iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** V **Month of publication:** May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5479

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

Role of Computer's Technology: Architectural Design

Ar. Mustakeem Raza Khan[1], Prof. S.K Gupta [2], Ar. Rakesh Kumar [3]
[1,3] Assistant Professor, Amity School of Architecture & Planning, Amity University Haryana, India
[2] Dean & Director, Amity School of Architecture & Planning, Amity University Haryana, India

Abstract: In the age of globalisation, Architects in developing countries have to keep pace with the latest advancements of technology & computing. The use of different soft wares in Architectural design nowadays gives freedom to students/Professional Architects/Academicians to visualize in a better & précised manner, technology today has so many advancements that automation in the design thought processes shows a significant improvements which has not been possible before.
Keywords: Automation, Architectural form generation, Architectural design studio, Design process, BIM, CAD.

I. INTRODUCTION

Although there is a growing literature on the role of computers in education in general, few of these studies focus on the perspective of the educators in architecture. The research that focuses on the educators' perspective in higher education is mostly in fields other than architecture or related with high-school education. Furthermore, the research in the field of architecture has been mostly conducted on how students perceive CAD and how their attitudes differ according to their experiences with computers. In the early 1960s, Alexander (1964) published a highly influential book titled Notes on the Synthesis of Form. In it Alexander quotes the need for rationality in the design process. If design, he argues, is a conceptual interaction between the context's demands and the inadequacies of the form, there may be a way to improve it by making an abstract picture of the problem, which will retain only its abstract structural features. As a mathematician, he introduced set theory, structural analysis, and the theory of algorithms as tools for addressing the design problem. Quality issues can be represented by binary variables. If a misfit occurs, the variable takes the value 1; if not, 0. Each binary variable stands for one possible kind of misfit between form and context. This approach was followed by a flurry of related research into the problem. However, Alexander's contribution was much more far-reaching. He introduced computers into the design process by suggesting which aspects of the design process are amenable to systematization and which are not. Further, he suggested that the design process entails frequent changes of mind (or changes of constraints, in scientific terms) and that a system should permit these changes to occur. One of the areas where the computer can be helpful to an architect is in space allocation, in finding a large number of possible schemes at a sufficiently early stage of the design process, and choosing the best one for further development. An early attempt was MIT's BUILD system [Dietz, 1974] which could be used to describe spaces that might go into a building, indicating their dimensions, their arrangement, and their materials. The computer then arranged the spaces.

In the early 1980s architects began using PC-based CAD. DWG files were exchanged with consultants instead of physical underlay drawings. These files communicated information about a building through their layer structure; a rectangle on one layer represented a concrete column, but on another layer a tile pattern on the floor. The use of CAD files was evolving toward communicating information about a building in ways that a plotted drawing could not. This evolution continued with the introduction of object-oriented CAD in the early 1990s. Data "objects" in these systems—doors, walls, windows, roofs—stored nongraphical data about a building in a logical structure together with the building graphics.

But object-oriented CAD systems remain rooted to building graphics, built on graphics-based CAD foundations, and as a result are not fully optimized for creating and managing information about a building. Another generation of software solutions, designed with current technology and purpose-built, is required to fully realize the benefits information technology can bring to the building industry. This next generation of information-centric software provides building information modeling in place of building graphic modeling.

What is BIM? BIM represents a migration in the architectural design field from two dimensions to three dimensions by creating intelligent, multi-dimensional building models. (Reddy, 2007) Through BIM, designers can enhance their computer projections to incorporate actual materials. BIM shows a building at every aspect of its development and illustrates construction, design and

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

materials in detail. The embedding capacities of BIM make it a dynamic platform and allow multiple groups in different locations to work on projects. (Thomson and Miner, 2007)

There are several slightly differing views of BIM and it's definition. The following are a few of the more widely accepted definitions by the manufacturers of the mainstream BIM software:

A. "A single repository including both graphical documents - drawings - and nongraphical documents - specification, schedules, and other data" – ArchiCAD

B. "A modeling of both graphical and non graphical aspect of the entire Building Life cycle in a federated database management system" – Bentley

C. "A building design and documentation methodology characterized by the creation and use of coordinated, internally consistent computable information about a building project in design and construction" – Autodesk

BIM uses information-rich databases to characterize virtually all relevant aspects of a structure. Parametric modeling is the basis for BIM processes, and the parametric model is data-rich. A parametric modeling system is generated from a relational database containing information regarding attributes of a structure's elements and the relationships among them. The model can be used to generate space calculations, energy efficiency analyses, structural details and traditional design documents.

