

Department of Architecture:  
«Sustainable Architecture and Landscape Design»  
2022

**MASTER THESIS THEME:**

*«Applying Sustainable Methods in Renovation of the Historical building in Tver, Russia.»*

**THESIS QUESTION**

*«How to apply sustainable renovation technique to a protected historical building?»*

**KEY WORDS:**

*Renovation, Restoration, Sustainable architecture, Preservation*

STUDENT::

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**POLITECNICO**  
**MILANO 1863**

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To deeply understand the borders of the thesis topic, it is necessary to clarify the mean of **key words**.

TERMS:

**Renovation** - the act or process of repairing and **improving** something, especially a building.

(Cambridge Advanced Learner's Dictionary & Thesaurus, United Kingdom 2022)

**Restoration** - the process of a highly specialized operation. Its aim is to **preserve** and reveal the aesthetic and **historic value** of the monument or building and is based on respect for original material and authentic documents. It must stop at the point where conjecture begins.

(Venice Charter, 1964)

**Sustainable architecture** - is architecture that seeks to **minimize** the negative **environmental impact** of buildings through improved efficiency and moderation in the use of materials, energy, development space and the ecosystem at large. Sustainable architecture uses a conscious approach to energy and ecological conservation in the design of the built environment.

(«Sustainable Architecture and Simulation Modelling», Dublin Institute of Technology, 2013)

**Preservation** - is an endeavor that seeks to safe, conserve and **protect** buildings, objects, landscapes or other artifacts of **historical significance**. It is a philosophical concept that became popular in the twentieth century, which maintains that cities as products of centuries' development should be obligated to protect their patrimonial legacy.

(«Encyclopedia of the City. Routledge», Caves, R. W., 2004)

## THESIS QUESTION

*How the historic building can be restored with all respect to a history and area, and at the same time having sustainable renovation strategies implemented to the building?*

*How we can mediate both of these different ways of building repair?*

## ABSTRACT

*In the traditional architectural practice of restoration in Russia, historical buildings are restored in accordance with historical documents without allowing any modern innovations. It is hard to find restoration design projects with modern: walls structure, glazing, ventilation system and etc. After, it turns out that restored buildings are not used with full efficiency.*

*Lack of different architectural practices and realized solutions coming from architectural rules and laws, which are mostly not as modern as they could be. Usually, restoration is carried out only on historical significant objects, which are now beginning to be classified more every year.*

*On the other hand, many renovated buildings losing their link with their history. Efficiency and economy - the main aim. New glass facades appear and the building changes in such a way that it is difficult to remember what was here before it. It is clear, that both sides are completely different.*

*But what will happen if, using the methods and laws of restoration, we apply to the former appearance of these buildings and at the same time use to modernize structures and technologies?*

*In this project, I will study all these questions on the example of one building, which is located in Russia, in the city of Tver. This is a historic building, which is already 165 years old.*

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## INTRODUCTION

*«The issue is no longer about new versus old, but about nature of the vital relationship between the two» [1]*

*Studying the construction and plans of the building, which were obtained from the city archives by myself, I will figure out how to restore a completely historical building and preserve the value of its facades and plans. Same time modernizing it into a sustainable building, using different technologies and recyclable materials.*

*I will determine the new development of the courtyard, pedestrian connections and the organization of new elements on the area. Also, taking into account economic opportunities after renovation.*

***Overall, my aim is to create a hybrid historic building project, fully consistent with the historical look and modern building, with strong economic profitability and modern technological and sustainable solutions.***

## WHY TRADITIONAL RESTORATION METHOD IS NOT EFFICIENT ?

*Restoration of a building often involves returning it to its original form. The main task is to restore the lost historical appearance, both in the exterior and in the interior. Materials, structure, engineering solutions coming from existence of the building, from its history.*

*Traditionally, that places becoming even more complicated to use as a property areas. Architecture laws and building practises having not enough opportunities to run the building economy efficient.*

*«Preserving both the historic architecture and the historical functions of the downtown is essential - saving just the building is not enough. The most successful preservation programs retain existing businesses, so that downtown continues to be economically viable, and avoid turning the downtown into museum.[2]»*

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[1] - Powell, Ken. Architecture Reborn: «Converting Old Buildings for New Uses», New York, 1999.

[2] - Daniel J. Levi, «Journal of Architectural and Planning Research», 2005

*Such buildings do not bring sufficient profit to the local administration or to the owner, because they do not work with full economy efficiency. Since according to a whole list of parameters they are not suitable for permanent work of people (office work, living spaces). Due to lack of modern engineering solutions, which would be in conflict with traditional restoration methods and practices.*

*In this regard, lately it has become difficult to find an investor for restoration of such historical buildings. Unfortunately, the city administration can not afford every restoration project. Buildings are abandoned for many years.*

### **WHAT DOES IT MEAN SUSTAINABLE RENOVATION METHOD ?**

*Sustainable restoration method is the integration of a building into society in a new way. This integration is proceeding in the same way as this building would be rebuilt in its original form, but taking into account the new cultural, historical and economic needs of society.*

*«Research by Herzog and Gale (1996) may explain why older buildings are sometimes not preferred to contemporary ones; that is, they may be less well-maintained or perceived to be not cared for. When maintenance of the building is poor, newer buildings are preferred.»**[3]***

*In my opinion, if the building, in conditions in which it is now and not needed by anyone (investors or administration) - it is a potential question of the efficiency of rules and norms for its restoration conditions. We cannot afford to let a historic building be abandoned for years or decades without repair. A compromise is a way out of this situation, a compromise for the investor in exchange for his investment to restore the building. Since some norms and rules will be slightly different from the classic restoration ones, it is more correct to continue to call the entire process a renovation, since the truth will be somewhere in between the two (renovation and restoration).*

*«Comprehensive rehabilitation increases business opportunities and helps stabilize the commercial district and its surrounding neighborhood.»**[4]***

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**[3]** - Daniel J. Levi, «Journal of Architectural and Planning Research», 2005

**[4]** - Barrett, Timothy H. «The Cleveland Storefront Renovation Program. Design Manual», 2002

*The public must also be involved in the process of renovation. Views and ideas from local residents of what they would like to see in renovated area, involve them fully in the process.*

*Recyclable materials, energy efficient and modern technological engineering solutions - all this also takes place in the principle of sustainable renovation. Similarly, the historical component of the building is an important and integral part of the process of sustainable renovation.*

*Often there is a situation when it is not possible to achieve the required efficiency from the building as part of its restoration. Lack of space, there is no way to use modern centralized ventilation in the volume of the building, and etc. An excellent solution would be to organize an extension to the building, which would not touch the historical boundaries of the building and at the same time contain many technological solutions that could not fit into the volume of the historical part.*

*«He started designing the renovation even before the settlement was finalised, opting to replicate the house`s original 8m x 8m footprint in a new open-plan space at the rear.»**[5]***

*All these can be attributed to the sustainable renovation of a historic building - the middle concept between traditional restoration and renovation (upgrade) of the building. Very unusual is that boundaries of this concept: creativity of the architect and modern technologies and tools. It means that this middle concept of sustainable renovation is a huge field in which architect should balance between strict restoration methods and modern renovation practices and materials. The goal is to save and protect history of the building and made it modern and sustainable at the same time.*

*«Renovation project success is often a balancing act, a strategic evaluation of many options and a continuous effort to find the best overall solution.»**[6]***

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**[5]** - Rachael Bernstone, «Sanctuary Modern Green Homes. Renovation special», 2017-1018

**[6]** - Brian Duggan, «The renovation of Building 909, The Military Engineer», 2016

## SUSTAINABLE RENOVATION - MODERN WAY OF RESTORATION

*Modern architects find solutions to many complex projects every year. This trend is growing. The world is improving and often, we can not longer simply restore buildings to satisfy our nostalgic needs. Modern solutions should serve both purposes: to preserve the historic building and give it a new, modern task. That task will deal with the current social and economic needs of the city. Same time , preserved building will be perfect example of time and architecture views for the future.*

*The way that preserves building and saving its original meaning, can be someway sustainable renovation in terms of society. Local people remember what was mean that building for them in the past. In my opinion, it is highly important to keep that link with locals and use it. It is «sustainable thinking» during renovation process.*

*«Out of necessity comes invention, and conservation and rehabilitation schemes now generate some of the most innovative and intelligent work... `Saving` old building is no longer enough. The aim is not preservation but transformation, an architectural... Aproach to create new form out of old fabric»**[7]***

*What needs to be done so that even a historical building has all the same parameters as a modern one? The two systems, the preservation of the old and the technology of the new, will work together to create a new modern technology for the sustainable renovation of historic buildings.*

*«We should not live in a bright shining new future, any more than we should hide in a comfortable pastiche of the past. We must inhabit an ever-evolving present, motivated by the possibilities of change, restricted by the baggage of memory and experience»**[8]***

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**[7]** - Powell, Ken «Architecture Reborn: Converting Old Buildings for New Uses», New York, 1999.

**[8]** - Guell, Xavier. «David Chipperfield: Recent Work. Barcelona: Watson-Guption Pubns», 1997

# - HISTORIC restoration and SUSTAINABLE design case studies -

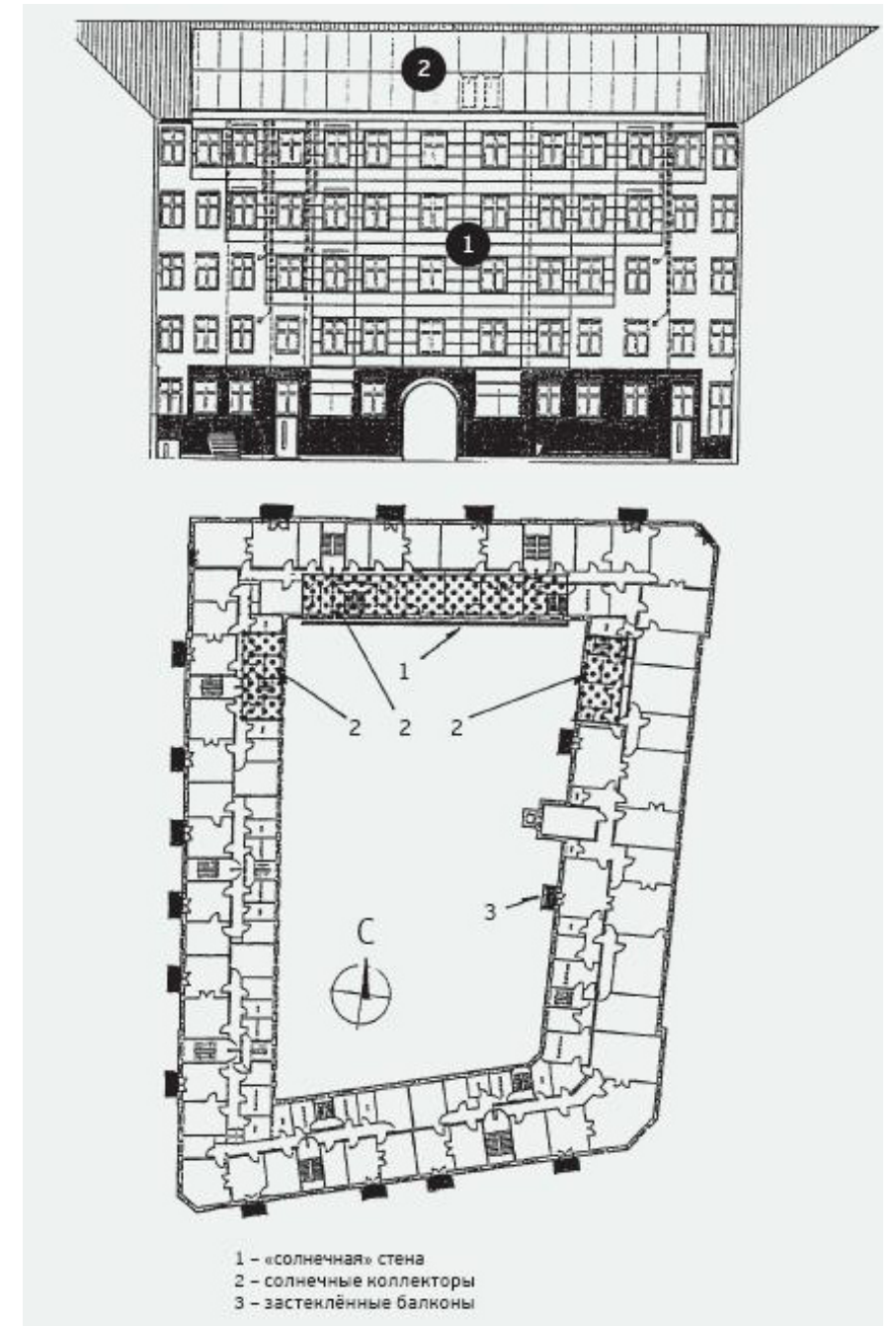
*Key words:*

*Historical orientation*

*Reuse of existing building materials*

*New recycable materials*

*Low energy use technics*



1 - «солнечная» стена  
2 - солнечные коллекторы  
3 - застеклённые балконы

NOTES:

/1995 year

The main energy-saving measures taken during the reconstruction of the building:

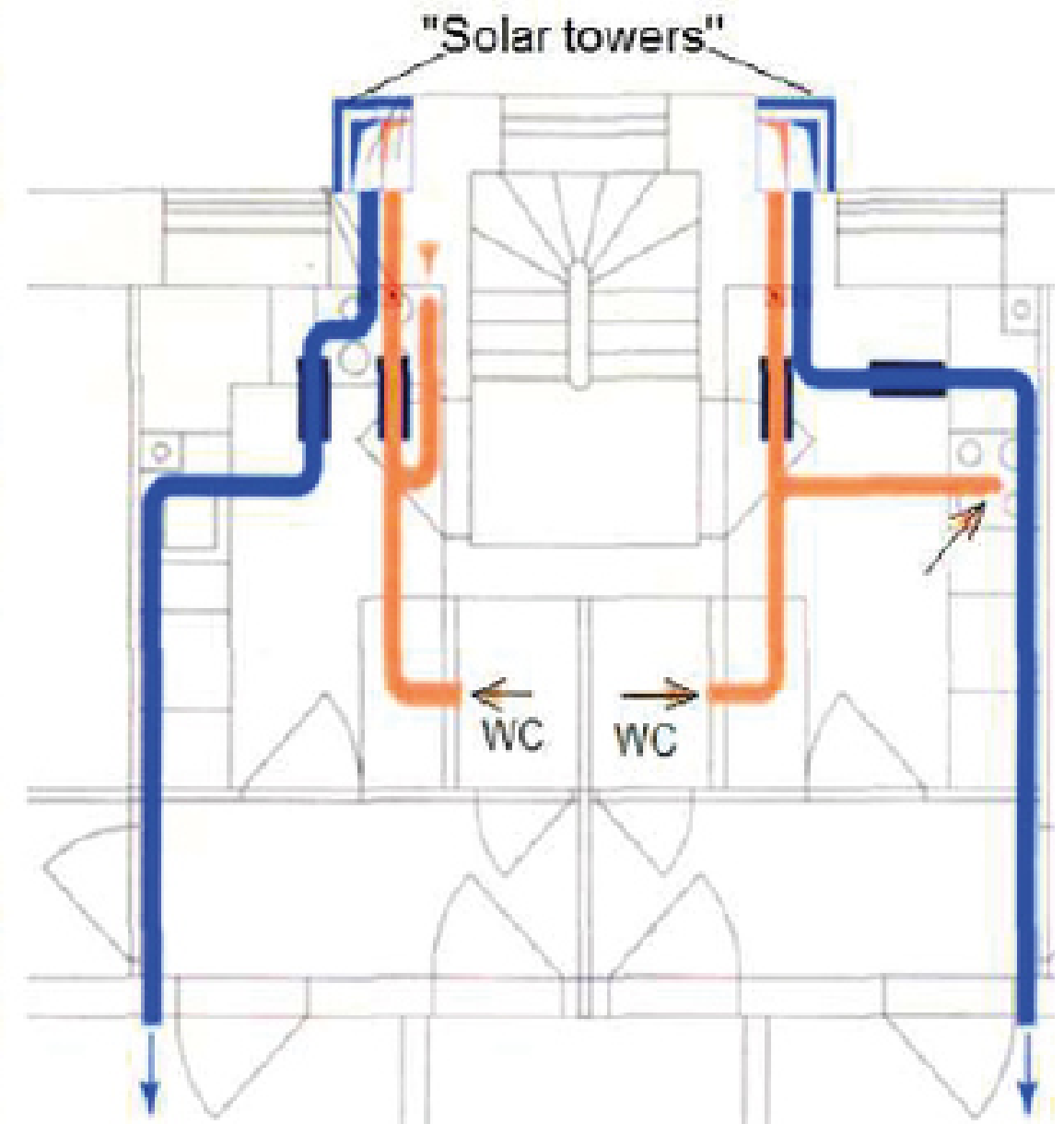
- Use of heat of solar radiation for hot water supply.
- «Solar» wall structures with an area of 178 m<sup>2</sup> with transparent thermal insulation on the facade of the building overlooking the courtyard for heating fresh air.
- Thermal insulation of walls and attic, use of windows with high heat-shielding properties and glazing of balconies to reduce heat loss.
- Mechanical ventilation system with supply air heating in counterflow waste heat exchangers to reduce energy costs for heating fresh air and to improve the quality of the microclimate of apartments.

After the reconstruction, the energy consumption of the building decreased by 51%.

**SUSTAINABLE RESTORATION :**

- New Solar panels surfaces on the sun facade and roof.
- Glazing balconies surfaces to reduce heat loses.
- New water hot supply from solar radiation.





The aim of the project was the construction of «solar ventilation towers» and the creation of a ventilation system with heat recovery as a new element of the old residential areas. This building is an apartment building built in 1920. This project demonstrates the possibility of integrating a ventilation system using solar energy with heat recovery into an old building without significant changes in the building structure.

NOTES:

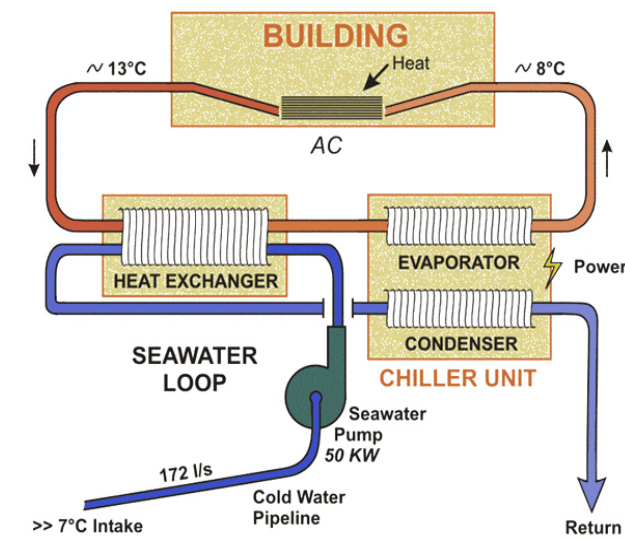
/1998 year

**SUSTAINABLE RESTORATION :**

- New solar ventilation towers to decrease heating energy consumption.
- Modern upgrade in ventilation system without any significant changes.



NATIONALMUSEUM RENOVATION, Stockholm, Sweden



NOTES:

/2013 year

During the restoration of the national museum in Sweden, it was decided to apply an interesting solution to the use of salty sea water in the ventilation air system.

This solution was effective, as it significantly reduces the system's energy needs and, in addition, it has the ability to produce energy itself using the principle of seawater evaporation.

**SUSTAINABLE RESTORATION :**

- Additional new experimental ventilation seawater system, which decreases energy consumption and can produce energy by using seawater air vaporation method.



HOUSE OF YAROSHENKO, THE OLDEST RESIDENT BUILDING OF MOSCOW - XVII century



NOTES:

/ 2018 year

*During the repair and restoration work in one of the apartments on the second floor, it became clear that not only the first, but also the second floor was preserved from the chambers. There was a lot of work to explore all parts of the building.*

*Before the revolution, this part of the house looked completely different - at the level of the first floor there were shopping arcades with shutters, and not apartments. Then the restorers made special recesses in the white stone in order to set the bases.*

**SUSTAINABLE RESTORATION :**

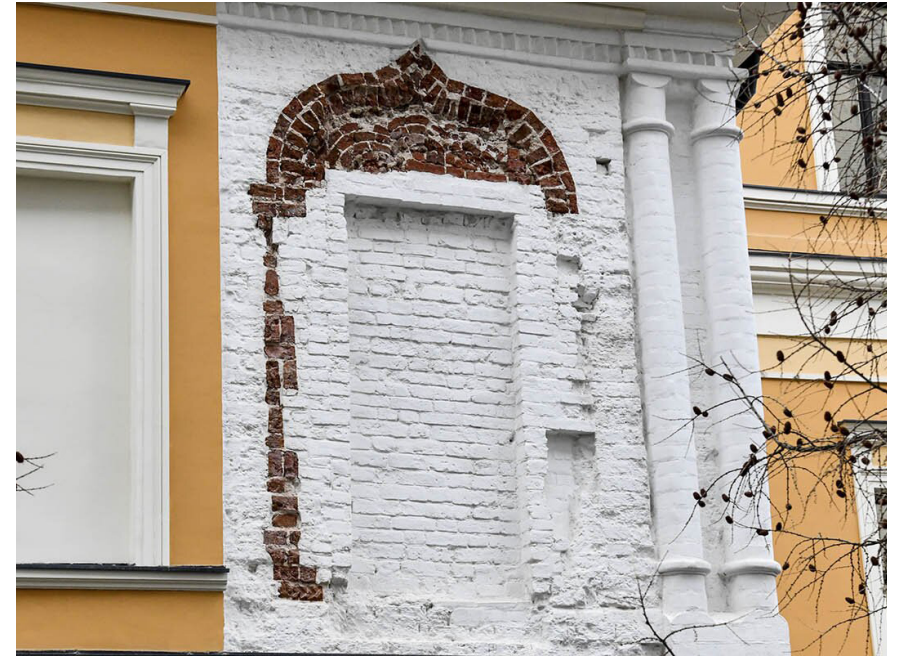
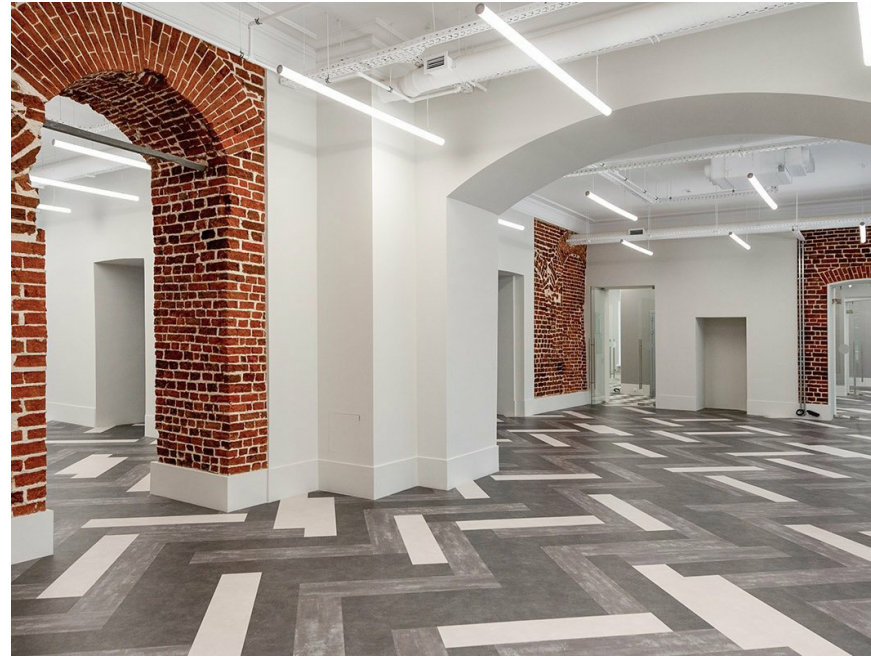
- Usage of existing brick stones in renovation.
- Leaving not finished facade walls, to show original material under plaster cover.

**CLASSIC RESTORATION :**

- Use of modern materials inside the building structures
- The modern facade of the building must fully comply with the historical one.



MOSCOW LAND SURVEY OFFICE, 400 years old building building in Moscow



NOTES:

/2021 year

The restoration of the 400-year-old office building was very difficult. Architects first carefully beat off the plaster in search of original traces of past centuries. The chancery was rebuilt several times, so it was not easy to look for the original brick decor.

