Analysis of Autodesk and BIM Software towards Architectural Practice

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***Abstract*— Architectural practice started off from hand drawings of basic plans, sections, elevations and working drawings. The architect's ideas were expressed through sketches which are also an important part of learning in the architecture school. Although hand drawing and sketching are the basic training and skill improvement of students, while entering towards architectural practice, modeling and rendering Softwares are the need of the hour. As the technology emerges, need of time saving and accuracy is the most important factor in designing parametric buildings. This research study aims to highlight the importance of Autodesk and Building Information Modeling Softwares in Architectural Practice. These Softwares are commonly used by engineers and designers in automobiles, gaming, mechanical and electrical designing, etc. and the study is limited to Architectural use. The method adopted is literature analysis, popularity in architectural firms and findings with comparative study of the Softwares such as AutoCAD, 3DsMAX, Autodesk Revit Architecture, Sketch up, ArchiCAD, Lumion, Rhinoceros and many more modeling and rendering Softwares. The analysis shows uses, benefits, limitations and differences between them for use and tries to set out their suitability related to factors such as, building typology, requirements, quality and cost.**

Keywords— architecture, interface, modeling, software

Introduction

The strongest mode of communication between architects and construction work is clear and accurate drawings. Visualizing a mass object before it comes into existence becomes possible with clear drawings and views. Architectural Models would express three dimensional buildings to the clients and stakeholders. As changes happen in design, it became time consuming and difficult to remake the whole model. Today, we find many software that provide three dimensional views of the building which saves a lot of time, shows realistic and timeline views with easy changes than the conventional model making. Although it has saved time, there are many software available to use. The cost of software license and features vary from version and type of software. The gap of this research is that how would you choose a suitable software for your firm which will give maximum benefit. The answer to this question lies only when we understand how many software are available, what is the cost of license, how suitable it is, what PC configuration is required and many more parameters will be discussed in this paper. The aim of this paper is to analyze architectural software and its use in Architectural firms. The paper gives an idea of what is the present scenario of use of software to create drawings, views and renders.

Aim: To study the existing architectural software & analyzes its parameters its.

Objectives:

- Literature Study of research articles
- Comparative Analysis of existing softwares used in architecture
- Questionnaire survey in various architectural firms

Research gap: what factors affects the choice of a software in a firm? How has software helped the architectural work? What issued are faced by architectural users?

I. Methodology

The methodology adopted in this research paper is literature review, product review from official websites, questionnaire survey of sample size 30 from architectural firms about the use of software. Google forms were circulated in architects who work in the architectural firms. Responses received give adequate information about type of projects, softwares used in 2D &3D drawings, benefits & drawbacks. This paper analyzes the features, cost, user interface, suitability & other necessary parameters derived from official websites, expert talks & author's observation. The questionnaire survey helps in understanding real time preferences of users. Literature study sets a background to this research & supports author's statement.

II. Types of Architectural Software Available:

A. AutoCAD

AutoCAD (Computer-Aided drawing) is the simplest and commonly used software in engineering and architecture work. [1] It has simple tools for 2D geometry and 3D models, it used UCS – Universal Co-ordinate System. The drafting layout consists of x and y axis. Versions are released every

year with new and advanced features. It can be used in any measurement thus dimensions and Annotation is easier. Basic 2D drawings are done in AutoCAD. It is the first software that became popular after hand drafting. Due to AutoCAD, errors in drawings become less, more accurate drawings are produced, any drawing can be plotted in various scales, line weights and colors can be provided to different layers, 3D objects can be created easily. [4] A startup Architectural firm must at least have AutoCAD to work. The cost of AutoCAD subscription in recent date and version 2022 is approximately 15000 rupees monthly, 1 lakh rupees annually and 3 lakh rupees every 3 years. For a regular working firm, annually or every 3 year subscription is economical. However the cost of software are so high that small firms cannot afford to invest. Economical options are also available sometimes but AutoCAD is been taught in academics and coaching and that makes it popular. The Indian Institute of Architects have launched an optional CAD software. [7]

