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THE USE OF MODERN TECHNIQUES FOR ENERGY ANALYSES IN IRAQI BUILDINGS

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Most architects and construction engineers need to use modern energy analysis software for the purpose of improving their design. There is software within the BIM (Building Information Modeling) that are specific to energy which help to get the calculations of energy in an easy way.

Building energy analysis studies in Iraq are few and limited and insufficient attention is given to this important stage in building design which is one of the necessary and important stages to obtain a good design

In this paper, one of the existing buildings in one of the regions of Iraq was modelled by using BIM modelling software (Autodeck Revit). The energy analysis was then carried out by the (Autodesk Ecotect) software after exporting the previously modelled model.

The results obtained are necessary to achieve the best design in terms of energy with the assumption of future changes in buildings that are similar in style and area conditions in order to optimize energy

Key words: BIM, Ecotect, energy, modelling, analysis

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1. INTRODUCTION

Energy is one of the most important factors influencing a country's wealth, as it plays an important role in social and economic growth. Therefore, it is critical to leverage new energy sources and limit consumption, because most energy sources are not renewable.

Undertaking energy analysis and management enables organizations to make permanent strategic improvements by significantly regulating their energy availability without affecting their performance or quality standards [1].

The need for modern sustainable buildings which minimize their environmental impact is clear, as the development of sustainable buildings accounts for a large part of non-essential energy usage [2]. The construction sector is responsible for about 40% of total energy consumption in the United States, so a move towards more sustainable buildings offers significant economic and environmental benefits [3].

Although energy analyses may be conducted using conventional methods, such methods are impractical because they are time-consuming, are carried out after the completion of the two-dimensional design and rely on the completion of plans and details [4,5]. This paper aims to illustrate how modern technologies can support building energy analyses, contributing to more sustainable design processes in the future.

2. SUSTAINABILITY IN BUILDING INFORMATION MODELLING

Building information modelling (BIM) is 'a digital representation of physical and functional characteristics of a facility. A building information model is the shared knowledge resource for information about a building that helps in making decisions during building lifecycle from its start to finish' [6]. Unlike CAD software, BIM treats modules as smart units within a smart environment, rather than simple lines or drawings. Studies have indicated that BIM represents a technological transfer within communities [7].

BIM, unlike CAD software, enables designers to integrate and monitor the sustainability of their models continuously throughout the entire design process [8]. BIM allows the integration of different factors and indicators into the design within a virtual environment. Using BIM, designers can simulate multiple systems and characteristics such as building orientation, building mass, photovoltaic systems, materials, ventilation and shadow and light. [8,9].

3. EXPERIMENTAL METHOD

3.1 CASE STUDY INFORMATION

This project focused on a building located at the Technical Institute (Baquba) at the Middle Technical University in Iraq. The building occupies an area of 1600 m2 and contains 24 rooms, including classrooms and administration areas, as well as interior corridors and an inner garden. The building has two floors, each of 3.5 m, and the outer facade is covered with stone.

To develop the model, I first obtained engineering drawings of the building from the Engineering department at the Institute. Next, I visited the building and took internal and external photographs to be used during modelling, as shown in figure 1 and figure 2.

Figure 1 The front face of the building

Figure 2 The eastern façade of the building

3.2 CASE STUDY MODELLING

I used Autodesk Revit 2018 for this project because of its ability to produce high-quality models. Figure 3 illustrates the Revit interface.

First, the AutoCAD file for the ground floor of the building was imported into Revit, and the modelling was completed based on the dimensions of the drawing. First, the foundations, walls, ceilings, columns, floors and stairs were modelled, then doors, windows and finishing materials were added.

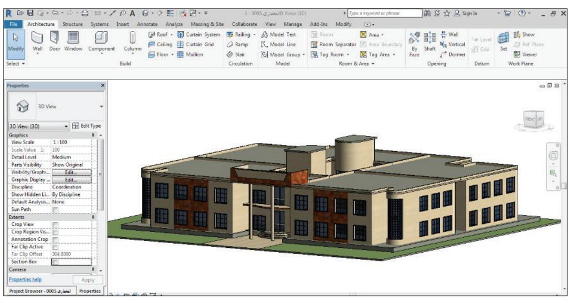

Figure 3 The Revit interface

Figure 4 shows some images of the completed Rivet model of the building.

Figure 4 The modelled building

3. 3 AUTODESK ECOTECT ANALYSIS

Ecotect is tool that simulates an environmental model for the purpose of thermal analyses, assisting in, for example, lighting design, the reflection of light and shadows and solar radiation. The program was developed by architects and can be used by engineers, consultants and environmental specialists [10].

After modelling the building using Revit, I imported the model into Ecotect and incorporated weather data (see Figure 5). Due to the lack of weather data for Iraq, I used weather data from Saudi Arabia, which is included in Ecotect and has a similar climate to that of Iraq.

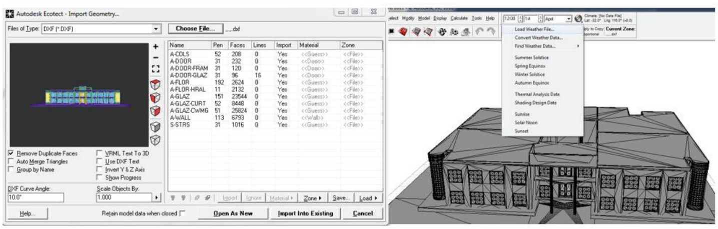

Figure 5 Importing the model to Autodesk Ecotect and incorporating weather data

Figure 6 illustrates the model of the building in Ecotect and shows the sun's annual path and daily path for 1st April, 12:00 a.m.

