

## 1.0 Introduction

In the first tutorial you will be introduced to Energy Modelling and Building Simulation using the basic function of **eQUEST**. By the end of this tutorial you should be familiar with **eQUEST**'s interface and understand what energy modeling is.

### 1.1 What is eQUEST ?

- **eQUEST** allows for a complete building performance analysis. This means that it recognizes that buildings are composed of smaller systems working together. These systems include the envelop, fenestration, lighting, HVAC and DHW. The energy analysis of these systems considers them individually and as components interacting with one another.
  - Consider model preparation time, simulation runtime, results trouble shooting time, and results reporting

### 1.2 What is a Building Simulation?

- Energy

For a complete building simulation the following need to identify first. These parameters should be outlined in each assignment given.

- Analysis Objective
- Building site information & weather data
- Building Shell, Structure, materials & shades
- Building operation & schedule
- Internal loading
- HVAC equipment & performance
- Utility rates
- Economic Parameters

### 1.3 How does eQUEST function?

- **eQUEST** is Windows-based
- Main purpose of **eQUEST** is to evaluate the energy use performance impact resulting from building design alternatives
  - This is completed by simulating two versions of the buildings, one base case and one with different alternatives
- EEM analysis vs. Parametric analysis
  - EEM analysis uses Wizard → easier and faster → less detailed control
  - Parametric analysis → required more detailed preparation and input → more detailed control
- On-Screen Data types: colors are used to identify the different input values
  - **red** → user input (or wizard input written to the Detailed Interface INP file)
  - **green** → eQUEST (or DOE-2.2) default values
  - **dk blue** → Library values

- **lt blue** → User-defined default values
- **magenta** → values based on formula-like ‘expressions’
- **purple** → linked values
- Results Reporting
  - Graphical
  - Parametric
  - Summary
  - Detailed Simulation
- Project Files
  - **PD2** → stores the building description input into the Wizards (user inputs only, no defaults) — viewed and modified using the Wizards.
  - **INP** → stores DOE-2.2 building description inputs. The INP file is initially created by the Wizard (when you click the ‘Finish’ button to leave the Wizard, but may be modified by the user in the Detailed Interface — viewed and modified using the Detailed Interface.
  - **PRD** → Parametric Run Definitions — used to define parametric run inputs. (EEM Wizard runs are stored in the PD2 file.) — viewed and modified using the Parametric Run dialog in the Detailed Interface.
  - **SIM** → DOE-2.2 Detailed Simulation Outputs — a large text file (132 column format, one SIM file is automatically produced for each eQUEST simulation run — viewed using the *D2SIM Viewer* available in the Detailed Interface.

#### 1.4 HVAC Zoning

- Depending on the building designs the load profile changes
- For control purposes, areas with similar load profiles are grouped together because they improve occupant comfort and have the potential to reduce energy use
- HVAC zoning simulation models are governed by the following guidelines, these are the same rules that HVAC engineers use to zone any building :
  - If the building already **exists**, refer to the actual zoning indicated by the HVAC plans
  - If the building is **new** consider the following characteristics:
    - Magnitude and schedule of internal loads
    - Magnetite and schedule of solar gains
    - Schedule of fan system operations
    - Outside air requirements
    - Intended efficiency measures (ECM’s)
    - Location of thermostat as shown on HVAC plans
  - To have a complete an accurate HVAC analysis, the following data must be provided:
    - One exterior zone per major orientation (12-18 feet deep)
    - One internal zone per use schedule
    - One plenum zone (if plenum returns) for each air handler to be modeled separately
    - One zone each for special uses (e.g., conference rooms, cafeterias etc.)
    - Separate ground and top floor zones

- There are two automatic zoning schemes that **eQUEST** will zone the model according to the user input:
  - One-zone-per-floor
  - Simple core-vs-perimeter zoning

### 1.5 Types of Heat Transfer Surfaces in DOE-2

- **eQUEST** can model various types of heat transfer in the modelled building
  - Window → light transmitting surfaces → windows, glass doors, skylights etc.
  - Exterior Wall → exterior surfaces → walls, roofs, floors etc.
  - Interior wall → interior surface → interior walls ceiling and floors
  - Underground wall → underground surfaces → slab on grade

