EQUEST 3.65 ANALYSIS FOR SCAIFE HALL

48722 - Building Performance Modeling

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October 18, 2015

Contents

ABSTRACT

The study shows parametric analysis of a four-story academic building named Scaife Hall at Carnegie Mellon University, in Pittsburgh. The geometric model for this building was developed in Autodesk Revit 2015.The building performance analysis presented here has been done in eQUEST. Both Revit and eQUEST run on DOE2 energy simulation engine. Here, comparative analysis of both the simulation tools has been done. The first part of the report consists of comparison between the baseline simulation models in both tools, in terms of description and performance. Then, the approach is to vary the default assumptions assigned by eQUEST and to analyze how parameters change energy use. The wall type, roof type, slab type and glazing were modified using a variety of materials, and the best ones were taken into consideration for a best-case model. Parametric analysis for different factors was carried out. Operational schedules were customized according to the school year and then the simulation was done. In the end, comparison of the baseline model and the best case model showed a **reduction of 15% in the overall electricity consumption of the building, and a fuel consumption reduction of 21%.**

INTRODUCTION

In today's time, it is necessary to evaluate a building's expected performance at the designing stage by simulating its model with different materials and methods, and thus knowing expected performance with some understanding of why this is the case, before construction is implemented. One software solution for early design stage energy modeling is eQUEST 3.65. An energy analysis conducted by eQUEST allows input of more specified details than other programs such as Autodesk REVIT. The building studied here as a basic conceptual model for evaluating energy performance is a four-story academic building with a basement and an auditorium, located in the southwest corner of Carnegie Mellon University's Pittsburgh campus.

Based on the default assumptions by eQUEST, initial results for the model are achieved. Consequentl, comparative analysis of the Revit and eQUEST baseline results is required to gain a further understanding of building optimization. In the process, the strengths and weaknesses of eQUEST compared to REVIT are noted, including the level of details in context of inputs and outputs. To gain the overall performance evaluation of the building, various permutations are done with the use of different construction choices in the walls, roof, slab and glazing. Then parametric simulations were run with under customized conditions, to track total electrical and fuel (natural gas consumption).

Additionally, changes were made in thermal zoning states (conditioned and unconditioned), internal loads (occupancy, lighting and interior equipment fraction densities) as well as their operational schedules, taking into account the building's purpose as an academic hall closely tied to the academic calendar. In the end, the best results of all different parameters are taken into consideration and a best-case model is presented with significant energy performance improvements over a baseline.

The assignment is restricted to a Pittsburgh weather data file and excludes the specifications of HVAC systems, other than to note that the building uses a variable air flow system with water chilling and water heating capabilities.

Geometric representation of model in eQUEST

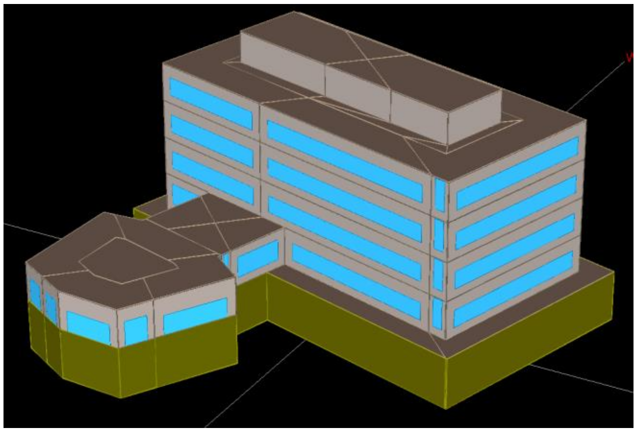

Figure 1 - Scaife Hall 3D model view in eQUEST

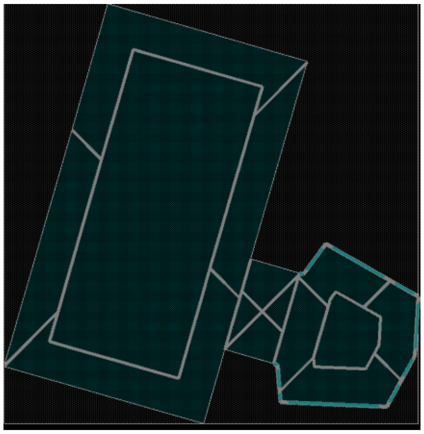

Figure 2 - Scaife Hall 2D plan view with thermal zoning

Employing a simple user interface, eQUEST is able to take a project file generated from Green Building Studio's online servers and present both three and two-dimensional views for building navigation. For site and building parameters such as thermal zoning and floor and level properties, the two-dimensional plan view (right in figure above) suffices. When examining glazing and wall properties, the surfaces are easily accessed in the three-dimensional viewing mode (left in figure above).

Generally, the model follows a simple format in terms of construction: Defined spaces contain geometries (rectangles), which contain surfaces (walls), which contain constructions, which contain layers, which contain materials. These can all be modified to the designer's preference.

Comparison between REVIT and eQUEST software

To make a valid and simplified study between the Revit/GBS simulation tool and the eQUEST simulation tool, the GBS model data was exported from the online servers and imported into eQUEST. Additionally, the appropriate Pittsburgh weather file was used. Before importing into eQUEST, the baseline model was slightly modified in Revit by converting the curvilinear surfaces of the auditorium to planar surfaces. It should be noted that eQUEST needs the data file to be in .inp format (GBS uses the gbxml version of file, but also provides the .inp format).

Here are some general observations about the two software platforms:

- eQUEST allows much more detailed input options than Revit does.
- eQUEST follows an IP unit system while Revit follows SI unit system by default.
- Revit is more user friendly comparatively. For instance, the rotation of the model with mouse is less complicated in REVIT than in eQUEST.
- REVIT has a very limited set of materials while eQUEST offers libraries for each material, which can make a huge difference in simulation results. Hence, the assumed model can be made realistic to a great extent.
- eQUEST allows making a material as well by specifying its individual properties while Revit does not have that flexibility.
- The accuracy of results from both the tools is almost the same.But eQUEST gives a more detailed result that segregates the usage by each component as well.
- Thermal zoning is done effectively in eQUEST by more specifications than in Revit.
- Parametric runs are possible by creating different parametric components while keeping the baseline model as it is,in eQUEST.
- Multiple selection was a major hindrance in eQUEST while Revit allows it.

Table 1 - eQUEST and REVIT GBS baseline characteristics

	Revit / GBS model	eQUEST
Model construction	Imported from GBS server using .inp file	Geometric forms created using conceptual mass modeling
Thermal zone configuration	Default thermal zone geometry with exterior and core partitions 3,439 m2 / 37,017 ft2	
Default building envelope	Basic wood construction with even glazing	
Baseline Electricity consumption EUI	119 kWh / sm / yr	119 kWh / sm / yr
Baseline Gas consumption EUI	551 MJ / sm / yr (0.522 MBtu / sm / yr)	0.521 MBtu / sm / yr (550 MJ / sm / yr)
Fuel (natural gas) use	Heating 81% Hot water 19%	Heating 82% Hot water 18%
Electricity use	HVAC (cooling) 52% Lighting 22% Equipment 25%	Space cooling 25% Lighting 22% Equipment 25% Fans, pumps, etc. 28%

Major benefits of eQUEST software

- Seamless transition from GBS or Revit conceptual mass modeling and eQUEST model, which automatically generates default building envelope, internal loads, HVAC, and scheduling
- Ability to customize building properties with fair amount of detail, and multiple ways of entering one setting (e.g. layers method or u-value method for walls)
- Good library of building materials for customizable layers or constructions
- Simulations run quickly, and usually under one minute
- Variety of simulation reports generated, with user-friendly results and comparisons

Major drawbacks of eQUEST software

- Time-consuming to manipulate and identify surfaces of interest, with default categories assigned not intuitive(e.g. interior floors are considered to be "interior walls," and slab-on-grade components are considered to be "underground walls."
- Names of default internal loads and schedules are not intuitively named
- Default and pre-made library constructions are often not realistic or ASHRAE-compliable, and units (e.g. imperial or US) are not decided by user
- Software has tendency to crash occasionally

Parametric variations

The parametric simulation study consists of analyzing the changes in building performance whenever any parameter is altered and simulation is run. In eQUEST, the simulation process includes specification of parametric runs, assigning of parametric components to each parametric run, their individual simulation and comparison of analysis. We tested the effects of various aspects of building envelope, internal loads and operational schedules on the performance of the building.

