

Development of a GUI for EnergyPlus

Philip Haves

Lawrence Berkeley National Laboratory

phaves@lbl.gov

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EnergyPlus GUI Project

Goals

- Develop a free Graphical User Interface that enables EnergyPlus to be used more easily and effectively by building designers and other professionals
- Distribute as an “Open Platform” with well documented API’s to facilitate collaborative development and derivative works

Funded by: CEC, DOE and Infosys Technologies

Team: LBNL, Infosys, Digital Alchemy, Arup, GARD, Taylor Eng.

Project Overview

- Preparation Phase:
 - Definition of user requirements – workshops, office visits
 - Identification of the overall software architecture
- Software Development Phase:
 - Detailed functional specification
 - Coding
 - Internal and 3rd party testing
- Dissemination, Training, User Support and Code Maintenance Phase:
 - Identify business models for training and user support

GUI Overview

- General:
 - Manage design alternatives
 - Link to compliance toolkit components
 - Zone groups
 - Existing buildings
- Envelope:
 - Import from 3-D CAD / BIM - IFC
 - OpenStudio – based on Google SketchUp
 - Sketch floor-plate and extrude
- HVAC:
 - Drag and drop component level editor
 - Templates!

Site

Project: My Project (1) Design Alternative: Design Alternative 'A'

Design Alternatives Site Buildings Systems Simulate Templates Libraries

Select Copy Find Import Export Manage Reports

New Delete Replace

Editing Import/Export Design Alternatives

Design Alternative 'A'

- Site
 - Buildings
 - Site Power Demand
 - Site Power Generation
 - Site Context
 - Solar Obstructions
 - Solar Obstruction 1
 - Solar Obstruction 2
 - Solar Obstruction 3
 - Solar Obstruction 4
 - Solar Obstruction 5
 - Solar Obstruction 6
 - Solar Obstruction 7
 - Solar Obstruction 8
 - Solar Obstruction 9

Design Data Model

3D View of Data Model

Plan View of Data Model

Select Design Alternative

Name	Systems	Building Standard
Design Alternative 'A'	Air System 1, Water Sys 2	ASHRAE 90.1
Design Alternative 'B'	Air System 1, Water Sys 2	CA Title 24 (2009)
Design Alternative 'C'	Air System 1, Water Sys 2	ICC IECC (2009)
Design Alternative 'D'	Air System 1, Water Sys 2	CA Title 24 (2006)

Design Alt last modified (in previous sessions) is selected by default.

Loc: [X] 960.0 [Y] 0.0 [Z] 0.0 Rotation: 0.0° Grid Spacing: [X] 25.0 [Y] 25.0

Select Building Standard Mins/Reqd's California Title 24 - 2006

- Building
 - Envelope
 - Occupancy
 - Schedules
- HVAC Systems
 - Zone Equipment
 - Air Systems
 - Water Systems

Select Location Berkeley, California, USA

Berkeley, CA, USA – CDD65: 135 – HDD65: 35 – Summer 1% DB/MCWB: 95/78

UI Screen 4 Screen Name: Design Alts - Define*1 Status Info 2*

Import from BIM

Project: My Project (1) Design Alternative: My Design 'A'

Design Alternatives Site Buildings Systems Simulate Templates Libraries

Copy Selection Delete Selection Save as new Alternative Import Design Data Export Design Data

Define Design Alternative Import/Export Design Data

Locate File to Import

Browse My_IFC_Project_A.ifc Import Data

Select Data Types to be imported: Select All Deselect All

- Buildings
 - Building Floors
 - Walls
 - Doors
 - Windows
 - Slabs
 - Material Assemblies
- Zones
 - Zone Equipment
 - Schedules
 - Air Systems
 - Schedules
 - Water Systems
 - Schedules
 - Controls

3D View of Building Geometry

Data Validation

Data Type	Found in File	Validated	Invalid
Buildings	1	1	0
Building Floors	7	7	0
Zones	760	754	6
Walls	3114	3069	45
Doors	2047	2047	0
Windows	1736	1736	0
Slabs	29	28	1
Schedules	23	23	0
Zone Equipment	267	265	2
Air Systems	21	21	0
Water Systems	0	0	0
Controls	56	56	0

