Centrum Rzeczoznawstwa Budowlanego

Inżynieria Bezpieczeństwa Obiektów Antropogenicznych 1 (2023) 1-21
https://inzynieriabezpieczenstwa.com.pl/

Inżynieria Bezpieczeństwa Obiektów Antropogenicznych

Renovation works in buildings in the area of former defensive fortifications

Maciej NIEDOSTATKIEWICZ*[1], Tomasz MAJEWSKI[2], Adam BARYŁKA

[1] Department of Engineering Structures, Faculty of Civil and Environmental Engineering, Gdańsk University of Technology, Gdańsk, Poland
[2] Implementation Doctoral School, Gdańsk University of Technology, Gdańsk, Poland
[3] Military University of Technology, Warsaw, Poland

Abstract

The paper presents the Complex of Buildings which was created in Gdańsk as a result of the reconstruction and development of the remains of the defensive fortifications of Redita Napoleońska. Some of the buildings of the Building Complex, after many years of operation, were in an emergency condition and required urgent renovation and repair work. The paper contains a detailed analysis of the technical condition of individual buildings of the Building Complex and analyzes the impact of the current use and the lack of regular periodic repairs on the technical efficiency of these facilities. Conceptual solutions in the field of renovation and repair works were also presented, the purpose of which was to bring the objects in question to the proper technical condition.

Keywords: renovation, monument, reconstruction, strengthening of structural elements

1 Introduction

Defensive fortifications from the past, including the 19th and early 20th centuries, are most often covered by conservation protection, being immovable monuments. Very often, these objects were not subjected to renovation works for years, becoming progressively degraded [1], [3]. Many of these facilities are currently in a pre-failure, emergency state, and the technical condition of some of them threatens the occurrence of a construction disaster [12]-[13].

The subject of the paper are the objects of the Building Complex, part of which is a fragment of the former South Guard of the Napoleonic Redita defensive fortifications in Gdańsk. Fragments of the fortification system, rebuilt and extended many times in the past, are currently elements of the Building Complex used for many years as office rooms, service apartments and storage rooms [2], [11]. After decommissioning, the rooms underwent progressive decapitalization, causing the destruction of historic fragments of the remains of defensive fortifications [9]-[10]. The aim of the paper is to present the proposed conceptual solution for the scope of renovation and repair works aimed at bringing the objects in question [7]-[8], [14] , including the remains of defensive fortifications, to the proper technical [15]-[18], [19]-[20].

* **Corresponding author:** E-mail address: (mniedost@pg.edu.pl) Maciej NIEDOSTATKIEWICZ, prof. PG

https://dx.doi.org/10.37105/iboa.164
Received 15 March 2023
Available online 27 March 2023
ISSN 2450-1859, eISSN 2450-8721
Published by Centrum Rzeczoznawstwa Budowlanego

2 General information

The Complex of Buildings being the subject of the paper is a fragment of the former Southern Guardhouse of the military fortifications located in Gdańsk. The location of the Building Complex in the area of the so-called Redita Napoleońska is shown in Fig. 1. Redita, i.e. a brick building with casemates and cannon posts, forming a defense center (the entrenchment), was the center of the fort called the redita fort. It was built during the Napoleonic period, during the fortifications of the defense system of Grodzisko Gdańskie. The originator of the construction of the Napoleonic Redita was General François Nicolas Benoît Haxo, who ordered to build, in the place of the destroyed Bousmard's Rampart, Senarmont's earthen, pentagonal Telescope and the Napoleonic Redita, which was a casemate artillery battery, serving as the last point of resistance. The specificity of Redita Napoleońska is the Haxo casemates, which are artillery casemates with arrowslits in the thin front walls. During peacetime, the casemates served as ordinary utility rooms, covered from the top with an additional earth breastwork, during warfare the building was covered with earth from the outside, and the cannon embrasures were led out through the backfilling with long tunnels secured with wood. Redita had the shape of an irregular pentagon. Artillery fire was directed towards Biskupia Górka, to the south of the Oliwa Gate in the north and towards the eastern slopes of the present Gdańsk-Suchanino district.

The subject of this paper is only the repeatedly expanded and rebuilt building of the former South Guardhouse of Napoleonic Redita. In the area of the building in question, the adjoining fragments of the Carnot wall were built. The state after many years of reconstruction and numerous adaptation works is shown in Fig. 2. Probably at the turn of the 1970s and 1980s, office rooms were built with the use of fragments of the Carnot wall (fragment A of the Building Complex - according to the markings in Fig. 1). The front wall of the building was flush with the completion of the defensive rampart, partly the front wall is made up of fragments of the historical defensive wall. The wall from the rear side was built with faults, probably with the use of brick reinforcements of the escarpment.

On the extension of the former office premises (A), a residential building was built, used in the past as a business apartment. Part of the residential development is the basic body of the South Guardhouse building (fragment B of the Building Complex – as marked in Fig. 1).

Building B is perpendicularly adjacent to contemporary buildings, used as utility rooms (fragment C of the Building Complex - as indicated in Fig. 1).

In the period described in the paper, the former office premises (A) were unused - out of service, the wire installations were disconnected, and the building was secured against access by third parties. The former service apartment (B) was used as a handy warehouse. The electrical installations in the rooms were disconnected, the rooms were not heated. Utility rooms (C) were used periodically as handy warehouses.

In the earlier period, a fortuitous event occurred involving the collapse of the roof slope due to the breaking (destruction) of the wooden elements of the roof structure over part A of the Building Complex.

Based on oral information obtained from the Principal's representatives, it was established that the chronology of events related to the collapse of the roof slope in question was as follows:

- in the spring period, an inspection of the technical condition of the building was carried out. During the inspection, a fragment of the roof slope was found to have collapsed in the area of one of the rooms,
- the degree of urgency of the renovation works was specified in the Protocol drawn up after the inspection of the technical condition of the building as II, i.e. as works requiring execution before the winter season or until the next technical inspection of the building,
- the user secured the room against access by third parties, and the ceiling in the place of visible deformations was supported with wooden square timber, set with the use of wooden joists and cap beams,
- in the summer period, he conducted activities aimed at preliminary estimation of the costs of renovation works on the supported part of the roof slope,
- in the autumn, a fragment of the ceiling over the rooms in part A collapsed.

3 Description of the condition of the existing Complex of Buildings at the Southern Guardhouse

A general view of the defensive rampart to which the Complex of Buildings covered by the study adjoins is shown in Photo. 1. Former office rooms (A) were created by using a part of the historical wall and aligning it with the completion of the defensive rampart. The extension of the wall are the rooms of the former service apartment (B), part of which is the historic buildings of the Southern Guardhouse. The former service apartment (B) was added to the front wall and the gable wall of the former office premises (A) in the later period, as evidenced by the lack of a full masonry bond at the junction of the walls and a different type of brick from which the wall was made (Photo 2). Utility rooms (C) perpendicularly adjoin the body of the former service apartment (B) (Photo 3). The wall on the back side of the former office rooms (A) was built with faults, probably with the use of brick reinforcements of the escarpment (Photo 4).

In the summer, in the room of the former office premises (A) adjacent to the defensive embankment, a random event occurred involving the collapse of a fragment of the roof structure (Photo 5). The roof, made as a ceiling on wooden beams with mineral wool insulation, has collapsed. Damage to the roof caused the ingress of rainwater into the interior of the rooms, contributing to the dampness of the walls and floor.

In the rooms of the former service apartment (B), local traces of dampness were visible, both in the floor area and at the height of the wall. In the historical part of the South Guardhouse, cracks and scratches in the plaster on the fillings under the brick arches were visible. Salination was visible on the surface of the walls inside the rooms of the Southern Guardhouse (Photo 6a and 6b), particularly intense on the surface of bricks, on fragments of walls that were subjected to renovation works in the past period. The porous lime-sand mortar was replaced with a sealed cement or cement-lime mortar (Photo 6c and Photo 6d).

