Eight years of passive design education - from energy efficiency to comfort, from ethics to aesthetics

Lorant Krajcsovics & **Henrich Pifko**

Slovak University of Technology in Bratislava
Bratislava, Slovakia

ABSTRACT: Increased demands for the energy performance of buildings increases the requirements for the education of architects and designers. The Passive House Institute (Inštitút pre Energeticky Pasívne Domy - iEPD) trained more than 260 designers including 80 architects, through its seminars entitled Passive House Design course (Navrhovanie Pasívnych Domov) over the past eight years (2010-2017). During that period, requirements for thermal insulation of building envelopes and buildings' energy performance have increased significantly. The changing conditions also necessitated modifications in the arrangement of a ten-day seminar in order to strengthen some of its sections or to eliminate others that have become part of the public domain and were no longer required. In this article are posed questions as to how architects should be educated taking into account present trends in energy performance and sustainability.

INTRODUCTION

The initial seminar in the Passive House Design Course (PDC) originated under the international CEPH (Council on Education for Public Health) project. During this project uniform training material was designed for the whole of Europe by a consortium composed of Passivhaus Institut Darmstadt (PHI), Passivhaus Dienstleistung GmbH (PHD) the Energie- & Umweltzentrum Allgäu (Energy and Environmental Centre Allgaeu) (EZA) and Energieinstitut Vorarlberg. The training material was then localised by individual project partners, with Slovakia being one of them, represented by the Institute for Passive Houses (iEPD). This project, supported through the Intelligent Energy Europe (IEE) project scheme responded to the need for education and training of experts to be able to deal with the progressively stricter requirements on energy performance and the Energy Performance of Buildings Directive (EPBD) II review forthcoming at that time. The project lasted between 2008 and 2010.

The first seminars within the project framework in Slovakia took place in March and October 2010. These consisted of a ten-day programme with the original content as shown in Table 1.

Table 1: Seminar content.

Dates 2010	Content
03 February	Passive house design in general, basic principles, building's thermal insulation envelope; Introduction to the Passive House Planning Package (PHPP)
04 February	Building's thermal insulation envelope; airtightness of thermal envelope
05 February	Thermal bridges and quality assurance
24 February	Windows
25 February	Ventilation
26 February	Heat sources and heating
10 March	Management and supervision of construction and renovation
11 March	Energy balance calculation using the PHPP energy balance tool
12 March	PHPP workshop
13 March	Economy; summary

The programme was built principally around the implementation of the latest knowledge in the field for achieving the highest energy efficiency level possible - the passive house standard. This was mirrored in the seminar structure,

which identified heat loss areas in a building, i.e. structures, thermal bridges, windows, achieving airtightness in buildings and ventilation systems with heat recovery. In its concluding part, the course synthesised all the information working with a PHPP calculation program and an economy balance tool. Satisfaction questionnaires were circulated at the end of every course, and these revealed an overall satisfaction with the course and with its individual modules; as well, ideas were presented for improvement. The programme was assessed as *good* based on the principles of building physics, and the technical and construction requirements.

Satisfaction was very high from the beginning. The course brought knowledge that was revolutionary at that time and not commonly present in the building industry. The participants were, thus, given the capability to differentiate themselves in the marketplace and gain competitive advantage. Course participants included architects, designers and construction companies, as well as sub-contractors of individual technologies or components. The building of a network of manufacturers and suppliers has been initiated.

In the course of 2011, the authors saw the revision of direction EPBD II and its subsequent transposition into Act No. 300/2012 of the Collection of Laws of 18 September 2012 and Implementation Decree No. 364/2012 of the Collection of Laws of 12 November 2012.

Requirements for thermal and technical properties of structures laid down in the Slovak standard STN 73 0540-2: 2012 have become stricter. Starting from 1 January 2013, the construction of new buildings requires the low-energy standard in terms of thermal protection of buildings. Recommended values for ultra-low energy buildings were defined for new buildings to be constructed after 2015 (which later became mandatory).

