



Reconstruction of the Residential District of St. Petersburg Historic Center

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ABSTRACT

Today the way of life and needs of the modern person considerably differ from how it was 200-300 years ago. In this regard, the requirement arises in a reorganization of historical buildings for increase of the accommodation level of them. Besides, the condition of some houses is emergency and accommodation at them becomes even dangerous. As St. Petersburg is the city with record concentration of monuments of architecture, reconstruction of its districts requires special approach. Reconstruction represents a radical reorganization, alteration for the purpose of improvement, a complex of the organizational and technical actions directed on elimination of moral and physical depletion of buildings in general or their separate elements and systems. For the solution of an objective, it is necessary to investigate reconstruction methods, and to define the list of parameters, which are fundamental for reconstruction of the building or district. As object of research two territories were chosen: "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya". The program on the example of the territory "Konyushennaya" and "Severnaya Kolomna - Novaya Hollandiya" will allow fulfilling complex the approach to its realization assuming simultaneous performance action on preservation historical site development, monuments and objects green planting. In addition, this program will allow fulfilling complex the approach to reconstruction, capital repairs of real estate objects, and the adaptation for modern use of cultural heritage objects. Together with it construction and reconstruction engineering infrastructures, construction of production facilities of new walking and tourist routes, decrease loads of road network of historic centre will be developed.

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1. Introduction

Reconstruction and modernization of residential buildings is the important economic task directed on preservation, resetting and transformation of the country housing stock. It allows not only to prolong life cycle, but also it is essential to improve quality of the dwelling, to liquidate municipal settling, to equip houses with the modern engineering equipment, to improve an architectural palette of buildings facades, to solve thereby one of important problems of town planning [2, 3]. The problem of reconstruction of housing stock of the city's historic centres affects two main aspects.

First, it is the cultural and historical importance and value of residential buildings, which form original historical appearance of the city and create unique historical ensembles. Secondly, it is the inhabited environment for permanent residents of the central regions of the city, and for other citizens and tourists. Therefore, it is very important to keep and improve qualities of a residential development of historic centre by means of its reconstruction.

A number of circumstances complicates the problem of reconstruction of St. Petersburg historic centre for housing stock. In the territory of historic centre the commonality of apartments settling is higher, than on average around the city by 2,5 times, volumes of shabby and emergency housing stock are maximum, wear of municipal infrastructure both physical and functional wear of buildings is high (6,5% - a shabby and emergency dwelling, 23% - wear for 30-60%). 4706 apartment houses of historical part of the city need complex repair where lives 339 thousand inhabitants. The housing stock of historic centre makes 22,245 million sq.m. of total area, or 18,7% of the general housing stock of the city, and the territory of historic centre - only about 10% of all territory of the city.

In 1918 there was a cancellation of a private property, and all housing stock passed into municipal property that led to consolidation of apartments and spontaneous re-planning. Communal flats were so formed. During the Siege of Leningrad in the city and its vicinities 3 200 houses were destroyed. As a result of bombardments many buildings of historic centre were partially or completely destroyed. Restoration of the buildings of the city began in post-war years. Restoration of affected houses with preservation of their former shape was fully complete in 1950 [1, 10]. In 1960 was created the first design institute "Lenzhilniiprojekt" which purpose was a development of a technique of reconstruction of buildings of St. Petersburg old residential development and carrying out capital repairs. For this purpose continuous surveying of all buildings of old fund was conducted for a long time. Results of inspection were classified by degree of moral and physical wear.

2. Overview

The problem of effective reproduction of housing stock is one of the most important problems of the city's development during the modern period. Special relevance is gained by questions of recycling of the built-up territories considering an acute shortage in St. Petersburg of free territories, and the decision of the authorities on reduction of volumes of pointed construction. Questions of the housing stock reconstruction developed building became a subject of serious scientific researches [27, 28, 29, 30, 31].

Babenko G.V. considers St. Petersburg and problematic issues of the historic centre role of the cities, their renovation and revival as an example of the accounting of the historic centre features in urban policy and practice [32].