Regarding the variation in material properties, first a layer was defined. This layer consisted of customized material assemblies as desired according to the need. This layer was then incorporated with a new defined construction type. This construction type was in turn used to run the parametric simulation for specific parameter. Also, eQUEST allowed us to create individual parametric components in order to compare and contrast results of different kinds of simulation results for the same parameter.

For the HVAC modifications, we took reference from ASHRAE 90.1-2010 (IP Edition) and the CIBSE Guide-A .ASHRAE helped in deciding the U-Value of the materials, so it does not exceed the prescribed limit. CIBSE guide was referred to decide the occupant density to different zones.

Operational schedules were decided according to the conventional school year calendar.

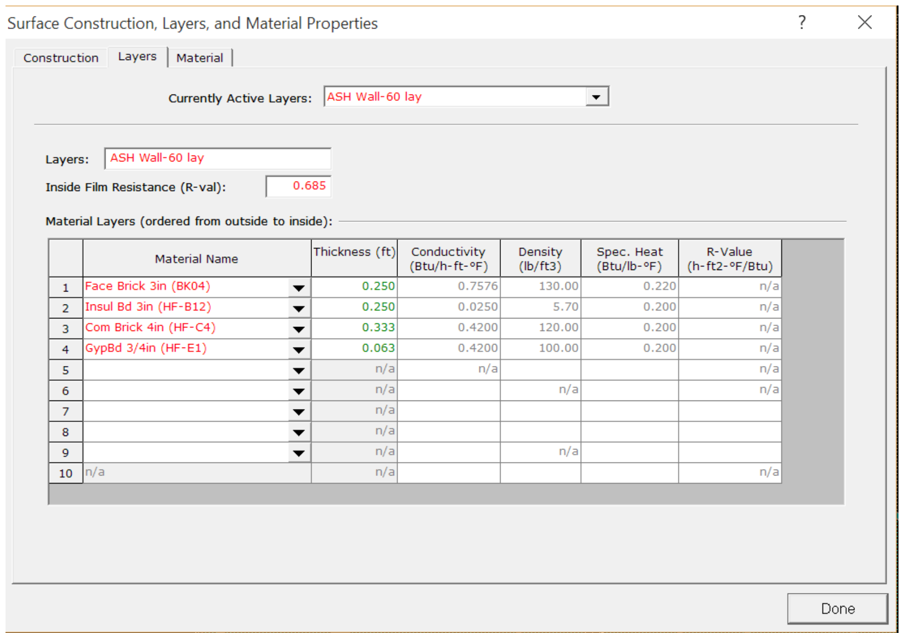

Figure 3 - Sample surface construction of wall, with layer of materials

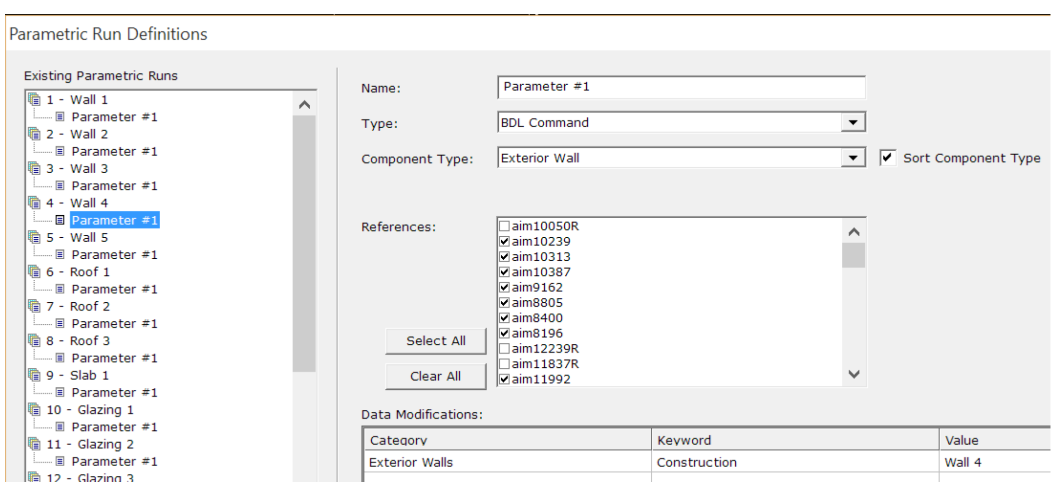

Figure 4 - Sample parametric run definitions, with parametric component (construction assignment)

Building Envelope Modification and Parametric Study

WALL CONSTRUCTION

Several alternatives for types of wall assemblies were experimented with in the eQUEST model by customizing new layers of materials, then a construction type, and finally a surface assignment in the parametric simulations. The main concern for the wall material selection was its performance in cold climate as the building is situated in Pittsburgh.So first of all,we decided to simulate two kinds of walls.These included concrete wall and brick wall.Narrowing down to bricks as the wall material sensible for an academic building of this stature, we then made changes in the insulation material. Polyurethane was selected as a competing alternative to a standard insulation board. Polyurethane is commonly installed in buildings in board form, or as a spray foam application. The U-values of the final layers were cross-checked to comply with the required values from ASHRAE 90.1-2010.

Table 2 - Wall construction alternatives

Wall	Materials	U-Value(Btu /h-ft2-°F)	Thickness (ft)	Assumptions / description / justifications
Default Baseline	**Wood shingle, Paper felt, Wood Sft, Minwool Bat(R13), GypBoard (⅝”)**	**0.081**	**0.17**	
Wall option 1	**Stucco (1”),Concrete HW (8”),Insulation Board(3”),Gypboard (¾”)**	**0.085**	**1.1**	**Standard concrete option with insulation**
Wall option 2	**Face Brick(3”),Insulation board (3”),Common brick(4”),Gypboard(¾”)**	**0.084**	**0.9**	**Standard brick option, concrete masonry unit**
Wall option 3	**Face Brick 4”,Polyurethane 4”,Common Brick 8”,GypBd ⅝”**	**0.035**	**1.4**	**Brick option with polyurethane insulation**

Findings / Results

It turns out that changing the majority of the building envelope by modifying the wall construction had a measurable increase in building efficiency in the case of option 3, which contains a polyurethane foam or board insulation among the layers. The 4 inches of polyurethane reduced the U-value of the wall construction by more than half, because this material has an R-value of at least 5 per inch, according to Energy.gov. As can be seen from the following figure, a noticeable 10% decrease in electricity load is found in the space cooling, as heat infiltration has decreased in the summer months. Meanwhile, a similar 10% decrease in fuel usage has been found, as less heat escapes during the winter months.

