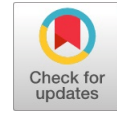# BIM Software in Architectural Modelling

A. Zeynep Onur, Fatemeh Nouban

Abstract: The Computer Models Of Buildings That Contain All The Information About Future Facilities, Which Is Called BIM (Building Information Modeling) Technologies, Took An Important Place In Architectural Offices And Architectural Design. By Means Of BIM Technologies, The Main Groups Of Specialists Had A Chance To Collaborate From The Very Beginning Of The Creation Of The Building Model And Its Use Up To The End Of The Design Of The Building. Since The 1960s, Computer Programs Were Mainly For Drawing, But With BIM Technologies, It Is Possible To Present A Virtual Reality Of A Building Process. Since It Is Extremely Important To Select Suitable Software To Perform The Analysis And Design In Building Tasks, With The Existence Of Much-Specialized Software In These Domains, In This Paper, Based On The Investigations Performed Especially For The Last Decade Developments And Added Capabilities, A Guideline For Architects And Engineers Is Presented. In This Regard Many Software Were Evaluated And The Most Useful Used Ones Such As Graphisoft Archicad, Autodesk Revit Architecture, Gehry Tech., Nemetschek Allplan Architecture, TAD, Nemetschek Vectorworks Architect, Digital Project Designer, Microstation, Dynamo Studio, Freecad Architecture, Sketchup Software Are Recommended To Be Employed In Analysis And Design Of Buildings. Employing The Recommended Software, Not Only Facilitate The Teamwork In Design But Also Increase The Performance Of The Design.

KEYWORDS: BUILDING INFORMATION MODELING, BIM, BIM-TECHNOLOGY, INFORMATION MODELING, NEW DESIGN TECHNOLOGY

I. INTRODUCTION

Architects' language is drawings to express information about a building. Until the 1960s they were done by pencil and ink, then in 1960s CAD (Computer-Aided Design) begun a new tool for those drawings. By means of CAD, drafters had an opportunity to visualize the drawings in a digital environment. From that moment on, the drawings were produced more quickly; allowed faster changes and computers became an integral part of architecture offices. When CAD turned 3D, it made possible to reach even more realistic visual documents [1].

The last twenty years BIM (Building Information Modelling) Technologies changed the tradition of drawing.

AutoCAD represents project components geometrically, it is a drafting tool, but BIM is a modeling tool, that each building component is identified by its function and technical data [2]. With AutoCAD, when you draw a rectangular it might be anything from a house to a room, the geometric shape alone does not give any information about the intended use. Nevertheless, for the same rectangular in BIM software, the intended use of every object has to be specified, it will automatically assign industry-standard measurements and materials [3]. It covers geometry, geographic information, light analysis, spatial relationships, and quantities as well as properties of building components [4].

BIM is a process that uses computer technology to simulate the performance of a building and provide a communications platform between the architects, the construction team and the client [1]. BIM is the digital description of every aspect of the built asset. It is possible to create and manage the information on a construction project across the project lifecycle that enables optimizing the actions of all actors involved in the construction process.

Talking about a BIM object means talking about a combination of many things such as the product defined by information content, the physical characteristics of the product by means of geometry, thermal performance by means of product properties, recognizable appearance by means of visualization data given to object and functional data [5].

BIM made it possible to collaborate on the planning, design, and construction of a building within one 3D model [1]. That means integrating all of the information that is required to carry out each specific activity in a virtual model. In the BIM model, nothing might be arbitrary to perform all intended activities and analyses [6].

When all the constructions were made in AutoCAD, all the information was needed to enter manually; BIM software enables to calculate the mass of a building, the number of materials needed in an instant, and its overall cost [4]. By means of BIM software, information is more easily shared, improved and innovative solutions will enable better designs, whole-life cost and environmental data will be controlled, with flexible documentation products will be more qualified, and automated assembly will be possible [7]. Recently, more engineers and architects employ BIM. Because BIM encourages a more collaborative environment. It also has a high focus on sustainability and creating more environmentally friendly buildings [8].

BIM is a single digital model of a building that everyone; architects, client, suppliers, builders, environmental managers can work on. Firms can use BIM methods to create more environmentally friendly buildings; and also, decreases much of the manual work and save money [9].

