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Reconstruction and restoration of historical buildings of transport infrastructure

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Abstract. The aim of this article is to identify the main problems in the restoration of the historical objects. For this reason, it is rationally to collect and analyze the existing world experience of restoration. The information which was put together showed that there are some problems which are common and can be solved. In addition, the protection of the Monuments of Culture and Architecture Committees always makes the restoration and reconstruction of the historical buildings complicated. By the examples of Germany, Italy and Russia it is shown that there are problems in organization, economy, planning and control. Engineers should think of and justify the methodology of organizing and monitoring of the restoration of the historical buildings. As a second solution, it will be possible to minimize time and financial costs through a favorable financial and legal background for investors and through the creation of a system of restoration work organizing. And for a faster process of restoration the imitation programs should be optimized for research and selection of the reconstruction technological and economic methods.

1. Introduction

Nowadays a lot of buildings in many countries need a major overhaul or restoration. The reasons which cause such situation are very broad, they are results of: human activity, nature disasters, natural aging. If the problems are caused by flood, storm, fire or explosion then the list of works becomes more complicated and the engineers often don't have accurate methods and algorithms in restoration works as the damage force is always different. That's why engineers lean on their experience and knowledge in this area, but it can't be enough for getting a qualitative result.

It is especially difficult to do the restoration of architectural monuments as they are imposed with restrictions by Cultural and Historical Monument Protection Committees which limit the technology of an overhaul or a reconstruction and give a preservation obligation to the internal and external appearance of the historical building. Frequently, if the correct workflow and the necessary resource fund are unknown then the estimate grows and it leads to unreasonable costs.

In the segment of scientific literature, the problem of restoring historical buildings is highlighted fairly widely. A. Buleev considers of the assessment of competitiveness of innovative investment projects in the historical city center in his article [1].



In the article [2] L.S. Romanova, O.G. Litvinova analyze the solution of the theoretical basis development problem and the methods of conservation and reconstruction of architectural building heritage in historical centers of the cities.

The problem of a building reconstruction with a change of the functional purpose in the historical city center is considered in the article [3-9].

An illustrative example, the analysis and the substantiation methods of efficiency of using the historical object– Petrovsky Dock, and the land attached to it which is situated in Kronstadt – the historical part of St. Petersburg are shown in the article [10].

The problems of using traditional building systems as an activation and preservation tool for historical city centers are considered in the article [11] by authors F. Pérez Gálvez, P. Rubio de Hita, M. Ordóñez Martín, M.J. Morales Conde, C. Rodríguez Liñán.

In the paper [12] there are the technological aspects of reconstruction of historical buildings, the way of keeping typical features of a historical building in particular.

The methods of activity intensification given in the articles [13-14] contribute to preserve and restore the historical monuments which are assigned with a new function – a zone extension and an adjustment of historical buildings by modern requirements. The difficulty of residential quarter reconstruction in existing development of the historical city center is one of the most important problems nowadays, which is discussed in the article [15]. The articles [16-22] V. Murgul give the reconstruction problems of the historical center of Saint Petersburg.

Reconstruction of transport infrastructure objects plays a special part. Most of the historic station houses are the pieces of architecture (Figure 1).



Figure 1. Examples of station houses being the pieces of architecture

It is important to prevent the disappearance of historical station buildings, which are the pieces of architecture.

Figure 2 shows the historical photo of the former railway station in Samara and the photo of the new station, which was built on the site of the old one.



Figure 2. Historical photo of the former railway station in Samara and the new station, which appeared on the site of the old one.

2. Methods

The information of the experience of restoring the historical objects in Italy, Germany and Russia was collected (as the countries of Europe with the greatest number of historical architectural heritage) [22].

In Germany, almost 5% of real estate, and this is 1.3 million buildings, are listed as architectural monuments. The Law on the Protection of Monuments of Culture and Architecture strictly regulates any attempt to change certain details of the facade, especially for historic windows or doors. So, you can not use the newest methods of insulation, which allow you to save up to 70% of the cost of heating. And only if the tree is very badly preserved, it is heavily corroded by the beetle, then the doors and windows can be replaced with modern energy-intensive copies.

However, in order to avoid the complete destruction and disappearance of architectural objects, officials involved in the preservation of cultural heritage, sometimes have to compromise with investors. For example, during the reconstruction of the House for the Elderly and Disabled in Frankfurt am Main, the developer was obliged to preserve the color of the plaster, the wooden window frames, the facade elements, the arches, the stained-glass windows, the mosaics, the elements of the painting. In exchange for this, he was allowed to attach the balconies to the inside and to modernize the engineering systems. Reconstruction of the building was lasting for three years and cost 22 million euros. The apartments were put on the market at a very high price for Germany - 4.6 thousand euro / sq. m, but the building quickly paid off due to quick and high-quality work and competent coordination with the security committees.



