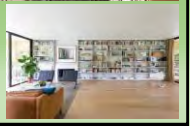
Modeling the Brillhart House

1





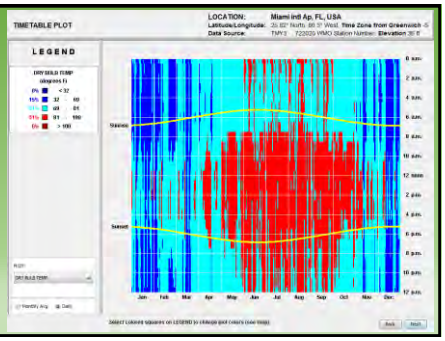


2

Located in a neighborhood like this

3

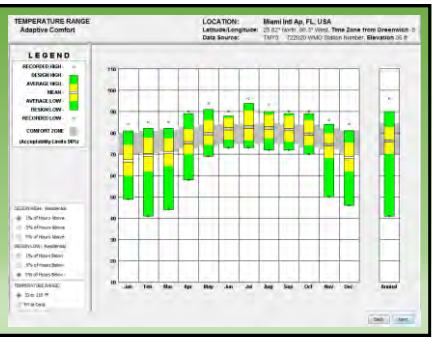
In a climate like this:



4

Where almost every day has hours in the adaptive comfort zone.

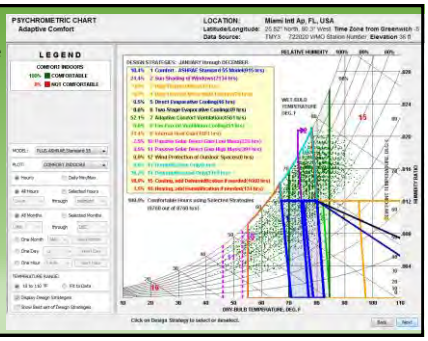
And outside that zone!



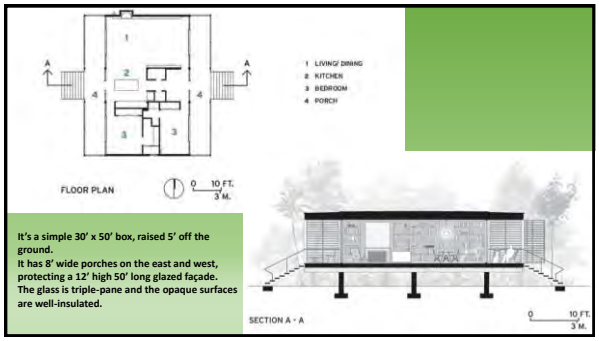
5

And the most effective passive strategies are:
1. Ventilation (52%)
2. Dehumidification (36%)
3. Shading (24%)

Plus, for heating:
4. Internal gain (11%)
5. Solar gain (5%)



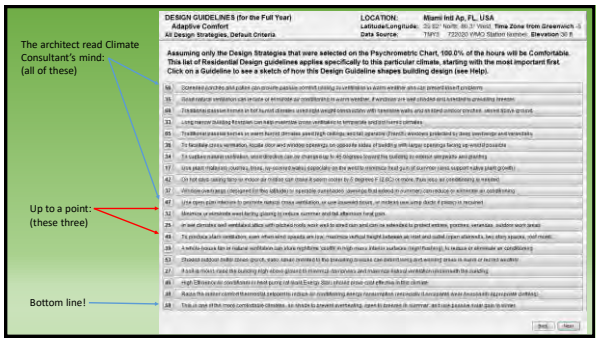
6



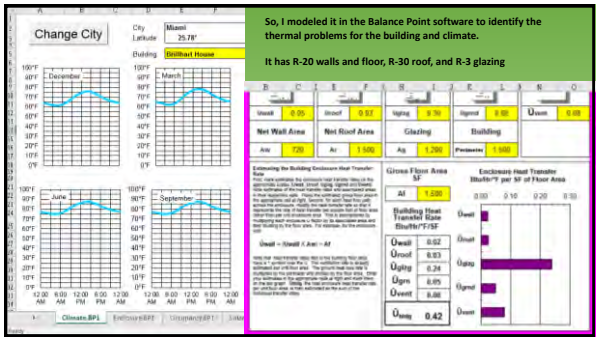
It's a simple 30' x 50' box, raised 5' off the ground.
It has 8' wide porches on the east and west, protecting a 12' high 50' long glazed façade.
The glass is triple-pane and the opaque surfaces are well-insulated.

