



# JPA Designer

**SAP 9.92 module • U-value modules  
& Condensation Risk**

**Version 7.1 and above**

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# **Part I**

## **JPA Designer basics**

# 1 Introducing JPA Designer

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Welcome to JPA Designer, the design and calculation program from JPA TL Ltd. JPA Designer can:

- carry out SAP calculations to SAP versions 9.92, 9.90, 9.81, 9.80 and 9.70, to demonstrate compliance with the energy efficiency requirements of Building Regulations and Building Standards<sup>1</sup> and as part of Code for Sustainable Homes (CSH) assessments;
- lodge On-construction Energy Performance Certificates (EPCs) for dwellings in England and Wales, Scotland and Northern Ireland;
- assess PV and wind turbine output calculations for feed-in tariff installations;
- calculate U-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;
- U-value templates to speed up calculations.
- 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;
- A database of common materials to speed U-value calculations;

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.

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<sup>1</sup>In order to lodge and issue EPCs you will need to be a member of an accreditation scheme (England and Wales, Northern Ireland) or protocol organisation (Scotland). You can find details of our partner schemes at [www.techlit.co.uk/training/accreditation](http://www.techlit.co.uk/training/accreditation).

## 1.1 Conventions for the manual

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 an option in a menu on the program's menu bar, e.g. Select **Edit>Primary heating system** means *click on the **Edit** menu and select **Primary heating system** from the list.*

This manual uses the following special terms:

- **Dialogue (dialogue box)**: a small window which displays text 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 lets you turn a setting on (ticked) or off (not ticked).
- **Text box**: an area on a dialogue in which you can type words or numbers.
- **List**: 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.

Many functions of JPA Designer can be accessed using either the menus or the toolbars: also, some may also have keyboard shortcuts. To avoid repetition this manual refers only to the menus.

## 1.2 Getting help

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 (see 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](mailto: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 enter a layer in a condensation risk 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;

If you are new to condensation risk calculations we offer distance learning and on-line training courses, which provide a thorough introduction to the software and its use. You can find more details at <http://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 adding your company details and logo to reports.

### 2.1 System requirements

JPA Designer runs on Windows XP, Windows Vista, Windows 7, Windows 8 (see Technical Note 2012/04) and Windows 10. Apple Macintosh users can run JPA Designer on a Windows virtual machine under Parallels Desktop or VMWare Fusion, or on a Windows installation using Boot Camp (we do not offer technical support for installing JPA Designer on such systems).

Whatever computer you are using it will require an internet connection to check the validity of the licence, to update the BRE Product Characteristics Database for the SAP 2012 module and to issue EPCs.

### 2.2 Installation

To install JPA Designer on your PC:

1. Go to our web site at [www.techlit.co.uk](http://www.techlit.co.uk) and *right click* on the link labelled *download JPA Designer*: select **Save link as** or **Save target as** (the exact wording will depend on which the browser you are using).
2. Save the installer file **jsetup990.exe** to your PC (we recommend downloading the file to the Desktop). The download is about 6.5 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 **Licence Agreement**. To continue with the installation click *I accept the terms of the licence agreement*, then click **Next**.

5. At the **Customer information** screen 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**.
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. We supply the user name and key code when you buy a licence for a module. If you do not enter your details JPA Designer runs in *demonstration mode* and will not display the results of calculations.

To enter license details for a module:

1. At the **Project Manager** window (Figure 2.1) select **Edit>User and Security Codes** from the menu bar. The **User Registration** dialogue opens (section 2.3).
2. In the section for the module (e.g. the U-value module) enter the company name – exactly as supplied in the registration email – in the box **Your company name**.  
*The company name is case sensitive and should be entered exactly as shown in the email: 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.*
3. Copy the key code from the registration email and paste it into the bottom box on the **User Registration** dialogue.
4. Click the **Apply ... code** button for the module. The program copies the code into the **Key code** boxes for the module.

If you have bought several modules repeat the steps for each one.

## 2.4 On-line licence checking

JPA Designer checks the validity of your licence for a module the first time you open a calculation after the the program has started. It does this by contacting our on-line licensing database and checking the expiry date for module<sup>1</sup>.

<sup>1</sup>The process only looks for the company name and checks the licence status and expiry date on the database.



Figure 2.1: The Project Manager window

The "User Registration" dialog box is shown. It has three sections: "U-value product details", "SAP product details", and "PV product details". Each section has a "Your company name" text field and a "key code" field consisting of five "0000" boxes. Below these sections, there is a text box containing the key code "1234578901234567890" and three buttons: "Apply U-value key code", "Apply SAP key code", and "Apply PV key code". At the bottom, there is a text line "Call JPA on +44(0) 0191 281 0031 to buy the software and obtain a Key Code" and two buttons: "OK" (with a green checkmark icon) and "Cancel" (with a red X icon).

Figure 2.2: The User Registration dialogue

- If the check is successful and the licence is valid the module will open. (The program will record the date and time of that successful check).
- 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 the module will open.
- 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 the check is successful and the licence is not valid the calculation will not open.

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 reset 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.

## 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. You can find the version number by selecting **Help>About** from the menu bar in JPA Designer and compare that with the version number shown on our web site<sup>2</sup> ([www.techlit.co.uk](http://www.techlit.co.uk)).

Higher numbers and letters indicate later releases, with characters coming earlier in the name being more important than 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<sup>3</sup> (see section 2.2).

You can find details of the changes in each version on the announcements section of our web forum<sup>4</sup>.

You can set JPA Designer to check for updates automatically by ticking the **Check for updates** box on the **General** tab of the **Options** dialogue. Whenever you start the program it will check the program date stamp against that of the latest installer on our web site. If the program is more than a day older than the installer the program will prompt you to download the latest version from our web site.

<sup>2</sup>[www.techlit.co.uk](http://www.techlit.co.uk)

<sup>3</sup>If you are using a version earlier than 5.02a3 you will have to uninstall the program using the Windows **Add/remove programs** or **Uninstall programs** control panel.

<sup>4</sup><http://forum.techlit.co.uk/viewforum.php?f=13>



Figure 2.3: The About dialogue showing the version number

## 2.6 Opening and closing JPA Designer

To open JPA Designer:

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

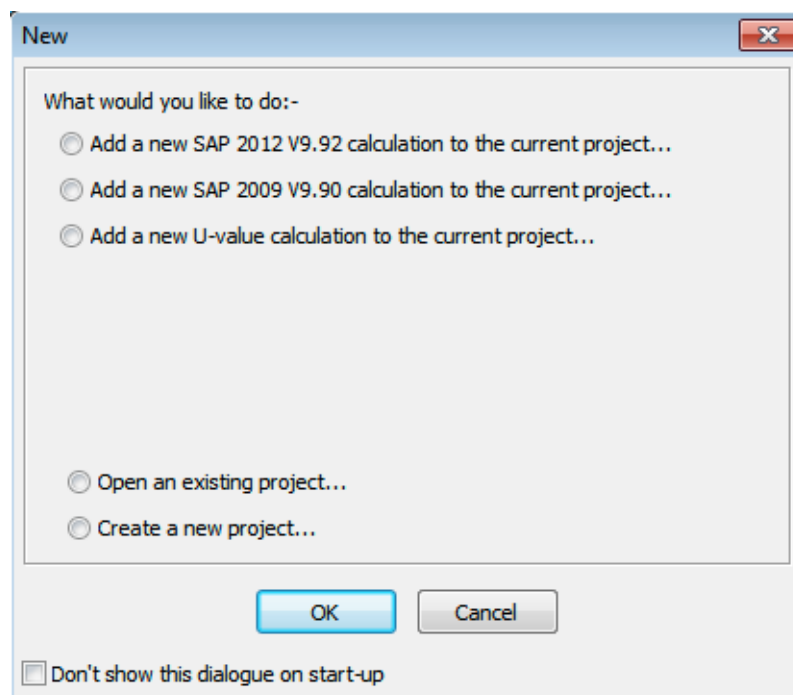


Figure 2.4: The **New** dialogue for JPA Designer

A splash screen appears when you open JPA Designer. The program can also be configured to show the **New** dialogue (Figure 2.4), which prompts you to create new calculations or projects.

