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Study of practical application of digital techniques in designing

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Abstract: Due to increasing use of digital techniques in designing, the efficiency of using software in architecture will be checkable after practical implementation of this method in architecture ateliers. The current research was conducted based on library method investigating the practical application of digital methods in architecture design, then some software were introduced and their efficiency was compared with each other. Finally, it was shown that simulation in initial levels of designing will have a significant effect on improvement of building efficiency, even if it looks too simple and general.

Key words: Digital design; Virtual design; Architecture software; Designing

1. Introduction

Today, the important in component in development and innovation of sciences is use and integration of technologies together, and their interpretations and distribution in several fields. The increasing process of impact of communication systems on human life is its non-separable part. Nowadays, information technology is applied in most universities around the world to transform knowledge due to its information being limitless and infinite. Now, use of information technology and other computer software is one of the challenging issues in architecture design. Some questions arise such as 'how using computer will be influential in creativity process or ability to solve design problems? ' with emergence of computer, first in architecture schools for computational lessons- it had seemed not that this magic box could rapidly be replaced for all previous tools and equipment, also present newer services to architects at the moment. Today, information technology is used in architecture offices to prevent doing repeated activities; the ones that cover any types of creativity. World of architecture witnesses important changes in process of buildings' design and this new approach require a comprehensive attitude in order to design buildings with suitable quality. Constructional rules also gradually move towards new conditions. In this regard, the current study looks to applicable methods of using digital tools in process of architecture design. Thus, some tools and their applications in designing are studied by library method, and finally the conclusions are presented.

2. GIS

One of the other tools influential in several scientific fields is geographical information system or GIS. It was transferred and applied from military sciences to other fields, and found a specific place in fields relative to urbanism and urban management (especially urban management) due to close relation between concepts of city and space. Every day, a new invention emerges about application of these tools in fields of urbanism. One of subcategories of urbanism maybe related with GIS is urban design. This filed use these tools less than analytic application of GIS in urban design due to perhaps due to its functional area. What is observed in GIS articles of urban design mostly relates to ability of displaying GIS 3D software, possibility of studying virtual environment, and suggestive design. Although this capability alone helps urban designers, but it had created a type of one dimensional view into use of geographical information system in urban design topics; while one of the best equipment it provides for user is high analytic potential and descriptive-spatial search with help of database connected to the system.

3. Spatial data modeling

The aim of modeling is to make data of real world. This is realized by GIS and presenting the facts in form of a setting of map layers and the relations between them. Construction of models from spatial form could be considered as a setting of data abstraction levels. Thus, we can follow modeling of real world in GIS environment through summarizing, simplification, explanation, and presentation.

There are two main methods for spatial data modeling: vector model and raster model. In vector model, each of complications is recorded by help of numerical values of coordinate pair; thus, nature of objects or locations is ostensible buy points, lines and polygons. Also all relations between spatial information are defined on these three categories.

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But the raster model in its simple form includes a regular network of square cells that defines location of each cell or pixel by number of its raw and column. The value assigned to the cell indicates type and quality of its descriptive information.

4. Behavioral approach in visual analysis

One of different approaches in visual analysis is behavioral approach. Gomblette et al. (1996) were among the first scholars who employed the modeling based on activity. Using RBSIM program (simulation of entertainment behavior), they formulate visitors' movement alone the ways. In this connection, Bishop (2001) conducted an experiment in which visual analysis was performed based on 3D environmental model by people in real world and to predict route selection. He believed that visibility as a main factor in human behavior and thus activity behavior. Farenc et al. (2000) developed this concept to create individual and group behavior simulations in formulated urban environment.

5. Evaluation of visual impact

Evaluation of visual impact is one of the common methods in study of elements' visual impacts and suggestive buildings in artificial and natural environment. Although there is not a complete agreement on definition and quality of performing such evaluations, but this method is considered as an acceptable one to study visual impacts. In this regard, Fernandez et al. (2004) studied the evaluation method of visual impacts based on spatial situation assessment of buildings by GIS using scene composition and background parameters. The difference between this method and visually one is that it mostly emphasizes on the observed scene including project and building, while visibility method is more based on building itself and suggestive project, disregarding the scene and view of the building.

6. 3D view analysis

3D view analysis is a method that tries to establish a relation between GIS based analyses and 3D projection analyses. This method suggests the relation between GIS and 3D projection that are traditionally separated, but they must be more coherent for efficiency in design environment. GIS systems and 3D projection are very different products; GIS is a tool to storage, manipulate, explore, and display geographical data, while in contrast 3D projection systems are more in line of design system with help f computer9CAD) so that they are optimized to show 3D graphic perspective. A suitable method for linking GIS and 3d projection is creating some 3D designs in GIS and using them as output in CAD systems. Generally, it could be said that this method is used by urban programmers, designers, and managers in urban perspective modeling. The most important ability of this method is providing a basis that people; even those who have low information about urban perspectives-could observe the results easily and make decisions.

