Is the sound insulation of a facade a relevant factor in price estimation of an apartment?

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Introduction

The quality of thermal insulation of a building facade significantly influences financial value of an apartment. Thought, type of the used thermal insulation system can have a significant impact on an acoustic behaviour of the wall cladding as such and depending on a type of the ETICS sound insulation may increase, stay the same or, in some cases, even decrease [1,2]. The current calculation algorithms that are used for price estimation of apartments in Slovakia use relatively large number of input data. Besides the factors such as location of the house in the city context and position of the evaluated apartment inside the building also other factors (e.g. size and age of the apartment, durability of constructions, energetic performance, daylight), have impact on the final price [3,4]. Although acoustic comfort can have significant impact on living standard and even on human health [5,6,7], in the recent algorithms the acoustic quality aspects (such as installation noise, façade insulation or insulation between apartments) are not really taken into account [8]. This article shows to what extend the inclusion of the sound insulation – as a factor in an apartment price calculation algorithm could possibly influence the economic value of an apartment.

Recent calculation algorithms for apartment value estimation

Different calculation method exists in Europe and sometimes even within each EU country [9]. In Slovakia there are several methods that can be use for estimation of the price of apartment. In this article we focus on so called "Calculation of the general value" [10]. In particular we refer to so-called "method of positional differentiation („metóda polohovej diferenciácie") [11] which is the only method that takes noise as a factor into account when calculating a value of an apartment.

In the mentioned calculation algorithm, the acoustic situation is taken into account as an environmental factor (Factor No.15) together with quality of air and water in the location of the evaluated apartment. In this way, noise pollution is judged together with air pollution. Sometimes it is not completely convenient, since places can be noisy while having still a good air quality and the other way around.

In this contributions we will investigate to what extend might Factor No. 15 influence the total general price and whether it gives a sense to split it into two factors, e.g. to assess the "air quality" and "noise quality" separately, or if the impact of this parameter is so minor.

Methodology

The calculation of the so-called "general value" (or "general price") is performed by means of the "method of positional differentiation" which uses 16 Factors (Fig.1, Tab.1) and 5 classes (Fig.2). In this stage of calculation the price of ground on which the dwelling is build is not yet taken into account.

Table 1: Description of different factors and their weight in recent calculation algorithm used in Slovakia

No.	description of a factor	weight	%
1	Real estate market in the given location	10	7%
2	Location of the dwelling house in relation to city center etc.	30	21%
3	Recent technical state of the dwelling house and apartment	7	5%
4	Infrastructure around the dwelling house (sports facilities, parks etc.)	5	3%
5	Facilities inside the dwelling house	6	4%
6	Accessories and facilities in the apartment (renovated, new or old)	10	7%
7	Employment possibilities	8	6%
8	Inhabitants in dwelling house and nearby (density of population etc)	6	4%
9	Orientation of the living rooms (north, south, east, west)	5	3%
10	Position of the apartment in the dwelling house (floor etc)	9	6%
11	Number of apartments in the block of the dwelling	7	5%
12	Infrastructure - train, bus, etc.	7	5%
13	Infrastructure - services (post office, bank, kindergarten, hospital, shops)	6	4%
14	Natural resort nearby	4	3%
15	Quality of living environment (noise and air pollution, drinking water)	5	3%
16	Experts opinion	20	14%

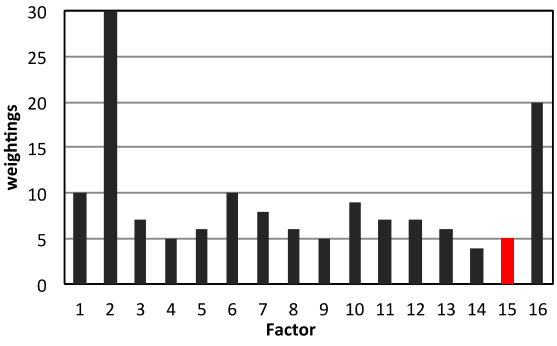

Figure 1: Weights of 16 main parameters that are taken into consideration when calculating the value of apartment in Slovakia.

