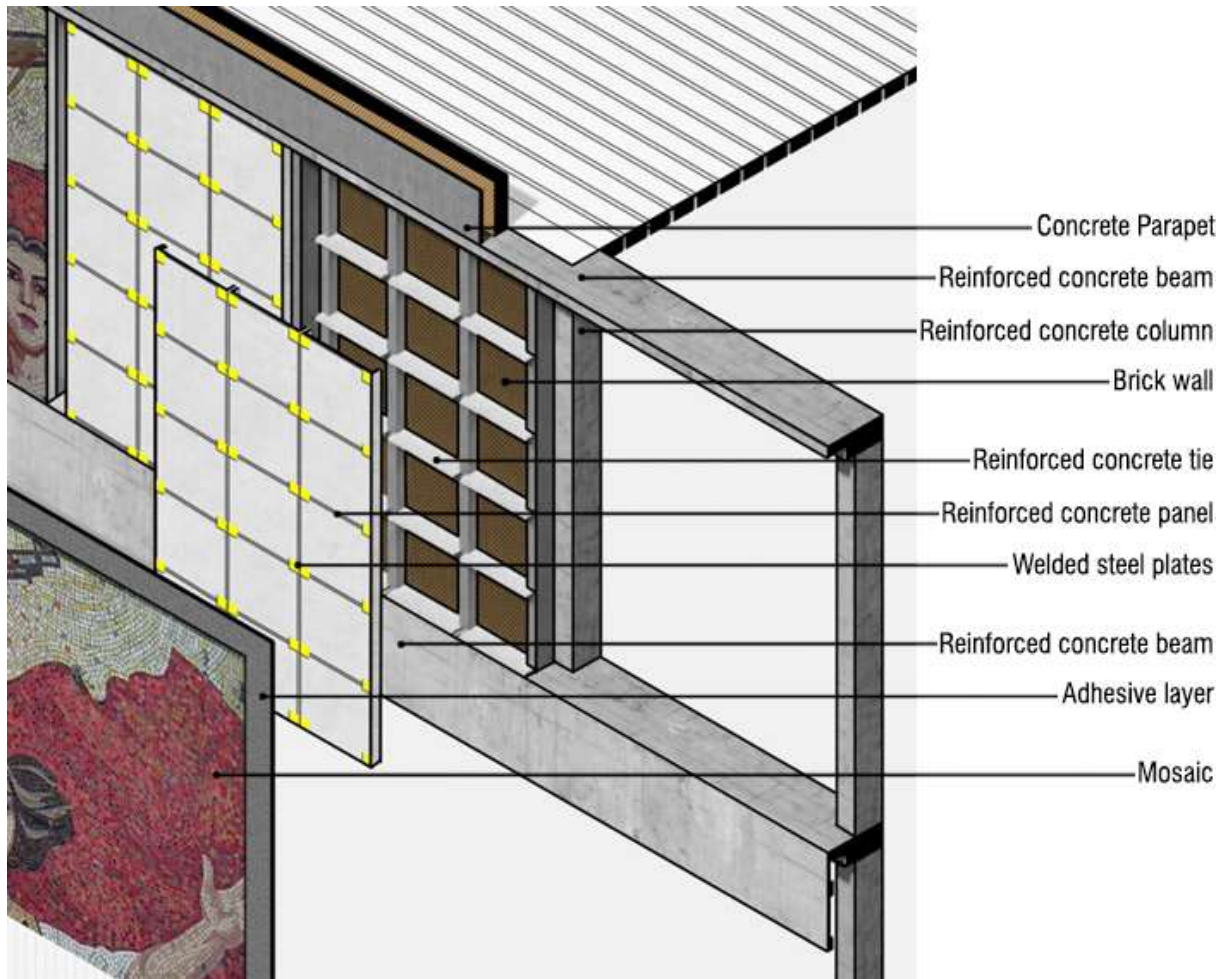


Fig. 4 – Illustration of mosaic construction layers

The mosaic had been preliminarily prepared in the atelier at one of the schools in Tirana (at "Fan Noli" school). First, the mosaic has been designed on paper in scale 1:1, over which there was applied a glue layer. After this process, the paper had been cut into small fragments, 40x40 cm or 50x50 cm, in order to facilitate the transport and the placement of the mosaic at the facade of Historical National Museum. Cutting the paper into small fragments, was a special process which had to take into consideration the scenes of the mosaic, in order not to make a cut in some important figures, like portraits or important details. After the cutting process, on each fragment there has been glued (on the reverse side) the mosaic tesserae; this was the final process that was done at the atelier. These fragments, which were in fact created as the negative of the mosaic, were transported and then fixed at the facade of the Historical National Museum. The fragments were fixed over the flattening layer of plaster, using another layer of cement plaster.

The mosaic tesserae had been produced from glass pulp material, in a specialized company in Venice, Italy. The dimension of tesserae is approximately 3~3.5 cm wide, 4~4.5 cm long and 0.25~0.5 cm thick.

The process of the mosaic's tesserae production at the Venice mosaic factory

First it needs to be prepared the glass pulp and then it needs to be spread into layers 2.5~5 mm thick. In this temporal condition, the glass pulp layer, is red, which is also temporary. The specific color of the tesserae is achieved after the hardening process in the hardening ovens. After this process, the hardened glass pulp layer, is cut into small tesserae. The cutting process gets done by diamond clippers.

After these two processes; production of the tesserae in Venice, transport and then preparation of the mosaics negatives; the fragments were mounted on site. The site work processes there has been performed by the construction workers that worked on site for the construction of the Historical National Museum building.

2.3. Mosaic scenes interpretation

At the beginning of the construction works for the Historical National Museum, the authors of the mosaic were introduced to the mosaic projection work (Terms of Reference), which was previously analyzed and approved by the Political Bureau of that time. According to the mosaic's ToR, the mosaic should have reflected the History of Albania, in a synthesized way, from the antiquity up the communist era.



Fig. 5 – The left fragment of the Mosaic, the scene which represents different historical period, from Illyrian until the national renaissance

The right half of the mosaic has been dedicated to the National partisan war for the Albania deliverance, during the world wars. This period is represented in the mosaic by 4 different people figures, standing at the right part of the mosaic.



Fig. 6 – The right fragment, the scene that represents the national partisan war

At the center part of the mosaic there are three different people figures, two men and one woman. The woman figure, represents the Albanian woman of the communist era; strong woman (symbolized by the gun that she holds in her right hand) and friendly woman at the same time (symbolized by her left hand that stands wide opened, which reflects hospitality). The woman in the center, wears one of the best known Albanian traditional garments, the Xhubleta.

At the right side of this woman, next to the partisans' figures, can be seen a man holding a gun and the national flag. This character, once again represents the partisan of the national deliverance war, but also through the flag, he represents the precise time of Albanian Deliverance, in 1944.

At the left side of the woman, stands a man in working clothes, whom represents the socialist work individual of the time right after the deliverance until the time of Historical National Museum construction.



Fig. 7 – The central fragment of the mosaic, the scene that represents the albanian woman and man of the communist era and the deliverance partisan

2.4. Interventions / modifications performed at the mosaic during its lifetime

Since the construction time, until today, no restoration or maintenance interventions has been performed on the "Albanian" mosaic.

The only one intervention done on the mosaic, is the one performed during the first years after the communist state collapse. These interventions aimed to change/remove some communist symbols. Since then, the mosaic bears the same scenery.

- The star symbol has been removed from the flag; it used to stand right above the head of the woman in the center of mosaic;
- There has been modified also the figure of the man representing the worker of the communist era. In the original mosaic this man, hold a book in his right hand. This element has been removed and the figure has been adopted making the character looking like he is holding his jacket over his shoulder.

These modifications are done by one of the authors of the original mosaic.



Fig. 8 – Fragment of the mosaic, highlighting the areas where has been done the symbols modifications



Fig. 9 – The mosaic before '90

2.5. Structural links - Mosaic retaining structure

2.5.1. General structural system of the "National Museum of History"

The primary structure of "National Museum of History" is reinforced concrete 3D frame with shallow foundations. Most of the beams and slabs are precast, with the others being concreted in situ.

The existing project of the structures, of which the museum is comprised of, dates back to 1980. The primary structure consists of 4 different substructures, each divided with fugue from one another. They were designated in the existing project as substructure A, B, C, D.

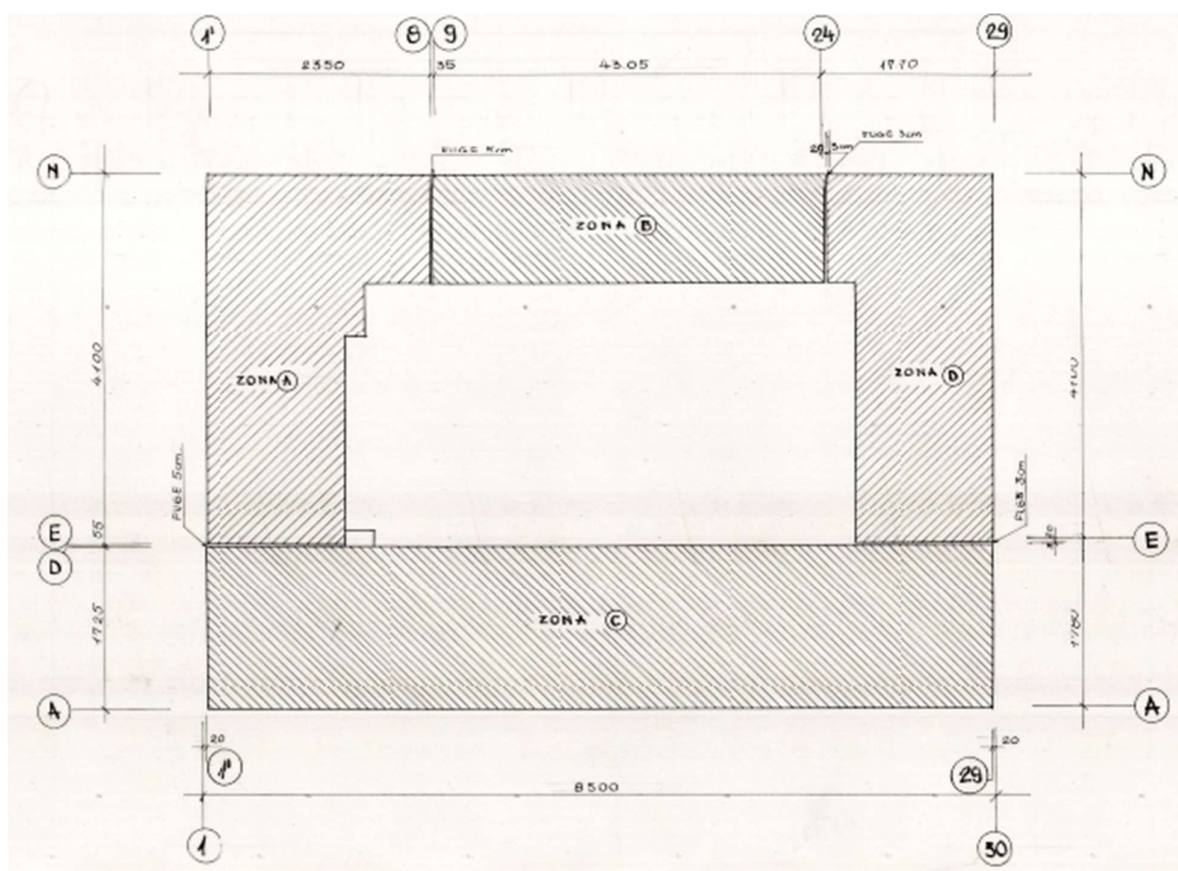


Fig.10 - Substructures, part of the initial project

The structural system of the substructures is made up of the foundation, vertical structure, consisting of columns and walls, horizontal structure, consisting of different beams slabs, as well as stairs, which play a linking functional role through the floors as well as provide the only structural link between them, due to the lack of vertical diaphragms.

The foundations of all substructures are shallow, while their quotes are not on the same level. Both substructure A and substructure C (partially) comprise of one underground floor, whereas substructure B and D do not comprise of any.

The vertical stiffness of the structure is realized through columns, walls and stairs, which link the floors both functionally and structurally.

The horizontal supporting structure consists of slabs and beams. Beams are positioned in a regular pattern, creating as a result simple structural systems for each substructure.

The concrete, used in the Museum, has been classified in the existing project as M300. Based on Euro code 2, concrete of the existing substructures corresponds to class C25/30. Reinforced steel in the existing project has a yield strength of 2100daN/cm². The perimetral walls of the underground floor are made of concrete with coarse aggregates.

The impact of the ground-structure interaction in the overall assessment of the existing substructures is taken into account based upon the parameters of the geological study of the original project.

The Mosaic with approximately 565 m² surface area is part of substructure C façade. Therefore, the own weight of the Mosaic, acting upon substructure C, was taken into account alongside other loads.

2.5.2. Mosaic's retaining structure calculations, as part of section "C" of the NHM

Database: 190719 Zona C.twp
Analysis date: 19.7.2019

Analysis type: 3D model

☒ Linear theory ☒ Mode Analysis ☐ Stability
☐ Non-linear theory ☒ Earthquake analysis ☒ Beam offset
☐ Stage Construction

Model size

Number of nodes: 12522
Number of area elements: 12133
Number of beams: 2941
Number of boundary elements: 35617
Number of primary loading cases: 6
Number of loading combinations: 22

Units

Length: m [cm,mm]
Force: kN
Temperature: Celsius

Level scheme

Title	z [m]	h [m]	Title	z [m]	h [m]
	17.33	5.55		0.00	4.70
	11.78	5.55		-4.70	1.80
	6.23	3.45		-6.50	
	2.78	2.78			

Table of materials

No	Material name	E[kN/m ²]	μ	γ [kN/m ³]	α [1/C]	Em[kN/m ²]	μ m
1	Concrete C 25	3.000e+7	0.20	25.00	1.000e-5	3.000e+7	0.20

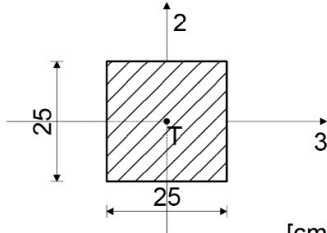
Slab sets

No	d[m]	e[m]	Material	Analysis type	Orthotropy	E2[kN/m ²]	G[kN/m ²]	α
<1>	0.250	0.125	1	Thin slab	Isotropy			
<2>	0.250	0.125	1	Thin slab	Unisotropy	0.000e+0	0.000e+0	0.00
<3>	0.250	0.125	1	Thin slab	Unisotropy	0.000e+0	0.000e+0	90.00
<4>	1.100	0.550	1	Thick slab	Isotropy			
<5>	0.400	0.200	1	Thin slab	Isotropy			
<7>	0.130	0.065	1	Thin slab	Isotropy			

Beam sets

Set: 1 Cross-section: Rectangle

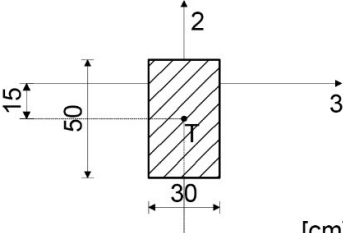
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		6.250e-2	5.208e-2	5.208e-2	1.000e-9	3.255e-4	3.255e-4



[cm]

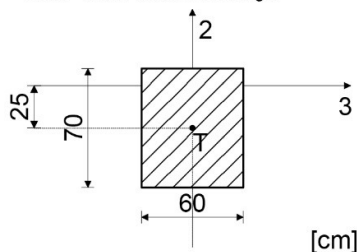
Set: 2 Cross-section: Rectangle

Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		1.500e-1	1.250e-1	1.250e-1	1.000e-9	1.125e-3	3.125e-3



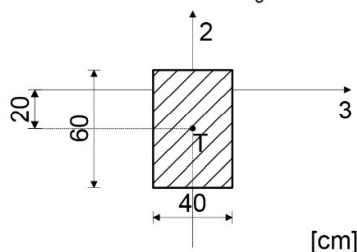
[cm]

Set: 3 Cross-section: Rectangle



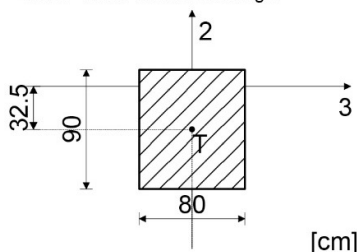
Mat.	P/Z	A1	A2	A3	I1	I2	I3
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Set: 4 Cross-section: Rectangle



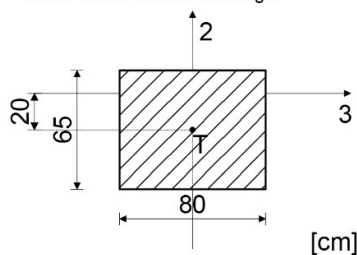
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		2.400e-1	2.000e-1	2.000e-1	1.000e-9	3.200e-3	7.200e-3

Set: 5 Cross-section: Rectangle



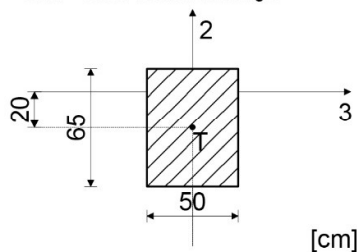
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		7.200e-1	6.000e-1	6.000e-1	1.000e-9	3.840e-2	4.860e-2

Set: 6 Cross-section: Rectangle



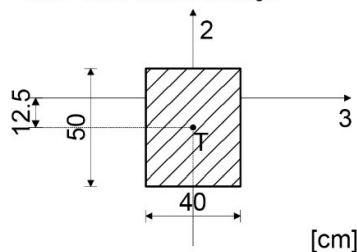
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		5.200e-1	4.333e-1	4.333e-1	1.000e-9	2.773e-2	1.831e-2

Set: 7 Cross-section: Rectangle



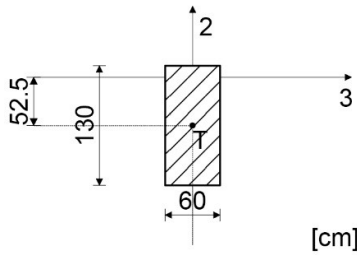
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		3.250e-1	2.708e-1	2.708e-1	1.000e-9	6.771e-3	1.144e-2

Set: 8 Cross-section: Rectangle



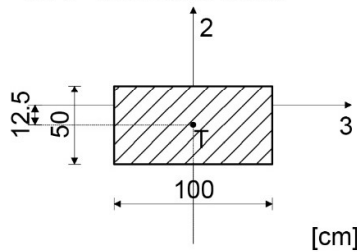
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		2.000e-1	1.667e-1	1.667e-1	1.000e-9	2.667e-3	4.167e-3

Set: 9 Cross-section: Rectangle



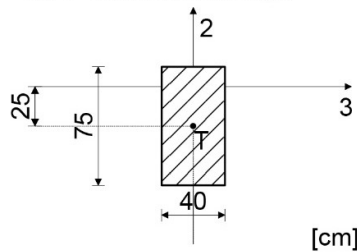
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		7.800e-1	6.500e-1	6.500e-1	1.000e-9	2.340e-2	1.098e-1

Set: 10 Cross-section: Rectangle



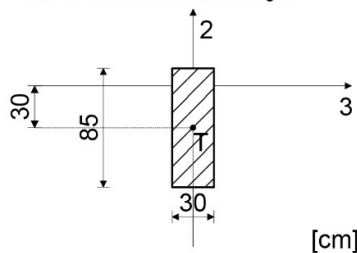
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		5.000e-1	4.167e-1	4.167e-1	1.000e-9	4.167e-2	1.042e-2

Set: 11 Cross-section: Rectangle



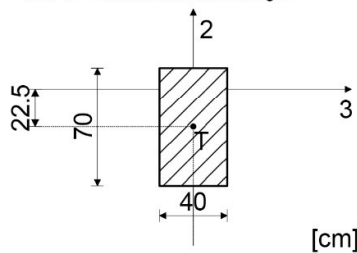
Mat.	P/Z	A1	A2	A3	I1	I2	I3
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Set: 12 Cross-section: Rectangle



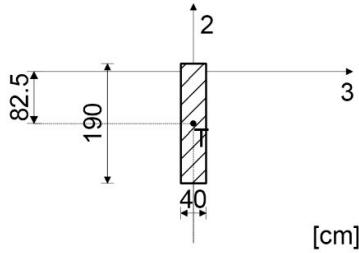
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		2.550e-1	2.125e-1	2.125e-1	1.000e-9	1.913e-3	1.535e-2

Set: 13 Cross-section: Rectangle



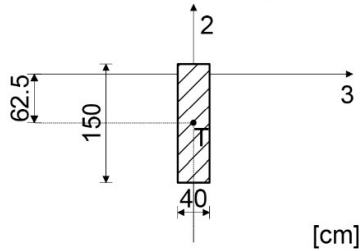
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		2.800e-1	2.333e-1	2.333e-1	1.000e-9	3.733e-3	1.143e-2

Set: 14 Cross-section: Rectangle



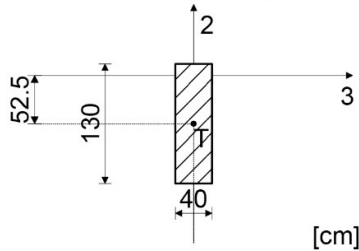
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		7.600e-1	6.333e-1	6.333e-1	1.000e-9	1.013e-2	2.286e-1

Set: 15 Cross-section: Rectangle



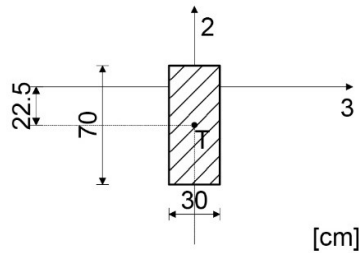
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		6.000e-1	5.000e-1	5.000e-1	1.000e-9	8.000e-3	1.125e-1

Set: 16 Cross-section: Rectangle



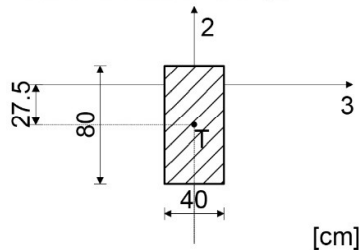
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		5.200e-1	4.333e-1	4.333e-1	1.000e-9	6.933e-3	7.323e-2

Set: 17 Cross-section: Rectangle



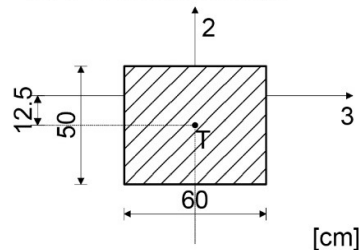
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		2.100e-1	1.750e-1	1.750e-1	1.000e-9	1.575e-3	8.575e-3

Set: 18 Cross-section: Rectangle



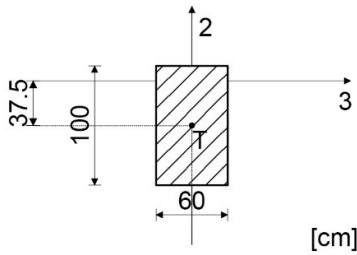
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		3.200e-1	2.667e-1	2.667e-1	1.000e-9	4.267e-3	1.707e-2

Set: 19 Cross-section: Rectangle



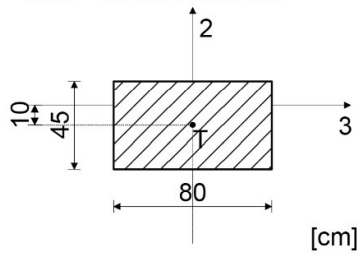
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		3.000e-1	2.500e-1	2.500e-1	1.000e-9	9.000e-3	6.250e-3

Set: 20 Cross-section: Rectangle



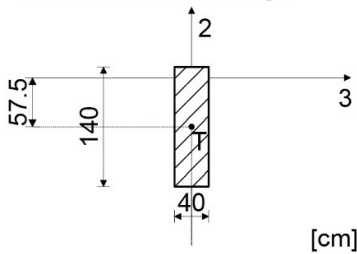
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		6.000e-1	5.000e-1	5.000e-1	1.000e-9	1.800e-2	5.000e-2

