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Design Efficiency for Badminton Training Building at West Java Sport Science Training Center

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Abstract. Badminton is one of popular sport in Indonesia. It is proved with the achievements that reached by the athletes from a long ago until now. Therefore, construction of a special training place at the provincial is a good thing to do. That also worthwhile for keeping performances badminton in Indonesia. However, the place for training need to be designed as good as possible in order to the athletes can practice with comfort and can reach better achievements. Badminton is one of sports that very closely related with the speed of wind and sunlight. It becomes a challenge for designer to indicate the practice area as per the standards. The high energy is really needed. However, the energy consumption that also high isn't good for the environment. In this papers will be discuss how to make the energy simulation that later can be used to efficiently use energy.
Keywords : Energy, athlete, wind, sun

1. Preface

Badminton is one of popular sports in Indonesia. It is proved with the achievements from the badminton athletes, Badminton much liked by various of society. Other than that, Indonesia also succeeded their name in the realm of international badminton through *Seven Magnificent Indonesia* which is Rudi Hartono, Liem Swie King, Herman, Tjun Tjun, Christian Handinata, Johan W., dan Iie Sumirat that successfully dominate the international badminton[1].

West Java is one of the provinces that produce many badminton athletes achievers, even some athletes have shown their achievement on the world level [2]. The athletes include Atik Sauhari, Susi Susanti, who won the 1992 Olympic Gold Medal of Barcelona, 1996 Atlanta Olympic Bronze Medal, 1989 Sudirman Cup Winner (Team Indonesia), and Uber Cup Winners 1994 and 1996 (Team Indonesia) [3], to Taufik Hidayat who has won the Maybank Malaysian Open Semifinals Open, YONEX All-England Open Allmight Open Badminton Championships 2012, Swiss Open 2012 Semi Finals, Quarterfinals 2012 Yonex Australian Open GP Gold, Yonex Sunrise India Open

It shows that West Java have a potential high enough in badminton sports branch. So the development of Pelatda is very appropriate for develop the potential that already there. Pelatda will be used for the badminton athletes West Java – from young athletes until the professional.

Badminton training center is a place for doing training activity with the participations that live in the camp with time period and pattern of life that has been done. In this place also have facilities that can support all training activity. For reach the certain goals need to be made some preparation, that is:

- Evaluation of the needs of *training*
- The formulation of the target *training*
- Program development *training*
- The implementation of *training*
- Evaluation *training* [1]

The ability of athletes is certainly influenced by the condition of the environment, such as temperature regulation. Temperature regulation is a matter of concern in designing a training center for badminton athletes, because wind is one of the factors of shuttlecock movement. The wind should be low, but athlete's body temperature must often increase. It becomes a challenge for the designs of badminton training centers. In designing Badminton Pelatda this time will be applied passive design / natural that can save energy, unlike most badminton building which choose to use air conditioner or lamp as lighting and temperature regulation.

2. Literature Review

2.1. Design Standard
This design uses two standards, namely BWF standard and ASHRAE. From the BWF standard, there is room requirement for badminton practice area. The allowed incoming windflow is 0.2 m / s, minimum lighting is 500 lux, temperature 12 ° - 20 ° Celsius, green wall color (Dulux 30 GG 40/290) or blue (86 BG 43/321), ceiling reflectance 70% - 90%, vinyl / wood parquet floors, and floor to ceiling height is 9 meters [5].

2.2. Sunhour Plugin
In the simulation program used is sunhour and EDGE Building App. Sunhour is one of the plugins in the Google Sketchup app that serves as a radiating counter on buildings, especially on the building envelope. The working principle is to calculate the percentage of building radiation that has been visualized in three dimensions on Google Sketchup. The result of the simulation is a visualization with a grid that shows the percentage of radiation through color. The advantage of the sunhour program is that the program can clearly show which part of the building is exposed to radiation with a clear percentage of radiation.

