The Summit Bechtel Reserve

DD Level

Energy Modeling Report

10/26/2011

Revised: 2/14/13

Executive Summary

The purpose of this report is to provide the client and the design team with feedback on the energy performance of the current designs for the following buildings under design for The Summit Bechtel Reserve.

- Building 19 – The Trading Post
- Building 20 – The Visitors Center
- Building 21 – The Sustainability Tree House
- Building 40 – The Gateway Restroom + Dining Pavilion

Energy models were developed in DesignBuilder, which utilizes DOE's Energyplus version 6 simulation engine. Each building energy model was developed, along with estimates of domestic hot water usage and kitchen refrigeration equipment in the Gateway Dining facility. These heating and cooling loads represent all of the current hot water and chilled water loads that will be served by the central plant located in Gateway Dining. These loads were tabulated on an hourly basis, and input to an annual model of the central plant equipment and the geothermal ground heat exchanger, using Ground Loop Design 2010 by Gaia Geothermal. The resulting hourly energy consumption was distributed to each of the buildings, so that central plant heating and cooling energy could be accounted for at the building users.

Results are tabulated below, and are generally on track with project objectives. We have listed some major assumptions that the design team should be aware of, and suggested some opportunities to improve energy performance. These results should be compared to Trinity Work's target of 50% below code baseline, and The Integral Group's estimated targets from schematic design, which are listed below.

Building	CBECs Baseline EUI [kBTU/sq.ft./yr]	Schematic Level Building Area [sq.ft.]	Target EUI [kBTU/sq.ft./yr]	Schematic Level Predicted Consumption [kBTU/yr]	DD Level Building Area [Sq.Ft.]	DD Level Estimated EUI [kBTU/sq.ft./yr]	DD Level Estimated Energy Consumption [kBTU/yr]
19 -Trading Post	95	22,250	42.7	950,075	20,850	39.6	825,660
20 - Visitors Center	98.3	22,940	29.5	676,730	11,650	29.7	346,005
21 - Tree House	98.3	6,845	24.6	168,387	3,226	14.93	48,164
40 - Gateway Dining*	431.6	4,860	172.6	838,836	8,576	102.3	877,325

* Central plan is included in the building, and central plant energy has been apportioned to building users.

