SOME ASPECTS OF SUSTAINABLE REAL ESTATE DEVELOPMENT: A CASE STUDY OF DRUSKININKAI SNOW ARENA IN LITHUANIA

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Introduction

Real estate development is a multi-aspect business covering activities starting from the reconstruction and release of existing buildings and ending up with the acquisition of undeveloped land and the sale of the built-up land. Buildings have an ever-increasing impact on the environment [5], [22]. The attitude towards designing, construction and building management has been changing. Building classification and norms defining their planning, design, construction and management contribute to the regulation of the impact on the environmental.

One of the reasons of sustainable real estate development is urban sprawl that has become a major policy issue in recent years. It is often driven by uncontrolled development of suburbs at the edge of the city. Usually it leads to low density and loss of natural landscapes, and enhanced energy consumption. That is why in global terms sustainable real estate development is increasingly becoming a major challenge.

1. Concept of Sustainable Development

The description of the sustainable development was first presented in the 1987 report of the special Commission on Environment and Development of the United Nations "Our Common Future" also known as Brundtland Report [38]. The concept of sustainable development outlined in this report – the development that meets the current needs of society, but also does not reduce the opportunities for future generations to meet their own needs. The main concept of sustainable development was adopted at the World Summit – the United Nations Conference on Environment and Development in Rio de Janeiro in 1992. An outcome of the Conference in Rio de Janeiro – Agenda 21 was an action plan related to the implementation of the sustainable development and together was and a declaration setting out the main principles of sustainable development. Bruntland Concept of Sustainable Development is described as a strategy or an instrument optimizing the relations between the society and the environment surrounding it, taking into consideration the social, economic and environmental goals of the society [36]. The sustainable development has been validated as a major long-term ideology of society development. The base of the sustainable development consists of 3 equal components – environment protection, economic and social development. The sustainable development has three performance criteria to evaluate each goal along with three warnings:

1. The economic objectives should not be maximized breaching the environmental and social constraints.
2. The environmental benefits should not be maximized without complying with the economic and social constraints.
3. The social benefits should be maximized without complying with the economic and environmental constraints.

The sustainable development means maximizing the economic, social and environmental benefits, taking into consideration the limitations and restrictions. The main factors affecting the sustainable development are poverty, population, pollution, participation, market and political failures, prevention and disaster management. The sustainable development covers the

development and environmental protection policy based on a comparison of costs and benefits and careful economic analysis, which strengthens the protection of the environment and sustainable prosperity [37].

The undeniable leader of the sustainable development is the European Union. The general provisions of the European Union for the sustainable development were officially formulated during the review of the programme of the policy and actions of the European Community in connection with the environment and sustainable development "Towards the Sustainable Development" performed and approved by the European Parliament and the European Council in 1998. The European Union Sustainable Development Strategy was approved in 2001 in Gothenburg (Sweden) during the Meeting of the European Council. It was stated there that the sustainable development is a long-term strategy of the European Union aimed to ensure a clean and healthy environment and better quality of life for the present and future generations. During the implementation of this strategy, it is necessary that the economic growth could accelerate social progress and improve the environment, whilst the social policies would promote economic growth and the environmental policy would be cost-effective. This strategy particularly focuses on separation of the economic growth from the use of resources and the impact on the environment, i.e. on the aim to achieve such a state when the economy is growing whilst the use of the natural resources and pollution of the environment are growing much more slowly than the economy or not growing at all.

The priorities of the renewed EU sustainable development strategy are as follows: climate change and clean energy production (i.e. the production of energy during which a small quantity of pollutants including those causing the green house effect is emitted in the environment), sustainable transport, sustainable consuming and production, protection and management of natural resources, public health, social inclusion, demography and migration, global poverty and challenges of sustainable development.

The National Strategy for Sustainable Development of Lithuania was approved by the Government of the Republic of Lithuania on 11 September 2003 [20]. The main long-term, medium- and short-term objectives and tasks are listed in the Strategy, their implementation measures are also provided there. After the intensive creation of the national and international strategies for the sustainable development was launched, it has been noticed that in order to formulate reasonable tasks of the sustainable development, foresee the effective measures for their implementation and ensure their implementation it is necessary to have clear criteria of sustainable development [6], [30], [41]. On 16 September 2009 the Government of the Republic of Lithuania amended and reformulated the National Strategy for Sustainable Development. The priorities and principles of the Lithuanian Strategy for Sustainable Development have been set out taking into consideration the national interests and identity of Lithuania as well as the priorities of the revised EU Strategy for Sustainable Development and provisions of other program documents.

