USER MANUAL

ADVANCED Tool

ECO-NIWAS 2.0

Version 1.1

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1 Introduction

1.1 About Advanced tool

India's National Action Plan on Climate Change (2008) points to building energy efficiency measures as very essential to carbon emission reduction of the country. At the forefront, GIZ and Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India are working together to form policies to promote energy efficiency and support their execution at national and state level. The ECONIWAS program aims to promote energy efficiency in residential buildings and in turn reduce the impact of carbon footprint on the environment, particularly for India. It target consumers who are eager to understand the variety of energy efficiency (EE) measures that are available and the professionals who want to exercise energy efficiency of various customizable options including the compliance status of the building design as per Bureau of Energy Efficiency (BEE) guidelines and regulation.

1.2 Who Should Use It?

The ECONIWAS Advanced tool is a simulation based evaluation platform that has been designed to assist the Architects, Engineers, MEP consultants, developers alike in understanding and evaluating the design features of the residential projects on account of their energy, environmental and economic performance. This tool has family of options for various building design parameters such as Building Geometry, Envelope, Lighting, Equipment, HVAC and Economics, the user can play with these customizable options that are available as input in the tool and come up with the best possible selection of parameters to make the building design optimized in terms of economics as well energy performance. The Advanced tool has been designed to keep it simple and easy to use; and does not require specific skill (energy simulation). Following individuals with little or no experience in the area of residential building sector can use this tool:

- Engineers
- Architects
- Consultants
- Residential project contractors

1.3 System Requirement

For smooth functioning of this tool, following system configuration is essential:

- Browser – Google Chrome, Safari, Explorer, Mozilla.
- Processor Speed – i3 (2.0 GHz or More)
- Memory – RAM (4 GB at least)
- Hard Disk Space – Not Required
- Net Connectivity – Yes

2 Advanced Tool Interface

2.1 Signing Up

The signup level is for the record keeping of credentials for individual user on the website. For creating an account, the user is required to input a few preliminary information.

Figure 1: Sign-Up level

1 **Name:** Enter the name of the user here.

For Example, let's take "GIZ" as name here.

2 **Email:** Enter the Email ID. This will be the username.

For Example: let's take "xxxx@gmail.com" as e-mail.

3 **Mobile Number:** Enter the mobile number of the user here.

For Example: let's take "9876543210".

4 **Password:** Choose and register a password which is unique and easy to remember.

5 **Confirm Password:** Retype the password here for verification.

6 **Address:** Enter the correspondence address here.

7 **Register:** After carefully filling the form, press this button. This will confirm the registration and show the confirmation message.

***Please note that in case of successful registration, a verification link shall be sent to the registered email ID. The user is required to click the link in the registration e-mail received for activation of the account. **Name, Email, Password** and **Confirm Password** are mandatory for registration.*

2.2 Signing In

At this level, the user is required to enter the registered email ID and password to login.
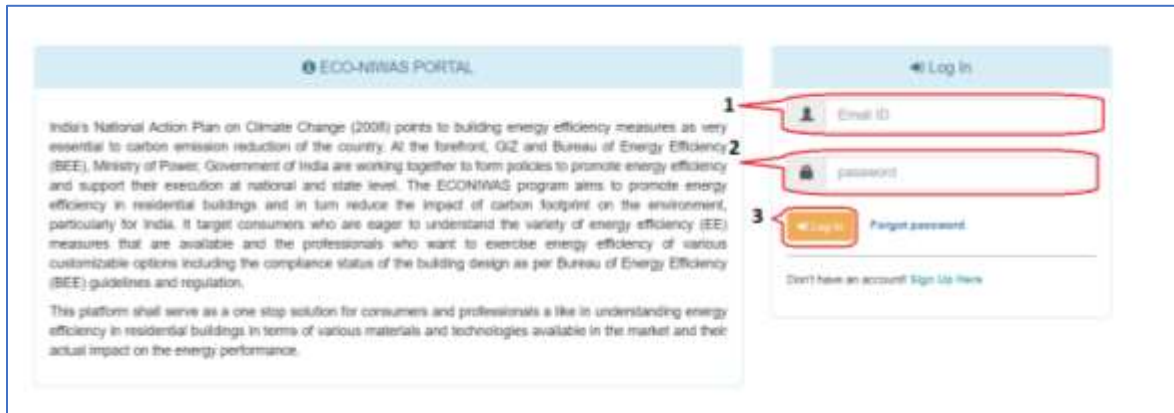
Figure 2: Sign-In level

1 **Email ID:** Enter the registered email ID at the time of sign-up here.

   For Example: Let's take example email as "giz@yahoo.com" here.

2 **Password:** Enter the registered password at the time of sign-up here.

   For Example: put "9876543210" here.

3 **Log In:** After filling the required information, press the Log In button. This shall take you to the project listing page of the tool.

2.3 Forgot Password

In case the user forgets the registered password, there is a provision to reset the password in the "Forgot Password" module. The user is required to enter the registered email ID where the password information shall be sent.
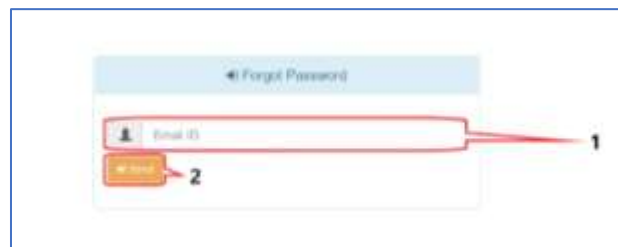
Figure 3: Forgot password level

1 **Email ID:** Enter the register email id where the password information will be sent

   For Example: "xxxx@gmail.com".

2 **Send:** After entering the email ID, press the send button. This will send the details of registered password to the registered e-mail ID.

2.4 Project Listing Page

This is the primary level of the tool where all the projects are listed.
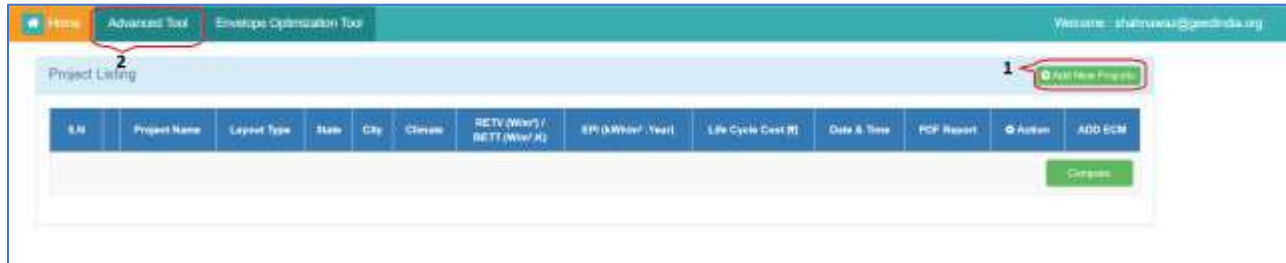
Figure 4: Project Listing level

1 **Add New Project:** Users can create new project by clicking this button, this will open a fresh form for the new project entry.

2 **Advanced Tool:** Make sure to click on "Advanced Tool" module before clicking on "Add New Project" Button, to work in the Advanced tool.

## 2.5 Basic Information level

After clicking on the "Add New Project" button, the Advanced tool opens a fresh form for new project entry. The first section of the form is the basic information level which asks the user to input the details of project location, climate, weather, building topology, number of occupant and latitude etc. User can also save the form information on the go by pressing the "Save Data" button on the right-side help panel of the tool.

Figure 5: Basic information level

1 **Project Name:** The project name is the name assigned to the project for identification purpose for later use and reference. Please enter a unique name preferably related to design or location of the project.

For Example, let us take "my_project" as project name.

2 **State:** This field represents the State in which the project is located. Please select the corresponding state where the project is being developed from the drop-down list.

For Example, let us select "Delhi" as project state.

3 **City:** This field represents the city in which the project is located. Based on the selection of state, the corresponding city list shall be available in the drop down. Please select the city where the project is being developed from the drop-down list.

For Example, let us select "New Delhi" from the list here.

4 **Climate:** India has five different types of climatic zones namely Composite, Warm & Humid, Hot & Dry, Temperate and Cold. The Climate field shall be auto selected based on the selected location of the project.

