JUNIORSTAV 2020

22. ODBORNÁ KONFERENCE DOKTORSKÉHO STUDIA

22ND INTERNATIONAL CONFERENCE OF DOCTORAL STUDENTS

SBORNÍK PŘÍSPĚVKŮ
PROCEEDINGS






VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ
FAKULTA STAVEBNÍ

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF CIVIL ENGINEERING

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Brno University of Technology, Faculty of Civil Engineering

Vysoké učení technické v Brně, Fakulta stavební

23. 1. 2020

ISBN of Proceedings: 978-80-86433-73-8
ISBN sborníku příspěvků: 978-80-86433-73-8

8. GEODÉZIE, KARTOGTRAFIE A GEOINFORMATIKA

GEODESY, CARTOGRAPHY AND GEOGRAPHIC INFORMATION SCIENCE

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BUILDING PHYSICS AND BUILDING SERVICES

TECHNICKÁ ZAŘÍZENÍ A ENERGIE BUDOV/ BUILDING SERVICES AND ENERGY

IMPACT OF BUMPER ZONES (WINTER GARDENS) ON THE PROJECT ASSESSMENT OF THE ZTB-13B RESIDENTIAL PANEL HOUSE

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Abstract

The dissertation, the part of which is the article dealed with the possibilities of integration of interspaces into the existing building structure in the form of conservatories or greenhouses. The aim of the research was regulate glazed loggias, balconies, which the owners of housing units arbitrarily, unregulatedly adjust, resulting in an ambiguous manuscript on the facades of apartment buildings. The research was the basis for the possibility of regulation of interspaces and facades from both energy and architectural aspects. At the same time, the article dealed with the optimization of the integration of the space into the existing heated volume and without it, where there was possibility of bumper space. The present case study focused on free standing panel apartment building built in 1976 in the construction system ZTB-13B situated in the city district of Petržalka in Bratislava.

Key words

Panel construction, apartment building, interspace, energy performance of buildings, buffer zone, facade regulation

1 INTRODUCTION

At present, measures in the territory of the European Union, including Slovakia, are being introduced, which should ultimately be environmentally friendly, reduce air emissions and thus reduce the ecological footprint of our planet. Given that 40 % of the world's energy consumption accounts for buildings, it is essential that energy consumption in buildings is minimized [1]. The European Directive 2010/31 / EU responds to the problem of energy consumption in buildings and therefore, from 1 January 2021, all new buildings in the EU territory will have to be built with almost zero energy consumption. This is one of the reasons why technical standards have been tightened, which deal mainly with thermal protection of buildings and their energy intensity. Currently, it is sufficient to meet the recommended values for new buildings and renovated buildings [2]. Since 2021, we will move to the standard and will need to meet the target benchmarks that apply to building structures (non-transparent fragments, external openings), specific heat demand for heating, hot water, air conditioning, lighting, total energy consumption and total primary energy consumption. The block construction of apartment buildings built after 1947 is no exception, which will have to meet all these criteria during the renovation. Currently, there are still non-renewed prefabricated apartment blocks built between the 1950s and 1990s in Slovakia, or are being renewed, but do not meet the latest energy criteria after 2021. Even some apartment buildings will need further modernization sooner or later. For this reason, too, the work focused on regulation for the renewal of prefabricated housing construction (Fig. 1) with a focus on interspaces as one of the mechanisms for improving the energy performance of buildings.

Fig. 1 Existing status of apartment building. The red space indicates the space which is the subject of alternative positions to the heated volume. The staircase buffer area is indicated in yellow.

