Architectural education for the conversion of old industrial buildings

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ABSTRACT: Conversion is a challenge to reveal the secrets of an original identity hidden under the layer of time. The conversion should maintain unity with its surroundings and reflect its industrial heritage. Presented in this article is a methodology for teaching the conversion of industrial architecture dating from the late 19th Century until the first half of the 20th Century. Industrial architecture has specific characteristics and limitations, which influence the holistic attitude towards conversion. These include typology, construction, historical production and surroundings. The methodology reveals the potential of a building by drawing on different professions and specialists to arrive at a consensus evaluation. The methodology is presented by a case study using models of the conversion of a former Stein brew house in Bratislava.

INTRODUCTION

There are theories and activities in architecture connected with the conversion, adaptation, reconstruction and reanimation of structures dependent on typology. An example is the conversion of industrial architecture from the turn of the 19th and 20th Centuries, which were created for industrial production and had a characteristic identity. Such conversions can produce a sustainable outcome, reinforcing the trend for such conversions. Lüley et al have described sustainability of buildings as:

> *The general objective is prolonging the life cycle of the building and reduce the need for destruction or clearance* [1].

Conversion has been taught as a part of architectural education in the Faculty of Architecture at Slovak University of Technology in Bratislava (FA-STU), Slovakia, for more than two decades. During this period methods and procedures have been developed dedicated to uncovering the potential value of industrial buildings, similar to a strengths, weaknesses, opportunities and threats (SWOT) analysis. This can be applied to a wide range of conversions.

In conversions, an essential role is played by *value*. Value can have many meanings, such as spiritual, documentational, historical, artistic, architectonical, constructional, technological and aesthetic, which in turn may have different levels of importance. Analysed in this article is industrial architecture without clear architectonic value, but with a series of partial values which, taken together, imply a holistic treatment as appropriate.

INDUSTRIAL ARCHITECTURE VALUES

The values of industrial architecture and modern architecture are not distinct, and there are disputes about how to protect buildings, especially if they are physically at the end of their lives.

> *Is it necessary to protect or wipe out late-modern palaces? We think neither the first nor the second one. We are looking for forms and a level of their possible transformation* [2].

There may be an assumption that older industrial buildings are old-fashioned and of no use. However, industrial production is a part of history and the development of society. It is part of a city and country, and embodies the history of the skills needed to provide the material needs of society. It is an identity that people connect with. History is the heritage, which is passed on from the current to the next generation [3]. But history must be rooted in reality, as Butterfield has written:

> *In order to catch these things in the life of the past and to make a bygone age live again, history must not merely be eked out by fiction; ... it must be turned into a novel* [4].

An architectonic masterpiece of historical and industrial value should not stay marooned in history, but should come alive in the present. Conversion gives a new visualisation, but also a new function so that the building has a new *life*. At the same time, it is not possible to cut completely away from the past. Conversion reflects continuation and consensus arrived at by dialogue with a society, city, a place respecting architecture and surroundings. It can be characterised as a metaphorical gallery presenting the history of a particular location [5].

At the beginning of the 21st Century, the conversion of industrial buildings has become a fashion trend, which highlights the economic usage of existing materials and structures; it is also an artistic style, where rough industrial aesthetics is *chic* [6].

Sustaining architecture depends on its value in terms of aesthetics, construction and period documentation. The values of industrial architecture specifically include the production function. They include technique and art, architecture and construction, exterior and unusual interiors of production premises.

If a building is coming to the end-of-life regarding its function, but is physically valuable, conversion aims to retain the culture-historical values of the building, but with new functions, architectonical features and surroundings. The identity remains and retains the original qualities while reflecting the new function. Conversion requires a thorough analysis and evaluation of its impact on the sustainability of the new functions in the future. Radu identified conversion as the transposition of architectural spaces and elements:

> *The functional conversion process involves the* poaching *spatial morphology and architectural vocabulary, the recovery of the identity of the place through the use of diversity* [7].

