Simple Box Model Workflow

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# Background

## Scope

This document describes the simple box model required to meet the GSG Integrated Design Process Credit.

This document covers IDP box models using eQuest, which is the Authority’s selected energy modeling program. Modelers should provide the information requested in the Box Model Information Summary.

## Notes

The purpose of these box models is to assist project teams with scheme selection by providing a comparative idea of how different schemes compare to each other to assist project with scheme selection. To reduce the level of effort, the IDP modeling procedure will rely on eQuest Design Development (DD) Wizard mode to build out each scheme. eQuest’s DD Wizard mode is intended to generate a model for IDP level analysis only. Where possible, the following guidelines and inputs will align.

Importance is given to modeling the IDP Box Models as close as possible to SCA Standards in order to compare the different schemes based on absolute metrics (total electric kWH as opposed to EUI) and 8670 hourly data.

# eQuest – Design Development Wizard

## Project and Site Data

### General Information (Wizard Screen 1 of 7)

1. Select one of the following building types:
   1. School, K-6 Elementary
   2. School, Middle School
   3. School, Secondary (High School)
2. Select Location as New York, New York

Graphical user interface, application

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### Seasons Definitions (Wizard Screen 3 of 7)

1. Select Description of Seasons: Full Nine Months, Reduced Summer Session
2. Define the seasons as show in screenshot.

Graphical user interface

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## Building Shell Components

### Building Shell: Project Navigator

1. Create a building shell for each floor of the building.
2. Create Air-Side Systems Types as follows:

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### Building Shell: Building Footprint (Wizard Screen 2 of 26)

1. Create footprint shape and zoning pattern as follows. See screen shots below for example.

* Create separate zones for kitchen, cafeteria, and gymnatorium.
* Zoning pattern for the rest of the building can be perimeter-core.

1. Specify Building Orientation.
2. Floor heights:
   * Set Flr-To-Flr and Flr-To-Ceiling to same number so that no plenum spaces are created.

|  |  |  |
| --- | --- | --- |
| \*The following is an example from a particular project to demonstrate the approach towards zoning | | |
| Kitchen and Cafeteria | Diagram  Description automatically generated |  |
| Gymnatorium |  |  |
| All other floors |  |  |

Graphical user interface

Description automatically generated with medium confidence

### Building Envelope Construction (Wizard Screen 3 of 26)

Due to software limitations, the following eQuest Inputs may not fully represent SCA standards. Where possible, the inputs have been selected to simulate SCA U-value performance as closely as possible. \*Please note that the below inputs are specified for the IDP Box Model only.

|  |  |  |
| --- | --- | --- |
| Description | IDP eQuest Input | |
| Roof | Construction: | 6 in. Concrete |
| Ext Finish/Color: | Roof, built-up, Medium (abs = 0.6) |
| Exterior Insulation: | 6 in. polyurethane (R-36) |
| Add’l Insulation: | No LtWt Conc Cap |
| U-value: | U-0.025 |
| Above Grade Walls | Construction: | Metal Frame, 2X4, 24 in. oc. |
| Ext Finish/Color: | Stucco/Gunite, Medium (abs=0.6) |
| Exterior Insulation: | 3 in. polyisocyanurate (R-21) |
| Add’l Insulation: | R-13 batt |
| Interior Insulation: | No board Insulation |
| U-value: | U-0.033 |
| Ground Floor (Slab On Grade) | Exposure: | Earth Contact |
| Construction: | 6 in. Concrete |
| Ext/Cav Insul: | Full under slab insul, R-10 |
| Interior Finish: | Vinyl Tile |
| F-Factor: |  |
| Below Grade Walls | Construction: | 12 in. Concrete |
| Insulation | Int bd, R-10 |
| C-Factor: | C-0.116 |

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### Building Interior Construction (Wizard Screen 4 of 26)

1. Ceilings

* Int. Finish: -none-

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### Exterior Doors (Wizard Screen 5 of 26)

1. Remove Doors

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### Exterior Windows (Wizard Screen 6 of 26)

1. Glass Category

* Specify Properties (See below)

1. Frame type

* Alum, w/o Brk, Fixed

1. Frame Width

* Set to 0

1. % Window

* Set % window to 20% on all facades

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#### Glass Properties

Following inputs based on SCA standard eQuest Inputs for a weighted average of fixed and operable window performance:

1. NFRC U-Factor = 0.25
2. NFRC SHGC = 0.36
3. Visible Transmittance = 0.4
4. The other properties in the dialog box will not affect the model.

Graphical user interface, application

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### Exterior Window Shades and Blinds (Wizard Screen 7 of 26)

1. Remove all window shades

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### Roof Skylights (Wizard Screen 8 of 26)

1. Skylit Roof top Zones: “None”

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### Building Operation Schedule (Wizard Screen 12 of 26)

1. Adjust the following schedules as shown below:

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### Activity Areas Allocation (Wizard Screen 13 of 26)

1. Adjust activity area based on each floor’s individual programming. See below for example of a floor with gymnasium.
2. Adjust occupancy based on SCA standards. Reference SCA eQuest Input Summary. These values follow ASRHARE 62.1.

|  |  |
| --- | --- |
| Diagram  Description automatically generated |  |

### Zone Group Definitions (Wizard Screen 14 of 26)

For floors where there is Kitchen, Cafeteria, or Gymnatorium, define the zone groups as follows:

1. Create a new Zone Group for Kitchen, Cafeteria, or Gym
2. Assign Zone to the newly created Zone Group
3. Adjust the Activity Area for the Zone Group
4. Assign correct HVAC System to Zone Group

For all other floors, define the zone groups as follows:

1. Adjust the Activity Area for the Zone Group
2. Assign correct HVAC System to Zone Group

Example on next page

|  |
| --- |
| Gymnatorium, Kitchen, Cafeteria Zone Group Example |
| Graphical user interface, text, application  Description automatically generated  4  2  3  1 |
| Rest of Building Zone Group Example |
| 2  1 |

### Non-HVAC End-uses to Model (Wizard Screen 15 of 26)

1. Select Interior and Exterior End-uses where applicable to each unique floor.
2. See the following sections for detailed input for each end-use selected.