BIM software might use for different purposes as listed below [10]:

For architecture:
• Autodesk Revit Architecture
• Nemetschek Allplan Architecture
• Graphisoft ArchiCAD
• Gehry Tech. - Digital Project Designer
• Bentley Architecture
• Nemetschek Vectorworks Architect
• 4MSA IDEA Arch. Design (IntelliCAD)
• Softtech Spirit
• CADSoft Envisioneer
• RhinoBIM (BETA)

For structure:
• Autodesk Navisworks
• Vico Office Suite
• Solibri Model Checker
• Vela Field BIM
• Tekla BIMSight
• Bentley ConstrucSim
• Synchro Professional
• Glue (by Horizontal Systems)
• Innovaya

For sustainability:
• Autodesk Ecotect Analysis
• Graphisoft EcoDesigner
• Autodesk Green Building Studio
• IES Sol. Virt. Environment VE-Pro
• Bentley Hevacomp
• Bentley Tas Simulator
• DesignBuilder

For statics:
• Autodesk Revit Structure
• Tekla Structures
• Bentley RAM, STAAD, and ProSteel
• Bentley Structural Modeler
• CypeCAD
• Nemetschek Scia
• StructureSoft Metal Wood Framer
• Graytec Advance Design
• 4MSA Strad and Steel
• Autodesk Robot Structural Analysis

For mechanics and electricity:
• Autodesk Revit MEP
• Bentley Hevacomp Mech. Designer
• 4MSA FineHVAC + FineLIFT + FineELEC + FineSANI
• Gehry Techn. - Digital Project MEP Systems Routing
• CADMEP (CADduct / CADmech)

For Management:
• Bentley Facilities
• Vintocon ArchiFM
• FM:Systems FM: Interact
• EcoDomus
• Onuma System.

This article introduces the most used BIM software mainly for architectural purposes.

II. METHODOLOGY

The characteristics, limitations, application, technical capabilities, ability to be adopted for new design methods, the ability of work by a design team, quality of architectural presentation and design of the BIM software in architectural modeling were investigated. Based on the carried out study, eleven software were designated and an important guide comprising all needed information for architects to select the suitable software to model and design the architectural aspect in buildings' design is submitted. In this research, the aspects listed below were applied as the leading criteria for the assortment of suitable software:

- The capability of modeling the buildings having any size and shape easily,
- Flexibility in editing the generated model,
- Categories of analysis supporting,
- The simplicity design process,
- Presenting good performance,
- Ability to be used at the same time by a design group.

Based on the mentioned criteria (similar to the criteria applied by Onur and Nouban as well as Sadeghi and Ghaboun [11, 12], a broad guide for selecting the software to model the buildings with BIM software is submitted.

III. SELECTED SOFTWARE

A. Sketch-up

Operating System: Windows 7 and later, MacOS

Sketch-up is a software preferred by professionals as well as design students because of its accessible 3D modeling program. When a user simply draws the edges of the desired model, software fills the shapes to create 3D geometry [13]. Since sketch up is a 3D software, it can be used as a BIM program with plugins. Sketch up allows compiling one's own BIM software that fits one's needs. For example, PlusSpec plugin makes it possible to create a bill of quantities, to create complex structures, allows you to move doors, windows, even walls. Another plugin, OpenStudio, supports Sketch-up to help to design energy-efficient buildings. 4D Virtual Builder plugin allows to plan the Project throughout the entire life-cycle from the various construction phases, furthermore, it makes possible to create animations and renders to communicate with all teams at the different stages. Therefore, it is possible to use Sketch Up as a BIM tool by means of those plugins [14].

B. Allplan

Operating System: Windows 7 and later

Allplan has been developed by the architectural firm Nemetschek. The 16 brands that have common four characteristics as Open, Innovative, Focused and Solid operate independently. The Open BIM method, enables open standards, and the information processing ensure the exchange of data between all the professionals involved in the building process, for the solutions to Innovative challenges, cooperation projects with universities is one of the very important issues, the

Focus on Architecture, Engineering and Construction is for the solutions of the customers, and all the brands have been connected as a Solid group [15]. Since Allplan Architecture is being used for the creation of 3D models, Allplan Engineering Building meets with the needs of structural engineers. Allplan BIM Plus is the 3D architecture software, is the BIM platform for all disciplines to collaborate all the data from engineering and architecture tools that planners and builders can visualize the building in virtual reality [16].