In many scientific works Korshunova E.M. considers this subject. She developed classifications of housing stock and residential districts of the city historic centre for reconstruction on classification signs [33]. Korshunova and Panibratov made the assessment of consumer cost of a residential building in historic centre. They offered system of reproduction of housing stock based on residential districts reconstruction [34].

3. Description of the research

There are two main methods of carrying out reconstruction: complex (group) and consecutive reconstruction. Complex reconstruction is the reconstruction of town-planning objects, which is carried out at a time (streets, residential districts, groups of residential districts). The main reception of a group method of reconstruction of an old housing estate is its decompaction generally by means of demolition of domestic structures. The Lenzhilniiprojekt design institute was the first in Russia who began development of projects of a group method of reconstruction. The district limited to Sadovaya St., Lermontovsky Ave., Fontanka River Emb. and Makarenko Lane [13] can be an example of a group method of reconstruction of the whole district.

The integrated approach to the solution of problems of reconstruction demanded development of the general concept which includes town-planning, architectural and constructive decisions, social and economic, ecological and organizational and technological aspects. Town-planning problems of a housing reconstruction estate provide increase of its profitability by expansion in density of building, creation of conditions comfortable accommodation

and improvement of architectural and composite decisions. Increase of commercial cost of the earth in the central parts of the cities results in need of consolidation of building by increase in number of storeys of the reconstructed buildings. Reconstruction of a housing estate shouldn't be followed by deterioration of a microclimate, comfort and conditions of the population accommodation. Carrying out a complex of reconstructive works has to be based on individual approach to each of objects, providing thus preservation of the principles of a community of architectural forms, characteristic for the particularizing area and improvement of forms and the image of buildings.

The accounting of communications of the reconstructed district or residential district with the adjacent parts of the city having a traditional historical link is necessary at building reconstruction design. Thus, methods of strengthening of architectural and composite unity of the reconstructed and adjacent town-planning formation of earlier construction have to be used. All-town-planning conditions, technical infrastructure, environmental protection and improvement of territories and transportation terms should be allocated from town-planning problems of reconstruction.

Single reconstruction is a carrying out selective actions for one or several elements of the developed area. As showed experiment of last years by the most logical and economically the first method is favorable. A large number of communal flats, unsatisfactory sanitary conditions, moral and physical wear of buildings, recession of possible investment of new construction are the reasons for which carry out reconstruction.

The integrated approach is put at the principle of a choice of reconstruction methods, reflecting town-planning, architectural and planning, social and ecological requirements. At the same time, each reconstructed object demands individual decisions first of all connected with its technical condition. Level of constraint of the construction area has considerable impact on a choice of a reconstruction method of buildings. It defines possibilities of the organization and the production technology of works with application of means of mechanization, progressive technologies and construction materials.

A number of events can be held for resettlement of communal flats. First, resettlement to the apartments located in districts of the city, remote from the downtown, construction of additional floors (taking into account admissible height), the device of penthouses [18]. Light steel thin-walled structures are one of reconstruction options of buildings and constructions, including in historic centre of the city. Light steel thin-walled structures – one of the most widespread ways of an addition of penthouses [19, 20]. A number of publications with the given calculations, such as [21], [23-25], is devoted to techniques, theoretical bases and features of calculation of Light steel thin-walled structures. All this has to be carried out taking into account architectural compliance with surrounding architectural monotony.

The main objective, which rises before designers by drawing up the project of object reconstruction, is an improvement of consumer qualities. It includes ensuring safety of fixed assets of the non-productive sphere, prevention of a premature exit of buildings from operation and their demolition and extension of term of its service, a reorganization for the purpose of a partial or radical change of functions, increase of operational reliability and comfort, decrease in energy consumption. Decrease in energy consumption is considered as warming of walls and overlappings, replacement of windows with wooden frames on double-glazed windows, the updating of the equipment providing a central heating. About 18% of heat can leave through a bad roof, about 40% - through walls and 10% - through the cellar. Thermal insulation of the listed designs will help to avoid such losses. One of the most widespread ways of essential decrease in energy consumption (according to the experts to 40%) - warming of facades of the building. Three types of an arrangement of a thermal insulation of the building are applied in new construction: internal, directly in a bearing wall, external. At reconstruction of old buildings the most simply realized and effective - system of external thermal insulation, which is also successfully applied and at the new construction.

