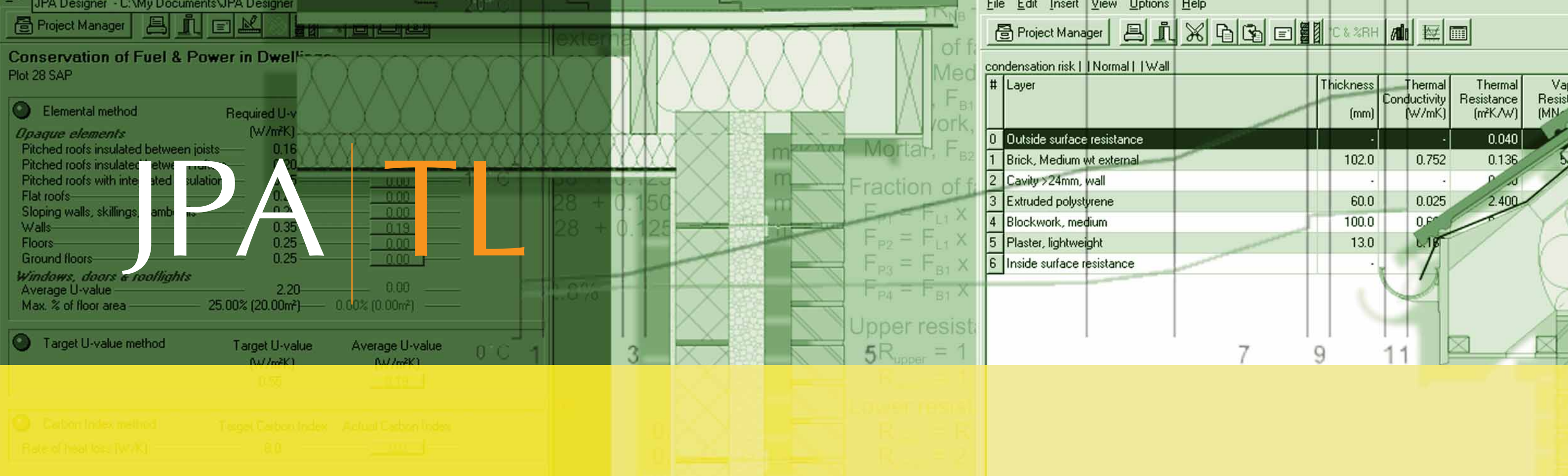

JPA Designer

SAP 9.90 module • U-value modules & Condensation Risk

Version 5.01a1 and above

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JPA TL Ltd.
Newcastle Business Village,
33 Bellingham Drive,
North Tyneside Ind. Est.,
Newcastle upon Tyne NE12 9SZ

T: 0191 270 5138
E: sales@techlit.co.uk
W: www.techlit.co.uk

Contents

Part I

JPA Designer basics

1 Introducing JPA Designer

Welcome to JPA Designer version 5.01, the design and calculation program from JPA TL Ltd.

JPA Designer can:

- carry out SAP calculations to SAP versions 9.90, 9.81, 9.80 and 9.70, to demonstrate compliance with the energy efficiency requirements of Building Regulations and Building Standards[1] and as part of Code for Sustainable Homes (CSH) assessments;
- issue On-construction Energy Performance Certificates (EPCs) for dwellings in England and Wales, Scotland and Northern Ireland;
- calculate U-values and κ-values for building elements;
- carry out condensation risk analysis to BS EN ISO 13788;

JPA Designer includes many features to make the calculation process easier:

- Project-based file system enables you to keep all the calculations for one development in same project file;
- Links between U-value and SAP calculations, so that SAP calculations are automatically updated when U-value calculations change;
- Calculation results can be produced as PDF files for emailing;
- Includes a database of common materials to speed U-value calculations;
- On-screen help which includes the official SAP guidance.

We hope you find JPA Designer a useful calculation tool. We are always happy to receive comments, suggestions for improvements or proposals for enhancements to suit your specific needs.

[1] In order to lodge and issue EPCs in England and Wales, and Northern Ireland you will need to be a member of an accreditation scheme. You can find details of our partner schemes at www.techlit.co.uk/training/accreditation.

1.1 JPA Designer modules

JPA Designer is a modular program, so you need only buy the modules which give you the functions you want to use: the current modules are:

- **SAP 2011** – calculates SAP ratings to the SAP 9.90 specification and tests new dwellings for compliance with the requirements of Building Regulations and Building Standards. (This module will also calculate SAP ratings to SAP 9.81, 9.80 and 9.70.)
- **Uvalue 2011** – calculates U-values of building elements taking account of repeating thermal bridges using the methods in ISO 6946 for exposed floors, walls and roofs, and the method in ISO 13370 for ground floors and basements. It also calculates κ-values.
- **Uvalue 2011 Professional** – analyses the risk of interstitial condensation to ISO 13788 and carries out elemental U-value calculations to ISO 6946 and ISO 13370, and κ-value calculations.

When you buy a licence for a JPA Designer module you will receive a key code to enable you to use that module. The other modules on the program will be visible, but will only work in demonstration mode and will not display calculation results. You can, of course, purchase additional modules at any time.

1.2 Getting help

This manual has been designed to provide easy reference to all the features of JPA Designer. The manual uses the following conventions:

- <angled brackets> for keys on the computer keyboard, e.g. the <Enter> key.
- the **+** sign indicates you should hold down one key while pressing another, e.g. <Alt+F> means `hold down the <Alt> key while pressing the <F> key'.
- **Bold type** indicates parts of JPA Designer's screen displays, e.g. the **Ventilation rate** dialogue.
- **Menu**>**option** indicates the option in the menu on the program's menu bar, e.g. Select **Edit**>**Primary heating system** means *select the **Primary heating system** option from the **Edit** menu*.

This manual uses the following special terms:

- **Dialogue (dialogue box)**: a small window which displays boxes or buttons for entering data.
- **Radio button**: a set of two or more related buttons - you can only select one at a time.

- **Tick box**: a box which shows whether or not a particular setting is on (ticked) or off (not ticked).
- **Text box**: an area on a dialogue in which you can type words or numbers.
- **Drop-down**: a box on a dialogue which can be expanded to show a number of pre-set options, usually by clicking an arrow on the right-hand side of the box.

There are many functions of JPA Designer which can be accessed using both the menus and the toolbars: in addition, some may also have keyboard shortcuts. To prevent this manual becoming repetitive we generally refer only to the menus.

If you have a problem with the *functioning* of the software please follow these steps:

- Download and install the latest version of JPA Designer from our web site (section 2.2 for instructions) and see if that resolves the problem.
- Check the forum and FAQ on our web site (http://forum.techlit.co.uk) to see if the problem is addressed there.
- If the problem persists, email details of the problem to *support@techlit.co.uk*. Please include details of your computer system and attach sample files or PDF outputs where possible. We will respond as soon as we can.

If you have difficulty *using* the program (for example, you are uncertain how to treat an integral garage in a SAP calculation) please follow these steps:

- Consult the program manual or on-line help system;
- Check the forum and FAQ on our web site (http://forum.techlit.co.uk) to see if the query is addressed there;
- Consult the official SAP specification and associated documents.
- If you are new to U-value or SAP calculations you should consider attending one our training courses, which provide a thorough introduction to the software and its use. We offer distance learning, on-line and live training sessions (www.techlit.co.uk/training)

2 Getting started

This section of the manual describes how to install JPA Designer on your PC and explains how the user registration and on-line licence checking systems work. It also includes instructions on updating your copy of JPA Designer.

2.1 System requirements

JPA Designer requires a PC running Windows XP or later. The PC will require an regular internet connection to check the validity of your licence, to update the BRE Product Characteristics Database for the SAP 2009 module and to issue EPCs.

JPA Designer can run on Intel-based Apple Macintosh computers using virtualisation software (such as Parallels or VMWare), or through Bootcamp. However, we do not guarantee the program will run on such systems, nor do we offer technical support.

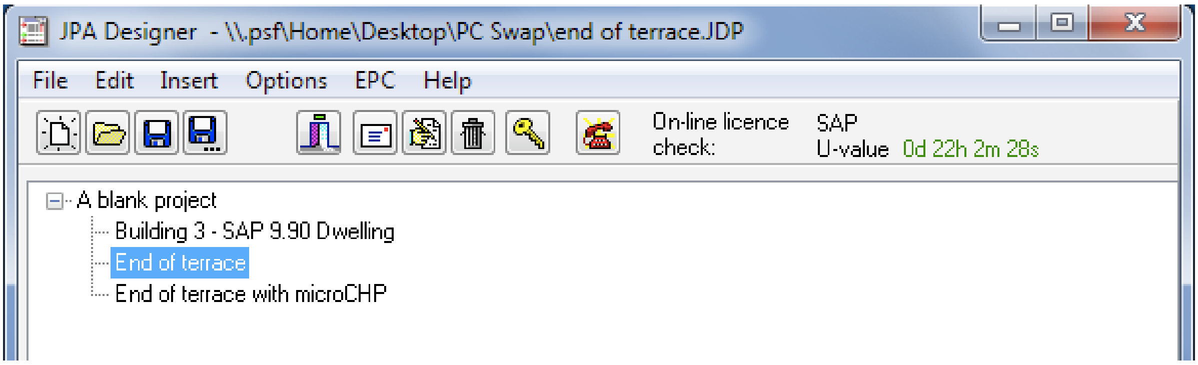
2.2 Installation

To install JPA Designer on your PC:

1. Go to our web site at www.techlit.co.uk and *right click* on the link labelled *download JPA Designer*: select **Save link as** (for Firefox) or **Save target as** (for Internet Explorer).
2. Save the installer file **jsetup990.exe** to your PC (we recommend downloading the file to the Desktop). The download is about 13 MB.
3. When the download is complete double click on the file **jsetup990.exe**. The InstallShield Wizard configures itself and, after a few moments opens.

   You may see a security warning that the publisher of the file could not be identified. If you do, click ***Run*** *to continue the installation process.*
4. Click **Next** to continue with installation. The installer displays the **Customer information** screen.
5. Enter your name and company name and, using the radio buttons, select whether you want JPA Designer to be available to all user accounts on the computer, or just one. (We recommend you select *all*.) Click **Next**.

Figure 2.1: The Project Manager window



6. At the **Choose Destination Location** screen we recommend you accept the default settings and install JPA Designer into the folder **c:\program files\jpatl\jpa designer 981**. Click **Next**. The installer will now copy the JPA Designer files onto your computer.

7. When installation has finished the **Setup Complete** screen is displayed. Tick the box labelled **Launch the program** and click **Finish**. The installer will close and **JPA Designer** will open, showing you the **Project Manager** window.

2.3 User registration

In order to use JPA Designer you must enter valid user registration details and the program must be able to check the status of your licence against our licensing database.

When you first install JPA Designer the program runs in *demonstration mode* and will not display the results of calculations, nor allow EPCs to be lodged. In order to access the full functionality of the software you must enter the user name(s) and key code(s) you received when you bought a licence for one or more program modules.

To enter licence key codes:

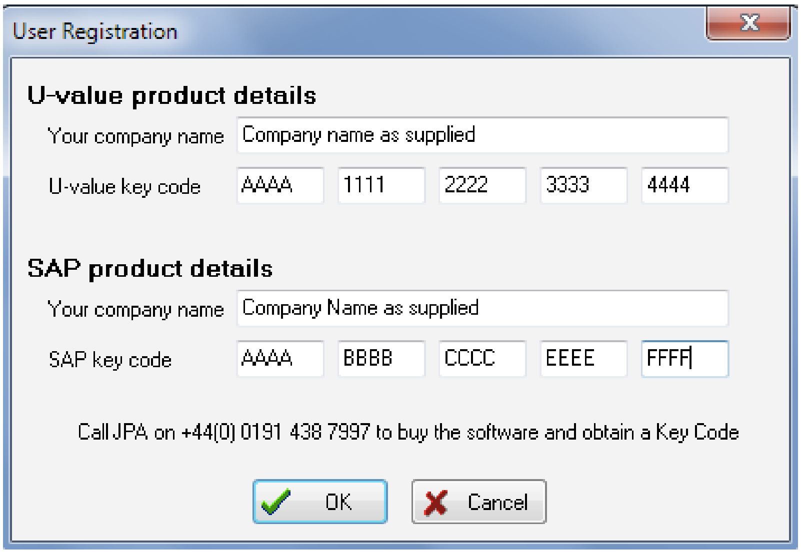
1. At the **Project Manager** window (Figure 2.1) select **Edit**>**User and Security Codes** from the menu bar. The **User Registration** dialogue opens (Figure 2.2.

2. For each module you have licensed, enter the company name and key code, exactly as supplied by JPA TL Ltd. If you have licensed two modules make sure you put the key codes against the correct modules.

   *The company name is case sensitive and should be written exactly as shown: so if, for example, you enter **Limited**, when the company name with the key code contained **Ltd** the program will not accept the key code.*

   In the key code, 1 = one and 0 = zero.

Figure 2.2: User registration



2.4 On-line licence checking

Because licences for JPA Designer generally run for a year the program has to check whether your licence is still valid. It does this by contacting our on-line licensing database and checking the expiry date for module.

The program will try to check the database the first time you open a SAP or U-value calculation after the program itself has been launched.

- If the check is successful the licence is valid the module will open (the program will record the date and time of that successful check).
- If the check is successful and the licence is not valid the calculation will not open.
- If the program is unable to connect with the database (for example, because you are using your lap-top away from your office) it will look at the date of the last successful check: if that is less than seven days ago then it will open the module.
- If the program is unable to connect with the database and the last successful check is more than seven days ago then it will **not** open the module.

If you often use JPA Designer away from the office there are two features you can use to prevent problems with the licence check:

- The **Project Manager** tool bar displays the length of time since the last successful licence check: provided the values shown are *green* the module will open.
- The **Check licence on-line** button on the tool bar will force a licence check and re-set the time since the last check to zero. You should force a check if you expect not to have an internet connection for a few days.

Figure 2.3: The About dialogue showing the version number

2.5 Updates

JPA Designer is continually being developed to introduce new features: to get the best from the program it is worth making sure you are using the latest version. To check whether there is a later version available you should compare the version number shown on our web site (www.techlit.co.uk) with that of the program you are using: you can find the version number by selecting **Help**>**About** from the menu bar in JPA Designer.

Higher numbers and letters indicate later releases, with characters coming earlier in the name being more important that later ones: so 4.05a1 will be more recent than 4.04c2, and 4.05b1 more recent than 4.04a4. The three digit *Build* number indicates a minor change in a version. Figure 2.3 shows the **About** dialogue for JPA Designer together with the version number on the web site: in this case the software is up to date, as both version numbers are the same.

The process for updating the software is identical to that of originally installing it, but with the additional step of **uninstalling** your current version of JPA Designer before installing the new version.

To update JPA Designer:

1. Use the Windows **Add/Remove Programs** or **Uninstall programs** control panel to uninstall the current version of JPA Designer.

   Uninstalling the current version will not affect your calculation files.

2. Download and install the new version of JPA Designer following the instructions in section 2.2.

2.6 Opening and closing JPA Designer

To open JPA Designer:

- Select **Start**>**Programs**>**JPA Designer**>**JPA Designer** from the Windows **Start** button.

To close JPA Designer:

- Select **File**>**Exit** from the JPA Designer menu bar. The program will prompt you to close any files which have not been saved.

2.7 Uninstalling JPA Designer

To uninstall JPA Designer:

1. Open the Windows **Add/Remove programs** control panel (to access Control Panels select **Settings**>**Control Panels** from the **Start** button).
2. Select JPA Designer in the **Add/Remove Programs Properties** dialogue and click **Add/Remove**. Windows will uninstall the program files and remove its icons.

   That will not remove any JPA Designer project files.

3 Managing projects and calculations

JPA Designer organises and saves calculations in project files, which have the extension **JDP**. You can save multiple SAP and U-value calculations in the same file.

Calculations are created, saved and managed in the JPA Designer **Project Manager** window (Figure 2.1), which lists all the calculations in the current project.

3.1 Starting a new project

Whenever you start JPA Designer the program creates a new blank project which you can start using straight away. You can also create a new project at any time by selecting **File**>**New Project** from the main menu, or clicking the **New Project** button on the toolbar.

You can change the default project name **A blank project** to something more useful:

1. Click once on the project name then select **Edit**>**Rename selected item**. The **Project name** dialogue opens (Figure 3.1).
2. Enter the new name for your project, then click OK.
3. The project is renamed

   The project name does not affect the calculations in any way.

Figure 3.1: Changing the name of a project

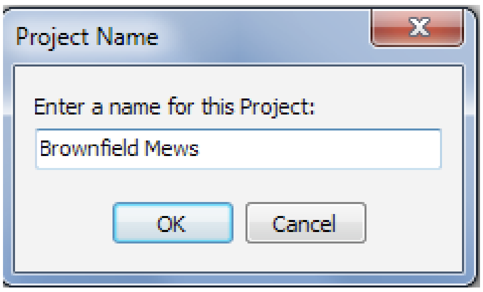
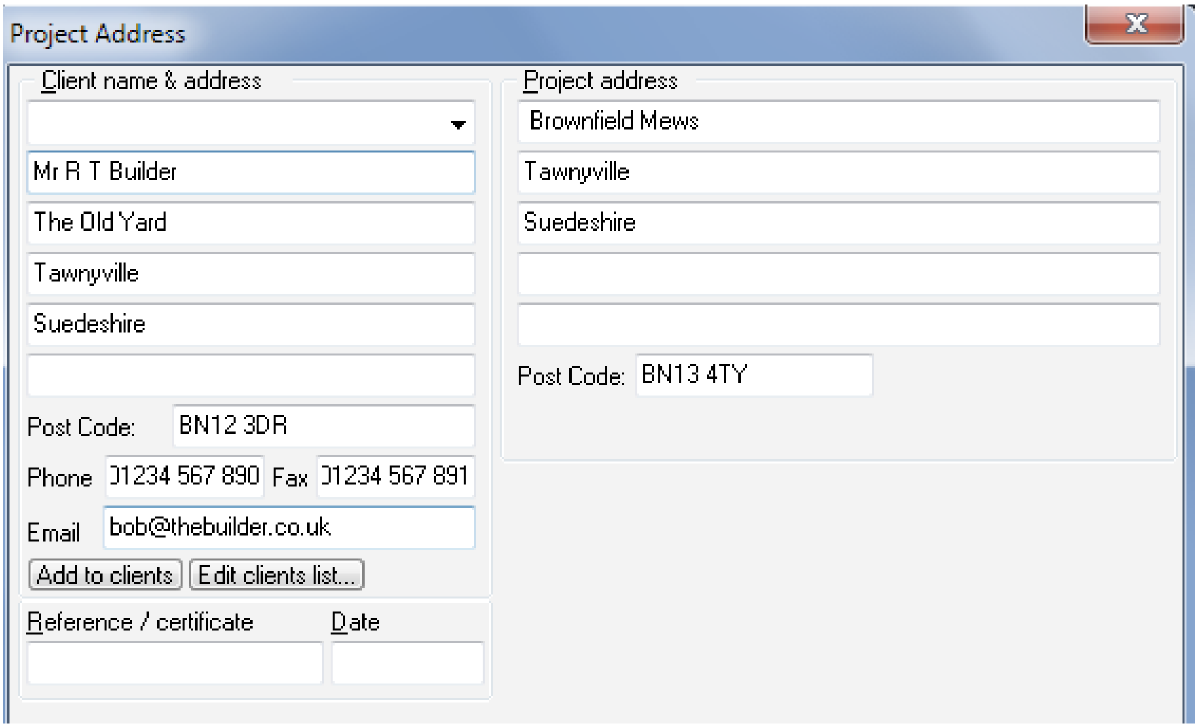


Figure 3.2: The Project Address dialogue



3.2 Adding project address details

JPA Designer can store client and site details for a project, which you can then copy to all the individual calculations within that project. You can enter and edit that information using the **Project Address** dialogue (Figure 3.2). You can also store client information and reuse it later.

To add or change project information:

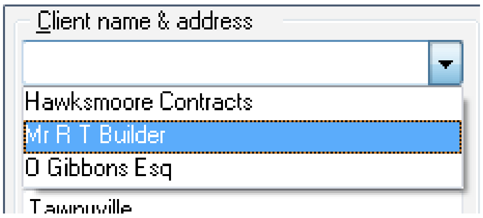
1. From the menu bar select **Edit**>**Project Address**. The **Project Address** dialogue opens.
2. Enter the data by typing it into the appropriate fields. Use the <Tab> key to move between fields.

   Do not try to enter data in the top left hand box: this box is used for retrieving details you have previously stored.
3. If you want to store the client details to re-use later click **Add to clients**.
4. Click **OK** when you have entered all the data you need.

To re-use existing client data simply click on the drop-down in the **Project information** dialogue and select a client from the list (Figure 3.3).

If you need to edit the stored details click **Edit clients list** then make the changes in the **Edit Clients** dialogue.

Figure 3.3: The client name and address drop-down



3.3 Saving projects

JPA Designer project are saved in the same way as any other file:

1. From the menu bar select **File**>**Save Project**. The **Save As** dialogue opens.
2. Select the folder into which the project should be saved, enter a name for the project file.

   *By default JPA Designer will add the extension **JDP** to all file names.*
3. Click **Save**. JPA Designer saves the project and displays the file name on the program title bar.

By default JPA Designer will save files into the JPA Designer folder (usually **c:\Program Files\JPATL\JPA Designer 981**). You can specify a different default folder using the **Options** dialogue (see section 3.12).

We recommend you have a daily back-up schedule for your data.

3.4 Opening projects

To open an existing project:

1. From the menu bar select **File**>**Open project**. The **Open** dialogue opens.
2. Select the file you want to work with, then click **Open**. The project opens in the **Project Manager** window.

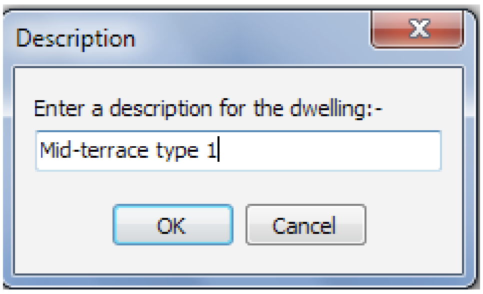
3.5 Adding calculations to a project

You can add new calculations to a project in the **Project Manager** window.

To add a new U-value calculation to a project:

1. From the menu bar select **Insert**>**U-value calculation**. The **Description** dialogue opens (Figure 3.4).

Figure 3.4: The Description dialogue



2. Type a name for the calculation in the **Description** dialogue, e.g. *warm roof,* and click **OK**. The new calculation is added to the project.

To add a new SAP calculation to a project:

1. From the menu bar select **Insert**>**Dwelling/SAP (v9.81 2005) calculation**>**Single dwelling**. The **Description** dialogue opens (Figure 3.4).
2. Type a name for the calculation in the **Description** dialogue, e.g. *Plot 23*, and click **OK**. The new calculation is added to the project.

You can also use the Insert menu to insert calculations to versions 9.81, 9.80 and 9.70 of SAP, as well as SAP calculations for multiple dwellings.

3.6 Opening and closing calculations

To open a U-value or SAP calculation from the **Project Manager** window, either:

- double click on the calculation name; or,
- click once on the calculation name, then from the menu bar select **Edit**>**Selected item**.

To close a calculation and return to the **Project manager** window click the **Project manager** button on the tool bar.

3.7 Duplicating calculations

If you want to prepare a calculation which is very similar to an existing calculation in a project you can duplicate the calculation and then make your changes to the copy, without affecting the original calculation. To duplicate a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Duplicate item**. The **Description** dialogue opens.
3. Type a name for the duplicate calculation and click **OK**. A copy of the original calculation is added to the project.

You can now work with the duplicate calculation in the usual way.

3.8 Renaming calculations

To change the name of a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Rename selected item**. The **Name** dialogue opens.

   *For a U-value calculation the dialogue will the titled **U-value Name** and for a SAP calculation it will be titled **SAP name**.*
3. Enter a new name for the calculation and click **OK**. The **Project Manager** window shows the new name.

Changing the name of the calculation will not affect the calculation results.

3.9 Deleting calculations

Calculations can be deleted from JPA Designer projects.

WARNING: there is no way of recovering a deleted calculation.

To delete a calculation:

1. In the **Project Manager** window click once on the calculation to select it.
2. From the menu bar select **Edit**>**Delete selected item**. JPA Designer asks you to confirm the deletion.
3. Click **Yes** to delete the calculation or **No** to abandon the deletion. If you click **Yes** the calculation is removed from the project.

3.10 Merging projects

To help you re-use SAP and U-value calculations JPA Designer allows you to merge all the calculations in an existing project into the currently open project. This can be useful if you have a number of standard calculations stored in different projects which you need to bring together for a particular job.

To merge calculations from one project into another:

1. In **Project Manager** open or create the project you want to *receive* the calculations.
2. From the menu bar select **File**>**Merge a project from disk into this Project**. The **Open** dialogue appears.
3. Select the file which *contains* the calculations and click **Open**. JPA Designer adds the calculations to the current project and lists them in the **Project Manager** window. You can now edit them without affecting the original project.

3.11 Importing and upgrading calculations

JPA Designer can convert SAP calculations carried out under one version of SAP to a later version of SAP. You may need to do this when the Building Regulations compliance calculation is based on a previous version of SAP, but the EPC has to be issued using the current version of SAP. The program takes a copy of the data from the original calculation and converts the copy to the latest version, leaving the original calculation untouched.

You can:

- convert SAP 9.81 calculations to SAP 9.90;
- convert SAP 9.70 calculations to SAP 9.80/9.81;
- import SAP 9.60 calculations from JPA SAP v2 and convert to SAP 9.70.

In each case you can convert the calculation from an older version of SAP to a more recent version, but you cannot convert a calculation to an older version of SAP.

To convert a SAP 9.81/9.80 calculation to SAP 9.90:

1. In the **Project Manager** window select the SAP 9.81 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP 9.8x 2005 dwelling to V9.90 2009**.
3. JPA Designer creates a copy of the original calculation as a SAP 9.90 calculation. The copy has the same name as the original, but appended with *SAP version 9.90*.

To convert a SAP 9.70 calculation to SAP 9.80:

1. In the **Project Manager** window select the SAP 9.70 calculation.
2. From the menu bar select **Edit**>**Copy selected SAP 9.70 2001 to SAP 9.80 2005 dwelling**.
3. JPA Designer creates a copy of the original calculation as a SAP 9.80 calculation. The copy has the same name as the original, but appended with *SAP version 9.80*.

   *The 9.80 calculation can then updated to 9.81 by ticking the **SAP version 9.81** box in the **Project Information** dialogue in the SAP module (see section 16.6)*
4. When you open the 9.80 calculation you will be prompted to add additional details which were not required by the earlier version of SAP.

3.12 Program options

There are many ways in which you can customise the performance and outputs of JPA Designer. Most of the options are controlled from the **Options** dialogue.

To open the **Options** dialogue, in **Project Manager** select **Options** from the menu bar.

The Options dialogue box has four tabs:

General:

- **Printer margins**: enables you to set the page margins. If you are using headed paper you can set the top margin for the first page to be greater than that of the second page, which can be printed on continuation paper or blank paper.
- **Company name and address**: the details entered here will appear on print outs and PDFs of U-value and SAP calculations.
- **Options**: select which items which should appear on the print outs and determine whether the program should attempt to make a back up copy of the project file.
- **Uvalue Disclaimer**: enter the disclaimer text to appear on print outs and PDFs of U-value calculations.
- **SAP/Nondwell disclaimer**: enter the disclaimer text to appear on print outs and PDFs of SAP and Nondwell calculations.
- **Default SAP location**: determines which regulations will be used for SAP calculations: currently the choices are England and Wales, Scotland or Northern Ireland.
- **Start-up folder**: sets the default folder for saving and opening project files.
- **Check for programme updates**: lets you specify whether or not the software will check for updated versions of JPA Designer. For more information see section 2.5.

Logo and signature:

- **Logo position**: JPA Designer can add your company logo to print outs. Use these settings to determine the position of the logo. The logo file must be a 256 colour bitmap with the file extension BMP, and it must be in the JPA Designer folder. Enter the name of the file in the text box: do not include the path (e.g. enter *logo.bmp* not *c:\Program files\JPATL\JPA Designer 981\logo.bmp*).
- **Address position**: These settings determine the position of your company address on print outs and PDFs. Enter the address itself in the **General** tab.
- **Certificate signature position**: JPA Designer can include a digitised signature on printouts of SAP calculations. Use these settings to determine the position of the signature. The signature file must be a 256 colour bitmap with the file extension, and must be stored in the same folder as the program files.

  The SAP certificate is only used with SAP 2001, version 9.70.

- **TIMSA Logo**: if you are a member of the BBA/TIMSA U-value accreditation scheme you can add the scheme logo to you print outs. The logo must be a 256 colour bitmap with the file extension, and must be stored in the same folder as the program files. Tick the **Default** box if you want the logo to be included on all U-value print-outs.

Email:

In future versions of the program you will be able to email calculations directly from JPA Designer. There is no need to provide this information in the current version of the program.

Other:

The **Other** tab lets you set :

- the default thermal conductivity of the screed in a beam and block floor construction;
- calculating the effect of mechanical fasteners in U-value calculations using the method in BS EN ISO 6946:2007.
- the location of the SAP preview window, together with it length (this is not the size of the window on screen, but the amount of scrollable space allocated to the preview – a long preview is helpful if you want to view the calculation results on screen when your calculation has a large numbers of elements and openings).
- whether EPCs are lodged in Landmark's test or live environments, and which version of the XML schema is used (this is mainly used by JPA TL and accreditation schemes for testing systems).

Part II

U-value calculations

4 The JPA Designer U-value modules

JPA Designer offers two U-value modules:

- **Uvalue 2010** calculates U-values for walls, roofs and intermediate floors using the combined method (BS EN ISO 6946) and also calculates U-values for ground floors to BS EN ISO 13370.
- **Uvalue 2010 Professional** has the functionality of Uvalue 2010 and also performs condensation risk analysis using the methods set out in BS EN ISO 13788:2002 and BS 5250:1989 Appendix D.

Uvalue calculations are carried out in the Uvalue module by:

1. Entering project information (section 4.1).
2. Entering key information about the building element, such as the element type (e.g.wall, floor, roof) and any special construction types (e.g. metal frame) (chapter 5);
3. Defining the different layers which make up the element (chapter 7);
4. Adding correction factors for factors such as mechanical fasteners and air gaps in insulation layers (chapter 8).
5. Printing calculation results, or creating PDF files of the results for emailing (chapter 12).

You can test the effect different materials have on the thermal performance of the element by using the variable layer feature (section 9.4).

4.1 Uvalue project information

JPA Designer can store and display client and project details for each calculation. You can either copy client and project details which you entered in the **Project Information** dialogue in the **Project Manager** window, or you can enter new data in the Uvalue modules. You can also save and re-use client data (section 3.2).

To copy project details from Project Manager:

1. In the Uvalue module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Click the **Inherit** button. Any information you entered in Project Manager is copied to the **Project Information** dialogue here.
3. Click **OK**.

To enter new project details:

1. In the Uvalue module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Enter project information by typing it into the appropriate fields. Use the <Tab> key to move between fields. Click **OK** when you have entered all the data you need.

5 Construction details

The thermal performance of building element will be affected by the type of element and its position within a building. These conditions are set in the **U-value Construction** dialogue (Figure 5.1), which accepts details of:

- The type of element (e.g. roof, wall, floor), together with additional information for some elements (section 5.1).
- The conditions at the internal and externals surfaces (see section 5.2).
- Details of any light steel frame construction (see section 9.1).
- Details of built up roofing or cladding (see section 9.2).
- Corrections factors for fasteners and unheated spaces (see section 8.5).

To enter data:

1. From the menu bar select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. Enter your data and click **OK**.

For some constructions, such as those with mechanical fasteners, you may find it easier to enter some of the data in the construction dialogue *after* you have entered the layers of the element.

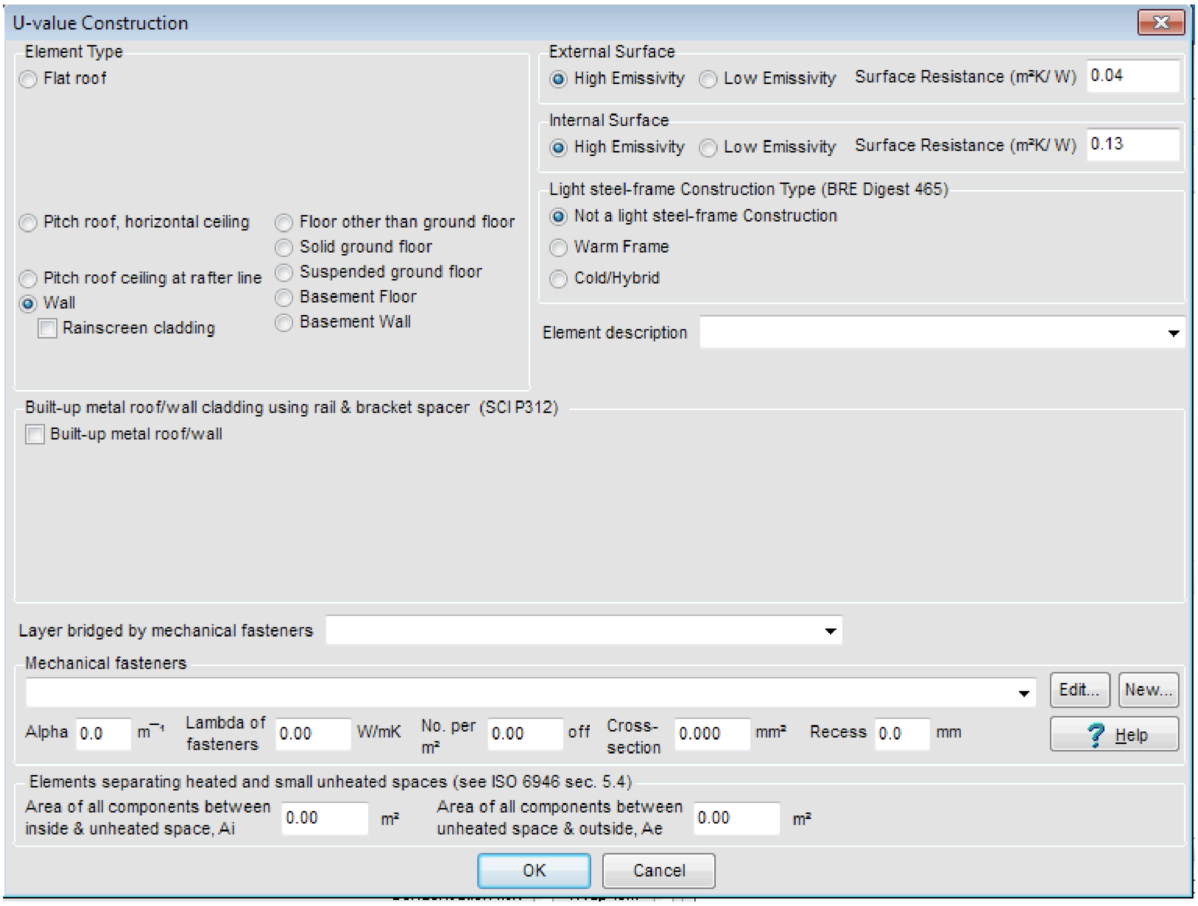
5.1 Element type

JPA Designer recognises several types of element which have to be treated differently in the calculation process. Use the radio buttons in the **Element type** section to select the type of floor, wall or roof. For some elements there are options for entering additional information.

The available element types are:

- Flat roof. A roof with a pitch typically less than 10°. There is an option to enter data for an inverted roof (section 9.3).

Figure 5.1: The U-value Construction dialogue



- Pitched roof with horizontal ceiling. Typically a `cold roof' with the insulation applied between and over the ceiling joists. You must enter the pitch (angle) of the roof, measured from the horizontal.
- Pitched roof with ceiling at rafter line. A `warm roof' with the insulation in the plane of the rafters.
- Wall. Any construction at an angle of more than 70° to the horizontal. There is an option to enter data for the fixings in rainscreen cladding (section 8.4).
- Floor other than ground floor. A floor over an open space (e.g. a parking bay) or an unheated space (e.g. an enclosed garage).
- Solid ground floor. A floor which is contact with the ground across its whole area, such as groundbearing concrete slab.
- Suspended ground floor. A floor with a ventilated space below the floor deck, such as a beam and block floor or timber joist floor.
- Basement floor.
- Basement wall.

You may also enter a description for the element in the **Description** box, or select one from the drop-down list. The description does not affect the calculation

5.2 Internal and external surfaces

U-value calculations include allowances for the effects of the thermal resistances of the thin layers of air on either side of the construction; the surface resistances. Those resistances are affected by the direction of heat flow through the construction and the emissivity of the exposed surfaces.

