QUALITY MANAGEMENT OF CONSTRUCTION PROJECTS IN TERMS OF SUSTAINABILITY

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Abstract: *Construction industry, as one of the key sectors of the national economy, has currently to consider the principles 3E (Effectivity, Economy, Environment) that create the frame for the quality and sustainable product. The quality assessment of construction projects in the context of sustainability is perceived as socio-economic problem. In all sectors, including the construction is observed the progressive transition from standards quality management system to systems of sustainability performance. The paper analyzes the strengths and weaknesses of buildings quality and sustainability in Slovakia compared with other countries by the data from the international portal „The Green Building Information Gateway" (GBIG).*

Keywords: *assessment, sustainability, quality, construction project, building*

JEL Classification: *M15*

1. INTRODUCTION

Paper is focused on the analysis of current state and knowledge in the field of building quality assessment in the widest context of its sustainability. The looking for new technology, using the new progressive material and design solutions that lead towards improving the construction, not only from economic but also from environmental and socio-cultural point of view, represent a huge potential in terms of ensuring the requirements of sustainable society development [1]. According the Governor's Green Government Council [2], the main aim of sustainable building is to minimize the negative impact on human health and environment throught efficient use of energy, water and other natural sources, throught the reduction of waste, pollution and environmental degradation and health protection of these buildings users.

All arguments of sustainability contribute to the demant for quality building. In the present, the synonymous of building quality is the term "green" or "sustainable" building [2]. The energy performance and efficiency, as well as the positive impact on the health, comfort and productivity of buildings users are able to return to the building owners their higher initial costs many times. Also the study solved at authors´institute [3], focused on segment of low energy family houses in Slovakia, proves that with the same initial costs we can build a house in a higher energy standard, which can save about 60 % energy. The latest material and technology are added value which will provide additional savings during the lifecycle of building. The higher initial costs begin to return by the first energy bills.

The research of Univerzity San Diego and CB Richard Ellis Group [4] has confirmed that the employees had an average of 2,88 fewer sick days in their current green office versus their previous non-green office and about 55 % of them indicated the improving of productivity.

The Colliers International as a leader in global real estate, offering comprehensive services to investors, property owners, tenants and developers around the world claims [5], the green building ensure rent higher in 6 %, the measure of occupancy higher in 3,5 %, lower energy costs, greater demand of tenants and healthier and more productive employees. The Colliers Interantional also carried out the comparison the green and non-green building. The using of green buildings has many advantages compared to conventional buildings:

- lower maintenance costs in 13 %,
- lower energy consumption in 24-50 %,
- lover CO_2 emission in 33-39 %,
- lower water consumption in 40 %,
- less landfilled solid waste in 70 %,
- higher satisfaction of tenants in 27 %.

The interpretations of sustainability and the opinions on its assessment are different considering the many criteria. The particular criteria determine the requirements on quality and sustainable buildings. There are many different systems for building assessment and certification at international, national, as well as regional levels. The most used systems are the American – LEED, the English – BREEAM and the German – DGNB. The SBToolCZ is used in the Czech Republic. The assessment system BEAS, which reflected the specific conditions of Slovakia, is currently developing.

The assessment of the building sustainability can be considered at any stage of design, construction or using of building. The greatest impact on the achievement of the construction quality and sustainability criteria presents the phase of building preparing. Therefore, the phase of construction preparing is the most suitable for begining the application of the assessment. Considering that the assessment systems difference from each other, the choice of only one assessment system is difficult process. There are particular certificates that are difficult to reach, therefore are more valued. The achievement of more prestigious certificate for the building presents the better perception of the public and higher competitive advantage.

These facts contribute to the overall quality of buildings. The quality, certified buildings will soon be standard [6]. The value of certified building will be more confident compared

to the values of other buildings. The motivating impulse for investors is the expected future trend in this issue. The reason for price difference is not only the higher quality of certificated building, but also the quarantee of sustainable value of investment. This expectation is increasing with the strengthening orientation to building sustainability. On the other hand, in Slovakia are only a few construction projects, mainly realized by developers, which were aimed on the certificate achievement of sustainability.

