



# Teaching Architecture + Energy

Hosted by Washington University in St. Louis



Welcome to the Teaching Architecture + Energy project at Washington University. This site is part of a collaborative network of energy technology teachers in architecture schools, sponsored in part by the U.S. Dept. of Education. Our goal is to make it easier for architecture students to understand energy concepts and to design energy efficient buildings. The curricula developed here and at other universities is centered around Energy Scheming, a energy simulation tool that helps the student think about energy as an integral part of building design.



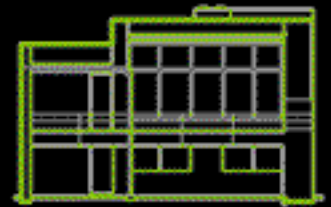
## Climate:

context for design



## Exercises:

"recycling with energy scheming"



## Example:

shanley building



## Student Work

## Legal Disclaimer

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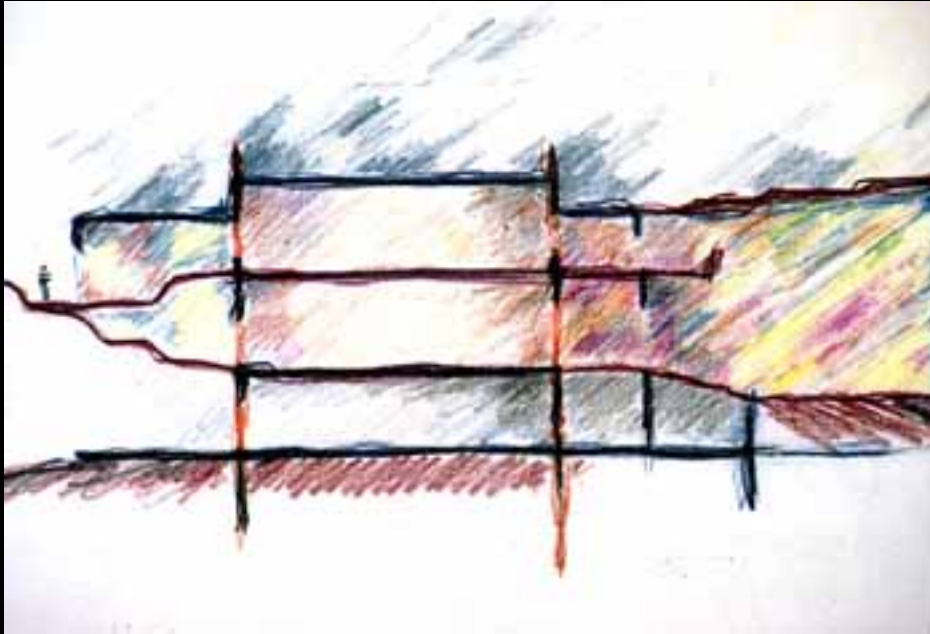
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# RECYCLING WITH *ENERGY SCHEMING*: Schematic Design & Performance



TERRAIN MAP: outline of exercise



A. DOCUMENTING: input your building



B. DEFINING: take-offs and specifications



C. ANALYZING: understanding energy patterns



D. RE-DESIGNING: 'generate and test' cycles



E. EVALUATING: energy codes as indicators



Download the PDF version of the exercise

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications



In Part B of this exercise, you establish performance goals, evaluate your first schematic design and understand its strengths and weaknesses, in terms of energy and daylighting. You will take-off all of the "architectural elements" of your project while leaving some settings at their default.

If you have not already, read Chapters 1 and 2 of the ES Manual. Also, please read Chapter 4, "Input Requirements" and Chapter 5, "Procedures," of the ES Manual.

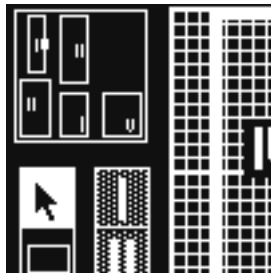
In part A, you already defined basic information about the project: the climate, the building type (residential or non-residential), and the building's total floor area. Make sure that the building's floor area you entered is accurate. You should include all occupied and conditioned floor area, including upper floors. Do not include things like unheated basements, mechanical areas, garages and attics. See the section, "Preliminaries" in Chapter 5 of the ES manual for help.

Part B, DEFINING, includes the following steps:



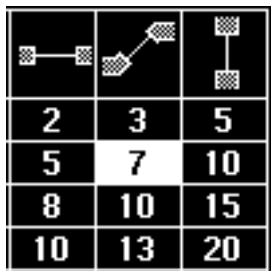
#### 1) [Tuning Settings to Fit Your Building](#)

First you will need to set a few options so that the assumptions Energy Scheming makes about your building are accurate. Most of these settings will stay the same throughout your use of ES for a particular building.



#### 2) [Define Your Daylight Zone Icon](#)

Before you can specify windows or electric lighting, you must create a "Daylight Zone Icon" (under the "DEFINE" menu), so that you will be able to use multiple daylight zones.



#### 3) [Set Performance Goals for Lighting, Heating, and Ventilation](#)

There are several ways that ES can help you to understand the performance of your design. The "Rule-of-Thumb Window Sizer" gives quick feedback about window sizes in relation to Solar Heating, Daylighting, and Natural Ventilation. In order to make use of this information, you need to set some performance goals.



#### 4) [Create Plan Specifications](#)

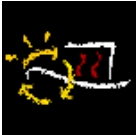
Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements that can be defined in a plan drawing.



##### 5) [Create Elevation Specifications](#)

Continue taking off building elements in the elevations.

[Part B Grading Criteria](#)



#### **RECYCLING WITH ENERGY SCHEMING**



**TERRAIN MAP**



**DOCUMENTING**



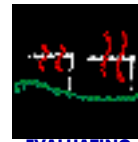
**DEFINING**



**ANALYZING**



**RE-DESIGNING**

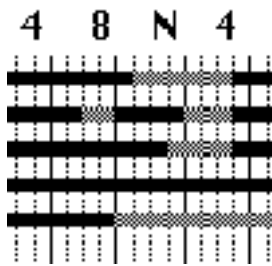


**EVALUATING**

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### settings



[shanley example.](#)

#### 1) Tuning Settings to Fit Your Building.

First you will need to set a few options so that the assumptions Energy Scheming makes about your building are accurate. Most of these settings will stay the same throughout your use of ES for a particular building.

- [Select the Long Takeoff List](#)
- [Define Infiltration or Ventilation Rate](#)
- [Set the "Evaluation Days"](#)
- [Check the Schedules](#)
- [Check the Interior Temperature Settings](#)
- [Set the Order of Energy Strategies](#)

---

#### Select the Long Takeoff List

Make sure that "SHORT TAKEOFF LIST" is NOT checked (IS greyed-out) under the "VIEW " menu before beginning, meaning that your are then working in the LONG TAKEOFF MODE. The Long Takeoff Mode allows you to specify lights, people, and equipment.



Under the OPTIONS menu, set [Preferences](#) to open files in "Long Takeoff Mode."

#### Define Infiltration or Ventilation Rate

Select the "[DEFINE / Infiltration/Min. Ventilation Rate](#)" menu. The dialog box that you get for this setting is dependent upon whether you have defined the building as Residential or Non-Residential. If you selected "Residential" when you defined the project, you will get options based on construction type and details. If you chose Non-Residential when defining the project, you will get options based on occupancy type.

##### *For Residential Buildings*

Select the option that matches your construction type. Older, uninsulated buildings will have higher rates. Unoccupied values are for times when the building is unoccupied. In residential buildings, it accounts for how occupants open windows and doors when they are in the building. For low occupant density buildings, unoccupied rates will be close to occupied rates, unless mechanical ventilation is scheduled.

**Infiltration or Minimum Ventilation Rates**  
(Btu/h,°F,sf floor area)

**Occupied**  
**Residential**

☐ **0.30** Insulated frame construction

☒ **0.20** + Plastic vapor barrier

☐ **0.10** + Sealed joints, foamed cracks

☐ **0.05** + more carefully sealed, and heat recovery unit

☐ **0.00** Other

**Unoccupied**

☐ **1.00**   ☐ **0.50**   ☐ **0.03**   ☒ **.20** Other

**OK**  
**Cancel**

*For Non-Residential Buildings*

Select the option that most closely matches your occupancy. If your building has a mix of occupancy types, estimate a weighted average based on the relative floor areas of each occupancy type. Commercial buildings are often ventilated on a schedule. For instance, a factory will not need to be ventilated at a high rate when its production processes are shut down on off hours. The same principle holds true for occupancies like assembly spaces or kitchens.

**Infiltration or Minimum Ventilation Rates**  
(Btu/h,°F,sf floor area)

**Occupied**  
**Non-residential**

☒ **1.44** Factory

☐ **1.00** Assembly

☐ **0.20** Restaurant Dining Area

☐ **0.10** Retail

☐ **0.05** Office, Gym, School

☐ **0.02** Hotel/Motel, Warehouse

☐ **0.00** Other

**Unoccupied**

☐ **1.00**   ☐ **0.50**   ☐ **0.03**   ☒ **0.20** Other

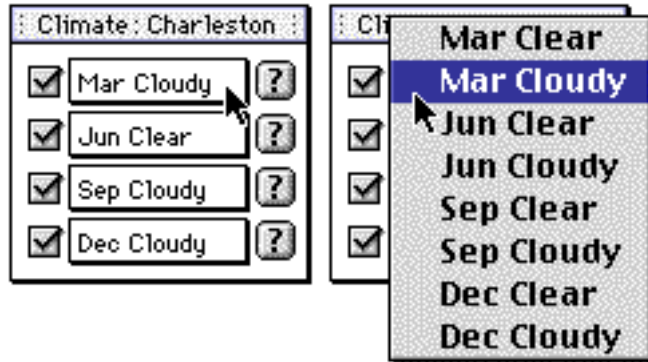
**OK**  
**Cancel**

**Set the "Evaluation Days"**

You can set four evaluation days in Energy Scheming. Most climate files created with data found on the web site have at least eight days, one cloudy and one clear day in each of four seasons. Some also have two extreme days. The evaluation days are

set from the Climate Palette on the Graphic Report window. To get there, choose "[VIEW / Graphic Report](#)." On the Graphic Report window, you will see the palette shown below. If it does not show the correct climate, change your climate by selecting "DEFINE / Project."

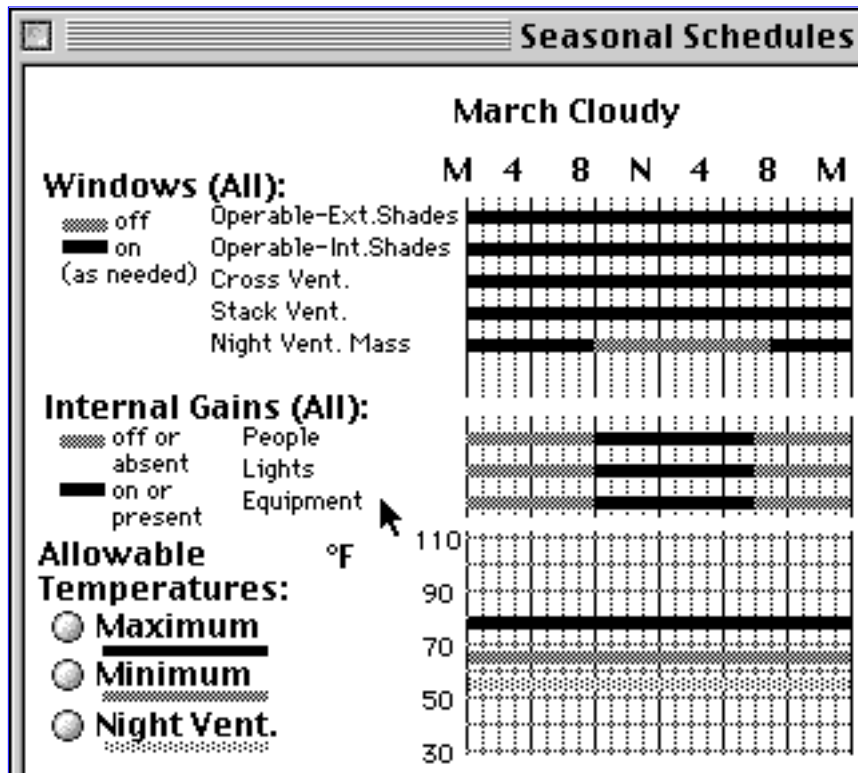
For this exercise, you will want to select the most "typical" day in each of four seasons. Determine whether, in your climate, the typical condition in each season is "mostly clear" or "mostly cloudy." Click and hold down on each day to select a different day. You can review and edit climate data for that day by clicking on the question mark. Make sure all four days are checked. Deselecting the checked box turns that day off and ES will not calculate performance for that day.



### Check the Schedules

The building's occupancy schedule affects internal loads from lights, people and equipment. Under the "[DEFINE / Schedules...](#)" menu, make sure the default settings approximate the conditions for your building. For a commercial building, the default will be occupancy during work hours. If your building occupancy schedule does not match the default, modify the schedules for Lights, People, and Equipment to fit your building's profile. For most buildings, lights, people, and equipment follow the same schedule. See the section, "Setting Schedules" in Chapter 5 of the ES manual for help.

**Note:** For this exercise, *leave the schedules for shades and ventilation at the defaults!* If a strategy shows a black bar for "on," then it will be used only as needed.



[click on image for a larger view](#)

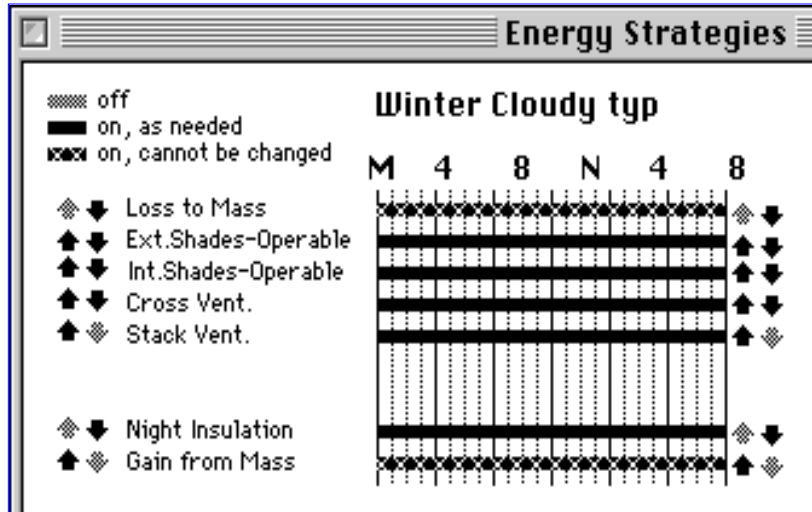
### Check the Interior Temperature Settings

Wider temperature ranges for allowable indoor temperature will decrease heating and cooling loads, but your assumptions must match reasonable expectations about your users. From the [Seasonal Schedules](#) window, make sure the default settings approximate the conditions for your building. The default settings are 65 degrees F minimum and 78 degrees F maximum.

This is a standard internal temperature range. In hot climates, 80 degrees is the upper end of the comfort zone. With mild air movement, such as with ceiling fans, most people feel comfortable up to 83 degrees F. Elderly people will need warmer settings in winter and will feel cold at 65 degrees F. Active facilities, such as a gymnasium will be fine at 60 degrees F. for a minimum. If your building occupancy does not fit well with the default settings, modify the maximum and minimum temperature settings. See the section, "Setting Schedules" in Chapter 5 of the ES manual for help.

### Set the Order of Energy Strategies

Energy Scheming calculates passive energy strategies in the order that you choose. You can also turn on or off any of the strategies to see its effect. The default order of energy strategies is most appropriate for summer months when cooling is the priority. From the DEFINE menu, choose "[Energy Strategies...](#)" A window like the one below allows you to set separately the order in which ES will apply energy strategies for each day.



[click on image for a larger view](#)

#### Heating Season Days

For evaluation days where heating is a priority, usually the winter and spring days in envelope load dominated buildings, you must reset the strategy order so that ES will take the effects of thermal mass into account properly. For days that you think will need heating, click on the UP arrow next to the 'Loss to Mass' strategy until it is moved to the top of the list. This will tell ES to store excess solar heat in the building's mass before using cooling strategies to reduce overheating.

#### Night Insulation

Your version of ES may show Night Insulation on as the default. Turn Night Insulation to OFF during daylight hours of occupancy. Otherwise, if there is net heat loss, ES will use night insulation to counteract it, thus blocking out desirable daylight. During cooling season days, turn Night Insulation to OFF; generally occupants will not bother with it in the summer.

#### Cooling Season Days

Since the use of Night Insulation is unlikely in the summer, move it down in the priority list, below 'Gain from Mass.' This will let ES use excess heat in the mass for heating on cool summer nights without employing night insulation.

#### Other Strategies

For now, leave all of the other settings at the default.

See the section, "Sorting Energy Strategies" in Chapter 5 of the ES manual for help.

### SAVE and BACK-UP your work.

#### Turn in

- A record of your settings for Ventilation/Infiltration Rate.
- A record of the evaluation days you have chosen.
- A printout of the energy performance report, done at the end of Part B, will show your settings for Schedules and Energy Strategies.
- For a guide, see the [shanley example](#).

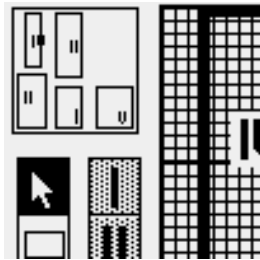
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**Jump to the next section:** [Define Your Daylight Zone Icon](#)



## B. DEFINING: take-offs and specifications

### daylight zone icon



#### 2. Define Your Daylight Zone Icon

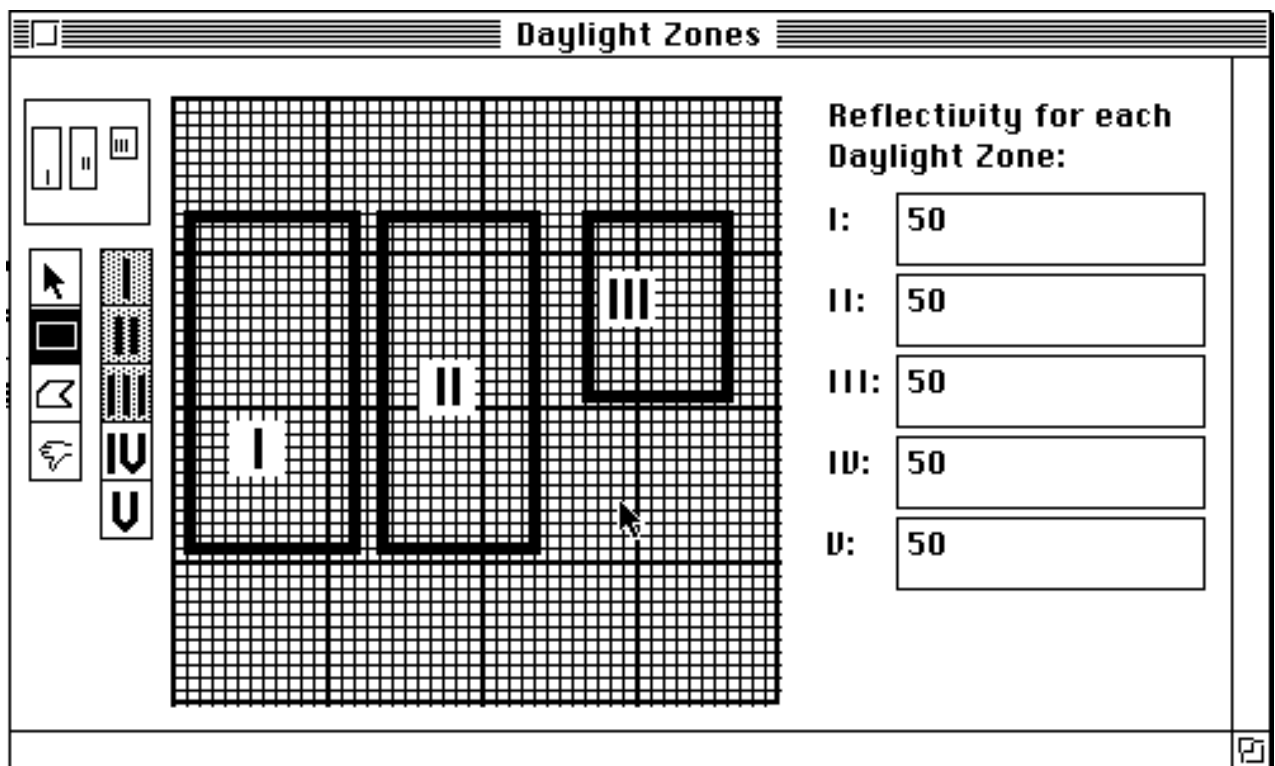
Before you can specify windows or electric lighting, you must create a "Daylight Zone Icon" ([under the "DEFINE" menu](#)), so that you will be able to use multiple daylight zones

[shanley example](#).

When you specify windows or electric lights, the icon that you create will appear in the spec window, so that you can associate the spec with a particular daylight zone.

See the section, "Daylight Zone Icons" in Chapter 5 of the ES manual for help.

Click on a part of the Daylight Zones window below for more information about each step in the process:



SAVE and BACK-UP your work.

Turn in

- A screen capture of the daylight zone icon screen.

For a guide, see the [shanley example](#). You will not be able to print the windows directly unless you use a [screen capture technique](#).

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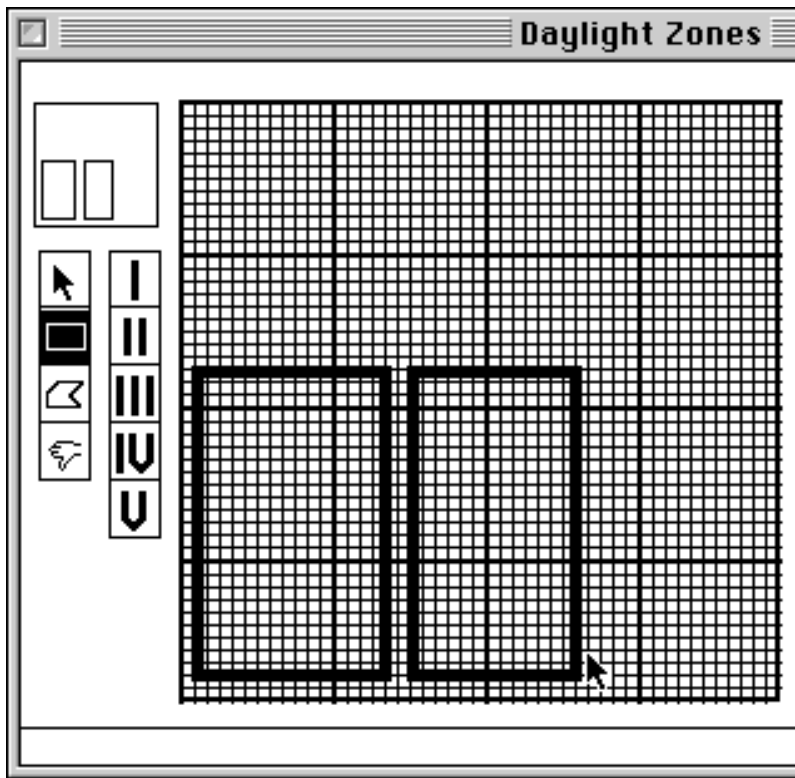
Jump to the next section: [Set Performance Goals](#)

## daylight zone icon: drawing zones

- Using your [daylight zone diagram](#) from Part A [DOCUMENTING](#) as a guide, design and then draw an icon for your building that represents its daylight zones. Use either the rectangle tool or the polygon tool to draw a shape for each of your zones (up to five).



- Make the zones AS BIG AS POSSIBLE in your gridded drawing window. If your zones are too small, they will be hard to click on later. Make sure your zone lines do not overlap. If you make a mistake, use the "Thumbs Down" tool to delete a zone.



- Check to make sure that you DO NOT see a thick black line around the outside of your drawing grid. If you do, it means that you started your work in the short takeoff mode and then switched to the long takeoff mode. You will need to delete the large perimeter square now.
- Check your icon once again and review the instructions above. Edit your work if necessary now. It can not be changed later without extra work.
- The screen image below shows several mistakes: 1) The large zone around the perimeter of the grid needs to be deleted; 2) Some zones are too small and will be hard to select; 3) The reflectances are probably too high. If your daylight zone icon has any of these problems, correct it now.

Daylight Zones

Reflectivity for each Daylight Zone:

I:

II:

III:

IV:

V:

## DESIGNING WITH "ENERGY SCHEMING": Schematic Design Performance

# Screen Capture Options

Only the graphic report, numeric reports, and the advisor report can be printed from ES. To export any screen or graphic from ES for use in another application, such as a word processor used to create your assignment report, use a screen capture technique. Options include:

- *Apple System Screen Capture.*  
The key command "COMMAND-SHIFT-3" will take a snapshot of the screen that can be opened in Photoshop or any image editor that will read PICT format. When you do this, you will hear an audible click. The image is stored on the local hard drive (Macintosh HD) and is named, "PictureN, " where N is a sequential number. If you take several screen captures, they will be labeled, "Picture 1," "Picture 2," "Picture 3, " etc. To open them, first start Photoshop or your favorite imaging program, choose FILE /Open, and navigate to your local hard drive where you will find the images. The image will be of the entire screen, so you will want to crop it to just the part you need. The image is created by default in RGB color. If the source captured is gray scale, you can convert the image to grayscale to make a much smaller file (in Photoshop, choose IMAGE / Mode...).
- *Screen Snap Utility.*  
If you are working on your own Mac or a Mac that you can configure by adding files to the system folder, you may want to try out the screen snap utility *Snap Jot*. It is freeware. Download [Snap.Jot](#) and place it in the Extensions Folder within your System Folder. Download [SnapJot DA](#) and place it in the Apple Menu Items Folder within your System Folder. You can use *Snap Jot* to take a picture of any portion of your screen.
- *Energy Scheming Screen Snap.*  
ES version 3.0 and higher has a built-in screen capture function available for selected screens.




SAVE and BACK-UP your work.

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## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### performance goals

		
2	3	5
5	7	10
8	10	15
10	13	20

#### 3) Set performance goals for lighting, heating, and ventilation.

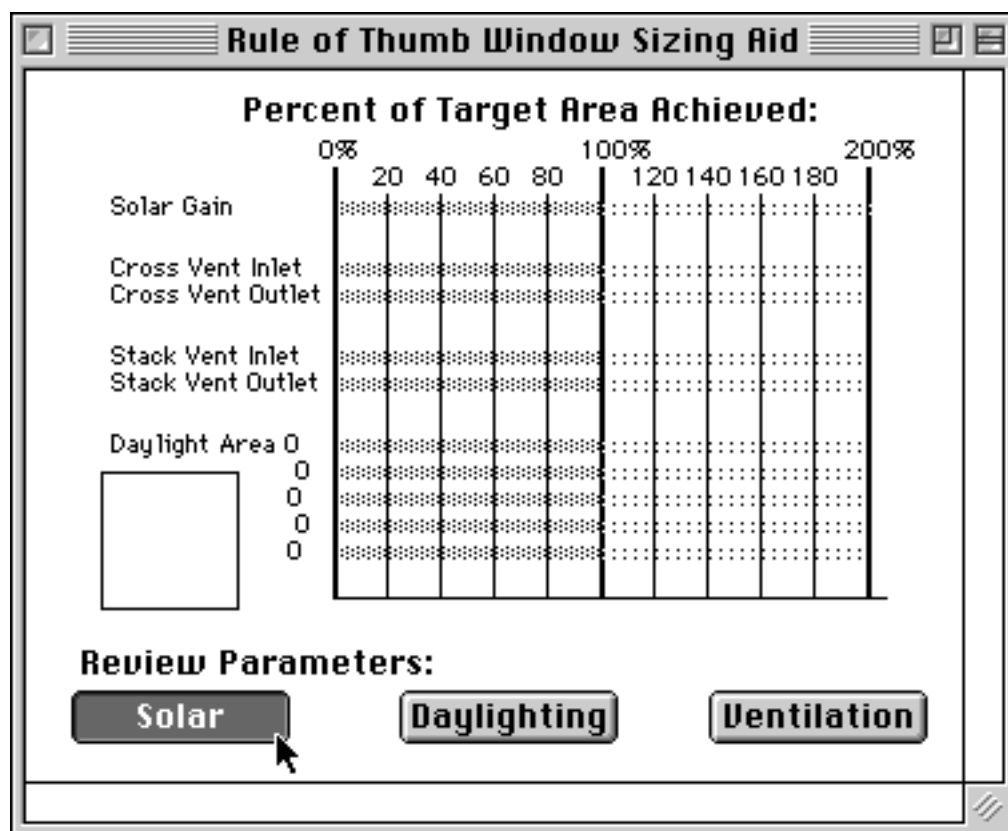
There are several ways that ES. can help you to understand the performance of your design. The "Rule-of-Thumb Window Sizer" gives quick feedback about window sizes in relation to Solar Heating, Daylighting, and Natural Ventilation. In order to make use of this information, you need to set some performance goals.

[shanley example.](#)

There are several ways that ES can help you to understand the performance of your design. One way is using the "Rule-of-Thumb Window Sizer," which uses Rule-of-Thumb (R/T) methods covered in most basic energy texts to give you feedback about the window sizing for Solar Savings Fraction (SSF), Daylight Factors (DF), and Natural Ventilation, both cross ventilation and stack ventilation.

In order to make use of this information, you first need to set some performance goals. For instance, for solar heating, the "Window Sizer" gives you feedback about the window area needed, in relation to your building's floor area, to achieve a particular SSF goal.

On the image below, click on the buttons for each of the parameter to find out more.



**SAVE and BACK-UP your work.**

**Turn in**

- A record of your daylighting, solar heating, and ventilation goals. You will not be able to print the windows directly unless you use a [screen capture technique](#).

**SAVE and BACK-UP your work.**

**Turn in**

- A record of your daylighting, solar heating, and ventilation goals. You will not be able to print the windows directly unless you use a [screen capture technique](#).

For a guide, see the [shanley example](#).

---

**Jump to the next section: [Create Plan Specifications](#)**

## performance goals: solar parameters

### Define Solar Heating Parameters

You can access the "Solar Parameters," from either the [RULE-OF-THUMB Menu](#) or from the [Window Sizer](#) screen. The SSF options are generated by ES from the climate file for your city. For now, a moderate level (R-5) of night insulation and a high SSF goal is recommended for most buildings.

See the section, "The Window Sizer / Solar Heating Parameters" in Chapter 5 of the ES manual for help.

**SOLAR HEATING PARAMETERS**

☐ No Night Insulation (R-8)

☐ Min SSF (21%)☐ Max SSF (33%)

☒ Moderate Night Insulation (R-5)

☐ Min SSF (31%)☒ Max SSF (49%)

☐ High Night Insulation (R-9)

☐ Min SSF (41%)☐ Max SSF (65%)

Assumptions:  
St. Louis, MO  
Double Glazing  
BLC = 7 Btu/DD,sf  
Inside Temperature = 75°F  
Internal Sources = Δ5°F  
Sizing for Clear Jan. Day  
Mass Area = 3 times  
South Glass Area

OK

- *Advanced option:*  
If you want to use an SSF goal somewhere between the minimum and the maximum R/T recommendation, you can modify the climate file. To do so, choose, "Define Project..." and then "User Defined Climate" to create a new climate file using the standard climate file for your site as a template. Enter your desired SSF goal in the Minimum or Maximum category of the General Info input screen (1st climate screen). You will also have to modify the collection area required by the appropriate linear proportion.
- If you are working in a shared computing environment, this will require that you make a copy of the software, so that your modifications will not effect other users and that your changes can be saved and used again without having to edit the climate again next time you work.

SAVE and BACK-UP your work.

## performance goals: daylight parameters




### Define Daylighting Parameters

You can access the "Daylighting Parameters," from either the [RULE-OF-THUMB Menu](#) or from the [Window Sizer](#) screen.


- Select a daylight zone by clicking on the daylight zone icon in the upper right.
- Set a daylight factor goal for that daylight zone by selecting a cell in the matrix. Daylight Factors (DF) are in far left column. For instance, a DF of 3 corresponds to a task such as reading.
- The icons at the top of the matrix represent different glass orientations. For vertical glazing with a 4% DF goal (reading), the zone would need a glass area equal to 20% of its floor area.
- Repeat the process for each zone.

### Daylighting Parameters For Daylight Zone 2

**Glass as a Percent of Floor Area**

Average Daylight Factors			
1 Walking	2	3	5
2 Conversing	5	7	10
3 Cleaning	8	10	15
4 Reading	10	13	20
5 Sewing	12	17	25
6 Drawing	15	20	30

**Assumptions:**  
Internal Reflectance = 40%  
Single Glazing  
No external obstructions  
Room depth equals twice window wall height



OK

See the section, "The Window Sizer / Daylighting Parameters" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.