The surface resistances used in the calculation are shown in the two **Surface Resistance** boxes. The program automatically adjusts the surface resistances according to the type of element being considered (section 5.1) and the emissivity of the surfaces, using the values from BS EN ISO 6946 shown in Table 5.1.

The default emissivity setting is *high emissivity*: as virtually every commonly specified surface material has a high emissivity there is rarely any need to change the default.

Table 5.1: Thermal resistances

Heat flow	Element	Internal resistance (Rsi)	External resistance (Rse)
Horizontal	Wall	0.13	0.04
Upwards	Roof	0.10	0.04
Downwards	Floor	0.17	0.04

5.3 Light steel frame construction type

U-values for light steel frame structures have to be calculated using a special method which allows for the high thermal conductivity of steel. The **Light steel-frame Construction Type** section indicates whether the structure has a light steel frame, and if so, whether it is of warm or cold construction.

For non-steel frame structures ensure **Not a light steel frame construction** is selected. For instructions for calculating U-values of light steel frame structures see section 9.1.

5.4 Built up metal roofing and cladding systems

U-values for built-up metal roofing and cladding systems have to be calculated by a special method which takes account of the thermal bridging effects of the rails and brackets. If the calculation is for a built-up wall or roof tick the **Built-up metal roof/wall** box and see section 9.2 for instructions on completing the calculation. Otherwise leave the box blank.

6 Working with layers

A U-value calculation is built up by inserting layers which correspond to the different materials in the construction. For example, a U-value calculation for a cavity wall would have a layer to represent each of:

- the outside surface resistance;
- the outer leaf of brickwork;
- the cavity;
- the cavity insulation;
- the inner leaf of masonry;
- the plaster finish;
- the internal surface resistance.

You can add layers to the calculation by inserting materials from the program's extensive database, which includes data for generic materials and cavities, as well as branded products from a number of manufacturers. For many common constructions it is possible to insert all the layers from the database.

If you cannot find a material in the database then you can insert a blank layer and edit the information yourself.

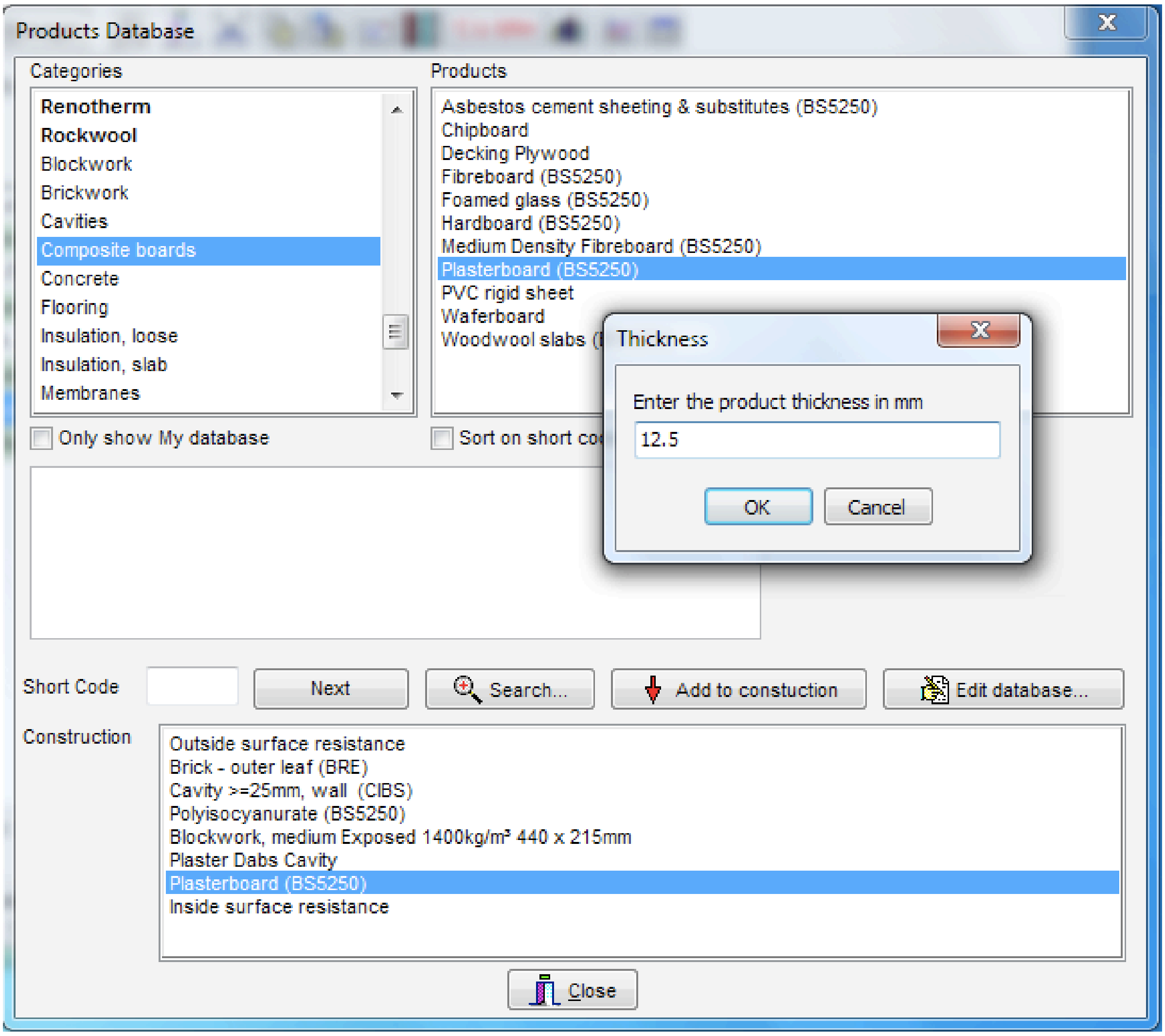
Because the program inserts new layers *above* the currently selected layer it is easiest to work from outside to inside for wall and roof calculations and from inside to outside for floor calculations.

6.1 Inserting layers from the Products database

The Products database contains a wide range of materials and cavities for use in U-value calculations and is accessed using the **Products Database** window (Figure 6.1).

The **Products Database** window has three main parts:

Figure 6.1: The Products Database window



- The **Categories** box, which is used to select the type of material you want to use. Categories of branded materials are shown in **bold**, categories of generic materials in normal text and user categories in *italics* (see chapter 14 for information on adding your own materials).
- The **Products** box, which you use to select a material from a particular category.
- The **Construction** box which shows the order of layers in the construction.

To insert layers using the Products Database:

1. Select the existing layer which will be *below* the new layer.
2. From the menu bar select **Insert>Layer from database** (or click the **Database** button on the toolbar). The **Products Database** dialogue opens.
3. Use the scroll bar on the **Categories** box to find the manufacturer or type of material you need, then click once on that category. The **Products** box shows the material in that category.

4. Click on a material to select it, then click the **Add to construction** button (alternatively you can double click on the material in the **Products box**). The **Thickness** dialogue opens.

   *If the material has a set thickness the layer will be added without the **Thickness** dialogue opening.*

5. Enter the thickness of the layer then click **OK**. The **Construction** box now shows the new layer.

6. You can now add more layers from the database, using the **Construction** box to control the position of the new layers.

7. When you have finished adding layers click the **Close** button. The main **Uvalue** window now shows the calculation with the new layers added.

If you are not sure which category a particular material belongs to you can use the **Search** button to find it.

You can use the **Only show My database** box to make the software only show categories which you have added.

If you have assigned short codes to materials you can view database items sorted according to the short code by clicking the sort by short code check box in the **Products Database** dialogue. You can use short codes to select materials by entering a code in the **Short Code** text box then clicking the **Add to construction** button: however the short code system is not in general use.

6.2 Inserting blank layers in a calculation

To insert a new blank layer:

1. Select the existing layer which will be *below* the new layer.

2. From the menu bar select **Insert**>**Blank layer** (alternatively you can press <Insert>). The new blank layer is added to the calculation *above* the existing layer.

3. Double click on the layer to open it for editing.

6.3 Cutting, copying, pasting and deleting layers

Cutting a layer from the calculation removes the layer, but keeps the details on the clipboard. To cut a layer:

1. Click on the layer to select it.

2. From the menu bar select **Edit**>**Cut layer to clipboard** (alternatively click the **Cut** button on the tool bar or press `<Ctrl+X>). The layer is removed.

Copying a layer in a calculation copies the layer to the clipboard but keeps the original layer in place. To copy a layer:

1. Click on the layer to select it.
2. From the menu bar select **Edit**>**Copy layer to clipboard** (alternatively click the **Copy** button on the tool bar or press <Ctrl+C>). The layer is copied to the clipboard.

Pasting a layer inserts the layer currently in the clipboard into the calculation. To paste a layer:

1. Click on the layer which you want to be *below* the pasted layer.
2. Select **Edit**>**Paste layer from clipboard** from the menu bar (alternatively click the **Paste** button on the tool bar or press <Ctrl+V>). The layer is inserted into the calculation *above* the selected layer.

To delete a layer:

1. Click on the layer you wish to delete.
2. Press <Del>.

7 Working with materials

The properties of layers are entered and edited in the **Edit Material** dialogue (Figure 7.1). The dialogue enables you to set:

- the basic characteristics of the material (section 7.1).
- the type of material (section 7.2).
- details of thermal bridging (section 7.3).
- any air gap correction (section 8.2).

To edit the properties of a layer:

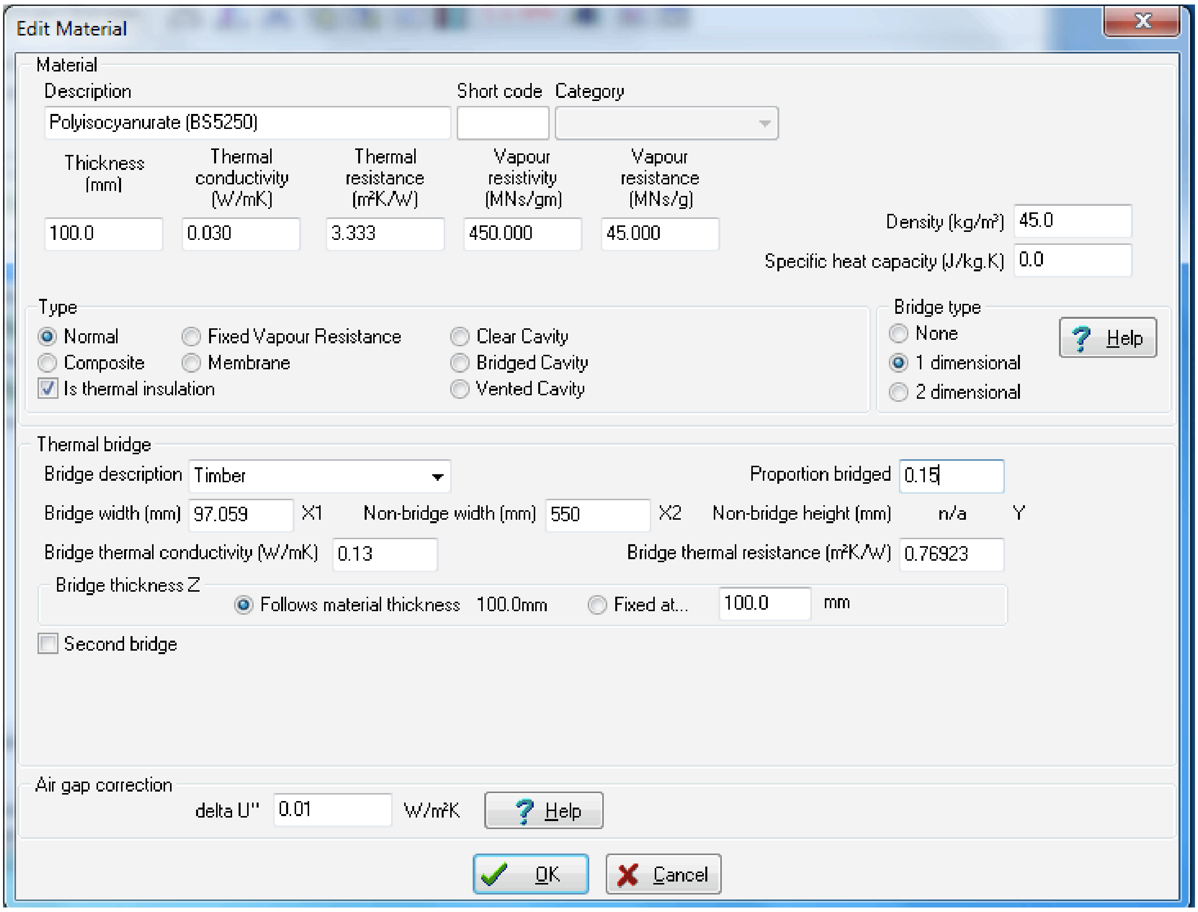
1. Click on the layer to select.
2. From the menu bar select **Edit**>**Layer** (alternatively, double click the layer, or press <Enter>). The **Edit Material** dialogue opens.
3. Amend the data for the layer and click **OK**.

7.1 Basic characteristics

The **Material** section contains the basic data about the layer, including:

- **Description**: the name of the material or a description, which appears in the calculation.
- **Short code**: used with the database to sort or enter materials – not in general use.
- **Category**: not in general use.
- **Thickness**: cross sectional thickness of the layer, measured in mm.
- **Thermal conductivity**: the rate of conduction heat transfer through 1m of the material, measured in W/mK. Sometimes referred to as the lambda value or k value.

Figure 7.1: The Edit Material dialogue



- **Thermal resistance**: the resistance to heat transfer provided by the layer, measured in m^2K/W.
- **Vapour resistivity**: the rate of transfer of water vapour through 1 m of the material, measured in MNs/gm.
- **Vapour resistance**: the resistance to water vapour provided by the layer, measured in MNs/g.

  The following two values are only required for κ-value calculations..
- **Density**: the mass per cubic metre of the material, measured in kg/m^3.
- **Specific heat capacity**: the amount of energy required to raise the temperature of one kilogram of the material by one Kelvin (equivalent to 1 degree Celcius). kJ/kg.

7.2 Types of materials and cavities

Layers within building elements have different combinations of properties: JPA Designer recognises four types of material and three types of cavity. In addition, the program distinguishes between materials which are thermal insulation and those which are not. The rest of this section describes the types of layer and the data required for each one.

7.2.1 Normal

Normal materials have the same composition all the way through, so the thermal resistance of a normal layer is determined by the material's conductivity and thickness. A normal material requires the following information:

- **Type**: select *Normal*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal conductivity**: enter in W/mK.
- The program calculates the **Thermal resistance** in m^2K/W.
- **Vapour resistivity**: (only required if you will be carrying out condensation risk analysis) enter in MNs/gm.
- The program calculates the **Vapour resistance** in MNs/g.

7.2.2 Composite materials

For composite materials, for example insulation-backed plasterboard, there is no direct link between the conductivity, thickness and thermal resistance. You must therefore use the thermal resistance for the specific configuration of the material (this will usually be supplied by the manufacturer of the product). A composite material requires the following information:

- **Type**: select *Composite*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: (only required if you will be carrying out condensation risk analysis) enter in MNs/g.

7.2.3 Fixed vapour resistance materials

Some materials, such as glass and metals, have very high vapour resistances, even when used in thin layers. To enable the vapour resistance to be represented properly in the calculation you should enter these materials as *fixed vapour resistance*. That will break the link between the vapour resistance and the thickness, and so prevent the vapour resistance being reduced to an unrealistically low level by the minimal thickness.

For U-value calculations materials with fixed vapour resistances behave the same way as normal materials: you should only need to use material with fixed vapour resistances in condensation risk calculations. A fixed vapour resistance material requires the following information:

- **Type**: select *Fixed vapour resistance*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal conductivity**: enter in W/mK.
- The program calculates the **Thermal resistance** in m^2K/W.
- **Vapour resistance**: enter in MNs/g.

7.2.4 Membranes

Membranes, such as vapour control layers or vapour open roofing underlays, are treated as having no thermal resistance. They therefore have no effect on U-value calculations, only affecting condensation risk analysis. Membranes require the following information:

- **Type**: select *Membrane*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Vapour resistance**: enter in MNs/g.

7.2.5 Clear cavities

The thermal resistance of a cavity is not calculated from its thickness, although it is affected by the direction of heat flow within the construction. Standard values for cavities may be found in the **Products Database** and in publications such as BS 5250. Clear cavities, such as those in cavity walls, require the following information.

- **Type**: select *Clear cavity*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

7.2.6 Bridged cavities

Bridged cavities, such as those in some timber framed constructions, are treated the same as clear cavities, but with bridging details added (section 7.3). Bridged cavities require the following information.

- **Type**: select *Bridged cavity*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

You will also need to enter the bridging details (section 7.3).

7.2.7 Vented cavities

Vented cavities, such as the batten space in a warm pitched roof, are treated the same as clear cavities. Identifying a cavity as vented allows some layers of the construction to be ignored for condensation risk analysis (for further information see chapter 13). Vented cavities require the following information:

- **Type**: select *Vented cavity*.
- **Description** : type a description of the layer – this will appear on the print out.
- **Thickness**: enter in millimetres, mm.
- **Thermal resistance**: enter in m^2K/W.
- **Vapour resistance**: cavities have a vapour resistance of 0.00 MNs/g.

7.2.8 Low emissivity cavities

A cavity which has one or more faces lined with a material with low surface emissivity (such as a metal foil, or metalised membrane) will have a lower rate of heat transfer by radiation than a cavity with conventional, high emissivity faces. Including such a `low emissivity cavity' within a construction will reduce the overall rate of heat loss through the construction, in some cases by as much as 10%.

There are several types of material with low emissivity surfaces:

- insulation boards with reflective surfaces, such polyisocyanurate boards;
- plastic films with aluminium foil facing;
- membranes with metalised faces;
- `multi-foil' insulants.

To be effective, each low emissivity surface must face a cavity, at least 25 mm wide.

Although the U-value calculation methods implemented in JPA Designer cannot directly assess the effect of reducing radiation heat loss, it is possible to account for the effect of such materials by adjusting the thermal resistance of a cavity which has a low emissivity material to one or more faces.

The thermal resistance value for a low emissivity cavity must be obtained by a valid test method, which considers only the effect of the material upon the overall conduction heat losses through an element. Values should have third party certification, such as in BBA Agrément certificates. If you are not supplied with certified values, use the default value for a low emissivity cavity of 0.44 m^2K/W for walls, 0.34 m^2K/W for roofs and 0.50 m^2K/W for floors (see BR 443 paragraph 4.8.2)

7.2.9 Thermal insulation

In order to comply with the requirements of European product standards for factory manufactured thermal insulation (standards BS EN 13162 to BS EN 13172) JPA Designer rounds the thermal resistance values for thermal insulation down to the nearest 0.05 m^2K/W. To ensure the program does this correctly you must tick the **is thermal insulation** box for all layers of factory manufactured thermal insulation. The original value for thermal resistance will appear in the **Edit material** dialogue while the **U-value** window will show the rounded value. For additional information on the rounding feature and instructions on how to turn it on or off see chapter 13.

7.3 Thermal bridging

Thermal bridges are formed where the material in a layer is interrupted by a second material with different thermal conductivity, for example, the insulation in a timber framed wall is interrupted (bridged) by the timber studs. In most cases thermal bridging increases heat loss through the bridged layer (hence the commonly used term `cold bridge'). The effect of thermal bridges which occur regularly throughout a layer (repeating thermal bridges) has to be included in U-value calculations by added the details of the thermal bridge to each bridged layer using the **Edit material** dialogue.

Thermal bridging is either:

- one-dimensional e.g. timbers running in one direction; or,
- two-dimensional e.g. mortar joints which run vertically and vertically.

The information required for setting thermal bridging includes:

- The thermal conductivity of the bridging material: for common bridge materials this can be set along with the **Bridge description**.
- The width of the bridging material (**Bridge width**) and horizontal distance between bridges (**Non-bridge width**). For two-dimensional bridging you will also need to know the vertical distances between bridges (**Non-bridge height**). The software uses those values to determine the **Proportion bridged**.

  However, for some constructions you will then need to adjust the **Proportion bridged** to allow for additional bridging material such as cross noggins and other framing in timber framed walls. You can find recommended standard proportions in the BRE publication BR 443 *Conventions for U-value calculations*.
- The thickness of the bridging material. In most cases the bridge thickness will be the same as that of the main material of the layer.

To enter thermal bridging details:

1. Use the **Bridge type** radio buttons to determine whether the bridging is *1 dimensional* or *2 dimensional*. The **Edit material** dialogue now shows the **Thermal bridge** section.

   *If you are not sure whether the bridging is one or two dimensional clicking the **Help** button will open a guidance window: the annotation on the help diagrams match those on the data entry boxes.*

2. Select the bridging material from the **Bridge description** drop-down. The program sets the **Bridge thermal conductivity**.

   If you are using an unusual bridging material you can enter your own description, then enter the conductivity manually.

3. Enter the **Bridge width** in mm.

4. Enter the **Non-bridge width** in mm.

5. For two-dimensional bridging enter the **Non-bridge height** in mm.

6. If necessary, change the **Proportion bridged** value to a standard value. The software adjusts the **Bridge width** accordingly.

7. Set the bridge thickness by selecting **Follows material thickness**, or selecting **Fixed at** then entering thickness in mm.

In some constructions – notably built up metal roof and wall cladding – there are two sets of thermal bridges. To enter details of a second bridge:

1. Enter the details for the first bridge.

2. Click the **Second bridge** box. The **Optional second bridge** section is displayed.

3. Select the bridging material from the **Bridge description** drop-down. The program sets the **Bridge thermal conductivity**.

   If you are using an unusual bridging material you can enter your own description, then enter the conductivity manually.

4. Enter the **Bridge width** in mm. The software uses the **Non-bridge width** for the first bridge to calculate the **Proportion bridged**.

   Non-bridge width = centre-to-centre distance - (bridge 1 + bridge 2).

5. When the bridging material is air you can use the **Small airspace resistance** button to calculate the thermal resistance of the bridge: enter the thickness of the airspace and its width – both in mm – then click **OK**. The resistance is displayed in the **Bridge thermal resistance** box.

8 Correction factors

Whilst the U-value of an element depends largely upon the thermal properties of the layers of which it is composed there are a number of other factors which can affect the rate of heat loss. Those are addressed by applying correction factors to the calculation.

There are correction factors for:

- Mechanical fasteners which penetrate insulation, dUf (section 8.1);
- Air gaps in insulation layers, dUg (section 8.2).
- The effect of rainwater cooling on inverted roofs, dUr (section 8.3;
- Brackets in rainscreen cladding systems (section 8.4).
- Insulation compression in built up metal roofing and cladding, dUp (section 9.2).

The correction factors are calculated separately from thermal resistances of the layers, and are then added to the raw U-value: however, if the correction factors total less than 3% of the raw U-value then they are ignored in calculating final U-value. The values for correction factors are displayed in the main U-value window, next to the final U-value.

It is also possible to adjust the result of a U-value calculation to account for the effect of having an unheated space to the cold side of the construction (section 8.5).

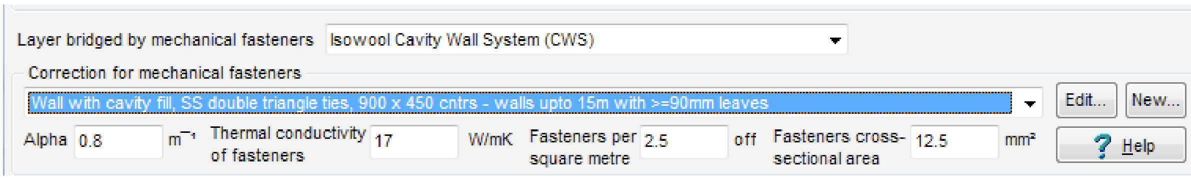
8.1 Mechanical fasteners

Metal fasteners which penetrate layers of thermal insulation reduce the effectiveness of the insulation: that effect has to be included in U-value calculations, using the correction factor dUf[1]. Common constructions which require the correction are:

- Cavity walls with partial or full-fill cavity insulation.
- Warm pitched roofs where insulation is laid over the rafters and restrained by counterbattens fixed back to the rafters.

[1]Note that the calculation method for mechanical fasteners has changed from version 4.04b1 build 025 onwards, and now uses the method in BS EN ISO 6946:2007.

Figure 8.1: Data entry boxes for the mechanical fasteners correction



- Warm flat roofs where the insulation and/or the waterproof membrane is mechanically fixed to the deck.

There is no need to apply a correction:

- to constructions without fasteners, e.g. solid masonry walls;
- for fasteners with both ends in contact with metal sheets;
- for wall ties across an empty cavity;
- for wall ties between a masonry leaf and timber studs;
- where the thermal conductivity of the fastener, or part of it, is less than 1W/mK (such as plastic ties).

The correction factor dUf is calculated from:

- The thermal resistance of the bridged layer and the element itself.
- The **alpha coefficient** which is 0.8 for the standard case of a non-recessed fastener.

  Alpha can be adjusted for recessed fasteners or fasteners which penetrate the insulation at an angle: See ISO 6946:2007 section D.3.2.
- The **thermal conductivity of the fastener**: typically 17 W/mK for stainless steel and 60 W/mK for mild steel.
- The **number of fasteners per square metre**.
- The **cross sectional area of the fastener**: typical double triangle ties have a cross sectional area of 11.3 mm^2 (based on 3.8 mm diameter).

To enter data for mechanical fasteners:

1. From the menu bar select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. Use the drop-down to select the **Layer bridged by mechanical fasteners**.
3. In the **Correction for mechanical fasteners** section either use the drop-down to select one of the standard fastener types or enter the individual items of data for the fasteners.

   *To view the default values click the **Help** button.*
4. Where the fastener is recessed, enter the length of the fastener that penetrates the insulation layer, in mm.

Figure 8.2: Correcting for air gaps in insulation layers

8.2 Air gap correction

Air movement through and around an insulation layer will reduce its thermal performance. The effect of that reduction is included in the U-value calculation by a correction factor, dUg, which is derived from the relative thermal resistances of the insulation layer and the construction as a whole, and from a coefficient dU'', which represents the size of gaps in the insulation layer. Values for dU''

- Where no air gaps penetrate the insulation layer and no air circulation is possible on its warm side, dU'' = 0.00 W/m^{2}K.
- Where some air gaps penetrate the insulation layer and no air circulation is possible on its warm side, dU'' = 0.01 W/m^{2}K.
- Where some air gaps penetrate the insulation layer and some air circulation is possible on its warm side, dU'' = 0.04 W/m^{2}K.

A value for dU'' must be set for *every* insulation layer.

To correct for air gaps:

1. In the main U-value window double click on the insulation layer. The **Edit material** dialogue opens.
2. Enter the appropriate value for dU'' in the **dU''** box (see Figure 8.2). then click **OK**.

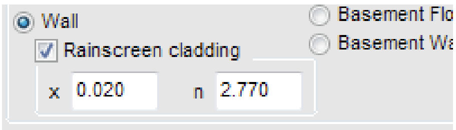
   *Click the **Help** button to view the standard values for dU''. In many cases the default value of zero is appropriate.*

8.3 Rainwater cooling

Inverted roofs – or protected membrane roofs – have some or all of the thermal insulation installed over the top of the waterproof membrane where it is restrained by aggregate or other ballast. Rainwater falling on inverted roofs can percolate between insulation boards to the waterproofing membrane, where it will increase the rate of heat loss. The reduction in performance is represented within a U-value calculation by the rainwater cooling correction factor, dUr, which is calculated from:

- The average rate of rainfall during the heating season, *p* (mm/day);
- A drainage factor, *f*, which represents the fraction of *p* which reaches the waterproofing membrane;

Figure 8.3: Data for rainscreen cladding correction



- A factor for increased heat loss caused by rainwater flowing on the membrane, *x* (Wday/m^{2}Kmm).

In JPA Designer that data is entered using the **U-value Construction** dialogue. As you have to indicate which layer is affected by the rainwater cooling it is best to add the correction factor *after* you have defined the layers in the construction.
To enter rainwater cooling data:

1. From the menu bar select **Edit**>**Construction Type**.
2. In the **Element type** section select *Flat roof*.
3. Tick the **Inverted roof** box. New data entry boxes appear.
4. In the **External insulation layers** box tick the layer(s) is affected by the rainwater cooling.

   Where a low U-value is required there may be more than one insulation layer affected.
5. Enter values for *f.x* and *p*. Click **OK**.

   If you do not have project-specific values you can use the default values for f.x and p.

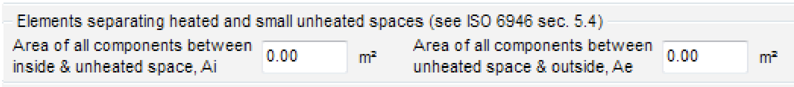
8.4 Rainscreen cladding

When calculating U-values for walls which include rainscreen cladding the results have to be adjusted to account for the effect of any metal fixings which penetrate the insulation. JPA Designer can correct for the effect of point fixings, using method (c) in section 4.9.5 of BR 443 *Conventions for U-value calculations*.
The calculation requires the point thermal transmittance of the fixing, **x**, and the number of fixings per square metre, **n**. As **x** depends on the type of fixing you must get the correct value from the fixing manufacturer. The data is entered in the **U-value Construction** dialogue.
To correct for brackets in rainscreen cladding:

1. From the menu bar select **Edit**>**Construction Type**. The **U-value Construction** dialogue opens.
2. In the **Element type** section select *Wall*.
3. Tick the **Rainscreen cladding** box. New data entry boxes appear (see Figure 8.3).
4. Enter values for **x** and **n**. Click **OK**.

   If you do not have project-specific values you can carry out an initial calculation using the default values for x and n.

Figure 8.4: Data entry for elements separating heated and unheated spaces



8.5 Elements separating heated and unheated spaces

The rate of heat loss through an element which separates a heated space from an unheated space will be lower than that through an identical element which separates a heated space from outside, as the relatively warm air within an unheated space acts as a thermal buffer.

The combined method for calculating U-values allows for this effect using the ratio of:

- the surface areas of the elements which separate the heated space from the unheated space, *Ai*, to,
- the surface areas of the elements which separate the unheated space from outside, *Ae*.

When measuring *Ai* and *Ae*, you should include walls and intermediate floors (such as that over an integral garage) but exclude ground floors. *Ai* and *Ae* are measured in m^2.

To allow for unheated spaces:

1. From the menu bar select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. Enter the two areas in the **Ai** and **Ae** boxes (see Figure 8.4).
3. Click **OK**.

9 Complex calculations

9.1 Light steel framed structure

There are three different forms of light steel-framed structures:

- *Warm* frame constructions: all the insulation is outside the steel framing.
- *Hybrid* constructions: some insulation is fitted between the steel studs and additional insulation placed on the outside of the studs to reduce thermal bridging through the steel.
- *Cold* frame constructions: all of the insulation is included within the thickness of the steel components and is bridged by it.

The high thermal conductivity of steel means the combined method must be modified for elements where some or all of the insulation is bridged by light steel framing. JPA Designer uses the modified calculation method which was published in BRE Digest 465. *U-values for light steel-frame construction*.

The procedure for calculating the U-value of a light steel-framed element using JPA Designer is the same as for any other element, but with the following modifications:

Figure 9.1: Setting the type and details of light steel frame construction

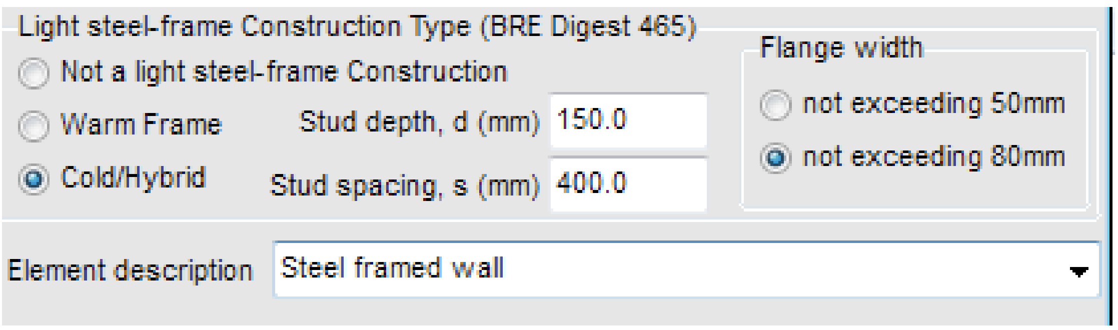
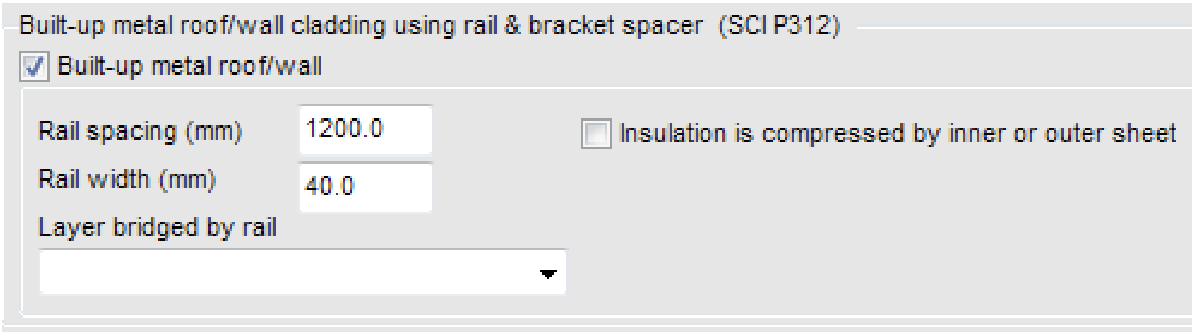


Figure 9.2: Built-up metal wall or roof cladding



1. Identify the element as light steel-framed and enter the framing details (Figure 9.1.

   In the **Uvalue Construction** dialogue use the light steel-frame radio buttons to define is as **warm** or **cold/hybrid**.

   If you select **Cold/Hybrid** enter the **stud spacing**, **stud depth** and **flange width**. Use the offered default values if you do not know the stud depth and spacing.

2. Enter the layers of the construction in the main **Uvalue** window.

   For *cold/hybrid* elements some of the layers will be bridged (section 7.3) for guidance on entering bridged layers):

   In *warm* elements the air space between the studs should be entered as a bridged cavity, with steel as the bridging material.

   In *cold/hybrid* elements the insulation layer will be bridged by steel.

   Any airspace behind the insulation and between the studs should be entered as a bridged cavity.

   Do not include the flanges of the steel studs when entering bridging details.

3. Enter corrections for any mechanical fasteners which penetrate the insulation by completing the **Correction for mechanical fasteners** section in the **Uvalue Construction** dialogue (section 8.1).

   Use the first drop box to indicate which layer is bridged by the mechanical fasteners, then enter the fasteners' dimensions and spacing. The **alpha coefficient** is 0.8 for warm constructions and 1.6 for cold/hybrid constructions.

9.2 Twin skin metal cladding and roofing

The extent of the thermal bridging in twin-skin metal roofing and cladding systems formed with rails and brackets means the combined method has to be modified. JPA Designer uses the method described in the Steel Construction Institute research paper SCI P312: that method takes account of:

- The bridging effects of the rail and the air spaces around the rail.
- The point bridging produced by the brackets.

- The compression of the insulation by a shallow-profiled liner (profile depth less than 25 mm).

To calculate U-values for twin-skin metal roofing and cladding:

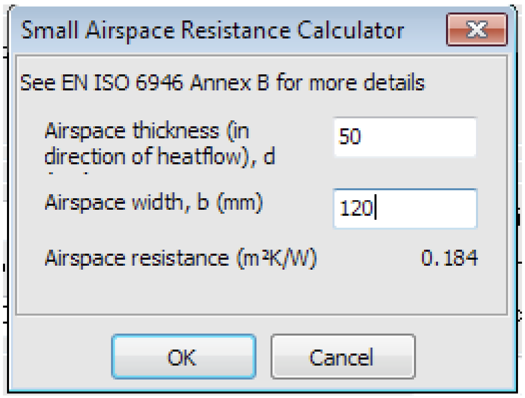
1. Create and open a new U-value calculation.
2. Enter any project information.
3. In the **U-value Construction** dialogue select either *wall* or *flat roof*. Do not tick the **Built up metal roof/wall** box at this stage. Click **OK**.
4. Enter the layers in the construction in the main **U-value** window. Enter the insulation in *two layers*: the first layer being the insulation which is bridged by the rails and the second that which is penetrated only by the brackets.

   For example, a 170 mm layer of insulation in a construction with 40 mm deep rails should be divided into one layer 40 mm thick and one layer 130 mm thick. You will find later parts of the calculation easier if you give the two layers distinctive names.
5. Enter the bridging details for the layer of insulation bridged by the rails (section 7.3 for details). In the **Edit Materials** dialogue select *one dimensional bridging* to show the thermal bridging details. Enter the details of the rails: **bridge material – steel studs, bridge width, non-bridge width**. The software sets the bridge thermal conductivity. The program will show the proportion bridged and the thermal resistance of the bridge.

