

A PC Program



RESFEN6

for Calculating the Heating and Cooling Energy Use of Windows in Residential Buildings

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This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology, State and Community Programs, Office of Building Systems of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

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RESFEN6: Program Description

A PC Program for Calculating the Heating and Cooling Energy Use of Windows
in Residential Buildings

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December 2012

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This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology, State and Community Programs, Office of Building Systems of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

TABLE OF CONTENTS

1. INTRODUCTION	1-1
1.1. Overview	1-1
2. QUICK START	2-1
3. INSTALLATION	3-5
3.1. Hardware Requirements	3-1
3.2. Setup.....	3-1
3.3. Running RESFEN5.....	3-8
3.5. Uninstalling RESFEN	3-10
3.6. Troubleshooting.....	3-13
4. PROGRAM DESCRIPTION	4-1
4.1. Overview	4-1
4.2. Steps to complete a RESFEN run.....	4-2
4.3. Toolbar	4-2
4.4. Menus.....	4-2
4.4.1. File	4-2
4.4.2. Edit	4-6
4.4.3. Record	4-6
4.4.4. Libraries	4-6
4.4.5. View	4-7
4.4.6. Options.....	4-7
4.4.7. Help	4-9
4.5. Libraries in General	4-10
4.5.1. List and Detail Views	4-10
4.5.2. Selecting Records from Libraries.....	4-11
4.5.3. Moving Between Records in Detail View	4-11
4.5.4. Creating New Records	4-13
4.6. House Library	4-16
4.6.1. House Library List View	4-16
4.6.2. House Library Detailed View	4-17
4.6.3. Whole House.....	4-27
4.8. Location Library	4-31
4.8.1. Location Library List View.....	4-31
4.8.2. Location Library Detail View	4-32
4.8.3. Location Databases	4-33
4.9. WIndow Library	4-34
4.9.1. Window Library List View	4-34
4.9.2. Window Library Detail View	4-38
4.10. Package Library	4-40
4.10.1. Package Library List View	4-41

4.10.2. Packages Library Detail View	4-42
4.11. Results Library	4-45
4.11.1. Results Library List View	4-45
4.11.2. Results Library Detail View	4-47
4.12. Electric Rate Library	4-48
4.12.1. Electric Rate Library List View	4-48
4.12.2. Electric Rates Library Detail View	4-50
4.13. Gas Rates Library	4-51
4.13.1. Gas Rates Library List View	4-51
4.13.2. Gas Rates Library Detail View	4-52

5. TECHNICAL REFERENCE 5-1

6.1. Location Library Data	5-1
6.2. RESFEN Modeling Assumptions	5-8
6.3. Simulation Envelope Insulation Values	5-11
6.4. Using WINDOW5 DOE2 Input File for RESFEN Calculations	5-12
6.5. RESFEN Window Library Documentation	5-13
6.6. Resources	5-16
6.6.1. Books	5-16
6.6.2. Organizations	5-16
6.7. References	5-17

6. ACKNOWLEDGEMENTS 6-1

1. INTRODUCTION

1.1. Overview

Today's energy-efficient windows can dramatically lower the heating and cooling costs associated with windows while increasing occupant comfort and minimizing window surface condensation problems. However, consumers are often confused about how to pick the most efficient window for a residence. Product information typically offers window properties: U-factors or R-values, Solar Heat Gain Coefficients or Shading Coefficients, and air leakage rates. However, the relative importance of these properties depends on site- and building-specific conditions. Furthermore, these properties are based on static evaluation conditions that are very different from the real situation a window will be used in.

A computer tool such as RESFEN can help consumers and builders pick the most energy-efficient and cost-effective window for a given application, whether it is a new home, an addition, or a window replacement. It calculates heating and cooling energy use and associated costs as well as peak heating and cooling demand for specific window products. Users define a specific "scenario" by specifying house type (single-story or two-story), geographic location, orientation, electricity and gas cost, and building configuration details (such as wall, floor, and HVAC system type). Users also specify size, shading, and thermal properties of the window they wish to investigate. The thermal properties that RESFEN requires are: U-factor, Solar Heat Gain Coefficient, and air leakage rate. RESFEN calculates the energy and cost implications of the window compared to an insulated wall. The relative energy and cost impacts of two different windows can be compared.

Table 6-2 lists the input assumptions used in RESFEN 6

Update information, future releases, and program information about RESFEN and other software tools (such as WINDOW, THERM, and Optics) from the Windows and Daylighting Group at LBNL can be found at: <http://windows.lbl.gov>, in the Software section.

1.2. Changes from RESFEN 5

The primary difference between RESFEN 5 and RESFEN 6 is modeling assumption changes to match those that were used for the Energy Star 2008 work done by LBNL.

2. QUICK START

To get started with RESFEN, do the following:

- Install the RESFEN program (see Chapter 3, "Installation").
- When the program is installed, **double click** on the RESFEN icon.

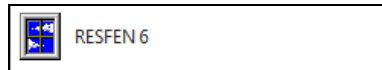


Figure 2-1. Click on the RESFEN icon in the Programs/LBNL Software list.

- The program will open with the default database, called RESFEN6.mdb.
- Change any input values that are not correct for the case you wish to model. For example, you can change the location to another city, change the HVAC system type, or input another window type. When you change an input value, the **Calculate** button becomes active and the values in the **Results** tabs are set to zero.

When RESFEN starts, it opens the input file database, called **RESFEN6.mdb**.

The screenshot shows the RESFEN software interface with the following sections:

- House Data:**
 - ID#: 1 - Miami - Double Clear
 - Name: Miami - Double Clear
 - Location: FL Miami
 - House Type: 1-Story New Frame
 - HVAC System Type: Gas Furnace / AC
 - Floor Area: 1700 ft²
 - Envelope Package: IECC06 Zone 01
 - Foundation Type: Slab-On-Grade
 - Electric Cost: Florida, 0.087 \$/kWh
 - Gas Cost: Florida, 1.711 \$/Therm
 - Description: Example #1 - Case A
- Window Data:**

Window Type	Area ft ²	U-factor Btu/h-ft ² -F	SHGC	Air Leakage cfm/ft ²	Solar Gain Reduction
North: User defined	63.75	0.35	0.6	0.3	Typical
East: User defined	63.75	0.35	0.6	0.3	Typical
South: User defined	63.75	0.35	0.6	0.3	Typical
West: User defined	63.75	0.35	0.6	0.3	Typical
Skylight: User defined	0	0	0	0	None

☑ East, South and West windows are the same type as North

Total Window Area: 255 ft² 15.0% of floor area
- Whole House:**

	Heating	Cooling	Total (source)
Annual Energy Totals	0.1 MBTU	4496 KWH	46.1 MBTU
Annual Energy per ft ²	0.1 kBTU/ft ²	2.64 KWH/ft ²	27.1 kBTU/ft ²
Peak	16.6 kBTU/hr	1.94 KW	
Cost \$	1.47	391.15	392.62

Annotations in the image:

- Arrow pointing to the top of the window: "When RESFEN starts, it opens the input file database, called **RESFEN6.mdb**."
- Arrow pointing to the input fields: "Change the values in any of these input boxes to model your specific situation."
- Arrow pointing to the results section: "When you change input values, the results boxes will be reset to '0', until you recalculate the results."

Figure 2-2. Change input values as needed for your building.

You can change the **Window Data** section either by entering all the values for each orientation by hand or by picking windows from a library of predetermined generic window products created with the WINDOW software. This library contains values for typical casement windows, but these values can be used for sliders and fixed windows because their properties are essentially the same. See Section 6.5, "Making Custom WINDOW Libraries" for detailed information about making your own libraries.

Type the total area of all windows on each of the four cardinal orientations into the Window input boxes.

Input the infiltration value (**Cfm/ft²**) for the window you are analyzing (the program defaults to 0.3 cfm/t2).

Select the Window Type by either:

- Clicking on the pulldown arrow to show the list from the Window Library

Window Type

1010: 1 - 101 - AL 1 Clr
1020: 2 - 102 - AL 1 Bron
1110: 3 - 111 - AL 2 Clea
1120: 4 - 112 - AL 2 Bron
1130: 5 - 113 - AL 2 SS T
1210: 6 - 121 - AL 2 PY L
1310: 7 - 131 - AL 2 SP L
1410: 8 - 141 - AL 2 SS L
1710: 37 - 171 - AL 2 SS
2010: 9 - 201 - ATB 1 Clr

OR

- Click on the double arrow button to the right of the pulldown list to show more details from the Window Library list.

Highlight a window from the library, and click on the OK button to select it.

The values for **U-factor** and **SHGC** will automatically update to the values of the selected window.

Window Data

Window Type	Area ft ²	U-factor Btu/h-ft ² -F	SHGC	Air Leakage cfm/ft ²	Solar Gain Reduction
North 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
East 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight User defined	0.	0.	0.	0.	None

☒ East, South and West windows are the same type as North

Total Window Area 255 ft² 15.0% of floor area

Window List

ID	Name	Ufactor Btu/h-ft ² -F	SHGC	Area ft ²	Width inches
1010	1 - 101 - AL 1 Clr	1.159	0.756	9.7	24.00
1020	2 - 102 - AL 1 Bronze	1.159	0.647	9.7	24.00
1110	3 - 111 - AL 2 Clear	0.762	0.675	9.7	24.00
1120	4 - 112 - AL 2 Bronze	0.762	0.562	9.7	24.00
1130	5 - 113 - AL 2 SS Tint	0.762	0.469	9.7	24.00
1210	6 - 121 - AL 2 PY Low-E	0.613	0.635	9.7	24.00
1310	7 - 131 - AL 2 SP Low-E	0.595	0.528	9.7	24.00
1410	8 - 141 - AL 2 SS Low-E	0.583	0.364	9.7	24.00
1710	37 - 171 - AL 2 SS Ultra Low	0.580	0.237	9.7	24.00

OK Cancel

Figure 2-3. Use the Window library to select windows for your building.

Press the **Calculate** button -- the single lightning bolt calculates only **Whole House** results, and the double lightning bolt calculates both **Whole House** and **Window Orientation** results.

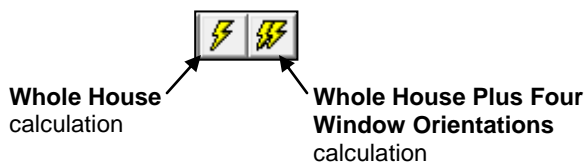


Figure 2-4. There are two calculation options, accessed with the lightning bolt toolbar buttons.

- An hourly simulation using the DOE2 calculation engine will be performed, which may take a few seconds for the **Whole House** only calculation, or somewhat longer for the **Whole House + 4 Orientations** calculation, depending on the speed of your computer. When the calculation is finished, the values in the **Results** tabs will be updated.



The **Whole House** calculation the total annual energy consumption for the entire building, including conduction gains and losses from windows, walls, roof and foundations.

Whole House			
	Heating	Cooling	Total (source)
Annual Energy Totals	98.4 MBTU	1638 KWH	115.2 MBTU
Annual Energy per ft2	35.1 kBTU/ft2	0.58 KWH/ft2	41.1 kBTU/ft2
Peak	87.1 kBTU/hr	3.40 KW	
Cost \$	850.25	124.49	974.74

The **Whole House + 4 Orientations** calculation



produces results for the Whole House as well as the four window orientations, which are displayed on the **Window Annual Energy**, **Window Energy Cost**, and **Window Peak Energy** tabs. The results for the four window orientations are relative to a standard insulated wall for each orientation.

Whole House Window Annual Energy Window Energy Cost Window Peak Energy			
	Heating	Cooling	Total (source)
Annual Energy Totals	98.4 MBTU	1636 KWH	115.2 MBTU
Annual Energy per ft2	35.2 kBTU/ft2	0.58 KWH/ft2	41.1 kBTU/ft2
Peak	87.1 kBTU/hr	3.40 KW	
Cost \$	850.53	124.34	974.87

Figure 2-5. The two calculation options are used to calculate different types of results.

3. INSTALLATION

3.1. Hardware Requirements

First, make sure your computer system meets these specifications:

- At least 16 MB of random access memory (RAM), configured as extended memory. 32 MB of RAM is preferred for optimum operation.
- Microsoft Windows XP™, Windows Vista™ or Windows 7™.
- Hard disk drive with at least 100 megabytes of available disk space.
- Monitor and mouse.

3.2. Setup

The installation program can be downloaded from the LBNL website at <http://windows.lbl.gov/software/resfen/resfen.html>

The first step is to uninstall any previous versions of the RESFEN 6 program. However, RESFEN 5 can remain on your computer and does not have to be uninstalled.

Once you have downloaded the installation program (RESFEN60SetupFull.exe), follow these steps to install the program:

1. Using Windows Explore, browse to where the installation file was downloaded and double click on it.

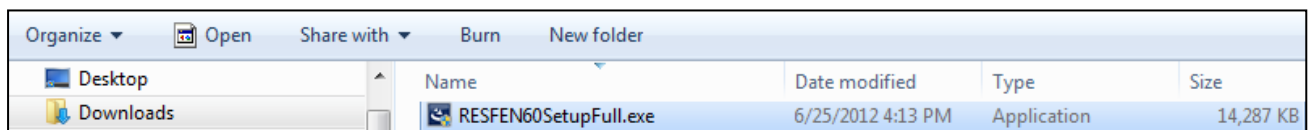


Figure 3-1. Double click on the downloaded installation file.

- The initial RESFEN **Preparing Setup** window will appear..

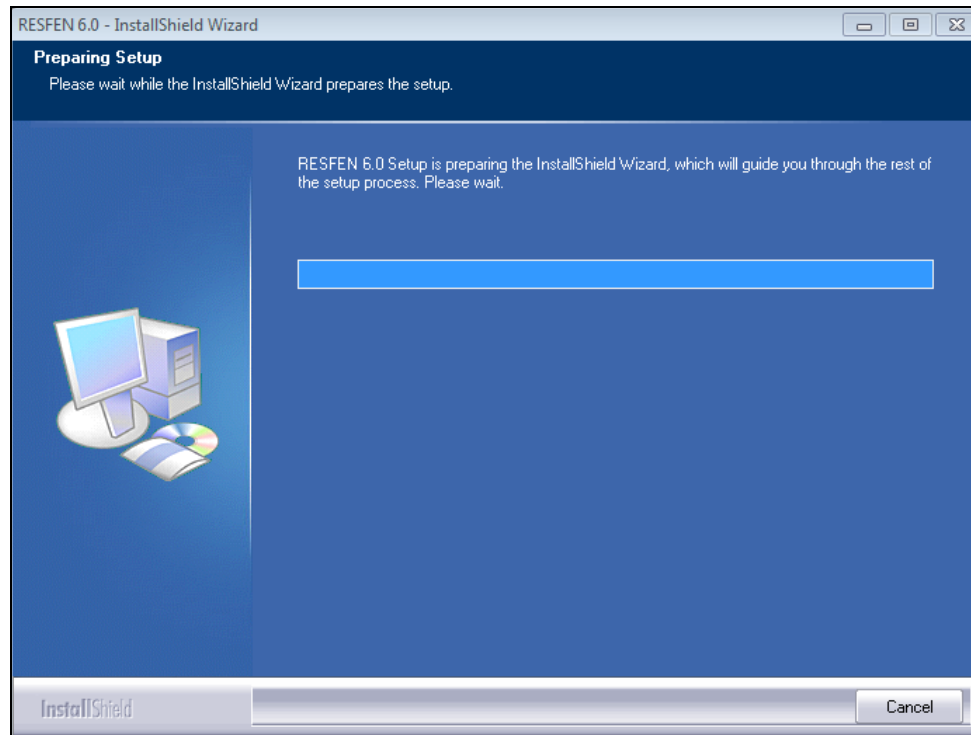


Figure 3-2. The initial RESFEN Setup window.

- When the initial **Setup** window has finished, a **Welcome** window will display. Click the **Next** button to proceed with the installation, or **Cancel** to stop.

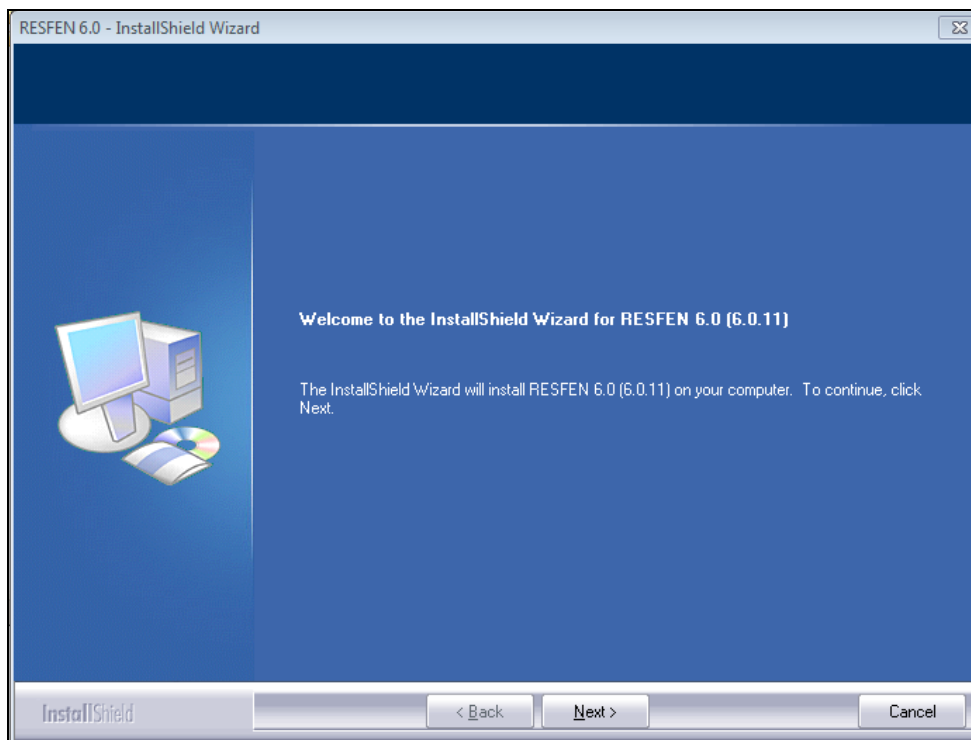


Figure 3-3. The RESFEN Welcome screen.

4. The **Software License Agreement** window will display next. Read through the license and make sure you agree to all the terms before proceeding. To proceed with the installation, click on the **Yes** button, or click on **No** to stop.

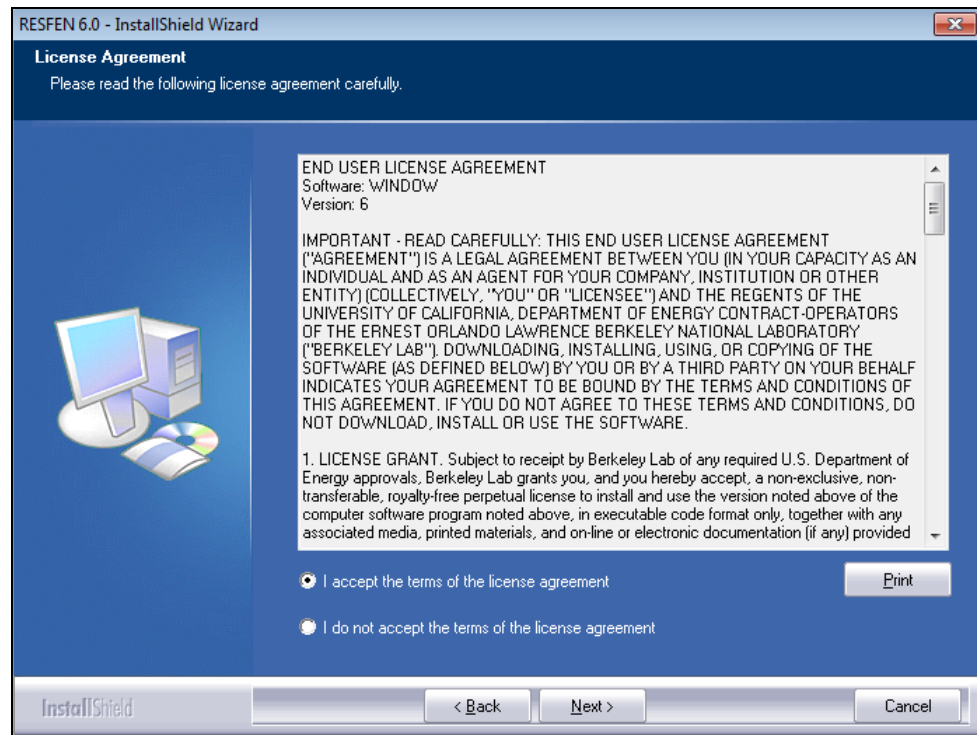


Figure 3-4. The RESFEN License Agreement screen.

5. The **Ready to Install the Program** window will display next. The directory where the program will be installed will depend on your operating system:

- XP:
 - Program Directory (RESFEN6.exe):
c:\Program Files\LBNL\RESFEN6
 - User Directory (all other RESFEN files):
c:\Documents and Settings\\LBNL\RESFEN6
- Windows 7 / Vista
 - Program Directory (RESFEN6.exe):
c:\Program Files(x86)\LBNL\RESFEN6
 - User Directory (all other RESFEN files):
c:\Users\Public\LBNL\RESFEN6

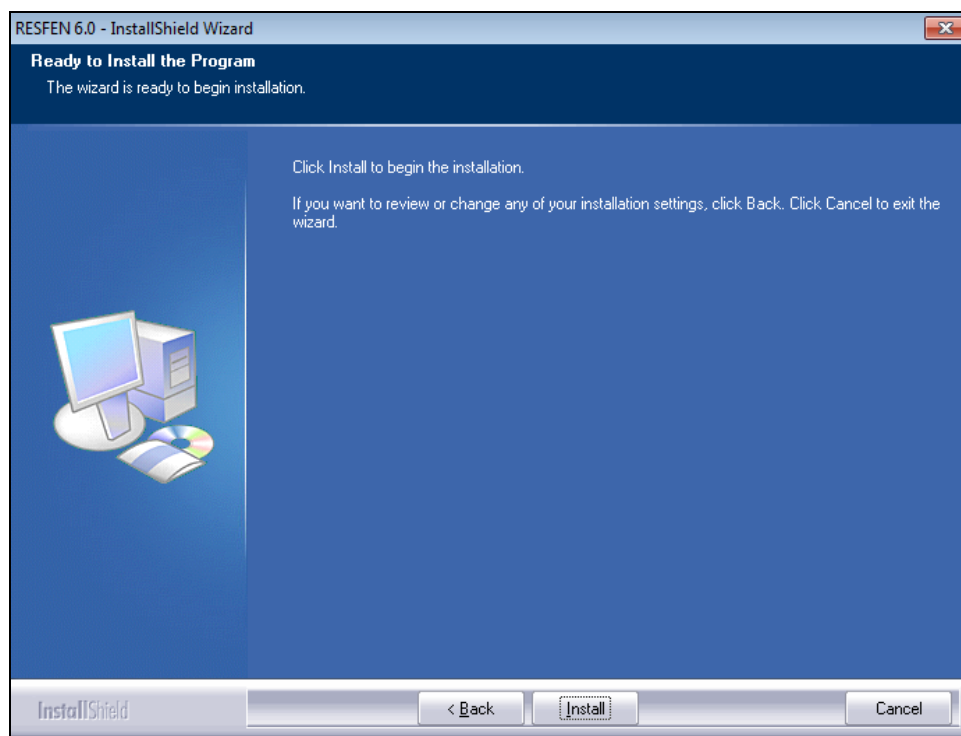


Figure 3-5. *Ready to Install the Program* screen.

6. The **Setup Status** screen will appear, and the program files will automatically be copied into the appropriate directories.

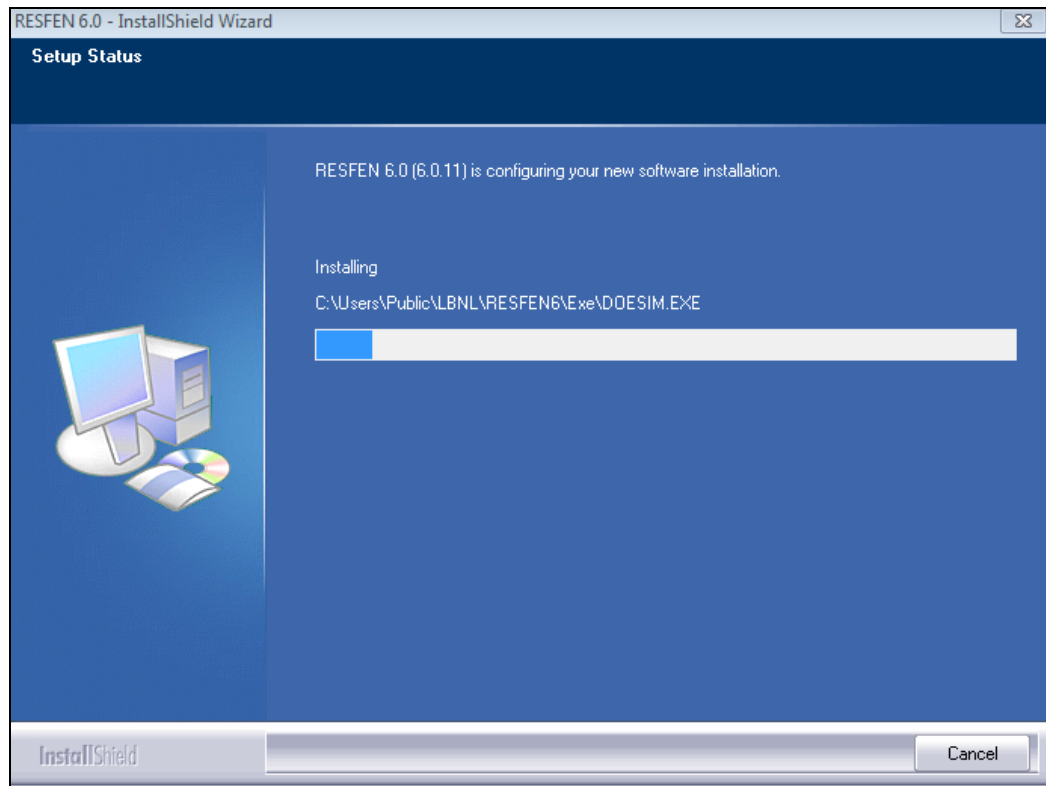


Figure 3-6. Setup will decompress and copy the program files into the specified destination directory.