If you do not want to use the **New** dialogue you can tick **Don't show this dialogue on start up**. Alternatively, you can turn the option on or off in the **Options** dialogue (chapter 36).

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** menu).
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.

*Uninstalling the program will not remove any JPA Designer project files.*

## 2.8 Adding your company details to reports

Most of the reports produced by JPA Designer can be customised to include your company name, address and logo. The details are added using **Options** dialogue from the main **Project Manager** window (see section 2.8). The logo must be a 256 colour BMP format file<sup>5</sup>.

It is also possible to set up details for several different companies within JPA Designer: these sets of address details and logos are referred to as identities (see section 2.8). You can switch between identities to produce calculation reports with different addresses and logos.

### Setting up address details

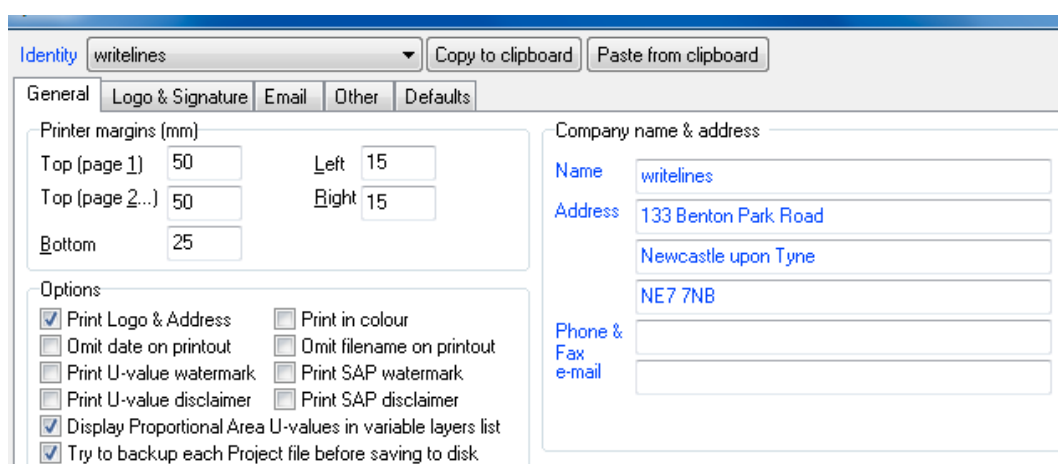


Figure 2.5: The Options dialogue - General tab

To set up your company details and logo for reports:

<sup>5</sup>If you have the company logo in a different format, such as a jpeg, tiff or png, you can use the free Paint program which comes with most versions of MS Windows™ to convert it to the right format and to set the correct colour depth.

1. In the Project Manager window, select **Options** from the menu bar. The **Options** dialogue opens.
2. In the **General** tab enter your company name, address, phone and email details in the *Company name & address* section (see Figure 2.5).
3. Tick the **Print Logo & Address** box.
4. Enter the wording of any disclaimers which you want to appear at the bottom of U-value and SAP reports in the **U-value disclaimer** and **SAP** boxes.
5. If you have entered wording for the U-value and/or SAP disclaimers tick the **Print U-value disclaimer** and/or the **Print SAP disclaimer** boxes.
6. Click the **Logo & Signature** tab.
7. In the *Logo position* section enter the location of the **Top** and **Left** sides of the logo, relative to the page, and enter the **Width** of the logo. All dimensions should be in millimetres. *It will probably take some experimentation to get the logo position and size correct.*
8. Enter the name of the **Logo file**, including the *.bmp* extension, then click **OK** to close the dialogue.
9. Copy or move the logo file to the folder containing the user data. On Windows 7 this will be **c:\ProgramData\JPA\JPA Designer**.

*Note: The **Certificate signature position** and associated settings are no longer in use.*

If you are a competent person under the TIMSA/BBA U-value competency scheme you can configure JPA Designer to add the scheme logo to your calculations:

1. Click the **Logo & Signature** tab.
2. In the *TIMSA logo position* section enter the location of the **Top** and **Left** sides of the logo, relative to the page, and enter the **Width** of the logo. All dimensions should be in millimetres.  
*It will probably take some experimentation to get the logo position and size correct.*
3. Enter the name of the **Logo file**, including the *.bmp* extension, then click **OK** to close the dialogue.
4. Copy or move the logo file to the folder containing the user data. On Windows 7 this will be **c:\ProgramData\JPA\JPA Designer**.
5. If you want the TIMSA logo to be used by default tick **Default to print TIMSA logo**.  
*You can always override the default setting in the **Sections To Print** dialogue.*

## Setting up identities

The procedure for setting up identities is similar to that for setting address details:

1. Enter the details for the first company as described in section 2.8.
2. Re-open the **Options** dialogue.
3. In the **Identity** list select the first blank identity (usually labelled *Blank 1*). The *Company name & address* and disclaimer information will be cleared.
4. Enter the details for the second company, including the data in **Logo and signature** tab. Click **OK** to close the dialogue and save the data.
5. Repeat steps 2–4 for any further identities.

As you add identities they will be added to the **Identities** list, using the **Name** of the company in the list. If you need to edit the data for any one of the identities, select it from the **Identities** list, make the changes and click **OK**. JPA Designer allows you to set up to twenty distinct identities.

If you need to copy the address details in identities between different computers (this is often done to ensure every user in a company has the same details set up) you can use the **Copy to clipboard** and **Paste from clipboard** buttons to the right of the **Identities** dropdown in the **Options** dialogue (see Figure 2.5).

When you come to create a PDF of a report or to print it you will be able to select one of the identities to use the associated details in the header. Note that whichever identity you select when producing a report, the report footer will always show the name of the company or individual holding the licence.

## 3 Managing projects and calculations

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This chapter explains how JPA Designer stores calculations and describes how to work with project files and calculations. It describes how to use calculation templates to speed up the calculation process.

### 3.1 The project file

JPA Designer organises and saves calculations in project files, which have the extension **JDP**. You can save multiple 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.

### 3.2 Starting a new project

Whenever you start JPA Designer the program creates a new blank project which you can use 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 and 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.*

### 3.3 Adding project address details

You can enter client address 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 address information to reuse in other projects.