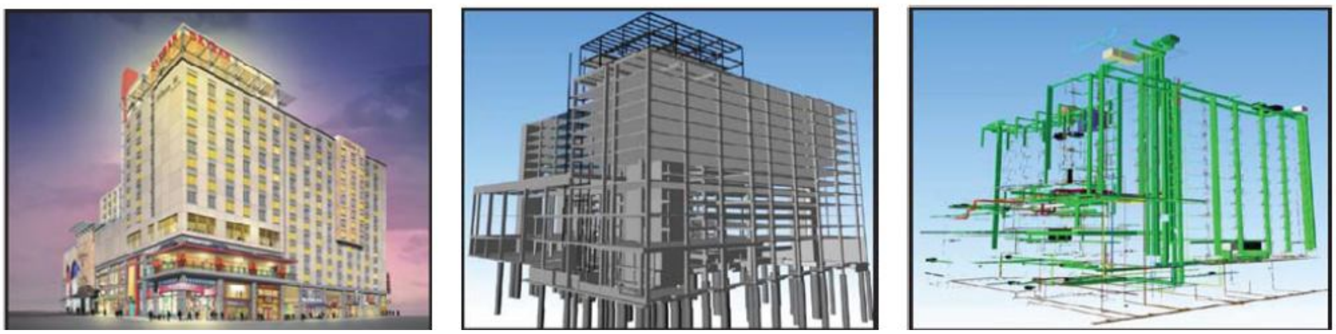


Figure 1, Source: Salman Azhar, Abid Nadeem, Johnny Y. N. Mok, Brian H. Y. Leung, Building Information Modeling (BIM): A New Paradigm for Visual Interactive Modeling and Simulation for Construction Projects.

D. Time Line Of Different Bim Softwares

Table 1- Historical Timeline of Revit® Software Releases

Revit Architecture	Revit Structure	AutoCAD Revit MEP Suite
Revit Architecture 2011 April 2010	Revit Structure 2011 April 2010	AutoCAD Revit MEP Suite 2011 April 2010
Revit Architecture 2010 April 2009	Revit Structure 2010 April 2009	AutoCAD Revit MEP Suite 2010 April 2009
Revit Architecture 2009.1 Sept. 2008	NA	NA
Revit Architecture 2009 April 2008	Revit Structure 2009 April 2008	AutoCAD Revit MEP Suite 2009 April 2008
Revit Architecture 2008 April 2007	Revit Structure 2008 April 2007	AutoCAD Revit MEP Suite 2008 April 2007
Revit Architecture 9.1 Sept. 2006	Revit Structure 4 Sept. 2006	AutoCAD Revit MEP Suite 2.0 Sept. 2006
Revit Architecture 9 April 2006	Revit Structure 3 April 2006	AutoCAD Revit MEP Suite 1.0 April 2006
Revit Architecture 8.1 April 2005	Revit Structure 2 Sept. 2005	
Revit Architecture 8.0 August 2005	Revit Structure 1 June 2005	
Revit Architecture 7.0 December 2004		

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

Revit Architecture 6.1 March 2004		
Revit Architecture 6.0 December 2003		
Revit Architecture 5.5 April 2003		
Revit Architecture 5.1 May 2003		
Revit Architecture 5.0 December 2002		
Revit Architecture 4.5 May 2002		
Autodesk acquires Revit Technology Corporation - April 1, 2002		

(Source: Blythe A. Vogt, Relating Building Information Modeling & Architectural Engineering Curricula)

Table 2: Historical Timeline of Bentley Microstation® Software

Microstation:
1985 - Keith Bentley founds Bentley Systems, Inc.
1986 - Bricsnet's initial architectural modeling software product was developed for IBM UNIX by architect Erik De Keyser. The first CAD software created by Bentley Systems is called PseudoStation and it allowed users to view Intergraph IGDS drawings files without Intergraph software or hardware.
1987 - MicroStation is released with the ability to edit IGDS files. 50% of Bentley is purchased by Intergraph.
1987 - Bentley creates the first version of the DGN file format.
1995 - Bentley develops advanced solid modeling for MicroStation and releases MicroStation 95 for the Windows platform.
1996 - MicroStation/J V7 is released.
1997 - After obtaining Bricsnet's architectural modeling software which becomes the core technology for MicroStation -TriForma, Bentley releases its first BIM application to run on MicroStation.
2002 - MicroStation V8 is released and the DGN file format changes for the one and only time since it's conception.
2007 - Generative Components is released enabling programmable modeling.
2008 - MicroStation V8i BIM applications are released enabling real time views of plans, sections, elevations and clipping planes.