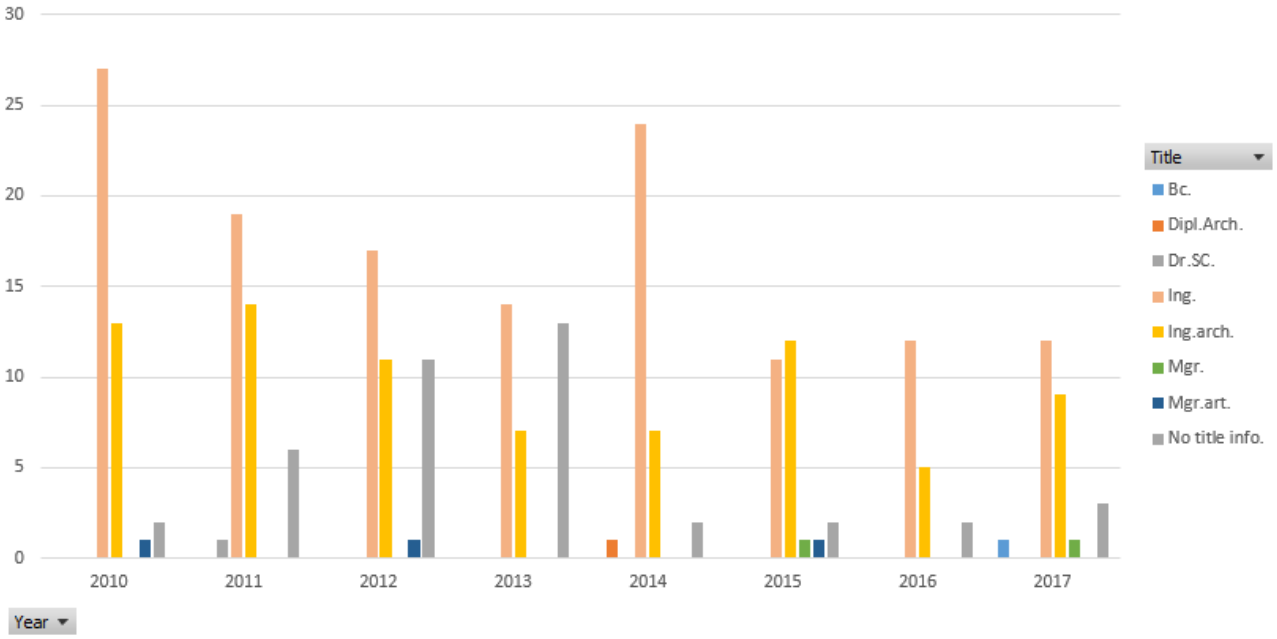

Figure 1: Number of participants according to their education.

Figure 1 shows the participants in the course by year and education. According to the number of participants per year, it is possible to notice the biggest interest in the course was in the first years, with a gradually declining tendency after that. This trend stabilised in 2015. This stabilisation corresponds with the changing legislation requirements for ultra-low energy standard buildings after 2015, a level approaching the passive house standard. The competitive edge for participants, i.e. differentiation in the marketplace, has begun to diminish as the information taught has become more generally accessible.

In June 2015, Tatiana Pifková, a seminar co-ordinator, noting the 2015 situation opined …*it is understandable that the overall evaluation of the course is worsening:*

- *the topic is better known;*
- *study materials have become more and more obsolete;*
- *adequate value for money is required;*
- *all of the enthusiasts have already been through it, now we will probably have participants who take it as being inevitable but they are not enthusiasts so they will be more critical;*
- *[nobody,] not even us will be able to pretend to be pioneers after ten years (iEPD was established in 2005).*

One of the reactions to the changing conditions was to revise the course goals, which originally aimed at energy performance, focusing in particular on the minimisation of energy required for heating. The course was expanded to

include more comprehensive topics of sustainability, design of large structures and various typology of structures in co-operation with a German partner EZA under the project Ochrana klímy prostredníctvom udržateľných stavieb: šetríme zdroje, podporujeme vývoj, chránime klímu (Climate protection through sustainable buildings: saving on resources, supporting development, protecting climate).

Participation in the seminars was often motivated by the economical and ethical requirements of the clients. Pifko observed that the requirements for aesthetics, and hence the quality of architecture lagged behind, and so such buildings were in the beginning called *efficient boxes* [1]. As stated by Špaček and Šíp, …*Architecture can first* claim *to be sustainable because of its beauty, quantifiable parameters can only come second* [2]. Therefore, the course was expanded to include a session on architectural principles of sustainable buildings led by Ing. arch. Jan Pokorný.

With the more frequent and more intensive summer periods and gradual warming tendency, it was necessary to put greater emphasis on thermal stability of well-insulated buildings during summer. Without the use of passive cooling systems, overheating in such buildings is greater than in standard insulated buildings [3].

Passive night cooling may be adequate for buildings in the northern part of Slovakia, which is forested and at higher altitudes and which generally is cooler. However, in the southern and south-west parts of the country, it is necessary to use active systems for protection against summer overheating, such as shading of transparent structures, in addition to passive strategies.

Although a module for the summer thermal comfort balance was included in the PHPP programme from the very beginning, with the localised PHPP 9 version 2016, this area required greater detail, but with certain limitations. The PHPP calculation program is based on a monthly calculation, which results in greater inaccuracy. The updated localised version of the software was made part of the modified seminar. It enables the architects to evaluate the building from the perspective of both winter and summer comfort at an early stage and adjust the overall building design accordingly, especially the design of transparent structures.

