JSACE 3/12

Sustainable Architecture in Slovakia after the Year 1990

Received 2015/07/01
Accepted after revision 2015/07/23

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http://dx.doi.org/10.5755/j01.sace.12.3.13001

Consciously applied sustainable principles of building emerge in architecture since 1973. The cause was the oil crises. It forced a re-evaluation and an abandonment of the previous energy wasting building concepts and triggered the need to seek a new and more efficient architecture, sources of energy and materials.
Forming thoughts about sustainability in architecture reached Slovak architectural scene with a slight delay compared to other western countries. While in abroad first projects focusing on new sources of energy originated in late 70s of the 20th century, in our territory these thoughts came in the center of interest only in the 90s. The period before the change of political situation in our country in 1989 can be characterized by numerous discussions and forming thoughts on reducing energy consumption of buildings and on utilizing alternative energy sources. Already in the first half of the 80s interesting projects were designed, but unfortunately they remained just paper projects. However, this beginning of ecologically conscious architecture was the essential for its later development. The decade of the 90s enabled to apply a sustainable design approach more intensely and triggered the construction of various architectural projects. The interest focused mainly on the solar energy and in the late 90s back on traditional natural building materials used in vernacular architecture in the past. The aim to reduce the energy consumption of buildings was the driving force in the construction of first experimental houses and public buildings and also in urban structures. Abrupt building boom in our country since the beginning of the new century evolved the market of energy efficient buildings. Monitoring of energy savings, inevitable according to the adopted ambitions of the European Union was the starting point of architectural designs especially of low-energy and passive houses. The usage of traditional natural building material remains still up to date. Except of technologically and materially sophisticated constructions, the uniqueness and the quality of architectural design are currently strongly emphasized. The awards-winning outstanding and sustainable architecture serves as a proof.
Up to now, most of sustainability in architecture has been performed on a scale of the object. At present, it transforms to the dimension of a city district. This is what we endeavor also at the Faculty of Architecture, STU in both research and teaching practice, mainly in the sustainable design studio.
Current ambitions of the European Union in the constructions of sustainable architecture force us to reflect the progress of sustainable architecture. To achieve these ambitions it is necessary to monitor the development of ecologically conscious architecture in Slovak architectural scene. This is the subject of our research "Mapping of ecologically conscious architecture in Slovakia". Partial outcome of this research is the content of our conference paper.

KEYWORDS: sustainable architecture in Slovakia, theory of architecture.

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Journal of Sustainable Architecture and Civil Engineering
Vol. 3 / No. 12 / 2015
pp. 34-43
DOI 10.5755/j01.sace.12.3.13001

Introduction

The up to date issue of sustainability is being frequently discussed especially in the field of architecture, which is the world largest sector of the total energy consumption. The ambitions of the European Union in the constructions of sustainable architecture according to the European strategy 20-20-20[1] force us to reflect the progress of sustainable architecture. The assessment of possibilities to achieve these ambitions is currently a subject of our research "Mapping of ecologically conscious architecture in Slovakia", where the last forty year development of sustainable architecture is being mapped in Slovakia since the 70s. Monitoring the up to date development of ecologically conscious architecture in Slovakia is very beneficial in order to identify potential prospects in the future and also to provide inspiration for our current architectural design in intentions of set sustainability strategies.

Methods

Our research was divided into two phases:

1st phase included mainly knowledge and data collection from various sources. The result was achievement of knowledge of designed sustainable houses in Slovakia, both built up and ideal projects, also acquirement of summary of theory and criticism of architecture in Slovakia, based on available published works in this field and comparison with the global context - the four decades of ecologically conscious architecture development.

2nd phase of our research, field research, is still in progress and is based on the outcomes of the first phase. It includes a detailed examination of certain characteristic buildings on site, which have been selected based on predetermined conditions. The attention is focused on the objects that are innovative in their own way, either by their architectural design, used material, construction and technology or by other way that differs them from conventional buildings.

Broader global context

Sometimes it is difficult to date the beginnings of period-styles and trends in architecture, however, in the case of sustainable architecture we can lean on two considerable historical events, which entailed a significant turning point in the development of architecture in the second half of the 20th century.