Set: 21 Cross-section: Rectangle



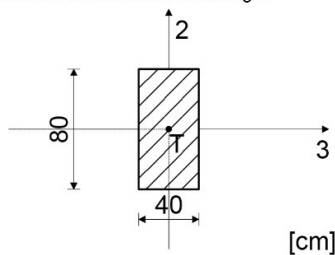
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		3.600e-1	3.000e-1	3.000e-1	1.000e-9	1.920e-2	6.075e-3

Set: 22 Cross-section: Rectangle



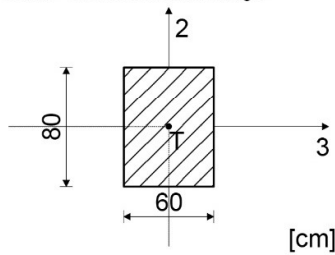
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		5.600e-1	4.667e-1	4.667e-1	1.000e-9	7.467e-3	9.147e-2

Set: 25 Cross-section: Rectangle



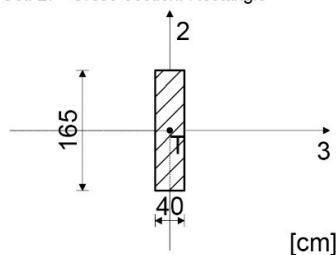
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		3.200e-1	2.667e-1	2.667e-1	1.172e-2	4.267e-3	1.707e-2

Set: 26 Cross-section: Rectangle



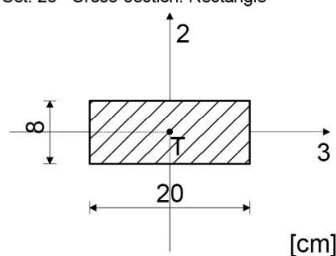
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		4.800e-1	4.000e-1	4.000e-1	3.110e-2	1.440e-2	2.560e-2

Set: 27 Cross-section: Rectangle



Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		6.600e-1	5.500e-1	5.500e-1	2.983e-2	8.800e-3	1.497e-1

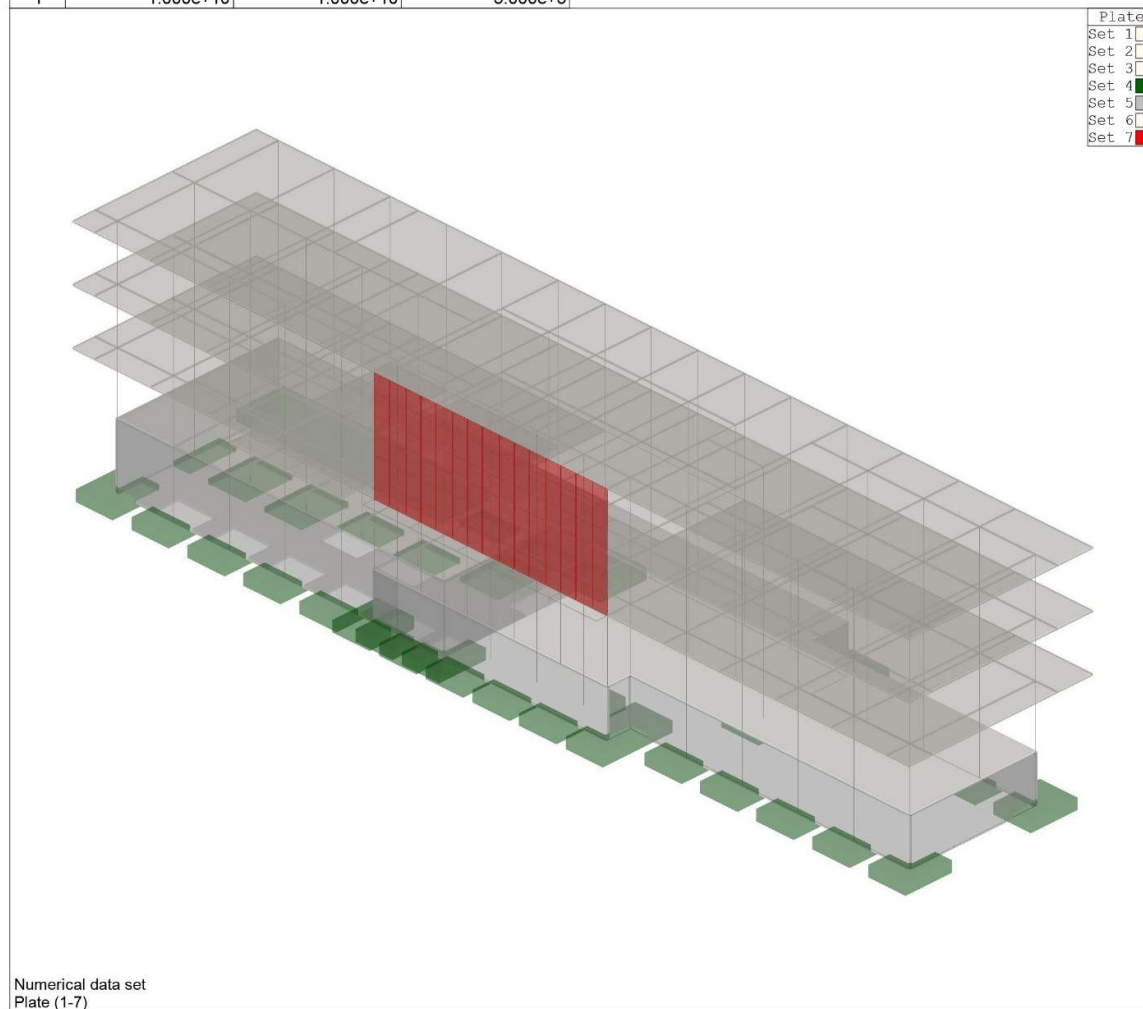
Set: 28 Cross-section: Rectangle



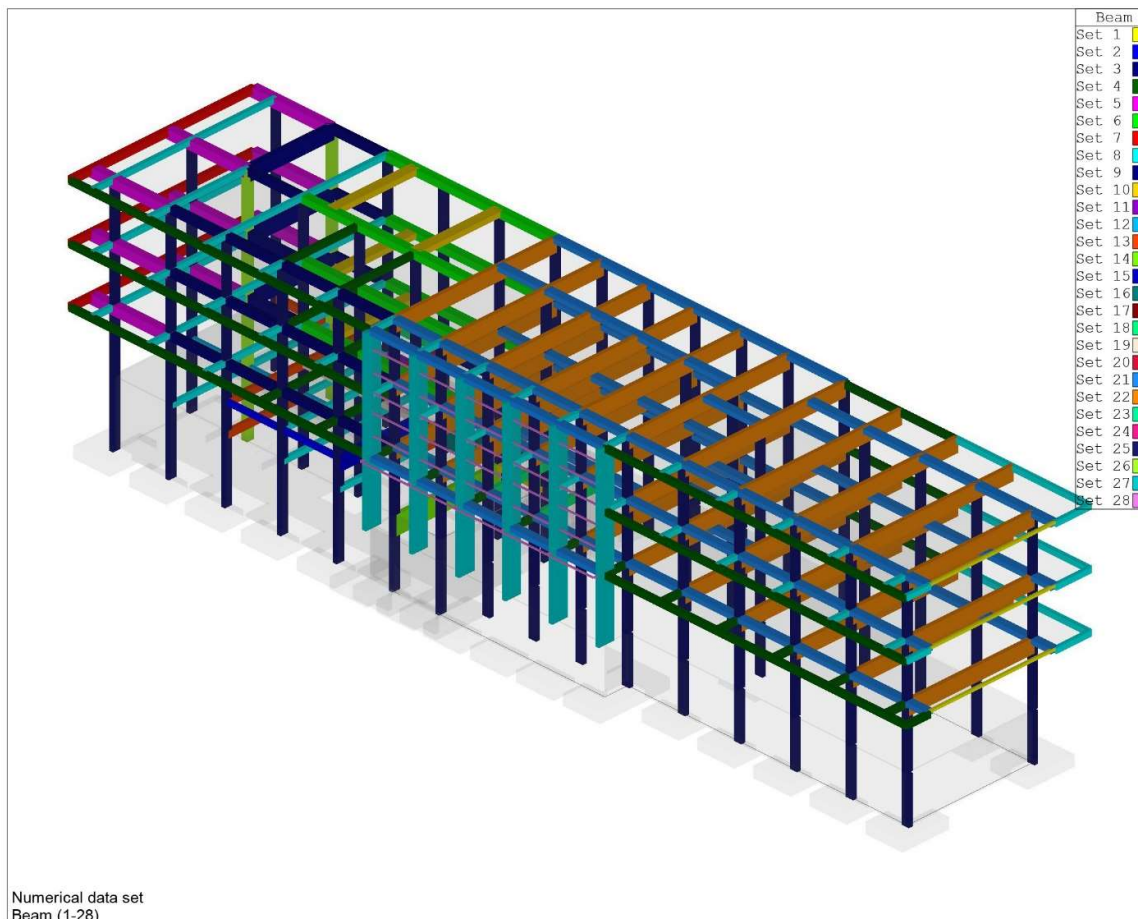
Mat.	P/Z	A1	A2	A3	I1	I2	I3
1		1.600e-2	1.333e-2	1.333e-2	1.000e-9	5.333e-5	8.533e-6

Area support sets

Set	K,R1	K,R2	K,R3
1	1.000e+10	1.000e+10	5.000e+5



Numerical data set
Plate (1-7)



Input data - Loading

Loading cases list

No	Title	No	Title
1	DEAD (g)	15	Combination: I+0.6xII+VI
2	LIVE C3	16	Combination: I+0.6xII-1xVI
3	WIND	17	Combination: I+0.6xII+IV
4	SX	18	Combination: I+0.6xII-1xIV
5	SY	19	Combination: I+1.5xIII
6	SZ	20	Combination: I+1.5xII
7	Combination: 1.35xI+1.05xII+1.5xIII	21	Combination: I-1xIV
8	Combination: 1.35xI+1.5xII+0.9xIII	22	Combination: I-1xVI
9	Combination: I+1.05xII+1.5xIII	23	Combination: I+VI
10	Combination: I+1.5xII+0.9xIII	24	Combination: I+IV
11	Combination: 1.35xI+1.5xIII	25	Combination: I-1xV
12	Combination: 1.35xI+1.5xII	26	Combination: I+V
13	Combination: I+0.6xII+V	27	Combination: 1.35xI
14	Combination: I+0.6xII-1xV	28	Combination: I

Mode Analysis

Load factors for mass calculations

No	Title	Factor
1	DEAD (g)	1.00
2	LIVE C3	0.60
3	WIND	0.00

Mass distribution per levels

Level	Z [m]	Mass [T]
	17.33	3222.26
	11.78	4603.35
	6.23	4359.15
	2.78	667.12
	0.00	3290.94
	-4.70	2145.64
	-6.50	1595.88
	$\Sigma=$	19884.34

Natural frequency of structure

No	T [s]	f [Hz]
1	1.2028	0.8314
2	1.0796	0.9263
3	0.9860	1.0142
4	0.3803	2.6292
5	0.3348	2.9868
6	0.3018	3.3132
7	0.2487	4.0205
8	0.2420	4.1331
9	0.2145	4.6622
10	0.2129	4.6965
11	0.2041	4.8998
12	0.1945	5.1406

Earthquake analysis

Earthquake analysis: Eurocode

Soil category: C
Importance factor: III
Ratio ag/g: 0.25
Behaviour factor: 3.15

Earthquake directional factors:

Title	Kx	Ky	Kz
SX	1.000	0.300	0.300
SY	0.300	1.000	0.300
SZ	0.300	0.300	1.000

SX

Level	Z [m]	Mode 1			Mode 2			Mode 3		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	3377.6	2.05	6.00	1387.9	246.66	-4.27	-17.99	1578.6	-1.89
	11.78	4457.5	-104.15	15.17	2152.2	376.53	-11.29	-66.47	1827.7	-1.80
	6.23	3274.1	-208.63	16.60	2090.8	376.92	-19.47	-97.70	1034.5	-7.16
	2.78	202.71	71.02	-0.85	116.54	-100.34	-1.45	-6.56	71.67	1.69
	0.00	27.06	29.76	-0.33	18.78	-52.12	1.00	-3.06	59.60	-0.69
	-4.70	0.68	1.31	0.31	0.39	-2.28	-0.06	-0.03	1.17	0.01
	-6.50	0.01	0.01	0.24	0.00	-0.02	0.17	0.00	0.01	-0.04
	Σ=	11339.7	-208.62	37.14	5766.7	845.34	-35.38	-191.81	4573.2	-9.88

Level	Z [m]	Mode 4			Mode 5			Mode 6		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	-335.82	-17.29	-6.82	21.38	-381.39	-0.56	14.22	-109.79	-0.56
	11.78	78.16	78.95	-11.59	16.91	111.45	-0.25	7.88	43.28	-1.25
	6.23	399.45	32.78	-0.43	-38.02	516.84	3.44	-27.95	173.65	-2.45
	2.78	35.24	75.86	1.40	-0.25	50.20	0.60	-5.24	23.28	0.83
	0.00	2.25	54.73	-0.03	-2.07	49.70	-0.04	-1.95	20.12	-0.24
	-4.70	0.09	1.93	-0.04	-0.02	1.38	0.03	-0.04	0.50	-0.01
	-6.50	0.00	0.02	0.02	0.00	0.01	0.02	0.00	0.00	0.00
	Σ=	179.37	226.98	-17.50	-2.08	348.18	3.23	-13.08	151.03	-3.69

Level	Z [m]	Mode 7			Mode 8			Mode 9		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	4.51	-111.17	7.20	-340.62	-4.04	0.20	-8.96	158.99	1.04
	11.78	-596.37	116.02	4.33	111.26	-22.72	3.44	-38.31	-254.31	-1.09
	6.23	666.77	23.17	-2.43	249.82	52.69	2.88	51.56	69.59	-2.57
	2.78	84.28	28.15	0.16	34.02	-35.54	-0.17	8.74	52.09	0.08
	0.00	10.54	26.22	0.32	6.73	-31.17	0.76	-2.55	51.85	-0.76
	-4.70	0.30	0.90	-0.03	0.15	-1.21	-0.08	-0.03	1.94	0.02
	-6.50	0.00	0.01	-0.00	0.00	-0.01	-0.04	0.00	0.02	-0.00
	Σ=	170.03	83.29	9.55	61.36	-41.99	6.99	10.45	80.17	-3.29

Level	Z [m]	Mode 10			Mode 11			Mode 12		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	-15.00	-22.01	0.36	18.15	43.12	1.54	111.62	-6.72	-2.07
	11.78	21.57	13.41	0.88	-2.36	-130.17	0.72	-177.67	-5.98	0.05
	6.23	-5.91	15.83	-0.09	-14.65	114.97	-1.21	64.19	35.10	2.49
	2.78	-6.89	16.96	0.42	-1.98	13.75	-0.19	18.20	-14.70	0.30
	0.00	-2.30	13.98	-0.10	-1.21	24.20	0.04	3.80	-20.00	0.26
	-4.70	-0.05	0.48	0.00	-0.01	0.78	0.02	0.08	-0.84	0.00
	-6.50	0.00	0.00	-0.01	0.00	0.01	0.00	-0.00	-0.01	0.02
	Σ=	-8.58	38.65	1.45	-2.06	66.66	0.91	20.23	-13.14	1.06

Level	Z [m]	All modes		
		Px [kN]	Py [kN]	Pz [kN]
	17.33	4217.0	1377.0	0.17
	11.78	5964.3	2050.0	-2.68
	6.23	6612.5	2237.4	-10.41
	2.78	478.82	252.39	2.81
	0.00	56.04	226.87	0.18
	-4.70	1.51	6.06	0.17
	-6.50	0.02	0.05	0.36
	Σ=	17330.2	6149.8	-9.39

SY

Level	Z [m]	Mode 1			Mode 2			Mode 3		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	958.82	0.58	1.70	592.31	105.27	-1.82	-68.96	6051.5	-7.24
	11.78	1265.4	-29.56	4.31	918.49	160.69	-4.82	-254.80	7006.4	-6.88
	6.23	929.42	-59.22	4.71	892.30	160.86	-8.31	-374.54	3965.6	-27.45
	2.78	57.55	20.16	-0.24	49.74	-42.82	-0.62	-25.13	274.73	6.47
	0.00	7.68	8.45	-0.09	8.02	-22.24	0.42	-11.73	228.47	-2.66
	-4.70	0.19	0.37	0.09	0.17	-0.97	-0.02	-0.12	4.47	0.04
	-6.50	0.00	0.00	0.07	0.00	-0.01	0.07	0.00	0.04	-0.15
	Σ=	3219.0	-59.22	10.54	2461.0	360.77	-15.10	-735.29	17531.3	-37.87

Level	Z [m]	Mode 4			Mode 5			Mode 6		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]

Earthquake analysis: Eurocode

	17.33	-382.03	-19.67	-7.76	72.10	-1286.26	-1.90	66.68	-514.97	-2.64
	11.78	88.92	89.81	-13.18	57.01	375.86	-0.84	36.96	202.99	-5.86
	6.23	454.41	37.29	-0.49	-128.23	1743.0	11.59	-131.10	814.49	-11.51
	2.78	40.09	86.30	1.59	-0.86	169.29	2.03	-24.58	109.18	3.89
	0.00	2.56	62.26	-0.04	-6.98	167.60	-0.12	-9.13	94.35	-1.12
	-4.70	0.10	2.20	-0.04	-0.08	4.67	0.08	-0.16	2.33	-0.06
	-6.50	0.00	0.02	0.02	0.00	0.04	0.06	0.00	0.02	0.01
	Σ=	204.05	258.21	-19.90	-7.02	1174.2	10.90	-61.33	708.40	-17.29

Level	Z [m]	Mode 7			Mode 8			Mode 9		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	3.13	-77.06	4.99	143.92	1.71	-0.09	-22.01	390.46	2.56
	11.78	-413.38	80.42	3.00	-47.01	9.60	-1.46	-94.09	-624.56	-2.68
	6.23	462.18	16.06	-1.69	-105.56	-22.26	-1.21	126.63	170.91	-6.32
	2.78	58.42	19.51	0.11	-14.37	15.02	0.07	21.47	127.94	0.19
	0.00	7.30	18.17	0.22	-2.84	13.17	-0.32	-6.25	127.34	-1.87
	-4.70	0.20	0.63	-0.02	-0.06	0.51	0.04	-0.07	4.76	0.04
	-6.50	0.00	0.01	-0.00	-0.00	0.01	0.02	0.00	0.05	-0.01
	Σ=	117.86	57.73	6.62	-25.93	17.74	-2.95	25.68	196.90	-8.09

Level	Z [m]	Mode 10			Mode 11			Mode 12		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	-158.46	-232.48	3.79	66.09	157.01	5.59	-45.44	2.73	0.84
	11.78	227.85	141.63	9.25	-8.59	-473.93	2.61	72.33	2.44	-0.02
	6.23	-62.39	167.22	-0.91	-53.32	418.58	-4.41	-26.13	-14.29	-1.01
	2.78	-72.78	179.17	4.39	-7.21	50.06	-0.69	-7.41	5.99	-0.12
	0.00	-24.32	147.69	-1.11	-4.41	88.10	0.14	-1.55	8.14	-0.11
	-4.70	-0.50	5.06	0.04	-0.05	2.84	0.07	-0.03	0.34	-0.00
	-6.50	0.00	0.05	-0.11	0.00	0.03	0.01	0.00	0.00	-0.01
	Σ=	-90.59	408.34	15.34	-7.49	242.68	3.33	-8.23	5.35	-0.43

Level	Z [m]	All modes		
		Px [kN]	Py [kN]	Pz [kN]
	17.33	1226.2	4578.8	-1.96
	11.78	1849.0	6941.7	-16.58
	6.23	1983.7	7398.3	-47.01
	2.78	74.92	1014.5	17.06
	0.00	-41.65	941.51	-6.64
	-4.70	-0.41	27.20	0.25
	-6.50	0.02	0.26	-0.01
	Σ=	5091.8	20902.4	-54.89

SZ

Level	Z [m]	Mode 1			Mode 2			Mode 3		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	1010.3	0.61	1.80	449.93	79.96	-1.39	-19.94	1749.4	-2.09
	11.78	1333.3	-31.15	4.54	697.71	122.06	-3.66	-73.66	2025.4	-1.99
	6.23	979.32	-62.40	4.97	677.81	122.19	-6.31	-108.27	1146.4	-7.94
	2.78	60.63	21.24	-0.26	37.78	-32.53	-0.47	-7.27	79.42	1.87
	0.00	8.10	8.90	-0.10	6.09	-16.90	0.32	-3.39	66.05	-0.77
	-4.70	0.20	0.39	0.09	0.13	-0.74	-0.02	-0.04	1.29	0.01
	-6.50	0.00	0.00	0.07	0.00	-0.01	0.05	0.00	0.01	-0.04
	Σ=	3391.8	-62.40	11.11	1869.4	274.05	-11.47	-212.56	5068.0	-10.95

Level	Z [m]	Mode 4			Mode 5			Mode 6		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	-144.76	-7.45	-2.94	22.15	-395.12	-0.58	17.22	-132.97	-0.68
	11.78	33.69	34.03	-4.99	17.51	115.46	-0.26	9.54	52.42	-1.51
	6.23	172.19	14.13	-0.18	-39.39	535.44	3.56	-33.85	210.31	-2.97
	2.78	15.19	32.70	0.60	-0.26	52.00	0.62	-6.35	28.19	1.00
	0.00	0.97	23.59	-0.01	-2.14	51.48	-0.04	-2.36	24.36	-0.29
	-4.70	0.04	0.83	-0.02	-0.02	1.43	0.03	-0.04	0.60	-0.02
	-6.50	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.00
	Σ=	77.32	97.84	-7.54	-2.16	360.71	3.35	-15.84	182.92	-4.47

Level	Z [m]	Mode 7			Mode 8			Mode 9		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	1.95	-48.06	3.11	-85.70	-1.02	0.05	-6.39	113.34	0.74
	11.78	-257.82	50.16	1.87	27.99	-5.72	0.87	-27.31	-181.30	-0.78
	6.23	288.26	10.02	-1.05	62.85	13.26	0.72	36.76	49.61	-1.83
	2.78	36.44	12.17	0.07	8.56	-8.94	-0.04	6.23	37.14	0.05
	0.00	4.56	11.34	0.14	1.69	-7.84	0.19	-1.81	36.96	-0.54
	-4.70	0.13	0.39	-0.01	0.04	-0.30	-0.02	-0.02	1.38	0.01
	-6.50	0.00	0.00	-0.00	0.00	-0.00	-0.01	0.00	0.01	-0.00
	Σ=	73.51	36.01	4.13	15.44	-10.57	1.76	7.45	57.15	-2.35

Level	Z [m]	Mode 10			Mode 11			Mode 12		
		Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]	Px [kN]	Py [kN]	Pz [kN]
	17.33	-45.46	-66.69	1.09	20.23	48.05	1.71	21.40	-1.29	-0.40
	11.78	65.37	40.63	2.65	-2.63	-145.04	0.80	-34.06	-1.15	0.01
	6.23	-17.90	47.97	-0.26	-16.32	128.10	-1.35	12.31	6.73	0.48
	2.78	-20.88	51.40	1.26	-2.21	15.32	-0.21	3.49	-2.82	0.06

Earthquake analysis: Eurocode

	0.00	-6.98	42.37	-0.32	-1.35	26.96	0.04	0.73	-3.83	0.05
	-4.70	-0.14	1.45	0.01	-0.02	0.87	0.02	0.02	-0.16	0.00
	-6.50	0.00	0.01	-0.03	0.00	0.01	0.00	-0.00	-0.00	0.00
	Σ=	-25.99	117.15	4.40	-2.29	74.27	1.02	3.88	-2.52	0.20

Level	Z [m]	All modes		
		Px [kN]	Py [kN]	Pz [kN]
	17.33	1240.9	1338.7	0.42
	11.78	1789.6	2075.8	-2.46
	6.23	2013.8	2221.8	-12.17
	2.78	131.36	285.30	4.56
	0.00	4.10	263.45	-1.32
	-4.70	0.27	7.44	0.09
	-6.50	0.01	0.07	0.07
	Σ=	5180.1	6192.6	-10.80

Distribution factors

Title / Mode				1	2	3	4	5	6	7	8
9	10	11	12								
SX				0.589	0.313	0.061	0.013	0.005	0.002	0.010	0.003
	0.002	0.000	0.001	0.001							
SY				0.041	0.049	0.772	0.014	0.052	0.031	0.004	0.000
	0.009	0.017	0.011	0.000							
SZ				0.297	0.186	0.425	0.013	0.033	0.013	0.011	0.001
	0.005	0.009	0.007	0.000							

Distribution factors

Mode	UX (%)	UY (%)	UZ (%)	ΣUX (%)	ΣUY (%)	ΣUZ (%)
1	43.28	0.01	0.00	43.28	0.01	0.00
2	19.56	0.42	0.00	62.84	0.44	0.00
3	0.10	59.13	0.00	62.95	59.56	0.00
4	0.38	0.62	0.00	63.33	60.18	0.01
5	0.00	3.40	0.00	63.33	63.57	0.01
6	0.02	2.12	0.00	63.35	65.69	0.01
7	0.42	0.10	0.00	63.77	65.80	0.01
8	0.21	0.10	0.00	63.98	65.90	0.01
9	0.01	0.56	0.00	63.99	66.45	0.01
10	0.06	1.25	0.00	64.05	67.70	0.01
11	0.00	0.71	0.00	64.06	68.41	0.01
12	0.07	0.03	0.00	64.13	68.44	0.01

Structural analysis

Knots' Deflection: max: |Xd|

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
4383	4	30.719	40.676	1.026
4584	4	30.718	39.619	0.714
4767	4	30.717	38.556	0.521
4927	4	30.716	37.649	0.552
5090	4	30.714	36.730	0.718

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
12522	4	30.712	40.110	2.051
5252	4	30.711	35.801	0.932
12520	4	30.711	39.086	2.109
12517	4	30.710	38.063	2.153
5414	4	30.708	34.862	1.162

Knots' Deflection: max: |Yd|

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
1082	4	22.195	40.686	2.031
1166	4	22.330	40.686	1.707
1242	4	22.489	40.686	1.406
1328	4	22.675	40.685	1.144
1448	4	22.951	40.685	0.853

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
1566	4	23.272	40.683	0.653
1686	4	23.624	40.682	0.542
1814	4	24.003	40.681	0.504
1953	4	24.407	40.681	0.509
2487	4	25.758	40.680	0.609

Knots' Deflection: max: |Zd|

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
7935	1	-0.137	-0.082	-46.513
8041	1	-0.141	-0.062	-45.866
7841	1	-0.133	-0.096	-45.616
8144	1	-0.144	-0.038	-43.703
7748	1	-0.129	-0.106	-43.211

Node	LC	Xd [mm]	Yd [mm]	Zd [mm]
8241	1	-0.148	-0.006	-40.154
7810	1	-0.116	-0.080	-39.560
7641	1	-0.126	-0.109	-39.437
7915	1	-0.116	-0.060	-38.988
7716	1	-0.116	-0.095	-38.775

2.5.3. Mosaic structural elements

The Mosaic has been constructed on 23 precast reinforced concrete panels, that serve as supporting structural elements, made in "Factory Josif Pashko".

