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Design for an Intelligent BIM Based Energy Management System

Li-Hong Juang*, Wei-Ya Fong and Lixin Zheng

The Engineering Research Center of Fujian Provincial Academics for Industrially Intelligent Technology and System, Engineering College, HuaQiao University, Fujian, P.R. China

Abstract

Building information modeling (BIM), it means a digital simulation of buildings with real information. Information connotation of just geometry description also contains a large number of non-geometric properties of information. Through discussion explores technologies such as BIM exhibition hall at an experimental building renovation of energy control systems of various types of applications, hoping to provide a new perspective to explore the building energy management.

Keywords: Energy Control; BIM; Building Alteration Experiment; Simulation; Debugging

***Corresponding Author:** Li-Hong Juang, The Engineering Research Center of Fujian Provincial Academics for Industrially Intelligent Technology and System,Engineering College, HuaQiao University, Fujian, P.R. China; E-mail: puuan.juang@msa.hinet.net

I. Background

Construction activity is one of greatest impact on natural resources, the environment of human activities. It consumes a lot of natural resources. Definition of building energy consumption in two ways: generalized building energy consumption refers to the building envelope materials manufacturing, building construction, building operations, maintenance and energy consumption of the entire process of reusing or dismantling. Energy consumption of buildings in the narrow sense, the use, operation and maintenance of the building energy consumption that are needed in the process, is the daily use of energy, such as heating, air conditioning, lighting, cooking, laundry and other energy, constitutes the main part of the building energy consumption.

Generally speaking, construction activities using the 40% of the total human use of natural resources, 40% of the total energy, as a result of construction waste is 40% per cent of total waste generated by human activities. As economic prosperity, social progress and technological development of the most common signs, Office building is built most of the public buildings category, however, Office building energy issues have become increasingly prominent. According to statistics, air conditioning, heating and lighting energy consumption is currently 70% per cent of China's total energy consumption of office building-80%, annual power consumption per square meter is 10-20 times the ordinary residential, Europe, Japan and other developed countries 1.5 times times that of comparable buildings. Office building energy efficiency situation is quite severe, high energy consumption should arouse attention [1-4].

II. The significance of the project:

Based on the above background, the positive response to domestic green building energy efficiency policies, and pre-built transformation conduct its internal architecture exhibition hall laboratory building, both on the campus of the old building re-use, but also to transform it into a green building, as the venue of their students First, become one of the beautiful landscape architecture school; at the same time implementing exhibition hall teaching philosophy, exercise civil engineering student self-learning ability.

III. BIM technology applied in the experimental building renovation project

1. Project

Building energy control planning phase of the project [5-10] requirements and standards as the baseline of the design phase. General scheme of project ideas: solar panels, batteries, lamps etc as the main body, computer programming, to act as a complete operational system. In the case of sun light, solar power systems, but also the surplus energy storage in batteries. In the case of no sun light, the system battery, release when battery power is completely finished, the system automatically switches to the power supply.

Construction operation and maintenance phase, through BIM model simulation can predict all types of energy in line with changes, development of appropriate energy solutions and reduce building energy consumption and improve energy efficiency. This

reference design project ideas, then behind the direction of the project and the software you need to learn (Lab VIEWBIM series: Revit, MEP, Ecotect etc).

