

# Making-Intelligent Place of Buildings in Parametric (Algorithmic) Architecture

Moein Moradi

MA Student of Architecture, Islamic Azad University, Rafsanjan Branch, Kerman, Iran

\*Corresponding authors' E-mails: MoeinMoradi1366@gmail.com

**ABSTRACT:** Regarding that constructing intelligent houses can meet a great part of users' needs, it is necessary to study parameters related to these buildings. In this time from the beginning process of designing and setting these controlling parameters in design algorithms, in fact design form can be first influenced by construction factors to remove every movement, twist (winding), bend or everything that make a problem to construct it to build the final form based on these measures. In parametric (algorithmic) architecture it is tried that effective parameters on building physical behavior such as structure and materials and ... influence architecture in constant analysis process and finally design cycle can be reformed in this way. Insisting of designer on developing a formic-space and then forcing an engineering team on making that project is never the best architecture phase. In other side work speed was increased and also a similar environment was created to test and examine project by which weak points can be recognized and strength points can be emphasized; however architecture quality is promoted. In addition all designers need to be able to analyze architecture multi-dimensional data simultaneously. And dominate on the most architecture aspects. However this research tries to point to some aspects of data analysis and finally measuring them by introducing simulating instruments. Expected conclusion is that analyzing data of physical frame and mental frame can simulate some conditions in which environment qualities are provided to some extent in short times for designers. This research is followed in analytical-descriptive way and by library studies.

**Keywords:** Intelligent buildings, Mental frame, Parametric architecture, Physical frame.

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## INTRODUCTION

Before 1970 building maps drawn by pen, ink and paper and several cases weren't regarded in them; but they were calculated and viewed separately and finally jointed to project. This occurred in some conditions while correcting map errors was so difficult and especially if the errors affected on other related maps, the result was terrible. In above decade, methods of computer drawing are able perform by simulating instruments just on graphic terminals of central computers. Since 1980 using simulating programs were more developed in engineering offices by innovating household computers. Drawing, reforming and transforming maps were easier by these electronic instruments, speed work was higher and drawing complicated and three-dimension forms entered a new stage. And the meaning of "building information modeling" or BIM could provide the new designing method for designer by making a relationship between plan, view, and cross section maps and... However the meaning of BIM or building information modeling was presented based on data station. In BIM process designing begins by making a model includes intelligent components that present door, window, roof, beam, stairs, conditioning system, and wiring ... These components recognized themselves and their relationship with other components. So it isn't necessary to examine several plan, cross section, view maps to get some

information about a determined component like size, glass quality, and framework and ... of a window. It is necessary to refer just to that component. This component stores all information related to its properties in itself and conforms itself to the new project by making any changes. In addition to making intelligent relationship between several components of designing, BIM studies several projects to design for all groups metaphorically. For example one of projects can be turning building model and studying changes of energy consumption rate in terms of several sun incidence angles (Goedert et al., 2008) (Figure 1).

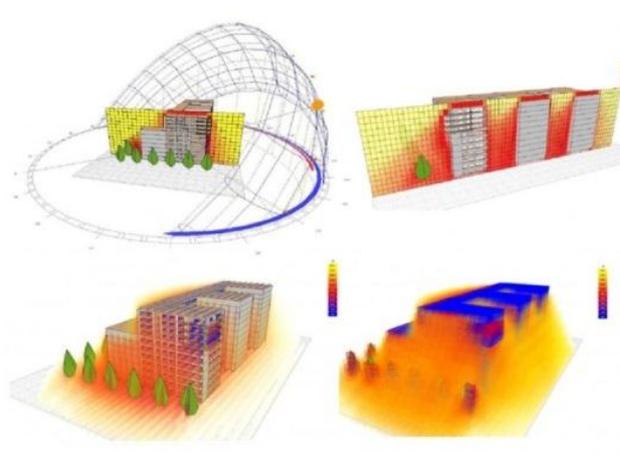


Figure 1. Solar Radiation Analysis

Also other designing group including structure, establishments and etc. are able to observe the effects of these projects in architecture design by making changes in their models. And finally contractors are able to experience some cases such as sequence of execution, efficiency, installation and etc. metaphorically while designing and developing building model (AGC, 2005).