**SUSTAINABLE RESTORATION :**

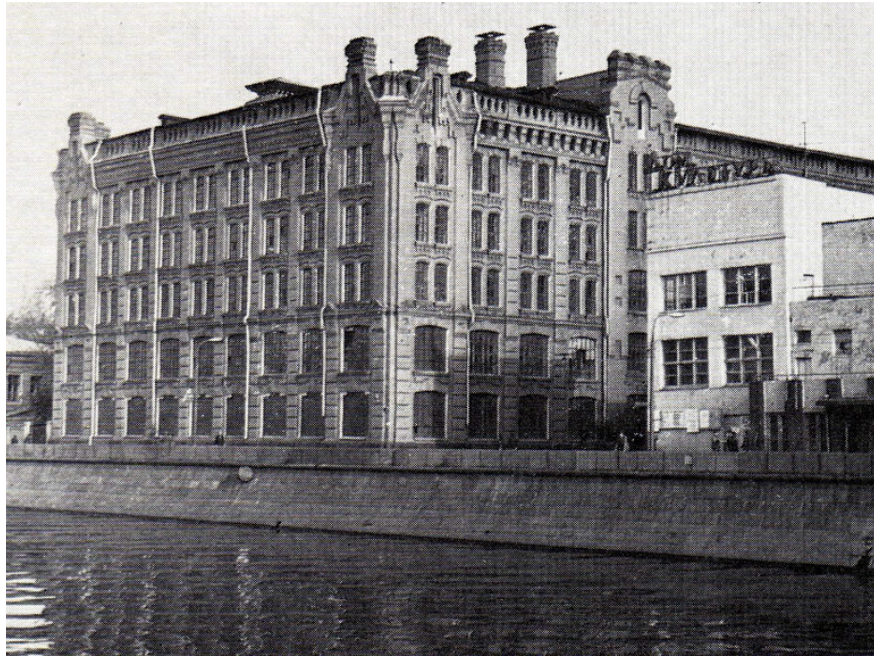
- Leaving not finished facade walls, to show original material under plaster cover in interior and exterior.

**CLASSIC RESTORATION :**

- The modern facade, interior spaces of the building must fully comply with the historical one.



GOLUTVINSKAYA MANUFACTORY AND TRADING HOUSE, one of the largest textile factories and trading houses in Russia- XIX century



The factory belonged to the Istomins until the revolution, and they managed it even until 1919. Since 1921, the factory was called «Red Textile Workers», and in the 1990s it became one of the first (if not the first) object of the old industrial architecture, converted into a business center. It was redone, on the one hand, it was not so bad, on the other hand, due to the fact that the alteration was carried out in the 90s, the old details were practically not preserved inside the buildings.

Several buildings of the Golutvinskaya manufactory were built by the well-known architect Alexander Kalmykov, who is famous primarily for industrial buildings.

NOTES:

/2013 year

**SUSTAINABLE RESTORATION :**

- Additional roof spaces to increase economy capability and profitability of the building.
- Designing art objects, which provides verbal communication about history of the place.
- New role of the building, determined by economical efficiency and possible profitability.

**CLASSIC RESTORATION :**

- The modern facade, interior spaces of the building must fully comply with the historical one.
- The way of building usage strictly determined by local authorities



# - RENOVATION courtyard case studies -

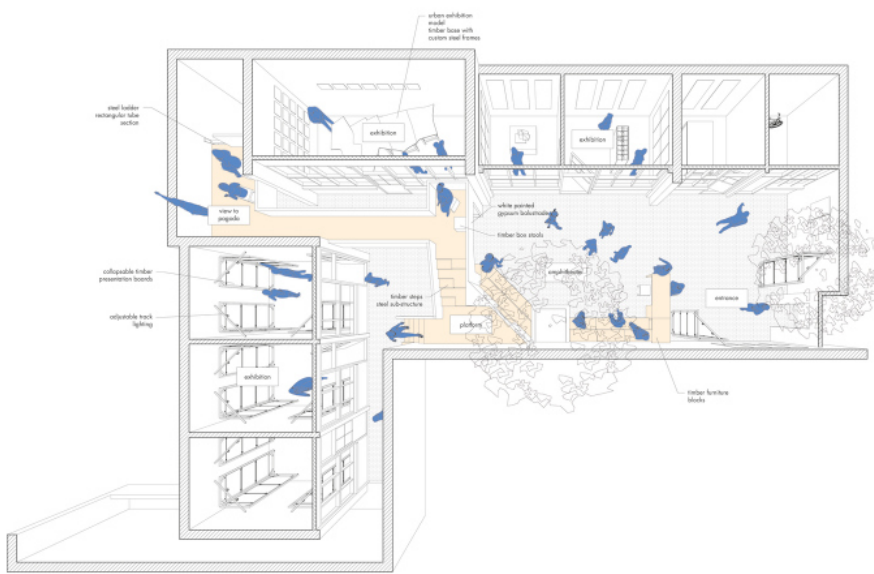
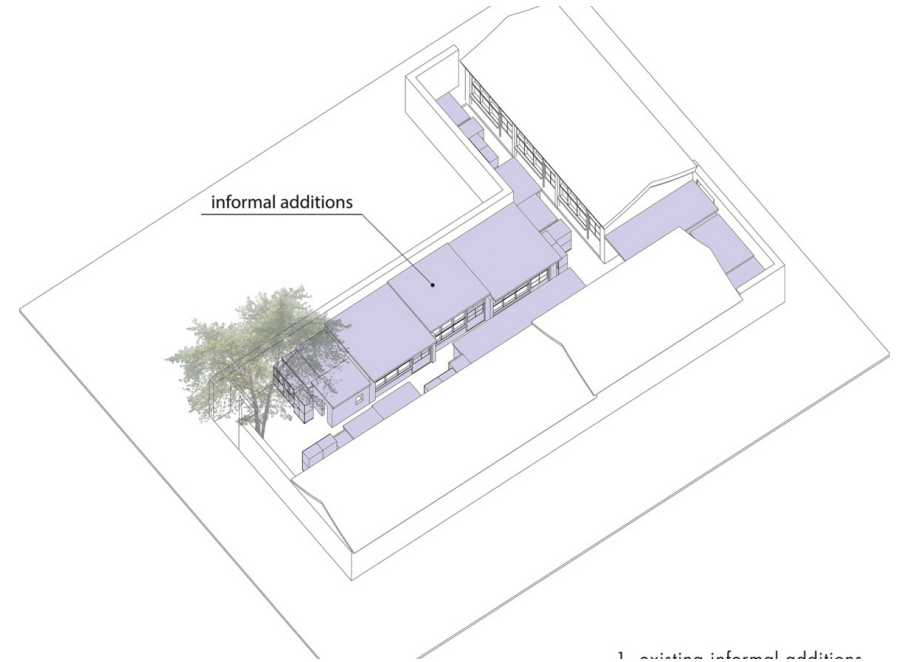
*Key words:*

*Sustainable reorganization of space and  
connections with the pedestrian street*

*Search for a solution with the addition of  
parking spaces*

*Reorientation of the inner courtyard*

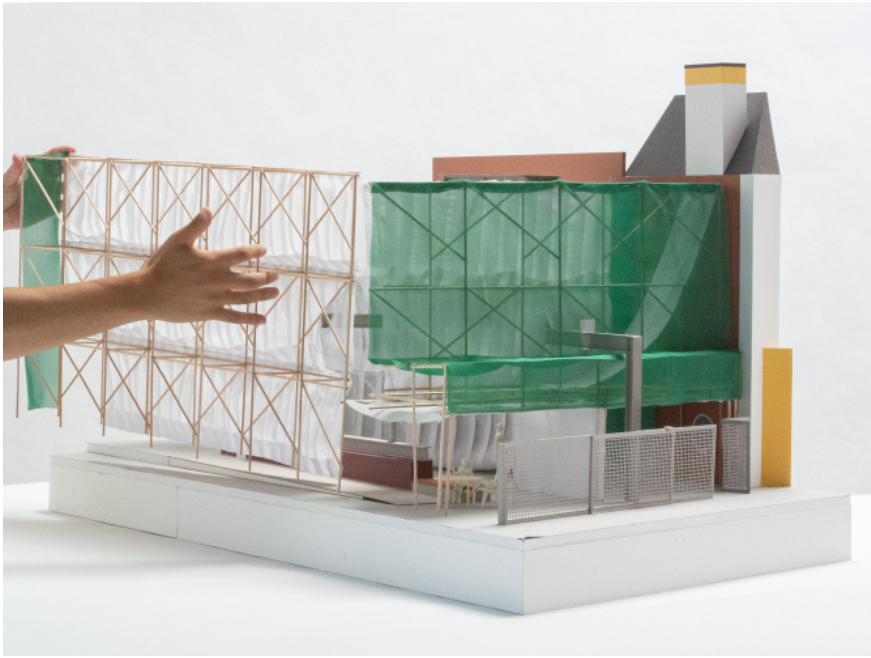
WHITE PAGODA TEMPLE, Courtyard Renovation in China



/ 2017 year



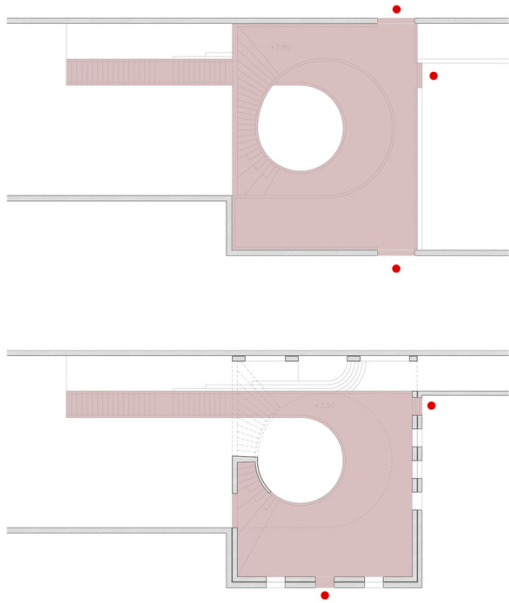
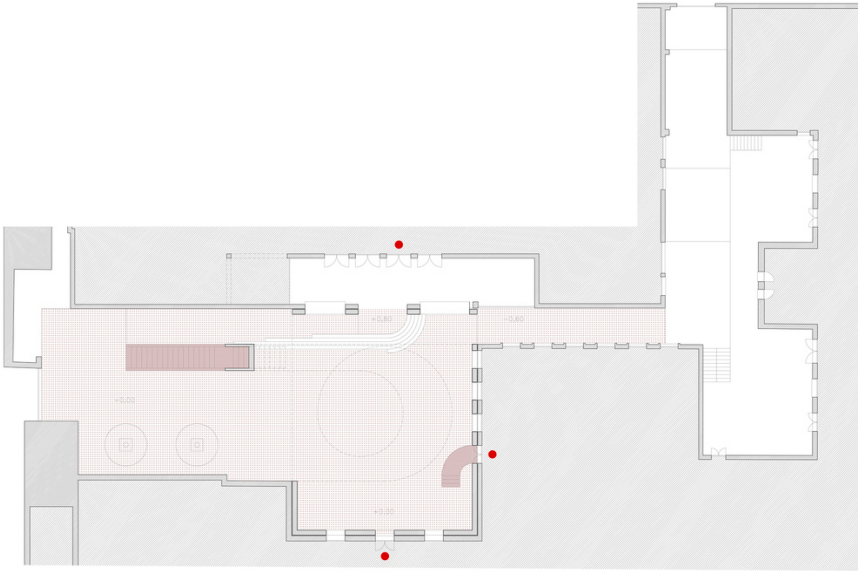
LANDCAPE INSTALLATIONS and ARCHITECTURE STRUCTURES «Veli Craft», Courtyard Reorganisation in US



/ 2021 year

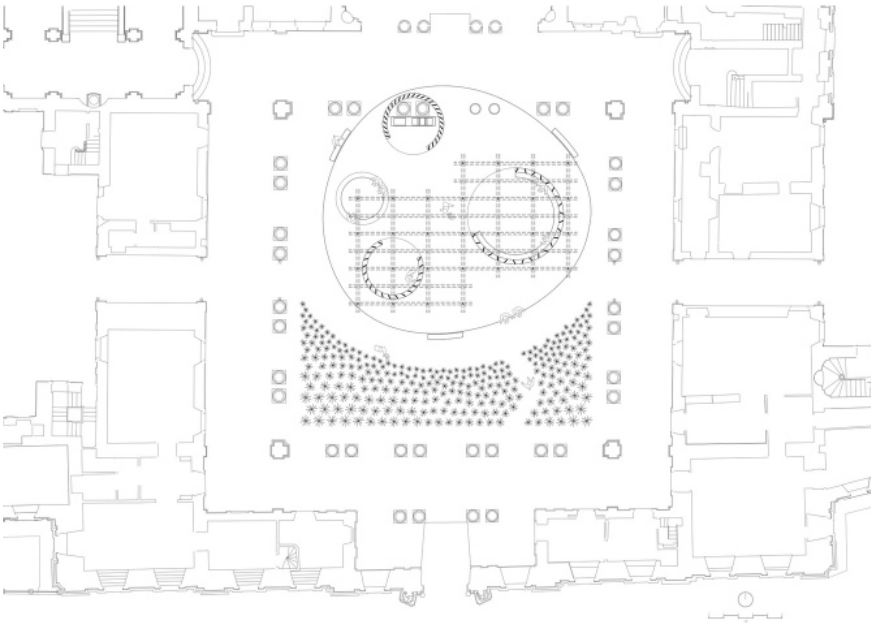


PUBLIC SPACE RENOVATION , Courtyard Reorganisation in Spain





TEMPORARY COARTYARD INSTALATIONS , Courtyard Village in Milan



/ 2016 year

## - EFFICIENT MODEL case studies -

*Key words:*

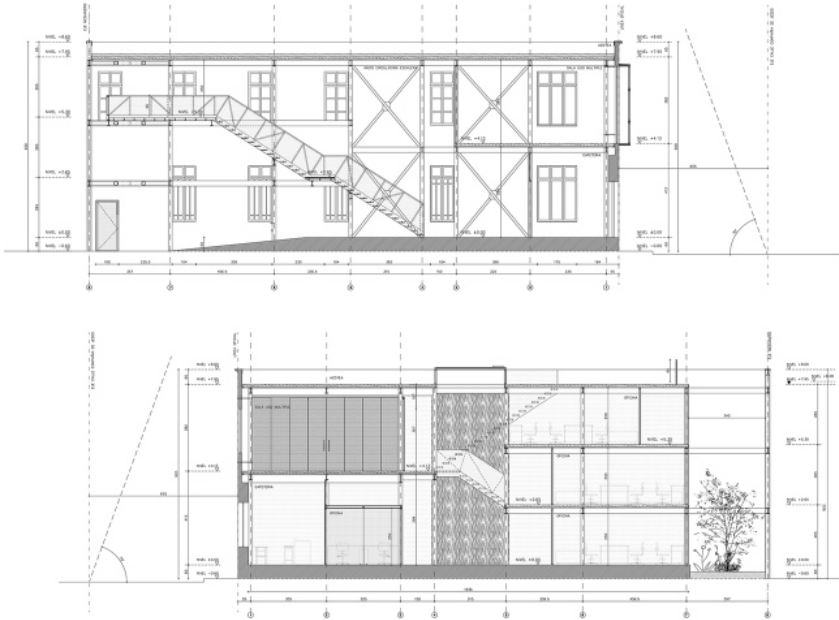
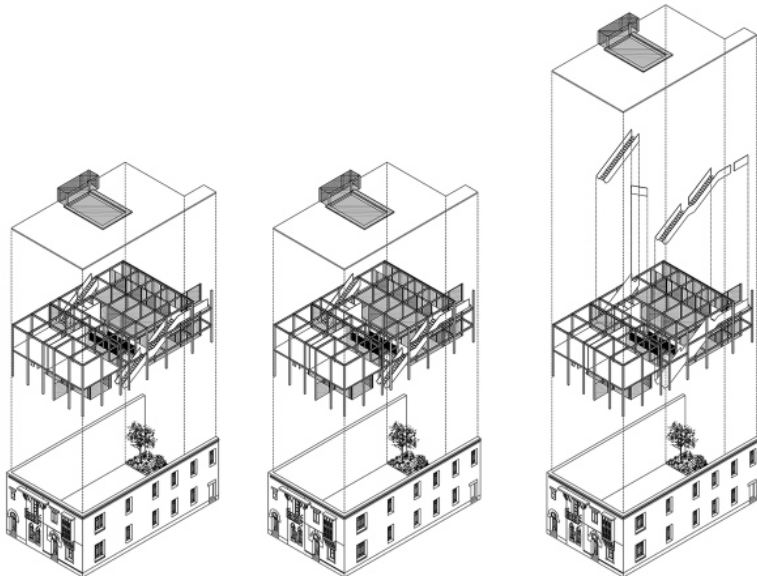
*Adding additional space and making  
existing one more efficient*

*Organization of space for new jobs and  
business*

*Social connection with the city*



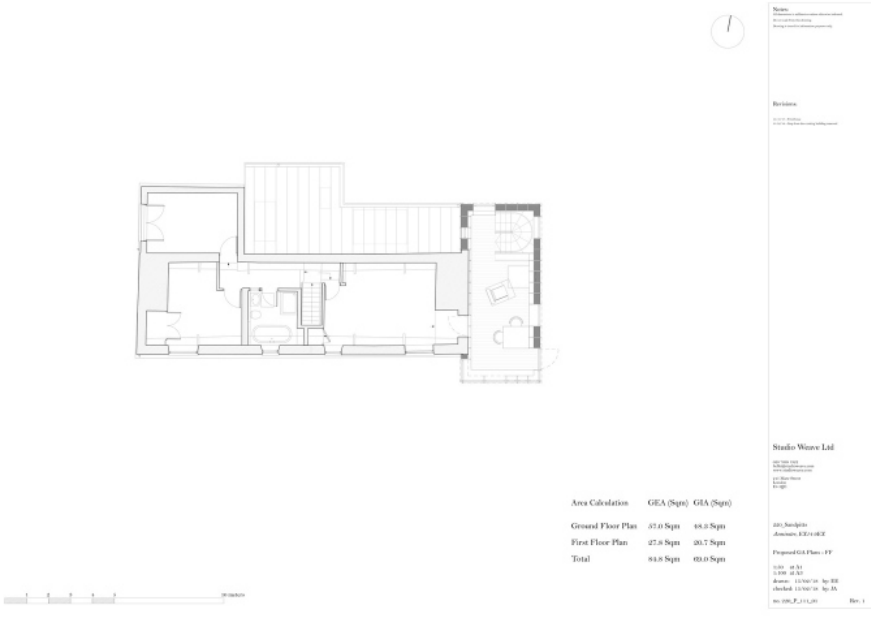
COWORK INTERIORS , Building restoration in Chile



/ 2021 year



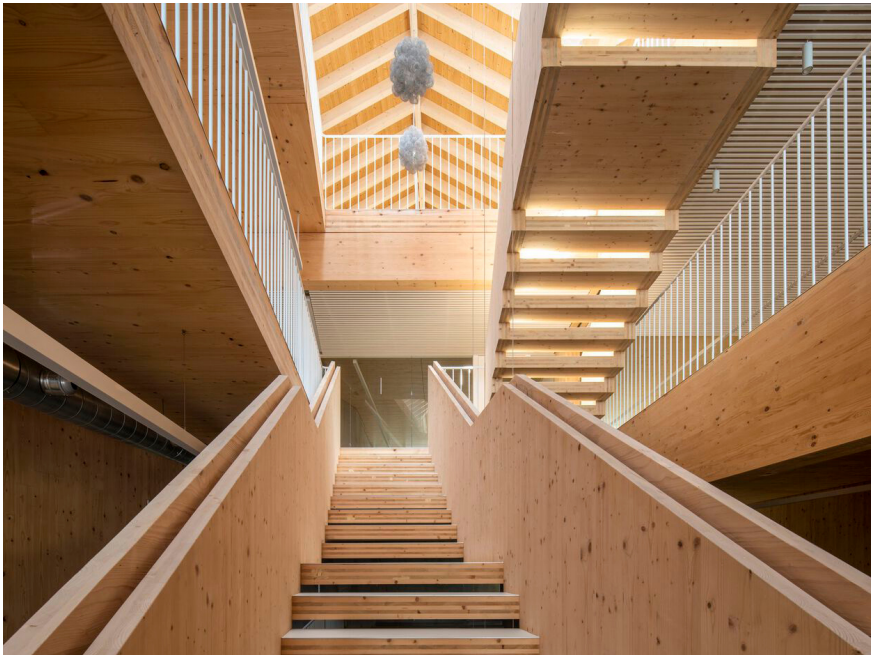
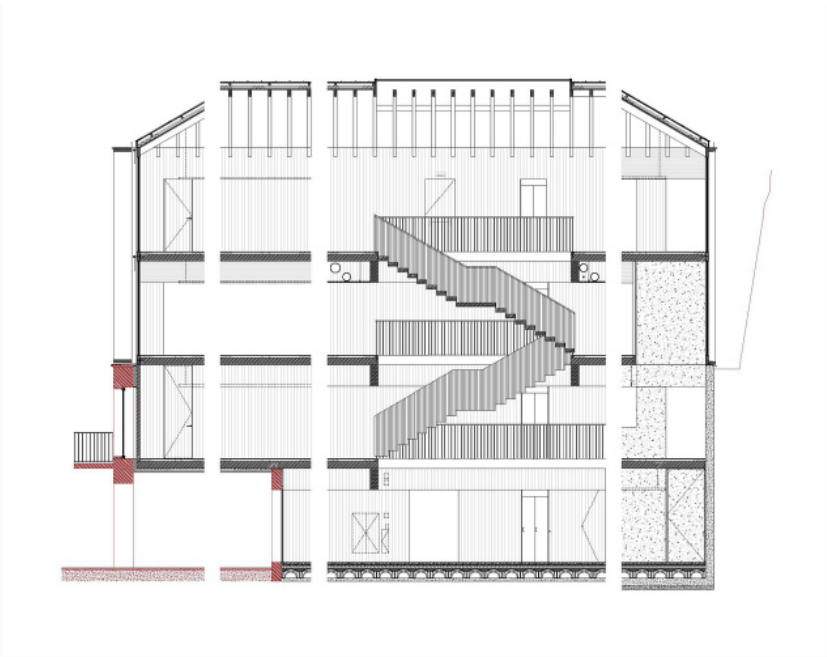
«MADE OF SAND» HOUSE EXTENTION , Building renovation in UK



/ 2022 year



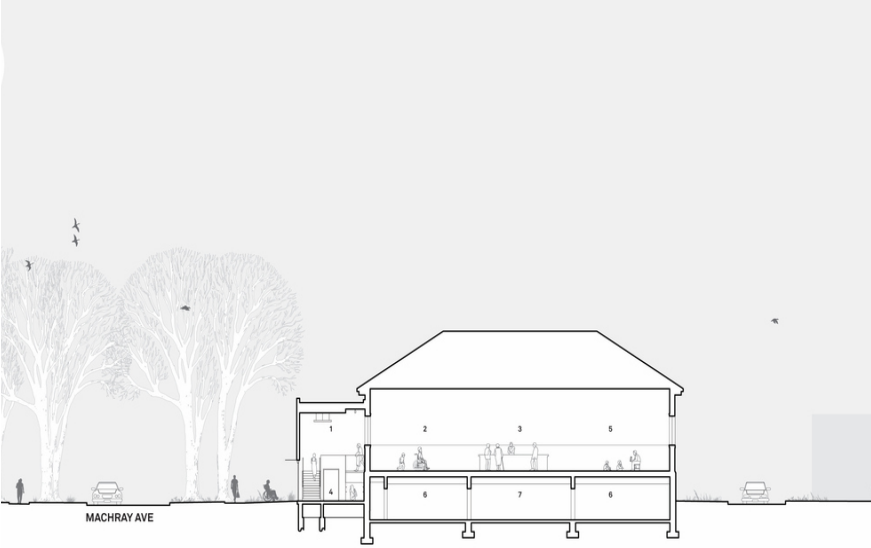
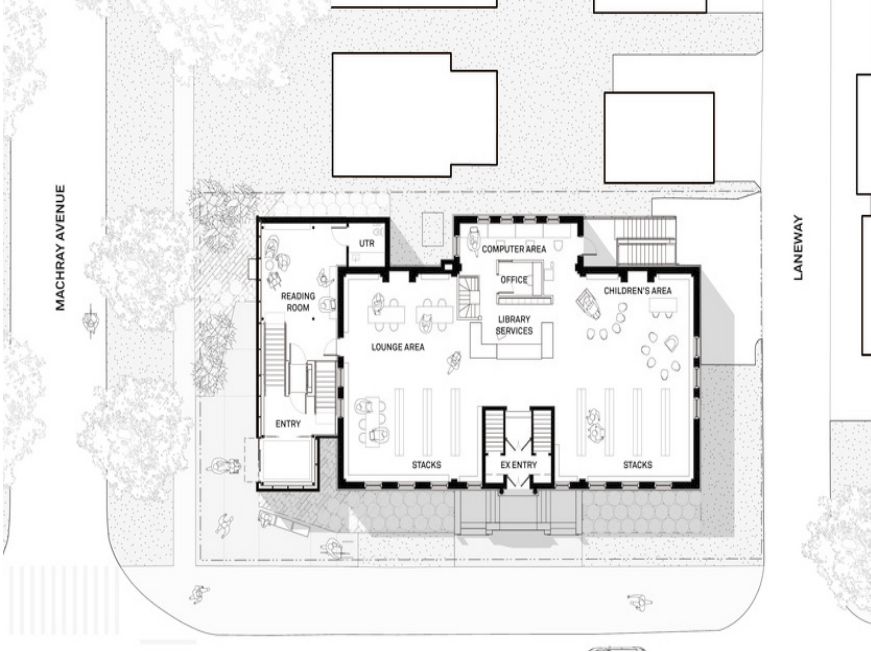
HEADQUARTERS REORGANISATION , Building of the University in Spain



/ 2020 year



LIBRARY RESTORATION , Building upgrade in Canada



/ 2019 year





## SITE SELECTION

- CITY URBAN ANALYSIS
- CENTRAL AREA ANALYSIS
- PUBLIC AREA ANALYSIS



SITE SELECTION , CITY URBAN ANALYSIS



The population of Tver is 425,000 people. The city was founded in 1135. Same age as Moscow, the capital of Russia. Tver was rebuilt in 1770, after the entire city burned to the ground in a fire.