Figure 3. The House for the Elderly and Disabled (1780) after the restoration in Frankfurt am Main.

In Italy, the reconstruction business is particularly complicated. First of all, because of the strict security legislation. An investor can not hire an arbitrary contractor in Italy - only one of the special companies recommended by the municipality. The most costly and laborious reconstruction is in Venice. Its cost is about 4-8 thousand euros per square, and materials for construction work have to be transported by boat at strictly defined hours, while the payback is very small. The state can participate in the financing of restoration works, but the share of its participation can not exceed half of the works' value. However, the state can assume all the burden of costs if the facility is completely owned by the state and is under its protection. There is a series of restrictions prohibiting the modification of buildings at the discretion. For example, it is forbidden to increase the volume of buildings by more than 20%, make, expand windows, build balconies and terraces. Also, the house should be in harmony with the surrounding landscape. In Russia in recent years, one of the major reconstructions of the monument of architecture and culture is the reconstruction of the Bolshoi Theater in Moscow.



Figure 4. The Bolshoi Theater (1856), Moscow

By the time the reconstruction began, the deterioration of the building was from 50 to 70 percent, according to various estimates. Various variants of its restoration have been offered: from major overhaul to complete reconstruction of the existing building. As a result, a project was selected to carry out the restoration of the spectator part of the theater and to reconstruct part of the stage with a deepening of the underground space. To provide theater with new premises was one of the important tasks. It was successfully solved by creating an underground space. But the reconstruction lasted from 2007 to 2011, and there were more than one scandals about unreasonable spending.

To solve a problem in cooperation with investors in the conditions of insufficient budget financing, there are two approaches. The first is to transfer the monuments to private ownership on preferential terms, this is actively practiced in Europe. In St. Petersburg a privilege will be imposed on the organizations' property tax for investors who have invested more than 500 million rubles in the restoration of historic buildings.

Another way is to transfer the objects in long-term lease on preferential terms of rent with encumbrance in the form of carrying out all necessary work. And only after fulfilling the obligations of encumbrance, the object becomes property.

For Russian cities with a rich historical architectural heritage, for example, St. Petersburg, Moscow and others, the issues of the efficiency of works on restoration and reconstruction have become topical. This can be traced in the example of the Bolshoi Theater in Moscow, BDT in St. Petersburg, the reconstruction of which was conducted with a violation of the timing and exceeding the estimate.

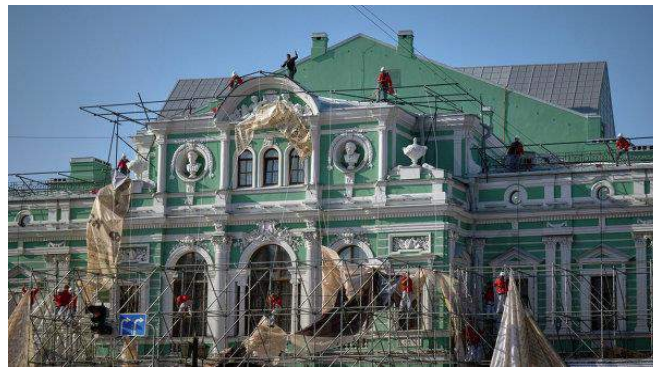


Figure 5. The Big Drama Theater named after Georgy Tovstonogov (BDT) (1919), St. Petersburg

3. Reconstruction and restoration activities for historical buildings in Saint-Petersburg

Reconstruction and restoration activities for historical buildings are executed in accordance with the existing standards for conservation of historical and cultural monuments. Constraints for any changes in certain building exteriors are stated in the Law of Saint-Petersburg «On the boundaries of protection areas of objects of cultural heritage and on the conditions of using the land in the above boundaries and on the introduction of changes into the law of Saint-Petersburg “On the master plan of Saint-Petersburg and on the boundaries of the protection areas of cultural heritage in the region of Saint-Petersburg». [16-21]

Protection area is the area to be protected with particular regulations developed to constraint city-planning and economic activities. These measures are taken to secure actual preservation of cultural and historical heritage.

