

# State of preservation of the Red Barracks of the Owcza Góra Fort

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**Abstract:** This paper is devoted to the object of the Red Barracks of the Owcza Góra Fort, which is located in Kłodzko. The building was erected as an external fort of the Kłodzko Fortress enabling observation of the foregrounds and protecting the hill from which the main fortress could be fired. The study presents the condition of the object, which has been unused for several decades and is subjected to destruction and degradation processes. The paper presents the results of inventory works, technical and laboratory tests.

**Keywords:** Fortress, Fort, Owcza Góra, technical tests, ruin tests, moisture tests, salinity tests

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## Introduction

The Owcza Góra Fort is located in south-west Poland, in the north-east of Kłodzko, on the right bank of the Nysa Kłodzka river. It was one of the elements of the defense system from the 17<sup>th</sup> and 18<sup>th</sup> centuries [4]. It was designed as a remote fort of the Kłodzko Fortress. Its main task was to prevent fire the Main Fortress from the top of the hill on which it was erected. In addition, the fort made it possible to observe the north-eastern forelands of the fortress [10].

The buildings of the Owcza Góra Fort were built on the plan of a seven-pointed star. The fort complex consists of the Low Crown and the High Crown. The first of them is a damned building equipped with an earthen bust with traverses. The shoulders of the crown were connected by crenellated lunettes. The High Crown is sheltered by a redoubt-donjon. The fort also has a cape caponier, which task was to cover the Upper Gate and the exit ramp of the Wrocław road. The building's neck includes the Red Barracks and White Barracks added in 1802 [8].

Over the years, the entire defensive complex of the Kłodzko Fortress underwent various types of expansions and reconstructions, still playing the role of a fortress. In 1877, by cabinet order, the complex of facilities loses its status and begins to serve as military depots and warehouses, and as a prison [9].

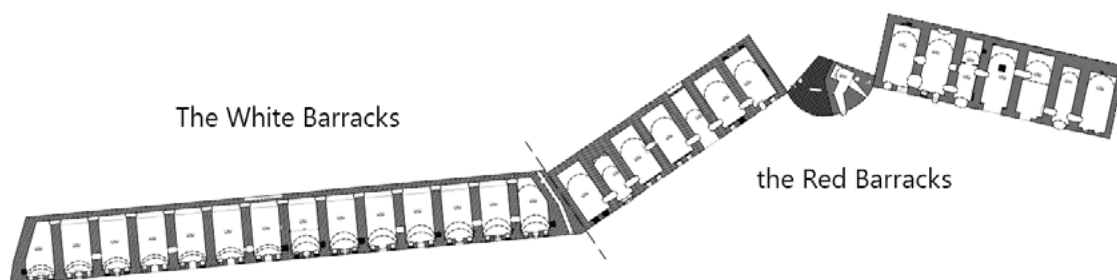
The passage of time, lack of major renovation works, introduction of new functions (which are alien to this type of objects), and uncontrolled development of high vegetation led to the slow degradation of the assembly.

At the beginning of the 21<sup>st</sup> century, intensive conservation and renovation works began on the area of the Kłodzko Fortress. The next objects are restored to splendor and new functions are introduced into them, primarily museum, didactic and administrative functions. The progress of works seems slow, however, it should be remembered that the Kłodzko Fortress is an object raised on a very large area with a large number of both cubature and defensive objects. Over the years, an increasing part of the complex is made available to visitors.

The big problem is still the lack of a development concept for the former most important element of the Kłodzko fortifications system – the donjon.

Unfortunately, the fate of the auxiliary Owcza Góra Fort did not turn out well. It was not used for a long time and is now neglected. Entered in the Register of Historical Monuments in 2003 (under number 143/A/02/1–17) the Owcza Góra Fort has been deprived of comprehensive protective and renovation measures for many years. The city of Kłodzko is not able to bear the costs generated by two such large complexes of facilities on its own.