The U.S. Green Building Council (USGBC), established in 1993, has long-term dealt with the publicity in field of quality, green and sustainable buildings. USGBC has launched (from 2012) a massive online database of buildings called the Green Building Information Gateway, or GBIG. GBIG is a web-based tool, search engine and data platform for exploring and comparing the green dimensions of the built environment. The aim of paper is an analysis of the quality and sustainability of Slovak construction projects in the context of the buildings registreted in GBIG. The result of this analysis is to identify the strengths and weaknesses of assessed and certified buildings in Slovakia.

2. METHODOLOGY

The gist of 3E principles (Effectivity, Economy, Environment) is the assessment of three fields for planning, preparation and realization of construction projects or for spending of public sources. Althoughthe principle of economy, purposefulness and effectivity are assessment together, the economy principle is still considered as the most important. On the other hand, the principle of the purposefulness is priority in term of the management decision-making, as well as in term of the management of public sources. There is necessary to focus on 3E principles already in the phase of planning and preparation of buildings, ie. in the phase of construction costs determination. The number of decision-making processes in order to set the optimal variants of solution has to be processed before the project realization.

The 35 410 buildings (certified by four international assessment systems) are registered in the database GBIG since 2012 year. The database gbig.org contains 41 buildings certified by three assessment systems in Slovakia [7].

Table 1 Number of assessed buildings using database gbig.org (April 2015)

Assessment systems	Total number of registred buildings	Number of buildings in Slovakia
LEED	25 774	22
BREEAM	7 735	18
DGNB	1 187	1
Green Star	714	-

Source: [6]

3. QUALITY ANALYSIS OF SLOVAK CERTIFICATED BUILDINGS

As we can see in table 1, the buildings certified through international assessment system in Slovakia is not too many. The table 2 provides a survey of buildings which achieved the LEED certificate. The certified buildings are only located in the largest Slovak cities. The buildings mostly present the administrative buildings (1,2,4,5,6), multi purpose building (3) and hotel building (7).

All constructions are assessed in one assessment system. Considering this, it is possible to create comparing table for identification of the strengths and weaknesses of particular projects. The table 3 provides the survey of certified buildings in Slovakia assessed by the point score. The assessed buildings earned the most points in the field Sustainable sites and Energy and atmosphere. On the other hand, the weakness of Slovak certified buildings presents the field of Water efficiency and Innovation in design. The building EcoPoint Kosice (No.6) received the most points of assessment. The LEED Gold certificate also received the constructions AUSK ALPS Project-Assembly Hall and BC Bratislava BBC1 plus in Bratislava (No.1,2). Other buildings were awarded by the LEED Silver certificate.

4. QUALITY OF THE SLOVAK CERTIFICATED BUILDINGS IN THE GLOBAL CONTEXT

The current situation of buildings assessment in Slovakia in the context of foreign countries is processed in table 4. Table 4 refers the given situation in members' countries of EU, as well as in selected other countries.

Table 2 Certified buildings in Slovak Republic (April 2015)

No.	PROJECT	LOCATION	DATE OF CERTIFICATION	TYPE OF CERTIFICATION	CERTIFICATE
1	AUSK ALPS Project-Assembly Hall	Bratislava	2012-03-20	LEED NC 2009 / 63 pts	Gold Certified
2	BC Bratislava BBC1 plus	Bratislava	2013-03-27	LEED CS 2009 / 63 pts	Gold Certified
3	Central Shopping SO:02	Bratislava	2014-11-17	LEED CS 2009 / 53 pts	Silver Certified
4	Office Tower SO:03	Bratislava	2013-09-12	LEED CS 2009 / 57 pts	Silver Certified
5	Administration Building SO:09	Bratislava	2014-05-21	LEED CS 2009 / 59 pts	Silver Certified
6	EcoPoint Kosice	Kosice	2014-08-20	LEED CS 2009 / 73 pts	Gold Certified
7	Hotel SO04	Bratislava	2014-05-21	LEED CS 2009 / 53 pts	Silver Certified

Source: [9]