TEACHING CONVERSION – DISCUSSION

Building effects must be assessed in relationship to the place, since they affect their surroundings and this affect can vary by effect and function. The function of the transformed building is determined by traditions, culture and the history of a place [8].

Many architects agree that the conversion of old industrial buildings and areas has both challenges and attractions. Such opinions have led to attempts to derive new practical methodologies for the conversion of old industrial buildings. Conversion benefits are mainly *space and constructional.* Space benefits mean that the converted building provides extra space in expansion and height with the construction able to carry the loadings. The conversion may require new functions and the creative usage of relived spaces [9]. Frederick Jung, the founder of Jung Architects in Paris opined:

> *For architects, it's an opportunity to create new elements inside an old structure and keep alive the history of these amazing places* [10].

Building conversion will involve the *integration* of old with new to produce a building with a new function in its surroundings. The constructional benefits relate to form focused on a c*ontrast* of old with new, which accentuates the form and expression of the original and converted building [11].

In building conversion both original and new forms should be reflected, which is confirmed by experience in Europe. Examples include: Germany - heavy industry in Ruhrgebiet; France - textile industry in Roubaix; and Italy - industrial areas of Pirelli Milan. There are also examples from the Czech Republic and Slovakia. Academics teaching conversion of industrial buildings have developed a complex methodology reflecting differences of area, buildings and specific details [12][13].

The conversion of no longer functional old industry buildings often is carried out through a methodology based on SWOT analysis. This identifies traces of the old industry and changes determined by the new functions, while taking account of the place and city [14]. Stratton's methodology evaluates the opportunities presented by the renewed building, thereby reducing the risk of the destruction of the building. In this methodology the architect's intuition is important:

> *There are two ways of devising strategies for the adaptation of industrial buildings:* sixth sense *intuition or meticulous feasibility studies* [15].

Methodology for Teaching Conversion

Teaching building conversion, as presented in this article, involves architecture and civil engineering, and in more difficult cases also structural design (static). As noted by Avsec and Savec, this multi-disciplinary approach is beneficial for education:

> *Students from different disciplines have different knowledge, skills and attitudes towards technology and engineering, which brings a new quality to design ideation* [16].

The methodology for teaching building conversion involves:

1. Initial evaluation index: Determine the status of the building including physical aspects, aesthetic value, technological fragments, documentation, socio-economic factors, industrial techniques and the *genius loci*. This new perception of an object represents the understanding of the object as an industrial ruin, with some history of a period and some architectonic expression.

2. The alternative architectonic and static engineering solutions for new or existing objects are developed. Multi-disciplinarity is supported in the design studios and other subjects' teaching.

The successive steps in the teaching are (see Figure 1):

- analysis;
- SWOT-like evaluation of the analysis, i.e. strengths (pluses), weaknesses (minuses), opportunities, threats (limitations);
- architectonic concept/proposals;
- static analysis - construction solutions;
- feedback/comparison of proposals.