Building 21 – The Tree House

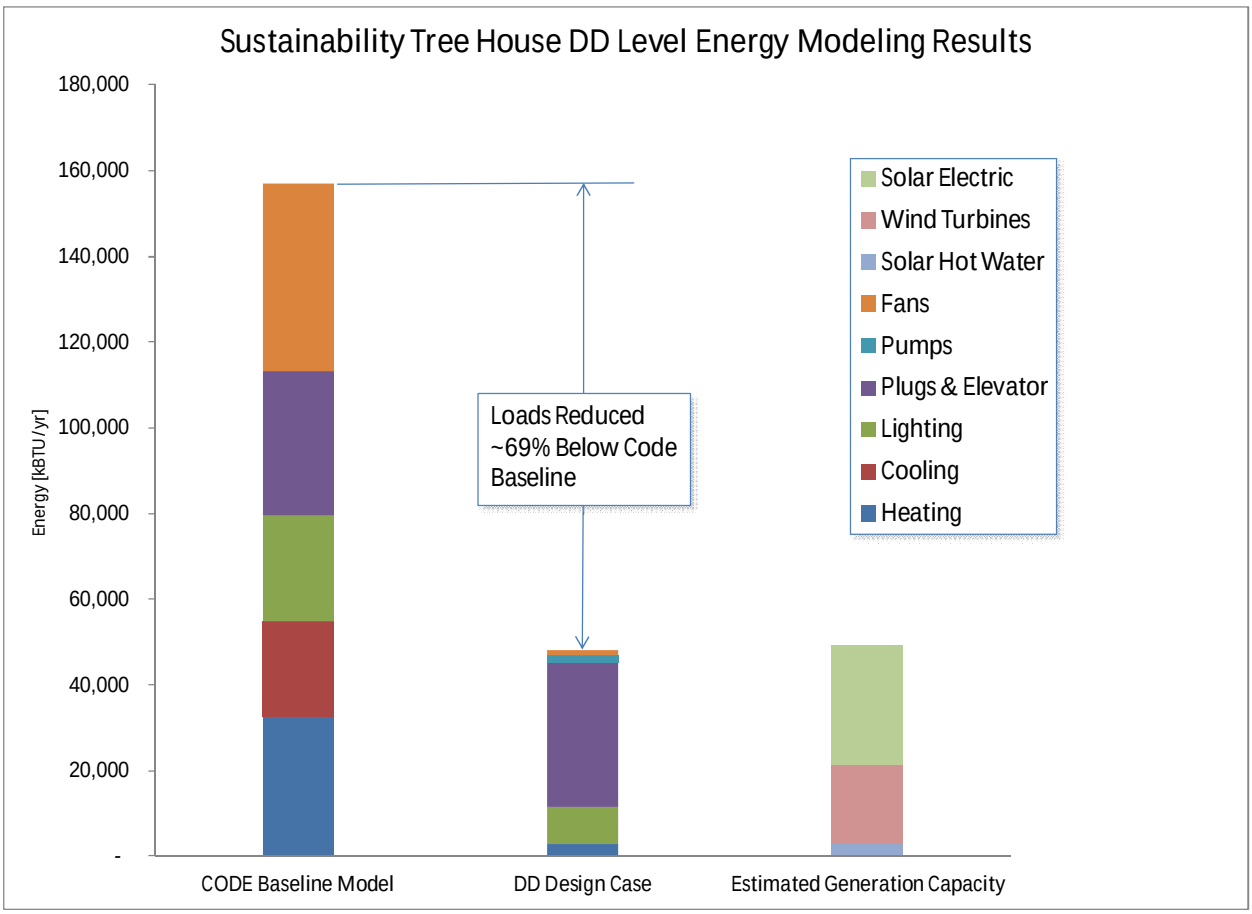
Building 21 - Sustainability Treehouse

Results Summary	Building Area	EUI [kBTU/sq.ft./yr]	Estimated Annual Energy Consumption [kBTU/yr]
CBECs Performance	3,226	98.3	317,116
Code Baseline Performance	3,226	49	158,074
Schematic Level Analysis (Target Performance)	6,845	24.6	168,387
DD Level Energy Modeling	3,226	14.9	48,164
Estimated PV Off-Set			27,774
Estimated Wind Turbine Off-Set*			20,472
Net Total Energy Required (Estimated)			(82)

*Note that this is an estimate of wind power generation from the Urban Green Turbines based on regional weather data. Actual performance will be influenced greatly by local wind patterns, which have not been measured.

The table above shows a summary of the energy modeling results for the Sustainability Tree House. The DD level model estimates a building EUI of 14.9 kBTU/sq.ft./year, which is lower than the original target's set by The Integral Group for this building during schematic design. The results represent a 69% reduction in building energy below an ASHRAE 90.1 code baseline, prior to accounting for renewable energy sources associated with the building. The graph below shows the predicted energy breakdown and savings vs. the code baseline.

Estimates for Solar electric power production are based on a 5.8 kW solar array mounted on the top of the Tree House structure. Wind energy is assumed to be produced by three Wind Spire turbines mounted on the Tree House structure.



The objective for this building is to produce as much energy as it consumes on site at the building. The energy balance above shows that according to current assumptions and estimates the building will produce only slightly more than it consumes. Therefore the design team needs to be very careful to maintain low loads in the building. Specific areas of concern and opportunities are discussed below.