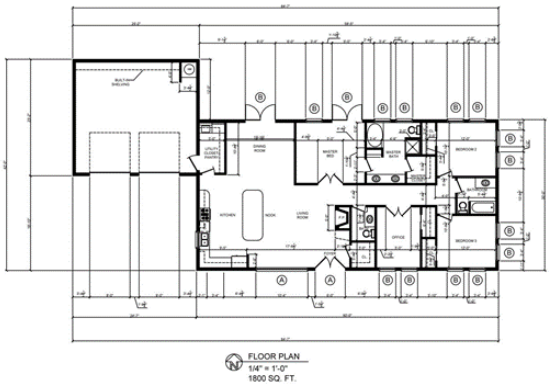

Fig. 1. Example of AutoCAD 2D plan

B. Sketchup

Sketchup by Trimble is a basic CAD software for 3D modelling that can import AutoCAD drawing [5] and generate 3D elements. Sketchup cannot be used to draw 2D plans, it provides all features of 3D and editing. However it has few 2D tools i.e. line, rectangle, arc, free line. Few 2D tools are given to draft the model at x, y and z axis. These are the reference lines while creating a model, if the axis is set n y axis, the 2D tool will create the shape on y axis. Annotation is not suitable in this software. Other advanced feature are, views, styles, adding materials and textures to elements, animation, lighting section, elevation, walkthrough, rendering and sunlight/shadows. However Sketchup alone does not give realistic renders. To create realistic renders, Vray Plugin for Sketchup is required based on compatible version. We can use it for rendering. The subscription price of latest professional version to date is around 23000 rupees per year (299 dollars) and studio version can go up to 53000 yearly. Sketchup provides wide range of plugins for additional features and faster work.

Fig. 2. Example of a Sketchup Model and Sketchup + Vray Render

C. Revit Architecture

Autodesk Revit Architecture is a software specially designed for architects or building work. It belongs to the BIM (Building Information Modelling) Family. [4] Revit comes in various engineering fields such as MEP, Electrical, etc. It is a well-developed interface that provides faster work than Sketchup. It reduces more than 75% time as compared to Sketchup. BIM is a process of creating 2D sketch and converting it into a 3D model without additional work. The process of BIM is plan, design, build, and operate. [2]

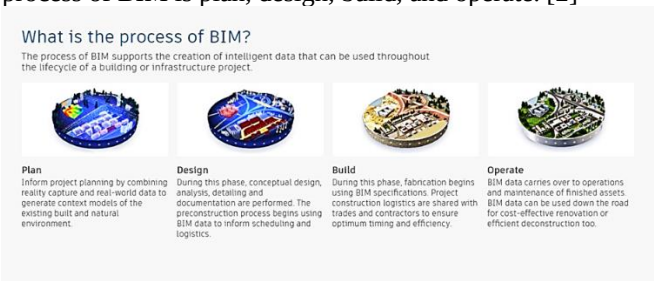

Fig. 3. Concept of BIM process

Revit helps designers to visualize in plan, elevation, section and 3D at the same time. Revit has tools such as wall, windows, doors, roof, ceiling, column, stair, etc. The elements of a building are the tools of the Revit software, thus while creating a wall, its elevation, plan, section and 3d view can be seen at the same time. This helps designers to understand what actually the element looks like, and this reduces mistakes in the structure. Such structural mistakes which are set by default in Revit cannot be rectified by CAD softwares. Revit and Sketchup are different systems and have different sets of tools. Revit is aimed at more complex projects of whole infrastructures. Revit offers realistic rendering at some extent, but not the best quality. It requires additional rendering plugin or Lumion rendering to create more realistic and high quality renders. [6] Revit can import CAD and Sketchup files. Its suitability is for structural engineering, fabrication, parametric architecture, MEP engineering, annotation, global parameters and large scale projects with complex site. Annual subscription costs around 1.5lakh and 4.50 lakh for 3 years.

Fig. 4. Example of a Revit Model

D. Vray – Plugins

Vray is developed by Chaos group, a powerful 3rd party graphics plugin which is not and independent software but is installed within existing software. Vray renders a scene which can be adjusted accordingly, if we want another perspective, the model should be rotated and again rendering process needs to be done. Rendering process time depends on the graphic card in a PC and the PC configuration. Vray plugins are available for Sketchup, Revit and 3DsMax, Rhinoceros, Maya, Blender, etc. It is also widely used in animation, visualization, product design film and video game production etc. Graphics software are becoming popular in architectural firms as the demand of 3D views are high. Interior designers also require graphics software to show the textures, colors, patterns, lights and shadows as much possible to look real. This ensures the client of what is being designed and changes can be done easily. The chances of getting hired for large projects is more when showing graphical presentations.

Fig. 5. Example of a Vray render – Day and Night Scene

E. Lumion

Lumion is a 3D rendering software to add finishing to a model. It makes the design complete and visualizes in all perspectives, climate conditions and time. Real life experiences are possible with this software. It is similar to Vray but it is an independent software which imports models and renders in 360 degrees. However vray and rendering in Revit or 3DsMax are scene rendering in which at a time you can render one view. The PC configuration and graphic card required for this software is high. Minimum 2GB graphic card is required. This makes the investment in PC very expensive. It is compatible with other architectural softwares and links the changes done in model to file. Night lighting, phase animation, real skies, atmospheric rain and snow in the model, water effect, glass effects, details of nature, model can be placed in real site photograph, and many more features are given in this software.