## MATERIAL AND METHODS

### Simulation instruments

Regarding data analysis of designing it is often observed that designing is difficult that needs to be studied; however environment simulation is needed to evaluate designing measures. So some cases such as heat, sound and etc. can be analyzed simultaneously. But regarding that everyone needs to study completely they are ignored in this study. However project conditions can be evaluated using qualitative and quantitative approaches. Whereas qualitative parameters should be regarded based on special standards in the project, it is necessary to change them to quantitative data; so they are evaluated by simulation standards. However effectiveness rate of this technology can be measured in architecture compatible with environment. Finally sun incidence conditions can be studied in different times by simulation instruments. And also several environment factors such as dominant winds, ground land slope and etc. are considered in the project that is somewhat similar to real environment. Also emphasizing on current standard based programming some instruments can measure buildings based on their quality and quantity. Simulation instruments include a set of functions by which designing process are defined more easily. It is while all efforts occur to produce a process. Models simulation instruments can gradually improve designing process by presenting more data (Drury et al., 2001).

### Design programming

Regarding that computer is used to facilitate architecture designing by simulation methods, it is necessary to analyze data and finally output can be regarded as specially to improve programming design process. It is worth to note that this approach isn't serious. Hones Mire also points construction as the base of rationality. Regarding other cases programming is ever presented to consider sun position and etc. Now it is asked that how extent philosophical meanings can decrease architecture designing? It is asked while simulation methods can make ideal conditions and examine several models. It is all as the project can be studied in test-error condition and ever has a way to correct errors. However three stages are approved for this scientific method to standardize: 1-data analysis, 2-design changes process, 3-final design evaluation. In a definition Cohen points that "programming can be researched as a problem" and explains that "designing methods based on several tests can cause to incorrect programming". He points that these cases are negligible against network and implicated knowledge (samples) based systems, however programming is considered as a problem to design data analysis. This paper also tries to explain process of using simulation instruments. Buildings that are designed intelligently and several

ideas about them which are presented by architect not by a completely computer method and finally presenting data set related to design process and models simulation instruments can be effective to improve this process. In this regard Spans in his book about conceiving information explains three main reasons for great development in the field of information conception which are influenced by computer as: first, fast and cheap access to memory leads to save extensively. Second, fast and powerful calculation allows a fast interactional choice from data subsets. Third, accessibility to graphic monitor clearly guarantees that presenting data is conformed to the power of human cognitive and visual systems. However authors generally consider four kinds of data to conceive from architecture space: geometric, topologic, implicated and social (Figure 2).

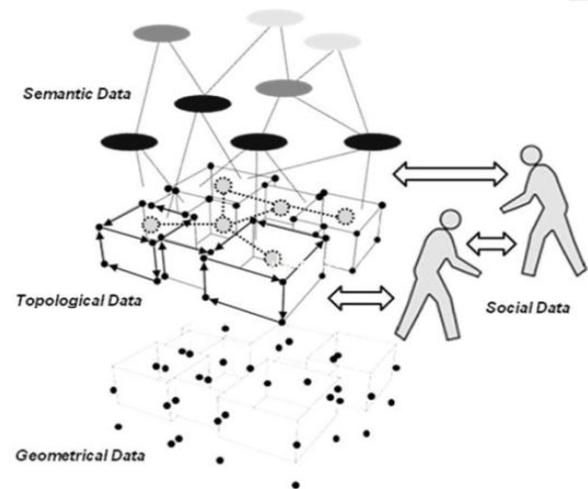


Figure 2. Data in Architecture Space

Functional programs such as AutoCAD, ArchiCAD and REVIT and many others try to make an integrated space in BIM system. In these instruments while a building user performs two-dimension drawings using traditional metaphors, the system automatically produce not only a building three-dimension model but also the relationship between things. In order to conceive several kinds of data simultaneously, it is multiple exhibition method that is often used in conceived environments (Figure 3).