Today heat-insulating materials are presented rather widely in the Russian market of building materials. Similar thermal insulations can be divided according to its structure on glass-wool, mineral wool, polyfoams, thermal insulation from natural materials and products of their processing (a stopper, peat blocks, paper, etc.), light cellular concrete, heat insulation based on synthetic rubber and other types. Besides, to destination the materials preserving heat can be divided on socle, front and roofing. Consumer qualities of housing are meant as the level of solidity and improvement of housing stock. Two signs can classify domestic premises: mass housing and housing with the increased comfort level. In turn, the first divide on the house-keeper - and comfort class, and the second – into a business class and an elite class. The architecture, type of the bearing and enclosure structures, glazing, space-planning decisions, total area of apartments, the kitchen square, engineering support, parameters of a parking and some other [9] are the main characteristics which participate in distribution of premises to classes.

The bearing structures, overlappings and the foundation are partially or completely replaced for prevention of a premature exit of buildings from operation and their demolition and, as a result, extension of term of operation. One of difficulties when carrying out similar works – a close arrangement of buildings. Thus, it is necessary to predict influence of the changes made to one of buildings on the next.

Now various organizations occupy the first floors. Often whole buildings are exposed to re-equipment under offices. All this demands special approach as initially the majority of buildings were built as mansions, palaces, profitable houses. Another problem of modern historic centre of St. Petersburg is certain difficulties of snow retention of roofs. The device of the detaining parapets, external heating of a roof and other methods can serve as the solution of current situation in this sphere. Work [22] is devoted to systems of snow retention as integral element of capital repairs of cattle roofs with a bias from 18 to 27 degrees. The majority of buildings of historic centre of our city have such roofs.

"The target program of St. Petersburg "Preservation and development territories of "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya ", being in historic centre of St. Petersburg, for 2013-2018"

The most actual example of an integrated approach at the moment can be considered reconstruction of the territory "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya", which are in the Central and Admiralty areas respectively.



Figure 1. The borders of the territory of St. Petersburg historic centre used for the Program.

High degree of wear the building, existence of communal flats in apartment houses, the expiration of standard terms of capital repairs the building, absence in apartment houses of hot water supply and bathrooms were considered at allocation of the territory by "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya", and also existence of objects of cultural heritage on them. The program on the example of the territory "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya" will allow to fulfill complex approach to its realization. The integrated approach assumes simultaneous performance action on preservation historical territory site development, monuments and objects green planting; to reconstruction, capital repairs of real estate objects, and also the adaptation for modern use of cultural heritage objects; to construction and reconstruction engineering infrastructures; to an arrangement of new walking and tourist routes; to decrease in load road system of historic centre.

The integrated approach will allow to optimize the following parameters:

1. Indicators action on design, capital repairs, reconstruction of real estate objects and the adaptation for modern use of objects
 - resettlement of 570 communal flats
 - to improve the living conditions for 2398 people
 - to provide with territories of green plantings the population which lives in borders of historic centre
 - the area of pedestrian zones in the territory of historic centre makes 88,37 thousand sq.m
 - extent of the comfortable movement territory of pedestrians in the territory of historic centre makes 50km
2. Indicators action on design, capital repairs and reconstruction of objects transport infrastructures in historic centre