5 **Weather Profile:** The field represents the climate profile which shall be used by the tool for various computations and simulations. The climate profile applicable shall be automatically selected by tool based on selection of state and city where the project is being developed.

6 **Building Topology:** Different typologies of buildings have different pattern of energy consumption. Please select the applicable typology from the drop-down list.
For Example, let us take, "Single Family" from the list here.

7 **Number of Occupancy:** One of the especially important aspect of equipment sizing in the building is how much the building is thermally loaded internally. Occupants generate and add a lot of heat in the occupied zones. Please select from the option of "Total Person" and "m^2/Pers" and input corresponding value to define the occupancy in the building.

8 **Latitude:** The field represents the Latitude at which the project is located. This input is essential for various computations and simulations. The latitude applicable shall be automatically selected by tool based on selection of state and city where the project is being developed.

9 **Save Data:** Use this button to save the information filled in the form.

2.6 Geometry Information level

The Geometry information level contains the information related to the layout, dimension of the building, no. of floors as well as floor height.
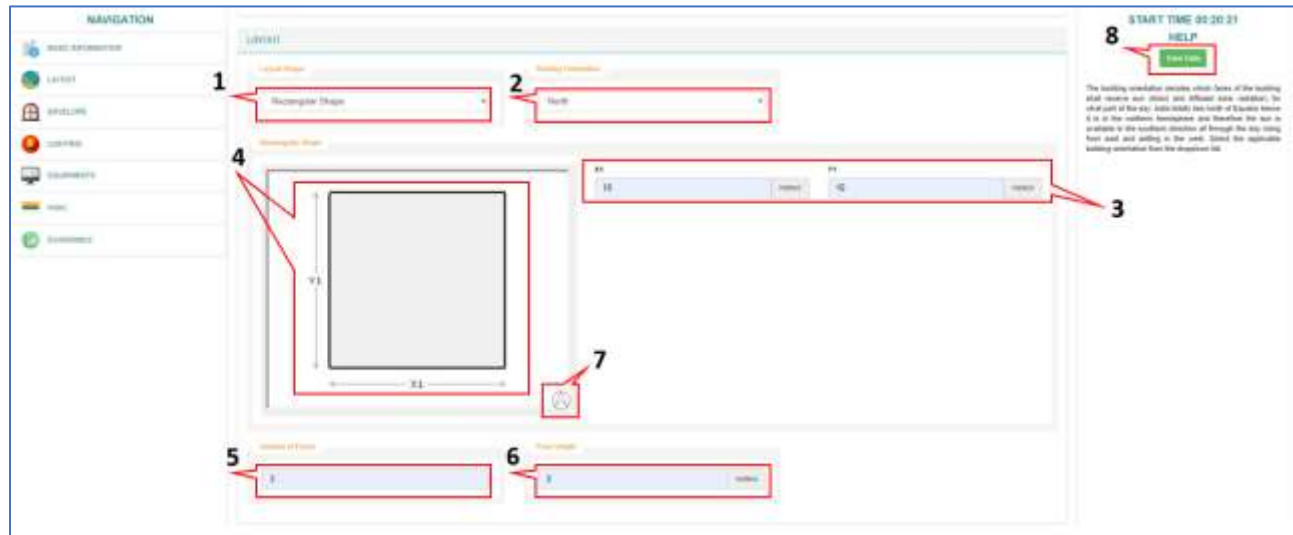

Figure 6: Geometry information level

1 **Layout Shape:** The more surface area exposed to the sun, the more solar heat incident on the building envelope (especially for Composite and Hot & Dry climate conditions). Therefore, the layout of the building plays an important role in deciding the thermal and lighting load in the building design. There are number of layout choices available in the tool such as Rectangle, L-Shape, U-Shape, T-Shape, Rectangle Minus Corner as well as provisions to create custom geometry. Select the applicable layout of the project from various options available in the dropdown. The number of dimension entries (X &Y) shall also be changed accordingly as per the selected layout.

Note: In case of custom geometry, please be sure to draw the shape clockwise to avoid error. Also please make sure to close the layout shape by pressing "C" on the keyboard.

For Example: In our case, let us choose "Rectangular Shape".

2 **Building Orientation:** The building orientation decides which faces of the building shall receive sun (direct and diffused solar radiation) for what part of the day. India totally lies north of the equator hence it is in the northern hemisphere and therefore the sun is available in the southern direction all through the day rising from the east and setting in the west. Select the applicable building orientation from the dropdown list.

For Example: In our case, let us select "North" from the list here.

3 **X, Y:** These fields are for defining the dimensions of the building. Input the exact dimension of the building layout as per the site plan details of the project. The unit for entering the dimensions in the tool is Meters (m). The number of these dimension inputs may change based on the selection of layout shape.

4 **Shape:** This picture represents the layout shape selected from the dropdown list.

5 **No. of Floors** The energy consumption of any building is proportional to the its overall built-up area. The maximum acceptable number of floors in the tool is 100. Input the applicable number of floors as per the project design.

6 **Floor Height:** The floor height is essential in ascertaining the volume of air inside the building, that needs to be brought the comfortable conditions with the help of Air conditioning systems. Enter the applicable floor height as per the design of the project.

7 **North Arrow:** This arrow always points towards the north direction with respect to the selected orientation of the building.

8 **Save Data:** Use this button to save the information filled in the form.

2.7 Envelope Information Level

Envelope Information Level contains two main sections: **Construction Details** and **Dimensional Details**.

2.7.1 Construction Details Level

Construction details level contains the information related to **Wall details**, **Roof details** and **Fenestration details**.

> ➢ Wall details section allows the user to make different wall construction assemblies based on material layers or properties.
> ➢ Roof details section allows the user to make different roof construction assemblies based on material layers or properties.
> ➢ Fenestration details section allows the user to define fenestration assemblies based on thermal properties.

For wall and roof construction, there are two different definition methods available in the tool which are:

1- Layer-by-Layer Construction: Using this method, the user can create composite assemblies of wall and roof by selecting different material layers and entering their corresponding thickness. The tool creates the assembly based on layers selection by the user along with calculation of equivalent thermal conductance (U-value) of the assembly. This method is particularly useful in case the user has the material specification of composite wall and roof assemblies of the project design.

2- Property: This is a relevantly straight forward method of defining a wall or roof construction. The user is required to input the overall thermal conductance (U value) in $W/m^2.K$ for the wall or roof assembly directly without specifying the construction materials. This method is useful when the user has the specification of the thermal properties of the composite wall or roof assembly.

***The detailed description for using both these definition methods has been explained in the **Wall Detail** & **Roof Detail** sections of this manual.*
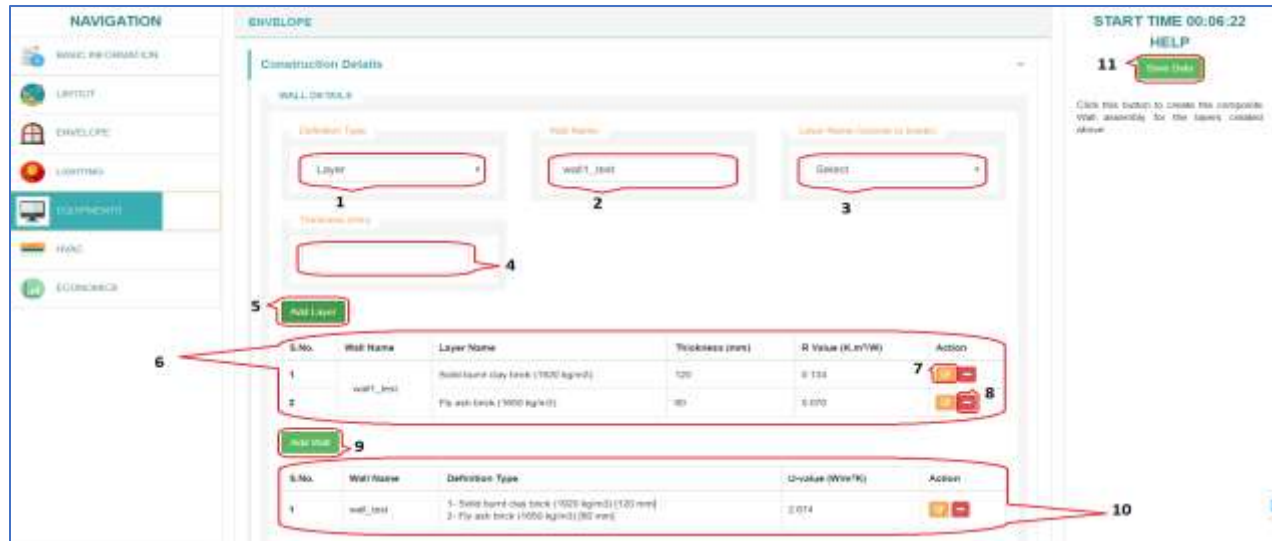
Wall Details:

Figure 7: Construction Information level

1 **Definition Type:** This field represents the methods to define the Wall assembly in the project. The user can add multiple wall assemblies using the methods available in the tool to create a library. These library materials then can be used to evaluate their performance on the overall energy efficiency of the project. Select "Property" method if you wish to input the overall heat transfer coefficient (U-value) of the Wall assembly and Select "Layers" if you wish to assemble the Wall layer-by-layer using standard materials.

