Teaching Architecture + Energy

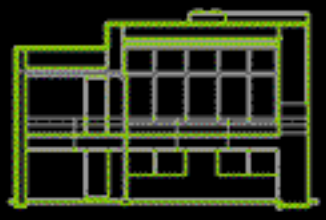
Hosted by Washington University in St. Louis

Contacts
Contents
Climate
ES Tour
Exercises
Example
Help
Home
Instructors
Manual
Students

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"

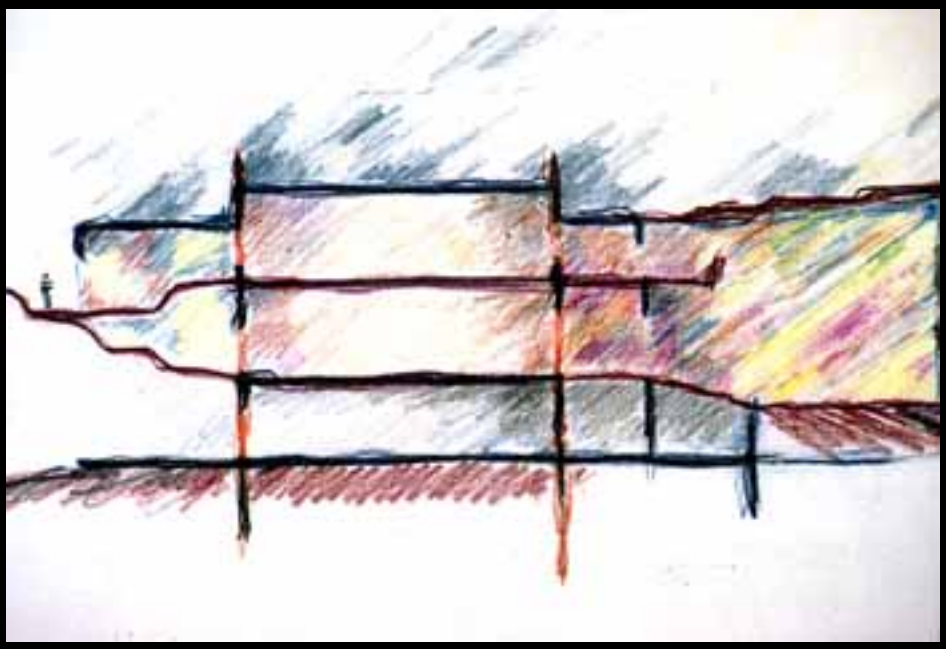


Example:
shanley building

Student Work

Legal Disclaimer

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

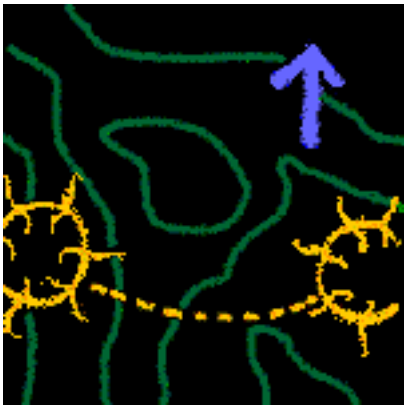
D. RE-DESIGNING: 'generate and test' cycles

E. EVALUATING: energy codes as indicators

Download the PDF vertion of the exercise

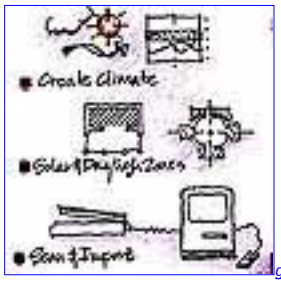
RECYCLING WITH "*ENERGY SCHEMING*": Schematic Design Performance

TERRAIN MAP: outline of exercise



OVERVIEW

In this exercise, a schematic design developed in a design studio class, or a case study building is evaluated for its performance using the computer software, "Energy Scheming." Using feedback about your building's patterns of energy use, you then redesign the building, alternating between proposing new solutions and testing them, until the design meets the performance targets that you have set. In the last part, you can also compare the performance of your design to that of a building specified by energy codes.



graphic outline

Objective:

- To gain experience with a design tool that can help architects to verify the quantitative thermal implications of non-thermal design decisions, and to explore the non-thermal design potentials latent in passive design.
- To understand the relationships between architectural form and its energy and lighting performance.
- To develop a process of cyclic architectural design that incorporates issues of energy and lighting.

A. DOCUMENTING: input your building

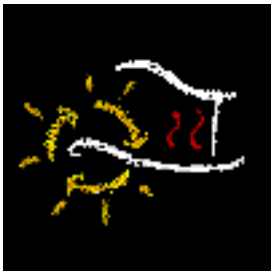
1. Assemble Schematic Plans and Elevations of Your Design
2. Identify the Building's Construction Type(s)
3. Diagram the Solar Concept
4. Determine Your Simulation Strategy
5. Diagram the Daylighting Zones
6. Get the Drawings into the Computer
7. Create a New Climate, if necessary

B. DEFINING: take-offs and specifications

1. Tuning 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

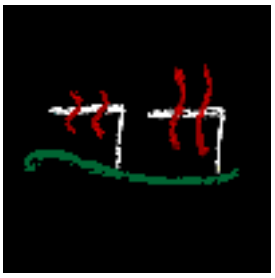
C. ANALYZING: understanding energy patterns

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



D. RE-DESIGNING: generate and test cycles

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



E. EVALUATING: comparing with energy codes

1. Setting an Energy Budget: a range of values
2. Choosing Reference Criteria
3. Model Your Reference Case Building
4. Compare the Performance of the Two Designs

Download the PDF version of the exercise

General Notes:

- Your studio project is the recommended vehicle for this assignment. You may choose a pre-designed "case study" building, if the assignment requirements do not match the development of your project or if the content is somehow inappropriate to the nature of your project. If you choose to use a "case study approach," you will still need to "renovate" the existing design to achieve contemporary performance standards and engage the issues of solar heating, natural ventilation and daylighting, while preserving the building's design intentions and quality.
- Remember that the character and quality of the space that you create is important. You can not afford to lose the Vision of the project. The quantitative performance methods must support and improve your conceptual approaches. They set boundaries, but do not limit your creativity. It is certainly more challenging to design with energy and lighting in mind!

Grading Criteria

RECYCLING WITH *ENERGY SCHEMING*

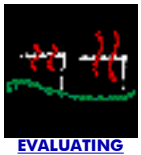

TERRAIN MAP


DOCUMENTING


DEFINING


ANALYZING


RE-DESIGNING


EVALUATING

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

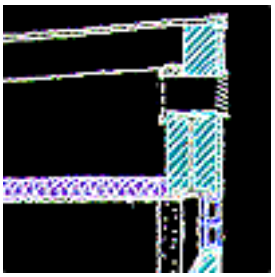
A. DOCUMENTING: import your building

In Part A of this exercise, you assemble schematic plans and elevations of your design, identify the building's construction types, diagram the solar concept and daylighting zones, decide on a strategy for what part of your building to model, and import your design drawings into *Energy Scheming.*

Before you start read chapters One and Two of the *ES Manual*.

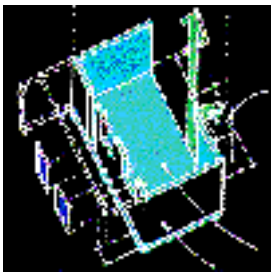
1) Assemble Schematic Plans and Elevations of Your Design

You ONLY need plan and elevation drawings to do take-offs in ES. While section drawings will definitely help you to design, ES does not make use of section information, so you do not have to import section drawings.



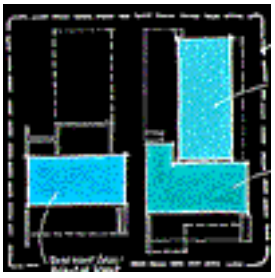
2) Identify the Building's Construction Type(s)

You should have a general idea of what construction assemblies you are using, although details of every part of the building are not required. Later, when you specify elements in ES, you will need to determine the construction of all floor, wall, roof, and window assemblies.



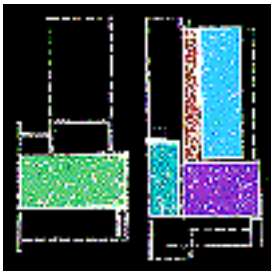
3) Diagram the Solar Concept

Understanding how your building's design impacts its ability to use solar energy is critical to knowing how to model it with a simulation program like Energy Scheming. One needs to understand the building's 'Solar Concept.'



4) Determine Your Simulation Strategy

Before beginning to use ES, you need to develop a logic, using your understanding of your building's solar zones, for how you will evaluate your building's performance. In some cases, such as small or single occupancy buildings, this is appropriate. In other cases, it may not be and you may need to choose one part of the building to analyze.



5) Diagram the Daylighting Zones

Zoning for daylight allows the designer to size windows to match the daylight goals in different parts of the building. A Daylight Zone is an area of the building with similar needs for lighting (low or high daylight factor?) and a similar formal configuration.

6) Get your drawings into the computer

There are four basic options for getting drawings into *Energy Scheming.*

- Scan and import each drawing separately
- Paste up drawings on a single page and scan it
- Paste images into *Energy Scheming*
- Sketch your design in Energy *Scheming*

7) Create a New Climate, if necessary

ES comes with four built-in climates. Your instructor may have created additional climates for this assignment. Alternatively, you may need to create a new climate file in ES for your specific project.

Part A Grading Criteria

RECYCLING WITH *ENERGY SCHEMING*

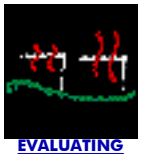

TERRAIN MAP


DOCUMENTING


DEFINING


ANALYZING

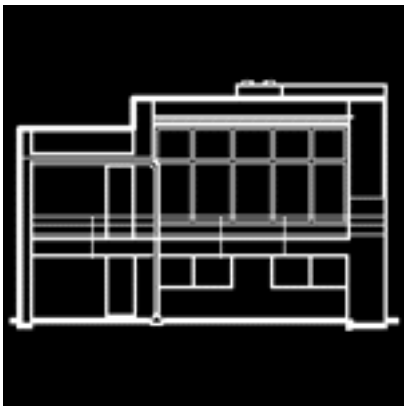

RE-DESIGNING


EVALUATING

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

A. DOCUMENTING: import your building

assemble drawings



shanley example

1) Assemble Schematic Plans and Elevations of Your Design.

You ONLY need plan and elevation drawings to do take-offs in ES. While section drawings will definitely help you to design, ES does not make use of section information, so you do not have to import section drawings.

The drawings must be TO SCALE. They may be hand drawn sketches or done in any computer drawing program that will output as a PICT or TIFF format image file.

market building example

PLAN drawings should indicate room areas, although all openings do not have to be located.