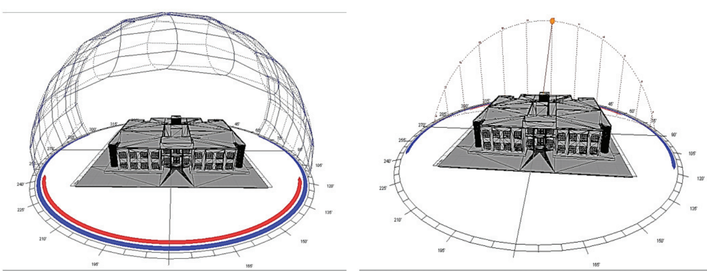

Figure 6 The Ecotect model

3.4 THERMAL ANALYSIS

3.4.1 MONTHLY DEGREE DAYS

The results from Ecotect indicated that the maximum thermal load during the year, 53.8, was recorded in January, whereas the maximum cooling load, 475, was recorded in July.

As shown in Figure 7 and Table 1, July was one of the highest months in terms of thermal load, suggesting the need for higher energy consumption during this month.

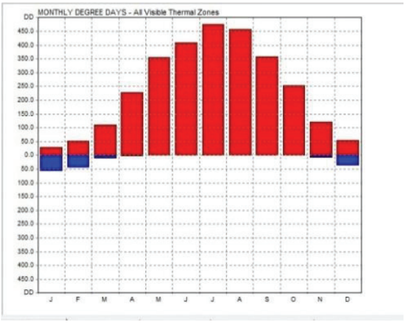

Figure 7 Monthly degree days

Table 1 Monthly degree day data

MONTH	HEATDD	COOLDD
	(dd)	(dd)
Jan	53.8	29.4
Feb	41.8	51.9
Mar	9.6	112.2
Apr	0.2	227.5
May	0	355.3
Jun	0	409.5
Jul	0	475
Aug	0	456.8
Sep	0	357.7
Oct	0	253.7
Nov	6.7	120.5
Dec	34.5	54.8

3.4.2 HOTTEST AND COLDEST DAYS

The results indicated that 22nd July was the hottest day of the year (see Figure 8), whereas 9th February was the coldest day (see Figure 9).

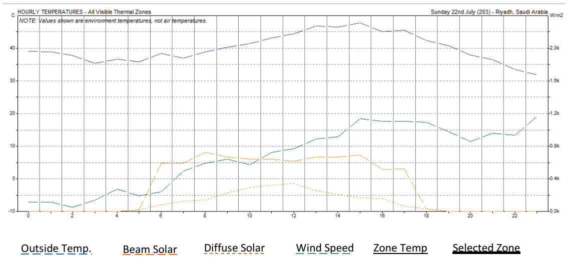

Figure 8 Hourly temperatures on hottest day

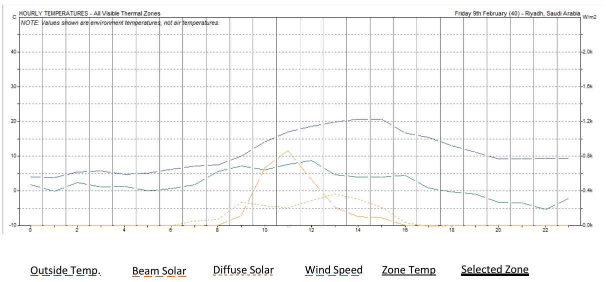

Figure 9 Hourly temperatures on coldest day

3.4.3 STRONGEST WIND

The results indicated that the strongest wind of the year was recorded on 6th July (see Figure 10).

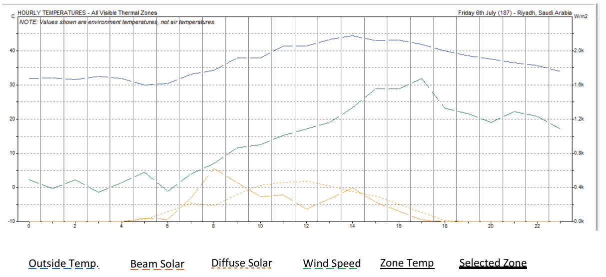

Figure 10 Strongest wind

3.4.4 MONTHLY SOLAR EXPOSURE

The results showed that May had the highest solar exposure hours (see Figure 11)

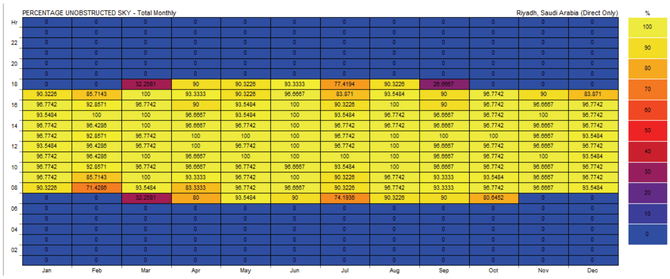

Figure 11 Solar exposure

4. CONCLUSION

Building energy analysis is one of the most important aspects of design. Modern technology enables the analysis of buildings within a simulated virtual environment. The results of this research showed that, for the building in question, the value of the cooling load was 475, about nine times the thermal load of 53.8. Therefore, it is crucial to consider the proportion of materials used for the insulation of buildings, in order to reduce the energy consumed for cooling purposes. Additionally, the exterior of the building was exposed to the sun for a long period during the summer months, this wasted energy could instead be used as a source of solar power, to reduce the building's high cooling load.

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