Fig. 6. Example of a Lumion render – Day and Night Scene

F. 3DsMax

3DsMax is highly popular and professional 3D graphics software for 3D animation, models, games, and images, Autodesk 3ds Max is used by television commercial studios, video game developers, architectural visualization studios, as well as for movie effects and pre-visualization. It is a professional CAD software that is more advanced, it can draft like AutoCAD or directly import, it can create 3d models, and also complex objects, as well as it has good rendering quality than Revit. Thus it almost has all in one software, and thus most suitable for interior designers. The reason for this is that interior designers cannot always import furniture objects but they have customized designed, these designs can be modelled in 3DsMax with ease and the interior lighting is more advanced in this software.

Fig. 7. Example of 3DsMax Interior Render

G. Rhinoceros- grasshopper

Rhinoceros is a commercial 3D computer graphics and computer-aided design (CAD) application software that was developed by Robert McNeel & Associates. It is used to create unusual geometry that any software may not develop easily. These softwares are used for parametric design, 3D printing, rapid prototyping, mathematical representation of forms and curves, etc. Other than architecture, it is also used

in product design, jewellery design, and watercraft, automotive and industrial. It also provides rendering with modelling. This software requires programming thus it might be difficult for architects to learn, but also it requires software engineer to operate and guide. This type of software is not very popular in small scale firms, in India. It has one-time payment subscription

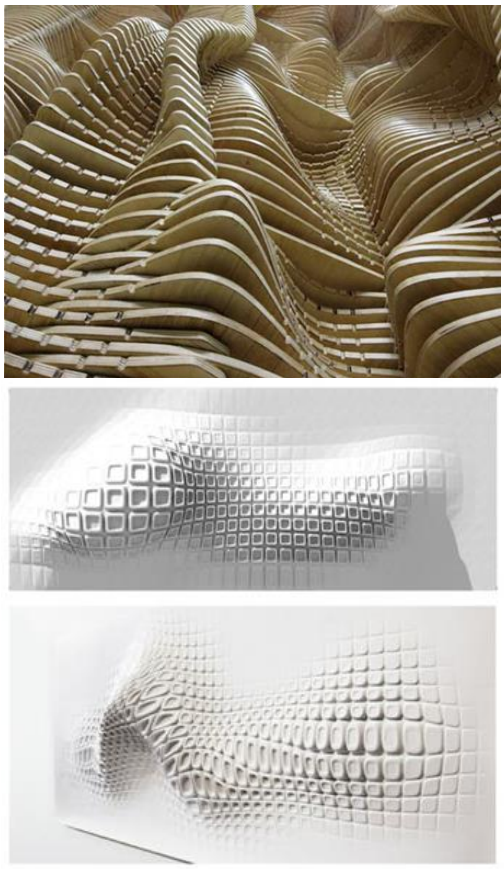

Fig. 8. Example of Rhino parametric Architecture Forms

All of the above softwares have student or educator's versions, educational licenses, studio and professional versions according to the use. The versions are updated every year or regular intervals. PC configuration of each software differs, thus consideration is required.

H. Survey Analysis

Our literature study towards each software is not enough to explain how to consider purchasing or using a particular software. Only the users know what difficulties are faced. Every architectural firm has varying number of employees, PCs, nature and type of projects done. The questions arises that how can we determine the suitability. Thus a survey questionnaire was regulated in Architectural firms to know the type of projects done and accordingly which softwares are used. The benefits and difficulties faced by Architects were also surveyed. Targeting 30 responses, we received 31 responses overall.

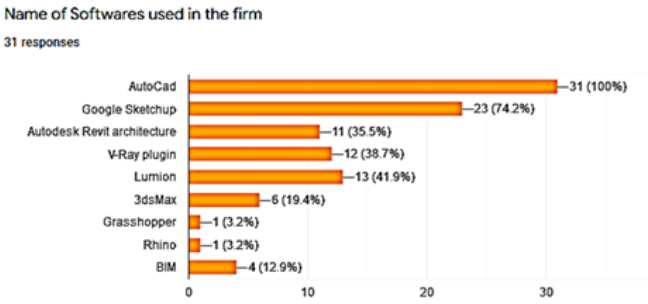

Fig. 9. Responses Chart- Name of Software used.

The figure above shows that all of the firms use AutoCAD as their basic drafting software. Following to that Sketchup is widely used as it is economical and suitable for residential and some commercial projects. As the project types vary such as industrial or outsourcing firms, the type of software referred is Revit and 3dsmax. The least used software is grasshopper and rhino. Lumion is very popular as it provides high quality renders. Rendered views are nowadays a requirement for clients before investing so much money in construction of the building. Other than these, the firms have mentioned softwares such as Photoshop, Coral Draw, Truview, ArchiCAD, Enscape, Google Earth, 3D Home, Vectorworks and Dynamo. Out of all Photoshop is most common as highest 16% responses mentioned it.