One of the first steps to protect the Owcza Góra Fort was to begin inventory works in the fortifications. In May 2017, students of the Renovation and Conservation of Monuments specialty at the Lublin University of Technology began works to inventory and evaluate the technical condition of the barracks. This article presents the results of works and research on the southern part of the fort barracks – the Red Barracks.



**Fig. 1.** Barracks plan of the Owcza Góra Fort



**Fig. 2.** Aerial photo of the current state of the Owcza Góra Fort (photo by Grzegorz Basiński).

## Description of the barracks

The barracks building of The Owcza Góra Fort consists of the Red Barracks and the White Barracks (added at a later date). The object of analysis and development are the Red Barracks located in the neck of the fort.

The barracks building consists of two parts. Each of them consists of seven rooms arranged in series, similar in shape and dimensions. Both parts of the Red Barracks are of similar dimensions (approx. 42×12 m). Height without an earth embankment approximately 7.5 m.

The barracks are a two-story building. Above the last floor there is an arched brick vault with an earth layer (the building is old). The ceilings dividing the floors were made of wood and based on stone consoles (none of the ceilings has survived to the present day). In one of the rooms there is a later reinforced concrete ceiling. Masonry walls are made of full ceramic brick (30×14×9 cm) on lime mortar. External walls 100 cm thick, while transverse walls 160 cm thick. Lintels in the form of brick arches, in some rooms secondary reinforced concrete lintels. Original lime plasters preserved only partially, in most rooms inside the building there are secondary cement-lime plasters. Window and door woodwork has not survived.



**Fig. 3.** The front elevation of the northern part of the former Red Barracks (1910–1920) (source: <https://polska-org.pl>).



**Fig. 4.** The front elevation of the northern part of the Red Barracks currently.

## Inventory

The existing documentation of the Owcza Góra Fort comes from the collections of the Berlin Archives. The drawings below show ground floor plans from the beginning and the end of the 19<sup>th</sup> century. During the period of several dozen years there were no changes in the body of the building, there are significant changes in the way the rooms are divided. In the 20<sup>th</sup> century, due to a change in the function of the object and the purpose of the rooms, the interior underwent further transformations. Practically all walls separating barracks rooms were demolished.