7. When the installation is complete, the **InstallShield Wizard Complete** screen will be displayed. Press **Finish** to finalize the installation.

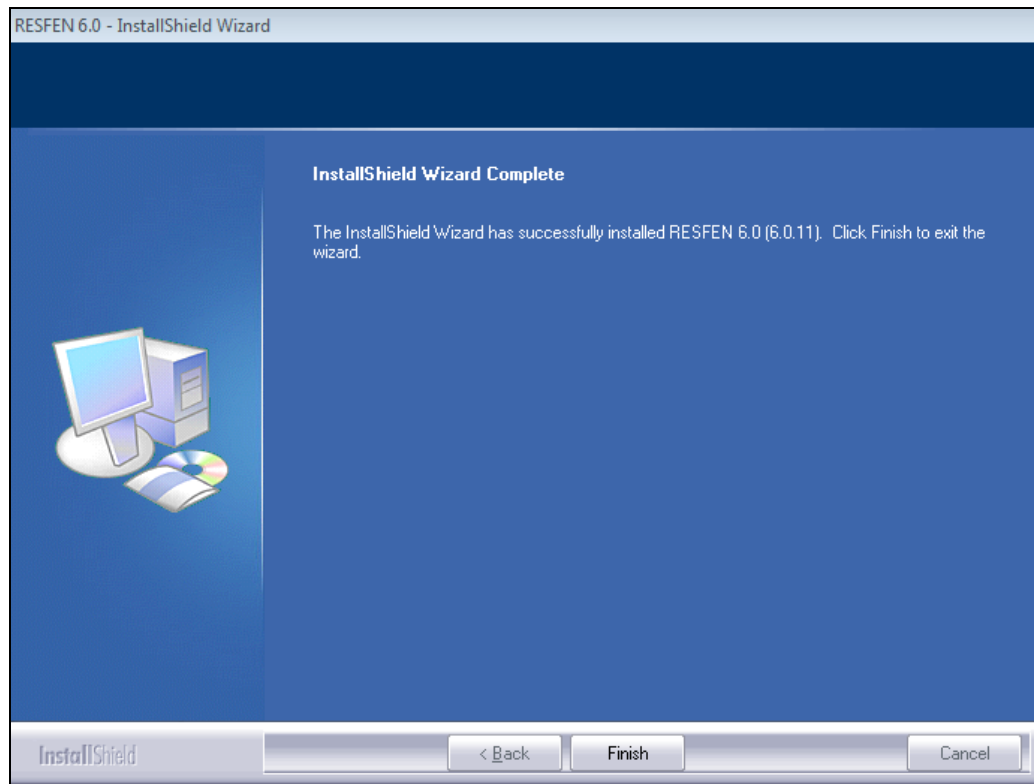


Figure 3-7. The **InstallShield Wizard Complete** screen will display when the installation is finished. Press the **Finish** button to finalize the installation.

8. Setup will automatically put a RESFEN Icon in the **Programs** menu under the **LBNL Software** group, accessed from the **Start** button.

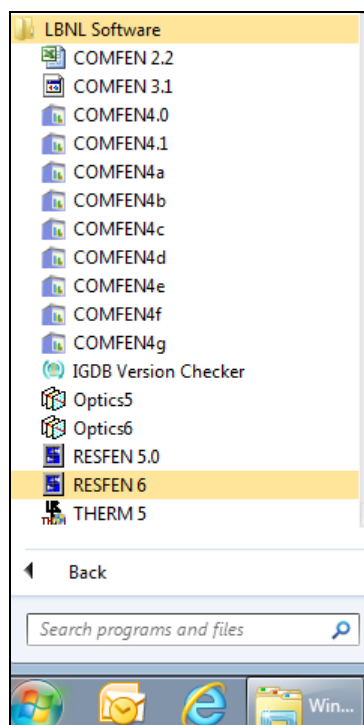


Figure 3-8. Program icon to run RESFEN.

3.3. Running RESFEN

To run RESFEN, click on the **RESFEN 6** icon:

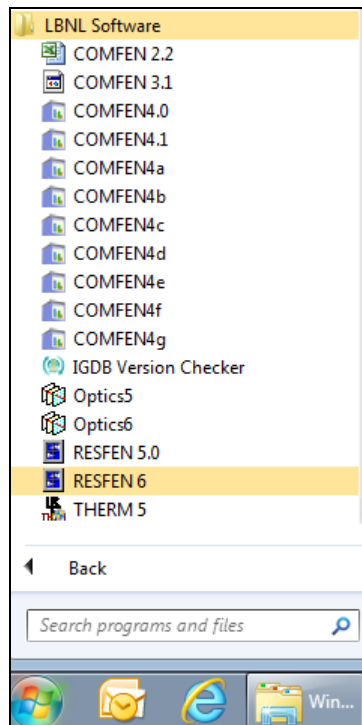


Figure 3-9. Click on Start / Programs / LBNL Software / RESFEN 3.1

The main program screen appears and starts by opening the default RESFEN database, called “RESFEN6.mdb”, as shown below.

House Data

ID# 1 - Miami- Double Clear

Name Miami- Double Clear

Location FL Miami

House Type 1-Story New Frame

HVAC System Type Gas Furnace / AC

Floor Area 1700. ft2

Envelope Package IECC06 Zone 01

Foundation Type Slab-On_Grade

Set to Defaults

Electric Cost Florida 0.087 \$/kWh

Gas Cost Florida 1.711 \$/Therm

Description Example #1 - Case A

Window Data

Window Type	Area ft2	U-factor Btu/h-ft2-F	SHGC	Air Leakage cfm/ft2	Solar Gain Reduction
North 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
East 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight User defined	0.	0.	0.	0.	None

☒ East, South and West windows are the same type as North

Total Window Area 255 ft2 15.0% of floor area

Whole House

	Heating	Cooling	Total (source)
Annual Energy Totals	0.3 MBTU	5064 KWH	52.2 MBTU
Annual Energy per ft2	0.2 kBTU/ft2	2.98 KWH/ft2	30.7 kBTU/ft2
Peak	25.1 kBTU/hr	2.29 KW	
Cost \$	5.46	440.57	446.03

*Results are based on a non-standard DOE-2 template file:
C:\Users\Public\LBNL\RESFEN6\data\RESFEN6template.d2

For Help, press F1

Figure 3-10. Main RESFEN screen.

3.4. Uninstalling RESFEN

If you need to uninstall RESFEN, follow the steps below.

1. Go to the Control Panel and find the Add/Remove Programs choice (exactly where this is will depend on your computer's operating system).

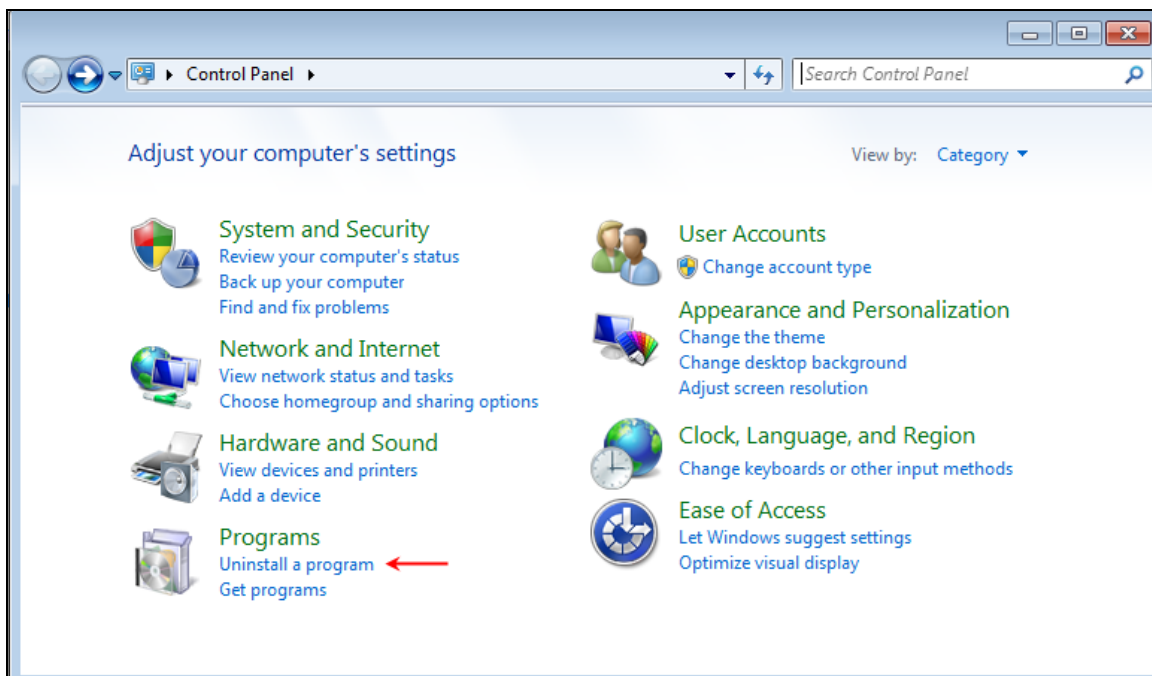


Figure 3-11. Go to the Control Panel and find the choice to Uninstall a Program.

2. Select RESFEN5 from the list of currently installed programs and click on the Change/Remove button.

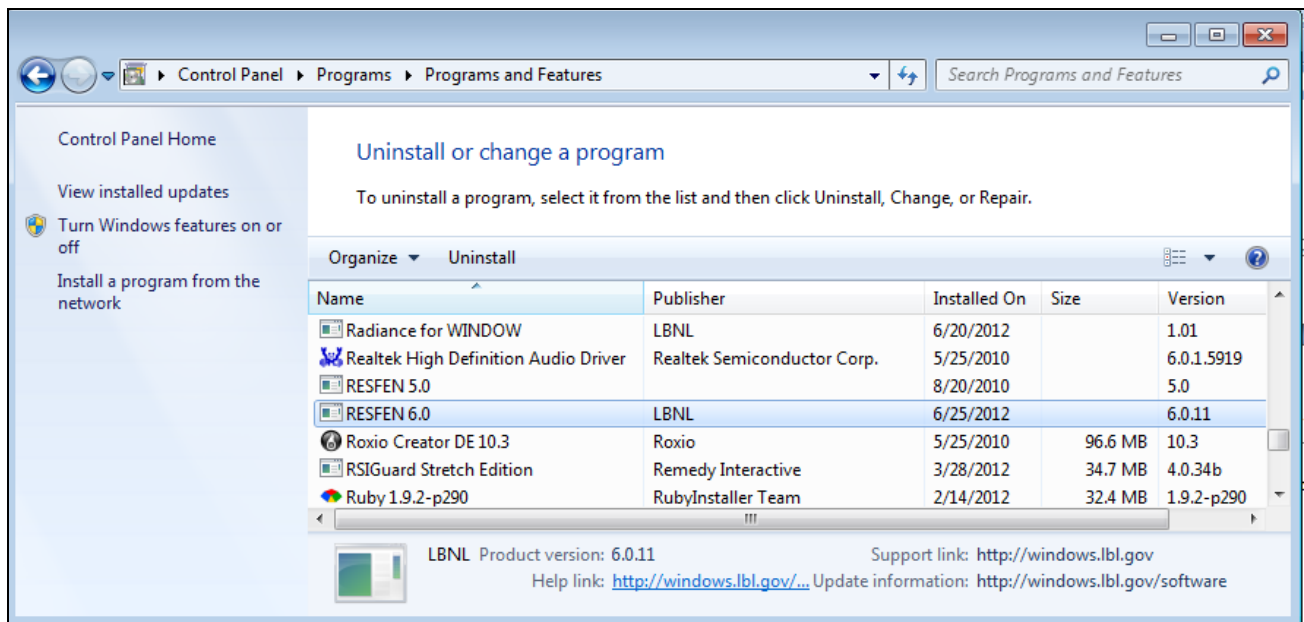


Figure 3-12. Select RESFEN5 from the list of currently installed programs.

3. The **Preparing Setup** screen appears.

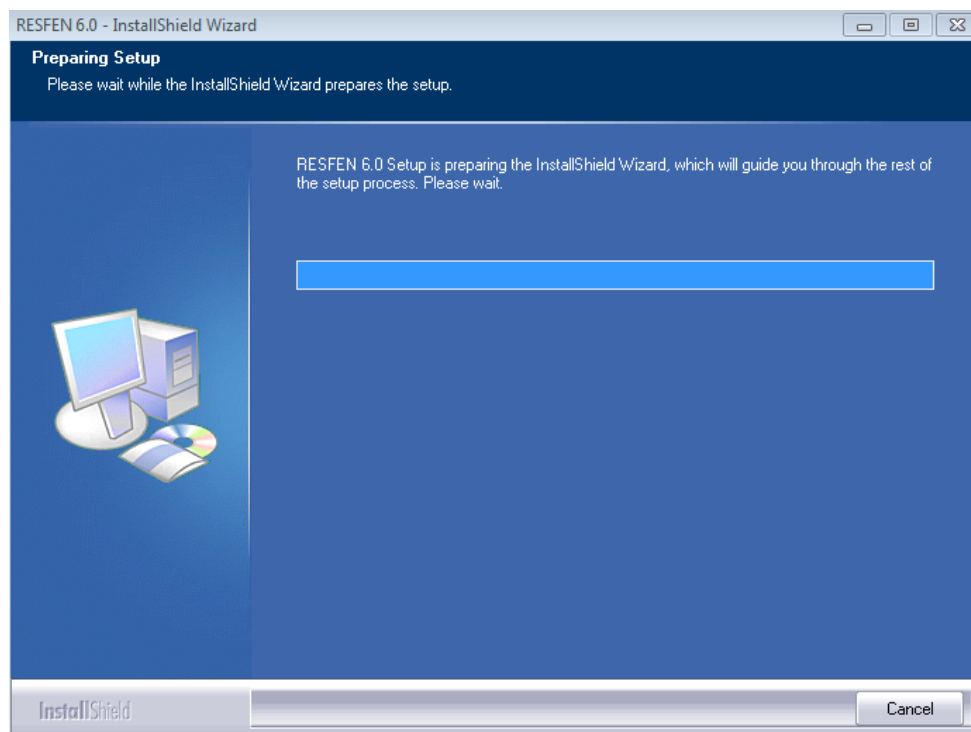


Figure 3-13. The **Preparing Setup** screen appears.

4. A dialog box appears asking if you want to remove the program. Click the Yes button

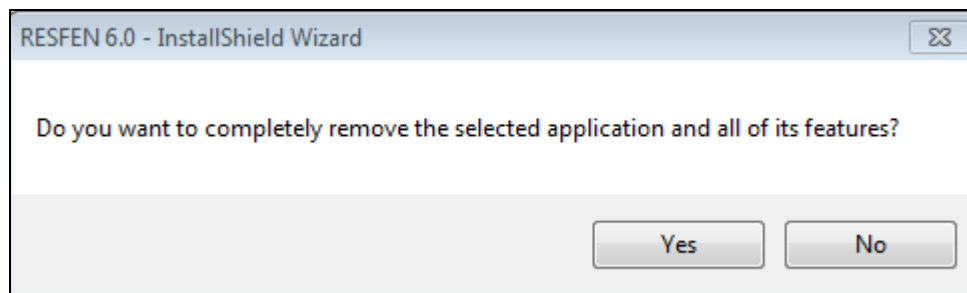


Figure 3-14. The *Preparing Setup* screen appears.

5. When the program is completely removed, the **Uninstall Complete** screen appears. Click the Finish button to complete the uninstall.

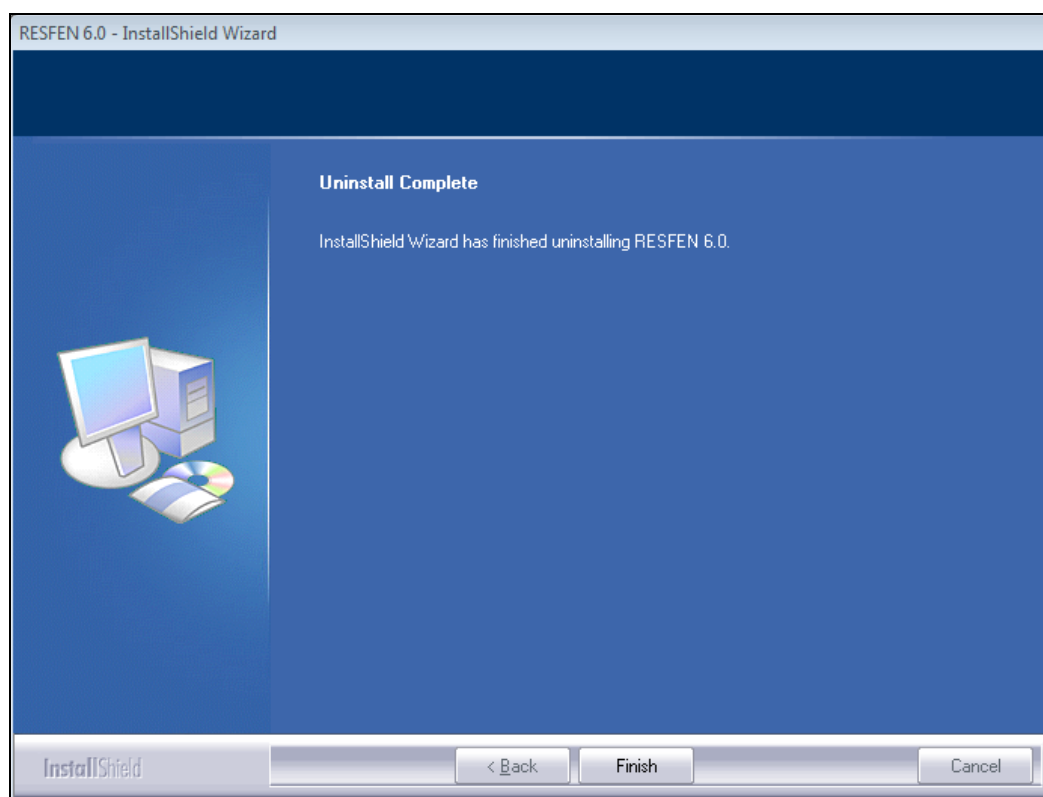


Figure 3-15. The *Uninstall Complete* screen.

6. The uninstall will delete files in the Program Files directory, but it will not delete files in your user directory.

3.5. Troubleshooting

Please send E-mail to RESFENhelp@lbl.gov if you have any trouble running the program.

4. PROGRAM DESCRIPTION

4.1. Overview

RESFEN is a program with a simple user interface, shown in Figure 4-1, tied to a powerful analytical tool, DOE-2E (Lawrence Berkeley Laboratory, 1998). The RESFEN default screen which opens when the program starts is the House Library Detailed View, which has several components:

- Main Menu
- Toolbar
- House Data input section
- Window Data input section
- Results section

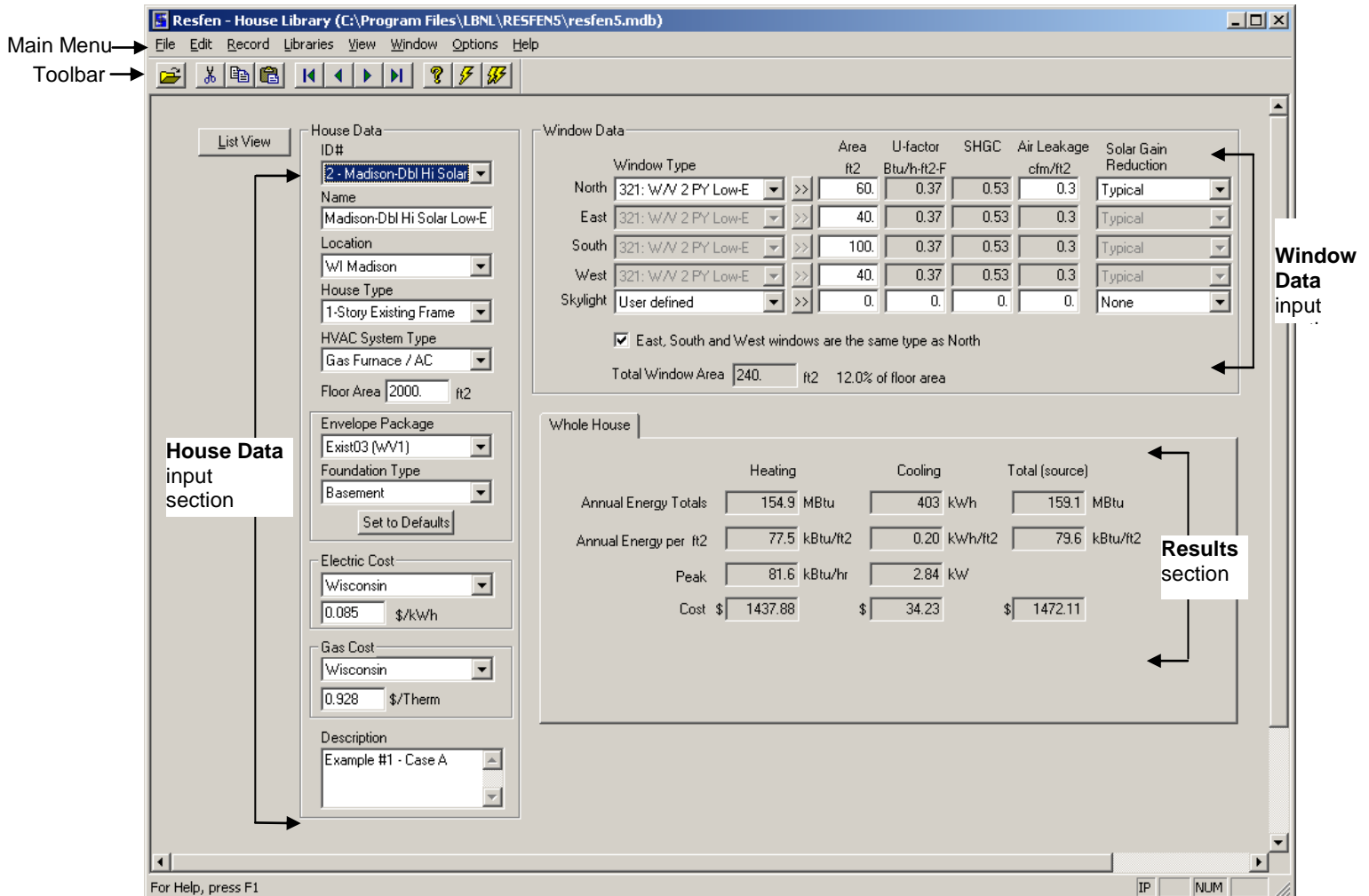


Figure 4-1. Components of the RESFEN House Library Screen

4.2. Steps to complete a RESFEN run

The primary steps to complete a RESFEN calculation are:

- Describe the building configuration by entering the appropriate input values in the **House Data** section
- Describe the windows in the building by entering the appropriate input values in the **Window Data** section
- Click on one of the lightning bolt tool buttons to do either a **Whole House** or **Whole House + 4 Orientations** calculation.
- View the answers in the **Results** section when the simulation has finished.

The following sections of this chapter describe the program in detail.

4.3. Toolbar

RESFEN has a toolbar with buttons for the most commonly used functions, shown below.

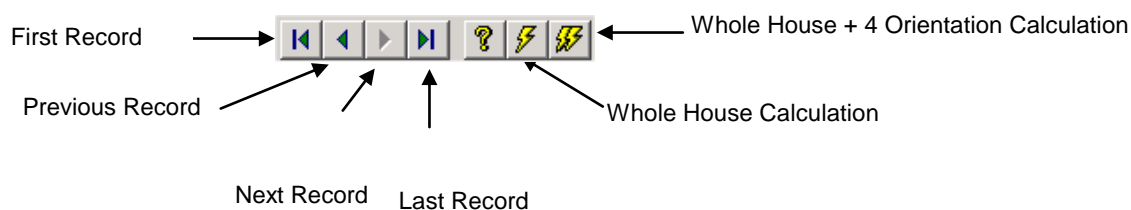


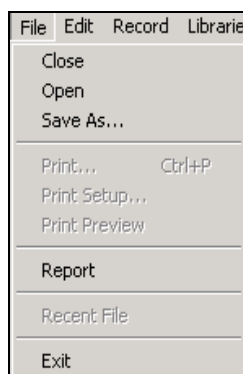
Figure 4-2. Toolbar

4.4. Menus

Each menu can be accessed with the mouse, by pointing and clicking on the menu choice, or with the keyboard, by pressing the **Alt** key and then typing the first letter of the menu name. For example, **Alt-F** would access the **File** menu. To select a menu choice, you can click on the choice with your mouse, type the underlined character of each menu choice, or use the **Up** and **Down** arrow keys. Keyboard shortcuts are indicated to the right of the menu item when available.