## performance goals: ventilation parameters

### Define Ventilation Parameters

You can access the "Ventilation Parameters" from either the [RULE-OF-THUMB Menu](#) or from the [Window Sizer](#) screen.

- Select a rate of heat gain to be removed by ventilation. Select the occupancy type that most closely matches your building, considering the rate of internal gains from electric lights, people, and equipment.
- You may also select how ES calculates ventilation of mass by either choosing an estimate of thermal mass area or using the actual takeoff numbers. The estimated values are good if you want feedback about ventilation before you have actually defined all of the elements. Mass levels beyond 2.0 ft<sup>2</sup> of mass per ft<sup>2</sup> of floor area are difficult to achieve in most buildings. For this exercise, click on the radio button for "As Taken Off."

**VENTILATION PARAMETERS**

☒ **Ventilation of Room Air**

☒ **Ventilation of Mass**

**Internal Heat Gain  
(Btu/h,sf):**

- ☐ 10 (Gymnasium)
- ☒ 15 (Residence)
- ☐ 20 (School)
- ☐ 25 (Office,Retail)
- ☐ 40 (Assembly)
- ☐ 50 (Factory)
- ☐ Other

**Estimate of Thermal Mass  
(per 1 sf Floor Area):**

- ☐ 0.5 sf
- ☐ 1.0 sf
- ☐ 2.0 sf
- ☐ 3.0 sf
- ☐ 4.0 sf
- ☒ As Taken Off: 2.6 sf

**Assumptions:**  
St. Louis, MO  
Wind = S  
 $\Delta t = 3^{\circ}\text{F}$

Speed = 9 mph

See the section, "The Window Sizer / Ventilation Parameters" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

# B. DEFINING: take-offs and specifications

### plan specifications



[shanley example.](#)

#### 4) Create Plan Specifications.

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

#### Set up your Floor Plan Drawing(s).

The *ES Manual* has a detailed explanation of how to set up plan drawings. From the file cabinet, [choose Plans](#). Then double click on the [New Plan icon](#). From the [Drawing Spec window](#), name the drawing and set its scale with the scale tool.

See the section, "Specifications from Plan Drawings" in Chapter 5 of the *ES manual* for help.

#### How many Drawings?

In general, you will need one plan drawing in ES for each different floor plan in your building. If you have a building with repetitive floors, you can use [ES's cloning functions](#) to clone the drawing with or without its associated takeoffs.

#### Where to Start?!

Once your drawings are set up, you are ready for takeoffs. Building elements are specified in ES as a part of a particular plan or elevation drawing. Because ES uses Electric Lighting Zones to define the floor area of daylight zones, it is a good idea to start with [defining electric lighting](#), which is specified in plan drawings. You must specify electric lighting before the daylighting bars in the Window Sizer will work.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



**SAVE and BACK-UP your work.**

**Turn in**

- A screen capture of your plans showing lighting zones. Turn off all other plan takeoffs in the "VIEW / Takeoffs..." menu. You will not be able to print the takeoffs unless you use a [screen capture technique](#).
- In the next section, Elevation Takeoffs, you will print the Energy Performance Report, which will document all your takeoffs.

For a guide, see the [shanley example](#).

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**Jump to the next section: [Create Elevation Specifications](#)**

## B. DEFINING: take-offs and specifications

### plan specifications: skylights

#### 4) Create Plan Specifications.

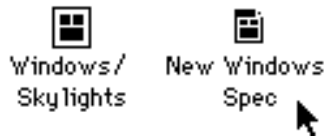
Click on one of the icons below for more information about creating specs and takeoffs for each element type:



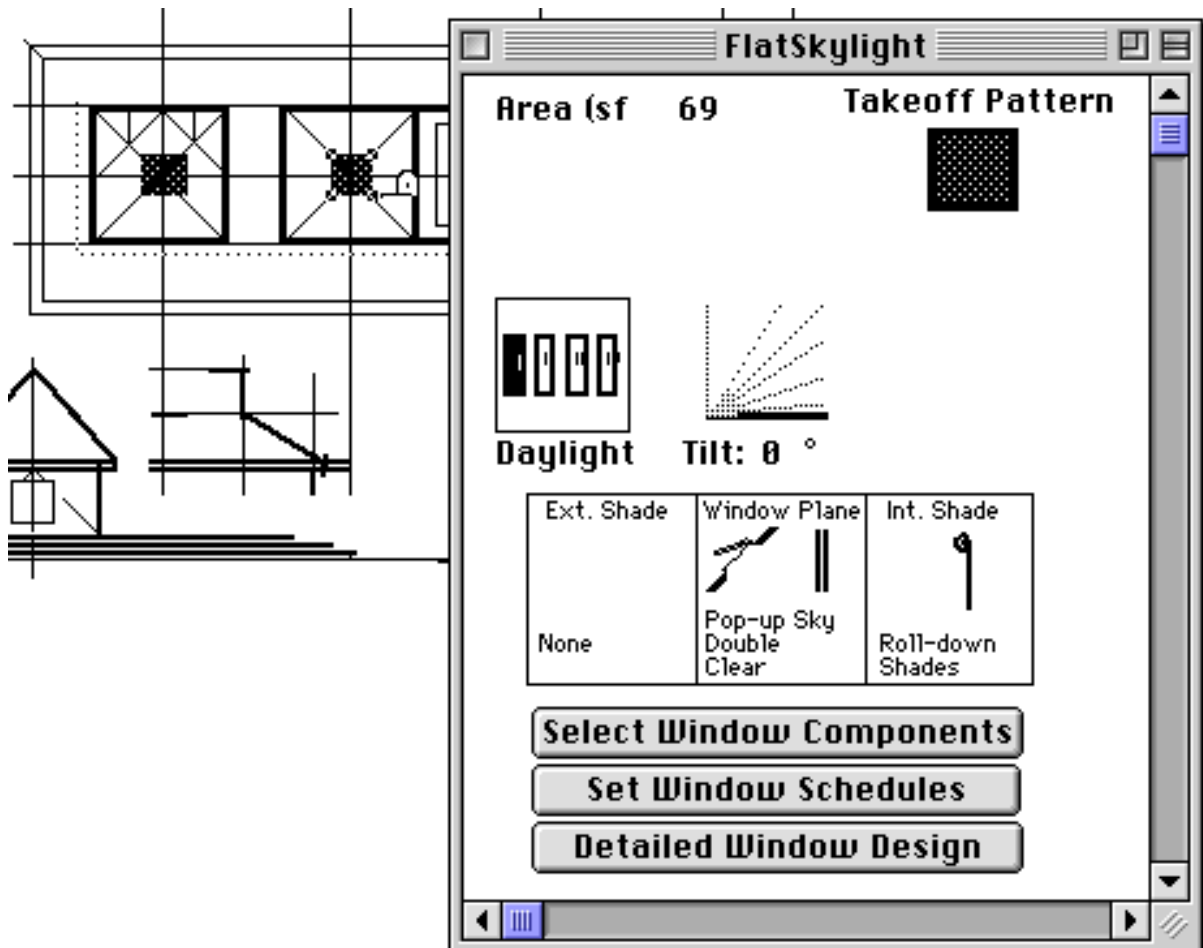
#### Flat Skylights

Flat (zero or near-zero slope), inoperable (fixed) skylights are the ONLY windows that you can specify from plans. Windows used as stack ventilation openings, MUST be specified in an elevation view, so that ES will properly calculate the stack height, which it does by measuring the height difference between inlets and outlets on the elevations.

- To set up Skylight Specs, double click on the Windows/Skylights icon then double click on the New Window Spec icon:



- You will get a spec window like the one below.



- Notice that the tilt options for skylights are grayed out in the spec window above, because skylights can only be flat.

- Skylight takeoffs are similar to takeoffs for Windows: First, select the daylight zone associated with the window by clicking on the Daylight Zone icon.
- Select the skylight components that are closest to your building's design:
  - Select the type of exterior shades, if any, in the Ext Shades icon.
  - Select the window type and glass type in the Window Plane icon.
  - Select the interior shading type, if any, in the Int. Shade icon.
  - OR, you can specify them in a table view by clicking on the Select Window Components button:

**SELECT WINDOW COMPONENTS**

External Shades	Window Plane			Internal Shade
Overhang/Awning	Fixed	Single	Clear	Venetian Blinds
Fins/Vert.Louvers	Casement	Double	Tinted Light	Roll-down Shades
Egg Crate/Mesh	Double Hung	Triple	Tinted Dark	Drapes
Roll-down Shades	Hopper	Glass Block	Mirrored	Insulating Shades
None	Pop-up Sky		Low-e	None
	Ctr Pivot Sky		Low-e, argon (heating)	
			Low-e, argon (cooling)	
Opaque	Fixed		Fin Heating	Dark
Translucent	Operable		Fin Cooling	Light

OK

- In the table view, you can also define several additional specifics:
  - External shades as fixed or operable, and opaque or transparent.
  - Glass type may be defined
  - Internal shades can be defined as dark or light
- Use the tape measure or polygon tape measure to draw the area of the skylights.
- If you wish, you may also specify the Detailed Skylight Design, which follows the same logic as the [Detailed Window Design](#).

See the section, "Plan Specifications: Windows / Skylights Specifications" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section: [Create Elevation Specifications](#)**

## elevation specifications: windows

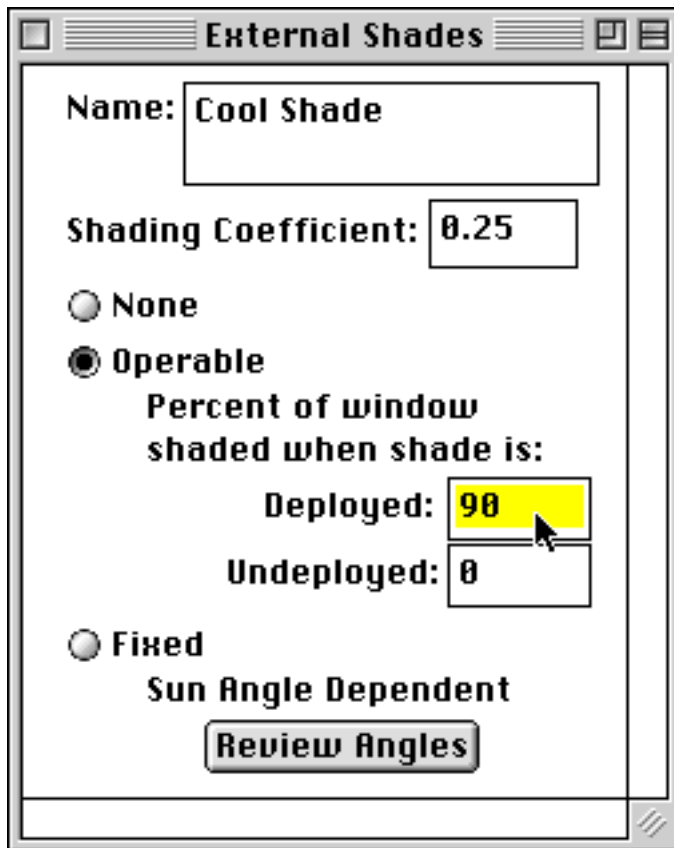
### Detailed Window Design

The window components available in ES are adequate for most designs, but you can also specify elements in very specific terms. See the section, "Elevation Specifications: Windows / Skylights" in Chapter 5 of the ES manual for help.

- Click on the Detailed Window Design button:



- A three-screen sequence will be presented, one each for:
  - External Shades
  - Window Plane
  - Internal Shades
- **External Shades**

A screenshot of a software dialog box titled "External Shades". It contains several input fields and radio buttons. The "Name" field is labeled "Cool Shade". The "Shading Coefficient" field is labeled "0.25". There are three radio buttons: "None", "Operable" (which is selected), and "Fixed". Under the "Operable" radio button, there is a label "Percent of window shaded when shade is:" followed by two input fields: "Deployed:" with the value "90" and "Undeployed:" with the value "0". A mouse cursor is pointing at the "Deployed:" field. Below the "Fixed" radio button, there is a label "Sun Angle Dependent" and a button labeled "Review Angles".

- **Window Plane**

**Window Plane**

Name: **Superwindows-solar colection**

Percent Operable: **100**

R-Value of Glazing: **9.5** °F,h,sf/Btu

R-Value of Night Insulation: **5** °F,h,sf/Btu

Disible Transmission: **.70**

Solar Heat Gain Coefficient (SHGC): **0.70**

- Internal Shades

**Internal Shades**

Name: **High Performance Interior Blinds**

Shading Coefficient: **0.33**

☐ Fixed ☒ Operable ☐ None

## B. DEFINING: take-offs and specifications

### plan specifications: roofs

#### 4) Create Plan Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



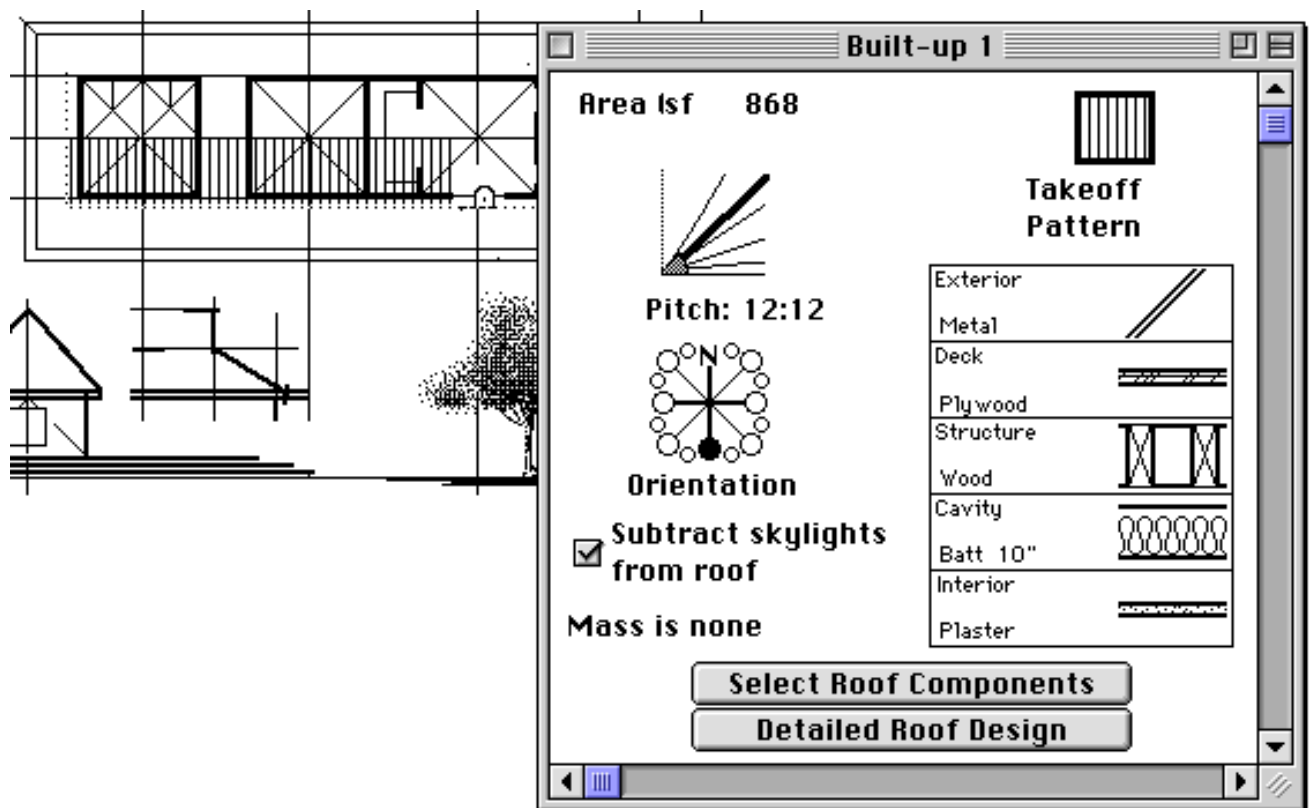
#### Roofs

Flat roofs, or roofs of very low slope must be specified in the plans. Sloping roofs may be specified in either Plan or Elevation views. Do a separate individual roof spec for each different type of roof construction.

- To set up Roof Specs, double click on the Roofs icon then double click on the New Roof Spec icon:



- You will get a spec window like the one below.



- Click on the Pitch icon to select the slope of your roof.
- Click on the Orientation icon to set the roof's aspect.
- Select the construction components that are closest to your building. Unless your building is made of very unconventional materials, you should find a combination that will work for you from the options available in ES. You can click on the icons for each layer in your roof assembly or you can specify them in a table view by clicking on the select roof components button.

**Select Roof Component** (in.)


Exterior	Decking	Structure	Cavity		Interior
Asphalt	Plywood	Wood	Batt	2"	Gyp Bd 1/2"
Shakes	Conc/Metal	Steel	Rigid Ins.	3"	Gyp Bd 5/8"
Clay Tile	None	Concrete	Air	4"	Plaster
Built-up		None	None	6"	Wood
Metal				8"	Acoustic
None				10"	T1-11
				12"	None
				14"	

**Ext. Color:**  

Light
Medium
Dark

**Mass:**  

Hollow	4
Solid	6
None	8
	12

**Solar**  


- NOTE: To take credit for mass in the roof, you must click on the "Select Roof Components" button. In the dialogue box that comes up, be sure to define:
  - the mass thickness that is exposed to the interior room air
  - whether the mass is hollow or solid
  - whether the mass is in a "solar" zone (room with direct sun) or "non-solar" zone (room linked to a room with direct sun)

Remember, mass outside the insulation, or covered with insulating materials like carpet, does not count.

- Use the tape measure or polygon tape measure to draw the area of the roof.
- If you wish, you may also specify the [Detailed Roof Design](#).

See the section, "Plan Specifications: Roof Specifications" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section: [Create Elevation Specifications](#)**



## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### plan specifications: floors

##### 4) Create Plan Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:

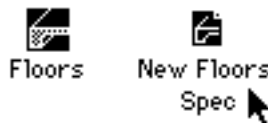


##### Floors

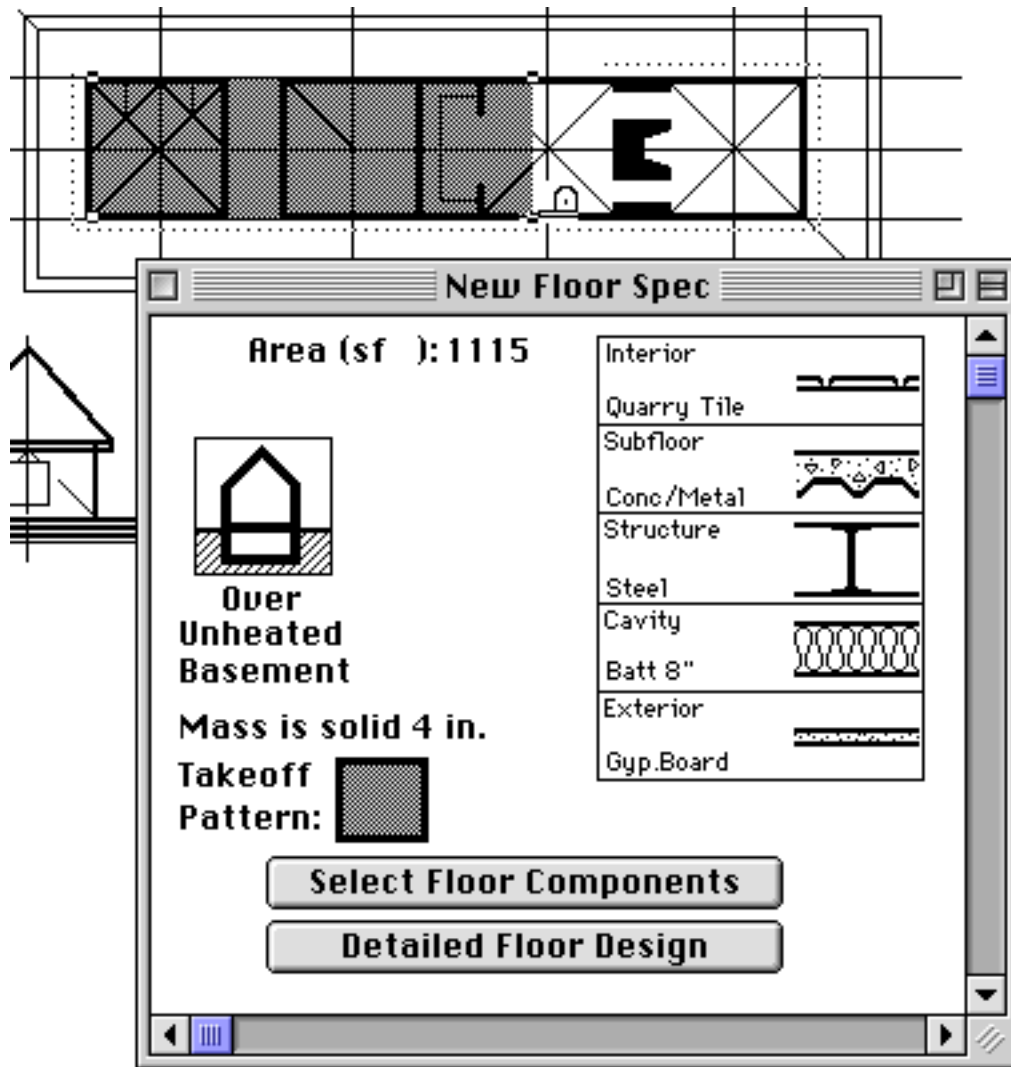
ONLY floor areas where heat loss or gain to the outside will occur should be taken off. This includes the perimeter of slabs (defined with the polygon tape measure), floors over crawl spaces and unheated basements, and overhanging or cantilevered floors where outside air is underneath. It does NOT include *intermediate* floors where a conditioned space is above and below the floor. In most buildings, this means that the lowest floor is taken off, but not the upper floors.

Create a different individual floor spec for each type of construction.

- To set up Floor Specs, double click on the Floors icon then double click on the New Floor Spec icon:



- You will get a spec window like the one below.




- Click on the icon for floor type to choose between the three options for underfloor conditions.
- Select the construction components that are closest to your building. Unless your building is made of very unconventional materials, you should find a combination that will work for you from the options available in ES. You can click on the icons for each layer in your floor assembly or you can specify them in a table view by clicking on the "Select Floor Components" button.

**Select Floor Components** (in.)

Interior	Subfloor	Structure	Cavity		Exterior
Carpet	Plywood 3/4"	Wood	Batt	1"	Plaster 5/8"
Quarry Tile	Conc./Metal 2"	Steel	Rigid Ins.	2"	Wood 3/4"
Wood	None	Concrete 6"	Air	3"	Acoustic 1/2"
Vinyl Tile		None	None	4"	Gyp. Bd 1/2"
None				6"	None
				8"	
				10"	
				12"	

**Mass:**  

Hollow	4
Solid	6
None	8
	12

**Solar Zone**  


OK

- To take credit for mass in the floor, you must click on the "Select Floor Components" button. In the dialogue box that comes up, be sure to define:
  - the mass thickness that is exposed to the interior room air
  - whether the mass is hollow or solid
  - whether the mass is in a "solar zone" (room with direct sun) or "non-solar zone" (room linked to a room with direct sun)

Remember, mass outside the insulation, or covered with insulating materials like carpet, does not count.

- Use the tape measure or polygon tape measure to draw the area of the floor space . You must use the polygon tape measure for slab-on-grade.
- If you wish, you may also specify the [Detailed Floor Design](#).

See the section, "Plan Specifications: Floors" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section:** [Create Elevation Specifications](#)

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### plan specifications: mass

##### 4) Create Plan Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



##### Thermal Mass

Any mass elements in the building which are NOT part of an exterior roof, wall, or floor that transfers heat conductively to the outside should be taken off using the mass icon. Take off internal mass in the PLANS if the mass is part of a HORIZONTAL surface, such as an exposed concrete intermediate floor or ceiling. VERTICALLY oriented mass, such as interior masonry bearing walls, should be taken off in the mass specification for ELEVATION drawings. Mass that is specified in wall, roof, or floor specs SHOULD NOT be specified again in the mass spec.

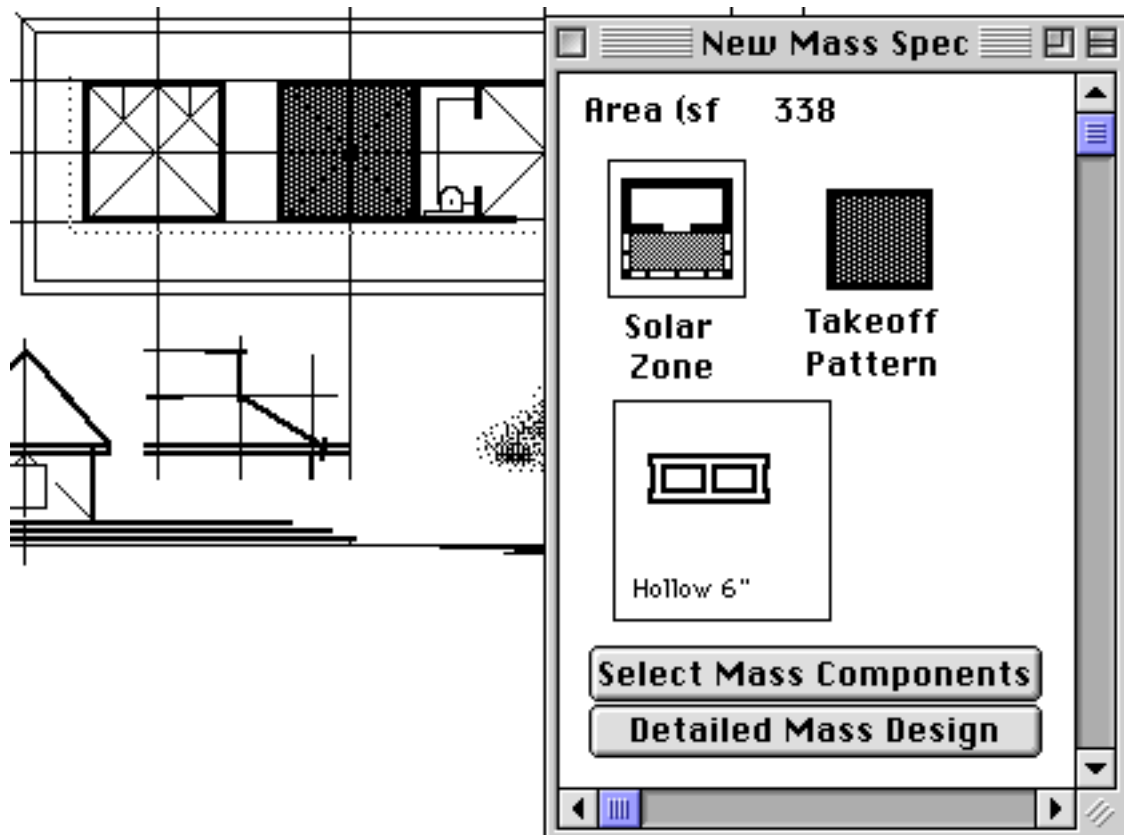
ES assumes that mass elements are exposed on only one side. If a mass element is exposed to room air on two sides, such as the top and bottom of a concrete spanning slab, then you should define the top and bottom as separate specifications, using one half of the actual mass thickness for each side.

Create a different mass spec for each different type of horizontal mass.

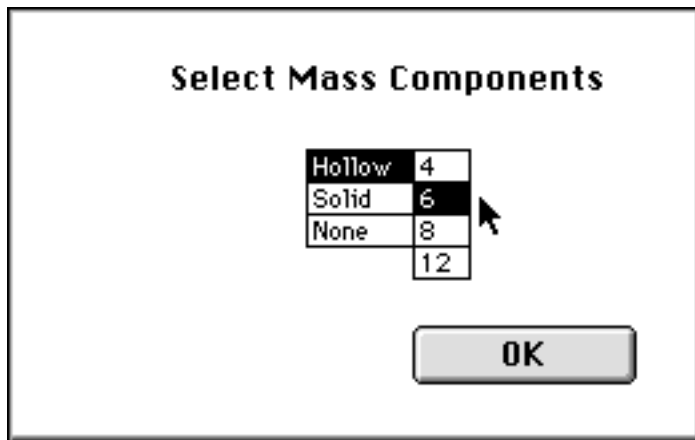
- To set up Mass Specs, double click on the Mass icon then double click on the New Mass Spec icon:



- You will get a spec window like the one below.



- Click on the Solar Zone icon to spec whether your mass is in a room with south sun or not.
- Select the type and thickness of mass that are closest to your building by clicking on the icon. You can also specify the mass in a table view by clicking on the Select Mass Components button.



- Use the tape measure or polygon tape measure to draw the area of the mass.
- If you wish, you may also specify the [Detailed Mass Design](#).

See the section, "Plan Specifications: Mass Specification" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

**Jump to the next section:** [Create Elevation Specifications](#)



**Jump to other Sections of: B. DEFINING: take-offs and specifications**

1. [Tuning Settings to Fit Your Building](#)
2. [Define Your Daylight Zone Icon](#)
3. [Set Performance Goals](#)
4. [Create Plan Specifications](#)
5. [Create Elevation Specifications](#)

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### plan specifications: occupants

##### 4) Create Plan Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

##### Occupants (People)

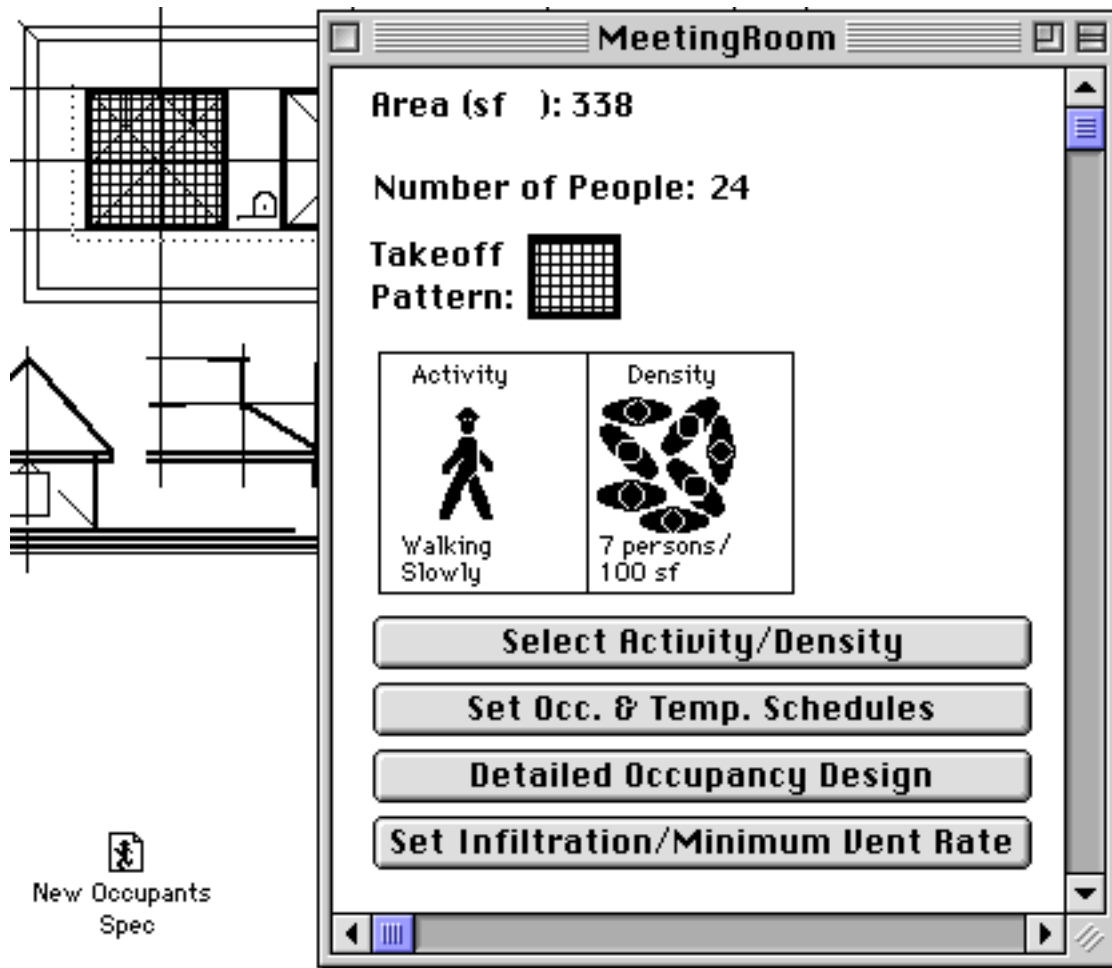
People make heat in buildings. Occupant loads increase with the higher metabolic rates of physical exertion. Higher occupant densities, such as assembly spaces will create more internal occupant load per square foot than a low occupant density.