New city plan idea of a classic «three lines» urban planning. It was taken by best Russian architects from «Italian example» the urban plan of the Rome.

COUNTRY:  
**RUSSIAN FEDERATION**  
REGION:  
**TVERSKAYA OBLAST**  
CITY:  
**TVER**



-  **CITY SENTIAL AREA:**  
HISTORIC PART OF THE CITY
-  **RAILWAY LINE:**  
REGIONAL RAILWAY CONNECTION
-  **SOCIAL AND CULTURAL PLACES:**  
MUSEUMS, EXEBITIONS, HISTORICAL BUILDINGS,  
MONUMENTS and etc
-  **DESIGN AREA:**  
NOVOTORGSKAYA STREET, 12/5



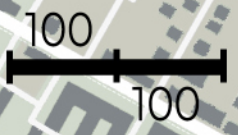


*The historical center of the city of Tver, the layout of which was designed at the end of the 17th century.*





- OFFICE BUILDINGS:**  
*Small office offices, areas for rent, small administrative business*
- COMMERCIAL ZONES:**  
*Restaurants, cafes, bars, small shops and groceries*
- ACCOMODATION BUILDINGS:**  
*Hotels, hostels and other accommodations for tourists*
- CULTUTRE BUILDINGS:**  
*Museums, Exhibition Centers and Administration Buildings*
- DESIGN AREA:**  
*Novotorgskaya street, 12/5*
- BUS STOPS**
- MAIN PEDESTRIAN STREETS OF TVER:**  
*Pedestrian streets, boulevards*
- BOATS DOCK:**  
*For transporting tourists along the Volga River*





SITE SELECTION , PUBLIC AREA ANALYSIS

**PUSHKIN`S SQUARE**  
Monument «City of Military Glory»

**PALACE GARDEN**  
Park of Culture and Leisure

**CITY GARDEN**  
Amusement and Leisure Park

**CITY CENTRAL SQUARE**  
Lenin memorial, Historical military burial



- CULTURAL & TOURIST sites:**  
Churches, entertainment areas
- CULTURAL & EDUCATION sites:**  
Universities, city libraries
- ADMINISTRATIVE sites:**  
Administration, courts, city administration
- DESIGN AREA:**  
Novotorgskaya street, 12/5
- MAIN PEDESTRIAN paths & SOCIAL OPEN areas:**  
Parks, squares, squares

50  
50



## SITE SELECTION



*The building is located on a pedestrian alley, the central walking city path. The place has a long history and is very valuable for the city and its inhabitants.*



## HISTORY

- ABSTRACT
- TIMELINE SCHEME
- CHRONICLES OF BUILDING`S RECONSTRUCTION

## WHAT DO WE KNOW ABOUT DESIGN AREA?

*The history of the building begins in 1803. This year, the merchant's wife A. Tatartseva building a stone two-story residential building. This building had 7 windows along the long facade and 3 windows along the short one. At that time, the building had its main (long) facade facing Novotorzhskaya Street.*

*In 1851, as documented, the State Councilor I.F. Lvov became the owner of the building. For 30 years, he served as provincial architect (1820-1850). In the same year (1851), a new one-story building was built close to the house. It was with 8 windows and an entrance along the coartyard alley. The two-story building itself will later be rebuilt with the addition of a third floor. Lvov I.F. family owned the building until the 1880s.*

*Between 1885 and 1893, F.A. Smirnov became the new owner of the house. In the following years, he will launch the most active construction activity on the territory of the building of its entire centurie-old history. As a result, in 1894, a three-story building appeared at the corner of Trekhsvyatsky Lane and Novotorzhskaya Street. It was elongated along a north-south axis. **By 1902**, when F.A. Smirnov acquires a neighboring (from the west) site, he decides to reconstruct the building into a hotel. From here begins the history of one of the most famous hotels in the city of Tver (That history will be almost one centure long). The facade, which the building acquires as a result of these reconstructions, will remain to this day.*

*(Documents claim that in the Soviet times, decor, dimensions and decor have not changed much since 1902) [9]*

*An interesting fact is that the building, with its shape, forms the red lines of the construction of Trekhsvyatsky Lane. Later, all of new architecture volumes will be arranged by this bulidng. That building is the dominant volume of the complex of residential and public commercial buildings till today's time.*

*The entire existing volume, rebuilt by 1902, is in the form of eclecticism with a predominance of neo-Renaissance motifs in the style of the facades. It also includes masonry arrays of the classic original two-story residential building and a one-story building.*

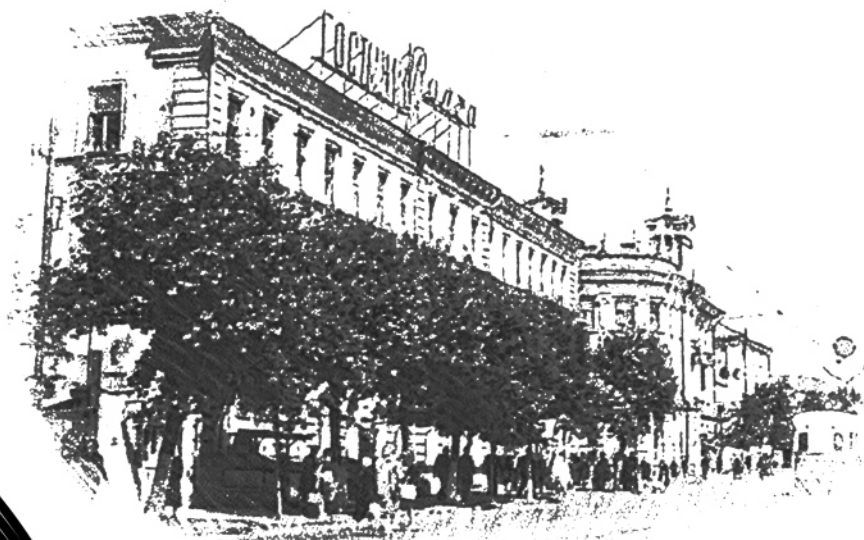
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[9] - Passport «Manor city. Main house. Hotel Central». Monuments of history and culture of the USSR. Ministry of Culture of the USSR.





I.F. Lvov is a provincial architect who owned the building until 1857-1880.



1960-1973, Hotel «Volga», former «Central».

1920



State architect F.A. Smirnov started a large construction activity by rebuilding the building in 1885.

1885



1970-1973, Restaurant «Volga» left from the former hotel. Very famous and tourist place.

1851



2022

2022, today the building has been abandoned for more than 20 years.



1997

1994-1997, The building is already half-abandoned, the first floor and partially the second are actively used. The photo shows the London Cafe, which was popular at that time.

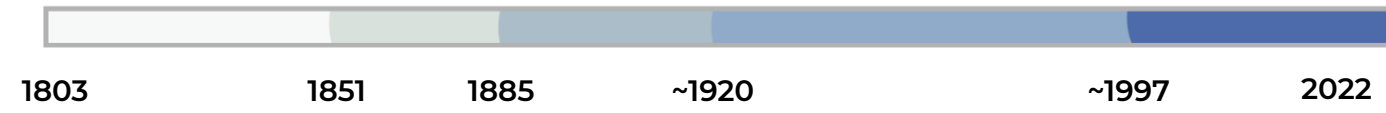
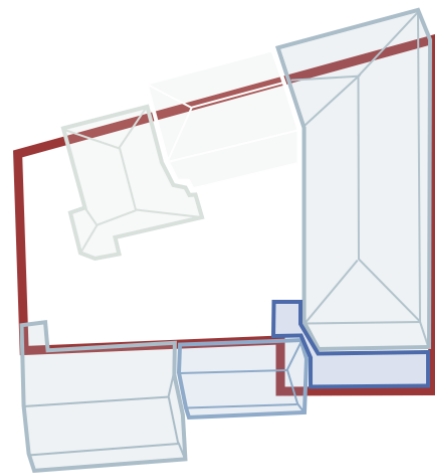
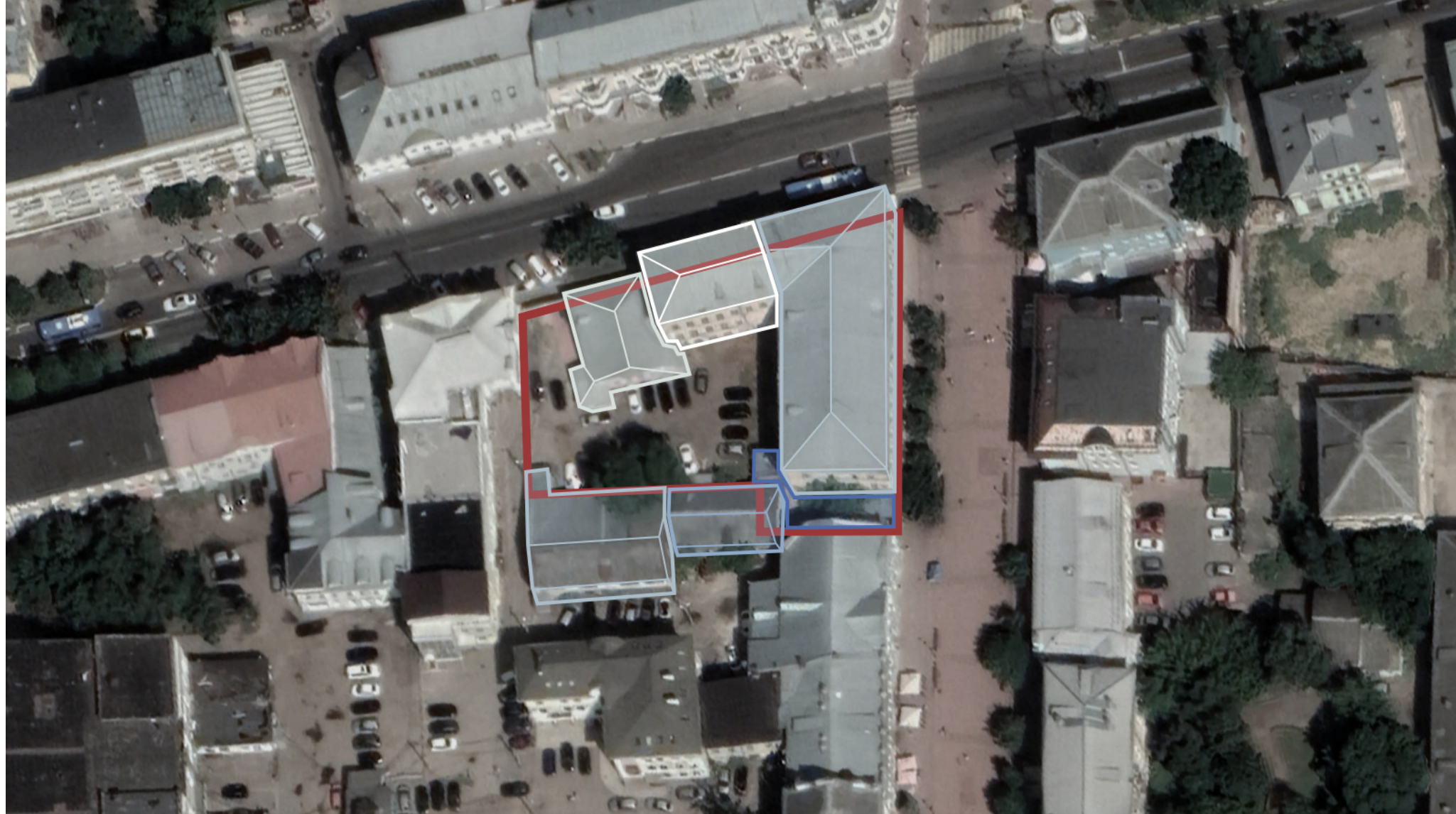
1803

In 1803, the merchant A.Tatarintseva built a stone two-story house «8 sazhen down the street and 5 in the yard.»

ARCHITECTURAL CHANGES

TIMELINE, YEARS





**RED LINES OF DESIGN AREA**  
(According to historic and today's situation)





/1903 year

*Hotel «London», 1903. (Throughout history, the hotel has changed its name three times.)*





/1920 year

*Provincial conference of workers, 1920. Facade of the building of the future hotel «Central».*





/1930 year

Hotel «Central», 1935





/1960 year

Hotel «Volga», 1935





/1960 year

*View of the hotel building from the  
roof of a neighboring building, 1975.*



/1995 year

*Cafe «London», according to locals, a very popular and inexpensive place, 1995. (It can be seen that the building has not been renovated for a long time.)*



## BUILDING CONDITION

- SURFACES and OTHER PARAMETERS
- FACADES DETAILS OVERVIEW
- PHOTO ARCHIVE OVERVIEW





BUILDING CONDITION, GROUND FLOOR M1:200

A commercial extension that appeared in the 1996-2000s. An obvious disturbance of the historical facade and perception of the main building.

Latest interior design with unorganized arrangement of small commercial spaces. The walls are thin and non-load-bearing. Built around the 2000s.

Additional entrance to the building. Was part of the original project. It was bricked up after the 1980s. \*The first floor was commercial, the original project had a door here.

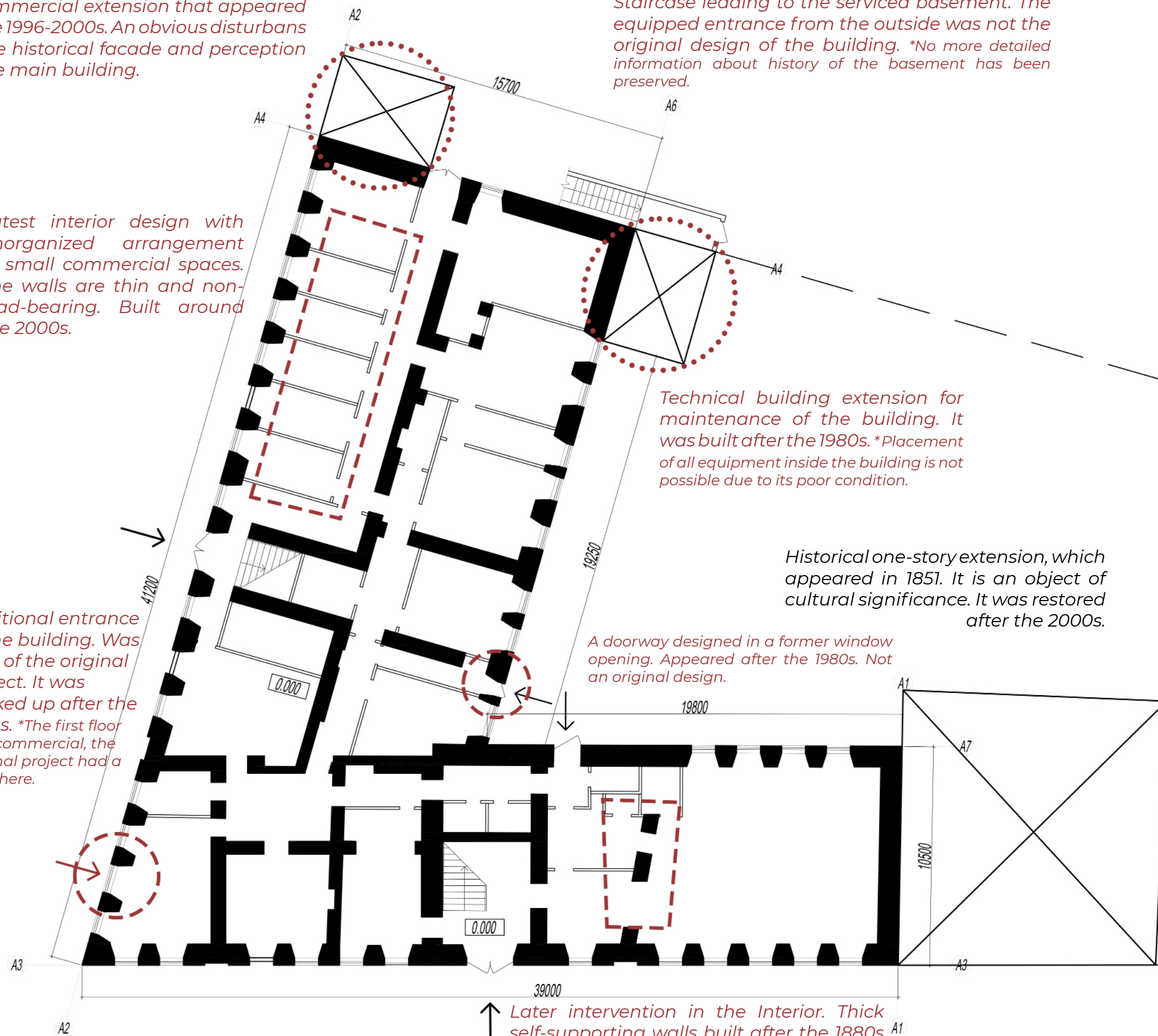
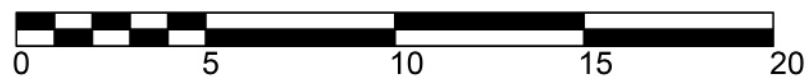
Staircase leading to the serviced basement. The equipped entrance from the outside was not the original design of the building. \*No more detailed information about history of the basement has been preserved.

Technical building extension for maintenance of the building. It was built after the 1980s. \*Placement of all equipment inside the building is not possible due to its poor condition.

Historical one-story extension, which appeared in 1851. It is an object of cultural significance. It was restored after the 2000s.

A doorway designed in a former window opening. Appeared after the 1980s. Not an original design.

Later intervention in the Interior. Thick self-supporting walls built after the 1880s - 1920s. The whole building, and especially the first floor, is rich in such examples. \*Many of the walls have already lost their intended purpose.



**0 FLOOR / BUILDING PARAMETERS**

**USE OF THE FLOOR:**

Restaurant, office and other commercial needs.

**TOTAL FLOOR AREA / TOTAL BUILDING AREA:**

685 m<sup>2</sup> / 2965 m<sup>2</sup>

**USEFUL FLOOR AREA / USEFUL BUILDING AREA:**

605 m<sup>2</sup> / 2498 m<sup>2</sup>

**TOTAL LAND AREA / FREE FROM BUILDING AREA:**

1876 m<sup>2</sup> / 815 m<sup>2</sup>

**TYPE OF THE BUILDING HEATING SYSTEM:**

Two-pipe heating independent from the centralized network.

**WATER SUPPLY AND SEWERAGE SYSTEM:**

Centralized cold water supply, from the city network, separate sewerage to the city network.

**POWER SUPPLY SOURCE:**

City power supply, from the nearest substation.

**VENTILATION & AIR COOLING:**

Local slot ventilation (window openings).

**FIRE EXTINGUISHING SYSTEM:**

Fire alarm system with people warning system. The fire water supply is combined with the building water supply. Water supply is carried out on one input.

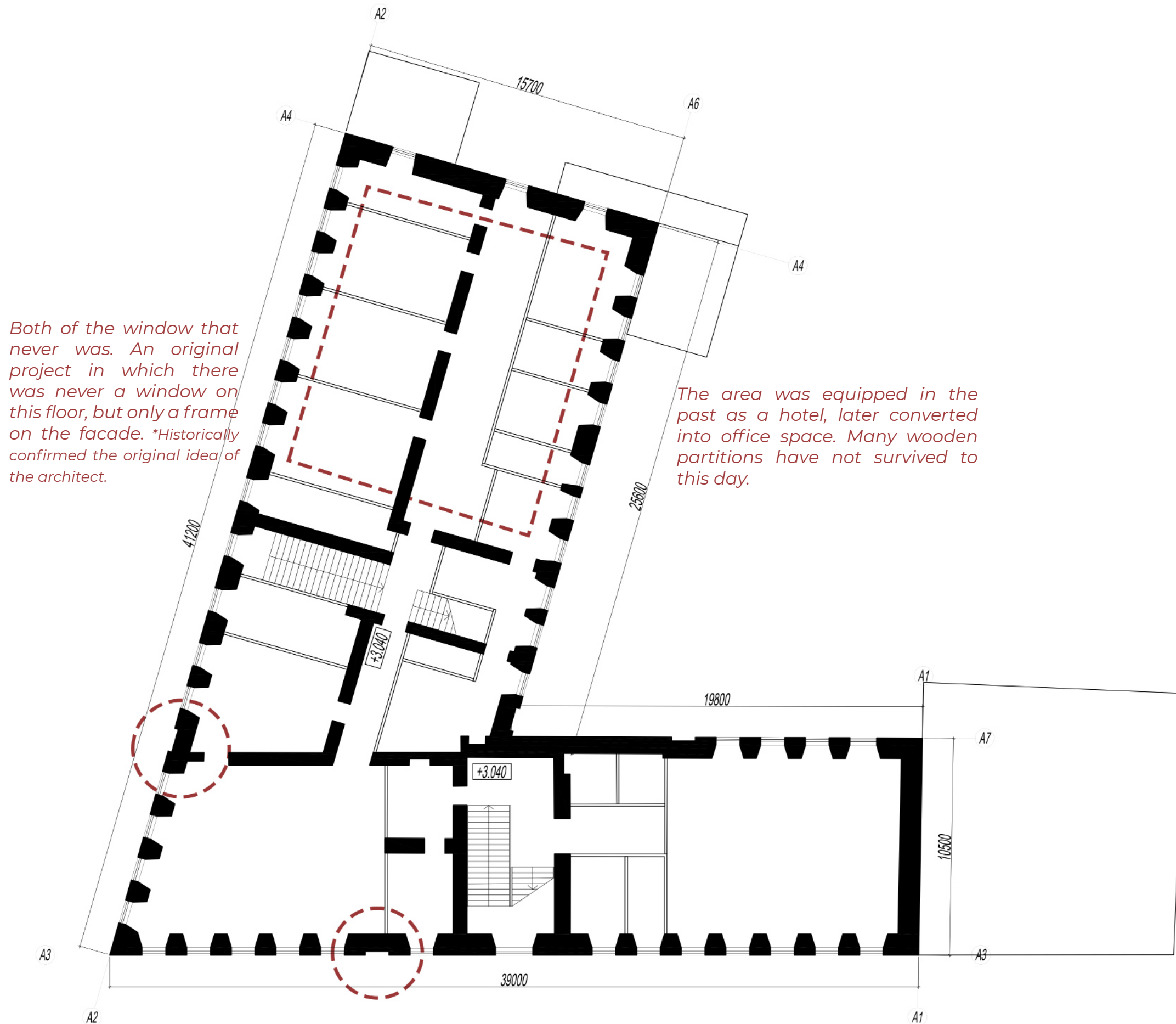
**VERTICAL HUMAN CONNECTIONS:**

Stairwells.

**THE MAIN MATERIALS USED IN THE BUILDING:**

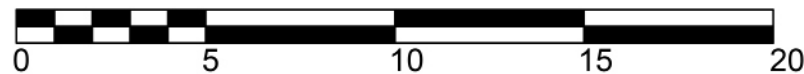
Brick load-bearing walls, wooden floor and roof structures, plaster coating of internal walls and facades, metal roofing, wooden window systems.





Both of the window that never was. An original project in which there was never a window on this floor, but only a frame on the facade. \*Historically confirmed the original idea of the architect.

The area was equipped in the past as a hotel, later converted into office space. Many wooden partitions have not survived to this day.