2.3. EDGE Building App
EDGE Building App is an internet-accessible application that can calculate the amount of energy used in a building. EDGE stands for Excellence in Design for Greater Efficience. The working principle is to enter the area of the room in accordance with the programatics that have been made before. This application will then ask for building length data on each side and the lighting system and lighting used - whether active or passive.

The result of the calculation is the percentage of energy use in buildings, water consumption, and material use. After that, the application will provide some design solutions that can be used for energy consumption of buildings to be more effective. The advantage of EDGE Building App is that the program can show the amount of energy and what energy it uses, for example for room cooling, lighting, and so on. Then the application can provide design solutions for more effective building performance.

Simulation guidelines:
Sunhour simulation → Determines the shape of mass → Determines the location of the ventilation.
EDGE Building App Simulation → See the amount of energy → Design synthesis.

3. Design Review

3.1. Design Location

The Sport Science Training Center is located in Walini, Jl Cipeundeuy, West Bandung regency. West Bandung itself is an area that is undergoing development. The development of Walini City and the Jakarta-Bandung rapid train station become an additional point why the design location is located in Walini area.

Figure 1.The Location

3.2. Climatic Condition

The average temperature at the site ranges from 23 ° - 30 ° C (average 26.5 ° C). The data is used to determine the type of carriage system to be applied - passive or active. The standard temperature for Badminton building is 16 ° - 20 ° C (average 18.5 ° C). There is a considerable difference between the temperature at the site and the recommended temperature of about 8 ° C (calculated from average). The number has a very small chance of achieving. Therefore the temperature regulation system used is the active temperature regulation system.

While the wind speed at the site ranges between 5 km/h or 1.3 m/s. The recommended wind speed for Badminton building is 0.2 m/s because it will affect the shuttlecock movement. From the data it can be concluded that the building should not be given too many openings, because the wind can enter through the aperture and wind speed in buildings increases. Thus, the lighting and respiration system will use an active lighting and temperature regulation system.

4. Analysis and Discussion

4.1. Site Plan

In the master plan, the building is located in the western part. This is because the biggest winds are in the northeast. As an anticipation so that the wind speed inside the building will not be too high, the badminton training building located in the western part of the plan. Around the building there are parking lots and buildings for utilities such as diesel and water tank houses.

Figure 2. Masterplan

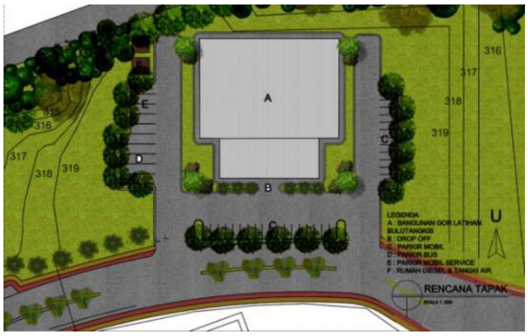


Figure 3. Siteplan

4.2. Sunhour Simulation

The first simulation is using Sunhour plugin. Before entering the plugin the design location should be entered using the geo-location feature in the Google Sketchup app. Once the location is entered, the building must be grided using the sunhour plugin. The grid settings used in this simulation are as follows::

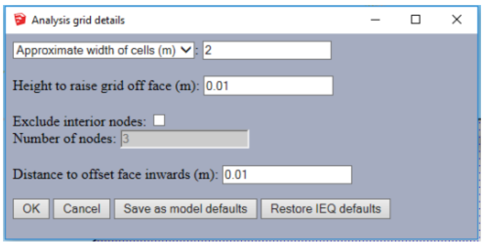


Figure 4. Sunhour Plugin Grid Setting

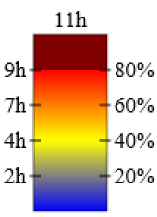


Figure 5. Radiation Scale

The result of the simulation using sunhour plugin is :