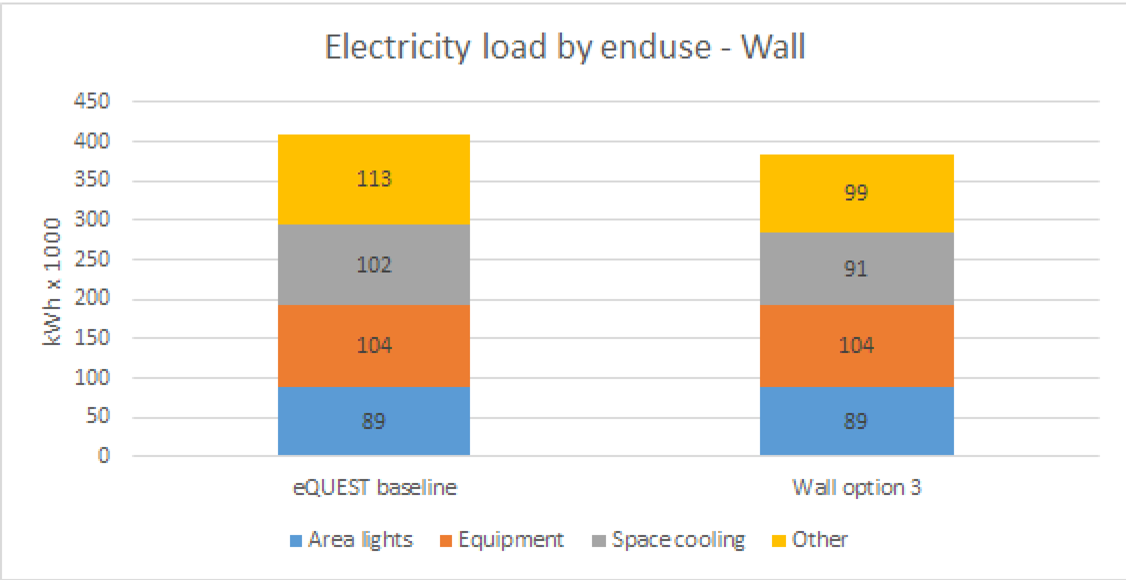

Figure 5 - Wall option 3 electricity loads

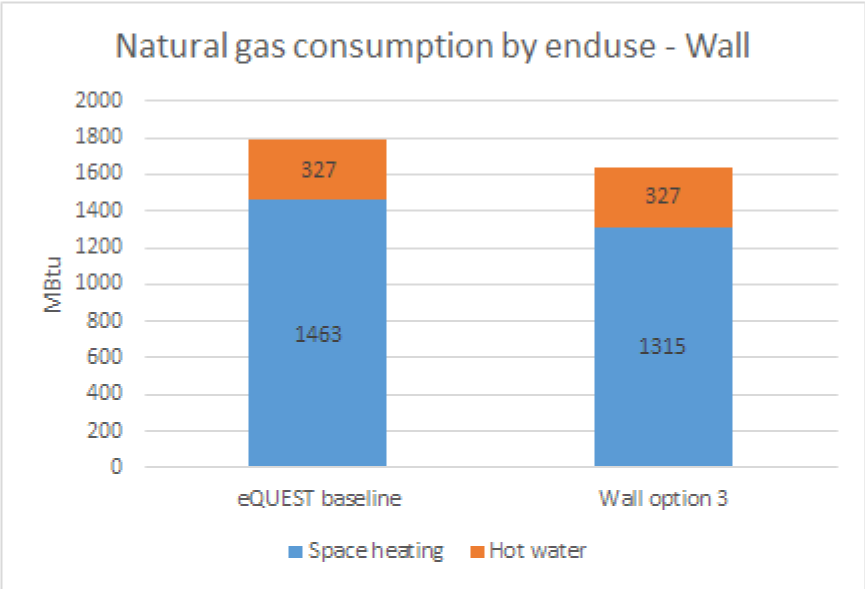

Figure 6 - Fuel loads for wall option 3

5.1.2 ROOF CONSTRUCTION

The roof of the building model is a flat roof and must be well insulated in order to avoid the effects of cold climate through infiltration. Various roof assemblies were selected consisting of materials whose combined layer U-value would comply within the ASHRAE limits. ASHRAE recommends U-value of 0.048 Btu/h·ft^2·°F for the roof type 'Insulation entirely above deck'. The lightweight concrete, stone and felt roof with acoustic tile was chosen in contrast to the built up roof assigned as default. In this assembly, further changes were made in the type of insulation. Cellulose insulation and polyurethane were used and these alternatives were simulated individually. Polyurethane proved to be a better insulation which also contributed to reducing the U-value of the assembly from 0.044 Btu/h·ft^2·°F of the default option to 0.029 Btu/h·ft^2·°F. This value is less than the max value allowed by ASHRAE so it is viable as well.

Table 3 - Roof construction alternatives

Roof	Materials	U-Value(Btu /h-ft2-°F)	Thickness (ft)	Assumptions / description / justifications
Baseline	**Blt-Up roof (⅜"),Paper Felt, MinBd(3"), MinBd(3"), Wood Sft (¾")**	**0.044**	**0.59**	
Roof option 1	**Stone (½"),Felt(⅜"),Concrete LW(8"), Cellulose insulation R20 (5.5"),Acoustic Tile**	**0.034**	**1.3**	**Common commercial flat roof with stones on concrete**
Roof option 2	**Stone (½"),Felt(⅜"),Concrete LW(8"), Polyurethane (4"),Acoustic Tile**	**0.029**	**1.1**	**Polyurethane successful insulation for wall, so applied to roof**

Findings / Results

With the U-value of roof option 2 almost 25% better than the baseline layers, Some energy savings could be expected. However, as evidenced by the following two figures that display annual electricity loads and gas consumption, this is not the case. Unsubstantial changes in both energy categories occurred. For some reason, the energy efficiency of the roof construction on this building doesn't have as profound of an impact on the energy profile, according to eQUEST. The reason may be that the glazing and walls have relatively lower insulation profiles to begin with; this is where heat will be lost in the winter and gained in the summer. As a result, modifying the roof from a low U-value to a slightly lower U-value will not change the overall energy profile.