ELEVATION drawings must show a preliminary design for window and door openings. Elevations with extensive curves (where the projection area of the curve in the plane of the elevation is significantly smaller than the actual area of the curved wall) should be drawn as "unrolled" flat elevations. In general, you will need all of the major elevations, but buildings with more complex geometries (for instance, extensive use of 45° walls) should have "straight on" elevations of each side.

Ignore party walls, as heat flow to attached, adjacent conditioned buildings is insignificant.

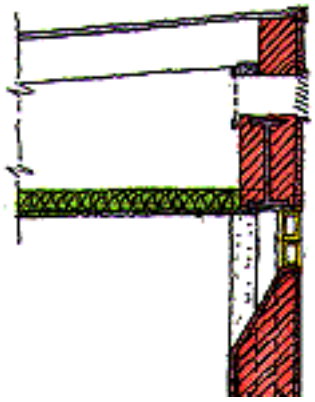
Turn in: Plans of all floors, complete elevations, and at least one building section. These drawings can be diagrammatic as long as they are to scale and show all the important thermal elements. Do this ON PAPER, not in ES. For a guide, see *shanley example*

Jump to the next section: Identify the Building's Construction Type(s)

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

A. DOCUMENTING: import your building

construction types



shanley example

2) Identify the Building's Construction Type(s).

You should have a general idea of what construction assemblies you are using, although details of every part of the building are not required. Is it a wood or concrete structure? Is the floor on grade or over a crawl space? Are you using thin walls with rigid insulation or thick walls with batt insulation? Etc.... Later, when you specify elements in ES,you will need to determine the construction of all floor, wall, roof, and window assemblies.

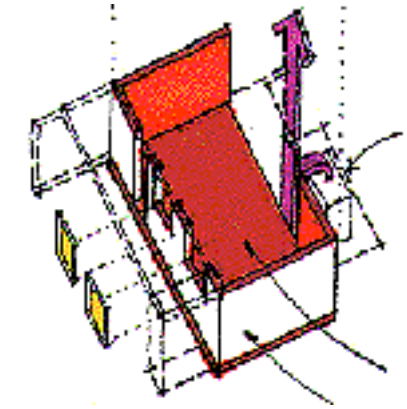
Turn in: A typical wall / floor / roof section. These drawings can be diagrammatic as long as they are to scale and show all the important thermal and construction elements. Do this ON PAPER, not in ES. For a guide, see the *shanley example*.

Jump to the next section: Diagram the Solar Concept

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

A. DOCUMENTING: import your building

solar concept



shanley example

3) Diagram the Solar Concept.

Understanding how your building's design impacts its ability to use solar energy is critical to knowing how to model it with a simulation program like *Energy Scheming*. One needs to understand the building's 'Solar Concept.' In this part of the exercise, think about how heat is collected, stored, and distributed. For this purpose, we will consider the building's 'Solar Zones.'

A Solar Zone, for the purposes of this assignment is defined as an area of occupied space, together with its associated solar collection area and thermal storage. A particular area of solar collection aperture is always associated or serves a particular area of floor space within the building. If two parts of the building are isolated from one another and thus can not exchange heat, they must be considered separate solar zones unless they are linked by supplemental ducts and fans. The solar aperture (collection area) of each zone would then need to be designed proportional to the heating load and floor area of the respective zones.

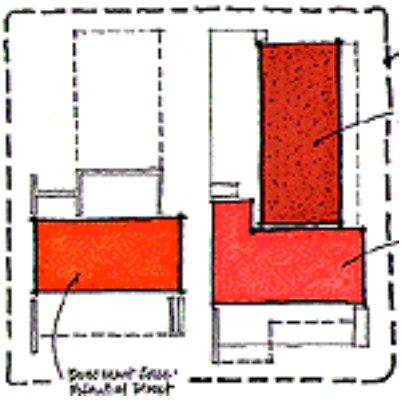
For instance, in a double loaded corridor dormitory facing south, the south rooms have direct gain potential through windows, so heat can be collected and stored within the room. Whereas, the corridor and north side rooms have no direct access to solar heat collected on the south, and thus are a separate solar zone. In diagramming such a building, you would want to think about how to get heat to the north side rooms, probably either through the roof (skylights, dormers, clerestories) or by moving hot air with fans from say, a thermal storage wall on the south side, to rooms on the north.

Turn in: Diagrams of your building's solar concept. Diagram the solar zones for the building three dimensionally. For each solar zone, show the collection aperture, the associated thermal storage, and the associated floor area. Do this ON PAPER, not in ES. For a guide, see the *shanley example*.

Jump to the next section: Determine Your Simulation Strategy

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

A. DOCUMENTING: import your building simulation strategy



shanley example

4) Determine Your Simulation Strategy

Before beginning to use ES, you need to develop a logic, using your understanding of your building's solar zones, for how you will evaluate your building's performance. ES treats the entire building as a single thermal zone. It assumes that heat collected in one part of the building can be used to offset losses in another part of the building. Thus, it is a schematic design tool that gives you schematic level performance information. In many cases, such as small or single occupancy buildings, this is appropriate. In other cases, it may not be and you may need to choose one part of the building to analyze.

Decide whether you will treat your design as one thermal zone or multiple thermal zones. *Energy Scheming* can handle only one solar zone per building file. This choice should be based on the following considerations:

- ***For buildings early in the design process***
  Treat the building as a single zone for a design early in the process of development. If you do not have detailed information about your building, then it is most appropriate to use a single ES file and treat the whole building as one zone. The abstraction of a single zone will still give you useful feedback for your design decisions, even if the building is quite complex.
- ***For very large, complex, or repetitive buildings***
  The building may need to be broken down into several zones.
  - If you have a *high rise building with repetitive floors,*
    you may evaluate just a typical floor.
  - If you have an *extruded, repetitive bay building,*
    you may choose to evaluate just a typical section or bay.
  - If you have a *highly thermally complex building,*
    where heat can not be easily transferred from one zone to another (for instance, an auditorium and a set of hotel rooms, a bagel kitchen and a warehouse, or a black box with tiny windows and a glass box), then you will need to choose one part to evaluate in ES. Although several zones may be appropriate for your design, for the purposes of this assignment, choose one *major* thermal zone to use in ES. If you follow this path, choose the *most significant portions* of your building.
- ***For small buildings,***
  make the whole building a single zone and thus evaluate the building's energy performance in *Energy Scheming* as a single ES file. This is the approach used in the example building, one that is appropriate for the majority of buildings encountered.
- ***For "disaggregated" schemes***
  If the design calls for discreet parts, such as a set of freestanding pavilions connected by outdoor circulation, then you will want to use multiple zones because you essentially have different buildings which can not share heat gains and losses.

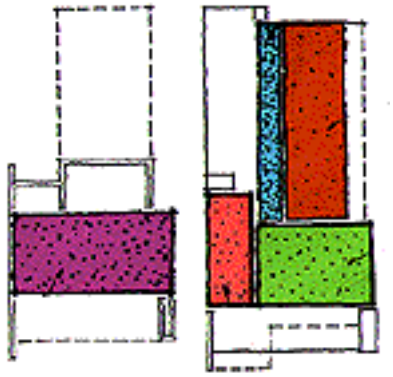
Turn in: A diagram of your simulation strategy, showing the building's thermal zones and which part of the building you will be analyzing in ES. This is a fairly important decision and your instructor will want to check your assumptions, so that the rest of your work will give you useful design feedback. Remember that most buildings at the schematic design stage will be fine treated as a single ES file; you should vary from this rule only if you have good cause to think that a single file will be too abstract. Do this ON PAPER, not in ES. For a guide, see the *shanley example*

Jump to the next section: Diagram the Daylighting Zones

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

A. DOCUMENTING: import your building

daylight zones



shanley example

5) Diagram the Daylighting Zones.

Zoning for daylight allows the designer to size windows to match the daylight goals in different parts of the building. A Daylight Zone is an area of the building with similar needs for lighting (low or high daylight factor?) and a similar formal configuration.

Energy Scheming, the designer may define multiple daylight zones (up to five) within each ES file. In a small building, each zone may represent a room. In a larger building, each zone will represent several rooms of similar character with respect to lighting. For example, a typical architecture school might be divided into zones for 1) brightly lit studios; 2) moderately lit office spaces; 3) internal corridors with no windows; 4) a computer lab with a specific lighting strategy; and 5) classrooms. Distinguish daylight zones by their difference in the desired daylight factor (DF). Group rooms into zones based on their similar need, similar format, and/ or contiguousness.

There are a couple of unique cases to consider also:

- ***Sunspaces and Atria***
  If your building has a sunspace or atrium, make it a separate daylight zone. These areas typically have very high light levels, so you do not want windows in these zones to be averaged with windows in zones where the lighting level is more critical.
- ***Thermal Storage Walls***
  A thermal storage wall, such as a water wall or Trombe wall should be treated as a separate daylight zone in ES, so that its glazing area can be separated in daylighting window sizing. Since all solar gain in ES is defined in window specifications, if the thermal storage wall is kept separate, its daylight will not be counted in the occupied space zones.

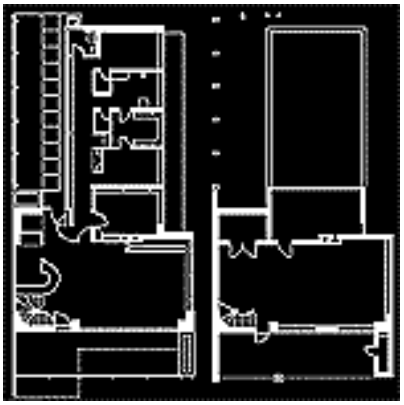
Turn in: a plan diagram of your building's five daylight zones and the daylight factor (DF) target for each zone. For DF targets, see SWL, strategy 59, WINDOWS: Size, pp. 127-129. Do this ON PAPER, not in ES. For a guide, see the *shanley example*.

Jump to the next section: Get the Drawings into the Computer

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

A. DOCUMENTING: import your building

import drawings



shanley example

6) Get your drawings into the computer.

There are four basic options for getting drawings into *Energy Scheming.* If you are designing on paper, you can scan and import each drawing separately . Alternatively, you can paste up drawings on paper into a single page which can be scanned. Thirdly, if you are designing on a computer, you can import PICT or TIFF images to *Energy Scheming.* Finally, you can sketch your design directly in the *Energy Scheming* drawing window.

Plans and elevation can be simplified, if necessary to retain clarity, to diagrams representing massing and solid/voids. But, in general, it will keep your design issues more in the fore if you work with drawings that are not too abstracted. The information required in elevations is more detailed than that for plans, so elevations should be more detailed and larger in ES than plans.