(Source: Blythe A. Vogt, Relating Building Information Modeling & Architectural Engineering Curricula)

Table 3: Historical Timeline of ArchiCAD® Software

ArchiCAD:
1982 **-** Development for ArchiCAD started in Budapest behind the Iron Curtain.
1987 **-** ArchiCAD is released. ArchiCAD is recognized as the first CAD product on a personal computer able to create both 2D and 3D drawings and considered the first BIM product.
2007 **-** Nemetschek AG purchases Graphisoft.

(Source: Blythe A. Vogt, Relating Building Information Modeling & Architectural Engineering Curricula)

II. POTENTIAL OF BIM SYSTEM

Following are the various applications of Bim

A. Teaching Design Method

In the education field, Florio (2007) points the BIM as a tool to aid on new developments and a better understanding of the design process. Students can establish decisions along design phase because it allows the reflection of their actions in data insertion: "The inclusion of BIM in the architecture teaching facilitates the understanding of linkages between construction elements of the building, making it more clear and precise communication of the information and design intentions" (free translation - Florio, 2007). Regarding the design method, BIM allows the student to understand the importance of collaborative project, testing parametric variations of constructive components, nonetheless involving students with capability construction issues whereas modeling provides a better understanding of the operations sequence that are performed by various professionals in the construction site. During the tutorial exercise it has clarified the perception of relationships between the components that were not explicit in the initial sketches. The 3D visualization and the method of construction of the model using components instead of layers make the user reflect on each element to be introduced in the model.

B. Enquiry and Simulation

The 3D model used as an enquiry tool makes possible the solution of problems in early production stages. The BIM allows the understanding of space and surroundings of the building, the projects synergies where the conflicts are automatically listed at the various construction phases together with the implementation schedule allowing review on the construction site definition. This change on the businesses design method, combining the new technologies at all project stages increases the product efficiency and robustness.

C. Collaborative Design

The information management from the BIM model is provided by a repository of standardized information from the construction drawings, which are being added by the various participants in product development, ensuring quality and integrity to the model (Ruschel & Crespo, 2007). The team is divided into groups, and these groups have different rules for access and control the changes of model central data base for the collective validation. The design is based on the collaborative knowledge and experience exchange, where risks, responsibilities and successes came from individual contributions. The easy access to information offered by BIM system allows a better exchange of ideas and to make faster decisions.

D. Information Management

The BIM implementation in an office changes the conventional working method, as the system not only shapes the product, but also includes features such as components, processes and documents. The technology allows the management of the life cycle with integrated information database to a 3D model. According to Christianssen & Sarshar (2004), BIM technology advantages are as follows:

1) Automated documentation, eliminating the risk of working with old version data,
2) Object modeled full understanding, since the details are entered at the initial design stage,
3) Unified database allows all team contributions archiving, and
4) Feedback facilitated by the documents organization.

Moreover, the simulations for thermal, sunlight and sound analysis as construction site workflow are important to implementation decisions, materials choice, among others.

E. Project Management

The project management, combined with BIM technology, facilitates the control of multiple files developed by different designers and promotes better understanding and visual control of the final project.

Project management approach by BIM has three main steps:

1) Project Planning
2) Project Process Management
3) Technical Solutions Management.

The BIM tool provides for the manager ways to coordinate the team, accompanying the changes and new information insertion, information flow control and compatibility process automation. So it facilitates the involvement of several designers from the project earliest stages, regarding the discussion and development of solutions for the project (Fabricio, 2002). The software to assess the process management, monitor schedules, allocate resources, estimate costs, monitor processes, so can efficiently and effectively assist five functions of management (Anantatmula, 2008)), as follows:

4) Document the roles defined in the design and implementation processes,
5) Establish formal and consistent processes,
6) Communicate expectations for processes,
7) Communicate openly with team members, even though virtually
8) Monitor and manage products

F. Interoperability

The BIM system is already present in different software which makes interoperability a major concern for the multidisciplinary work (Crespo & Ruschel, 2007). Various software and modeling analysis of the BIM model, compatible with the standard IFC model developed by the IAI - International Alliance for Interoperability - enables the exchange of information between software architecture and design with intelligence based on the object - such as: ArchiCAD, Revit, VectorWorks Architect, Roland Messerli, EliteCAD, Ecotect e Sketch-up, among others.