Figure 1: Exhibition hall total energy management system design idea

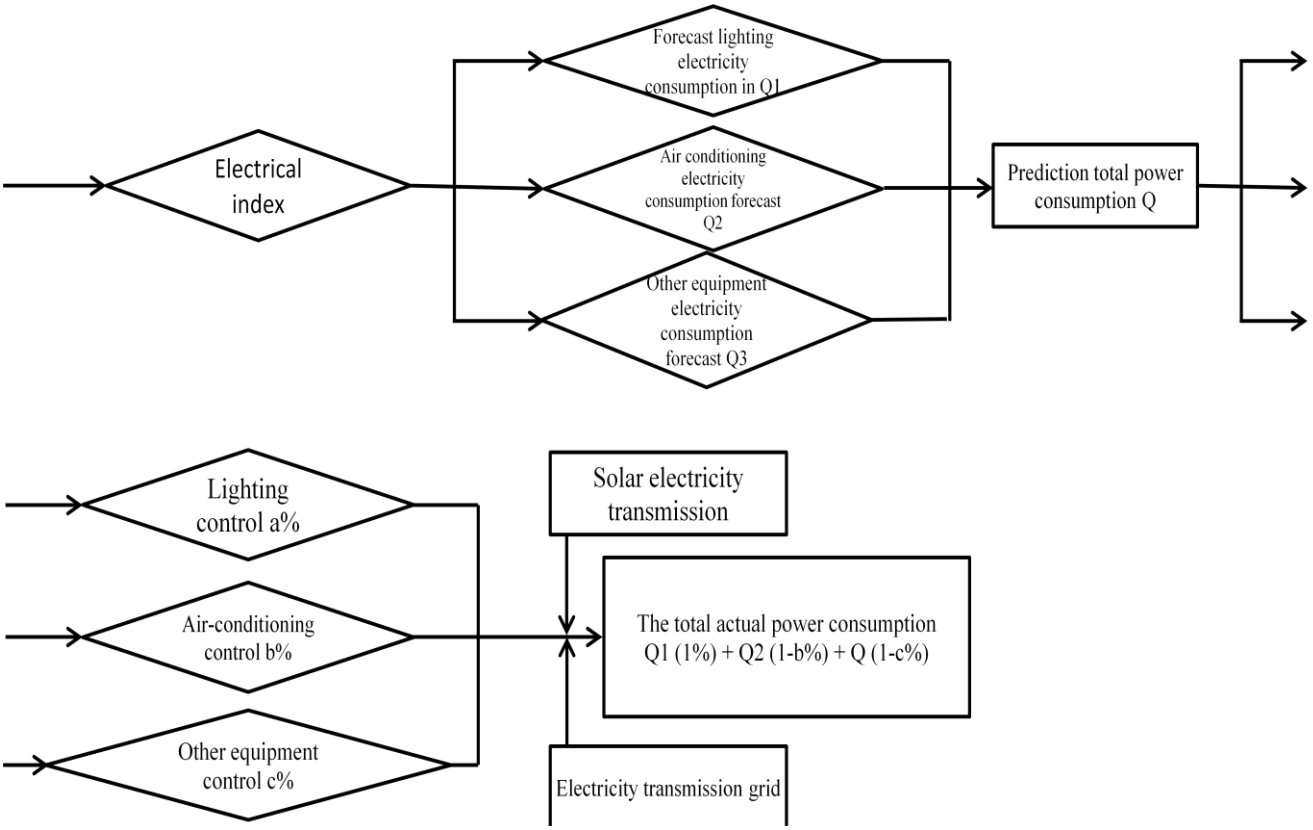
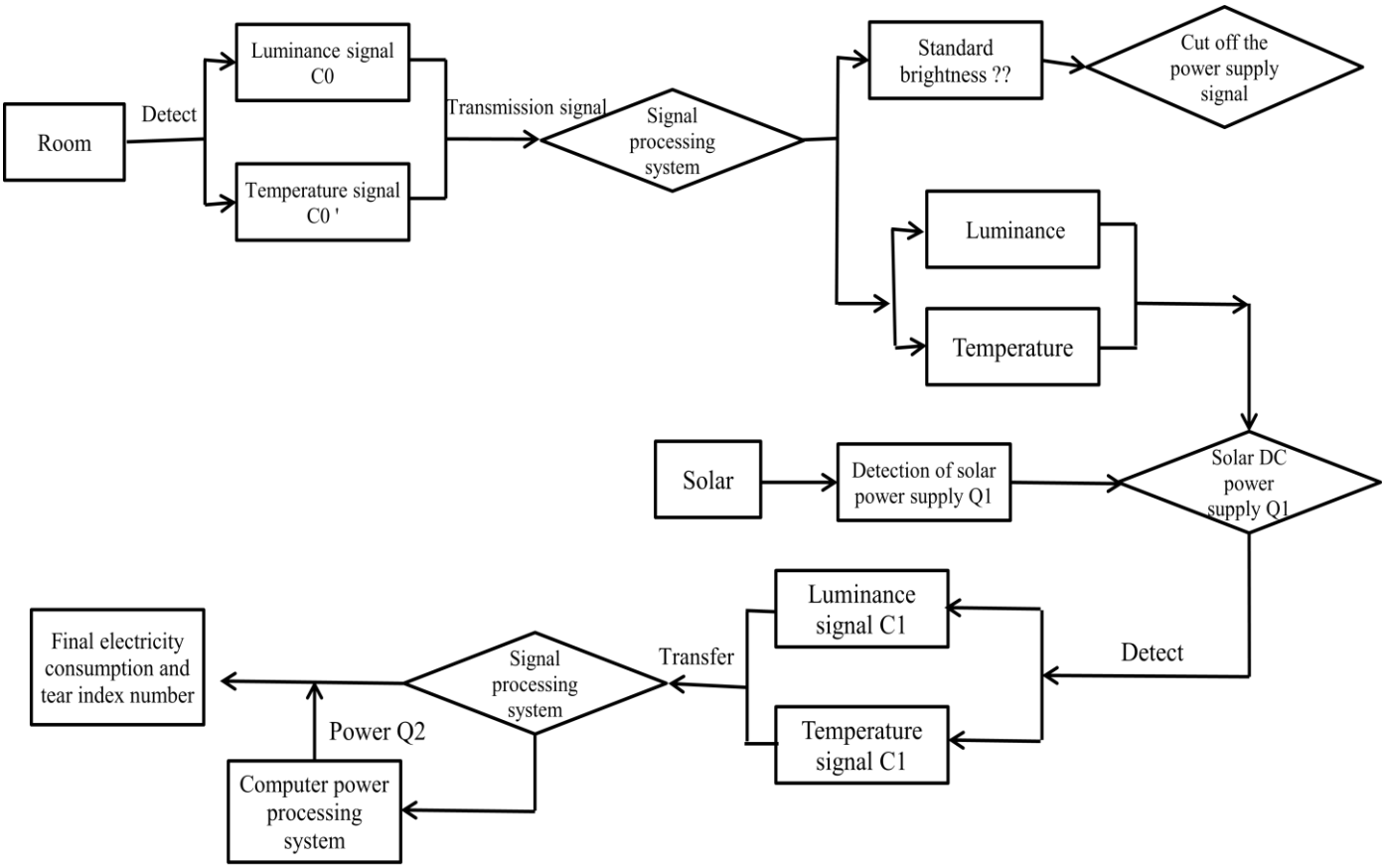