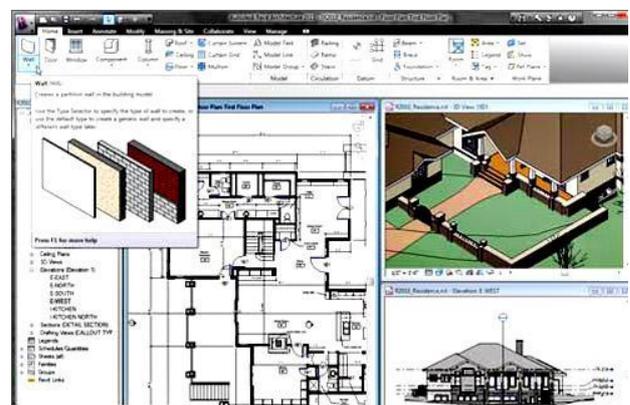


Figure 3. Conceive Several Kinds Of Data Simultaneously

Also architects are allowed to decide about building making-intelligent by placing people in metaphorical environments. For example other program called 'V-PlaceLab' allows you to simulate intelligent

houses. This intelligent space points to human limit and space integrated technologies in an informed and autonomous position and can be effective in controlling luminescence (Lee et al., 2008) (figure 4).



**Figure 4.** Program Called 'V-PlaceLab' to Simulate Intelligent Houses

In this metaphorical test, functions and furniture set of building model are created based on real spaces of intelligent houses and living in metaphorical space. Intelligent houses are unique in form, place, furniture, implication and etc. For example: controlling light, controlling air heat degree and many other cases of intelligent houses' services for every space. Testing building model starts by a USS project and by entering a user to life space and going to the sofa to watch TV. In this time, determining host system is observed. However users are allowed to understand the quality of technology space. In addition to showing the quality of furniture a suitable programming can be done for several activities (Vikram and Barton, 2002).

## RESULTS AND DISCUSSIONS

### Models simulation

A building can be examined regarding current position in the building and using simulation instruments: 1-picture processing 2-three-dimension modeling and creating models for programming 3-presenting ideas to remove weak points and emphasizing on strength points and finally programming. It should be noted that changing design and sides of a building shadow position can be changed; however radiant energy can be used optimally. Also light can be controlled by creating color elements against spaces which receive