To add client and project details:



Figure 3.1: Changing the name of a project

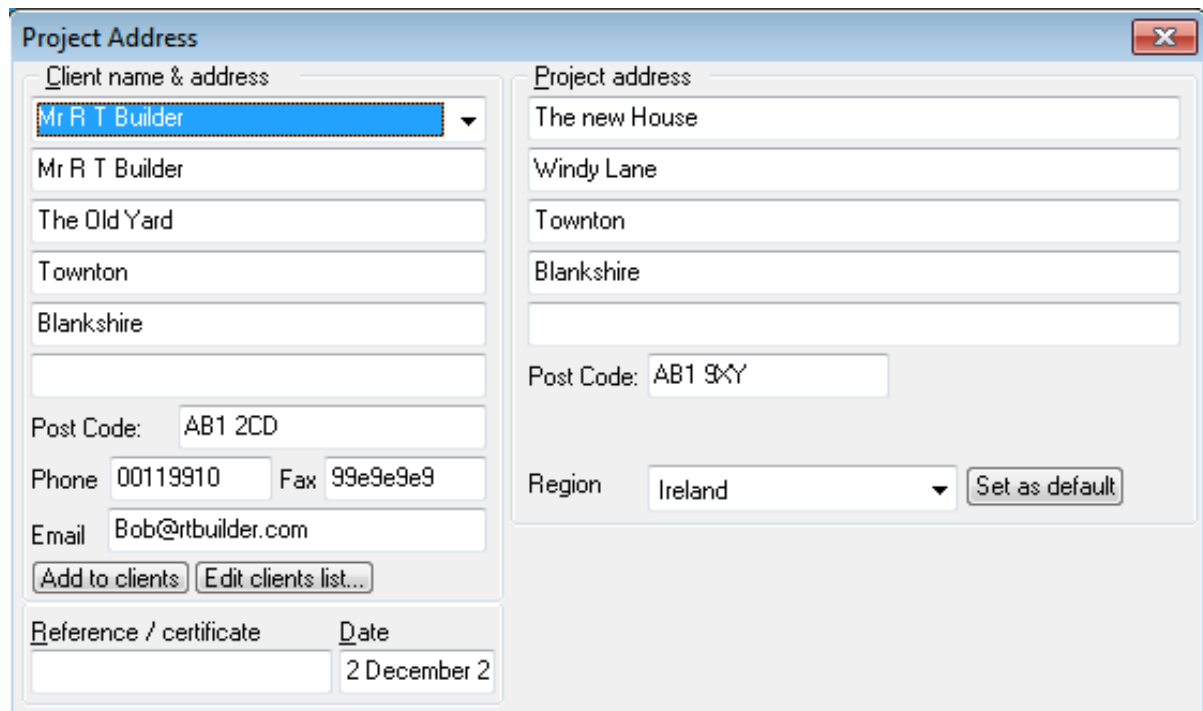


Figure 3.2: The Project Address dialogue

1. From the menu bar select **Edit>Project Address**. The **Project Address** dialogue opens.
2. Enter the data by typing it into the appropriate boxes. Use the <Tab> key to move between boxes.  
*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 copy the project address details to all the calculations in a project:

1. Enter the address details in the **Project Address** dialogue.
2. Click **Passdown**.

3. Click **Yes** at the confirmation dialogue.
4. Once the copying is done click **OK**.

You can also copy project address details to individual calculations once you have opened the calculations (see section 4.1).

To re-use existing client data simply click on the list at the top of the **Project information** dialogue and select a client name (Figure 3.3).

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

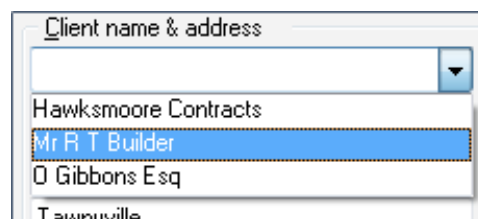


Figure 3.3: The client name and address list

### 3.4 Setting the calculation region

JPA Designer is designed to carry out the thermal calculations required in different regions of the world. Some regions require U-value calculations, while others require R-value calculations: some regions only consider one-way heat flow while others require two-directional heat flow (see Table 3.1. The region settings also determine the climate data available for condensation risk analysis.

Table 3.1: Regional calculation settings

Region	Calculation type	Heat flow
Asia	U-value	Heat-out
Australia	R-value	Heat-in/heat-out
Ireland	U-value	Heat-out
Middle East	U-value	Heat-in/heat-out
New Zealand	R-value	Heat-in/heat-out
UK	U-value	Heat-out

The calculation region can be set in the **Project Address** dialogue (see Figure 3.2):

1. Select the **Region** in the list.
2. Click **Set as default**.
3. All new calculations will use that region.

You can override the region setting for individual calculations in the **Project Information & Options** dialogue.

### 3.5 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 user data folder (on Windows 7 usually **c:\ProgramData\JPATL\JPA Designer 981**). You can specify a different default folder by specifying the *startup* folder using the **Options** dialogue).

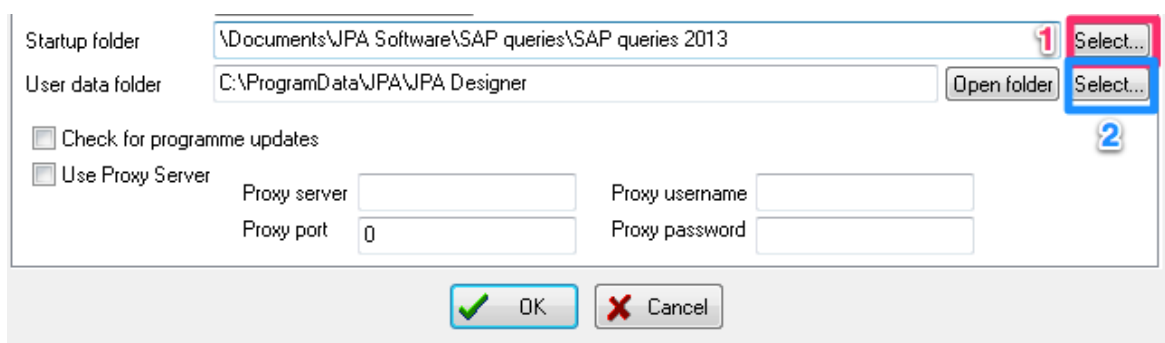


Figure 3.4: Startup folder controls in the Options dialogue

To specify the *startup* folder:

1. From the menu bar select **Options**.
2. On the **General** tab click the **Select** button for the **Startup folder** (item 1 in Figure 3.4).
3. In the **Browse For Folder** dialogue select a folder and click **OK**.
4. The folder will now be the default location for saving JPA Designer files and PDF files of calculation reports.

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

### 3.6 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.

### 3.7 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 3.5).
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.

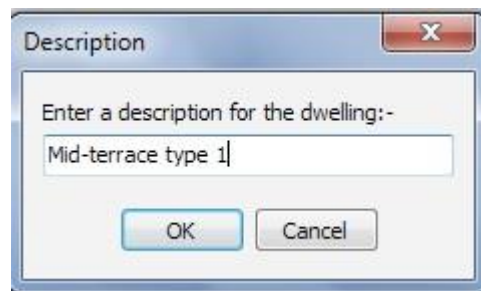


Figure 3.5: The Description dialogue

To add a new SAP calculation to a project:

1. From the menu bar select **Insert>Dwelling/SAP (v9.92 2012) calculation>Single dwelling**. The **Description** dialogue opens (Figure 3.5).
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 9.90, 9.81, 9.80 and 9.70 of SAP, as well as SAP calculations for multiple dwellings. Follow the same basic procedure to add PV assessment and Psi-value assistant calculations to a project.

When naming U-value and SAP calculations avoid using the Windows restricted characters ' \ : \* ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12 for a more detailed explanation).