   For `L' shaped sections the **bridge width** will usually be the thickness of the steel, but for `C' and `U' sections, where the rail penetrates the insulation layer twice, use double the thickness of the steel as the bridge width.
6. Enter the bridge details for the air spaces caused by the rail. Tick the **Second bridge** box. The **Optional second bridge** section is displayed.
7. Enter the **bridge material** (air) and **bridge width** (in mm): use twice the rail width to allow for the compression of the insulation around the rails.

   The program calculates the proportion bridged using the data from the first bridge, so the non-bridged width = (Centre-to-centre distance of rails) - (bridge thickness 1 + bridge thickness 2).
8. To calculate the thermal resistance of the air space click the **Small airspace resistance** button. The **Small Airspace Resistance Calculator** dialogue opens (Figure 9.3).
9. Enter the **thickness** and **width** of the air space. The thickness will be the same as the rail depth. The width should be twice the rail thickness. Click **OK** to close the dialogue transfer the results to the bridging calculation.
10. Enter the air gap correction, dU'', for *both* insulation layers (section 8.2): use the value 0.01. Click **OK**.
11. From the menu bar select **Edit**>**Construction Type**. The **Uvalue Construction** dialogue opens.

Figure 9.3: The Small Airspace Resistance Calculator



12. Tick the **Built up metal roof/wall** box. The dialogue now displays the **Built-up metal roof/wall cladding** section.

13. Enter the **Rail spacing** and **Rail width** (Figure 9.2). Use the drop-down to indicate which layer is bridged by the rail liner details.

14. If the liner profile compresses the insulation and the depth of the profile is 25 mm or less tick the box **Insulation is compressed by inner or outer sheet**. Four new data boxes appear.

15. Enter the **Sheet profile width**, **Sheet profile depth** and **Sheet profile centres** in mm. In the drop box select the layer of insulation which is *not* bridged by the rails.

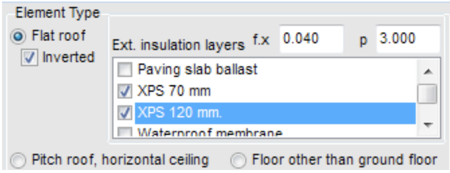
    If the liner profile is deeper than 25 mm ignore the check box and change the thickness of the insulation layer by subtracting the profile depth from the original thickness (e.g. for a 30 mm profile with 130 mm actual depth of insulation use a value of 130 – 30 = 100 mm).

16. Enter the details for the brackets in the **Correction for mechanical fasteners** section. Enter the **thermal conductivity of the brackets** (usually 60.00 W/mK for mild steel), the **number of brackets per square metre** (calculated by dividing the total number of brackets by the total element area) and the **cross sectional area of the brackets** (measured at the thickest point). The value of **alpha**, 1.6, is the default setting for these constructions. Finally, use the drop-down to select the layer which is bridged by the brackets. Click **OK**.

9.3 Inverted roofs

In inverted roofs (often known as protected membrane roofs) some or all of the thermal insulation is applied above the waterproof membrane and restrained by aggregate or other ballast. Rainwater falling on the roof can percolate to the waterproofing membrane and increase the rate of heat loss. To allow for this effect a rainwater cooling correction factor, dUr, has to be applied to inverted roof calculations (the rainwater cooling factor is described in section 8.3). Because you have to indicate the layer or layers affected by the

Figure 9.4: Inputting data for rainwater correction



rainwater cooling it is best to add the correction factor *after* you have defined the layers in the construction.

To enter an inverted roof:

1. From the file menu select **Edit**>**Construction type**. The **U-value Construction** dialogue opens.
2. In **Element type** select *Flat roof*. Insert an **Element description** then click **OK**.
3. Add the layers of the construction (chapter 6).
4. Open the **U-value construction** dialogue again and in **Element Type** tick the **Inverted** box. The dialogue shows three data boxes (Figure 9.4).
5. Enter the values for **f.x** and **p** and in the box select the layers of insulation above the waterproof membrane. Click **OK**.

9.4 Using variable layers

The variable layer feature of JPA Designer helps you assess the effect of using different materials in the same place within an element; for example, by using a variable layer you could compare the effect of different insulants on the U-value of a cavity wall.

A calculation with a variable layer has a place-holder layer in the main window, and has the additional **Variable layer** pane which accepts a number of different layers. Each of those layers shows the results of the U-value calculation *as if* that layer replaced the place-holder layer in the main calculation.

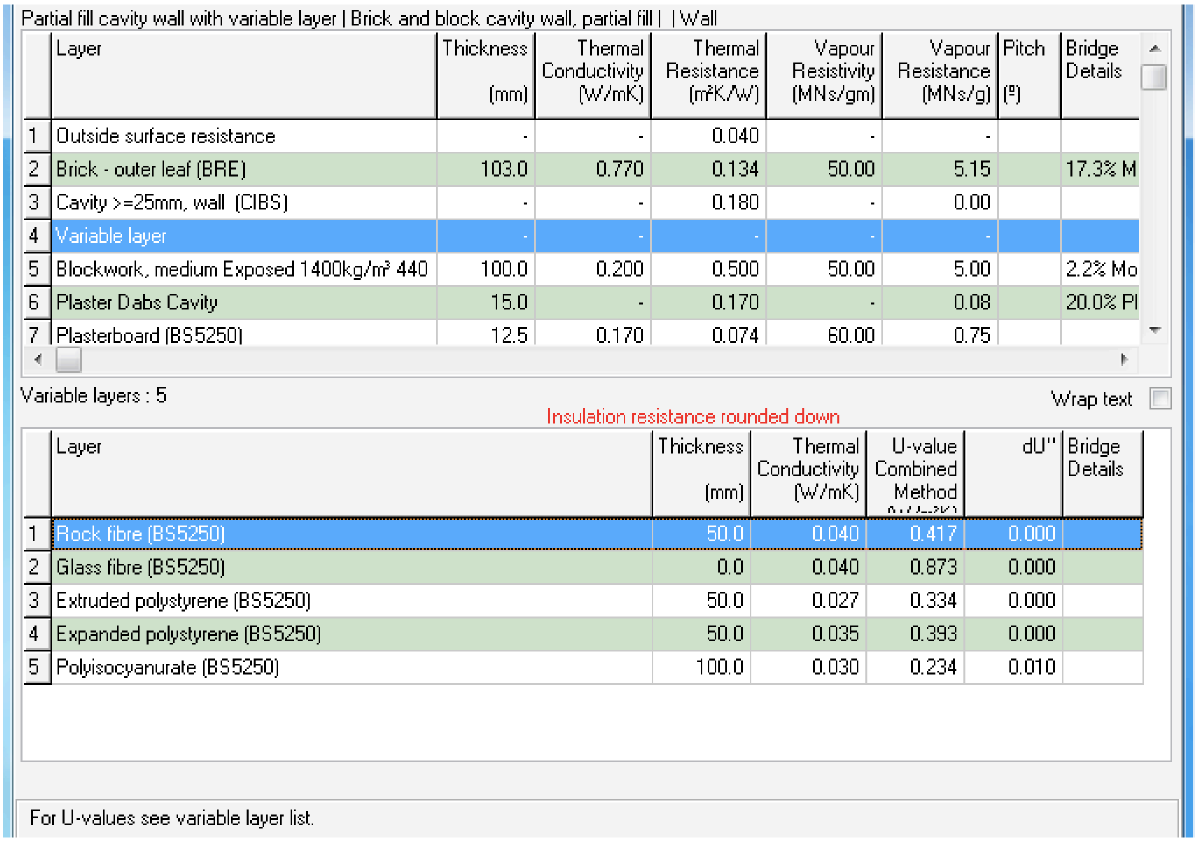
To use a variable layer:

1. In the main **U-value** window click the layer *below* the position for the variable layer.
2. From the menu bar select **Insert**>**Variable layer**. The program inserts a variable layer in the calculation and displays the **Variable layer** pane (see Figure 9.5).
3. Select the blank layer in the variable layer pane and add layers from the database, or by add and edit blank layers.

   *When using the database, you must be ensure the contents of variable layer pane are showing in the **Construction** box of the **Products Database** dialogue.*

The U-values for the constructions with the variable layer are shown alongside the variable layer materials: no U-value appears in the status bar. You can only have one variable layer in a calculation.

Figure 9.5: U-value calculation with a variable layer


Partial fill cavity wall with variable layer | Brick and block cavity wall, partial fill | | Wall

	Layer	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m²K/W)	Vapour Resistivity (MNs/gm)	Vapour Resistance (MNs/g)	Pitch (º)	Bridge Details
1	Outside surface resistance	-	-	0.040	-	-		
2	Brick - outer leaf (BRE)	103.0	0.770	0.134	50.00	5.15		17.3% M
3	Cavity >=25mm, wall (CIBS)	-	-	0.180	-	0.00		
4	Variable layer	-	-	-	-	-		
5	Blockwork, medium Exposed 1400kg/m³ 440	100.0	0.200	0.500	50.00	5.00		2.2% Mo
6	Plaster Dabs Cavity	15.0	-	0.170	-	0.08		20.0% Pl
7	Plasterboard (BS5250)	12.5	0.170	0.074	60.00	0.75		

Variable layers : 5

Wrap text

Insulation resistance rounded down

	Layer	Thickness (mm)	Thermal Conductivity (W/mK)	U-value Combined Method	dU''	Bridge Details
1	Rock fibre (BS5250)	50.0	0.040	0.417	0.000	
2	Glass fibre (BS5250)	0.0	0.040	0.873	0.000	
3	Extruded polystyrene (BS5250)	50.0	0.027	0.334	0.000	
4	Expanded polystyrene (BS5250)	50.0	0.035	0.393	0.000	
5	Polyisocyanurate (BS5250)	100.0	0.030	0.234	0.010	

For U-values see variable layer list.

9.5 Tapered layers

Tapered insulation layers are commonly found on flat roofs, where `cut-to-falls' insulation is being used to create drainage falls on an otherwise flat deck. As the thickness of the insulation varies across the roof a special method is required to calculate a representative thermal resistance for that layer.

JPA Designer uses the method in Annex C of BS EN ISO 6946:2007 to determine the resistance of tapered insulation layers. That method treats the tapered insulation layer in two parts: first the minimum thickness of the layer which is laid across the whole roof, then the rest of the insulation which is treated as a series of blocks, with different shapes. There are three types of block:

- blocks with rectangular plan, which have their greatest thickness, t, on one side, and slope down from that side to the other;
- blocks with triangular plan which have their thickest part, t, at the one corner and slope down to zero at the other corners;
- blocks with triangular plan which have their thickest part, t, along one side, and slope from there down to the other corner.

Depending on its size a roof may have several blocks of each type, each with different areas and, in some cases, different maximum thicknesses.

Tapered insulation is entered in JPA Designer using the **Tapered Areas** dialogue (Figure 9.7). The dialogue requires three items of general information:

- a **description** of the layer: you can use the name or type of insulation.
- the **minimum tapered layer thickness**: that is, the minimum depth of the insulation layer which is continuous across all parts of the roof, measured in mm.
- the conductivity of the insulation, **lambda**: this is entered in W/mK.

The data on the different roof blocks is entered in the three tables , with each block having its own entry, in the appropriate section, with the following data:

- surface area, m^2;
- taper thickness, t, in mm.

Figure 9.6 shows a roof with tapered insulation laid with falls towards the perimeter. To calculate the U-value the tapered layer should be divided into eight blocks, with two (a and e) being rectangles sloping from the centre line to the perimeter and the remainder being triangles, in each case sloping from the highest corner at the centre line to the lowest side at the perimeter (b, c, d, f, g and h). Figure 9.7 shows those eight blocks entered on the **Tapered areas** dialogue.

To enter a tapered layer in an existing U-value calculation:

1. Divide the roof into blocks and calculate the minimum thickness, block areas and taper thicknesses.
2. From the menu bar, select **Insert**>**Tapered layer**.
3. Enter the data for the minimum thickness and the conductivity of the insulation.
4. Enter the data for each block in turn, making sure each block goes into the appropriate table.

   You can use the ***Total area*** *figure at the bottom right of the dialogue to check you have entered all the sections of the roof.*

Figure 9.6: A typical roof with tapered insulation

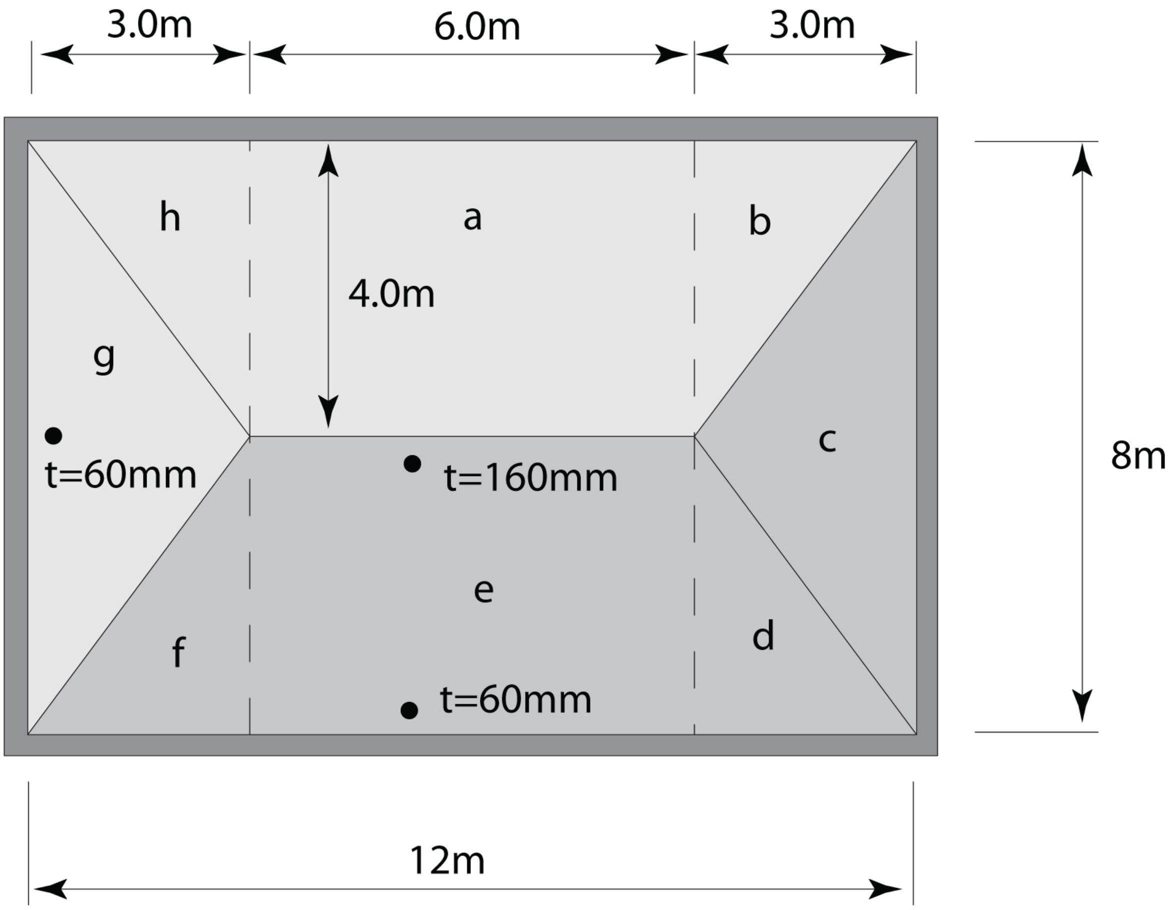
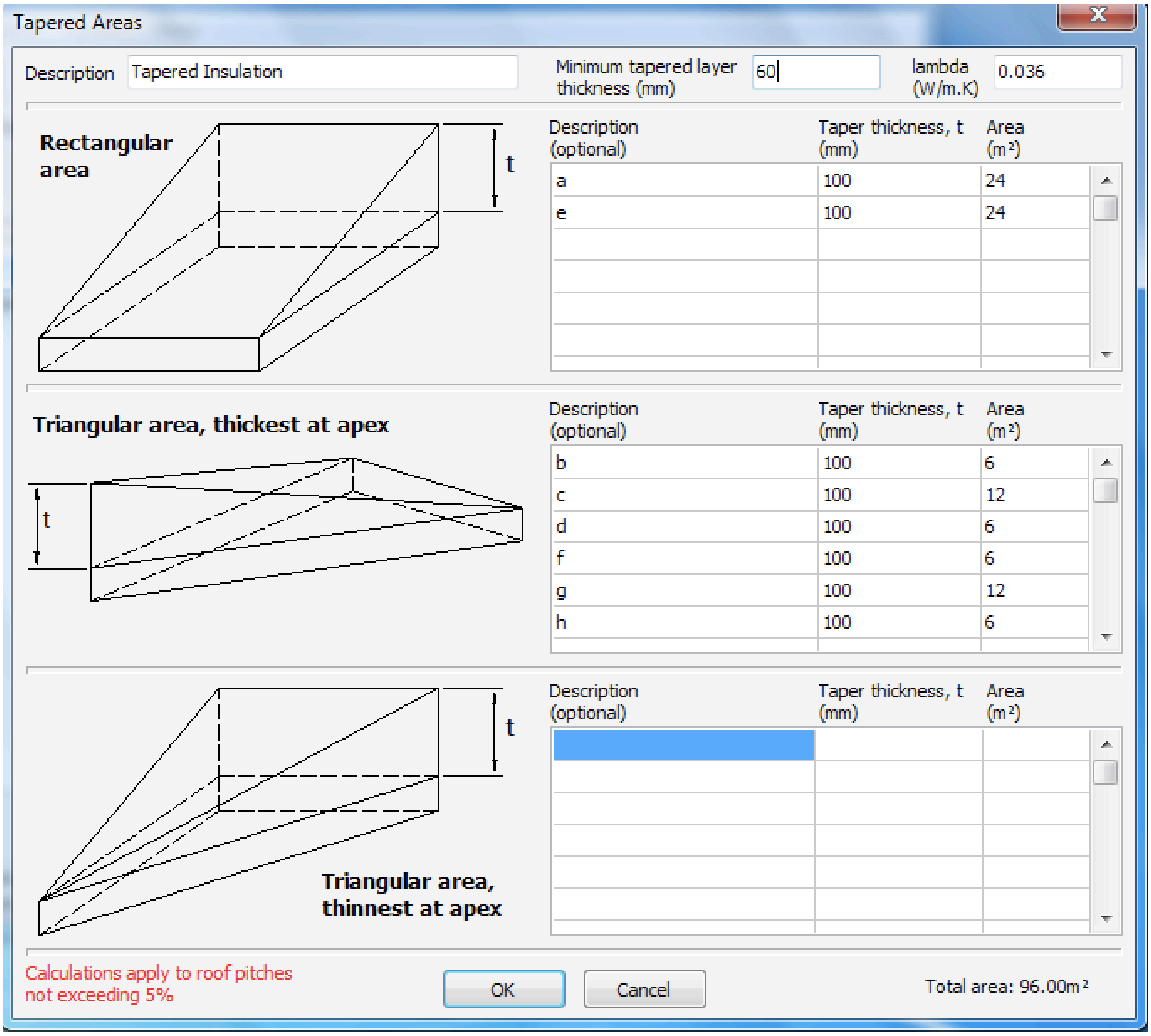


Figure 9.7: The Tapered areas dialogue



10 Ground floor U-values

As the combined method deals with heat loss from air to air, through an element, it has to be modified for ground floors to include the thermal resistance of the ground itself. JPA Designer calculates U-values for ground floors using the method is set out in ISO 13370[1].

This section describes the general procedure for calculating the ground floor U-value, whilst the following sections describe the individual parts of the calculation.

To calculate a ground floor U-value:

1. Create a new U-value calculation in the **Project Manager** window and open it for editing (section 3.5).
2. Enter any project information in the **Project Information** dialogue.
3. In the U-value Construction dialogue select *Solid ground floor* or *Suspended ground floor*, enter a description for the construction, then click **OK**. The **Ground Floor Details** dialogue opens.
4. Enter the data for the ground (section 10.1). Click **OK**.
5. Add the remaining layers of the floor construction.

Include layers to represent:

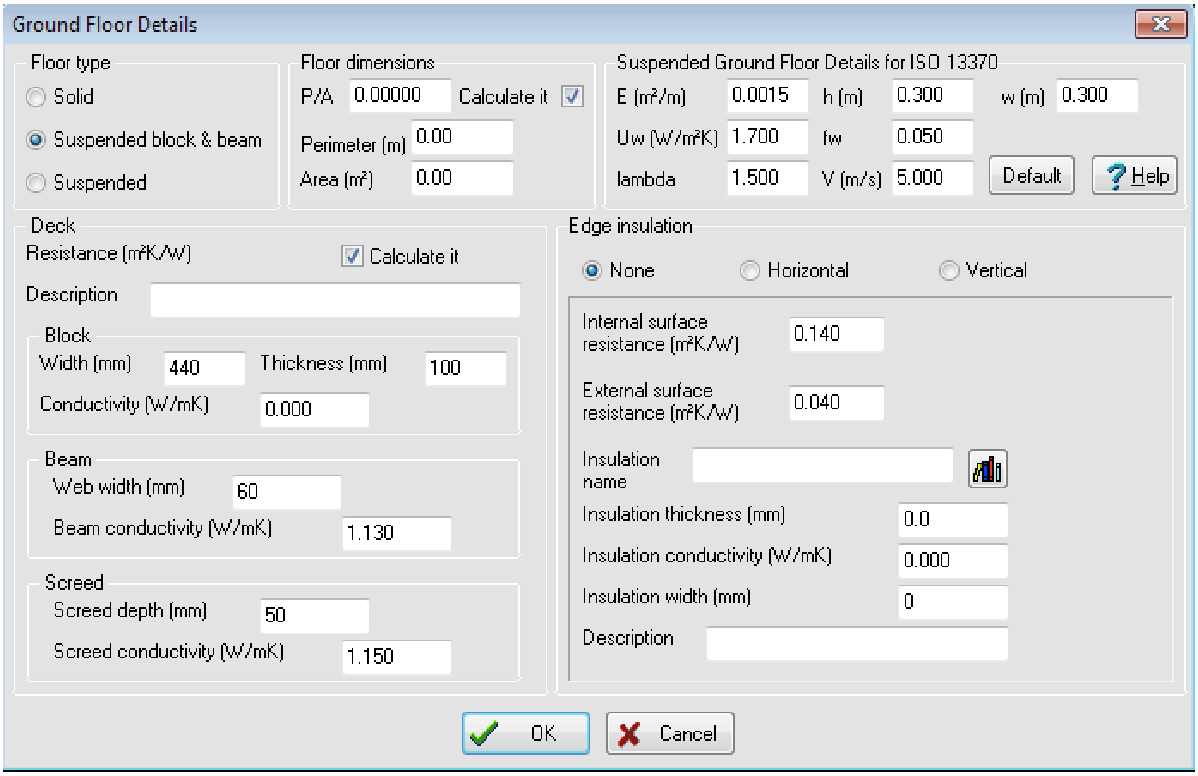
- Screed;
- Insulation;
- Flooring, such as particle board.

Omit any layers which consist of:

- Hardcore beneath a groundbearing slab.
- Groundbearing concrete slabs with density greater than 1800 kg/m^3.
- Thin floor coverings such as vinyl or carpet.

For further guidance refer to the BR 443 *Conventions for U-value calculations*.

Figure 10.1: The Ground Floor Details Dialogue



10.1 Ground floor details

The **Ground Floor Details** dialogue contains the data which describes the ground and the floor structure (Figure 10.1).

It has five sections:

- Floor type. The choice of floor type will determine how other parts of the dialogue appear.
- Floor dimensions.
- Deck.
- Suspended ground floor details.
- Edge insulation.

10.1.1 Floor type

There are three types of ground floor:

[1] Do not use this method to calculate U-values of floors over open or unheated spaces such as car parks or garages; instead select floors other than ground floors in the Construction dialogue box and proceed as usual.

- *Solid*: a floor which bears directly on the ground with no void between the floor structure and the ground, for example, a ground-bearing concrete slab;
- *Suspended block and beam*: with a void between the floor deck and the ground, with the deck formed from pre-cast concrete beams infilled with concrete blocks or proprietary insulating units;
- *Suspended*: a floor with a void between the floor structure and the ground, with a timber deck supported on timber joists.

Use the **Floor Type** radio buttons to select the type of floor construction.

10.1.2 Floor dimensions

The thermal resistance of the ground is determined from the ratio of the floor's perimeter and area. The perimeter length (expressed in metres) is measured along the finished internal surfaces of exposed and semiexposed walls. The area (expressed in square metres, m^2) is measured between the finished internal wall surfaces. Unheated spaces outside the insulated fabric should be excluded when calculating the perimeter and area.

If you are calculating the ground floor U-value for flats in a block or for a house in a terrace you can use the perimeter and area for the whole block or terrace instead of the dimensions of the individual occupancies.

To enter the Floor dimensions:

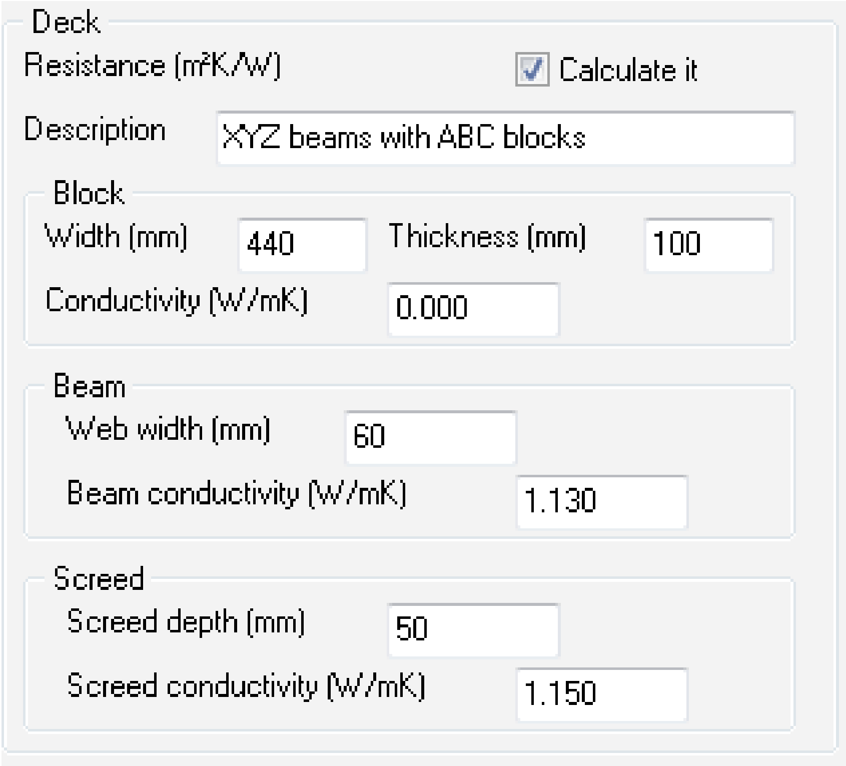
- If you have calculated the Perimeter/Area ratio you can enter it directly in the **P/A** box.
- Alternatively, tick the **Calculate it** box and enter the values in the **Perimeter** and **Area** boxes for you to fill in.

10.1.3 Deck

The data required for this section depends upon the type of construction specified in the **Floor Type** section of the **Ground Floor Details** dialogue.

- Solid floor: no deck data required.
- Suspended block and beam floor: the program offers a default thermal resistance for the deck of 0.2 m^2K/W. Alternatively, the program can also calculate the resistance using the specific details for your floor if you tick the **Calculate** box (Figure 10.2) then input data for:
- The blocks: **Width**, **Thickness** and **Conductivity**.
- The beams: **Web width** and **Beam conductivity**.
- The screed: **Screed depth** and **Screed conductivity**.
- Suspended floor: the program offers a default thermal resistance for the deck of 0.2 m^2K/W for the deck. This represents a 18 mm softwood deck. Insulation between joists should be entered as a separate layer, bridged by timber in one dimension, (section 7.3).

Figure 10.2: Calculating the resistance of a beam and block deck



10.1.4 Suspended ground floor details

In a suspended ground floor, whether beam and block or timber, there will be some heat loss through the walls of the sub-floor void, both by conduction and also by air movement. JPA Designer calculates that heat loss using the data in **Suspended Ground Floor Details** section of the **Ground Floor Details** dialogue. The values required are:

- *E* - the area of ventilation openings per perimeter length of under floor space, in m^2/m;
- *H* - the height of the upper surface of the floor above external ground level, in m;
- *Uw* - the Uvalue of the walls of the under floor space above ground level, calculated according to BS EN ISO 6946, in W/m^2K (you can do this as a separate calculation using JPA Designer);
- *Fw* - the wind shield factor, see Table 10.1.
- *V* - the average wind speed at 10 m above ground level, in m/s
- *Lambda* - the conductivity factor for the type of ground: use 1.5 for clay or silt, 2.0 for sand or gravel and 3.5 for homogeneous rock.

Where some or all of these details are unknown you should use the default values. If you edit the values then want revert to using the defaults click the **Default** button.

Table 10.1: Windshield factor

Location	Example	Fw
Sheltered	City centre	0.02
Average	Suburban	0.05
Exposed	Rural	0.10

10.1.5 Edge insulation

Installing insulation horizontally around the perimeter of the floor – edge insulation – will reduce thermal bridging at the perimeter and improve the floor's overall thermal performance. Edge insulation can be:

- Horizontal: insulation installed around the perimeter of the floor in the same plane as the floor[2].
- Vertical: insulation installed at the perimeter of the floor, at right angles to the plane of the floor.

Use the radio buttons to select the type of edge insulation present, then enter the details of the insulation (if there is no edge insulation leave the rest of this section blank).

- **Internal** and **external surface resistances** use the default values of 0.140 m^2K/W and 0.040 m^2K/W.
- **Insulation thickness**: board thickness, in mm.
- **Insulation conductivity**: the lambda value, in W/mK.
- **Insulation name**.
- **Insulation width** or **depth** (depending upon whether the insulation is laid horizontally or vertically): the board width, in mm.
- **Description**: optional description of the insulation.

You can also use the **Products Database** to enter details of the insulation by clicking on the button by the **Insulation name** box.

Further information on edge insulation may be found in BRE Information Paper 7/93.

[2]Horizontal edge insulation was commonly used to reduce thermal bridging and cold spots on larger floors which did not require a complete layer of thermal insulation. However, the lower U-values now required by Building Regulations usually require a full layer of insulation, making the use of horizontal edge insulation unlikely.

11 Basement U-values

The methods for calculating U-values of basements are set out in BS EN ISO 13370. The calculations for basement floors and walls are linked, with each calculation requiring data about the other element. Because of this it is easier to calculate the basement floor U-value first, followed by the basement wall U-value. For a full explanation of the calculation methods consult BS EN ISO 13370.

11.1 Basement floors

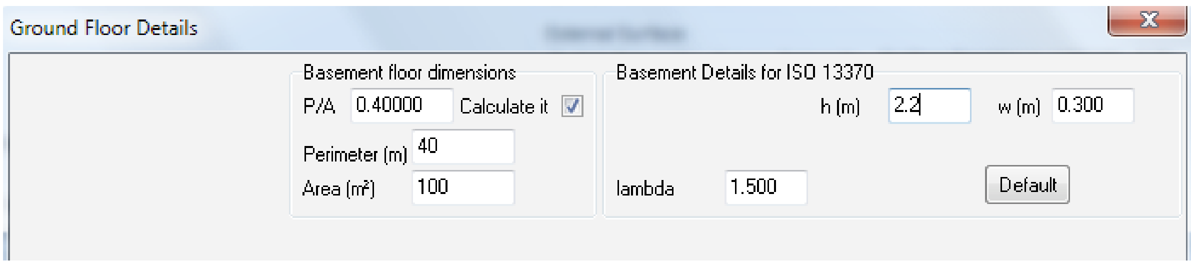
To complete a basement floor U-value calculation you will need to know:

- The floor's Perimeter/Area ratio: *P/A*;
- The thickness of the basement walls: *w* (metres);
- The average depth from the external ground surface to the basement floor: *h* (metres);
- The thermal conductivity of the ground: lambda, λ, (W/mK) (see Table 11.1 and annex G of BS EN ISO 13370).

To calculate a basement floor U-value:

1. Create a new U-value calculation in the **Project Manager** window and open it for editing.

Figure 11.1: Entering data for basement floors



2. In the **U-value Construction dialogue** set the **Element Type** to *Basement Floor*, enter an **Element description** then click **OK**. The **Ground Floor Details** dialogue opens (Figure 11.1).
3. Enter the Perimeter/Area ratio, **P/A**, or check the box labelled `calculate it' and enter the **Perimeter** and **Area** separately.
4. Enter the wall thickness, **w**, the basement depth, **h**, and the thermal conductivity of the ground, **lambda**. Click **OK**.
5. Enter the layers which make up the floor construction.

Include layers to represent:

- Screed;
- Insulation;
- Flooring, such as particle board.

Omit any layers which consist of:

- Hardcore beneath a groundbearing slab.
- Groundbearing concrete slabs with density greater than 1800 kg/m^3.
- Thin floor coverings such as vinyl or carpet.

Table 11.1: Thermal conductivity of the ground

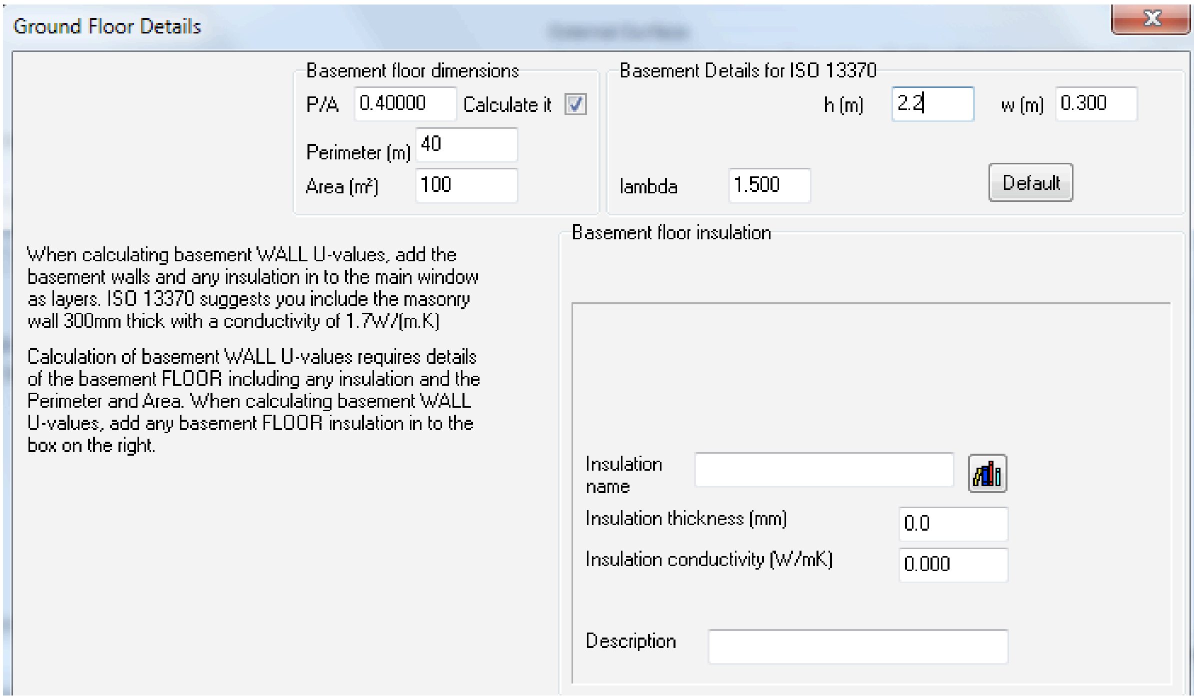
Category	Description	Thermal conductivity, (W/mK)
1	clay or silt	1.5
2	sand or gravel	2.0
3	homogeneous rock	3.5

11.2 Basement walls

To complete a basement wall U-value calculation you will need to know:

- The floor's Perimeter/Area ratio: *P/A*;
- The thickness of the basement walls: *w* (metres);
- The average depth from the external ground surface to the basement floor: *h* (metres);
- Details of the insulation in the basement floor.

Figure 11.2: Entering data for basement walls



- The thermal conductivity of the ground: λ, (W/mK) (Table 11.1 and annex G of BS EN ISO 13370).