The details of the system, as in IFC interoperability, allow different applications to be compatible (Robinson, 2007). The interface of the IFC viewer consists of four sub-windows: a hierarchical objects list and their relationships, a virtual 3D model, a table listing all attributes of a selected object, and a list showing the assessment results (Fu et al., 2006).

III.COMPARISION BETWEEN CONVENTIONAL CAD AND BIM

The principal difference between BIM and conventional 3D CAD is that the latter describes a building by independent 3D views such as plans, sections and elevations. Editing one of these views requires that all other views must be checked and updated, an error-prone process that is one of the major causes of poor documentation. In addition, data in these 3D drawings are graphical entities only, such as lines, arcs and circles, in contrast to the intelligent contextual semantic of BIM models, where objects are defined in terms of building elements and systems such as spaces, walls, beams and columns. A building information model carries all information related to the building, including its physical and functional characteristics and project life cycle information, in a series of "smart objects". For example, an air conditioning unit within a BIM would also contain data about its supplier, operation and maintenance procedures, flow rates and clearance requirements (CRC Construction Innovation, 2007). Figure 2 shows a comparison between the conventional CAD and the 'new' BIM approach.

A. Old Process: Cad

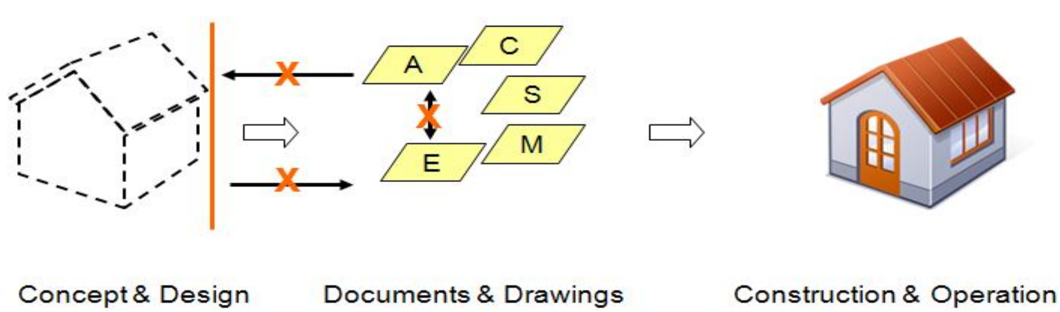


Figure - 2A, Source: Salman Azhar, Abid Nadeem, Johnny Y. N. Mok, Brian H. Y. Leung, Building Information Modeling (BIM): A New Paradigm for Visual Interactive Modeling and Simulation for Construction Projects.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

B. New Process: Bim

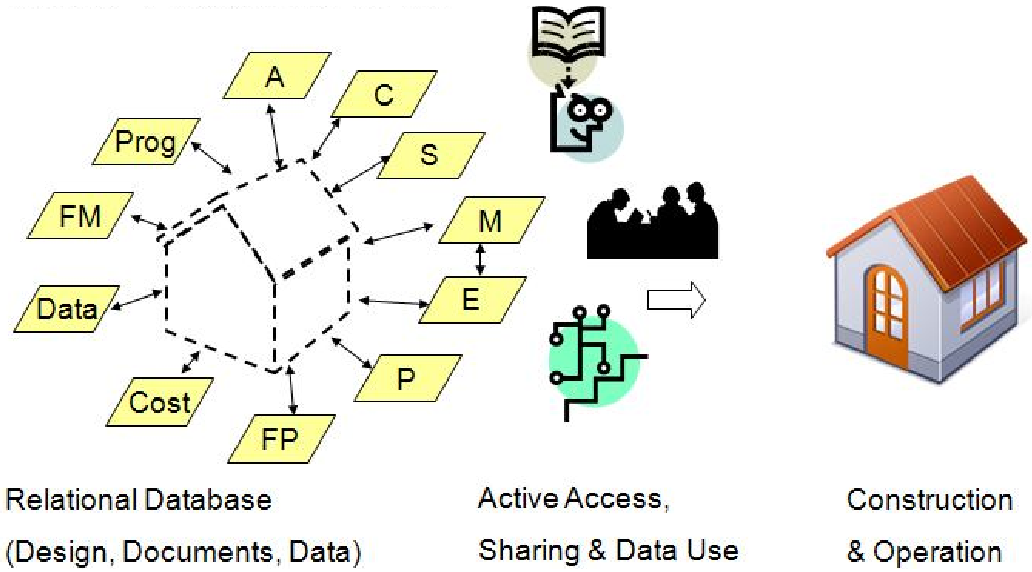


Figure - 2B, Source: Salman Azhar, Abid Nadeem, Johnny Y. N. Mok, Brian H. Y. Leung, Building Information Modeling (BIM): A New Paradigm for Visual Interactive Modeling and Simulation for Construction Projects.

