Welcome to the Teaching Architecture + Energy project at Washington University. This site is part of a collaborative network of energy technology teachers in architecture schools, sponsored in part by the U.S. Dept. of Education. Our goal is to make it easier for architecture students to understand energy concepts and to design energy efficient buildings. The curricula developed here and at other universities is centered around Energy Scheming, a energy simulation tool that helps the student think about energy as an integral part of building design.

Climate: context for design
Exercises: "recycling with energy scheming"
Example: shanley building

Student Work

Legal Disclaimer
EXAMPLE PROJECT
shanley dental building, clayton, mo

Worked Example
Re-Cycling with Energy Scheming exercise

Model
Final Drawings
Drawings
Site Photos
EXAMPLE PROJECT: example exercise

outline of example problem pages

A. DOCUMENTING: input your building (example)
   1. Assemble Schematic Plans and Elevations of Your Design
   2. Identify the Building's Construction Type(s)
   3. Diagram the Solar Concept
   4. Determine Your Simulation Strategy
   5. Diagram the Daylighting Zones
   6. Get the Drawings into the Computer
   7. Create a New Climate, if necessary

B. DEFINING: take-offs and specifications (example)
   1. Tune Settings to Fit Your Building
   2. Define Your Daylight Zone Icon
   3. Set Performance Goals for Lighting and Heating
   4. Create Plan Specifications
   5. Create Elevation Specifications

C. ANALYZING: understanding energy patterns (example)
   1. Use the Rule-of-Thumb Window Sizer
   2. View the Graphic Report
   3. Interpret and Assess the Building's Performance

D. RE-DESIGNING: generate and test cycles (example)
   1. Re-Design to Meet Your Window Performance Targets
   2. Re-Design to Reduce Net Flows and Peak Loads
   3. Print the "Energy Performance Report"
   4. Document Design Changes

E. EVALUATING: comparing with energy codes (example)
   1. Set an Energy Budget
   2. Choose Reference Criteria
   3. Model Your Reference Case Building
   4. Compare the Performance of the Two Designs
1. Re-design to Meet Your Window Performance Targets

Performance Targets "BEFORE"

Click on one of the sizing bars in the graph to learn more about it. Click on any of the parameters buttons to review the design targets.

Performance Targets "INTERMEDIATE" first re-design
Solar Gain
Our re-design added a sunspace in two sections across the narrow south facade, linked by a fan-driven loop to the north side rooms. Our performance after this initial re-design increased from about 35% to about 75% of our target. Any additional south glass would have to be added to the roof of the north wing.

Cross Ventilation
Previously, we had lots of cross ventilation outlet, but no inlets. We made operable some of the windows on the south, north and west sides of the building. South windows are the only inlets possible, since the wind comes from that direction in summer. Even though the overall performance for cross ventilation now exceeds what is necessary, according to the rule-of-thumb, we know that the north side offices can not be effectively cooled with cross ventilation.

Stack Ventilation
In the re-design, there is now stack outlet at the back of the waiting room and over the corridor to serve the offices. Inlets are provided via the south sunspace, which open up completely in summer, and through the operable portion of the east office windows. As one can see, the stack inlets are only about 70% of what is required, and the outlets are a miserable 18%. To solve this, we will change the double-hung east and windows to casements (inlets) and make the stack towers much larger by increasing them in the E/W dimension.

Daylighting
In the initial design, zones I, II, and IV showed excessively high levels, with two zones over 200%. In our redesign, we added a sunspace. It will obviously have very high levels of daylight. We re-ordered the daylight zones, assigning zone 1 to the sun space and combining the previous zones I (waiting) and II (reception) into a single new zone II. Windows in the back wall of the sunspace are now a part of zone II, reducing the light in the waiting area to a more reasonable level. All sunspace windows now go with zone I, so we don't care if it overshoots the daylighting target. Zones II and II are now right at 100%. Given the shading and double glazing, we might consider adding more window area later. Otherwise, we are doing good.
Stack Ventilation

In the final design, we have substantially increased the size of the stack ventilation towers; we also made the windows at the top of the sunspace operable. The stack outlet is now up to 92% of the target. Since our graphic reports show that we have no net cooling loads on the typical summer day, we believe that our target is achieved. Although, more ventilation will likely help on the extreme days.

Jump to the next EXAMPLE section: Re-design to Reduce Net Flows and Peak Loads
D. RE-DESIGNING: generate and test cycles.

net flows and peak loads

2. Re-Design to Reduce Net Flows and Peak Loads

Annotated "Net Flow graphic report" for the Shanley Building.

Annotated "Total Gain and Loss" graphic report for the Shanley Building.
Annotated "By Element Group," graphic report for the Shanley Building.

ANALYSIS

- Reducing the building’s net daily heat flow.
- Reducing the magnitude of gains and losses
- Minimize the peak loads

Jump to the next EXAMPLE section: Print the "Energy Performance Report"
D. RE-DESIGNING : generate and test cycles.

3. Print the "Energy Performance Report"

We printed as instructed.

Jump to the next EXAMPLE section: Document Design Changes
design changes

4. Document Design Changes

INTERMEDIATE SCHEME

The following design changes were made in the initial re-design cycle (the Intermediate Scheme):

Strategic Changes
- Changed roof form over offices to promote flow to stack outlets, increasing its slope.
- Created a series of new ventilation stacks on west side of offices and on north side of waiting room.
- Added a Sun Space on south elevation for solar heating, allowing a large increase in collection area.

Tactical Changes
- Added wall insulation to uninsulated walls.
- Added floor insulation to uninsulated floor over crawl space.
- Increased ceiling insulation.
- Made windows operable on south side for inlets.
- Changed some windows to operable types, creating a ventilation path from inlets to outlets for each space.
- Changed windows to double glazed, low-e type to improve their R-value.
- Added shading on all sides, except north.

FINAL SCHEME

The following design changes were made in the final re-design cycle (the Final Scheme):

Strategic Changes
- Made stacks much bigger, expanding them to the width of the corridor.

Tactical Changes
- Added additional thermal storage in the Sun Space, in the form of water.
- Changed block mass in exterior walls from "Hollow" to "Solid" mass, by filling with high sand content grout.
- Changed South windows in Sun Space to clear glazed to increase solar transmission.
- Added Night Insulation to all windows: R-5 for most windows, R-9 for Sun Space.
- Added rigid insulation to walls below grade.
- Added insulation to floor of Sun Space and to Sun Space slab edge.
- Changed electric lights from incandescent general diffuse type to the more efficient fluorescent indirect type.

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3. Print the "Energy Performance Report"
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