To calculate a basement wall U-value:

1. Create a new U-value calculation in the **Project Manager** window and open it for editing.
2. In the **U-value Construction dialogue** set the **Element Type** to *Basement Wall*, enter an **Element description** then click **OK**. The **Ground Floor Details** dialogue opens (Figure 11.2).
3. Enter the Perimeter/Area ratio, **P/A**, or check the box labelled `calculate it' and enter the **Perimeter** and **Area** separately.
4. Enter the wall thickness, **w**, the basement depth, **h**, and the thermal conductivity of the ground, **lambda**.
5. Enter the details of insulation in the basement floor. Either enter the **name**, **thickness** and **conductivity** of the insulation, or use the database button to select the insulation from the **Products Database**. Click **OK**.
6. Now add the layers of the construction in the main **U-value** window.

12 Outputting results

You can print the results of U-value calculations onto paper or produce a PDF file which can be opened on any computer with the free Adobe Reader software installed; PDF files are ideal for emailing to people who need to see the results of the calculation but do not have JPA Designer. For both print and PDF the output includes:

- Project information;
- Details of the construction;
- The U-value and any correction factors.

To print results:

1. Select **File**>**Print** from the menu bar (or click the **Print** button on the tool bar). The **Sections To Print** dialogue opens (Figure 12.1).

Figure 12.1: Sections To Print dialogue

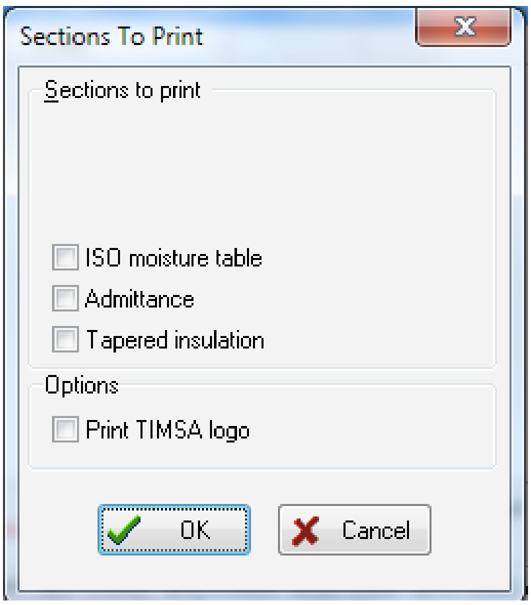


Figure 12.2: Print preview controls

2. Use the tick boxes to select whether to print an additional page showing the details of the bridging calculations. You can also choose whether to include the ISO moisture table for condensation analysis, and whether the calculation should show the logo of the BBA/TIMSA U-value accreditation scheme.

3. Click **OK**. The **Print preview** window opens.

4. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2).

To create a PDF file of the results:

1. From the menu bar select **File**>**Create PDF**. A dialogue asks if you want to open the PDF when it is created.

2. Select **Yes** or **No**. The **Sections To Print** dialogue opens (Figure 12.1).

3. Use the tick boxes to select whether to print an additional page showing the details of the bridging calculations (you can also choose whether to include the ISO moisture table for condensation analysis).

4. Click **OK**. The **Print preview** window opens.

5. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2). The program will then create a PDF file of the calculation.

   *The name of the PDF file will include the JPA Designer file name and the calculation name, so the calculation **tile hung wall** in a project **The Meadows** will be called **The Meadows.JDPtile hung wall.PDF**. The file will be saved into the JPA Designer program folder or in the start-up folder you have specified.

   Note: as Windows does not allow certain characters to be used in file names you should ensure the calculation names in JPA Designer do not contain those characters, otherwise PDF creation will fail. The restricted characters are: ' / \ : * ? < > |.

You can change the printer settings by selecting **File**>**Printer setup** from the menu bar.

13 U-value calculation options

The European standards for factory produced thermal insulation products[1] set out the requirements for determining and quoting the thermal performance of thermal insulation. For each product:

> the value of thermal resistance, R90/90, shall be . . . rounded downwards to the nearest 0.05 m^2K/W, and declared as RD in levels with steps of 0.05 m^2K/W.

To comply with that requirement JPA Designer rounds down the thermal resistance of all layers which are marked at thermal insulation. To mark a layer as thermal insulation tick the **is thermal insulation** box in the **Edit material** dialogue.

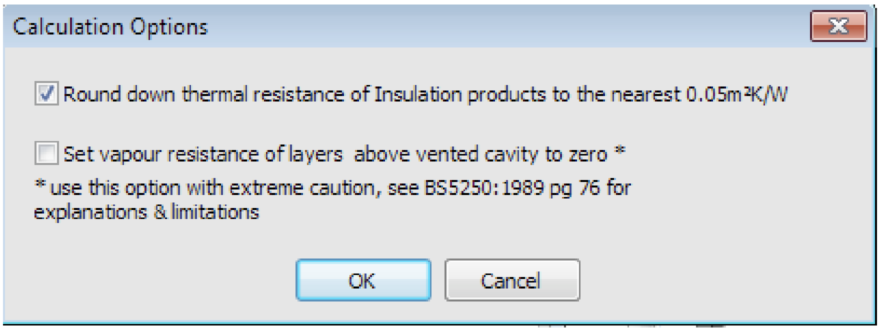
Because there may be occasions when you need to carry out calculations without rounding the feature may be turned off and on. By default, rounding is on: this is indicated by red text in the bottom margin of the U-value window.

To change the rounding setting: 1. From the menu bar select **Options**. The Calculations Options dialogue opens (Figure 13.1).

1. Tick the **Round down thermal resistance** box to toggle rounding on or off.
2. Click **OK** to accept the change.

[1]The series runs from BS EN 13162:2001 *Thermal insulation products for buildings. Factory made mineral wool (MW) products. Specification* to BS EN 13172:2001 *Thermal insulating products. Evaluation of conformity*. There is one standard for each major thermal insulation material.

Figure 13.1: U-value calculation options



14 Editing the Products database

To make U-value calculations easier all JPA Designer U-value modules include the **Products database**, which provides the key data on generic construction materials, cavities and branded products from a number of manufacturers. This section explains how you can add frequently used products to the database.

The materials within the database are organised into three categories:

- Branded products from manufacturers, shown in **bold** in the categories list;
- Generic materials, shown in normal type in the categories list;
- User defined materials, shown in *italics* in the categories list.

You can use all three types of material in Uvalue calculations and you can create, edit and delete user defined categories and materials. However, you can not edit or delete branded or generic categories or materials. To change the values of branded or generic materials you must work on a duplicate (clone) of the category or material. Cloning a category creates a new category containing the same materials as the original.

To make changes to the **Products database** you must first open the **Edit database** dialogue (Figure 14.1) by selecting **Edit**>**Database** from the main menu.

To add a user defined category:

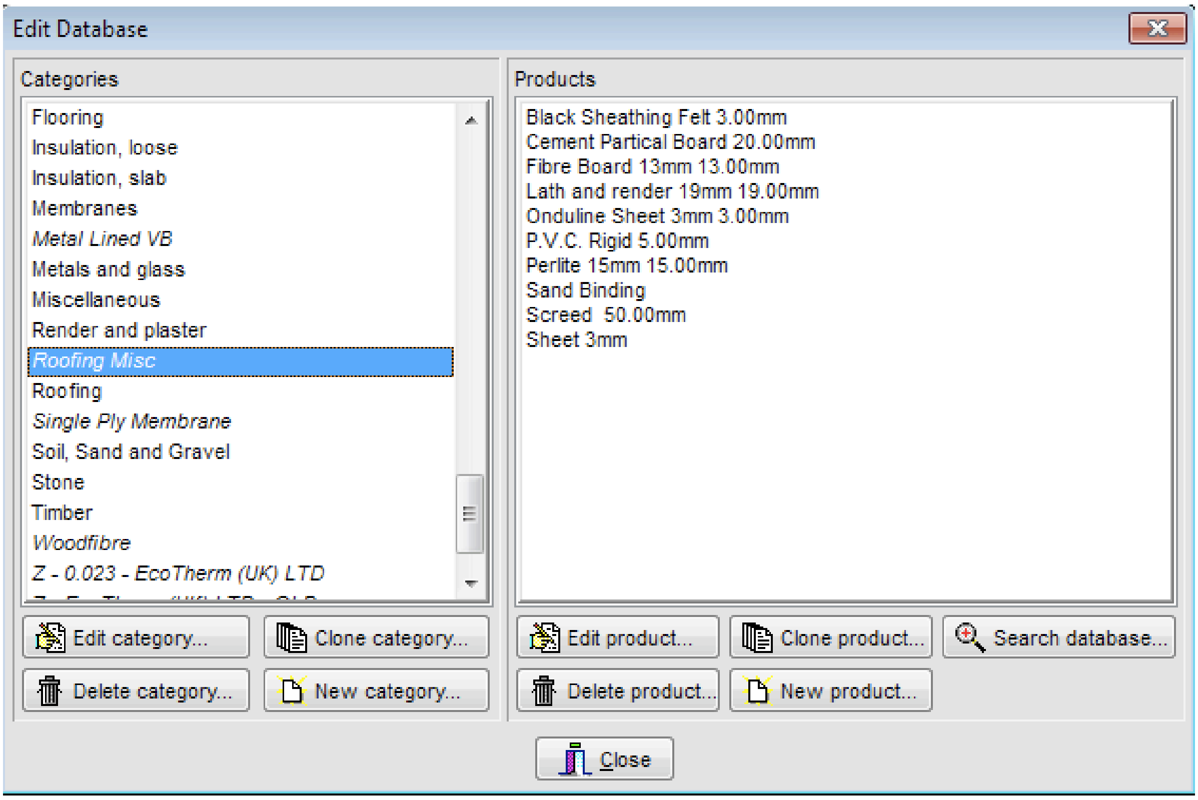
1. Click the **New category** button.
2. Enter the name of the category in the **New category** dialogue.
3. Click **OK**. The new category is created.

To rename an existing user defined category:

1. Select a category by clicking on it.
2. Click the **Edit category** button. The **Edit category** dialogue opens.
3. Enter a new name then click **OK**. The category is renamed.

To clone a category:

Figure 14.1: The Edit Database dialogue



1. Select the category to clone by clicking on it.
2. Click the **Clone category** button. The **Clone category** dialogue opens.
3. Enter a name for the new category and click **OK**.
4. A new category will be created, containing copies of the original materials.

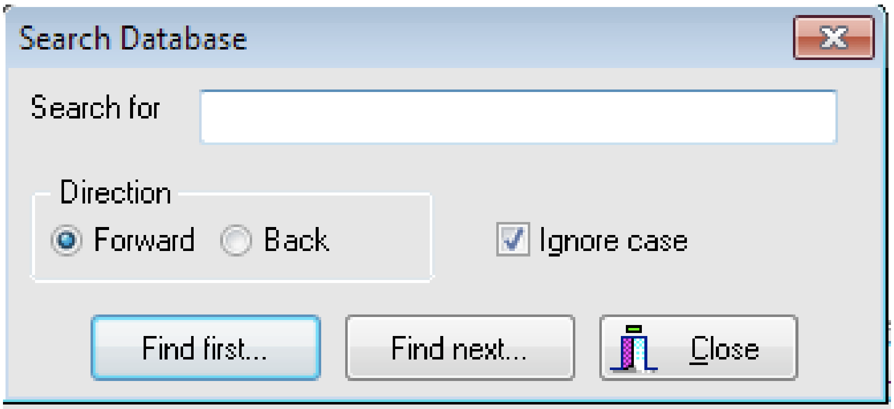
To delete a user defined category:

1. Select the category to delete.
2. Click the **Delete category** button. An **Information** dialogue asks you to confirm the deletion.
3. Click **Yes** to delete the category, **No** to keep it.

To insert a new material in a user-defined category:

1. Select the category in which you want to create the new material.
2. Click the **New product** button. The **Edit material** dialogue opens.
3. Complete the **Edit material** dialogue (chapter 7).
4. Click **OK**. The new product is added to the category.

Figure 14.2: The Search Database dialogue



To edit an existing user defined material:

1. Select the product you wish to edit.
2. Click the **Edit product** button. The **Edit material** dialogue opens.
3. Make the changes in the **Edit material** dialogue (chapter 7).
4. Click **OK**. The product information is updated.

To clone an existing product in a user defined category:

1. Select the product and click the **Clone product** button. A copy of the product will be inserted in the category.
2. Click on the clone to edit it.

To delete a product from a user-defined category:

1. Select the product you wish to delete.
2. Click the **Delete product** button. The product is deleted.

You can search the database to find specific products:

1. Click the **Search** button. The **Search Database** dialogue opens (Figure 14.2).
2. In the **Search Database** dialogue enter the text you want to search for and the direction the program should search through the database (*forwards* or *backwards*).
3. Tick the **Ignore case** box if you want the search to ignore capitals and lower-case letters.
4. Click **Find first** to start the search. The program will display the first matching product in the **Products** pane.
5. Click **Find next** to go on to the next matching product.
6. When you have found the product you want click **Close** to close the Search dialogue.

When you have finished working on the database, click the **Close** button to return to the main U-value window.

14.1 Short codes

You can assign codes to user defined materials as you enter them in the database. The short codes can then be used for rapid data entry using the Products database (section 6.1). You can also use short codes to determine the order in which products and materials are presented within categories, to speed up data entry for common constructions.

To sort the database by short codes you must first assign short codes to the materials; use a numbering system which matches the order in which you want the materials to appear. Once you have assigned short codes you should click on the **Sort on short code** tick box in the **Products database** dialogue (Figure 6.1).

Part III

Condensation risk

15 Assessing the risk of interstitial condensation

The Uvalue Professional module calculates the risk of interstitial condensation forming at the interfaces of layers within an element.The module, which follows the recommendations of BS 5250[1] uses the method of analysis set out in BS EN ISO 13788[2].
For each interface within a building element the module determines:

- the amount of condensation or evaporation during each month;
- the maximum amount of moisture deposited;
- the accumulated mass of water compared to total evaporation during the year;
- the annual moisture balance.

The program can still perform analyses to the BS 5250:1989 method[3]. For information on using this method see section 15.3.
The likelihood of condensation forming within a building element depends upon the hygrothermal properties of the materials (thermal conductivity or resistance and vapour resistivities or resistance) and the environmental conditions (internal and external temperatures and relative humidities).
Most of the information used by JPA Designer for calculating condensation risk is also used in the main body of the program for calculating U-values. The only additional information required is the vapour resistivity and resistance data for the materials in the construction, and the environmental data for the building and site.
To carry out condensation risk analysis:

1. Build up an element in the same way as you would for a U-value calculation.
2. Ensure vapour resistance properties have been defined for each layer (chapter 7).
3. Set the environmental conditions (section 15.1);
4. View the results (section 15.2).

Please note the module can not carry out condensation risk analysis for ground floors, basements nor constructions containing variable layers; neither will it calculate the risk of surface condensation.

[1]BS 5250:2002 Code of practice for control of condensation in buildings.

[2]BS EN ISO 13788:2002 Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods.

[3]The BS 5250:1989 Appendix D method is based on the same underlying principles as the method set out in ISO 13788, but (i) analyses condensation risk for a 60 period rather than the whole year and (ii) reports results in a different way.

15.1 Environmental conditions

The condensation risk calculation requires mean monthly data for:

- **Internal temperature (Int T)**; the design temperature inside the building, in degrees Celsius. The default for analysis is to use the same internal temperature throughout the year. If no project temperature has been specified use 20ºC as a default value for a UK building.
- **Internal relative humidity (Int RH)**; this is largely determined by the type of activity which will take place within the building. ISO 13788 defines five occupancy types with different humidity characteristics: BS 5250:2002 suggests relative humidity ranges for those types, see Table 15.1. The internal relative humidity is affected by the external conditions.
- **External Temperature (Ext T)** and **External Relative Humidity (Ext RH)**; the external conditions depend upon the building's location. JPA Designer includes external temperature and humidity data from 20 sites around the UK, allowing you to select the nearest location to the project site [4]. For a `worst case' scenario select *Eskdalemuir*.

The data is entered using the **Environmental conditions** dialogue, which allows you to enter data for analysis using ISO 13788 or BS 5250:1989. The default calculation method is ISO 13788 (to use the previous BS 5250:1989 calculation method see section 15.3). To set the environmental conditions:

1. From the menu bar select **Edit**>**Environmental conditions**. The **Environmental conditions** dialogue opens.
2. Select the humidity class using the **Internal humidity class** dropdown. The **Int RH** column is completed.
3. Enter the internal design temperature in the **Internal temperature** box. The **Int T** column displays the values. If you wish to vary the internal temperature throughout the year you can type values directly into the **Int T** column for each month.
4. From the **Building location** dropdown select the location of the building. The **Ext T** and **Ext RH** columns are completed and the values in the **Int RH** column adjusted. If you have site specific data you can type values directly into the table.
5. Click **OK** to accept the data and close the dialogue.

15.2 Viewing results

JPA Designer presents the results of condensation risk analysis in three formats:

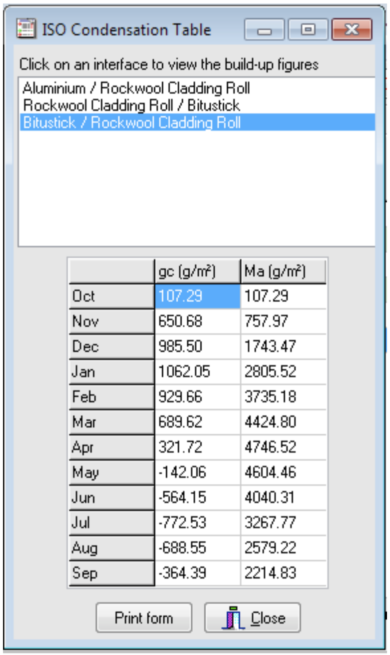
- As month by month data, in the ISO Condensation Table (subsection 15.2.1).
- As a graph, in the Dewpoint graph (subsection 15.2.2).
- In summary form, in the Results table (subsection 15.2.3).

[4] The data is taken from Meteorological data 1961 –1990 published by the World Meteorological Office.

Table 15.1: Humidity classes

Class	Building type	Relative humidity (%) 15ºC	20ºC	25ºC
1	Storage areas	<50	<35	<25
2	Offices, shops	50-65	35-50	25-35
3	Dwellings with low occupancy	65-80	50-60	35-45
4	Dwellings with high occupancy, sports halls,	80-95	60-70	45-55
5	Special buildings, e.g. laundry, swimming pool	>95	>70	>55

Figure 15.1: ISO 13788 Condensation table



	gc (g/m²)	Ma (g/m²)
Oct	107.29	107.29
Nov	650.68	757.97
Dec	985.50	1743.47
Jan	1062.05	2805.52
Feb	929.66	3735.18
Mar	689.62	4424.80
Apr	321.72	4746.52
May	-142.06	4604.46
Jun	-564.15	4040.31
Jul	-772.53	3267.77
Aug	-688.55	2579.22
Sep	-364.39	2214.83

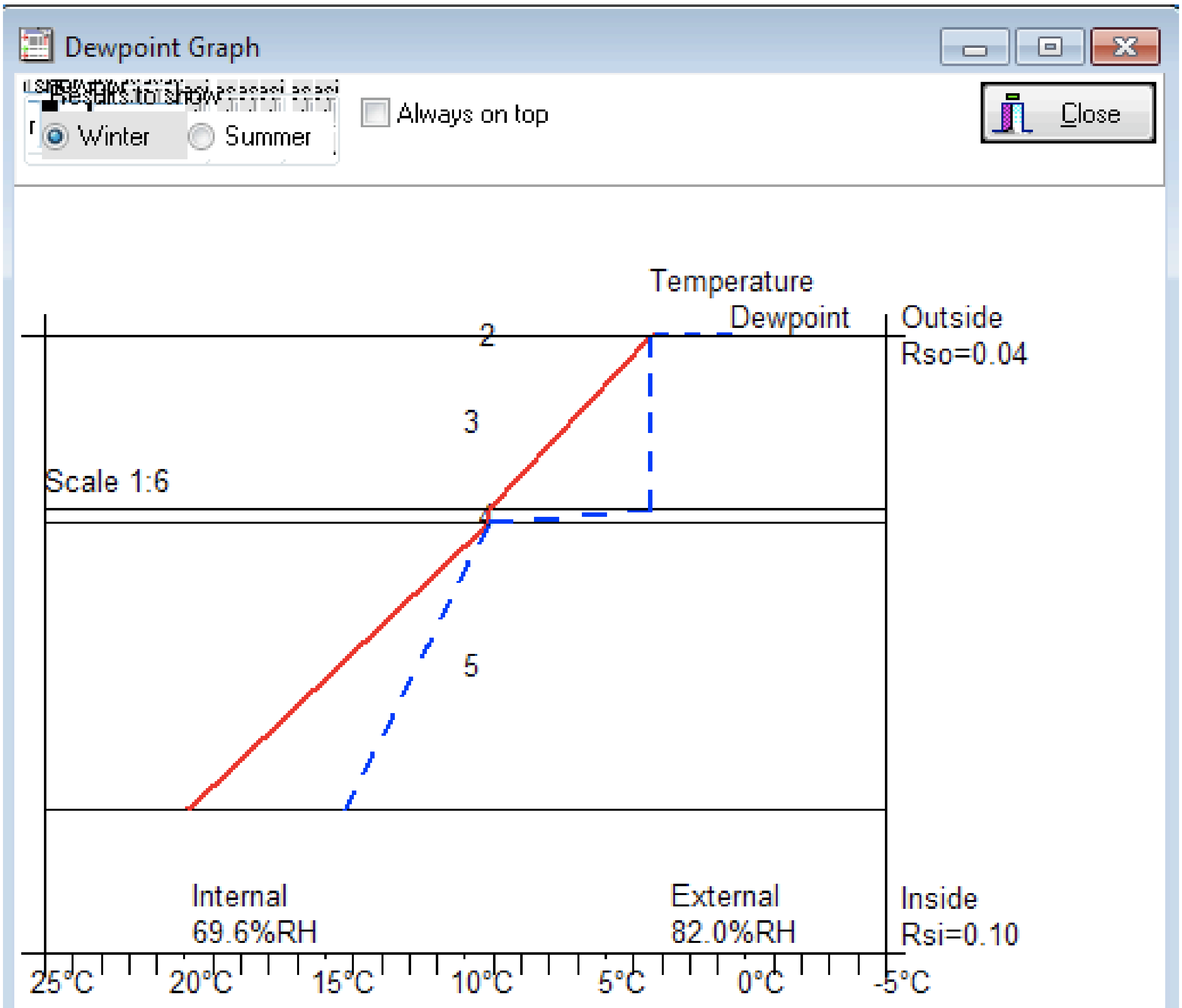
15.2.1 ISO Condensation Table

The **ISO Condensation Table** shows the amount of condensate predicted at each interface in the construction, and is the most accurate means of viewing the results of an analysis to ISO 13788.

To view the **ISO Condensation Table** select **View>ISO Condensation Table** from the menu bar.

The upper part of the table (Figure 15.1) shows the interfaces within the construction. When you select an interface by clicking on it, the lower half of the table shows the amount of condensation predicted at that interface. It shows the amount of condensate deposited or evaporated each month, **gc**, and the accumulated condensate at the end of each month, **Ma**, both measured in g/m^2 (negative numbers indicate evaporation). The results start with the first month in which condensation is predicted, or January if no condensation is predicted in any month. Guidance on interpreting results is given in BS 5250:2002 and BS EN ISO 13788.

Figure 15.2: Dewpoint graph for a roof with condensation predicted at the interface between layers 4 and 5



15.2.2 The Dewpoint graph

The **Dewpoint graph** plots the predicted temperature through the construction with dewpoint temperature for the worst month[5]. Condensation is predicted at any interface where the two lines touch (see Figure 15.2). The orientation of the **Dewpoint graph** is determined by the building element: walls are shown with layers running vertically and roofs with layers running horizontally.

To open the **Dewpoint graph** select **View**>**Dewpoint graph** from the menu bar or click the Dewpoint graph button on the tool bar. To view the results for the month with the greatest evaporation click on the **Summer** radio button in the **Results to show** section.

15.2.3 The Results table

The **Results Table** shows the headline results for each interface in the construction. To view the **Results table** select **View**>**Results Table** from the menu bar. When the table is

[5]The *dewpoint temperature* is the temperature at which saturation vapour pressure would occur. Any lower temperature would result in condensation.

open click the **Always on top** box to keep it visible on screen while you continue to work on the calculation. When you have finished, click **Close** to close the Results Table.

For calculations to ISO 13788 the significant columns are:

- **ISO - Winter worst build up**: the month in which the highest amount of condensate is predicted to be deposited;
- **ISO - Winter peak build up**: the month which sees the highest cumulative amount of condensation.

For each column the amount of condensate is shown in grams per square metre. The result *n/a* means no condensation is predicted at that interface. You can see more detailed results in the **ISO Condensation table.**

For calculations to BS 5250:1989 Appendix D the significant columns are:

- **Winter buildup**: the amount of condensate predicted over 60 winter days;
- **Annual buildup**: the amount of condensate carried forward after allowing for summer evaporation,

For each column the amount of condensate is shown in grams per square metre (g/m^2). Zero shown in both columns means no condensation is predicted, while a negative number in the annual buildup column indicates summer evaporation will be greater than winter deposition.

15.3 Using the previous calculation method

To use the BS 5250: 1998 calculation method untick the **Use 2003 condensation method** box in the **Environmental conditions** dialogue. The dialogue box will now show the environmental data for the BS 5250:1989 method.

External conditions The program sets standard values for external environmental conditions, following BS 6229 and BS 5250, which are:

- summer temperature: 18ºC.
- winter temperature: 5ºC.
- summer relative humidity: 65%.
- winter relative humidity: 95%.

If you need to calculate condensation risk for other external environments you can change the standard values by typing new values into the text boxes. To return to the default values for external environmental conditions click the **Default** button.

Condensation build up period Build-up of condensate is assessed over a standard 60 day winter period: that value can be changed using the **Condensation build up period** box.

Internal conditions The internal temperature and relative humidity values will be determined largely by the building use. You can enter design data or measured values in the four boxes, or select one of the pre-defined building use groups listed in the **Building Use** drop-down box: that will automatically set the temperatures and relative humidities to those defined in BS 5250 and BS 6229, Table 7.

Once you have set the environmental conditions you can view the calculation results using the **Results table** (subsection 15.2.3)and the **Dewpoint graph** (subsection 15.2.2).

Calculation options The BS 5250:1989 method does not allow for the removal of moisture by air movement, however, the standard suggests some indication of the effect of vented cavities can be obtained by assuming the air in the cavity is at outside conditions. This can done by setting to zero the vapour resistances of the materials to the outside of a cavity.

For an explanation of the limitations of this technique please refer to BS 5250: 1989 page 76.

To use this option in JPA Designer:

1. In the **Edit material** dialogue set the cavity type to **vented cavity**.
2. From the menu bar select **Options**. The **Calculation options** dialogue opens.
3. Tick the box **Set vapour resistance of layers above vented cavity to zero**.
4. Click **OK**. The program sets the vapour resistances of all the layers to the outside of the cavity to zero.

15.4 Outputting calculation results

The results of condensation risk analysis can be printed or produced as PDF files in the same way as the results of U-value calculations (chapter 12). The main differences are:

1. Before starting to print or create a PDF, tick the **Condensation risk** box on the status bar at the bottom of the main **U-value** window.
2. In the **Sections To Print** dialogue review whether you want to print the summer-time condensation results and the ISO moisture table and tick the appropriate boxes.

Part IV

SAP 2009

16 JPA Designer SAP 2009 module

16.1 Overview of the SAP 2009 module

The JPA Designer SAP 2009 module enables you to carry out calculations to demonstrate a dwelling complies with the requirements of Part L1 2010 (England and Wales) and section 6 of the Scottish Building Standards 2010 (Scotland) (for Northern Ireland you should currently use SAP 2005 - 9.91 as the regulations have not been revised). The module also lets you issue energy performance certificates (EPCs) for new dwellings[1], whilst the results of calculations may be used as part of assessments under the Code for Sustainable Homes.

The SAP 2009 module uses the SAP 9.90 methodology to calculate the Target Carbon Dioxide Emission Rate (TER) and the Dwelling Carbon Dioxide Emission Rate (DER). The module also checks for compliance against a number of other criteria set out in Approved Document L1A and in the Domestic Building Services Compliance Guide.

Whilst this section of the manual gives instructions on how to enter data into the program it does not offer authoritative guidance upon SAP 9.90 nor the Building Regulations. We suggest you use this manual in conjunction with the government's guide to SAP (available from the BRE web site - www.bre.co.uk/sap2009), Approved Document L1A and the Domestic Building Services Compliance Guide (both available as PDFs from the Planning Portal: www.planningportal.gov.uk).

Carrying out a SAP 2009 calculation using JPA Designer is straight forward. The main **SAP window** shows the on-going results of the calculation and the compliance status of the dwelling, while the **SAP Worksheet Values** dialogue allows you to enter the data required for the calculation. Once you have finished entering data you can print off the results or make adjustments to the data.

16.2 Determining compliance

There are five criteria against which a new dwelling is tested to determine whether or not it complies with the requirements of Part L[2]:

[1] In order to issue an EPC you will need to be a member of a government approved accreditation scheme. You can find more information on suitable accreditation schemes on our web site.

[2] The software also carries out similar tests for regulations in Scotland.

1. Meeting the TER: The Dwelling CO_2 Emission Rate (DER), measured as the amount of CO_2 per square metre of floor area emitted as a consequence of providing space heating, hot water and lighting for a dwelling must be less than a target rate. That Target Emission Rate (TER) is based on the CO_2 emissions from a notional dwelling of the same dimensions as the proposed dwelling, but reduced by an improvement factor of 25% from 2006 standards (30% reduction in Scotland).

   The SAP 2009 module calculates the TER using the data you enter about the proposed dwelling and the default conditions specified in Appendix R of the SAP document.

2. Limits on design flexibility: To ensure long-term performance, and to prevent excessive trade-offs between fabric and plant, Approved Document L1 sets out:

   - maximum permissible fabric U-values (both worst case values and average values);
   - maximum permissible air leakage rates;
   - design limits for fixed building services.

   The SAP 2009 module checks for compliance against all those standards.

3. Limiting the effects of solar gain in summer: The regulations require designers to make provision to avoid excessive internal temperatures as a result of solar gain. Appendix P of the SAP 9.90 document contains a method for testing levels of solar gain. The SAP 2009 module implements that method to test for compliance.

4. Quality of construction: The performance of the dwelling as built must be consistent with that predicted by the DER: one measure is the air permeability rate, established by pressure testing. For a dwelling which is pressure tested the measured air permeability must be lower than $10\,m^3/hm^2$ and the DER calculated using the test result must be lower than the TER.

   The SAP 2005 module allows pressure testing data to be entered and will check for compliance.

5. Operating and maintenance instructions: Regulation 40 requires the building owner to be provided with information to enable energy efficient operation of the building. The outputs from the SAP 2009 module can be used to help to meet that requirement.

16.3 Preparing to carry out a SAP 2009 calculation

Before starting a SAP calculation you should ensure you have all the input data, including:

- dwelling floor area;
- the ventilation strategy;
- the design or achieved air permeability;

- U-values, κ-values (kappa-values) and areas of external, and party, walls, roofs and floors (you can carry out the U-value and κ-value calculations using one of the JPA Designer U-value modules);
- κ-values and areas of internal walls and floors;
- ψ-values (psi-values) for junctions and the lengths of junctions;
- U-values, areas and orientation of windows, doors and rooflights;
- the proposed water heating system;
- the proposed primary and secondary heating systems;
- details of any photovoltaic cells or other low carbon technology.

16.4 Carrying out a SAP 2009 calculation

The main steps to carry out a SAP 2009 are:

1. Create a new SAP 2005 calculation (section 3.5).
2. Open the calculation in the SAP module (section 3.6).
3. Enter the **Project Information** (section 16.6).
4. Open the **SAP Worksheet Values** dialogue and enter the dwelling data (section 16.7).
5. Check the compliance status on the main **SAP window** (section 16.5) and make any necessary changes.
6. Produce print-outs or PDF files of the calculation results (chapter 29).
7. Save your project (section 3.3).

16.5 The SAP window

The **SAP window** lets you access the SAP menus and tool bar and displays the results of calculations (Figure 16.1). The main features are:

1. The menu bar.
2. The SAP 2009 toolbar: the buttons give direct access to key program functions and to the tabs on the **SAP Worksheet Values** dialogue.
3. The status lights which indicate whether you have entered all (green), some (amber) or none (red) of the data for each section.
4. The calculation name, as entered in the **Project Manager** window.

Figure 16.1: The main SAP window

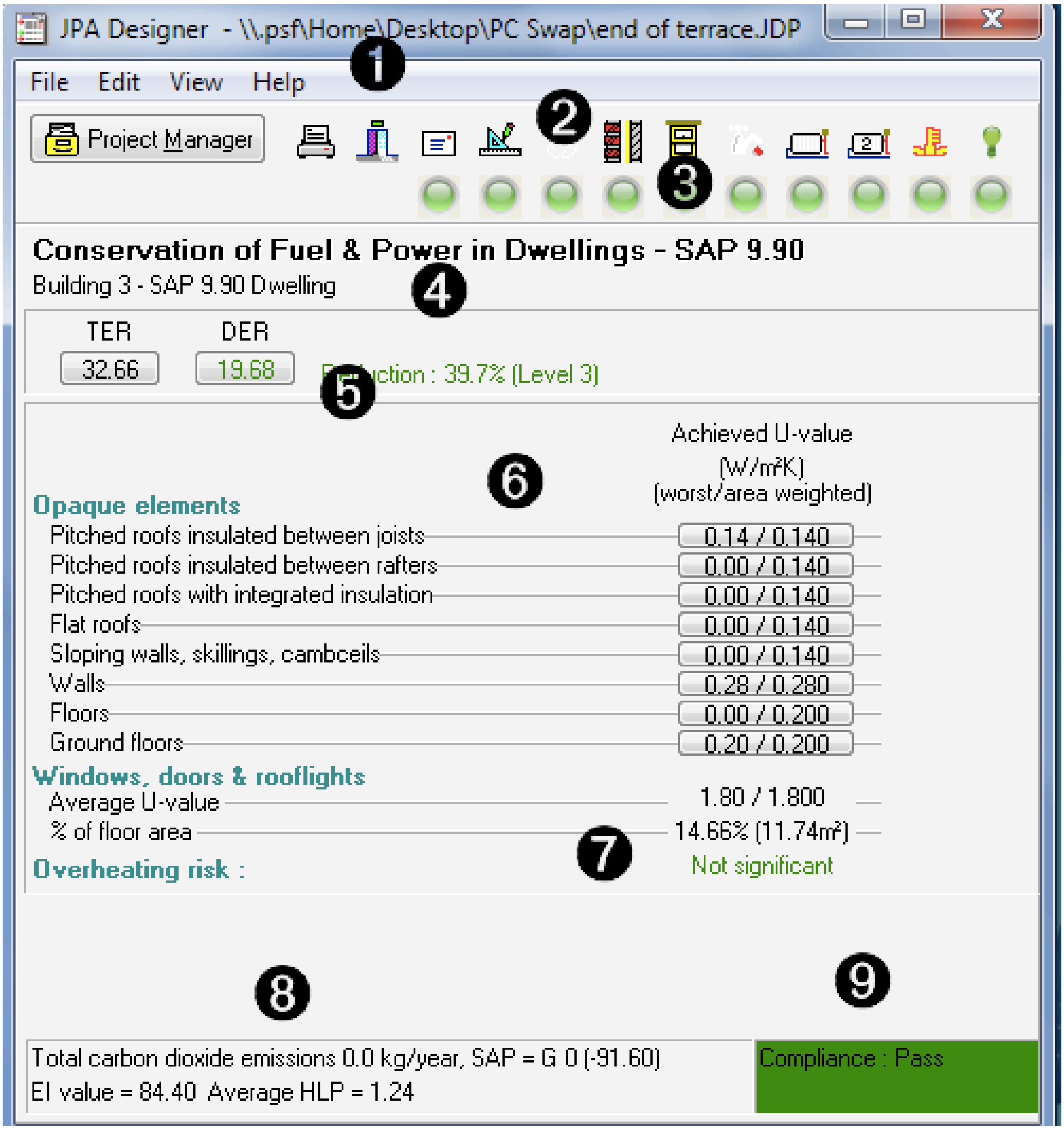
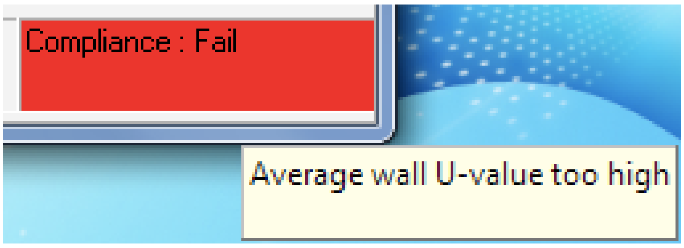


Figure 16.2: Tool tip showing the primary cause of failure



5. The TER and DER results, with the percentage reduction of the DER against the TER and Code for Sustainable Homes (CSH) level that reduction represents. The software also displays the *Fabric Energy Efficiency* (FEE) which is required for CSH assessments.

