

BEYOND

SMART CITIES

ENERGY SIMULATION OF HIGH PERFORMANCE GREEN BUILDINGS

FOR ENERGY AND GREEN BUILDING SPECIALISTS

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP

ENERGY SPECIALIST CURRICULUM

ENERGY MODELING CURRICULUM

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ENHANCING INTEGRATION OF ELECTRIC AND HVAC DESIGN

FOR ENERGY AND GREEN BUILDING PROFESSIONALS

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LEARNING OBJECTIVES

Visual DOE HVAC Integration

ENERGY Modeling

Geometric Modeling

ENERGY MODELING CURRICULUM

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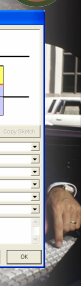
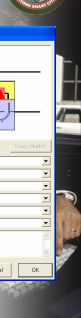
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VISUAL DOE HVAC INTEGRATION

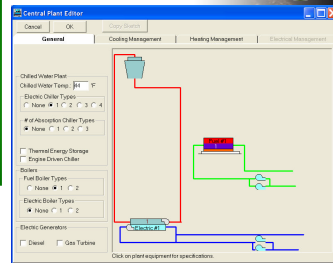
Assigning HVAC System(BASECASE) 1.Select HVAC System Type: Table G.3.1.1A
Major Types: Chillers 1.Get EER from Table 6.8.1E
EER =3.413X COP

TABLE 6.8.1E Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements

Equipment Type	Size Category (Tonnage)	Subcategory or Rating Conditions	Minimum Efficiency	Test Procedure ^a
PTAC (Cooling Mode) New Construction	All Capacities	SPF db Outdoor air	12.5 – (0.213 × Cap100W) EER	ARI 310/380
PTAC (Cooling Mode) Replacement ^b	All Capacities	SPF db Outdoor air	10.9 – (0.213 × Cap100W) EER	
PTHP (Cooling Mode) New Construction	All Capacities	SPF db Outdoor air	12.5 – (0.213 × Cap100W) EER	
PTHP (Cooling Mode) Replacement ^b	All Capacities	SPF db Outdoor air	10.9 – (0.213 × Cap100W) EER	
PTHP (Heating Mode) New Construction	All Capacities	SPF db Outdoor air	3.2 – (0.026 × Cap100W) COP	
PTHP (Heating Mode) Replacement ^b	All Capacities	SPF db Outdoor air	3.0 – (0.026 × Cap100W) COP	
RPVAC (Cooling Mode)	All Capacities	SPF db Outdoor air	12.5 – (0.213 × Cap100W) EER	

VISUAL DOE HVAC INTEGRATION

Assigning HVAC System(BASE CASE)
Major Types: Chillers
1.Central Plant Editor
2.Select “Chillers”
3.Change the value at full load efficiency at reference conditions (the value is 1/EER)



VISUAL DOE HVAC INTEGRATION

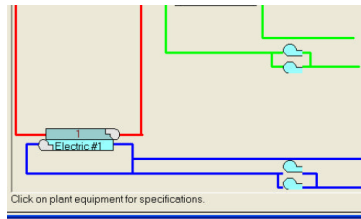
Assigning HVAC System(BASECASE) Major Types: Chillers If the size is more than 800 tons and / or based on SQFT(refer Table G3.1.3.7) ADD more chillers

TABLE G3.1.3.7 Type and Number of Chillers

Building-Conditioned Floor Area	Number and Type of Chiller(s)
≤ 120,000 ft ²	1 screw chiller
> 120,000 ft ² , < 240,000 ft ²	2 screw chillers sized equally
≥ 240,000 ft ²	2 centrifugal chillers minimum with chillers added so that no chiller is larger than 800 tons, all sized equally