### 3.8 Using U-value calculation templates

JPA Designer offers a range of standard U-value calculations, which you can use to speed up the calculation process and minimise repetitive work. We refer these standard calculations as U-value templates. Each template contains the same information as a normal U-value calculation including element definitions, layers with bridging details and correction factors.

You can either use the template 'as is' without modifying it, or use it as a starting point to produce your own calculation, but whichever route you chose, the calculation process will be quicker.

There are three types of U-value template:

- *standard templates for roofs, walls and floors*. These are generic calculations which can be adapted by changing materials and thicknesses. They are supplied with the program.
- *manufacturers' templates*. A number of construction product manufacturers have supplied U-value templates for typical constructions featuring their products. The templates are supplied with the program<sup>1</sup>.
- *user-defined templates*. These are calculations which you have previously performed and then saved as a template, enabling you to build up a library of commonly used calculations. See section 3.8 for instructions.

### Inserting a U-value calculation from a template

The controls for inserting U-value calculations based on templates are at the bottom of the **Project Manager** window (Figure 3.6). To insert a new U-value calculation based on a template:

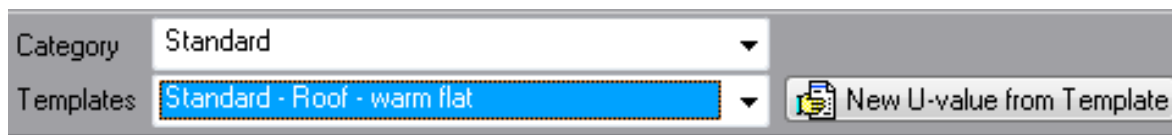


Figure 3.6: The template selection controls

1. In the **Categories** list select the *type* of template you want. That may be a manufacturer's category, one of the default categories, or a template group you have created previously.
2. In the **Templates** drop-down list pick the template you wish to use.
3. Click **New U-value from Template**. The **Description** dialogue opens.
4. Edit the name of the template to suit your project, or accept the default name. Once you are ready, click **OK**.
5. A new U-value calculation is added to the project.
6. You can now open and edit the calculation by double-clicking on its name in the **Project Manager** list.

### Creating user defined templates

You can create templates from your own U-value calculations by saving them in JPA Designer template files, which have the file extension JTF. You can have several different template files which allows you to sort the calculations into groups: you might have one

<sup>1</sup>If you are a manufacturers of construction materials you can add U-value calculations which include your materials into the set of templates which is distributed with JPA Designer. Offering U-value calculations with your materials makes it easier for designers to include them in U-value calculations and specifications and helps to ensure the materials are included in calculations correctly. Please contact JPA TL Ltd for information and current pricing.

for wall calculations and one for floor calculations, alternatively, you might divide them into masonry or timber framed calculations.

The simplest way to create a template file is to use the **Import U-value** feature to collect all the existing U-value calculations you want available into one project then save the project as a template file.

To import an existing U-value calculation to a project:

1. Start a new project in JPA Designer: on the **File** menu click **New**.
2. On the **File** menu click **Import U-value from another JPA Designer project**.
3. In the **Open** window select the file which contains the calculation.
4. At the **Import U-value from Project** dialogue (Figure 3.7) select the U-value calculation from the list and click **OK**.
5. The U-value calculation is added to the open project.
6. Repeat the process to import all calculations you want into the project.

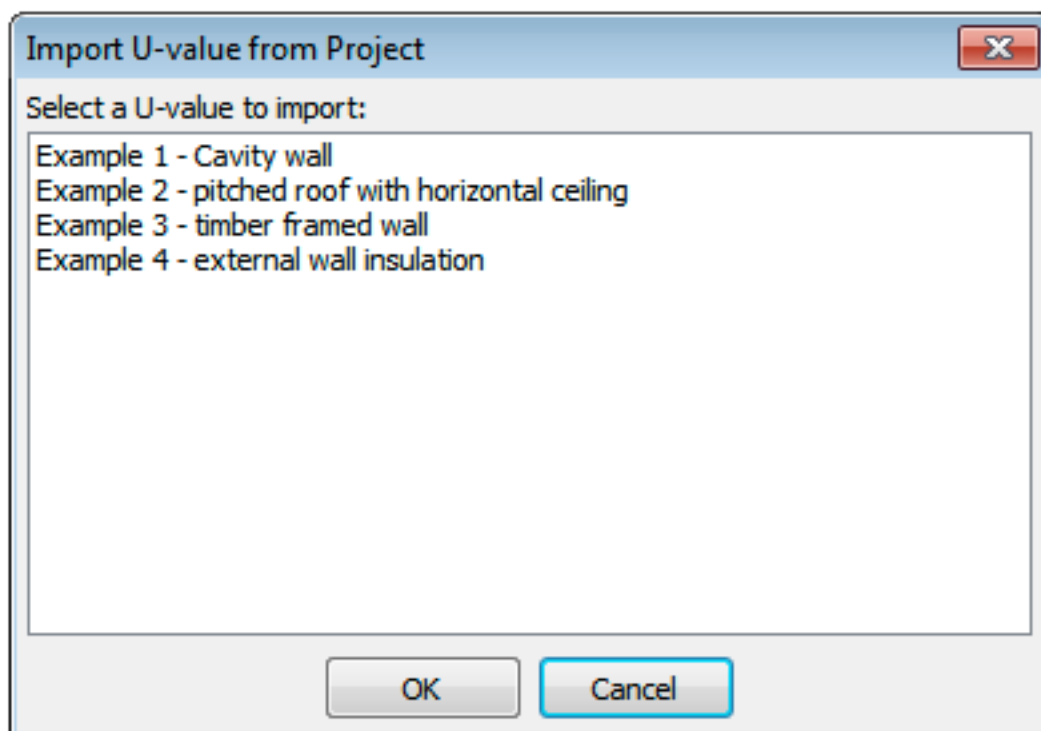


Figure 3.7: The Import U-value dialogue

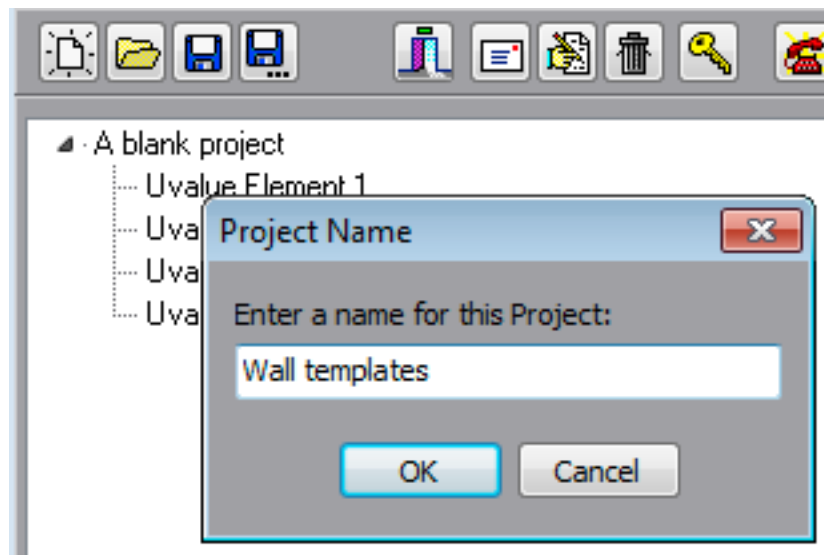
You can, of course, create new calculations for the template if you want to.