Figure 2: Exhibition hall total energy management system design idea



2. Ecotect applications

Autodesk Ecotect Analysis software is a fully functional, apply from concept to detailed design aspects of sustainable design and analysis tools, which contains extensive simulation and analysis capabilities, can improve the performance of existing buildings and new building projects. The software will online energy efficiency, water consumption and carbon emission Analytics integration with desktop tools, visualization and simulation for real building performance in your environment. Interactive analysis using powerful three dimensional performance functions to simulate sunlight, shadows, launches and light on the environmental impact of [11-16].

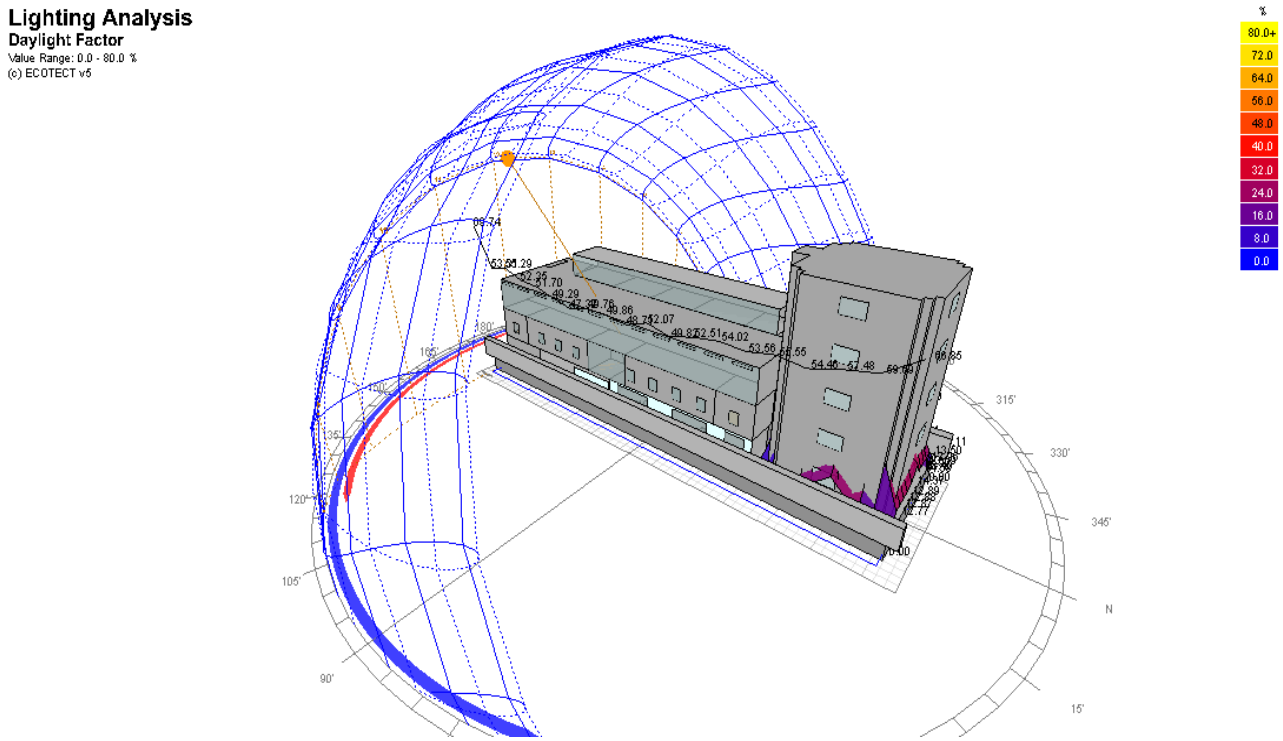
Exhibition hall environmental detail and investigation of the lab building, exhibition hall obtained experimental building location, solar radiation, solar illumination brightness, temperature distribution, and so on.

