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Fenestration System

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Abstract: The paper is developed to assess various glass type and their effect on building energy. Consumption. The research will help to understand the effect of types of glass considering its parameters which are VLT (visual light transmit) and SHGC (solar heat gain coefficient). The analysis is done to see effect on energy consumption by changing glass type firm single to double to triple glazing. The analysis is done with the help of BIM software Autodesk Revit with Insight plugin. Use of various types of glass is used. The study is limited to commercial building with G+5 floors located at Ravet. Also, to study varying WWR (window to wall ratio) to varying glass types is done. This paper seeks to integrate the use of BIM based energy analysis in predicting the energy consumption of a Library building.

Keywords: *BIM, Autodesk Revit, Autodesk Insight, Energy Analysis*

I. INTRODUCTION

New design methods primarily focus on developing both low emission and energy-efficient. Climate change has established itself as a major issue, which requires an urgent and coordinated global response. Over the last few years, several studies have been performed in this direction.

One of the methods is to design fenestrations according to climate, to maintain good environment quality inside the building, and to save energy. Fenestration is an architectural term that refers to the arrangement, proportion, and design of window, skylight, and door systems within a building. Fenestration components include glazing material, either glass or plastic framing, mullions, dividers, and opaque door slabs, external shading devices, internal shading devices, and integral (between-glass) shading systems. fenestration and fenestration systems refer to the basic assemblies and components of exterior window, skylight, and door systems within the building envelope. Fenestration can serve as a physical and/or visual connection to the outdoors, as well as a means to admit solar radiation. The solar radiation provides natural lighting, referred to as daylighting, and heat gain to a space. Fenestration can be fixed or operable units can allow natural ventilation to a space and egress in low-rise buildings. Fenestration affects building energy use through four basic mechanisms thermal heat transfer, solar heat gain, air leakage, and daylighting. commercial. It will be G+5 floors located at Ravet. In built material in software are only considered. Variation in glass manufacture is not taken in considered BIM is an intelligent model based process that connects architectural, constructional and engineering professional so they can more efficiently design, build and operate buildings. With BIM, designers can create 3D model that include data associated with physical and functional characteristics. BIM collaborate architects, Engineers and contractors on coordinated models giving everyone the insight of the project and help them work more efficiently. It provides insight into the design's constructability, improving the efficiency and effectiveness of the construction phase and also provide better understanding of the building's future operation and maintenance.

Autodesk Revit Architecture is a robust architectural design and documentation software application created by Autodesk for architects and building professionals. The tools and features that make up Revit Architecture are specifically designed to support building information modeling (BIM) workflows. Revit was intended to allow architects and other building professionals to design and document a building by creating a parametric three-dimensional model that included both the geometry and non-geometric design and construction information, which is also known as Building Information Modelling or BIM. The 3D model of a building required for the energy analysis process is created using this Revit software.

Autodesk Insight is a cloud-based Energy Analysis Program which helps to improve energy and environmental performance throughout the building life cycle by letting us integrate Energy analysis, lighting analysis and solar analysis for a holistic approach to building performance design. This tool is only available to subscribers of Autodesk software and students for a period of 3 years.

The aim is to study different fenestration types by which the heat gain is minimized to make an energy efficient air-conditioned space. The objective is to study types of glass of window opening with respective to heat gain. The study each window to wall ratio for all types of glass chosen. The use parameters of glass, VLT and SHCG to select fenestration to reduce heat gain and maximize daylight. The scope is to understand the optimization of usage of glass for building envelop. The study about wall window ratio and glass types. The study inter relation between wall window ratio and glass type to reduce in energy in consumption. The paper has certain limitations, it is studying the glass with respective value of VLT and SHGC only and not considering any other parameters. Type of building is be used only.

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II. LITERATURE REVIEW

Passive building systems are fundamental to achieve high energy efficiency and comfort in built environment. Based on a typical residential case in Hong Kong, this study aims to analysis the integration of various passive cooling techniques on annual and hourly building energy demand with whole building simulation. thermal characterization of this glazing technology is presented [1]. Experiments and data analysis led to the characterization of the behavior of the thermotropic glazing both when this technology is used alone (single glass pane) and when it is integrated in a multilayer fenestration (a triple glazed unit. Switchable windows are glazing technologies that exhibit dynamic optical properties and may thus be used to improve the energy performance of buildings [2]. The method to evaluate energy consumption of buildings is Energy analysis using Building Information Modeling (BIM) tools – Autodesk Insight, BIM is an intelligent 3D model-based process that gives Engineers the insight tools to more efficiently plan, design, construct, and manage buildings and infrastructure. The energy analysis needs to be amalgamated into the design phase of the building with respect to the increased regulations required all over the world [3],[4].