Each Factor is in the recent algorithm described by 5 basic classes (Fig.2) which expres the qualitative situation (within each Factor). Distribution of classes in the recently used standardized calculation method is not linear. Given algorithm (used also in the Hypo software) distributes classes as follows. Class I is equal to Class III + 200% of the Class III. Class II is arithmetic average between Class I and Class III. Class V is equal to Class III – 90% of the Class III and Class IV is arithmetic average between Class V and III.

$$- 2.\ln(x) + C \qquad [-] \qquad (1)$$

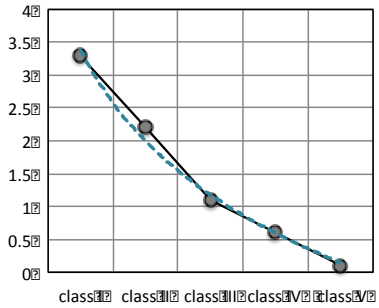

Figure 2: Distribution of the five classes used within each of 16 mentioned Factors that are taken into consideration when calculating the value of apartment in Slovakia.

If we have a closer look at the distribution of classes, we can see that this distribution is quasi logarithmic and can be instead two lines easily described by formula (1) indicated by the dashed blue line in the Fig. 2. In this way it is easier to understand the weight of each class better and to see that differences between best classes I, II and III are larger in comparison with classes III, IV and V.

Case study

The chosen case study is a flat in an older apartment building (from 50-ties) in the city center of Bratislava. Assessed apartment is some 10 minutes walking distance from the old city hall, 5 minutes walking distance from the main bus station and 10 min from large shopping malls near river Danube call Eurovea (Fig.3).

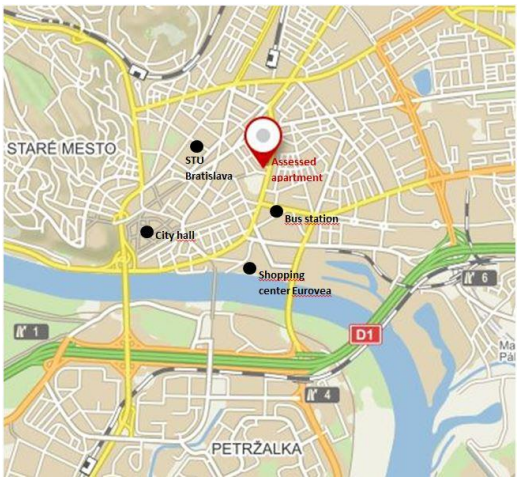

Figure 3: Map of Bratislava with indication of the case study (in red); source: https://mapy.cz/

The floor surface of the apartment is 64 m^2. The dwelling house is situated nearby a park "Medická záhrada" and St Andrew's Cemetery „Ondrejský cintorín", which is a historic cemetery, protected as a National Culture Heritage. While the park Medická záhrada provides a space for old and young people to relax, play games, picnics and sports, Ondrejský cintorín is a city park with a quiet and meditative atmosphere. Two places together create pleasant areas at only 10 minutes walking distance from the historical town hall and main square of Bratislava.

Figure 4: Picture of the dwelling house with indication of the apartment chosen for the case study.

Calculation of the so called "general value"

For sake of better understanding and in order to work with realistic numbers, first a real situation was taken into account, actual technical state of the dwelling was assessed and its value was calculated by means of the software Hypo [11], which is a standardized software for forensic engineers in Slovakia. The general value of the apartment (e.g. without taking into account the price of the ground) have been estimated to 130 426,- EUR. The price of the ground for the given apartment at the given location, in a multi-storey building was estimated to 16 668,- EUR.

This has resulted to the total general value of the assesed appartment (after rounding) to 147 000,-EUR.

A parametric study

A parametric study was chosen for this paper to shown a relative influence of influencing factors. For sake of simplicity, it has been decided to work only with the general value of the house, e.g. without taking the price of the ground into account.