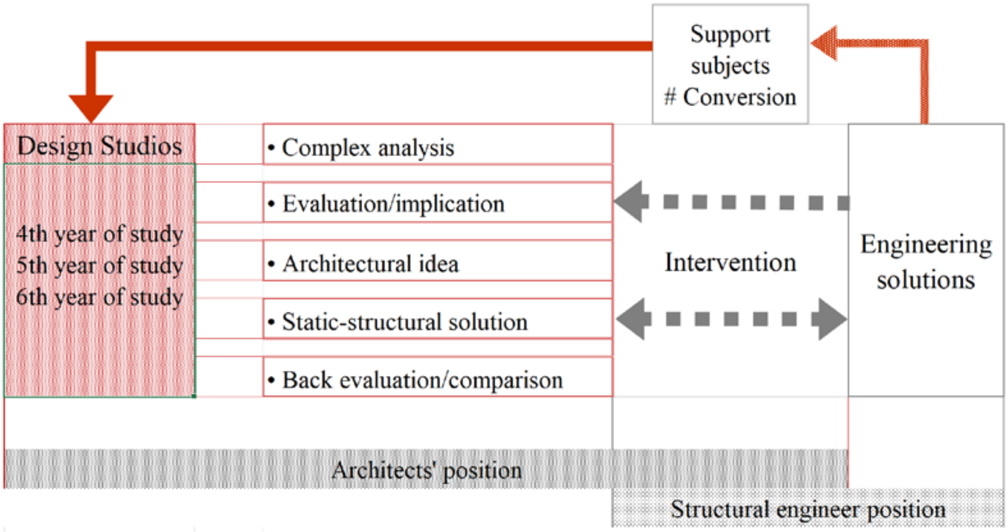


Figure 1: Successive steps for building conversion.

Methodological tools have been created for students in the form of an *evaluation sheet* (Table 1) and *graphic schemes*, which point to important fragments of a building (Figure 2 and Figure 3). The sheet and schemes record values for the criteria to evaluate an examined object for conversion (Table 1). There are five categories each with four sub-categories or criteria with a value awarded for each criterion. Each criterion is assessed by points from 1 to 5 and the overall building index value i_b is given as a fraction of the maximum possible value:

$$i_b = \sum [\text{criteria values, } c^i_{real}] / \sum [\text{max criteria values, } c^i_{max} (100)] \quad (1)$$

Where: i_b – building value index; c^i_{real} - i^{th} actual criterion value; c^i_{max} - i^{th} maximum criterion value.

The methodology can be applied for a proposed conversion or to verify an existing one.

Figure 2: Architectural, structural and technological values of an old industrial building (photo - authors).

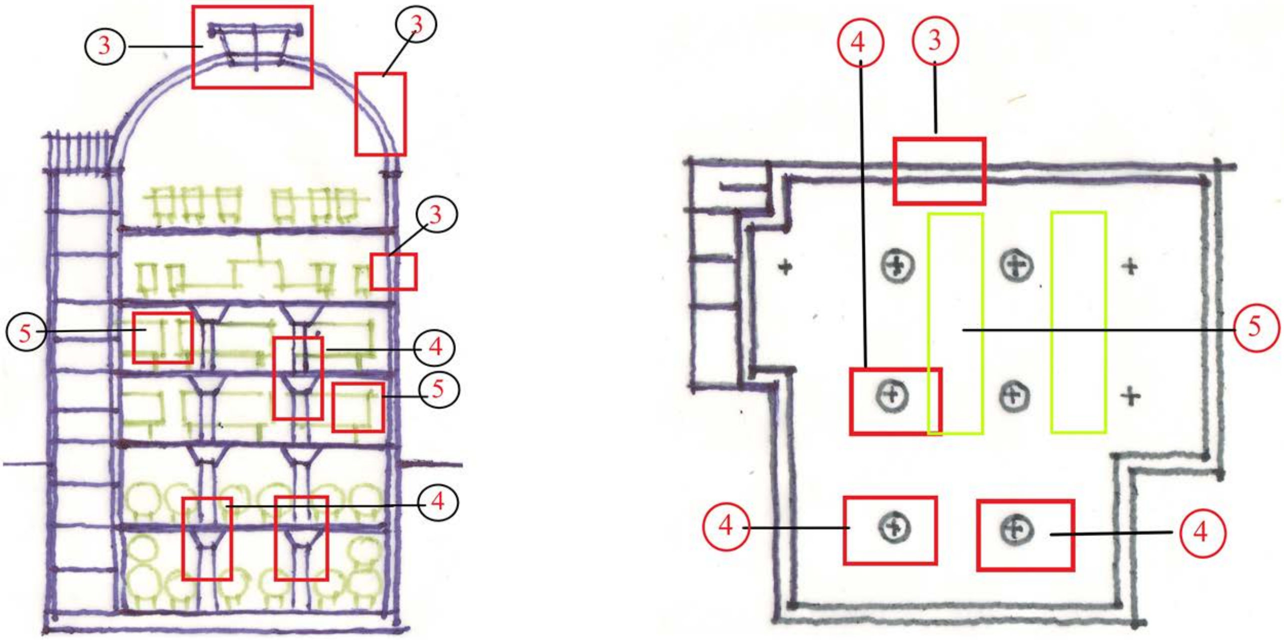


Figure 3: Graphic schemes with important fragments for building in Figure 2.

