Some Aspects of the Application of Cloud Services in Calculating the Energy Consumption of Buildings

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ABSTRACT

This article discusses the use of cloud technology in the calculation of energy consumption of buildings, for example, the definition of the amount of energy consumed in the operation of the building, and the cost of its life cycle. In addition to the calculations cloud services is useful for project teams. Members of the project team can simultaneously access, download, and edit the options granted to the project. With cloud-based solutions we have virtually infinite computing power at their fingertips. Create, visualize, analyze, simulate, and iterate your designs faster– eliminating long wait time in studios or computer labs. Improve your course project outcomes by moving computation-intensive tasks to the cloud, enabling rapid visualization and simulation and optimized collaboration with access to intelligent, data-rich models. Solve your complex design challenges anywhere, anytime.

INTRODUCTION

Building Information Modeling (BIM) in the cloud, the next generation of BIM, is for virtually anyone, anywhere, at any time. Building, infrastructure, design, and construction professionals can access intelligent, model-based workflows through a broad range of cloud-based services within the Autodesk 360 cloud-based platform that provide mobility, accessibility, and virtually infinite computing power.

BIM in the cloud helps multidiscipline design and construction teams improve project outcomes by moving computation-intensive tasks to the cloud, enabling more rapid visualization and simulation and optimized collaboration with access to intelligent, data-rich models [1].

DESCRIPTION OF RESEARCH

What can you do with BIM in the cloud? Software for construction collaboration and management is the main reason of using. Firstly, let's make analysis this software. Autodesk BIM 360 transforms the way construction data is collected,

connected, visualized, and managed. This cloud-based software combines cloud and mobile technologies to manage your data from preconstruction to the field. Improve construction collaboration to prevent issues and drive higher quality and profitability. There two main group BIM 360 Field software and BIM 360 Glue

BIM 360 Field software (formerly Vela Systems) is construction field management software that combines mobile technologies at the point of construction with cloud-based collaboration and reporting. Turn your field data into information that improves quality, safety, and profitability for construction and capital projects. This is a cloud-based service.

Features:
- executive dashboard enables field data oversight;
- mark up and annotate photos and plans;
- connect equipment with object model information;
- provide the team with up-to-date project documents;
- easily document construction issues;
- update equipment records in the field;
- pushpins for tracking issues in 2d and 3d.

BIM 360 Glue is an online BIM coordination and management service that provides anytime, anywhere access to connected project information. Accelerate multidiscipline collaboration, reduce coordination review cycles, and improve project efficiency.

Features:
- review complex multidisciplinary project models;
- help identify and avoid potential problems;
- link documents directly to intelligent BIM objects;
- help isolate clashes in certain Autodesk products;
- review models, ask questions, and send notifications;
- intuitively explore project model details;
- mark up models and verify dimensions online or off;
- connect workflows with Navisworks manage.

That's why we decided to apply BIM-technologies in our research[2,3]. The main idea of our work is to connect two modern technologies BIM (Building Information Modeling) and GIS (Geographic Information System) with automatic selection of solar panels.
- Therefore, the program will consist of three modules:
- Calculation of solar panels;
- Presentation of results on an interactive map of the GIS system;
- Intelligent binding solar panels to the BIM-model.