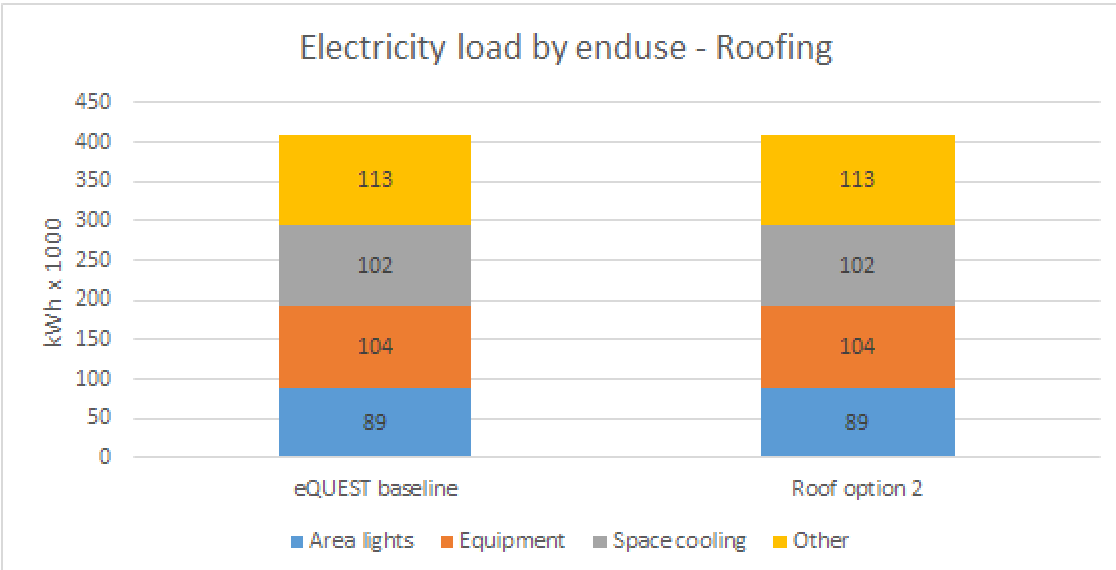

Figure 7 - Electricity loads for roof option 2

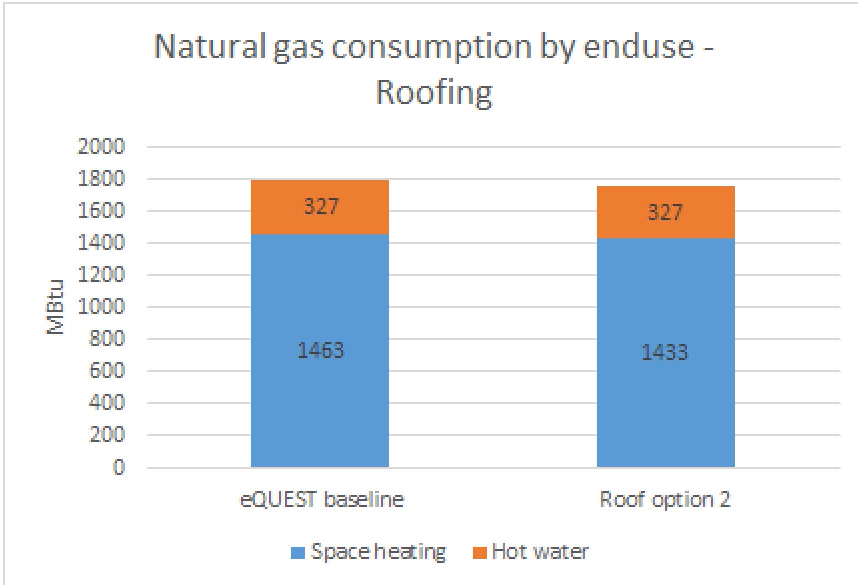

Figure 8 - Fuel loads for roof option 2

5.1.3 SLAB CONSTRUCTION

This section shows the slab materials' parametric variation and its effect on the performance of building.The slabs were divided into two categories: the first one being the slab-on-grade while the second one being the interior floor slab.The basement had the use of wood as the cladding material as an added material in order to improve the thermal heat transfer. But no major difference was achieved by doing that. In the case of the interior floor slab, use of steel siding with lightweight concrete,insulation and acoustic tile was found to be more efficient than the option that was assigned as the baseline default. The lower U-value of the floor slab indicates better performance of using this alternative for interior floors. ASHRAE recommends maximum U-value of 0.038 $Btu/h\cdot ft_2\cdot {}^{\circ}F$ but the default assigned was 0.2 $Btu/h\cdot ft_2\cdot {}^{\circ}F$. So different insulation and slab type (steel decking, or steel siding as a proxy) was used rather than using the default assigned slab as it has higher commercial value structurally anyway.

Table 4 - Slab and internal floor construction alternatives

Slab	Materials	U-Value(Btu/h-ft2-°F)	Thickness (ft)	Assumptions / description / justifications
Default Slab on grade Baseline	**Soil contact for insulation,Soil 8”, Conc HW 140 lb(8”)**	**0.03**	**0.13**	
Slab on grade option	**Soil contact for insulation,Soil 8”,Concrete HW 140 lb(10”), wood Hd ¾”**	**0.03**	**1.56**	**Increase concrete thickness and add wood floor**
Default Interior Floor Baseline	**Wood Sft (¾”),Minwool Batt,Carpet and Fiber Pad**	**0.2**	**0.06**	
Interior floor option 1	**Conc LW 40lb (4”), Steel siding, Minwool Fill R11 (3.5”),Acoustic tile**	**0.06**	**1.3**	**Typical concrete poured on steel decking for commercial bldg**

Findings / Results

As previously mentioned, the slab and internal floor options do not result in significant energy savings. This is likely similar to why the roof construction modifications did not have a large impact on building performance: the majority of infiltration occurs probably through the glazing and walls. On particular result is that the preferred slab-on-grade alternative results in a dramatic 40%+ decrease in electricity consumption for equipment. It is unclear why this is the case, but one possibility is that the basement is an unconditioned space full of mechanical equipment. Thus, this space will benefit tremendously from more efficient slab where heat is at a premium.