An average annual GDP growth rate of 5–6 % would allow to reach the average 2003 EU Member States' level of economic development during the strategy implementation period (until 2020). A slow economic growth would not allow achieving of the basic objectives of sustainable development whilst a rapid economic growth would increase the risk of too fast pollution of the environment. However, during the last years the economic and social differences between regions in Lithuania not only decreased but even increased. Whilst due to the very poor thermal properties of the most of the blocks of flats and the distressed heating supply infrastructure the efficiency of the energy consumption for housing is 1.8 times lower in Lithuania than in the most of the EU states. Developing countries give priority to social and economic problems [12], while Libovich says that developing countries, in order to ensure sustainable development, should not give priority to the environmental problems [19].

The basic idea of sustainability is that the current decisions should not affect the maintenance of the level of the living standards or the future prospects of their improvement. This means that the economy should be managed so that people could live from the dividends of their own resources. The "resources" cover the natural and other capacities, i.e. interest rate is regenerated by the natural or

man-made environment. In order to maximize profits, developers analyze the results of market research before finding a plot of land. During the period of searching for and learning about the plot of land developers use all their knowledge to determine the results that are mostly financially attractive. The following factors may have an influence on the market supply and demand characteristics such as the rental charges, profitability and value of the capital:

1. It may be difficult to sell or lease larger buildings or plots of land as single units, for only large companies can afford them. If the demand is low and only a few companies compete for the property, the demand decreases together with the value.
2. Building accessibility is a key factor for its value. Rents and capital values may be higher if the building has better access.
3. Attributes of a building affect its value. Investors may give preference to newly constructed buildings because there are fewer risks in connection with them than with older buildings. Moreover, tenants give similar preference to the buildings that have more modern facilities, reduced operating costs or use energy more efficiently. The said factors help to increase the value of a building. The natural lighting and parking areas may also have an impact.

The sustainable economic growth means that the real GDP per capita increases over time and there is no threat of bio-physical (pollution, resource reduction) or social factors. The sustainable development:

- is a set of restrictions, which defines the rates of use of the resources not greater than the natural rates of their renewal.
- waste disposal rate should not exceed the Natural rate of absorption capacity of the ecosystem.

A sustainable approach also differs from a purely environmental when the nature and some of its resources cover and have an effect on the decisions in other areas. The early concept of sustainable development was characterized by strong environmental movement and the sustainability was often explained as economical utilisation of natural resources [14]. The aim is to maintain the flexibility and firmness of the biological and physical systems. The sustainable development talks about the essential ecological processes and life support systems, preservation of genetic diversity, and sustainable use of species and ecosystems. The main issues of sustainability of the environment cover the population, income, urbanization, health care, food, fish farming, agriculture, materials and energy, and these are just a few of them.

The term "sustainable development" shows that the ecology lessons can and should be applied to the economic processes. Thus, the requirement to the development to seek to improve the quality of life (of all population) is challenging and should be checked. In accordance with the social and cultural approach the objective should be to maintain stability of social and cultural systems. The sustainable economic development is directly related to rising of living standards of the poor, which can be measured by increased food, real income, education, health care, water supply, and sanitation, and only indirectly related to the overall economic growth.

The three main factors, which are very important for the sustainable development, may be analysed separately. When performing the analysis of real estate development according to the principles of sustainability, it is seen that merging of these three aspects very is important for built-up environment. However, none of the major issues should be pushed away for the account of others. Thus, the well-known concept has been divided into three approaches to sustainable development. Elkington named this concept as the "triple bottom line" concept of sustainable development [36]. This "triple bottom line" approach to the sustainable development aims to rationalize the economic development and growth, but also covers the importance of social welfare and promotes reducing of the impact on the environmental. In this manner sustainability consists of the following three elements:

1. Economics: salaries, income, labour productivity, creation of jobs, research and development costs, investments in training and other forms of human capital;
2. Environment: the effect of the processes, products and services on the air, water, land, biodiversity, human health, and
3. Social consequences: health and safety in the workplace, employee retention, rights, human rights, salaries and working conditions.

O'Riordan, Lutzkendorf and Lorenz developed an alternative “Three Pillars’” model which is based on the “Triple bottom line” concept [21], [25]. In this model sustainability is seen as an assimilation of economic activity, social welfare and integrity in terms of the environment. This model is generally referred to as the "Russian doll" model. As it may be seen, the economic capital is the main basis for creation of well-being, which is promoted by the development, but it inhibits the social and environmental factors. During the planning of sustainable development of real estate it is necessary to take into consideration the environmental, economic and social aspects as equal and crucial [3].

2. The Principles of Sustainable Real Estate Development

The field of sustainability is very vast and the whole term cannot be covered by one definition [8]. Sustainable development in the context of a sustainable urban environment is perceived as such a construction, which creates the built-up environment through efficient use of resources and taking into consideration the environmental aspects [10], [16]. In 1993 the European Commission described the urban sustainability as a challenge in solving both the internal problems of cities and the problems caused by cities, recognizing that cities themselves provide many potential solutions [9]. There should be performed the multi-criteria analysis of the components of the sustainable development of cities together with the selection of the most effective cycle of life of the sustainable city development [15].