The name which appears in the **Categories** list is taken from the *project name* in the Project Manager window. So before you save a template file you should change the *project name* to something which will help you identify the calculations from the list (Figure 3.8)<sup>2</sup>.

To set the *project name*:

---

<sup>2</sup>The default *A Blank Project* will be no help at all a few weeks after you have created the template.

Figure 3.8: Changing the *project name*

1. In the **Project Manager** window double click on the *project name* – the default value is *A blank project*.
2. In the **Project Name** dialogue type a new name for the project.

The template file must be saved in the same folder as the other JPA Designer user data files and in the JTF format. To save a project as a template:

1. On the **File** menu click **Save Project as Template**.
2. Enter a *File name*.
3. Set the folder to the user data folder (in Windows 7: **c:\ProgramData\JPA\JPA Designer**).
4. Make sure **Save as type** is set to *JPA Designer U-value Template (JTF)* and click **OK**.
5. Your template project is now included in the **Categories** list.

### 3.9 Opening and closing calculations

To open a 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.

### 3.10 Duplicating calculations

If you want to carry out a calculation which is very similar to an existing calculation in a project you can duplicate the calculation and then change the copy, leaving the original calculation untouched. 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.

*When naming a calculation avoid using the Windows restricted characters ' / \ : \* ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12) for a more detailed explanation.*

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

### 3.11 Importing U-value calculations

When you need to re-use an existing U-value calculation in a new project you can import a copy of the calculation from its original project into a new one.

To import a calculation into the current project:

1. On the **Program Manager File** menu select **Import U-value from another JPA Designer project**.
2. In the **Open** dialogue select the project containing the original U-value calculation. Click **OK**.
3. In the **Import U-value from Project** dialogue click on the calculation to select it, then click **OK**. The U-value calculation is copied into the current project.

*Importing existing U-value calculations into a new project is a quick way of building a set of U-value templates (see section 3.8).*

### 3.12 Converting between SAP versions

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

You can convert:

- SAP 2001 (V9.70) to SAP 2005 (V9.80/9.81);

- SAP 2005 (V9.81) to SAP 2009 (V9.90);
- SAP 2009 (V9.90) to SAP 2012 (V9.92);
- SAP 2009 (V9.90) to SAP 2005 (V9.81).
- SAP 2012 (V9.92) to SAP 2009 (V9.90).

To convert a calculation:

1. Select the calculation in the project list by clicking on it once.
2. From the **Edit** menu select the appropriate **Copy selected ...** item.
3. JPA Designer creates a copy of the original calculation in the new format. The copy has the same name as the original, but appended with the new format (for example, *SAP version 9.92*).

Once you have carried out the conversion you should check the new calculation, particularly when converting to a newer version of SAP, as there may be additional information which you need to enter. Where building services information has been taken from the boiler database (SAP 2001 and SAP 2005) or the Product Characteristics Data File (SAP 2009 and SAP 2012) you should re-select the systems in the converted calculation.

Finally, it is also possible to import SAP 1998 (9.60) calculations from JPA SAP v2<sup>3</sup> and convert them to SAP 9.70:

1. From the menu bar select **Import JPA SAP file into this Project**.
2. In the **Open** dialogue select the JPA SAP file you wish to import.
3. JPA Designer creates a copy of the original calculation as a SAP 2001 (V9.70) calculation.

### 3.13 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.
3. Enter a new name for the calculation and click **OK**. The **Project Manager** window shows the new name.

*When naming a calculation avoid using the Windows restricted characters ' / \ : \* ? < > |, otherwise you will have problems creating PDFs of calculation reports (see chapter 12 for a more detailed explanation).*

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

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<sup>3</sup>JPA SAP v2 was the precursor of the JPA Designer SAP module.

### 3.14 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.

### 3.15 Merging projects

Using the **Merge projects** function you can copy 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. Merging does not change the project you are copying *from*.

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.

## **Part II**

### **U-value calculations**

## 4 The JPA Designer U-value modules

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JPA Designer offers two U-value modules:

- **U-value 2014** calculates U-values for walls, roofs and intermediate floors using the combined method (BS EN ISO 6946: 2007) and also calculates U-values for ground floors to BS EN ISO 13370:2007.
- **U-value 2014 Professional** has the functionality of U-value 2014 and also performs condensation risk analysis using the methods set out in BS EN ISO 13788:2012.

U-value calculations are carried out in the U-value module by:

1. Entering project information (section 4.1).
2. Setting key information about the construction as a whole, 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).

The details of U-value calculation are shown in the main U-value window (see Figure 4.1). The window shows the layers which make up the construction: each layer has thermal and vapour data, and may have thermal bridge data. The results of the calculation are shown at the bottom of the window.

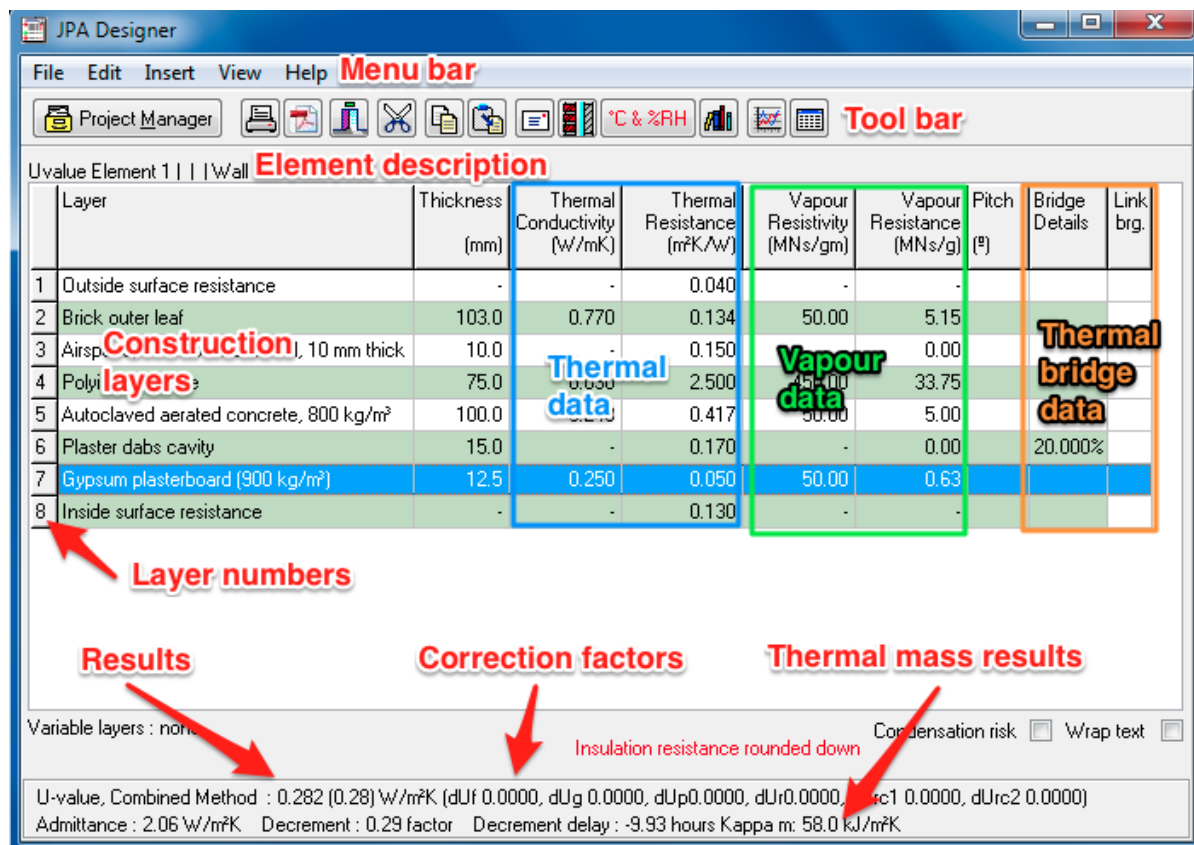


Figure 4.1: The U-value window

## 4.1 U-value project information

JPA Designer can store client and project details for each calculation and then add them to calculation reports. You can either the 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 U-value modules. You can also save and re-use client data (see section 3.3). In either case you can select the **Region** for the calculation (see section 3.4 for an explanation of how region settings affect calculations).

