SUMMARY

BRICK DESIGN TO PREVENT SUMMER OVERHEATING

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1 PROBLEM DEFINITION

Considering the actual tendency of climate change it is highly important to lower the environmental impact of buildings such as reducing the heating and cooling energy consumption. The main goal of the project is to verify the influence of the construction elements (roof, floor, wall, and floor) on the thermal performance of the buildings and to find design methods and variant construction solutions to prevent summer overheating. For the calculations the Wienerberger e4 model-house -situated in Budapest, Hungary- was analyzed. As the project aims at avoiding cooling in the building it is important to prevent summer overheating and to monitor the thermal comfort of the occupants.

2 METODOLOGY

2.1 Selection of Simulation Tools

A first step was the designing of a 3D model based on the existing building in Google SketchUp with the Open Studio plug-in. Then a dynamic thermal simulation of the building with Open Studio and Energy Plus was performed.

2.2 Weather Files

The accurate weather data played a significant part during the simulation process as it can highly influence the outcome of the thermal simulation. For the first part of the project the Hungarian weather file from Szombathely was used to find the optimal constructions. For the final simulation with the chosen constructions the weather files of all four countries (Hungary, Belgium, Austria and Switzerland) were employed.

2.3 Basic Simulation

The design phase model of the brick made e4 building was implemented in the simulation environment EnergyPlus. The model contains the building geometry based on the available architectural documentation with precise information about building dimensions. The physical values of the construction materials are based on the default template properties from the simulation software. For the thermal simulation in the software environment, the established internal conditions were defined. The ventilation was implemented as constant air change rate of 1 ACH. The heating was modeled as the ideal heating (unlimited heating power) with the constant temperature set point of 21°C. The model did not have a defined non-heating period. The internal gains such as persons’ presence or lighting were defined based on the scheduled values of the template. The first digital model created in the design phase used the Hungarian weather file which is based on actual historical metrological measurements from the past 30 years of the weather station in the area of the building site (Budapest's airport).

3 RESULTS

3.1 Selection of Structures

3.1.1 Floors

The slab-on-grade has a significant effect on the occupants' thermal comfort. Therefore, in order to gain and to keep the pleasant temperature there needs to be enough insulation in the construction.

3.1.2 External Walls

To prevent thermal losses it is essential to analyze the U-value of the structure but it is also important to have proper thermal mass that enables to store the heat and effectively improve the comfort inside the building.

3.1.3 Roof

As for the floors the amount of insulation of the roof can affect the energy consumption of the buildings for heating.

3.1.4 Openings

The energy efficiency of windows depends on the number of layers and type of glass we choose. Shading is necessary on the sun exposed facades to prevent overheating during the summer.

3.2 Evaluation of Constructions

With respect to evaluating the optimal structures for the model-building the constructions with either the best U-value or with the best Environmental Indicators were chosen. All simulations were run with the Hungarian weather data file of Szombathely to be able to compare the results. For comparing the outcome the Operative Temperature and the Predicted Mean Vote (PMV) were analyzed.

4 CONCLUSION

4.1 Wall

The simulations showed a significant gap between light and heavy brick constructions. Therefore thermal mass has a big influence on the thermal comfort especially during the summer. For that reason the decision was made to choose the heavy double layered brick wall.

4.2 Roof / Floor

We could observe that roof and floor constructions do not affect the performance of the model house. The decision was made to choose the most efficient solutions such as the steep roof with 38 cm insulation and the ground foundation with 20 cm insulation**.**

4.3 Openings

There was a big difference between shaded and unshaded windows concerning the thermal comfort. Results showed overheating when there was no shading of windows on the southern and western facade. Based on the analysis the most effective Shaded Triple Layer Solar Glass Window was chosen.

5 RECOMMENDATION

For future work it is recommended to take a deeper look into the night ventilation, glassing and the shading design since these are also known to influence the thermal simulation results.