III. METHOLOGY

For the purpose of the energy analysis of building with the help of Autodesk insight andRevit software, the study is limited to commercial building with G+5 floors located at Ravet.

The three-dimensional model of the building is created using Revit architecture and the model is further analyzed using Autodesk insight. The energy simulation of a building involves the following steps:

- generate the Drawings and information about the building to be studied.
- Create a 3D model using the Autodesk Revit software with the help of the drawingscollected.
- Change the energy setting WWR,type of glazing etc. as per your need.
- Locate your building using Internet Mapping Service inbuilt in Autodesk Revit to get on site co-ordination and climatic parameters.
- Locate your building using Internet Mapping Service inbuilt in Autodesk Revit to get on site co-ordination and climatic parameters.
- Automatically create a building energy model using the analyse panel in Revitsoftware.
- Analyse and run results in the Autodesk Insight over the cloud softwareEstimate the energy use of the building.
- Compare and analysis the various output to determine the most energy efficient(fenestration system).
- Parameters for simulations.

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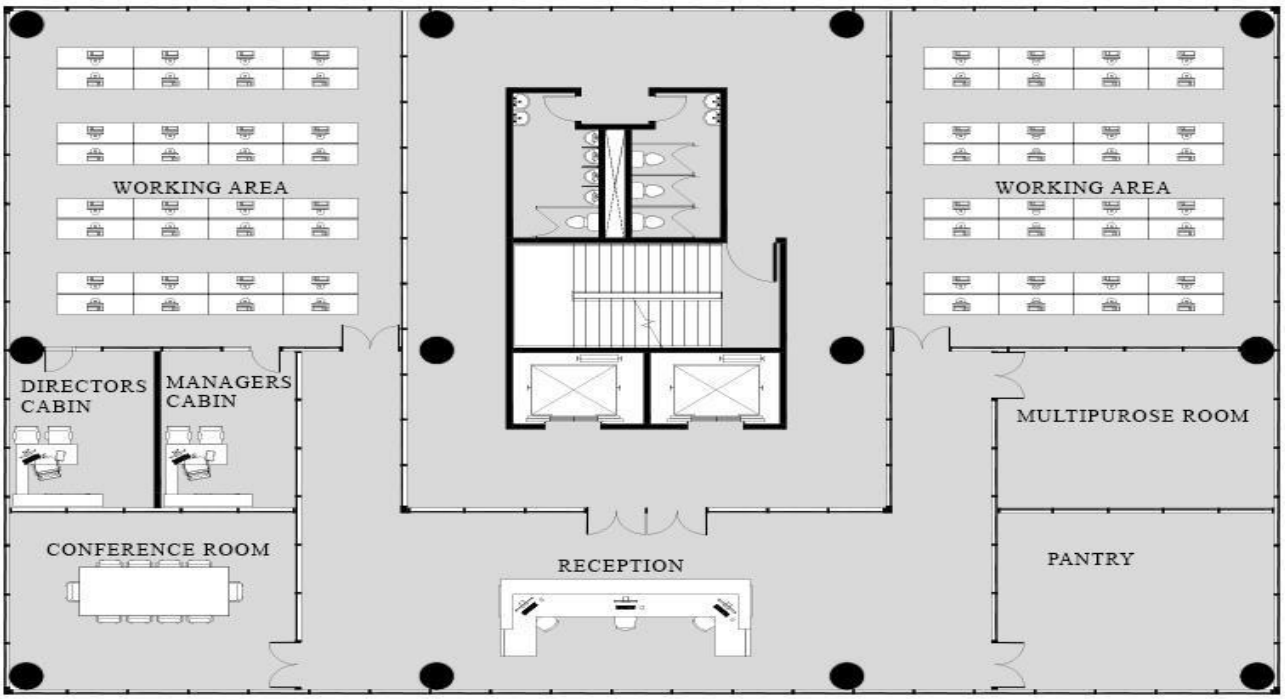
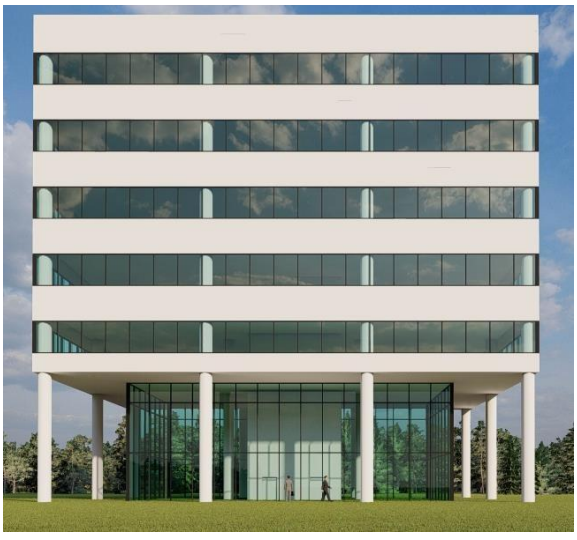
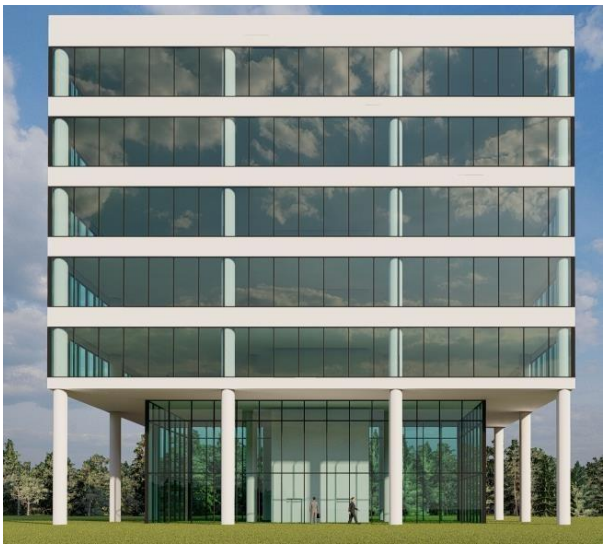


