IJEE 0973-7383 Volume-7 • Number-2 Jun -Dec 2015 pp. 53-59 Impact Factor 2.5 available online at www.csjournals.com

Recent Advancements in Architectural Design Visualization through Computer Simulations

Neha Yadav

Assistant Professor, Department of Architecture, DCRUST, Murthal

Abstract: With the advancement in modern computer technology, several Building Information Modeling (BIM) and Building Performance Simulation software are available in the market which overpowers the traditional architectural design visualization system that uses scaled 2D drawings (plans, elevation, sections, perspective view etc.), scaled building models, animated walkthrough which looks un-interactive and mechanical if not done in advanced production software. This paper explores new possibilities in interactive architectural design visualization through recent advancement in computer technology in BIM and building simulation technology which favors the augmented reality and virtuality models.

Key Words: ICT; BIM; Augmented Reality; AI; CAAD; CFD; Building Simulation; Architectural Design Visualization.

Introduction

Architectural Design Visualization (ADV) reflects the recent transformation of ICT in architectural world. Building BIM (Building Information Modeling) is an important tool for managing complex interactions among customer and designers in order to level all of the project's restrictions and requirements. The evolution of BIM seems as the “backbone” for recent ADV and also it become easier to satisfy the clients and stakeholders with the detailed concept and architectural design. Conventional ADV system uses either static perspective images or 3D CAD models which is time consuming and therefore, expensive to work on and lacking in stakeholdersinteractive communication and also has limited reusability. Even the 3D animated walkthroughs, which intern seems less attractive and cold unless done in advanced production Software (Wang, 2014).

In the past decades, there had been an increasing interest in Architecture and building sector by using ICT in the form of BIM. Studied had been conducted which uses both BIM+AR together it called BAAVS to reduce time and increases efficiency of the 3D modeling effect (Wang, 2014). 2D shows the basic design whereas 3D shows the relation between surroundings and building with all details. In 2D errors occur at time of construction because of misunderstanding and 3D is a clear building model at small scale. Geographic Information System (GIS) provides geographical information of place and BIM provides information of building utilities. BIM gives a virtual 3D of the design work we are doing. These software help in developing design schemes, property marketing and information facilities. The 2D and 3D’s are used to show the compatibility of the design to owner. Even small details can be taken care of the building height, services, colour, texture, form etc. It reduces the designing cost. Augmented Reality (AR) gives the effect of reality like one is walking in the project (walk through), geometric and non geometric building information. The BIM+AR transform information into modeling system. It is helpful in 3D printing.There are many drawbacks of conventional architectural manifestationsthat has a direct impacton building performance and its application (Kalkofen et al., 2009). Above mentioned issues incorporate many issues like difficulty in surveying plan of the respective buildings according

to environment, very much time consuming,the expense of creating showcasing material for a property offering is significant, and the data mix is limited.

Difficult to-survey idea plan in respect of building encompassing environment

Planners must give basic representations to the owner for approval at the idea planning stage. One of the most important aspects of these representations,its purpose was to give the owner a basic idea of the structure's compatibility with the surrounding environment.such as rapprochement with the local humanistic society, building style and environment coordination

Two-dimensional drawing is the basic structure to demonstrating the fundamental format of all ranges of the proposed fabricating plan; notwithstanding, the proprietors can just get basic engineering geography data showing and building area design in two-dimensional drawing. It is difficult to exhibit and appraisestructure/building concordance with encompassing environment. The connection amongst structure/building and the natural world and relationship between structures are barely noticeable in the customary configuration process. Some product organizations are committed to creating virtual reality to envision ventures, while single hindrance of the implicit the truth is that it neglects to accomplish association between genuine encompassing environment and virtual subjects.

Highly time consuming and costly

An architectural scale-model is a physical depiction of a structure/building that is build or utilized to convey outline proposal to customers. Be that as it may, the technique for assembling building scale model is tedious and work concentrated. Fashioners use proficient model creators and impart their configuration thoughts to get a perfect model. Every item is manufactured by hand or machine during the process, and any minor errors would result in waste and rework. Furthermore, when the configuration changes, the engineering scale model cannot quickly recreate a new model.3-D printing is a current breakthrough that will quickly create a 3-D sturdy form/model from a computerized outline. First notable issue is that printed material is finite and costly. Secondlythreat significant is that the form/model formed by 3-D printing is finite in size; the bigger the structure that must be created, larger the printer machine must be.