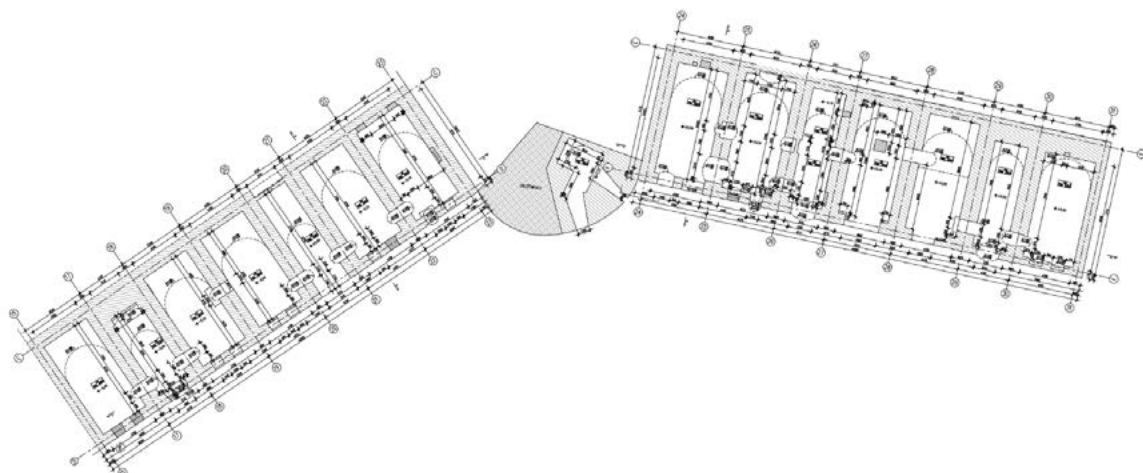


**Fig. 5.** Ground floor plan of the Red Barracks building (1812) [11].

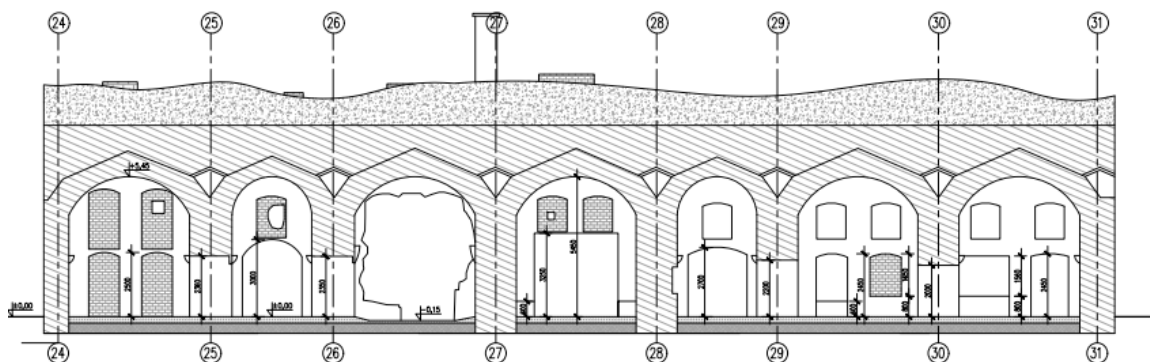


**Fig. 6.** Ground floor plan of the Red Barracks building (1885) [11] .

The drawing documentation including ground and floor plans, cross-section and longitudinal sections as well as views of the current state of the barracks was made in 2017. Inventory measurements were made in May during workshops-practices implemented by the Department of Conservation of Built Heritage at the Lublin University of Technology. The complete documentation was handed over to the fortress representatives in the middle of the year.



**Fig. 7.** Inventory – ground floor plan of the Red Barracks



**Fig. 8.** Inventory – cross-section through the Red Barracks – the southern part

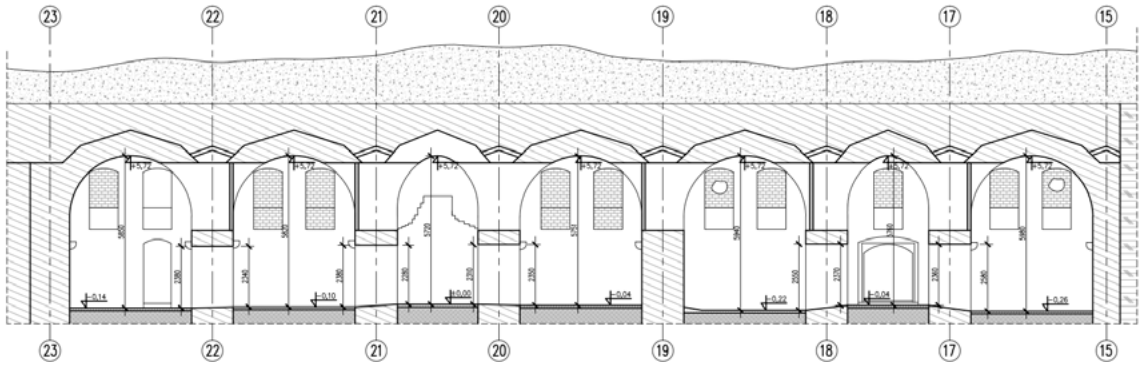


Fig. 9. Inventory – view of the Red Barracks facade – northern part

## Research on site

During the measurements and works carried out at the facility, the moisture content of the walls was tested using the dielectric method, and samples were taken for testing the moisture and salinity of the walls using laboratory methods. Samples for laboratory tests were transported and tested in the Construction Laboratory of the FCEA LUT.

## In-situ moisture content testing

When carrying out the test with a hygrometer, the results are get immediately, thanks to which it is possible to make many measurements in a relatively short time. The dielectric method is a non-destructive method. The test was performed with the LB-796 moisture meter using a capacitive probe. The capacitive method consists in measuring the dielectric constant of a material, which depends on the water content of a given material [12].