4.4.1. File

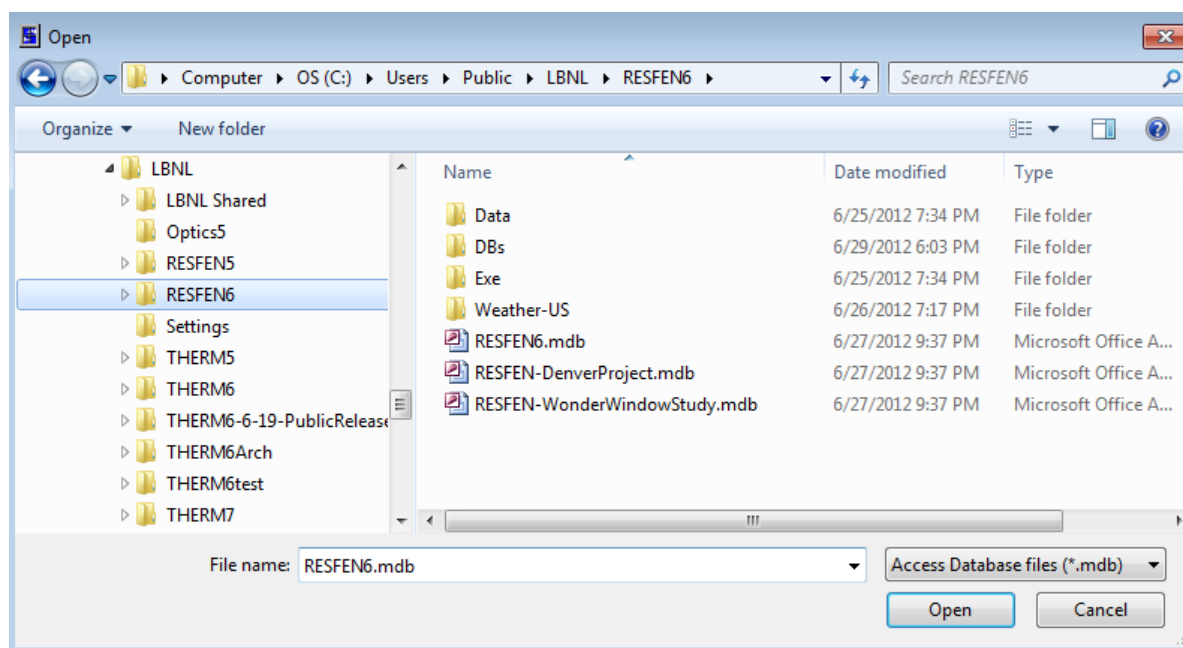
The **File** menu is used to manipulate the RESFEN input files, to print the current screen, and to exit the program. Each set of input values on the main screen makes up a file, and different input configurations can be saved with different file names, so you can retrieve the input values as well as the results by opening the files that you save. RESFEN automatically opens the input file named "default.rs" when the program starts. You can make changes to this file and save the changes to a new file name. RESFEN automatically adds the "RSF" extension to the file name that you provide.

Figure 4-3. The **File** menu*Close*

Close the RESFEN program. Equivalent to Exit.

Open

Open a RESFEN database, which will have an “mdb” extension.

Figure 4-4. The **File Open** dialog box.*Save As*

Save the current database into another database. You can use this feature to develop different modeling scenarios and save them for future use. RESFEN supports the Windows 95™, Windows 98™, and WindowsNT™ long file-naming convention.

When the RESFEN program starts, it opens the last database opened. If changes are made to this file, and you want to save it into a different database, use the **Save As** menu choice.

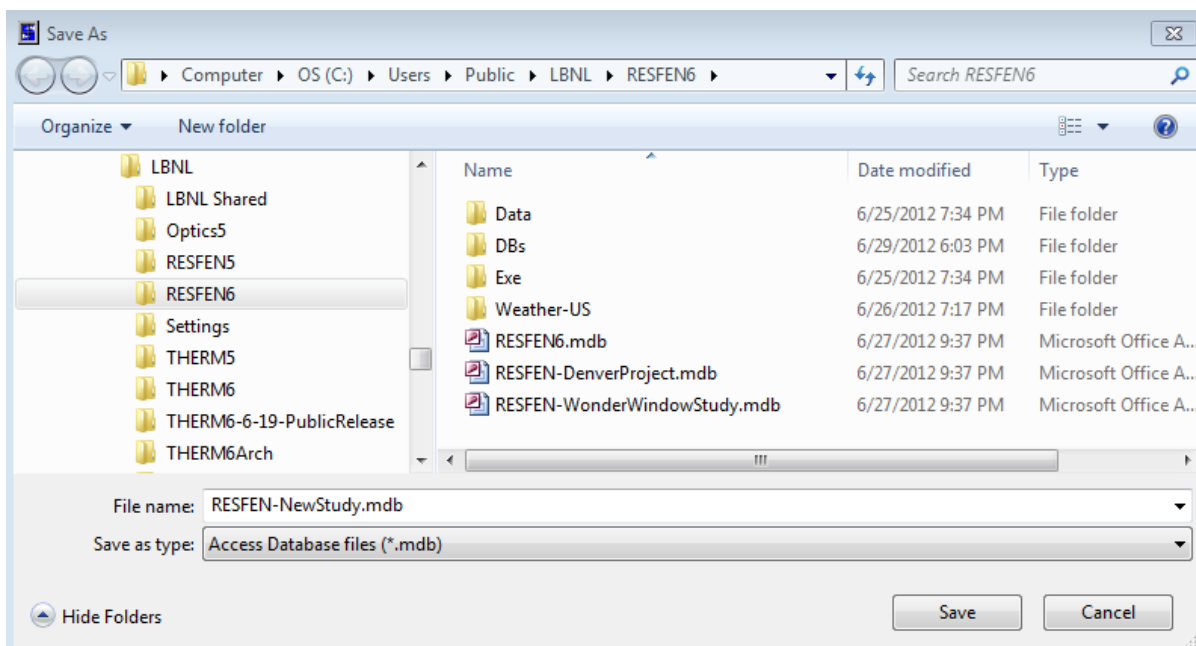


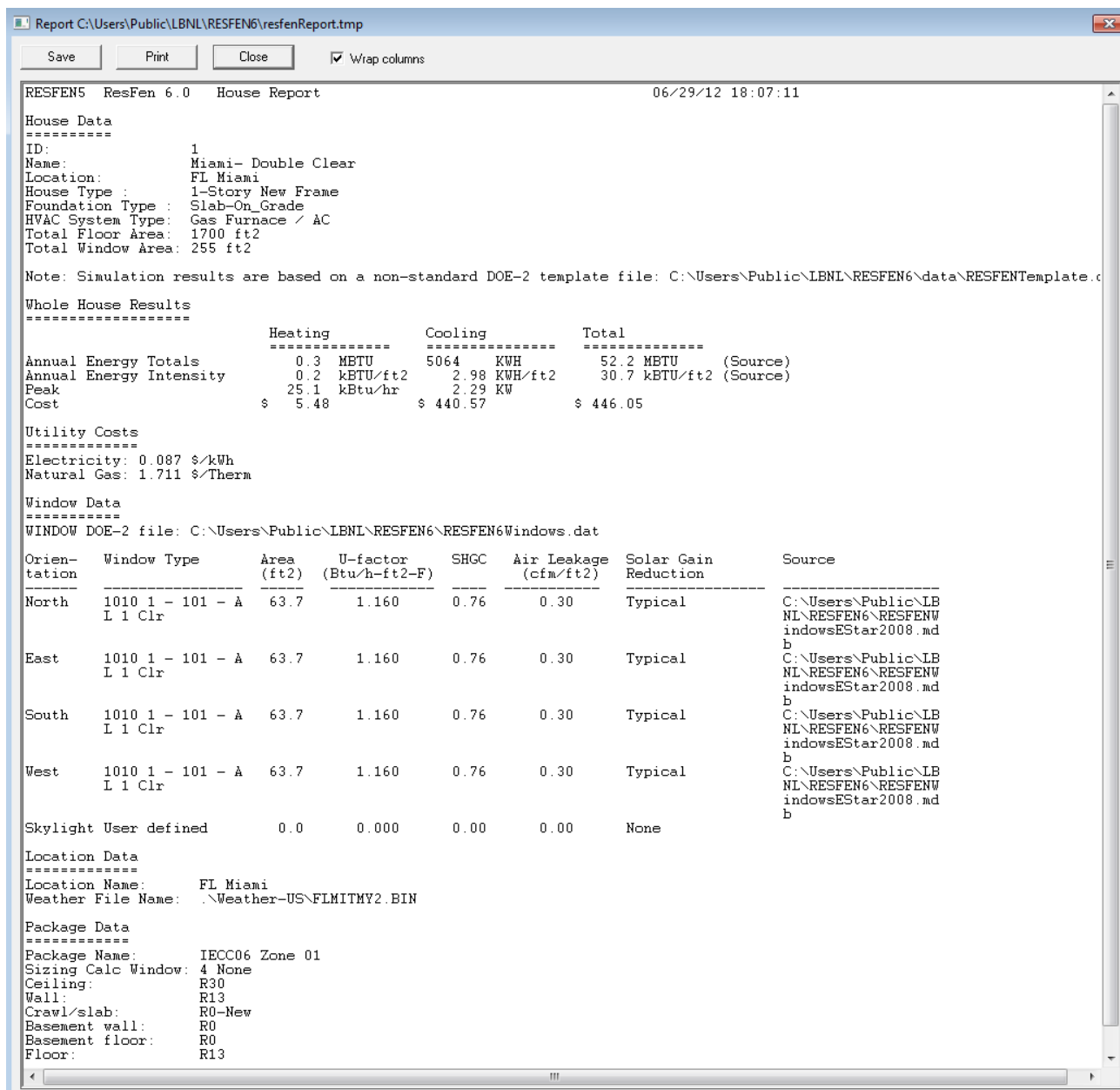
Figure 4-5. Use the *Save As* feature to save the database under a different name for future use.

Print Not currently implemented

Print Setup Not currently implemented.

Print Preview Not currently implemented.

Report If there are results from a calculation, the results can be viewed in a report, as shown in the figure below. The report can be saved to a text file using the Save button, or printed using the Print button. If the “Wrap columns” checkbox is not checked, any data wider than the column will be truncated.

Figure 4-6. The **Report** dialog box.

Recent File Shows the four most recently opened RESFEN databases.

Exit Quits the program.

4.4.2. Edit

The **Edit** menu functions can be accessed from the Edit menu, and also using the standard shortcut keys listed in the menu.

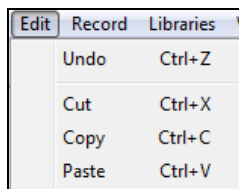


Figure 4-7. The **Record** menu

4.4.3. Record

The Record menu can be used to move between records (rows) in any of the Library screens, as well as to save edits made to the currently open record.

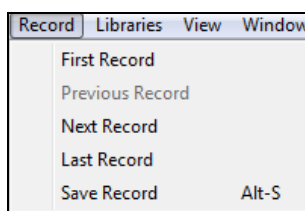


Figure 4-8. The **Record** menu

4.4.4. Libraries

The RESFEN program consists of Libraries which are used to define a building model. The figure below shows the options in the Libraries menu.

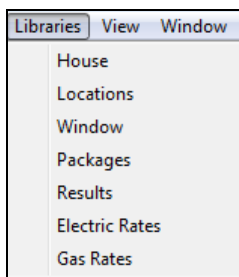


Figure 4-9. The **Libraries** menu

The Libraries, which are described in detail in the rest of this section, are:

- | | |
|------------------|--|
| <i>House</i> | The House Library is where the definition of a specific building to be modeled is specified. The building data, location, and window data are all specified in the House Library. |
| <i>Locations</i> | The Location Library is used to specify information about a location for the RESFEN calculation engine, including the weather file for the DOE2 simulation, the building insulation packages to be used in the simulation, and the utility rates associated with the location. |
| <i>Window</i> | The Window Library is used to define a set of windows that can be used in the House Library window definitions. Records in the Window Library can be imported from the LBNL WINDOW program, or user defined. |

<i>Packages</i>	The Packages Library is used to construct a set of building envelope insulation definitions, such as the insulation level for the walls, floors, ceilings and foundation. These packages are then associated with a Location in the Location Library.
<i>Results</i>	The Results Library is where the results of each of the input definitions is stored. Different views of the results are possible from this library, and the results of multiple input definitions can be viewed at once, as well as exported to a comma separated text file which can be imported into a spreadsheet program for further analysis.
<i>Electric Rates</i>	The Electric Rates Library contains a list of electric rates which can be selected from in the Location Library.
<i>Gas Rates</i>	The Gas Rates Library contains a list of electric rates which can be selected from in the Location Library.

4.4.5. View

The View menu is used to control the toolbar and status bar display settings.

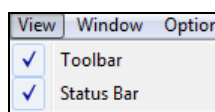


Figure 4-10. The **View** menu

4.4.6. Options

The Options menu is used to set program level default values.

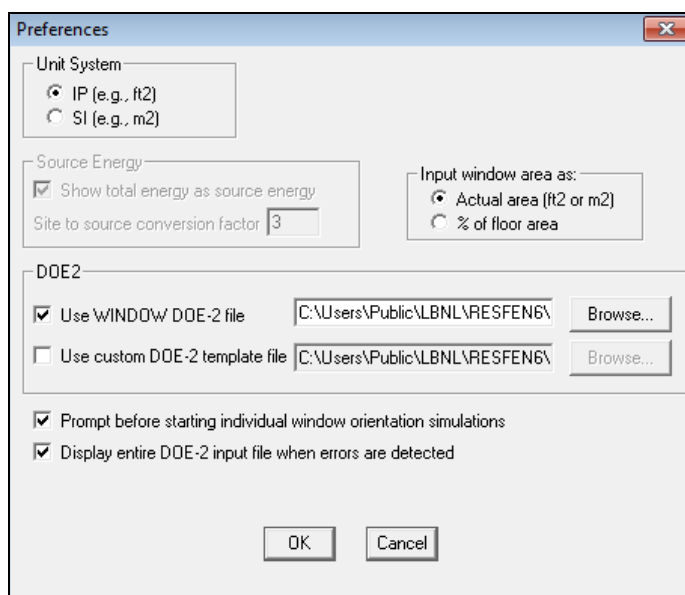


Figure 4-11. The **Options** menu

<i>Unit System</i>	The system of units, from the choice of either: <ul style="list-style-type: none"> ▪ IP: Inch pounds ▪ SI: International units
--------------------	--

*Input Window
Area as*

- Area (sf): this option allows input of the window as actual area. **Units:** square feet (IP); square meters (SI).
- % of floor area: *Currently inactive.* (This option allows input of the window area based on the floor area.)

DOE2

*Use WINDOW
DOE-2 file*

This option allows specification of a DOE2 “dat” file, such as that generated by the WINDOW program, for one or more windows, to provide the DOE2 calculation engine with more detailed information about the window glazing characteristics. If this option is used, the House Library window input must use the WINDOW library option, and the ID numbers in the DAT file must match the ID numbers in WINDOW library. See Chapter 6, Section 6.4, “Using WINDOW DOE2 Input File for RESFEN Calculations” for more details about this option.

*Use custom
DOE-2 template
File*

Because RESFEN uses the DOE2 simulation engine to calculate the results, the program must have a DOE2 input file as a basis for that calculation. By default the program uses an encrypted file called RESFENTemplate.d2 for that input file. However, it is possible to use other DOE2 input files if they are constructed so that RESFEN can interpret them properly. In general, using an input file other than the default one supplied with the program is not advised. However, advanced users familiar with DOE2 may want to use this option. If so, it is best to start with a default text file that RESFEN can read, which is supplied with the program, called Template.new. This file can be edited (with extreme care not to make the file uninterpretable by RESFEN and DOE2) and then referenced from this Preferences option. If a file other than the default one is used, RESFEN will report that fact on the House Library Detail view as well as in the report.

*Prompt before
Starting individual
Window orientation
Simulations*

If this box is checked, when the “double lightning bolt” button is clicked to generate results for the four orientations, RESFEN will put up the message box shown in the figure below. If this message is annoying, it can be eliminated by unchecking this box in the Preferences dialog box.

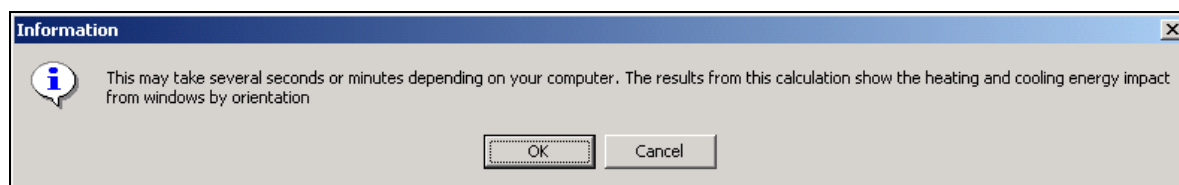


Figure 4-12. Message displayed before the House + 4 Orientations run begins.

*Display entire
DOE-2 input file
When errors are*

Detected In the hopefully unlikely event that the DOE2 simulation engine cannot perform the calculation because of input errors, this option allows the user to see the raw DOE2 input file, with the errors indicated. This input file is not for the faint-of-heart, and will only make sense to someone very familiar with DOE2, which the typical RESFEN user should not need to be. If this happens (and it bascially never should), the best option is to contact LBNL at RESFENHelp@lbl.gov.

4.4.7. Help

About Information about RESFEN, including the version number of the program.

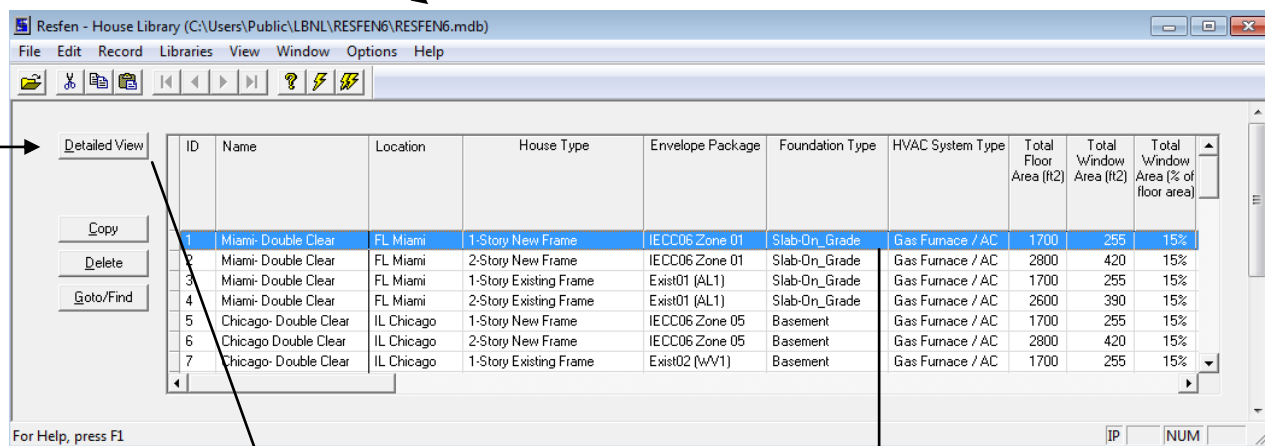
4.5. Libraries in General

Libraries are the main components of the RESFEN program, and each library contains characteristics necessary for the calculations.

4.5.1. List and Detail Views

There is a “List” and a “Detail” view of the data in each library. The List View shows all the records (rows) in the library but only some of the fields (columns with data), and the Detail View shows all the data (or fields) for one record. Most changes to the library records are made in the Detail View.

The List View of the House Library



Click on the List button to see the List View of the library

Click on the Detailed View button to see the Detail View of the selected record, where the values can be edited.

The Detailed View of the House Library for the selected record, ID #2.

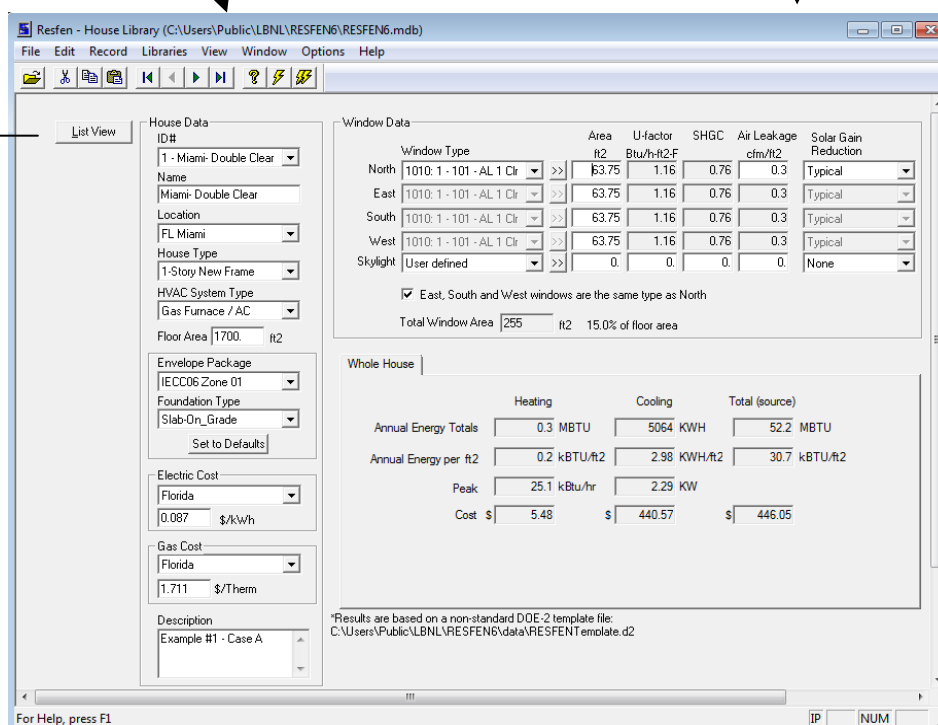


Figure 4-13. Switching between the List View and Detail View in a Library.

4.5.2. Selecting Records from Libraries

From many of the libraries, it is necessary to select records from other libraries. For example, in the Location Library Detail View, in order to define a location, it is necessary to select records from the Packages Library, the Gas Rates Library, and the Electric Rates Library. There are pull-down boxes for each of these inputs that will display the choices from the appropriate library.

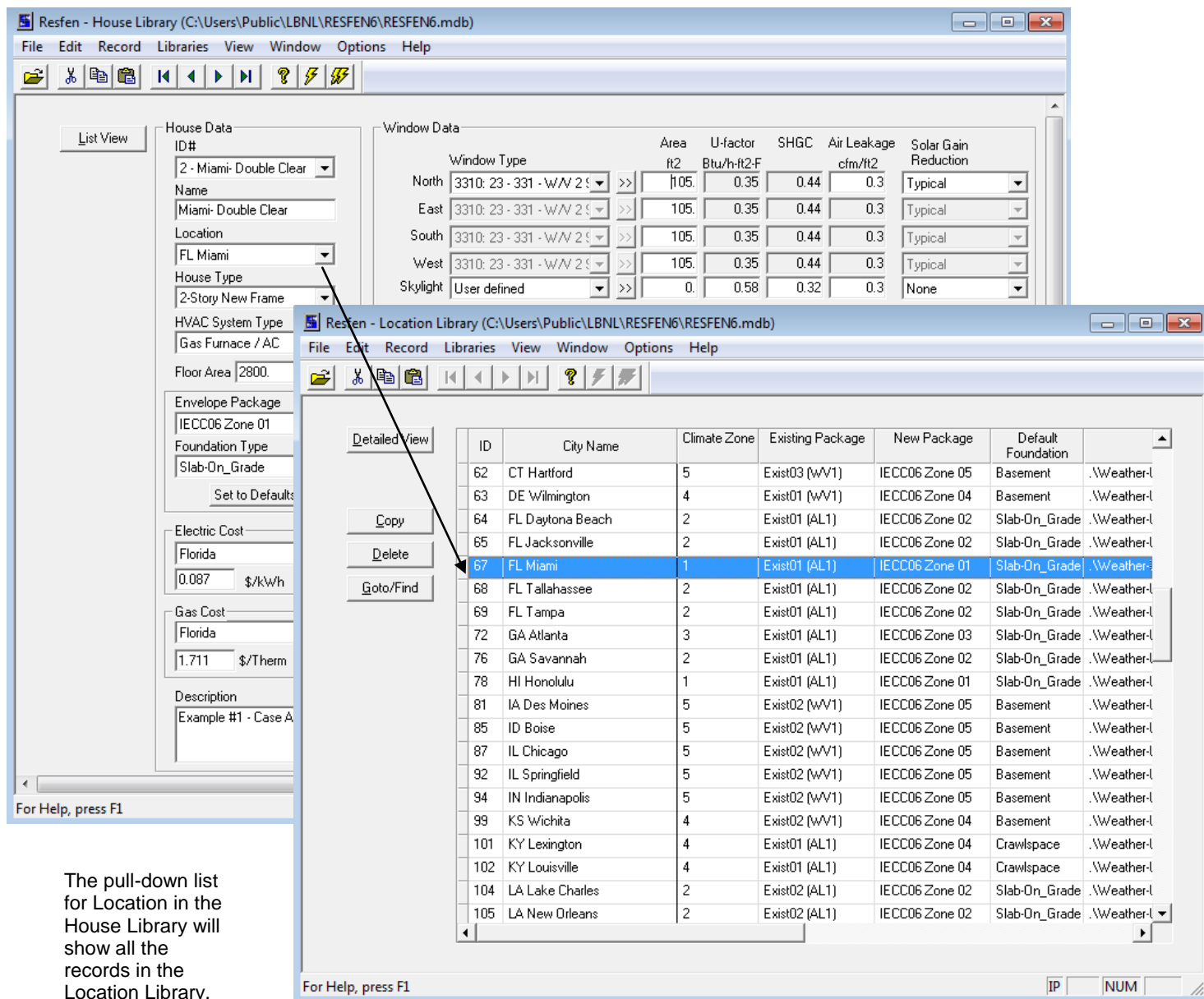


Figure 4-14. Selecting a record from another library.

4.5.3. Moving Between Records in Detail View

There are several ways to move between records in the Library Detail View:

- The **Record Menu** contains choices for First Record, Previous Record, Next Record, Last Record

- The **Toolbar** has buttons for first , previous , next , and last  record to move between records.