2 LITERARY OVERVIEW/DESCRIPTION OF THE CURRENT STATUS

Interspace was also perceived in the past as an optical connection between interior and exterior with the possibility of social interaction of an individual built in this space with the immediate surroundings. The social aspects were important design parameters. Architecture has lost the meaning of its social ambitions and is more interested in decor than a wardrobe, a marketing product designed with clearly defined business goals [3]. Thinking about the facade should be part of thinking about the apartment. Precisely because facades have become so complicated and costly, new housing concepts that include and integrate the facade should be considered. If time is likely to change, the facades must be able to react. The main research questions are as follows: Is there any relation between apartments and facade as a layer between interior and exterior? How can facades facilitate the transition between interior and exterior? Are lifestyle changes making new demands [4]? Based on Jürgenhake's research questions, the topic of the dissertation thesis was also proposed, part of which was dealt with in this article. On the other hand, an appropriately selected energy-efficient interspace can improve the project assessment of the building, as Omidian's research has shown. Obviously, double facades offer a better view of the exterior and reduce heat loss and external noise while taking into account the additional layer of glazing compared to a traditional single-layer transparent construction. The double-facade contains the necessary elements of energy-responsible building design, which are believed to be essential for the further development of sustainable buildings. The double glazing system is more cost-effective in the long run [5]. No research has yet been found to investigate the impact of smaller interspaces on the energy efficiency of panel construction in Slovakia. Against this background, the research presented began to address issues in this respect as well. The first adept of the research is an apartment house built in 1976 in the construction system ZTB-13B.

3 METHODOLOGY

The article mainly focused on the energy aspects of the case study. The chosen methodology in this work dealt with the comparison and optimization of interspaces on the facade of the building, which became the basis for the architectural design. First, the energy efficiency of the existing state of the building was assessed and subsequently the energy efficiency of the existing state was assessed with the addition of glazing on loggia in two variants - the principle of the first solution lies in the glazing that created the buffer zone, but the space of the loggia was not counted in the heated volume, in the second solution, the glazed loggia space was integrated into the heated volume. The existing state and the two solutions of glazed loggia integration in the existing state were compared. This procedure was also repeated after thermal insulation and replacement of windows and doors, where it was necessary to choose technical solutions of fragments and constructions that met the target recommended values according to the standard STN 73 0540-2/Z1[6]. Energy efficiency also depended on the orientation of the building on the plot. For this reason, this calculation was also made for other cardinal points and compared in the end. The compared data helped us to choose the ideal solution of the interspace in relation to the heated volume in relation to the orientation. Later, the selection was judged from the architectural and artistic side. The calculations were processed in ISOVER Project Evaluation 1.0 and ISOVER Fragment 5.0.

The boundary conditions were taken from the thermo-technical standard STN 73 0540-3 [7]. The case study was solved in the territory of the city of Bratislava, which is according to the standard located in temperature area 1 with altitude 140 and wind area 2. The external calculation temperature was considered for the city of Bratislava with value -11 ° C (calculation area -10 ° C) The design relative humidity of the indoor air is 83,2 %. The proposed indoor temperature for apartment buildings (living rooms) was 20 ° C with a design indoor humidity of 50 %. For a general comparison of the energy performance of individual solutions, a new fragment composition was designed uniformly. The existing wall structure was considered from a 150 mm thick reinforced concrete panel with a cavity and 260 mm thick ceramic reinforced concrete. The wall insulation was designed from ISOVER CLIMA 034 mineral wool thickness 200 mm. The existing structure of the roof was similar to the thermal insulation made of stone (basalt) wool ISOVER LAM 50, 400 mm thick. On the first floor there was a technical background, a room for bicycles and entrance areas that were not heated. For this reason, the lower surface of the heated volume is the inner ceiling (with heat flow from top to bottom) between the first and second floors. The ceiling was estimated as a reinforced concrete slab 150 mm thick, where the ISOVER Styrodur 2800 C thermal insulation 100 mm thick was designed on the underside. In the variant, where the loggia glazing was considered as a buffer barrier, it was necessary to design a 100 mm thick ISOVER UNI mineral wool thermal insulation on the existing staircase wall.