The concept of smart growth or sustainable development, i.e. the quality growth is becoming increasingly commonplace for the development process. The principles of sustainability are applied during the designing, construction, utilisation or demolition of buildings. The sustainability shows a connection between the society and the specialists that create the environment. Whether the real estate development that is being performed is sustainable is conditioned by how much attention is paid to reduction of consumption of the natural resources and the human created resources. This definition has drawn the universal interest as one of the ways to solve problems and continues influencing the development processes [24]. The smart growth is economically meaningful and environmentally friendly. It is a base for the conditions appropriate to live in and it increases the quality of life. And vice versa, when the mechanisms are controlled by rigid growth via the management strategies of the previous growth, the smart growth tries to contribute to the better quality during the development, promoting the economies by creation of new workplaces, earnings, tax revenues, raising the value of property, ensuring diversity of housing and transport alternatives, preserving or improving the environment, i.e. raising the quality of life. One of the instruments of ensuring sustainability in the real estate development could be the land value tax applied in accordance with real estate taxation [26], [27]. It is likely that smart growth will have a significant impact on future development via public pressure and politics.

The difficulties of the smart growth faced by developers are of two kinds. It is very important to encourage using the assessment tools at the very early stage, for basing on the determined objectives, it is possible to reject or at least reduce the occurrence of negative processes [2]. It is necessary to convince the public that the ways of development, especially in the peri-urban areas, should not be the same as they used to be, and prove that the smart growth is financially beneficial. At the same time, the public opposition is afraid of only the high-quality projects by which smart growth principles are implemented. The aim is to show people some examples of how it works, making the smart growth the rule rather than the exception. Both creditors and the public policy supported the development of the single family housing in the suburbs, whilst the development of the mix-use housing faced difficulties in the process of gaining permits. Changes in public opinion on suburban development are pushing the lending institutions, government representatives and developers to find a new way of promoting development of renovations and mixed-use development that is aimed for more than one purpose. When workplaces, housing and commercial entities are close to each other, the public transport possibilities increase. The best way of reducing traffic congestion is to reduce the required travel distance and eliminate minor roads. Developers can contribute to the implementation of these necessary changes in development plans by offering dense, compact

forms with mixed use, accessible by public transport. Sustainability experts stress that anyone – individuals, groups, governments, non-governmental organizations and large corporations can do it differently and encourage each other to do so. If every family used only one car, it would reduce traffic congestion, emission of the gases causing the greenhouse effect and noise at the same time eliminating the inconveniences caused to cyclists and pedestrians.

Basically, the policy of sustainable development means the following:

- Development of the mixed-use becomes the norm.
- The priority is give to the public transport rather than to the personal.
- The diversity of the users of new development: owners and tenants, private and social housing.
- High quality projects both in the public sector and the sector of individual buildings.
- Promotion of the green buildings and treatment of contaminated land.
- Revitalization of the city economy, at the same time promoting living in cities.

Development of housing, offices, trading centres and entertainment centres in easy accessible places reduces the number of trips using the means of transport, expands the rush hour flows on the roads, makes transportation more cost effective and makes it possible for a larger part of people to live closer to their workplaces. Furthermore, mixed-use development usually makes the value of property bigger. The utilisation of the mixed-use development in the existing city locations or as a part of a new commercial centre of a city usually provides the commercial and dwelling units with a spectrum of sizes and choices. In terms of planning it could mean a combination of residential, commercial, industrial, office, public and other ways of using the land.

The policy of governments in respect to the real estate development has changed a lot recently. Usually, the most positive promotion is given to the development of brownfield, whilst green-field development is being rejected. Thus it is aimed to encourage urban renewal through “urban renaissance”. The conversion of older office buildings into residential premises (lofts) and construction of lots of residential buildings in central business district and around it – these are signs of the growing popularity of urban living.

Planners should make a compromise between the environment protection problems that raise a serious concern for the largest part of the population [23]. Analysing the changes of the environment protection and social and economic factors in accordance with two alternative scenarios of land use development it has been established that the development of compact centres of a relatively high density improves the quality of land utilising a smaller amount of resources. Lee and Jou examined how politicians should choose the ceiling limits for built-up density and how the optimal policy is influenced by the main demand and technologies [17]. Landowners aim to develop property in a density which is higher than the socially optimal; however, the regulator can adjust it by setting the control of built-up density. The regulatory authority should make the developers build in a lower density (1) when development of the land becomes less risky (2), the development costs are expected to grow much faster, and (3) the rent of undeveloped land is lower.

