Continuing Chapter 7
High Energy Efficient Design

Lecture #16
HNRS 228
Energy and the Environment
Adapted from Murray Milne Lecture
UCLA and HEED office

Overview of Chapter 7
- Energy Conservation
- Space Heating
- Thermal Insulation
- Air Infiltration
- Lighting
- Appliances
- Some considerations of agriculture and industry

Designing High Performance Sustainable Buildings

My Objectives are:
1. To show you how to use HEED to design a Basic Residential Building
2. To show you how HEED reports Site Energy Use and CO2 Production with each design change you make.
3. To show you six concepts of Energy Efficient Buildings using HEED’s Advanced Graphic Evaluation tools
4. To give EACH of you a chance to use HEED on your own.
5. To end by showing how well each of your designs compare.

What is the 2010 Imperative

Ed Mazria, the AIA, the USGBC and others have jointly issued the 2030 Challenge, that asks architects to create buildings that are carbon-neutral by 2030.

As a first step they also ask that the fossil fuel reduction of all new buildings be reduced by 50% between now and 2010.

This target is readily achievable, but to do it Mazria says we need a little “performance box” in our design tools to show how close each design change gets us toward that goal.

HEED now has such a little “performance box”.

When you install the HEED disk on your laptop it will automatically begin loading...

Next it will show you the Tutorial

Whenever you are in doubt about what to do next...click “next” to continue
1. Start in the 'Initial Design' screen by giving Four Facts about your home:
   - Building Type
   - Square Footage
   - Number of Stories
   - Zipcode or Location.
2. Using this data, HEED will automatically design two basecase buildings:
   - Scheme 1 that meets the Energy Code
   - Scheme 2 that is more Energy Efficient.
3. It will COPY Scheme 2 and ask you to revise it to create your own design.
4. Every few minutes COPY your Scheme and keep on improving your design.
5. Try to make its Energy Costs less than the basecase designs.
On Initial Design Screen, Answer These Questions

Then click Next

From this, HEED Automatically Creates Two Buildings

Then it asks you to Copy and Re-Name Scheme 2

Click on the 'Basic' icon to see Basic Design Options

<table>
<thead>
<tr>
<th>Scheme 1: CODE MINIMUM DESIGN</th>
<th>Scheme 2: ENERGY EFFICIENT DESIGN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square floor plan</td>
<td>Rectangular floor plan facing South</td>
</tr>
<tr>
<td>Equal area of glass on each wall</td>
<td>Most glass on South, min. on E &amp; W</td>
</tr>
<tr>
<td>Windows tinted as required by code</td>
<td>Often clear glass on South and North</td>
</tr>
<tr>
<td>No window shading</td>
<td>Overhang shading South Window</td>
</tr>
<tr>
<td>Shub and Stucco walls</td>
<td>High mass walls, exterior insulation</td>
</tr>
<tr>
<td>Raised wood floor</td>
<td>Slab on grade floor, carpet or tile</td>
</tr>
<tr>
<td>Code required air change infiltration</td>
<td>Whole-house Fan, 10 or changes/hr</td>
</tr>
<tr>
<td>Lights are mostly incandescent</td>
<td>Lights are mostly fluorescent</td>
</tr>
</tbody>
</table>

Both Schemes have the same:
Floor area, Window area, Climate, Occupancy Schedules

Now begin changing your new Scheme 3 to your own design
Draw in your own Floorplan by Filling-the-Squares

Click and Rotate your House to its correct Orientation

Drag and Drop Windows/Doors to Exact Location

Checklists let you Describe your Home’s Construction

There are over a dozen BASIC Checklists to choose from

Finally, the Energy Cost bar charts show how each of your Schemes Compare with Schemes 1 and 2
This same Bar Chart can be plotted in terms of Site Energy or CO2 Production, in Pounds or in Pounds per Square Foot.

Almost everything you touch in HEED either gives you more data or moves to show more information.

The 'Energy Efficient Design' screen shows the number of hours the building runs Passively (green) and also gives the top ten Design Guidelines for this climate.

The 'Economics' screen will Calculate the Payback of Each Scheme.