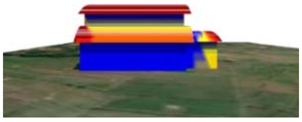
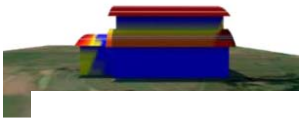
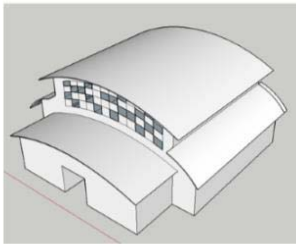
Existence	Synthesis	Result
In the first simulation used to form the building mass is still simple. This building mass is taken from the BWF standard such as applying arch roof and the minimum height of the building is 9 meters. Here's the first simulation result:  Figure 6: Results of the Eastern Sunhour Simulation  Figure 7: Results of the Northern  Figure 8: Results of the Western  Figure 9: Results of the Southern Sunhour 1 From the results of this simulation can be seen that the four sides of the building still got a lot of radiation. When the openings are placed then the heat coming into the building will be more. So the building mass must be changed so that the radiation is reduced.	The synthesizes such as applying 2 meters canopy and decide to change the orientation of the building, so it facing the south. Here's the simulation result :  **Figure 10**. Western Facade  **Figure 11.** Southern Facade  **Figure 12.** Eastern Facade  **Figure 13.** Northern Facade	The results of the second simulation showed that the radiation decreased from the average of 40% radiation to 20% radiation average, especially in the south facing building. From these results the location of the ventilations can be estimated. The main ventilation will be placed on the upper south directly connected to the training area and at the bottom of the eaves.  **Figure 14.** The Ventilation  **Figure 15.** Final Building Mass

Table 1 : Sunhour Simulation Result

4.3. EDGE Building App Simulation
For simulations using the EDGE Building App, there is no need for a three-dimensional model such as the sunhour simulation. In this simulation the required data is the space in accordance with the programatics that have been done before. Before entering the simulation, the type of building must be determined first.

For Badminton Training Building, the type of building is sport facilities. Once selected, will appear a broad column of space that must be filled. Furthermore, there is a long column of buildings on each side and data that the building uses an active or passive temperature regulation system.

