Comparison between Sunhour Software Results and Autodesk FormIt360 as a Solar Based Application Analysis

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Abstract. The complexity of design process and climate issues for architecture students often leaves behind design issues that are less responsive to the local environment. The design recommendations somehow lack of quantitative approaches, which are unable to achieve optimal building performance. Such as the solar analysis on buildings, especially in buildings with locations in tropical climates, can be both advantages and disadvantages. Therefore, the urgency to do simulations to solar analysis buildings becomes necessary. There are many software about solar analysis and many studies have examined it. In this study will be discussed further about the comparison between the results of the Sunhour (Sketchup Plugin) and Autodesk FormIt 360 solar analysis software, where both software are widely used by architectural students and can be obtained free of charge. The building that became the case study in this study is the right-wing facade building of the FPTK UPI (Universitas Pendidikan Indonesia) located in Bandung City, analyzed with both software with the exact same location and time. The results from Sunhour and Autodesk FormIt360 compared were found to have correlated results.

Keywords: Sustainable Architecture; Autodesk FormIt360; Building Performance; Sunhour

1. Introduction

Solar radiation is different from one part to other of the earth, especially in the condition with two seasons get radiation from the sun much longer then the country with four seasons. Focus in this research is how the building plan in the tropical region applies sustainable ideas to reduce energy consumption and it relate to building envelope.

The external surface of a building is an essential factor to be designed which will determine how the solar radiation will be transferred to the building. To reduce the solar radiation, need passive design solution to be designed to the building.

Most of the many undergraduate students put aside design by considering passive design to minimize energy use and also achieve good thermal comfort. However, many problems experienced by student
undergraduate in using software for building performance simulation, including software that is too difficult to understand and also most software is not free.

Sketchup is one of the most popular 3D modeling apps used for students. Sketchup has the advantage of easy to use, easy to download, and not much memory. In the sketchup application there is a plugin to simulate solar insolation that is the Sunhour application that has affordable advantages for undergraduate students: it's free and easy too. There have been further studies on the use and features of Sunhour. From the research Sunhour needs to be compared with other applications because the results obtained from Sunhour are not in the form of numbers only in the form of colors.

To compare Sunhour, the need for comparable software that has the same Solar Analysis feature, namely Autodesk FormIt360. This software is also affordable for unpaid student undergraduate programs for Student Accounts, and also easy to use. In this study, we will discuss further the comparison between the Sunhour Application and the FormIt360 which has the same Solar Analysis feature with the same time and place settings.

1.1. Definition

- **SunHours**

SunHours is a plugin from Sketchup software. SunHours is an application that can make a grid on a building that we will calculate how long the sun exposure on each grid is for the desired year and date. The output displayed is a colored grid that can also be exported as a CSV file.

![Figure 1. SunHours Plugin Surface](image)

SunHours has several advantages such as affordable for undergraduate students, not charging fees, and also not difficult to use. But there are some disadvantages, namely the absence of further data apart from the duration of sun exposure, and also not flexible in its use for curved building envelopes.

- **Autodesk FormIt 360**
FormIt 360 is an application under the auspices of the Autodesk company. Where FormIt 360 can be opened on various devices, multi-operating system, which functions for the conceptual design platform. FormIt 360 is basically the same as Sketchup, which is the same as modeling software.

![Figure 2: FormIt 360 Surface](image)

There are several advantages to using FormIt 360, the application includes energy analysis & solar analysis without having to install other additional applications, easily link with other BIM Autodesk applications, and also can real-time collaboration with other colleagues.

For solar analysis available on FormIt 360, it can only be used for pro users. For students, Autodesk provides pro users for 3 years. Making it easier for undergraduate students to gain access to the application.

The solar analysis output in FormIt 360 is visual in the form of sun exposure and if calculated based on categories per month, the output is BTU Sq / ft² / If calculated based on the cumulative year, the output is in units of Kwh / m² year.

2. Methods
Comparison between these two software is done using quantitative methods. Comparatively compare the two features and also the pros and cons in each SunHours and FormIt 360. Then do a study case in North Wing, FPTK Building (Faculty of Technology and Vocational Education / Faculty of Education Technology and Vocational) UPI (University of Education Indonesia) in Bandung by setting the same location and time settings.

2.1. Test Time
The time that is set in doing simulations is the span of one year, from January to December. So the results of the simulation are cumulative from the results of one year.

2.2. Area of Study
The study area is FPTK (Fakultas Pendidikan Teknologi dan Kejuruan / Faculty of Education Technology and Vocational) UPI (Universitas Pendidikan Indonesia) in Bandung, West Java, Indonesia with -6.86 S
and 107.59 E. FPTK consists of one buildings with letter U configuration and the main orientation are facing to the plaza.

Figure 3. : Location of FPTK Building

Measurements were made only on the north wing of the UPI FPTK Building. Where the simulated side there are only 5 sides consisting of the west, south, east, north and also the roof.

2.3. An Overview of The Climate
  Temperature $T_a$ min  19 $T_a$ max : 28 $^\circ$C
  Wind speed : 1-9 km/h!
  RH min : 79 %
  RH max : 97 % 79 – 97 %
  Direction of sunlight : Tend from the southeast
(Source : meteoblue.com)

3. Discussion
After simulating SunHours, we get results in the form of colored grids on the north, east, south, west, and also the roof. In the western part (Fig. 5), the majority of the grid color produced is yellow. The yellow color shows only short exposure to sunlight.
Then in the south (Fig. 5), the grid is relatively blue, it shows that in the south it is the least time exposed to sunlight. On the south side slightly exposed to sunlight due to gazing inward. Because the southern part is oriented inward, it is exposed to the shadow of the building next to it.