To copy project details from Project Manager:

1. In the U-value module select **Edit>Project Information** from the menu bar. The **Project Information** dialogue opens.
2. Click the **Inherit** button.
3. At the prompt choose whether you want the calculation to inherit the region settings for the project or not<sup>1</sup>.
4. Any information you entered in Project Manager is copied to the **Project Information** dialogue here.
5. Click **OK**.

<sup>1</sup>In most cases you will want to inherit the project region settings.

To enter new project details:

1. In the U-value 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.
3. If you need to use a region other than the default, select the new **Region** in the list.
4. Click **OK** when you have entered all the data you need.

To copy project details from the current calculation to all other calculations in project:

1. Enter the address details in the **Project Information and Options** dialogue.
2. Click **Passdown**.
3. At the **Information** dialogue click **Yes**.

## 5 U-value Construction Dialogue

---

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 has three tabs:

- **Element Details:** described below.
- **Unheated spaces:** used to allow for the effect of unheated spaces on the thermal performance of building elements. See section 8.7.
- **Print Report Notes:** this tab allows you to add notes to the calculation which will appear on the PDF or print calculation report. Typically used to set out any assumptions made in the calculation.

The **Element Details** tab accepts information on:

- The **Element type:** that is, whether it is a floor, wall or roof, together with additional information for some elements (section 5.1).
- The conditions at the internal and external surfaces (see section 5.2).
- Details of any light steel frame construction (see section 9.1).
- Details of twin-skin metal roofing or cladding (see section 9.2).
- Corrections factors for mechanical fasteners (see chapter 8).

To enter data:

1. From the menu bar select **Edit>Construction type**. The **U-value Construction** dialogue opens (Figure 5.1).
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.

Figure 5.1: The U-value Construction dialogue

## 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. Some elements have 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).
- *Wall*: any construction at an angle of more than 70° to the horizontal. There is an option to enter data for brackets and rails in rainscreen cladding (section 8.4), or for windposts supporting masonry (section 8.5).
- *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). There is an option to enter brackets for a cladding system on the soffit.
- *Pitched roof with horizontal ceiling (legacy)*: typically a cold pitched roof with the insulation applied between and over the ceiling joists. You must enter the pitch (angle) of the roof, measured from the horizontal. There is an option to correct for the effect of the loft hatch, see section 8.6.

*This element type represents the method of treating cold pitched roofs which was in use before the introduction of BR 443, as it contains a loft space with a fixed thermal resistance and will adjust the resistance of any layers above the loft for the pitch. New calculations to comply with BR 443 should use one of the BRE443 Pitched roof element types.*

- *Pitch roof ceiling at rafter line:* a warm roof with the insulation in the plane of the rafters.
- *BRE443 Pitched roof – insulation at ceiling level:* a cold pitched roof with insulation applied between and over the rafters. The thermal resistance of all layers above the insulation is represented by a single layer selected from the **Roof construction** list, using thermal resistances taken from ISO 6946. There is an option to correct for the effect of the loft hatch: see section 8.6
- *BRE443 Pitched roof – insulation at rafter level, flat ceiling:* warm roof, with the insulation applied at rafter line (between, below or above the rafters, or a combination of those), but a horizontal ceiling. Specify the roof pitch in degrees (measured from the horizontal) to correct for the insulation being in a different plane to the ceiling.
- *Suspended ground floor:* a floor with a ventilated space below the floor deck, such as a beam and block floor or timber joist floor. See chapter 10.
- *Solid ground floor:* a floor which is contact with the ground across its whole area, such as groundbearing concrete slab. See chapter 10.
- *Basement wall:* a below ground wall of a heated basement. See chapter 11.  
*This calculation requires information about the basement floor construction.*
- *Basement floor.* See chapter 11.

You can 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 take account of the heat flow at the internal and external surfaces of an element by means of the internal and external *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 sets the surface resistances based on the element type (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* which suits the great majority of facing materials<sup>1</sup>. You can, of course, replace the default resistances with your own values in the very rare cases where that is necessary.

<sup>1</sup>There are very few conditions where it is necessary to set the emissivity to low.

Table 5.1: Surface 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.

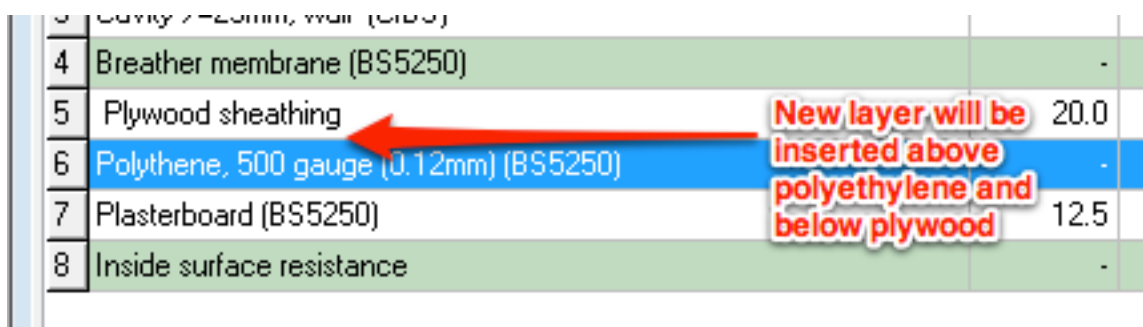
For non-steel frame structures ensure **Not a light steel frame construction** is selected. For instructions for calculating U-values of light steel frame structures see section 9.1.

## 6 Working with layers

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Each 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.



3	Cavity / 25mm, void (BS5)	
4	Breather membrane (BS5250)	-
5	Plywood sheathing	20.0
6	Polythene, 500 gauge (0.12mm) (BS5250)	-
7	Plasterboard (BS5250)	12.5
8	Inside surface resistance	-

Figure 6.1: The new layer will be inserted *above* the selected layer

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.