VISUAL DOE HVAC INTEGRATION

Assigning HVAC System(BASE CASE) Major Types:
Chillers Click the "Pumps" and remove the
secondary pumps(VSD,etc)



re 128. VisualDOE Tutorial - Central Plant Editor

VISUAL DOE HVAC INTEGRATION

DONTS!!!!!! Don't change
anything ELSE(flow ,pressure
drop, etc) NOTHING

VISUAL DOE HVAC INTEGRATION

Energy Simulation: Unmet HOURS....
Remember :No more than 300 Hrs of Unmet
hours(ASHRAE 90.1)
1.Run the simulation
2.Check the diagnostics
3.And ,note down the ZONES & CFM OR(CFM/
SQFT) That have more unmet hours....
4.Reasons may be:
1.Occupancy(more!!!/) ...then check and rectify
2.Increase "incrementally" the CFM/SQFT until
the unmet hours are resolved

ENERGY MODELING

DATA INPUT

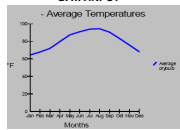
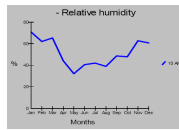
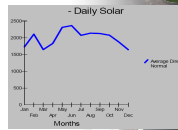


Table 4: Values of building envelope for base case and proposed case.

	Envelope/Detail (ft)	
	Base Case	Proposed
Roof Construction	6.00	6.00
Wall Construction	1.00	6.00
Floor Construction	6.00	6.00

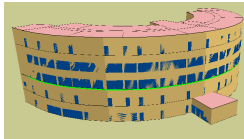
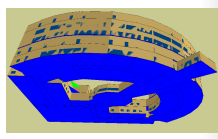
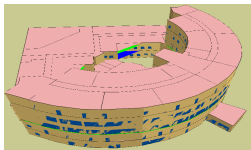
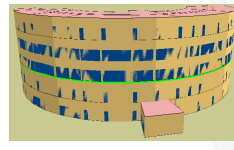
Table 5: U value, SHGC, and T_{sp} of Glazing in base case and proposed case.

	U Value		SHGC		T _{sp}	
	Base Case	Proposed	Base Case	Proposed	Base Case	Proposed
Glazing	0.20	0.20	0.25	0.20	0.5	0.5
North Glazing	0.20	0.20	0.20	0.20	0.5	0.5

Table 6: Design Temperature in summer

Room type	Data or Description
Terminal	74 °F
Reception	74 °F
Restrooms	Flushing, no controls
Office	77 °F
shops	77 °F

ENERGY MODELING - GEOMETRIC MODELING

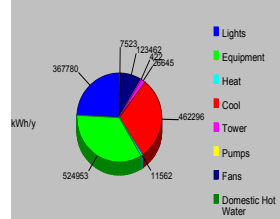


ENERGY MODELING - GEOMETRIC MODELING

RESULTS

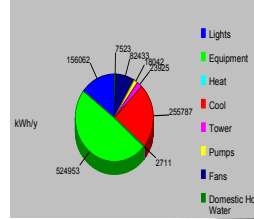
BASE CASE

Electric End Uses



PROPOSED CASE

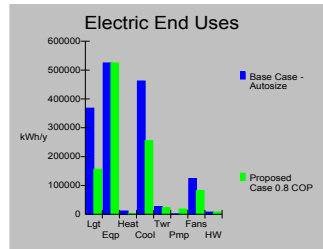
Electric End Uses



ENERGY MODELING - GEOMETRIC MODELING



OBSERVATIONS



	Total Energy Consumption
Base Case	1524643 Kwh
Proposed	1071436 Kwh

% Saving- 29.7 (Without Solar Energy)

% Saving- 55.5 (With Solar Energy)

ENERGY MODELING - OBSERVATIONS



Electrical Use Summary

Electrical End-use Totals (kWh)

Alternative	Lights	Equip.	Heating	Cooling	Tower	Pumps	Fans	Hot Water	Total
Base Case -	367,780	524,953	11,562	462,296	26,845	422	123,462	7,523	1,524,843
Proposed Case -	156,062	524,953	2,711	255,767	23,925	18,042	82,433	7,523	1,071,436

% Saving- 29.7 (Without Solar Energy)

% Saving- 55.5 (With Solar Energy)

Some of the suggested Energy Conservation Measures are improved chiller efficiency, using appropriate LPD values, high insulated envelope, high performance glazing, BMS with the use of sensors and dimmers, external shading and variable speed drives. These energy conservation measures were simulated with the help of DOE software.