Options for Paper Drawings

A. Single Import File

If you are in the very early stages of design, you can photocopy reduce and paste up all of your drawings onto a single page and then scan the page into Photoshop for use in ES. This is the easiest and fastest way to get drawings into ES. You should start with good copies of high contrast.

B. Multiple Import Files

If you are farther along in your design, you will (usually, but not necessarily) want to scan each drawing separately. In this case, each individual drawing must be reduced to a single page and then scanned and used to create an ES input file.

Options For Computer Drawings

C. Import CAD Drawings

If you are creating the plans and/or elevations in a computer application, your images should be saved as 2-D TIFF or PICT format, which ES can import. You may work in whatever software with which you are comfortable.

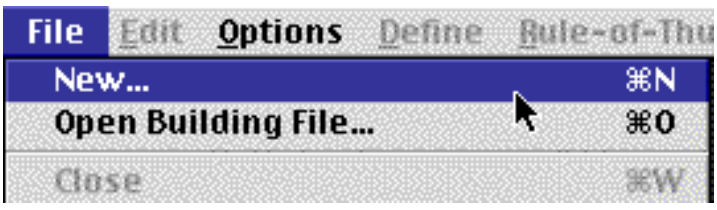
D. Draw in Energy Scheming.

You may draw the building to scale in the ES drawing window and avoid importing. This probably only makes sense if your building is VERY schematic and simple. The drawing tools really work better to make minor modifications to an existing drawing, rather than drawing a building from scratch.

See the section, "Building Drawings" in Chapter 5 of the ES manual for help.

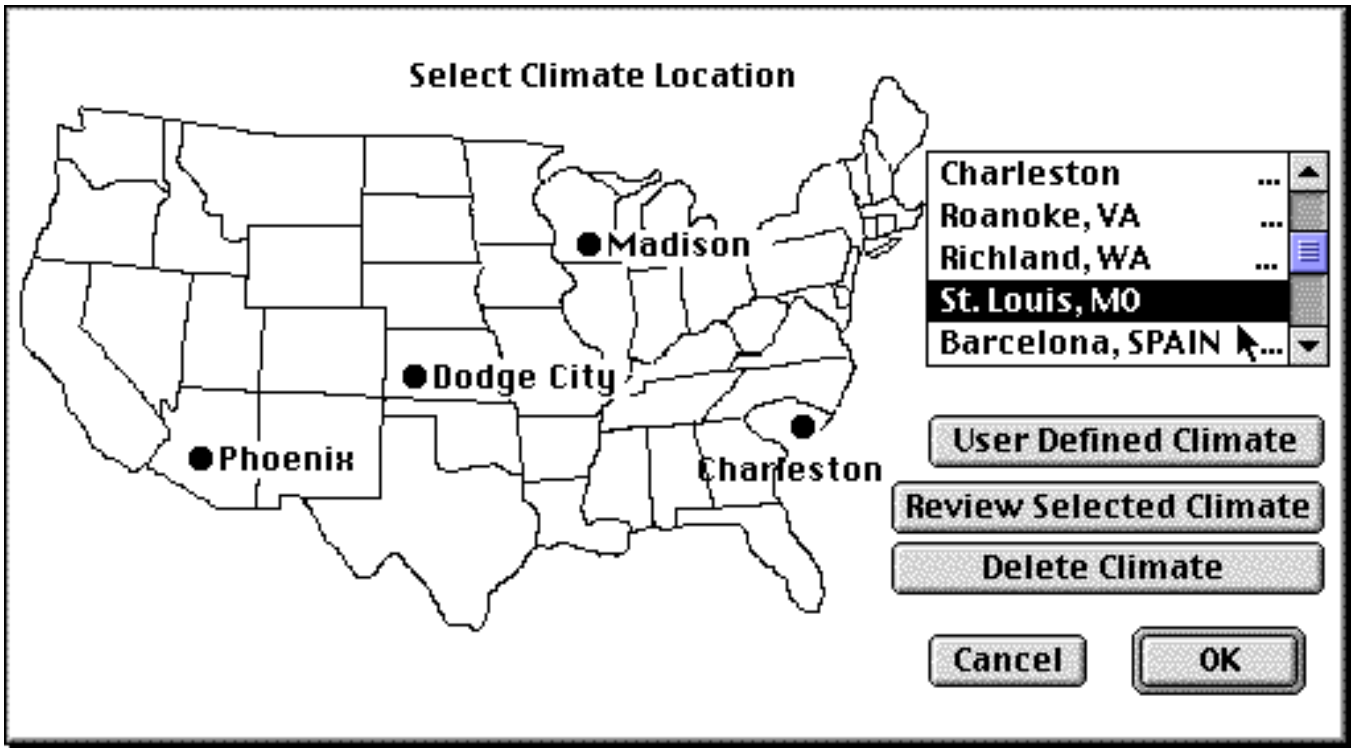
Creating a New ES File

Before you can import a graphic, you must first create a new, blank, ES file. To create a new file, choose the "File / New..." menu:

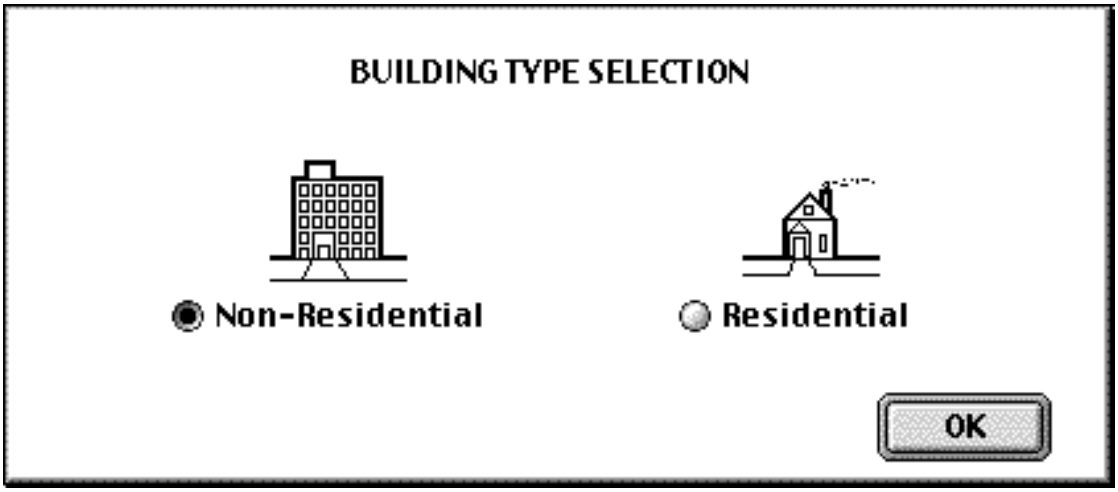


When creating a new ES building file, you must select a few settings. The first screen asks you to locate the building site in a climate. Scroll to choose the closest match for your site. If there is no appropriate climate, you can set one up later. If this is the

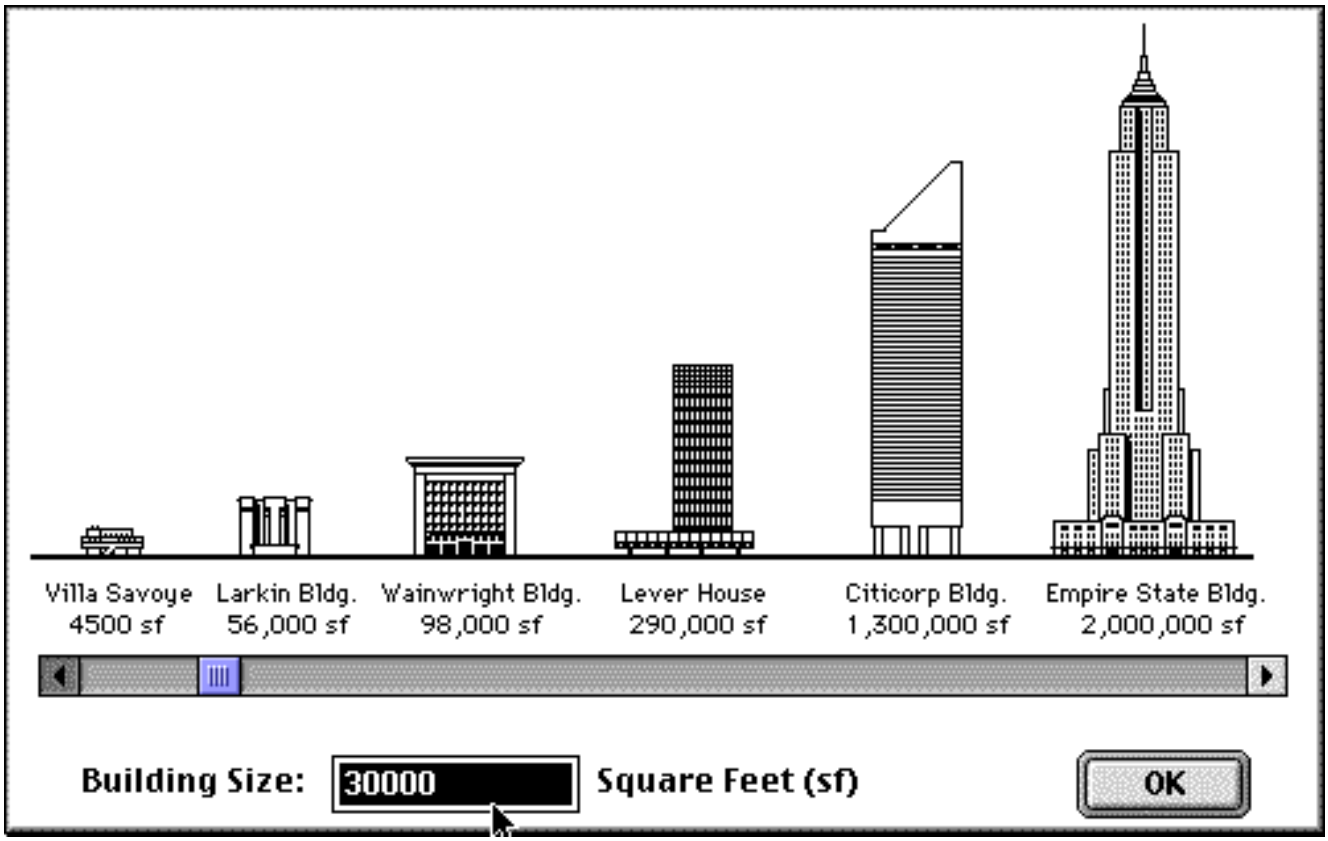
case, just pick any climate for now. Then click OK.