Table 1: Evaluation sheet for building in Figure 2.

	Group of values			Partial values	1	2	3	4	5	
1		Socio - historical value	1	Direct historical value of production						5
			2	Indirect historical value of production						3
			3	History and production tradition/heritage						5
			4	....						
2		Territory value	1	Direct historical value						5
			2	Technical infrastructure						5
			3	Landscape-ecology sustainability						4
			4	....						
3		Architectural value	1	Whole						4
			2	Fragment						5
			3	Detail						5
			4	....						
4		Value of structure	1	Whole						4
			2	Fragment						5
			3	Detail, material						5
			4	....						
5		Value of technology	1	Whole (technology-value)						2
			2	A part of technology (module)						4
			3	Detail (technology artifact)						5
			4	....						
									Σ	66
Reference value index of building conversion									i_b	0.88

APPLICATION: CASE STUDY AND RESEARCH RESULTS

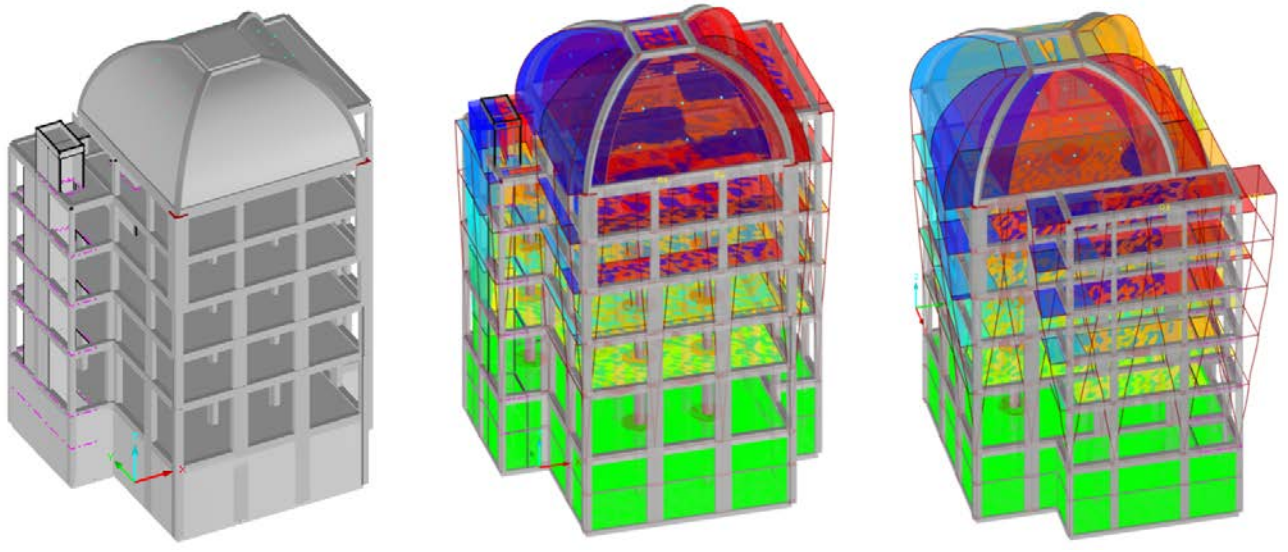
As an example of the application of the methodology shown in Figure 1, an alternative has been studied to an already performed conversion. The conversion is of a national cultural heritage fermenting cellar, which was part of a former brewery area - Stein in Bratislava - which was built at the end of the 19th Century (Bouda & Masár Architects, 2019).

For consideration, the open beer fermentation tanks could be accentuated. From the architectonic-structural view, there are very important ceilings with circular mushroom heads, an original concrete hanging dome above the space of a fermenting cellar with recognisable ribs in the exterior of the roof (H. Zrnovský, 1950) [17].