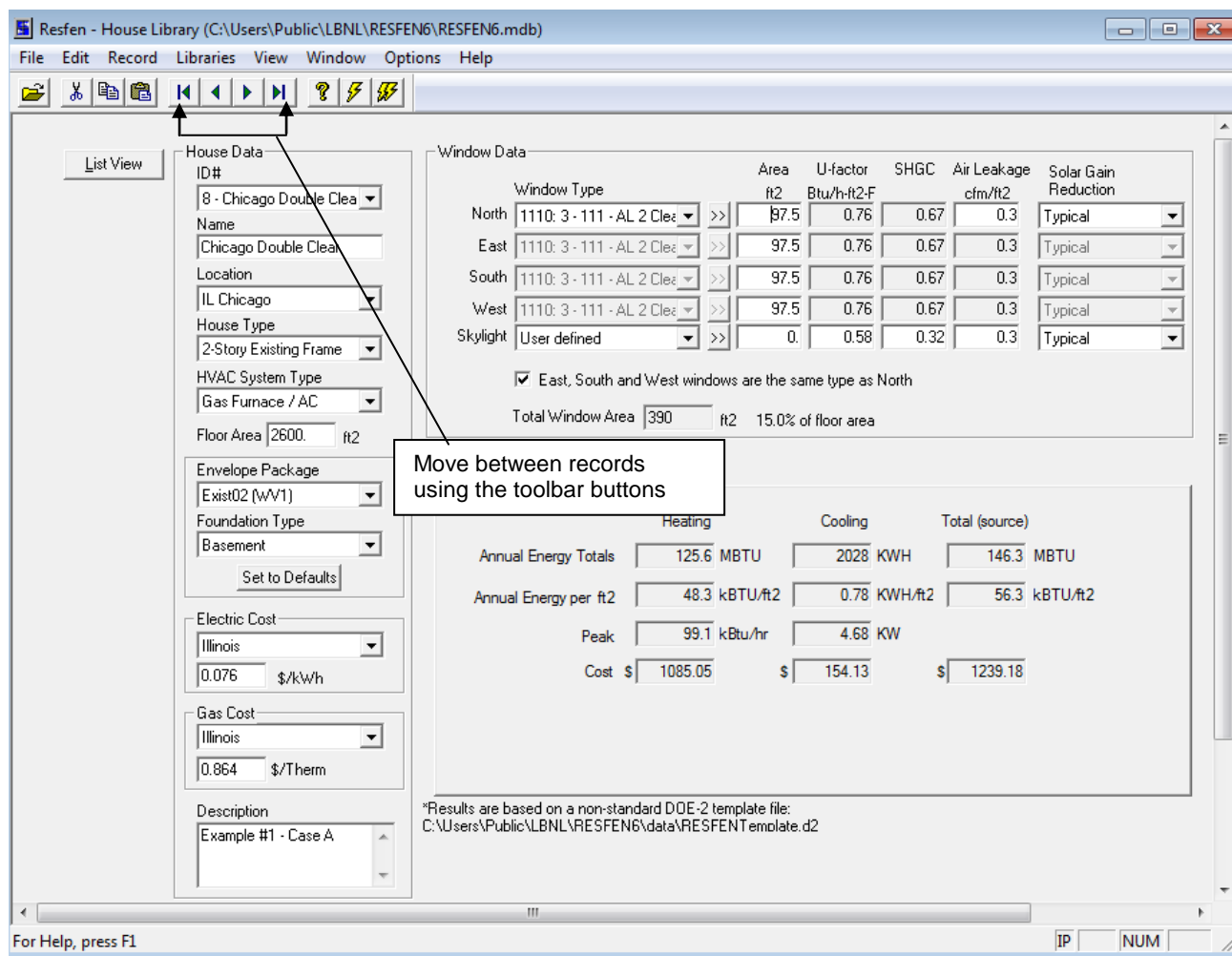


Figure 4-15. Use the Toolbar buttons to move between records.

4.5.4. Creating New Records

New records can be created in all the libraries by copying an existing record (by highlighting it and clicking on the Copy button in the List View) and then editing the new record with the desired values in the Detailed View. The ID number for the new record is automatically incremented by the program based on the last ID number that was used. That value can be changed to any other number by the user, as long as the ID is unique. If the ID entered for the new record already exists, the program will ask if the existing record should be overwritten. There is also a checkbox in the “Adding a record” dialog box which tells the program to overwrite existing records without asking.

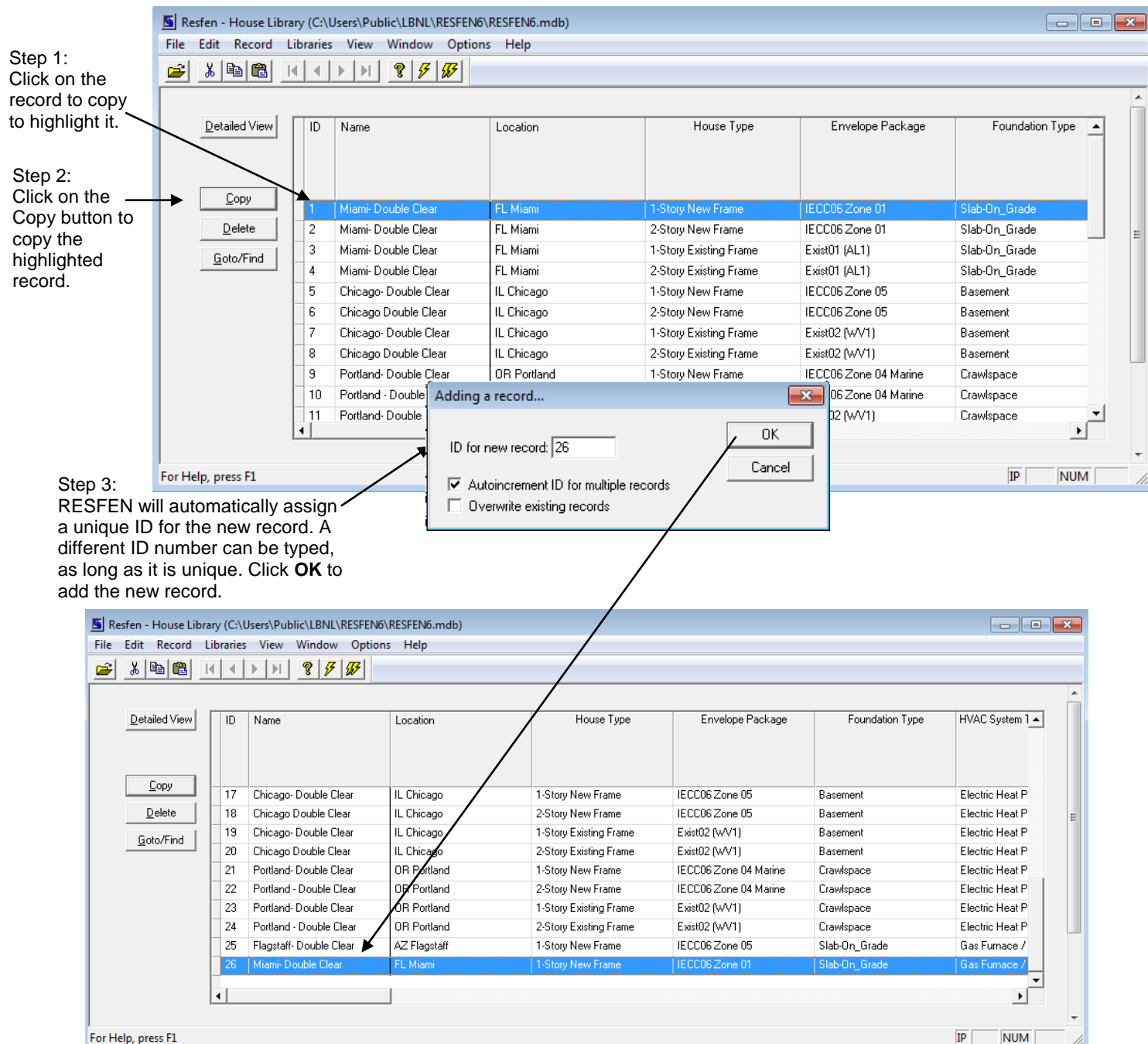
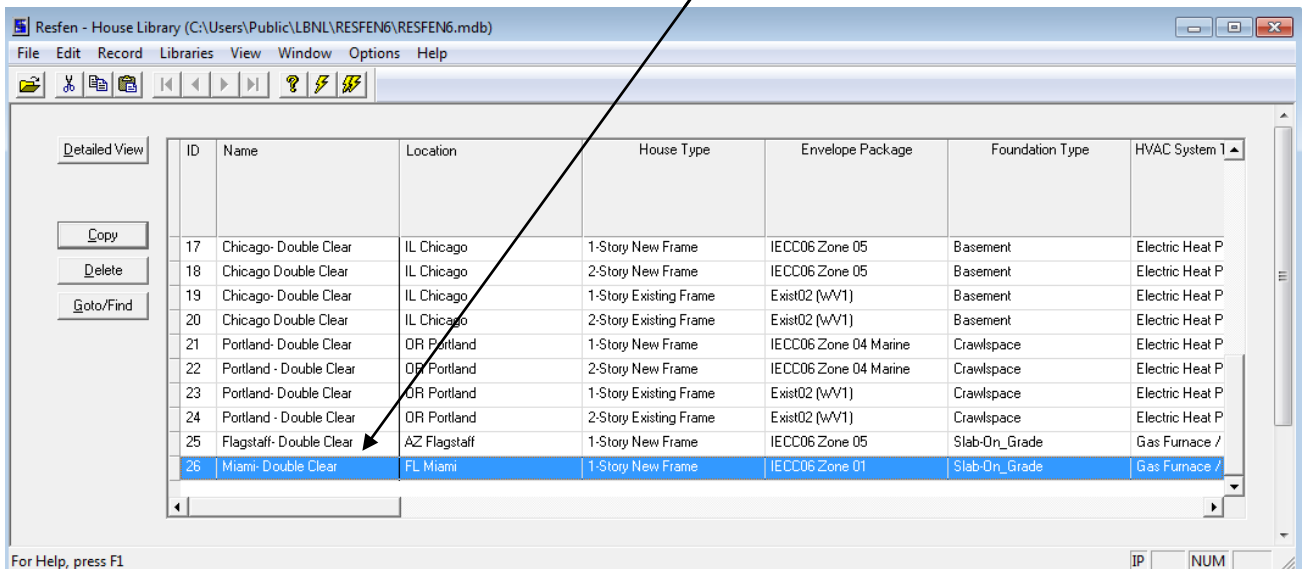
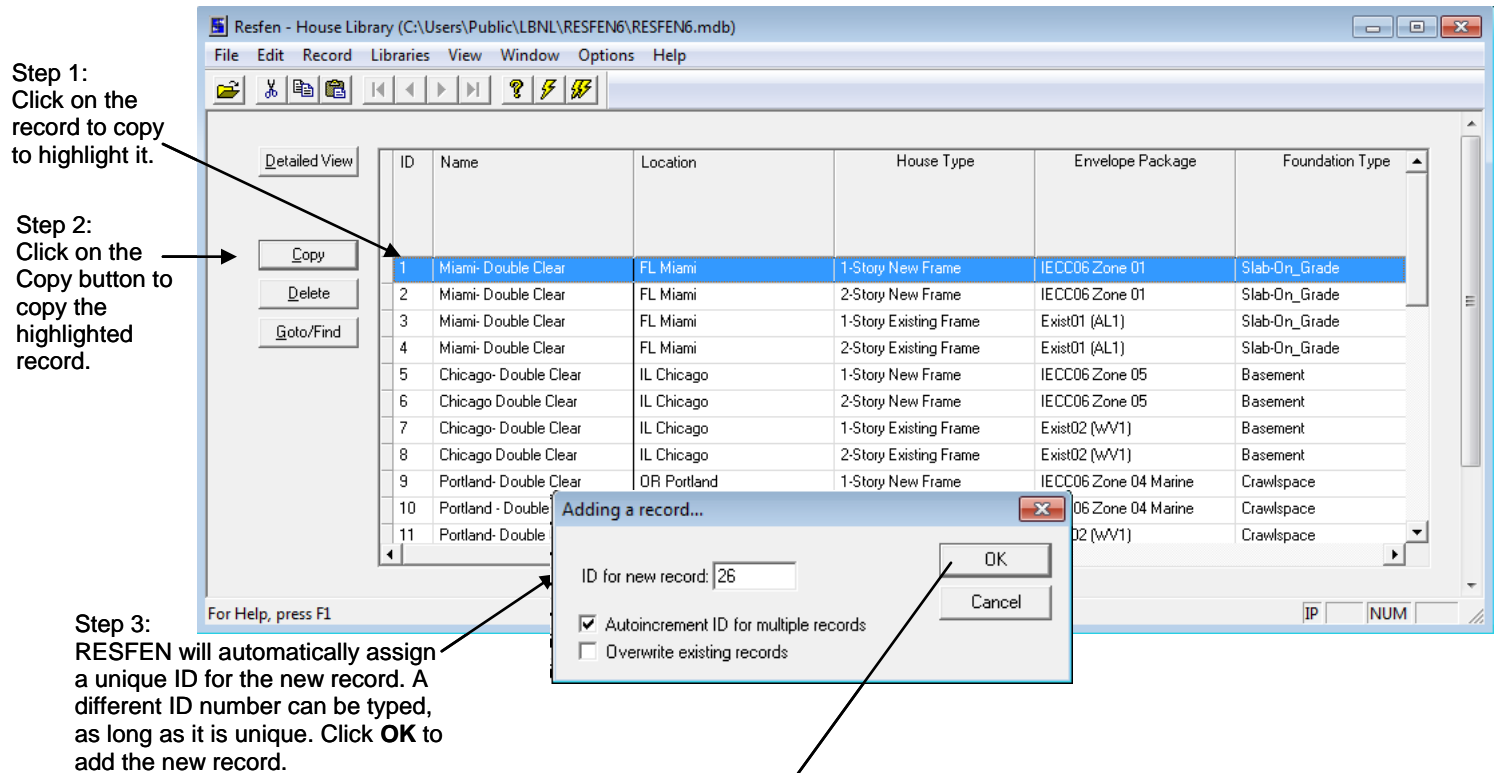


Figure 4-16. Create a new record by copying an existing record in the List View of any library.

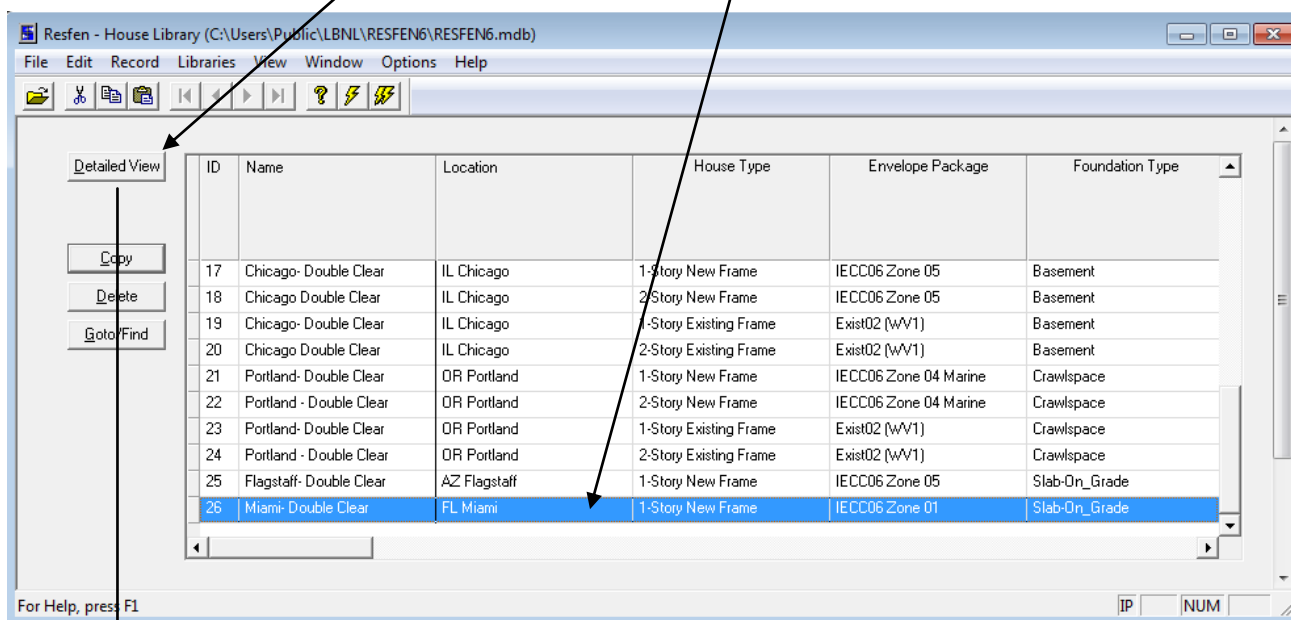
Figure 4-17. Create a new record by copying an existing record in the List View of any library.

Figure 4-18. Create a new record by copying an existing record in the List View of any library.



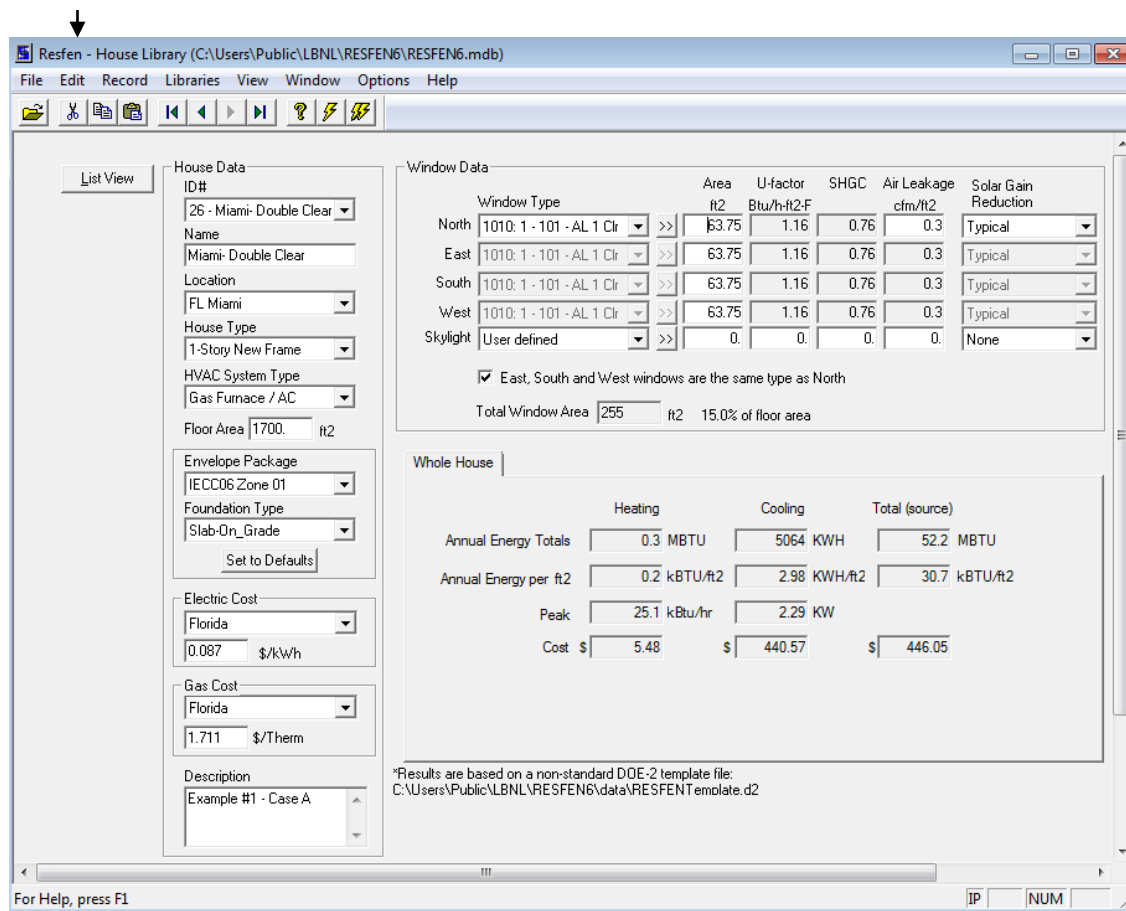
Step 5:

To edit the copied record, highlight the record and click the Detailed View button.



Step 6:

The detailed view of the highlighted record will open, and values can be edited as desired.



4.6. House Library

The House Library is where the building to be analyzed is defined. Because RESFEN is structured around a database, each building configuration can be defined as a separate record in the House Library.

4.6.1. House Library List View

As with the other libraries, the House Library List View shows all the records in the currently open database.

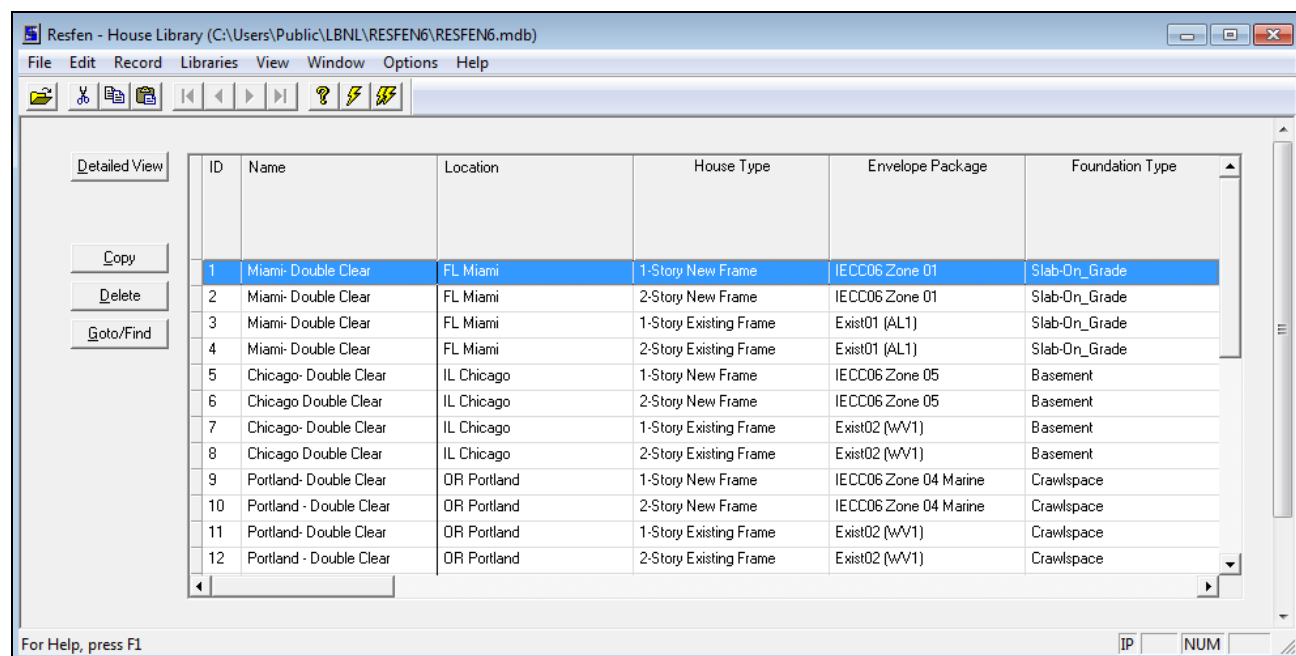


Figure 4-19. The House Library Detail View.

- Detailed View** Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy** Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will be unique for this library.
- Delete** Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Delete** button.
- Goto/Find** Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.

4.6.2. House Library Detailed View

The detailed view of the House Library allows editing of all the building definition fields.

Resfen - House Library (C:\Users\Public\LBNL\RESFEN6\RESFEN6.mdb)

File Edit Record Libraries View Window Options Help

House Data

List View

ID# 1 - Miami- Double Clear

Name Miami- Double Clear

Location FL Miami

House Type 1-Story New Frame

HVAC System Type Gas Furnace / AC

Floor Area 1700. ft2

Envelope Package IECC06 Zone 01

Foundation Type Slab-On_Grade

Set to Defaults

Electric Cost Florida 0.087 \$/kWh

Gas Cost Florida 1.711 \$/Therm

Description Example #1 - Case A

Window Data

Window Type	Area ft2	U-factor Btu/h-ft2-F	SHGC	Air Leakage cfm/ft2	Solar Gain Reduction
North 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
East 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight User defined	0.	0.	0.	0.	None

☒ East, South and West windows are the same type as North

Total Window Area 255 ft2 15.0% of floor area

Whole House

	Heating	Cooling	Total (source)
Annual Energy Totals	0.3 MBTU	5064 KWH	52.2 MBTU
Annual Energy per ft2	0.2 kBTU/ft2	2.98 KWH/ft2	30.7 kBTU/ft2
Peak	25.1 kBTU/hr	2.29 KW	
Cost \$	5.48	440.57	446.05

*Results are based on a non-standard DOE-2 template file:
C:\Users\Public\LBNL\RESFEN6\data\RESFEN6template.d2

For Help, press F1

Figure 4-20. The House Library Detail View.

The following discussion explains the different sections of the House Library Detail View.

4.6.2.1. House Data

The left side of the main screen contains the **House Data** section, a series of pull-down lists that allow you to specify geographic location, house type, foundation type, HVAC type, floor area, and utility costs.

The screenshot shows a vertical form titled "House Data". It contains the following fields and values:

- ID#**: A pull-down menu showing "1 - Miami- Double Clear".
- Name**: A text box containing "Miami- Double Clear".
- Location**: A pull-down menu showing "FL Miami".
- House Type**: A pull-down menu showing "1-Story New Frame".
- HVAC System Type**: A pull-down menu showing "Gas Furnace / AC".
- Floor Area**: A text box containing "1700." followed by "ft2".
- Envelope Package**: A pull-down menu showing "IECC06 Zone 01".
- Foundation Type**: A pull-down menu showing "Slab-On-Grade".
- A "Set to Defaults" button is located below the Foundation Type field.
- Electric Cost**: A pull-down menu showing "Florida". Below it, a text box contains "0.087" followed by "\$/kWh".
- Gas Cost**: A pull-down menu showing "Florida". Below it, a text box contains "1.711" followed by "\$/Therm".
- Description**: A text box containing "Example #1 - Case A".