The construction industry is facing the challenge of increasing demands of its sustainability performance. Sustainability has become a very important factor in the design, constructing and managing buildings, recently. The real estate industry strongly believes that green building implementation is environment-friendly and can improve social values to the consumers. The selection of a location for green-houses among alternative locations is a multi criteria decision-making problem including both quantitative and qualitative criteria [1], [28], [35]. Green buildings have now become a flagship of sustainable development in this century that takes the responsibility for balancing long-term economic, environmental and social health. They have the following advantages: minimize energy consumption, waste, site impact, use of resources, environmental impact of building materials, maximize re-use of existing buildings, quality of indoor environments and use of existing transport networks. Precisely, green buildings assessment, while applying effective rating systems, allows solve some problems of sustainable real estate development.

3. Sustainable Building Rating Systems

The main international organization bringing together the largest and most common sustainable building rating systems is the Green Building Council (GBC), which was established in 1999; at present it unites more than 30 separate systems tailored to different countries [39]. The GBC do not advertise any particular sustainability assessment models. Their aim is to help and promote the emergence of new or adapted methods of assessment in particular countries. Developing sustainable / green building market, the GBC expects that the "green and cost-effective houses" will become a part of a comprehensive strategy aimed to reducing of CO_2 emissions.

A number of studies have been carried out and different assessment methods have been adapted to buildings as solutions for the efficiency of consumption of energy and other resources over the past decades [11], [13], [29], [31], [34], [40,] and many others. The main purpose of the built environment assessment system is to provide a diversified assessment of the characteristics of the built environment using simple, reliable and precise criteria for achievement of higher environmental standards by the owners and designers. A lot of building assessment methods have been created all over the world since 1990. The most common are listed in Table 1. The internationally recognized system of methods of assessment of the environmentally friendly building are focused on energy saving, efficiency of water consumption, CO_2 emissions reduction, improvement of the internal quality of life, management of resources and their targeted use. In addition, national policies on sustainable development should promote the legislation and accompanying measures that enable full implementation of the integrated quality and sustainability assessment in construction [33].

Tab. 1: Sustainable building rating systems

Name of system	Year of creation, country
BREEAM (Building Research Establishment Environmental Assessment Method)	1990, UK
LEED (The Leadership in Energy and Environment Design)	1998, USA
HK-BEAM (Hong Kong building environmental assessment method)	1996, Hong-Kong
GBTool (Green building challenge)	1995, International
CASBEE (Comprehensive assessment system for building environmental efficiency)	2004, Japan
BEPAC (Building environmental performance assessment criteria)	1993, Canada
DGNB (German Sustainable Building Council)	2007, Germany
LiderA	2000/2005, Portugal
Green Star	2003, Australia
HQE (High Quality Environmental standard)	1992, France
Minergie	1994/1997, Switzerland
TQB	2002, Austria
CEPAS (The Comprehensive Environmental Performance Assessment Scheme for Buildings)	2001, Hong-Kong
BCA Green Mark	2005, Singapore
TERI GRIHA	2007, India
Protocollo ITACA (Innovation and Transparency of the Contracts and Environmental Compatibility)	2005, Italy

Source: own elaboration

These systems, and many others, which are based on the principles of the environment protection and sustainable development, have been designed in order to reduce the negative impact on the environment when designing, constructing, renovating and/or operating buildings. The BREEAM (Building research establishment Environmental Assessment Method) and LEED (The Leadership in Energy and Environment Design) are well advanced, they are applied in a number of countries worldwide, and the majority of later systems are based on them. There are different versions of these leaders of sustainable building assessment for assessment of different types of buildings. Therefore the possibilities of their application are wider.

The United Kingdom is the first country which started assessing building sustainability. Other countries followed its example. However, British BREEAM system is still one of the main systems of certification of sustainable buildings [4]. The BREEAM has changed a lot – from a 19-page report with 27 possible points to the 400-page technical guidelines (an edition intended for newly constructed buildings) with 132 points. The BREEAM system provides its customers, developers, designers and others with the following opportunities [7]:

- to recognise for the market the building with low environmental impact;
- to ensure that a building is installed with the best environment protection systems;
- provides innovative solutions on decreasing the impact of the environment;
- to provide guidance on how to reduce operating costs, improve working and living environment;
- to present a standard that reflects the progress of the objects of general and environmental organizations.