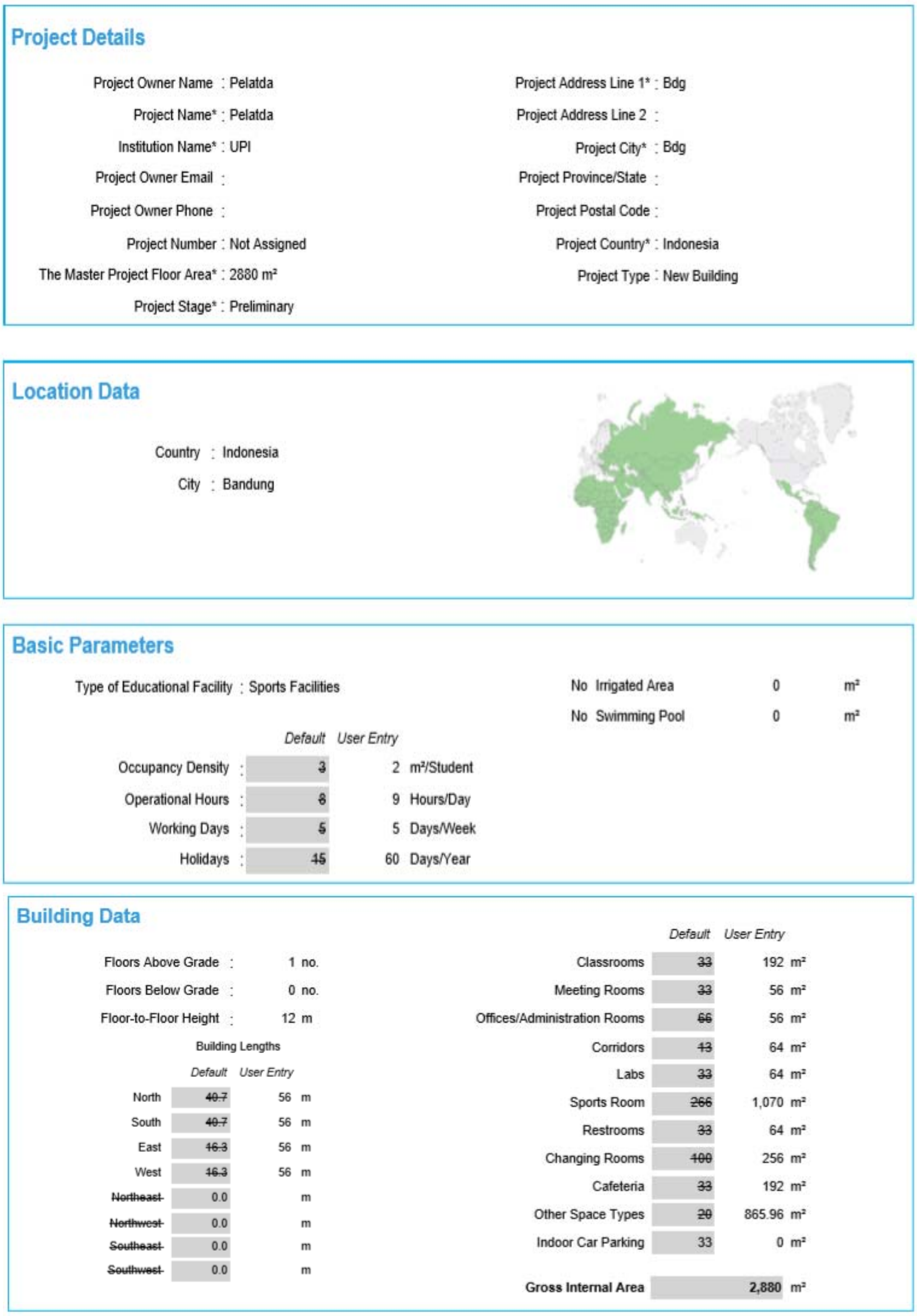
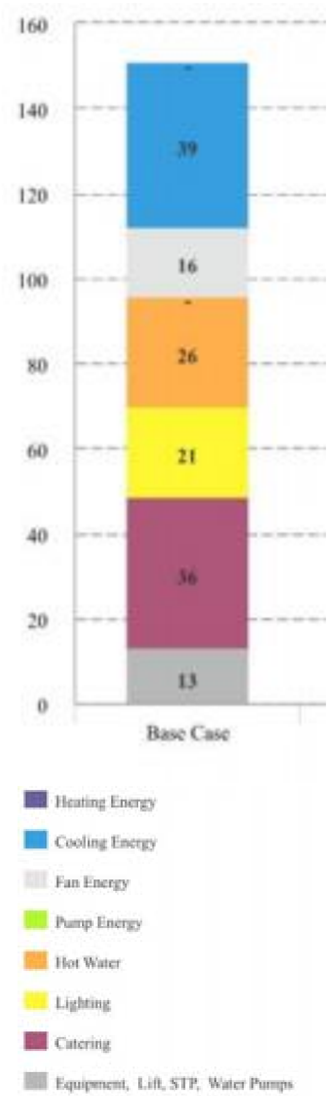
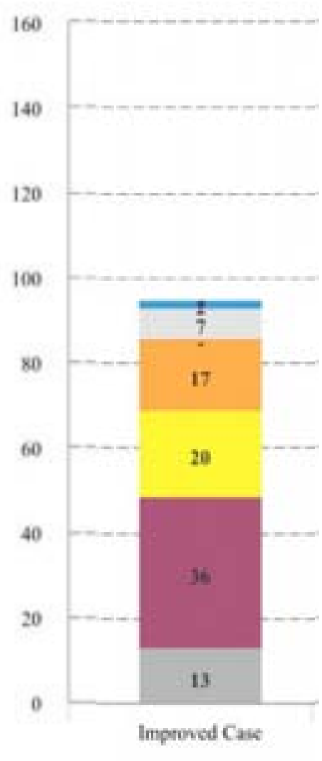