Thanks to the speed of taking measurements and obtaining results, as well as the non-invasiveness of this method, the moisture of the wall at many points on its surface can be measured. By measuring moisture in such a large number of points, e.g., the most moist places can be accurately located.

The test was performed on the entire length of the front facade of the building. The moisture was measured at five heights of a given section (at the ground/floor, at a height of 0.5 m, 1.0 m, 1.5 m and 2.0 m).

The results obtained are presented in a tabular form. In order to better illustrate the moisture of the walls, the moisture maps were prepared in the GoldenSoftware Surfer software.

In the tables with the results of moisture measurements, the appropriate levels of moisture are indicated in accordance with the classification in Table 1.

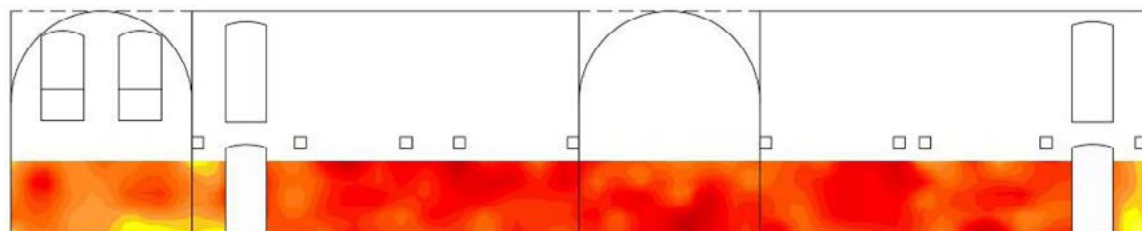
Table 1. Moisture levels of the brick walls [1].

Degree	Mass moisture [%]	Description
I	0 – 3	Walls with permissible moisture
II	3 – 5	Walls with increased moisture
III	5 – 8	Moderately moist walls
IV	8 – 12	Heavily moist walls
V	> 12	Wet walls

**Table 2.** Results of moisture measurements of the front elevation of the southern part of the barracks [%].

Measuring No.	1	2	3	4	5	6	7	8	9	10	11	12	13	
Length [m]	0.00	1.26	3.73	4.37	5.00	5.69	7.75	7.82	8.13	8.89	9.92	11.01	12.16	
Height [m]	2.00	2.5	0.0	0.0	–	–	–	0.2	0.0	–	0.2	–	0.0	0.0
	1.50	1.0	0.1	0.0	–	–	–	0.0	0.0	–	0.1	–	–	0.0
	1.00	1.6	1.4	0.0	3.8	0.1	0.5	0.1	0.0	0.0	0.1	0.1	0.0	9.4
	0.50	6.0	8.0	5.4	0.1	1.3	2.5	0.1	0.0	0.6	5.7	3.6	2.2	9.4
	0.00	7.5	10.0	7.1	2.0	3.0	4.5	1.5	1.5	1.5	6.6	4.5	2.9	12.0
Measuring No.	14	15	16	17	18	19	20	21	22	23	24	25	26	
Length [m]	13.21	13.94	17.90	18.04	18.76	23.14	24.03	29.57	30.11	30.99	34.59	35.21	35.86	
Height [m]	2.00	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.1	1.2	1.5	0.0	1.5	1.0
	1.50	0.0	0.0	0.0	0.0	0.1	0.0	0.2	7.5	0.5	1.5	3.7	1.9	–
	1.00	0.0	0.0	0.0	0.0	0.5	0.1	4.1	2.7	2.9	0.7	2.2	2.0	8.9
	0.50	3.0	3.7	4.2	7.2	8.8	0.1	0.7	0.0	6.4	4.8	5.0	6.8	3.8
	0.00	5.0	5.7	6.0	12.0	10.5	2.0	1.9	0.9	8.0	5.9	8.0	6.4	2.4

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**Fig. 10.** Moisture map of the front elevation of the Red Barracks – southern part.**Fig. 11.** Moisture map of the front elevation of the Red Barracks – northern part.**Fig. 12.** Map of interior moisture – development of the 020 room

Analyzing the moisture maps of the front elevation it can be seen that the wall is mostly dry. Only at the terrain level, elevated moisture values were noted. The front elevation wall is classified to the 1<sup>st</sup> degree of moisture, i.e., to walls of an acceptable moisture.