These were the kinds of thing you can do using only the BASIC Design options...

These were the kinds of thing you can do using only the BASIC Design options...

but...

at any point you can switch to HEED's ADVANCED Design Data Input Options or HEED's Advanced EVALUATION Graphic Output options...
There are more a dozen different Advanced Design Data Input Options

and over three dozen different Advanced Evaluation Graphic Output options

3D Graphic Plots can show the comparison of any pair of components within a Scheme

_ or click on the menu and ‘Capture a Snapshot’ to compare with any component in any other Scheme

... here for Scheme 9 the Air Conditioner has been ‘Captured’ and is compared to the Outdoor Temperature

The Hourly Bar Chart shows which components need your design attention and which do not
The BEPS screen shows quantitative data for various measures of Building Energy Performance.

Fuel and Electric Charges are available for 5 California Utilities, or you can input your own utility rates.

This Comparison screen shows how Site Energy and CO2 Production compare for all nine schemes...

Click 'Next' and it will give Site Energy in kBTU/sq.ft. and CO2 Production in Lbs/sq.ft. for all nine schemes.

This is the data you need for the 2010 Challenge.

This example shows that compared to the Scheme 1 Basecase, Scheme 9 uses only 58.13% of the Site Energy and produced only 54.14% of the CO2... (so it is almost there)

PLEASE every few minutes click on Library...

...and make a copy of your current scheme in order to create a new scheme... and try out new design options that you think will improve its performance...

Each time check back on 'Energy Costs' under the 'Basic' icon to see how well you newest scheme is doing.
Part 2: How HEED’s advanced evaluation options can help you visualize graphically...

**Six Concepts of High Performance Buildings**

1. Good Passive Buildings have **Saddle Shaped Plots**
2. Bad Passive Buildings have lots of **Heat Mountains**
3. High Mass Walls cause **Time Lags** in Heat Gain/Loss
4. **Economizer Bowl** shows the Free Cooling with Outdoor Air
5. **Daylight Canyon** shows the Electric Lighting displaced by Good Design
6. **Powerful Tools** help you create High Performance Buildings
Finally it is your turn to create your own design:

1. Answer the questions on Initial Design, under Basic Design
2. When in doubt, click 'Next'
3. Regularly Click on Library and 'Copy' to create new designs
4. To see how your designs Perform, Click on Energy Costs
5. To Start with a new Project, click on Library, then Projects

For Other Climates...
To load in climate data for any station outside California, click on Help at the Climate screen or see the READ-USA.TXT file in the c:\heed..doc folder. It explains how HEED can directly read EnergyPlus Weather data for over 1000 stations around the world.
From the HEED web site, click on the EnergyPlus site, then select the city you wish. Click on the EPW format option, then Save This Page into the c:\heed..Solar..5..tmy folder.
Now go back to HEED's 'Initial Design' screen and click the down arrow on the Location line.

For 12-Day Plots...
To look at any individual hour of the year, you can "zoom in" on any 12-day segment you choose from the Climate Data screen.

Start with July 4
Validation:

- HEED calculates an Hourly Heat-Balance for all 8760 hours of the year (similar to the method used in DOE's new EnergyPlus).
- HEED has been validated against DOE-2 and others programs, using BESTEST (the ASHRAE Standard 140-2001). Results are posted on the website.
- HEED accommodates single zone buildings up to 4,600 s.f. per floor.
- HEED accommodates energy-efficient design strategies such as: natural ventilation, daylighting, external shading, smart HVAC controls, thermal mass, passive solar heating, night flushing, economizer cycles.
- HEED uses electric rate structures for the four major utilities, but you can input electric, gas, oil, or propane rates for your own utility.
- HEED has a huge help system to answer your questions (click the Help icon), Advice, Getting Started Tutorial, an on-line Demo, and a basic Users Manual.

Some of Our Other Energy Design Tools You Might Find Helpful...

HEED (and a copy of this Power Point) can be downloaded at no cost from:

www.aud.ucla.edu/heed

Our other Design Tools can be downloaded from

www.aud.ucla.edu/energy-design-tools

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