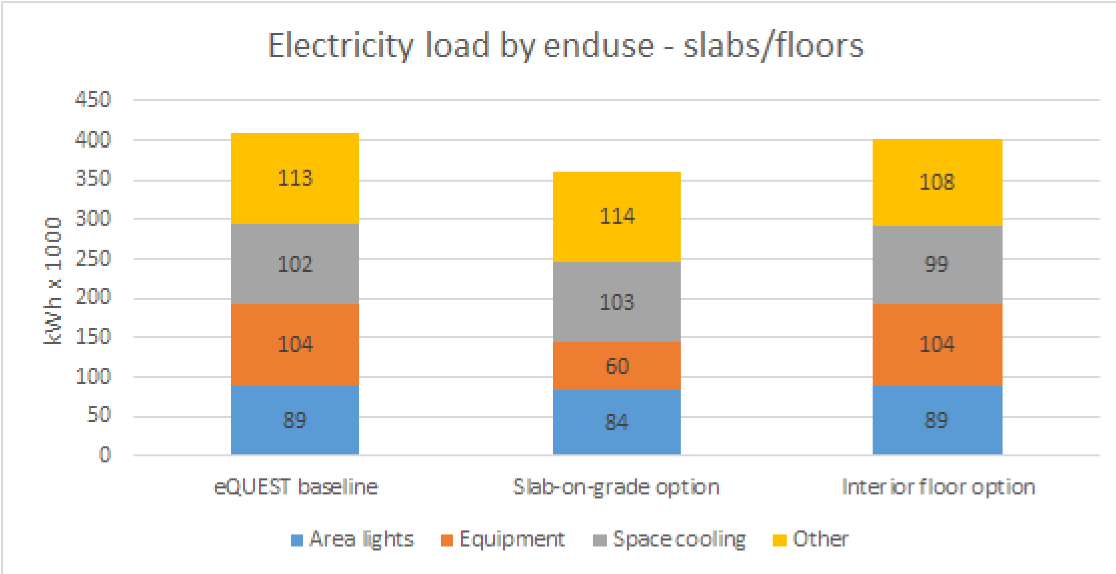

Figure 9 - Electricity loads for slab-on-grade and floor options

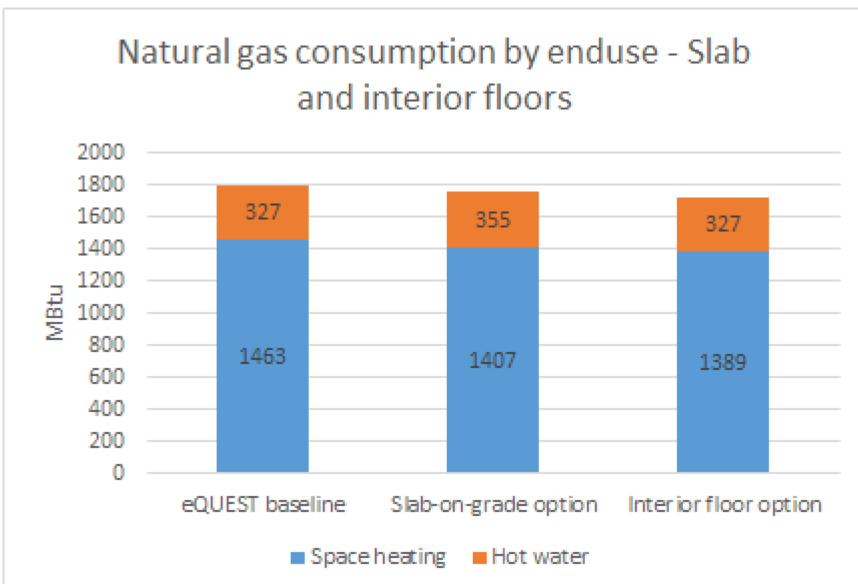

Figure 10 - Fuel consumptions for slab-on-grade and interior floor options

GLAZING STUDY

In this section,effect of glazing on the building performance is studied. According to ASHRAE 90.1-2010,Pittsburgh lies in Climate 5. The maximum U-Value given for the metal framed vertical glazing is 0.55 Btu/h·ft$_2$·°F which is almost similar to the U-value assigned to our default vertical glazing. Hence,we decided to use different alternatives for the glazing by varying the no. of panes i.e.single pane and double pane. Also,low emissivity glazing is recommended for the cold climates so that factor was kept permanent while trying different alternatives.

First of all, single pane low E glazing was applied which yielded U-value of 1 Btu/h·ft$_2$·°F. Also, other single pane option was tried which was a product of Pilkington company (found in eQUEST library), whose U-value did not make any difference but apparently, there was some change in solar heat gain capacity. Now, the U-value of the single pane low-E windows exceeded the ASHRAE recommended limit. So, to improve the performance of glazing, double pane windows were applied which were more effective than the previous one. Furthermore, air and argon were also added to different alternatives so as to improve upon the thermal insulation property of the glazing. The best case achieved was application of double pane low E glass with 3mm/13mm argon filling, that had the U-value of 0.36 Btu/h·ft$_2$·°F.

Table 5 - Glazing construction alternatives

Glazing	Materials	U-Value(Btu/h-ft2-°F)	Visible transmittance	SGHC	Glass shading coeff	Outside emmisivity
Baseline	Double Clear	0.536	0.781	0.70	0.81	N/A
Glazing option 1	Low E Single pane (e2=0.4)	1.0	0.85	0.8	0.91	0.4
Glazing option 2	Pilkington Single (Energy Adv Low E 3)	1	0.824	0.68	0.78	
Glazing option 3	Double Low E (e3=.4), Clear 3mm/6mm air	0.4	0.77	0.73	0.84	0.4
Glazing option 4	Double Low E (e3=0.4),Clear 3mm/13mm argon	0.36	0.77	0.74	0.85	0.4

Findings / Results

In terms of electricity consumption, the most efficient window option 4 did not have a profound impact. It is noteworthy that the default baseline windows are clear double-pane, so the standard was set fairly high. But since Pittsburgh is in a cold climate, the fact that option 4 is a low-E construction impacted natural gas consumption positively. A 15% reduction in fuel use was found in the simulation. These types of windows are highly recommended for Pittsburgh, climate zone, and this result may provide some justification. These types of windows seem to be a smart alternative for an academic building that will require plenty of natural light for comfortable classroom spaces.

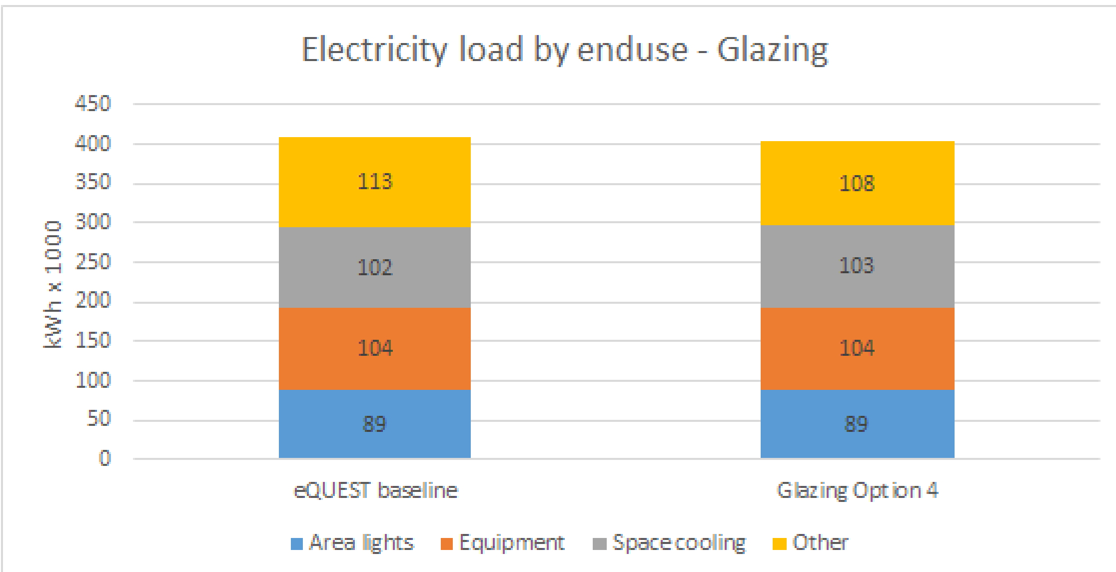

Figure 11 - Electricity loads for glazing option 4

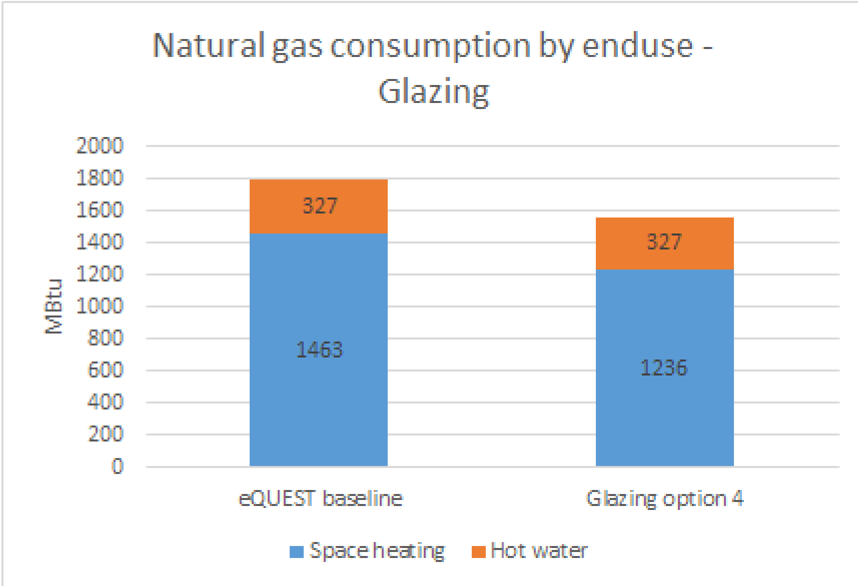

Figure 12 - Fuel consumption for glazing option 4

INTERNAL LOADS and BUILDING PERFORMANCE

Internal loads include the effect of heat generated by occupants as well as by lighting and equipment inside the building. For assessing the effect of internal loads on the building's performance, the building was divided into 5 zones. These included the academic zone, office space zone, basement, auditorium and penthouse, according to their uses and need of conditioning. The baseline model had all spaces conditioned except the penthouse. We have assumed the basement as unconditioned space as well because it does not have occupants and houses the operating systems.

