DOE Commercial Building Energy Asset Score Web Service (Draft)

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Version 1

Pacific Northwest
NATIONAL LABORATORY

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Authors' Note

This documentation for the Energy Asset Score API is still a work in progress. Feedback is welcome and can be directed to Geoff Elliott (geoff.elliott@pnnl.gov), Justin Almquist (justin.almquist@pnnl.gov) and Nora Wang (na.wang@pnnl.gov).

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1.0   Objects

The central object in the Energy Asset Score application is a Building. Buildings belong to Users. Each Building is composed of one or more Blocks, each of which is the parent of several other objects that contain the definitions of that Block. A Building also holds references to HVAC Systems and Water Heaters. Once a Building has been simulated, it receives a Score object containing the simulation results.
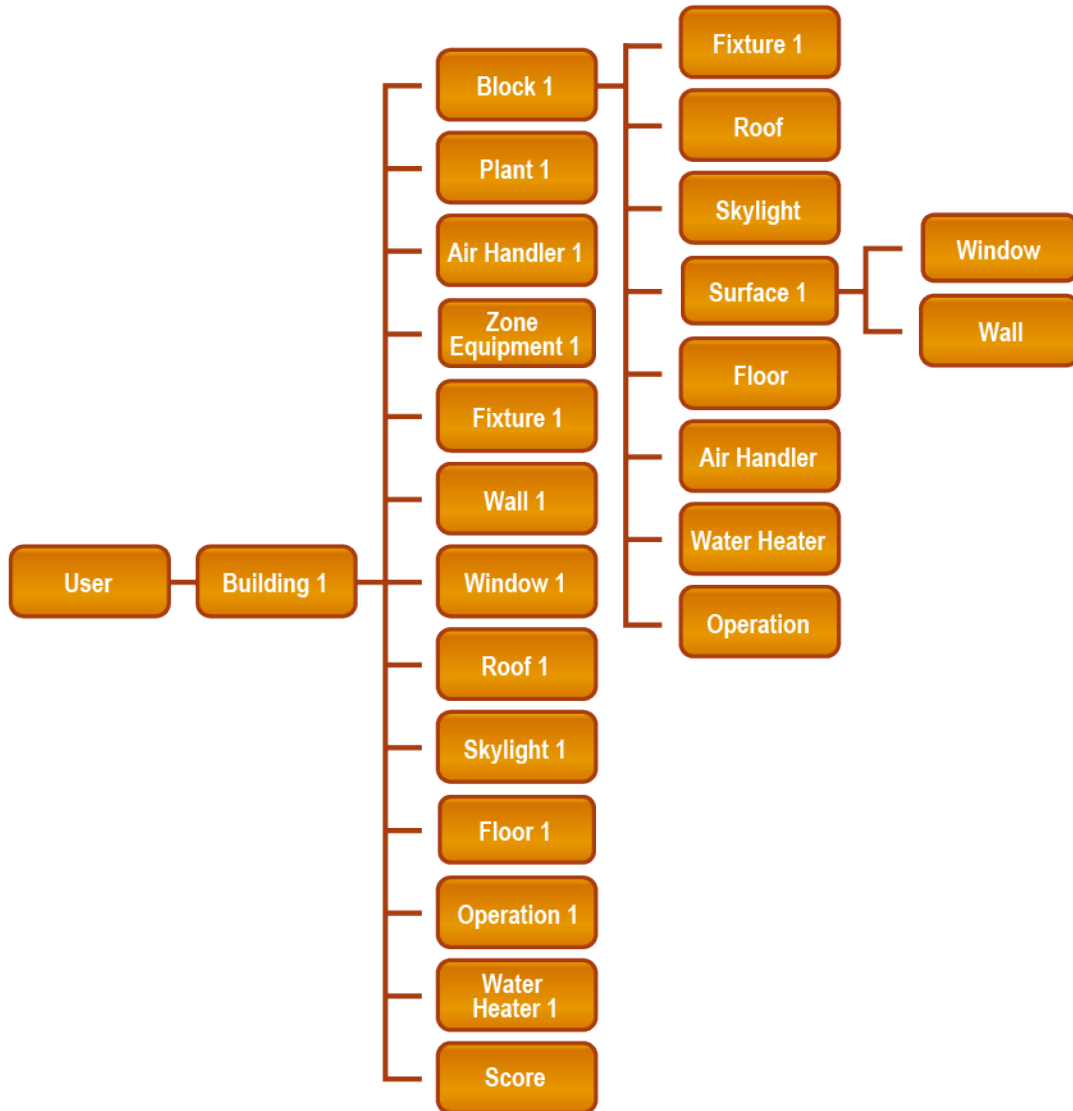