The next screen asks you to choose between Non-Residential and Residential building types. ES will use this information to set certain defaults for things like occupancy schedules. Click on the appropriate radio button, then click OK.

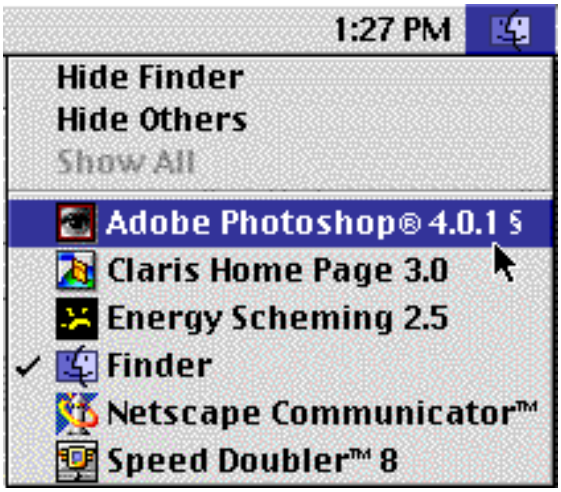


Finally, you will need to input the total square footage of the building or part of the building that you are analyzing. Be sure that if you are using ES to design only one part of your building, such as a typical floor or bay, you input the floor area for that part and not for the whole building. ES uses this information when calculating several things, including your feedback for solar heating in the rule-of-thumb window sizer. Set your size using the scroll bar or type the exact size, then click OK.



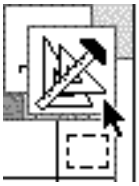
Import Your Drawings

Use the finder icon (far upper right) to switch back to your drawing or imaging program. "Select" (all) and "Copy" (under EDIT menu) your drawing from the draw/image image program.



Use the finder again to switch back to ES (make it active in the front). Make sure the drawing layer in ES is active by selecting the triangle and T-square icon. Make one click with the mouse inside the active drawing window of ES.

Choose "Paste" (under the EDIT menu) to import your composite drawing file to ES. If your drawing is bigger in any dimension than the ES drawing window, you may be asked to choose for ES to scale your drawings to fit its window.



You should see a dashed box around the drawings. Before doing anything else, scroll around the ES drawing window to be sure

all the drawing is visible in the window. Drag the box to where you want it, leaving some white space on the *left side*, if possible (so take-off icons will be easily visible later). When you click outside the box, the drawing is converted to a pixel based "paint" or "bitmap" format. You can then sketch over it with the ES drawing tools, use the eraser tool, etc. You may want to darken some major lines or use the rectangle tool to define windows, if necessary.

Save and Back-up
You are ready to begin using *Energy Scheming*. SAVE and BACK-UP your work. Right now, make a second copy of the ES file you just created. If anything goes wrong or you lose the file, you will have a place to start over. You should have at l;east two copies of your work. At least one of these should be on a portable media you control, such as a zip disk.

Turn in:
A print out of the Energy Scheming drawing window showing your drawing input file. For a guide, see the *shanley example*.

Jump to the next section: Create a New Climate

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

A. DOCUMENTING: input your building

working with a single import file

A. Single Import File. If you are in the very early stages of design, you can photocopy reduce and paste up all of your drawings onto a single 8-1/2 x 11 page and then scan in a single page to Photoshop for use in ES This is the easiest and fastest way to get drawings into ES. You should start with good copies of high contrast.

i. First photocopy reduce and paste up your drawings onto a single page. Since your drawing will end up as a bitmap image (all black and white pixels), make sure that your originals are high contrast with no light pencil lines. A black felt pen (medium or bold lines, not fine point) drawing will show up well in ES.

ii. Scan each of the drawings into Photoshop. You can preview the scan and select only the part of the drawing that you need. This makes scanning faster and file size smaller. It may be best to scan in grayscale, unless your original is a ink line art. Color is not required and many Photoshop adjustments can not be made to line art (high contrast bitmap). Scanning at high resolutions is not necessary. Eventually, your images will end up as 72 dpi bitmaps in ES. Since you may need to resize your images, scanning at 150 dpi and resizing or reducing the resolution later is a good idea.

Adjust and tune your images as necessary. In Photoshop, you can "Crop," to save only the drawing portion of you file; "Rotate," to correct for any misalignment of the drawing as scanned; "Sharpen," to make lines crisper, or "Adjust Levels "to tune your values, eliminate gray backgrounds and darken lines, as necessary.

After your images are tuned and look good, resize each image to no more than 7" wide at 72 dpi. A long elevation at 7" wide leaves a little space in ES for the icons that appear down the left side of your screen. To resize your image, use the "IMAGE / Image Size" menu. ES 3.0 has a larger drawing window about the size of an 11x17 page, so drawings may be much wider than in earlier versions. Still if you have enough detail in the 7" wide drawings, smaller drawings will save you lots of scrolling around in ES later.

Save each scanned image to your home account and to portable media such as a zip disk. Be sure to save as 72 dpi BITMAP. To convert to bitmap, chose Bitmap from the Mode submenu on the Image menu (Image>Mode>Bitmap) and set to 50% threshold, do not dither. Keep your images on file, even after your ES file is created. You may need the backup.

iii. Return to the import drawings page to complete the process.

---

back to import drawings

A. DOCUMENTING: input your building

working with multiple import files

B. Multiple Import Files. If you are farther along in your design, you will (usually, but not necessarily) want to scan each drawing separately. In this case, each individual drawing must be reduced to 8-1/2 x 14 or the largest size your scanner will take, then scanned and used to create an ES input file.

i. Each drawing must be reduced to a size that can be scanned (about 8-1/2 x 14). Photocopy reduce as necessary to get to a size that can be scanned. Since your drawing will end up as a bitmap image (all black and white pixels), make sure that your originals are high contrast with no light pencil lines. A black felt pen (medium or bold lines, not fine point) drawing will show up well in ES.

ii. Scan each of the drawings into Photoshop. You can preview the scan and select only the part of the drawing that you need. This makes scanning faster and file size smaller. It may be best to scan in grayscale, unless your original is a ink line art. Color is not required and many Photoshop adjustments can not be made to line art (high contrast bitmap). Scanning at high resolutions is not necessary. Eventually, your images will end up as 72 dpi bitmaps in ES. Since you may need to resize your images, scanning at 150 dpi and resizing or reducing the resolution later is a good idea.

Adjust and tune your images as necessary. In Photoshop, you can "Crop," to save only the drawing portion of you file; "Rotate," to correct for any misalignment of the drawing as scanned; "Sharpen," to make lines crisper, or "Adjust Levels "to tune your values, eliminate gray backgrounds and darken lines, as necessary.

After your images are tuned and look good, resize each image to no more than 7" wide at 72 dpi. A long elevation at 7" wide leaves a little space in ES for the icons that appear down the left side of your screen. To resize your image, use the "IMAGE / Image Size" menu. ES 3.0 has a larger drawing window about the size of an 11x17 page, so drawings may be much wider than in earlier versions. Still if you have enough detail in the 7" wide drawings, smaller drawings will save you lots of scrolling around in ES later.

Save each scanned image to your home account and to portable media such as a zip disk. Be sure to save as 72 dpi BITMAP. To convert to bitmap, chose Bitmap from the Mode submenu on the Image menu (Image>Mode>Bitmap) and set to 50% threshold, do not dither. Keep your images on file, even after your ES file is created. You may need the backup.

iii. On another computer, (leaving the scanner free) create a single document with all of your plans and elevations. This may be done in a variety of applications, including Photoshop and Canvas. Do not try this in PageMaker, because you can not export your files. This step may also be accomplished directly in Photoshop or you may choose to use any drawing, paint, or CAD program that will allow you to work with "objects." This is important because you will need to move the drawings around.

The point of this step is to arrange the appropriate plan(s) and elevations(s) into a single drawing of approximately 8-1/2 x 11 proportion (the proportion of the ES 2.5 drawing window or 11x17 for ES 3.0 and higher). You may need to resize the individual drawings (using either handles or a scaling command), to get them all to fit. Drawings may be turned vertically or horizontally if necessary. In general, you will want more detail in elevations than in plans, so the plans can be reduced to a rather small size if needed. Be sure to "Save" this composite import file to your home account and to portable media such as a zip disk. You may need it later.

iv. Return to the import drawings page to complete the process.

---

back to import drawings

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

A. DOCUMENTING: input your building

working with importing cad drawings

C. Import CAD Drawings.

If you are creating the plans and/or elevations on the computer, you can just follow instructions on Multiple Import Files page, beginning at step iii. Your images should be saved as 2-D TIFF or PICT format, which ES can import. You may work in whatever software you are comfortable with and may be able to complete the above steps from within your favorite package.

i. *Creating a single image file to import.*

Create a single document with all of your plans and elevations. This may be done in a variety of applications, including Photoshop and Canvas. Do not try this in PageMaker, because you can not export your files. This step may also be accomplished directly in Photoshop or you may choose to use any drawing, paint, or CAD program that will allow you to work with "objects." This is important because you will need to move that drawings around.

The point of this step is to arrange the appropriate plan(s) and elevations(s) into a single drawing of approximately 8-1/2 x 11 proportion (the proportion of the ES 2.5 drawing window or 11x17 for ES 3.0 and higher). You may need to resize the individual drawings (using either handles or a scaling command), to get them all to fit. Drawings may be turned vertically or horizontally if necessary. In general, you will want more detail in elevations than in plans, so the plans can be reduced to a rather small size if needed. Be sure to "Save" this composite import file to your home account and to portable media such as a zip disk. You may need it later.

ii. Return to the import drawings page to complete the process.

---

back to import drawings

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

A. DOCUMENTING: import your building

create a climate

shanley example

7) Create a New Climate, if necessary
ES comes with four built-in climates. Your instructor may have created additional climates for this assignment. Alternatively, you may need to create a new climate file in ES for your specific project.

For specific instructions on how to input data for your climate, see the page on Creating New Energy Scheming Climate Files.

The climate database on this web site includes climate data for representative sites throughout the continental U.S., Alaska, Hawaii, and a few of the U.S. possessions. To find information about your climate, you can start with the main Climate page. Or, you can select from a list of cities for which ES climate data has been collected on the Climate Data for Energy Scheming page.

For a guide, see the *shanley example*.