7

8



9



So, I modeled it in the Balance Point software to identify the thermal problems for the building and climate.

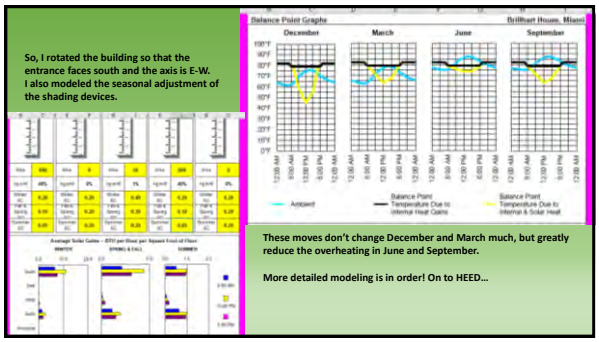
It has R-20 walls and floor, R-30 roof, and R-3 glazing

10

It's 1,500 sqft occupied by 2 people (750 sqft each) at rest (250 btuh).

As I suspected December and March are comfortable when the sun is pouring in in the morning, and June September are too warm and more so when the sun pours in.
This means solar gain is welcome winter and spring mornings and shading and ventilation are more important summer and fall. Can the design be changed to better accomplish these recommendations?

11



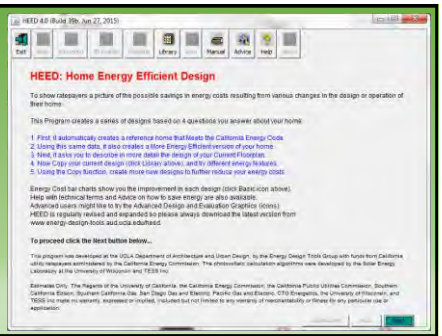
So, I rotated the building so that the entrance faces south and the axis is E-W.
I also modeled the seasonal adjustment of the shading devices.

These moves don't change December and March much, but greatly reduce the overheating in June and September.

More detailed modeling is in order! On to HEED…

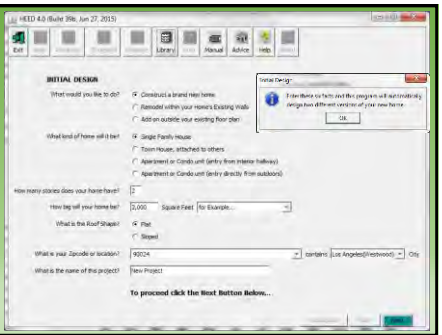
12

Looks to be an easy job to model with HEED!
The domestic brother of SBEED.



13

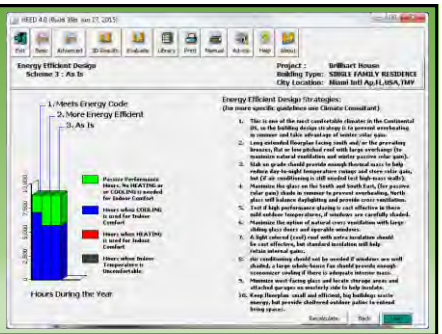
HEED only needs to know 6 things to get you started.



14

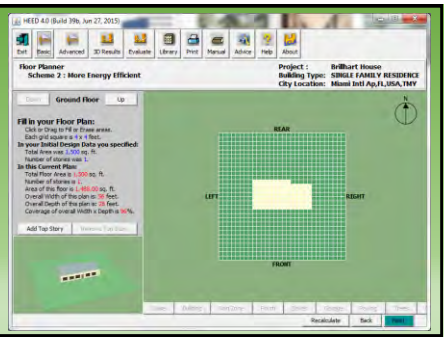
HEED sets up an energy code compliant model and an energy efficient model.

My job is to model the building as designed by altering Scheme 3, which I named "As Is".