Table 6 - Thermal zone states

Zone	Description	Zone Type
Z1	Academic space Core (1st - 4th floor)	Conditioned
Z2	Office space Perimeter (1 - 4th floor)	Conditioned
Z3	Basement	Unconditioned
Z4	Auditorium (Basement - 1st floor)	Conditioned
Z5	Penthouse (5th floor)	Unconditioned

OCCUPANT DENSITY

The baseline model contains the default values for occupant density, lighting density and equipment density .But, we further modified those values according to the specifications given in CIBSE Guide A (Chartered Institution of Building Services Engineers). These values are consistent with what the spaces are used for. The less square footage assigned to a person, the more crowded the space is. The auditorium, with a density of 13 ft^2 / person, is a dense space. Consequently, we can expect the model to see a high thermal heat gain from the occupants in these spaces, which might save fuel or heating energy use.

Table 7 - Occupancy density values

ZONE TYPE	CIBSE Use specification	MODIFIED OCCUPANT DENSITY (Ft^2/person)
Academic (Z1)	**Teaching space**	**16**
Office (Z2)	**Office space**	**150**
Basement (Z3)	**---**	**0**
Auditorium(Z4)	**Lecture theatre**	**13**
Penthouse (Z5)	**---**	**0**

LIGHTING POWER DENSITY

The CIBSE guide also provides light densities, which behave similarly to occupancy, but also relate to the way the space is used. Offices and academic spaces require more light for productivity than a basement. The auditorium is multimedia-centric, and will require many lights when in use. The reasoning is similar for the equipment densities, which follow in Table 9.

Table 8 - Lighting power density values

ZONE TYPE	ASHRAE 90.1-2004 Base Case specifications	MODIFIED LIGHT DENSITY (W/Ft^2)
Academic (Z1)	Classroom	1.4
Office (Z2)	Enclosed Office space	1.1
Basement (Z3)	HVAC Plant Room	0.28
Auditorium(Z4)	Audience/Theatre	2.59
Penthouse (Z5)	Inactive Storage	0.28

EQUIPMENT POWER DENSITY

Table 9 - Equipment power density values

ZONE TYPE	ASHRAE 90.1-2004 Base Case specifications	MODIFIED EQUIPMENT POWER DENSITY (W/Ft^2)
Academic (Z1)	Classroom	0.82
Office (Z2)	Enclosed Office space	0.82
Basement (Z3)	HVAC Plant Room	0.28
Auditorium(Z4)	Audience/Theatre	0.19
Penthouse (Z5)	Inactive Storage	0.28

EFFECT OF OPERATIONAL SCHEDULES ON BUILDING PERFORMANCE

OCCUPANT, LIGHTING AND EQUIPMENT SCHEDULE

The occupant schedule has been assigned according to the school calendar. It is assumed that there would be break from mid-December to second week of January. Then, there would be summer break from June to August. Accordingly, the annual occupancy schedule is designed with a heavy discrepancy between building usage during the academic calendar and during off-times. The lighting and equipment default schedules are used and no modifications have been made.

The auditorium has been assigned custom lighting schedule and equipment schedule as it will be used only on some days for some period of time—during the middle of the day when lectures are occurring. All lights are assumed to be on during class time. Every other zone uses the default schedule, because the imported GBS building type contains a reasonable scheduling system for a university building.

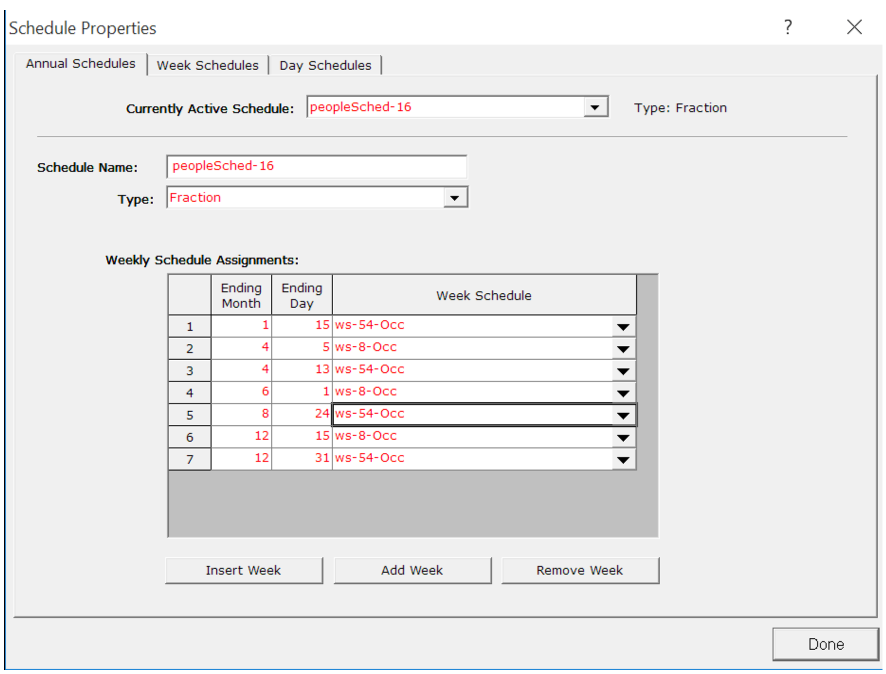

Figure 13 - Example of schedule properties, with weeks assigned for academic calendar