Fever data coordination

Compositional outline is typically displayed in two-dimensional drawings or 3D-scale form/models. The building geometry data display and development system showcase are merely 2D drawings and scale models with no task data. Customers, planners, draughtsman, and temporary workers, among others, are unable to obtain essential data and complete data joining during the development process. Floor plans, rises, and segments are all included in 2D building drawings. The building geometry data is displayed in these illustrations, as well as segment sizes like as length, breadth, and stature. Development is a proceeding of transitioning from two-dimensional drawings to a hard structure, and mistakes are common. Furthermore, because the limitations of two-dimensional drawing programming, the drawings can’t be rebuilt as a result, and whenever an outlining modification occurs, all the attractive sights must be physically upgraded. The drawings used in development projects are frequently outdated or do not preciselyshow the design ideas/concepts. A 3-D scale model is a hard

representation of the growth structure. It’s mostly used for display of a building's appearance, and it lacks a relevant development manual.

Visualization in architectural design

Generally, the most normally utilized technique for design perception was 2D drawings, full-scale mock-ups and scaled physical models of bits of a task (Wang et al. 2014). Koutamanis, (2000), According to him,Computer technologies were altering compositional perception in two major ways.Firstly, was that sophisticated media's accessibility encouraging more extensive and serious computer visualization. The secondly topic was the addition of structural outline to data framework representation. Al-Kodmany (2001) characterized perception advances into two classes: conventional apparatuses (i.e.hand-made sketches, photographs, maps and physical scaled models of building) and visualizing tool (i.e.virtual reality, GIS apping, 3D modelingand building simulations). The accompanying substance concentrates on talking about the electronic perception devices. GIS aping can be characterized as a contiguous information handling framework with 3 imperative segments: spatial database, scientific usefulness and representation ability (Irizarry et al., 2013; Huang et al., 2001). GISapping can give information of location and the building's nearby environment for visualizing architectural design schemes.

Fig.1 Examples of Architectural Design Visualization (Source:architizer.com/blog/7-most-common-architectural-visualization-styles)

BIM in Architectural Design Visualization

Visualisationis a standout amongst theeminentlycritical role about BIM. A number of surveys and studies found that implementing 3-D/4-D BIM/CAD in the construction business has a variety of possible uses and benefits.BIM is digital portrayal of the functional and physicalelements of a facility that supply as a common information. It is based on the life-cycle design technique and encourages integrated cooperation (Jaradat 2012).

Eastman et al (2011) said, BIM alters components and connections of project participants' interactions, reducing cost and time if properly implemented.

BIM is an interactive representation model that eliminates coordination errors and improves overall job quality. BIM stands for Building Information Modeling, and it is a 3-D digital portrayal of building and its construction features. BIM also known “a digital representation of physical and functional characteristics of a facility and a shared knowledge resource for information about facility forming a reliable basis for decision during its life cycle; defined as existing from earliest conception to demolition” (Smith and Edgar 2008). BIM is an IT artefact that models the functional and physical aspects of facility, as well as a common knowledge resource to store information about facility that develops a reliable basis for actions and decisions throughout its lifecycle, which is defined as existing from start of conception to end of demolition. BIM, on the second hand, is concerned with the gaining access and philosophy of managingof shared building and facility data and information.The major goal of BIM, to offer caretakers and installation ownerswith the greatest information for making best value action and decisions and decreasing overall possession costs. BIM is used all day in the facilities lifecycle, from the start of requirements definition to end of the disposal. To achieve a smooth changeover from a traditional strategy to incorporating this latest technology into the project process, facility possessor and project stakeholders (contractors, designers, subcontractors and manufacturers) must plan comprehensively.BIM is regarded as digital representation of the building process often regarded as ‘Virtual Building’ or ‘Integrated Project Modeling’. (Underwood 2009) (“What Is Building Information Modeling (BIM) | IGI Global”)