   The CSH level is only a guide for the carbon emissions component of the Code: it is not a full evaluation against the Code.

6. Fabric U-values for opaque elements (floors, walls, roofs) and for openings. In each line the first number shows the worst (highest) U-value and the second the area-weighted average.

7. Overheating risk assessment.

8. Carbon dioxide emission and SAP results, including the Heat Loss Parameter (HLP).

9. Compliance zone. This shows green for a pass and red for a fail. If the dwelling does not comply you can hold your mouse cursor over this zone to show a tool-tip identifying the primary cause of failure (Figure 16.2). Double clicking on the zone will open the **Compliance Checklist**.

The tool bar buttons are shown in Figure 16.3, the majority of them open the **SAP 9.90 2009 Worksheet Values** dialogue at different tabs.

16.6 Project information in SAP

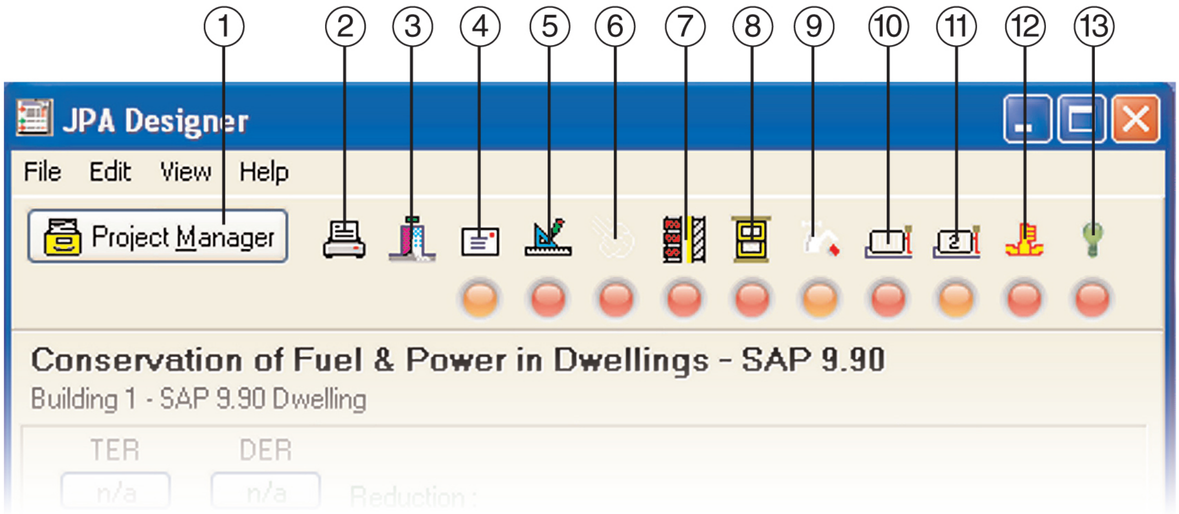
General information about the dwelling, such as the client, project address, and type of dwelling in the **Project Information** dialogue (Figure 16.4). This dialogue is also used to set some of the dwelling details (some of which are used for the EPC) a number of calculation options.

16.6.1 Address details

The client and project address details are shown on all the calculation outputs. You can enter the details in two ways:

- type the information directly into the **Project Information & Options** dialogue; or,

Figure 16.3: Buttons on the SAP toolbar



① Returns to Project Manager

② Opens the Print dialogue

③ Exit to Project Manager

④ Opens the **SAP Project Information** dialogue

⑤ Opens the Overall Dwelling Dimensions tab

⑥ Opens the Ventilation Rate tab

⑦ Opens the Roofs, Walls and Floors tab

⑧ Opens the Doors, Windows and Rooflights (Openings) tab

⑨ Opens the Water Heating tab

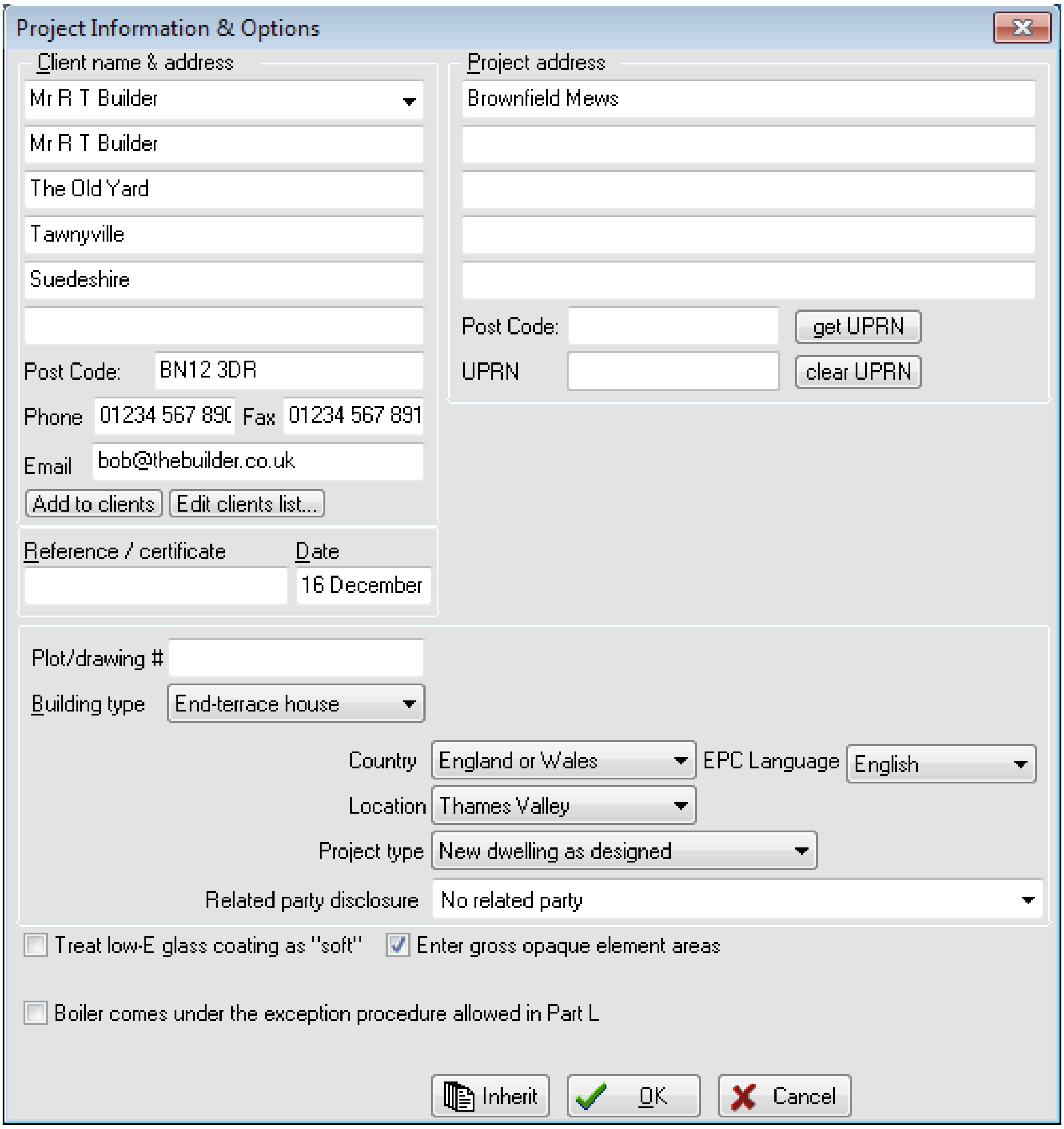
⑩ Opens the Main Space-heating (Primary) tab

⑪ Opens the Secondary Space-heating tab

⑫ Opens the Overheating tab

⑬ Opens the Photovoltaic and alternative technologies tab

Figure 16.4: The Project Information dialogue



- use the information which you set for the whole JPA Designer project in the **Project Information** dialogue in the **Project Manager** window.

To enter new project details:

1. In the SAP module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Enter project information by typing it into the appropriate fields. Use the <Tab> key to move between fields.

   You can also add plot numbers and drawing references to link the calculation to a particular dwelling on site.

   *Note: The **UPRN** box and the **get UPRN** and **clear UPRN** buttons are only used when preparing to issue an EPC for a completed dwelling. For instructions on using them please see the separate guide to issuing EPCs.*

To copy project details from Project Manager:

1. In the SAP module select **Edit**>**Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Click the **Inherit** button. Any information you entered in Project Manager is copied to the **Project Information** dialogue here.

16.6.2 Dwelling details

The **Project Information** dialogue also contains general information about the dwelling, including the type of building, the country and the location.

- **Building type**: this is used in the Energy Performance Certificate. Select the closest matching value from the drop-down.
- **Country**: the different parts of the UK have implemented SAP 2009 in slightly different ways[3]. You must use the **Country** drop-down to select the correct location to ensure the dwelling is tested against the appropriate regulations.
- **EPC language**: sets the language in which the EPC is produced.

  EPCs in England, Scotland and Northern Ireland must be produced in English. EPCs in Wales may be issued in in English or Welsh.
- **Location**: this is used in the overheating assessment and in SAP calculations for dwellings with space cooling. The regions in the drop-down are shown in the map to Table 10 in the SAP 2009 document.

  *In subsequent versions of the software the location will be set from the post code for the dwelling, using the **Look-up** button.*
- **Project type**: defines whether the calculation is for a new build, existing dwelling or conversion.

  *An EPC can only be produced for a **new dwelling as built**.*
- **Related party disclosure**: overrides the default disclosure for EPCs for that calculation.

[3] As of March 2011 Northern Ireland is still using SAP 2005 (version 9.81), but is expected to switch to SAP 2009 later in the year.

16.6.3 SAP calculation options

The bottom of the **Project Information** dialogue contains several calculation options:

- **Treat low e glass coating as `soft'**: soft low emission coatings allow less solar energy through glass than hard coatings and will therefore reduce the amount of solar gain (however, windows with soft coatings will have better U-values than those with hard coatings). Tick the box to apply this option to all low-E glass in the calculation.

- **Enter gross opaque element areas**: the SAP 2009 calculation uses the net areas of walls and roofs, after the areas of openings (doors, windows and rooflights) have been removed). If you select this option you can enter the *gross* areas of walls and roofs, and the program will determine the net areas, by subtracting the areas of windows and rooflights.

  If you change the setting of this box the software then close the **Project Information** the program asks if you want to use that setting as the default value for future calculations.

- **Boiler comes under the exception procedure allowed in Part L.** The Domestic Building Services Compliance guide requires new or replacement gas or oil boilers to have efficiency levels which can only be achieved by condensing appliances. A non-condensing boiler may be be permitted if the situation meets the conditions in the government's *Condensing boiler installation assessment procedure for dwellings*[4]. You may therefore only tick this box if the conditions of the assessment procedure are satisfied.

16.7 Entering project data

The data for the SAP calculation is entered using the **SAP 9.90 2009 Worksheet Values** dialogue. The dialogue is organised by a series of tabs, each covering one part of the SAP input data: they are:

- **Dwelling dimensions**: the basic configuration of the dwelling, including the proportion of low energy lighting (chapter 17).

- **Ventilation**: air infiltration rates, ventilation strategy and system efficiency (chapter 18).

- **Walls, roofs and floors**: heat loss and thermal mass of the opaque building fabric (chapter 19).

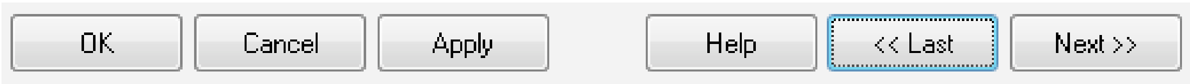
- **Openings**: heat loss, solar gain and daylighting information for windows, doors and rooflights (chapter 20).

- **Water heating**: the source of domestic hot water, its efficiency and fuel type, including details of any solar panels (chapter 21).

[4] Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings. CLG. 2005. http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_CONDBOILER.pdf

Figure 16.5: Tabs on the SAP 9.90 2009 Worksheet Values dialogue

Figure 16.6: The buttons on the SAP Worksheet Values dialogue



- **Primary heating**: the main heating system, controls and fuel (chapter 22).
- **Secondary heating**: any additional heating system (chapter 23).
- **Overheating and cooling**: details for summer overheating, and any fixed cooling systems (chapter 24 and chapter 25).
- **PV & Alt Tech**: Photo-voltaic panels, wind turbines, and new renewable technologies (chapter 26).

To open the dialogue at the start of a calculation, click on the **Dwelling dimensions** button on the toolbar or select **Edit**>**Dwelling dimensions**. The tabs are listed at the top of the dialogue in the same order as they appear in the **Edit** menu (Figure 16.5). To move between sections simply click on the tabs. We recommend you start with the **Dwelling Dimensions** tab and work from left to right, finishing with the **PV & Alt Tech** tab.

At the bottom of the dialogue are a series of buttons (Figure 16.6):-

- **OK**: Revises the calculation taking account of any changes you have made to the data, and closes the dialogue.
- **Cancel**: Closes the dialogue but ignores any changes you have made to the calculation.
- **Apply**: Revises the calculation, taking account of any changes you have made to the data, but leaves the dialogue open.

  *With a monitor set to 1024 by 800 pixels or higher, it is possible to see the main **SAP** window and the **SAP 9.90 2009 Worksheet Values** dialogue at the same time. By using the **Apply** button you can see the effect of design changes upon the calculation immediately.*
- **Help**: Gives you access to the government's SAP guidance and an on-line version of this manual.
- **Last**: Takes you to the previous tab on the dialogue.
- **Next**: Takes you to the next tab on the dialogue.

17 Dwelling dimensions

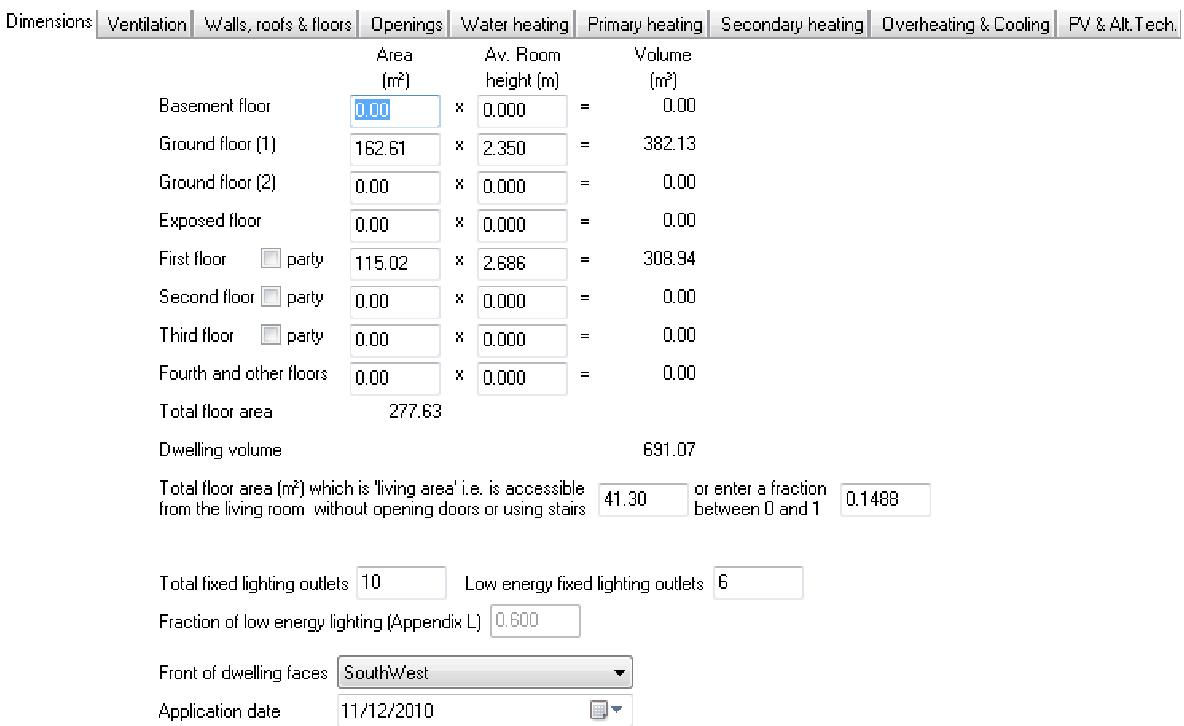
The area and average room height for each storey are used throughout the SAP calculation, for example, to determine hot water and lighting usage and the rate of heat loss through ventilation.

The data is entered using the **Dwelling dimensions** tab of the **SAP Worksheet values** dialogue (Figure 17.1):

- For each storey, the **floor area**, in m^2 and the **average room height**. JPA Designer will calculate and display the volume of each storey, the total floor area of the dwelling and the total volume of the dwelling.

  There are two lines for *Ground floors*, to allow for dwellings which have a double height lounge. The *Exposed floor* line may be used for floors of apartments which are over garages, parking bays or walkways.

Figure 17.1: The Dimensions tab



Floor areas are measured to the internal surfaces of the walls bounding the dwelling, and should include all internal walls and built-in cupboards accessible from the occupied area of the dwelling and all porches and conservatories which are heated and form part of the habitable space. (Exclude porches and conservatories which are unheated and thermally separated from the living space.)

The **average room height** for the lowest floor is measured from finished floor surface to ceiling surface. For every other storey, the height is measured from the ceiling of the floor below: for example, the height of the second storey in a two storey house is measured from the underside of the ceiling of the first storey, to the underside of the ceiling of the second storey. This convention ensures that the volume of the floor structure is included within the calculation. For room in the roof constructions you will need to determine an average storey height.

Where a floor has a different occupancy beneath it (such as another flat or maisonette) the **party** box should be ticked for that floor.

Make sure you enter the values against the appropriate storey, otherwise you may subsequently have problems lodging the EPC. This is particularly important for flats: do not use `ground floor' unless it actually is a ground floor flat.

- **Total floor area which is living area**: Enter the area of the main living room of the dwelling. JPA Designer will calculate the fraction that forms of the total floor area. The living room is defined as *the room marked on the plan as the lounge or living room, or the largest public room*. The area of other rooms which are not separated from the living room by doors should also be included. However, the living area cannot extend over more than one storey.

- **Building faces**: Select the orientation of the front face of the dwelling from the list. The value is used in conjunction with the window orientation data to determine solar gain.

  For a house, it is usually easiest to treat the elevation containing the front door as the front face; for an block of flats it may be better to treat the front of the block as the front face for all flats rather than setting different front orientations for each flat.

- **Application date**; Enter the date on which the dwelling will be submitted to the Building Control Body. Clicking the down arrow will open a calendar.

17.1 Low energy lighting

The proportion of low energy lighting is used in the calculation of electricity consumption for lighting, with a higher proportion of low energy lighting resulting in lower electricity use and a lower DER. The proportion of low energy lighting is also used to test compliance with the minimum efficiency standards for fixed building services (criterion 2 in Approved Document L1A): the Domestic Building Services Compliance Guide requires a minimum of 3 out of 4 (0.75) light fittings to be low energy.

Further information on lighting is given in chapter 12 of the Domestic Building Services Compliance Guide.

The data required to determine the proportion of low energy lighting is:

- the total number of lighting units, which is entered in **Total fixed lighting outlets**;
- the number of low energy fixed lighting units, which is entered in **Low energy lighting units**.

Once you have entered that data the program will calculate and display the **Fraction of low energy lighting**[1].

At the design stage, when it is unlikely that the exact number of lighting units will be known, the simplest strategy is to set the total number of units to 10 or 20, then set the number of low energy units to give the correct proportion: 15 out of 20 will give a proportion of 0.75.

[1] This change in the way the fraction of low energy lighting is entered has resulted from a change made to the data submission which accompanies the EPC, which means it is no longer sufficient simply to enter the fraction.

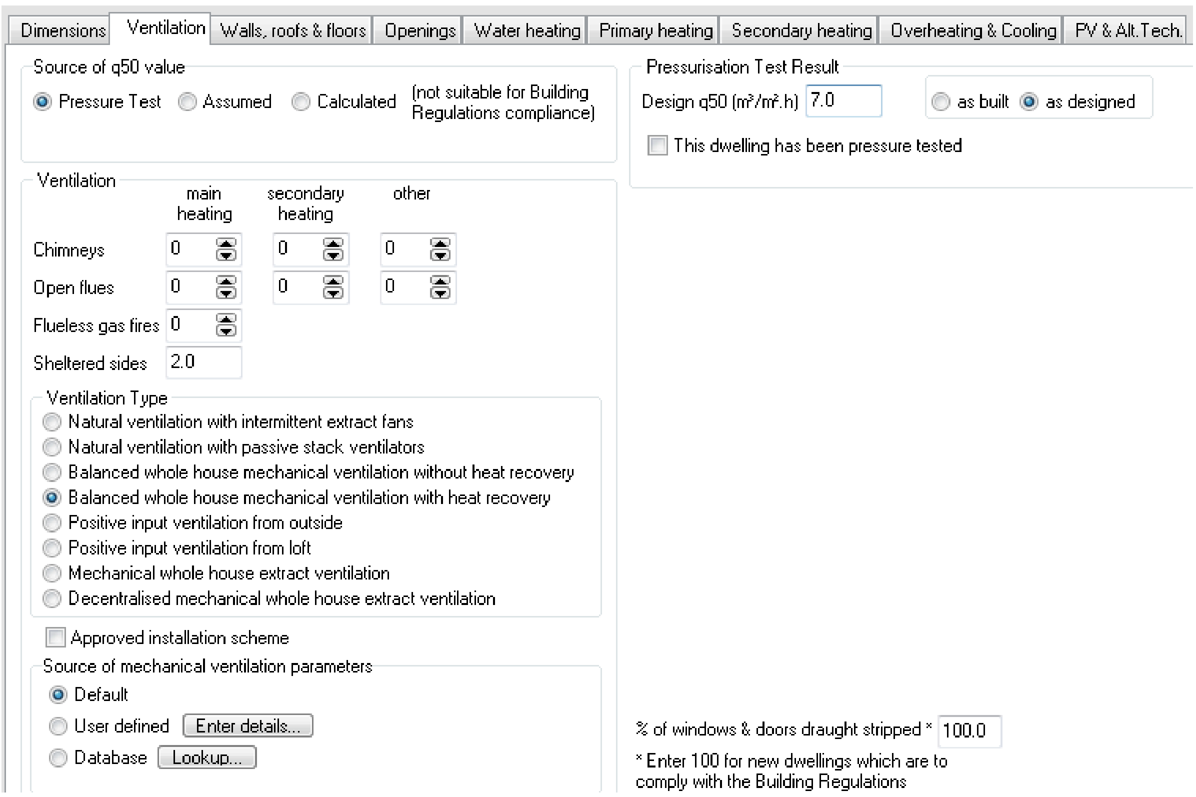
18 Ventilation

The movement of air from the inside to the outside of the dwelling will result in heat loss. SAP considers two components of air movement:

- Air infiltration through the building fabric.
- Ventilation.

Data for air movement is entered using the **Ventilation** tab (Figure 18.1), which has sections for air infiltration and ventilation strategy.

Figure 18.1: The Ventilation tab



18.1 Air infiltration

Air infiltration represents *unplanned* air movement: higher levels of air infiltration will give higher DER values. The rate of air infiltration is expressed in terms of the volume of air which passes in one hour through a square metre of the surface of the building envelope: m^3/hm^2. the measure is often referred to as the *q50* value, after the calculation result in BS EN 13829.

The DER calculation does not require any specific value for air infiltration, but Part L imposes upper compliance limit of 10 m^3/hm^2 for all dwellings, which will be checked by pressure testing. Design stage calculations have to be revised using the actual infiltration rate once testing has been carried out.

The only exception to that regime is for developments of one or two dwellings, where an air pressure test is not required, so long as the DER is calculated using an air infiltration rate of 15 m^3/hm^2. That presumed rate of air infiltration will give a higher DER, which must then be reduced by compensating improvements to the building fabric or services.

There are three methods to enter the air infiltration data into the software:

- Set a design test pressure, and replace it later by the result of the pressure test.
- On small developments, use an assumed value of 15 m^3/hm^2.
- Allow the software to calculate the infiltration rate from the construction type and building size.

  This method is not valid for demonstrating compliance under building regulations.

18.1.1 Pressure test data

The treatment of a dwelling subject to the air pressure testing regime depends on whether a pressure test is carried out on the dwelling, or whether it is part of a group of dwellings in which other dwellings are tested.

At the pre-construction stage, the design pressure test value should be used for all dwellings, but the final calculation:

- for dwellings which are pressure tested: the pressure test result.
- for dwellings which are not themselves pressure tested: the average test result for dwellings of that type, plus two.

To use air pressure test data:

1. At **Source of q50 value** select *Pressure test*.
2. For *pre-construction* stage calculations enter the air permeability in the **Design q50** box, and set the radio buttons to *as designed*.
3. For post completion calculations enter either the result of the air pressure test, or the average test value for that type of dwelling, and set the radio buttons to *as built*.
4. If the dwelling has been pressure tested tick **This dwelling has been pressure tested**. The DER calculation will use the **Design q50** value. If you do not tick that box the program will carry out the calculations using the q50 value plus two.

18.1.2 Using the assumed air permeability rate

The only exemption to the requirement for air testing is for dwellings on small developments of one or two houses: an air pressure test is not required, provided the DER calculation is carried out using an air permeability of 15 m^3/hm^2. That high value requires the performance of the rest of the building to be improved to meet the DER, in order to off-set the potentially poor air-permeability.
To use an assumed air permeability:

1. At **Source of q50 value** select *Assumed value*.
2. Tick the **Small development** box, which indicates the dwelling is part of a development of one or two dwellings. If you do not tick the box the dwelling will fail its compliance checks.

The **Design q50** box is now fixed at 15 m^3/hm^2.

18.1.3 Using a calculated air permeability rate

Where a dwelling is not subject to the air pressure testing requirements of Part L an air permeability value can be estimated from basic details of the construction and configuration of the dwelling.

1. At **Source of q50 value** select *Calculated*. The tab shows additional text boxes.
2. Specify:
   - the Type of construction;
   - whether there is a draught lobby;
   - the floor construction;
   - the number of storeys.
3. The software then calculates an air permeability rate based on the SAP defaults.

18.2 Ventilation openings and sheltering

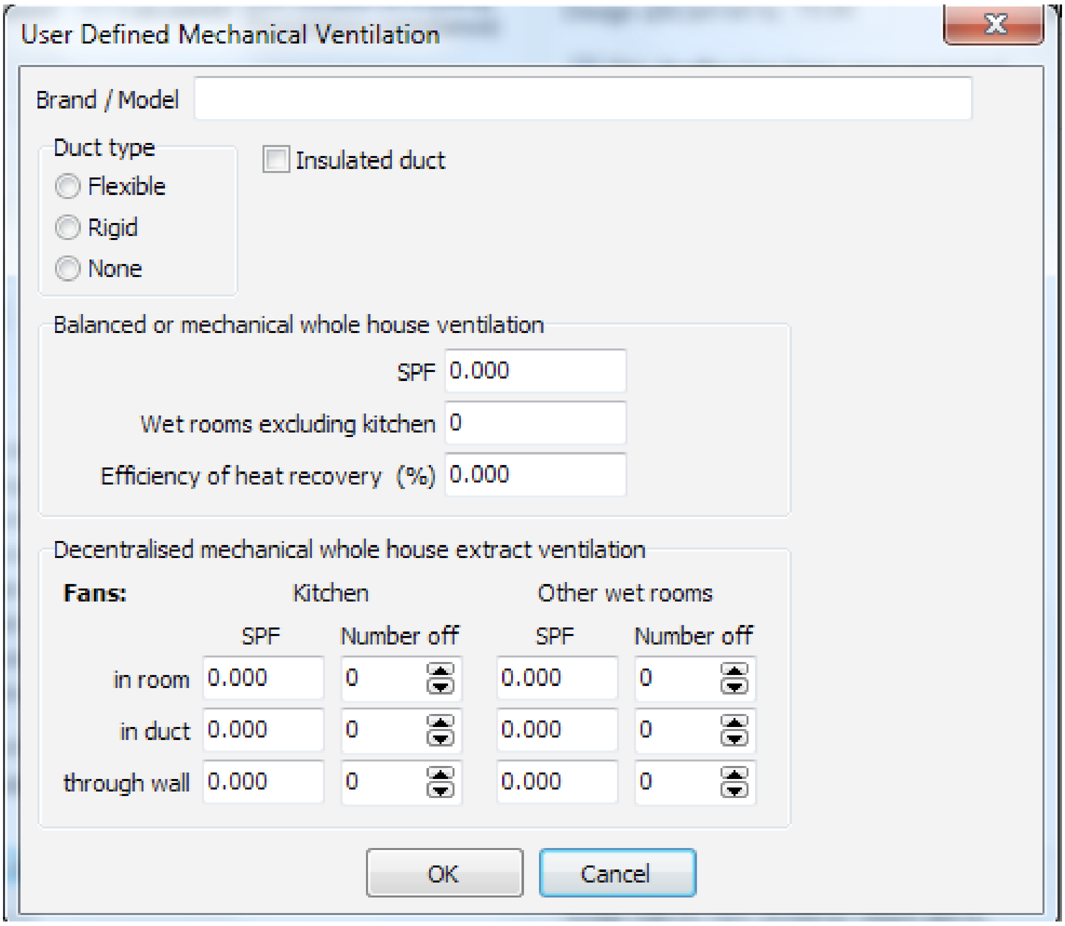
In the **Ventilation** section enter details of the ventilation provision for the dwelling. Use the boxes to enter the numbers of:

- **Chimneys**: vertical ducts for combustion gases with diameter greater than 200 mm.
- **Flues**: vertical ducts for combustion gases with diameter less than 200 mm.

  These can be associated with the main heating system, or with secondary or other heating.
- Extract **fans and passive vents**: intermittent extract fans in bathrooms and toilets and passive vent systems.
- **Flueless gas fires**.
- Number of **Sheltered sides** to the dwelling. Sheltered sides reduce the rate of air infiltration resulting from exposure to wind forces.

  See section 2.5 of the SAP 2009 documentation for further guidance.

Figure 18.2: The User defined mechanical ventilation dialogue



18.3 Ventilation type

Set the general type of ventilation using the **Ventilation types** radio buttons (section 2.6 of the SAP document describes the different ventilation systems). If the installation has been carried out as part of an approved insulation scheme tick the **Approved installation scheme**.

The **Source of mechanical ventilation parameters** section determines which efficiency data the program uses:

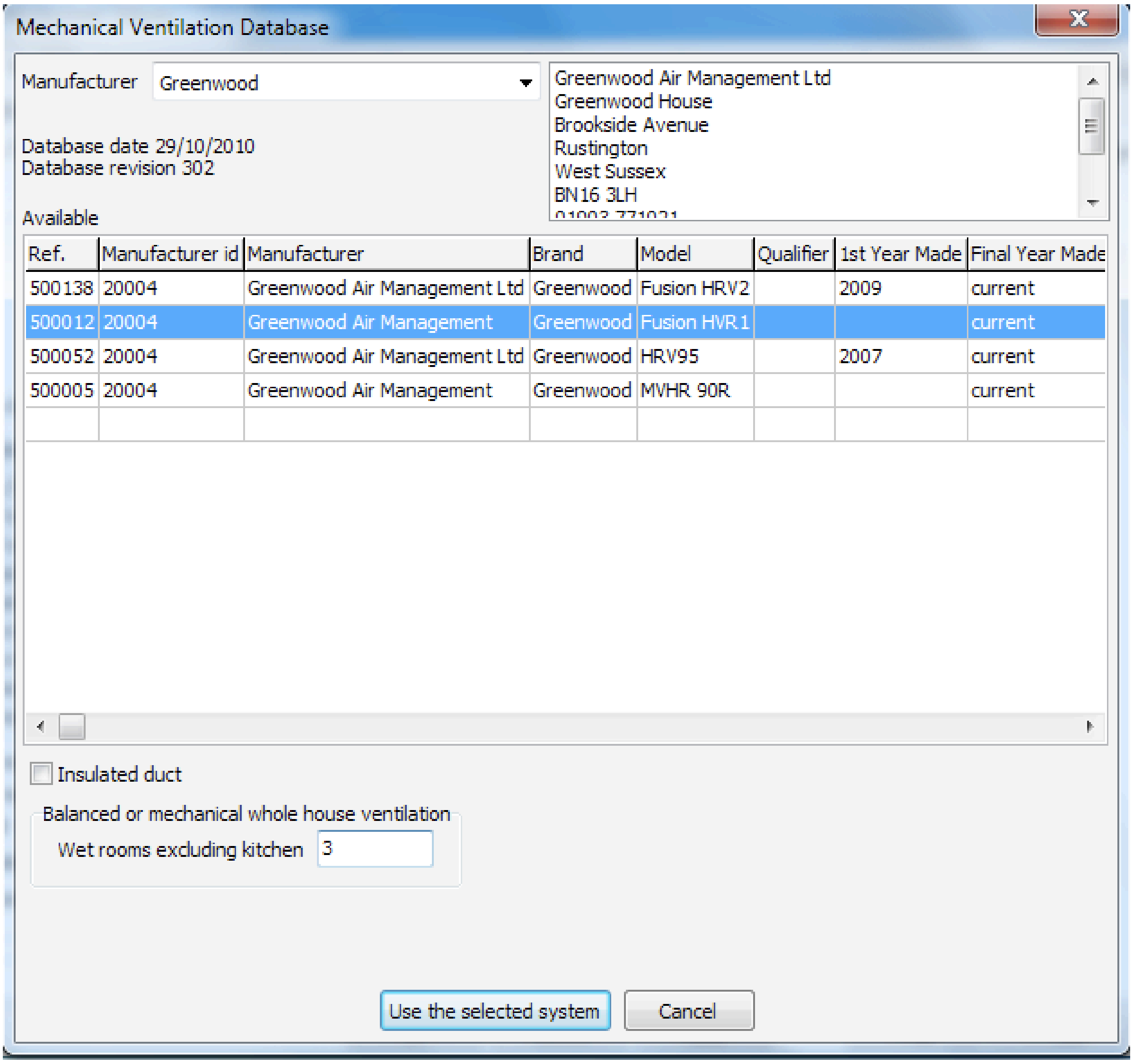
- *Default*: the performance values built into the SAP specification;

  This is the only option for natural ventilation, but for whole house ventilation, positive input ventilation or whole house extract ventilation, the default performance values in the SAP specification will give comparatively poor results.

- *User defined*: allows you to enter your own performance values, such as those supplied by product manufacturers:

  1. From the **Source of mechanical ventilation parameters** select *User defined*.
  2. Click the **Enter details** button. The **User defined mechanical ventilation** dialogue opens and you can now enter the data (Figure 18.2.

Figure 18.3: The BRE Ventilation Database dialogue



- *Database*: performance values from the Product Characteristics Database maintained by BRE.

   1. From the **Source of mechanical ventilation parameters** select *Database*.
   2. Click the **Lookup** button. The **Mechanical Ventilation Database** dialogue opens (Figure 18.3).
   3. Use the drop-down to select the **Manufacturer**. The list of available products appears.
   4. Select a product by clicking on it.
   5. Specify the number of **Wet rooms excluding kitchen**.
   6. If the ductwork is insulated tick the **Insulated duct** box.
   7. Click the **Use the selected system** button. The dialogue closes and the summary of the system is displayed next to the *Database* radio button.

In all cases, leave the box **100% draught-stripping** ticked.

19 Walls, roofs and floors

The data on the opaque building fabric –- walls, roofs and floors –- is used to calculate:

- the rate of conduction heat loss for the dwelling through those elements and the junctions between them;
- the thermal mass of the dwelling.

In JPA Designer you must enter the areas, U-values and κ-values for each of the building elements (section 19.3), and also enter details of the linear thermal bridging a the junctions between the elements and at the edges of openings (section 19.4). The data is entered using the **Walls, roofs & floors** tab of the **SAP Worksheet values** dialogue (Figure 19.1).

19.1 Defining building elements

SAP 2009 requires data for *all* elements of the building fabric, not just the heat loss elements[1]. You must enter data for:

- Exposed elements which separate the building interior from outside, or from an unheated space, or from an adjacent occupancy with a different heating pattern.
- Party elements which separate the dwelling from another space with a similar heating pattern.
- Internal walls and floors.