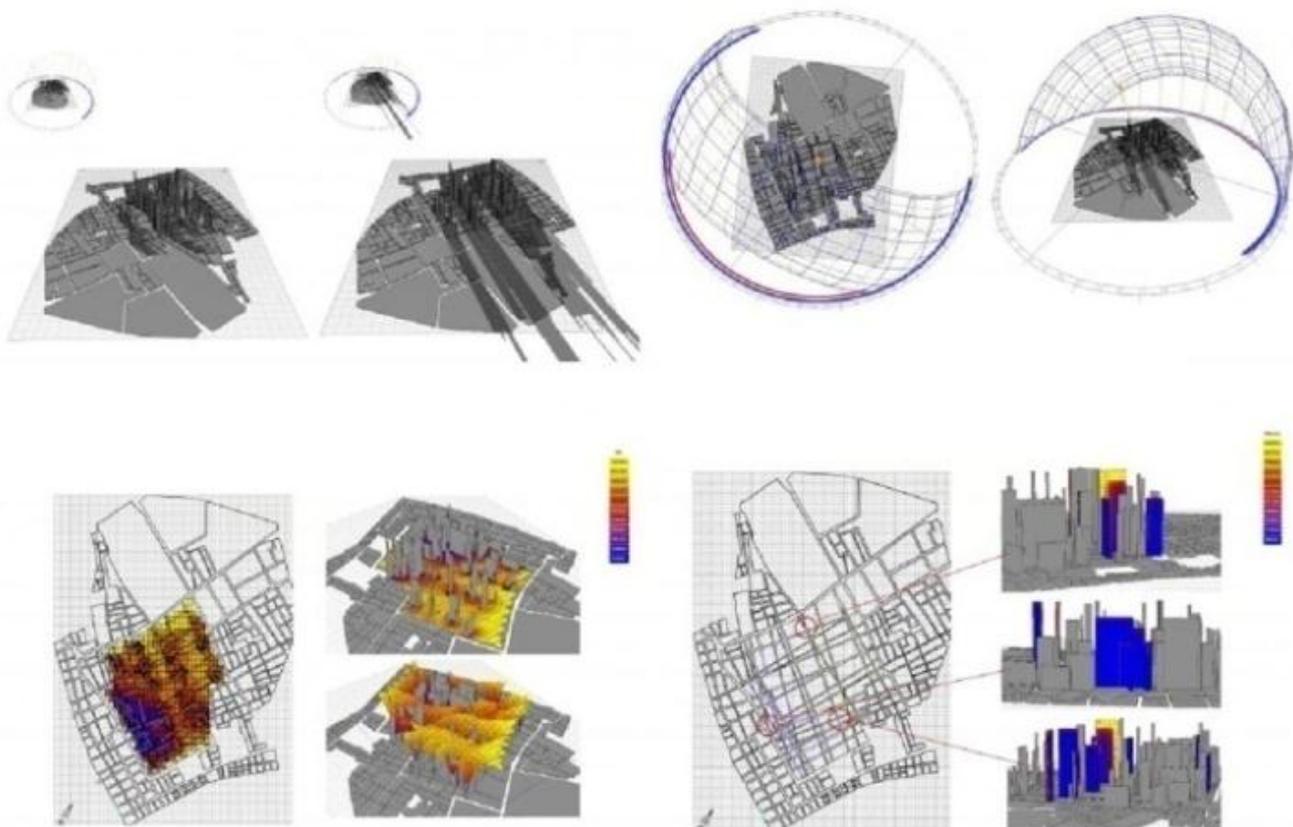
light and also radiant energy can be used in the best way by defining Thrombus wall for modeling software and locate it in a construction program. Glass views help to absorb the most sun heat during winter in south and west sides. Also ceiling projections can be useful by creating shadow during summer months. This is while luminescence towards optimizing is important regarding change of light during day. In this condition using simulation instrument for present models is the best suggestion for which an attractive graphic mediator can be produced that is suitable for integrating the meanings of sun buildings during design stages. People, who are aware to work with these instruments, understand speed and quality of changes using three-dimension and simulation models. Using simulation instruments and creating models can increase design decision speed. Also producing a three-dimension design all components can be examined and controlled skillfully towards the location of building in order to use the most surrounded environment. Multi-dimension of a building can be analyzed based on doing exact heat, acoustic calculations and many other cases separately. Also it is worth to note that instruments which are available now not only are defined for Euclidean forms but also are used for non-Euclidean and topologic forms. In other side regarding that executive maps of several designing groups should be provided in separate but coordinately, it faces some problems such as: high construction costs, low work

quality and etc. that leads to one of the most excited recent developments is presented in the field of construction management in BIM technology. Generally BIM adds to two-dimension maps and related properties, three-dimension modeling components with special property. That property is that every member of designing shown in IBM has an arrangement of information related to several activities and tasks of construction management in addition to its three-dimension physical nature. This information relates to all project life cycle from explanation studies to sense designing, first and second p ecological-environment architecture phase studies, supply, construction and installation, establishing, operation period and even its end. So if we want explain BIM in a short sentence it means process of production and building information management during its life cycle. In other words a BIM model is a digital three-dimension exhibition of building physical and operational properties. The main difference between BIM models with an ordinary three-dimension model by current software is saving important information of all construction process with all its components. This information includes some cases such as materials (weight, color, size, resistance rate against firing and...), installation and montage guideline, products guarantee services, conditions of maintaining and repairing, information about components prices and... BIM is technically a three-dimension model that is connected to data base as all information related to project can be saved. However BIM serves as resource of common information between all building design and execution team. The result of information integrating is increasing coordination, decreasing errors and wastes

and finally work quality (CRC Construction Innovation, 2007). Although designer architectures and engineering are known as the main users of BIM, but it should be explained that construction industry is also so interested in this field. BIM give a big chance For program their needed Designing and execution methods before starting to dig land. In addition for the meaning of information in IBM produced model is developed behind three-dimension properties called by architect as the instruments to transform their designing decisions for others. In other words we can observe the entire project in this model. The meaning of information allows us to add two other dimensions to model in addition to three dimension of distance. Fourth dimension is time and fifth dimension is cost. Advantages of BIM system used in several projects can be effective to make LEED. In addition to all these subjects, a process presents a fast permission to complete construction documents (Ghang Lee, et al, 2006).