## 1 FLOOR / BUILDING PARAMETERS

### USE OF THE FLOOR:

Office and other commercial needs until 2000s.  
(Central Hotel before)

### TOTAL FLOOR AREA / TOTAL BUILDING AREA:

685 m<sup>2</sup> / 2965 m<sup>2</sup>

### USEFUL FLOOR AREA / USEFUL BUILDING AREA:

605 m<sup>2</sup> / 2498 m<sup>2</sup>

### TYPE OF THE BUILDING HEATING SYSTEM:

Two-pipe heating independent from the centralized network.

### WATER SUPPLY AND SEWERAGE SYSTEM:

Centralized cold water supply, from the city network, separate sewerage to the city network.

### POWER SUPPLY SOURCE:

City power supply, from the nearest substation.

### VENTILATION & AIR COOLING:

Local slot ventilation (window openings).

### FIRE EXTINGUISHING SYSTEM:

Fire alarm system with people warning system. The fire water supply is combined with the building water supply. Water supply is carried out on one input.

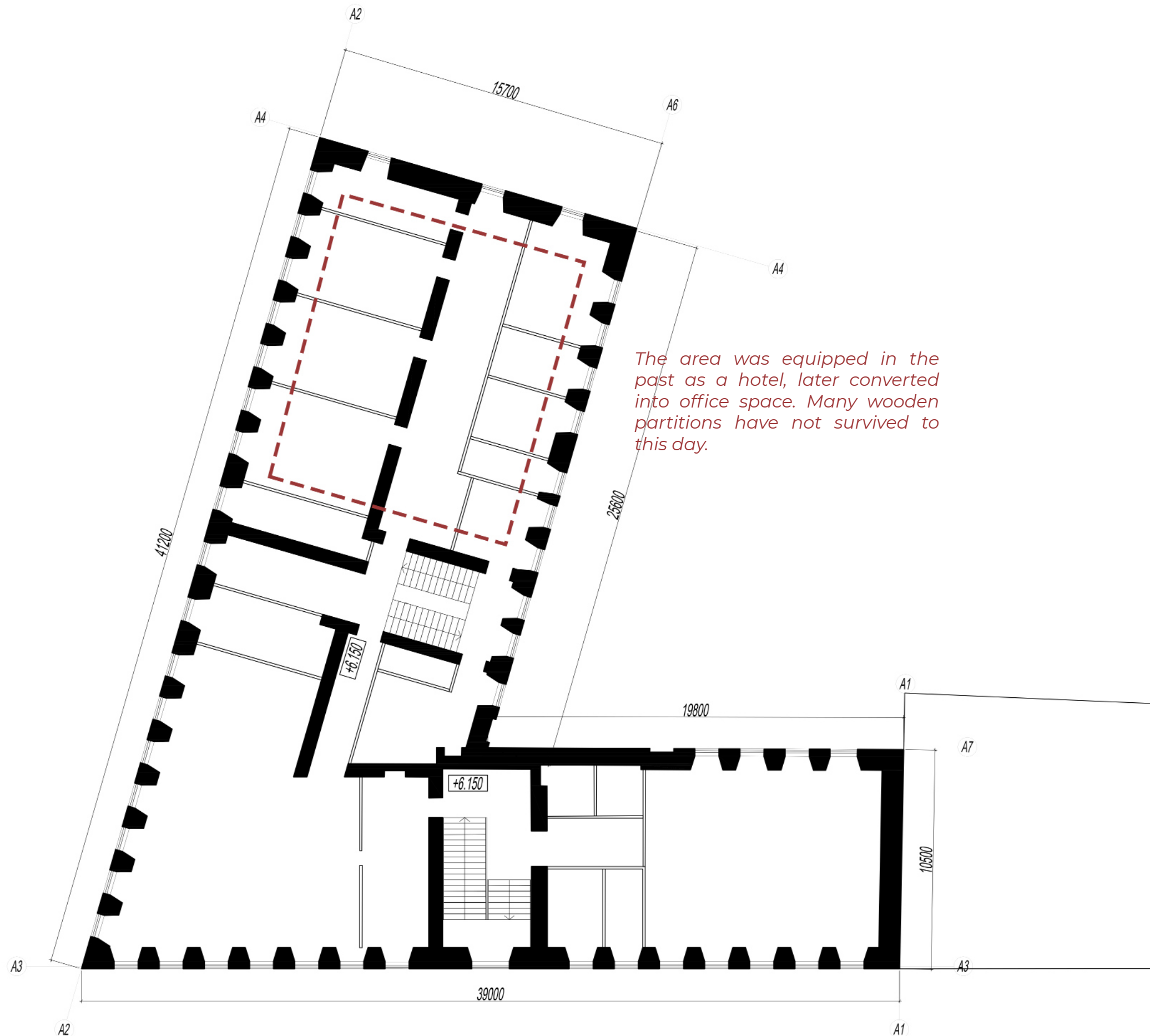
### VERTICAL HUMAN CONNECTIONS:

Stairwells.

### THE MAIN MATERIALS USED IN THE BUILDING:

Brick load-bearing walls, wooden floor and roof structures, plaster coating of internal walls and facades, metal roofing, wooden window systems.





The area was equipped in the past as a hotel, later converted into office space. Many wooden partitions have not survived to this day.

## 2 FLOOR / BUILDING PARAMETERS

### USE OF THE FLOOR:

Office and other commercial needs until 2000s.  
(Central Hotel before)

### TOTAL FLOOR AREA / TOTAL BUILDING AREA:

685 m<sup>2</sup> / 2965 m<sup>2</sup>

### USEFUL FLOOR AREA / USEFUL BUILDING AREA:

608 m<sup>2</sup> / 2498 m<sup>2</sup>

### TYPE OF THE BUILDING HEATING SYSTEM:

Two-pipe heating independent from the centralized network.

### WATER SUPPLY AND SEWERAGE SYSTEM:

Centralized cold water supply, from the city network, separate sewerage to the city network.

### POWER SUPPLY SOURCE:

City power supply, from the nearest substation.

### VENTILATION & AIR COOLING:

Local slot ventilation (window openings).

### FIRE EXTINGUISHING SYSTEM:

Fire alarm system with people warning system. The fire water supply is combined with the building water supply. Water supply is carried out on one input.

### VERTICAL HUMAN CONNECTIONS:

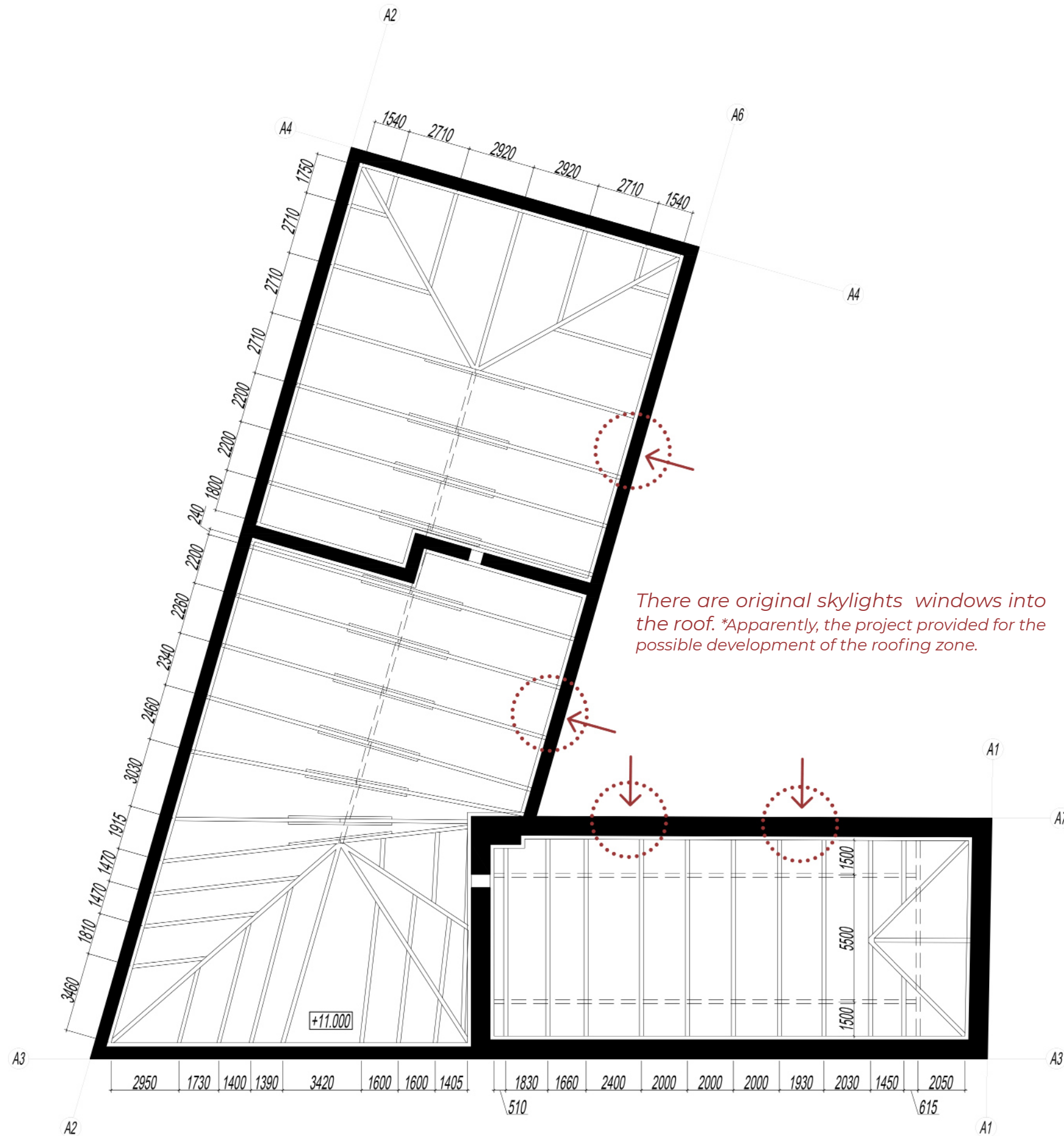
Stairwells.

### THE MAIN MATERIALS USED IN THE BUILDING:

Brick load-bearing walls, wooden floor and roof structures, plaster coating of internal walls and facades, metal roofing, wooden window systems.







## ROOF FLOOR / BUILDING PARAMETERS

### USE OF THE FLOOR:

Roof area

### TOTAL FLOOR AREA / TOTAL BUILDING AREA:

685 m<sup>2</sup> / 2965 m<sup>2</sup>

### USEFUL FLOOR AREA / USEFUL BUILDING AREA:

455 m<sup>2</sup> / 2498 m<sup>2</sup>

### VENTILATION & AIR COOLING:

Local slot ventilation (window openings).

### FIRE EXTINGUISHING SYSTEM:

Fire alarm system with people warning system. The fire water supply is combined with the building water supply. Water supply is carried out on one input.

### VERTICAL HUMAN CONNECTIONS:

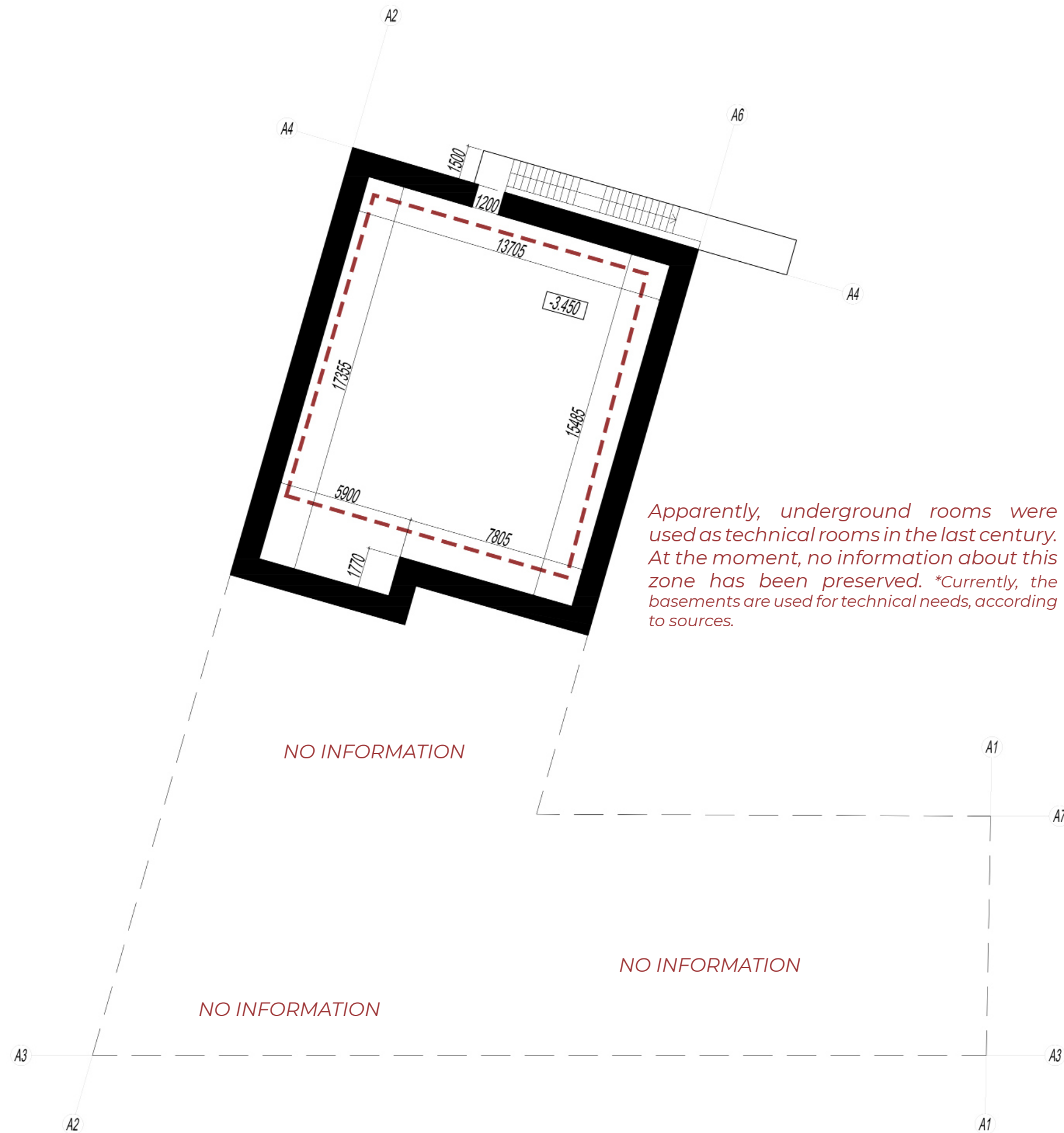
Wall stairs.

### THE MAIN MATERIALS USED IN THE BUILDING:

Brick load-bearing walls, wooden floor and roof structures, plaster coating of internal walls and facades, metal roofing, wooden window systems.







Apparently, underground rooms were used as technical rooms in the last century. At the moment, no information about this zone has been preserved. \*Currently, the basements are used for technical needs, according to sources.

**ROOF FLOOR / BUILDING PARAMETERS**

**USE OF THE FLOOR:**  
*Thecnical maintainanse of the building.*

**TOTAL FLOOR AREA / TOTAL BUILDING AREA:**  
 225m<sup>2</sup> / 2965 m<sup>2</sup>

**USEFUL FLOOR AREA/USEFUL BUILDING AREA:**  
 225 m<sup>2</sup> / 2498 m<sup>2</sup>

**VENTILATION & AIR COOLING:**  
*Possible ventilation shafts connected to the ground floor.*

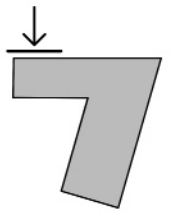
**FIRE EXTINGUISHING SYSTEM:**  
*Fire alarm system with people warning system. The fire water supply is combined with the building water supply. Water supply is carried out on one input.*

**VERTICAL HUMAN CONNECTIONS:**  
*Outside stairs.*

**THE MAIN MATERIALS USED IN THE BUILDING:**  
*Brick load-bearing walls, wooden floor and roof structures, plaster coating of internal walls and facades, metal roofing, wooden window systems.*



BUILDING CONDITION, NORTH FACADE M 1:50



**A**

Exposing building structures. A chipped/lost layer of plaster and top coat.

**B**

Loss of the architectural and stylistic element of the facade.

**C1**

The opening is laid with brickwork, according to the history and project.

**C2**

Opening laid with brickwork, not according to the history and project.

**D**

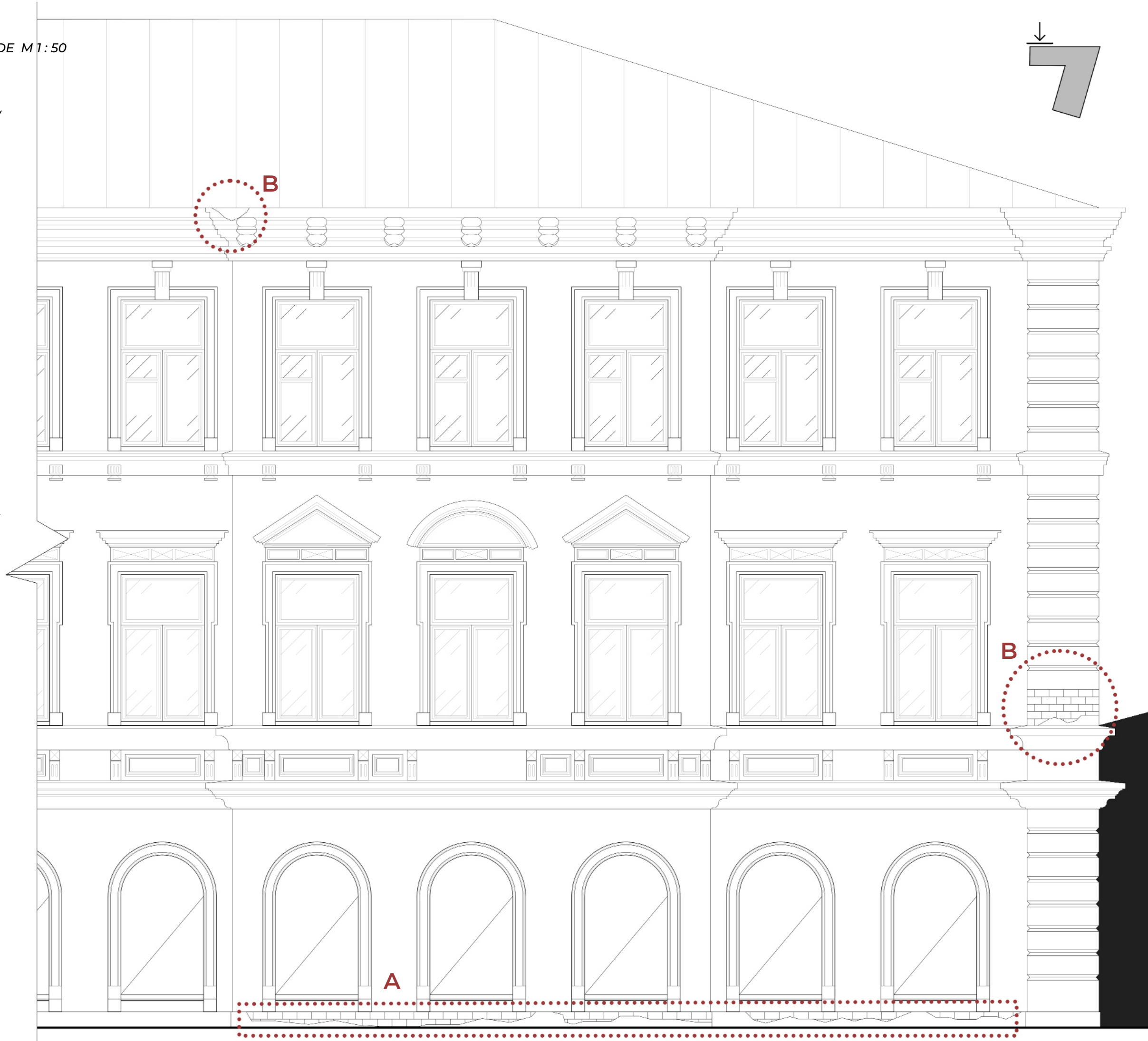
Element clogged / boarded up with a wooden protective sheet (plywood).

**F1**

A hole in the wall, not according to the project (from previous temporary structures or supports).

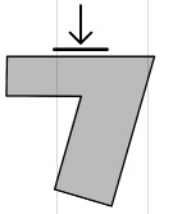
**F2**

Traces of former brick outbuildings (lost over time).





BUILDING CONDITION, NORTH FACADE M1:50



**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

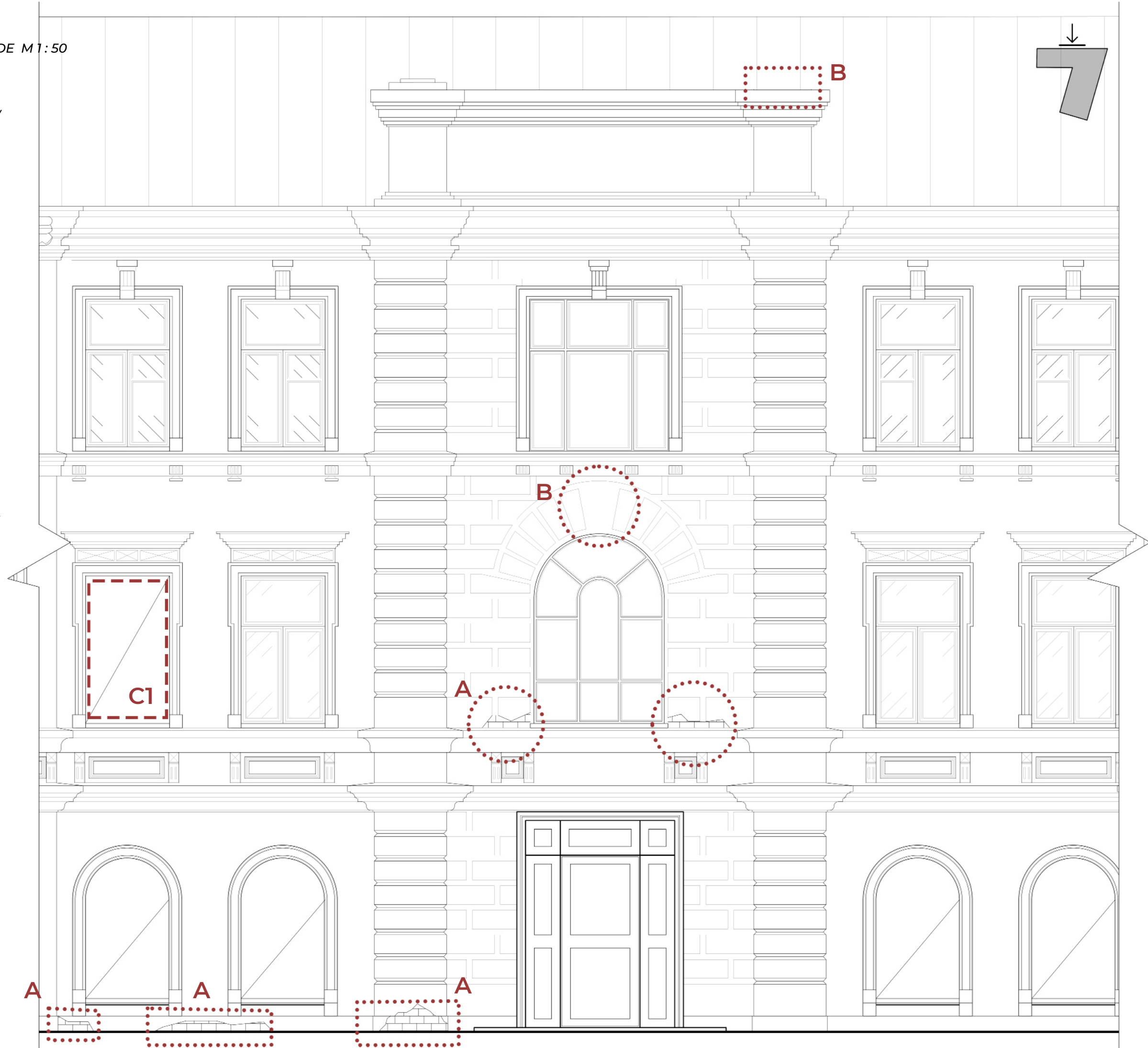
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

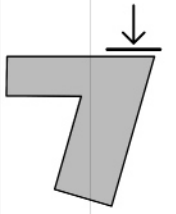
**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).





