Journal of Science and Engineering Management
Vol. 1, No. 1 (2020), pp.21-28
http//dx.doi.org/10.33832/jsem.2020.1.1.04

A STUDY ON SIMULATION ANALYSIS USING ARCHITECTURAL IT TECHNOLOGY

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***Abstract*— The development of new and renewable energy technologies is being promoted as a countermeasure against global warming caused by global energy consumption and a rising oil price problem over time. The way to solve this environmental problem is to replace fuel with new and renewable energy instead of fossil fuel through technology development. Unlike fossil fuels such as nuclear energy, raw materials are replaced with energy from nature such as wind power and solar power. Therefore, this study intends to review the applicability of eco-friendly materials and technologies through the energy simulation program for renewable energy and passive construction, and to conduct an efficient study of space creation for eco-friendly residence of architectural projects.**

***Keywords*— Simulation Analysis, IT Technology, Renewable Energy, Eco-friendly, Environmental**

1. INTRODUCTION

The development of new and renewable energy technologies is being promoted as a countermeasure against global warming by global energy consumption and against rising oil prices over time. The current energy system is based on fossil fuels and has many problems such as global warming and greenhouse gas. Environmental problems arise when human-induced results are beyond the purifying capacity of nature [1]. The way to solve these environmental problems is to change fuel to new and renewable energy instead of fossil fuels through technology development. Unlike fossil fuels such as nuclear energy, it is changing raw materials to energy from nature such as wind and solar power [2,3]. In addition, mandatory standards for the installation of new and renewable energy are being strengthened around the world, and there are increasing cases in which building energy policies such as zero energy for buildings are changed to environment-friendly. However, when the current renewable energy is applied, it will be difficult for a person who lacks expertise to even select a system [3]. This study aims to develop a decision selection tool for the selection of new and renewable energy sources, capacity calculation, and combination design of various systems using programs available in the initial design stage.

Therefore, through the Energy Simulation Program for New and Renewable Energy and Passive Architecture, this study aims to review the applicability of eco-friendly materials and technologies and to conduct efficient research on space production for eco-friendly residence of architectural projects.

Received: May 4, 2020
Reviewed: July 1, 2020
Accepted: July 8, 2020

ISSN: XXXX-XXXX JSEM

2. THEORETICAL CONSIDERATION

Before reviewing the renewable energy program, you should first find out what technologies exist for renewable energy. Various technologies are being developed to save energy in buildings, and it is necessary to review the principles and efficiency of these technologies to review the composition applicable to the design of new and renewable energy programs and complex combinations.

2.1. NEW AND RENEWABLE ENERGY

2.1.1. PHOTOVOLTAIC POWER GENERATION

1) PV Module

The crystalline silicon solar cell module is called the solar cell module, which is manufactured in the order of surface glass/charging material/rechargeable material/rear seat inside a solid aluminum frame to protect against shock or bad weather, since several cells are left or cut in parallel with series and are easily damaged [Figure 1].

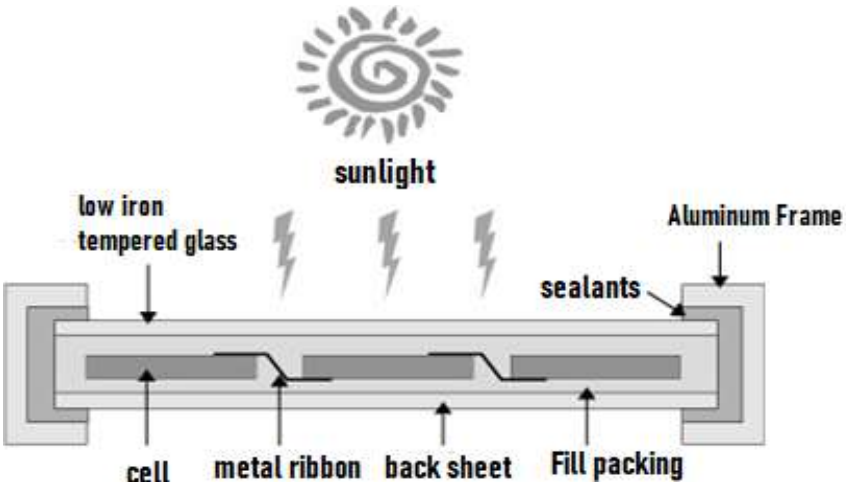

Fig. 1 Solar Cell Module Schematic

2) PV Array

Solar cell array refers to a device in which one or several solar cell modules are connected to suit the conditions of use by installing a stand considering the best conditions (slope angle, azimuth angle [Figure 2]).