The majority of the buildings in the historical center of Saint-Petersburg are considered to be historical and cultural monuments under protection. City protection authorities are mainly focused on the ensembles in the historical center and cultural suburbs of Saint-Petersburg enlisted into the UNESCO World Heritage Center. The most significant assets of value in the cultural and historical context, their object-based content and regimes for use are determined. Stiff constraints for 1186 Innovative Technologies in Development of Construction Industry reconstruction of the valuable objects in the cultural and historical context (buildings, front facades, squares) have

been imposed within these areas. The rest part of combined areas is subject to differential constraint regimes allowing construction and more radical reconstruction without changing structure layouts (traffic networks, residential blocks layouts), basic environmental features, and certain cultural heritage-listed objects. In the majority of cases it is allowed to cover secluded courtyards; change the heights of certain courtyard blocks (not higher than a front block located in front of the object under reconstruction); change architectural solution of the walls facing the courtyards in accordance with the statement decision of the cultural and historical heritage-enlisted objects protection authorities. It is not allowed to change architectural solution in the front facades, engineering and technical equipment placement in particular [16-21].

The structure of protection areas for cultural heritage of historically developed central districts of Saint- Petersburg is presented in the Figure 6.

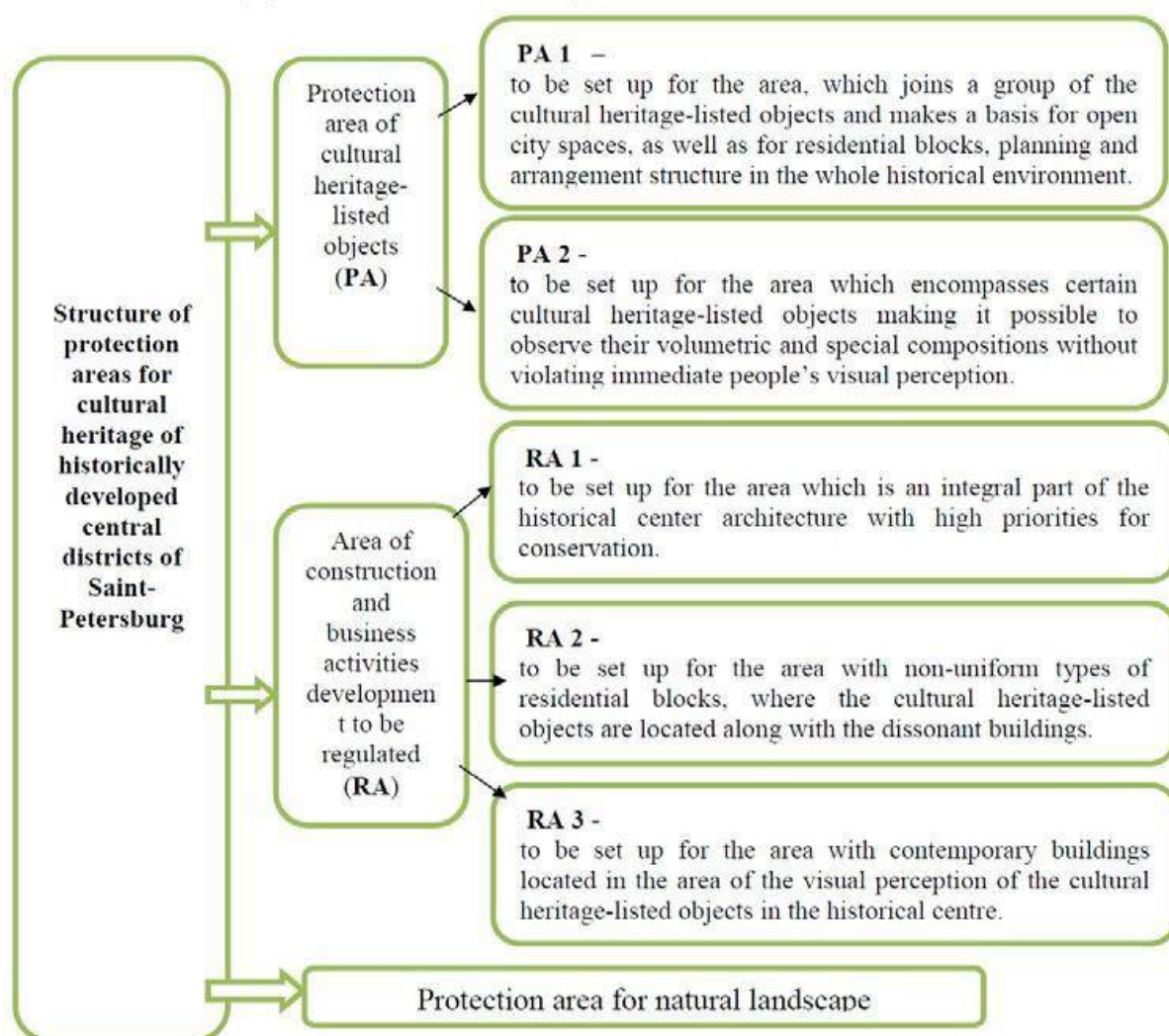


Figure 6. Structure of protection areas for cultural heritage of historically developed central districts of Saint-Petersburg [21].