Jump to the next section: DEFINING Front Page

EXAMPLE PROJECT

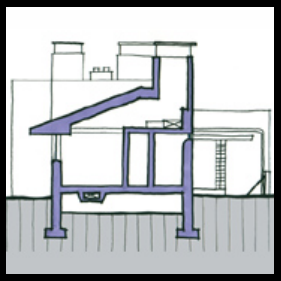
shanley dental building, clayton, mo

harris armstrong, architect, 1936

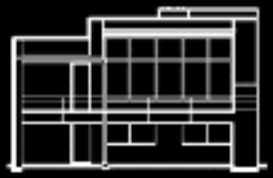
Worked Example

Re-Cycling with *Energy Scheming* exercise

Model



Final Drawings



Drawings

Site Photos

EXAMPLE PROJECT: example exercise

outline of example problem pages


exercise

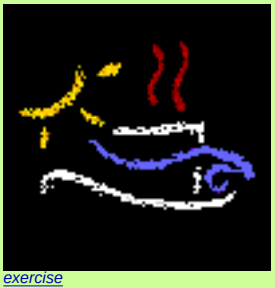
A. DOCUMENTING: input your building (example)

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

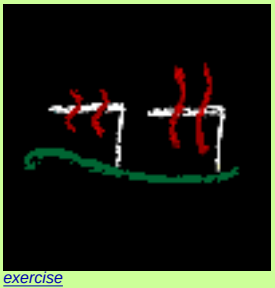
C. ANALYZING: understanding energy patterns (example)

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

RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

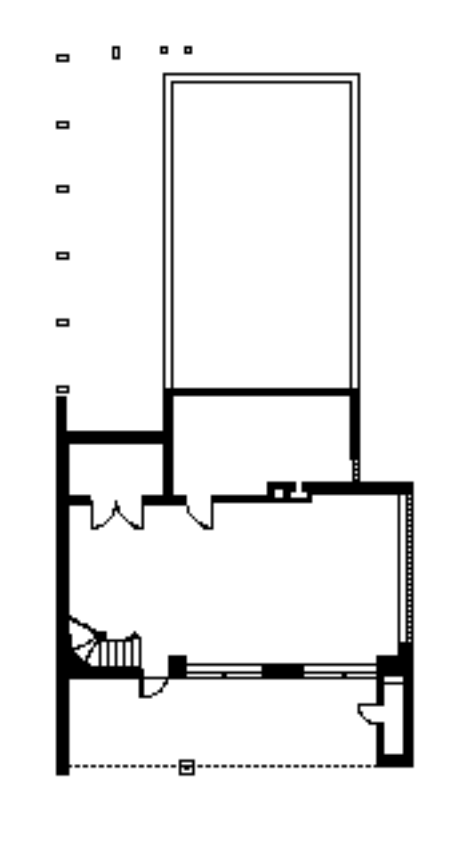
A. DOCUMENTING: input your building

drawings

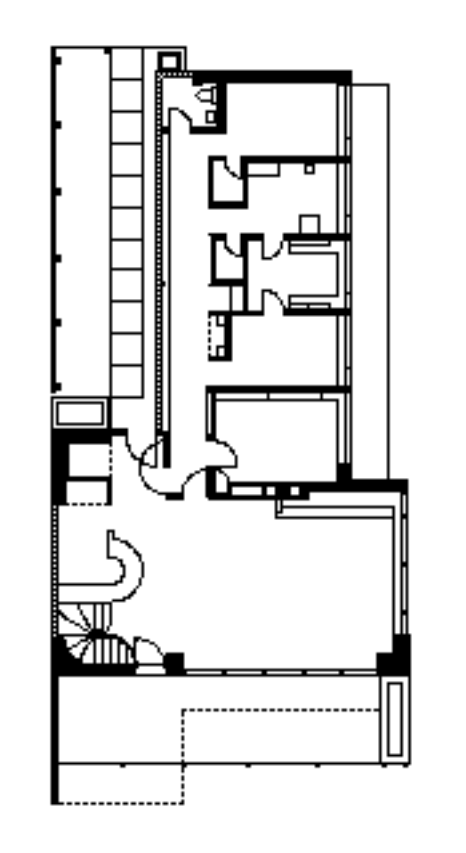
1) Assemble Schematic Plans and Elevations of Your Design.

exercise

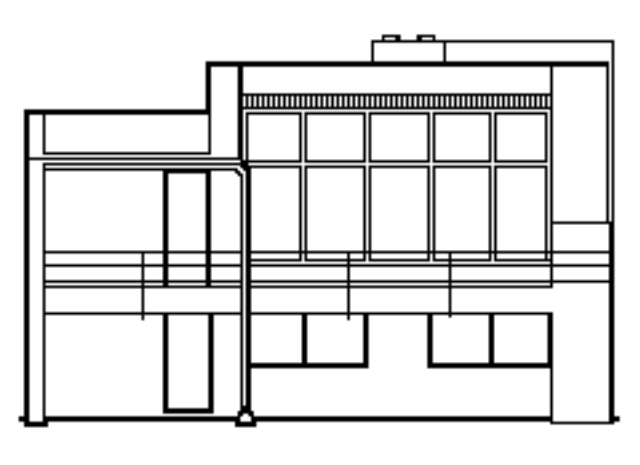
market building example



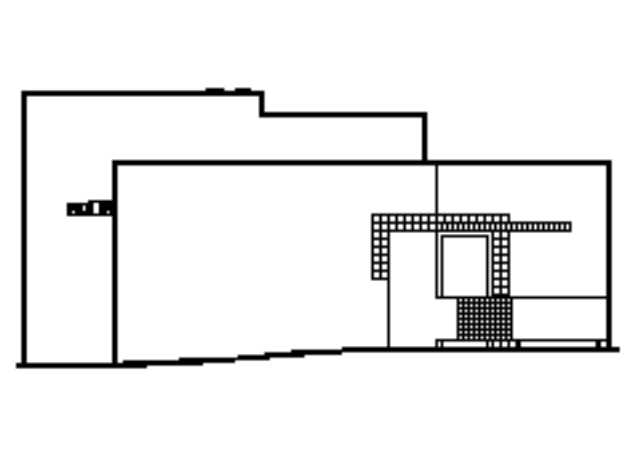
Basement Floor Plan



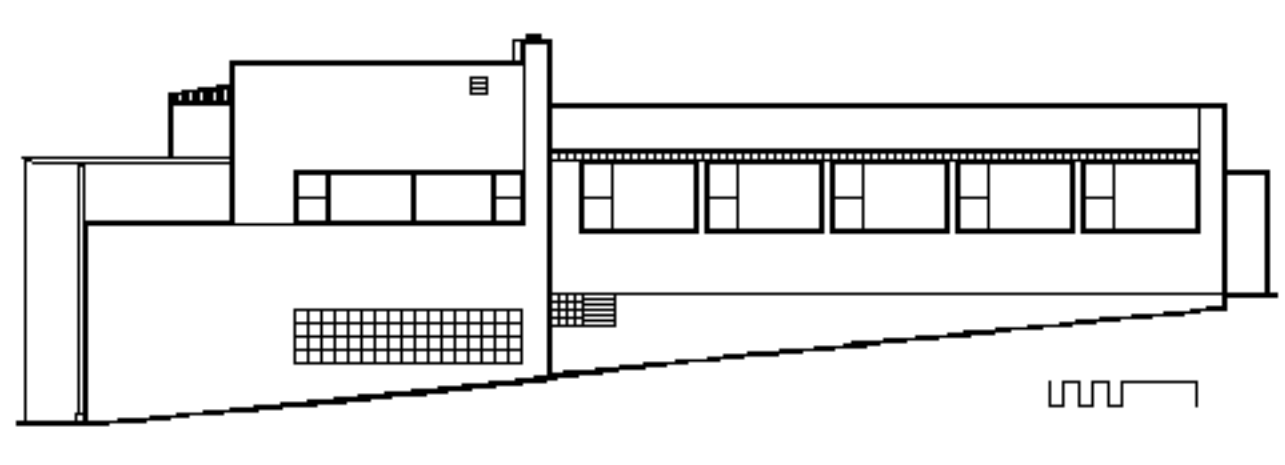
Main Floor Plan



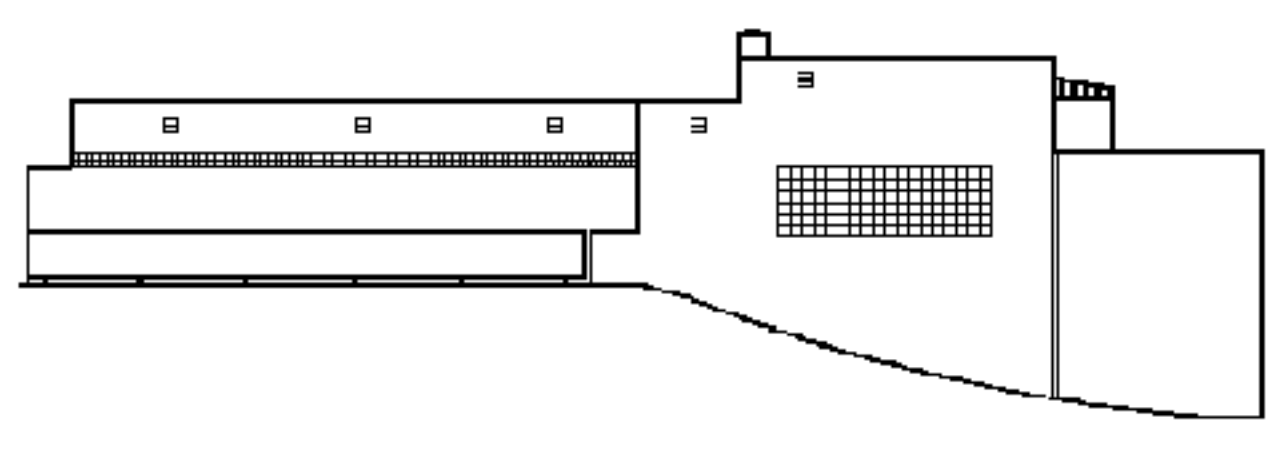
South Elevation



North Elevation



East Elevation



West Elevation

Jump to the next EXAMPLE section: Identify the Building's Construction Type(s)

