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ORADEA'S 1900s INDUSTRIAL STRUCTURES BEHAVIOUR

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ABSTRACT:

The paper brings to attention the industrial buildings from the 1900s through two case studies of high-rise buildings for the period in which they were built. The study is done by analyzing the resistance structure of two buildings built around the 1880s and their behavior over time. The destiny of these very valuable buildings from a historical, architectural and structural point of view is regarded as a motivation for the authors for the elaboration of the present paper. One of the studied buildings has been dismantled, while for the second one, the owners are allocating funding for structural rehabilitation in order to maintain it, in parallel with the re-conversion, modernization and expansion of the building. For valuable buildings and historic monument buildings, maintenance activity is particularly important in order to prevent structural degradation. It is especially important to pass on the historical legacy to future generations, therefore its structural strengthening and rehabilitation must take precedence over financial implications.

1. INTRODUCTION

Located in the western part of the country, less than 15 km from the Hungarian border, the city of Oradea (Nagyvárad, Großwardein, Veľký Varadín, Varadinum) enjoys a relevant history in terms of trade and industry. After the sanctification of the king of Hungary, Ladislaus I, his bones being deposited in the Oradea Citadel's cathedral, the pilgrimage of the Catholic faithful to his tomb led to the opening of the city to development. The impetus for the development of industry is marked by the period after 1784, when the Subcetate neighbourhood also begins to be populated by Jews. In 1786, the leadership of the city is ensured in equal shares by Romanians, Hungarians and Germans (Anghel, 2007). "In 1860, Velența and Subcetate were unified with Oradea. A new turning point meant the regaining of constitutional administrative rights by the local authority in 1861. In 1870, the city was given the status of a locality with its own jurisdictional law. Thus, the administrative body was made up of the City Council, the Administrative Commission, the mayor, councillors, the gendarmerie office and the council for orphans. In 1872 the administration was partially reorganized, the leadership being formed by the Commission jurisdiction, of which 114 people – the so-called "virilists" – were chosen from among the wealthiest people in the city, counting on the level of tax paid. In 1886, the Council of Industrialists of Oradea was established, with the appearing in this decade of many plants and factories, among them: the Perge and Rozslay machinery and equipment factory, the machine and locksmith factory of Gitye Demeter, the brick factories of Rimanóczy Kálmán, Knapp Ferenc, Rendes Vilmos as well as a number of rolling mills, distilleries and banks" (Pafka, 2019).

In 1850, 18,904 people (Hungarians, Germans, Romanians, and Jews) lived in the four cities (Oradea – Olosig/ Oradea – Orașul Nou/ Oradea- Subcetate/ Oradea – Velenta). These connected cities united politically under the same mayor, maintaining an independent neighborhood administration (Prada, 2019). In the 1870-1910 period, many industrial complexes appeared, among which the two structures that are the subject of the present study: 1870 "László" Steam Mill, establishment II – former Rosenthal, previously Dunkel, and later part of the Factory complex of furs "1 Mai" and more recently Rovex S.A., and in 1884 the "Jakab Weinberger" Mill, later known as the Emilia Mill. Their location is shown in figures no. 1 and 2. During this period, the city of Oradea was one of the most industrialized and modern cities in Transylvania (Emődi, 2011). In Oradea there are still old industrial buildings, precious vestiges for the city's evolution and development. However, industrialization and architectural development are closely related to the time period in which these processes take place (Bungău et al., 2022). The present work deals with the structural elements of two buildings with the destination of a mill, being built in the same period, but having different (resistance) structures: the "Emilia" Mill and the "Jakab Weinberger" Mill.

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The authors studied the existing documents: historical studies, technical expertise reports, surveys and photo archives, to describe the resistance structure of these buildings, which are relevant both from an architectural and as solutions for resistance and stability point of view for the period in which were built (figures no. 1 and 2). On the current satellite image of the city of Oradea, the "Emilia" Mill does not exist (figure no. 3).