Table 3 Point score of LEED buildings in Slovakia (April 2015)

No.	Earned / possible points						
	Energy and Atmosphere	*Materials and Resources*	*Indoor Environmental Quality*	*Sustainable Sites*	*Water Efficiency*	*Innovation in Design*	***Total points***
1	16 / 35	5 / 14	10 / 15	15 / 26	12 / 10	5 / 6	**63 / 110 – G**
2	19 / 37	7 / 13	4 / 12	26 / 28	3 / 10	4 / 6	**63 / 110 - G**
3	10 / 37	4 / 13	3 / 12	25 / 28	7 / 10	4 / 6	**53 / 110 - S**
4	13 / 37	4 / 13	4 / 12	25 / 28	7 / 10	4 / 6	**57 / 110 - S**
5	20 / 37	4 / 13	3 / 12	25 / 28	3 / 10	4 / 6	**59 / 110 - S**
6	**23 / 37**	**6 / 13**	**9 / 12**	**22 / 28**	**10 / 10**	**3 / 6**	**73 / 110 - G**
7	13 / 37	4 / 13	3 / 12	25 / 28	6 / 10	2 / 6	**53 / 110 - S**
**S – Silver certified(50-59pt), G –Gold certified(60-79pt)*							

Source: [8]

Table 4 Comparison of selected countries in the field of building certification (April 2015)

State	Certification	Awards	Case studies	State	Certification	Awards	Case studies
EUROPEAN UNION							
Great Britain	5 400	88	91	Denmark	41	1	1
Germany	1 328	4	4	Luxembourg	41	0	0
France	622	15	9	**Slovakia**	**31**	**0**	**0**
Netherlands	394	0	3	Ireland	22	3	2
Poland	348	2	3	Bulgaria	17	0	0
Belgium	275	4	2	Portugal	13	0	1
Sweden	245	1	2	Greece	6	1	1
Spain	244	1	2	Estonia	5	0	0
Finland	135	0	1	Malta	3	1	0
Italy	127	3	0	Slovenia	3	0	0
Czech Rep.	112	3	0	Latvia	2	16	0
Romania	104	1	1	Croatia	2	0	0
Hungary	87	0	0	Cyprus	0	0	0
Austria	78	0	2				
WORLD							
USA	**91 349**	**1 252**	**1 649**	Brazil	258	5	1
China	2 206	25	2	Japan	64	0	0
Australia	1 652	7	44	South Africa	10	7	11

Source: [9]

The number of certified buildings (number of buildings which are already certified and number of buildings which are trying to reach the certificate), number of awarded buildings and number of researched buildings during the case study were analyzed. Countries are ordered according the number of certified buildings (from the highest to the lowest number).

The most assessed buildings in EU are located in the Great Britain (5 400) and in Germany (1 328). The Slovak Republic is in second half of the list. Compared to the Czech Republic and Hungary is the situation in Slovakia significantly worse. Globally, the world power in the field of buildings sustainability is the USA.

The selected countries in middle Europe belonging to the EU are mentioned in table 5. There were analyzed the published activities and average value of earned points. Considering that the dabatase gbig.org provides the number of earned points only for assessment system LEED, only information related this assessment system was analyzed. Coutries of middle Europe are able to design and build of green contruction in high quality level (LEED Gold certificate; 60-79pt). The average value of building assessment in the Western European countries is lower than middle Europe countries. Despite the fact Western European countries have assessed more buildings in system LEED, the constructions reached lower score (even at the lowest level of certification). This may indicate that the environment of these countries (where the buildings are located) is less sustainable.

The presented studies show that number of assessed buildings in Slovak republic is significantly lower than surrounding countries. On the other hands, we are able to design and construct the green buildings which achieve high score. There are several causes:

- this type of building assessment is not obligated in Slovakia (obligated is only the processing of energy certificate for new buildings, the buildings must to have at least the status of energy-efficient buildings),
- the developers are not interested in certification of their buildings, respectively, they do not have knowledge about the buildings sustainability, assessment systems and its benefits:
  - healthy environment for their tenants,
  - achievement of the higher monthly rent, higher demand of tenants, longer rental contracts, long-term lower operating costs, diversity of tenants and longer service life compared to conventional buildings,
  - lower operating costs mean a higher sale price for the renters or developers.
- the lower number of investors comes to Slovakia than to surrounding countries, etc.