The damaged roof in the area of the former office spaces (A) (Photo 7) had additional lighting in the form of roof skylights (Photo 8). In front of the skylights, there were no fenders (so-called kozubków), as a consequence of which pools of water formed at the windows, the lack of baskets hindered the flow of rainwater.

In order to estimate the method of constructing the wall from the side of the slope in the area of the former office premises (A), excavations were made, both from the outside and the inside of the building (Fig. 2). Thanks to the excavations made, it was checked whether the historical, brick reinforcements of the escarpment were used during the construction of the rear wall. Based on the excavations made, it was found:

- inner outcrop (inside the building) O1:
  contemporary brick wall + cement-lime plaster from the inside (Photo 9a),
- inner outcrop (inside the building) O2:
  contemporary brick wall + cement-lime plaster from the inside (Photo 9b),
- inner outcrop (inside the building) O3:
  local redevelopment of a modern brick wall with a fragment of a modern wall built later (with high probability in the place of a bricked-up window opening) + cement-lime plaster from the inside (Photo 9c),
- inner outcrop (inside the building) O4:
  contemporary fragment - brick wall with redevelopment made of cellular concrete (aerated concrete) + 4 cm polystyrene insulation with a protective layer (elevation mesh) and gypsum plaster from the inside (Photo 9d),
- inner outcrop (inside the building) O5:
  probably an old (historical) brick wall + 4 cm polystyrene insulation with a protective layer (elevation mesh) and glazed tiles on the inside (Photo 9e),
- inner outcrop (inside the building) O6:
  probably an old (historical) brick wall + 4 cm polystyrene insulation with a protective layer (elevation mesh) and gypsum finish from the inside (Photo 9f),
- outdoor outcrop (outside the building) O7:

contemporary brick wall + 10 cm polystyrene insulation with a protective layer (elevation mesh) (Photo 9g),

- external outcrop (outside the building) O8:
  contemporary brick wall with a protective layer of plaster + 10 cm polystyrene insulation with a protective layer (elevation mesh) (Photo 9h),
- outdoor outcrop (outside the building) O9:
  contemporary brick wall + 10 cm polystyrene insulation with a protective layer (elevation mesh) (Photo 9i),
- outdoor outcrop (outside the building) O10:
  contemporary brick wall + 10 cm polystyrene insulation with a protective layer (elevation mesh) (Photo 9j),
- outdoor outcrop (outside the building) O11:
  contemporary brick wall + 10 cm polystyrene insulation with a protective layer (elevation mesh) (Photo 9k).

4 Analysis of the condition of the existing complex of buildings at the Southern Guardhouse

During the on-site inspections, no visible faults and damages were found in the Building Complex at the Southern Guardhouse, the morphology of which would indicate that the reason for their creation may be the negative impact of the traffic of motor vehicles (cars) moving on the surrounding roads. No damages characteristic of vibrations caused by the movement of motor vehicles (cracks and cracks with a typical morphology of the letter X or ½ X) were found in the structure. It should also be noted that during the on-site inspections, no perceptible vibrations of the ground around the Complex of Buildings covered by the study were found - during the on-site inspections, no ground vibrations were measured around the objects in question, and no measurements of vibrations in the structure of the objects themselves were made: taking into account the location realities and the current technical condition, it was considered completely unnecessary to carry out dynamic measurements.

Based on the analysis of the available oral information, it was established that in the past period, no trees with a significant trunk or crown size were removed from the area adjacent to the object covered by the study, including the escarpment overgrown with trees and bushes.

In the past period, no new high-stem trees and shrubs were planted, with the exception of periodic, albeit irregular, so-called maintenance pruning of the old stand constituting the strengthening of the escarpment.

Thus, there are no grounds to conclude that the root system of the stand has ever had or will have in the future a significant impact on the occurrence of faults and/or damage to the foundations of the facilities covered by this study, as well as to formulate a thesis that the roots of the stand contributed or will contribute to in the future to disturb ground and water conditions in the area of the Building Complex which is the subject of this study, in accordance with the mechanism described in the following publications [4]-[6].

In the period covered by this article, the Building Complex consisted of 3 main parts:

- former office spaces (A),
- former business apartment (B),
- utility rooms (C).

The user did not have full knowledge about when exactly the individual elements of the Building Complex were completed. Probably the staging of individual objects looked like this:

- stage I: in the second half of the 19th century, the construction of the defensive rampart was completed, fragmentary brick reinforcements of the escarpment were made and the Southern Guardhouse was built, which is now part of the former service apartment (B),
- stage II: probably at the turn of the 70's and 80's of the 20th century, a building was constructed which is currently referred to as former office space (A). It is highly probable that in the period between stage I and stage II, utility rooms (C) were added to the front wall of the South Guardhouse,

- stage III: a fragment of the area between the Southern Guardhouse and the former office premises (A) was developed, thanks to which a building was created that was later used as a former business apartment (B),
- stage IV: at the beginning of the 21st century, probably at the turn of 2000-2001, the former office premises were renovated (A)

Former office premises (A)

Foundations

There were no visible signs of overloading the foundations in the area of part (A) of the Building Complex. There were also no visible signs of faults and damage that would indicate uneven settlement of the foundations of this part of the Building Complex.

Walls

On the surface of the walls, both external and internal, there were no defects or damage that could indicate their overload or incorrect static operation. There were also no cracks or cracks, the morphology of which would indicate a local loss of load-bearing capacity of the walls of part (A) of the Building Complex.

The walls of the building are mostly made of ceramic bricks, insulated along the back wall (longitudinal, with faults) with polystyrene, both from the outside and from the inside.

Based on the inspection, it was established that the longitudinal wall in the front elevation in the section adjacent to the top of the defensive rampart is a historical wall made of ceramic brick. The remaining part of the front wall is younger, reconstructed in various years of the later period.

The excavations made in the back wall showed that the wall with faults is a secondary wall and was reconstructed using contemporary bricks. The excavations made from the inside and the outside confirmed mostly the same type of brick built in the checked places, only in the case of excavation no. from the outside) fragments of the wall with contemporary brick bonding are visible. However, it cannot be ruled out that in the past period, local redevelopments were made from the outside using contemporary bricks, it is also possible that the modern redevelopment is visible from the outside, because the places of open pits No. 5 (inside the structure) and No. 11 (outside the structure) are slightly shifted from each other, and in the place of open pit No. 11, it was made as a contemporary brick throughout the entire thickness of the wall.

Flat roof (roof)

The shape of the roof in the area of part (A) of the Building Complex did not correspond to the state adopted as a solution in the archival design documentation. Probably for cost-saving reasons (optimizing costs and looking for a solution that would be easier and faster to implement), the execution of chalk roofs along the slope of the land was abandoned, and the entire roof slope was made as a single-pitch roof with skylights (Fig. 3) during renovation works.

During the inspection, a local collapse of the flat roof structure (roof collapse) was found, made as a ceiling on wooden beams with mineral wool insulation. The direct cause of the damage to the roof structure was the breaking of the beams caused by biological corrosion of the wood, its rotting, probably the result of long-term dampness of the wood and the fungus and mold. It is worth noting that the roof damage occurred in the place where snow bags formed in winter, i.e. the wet wooden beams, weakened by biological corrosion, were subjected to an increased load from the weight of the snow. With the passage of time and the progress of corrosion, the wooden beams weakened so much that during the next winter, after snowfall, their bearing capacity was exhausted and the roof collapsed.

