Performance Gap

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September 11, 2018

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1 Abstract

2 Introduction

2.1 Purpose of this thesis

The purpose of this thesis is to find out most influential factors in building simulation. By performing an indepth analysis of 2 existing buildings, the influence of all parameters can be determined.

2.2 Residential Building Introduction

- Location of the building
- Year of construction
- Building plan and brief introduction (number of floors/areas/orientation/etc)

2.3 Office Building Introduction

Same as Residential Building

3 Literature Review

3.1 SIA Documentations

Introduction of SIA 180 calculation method. Also briefly introduce a set of documentations such as

- SIA Weather data
- SIA dynamic energy analysis
- SIA occupancy and schedule

3.2 Previous Analyses

- Discuss the existing result of the previous study.
- A significant performance gap is observed. Possible causes of the performance gap.
- The data and measurement of previous studies.

4 Methodology

4.1 DesignBuilder - Building Modeling

A brief introduction of DesignBuilder, also describe the scope of work (Building envelope, create a formated file for EnergyPlus engine, also provide accurate geometry data for SIA calculation)

4.1.1 Existing Plan

Show the building floor plan and functions

4.1.2 Building Envelope Material

A detail description about building envelope material
Show the complete building model

4.1.3 Assumptions

- Wall/Roof/Ground Floor boundary conditions
- Adiabatic boundary conditions

4.2 EnergyPlus on Nominal Schedule Analysis

How did I use EnergyPlus in this Project, and how dose it help me in presenting the data

4.2.1 Schedule and Occupancy Assumptions

- Detail Schedule and Occupancy Assumptions
- Documentation base (SIA xxx)

4.2.2 Weather Data Selection

- Data source: IDAweb
- Weather data selection base: location,date
- Weather file modification (replaced parameters)
  - Temperature (dry/wet)
  - Relative Humidity
  - Wind speed
  - Wind direction

4.3 SIA Calculation

Briefly describe the reason why another SIA calculation is necessary
(Huge gap in building area assumption, huge gap in weather condition)

4.3.1 Basic description of SIA Calculation Method

- Gain
  - Solar Gain
  - Internal Gain (appliance/activities)
- Loss
  - Transmission Loss (Conduction and Convection)
  - Ventilation Loss (Air circulation and infiltration)

4.3.2 Calculation Assumptions

Two sets of calculation are performed. One uses SIA standard weather condition, the other one uses 2015 weather condition. The 2015 weather data is extracted from the 2015 weather file using Rhino/Grasshopper add-on.

4.3.3 Measurements expected to close the performance gap

Mention a number of suspected parameters which help to help the calculate result reach the historical measurement value.

- Modify the infiltration value
- Use correct weather file
- Use more accurate floor area

4.4 jEPlus Dynamic Simulation

Why using je-Plus and how to use

4.4.1 Basic description of je-Plus

- Main functions
- Advantages
- How to use

4.4.2 Dynamic Parameter Assumptions

List of parameters, range of parameters and distribution of parameters

4.5 Calibration

How to calibrate the building envelope by choosing summer period (early autumn) and compare the building indoor environment with the historical data.

4.5.1 Outdoor Environment Calibration

4.5.2 Building Envelope Calibration

- EnergyPlus Hourly Analysis

4.6 Data Processing

Briefly describe the resulting data structure from je-Plus and introduce 2 different graphs.

4.6.1 Dynamic Analysis Range

4.6.2 Correlation Matrix

An introduction about Correlation matrix

5 Results

5.1 Initial Annual Energy Analysis

5.1.1 EnergyPlus Simulation Result

- Floor Area (be used in SIA calculation)
- Heating Demand
- Air Ventilation

The first set of dynamic analysis (4 sets of heating demand distribution from infiltration 0.1 to 0.4)

5.1.2 SIA Calculation

Take

5.1.3 Calibration

- Steps of calibration (hourly - annually)
- Results of each variation (new lighting schedule/shading schedule etc)
- Recommended base values

5.1.4 jE-Plus Simulation Results

- Dynamic Heating Demand Variation
- Dynamic DHW Demand Variation
- Results of all parameters (range and distribution of heating demand and DHW demand)
- Correlation of parameters

6 Discussion

- Key parameters (Which parameters are the most important and which are not as important)
- Key assumptions (Are these assumption still applicable)
- Recommendation (building envelope much be accurate, a weather data update is critical etc)

7 Conclusion

- Key parameters
- Recommended set of parameters
- General Recommendations