Figure 1. Energy Asset Score Application Objects

1.1   User

The User object is created for each unique account within the Energy Asset Score application. Each User has a unique, automatically assigned ID, in addition to a unique email address supplied when the account is created.

Table 1. User Object Fields

Field	Type	Description
id	Integer	The unique identifier for this user, used in get and update requests.
email	String	Email address used for login, resetting passwords, and contacting the user with simulation results.
password	String	
organization_id	Integer	Unique identifier for the organization this user belongs.
created_at	Datetime	Date and time the user account was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the user account was updated in the Energy Asset Score application.

1.2   Building

Each Building is represented by a unique, automatically assigned ID and a user-supplied name (which doesn't need to be unique). Additionally, the building object holds references to all "assets" that may be later assigned to particular blocks of that building. For instance, the construction informatation such as roofs, walls and windows, as well as fixtures, heating/cooling and operations.

Table 2. Building Object Fields

Field	Type	Description
id	Integer	The unique identifier for this building, used in get and update requests.
Name	String	A custom name given to the building. This is displayed in the Energy Asset Score Report and used in the application as the primary identification for the building.
year_of_construction	Integer	The year the building was originally constructed.
total_floor_area	Float	The sum of the floor areas of the spaces within the building, including basements, mezzanine and intermediate-floored tiers, and penthouses with a headroom height of 7.5 ft or greater. It excludes covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.
user_id	Integer	ID of the user who created the building.
notes	String	Description of the building.
address	String	Street address for the building.
city	String	City in which the building is located.
state	String	State in which the building is located.
zip_code	Integer	Postal code in which the building is located.
created_at	Datetime	Date and time the building was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the building was last updated in the Energy Asset Score application.
status_type_id	Integer	Indicates the current simulation status of the building: 1. No active score, can be updated 2. In the simulation queue, unavailable for updates 3. Has an active score, unavailable for updates
blocks	Array	An array of Block objects.

Field	Type	Description
air_handlers	Array	
zone_equipment	Array	
water_heaters	Array	
use_types	Array	
roofs	Array	
skylights	Array	
walls	Array	
windows	Array	
floors	Array	
fixtures	Array	
plants	Array	
operations	Array	

1.3 Block

Blocks are the foundational object of a Building. Each Block contains Roof, Floor, Surface, Mechanical, Water Heater, and Operations objects, as well as one or more Fixture objects.

Table 3. Block Object Fields

Field	Type	Description
id	Integer	The unique identifier for this block.
name	String	A custom name given to the block. This name is displayed in the user interface.
shape_id	Integer	ID corresponding to a specific block shape: 　1. Rectangle 　2. Courtyard 　3. H-shape 　4. L-shape 　5. T-shape 　6. U-shape
dimension_1	Float	These dimension values change depending on the shape being used. See Figure 2 through Figure 7.
dimension_2	Float	
dimension_3	Float	
dimension_4	Float	
dimension_5	Float	
dimension_6	Float	
dimension_7	Float	
dimension_8	Float	
dimension_9	Float	
created_at	Datetime	Date and time the user account was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the user account was updated in the Energy Asset Score application.
number_of_floors	Integer	Number of above ground floors included in the block.
number_of_bg_floors	Integer	Number of below ground floors included in the block.
floor_to_floor_height	Float	Distance between floors, including any drop ceiling space.
has_drop_ceiling	Boolean	Value should be true if the floors within this block include a drop ceiling.
floor_to_ceiling_height	Float	Distance between the floor and ceiling, not including any drop ceiling

Field	Type	Description
		space.

