BIM проектиране в съвременното академично обучение по архитектура – аспекти и бъдещо развитие

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BIM design in contemporary academic education in architecture – aspects and future development

Emil Mihov

Abstract:
Building Information Modeling (BIM) is an intelligent process for 3D modeling and management of construction information that enhances design, operation, and decision-making throughout the entire life cycle of buildings and facilities. The adoption of BIM is transforming architectural design and plays an important role in university-level architectural education. This article examines the current state of academic training in this field. It explores the prospects for its development in response to the expectations of professional practice, good practices and trends from international academic experience, as well as the challenges associated with their implementation.
Keywords: BIM, architecture, computer technologies, education

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INTRODUCTION

The digital transformation in architecture and construction over the past two decades has introduced new requirements regarding the approach to designing, building, and managing the built environment. At the core of this transformation lies the methodology of Building Information Modeling (BIM), an integrated process for creating and managing digital information models of buildings and infrastructure. BIM enables a multilayered representation of the architectural concept, technical systems, and construction processes within a shared coordinated environment, significantly improving the efficiency and quality of design, execution, and operation. The integration of BIM technologies into architectural practice requires a rethinking and adaptation of architectural academic education.

The implementation of modern information technologies in investment design and architectural practice has been the subject of various academic studies [1], [2], [3]. The topic of adapting computer-based education in architectural education has been explored by both international [4], [5] and Bulgarian authors [6].

ESSENCE OF BIM DESIGN

BIM design is a process of creating and managing a digital model that includes comprehensive information about the physical and functional characteristics of a building. Unlike traditional 2D or 3D design, BIM provides an integrated platform for collaboration among all stakeholders in the construction process—architects, engineers, and contractors. BIM revolutionizes the way architectural projects are presented and coordinated by enabling design and decision-making in a virtual environment.

The main advantages of BIM include improved coordination, reduction of errors and inconsistencies, cost and time optimization, the ability to perform simulations and

analyses in the early design stages, as well as traceability and management of the building throughout its entire life cycle [3].

Compared to a traditional workflow, BIM-based processes require more effort during the early design stages, but subsequent changes are easier and less costly, and decisions are better informed through simulations and analyses (Fig. 1). It is important to note that, despite the many benefits offered by an integrated BIM process, the technology is merely a tool that facilitates but does not replace the design process itself.

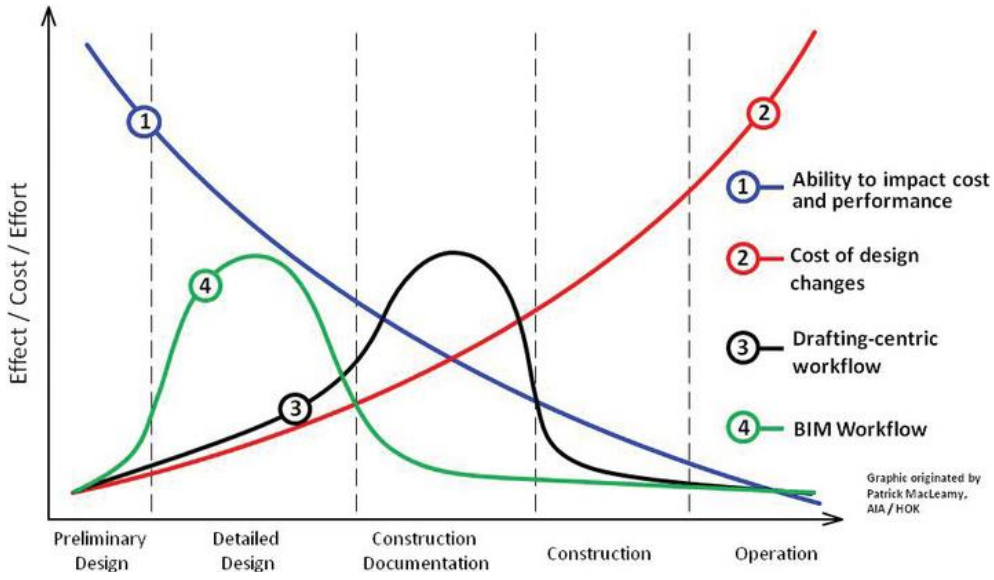

Fig. 1. MacLeamy Curve – BIM vs. traditional workflow [7].