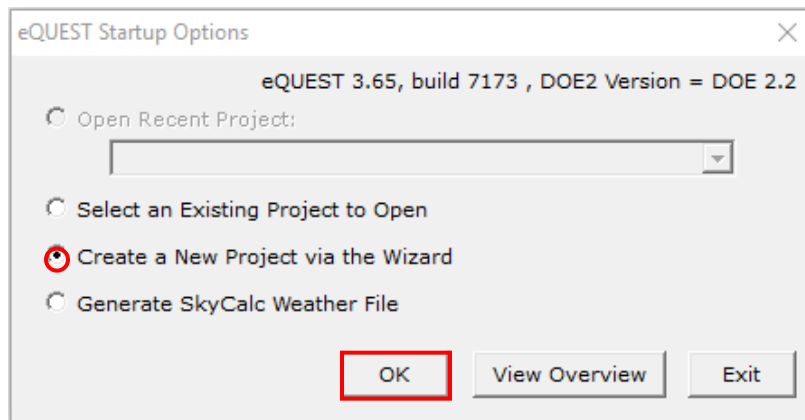
### 1.6 Type of Internal Loads

- There are three internal loads that **eQUEST** uses to view the simulation
  - **both** a *thermostat* and the *utility meter*
  - **only** by a *thermostat* not by a utility meter
  - **only** by the *utility meter*, not by any thermostat

### 2.0 Starting a new Simulation

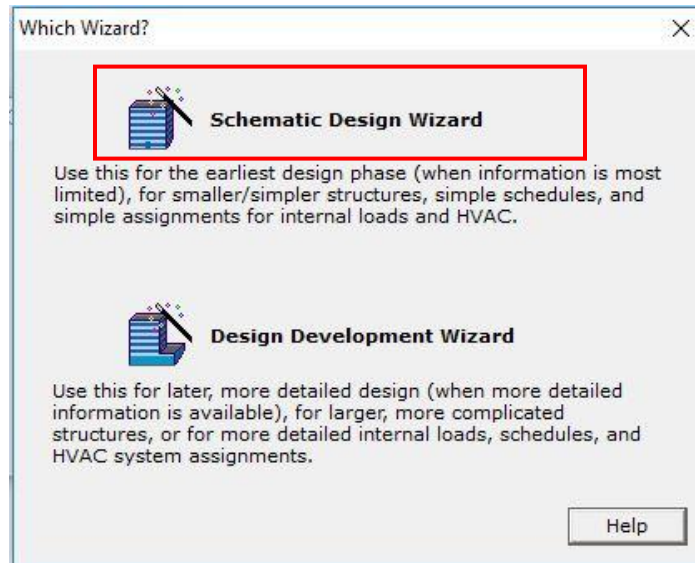


- **Starting eQUEST:** Double click on the icon → the location “C:\Program Files\eQUEST..”
- **Creating a new building description using eQUEST Wizards:**
  - From the *Startup Options* dialog, select “Create a New Project via the Wizard” (the default) then click “OK”