**The program always adds a new layer directly *above* the currently selected layer, so in Figure 6.1 the new layer would be inserted above the polyethylene and below the plywood sheathing.**

When you start a calculation you should select the lowest layer (which will be the inside surface resistance for walls and roofs, and the outside surface resistance for floors) before beginning to add layers. Because layers are of this it is quicker 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

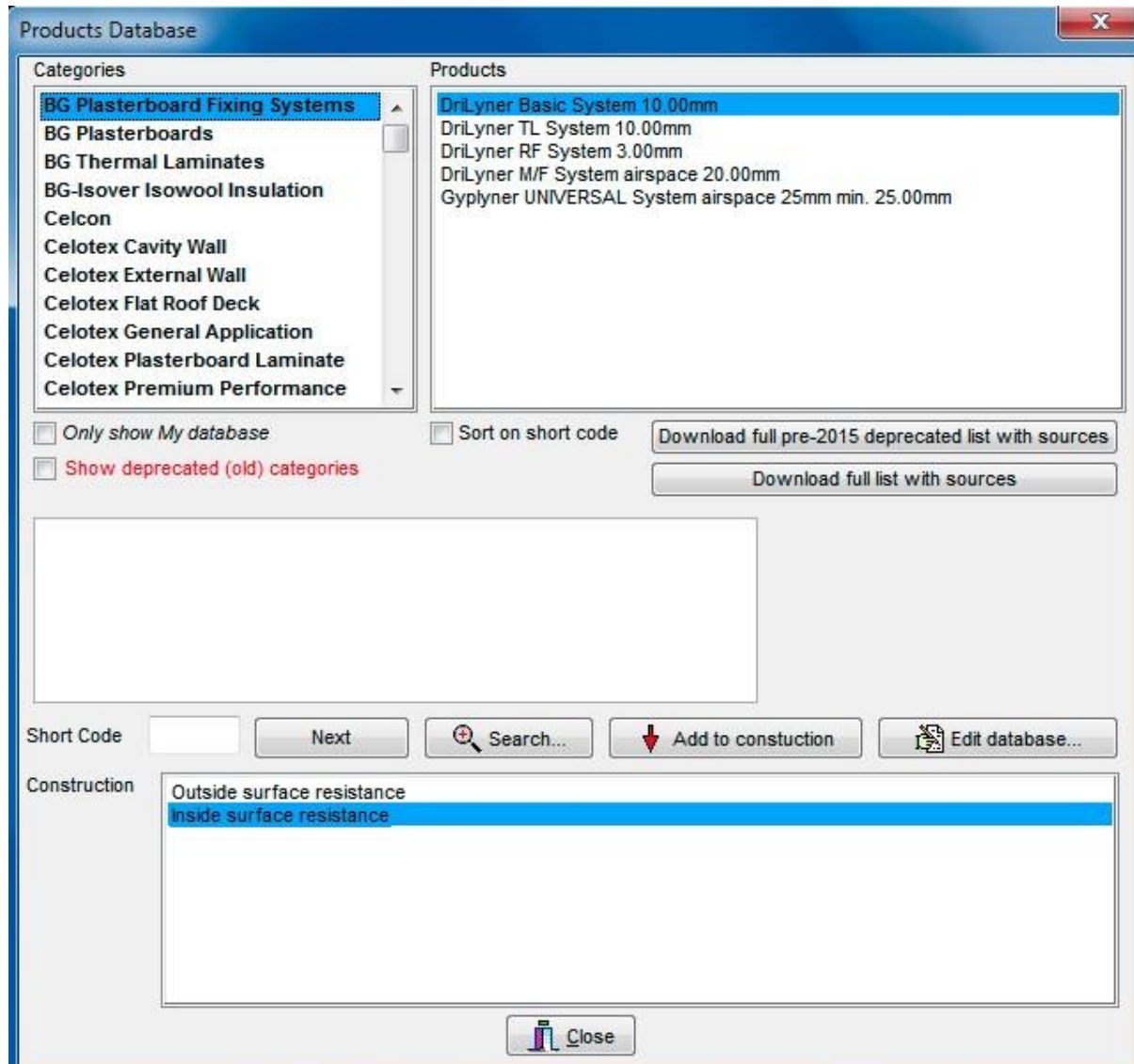


Figure 6.2: The Products Database window

The Products Database contains a wide range of materials and cavities for use in U- value calculations. By default it contains a range of manufacturers products and generic, unbranded materials. You can also add other products which you use frequently to the database.



### Generic categories and materials

The original Products Database supplied with JPA Designer was compiled some years ago, so not all the values associated with materials can be traced to reliable sources. To overcome this we have added a new set of generic materials which are taken from accepted sources, including ISO 10456, BR 443, CIBSE guide A and ISO 6946. The categories containing these sourced values are shown by default. If you wish to see and use the older categories you can tick **Show deprecated (old) categories**.

The two buttons immediately below the products list can be used to download spreadsheets containing the source data for the new and original generic materials.

The Products database is accessed using the **Products Database** window (Figure 6.2). The window has three main parts:

- 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, user categories in *italics* (see chapter 13 for information on adding your own materials) and deprecated generic categories in red text.
- 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. In the layers list select the existing layer which will be *below* the new layer (see Figure 6.1).
2. On the **Insert** menu click **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 on that category. The **Products** box shows the material in that category.
4. Click on a material to select it, then click **Add to construction** (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 **Close**. The main **U-value** window now shows the calculation with the new layers added.

**Product database hints**

Product categories are sorted with branded materials first, followed by generic and user categories sorted in alphabetical order.

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

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

## 6.2 Inserting blank layers in a calculation

When you need to use a material which is not in the Products Database you should insert a blank layer then edit it to insert the correct data.

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 Managing layers

Once you have added layers to your calculation you change their order, cut, copy and paste them, or delete them.

- **Moving a layer:**
  - Click and hold the right-hand mouse button on the layer number at the left-hand side of the window.
  - Drag the layer to a new position.
  - Release the mouse button
- **Cutting a layer:** removes a layer from the calculation but keeps it available on the clipboard.
  - Click on the layer to select it.
  - Click the *Cut* button on the toolbar.
  - The layer is deleted from the calculation but remains on the clipboard for pasting.
- **Copying a layer:** puts a copy of the layer on the clipboard.
  - Click on the layer to select it.
  - Click the *Copy* button on the toolbar.

- The layer remains in place but is copied to the clipboard.
- **Pasting a layer:** places the layer on the clipboard into the calculation.
  - Click on the layer which you want to be *below* the pasted layer.
  - Click the *Paste* button on the tool bar.
  - The layer on the clipboard is placed in the calculation *above* the selected layer.
- **Deleting a layer:** removes a layer permanently from the calculation.
  - Click on the layer to select it.
  - Click <Delete>.

## 7 Working with materials

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The properties of layers are entered and edited in the **Edit Material** dialogue, which has three tabs:

- **General** – used to set the basic characteristics of the material (section 7.1).
- **Repeating Thermal Bridges** – used to set thermal bridging (section 7.4).
- **Correction factors** – used to set correction factors for mechanical fasteners and air gaps (chapter 8).

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 General characteristics

The **General** tab (Figure 7.1) contains the basic data about the layer, including:

- **Description**: the name of the material or a description, which appears in the calculation.
- **Code** and **Category** : used with the database to sort or enter materials – but not in general use.
- **Thickness**: the 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. Usually referred to as the lambda value.
- **Thermal resistance**: the resistance to heat transfer provided by the layer, measured in  $\text{m}^2\text{K/W}$ .
- **Vapour resistivity**: the rate of transfer of water vapour through 1 m of the material, measured in MNs/gm.

Figure 7.1: Edit Material dialogue – the General tab

- **Vapour resistance:** the resistance to water vapour provided by the layer, measured in MNs/g.