Select the definition method from the dropdown list to define the method of wall definition. The field **4** shall be disabled and **3** shall be replaced by "U-value" in case "Properties" is selected.

2 **Wall Name:** The wall name is the name assigned to the project wall entry being created for identification purpose for later use and reference. Please enter a unique name preferably related to assembly type or other distinguishable factors.

For Example: In our case, let us make a wall construction named "Wall_test".

3 **Layer Name:** Many times, the wall of the building is composed of multiple layers. The tool has provisions to define the wall by defining the layers it is composed off. Select the layers from the dropdown list along with the thickness of the layer and click on "Add Layer" button to create the wall assembly layer. Once the layer addition is complete, click on "Add Wall" to add the created composite Wall in the main table for later use.
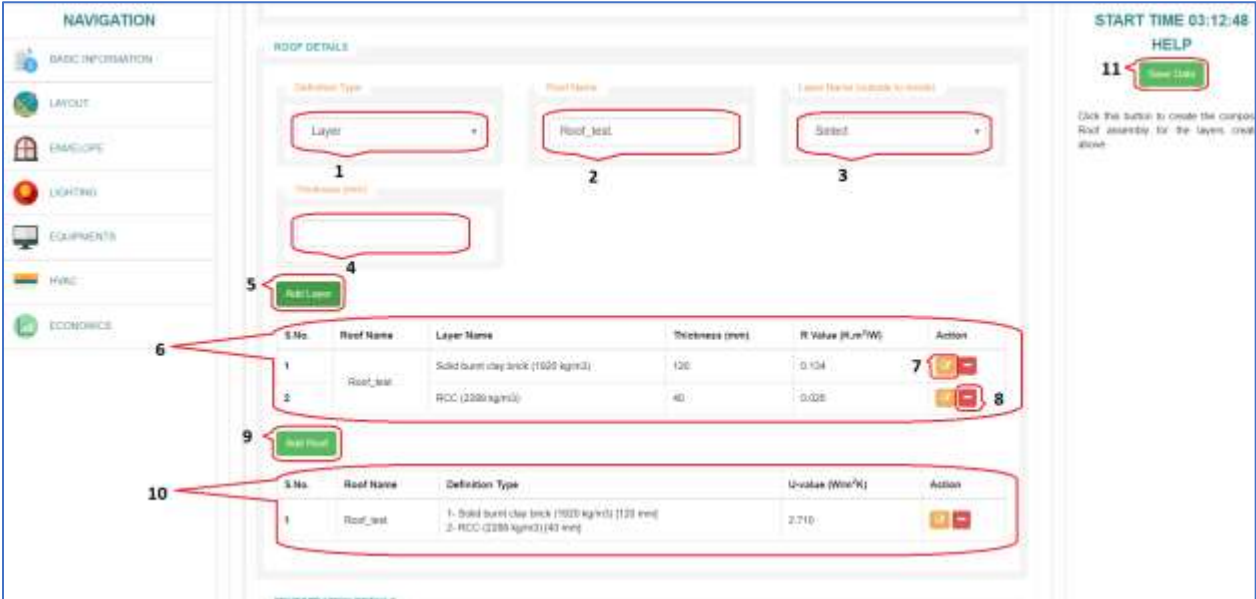Select the applicable material layer from the dropdown list.

For Example: let us select "Fly ash brick (1650 kg/m^3) block" from the layers list.

4 **Thickness(mm):** Enter the thickness of the layer selected in the previous field to define one layer of the composite wall assembly. Next, click on "Add Layer" button to add the layer in the assembly being created in the below table.

For Example: In our case, let us take thickness of "150" (mm) in this textbox.

5 **Add Layer:** Click this button to add the selected layer to the current wall assembly table.

6 **Wall Assembly Table:** This table contains the details of all the layers used to define a particular wall assembly.

7 **Edit:** Click this button to edit the properties of layer/construction. The same is applicable for Wall Construction Table **10**

8 **Delete:** Click this button to delete the selected layer/construction from the table. The same is applicable for Wall Construction Table **10**

9 **Add Wall:** Clicking this button will add all the layers present in the wall assembly table as a unique wall construction along with calculated equivalent U-value in the wall construction table.

10 **Wall Construction Table:** This table contains the details of all the wall constructions created by the user along with their equivalent U values in W/m^2K.

11 **Save Data:** Use this button to save the information filled in the form.

Roof Details:

Figure 8: Roof details

1 **Roof Definition Type:** This field represents the methods to define the Roof assembly in the project. The user can add multiple Roof assemblies using the methods available in the tool to create a library. These library materials then can be used to evaluate their performance on the overall energy efficiency of the project. Select "Property" method if

you wish to input the overall heat transfer coefficient (U-value) of the Roof assembly and Select "Layers" if you wish to assemble the Roof layer-by-layer using standard materials.

Select the definition method from the dropdown list to define the method of wall definition. The Field 4 shall be removed and 3 shall be replaced by "U-value" in case "Properties" is selected.

2 **Roof Name:** The roof name is the name assigned to the project roof entry being created for identification purpose for later use and reference. Please enter a unique name preferably related to assembly type or other distinguishable factors

For Example: In our case, let us make a roof construction named "Roof_test".

3 **Roof Layer:** Many times, the roof of the building is composed of multiple layers. The tool has provisions to define the roof by defining the layers it is composed off. Select the layers from the dropdown list along with the thickness of the layer and click on "Add Layer" button to create the roof assembly layer. Once the layer addition is complete, click on "Add Roof" to add the created composite roof assembly in the main table for later use.

For Example: let us select "RCC (2268 kg/m^3) block" from the layers list.

4 **Thickness(mm):** Enter the thickness of the layer selected in the previous field to define one layer of the composite roof Assembly. Next, click on "Add Layer" button to add the layer in the assembly being created in the below table.

For Example: In our case, let us put thickness of "100" (mm) in this textbox

5 **Add Layer:** Click this button to add the selected layer to the current roof assembly table.

6 **Roof Assembly Table:** This table contains the details of all the layers used to define a particular roof assembly.

7 **Edit:** Click this button to edit the properties of layer/construction. The same is applicable for roof Construction Table **10**

8 **Delete:** Click this button to delete the particular layer. Same as for the Roof Construction Table **10**

9 **Add Roof:** Clicking this button will add all the layers present in the roof assembly table as a unique roof construction along with calculated equivalent U-value in the roof construction table.

10 **Roof Construction Table:** This table contains the details of all the roof constructions created by the user along with their equivalent U values in W/m^{2}K for defining project.

11 **Save Data:** Use this button to save the information filled in the form.

Fenestration Details:

Figure 9: Fenestration details

1 | **Fenestration Type:** The fenestration can be defined as an opaque or semi-opaque element of the external envelope that allows the transmission of light and solar radiation in the building. There are various types of fenestrations which are generally installed in the residential buildings. Select the applicable fenestration type from the dropdown list to define the properties of the entry.

For Example: In our case, let us make a fenestration type "Window".

2 | **Name of Window:** The Window name is the name assigned to the project window entry being created for identification purpose for later use and reference. Please enter a unique name preferably related to window property or other distinguishable factors.

For Example: In our case, let us make a window named "Window".