FLOOR PLAN

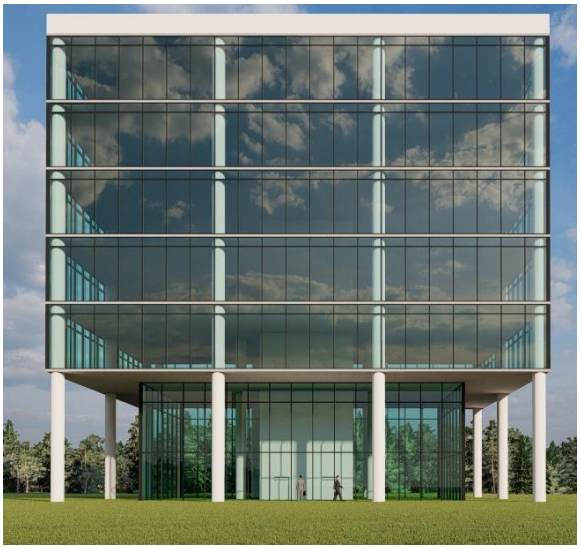
- Area: 600sqm
- **Project type**: office area
- **Operating schedule**: 12/6
- **No. Of floors**: g+5
- **Location**: ravet
- **SGU glass**: 6mm thk performance glass
- **DGU glass**: 6mm thk performance hs glass+ 12mm thk argon filling +6mm thk clearhs glass
- **TGU glass**: 6mm performance hs glass +12 mm thk argon filling +6mm thk+12thkargon filling +6mm thk clear hs glass
- **Glass area for 100 percent glazing**: 2000sqm
- **Glass area for 75 percent glazing**: 1500sqm
- Glass area for 50 percent glazing: 500sqm



50 PERCENT GLAZING



75 PERCENT GLAZING



100 PERCENT GLAZING

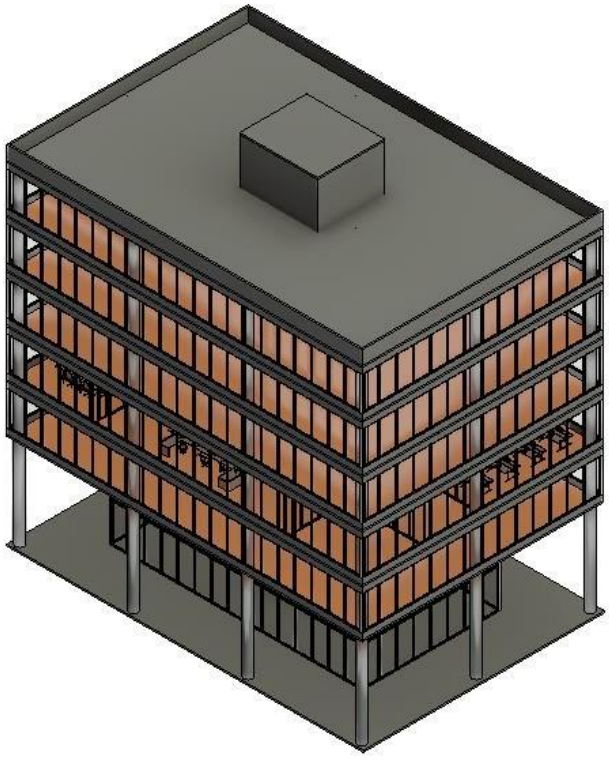


Fig. 1: A 3d Model Is Created Using Autodesk Revit Software With The HelpOf Plans Availabe Of Building