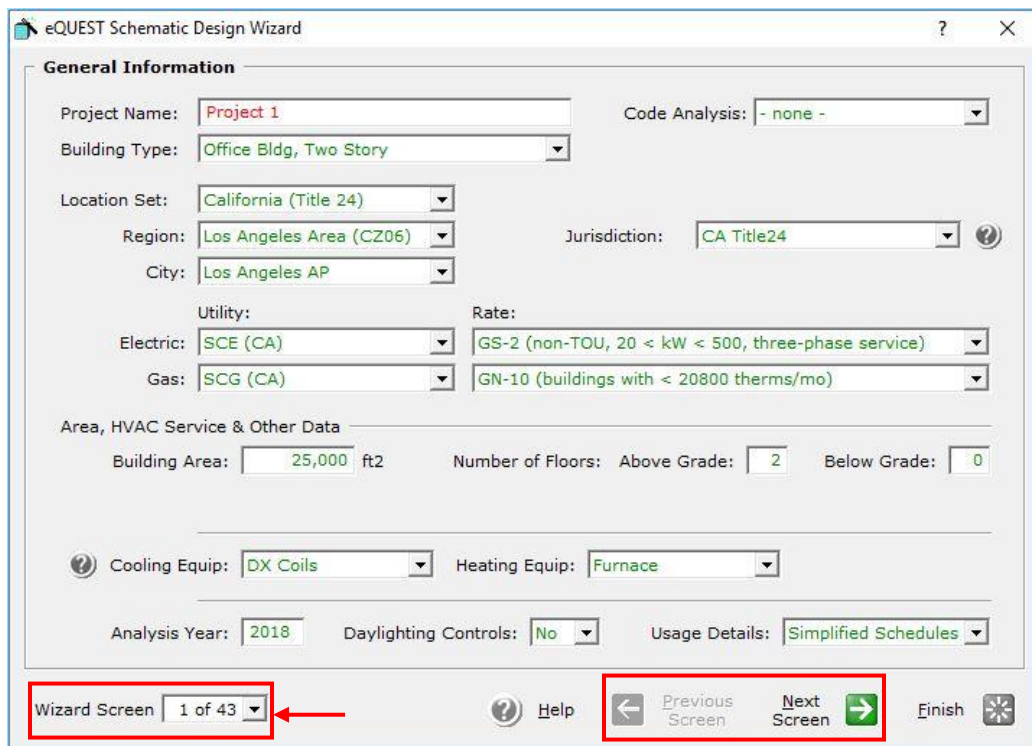


- From the *Which Wizard?* dialog select Schematic Design Wizard (SD)



## 2.1 Schematic Wizard

- You can edit the *Schematic Wizard's* inputs as you prefer including. Note that user inputs are in **red** and program defaults are in **green**. This page allows you to customize the building according the required specifications. Below is the first page of the design wizard illustrating the general information:
  - **Note:** There are 43 *Screen Wizard* pages that allows you to add different Specification to the building analyzed  
To switch to a different screen, click on the drop-down menu or click the Next Screen button



- This is a short list of the Wizard Screens that will appear when you click the dropdown menu beside the **red** arrow:
  - Project information: building type, size and principal HVAC system type
  - Building geometry: footprint, floor-to-floor distance and zoning pattern
  - Construction types for walls, floors, roofs, etc.
  - Design: windows and door sizes, distribution by orientation & glass type
  - “activity area” by fraction of total building area and distribution
    - This function is used to set default values for occupant density, other internal loads and ventilation requirements
  - Building operations schedules: occupancy, lights and equipment
  - HVAC systems: types & area assignments
  - Air-side and water-side equipment: design capacities, power and efficiencies, setpoints, and control options
  - Domestic water: heating type, demands, capacity and efficiency
- Since the building examined in this tutorial will be in Canada. The location must be changed accordingly.
  - Click on the drop-down menu to change:
    - the Location Set to “All eQUEST Locations”
    - the State to “CANADA”
    - City to “Toronto, Ont.”
  - **Note:** that once you edit the building properties the font color changes to **red**. The city can be chosen per the assignment. For this tutorial, the city chosen is Toronto

- To switch screens, click on the drop-down menu

The screenshot shows the 'eQUEST Schematic Design Wizard' window. The 'General Information' section contains the following fields:

- Project Name: Project 3
- Building Type: Office Bldg, Two Story
- Location Set: All eQUEST Locations
- State: CANADA
- City: Toronto, Ont.
- Code Analysis: - none -
- Jurisdiction: - other -

The 'Utility' section includes:

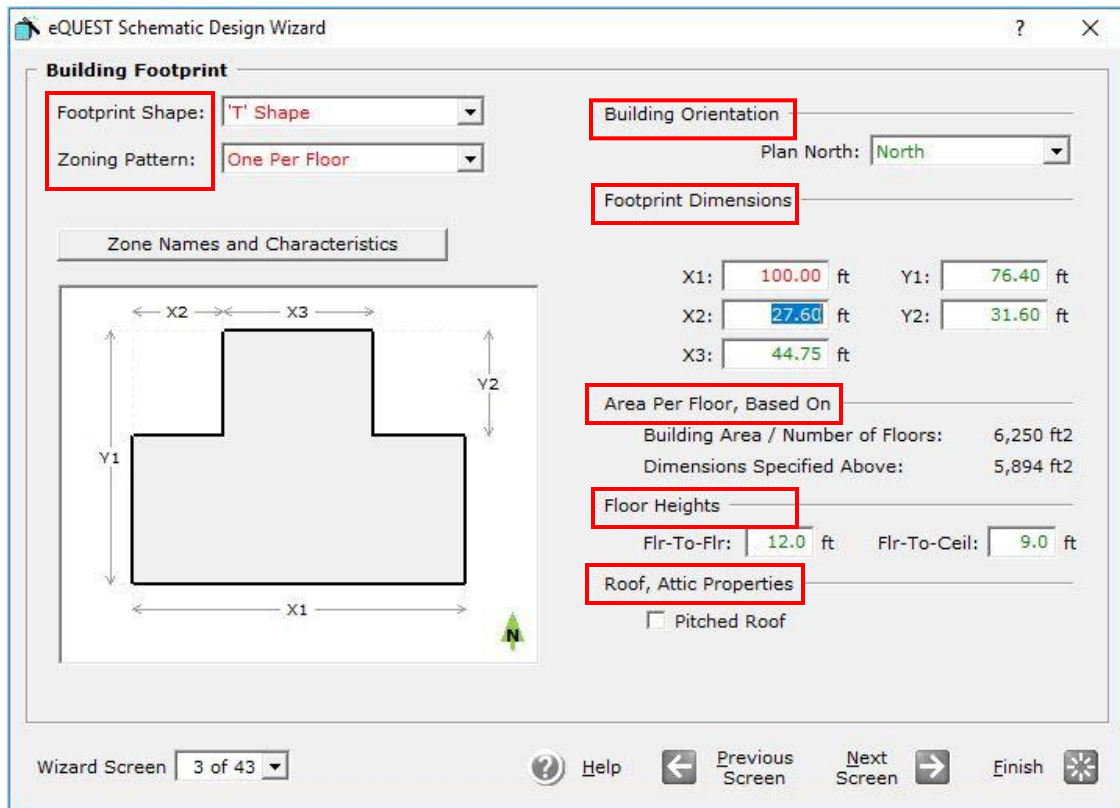
- Electric: file -
- Gas: - file -
- Rate: - none -

The 'Area, HVAC Service & Other Data' section includes:

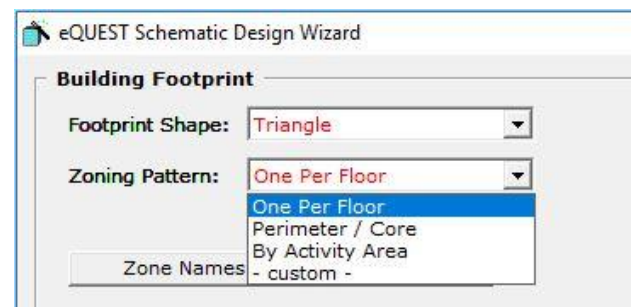
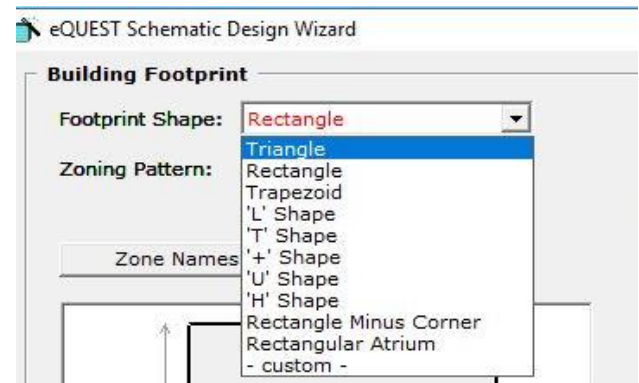
- Building Area: 25,000 ft2
- Number of Floors: Above Grade: 2, Below Grade: 0
- Cooling Equip: No Cooling
- Heating Equip: No Heating

At the bottom, the 'Analysis Year' is 2018, 'Daylighting Controls' is No, and 'Usage Details' is Simplified Schedules. The 'Next Screen' button is highlighted with a red box.