Figure 1. Location of the Steam Mill „László" (right) and the "Jakab Weinberger" Rolling Mill (left) - Nagy Varad (Oradea). Map 1890 by Berger Samuel (Pafka, 2019)

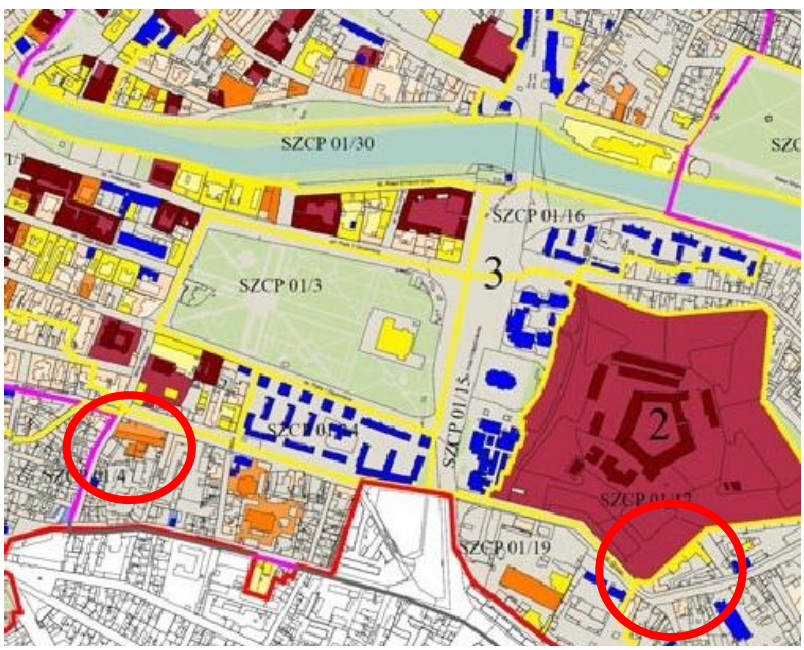


Figure 2. Location Rovex S.A. (right) and Moara Emilia site - Oradea General Urban Plan, (Source: https://culturabh.ro/images/patrimoniu-mobil/ansamblu_centrul_istoric_PUG-web.jpg)



Figure 3. Location of the Steam Mill „László" (right) and the "Jakab Weinberger" Rolling Mill (left)
(Source: https://www.google.com/maps/@47.0505385,21.9373688,1527m/data=!3m1!1e3)

"The Emilia Mill ensemble, founded in 1884-85 by Iacob Weinberger and Mor Aufricht, and built in several stages (1885, 1891, 1918), is among the most representative examples of industrial architecture in Oradea, operating here for a long time a prestigious rolling mill" (Emődi, 2011). It is not known with certainty who was the original designer of this imposing building from the end of the 19th century. It is implied that it could be "the engineer Incze Lajos or the architect Kalman Rimanoczy junior – the most important architect of the city during the whole period of 1880-1910 -, whose offices also designed the projects of the Lederer and Kalman Mill and distillery" (Emődi, 2011). The expansion of the mill is designed by architect Sztarill Ferenc. For a long time, the Emilia Mill Building dominated the city by its purpose, being an accent that brought into the picture the story of the industrial area that marked the southern outskirts of the city almost 100 years ago (Figure no. 4). The mill was famous, producing 5000 tons of ground grain, which was sold in the west of the Austro-Hungarian Empire, in the Balkans and in France (Hochhauser, 2010). Built in 1870, the building of the "László" Steam Mill, plant II, has undergone interventions over time as its function has changed. In 1932-1933 it was taken over for the purpose of processing sheep fur on an industrial scale. After the nationalization in 1948, the factory was greatly developed, increasing production both for export and for domestic use (Pafka, 2019).



Figure 4. Emilia Mill – the Nordic facade (Emődi, 2011)

1.

