

HEED and SBEED HINTS, KNOWN BUGS, AND WORKED EXAMPLES

For Advanced users the following are some hints, known bugs, and worked examples for HEED and SBEED as of November 2019

How Performance Values Are Calculated: The final overall performance of each individual design scheme or combination of schemes is summarized in the Building Energy Performance Standards (BEPS) screen which is under the Evaluation icon.

1. To Understand How the Heating and Cooling Output Values are Calculated in BEPS:

On the BEPS screen the Air Conditioner or Heat Pump Cooling Electricity Consumed in kWh or the Air Conditioner Energy on the Energy Cost bar chart screen in kWh is equal to the Cooling HVAC System Output value in kBTU/SqFt multiplied by Floor Area in sq ft and divided by Seasonal Energy Efficiency Ratio (SEER).

If Fuel is used for heating, the Heating HVAC Output Normalized in kBTU/sf in BEPS multiplied by Floor Area in sq ft and divided by Annual Fuel Utilization Efficiency (AFUE) will be equal to the Furnace Fuel on the Energy Cost bar chart screen, or the Heating Fuel Consumed in Therms in BEPS when divided by 100 (remember a Therm is about 100 kBTU.)

If Electricity is used for heating, the Heating Energy Consumed value in BEPS will be equal to the value for Heating Output Normalized in BEPS or on the Energy Cost bar chart screen times the Floor Area in sq ft and divided by the Heating System Performance Factor (HSPF) (remember that the units of HSPF are BTU/Watt-hr). However if there is an electric heat pump involved this number might be a bit too high because HSPF actually decreases as outdoor air temperature falls below 47 degrees because condensation freezes on the outdoor coils, and each manufacturer uses a different method to control this problem.

2. To Understand the Heating Fuel and Air Conditioning Energy demand in BEPS:

The Heating Fuel Consumed is given in therms or gallons, one gallon of fuel is assumed to be about one therm, and one therm is 100,000 BTU. So this value multiplied by 100 kBTU per therm will equal the Heating Fuel Consumed.

The Air Conditioning Energy is given in kWh so multiplying by 3.412 BTU/Watt-hr will equal the Air Conditioning Energy kBTU.

3. To Understand the 3D Plot of Heating Output and Cooling Output:

If there are not too many data points (hours) on the 3D plot of the Heating Output or Cooling Output, you might be able to estimate each of their values and then add them up. Then multiply by 365 days and divide by 12 months and then divide by the floor area in square footage which should equal the Heating Output or Cooling Output value in BEPS (depending on how accurately you estimated each hourly value on the 3D plot).

4. To Check Individual HVAC Zone Schemes:

All the same rules apply to individual HVAC Zone schemes, but be sure to divide by the floor area of each HVAC zone, not of the full building.

WORK FLOW: Creating an All Electric Building:

If you want to create an All Electric scheme, it is easiest if you make the following changes in the following order:

1. Basic Heating-Cooling screen: eliminate gas furnace, probably changing to an electric heat pump.

Do not worry if Recalculate gives an error until the final recalculate.

2. Advanced Water Heater screen: change to one of the electric water heaters,

3. Basic Appliance and Plug Loads screen: subtract out gas to zero out the totals on the two gas columns, then recalculate.

4. Basic Utility Rates screen: eliminate fuel and maybe change to single flat rate electric (maybe also go to Advanced Electric Rates screen to omit the Meter Hookup Charge).

5. Recalculate, then go back to Basic Appliance and Plug Loads screen to check if all gas has been automatically changed to electricity, and check to be sure the gas columns add up to zero.

HINT: If there is an error, check the Evaluate Electricity Charges screen to see if the Daily Meter Hookup charge was added in or eliminated correctly, if not simply set it to zero in Advanced Electric Rates. If there is still an error, check the Advanced HVAC System screen to see if Infiltration is negative, and if you cannot correct it to a positive value it will usually be easier to Exit HEED and re-load the Project again.

COMBINATIONS: Creating a Building with 2 or More HVAC Zones or Separate Apartments

If for example you are creating a building with three separate HVAC Zones, the best process is to first load your best designed total building, then copy it into three new schemes, and make each into one of the HVAC Zones by filling in the Non-Zone areas on the Floor Planner screen. Be sure all the Building zones fit together to equal the

original building. You can check all the Floor Areas totals of each zone using the individual Evaluation Comparison Charts for Envelope Performance. Then you can re-assemble the original building in a new scheme by selecting Combine HVAC Zones in the Library screen. Now each zone can have its own different utility meters, HVAC Systems, schedules, internal loads, envelope size and shape, etc. You can also use HVAC Zones to assemble multiple free standing buildings or separate apartments.

HINT: When creating an HVAC Zoned building, the warnings that floor areas and window areas not matching are too sensitive, and can often be ignored.