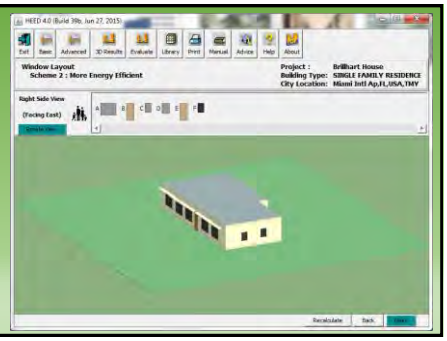
15

This is HEED's guess at the building shape and orientation based on the location (Miami) and plan area (1,500 sqft.) that I input.



16

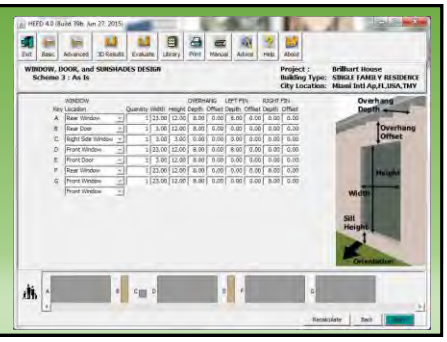
So, I need to change several things to correct the model.



17

Window size and external shading devices needed to be corrected.

Note that HEED assumes that the south façade is the front.

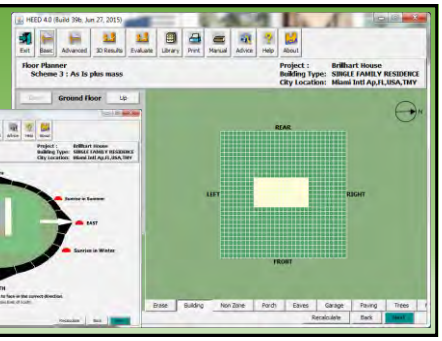


18

Then check for accuracy by placing them on the elevations.

19

Then change the orientation by spinning the front to the east.



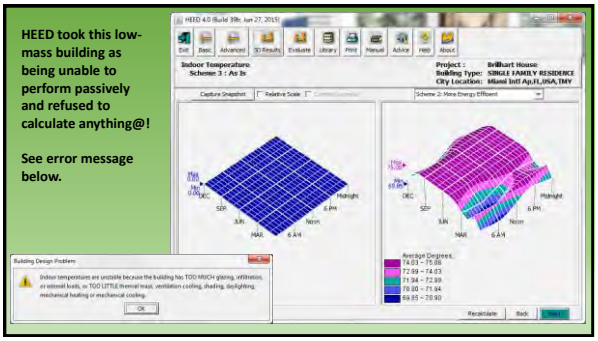
20

And to see how well it performs in the passive mode, I turned off the heating and air conditioning.

21

HEED took this low-mass building as being unable to perform passively and refused to calculate anything@!

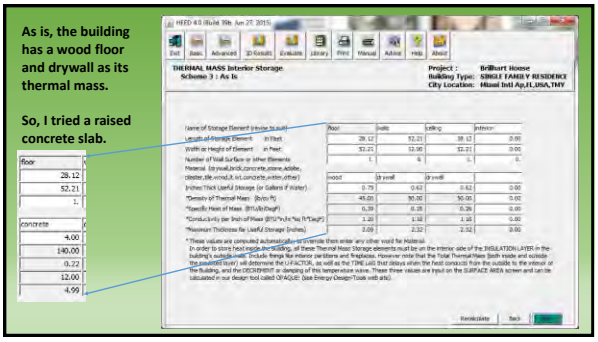
See error message below.



22

As is, the building has a wood floor and drywall as its thermal mass.

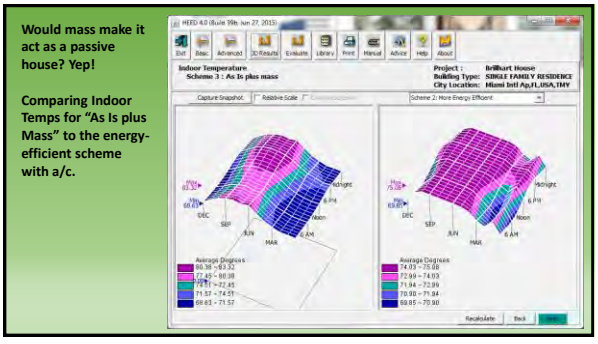
So, I tried a raised concrete slab.