C. A Building Information Model Can Be Used For The Following Purposes

1) *Visualization*: 3D renderings can be easily generated in-house with little additional effort.
2) *Fabrication/shop drawings*: it is easy to generate shop drawings for various building systems, e.g, the sheet metal ductwork shop drawing can be quickly produced once the model is complete.
3) *Code reviews:* fire departments and other officials may use these models for building projects review.
4) *Forensic analysis*: a building information model can easily be adapted to graphically illustrate potential failures, leaks, evacuation plans, etc.
5) *Facilities management*: facilities management departments can use BIM for renovations, space planning, and maintenance operations.
6) *Cost estimating:* BIM software(s) have built-in cost estimating features. Material quantities are automatically extracted and changed when any changes are made in the model.
7) *Construction sequencing:* a building information model can be effectively used to create material ordering, fabrication, and delivery schedules for all building components.
8) *Conflict, interference and collision detection*: because BIM models are created, to scale, in 3D space, all major systems can be visually checked for interferences. This process can verify that piping does not intersect with steel beams, ducts or walls as shown in Figure 3.

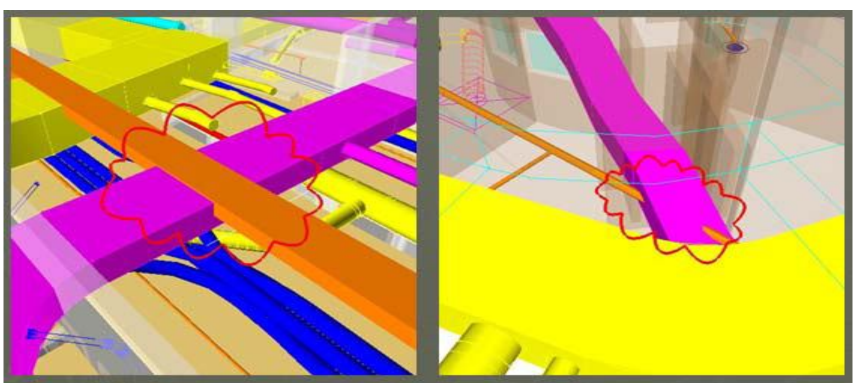


Figure 3: An Illustration of Clash Detections via Building Information Modeling
(Courtesy of: PCL Construction Services, Orlando, Florida, USA)

D. Building Information Modeling (BIM) Benefits

The key benefit of BIM is its accurate geometrical representation of the parts of a building in an integrated data environment (CRC Construction Innovation, 2007). Other related benefits are:

1) *Faster and more effective processes:* information is more easily shared, can be value-added and reused.
2) *Better design:* building proposals can be rigorously analyzed, simulations can be performed quickly and performance benchmarked, enabling improved and innovative solutions.
3) *Controlled whole-life costs and environmental data:* environmental performance is more predictable, lifecycle costs are better understood.
4) *Automated assembly:* digital product data can be exploited in downstream processes and be used for manufacturing/assembling of structural systems.
5) *Better customer service:* proposals are better understood through accurate visualization.
6) *Lifecycle data* : requirements, design, construction and operational information can be used in facilities management.

IV. CONCLUSION

Computerised synthesis – being the generation of formal design solutions with the aid of computers was traced back to 1963. It is thus, one of the oldest applications of computers in architecture. As the time changes Architects start using the advanced software's which not only stores information but also provides automation in design/ construction process. Computers technology revolution has totally changed the Architectural design thought processes of visualizations. The revolution of technology not only cuts down the time but also cost consideration during the construction process. This may lead to further improve the status of Architectural design & construction. It gives a boom to the young fresh minds in the field to use this tool frequently for early coming projects.

We pray to the almighty god, that the computer technology continues to evolve and reach to the new era of software for Architects & town planners to cut short the time frame as well as cost factor for high end projects in near future.