BUILDING CONDITION, NORTH FACADE M1:50



**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

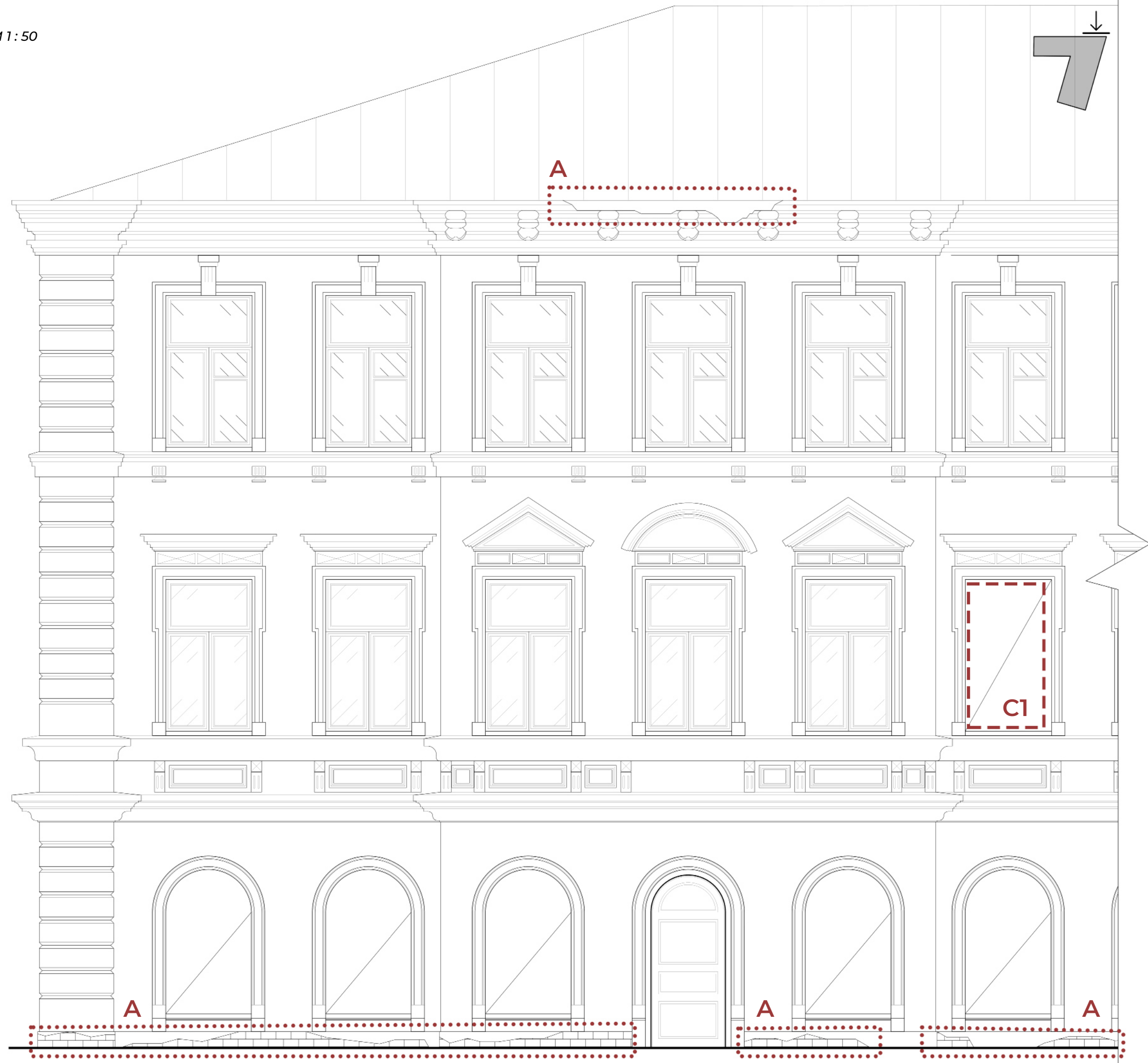
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

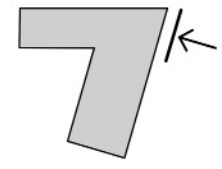
**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).





BUILDING CONDITION, EAST FACADE M 1:50



**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

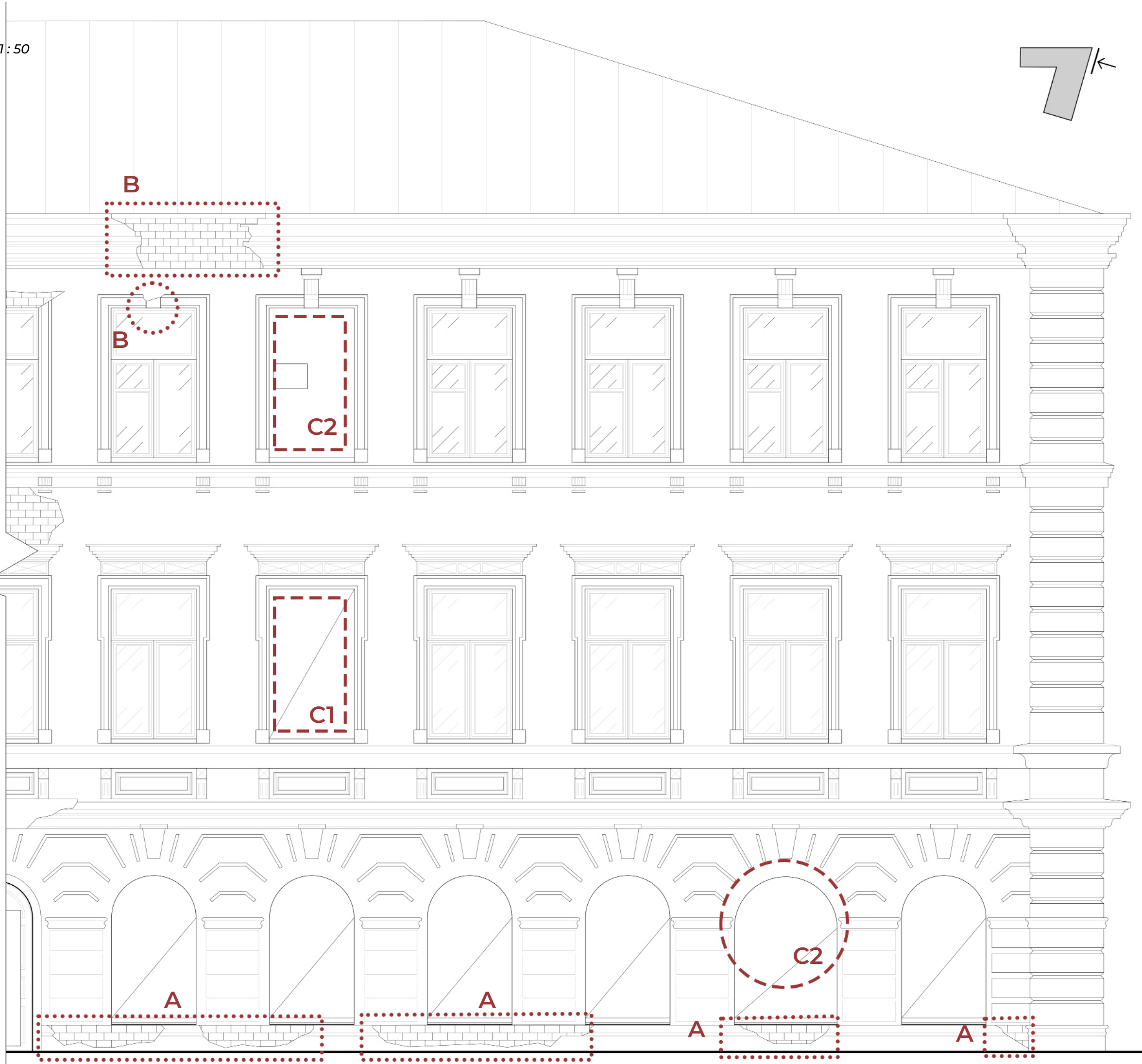
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

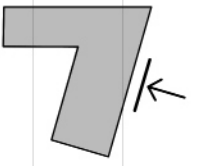
**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).







**A**

Exposing building structures. A chipped/lost layer of plaster and top coat.

**B**

Loss of the architectural and stylistic element of the facade.

**C1**

The opening is laid with brickwork, according to the history and project.

**C2**

Opening laid with brickwork, not according to the history and project.

**D**

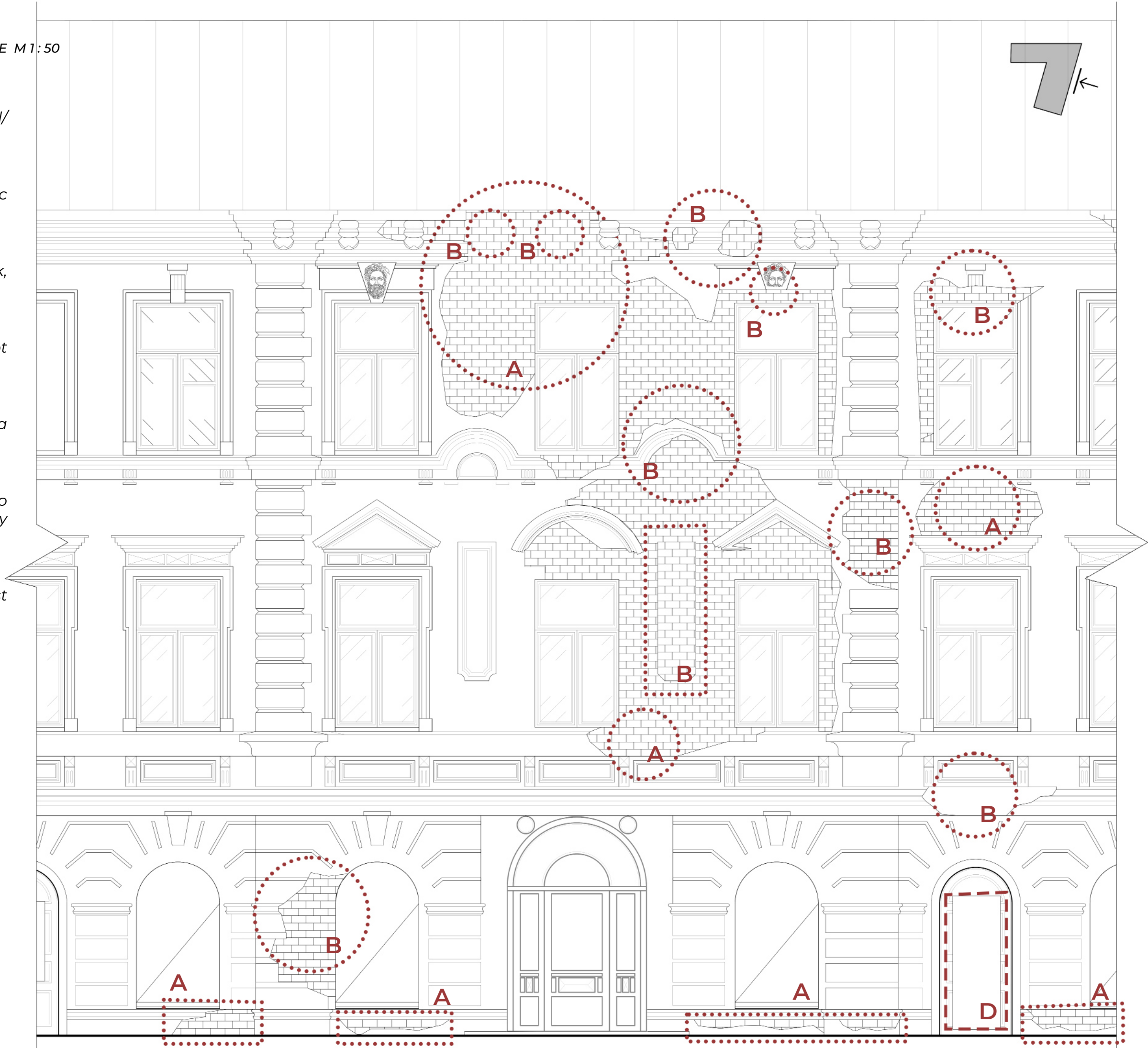
Element clogged / boarded up with a wooden protective sheet (plywood).

**F1**

A hole in the wall, not according to the project (from previous temporary structures or supports).

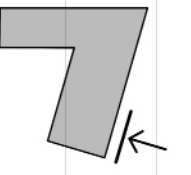
**F2**

Traces of former brick outbuildings (lost over time).





BUILDING CONDITION, EAST FACADE M1:50



**A**

Exposing building structures. A chipped/lost layer of plaster and top coat.

**B**

Loss of the architectural and stylistic element of the facade.

**C1**

The opening is laid with brickwork, according to the history and project.

**C2**

Opening laid with brickwork, not according to the history and project.

**D**

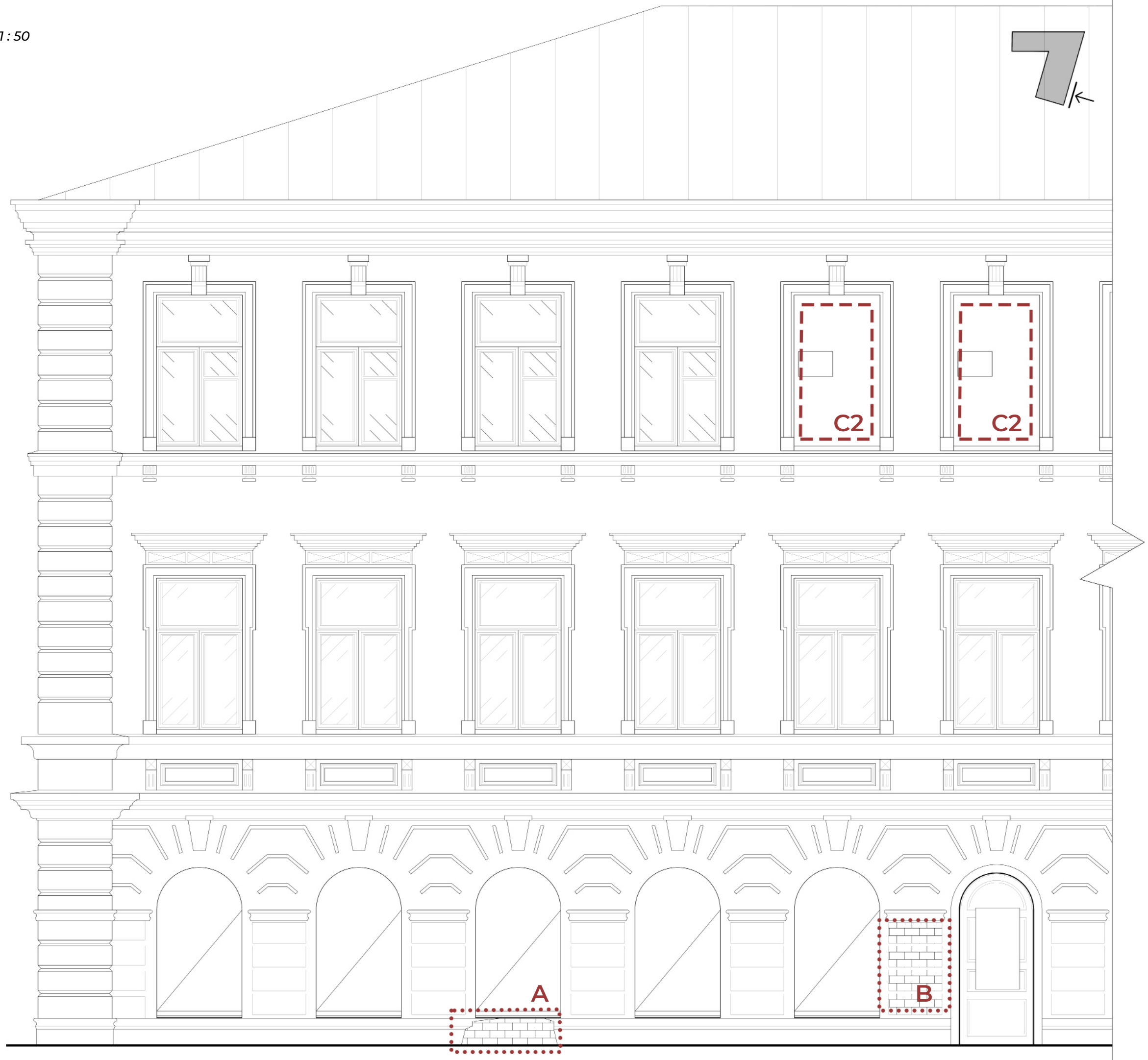
Element clogged / boarded up with a wooden protective sheet (plywood).

**F1**

A hole in the wall, not according to the project (from previous temporary structures or supports).

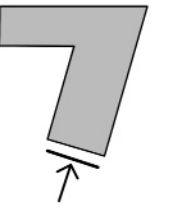
**F2**

Traces of former brick outbuildings (lost over time).





BUILDING CONDITION, SOUTH FACADE M1:50



**A**  
Exposing building structures. A chipped/lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic element of the facade.

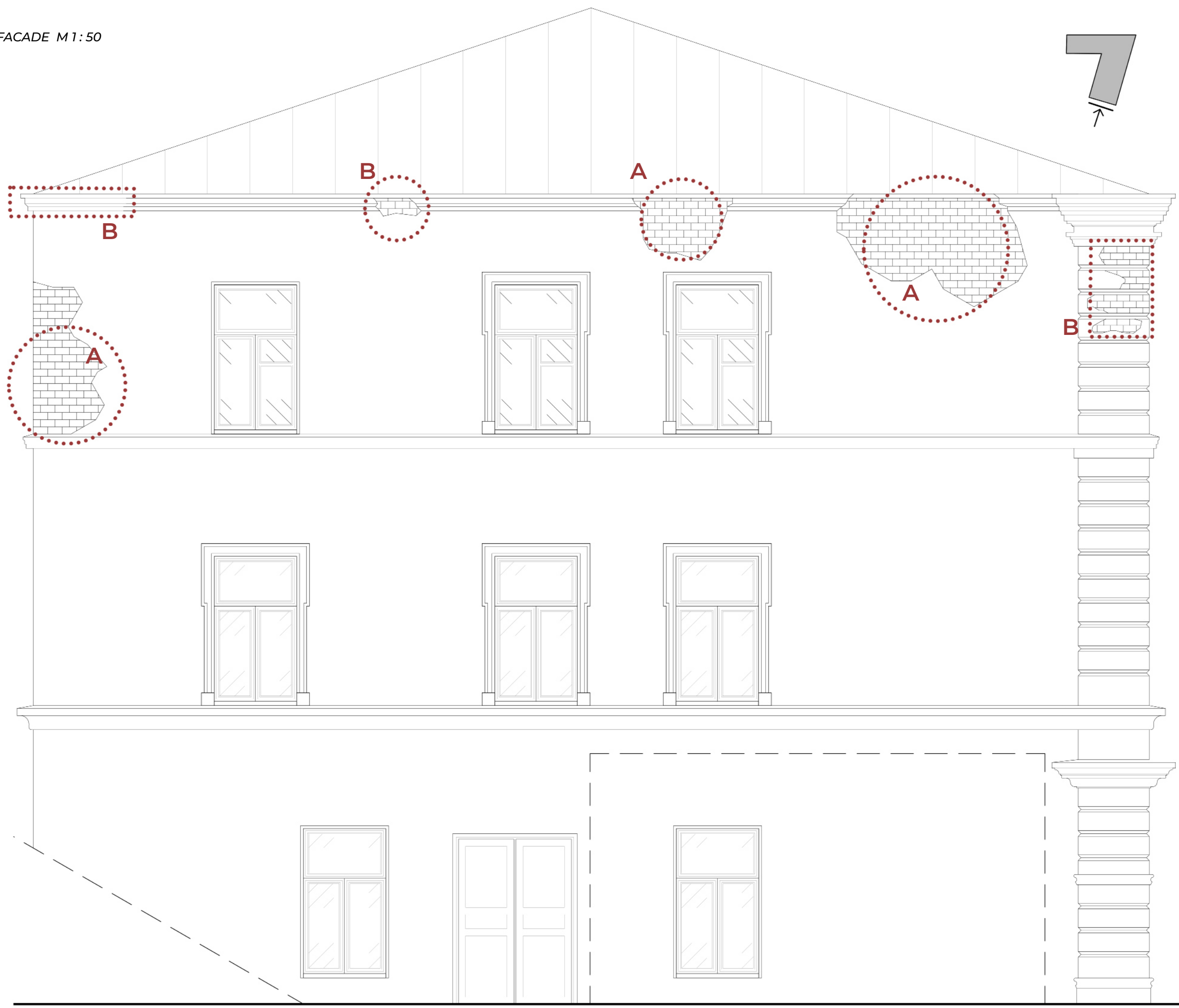
**C1**  
The opening is laid with brickwork, according to the history and project.

**C2**  
Opening laid with brickwork, not according to the history and project.

**D**  
Element clogged / boarded up with a wooden protective sheet (plywood).

**F1**  
A hole in the wall, not according to the project (from previous temporary structures or supports).

**F2**  
Traces of former brick outbuildings (lost over time).





BUILDING CONDITION, WEST COARTYARD FACADE M 1: 50



**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

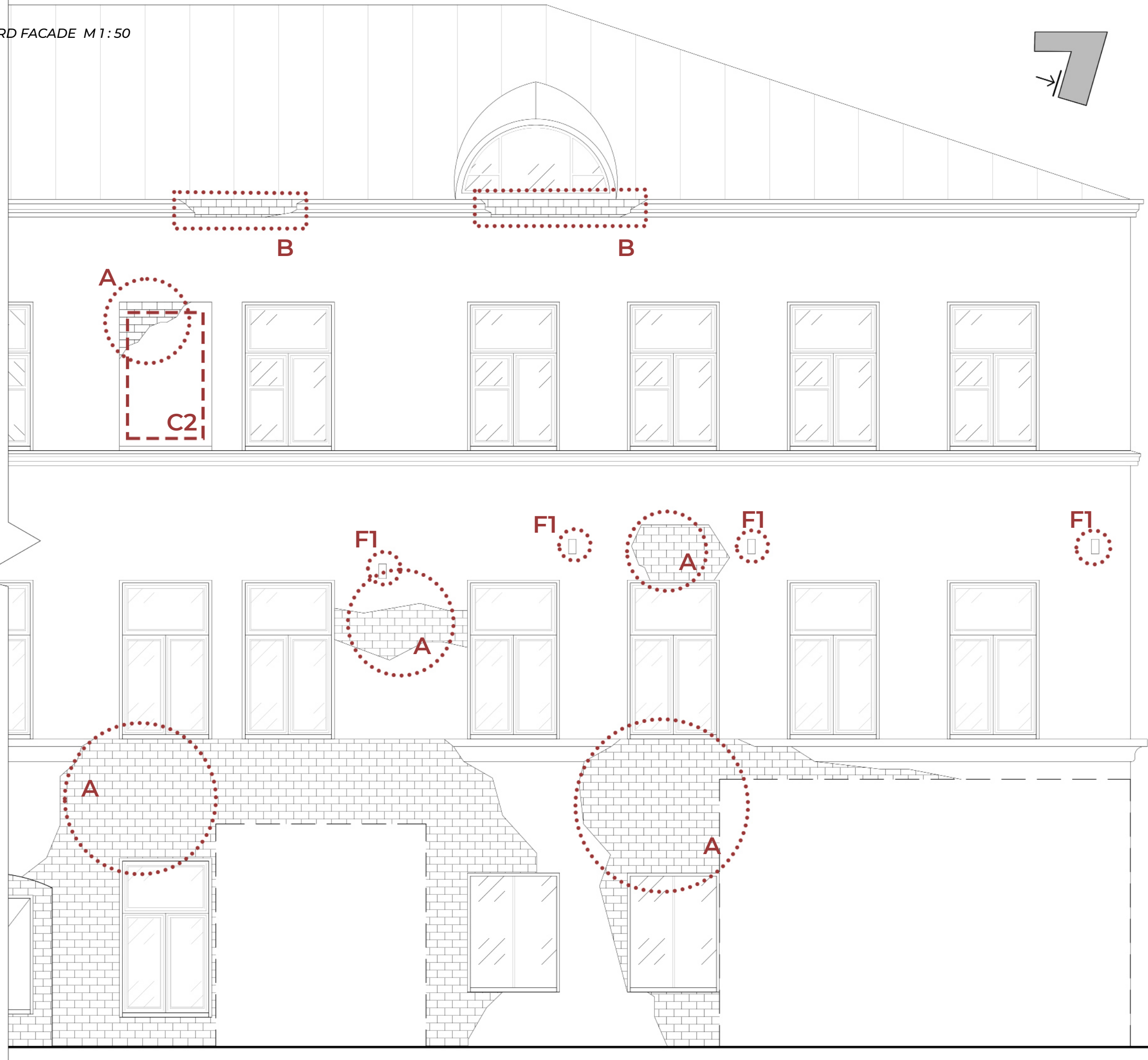
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

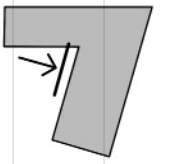
**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).