2. MAIN BODY

The present work brings to attention the resistance structure of two buildings being part of two ensembles: the building of the "Emilia" Rolling Mill and the "Laszlo" Steam Mill. Both are located inside the protected area "Oradea Historic Center Urban Complex", a historical monument complex with list code 2016: BH-II-a-A-01037. In addition, the building of the former Steam Mill is located in the immediate vicinity of the Oradea Citadel, historical monument with list code 2015: BH-II-a-A-01052, being part of the "Rovex" industrial complex **(**National Heritage Institute, 2016).

2.1 Case study – "Emilia" Rolling Mill

The ensemble was functional for 75 years; around the 1960s, the mill became a warehouse, its machinery being decommissioned. Nowadays The Emilia Mill building is just a story; it was demolished in the years 2013-2014 with a demolition permit, despite the efforts to have it classified as a historical monument. The representative building body of the Emilia Mill, in the shape of the letter "T", had a 5 floors height regime (figure no. 5) – the side parallel to M. Kogălniceanu street and a 4 floors height regime – the side perpendicular to it. The fence from Kogălniceanu Street was made of simple masonry brick, of very good quality, reinforced with brick pilasters, with clinkered brick blocks arranged on the outside. Figures no. 5 and 6 shows the body of the blade with the plan dimensions of 10 x 77 m, and the height at the cornice of 13.60 m. This wing has two expansion joints, one of which separates the area of the building erected in different stages. The resistance structure is made of load-bearing walls of simple brick masonry with lime mortar on the entire exterior contour and several transverse bracing walls placed at large distances between them, varying between 10.30 m and 27.50 m. Figure no. 7, highlights the metal ties, having the role of bracing the walls; the vertical perimeter structure of resistance is only made up of longitudinally arranged walls. Inside, the entire structure it is made of wood, forming two longitudinal frames with a board made of wooden cabinets.



Figure 5. Emilia Mill – North-East facade (author archive)

At the level of each floor, metal ties were inserted that connected the opposite longitudinal walls with each other and with the wooden frames. All floors are made of wooden beams. The two slopes roof framing is made of wood (Pantea, 2011). In the last period, the covering was made of tin, initially being inferred that it was made of ceramic tiles. The concrete foundations, continuous under the masonry and point-shaped 120x120 cm under the wooden pillars (figure no. 6).



Figure 6. Emilia Mill - internal infrastructure (author's archive)

The structure "was calculated for a self-weight of 250 kg/sqr meter for the upper floor, 320 kg/sqr meter for the floor above the second floor, respectively 400 kg/sqr meter for all other floors". Figure no. 7 shows the internal wooden structure of the lamellar body, as well as the metal ties that connects the exterior longitudinal walls. The photos presented in this paper, highlighting the structure, were taken by the authors in 2010.



Figure 7. Emilia Mill – interior structure (co-author archive)

Figures 8 and 9 highlights interventions over time on the gaps, respectively the method of anchoring the metal ties. The

windows of the lamellar body lost their original shape over time, meanwhile those on the southern body keep their shape with an arch segment ending.



Figure 8. Emilia Mill – South-East facade (author's archive)

In the last period of the complex's existence, it was no longer maintained, with visible deterioration, until partial self-demolition, afterwards, the demolition of the complex being carried out with a Demolition Authorization obtained by the owners who had purchased the investment from the town hall. The site is currently free of encumbrances, with the owners intending to build on it an apartment block with commercial premises on the ground floor.



Figure 9. "Emilia" Mill - South facade (author's archive)

2.2 Case study – "László" Steam Mill

"The construction of the building was executed according to the project of the renowned architect Kálmán Rimanóczy senior, the carpentry works bearing the signature of József Cziffra, a renowned craftsman from Szolnok. With an enviable capacity at the time, "László" steam milling managed to cover the needs of the domestic market, producing for export as well (Figs.10, 11). Among the countries where its products reached, were: England, Switzerland and Brazil. The mill was among the top three profile units in the province" (Pafka, 2019).