4 RESULTS

Alternative calculations of the project assessment of the energy performance of a building with different integration of interspace into existing volume

The basic calculation of the energy performance of the building was the existing state, whose orientation was southwest. This calculation declared the energy efficiency of the building without thermal insulation, replacement of openings and without glazing loggia (Fig. 2). In the second calculation, the existing loggies were technically modified to remove the window sill and the entire loggia opening was glazed with double glazing (Fig. 3). In the last - third calculation of the existing condition, the loggie sill was not removed. The space between the loggia and the ceiling was glazed with a thermal insulating triple glazing. In this case, loggia became part of the heated volume (Fig. 4). The only exception was the staircase area, which remained as a buffer zone. In the fourth calculation, we only considered restoring the original cladding, roof and slab between the second and third floors, without using glazing in loggia (Fig. 2). The fifth and sixth variants are similar to the second and third, but with the use of thermal insulation and replacement of openings (Fig. 3, Fig. 4).

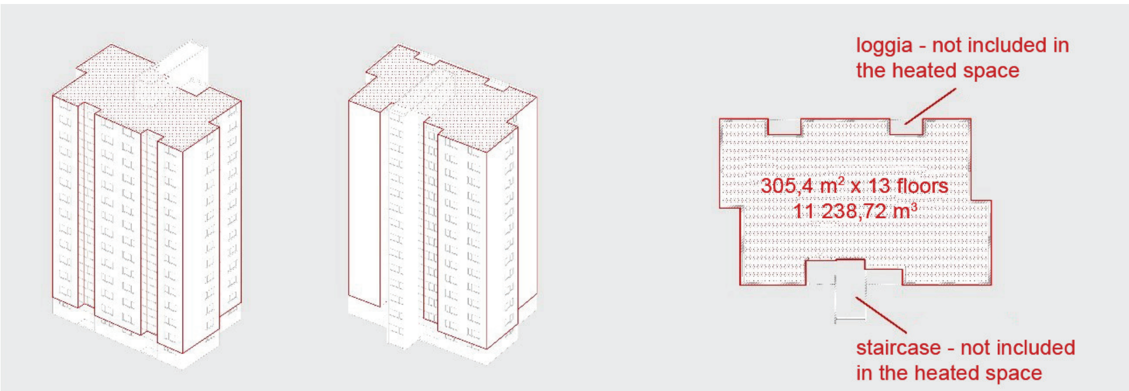

Fig. 2 Setting out the heated volume without integrating the interspaces.

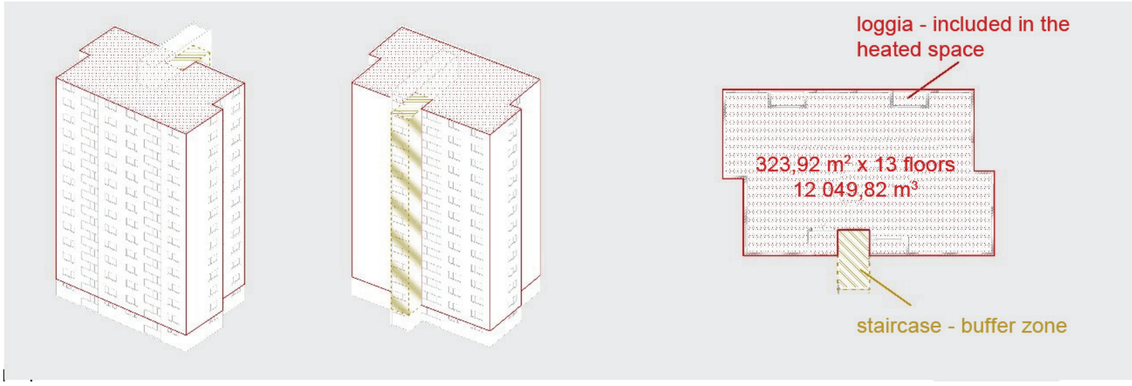

Fig. 3 Setting out the heated volume with the integration of glazed loggias as buffer zones.