The demolition of a housing complex Pruitt-Igoe (built in 1950s in St. Louis, Missouri) was the first event. The American critic and theorist Charles Jencks identified the 15th July 1972 demolition as a moment when modern architecture died (Jencks, 1977). From the present-day perspective, we already know that this claim was much exaggerated, but it was a signal for the onset of a modern architecture crisis.

The second, from a pragmatic point of view a more important event, was the Arab-Israeli conflict in 1973 leading to the oil crises with serious consequences for the highly industrial countries' economies. The oil crises forced a re-evaluation and a re- assessment of the previous energy wasting building concepts and triggered the need to seek a new and more efficient architecture.

The first decade, the years between 1973 and the beginning of the 1980s (1982) can be described as *the period of searching*. First of all it was about finding new sources of energy, which would have been a substitute for fossil fuels, mainly oil. The ambient energy and renewable energy sources have become an alternative to fossil fuels. Solar power has become a main energy source for building performance. In the second half of the 1970s a series of experimental houses were constructed and various principles how to utilize solar energy were developed. Effectiveness of solar technologies had an essential impact on the form and expression of nascent solar architecture.

Another phenomenon indicated by the oil crisis was a high degree of dependence on civilization and technical conveniences requiring a lot of energy. The reaction of architects on the phenomenon of dependence was to design and to build a house which would have been built from local ma-

1 European strategy 20-20-20 sets the goals for European Union to reduce the greenhouse gas emissions by 20%, increase the energy from renewables by 20% and increase energy efficiency of buildings by 20%

terials and performed by use of local energy sources, recycling principles, etc. It means to develop an autonomous house. In this context, the term *Ecological House* appeared for the first time, too.[2] The term Ecological house did not reflect a special architectural appearance but the new quality of relationship between building, its users and the surroundings. It can be understood as the first formal reference to the ecologically conscious building.

Probably the most simple and highly effective methods to reduce energy consumption were so called conservation methods, which are characterized by an ambition for a more efficient use of energy delivered to the system. The conservation methods represented energy savings by a well-insulated building envelope, controlled ventilation, thermal zoning of spaces and efficient heating systems.

In the second decade, which could be defined within the period from the beginning of the 1980s until 1992, the builders have moved from the experiments to improved building technologies and procedures, ranging from single family houses to larger and more sophisticated buildings. A major qualitative change in architectural design brought a holistic approach to architectural design. It was a significant change of an approach to architecture – a building stopped to be a product situated into the surroundings and became an integral part of the environment. However, a greater effort to reduce the negative environmental impact of buildings and construction activities appeared only at the end of the second decade.[3] While the first decade was more or less omitted by critics and theoreticians of architecture, the first attempts to create an ecological architecture were described as the: *"romantic and naive ideas of eccentric enthusiasts how to solve environmental crisis"* or *"... tendencies, which refuse to comply with the normal architectural standards and are looking for inspiration in fields outside architecture, in nature, human appearance under the form of a man* (Čejka, 1991).

Three major events allocate the beginning of the third decade. The United Nations Conference on Sustainable Development "Earth Summit" in Rio de Janeiro in 1992 was the first and the most important event. The second one was the European Congress of the UIA on Eco-logical architecture held in Stockholm and Helsinki in 1992 and the third one, perhaps the most important for development of architecture was the World Congress of UIA held in Chicago in 1993. Participants of the Congress adopted a document the Declaration of Independence for a Sustainable Future in which sustainable architecture was officially recognized. At the beginning of 90s systems for the evaluation of environmental quality of buildings were developed,[4] concepts of "sustainable architecture" or "green buildings" originated. "Deviancy" is becoming a trend in the development of modern architecture. In this decade many significant buildings and urban complexes proudly reported that ecological orientations have been accomplished and even have been recognized by architectural critique. Edition of the publication Green Vitruvius (1999) can be perceived as a certain culmination of this decade, a launch of literature on the topic of architecture and sustainable constructions, but also a challenge to create certain principles and standards on the designing of sustainable architecture and sustainable cities (Keppl, 2004).