During the visual inspection, it was decided not to measure the moisture content of the wooden elements of the flat roof structure: both mass moisture measurements (Um) made with an electronic moisture meter whose operation is based on the electro-resistance (resistive) method consisting in measuring the resistance of the material, depending on its moisture content, i.e. water content in this material, for which the moisture meter scaling technique (using a fixed correlation curve) enables direct measurement of mass humidity (Um), and no wood samples were taken at the facility for testing mass humidity (Um) using the drying-weigh method, in accordance

with the requirements of the standard PN-EN ISO 12570 Heat and humidity properties of construction materials and products. Moisture determination by drying at elevated temperature.

A visual assessment of the wood in the area of the damaged flat roof, in the zone of rooms adjacent to the top of the defensive rampart, clearly allowed to classify the wood as wet.

It was also very important that the roof surface had undulations, i.e. on fragments of the slope there were depressions in which the roofing could be felt. This is a characteristic symptom for wooden roof trusses with wooden elements damaged by biological corrosion. Depressions (sinks) were particularly perceptible in the zones in front of the skylights, where there were no fenders (baskets), i.e. in places where there were water pools. In the case of leaks in the roofing felt, these places are particularly exposed to moisture, and the depressions of the pavement indicated that such damage occurred in these places.

Plasters

The interior plasters in part (A) showed a far-reaching exploitation and technical depreciation: in some rooms the plasters detached from the ground (a hollow sound was found when tapping them), and they were also damp (a typical damp stuffiness was felt in the rooms), in some rooms, plasterboard cladding showed extensive moisture,

Floors and floors

In the area of part (A) of the Building Complex, there were no visible abnormal deformations of the floor (sinks), the finishing layers in the form of a floor made of gres or terracotta tiles were locally chafed from the base (base).

Installations

Pipe and line installations located in the area of part (A) of the Building Complex have been disconnected and secured against their restarting by unauthorized persons.

Former Business Apartment (B)

Foundations

There were no visible signs of overloading the foundations in the area of part (B) of the Building Complex. As in the case of part (A), also in part (B) there were no visible signs of defects and damage that would indicate uneven settlement of the foundations of this part of the Building Complex.

Walls

On the surface of the walls, both external and internal, there are no signs whose morphology would indicate a local loss of the load-bearing capacity of the walls of part (B) of the Building Complex: this applies to both the rooms added later, as well as the rooms of the Southern Guardhouse.

In the rooms of the Southern Guardhouse, on the walls, especially in the floor zone, salt efflorescence and brick discoloration were visible on the surface of the brick wall - this situation was caused by the capillary rise of moisture resulting from the lack or technically inefficient anti-moisture insulation of the vertical and horizontal parts of the walls sunk in the ground. Similar faults and damages also occurred locally on keystones and runoffs of brick vaults and were a consequence of moisture seepage from the roof side as a result of local leaks in the roofing as well as due to the lack of proper thermal insulation of the roof over part (B) of the Building Complex. .

In the view from the inside of the rooms of the Southern Guardhouse, 3 variants/types of the wall could be identified:

- old (old) bricks with joints filled with mortar, bricks and joints were cleaned during renovation works carried out in previous years,
- old (old) bricks with joints supplemented with a new (modern) mortar, the bricks were cleaned and the space between the bricks was filled with modern mortar during renovation works carried out in previous years,
- modern (new) bricks laid on a new mortar, local repairs of the wall with modern ceramic bricks with joints filled with modern mortar were made during renovation works carried out in previous years.

Fragments of the wall made of old, cleaned brick with joints filled with cleaned mortar had no damage or discoloration in the form of lighter salt efflorescence on their surface.

Extensive discoloration occurred on the old fragments of the wall made of old bricks (historical fragments of the wall), the joints of which had previously been cleaned and filled with modern mortar (as part of renovation works carried out in recent years) and on the wall made of new brick laid on modern mortar. It should be noted here that the number of redevelopments with modern bricks along with filling with modern mortar was negligible.

In ceramic walls, including the walls of the Southern Guardhouse, moisture migrates from more to less humid areas, mainly as a result of capillary action. In the vast majority of cases, damp walls freeze during winter periods. In saline walls, the migration of moisture is also accompanied by the transport of salts, which accumulate in the pores of the material and on the surface of the wall elements. Because a brick wall is a composite of materials with different porosity (bricks and mortar), the speed of moisture migration varies and depends on many factors, including: terrain, location of the building, type and stratification of soils in its vicinity as well as under the building, the level of groundwater, the level of foundation of the building, as well as the physical and chemical properties of the materials from which the walls are made. Too much moisture reduces the compressive strength of both bricks and mortar, especially lime mortar, and reduces the durability of walls, negatively affecting the deterioration of operating conditions in the building. According to the authors' assessment, the brick wall destruction mechanism described above occurred in the rooms of the Southern Guardhouse.

In historic buildings, and one of them is the building of the Southern Guardhouse, a very important problem is also harmful salts, accumulating in and on the surface of the walls, as a result of long-term capillary transport of moisture. The presence of salt in the wall increases the hygroscopic ability of the wall to absorb moisture.

The increase in wall moisture due to the sorption of moisture from the air may be comparable in the case of highly saline walls to the moisture caused by the capillary rise of water from the ground. The amount of moisture taken from the air depends on the type and concentration of salt in the wall and the relative humidity of the air. In the case of the rooms of the Southern Guardhouse, the humidity has been elevated for a long time due to the lack of heating in the rooms and inefficient (or lack of) waterproofing of the wall in parts buried in the ground.

Increased humidity and the presence of salt in the air were manifested by bright efflorescence, discoloration and salt crystallization on the surface of the wall. According to the authors, such a mechanism of brick wall destruction also occurs in the rooms of the Southern Guardhouse.

As it is known, the process of salt crystallization in the wall is accompanied by the formation of tensile stresses causing damage to bricks and mortar by bursting them. The scope of this type of damage caused by the mechanism described above in the rooms of the South Guardhouse is negligible in practice.

In the case of old walls made on lime mortars, due to the chemical properties of lime and the high porosity of the mortar, bright salt efflorescence on the wall surface is observed less often than in the case of mortars based on cement binder. Modern cement mortars are characterized by lower porosity (greater tightness) compared to lime mortars and contain water-soluble compounds that form salts during operation and are leached from the mortar, accumulating on the outer surfaces of the wall. This situation occurs in the rooms of the Southern Guard House, in places where, as part of renovation works in the past period, a filling made of modern tight mortar (based on cement) was used, and in places where additional brickwork was made using modern bricks.

Flat roof (roof)

The slope of the roof slope of part (B) was the same as in the area of part (A) of the Building Complex. In the rooms added later, no damage to the flat roof structure was visible, in the original rooms of the Southern Guardhouse there was no visible damage to the brick vaults.

Plasters

Internal plasters in the rooms added later in part (B) showed far-reaching decapitalization: local chafing of cement-lime plasters from the substrate (deaf sound when tapped), as well as their increased humidity. In the rooms of the Southern Guardhouse, cracks and scratches on the plaster on the fillings under the brick arches were visible.

Floors and floors

In the area of part (B) of the Building Complex, there were no visible abnormal unevenness of the floor, the finishing layer in the form of a floor made of gres tiles was locally scalded from the ground.

Installations

Pipe and line installations located in the area of part (B) of the Building Complex have been disconnected and secured against their restarting by unauthorized persons.

Utility rooms (C)

Part (C) of the Building Complex has been intended for demolition for many years, therefore no detailed analysis of the technical condition of this part of the Building Complex has been performed.

The current technical condition of the facility approximately corresponds to the period of its use - the facility was built in accordance with technical standards and with the use of solutions from the past period, which resulted in the fact that it was used temporarily (periodically) as storage rooms and was characterized by substandard conditions of use: the rooms were unheated, there was in them, the walls and the flat roof were freezing, and there was no efficient gravitational ventilation in the rooms.