The BREEAM system covers a wide range of environmental and sustainability issues and provides developers and designers with a clear proof of whether a building complies with building a sustainable level or not. The system employs a clear points system that is easily understood and has been prepared in accordance with the actual examples of best practice. The BREEAM has a positive impact on the design, construction and management of buildings. For that purpose, clear technical standards, which are accurately examined and assessed by professional evaluators, have been established and adopted. It is very important that the assessment is carried out at a very early stage of the design, for it is possible to avoid or at least reduce the occurrence of negative processes based on the set objectives. The BREEAM system assesses buildings by the number of the % gained. There are five categories:

1. Pass – at least 30 %.
2. Good – 45 %.
3. Very Good – 55 %.
4. Excellent – 70 %.
5. Outstanding – over 80 %.

Currently, more than a million of buildings worldwide have been assessed using the BREEAM system. More than 200,000 of those buildings have already been given certificates of some certain level. After a building has been assigned to a certain type, it is assessed in accordance with the following 10 criteria [4]:

1. Management.
2. Waste.
3. Health and wellbeing.
4. Pollution.
5. Energy.
6. Use of the land and environment.
7. Transport.
8. Materials.
9. Water.
10. Innovations.

The BREEAM system is widely used in the UK. All state institutions must be assessed under BREEAM. Majority of local authorities require BREEAM assessment for approval of larger projects developed.

The LEED system created in the USA in 1998 has also been widely used and is the Green Building Assessment System recognised worldwide. In order to establish and evaluate environmental friendliness, the LEED system, as well as the BREEAM, examines the sustainability of a building in terms of the whole of aspects important for human health and environment. This assessment method may also be used on any stage of the building life cycle. The LEED promotes a sustainable approach to the buildings in the following key areas [18]: Sustainable Sites; Water Efficiency; Energy and Atmosphere; Materials & Resources; Indoor Environmental Quality; Innovation in Operations; Regional Priority.

The fields of assessment of these two methods are similar and so is their evaluation system: each of the assessed fields is given a certain number of credits (points) which are

assigned depending on how much the assessed building complies with the criteria of that field. Summing up the number of credits (points) gathered in all fields gives the total result which is compared with the assessment scale in order to assess (certify) the building: in accordance with the LEED: Certified; Silver; Gold; Platinum.

4. Sustainability Assessment: Case Study of the Druskininkai Snow Arena

The oldest and most extensive is the British system BREEAM with its lifetime of 22 years and its 16 different versions. As whole, the BREEAM system reveals the application of the three aspects of sustainable development to buildings better, what is more, compared to others this system evaluates the building while using more criteria. Therefore this system is to be applied in assessment of the Druskininkai Snow Arena [32]. The structure intended for the enthusiasts of winter activities and professional athletes who are able to ski here all year round (Fig. 1). The project has been implemented in close cooperation of the public and private sectors in accordance with the principle of partnership. The partner of project, JSC Stamita, has invested more than 50 million Litas (LTL); 40 million Litas have been received from the European Union support funds by the municipality's efforts (1 EUR = 3.4528 LTL). Druskininkai Snow Arena is one of the largest and most advanced indoor ski complexes in Europe. By its technical parameters it may pretend for a place in top five indoor skiing facilities in the world. The Arena can accommodate up to thousands of winter sports enthusiasts. At present there are about 50 indoor skiing slopes operating around the world, most of them – about 30 – are in Europe. However, the closest to the Arena is approx. 1000 km away from it. The developers of the project had estimated that the novelty and complexity of the services would attract about 400 visitors per day and 150 thousand visitors over a year. Other technical parameters of the Arena:

- Main area: 29,719.60 m^2 (Overall heated area: 5,468.09 m^2; Overall cooled area: 24,903.08 m^2; Auxiliary area: 1,787.37 m^2);
- Overall area: 31,462.08 m^2;
- Overall length of the slopes – more than 1100 m;
- The height of hills – 66 m, incline – up to 25 %.

Fig. 1: The overall picture of Druskininkai Snow Arena

Source: authors

For sustainability assessment of Druskininkai Snow Arena the BREEAM system has been selected based on the available data on the building. After the complex has been established as non-residential building type, it was assessed in accordance with the ten groups of criteria which are of different importance. The process of determining a BREEAM rating is outlined below and an example calculation included in Table 2:

1. For each environmental section the number of credits awarded must be determined by the assessor in accordance with the criteria of each assessment issue.

2. The percentage of credits achieved is then calculated for each section.
3. The percentage of credits achieved in each section is then multiplied by the corresponding section weighting. This gives the overall environmental section score.
4. The section scores are then added together to give the overall BREEAM score. The overall score is then compared to the BREEAM rating benchmark levels and, provided all minimum standards have been met, the relevant BREEAM rating is achieved.
5. An additional 1 % can be added to the final BREEAM score for each innovation credit achieved (up to a maximum of 10 %).