C. Microstation

Operating System: Windows 7 and later

Microstation is a CAD software by Bentley, and it has extensive BIM capabilities, so it can be used as a software application and also as a technology platform [17]. Therefore, it enables the professionals to communicate and collaborate more efficiently. BIM tool of Microstation is so effective for larger projects. It can be seen easily view, model, document, and visualize projects of any size or complexity. It allows us to use all CAD capabilities and visualize information-rich 2D and 3D designs of all types and scales [18]. Microstation also allows analyzing the models to understand where interferences might occur to reduce the cost, the deliverables like construction sheets and solar exposure analysis. The software is so flexible to create almost any geometrical shape, moreover, it allows reshaping the design [19]. All professionals might use MicroStation PowerDraft as a companion. It is possible to reach the information related to drawings, schedules, and reports directly from the models. The built reports of object properties are also reachable. Drawings and models in any format might be exchanged.

D. TAD

Operating System: Windows 7 and later

TAD (The Architect's Desktop) software had been originated in Ana Indian architectural firm. TAD software does not cover all of the design processes. Since most of the 3D architectural software overemphasizes the engineering aspect, TAD software is unique to be used from the first concepts and sketches [20]. Since all the BIM solutions were developed according to the needs of the AEC industry, TAD is actually developed for architects and architectural design [21]. It has been designed for senior architects who create the concept of the buildings. TAD can perform BIM operations like calculating quantities [22] We may list the TAD benefits such as; offering early-stage designing and BIM tools, design right from early stages, not enforcing any methodology, dealing on the logical volume of space, not to force first decompose shape in your mind, allows editing, offers probation at the very inception of design projects, helps in iterations, producing alternatives for the same Project, fast draft views, small size files, collaborative design environment allows more than one architect/ Professional working on the same project at the same time [23].

E. Dynamo Studio

Operating system: windows7 and later

Dynamo Studio it is possible to explore parametric conceptual designs and automate tasks by means of a visual logic-programming environment [24, 25]. In Dynamo there are graphic elements called nodes. For visual programming, there is Dynamo Sandbox that is an open-source environment.

To customize your building information workflow DynamoRevit is a graphical programming interface. For engineers and designers, Dynamo for Civil 3D is the visual programming platform. Concept variations might be realized within the Alias workspace. For a new breed of conceptual design, Dynamo for FormIt combines computational design power solid modeling environment. To improve modeling productivity Advance Steel adds in the computational design power of Dynamo to generate complex structure using native beams and plates [26].

F. FreeCAD

FreeCAD is a multiplatform, produced to fit a wide range of uses and users. Any user from a hobbyist to a professional CAD user might be comfortable with the software. The advantage of FreeCAD is that objects as walls, floors have not been restricted as stereotypical shapes, so it is easy to connect the horizontal and vertical planes. It has been designed around parametric modeling, so it is so easy to modify the design by changing parameters. There are important components of FreeCAD such as OpenCASCADE, Coin3D library, Python and Qt [27].

G. ArchiCAD

Operating system: Windows 7and later, MacOS 10.9 or later

3D architecture software ArchiCAD has been developed by Hungarian Company Graphisoft in 1982 and it was developed for the Apple Macintosh. ArchiCAD was the first CAD product for the personal computer and also is the first implementation of BIM [28]. Laboratory of Spatial design, develops software add-ones such as; LabPP_Landscape for landscape design, LabPP_Solaris for accounting, LabPP_Calc, for fast calculations, fort the master plans, LabPP_GenPlan, for the definition of insolation, Labpp_Insolation, LabPP_Automat is for aromatization and for interactive geometry, LabPP_GoodwinGDL. By means of those add-ones, it is possible to extend the necessary function [29].

H. BricsCAD BIM

Operating System: Windows, MacOS, and Linux

BricsCAD BIM is a 3D architecture software, is an ideal solution to work on large projects [30-32]. It is possible to store Project files in the cloud makes accessible to all participants. Metadata and geometry might be viewed by all team members in an online 3D viewer. There are some sophisticated tools that make it possible complex structures and any revision might be made without the need to redraw. To help the engineers to quickly block out the basic building structure, the structural tool classifies linear solids as columns, railings, etc. [33].

I. Revit

Operating System: Windows

Developed by Autodesk, Revit software is among the most popular in BIM applications. By cloud computing, it enables every member of the team to access to the information needed.

It allows the designer to design singular models and employs cloud computing to make sure all members of the design team have access to the information that they require. Revit BIM software retains data and adapts to the related changes. From one model, it is possible to extract other drawings. Any change in the 3D model will be reflected in 2D drawings or vice versa. There will be no need to go through drawings to ensure everything matches up, meaning to save a lot of time. BIM software is suitable for architectural, mechanical, plumbing, electrical, electronics and communications projects, structural and construction coordination and documentation [34].