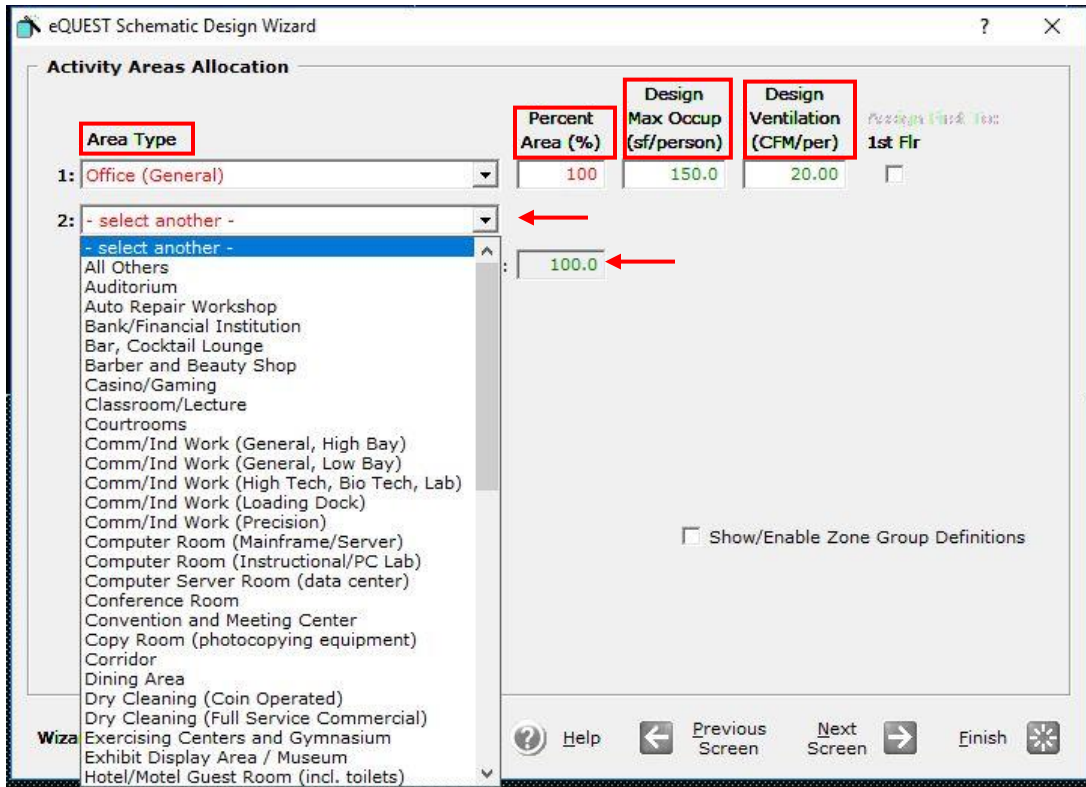
- Click on Next Screen to get to the *Building Footprint*, this page is important as you can specify the characteristics of the building.
- In the **red** squares: the shape, zoning pattern, dimensions, building orientation and floor height can be chosen.



- Footprint Shape: allows you to pick from a list of shapes or customize your own for this chapter
- The list of shapes are presented in **Figure #**
- For the purpose of the tutorial a 'T' Shape was chosen as presented below. The shape you choose should be given in **the assignment**.
- Zoning Pattern: determines the HVAC zoning required. For this tutorial "One Per Floor" is chosen for the demonstration
- **Note:** You can customize both the Footprint Shape and Zoning Pattern this will be demonstrated in the next chapter



- Again click on Next Screen or the drop down menu to get to page 13 *Activity Areas Allocations*
  - This page allows you to determine the type of building you are simulating
- For this example an office space is being tested. All you need is one floor of general offices
  - To remove the default options given, click on the drop down menu and choose “select another”
  - As the number of area types decreases notice the Percent Area (%) also decreasing
  - For now the Design Max Occup and Design Ventilation will remain as a default
- To move to the next page the Percent Area (%) has to be set to 100%
- It is encouraged that you flip through all screens and become familiar with the inputs.
  - **Note:** Check the assignment requirements to make sure you insert the correct inputs



- Once you are done click on finish. This will save your wizard inputs and navigate you to the eQUEST interface