In this study, the value of the apartment was calculated for all five Classes within 3 chosen Factors (No.1, No.2, No.15 and No.16), summarized in matrixes of values shown in the Tables 2-4 and Figures 5-7. Factor No.1 (e.g. real estate market situation at the given location) has weight 10, which in the global weighting system corresponds to 7%. Factor No.2 (e.g. location of the apartment in the city context) is in the recent calculations the most influencing factor with an absolute weight 30 (and corresponding relative weight of

21%). Factor No.15, which deals with noise, air and water pollution, has in the recent calculation scheme weight 4 which corresponds to 3 %.

Factor No.1 distinguishes: (Class 1) demand is obviously larger then supply, (Class 2) demand is larger then supply, (Class 3) demand and supply is in balance, (Class 4) demand is smaller then supply, (Class 5) demand is obviously smaller then supply.

Factor No.2 (e.g. location of the apartment in the city context) distinguishes: (Class 1) shopping centre and main streets, best locations in chosen settlements, (Class 2) parts of the city situated not directly in the shopping areas or main streets and chosen settlements, (Class 3) parts of the city suitable for living and typical ordinary residential areas, (Class 4)) parts of the city suitable for living out of the city or close to industrial zone, (Class 5) location out of city, close to agricultural land etc.

Factor No.15 (e.g. noise and air pollution) distinguishes following classes: (Class 1) quiet environment without pollution of air or water, (Class 2) ordinary noise and air quality conditions, (Class 3) increased pollution and noise near main traffic roads, (Class 4) increased noise and air pollution, exhalants or smells, and (Class 5) very noisy and polluted areas, presence of radon or water pollutions etc.

Last assessed Factor is No.16, which is expressing the opinion of the evaluator. Class I means that evaluator thinks that the apartment if excellent, Class II – good apartment, Class III – average apartment, Class IV – problematic apartment, Class V – very problematic apartment.

Table 2: Summary of calculated prices for different Classes of the Factor 15 and Factor 2.

	Factor 15 Class I	Factor 15 Class II	Factor 15 Class III	Factor 15 Class IV	Factor 15 Class V
Factor 2 Class I	142 754 €	140 699 €	138 644 €	137 725 €	136 806 €
Factor 2 Class II	130 426 €	128 370 €	126 370 €	125 450 €	124 477 €
Factor 2 Class III	118 150 €	116 096 €	114 041 €	113 122 €	112 202 €
Factor 2 Class IV	112 581 €	110 526 €	108 525 €	107 606 €	106 633 €
Factor 2 Class V	107 065 €	105 011 €	102 956 €	102 037 €	101 117 €

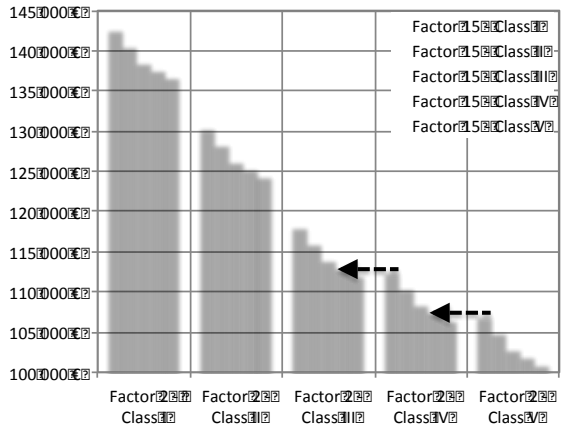

Figure 5: Example to what extend can Factor No.15 (e.g. noise and air pollution) and Factor No.2 (Location of the apartment) influence the apartment value.

The rows in the Tables 2 shows, how the price of the apartment would change depending on the noise and air quality in different locations in city (expressed by columns). For better illustration Fig.5 was made which shows that the noise quality has only minor impact on price when apartment is located in a popular place to live.

Table 3: Summary of calculated prices for different Classes of the Factor 15 and Factor 1.