Four most degraded rooms were selected for testing the moisture content of a building interior using dielectric method. Inside these rooms significantly higher moisture was found than in the case of the façade wall from the outside. The moisture values classify internal walls as the III–IV-th degree (medium and very moist walls), and sometimes even as the V-th degree (wet walls).

Unfortunately, the dielectric method of testing the moisture content of walls is only informative. This method is easy and fast to locate moist places, but unfortunately it is not reliable when it comes to precise determination of moisture values [7]. In order to carry out a more detailed analysis and to determine the exact moisture value, the moisture content of walls was tested using the laboratory method.

### Testing the moisture content of walls by the laboratory method (the gravimetric method)

The gravimetric (drying) method of determining the value of the moisture of walls is considered to be the only reliable method despite many limitations. It is necessary to have laboratory facilities and appropriate sampling equipment. The method and place of obtaining the material for the tests is also important [7].

Basic rules concerning the place and method of sampling for the gravimetric method of moisture testing:

- In the case of determining the distribution of moisture depending on the height of the wall, a sample should be taken from the floor/ground level and additionally at least one above the previous location.
- The sampling depth should be  $\frac{1}{3}$ – $\frac{1}{4}$  of the wall thickness. The drilled material should be from the whole length of the hole.
- Overheating of the drilled material must be prevented during sampling.
- The material collected should be stored in a sealed container. It is necessary to store the samples in a refrigerator during transport (for determination of the moisture value at a later stage from the time of sampling). If the on-site investigations last several days, it is necessary to freeze the collected material.
- After sampling, the holes obtained must be filled with material compatible with that collected.
- During testing, photographic documentation of the sampling sites should be taken for the purpose of later marking on the drawing documentation.

Moisture tests using the laboratory method were carried out both inside and outside the building. In total, material was taken from 78 points, samples from the front elevation were taken from 28 places, from the inside – 50 places. The tests were carried out in the Construction Laboratory of the Lublin University of Technology. Below are some examples of the research results.

Laboratory tests have largely confirmed previous measurements. Similarly as in the case of dielectric tests, very large differences in the level of moisture of the front facade and internal walls were found.

Significant moisture in the front wall occurred only in 3 out of 28 points and it was 1 point with the V-th degree (wet walls) and 2 points with the IV-th degree (very moist walls). In other places, the wall had acceptable or only minimally increased moisture.

The situation inside the barracks was definitely worse, both the external wall covered with embankment and the internal walls not coming into contact with the ground were very moist locally. In the examined 50 samples, all degrees of moisture were found, however, high and very high water loads on the material dominated. In 23 samples the V-th degree was found and in 13 samples the IV-th degree of moisture was found. In the remaining 11 measurement points, the walls had acceptable moisture or were characterized as having elevated or medium moisture.

**Table 3.** Results of measurements of samples taken from inside the southern rooms.

Sample No.	Place of collection	Height of collection	Moisture
		[m]	[%]
143	Room No. 24	0.5	6.53
144	Room No. 24	1.0	1.67
145	Room No. 24	0.5	6.65
146	Room No. 24	1.0	1.46
147	Room No. 25	0.5	15.33
148	Room No. 25	1.0	5.26
149	Room No. 25	0.5	25.13
150	Room No. 25	1.0	21.93
151	Room No. 27	0.5	8.08
152	Room No. 27	1.0	9.49
153	Room No. 27	0.5	21.12
154	Room No. 27	1.0	14.29
155	Room No. 28	0.5	4.08
156	Room No. 28	1.0	0.75
157	Room No. 28	0.5	22.71
158	Room No. 28	1.0	18.99