use_type_id	Integer	ID corresponding to a specific use type:
		   1. Assembly
		   2. Education
		   3. Food Sales
		   4. Food Service
		   5. Health Care
		   6. Lodging
		   7. Mercantile and Service
		   8. Office
		   9. Public Order/Safety
		   10. Warehouse, nonrefrigerated
		   11. Refrigerated Warehouse
		   12. Other

has_timer_controls	Boolean	Value should be true if the lighting fixtures within this block have timer controls.
surfaces	Array	An array of Surface objects.
roof	Object	The Roof definitions for this block.
floor	Object	The Floor definitions for this block.
fixtures	Array	An array of Fixture objects.
air_handlers	Array	The Air Handlers assigned to this block.
zone_equipment	Array	The Zone Equipment assigned to this block.
operation	Object	The Operation definitions for this block.
water_heaters	Array	The Water Heaters assigned to this block.
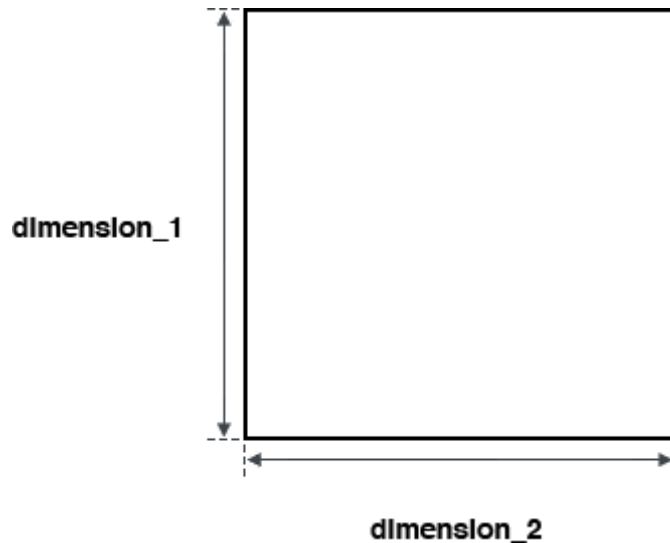
Figure 2. A Rectangle Shape and Associated Dimensions
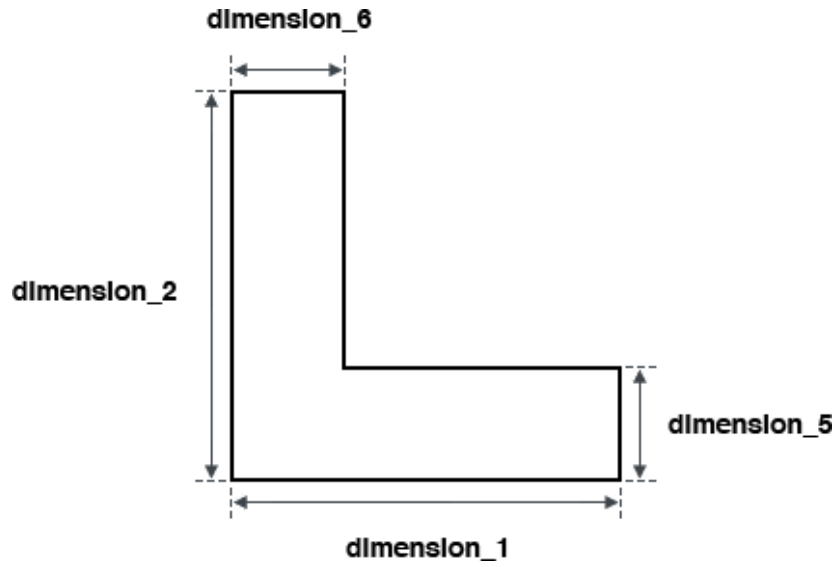
Figure 3. An "L" Shape and Associated Dimensions
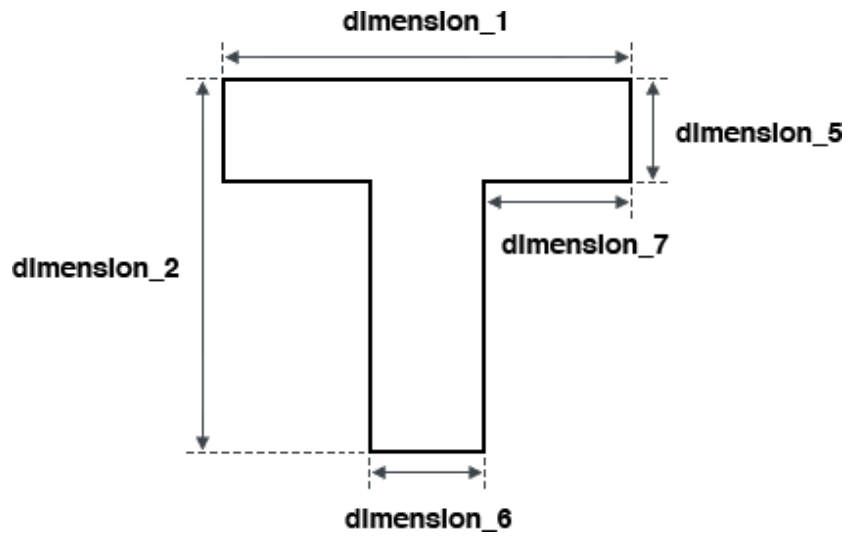
Figure 4. A "T" Shape and Associated Dimensions
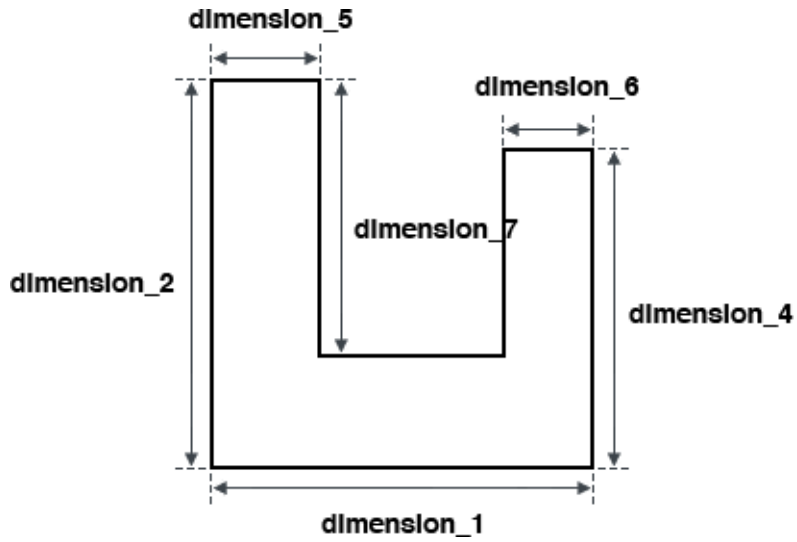
Figure 5. A "U" Shape and Associated Dimensions
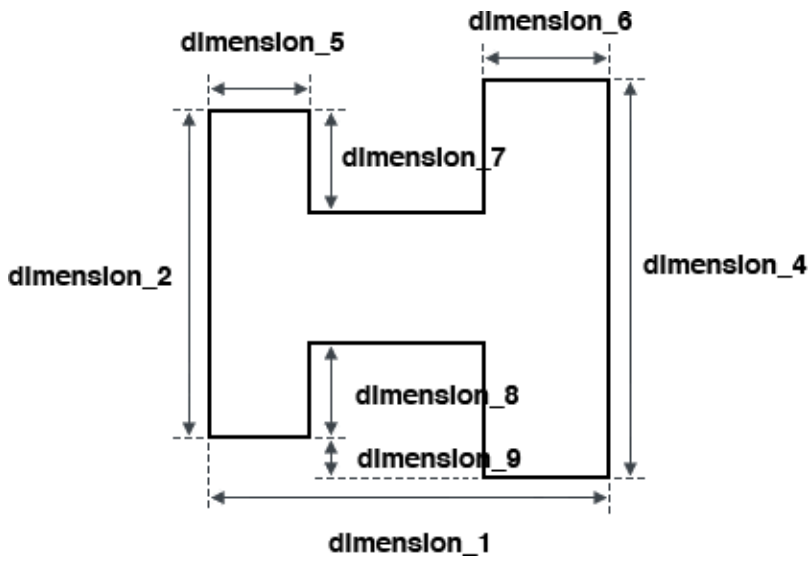
Figure 6. An "H" Shape and Associated Dimensions
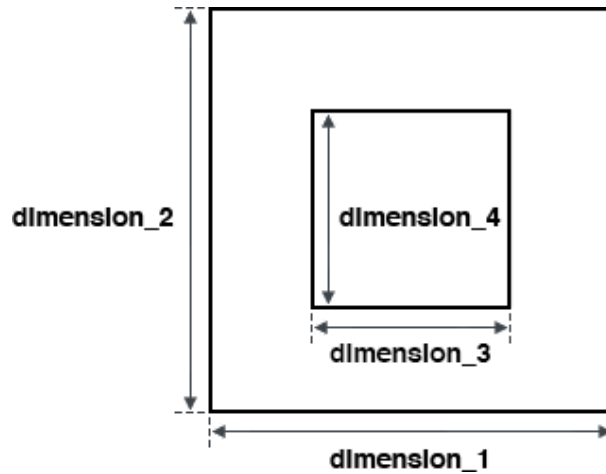
Figure 7. A Courtyard Shape and Associated Dimensions