The structural assessment of the panels has been based upon the existing structural project, as well as upon a visual evaluation of the present condition of the Mosaic itself.

The implementation of the panels are presented on Page No.356/K-304, K-305 Structural Design Project "National Museum of History".

Precast concrete channel panels are dimensioned 151x712cm and 95x712cm. They are complemented through beams T-81, T-82 with a height of 187cm. The link between the panels and beams has been executed through welding joints in the upfront part of the Mosaic.

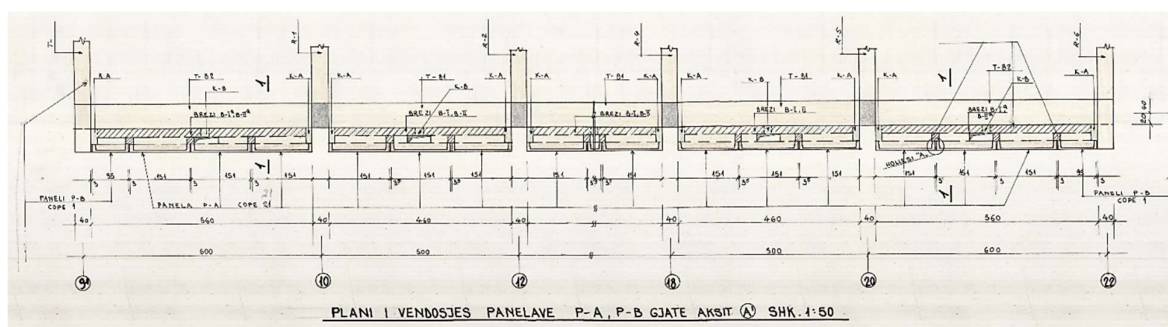
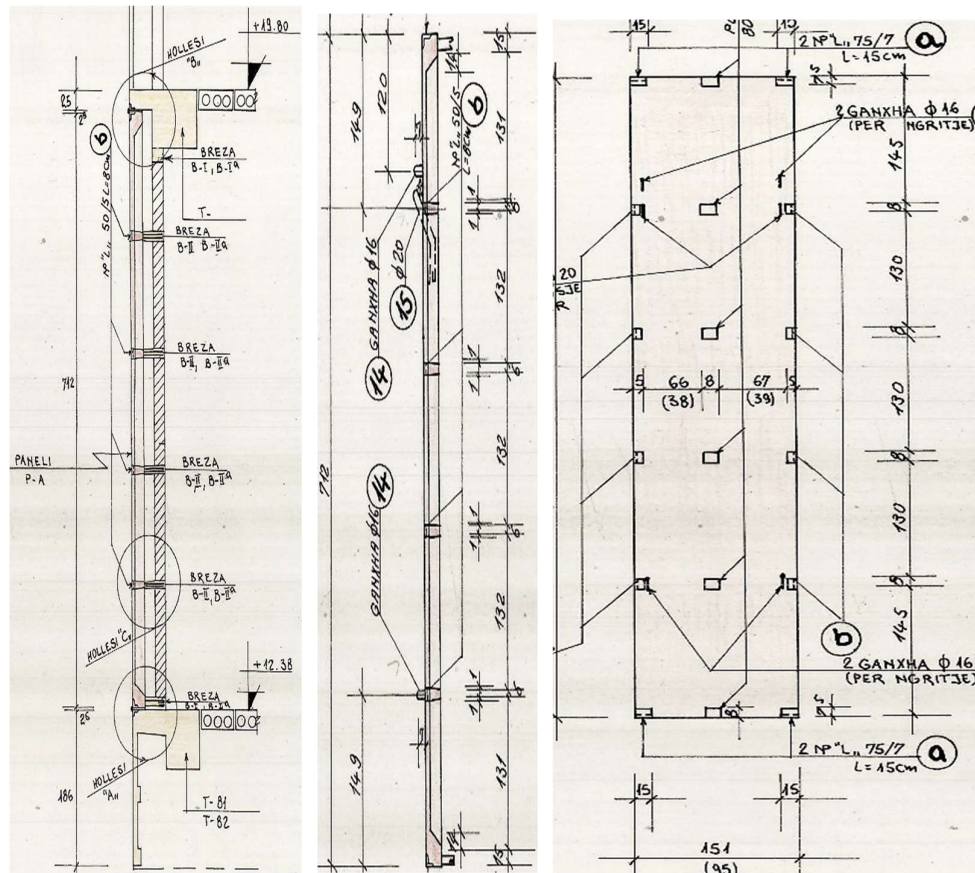


Fig. 11 - View of Mosaic Panels



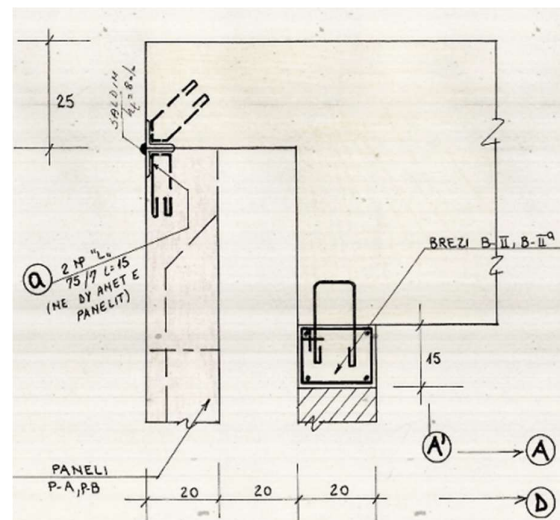
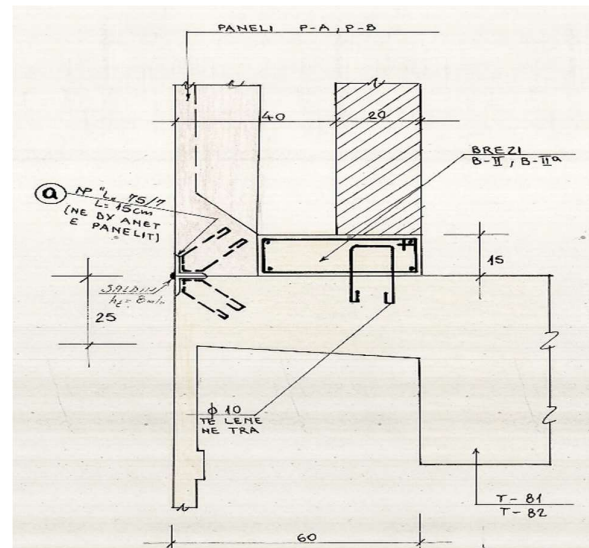
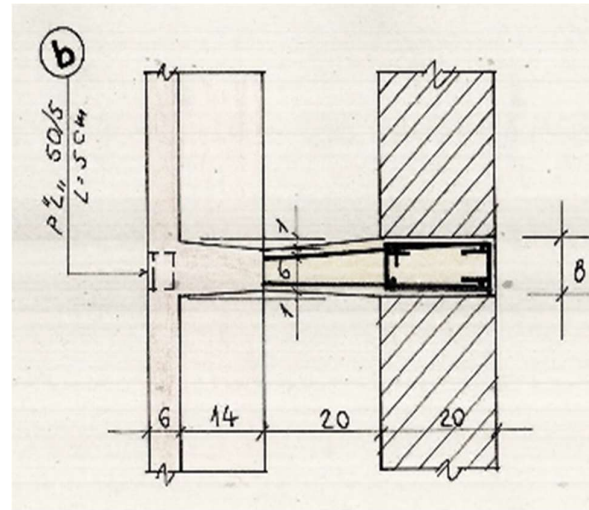


Fig. 13-14-15 - Links between the panels

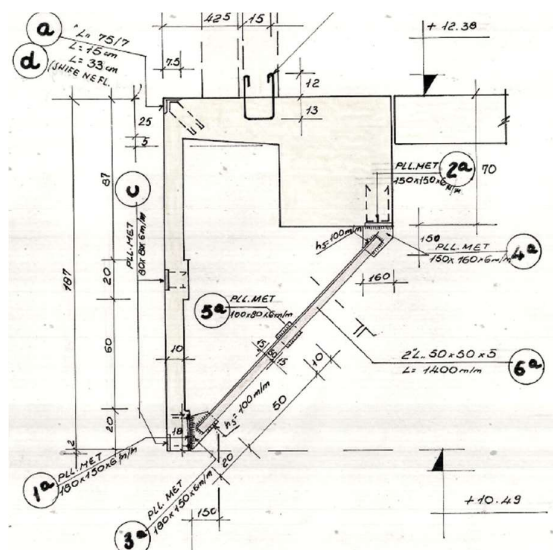
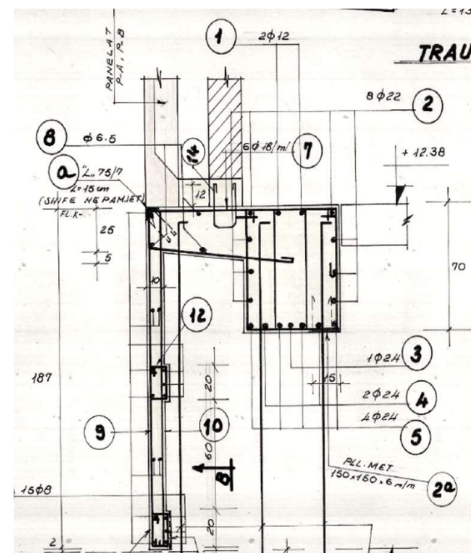
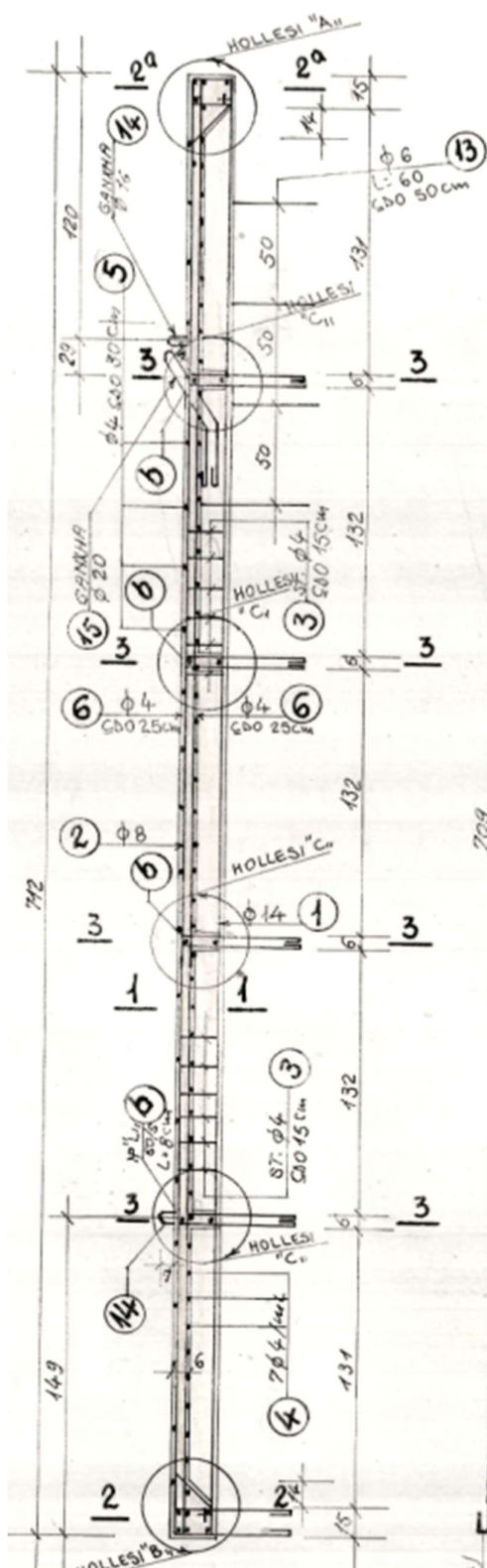


Fig.16-17-18 - View of the reinforced steel on the panel, beam and the steel braces of the supporting beam

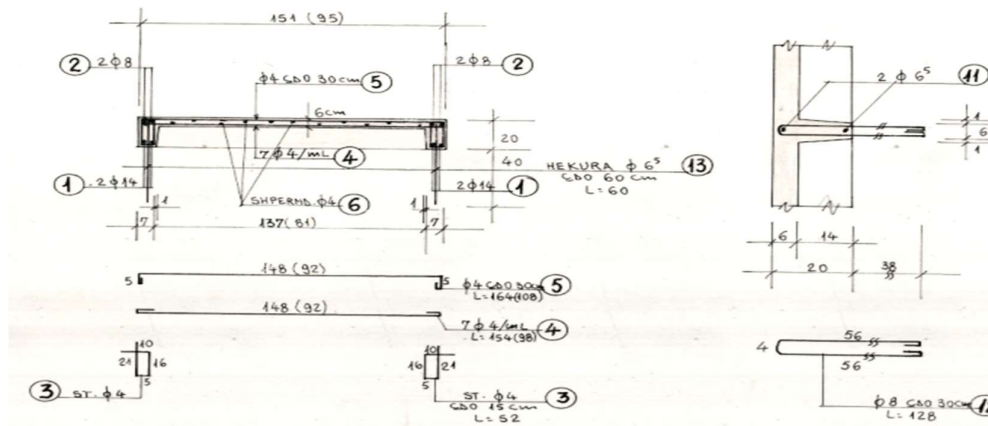


fig.19 View of the reinforced concrete panel and the masonry ties

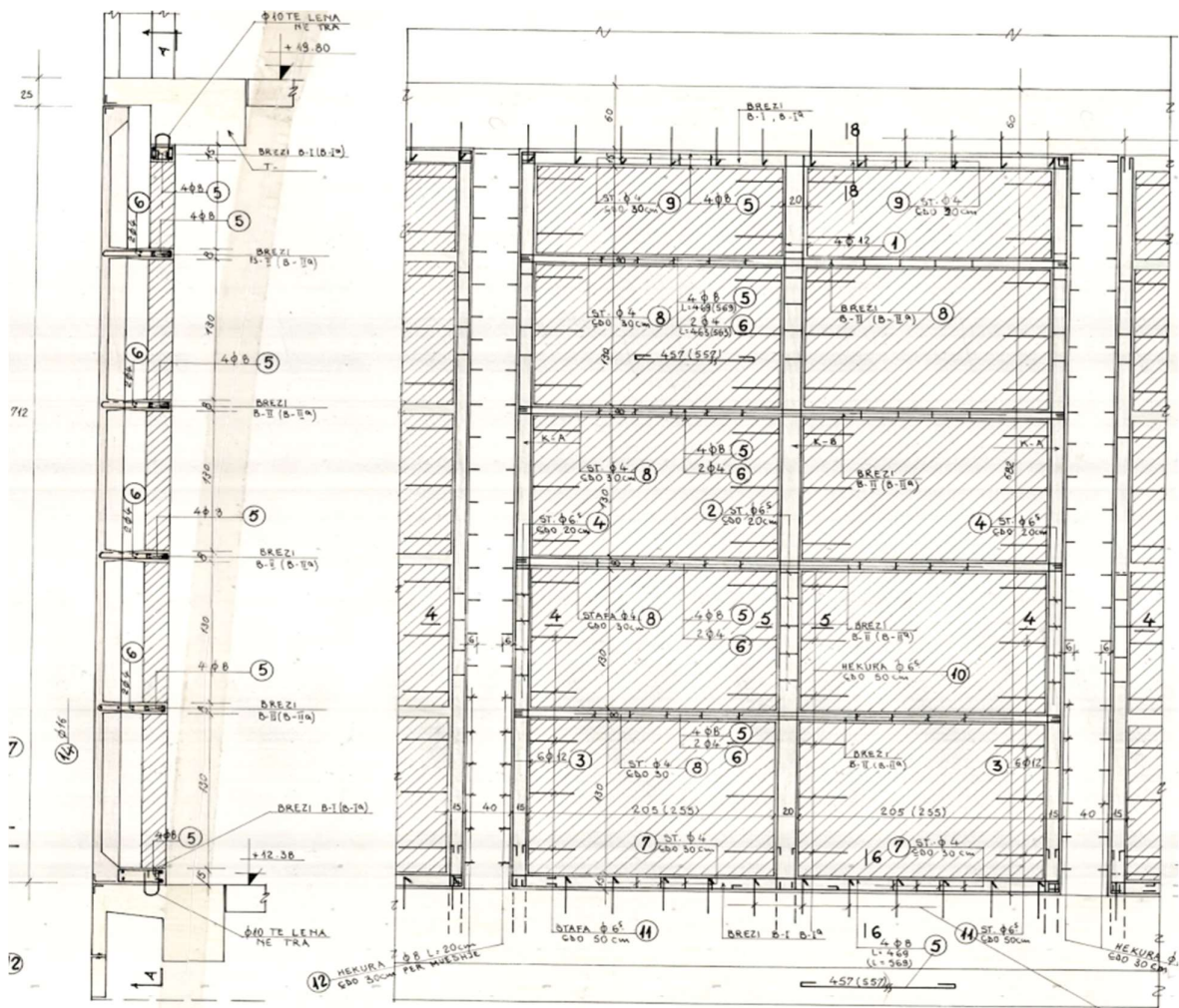


Fig. 20 View of the masonry reinforced concrete

Based on the structural project of the existing substructure C, precast concrete channel panels, which support the mosaic, have been conceived as panels with a height of 6cm and the beams, which play a supporting role in positions where joints and ties are linked, with a height of 20cm. The reinforcement steel of the panels was designed as double mesh $\phi 4/25\text{cm}$, $\phi 4/15\text{cm}$, $\phi 4/30\text{cm}$.

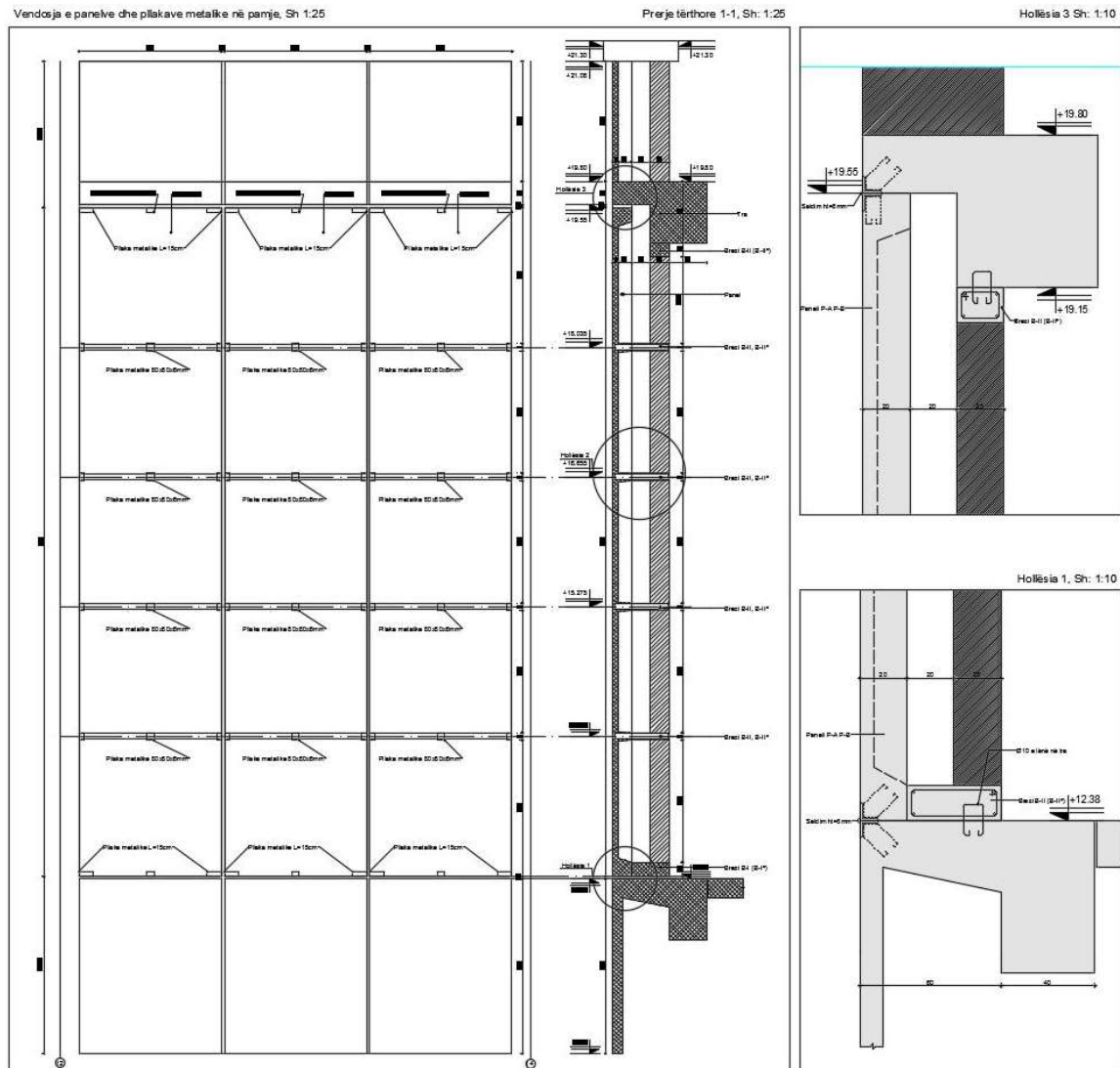


Fig 21. - Supporting panels of the mosaic

2.6. Analysis of rainwater drainage system and the influence on causes of degradation of mosaic.

One of the reasons for the mosaic degradation and its constructive structure, are the problems caused by the rainwater drainage system in the mosaic part. A full analysis of these problems will be carried out only after a close look of the critical points of these problems, after revealing or dissecting parts of the mosaic, inside of which invisible from the outside, with the passage of time and out of technical attention, phenomena have occurred which have led to the degradation of the mosaic as a whole.