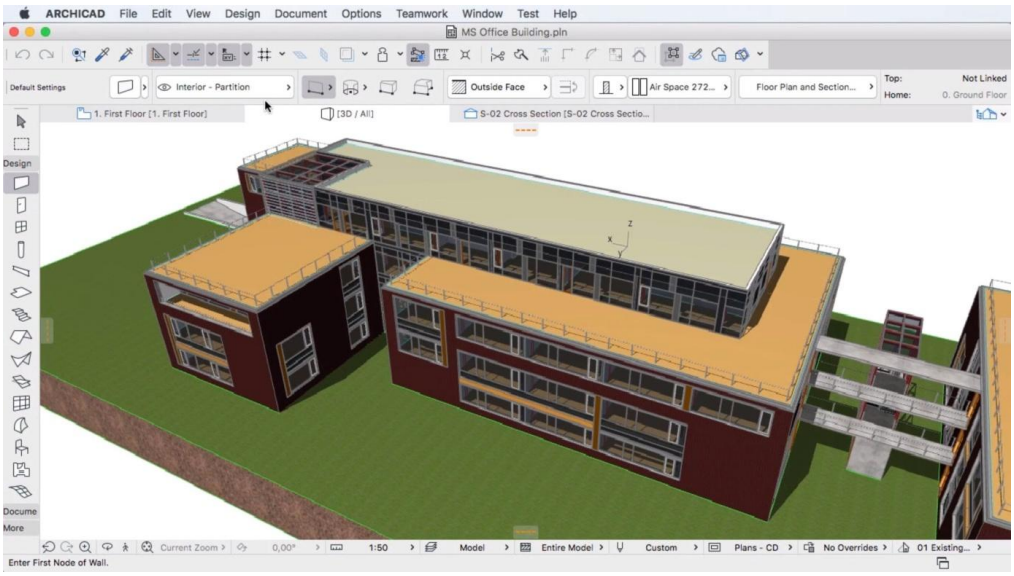

Fig. 2 Application of BIM in 3D Architectural Design Visualisation (Source: http://img.youtube.com /vi/CkejeQwt9Zg/maxresdefault.jpg)

In the Architecture,Construction (AEC) andEngineering industry, BIM used in a variety of ways that is increasing rapidly in the past two decades as it has curtained advantages over the traditional 2D Computer Aided Drafting (CAD) tools and it talks of collaborative planning and design of buildings where Architects, Structural Engineers, MEP and other consultants, Manufacturers, Contractor(s) and Client works together.

Augmented Reality(AR) in Architectural Design Visualization

The use of augmented reality (AR) to over-lay computer visual representations on the tangible environment is a useful perceptual method. In a variety of sectors, a large number of AR applications are developed, tested and implemented.Techniques for combining the actual and virtual learning environments have emerged, opening up new opportunities for innovation design. The evolution of a design studio through an examination of its fundamental educational concepts, from pre-design to design development. The mixing of virtual toreal world to create new domain and visualizations where digital and actual items exist and interacting real time is known as mixed reality (MR). Design studio is the major aspect which collaborate ideas,data, analysis and alternatives to solve design work with one-on-one mentoring between a student andan instructor.

Architectural design studios validate teaching and practise by playing a central role in the thought process, as shown in architecture schools' curricula, such as the Fine Art School in Paris École des Beaux-Arts. Design studio components include mind, reality, media, organization, processes.Mind evolves various stages indulging making or building through various methods of construction and local material processing there stages design as a science stage followed by craft design stage and design by drawing stage. The new media of architecture emerges from mixed reality which includes augmented virtuality, augmented reality and virtual environment.

The Virtual and realworld are major components of architecture education and generate design thinking processes. Architectural education can not only be achieved through studio based learning but also through interaction (student to student, student with professors). Digital design may also enhance students' architectural thought and increase digital technology in field of imaginary world and combining real.

Fig.3 Application of Augmented Reality in 3D Architectural Design Visualisation

Source:www.slideshare.net/GulnazAksenova/augmented-reality-for-architectural-visualisation-26330449

Computer Aided Architectural Design in Architectural Design Visualization

ComputerAided-Architectural Design (CAAD) has become avery important tool in many engineering firms and architectural firms in the last two decades. Adding intelligent features to a CAD system was a necessary step on the road to automation.

CAAD is helpful in making Conceptual Design(s); Synthesis and analysis of data; identifying similarity between characteristics of two projects; Semantic Mapping of Graphical Objects; Electronic Sketch-book; Project Management; Project Control Planning etc.