5 The proposed scope of repair works of the Building Complex at the Southern Guardhouse

Former office premises (A)

Taking into account the technical and economic conditions, it was recommended to demolish the former office rooms (A) - the construction works planned for implementation had to be carried out in the following scope:

- on the basis of the developed demolition project, demolish the existing facility,
- develop a demolition project taking into account:
  - ❖ guidelines and restrictions, including financial ones of the Facility User,
  - ❖ restrictions and conservation guidelines,
  - ❖ anticipated hazards occurring during the execution of construction works, specifying the scale and type of hazards as well as the place and time of their occurrence,
  - ❖ noise emission and its impact on the natural environment,
  - ❖ emission of vibrations and their impact on the historic substance of the object - in the case of using heavy mechanical equipment for demolition works,
  - ❖ emissions of pollutants and their impact on the natural environment,
  - ❖ generation of waste and its impact on the natural environment, including the division into safe and hazardous waste,
  - ❖ threats to human safety and health,
  - ❖ the method of instructing employees before starting the execution of particularly dangerous works,
  - ❖ the execution of demolition works must be carried out in accordance with applicable occupational health and safety (OSH) and fire protection regulations,
- perform temporary protection of the damaged flat roof as a matter of urgency:
  - ❖ in the space of the collapsed ceiling, place wooden square timber vertically, which will ultimately serve as a supporting structure for the roof over the damaged fragment of the roof,
  - ❖ in order to increase the stiffness, brace the square timber in the transverse direction with longitudinal gratings made of boards (make the so-called St. Andrew's crosses). Additionally, horizontally under the ceiling, make horizontal braces made of square timber leaning against the longitudinal and transverse walls of the room - the execution of vertical braces and horizontal braces will increase the spatial rigidity of the supporting structure of the roof,
  - ❖ run square timber above the roof slope to a height of ~20 cm,

- ❖ cover the space of the collapsed ceiling with OSB boards, adjust the inclination angle of the cover to the inclination angle of the roof slope,
- ❖ protect the roofing with a roofing felt made of heat-weldable roofing felt, overlapping the existing roofing felt covering of the roof slope,

- taking into account the current regulations, the demolition of the facility is possible on the basis of an administrative decision, the so-called a demolition permit issued by the competent local administrative authority, in consultation with the Provincial Conservator of Monuments.

Former Business Apartment (B)

Taking into account the technical and economic conditions, it was recommended to carry out a major renovation of the former service apartment (B), with particular emphasis on the revitalization of the rooms constituting the Southern Guardhouse - the construction works planned to be carried out had to be carried out in the following scope:

- develop detailed, multi-discipline technical documentation in which design solutions will be included, taking into account the intended use of the facility in accordance with the needs and expectations of the User,
- it cannot be ruled out that the scope of renovation works will include the need to partially demolish the analyzed part of the Building Complex, in particular in the part that is not the historical South Guard House, but is a modern extension (a fragment of the apartment),
- during the design work, particular attention should be paid to the following issues:
  - ❖ securing, possible strengthening of foundations,
  - ❖ revitalization of external walls (homogenous, ceramic) through the use of design solutions that ensure the required current regulations: thermal and acoustic insulation of vertical partitions,
  - ❖ reconstruction of the anti-moisture insulation of the vertical and horizontal parts of the walls sunk into the ground,
  - ❖ revitalization of the flat roof by insulating it and adapting it to the current requirements in the field of thermal protection,
  - ❖ reconstruction of gravitational ventilation, ensuring the appropriate number of air exchanges,
  - ❖ reconstruction of pipe and line installations according to modern executive and operational standards,
- taking into account the currently applicable regulations, a major renovation of the building is possible on the basis of an administrative decision, the so-called a building permit issued by a locally competent administrative authority,
- until the decision on demolition was made, regular inspections of the technical condition of the facility in question had to be carried out at monthly intervals.

Utility rooms (C)

Taking into account the technical and economic conditions, it was recommended to demolish the utility rooms (C) - the construction works planned for implementation had to be carried out in the following scope:

- based on the developed demolition project, demolish the existing facility, similarly to the former office premises (A),
- taking into account the current regulations, the demolition of the facility is possible on the basis of an administrative decision, the so-called a demolition permit issued by the competent local administrative authority, in consultation with the Provincial Conservator of Monuments,
- until the decision on demolition was made, regular inspections of the technical condition of the facility in question had to be carried out at monthly intervals.

6 Conclusions

The Complex of Buildings located at the Southern Guardhouse, fortifications constituting a part of Redita Napoleońska located in Gdańsk, consists of 3 basic elements:

- former office rooms (A): which were built with the use of fragments of the Carnot wall, the wall in the front façade was flush with the completion of the defensive rampart, partly the front wall is made up of fragments of the historical defensive wall. The wall from the rear side was built with faults, with high probability using brick reinforcements of the slope,
- former service apartment (B): later used as a handy warehouse. Part of the residential development is the historic building of the Southern Guardhouse,
- utility room (C): built in the past to be used as a storage room.

The direct reasons for the technical condition of the Building Complex as a whole included in the study were:

- imperfections of technical solutions used during the implementation of its individual parts,
- long-term operation,
- lack of regular periodic repairs,
- no major overhaul carried out so far.

Bibliography

[1] Baranowski W.: Zużycie obiektów budowlanych. *Wydawnictwo Warszawskiego Centrum Postępu Techniczno-Organizacyjnego Budownictwa, Ośrodek Szkolenia WACETOB sp. z o.o.*, Warszawa, 2000,

[2] Baryłka A.: Uwarunkowania prawne zmiany sposobu użytkowania obiektów budowlanych. *Inżynieria Bezpieczeństwa Obiektów Antropogenicznych*, Warszawa, 38-44, 1, 2016,

[3] Halicka A.: Ocena istniejących konstrukcji budowlanych według normy ISO 13822-2010. *V Ogólnopolska Konferencja Problemy techniczno-prawne utrzymania obiektów budowlanych.* Warszawa, 2019,

[4] Jeż J.: Przyrodnicze aspekty bezpiecznego budownictwa. *Wydawnictwo Politechniki Poznańskiej*, Poznań, 1998,

[5] Jeż J., Suwalski J.: Wpływ nieprawidłowego zadrzewienia osiedla na rysowanie się ścian budynków. *VII Konferencja Naukowo-Techniczna Problemy Remontowe w Budownictwie Ogólnym*, Wocław-Szklarska Poręba, 221-229, 1996,

[6] Jeż J., Wojtasik A.: Wpływ drzew na awarię budynku posadowionego na gruncie pęczniejącym. *Inżynieria i Budownictwo*, Warszawa, 7/89, 1989.