In accordance with the BREEAM New construction 2011 assessment instrument the Indicative Overall BREEAM Score was 57.80 % (of 122 possible +10 additional, i.e. – 75 points). Having applied only existing standards of construction and foreign examples BREEAM reports that Druskininkai Snow Arena has gathered relatively many points. Since the building complied with the minimum mandatory requirements, it has been evaluated as "Very Good", which is a high result for a recreational building in Lithuania. The most important part during the assessment was Health and Well-being. It scored almost all points possible and made 14.12 % in the whole system. The Energy part, which is the most significant in the system, was implemented in ~50 % and made 9.50 % of the overall result. The part Transport was implemented by 71.42 %, where 10 points were scored out of 14 possible. The part that met the criteria least was the one where the use of land had been assessed. However, this happened due to the only fact that the land plot on which the Arena was built had not been built up before.

Tab. 2: The aggregate results of the assessment of Druskinininkai Snow Arena using the BREEAM

BREEAM Section	Section Weighting	Number of BREEAM credits available	Total predicted BREEAM credits achieved	Indicative (weighted) Section Score, %
Management	0.12	18	14	9.33
Health and well-being	0.15	17	16	14.12
Energy	0.19	26	13	9.50
Transport	0.08	14	10	5.71
Water	0.06	9	5	3.33
Materials	0.125	15	6	5.0
Waste	0.075	8	3	2.81
Use of the land and environment	0.10	10	2	2.0
Pollution	0.10	13	5	5.0
Total score	1.00	122	74	56.80
Innovations	0.10	10	1	1.0
Final BREEAM Score		57.80		
BREEAM Rating		VERY GOOD		

Source: own research

Though the results have barely exceeded the evaluation of a building "Very Good", it can be stated that while having all the data of energy consumption, CO_2 emission, information on all the enterprises manufacturing materials and equipment used in the building, the result would be even better. There is a significant proportion of manufacturers who apply the standards of socially competent activity and some of their devices were to be made of recycled materials.

Conclusions

At present, the process of real estate development has been based on the principle of sustainability. Sustainability has become a significant factor in the design, construction and management of buildings.

Certificating systems (BREEAM, LEED, DGNB, HQE, Green Star etc.) of sustainable buildings based on the principles of the environment protection and sustainable development, have been designed in order to reduce the negative impact on the environment.

Construction of recreational buildings is an integral part of the sustainable development of real estate. For sustainability assessment of Druskininkai Snow Arena the BREEAM New construction 2011 system has been selected. The Indicative Overall BREEAM Score was 57.80 % (of 122 possible +10 additional, i.e. – 75 points) and since the building complied with the minimum mandatory requirements, it has been evaluated as "Very Good", which is a high result for a recreational building in Lithuania.

Based on the result it is obvious that it was possible to adjust the project of Druskininkai Snow Arena considering the assessment of materials and wastes, consumption of energy and water, and to improve the attributes of the building in order to achieve the assessment “Excellent”.

References

[1] AKBIYIKLI, R., EATON, D., DIKMEN, S. U. Achieving sustainable construction within private finance initiative (PFI) road projects in the UK. *Technological and economic development of economy*. 2012, Vol. 18, Iss. 2, pp. 207-229. ISSN 1822-3605.

[2] ALI, H. H., NSAIRAT, S. F. A. Developing a green building assessment tool for developing countries – Case of Jordan. *Building and Environment*. 2009, Vol. 44, Iss. 5, pp. 1053-1064. ISSN 0360-1323.

[3] BLEWITT, J. *Understanding Sustainable Development*. London, Sterling (VA): Earthscan, 2008. 279 p. ISBN 978-1-849773645.

[4] BREEAM. The world’s leading design and assessment method for sustainable buildings [online]. [cit. 2011-12-23]. Available from: <http://www.breeam.org/page.jsp?id=374>.

[5] CHAU, C. K., TSE, M. S. CHUNG, K. Y. A choice experiment to estimate the effect of green experience on preferences and willingness-to-pay for green building attributes. *Building and Environment*. 2010, Vol. 45, Iss. 11, pp. 2553-2561. ISSN 0360-1323.

[6] ČIEGIS, R., RAMANAUSKIĖN, J. Integruotas darnaus vystymosi vertinimas: Lietuvos atvejis (Integrated Assessment of Sustainable Development: Lithuanian Case). *Management theory and studies for rural business and infrastructure development*. 2011, Vol. 2, Iss. 26. ISSN 1822-6760.

[7] DALAL-CLAYTON, B., BASS, S. *Sustainable development strategies: a resource book*. Organisation for Economic Co-operation and Development, 2002. 358 p. ISBN 1853839477.

[8] EJDYS, J., MATUSZAK-FLEJSZMAN, A. New management systems as an instrument of implementation sustainable development concept at organizational level. *Technological and economic development of economy*. 2010, Vol. 16, Iss. 2, pp. 202-218. ISSN 2029-4913.