Summary Data

Avg. Area Per Floor:	580,000 sq ft	Total Win/Wall Ratio – North:	23%
Total Floor Area:	3,930,000 sq ft	Total Win/Wall Ratio – South:	20%
Total Win/Wall Ratio:	22%	Total Win/Wall Ratio – East:	22%
		Total Win/Wall Ratio – West:	22%

UI Screen 8 *Screen Name: Design Alts - Imp Data 4 [4] Status Info 2 *

Internal Creation of Geometry

Project: My Project (1) Design Alternative: My Design 'A'

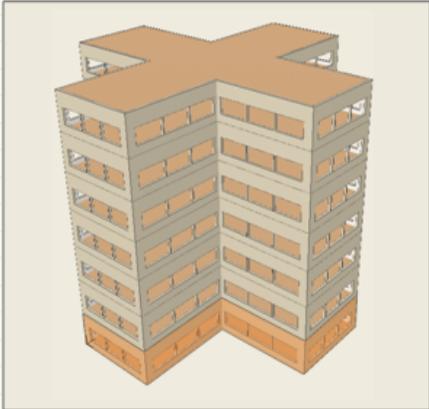
Design Alternatives Site Buildings Systems Simulate Templates Libraries

Copy Selection Delete Selection Import Design Data Export Design Data Building Floors/Zones Building Envelope Naming Patterns Zone Grouping Zone Templates Zone Loads Zone Conditions Zone Envelope

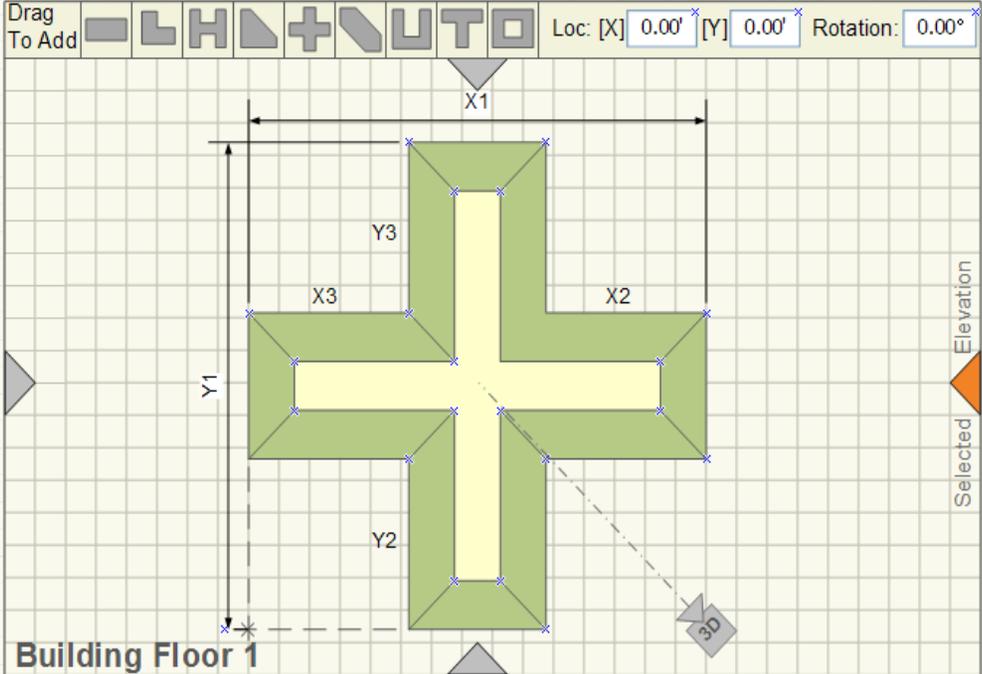
Edit Selection Import/Export Design Data Building/Floor/Zone Definition Zone Assignments/Parameters

My Design A

- Site
- My Building 01
 - Building Floor 1
 - Zone 1-1
 - Zone 1-2
 - Building Floor 2
 - Zone 2-1
 - Zone 2-2
 - Building Floor 3
 - Zone 3-1
 - Zone 3-2
 - Building Floor 4
 - Zone 4-1
 - Zone 4-2
 - Building Floor 5



Drag To Add [Icons] Loc: [X] 0.00' [Y] 0.00' Rotation: 0.00°



Building Floor 1

Show Floor Below Grid Spacing: [X] 10.0' [Y] 10.0'

Building Floor 1 - East Elevation Win/Wall Ratio: 35.0%

Floor Above Ceiling Floor

Window Orientation Window/Wall Ratio Uniform or Discrete Window Top Elevation Typical Window Ht. Typical Window Wd.