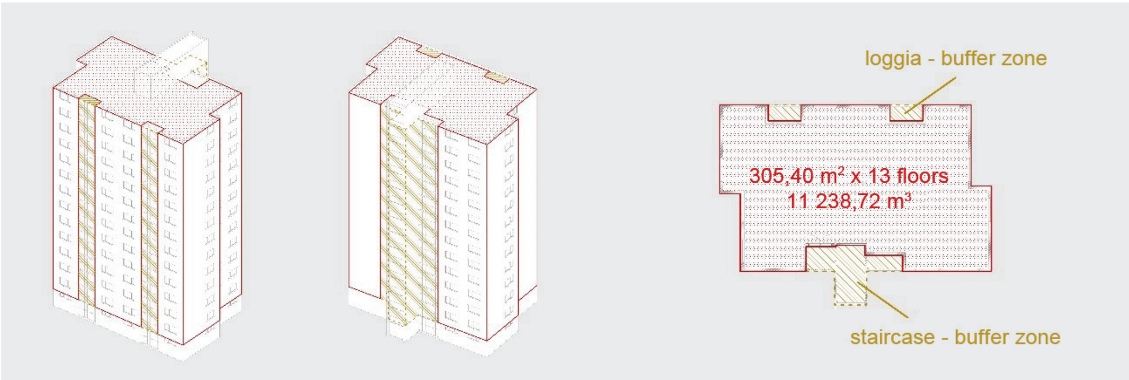

Fig. 4 Setting out the heated volume with the integration of glazed loggies within the heated volume, except for the staircase.

In the last phase, a comparison was made between the different options, which in the end showed a real improvement in energy efficiency due to the integration of interspaces. In Tab. 1 we can see a comparison of the seasonal energy consumption, the global total energy consumption indicator and the global primary energy consumption indicator. The energy consumption for heat water production per season is the same in every variant in order to be able to objectively evaluate especially the consumption for heating. Tab. 1 also evaluates the percentage improvement over the glazing-free state of the loggia and classification into energy class.

Tab. 1 Comparison of the original and the new state with or without integration of the intermediate space into the heated volume of the building.

Expected classification in energy efficiency class	Condition without insulation and replacement of windows, doors			Restored state		
	1. without interspace	2. glazed loggia as bumper space	3. glazed loggia within the heated volume	4. without interspace	5. glazed loggia as bumper space	6. glazed loggia within the heated volume
Energy consumption for heating per season ($kWh/(m^2.a)$)	134,353	121,312	114,093	24,924	20,974	22,066
	0 %	9,71 %	15,08 %	0 %	15,85 %	11,47 %
	F	E	E	A	A	A
Energy consumption for heatt water production per season ($kWh/(m^2.a)$)	15,267	15,267	15,267	15,267	15,267	15,267
	B	B	B	B	B	B

Global indicator - total energy consumption (kWh/(m².a))	149,62 0 % D	136,578 8,72 % D	129,359 13,54 % D	40,191 0 % A	36,24 9,83 % A	37,333 7,11 % A
Global indicator - primary energy consumption (kWh/(m².a))	194,506 0 % D	177,553 8,72 % C	168,168 13,54 % C	52,248 0 % A1	47,113 9,83 % A1	48,533 7,11 % A1

Comparison of the energy efficiency of the restored state according to the orientation of the building

One of the effects on the overall energy efficiency of the building was also the location on the plot and orientation to the cardinal points. Given that the same type of prefabricated apartment building does not have to be oriented only to one side, it was necessary to select cardinal points where the same calculation would take place as in the previous calculations. The north, north-east and north-west sides were disregarded as buildings of this type were not oriented towards these sides. Solar gains on the southwest and southeast were almost identical, as well as solar gains on the east and west. Of course, it depends on the ratio of glazing on individual facades, but in our case on the side facades the ratio of windows was approximately the same. Only the front facades were important, for which three cardinal points were finally chosen: southwest, south and west. In Tab. 2 shows a comparison of the different approaches to the integration of interspaces (variants 4, 5, 6 from the previous calculation), whose energy performance results of a building are greatly influenced by the orientation of the building. In selected cardinal orientations, they were best when loggia glazed and used as a buffer space. On the southwest side, the difference between the five and six variations was 4,38 %, on the south side 4,35 % and on the west side only 1,12 %. From the results it is evident that in terms of energy, the southwest and south sides have similar values and loggies in the form of a buffer area would be preferred. On the west side, the overall values were more favorable, but they are almost in an equal position, and the choice of a given loggia glazing need not be subject to energy considerations. In this case, we can take into account in particular the architectural design of loggia.