Create a different individual occupant spec for each different occupancy condition in your building. If an area is unoccupied, do not create a spec for it.

- To set up Occupant Specs, double click on the "Occupants" icon, then double click on the "New Occupant Zones Spec" icon:



- You will get a spec window like the one below.



- Click on the icons for Activity and Density to choose the conditions that match the zone of your building.
- You can also specify occupants in a table view by clicking on the "Select Activity / Density" button:

**Set Occupant Activity and Density**

Activity Level Btu/h, person	Density persons/100sf
Light Work	Residential (0.3)
Walking Slowly	Hotels (0.5)
Moderate Dancing	Offices (1)
Fast Walking	Libraries (2)
Heavy Work	Retail (3)
	Classrooms (5)
	Conference Rooms (7)
	Assembly (14)

**OK**

- Use the tape measure or polygon tape measure to draw the area of the occupant zone.  
**NOTE!:** After your occupant zone is taken off with the tape measure tool, look in the spec window at the number of occupants calculated. If this is too high or too low, adjust the size of the occupant zone until you get the right number of people.
- If you wish, you may also specify the [Detailed Occupant Design](#).

See the section, "Plan Specifications: Occupancy Zones" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

### Set Occupant Activity and Density

Activity Level Btu/h, person	Density persons/100sf
Light Work	Residential (0.3)
Walking Slowly	Hotels (0.5)
Moderate Dancing	Offices (1)
Fast Walking	Libraries (2)
Heavy Work	Retail (3)
	Classrooms (5)
	Conference Rooms (7)
	Assembly (14)

OK

- Use the tape measure or polygon tape measure to draw the area of the occupant zone.  
**NOTE!:** After your occupant zone is taken off with the tape measure tool, look in the spec window at the number of occupants calculated. If this is too high or too low, adjust the size of the occupant zone until you get the right number of people.
- If you wish, you may also specify the [Detailed Occupant Design](#).

See the section, "Plan Specifications: Occupancy Zones" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section:** [Create Elevation Specifications](#)



## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### plan specifications: equipment

##### 4) Create Plan Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

#### Equipment

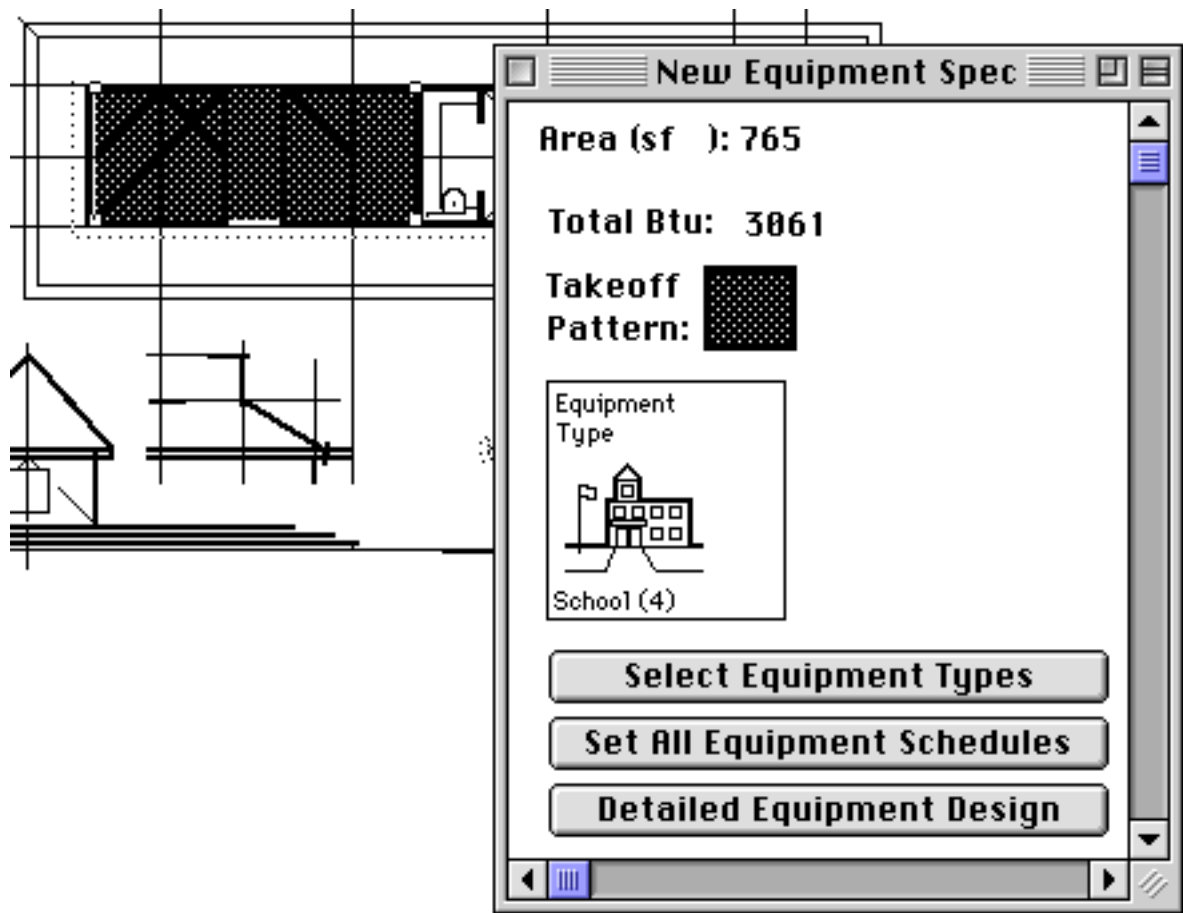
Equipment gains refer to the heat produced by machines inside the occupied parts of the building. It generally DOES NOT refer to waste heat from the building's mechanical heating or cooling system, since that type of equipment is generally located in separate, unconditioned space and is most often separately ventilated. Take off any zones of the building that have mechanical sources of heat, such as office equipment, computers, kitchen appliances, etc.

Create a different individual equipment spec for each different equipment load condition in your building. For instance, an architecture school might have studios with a low rate, offices with a moderate rate, and a computer lab with a high rate of equipment load. If an area is unoccupied or does not have significant equipment, do not create a spec for it.

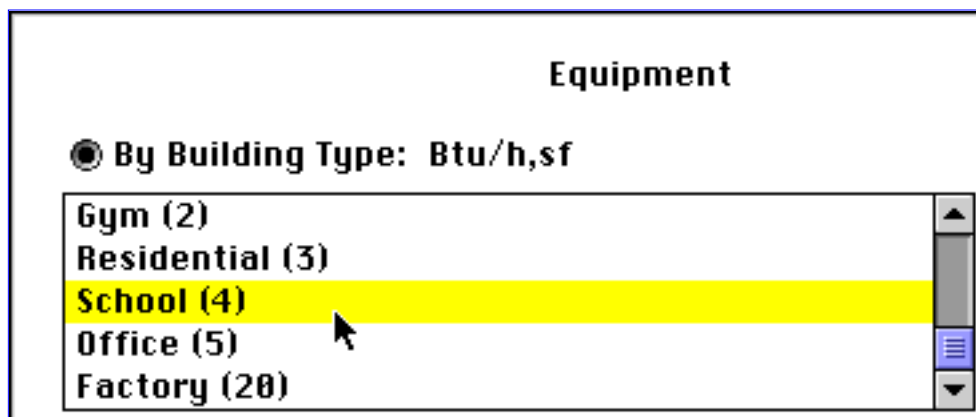
- To set up Equipment Specs, double click on the "Equipment" icon then double click on the "New Equipment Zones Spec" icon:



- You will get a spec window like the one below.



- Click on the icon in the spec window to choose the zone's equipment type according to its occupancy.
- You can also specify occupants in a table view by clicking on the "Select Equipment Types " button:



- Use the tape measure or polygon tape measure to draw the area of the Equipment zone.
- If you wish, you may also specify the [Detailed Equipment Design](#).

See the section, "Plan Specifications: Equipment Zones" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section:** [Create Elevation Specifications](#)

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### plan specifications: electric lighting

##### 4) Create Plan Specifications.

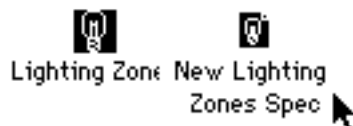
Click on one of the icons below for more information about creating specs and takeoffs for each element type:



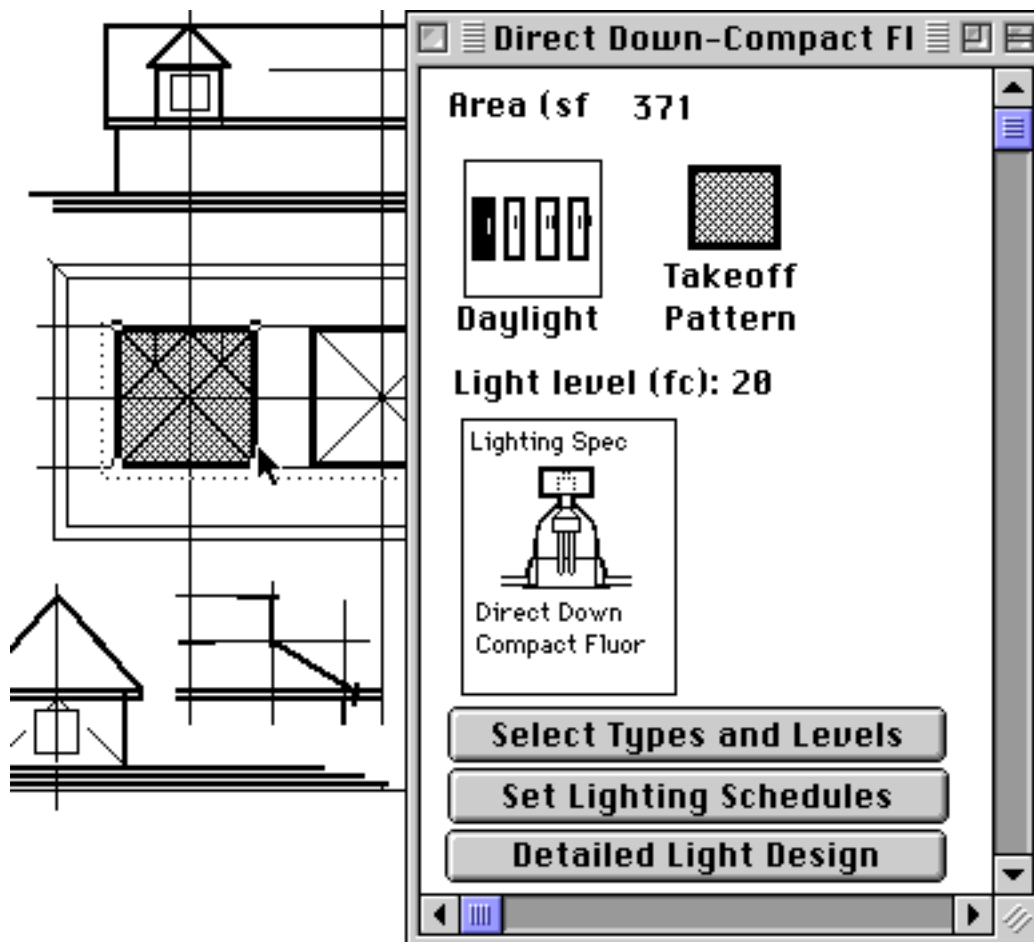
##### Electric Lighting

You can use the lighting specs to define as many different floor areas as you have lighting types or levels. More than one lighting spec can be associated with a particular daylight zone.

- To set up electric lighting zones, double click on the Lighting Zone icon, then double click on the New Lighting Spec icon:

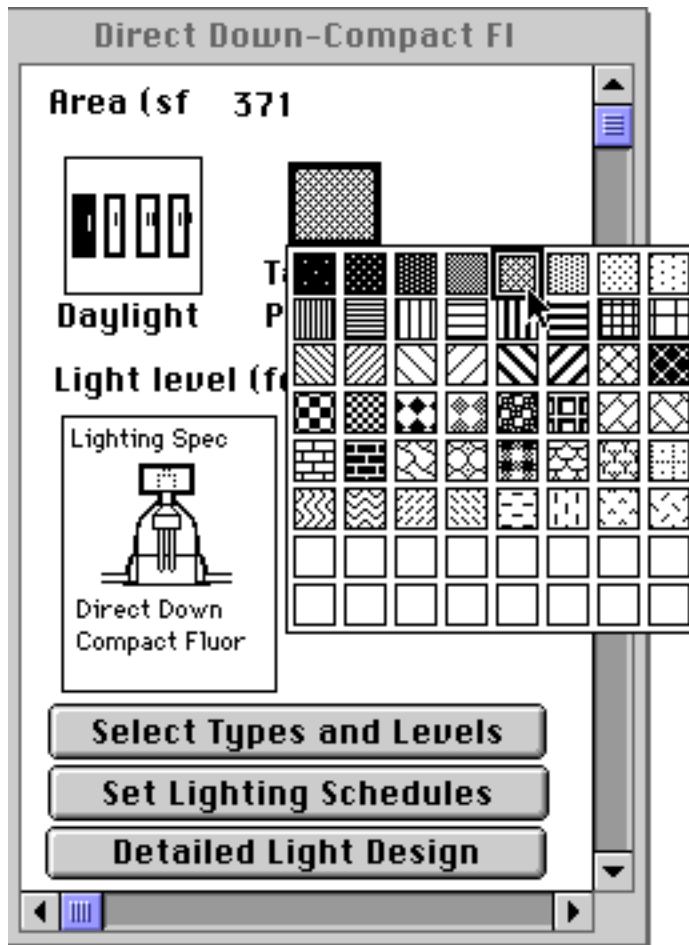


- You will get a spec window like the one below.



- Select the appropriate daylight zone in the daylight zone icon. Zone I is selected in the example.

- Use the tape measure or polygon tape measure to draw the area of the zone. The total of all Electric Lighting Zones associated with a daylight zone MUST sum to be exactly the same area as that daylight zone in plan. ES uses the electric lighting takeoff area to calculate the R/T area for daylighting in the Window Sizer.
- If desired, you can change the pattern of the takeoff by holding down on the Takeoff Pattern in the spec window.



- Select the "Lighting Types and Levels" by clicking on the button with that name. You can also click on the luminaire icon to cycle through the lighting types. Notice that, depending on the lighting type you choose, some light levels foot - candles under the Visual Task column will be greyed-out, indicating some the type is inappropriate for that illuminance intensities.

## Select Visual Tasks and Lighting Type

Visual Task ( fc )	Lighting Type ( Btu/h,sf,fc )
Corridor (5)	Surface-High Pressure Sodium (0.082)
Warehouse (10)	Surface-Metal Halide (0.096)
Residential (20)	Troffer (0.122)
Classroom (30)	Open Direct Fluorescent (0.124)
Factory (35)	Batwing Louvered (0.136)
Office (40)	Direct Open Reflector-Compact Fluor (0.163)
Library (50)	Indirect Luminous Bottom (0.164)
Assembly Line (75)	Luminous Ceiling (0.164)
	Direct Down-Compact Fluorescent (0.211)
	General Diffuse-Compact Fluorescent (0.234)
	Direct Open Reflector-Halogen (0.332)
	Direct Down-Halogen (0.430)
	General Diffuse-Halogen (0.476)
	Direct Down-Incandescent (0.860)

OK

- When a Portion of the Electric Lights Will Always Be Off**  
*Energy Scheming* assumes that all the lights, in every part of the building, are turned on when the building is occupied and there is insufficient daylight available. In many buildings, this will overestimate gains from lighting. BUT, be sure not to reduce the AREA of the electric lighting zones; if you do, then the daylight calculations in the R/T Window sizer will be wrong. Instead, account for part of the lights being turned off (as is usually the case in a residence) by lowering the VISUAL TASK footcandle (fc) level in the Electric Lighting Spec window. If, for instance, you need 40 fc of light, but only half of the lights will ever be on at any one time, use 20 fc as your lighting level specification.
- Other Lighting Types**  
 If the options do not fit your lighting system well enough, you may choose to use the [Detailed Light Design input method](#).

See the section, "Plan Specifications: Electric Lighting Zone Specifications" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

---

**Jump to the next section:** [Create Elevation Specifications](#)

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

# B. DEFINING: take-offs and specifications

### elevation specifications



[shanley example.](#)

#### 5) Create Elevation Specifications.

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

#### Set up your Elevation Drawings.

The ES Manual has a detailed explanation of how to set up elevation drawings. From the file cabinet, [choose Elevations](#). Then double click on the [New Elevation icon](#). From the [Drawing Spec window](#), name the drawing and set its scale with the scale tool. See the section, "Specifications from Elevation Drawings" in Chapter 5 of the ES manual for help.

#### How many Drawings?

In general, you will need one elevation drawing in ES for each different elevation of your building. You may want to review the suggestions about what drawings to use in ES found in [Part A . DOCUMENTING](#). If you have a building with repetitive bays of Elevations, you can use [ES's cloning functions](#) to clone the drawing with or without its associated takeoffs.

#### Where to Start!

Once your drawings are set up, you are ready for takeoffs. Building elements are specified in ES as a part of a particular plan or elevation drawing.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



**SAVE and BACK-UP your work.**

#### Turn in

- A screen capture of your Elevations, showing walls, roofs, and windows. Turn off all other elevation takeoffs (Mass) in the "VIEW / Takeoffs..." menu. You will not be able to print the takeoffs unless you use a [screen capture technique](#).
- A printout of the energy performance report, with items checked as shown in [this window](#).

File	Edit	Options	Define	Rule-of-Thu
New...				⌘N
Open Building File...				⌘O
Close				⌘W
Save				⌘S
Save Building File As...				
Export				▶
Calculate Energy Performance				⌘=
Page Setup...				
Print Drawing Window				
Print Graphic Report				
Print Energy Performance Report				⌘P
Quit				⌘Q

For a guide, see the [shanley example](#).

---

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### elevation specifications: walls

##### 4) Create Elevation Specifications.

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

##### Walls

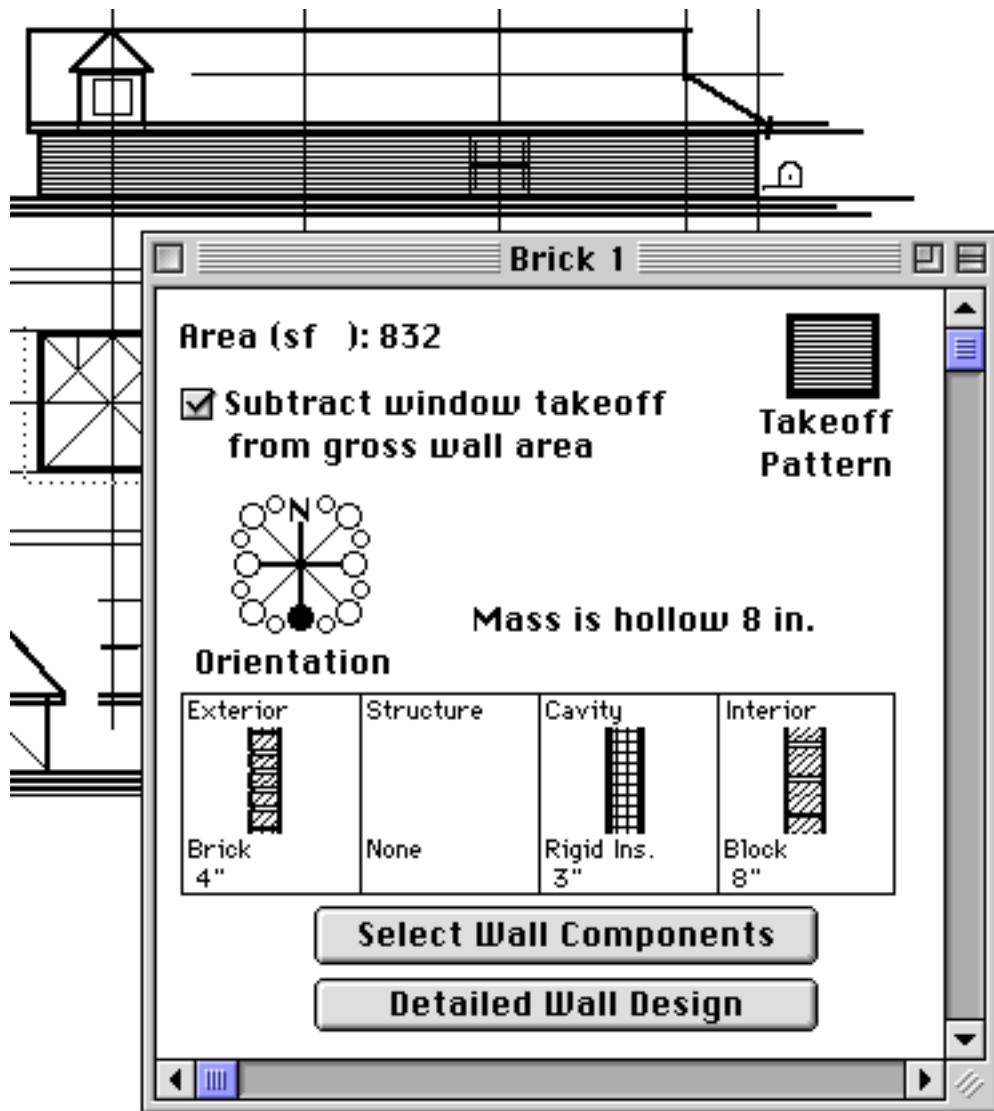
Walls are easy to define in ES. Create a different individual wall spec for each type of construction in each elevation. ES will automatically subtract any window area for window takeoffs that are drawn over the wall takeoffs. That makes your work simple!

- To set up Walls Specs, double click on the Walls icon then double click on the New Wall Spec icon:



- You will get a spec window like the one below.





- Wall orientation defaults to the orientation of the elevation drawing. If the wall takeoff you are working on is oriented in some other way, such as an angled wall in an elevation, define a different orientation by clicking on the orientation (compass) icon.
- Select the construction components that are closest to your building. Unless your building is made of very unconventional materials, you should find a combination that will work for you from the options available in ES. You can click on the icons for each layer in your wall assembly or you can specify them in a table view by clicking on the "Select Wall Components" button.

## Select Roof Component

(in.)

Exterior	Decking	Structure	Cavity		Interior
Asphalt	Plywood	Wood	Batt	2"	Gyp Bd 1/2"
Shakes	Conc/Metal	Steel	Rigid Ins.	3"	Gyp Bd 5/8"
Clay Tile	None	Concrete	Air	4"	Plaster
Built-up		None	None	6"	Wood
Metal				8"	Acoustic
None				10"	T1-11
				12"	None
				14"	

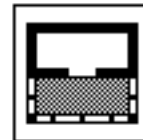
### Ext. Color:

<input type="checkbox"/>	Light
<input type="checkbox"/>	Medium
<input type="checkbox"/>	Dark

### Mass:

Hollow	4
Solid	6
None	8
	12

### Solar



OK

- To take credit for mass in the wall, you must click on the "Select Wall Components" button. In the dialogue box that comes up, be sure to define:
  - the mass thickness that is exposed to the interior room air
  - whether the mass is hollow or solid
  - whether the mass is in a "solar zone" (room with direct sun) or "non-solar zone" (room linked to a room with direct sun)

Remember, mass outside the insulation, or covered with insulating materials like carpet, does not count.

- Use the tape measure or polygon tape measure to draw the area of the wall.
- If you wish, you may also specify the [Detailed Wall Design](#).

See the section, "Elevation Specifications: Walls" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

### B. DEFINING: take-offs and specifications

#### elevation specifications: roofs

##### 4) Create Elevation Specifications.

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

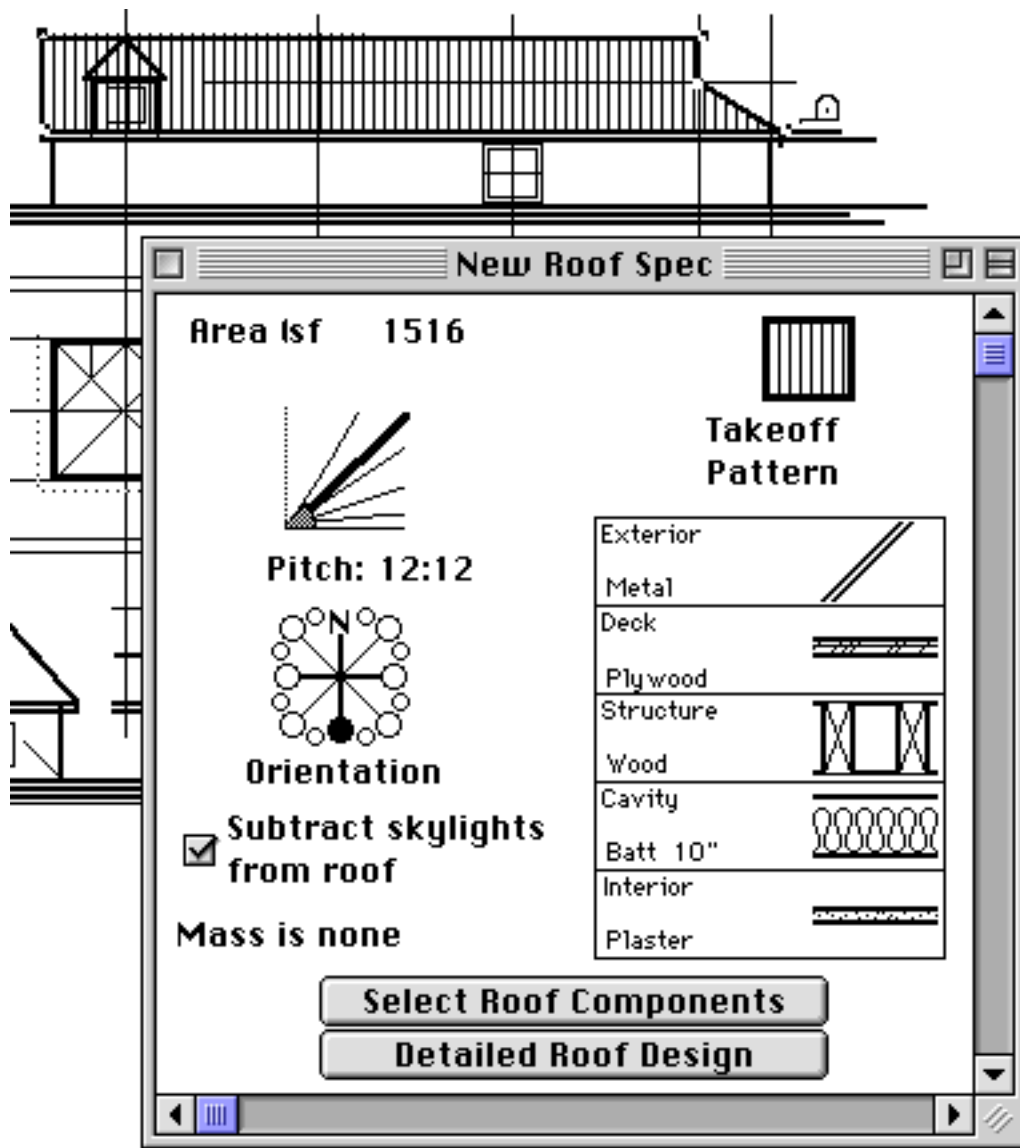
##### Roofs

Flat roofs, or roofs of very low slope must be specified in the plans. Sloping roofs may be specified in either Plan or Elevation views. Do a separate individual roof spec for each different type of roof construction.

- To set up Roof Specs, double click on the Roofs icon then double click on the New Roof Spec icon:



- You will get a spec window like the one below.



- Click on the Pitch icon to select the slope of your roof.
- Click on one of the compass points in the Orientation icon to set the roof's orientation.
- Select the construction components that are closest to your building. Unless your building is made of very unconventional materials, you should find a combination that will work for you from the options available in ES. You can click on the icons for each layer in your roof assembly or you can specify them in a table view by clicking on the select Roof Components button.

(in.)

Exterior	Decking	Structure	Cavity		Interior
Asphalt	Plywood	Wood	Batt	2"	Gyp Bd 1/2"
Shakes	Conc/Metal	Steel	Rigid Ins.	3"	Gyp Bd 5/8"
Clay Tile	None	Concrete	Air	4"	Plaster
Built-up		None	None	6"	Wood
Metal				8"	Acoustic
None				10"	T1-11
				12"	None
				14"	

**Ext. Color:**

<input type="checkbox"/>	Light
<input type="checkbox"/>	Medium
<input type="checkbox"/>	Dark

**Mass:**

Hollow	4
Solid	6
None	8
	12

**Solar**

OK

- NOTE: To take credit for mass in the roof, you must click on the "Select Roof Components" button. In the dialogue box that comes up, be sure to define:
  - the mass thickness that is exposed to the interior room air
  - whether the mass is hollow or solid
  - whether the mass is in a "solar zone" (room with direct sun) or "non-solar zone" (room linked to a room with direct sun)

Remember, mass outside the insulation, or covered with insulating materials like carpet, does not count.

- Use the tape measure or polygon tape measure to draw the area of the roof.
- If you wish, you may also specify the [Detailed Roof Design](#).

See the section, "Elevation Specifications: Roofs" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

## B. DEFINING: take-offs and specifications

### elevation specifications: windows

#### 4) Create Elevation Specifications.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

#### Windows

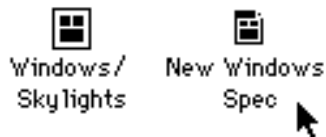
All operable windows should be specified in the elevations. Flat (zero or near-zero slope), inoperable (fixed) skylights are the ONLY windows that you can specify from plans. Windows used as stack ventilation openings, MUST be specified in an elevation view, so that ES will properly calculate the stack height, which it does by measuring the height difference between inlets and outlets on the elevations.

#### Common Mistakes with Windows

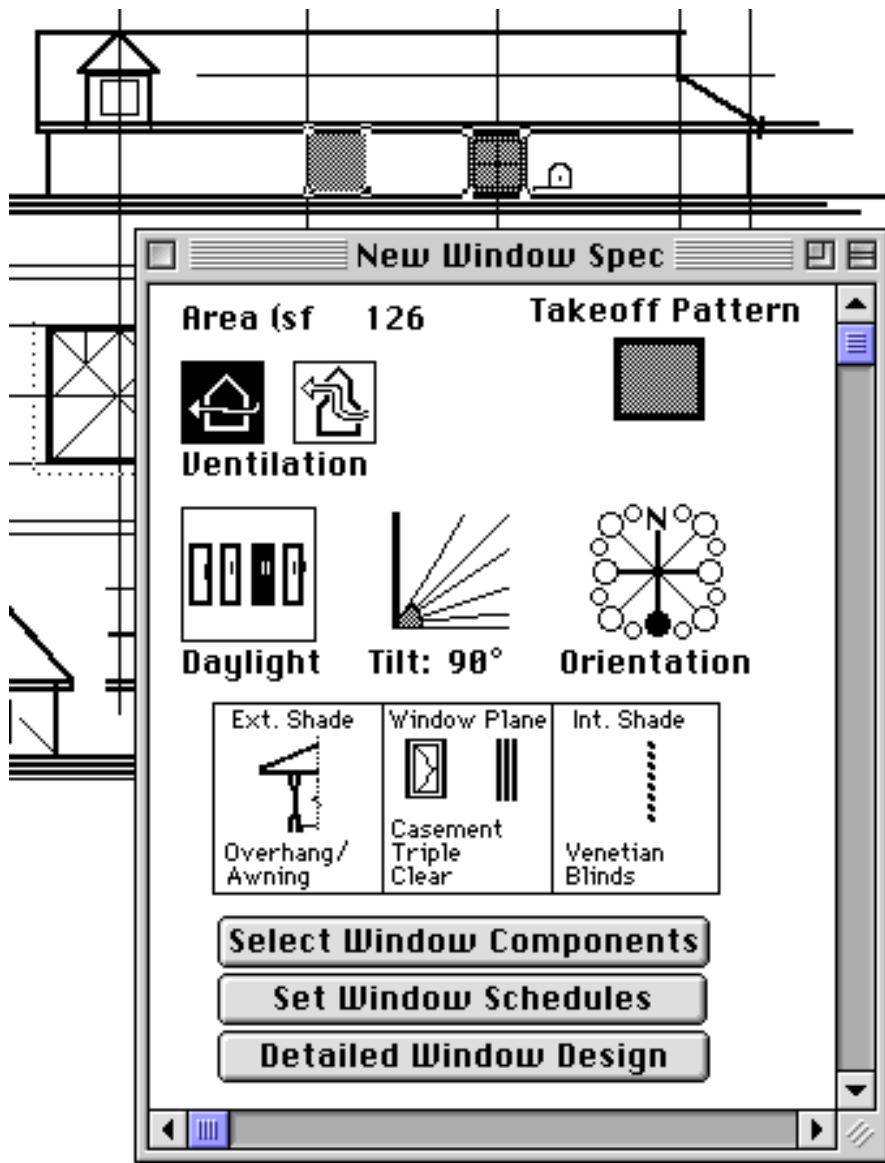
Specific notes on avoiding mistakes with the Stack Reference Line, Daylight Zones, Opaque Shades, Night Insulation, Tress and Site Obstructions

#### Window Specifications

- To set up Window Specs, double click on the Windows/Skylights icon then double click on the New Window Spec icon:




- You will get a spec window like the one below.