ANNUAL MODIFIED OCCUPANCY TABLE

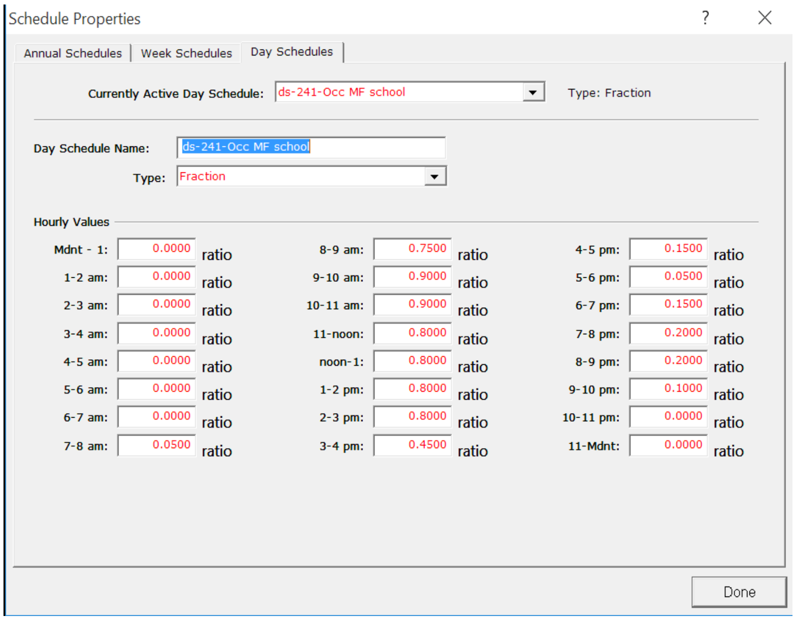

Figure 14 - Typical occupancy densities for an academic day

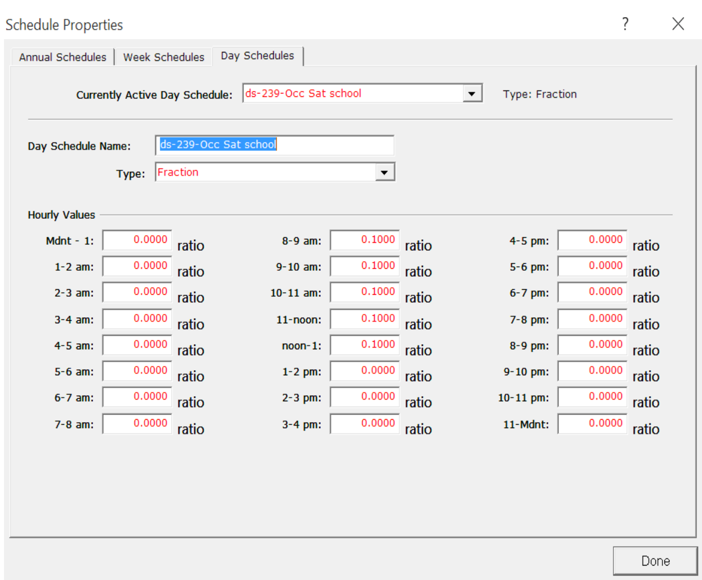

Figure 15 - Typical occupancy densities for a Saturday during school year

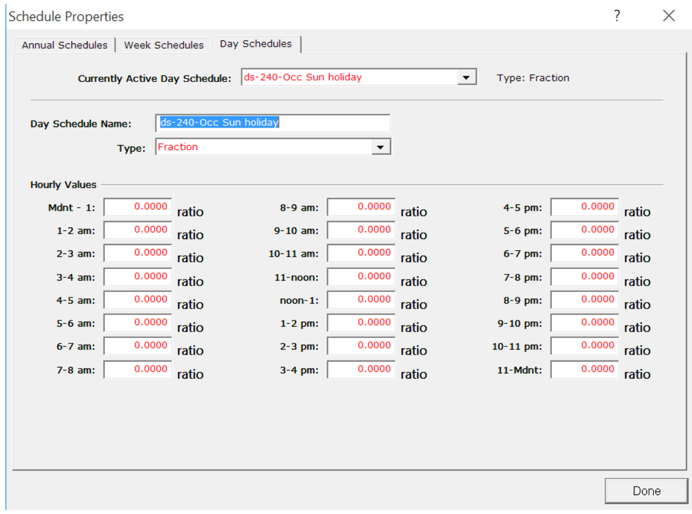

Figure 16 - Typical building occupancy densities for a Sunday or Holiday

The above figures represent default occupancy values for an academic calendar. For further modeling, the schedules were modified to reflect a more accurate scenario. The auditorium is fully active during lecture hours, while the other schedules attempt to recreate accurate scenarios of lesser occupancy and usage around lunch and dinner hours. One additional change is that the building loads do not sit at zero overnight (except in the completely dark auditorium), as academic buildings often have lab equipment or computers that still run.