	Factor 15 Class I	Factor 15 Class II	Factor 15 Class III	Factor 15 Class IV	Factor 15 Class V
Factor 1 Class I	138 645 €	136 590 €	134 535 €	133 616 €	132 697 €
Factor 1 Class II	134 535 €	132 481 €	130 426 €	129 506 €	128 587 €
Factor 1 Class III	130 426 €	128 371 €	126 370 €	125 451 €	124 478 €
Factor 1 Class IV	128 587 €	126 532 €	124 478 €	123 558 €	122 639 €
Factor 1 Class V	126 749 €	124 694 €	122 639 €	121 720 €	120 801 €

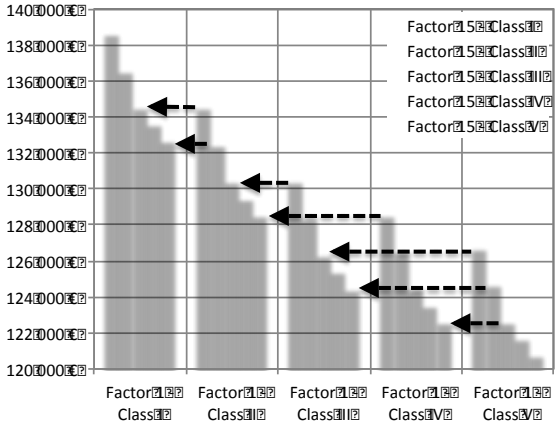

Figure 6: Example to what extend can Factor No.15 (e.g. noise and air pollution) and Factor No.1 (e.g. real estate market situation at the given location) influence the apartment value.

In the Tables 3 the rows express the price changes depending on the noise, water and air quality under different real estate market situation (Factor No.1) given in columns. Figure 6 is based on the Table 3 and arrows indicate the same price depending on different classes in Factor 1 and 15. Several conclusions can be stated from the figure. For instance, if we would like to keep the price of the apartment when changing the real estate market situation from Class III to Class V, we would need to improve the quality of the environment from Class III to Class I. But in the in the situation where the demand is obviously larger then supply, the improvement of the noise, water or air quality won't have an impact. In other words, environmental factors cannot compete with real estate demands when it comes to very popular places. The influence can be seen only when it goes on less popular places.

The last comparison in this paper relates to questions, to what extend can an evaluator "forensic engineer" influence the price of the apartment in comparison with the environmental Factor No.15 (Table 4 and Figure 7).

Graphical representation of the comparison in Fig.7 shows that the evaluators opinion is more important than the noise and air pollution factors to such an extend, that the objective

classification of the environment will have impact only in "low quality situation, e.g., in cases in which the evaluator will consider the assessed dwelling as average, problematic or very problematic.

On the other hand, evaluator can take the acoustic quality of the dwelling into account in his/her subjective assessment and in this way it is nowadays possible to "fine-tune" the acoustic comfort issues.

Table 4: Summary of calculated prices for different Classes of the Factor 15 and Factor 16

	Factor 15 Class I	Factor 15 Class II	Factor 15 Class III	Factor 15 Class IV	Factor 15 Class V
Factor 16 Class I	138 645 €	136 590 €	134 535 €	133 616 €	132 697 €
Factor 16 Class II	130 426 €	128 371 €	126 370 €	125 451 €	124 478 €
Factor 16 Class III	122 261 €	120 206 €	118 151 €	117 232 €	116 312 €
Factor 16 Class IV	118 530 €	116 475 €	114 474 €	113 555 €	112 581 €
Factor 16 Class V	114 853 €	112 798 €	110 743 €	109 824 €	108 904 €

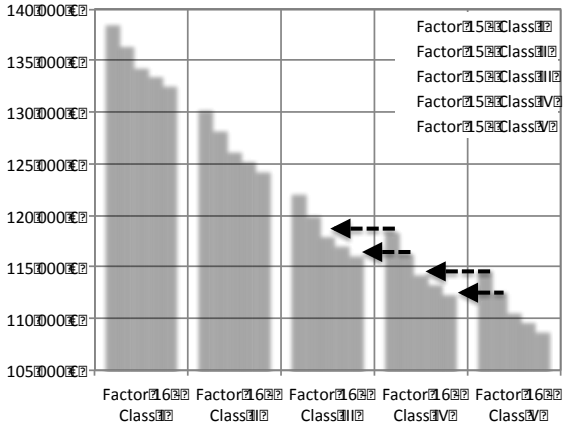

Figure 7: Example to what extend can Factor No.15 (e.g. noise and air pollution) and Factor No.16 (e.g. opinion of evaluator) influence the apartment value.