1.4   Wall

The Wall object is a sub-object of a Block. There are as many Walls as there are vertical surfaces for a block, which depends on the shape selected for that particular Block.

Table 4. Wall Object Fields

Field	Type	Description
id	Integer	The unique identifier for this wall.
wall_type_id	Integer	ID corresponding to a specific wall type: 1. Metal panel/curtain wall 2. Siding on wood frame 3. Brick/stone on wood frame 4. Brick/stone on steel frame 5. Brick/stone on masonry
r_value	Float	The R-value of the insulation used in the exterior walls of the parent block.
insulation_thickness	Float	The thickness in inches of the insulation used in the exterior walls of the parent block.
u_factor	Float	The U-factor of the insulation used in the exterior walls of the parent block.
created_at	Datetime	Date and time the envelope was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the envelope was updated in the Energy Asset Score application.
window	Object	The Window definitions for this Wall.
points	Array	An array of point objects.

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1.5 Surface

A Surface describes one surface of a particular block.

Table 5. Point Object Fields

Field	Type	Description
id	Integer	The unique identifier.
vertices	String	Describes the x, y, and z coordinates for the surface
block_id	Integer	The block this surface belongs to
edge_fins_only	Boolean	
created_at	Datetime	Date and time the point was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the point was updated in the Energy Asset Score application.
edge_offset	Float	
fin_depth	Float	
fin_distance_between	Float	
height	Float	
width	Float	
light_shelf_distance_from_top	Float	
light_shelf_ext_protrusion	Float	
light_shelf_int_protrusion	Float	
number_of_windows	Integer	
overhang_depth	Float	
overhang_height_above_window	Float	
shading_type_id	Integer	Unique identifier of ShadingType object
sill_height	Float	
wall_id	Integer	Unique identifier of a Wall object
window_id	Integer	Unique identifier of a Window object
window_layout_id	Integer	Unique identifier of a WindowLayout object
window_width	Float	
window_height	Float	
window_wall_ratio	Float	The *Window-to-Wall Ratio* is the fraction of the above grade wall area that is covered by fenestration, calculated as the ratio of the wall fenestration area to the gross above grade wall area.

1.6 Window

The Window object is a sub-object of the Walls of a Block. There is one Window object per Wall.

Table 6. Window Object Fields

Field	Type	Description
id	Integer	The unique identifier for this window.
framing_type_id	Integer	ID corresponding to a specific framing type: 1. Metal 2. Metal with Thermal Breaks

Field	Type	Description
		3. Wood/Vinyl/Fiberglass

glass_type_id	Integer	ID corresponding to a specific glass type:
		  1. Single Pane
		  2. Double Pane
		  3. Double Pane with Low-E
		  4. Triple Pane
		  5. Triple Pane with Low-E

gas_fill_type_id	Integer	ID corresponding to a specific gas fill type:
		  1. Air
		  2. Other
		  3. None
		For single pane windows, the value should be 3.