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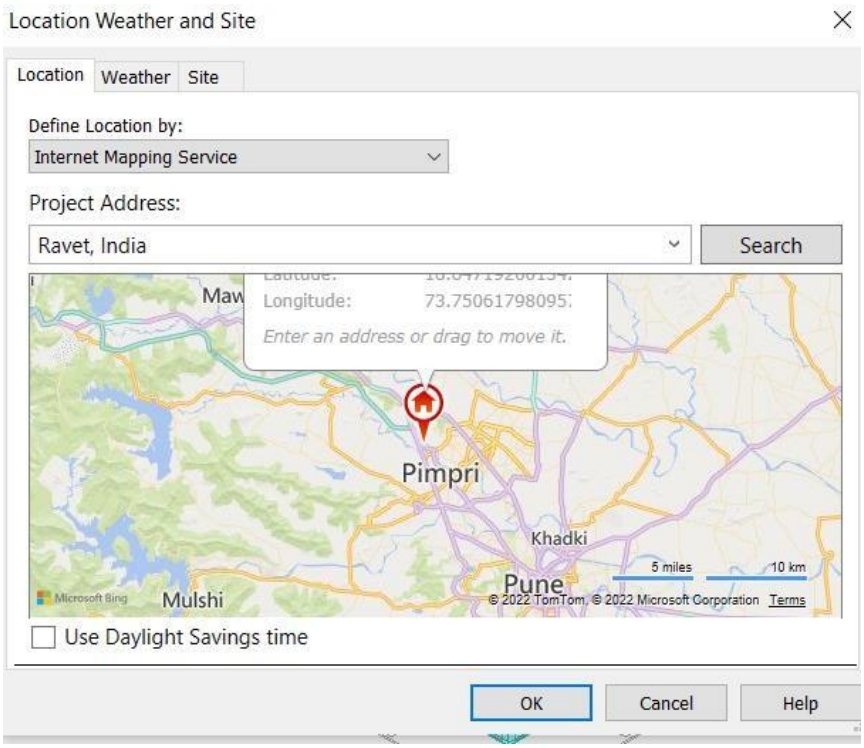