[7] Masłowski E., Spiżewska D.: Wzmacnianie konstrukcji budowlanych. *Wydawnictwo Arkady*, Warszawa, 2000,

[8] Mitzel A., Stachurski W., Suwalski J.: Awarie konstrukcji betonowych i murowych. *Wydawnictwo Arkady*, 1982,

[9] Niedostatkiewicz M.: Building modernization located in the conservation protection zone in the aspect of technical conditions. *Safety Engineering of Anthropogenic Objects*, 1, 58-74., Warsaw 2022,

[10] Niedostatkiewicz M., Majewski T.: Demolition of the cereal elevator building located in the conservation protection zone in the aspect of technical, functional-utility and economic conditions. *Safety Engineering of Anthropogenic Objects*, 3, 55-65., Warsaw 2022,

[11] Obolewicz J., Baryłka A.: Inżynieria zarządzania budową. *Inżynier Budownictwa*, Warszawa, 56-61, 12, 2021,

[12] Substyk M.: Utrzymanie i kontrola okresowa obiektów budowlanych. *Wydawnictwo ODDK*, Warszawa, 2012,

[13] Szer J., Jeruzal J., Szer I., Filipowicz P.: Kontrole okresowe budynków – zalecenia, wymagania i problemy. *Wydawnictwo Politechniki Łódzkiej*, Łódź, 2020,

[14] Thierry J., Zaleski S: Remonty budynków i wzmacnianie konstrukcji. *Wydawnictwo Arkady*, Warszawa, 1982,

[15] Rozporządzeniu Ministra Infrastruktury z dnia 12.IV.2002r. *w sprawie warunków technicznych jakim powinny odpowiadać budynki i ich usytuowanie (*Dziennik Ustaw nr 75 z 2002r., poz.690 wraz z późniejszymi zmianami),

[16] Rozporządzenie Ministra Kultury i Dziedzictwa Narodowego z dnia 2 sierpnia 2018r. *w sprawie prowadzenia prac konserwatorskich, prac restauratorskich i badań konserwatorskich przy zabytku wpisanym do rejestru zabytków albo na Listę Skarbów Dziedzictwa oraz robót budowlanych, badań architektonicznych i innych działań przy zabytku wpisanym do rejestru zabytków, a także badań archeologicznych i poszukiwań zabytków* (Dz. U. 2018 poz. 1609),

[17] Rozporządzenie Ministra Budownictwa i Przemysłu Materiałów Budowlanych z dnia 28 marca 1972r. *w sprawie bezpieczeństwa i higieny pracy przy wykonywaniu robót budowlano-montażowych i rozbiórkowych* (Dziennik Ustaw nr 13, poz. 91 wraz z późniejszymi zmianami),

[18] Rozporządzenie Ministra Infrastruktury z dnia 23 czerwca 2003r. *w sprawie informacji dotyczącej bezpieczeństwa i ochrony zdrowia oraz planu bezpieczeństwa i ochrony zdrowia* (Dziennik Ustaw nr 120, poz. 1126 wraz z późniejszymi zmianami).

[19] Owczarek M., Baryłka A., Estimation of thermal diffusivity of building elements based on temperature measurement for periodically changing boundary conditions, Rynek Energii nr 5(144), 2019 (str. 55-59).

[20] Obolewicz J Baryłka A.,. Technical diagnosis as an important engineering tool of electrical power facilities, Rynek Energii nr 6 (151), 2020 (str. 65-70).

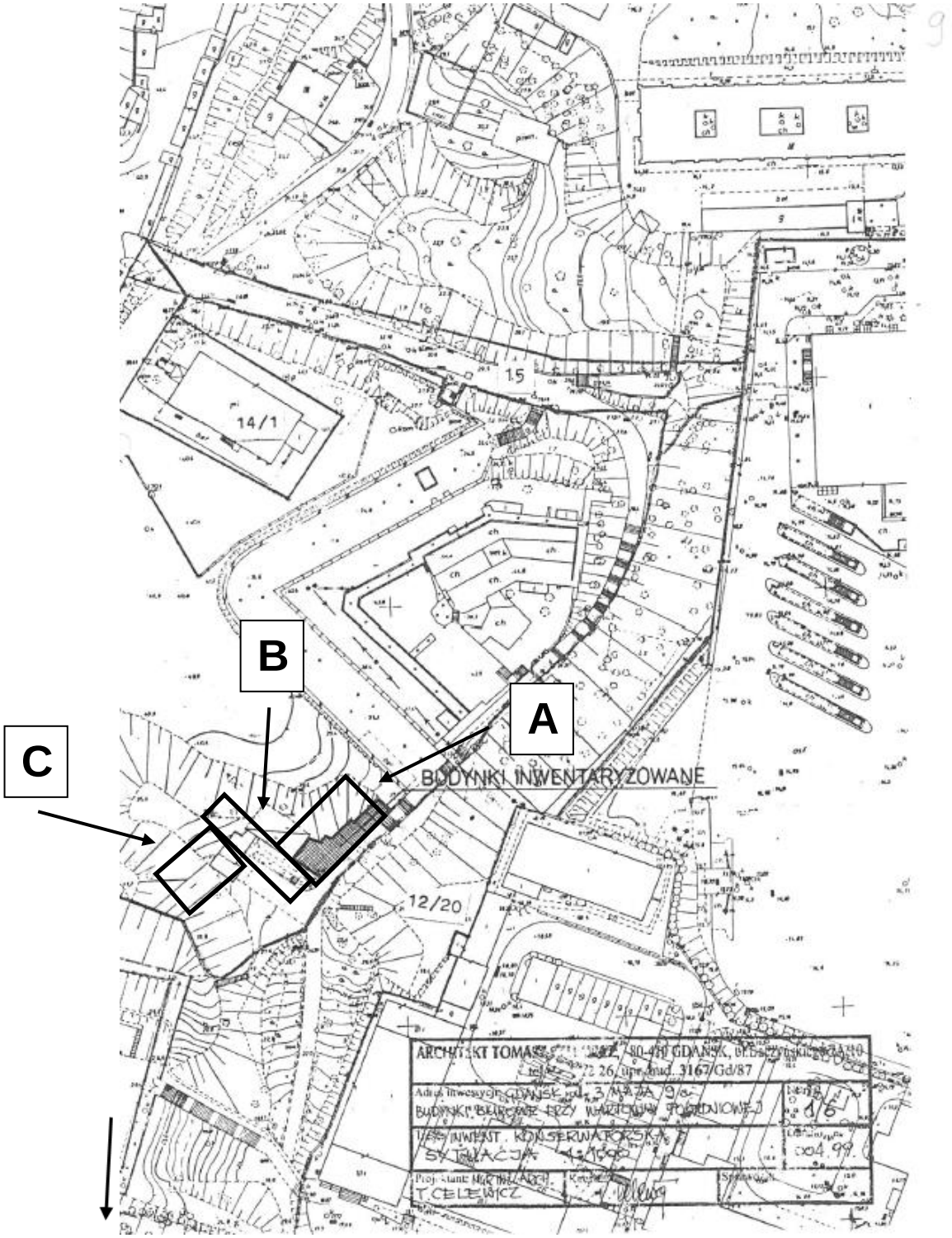


Fig. 1: Scheme of the Complex of Buildings located at the South Guardhouse of Napoleon's Redita in Gdańsk: A - former office rooms, B - former business apartment, C - utility rooms

Photo. 1: Widok ogólny szańca obronnego przylegającego do Zespołu Budynków

Photo. 2: No masonry bond at the junction of the former office spaces (A) with the former staff apartment (B), part of which are the rooms of the Southern Guardhouse

Photo. 3: Utility rooms (C) adjacent to the former service apartment (B)

Photo. 4: Steps of the external wall (from the escarpment side) of the former office rooms (A)