### Simulation in order to design frame buildings

Natural light rate in a space depends on our use of applied cases in the frame of that space, kind of volume, quality of locating spaces and many other cases. Regarding the diversity of simulation software and also their abilities towards BIM, Ecotect Analysis software can be considered as a sample of modeling instruments that can be studied in several dimensions of a project. Importance of using most sun incidence is considered because of growing ecological-environment architecture and this is as output rate of ecological-environment architecture is negligible regarding development of computer science during past years (Figure 5).



**Figure 5.** Calculating SOLAR RADIATION by program called "Ecotect Analysis"

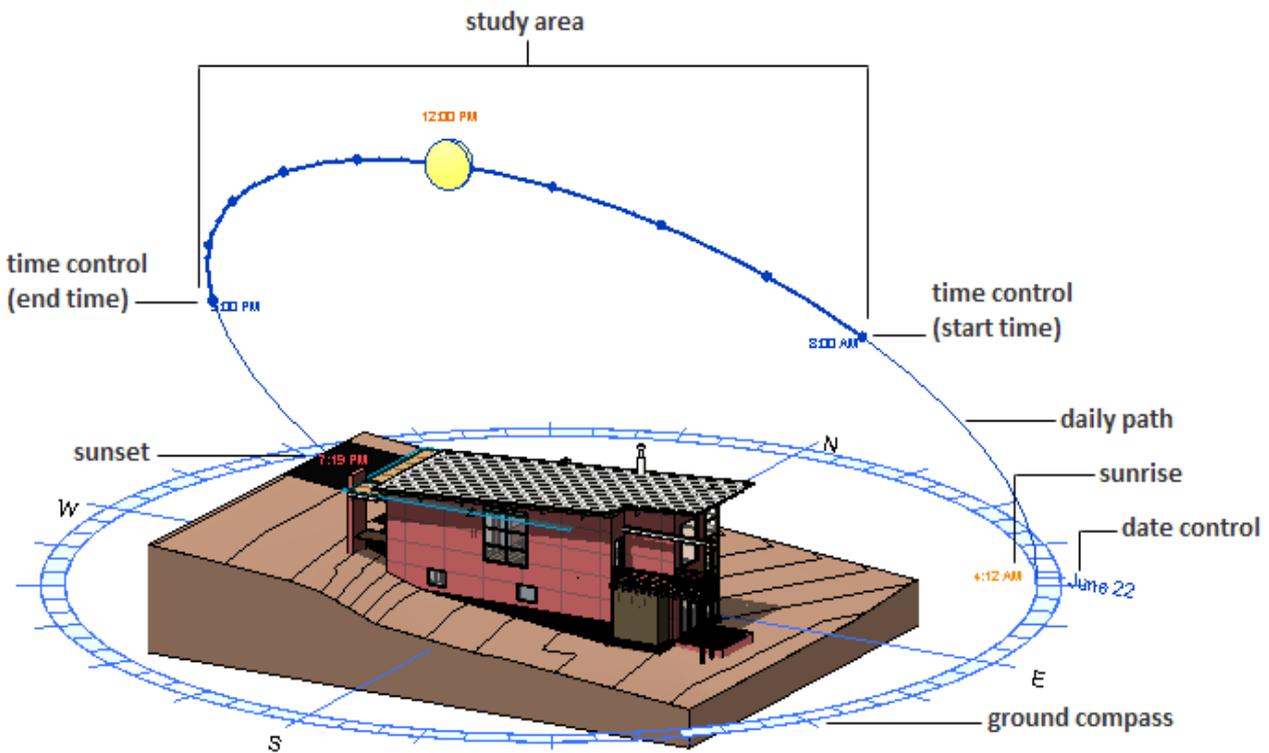


Figure 6. Most use of natural light By program called " Revit Architecture"

In other side luminescence subject is presented that is variable regarding time during day and also other effective factors on it are considered. However the best positions can be recognized and used in order to improve project by analyzing design data and modeling in the most use of natural light (Figure 6).