7. Huff transformation method

This method of image processing is a new technique that presents the image in form of diagram based on differences and similarities. Tucker et al. (2004) used Huff transformation method based on software called 'escape' to analyze visual appearance of street. In this research, the view of street was taken by digital camera, and then the images were processed using algorithms created by computer to distinguish visual environment based on boundaries formed by shapes, colors, texture, and severity. Using this method, scape can find discontinuous boundaries that humans imagine them as a continuous edge. Based on 'scape' application in visual analysis, Tucker et al. (2004) processed the components of three street portraits located in Australia. The portrait of street A is based on city's central street constructed during the last 100 years. There is no parking available outside the main street, and the vehicles are mostly parked in front of streets. The portrait of street B is based on suburban streets in which separate houses are far from road due to their low-height front yards, and the parking is available outside the main street in form of garages and vehicle routes. The portrait of street C is based on new urban houses in new suburban areas, and vehicles are parked behind the houses.

by overlaying diagram of streets A, B, and C it is determined that length of edges in streets B and C are not distributed equally than items available in diagram of street A. also, we can observe that diagram of street A has tips with linear distribution; while tips of streets B and C decrease in terms of height (Fig. 1 and 2). Huff transformation method is a completely quantitative one by which we can transform physical features of a scene (e.g. color and edges) to quantitative data, and that consider the impact of these variables on attractiveness ort human behaviors.

3D programs such as 3D MAX, 3D program in Auto Cad, ARC GIS or programs of image processing like Photoshop are all software that can provide visual evaluation by environment simulation. The significant point of this method is focus on the difference between axonometric scenes and sky captured images. Inattention to the difference between these two methods cause some faults in decision making. The strength of GIS is its ability for further 3d analyses, one of the most applicable commands for visual analyses of GIS are view sheds. 3D design programs such as 3D MAX can provide more accurate features than GIS but in a smaller range. Thus, we can use these two tools together in order to improve accuracy of urban views. Software analyses can be very helpful for items like visibility analysis with new suggestions for urban

construction. Also it is possible to display city in 3D; but the main problem of software such as ARC GIS is that simulations are somehow different from existing realities.

Fig. 1: Streetscape A, B, and C

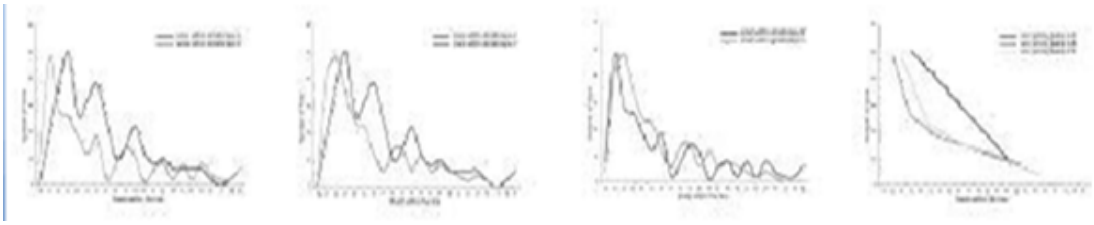

Fig. 2: The graphs of streetscape A, B, and C

For example, it is not possible to simulate urban environment software completely based on reality, and most significant details are deleted from visual analyses. But in a situation that photo montage and real images are used for visual analysis, we can expect that images make a better relation with viewer. Despite the shortcomings of this method, it is still a more reliable method, especially when visual analysis is considered with qualitative approach.

8. Simulator software

In addition to provide ability of comparison for several functions, these software decrease incompetence risk and also show appropriateness of strategies.in contrast to previous methods that were unilateral, solution-oriented, and non-dynamic, simulator software is multilateral, problem-oriented, and dynamic that solves the problems using numerical methods in conditions completely similar to real conditions.

Mahdavi (1998) states that using 3D simulator software is common among architects, but these simulations are limited just too visual display of project. He suggests that architects can use these software in the field of thermal efficiency, energy consumption, and quality of lightings.in his book, Clarke (2001) suggests the idea of concurrent use of simulation against common method of design; the suggestion which was accepted by several experts, and different research were conducted around it. The diagram proposed by Clarke is shown in fig 3.

Architects are responsible for their direct actions. In the recent years, there was a rise in the belief that correct decisions in initial levels of design have the greatest impact on building's final functionality in several parts of the world.