Window Orientation	Window/Wall Ratio	Uniform or Discrete	Window Top Elevation	Typical Window Ht.	Typical Window Wd.
North	35%	Uniform	7' - 6"	5' - 0"	8' - 0"

UI Screen 23 Screen Name: Buildings - Floors [?] Status Info 2

Zones – Internal Loads

Project: My Project (1) Design Alternative: My Design 'A'
Templates Libraries

Design Alternatives Site Buildings Systems Simulate

Copy Selection Delete Selection Import Design Data Export Design Data

Edit Selection Import/Export Design Data

Building Floors/Zones Building Envelope Naming Patterns

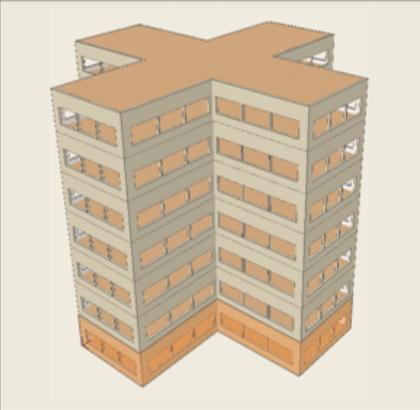
Building/Floor/Zone Definition

Zone Grouping Zone Templates Zone Loads Zone Conditions Zone Envelope

Zone Assignments/Parameters

My Design A

- My Site
- My Building 01
 - Building Floor 1
 - Zone 1-1--Perimeter
 - Zone 1-2--Core
 - Building Floor 2
 - Zone 2-1--Perimeter
 - Zone 2-2--Core
 - Building Floor 3
 - Zone 3-1--Perimeter
 - Zone 3-2--Core
 - Building Floor 4
 - Zone 4-1--Perimeter
 - Zone 4-2--Core
 - Building Floor 5



Edit Internal & Airflow Loads – Internal Loads Template 12

Peak Occupancy:

Sensible Load:

Latent Load:

Schedule:

Peak Electrical Load:

% Sensible:

% Load to Space:

Schedule:

Peak Load to Group:

& Load to Space:

Schedule:

Daylighting Control:

Infiltration:

Schedule:

DHW Peak Use:

DHW Schedule:

	Sensor 1	Units	Sensor 1	Units	Sensor 1	Units
Sensor location						
Distance from nearest external wall						
Sensor height						
%Zone Affected						
Angle between occupant View and window surface						
Maximum glare index						

New Group		Custom Edit Template Values	Custom Edit Template Values	Custom Edit Template Values	
Zone Group List	Floor	Orientation	Zone Template	Internal Loads Template	Conditions Template
+ Zone Group - Perimeter			Zone Template 15A	Loads Template 12	Conditions Tempt. 5
- Zone 1-1--Perimeter	1	North			
- Zone 2-1--Perimeter	2	South	Custom Values		
- Zone 3-1--Perimeter	3	East		Custom Values	
- Zone 4-1--Perimeter	4	West			
+ Zone Group - Core			Zone Template 14B	Loads Template 11	Conditions Tempt 4
- Zone 1-2--Core	1	North			
- Zone 2-2--Core	2	South			Custom Values
- Zone 3-2--Core	3	East			
- Zone 4-2--Core	4	West			

UI Screen 32 Screen Name: Zones - Edit Internal Loads [13-14] Status Info 2

HVAC Air Systems

Project: My Project (1) Design Alternative: My Design 'A'

Design Alternatives Site Buildings Systems Simulate Templates Libraries

Select Copy Find New Delete Replace Import Export Group Edit Equipment Assign Surfaces Group Manage Modify Validate Group Manage Modify Verify Group Manage Modify Verify