shading_type_id	Integer	ID corresponding to a specific shading type:
		  1. No Shading
		  2. External Overhangs
		  3. Vertical Fins
		  4. Light Shelves

operable	Boolean	The value should be true if the windows are operable.
window_wall_ratio	Float	Value between 0-1. 0.5 would mean that 50% of the exterior wall area is glazed

window_layout_id	Integer	ID corresponding to a specific window layout:
		  1. Continuous
		  2. Discrete
		  3. Various

overhang_height_above_window	Float	
overhang_depth	Float	
light_shelf_distance_from_top	Float	
light_shelf_ext_protrusion	Float	
light_shelf_int_protrusion	Float	
fin_depth	Float	
edge_fins_only	Boolean	
fin_distance_between	Float	
edge_offset	Float	
sill_height	Float	
window_width	Float	
window_height	Float	
ufactor	Float	
shgc	Float	
vt	Float	
number_of_windows	Integer	
created_at	Datetime	Date and time the window was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the window was updated in the Energy Asset Score application.

1.7 Roof

The Roof object is a sub-object of a Block. There is one Roof per Block.

Table 7. Roof Object Fields

Field	Type	Description
id	Integer	The unique identifier for this roof.
r_value	Float	The R-value of the insulation used in the roof of the parent block.
insulation_thickness	Float	The thickness in inches of the insulation used in the roof of the parent block.
u_factor	Float	The U-factor of the insulation used in the roof of the parent block.
skylight	Object	The skylight definitions for this roof.
created_at	Datetime	Date and time the roof was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the roof was updated in the Energy Asset Score application.

1.8 Skylight

The Skylight object is sub-object of a Block. There is one Skylight per Roof.

Table 8. Skylight Object Fields

Field	Type	Description
id	Integer	The unique identifier for this skylight.
ufactor	Float	
shgc	Float	
vt	Float	
percent_footprint	Float	
skylight_layout_id	Integer	ID corresponding to a specific skylight layout: 1. Core Only 2. All Zones
created_at	Datetime	Date and time the skylight was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the skylight was updated in the Energy Asset Score application.

1.9 Floor

The Floor object is a sub-object of a Block. There is one Floor per Block.

Table 9. Floor Object Fields

Field	Type	Description
r_value	Float	The R-value of the insulation used in the floor of the parent block.
insulation_thickness	Float	The thickness in inches of the insulation used in the floor of the parent block.
u_factor	Float	The U-factor of the insulation used in the floor of the parent block.
has_carpet	Boolean	The value should be true of the floor of the parent block is carpeted.
created_at	Datetime	Date and time the floor was updated in the Energy Asset Score application.
updated_at	Datetime	Date and time the floor was updated in Energy Asset Score.

1.10 Fixture

The Fixture object is a sub-object of a Block. Fixtures are contained within the "fixtures" array of a Block, and there must be one or more to simulate the building.

Table 10. Fixture Object Fields

Field	Type	Description
id	Integer	The unique identifier for this fixture.
mounting_type_id	Integer	ID corresponding to a specific mounting type: 1. Recessed 2. Surface 3. Pendant
lamp_type_id	Integer	ID corresponding to a specific lamp type: 1. Incandescent/Halogen 2. Fluorescent T8 3. Fluorescent T12 4. Metal Halide 5. High-Pressure Sodium 6. Compact Fluorescent 7. Fluorescent T5 8. Mercury Vapor 9. LED
uses_percent_served	Boolean	Value should be true if specifying the percentage of the floor area served by this type of fixture, false if specifying the lamp wattage and total number of fixtures in the block.
percent_served	Float	Percentage of the block floor area served by this type of fixture.
number_of_lamps	Integer	The number of lamps per fixture.
number_of_fixtures	Integer	Total number of fixtures of this type in the block.
lamp_wattage	Float	
has_daylight_controls	Boolean	Value should be true if daylight sensors are used to control this type of fixture.
has_occupancy_controls	Boolean	Value should be true if occupancy sensors are used to control this type of fixture.
created_at	Datetime	Date and time the fixture was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the fixture was updated in the Energy Asset Score application.

1.11 Air Handler

The air_handler object is a sub-object of a Building, and linked to one or more blocks.