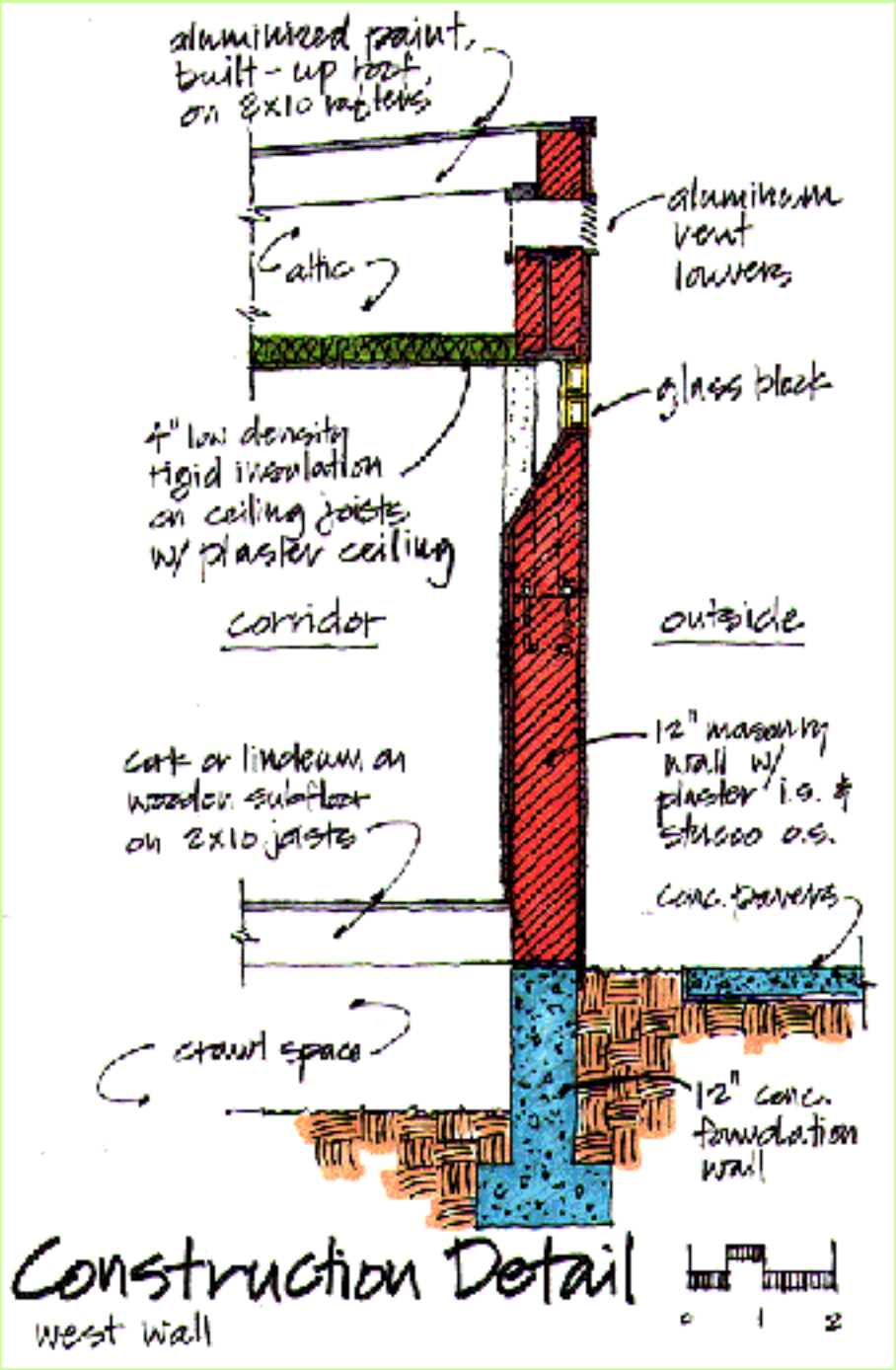
RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

construction

2. Identify the Building's Construction Type(s)

exercise



Walls:
The Shanley building's walls are mostly uninsulated 8" concrete block with plaster inside and stucco outside. The section shown is the west wall that uses a thicker masonry wall, most likely concrete, but possibly brick or block. The sketch shows the graphic symbol hatching used by the architect in the surviving detail drawing. The east wall of the examination wing is a third type of thinner, 6" concrete block. On the main floor, the walls provide the only available thermal mass.

Floors:
The basement recreation area floor is an uninsulated concrete slab-on-grade. The main floor has an uninsulated wood frame structure, with most of the examination wing over a crawl space and the rest over the unoccupied basement storge and mechanical spaces.

Roof:
The roof is a shallow attic construction, ventilated at both ends to remove excess heat built-up. The structure is 2 x 10 wood frame rafters, most likely with a built-up asphalt and felt roofing, which is covered with a reflective, aluminized paint. Thin 2 x 4 ceiling joists hold a four inch insulating layer over a plaster ceiling.

Windows:
Windows are of two types, glass block and double layer clear glass. All windows in this centrally air-conditioned building are fixed, except for double hung windows used in the strip on the east facade. East and south windows have both overhangs and opaque roll-down, external canvas shades that run on wires. The double glazing has a unique system of calcium chloride dessicants to keep the pre-thermopane windows from fogging.

Jump to the next EXAMPLE section: Diagram the Solar Concept

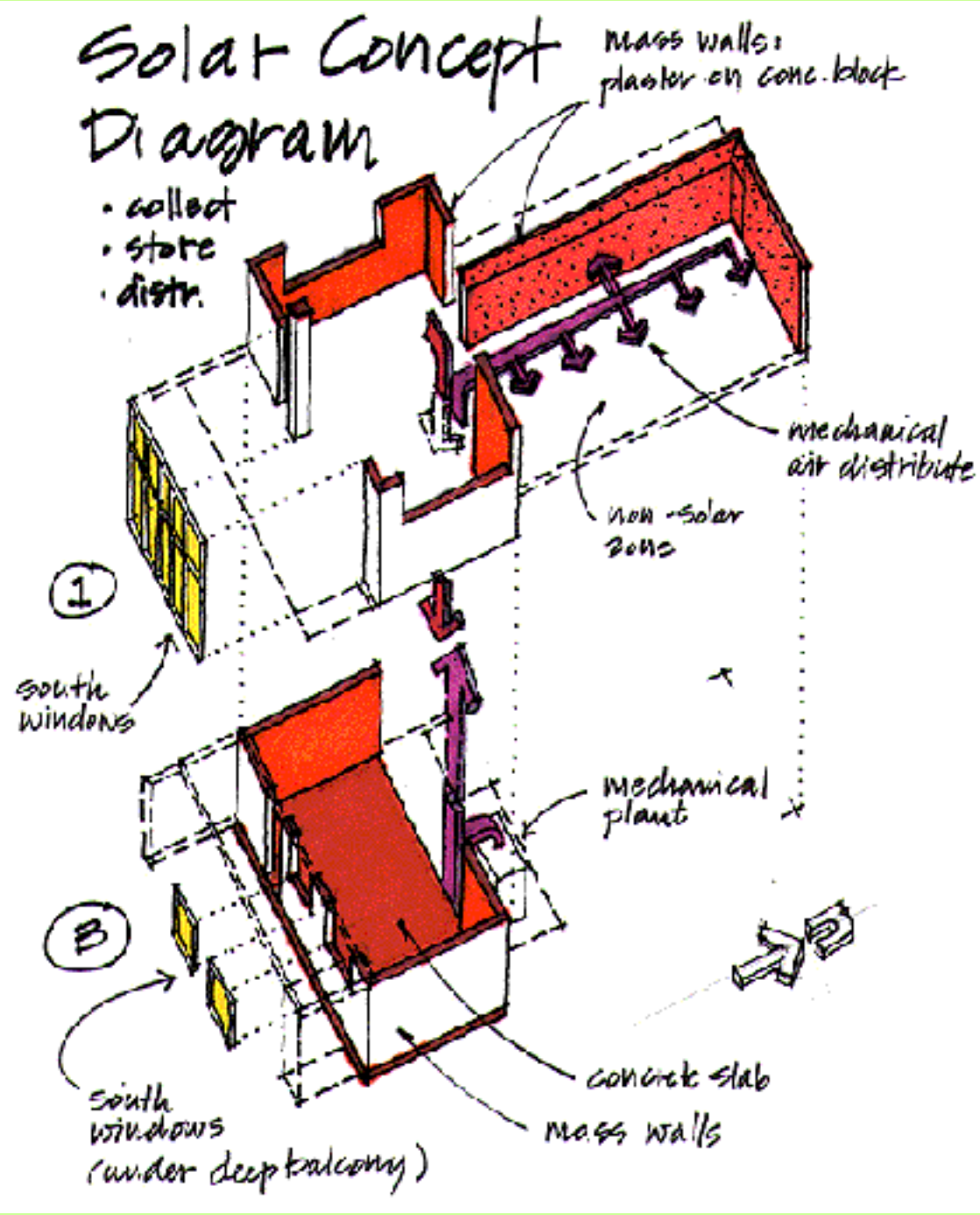
RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

solar concept

3. Diagram the Solar Concept

exercise



Does this Building HAVE a Solar Concept?

As designed, the Shanley building may or may not be considered a solar heated building. Although Armstrong was clearly conscious of many climatic issues of building in the temperate Midwest, it is not clear whether the south-facing glass of the waiting area is intended as a heating strategy, in addition to its architectural and experiential roles. We do know that the architect was later hired by the LOF company to design a solar house to demonstrate its thermopane products.

Part of the exercise will be to determine whether the significant amount of solar energy collected on the south side can be stored in the available mass, and whether its magnitude is enough to offset heat loss through the uninsulated walls and floors.

Solar Zones

This building could be considered to have three distinct solar zones:

1. the basement level
2. the south facing rooms
3. the northern examination wing

The basement is isolated from the upper floor, so it must be heated from windows in its south side. The south facing reception and waiting areas can also be heated via direct gain windows in the south wall. The examination wing, however has neither a direct access to south light nor a spatial connection to sun collecting rooms. It is therefore considered a separate zone. Our redesign of the Shanley Building will have to address the heating of the north wing.

Collection

Large south facing windows run floor to ceiling in the waiting room. Heavy, opaque drapes can be drawn at night to reduce heat loss through the glass. There is more potential collection area in the lower level south windows, but they are shaded by a very large overhang, in the form of the main floor balcony. This factor will have to be accounted for in the shading specification when we get to defining windows in *Energy Scheming*. The examination wing has no south facing windows.

Storage

Solar heat collected from the windows can be stored in the basement level slab and in massive exterior walls that surround the south-facing reception and waiting rooms. These massive elements can be considered in a "solar zone," because they are in rooms that collect sun. The examination wing has a thick mass wall along the west elevation of the corridor. Since the main floor is all wood framed with a wood subfloor and non-massive floor coverings, there is no thermal storage capacity in the main floor. The examination rooms have a thinner, 6" concrete block wall underneath the windows of their east walls. Interior partition walls are constructed of non-massive light framing. The massive elements in the examination wing are considered to be in a "non-solar" zone, because they have no sun collecting apertures. Unfortunately, the walls are uninsulated, so what heat is stored in them from the inside may move quickly via conduction in the direction of the colder outside air.