- Define the window's role in ventilation: click on the Cross Ventilation icon if the window is an inlet or outlet for cross ventilation. Click on the Stack Vent icon if the window is part of a stack ventilation strategy. When you select stack venting for the first time in an elevation, ES will prompt you to draw a reference line. For more info, see [Common Mistakes with Windows](#).
- First, select the daylight zone associated with the window by clicking on the Daylight Zone icon.
- Define the window's tilt angle in the Tilt icon.
- Define the window's orientation, if different from the elevation (such as for the angled parts of a bay window) in the Orientation compass icon.
- Select the window components that are closest to your building's design:
  - Select the type of exterior shades, if any, in the Ext Shades icon.
  - Select the window type and glass type in the Window Plane icon. When there are two images, click on each icon separately.
  - Select the interior shading type, if any, in the Int. Shade icon.
  - OR, you can specify them in a table view by clicking on the Select Window Components button:

### SELECT WINDOW COMPONENTS

External Shades	Window Plane			Internal Shade
Overhang/Awning	Fixed	Single	Clear	Venetian Blinds
Fins/Vert.Louvers	Casement	Double	Tinted Light	Roll-down Shades
Egg Crate/Mesh	Double Hung	Triple	Tinted Dark	Drapes
Roll-down Shades	Hopper	Glass Block	Mirrored	Insulating Shades
None	Pop-up Sky		Low-e	None
	Ctr Pivot Sky		Low-e, argon (heating)	
			Low-e, argon (cooling)	
Opaque      Fixed			Fin Heating	Dark
Translucent   Operable			Fin Cooling	Light



- In the table view, you can also define several additional specifics:
  - External shades as Fixed or Operable, and Opaque or Transparent.
  - Glass type may be defined
  - Internal shades can be defined as Dark or Light
- Use the tape measure or polygon tape measure to draw the area of the skylights.
- If you wish, you may also specify the [Detailed Window Design](#). The detailed screens will also allow you to see the values used by ES for the elements you have already selected in the simple method.

See the section, "Elevation Specifications: Windows / Skylights" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.



## elevation specifications: windows

### Common Mistakes with Windows

- **Stack Reference Line**

In order to calculate stack height (the distance between vertical inlets and outlets), ES needs a reference line drawn on each elevation from which to measure. This reference line should be defined in the first window specification of each elevation. When you open your first window spec box, click on the radio button for a stack ventilation inlet or outlet. You will get an [instruction window](#). Follow the procedures in the ES manual to [define the reference line](#). It is important that the reference line be drawn at a height which represents the same "elevation above sea level" on each elevation drawing. On a flat site, this is easy, just use the ground line. On a sloping site, it can be tricky, so be careful.

- **Daylight Zones**

Be sure to associate each window with the appropriate Daylight Zone by clicking on the daylight zone icon in the upper left of the window spec box.

- **Opaque shades**

Opaque Shades will do a good job at blocking solar heat gain, but they will also block out daylight. If you use opaque internal shades, you will see the electric lights come on during the hot parts of the day.

- **Night Insulation**

If you want to specify night insulation, do NOT use the "Insulating Shades" option, as it will block daylight whenever employed and is NOT regulated by the Night Insulation Schedules. Instead, specify all the window elements, including exterior and interior shades, if desired. Then click on the "Detailed Window Design" button in the window spec box. The values shown in each of the three new spec windows represent the selections you have made already. You do not need to change them. In the [spec window for the "Window Pane,"](#) you can specify an R-Value for night insulation. This done, ES will employ internal shading and night insulation *separately* as needed and per your schedules.

- **Trees and Site Obstructions.**

Window takeoffs are the place to account for Trees and Site Obstructions. To do so, you will have to do a detailed window spec. First define all the window elements in the window spec. Then click on the "Detailed Window Spec" button. Input an external layer shading coefficient to account for trees or external obstructions from buildings, walls, etc. If your building also has external shading on the building itself, multiply the external shading device's shading coefficient by the shading coefficient that you are using to account for external obstructions. Use the product of these as an input. *Shading coefficients can be found in Appendix A of the ES Manual.* Alternatively, the percentage of glass shaded at specific sun angles can be input to define the exterior obstructions by clicking on the "Review Angles" button in the External Shades spec window.

## RECYCLING WITH "ENERGY SCHEMING": Schematic Design Performance

# B. DEFINING: take-offs and specifications

### elevation specifications: mass

#### 4) Create Elevation Specifications.

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

Click on one of the icons below for more information about creating specs and takeoffs for each element type:



---

#### Thermal Mass

Any mass elements in the building which are NOT part of an exterior roof, wall, or floor that transfers heat conductively to the outside should be taken off using the mass icon. Take off internal mass in the PLANS if the mass is part of a HORIZONTAL surface, such as an exposed concrete intermediate floor or ceiling. VERTICALLY oriented mass, such as interior masonry bearing walls, should be taken off in the mass specification for ELEVATION drawings. Mass that is specified in wall, roof, or floor specs SHOULD NOT be specified again in the mass spec.

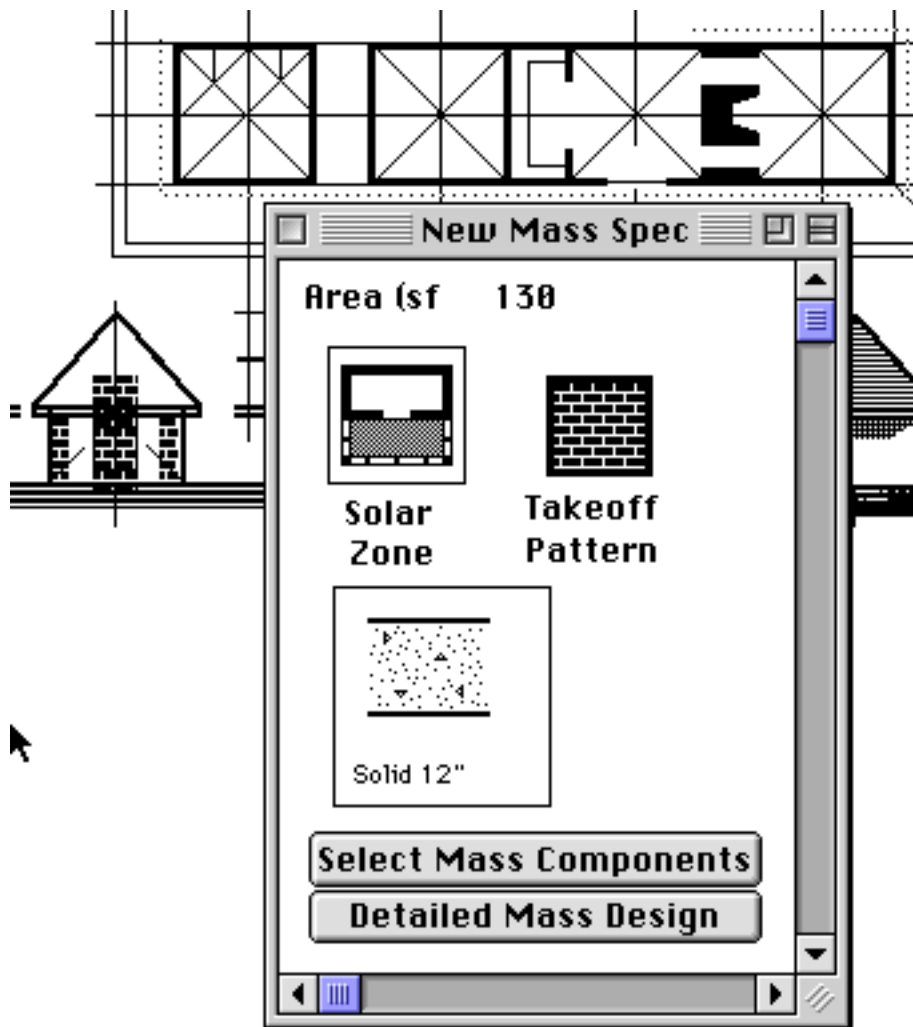
ES assumes that mass elements are exposed on only one side. If a mass element is exposed to room air on two sides, such as both sides of an interior masonry wall, then you should define the each side as separate specifications, using one half of the actual mass thickness for each side. Remember that exposed area is a more important factor in the mass's thermal performance than is its thickness.

Create a different mass spec for each different type of vertical mass.

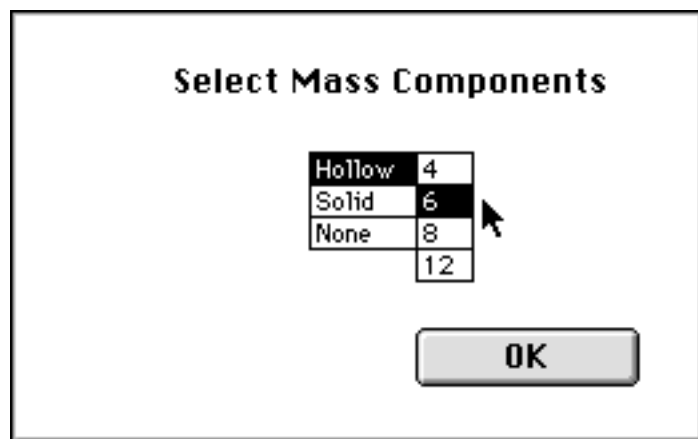
- To set up Mass Specs, double click on the Mass icon then double click on the New Mass Spec icon:



- You will get a spec window like the one below.



- Click on the Solar Zone icon to spec whether your mass is in a room with south sun or not.
- Select the type and thickness of mass that are closest to your building by clicking on the icon. You can also specify the mass in a table view by clicking on the Select Mass Components button.



- Use the tape measure or polygon tape measure to draw the area of the mass.

If you wish, you may also specify the [Detailed Mass Design](#).

See the section, "Elevation Specifications: Mass Specification" in Chapter 5 of the ES manual for help.

SAVE and BACK-UP your work.

## EXAMPLE PROJECT

shanley dental building, clayton, mo



*harris armstrong, architect, 1936*

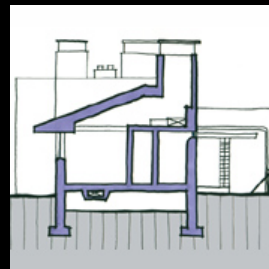


### Worked Example

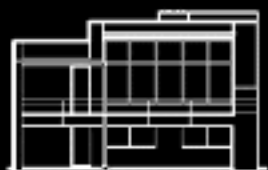
Re-Cycling with *Energy Scheming* exercise



Model



Final Drawings



Drawings



Site Photos

# EXAMPLE PROJECT: example exercise

## outline of example problem pages



[exercise](#)

### A. DOCUMENTING: input your building (example)

1. [Assemble Schematic Plans and Elevations of Your Design](#)
2. [Identify the Building's Construction Type\(s\)](#)
3. [Diagram the Solar Concept](#)
4. [Determine Your Simulation Strategy](#)
5. [Diagram the Daylighting Zones](#)
6. [Get the Drawings into the Computer](#)
7. [Create a New Climate](#), if necessary



[exercise](#)

### B. DEFINING: take-offs and specifications (example)

1. [Tune Settings to Fit Your Building](#)
2. [Define Your Daylight Zone Icon](#)
3. [Set Performance Goals for Lighting and Heating](#)
4. [Create Plan Specifications](#)
5. [Create Elevation Specifications](#)



[exercise](#)

### C. ANALYZING: understanding energy patterns (example)

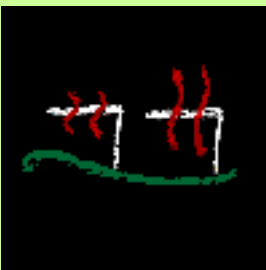
1. [Use the Rule-of-Thumb Window Sizer](#)
2. [View the Graphic Report](#)
3. [Interpret and Assess the Building's Performance](#)



[exercise](#)

### D. RE-DESIGNING: generate and test cycles (example)

1. [Re-Design to Meet Your Window Performance Targets](#)
2. [Re-Design to Reduce Net Flows and Peak Loads](#)
3. [Print the "Energy Performance Report"](#)
4. [Document Design Changes](#)



[exercise](#)

### E. EVALUATING: comparing with energy codes (example)

1. [Set an Energy Budget](#)
2. [Choose Reference Criteria](#)
3. [Model Your Reference Case Building](#)
4. [Compare the Performance of the Two Designs](#)



[Download the PDF version of the exercise](#)

## B. DEFINING: take-offs and specifications

### settings



#### 1. Tune Settings to Fit Your Building

##### Turn in

- A record of your settings for Ventilation / Infiltration Rate.
- A record of the evaluation days you have chosen.
- A printout of the energy performance report, done at the end of Part B, will show your settings for Schedules and Energy Strategies.

[exercise](#)

#### Infiltration or Minimum Ventilation Rates

Since the Shanley Building is a non-residential building, we are given ventilation options by building type. We selected "0.05 Office, Gym School." This represents a ventilation rate recommended by code. Commercial buildings are often ventilated based on an occupancy schedule. Because of this, and since fewer people are opening and closing doors and windows during unoccupied periods, we have set the unoccupied rate lower "at 0.03."

**Infiltration or Minimum Ventilation Rates**  
(Btu/h, °F, sf floor area)

**Occupied**

**Non-residential**

☐ 1.44 Factory

☐ 1.00 Assembly

☐ 0.20 Restaurant Dining Area

☐ 0.10 Retail

☒ 0.05 Office, Gym, School

☐ 0.02 Hotel/Motel, Warehouse

☐ 0.00 Other

**Unoccupied**

☐ 1.00 ☐ 0.50 ☒ 0.03 ☐ 0.00 Other

OK Cancel

#### Set the "Evaluation Days"

For our four evaluation days we chose days typical of the St. Louis climate in each of four seasons: December cloudy, March cloudy, June cloudy, and September clear.

Climate: St. Louis

☒ Winter Cloudy ?

☒ Spring Cloudy ?

☒ Summer Cloud ?

☒ Fall Clear typ ?

#### Check the Schedules

##### • Shades

The operable shades are turned on all the time. This does not mean that they are in use all of the time; it only means that they are *available for use* all of the time.

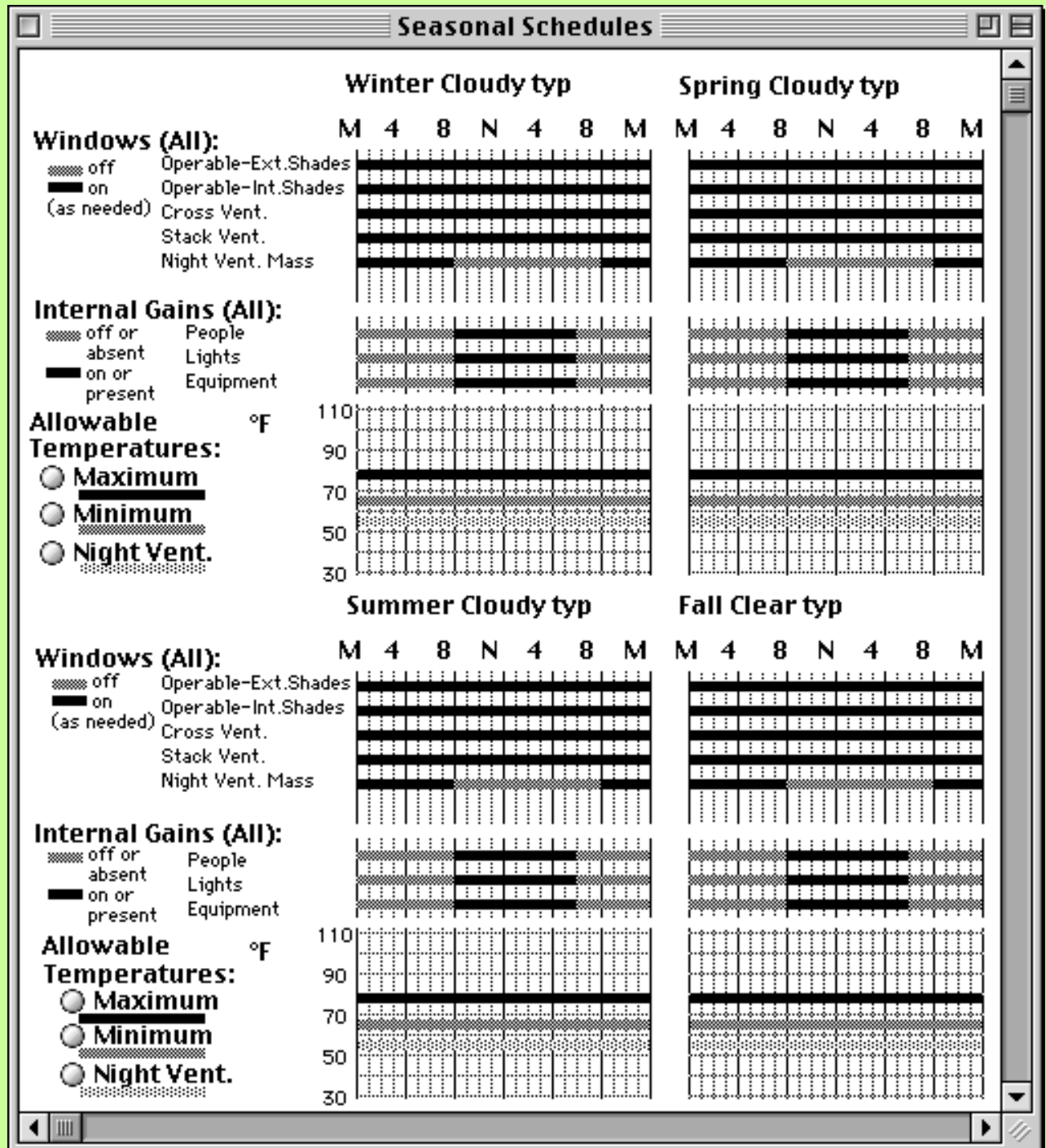
- **Ventilation**

Although the Shanley Building cannot take advantage of cross ventilation because it only has operable windows on one wall, we do not need to turn off "Cross Vent." because Energy Scheming will realize that there is an outlet but no inlet. We will want it on later when we redesign to improve ventilation. "Stack Vent." also does not need to be turned off.

We turned off "Night Vent. Mass" during daytime hours of 8 AM and 8 PM so that it would not be used during occupied hours. Even though the occupied hours typically end at 6 PM, we do not want high volumes of possibly cool air in the building until we are sure people have gone home. In St. Louis, this is probably not a problem, because the outside temperature in the summer will only drop below the inside temperature later in the evening.

- **People, Lights, and Equipment**

These are turned on from 8 AM to 6 PM because those are the expected times of occupancy.



- **Check the Interior Temperature Settings**

We used the default temperature settings of 65 F Minimum to 78 F Maximum, with a 55 F minimum for Night Ventilation.

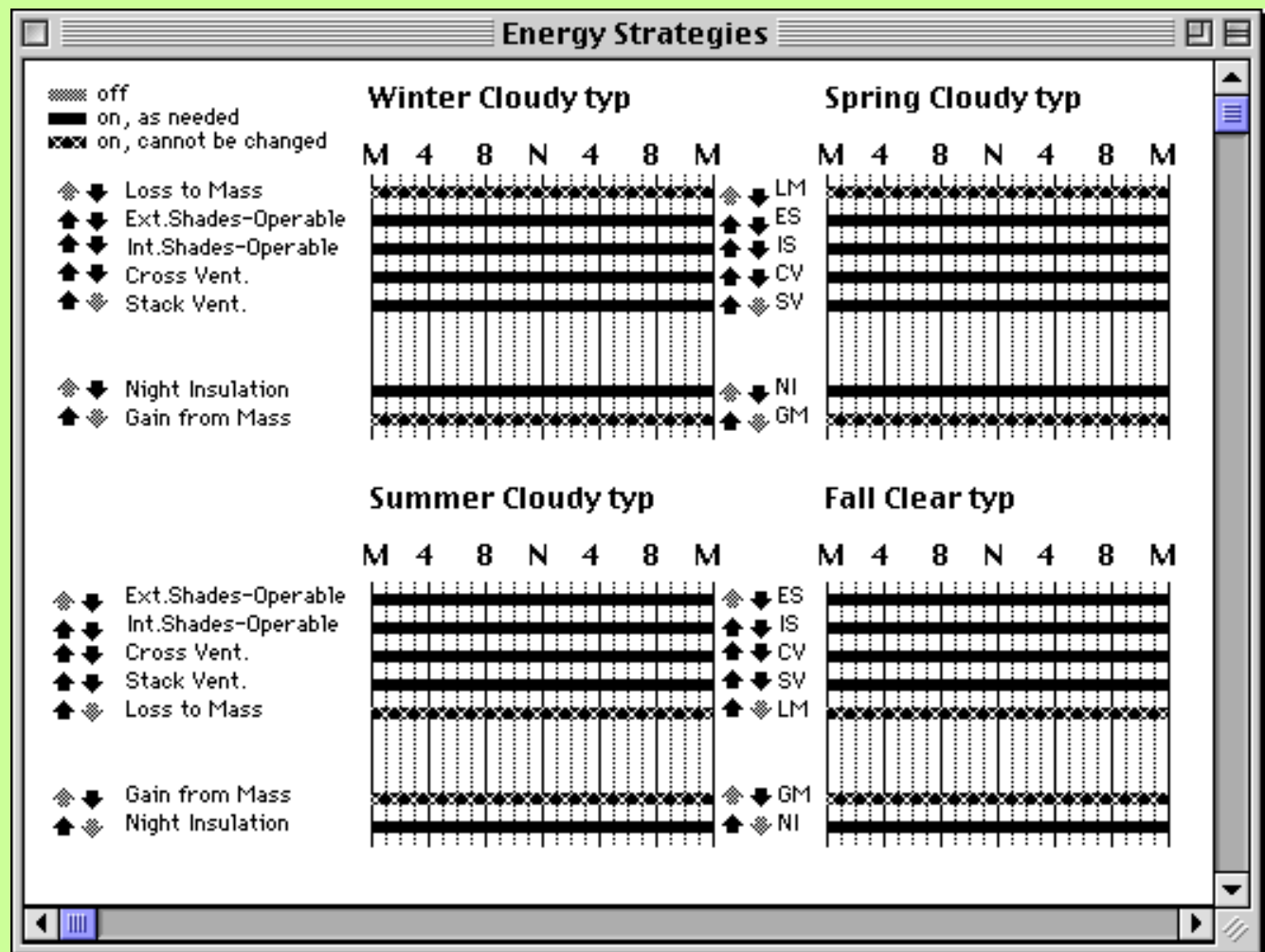
### Set the Order of Energy Strategies

In winter and spring we moved "Loss to Mass" up to the top of the list so ES will know to store excess heat before trying to remove it by passive cooling strategies. This is appropriate whenever thermal storage is necessary to store excess gains from one part of the day to be used to offset net losses during another portion of the day.



"Night Insulation" was turned off during the daylight hours of 8 AM to 6 PM because night insulation (heavy drapes in the initial design) will not be drawn during hours of operation. If it was, it would block all our daylight and views!

"Gain from Mass" was moved above "Night Insulation" for the summer and fall seasons (typically cooling seasons) because of the unlikeliness that night insulation will be used in the summer. NI is turned off in summer for the same reason. We leave NI on top in the Winter and Spring, because, being heating seasons, we want heat inside the building to be kept in by the NI before heat stored in the mass is used.



Jump to the next EXAMPLE section: [Daylight Zone Icon](#)



## B. DEFINING: take-offs and specifications

### daylight zone icon

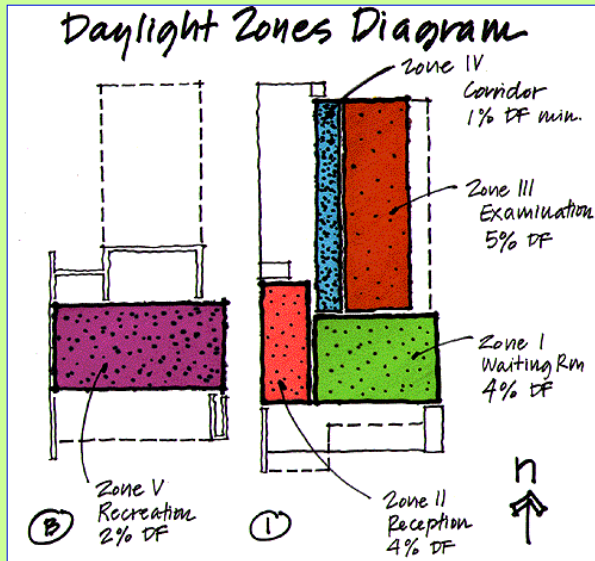


#### 2. Define Your Daylight Zone Icon

Turn in

- A Screen capture of the daylight zone icon screen

[exercise](#)



**Daylight Zones**

Reflectivity for each Daylight Zone:

I:	50
II:	45
III:	47
IV:	55
V:	50

### Drawing the Icons

In section A, we explained how we chose the [daylight zones](#). The image above shows how we diagrammed them. When drawing these zones in the dialog box, we drew the general shapes and adjacencies of the zones for our own reference, while trying to draw each zone *as large as possible*. The daylight zones will appear as small icons; if the zones are drawn too small, it will be difficult to select the appropriate zone when defining windows and electric lighting later. Referencing to the plan, daylight zone I represents the waiting room; II is the reception area; III is the series of offices; IV is the hallway and bathroom; and V is the basement recreation room. Notice we did not include the mechanical room because it is unconditioned, has no windows, and will not be occupied most of the time.

### Setting Reflectivity Levels

Average reflectivity for rooms with white walls and ceilings, with medium colored floors, will generally be in the 40-50% range. In our building, reflectivity for each zone was estimated using a weighted average of the reflectivity of the various room surfaces. For instance, in zone III which contains the offices, there are white tiled walls (70% reflectivity), dark colored floors and ceilings (15%), and a strip of windows on one wall (glass is about 15% reflective). We estimated that the dark surfaces composed about 5/12 of the surface area in the room and the white tile, the other 7/12. This averages out to a reflectance level of 47%:  $[(70 \times 7) + (15 \times 5)] / 12 = 47$ .

---

**Jump to the next EXAMPLE section:** [Set Performance Goals](#)

## B. DEFINING: take-offs and specifications

### performance goals



[exercise](#)

### 3. Set Performance Goals for Lighting and Heating

Turn in

- A record of your daylighting, solar heating, and ventilation goals. You will not be able to print the windows directly unless you use a [screen capture technique](#).

#### Define Daylighting Parameters

For each of the five daylighting zones, we chose a representative activity type from the list in the dialogue box. All of our glass is vertical, so all selections are made in the column below the icon for vertical glass.

- Zone I & II: The waiting room (zone I) and reception area (zone II) are best associated with "reading," for a 4% daylight factor (DF).
- Zone III: We chose a 5% DF, good for a more difficult task like "sewing," for the dental examination and laboratory rooms. We assumed that the light level would be supplemented by task lighting (you remember those intense dental lamps!) for close work performed in the orthodontic offices.
- Zone IV: The hallway is associated with "walking" and functionally requires very little light. However, given the brightness of the well lit adjacent spaces and the short adjustment time between them, we were concerned about having too much contrast. So we actually set that space to a 2% DF, "conversing."
- Zone V: Finally, we chose a 3% DF, "cleaning," for the recreation room, since play requires more light than conversing but less than reading.

**NOTE:**Remember to switch between daylight zones by clicking on the small daylight zone icons in the upper right corner of the dialogue box.

The day lighting in the building can be evaluated by using the Rule of Thumb Window Sizing Aid once the window and electric light takeoffs are complete. It will show if the windows are over- or undersized for each daylight zone, in relation to the parameters, set here.

### Daylighting Parameters For Daylight Zone 2

**Glass as a Percent of Floor Area**

Average Daylight Factors			
1 Walking	2	3	5
2 Conversing	5	7	10
3 Cleaning	8	10	15
4 Reading	10	13	20
5 Sewing	12	17	25
6 Drawing	15	20	30

**Assumptions:**

- Internal Reflectance = 40%
- Single Glazing
- No external obstructions
- Room depth equals twice window wall height

OK

Click on a zone in daylight zone icon of the image above to see the takeoff for daylighting parameters in each zone .

#### Define Solar Heating Parameters

The Shanley Building as designed does not have any significant night insulation except for some heavy drapes in the reception area. However, we plan on achieving a reasonable level of solar heating in the building through redesign. This is the place to set our target. We may add night insulation, and in all likelihood upgrade the windows to a higher performance window type. Therefore, we used the high end of the rule-of-thumb recommendation, a setting of Moderate Night Insulation (R-5) with Max SSF (49%).

### SOLAR HEATING PARAMETERS

- ☐ No Night Insulation (R-0)
- ☐ Min SSF (21%)
  - ☐ Max SSF (33%)
- ☒ Moderate Night Insulation (R-5)
- ☐ Min SSF (31%)
  - ☒ Max SSF (49%)
- ☐ High Night Insulation (R-9)
- ☐ Min SSF (41%)
  - ☐ Max SSF (65%)

#### Assumptions:

St. Louis, MO  
Double Glazing  
BLC = 7 Btu/DD,sf  
Inside Temperature = 75°F  
Internal Sources = Δ5°F  
Sizing for Clear Jan. Day  
Mass Area = 3 times  
South Glass Area

OK

#### Define Ventilation Parameters

- Under Ventilation of Room Air, we selected "20 Btu's per hour per square foot (School)" because, even though this is a small office building, its occupant density and equipment are less than a typical office.
- Under Ventilation of Mass we selected "As Taken Off," because we would like to see the effect of the mass in the building as designed. If you want to work on window sizing in your elevations before defining the mass, you can make an assumption about the level of mass in the building by selecting one of the other settings. An "average mass" building might be about 1.0 sf of mass per sf of floor area; a "high mass" building, 2.0.

### VENTILATION PARAMETERS

#### ☒ Ventilation of Room Air

Internal Heat Gain  
(Btu/h,sf):

- ☐ 10 (Gymnasium)
- ☐ 15 (Residence)
- ☒ 20 (School)
- ☐ 25 (Office,Retail)
- ☐ 40 (Assembly)
- ☐ 50 (Factory)
- ☐ Other

#### ☒ Ventilation of Mass

Estimate of Thermal Mass  
(per 1 sf Floor Area):

- ☐ 0.5 sf      ☐ 3.0 sf
- ☐ 1.0 sf      ☐ 4.0 sf
- ☐ 2.0 sf      ☒ As Taken Off: 2.8 sf

#### Assumptions:

St. Louis, MO  
Wind = S  
Δt = 3°F

Speed = 9 mph

OK

Jump to the next **EXAMPLE** section: [Create Plan Specifications](#)

## B. DEFINING: take-offs and specifications

### plan specifications



[exercise](#)

#### 4. Create Plan Specifications

Turn in

- A screen capture of your plans showing lighting zones. Turn off all other plan takeoffs in the "VIEW / Takeoffs..." menu. You will not be able to print the takeoffs unless you use a [screen capture technique](#).
- In the next section, Elevation Takeoffs, you will print the Energy Performance Report, which will document all your takeoffs.

Click on all icons below for specific information:



#### A few notes on managing takeoffs

- **Renaming Icons**

When you are doing takeoffs, you end up with a lot of icons representing various building elements. When you have many icons under one category, it sometimes helps to avoid confusion if you rename each takeoff icon with a specific name, such as "bedroom window" or "dormer roof". You can rename an icon by highlighting its name with the mouse and typing a new one in its place. This can only be done if the dialogue box associated with the icon is closed. We found this technique particularly useful when defining windows in the "Create Elevation Specifications" section.

- **Visibility of Icons**

Another way to keep from getting too confused during the takeoff mode of *Energy Scheming* is to change the settings of the takeoffs under "VIEW/Takeoffs..." You can make visible only the takeoffs that you want to see, such as only electric lights, or only takeoffs in the open spec.