Fig. 2 Solar Array

2.2 PASSIVE SYSTEM

2.2.1. SMALL COGENERATION SYSTEM

The small gas cogeneration system is a cogeneration system that produces power and heat using clean raw materials, natural gas (LNG), which usually means using gas engines or turbines of 10 MW or less [4]. The standby power cut-off device is used to save building energy through the following process.

1) Characteristics and Advantages of Standby Power Barrier [5,6].

・The switch integrated with the light switch allows anyone to easily turn on/off the power supplied to the outlet.

・Use a sensor embedded in the switch > Shut down the power supply.

・Using the sensor installed on the lamp > The out-of-office light is automatically turned off [7,8].

・Display the current amount of the outlet through the display window > induce energy savings for the user.

・Use the switch to turn off the lights and power to the outlet at once.

2) Diagram of the Standby Power Barrier [Figure 3]

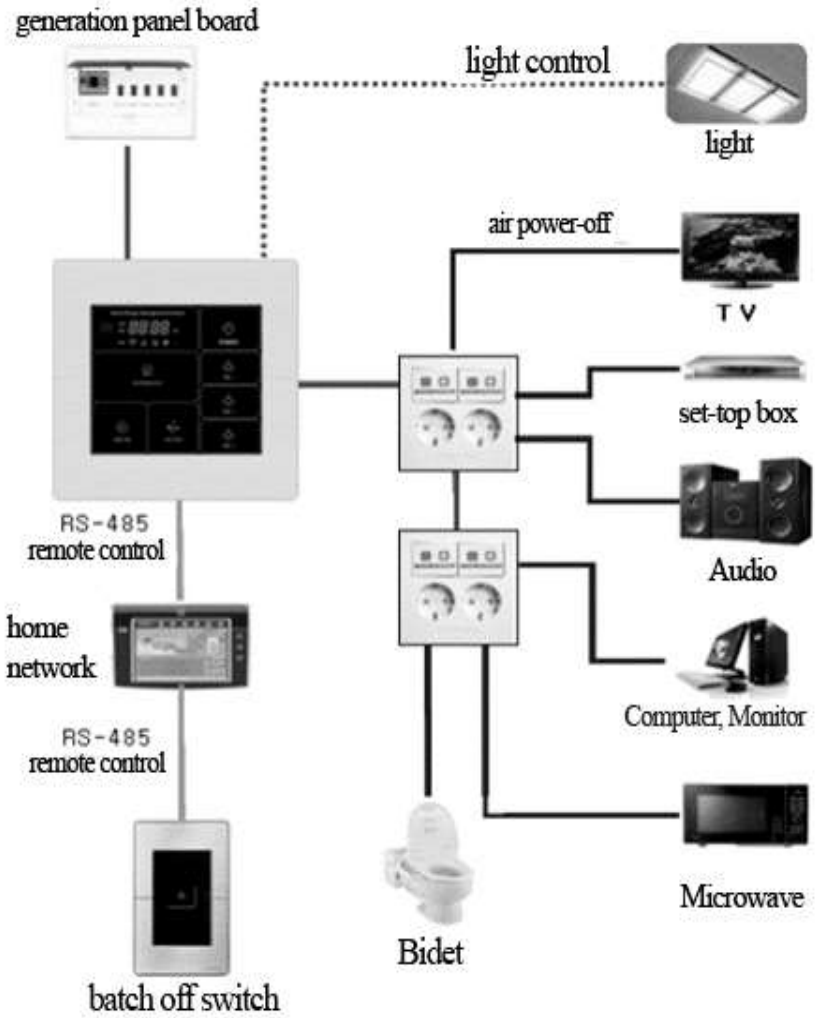

Fig. 3 Air power-off Device Composition Diagram

2.2.2. GEOTHERMAL COOLING AND HEATING SYSTEM

1) Heat Pump Cooling Cycle

After exchanging geothermal heat with a constant temperature using a circulating pump, it is reduced to the required temperature through the compressor to supply the heat indoors, and this cycle is called cooling cycle. At this time, the heat thrown on the ground is used for heating and is returned every year.