3 | **Fenestration Opening Type:** The fenestration opening type is an important factor that decides the amount of air inlet/out through the window opening. The "Casement" window is assumed to be 90% openable area, "3-Door Sliding" category is assumed to have 66% openable area and "2-Door Sliding" is assumed to have 50% openable area. Please select applicable fenestration opening type from the dropdown list.

For Example, let us select "Casement" from the dropdown list.

4 | **U-value(W/m²K):** The overall heat transfer coefficient or U-value is the measure of the amount of heat transferred in watts (W) from hotter surface to colder surface of the fenestration, if the temperature difference between the two surfaces of the fenestration is 1 °K. Enter the U-value of the fenestration as per the design of the project.

For Example: In our case, let us put U-value of "2.3" (W/m².K) in this textbox.

5 **SHGC:** Solar Heat Gain Coefficient (SHGC) is the ratio of the amount of solar radiation incident on the fenestration surface to the amount of solar radiation transmitted through the incident fenestration surface. It is a very important property of the non-opaque envelope of the buildings that describes the intensity of radiative heat transfer through it. Please enter the SHGC of the fenestration as per the design specifications.

For Example: In our case, let us set the slider of SHGC to "0.4".

6 **VLT %:** Visible Light Transmittance or VLT is the ratio of the amount of solar visible light incident on the fenestration surface to the amount of solar visible light transmitted through the incident fenestration surface. It is an important property of the non-opaque envelope of the buildings that describes the availability of daylight inside a building. Please enter the VLT of the fenestration as per the design specifications

For Example: In our case, let us set the slider of VLT to "0.5".

General Specification for Different Types of Glass			
Glass Type	U Value (W/m^2.K)	SHGC	VLT
Single Glazed Unit	5.8	0.8	0.85
Double Glazed unit	3.6	0.55	0.50
Triple Glazed Unit	1.8	0.30	0.25

7 **Glazing:** For every fenestration system installed in the building, there are two major elements of the fenestration assembly, first is the glass area and the second is the frame area. Enter the total glass area percentage of the fenestration system here.

For Example: In our case, let us set the Glazing % to "50 %"

8 **Opaque Frame Properties:** The opaque frame U-value or overall heat transfer coefficient is the measure of the amount of heat transferred in watts (W) from hotter surface to colder surface of the opaque frame of fenestration, if the temperature difference between the two surfaces of the opaque frame is 1 °K. Select the opaque frame of fenestration from the drop-down menu.

For Example: In our case, let us select "Metal frame" from the drop-down.

9 **Add Fenestration:** After input of all the required entries to define the fenestration element, click on this button to add the fenestration entry in the library table below.

10 **Fenestration Table:** This table contains the details of all the fenestration assemblies created by the user.

11 **Edit:** Click this button to edit the properties of fenestration assembly.

12 **Delete:** Click this button to delete any fenestration assembly in table.

13 **Save Data:** Use this button to save the information filled in the form.

2.7.2 Dimensional Details Level

In the dimensional details level, the user is required to assign construction details such as type of wall, type of fenestration and shading details to each façade of the layout defined in the previous section of the tool including roof construction details. The tool automatically populates the number of walls and assigns orientation based on the layout definition.
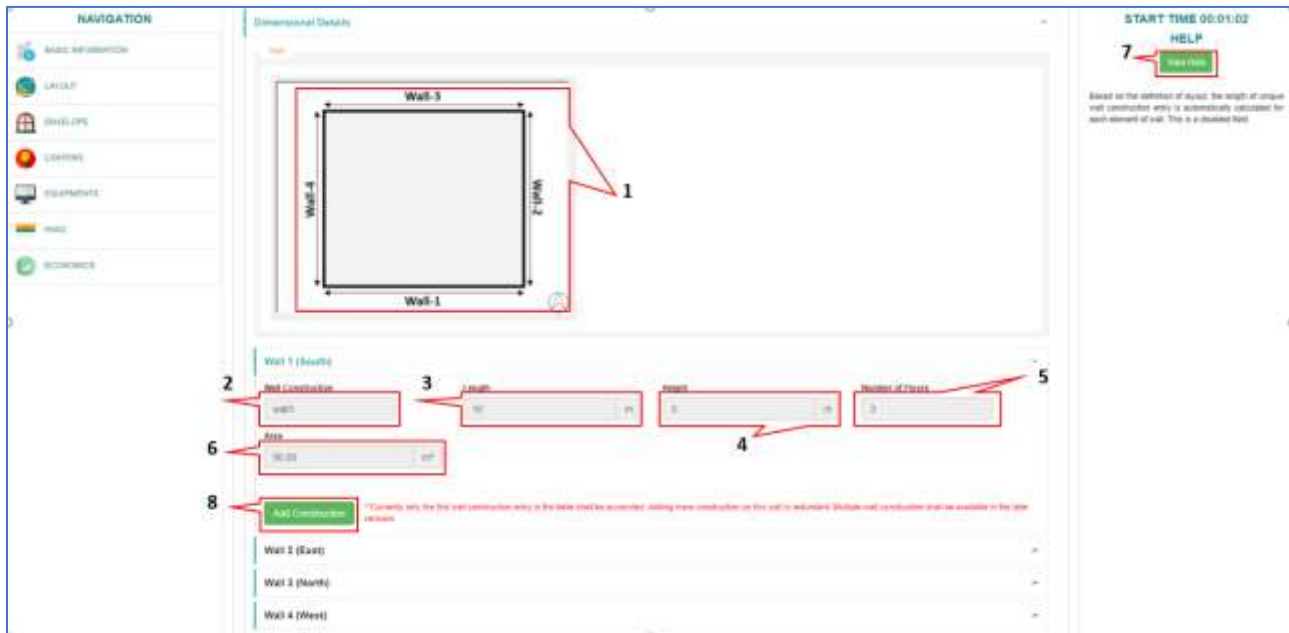

Figure 10: Dimensional details level

1 **Wall Configuration:** This is the layout shape defined by the user. The tool automatically assigns name and orientation to each façade of wall for ease of reference.

2 **Wall Name:** Based on the definition of layout, a unique wall construction name is automatically assigned to each element of wall based on the orientation. This is a disabled field.

3 **Length:** Based on the definition of layout, the length of unique wall construction entry is automatically calculated for each element of wall. This is a disabled field.

4 **Height:** This field shows the height of individual floor initially defined in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

5 **Number of Floor:** This field shows the number of floor/s initially defined in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

6 **Area:** The total area of the selected wall dimension entry is computed based on the inputs in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

7 **Save Data:** Use this button to save the information filled in the form.

8 **Add Construction:** For each unique wall dimension entry, the tool has the provision to define wall constructions, based on the libraries of envelope constructions (Wall & Window) defined in the construction section of the tool. Click on this button to select and define construction materials for the selected wall dimension entry along with the details of fenestration on the façade and the shading devices.

Assigning wall construction type:

After clicking on the "Add Construction" button, a pop-up will appear in the tool to enter the construction type of the wall, exposure to outside environment, fenestration well as shading details. The details of these inputs have been explained below:

Figure 11: Wall construction details level

1 **Type:** Based on the library of wall constructions created in the construction section of the tool, all the options are available in the dropdown list to be assigned to this wall dimension entry. Select the type of construction applicable to this entry. Currently, only one wall construction per wall entry is allowed in the tool, the provisions for multiple entries is under development and shall be made available soon.

2 **Length:** Based on the definition of layout, the length of unique wall construction entry is automatically calculated for each element of wall. This is a disabled field.

3 **Height:** This field shows the height of individual floor initially defined in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

4 **Number of Floor:** This field shows the number of floor/s initially defined in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

5 **Area:** The total area of the selected wall dimension entry is computed based on the inputs in the layout section of the tool. This is a disabled field and is shown here for representation purpose only.

6 **Boundary condition:** Although the external envelope has been defined in the layout section of the tool, the building may be adjacent to other buildings for the selection dimensional entry and may not be exposed to the external environment. This affects the heat gain/loss from/to the external environment. Please select from the dropdown list as whether the selected wall entry is "exposed" or "not- exposed" to outside environment.

For Example: In our case, let's select "Exposed to outside" from dropdown.

7 **Add Fenestration:** In case you select the boundary condition as "**Exposed to Outside**", this button will appear. Click it to assign fenestration elements to this wall entry, as per the library created in the fenestration construction section of the tool, along with the shading details. Multiple entries of fenestration elements for single wall dimension entry can be done.