23

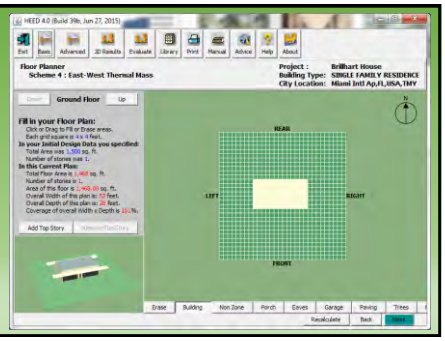
Would mass make it act as a passive house? Yep!

Comparing Indoor Temps for "As Is plus Mass" to the energy-efficient scheme with a/c.



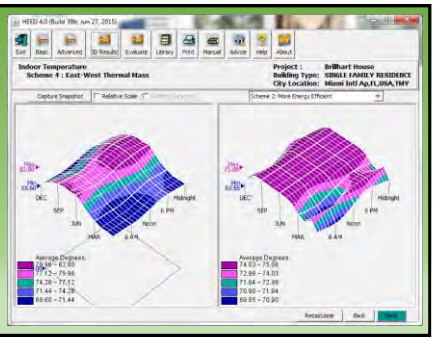
24

For the next scheme, I took *Climate Consultant's* advice and oriented the building on a true east-west axis.



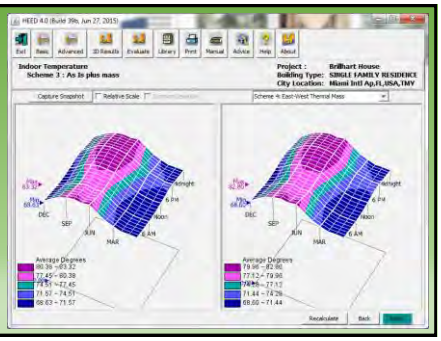
25

Compared its passive performance to the energy-efficient model with a/c.



26

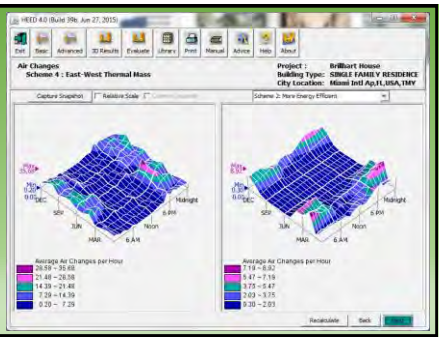
And compared passive performance of the "As Is" scheme w/mass to the east-west axis scheme with mass.



27

Looking at air changes per hour we can see the difference in passive cooling and a/c.

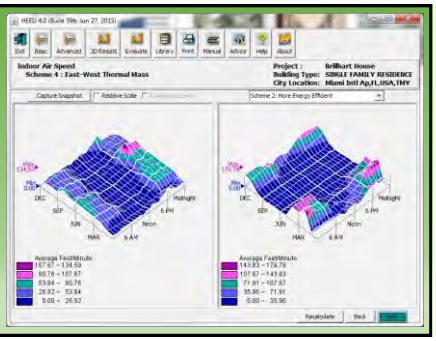
Note that the max air changes is 36 for passive (at night in summer) and 9 for a/c (in the winter only).



28

In spite of the difference in air changes per hour, the maximum air speed in the passive house is slower!

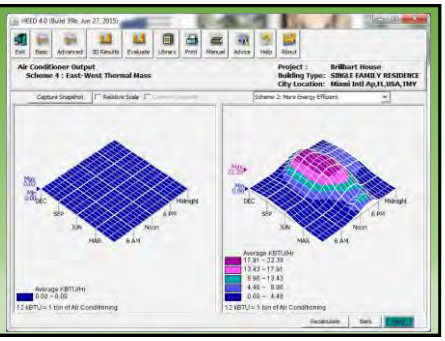
Note: night ventilation vs. winter/spring ventilation!?