BIM design is becoming established as a leading practice in the contemporary global architectural field. The technology is widely adopted as a standard working method by architectural studios and engineering companies (Fig. 2).

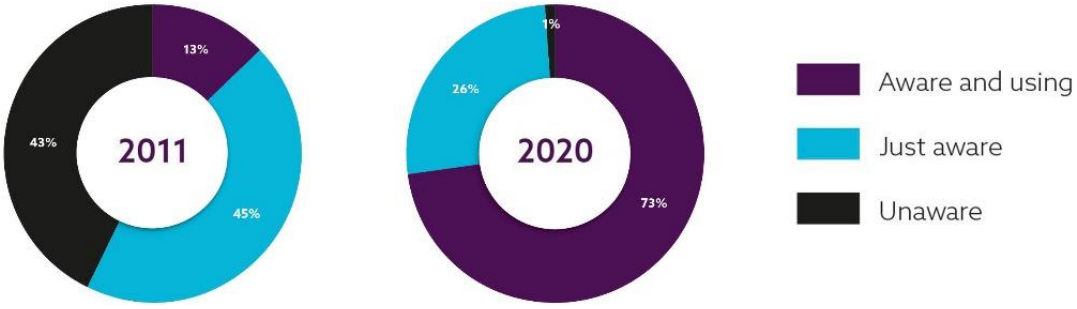

Fig. 2. BIM adoption over time in UK [8].

Furthermore, in many major world economies, regulatory frameworks have been introduced or are expected to be introduced, that mandate the use of BIM in public projects above a certain budget or floor area. Examples of countries with such requirements include Singapore (2015), South Korea (2016), the United Kingdom (2016), Italy (2019), Germany (2020), and Dubai (2024). According to the National Strategy for the Transformation of the Bulgarian Construction Sector (2023), the implementation of BIM in investment design and construction is planned by 2030 [9].

ACADEMIC TEACHING OF BIM

The widespread integration of information technologies, and in particular BIM, into architectural practice is encouraging the training and further qualification of specialists in the field. As a natural response to this trend, academic institutions are also integrating BIM-related courses into their curricula.

An example of introducing computer-based education into an academic program is the development of the curriculum at the University of Architecture, Civil Engineering and Geodesy (UACEG) in Sofia. Computer education there began in 1983, when the discipline "Automated Methods in Architectural Design" was introduced into the curriculum of the Department of Industrial and Agricultural Buildings [6]. Since then, various information technologies and software tools have been taught as part of either mandatory or elective courses. BIM was initially taught within an elective course in computer-aided design – "Archicad", and since the 2016/2017 academic year, it has been included in the newly introduced mandatory courses "Computer Technologies – Part I" and "Computer Technologies – Part II", offered in the 5th and 6th semesters respectively. Elective courses on the topic are also available during the 9th and 10th semesters.

Current state

The Architecture program in Bulgaria is offered at the following universities:

- University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia;
- New Bulgarian University, Sofia;
- Higher School of Civil Engineering “Lyuben Karavelov”, Sofia;
- Varna Free University “Chernorizets Hrabar”.

According to the current curricula of these four universities, all include a mandatory basic course lasting from two to three semesters. These courses provide an introduction to the software and basic modeling guidelines. Subsequently, elective courses offer opportunities for further specialization in the subject. At UACEG and Varna Free University “Chernorizets Hrabar,” a Master’s program titled “Management and Optimization of Investment Projects in Construction through BIM” was introduced in 2021 [10].