- the share of the bridges located in historic centre and conforming to standard requirements will increase with 47 to 65%
 - the share of the embankments located in historic centre and conforming to standard requirements will increase with 91 to 93%
 - average time passenger communications on public transport in St. Petersburg will decrease from 72,7 to 71,6 minutes
 - the quantity of system jams in St. Petersburg will decrease with 280 to 275 pieces
3. Indicators action on design, reconstruction and construction of engineering facilities and power providing
- specific density of water tests which selection is made from water-supply system and which don't correspond to hygienic standards of quality of water - 2,7-0,1%
 - the volume of the sewage passed through treatment facilities in a total amount of sewage in St. Petersburg - 93-98%
 - specific density of thermal energy losses in heat supply network in St. Petersburg - 7,69-8,25%
 - gain of productivity specified intake heading of water supply system in St. Petersburg - 422 in 2013 and 772 in 2018
 - increase electric capacities of the power generation facilities used for providing services on power supply of consumers, which are in the territory of historic centre 126 Mega Watts
4. Indicators action on increase of St. Petersburg appeal to tourists
- number of the Russian tourists in St. Petersburg - 2,9-5,5 million people
 - number of foreign tourists in St. Petersburg - 2,6-4,0 million people

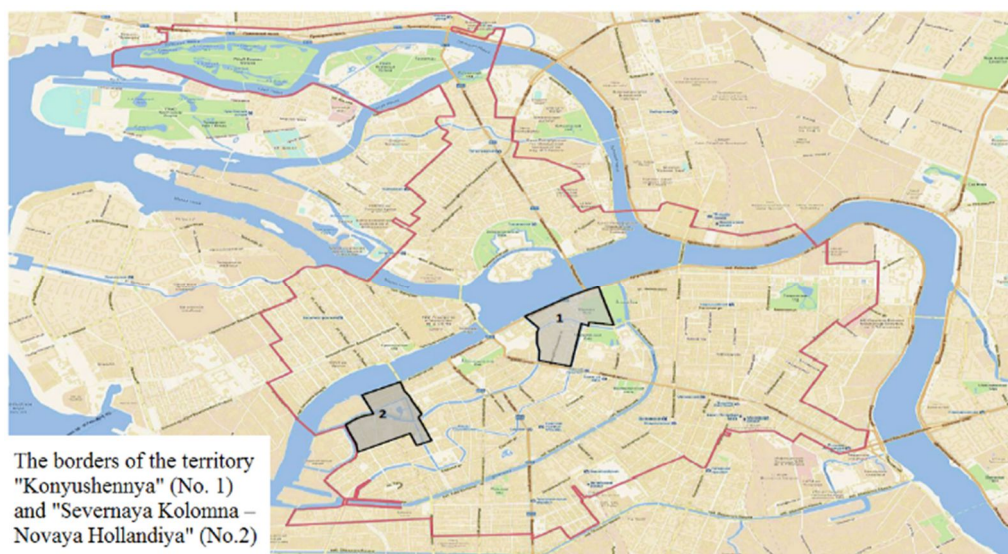


Figure 2. The borders of the territory of St. Petersburg historic centre used for the Program.

Preliminary (visual) survey of the real estate objects located in territories of "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya", and also apartment houses are carried out within implementation of the program. Preliminary (visual) survey represents itself continuous visual inspection of the building construction both detection of defects and damage on external signs with necessary measurements and their fixing. Preliminary survey allows to estimate the technical condition construction designs and the engineering equipment on external signs, and determination of need for carrying out detailed (tool) inspection. The list of the real estate objects located in territories of "Konyushennaya" and "Northern Kolomna – New Holland" is approved based on preliminary survey for which carrying out detailed (tool) inspection is necessary. Detailed inspection is necessary for determination of exact geometrical parameters of the building, elements and knots of a construction, including use of geodetic devices. In addition, parameters of defects and damage, the actual characteristics of materials of the main bearing construction and their elements, real operational loadings and actions, settlement effort in the bearing construction perceiving operational loadings are defined. Results preliminary (visual) and detailed (tool) inspection are basic data for realization of preparation of the territory site plannings. The state historical and

cultural examination will be carried out prior to development design documentation on objects of cultural heritage for definition of possibility of the adaptation for modern use of cultural heritage objects.

4. Concluding Remarks

After detailed studying of reconstruction methods of the residential district of St. Petersburg historic centre complex reconstruction can be considered as the most rational way of carrying out reconstruction. On the example of reconstruction of territories of "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya" it is shown that this method allows to resolve not only the issues connected with a certain building but also to solve the problems connected with objects of transport, engineering and power infrastructures and to increase appeal of the city to tourists.