REFERENCES

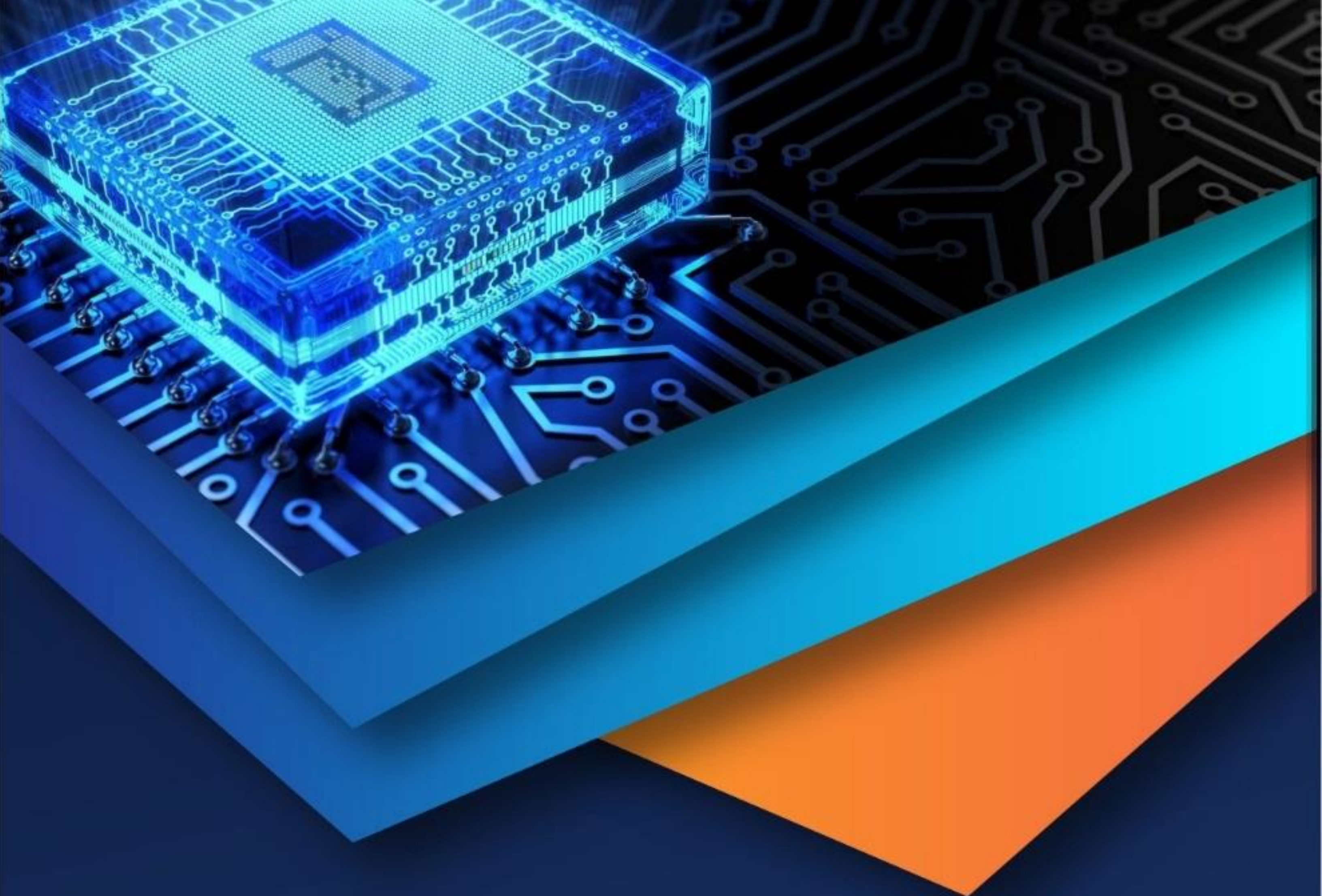
[1] Redefining the role of computers in architecture: from drafting/modelling tools to knowledge-based design assistants by Yehuda E. Kalay - Volume 17, Issue 7, September 1985, Pages 319-328 – ELSEVIER

[2] DESIGN INSTRUCTOR'S PERSPECTIVE ON THE ROLE OF COMPUTERS IN ARCHITECTURAL EDUCATION: A CASE STUDY by Ela ÇİL and Oya PAKDİL.

[3] The role of computers in Architectural design by KOSTAS TERZIDIS

[4] Alexander, C., Notes on the Synthesis of Form, Cambridge: Harvard University Press, 1967.

[5] Blythe A. Vogt, Relating Building Information Modeling & Architectural Engineering Curricula.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY