Beaverton High School

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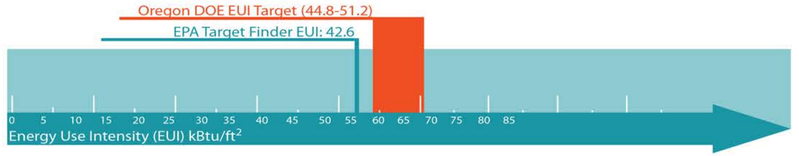
Project Description

The Beaverton School District in Beaverton, OR is building a new Comprehensive High School. The program consists of 320,000sf over 3-stories and is intended to house 2,200 students in Grade Levels 9-12. The program includes an auditorium, gymnasium, student commons, general purpose classrooms (30 students per classroom), labs, and offices.

Sustainability Goals



Tools

SEFAIRA SKETCHUP

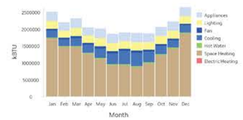
Primary Measurement Parameters

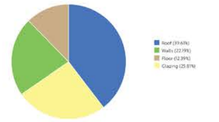
ENERGY USE INTENSITY (EUI) measures the energy a building consumes per square foot per year (kBtu/sf/yr). It is used to set energy targets for building performance.

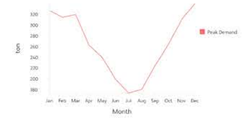
MONTHLY ENERGY CONSUMPTION measured in kBtu per month for the buildings equipment and systems. This allows identification of various strategies to retain heat and reduce the energy consumption of the building.

FABRIC CONDUCTION LOSS measured in kWh measures what components of the building envelope are losing the most heat. Various strategies from changing glazing ratios, glazing u-factors or increased insulation values can then be tested for levels of impact.

PEAK SPACE HEATING DEMAND measured in tons per year is used to measure the amount of heat that needs to be added or removed from a space to maintain the desired temperature. The peak heating demand is the largest amount of heat that needs to be added to the space in a single hour. Any reduction in peak loads can reduce the size and cost of the mechanical system.







Comparing Massing Models

Original Task

The intended task was to study early massing concepts for climate responsiveness using Sefaira as an analytical tool. We were to work rapidly to analyze a series of massing concepts during the schematic design phase and provide feedback to the Boora design team to determine which factors/outputs to be studied such as daylighting, energy use, and building orientation. We received three massing models from Boora to study in Sefaira and compare EUI, Fabric Conduction Loss, Peak heating hours, and Monthly Consumption. Some of the results we were coming to evolved the initial task and drove this project down a different path. What we ended up doing was helping Boora understand the information that Sefaira was giving them by trouble shooting specific model data results and adjusting input values.

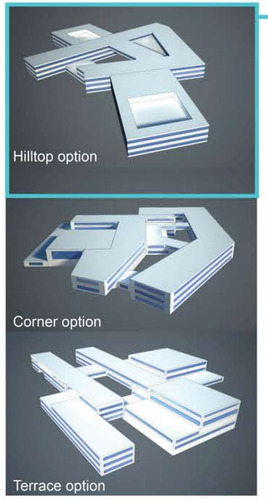
The Process

The engineers at PAE used EQuest to compare the three massing models and we used their results to compare with ours, and it seemed to comparatively resemble Sefaira's results after correcting some issues with the SketchUp models. We analyzed the results and discovered that some of the information wasn't making any sense such as where heat loss was happening. Sefaira concluded that 53% of our heat loss was occurring through the roof but only 12% was lost through the glazing, those results should have been flipped. A conclusion was made that the software was sensitive to the way a building was modeled. We were modeling the building with basic ribbon windows which wasn't working with Sefaira; the windows need a wall completely around it in order to establish a frame for the window to be analyzed properly. Also, Sefaira only recognized walls as exterior walls which meant that internal walls needed to be omitted to prevent any confusion on the software's side. Floors were another issue we came across; floors need to be represented in the model. The model above all needs to be as simple as possible to create a simple analysis. Another common error that we needed to keep an eye out for is making sure that walls, glazing, roofs, and floors were all properly assigned in Sefaira's plugin while working in SketchUp.

A set of parameters were given to us by PAE so that our analysis could be stricter with the intent of getting results that make sense. These parameters were the settings PAE used to calculate the output by setting specific HVAC set points as well as the envelope set points. The set points matched the EQuest model's settings but our results still weren't making sense; space heating was a significant value during our summer months when heating shouldn't be active. At this point we couldn't understand what was going wrong or where the issues were. Many strategies were run trying to get it figured out but the more frustrated we got the more we questioned our faith in the software. This program claims to be one that doesn't require any energy modeling experience needed, why weren't we being able to understand the results?