Distribution

Heat collected from south windows and stored within the room (in the building's structure) is distributed by radiation whenever surfaces or air in the space is at a lower temperature than the mass temperature. Its distribution is quite simple. The examination wing is a more difficult problem. Because no sun is collected there, any excess heat collected by the windows in the south elevation must be moved via the medium of air to the north side of the building. Since the Shanley Building has a "closed" section, with each room an independent cell, thermosiphoning circulation is not possible. However, the building's ducted mechanical system could conceivably be adapted for this purpose. The mechanical plant, including both a boiler and air conditioning system is located in the basement. Vertical chases for supply and return run through the back wall of the waiting area. Horizontal distribution is located in the attic as a simple linear run.

Jump to the next EXAMPLE section: Determine Your Simulation Strategy

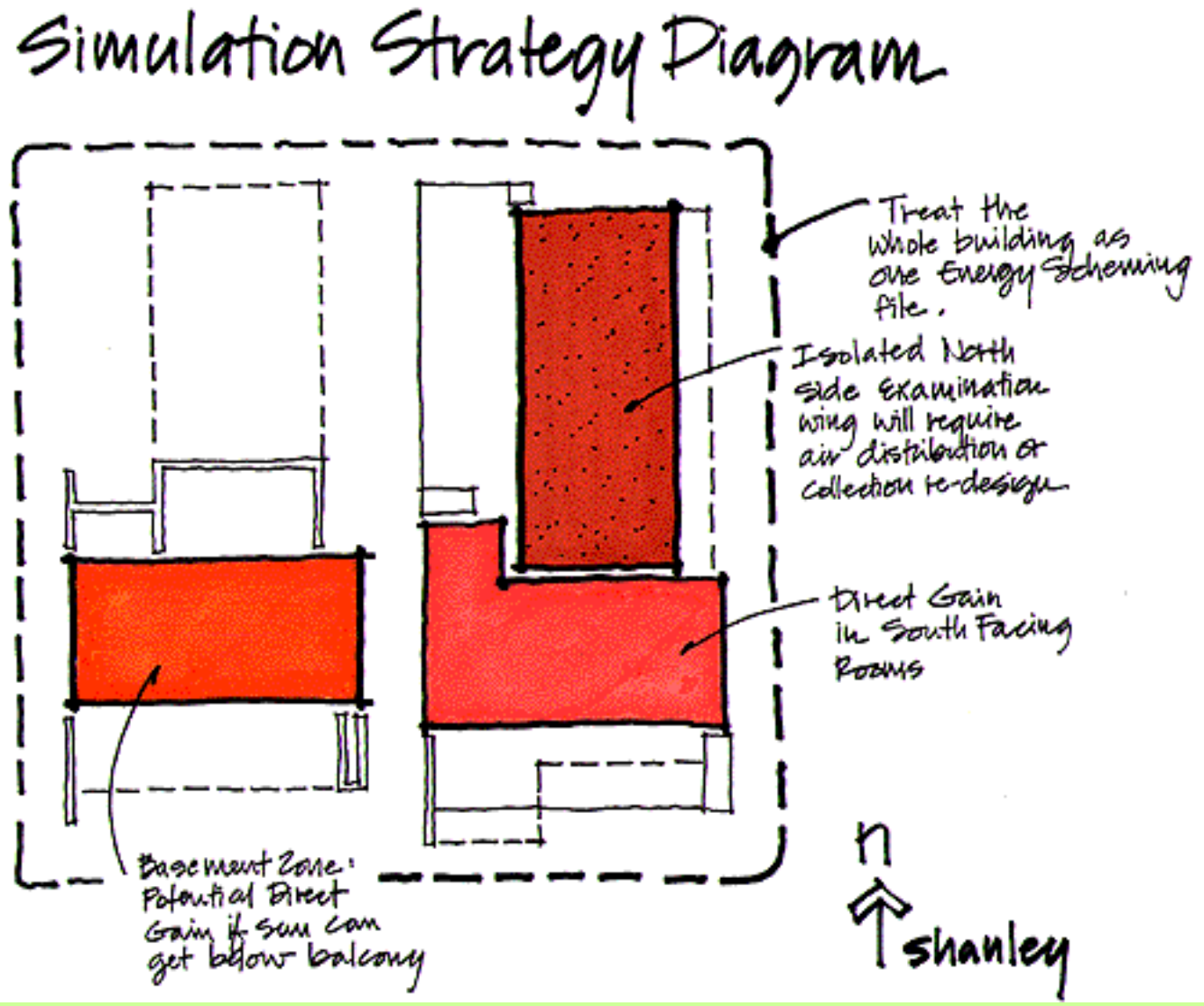
RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

simulation strategy

4. Determine Your Simulation Strategy

exercise



As detailed in the discussion of solar zones in the Solar Concept section, the Shanley Building has three solar zones: the basement level, the south facing rooms on the main floor, and the northern examination wing. Since the building is small and we plan to have a way to solar heat each part, and because the excess warm air from one zone can be redistributed to other zones by fans and ducts, we will analyze the whole building in *Energy Scheming* as a sigle solar zone.

Jump to the next EXAMPLE section: Diagram the Daylighting Zones

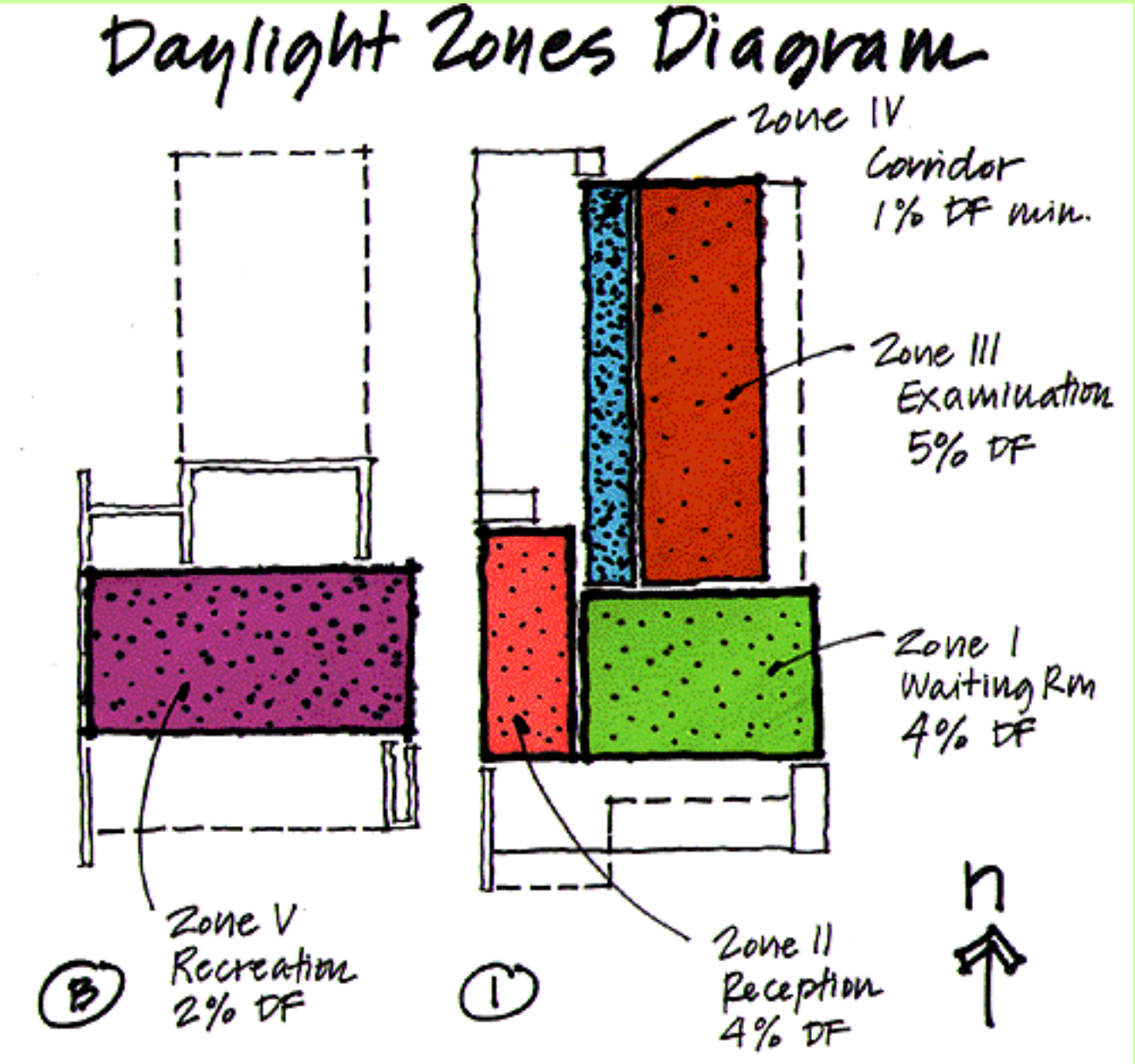
RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

daylight zones

5. Diagram the Daylighting Zones

exercise



The plans for the Shanley Building have been divided into five daylight zones based on the building's organization and the needs for lighting within each zone.

Zone 1:
The waiting room is designed to be the major space of the building, with high ceilings, tall south facing windows, and a significant

east facing window. The intent of the design is to both contrast the closed, mysterious entry sequence, and to give the patients a good view of the city while waiting. Activities are not critical, but would include reading. A 4% DF would provide ample daylight levels for reading and give the desired experience of brightness. Higher DF's may be acceptable in this space, if the thermal issues can be resolved.

Zone 2:
In the reception area, office staff would require a 4% daylight factor, if no significant task lighting is used. If task lighting is used, a lower DF of 2% might be acceptable. Some distinction between light levels in this zone and the adjacent waiting area seems to have been intended by the architect. Lit by west-facing glass block in the original design, afternoon overheating may limit expansion of glazing, if needed.

Zone 3:
The examination rooms would generally benefit from a relatively high level of lighting. Even though intense task lights are used by the dentist, a high level of background illumination might help to reduce the patient's perception of glare causes by the extreme contrast between the examination lighting and the ambient light. Thus, a target of 5% DF has been chosen.

Zone 4:
The corridor space, lit by a thin west-facing strip of glass block has low requirements for lighting intensity. A 1% daylight factor (DF) will be sufficient, but a higher level would be acceptable to ease the transition from the brighter waiting room to the corridor, and back to higher brightness in the examination rooms.

Zone 5:
Many of the original client's patients were children. The recreation room, located at the walk-out basement level, has non-critical tasks. Since it will be harder to light than a similar space entirely above grade, a moderate 2% DF target was chosen.