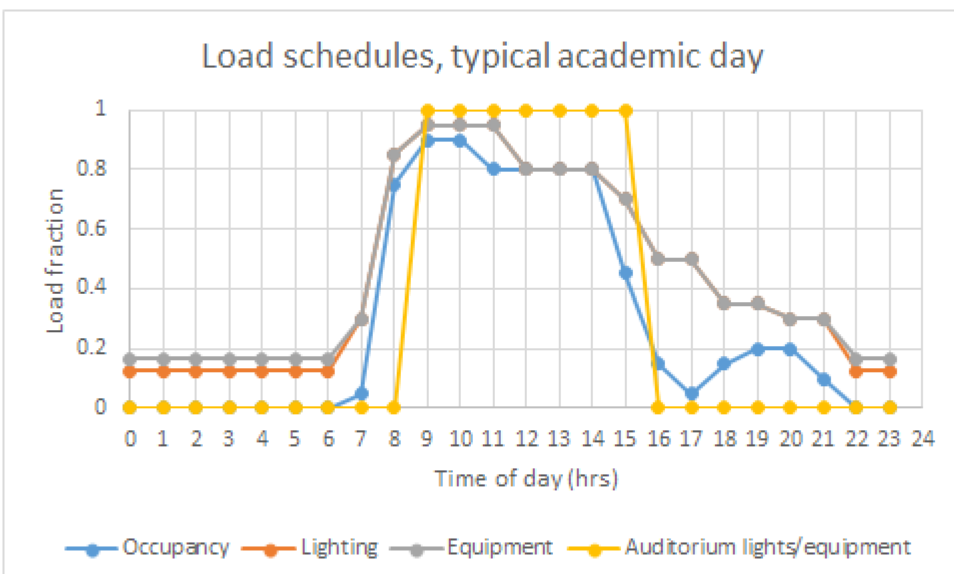

Figure 17 - Modified daily schedules, typical academic day

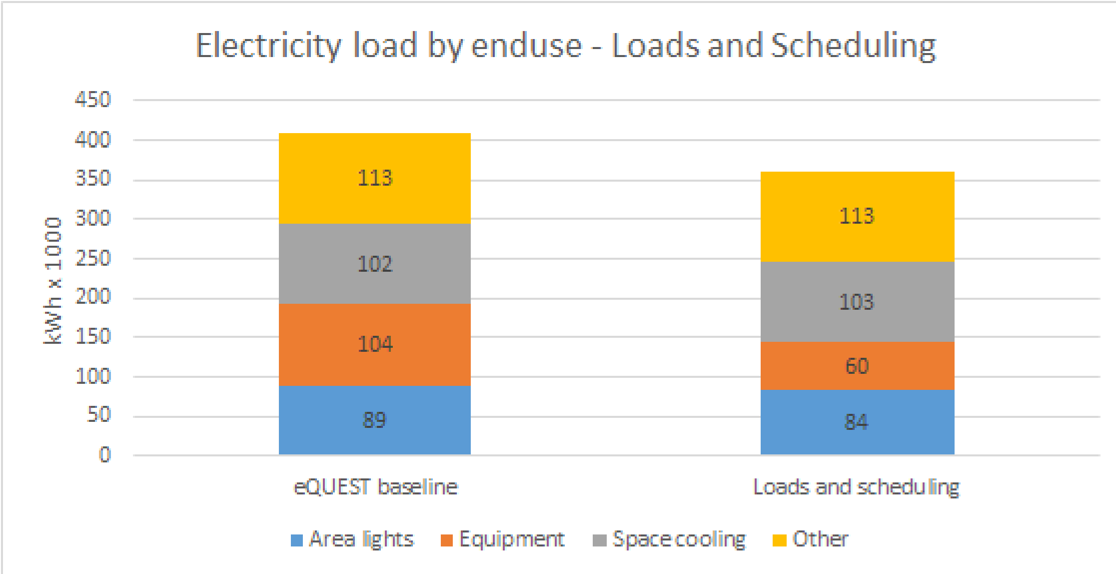

Figure 18 - Electricity consumption for complete loads and scheduling model

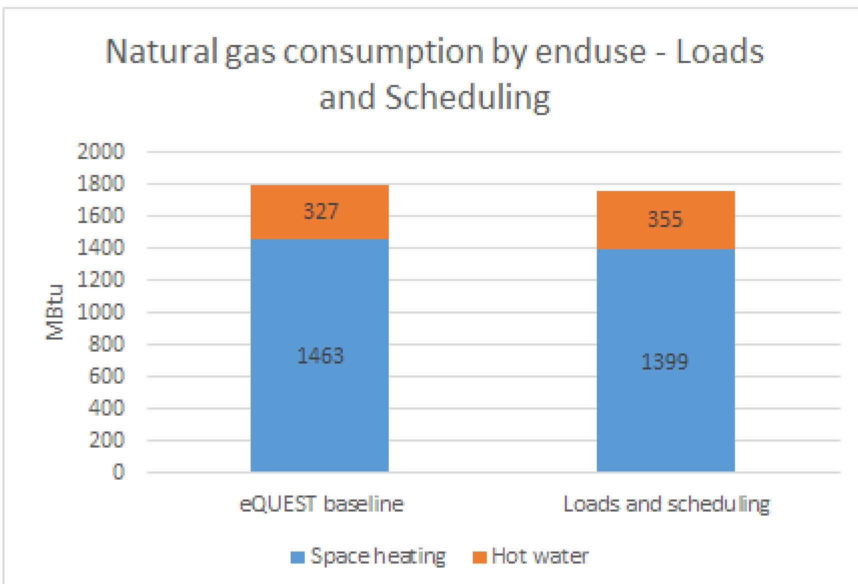

Figure 19 - Fuel consumption for complete loads and scheduling model

Findings / Results

The occupancy, lighting, equipment, and modified academic scheduling for all systems (on top of the baseline model) resulted in a substantial improvement in energy performance due to the academic off-times of the schduling, with a 12% decrease in electricity consumption, and a negligible 2% improvement in fuel requirements.

5.4 THE OPTIMIZED ALTERNATIVE FOR SCAIFE HALL

For additional insight into the way eQUEST can determine an optimized version of a building, the best-case constructions were run on a single simulation, on top of the modified internal loads and scheduling for all systems. That is, wall option 3, roof option 2, slab-on-grade option, interior floor option, and the double-pane low-E glazing constructions were chosen on their appropriate surfaces. The following figures represent the final results of an optimized model.

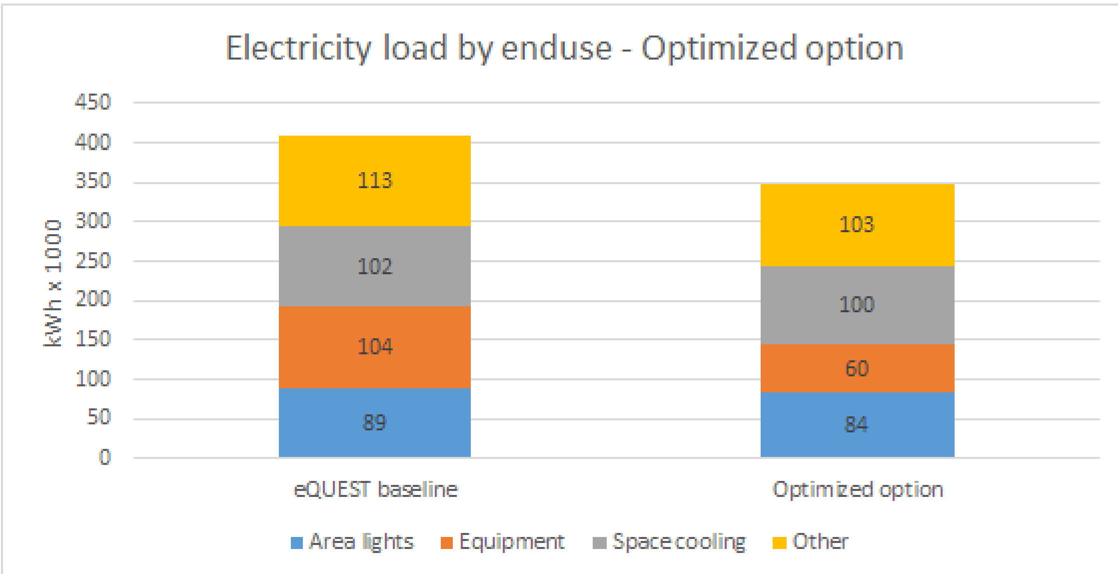

Figure 20 - Electricity use for best-case model

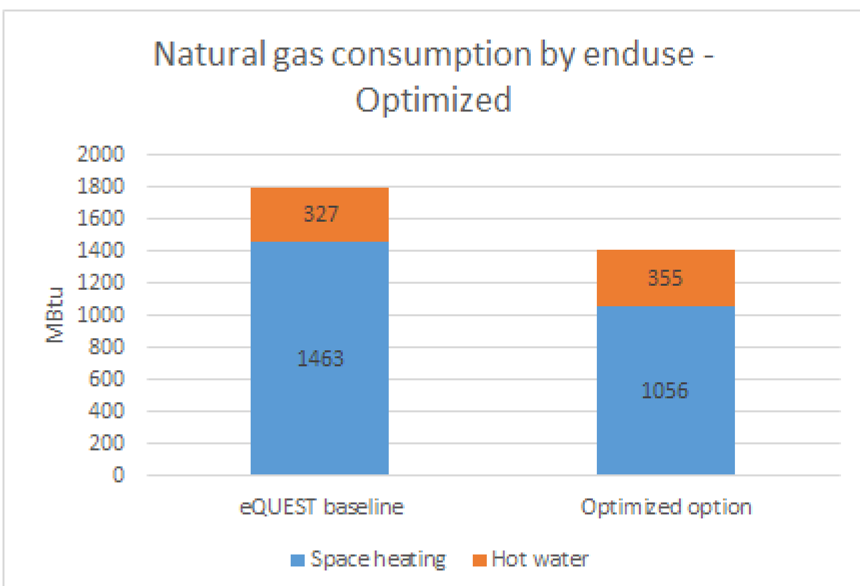

Figure 21 - Fuel consumption for best-case model

Findings / Results

Not surprisingly, these constructions result in an efficient building. Electricity use decreased by 15%, most notably in equipment use. This is likely because many spaces were changed from the default equipment loads (office space) to academic loads, which are slightly less. Additionally, the auditorium is not used for much of the day—this represents a significant area of the building.

For fuel consumption, hot water demand increased slightly (8%), but this was negated by the large decrease in space heating fuel requirements, which dropped 28%. These are substantial changes, and should be treated with caution. But several of the chosen construction layers included improvements in insulation (like polyurethane). In the cold Pittsburgh climate, this can make a large difference for a building. It's also worth cautioning that the glazing wall-to-window ratios were not modified. The more glazing on a building, the less that the wall construction controls the overall efficiency.

6. CONCLUSION

This assignment is aimed at studying the impact of various design parameters and their effect on Scaife Hall's overall performance by running simulations in eQUEST 3.65, thus getting acquainted to various features of eQUEST It can be deduced that eQUEST is more flexible in inputting various details related to different aspects of the building compared to simpler software like REVIT. For obtaining informative results, first of all, the building was divided into different zones based on the functional use of the space. Then, modifications were carried out in the building envelope properties such as walls, roof, and glazing. Various combinations of materials were assigned and tested for achieving optimized energy consumption and the best cases were drawn out. These were decided based on the detailed results provided by eQUEST in terms of all possible aspects.

It is important to carry out parametric runs for different alternatives so as to decide the most viable option. By applying the best case of all parametric runs in different aspects of the building, the **electricity consumption decreased by 15%, and fuel use by 21%,** from the baseline model. We also referred to ASHRAE 90.1-2010 (IP Version) to make sure that the U-values of the applied materials do not exceed the recommended maximum limits for each parameter. The modification in occupancy density that was set according to the school year and weekdays schedule according to the timings made for a 12% improvement in the electricity consumption alone.

REFERENCES

http://www.energy.gov/energysaver/insulation-materials

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ASHRAE 90.1-2010 (IP EDITION)