The problems caused by the rainwater drainage system may be the main direct or indirect cause for the damages intensification due to other problems which are closely linked with the rainwater presence as a result of the malfunction of the rainwater discharge system.

These problems, generally are created directly from the reasons below:

- The flawed conceptual solution of the rainwater discharge system of the mosaic roof.
- Inappropriate quality of the used materials and the building techniques of the rainwater discharge system in general.
- Lack of monitoring of exposure to atmospheric thermo / climatic phenomena, lack of overall maintenance etc.

The causes may be of a wider range than we can think, but surely the problems caused by damage, degradation and malfunction of the rainwater discharge system, are obvious regardless of their influence.

As follows below we are going to analyze these causes based on the direct influence in the mosaic damage, as well as the logical and technical connections of the harmful phenomena intensified between them by the presence of the unwanted rainwater, which initially are created from the flawed conceptual solution of the rainwater discharge system.

According to the existing rainwater drainage projects, the roof waters of the front of the museum building are collected on a surface about 750 m² and are discharged through 9 columns, of which 6 columns are located behind the mosaic and go down through the columns of the facades and end up in the wells of the urban rainwater network. From the original construction projects, we distinguish.

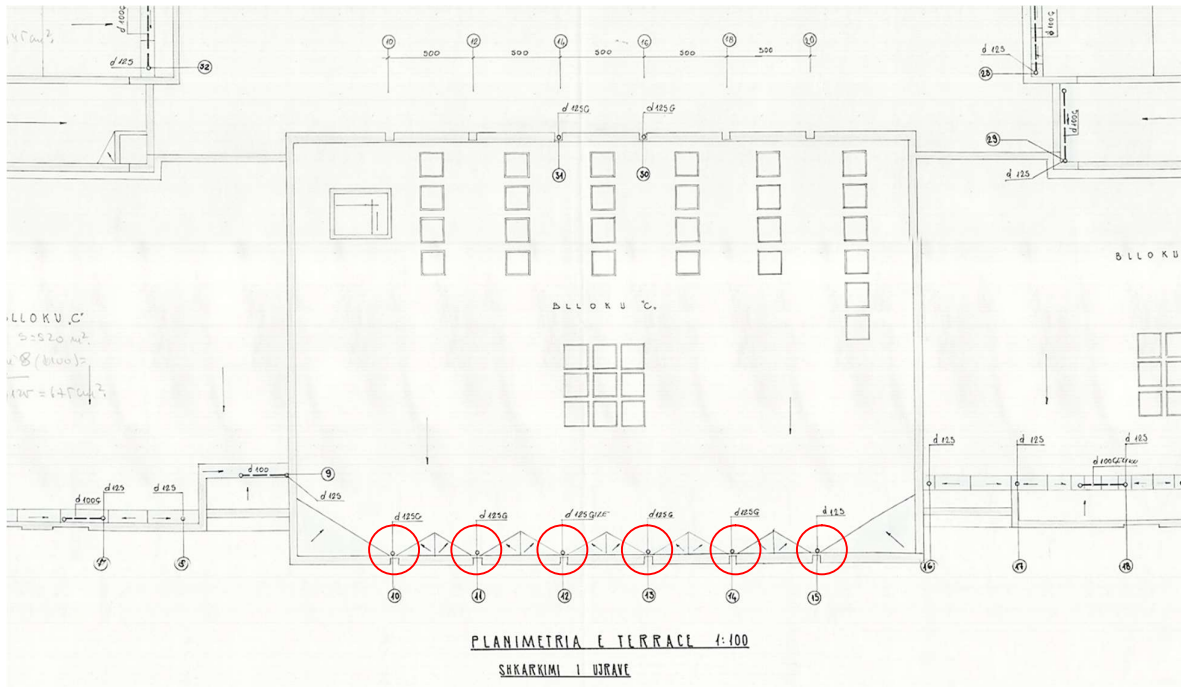


Fig. 22 – 6 existing rainwater discharge columns in the roof plan

Roof discharge plan in which we can distinguish 6 rainwater discharge columns in the southern part- exactly the columns that go down behind the mosaic that are the cause of the problems that arise from the malfunction of the columns.

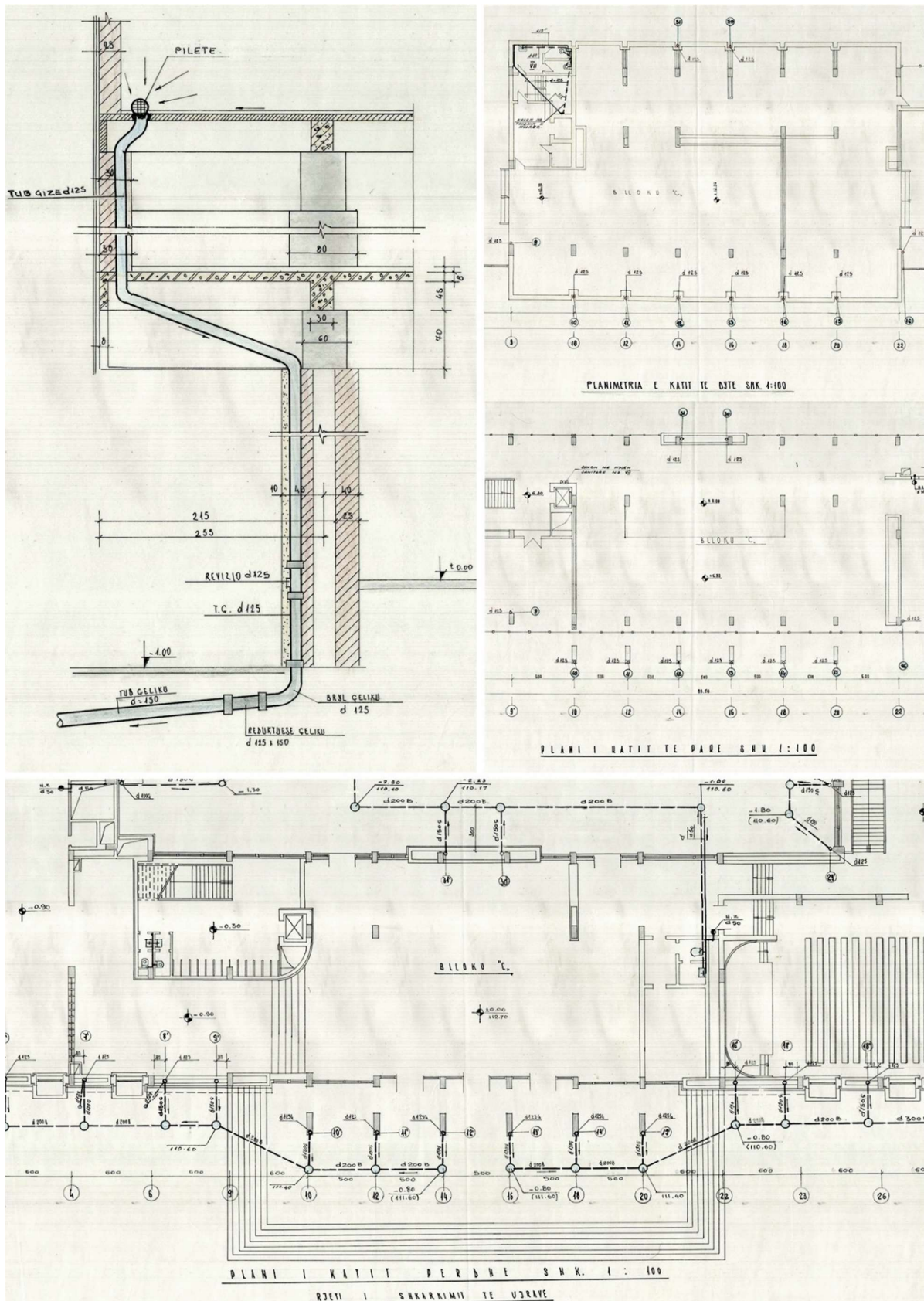


Fig. 23– Technical details of waste water system



Fig. 24 – Existing discharge pipes

Analyzing the existing projects, we conclude that the project has the flaws as below:

- 1- Across all the roof perimeter above the mosaic shouldn't have been built the rainwater discharge system, but all the roof rainwater should have been arranged to discharge in the columns built in the northern part of the roof.
- 2- This solution should have been avoided by the projector because the columns in the back of the mosaic are not easily accessible for inspection, repair and replacement.
- 3- The need for the accessibility (inspection, repair etc.) of every installation is the base requirement for every project of the relative importance, while for the importance that this building presents, in addition to the special importance of the mosaic, respecting the request for access, the passage of the columns behind the mosaic and inside its structure must have been avoided.
- 4- The avoidance of the rainwater columns inside the mosaic structure, becomes necessary also because of the usage of the pipes materials etc. of the poor quality and unsuitable for so-called hidden installations, without access to it etc.
- 5- Of course, projecting and building the rainwater discharge system according to the existing situation does not allow the possibility of monitoring its status in any aspect related to the mosaic damage because of the malfunction, degrading of the rainwater columns system.

3. DETERIORATION ANALYSIS

3.1. Deterioration analysis of the mosaic

The mosaic manifests two different groups of deterioration: deterioration that are linked to the bad mosaic construction technique; deterioration due to the lack of maintenance and restoration interventions.

Deterioration due to the inappropriate construction technique:

- Behind the concrete panels of the mosaic there are installed the downpipe of roof rainwater drainage system. Due to the lack of maintenance interventions for a very long time period, these water spouts lost (partially or completely) their function. For this reason, the rainwater coming from the roof, does not easily follow its predefined flow, and in some point it can get collected within these rainwater spouts, which are right behind the concrete panels. With the passing of the time, in continuous presence of water and garbage, these rainwater spouts have been deteriorated, letting the water leak out of them, being infiltrated to the concrete panels, sometimes reaching the metallic grill and corroding it. In the continuous water presence, the iron gets corroded and expands its volume up to 2.5 times. The pressure caused by the iron expansion due to corrosion, gets transmitted to the concrete and mosaic surface, causing this way, the tesserae detachment.
- The deteriorated water spouts are not the only way that the water can leak up to the concrete panels. Another cause is linked to the poor construction quality at the time of construction, like the cracked concrete panels. As it has been mentioned at the paragraph 2.2, the site works are not performed by the mosaic specialists, but by the construction workers. One of the concrete panels, during the transport from the construction factory to the Historical National Museum building, has been cracked, and it was mounted at the facade, anyway. After the installation of this panel, its cracks had been caulked with cement plaster. But this improvement intervention, was not enough, because the cracks already made this panel vulnerable. The cracked panel should have been replaced by another one, in perfect condition.
- The inappropriate material used to glue the tesserae on the facade (cement plaster), was another weakness linked to the mosaic construction technique. The cement plaster after sometimes hardens too much and it can be more hard than the tesserae

themselves, which means that during the atmospheric cycles, frosts-high temperatures, the tesserae will support the pressure, not the plaster.

- The negative using technique, by gluing the tesserae on paper and removing it afterwards, was another bad decision from the specialists. Using that specific glue, made it difficult the process of removing the paper from the tesserae at the end of works, and sometimes the glue caused deterioration to the mosaic tesserae.

After the deterioration causes analysis, below are listed the deteriorations that the mosaic manifests:

- Deterioration of the roof parapet (handrail);
- Cracks (*fissure*) on the mosaic surface;
- Missing of single sporadic tesserae (detached);
- Missing of a group of mosaic tesserae, creating the lacunae;
- Exposed fragments of the metallic grill of the concrete panels;
- A stubborn layer of dirt accumulated on the mosaic surface, due to the fact that the mosaic has been exposed for a long time to the atmospheric phenomena and air pollution.



Fig. 25 – Deterioration of the roof parapet (handrail)



Fig. 26 – Cracks presence



Fig. 27 – Lacunae presence



Fig. 28– Exposed metallic grill

3.2. Deterioration analysis of retaining structure

3.2.1. Deteriorations of the general structure

The evaluation of substructure C, based on the existing project, where the mosaic serves as structure façade, is based upon the assessment of the time window when the project has been executed, technical codes used in planning and execution of the project, as well as the geological, architectural, structural, mechanical and electrical projects.

The structural details are known from the original executive construction drawings and limited in-situ inspections.

Overall assessment of the degradation of substructure C is presented below:

1) Design life of substructure C

The design life of substructure C, is towards its end. The design life of some elements are affected by environmental factors such as:

- Moisture, humidity and rain.
- Wind.
- Temperature and temperature fluctuations.
- Pollution.
- Solar radiation.

The Mosaic itself is affected by all the above factors.

2) The effect of seismic loads.

The first seismic map of Albania dates back to 1952. An improved version of it has been published in 1963. The current seismic regionalization map dates back to 1979. Since 1952, due to improvements made on each version of the seismic map, the seismic danger was increased each time. The structural planning process of the National Museum of History has been done before 1979, resulting not only in old building codes being used, but also being based upon an old version of the seismic map, which had at the time, low intensity seismic values of the anticipated earthquakes. It is observed that the projected seismicity, upon which the project was completed, had a magnitude of 6, according to MMS. This selection refers to the seismic map, published in 1963.

The reevaluation of the seismic activity for the main supporting substructures is dictated from the adjustment of the building technical codes for anti-seismic buildings.

3) Use of the building and loads

It is observed that the use of building has been classified since its first conception as: National Museum. In continuity the use of building has not been changed, however due to the adjustment of the building codes, the load values have been lower than the current Eurocode recommendations.

4) General visual evaluation of the supporting structures

Visually, cracks can be observed on the floor levels of substructure C. They are mainly exhibited in areas where the precast panels are connected with one another and in some cases, in structural element joints.

Panel displacements in substructure C are not affected by mosaic transmitted loads, as side beams T-81, T-82 of the facade, serve as connections between the side columns as well as withstand the load of the mosaic transmitted to the columns. Precast panels of the floors do not directly transmit loads on the above beams. Reference, Page. Nr. 356/K-304 of the existing structural project.

5) Mechanical properties of structural materials

Supporting structural materials are concrete, steel and plates of the steel structures between precast elements.

- **Concrete**

Non-destructive tests are executed without damaging the structure. The evaluation of the concrete state has been done for the structural elements of substructure A, B, C, D using the Schmidt hammer. This test is called "the non-destructive test" and is executed directly on the structure, providing an indication of the compressive strength of the concrete. The test consists of pressing the hammer firmly at least 10 times on a 15x15cm area. The results are based on Gauss curve. Furthermore, at least 10 different structural elements of the existing structure need to be examined in order to give an accurate result for the compressive strength of the concrete.



Fig. 29 –Schmidt hammer concrete evaluation

Tests are taken randomly on the supporting structural elements of all 4 substructures. The average results which show the compressive strength of the concrete are shown in the table below:

Level / Element	Compressive strength of concrete [N/mm ²]
Level 3 / Column 1	51.63
Level 3 / Column 2	54.64
Level 3 / Column 3	50.13
Level 3 / Column 4	55.09
Level 2 / Column 1	53.36
Level 2 / Column 2	44.00
Level 2 / Column 3	55.64
Level 0.00 / Stairs	44.50
Level 0.00 / Column 1	57.61
Level Podrum / Column 1	57.80
Level Podrum / Column 2	57.23
Level Podrum / Column 3	54.08
Level Podrum / Column 4	63.10
Average value	53.75

In the existing project, the strength of concrete is M300, which corresponds approximately to C25/30 according to Euro code 2.

Tests are executed in columns, as beams and panels in the pavilions open to the public, are covered by gypsum layers. The mosaic area is not directly proved, as it is impossible to find a direct contact zone of the panel concrete. The Mosaic panels are part of the initial project.

- **Steel**

The assessment of the yield strength of steel is based upon the technical drawings of the existing project, where the steel used has a calculation strength of 2100daN/cm².

Conclusions

1. Substructure C presents a high physical degradation level, due to the adjustment of building codes as well as due to time factors.
2. The Mosaic is the façade of substructure C, affecting through its own weight the structural system of the substructure. The structural elements, where the Mosaic is supported on, are precast reinforced concrete panels.
3. The physical and technical degradation of substructure C, affects directly to the degradation of the Mosaic.

3.2.2. Deteriorations of the Mosaic's structural elements

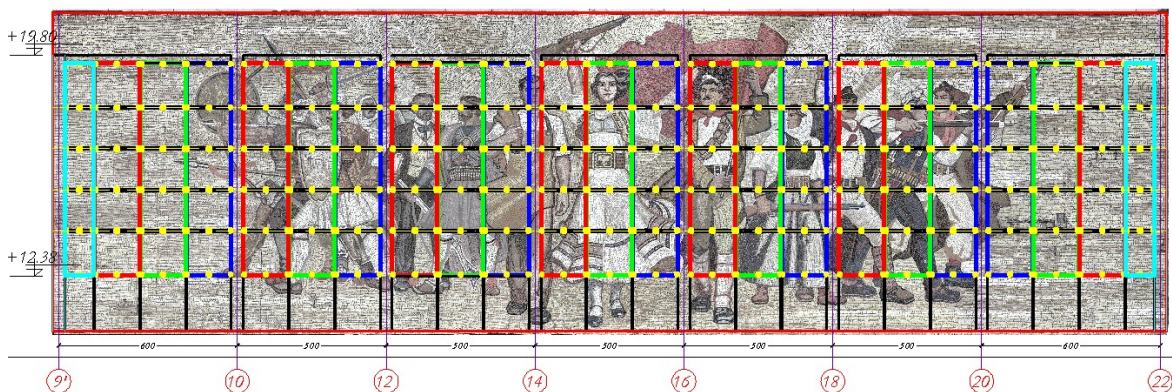


Fig. 30 – View of precast concrete panels

The assessment of the degradation of the Mosaic's panels is based on the following factors:

1. Structural and detailed design
2. Joints' exposure level
3. Effect of water either directly or indirectly on panels and joints
4. Relative humidity and temperature change
5. Geometry of the structure, space between the panels and ties
6. Quality of concrete, concrete cover of reinforcement and the presence of cracks on the panels, ties and main supporting beams
7. Dimensions of structural elements
8. Investigation level
9. Maintenance and adjustment of humidity levels, where the panels meet each other.

The degradation level of the structural elements has been visually assessed. The mosaic has a surface area of approximately 565 m². As supporting structural elements of the mosaic serve 23 precast concrete panels, connected through ties with the façade masonry and the beams of substructure C. Noted issues have been assessed based upon the position of the Mosaic's panels.

In order to visually evaluate the degradation of the structural elements of the mosaic, joints have been positioned on panels and beams. The complete overlap has been presented in the photo above.

Deterioration assessment of the precast panel linking joints on Mosaic's front side

Cracks and spalling have been noted on the Mosaic façade, where the reinforcement steel has been exposed. The position of cracks and spalling gives information on the damage level between the panels and the structure and between the panels themselves.

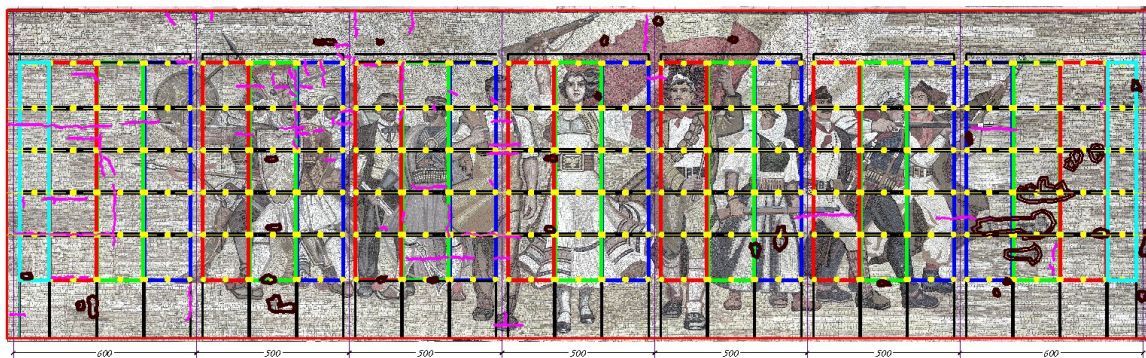


Fig. 31 – Cracks and spalling of concrete (---) Cracks (-----) Spalling

Cracks are located in irregular positions and are caused from the lacking of fugues, as the exposed area (Mosaic area) is large.

Generally, there are no cracks and spalling where the Mosaic's steel plates are located. In some cases, mainly between axes 20-22, but also on certain positions, there is an overlap between the cracks/spalling and the linking plate, according to the technical project. According to visual observations, there is no notable rust, which shows consequently neither visual signs of oxidation processes nor exposure of the Mosaic's façade to outside agents.

Crack and fractures, positioned as shown in the figure above, show exposure of the panel steel bars, which appear to have an advanced level of oxidation. The appearance of the exposed heavily oxidized bars shows a significant reduction of the panel supporting ability. This phenomenon is more intense in the area between axes 20-22.

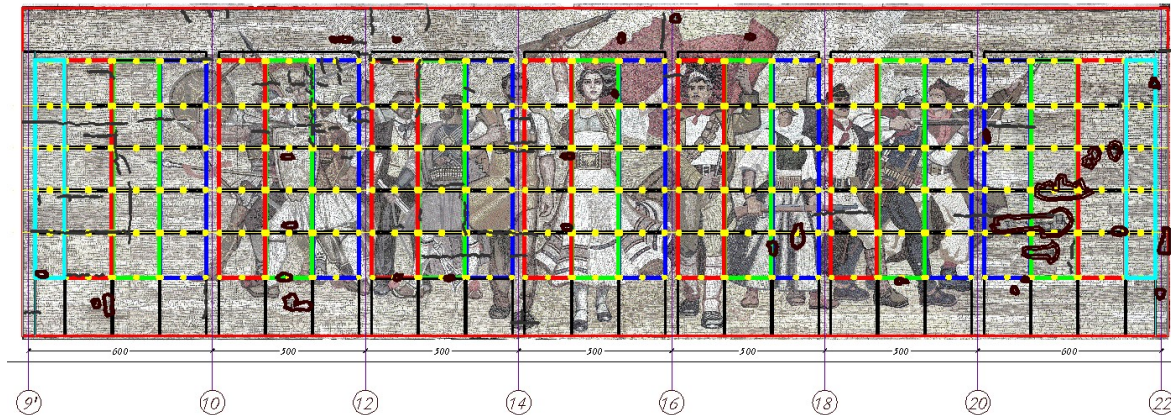


Fig. 32 Spalling of concrete

The degradation scale of the structural elements has been visually assessed. 23 precast concrete panels connected through ties with the façade masonry, serve as supporting structural elements of the Mosaic. The following concerns have been noted:

- a) The assemblage of the Mosaic on the precast reinforced concrete panels has been completed without the presence of the fugues, creating a large area exposed to environmental conditions. This has introduced cracks on the supporting panels.
- b) The mortar layer on the panels has been detached from them on certain places, due to the temperature fluctuations. The influence of the mortar layer cracks on the supporting panels has caused again a direct exposure of these areas to environmental.
- c) The panels are channel precast panels with a side thickness of 6cm. The reinforcement is a double mesh $\varphi 4$ type. The cover concrete of the panel has a tiny thickness of just 1 cm. It is observed that in the exposed zones there has been a reduction, up until total destruction of the protective layer, exposure of the panel reinforcement as well as a reduction of the reinforcement area, due to oxidation processes. The steel plates are not exposed on the Mosaic Façade.
- d) The presence of moisture raises the negative impact of this phenomenon not only on the steel structures, that link the panels, but also on the steel elements of the reinforced concrete. The corrosion of the reinforcement increases the steel volume, which is accompanied by concrete cracks as well as reduction of the cohesive forces between steel and concrete. Consequently, the structure has a lower supporting ability and a lower number of linking joints.