Figure 4-21. The **House Data** portion of the main screen

<i>ID#</i>	The ID# field is automatically created by the program, and is a combination of the record number (generated by the program when the record is created, such as using the Copy button in the List View) and the Name field (entered below). This value is in a pull-down list, which shows all the House Library records, and is another way to move between records in this library.
<i>Name</i>	Name of the record, input by the user. The Name is appended to the record ID number and used in the previous field.
<i>Location</i>	A pull-down list showing the entries in the Location Library. The location chosen is used by RESFEN to specify Typical Meteorological Year (TMY2) weather data used for the DOE-2 simulation. The location selection determines the default values for: <ul style="list-style-type: none"> ▪ Envelope Package ▪ Foundation Type
<i>House Type</i>	A pull-down list for specifying whether the building is one story or two story, new or existing construction, and what the predominant construction type is – either frame or masonry. For a two-story building case, the program assumes an equal floor area on each floor, based on the total floor area that you specify in the Floor Area input box. <ul style="list-style-type: none"> ▪ 1-Story New Frame ▪ 1-Story New Masonry

	<ul style="list-style-type: none"> ▪ 1-Story Existing Frame ▪ 1-Story Existing Masonry ▪ 2-Story New Frame ▪ 2-Story New Masonry ▪ 2-Story Existing Frame ▪ 2-Story Existing Masonry
	Default: 1-Story New Frame
<i>HVAC System Type</i>	<p>A pull-down list for specifying the house's heating and cooling system. The efficiencies are different for New and Existing Construction (see Section 6.2, "RESFEN Modeling Assumptions" for details).</p> <ul style="list-style-type: none"> ▪ Gas Furnace / AC ▪ Electric Heat Pump
<i>Floor Area</i>	<p>The total floor area of the house.</p> <p>Units: square feet (ft²) (IP); square meters (m²)(SI)</p> <p>Legal values: 1,000 to 4,000 square feet</p>
<i>Envelope Package</i>	<p>A pull-down list for specifying the insulation package for the building envelope. The choices in this list are from the Packages Library. The default values are based on the Location, but can be overridden by the user from this pulldown. When the Location is changed, the program will ask whether to use the default package from that Location. If the user says "Yes", the package will be set to that associated with the Location in the Location Library. If the user says "No", any package can be chosen from this list. The default packages in the Packages Library are based on the Model Energy Code (MEC) from 1993, and more packages can be created in the Packages Library. For more details about the Packages Library, see Section 4.10.</p>
<i>Foundation Type</i>	<p>A pull-down list for specifying the predominant type of foundation construction. The default value used by the program is based on the Default Foundation Type specified in the Location Library. However, it is possible to change that default value here in the House Library Detailed view. The possible foundation types are.</p> <ul style="list-style-type: none"> ▪ Basement ▪ Slab-on-Grade ▪ Crawlspace <p>Default: dependent on the location selected.</p>
<i>Set to Defaults</i>	<p>Clicking on this button will reset the Envelope Package and the Foundation Type to the values defined in the Location Library.</p>
<i>Electric Cost</i>	<p>There are two input boxes for Electric Cost.</p> <p>The first is a pull-down list, which shows the records in the Electric Rates Library. The default records that come with the program are one value per state. (See Section 4.12 for more details about the Electric Rates Library). Based on the selection from the pull-down list, electric rate in the box below it will change. The first choice in the pull-down list is User Defined, which allows the input of any value, overriding the value from the Electric Rates Library.</p> <p>The second input box is a value representing the average cost of electricity for the location. This value initially is based on the choice from the Electric Rates Library, but can be edited by the user to any value. This number is multiplied by the energy consumption to calculate total cost.</p>

	Legal Values: Any number. Units: \$/kWh
<i>Gas Cost</i>	<p>There are two input boxes for Gas Cost.</p> <p>The first is a pull-down list, which shows the records in the Gas Rates Library. The default records that come with the program are one value per state. (See Section 4.12 for more details about the Gas Rates Library). Based on the selection from the pull-down list, Gas rate in the box below it will change. The first choice in the pull-down list is User Defined, which allows the input of any value, overriding the value from the Gas Rates Library.</p> <p>The second input box is a value representing the average cost of Gas for the location. This value initially is based on the choice from the Gas Rates Library, but can be edited by the user to any value. This number is multiplied by the energy consumption to calculate total cost.</p> <p>Legal Values: Any number. Units: \$/Therm</p>
<i>Description</i>	<p>An optional field that can be used to record information about the case being modeled.</p> <p>Legal Values: Any character or number, up to 50 characters.</p>

4.6.2.2. Window Data

The upper right-hand section of the screen is used to input information about the windows in the house for each of the four orientations, **North**, **East**, **South** and **West**, as well as **Skylights**, as shown in the figure below. Use your mouse, the **Tab** key or the **arrow** keys to move between the fields.

	Window Type	Area ft2	U-factor Btu/h-ft2-F	SHGC	Air Leakage cfm/ft2	Solar Gain Reduction
North	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
East	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight	User defined	0	0	0	0	None

☒ East, South and West windows are the same type as North

Total Window Area: 255 ft2 15.0% of floor area

Figure 4-22. The **Window Data** portion of the screen

When modeling the windows in your house, group the windows on an orientation together to determine the total area by orientation. If your windows do not face the exact cardinal orientations (north, south, east and west), use the closest orientations. The program has the capability of varying fenestration system parameters for each orientation. The NFRC total product properties, which include the glazing and frame, should be used for the area, U-factor, solar heat gain coefficient (SHGC), and infiltration (CFM per unit area). The **Area** parameter represents the total window area on any one facade in square feet or as a percentage of the total floor area (see detailed **Area** explanation below).

Skylights are modeled as vertical glazing in the roof of the building, with solar heat gain reduced by 50% to account for skylight-well effects. This correction factor is a placeholder; research is ongoing to improve the skylight well solar correction.

Because it is necessary to group windows by orientation, use the window properties for the window type that predominates on an orientation if the building has different types of windows on the same orientation. Input the total window area. For example, if all the windows on the west orientation are wood casements except for one aluminum frame picture window or one patio door with an area significantly less than the sum of the wood windows, model the west-facing windows as all wood casements. You could also obtain the properties for each window type on a given orientation and area-weight these values based on the square footage of each window type.

Window Type

There are two options for **Window Type**, which are accessed by clicking on the **Window Type** pulldown list for each orientation:

Orientation	Window Type	Area (ft²)	U-factor (Btu/h-ft²-F)	SHGC	Air Leakage (cfm/ft²)	Solar Gain Reduction
North	User defined	60	0.45	0.55	0.2	Typical
East	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West	1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight	User defined	0	0	0	0	None

☐ East, South and West windows are the same type as North

Total Window Area: 251 ft² 14.8% of floor area

Figure 4-23. Two **Window Type** choices, *User specified* or *Window4 Lib*.

- **User Defined:** Selecting the first choice in the pull-down list, User Defined, allows the user to enter the U-factor and SHGC window properties for each orientation. This choice can be used when comparing windows to get general trends about window technologies, but are not concerned about a detailed analysis for a particular window.
- **Window Library Selection:** All the other choices in the pull-down list other than User Defined are records from the Window Library. In the Window Library, the user can create more windows, or import records created by the WINDOW program (see the *WINDOW 5.0 User Manual*). The U-factor and SHGC values from the Window Library are input automatically into those fields in the House Library Window Data. A default WINDOW library, **RESFENWindows.mdb**, has been imported into the default REFEN database (REFEN.mdb) and is included in the installation files. The values contained in this library are for single casement windows, but can be used for sliders and fixed windows because their properties are essentially the same.



The double arrow button next to the pull-down list arrow shows the same records as the pull-down list, but displays more information about each record in a row/column grid, also allowing sorting by the grid column headings.

ID	Name	Ufactor Btu/h-ft²-F	SHGC	Area ft²	Width inches
1010	1 - 101 - AL 1 Clr	1.159	0.756	9.7	24.00
1020	2 - 102 - AL 1 Bronze	1.159	0.647	9.7	24.00
1110	3 - 111 - AL 2 Clear	0.762	0.675	9.7	24.00
1120	4 - 112 - AL 2 Bronze	0.762	0.562	9.7	24.00
1130	5 - 113 - AL 2 SS Tint	0.762	0.469	9.7	24.00
1210	6 - 121 - AL 2 PY Low-E	0.613	0.635	9.7	24.00
1310	7 - 131 - AL 2 SP Low-E	0.595	0.528	9.7	24.00
1410	8 - 141 - AL 2 SS Low-E	0.583	0.364	9.7	24.00
1710	37 - 171 - AL 2 SS Ultra Low	0.580	0.237	9.7	24.00

Figure 4-24. The double arrow selection button displays more information about the records in the *Window Library*.

Window Data

Window Type	Area ft ²	U-factor Btu/h-ft ² -F	SHGC	Air Leakage cfm/ft ²	Solar Gain Reduction
North User defined >>	60.	0.45	0.55	0.3	Typical
East User defined >>	40.	0.45	0.55	0.3	Typical
South User defined >>	100.	0.45	0.55	0.3	Typical
West User defined >>	40.	0.45	0.55	0.3	Typical
Skylight User defined >>	0.	0.	0.	0.	None

☐ East, South and West windows are the same type as North

Total Window Area 240 ft² 12.0% of floor area

To select a record from the Window Library, click on either the pull-down list or the double arrow

Window Type

North 321: 321 W/V 2 PY Low-E >>

East 301: 301 W/V 1 Clr >>
302: 302 W/V 1 Bronze >>

South 311: 311 W/V 2 Clear >>
312: 312 W/V 2 Bronze >>

West 313: 313 W/V 2 SS Tint >>
321: 321 W/V 2 PY Low-E >>

Skylight 331: 331 W/V 2 SP Low-E >>
341: 341 W/V 2 SS Low-E >>
351: 351 W/V 3 HT Super >>
352: 352 W/V 3 SS Super >>

List

ID	Name	Ufactor Btu/h-ft ² -F	SHGC	Area ft ²	Width inches	Height inches
301	301 W/V 1 Clr	0.147	0.635	104.3	0.94	2.32
302	302 W/V 1 Bronze	0.147	0.540	104.3	0.94	2.32
311	311 W/V 2 Clear	0.087	0.564	104.3	0.94	2.32
312	312 W/V 2 Bronze	0.087	0.466	104.3	0.94	2.32
313	313 W/V 2 SS Tint	0.087	0.385	104.3	0.94	2.32
321	321 W/V 2 PY Low-E	0.064	0.529	104.3	0.94	2.32
331	331 W/V 2 SP Low-E	0.062	0.436	104.3	0.94	2.32
341	341 W/V 2 SS Low-E	0.060	0.297	104.3	0.94	2.32
351	351 W/V 3 HT Super	0.050	0.382	104.3	0.94	2.32
352	352 W/V 3 SS Super	0.050	0.254	104.3	0.94	2.32
411	411 INS 2 Clear	0.078	0.596	104.3	0.94	2.32

OK Cancel

Highlight the desired record from either selection option (both selection options show the same records in the Window Library, but one shows more detail)

The selected entry is displayed in the **Window Type** input field, and the values from the library are automatically used in the **U-factor** and **SHGC** fields. Remember to change the **Cfm** field if necessary because it is not determined by the WINDOW 5 library.

Window Data

Window Type	Area ft ²	U-factor Btu/h-ft ² -F	SHGC	Air Leakage cfm/ft ²	Solar Gain Reduction
North 321: W/V 2 PY Low-E >>	60.	0.37	0.53	0.3	Typical
East 321: W/V 2 PY Low-E >>	40.	0.37	0.53	0.3	Typical
South 321: W/V 2 PY Low-E >>	100.	0.37	0.53	0.3	Typical
West 321: W/V 2 PY Low-E >>	40.	0.37	0.53	0.3	Typical
Skylight User defined >>	0.	0.	0.	0.	None

☐ East, South and West windows are the same type as North

Total Window Area 240 ft² 12.0% of floor area

Figure 4-25. Select window properties from the Window Library

<i>Window</i>	<p>Total window area input as either total area or percent of total house floor area for each of four orientations. For example, if you want to model four windows that are 3' x 4' on the south orientation, the total window area for that orientation is 36 square feet, which is 2.3% for a house whose floor area is 1,560 ft² (36/1540).</p> <p>Units: square feet (ft²)(IP), square meters (m²)(SI), or % of floor area (% Flr Area), depending on the settings in the Options menu.</p> <p>Legal values: 0% to 12% per orientation; 0 to 480 square feet (4,000 square feet maximum floor area * 0.12 = 480); the sum of the percentages for the four orientations cannot exceed 48% of the floor area.</p>
<i>U-Factor</i>	<p>The U-factor of the total fenestration product at standard NFRC winter conditions, which includes the frame as well as the glazing, from a source such as the window NFRC label, manufacturer's literature, or a WINDOW 5 analysis.</p> <p>Units: Btu/hr-ft²-°F (IP), W/m²-°C (SI).</p> <p>Legal values: between 0.05 and 1.40 Btu/hr-ft²-°F at standard NFRC winter conditions.</p>
<i>SHGC</i>	<p>The Solar Heat Gain Coefficient of the total fenestration product, which includes the frame as well as the glazing, from a source such as the window NFRC label, manufacturer's literature, or a WINDOW 4.1 analysis.</p> <p>Legal values: between 0.05 and 0.90.</p>
<i>CFM/Area</i>	<p>The infiltration of the total fenestration product (from ASTM E283 tests or equivalent), which includes the frame as well as the glazing.</p> <p>Units: CFM/ft².</p> <p>Legal values: between 0.05 and 2.0 CFM/ft².</p>
<i>Solar Gain Reduction</i>	<p>The type of solar gain reduction for the building, from the following list:</p> <ul style="list-style-type: none"> ▪ Typical: A statistically average solar gain reduction which includes some interior shade, overhangs, exterior obstructions and screens. See Section 6.2, "RESFEN Modeling Assumptions" for specific details. ▪ None: No interior shading, exterior overhangs, or obstructions. ▪ Interior: Interior drapes. See Section 6.2, "RESFEN Modeling Assumptions" for specific details. ▪ Overhang: two-foot exterior overhang at roof line. ▪ Obstruction: Used to model large obstructions, such as neighboring houses or other buildings. See Section 6.2, "RESFEN Modeling Assumptions" for details. ▪ Int+Ovh: A combination of the Interior and Overhang options. ▪ Ovh + Obs: A combination of the Overhang and Obstruction options. ▪ Int + Obs: A combination of the Interior and Obstruction options. ▪ All: A combination of the Interior, Overhang, and Obstruction options.
<i>East, South and West windows are The Same type as North</i>	<p>Checking this box will set the Window Type values for the East, South and West windows to that of the North window. The program will ask you if you want to also set the window area to the same value as the North window.</p>
<i>Total Area Window</i>	<p><i>Feedback only.</i> This box displays the total window area of all the building orientations, including skylights; this total is calculated automatically by the program.</p>

Units: square feet (ft²) (IP), square meters (m²) (SI), or percentage of floor area (%), depending on the settings in the **Options** menu choice for **Window Area**.

4.6.2.3. Results

The lower portion of the screen shows the results of the calculations, in the **Results** section. There are four tabs in this section, which display the following results:

- **Whole House:** the total annual energy consumption for the building, including conduction gains and losses from windows, walls, roof, and foundations.
- **Window Annual Energy:** the portion of the annual energy consumption attributed to the windows, broken down by four window orientations.
- **Window Energy Cost:** the portion of the annual energy cost attributed to the windows, broken down by four window orientations.
- **Window Peak Energy:** the portion of the peak energy consumption attributed to the windows, broken down by four window orientations.

Resfen - House Library (C:\Users\Public\LBNL\RESFEN6\RESFEN6.mdb)

File Edit Record Libraries View Window Options Help

House Data

List View

ID# 5 - Chicago- Double Clea

Name Chicago- Double Clear

Location IL Chicago

House Type 1-Story New Frame

HVAC System Type Gas Furnace / AC

Floor Area 1700. ft2

Envelope Package IECC06 Zone 05

Foundation Type Basement

Set to Defaults

Electric Cost Illinois 0.076 \$/kWh

Gas Cost Illinois 0.864 \$/Therm

Description Example #1 - Case A

Window Data

Window Type	Area ft2	U-factor Btu/h-ft2-F	SHGC	Air Leakage cfm/ft2	Solar Gain Reduction
North 1010: 1 - 101 - AL 1 Clr	60	1.16	0.76	0.3	Typical
East 1010: 1 - 101 - AL 1 Clr	40	1.16	0.76	0.3	Typical
South 1010: 1 - 101 - AL 1 Clr	100	1.16	0.76	0.3	Typical
West 1010: 1 - 101 - AL 1 Clr	40	1.16	0.76	0.3	Typical
Skylight User defined	0.	0.58	0.32	0.3	Typical

☒ East, South and West windows are the same type as North

Total Window Area 240 ft2 14.1% of floor area

Whole House

	Heating	Cooling	Total (source)
Annual Energy Totals	60.6 MBTU	810 KWH	68.9 MBTU
Annual Energy per ft2	35.7 kBtu/ft2	0.48 KWH/ft2	40.5 kBtu/ft2
Peak	54.8 kBtu/hr	1.84 KW	
Cost \$	523.98	61.56	585.54


*Results are based on a non-standard DOE-2 template file:
C:\Users\Public\LBNL\RESFEN6\data\RESFEN6Template.d2

For Help, press F1

IP NUM

Figure 4-26. The **Results** section contains four different sets of results.

When you have input all the appropriate values into the **House Data** and **Window Data** sections, to start the simulations, click either:

- the **Whole House Calculation** toolbar button 

or

- the **Whole House + 4 Orientations** toolbar. 

These two different calculation types are described below:

- **Whole House:** this option calculates the energy consumption for the entire house. It includes energy use attributable to the building windows, walls, roof, and foundation (including infiltration). It does not include lighting or appliance or hot water energy consumption. If this calculation is selected, only the Whole House tab will be displayed in the Results section.
- **Whole House + 4 orientations:** this option calculates the energy consumption of the entire house and also the energy attributed to only the windows, for each orientation. Because separate simulations are run for the whole house and each window orientation, this calculation can take some time, depending on the speed of your computer. If this calculation is selected, all four tabs will be displayed in the Results section.

The window results by orientation are all relative to a standard insulated windowless wall. Positive values mean that the window uses *more* energy than an insulated wall with no windows; negative values mean that the window uses *less* energy than an insulated wall with no windows. All cooling results will be positive, but heating energy use can be either positive or negative. If the results are positive, the smallest value will be the most energy-efficient window configuration. If the results are negative, the largest negative value will be the most energy-efficient window configuration. When comparing positive and negative results, the window configurations with negative results will be the most energy efficient. It is possible for a window configuration to use less heating energy than an insulated wall (and thus have a negative result) because the solar heat gain from the window provides heat to the space and reduces the heating requirements of the building.

The results are reset to 0 whenever any changes are made to the input values, so you must recalculate the results.

4.6.3. Whole House

The **Whole House** results show the total annual energy consumption for the building, broken into the following results:

- Energy Totals
- Energy per ft²
- Total Cost

Whole House	Window Annual Energy	Window Energy Cost	Window Peak Energy
	Heating	Cooling	Total (source)
Annual Energy Totals	60.6 MBTU	849 KWH	69.3 MBTU
Annual Energy per ft2	35.6 kBtu/ft2	0.50 KWH/ft2	40.8 kBtu/ft2
Peak	54.5 kBtu/hr	1.88 KW	
Cost \$	523.25	\$ 64.52	\$ 587.77

Figure 4-27. The **Results** tab for the **Whole House** calculation.

Annual Energy Totals

Total annual energy consumption for the entire house, broken into the following components:

- **Heating:** The annual heating energy consumption for the entire house.
Units: MBtu/year (IP), GJ (SI) for Gas Furnace; kWh/year (IP and SI) for Electric Heat Pump.
- **Cooling:** The annual cooling energy consumption for the entire house.
Units: kWh/year (IP and SI).
- **Total:** The annual total energy consumption for the entire house.
Units: MBtu/year (IP), GJ/year (SI) for Gas Furnace/AC ; kWh/year (IP and SI) for Electric Heat Pump.

Energy per ft²

The annual energy consumption for the entire house divided by the area of the house, broken into the following components:

- **Heating:** The annual heating energy consumption for the entire house per floor area.
Units: kBtu/ ft² (IP), GJ/ m² (SI) for Gas Furnace; kWh/ ft² (IP), kWh/ m² (SI) for Electric Heat Pump.
- **Cooling:** The annual cooling energy consumption for the entire house per floor area.
Units: kWh / ft² (IP), kWh / m² (SI).
- **Total:** The annual total energy consumption for the entire house per floor area.
Units: MBtu/ ft² (IP), GJ/ m² (SI) for Gas Furnace/AC ; kWh/ ft² (IP), kWh/ m² (SI) for Electric Heat Pump.

Total Cost

The cost of the annual energy consumption for the entire house, which is the energy totals multiplied by electricity and gas prices, broken into the following components:

- **Cooling:** The cost of the annual cooling energy consumption for the entire house. This value should equal the **Cooling Energy Total** multiplied by the **Electricity** cost.
Units: \$/year
- **Heating:** The cost of the annual heating energy consumption for the entire house. This value is the **Heating Energy Total** multiplied by either the **Gas** cost for gas furnaces or the **Electricity** cost for heat pumps.
Units: \$/year
- **Total:** The total cost of the annual energy consumption for the entire house. This value is the sum of the heating and cooling costs.
Units: \$/year

4.6.3.1. Window Annual Energy

The **Window Annual Energy** results show the portion of the annual energy consumption of a building that can be attributed to the window being modeled. Positive values mean that the window adds that amount to the energy consumption of the house on an annual basis. Negative values can occur for heating, meaning that the window provides heating in the form of useful solar gain, which more than compensates for heat lost, and helps to lower the house's heating energy consumption. The first four columns represent the four window orientations (north, east, south and west). The fifth column represents skylights.

	North	East	South	West	Skylight
Cooling ft2 (kWh/ft2)	0.00	0.00	0.00	0.00	0.00
Heating ft2 (kBtu/ft2)	0.00	0.00	0.00	0.00	0.00
Cooling (kWh)	00	00	00	00	00
Heating (MBtu)	0.00	0.00	0.00	0.00	0.00

Figure 4-28. The **Results** tab for **Window Annual Energy**.

<i>Cooling/ft²</i>	Cooling energy per unit window area. Units: kWh/ft ² -year (IP), kWh/m ² -year (SI).
<i>Heating/ft²</i>	Heating energy per unit window area. Units: kBtu/ft ² -year (IP), GJ/m ² -year (SI) for Gas Furnace ; kWh/ft ² -year (IP), kWh/m ² -year (SI), for HeatPump .
<i>Cooling Energy</i>	Cooling energy attributed to windows. Units: kWh/year (IP and SI)
<i>Heating Energy</i>	Heating energy attributed to windows. Units: MBtu/year (IP), GJ/year (SI) for Gas Furnace , or kWh/year (IP and SI) for HeatPump .

4.6.3.2. Window Annual Cost

The **Window Annual Cost** result shows the difference between the annual energy cost of a building with the window being modeled and with a windowless wall. The energy use values in the **Window Annual Energy** result are converted to costs using the input values for electricity and gas. Positive values mean that the window uses *more* energy than a standard insulated wall with no windows; negative values for heating mean that the window uses *less* energy than a standard insulated wall with no windows. Negative values represent economic savings that will offset other energy-consuming features in the house, thus reducing the total home heating bill.

	North	East	South	West	Skylight
Cooling (\$/ft ²)	0.13	0.33	0.23	0.26	0.00
Heating (\$/ft ²)	-0.03	-0.21	-0.42	-0.15	0.00
Cooling (\$)	9.71	24.43	16.94	19.39	0.00
Heating (\$)	-2.18	-15.40	-31.44	-11.38	0.00
Total (\$)	7.53	9.03	-14.50	8.01	0.00

Figure 4-29. The **Results** tab for **Window Energy Cost**.

<i>Cooling (\$/area)</i>	Cooling energy per unit window area. Units: \$/ft ² -year (IP), . \$/m ² (SI)
<i>Heat (\$/area)</i>	Heating energy per unit window area. Units: \$/ft ² -year (IP), . \$/m ² (SI)
<i>Cooling (\$)</i>	Cooling energy attributed to windows. Units: \$/year.
<i>Heating (\$)</i>	Heating energy attributed to windows. Units: \$/year.
<i>Total Energy (\$)</i>	Sum of the Cooling and Heating Energy Cost. Units: \$/year.

4.6.3.3. Window Peak Demand

The **Window Peak Demand** result shows the difference between the peak energy demand of a building with the window being modeled and with a windowless wall. Positive values mean that the window has a higher peak demand than a standard insulated wall with no windows; negative values mean that the window has a lower peak demand than a standard insulated wall with no windows.

Peak heating and cooling loads determine the required size of the furnace and air conditioner needed to meet maximum thermal loads. Lower peak demand means smaller, less expensive equipment. Peak heating conditions typically occur on cold winter nights, and peak cooling conditions typically occur on hot, sunny summer afternoons. Make sure that the equipment sizing calculations done by your HVAC contractor take into account the benefits of high-performance windows.

	North	East	South	West	Skylight
Cooling ft2 (W/ft2)	1.81	2.30	1.85	5.56	0.00
Heating ft2 (Btu/h-ft2)	6.28	6.20	5.18	5.78	0.00
Cooling (kW)	0.14	0.17	0.14	0.42	0.00
Heating (MBtu)	0.47	0.47	0.39	0.43	0.00

Figure 4-30. The **Results** tab for **Window Peak Energy**.

Cool Peak/

Unit Area

Cooling peak per unit window area.

Units: W/ft² (IP).

Heat Peak/

Unit Area

Heating peak per unit window area.

Units: Btu/ ft² (IP). or kW (IP and SI) for HeatPump.

Cooling Peak

Cooling peak attributed to windows.

Units: kW (IP and SI).