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### Interior lighting Loads and Profiles (Wizard Screen 16 of 26)

1. Set LPD to 0.40 W/SF for all Area Types.

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### Cooking Loads and Profiles (Wizard Screen 18 of 26)

Applicable only to floors where there is Kitchen/Cafeteria.

1. Use provided calculator below to calculate the EPD for kitchen loads.
2. Enter Load and Sensible Ht (0.25) in the appropriate Area type.

Primary School, Full Kitchens

|  |  |  |  |
| --- | --- | --- | --- |
| # of students | 401-500 | 501-1000 | 1000+ |
| Source Type | Electric | Electric | Electric |
| Input power (kW)  Cooking , Non-Cooking | 51, 36 | 68,60 | 84, 74 |
| Annual full load hours  (Cooking, Non-cooking) | 712, 1047 | | |

High School, Full Kitchens

|  |  |  |  |
| --- | --- | --- | --- |
| # of students | 401-500 | 501-1000 | 1000+ |
| Source Type | Electric | Electric | Electric |
| Input power (kW)  Cooking , Non-Cooking | 51, 60 | 68,95 | 84, 127 |
| Annual full load hours  (Cooking, Non-cooking) | 712, 1047 | | |

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Graphical user interface

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### Domestic Water Heating Hourly Profiles

1. Click “Return to Navigator”.
2. Select “DHW Equipment” under DD Wizard Components.
3. Update inputs as follows:
   1. Heater Fuel: Electricity
   2. Hot Water Use: 0.6 gal/person/day as per Appendix A calculator
   3. Supply Water: 100F

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### HVAC System

#### Classroom HVAC

##### Classroom HVAC: HVAC System Definition (Wizard Screen 1 of 7)

SCA Standard HVAC for Classrooms, offices, most corridors, and other similar spaces will be served by packaged air-source heat pumps with heat recovery wheels and supplemental electric resistance baseboards. The electric resistance baseboards will pick up any skin loads as needed.

Limitations in eQuest DD Wizard mode as follows:

* Can’t model electric resistance baseboards as secondary HVAC.
* No ability for heat recovery.

DD Wizard limits HVAC plant connections and inputs. This means that the typical workarounds for the modeling HP systems cannot be implemented. The HW-LOOP with Electric Boiler at 200% efficiency may be the best option for approximating this workaround but is very simplified and should be differentiated from the existing SCA modeling methodology since mentioned in section 2.2.17.1.1.

1. Set Classroom HVAC as follows:
   1. Cooling Source: DX Coils
   2. Heating Source: Hot Water Coils
   3. Hot Water Src: Hot Water Loop
   4. System Type: Packaged VAV with HW Reheat
   5. System per Area: System per Floor
   6. Return Air Path: Ducted
   7. System Assignment to Thermal Zones: No need to update here, assignment was done in zone area.

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##### Classroom HVAC: Temperatures and Air Flows (Wizard Screen 2 of 7)

1. Update the following as shown below for Classroom HVAC:

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##### Classroom HVAC: Packaged HVAC Equipment (Wizard Screen 3 of 7)

1. No changes needed.

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##### Classroom HVAC: HVAC System Fans (Wizard Screen 4 of 7)

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##### Classroom HVAC: Air-Side System Type (Wizard Screen 5 of 7)

Cycle Fans at Night: Cycle Fans (no OA at night)

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##### Classroom HVAC: Zone Heating, Vent and Economizers (Wizard Screen 6 of 7)

Please ensure that electric baseboards are excluded. Since secondary

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##### Classroom HVAC: Hot/Cold Deck Resents (Wizard Screen 7 of 7)

1. No updates needed.

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#### Classroom HVAC: HW Plant Equipment

1. Click HW Plant Equipment.
2. Input based on screenshots below:

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#### Kitchen/Cafeteria HVAC

Model same as described under classroom HVAC.

#### Gym HVAC

Model same as described under classroom HVAC.

## Energy Efficiency Measure Wizard

The following instructions will show how to create a sensitivity analysis for window-to-wall ratio for 15%. Repeat the following instructions for additional measures (ex: alternative HVAC, envelope U-value, window performance… etc.)

1. Click Icon indicated below to enter into the EEM Wizard.

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1. Select the following.

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1. Click “EEM Run Details…”. This will take you the navigation screen similar to the one for the DD Wizard.

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1. For each Building Shell Component, navigate to the Exterior Windows Screen and change the WWR to 15%.

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## Hourly Reporting Blocks

Option 1 is default because it is readily available & does not need additional steps. If using “Option 2: HVAC Loads Summary“, set up additional hourly reporting blocks based on the instructions below.

Option 2 looks at building loads (thermal loads) without the layer of equipment efficiency and load conditions. More experienced modelers may like to look at the loads and assess priorities in terms of massing & orientation. This is the advantage of Option 2.

1. Under “Project & Site”, Select Hourly Reports and create a new Hourly Report Block as show below.

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2. Add the newly created hourly block to the Hourly Report.

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