Fig. 2: locating the building in revit using internet mapping service

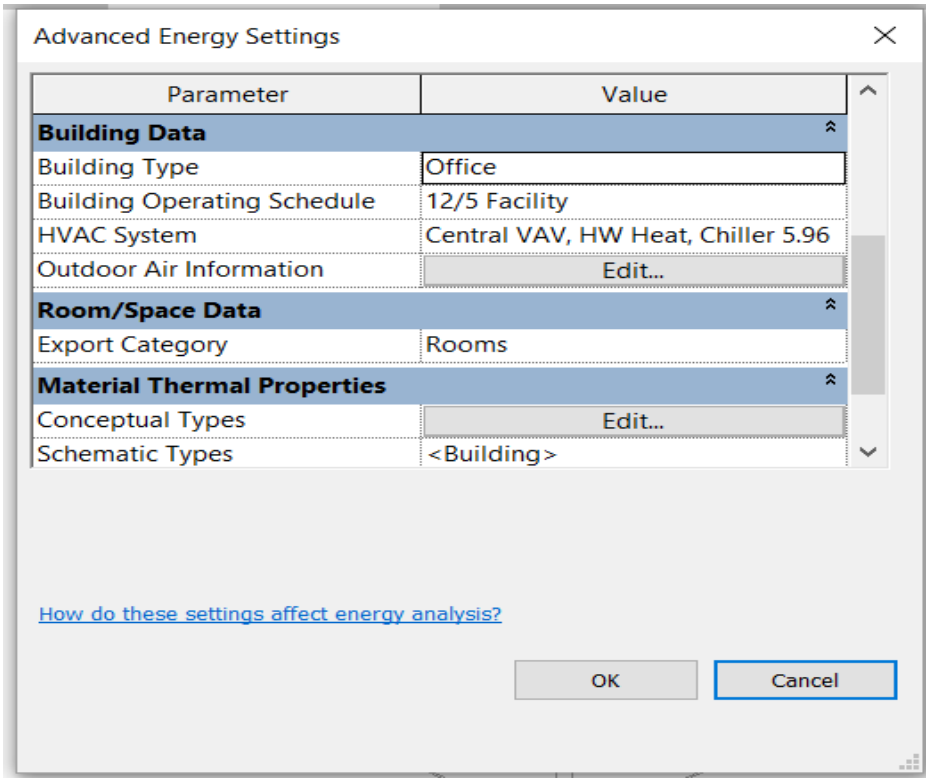

Fig. 3: Setting Parameters To Convert To Energy Analysis Model

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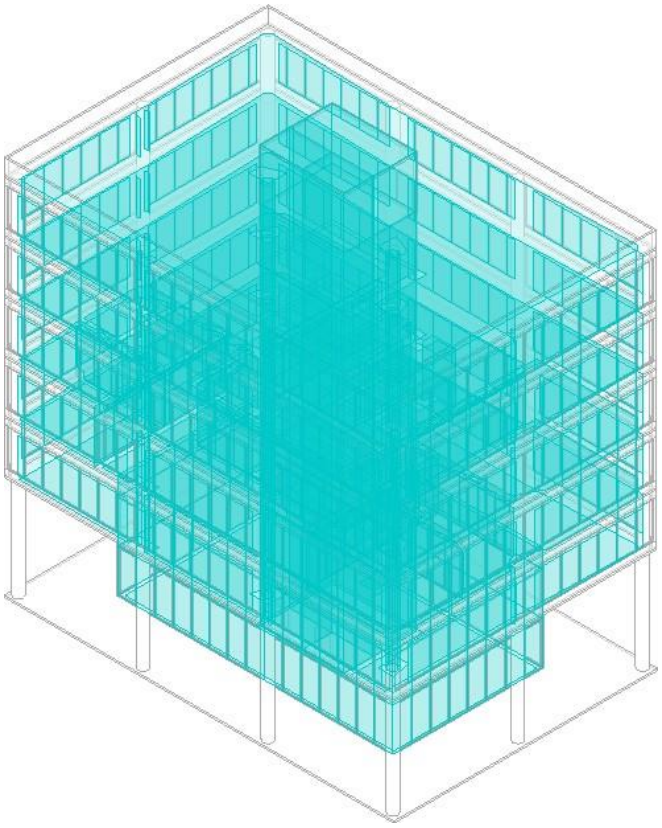


Fig. 4: Energy Analysis Model Converted Ready To Import In AutodeskInsight

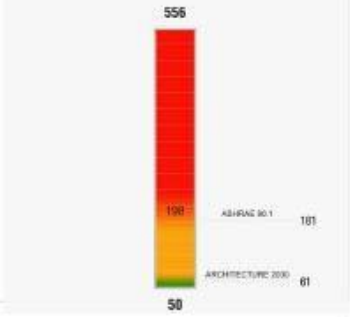
Back to Insight (/OneEnergy/Insight/153050)

RIA 50 PERCENT

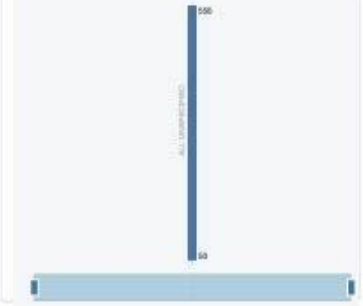
Building Form

Location

Benchmark Comparison
kWh / m² / yr



Model History
kWh / m² / yr



Building Orientation

Rotates a building clockwise from 0 degrees, e.g. 90 degrees rotates the North side of the building to face East.

Current Setting:
180 - 315

WWR - Southern Walls

Window-Wall-Ratio (glazing area / gross wall area) interacts with window properties to impact daylighting, heating & cooling.

Current Setting:
95% - 0%

Window Shades - South

Shades can reduce HVAC energy use. The impact depends on other factors, such as window size and solar heat gain properties.

Current Setting:
BIM - 2/3 Win
Height

Window Glass - South

Glass properties control the amount of daylight, heat transfer & solar heat gain into the building, along with other factors.

Current Setting:
Dbl LoE - Trp LoE

WWR - Northern Walls

Window-Wall-Ratio (glazing area / gross wall area) interacts with window properties to impact daylighting, heating & cooling.

Current Setting:
95% - 0%

Window Shades - North

Shades can reduce HVAC energy use. The impact depends on other factors, such as window size and solar heat gain properties.

Current Setting:
BIM - 2/3 Win
Height

Window Glass - North

Glass properties control the amount of daylight, heat transfer & solar heat gain into the building, along with other factors.