J. Digital Project

Operating systems: Windows 7, Windows Vista, Windows XP

Digital Project is a software developed by Gehry Technologies is able to interface with other systems and enables architects to build BIM and CAD models regardless of geometric complexity. When the architect establishes the skeleton, the structural engineer would dimension and build the columns then the cladding fabricator would build a model of the cladding system and integrate. All the professionals would be connecting to each other, deriving information and contribute back to the model [29]. These capabilities allow exchange with other software products. The software makes it possible to create and combine CAD and BIM models from the city scale to the construction detail, build 4D sequences and more. By means of the collaboration from the very early steps of the building process, enables companies to reduce errors, integrates financial and Project management data, and reduces costs.

K. Vectorworks

Operating System: MacOS and Windows

The software Vectorworks was the first CAD software available on MacOS. Then owned by the Nemetschek Group, and again was one of the first a CAD software to explore and introduce BIM capabilities and BIM technology. Vectorworks is not a core use case product, depending on the industry it is possible to choose the VectorWorks product to use. For entertainment performances, the solution will be Vectorworks Spotlight, for architectural landscape design and GIS planning the solution will be Vectorworks Landmark. The ability to sketch products, build models and create an analysis of them the solution will be Vectorworks Fundamentals. For 2D drafting and 3D modeling, the solution will be Vectorworks Architect with full BIM capabilities [34].

IV. CONCLUSIONS

The choice of the BIM (Building Information modeling) models differs according to the purposes of the user. Nevertheless, it is obvious that construction works have to be more collaborative and digital.

The software produced for BIM models offers highly professional specifications for different purposes. Offices have to select the software according to their purposes. For example, the Revit software offers perfect collaboration and communication between all the professionals related to the building, while Windows software is the only operating system. On the other hand, Vectorworks is compatible with Mac. and Windows. With Microstation, there is access to other Bentley applications; meaningfully applying templates to control geometry and data standards and Vectorworks offers several programs for different purposes.

The software have been listed and discussed in this paper intended to guide for firms and students to choose the needed BIM models according to their purposes.

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AUTHORS PROFILE

Prof. Dr. Zeynep Onur
zeynep.onur@neu.edu.tr
Near East University, Nicosia, North Cyprus
Prof. Zeynep Onur is graduated from the State Academy of Engineering and Architecture, Department of Architecture. She has been completed her master degree in MBA from the Academy of Administrative and Economic Sciences and she completed the Ph.D. degree from the Gazi University in Architecture. She has been worked at the Department of Architecture of Gazi University between 1978-2002, then she moved to Cyprus and has been worked at the Girne American University between 2002-2011, she was the Dean of the Engineering and Architecture Faculty. Between 2011-2016 she was the Dean of Faculty of Architecture of the Çankaya University, and between 2011-2016, she was the Dean of Faculty of Architecture at AHEP University in Turkey. Professor Onur has had experience as a coordinator in the design studio "Basics of Design" the first year of architecture education. She has published many papers and attended many international conferences. She is a Member of the Board of Directors of the International Association of Semiotic Studies (IASS) as a Representative of Turkey. She has been organized several conferences in different Universities related to Visual Semiotic Studies. She has been established and still coordinating the 3rd Age University both in AHEP and GIRNE Universities. She received the "Asia Region Award" for the work of "Ankara Meeting" from the International Competition "Convivial Spaces," organized by the United International Architects (UIA). Currently, she is the Dean of the Faculty of the Architecture at Near East University in Cyprus.

Assist. Prof. Dr. Fatemeh Nouban
fatemeh.nouban@neu.edu.tr
Civil Engineering Department, Near East University, Nicosia, North Cyprus
Dr. Nouban has received her Ph.D., MSc and BSc degrees in 2015, 2005, 2002 from GAU/Cyprus, IAU/Iran, IAU/Iran, respectively. She has proposed two new analytical models and algorithms in the construction management field. Dr. Nouban has worked as project manager and supervisor in the construction of buildings, also as an expert in the preparation of the contracts' documents. Over 25 articles have been published from her works in the SCI journals, Scopus Indexed journals, and international journals. Dr. Nouban has researched/taught in different universities. She is currently is an Assistant Professor in Civil Engineering at Near East University.