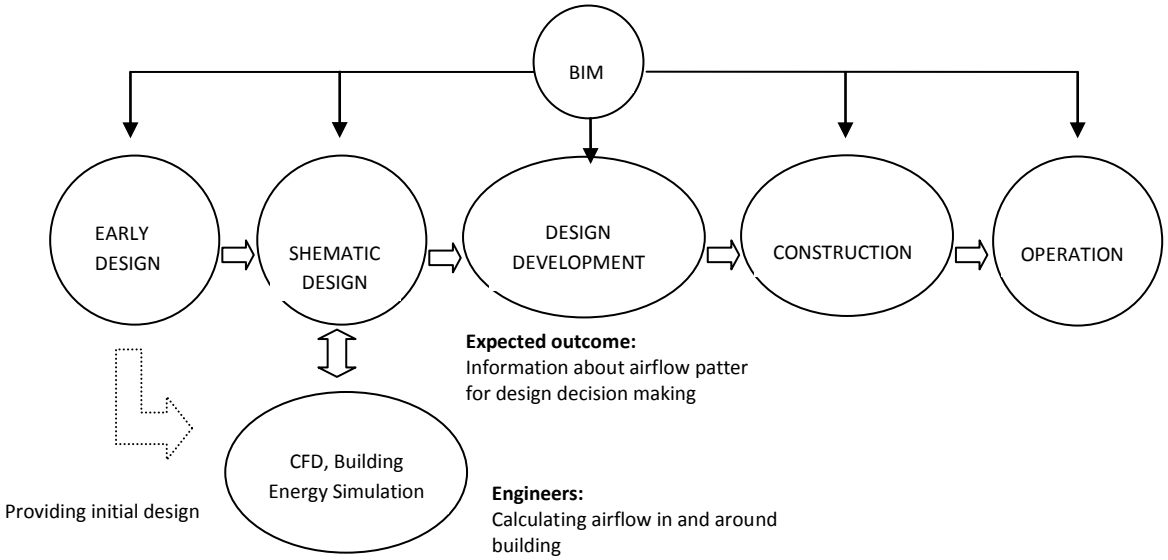

Fig. 4 Application of advanced computer simulations and BIM in building life cycle

Conclusion

The paper focus on recent trends and advancement of computer applications and software in architectural designing and modeling. Various different types of tools and software are available which gives a new and modern approach to enhance architectural visualization in buildings. Due to rapid development in BIM challenging research opportunities are available to existing buildings. BIM is a computerized portrayal of the functional and physical elements of a facility that serves as common knowledge of information. It is based on the life-cycle design technique and encourages integrated cooperation (Jaradat 2012). BIM regarded as a digital portrayal of the building process often regarded as 'Virtual Building' or 'Integrated Project Modeling'.Conventional approach of making drawings in architecture have many issues like difficulty in surveying plan of the respective buildings according to environment, very much time consuming, producing showcasing material for property offerings is expensive, and the data mix is limited, necessitating the use of labour and advanced 3D modelling.For sound Architectural Visualisationof buildings, we have advanced software like CAAD, BIM, GIS and AR etc. To make building more sustainable and energy efficient many software and application are available like eQUEST, Design Builder, EnergyPlus, Ecotect etc. which helps in calculating the load and building requirement so that it is comfortable for occupants and also meet the standard guidelines of energy efficient requirements of building mentioned by Energy Conservation Building Code (ECBC) India.The overall conclusion is that information and communication technology (ICT) has indeed enable us to create more complex building projects better and more broadly than earlier, and more energy efficient architectural expression can be used in construction and designing.

References:

1. Al-Kodmany, K., 2001. Visualization tools and methods for participatory planning and design. Journal of Urban Technology, 8(2), pp.1-37.

2. Eastman, C., Eastman, C.M., Teicholz, P., Sacks, R. and Liston, K., 2011. BIM handbook: A guide to building information modeling for owners, managers, designers, engineers and contractors. John Wiley & Sons.

3. Gopinath, R., 2004. Immersive virtual facility prototyping for design and construction process visualization (Doctoral dissertation, Architectural Engineering).

4. Huang, B., Jiang, B. and Li, H., 2001. An integration of GIS, virtual reality and the Internet for visualization, analysis and exploration of spatial data. International Journal of Geographical Information Science, 15(5), pp.439-456.

5. Irizarry, J., Karan, E.P. and Jalaei, F., 2013. Integrating BIM and GIS to improve the visual monitoring of construction supply chain management. Automation in Construction, 31, pp.241-254.

6. Jaradat, S., 2012, July. The architect's role and the interactions in BIM-enabled projects. In Javernick-Will A, Mahalingam A (2012) Proceedings—EPOC 2012 Conference. Rheden, The Netherlands.

7. Kalkofen, D., Mendez, E. and Schmalstieg, D., 2009. Comprehensible visualization for augmented reality. IEEE transactions on visualization and computer graphics, 15(2), pp.193-204.

8. Koutamanis, A., 2000. Digital architectural visualization. Automation in construction, 9(4), pp.347-360.

9. Omar, M.F., Nawi, M.N.M. and Nursal, A.T., 2014, January. Towards the significance of decision aid in Building Information Modeling (BIM) software selection process. In E3S Web of Conferences (Vol. 3). EDP Sciences.

10. Smith, D.K. and Edgar, A., 2008. Building information modeling (BIM). Natonal Institute of Building Sciences, Washington.

11. Srivastav, S., Lannon, S., Alexander, D.K. and Jones, P., 2009, July. A review and comparison of data visualization techniques used in building design and in building simulation. In Eleventh International IBPSA Conference (pp. 1942-1949).

12. Underwood, J. ed., 2009. Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies. IGI Global.

13. Wang, J., Wang, X., Shou, W. and Xu, B., 2014. Integrating BIM and augmented reality for interactive architectural visualisation. Construction Innovation, 14(4), pp.453-476.