While the previous three decades were characterized by designing and building ecologically conscious architecture, where more-less each building was a prototype, the fourth decade is about the declaration of the necessity to be concerned about sustainability in all spheres of human activities and the adoption of appropriate standards for the implementation of these plans. At the beginning of the 21st century, the European Union set out a long-term strategy for *"A Sustainable*

2 One issue of AD (Architectural Design) in 1976 was devoted to autonomous houses. There is an illustration of Ecological house: An archetype – a miniature ecosystem in the country, sustained by sun, wind, rain, muck and muscle.

3 The Report of the Brundtland Commission on Our Common Future, published by Oxford University Press in 1987. The Report launched an increasing interest on environmental issues.

4 Assessment and certification of environmental and sustainability standards of buildings e.g. BREEAM, in Great Britain, 1990, LEED in USA, 1993, etc.

Europe for a Better World: A European Union Strategy for Sustainable Development". In 2004, the Architectural Council of Europe (ACE) issued a publication Architecture & Quality of Life, in which it sets out the rules for the development of a long-term policy ACE deriving from principles of sustainable development. In an initiative *"Architecture and Sustainability"* issued in 2009 sustainable design is becoming imperative. Leipzig Charter on sustainable European towns came out in 2007. But the European directive on the energy performance of buildings EPBD 2010 (2010/31/EU Directive on the Energy Performance of Buildings) is perhaps the most important document adopted at the European level. The Directive contains requirements to design passive or nearly zero energy buildings after year 2020 and initiative 202020. To fulfill those requirements massive employment of ambient energy, mainly solar power is necessary.

Sustainable architecture in Slovakia

Let us try to evaluate the forty year development of sustainable architecture in Slovakia on the background of this broader global context. Thoughts about sustainability in architecture reached Slovak architectural scene with a slight delay. Problems related to the oil crises that shook the world in the 1970s, such as the oil crisis or the reports of depletion of mineral resources have not been taken very seriously in our country initially. The reason consisted in a certain independence of "Eastern Block Countries" in the global oil market.

Forming of thoughts

In the period of 1970s discussions of informal groups of intellectuals and specialists have been organized. They dealt with the issue of energy efficiency, use of alternative energy sources and the environmental situation and sought to draw attention to the imminent crisis of energy and resources. Another group was formed by enthusiasts who practiced alternative lifestyle and building style. Over time this issue got into the awareness of professional public, who expressed their reflections and thoughts in number of contributions (Dušek, 1977), conferences or scientific publications (Kittler, Mikler 1978). They discussed the energy efficiency of buildings and a need for its reduction based on inspirations from abroad. The attention of Czechoslovak designers and experts focused on reducing energy consumption in both new and existing build-up. The legislative support of these thoughts in terms of revising standards for thermal insulation of buildings following the examples from foreign countries appeared to be the next essential step.

One of the alternative energy sources that could significantly supplement the deficiency of fossil fuels was solar energy. This has been reflected also in the choice of study tasks and publications. For the professional public, the publication *Solar Energy and Its Use* (Halahya, Valášek, 1983) was the most significant accomplishment, as it was published in 1983 as the first publication on the issue of ecologically conscious architecture in Czechoslovakia. Before, all ongoing activities were just theoretical discourses or ideal architectural design proposals.

New era of architecture and first projects built

In the 1980s, the interest in the sun, as an alternative source of energy, increased. Construction, design and delivery capabilities of this period facilitated to use unconventional energy sources. New era of architecture began. First projects were designed and built, where certain ratio of energy consumption was replaced by energy from alternative sources. In Czechoslovakia, several projects of solar and experimental architecture originated. Through the use of solar power they endeavored to reduce the energy consumption of the buildings.

Although Czech and Slovak republics formed in this period one common Czechoslovak republic, the new era of architecture found a stronger response and more enthusiast in the Czech territory. Here, first energy efficient houses were built. In Slovak territory, the first houses of this issue were managed by almost a decade later. Until then, enthusiasts of new thoughts focused on theoretical drafting and designing of experimental buildings. Some projects were designed for a specific