4. Conclusions

The review showed that there are a number of difficulties that are on the way of restoring the architectural objects of history. A compliance of the restrictions on the part of security committees, a reconciliation of a project and a well-designed budget with the authorities, an attraction of investments

and proper technology of works are the most important issues, the solution of which will affect the success of the restoration work.

References

- [1] Buleev A 2009 Assessment of the competitiveness of innovation-investment projects in the historical and cultural center of the city *Innovacionnaya logistika v ekonomicheskoy deyatelnosti* **1** pp 94-98
- [2] Romanova L S and Litvinova O G 2010 Modern buildings in the historical centers of cities: research, problems, prospects *Vestnik TGASU* **2** pp 65-76
- [3] Martynenko E A, Staritsyna A A and Rybakov V A 2016 *Reconstruction of the Residential District of St. Petersburg Historic Center. Construction of Unique Buildings and Structures* **1(40)** pp 32-42
- [4] Industry Building Code 53-86 «Estimates of physical wear of residential buildings».
- [5] SDOS 04-2009 "A technique of carrying out construction control at construction, reconstruction, capital repairs of capital construction projects".
- [6] Kaklauskas A, Rute J, Zavadskas E, Daniunas A, Pruskus V, Bivainis J, Gudauskas R and Plakys V 2012 Passive House model for quantitative and qualitative analyses and its intelligent system *Energy and Buildings* **50** pp 7-18
- [7] Gaevskaya Z A and Rakova X M 2014 Modern building materials and the concept of "sustainability project" *Advanced Materials Research* **941-944** pp 825-830
- [8] Sternik G M and Sternik M G 2012 *Uniform method of classification civil object on consumer quality (class)* (Moscow)
- [9] Yavein N I 2006 Experience in the reconstruction of historical buildings in the center of St. Petersburg with a change in their functional purpose *Sankt Peterburgskiy gosudarstvennyy akademicheskyy institut zhivopisi, skulptury i arhitektury im. Repina* **1 E 2** pp 33-68
- [10] Romanovich M and Vilinskaya A 2016 Methods of determining the optimal project of reconstruction of the Petrovsky Dock in Kronstadt *MATEC Web of Conferences* **53 C** 01052
- [11] 2013 Sustainable restoration of traditional building systems in the historical centre of Sevilla *Energy and Buildings* (Spain) Volume 62 July pp 648–659
- [12] Marta Hočová, Marek Cangár and Silvia Baďurová 2015 Technological Aspects of Reconstruction of Historical Buildings *Procedia Engineering* **111** pp 302-310
- [13] Milja Penica, Golovina Svetlana and Vera Murgul 2015 Revitalization of Historic Buildings as an Approach to Preserve Cultural and Historical Heritage *Procedia Engineering* **117** pp 883 – 890
- [14] Shishkin V Ya, Pogorelov A Ye and Makeyev V A 2011 *Reconstruction of buildings of historic buildings on the example of an auxiliary building of the Moscow Conservatory (Zhilishchnoye stroitelstvo)* **9** pp 16-23
- [15] Kaganova I O 2014 Reconstruction of residential buildings in cultural and historical centers of the cities: experience and problems *Gumanitarnyye nauchnyye issledovaniya* **12-2(40)** pp103-106
- [16] Murgul V 2016 *MATEC Web of Conferences* **53** 01046 DOI: <https://doi.org/10.1051/mateconf/20165301046>
- [17] Murgul V 2016 *MATEC Web of Conferences* **73** 02001 DOI: <https://doi.org/10.1051/mateconf/20167302001>
- [18] Murgul V 2017 *MATEC Web of Conferences* **106** 06001 DOI: <https://doi.org/10.1051/mateconf/201710606001>
- [19] Murgul V 2017 *MATEC Web of Conferences* **106** 06002 DOI: <https://doi.org/10.1051/mateconf/201710606002>
- [20] Murgul V 2015 Reconstruction of the Courtyard Spaces of the Historical Buildings of Saint-Petersburg with Creation of Atriums *Procedia Engineering* **117** pp 808-818 DOI: <https://doi.org/10.1016/j.proeng.2015.08.145>

- [21] Murgul V and Pukhkal V 2015 Procedia Engineering **117** pp 891-899
DOI: <https://doi.org/10.1016/j.proeng.2015.08.173>
- [22] <http://heritage.unesco.ru> (last accessed 10.04.2017)