---

Jump to the next **EXAMPLE** section: [5. Create Elevation Specifications](#)



## plan specifications: skylights

worked example

Click on all icons below for specific information:



### HORIZONTAL SKYLIGHTS

There are no horizontal skylights in the Shanley Building.



Back to [plan specifications](#)



worked example

## plan specifications: roofs

Click on all icons below for specific information:

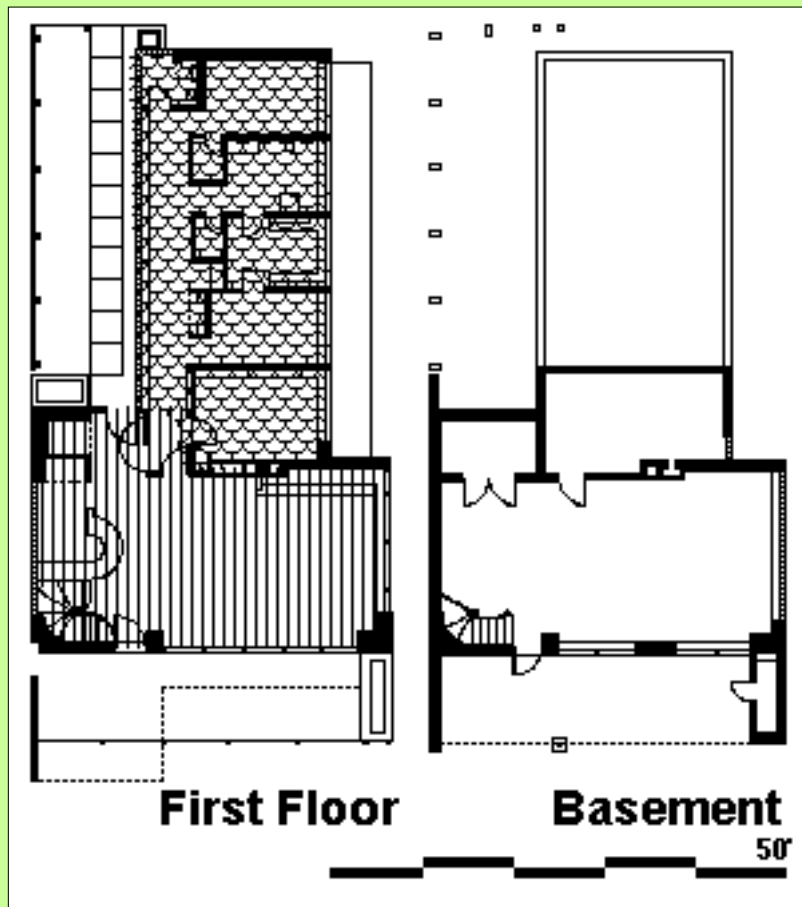


### ROOFS

Roofs for our building are taken off in plan view because they have a very low slope. Sloped roofs can also be taken off in the elevations. We took off two different roof areas:

- one over the office wing, sloping East
- one over the waiting room/reception area, sloping South

The construction of the roof is discussed in [Part A: DOCUMENTING](#)



Click on one of the Roof takeoffs in the above plan to see its associated specifications



Back to [plan specifications](#)



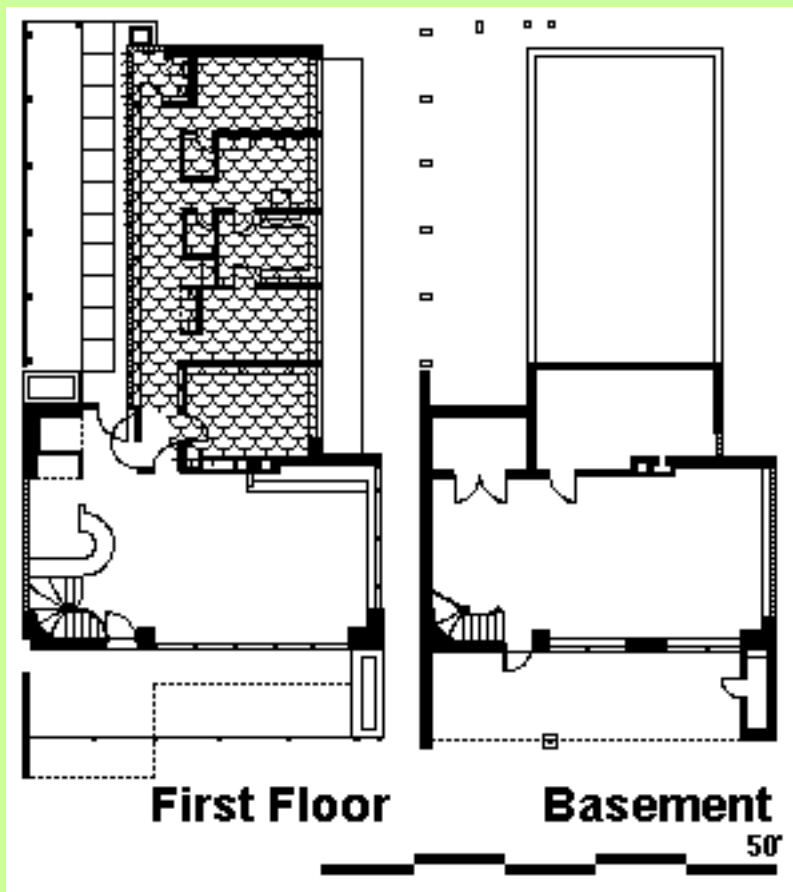
worked example

## plan specifications: roofs



### ROOF OVER OFFICE WING


The office wing roof has a 1:12 pitch to the East. Under "Select Roof Components" we selected the elements: built-up roofing, plywood decking, wood structure, 4" batt insulation (a good equivalent for the 3" of 1930's rigid insulation), and 1/2" interior gypsum board. We represented the exterior aluminum roof paint by selecting "light" exterior color. There is no roof mass and it is in a non-solar zone.






OfficeRoof

Area (sf ): 960



Pitch: 1:12













Orientation

☐ Subtract skylights from roof

Mass is none

Takeoff Pattern

Exterior	
Built-up	
Deck	
Plywood	
Structure	
Wood	
Cavity	
Batt 4"	
Interior	
Gyp.Board 1/2"	

Select Roof Components

Detailed Roof Design



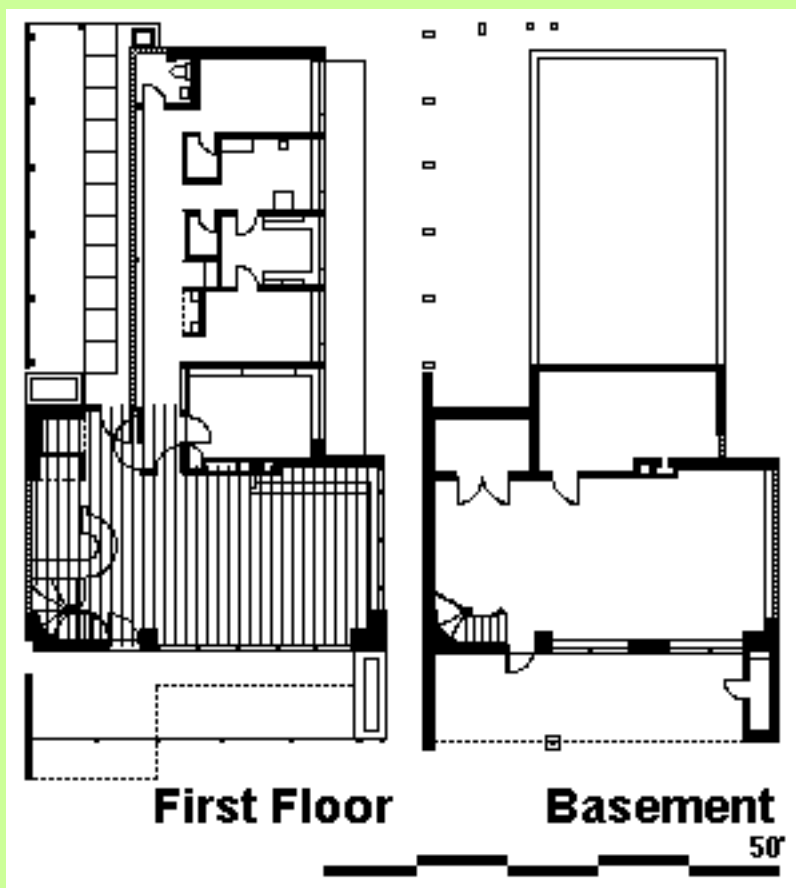
worked example

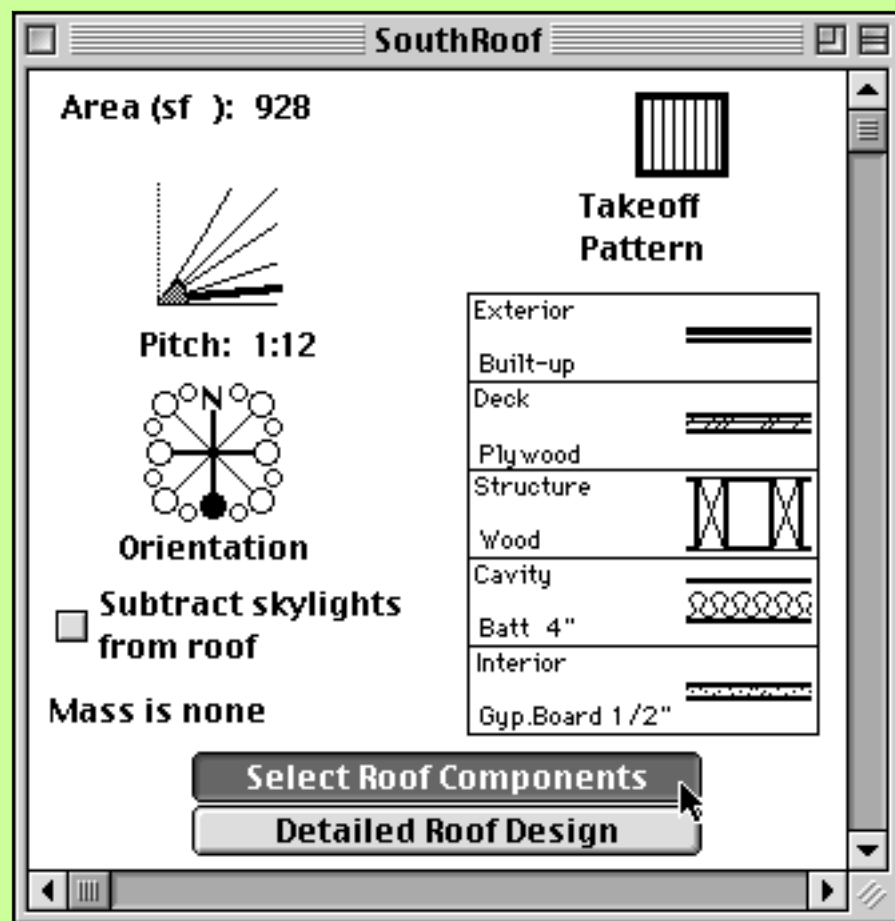
## plan specifications: roofs



### ROOF OVER THE WAITING ROOM/RECEPTION AREA

The roof over the waiting room/reception area was specified as having a 1:12 pitch to the south. It is made of the same materials as the other roof spec, but it is in a solar zone. Under "Select Roof Components" we selected the elements: built-up roofing, plywood decking, wood structure, 4" batt insulation (a good equivalent for the 3" of 1930's rigid insulation), and 1/2" interior gypsum board. We represented the exterior aluminum roof paint by selecting "light" exterior color. There is no roof mass.







worked example

## plan specifications: floors

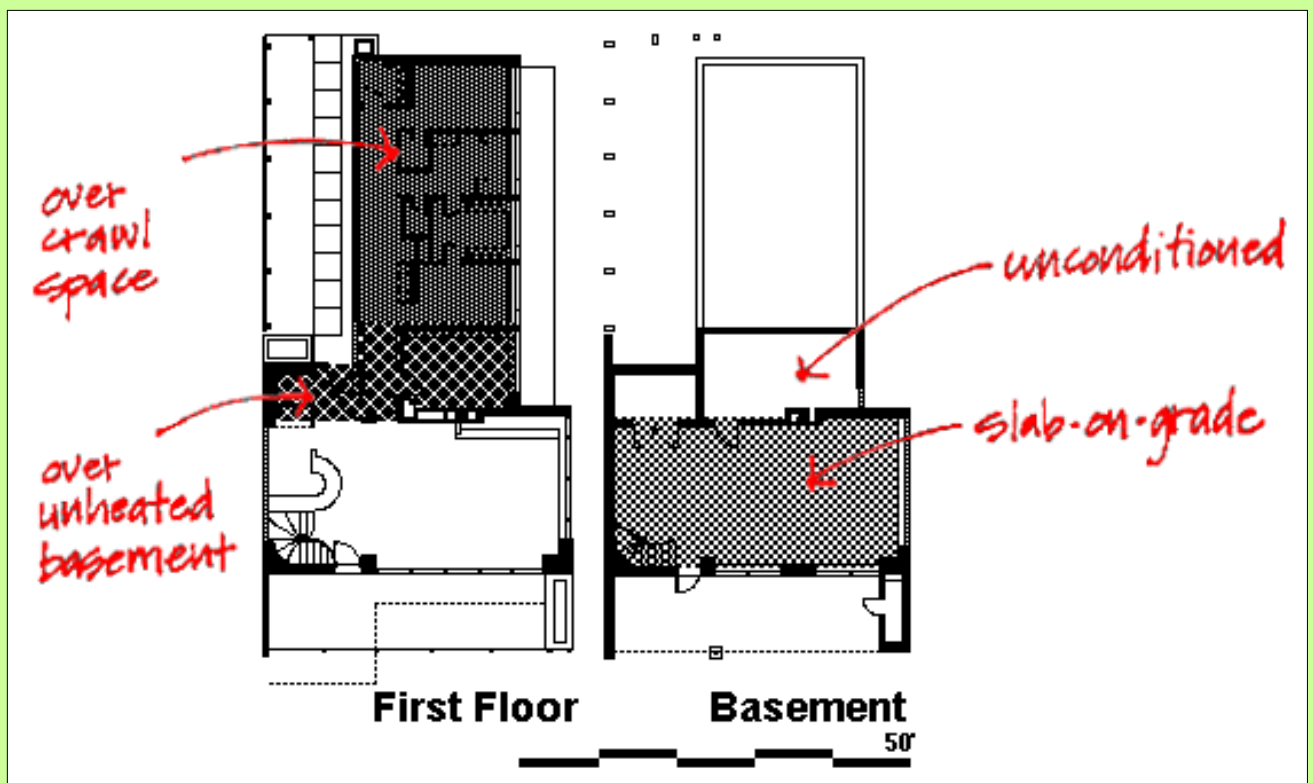
Click on all icons below for specific information:



### FLOORS

The only portions of the floors which should be taken off are those which are exposed to the outdoors. There are three floor areas that satisfy this requirement:

1. The floor of the office wing where it is over a crawl space,
2. The floor of the office wing where it is over the unheated mechanical room (over unheated basement), and
3. The floor of the basement rec room which is a slab-on-grade.



Click on one of the Floor takeoffs in the above plan to see its associated specifications

The mechanical room floor is ignored because it is not a heated or cooled space. The waiting room/reception area floor is also ignored because it is over a heated space, and therefore no heat transfers across it. We do not specify the waiting room/reception area floor anywhere in *Energy Scheming* because it is not massive. If it were a thermally massive floor we would define it under "Thermal Mass," not "Floors".



Back to [plan specifications](#)



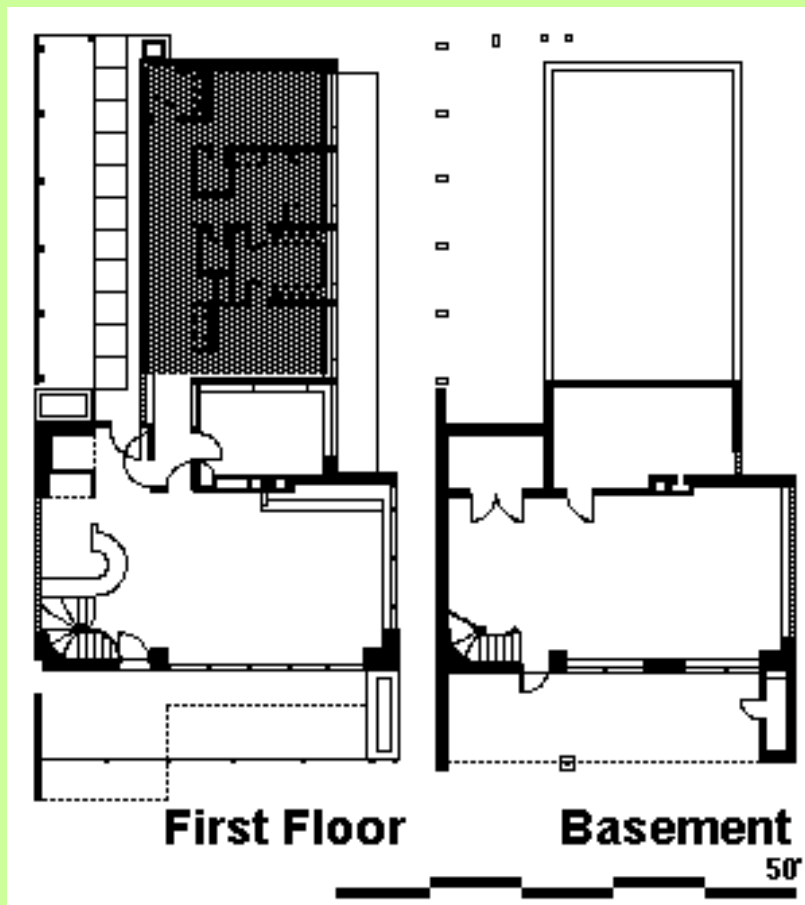
worked example

## plan specifications: floors




### FLOORS OVER A CRAWL SPACE

The office wing floor is linoleum on wood frame over an uninsulated crawl space. We selected "Over Crawl" and under "[Select Floor Components](#)," we highlighted vinyl tile, 3/4" plywood subfloor, wood structure, no cavity insulation, no exterior material, no mass, non-solar zone.




Over Crawl

Area (sf ): 740



Over Crawl

Mass is none

Takeoff Pattern: 

Select Floor Components

Detailed Floor Design

Interior

Vinyl Tile

Subfloor

Plywood

Structure

Wood

Cavity

None

Exterior

None



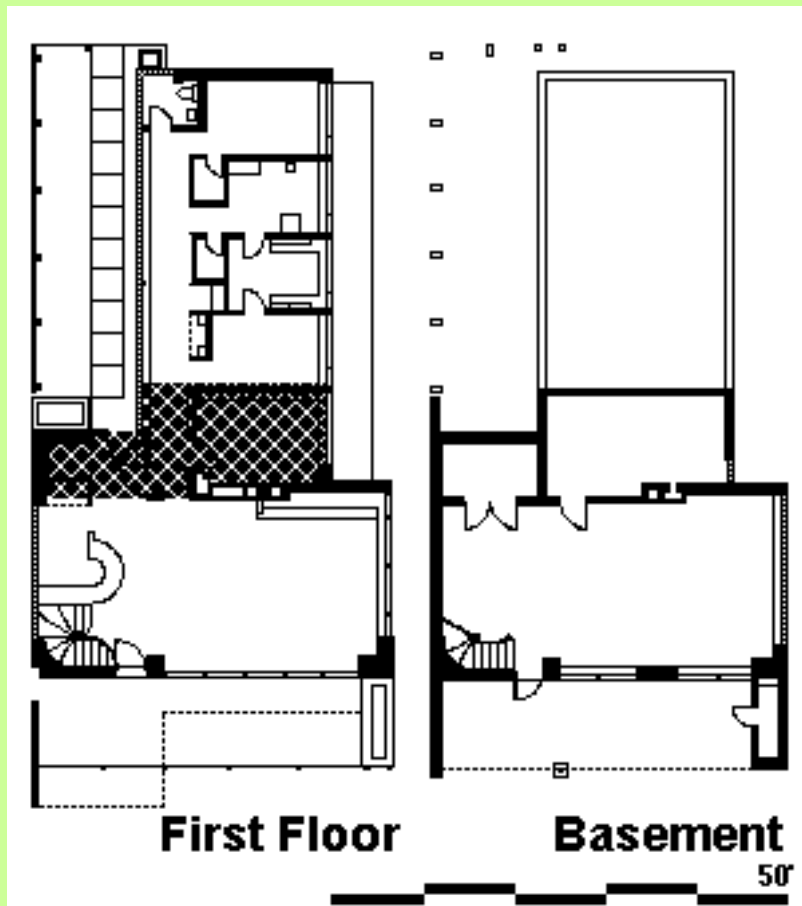
worked example

## plan specifications: floors




### FLOORS OVER AN UNHEATED BASEMENT

There is a small floor section over the unheated storage and mechanical rooms. We spec it as "Over Unheated Basement," with the same floor construction as the offices floor.




Over Base

Area (sf ): 313







Over  
Unheated  
Basement

Mass is none

Takeoff  
Pattern: 

Select Floor Components

Detailed Floor Design

Interior	
Vinyl Tile	
Subfloor	
Plywood	
Structure	
Wood	
Cavity	
None	
Exterior	
None	





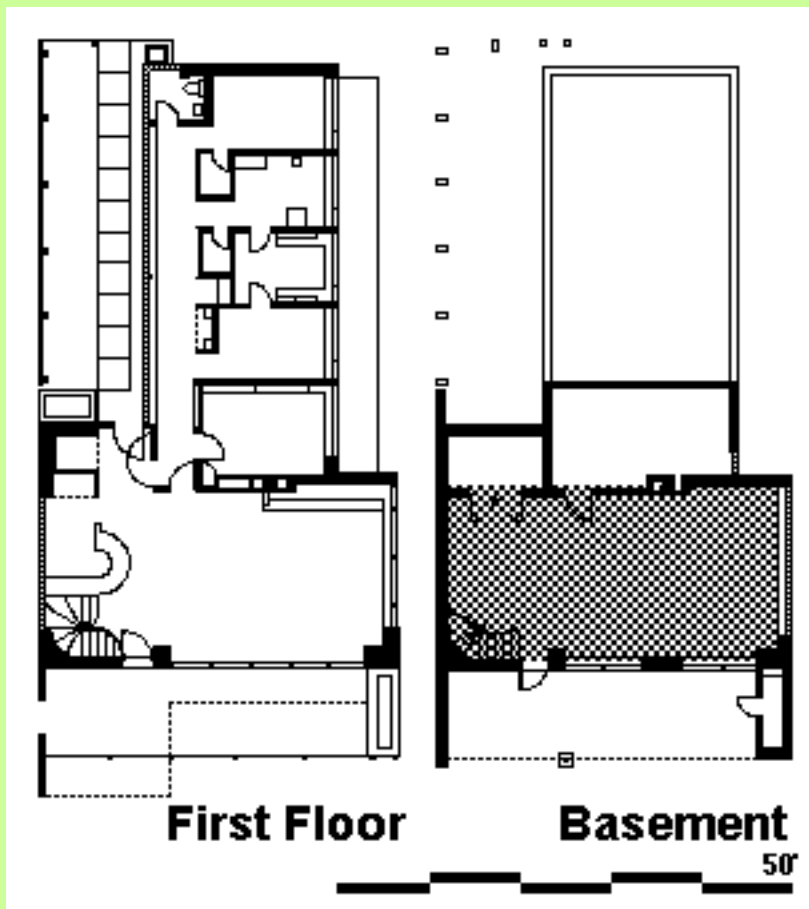
worked example

## plan specifications: floors




### SLAB-ON-GRADE FLOOR

The recreation room floor is an uninsulated, linoleum-covered slab-on-grade. Since it is a slab, we used the polygon tape measure; this is so ES can calculate the linear footage of slab edge that it needs to estimate heat flow from the slab. We selected the elements as follows: vinyl tile, no subfloor, concrete 6", no perimeter or under slab insulation. Under "Mass" we entered: solid 6," occupying a solar zone, because the floor is in a room with sun-collecting south glass.




Slab

Perimeter (ft ): 115







Slab

Mass is solid 6 in.

Takeoff Pattern: 

Select Floor Components

Detailed Floor Design

Interior	
Vinyl Tile	
Subfloor	
None	
Structure	
Concrete	
Perimeter	
None	
Underslab	
None	



worked example

## plan specifications: mass

Click on all icons below for specific information:



Windows/  
Skylights



Roofs



Floors



Mass



Occupant Zones



Equipment  
Zones



Lighting Zones

### THERMAL MASS

The only thermal mass in a horizontal orientation is the floor of the rec room. Since the floor of the rec room was defined in the floor take-off as having mass, it does NOT need to be taken off again. Vertically oriented mass is specified in the elevation specifications.



Back to [plan specifications](#)



worked example

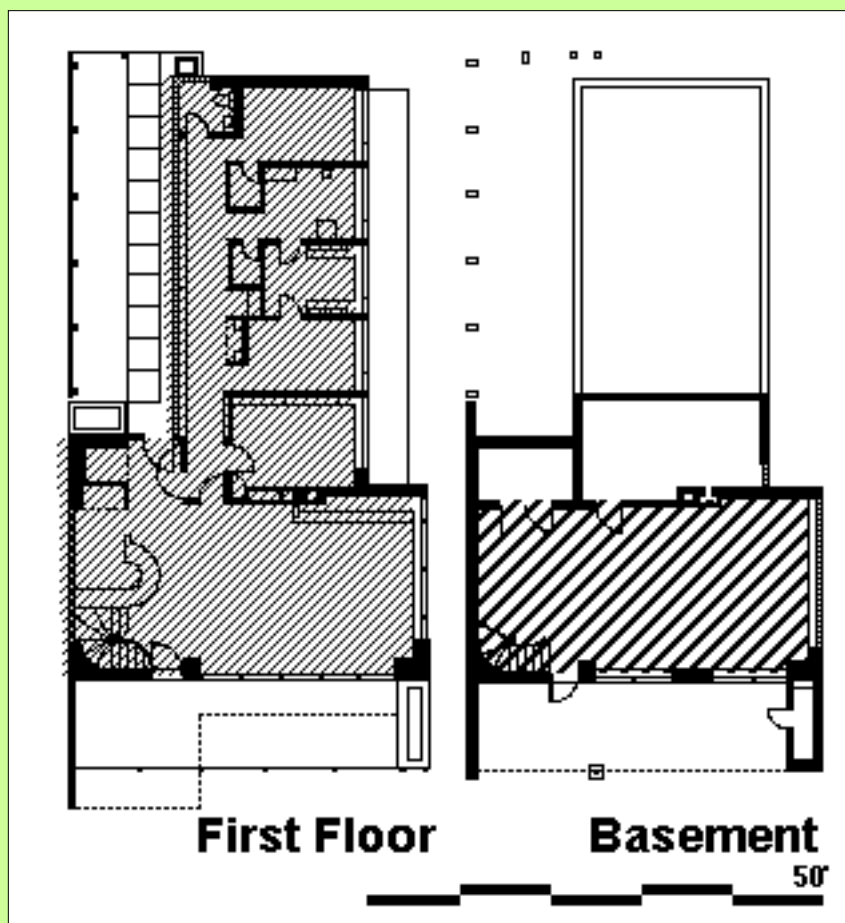
## plan specifications: occupants

Click on all icons below for specific information:



### OCCUPANT ZONES

In the Shanley building, the occupant zones were very simple because we figured that "light work" best described the entire first floor's typical activity with an approximate density of one person per 100 square feet (office). This was all done in one takeoff.




Click on one of the occupant zone takeoffs in the above plan to see its associated spec window.



The basement contains a children's rec room, so we specified it as "moderate dancing" at the density of one person per 100 square feet.

**Moderate Dancing 1**

Area (sf ): 741

Number of People: 7

Takeoff  
Pattern: 

Activity	Density
 Moderate Dancing	 1 persons/ 100 sf

Select Activity/Density

Set Occ. & Temp. Schedules

Detailed Occupancy Design

Set Infiltration/Minimum Vent Rate






Back to [plan specifications](#)

**Light Work 1**

Area (sf ): 1930

Number of People: 19

Takeoff Pattern: 

Activity	Density
 Light Work	 1 persons/ 100 sf

Select Activity/Density

Set Occ. & Temp. Schedules


Detailed Occupancy Design



Set Infiltration/Minimum Vent Rate

**Moderate Dancing 1**

Area (sf ): 741

Number of People: 7

Takeoff  
Pattern: 

Activity	Density
 Moderate Dancing	 1 persons/ 100 sf

Select Activity/Density

Set Occ. & Temp. Schedules

Detailed Occupancy Design

Set Infiltration/Minimum Vent Rate



worked example

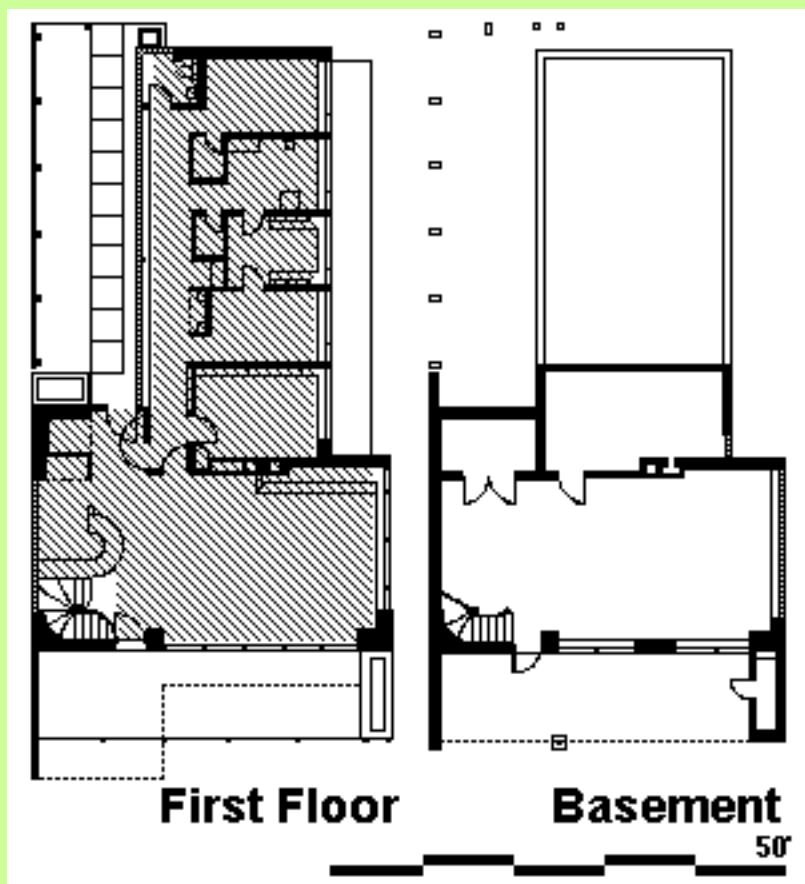
## plan specifications: equipment

Click on all icons below for specific information:



### EQUIPMENT ZONES

Heat gain rates from equipment are based on gross square footage, so we took off the entire floor area of the main floor, even though some areas will have little or no equipment.




Since the building has significantly less equipment than a typical office building, we chose a heat gain rate for "school." The image below shows the equipment zone takeoff.




Main Floor

Area (sf ): 1534

Total Btu: 6136

Takeoff Pattern: 

Equipment Type



School (4)

Select Equipment Types

Set All Equipment Schedules

Detailed Equipment Design

We did *not* specify any equipment zones for the basement level, because there is no equipment in the recreation room. Even though the mechanical room has a hot water heater and HVAC equipment that will generate excess waste heat, the room is ventilated separately and will not be heated or air conditioned. Therefore, it will not contribute to the heating and cooling loads of the building. So, we have *not* taken off an equipment zone for the mechanical room.