2) Heat Pump Heating Cycle

After exchanging geothermal heat with a constant temperature using a circulating pump, the heat exchanger is used to heat the refrigerant furnace (R-22, R410A) and the compressor increases the temperature required to supply the room, and the lost heat is replenished in the underground. This cycle is called a heating cycle. The heat thrown away from the air-conditioning cycle is reused when heated to return to the one-year cycle.

3. EXPERIMENT AND APPLICATION

The Environment-Friendly Housing Performance Evaluation Software Ver 1.0 program is used as data to determine the conditions for project approval for new projects and is designated as a compulsory requirement for producing results above the program's standard values depending on the energy performance, carbon dioxide quantity, and application of new and renewable energy of structural elements. It is necessary to review the applicability of eco-friendly materials and technologies through energy simulation programs for green building design and to review and research products efficiently for future order strategies [9]. Therefore, low-carbon green products were examined for performance beyond the review regulations for sites that were to be constructed in the future by evaluating the building energy performance of public apartments through simulation programs and examining their applicability, economic feasibility, and energy efficiency [10].

3.1. APPLICATION OF SIMULATION PROGRAM FOR PUBLIC APARTMENT SITES

Figure 4 is an example of applying the eco-friendly energy program, and the simulation of the new and renewable energy program was evaluated based on the type of apartment house where many people generally live.

Fig. 4 View of Public Apartment a Site

In particular, energy efficiency and economic feasibility for each new and renewable energy were derived as a combination of various technologies through the program process. Project Site Overview is as follows- Name of the current site: Public apartment A site

- Number of floors: 3 apartment buildings with 2 basement floors and 20 ground Floors (Other: 207 apartment units)

- Section : Reinforced concrete wall structure

Application of Software Ver 1.0 for Environmental-Friendly Housing Performance Evaluation on Current Design of Public Apartment Sites

- Application criteria for public apartment sites

1. Plan Type of Public Apartment

Type	exclusive area	content
A-1	84.98 ㎡	mid-position type
A-2	84.98 ㎡	side-located type
B	84.84 ㎡	Filoti type on ground floor (separate diagram classification)
C	84.62 ㎡	Side-located type and ground-floor piloti type (separate diagram classification)
D-1	84.6 ㎡	side-located type(short sidewall type)
D-2	84.6 ㎡	side-located type(long sidewall type)

3.2. PROGRAM CONFIGURATION

The method of using the new and renewable energy program proceeds from the initial screen according to the process of each sequence as follows. The composition of the new and renewable energy system is to select and input system information to be installed by the user through the database for each new and renewable energy system for solar, wind, geothermal, and fuel cells, and to set the range for the facility capacity and number of units.

- Initial Screen: Perform performance evaluation of eco-friendly housing by “start” [Figure. 5]

- Regional, thermal source system, and new and renewable energy input screen [Figure. 6]

- Select the area of the applied housing, select the heat source system, and enter the capacity of new and renewable energy: External Cover Performance Input Screen [Figure. 7]

- Enter area and heat perfusion rate of exterior walls, side walls, windows, front doors, floors, and roofs: Preparation screen for calculation [Figure. 8]

- The screen just before running the calculation after all the required data has been entered: Calculation result screen [Figure. 9]

- Output of calculation results based on apartment complex: Calculation result and project approval judgment screen [Figure. 10]

- Printing the calculation results based on apartment type and checking whether the project is approved or not