3.3. The analysis of the deterioration of the rainwater discharge system.

The problems of the rainwater discharge system start from the degradation of the roof drains which are not according the standards and totally amortized. There are leaks out of the column pipes that damage not only the building but also the inside structure of the mosaic (panels, their connections etc.) which are transmitted in the mosaic and intensify its damages.

Discharge columns pipes and fittings are made of cast iron, with old techniques of joining that are not usable in now days and totally amortized. There are a lot of water loss in the columns that flows outside uncontrolled causing and intensifying the corrosion of the metallic components of the mosaic reinforced concrete panels and the carrying structure.

Another problem is the degradation of the roof parapets above the mosaic area. Through the creation of the joints disconnection of this cover, there are created spaces through which enters the rainwater and flows into the interior of the mosaic, thus affecting the deterioration of its degrading conditions.

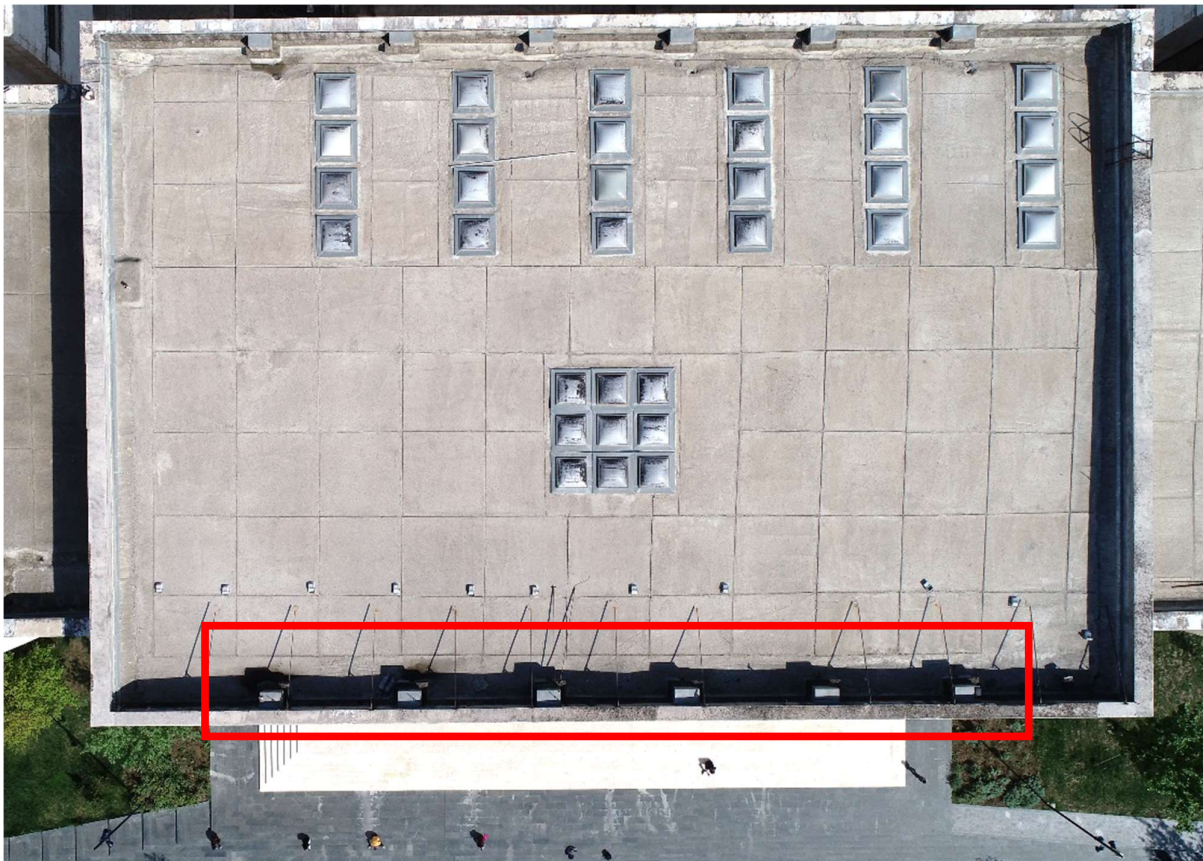


Fig. 33– Roof view in which are visible the rainwater drains



Fig. 34 – Drain images that are not according the standard and totally amortized



Fig. 35 – Drain images that are not according the standard and totally amortized



Fig. 36 – Drain images that are not according the standard and totally amortized

In the presence of rainwater, the mosaic reinforced concrete panels are even more damaged by the absorption of moisture from the hygroscopic phenomenon and the high capillary that represents the low marks concrete and for reasons that are analyzed at point 2.5. Ne The damage to these panels is strongly intensified in combination with the phenomenon of climatic frost factors, in which the pressure and the increase of the ice volume between the gaps or concrete porosity destroys it in a progressively unstoppable way.

Also, the climatic factors, the summer-winter temperature variation cause cyclic thermal dilatations in the mosaic itself, in the tesserae, in their adhesive with concrete plates and with them self. This causes a tense disturbance between the differences in behaviors and the different values of thermal expansion of mosaic tesserae, adhesive and concrete plates, creating the phenomenon that in the technique is called fatigue as a result of which the intersection is further intensified between them, causing the breakdown and the decline of mosaic tesserae, the visible division of the panels creating cracks especially in the vertical direction etc.

The damage of the structure of the supporting construction and the fixing of the panels is foreseen to be even more problematic, since being an exposed structure, their corrosion due to the presence of water should be even more advanced. This is a very serious problem since the

structure is made of low marks carbonic steel (for an easy welding), but that represents a high enough and uninterrupted corrosion ability. The damage of this structure is obvious, posing risks to the sustainability of the mosaic plates and therefore poses serious problems for its existence

Another important factor is the fact that the aggressive corrosion of the metallic structures with carbonic steel, increases from the worst combination between the presence of polluted and water with high carbon-monoxide contain. In this environment, salts are created that intensify the corrosion process.

Also, all welding connections for the very nature of its technological process, creates unavoidable oxidation zones of carbonic steels, which create deep corrosion and which, over time, intensify to the loss of bonds between the parts and the breakdown of the them. In exposed and long-term metal structures it is not allowed to be welded (but only ribatine or bolted), in addition there is a special attention to production and monitoring of degrading factors such as corrosion (parts are made of galvanized zinc coating melted in hot) etc. Precisely for this reason, the application of an incorrect technology during its construction, as well as the lack of materials for deoxidize and further corrosion protection of welded joints etc., we think that it is immediately needed to make a verification and analyze of the technical condition of all metal structures with enough responsibility and as soon as possible, and even eventually, to prevent any unwanted events. In order to carry out the supervision and evaluation of the technical condition of the metal structure of the mosaic, it is necessary to proceed with partial or total dismantling of the mosaic, removal of concrete panels and verification of its condition in general, verification of the metal structure joints with the panels and with columns of the building, etc.



Fig.37- the pit picture of the rainwater discharge columns which is in a position and dimension inaccessible for inspection. It is distinguished the inadequate technique of building of the pit as well as the degradation of the cast iron pipes, their joint etc.

Evaluating all the factors known as the cause of the degrading of the National Historic Museum mosaic, as well as the factors presumed as potential factors of degradation, in analogy with similar experiences in constructions built in opposition and without respecting technical norms etc. , as well as in the context of risk factor assessment for the quickest prevention of unwanted events, our conclusions are that the intervention strategy for mosaic rehabilitation should consist of a capital reconstruction and precisely in intervening in constructive elements , in the engineering elements and in the architectural and reclamation elements as follows.

The elimination of water discharge columns that are positioned behind the mosaic considering the possibility of modifying the rainwater discharge system functioning with the purpose of discharging the rainwater discharge columns in the northern part of the building (from the inner courtyard). the elimination of the columns behind the mosaic is necessary and undisputable, regardless the conclusions of the other aspects of disciplines, architectural, constructive and restorative disciplines.

4. RESTORATION INTERVENTIONS

The restoration interventions for this project consist in the reconstruction of part of the museum building and the restoration of the mosaic façade.

For the rescue and rehabilitation of the mosaic "Albanians" the intervention will firstly be in the reconstruction of the mosaic roof to remove the rainwater from the mosaic facade, to permanently avoid the danger of rainwater and then it will continue in the reinforcement of the retaining support structure, where necessary, and then proceeds to the proper restoration of the mosaic and its tesserae.

For this reason, restorative interventions are listed in the following subchapters in this order:

Për këtë arsye, ndërhyrjet restauruese renditen në nënkapitujt e mëposhtëm sipas këtij rendi:

- 4.1. Restoration Interventions - Rehabilitation of the rainwater drainage system;
- 4.2. Restoration Interventions - Rehabilitation of the retaining structure;
- 4.3. Restoration Interventions – Restoration of the mosaic.

4.1. Restoration - rehabilitation interventions in the rainwater drainage system

4.1.1. Proposed interventions for rainwater and humidity regulations

These interventions consist in eliminating the function of the rain columns behind the mosaic and the construction of a new system of rainwater columns in the northern part of the roof.

Collection of roof waters to be discharged into the new columns of the northern part requires the change of the slope of the roof from the slope toward the southern part - as it is currently, with a slope toward the northern part. For this purpose, a new roof with new constructive-architectural layers, with new slopes of water collection, should be constructed.

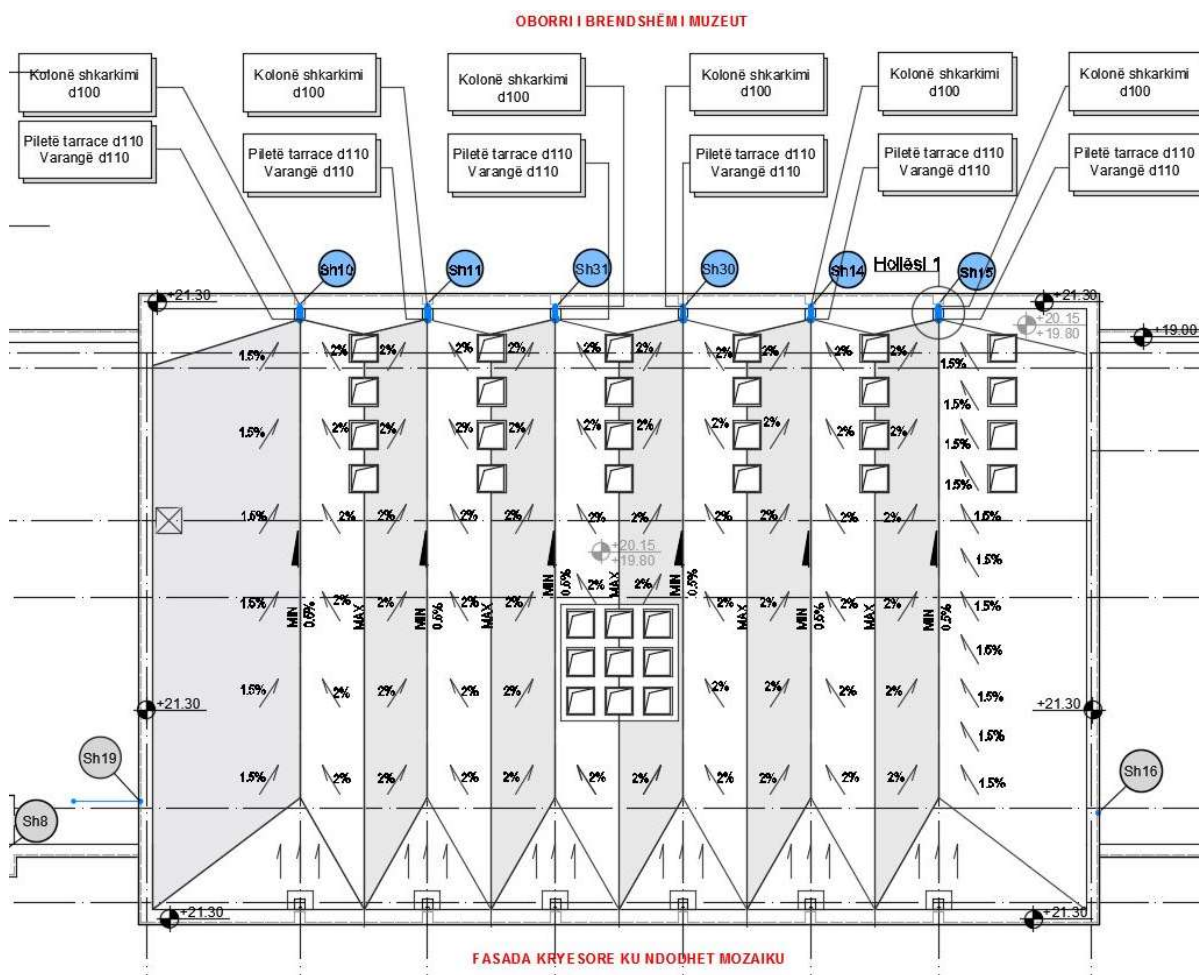


Fig. 38- Roof plan proposal

The change of the position and function of the discharge columns in the northern part of the roof, requires the change (increase of capacity) of the corresponding underground pipeline system to the inside courtyard of the museum as well as the increase of the number of the pits in accordance with the way of building new columns.

Also, the elimination of the columns behind the mosaic requires extraction from the function of the pits and the corresponding part of the underground pipeline network belonging to these columns in the front at the entrance of the museum.

All rehabilitation interventions of the rainwater drainage system, from the existing mosaic-system in the new system to the northern part of the roof with discharges to the reconstructed ground network in the museum's inner courtyard, are presented in the implementation projects below.

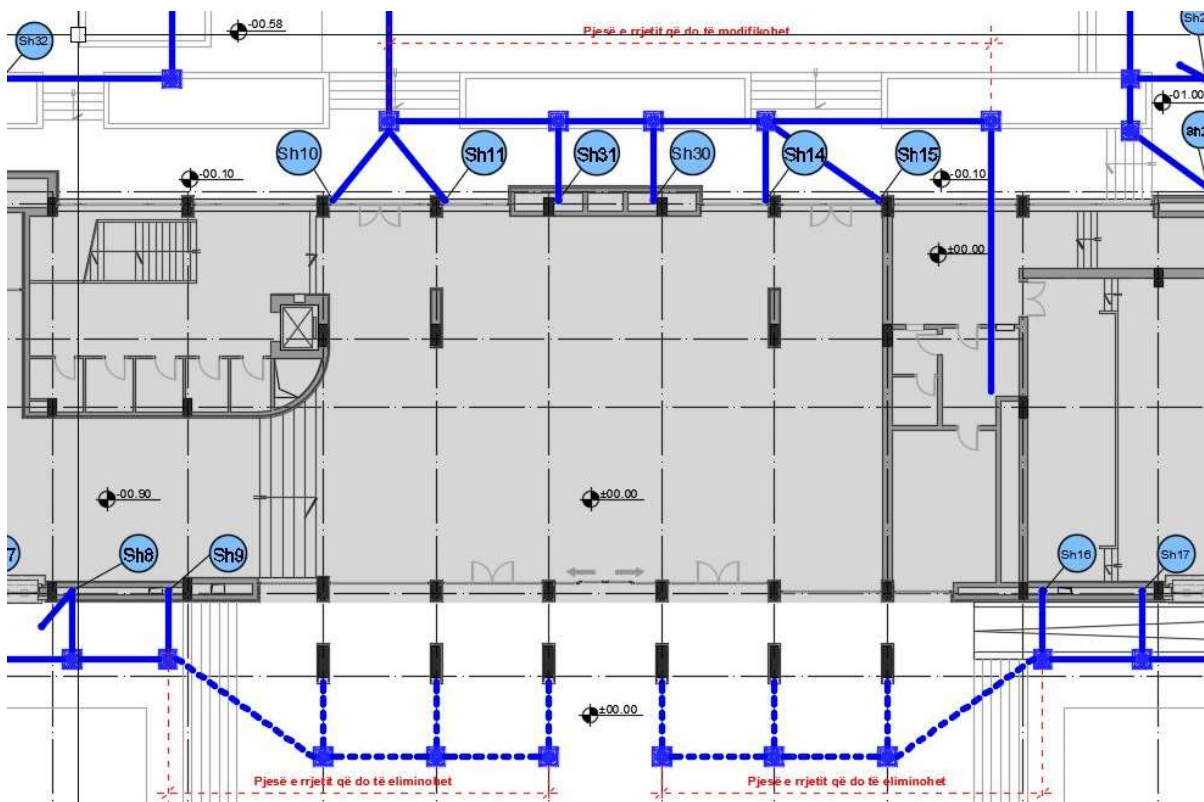


Fig. 39 – Concept idea – Interventions – Rainwater drainage system

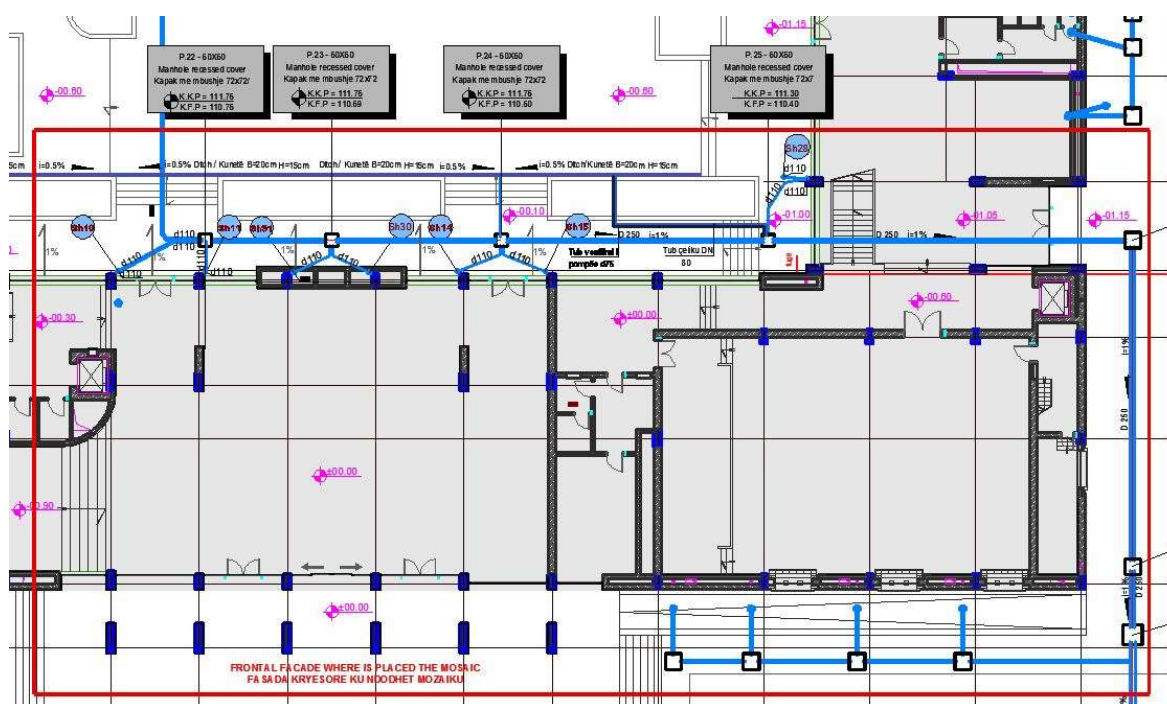


Fig. 40 – Interventions - Rainwater drainage system

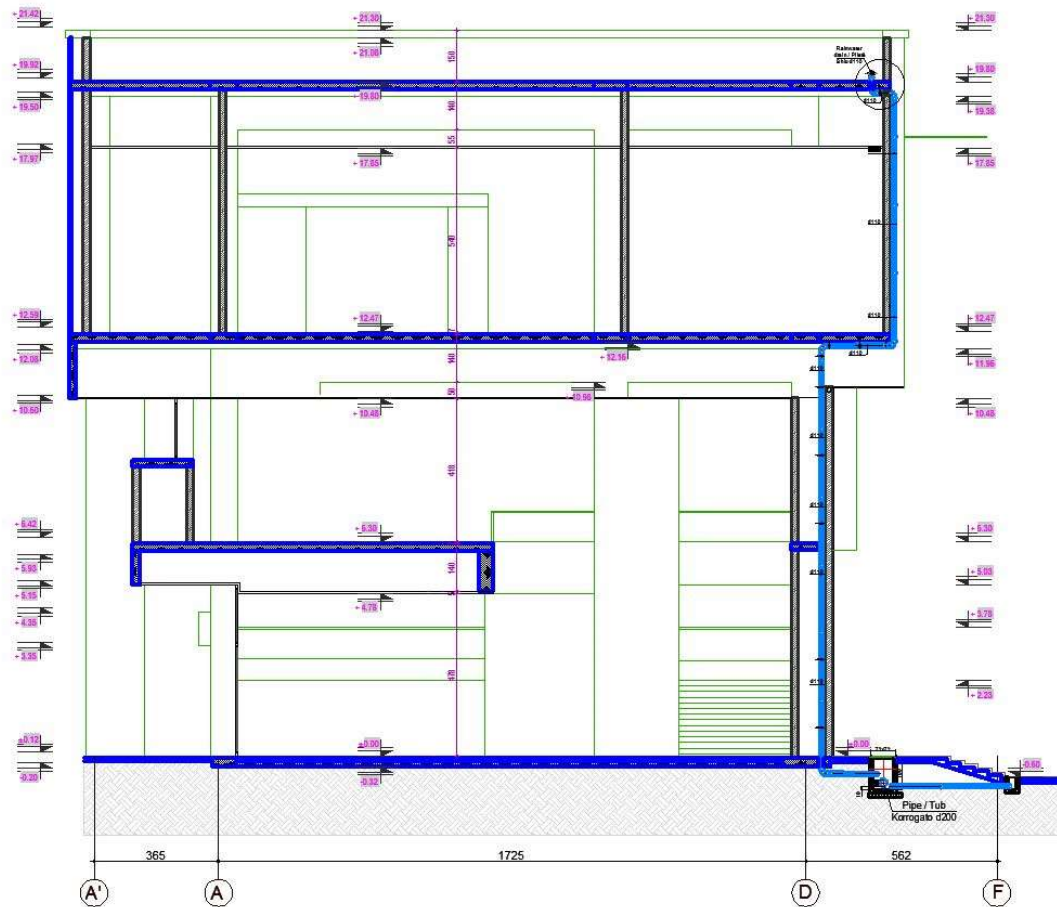


Fig. 41 – Interventions - Drainage columns view, in cross section

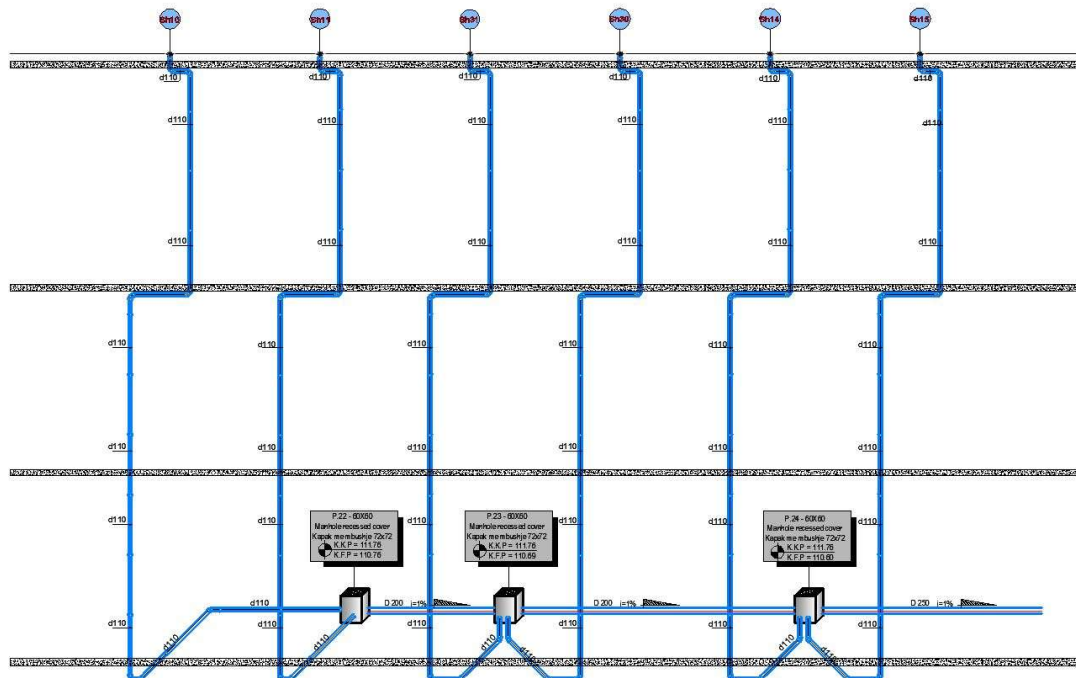


Fig.42 – Schematic preview of rainwater discharge columns

4.1.2. Waste water discharge system - Technical specifications

Discharge pipe + fittings

Polypropylene pipe is a polymer without color, odor, nearly transparent and partially crystalline structure which means it can be paint with a lot of colors and have a smooth surface and shiny. Is distingue from below characteristics:

Parameters	Value	Test Method
Density 23°C	>1.02 g/cm ³	EN ISO 1183-2
Elasticity Module	1500Mpa	ISO 527-2
Melt Index230/2.16	>5.0 g/10min	EN ISO 1133
Temp. of melted than crystals	≥160°C	EN728
Linear expansion coefficient	0.08	-
Noise level 2 l/s	12dB(A)	EN 14366

Nominal diameter Dn (mm)	External diameter. DE(mm)	The average external diameter, minimum, and maximum (mm)		Thickness s (mm)	
32	32	32.0	32.3	1.8	+0.4/0
40	40	40.0	40.3	1.8	+0.4/0
50	50	50.0	50.3	1.8	+0.4/0
70	75	75.0	75.4	2.6	+0.5/0
90	90	90.0	90.4	3.1	+0.6/0
100	110	110.0	110.4	3.4	+0.6/0
125	125	125.0	125.4	3.9	+0.6/0



Fig. 43 - Discharge pipes

Roof drain

Roof drain for water discharge, should ensure high water flow, according to UNI EN 1451.