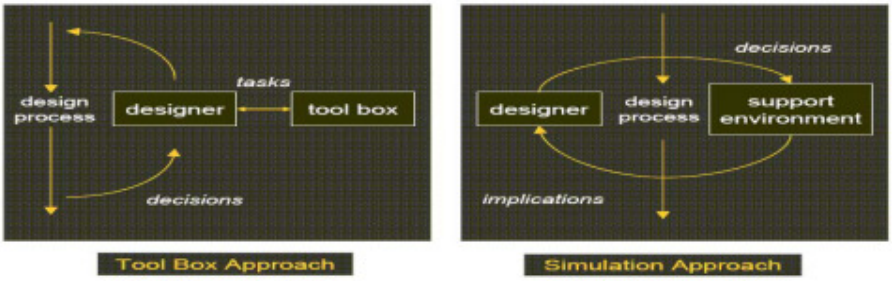

Fig. 3: Using software out of design and during it

9. Computer simulation of building

Using computers for simulation of building's efficiency draw new horizons in this field. The philosophy of computer simulation is complete creation of a virtual building similar to real one measuring the impact of all factors influential on building's efficiency with conditions similar to real ones. Now, computer software of several samples with different functions is available. Some software has the ability to simulate building's thermal dynamic; while some others just simulate the model in specific conditions and for a moment. For example, some CFD and lighting software lie in this category that simulates the air flow and brightness in a limited condition, respectively. Some other simulator software with the ability of solving different problems simultaneously allow user to measure different aspects of building's function. The collection of ESP-r software is one of these items; it is multilateral simulator software with Linux free engine that is mostly used by European researchers.

Also HEED software is designed for simulation of residential models with the capability of comparison among several modes; thereby, it helps the designer to find better options. The other famous software is Energy Plus with DOE 2.1 solution engine to solve energy equations.it is a free windows software that is now of the most common and valid software simulators; energy Plus lacks a suitable user interface, so some user interface are designed to develop this software, such as Design Builder. According to the accuracy of calculations in DOE 2.1 engine, there are other user interfaces such as eQUEST, PowerDoe, and VisualDOE that simulate problems using this simulator engine. eQUEST is one of these user interfaces that has proper graphic interface, and is designed for Windows. Today, this software has many users and is downloadable for free from internet.

10. Reliability of simulation tools

Verification and reliability in levels of architecture design could be performed with accuracy of simulation model and input-output values. In initial experiences of simulation, the best possible solution for removing external errors is user's proper training and yet supportive control and supervision by simulation experts. The experienced simulation users can check values before and after simulation to ensure its authenticity. Installation engineers and environmental designers can help to verification and reliability of simulation in two ways. They can be sure about accuracy of input values and also study simulation feasibility. Doing this, we can use the comparison between simulation results with benchmark obtained from similar projects. It must be noted that the important thing in simulation, especially in design level- is the comparison between two different p resented options (Hensen et al., 2012), therefore, if the results of similar simulations are available, then designers can verify simulation results using comparative techniques. After a while, designers obtain more experience and will be able to verify results; of course, there is not a specific standard available in this field, and the published ones are also little. In most of cases, the results of simulator software have significant importance.

11. Designer architecture software or designer assistant?

Simulator software and other computer software simultaneously help designers to adopt more suitable strategy when designing. Performing repeated tasks, this software provide the possibility of testing more options and revising those several times to obtain an optimum answer. But on the other hand, some of these programs also play another role, i.e. direct participation in design. Thus, some levels of design are deposited to computer, and designer loses his/her central role in formation of final option. Duffy & Duffy (1996) propose two main philosophies for process of software implementation: in idea of implementing software as designer assistant, the design with help of comports is considered and software act as designer assistant. While computers act as designer substitute with emergence of automatic design. It is for a long time that use of software as designer assistant is common among architects; now the question arises that' whether computers have the right to design instead of designers? If yes, when and how?

In addition to these benefits, another point must be considered. Using software as designer substitute in some levels of design will be helpful when designer has the required ability to manage simulation process. In this case, the simulation results complete amount of designer's awareness. Otherwise, using this software might lead to more ignorance of designers. Since process of decision making is non-linear, multilateral, reciprocating, and indefinite, so the optimum decision among several possible options will be impossible without having required knowledge.

12. Comparison of simulator software

The comparison between simulator software is not easily possible, and it needs collaboration of a group of experts for a somehow long-term. In 2005, a research was conducted for comparison of 20 famous software in the field of simulation. In the beginning of this research that was conducted with collaboration of four grand institutions including US department of energy, energy systems research unit(university of Strathclyde), university of Wisconsin-Madison (solar energy laboratory) , and national renewable energy laboratory , researchers

acknowledged to their disability in obtaining acceptable results.

In this classification, the software is distinguished based on these questions;" who use this software? Which software are currently used by designers? And what type of software require special knowledge and complex data?" These studies are conducted based on questionnaires completed by 200 American users.

13. Conclusions

With increase of responsibilities of architectures, designers face with great pressure. Thus, there is always the risk of simulator software as an extra load for design group. According to difficulties available in implementing simulator software and the little time in initial levels of design, the necessity of using software might damage other r aspects of design. Hence, it seems essential to provide software that can really help the architects in designing. Simulation is due to mass of calculations, several levels of its performance, and type of available software. The latter is one of the shortcomings that must be resolved with simultaneous collaboration of users and software manufactures.

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