29

Passive (no a/c) vs. a/c shows a dramatic difference.

The a/c even runs during the day in the winter!

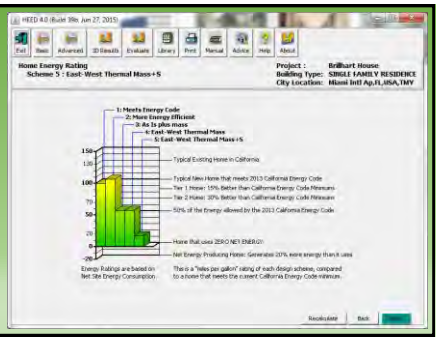


30

To see if the building could be net-zero I created a new scheme with Solar Hot Water heating (no-brainer in Florida) and a 2kw Photovoltaic array (I guessed it would be about the right size).

31

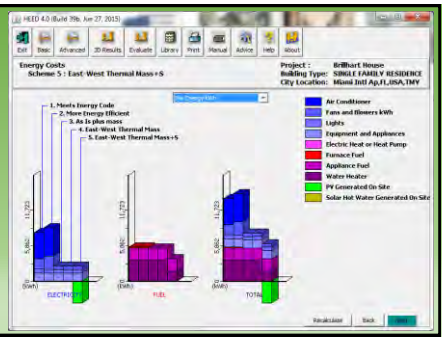
A pretty good guess!



32

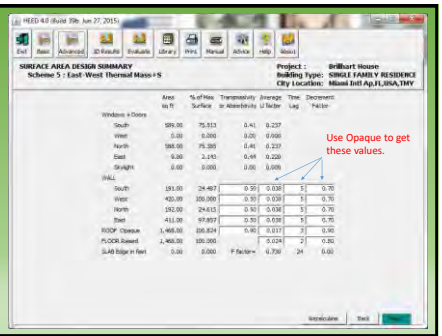
The building actually generates more electricity than it uses and only needs about ½ as much fuel for water heating.

The solar hot water panels could be doubled.



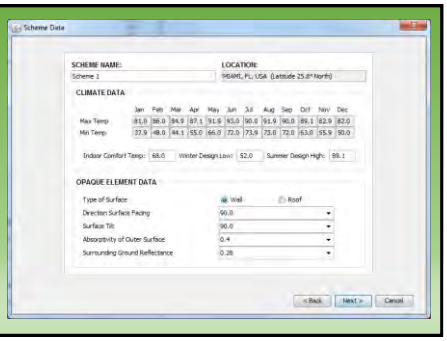
33

I double-checked to see that I had all the building surfaces modeled correctly.



34

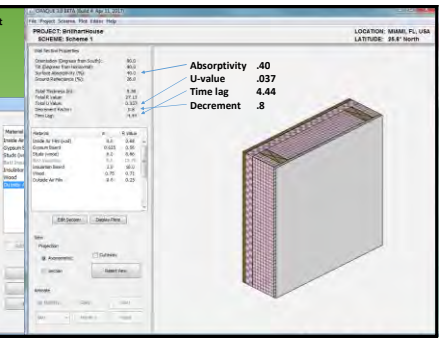
For example, I modeled the west wall in Opaque



35

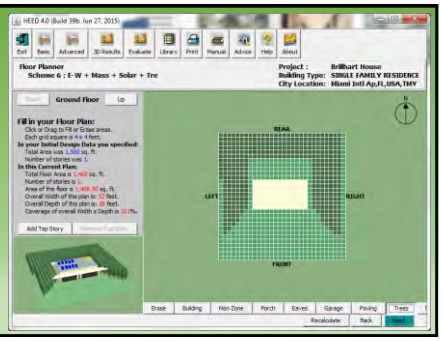
So, the defaults in HEED aren't accurate…but are close