- Material PE
- Dimension DN 100
- Weight 0.1800kg
- Depth 57 mm
- Completed with electric resistance



Fig. 44- Roof drain

Manhole recessed cover D400

This kind of manholes is used to be invisible at areas where it is placed.

- Solid steel base plate
- Double sealed cover, impermeable by water manhole cover
- Completed with lifting keys & locks
- Brass edge & stainless-steel edging available

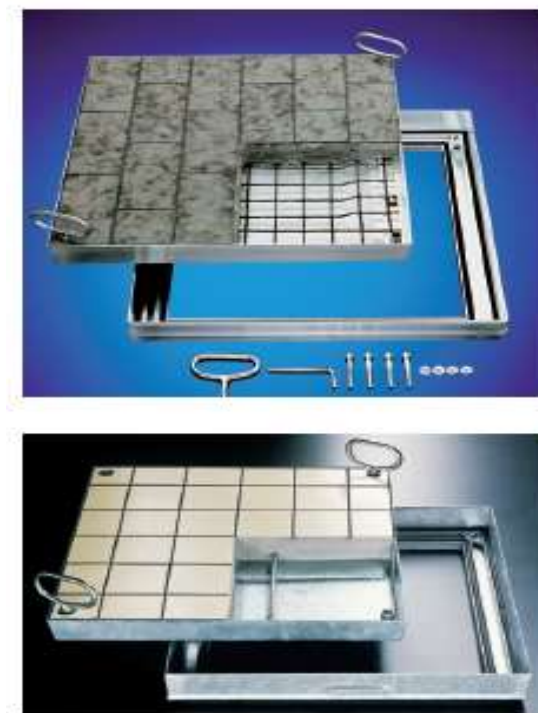


Fig. 45 - Manhole recessed cover D400

Corrugated pipe PP

- The technical characteristics that these tubes should have are:
- High resistance to loads that can be exerted on, including their covering layer and the weight of cars passing over the road. According to the standard ISO9969 the loads to be covered by these pipes should range from 2 to 16 KN / m².
- High shock resistance eliminating the possibility of creating cracks during transport, storage and assembly especially at low temperatures. These tubes should have a modulus of 1.0×10^3 M Pa elasticity. High network resistance over the years.
- Taking into account the thermal extensions that occur during the change of temperatures, these pipes should have a linear thermal expansion coefficient $(1.7 \pm 2) 10^{-4} \text{ C}^{-1}$.
- High resistance to various chemicals and to seismic impacts.

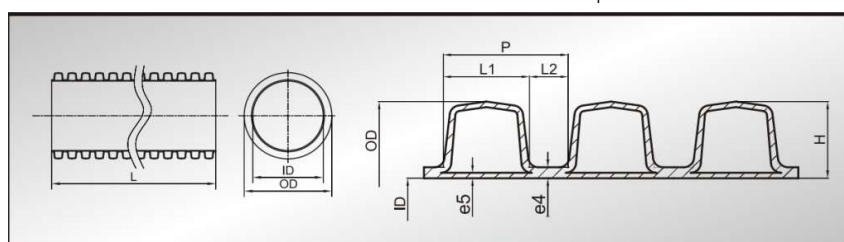


Fig. 46 Corrugated pipe PP

4.1.3. Roof layers

The roof layers are provided with the relevant detail, according to the technical drawings

- Insulating layer with thickness $t=12\text{cm}$, with rock wool 175 kg/m^3 , in line with the instructions in the design, laid in order to form a unique surface.
- Vapor barrier layer with aluminum barrier, placed before the insulating layer.
- Protective layer with geo textile artificial blanket, laid over the insulating layer of rock wool.
- Polished cement layer applied on the damaged areas
- Light concrete layer for sloping, between geo textile layer and waterproofing layer
- Setting (before waterproofing) of the new zinc coated tin roof tapes, and everything else necessary to guarantee the perfect functioning of the drainage system;
- Waterproof layer PVC $t=5\text{mm}$, plus metallic fastening accessories, on a surface leveled in advance, including the vertical parts, on all the angles and corners rounded well beforehand, treated 100% with adhesive.
- Gluing layer PVC, applied according to the T.D. specifications, including the vertical parts, on all the angles and corners rounded well beforehand, treated 100% with adhesive.
- Granulated stone concrete layer $t=4\text{ cm}$, with electrodeposited carrier $\varnothing=6\text{mm}$, $20 \times 20\text{ cm}$
- Coating of the parapet frames with zinc coated tin $t=3\text{ cm}$
- Placement of gutters in the rain wells.
- Any other thing necessary in order to complete the roof perfectly.

4.1.4. Roof layers – Technical specifications

4.1.4.1. Vapor barrier layer

Furnishing and placing of vapor barrier layer with these characteristics:

- a) Minimal thickness 0.20 mm (UNI EN 1849 - 2)
- b) Steam proof resistance (μ) $240\,000$ according to the normative (UNI EN 1931)
- c) Reaction class from fire F (UNI EN 13501 - 1)

4.1.4.2. Waterproofing layer with PVC 5mm

Furnishing and placing of PVC membrane with 5 mm thickness, reinforced with polyester mesh, resistant to UV rays, atmospheric agents, plant roots and with Termofusion welding.

Pvc membrane must be classified as fire "BROOF T3" according to UNI EN 13501 - 5 and UNI ENV 1187 normative.

Mechanical fixation of the membrane should be performed with zinc- metal plates and white zing system "GUARDIAN" screws. The calculation of mechanical fastening shall be performed in accordance with UNI-EN 1991-1-4 normative. In the join points with parapet, should be used the curved metallic element in both extremes and must be fastened mechanically in parapet. At the upper part, a 4 mm Pvc thread should be welded.

The membrane closing element on the parapet should be a 5 cm wide Pvc coated sheet and a 45 ° upper corner which should be sealed with polyurethane silicon.

4.1.4.3. Adhesive layer

Adhesive produced on elastomeric base, in a solvent based solution, single-component, liquid with low viscosity, resistant to water.

Application method

The supports must be clean and without inconsistent elements on the surface.

The adhesive must be spread and leveled using a toothed brush or roll or another similar tool applied on the whole surface of the two layers to be glued.

After verifying the status of stickiness, couple the two layers exerting on them a pressure by metal or rubber roll.

The setting of the adhesive is immediate while maximum adhesive level is obtained within few days.

The laying tools can be cleaned with acetone or methyl ethyl ketene.

Specific instructions

Do not use for bonding on polystyrene.

Do not apply on wet support.

With a temperature below 10 ° C facilitate the evaporation of the solvent using hot air.

4.1.5. Skylights

The skylights are factory-made and instantly assembled. The skylights will be fixed and unopened.

Double glazed

The 8 mm exterior glass panel is efficient in conveying energy. The space between two glass windows is 18 mm and is filled with argon gas, then comes the interior glass, with 6.8 mm thickness.

U-value 1.4 W/m

Light transmission 42%

Energy transmission 50%

Noise reduction 32 db

Frame and seal

Flexible EPDM ensures complete weather tightness between roof and flashing.

4.2. Restoration intervention- Retaining structure

4.2.1. Proposed interventions in the general structural system

The structural system of substructure "C" has been analyzed according to the loads specified in the Eurocode0, 1. It is noted that, with the parameters of the seismic risk of Tirana, the substructure "C" generally requires a reinforcement on certain elements, mainly in column positions. The columns, on which the Mosaic is supported, do not pose a problem that requires a retrofitting intervention. The presence of masonry columns and ties, where the Mosaic panels are supported, provides enough stiffness.

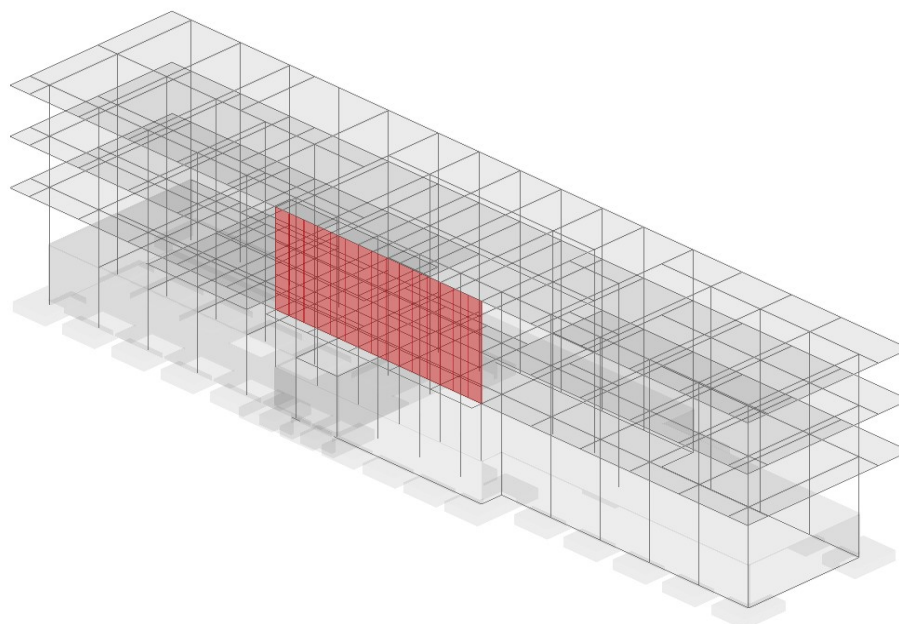


Fig. 47 - The position of Mosaic on the structure scheme

4.2.2. Proposed interventions in mosaic support panels

The selection method, repair or reinforcement, is determined depending on the degree of damage.

Repair of the supporting panels

An efficient method for treating cracks in structural elements of small dimensions that do not exhibit deep damage to the protective layer of panels is the use of epoxy materials.

The use of epoxy materials:

Epoxy may be used in case of small cracks from 0.05 mm up to 20 mm that do not appear in deeper layers of the structure or armature.

1. The first step is to clean the cracks that have been contaminated; to the extent this is possible and practical. Contaminants such as oil, grease, dirt, or fine particles of concrete prevent epoxy penetration and bonding, and reduce the effectiveness of repairs.

Preferably, contamination should be removed by vacuuming or flushing with water or other especially effective cleaning solutions.

2. Surface cracks should be sealed to keep the epoxy from leaking out before it has gelled. Where the crack face cannot be reached, but where there is backfill, or where a panel-on-grade is being repaired, the backfill material or sub base material is sometimes an adequate seal.

A surface can be sealed by applying an epoxy, polyester, or other appropriate sealing material to the surface of the crack and allowing it to harden. The drying time, which is only a few hours, must be held in order to achieve the required end results. If a permanent glossy appearance along the crack is objectionable and if high injection pressure is not required, a strippable plastic surface sealer may be applied along the face of the crack.

When the job is completed, the surface sealer can be stripped away to expose the gloss-free surface. Cement seals can also be used where appearance of the completed work is important.

3. The mixing of epoxy is done either by batch or continuous methods. In batch mixing, the adhesive components are premixed according to the manufacturer's instructions, usually with the use of a mechanical stirrer, like a paint mixing paddle. Care must be taken to mix only the amount of adhesive that can be used prior to commencement of gelling of the material.

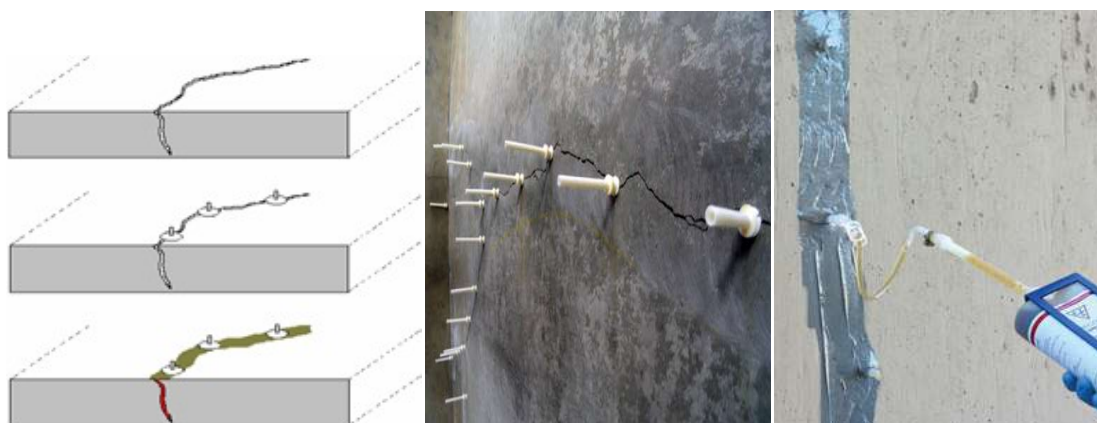


Fig. 48 - Method of concrete crack repair with Epoxy Resin

4. Hydraulic pumps, paint pressure pots, or air-actuated caulking guns may be used to inject the epoxy. The pressure used for injection must be selected carefully. Increased pressure often does little to accelerate the rate of injection.

If the crack is vertical or inclined, the injection process should begin by pumping epoxy into the entry port at the lowest elevation until the epoxy level reaches the entry port above.

For horizontal cracks, the injection should proceed from one end of the crack to the other in the same manner. The crack is full if the pressure can be maintained. If the pressure cannot be maintained, the epoxy is still flowing into unfilled portions or leaking out of the crack.

5. After the injected epoxy has cured, the surface seal should be removed by grinding or other means as appropriate.

4.2.3. Retrofitting of the support panels - Technical specifications

Reinforcement interventions in the Mosaic retaining structures take place only in the damaged part of the panels, as mentioned in Chapter 2. It is observed that damage to the protective layer of the panels, exposure of the armature to the outside environment as well as corrosion are all present problems. Therefore, the method of reinforcement will be used for the repair process of the panels.

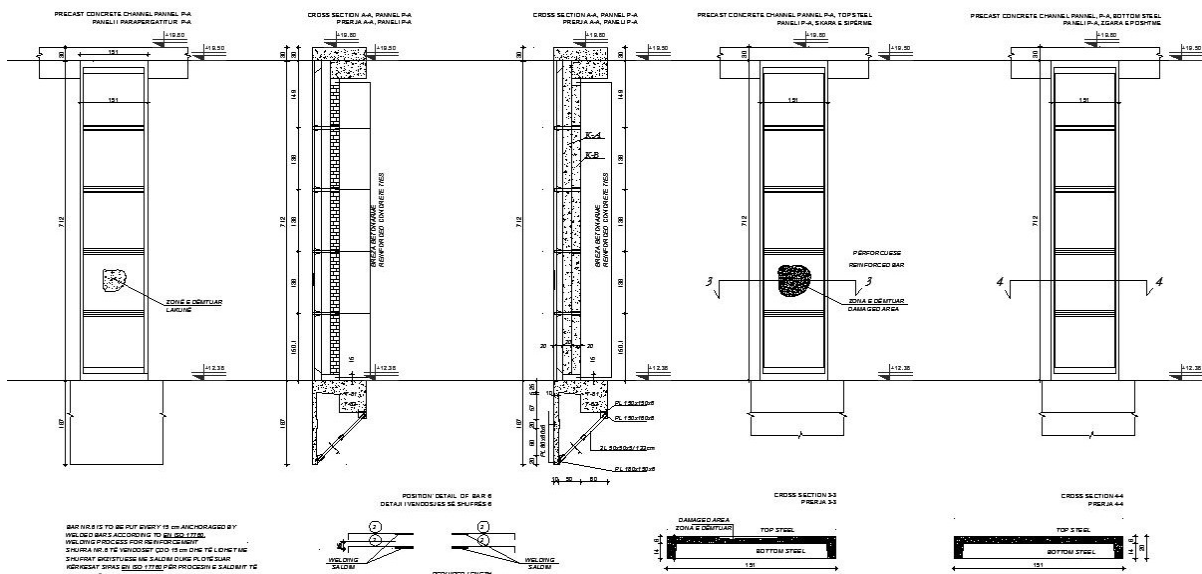


Fig. 49 – Retrofitting of the support panels

1. Firstly, the already damaged layer are to be thoroughly cleaned. Remove any loose concrete from the spalled surface. Chipped or splintered pieces can be removed using a cold chisel and hammer.

2. Cut a square around the spalled concrete 1 cm deep using a circular saw.

3. Use the chisel and hammer to break away the concrete contained in the cut area. Expose the reinforcing bars beneath the surface of the concrete and break away any concrete attached to the bars.
4. Brush any rust away from the bars using a wire brush. Examine the ends of the bars still covered in concrete. If rust is still present, cut and clear away the concrete until you reach an un rusted section.
5. Replace the damaged parts of the bars with reinforcing steel bars, diameter $\phi 6\text{mm}$, by welding them with the existing panel bars, or by adding them in between. The existing bars on the outside wire mesh are every 30cm. With the addition of the steel bars on the damaged areas, the distance between is set to be 15 cm. The bars are to be brushed with antirust paint.
6. Brush a layer of epoxy adhesive to the cleared concrete surface. Allow the epoxy to dry until it is tacky but not wet. The adhesive trait will help create a bond between the old and the new concrete.
7. The concrete will be produced inside a concrete mixer by mixing the ingredients of Concrete C25/30 with fine aggregates, whose diameter must not exceed 10mm.
8. Fill the cracks in the concrete with the new concrete mix using a trowel. Pack the hole tightly, leaving no gaps that may weaken the wall.
9. Use the trowel to smooth the surface of the concrete patch with the surrounding surface of the wall.
10. Cover the new concrete with a plastic sheet to keep the water in the concrete from evaporating too quickly as the concrete cures. Lift the sheet after 48 hours and spray the concrete with a fine mist of water to ensure that it remains wet enough. Remove the sheet after two weeks and then allow the concrete to cure completely for another week to 10 days.
11. The fugues are to be placed in axes 10_20, every 5m in the mortar layer of the support panels, with a width of 10mm.

Based on the panel connection mode, the degradation investigation should be carried out by removing bricks from the existing masonry, positioning wall ties as well as panel pickup points on each panel. This investigation was not carried out at this stage due to the fact that the wall where the wall ties are positioned has been covered with gypsum panels and the pavilions are open to the public.

Moisture control is one of the important factors to ensure the durability of panel joints as well as the panels themselves.

4.2.3.1. Technical specifications of used materials

Epoxy resin for iron dyeing, FERROSEAL-CSI

Water-based emulsion with high penetrating ability that acts as a corrosion inhibitor of steel reinforcement. FERROSEAL-CSI penetrates the concrete and forms a protective layer on the surface of the reinforcing steel. Ideal for repairing reinforced concrete surfaces. Also suitable as an anticorrosive protection for reinforced concrete structures exposed to aggressive environments.

Technical data:

Form: liquid

Color: transparent

Density: 1,02 kg/l pH: 11

Epoxy resin for concrete injection DUREBOND

Durebond is two-component epoxy system without solvents complies with the requirements of ASTM C 881-90, Type II, Grade 2, Class B+C, classified as a structural bonding agent for concrete and as a product for concrete injection, according to EN 1504-4 and EN 1504-5.

Basis: two-component epoxy resin.

A-component color: grey

B-component color: brownish green

A+B color: grey.

Technical data:

Viscosity: 2.500 ± 500 mPa. at $+23^{\circ}\text{C}$

A-component density: 1.57 ± 0.03 kg/lit

B-component density: 1.04 ± 0.03 kg/lit

A+B density: 1.47 ± 0.03 kg/lit

Mixing ratio (A+B): 100:20 by weight.

Pot life: approx. 40 min at $+20^{\circ}\text{C}$

Minimum hardening temperature: $+8^{\circ}\text{C}$

Final strength: after 7 days at $+23^{\circ}\text{C}$

Flexural strength: ≥ 40.0 N/mm² (DIN EN 196-1)

Tensile strength: 29.9 N/mm² (ASTM D 638)

Modulus of elasticity: 3,500 N/mm² (DIN 1048)

Water absorption: 0.29% w/w after 24 h (ASTM D 570)

Adhesion: > 3.0 N/mm² (breaking point of concrete)

The cement mortar used in the surface of the panels:

Cement/sand ratio is 1/3.5 and w/c ratio is 0.4. This means of 1 kg mortar, 0.4 part is water, 1 part is cement and 3.5 parts are sand.

Fugue filling, between mosaic structural panels, ISOMAT PUFOAM PROFESSIONAL:

One-component, self-expanding, low expansion polyurethane foam which cures by reacting with moisture in the air.

Technical data:

Base: Polyurethane

Color: yellow

Density: 18-20 kg/m³

Service temperature limits of cured foam: -55°C to +100°C

Film formation: 7-8 min (at 20°C, RH >30%)

Curing time: 1h / 93% RH, 18 h / 15% RH, max 24h

Reaction to fire (DIN 4102): B3

Shear strength: 0.07MPa

4.3. Restoration interventions – the mosaic



Fig. 50 - The mosaic "Albanians"

Interventions needed for the correction of the deterioration that the mosaic manifests due to the incorrect technique when it was originally mounted on Historical National Museum facade

After the detailed analysis, performed during the previous phases of the project and according to the National Council of Restoration's decision regarding the mosaic restoration intervention, the interventions will consist on a total remounting of the mosaic. This approach will ensure a better and longer durability of the mosaic and will prevent the recreation of the actual deteriorations.

During the restoration project implementation, will be necessary to establish a temporary atelier/office for the mosaic specialist.

4.3.1. The mosaic - Detailed phases of restoration work

The restoration interventions that will be implemented on site will be of two different kinds: preliminary peripheral interventions in order to cut off the cause of deteriorations (avoid moisture presence and its source); direct interventions on the mosaic (dismantling and recreation of it).

1. Identification and elimination of the moisture's source, in order to prevent the further moisture infiltration within the concrete panels

- Deviation of the roof drainage system from the vertical rain water spouts;

The main cause of the mosaic deterioration is moisture presence; which main source are the blocked vertical rain water spouts that are installed right behind the concrete panels. These spouts have lost their function due to the lack on periodical maintenance. The rain water that is accumulated on the roof's surface, is funneled toward the vertical spouts. The vertical water

spouts, being blocked due to the garbage accumulated inside them, cannot fulfill their function to pour the rain water toward the ground collector. So the rainwater gets stuck within the vertical spouts, or can leak out of them toward the concrete panels. The moisture/water can infiltrate to the concrete panel along their whole thickness, from the rear side, toward the mosaic surface. The metallic grill within the concrete panels, due to the moisture presence, has been corroded and has expanded its volume, causing pressure to the concrete panels and consequently to the mosaic surface; as the result we can see the metallic grill and several lacunae on the mosaic's surface.