Figure 3: A modified exhibition hall experimental building

Exhibition hall laboratory building is located in the West of longitude: 116.6294 latitude: 23.4162

Using Ecotect Weather Tool, exhibition hall laboratory building level trajectories of the Sun can be obtained, this project is very important to set the position and angle of the solar panel and other help.

Exhibition hall Laboratory building horizontal Sun path chart



Thermal analysis for the exhibition hall laboratory building, each month of radiation.

TOTAL MONTHLY SOLAR EXPOSURE

An, CHN (Direct Only)

AVAIL. REFLECT INCIDENT TRANSMITTED

MONTH	Wh/m^2	Wh/m^2	Wh/m^2	TOT.Wh	Wh/m^2	TOT.Wh
Jan	87305	0	37996	881655	37958	880774
Feb	66722	0	35147	815532	35111	814716
Mar	71866	0	39598	918812	39558	917893
Apr	76336	0	41256	957290	41215	956333
May	65629	0	34337	796755	34303	795958
Jun	47619	0	21234	492709	1213	492216
Jul	85029	0	44964	1043336	4919	1042293
Aug	86206	0	45203	1048888	45158	1047839
Sep	101122	0	54250	1258812	54196	1257554
Oct	91451	0	44649	1036027	44604	1034991
Nov	80448	0	38238	887274	38200	886387
Dec	130787	0	54864	1273040	54809	1271767
TOTALS	990520	0	491736	11410131	491245	11398721

Combination of Retscreen, brightness values get sunlight in the experiment building of exhibition hall. Predictable laboratory building in the room needed to compensate the illumination values to design lighting systems, select the specification proper lamp.

	unit	Location data	Item Location	Source
Latitude	north	23.4	23.4	
Longitude	east	116.7	116.7	
Altitude	Meter	3	3	NASA
Heating design temperature	Celsius	8.5		Ground
Cooling design temperature	Celsius	32.6		Ground
Land temperature amplitude	Celsius	12		NASA

		Daily solar radiation				Heating degree - days in	Cooling degree days
Air temperature	Relative humidity	Level	Atmospheric pressure	Wind velocity	Land temperature	18 degrees Fahrenheit	10 degrees Celsius
Celsius	%	Degrees / square meter / day	KPa	M / s	Celsius	Degrees Celsius for several days	Degrees Celsius for several days
14.2	76.2%	3.26	100.3	2.8	14.9	118	130
14.6	79.6%	3.08	100.2	3.0	16.6	95	129
16.8	81.2%	3.15	99.9	2.8	20.1	37	211
20.9	81.8%	3.68	99.6	2.6	23.7	0	327
24.6	83.3%	3.99	99.3	2.6	26.1	0	453
27.2	84.6%	4.31	99.0	2.8	27.1	0	516
28.5	82.6%	5.07	98.9	2.8	27.6	0	574
28.3	82.9%	4.57	98.8	2.7	27.3	0	567
27.0	79.7%	4.17	99.2	2.7	25.8	0	510
24.2	74.3%	4.20	99.8	3.0	23.7	0	440
20.3	74.8%	3.69	100.1	2.8	20.4	0	309
15.9	73.8%	3.39	100.4	2.8	16.2	65	183
21.9	**79.6%**	**3.89**	**99.6**	**2.8**	**22.5**	**315**	**4,348**
Ground	Ground	NASA	NASA	Ground	NASA	Ground	Ground
			Meter	10	0		