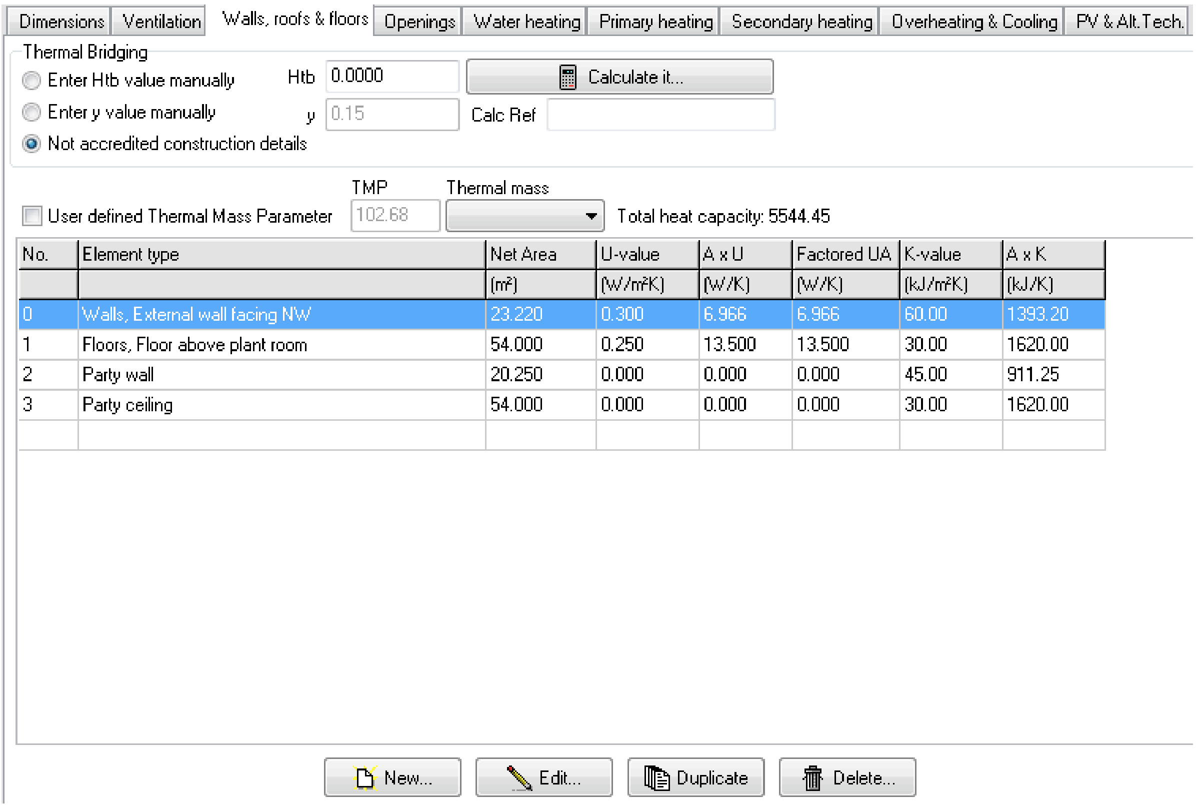
The data required for each element depends on its function: the principle items being:

- **Area**: the surface area of the element, in m^2, which should be measured to the boundaries of internal finished surfaces. If you have chosen to use *gross* areas for opaque elements there is no need to subtract the areas of openings from wall or roof areas.

  When adding internal walls, the areas of both sides of the wall should be measured.

[1] This is one of the significant changes in data gathering between SAP 2005 (9.8x) and SAP 2009 (9.90). It is a result of the new method for calculating the energy required for heating, which now considers the thermal mass of the building fabric: every element which contributes to that thermal mass has to be included in the calculation.

Figure 19.1: The Walls, Roofs and Floors tab



- **U-value**: the rate of heat transfer through the element. U-values should be calculated to BS EN ISO 6946 and BS EN ISO 13370, following the guidance in BR 443. Conventions for U-value calculations. The requirements for U-values for different elements are summarised in Table 19.2. Note that for party walls between dwellings the U-values must be taken from Table 19.1.

- κ-values (kappa-values): this is the heat capacity of the element, which expresses the amount of energy required to raise its temperature. Table 1e of the SAP document contains additional information about κ-values.

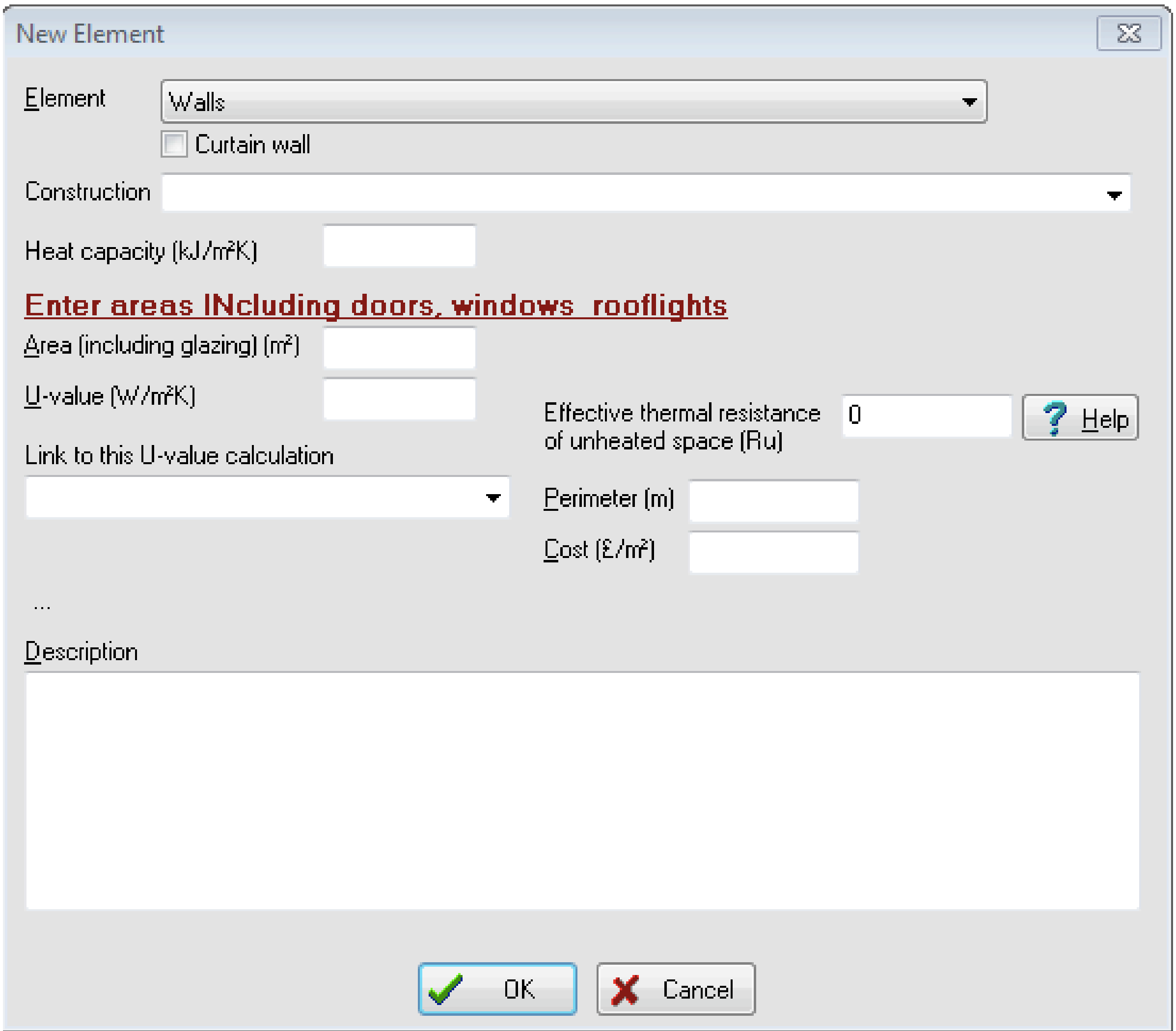
Table 19.1: U-values for party walls

Party wall construction	U-value (W/m^{2}K)
Solid	0.0
Unfilled cavity with no effective edge sealing	0.5
Unfilled cavity with effective edge sealing	0.2
A fully filled cavity with effective sealing	0.0

Table 19.2: U-values for building elements

Element	U-value	Notes
Exposed element	As calculated	
Semi-exposed	As calculated	Ru adjustment to U-value
Party wall between dwellings	From Table 19.1	
Party wall – similar heating pattern	0.00 W/m^2K	
Party wall – different heating pattern	Half calculated value	
Party floor – similar heating pattern	0.00 W/m^2K	
Party floor – different heating pattern	Half calculated value	
Party ceiling – similar heating pattern	0.00 W/m^2K	
Party ceiling – different heating pattern	Half calculated value	
Internal wall	N/A	Take area of both sides
Internal floor	N/A	
Internal ceiling	N/A	

Figure 19.2: The Element dialogue



19.2 The Element dialogue

The **Element** Dialogue is used to enter data on each of the dwelling's opaque elements (see Figure 19.2): it takes the following data:

- **Element**: Use the drop-down to set the *type* of element from the list. The element type is used for checking average U-values, so it is important to set the right element type.
- **Curtain wall**: Tick this box if the wall element consists of curtain walling.

  Curtain walling has to be treated differently from normal walls in order to obtain the correct values for heat loss and solar gains. The area of wall should be entered as normal, but the U-value set to that of the whole curtain wall system. The window area should also be that of the whole facade, with the same U-value.
- **Construction**: the drop-down lists a number of common constructions for the specified element type, and offers a quick way of setting the **heat capacity** for the element. Alternatively, you can leave the construction blank and enter the **heat capacity** directly.
- **Party wall type**: this drop-down is only displayed if the **Element** is a party wall.
  - For a party wall between two dwellings select the appropriate construction: that will also set the **U-value**.
  - For a party wall between a dwelling and an occupancy which is *not* a dwelling ignore this box.
- **Storey**: this box is only displayed if the **Element** is a party floor or internal floor. Set the storey number, relative to the building (not just the dwelling).
- When **Element** is set to *internal floors* the program displays the **Ceiling below** drop-down: select the internal ceiling which forms the other part of the internal floor construction.

  You must therefore define the internal ceiling elements before you enter the internal floors.
- **Heat capacity**: enter the heat capacity (κ-value) for the element: if you have selected a **Construction** its default heat capacity will already be entered.
- **Area**: Enter the area of the element.

  *If you have chosen to use gross areas the text above the **Area** box will read **Enter areas INcluding doors, windows rooflights**. If it reads **EXcluding doors, windows rooflights** you must enter net areas.*
- **U-value**: Enter the **U-value** in the text box. If you have already carried out the U-value calculation in the same JPA Designer project you can select it using the **Link to this U-value calculation** drop-down: that creates a permanent link between the element in the SAP calculation and the U-value calculation; the software will update the SAP calculation if the U-value changes.

- **Effective thermal resistance of unheated space (Ru)**: The **Ru** coefficient is used to adjust the U-value of an element to allow for the beneficial effect of an enclosed but unheated space to its exterior. The commonest unheated spaces are integral garages in houses and access corridors to apartment blocks: some parts of room-in-the-roof constructions are also treated as unheated spaces. Values for **Ru** are given in section 3.3 of the SAP documentation; clicking the **Help** displays the relevant guidance.
- **Description**: An optional text description of the element can be entered in the Description text box. A description makes it easier to distinguish between several elements of the same type when editing a calculation.
- **Perimeter** and **Cost**: these boxes should be ignored.

19.3 Managing building elements

To add a new element:

1. Click the **New** button; the **New Element** dialogue opens.
2. Enter the data for the element then click **OK**. JPA Designer shows the summary data new element in the element list.

To edit an element:-

1. Click the element to edit then click the **Edit** button. The **Edit Element** dialogue opens.
2. Make the changes to the element, then click **OK**.

To duplicate an element:-

1. Select the element to duplicate by clicking on it once.
2. Click the **Duplicate** button. A copy of the element is created.
3. Select the new element and click **Edit** to make changes.

To delete an element:-

1. Select the element to delete by clicking on it once.
2. Click the **Delete** button. A confirm dialogue appears.
3. Click **Yes** to delete the element, or **No** to cancel the deletion.

19.4 Linear thermal bridging

Besides calculating the rate of heat loss *through* the building elements SAP also calculates the rate of heat loss at the junctions *between* those elements and around openings, which results from linear thermal bridging. There are three possible methods for entering data on thermal bridging.

1. Calculating the total heat loss from thermal bridging at junctions, **Htb**, by entering the length and ψ-value (psi-value) for each junction type (subsection 19.4.1).
2. Use a simplified method based on a calculated **y** factor (subsection 19.4.2).
3. Use a simplified method based on a default **y** factor (subsection 19.4.3.

Further information on the treatment of linear thermal bridging can be found in Appendix K of the SAP document.

19.4.1 The Htb calculation

An accurate calculation of Htb requires the length and ψ-value of each junction. The length should be obtained by measurement from the design drawings: it is acceptable to sum the length of separate junctions of the same type, for example, adding together the lengths of all the window jambs. The ψ-value can be obtained from a number of sources:

- where an accredited construction detail is used, the ψ-value for that detail.
- where a ψ-value has been calculated, the ψ-value for that detail.

  Note that the requirement in Approved Document L1A to increase such calculated but non-accredited ψ-values by the greatest of 0.02 or 25% will not be introduced until third party accreditation schemes are operating.
- a default value from the final column of table K.1 in the SAP 2009 document.

The data for the Htb calculation is entered using the **Calculate HTB** dialogue (Figure 19.3 which lists all the junction types assigned to the dwelling, showing for each one:

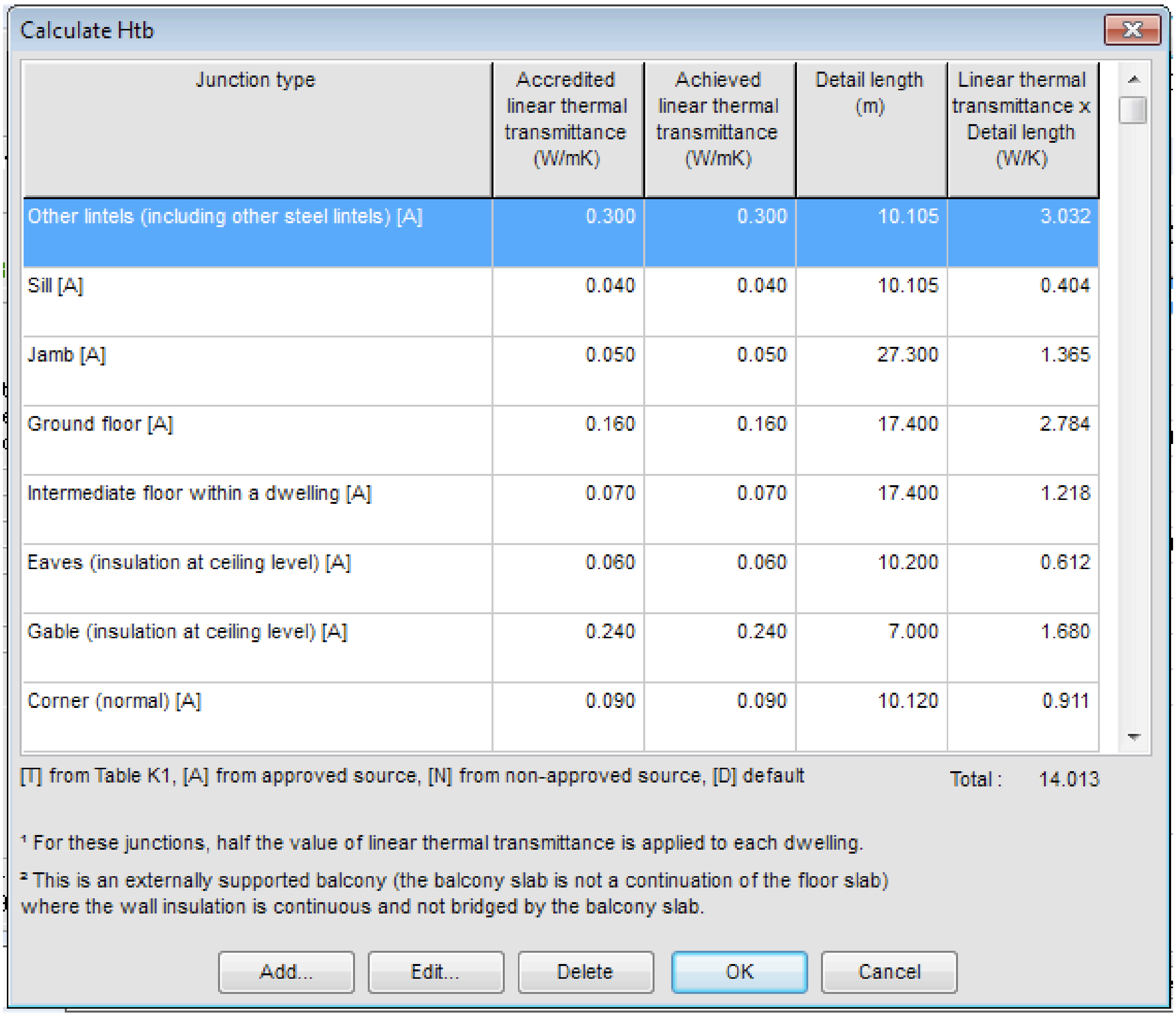
- the accredited linear thermal transmittance, which represents the ψ-value for the corresponding accredited construction detail;
- the achieved linear thermal transmittance for the junction;
- the length of the detail, in metres;
- the rate of heat loss through the junction, W/K.

The buttons at the bottom of the dialogue allow you to **Add**, **Edit** and **Delete** junctions.

To use the **Calculate Htb** dialogue:

1. In the **Thermal Bridging** section select *Enter HTB value manually*.

Figure 19.3: The Calculate Htb dialogue



Junction type	Accredited linear thermal transmittance (W/mK)	Achieved linear thermal transmittance (W/mK)	Detail length (m)	Linear thermal transmittance x Detail length (W/K)
Other lintels (including other steel lintels) [A]	0.300	0.300	10.105	3.032
Sill [A]	0.040	0.040	10.105	0.404
Jamb [A]	0.050	0.050	27.300	1.365
Ground floor [A]	0.160	0.160	17.400	2.784
Intermediate floor within a dwelling [A]	0.070	0.070	17.400	1.218
Eaves (insulation at ceiling level) [A]	0.060	0.060	10.200	0.612
Gable (insulation at ceiling level) [A]	0.240	0.240	7.000	1.680
Corner (normal) [A]	0.090	0.090	10.120	0.911

2. Click the **Calculate it** button. The **Calculate Htb** dialogue opens.

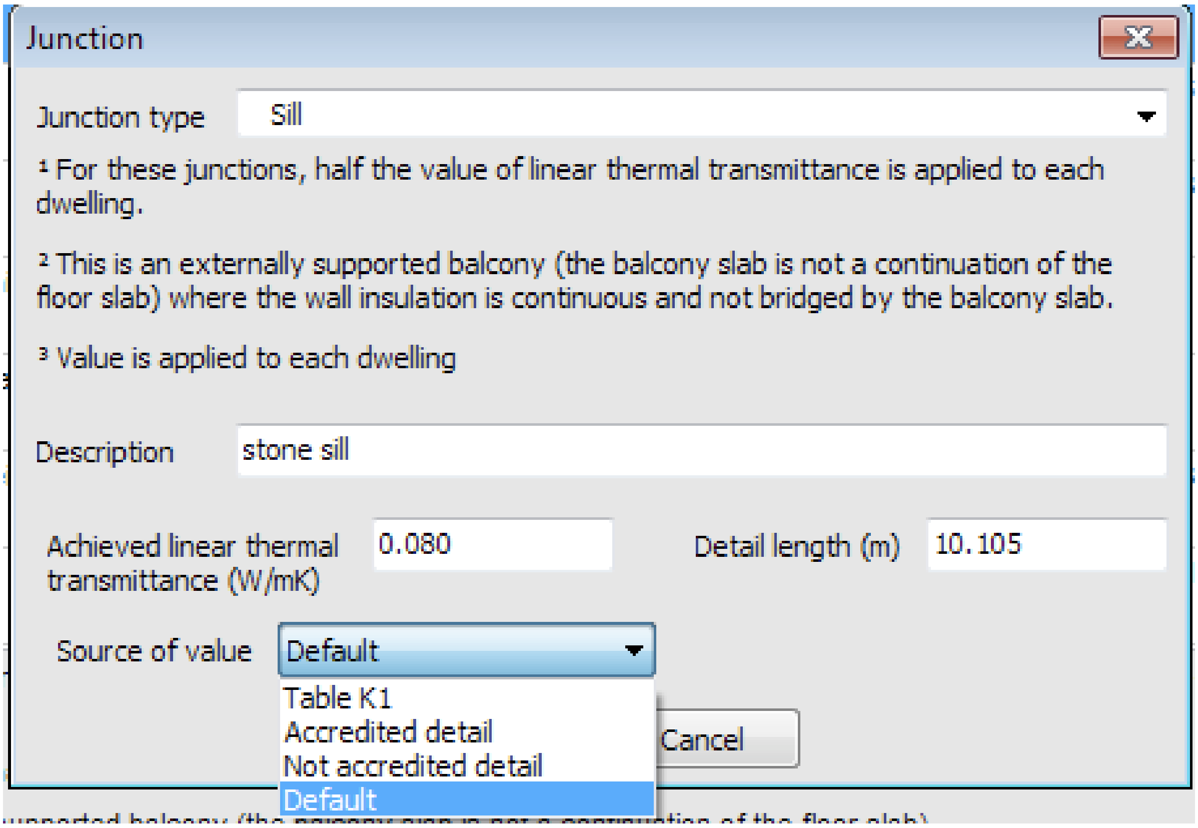
To add a junction:

1. Click **Add**. The **Junction** dialogue opens.
2. Select the **Junction type** from the drop-down.
3. Enter a **Description**; this is optional, but adding a description will make it easier to manage the calculation.
4. Enter the **Achieved linear thermal transmittance**: this is the ψ-value.

   The program will offer standard values based on the junction type.
5. Enter the **Detail length**, the total length of the junction, in metres.
6. Set the **Source of value**.

   Currently this simply records the source: in the future it will be used to trigger the penalty on calculated, but non-accredited details.

Figure 19.4: The Junction dialogue



7. Click **OK**. The junction is added to the **Calculate Htb** dialogue.

There are two additional points to note when adding junctions:

- there is a distinction between junctions to exposed walls and junctions to party walls: the latter commonly have lower ψ-values.
- if the dwelling has curtain walling there is no need to include the lengths of the window surrounds as the thermal bridging heat losses will have been included in the overall U-value for the curtain wall system.

Accredited construction details for England and Wales are available on the Planning Portal: http://www.planningportal.gov.uk/. Those for Scotland from the Scottish Government web site: http://www.scotland.gov.uk/Topics/Built-Environment.

19.4.2 User-calculated y factor

An approximate value for **Htb** can be obtained by multiplying the total area of the exposed elements (floors, walls and roofs) by a factor, **y**. This procedure may be used where **y** has been calculated for that type and configuration of dwelling. To use a calculated value for y:

1. In the **Thermal Bridging** section select *Enter y value manually*.
2. Enter the value for **y** in the box.
3. Enter a reference for the calculated value of **y** in the **Calc ref** box.

   The reference must refer to the calculation used to obtain the stated value.

19.4.3 Default y factor

An approximate value for **Htb** may obtained by using the simplified calculation method with a **y** factor of 0.15: this represents the use of details which are not accredited construction details, and will give a poor result.

To use this method select *Not accredited construction details* in the **Thermal Bridging** section. No other data is required.

19.5 Thermal mass

There are three methods for entering data on the thermal mass of the building fabric:

1. Set the κ-value for all exposed, party and internal elements. The program calculates the thermal mass parameter (TMP) from those values and the areas of those elements; the result is displayed in the **TMP** box.

   This is the most accurate and straightforward method.
2. Enter a TMP value which has been calculated elsewhere. Tick **User defined Thermal Mass Parameter** then enter the value in the **TMP** box.
3. Use one of the three default thermal mass parameters. Tick **User defined Thermal Mass Parameter** then select a thermal mass category from the **Thermal mass** drop down.

20 Openings

Openings in walls and roofs – windows, doors, affect three aspects of the SAP calculation:

- Heat loss: assessed through the U-value.
- Solar gain: assessed through the g window value.
- Daylighting: assessed through the type of glazing.

Data on openings is entered using the **Openings** tab of the **SAP Worksheet Values** dialogue (Figure 20.1). The tab lists the dwelling's windows, doors and rooflights, grouping them according to the building element in they sit. The buttons below the list allow you to create, edit and delete openings. For each opening the data is entered using the **Doors, Windows & Rooflights** dialogue[1] (section 20.1).

To define a new opening:

1. In the **Openings** tab click the **New** button. The **New Doors, Windows & Rooflights** dialogue opens.
2. Enter the data for the opening and click **OK**.

To duplicate an opening:

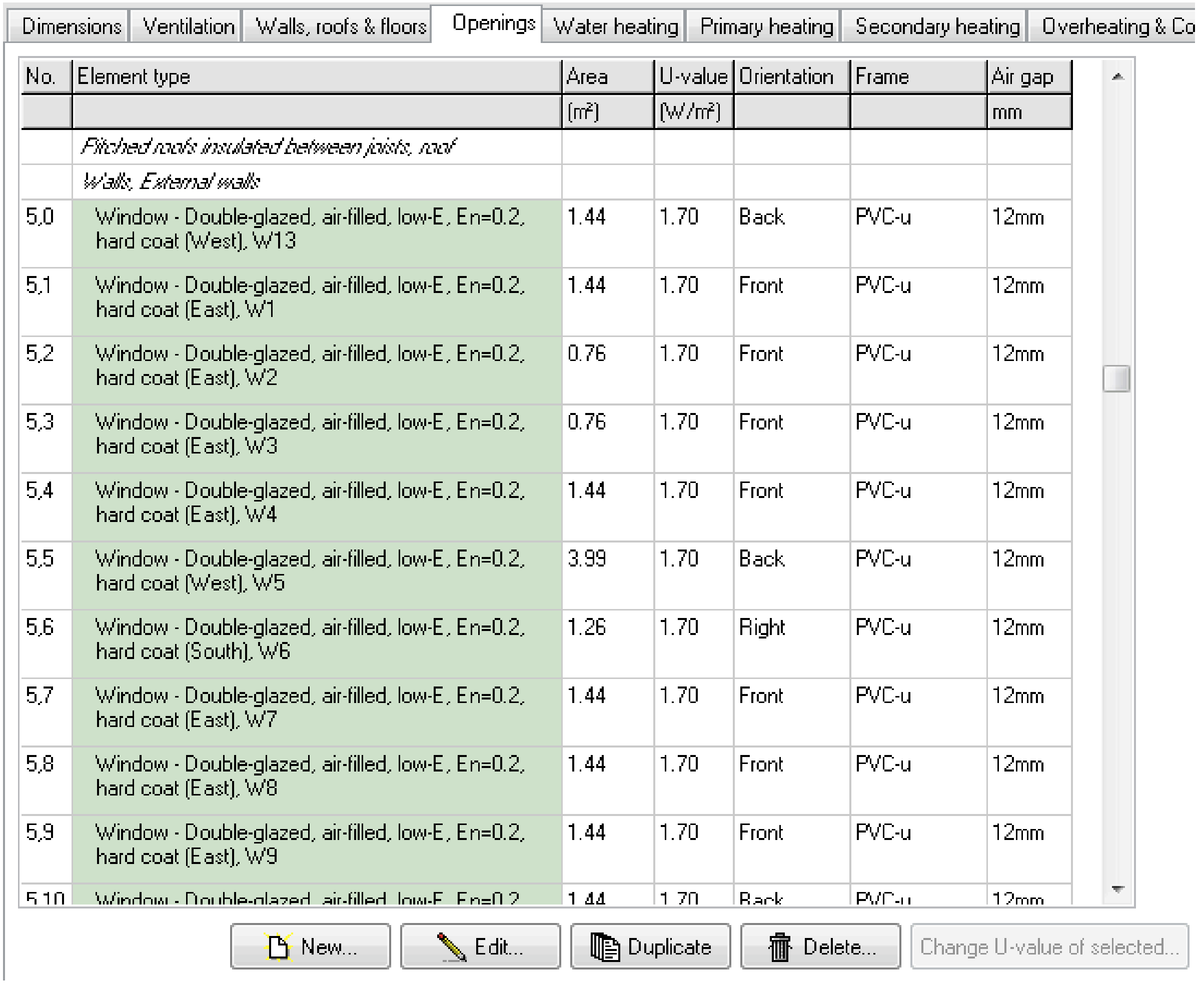
Duplicating an opening creates a new copy of the original opening which can then be edited: as most openings will share the same glazing and frame type, using the duplicate facility can speed up data entry.

1. In the **Openings** tab select the opening you want to duplicate.
2. Click the **Duplicate** button. A copy of the opening is created.
3. Double click on the duplicated opening to edit it.

To edit an existing opening:

[1] You can enter each opening individually, or you can group the openings on each face of the building into one area, provided they have the same frame and glazing type.

Figure 20.1: The Openings tab



No.	Element type	Area	U-value	Orientation	Frame	Air gap
		(m²)	(W/m²)			mm
	Pitched roofs insulated between joists, roof					
	Walls, External walls					
5,0	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (West), W13	1.44	1.70	Back	PVC-u	12mm
5,1	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W1	1.44	1.70	Front	PVC-u	12mm
5,2	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W2	0.76	1.70	Front	PVC-u	12mm
5,3	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W3	0.76	1.70	Front	PVC-u	12mm
5,4	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W4	1.44	1.70	Front	PVC-u	12mm
5,5	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (West), W5	3.99	1.70	Back	PVC-u	12mm
5,6	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (South), W6	1.26	1.70	Right	PVC-u	12mm
5,7	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W7	1.44	1.70	Front	PVC-u	12mm
5,8	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W8	1.44	1.70	Front	PVC-u	12mm
5,9	Window - Double-glazed, air-filled, low-E, En=0.2, hard coat (East), W9	1.44	1.70	Front	PVC-u	12mm
5,10	Window - Double-glazed, air-filled, low-E, En=0.2,	1.44	1.70	Back	PVC-u	12mm

1. Double click on the opening in the list in the **Openings** tab. The **Edit Doors, Windows and Rooflights** dialogue opens.

   *Alternatively, you can select the opening then click the **Edit** button.*

2. Make your changes then click **OK**.

To delete an opening:

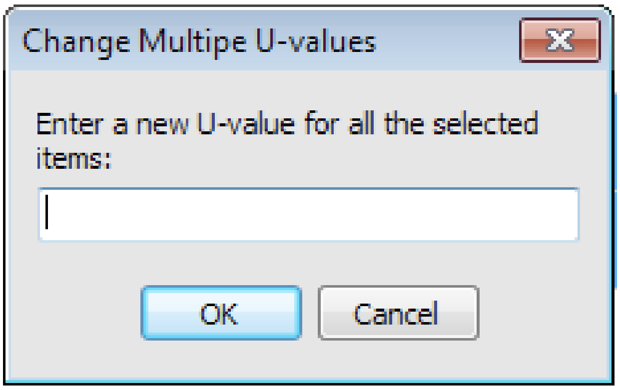
1. Select the opening in the list in the **Openings** tab.
2. Click the **Delete** button. A confirmation dialogue appears.
3. Click **Yes** to delete the opening, or **No** to retain it.

To change multiple U-values:

This function enables you to revise the U-values of several openings at once.

1. Select the first of the openings by clicking on it once.

Figure 20.2: Changing the U-values of several openings at the same time



2. Hold down the <Shift> key and click the last of the openings. That opening, and all the openings between the first and last are now selected.

3. Click the **Change U-value of selected openings** button. The **Change Multiple U-values** dialogue opens (Figure 20.2).

4. Enter the new U-value then click **OK**. The U-values are changed.

20.1 The Windows, Doors and Rooflights dialogue

The **Doors, Windows & Rooflights** dialogue is used to enter the data about the openings within the dwelling (Figure 20.3: the dialogue is headed either *New Doors, Windows & Rooflights* or *Edit Doors, Windows & Rooflights*). The dialogue requires the following data:

- **Opening Type**: Use the drop-down to select whether it is a window, rooflight or door.

- **Opening within**: Use the drop-down to select which element (wall, roof) which contains the opening. The software uses this information to calculate the net areas of the elements. The elements offered in the drop-down will only be those appropriate for the **Opening type**.

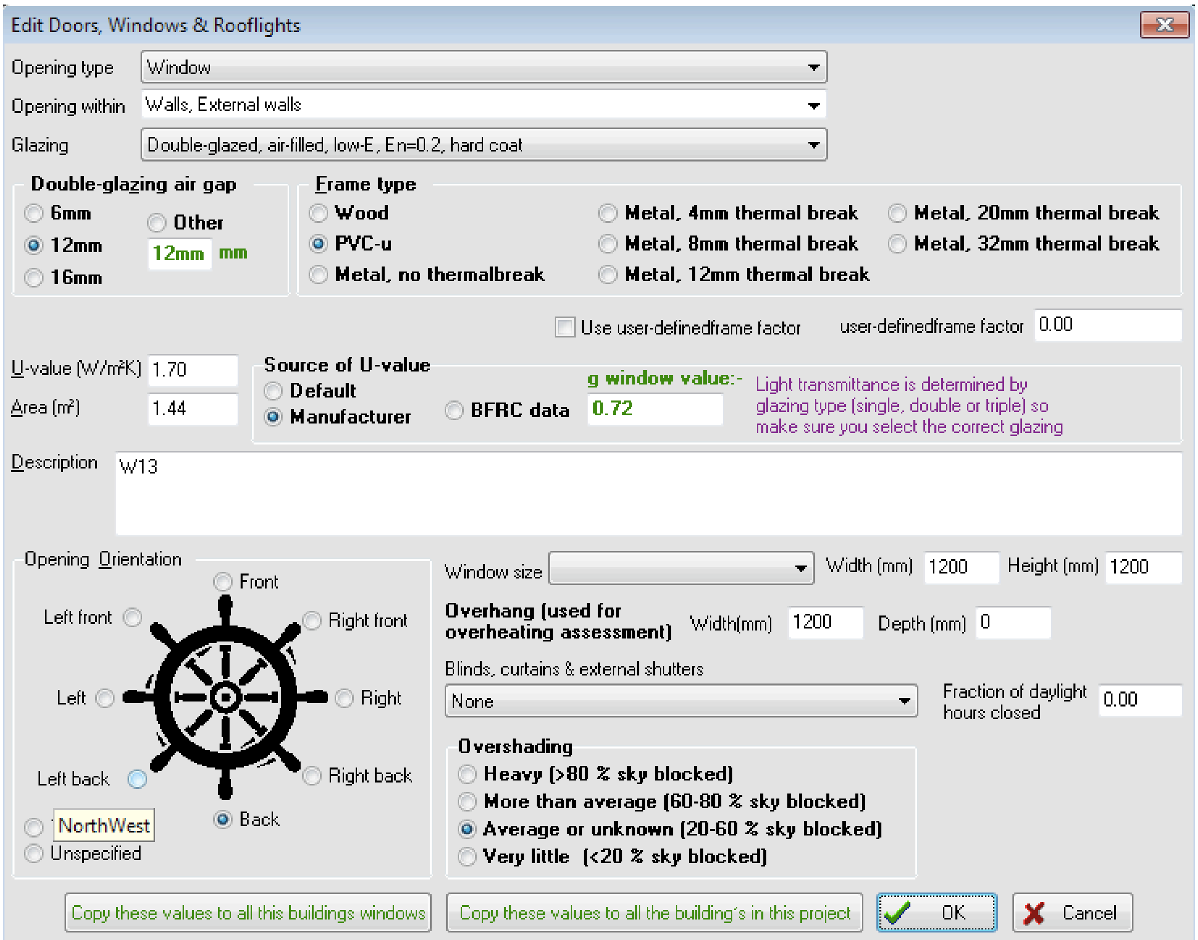
  *For example, if you have set the **Opening type** to **Window**, the **Opening within** drop-down will show only walls. Similarly, if you chose **Rooflight**, then **Opening within** will show only roof elements.*

- **Glazing**: Use the drop-down to select the type of glazing, considering the number of leaves of glass, the gas within the cavity or cavities and any low emissivity (low-E) coating.

  Even if you go on to enter a manufacturer's U-value and/or g window value you must still make a selection here to set the correct parameters for daylight.

- **Double-glazing air gap**: Use the radio buttons to select one of the default values or enter your own value. If the gap is greater than 16 mm select **Other** and enter a width in the box.

Figure 20.3: The Edit Doors, Windows & Rooflights dialogue



- **Frame type**: Use the radio buttons to select the frame material and, for metal frames, the depth of the thermal break.
- **Source of U-value**: If you select *Default* the software will use the built-in values for the U-value and solar transmittance. If you select *Manufacturer* the software will expect you to enter a U-value, but will use a default solar transmittance based on the glazing and frame type. If you select *BFRC data* the software will expect you to enter a U-value and solar factor (g window value). The g window value must be certified by the British Fenestration Rating Council.
- **U-value**: If **source of U-value** is set to *Default* this box will be greyed out. Otherwise enter the manufacturer supplied U-value.
- **g window value**: Only enter a g window value in here if it is BFRC certified.
- **Area**: You can enter the opening area directly into the **Area** box, or you can select a size from the **Window size** drop-down, or you can enter the **Width** and **Height** of the opening.