Sefaira assigns a representative to firms who buy their product and unlimited meetings that can be scheduled. Our team was lucky enough to sit in on two meetings Mike Manzi had with Boora's rep, Hari Natarajan. We brought up the issues we were having, many times he was able to immediately fix our problems and if he couldn't then he would do some research and get back to us. Just when we were about to lose faith in the program Hari came up with a couple solutions; we changed the HVAC system type from a centralized system to a split heating and cooling system and we changed the hours and days that the building wasn't being occupied to have 1% of the full load on the HVAC. These changes prevented the building from constantly cooling itself just to reheat itself, and prevented the building from completely shutting off its HVAC system during the hours people weren't in the building. One other important change was the comfort ventilation rate; Sefaira has guidelines on how calculate this number and by lowing it to the correct number we were able to cut out much of the extra heating.

Sefaira is a comparative tool that allows a person to view energy consumption at an early stage in design. It is the only tool out there right now that is easy for architects to use that bridges the gap between design and energy modeling and gives architects the ability to get real-time energy and daylighting analysis. At the moment, the software is user friendly and easy to navigate but understanding how to manipulate the results is an issue that needs to be resolved with the person who is using the tool. Once the initial education process is done and the users understand how to manipulate the settings, this tool opens up very hopeful possibilities. Now that Mike Manzi has a solid understanding of this program he is excited to use this tool on upcoming projects.



Issues

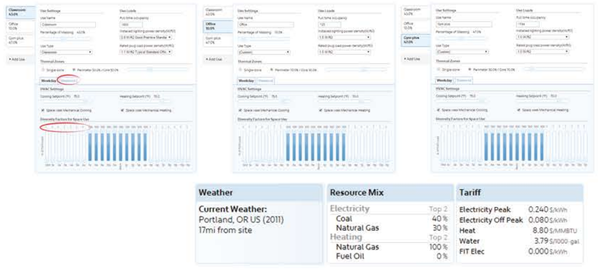
1. MODELING
-The simpler the better model, complext models have more errors.
-Ribbon windows don't work.
-No interior walls can be added.
-Make sure walls, roof, and glazing correctly assigned.

2. SETTINGS
-Specific settings need to be set up in order to have acurate results.
-Changes made in the settings don't have an expect impact on the results.
-Weather files don't seem to be correct for the Hillsboro location.

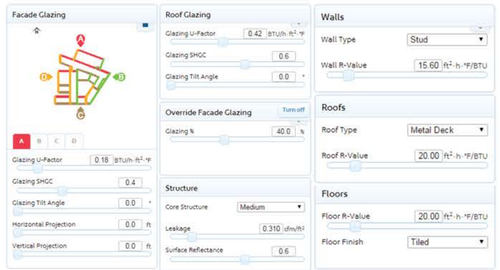
3. KNOWLEDGE BASE
-Our understanding of what the results mean seem to not be aligned with what they acutally mean.
-Manipulating parameters in sefaira don't match the real world understanding of sustainable measures.
- Common best practices don't seem to impact Sefaira the way that would be expected from real world exeriences.

Fine Tuning

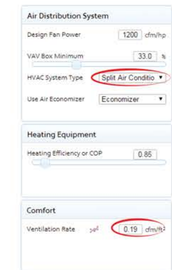
Space Use Settings



Envelope

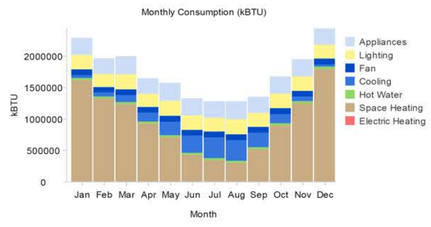


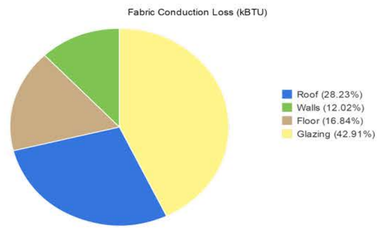
HVAC

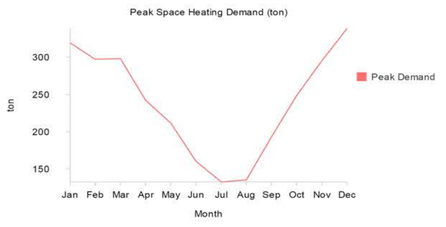


Energy Output

Annual Energy Consumption kBTU	Annual Energy Use per Gross Internal Area kBTU/ft2	Annual Utility Cost $	Annual Space Cooling kBTU	Annual Space Heating kBTU	Heating Capacity ton	Cooling Capacity ton	Annual Grid Fuel Used kBTU
20,798,634	65	752,150	1,976,020	11,406,894	338.38	638.31	11,787,923







Early Discrepancies