[9] FALUDI, A. Gathering the Evidence for European Planning. *Land Lines. Newsletter of the Lincoln Institute of Land policy.* 2007, Vol. 19, Iss. 3, pp. 20-23. ISSN 1051-3035.

[10] FRIEDMAN, A. *Sustainable Residential Development: Planning and Design for Green Neighborhoods*. McGraw-Hill, 2007. 288 p. ISBN 0071479619.

[11] FILIPPIN, C., LARSEN, F. S. Analysis of energy consumption patterns in multi-family housing in a moderate cold climate. *Energy Policy.* 2009, Vol. 37, Iss. 9, pp. 3489-3501. ISSN 0301-4215.

[12] GIBBERD, J. Assessing sustainable buildings in developing countries – the sustainable building assessment tool (SBAT) and the sustainable building lifecycle (SBL). In *The 2005 World Sustainable Building Conference*. Tokyo, 2005, pp. 1605-1612.

[13] GALVIN, R. Thermal upgrades of existing homes in Germany: The building code,

subsidies, and economic efficiency. *Energy and Buildings.* 2010, Vol. 42, Iss. 6, pp. 834-844. ISSN 0360-1323.
[14] GRAHAM, P. *Building Ecology: First Principles for a Sustainable Built Environment*. 1st ed. Oxford: Blackwell Science Ltd., 2003. ISBN 978-1405147545.
[15] KAKLAUSKAS, A., ZAVADSKAS, E. K. ŠAPARAUSKAS, J. Conceptual modelling of sustainable Vilnius development. *Technological and economic development of economy*. 2009, Vol. 15, Iss. 1, pp. 154-177. ISSN 2029-4913.
[16] KIBERT. C. *Sustainable construction: green building design and delivery*. New York: John Wiley & Sons, 2005. ISBN 0471661139.
[17] LEE, T., JOU, J. B. The regulation of optimal development density. *Journal of housing economics*. 2007, Vol. 16, Iss. 1, pp. 21-36. ISSN 1051-1377.
[18] LEED. USGBC [online]. US Green Building Council [cit. 2011-06-01]. Available from: <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1970>.
[19] LIBOVICH, A. Assessing green building for sustainable cities. *The 2005 World Sustainable Building Conference*. Tokyo, 2005. pp. 1968-1971.
[20] Lietuvos Respublikos Vyriausybės 2003 m. rugsėjo 11 d. nutarimas Nr. 1160 "Dėl Nacionalinės darnaus vystymosi strategijos patvirtinimo ir ágyvendinimo" [The Resolution "On the Approval and Implementation of the National Strategy for Sustainable Development, No. 1160], Vilnius, *Valstybės žinios*, 2003-09-19, Nr. 89-4029. (In Lithuanian).
[21] LUTZKENDORF, T., LORENZ, D. Sustainable property investment: valuing sustainable buildings through property performance assessment. *Building Research & Information*. 2005, Vol. 33, Iss. 3, pp. 212-234. ISSN 0961-3218.
[22] MEDINECKIENĖ, M., TURSKIS, Z., ZAVADSKAS, E.K. Sustainable construction taking into account the building impact on the environment. *Journal of the Environmental Engineering and Landscape Management*. 2010, Vol. 18, Iss. 2, pp. 118-127. ISSN 1648-6897.
[23] MEHAFFEY, M., WAINGER, L., WADE, T., YANKEE, D., SMITH, E., BOTT, V., YARBOURGH, R. Assessing vulnerabilities from alternative development patterns. *Landscape and urban planning*. 2008, Vol. 87, Iss. 1, pp. 84-95. ISSN 0169-2046.
[24] MILES, E. M., BERENS, L. G., EPPLI, J. M., WEISS, A. M. *Real Estate Development: Principles and Process*. 4th ed. Urban Land Institute, 2007. 576 p. ISBN 978-0874209716.
[25] O'RIORDAN, T., CAMERON, J. JORDAN, A. *Reinterpreting the Precautionary Principle*. London: Cameron May, 2001. ISBN 1874698236.
[26] RASLANAS, S., ZAVADSKAS, E. K., KAKLAUSKAS, A. Land value tax in the context of sustainable urban development and assessment. Part I. Policy analysis and conceptual model for the taxation system on real property. *International Journal of Strategic Property Management*. 2010, Vol. 14, Iss. 1, pp. 73-86. ISSN 1648-715X.
[27] RASLANAS, S., ZAVADSKAS, E. K., KAKLAUSKAS, A., ZABULĖNAS, A. R. Land value tax in the context of sustainable urban development and assessment. Part II. Analysis of land valuation techniques: the case of Vilnius. *International Journal of Strategic Property Management*. 2010, Vol. 14, Iss. 2, pp. 55-68. ISSN 1648-715X.
[28] REZAEINIYA, N., ZOLFANI, S. H., ZAVADSKAS, E.K. Greenhouse locating based on ANP-COPRAS-G methods – an empirical study based on Iran. *International Journal of Strategic Property Management*. 2012, Vol. 16, Iss. 2, pp. 188-200. ISSN 1648-715X.
[29] SABAPATHY, A., RAGAVAN, S. K. V., VIJENDRA, M., NATARAJA, A. G. Energy efficiency benchmarks and the performance of LEED rated buildings for Information Technology facilities in Bangalore, India. *Energy and Buildings*. 2010, Vol. 42, Iss. 11, pp. 2206-2212. ISSN 0360-1323.
[30] SAKALAUSKAS, L. Sustainability models and indicators. *Technological and economic development of economy*. 2010, Vol. 16, Iss. 4, pp. 567-577. ISSN 2029-4913.
[31] SARTORI, I., WACHENFELDT, B. L., HESTNES, A. G. Energy demand in the Norwegian building stock: Scenarios on potential reduction. *Energy Policy*. 2009, Vol. 37, Iss. 5, pp. 1614-1627. ISSN 0301-4215.
[32] Snow Arena [online]. [cit. 2011-11-01]. Available from: <http://www.snowarena.lt/lt/apie_mus>.
[33] SRDIĆ, A., ŠELIH, J. Integrated quality and sustainability assessment in construction: a conceptual model. *Technological and economic development of economy*. 2011, Vol. 17, Iss. 4, pp. 611-626. ISSN 2029-4913.
[34] SWAN, L. G., UGURSAL, V. I. Modeling of end-use energy consumption in the residential sector: A review of modeling techniques.