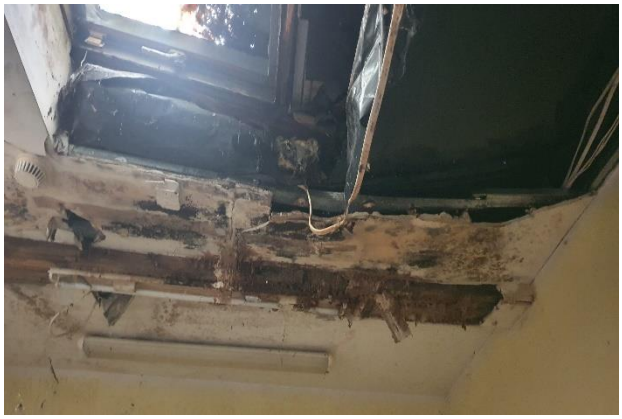
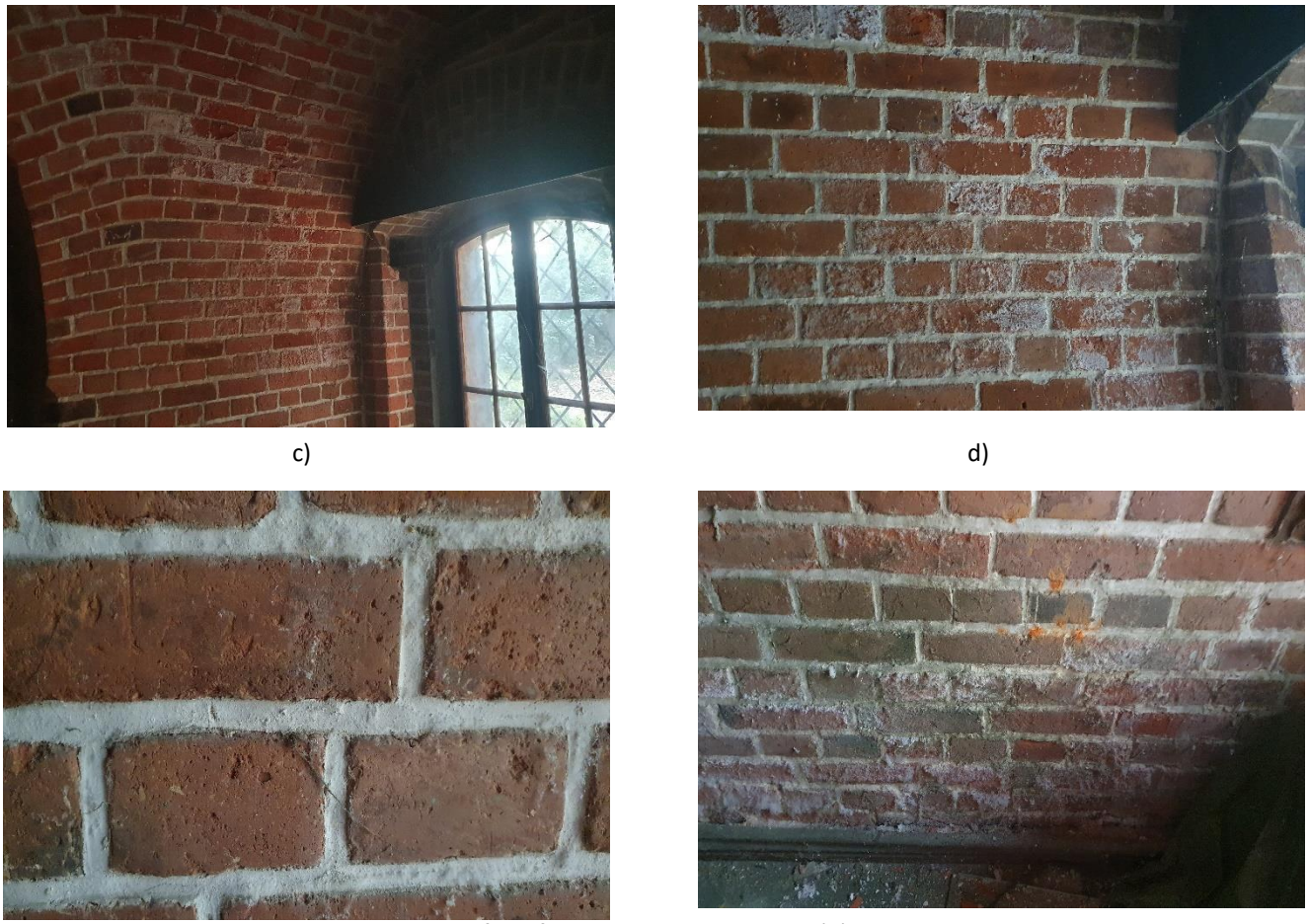


Photo. 5: Zapadnięty dach w części nad dawnymi pomieszczeniami biurowymi (A) Collapsed roof in part above former office spaces (A)

a) b)



c) d)

Photo. 6: Salting the walls inside the rooms of the former service apartment (B)

Photo. 7: Collapsed roof over former office spaces (A)

Photo. 8: No bumpers (bumpers) in front of the windows next to the windows on the roof above the former office spaces (A)

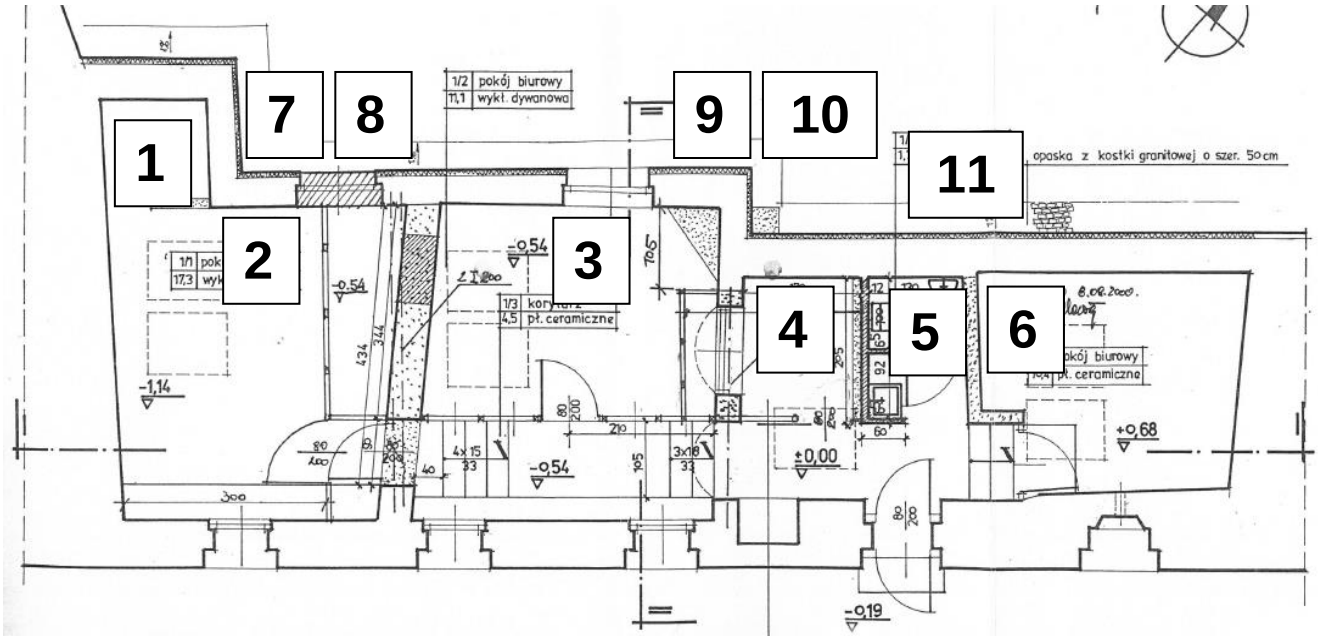


Fig. 2: Location of opencasts in the external wall (on the slope side) of the former office rooms (A): 1, 2, 3 ... - number of the opencast

a)

b)

c)

d)

e)

f)

g)

h)

Photo. 9: View of the outer wall (from the escarpment side) of the former office rooms (A): a) O1, b)O2, c) O3, d) O4, e) O5, f) O6, g) O7, h) O8, i) O9, j) O10, k) O11