Assigning Fenestration to Wall:

After assigning the construction type for the wall, the next input required from the user is the type and size of fenestrations available on the wall along with the details of shading element. The tool has provision to create and assign multiple fenestrations on a single wall with different shading element. The details of these inputs are given below:

Figure 12: Fenestration details level

1 **Type:** Select the applicable fenestration construction type from the given dropdown list to be assigned on the selected wall dimension entry.

2 **Number:** Enter the number of fenestration element available on the selected façade of wall dimension entry. Please ensure that the total product of Number, Length and Height of Fenestration must not exceed the total area of the parent wall dimension entry.

For Example: In our case, let us take the number of windows as "5"

3 **Length:** Enter the individual horizontal length of the fenestration element in meters.

For Example: In our case, let us take the window length as "1 m"

4 **Height:** Enter the individual vertical height of the fenestration element in meters.

For Example: In our case, let us take the window length as "1.5 m"

5 **Area:** The total area of the selected fenestration entry is computed based on the total product of Number, Length and Height of Fenestration. This is a disabled field and is shown here for representation purpose only.

6 **Shading Type:** The defined fenestration element may have just overhang or side-fin or a combination of both. Select from six different possible combinations of shading devices as applicable

For Example: In our case, let's select "Overhang+ Right Side Fin" from dropdown.

*** In case the user selects any option other than "**No shading**", then a separate form for defining dimension of selected shading appears on the form.*

7 **Delete:** Click this button to delete the fenestration entry from the wall.

Assigning Shading Elements to Fenestration:

The tool gives the provision to install various shading elements such as Overhang and Side fins on the different fenestration of the project. The user needs to specify the dimension of these shading elements individually for each type of fenestration. Currently, following shading elements are available in the tool for installation:

1- **Overhang,**
2- **Left Side fin**
3- **Right Side fin**
4- **Overhang and Left-Side fin**
5- **Overhang and Right-Side fin**
6- **Overhang and Left-Side fin and Right-Side fin**

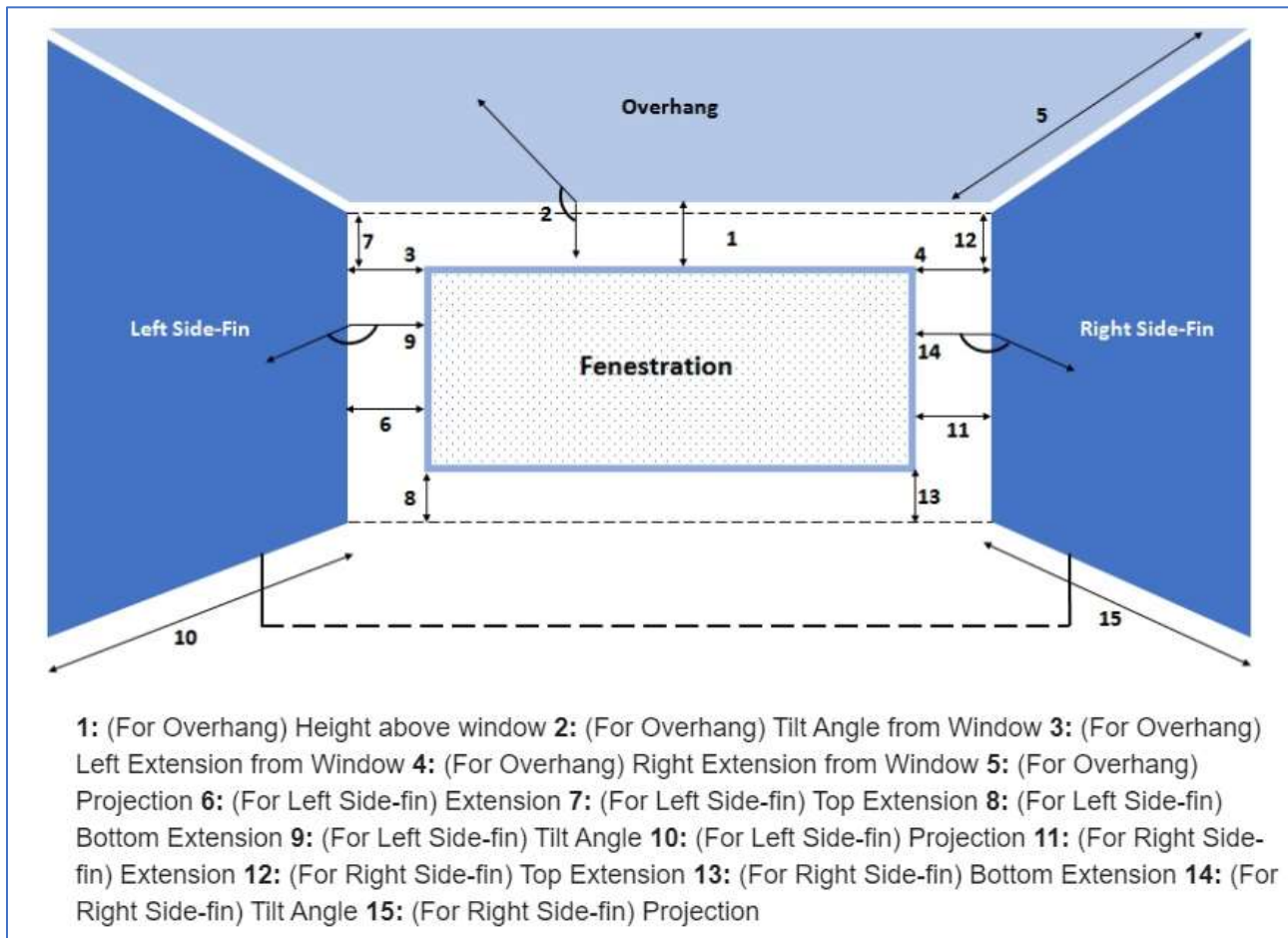The details of input for the shading element has been explained below.

1: (For Overhang) Height above window **2:** (For Overhang) Tilt Angle from Window **3:** (For Overhang) Left Extension from Window **4:** (For Overhang) Right Extension from Window **5:** (For Overhang) Projection **6:** (For Left Side-fin) Extension **7:** (For Left Side-fin) Top Extension **8:** (For Left Side-fin) Bottom Extension **9:** (For Left Side-fin) Tilt Angle **10:** (For Left Side-fin) Projection **11:** (For Right Side-fin) Extension **12:** (For Right Side-fin) Top Extension **13:** (For Right Side-fin) Bottom Extension **14:** (For Right Side-fin) Tilt Angle **15:** (For Right Side-fin) Projection

Figure 13: Shading Dimensions

Overhang:

1 **Height Above Window:** This field represents the height (meters) above the top of the window for the overhang.

For Example: In our case, let us take height above window as "0.1"

2 **Tilt Angle from Window:** This field is the tilt angle from the Window. For a flat overhang, this would be 90 (degrees).

For Example: In our case, let us take tilt angle from window as "90 degree"

3 **Left Extension from Window:** This field is the distance from the left edge of the window to the start of the overhang (meters).

For Example: In our case, let us take left extension from window as "0.1"

4 **Right Extension from Window:** This field is the distance from the right edge of the window to the start of the overhang (meters).

For Example: In our case, let us take right extension from window as "0.1"

Figure 14: Shading form details

5 **Projection:** An overhang typically is used to shade a window in a building. This field is the depth of the overhang (meters) projecting out from the wall.

For Example: In our case, let us take projection of window as "0.5 m".

Side Fin:

6 **Right Extension:** This field is the width from the Right edge of the window/door to the plane of the Right fin (meters). The extension width is relative to the edge of the glass and includes the frame width when a frame is present.

For Example: In our case, let us take Right Extension as "0.1 m"

7 **Right Top Extension:** This field is the distance from the top of the window to the top of the Right fin (meters) and is relative to the edge of the glass and includes the frame width when a frame is present.

For Example: In our case, let us take Right Top Extension as "0.1 m"

8 **Right Bottom Extension:** This field is the distance from the bottom of the window to the bottom of the Right fin (meters) and is relative to the edge of the glass and includes the frame width when a frame is present.

For Example: In our case, let us take Right Bottom Extension as "0.1 m".

9 **Right Tilt Angle:** This field is the tilt angle from the window / door for the Right fin. Typically, a fin is 90 degrees (default) from its associated window/door.