  *Note: the **Area** is entered in metres square, but the values for **Width** and **Height** are entered in millimetres (mm). Where there is an overhang above the window* *you should use the **Width** and **Height** boxes, to ensure the software correctly takes account of the overshading in the summer overheating calculation.*

- **Description**: The Description box allows you to enter a text description for the element. The description does not affect the outcome of the calculation. If you have entered a manufacturer's U-value the software requires a description.

  We strongly recommend you use the description box to enter a short description for every opening, such as its number on the window and door schedule: it is much easier to keep track of openings in the calculation when you have a description.

- **Opening orientation**: The direction in which the opening faces determines how much light it will receive and will therefore affect how much solar flux will pass through the opening. The orientation of an opening is set relative to the front elevation of the dwelling: usually that which contains the front door. Set the orientation using the radio buttons. Rooflights always face *Top*. If you are unsure which way the building will be facing then select *Unspecified*.

  *Make sure the **Front** elevation here is the same one you selected in the **Building faces** drop-down in the **Dimensions** tab.*

- **Overhang**: Features such as balconies or brise soleil which overhang a window will reduce the amount of sunlight falling on it in summer, and so reduce the risk of overheating. If there is such an overhang enter its **Width** and **Depth**, both in mm. The depth is measured from the outer edge of the overhang to the external face of the glazing.

- **Blinds, curtains and external shutters**: These will also reduce the amount of solar gain and the risk of overheating in summer. Use the drop-down to select the type of shading and then set the **Fraction of daylight hours closed**.

  Appendix P of the SAP documentation gives some guidance of reasonable assumptions for these occupant-determined values.

- **Overshading**: The extent to which the sky is obscured by trees and neighbouring buildings will determine the amount of sunlight and solar flux passing through the glazing. Set the degree of overshading using the radio buttons. Select *Average or unknown* if you cannot establish the amount of overshading. The SAP guidance disallows the use of the *Very little* overshading category for new dwellings as it does not take account of conditions likely to apply over the whole life of the building.

20.2 Editing multiple openings

Changing the specification for openings once they have been added to a calculation can be a time consuming process. JPA Designer has two tools to make the process quicker, by enabling you to copying certain parts of the window data for one window to other windows in the dwelling or project. The only data items copied to the windows are:

- Glazing.
- Double glazing air gap.

- Frame type.
- g window value.

To copy values between openings:

1. Open one window in the **Edit Doors, Windows & Rooflights** dialogue (Figure 20.3).
2. Adjust the data for the window, if necessary.
3. Click one of two buttons:
    - **Copy these values to all this building's windows**: clicking this button sets the window data for all windows in the dwelling to that the currently viewed window.
    - **Copy these values to all the buildings in this project**: clicking this button sets the window data for all windows in all the dwellings in the JPA Designer project to that the currently viewed window.
4. JPA Designer displays a confirmation dialogue. Click **Yes** to carry out the changes, or **No** to ignore them.

    The operation cannot be un-done automatically.

21 Water heating

SAP considers the amount of energy used to heat domestic hot water such as that used for bathing, laundry and dishwashing. The demand for hot water is based upon the floor area of the dwelling. Data on domestic hot water is entered using the **Water heating** tab of the **SAP Worksheet values** dialogue (Figure 21.1.

The first step is to select the type of water heating system using the **Source of domestic hot water** drop-box. Once you have made a selection the program will display the appropriate data entry fields. The hot water sources are:

- Hot water storage tank.
- Instantaneous water heating at point of use.
- Combination boiler.
- Community heating scheme.
- Multi-point gas water heater or heat exchange built into a gas warm air system.
- Boiler with thermal store.
- Combined primary storage unit (CPSU).
- MicroCHP or Heat pump.

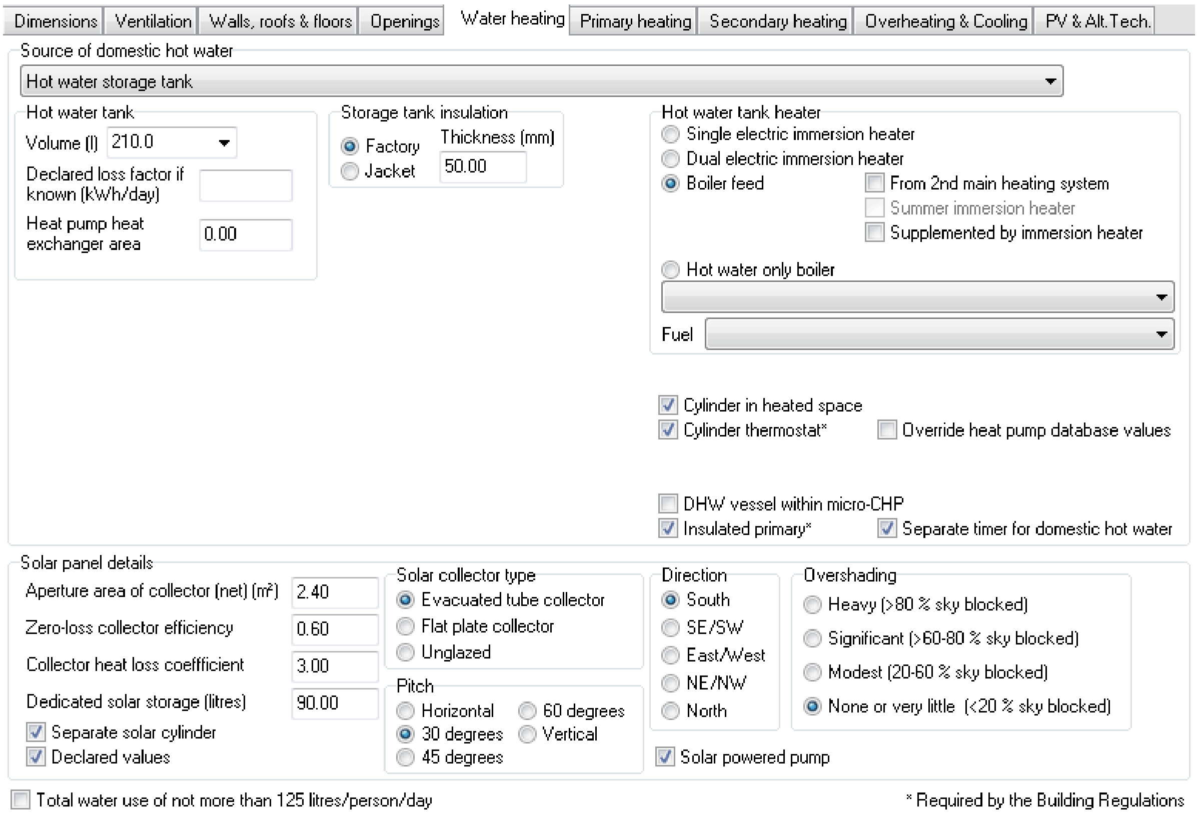
  *Use this option for heat pump with data taken from the Product Characteristics Database (section 22.2. For all other heat pumps use **Hot water storage tank**.*
- Community heating scheme providing domestic hot water only.

21.1 Hot water storage tank

This system should be selected where the hot water which is heated by the central heating boiler or immersion coil, then stored in a tank or cylinder ready for use (Figure 21.1). Enter the following data for the tank:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.

Figure 21.1: The Water heating tab, showing settings for a hot water storage tank



- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.

- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

The means of heating the hot water must be specified using the **Hot water tank heater** radio buttons:

- *Single electric immersion heater*: a single coil electric immersion heater in the tank;

- *Dual electric immersion heater*: a dual coil electric immersion heater in the tank: this will usually be associated with an off-peak tariff, in which case tick **Off peak electricity immersion heaters**.

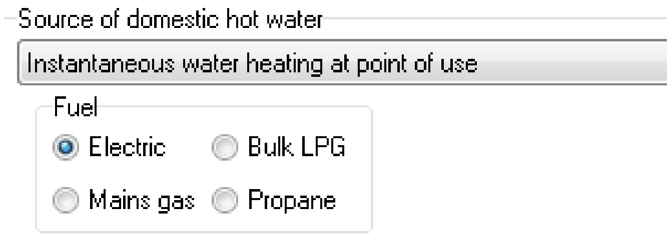
- *Boiler feed*: this indicates a heat source which also provides space heating, such as an oil or gas boiler, or a default efficiency heat pump. There are additional boxes to indicate:

  – the hot water is provided by the second main heating system;

  – the hot water is provided by the secondary heating system, which might be a solid fuel room heater with a back boiler;

  – a default efficiency heat pump is supplemented by an immersion heater in the summer.

Figure 21.2: Entering an instantaneous hot water heater



- *Hot water only boiler*: a dedicated unit which supplies domestic hot water only. Use the drop-down to select the type of boiler, then specify the **Fuel**.

Use the four lower boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- the primary pipework between the boiler and tank is insulated (tick box only displayed if boiler feed is selected) (required by Domestic Building Services Compliance Guide;
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 21.10).

21.2 Instantaneous water heating at point of use

For a system which heats the water on-demand at the point of use, you need only select the **Fuel** using the radio buttons.

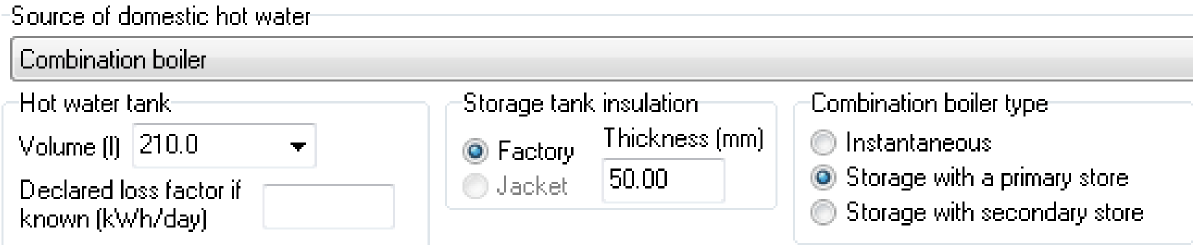
21.3 Combination boiler

Combination boilers provide heating and hot water: they may be instantaneous (with up to 15 litres storage), or they may contain small primary or secondary storage tanks (see Appendix B of the SAP 2009 document for definitions). Use the **Combination boiler type** radio buttons to select the type.

If you have selected *Instantaneous* there is no further data to enter. For a boiler with a *primary* or *secondary* store enter the following data:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.

Figure 21.3: Hot water options for combination boilers



- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (see section 21.10).

21.4 Community heating scheme

The hot water for dwellings heated by community heating schemes can provided by immersion heaters or by a heat exchanger fed from the scheme. In all cases specify the hot water tank heater. There may be additional data required, depending on the configuration of the system:

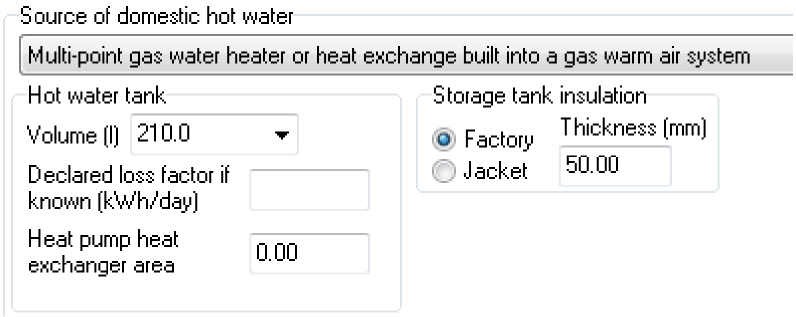
- Where there is neither a hot water tank nor a heat exchange in the dwelling no further data is required.
- If there is a hot water tank within the dwelling tick **DHW cylinder within dwelling**, the standard data boxes for a **Hot water tank** will then be displayed. Enter the tank details (section 21.1) and tick **DHW cylinder within dwelling**
- If there is no tank and the hot water is provided by a heat exchanger, tick **DHW cylinder within dwelling**, the standard data boxes for a **Hot water tank** will then be displayed. Enter the volume of the heat exchanger and details of its insulation and tick **DHW cylinder within dwelling**

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 21.10).

21.5 Multi-point gas water heater or heat exchange built into a gas warm air system

This represents systems with one gas-fired water heater providing hot water to a number of outlets, or a water heater which uses a heat exchanger built into a warm air heating system. Enter the following data:

Figure 21.4: Data entry for gas water heaters or heat exchangers



- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

Use the four lower boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- the primary pipework between the boiler and tank is insulated (tick box only displayed if boiler feed is selected) (required by Domestic Building Services Compliance Guide;
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 21.10).

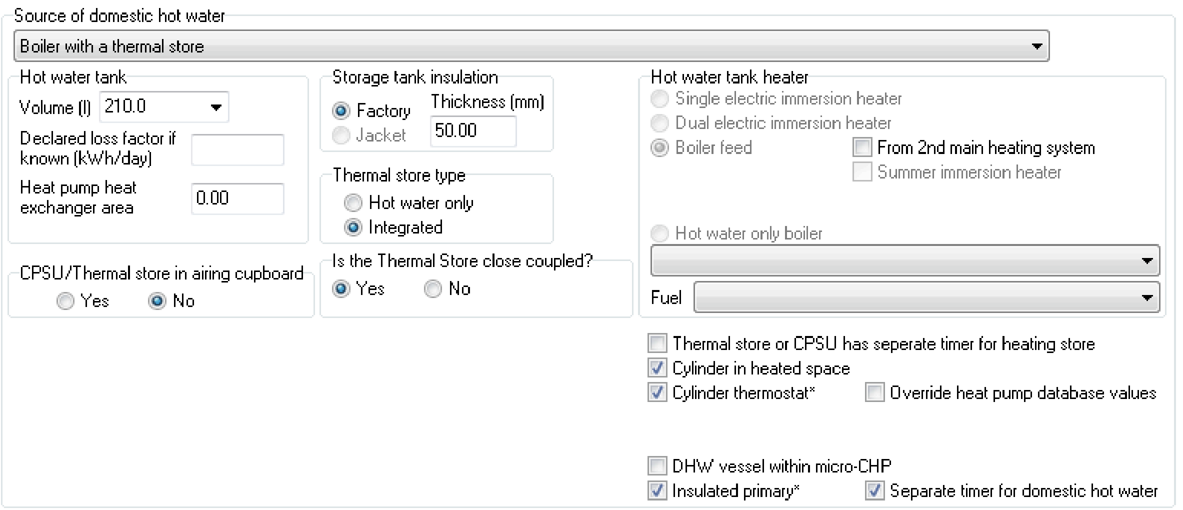
21.6 Boiler with thermal store

In these systems a thermal store contains water heated by a separate boiler, with domestic hot water provided by means of heat exchanger within the store.

Enter the following data for the store:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.

Figure 21.5: Data entry for a thermal store hot water system



- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

The hot water tank heater will always be *Boiler feed*.

Use the radio buttons and tick boxes to indicate whether:

- The thermal store is integrated or hot water only.
- The thermal store is in an airing cupboard.
- The thermal store is close coupled.

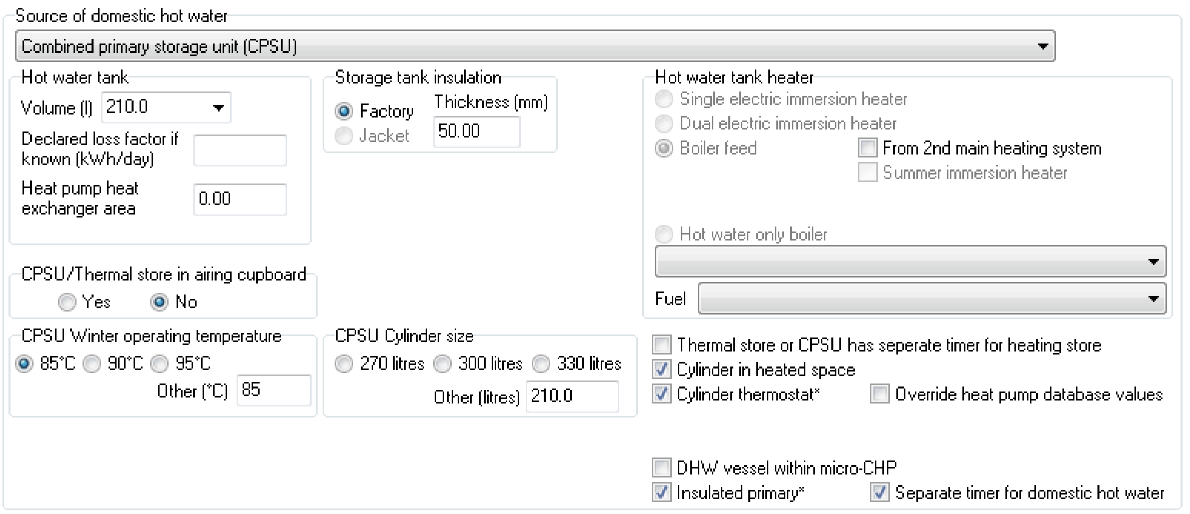
  Close coupled means the store is either within the same casing as the boiler, or separated from the boiler by no more than 1.5m of insulated pipework.
- There is a separate timer to the thermal store for the heating store.

Use the four lower tick boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);
- the primary pipework between the boiler and tank is insulated (tick box only displayed if boiler feed is selected) (required by Domestic Building Services Compliance Guide;
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel** section of the **Water heating** tab (see section 21.10).

Figure 21.6: Data entry for CPSU hot water supply



21.7 Combined primary storage unit (CPSU)

A Combined Primary Storage Unit provides hot water by means of heat exchanger within the primary store. Enter the following data for the tank:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

Use the radio buttons and drop-downs to indicate:

- whether the **CPSU is in an airing cupboard**;
- the **winter operating temperature of the CPSU**;
- the **size of the CPSU cylinder**.

Use the lower boxes to indicate whether:

- the CPSU as a **separate timer for the heating store**;
- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank (cylinder) (required by Domestic Building Services Compliance Guide);

- the primary pipework between the boiler and tank is insulated (tick box only displayed if boiler feed is selected) (required by Domestic Building Services Compliance Guide;
- there is a separate timer for the domestic hot water.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 21.10).

21.8 MicroCHP or heat pump

In these systems the hot water is provided by either a domestic-sized combined heat and power (microCHP) system or by means of a heat pump entered by means of the Product Characteristics Database (section 22.2) [1].

For a microCHP system the only options are whether there is:

- a summer time immersion heater for hot water;
- a hot water vessel within the microCHP system;
- a separate timer for domestic hot water.

For heat pump the standard method is to accept the database values, in which case it is only necessary to specify whether there is:

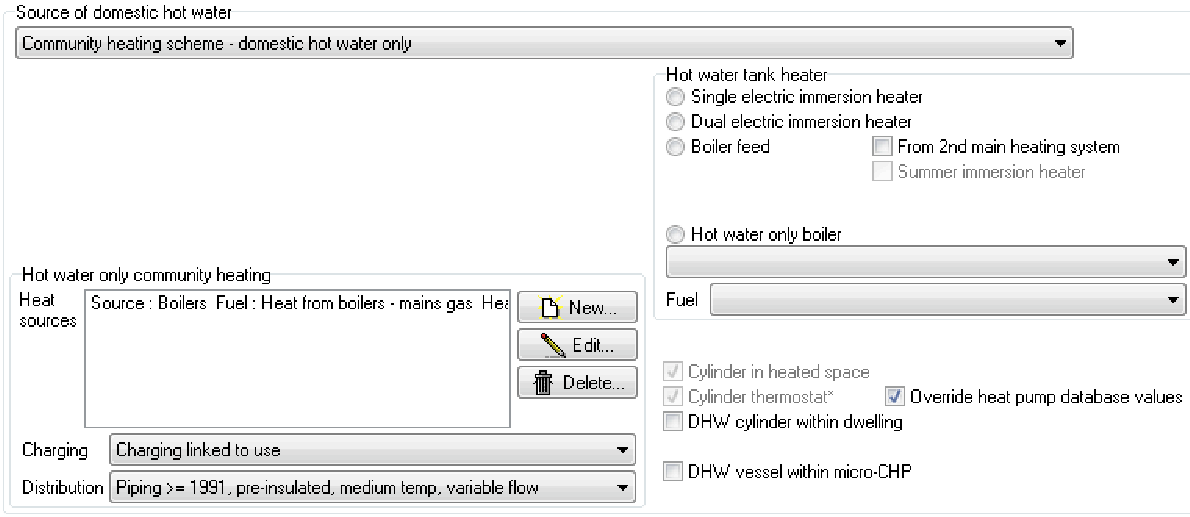
- a summer time immersion heater for hot water;
- a hot water vessel within the microCHP system;
- a separate timer for domestic hot water.

However, it is possible to override the values by ticking **Override heat pump database values**. The tab now shows the **Hot water tank** data boxes:

- **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
- **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
- **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.
- **Heat pump heat exchanger area**: Enter the area of the heat exchanger plates in m^2.

If the dwelling has solar panels complete the **Solar panel** section of the **Water heating** tab (section 21.10).

Figure 21.7: Settings for a community heating scheme which supplies only domestic hot water



21.9 Community heating scheme providing domestic hot water only

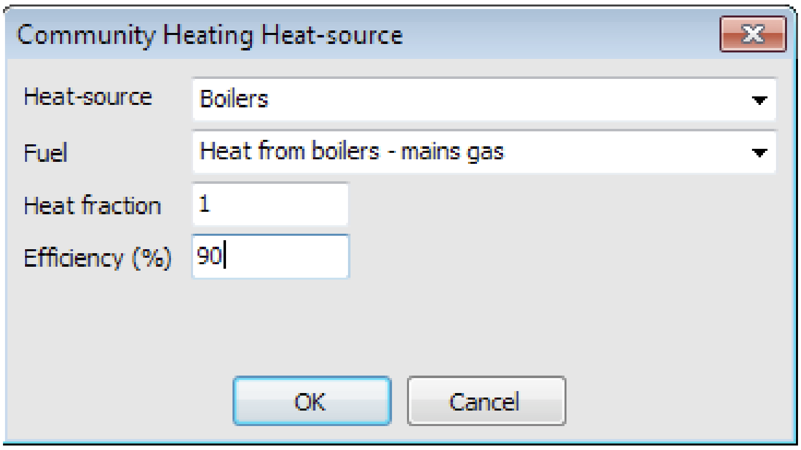
This system represents hot water provision by a community heating scheme which does **not** provide the space heating. The system can have several heat sources.

To specify such a system:

- Set the **Source of domestic hot water** to **Community heating - domestic hot water only** (Figure 21.7).
- Set the **Heat Sources** for the system (subsection 21.9.1.
- Set the method of **charging** for the hot water supply, using the drop-down: this will either be a flat rate charge for the heating, or will be linked to hot water usage.
- Set the **distribution** method using the drop-down.
- If there is a solar panel linked to the system enter its details (section 21.10).
- If there is a hot water tank or cylinder within the dwelling tick **DHW cylinder within dwelling**: additional data boxes will be displayed for:
  - **Hot water tank volume**: select one of the default values or enter the actual volume in the **Volume** drop-down.
  - **Storage tank insulation**: use the radio buttons to select the type of insulation, then enter its **Thickness** in mm.
  - **Declared loss factor**: Use the box to enter a heat loss factor supplied by the tank manufacturer, instead of relying on the default values in SAP 2009.

[1] Where the heat pump has been entered using the default efficiency figures in SAP and *not* the Product Characteristics Database then you should select *Hot water storage tank* as the source of domestic hot water.

Figure 21.8: Setting a heat source for community heating/hot water



21.9.1 Heat sources

Community heating and hot water schemes can be fed by a variety of heat sources including conventional boilers, heat pumps, combined heat and power systems and even geothermal. The **Heat sources** box lists the sources for domestic hot water (Figure 21.7): sources can be added and edited using the buttons next to the box:

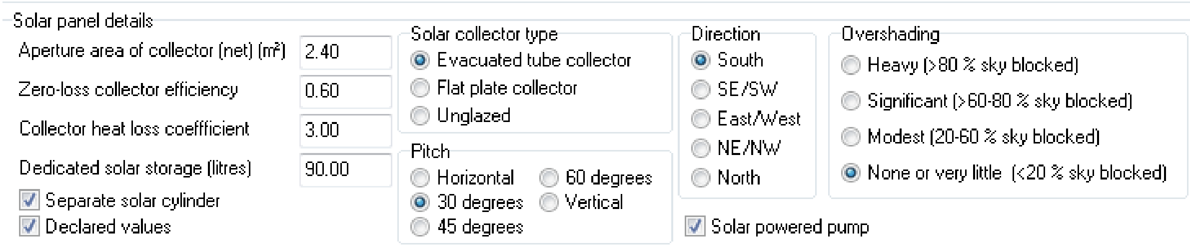
- the **New** button, which opens the **Heat source** dialogue ready for new data;
- the **Edit** button, which opens the **Heat source** dialogue showing the selected heat source.
- the **Delete** button which removes the selected heat source.

The **Heat Source** dialogue (Figure 21.8 requires:

- the type of heat source, selected from the **Heat source** drop-down.
- the fuel, selected from the **Fuel** drop-down.
- the proportion of the total energy load provided by that source. Enter a fraction between 0 and 1 in the **Heat fraction** box.
- the efficiency of that heat source. Enter as a percentage in the **Efficiency** box.

  For most sources the efficiency will be less than 100, but for heat pumps the efficiency may be considerably higher.

Figure 21.9: Data entry for solar water heating



21.10 Solar panels

Solar panels use sunlight to pre-heat water for the domestic hot water system. Guidance on including solar panels in the calculation is given in Appendix H of the SAP documentation. Where possible data from the panel's test certificate should be used, otherwise use data from table H1 of the SAP documentation.

Where a dwelling has solar panels, specify:

- The net **Aperture area of solar collector**, in square metres.
- The **Zero-loss efficiency of the collector**.
- The **heat loss coefficient** of the collector.
- The volume of the **dedicated solar storage**. See figure H2 of the SAP documentation for definitions.
- Whether there is a **separate solar cylinder**.
- The **solar collector type**, using the radio buttons.
- The **pitch** of the panels, measured from the horizontal, and their **orientation**.
- The amount of **overshading** on the panels; generally this will be less than the overshading of windows facing the same direction.
- Whether there is a solar powered pump. This will reduce the amount of electricity used for pumping water.

22 Primary heating

The primary heating system is the main heating system for the dwelling, which will often provide hot water as well as space heating; it is usually not based on individual room heaters. Data on the primary heating system is entered using the **Primary heating** tab (Figure 22.1).

22.1 Dwellings with two main heating systems

SAP 2009 can account for the uncommon case of a dwelling having two main heating systems, which are designed to heat the house together. (This should not be confused with secondary heating appliances, such as gas fires or wood-burning stoves, which are designed to provide additional heat for individual rooms.) The two systems may be configured to heat the all the dwelling together, or to heat parts of it separately.

To specify two heating systems:

1. Tick **Dwelling has two main heating systems**. The program now displays a pair of radio buttons, *Main heating system 1* and *Main heating system 2* (Figure 22.2).
2. With *Main system 1* selected, enter the proportion of the dwelling's space heating demand which is provided by that system in the **Fraction** box (the fraction should be in the range 0.0–1.0).
3. If both systems heat the whole house tick the box **Both systems heat whole house**.

   This affects the treatment of the hot water system.
4. Specify the first system in the **Primary heating** tab.
5. Click *Main system 2* and specify the second system in the **Primary heating** tab.

You can always switch between the systems using the radio buttons: the large number at the top right of the **Primary heating** tab indicates which of the two systems you are working on.

Figure 22.1: The primary heating tab

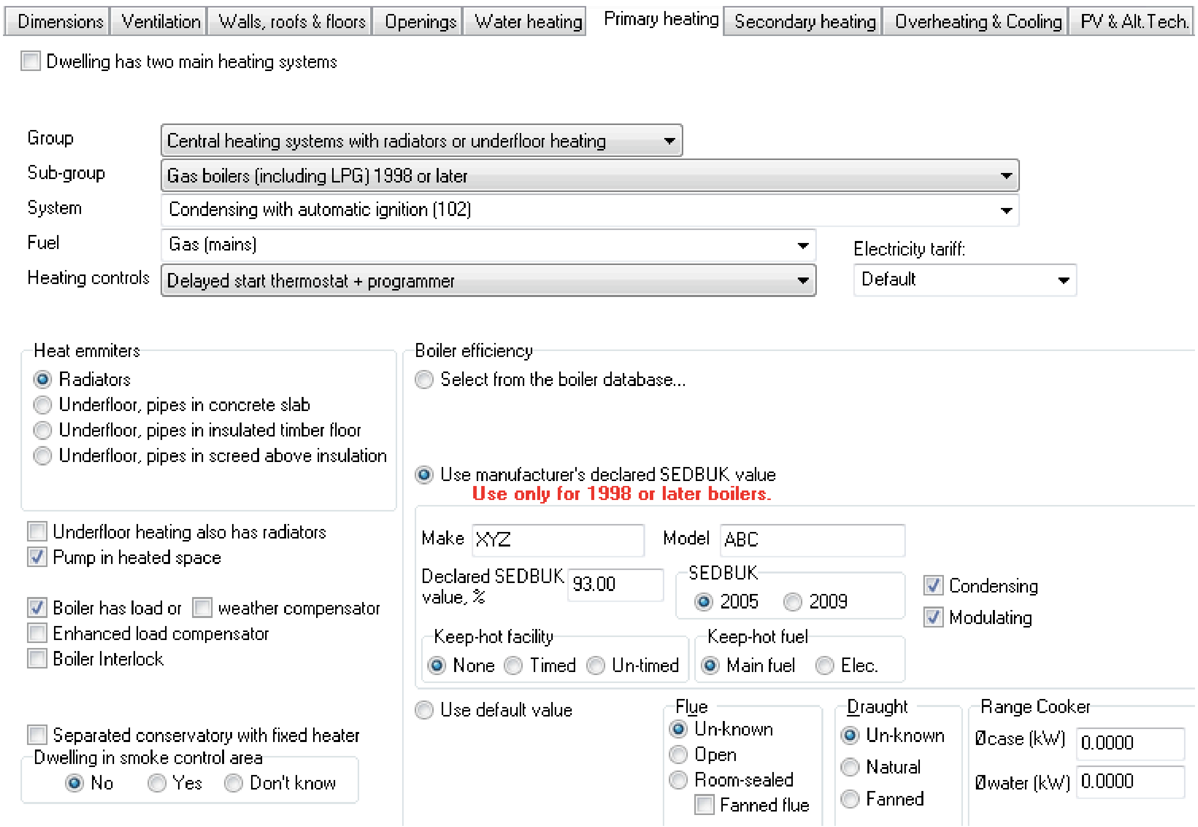
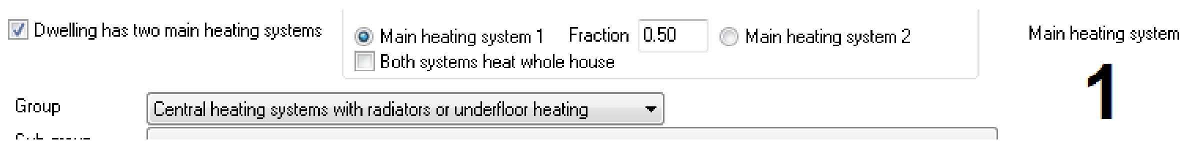


Figure 22.2: Configuring a dwelling with two main heating systems



22.2 Efficiency data for heating systems

There are three possible sources of efficiency data for heating systems:

- default values given in Table 4 of the SAP 2009 document.
- user-entered efficiencies: this can be useful at the design stage when no appliance has been specified.
- data from the Product Characteristics Database (PCD, subsection 22.2.1): this gives the most accurate values for specific appliances.

For some systems (for example, gas-fired warm air systems) only the default SAP 2009 efficiencies may be used, whilst for others (for example, gas condensing boilers) any of the three sources is acceptable. Note that heat pumps must be specified either using the PCD, or by accepting the default efficiencies: microCHP systems can only be specified by means of the PCD.

22.2.1 The Product Characteristics Database

The Products Characteristics Database (PCD) contains performance data for gas, oil and solid fuel boilers, heat pumps, mechanical ventilation systems and some renewable technologies (section 26.4). The database is maintained by the BRE and is available for download at www.boilers.org.uk. A new version of the database is issued at the end of every month.

To ensure you are using an up-to-date version of the database, JPA Designer checks the issue date every time you start the program: if the database is more than a month old the software prompts you to download the latest version. You can also download the database yourself.

To download the database:

1. With your web browser go to www.boilers.org.uk.
2. On the home page click on *Download the Boiler Efficiency Datafile*.
3. Right click on the *Download* button for *SAP 2009 – unzipped file (.dat)*, and choose *Save target as*. The download begins.

   The .dat file is larger than the others, but is simpler to install. On a broadband internet connection the difference in size is negligible.
4. In the **Save As** dialogue select the *JPA Designer 981* folder and accept the suggested file name *bedf2009.dat*.
5. At the warning *bedf2009.dat already exists. Do you want to replace it* click **Yes**.
6. At the **Download complete** dialogue click **Close**.
7. In the JPA Designer **Project Manager** window select **File**>**Re-load Product Characteristics Data File**.

22.2.2 SEDBUK efficiencies

One of the significant differences between SAP 2005 and SAP 2009 is a change in the calculation method for SEDBUK efficiency ratings for boilers; the change has resulted in the general lowering of efficiencies. Whilst JPA Designer allows you to enter either 2005 or 2009 SEDBUK ratings, you should be ensure you do not enter a value compatible with the 2005 rating if you have selected the 2009 rating; you may find you have entered a value which cannot be achieved by any boiler in the database.

22.3 The main primary heating systems

There are seven main groups of primary heating system[1]: the following sections describe how to enter data for the each group. In all cases (except community heating schemes), start by using the drop-boxes to set the:

[1] Note that *none* is not an acceptable heating option for a new dwelling.

- **Group**;
- **Sub-group**;
- **System**;
- **Fuel**;
- **Heating controls**.

Always work from **Group** downwards, as the options in the lower drop-boxes change according to the selections made higher up. Once you have set all the drop boxes you should enter any other requirements for that group then enter any additional data.

22.3.1 Central heating systems with radiators or underfloor heating

This group covers wet central heating systems with radiators, underfloor pipes, or fan coil units: the heat can be provided by gas, oil, solid fuel or electric boilers, heat pumps or microCHP units. To specify such systems, set:

- the **Group**, **Sub-group**, **System**, **Fuel**, **Heating controls** and **Electricity tariff**;
- the **Heat emitters**;

  *Note that when **Sub-group** is set to Heat pumps the additional option of **Fan coil units** is shown. It is possible to combine underfloor heating with radiators: tick **Underfloor heating also has radiators**.*
- the efficiency of the boiler (subsubsection 22.3.1.1;
- additional items such as load or weather compensator, boiler interlock (recommended) and if the central heating pump is in a heated space (affects internal gains).

22.3.1.1 Boiler efficiency

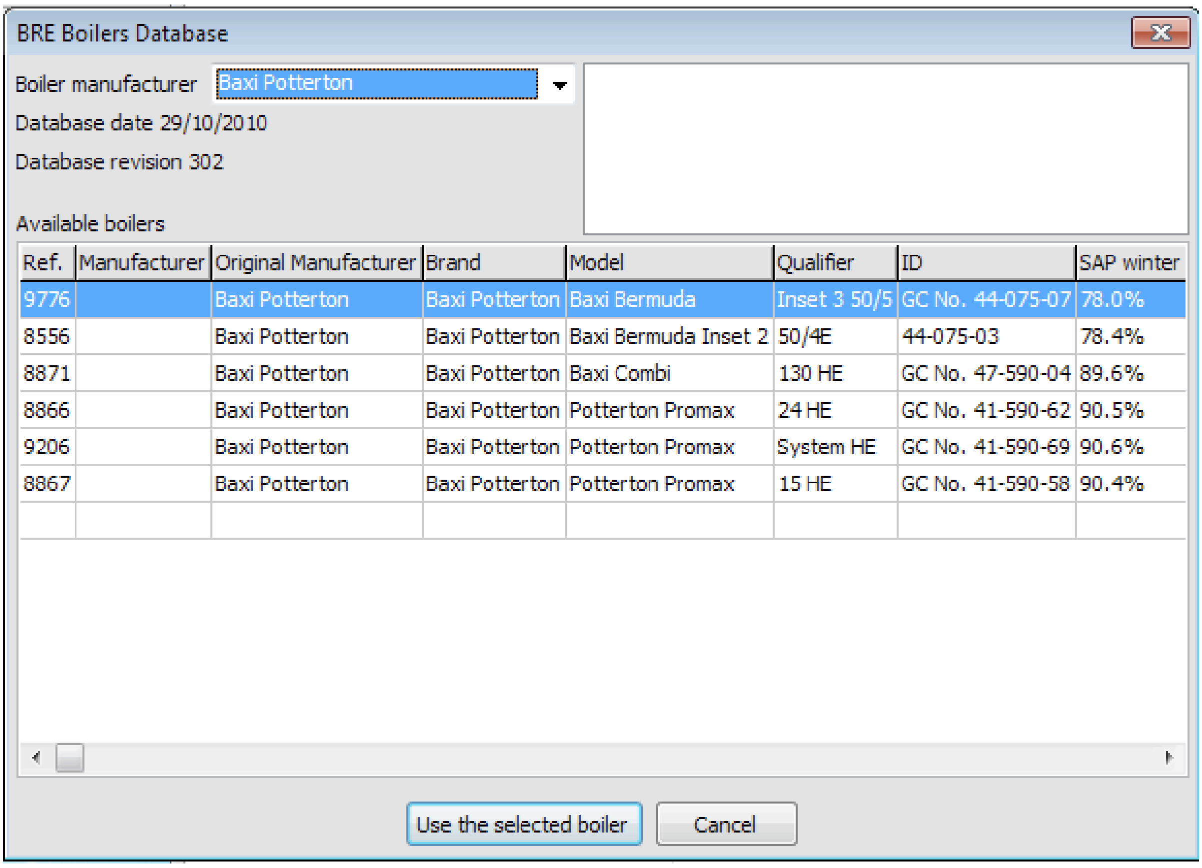
The efficiency of the boiler or other heat source can be entered in one of three ways.