Figure 10. The Rovex ensemble – the North-West facade – the building of the steam mill (Pafka, 2019)



Figure 11. Rovex ensemble maintained for integration into the new project – South-East facade "László" Steam Mill Body, plant II (Șuvana, 2022)

In the years 1932-1933 József Leichner, a large manufacturer of sheepskin furs purchased the mill buildings, modifying and expanding them for the purpose of processing hides. In 1941, the field of activity expanded, the factory also producing fur garments. In 1947, garments were produced for export: France, Switzerland, Sweden. In 1948 the factory was nationalized, and today it is owned by Rovex S.A. "This course of business development in historical and economic stages, over time has left its mark on construction stages and interventions on existing buildings" (Suvana & Crisan-Man, 2022). On the site, today it is desired to build a set of residential blocks with commercial premises. Part of the existing buildings will be dismantled, and two of them will be rehabilitated, re-functionalized and expanded. New buildings will also be built. The old body of the steam mill will be rehabilitated and storeyed.

"Over time, a building body with ~~an~~ basement + ground floor height regime was added in the southern part of the E Block, which was demolished in 2022 as part of the "Rovex Mixed Complex – (partial) dismantling of existing bodies, expansion, rehabilitation and re-functionalization of existing bodies, building new bodies – Technical documentation for authorization of demolition works, Technical documentation for the authorization of construction works, site organization, vertical systematization (figure no 12). Household point, cadastral operations, enclosure, branches – utilities, building networks".



Figure 12. Rovex ensemble proposed for integration into the new project – South-East Façade "László" Steam Mill Body, building II (author's archive)

The construction with height regime basement + 3 floors has the plan dimensions of 30.60 x 15.10 m. Access to the interior is ensured from the southern facade. Elevation ±0.00 is approximately 1.20 m above the level of the yard platform. The infrastructure consists of continuous and isolated brick masonry and concrete foundations with brick masonry elevations (figure no. 13).



Figure 13. E block – The Rovex complex maintained for integration into the new project – infrastructure (Maniu & Petrovay, 2022)

The structure is made up of a mixed spatial system: perimeter structural walls of plain old brick masonry (50 cm thick) and a central longitudinal frame of metal profiles (figure no. 14).



Figure 14. E block – The Rovex complex maintained for integration into the new project – resistance structure (author's archive)

The floors are made of metal profiles and ceramic domes, and the last floor, the bridge, is made of wooden beams (figure no. 15).



Figure 15. E block – The Rovex complex maintained for integration into the new project – floor structure (Maniu & Petrovay, 2022)

The roof framing is made of the wood; the cover is made of ceramic tiles. Through the current project, the de facto owner is dismantling part of the buildings of today's Rovex complex, with the intention to develop the area with residential blocks and commercial premises. There are 4 new building bodies with a variable height regime being proposed of up to 3 basement floors + 7 overground floors– in compliance with the restrictions of Oradea's General Urban Plan (General Urban Plan Oradea, 2016), "rehabilitation, re-functionalization and over-storying of the preserved existing bodies named D and E" (figure no. 12). "A precinct with public access is being created, with pedestrian access to spaces with a complementary purpose to residential and to the Citadel Park – a built-up protected area" (Suvana & Crisan-Man, 2022).

2.3 Results – case study "Emilia" Roller Mill

The condition of the construction at the time of the technical expertise – 2011: The lack of metal ties connecting the outer longitudinal walls, make this structure uncomplying with current norms. Due to lack of maintenance of the building over a long period, respectively due to the lack of external **plaster, the masonry** of the building was exposed to the elements. Thus, the masonry became dry; the cementless lime mortar over time became sand, finally the bearing capacity of the masonry being lost (Pantea, 2011).

The wooden structure inside is well preserved, the wooden material being originally treated, but this doesn't correspond to any possible contemporary function. Due to the lack of maintenance, the lack of activity in this area and the lack of disinterest of the owners, over time elements of the building's structure disappeared (first the metal braces, later cladding elements, wooden structural elements, and brick blocks). At the time of the technical expertise, the building presented a major risk of collapse.

Considering the financial effort required consolidating the "Emilia" mill building, in the case of this site, following the steps taken by the owners, in 2013 the historic building was ordered to be dismantled with the release of its site.