All design program BIM models are based on the parameterization, so the main idea is to create a parametric relationship between the location of the installation of solar panels and building object (BIM-model). In this case, the automated matching system of solar panels can be an additional module, such as Autodesk Revit. Of course then if you need to export your model to another software you can use IFC-format. You can imagine the overall structure of the program as the circuit shown below (Figure 1)
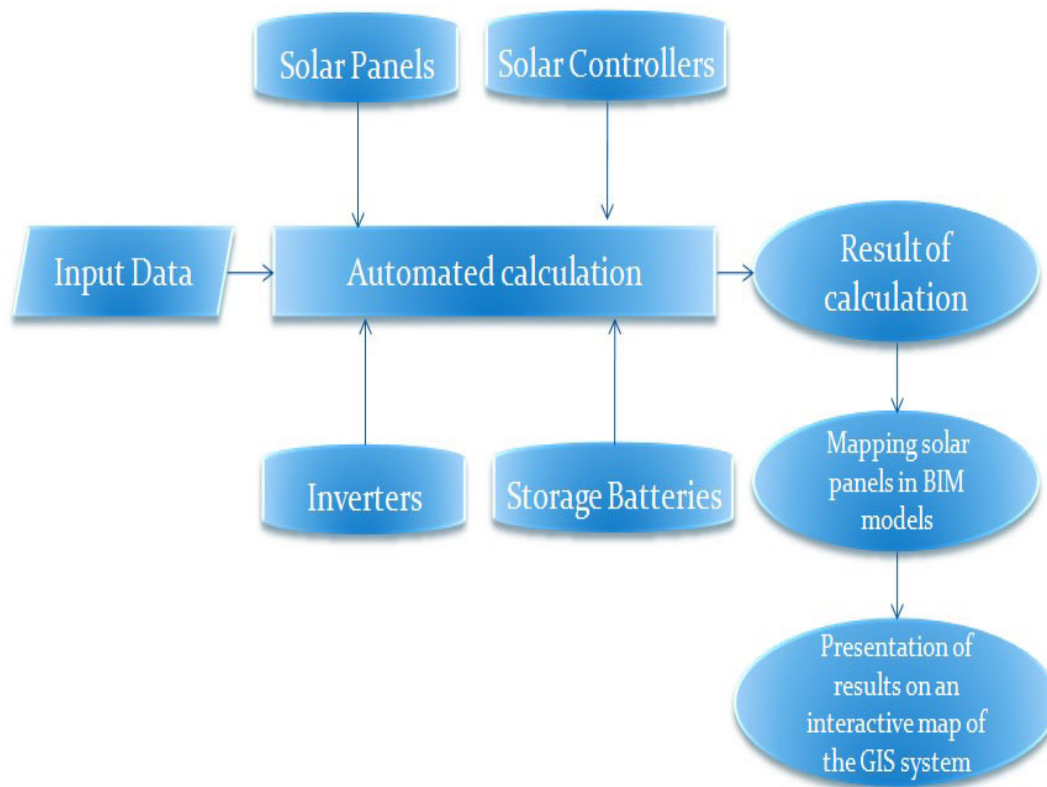
Figure 1. A block scheme ofthe automated selection ofsolar panels.

We have chosen Autodesk Revit to realize our task. Firstly, it is necessary to create new 'family' of solar panels for mapping solar panels in BIM models after calculation. But new difficulties have appeared, for example, how to save new 'family' and all its elements in IFC file and how to find them, if it will be need. More than that, how to estimate the adequacy of our model, how to check energy consumption of our building? We found answer during analysis of software. There are many ways and needed software for this.

Let's look at one of them. Autodesk Green Building Studio energy-analysis software enables architects and designers to perform whole-building analysis, optimize energy consumption, and work toward carbon-neutral building designs earlier in the process. Cloud-based energy-efficiency software helps teams achieve sustainable building designs faster and more accurately with powerful energy- and carbon-analysis tools.

Features:
– Whole-building energy analysis

Account for all of the energy-using systems in a building to understand energy cost projections that inform design decisions and financial analyses. Green Building Studio energy analysis software adds defaults and assumptions based on your building type and location to complete the energy analytical model. This helps you perform a valid and useful analysis for decision making.
– Detailed weather data

Green Building Studio gives you access to over a million virtual weather stations that are compiled from a variety of trusted sources.

– Energy Star and Leed support

Understand how the energy efficiency of your project compares to similar designs, and get Leed point estimates directly from Green Building Studio. For every project located in the United States, Green Building Studio provides an Energy Star score to compare the energy efficiency of your design to similar energy-efficient buildings, including a Leed point estimate for glazing factor and water credits.