For Example: In our case, let us take Right Tilt Angle as "90" degrees

10 **Right Projection:** This field is the depth (meters) of the Right fin (projecting out from the wall).

For Example: In our case, let us take Right Top Extension as "0.1"

11 **Delete:** Click on this button to delete the shading entry from the fenestration.

12 **Add Fenestration:** Click this button to add another fenestration type to the wall.

13 **Add:** Clicking this button will assign all the wall, fenestration and shading details entered by the user in the selected wall façade. These added details can be seen in the dimension table visible on the main page of the Dimension Details module.

S. No.	Wall Construction	Wall U - Value - W/m²K	Wall Length - m	Wall Height - m	Window Construction	Window Length - m	Window Height - m	Window U - Value – W/m²K	No. Of Window	SHGC	VLT	SL		SR		OH		Action
												Dep	Dis	Dep	Dis	Dep	Dis	
1	Brick Wall	2.151	10.00	8	Wm1	1.00	1.50	4.5	5	0.4	0.5	–	–	0.1	0.1	0.1	0.1	

Figure 15: Dimension details table

2.8 Lighting Information Level

The next section in the Advanced tool is the Lighting Information Level. The user is required to define the lighting design load of the building by using either of the two methods as per Energy Conservation Building Code:

1- Building Area Method
2- Space Function Method.

2.8.1 Defining Lighting Load Using Building Area Method

Figure 16: Lighting details level (Building Area Method)

1 **Definition Method:** Lighting Power Density (LPD) is defined as the density of lighting power usage which means how much amount of wattage shall be utilized to luminate one square meter of area. For Building Area Method, the user is required to consider the whole building area as a single space and assign a constant LPD for whole building. Select the applicable option from the dropdown list.

For Example: In our case, let's select "Building Area Method" from dropdown.

2 **Lighting Power Density:** There are two different ways to define lighting power density here:
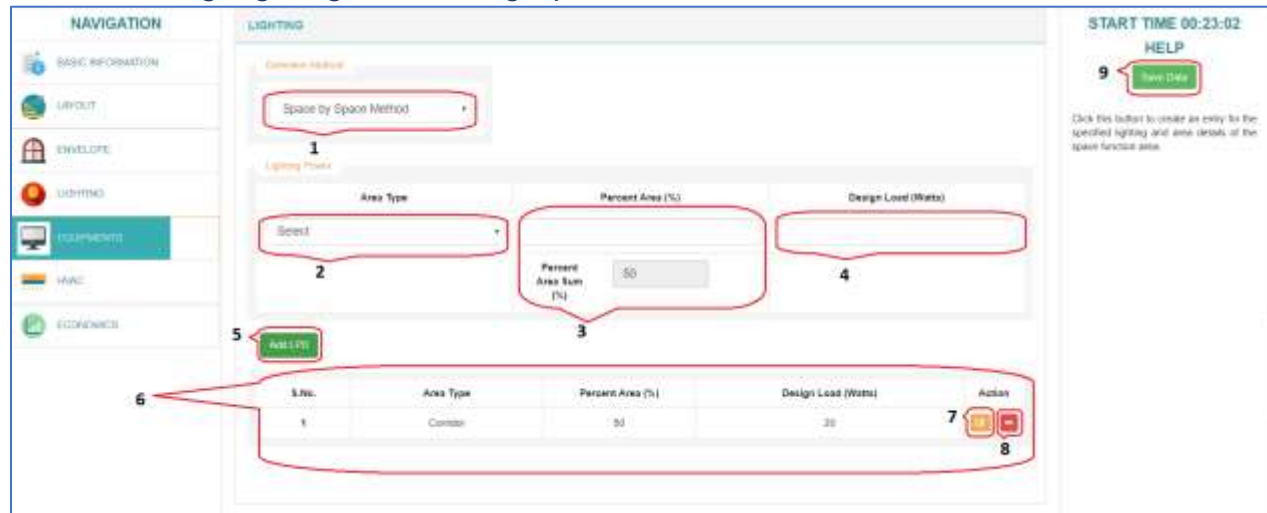
3 **W/m²:** under this option, the user is requested to input the load density of lighting per square meter of the building area

Watts: Under this option, the user is requested to input the total lighting load (in Watts) for the total built-up area of the building where the lighting fixtures are installed

For Example: In our case, let's put lighting power density "12" in this textbox and select unit as "W/m²" from dropdown

4 **Save Data:** Use this button to save the information filled in the form.

2.8.2 Defining Lighting Load Using Space Function Method

Figure 17: Lighting details level (Space Function Method)

1 Definition Method: For Space Function Method, the user is required to define the lighting load of each category of space in the building separately. This is a more organized way of defining the LPD where different zones may have different lighting load. Select the applicable option from the dropdown.

For Example: In our case, let us select "Space by Space Method" from dropdown.

2 Area Type: Select the applicable space function area type from the dropdown list. Please ensure that no two-space function area definition have same Design LPD. Choose the applicable option from the dropdown list.

For Example: In our case, let us select "Corridor" from dropdown.

3 Percent Area (%): This is the percentage of area for the above defined space function area type. Input the percentage of this area type available in the building. Please ensure that the total sum of individual space function area percentage must not exceed 100%.

4 Design Load (Watts): Under this option, the user is requested to input the lighting load (in Watts) for the percent area of the building where the lighting fixtures are installed

For Example: In our case, let us put Design Load "20" in this textbox.

5 Add LPD: After input of all the required entries to define the space by space method, click on this button to add the LPD entry in the library table below.

6 LPD Table: This table contains the details of all the LPD entries created by the user.

7 Edit: Click this button to edit the properties of fenestration assembly.

8 Delete: Click this button to delete any fenestration assembly in table.

9 Save Data: Use this button to save the information filled in the form.

2.9 Equipment Information Level

The next section in the Advanced tool is the Equipment Information Level. The user is required to define the equipment design load of the building by using either of the two methods as per Energy Conservation Building Code:

1- Building Area Method
2- Space Function Method.

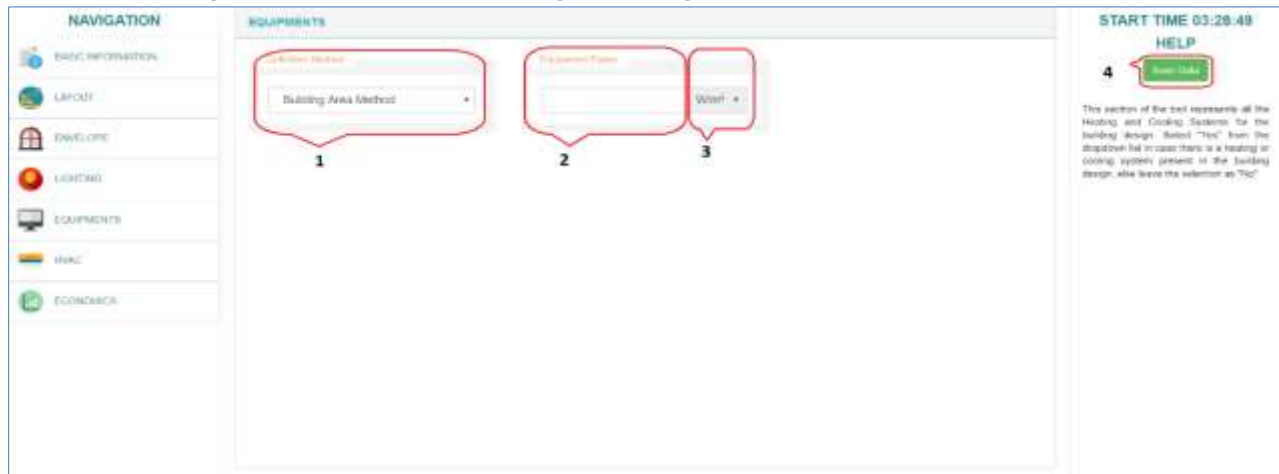### 2.9.1 Defining Equipment Load Using Building Area Method

Figure 18: Equipment details level (Building Area Method)

1 **Definition Method:** Equipment Power Density (EPD) is defined as the density of Equipment power usage which means how much amount of wattage of equipment is installed for one square meter of area. For Building Area Method, the user is required to consider the whole building area as a single space and assign a constant EPD for whole building. Select the applicable option from the dropdown list.