As for the eastern part (Fig. 6), it is relatively the same as the western part. Majority of yellow-colored grids which show that in the east it is not too long exposed to sunlight.

In the northern part (Fig. 6) the majority of the grid is red. The part that is not red is the side shaded by the roof and also the part that protrudes slightly inward. This northern part shows the longest exposure to sunlight compared to the South, East and West sides. This refers to the study. it sun rays during the day in one year more in the north. So the North side receives more heat than sunlight South side.

For the entire roof (Fig. 6), the grid is red because it is almost certainly exposed to the longest sunshine.
In the FormIt application the relative color distribution is almost the same as the simulation results in sketchup. On the western part (Fig. 7) of the Form, the majority is orange on this side. On this side the highest shows the number of 658.4 kWh / sq. M and the lowest is 120 kWh / sq. M.

Then in the south (Fig.7) it correlates with the results produced by SunHours, where SunHours is dominated by blue and slightly exposed to sunlight, and FormIt also has the majority of the southern side dominated by blue, where blue is the color that shows the lowest number around below 120 kWh / sq. M.

In the eastern (Fig.7) part after being simulated by FormIt, the dominating color is orange to brass. This shows that the sun is exposed to the sun longer. On this side the number is 658.4 kWh / sq. M.

On the North side (Fig.7), dominated with orange color almost the same as the West and East sides. Where this shows the old North exposed to sunlight. The number on this side shows the range 658.4 kWh / sq m.
Figure 7 FPTK Building FormIt Simulation Result

While on the roof after simulated with FormIt shows that the roof is the longest exposed to sunlight than the other side. Shown with a whole yellow roof and shows the numbers 1654 kWh / sq m to 1753 kWh / sq. M.

4. Result
Here the comparison between SunHours and FormIt360 by feature:

| Category | SunHours | FormIt360 (Solar Analysis) |
|----------|----------|----------------------------|
| Inputs   | • Architectural Model  
          • Location  
          • Time Settings | • Architectural Model  
                          • Location  
                          • Time Settings |
| Outputs  | • Grid that contains colors showing how long sunlight is exposed on each grid.  
          • CSV File | • BTU / Sq / ft2 per month.  
                          • Cumulative kWh / m2 number for one year.  
                          • Visuals in the form of color gradations that can be known as well as the results of the numbers. |
| Pros     | • Free  
          • Easy to use  
          • No need internet Access  
          • No need high specification PC | • Free for Student  
                          • Easy to use  
                          • Real time collaboration  
                          • Have exact data of solar simulation |
Here the comparison the result from simulation that done by Sunhours and FormIt360

| Side  | SunHours | FormIt360 | Analysis |
|-------|----------|-----------|----------|
| West  | ![SunHours Image] | ![FormIt360 Image] | In the western facade this simulation produced between SunHours and FormIt has a correlation with each other. So that the yellow part of SunHours is around 600 kWh / sq. M. |

Table 2. Comparison Software Feature between Sunhour and FormIt360

| Side         | SunHours | FormIt360 | Analysis |
|--------------|----------|-----------|----------|
| Cons         | • Not have exact data per grid  
              • Not flexible when meet curve envelope | • Can use in multi device  
              • Need internet connection  
              • Solar Analysis result just can be save in jpg not a model |          |
| Simulation Assumptions | • Location (weather data cloud)  
                           • Time Settings | • Location (weather data cloud)  
                           • Time settings |          |
| Running Time | • Minutes to hours | • Minutes to hours |          |
| Documentation | • .skp model  
                          • CSV File | • .jpg file |          |
In the southern facade this simulation produced between SunHours and FormIt has a correlation with each other. So that in the blue section found on SunHours is around 120 kWh / sq. M.

In the eastern facade this simulation is produced between SunHours and also FormIt has a correlation with each other. So that in the yellow section found on SunHours is around 600 kWh / sq. M.

In the facade the main part is a simulation produced between SunHours and Form. There is a slight difference where SunHours shows on the North side the longest side is illuminated by the sun, while FormIt does not show such things.

On the facade of the roof part this simulation produced between SunHours and FormIt also has a correlation with each other.
5. Conclusion
Both are between SunHours and FormIt have many similarities, advantages, and disadvantages. SunHours and FormIt have some similarities like using the conceptual form to do the simulation, then the same is needed to input the location and also the time to get the appropriate results. SunHours is more recommended for those who just want to get how long the exposure time is, but there is no result of a number other than the exposure time. While FormIt is recommended for those who want to know the exact number of figures from sun exposure.

Study case results from the North Wing building of the FPTK UPI shows the results of FormIt and SunHours are generally correlated with each other and the data produced shows a lot in common, so that the results from SunHour and FormIt can be recommendations for applying Photovoltaic or Solar Panels with the results obtained in both applications.

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Acknowledgement
I would like to thanks to Tutin Aryanti, Ph.D. as Head of Department Architecture that help us by giving support. Beta Paramita as a guidance lecturer and gave inputs to complete this paper. And also friends of my class that have help us direct and indirectly.

This article is presented at the International Conference on Smart City Innovation 2018 that supported by the United States Agency for International Development (USAID) through the Sustainable Higher Education Research Alliance (SHERA) Program for Universitas Indonesia’s Scientific Modeling, Application, Research and Training for City-centered Innovation and Technology (SMART CITY) Project, Grant #AID-497-A-1600004, Sub Grant #IIE-0000078-UI-1