Fig. 1
Project of experimental family house designed in 1984 as an exhibit large scale model for Agrokomplex fair in Nitra, to promote the use of alternative energy sources and various biotechnologies. Authors: J. Bóna, J. Keppl, R. Špaček

customer, e.g. experimental family house designed for the Agrokomplex Nitra exhibition (Fig. 1). Slovak architects took part also in international architectural competitions on solar architecture and other projects were the outcomes of research projects. Orientation on the solar energy stimulated the application of various methods aimed to reduce the energy consumption of the buildings. Methods applied were appropriate shape and spatial solution supporting low energy consumption, use of energy from the environment, return to the use of local materials and building traditions and later the use of active solar systems, which have been transforming solar energy through solar collectors. Solar energy became a new architectural element that needed to be taken into account from the very beginning of project design. Mastering technical problems and reconciliation of more applicable methods triggered the rise of greater number of architectural projects striving for a sustainable design approach. Despite the fact that all of these projects in Slovakia remained unbuilt, they meant a significant progress for architecture of the 1980s while presenting real possibilities of using alternative energy sources.

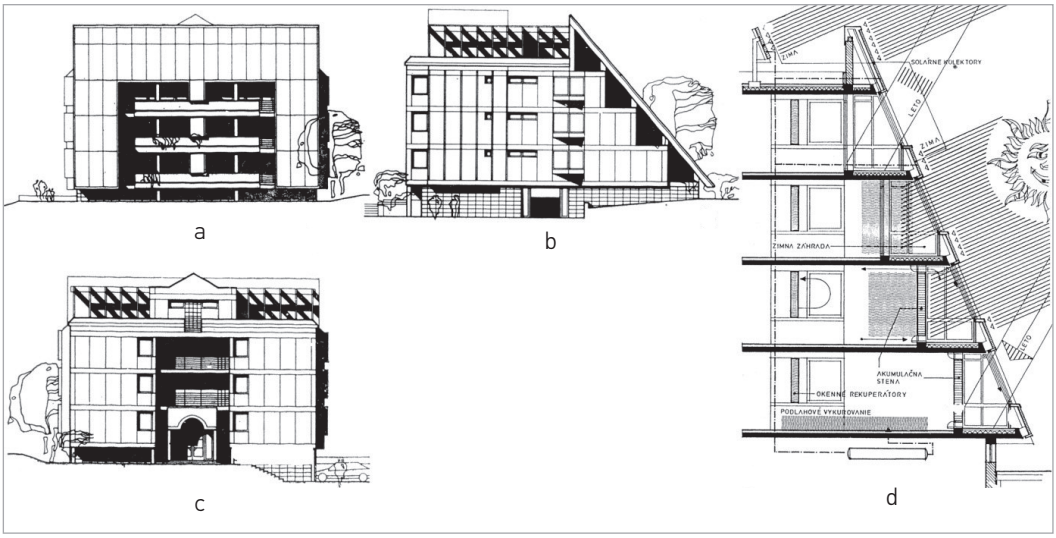

Fig. 2
Experimental residential house in Holíč. a. South elevation, b. West elevation, c. North elevation, d. Section. Authors: L. Kušnír, M. Kiaček, B. Hnát, I. Kubík

One of the first solar houses built in Slovakia were designed by architect Kušnír. First of his experimental residential houses, aimed to energy savings was built in 1987 in Valtice (on the territory of current Czech republic). The second experimental apartment building was completed in 1991 in Holíč (Fig. 2). The aim of this experiment was to verify the energy savings of proposed facilities of active and passive use of solar energy and their impact on the expression of architectural design of residential buildings.

Application of ecological aspects in theory and practice

The change of economic and political situation in our country has had an significant impact on the 1990s architectural design in Slovakia. After 1989 a number of interesting ecologically conscious

projects has been designed. New projects have started, following the national and international interests, such as The National Program for Reducing Energy Consumption for Housing in Slovakia or the international Brundtland City Program[5].

Reducing energy consumption of buildings and monitoring of energy savings was the starting point of some architectural designs in the 90s, most of which were built. Described intentions continued to be applied for family houses and started to be applied also for public buildings design in particular through the use of solar energy, which was the most accessible renewable energy source. Architects Schleger and Liesler incorporated these ideas in their design of indoor swimming pools and halls. Among all of their projects abroad, a solar collector house for swimming pool in Neresnica (1992) (Fig. 3) has been built in Slovakia. The authors have formed their solar architecture as a combination of passive and active solar systems. In new buildings, especially in family houses, conservatories and greenhouses were incorporated. However, in many cases their stocking and technical solution did not meet the requirements of a buffer zone, that would prevent the interior from overheating in the summer and capture sun's rays during colder season to heat the indoor air.