3. MEP Application: The angular position of the lamp decoration design

Autodesk Revit MEP is a plumbing system modeling, design and analysis system to help improve the efficiency of the professional software. Based on the basic functions of the MEP, on the floor of the existing building structure exhibition hall power system, primarily designed lighting system. In order to make the whole building energy conservation, to ensure sufficient brightness, the possible use of low-power lamps, and different directions with different types of lamps, make it more distinctive, but also to meet for comfortable use.

Figure 4: Floor lamp lighting system distribution

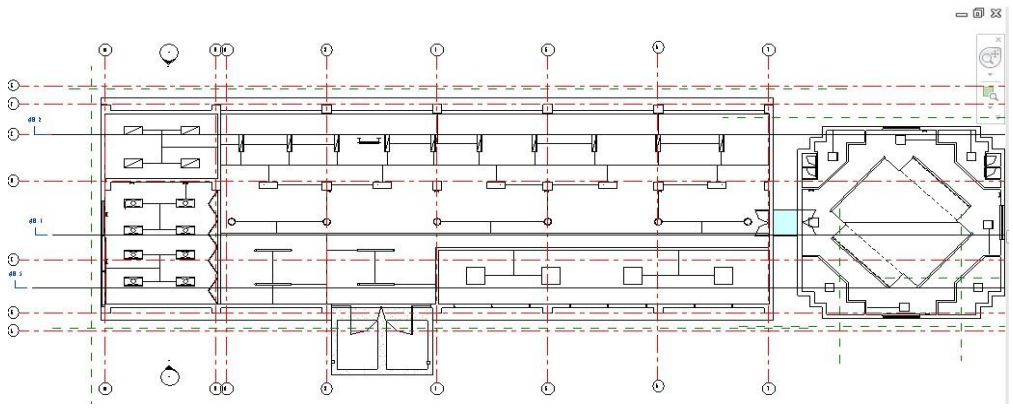


Figure 5: Floor lamp lighting system distribution

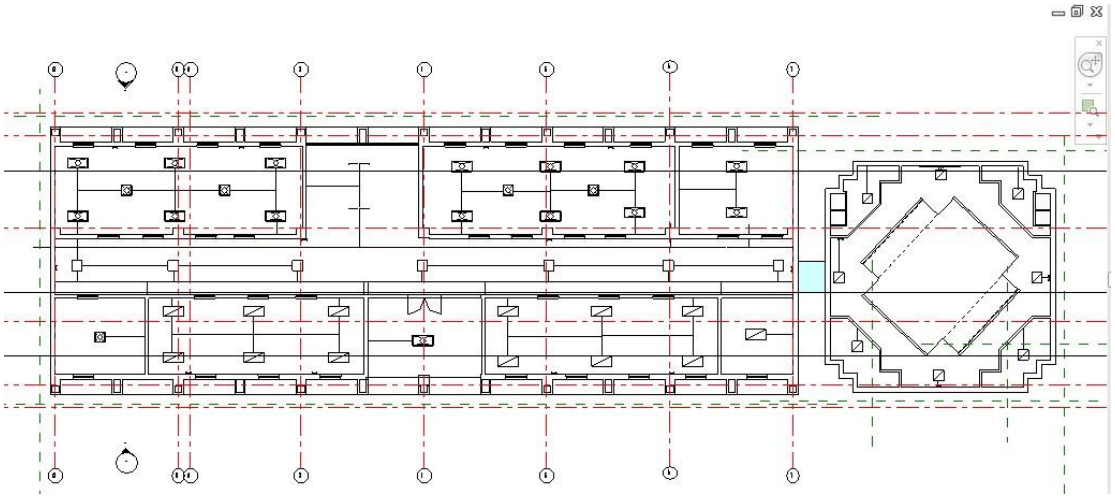


Figure 6: Floor lamp lighting distribution system

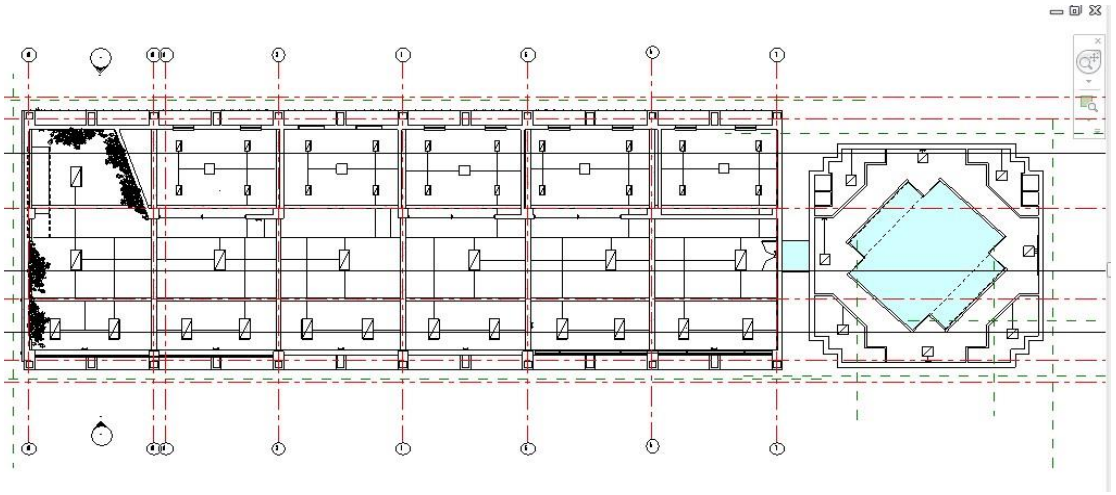
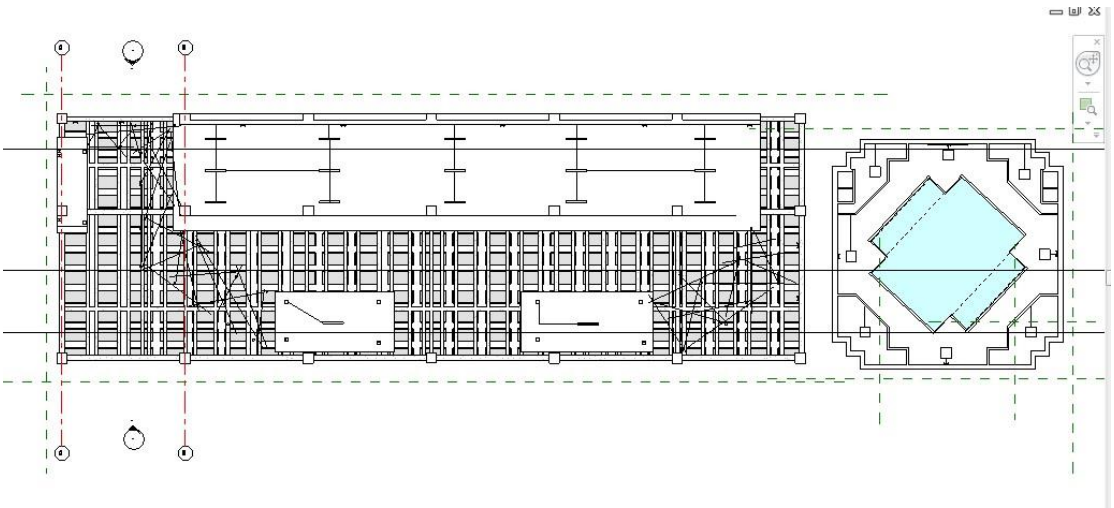