Heating Peak

Heating peak attributed to windows.

Units: kBtu/hr (SI and IP) or kW (SI and IP) for HeatPump.

The Location Library is used to define new locations for calculations. RESFEN comes with over 200 locations predefined, and if the appropriate weather files for the DOE2 simulation can be obtained, more locations can be added.

The information contained in the Location Library includes:

- Weather file for the DOE2 simulation
- Insulation package which determines the level of insulation for the building envelope
- Utility rates for that location which are used to calculate the building energy costs

Because the insulation levels for the calculation are contained in the Location Library, it is possible to make a new record in this library, using the same weather file and utility rates, but specifying a different insulation package.

4.8. Location Library

4.8.1. Location Library List View

The Location Library List view shows all the records that are in the library. Some of the records in the Location Library do not have all the information defined, such as the insulation packages. These records have an “*” in front of the name, and should not be used for calculations.

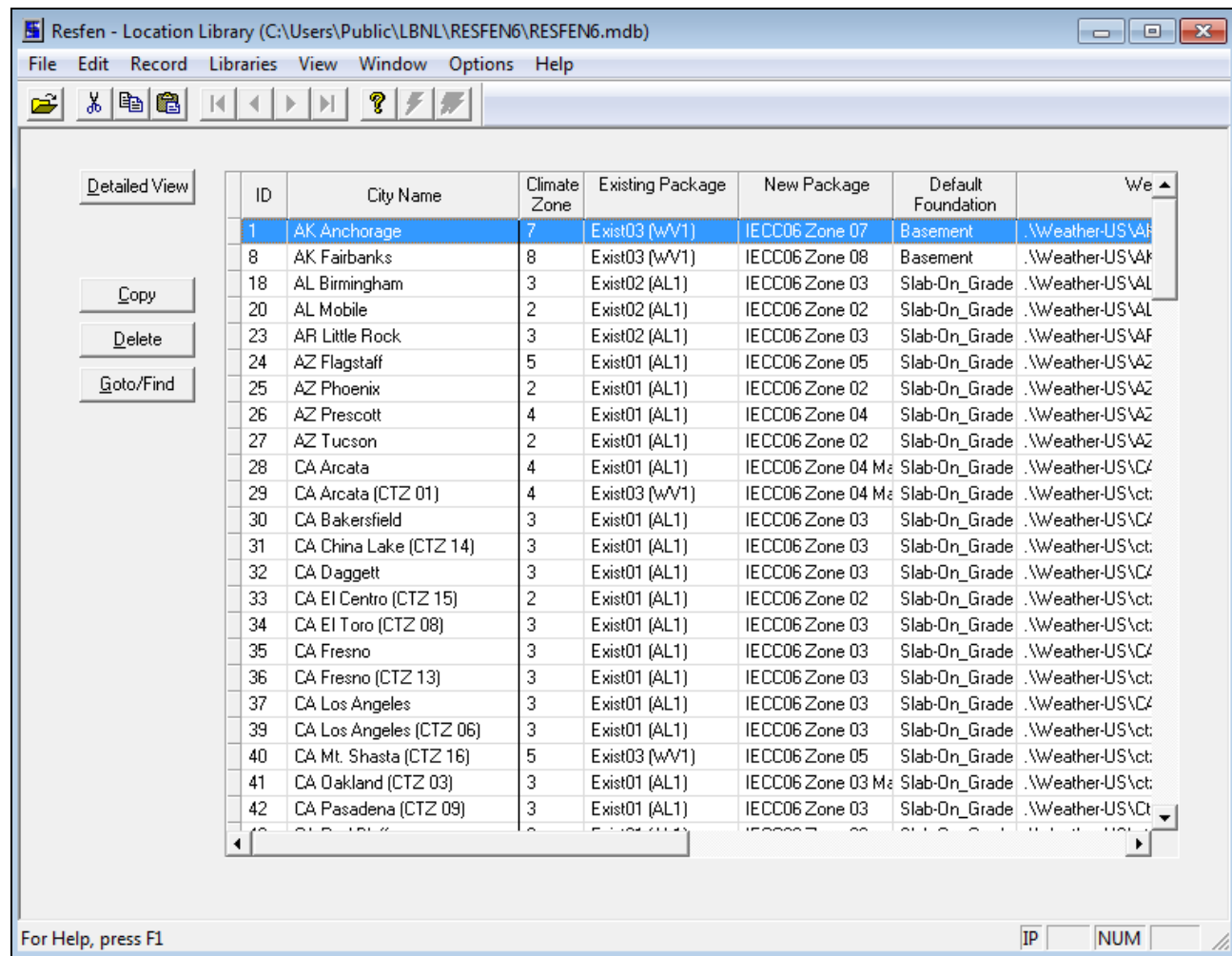


Figure 4-31. The Location Library List View.

- Detailed View** Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy** Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will be unique for this library.
- Delete** Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Delete** button.

Goto/Find Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.

4.8.2. Location Library Detail View

The Location Library detailed view shows all the input values for each individual record, as shown in the figure below.

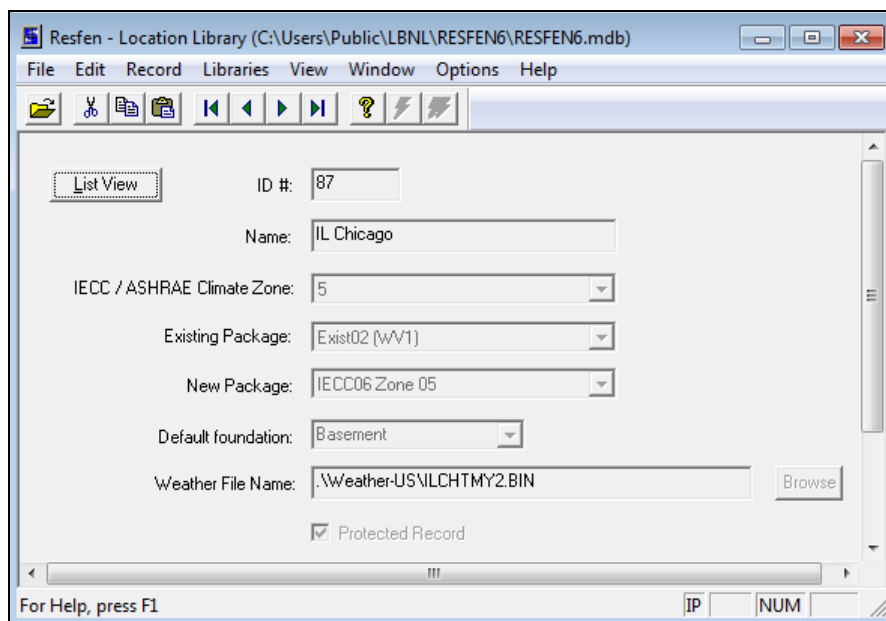


Figure 4-32. The Location Library Detail View.

The fields in the Location Library detailed view are the following:

- | | |
|---------------------------|--|
| <i>ID</i> | The ID of the record, set automatically by the program or by the user when copying an existing record. This ID must be unique. |
| <i>Name</i> | The name of the record, which can be any text. The default locations are named by the state abbreviation first, then the city name. |
| <i>Existing Package</i> | The building envelope insulation package to be used for this location, from the Package Library . This insulation package will be used if “Existing” is selected in the House Type pull-down in the House Library. See the section on Package Library in this manual for more information about adding new insulation packages to that library. This value can be changed from the House Library for a particular modeling scenario. |
| <i>New Package</i> | The building envelope insulation package to be used for this location, from the Package Library . This insulation package will be used if “New” is selected in the House Type pull-down in the House Library. See the section on Package Library in this manual for more information about adding new insulation packages to that library. This value can be changed from the House Library for a particular modeling scenario. |
| <i>Default foundation</i> | The default foundation type for the location. This value can be changed from the House Library for a particular modeling scenario. The types to select are: <ul style="list-style-type: none"> ▪ Crawlspace ▪ Slab-On-Grade ▪ Basement |

*Weather File**Name*

The name of the DOE2 weather file, which must exist in the Weathr directory under the RESFEN program directory. These are binary files that contain weather data specifically formatted for the DOE2 simulation program which RESFEN uses for the calculations. In general, these weather files need to come from LBNL and cannot be generated by the user.

4.8.3. Location Databases

Each record in the Location Library references a weather file for RESFEN to use in the building calculation. There are default databases that come with the program which reference different sets of weather files. Other databases are available on the LBNL RESFEN website Knowledge Base (<http://windows.lbl.gov/software/resfen/resfen.html>)

- **RESFEN.mdb:** the default database that RESFEN opens, which contains all the US cities defined in the Location Library, with a few example House Library records
- **RESFEN-CanadaWthr.mdb:** a database which has all the Canadian cities (locations with DOE2 weather data) in the Location Library, with a sample record for each location defined in the House Library.
- **RESFEN-Chile.mdb:** a database which has all the US cities defined in the Location Library, and a House Library record defined for each of those US locations
- **RESFEN-ChinaWeather.mdb:** a database which has all the Chinese cities (locations with DOE2 weather data) in the Location Library, with a sample record for each location defined in the House Library.

4.9. Window Library

The Window Library is used to define windows that can be used in the House Library input. The records in the Window Library can be imported from WINDOW databases, or they can be defined by the user.

4.9.1. Window Library List View

The Window Library List view shows all the records that are in the library. The default records in the library were imported from a WINDOW library (RESFENWindows.mdb, which is installed automatically in the RESFEN program directory). These default windows correspond to the default windows shown on the Efficient Windows Collaborative website (www.efficientwindows.org). It is possible to create new records in this library by either:

- Copying an existing window using the Copy button in the List View. Then highlight that record and click the Detailed View button and edit the input values for the new window as needed.
- Importing records from a WINDOW database using the Import button. This method is explained in more detail later in this section

The screen below shows the List View of the Window Library.

ID	Name	Ufactor Btu/h-ft ² -F	SHGC	Area ft ²	Width inches	Height inches	Source
101	AL 1 Clr	1.159	0.756	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
102	AL 1 Bronze	1.158	0.647	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
111	AL 2 Clear	0.762	0.675	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
112	AL 2 Bronze	0.762	0.562	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
113	AL 2 SS Tint	0.761	0.469	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
121	AL 2 PY Low-E	0.613	0.635	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
131	AL 2 SP Low-E	0.595	0.528	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
141	AL 2 SS Low-E	0.585	0.367	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
201	ATB 1 Clr	1.004	0.696	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
202	ATB 1 Bronze	1.004	0.594	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
211	ATB 2 Clear	0.634	0.620	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
212	ATB 2 Bronze	0.634	0.515	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
213	ATB 2 SS Tint	0.634	0.428	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
221	ATB 2 PY Low-E	0.496	0.583	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
231	ATB 2 SP Low-E	0.480	0.483	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
241	ATB 2 SS Low-E	0.470	0.333	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
301	W/V 1 Clr	0.837	0.635	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
302	W/V 1 Bronze	0.837	0.540	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
311	W/V 2 Clear	0.493	0.564	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
312	W/V 2 Bronze	0.493	0.466	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
313	W/V 2 SS Tint	0.493	0.385	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
321	W/V 2 PY Low-E	0.365	0.529	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
331	W/V 2 SP Low-E	0.350	0.436	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
341	W/V 2 SS Low-E	0.341	0.297	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
351	W/V 3 HT Super	0.285	0.382	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
352	W/V 3 SS Super	0.281	0.254	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
411	INS 2 Clear	0.444	0.596	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
412	INS 2 Bronze	0.444	0.492	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
413	INS 2 SS Tint	0.444	0.405	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
421	INS 2 PY Low-E	0.290	0.559	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
431	INS 2 SP Low-E	0.271	0.460	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
441	INS 2 SS Low-E	0.259	0.310	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
451	INS 3 HT Super	0.182	0.402	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF
452	INS 3 SS Super	0.177	0.264	9.69	24.00	59.00	C:\Program Files\LBNL\RESFEN5\RESF

Figure 4-33. The Window Library List View.

- Detailed View** Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy** Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will be unique for this library.
- Delete** Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Delete** button.

- Goto/Find** Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.
- Import** Used to import window records from a WINDOW database. To use this feature, windows need to be created in the WINDOW program, which is used to define accurate U-value and SHGC values from detailed information about the window frame and glazing system. See the *WINDOW User's Manual* for details about making that database, or visit the website at <http://windows.lbl.gov/software>.
- To import records from the WINDOW database, click the Import button. A dialog box will appear, where the WINDOW database can be specified

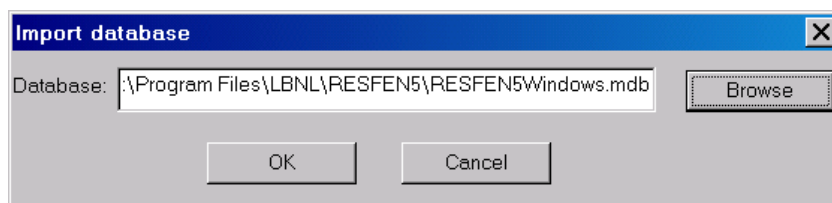


Figure 4-34. Importing a WINDOW window database.

The Browse button can be used to locate the WINDOW database. The default WINDOW database installed with RESFEN is called RESFENWindows.mdb, and the records in that database are the default records in the RESFEN Window Library.

Click OK when the database path has been entered, and the program will open the database and display the records that can be imported.

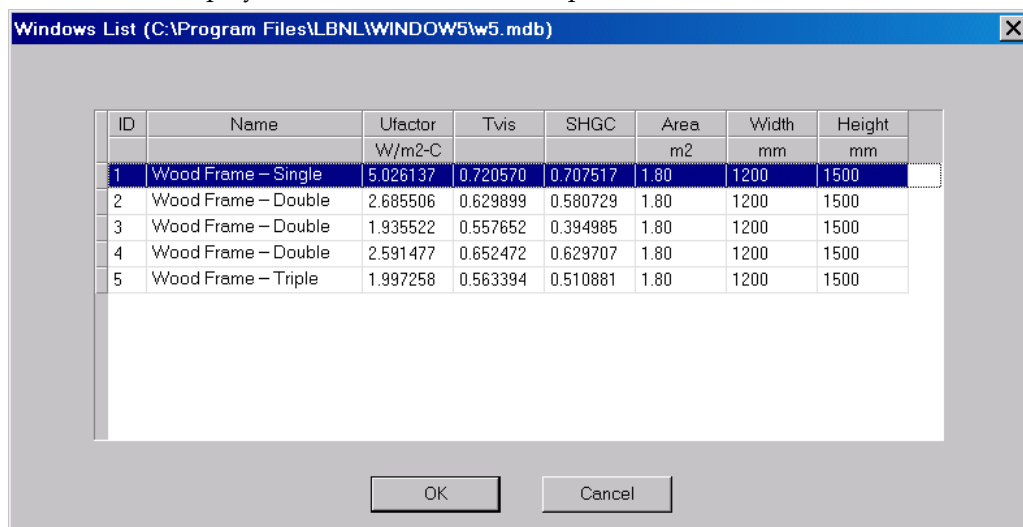
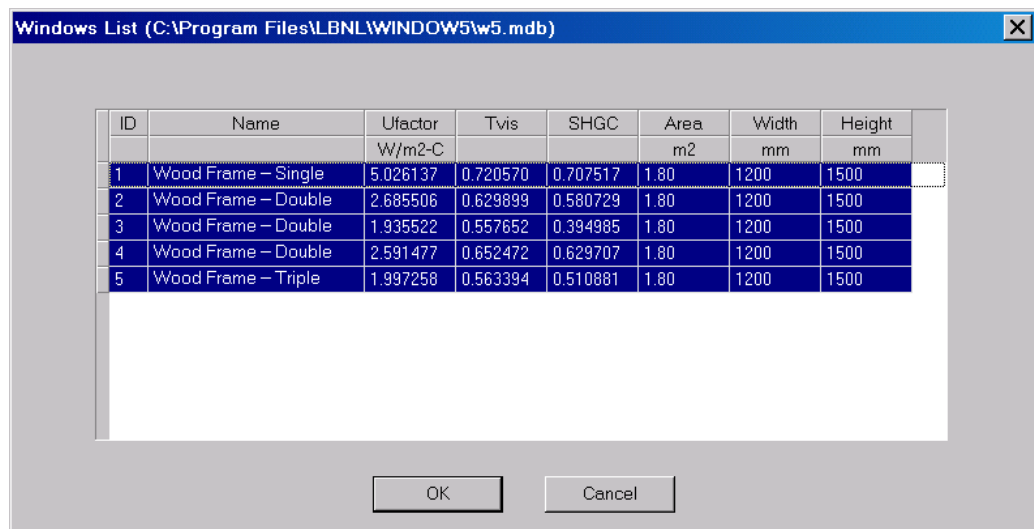


Figure 4-35. Select records from the WINDOW window database to be imported into the RESFEN Window Library.

Select the records to be imported (multiple records can be highlighted using Ctrl and Shift with mouse clicks) into the RESFEN Window Library, and click the OK button.



Windows List (C:\Program Files\LBNL\WINDOW5\w5.mdb)

ID	Name	Ufactor W/m2-C	Tvis	SHGC	Area m2	Width mm	Height mm
1	Wood Frame - Single	5.026137	0.720570	0.707517	1.80	1200	1500
2	Wood Frame - Double	2.685506	0.629899	0.580729	1.80	1200	1500
3	Wood Frame - Double	1.935522	0.557652	0.394985	1.80	1200	1500
4	Wood Frame - Double	2.591477	0.652472	0.629707	1.80	1200	1500
5	Wood Frame - Triple	1.997258	0.563394	0.510881	1.80	1200	1500

OK Cancel

Figure 4-36. Select records from the WINDOW window database to be imported into the RESFEN Window Library.

4.9.2. Window Library Detail View

The Window Library detailed view shows all the input values for each individual record, as shown in the figure below.

The screenshot shows a software window titled "Resfen - Window Library (C:\Program Files\LBNL\RESFEN5\resfen5.mdb)". It has a menu bar with "File", "Edit", "Record", "Libraries", "View", "Window", "Options", and "Help". Below the menu is a toolbar with icons for file operations and navigation. The main area is titled "List View" and contains a form with the following fields and values:

- ID #: 101
- Name: AL 1 Clr
- Type: (empty)
- Source: C:\Program Files\LBNL\RESFEN5\RESFEN5Wi
- Height: 59.000 inches
- Width: 24.000 inches
- Area: 9.690 ft2
- Ufactor: 1.159 Btu/h-ft2-F
- SHGC: 0.756

At the bottom of the form is a checkbox labeled "Protected". The status bar at the very bottom says "For Help, press F1" and includes buttons for "IP" and "NUM".

Figure 4-37. The Package Library List View.

The fields in the Package Library detailed view are the following:

<i>ID</i>	The ID of the record, set automatically by the program or by the user when copying an existing record. This ID must be unique.
<i>Name</i>	The name of the record, which can be any text. If the records were imported from WINDOW, the Name is the same as the Name value in the WINDOW database.
<i>Type</i>	Unused
<i>Source</i>	The source of the data. For records imported from a WINDOW database: The name of the WINDOW database where the record was imported from, including the computer path of the database location. For records copied from an existing record: Set automatically to User
<i>Height</i>	The height of the window, either from the WINDOW database or input by the user. Units: inches (IP)
<i>Width</i>	The width of the window, either from the WINDOW database or input by the user. Units: inches (IP)
<i>Area</i>	The area of the window, either from the WINDOW database or input by the user. Units: square feet (IP)
<i>Ufactor</i>	The U-factor of the window, either from the WINDOW database or input by the user Units: Btu/ft ² -h-°F (IP)
.	

<i>SHGC</i>	The Solar Heat Gain Coefficient, either from the WINDOW database or input by the user.
<i>Protected</i>	This field controls whether the data in the record can be edited. If it is checked, the fields in the record cannot be edited, and that field cannot be unchecked. If it is not checked, the data can be edited. Records imported from a WINDOW database automatically have the Protected field checked. Fields created by copying another record, even a record from a WINDOW database, are not protected.

4.10. Packages Library

The Package Library is used to defined the building envelope insulation levels for the following building components:

- Ceiling
- Wall
- Floor
- Crawlspace
- Basement

These packages are referenced from the Location Library and are used in to define the building when that location is referenced in the House Library.

4.10.1. Packages Library List View

The **Package Library** List view shows all the records that are in the library. The default records in the library are based on the requirements for the default locations that come with the program. It is possible to make new insulation packages in this library by copying an existing package using the Copy button in the List View. Then highlight that record and click the Detailed View button and edit the input values for the new package, including the name, as needed.

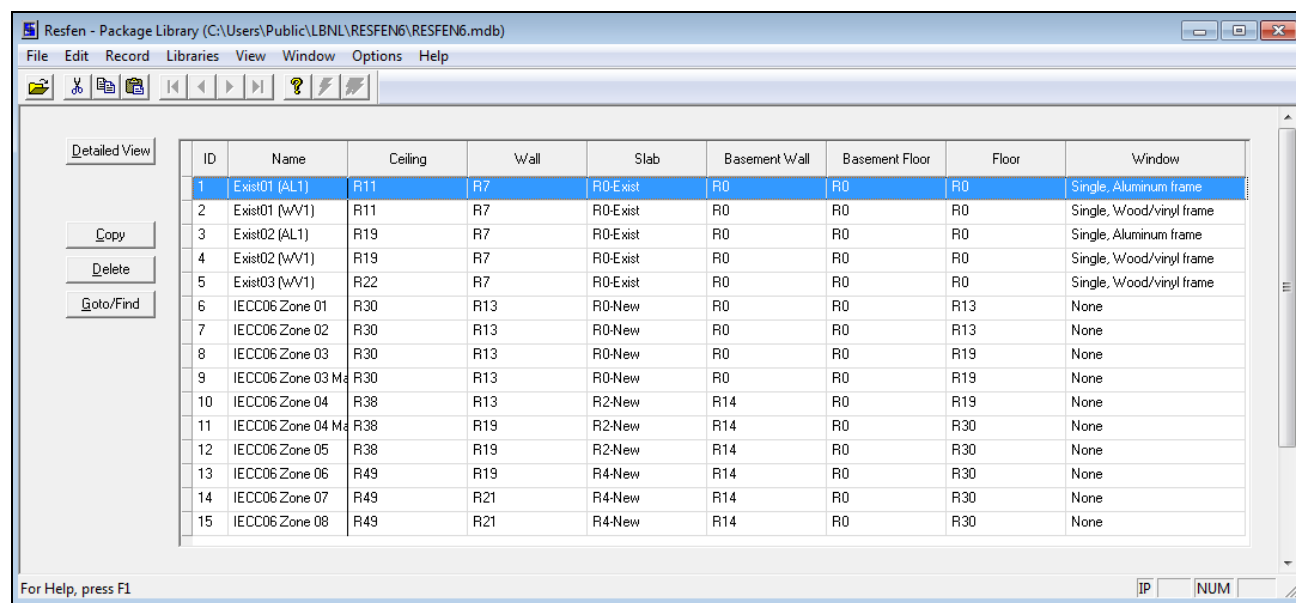


Figure 4-38. The Package Library List View.

- Detailed View** Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy** Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will be unique for this library.
- Delete** Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Delete** button.
- Goto/Find** Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.

4.10.2. Packages Library Detail View

The Location Library detailed view shows all the input values for each individual record, as shown in the figure below.

Figure 4-39. The Package Library Detail View.

The fields in the Package Library detailed view are the following:

<i>ID</i>	The ID of the record, set automatically by the program or by the user when copying an existing record. This ID must be unique.
<i>Name</i>	The name of the record, which can be any text. The default packages are used in the default locations, and are named according to whether they are to be used to define the insulation levels for New or Existing construction.

Residential Construction Values

The names of the insulation levels reflect the R-value of the insulating layer, not the overall R-value of the wall. The U-values that correspond to these R-value constructions are documented in Table 6-5.

<i>Ceiling</i>	The level of ceiling insulation for this package, from the predefined list of the following values:
	<ul style="list-style-type: none"> ▪ R11 ▪ R19 ▪ R22 ▪ R26 ▪ R30 ▪ R38 ▪ R49

<i>Wall</i>	<p>The level of wall insulation for this package, from the predefined list of the following values:</p> <ul style="list-style-type: none">▪ R7▪ R11▪ R13▪ R14▪ R19▪ R21▪ R28
<i>Crawl Slab</i>	<p>The level of crawlspace insulation for this package, from the predefined list of the following values:</p> <ul style="list-style-type: none">▪ R0▪ R2▪ R3▪ R4▪ R5▪ R6▪ R12
<i>Basement Wall</i>	<p>The level of basement wall insulation for this package, from the predefined list of the following values:</p> <ul style="list-style-type: none">▪ R0▪ R5▪ R6▪ R7▪ R8▪ R9▪ R11▪ R14▪ R15▪ R19▪ R28▪ R30
<i>Basement Floor</i>	<p>The level of basement floor insulation for this package, from the predefined list of the following values:</p> <ul style="list-style-type: none">▪ R0▪ R5▪ R6▪ R7

- R8
- R9
- R11
- R14
- R15
- R19
- R28
- R30

Floor

The level of ceiling insulation for this package, from the predefined list of the following values:

- R0
- R11
- R13
- R14
- R19
- R26
- R28
- R30

Window for Sizing calc

Base Window The base window to be used for this location. This window is what the program uses to calculate the orientation specific results.

Protected Record

If this box is checked, the record is protected from editing. Protected records are generally those that are shipped with the program. Copying a protected record turns off the protection and allows the user to edit the copied record.

4.11. Results Library

The Results Library is used to view results from multiple records from the House Library. This can be extremely useful when trying to compare the impact of different window configurations on a building. The Results Library also has a feature that allows the data from these results to be exported to a file that can be imported into a spreadsheet program.

4.11.1. Results Library List View

The Results Library List View shows the results from the House Library calculations.