Table 11. Air_Handler Object Fields

Field	Type	Description
id	Integer	The unique identifier for this HVAC System definition.
cooling_air_handler_type_id	Integer	ID corresponding to a specific cooling air_handler_type: 1. No Heating

Field	Type	Description
		2. Central Furnace
		3. Heat Pump
		4. Plant
		5. No Cooling
		6. Central DX
heating_air_handler_type_id	Integer	ID corresponding to a specific heating air_handler_type:
		1. No Heating
		2. Central Furnace
		3. Heat Pump
		4. Plant
		5. No Cooling
		6. Central DX
heating_plant_id	Integer	ID corresponding to a specific heating plant object
cooling_plant_id	Integer	ID corresponding to a specific cooling plant object
distribution_type_id	Integer	ID corresponding to a specific air_handler distribution type:
		3. Single Zone
		4. Multi-Zone
		5. Distributed
		6. Looped
fuel_type_id	Integer	ID corresponding to a specific fuel type:
		1. Gas
		2. Electricity
		3. Oil
heating_pieces_of_equipment	Integer	
heating_efficiency	Float	
heating_equipment_vintage	Integer	The year the installed heating equipment was manufactured.
heating_capacity	Float	
cooling_type_id	Integer	ID corresponding to a specific cooling type:
		1. No Cooling
		2. Terminal DX
		3. Central DX Single Zone
		4. Central DX Multi- Zone
		5. Chiller
		6. District
cooling_efficiency	Float	
cooling_pieces_of_equipment	Integer	
cooling_capacity	Float	
cooling_equipment_vintage	Integer	The year the installed cooling equipment was manufactured.
has_economizer	Boolean	
sink_source_type_id	Integer	ID corresponding to a specific sink source type:
		1. Air
		2. Ground
fan_efficiency	Float	
fan_motor_efficiency	Float	
fan_control_id	Integer	1. Constant volume
		2. Variable air volume
heating_vintage	Integer	Year of equipment
cooling_vintage	Integer	Year of equipment
created_at	Datetime	Date and time the air_handler was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the air_handler was updated in the Energy Asset

Field	Type	Description
		Score application

1.12 Zone Equipment

The zone_equipment object is a sub-object of a Building, and linked to one or more blocks.

Table 12. Zone_Equipment Object Fields

Field	Type	Description
id	Integer	The unique identifier for this HVAC System definition.
cooling_zone_equipment_type_id	Integer	ID corresponding to a specific cooling zone_equipment type: 1. No Heating 2. Central Furnace 3. Heat Pump 4. Plant 5. No Cooling 6. Central DX
heating_zone_equipment_type_id	Integer	ID corresponding to a specific heating zone_equipment type: 1. No Heating 2. Central Furnace 3. Heat Pump 4. Plant 5. No Cooling 6. Central DX
heating_plant_id	Integer	ID corresponding to a specific heating plant object
cooling_plant_id	Integer	ID corresponding to a specific cooling plant object
fuel_type_id	Integer	ID corresponding to a specific fuel type: 1. Gas 2. Electricity 3. Oil
heating_pieces_of_equipment	Integer	
heating_efficiency	Float	
heating_equipment_vintage	Integer	The year the installed heating equipment was manufactured.
heating_capacity	Float	
cooling_type_id	Integer	ID corresponding to a specific cooling type: 1. No Cooling 2. Terminal DX 3. Central DX Single Zone 4. Central DX Multi- Zone 5. Chiller 6. District
cooling_efficiency	Float	
cooling_pieces_of_equipment	Integer	
cooling_capacity	Float	
cooling_equipment_vintage	Integer	The year the installed cooling equipment was manufactured.
has_economizer	Boolean	

Field	Type	Description

sink_source_type_id	Integer	ID corresponding to a specific sink source type:
		  1. Air
		  2. Ground

heating_vintage	Integer	Year of equipment
cooling_vintage	Integer	Year of equipment
created_at	Datetime	Date and time the air_handler was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the air_handler was updated in the Energy Asset Score application

1.13 Operation

The Operation object is a sub-object of a Block. There is only one Operation object per Block.