Figure 16. Input Data for EDGE Simulation

1) Energy Simulation

The left bar chart is the result of the initial simulation before being synthesized. The component that consumes the most energy is air conditioning. Total energy used is about 151 kWh / m². After the simulation will appear some design solutions to reduce energy consumption in buildings, as follows:

<table>
<tr><th>Existence</th><th>Synthesis</th><th>Results</th></tr>
<tr>
<td>

Most energy is used for air conditioning and pantry areas.</td>
<td>The design solutions applied in the design are:
- Reducing Wall Window Ratio (WWR)
- Using natural lighting for class areas
- Using natural lighting for the corridor area
- Using reflectivity paint (Albedo) 70 for the roof
- Using reflectivity paint (Albedo) 70 for walls
- Using insulation for the roof
- Use insulation for walls
- Using the territory
- Using glass with U Value = 3 W / m2
- Using automatic sensors in class, KM / WC, and corridors.</td>
<td>

Energy simulation results show that energy consumption decreases by 56 kWh / m² - from 151 kWh / m² to 95 kWh / m². Energy efficiency values also increased to 36.6%.</td>
</tr>
</table>

Table 2 : Energy Simulation Design

According to these standards the ideal energy consumption for building sport facilities is 345 MJ / m² or 95 kWh / m² [8]. Meaning the figure is 150 kWh / m² still exceeding the ideal energy limit for building sport facilities. So it needs to be reduced by about 60 kWh / m² in its energy consumption. According to the table, the building's energy consumption reduced about 56 kWh / m² meaning the building fulfilled the ASHRAE energy standard.

2) Water Consumption Simulation

To simulation of water consumption, EDGE Building App still uses the data listed above. The initial simulation results are still general results. The concept of water utility applied to buildings cannot be entered. Here are the results for simulating water consumption:

From the table of the simulation results it is known that the expenditure of water can reach 39 m3 / day. Then the design solution applied is to recycle the dirty water for reuse, using a shower with a capacity of 8 liters / minute, using a water faucet with a capacity of 2 liters / minute, and using a dual flush for the toilet. As a result, water consumption per day decreased to 30 m3 with water efficiency value reaching 25,85%.

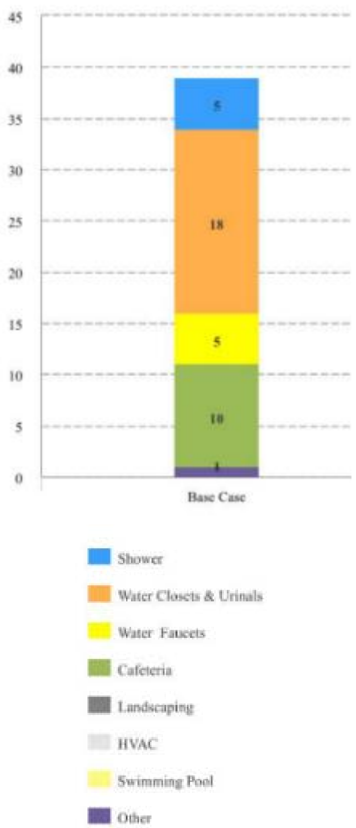
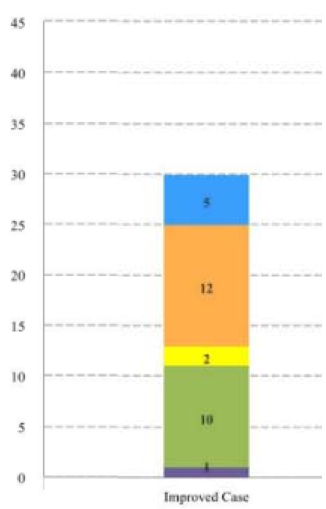
Existence	Synthesis	Results
	The design solutions applied in the design are: - Low water flow for shower is 8 lt / minute. - Low water flow for water tap which is 2 lt / minute. - Using a dual flush for the toilet, which is 6 liters for the first spray and 3 liters for the next spray. - Treating dirt and rain water into clean water quality bathing. Rainwater treatment is applied using infiltration wells and sewage water is processed using a modular frame.	 Water simulation results show that water consumption decreased from 39 m3 / day to 30 m3 / day with an efficiency of 25.85%.