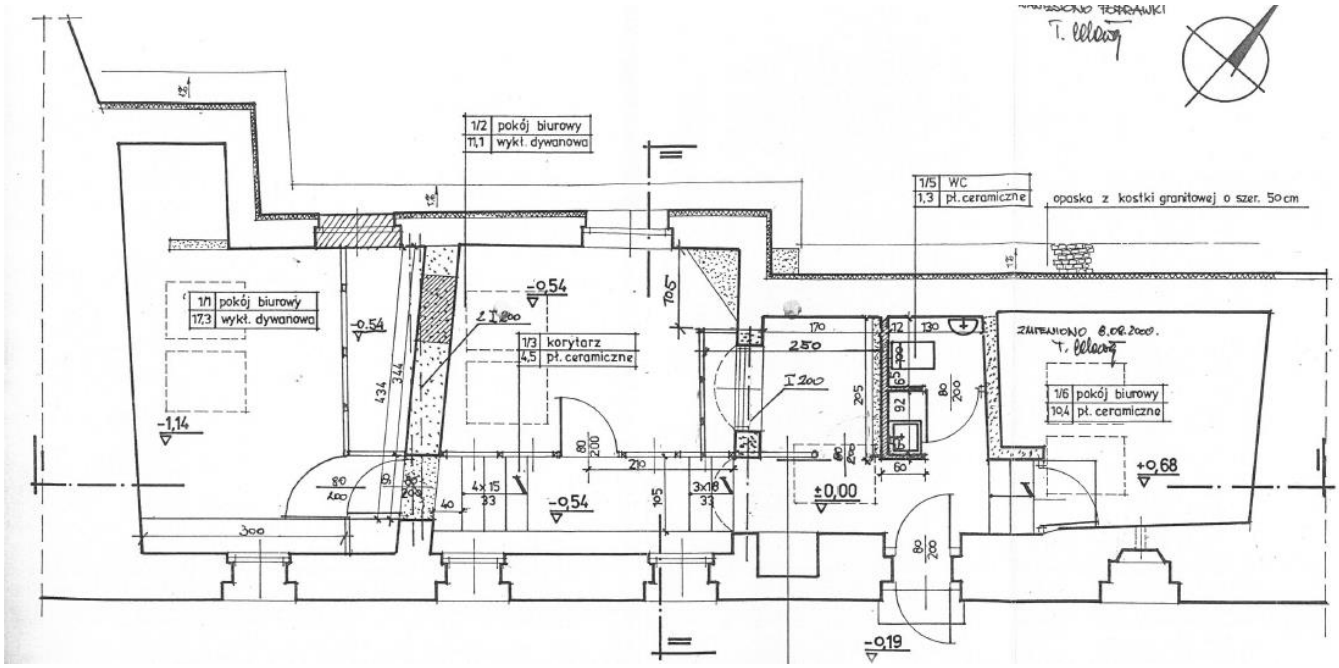
i)

j)

k)

Photo. 9: View of the outer wall (from the escarpment side) of the former office rooms (A): a) O1, b)O2, c) O3, d) O4, e) O5, f) O6, g) O7, h) O8, i) O9, j) O10, k) O11

a)



b)

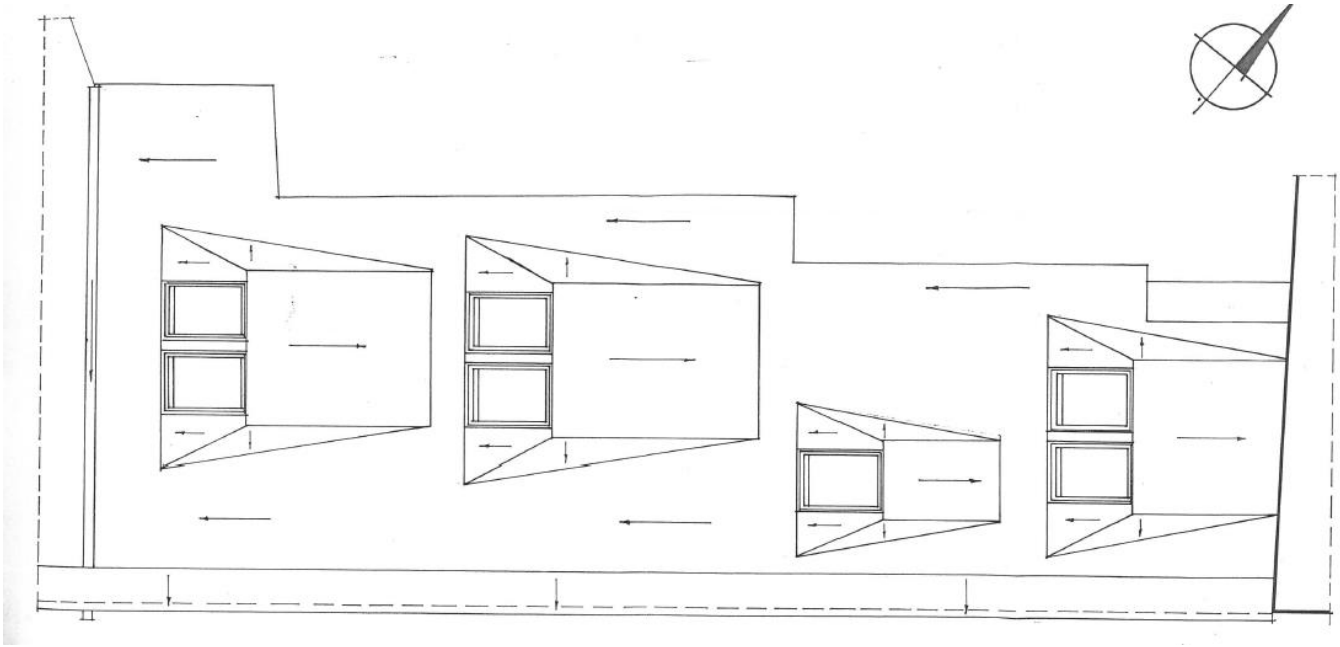
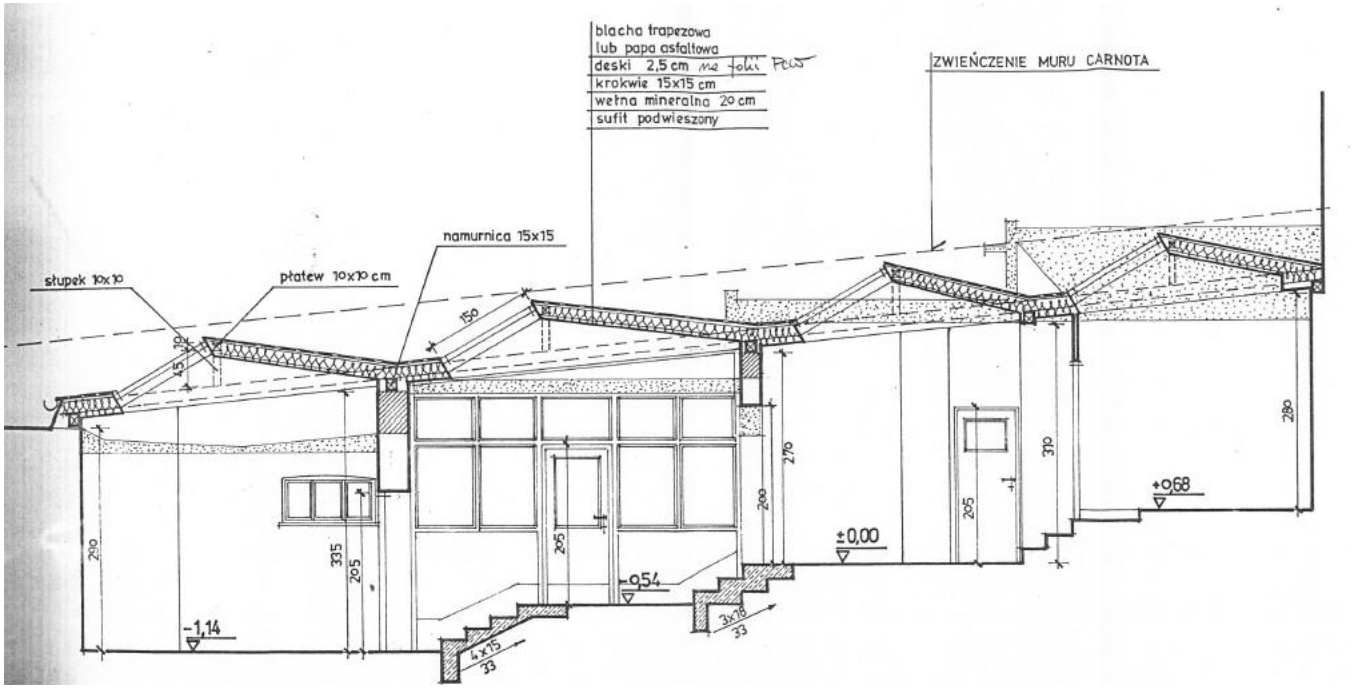