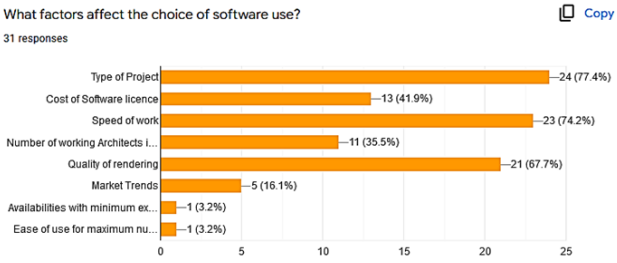

Fig. 10. Responses Chart- Factors Affecting Choice of Software.

Architects strongly believe that the type of project affects the use of software in a firm. The speed of work is also a factor that affects choice of software. Around 74.2% agree that the speed of work is important in a particular software. As we can see in the chart above, 67.7% agree that rendering quality is a requirement and choice of software depends on it. The least concerns are market trends, availabilities and expenses, number of architects working in a firm. But the amount is considerable while planning for choice.

TABLE I. ANALYSIS OF SOFTWARE AND SURVEY RESPONSES

Software	Type of Projects in Firm	Cost	2D Drawings	3D Drawings	Rendering quality	Suitability
AutoCAD	All types	high	✓	✓	NA	✓
Sketchup	Conservation Residential, Commercial, Urban design,	low	NA	✓	low	✓

Software	Type of Projects in Firm	Cost	2D Drawings	3D Drawings	Rendering quality	Suitability
	Conservation, Transport					
Revit	Commercial, Transport	high	✓	✓	moderate	2D, 3D & rendering
3Ds max	Residential, commercial	high	✓	✓	better	interiors
Lumion	Residential, commercial, landscape,	high	NA	✓	High	rendering
Vray	Redidentail, commercial, industrial, urban design, conservation.	medium	NA	✓	high	rendering
Rhino	commercial	moderate	✓	✓	medium	parametric

The above table of analysis shows the type of projects and suitable softwares for particular project. The ability of every software is different in terms of use, cost, speed of work and rendering quality. Architects have recommended the best softwares are AutoCAD [5] and Revit. [6] However there are some points which were asked such as benefits and drawbacks while using particular software.

The benefits gained by practicing Architects are:

- Easy to use
- Easy imagination, ideas easily conveyed
- Fast work, easy and fast revisions can be obtained
- Saved time
- Learned Coordination with different agencies involved in construction (Structure, MEP), more understanding of design through 3D model
- Fast and easy to understand finished work produced
- Client gets a clear idea about proposed design.
- Repetitive or revised drawing is prepared very fast
- Easy to make various options using base file with min time
- Drawing file size is less.
- Helps in visualization, easy to explain
- Optimum use of resources
- Various options can be designed and presented to the client in less amount of time. Easier for the client to visualize the design through realistic 3D views.
- Layers benefit to create plantations at different levels in plans and sections
- 2D drafting is easy in AutoCAD
- 3DsMax has better render quality than other
- Fast work and good presentation

The drawbacks faced by Architects are:

- Time consuming for creating first draft
- In Revit ,Small changes takes lot of time than AutoCAD
- Lack of knowledge among the full team in BIM working, lack of IT infrastructure to support BIM softwares
- Software versions
- Revit takes time while rendering
- Issues are faced when we switch between softwares as the interface changes
- License version of AutoCAD subscription is not economical. It is very costly. Small scale firms cannot afford it.
- PC are not compatible to latest versions thus hangs a lot.
- Revit and Lumion- Takes time to open the file as the file size are too heavy.
- It is a challenge to remember the Commands
- Creating Landscape details on steep contour site is difficult in Sketchup
- Revit has poor quality rendering despite being so expensive, we need additional software like vray
- At the concept level stage software's are not free flowing for any creative design ideas it restricts the mind. Concept development cannot be done on any software, easier with hand drawings.
- Representation of plants in Sketchup is generic
- Lack of complete knowledge about the software.
- While drafting in AutoCAD and making its 3D in Sketchup, it is very difficult to make frequent changes

CONCLUSION

This research study is important to have a clear understanding about software use in architectural practice. Various factors need to be considered while using a software. The literature study reveals the basic information and understanding of each software. Questionnaire survey helped us understand real time problems faced by Architects. The view of Architects explain that Type of project, Speed of Work and quality of rendering are the main aspects to be considered while choice. AutoCAD and Revit are considerably good softwares as per responses. Though other parameters such as cost of subscription, PC configuration, knowledge and presentation are a challenge to face.

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