**Table 4.** Results of measurements of samples taken from the front elevation of the southern part of the building.

Sample No.	Place of collection	Height of collection	Moisture
		[m]	[%]
123	Front facade	0.5	0.60
124	Front facade	1.0	2.47
125	Front facade	0.5	3.07
126	Front facade	1.0	0.64
127	Front facade	0.5	2.81
128	Front facade	1.0	0.79
129	Front facade	0.5	6.19
130	Front facade	1.0	0.59
131	Front facade	0.5	1.06
132	Front facade	1.0	2.70
133	Front facade	0.5	2.45
134	Front facade	1.0	5.65
135	Front facade	0.5	8.29
136	Front facade	1.0	1.53
137	Front facade	0.5	12.65
138	Front facade	1.0	1.87

## Testing of salinity of walls

During the works at the site, samples of material were taken for the presence analysis of harmful building salts such as sulphates, nitrates and chlorides. The walls of the Red Barracks were drilled to take 20 samples, 6 from the front elevation and 14 from the internal walls and the rear elevation covered with soil, respectively.

The samples were transported to the laboratory and the salinity tests were carried out there. The samples were dried to a constant mass and then dissolved in distilled water. The prepared material was filtered and analyzed to determine the concentration of salts and the pH level was measured.

**Table 5.** Salinity level of walls based on the salts concentration [5].

Sole	Salinity [%]		
	low	average	high
Chlorides	< 0.2	0.2–0.5	> 0.5
Nitrates	< 0.1	0.1–0.3	> 0.3
Sulphates	< 0.5	0.5–1.5	> 1.5

**Table 6.** The pH scale.

The pH value	0–6	7	8–14
Reaction	acidic	neutral	alkaline



**Table 7.** Obtained values of salinity of walls and pH level.

Sample No.	Place of collection	Sulphates [%]	Nitrates [%]	Chlorides [%]	pH
20	Front facade	0.28	0.00	0.02	5
21	Front facade	0.22	0.00	0.02	5
22	Front facade	0.30	0.00	0.02	4.5
23	Room No. 20	0.16	0.00	0.02	5
24	Room No. 19	0.23	0.00	0.02	5
25	Room No. 21	0.10	0.00	0.02	5
26	Room No. 15	0.11	0.00	0.02	5
27	Room No. 17	0.23	0.00	0.02	5
28	Room No. 18	0.37	0.00	0.02	5
29	Room No. 20	0.15	0.00	0.02	5
30	Front facade	0.22	0.00	0.02	5
31	Front facade	0.21	0.00	0.02	5
32	Front facade	0.77	0.00	0.02	5
33	Front facade	0.46	0.00	0.02	5
34	Room No. 23	0.44	0.00	0.02	5
35	Room No. 24	0.39	0.00	0.02	5
36	Room No. 27	0.55	0.00	0.02	5
37	Room No. 27	0.26	0.00	0.05	5
38	Room No. 30	0.21	0.00	0.02	5
39	Room No. 30	0.39	0.00	0.02	5

Analyzing the obtained test results, it was found that there were no significant salinity on the walls tested. Slight exceedances of the low level occurred only in 2 out of 20 samples and concerned one of the groups of salts tested. The pH level was 5 in most of the samples (slightly acidic reaction).

## Assessment of technical condition

The general technical condition of the entire building is described as poor. There are numerous defects in construction and finishing materials, as well as a lack of door and window joinery.

The lack of insulation of walls and vault from the ground caused water to get into the structure of the wall, which led to strong moisture and the appearance of a biological and chemical corrosion.

The rear wall meets the ground at its entire height and therefore increased moisture can be observed on its entire surface. Side walls are moist up to half of the wall height, which indicates the capillary rising of water from the foundation side.