Major Assumptions:

- The current energy model carries 1.0 W/sq.ft. in the exhibit areas for exhibit loads.
- The current energy model carries 0.25 W/sq.ft. in the exhibit areas for exhibit lighting.
- The heating energy required in the building is very sensitive to infiltration. Even when the building is un-occupied in the winter, freeze protection can require significant energy due to air leakage into the space. We therefore recommend that special attention be given to doors and window openings to make sure they are specified with tight connections. The design team may want to specify tightness criteria for this building that would need to be demonstrated with blower door testing (on the exhibit levels).
- Occupancy: It was assumed that this building will operate 12 months out of the year, and be open daily. Occupancy was assumed to be light (~10% of peak) during the winter months except around major holidays.
- Additional modeling assumptions are documented in the appendix.

Opportunities:

- The most important factor to reducing the heating load for this building is making it tight. We suggest therefore that building performance testing be specified. An aggressive target for building leakage would be 0.60 air changes at 50 pascals.
- Triple glazing would reduce heating loads.

Appendix: Energy Modeling Assumptions

Treehouse

Area = 3,226 Sq. feet

Energy Model Input Data		
Building Element	**App. G Baseline**	**Proposed Design**
Envelope		
External Wall Construction	U=0.064 : Steel-framed from Table 5.5-5, Zone 5A	U=0.038 (R25): Wood siding, 4" Mineral wool, plywood, 2" mineral wool (bridged), drywall.
External Roof Construction	U=0.048 :Table 5.5-5 Zone 5A	U=0.026 (R38)
External Floor Construction	U=0.033: Table 5.5-5 Zone 5A	U=0.026 (R38)
Slab-On-Grade Construction	F=0.730	F=0.730
Fenestration Type(s)	ASHRAE Baseline	Viracon VE1-2M for Vertical, and VUE 1-50 for skylight
Fenestration Assembly U-factor	0.45 BTU/sq.ft. hr F (Storefront)	Glass U=0.28, Thermally broken aluminum frame
Fenestration Assembly SHGC	All 0.40	0.39 (0.25 for skylight)
Fenestration Visual Light Transmittance	70%	70%
Shading Devices	None	Building overhangs & Simulated Tree shade.
Natural Ventilation	Not Modeled	YES
Building Element	**App. G Baseline**	**Proposed Design**
Electrical Systems & Power Loads		
Ambient Lighting Power Density, and Lighting Design Description	1.3 W/ft2 (Table 9.5.1)	0.5 W/ft2
Task/exhibit Lighting	None	0.25 W/ft2
Lighting Occupant Sensor Controls	None	Yes
Daylighting Controls	None	Daylight switching
Exterior Lighting Power	None	None
Office Equipment	1 W/sq.ft. Exhibit	1 W/sq.ft. Exhibit
Elevators or Escalators	Modeled Seperately, Typical Hydraulic	Modeled as Kone Ecospace
Refrigeration Equipment	None	None

Other Process Loads	None	None

Building Element	Appendix G	Proposed Design
Mechanical & Plumbing Systems		
HVAC System Type(s):	System 4 -PSZ-HP	Radiant Heat / Natural / Fan assisted ventilation in Treehosue & Fan coil in mechanical room. Fed from Geo Central Plant
Design Supply Air Temperature Differential	20 F	20 F
Fan Control	Continuous, Constant Volume	CO2 controlled vent air.
Fan Power	Pressure Rise = 4.180. total efficiency = 70%	Fan Coil 0.5" Static efficiency = 70%
Economizer Control	yes - upper limit 70F, lower limit 45F	Natural Ventilation via windows.
Demand Control Ventilation	None	Yes
Unitary Equipment Cooling Efficiency	EER = 10.4 per Table 6.8.1.B therefore CoP = 3.04	N/A
Unitary Equipment Heating Efficiency	3.2 CoP per Table 6.8.1 B	N/A
Chiller Type, Capacity, Efficiency	N/A	EER: 22.7
Cooling Tower	N/A	Geothermal loop
Boiler Efficiency	N/A	COP 8.7
Chiller Water Loop/Pump Param.	N/A	Yes
Condenser Loop/Pump Param	N/A	Yes