Current Setting:
Dbl LoE - Trp LoE

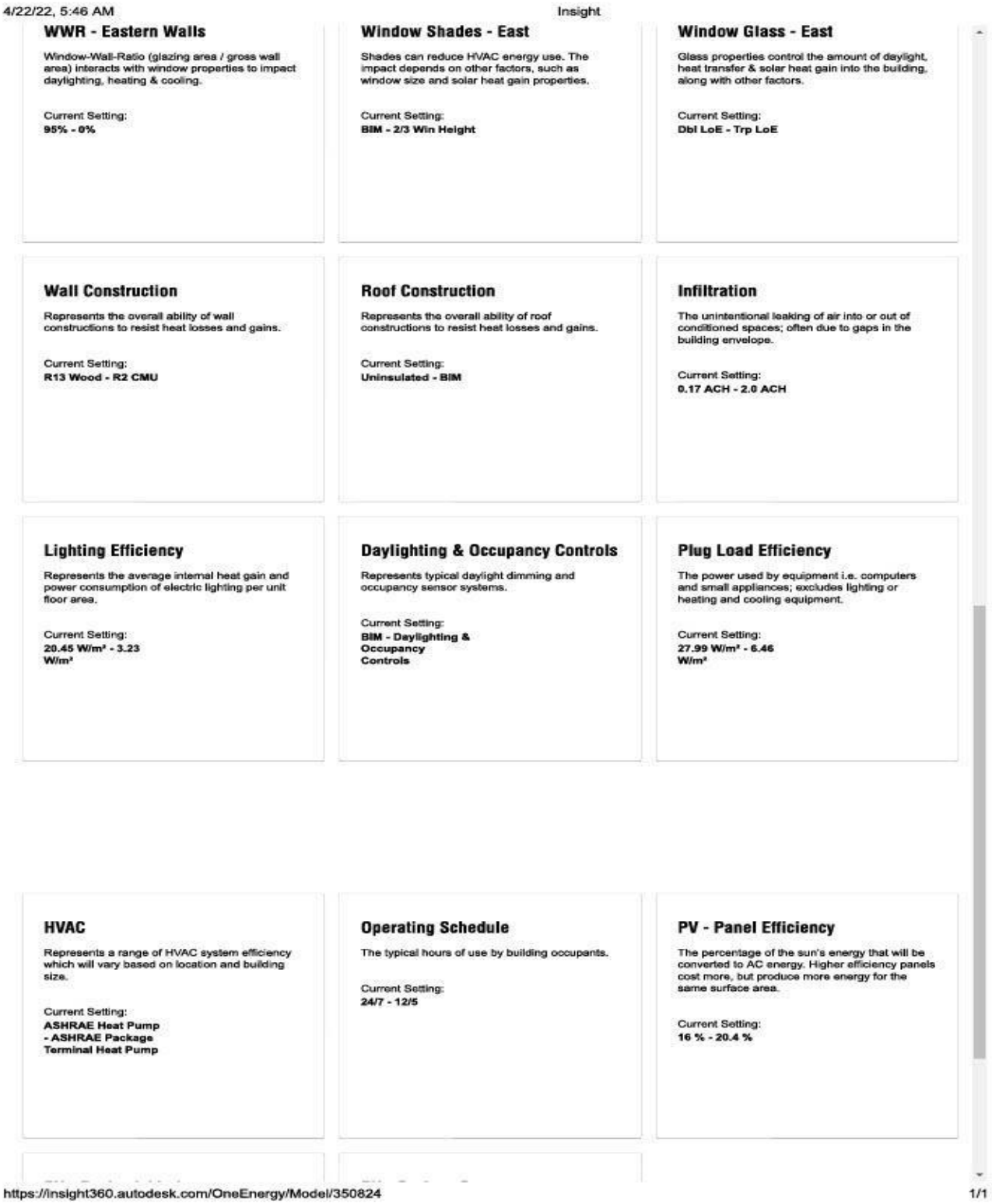


Fig 5 :Model Imported To Insight

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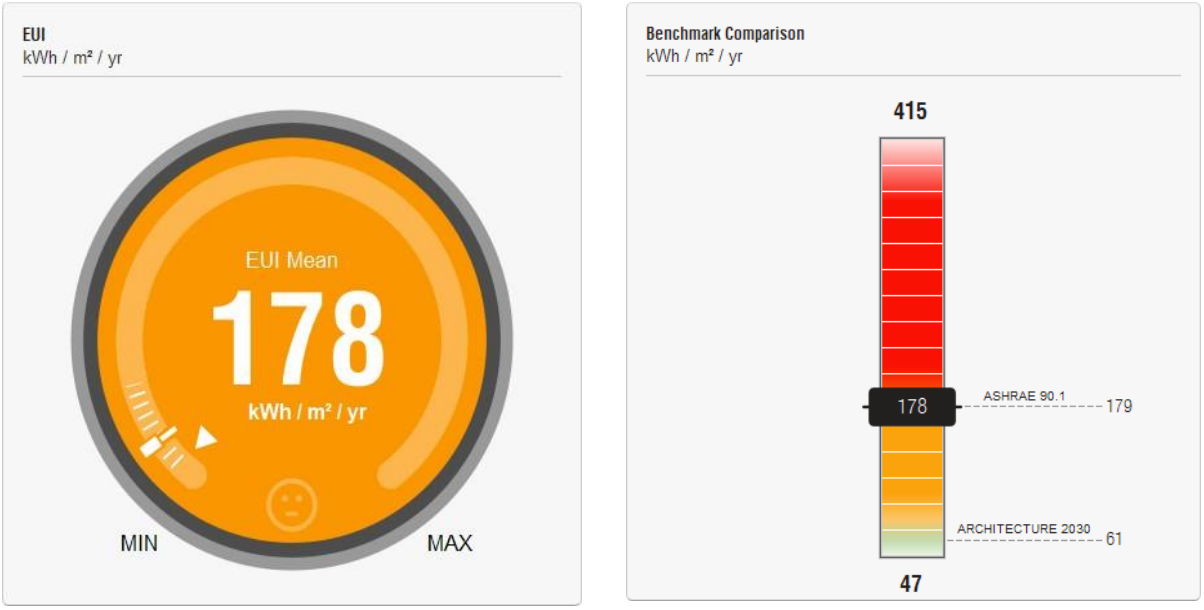
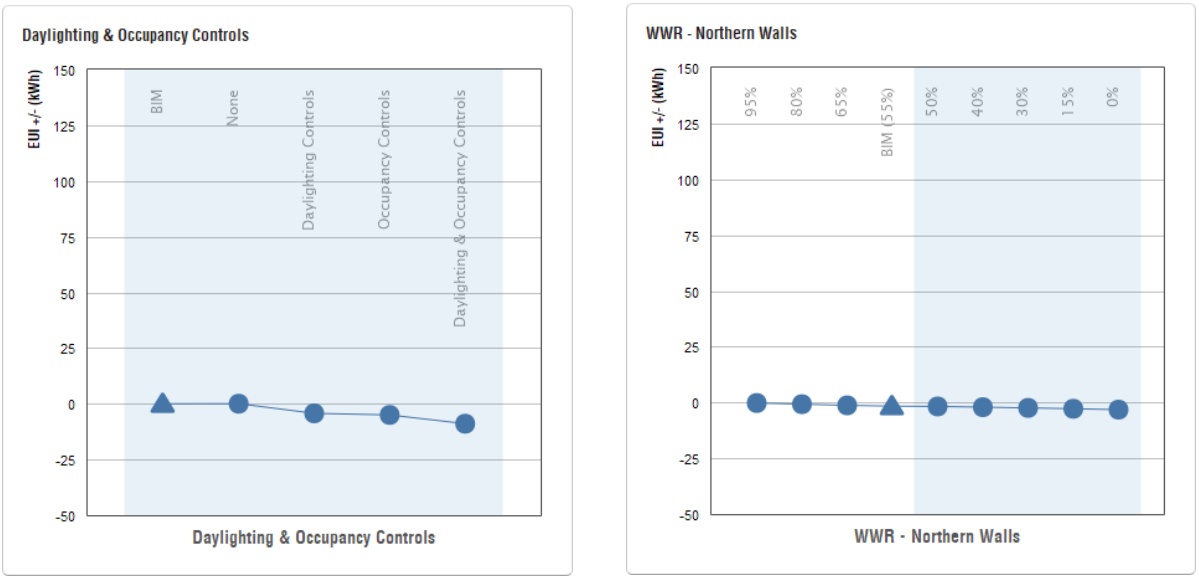


Fig. 6 : To reduce the overall energy use intensity of the building, we can changethe range of each design criteria and see how much the change in design of individual features like window to wall ratio, operating schedule etc. can affect the energy consumption of the whole building