Development technology and use of metaphoric models can be accompanied by a revolution in analyzing luminescence and finally growing ecological-environment architecture. Today there are several kinds of software for simulation as they can cover each other. Simulation software is so low efficient for light analysis and decreases errors in design. Also changing luminescence can control designing program and analyze and finally measure it. Examining simulation instruments this research tries to make importance in privatization field. Standardizing some needs of residents needs to test and measure diversely. This research also can guide architecture students and also is used as a professional tool. A few studies have been done in Iran that can be a reason of engineers' increasing indifference to technology (Sadeghipour Roudsari, Mostapha et al., 2013).

### Simulation for building inter designing

Revit software can present all information about inter designing in a model and also different analyses can be measured by this instrument. The company of presenting Revit instrument tries to make designing easier by putting components preparedly which conform to products technical properties. Among some components such as: light equipments and also luminescence that are defined regarding present products in market and are gained to access by performing the order of Load Family. Suitable choice of these

equipments can define them in building inter space. Also every component can change edited again after selecting and determining its location. It means that you are able to define some factors such as initial color, wattage of electricity and light efficacy, luminescence and many other cases for every section by choosing the choice of Edit Type (Figure 7).

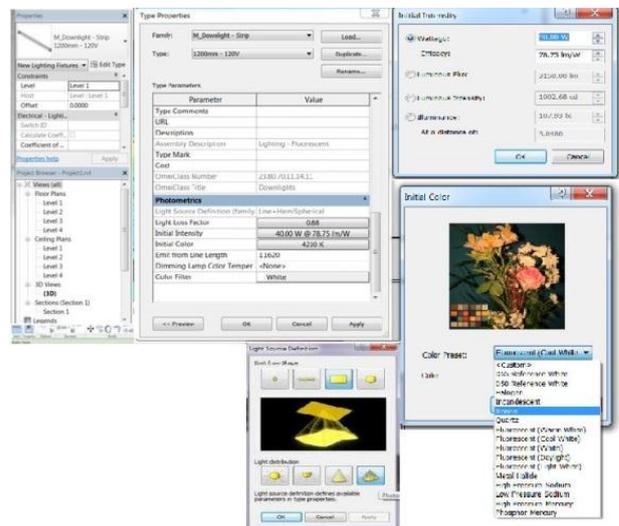


Figure 7. Editing each component

Also presenting point by point light calculation for every usual or special space can present optimal luminescence rate in a project (figure8). However light calculations can be done during a few seconds and used for luminescence and integrating for light (luminosity); however time is shortened in designing. As a result a model can be observed in Revit software that can be a

conception of above project by analyzing in a

framework.