Figure 7: Distribution fourth floor lamp lighting system

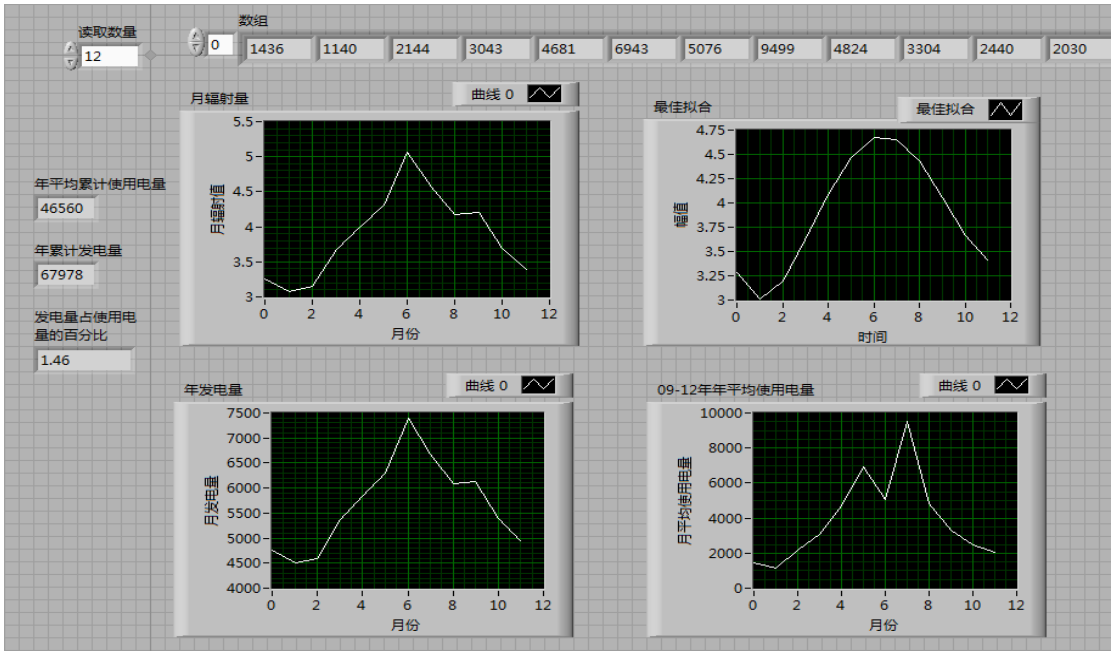


4. Combination of LabVIEW programming system

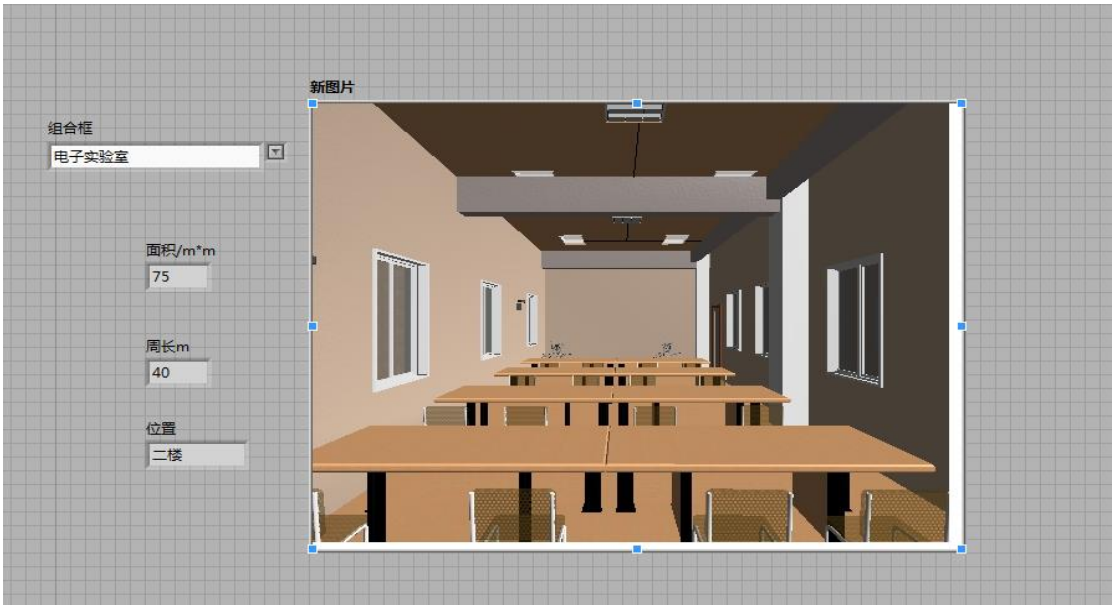
LabVIEW is a general purpose programming system, there is a huge library of any programming tasks. LabVIEW has many advantages, especially in the aspects of measuring, control and simulation in particular. Exhibition hall experiments in the design of the building's energy management system using LabVIEW programming, improving energy control system as a whole.