In these conditions, what it can be done to prevent the further water/moisture infiltration to the concrete panels, is to totally avoid the roof's rain water funneling toward these spouts. The roof's water drainage system should be organized differently from the actual one.

- Moisture isolation of the roof's parapets on the southern facade of Historical National Museum, especially the parapets of the area over the mosaic.

During the conservation state investigation phase (the first phase of the project), there have been identified specific areas where the roof's parapet is deteriorated; the upper tile of the parapet is missing or is cracked, which can be a moisture source spot.

Isolating these spots is crucial for the future conservation state of the mosaic and for its maintenance. There will be replacement of the missing granite tiles; the new granite tiles will be of the same color and dimensions as the existing one. The cracks and the joints between two different tiles will be isolated by using waterproof plasters.

2. Direct interventions on the mosaic's surface; dismantling and recreation of the mosaic

Due to the large surface of the mosaic, the restoration works will be not executed at the entire surface at the same time; they will be implemented in smaller fragments in order to keep better under control all the restoration processes. The entire mosaic's surface will be divided into 8-10 fragments, 6 m wide and their length will be as the total height of the mosaic. For each fragment the processes will be exactly the same and they will be executed in these phases:

- The graphic and photographic documentation of the existing mosaic;

After the scaffolding installation, the implementation team leader in collaboration with the design team will define the fragments of the mosaic and will take high quality pictures of each fragment; the pictures will be printed in scale 2:1. Then, will take place the process of copying the scenes and figures of the mosaic using a transparent film (resistant plastic sheet, or tracing

paper), over which, with a felt tip pen will be designed the scenes and figures (sometimes even some single tesserae) in real scale.

- The dismantling phase;

Immediately after the graphic and photographic documentation phase, the mosaic will be dismantled from its support. During this process, will be evaluated the conservation state of each fragment, and only on site will be decided if there are areas in the original mosaic, that can be saved and conserved. The dismantling process will be executed using manual tools only, avoiding high vibrations that may be caused by the electrical dismantling tools. Will be removed all the mosaic's layers (tesserae, plaster and flattening layer), until the concrete panel's surface will be visible.

- The office/atelier's work phase;

In the office/atelier exclusively established near the site for the mosaic's restoration, will be recreated the new mosaic, strictly following the model of the original one. The pictures taken during the first implementation phase, will be high quality printed in scale 2:1 and will be used as the main guide for the new mosaic. Then, the drawings done also during the first implementation phase on the transparent film (tracing paper), will be fixed over the table. Over these drawings will be fixed a plastic net, like the usual one that it is widely used in architectural finishes work, and over this plastic net will be fixed the mosaic tesserae following the drawing in the tracing paper. Then, the half-ready prepared fragments will be transported on site and then will be mounted over the mosaic's support.

- The concrete panel's consolidating phase;

After the dismantling of the existing mosaic (removal of the tesserae, plaster and flattening layer) until uncovering the concrete panels' surface, will take place their consolidating process. During this phase, should be done a detailed investigation regarding the conservation state of the concrete panels. They will be investigated for:

- The welding points of the concrete panels with the Historical National Museum building's structure;
It should be investigated whether they manifest corrosion or not. If they do have corrosion, it will be brushed with a metallic brush and then will be painted with specific anticorrosion solution.
- The cracks that the concrete panels may have;

If there are cracks, they will be mechanically widened and deepened using a hammer and a chisel, then they will be brushed with a metallic brush and then washed with clean water, in order to remove all the small particles of inert, and then they will be filled (caulked) with cement plaster.

- The areas where the metallic grill of the concrete panels may be visible;
In these cases, the metallic grill will be investigated itself, to check if it is still in good conditions or if it will need to be replaced.
If the metallic grill is not excessively corroded it will be brushed with a metallic brush, painted with a corrosion proof solution and then the lacunae will be filled (caulked) with cement concrete. If the metallic grill is so much corroded that it has lost its resistance, they will be cut off and another fragment of metallic grill will be welded with the remaining grill. The new one will be of the same material and dimension as the existing grill. After the replacement, the lacunae will be brushed with a metallic brush, washed with clean water and then filled (caulked) with cement concrete.
- The joints of the mosaic's tesserae
The last gaps between tesserae will be filled with plaster, which specification's will be determined on site, by the restorer expert

The new mosaic mounting phase.

This is the final phase and this itself will undergo in some different sub phases:

After the consolidation of the concrete panels, over them will be fixed a stainless steel grill, the dimension of each cell of this grill will be 5x5 cm, and the diameter of the steel itself will be 0.3-0.5 cm. After fixing this grill, will be applied a flattening layer, prepared with cement and rough granite sand. The thickness of this layer will vary between 1.5 – 3 cm, which will be decided on site, during the implementation works.

Two-three days after the leveling layer application, when this will be consistent enough, another plaster layer will be applied. This will be prepared of rough clean river sand and cement; its result will be also rough, but flat.

The first plaster layer (the rough granite sand + cement plaster) will be applied in order to permanently fix the stainless steel grill. The grill is indispensable in order to avoid the cracks on the mosaic layer and sub layers. The second layer of plaster (the clean rough river sand + cement) will be applied to flatten the entire surface, over which will be mounted the mosaic layer.

After the flatten process of the mosaic's support surface, will take place the process of the installation of the half-ready prepared mosaic's fragments. They will be glued with ready bought plaster, that bears elastic and plastic properties. This type of plaster hardens very much but rather slowly, so this way the workers can take the necessary time to apply it and to fix the mosaic fragments with very high precision. After this process, over the mosaic will be applied a layer of the same ready bought plaster in order to fill the gaps between the tesserae, and after this layer will be dried and hardened, over the mosaic's surface will be applied a layer of water based transparent varnish, that bears hydro-insulating properties, to avoid the infiltration of the rain water from the mosaic's surface toward its inner layers.

The tesserae that will be used for the new mosaic, will be exactly like the actual tesserae. They will be ordered to the same company in Venice, where have been ordered the original tesserae, decades ago. The quantity and the colors of the tesserae that will be ordered, will be calculated on site, by the implementation team leader in collaboration with the design team leader. This can be done only after the graphic and photographic documentation phase. The calculation can only be approximated by calculating the areas (not the exact number of tesserae) of each color and nuance used in the original mosaic. Taking this into account, the order will be done for 15~20% more than the calculated areas.

The dimensions of tesserae will be the same for all of them; they may be all rectangular or quadratic, 3-5 cm. In some specific cases, when due to the fine details that will be done, the tesserae may be smaller. They can be modified on site, as per specific needs of the mosaic. They can be easily cut with special scissors.

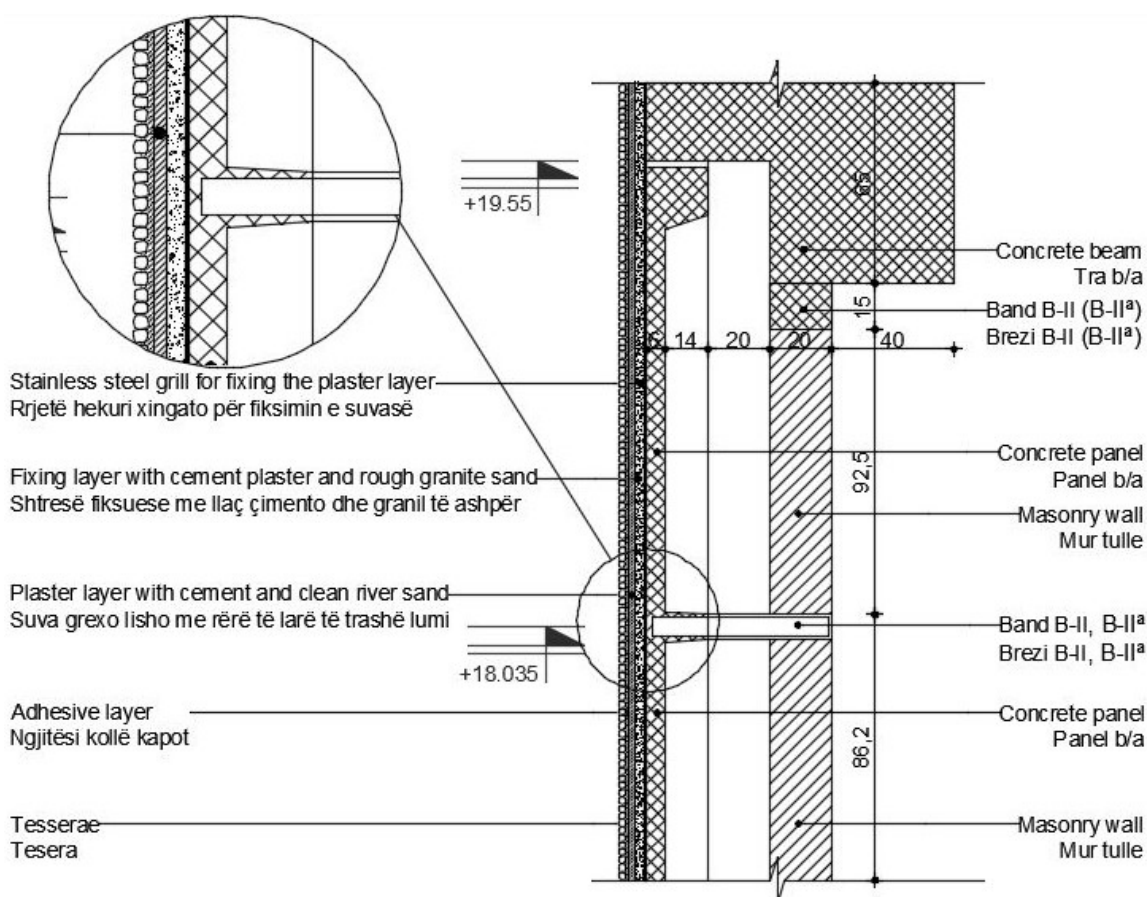


Fig. 51 – Mosaic graphic documentation example



Fig. 52 – On the left, the type of the glue that needs to be used to fix the mosaic fragments over the mosaic support (concrete panels); on the right, the type of the water based transparent varnish that can be applied over the mosaic surface, once it is all mounted and fixed on site.

4.3.2. The mosaic - Technical specifications



Water-based coatings (VARNISH)

Durability has always been the primary criterion of exterior-grade wood coatings. With coatings, the life of different façades has considerably increased. These products are designed for the

reduction of water absorption and protection from the sun's radiation and they ensure several advantages in terms of outdoor resistance and solvent emission reduction.

Durability of these products on outdoor exposure joinery is superior. Unlike solvent products, waterborne products maintain their elasticity over time, which allows the coating's film to follow the façade's movement without cracking or flaking. Hydro coatings are low environmental impact products: solvent **emissions are reduced by 95%** compared to synthetic products. These coatings **are not flammable**, can be thinned with tap water, allow fast coating systems without spontaneous combustion and lifting. All these kind of products for exterior use meet the requirements of the EN 14351-1 regulation governing CE marking.

Advantages arising from the use of water-based for exteriors

1. Low impact on the environment
2. Not flammable
3. Equipment can be washed with water
4. Short drying time
5. Durability on outdoor exposure
6. Gloss retention
7. Non-yellowing film
8. Resistance to skin formation
9. Maintains its elasticity on ageing
10. Lifting resistance (over-coat ability)
11. No spontaneous combustion
12. Topcoats high thixotropic

These topcoats are thixotropic. This allows a thick coat of product to be applied without sagging or running, maintaining excellent flow and transparency. The applied film maintains a high level of elasticity over time, without being prone to "blocking" phenomenon. In order to ensure a good resistance in outdoor exposure, the clear products are formulated with an optimal dose of UV absorbers to block out UV rays that damage the exposed timber, reducing any changes in color.

The most important precautions to be observed in the use of water-based coatings are:

1. During application, for both the product and for the substrate and for the environment, a minimum temperature of 15°C should be maintained. Films formed below such

temperature exhibit lower mechanical and chemical resistance properties than the standard quality values.

2. Products must be stored in places with a minimum temperature of 5°C.

The base must exhibit some important features:

- There must be no traces of fungal attack.
- There must be no traces of insect attack.
- There must be no transverse cracking

Water-based topcoats application

Water-based coatings can be applied by the conventional coating systems (airless, air mix, electrostatic) provided that the equipment is suitable for water contact. Water-based coatings are also suitable to be used in coating systems where the sprayed material is recovered.

Before starting, always check that the tools you are using to apply the coating are in good condition. Equipment not in perfect working order (faulty gaskets, too high pressures) can produce considerable defects in the film (e.g. air blisters).

The use of a pre-atomizer and/or of a pre-heater has given excellent results. The first one allows obtaining a better coating atomization, even at lower pressures, reducing air incorporation and increasing the film transparency. The second one allows better film flow (especially in winter) and a higher topcoat quality as well as regular results at all times of the year. The pre-heated coating should be between 25°C and 35°C. The equipment must be washed immediately after use. If dry coating films are to be removed, use XA 4060, leaving it for 6-12 hours, then rinse with water. Do not use the same pump for applying water and solvent-based products.

Guidelines for application:

Conventional	Nozzle 3 mm	Pressure 4 bar.
Airmix	Nozzle 11-13	Material pressure 90-140 bar. Air pressure 1-2 bar
Airless	Nozzle 11-13	Material pressure 90-140 bar.

Coating thickness

To achieve sufficient outdoor resistance, apply a minimum wet film thickness of 250 microns on the window and 300 microns on shutters. Heavier coats of topcoat should not be applied in a single coat since, especially in the accumulation zones (such as grooves of shaped panels), due

to the fact that the film does not dry in a uniform manner, it might lead to cracking, splitting and/or peeling.

Coating thickness should always be checked by means of a thickness gauge.

Iron oxides water-based pastes

The addition of the clear iron oxide pastes to the clear topcoats considerably extends the coating life. In fact, they absorb the ultraviolet component of the solar radiation, improving the protection of surface.

Drying

The drying of water-based products must take place in rooms with a minimum temperature of 15°C and relative humidity preferably between 50% and 70%.

Outside these limits, the drying is slower and the film could exhibit lower hardness and chemical resistance. Drying should always take place in areas with forced air circulation, preferably dehumidified and slightly warm (25-35°C). The coating application method (sprays, immersion, etc.) can influence the drying times and conditions.

Water resistance

Some water-based products can suffer surface defect, where the coating becomes white, if they come in contact with water in the first few days after they are applied. This phenomenon is reversible and disappears quickly.

Avoid the material coming into contact with water (ex. rain), especially during transit in/out of the facilities. This phenomenon is only observed when water has the chance to pool. Topcoats are also available that do not show this defect.

Water-based topcoat storage

Once the can has been opened, water-based coatings can spoil due to bacteria, molds and fungi

commonly present in the air. This phenomenon is easily detected as it produces bad smells, increase of viscosity, mold on the surface and change of the color of the product in the can.

Do not recover old products into fresh coating, nor leave open cans for longer periods, especially

in summer. Adding the bactericide extends the product preservability. Check the relative technical data sheet for the correct use.

Coating residues

Coating residues (wash water, booth water, exhaust coating) must be disposed of according to the regulations in force. Do not throw any residues in the sewers.

Additives

To keep the chemical and physical characteristics of water-based products unchanged over time, the following range of Additives is available:

Description	Application
Sealant	Për aplikim me furçë
Filler / Sealer	Mbushje me material kokrrizor dhe izolues përpara veshjes përfundimtare
Matting paste	Shtresë përfundimtare e pastër dhe e pigmentuar
Recycled coating thinner	Shtresë përfundimtare e pastër dhe e pigmentuar. Sisteme të riparimit me sprucim, shpëlarje ose zhytje të materialit.
UV absorber	Shtresë përfundimtare e pastër
Anti foam	Shtresë përfundimtare e pastër dhe e pigmentuar
Anti-foam for flow-coating	Mbrojtje nga njollat dhe larja
Retardant thinner	Shtresë bazë dhe shtresë përfundimtare e pastër dhe e pigmentuar, e mbrojtur nga njollat dhe nga larja
Iron oxides	Shtresë bazë dhe shtresë përfundimtare e pastër, e mbrojtur nga njollat dhe nga larja
Anti spoil-age additive	Shtresë bazë dhe shtresë përfundimtare e pastër, e mbrojtur nga njollat dhe nga larja
Anti-cissing additive	Shtresë bazë dhe shtresë përfundimtare e pastër, e mbrojtur nga njollat dhe nga larja
Detergent / Cleanser	Për pastrimin e pajisjeve për aplikimin e materialit
Addensante	Shtresë përfundimtare e pastër dhe e pigmentuar
Sealant	Izolues fishek për aplikim në nyjet e bashkimit në formë V

Adhesive layer

Description

- **Grey adhesive** is a high quality adhesive, made of white cement, qualitative fillers and additives, and enriched with suitable polymers

Advantages

- Easily prepared and applied
- For the adhesion and reinforcement layer on all insulation boards

- Produced from high-quality raw materials that make it possible to use it in thicker layers and on low-adhesion insulating slabs.

Scope of use

- It is used for installing and reinforcing all thermal insulation materials
- It is used in thermal insulation systems
- It is also used for flattening surfaces

Surface preparation

- The substrate where the panels will be applied must be strong, stable, clean and free of dust or microorganisms.
- Possible problems with the substrate should be repaired before starting the work.
- The work surface should be protected with scaffolding mesh from direct impact of wind, sun or rain, it is advised not to work under severe weather conditions.
- The air and substrate temperature during application and drying should be above 5°C and below 30°C

Application

- The bag content is mixed with an electric mixer by gradually adding 6,5-7 l of water as needed.
- After the first mix, the mass is left at rest for about 10 min and then mixed again before applying, the prepared mass should be used within 3 hours.
- Installation of grooves and reinforcement mesh is possible 2 days after the adhesive bonding.
- The surface of the insulation panels is leveled with a layer of 2-4 mm thick layer on which the netting is made, in 1/3 of the thickness of the adhesive layer, the grinding layer must be made after the previous layer has completely dried.
- The decorative finishing layer should be applied at least 7 days after application of the last layer of adhesive.
- For buildings with a height of more than 3m, it is advisable to use the façade ups for fixing the panels to the plinth, 6 anchors / m²
- The adhesive is not recommended to be used for filling residual spaces between thermal insulation tiles - should be filled with insulating material.

Tools

- For mixing: electric mixer
- For application: steel trowel

Expiration

12 months stored on pallets in a dry place with no direct impact of weather conditions and moisture. Protect from freezing.

Technical Data Table

Packing	Papper bag	
Quantity per unit	25 kg / bag	
	1400 kg / pallet	
Color	grey	
Granulation	0.8 mm	
Consumption	8-10 kg/m ²	The data on consumption are orientative and depending on the characteristics of the base and the application technique.
Consumption (adhesion)	6-7 kg/m ²	
Consumption (reinforcement)	2-3 kg/m ²	
Water consumption	6,5 – 7 l	
Layer thickness	3 mm	

Physical and mechanical indicators

PARAMETER	MEAN VALUE	MEASURING UNIT
Vase – dry state	1.72	Gr/m ³
Water need for normal performance	27	%
Residues ↓ 180 μ	55	%
Water retention	99	%
Vase of mortar 20 °C	1860	Kg/L
Appearance	grey	
State	powder	

Chemical indicators

PARAMETER	MEAN VALUE	MEASURING UNIT
Humidity	0.10	%
Additives	2	%

All the above parameters relate to standard weather -20°C temperature, relative air humidity up to 65%. If weather conditions are not in accordance with the mentioned method of operation, it is necessary to adjust the circumstances.

5. MOSAIC MAINTENANCE PROGRAM

At the end of the works there will be set a periodical maintenance program that may be executed from the implementation team. Respecting the maintenance program will be crucial for the future preservation of the mosaic. It will prevent the creation of deterioration over the mosaic's surface, ensuring that it stays in optimal conditions for many decades after.

- A periodical cleaning of the mosaic's surface should be done. The aim is to avoid the accumulation of dust and pollution over the mosaic's surface. The cleaning can be done by using simple tools that are used for the glass cleaning and using detergents that does not cause chemical reaction to the varnish applied at the end of the works. Nonionic detergents are advisable for periodical cleaning. The cleaning frequency will be decided at the end of the works, by the implementation team leader in collaboration with the design team leader.
- The periodical cleaning will be necessarily executed by installing a scaffolding around the southern Historical National Museum facade. These cases should be used also to investigate the conservation state of the entire mosaic, in order to identify if there is any deterioration and to intervene.
- Periodical investigations should be carried out to check the conservation state of the Historical National Museum roof, to make sure there are no weak points that can allow the rain water leak within the mosaic surface and under layer.
- The water based transparent varnish that will be applied at the end of the implementation phase, is foreseen to keep its effect over the mosaic's surface, for 10 years' maximum. After this period, the varnish starts to lose its hydro-insulation properties. Thus the varnish layer should be applied periodically, once in 8-10 years.

6. SITE WORKS SCHEDULE

The works for the realization of this project are complex and include construction work and, most importantly, contain artwork.

Work plan planning is foreseen as time and work management, without regard to the weather conditions that may occur during the execution of works and which may compromise the work on site.

Mosaic "Albanians" restoration work will be carried out in the order of work as provided in this report.

- Phase I:

Site works mobilization, establishment, refurbishment with double scaffolding nonattached to the façade, supply of necessary components and whole assembly of the site management offices. These offices must have sufficient areas of work for the contractor, supervisor and investor.

- Phase II:

Mosaic Documentation and Roof Works and Rainwater Removal Plan.

- Phase III:

Reconstruction of the mosaic retaining structure.

- Phase IV:

Mosaic restoration works.

Site works schedule										
No.	Unit	Site works description	Site works implementation duration - 8 months							
			1	2	3	4	5	6	7	8
Mobilisation - Site mounting										
1	dp	Scaffolding mounting works for the entire surface								
2	dp	Scaffolding cover, printed textile								
Mosaic restoration work										
3	dp	Site inspection and geometrical survey of the mosaic								
4	m²	Dismantling of the damaged parts								
5	m²	Storage of the damaged parts								
6	m²	Sketching of the damaged parts of the mosaic								
Reconstruction structural works										
Reconstruction roof works										
7	m²	Demolition of the existing roof layers								
8	m²	Roof works: slope in-situ laid concrete, thermo-waterproofing, water vapour barrier layer, geotextile								
9	copé	Tempered glass skydomes installation								
10	ml	Rainwater discharge columns								
11	ml	External rainwater discharge: concrete wells (60 x 60) cm; PP pipes wrinkled highway Ø 200 mm and 250 mm								
Reconstruction works of the mosaic's retaining structure										
12	m²	Removal of the damaged concrete and cleaning of the reinforcing steel								
13	m²	Treatment of reinforcing steel with epoxy resin paste, filling of cracks with epoxy resin injection								
14	m²	Filling of cracks on the surface with concrete C-25/30 + F.V. concrete iron Ø 6 - 10 mm								
15	m²	Surface plastering with granular mortar + wire mesh Ø4mm every 15cm								
Mosaic restoration work										
16	m²	Recovery of damaged parts of the mosaic								
17	m²	Restoration works of replacement parts in mosaic								
Site dismanteling										
18	dp	Removal and transport of waste								
19	dp	Dismantling and transport of scaffolding								

7. HEALTH AND SECURITY ENVIRONMENT (HSE)

The terms of the technical health and safety manual are mandatory, and employees must comply with these terms and strictly adhere to the procedures provided. Failure to comply with or disregard any term, any technical assurance and health procedures, entails punishing the employee under the penalties provided for by the Company's Internal Regulations and depending on the gravity of the breach of the terms, the penalty can be the exclusion of the employee.

7.1. General considerations

Albanian legislation

- Law no. 10237 date 18.02.2010
- The Council of Ministers Decision no. 108 date 09.02.2011 "For health and safety"
- The Council of Ministers Decision no. 312 date 05.05.2010 "On the approval of the regulation of safety in construction sites"

European directives

- European framework directive 1989 / 391 / EEC
- 92 / 57 EEC directive
- 89 / 391 EEC directive

Prior to the commencement of any hazardous operation, the Contractor will prepare a Safety/Method Statement. All operatives have to be suitably trained prior to commencing work and are to be adequately supervised whilst carrying it out.