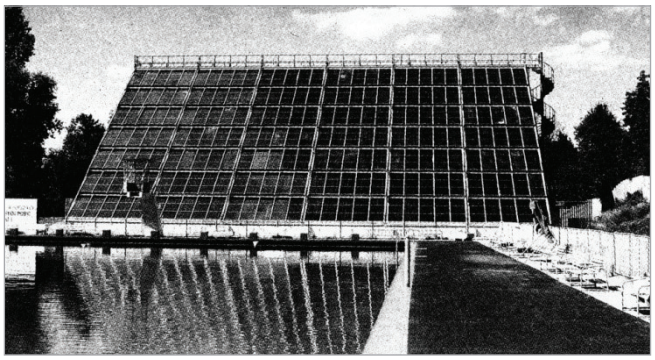

Fig. 3
Solar collector house for swimming pool in Neresnica with area of 577,5 m2 of solar collectors. Authors: E. Schleger, L. Liesler

Fig. 4
Clay house with wattle roof in Hamuliakovo. Author: H. Pifko

In this decade, environmental aspects in architecture have been taken into account also by using traditional natural building materials such as wood, stone, clay or straw, which have been rediscovered. Besides the economic savings, environmental impact, recyclability of the materials and the aesthetics and architectural design of buildings from natural materials have been considered. One of the first projects of contemporary experimental clay house was designed by architect Pifko in 1995. At a family house in Hamuliakovo (Fig. 4) he applied all gained knowledge of the proposal of environmentally conscious architecture while following the traditional regional architecture. Construction of all mentioned projects enabled to verify the energy parameters and set goals that needed to be achieved in order to make further progress in society.

Another way of achieving sustainability in architecture was deepening knowledge on the energy efficiency of buildings. Ecologically conscious architecture became more complex, relying on high-quality materials and new technologies, available information from abroad and also on domestic research results. The building of National Bank of Slovakia in Bratislava (1997-2002) (Fig. 5) designed towards the end of century is an example of such an architecture. Architects inspired by structures from abroad designed the bank with an emphasis on reducing the energy consumption of the building. This building started the design of technologically advanced buildings

5 Brundtland City Program was aimed at reducing energy consumption by half by 2030; among other Slovak applying towns the town of Rajec was selected for this project with its project "Energy Efficiency in Rajec Region".

Fig. 5
National Bank of Slovakia in Bratislava, the first intelligent building in Slovakia finished in 2002. Authors: M. Kusý, P. Paňák; http://www.asb.sk/fotogalerie/novinky/priebezna-diagnoza-spolocnosti-abc-klima-uspech-fotoalbum/priebezna-diagnoza-spolocnosti-abc-klima-uspech-5

that have been hiding their ingenious proposal inside without showing typical signs of sustainable architecture. The formal expression of the building still remained one of the main priorities. However, the interest in technologically advanced and energy-efficient houses had increased only in the following years.

Sustainable architecture as a standard

At the beginning of the new millennium, building of energy efficient houses and sustainable buildings was rather declared than real in Slovakia, compared to neighboring countries. Energy efficient houses were already a standard in abroad, while their social demand in our country was at its inception. The situation changed approximately in the half of the first decade of the 21st century. Slovakia, as part of the European Union started to take over and implement European standards and regulations, which forced us to revaluate our conventional building techniques. Last years, therefore, can be described as a period when it is inevitable to deal with sustainability at institutional level and international level. Domestic and international conferences on sustainable architecture are being organized. Standards, regulations and legislation on the energy performance of buildings or on the promotion of renewable energy sources, inspired by the European directives[6] are being adopted and issued. One of the most important documents adopted at the European level and having a substantial impact also on Slovak architectural scene is the European Directive on the Energy Performance of Buildings as part of the European Strategy 20-20-20. It imposes designing of energy efficient buildings as mandatory requirement. Activities of institutions and organizations endeavoring to apply sustainability in architecture increase awareness in this field of architecture for both the professional and laic public, thus leading to increased demand for ecologically conscious architecture.