Good Practices and Development Prospects

Good practices in academic BIM education in architecture can be found in several leading international universities. Examples that can serve as guidelines for future development in the field include the following:

1. Expanding the range of elective courses for deeper specialization. Current academic training in Bulgaria focuses on 3D modeling but does not cover data exchange, quantity take-offs, or international BIM standards (ISO 19650, EU BIM Task Group Guidelines, etc.).

2. Introducing courses that encourage teamwork – both among architecture students and among students from different disciplines. Teamwork is an essential part of real-world architectural and construction practice but is rarely addressed in academic education.

3. Implementing multidisciplinary projects that require in-depth collaboration between students from different fields – architecture and engineering specialties. An

example is the “Integrated BIM Design Lab” at TU Vienna [11]. Within this course, students work in interdisciplinary teams consisting of representatives from various fields – architecture, civil engineering, and building services – with the aim of developing a shared integrated BIM model of a specific building.

4. Establishing a dedicated academic unit focused on up-to-date education in the digital domain. Digital technologies in architecture include not only BIM but also fields like parametric design, 3D printing, and artificial intelligence [12]. To ensure an academic environment for exploring innovations in the field, it is appropriate to concentrate efforts within an independent structure with a focus on digitalization. Examples include the Institute for Computational Design and Construction at the University of Stuttgart (founded 2008) and the Chair of Architectural Informatics at TU Munich (founded 2021).

Challenges

Information technologies, and BIM in particular, are developing rapidly, making it difficult for academic education to keep pace. The main challenges accompanying this process include the following:

1. Providing technical infrastructure – it is necessary to ensure both licenses for software products (e.g., Archicad, Revit, Allplan) and laboratories equipped with high-performance computers.

2. Availability of different software products – globally, with some regional preferences, two main BIM modeling platforms have become dominant: Archicad and Revit (Fig. 3). Studying only one of them within the academic curriculum may prove insufficient for the demands of the professional market, while studying both may lead to a certain amount of content redundancy.

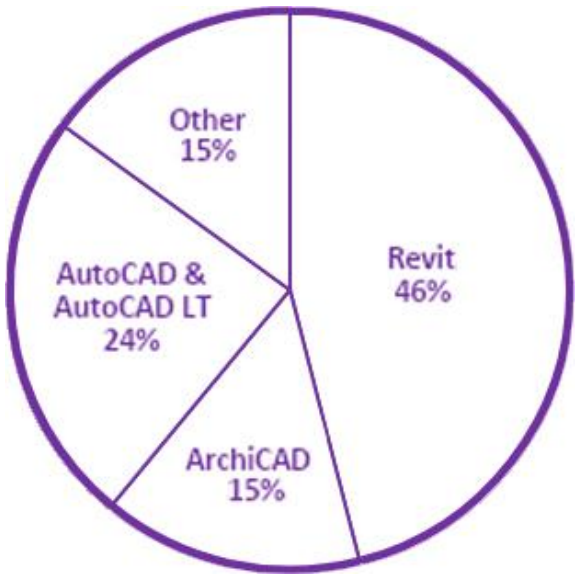

Fig. 3. Share of BIM software used in architectural practice in the UK, 2019 [8].

4. Need for qualified teaching staff – many universities do not have enough instructors with real practical experience in BIM projects. Some faculty members were trained in an era when BIM did not exist, which requires additional retraining.

5. Slow institutional adaptation – updating curricula and accreditations is a slow process that, in some cases, cannot reflect rapidly evolving innovations in the field in a timely manner.

CONCLUSION

BIM design is an integral part of contemporary architectural practice, which requires its adequate representation in academic education. Despite its clear advantages and the availability of good international examples, the continuous updating of the topic within academic practices and content faces numerous technological, pedagogical, and organizational challenges. Achieving full integration of BIM into the educational system requires strategic planning, institutional support, and active partnerships between academia, industry, and the public sector.

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