Fig. 3: Part A of the Complex of Buildings located at the South Guardhouse of the Napoleonic Redita in Gdańsk, in accordance with the solutions included in the design documentation: a) ground floor plan, b) roof plane plan, c) longitudinal section, d) south-eastern (front) elevation (fragment)

c)



d)

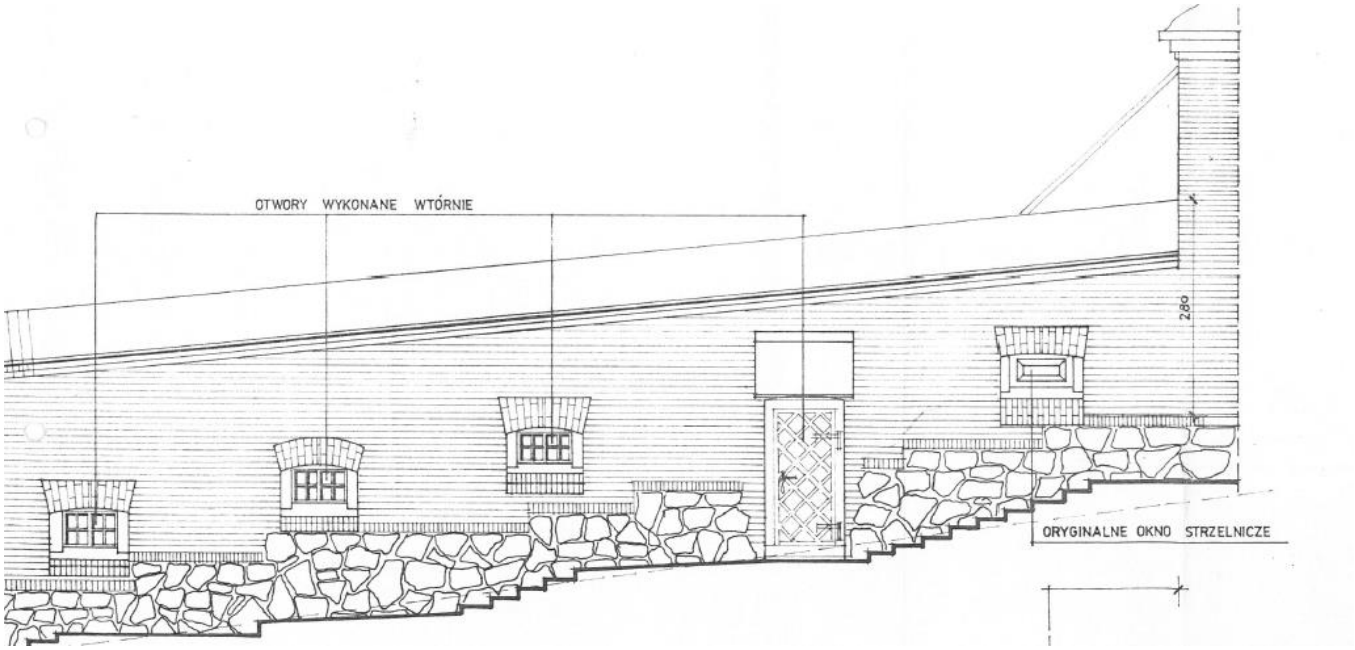


Fig. 3: Part A of the Complex of Buildings located at the South Guardhouse of the Napoleonic Redita in Gdańsk, in accordance with the solutions included in the design documentation: a) ground floor plan, b) roof plane plan, c) longitudinal section, d) south-eastern (front) elevation (fragment)

a)

b)

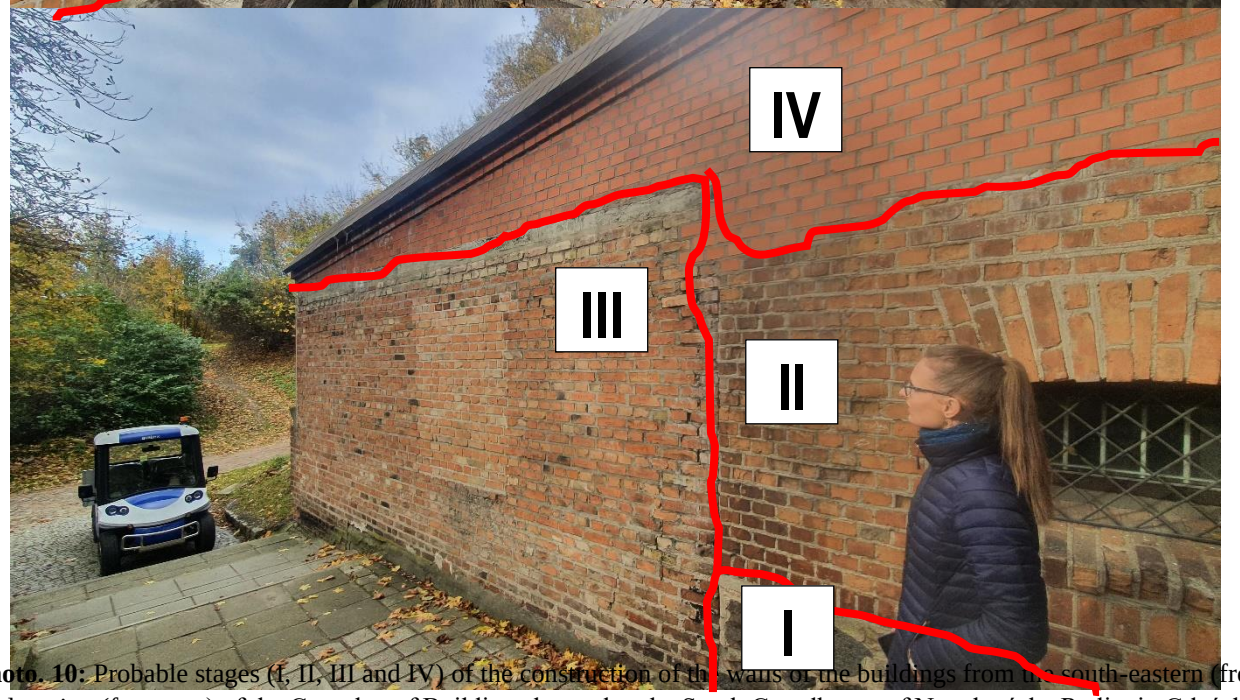


Photo. 10: Probable stages (I, II, III and IV) of the construction of the walls of the buildings from the south-eastern (front) elevation (fragment) of the Complex of Buildings located at the South Guardhouse of Napoleońska Redita in Gdańsk: a) former office rooms (A), b) former apartment service (B) + former office space (A)