Using the LabVIEW simulation of solar collection and solar-powered electricity generation on building help. Through Ecotect prediction of optical radiation, the proposed acquisition for signal acquisition for solar panels, the signal is fed back to the system control center, system control signals into data, after calculation, solar energy can be drawn and displayed on the control panel screen, can learn at any time from the control panel screen of solar panels, wind power generation. The same principle, the system also exhibition hall experiment building of feedback electrical energy consumed. Through the energy generated compared with the building before the power can come to solar effects.

In a separate private room and features distance sensors and light sensors.



Dang people from outside into room, distance induction device induction to people Hou, will directly will signal to control Central, in control panel screen Shang will displayed prior prefabricated good of moving figure (people into to), points bright room within of lamp; Dang people left room Hou, distance induction device in 15 minutes of time within not induction to human, control central will close room within of lamp.



Light sensor setting preset value: 35 Lux. In the room, the light sensor will capture the indoor illuminance, when the room reaches 35 Lux, illuminance, luminance is zero, when not up to 35 Lux of illumination, automatically turning on the light and the light adjust the brightness of the system supplying indoor illumination to the nominal illumination. Activities both indoors and do not hurt the eyes, and can save unnecessary power.

IV. Making exhibition hall experiment building solid model for simulation and debugging model is divided into two parts: the main building and equipment

1. Main parts: Exhibition hall experiment building roughly the same layout on each floor, the project will targeting laboratory building third floor, exhibition hall laboratory building third floor is made of KT made single-layer model. Model experiment building basic framework in the third layer, the whole framework in accordance with the scale, exterior wall using two layers of KT plate, interior walls with a KT plate, simplify internal in the third layer, remove some interior walls and Windows that open, so that the device has sufficient positions to set display, better energy control system operation in the exhibition hall laboratory building.

2. Equipment parts: The main part of the project for the energy control systems. Project will use small batteries as an energy source control system in the large battery scale solar panel area; a small LCD screen as an energy control system the control panel screen; uses LED light for energy control system lamp energy control system of main body assembly using a circuit board, main functions of energy control systems.

3. Staging: the device is installed on the model, select the model left open as a device of staging room, to import the wire room, installed in the room around 4 LED lights, light sensor and range sensor, and battery and solar power in the form of parallel access to the system and place it outside the room.

To simulate the light environment of the room, open the entire system.

① To get solar panels under sunlight, when the illumination in the room enough, namely illumination ≥ 35 Lux case, as human hands, into the room, LED lamp will be lit in the room, but this time, the display shows the voltage and current values, said solar panels convert solar energy into electricity stored in storage in the pool. Blind cover with solar panels, solar panel stops working, the system current and voltage values in smaller, no more battery storage.

② Putting solar panels under sunlight, with a blind cover part of the room, in the room illumination is low, or 15 lux ≤ ≤ 35 Lux, illuminance, the hand into the room, the system will automatically light 2 LED lamp, room compensation to more than 35 Lux of illumination. The system powered by solar panels and battery storage. Blind cover with solar panels, solar panel stopped working, no longer on the system power, go for battery, 2 LED lamp is still burning in the room.

③ Put the solar panels under sunlight, shade shelter room, basic dark in the room, that is ≤ 15 lux, illuminance, the hand into the room, all 4 LED light in the room is lit, the system powered by solar panels and battery storage. Blind cover with solar panels, solar panel stopped working, no longer on the system power, go for battery, make room 4 LED light remains on.

V Conclusion and Outlook

This project at this point, only addresses the design and applications of photovoltaic systems and lighting systems. In addition, for the analysis of various factors affecting the building energy-saving design, team members are still in the development process, software in use, parameter setting, and so there are a lot of skills needs summary of experience. Follow-up has been carried out in air conditioning systems and water harvesting system design and perfection requires a lot of skill and experience support. Anyway, use of BIM technology in the auxiliary building energy-saving aspects, will give the study and practice of energy-saving green buildings have a profound impact, will use exhibition hall to experiment building renovation project, will enable this project to get much benefit.

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