The object is condemned (brick vault covered with a thick layer of an earth embankment from the top). Historically, the vaults were not insulated, and rainwater flowing through the ground was flowing down the vaults, and then the system of canals at the confluence of the groin was draining the water to the outside. At the moment, this system is most probably partly clogged. Some drainpipes are damaged and the high moisture of the vaults indicates the penetration of rainwater into the structure of these elements. In some rooms the vaults are heavily affected by the biological corrosion – algae.

In the object in question, numerous damages and loosening of the upper layer of bricks and losses of joints were found. The degradation of the face is particularly intensive on the front elevation of the object, in internal rooms this type of damage is near-surface.

The object has been deprived of door and window joinery for a long time. Some of the openings have been bricked up with ceramic bricks. Rainwater penetrates through the holes into the interior and large quantities of leaves from trees growing in the immediate vicinity of the barracks are blown in.

Historical stone elements are in poor technical condition. Large fragments of stone slabs forming a cornice on the front elevation were damaged. Some of them were pushed out by the roots of trees and shrubs developing on the crown of the barracks. Most of the semicircular cornice located directly under the crowning cornice was destroyed. Some of the drainpipes are missing and the others are more or less damaged. It is most likely that during the bricklaying up of windows, stone bands and window sills were completely destroyed in some of the openings. Most of the remaining stone elements on the facade are damaged. The damage has a variety of characteristics, from small surface defects, through damage to the corners of the elements, to large fragments.

Another reason for the degradation of the object is the destructive effect of humans. The building remained unused for years and was not secured in any way. General access to the building resulted in many mechanical damages and devastation of walls in the form of graffiti. Lack of care and action on the part of man contributed to the deterioration of many elements of the object.



**Fig. 13.** The northern part of the Red Barracks. Significant damage to the corner of the front wall. Numerous cavities and shortages of bricks. Lack of joints.



**Fig. 14.** The southern part of the Red Barracks. Extensive losses of bricks and stone cornice. Visible biological corrosion of a drainpipe and chemical corrosion of bricks.



**Fig. 15.** The northern part of the Red Barracks. Significant shortages and cavities in the wall.



**Fig. 16.** The southern part of the Red Barracks. Extensive cavity in the front wall. South



**Fig. 17.** The northern part of the Red Barracks. Biological corrosion of the plinth in the form of mosses and lichens. Chemical corrosion of bricks.



**Fig. 18.** The northern part of the Red Barracks. Mechanical damage to stone bands. Vandalism in the form of graffiti.



**Fig. 19.** Room No. 16. High degradation degree is visible. Numerous defects and cavities in the surface of walls and vaults. Strong biological corrosion and high moisture content in the back wall.



**Fig. 20.** Rooms No. 25 and 26. View of the entire room. Numerous loosening of plaster and cavities in bricks.



**Fig. 21.** Room No. 16. Losses of bricks in the structural wall and visible biological corrosion.



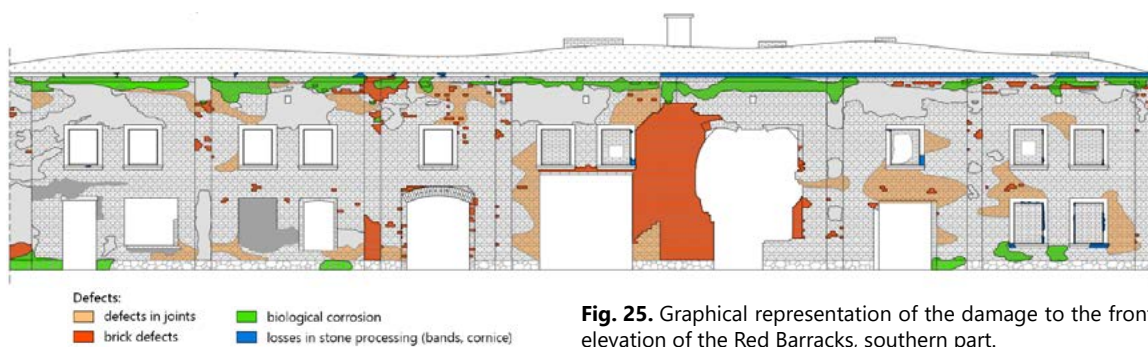
**Fig. 22.** Rooms No. 25 and 26. Extensive cavities and damage to bricks on the wall and door lintel.