Absorptivity	.5
U-value	.038
Time lag	5
Decrement	.7



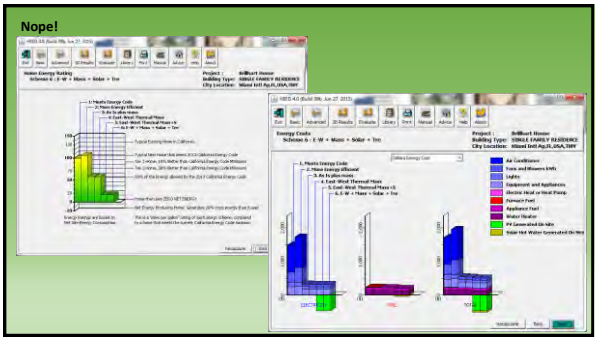
36

I also wondered if proper tree cover on the site would affect performance.



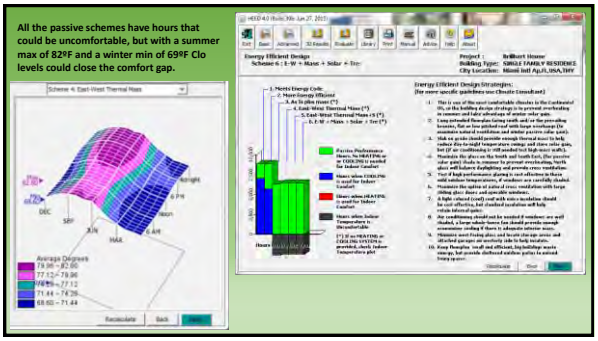
37

Nope!



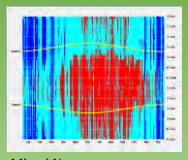
38

All the passive schemes have hours that could be uncomfortable, but with a summer max of 82ºF and a winter min of 69ºF Clo levels could close the comfort gap.

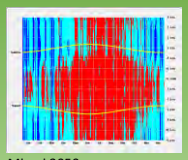


39

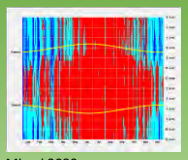
Will the design stand up to the climates of 2050 and 2080?



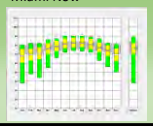
Miami Now

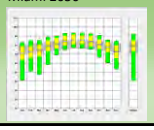


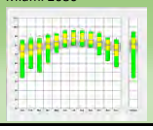
Miami 2050



Miami 2080



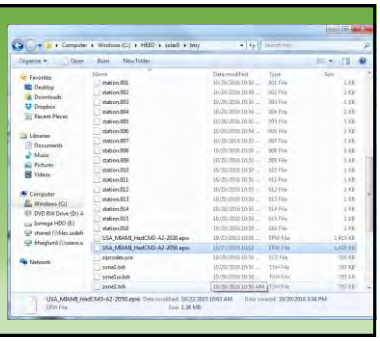




40

So, I put the future climate files for Miami into the proper place for HEED.

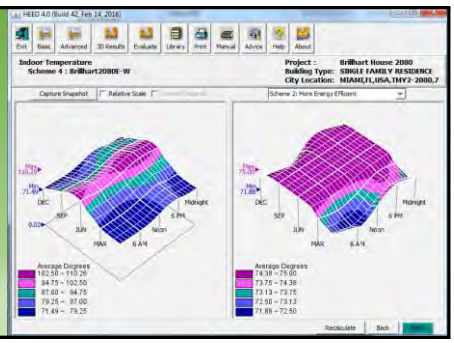
C:HEED/solar5/tmy



41

And I modeled the house with the same parameters that I used for the current weather file.

Yikes the indoor temperature peaks at 110º!!! In the passive mode.

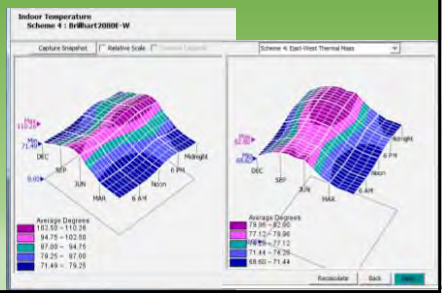


42

2080 vs. Today

So, the passive techniques that worked today just won't work in Miami in 2080!

Don't plan on retiring in Florida!



43