eQUEST Energy Modeling – Project

Your assignment is to analyze a list of energy efficiency measures (EEMs) for an existing building located in Corvallis, OR. The building is a 4 story office building with a total of 62,500 sf floor area. You have conducted a thorough audit of the building and systems with the details of that audit informing your energy model. See building description below for all building details.

Energy Efficiency Measures:

The client is looking to spend money on efficiency upgrades. You've identified the following potential energy upgrades.

EEM1 Lighting Upgrades: Upgrade the interior lighting from fluorescent to LED lighting. New lighting power density for LED fixtures is estimated to be 0.7 W/sf average for all spaces. The cost of an LED upgrade is estimated at $1.5/sf of building area

EEM2 Boiler Replacement: Replace the existing boiler with high efficiency condensing boilers (natural draft) with 96% efficiency. The new boiler cost $12,000 to replace.

EEM3 Window Upgrade: Replace ALL windows with super-efficient, triple pane low e windows with Argon in the gaps (glass type 3603 in eQuest). Total replacement costs are $320,000

EEM4 Variable Speed Pumps: Install new variable speed drives on the chilled water AND hot water pumps. Total cost is $11,000 to install VFDs for both chilled water and hot water pumps.

Energy Modeling

Model the existing building based on the gathered building details listed below. This will be your baseline building for use in comparing performance of each EEM.

For each EEM, save a copy of the baseline building (and change the name, use EEM1, EEM2 etc as a prefix). Modify the EEM model based on the proposed EEM upgrades and simulate the energy use. Calculate the EEM energy savings (kWh/Therms) over the existing baseline. Calculate the simple payback for each EEM based on the energy cost savings based on the utility rates given and the EEM installation costs above.

Determine if the EEMs are viable in payback time based on the estimated EEM measure life (see EEM Life Table on Canvas). Viable means payback time is less than the measure life.

Create a final Combined EEM model that incorporates all viable EEMs that have a favorable payback.

Remember to use the eQuest tutorial videos as a guide on using eQuest in creating your energy models.

What you will turn in to Canvas:

A. A summary report that includes the following:
   1. Identify the existing building EUI using the developed energy model. Compare to the average EUI from office buildings from the published EUI median data posted on Canvas.
   2. Describe energy use in the building by end use type. What systems use the most energy? Is this building efficient for an Office Building? Why or why not?
   3. For each EEM provide the total electricity kWH and natural gas savings (or increase). Describe the energy savings or increase for each end use type and explain why the EEM results in these changes to energy consumption.
   4. For each EEM calculate the simple payback and if the EEM meets the cost effectiveness requirements of the client (simple payback less than the measure life). Present in the table provide below or similar.
   5. Present the energy results for the combined EEMs selected. Does the combined EEM model savings equal the sum of the individual EEMs? Why or why not. What is the resulting EUI after implementing all energy upgrades?
   6. The client is also considering a possible complete HVAC system replacement with a VRF system and heat pump DOAS for ventilation. Describe how this new system might change each of the energy end uses for HVAC:
      a. Space Cooling
      b. Heat Rejection (heat rejection is for the cooling tower in the baseline system)
      c. Space Heating
      d. Pumps
      e. Ventilation Fans.

      Consider each end use for both electrical and natural gas where applicable. Reminder the baseline system is a VAV system with boiler for heating and chiller with cooling tower for cooling.

B. Upload the .inp file, .pd2 file, and pdfs of the monthly simulation results for the existing building, each EEM model, and the combined EEM model (six models in total)

EEM Savings Table

MEASURE	ELECTRIC SAVINGS (kWh)	GAS SAVINGS (THERMS)	ENERGY COST SAVINGS ($)	INSTALLATION COST ($)	SIMPLE PAYBACK (YEARS)	EEM is Viable (Y or N)
EEM #1						
EEM #2						
EEM #3						
EEM #4						
Combined EEMs						

For Utility costs use: $0.075 per kWh for electricity $0.8 per therm for natural gas

Existing Building Information (Baseline)