Back to [plan specifications](#)



worked example

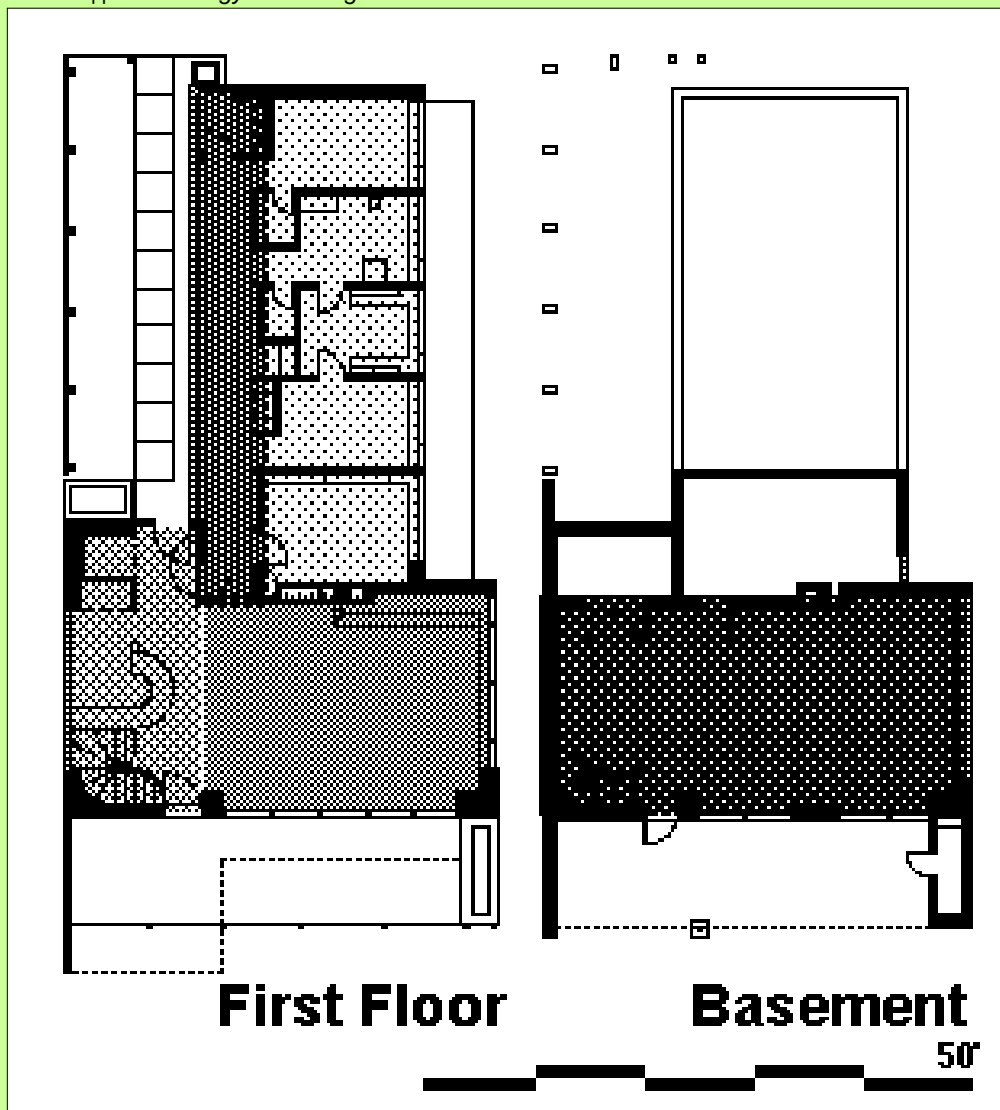
## plan specifications: electric lighting

Click on all icons below for specific information:



### ELECTRIC LIGHTING ZONES

We defined five different electric lighting zones, which correlate exactly with the size and area of the daylight zones. The plans below show how these takeoffs appear in *Energy Scheming*.



Click on one of the electric lighting takeoffs in the above plan to see its associated spec window.

### Lighting Types

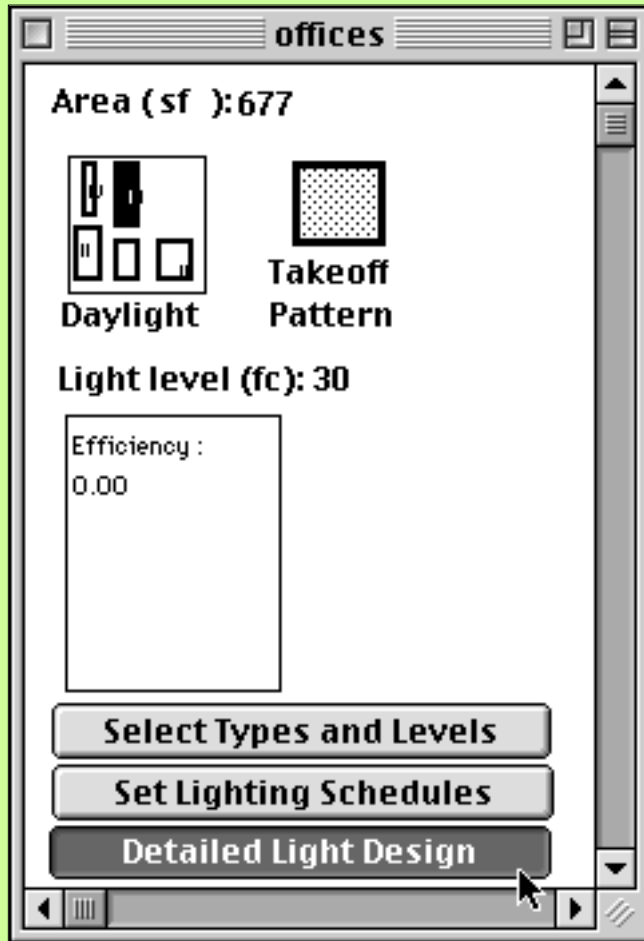
The original lighting in the building was primarily ceiling mounted, general diffuse luminaries. There was some indirect, cove type, electric lighting in the waiting room, in addition to general diffuse, but only one lighting type per zone can be specified. Therefore, all five zones were assigned the same lighting type: incandescent general diffuse. ES 2.5 has an option for General Diffuse, but ES 3.0 has eliminated that option, in favor of more contemporary lighting choices. We took the lighting efficiency for General Diffuse Incandescent from ES 2.5; it has a value of 0.59 Btu/h, per square foot of floor area, per foot-candle of interior illuminance (Btu/h,sf,fc). Values for some older lighting types that have been eliminated from ES 3.0 can be found in the [Table of Lighting Efficiencies](#).

### Visual Task Levels

Each takeoff can have its own visual task level, measured in foot-candles or Lux. Each zone or area within a zone can have its own lighting takeoff. If there is more than one lighting level in a zone, you can take off each area separately. We chose lighting levels appropriate for the activities in each zone and the subjective brightness levels desired, as follows:

- ZONE I, waiting room --30 fc for reading
- ZONE II, reception area --40 fc for general office type work
- ZONE III, dental examination and laboratory rooms --50 fc, averaged across the zone, for detailed work, to be supplemented by high intensity localized task light as required.
- ZONE IV, corridor --20 fc
- ZONE V, recreation --30 fc

The images below shows the Spec Window for Zone III. To see Spec Windows for other zones, click on one of the electric lighting takeoffs in the above plan.



Back to [plan specifications](#)

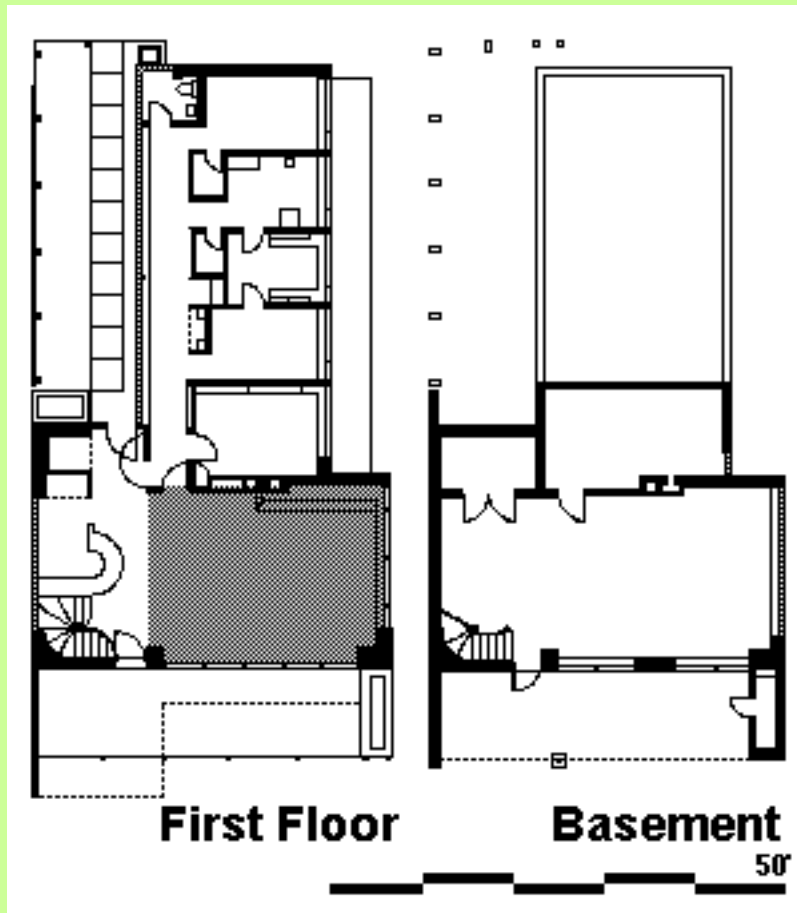


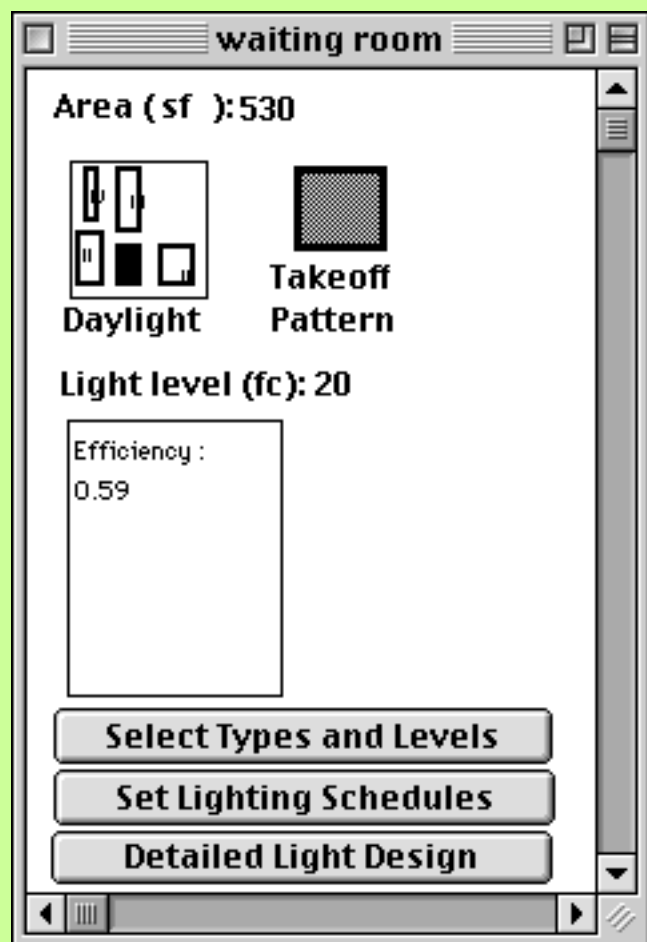
worked example

## plan specifications: electric lighting



### ELECTRIC LIGHTING ZONE I





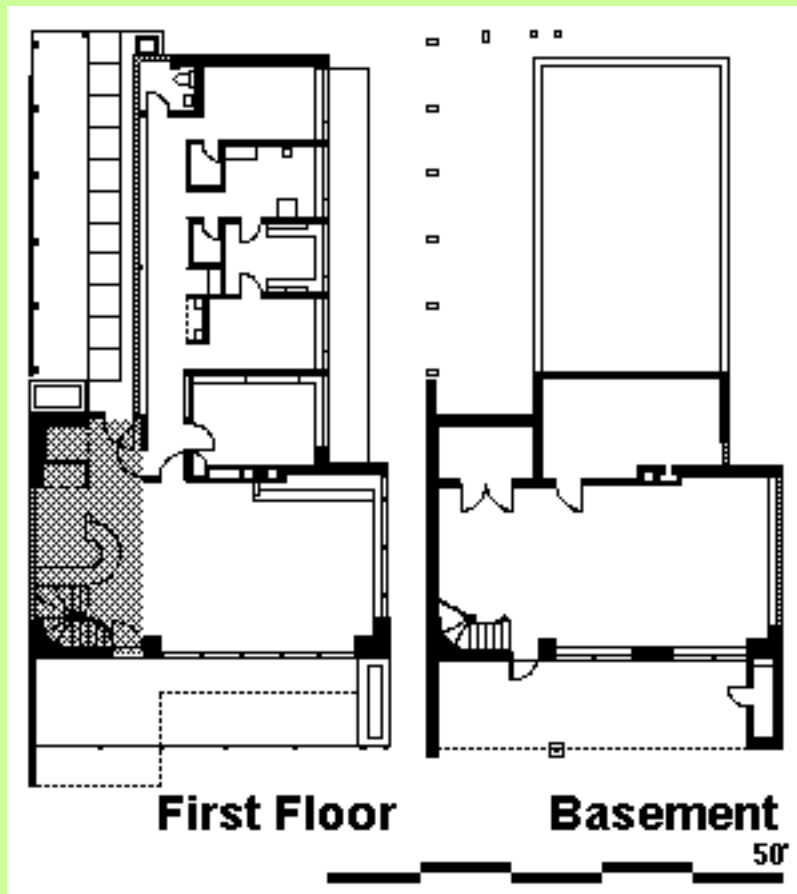


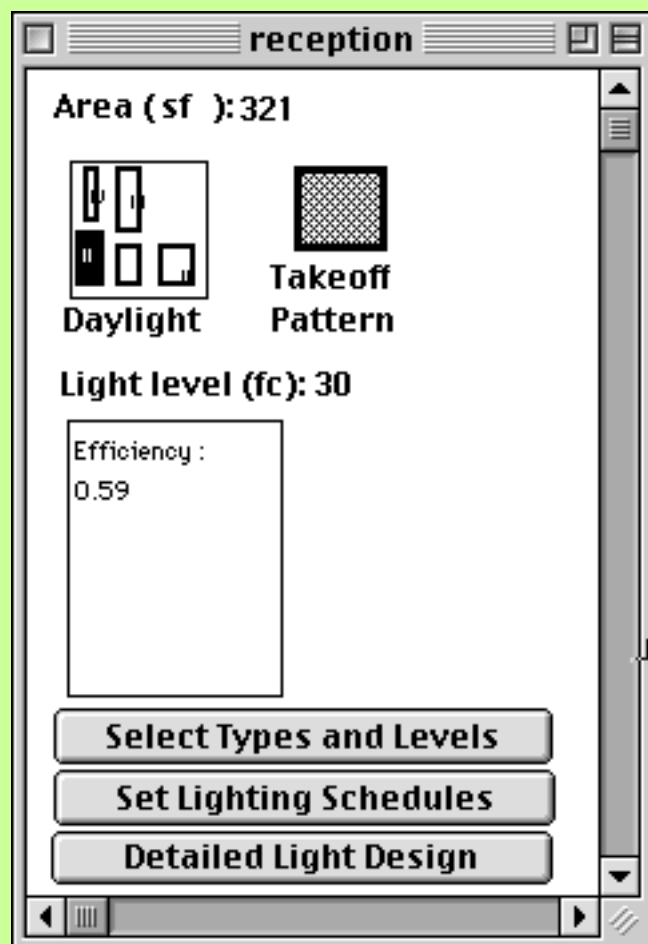
worked example

## plan specifications: electric lighting



### ELECTRIC LIGHTING ZONE II





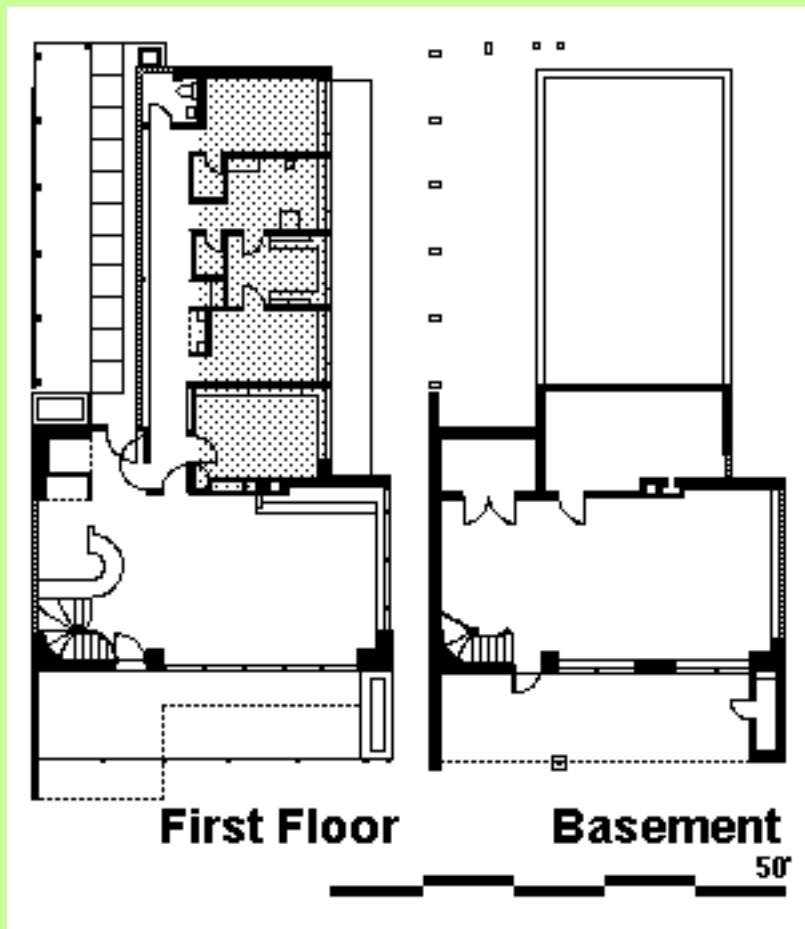


worked example

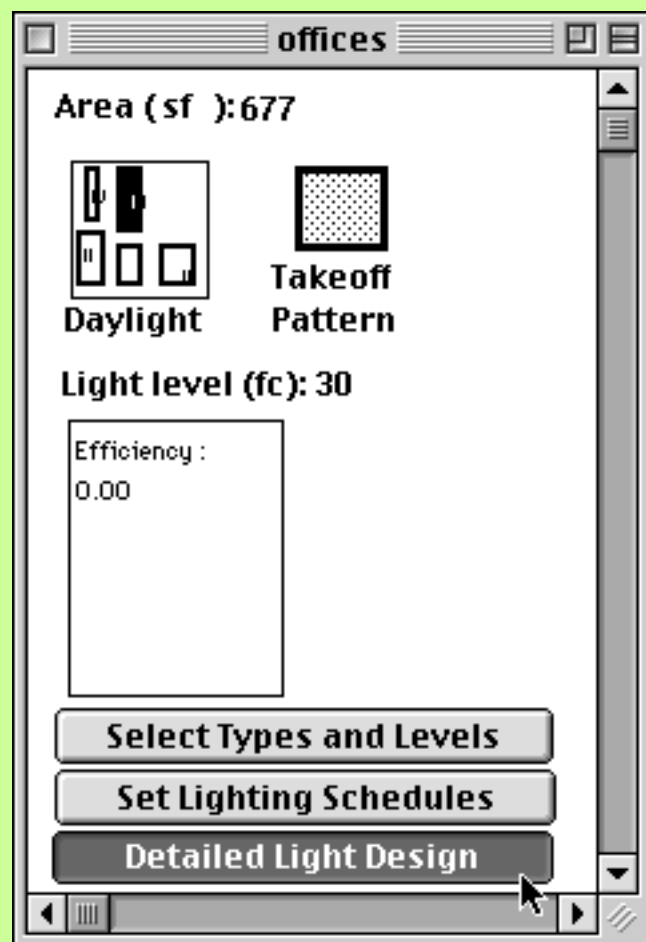
## plan specifications: electric lighting



### ELECTRIC LIGHTING ZONE III







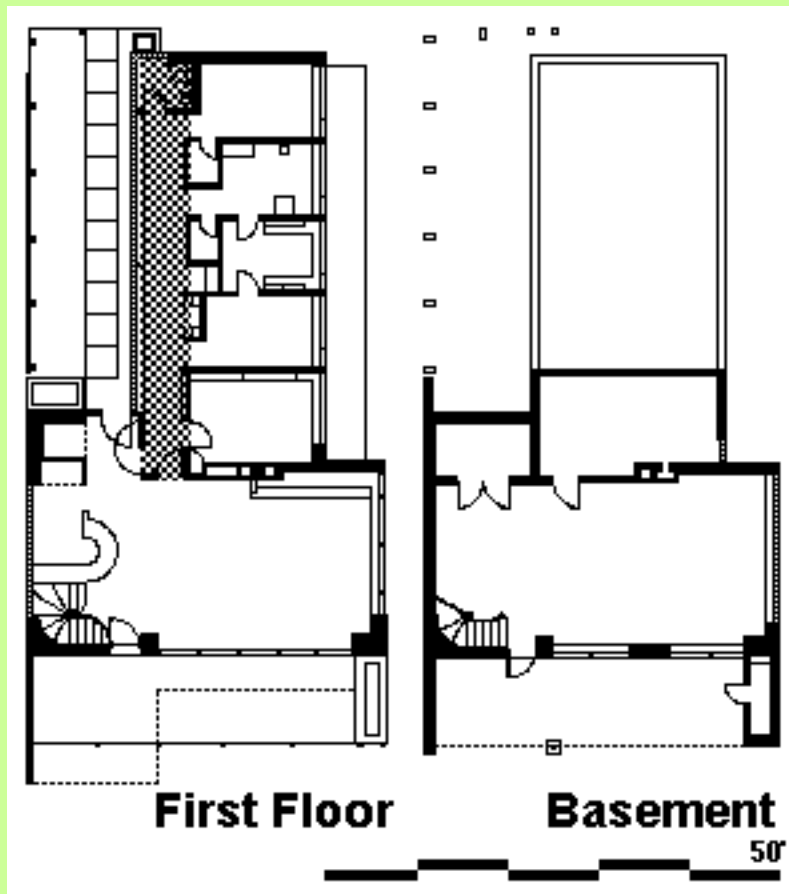


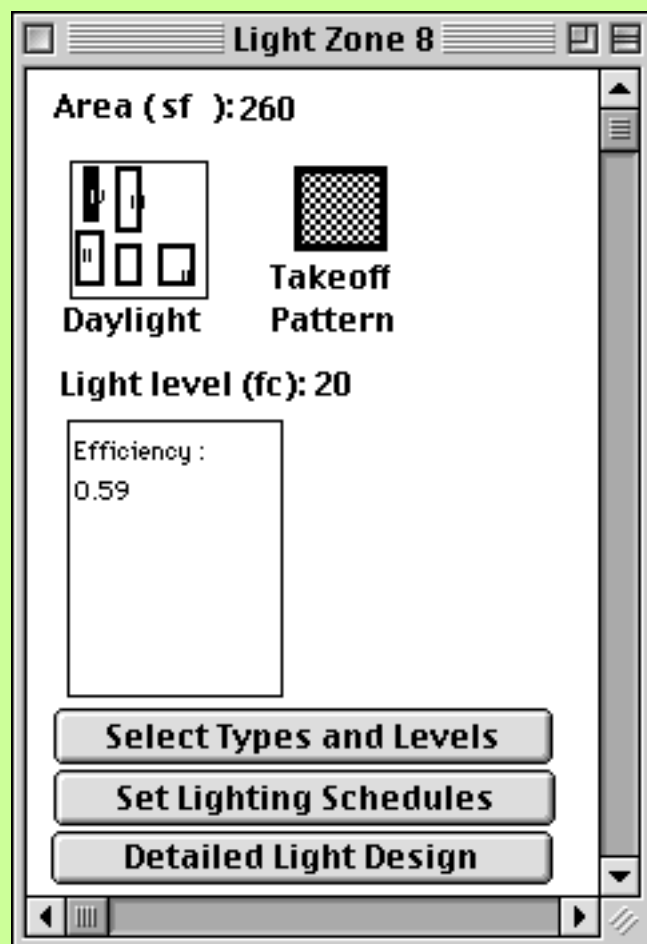
worked example

## plan specifications: electric lighting



### ELECTRIC LIGHTING ZONE IV





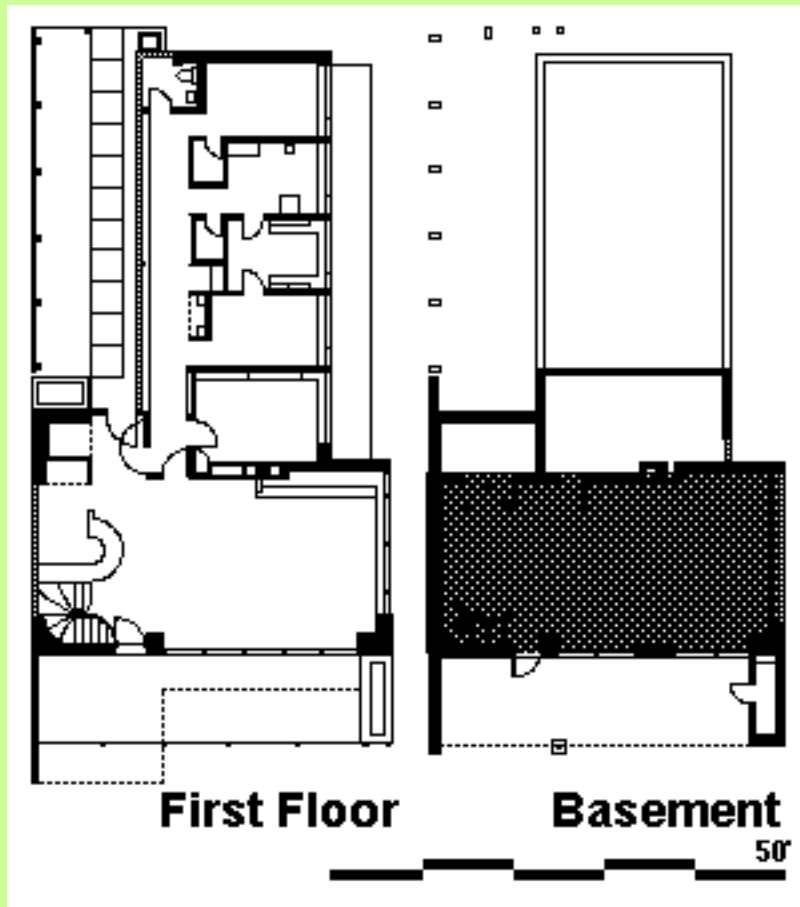


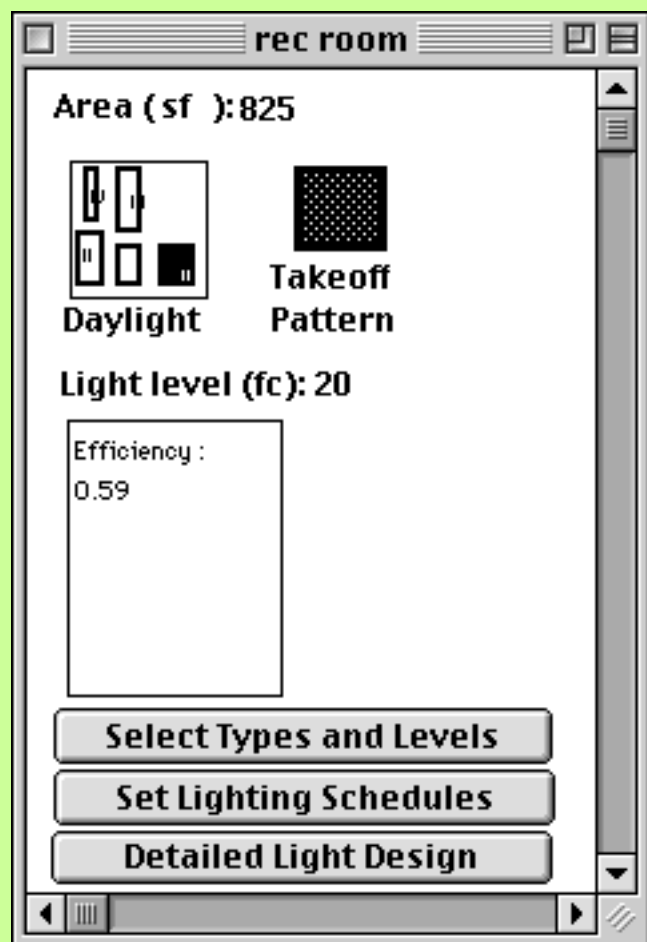
worked example

## plan specifications: electric lighting



### ELECTRIC LIGHTING ZONE V





## B. DEFINING: take-offs and specifications

### elevation specifications



#### 5. Create Elevation Specifications

Turn in

- A screen capture of your Elevations, showing walls, roofs, and windows.
- A printout of the energy performance report

[exercise](#)

Click on all icons below for specific information



#### A few notes on managing takeoffs

- **Renaming Icons**

When you are doing takeoffs, you end up with a lot of icons representing various building elements. When you have many icons under one category, it sometimes helps to avoid confusion if you rename each takeoff icon with a specific name, such as "bedroom window" or "dormer roof." You can rename an icon by highlighting its name with the mouse and typing a new one in its place. This can only be done if the dialogue box associated with the icon is closed. We found this technique particularly useful when defining windows in the Create Elevation Specifications section.

- **Visibility of Icons**

Another way to keep from getting too confused during the takeoff mode of Energy Scheming is to change the settings of the takeoffs under "VIEW/Takeoffs..." You can make visible only the takeoffs that you want to see, such as only electric lights, or only takeoffs in the open spec.

---

Return to the [EXAMPLE OUTLINE](#)



worked example

## elevation specifications: walls

Click on all icons below for specific information:



Walls



Roofs



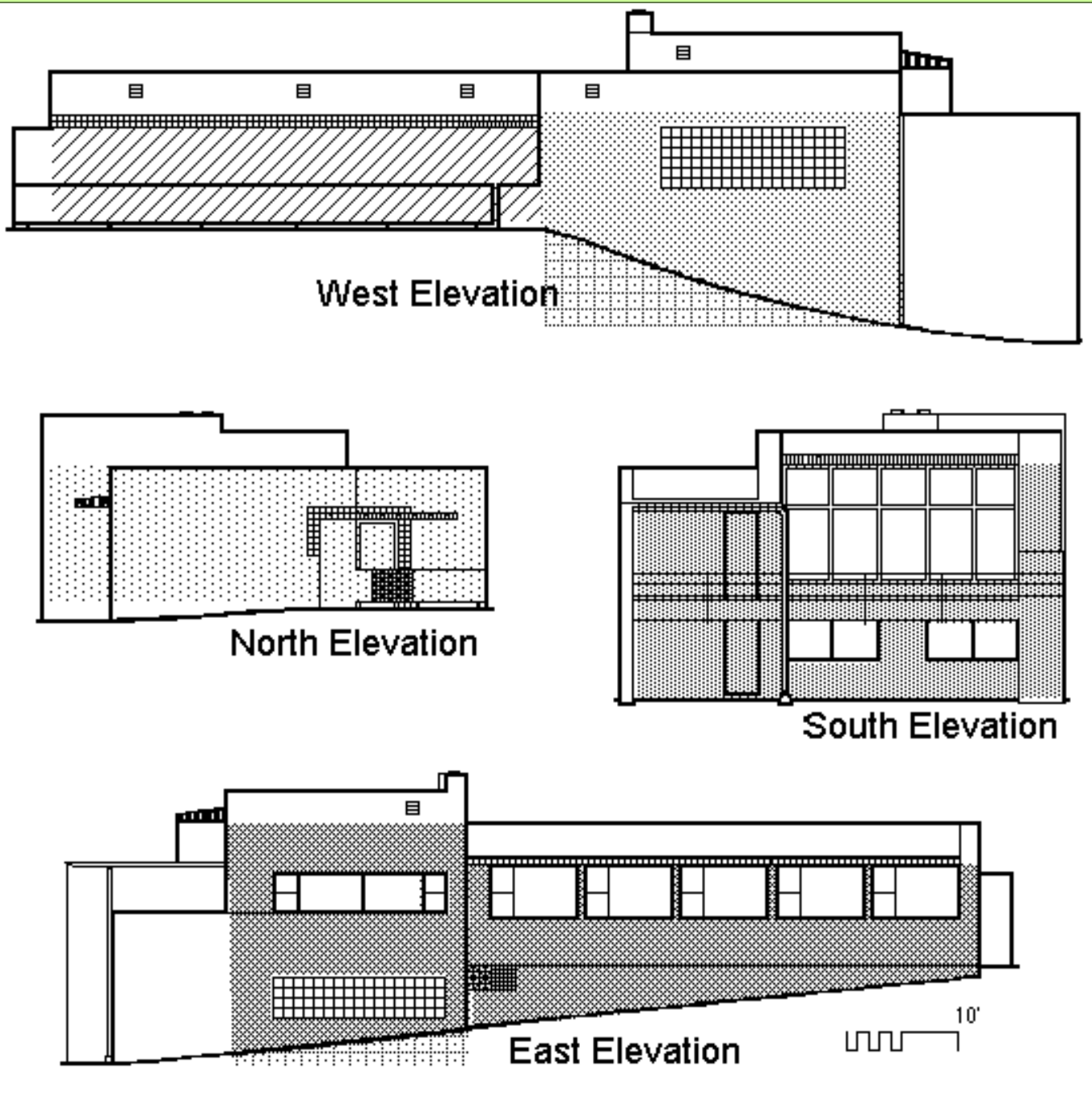
Windows/  
Skylights



Mass

### WALLS

We only took off the portions of the elevations which had heated space behind them, making sure that the "Subtract window area" box was checked, so that wall takeoffs would be simpler. All exterior walls were defined as massive because they are of masonry.