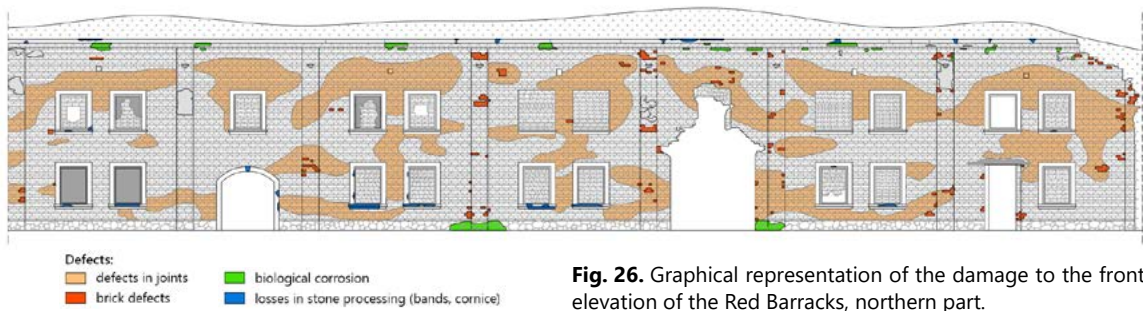
**Fig. 23.** Room No. 27. Mosses, lichens and salt efflorescence on the window lintel and vault.



**Fig. 24.** Room No. 28. Deconsolidation of the top layer of bricks caused by chemical corrosion. Biological corrosion in the form of mosses and lichens.



**Fig. 25.** Graphical representation of the damage to the front elevation of the Red Barracks, southern part.



**Fig. 26.** Graphical representation of the damage to the front elevation of the Red Barracks, northern part.

## Summary

The evaluation of the technical condition of the Red Barracks of the Owcza Góra Fort in the opinion of the authors is ambiguous. During the inspection, numerous damages and losses of finishing materials and architectural details can be seen. Historical ceilings, door and window carpentry have not been preserved, the majority of stone details are in bad condition. The building is moist, locally intensively affected by biological corrosion. At the same time, there are no significant structural problems. Walls and vaults do not bear traces of major damage, there is no excessive load or changes in the structural system.

When left, with a high probability, it will last for the next decades in a fairly similar condition. It is influenced by: massiveness of walls and vaults covered with a thick layer of earth, high quality of workmanship and materials used.

On the other hand, leaving the building in its existing condition will mean its slow degradation as a historic, historically valuable and important element of the Kłodzko Fortress complex.

According to the authors of the study, there is a small chance to carry out extensive renovation works in the facility in the near future. The main part of the Fortress will remain a priority for the next several years or longer. For this reason, a protective and orderly work programme should be implemented in the barracks, which will allow to slow down the degradation processes of the facility.

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## Stan zachowania Koszar Czerwonych Fortu Owcza Góra

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**Streszczenie:** Artykuł niniejszy poświęcony jest obiektowi Koszar Czerwonych Fortu Owcza Góra, znajdującego się w miejscowości Kłodzko. Obiekt wniesiony został jako fort zewnętrzny Twierdzy umożliwiający obserwację przedpól i zabezpieczający wzgórze, z którego mógłby być prowadzony ostrzał twierdzy głównej. W opracowaniu przedstawiono stan zachowania obiektu, który od kilkudziesięciu lat jest nieużytkowany i ulega procesom niszczenia i degradacji. W artykule przedstawiono wyniki prac inwentaryzacyjnych, badań technicznych i laboratoryjnych.

**Słowa kluczowe:** twierdza, fort, Owcza Góra, badania techniczne, badania ruin, badania wilgotności, badania zasolenia

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