Table 13. Operation Object Fields

Field	Type	Description
id	Integer	The unique identifier for this operations definition.
misc_electric_load	Float	
misc_gas_load	Float	
weekdays_open	Boolean	Value should be true if the block is open on weekdays.
weekday_open_time	String	
weekday_close_time	String	
weekends_open	Boolean	Value should be true if the block is open on weekends.
weekend_open_time	String	
weekend_close_time	String	
total_occupants	Integer	Total number of occupants of the block.
setpoint_heating	Integer	
created_at	Datetime	Date and time the operation was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the operation was updated in the Energy Asset Score application.

1.14 Water Heater

The water_heater object is a sub-object of a Block. There can be zero or more Water Heaters per Block.

Table 14. Water Heater Object Fields

Field	Type	Description
id	Integer	The unique identifier for this water heater.

fuel_type_id	Integer	ID corresponding to a specific fuel type:
		  1. Gas
		  2. Electricity

Field	Type	Description
		3. Oil

distribution_type_id	Integer	ID corresponding to a specific distribution type:
		  1. Distributed
		  2. Looped

uses_heat_pump	Boolean	Value should be true if the water heater uses a heat pump.
water_heater_efficiency	Float	
tank_insulation_thickness	Float	The thickness in inches of the insulation used on the water heater tank.
tank_insulation_r_value	Float	The R-value of the insulation used on the water heater tank
tank_volume	Float	
created_at	Datetime	Date and time the water_heater was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the water_heater was updated in the Energy Asset Score application.

1.15 Plant

The plant object is a sub-object of Building and Block.

Table 15. Plant Object Fields

Field	Type	Description
id	Integer	The unique identifier for this plant.

plant_type_id	Integer	ID corresponding to a specific plant type:
		  1. Chiller
		  2. District
		  3. Boiler

is_heating	Boolean	True if this is a heating plant
Vintage	Integer	
pieces_of_equipment	Integer	
efficiency	Float	
capacity	Float	
condenser_type_id	Integer	ID corresponding to a specific condenser type: 1. Air 2. Water
compressor_type_id	Integer	ID corresponding to a specific compressor type: 1. Scroll/Screw 2. Reciprocating 3. Centrifugal

fuel_type_id	Integer	ID corresponding to a specific fuel type:
		  1. Gas
		  2. Electricity
		  3. Oil

created_at	Datetime	Date and time the water_heater was created in the Energy Asset Score application.
updated_at	Datetime	Date and time the water_heater was updated in the Energy Asset Score application.

1.16 Block_Air_Handler

Manages relationship between an Air_Handler and a Block.

Table 16. Block_Air_Handler Object Fields

Field	Type	Description
block_id	Integer	Unique identifier for block
air_handler_id	Integer	Unique identifier for air_handler

1.17 Block_Fixture

Contains all of the fixture info for a particular block.

Table 17. Block_Fixture Object Fields

Field	Type	Description
block_id	Integer	Unique identifier for block
fixture_id	Integer	Unique identifier for air_handler
uses_percent_served	Boolean	
percent_served	Float	
number_of_fixtures	Integer	
has_daylight_controls	Boolean	
has_occupancy_controls	Boolean	

1.18 Block_Water_Heater

Manages relationship between a Water_Heater and a Block.

Table 18. Block_Water_Heater Object Fields

Field	Type	Description
block_id	Integer	Unique identifier for block
water_heater _id	Integer	Unique identifier for water_heater

1.19 Block_Zone_Equipment

Manages relationship between a Water_Heater and a Block.

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Table 19. Block_Zone_Equipment Object Fields

Field	Type	Description
block_id	Integer	Unique identifier for block
water_heater_id	Integer	Unique identifier for zone_equipment

1.20 Score

The Score object is returned after a Building has finished simulation.

Table 20. Score Object Fields

Field	Type	Description
current_score	Integer	The current score for the building.
current_source_eui	Float	The Source EUI for the current building.
potential_score	Integer	The potential score for the current building if recommended upgrades were made.
potential_source_eui	Float	The potential Source EUI for the current building if recommended upgrades were made.
reference_score	Integer	The score for the corresponding reference building.
reference_source_eui	Float	The Source EUI for the corresponding reference building.