The following tasks were solved:

- various methods of reconstruction were investigated, the main of them are methods of single and complex reconstruction
 - the list of parameters on the basis of which reconstruction of the building or district is carried out is defined
In the course of the analysis of the obtained data is defined:
 - necessity of carrying out reconstruction becomes clear after carrying out external (visual) and internal (technical) inspection
 - the condition of the bearing and enclosure structures, roofs, ladders, windows
 - the condition of systems of a central heating, hot and cold water supply, the sewerage and drains, electric equipment of buildings and degree of urgency of their replacement
 - necessity of construction of elevators and refuse chutes
- Detailed criteria of an assessment of physical wear of buildings are given in Industry Building Code 53-86 [5]

References

- [1]. Murgul V. Solar Energy systems in the reconstruction of heritage historical buildings of the northern towns (for example Saint-Petersburg), *Journal of Applied Engineering Science*, 2014, 12 (2), pp. 121-128.
- [2]. Pukhkal V.A., Murgul V., Vatin N.I., Central ventilation system with heat recovery as one of the measures to upgrade energy efficiency of historic buildings, *Applied Mechanics and Materials*, 2014, 633-634, pp. 1077-1081.
- [3]. Vatin N.I., Nemova D.V., Kazimirova A.S., Gureev K.N., The Increase of the Thermal Shielding Level for a Residence Building of 1-528 KP Series, *Applied Mechanics and Materials*, 2015, 725-726, pp. 1402-1407.
- [4]. Industry Building Code 2-89 «Reconstruction and building of historically developed districts of St. Petersburg».
- [5]. Industry Building Code 53-86 «Estimates of physical wear of residential buildings».
- [6]. SDOS 04-2009 "A technique of carrying out construction control at construction, reconstruction, capital repairs of capital construction projects".
- [7]. Kaklauskas A., Rute J., Zavadskas E., Daniunas A., Pruskus V., J. Bivainis, R. Gudauskas, V. Plakys, Passive House model for quantitative and qualitative analyses and its intelligent system, *Energy and Buildings*, 2012, 50, pp. 7-18.
- [8]. Gaevskaya Z.A., Rakova X.M., Modern building materials and the concept of "sustainability project", *Advanced Materials Research*, 2014, 941-944, pp. 825-830.
- [9]. Sternik G.M., Sternik M.G., Uniform method of classification civil object on consumer quality (class), Moscow, 2012.
- [10]. Bunin A.V., History of town-planning art, Stroyizdat, Moscow, 1979.
- [11]. Industry Building Code 2-89 «Reconstruction and building of historically developed districts of St. Petersburg».
- [12]. Rybakov V.A., Panteleev A., Sharbabchev G., Epshtein E., Snow-retaining system as a temporary decision for providing of the suitable temperature and humidity level of pitched roofs, 2014, *Applied Mechanics And Materials*, pp. 584-586.
- [13]. Gorshkov A.S., The energy efficiency in the field of construction: questions of norms and standards and solutions for the reduction of energy consumption at buildings, *Magazine of Civil Engineering, Russia*, 2010.
- [14]. Nemova D.V., The analysis of expediency of increase in the thickness of the Insulant in systems of rear ventilated facades with a view of Power efficiency increase, *Vestnik Moskovskogo gosudarstvennogo stroitel'nogo universiteta, Russia*, 2011.
- [15]. Catalin Popa, Dan Ospira, Stéphane Fohanno, Cristian Chereches, Numerical simulation of dynamical aspects of natural convection flow in a double-skin façade, *Energy and Buildings*, 2012, 50, pp. 229–233.
- [16]. Nemova D.V., Murgul V., Pukhkal V., Vatin N.I., Reconstruction of administrative buildings of the 70's: The possibility of energy modernization, *Journal of applied engineering science, Montenegro*, 2014.
- [17]. About Rules of land use and building: The law of St. Petersburg of February 04, No. 29-10. Legislative assembly of St. Petersburg, 2009.
- [18]. About the target program of St. Petersburg "Moving of communal flats in St. Petersburg": The law of St. Petersburg from 17.10.2007. No. 513-101, Legislative assembly of St. Petersburg, 2007.
- [19]. Rybakov V.A., Application of the semi-shift theory of v. I. Slivker for the analysis of the intense deformed condition of systems of thin-walled cores, *Manual for students of higher educational institutions, Ministry of Education and Science of the Russian Federation St. Petersburg*, 2011.
- [20]. Vatin N.I., Rybakov V.A., Alhimenko A.I., Technology of the easy steel thin-walled structures (ESTWS), St. Petersburg, 2008.
- [21]. Bukhartsev V.N., Petrichenko M.R., Condition of mechanical-energy balance of an integral flow with a variable rate, *Power Technology and Engineering, United States*, 2001.
- [22]. Wilmer Pasut, Michele De Carli, Evaluation of various CFD modelling strategies in predicting airflow and temperature in a naturally ventilated double skin façade. *Applied Thermal Engineering*, 2012, 37, pp. 267-274.
- [23]. Vatin N.I., Nemova D.V., Increase of power efficiency of buildings of kindergartens, *Construction of Unique Buildings and Structures, Russia* 2012.