2.4 Results – case study – "László" Steam Mill

Table no. 1 compares the actual normalized loads and the proposed ones, highlighting that the difference is insignificant:

Current floor			
Existing Loads		**Proposed Loads**	
Name	**[daN / sqr meter]**	**[daN / sqr meter]**	**Name**
Permanent			Permanent
Lower finish	10.0	10.0	Lower finish
Metal profiles	15.0	15.0	Metal profiles
Ceramic blocks	360.0	360.0	Ceramic blocks
Filling	324.0	324.0	Filling
		120.0	Screed and flooring
Total (permanent)	709.0	829.0	Total (permanent)
Variables			Variables
Last ones	250.0	150.0	Last ones
Total Variables	250.0	150.0	Total Variables
Total	**959.0**	**979.0**	**Total**

Table 1. E block – Rovex Complex – existing / proposed loads of the current floor according to the new function (Maniu & Petrovay, 2022)

Table no. 2 shows a comparison for the building with the existing function and for the proposed extended one, the loads summed up at the base of the foundations (total loads) as well as the required width of the foundation (required B) and their effective existing width (effective B), according to current regulations:

	Existing Loads	**Proposed Loads**
Total loads **[daN / sqr]**	30800.00	50000.00
Required B	0.64	1.04
Effective B	0.75	0.75

Table 2. Building E – Rovex Complex –loads summed up at the base of the foundations for the existing / proposed building (Maniu & Petrovay, 2022)

The existing foundations correspond to the current function, but are not wide enough for the proposed, vertically extended building. The uncovered foundations show no cracks or degradation, thus being well preserved.

The vertical structure of the building has behaved well over time, being undegraded in most of the building. Insignificant and generally harmless cracks are observed on the walls. The area that was exposed to the weather due to the deterioration of the roof of the neighbouring building shows major degradation.
The floors of the building are generally in good condition, except for a few areas where the lower boom of the metal profiles is corroded (figure no. 15). The capable bending moment of the metal profiles is greater than the required one, calculated with the loads of the current norms and with the characteristics of the materials at the time of the construction of the building:

$$M_{cap} = W_{yy} * f_{yd} = 41\ KNm \quad (1)$$

$$M_{ef} = 36\ kNm \quad (2)$$

where: $M_{cap} =$ the capable bending moment
$M_{ef} =$ the effective bending moment
$W_{YY} =$ the static moment of the metal profile section
$f_{yd} =$ the resistance value of the metal profile

The floors do not vibrate under dynamic loads, having adequate rigidity.

A technical expertise was drawn up, in which the author analyzed the load-bearing capacity of the E block: "The general technical condition of the structures of the preserved bodies is good considering their age, they do not present defects or structural degradation that would put them endurance and stability at risk.

From the load-bearing capacity for seismic loads point of view, the existing buildings have sufficient load-bearing capacity in relation to the demands to which they are currently subjected, but in order to add more floors, it is necessary to strengthen them and bring them within the parameters required by the anti-seismic regulations in force" (Maniu & Petrovay, 2022).

The classification of the building in the Rs III seismic risk class (according to Romanian norms - P 100 / 2013) includes constructions that under the effect of an earthquake may present structural degradations that do not significantly affect structural safety, but where non-structural degradations may be important.

Taking these considerations into account, it was decided to maintain the existing E block and expand it vertically with three floors. In order to be able to implement the proposed project, in order to change the function, modernize and add more floors to E block, the following were ordered: infrastructure consolidation, the introduction of a reinforced concrete longitudinal frame, the confinement of the masonry walls, the stiffening of the structure as a whole by the introduction of bracing walls, the realization of the vertical extension with its own structure of reinforced concrete and masonry.

2.5 Discussions

The two buildings that are the subject of the case studies of the present work, having a considerable age of over 100 years, being conformed according to the building rules of that time, during exploitation they behaved very well following the earthquakes that affected the territory of Romania, the load-bearing and non-load-bearing elements not having seismic degradation: March 4, 1977 – 7.4 degrees on the Richter scale; August 30, 1986 – 7.1 degrees on the Richter scale; May 30, 1990 – 6.9 degrees on the Richter scale; May 31, 1990 – 6.4 degrees on the Richter scale; October 27, 2004 – 6.0 degrees on the Richter scale (Maniu & Petrovay, 2022).