For Example: In our case, let's select "Building Area Method" from dropdown.

2 **Equipment Power Density:** There are two different ways to define equipment power density here:

3 **W/m^2**: under this option, the user is requested to input the load density of lighting per square meter of the building area

Watts: Under this option, the user is requested to input the total equipment load (in Watts) for the total built-up area of the building where the equipment fixtures are installed

For Example: In our case, let's put equipment power density "6" in this textbox and select unit as "W/m^2" from dropdown

4 **Save Data:** Use this button to save the information filled in the form.

2.9.2 Defining Equipment Load Using Space Function Method

Figure 19: Equipment details level (Space Function Method)

1   **Definition Method:** For Space Function Method, the user is required to define the equipment load of each category of space in the building separately. This is a more organized way of defining the EPD where different zones may have different equipment load. Select the applicable option from the dropdown.

For Example: In our case, let us select "Space by Space Method" from dropdown.

2   **Area Type:** Select the applicable space function area type from the dropdown list. Please ensure that no two-space function area definition have same Design EPD. Choose the applicable option from the dropdown list.

For Example: In our case, let us select "Corridor" from dropdown.

3   **Percent Area (%)**: This is the percentage of area for the above defined space function area type. Input the percentage of this area type available in the building. Please ensure that the total sum of individual space function area percentage must not exceed 100%.

4   **Design Load (Watts):** Under this option, the user is requested to input the lighting load (in Watts) for the percent area of the building where the lighting fixtures are installed

For Example: In our case, let us put Design Load "200" Watts here.

5   **Add EPD:** After input of all the required entries to define the load in the selected space, click on this button to add the EPD entry in the library table below.

6   **EPD Table:** This table contains the details of all the EPD entries created by the user.

7   **Edit:** Click this button to edit the properties of fenestration assembly.

8   **Delete:** Click this button to delete any fenestration assembly in table.

9   **Save Data:** Use this button to save the information filled in the form.

2.10 HVAC Information Level

As we move further in the tool, the next section is the HVAC (Heating Ventilation & Air Conditioning) information level, where the user is required to input the information related to the comfort systems installed in the project.

Figure 20: HVAC details level

1 **HVAC Present:** This section of the tool represents all the Heating and Cooling Systems for the building design. Select "Yes" from the dropdown list in case there is a heating or cooling system present in the building design, else leave the selection as "No".

For Example: In our case, let us select "Yes" from dropdown.

2 **Conditioned Area %:** The conditioned area is the percentage of area in the building which is served by the comfort system. Adjust the slider to match the percentage of area in the project that requires cooling or heating.

For Example: In our case, let us assume conditioned area of "50%".

3 **Cooling Present:** Choose "Yes" if there is a provision of Cooling System in the building design, else leave the selection as "No".

For Example: In our case, let us select "Yes" from dropdown.

4 **Cooling Thermostat setpoint:** The thermostat is a device that regulates the internal air temperature for an occupied zone where comfort systems are working. Adjust slider to define setpoint of thermostat for triggering of the cooling system.

For Example: In our case, let us set Cooling Thermostat setpoint of "25 °C".

5 **Coefficient Performance:** The Coefficient of Performance or COP is the ratio of total thermal load removed/added to the total energy consumed by the heating or cooling equipment to remove/add the heat. It is a very vital factor that affects the overall energy efficiency of comfort systems. Currently, the tool considers single COP value for heating & cooling system both. Enter corresponding COP of system here.

For Example: In our case, let us take the system COP as "4".

6 **Heating Present:** Choose "Yes" if there is a provision of Heating System in the building design, else leave the option as "No".

For Example: In our case, let us select "Yes" from dropdown.

7 **Heating Type:** Currently, there is only one available option for heating in the tool which is "Electric" .Please select from the dropdown list in case heating is present in the building.

8 **Heating Thermostat setpoint:** Adjust slider to define setpoint of thermostat for triggering of the heating system.

For Example: In our case, let us set heating thermostat setpoint of "15 ^{o}C".

9 **Save Data:** Use this button to save the information filled in the form.

2.11 Economics Level

The last section of the Advanced tool is the Economics level. This is an optional analysis module given to the user if he/she wants to evaluate the economic feasibility of the project design.
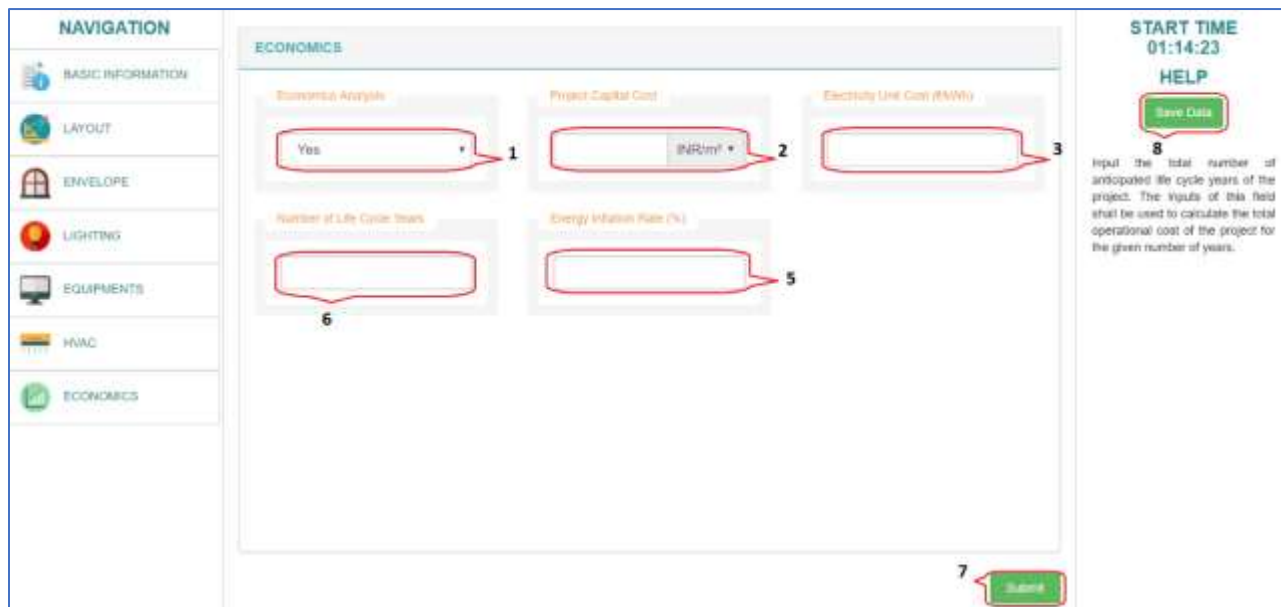

Figure 21: Economics evaluation tool

1. **Economics Analysis:** No option for energy efficiency is viable unless it makes an economical sense. This section of the tool is designed to perform economic analysis of the project design. To use this section, you must have an understanding of the project initial capital cost, Electricity unit cost in the project location, life cycle years of the project and energy inflation rate for the life cycle years. Choose "Yes" if you wish to perform economic analysis, else leave the selection as "No"

2. **Project Capital Cost:** Capital Cost (₹/m^2): Please change this label as "Project Capital Cost"

   There are two methods available in the dropdown list for input of capital cost:

   1) **Rupees (₹):** Select this option if you know the overall lumpsum total cost of the project and input the corresponding cost.
   2) **Rupees per square meter (₹/m2):** Select this option if you know the cost per meter square for the construction of the project and input the corresponding value.

3. **Electricity Unit Cost (₹/kWh):** Currently the tool supports the flat tariff provisions only. Input the applicable electricity unit cost in the project location.

4. **Number of Life Cycle Years:** Input the total number of anticipated life cycle years of the project. The inputs of this field shall be used to calculate the total operational cost of the project for the given number of years.

5. **Energy inflation Rate:** The Energy Inflation Rate is the percentage increment in the cost of energy annually. Enter the applicable energy inflation rate here.

6. **Submit:** On clicking this button, the tool will initiate the simulation program. Please make sure that all the input provided in the report are correct and standardized. In case of absurd values, the tool is prone to showing erratic results.

7. **Save Data:** Use this button to save the information filled in the form.