5. CONCLUSION

The precessed survey and analysis demonstrate that the Slovak Republic has a potential for a design and realization of green buildings. The Slovak construction sector is able to deliver the high quality buildings which comply the requirements of sustainable developments. Compared with foreign countries, there is few buildings which declare own quality and sustainability. Therefore is necessary to encourage the investors to increase the number of sustainable buildings of all types (apartment houses, administrative buildings, buildings of public service, etc).

Table 5 Point score of LEED buildings in selected foreign countries (April 2015)

MIDDLE EUROPE (States which are members of the EU)			WESTERN EUROPE (States which are members of the EU)		
State	**Published activities**	**Average value**	**State**	**Published activities**	**Average value**
Germany	319	63	Great Britain	104	49
Poland	119	63	France	58	60
Hungary	49	64	Belgium	29	52
Czech Rep.	39	67	Ireland	26	54
Austria	24	64	Netherlands	21	61
Slovakia	17	61	Luxembourg	1	39

Source: [9]

This is one of ways of improving the level of country and fulfilling the requirements of EU in the strategy of emission reduction, increasing the share of renewable sources and improving the energy efficiency of buildings focused on the creation of quality environment for our and future generations. The constructive and technological changes for improving of buildings energy performance consider the climatic conditions, local conditions, as well as indoor climate in buildings and cost-effectiveness during all life-cycle of building. The fulfilment level of quality criteria and sustainable development conditions by the particular buildings is able to determine through the assessment systems which can be already used in the design phase.

The article presents a partial research result of project VEGA - 1/0677/14 „Research of construction efficiency improvement through MMC technologies".

REFERENCES

[1] KOZLOVSKA, M., STRUKOVA, Z,. TAZIKOVA, A. 2014. ***Integrated assessment of buildings quality in the context of sustainable development principles.*** Quality Innovation Prosperity, vol. 18, Issue 2, 2014, p. 100-115. ISSN 13351745

[2] Governor's Green Government Council, Pennsylvania: What is a green building? Dostupné na internete: <http://www.epa.gov/statelocalclimate/documents/pdf/12_8_what_is_green_GGGC.pdf>

[3] KOZLOVSKÁ, M., ŽUPOVÁ, L. 2013. ***Sustainable constructions in terms of energy efficient buildings and costs.*** Zagreb : University of Zagreb, 2013 P. 235-243. ISBN 978-953-7686-04-8

[4] ELLIS, R. 2009. ***Landmark Study Finds Increased Productivity, Lower Vacancy and Higher Rents in Green Buildings.*** < http://www.cbre.com/EN/AboutUs/MediaCentre/2009/Pages/110209.aspx >

[5] **Colliers International Commercial Leasing Guide 2010.** < http://www.slideshare.net/ColliersInternational/col-commercial-leasingguide17032010final >

[6] KOZLOVSKÁ, M., ŠVAJLENKA, J., STRUKOVÁ, Z. 2014. ***Arguments for marketing benefits of sustainable buildings***. Nehnuteľnosti a Bývanie. č. 1, s. 1-6. ISSN 1336-944X

[7] The Green Building Information Gateway. Activities: **Featured Rating Systems.** < http://www.gbig.org/activities/featured >

[8] The Green Building Information Gateway. **Slovak Republic.** < http://www.gbig.org/places/880 >

[9] The Green Building Information Gateway. **Places.** < http://www.gbig.org/places >

[10] KOZLOVSKÁ, M., BAŠKOVÁ, R., TAŽIKOVÁ, A., KRAJŇÁK, M. 2014. ***Sustainability of construction from perspective of applications technologies for green buildings.*** SGEM 2014: 14th international multidiscilinary scientific geoconference. P. 323-330. ISBN 978-619-7105-21-6. ISSN 1314-2704.

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