The "Emilia" Mill building did not have rigid floors, its storied structure being entirely made of wood inside the masonry shell and the perimeter walls.

Due to its disinterest and lack of maintenance, the structure of the building deteriorated over time, remaining for a long time without plaster and being strongly subjected to water infiltration through the roof.

The building was vandalized, with many important structural elements being extracted recently.

In order to maintain the building and to save one of the landmarks of the industrial heritage of Oradea, in the steps to classify it as a historical monument, the architect Tamás Emődi states: "The mill buildings have kept their main architectural and structural characteristics, even if some of the gaps as well as the structures internal resistance (wooden floors and columns) were modified in the interwar period.

The relevant valences of the industrial complex consist in the specific character of the volumetry and in the typical appearance of the apparent brick facades, loaded with the special symbolism that dresses the functions of an industry, which deeply marked the period of spectacular rise of Oradea's capitalism". The architect recommends its functional reconversion.

The building of the "Laszlo" Mill has a completely different structural design; it has a very high rigidity and a high global bearing capacity.

The construction will be saved by the current owners and included in a project of reconversion and development of the former complex of the "Rovex" Fur Factory, the owners allocating the necessary funds for its consolidation, modernization, re-functionalization and supersizing.

"Industrial heritage is a cultural asset. It is part of our social, economic and territorial evolution. It can be considered a proof of history, useful in explaining our present" (Prada et.al., 2019). "As places of a common European memory, they bear witness to scientific discoveries, technological innovation and workers' life histories" (Council of Europe Portal, https://www.coe.int/en/web/cultural-routes/european-route-of-industrial-heritage).

Conservation and rehabilitation become two essential processes. The preservation of the building's original elements is essential for recognizing the age. From the general theory and technique of restoration's perspective, understanding the causes of degradation is vital for assessing the condition of a structure in terms of its resistance, structural changes, and deteriorated elements over time (Bogdan et.al., 2022).

3. CONCLUSIONS

The paper fully demonstrates the following:

-The industrial heritage is a material tool that helps people to remember their past. It is still not sufficiently appreciated in Romania; therefore there is a thin line between these sites to be seen as obstacles or opportunities (Prada. 2019 b). The conversion of industrial buildings is an increasingly common phenomenon today.

-Oradea's buildings dating from around 1880-1920 have a resistance structure that, following the seismic events during their existence, did not suffer damage. Moreover, these constructions, if they have been maintained, have the load-bearing capacity for their functioning.

-The structures from 1900s in Oradea, similar to the structure of the "Laszlo" Mill, whose structures have not undergone considerable interventions over time and have been maintained, correspond (sometimes to the limit) to the current functions whose loads are comparable to those for which they were built. In the case of vertical expansion proposals, consolidation interventions are required. For studying and analysing their current state, the interventions over time on the structure, historical studies have a special role.

-In the case of any buildings, during their exploitation, maintenance activity is very important. At the same time, the preservation of constructions is very important – to prevent structural degradation even when the construction is not in use.

-In the case of Historic Monument buildings or buildings of historical value with a considerable age of more than 100 years, similar or comparable to the case studies of this paper, special attention should be paid to the conservation and maintenance activity in order to maintain the heritage and pass it on to future generations.

-Moreover, the significance of the protected built fund must be understood, it must be treated as a "work of art", so that the cost of rehabilitation works, if any, does not matter. Through the disappearance of the "Emilia" Mill from the industrial heritage, the present study demonstrates that in order to pass on to the next generations a patrimonial heritage like these buildings with historical value from the 1900s, the level of investment and rehabilitation of the structure should not matter.

-The conclusion of a technical expertise of a valuable building must provide solutions for consolidation and only the alternative of dismantling – in extremis, with the related technology, if necessary.

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