Click on one of the Elevations to see the wall specs for that elevation.

There are three types of walls in the Shanley Building:

- The east wall, south wall, north wall, and the reception area portion of the west wall are composed of uninsulated 6" concrete block, with plaster inside and stucco outside.
- The portion of the west exterior wall next to the hallway is similar, but made of 12" solid masonry.
- Portions of walls on the east and west sides of the recreation room are partially below grade.

*Important Note:* We also made sure each of the takeoff patterns were different from one another because, in the analysis, one of the options available is to look at heat gain/loss through just walls. The gains and losses are shown by a graph that uses the takeoff patterns we choose to represent each wall type in the graph. A little planning now will pay off later!



Back to [elevation specifications](#)



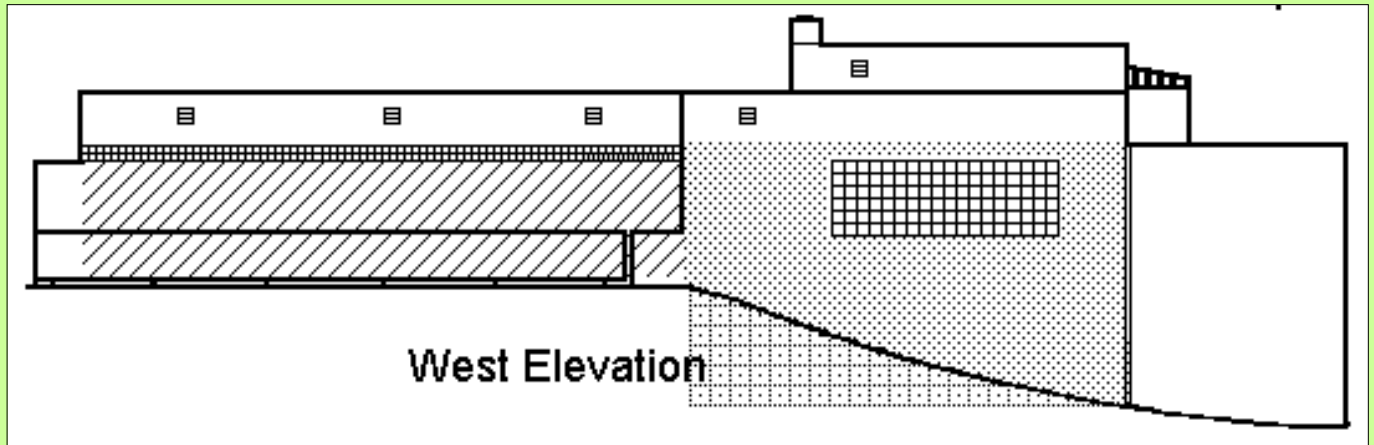


worked example

## elevation specifications: walls



### WEST WALLS



There are three types of wall construction on the west wall. Click on the wall takeoff to see the wall specs for that area.

#### 1. West Typical Above Grade Wall

The reception area portion of the west wall is the typical wall construction for the building: uninsulated 6" concrete block, with plaster inside and stucco outside. There is no 6" Concrete Block option, so we chose 4" block, but in the mass section, we specified the mass as Hollow, 6". The interior is plaster, which we selected; the exterior, cement stucco, so we selected plaster. There is no insulating cavity. This gave a very close thermal representation of the actual wall construction for each of the walls.

Typical Wall

Area (sf ): 410

☒ Subtract window takeoff from gross wall area

Takeoff Pattern

Orientation

Mass is hollow 6 in.

Exterior  Plaster	Structure  Block 4"	Cavity  None	Interior  Plaster
-------------------------	---------------------------	--------------------	-------------------------

Select Wall Components

Detailed Wall Design

## Select Wall Components

Exterior	Structure	Cavity		Interior
Wood 3/4"	Wood Stud	Batt	1"	Gyp.Board 1/2"
Plaster	Metal Stud	Rigid Ins.	2"	Plaster
Metal	Brick 4"	Air	3"	Wood 3/4"
Concrete 1"	Block 4"	None	4"	Concrete 6"
Brick 4"	Concrete 6"		6"	Brick 4"
Block 8"	None		8"	Block 8"
T1-11			10"	None
None			12"	

**Ext. Color:**

<input type="checkbox"/>	Light
<input checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	Dark

**Mass:**

Hollow	4
Solid	6
None	8
	12

**Solar**



OK

## 2. West Hallway Wall

The portion of the west exterior wall next to the hallway is of a slightly different construction. It is similar to the typical wall, but 12" thick instead of 8" -- and solid masonry.

HallwayWall

Area (sf ): 369

☒ Subtract window takeoff from gross wall area

Orientation

Takeoff Pattern

Mass is solid 12 in.

Exterior	Structure	Cavity	Interior
Plaster	Concrete 6"	None	Concrete 6"

Select Wall Components

Detailed Wall Design

### Select Wall Components

Exterior	Structure	Cavity	Interior
Wood 3/4"	Wood Stud	Batt	1" Gyp.Board 1/2"
Plaster	Metal Stud	Rigid Ins.	2" Plaster
Metal	Brick 4"	Air	3" Wood 3/4"
Concrete 1"	Block 4"	None	4" Concrete 6"
Brick 4"	Concrete 6"		6" Brick 4"
Block 8"	None		8" Block 8"
T1-11			10" None
None			12"

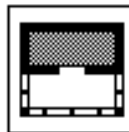
Ext. Color:

<input type="checkbox"/>	Light
<input checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	Dark

Mass:

Hollow	4
Solid	6
None	8
	12

Non-Solar



OK

### 3. West Below Grade Wall

The area below grade has the same construction as the wall above ground, but we do a detailed wall spec to account for the insulating value of the earth. The takeoff area shows a triangular wall section below grade. The average depth below grade is only about four feet. From Sun, Wind, and Light: architectural design strategies (G. Z. Brown, 1984), pp. 86-87, we can estimate that at a two foot depth, in damp, medium weight soil, we can expect an added R-value of the earth of about R-12.

We first specified the wall as usual, the same as the wall above grade. Then, in the detailed spec, noted the R-value from the wall without the earth, and then added R-12, to give us an R-14 wall. We also set the lag to 9 hours and decrement factor to 0.15 (see ES Manual Appendix, p. 45, for Hollow, Insulated, Massive walls). Adding the earth changed the wall from uninsulated to insulated. We also set the Absorptivity/Conductance to zero, since the below grade wall will not absorb any solar energy.

BelowGrade

Area (sf ): 133

☒ Subtract window takeoff from gross wall area

Orientation

User Defined Wall

Total R-Val: 14.00

Thermal Lag (hours): 9

Thermal Decrement: 0.15

Absorptivity /Conductance: 0.00

Select Wall Components

Detailed Wall Design

Takeoff Pattern

Mass is hollow 6 in.

**Wall Type**

Name:

Total R-value:  °F,h,sf/Btu

Lag in Hours:

Decrement Factor:

Absorptivity/Conductance:

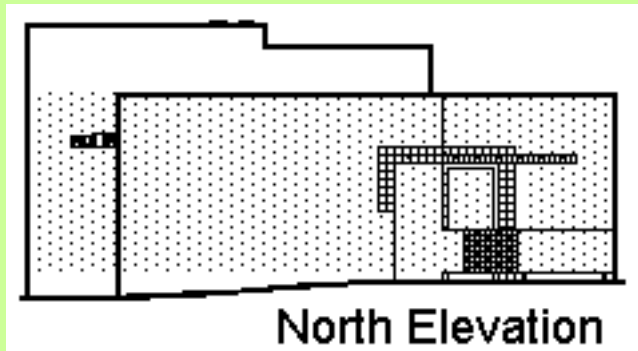


worked example

## elevation specifications: walls



### NORTH WALLS



The north wall is composed of uninsulated 6" concrete block, with plaster inside and stucco outside. There is no 6" Concrete Block option, so we chose 4" block, but in the mass section, we specified the mass as Hollow, 6". The interior is plaster, which we selected; the exterior, cement stucco, so we selected plaster. There is no insulating cavity. This gave a very close thermal representation of the actual wall construction.

**Typical Wall**





Area (sf ): 410

☒ Subtract window takeoff from gross wall area

**Takeoff Pattern**

**Orientation**

Mass is hollow 6 in.

Exterior	Structure	Cavity	Interior
			
Plaster	Block 4"	None	Plaster

**Select Wall Components**

**Detailed Wall Design**

## Select Wall Components

Exterior	Structure	Cavity		Interior
Wood 3/4"	Wood Stud	Batt	1"	Gyp.Board 1/2"
Plaster	Metal Stud	Rigid Ins.	2"	Plaster
Metal	Brick 4"	Air	3"	Wood 3/4"
Concrete 1"	Block 4"	None	4"	Concrete 6"
Brick 4"	Concrete 6"		6"	Brick 4"
Block 8"	None		8"	Block 8"
T1-11			10"	None
None			12"	

Ext. Color:

<input type="checkbox"/>	Light
<input checked="" type="checkbox"/>	Medium
<input type="checkbox"/>	Dark

Mass:

Hollow	4
Solid	6
None	8
	12

Solar



OK

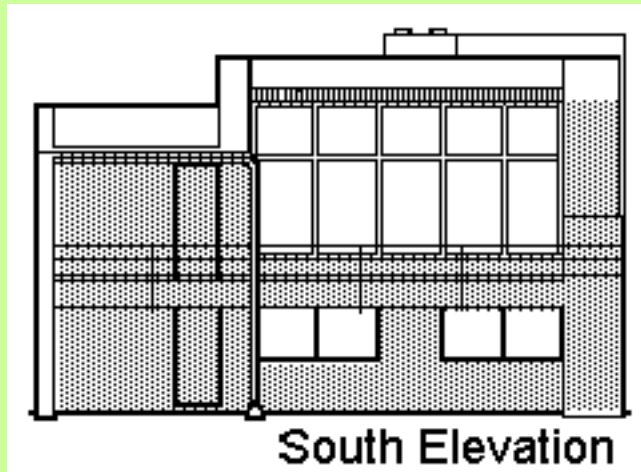


worked example

## elevation specifications: walls



### SOUTH WALLS




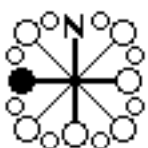
The south wall is composed of uninsulated 6" concrete block, with plaster inside and stucco outside. There is no 6" Concrete Block option, so we chose 4" block, but in the mass section, we specified the mass as Hollow, 6". The interior is plaster, which we selected; the exterior, cement stucco, so we selected plaster. There is no insulating cavity. This gave a very close thermal representation of the actual wall construction.

**Typical Wall**




Area (sf ): 410

☒ Subtract window takeoff from gross wall area

 Takeoff Pattern

 Orientation

Mass is hollow 6 in.

Exterior	Structure	Cavity	Interior
 Plaster	 Block 4"	None	 Plaster




Select Wall Components

Detailed Wall Design

**Select Wall Components**

Exterior	Structure	Cavity	Interior	
Wood 3/4"	Wood Stud	Batt	1"	Gyp.Board 1/2"
Plaster	Metal Stud	Rigid Ins.	2"	Plaster
Metal	Brick 4"	Air	3"	Wood 3/4"
Concrete 1"	Block 4"	None	4"	Concrete 6"
Brick 4"	Concrete 6"		6"	Brick 4"
Block 8"	None		8"	Block 8"
T1-11			10"	None
None			12"	


Ext. Color:

 Light
 Medium
 Dark

Mass:

Hollow	4
Solid	6
None	8
	12

Solar



OK



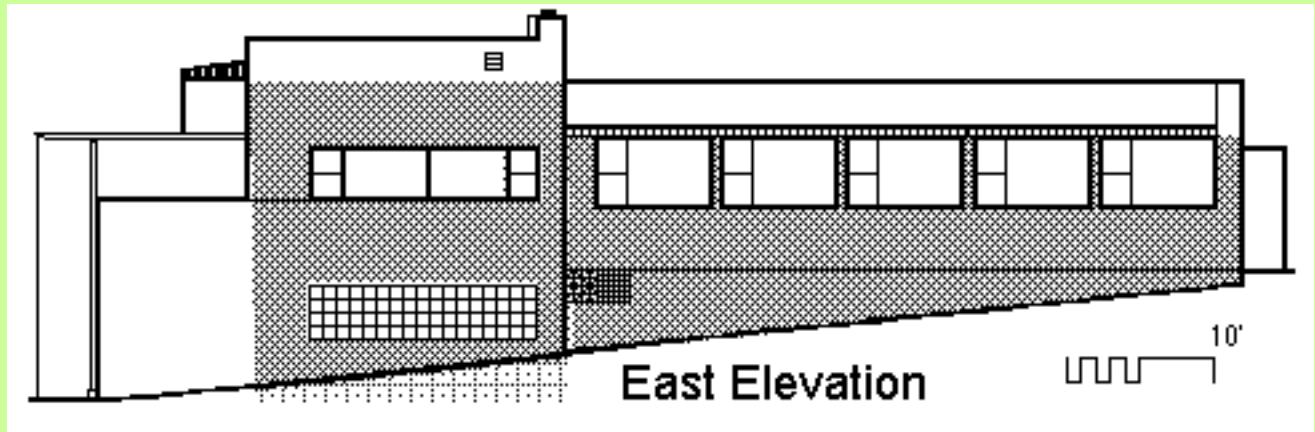


worked example

## elevation specifications: walls



### EAST WALLS



*There are two types of wall construction on the west wall. Click on the wall takeoff to see the wall specs for that area.*


#### 1. Above Grade Wall


Most of the east wall is composed of uninsulated 6" concrete block, with plaster inside and stucco outside. There is no 6" Concrete Block option, so we chose 4" block, but in the mass section, we specified the mass as Hollow, 6". The interior is plaster, which we selected; the exterior, cement stucco, so we selected plaster. There is no insulating cavity. This gave a very close thermal representation of the actual wall construction.

**Typical Wall**




Area (sf ): 410

☒ Subtract window takeoff from gross wall area

 Takeoff Pattern

 Orientation

Mass is hollow 6 in.

Exterior  Plaster	Structure  Block 4"	Cavity  None	Interior  Plaster
--	--	--------------------	--

Select Wall Components

Detailed Wall Design

**Select Wall Components**

Exterior	Structure	Cavity	Interior	
Wood 3/4"	Wood Stud	Batt	1"	Gyp.Board 1/2"
Plaster	Metal Stud	Rigid Ins.	2"	Plaster
Metal	Brick 4"	Air	3"	Wood 3/4"
Concrete 1"	Block 4"	None	4"	Concrete 6"
Brick 4"	Concrete 6"		6"	Brick 4"
Block 8"	None		8"	Block 8"
T1-11			10"	None
None			12"	


Ext. Color:

	Light
	Medium
	Dark

Mass:

Hollow	4
Solid	6
None	8
	12

Solar

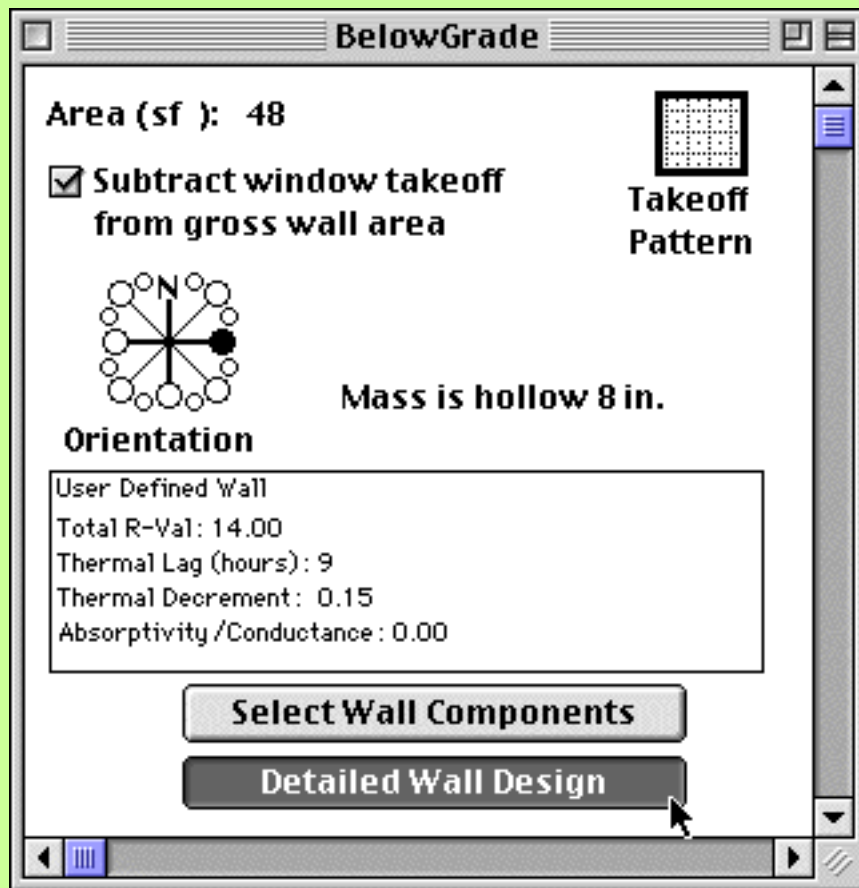


OK

## 2. Below Grade Wall

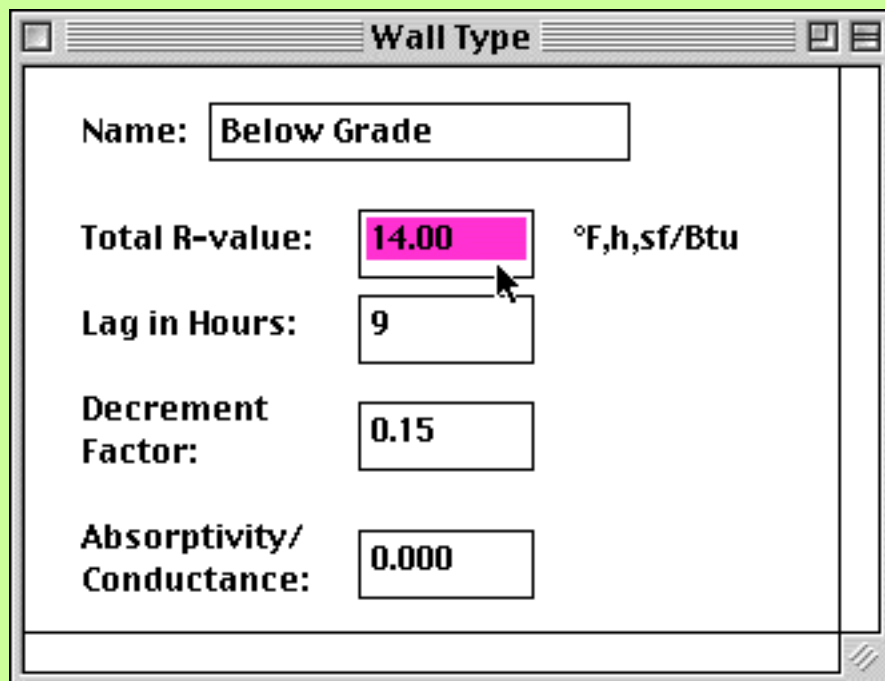
The area below grade has the same construction as the wall above ground, but we do a detailed wall spec to account for the insulating value of the earth. The takeoff area shows a triangular wall section below grade. The average depth below grade is only about two feet. From *Sun, Wind, and Light: architectural design strategies* (G. Z. Brown, 1984), pp. 86-87, we can estimate that at a two foot depth, in damp, medium weight soil, we can expect an added R-value of the earth of about R-5.

We first specified the wall as usual, the same as the wall above grade. Then, in the detailed spec, noted the R-value from the wall without the earth, and then added R-5, to give us an R-7 wall. We also set the lag to 9 hours and decrement factor to 0.15 (see ES Manual Appendix, p. 45, for Hollow, Insulated, Massive walls). Adding the earth changed the wall from uninsulated to insulated. We also set the Absorptivity/Conductance to zero, since the below grade wall will not absorb any solar energy.



The 'BelowGrade' window displays the following information:

- Area (sf):** 48
- ☒ **Subtract window takeoff from gross wall area**
- Takeoff Pattern:** A 4x4 grid icon.
- Orientation:** A compass rose showing North (N) and a shaded area indicating the wall's orientation.
- Mass is hollow 8 in.**
- User Defined Wall:**
  - Total R-Val: 14.00
  - Thermal Lag (hours): 9
  - Thermal Decrement: 0.15
  - Absorptivity / Conductance: 0.00
- Select Wall Components** (button)
- Detailed Wall Design** (button)



The 'Wall Type' window displays the following information:

- Name:** Below Grade
- Total R-value:** 14.00 °F,h,sf/Btu
- Lag in Hours:** 9
- Decrement Factor:** 0.15
- Absorptivity/Conductance:** 0.000



worked example

## elevation specifications: roof

### 5) Create Elevation Specifications.

*Click on all icons below for specific information:*



### ROOFS

There are no significantly sloped roofs, thus we specified all roofs in the plan takeoffs. ([roof plan takeoffs](#))



Back to [elevation specifications](#)



worked example

## elevation specifications: windows and skylights

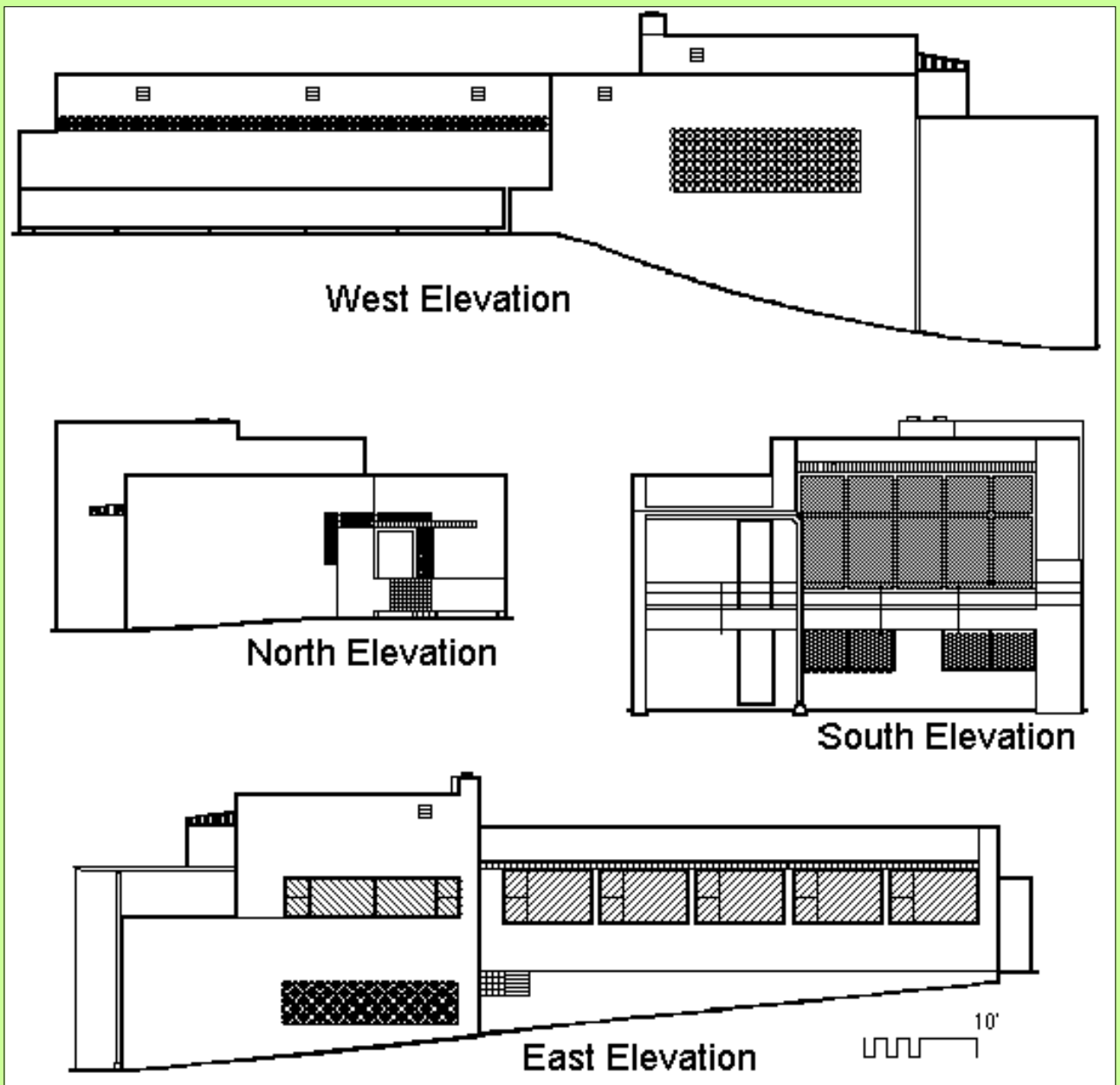
Click on all icons below for specific information:



### WINDOWS

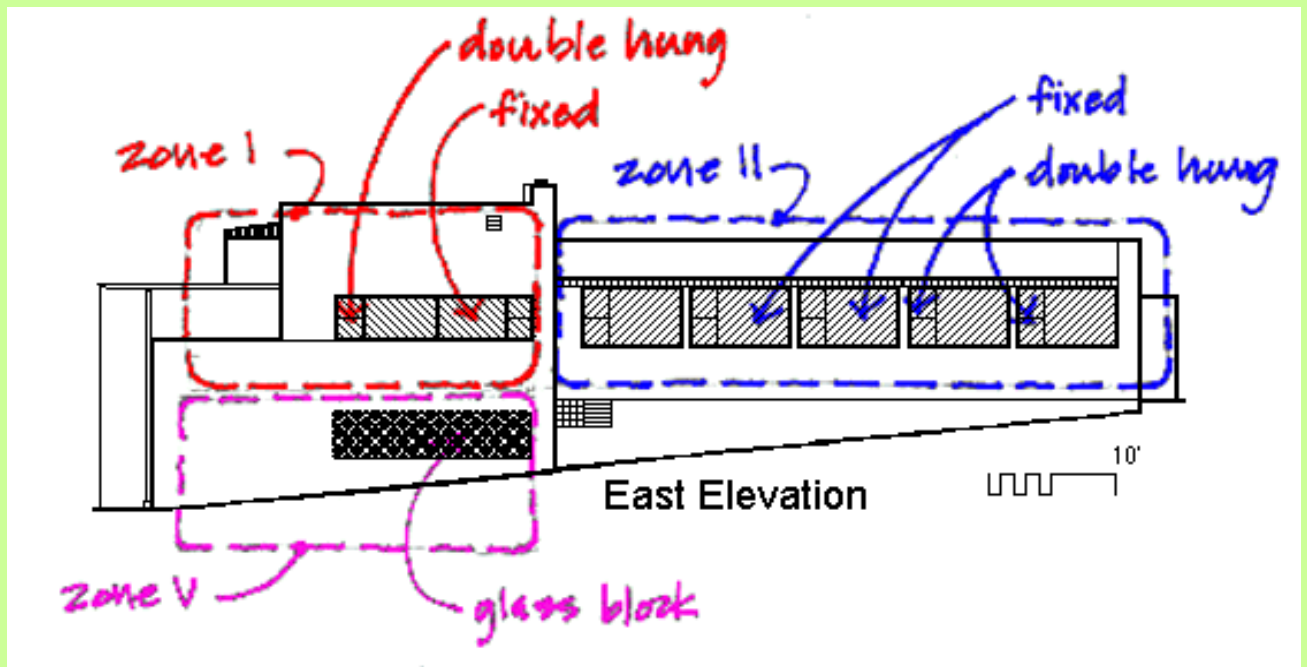
The Shanley building has three different kinds of windows:

- glass block
- fixed, double glazed windows
- double hung, double glazed windows



Click on one of the Elevations to see the Window Specs for that elevation.

We created a different takeoff for each window type in *each daylight zone* (remember windows have to be associated with a particular daylight zone.) For example, the east facade ([East windows page](#)) has all three window types and three [daylight zones](#). Both fixed and double hung windows are located in daylight zones I and III, thus we created four different takeoffs for those windows. We created a fifth takeoff for the glass block window in daylight zone 5. We then renamed the window spec icons to avoid confusion, since there were so many of them.



As with walls, we used different takeoff patterns for different window types. Windows show up in the [graphic report](#) by orientation and spec. We made different window takeoff patterns for each different shading condition. These will be used later by *Energy Scheming* to represent a graphic analysis of heat gain and loss through the windows.



Back to [elevation specifications](#)

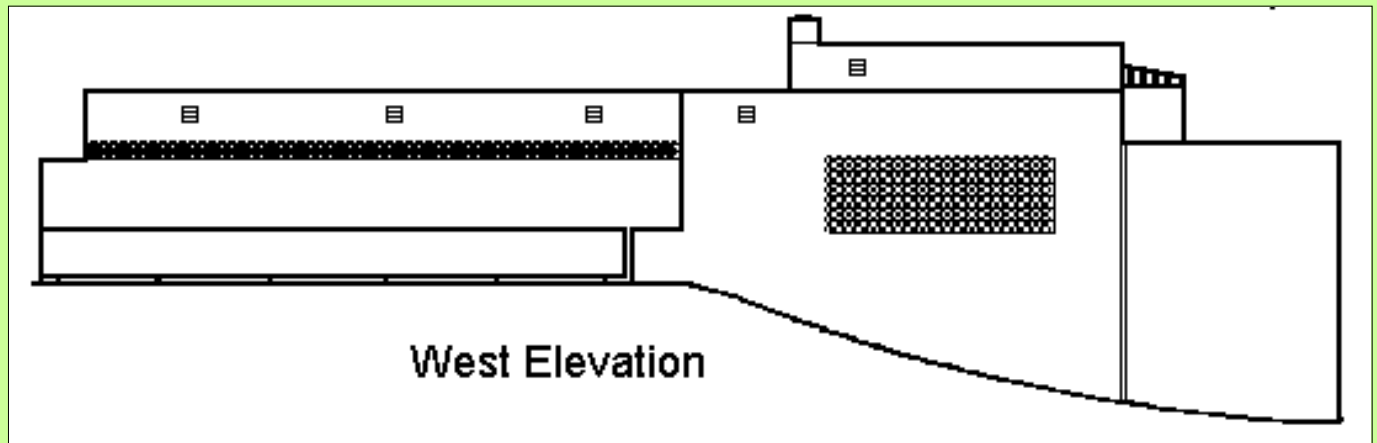


worked example

## elevation specifications: windows and skylights



### WEST WINDOWS



Click on the Window takeoff to see the Window Specs for that area.

### Reception Area Windows (main floor)

reception

Area (sf ): 94

Takeoff Pattern

Ventilation

Daylight

Tilt: 90°

Orientation

Ext. Shade

Window Plane

Int. Shade

None

Fixed Glass Block

None

Select Window Components

Set Window Schedules

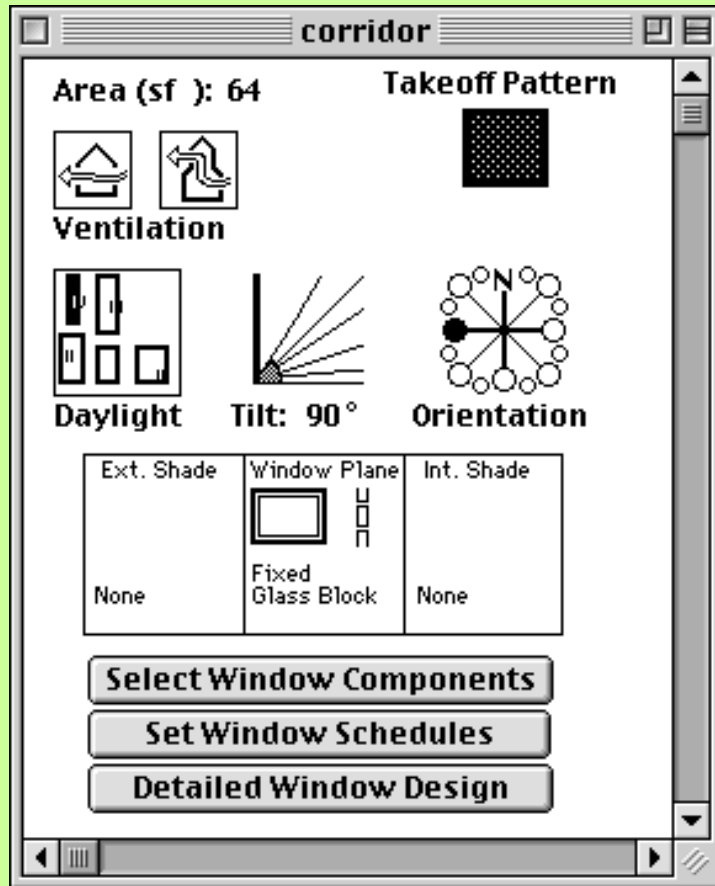
Detailed Window Design

The reception area is lit with a single large unshaded glass block window.