BUILDING CONDITION, WEST COARTYARD FACADE M 1:50



**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

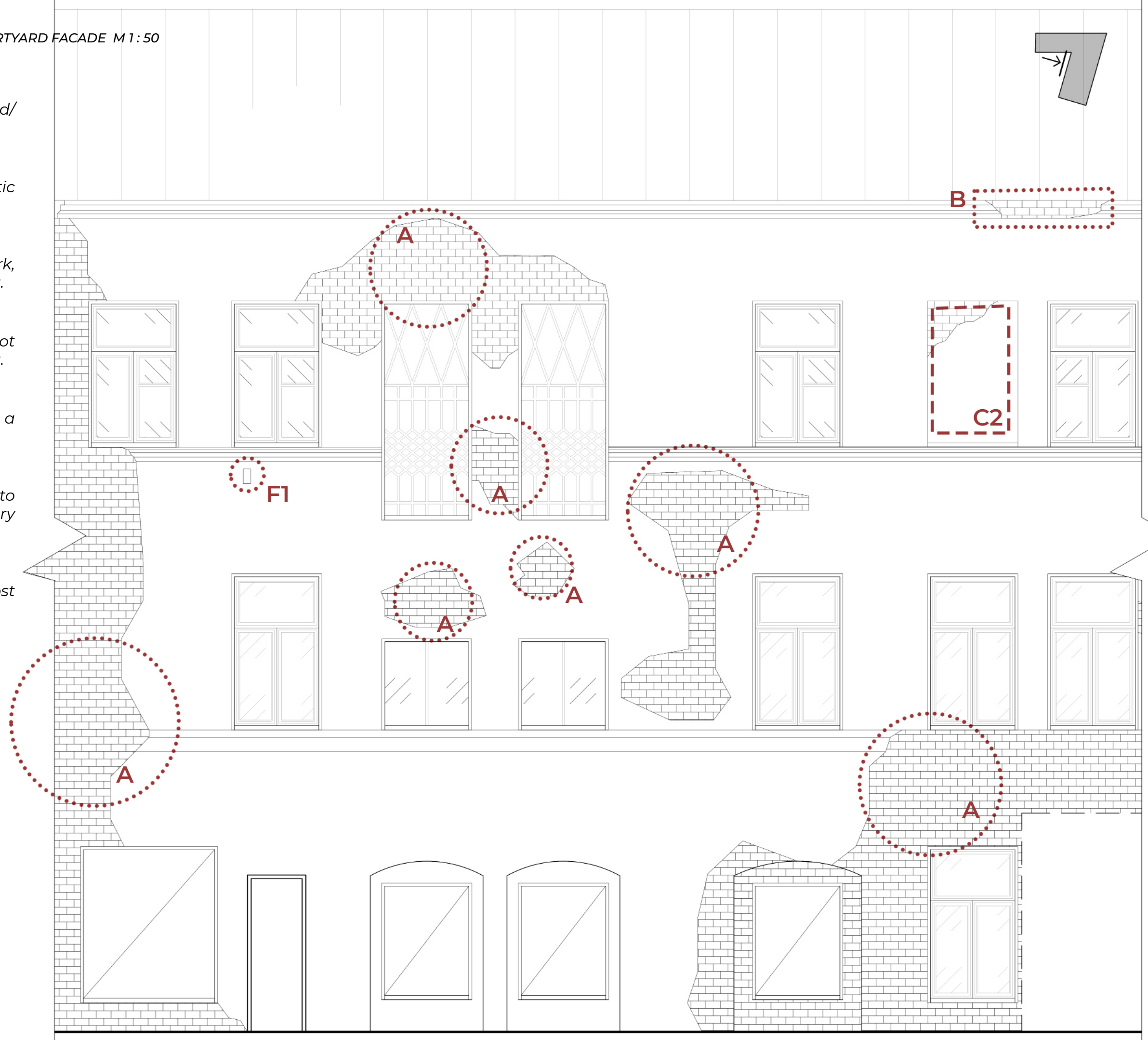
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).







BUILDING CONDITION, SOUTH COARTYARD FACADE M 1: 50

**A**  
Exposing building structures. A chipped/  
lost layer of plaster and top coat.

**B**  
Loss of the architectural and stylistic  
element of the facade.

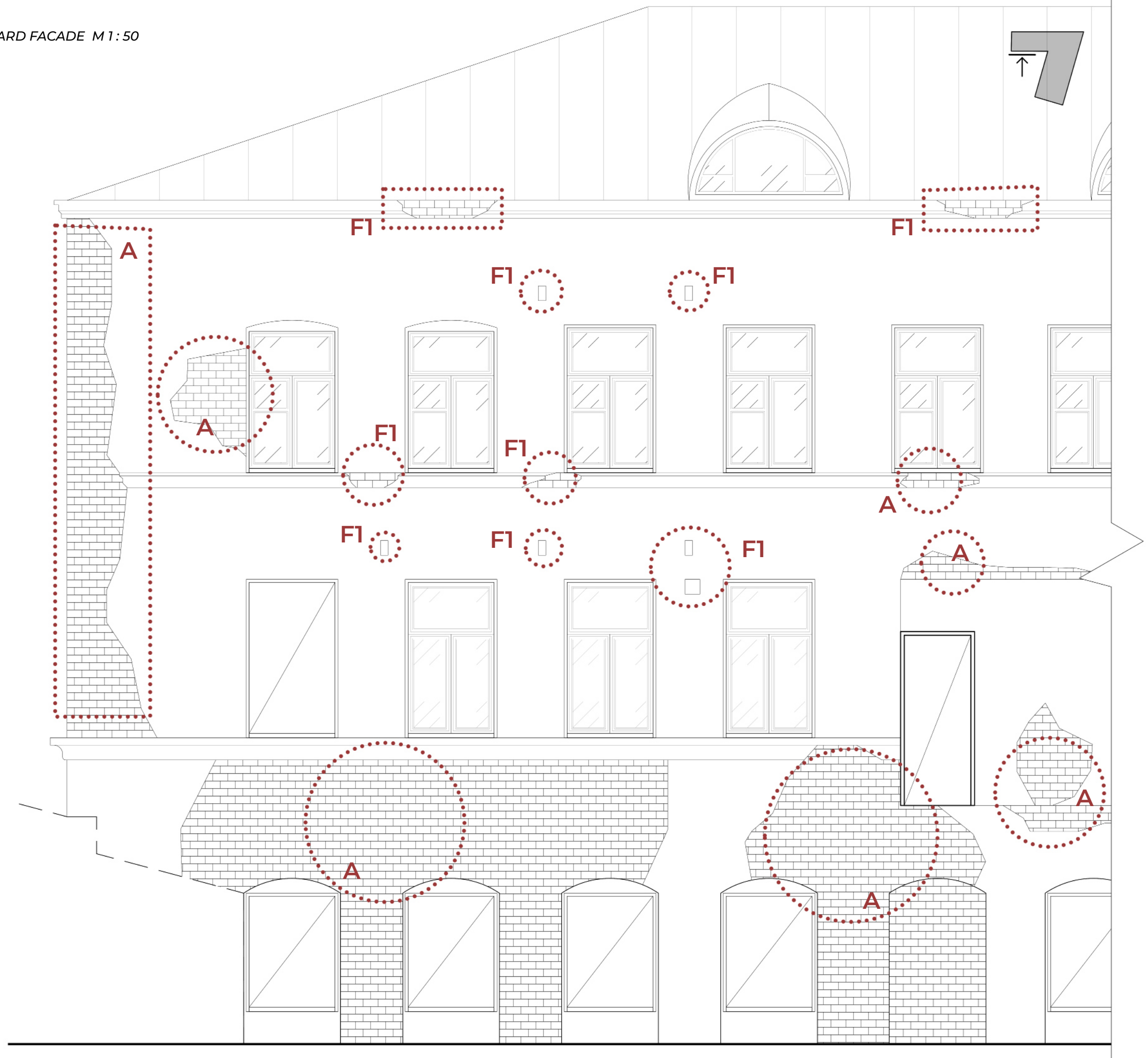
**C1**  
The opening is laid with brickwork,  
according to the history and project.

**C2**  
Opening laid with brickwork, not  
according to the history and project.

**D**  
Element clogged / boarded up with a  
wooden protective sheet (plywood).

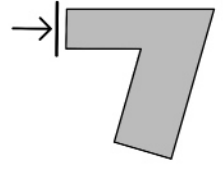
**F1**  
A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).

**F2**  
Traces of former brick outbuildings (lost  
over time).





BUILDING CONDITION, WEST FACADE M 1:50



**A**  
*Exposing building structures. A chipped/  
lost layer of plaster and top coat.*

**B**  
*Loss of the architectural and stylistic  
element of the facade.*

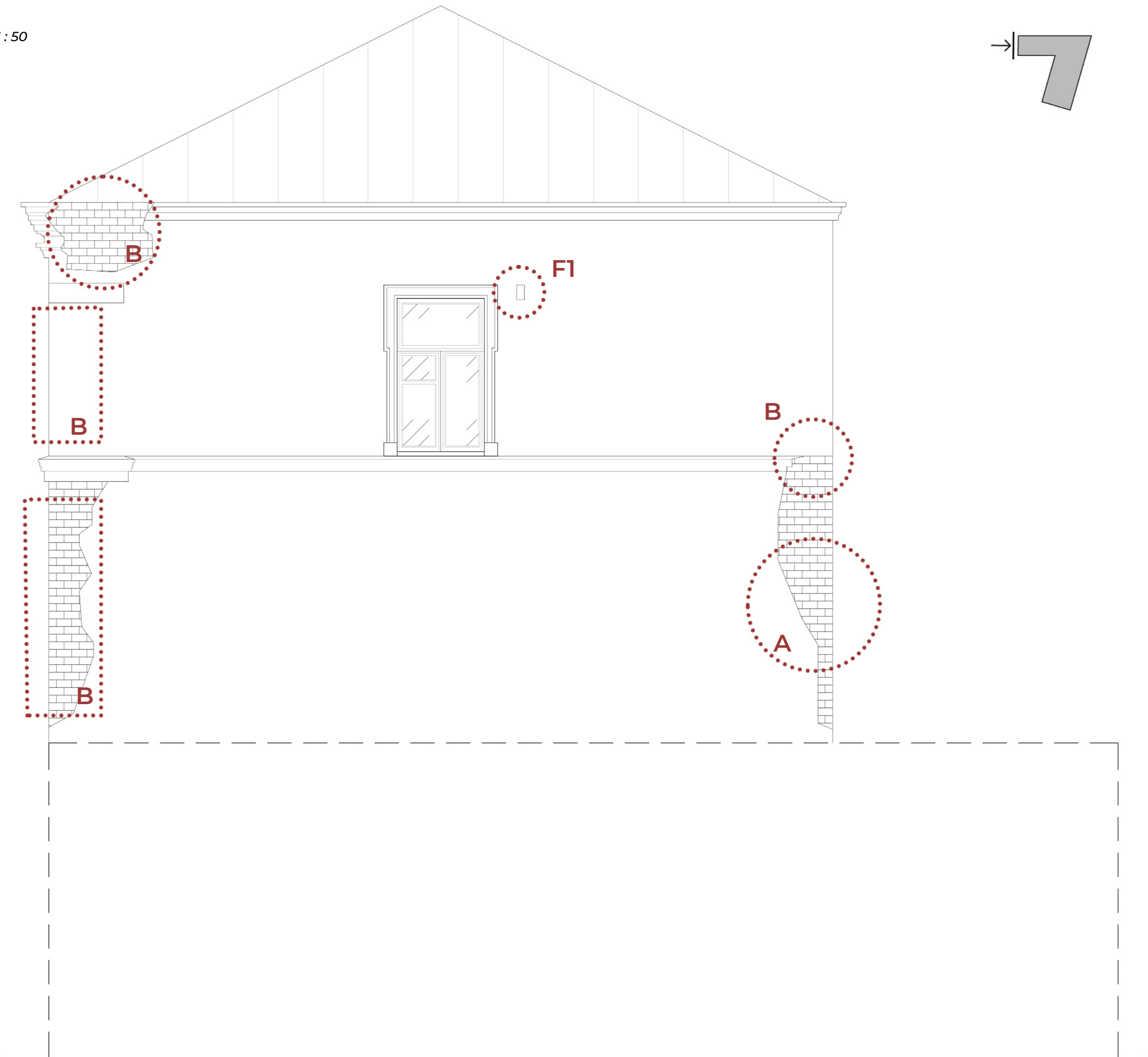
**C1**  
*The opening is laid with brickwork,  
according to the history and project.*

**C2**  
*Opening laid with brickwork, not  
according to the history and project.*

**D**  
*Element clogged / boarded up with a  
wooden protective sheet (plywood).*

**F1**  
*A hole in the wall, not according to  
the project (from previous temporary  
structures or supports).*

**F2**  
*Traces of former brick outbuildings (lost  
over time).*





/2012 year

*2012, the building burned down twice already. Empty areas inside, emergency condition. The building is actually abandoned.*



PHOTO ARCHIVE, PRESENT CONDITION



/ 2022 year, outside photoes condition

2012, the building burned down twice already. Empty areas incide, emergency condition. The building is actually abandoned. 2012, the building burned down twice already. Empty premises, emergency condition. The building is actually abandoned. Mold covers a significant part of the walls both inside and out. Facade elements of the building are crumbling.



*PHOTO ARCHIVE, PRESENT CONDITION*



*/ 2012 year, incide photoes condition*

*The interior has been redone many times. The walls have a thick layer of previous finishes that have completely lost the original design and appearance of the interior of the building. The floor structures are dilapidated. There is a great need for reconstruction and complete renovation of some structural elements.*





/ 2020 year

*View from the side of the central pedestrian boulevard. The constructions protecting the first floor emergency rooms from penetration have been dismantled, 2020.*





/ 2022 year



*The state of the building today. Boarded up windows, screened the façade to disguise it in the streetscape. The same deplorable state of the building's structures. Masking the facade with trees, from the side of the pedestrian boulevard. Fences preventing passage near the emergency facade.*





## DESIGN PROPOSAL

- PROPOSAL STRATEGY OVERVIEW
- MASTREPLAN SCHEME
- SOLAR HEATER SYSTEM STRATEGY AND CALCULATIONS
- FLOOR PLANS
- FACADE CHANGES





## **PROPOSAL STRATEGY**

*Many things have been changed in this building. Despite this, it retained that look and that imprint of history on its facades, which can be called the personification of time. The task was to keep that historical thread and not touch it, and at the same time to restore and transform the existing building into a modern house, filling it with as many functions as possible.*

### **FACADES:**

*The «facial» facades overlooking the pedestrian boulevard and the street were restored. Lost plaster returned. The details of the facades, lost over time, have been restored. The appearance of the building most closely resembles the original idea of the architect during its construction. The internal facades were restored, the plaster and the missing masonry were returned. Window frames and doors, which have changed many times over the decades, have survived to this day. Every imprint of history and every «modernization» of this part of the building is preserved. You can see the history of the building with your own eyes. How and why did it have such forms of openings and windows.*

### **SUSTAINABLE RENOVATION:**

*A new roof was designed with its supporting structures, which meets modern safety standards and regulations. Also, part of the roof floor is now in operation, while the second part is the technical and engineering center of the building. Floor structures and connections have also been rethought. In the area of the hotel, the idea of water floor heating is organized, the heat for which is collected by the roof with the help of solar heaters integrated into the roof. The underground floor has also been rebuilt. On the adjacent territory, or rather under it, a parking lot is designed. This car park is accessed via an elevator connection in one of the nearby non-residential buildings.*

### **VERTICAL CONNECTIONS:**

*New communications of human movements are designed. Added stairs to the basement and to the roof floor. New ventilation and engineering shafts were arranged to the height of the entire building. Elevator systems now connect all floors up to the roof.*



### **COARTYARD AREA:**

*The backyard has been rethought. All parking spaces have gone under it, and in their place, a glass light-transparent structure will partially occupy, which will serve as «lungs» for the building. The green areas of the yard have been enlarged, a link has been added across from the street to the pedestrian boulevard, previously built up over time. The idea of the courtyard is to organize a modern place for a comfortable pastime for residents and passers-by.*

### **SUSTAINABILITY and ECONOMY of BUILDING:**

*The building can rightly be called an excellent example of sustainable restoration. New leased areas, hundreds of new square meters for business and a technologically advanced heating and ventilation system for the building, which has not been widely used before and is of a unique nature. The air that is delivered to the building is taken from the light-transparent adjoining structure (more than 100 m<sup>2</sup>) filled with many plants all year round. The freshness and necessary natural humidity give the visitors and workers of the building the cleanest air in the city. The new economic system, which includes restaurant and hotel space, rental office space and meeting and event space for up to 60 people, will be an excellent basis for the economic surplus of the building.*



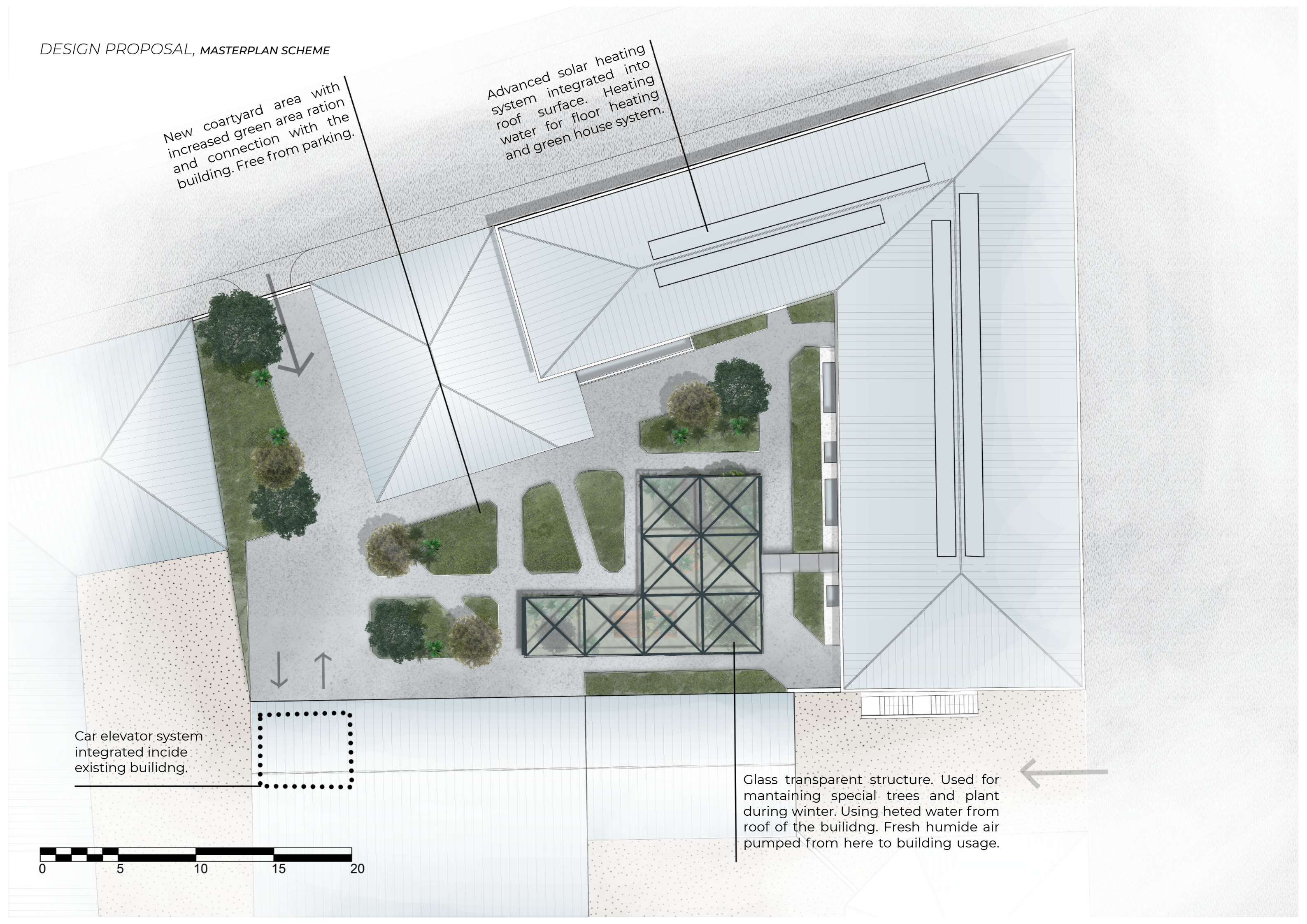
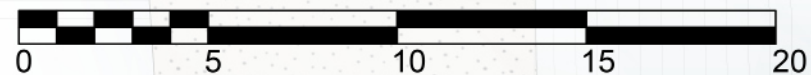
DESIGN PROPOSAL, MASTERPLAN SCHEME

New coyard area with increased green area ration and connection with the building. Free from parking.

Advanced solar heating system integrated into roof surface. Heating water for floor heating and green house system.

Car elevator system integrated inside existing building.

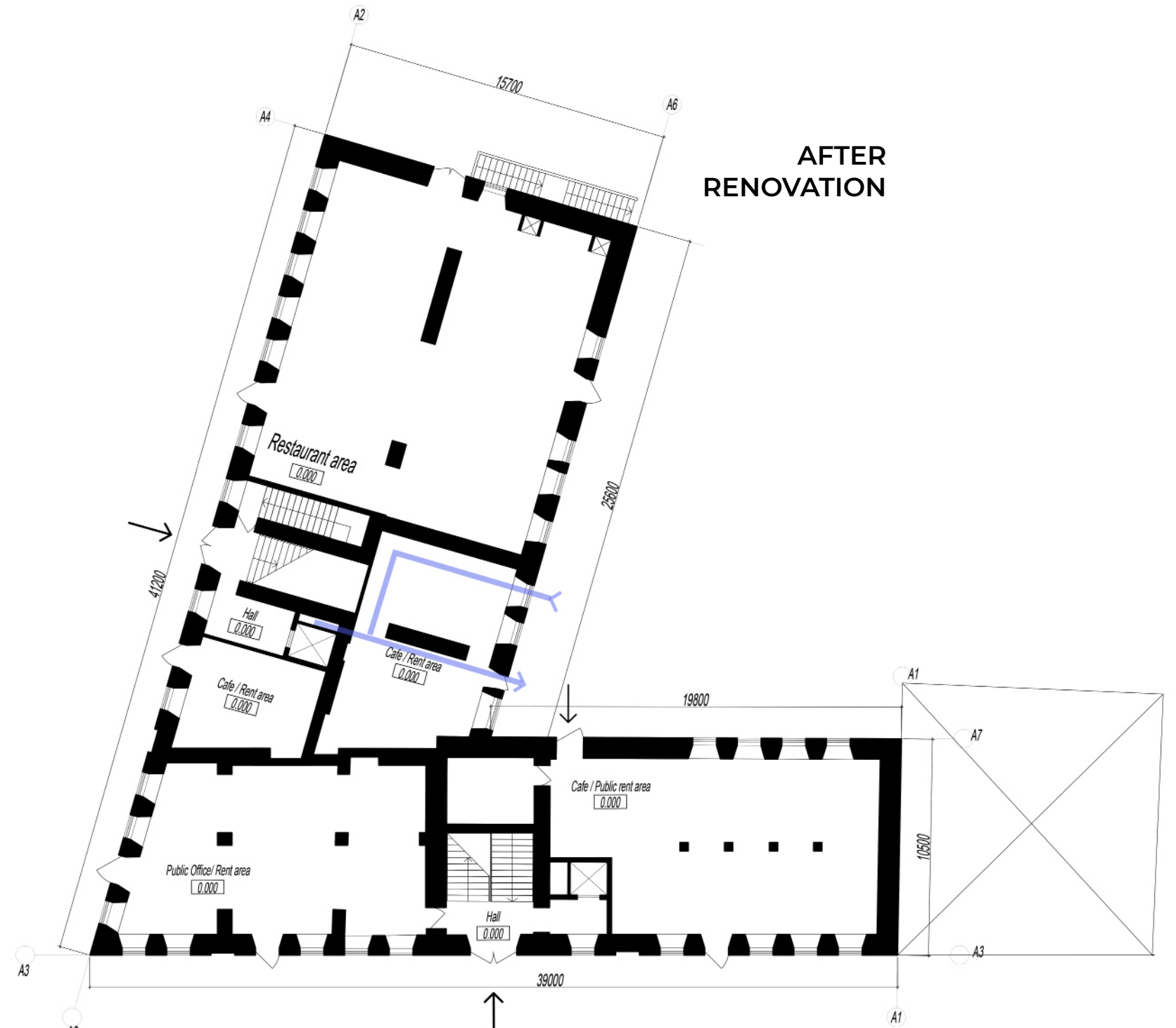
Glass transparent structure. Used for maintaining special trees and plant during winter. Using heted water from roof of the building. Fresh humide air pumped from here to building usage.