Table 3. Water Simulation Result

1) Efficiency Material Simulation
Similar to the simulation of water consumption, the simulation of material efficiency also produced general simulation results initially. Then, the design concept and design solution can be applied after the initial simulation. The following is the result of the initial simulation of material efficiency:

	Window	Floor	The Outer Wall	Wall Inside	Roof	*Slab*
Embodied Energy (MJ/m²)	3227	864	3924	3520	1148	1148

Table 4 : Material Simulation Result Before the Synthesis Inserted

Embodied energy required for the material used reaches 13,831 MJ / m2. Then, the material is altered using more efficient materials such as using in situ materials and using prefabrication materials. The resulting *embodied energy* is reduced to 10,156 MJ / m2.

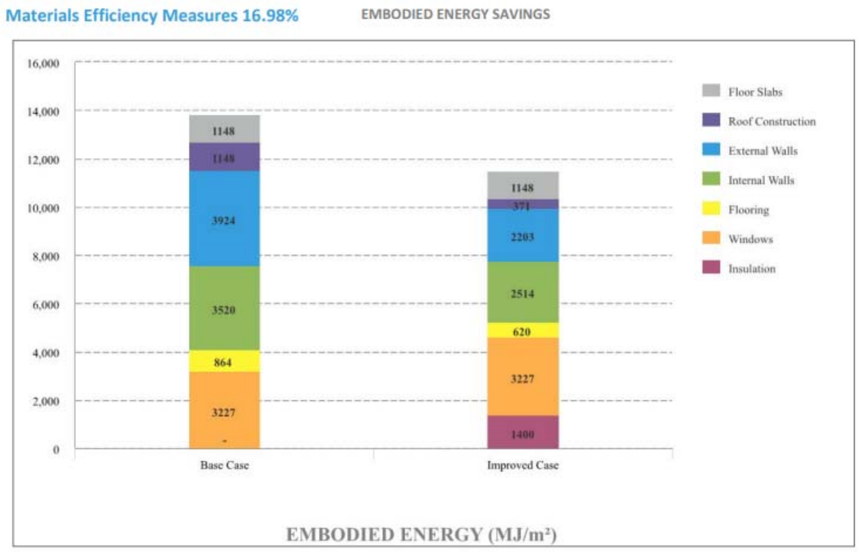


Figure 17. Material Simulation Result After the Syntesis Inserted

5. Conclusion

After going through several simulation steps, the building energy consumption becomes lower. The complex problems contained in Badminton Training Building can slowly be overcome. Badminton Building in general will feel hot and stuffy because of the permitted wind only 0.2 m / s. Through the sunhour simulation it can be overcome because the openings are not placed in any place. Parts of buildings that are low radiation that can be used as a place of openings. Energy consumption is certainly high because this building uses Temperature Regulation system and active lighting. Buildings with low energy consumption are certainly expected by the designer. Through the EDGE Building App simulation energy consumption can be monitored and given a solution to reduce it.

Similarly, the consumption of water and materials. Water consumption can be reduced in several ways, one of which is the recycling of dirty water into clean water quality of the bath or even the quality of drinking. For material use, EDGE Building App suggests several solutions, one of which is to use locally available materials so that embodied energy can be reduced. This design takes several design solutions that can be applied, including water treatment into good quality water for bathing, water consumption efficiency for flush, the use of natural lighting in some rooms, and the use of local materials.

6. References

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