Conclusions

Case study has shown the relative impact of four out of 16 different Factors that serve in the recent calculation algorithms in Slovakia for the estimation of the value of an apartment. It has been shown that the Environmental factor (i.e. Factor No.15) doesn't have very strong impact on an apartment price. The only exception is if other, more influencing factors "move" an apartment in unfavourable class. In such situation can the sound, air and water quality influence the value of a dwelling more significantly.

On the other hand complains of inhabitants show that acoustic comfort is considered as an important parameterin an assessment of an overall living standard. It is therefore recommended to revise the weights of the 16 factors according to the nowadays requirements.

Acknowledgements

We acknowledge the VEGA no.1/0286/15 and H2020-MSCA-RISE-2015 No. 690970 „papabuild".

References

[1] Di Bella, A., Granzotto, N., Elarga, H., Semprini, G., Barbaresi, L., Marinosci, C., Balancing of thermal and acoustic insulation performances in building envelope design, Proceedings of InterNoise 2015, 2015, DOI: 10.13140/RG.2.1.1435.9122

[2] Zaťko, P., Urbán D., Tomašovič, P. Rychtáriková, M.: Acoustic Performance of the External Thermal Composite Insulation Systems Influence in Slovakia. DAGA 2016, Aachen, Germany. www.daga2016.de

[3] Di Bella, A., Granzotto, N., Pavarin, C., Comparative analysis of thermal and acoustic performance of building elements, Proceedings of Forum Acusticum 2014, Krakow, Poland, September 7-12, 2014, ISSN: 22213767 ISBN: 9788361402282

[4] Hraška, J. (2011). Daylight requirements in sustainable building rating systems. Ingineria iluminatului, 5.

[5] Fausti P., Secchi S., Di Bella A., Scamoni F., Building acoustics throughout Europe - Volume 2: Housing and construction types country by country: Italy, Edited by Birgit Rasmussen & María Machimbarrena (editors, COST Action TU, 05/2014: chapter Chapter 13: Italy: pp. 214-237; DiScript Preimpresion, S.L., ISBN: 9788469701591

[6] Bielek, B., & Bielek, M. (2012). Environmental Strategies for Design of Sustainable Buildings in Technique of Green Eco-Architecture. Journal of Civil Engineering and Architecture, 6(7), 892.

[7] Chmelik, V. (2013). *Principles of inclusive design in architecture and room acoustics* (Doctoral dissertation, doctoral thesis, Slovak university of technology, Bratislava).

[8] Vyparina, M. et al (2001).: Metodika výpočtu všeobecnej hodnoty nehnuteľností a stavieb, Žilinská univerzita v EDIS, ISBN 80-7100-827-3.

[9] Majdúch, D. (2006): Všeobecná hodnota stavieb a pozemkov, STU v Bratislave, ISBN 80-227-2433-5

[10] Bradáč, A. (2016): Teorie a praxe oceňování nemovitých věcí, Akademické nakladatelství CERM, Brno, ISBN 978-80-7204-930-1

[11] Všeobecná hodnota je vypočítaná metódou polohovej diferenciácie, podľa Metodiky výpočtu všeobecnej hodnoty nehnuteľností a stavieb vypracovanej Ústavom súdneho inžinierstva Žilinskej univerzity v roku 2001, programom HYPO verzia 13.50.

[12] Varga, T., Ingeli R. (2016): The Effect of Thermal Bridges on Energy Balance of Wood Frame Houses, Applied Mechanics and Materials, 824, 323-330.