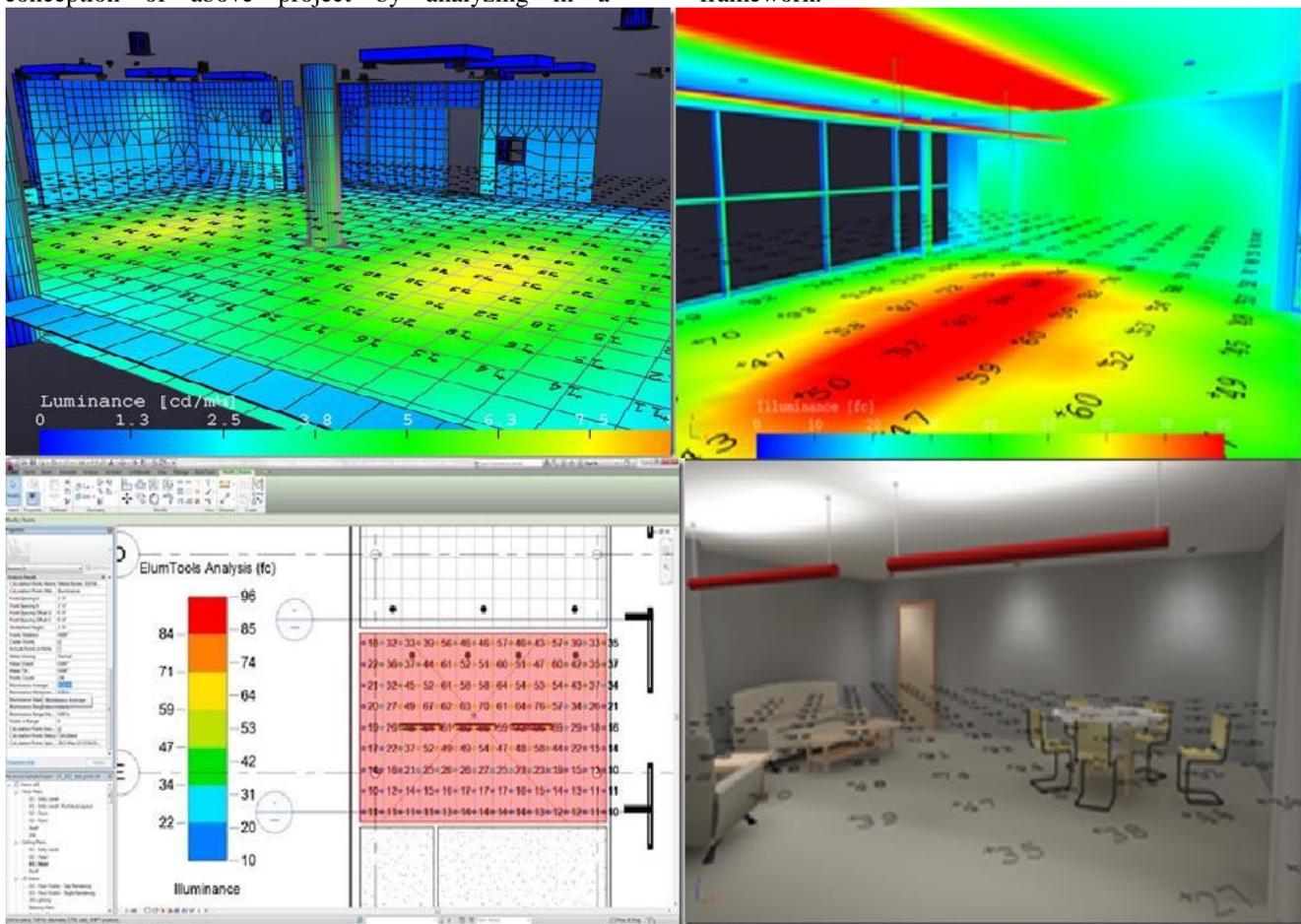


Figure 8. Lighting Domestic

## CONCLUSION

Performed studies determine that creating simulation system of multi-dimension models in every space can lead to use energy in the best way. So simulation system can be used to prevent errors and deficiencies; however project can be created in ideal condition and models can be measured exactly regarding present parameters, for example some parameters such as luminescence is so important in designing and depends on levels properties. So necessity of analyzing design data by models simulation is the best solution that can help to design output in natural environment conditions. It guides designer design their projects by high output in a short time. Although designing data are ever much and always received parameters are insufficient, that exact figure aren't expected from these instruments and in other words some conditions such as a region climates are resulted from books based on an ordinary years and this is as climate is ever change or consumption cases of a building like: light absorption coefficient in materials, light reflection rate in materials and many other cases aren't known, but it is worth to note that it can approach ideal conditions. However for a few studies a long time is needed to get more exact conclusion. In addition to be present for everyone, simulation system can give the most output in a short time and whereas some projects are very complicated and time-consumed, using these instruments are effective on speed and efficiency of

models in professional or student works. Although using simulation instruments is so difficult, but regarding the distinction between studying and designing areas a deep connection can be produced between design and studies; for example environment-oriented designer can consider effective factors on building proportionate to regional location in the building. For example as the intensity of a region is so high, as a result it is observed that some troubles are produced to in accessing natural light; however simulated models as analysis instruments can measure latitude, proper orientation, proper incidence angle, quality of interaction with environment and many other cases. Although simulation instruments are very suitable and efficient for analyzing space, using these instruments needs training and experience and also deep conception of abilities and time-consuming for performance and experience. But some equipped instruments will be presented for digital models in future that increase speed; however some products such as simulation instruments and BIM are felt for developing in modern and active space by which space management can be controlled and their users' behaviors can be anticipated.

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