4 Story office building, 15,625 square feet per floor, 62,500 total, all above grade

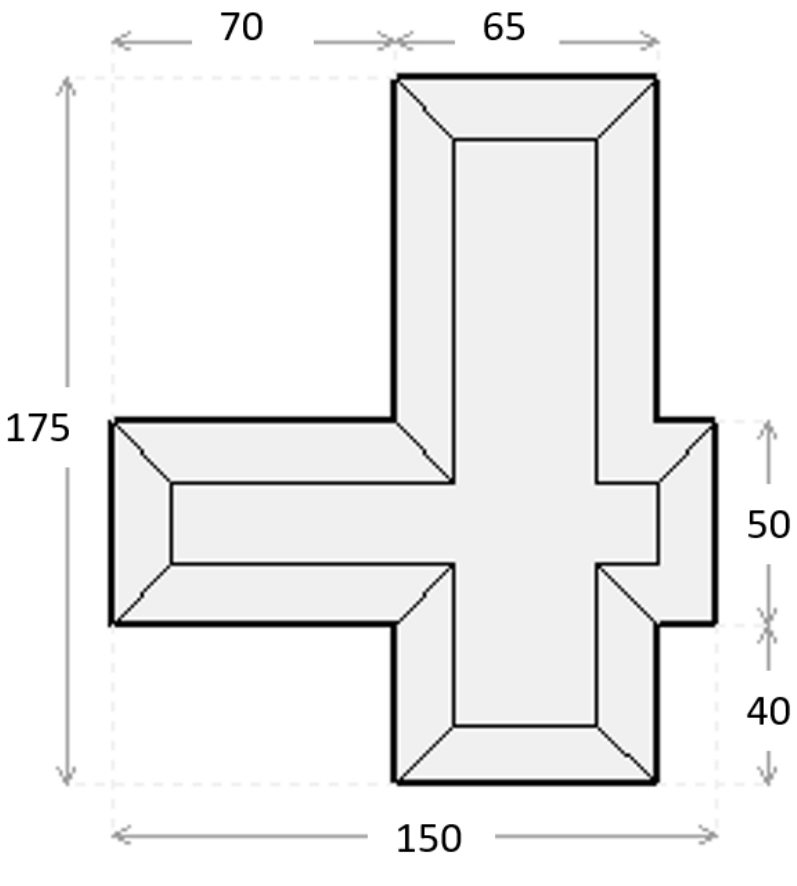
Location: Corvallis, OR

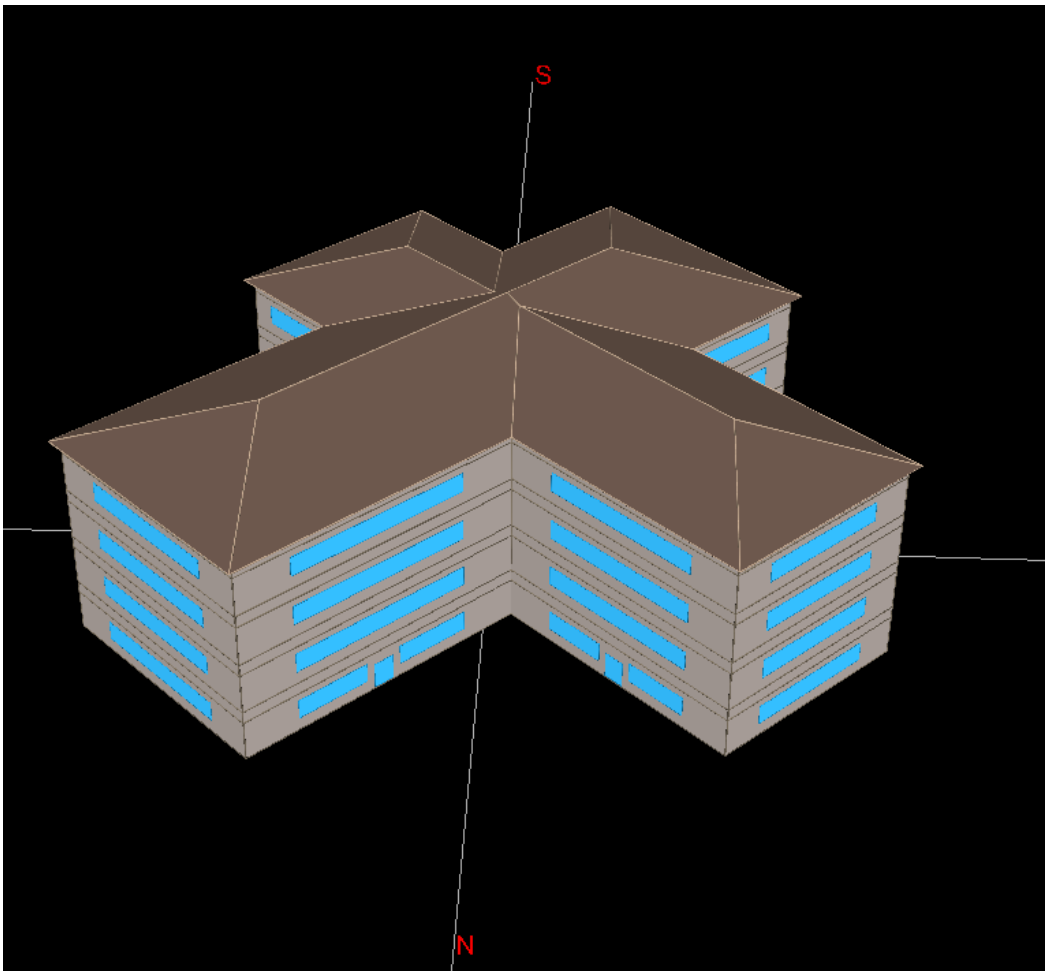
Use Perimeter/Core zoning, 18 foot zone depth

Pitched roof, 20 degree slope, all 4 ends gabled

Floor to floor height: 13 feet, floor to ceiling 10 ft

Floor plan and orientation:





Envelope details:

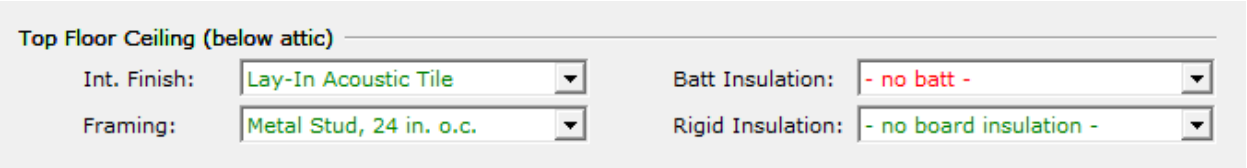
Roof: metal framing, R-12 exterior insulation

Walls: 8 inch CMU, perlite filled, 2” Polyurethane board insulation (R12), no furred insulation

No ground floor slab insulation

Infiltration: 0.07 CFM/sf perimeter zones, 0.0 for core zones

No below attic batt or rigid insulation (insulation is at the roof level, not on the attic floor)



Use default interior wall type and floor finishes

Exterior doors: 1 door on each face. Doors are 7 feet high and 6 feet wide. Glass in doors is double pane, double clear type 2000. Aluminum frames with no break. 3 inch frame width.

Windows: 25% of wall area on each face of the building. Same glass type as the doors. Frame width 1.3 inches.

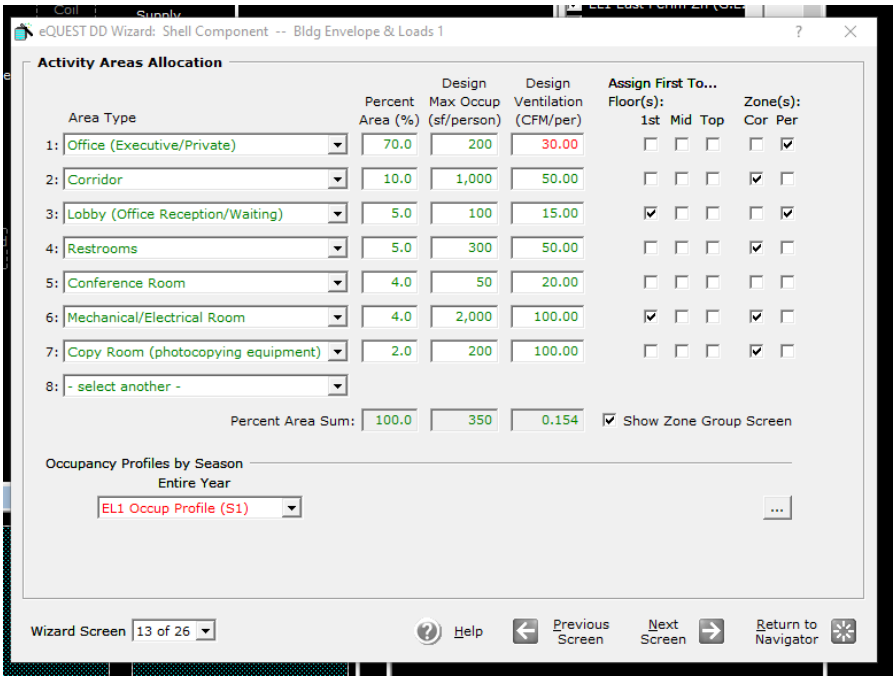
No overhangs, shades, or blinds.

No skylights.

Building Schedule:

Occupied M-F 7 am – 6 pm and Sat 9am-12pm, Sun and Holidays – closed

Use default area percentages. Set Office Area to 30 CFM/per



Don't need to model exterior lighting or domestic hot water. Unselect these items.

Light power density: 1.2 watt/square foot for all rooms

Miscellaneous loads: Office areas 1.25 watts/square foot, all other area types use 0.5 w/sf

Existing HVAC System is as follows

System Type is Standard VAV with Hot Water Reheat with an AHU system per floor, return air is ducted

Cooling Source: Chilled Water Coils

Heating Source: Hot water coils/loop

Indoor setpoints 75F cooling, 72F heating, 82F cooling/64F Heating unoccupied setback, all fans should run continuously (not intermittent).

VAV Minimum Flow is 50% for both core and perimeter spaces

Fans should match default settings (3.5 inWG high efficiency, variable speed drive, return fans 1.17 inWG high efficiency, variable speed drive)

Fans operate 1 hour before and 1 hour after close. Fans cycle on to meet load at night with no OA (outdoor air). Night fans cycle on any zone require heating/cooling.

No zone heating

Economizer operates on dual temperature (compares return air and outdoor air)

Cold deck reset is constant 55F

HW Boiler Plant

2 boilers at 80% efficiency.

Flow is Constant

Operation is on Demand.

Temp setpoint is 140F

Other settings at Default

Chiller Plant

1 Screw Chiller 0.9 kW/ton efficiency.

Operation is on Demand

Flow is Constant

Chilled water setpoint value is 45 degree F

Other settings default