- [24].Lalin V.V., Rybakov V.A., Sergey A., The Finite Elements For Design Of Frame Of Thin-Walled Beams, Applied Mechanics and Materials, 2014, pp. 858-863.
- [25].Trubina D.A., Abdulaev D.A., Pichugin E.D., Rybokov V.A., Geometric Nonlinearity Of The Thin-Walled Profile Under Transverse Bending, Applied Mechanics and Materials, 2014, pp. 1133-1139.
- [26].Supplement to the resolution of a government of St. Petersburg "Target program of St. Petersburg "Preservation and development of the territory~ "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya", being in historic centre of St. Petersburg, for 2013-2018".
- [27].Asaul A.N., Problems Of An Economic Assessment Of Reconstruction Of Objects Of Historic Centre Of St. Petersburg, Saint Petersburg State University of Architecture and Civil Engineering, 2003, pp. 118.
- [28].Drozdova I.V., Efficiency Of Options Of Reconstruction Of The City Inhabited Environment, Economic Revival of Russia, 2008, 3(17), pp. 63-67.
- [29].Malinina K.V., Methodical Approach To An Assessment And Preservation Of A Historical Urban Environment, Economic Revival of Russia, 2005, 3(5), pp. 64-66.
- [30].Rybakov F.F., The prospects of socio-economic development of St. Petersburg, Economic Revival of Russia, 2008, 1(15), pp. 56-61.
- [31].Sitdikov S.A., Management overhaul of the housing stock of the city, 2008, SPb: Layla, pp. 232.
- [32].Babenko G.V., PROBLEMS Renovation And Revitalization Of Historic City Center RUSSIA, Vestnik Rossiyskoy akademii estestvennyih nauk (Sankt-Peterburg), 2013, 2, pp. 66-67.
- [33].Korshunova E.M., Classification of the housing stock of Saint-Petersburg historic centre, Vestnik grazhdanskih inzhenerov, 2014, 3(44), pp. 195-199.
- [34].Korshunova E.M., Panibratov Yu.P., Features of reproducing the housing fund of historic cities centres, Vestnik grazhdanskih inzhenerov, 2011, 3, pp. 106-110.