All plant and equipment is to be suitable for the task to be undertaken and properly inspected/tested prior to being put into operation.

The Contractor will have to appoint accident prevention officer (trained technical person) at the Site, responsible for maintaining safety and protection against accidents. This person will be qualified for this responsibility, and have the authority to issue instructions and take protective measures to prevent accidents.

The prevention officer will maintain detailed records of any accident inform the Engineer about it as soon as possible after its occurrence and make reports concerning health, safety and welfare of persons, and damages to property.

The Contractor will remove (or cause to be removed) any person employed on the Works who persists in any conduct that is prejudicial to safety, health or the protection of the environment. All places occupied by working operational mechanical, electrical or chemical equipment, and operational sewers, manholes and chambers will usually be designated areas.

Suitable arrangements are to be made to cater for emergencies, including:

- First aid equipment (dressings, etc.)
- Person(s) trained to administer first aid
- Communication with, and transport to, the nearest hospital with an accident / emergency
- Department monitoring equipment,
- Rescue equipment
- Firefighting equipment
- Communication with nearest fire brigade station

The Contractor will have to provide the necessary monitoring equipment required for entry to hazardous or potentially hazardous atmospheres. Monitoring of all hazardous or potentially hazardous atmospheres shall be carried out by the Contractor.

The Contractor will have to provide all necessary rescue equipment that shall be regularly checked and maintained. A register of equipment checks will be kept on site. Personal protective equipment will be available, and used by operatives when appropriate, including:

- Safety helmets



- Eye protection glasses



- Ear (hearing) protection



- Hand protection (Gloves)



- Foot protection (Construction Shoes)



- The use of seat belts is mandatory when performing site works on height on scaffolding



- The use of vests is also very important during work processes



- Work uniform, such as. costumes, it's important because it distinguishes employees in the site from civilians. It is important and mandatory for employees to have a uniform.



Individual and collective safeguard measures at site work are mandatory as it helps protect the health of employees and guarantees safety at work.

7.2. Scaffolding

The museum activity will continue during the operational works for the restoring of the mosaic:

- The scaffolding will be designed in such a way, not to block the main door of the museum and be safe for the visitors in the same time
- Hazardous works will be done when there is no flow of visitors, or during the days off
- In collaboration with museum staff and relevant institutions, a guide person will be available to guide the visitors to the alternative entries.

***Important note:

The scaffolding will be designed by the scaffolding company, with a special project, double scaffolding - structure that will sustain itself, that will not be attached on the facade at any point, to ensure the realization of works according to the phases foreseen in this project, so as not to have any damage of the facility, while carrying out the works for the realization of the project.

For the installation of scaffolds that do not comply with the relevant legislative norms or for heights greater than 20m, it is mandatory to have a specific scaffolding design signed by a licensed engineer, by the supervisor company. (Max. height of the building reaches 21.30 m)

Scaffolding shall be made off with "authorized" elements with the marking of the manufacturer and assembled by the specially instructed workers, in accordance with the relevant rules and regulations. All precautionary / preventive measures against falling persons and / or objects (parapets, mannequins, foot-scaffolding, etc.) should be considered.

Pipes and fittings, if not provided by the scaffolding book, bring the intervention of the professionals who have to design a specific implementation project of the relevant calculations (as a rule the re-calculations bring additional costs).

The scaffolds have differences between them based on the number of levels provided by the scaffolding book. This is an important index in determining the quality of the scaffold.

For precise and correct assembly, the scaffolding components must all be of the same manufacturing factory, brand and model.

Mixed / combined use of elements it is not permitted.

7.2.1. Scaffolding possible problems

- Installation and dismantling of scaffolding
- Ascent and descent to the pier
- Sudden displacement or breakage of scaffolding supports
- Incorrect loading of scaffolding
- Incorrectly placed platforms
- Platforms without protection
- Non placement of additional elements such as plates, fasteners and rugs
- Relocation of movable scaffolding with workers on them, below the high voltage lines.

7.2.2. Choosing the proper scaffolding type

Safe and efficient use of scaffolding depends first and foremost on choosing the right system for the kind of work. If the scaffolding features are not suitable for the work performed, or if there is a lack of scaffolding elements, then staff feel obligated to improvise, to complete the work and this can lead to dangerous and life threatening accidents. Proper scaffolding selection, requires basic knowledge for the conditions of the site and the characteristics of the work processes to be performed on the site.

These include:

- Recognition of the weight of workers, work tools and materials to be held by the scaffolding;
- Site condition (e.g. interior, exterior, layered, concrete slabs, types and condition of walls, level differences, supporting points etc.)
- Height to which the scaffolding will be built
- The type of work processes to be performed on the pier
- Duration of work
- Measures to be taken to protect pedestrians and movements under the pier
- Sufficient experience of supervisor and team, working with that type of scaffold
- Weather forecast
- Stairs or other elements to climb the platforms
- Different obstacles

7.2.3. Scaffold overload

Overloading can cause deformation in the scaffolding elements and may cause degradation or breakage of the elements. Overloading occurs more frequently during masonry work where the weight of the materials can exceed 1500 kg. Also, if the materials are left for too long on the scaffold, it may cause losing the scaffold structure balance causing it to collapse.

- Scaffolding should only be designed, built, modified or dismantled by specialized personnel
- Scaffolding should not be mounted and dismantled on sidewalks that have a high flow of people in order to prevent the risks of civilian injury. If it is not possible to have a sidewalk with a small flow of people, then the area below the pier must be protected.
- Make sure the scaffolding is firmly mounted. The soil on which the scaffold is placed must be capable of carrying the weight of the scaffold and the loads that will be placed on it.
- Make sure the scaffolding is securely attached to the structure
- Holding capacity for "general purpose" scaffolds shall be not less than 2 kN / m², for "inspection and light work" scaffolds not less than 0.75 kN / m² and for "hard work" scaffolds shall be 3 kN / m²

Before using the scaffolding, you should:

- Ensure that the holding platform is wide enough to work and move easily (at least 600 mm wide)
- Check that all platforms are supported and non-hanging more than 4 times their thickness
- Ensure that climbing in the scaffold, is made by a suitable staircase or tower
- Ensure that the scaffold is suitable for the work that will be performed and not affected by winds and other atmospheric agents

7.2.4. Dangers while working on scaffolds

- Worker fall from heights caused by slipping, and lack of safety measures
- Shocks from vehicles, or pieces of material that may fall from heights;
- Scaffold crash caused by instability or overloading
- Incorrect placement of foot support elements

7.2.5. How we should be protected?

Falling from heights

- If for a worker, there is a risk of falling from a 3 m height, then the scaffolding must be surrounded by protective elements, or the worker must be provided with a personal safety rope system.
- Must not work on platforms that are covered by snow or ice
- Must not work during a storm or in high-speed winds

Shock from vehicles, or pieces of material that may fall from heights

- The worker must be equipped with a helmet to protect his head against falling objects
- If there is a risk of falling tools or scraps or other materials from a height, a tent or mesh shall be built above the pier, to hold the falling objects.

Scaffold platforms must fulfill the following conditions:

- They shall be continuous with a spacing not more than 20 mm
- They must be capable of carrying their own weight and 4 times more than the max load
- They must be at least 450 mm wide
- There must not be a large gap at the front edge of the platform
- Each end part must be supported in a separate surface
- In case platforms are not fixed, platform overlap shall be at least 300 mm from the supporting points, to prevent possible movements.

8. TECHNICAL ANALYSIS OF PRICES (see BoQ)

analizë F.V. MBULIMI I FASADAVE				
I Material	Për 1m²			
	Njësia	Sasia	Çmimi	Vlera
F.V. Copë plastike me vrima për depërtimin e ajrit, e printuar me pamjen e Mozaikut	m²	1.0		
Shuma	Lekë			
II Punëtori				
Specialist + punëtor	op	0.2		
Shtesë mbi punëtorin 16.7%	Lekë	37.0		
Shuma	Lekë			
Shuma gjithsej	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analizë ÇMONTIM DHE TRANSPORT I SKELERISË					
2.37/5b	I Punëtori		Për 1 dp		
	Specialist + punëtor	op	8.0		
	Shtesë mbi punëtorin 16.7%	Lekë	1,480.0		
	Shuma	Lekë			
	II Transport				
	Transport materiale ndërtimi me auto deri 10.0 km	ton/km	1.0		
	Shuma	Lekë			
	Shuma gjithsej	Lekë			
	Shpenzime plotësuese 8%	Lekë			
	Fitimi i ndërmarrjes 10%	Lekë			
Totali		Lekë			

an. Çukitje muri beton arme për pastrim					
		Për 1m²			
		Njësia	Sasia	Çmimi	Vlera
I Punëtori					
Specialist + Punëtori		op	1.2		
Shtesë mbi punëtorin 16.7%		Lekë	222.0		
Shuma		Lekë			
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

an. Pastrim hekuri me letër zmeril				
I Punëtori	Për 1m²			
	Njësia	Sasia	Çmimi	Vlera

Specialist + Punëtori	op	2.0
Shtesë mbi punëtorin 16.7%	Lekë	370.0
Shuma	Lekë	
II Material		
Letër zmeriluese	m ²	1.4
Shuma	Lekë	
Shuma gjithsej	Lekë	
Shpenzime plotësuese 8%	Lekë	
Fitimi i ndërmarrjes 10%	Lekë	
Totali	Lekë	

an. Beton C-25/30 për mbushje në sipërfaqe muri					
		Për 1m ²			
	I Material	Njësia	Sasia	Çmimi	Vlera
1	Beton C 25/30 me betonpompë	m ³	1.02		
	Shuma	Lekë			
	II Punëtori				
	Specialist + Punëtori	op	16.5		
	Shtesë mbi punëtorin 16.7%	Lekë	3,048.8		
	Shuma	Lekë			
	III Makineri				
	Vinç kullë 0.5 t	op	0.42		
	Vibrator	op	2.0		
	Shuma	Lekë			
	Shuma gjithsej	Lekë			
	Shpenzime plotësuese 8%	Lekë			
	Fitimi i ndërmarrjes 10%	Lekë			
	Totali	Lekë			

analiza Beton arme C-30/37 për përforcim solete					
		Për 1m³			
		Njësia	Sasia	Çmimi	Vlera
	I Material				
1	Vibrator sipërfaqësor	op	2.3		
2	Beton C 25/30 (betonpompë)	m³	1.02		
3	Kallëp solete	m²	8.0		
	Shuma	Lekë			
	II Punëtori				
	Specialist + Punëtori	op	22.9		
	Shtesë mbi punëtorin 16.7%	Lekë	4,234.7		
	Shuma	Lekë			
	Shuma gjithsej	Lekë			
	Shpenzime plotësuese 8%	Lekë			
	Fitimi i ndërmarrjes 10%	Lekë			
	Totali	Lekë			

an. SUVATIM I SIPËRFAQES PARA VENDOSJES SË MOZAIKUT

		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					
1	Rërë e larë lavatriçe	m ³	0.005		
2	Çimento 32.5 N	kg	6.6		
3	Çimento e bardhë 42.5 R	kg	7.9		
4	Llaç i përzier M 25	m ³	0.0		
5	Granil	m ³	0.0		
6	Rjetë teli Ø4 mm çdo 15 cm	kg	1.0		
Shuma		Lekë			
II Transport					
	Transport materiali	ton/km	0.65		
Shuma		Lekë			
III Makineri					
	Vinç kullë	op	0.4		
	Skelë inventar	m2	1.3		
Shuma		Lekë			
IV Punëtori					
	Specialist + Punëtori	op	4.0		
	Shtesë mbi punëtorin 16.7%	Lekë	740.0		
Shuma		Lekë			
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

an. Lyerje me bojë antindryshk		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					
1	Bojë antindryshk	kg	1.2		
2	Të ndryshme 2%	Lekë	138.0		
Shuma		Lekë			
II Punëtori					
	Specialist + Punëtori	op	0.3		
	Shtesë mbi punëtorin 16.7%	Lekë	61.1		
Shuma		Lekë			
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

an. Lyerje e hekurit me pastë rezinë epoxy FERROSEAL-CSI (emulsion me bazë uji)		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					

1	Emulsion me bazë uji, me penetrimit të lartë që mundëson veprimin frenues të korrodimit të armaturës. FERROSEAL-CSI depërton në beton dhe formon një shtresë mbrojtëse në sipërfaqe të armaturës së çelikut. Dendësia 1,02 kg/l pH: 11	kg	1.2
2	Të ndryshme 2%	Lekë	4,392.0
	Shuma	Lekë	
	II Punëtori		
	Specialist + Punëtori	op	0.9
	Shtesë mbi punëtorin 16.7%	Lekë	166.5
	Shuma	Lekë	
	Shuma gjithsej	Lekë	
	Shpenzime plotësuese 8%	Lekë	
	Fitimi i ndërmarrjes 10%	Lekë	
	Totali	Lekë	

an. Injektivim rezinë epoxy DUREBOND me dy komponente, në sipërfaqet e plasaritura të betonit					
		Për 1m ²			
I Material		Njësia	Sasia	Çmimi	Vlera
1	DUREBOND material epoxy me dy komponente pa shkërrës, element për lidhje në strukturat e betonit me injektivim në beton. Viskoziteti: 2.500 ± 500 mPa. në +230C; Raporti i përzierjes (A+B): 100:20 në peshë.	kg	1.8		
2	Të ndryshme 2%	Lekë	5,490.0		
	Shuma	Lekë			
II Punëtori					
	Specialist + Punëtori	op	0.8		
	Shtesë mbi punëtorin 16.7%	Lekë	148.0		
	Shuma	Lekë			
	Shuma gjithsej	Lekë			
	Shpenzime plotësuese 8%	Lekë			
	Fitimi i ndërmarrjes 10%	Lekë			
	Totali	Lekë			

an. Mbushja e fugave ndërmjet paneleve të betonit me ISOMAT PUFOAM Profesional (produkt poliuretani me një komponent)				
I Material	Për 1kg			
	Njësia	Sasia	Çmimi	Vlera

1	ISOMAT PUFOAM PROFESSIONAL; Produkt poliuretani me një komponent, vetë-zgjerues, që ngurtësohet duke reaguar me lagështinë e ajrit. Dendësia: 18-20 kg/m ³	kg	1.0
2	Të ndryshme 2%	Lekë	600.0
	Shuma	Lekë	
	II Punëtori		
	Specialist + Punëtori	op	1.0
	Shtesë mbi punëtorin 16.7%	Lekë	185.0
	Shuma	Lekë	
	Shuma gjithsej	Lekë	
	Shpenzime plotësuese 8%	Lekë	
	Fitimi i ndërmarrjes 10%	Lekë	
	Totali	Lekë	

SHTRESA TARRACE

analiza 1 PRISHJE SHTRESA TARRACE				
		Për 1m ²		
		Njësia	Sasia	Vlera
I Punëtori				
Punëtor	op		1.4	
Shtesë mbi punëtorin 16.7%	Lekë		253.8	
Shuma	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analize SHTRESË TERMOIZOLUESE t=12cm, (Lesh guri 175 kg/m ³)				
		Për 1 ml		
		Njësia	Sasia	Vlera
I Material				
Lesh guri / pambuk mineral	m ³		0.083	
Shuma	Lekë			
II Transport				
Transport materiali	tonxkm		0.08	
Shuma	Lekë			
III Punëtori				
Specialist + Punëtori	op		0.25	
Shtesë mbi punëtorin 16.7%	Lekë		46.3	
Shuma	Lekë			
Shuma gjithsej	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analize SHTRESË BEZE GJEOTEKSTILE				
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		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					
Beze Gjeotekstile	m ²	1.22			
Shuma	Lekë				
II Transport					
Transport materiali	ton/km	0.08			
Shuma	Lekë				
III Punëtori					
Specialist + Punëtori	op	0.8			
Shtesë mbi punëtorin 16.7%	Lekë	148			
Shuma	Lekë				
Shuma gjithsej	Lekë				
Shpenzime plotësuese 8%	Lekë				
Fitimi i ndërmarrjes 10%	Lekë				
Totali	Lekë				

analize SHTRESË NGJITËSE		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					
Shtresë ngjitëse	m ²	0.4			
Pajisja e saldimit të tipit "TERMOFUZION"	op	0.25			
Shuma	Lekë				
II Transport					
Transport materiali	ton/km	0.08			
Shuma	Lekë				
III Punëtori					
Specialist + Punëtori	op	0.25			
Shtesë mbi punëtorin 16.7%	Lekë	46.3			
Shuma	Lekë				
Shuma gjithsej	Lekë				
Shpenzime plotësuese 8%	Lekë				
Fitimi i ndërmarrjes 10%	Lekë				
Totali	Lekë				

analizë SHTRESË HIDROIZOLUESE		Për 1m ²			
		Njësia	Sasia	Çmimi	Vlera
I Material					
Membranë Pvc-P me t=5 mm, e armuar me rrjetë poliestre, rezistente ndaj rrezeve të diellit U.V. , agjenteve atmosferikë, rrënjëve të bimëve	m ²	1.2			
Shuma	Lekë				
II Transport					
Transport materiali	ton/km	0.08			
Shuma	Lekë				
III Punëtori					
Specialist + Punëtori	op	0.25			

Shtesë mbi punëtorin 16.7%	Lekë	46
Shuma	Lekë	
Shuma gjithsej	Lekë	
Shpenzime plotësuese 8%	Lekë	
Fitimi i ndërmarrjes 10%	Lekë	
Totali	Lekë	

analizë P		PRODHIM IZOLBETONI (stirobeton)			
		Për 1m³			
	I Material	Njësia	Sasia	Çmimi	Vlera
1	Rërë	m³	0.09		
2	Polistirol kokërr	m³	1		
3	Çimento	kg	300		
	Shuma	Lekë			
	II Punëtori				
	Punëtori për pregatitje	op	4.6		
	Shtesë mbi punëtorinë 16.7%	Lekë	501.4		
	Shuma	Lekë			
	III Makineri				
	Betoniere 250 litra	op	0.87		
	Shuma	Lekë			
	GJITHSEJ	Lekë			

Analizë SHTRESË BETON I LEHTËSUAR					
		Për 1m³			
	I Material	Njësia	Sasia	Çmimi	Vlera
Analizë p	Stirobeton i përgatitur në kantier	m³	1.02		
	Shuma	Lekë			
	II Transport				
	Transport rëre (0,09*1,8*10*1,02)	tonxkm	1.6524		
	Shuma	Lekë			
	III Punëtori				
	Specialist + Punëtori	op	5.8		
	Shtesë mbi punëtorinë 16.7%	Lekë	1,066.6		
	Shuma	Lekë			
	IV Makineri				
Vinç 5kN	op	0.3			
Shuma	Lekë				
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

analizë		SHTRESË BETON GRANILI ME ZGARË TË ELKTROSALDUAR t=6cm e fuga bitumi 1x1m			
		Për 1m ²			
I Material		Njësia	Sasia	Çmimi	Vlera
1	Beton granili	m ³	0.06		
2	Hekur betoni Ø 4	kg	2.22		
3	Bitum	kg	0.2		
Shuma		Lekë			
II Transport					
Transport materiali		tonxkm	1.62		
Shuma		Lekë			
III Punëtori					
Specialist+Punëtor		op	1.38		
Shtesë mbi punëtorin 16.7%		Lekë	255.3		
Shuma		Lekë			
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

analize		F.V. Skajdome			
		Për 1 cope			
I Material		Njësia	Sasia	Çmimi	Vlera
F.V. Skajdome me dopio xham, gaz argon, e mbrojtje UV		cope	1.0		
Aksesorë për mbërthim 5 %		Lekë	34,850		
Shuma		Lekë			
II Transport					
Transport		tonxkm	0.15		
Shuma		Lekë			
III Punëtori					
Specialist + punëtor		op	1.2		
Shtesë mbi punëtorinë 16.7%		Lekë	1,320.0		
Shuma		Lekë			
Shuma gjithsej		Lekë			
Shpenzime plotësuese 8%		Lekë			
Fitimi i ndërmarrjes 10%		Lekë			
Totali		Lekë			

PUNIME RESTAURIMI TË MOZIKUT

analiza	PUNIME EKZAMINIMI TË GJENDJES FAKTIKE			
	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera
I Punëtori				
Specialist Restaurator / Piktur + Fotografimi	op	1.3		
Shtesë mbi punëtorinë 16.7%	Lekë	442.8		
Shuma				Lekë
Shpenzime plotësuese 8%				Lekë
Fitimi i ndërmarrjes 10%				Lekë
Totali				Lekë

analiza	ÇMONTIM MOZAIKU			
	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera
I Punëtori				
Specialist Restaurator + Punëtor	op	0.40		
Shtesë mbi punëtorinë 16.7%	Lekë	74		
Shuma				Lekë
II Material				
Doreza	cope	1		
Syze mbrojtëse	cope	1		
Maska mbrojtëse	cope	1		
Aksesorë të ndryshëm 2 %	Lekë	2,956		
Shuma				Lekë
Shuma				Lekë
Shpenzime plotësuese 8%				Lekë
Fitimi i ndërmarrjes 10%				Lekë
Totali				Lekë

analiza	Transport i mozaikut në atelier restaurimi			
	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera
I Punëtori				
Punëtor ndihmës	op	0.6		
Shtesë mbi punëtorinë 16.7%	Lekë	111.0		
Shuma				Lekë
Shpenzime plotësuese 8%				Lekë
Fitimi i ndërmarrjes 10%				Lekë
Totali				Lekë

analiza	PUNË KRIJUESE E SKICIMIT			
	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera

I Punëtori	Njësia	Sasia	Çmimi	Vlera
1 Specialist Restaurator + 2 ndihmës piktorë	op	8.0		
Shtesë mbi punëtorin 16.7%	Lekë	3,582		
Shuma	Lekë			
II Material				
Letër kalk	m ²	1		
Letër kartoni	m ²	1		
Lapsa dhe bojra	komplet	0.10		
Aksesorë të ndryshëm 10 %	Lekë	900		
Shuma	Lekë			
Shuma	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analiza	PUNË KRIJUESE E RIKRIJIMIT TË MOZAIKUT			
I Punëtori	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera
1 Specialist Restaurator + 2 ndihmës piktorë	op	8		
Shtesë mbi punëtorin 16.7%	Lekë	10,396		
Shuma	Lekë			
II Material				
Letër kalk	m ²	1		
Aksesorë të ndryshëm 10 %	Lekë	250		
Shuma	Lekë			
Shuma	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analiza	MATERIAL TESERINË MURANO, VENECIANE			
I Material	Për 1m ²			
	Njësia	Sasia	Çmimi	Vlera
Teserina murano Veneciane, dimension dhe ngjyra sipas Restauartorit	m ²	1.0		
Shuma	Lekë			
II Transport				
Transporti porti Durrës deri Tiranë	tonxkm	0.15		
Shuma	Lekë			
Shuma	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analiza	RIVENDOSJA E MOZAIKUT			
	Për 1m ²			

I Punëtori	Njësia	Sasia	Çmimi	Vlera
1 Specialist Restaurator + 2 ndihmës piktorë	op	3.6		
Shtesë mbi punëtorinë 16.7%	Lekë	2,518		
Shuma	Lekë			
II Material				
Materiale ndihmëse të ndryshme	Lekë	1		
Shuma	Lekë			
Shuma	Lekë			
Shpenzime plotësuese 8%	Lekë			
Fitimi i ndërmarrjes 10%	Lekë			
Totali	Lekë			

analiza	Materiale specifike për Ambientin e Restaurimit të Mozaikut			
		Për 1m ²		
I Material		Njësia	Sasia	Vlera
1	Tavolinë pune për mozaikun 2.4 x 6 X 76 cm	cope	1	
2	Tavolinë pune 150 x 80 cm x 76 cm,	cope	6	
3	Kompiuter 21" + instalimi	cope	3	
4	Karrige pune	cope	6	
5	Të ndryshme Materiale punë	Lekë	1	
	Shuma	Lekë		
II Transport				
	Transport (furnizim vendosje dhe çmontim)	tonxkm	1	
	Shuma	Lekë		
	Shuma	Lekë		
	Shpenzime plotësuese 8%	Lekë		
	Fitimi i ndërmarrjes 10%	Lekë		
	Totali	Lekë		