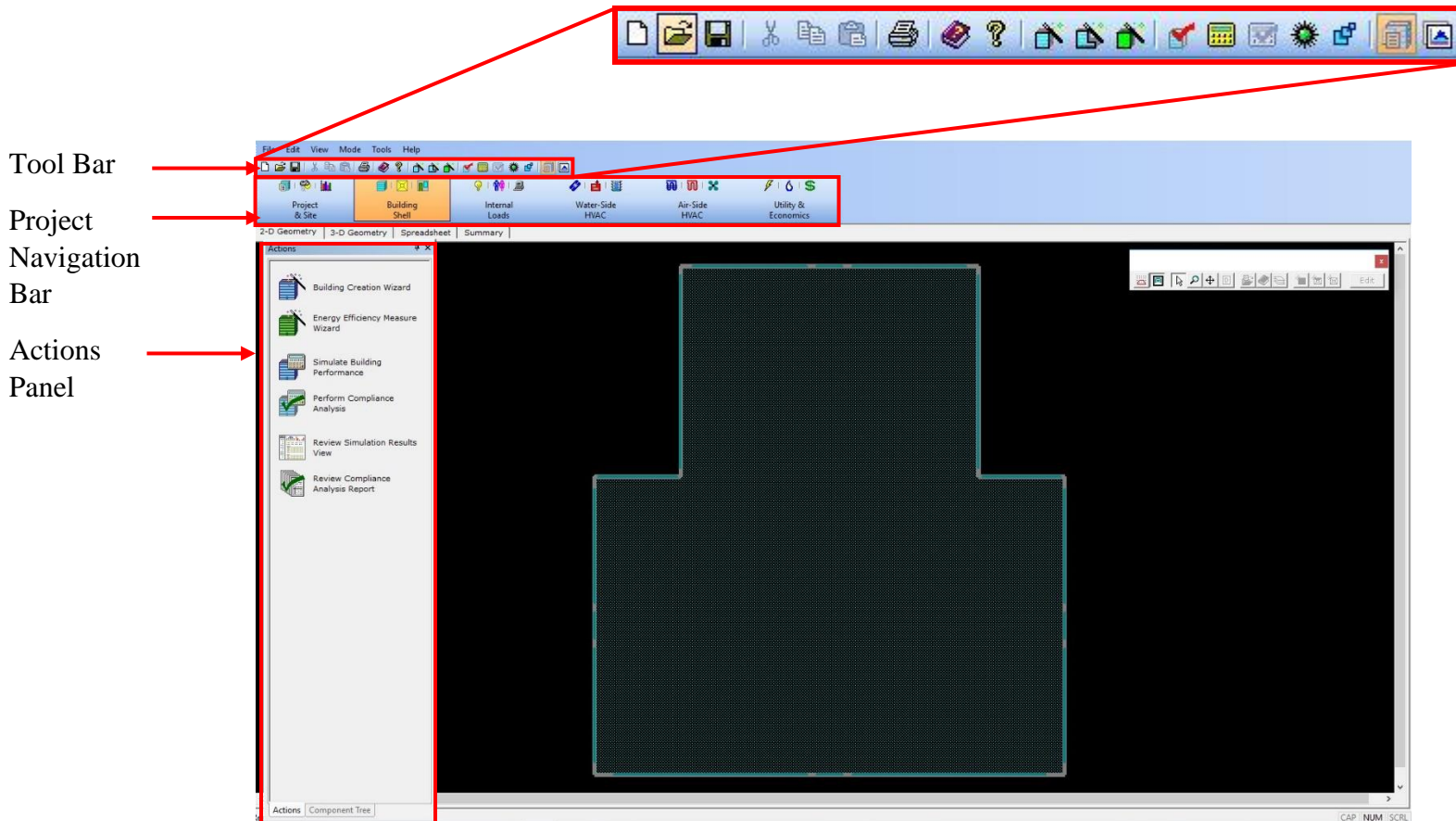


### 3.0 Navigating the webpage

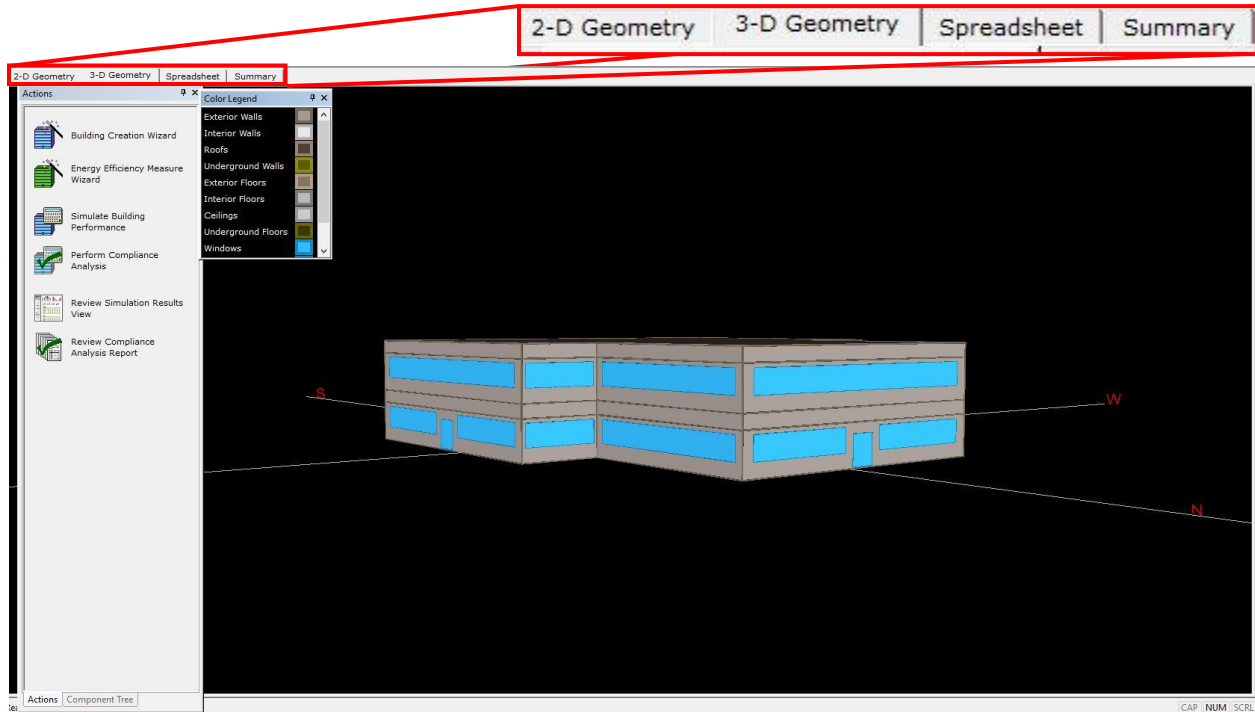
This section will introduce you to the main page on **eQUEST** and present what each function does. This includes the side bar and the top tool bars.

#### 3.1 Main Page

- Once you click **Finish eQUEST** will switch to the main interface as shown below. This presents the plan view of the building.
- In red you can see the top tool bar, Actions Panel and Project Navigation bar.



- You can switch between 2D and 3D Geometry by clicking on the options shown on the figure below.
  - In 3D you can:
    - zoom** by holding down the control key and right click on the mouse
    - move** by holding down the control key and left click on the mouse



- Building Creation Wizard**
  - This wizard modifies any existing model in the detailed interface. This allows you to return to the SD or DD Wizard, in this tutorial the SD wizard was chosen.
  - You can modify your wizard inputs only if the original building model was generated in one of the wizards.
  - Note:** any edits made to the model directly in the interface will not be reflected in the SD or DD Wizard.
  - To save the original building model before making any changes simply save the model using the save icon in the tool bar.
  - You can visit the wizard window by clicking on any of the icons shown on the right side which are in the Actions Panel or top tool bar.
- Energy Efficiency Measure Wizard (EEM)**
  - This wizard allows you to explore your proffered design alternatives
  - Once you are done creating a new building design or editing an existing one. The EEM Wizard will describe ten alternative to your original building design.
  - Select EEM's by *measure by category* or select the *Whole Site/Building* which will access the full wizard.
  - This will allow you to simulate any of the alternatives given and compare your results to your base case.
  - The icons on the side are **eQUEST**'s EEM which can be found on the Action Panel or tool bar