Table 2: Content of the (innovative) seminar as of 2016.

Introduction to design
Architectural principles of sustainable buildings
Current legislation
Construction, thermal insulation
Airtightness and quality assurance
Windows, doors and glazed walls
Airtightness in practice, thermal bridges elimination
Ventilation
Renewable energy sources
Heating and cooling
Calculation methods, PHPP 9, *design* PH
PHPP workshop

Questionnaires are used to assess the seminars. Figure 2 shows the attendance and number of completed questionnaires (y-axis) by year (x-axis). The results from the questionnaires are shown in Table 3.

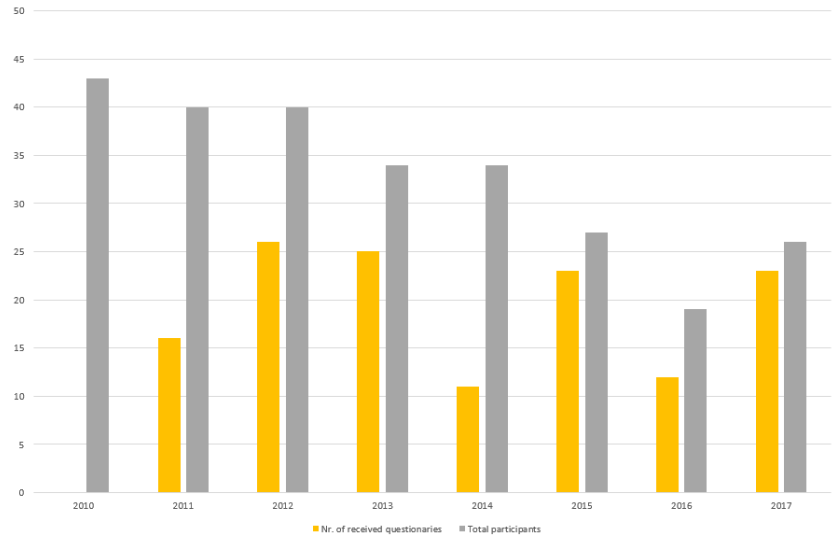

Figure 2: The number of filled-in questionnaires; number of participants by year.

Table 3: Results of the filled-in questionnaires.

Course No.	PDC 3	PDC 4	PDC 5	PDC 6	PDC 7	PDC 8	PDC 9	PDC 10	PDC 11	PDC 12	PDC 13
Year	2011	2012	2012	2013	2013	2014	2015	2015	2016	2016	2017
Quality of printed materials	1.56	1.0	1.31	1.25	1.28	1.33	1.33	1.25	1.17	1.17	1.18
Overall satisfaction	1.38	1.15	1.46	1.5	1.17	1.17	1.75	1.17	1.0	1.36	1.0
Course duration	1.71	1.4	1.44	1.5	1.83	1.64	1.33	1.73	1.0	1.73	1.4

CONCLUSIONS

Despite the innovation of course content and efforts made to meet the needs of architects, there are still barriers, when considering the comfort criteria for users. Making assessments using the PHPP methodology requires laborious entries of a building's shape in a Microsoft Excel spreadsheet table. Although the designPH add-on attempts to solve this problem, since it can communicate with the SketchUP platform and allows for data export to PHPP (Passive House Planning Package), it is not possible to assess the summer thermal comfort situation easily and quickly.

An hour's calculation is a barrier; as compared to the monthly based calculation used in PHPP. This restricts the scope of application to residential buildings and smaller office/administration buildings without significant transparent surfaces and internal heat gains. The solution would be to switch to a 3D object design, with add-on modules enabling the maximum accuracy in the design phase of an architectural study.

The greatest added value to the seminars was the participants themselves. The varied composition of attendees in terms of their professional focus and experience facilitated finding innovative solutions in their interaction and group work. Hence, in the authors' opinion any quality education covering principles of sustainability must take place in an interdisciplinary team. A narrow specialisation on a single target group or profession will yield only partial results. Similarly, regarding the design, it is necessary to enhance the methodology of integrated design, which is still fragmented nowadays. If the university wishes to deliver education on this topic, it should consider the introduction of complementary fields of engineering studies.

REFERENCES

1. Pifko, H., *NEED Navrhovanie Energeticky Efektívnych Domov*. Vydavateľstvo Eurostav, spol. s r.o., 268 (2017) (in Slovak).
2. Špaček, R. and Šíp, L., Architektonická identita energeticky úsporných budov. *Stavebné Hmoty*, 7, **3**, 22-26 (2011) (in Slovak).
3. Feist, W., Das Passivhaus - Konzept fur den Sommerfall. Protokollband Nr.15, PassivhausInstitut (2006) (in German).