Editing Import/Export Zone HVAC Groups Air Systems Water Systems Refrigeration Systems

My Building 01

- Building Floors
- Zones
- Zone Groups
- HVAC Systems
- Zone HVAC Groups
- Air Systems
 - Air System A**
 - Zone HVAC Grp - Perimeter
 - Zone HVAC Grp - Core Lowe
 - Air System B
 - Zone HVAC Grp - Perimeter
 - Zone HVAC Grp - Core Midd
 - Air System C
 - Zone HVAC Grp - Perimeter
 - Zone HVAC Grp - Core Uppe

HVAC Diagramming

System HVAC Equipment

Fan	Cooling Col	Heat Col
Damper	Valve	Louver
Boiler	Cooling Tower	Heat Pump
Fan	Cooling Col	Heating Col
Damper	Valve	Louver
Boiler	Cooling Tower	Heat Pump
Fan	Cooling Col	Heating Col
Damper	Valve	Louver

Controls & Sensors

Flow Elements

Zone HVAC Equipment

Zones & Plenums

Connections

ID	Type	Connected?
01	Air In	<input checked="" type="checkbox"/>
02	Air Out	<input checked="" type="checkbox"/>
03	Water in	<input checked="" type="checkbox"/>
04	Water out	<input checked="" type="checkbox"/>
05	Control	<input type="checkbox"/>
06	Sensor	<input checked="" type="checkbox"/>

Air System A

Drag-n-drop new shapes onto existing flows

The diagram illustrates the air flow for Air System A, divided into Supply Side and Demand Side. On the supply side, air enters through L-1, passes through damper D-1, fan F-1, and coil SF-1. It then splits into two paths: one through coil HC-1 and another through coil CC-1. On the demand side, air is distributed to three zones: Perimeter Lower, Core Lower, and Group 'n'. Each zone has its own supply and return plenums. A shared supply plenum and shared return plenum are also shown. Controls (CNTL) and sensors are placed at various points in the system. A return air loop (RRLF-1) is shown at the bottom, passing through damper D-3 and fan F-1 back to the supply side.

Selected Component Information

Object Type: <library value>

Manufacturer: <filtered library value>

Model: <filtered library value>

Property 1: <value for selection>

Property 2: <value for selection>

Property 3: <value for selection>

Property 4: <value for selection>

Property 5: <value for selection>

Property 6: <value for selection>

Refrigeration Systems

Project: My Project (1) Design Alternative: My Design 'A'

Design Alternatives Site Buildings Systems Simulate Templates Libraries

Copy Selection Delete Selection Import Design Data Export Design Data Equipment Groups Edit Equipment Assign Surfaces Demand Group Manage Modify Validate Demand Group Manage Modify Validate Demand Group Manage Modify Validate

Edit Selection Import/Export Design Data Zone HVAC Systems Air Systems Water Systems Refrigeration Systems

- × Building Floor 3
- × Building Floor 4
- × Building Floor 5
- × Building Floor 6
- × Zone Groups
- × HVAC Systems
- × Zone HVAC Systems
- × Air Systems
- × Water Systems
- × Refrigeration Systems
- × Refrigeration System F
 - × Zone 1-1--Perimeter
 - × Zone 1-2--Core
- × Compressor Rack System
 - × Zone 1-1--Perimeter