Jump to the next EXAMPLE section: Get the Drawings into the Computer

RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

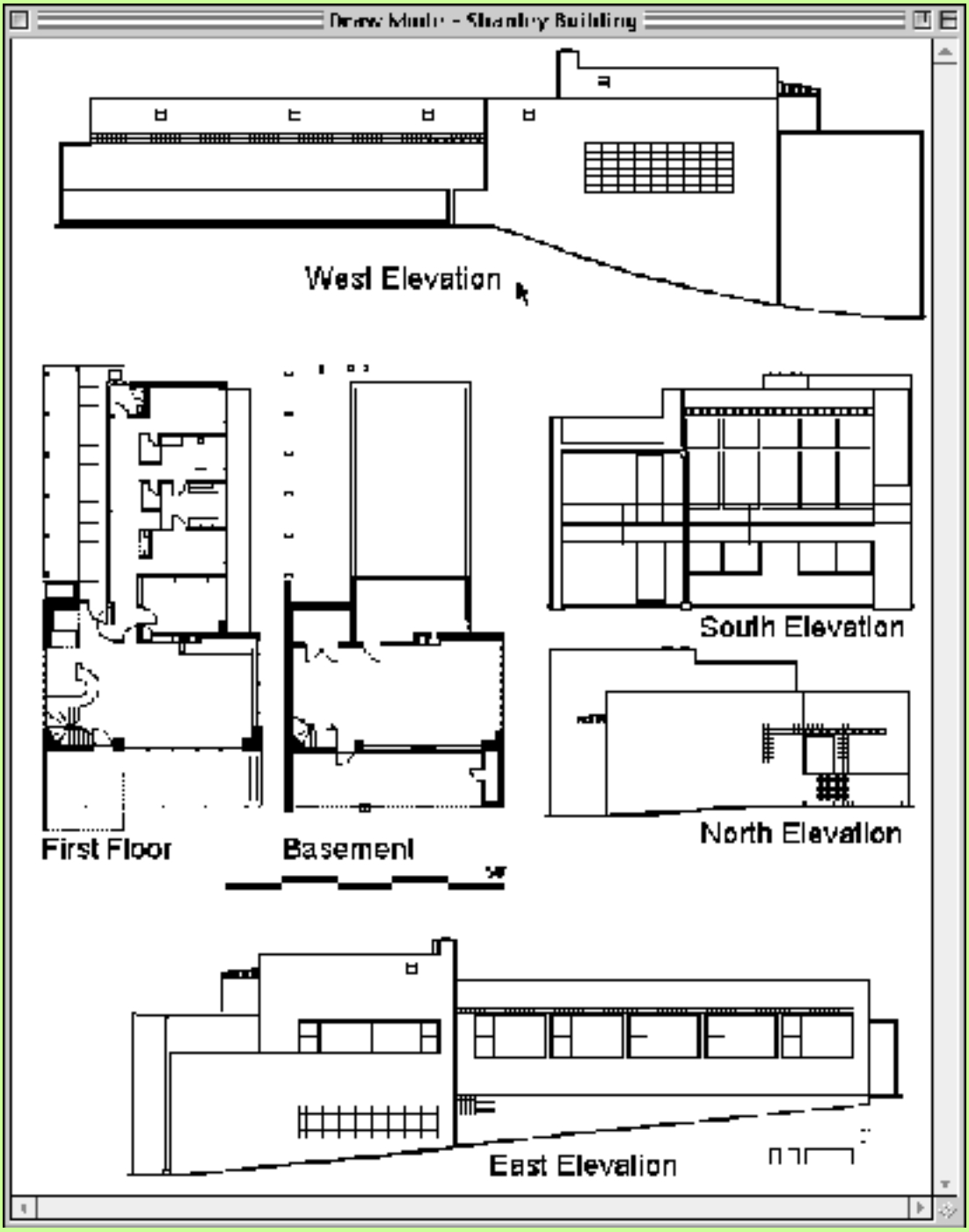
import file

6. Get the Drawings into the Computer

exercise

Here is the Drawing Layer of the Shanley Building Energy Scheming file, above, and the process that we used to create it below. You can click on the image above for a slightly larger full size view.

- **Scanning**
  Hand drawings were scanned into Photoshop, each as a separate Photoshop format (.PSD) file. Since our originals were were high contrast, we scanned them as 'line art" at 150 dpi, full size. Then we tuned them up a little in Photoshop, redrawing some of the fine of lines that got lost in the scanning.
- **Organizing as a Single File**
  When the tune-up was done on each file, which took only a couple of minutes each, we created a new Photoshop file that was 8.5 x 11 inches at 72 dpi. The drawing window is much bigger in Energy Scheming 3.0 and higher, but we wanted to make it easy for you (and us) to print our pages on letter size. If you have a larger or more complex building, you may want to use more of the drawing window. Each drawing was then copied into the new Photoshop file, arranged, and re-scaled until everything fit nicely. Notice that the plans are at one scale and that the elevations are all at a different scale and appear larger. During the process of defining drawings in ES, we will be able to set the scale of each drawing.
- **Saving Back-ups**
  Each file, along with the composite file for importing was saved as a back-up. You never know...
- **Creating a new ES File**



- To import drawings into ES, you need both ES and your source software running at the same time. With the source file open in Photoshop, we created a new, blank ES file, setting climate to St. Louis, Building Type to Non-Residential, and Building Size to 3000 sf.
- **Importing**
  Finally, we copied the composite image from Photoshop and pasted it into Energy Scheming. After positioning the image on the ES drawing window, we clicked outside the dashed selection fence, then saved our new file.
- **Saving an Empty File**
  It is a good idea to save an archive copy of the new ES file before your do any take-offs. You may want to be able to start over on a fresh file at some point in the future.

Jump to the next EXAMPLE section: Create a New Climate

RECYCLING WITH "*ENERGY SCHEMING*": Worked Example

A. DOCUMENTING: input your building

create a climate

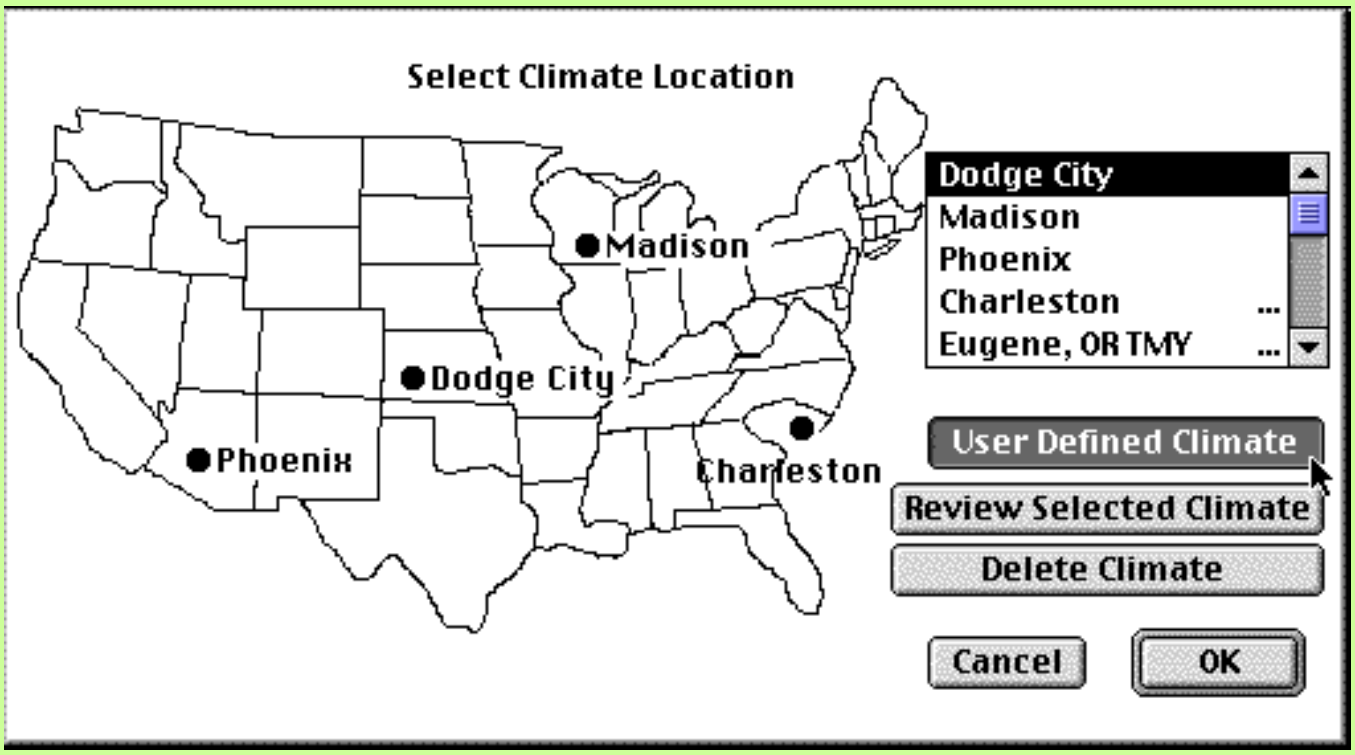
7. Create a New Climate, if necessary

exercise

Since we were using a new version of Energy Scheming to work this example, we needed to create a new climate for St. Louis, MO. The Shanley Building is located in Clayton, MO, a suburb of St. Louis and the region's first "edge city." Luckily, we were able to use one of the Climate Data pages included in the database on this web site. The Architecture + Energy Project has collected climate data for representative sites throughout the continental U.S., Alaska, Hawaii, and a few of the U.S. possessions.

To find information about your climate, you can start with the main Climate page. Or, you can select from a list of cities for which ES climate data has been collected on the Climate Data for Energy Scheming page. Following the links, we started with the ES climate data for St. Louis. Because once one begins the process of inputting new climate data, one can not switch out of ES to go to another software, we printed the St. Louis ES climate data, so we would have it as a reference.

Since St. Louis has been used as the example climate, you can get to the pages for how to Create a New Climate for a full detailed explanation of the procedure. To go there, click on the button for "User Defined Climate" in the image below.



This is the last section of this part of the example. Return to the outline for more.

Return to the EXAMPLE OUTLINE

RECYCLING WITH *ENERGY SCHEMING:*
Download Exercise and Example

Download the execise and example
The flowing links download a PDF version of the exercise and the example.

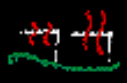
- to download the files mouse click once on the links below
- to download all parts at once click here **(RECYCLING WITH *ENERGY SCHEMING* 3.2MB)zipped**
- to download a copy of AdobeReader follow the following link

A. DOCUMENTING: input your building — .5MB zipped

B. DEFINING: take-offs and specifications — 1.2MB zipped

C. ANALYZING: understanding energy patterns — .5MB zipped

D. RE-DESIGNING: 'generate and test' cycles — .5MB zipped



E. EVALUATING: energy codes as indicators — .8MB zipped