Реконструкция жилого квартала исторического центра Санкт-Петербурга

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АННОТАЦИЯ

В настоящее время образ жизни и потребности современного человека радикально отличаются от того, как это было 200-300 лет назад. В связи с этим возникает необходимость в переустройстве исторических зданий для повышения комфорта проживания, ведь в них часто даже отсутствует горячее водоснабжение. Кроме того, состояние некоторых домов является аварийным и проживание в них становится не просто не комфортным, а даже опасным. Так как Санкт-Петербург является городом с рекордной концентрацией памятников архитектуры, требуется особый подход в реконструкции его кварталов. Реконструкция представляет собой радикальную перестройку, изменение с целью улучшения, комплекс организационных и технических мероприятий, направленных на устранение морального и физического износа зданий в целом или их отдельных элементов и систем. Для решения задачи, необходимо исследовать методы реконструкции, и определить перечень параметров, дающих основание для реконструкции здания или квартала. В качестве объекта исследования были выбраны две территории: "Конюшенная" и "Северная Коломна - Новая Голландия". Программа реконструкции на примере данных территорий позволит нам рассмотреть комплексный подход, предполагающий одновременное воздействие на сохранение исторических памятников, объектов зеленых насаждений; реконструкцию, капитальный ремонт объектов недвижимости, а также приспособление для современного использования объектов культурного наследия; строительство и реконструкцию инженерной инфраструктуры, строительство новых пешеходных и туристических маршрутов; уменьшение нагрузки на улично-дорожную сеть в историческом центре города.

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Литература

- [1]. Murgul V. Solar Energy systems in the reconstruction of heritage historical buildings of the northern towns (for example Saint-Petersburg), *Journal of Applied Engineering Science*, 2014, 12 (2), pp. 121-128.
- [2]. Pukhkal V.A., Murgul V., Vatin N.I., Central ventilation system with heat recovery as one of the measures to upgrade energy efficiency of historic buildings, *Applied Mechanics and Materials*, 2014, 633-634, pp. 1077-1081.
- [3]. Vatin N.I., Nemova D.V., Kazimirova A.S., Gureev K.N., The Increase of the Thermal Shielding Level for a Residence Building of 1-528 KP Series, *Applied Mechanics and Materials*, 2015, 725-726, pp. 1402-1407.
- [4]. Industry Building Code 2-89 «Reconstruction and building of historically developed districts of St. Petersburg».
- [5]. Industry Building Code 53-86 «Estimates of physical wear of residential buildings».
- [6]. SDOS 04-2009 "A technique of carrying out construction control at construction, reconstruction, capital repairs of capital construction projects".
- [7]. Kaklauskas A., Rute J., Zavadskas E., Daniunas A., Pruskus V., J. Bivainis, R. Gudauskas, V. Plakys, Passive House model for quantitative and qualitative analyses and its intelligent system, *Energy and Buildings*, 2012, 50, pp. 7-18.
- [8]. Gaevskaya Z.A., Rakova X.M., Modern building materials and the concept of "sustainability project", *Advanced Materials Research*, 2014, 941-944, pp. 825-830.
- [9]. Sternik G.M., Sternik M.G., Uniform method of classification civil object on consumer quality (class), Moscow, 2012.
- [10]. Bunin A.V., History of town-planning art, Stroyizdat, Moscow, 1979.
- [11]. Industry Building Code 2-89 «Reconstruction and building of historically developed districts of St. Petersburg».
- [12]. Rybakov V.A., Panteleev A., Sharbabchev G., Epshtein E., Snow-retaining system as a temporary decision for providing of the suitable temperature and humidity level of pitched roofs, 2014, *Applied Mechanics And Materials*, pp. 584-586.
- [13]. Gorshkov A.S., The energy efficiency in the field of construction: questions of norms and standards and solutions for the reduction of energy consumption at buildings, *Magazine of Civil Engineering, Russia*, 2010.
- [14]. Nemova D.V., The analysis of expediency of increase in the thickness of the Insulant in systems of rear ventilated facades with a view of Power efficiency increase, *Vestnik Moskovskogo gosudarstvennogo stroitel'nogo universiteta, Russia*, 2011.
- [15]. Catalin Popa, Dan Ospira, Stéphane Fohanno, Cristian Chereches, Numerical simulation of dynamical aspects of natural convection flow in a double-skin façade, *Energy and Buildings*, 2012, 50, pp. 229–233.
- [16]. Nemova D.V., Murgul V., Pukhkal V., Vatin N.I., Reconstruction of administrative buildings of the 70's: The possibility of energy modernization, *Journal of applied engineering science, Montenegro*, 2014.
- [17]. About Rules of land use and building: The law of St. Petersburg of February 04, No. 29-10. Legislative assembly of St. Petersburg, 2009.
- [18]. About the target program of St. Petersburg "Moving of communal flats in St. Petersburg": The law of St. Petersburg from 17.10.2007. No. 513-101, Legislative assembly of St. Petersburg, 2007.
- [19]. Rybakov V.A., Application of the semi-shift theory of v. I. Slivker for the analysis of the intense deformed condition of systems of thin-walled cores, *Manual for students of higher educational institutions, Ministry of Education and Science of the Russian Federation St. Petersburg*, 2011.
- [20]. Vatin N.I., Rybakov V.A., Alhimenko A.I., Technology of the easy steel thin-walled structures (ESTWS), St. Petersburg, 2008.
- [21]. Bukhartsev V.N., Petrichenko M.R., Condition of mechanical-energy balance of an integral flow with a variable rate, *Power Technology and Engineering, United States*, 2001.
- [22]. Wilmer Pasut, Michele De Carli, Evaluation of various CFD modelling strategies in predicting airflow and temperature in a naturally ventilated double skin façade. *Applied Thermal Engineering*, 2012, 37, pp. 267-274.
- [23]. Vatin N.I., Nemova D.V., Increase of power efficiency of buildings of kindergartens, *Construction of Unique Buildings and Structures, Russia* 2012.