DESIGN PROPOSAL, GROUND FLOOR

- Demolished parts of interior
- New parts of interior after renovation



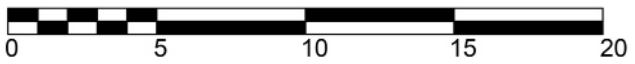
**AFTER RENOVATION**

**DEMOLISHED:**

1. Brick walls (partially).
2. Wooden frame partitions.
3. Laying of some openings in load-bearing brick walls.

**CONSTRUCTED:**

1. Column system.
2. Stairs system to basement floor.
3. Elevator system from -1 to 3 floor (roof).
4. New ventilation system combined with courtyard outside area and intire building.
5. Floor water pipe heating system for hotel apartments area. Connected through new vertical passage system and finishing incide of courtyard ground. (minimal temreture > 30 celsius degree)
6. New floor construction system.



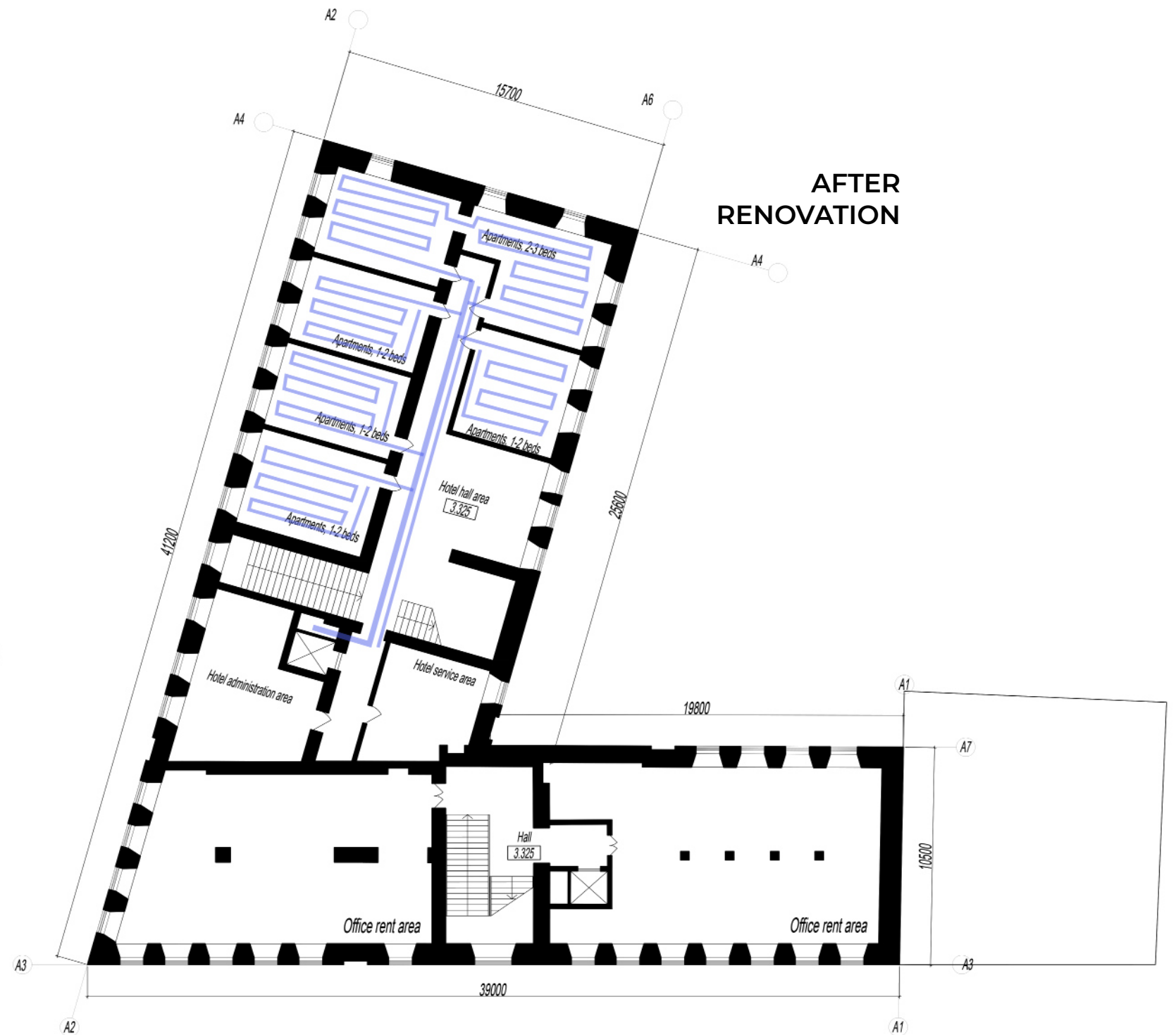


- Demolished parts of interior
- New parts of interior after renovation

BEFORE  
RENOVATION



AFTER  
RENOVATION

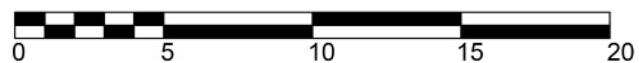


**DEMOLISHED:**

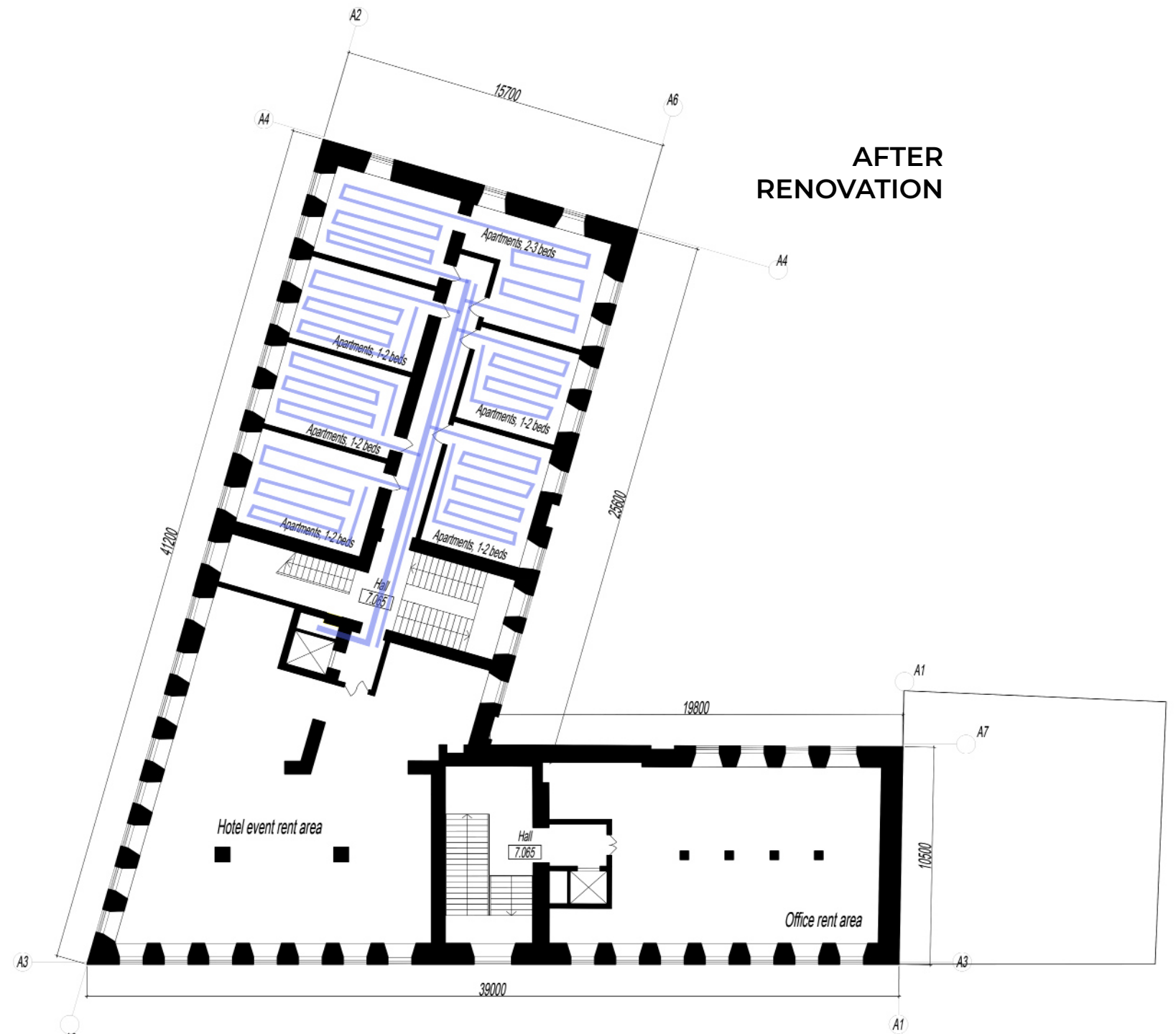
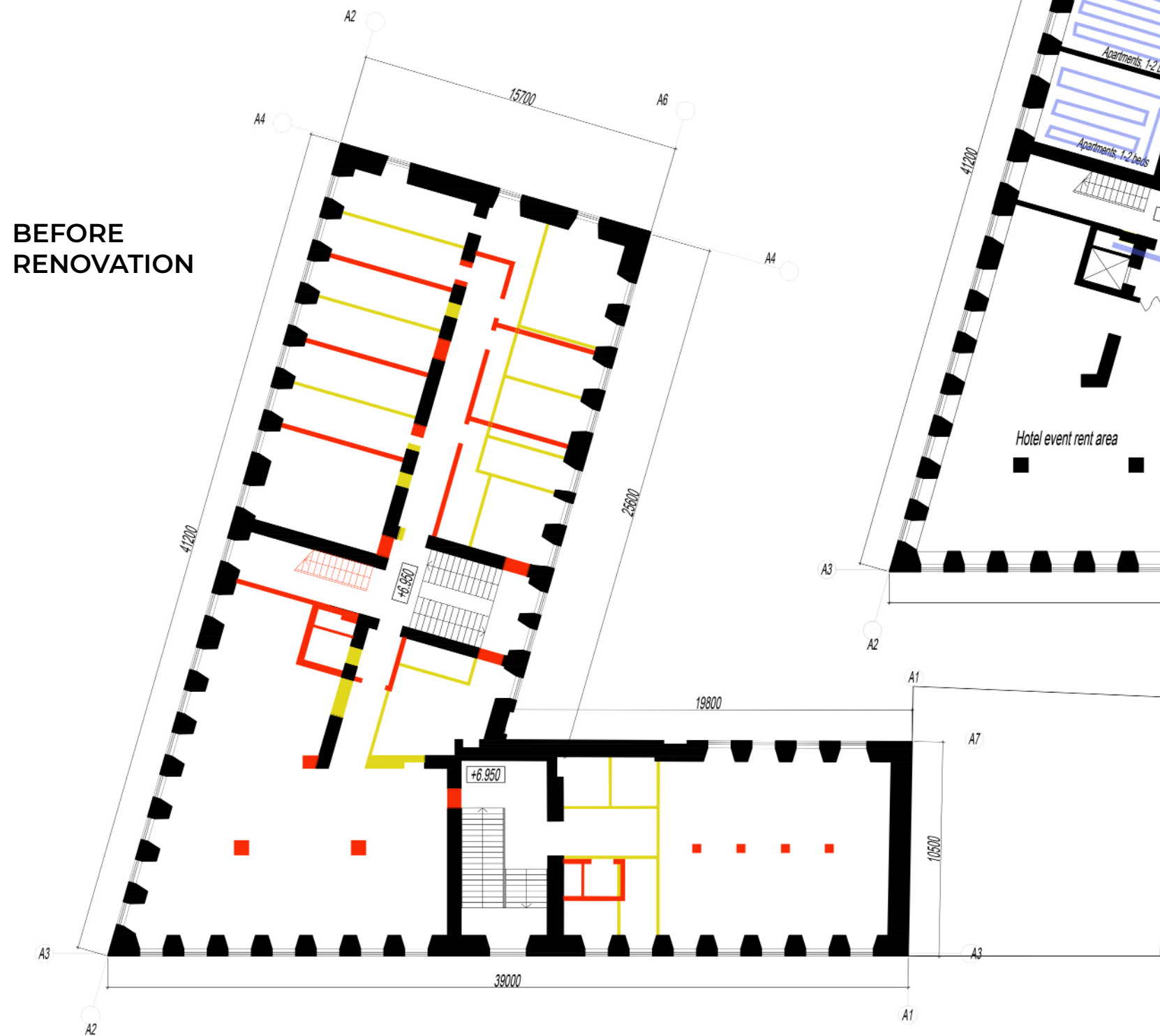
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- Demolished parts of interior
- New parts of interior after renovation

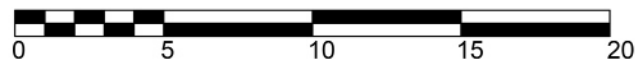


**DEMOLISHED:**

1. Brick walls (partially).
2. Wooden frame partitions.
3. Laying of some openings in load-bearing brick walls.

**CONSTRUCTED:**

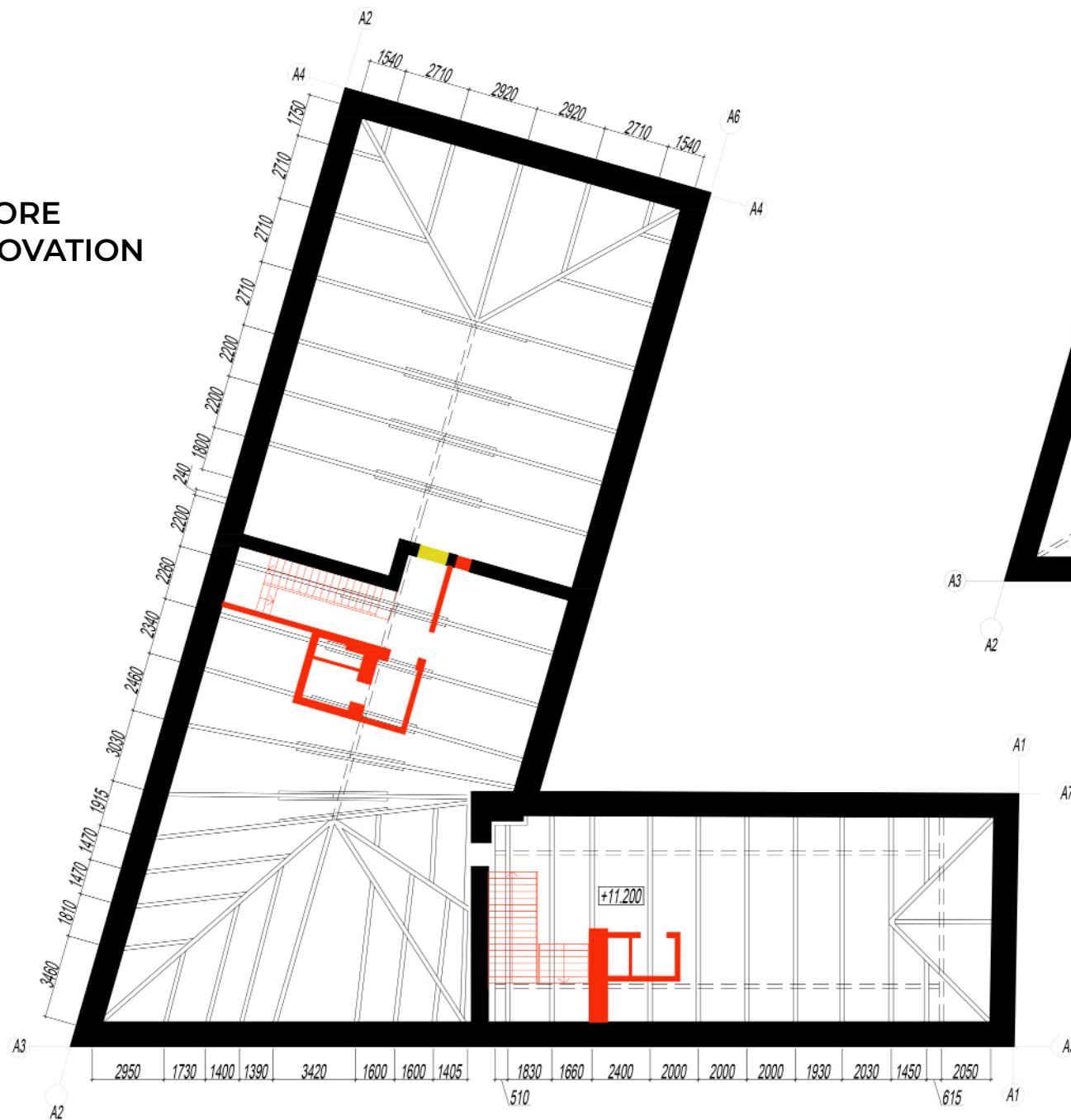
1. Column sistem.
2. Elevator system from -1 to 3 floor (roof).
3. New ventilation system combined with coartyard outside area and intire building.
4. Floor water pipe heating system for hotel apartments area. Connected through new vertical passage system and finishing incide of courtyard ground. (minimal temreture > 30 celsius degree)
5. Stairs system to roof floor.
6. New floor construction system.



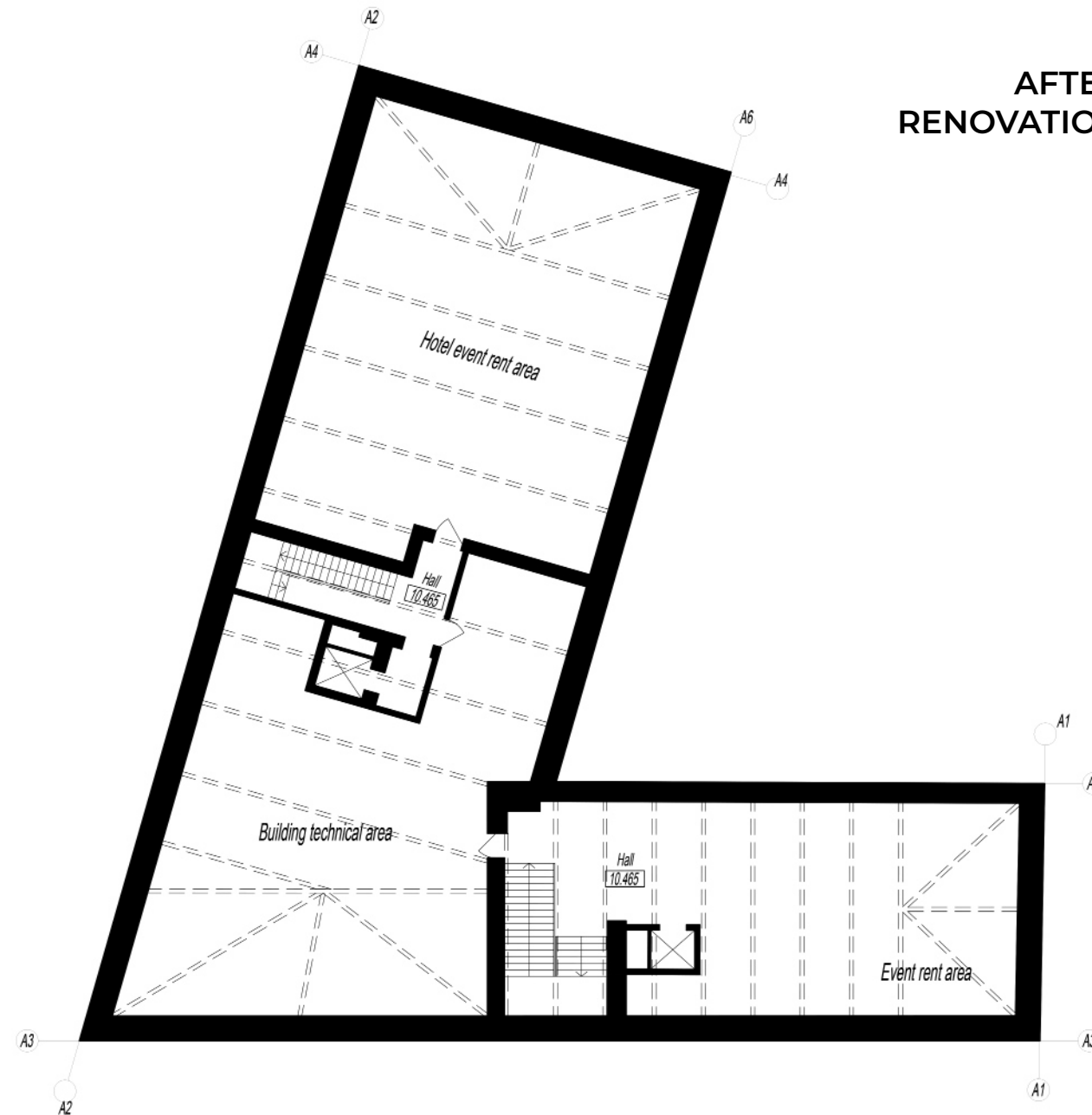


- Demolished parts of interior
- New parts of interior after renovation

BEFORE  
RENOVATION



AFTER  
RENOVATION

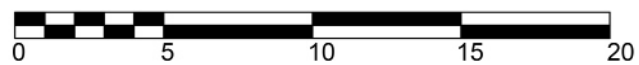


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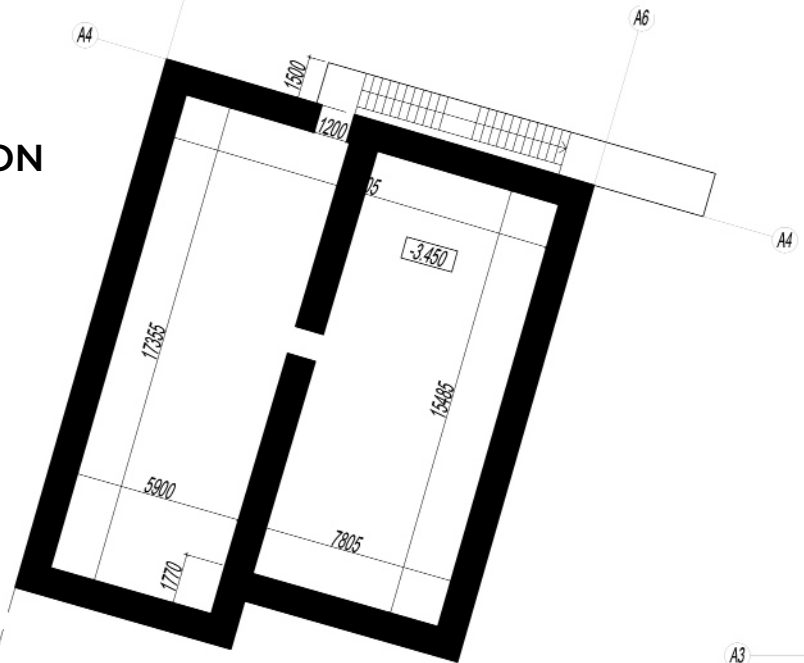
1. Brick walls (partially).
2. Laying of some openings in load-bearing brick walls.

**CONSTRUCTED:**

1. Elevator system from -1 to 3 floor (roof).
2. New ventilation system combined with coartyard outside area and intire building.
3. New entire floor, which can be used and be economy positive for building.
4. New floor construction system.