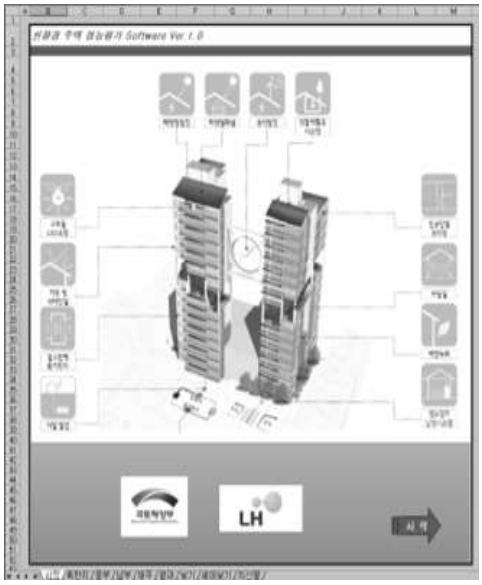

Fig. 5 Initial Screen

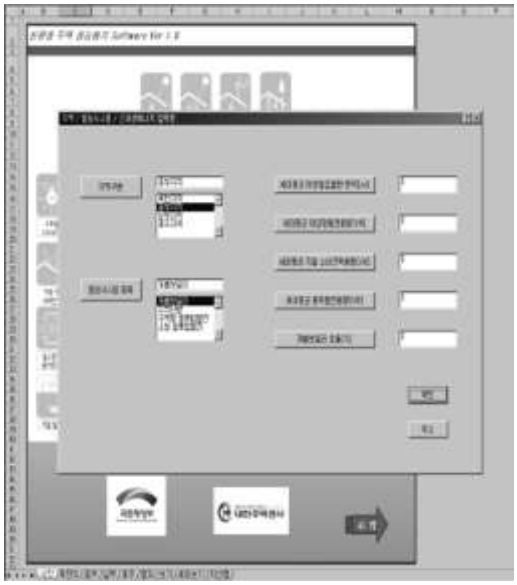

Fig. 6 Regional, Thermal Source System, and New and Renewable Energy Input Screen

Fig. 7 External Cover Performance Input Screen

Fig. 8 Preparation Screen for Calculation

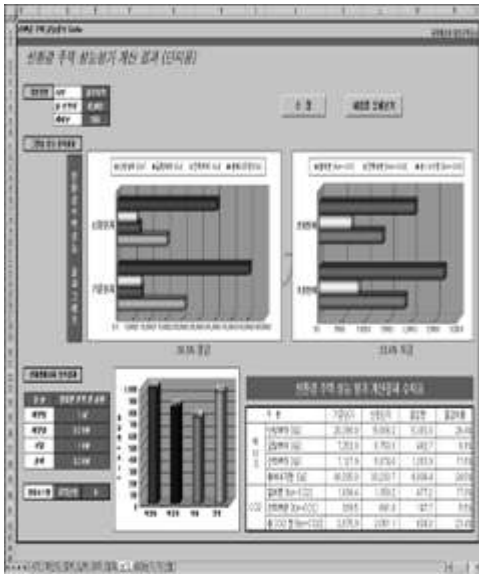

Fig. 9 Calculation Result Screen

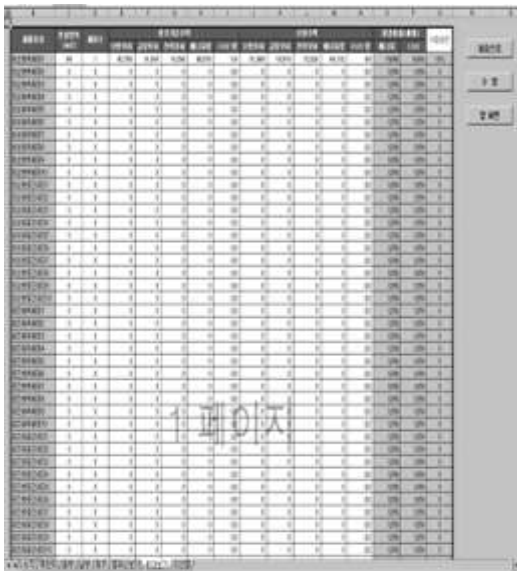

Fig. 10 Calculation Result and Project Approval Judgment Screen

4. CONCLUSION

Assuming that the results of the evaluation by the Korea Institute of Industrial Technology Certification are 10.6% (7 to 13%) energy saving on average, most of the "N0" is calculated and approved under the current conditions, design changes and additional construction costs for energy improvement are expected.

As a result of the evaluation based on EA urban architecture, most "YES" is calculated by averaging 18.6% (14% to 21%) energy saving, and most of the project approval conditions are satisfied with the current energy saving rate of 15% or more than 15%. However, some households with many openings, such as windows by equilibrium type, did not meet the standard (15%) for project approval conditions. This should be reviewed during the initial design phase and measures such as design changes should be taken.

ACKNOWLEDGEMENTS

This paper was funded by the government (Ministry of Education, Science and Technology) in 2017 with support from the Korea Research Foundation (NRF-2017R1D1A3805030876).

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