The architectonical conversion concept follows the evaluation of the building, and builds on an original statical-structural proposal for the building. The alternative student-developed model for reconstruction was designed to meet the limits of the loading values identified by the statical-structural proposal. The retroactive evaluation compared the loads at the time of the original conversion (1950) with the present. A comparison was also made of the original with currently available materials, and their effect on the structural design and the behaviour of the building as a whole.

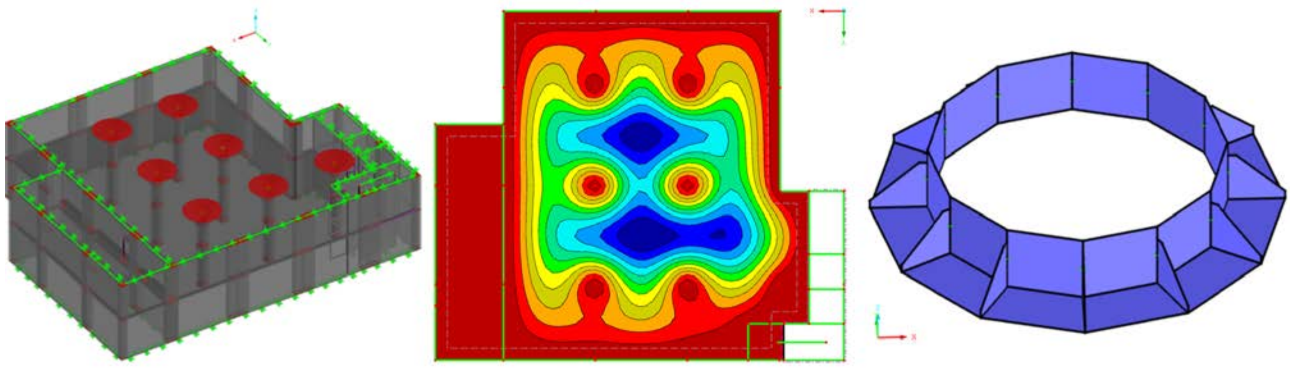
The retroactive evaluation stressed reinstating the original supportive parts of the structure to maintain the mechanical strength and building stability as a whole and for individual parts of the structure. These effects were not present in the original conversion. A statical-dynamic analysis of the building was performed using the 3D finite element analysis programme RFEM (from the Dlubal Co.).

In the dynamic analysis, seismic effects on the building before and after the reconstruction were modelled (Figure 4). A frequent problem with the conversion of industrial buildings is the natural lighting of the premises. As an architectonical solution an insert of a new ceiling structure was considered, but this caused problems in connecting new ceilings with the original columns. The solution was steel *cuffs* anchored into the columns (Figure 5).



a) b) c)

Figure 4: Seismic load assessment - 3D models; a) structural model; b) seismic load transfer in the x-direction; and c) seismic load transfer in the y-direction (diploma thesis: T. Ilkovič, supervisor: O. Ivánková).



a) b) c)

Figure 5: Ceiling plate - solution; a) model of plate; b) non-linear plate deflection; and c) model of steel cuff (diploma thesis: T. Ilkovič, supervisor: O. Ivánková).

The conversion of the building using the evaluation sheet (Table 1) yielded $i_b = 0.88$, which is high and involves retaining a maximum content of architecture, construction items and other technological artefacts (i.e. large-capacity steel-concrete tanks) to be used in the newly transformed interior.

CONCLUSIONS

The results of the research on the conversion of an old building that was a fermenting cellar confirm the validity of the evaluation method, presented in this article, for the conversion of old industrial buildings. A conversion has constraints regarding the building, which in education can lead to energetic discussions between students, teachers and engineering specialists. These discussions centre on new technical solutions, and non-traditional and multifunctional typologies. As Pusca and Northwood opine:

According to the creativity from constraints theory, well-designed constraints improve creativity [18].

The conversion of old industrial buildings, sometimes considered useless monsters, is not new and is always topical given the unusual features and need for sustainability. The pedagogical process should be creative, searching, evaluative and seek inspiration from the past.

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