Another change that occurred within the last decade was an extensive building boom in Slovakia evolving the constantly growing market of energy efficient houses. At the same time also sustainable architecture got into awareness of our professional public regarding numerous articles and publications dealing with development and progress of sustainable architecture. A number of ideal projects and built ecologically conscious houses does not allow to map all sustainable buildings as accurately as in previous decades. Monitoring of energy savings was the starting point of architectural design especially for low energy houses and later for passive houses, as evidenced by innumerable energy efficient houses in Slovakia. A turning point in building of passive houses in our country intervened in 2007, when first certified passive house in Slovakia was built and launched the construction of number of passive houses.

Low energy and passive houses in Slovakia are built especially as family houses, rarely as residential buildings. Except of technologically and materially advanced buildings, the emphasize is accentuated on the quality of architectural design, which is becoming increasingly important, unlike the monotonous intensive build-up at the end of the last century. Exceptional architectural works

6 e.g. Directive 2002/91/ES on the Energy Performance of Buildings, Act No. 476/2008 Coll. on the Energy Efficiency, Act No. 309/2009 Coll. on the Promotion of Renewable Energy Sources and Highly Effective Combined Production and amending other acts, etc.

get in the centre of public attention and attention of architectural critique and thus become strong candidates for nominations for various domestic or European prestigious awards, acknowledging outstanding architecture. An office building of Unipharma company in Bojnice (**Fig. 6**) or a passive wooden-straw family house on the northern slope in Melčice - Lieskové from Oximoron studio (2012) (**Fig. 7**) serve as examples. Unipharma office building designed already in 1999 by architect Keppl was awarded with the prestigious award of Slovak Architecture, Building of the Year 1999, precisely for its ecological concept. Passive house in Melčice - Lieskové designed according to the requirements of investor from ecological recyclable materials, utilizing local resources, passive and active solar gains was nominated to ARCH magazine Award 2013[7]. This fact indicates the progress of sustainable architecture and its infiltration to the awareness of professional and laic public as well as to the awareness of architectural criticism in Slovakia.

Current from the previous decades remains also the rediscovered use of traditional natural building materials, especially wood, clay and straw. Their use results from different motivations, whether in terms of the context of the building and its surroundings, because of their architectural expression or because these materials represent a renewable resource and their carbon footprint is almost negligible. Thus conceived architecture represents a complex combination of several aspects of sustainability. Some of the above mentioned houses as well as a low energy straw bale dome in Hrubý Šúr (2010) (**Fig. 8**) can be used as an example of such an architecture.

Fig. 6

Office building of Unipharma company in Bojnice, Prize - Building of the Year 1999. Author: J. Keppl

Fig. 7

Original architectural and technological design of building with a maximum gain of solar radiation. Author: studio Oximoron

Fig. 8

First self-help built self-contained straw dome in the world in Hrubý Šúr in Slovakia. Authors: G. Minke, studio Createrra: http://www.zelenarchitektura.sk/2011/06/kupola-zo-slamy-a-hliny-v-pasivnom-standarde/

In contrast to low-tech buildings, predominantly self-help completed houses from natural building materials which keep their technological processes relatively simple, stand buildings with technically and technologically developed processes. Their build-up in Slovakia began at the beginning of the new millennium with the construction of the first intelligent building in our country, the National Bank of Slovakia. Over time, high-tech buildings smartened up. Due to the globalization and available technologies and processes from abroad, international green building rating systems, evaluating the complexity of buildings' sustainability got into interest[8]. In ad-

7 ARCH award, being awarded since 1998 is a prestigious award for architecture. It has a high professional credit ensured by the participation of top European architects on the jury. The aim is to highlight the remarkable domestic architecture.

8 the international green building rating systems used currently in Slovakia are especially LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Methodology). First buildings were certified only in 2012.

dition to energy savings, quality of used materials, healthy indoor environment and preserving and promoting the greenery are accentuated.

At present, sustainability in architecture is being discussed almost constantly. While for some people the fundamentals of sustainable design resides in using natural renewable materials and in following the traditions, for others energy savings, reliable processes or emerging of green architecture is the fundamental. However, sustainability in relation to architecture cannot be evaluated only on the basis of measurable values and parameters, but also of unquantifiable social, cultural, aesthetic and other values. While sustainability of houses built from natural building materials is directly visible, technologically advanced buildings often spend considerable resources to obtain various certificates declaring their positive approach to the environment and the sustainability. Although staying in mutual contrast, the merit of both approaches is progressive thinking and a seek for less burden of the environment.