Renewable and Sustainable Energy Reviews. 2009, Vol. 13, Iss. 8, pp. 1819-1835. ISSN 1364-0321.
[35] TAM, W. I., HAO, J. L., ZENG, S. X. What affects implementation of green buildings? An empirical study in Hong Kong. *International Journal of Strategic Property Management*. 2012, Vol. 16, Iss. 2, pp. 115-125. ISSN 1648-715X.
[36] WILKINSON, S., REED, R. The Structural and Behaviourial Barriers to Sustainable Real Estate Development. *American Real Estate Society (ARES) Conference*. San Francisco, 11–14 April 2007.
[37] World Bank. *Human Development Report 1992* [online]. World Bank, c1992 [cit. 2011-10-22]. Available from: <http://hdr.undp.org/en/reports/global/hdr1992/chapters/>.
[38] World Commission on Environment and Development (WCED). *1987 The Brundtland Report, Our Common Future* [online]. [cit. 2011-05-22]. Available from: <http://habitat.igc.org/open-gates/wced-ocf.htm>.
[39] World Green Building Council. *Who we are* [online]. World Green Building Council, c2011 [cit. 2011-04-28]. Available from: <http://www.worldgbc.org/site2/index.php?cID=83>.
[40] ZAVADSKAS, E. M., TURSKIS, Z., TAMOŠAITIENĖ, J. Risk assessment of construction projects. *Journal of Civil Engineering and Management*. 2010, Vol. 16, Iss. 1, pp. 33-46. ISSN 1822-3605.
[41] ZAVADSKAS, E. M., TURSKIS, Z. Multiple criteria decision making (MCDM) methods in economics: an overview. *Technological and economic development of economy*. 2011, Vol. 17, Iss. 2, pp. 397-427. ISSN 1822-3605.

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Abstract

ANALYSIS OF SUSTAINABLE REAL ESTATE DEVELOPMENT

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The understanding that buildings have a constantly increasing impact on the environment has changed the attitude towards the designing, construction and building management, whilst the classification of buildings regulating their planning, designing, construction and management contributes to the regulation of the effect on the environment. Sustainable development is defined as the development of community providing opportunity to gain comprehensive well-being at present as well as for the future generations by integrating environmental, economic and social issues, yet not exceeding the acceptable impact on the environment. A chaotic growth of cities jeopardises the environmental stability. At present, the process of real estate development is based on the principle of sustainability. The principles of sustainability have been applied to the designing, evaluation, construction, operation and demolition of buildings. Sustainable real estate development is bound up with construction of recreational buildings. For sustainability assessment of Druskininkai Snow Arena the BREEAM New construction 2011 system has been selected based on the BREEAM New construction 2011 assessment instrument. The Indicative Overall BREEAM Score was 57.80 %, it has been evaluated as "Very Good", which is a high result for a recreational building in Lithuania.

Key Words: *real estate, urban sprawl, sustainable development, BREEAM, Snow Arena.*

JEL Classification: *J11, O18, Q51, Q56, R11.*