- Simulate Building Performance
  - From the tool bar or action panel click on *Run Simulation* to perform an annual simulation of the base building design or any of the alternative designs



- Review Simulation Results View
  - Once the simulation is complete select *View Summary Results/Reports* to view the graphic outputs
  - In the results screen, select Project/Runs tab then select the desired report you wish to view
  - Then select the *Reports* tab, then select any of the *Single-Run Reports*

### 3.2 Exploring the Navigation Bar

- **eQUEST** organizes the model information into six sections as presented in the project navigation bar at the top of the View screen. The following list describes what each function does:



**Project & Site**: This is the first window that opens when you click Finish. It presents the overall project information such as design day, annual weather data and project report requests



**Building Shell**: demonstrates zoning, geometry and construction for spaces, walls, windows and doors



**Internal Loads**: looks at internal loading and schedules for people including lights and equipment



**Water-Side HVAC**: water-side distribution and primary equipment

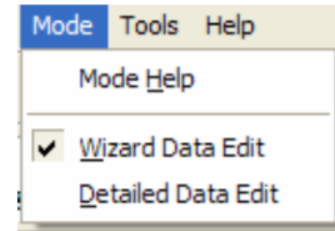


**Air-Side HVAC**: air-side distribution and secondary equipment



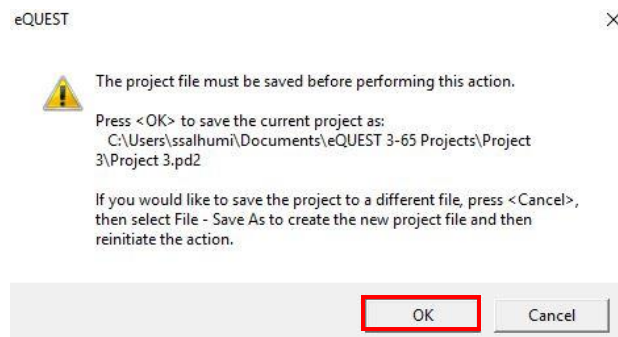
**Utility & Economics**: evaluates meter/sub-meter assignments and utility rate tariffs

- **Note:** to make edits to the model, click on Mode and select *Detailed Data Edit*

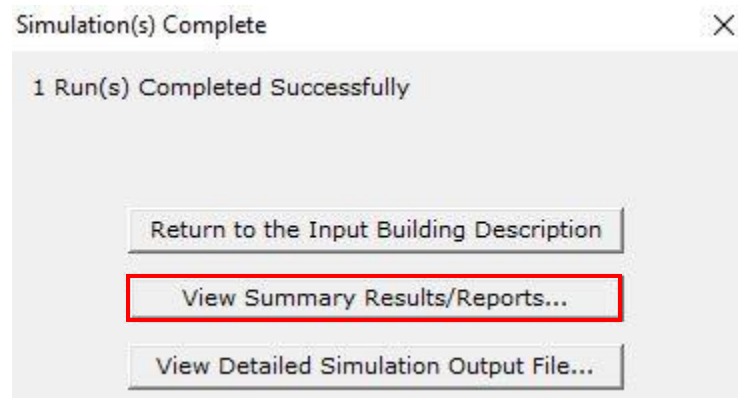


### 3.3 Running the First Simulation

- Now that all the data has been entered you can run your first simulation
- Click on *Simulate Building Performance*, the following window will pop up click 'OK'



- Next it will ask you to install the weather file, click on 'Install via Internet'.
  - **eQUEST** will retrieve the data associated with the chosen location. In this case, it is Toronto.
  - **Note:** The program installs the data from the website where the program was downloaded
- Once the simulation is finished you can click on *View Summary Results* as shown in the figure below:





- You can also modify the simulation by clicking on *Project View* on the tool bar then click Building Creation Wizard in the Action bar on the side
  - You can also switch back to the Reports by clicking the icon in purple



- Subsequently, a small window will appear and ask if you want to save the click 'Yes' then 'OK'
- This will take you back to the wizard and edit per **the assignment** If needed
- Then you can run the simulation again as stated above

<http://energy-models.com/what-is-energy-modeling-building-simulation>