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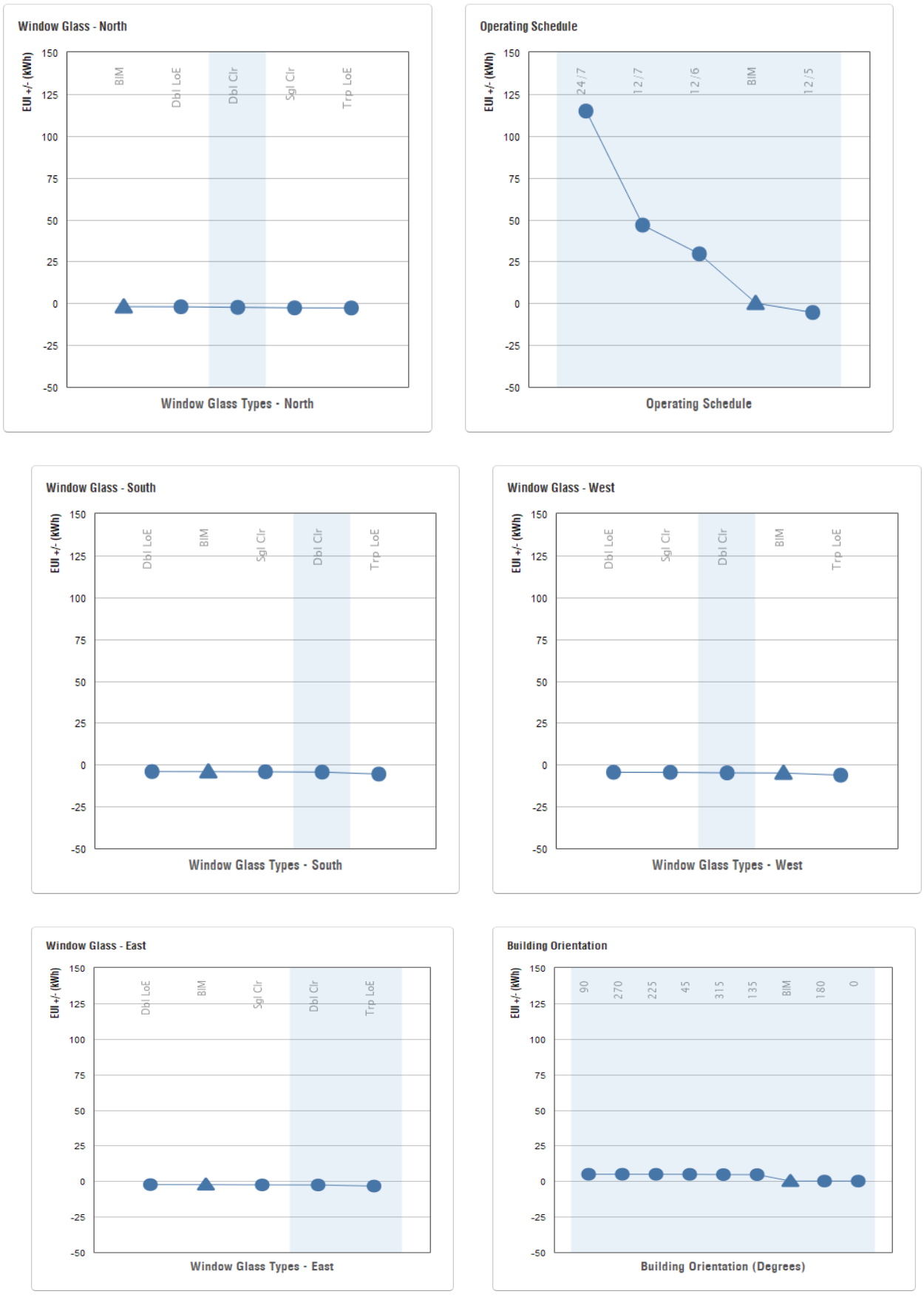

Fig. 7

ISSN No:-2456-2165

IV. ANALYSIS

A. WINDOW WALL RATIO

WALL AREA (sqm)	GLAZING PERCENTAGE	WINDOWAREA (sqm)
2000	50	1000
2000	75	1500
2000	100	2000

Table 1

B. ENERGY USE INTENSITY

The energy consumption of the building will be calculated as Energy Use intensity (EUI) in kWh/m2 per year based on the energy setting of the project. EUI is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building.

TYPES OF GLASS	PRICE (Per sqm.)	SHGC	VLT	50 PERCENT GLAZING FACADE	75 PERCENT GLAZING FACADE	100 PERCENT GLAZING FACADE
				1000 sqm	1500sqm	2000sqm
SINGLE GLAZING	Rs.1200	0.81	0.88	190 kWh/m^2	200kWh/m^2	220 kWh/m^2
DOUBLE GLAZING	Rs.2300	0.55	0.7	134 kWh/m^2	147 kWh/m^2	178 kWh/m^2
TRIPLE GLAZING	Rs.9000	0.62	0.68	114 kWh/m^2	120 kWh/m^2	155 kWh/m^2

Table 2

C. COSTING

GLASS	PRICE (per.sqm)	COSTING		
		50	75	100
		1000sqm	1500sqm	2000sqm
SGU	Rs.1200	Rs. 1200000	Rs. 1800000	Rs. 2400000
DGU	Rs.2300	Rs. 2300000	Rs. 3450000	Rs. 4600000
TGU	Rs.9000	Rs. 9000000	Rs. 13500000	Rs. 18000000

Table 3

V. CONCLUSION

OPTIONS	EU VLAUE	COST	VLT
1	114 kWh/m^2	Rs. 9000000	0.68
2	120kWh/m^2	Rs. 13500000	0.68
3	134kWh/m^2	Rs. 2300000	0.7
4	190kWh/m^2	Rs. 1800000	0.81

Table 4

Average EU unit: 162kWh/m^2 Average cost : Rs.6500000

Therefore ,we can conclude that double glazing 50 percent glazing façade isoptimum solution for façade as it is less can than average 134kWh/m^2 < 162kWh/m^2.

The lowest value is still triple glazing50 percent glazing (114kWh/m^2 <134kW/m^2) but considering cost factor double glazing unit is considerable.

In india the most part, the country has a tropical climate which throughout most ofthe interior is a mixture of wet and dry tropical weather, so 100 percent glazing façade is soluble.

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