Besides high-tech and low-tech architecture, another current trend is the transformation of forming thoughts about sustainability in architecture from object scale to the scale of a settlement. Although some efforts of applying sustainability in urban scale have taken place during the past four decades of development of sustainable architecture already, such as Brundtland City Program or project Ecocity Trnava, unfortunately, it did not remain as a long-term intention. This is what we seek at the Faculty of Architecture STU in Bratislava in both research and teaching practice, particularly in sustainable design studio. One of the effective methods to find the optimal building up for areas from individual building plots to the dimension of district structures is a method of solar envelope. Solar envelope is defined as a "spatial definition of the maximum volume of the building on a building plot, which does not cast a shade in the neighborhood, during defined period of time."[9] For several years already, this method is an integral part of educational process at our faculty as well as subject of further development. In recent years, its use has been verified for structures of larger dimensions, such as zones or districts. This could be the greatest potential of the solar envelope method, as it could help to define limits for build-up of areas, especially for intensive exploitation of energy efficient houses and solar architecture (Fig. 9). However, adoption of this powerful and efficient design tool for constructions in reality, remains questionable.

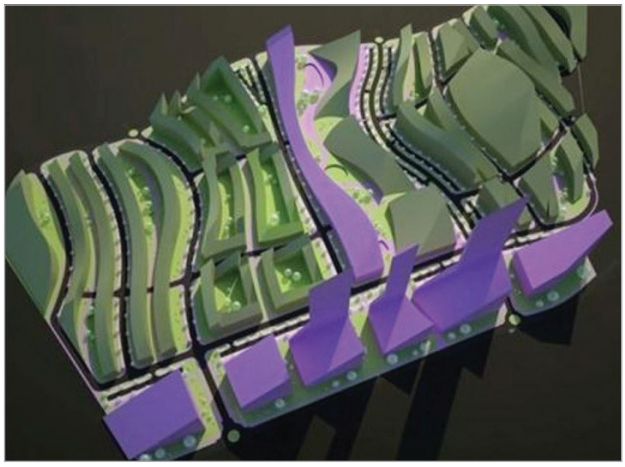

Fig. 9
Solar envelope used in a scale of a settlement, 3D model of final urban structure. Authors: Mihaľková, Martinkovičová, 2011 in studio led by architect Klára Macháčová

Discussion

Brief overview of the forty year development of sustainable architecture in Slovakia presented in a broader global context reflects changes in architecture on the background of social and economic events and environmental influences. Listed examples of our architecture highlight new approaches and progress of sustainable architecture. Initial ecologically conscious thoughts proceeded to first projects and built houses, emanating from enthusiasm of their authors or investors. Over time, ecologically conscious architecture became a public trend and nowadays it is becoming a necessary standard. Two approaches of creating sustainable architecture emerge. One is an autonomous architecture highlighting the connection to the environment. Particularly

9 Professor Ralph Knowles from the University of Southern California in Los Angeles, the author of the method of solar envelope, brought this method to the Faculty of Architecture STU in Bratislava in 1993.

its architectural design is mostly emphasized. In contrast, technologically advanced buildings and complexes are being built. Their functioning is based on advanced technologies and processes, which overtake the architecture itself. Both approaches, however, seek for innovative strategies for environmental issues. Solar architecture and urbanism are offering another approach dealing with sustainable living standards and with minimal impact on nature and on exhaustible energy sources. By using an effective method, the directive on the use of solar energy in construction[10] would be applied, thus contributing to the sustainability of architecture in Slovakia.

Acknowledgment

This research project has been supported by Young Researcher Grant No. 1304 Mapping of ecologically conscious architecture in Slovakia provided by Slovak University of Technology in Bratislava as well as by VEGA Grant No. 1/0559/13 Architecture and Urbanism 2020 - Moving Towards Nearly Zero Energy Standard.

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10 Directive 2009/28/EC on the promotion of the use of energy from renewable sources.