We have already tested Autodesk Ecotect Analysis (Figure 2.), this analysis software is a comprehensive concept-to-detail sustainable building design tool. Ecotect Analysis offers a wide range of simulation and building energy analysis functionality that can improve performance of existing buildings and new building designs. Online energy, water, and carbon-emission analysis capabilities integrate with tools that enable you to visualize and simulate a building's performance within the context of its environment.
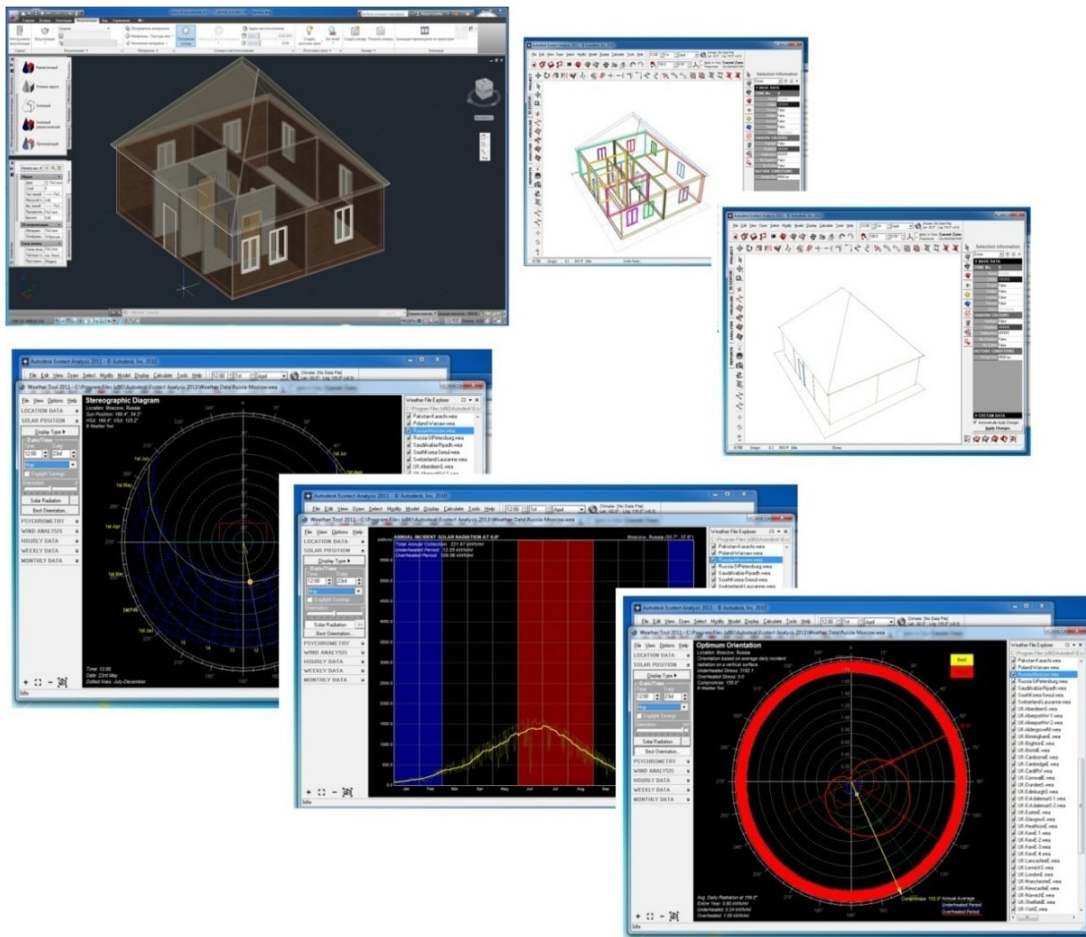

Figure 2. Work with Autodesk Ecotect Analysis

Features:
‒ Whole-building energy analysis

Calculate total energy use and carbon emissions of your building model on an annual, monthly, daily, and hourly basis, using a global database of weather information.

‒ Thermal performance

Calculate heating and cooling loads for models and analyze effects of occupancy, internal gains, infiltration, and equipment.

‒ Water usage and cost evaluation

Estimate water use inside and outside the building.

‒ Solar radiation

Visualize incident solar radiation on windows and surfaces, over any period.

‒ Daylighting

Calculate daylight factors and illuminance levels at any point in the model.

‒ Shadows and reflections

Display the sun's position and path relative to the model at any date, time, and location.

CONCLUSION

Of course, Ecotect Analysis is not cloud-based energy-efficiency software, nevertheless we came to the conclusion that besides advantages there are some difficulties:

‒ there are no weather data, solar radiation, daylighting for the entire territory of Russia, further work is needed to address this issue (for example, to create database of weather data[4,5]);

‒ there is no information about using standards for calculating energy efficiency. It would be good to have an opportunity for choosing these standards;

‒ there is no assessment of the adequacy BIM model used. There are many theories for this, for example, we can create simulation of human behavior, besides, it will help us to determine Building Intelligence Quotient [6-8].

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