To use the PCD:

1. Select the *Select from the boiler database* radio button.
2. Click the **Select boiler** button. The **BRE Boilers Database** dialogue opens(Figure 22.3).
3. Select the **Boiler manufacturer** from the drop-down. The program then displays the list of available boilers.
4. Scroll down the list and click on a boiler to select it. You can scroll sideways to view the details of each boiler, such as its efficiency and configuration.

   *The program only shows boilers which match the criteria you specified using the drop-downs on the **Primary heating** tab. As a manufacturer does not necessarily offer a boiler in every category the database may not display any boilers.*

Figure 22.3: Using the Product Characteristics Database to set the boiler efficiency



5. Click the **Use selected boiler** button. The **Boiler database** window closes and the **Primary heating** tab shows the summary details for the chosen boiler.

   There is no need to enter flue, draught, or keep hot details as all that information is present in the database entry for the boiler.

To enter a SEDBUK value directly:

1. In the **Boiler efficiency** section select the *Use manufacturer's declared SEDBUK value* radio button.
2. Enter the **Make** and **Model** of boiler.
3. Use the radio buttons to specify whether a SEDBUK 2005 or 2009 value is being used and enter the **Declared SEDBUK value**.
4. Specify the type and fuel of any **Keep-hot facility**.
5. Set the **Flue** and **Draught type**.
6. For range cookers you must also enter the values for ϕ**case** and ϕ**water**.

To use the default value:

1. In the **Boiler efficiency** section select the *Use default value* radio button. The software shows the default value for that boiler type.

2. Use the radio buttons to enter the details of the **Flue** and **Draught type**.

3. For range cookers you must also enter the values for ϕ**case** and ϕ**water**.

Note that the default values are generally too poor to comply with the standards in the Domestic Building Services Compliance Guide.

22.3.2 Storage radiator systems

Storage radiator systems are heated with off-peak electricity during the night and release that heat throughout the day. The only data required is that from the primary heating drop boxes.

22.3.3 Warm air systems

The heat for warm air systems is provided by gas, oil, electricity or heat pumps. The only data required is that from the primary heating drop boxes, except where the heat pump data is entered from the PCD database, instead of the default values.

22.3.4 Room heater systems

This group includes room heaters such as gas or solid fuel fires[2]. In most cases, the only data required is that from the primary heating drop-boxes. However, where the declared efficiency of the heater is known. tick the box **Use manufacturer's declared efficiency** then complete the **Make**, **Model** and **Declared efficiency** boxes and select the **BS Test Method** used to obtain the efficiency.

22.3.5 Other space and water heater systems

Electric ceiling heating is currently the only system in this category. The only data required is that from the primary heating drop boxes.

22.3.6 Community heating scheme

Community heating schemes use central heat generators to heat water which is then circulated through pipes to supply space heating and hot water to more than one dwelling. The heat may be provided by a number of different systems, and community heating schemes may often include Combined Heat and Power (CHP) systems, which will provide heat and generate electricity. Appendix C of the SAP 2009 document contains further information on the treatment of community heating schemes in SAP.

To specify a community heating scheme in JPA Designer:

- set **Group** to *Community heating scheme*. JPA Designer displays the **Community heating** section of the **Primary heating** tab (Figure 22.4).

Figure 22.4: Data entry for a community heating scheme with two heat sources

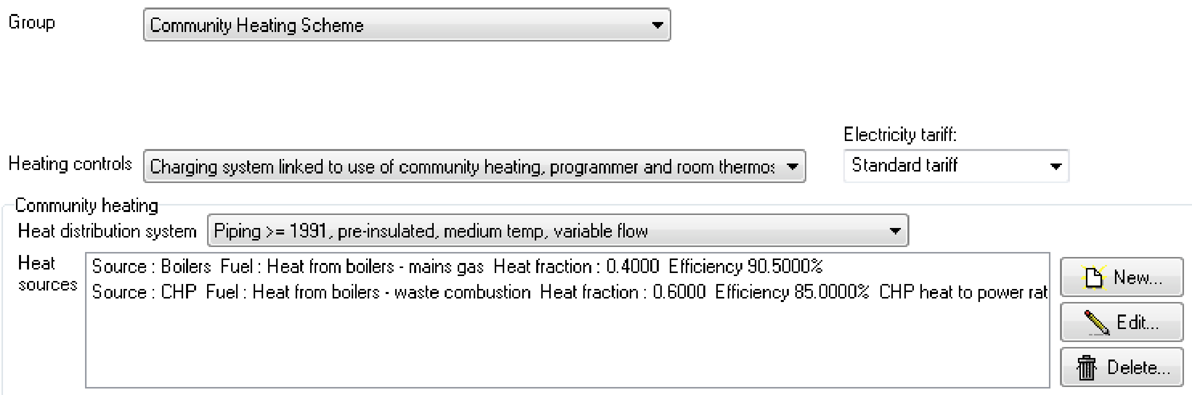
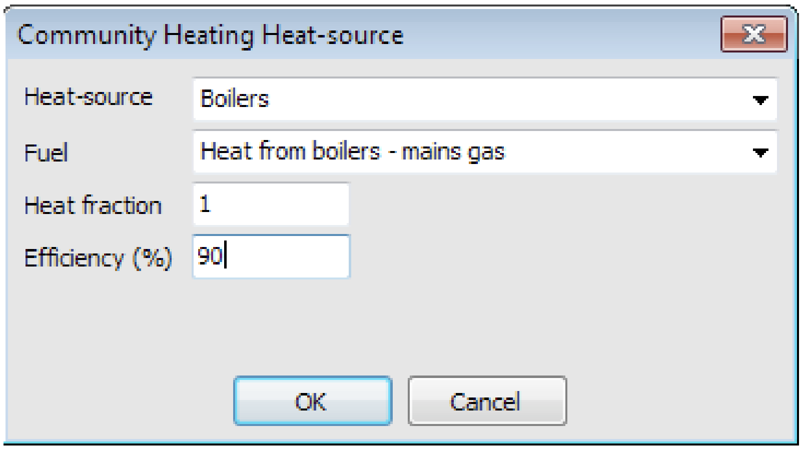


Figure 22.5: Setting a heat source for community heating



- set the heat sources; then,
- set the heating controls and the heat distribution system.

To set the heat sources:

- Click the **New** button: the **Heat source** dialogue opens (Figure 22.5.
- Select the type of heat source from the **Heat source** drop-down.
- Select the **Fuel** from the drop-down.
- Set the proportion of the total heat load provided by that source: enter a fraction between 0 and 1 in the **Heat fraction** box.

  The total heat fraction from all the heat sources must total 1.00.

[2]Some of the options will not be appropriate for new-build, but are included for compatibility with the Reduced data SAP (RdSAP) used for EPCs for existing dwellings.

- Enter the percentage **Efficiency** of the heat source.

  For most sources the efficiency will be less than 100, but for may be considerably higher.

- Click **OK** to close the dialogue.
- Repeat the procedure for multiple heat sources: use the **Edit** and **Delete** buttons to adjust or remove heat sources.

To set the controls and distribution system:

- Set the **Heating controls** and the **Electricity tariff**.

  *Systems which rely on flat rate charging will usually be less efficient than those where charging is linked to use.

- Use the **Heat distribution system** drop-box to specify the type of pipes used to circulate the hot water.

22.3.7 Electric underfloor heating

This option reqpresents underfloor heating systems based on electric cables in the floor slab or integrated into flooring.

The only data required is that from the primary heating drop boxes.

22.4 Additional data

There are two items of additional data which the software collects for producing the EPC which appear on the **Primary heating** tab:

- **Separated conservatory with fixed heater**: Tick this box if the dwelling has a thermally separated conservatory (see SAP guidance section 3.3.3 for the definition of thermally separated) which has a fixed heater within it.
- **Dwelling in smoke control area**: This box is only relevant if solid fuel is set as the fuel for the primary or secondary heating. If the dwelling is within a smoke control zone the use of house coal and dual fuel is not permitted, and wood is permitted for an exempted appliance only. For further information on smoke control areas see www.smokecontrolareas.co.uk. Tick the box if the dwelling is within a smoke control area.

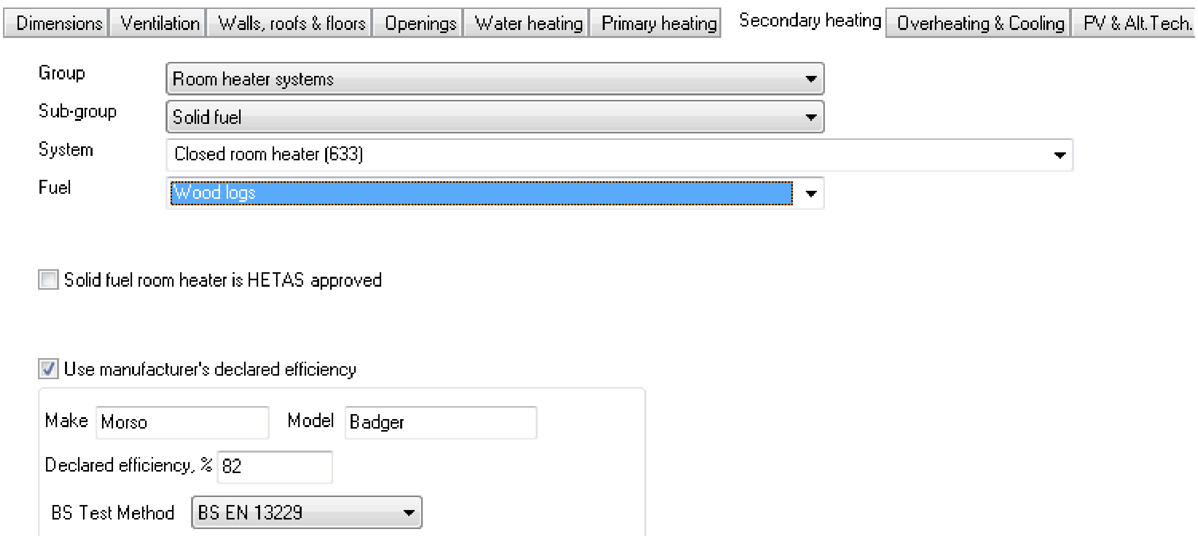
23 Secondary heating

A secondary heating system is an additional space heating system for the dwelling: common examples are gas fires or wood burning stoves. Where a secondary system is provided it should be included in the calculation: guidance on when to include a system is given in Approved Document L1A paragraph 4.12. The fraction of space heating provided by the secondary system is defined in table 11 of the SAP 2009 document. Data on secondary heating is specified using the **Secondary heating** tab (Figure 23.1).

To specify secondary heating:

1. Set the **Group** drop-down to *Room heater systems*.
2. Select the **Sub-group**.
3. Select the **System**.
4. Select the secondary heating **Fuel**.

Figure 23.1: The Secondary heating tab



If the solid fuel room heater has been **approved by HETAS**[1] tick the box. The calculation will then use a higher default efficiency for the heater.

Where the actual efficiency for a solid fuel heater is known, tick the **Use manufacturer's declared efficiency** box then enter the **Make**, **Model** and **Declared efficiency**. The **BS Test Method** used to obtain the efficiency value should also be entered.

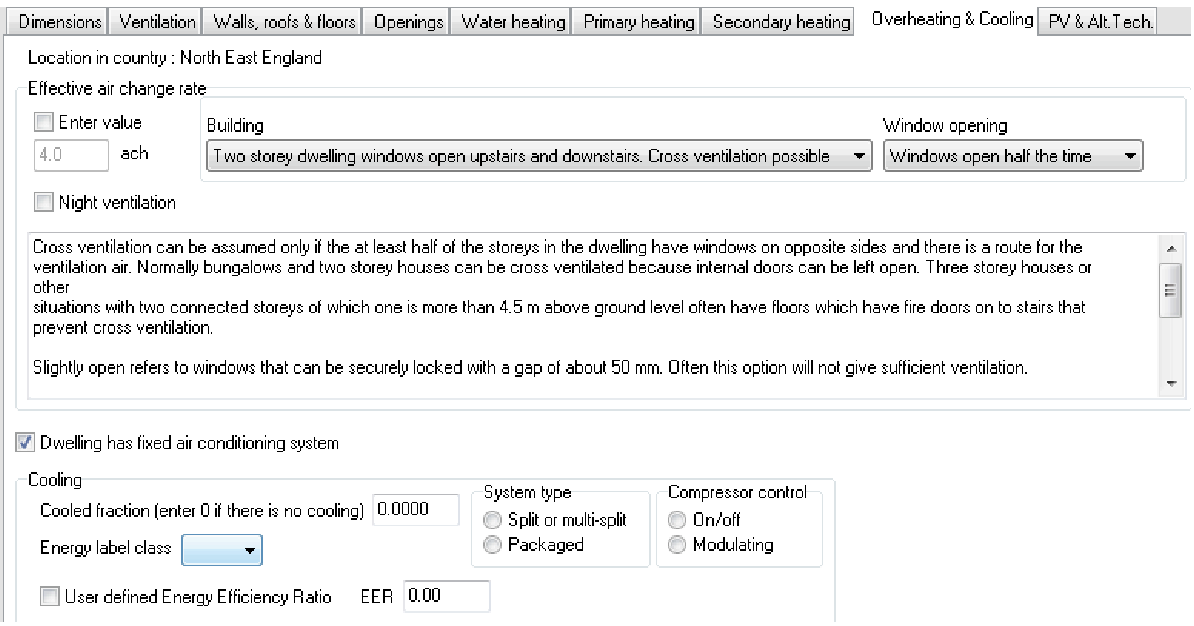
[1] Heating Equipment Testing and Approval Scheme.

24 Overheating

Dwellings must not have an excessive risk of high internal temperatures in summer as a result of solar gain. The test for overheating risk is set out in Appendix P of the SAP document; overheating risk depends on the predicted amount of solar gain and the thermal mass of the dwelling. The result of the overheating assessment is shown in the main SAP window: a dwelling with a high risk of overheating will not comply with regulations.

Most of the data for the calculation is entered elsewhere in the SAP calculation from data, so the only information required is the **Effective air-change rate**. You can either tick the **Enter value** box and enter a design air change rate, in air changes per hour (ach), or use the **Building** and **Window opening** drop-downs to set default values.

Figure 24.1: The Overheating tab



25 Cooling

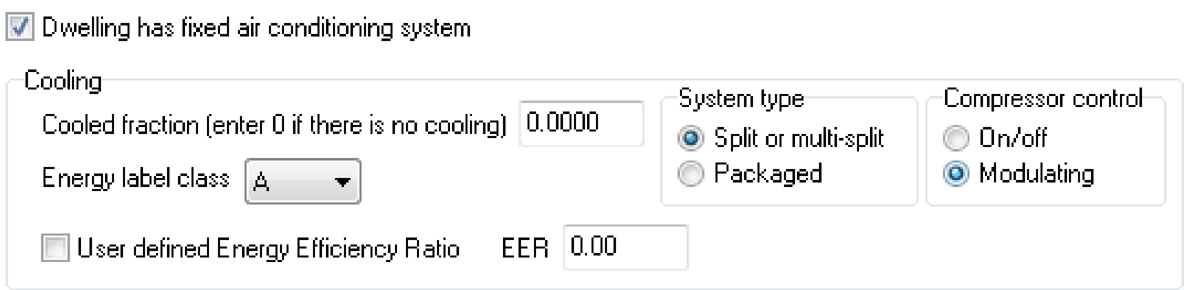
The energy used for space cooling must be included in the SAP 2009 calculation whenever space cooling is present. The data for the system is entered in the **Overheating & cooling** tab (Figure 25.1). The **Cooling fraction**: the proportion of the dwelling which is served by the cooling system. This can be determined by dividing the floor area of the cooled part by the total floor area.

The efficiency of the system can either be set to default values by setting:

- **System type**: The system can be *Split or multi-split*, or *Packaged*.
- **Compressor control**: This can be set to *On/off* or *Modulating*.
- **Energy label class**: Select A to G (with *ND* for no data).

Where the Energy Efficiency Rating (EER) is known, tick the **User defined Energy Efficiency Ratio** and enter the value in the **EER** box.

Figure 25.1: Settings for air conditioning systems



26 Renewables

SAP 2009 takes account of the contribution of certain renewable sources of energy and some heat recovery technologies, including:

- photovoltaic panels (section 26.1);
- wind turbines linked to one dwelling[1] (section 26.2);
- hydro-electric generators (section 26.3);
- waste water heat recovery units (WWHRS) (section 26.4);
- flue gas heat recovery systems (FGHRS) (section 26.5).

The data for all those systems is entered in the **Photovoltaics and Alternative Technologies** tab (abbreviated to **PV & Alt Tech**, Figure 26.1). That tab is also used for entering the amount of any additional energy generated by other means (section 26.6.

26.1 Photovoltaic panels

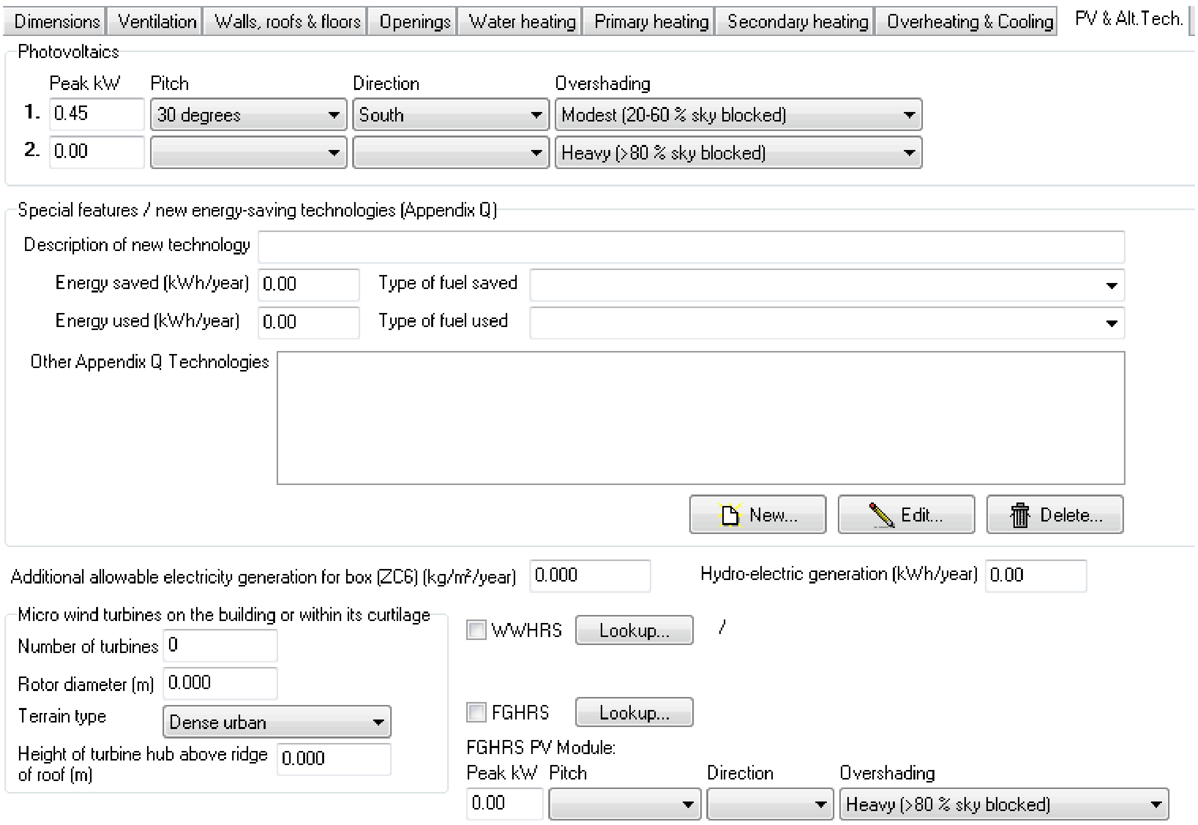
Photovoltaic panels generate electricity from sunlight. JPA Designer enables you to include two photovoltaic installations, to allow for situations where panels are set at two different orientations. For each installation:

1. Enter the **Peak kW** of the system (obtain this value from the manufacturer or supplier);
2. Select the **Pitch** of the panels;
3. Select the **Direction** which the panels face;
4. Select the amount of **Overshading** (which may not be the same as the overshading of the windows);

For blocks of flats, where the PV output is connected into the landlord supply the total PV area should be divided between the dwellings in proportion to their total floor areas. If the PV output is connected directly to individual flats then the whole PV area should be allocated to those flats.

[1] Electricity generated by a wind turbine attached to the dwelling, or on a mast within its grounds can be included in the SAP calculation: however, where a turbine supplies electricity to more than one dwelling, or is connected to a development by private wire, the electricity can not be included in the SAP calculation: see Appendix M of the SAP 2009 document for further details.

Figure 26.1: The Photovoltaics and Alternative Technology tab



26.2 Wind turbines

The electricity generated by a wind turbine on the building or within its curtilage (grounds) should be included in the SAP calculation. To specify a wind turbine:

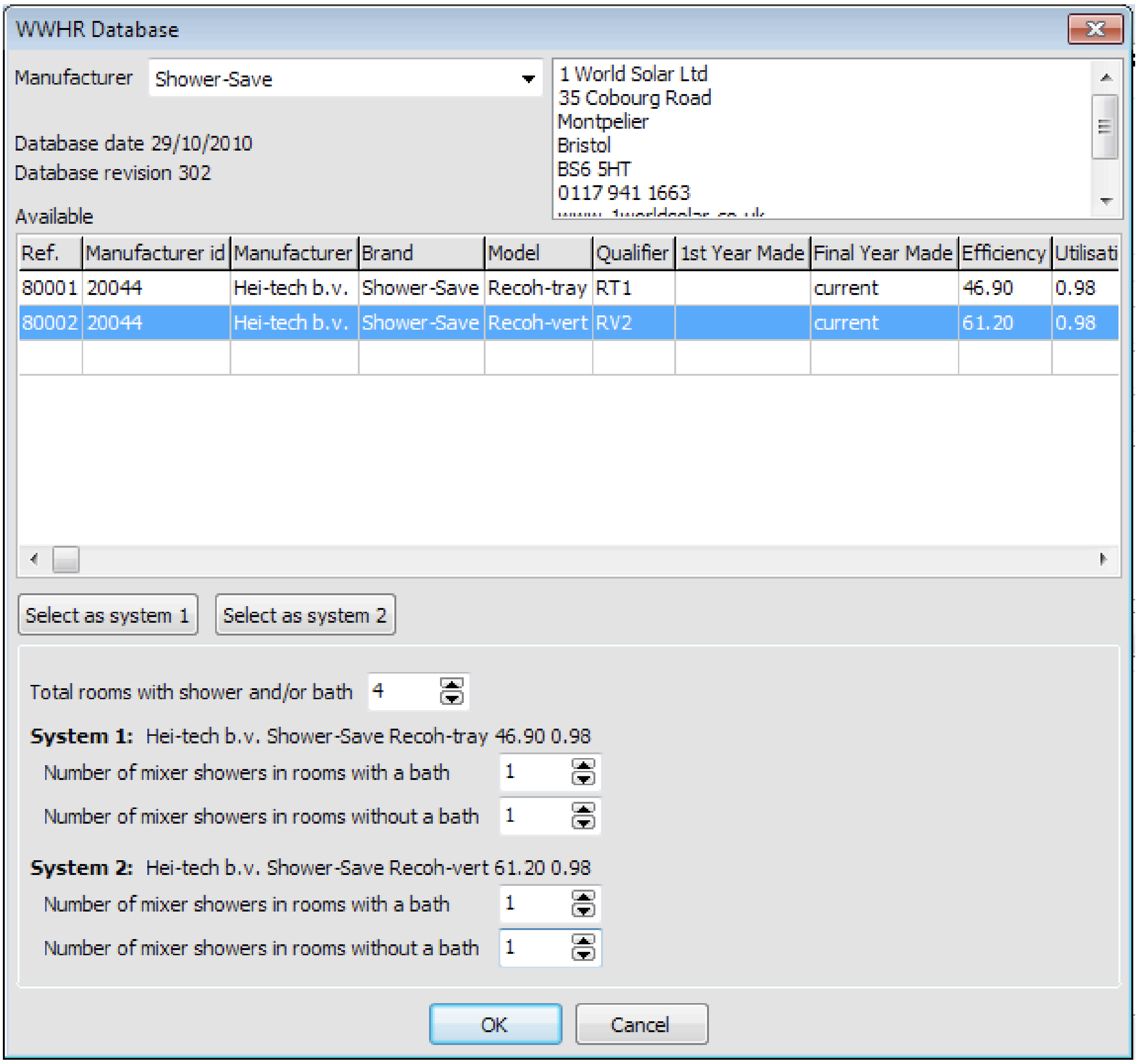
1. Enter the **Number of turbines**.
2. Specify the **Rotor diameter** in metres.
3. Select the type of **terrain** which surrounds the dwelling.
4. Enter the **height** of the hub of the turbine above the ridge of the roof, in metres.

As part of the process of producing an EPC the software must calculate the likely benefit from installing a wind turbine. You must therefore specify the **Terrain type** even if there is no wind turbine on the dwelling.

26.3 Hydro-electricity

The electricity from hydro-electric units can be included in the SAP calculation, provided the total amount generated has been calculated and signed off by an appropriately qualified engineer. The amount of electricity is entered in **Hydro-electric generation (kWh/year)**. Where electricity is supplied to several dwellings it should be assigned in proportion to their floor areas. See Appendix M4 of the SAP 2009 document for further details.

Figure 26.2: Entering data on WWHR systems



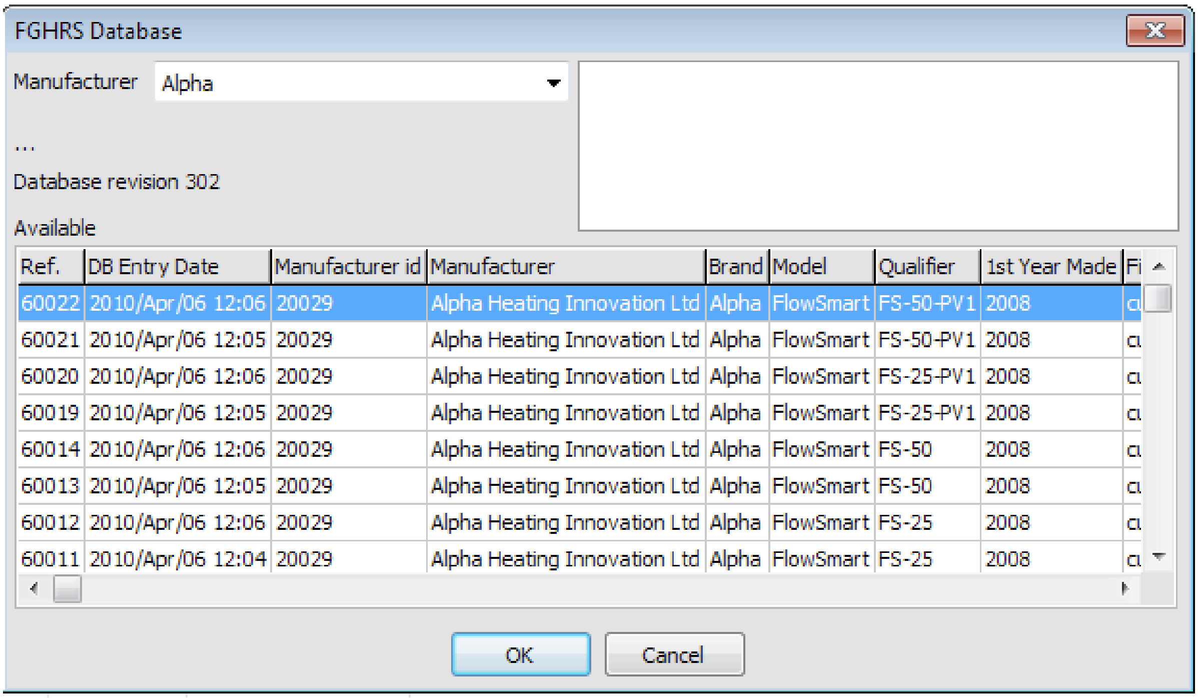
26.4 Waste water heat recovery systems

Waste water heat recovery systems (WWHRS) use heat exchangers to recover heat from the heated water passing out of the wastes of showers and baths, and to feed it back into the hot water system (pre-heating the cold water feed to the boiler or hot water cylinder). The effectiveness of the WWHRS depends on the system and on the proportion of baths and showers to which it is linked.

To specify WWHRS in JPA Designer:

- In the **PV & Alt Tech** tab tick **WWHRS** and click the **Lookup** button. The **WWHR Database** dialogue opens (Figure 26.2.
- Use the **Manufacturer** drop-down to select the manufacturer, then highlight the specified product in the list and click **Select as system 1**. Repeat this process if there is a second system, but click **Select as system 2**.

Figure 26.3: The flue gas heat recovery systems (FGHRS) database



- Enter the **total rooms with shower and/or bath**.
- For each system specify the number of mixer showers to which the system is linked in rooms **with a bath** and **without a bath**

WWHR systems attached to instantaneous electric showers (IES) are not included in the assessment. Therefore IES should not be counted in the number of showers for a system, but should be counted in the total rooms with shower and/or bath.

26.5 Flue gas heat recovery systems

Flue gas heat recovery systems (FGHRS) recover heat from the combustion products of condensing boilers to pre-heat the domestic hot water supply. To specify FGHRS:

1 Tick **FGHRS** and click the **Lookup** button. The **FGHRS database** dialogue opens (Figure 26.3.

1. Select the **Manufacturer**.
2. Select the type from the **Available** list.
3. Click **OK**.

Where the FGHRS has a photovoltaic array feeding directly into a close coupled store the **PeakkW**, **Pitch**, **Direction** and **Overshading** of the PV array should be set in the **FGHRS PV Module** section.

26.6 Other allowable generation

There are some sources of electricity which cannot be included in the calculations for Building Regulations compliance, but can be included for other calculations, particularly those to demonstrate zero carbon homes status, Code for Sustainable Homes level 6, and for the Northern Ireland low and zero carbon homes scheme.

Electricity from such sources should be entered in the box **Additional allowable electricity generation for box (ZC6)**. ZC6 is the box number on the zero carbon homes calculation (see section 16 of the SAP 2009 document). Electricity generated by wind turbines linked to a development by private wire may be entered here.

27 Special features

SAP 2009 includes a procedure for including new technologies in calculations in the intervals between revisions of the SAP. The Appendix Q procedure (which is named after the appendix of the SAP document in which it is described) may only be used for products which have been independently assessed and are listed on the Appendix Q web site at http://www.sap-appendixq.org.uk. The web site has a calculation spreadsheet for the various product types[1] and, in some cases, data sheets for individual products.

To incorporate a technology using the Appendix Q procedure:

1. Carry out the SAP calculation as normal.
2. Complete the the appropriate Appendix Q spreadsheet: this may require information on the product taken from a datasheet, and may involve changes to the SAP calculation.
3. Transfer the results from the spreadsheet to the **Special features** section of the **Photovoltaics and Alternative Technologies** tab (Figure 26.1), entering:
   - a brief **Description** of the technology.
   - the **Energy saved** figure, using the drop-down to select the **Type of fuel saved**.
   - the **Energy used** figure, using the drop-down to select the **Type of fuel used**

   Where there is more than one Appendix Q technology use the **New** and **Edit** buttons to add those technologies to the calculation

Note that all the technologies which required Appendix Q with SAP 9.81 can all be entered directly in JPA Designer in SAP 2009.

[1] There are separate spreadsheets for different versions of SAP: make sure you use the appropriate version.

28 Checking compliance

Once you have entered all the data for the dwelling you can check its compliance status.

The program will display *pass* (green) or *fail* (red) in the **compliance zone** at the bottom right corner of the main **SAP window**. If the dwelling fails you can hold your curser over over the **compliance zone** and the software will display a tool-tip will show the primary cause of failure (see Figure 16.2).

Click on the **compliance zone** opens the **Compliance Checklist** which lists the main criteria the SAP module tests and shows the status of the dwelling against each one. The compliance check window is particularly useful when the dwelling has failed on one of the secondary criteria, such as the efficiency of heating controls, or excessive losses from the hot water cylinder.

You can use the tabs at the bottom of the **Compliance Checklist** to view:

- the SAP worksheet;
- the TER worksheet;
- the DER worksheet;
- the Overheating risk assessment.

Once you have reviewed the results you can then make changes to the calculation.

29 Outputting SAP results

You can print the results of SAP calculations or produce a PDF file which is ideal for emailing. For both print and PDF you can select which parts of the results you want to include in your output:

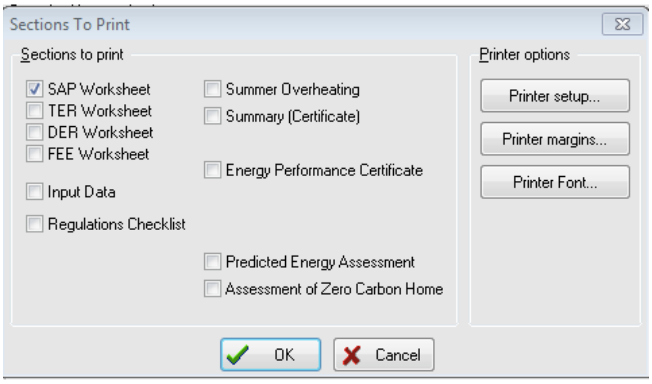
- SAP worksheet: the results of the SAP calculation.
- TER worksheet: the results of the TER calculation for the notional dwelling.
- DER worksheet: the results of the DER calculation for the actual dwelling.
- FEE worksheet: the results of the FFE calculation.
- Input data: a reflection of the information you have entered into the software.
- Regulations checklist: shows the compliance status of the dwelling in a checklist which follows the criteria in AD L1A.
- Summer overheating: results of the overheating assessment.
- Energy performance certificate (EPC): a draft energy performance certificate.

  You must be a member of an appropriate accreditation scheme to produce a final EPC – see the separate guidance document for instructions.
- Predicted Energy Assessment (PEA): the energy assessment required for off-plan sales.
- Assessment of Zero Carbon Home.

To print the results:

1. Select **File**>**Print** from the menu bar (or click the **Print** button on the tool bar). The **Sections To Print** dialogue opens ((Figure 29.1).
2. Use the tick boxes to select the outputs you want to produce.
3. Click **OK**. The **Print preview** window opens.
4. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2).

Figure 29.1: SAP Sections To Print dialogue



To create a PDF file of the results:

1. From the menu bar select **File**>**Create PDF**. A dialogue asks if you want to open the PDF when it is created.

2. Select **Yes** or **No**. The **Sections To Print** dialogue opens (Figure 29.1).

3. Use the tick boxes to select the outputs you want to produce.

4. Click **OK**. The **Print preview** window opens.

5. Use the buttons on the tool bar to view successive pages of the print out, then click the **Print** button to print the pages (Figure 12.2). The program will then create a PDF file of the calculation.

   *The name of the PDF file will include the JPA Designer file name and the calculation name, so the calculation **Plot 28** in a project **The Meadows** will be called **The Meadows.JDPtile hung wall.Plot 28.PDF**. The file will be saved into the JPA Designer program folder or in the start-up folder you have specified.

   Note: as Windows does not allow certain characters to be used in file names you should ensure the calculation names in JPA Designer do not contain those characters, otherwise PDF creation will fail. The restricted characters are `/ \ : * ? < > |.

You can change the printer settings by selecting **File**>**Printer setup** from the menu bar.