2.12 Results Panel

After the submission of the input form, the Advanced tool runs the server side simulation program for evaluation of energy, environmental and economic performance of the project. After execution, the result panel shows the computed EPI value and RETV value as well as Annual Capital cost, Annual Operational Cost and Annual CO_2 Emissions details of the project design.

Figure 22: Result panel

Alongside this, some other useful information of the project is also displayed on the page such as Climate, Orientation, Shape of the layout, Heating present and Cooling present.
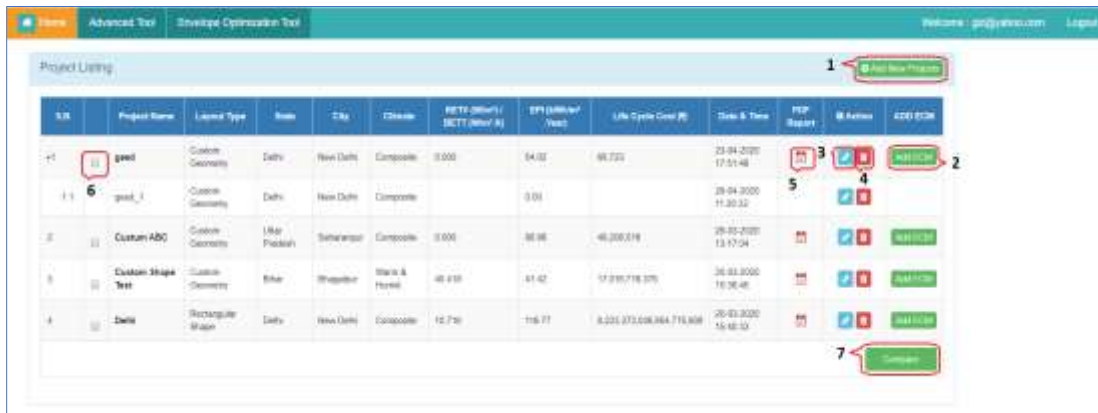

Figure 23: Result details level

1 **Download Report:** The user has the option to export the results in PDF format for later use, using the "Download Report" button on the results page.

2 **Home:** Clicking on this button will take the user to the project listing page.

3 **Advanced Tool:** Clicking this button will open the fresh form to create a new project.

2.13 Performance Comparison

On the project listing page of the tool, the user is provided with an option to select and compare the energy and life cycle performance of various project listed in the table. In addition, there is a provision to create an ECM (Energy Conservation Measure) option for a particular project on a click.

Figure 24: Project List level

1 **Add New Project:** Clicking this button will open a fresh form for a new project entry.

2 **Add ECM:** Clicking this button will add the copy of same projects as a child project, which can be used for alteration and installation of Energy Conservation Measure in the design.

3 **Edit:** Click this button to edit the project and make changes in the present design.

4 **Delete:** Click this button to delete the selected project.

5 **PDF:** Click this button to download detailed project report in ***.pdf** format.

6 **Tick/Untick:** Click this button to select the list of projects that you wish to compare.

7 **Compare:** Click this button to compare the performance of selected projects from the list. The results will show the comparison graph as given below for EPI, RETV, annual CO_2 generation as well as Life Cycle Cost of the projects.
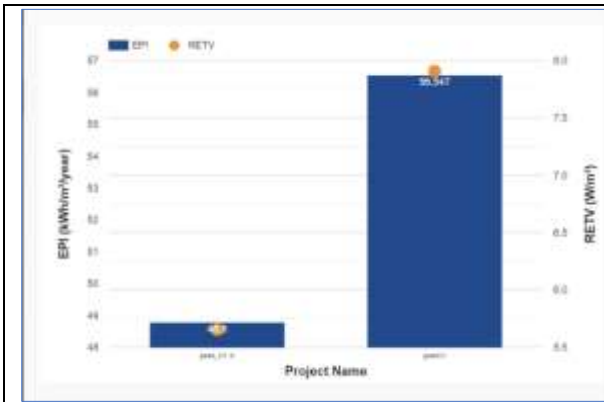
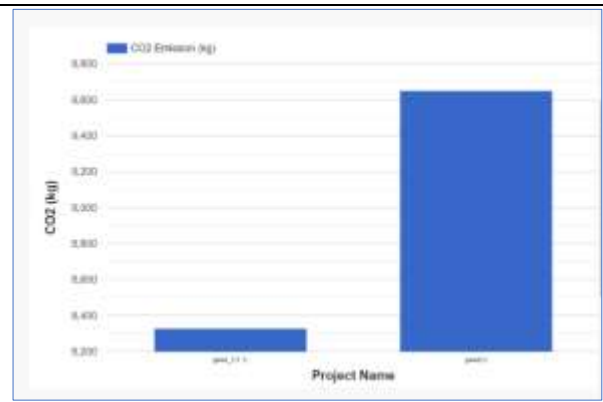*Figure 25: Comparison Graph of EPI & RETV*

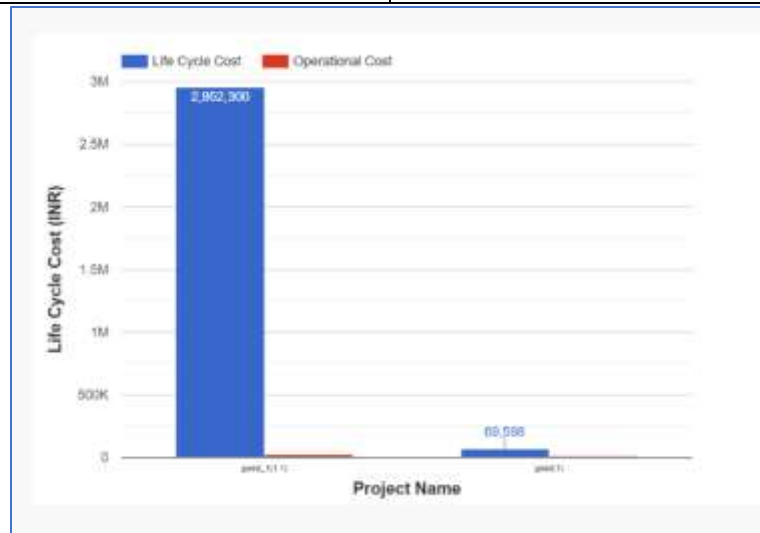*Figure 26: Comparison Graph of Annual CO_2*

Figure 27: Comparison Graph of Life Cycle Cost

Annexure-1 – Assumptions used for generating results

1.1 Energy Simulation Modelling Assumptions

S. No.	Parameter	Values
1.	Run Period	1 year
2.	Schedules	ECBC Guest House
3.	Wall	Based on User Input
4.	Window	Based on User Input
5.	Roof	Based on User Input
6.	Zone Dimension	7 x 7 x building height user input
7.	Window	7 x Window height user input
8.	Internal Mass	Based on User Input
9.	Occupancy (m²/person)	10
10.	LPD (Watt/Area)	6
11.	EPD (Watt/Area)	8
12.	Daylight Control	Yes
13.	Infiltration (ACH)	0.5
14.	HVAC System	Ideal Load Air System

1.2 Assumptions used for analysis:-

EnergyPlus Engine: EnergyPlus v8.8 has been used for simulation.

EnergyPlus Timesteps: No. of Timesteps per Hour = 6

Schedules: Nighttime occupancy, equipment, and lighting operation.

Occupancy: EnergyPlus uses a polynomial function to divide the total metabolic heat gain into sensible and latent portions. Total metabolic heat gain has been assumed as 117 W/Person. Occupancy radiant fraction is 0.3.

Lights:

Return air fraction = 0

Fraction radiant = 0.59

Fraction Visible = 0.2

Equipment:

Fraction Latent= 0

Fraction radiant = 0.2

Fraction Lost = 0

Infiltration: Infiltration is the unintended flow of air from the outdoor environment directly into a thermal zone. Infiltration is generally caused by the opening and closing of exterior doors, cracks around windows, and even in small amounts through building elements. 0.5 ACH (Air Change Per Hour) has been assumed.

HVAC:- Packaged Terminal Air Conditioner (PTAC):

Outdoor Air Flow = 9.44 L/s per person

Supply Fan delta Pressure = 75 Pa

Supply fan total efficiency = 70%

Zone Cooling Design Supply Air Temperature = 14

Zone Heating Design Supply Air Temperature = 50

END OF DOCUMENT