ID	Name	Location	Whole House Cooling	Whole House Heating	Whole House Energy (Source)	Whole House Cooling Cost (\$)	Whole House Heating Cost (\$)	Whole House Total Cost (\$)
1	Miami- Double Clear	FL Miami	5064 KWH	0.3 MBTU	52.2 MBTU	440.57	5.46	446.03
2	Miami- Double Clear	FL Miami	6516 KWH	0.2 MBTU	66.9 MBTU	566.89	2.77	569.66
3	Miami- Double Clear	FL Miami	7783 KWH	0.7 MBTU	80.4 MBTU	677.12	11.86	688.98
4	Miami- Double Clear	FL Miami	11445 KWH	1.2 MBTU	118.4 MBTU	995.71	21.35	1017.06
5	Chicago- Double Clear	IL Chicago	914 KWH	64.3 MBTU	73.6 MBTU	69.46	555.21	624.67
6	Chicago Double Clear	IL Chicago	1638 KWH	98.4 MBTU	115.2 MBTU	124.49	850.25	974.74
7	Chicago- Double Clear	IL Chicago	1117 KWH	95.1 MBTU	106.5 MBTU	84.89	821.39	906.28
8	Chicago Double Clear	IL Chicago	2028 KWH	125.6 MBTU	146.3 MBTU	154.13	1085.05	1239.18
9	Portland- Double Clear	OR Portland	525 KWH	43.5 MBTU	48.8 MBTU	37.28	427.75	465.03
10	Portland - Double Clear	OR Portland	912 KWH	64.9 MBTU	74.2 MBTU	64.75	638.49	703.24
11	Portland- Double Clear	OR Portland	728 KWH	96.1 MBTU	103.6 MBTU	51.69	945.98	997.67
12	Portland - Double Clear	OR Portland	1194 KWH	107.8 MBTU	120.0 MBTU	84.77	1060.57	1145.34
13	Miami- Double Clear	FL Miami	5064 KWH	21.0 KWH	15255.0 KWH	440.57	359.31	799.88
14	Miami- Double Clear	FL Miami	6516 KWH	12.0 KWH	19584.0 KWH	566.89	205.32	772.21

Figure 4-40. The **Results Library List View**.

Detailed View Used to change to the Detailed View of the highlighted record in order to edit the input values.

Modify List This allows the user to create lists that allow different collections of the results, by defining which results records are to be associated with each list. Clicking this button opens another dialog box where the results for each list can be defined, as shown in the following figure.

The fields in the Modify List dialog box are:

- **List Name:** This is the name of the List, input by the user, which will appear in the List Name pull-down in the Results Library List View.
- **Description:** This is a description of the List, input by the user.
- **Left hand table:** The left hand table shows the House Library results that are not currently part of the current list.
- **Selection buttons:** the Selection buttons are used to move results from the left hand table to the right hand table. The single arrow buttons move the currently highlighted records, the double arrow buttons move all the records.
- **Right hand table:** The right hand table shows the House Library results that have been selected to be associated with this list. They can be removed with the “left pointing” Selection buttons, which will put them back into the left hand table.

- **New List** button: This button is used to make a new list. Clicking this button will open a new list with the the List Name and Description fields blank, and all the House Library results listed on the left hand table.
- **OK**: The OK button is used to accept the changes to the List and return to the Results Library List View display.
- **Cancel**: The Cancel button is used to return to the Results Library List View display without saving any changes made to the list.

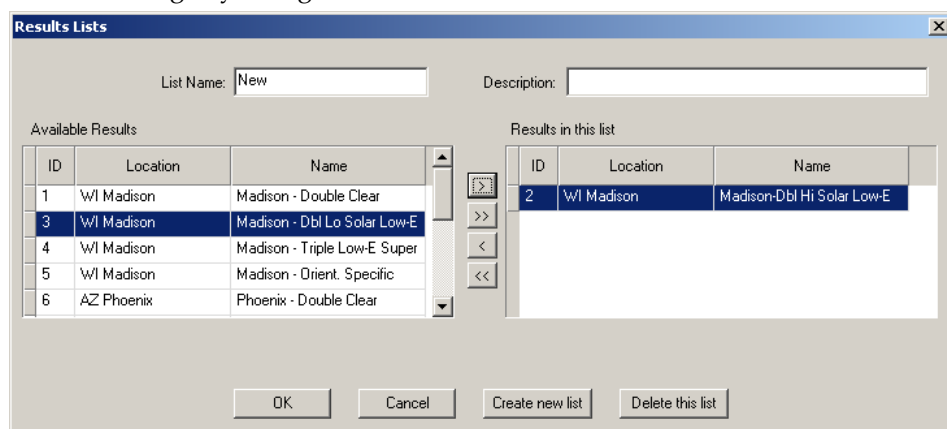


Figure 4-41. The *Modify List* dialog box.

Export

Used to export the results in the list to a comma separated ASCII text file, which can then be imported into a spreadsheet program.

Bar Chart

Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.

4.11.2. Results Library Detail View

The Results Library Detail View is similar to the House Library Detail View except that the input values are not editable. It is merely a way to quickly see what the input variables were for a set of results.

Resfen - Result Library (C:\Users\Public\LBNL\RESFEN6\RESFEN6.mdb)

File Edit Record Libraries View Window Options Help

House Data

ID# 1 - Miami-Double Clear

Name Miami-Double Clear

Location FL Miami

House Type 1-Story New Frame

HVAC System Type Gas Furnace / AC

Floor Area 1700. ft2

Envelope Package IECC06 Zone 01

Foundation Type Slab-On-Grade

Set to Defaults

Electric Cost Florida 0.087 \$/kWh

Gas Cost Florida 1.711 \$/Therm

Description Example #1 - Case A

Window Data

Window Type	Area ft2	U-factor Btu/h-ft2-F	SHGC	Air Leakage cfm/ft2	Solar Gain Reduction
North 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
East 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
South 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
West 1010: 1 - 101 - AL 1 Clr	63.75	1.16	0.76	0.3	Typical
Skylight User defined	0.	0.	0.	0.	None

☒ East, South and West windows are the same type as North

Total Window Area 255 ft2 15.0% of floor area

Whole House

	Heating	Cooling	Total (source)
Annual Energy Totals	0.3 MBTU	5064 KWH	52.2 MBTU
Annual Energy per ft2	0.2 kBTU/ft2	2.98 KWH/ft2	30.7 kBTU/ft2
Peak	25.1 kBTU/hr	2.29 KW	
Cost \$	5.46	440.57	446.03

*Results are based on a non-standard DOE-2 template file:
C:\Users\Public\LBNL\RESFEN6\data\RESFEN6template.d2

For Help, press F1

Figure 4-42. The Results Library Detail View.

4.12. Electric Rate Library

The Electric Rate Library is used to define electricity rates that are then used in the Location Library definitions and in the House Library Detail View in the House Data section. New rates can be added to the library and then used in the Location Library

The default utility data for each location is from the National Association of Regulatory Utility Commissioners (NARUC) -- "Residential Electric Bills, Winter 1994-95", published May 31, 1996.

4.12.1. Electric Rate Library List View

The Electric Rate Library List View shows all the electricity cost records in the currently open database.

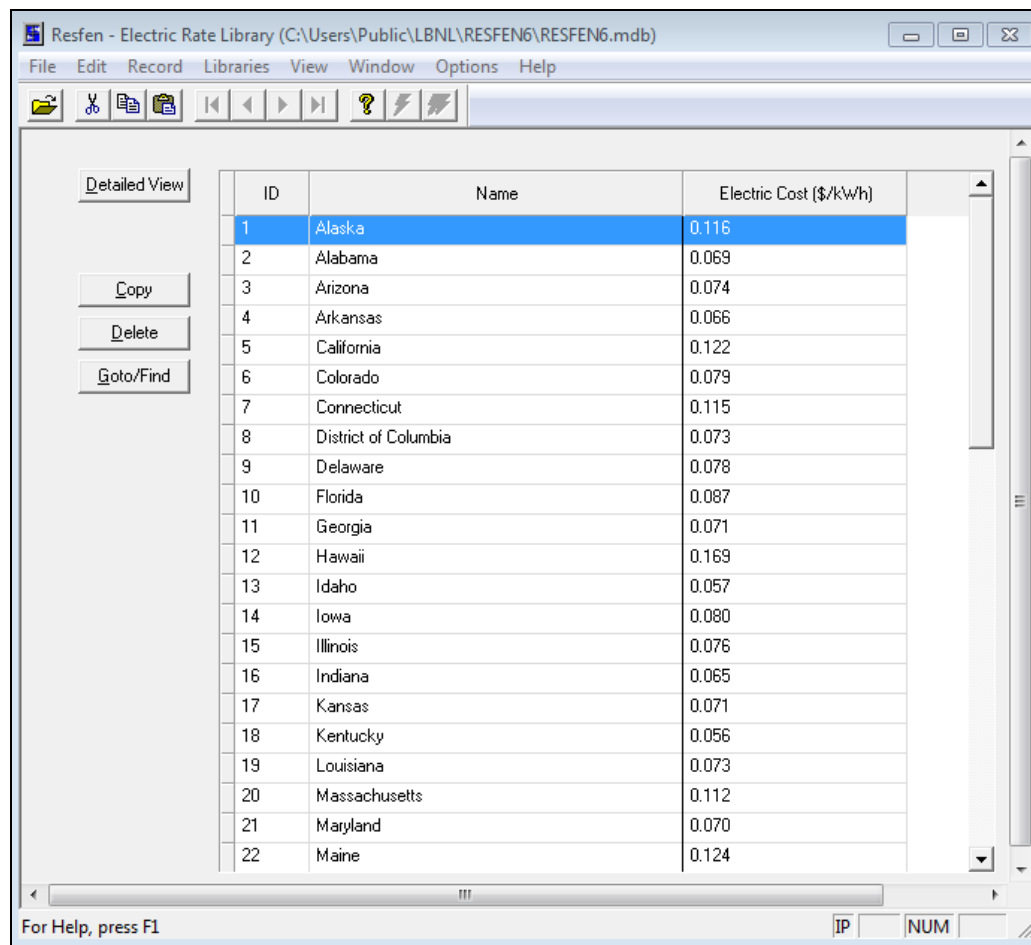


Figure 4-43. The Electric Rate Library List View.

- Detailed View* Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy* Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will unique for this library.

<i>Delete</i>	Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the Delete button.
<i>Goto/Find</i>	Used to find a record in the library based on the Name field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose Name field starts with those letters will be highlighted.

4.12.2. Electric Rates Library Detail View

The Electric Rate Library Detail View shows the input values for each individual record, as shown in the figure below. The input values for this library are quite simple, just the actual electricity cost. The default values are from the Efficient Windows Collaborative website (updated 2004), with one record per state. These values can be changed to reflect different prices, or new records can be created for specific cases.

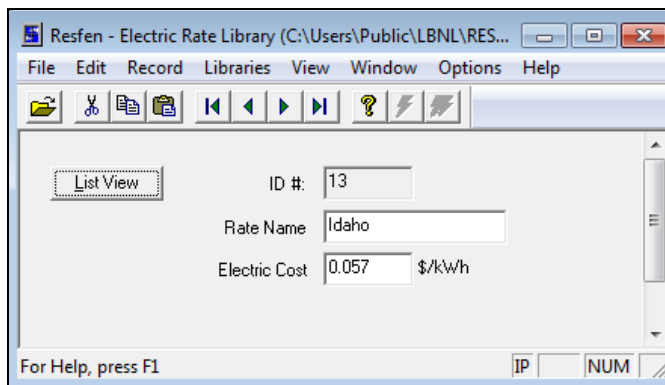


Figure 4-44. The Electric Rate Library Detail View.

The fields in the Electric Rate Library detailed view are the following:

<i>ID</i>	The ID of the record, set automatically by the program or by the user when copying an existing record. This ID must be unique.
<i>Rate Name</i>	Name of electric rate.
<i>Electric Cost</i>	The electricity rate. Units: \$0.00/kWh (IP and SI). Legal Values: any number.
<i>List View Button</i>	This button is used to return to the List View of the library.

4.13. Gas Rates Library

The Gas Rate Library is used to define natural gas rates that are then used in the House Library Detail View in the House Data section. The default values are from the Efficient Windows Collaborative website (updated 2004), with one record per state. These values can be changed to reflect different prices, or new records can be created for specific cases.

The default utility data for each location is from the National Association of Regulatory Utility Commissioners (NARUC) -- "Residential Gas Bills, Summer 1995", published Jan. 18, 1996.

4.13.1. Gas Rates Library List View

The Gas Rate Library List View shows all the electricity cost records in the currently open database.

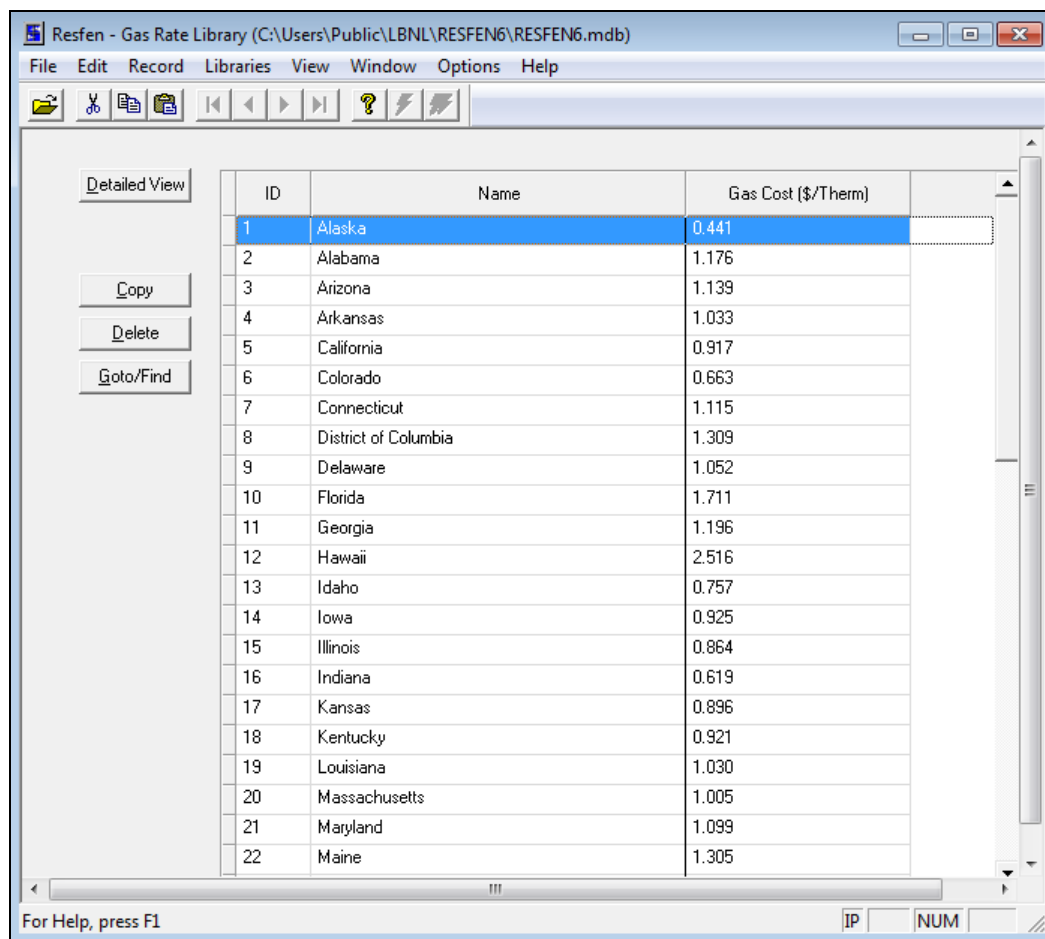


Figure 4-45. The Gas Rate Library List View.

- Detailed View* Used to change to the Detailed View of the highlighted record in order to edit the input values.
- Copy* Used to copy existing records to create new records which can then be edited as needed. Highlight the record or records to be copied (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Copy** button. By default the program will increment the ID number based on the last ID value, but this can be changed by the user as long as the ID will be unique for this library.

- Delete* Used to delete existing records. Highlight the record or records to be deleted (use Shift + left mouse click to select multiple contiguous records, or Ctrl + left mouse click to select multiple non-contiguous records), and click the **Delete** button.
- Goto/Find* Used to find a record in the library based on the **Name** field. When this button is clicked, a small dialog box will appear, and the beginning letters of the name can be typed, and the first record whose **Name** field starts with those letters will be highlighted.

4.13.2. Gas Rates Library Detail View

The Gas Rate Library Detail View shows the input values for each individual record, as shown in the figure below. The input values for this library are quite simple, just the actual gas cost.

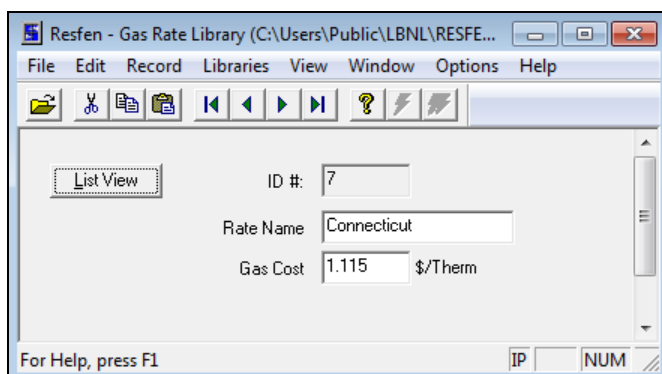


Figure 4-46. The Gas Rate Library Detail View.

The fields in the Electric Rate Library detailed view are the following:

- ID* The ID of the record, set automatically by the program or by the user when copying an existing record. This ID must be unique.
- Rate Name* Name of gas rate.
- Gas Cost* The natural gas rate.
Units: \$0.00/kWh (IP and SI).
Legal Values: any number.
- List View Button* This button is used to return to the List View of the library.

5. TECHNICAL REFERENCE

5.1. Location Library Data

The Locations with the “ID” field completed are contained in the default RESFEN database file (RESFEN6.mdb). The other weather files will be added to the default database in the future. The weather files used in the Energy Star 2008 analysis, which is primarily what is in the default RESFEN database, are all TMY2 weather files. The California Climate Zone files (CTZ<nn>c.bin) are specially compiled weather data.

The locations with a * in the E* column were used in the Energy Star 2008 analysis.

Table 5-1. RESFEN Locations

E*	ID	State Abbreviation / City Name	WeatherFile	New Construction Package	Existing Construction Package	Default Foundation
*	1	AK Anchorage	AKANTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	2	AK Annette	AKATTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	4	AK Bethel	AKBETMY2.BIN	IECC06 Zone 08	Exist03 (WV1)	Basement
	6	AK Big Delta	AKBDTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	7	AK Cold Bay	AKCBTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
*	8	AK Fairbanks	AKFATMY2.BIN	IECC06 Zone 08	Exist03 (WV1)	Basement
	9	AK Gulkana	AKGUTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	10	AK King Salmon	AKKSTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	11	AK Kodiak	AKKOTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	13	AK McGrath	AKMCTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	14	AK Nome	AKNOTMY2.BIN	IECC06 Zone 08	Exist03 (WV1)	Basement
	15	AK St. Paul Island	AKSITMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	16	AK Talkeetna	AKTATMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	17	AK Yakutat	AKYATMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
*	18	AL Birmingham	ALBITMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	19	AL Huntsville	ALHUTMY2.BIN	IECC06 Zone 03	Exist02 (WV1)	Slab-On_Grade
*	20	AL Mobile	ALMBTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	21	AL Montgomery	ALMNTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	22	AR Fort Smith	ARFSTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	23	AR Little Rock	ARLRTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	24	AZ Flagstaff	AZFLTMY2.BIN	IECC06 Zone 05	Exist01 (AL1)	Slab-On_Grade
*	25	AZ Phoenix	AZPHTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
*	26	AZ Prescott	AZPRTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Slab-On_Grade
*	27	AZ Tucson	AZTUTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
*	28	CA Arcata	CAARTMY2.BIN	IECC06 Zone 04 Marine	Exist01 (AL1)	Slab-On_Grade
	29	CA Arcata (CTZ 01)	ctz01c.BIN	IECC06 Zone 04 Marine	Exist01 (AL1)	Slab-On_Grade
*	30	CA Bakersfield	CABATMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	31	CA China Lake (CTZ 14)	ctz14c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	32	CA Daggett	CADATMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	33	CA El Centro (CTZ 15)	ctz15c.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
	34	CA El Toro (CTZ 08)	ctz08c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	35	CA Fresno	CAFRTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	36	CA Fresno (CTZ 13)	ctz13c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	37	CA Los Angeles	CALATMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade

E*	ID	State Abbreviation / City Name	WeatherFile	New Construction Package	Existing Construction Package	Default Foundation
	38	CA Long Beach	CALBTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	39	CA Long Beach (CTZ 06)	ctz06c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	40	CA Mt. Shasta (CTZ 16)	ctz16c.BIN	IECC06 Zone 05	Exist01 (AL1)	Slab-On_Grade
	41	CA Oakland (CTZ 03)	ctz03c.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	42	CA Pasadena (CTZ 09)	Ctz09c.bin	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	43	CA Red Bluff	ctz11c.bin	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	44	CA Red Bluff (CTZ 11)	Ctz11c.bin	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	45	CA Riverside (CTZ 10)	ctz10c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	46	CA Sacramento	CASCTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	47	CA Sacramento (CTZ 12)	ctz12c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	48	CA San Diego	CASDTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	49	CA San Diego (CTZ 07)	ctz07c.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	50	CA San Francisco	CASFTMY2.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	51	CA Santa Maria	CASMTMY2.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	52	CA Santa Maria (CTZ 05)	ctz05c.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	53	CA Santa Rosa (CTZ 02)	ctz02c.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	54	CA Sunnyvale (CTZ 04)	ctz04c.BIN	IECC06 Zone 03 Marine	Exist01 (AL1)	Slab-On_Grade
	55	CO Alamosa	COALTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
*	56	CO Denver	COBOTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	57	CO Colorado Springs	COCSTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	58	CO Eagle	COEATMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
*	59	CO Grand Junction	COGJTM2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	60	CO Pueblo	COPUTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	61	CT Bridgeport	CTBRTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	62	CT Hartford	CTHATMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	63	DE Wilmington	DEWLTM2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
*	64	FL Daytona Beach	FLDBTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
*	65	FL Jacksonville	FLJATMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
	66	FL Key West	FLKWTMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
*	67	FL Miami	FLMITMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
*	68	FL Tallahassee	FLTLTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
*	69	FL Tampa	FLTMTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
	70	FL West Palm Beach	FLWPTMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
	71	GA Athens	GAATtmy2.bin	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	72	GA Atlanta	GAATTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	73	GA Augusta	GAAUTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	74	GA Columbus	GACOTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
	75	GA Macon	GAMATMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	76	GA Savannah	GASATMY2.BIN	IECC06 Zone 02	Exist01 (AL1)	Slab-On_Grade
	77	HI Hilo	HIHITMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
*	78	HI Honolulu	HIHOTMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
	79	HI Kahului	HIKATMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
	80	HI Lihue	HILITMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
*	81	IA Des Moines	IADMTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	82	IA Mason City	IAMCTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	83	IA Sioux City	IASCTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	84	IA Waterloo	IAWATMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement

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*	85	ID Boise	IDBOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	86	ID Pocatello	IDPOTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
*	87	IL Chicago	ILCHTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	88	IL Evansville	ILEVTMY2.BIN	IECC06 Zone 04	Exist02 (WV1)	Basement
	89	IL Moline	ILMOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	90	IL Peoria	ILPETMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	91	IL Rockford	ILROTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	92	IL Springfield	ILSPTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	93	IN Fort Wayne	INFWTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	94	IN Indianapolis	ININTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	95	IN South Bend	INSBTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	96	KS Dodge City	KSDCTMY2.BIN	IECC06 Zone 04	Exist02 (WV1)	Basement
	97	KS Goodland	KSGOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	98	KS Topeka	KSTOTMY2.BIN	IECC06 Zone 04	Exist02 (WV1)	Basement
*	99	KS Wichita	KSWITMY2.BIN	IECC06 Zone 04	Exist02 (WV1)	Basement
	100	KY Covington	KYCOTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
*	101	KY Lexington	KYLETMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
*	102	KY Louisville	KYLOTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	103	LA Baton Rouge	LABRTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	104	LA Lake Charles	LALCTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	105	LA New Orleans	LANOTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	106	LA Shreveport	LASHTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	107	MA Boston	MABOTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
	108	MA Worcester	MAWOTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	109	MD Baltimore	MDBATMY2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
	110	ME Caribou	MECATMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
*	111	ME Portland	MEPOTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	112	MI Alpena	MIALTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	113	MI Detroit	MIDETMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
	114	MI Flint	MIFLTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	115	MI Grand Rapids	MIGRTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	116	MI Houghton	MIHOTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	117	MI Lansing	MILATMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
	118	MI Muskegon	MIMUTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
	119	MI Sault Ste. Marie	MISMTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	120	MI Traverse City	MITCTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	121	MN Duluth	MNDUTMY2.BIN	IECC06 Zone 07	Exist02 (WV1)	Basement
*	122	MN International Falls	MNIFTMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
*	123	MN Minneapolis	MNMITMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	124	MN Rochester	MNROTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	125	MN Saint Cloud	MNSCTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	126	MO Columbia	MOCOTMY2.BIN	IECC06 Zone 04	Exist03 (WV1)	Basement
*	127	MO Kansas City	MOKCTMY2.BIN	IECC06 Zone 04	Exist03 (WV1)	Basement
	128	MO Springfield	MOSPTMY2.BIN	IECC06 Zone 04	Exist03 (WV1)	Basement
*	129	MO St. Louis	MOSTTMY2.BIN	IECC06 Zone 04	Exist03 (WV1)	Basement
*	130	MS Jackson	MSJATMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	131	MS Meridian	MSMETMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade

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*	132	MT Billings	MTBITMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	133	MT Cut Bank	MTCBTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	134	MT Glasgow	MTGLTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
*	135	MT Great Falls	MTGFTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	136	MT Helena	MTHETMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	137	MT Kalispell	MTKATMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	138	MT Lewistown	MTLETMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	139	MT Miles City	MTMCTMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	140	MT Missoula	MTMITMY2.BIN	IECC06 Zone 06	Exist02 (WV1)	Basement
	141	NC Asheville	NCASTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	142	NC Cape Hatteras	NCCHTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
*	143	NC Charlotte	NCCRTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
	144	NC Greensboro	NCGRTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
*	145	NC Raleigh	NCRATMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	146	NC Wilmington	NCWITMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
*	147	ND Bismarck	NDBITMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	148	ND Fargo	NDFATMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	149	ND Minot	NDMITMY2.BIN	IECC06 Zone 07	Exist03 (WV1)	Basement
	150	NE Grand Island	NEGITMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	151	NE Norfolk	NENOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	152	NE North Platte	NENPTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	153	NE Omaha	NEOMTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	154	NE Scottsbluff	NESCTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	155	NH Concord	NHCOTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	156	NJ Atlantic City	NJACTMY2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
	157	NJ Newark	NJNETMY2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
*	158	NM Albuquerque	NMALTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Slab-On_Grade
	159	NM Tucumcari	NMTUTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Slab-On_Grade
	160	NV Elko	NVEKTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Slab-On_Grade
	161	NV Ely	NVELTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Slab-On_Grade
*	162	NV Las Vegas	NVLVTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Slab-On_Grade
*	163	NV Reno	NVRETMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Slab-On_Grade
	164	NV Tonopah	NVTOTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Slab-On_Grade
	165	NV Winnemucca	NVWITMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Slab-On_Grade
*	166	NY Albany	NYALTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	167	NY Binghamton	NYBITMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
*	168	NY Buffalo	NYBUTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	169	NY Massena	NYMATMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
*	170	NY New York City	NYNYTMY2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
	171	NY Rochester	NYROTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	172	NY Syracuse	NYSYTM2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	173	OH Akron	OHAKTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	174	OH Cleveland	OHCLTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	175	OH Columbus	OHCO2MY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	176	OH Dayton	OHDATMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	177	OH Mansfield	OHMATMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	178	OH Toledo	OHTOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement

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	179	OH Youngstown	OHYOTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
*	180	OK Oklahoma City	OKOCTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	181	OK Tulsa	OKTUTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	182	OR Astoria	ORASTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
	183	OR Burns	ORBUTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Crawlspace
	184	OR Eugene	OREUTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
*	185	OR Medford	ORMETMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
	186	OR North Bend	ORNBTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
	187	OR Pendleton	ORPETMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Crawlspace
*	188	OR Portland	ORPOTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
	189	OR Redmond	ORRETM2.BIN	IECC06 Zone 05	Exist02 (WV1)	Crawlspace
	190	OR Salem	ORSATMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Crawlspace
	191	PA Allentown	PAALTM2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	192	PA Bradford	PABRTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	193	PA Erie	PAERTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	194	PA Harrisburg	PAHATMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
*	195	PA Philadelphia	PAPHTMY2.BIN	IECC06 Zone 04	Exist01 (WV1)	Basement
*	196	PA Pittsburgh	PAPITMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	197	PA Wilkes-Barre	PAWBTM2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
*	198	PA Williamsport	PAWITMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	199	PI Guam	PIGUTMY2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
	200	PR San Juan	PRSJTM2.BIN	IECC06 Zone 01	Exist01 (AL1)	Slab-On_Grade
*	201	RI Providence	RIPRTMY2.BIN	IECC06 Zone 05	Exist03 (WV1)	Basement
*	202	SC Charleston	SCCHTM2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
	203	SC Columbia	SCCOTMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
*	204	SC Greenville	SCGRTM2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
	205	SD Huron	SDHUTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	206	SD Pierre	SDPITMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	207	SD Rapid City	SDRCTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	208	SD Sioux Falls	SDSFTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	209	TN Bristol	TNBRTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	210	TN Chattanooga	TNCHTM2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	211	TN Knoxville	TNKNTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
*	212	TN Memphis	TNMETMY2.BIN	IECC06 Zone 03	Exist01 (AL1)	Crawlspace
*	213	TN Nashville	TNNATMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Crawlspace
	214	TX Abilene	TXABTM2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	215	TX Amarillo	TXAMTM2.BIN	IECC06 Zone 04	Exist02 (AL1)	Slab-On_Grade
	216	TX Austin	TXAUTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	217	TX Brownsville	TXBRTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	218	TX Corpus Christi	TXCCTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	219	TX El Paso	TXEPTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	220	TX Fort Worth	TXFWTM2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	221	TX Houston	TXHOTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
*	222	TX Lubbock	TXLBTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	223	TX Lufkin	TXLFTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	224	TX Midland	TXMITMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
	225	TX Port Arthur	TXPATMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade

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	226	TX San Angelo	TXSGTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	227	TX San Antonio	TXSNTMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	228	TX Victoria	TXVITMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	229	TX Waco	TXWATMY2.BIN	IECC06 Zone 02	Exist02 (AL1)	Slab-On_Grade
	230	TX Wichita Falls	TXWFTMY2.BIN	IECC06 Zone 03	Exist02 (AL1)	Slab-On_Grade
*	231	UT Cedar City	UTCCTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
*	232	UT Salt Lake City	UTSLTMY2.BIN	IECC06 Zone 05	Exist01 (WV1)	Basement
	233	VA Lynchburg	VALYTM2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
	234	VA Norfolk	VANOTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
*	235	VA Richmond	VARITMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
	236	VA Roanoke	VAROTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
*	237	DC Washington (Sterling, VA)	VASTTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
*	238	VT Burlington	VTBUTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	239	WA Olympia	WAOLTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Basement
	240	WA Quillayute	WAQUTMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Basement
*	241	WA Seattle	WASETMY2.BIN	IECC06 Zone 04 Marine	Exist02 (WV1)	Basement
*	242	WA Spokane	WASPTMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	243	WA Yakima	WAYATMY2.BIN	IECC06 Zone 05	Exist02 (WV1)	Basement
	244	WI Eau Claire	WIECTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	245	WI Green Bay	WIGBTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	246	WI La Crosse	WILCTMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	247	WI Madison	WIMATMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
	248	WI Milwaukee	WIMITMY2.BIN	IECC06 Zone 06	Exist03 (WV1)	Basement
*	249	WV Charleston	WVCHTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
	250	WV Elkins	WVELTMY2.BIN	IECC06 Zone 05	Exist01 (AL1)	Basement
	251	WV Huntington	WVHUTMY2.BIN	IECC06 Zone 04	Exist01 (AL1)	Basement
	252	WY Casper	WYCATMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
*	253	WY Cheyenne	WYCHTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	254	WY Lander	WYLATMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	255	WY Rock Springs	WYRSTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement
	256	WY Sheridan	WYSHTMY2.BIN	IECC06 Zone 06	Exist01 (WV1)	Basement

5.2. RESFEN Modeling Assumptions

The following table contains the input value assumptions used for the DOE2 simulations in RESFEN 6. These are the modeling assumptions that were used in the Energy Star 2008 development work.

More information about the Energy Star 2008 analysis can be found at the following website:

<http://windows.lbl.gov/estar2008/>

Table 5-2. Modeling Assumptions

PARAMETER	DESCRIPTION
Floor Area (ft ² & dimensions)	Variable, from 1,000 to 4,000 square feet, input by user. The defaults for the Energy Star 2008 analysis were: New – 1 Story: 1700sf New – 2 Story: 2800sf Existing 1 Story: 1700sf Existing 2 Story: 2600sf
House Type	New Construction Existing Construction
Foundation	Foundation is based on location. There are a maximum of three options per climate zone, chosen from: Basement Slab-on-Grade Crawlspace See Table 6-1. ^(b)
Insulation	Envelope insulation levels are based on the IECC 2006 Climate Zone of the location. See Table 6-1 for a list of Packages that correspond to each location. See Tables 6-3 and 6-4 for a list of R-values for each building component for package New construction: See Table 6-4. (based on IECC 2006 envelope requirements) ^(c) Existing construction: See Table 6-5. (Ritschard, et al. 1992)
Infiltration	New Construction: SLA = 0.00036 Existing Construction: SLA = 0.00054 Consistent with 2006 IECC reference home Table 404.5.2(1) average value.
Structural Mass (lb/ft ²)	3.5 lb/ft ² of floor area for interior mass, in accordance with the Model Energy Code and NFRC Annual Energy Performance Subcommittee recommendation (September 1998). Where masonry floors are used: 80% of floor area covered by R-2 carpet and pad, and 20% of floor directly exposed to room air. This is in addition to the 3.5 lb/ft ² For Basement walls: masonry, and include insulation located on the exterior of the walls (new construction) and the interior side of the walls (existing construction). This is in addition to above.
Internal Mass Furniture (lb/ft ²)	8.0 lb/ft ² of floor area. Consistent with 2006 IECC reference home Table 404.5.2(1).
Solar Gain Reduction	The Energy Star 2008 analysis used the “Typical” option. Options: None: No solar gain reduction Overhang: 2’ Exterior Overhangs Obstruction: Exterior Obstructions, a completely opaque ($\tau=0.0$), same-height obstruction 20 feet away, intended to represent adjacent buildings.

	<p>Interior: Interior shades with a Seasonal SHGC multiplier, summer value = 0.80, winter value = 0.90.</p> <p>Int+Ovh: Interior shades & 2' overhangs</p> <p>Ovh+Obs: 2' overhangs & obstructions</p> <p>All: Interior shades, 2' overhangs, & obstructions</p> <p>Typical^(a): to represent a statistically average solar gain reduction for a generic house, this option includes:</p> <p style="padding-left: 40px;">Interior shades (Seasonal SHGC multiplier, summer value = 0.80, winter value = 0.90);</p> <p style="padding-left: 40px;">1' overhang;</p> <p style="padding-left: 40px;">a 67% transmitting same-height obstruction 20' away intended to represent adjacent buildings.</p> <p style="padding-left: 40px;">To account for other sources of solar heat gain reduction (insect screens, trees, dirt, building & window self-shading), the SHGC multiplier was further reduced by 0.1. This results in a final winter SHGC multiplier of 0.8 and a final summer SHGC multiplier of 0.7.</p>
Window Area (% Floor Area)	<p>Variable, input by the user.</p> <p>The Energy Star 2008 analysis used 15% of floor area</p>
Window Type	Variable, input by the user.
Window Distribution	<p>Variable, input by the user.</p> <p>For the Energy Star 2008 analysis, the windows were distributed evenly on all four orientations.</p>
HVAC System	Furnace & A/C, Electric Heat Pump
HVAC System Sizing	<p>For Existing Construction:</p> <p>For each climate, system sizes are fixed for all window options. Fixed sizes are based on the use of DOE-2 auto-sizing for the same house as defined in the analysis, with the most representative window for that specific climate. An auto-sizing multiplier of 1.3 used to account for a typical safety factor. ^(e)</p> <p>For New Construction: The DOE2 auto-sizing option was used on the specific windows used for each simulation.</p>
HVAC Efficiency	<p>New Construction:</p> <p>AFUE = 0.80 for IECC Climate Zones 1-3, 0.90 in IECC Climate Zones 4-8</p> <p>A/C SEER=13</p> <p>Heat Pump HSPF = 7.7</p> <p>Existing Construction:</p> <p>AFUE = 0.78</p> <p>A/C (and Heat Pump) SEER= 10</p> <p>Heat Pump HSPF = 6.8</p>
Duct Losses	<p>12% for basement foundation</p> <p>20% for crawlspace and slab-on-grade foundations</p>
Part-Load Performance	New part-load curves for DOE2 (Henderson 1998) for both new and existing house types
Thermostat Settings	<p>Heating: 70°F, Cooling: 78°F</p> <p>Basement (partially conditioned): Heating 62°F, Cooling 85°F</p>
Night Heating Setback	65°F (11 PM – 6 AM ^(f))
Internal Loads	<p>From IECC Table 404.5.2(1)</p> <p style="text-align: center;">Internal gain (Btu/day) = 17,900 + 23.8 * floor area + 4104 * number of bedrooms</p> <p>Where 3 bedrooms were assumed</p>
Natural Ventilation	Maximum operable window area reduced from 25% to 12.5%. Max ACH capped at 10. Based on California Research on use of windows for ventilation.
Weather Data	All TMY2 ^(h)
Number of Locations	<p>239 US cities^(h)</p> <p>4 Canadian cities</p>
Calculation Tool	DOE-2.1E

Footnotes:

- (a) RESFEN allows the floor area to vary, so floor-area-dependent parameters (such as exterior and interior wall area, perimeter area, internal gains, infiltration, and so forth) are calculated for each specific case.

- (b) In Table 6-1, the default foundation option is the most common foundation type in that location; the other options are other foundation types found in more than 10% of the houses according to a National Association of Homebuilder's survey (Labs et al. 1988).
- (c) The insulation levels for the different building components are based on Table 402.1.1 in IECC 2006.
- (d) These assumptions are intended to represent the average solar heat gain reduction for a large sample of houses. A one-foot overhang is assumed on all four orientations in order to represent the average of a two-foot overhang and no overhang. A 67% transmitting obstruction 20 feet away on all four orientations represents the average of obstructions (such as neighboring buildings and trees) 20 feet away on one-third of the total windows and no obstructions in front of the remaining two-thirds of windows. An interior shade is assumed to have a Solar Heat Gain Coefficient multiplier of 0.9 during the winter and 0.8 during the summer. To account for solar heat gain reducing effects from other sources such as screens, trees, dirt, and self-shading of the building, the SHGC multiplier was further reduced by 0.1 throughout the year. This amounts to a 12.5% decrease in the summer and an 11.1% decrease in the winter. The final SHGC multipliers (0.8 in the winter and 0.7 in the summer) thus reflect the combined effects of shading devices and other sources.
- (e)
- (f) RESFEN models a moderate setback of 65° F in recognition that some but not all houses may use night setbacks. Recent studies of residential indoor conditions have shown that, during the heating season, nighttime temperatures are significantly lower than daytime temperatures (Ref: "Occupancy Patterns and Energy Consumption in New California Houses," Berkeley Solar Group for the California Energy Commission, 1990).
- (g) RESFEN uses a feature in DOE-2 that allows the ventilation temperature to switch between a higher heating (or winter) and a lower cooling (or summer) temperature based on the cooling load over the previous four days.
- (h) RESFEN uses Typical Meteorological Year (TMY2) weather tapes from the National Renewable Energy Laboratory. There are 239 TMY2 locations with average weather data compiled from 30+ years of historical weather data.

5.3. Simulation Envelope Insulation Values

Table 5-3. RESFEN New Construction Insulation Values (IECC 2006)

IECC Climate Zone	Ceiling R-value	Wall R-value	Slab R-value	Basement Wall R-value	Basement Floor R-value	Floor R-value
IECC06-Zone01	30	13	0	0	0	13
IECC06-Zone02	30	13	0	0	0	13
IECC06-Zone03	30	13	0	0	0	19
IECC06-Zone03 Marine	30	13	0	0	0	19
IECC06-Zone04	38	13	2	14	0	19
IECC06-Zone04 Marine	38	19	2	14	0	30
IECC06-Zone05	38	19	2	14	0	30
IECC06-Zone06	49	19	4	14	0	30
IECC06-Zone07	49	21	4	14	0	30
IECC06-Zone08	v	21	4	14	0	30

Table 5-4. RESFEN5 Existing Construction Insulation Values. (Ritschard, et. al. 1992)

Package Name	Ceiling R-value	Wall R-value	Slab R-value	Basement Wall R-value	Basement Floor R-value	Floor R-value	Window for sizing
Exist01 (AL1)	11	7	0	0	0	0	Single, Aluminum Frame
Exist01 (WV1)	11	7	0	0	0	0	Single, Wood/Vinyl Frame
Exist02 (AL1)	19	7	0	0	0	0	Single, Aluminum Frame
Exist02 (WV1)	19	7	0	0	0	0	Single, Wood/Vinyl Frame
Exist03 (WV1)	22	7	0	0	0	0	Single, Wood/Vinyl Frame

5.4. Using WINDOW DOE2 Input File for RESFEN Calculations

Window Library entries created in WINDOW can be imported into the RESFEN Window Library. In addition, the detailed DOE2 input file generated by WINDOW for windows can also be used in the RESFEN analysis for a more accurate definition of the glazing in the window. Importing records from a WINDOW database are discussed in Section 4 in the Glass Library section.

To use the WINDOW DOE2 Input file in a RESFEN calculation, the *.dat file from WINDOW must be specified, and the calculation procedure “turned on”. Both these functions are found in the Options dialog box, opened by clicking on the Options menu.

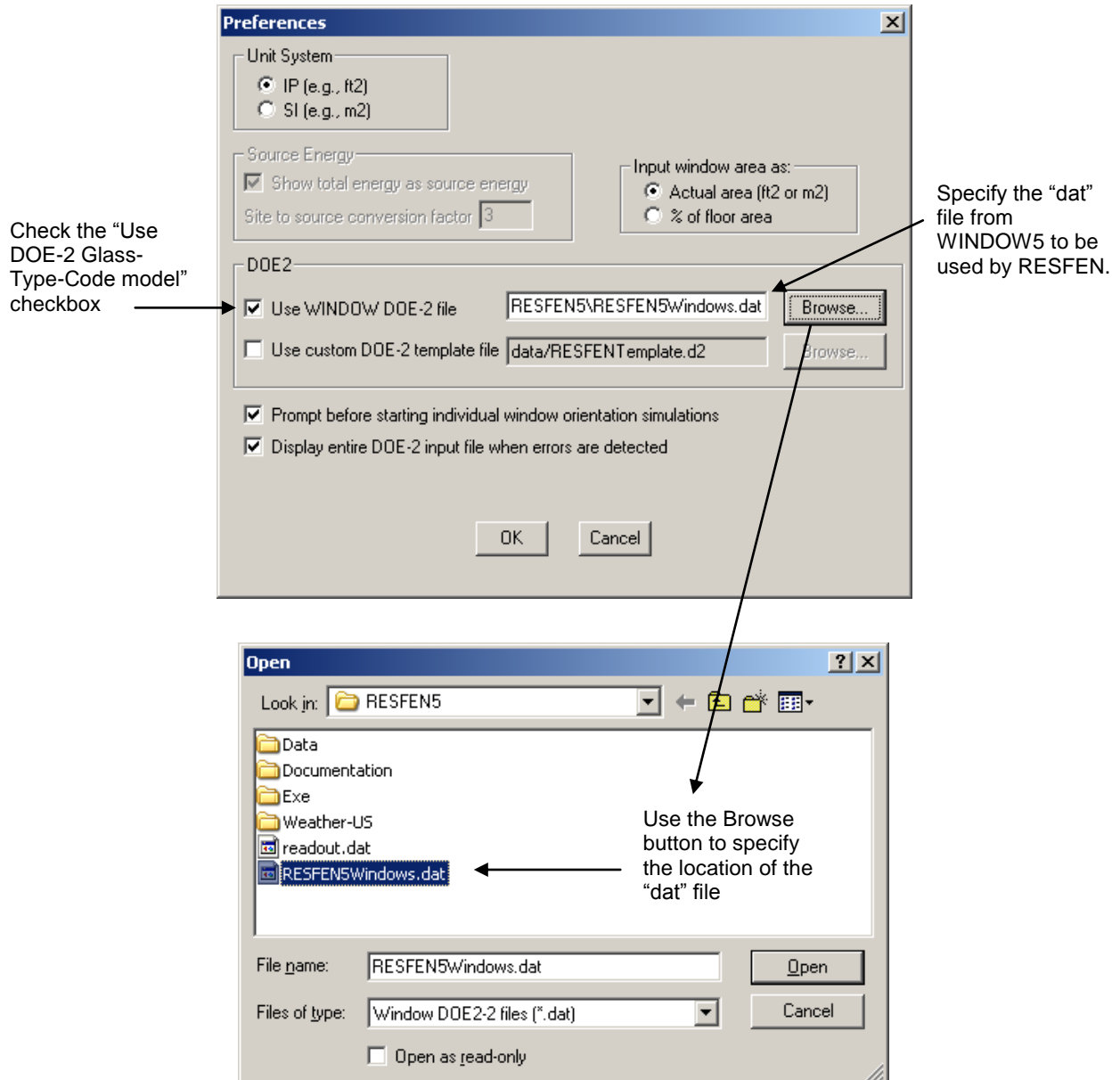


Figure 5-1. To use the DOE2 detailed input file from WINDOW (specified as a “dat” file), go to the Options dialog box from the Options menu.

5.5. RESFEN Window Library (from WINDOW) Documentation

ID	window_Name	Frame Type	# Glass Layers	Glazing Description	Gas (See Note for Air/Argon)	Gap Width (inches)	Total Window		
							U-factor (Btu/hr-ft ² -°F)	SHGC	Tvis
10	Single Clear - Alum. Frame	AL	1	Clear	N/A	N/A	1.291	0.735	0.695
102	Double Clear - Alum. Frame	AL	2	Clear	Air	0.375	0.833	0.647	0.628
103	Double Tinted - Alum. Frame	AL	2	Tint	Air	0.375	0.833	0.545	0.473
104	Double Low-E, High Solar Gain, Alum.Improv. Frame	ALI	2	High Solar Gain Low-E	Argon	0.5	0.645	0.577	0.607
105	Double Low-E, Med Solar Gain, Alum.Improv. Frame	ALI	2	Medium Solar Gain Low-E	Argon	0.5	0.636	0.381	0.556
106	Double Low-E, Low Solar Gain, Alum.Improv. Frame	ALI	2	Low Solar Gain Low-E	Argon	0.5	0.63	0.261	0.492
107	Double Clear, Alum. Frame w/Thermal Break	ATB	2	Clear	Air	0.5	0.597	0.618	0.628
108	Double Tint, Alum. Frame w/Thermal Break	ATB	2	Tint	Air	0.5	0.597	0.514	0.473
109	Double Low-E, High Solar Gain, Alum. Frame w/Improv.Thermal Break	ATBI	2	High Solar Gain Low-E	Argon	0.5	0.423	0.547	0.607
110	Double Low-E, Med Solar Gain, Alum. Frame w/Improv.Thermal Break	ATBI	2	Medium Solar Gain Low-E	Argon	0.5	0.415	0.350	0.556
111	Double Low-E, Low Solar Gain, Alum. Frame w/Improv.Thermal Break	ATBI	2	Low Solar Gain Low-E	Argon	0.5	0.409	0.231	0.492
112	Single Clear, Non-metal Frame	WV	1	Clear	N/A	N/A	0.879	0.640	0.648
113	Double Clear, Non-metal Frame	W/V	2	Clear	Air	0.5	0.517	0.570	0.585
114	Double Tint, Non-metal Frame	W/V	2	Tint	Air	0.5	0.517	0.473	0.441
115	Double Low-E, High Solar Gain, Non-metal Thermally Improved Frame	W/VI	2	High Solar Gain Low-E	Argon	0.5	0.285	0.497	0.566
116	Double Low-E, Med Solar Gain, Non-metal Thermally Improved Frame	W/VI	2	Medium Solar Gain Low-E	Argon	0.5	0.278	0.313	0.518
117	Double Low-E, Low Solar Gain, Non-metal Thermally Improved Frame	W/VI	2	Low Solar Gain Low-E	Argon	0.5	0.272	0.202	0.459
118	Triple Low-E, High Solar Gain, Non-metal Thermally Improved Frame	W/VI	3	High Solar Gain Low-E	Argon	0.375	0.196	0.407	0.498
119	Triple Low-E, Med Solar Gain, Non-metal Thermally Improved Frame	W/VI	3	Medium Solar Gain Low-E	Argon	0.375	0.193	0.281	0.454
120	Triple Low-E, Low Solar Gain, Non-metal Thermally Improved Frame	W/VI	3	Low Solar Gain Low-E	Argon	0.375	0.189	0.184	0.369

NOTES:

FRAME TYPE CODES:

AL = Aluminum

ATB = Aluminum, Thermally Broken

W/V = Wood/Vinyl

I = Thermally Improved Frame

GAS FILLS:

Argon = 90% air, 10% argon

WINDOW PROPERTIES:

The properties for U-factor, SHGC, and Tvis were calculated with WINDOW 6.3.72 (2012).

The data presented here and in RESFEN are average properties for several commercially available products. Specific products will perform slightly above or below the average products defined here. Users are encouraged to only use these numbers as a general guide and to use specific manufacturer's product data (i.e. NFRC U-factors and Solar Heat Gain Coefficients) whenever possible.

5.6. Resources

The following listings are resources for learning more about energy-efficient windows:

5.6.1. Books

Residential Windows, A Guide to New Technologies and Energy Performance

by John Carmody, Stephen Selkowitz, and Lisa Heschong

W.W.W. Norton & Company, 1996.

Updated material from this book can be found at the web site www.efficientwindows.org.

5.6.2. Organizations

Efficient Windows Collaborative

Alliance to Save Energy

1200 18th Street N.W., Suite 900

Washington, DC 20036

Phone: (202) 857-0666

Fax: (202) 331-9588

Web site: www.efficientwindows.org

National Fenestration Rating Council

1300 Spring Street, Suite 500

Silver Spring, MD 20910

Phone: (301) 589-NFRC

Web site: www.nfrc.org

Windows and Daylighting Group

Lawrence Berkeley National Laboratory

MS 90-3111

1 Cyclotron Road

Berkeley, CA 94720

Web site: windows.lbl.gov

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6. ACKNOWLEDGEMENTS

The development of RESFEN6 was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy; Office of Building Technology, State and Community Programs; Office of Building Systems of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098. The authors appreciate the assistance of the following colleagues in the design and development of RESFEN: Fred Buhl, Ender Erdem, Rob Hitchcock, Steve Selkowitz, and Fred Winkelmann. The user interface was developed by Santosh Philip of Gabel Associates, Berkeley, California. Development of the modeling assumptions for use in RESFEN was a collaborative process between LBNL staff and NFRC members; the authors wish to acknowledge the significant effort and contributions from many in the window community.