- [24].Lalin V.V., Rybakov V.A., Sergey A., The Finite Elements For Design Of Frame Of Thin-Walled Beams, Applied Mechanics and Materials, 2014, pp. 858-863.
- [25].Trubina D.A., Abdulaev D.A., Pichugin E.D., Rybokov V.A., Geometric Nonlinearity Of The Thin-Walled Profile Under Transverse Bending, Applied Mechanics and Materials, 2014, pp. 1133-1139.
- [26].Supplement to the resolution of a government of St. Petersburg "Target program of St. Petersburg "Preservation and development of the territory" "Konyushennaya" and "Severnaya Kolomna – Novaya Hollandiya", being in historic centre of St. Petersburg, for 2013-2018".
- [27].Asaul A.N., Problems Of An Economic Assessment Of Reconstruction Of Objects Of Historic Centre Of St. Petersburg, Saint Petersburg State University of Architecture and Civil Engineering, 2003, pp. 118.
- [28].Drozdova I.V., Efficiency Of Options Of Reconstruction Of The City Inhabited Environment, Economic Revival of Russia, 2008, 3(17), pp. 63-67.
- [29].Malinina K.V., Methodical Approach To An Assessment And Preservation Of A Historical Urban Environment, Economic Revival of Russia, 2005, 3(5), pp. 64-66.
- [30].Rybakov F.F., The prospects of socio-economic development of St. Petersburg, Economic Revival of Russia, 2008, 1(15), pp. 56-61.
- [31].Sitdikov S.A., Management overhaul of the housing stock of the city, 2008, SPb: Layla, pp. 232.
- [32].Babenko G.V., Problems Renovation And Revitalization Of Historic City Center RUSSIA, Vestnik Rossiyskoy akademii estestvennyih nauk (Sankt-Peterburg), 2013, 2, pp. 66-67.
- [33].Korshunova E.M., Classification of the housing stock of Saint-Petersburg historic centre, Vestnik grazhdanskih inzhenerov, 2014, 3(44), pp. 195-199.
- [34].Korshunova E.M., Panibratov Yu.P., Features of reproducing the housing fund of historic cities centres, Vestnik grazhdanskih inzhenerov, 2011, 3, pp. 106-110.

Мартыненко Е.А., Старицына А.А., Рыбаков В.А. Реконструкция жилого квартала исторического центра Санкт-Петербурга //Строительство уникальных зданий и сооружений. 2016. №1(40). С. 32-42.

Martynenko E.A., Staritsyna A.A., Rybakov V.A. Reconstruction of the Residential District of St. Petersburg Historic Center. Construction of Unique Buildings and Structures, 2016, 1 (40), Pp. 32-42.