**BEFORE  
RENOVATION**

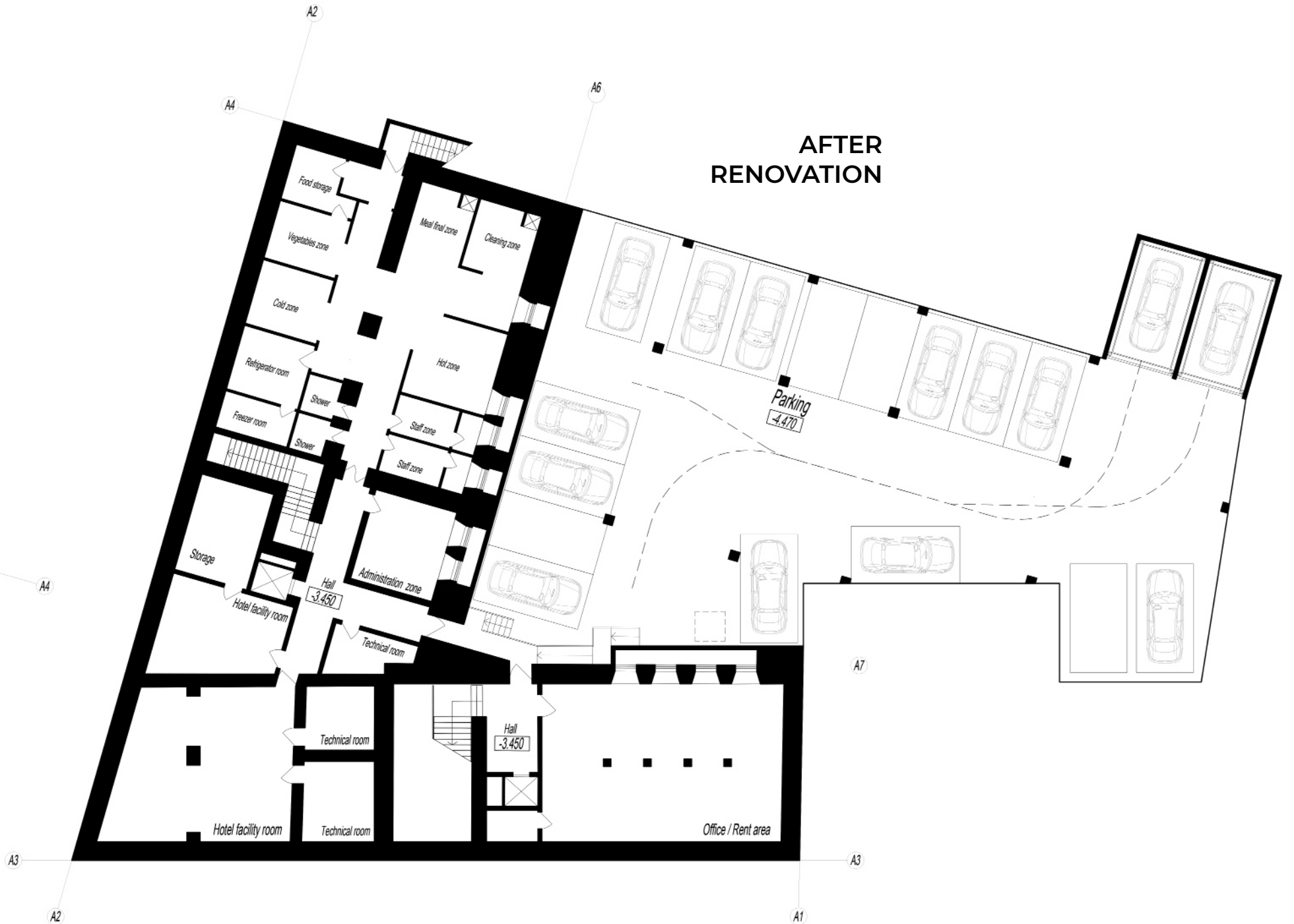


NO INFORMATION

NO INFORMATION

NO INFORMATION

**AFTER  
RENOVATION**

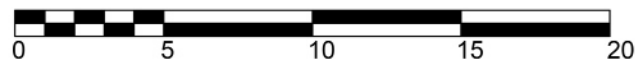


**DEMOLISHED:**

1. Brick walls (partially).
2. Laying of some openings in load-bearing brick walls.

**CONSTRUCTED:**

1. Elevator system from -1 to 3 floor (roof).
2. New ventilation system combined with coartyard outside area and intire building.
3. New entire renovated basement floor, which can be used and be economy positive for building. (Resturant working area for kithcen and sto raging products)
4. New floor construction system.
5. Parking spots (16) and new garage system with car elevators (2), integrated into side building.
6. Additional high windows. New working areas with direct sunlight.







A2



**COLOR GUIDANCE:**

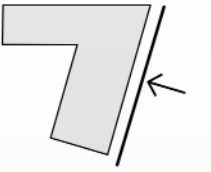


The color scheme of the facade is made by a coloristic design project. These recommendations indicate the required contrast of the hue of the tone (within the same color). \*Corresponds to archival records and historical documents.

**NORTH FACADE DESCRIPTION:**

1. The color scheme indicated on the facade is a guideline for a coloristic project.
2. Roofing elements on the upper part of the roof are translucent material. Thermal solar heaters are located below it, providing the use of solar energy to heat the vacuum tubes with liquid. This liquid is used for heating water floors on the 2nd, 3rd floors of the hotel. Also, this liquid descends down to ground level and passes through the soil of the yard in the greenhouse area.
3. The classical view of the facade has been preserved and restored, as it was conceived by the architect during a major reconstruction in 1885.
4. The roofing material is metal, as in the historical original. This (metal) roofing was a classic for the buildings of those times (17th century) and is largely preserved to this day.
5. Window frames restored from preserved original wooden frames. Without the possibility of opening after reconstruction. (The building is fully provided with centralized ventilation, air intakes through the roof)
6. Existing doorways have been retained to maintain the historical influence on the architecture and life of the building.

A1



A4

A3



**COLOR GUIDANCE:**



The color scheme of the facade is made by a coloristic design project. These recommendations indicate the required contrast of the hue of the tone (within the same color). \*Corresponds to archival records and historical documents.

**EAST FACADE DESCRIPTION:**

1. The color scheme indicated on the facade is a guideline for a coloristic project.
2. Roofing elements on the upper part of the roof are translucent material. Thermal solar heaters are located below it, providing the use of solar energy to heat the vacuum tubes with liquid. This liquid is used for heating water floors on the 2nd, 3rd floors of the hotel. Also, this liquid descends down to ground level and passes through the soil of the yard in the greenhouse area.
3. The classical view of the facade has been preserved and restored, as it was conceived by the architect during a major reconstruction in 1885.
4. The roofing material is metal, as in the historical original. This (metal) roofing was a classic for the buildings of those times (17th century) and is largely preserved to this day.
5. Window frames restored from preserved original wooden frames. Without the possibility of opening after reconstruction. (The building is fully provided with centralized ventilation, air intakes through the roof)
6. Existing doorways have been retained to maintain the historical influence on the architecture and life of the building.





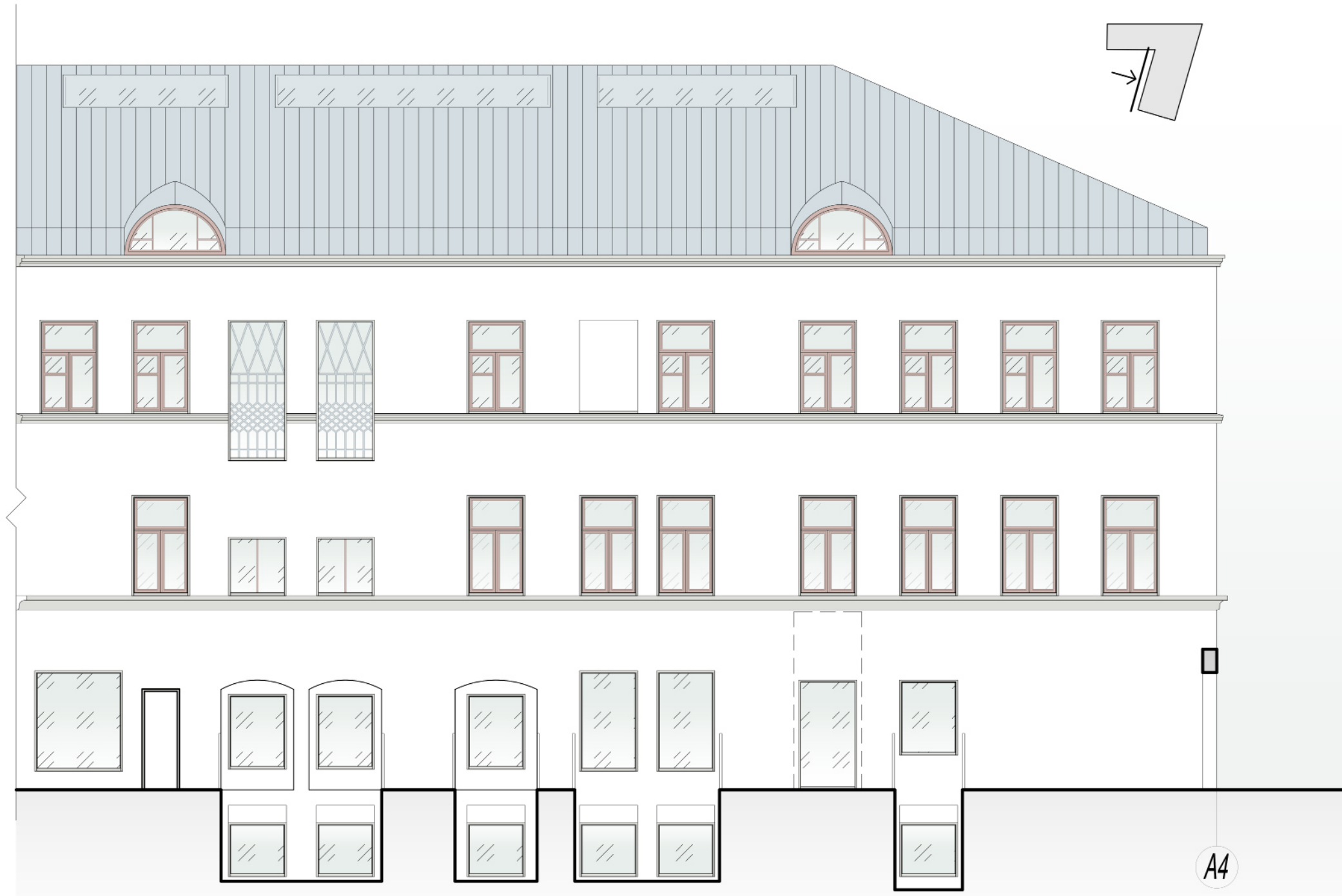
**COLOR GUIDENCE:**



The color scheme of the facade is made by a coloristic design project. These recommendations indicate the required contrast of the hue of the tone (within the same color). \*Corresponds to archival records and historical documents.

**WEST & SOUTH FACADES DESCRIPTION:**

1. The color scheme indicated on the facade is a guideline for a coloristic project.
2. Designed staircase to the underground floor (it is a separate entrance to the kitchen area, under the restaurant).
3. The classical view of the facade has been preserved and restored, as it was conceived by the architect during a major reconstruction in 1885.
4. The roofing material is metal, as in the historical original. This (metal) roofing was a classic for the buildings of those times (17th century) and is largely preserved to this day.
5. Window frames restored from preserved original wooden frames. Without the possibility of opening after reconstruction. (The building is fully provided with centralized ventilation, air intakes through the roof).
6. New street entrance to the courtyard area.
7. New windows were arranged, using overhead light to partially illuminate the basement.



**COLOR GUIDENCE:**

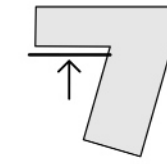


The color scheme of the facade is made by a coloristic design project. These recommendations indicate the required contrast of the hue of the tone (within the same color). \*Corresponds to archival records and historical documents.

**WEST COURTYARD FACADE DESCRIPTION:**

1. The color scheme indicated on the facade is a guideline for a coloristic project.
2. Roofing elements on the upper part of the roof are translucent material. Thermal solar heaters are located below it, providing the use of solar energy to heat the vacuum tubes with liquid. This liquid is used for heating water floors on the 2nd, 3rd floors of the hotel. Also, this liquid descends down to ground level and passes through the soil of the yard in the greenhouse area.
4. The roofing material is metal, as in the historical original. This (metal) roofing was a classic for the buildings of those times (17th century) and is largely preserved to this day.
5. Window frames restored from preserved original wooden frames. Without the possibility of opening after reconstruction. (The building is fully provided with centralized ventilation, air intakes through the roof)
6. Existing doorways and roght window frames have been retained to maintain the historical influence on the architecture and life of the building. The windows in the roof have been preserved in their original location and style.
7. New windows were arranged, using overhead light to partially illuminate the basement.





**COLOR GUIDENCE:**



The color scheme of the facade is made by a coloristic design project. These recommendations indicate the required contrast of the hue of the tone (within the same color). \*Corresponds to archival records and historical documents.

**SOUTH COURTYARD FACADE DESCRIPTION:**

1. The color scheme indicated on the facade is a guideline for a coloristic project.
2. Roofing elements on the upper part of the roof are translucent material. Thermal solar heaters are located below it, providing the use of solar energy to heat the vacuum tubes with liquid. This liquid is used for heating water floors on the 2nd, 3rd floors of the hotel. Also, this liquid descends down to ground level and passes through the soil of the yard in the greenhouse area.
4. The roofing material is metal, as in the historical original. This (metal) roofing was a classic for the buildings of those times (17th century) and is largely preserved to this day.
5. Window frames restored from preserved original wooden frames. Without the possibility of opening after reconstruction. (The building is fully provided with centralized ventilation, air intakes through the roof)
6. Existing doorways and roght window frames have been retained to maintain the historical influence on the architecture and life of the building. The windows in the roof have been preserved in their original location and style.
7. New windows were arranged, using overhead light to partially illuminate the basement.

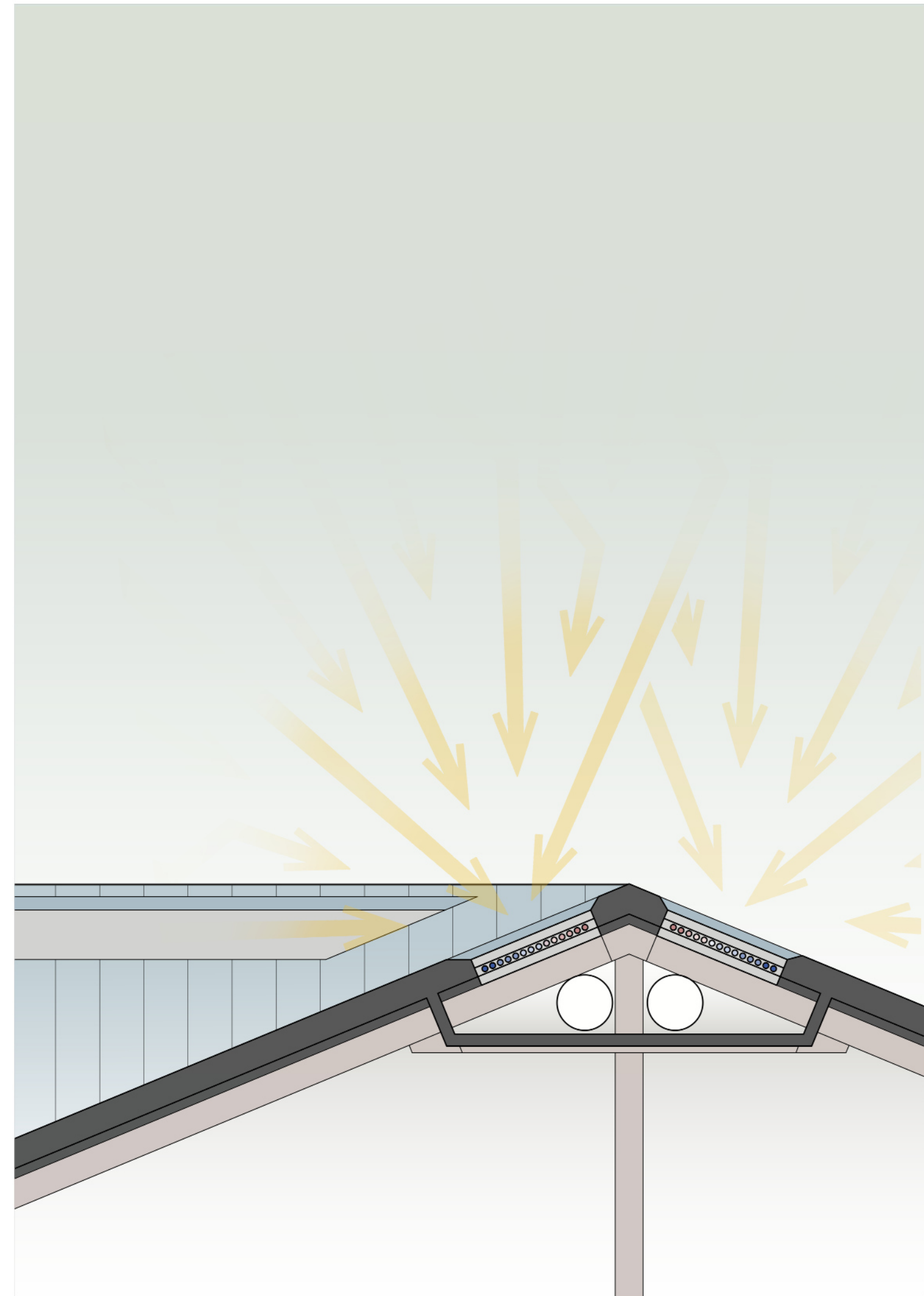
## CALCULATION OF THE THERMAL POWER OF A VACUUM SOLAR HEATER

### Initial data:

1. *Region of operation of the solar collector - Tver region. (1.195 KW.h/m<sup>2</sup> - average of two most coldest months: December + January)*
2. *The absorption area of the solar heater - known from the technical documentation for the heater.*
3. *We accept the efficiency of a vacuum solar heater as ~ 67% - 80%. \*(Efficiency = 67% is the value for the «average» collector, which is given in the technical literature for the «old» models. The efficiency of modern collectors reaches 85%. We used in the calculations the average value of efficiency = 74% to get more «honest» values)*
4. *We take the angle of inclination of the «plane» of the solar heater to the sun - 20 degrees (roof slope).*
5. *15 tubes make up 2.35 m<sup>2</sup> of absorbing area, then one tube  $2.35 \text{ m}^2 / 15 = 0.156$  (6) m<sup>2</sup> or rounded 0.15 m<sup>2</sup>. Number of overall solar tubes ~ 640 pieces (1800mm each).*
6. *Total solar heater roof area - 120 m<sup>2</sup>.*

#### \*Solar heater tubes parametrs:

Length - 1800±5mm. The outer diameter of the tube - 58±0.7mm. The thickness of the outer glass tube is 1.8±0.15mm. Tube inner diameter - 47±0.7mm. The thickness of the inner glass tube is 1.6±0.15mm. Glass material - borosilicate glass 3.3mm. Vacuum level - between the walls of the tube  $P 5 \times 10^{-3}$ Pa. Absorption rate > 91%. Loss of solar radiation < 8% (80C±1.5C). Max. temperature 270C - 300C. Rated pressure - 0.6MPa. Average heat loss coefficient - 0.6W/(m<sup>2</sup>). Three Layer Vacuum Tube Coating - Advanced Selective Absorption Coating: Composite - Copper, Stainless Steel, Aluminum (CU/SS-ALN(H)SS/ALN(L)/ALN). Application method - DS reactive spraying.





## CALCULATION OF THE THERMAL POWER OF A VACUUM SOLAR HEATER

### Calculations:

1. Calculation of the daily power consumed by 1 solar tube 1800mm long - **0.15** (surface area of a vacuum solar tube) x **1.195** (value for the Tver region) x **0.76** (averaged efficiency for more «honest» values) = 0.137 KW.h for 1 solar tube.

2. The total power of all tubes over the entire area is - **640 pieces** x **0.137 KW / h** = **87.68 KW / h**

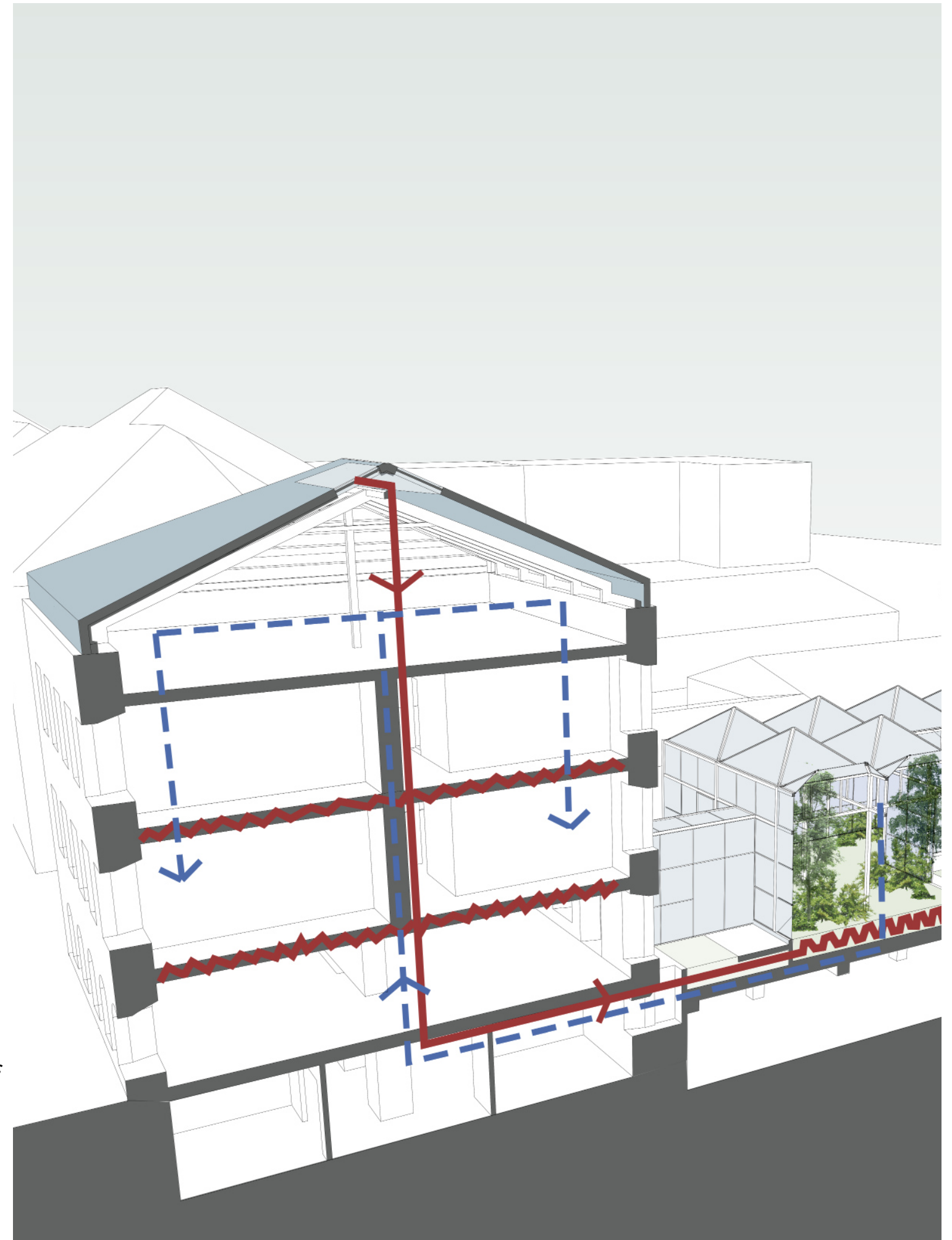
### Calculation of the consumption of thermal energy by a water heated floor inside and outside:

1. The average consumption of a thermal water floor per 1 m<sup>2</sup> - **150 watts** per hour.

2. The total area of heated water floors inside the building (hotel zone) - **320m<sup>2</sup>**. Overall heat power consumption will be - 320 x 150watts ~ 48000 watts (48 KW/h).

3. The total outside heated soil surface (inside glass structure) ~ **90 m<sup>2</sup>**. Lets take double consumption for soil inside the glass structure (greenhouse) as **300 watts** for 1 m<sup>2</sup>. Then 90 m<sup>2</sup> x 300 watts = 27000 watts (**27 KW/h**).

4. Checking - **27 KW/h** + **48 KW/h** + **10.5 KW/h** (~12% loses of overall heating system) = **85.5 KW/h** < **87.68 KW/h**.



*«Applying Sustainable Methods in Renovation of the Historical building in Tver, Russia.»*

*Summing up, we can definitely say that the goal of the thesis was achieved. Naturally, there is no limit to perfection, but the main and auxiliary issues of sustainable renovation have been reached. The idea to combine the engineering method of heating and ventilation used by plants in the renovation of a building is unusual and new. The building itself has remained historically authentic and has retained the thread of history of the entire street*

*.Any literary or scientific work should end with the words of a great man about the great.*

*«Los que miran las leyes de la naturaleza como apoyo de sus nuevos trabajos colaboran con el creador»*

*Antoni Gaudi*

*«Those who look to the laws of nature as support for their new works collaborate with the creator»*

*Antoni Gaudi*



## LIST OF SOURCES

- [1]** - Powell, Ken. Architecture Reborn: «Converting Old Buildings for New Uses», New York, 1999.
- [2] [3]**- Daniel J. Levi, «Journal of Architectural and Planning Research», 2005
- [4]** - Barrett, Timothy H. «The Cleveland Storefront Renovation Programm. Design Manual», 2002
- [5]** - Rachael Bernstone, «Sanctuary Modern Green Homes. Renovation special», 2017-1018
- [6]** - Brian Duggan, «The renovation of Building 909, The Military Engineer», 2016
- [7]** - Powell, Ken «Architecture Reborn: Converting Old Buildings for New Uses», New York, 1999.
- [8]** - Guell, Xavier. «David Chipperfield: Recent Work. Barcelona: Watson-Guption Pubns», 1997