It is specified as:

- No ventilation
- Daylight zone II
- Vertical tilt
- West orientation
- No exterior shades
- Fixed glass block
- No interior shades

#### Corridor Window (main floor)



There is a thin high strip glass block window along the entire length of the corridor.

It is specified as:

- No ventilation
- Daylight zone IV
- Vertical tilt
- West orientation
- No exterior shades
- Fixed glass block
- No interior shades



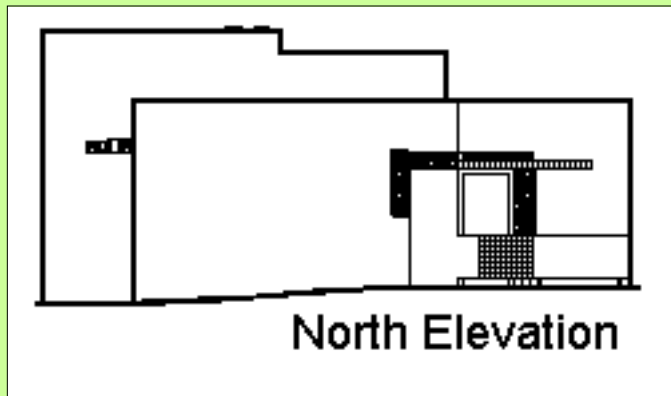


worked example

## elevation specifications: windows and skylights

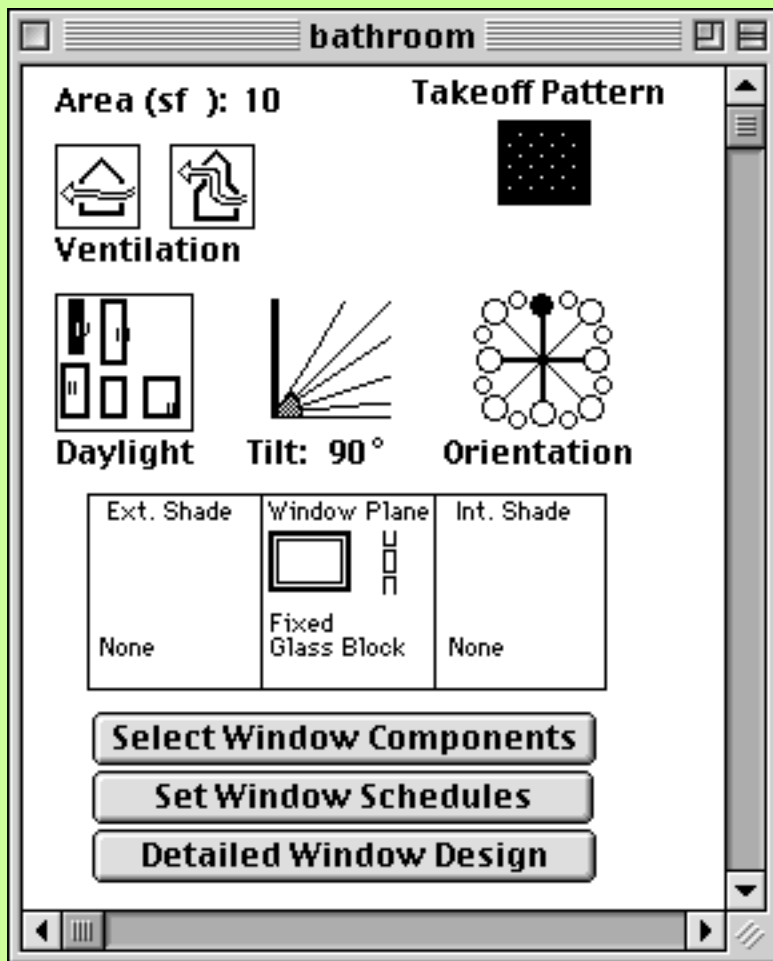


NORTH WINDOWS



North windows are thin strips of glass block in two locations: the bath room at the end of the corridor and around and over the entry.

### Bathroom Windows (main floor)



It is specified as:



- No ventilation
- Daylight zone IV
- Vertical tilt
- North orientation
- No exterior shades
- Fixed glass block
- No interior shades

Entry glass block windows have the same spec, except they are in daylight zone II


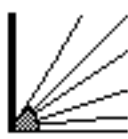
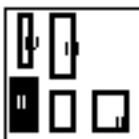
entry

Area (sf ): 10

Takeoff Pattern



Ventilation




Daylight

Tilt: 90°



Orientation

Ext. Shade



Fins/  
Vert.Louvers

Window Plane



Fixed  
Glass Block

Int. Shade

None

Select Window Components

Set Window Schedules

Detailed Window Design

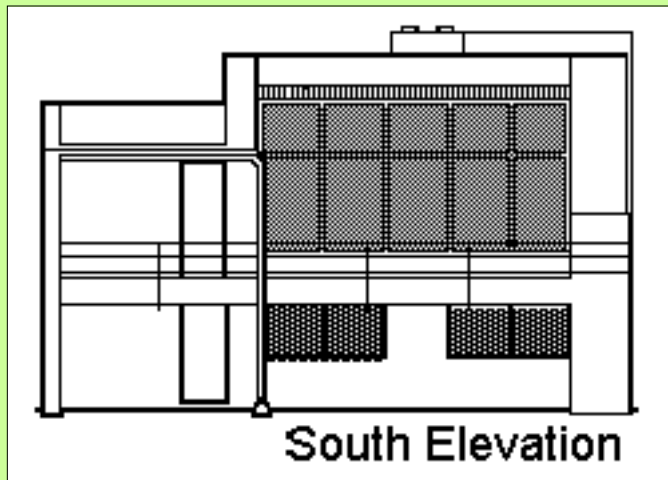


worked example

## elevation specifications: windows and skylights

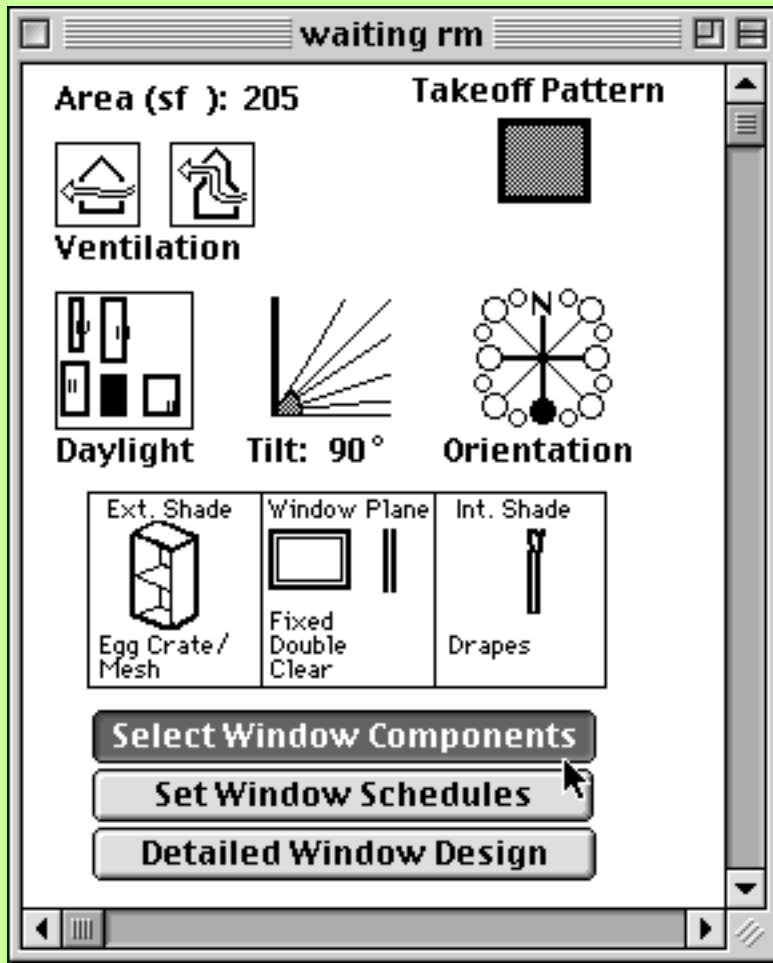


### SOUTH WINDOWS



*Click on the Window takeoff to see the Window Specs for that area.*

**Waiting Room Windows (main floor)**



The south elevation has fixed double glazed windows in the Waiting Room. The unique design uses an early desiccant system between the two panes ([detail drawing](#)). We picked Fixed, Double, Clear glass.

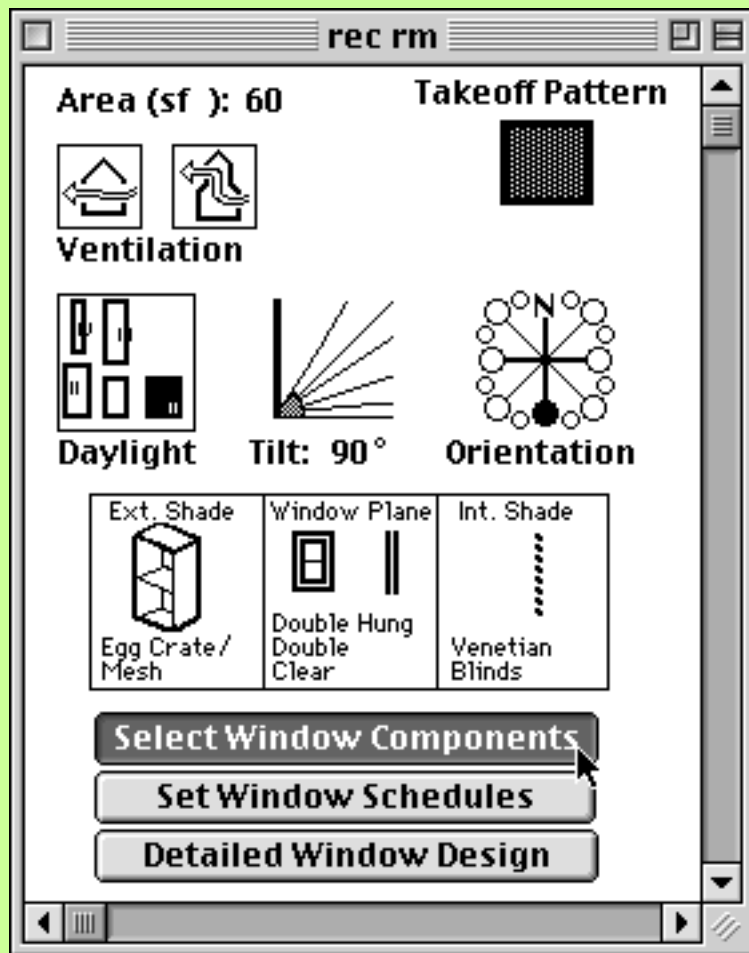
The windows are protected by three forms of external shading, a large projecting overhang, a projecting fin wall on the west side, and an operable roll-down canvas shade that drops on guide wires from the overhang. ([drawings of shades](#))

Additionally, there are drapes inside. When specifying window components, you can specify *only one type* of exterior shading that must approximate the combined effect of all three. We had to decide which exterior shading element to include -- the overhangs, fin, or the roll-down shades? Since exterior shades are manually operable, they may be deployed when needed (or may not!), whereas the overhangs are always in place. Therefore, it seemed to make the most sense to specify the exterior overhang on the south. However, the fin wall makes the fixed system more like an egg-crate. If we assumed perfectly attuned occupants, we would use the roll-down shade; we compromised with the egg-crate outside and interior drapes inside, still a very good shading scheme.

We also defined the other options as:

- Windows are fixed, so neither ventilation icon is selected.
- Daylight zone 1
- Vertical tilt
- South orientation

#### Recreation Room Windows (basement level)



On the south side, the basement level has double glazed slider windows in the Recreation Room daylight zone V. The windows are shaded by both the main floor balcony above, and by large projecting fins on each side. The combination of vertical and horizontal shading functions like one large egg-crate shading element.

Even though the windows are operable, and the wind in summer comes from the south, there are no outlets on this floor. To keep ES from showing some cross ventilation effect that would not occur because of the lack of internal air path (some East windows are also operable), we turned off the ventilation icons.

We defined these windows as:

- No ventilation
- Daylight zone V
- Vertical tilt
- South orientation
- Egg-crate exterior shades
- Double-hung (same operable area as slider), double, clear windows
- Interior venetian blinds, light

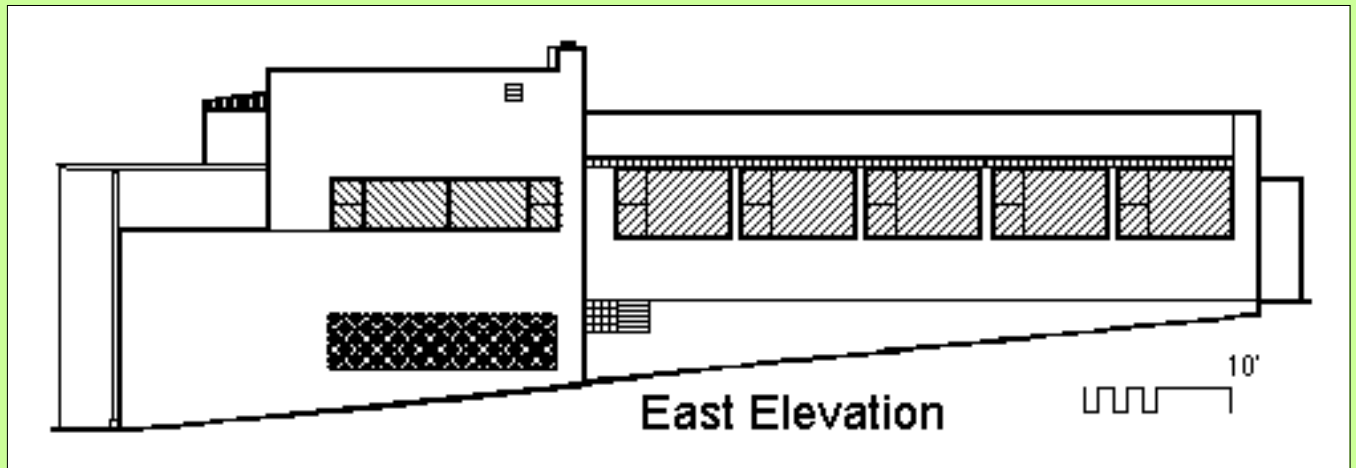


worked example

## elevation specifications: windows and skylights

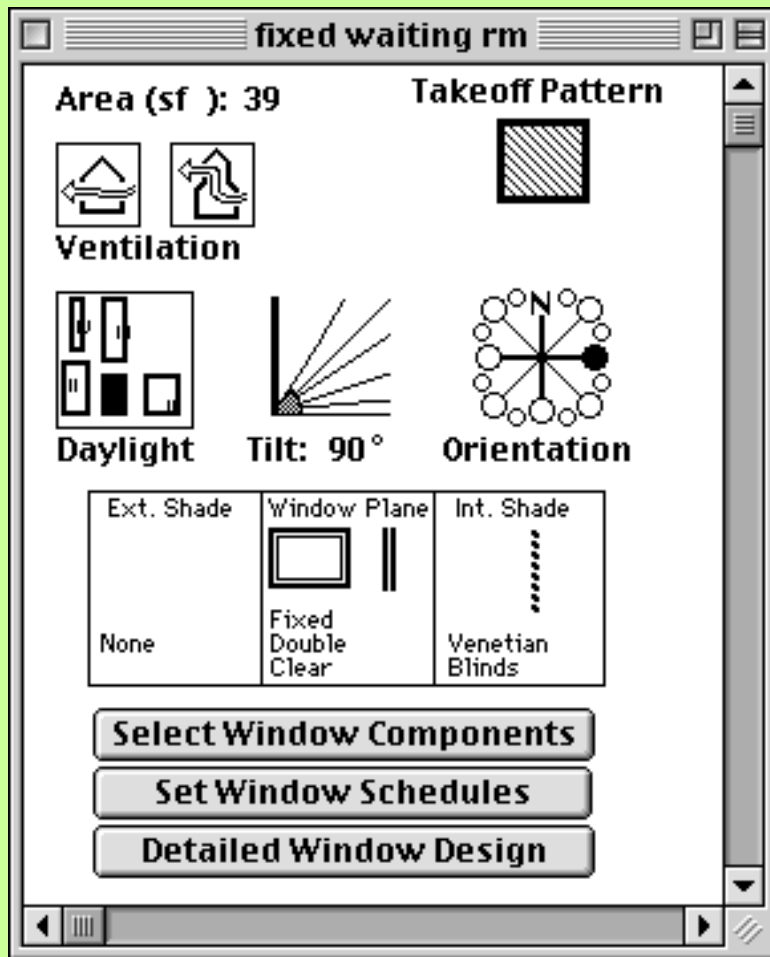


### EAST WINDOWS



*Click on the Window takeoff to see the Window Specs for that area.*

**Waiting Room Window (main floor)**

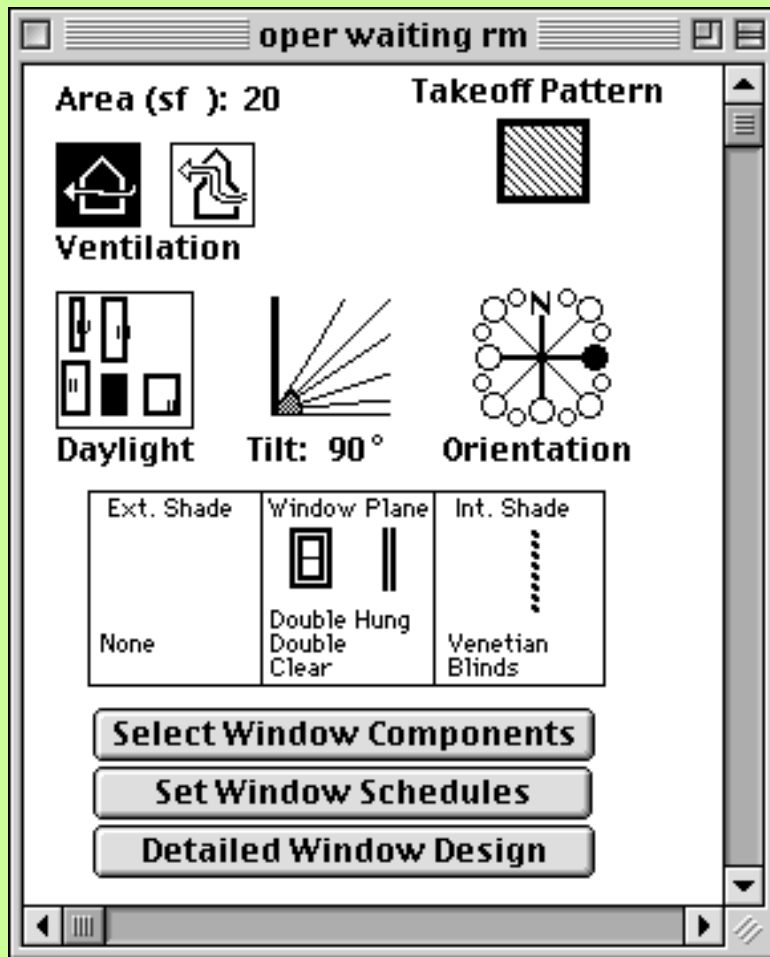


Waiting room windows are fixed double glazed windows set between narrow double glazed double hung windows.

Fixed, center windows are specified as:

- No ventilation
- Daylight zone I
- Vertical tilt
- East orientation
- No exterior shades
- Fixed, double, clear windows
- Interior venetian blinds, light





Operable, outer windows are specified as:

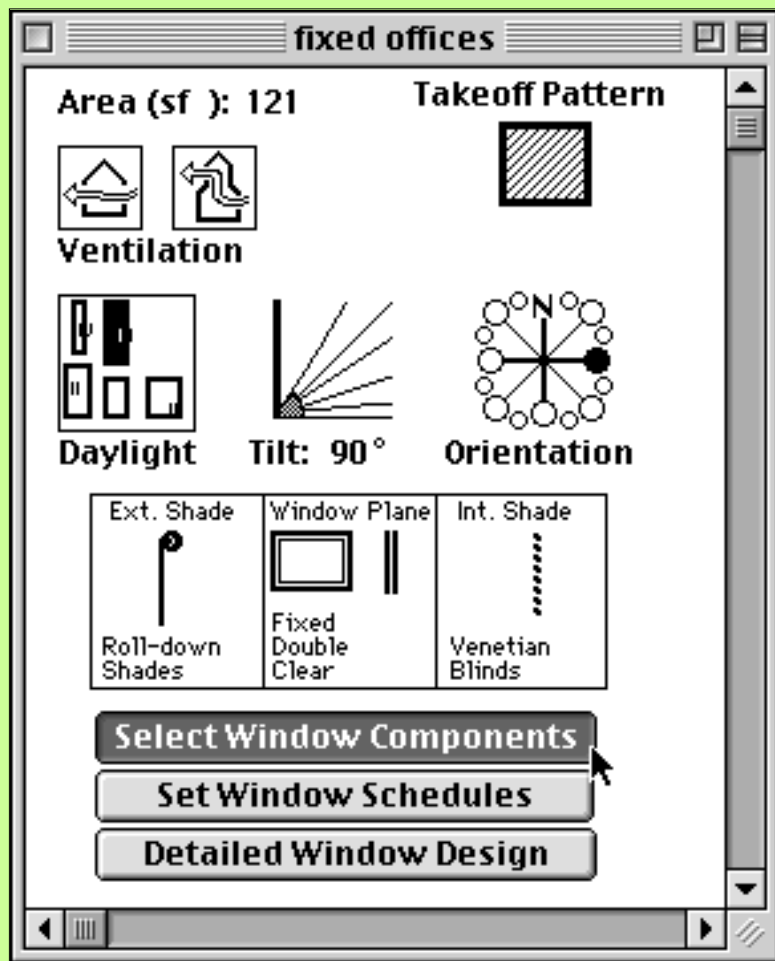
- Cross ventilation
- Daylight zone I
- Vertical tilt
- East orientation
- No exterior shades
- Fixed, double, clear windows
- Interior venetian blinds, light

### Office Windows (main floor)

Windows in the office wing are also a combination of fixed double glazed windows alternating between narrow double glazed double hung windows.

These windows are shaded by a horizontal overhang, perforated with daylight openings, and by an exterior operable canvas roll-down shade ([drawings of shades](#)), suspended from the overhang and run on cables. Additionally, there are interior venetian blinds. When specifying window components, you can specify *only one type* of exterior shading. We had to decide which exterior shading element to include -- the overhangs or the roll-down shades?

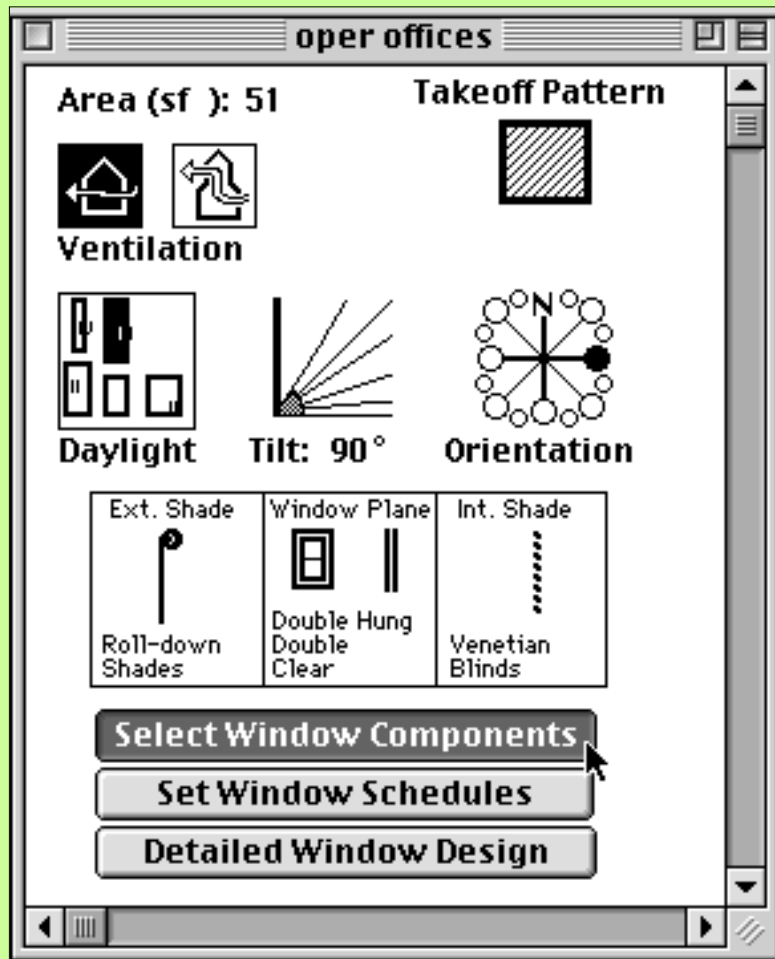
Since an overhang will not be very effective on the east elevation, because the sun is at a very low altitude in the morning when it shines from the East, and because the overhang is perforated, we chose to use the roll-down shade and ignore the overhang on the east elevation.



Waiting room windows are fixed double glazed windows set between narrow double glazed double hung windows.

Fixed windows are specified as:

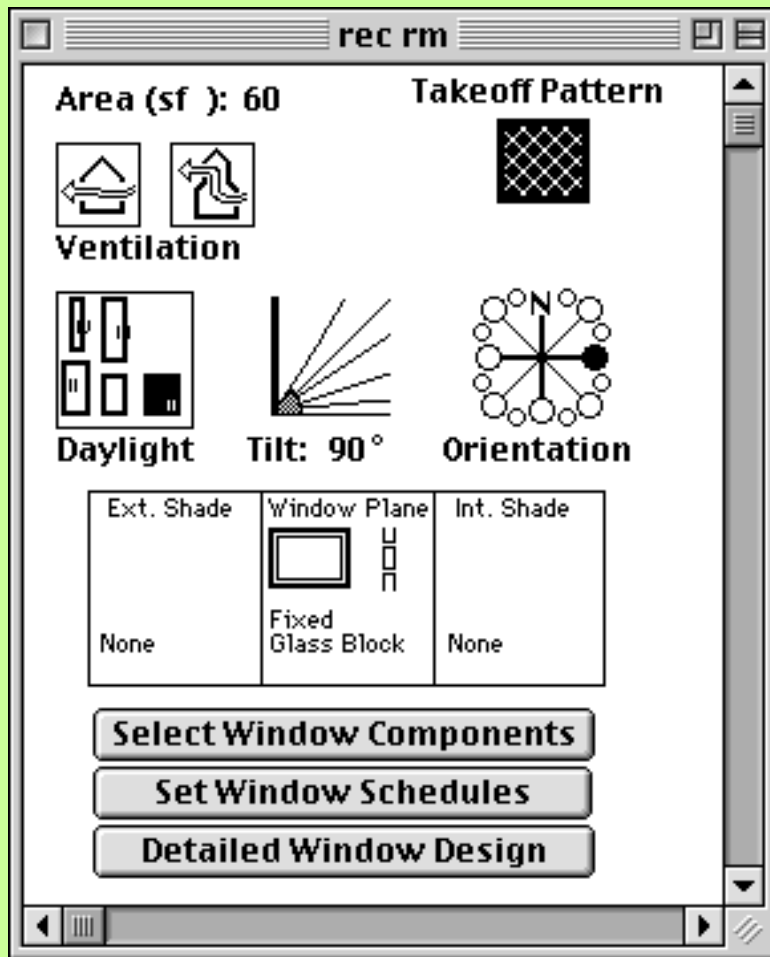
- No ventilation
- Daylight zone III
- Vertical tilt
- East orientation
- Exterior roll-down shade, translucent
- Fixed, double, clear windows
- Interior venetian blinds, light



Operable windows are specified as:

- Cross ventilation
- Daylight zone III
- Vertical tilt
- East orientation
- Exterior roll-down shade, translucent
- Fixed, double, clear windows
- Interior venetian blinds, light

#### Recreation Room Windows (Basement)



The basement level on the east side is lit with a single large glass block window.

It is specified as:

- No ventilation
- Daylight zone V
- Vertical tilt
- East Orientation
- No exterior shades
- Fixed glass block
- No interior shades



worked example

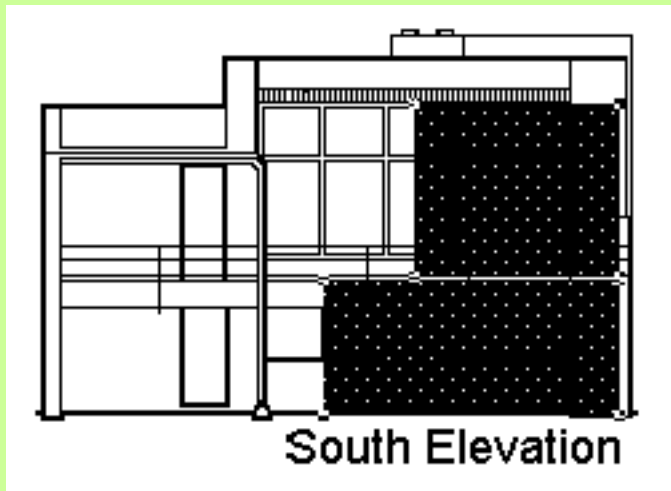
## elevation specifications: mass

Now that you have defined settings and parameters to fit your building, you are ready to take off the building elements.

*Click on all icons below for specific information:*



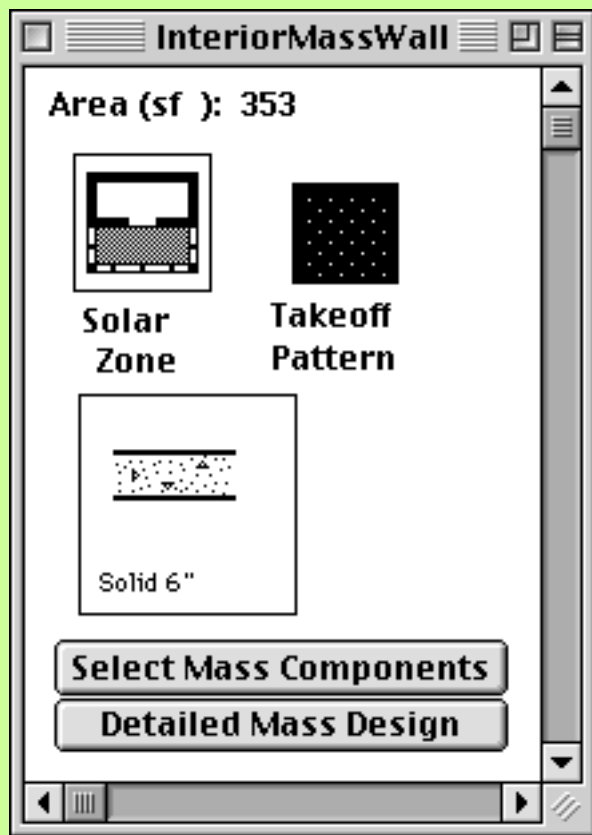
### MASS



The exterior walls were all specified as massive when they were taken off under "walls" so they already have their massive characteristics registered under thermal mass automatically. If you have already defined some exterior walls with mass, then when you open the mass icon, there will be one or more predefined mass elements. These can not be changed in the mass specs, only in the wall specs that created them. If you open one, it looks like this: [Mass Associated](#)

There is one other thermally massive vertical element in the Shanley building, however. The chimney and the concrete interior wall it is located in are exposed to the south facing waiting room. We took off the chimney and wall on the south elevation under the [interior] mass icon.

It was specified as solid 6" mass in a solar zone.



Back to [elevation specifications](#)

# RECYCLING WITH *ENERGY SCHEMING*:

## Download Exercise and Example



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The following links download a PDF version of the exercise and the example.

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B. DEFINING: take-offs and specifications

1.2MB  
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