WORKED EXAMPLE: How to Create a HVAC Zoned All-Electric Building

This example will create a 3 Story stack of separate HVAC zones, each a separate 1600 SqFt apartment. In this example the zones are rather similar, but in fact they can be very different in terms of floor area, number of windows, geometry, plug loads, construction, geometry, etc. There can be multiple zones on a single floor. Or each zone can be a separate free-standing building. Different composite buildings can be created from different combinations of zones. You can add PV and assign different numbers of collectors to each zone. In fact almost every input variable on every Basic and Advanced Design screen can be different for each zone. This worked example is for HEED, but the principles are the same in SBEED.

Hint: Because the floor planning module is 4 feet by 4 feet, try to make the floor area of each floor divisible by 16 square feet. But do not worry if it does not work out exactly at 16 square feet because the differences in performance are tiny.

On the Initial Design screen answer the six questions that HEED uses to automatically create the Scheme 1 Basecase Design (meets prior Energy Code), and then Scheme 2 the More Energy Efficient Design (that is also the best fit to the Current California Code).

These six questions can be answered:

- Construct a Brand New House
- Townhouse Attached to Others on each side
- 3 Stories
- 4800 Square Feet
- Flat Roof
- 90024 Zipcode (which is in California Climate Zone 9)
 - Let's call it, "3 All Electric HVAC Zoned Apts"

This will automatically create Scheme 1, and then Scheme 2 that is a better fit for the current California Code.

Hit Next to copy Scheme 2 to Scheme 3: and call it something like
"Copy 2: 3 All-Electric:

Assume these are all one-floor units in a three story town house building, so on the Floor Planner screen check that Neighbors are on the West and East side of each floor.

On Windows screen eliminate all windows and doors except on south and north. Try to make total number of windows a multiple of number of floors (i.e. 3, 6, or 9 windows). Also check that there are no tiny windows left on the East or West sides. Change Scheme 3 to make the building all electric:

Note: the order in which you make all these changes makes a difference. Change Basic Heating-Cooling screen probably to one of the heat pumps.

Do not worry if Recalculate gives an error until the final recalculate.

Change Advanced Water Heater to one of the electric options.

Check that Basic Appliances and Plug Loads are only electric. If not subtract to make the two gas columns equal zero.

Make Basic Utility Rates screen something like Electric single flat rate and Fuel Rates none.

On Advanced Electric Rates probably eliminate Meter Hookup charge.

Check Basic Appliances again that the gas columns equal zero and the equivalent electricity has been added in automatically (if total gas is negative remove it).

Copy Scheme 3 to 4: call it "Copy 3 Ground Floor"

On Floor Planner shade in the upper floors 2 and 3 as NonZone

On Window Design delete the windows that would have been on floors 2 and 3.
(make the original total number of windows divided by number of floors)
(decide how you want to handle the exterior doors: 1 or per building or 1 each floor).

On Roof screen, make No Heat Loss through Ceiling

Check that Appliances and Plug Loads screen does not have gas restored, also divide each of the three electric column values by about 3 (otherwise each floor will still have one huge kitchen with its. HEED tries to guess what the new smaller kitchen loads would be so may change this value).

Check Thermal Mass screen (divide number of walls, floors, and ceilings by 3: this is not done automatically).

Copy Scheme 4 to 5: "Copy 4 Second Floor" (this will copy all of the first floor changes)

On Floor Planner shade in floor 2 as Building and floor 1 as NonZone

On Window Design check that it has the correct number of windows for one floor

On Floor screen make Underfloor No Heat Loss and select Construction (wood?)

Check that Appliances and Plug Loads are correct (do not have gas restored, and also check each has been divided 3)

Check Thermal Mass screen is correct for only the second floor,

If you want just one Water Heater for the whole building, eliminate it here

but leave it on the first floor (scheme 4), else there will be one in each unit

HINT: If you want to have just one water heater for whole building you can place it in only the first floor unit and delete it from the upper floors. Otherwise with multiple water heaters the total building water heater load will be a bit high (the code water heater algorithm is pretty insensitive to size of units or number of users).

Copy Scheme 5 to 6: call it “Copy 5 Top Floor”

On Floor Planner screen shade in top floor as Building and floor 2 as NonZone

On Roof screen, add a roof

Check that the other screens were not changed

Scheme 7: In Library select Combine HVAC Zones and click on Schemes 4, 5, 6

Do not worry if the floor area or window area do not exactly match the original Building because we realize that this test is sometimes too sensitive

This will show you the composite total performance of the three zoned building.

WARNING: For HVAC Zone Combined Buildings, most of the Evaluation screens are available including BEPS, Electric Charges, Fuel Charges, and Performance Spreadsheets. However Shades and Shadows, HVAC Systems Sizing, and some of the options on Comparison Charts are only available for individual zones and not for the Combined building because of complex calculations and conflicts in measurement units when assembling individual zones.

ERROR RECOVERY: When combining multiple complex HVAC Zones, conflicts sometimes accumulate that might create negative values for things like Appliances and Plug Loads totals, or Infiltration Air Changes (which are impossible). You can try to go back and Recalculate an Old Project. However HEED and SBEED are not always able to automatically recover from all computation errors. If you get an error which you cannot easily correct, it will probably be quicker to hit Ctrl-Alt-Del and start a new Project again from scratch. Then you should later go back and erase the old flawed Project

Murray Milne, 10/18/2019