Tab. 2 Comparison of the energy performance of the new state building according to cardinal points and according to the integration of the interspace into the heated volume.

Expected classification in energy efficiency class	Restored state								
	Southwest			South			West		
	4. without interspace	5. glazed loggia as bumper space	6. glazed loggia within the heated volume	4. without interspace	5. glazed loggia as bumper space	6. glazed loggia within the heated volume	4. without interspace	5. glazed loggia as bumper space	6. glazed loggia within the heated volume
Energy consumption for heating per season (kWh/(m².a))	24,924	20,974	22,066	22,897	19,346	20,342	25,346	20,616	20,899
	0 %	15,85 %	11,47 %	0 %	15,51 %	11,16 %	0 %	18,66 %	17,55 %
	difference	4,38 %		difference	4,35 %		difference	1,12 %	
Global indicator - total energy consumption (kWh/(m².a))	52,248	47,113	48,533	48,447	44,997	46,292	52,797	46,648	47,016
	0 %	9,83 %	7,11 %	0 %	7,12 %	4,45 %	0 %	11,65 %	10,95 %
	difference	2,72 %		difference	2,67 %		difference	0,70 %	

5 DISCUSSION

The main question before the research was whether loggia glazing makes any sense in terms of improving the building's energy efficiency. The results show that glazing increases energy efficiency in both restored and non-restored condition. An interesting fact is that when glazing an existing state of loggia it has better result values of variants, where the loggia is within the heated volume and after the heat-exchange envelope of the building is restored, the loggia wins as a buffer space. Another surprise was the difference in the results when setting the building on different cardinal points. The results on the south and west sides were approximately the same, and the difference between the interspace integrated into the heated volume and outside was 1 kWh / (m^2.a). However, this rule did not apply to the western side, proving that the cardinal orientation should be taken into account in this matter.

6 CONCLUSION

In the present research we dealt with the energy aspect of the renovation of an apartment building and the impact of energy-efficient interspace on the overall energy performance of the building. The research was processed as a basis for the selection of the type of interspace, the result of which depended on the rate of use of thermal insulation, the degree of integration of loggia into the heated volume and orientation on cardinal points. Comparison of the alternatives encourages a clear choice of glazed loggia as a buffer space (only in the case of a comprehensive restoration), but it is important not to forget the architectural and artistic aspects that should be examined at the next stage of the work. The case study deals with one of the many prefabricated housing construction systems of the last century. The research met expectations by confirming the hypothesis that a properly selected space significantly improves the energy performance of a building. The work would need to continue and compare similar calculation methods with other construction systems of panel construction. The construction system ZTB-13B is a good example of a point type apartment building with loggia, but there are other representatives such as. longitudinal construction system T06B BA, where there are no loggies and it is possible to extend the space throughout the apartment building.

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JUNIORSTAV 2020

22. odborná konference doktorského studia s mezinárodní účastí

22ndInternational Conference of doctoral Students

Vydal

ECON publishing, s.r.o.
Pod Nemocnicí 590/23, 625 00 Brno
e-mail: econ@atlas.cz
tel.: 602 755 541
www.econ.cz

v roce 2020 jako svoji 88. publikaci v systému ISBN.

Vydání první.

Redakce:

Ing. Eva Šuhajdová, Ing. Vojtěch Biolek,
Ing. Zuzana Mrňová,

Grafické zpracování:

Ing. Svatopluk Pelčák

Tisk: FAST VUT

978-80-86433-73-8