Manage Refrigeration System

Click on Manage to return to management overview

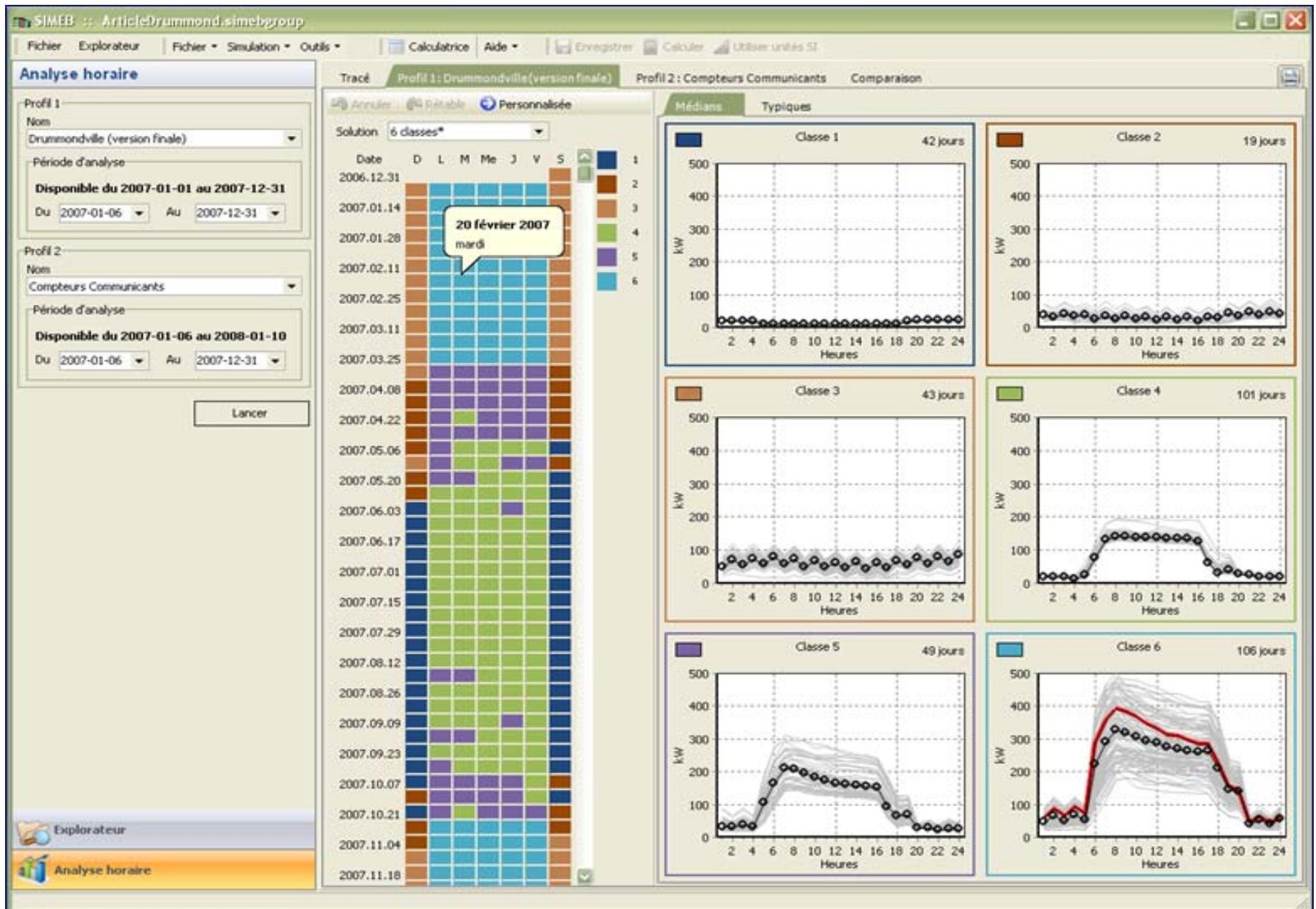
Refrigeration System Group List		Floors	Orientation	Refrigeration Systems Template
+ Refrigeration System F				Unspecified
- Zone 1-1--Perimeter		1	Varies	
- Zone 1-2--Core		1	Interior	
+ Compressor Rack System G				Custom System Configuration
- Zone 1-1--Perimeter		1	Varies	

System Validation Issues

System Component	Issues to be Resolved
Component ID	⚠ Issue Description, advice for resolution ...
Component ID	⚠ Issue Description, advice for resolution ...
Component ID	⚠ Issue Description, advice for resolution ...
Component ID	⚠ Issue Description, advice for resolution ...
Component ID	⚠ Issue Description, advice for resolution ...
Component ID	⚠ Issue Description, advice for resolution ...

Issues are flagged by component in the overview and reported below. These issues should be resolved before this system is used in a simulation.

Output Visualization



Status and Schedule

- Functional requirements specification: 90+% complete
- 'Phase 1' Proof-of-Concept (20%) functionality – 8/2010
- 'Phase 2' Product Preview (70%) functionality – 1/2011
- 'Phase 3' Version 1 - ~7/2011