*The following two values are only required for  $\kappa$ -value calculations.*

- **Density:** the mass per cubic metre of the material, measured in  $\text{kg/m}^3$ .
- **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).  $\text{kJ/kg}$ .

The tab also includes the definition of the material **Type** (see section 7.2 and section 7.3). The two-directional heat-flow settings are not used for calculations in the UK.

## 7.2 Types of material

Layers within building elements have different combinations of thermal and hygrothermal properties, which have to be address in U-value and condensation risk calculations. JPA Designer use four types of solid material and three types of cavity (see section 7.3). In addition, the program distinguishes between materials which are thermal insulation and those which are not. The rest of this section describes those types of layer and cavity, and the data required for each one.

## Normal

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

- **Type:** select *Normal*.
- **Description :** type a description of the layer – this will appear on the report.
- **Thickness:** enter in millimetres, mm.
- **Thermal conductivity:** enter in W/mK.
- The program calculates the **Thermal resistance** in  $\text{m}^2\text{K/W}$ .
- **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.

## 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). The same principle applies to the vapour resistance.

A composite material requires the following information:

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

## Fixed vapour resistance materials

Some materials – such as glass and metals – have vapour resistances which are effectively infinite, even if they are used in very thin layers. The *fixed vapour resistance* material type allows the thermal performance of these materials to behave in the same way as normal materials (changing according to the thickness), but allows their vapour resistances to be set as very high fixed values (typically 100 000 MNs/g).

As materials with fixed vapour resistances behave the same way as normal materials in thermal calculations you need only use the type 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 report.
- **Thickness:** enter in millimetres, mm.
- **Thermal conductivity:** enter in W/mK.
- The program calculates the **Thermal resistance** in  $\text{m}^2\text{K/W}$ .
- **Vapour resistance:** enter in MNs/g.

## Membranes

Membranes, such as vapour control layers or vapour open roofing underlays, are treated as having no thermal resistance. The only property they have is their vapour resistance. Membranes require the following information:

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



### Membranes with low emissivity surfaces

Membranes have no direct effect on thermal calculations. However, a membrane which has one or two low emissivity faces may improve the thermal performance of a construction by increasing the resistances of adjacent cavities; that is addressed in the calculation by changing the resistance of the cavities, not the membrane.

## Thermal insulation

The European product standards for factory manufactured thermal insulation<sup>1</sup> require the thermal resistance values of the applicable insulants be rounded down to the nearest  $0.05 \text{ m}^2\text{K/W}^2$ . 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. The original value for thermal resistance will appear in the **Edit material** dialogue (e.g.  $2.348 \text{ m}^2\text{K/W}$ ) while the **U-value** window will show the rounded value (e.g.  $2.30 \text{ m}^2\text{K/W}$ ).

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

<sup>1</sup>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

<sup>2</sup>The standards state: the value of thermal resistance,  $R_{90/90}$ , shall be ...rounded downwards to the nearest  $0.05 \text{ m}^2\text{K/W}$ , and declared as  $R_D$  in levels with steps of  $0.05 \text{ m}^2\text{K/W}$ .

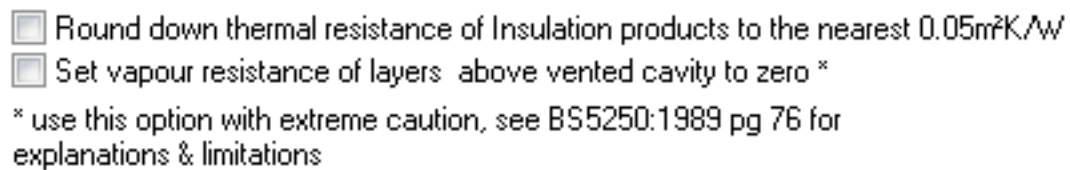
- 
- ☒ Round down thermal resistance of Insulation products to the nearest 0.05m<sup>2</sup>K/W
  - ☐ Set vapour resistance of layers above vented cavity to zero \*
- \* use this option with extreme caution, see BS5250:1989 pg 76 for explanations & limitations

Figure 7.2: Controls for rounding of thermal resistance

1. On the **Project Manager** menu bar select **Options**.
2. Click on the **Other** tab.
3. (Figure 7.2).
4. Untick **Round down thermal resistance** to turn rounding off.

## 7.3 Types of cavity

JPA Designer recognises five types of cavity:

- clear cavities: cavities with limited air exchange with outside, and no thermal bridging.
- bridged cavities: cavities with limited air exchange with outside and which are thermally bridged.
- well vented cavities: cavities with substantial air exchange with outside.
- slightly vented cavities: cavities with some air exchange with outside.
- vented cavities: a type of well-vented cavity originally intended for use with condensation risk analysis. Not widely used.

Although the thermal resistance of a cavity can be calculated in JPA Designer (see section 7.3) it is usually entered as a default value appropriate for the direction of heat flow and the thickness range. The Product Database contains standard resistance values taken from BS EN ISO 6946.

### Clear cavities

A clear cavity is an unvented cavity which has openings to outside of less than 500 mm<sup>2</sup>/m. For example, a cavity in a cavity wall will be classified as an unvented cavity because the openings provided by the weep holes will be less than 500 mm<sup>2</sup>/m limit.

Clear cavities require the following information.

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

## Bridged cavities

Bridged cavities, such as those in some timber framed constructions, are treated the same as unvented clear cavities, but with bridging details added (section 7.4). Bridged cavities require the following information.

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

You will also need to enter the bridging details (section 7.4).

If the width of the cavity is less than ten times its thickness you should use the **Airspace Resistance Calculator** to determine its thermal resistance (see section 7.3).

## Well vented cavities

A well vented cavity has large ventilation openings between the cavity and the outside air, resulting in the conditions within the cavity being virtually the same as outside. A cavity is considered well vented if it has ventilation openings greater than  $1500 \text{ mm}^2/\text{m}$  (BS EN ISO6946): typically, the cavity behind rain-screen cladding will be well vented.

When well vented cavity is included in a calculation:

1. The thermal resistance of the cavity is set to zero.
2. The thermal resistances of all layers to the outside of the cavity are also set to zero.
3. The external surface resistance is set to match the internal surface resistance. This allows for the inner face of the cavity (which is effectively now the external face of the construction) being sheltering from the wind<sup>3</sup>.

Well vented cavities require the following information:

- **Type:** select *Well vented cavity*.
- **Description :** type a description of the layer – this will appear on the report.

Figure 7.3: Entering data for a slightly vented cavity

## Slightly vented cavities

A slightly vented cavity has openings which are larger than those of an unvented cavity but smaller than those of a well vented cavity (500–1500 mm<sup>2</sup>/m). As it is not possible to calculate the cavity resistance directly, JPA Designer calculates the resistance of the construction with an unvented cavity and also with a well vented cavity then calculates an average resistance, weighted according to the area of openings (the procedure is described in ISO 6946:2007 section 5.3.3).

Slightly vented cavities require the following information:

- **Type:** select *Slightly vented cavity*.
- **Description:** type a description of the layer – this will appear on the report.
- **Slightly vented cavity opening area** mm<sup>2</sup>/m: this is the area of openings in each linear metre of the cavity (see Figure 7.3).
- **Cavity details:** if the cavity has one or more low emissivity surfaces, or the width is less than ten times the thickness use the **Cavity details** button to open the **Airspace Resistance Calculator** (see section 7.3).

## Vented cavities

A vented cavity is a special cavity type used in condensation risk analysis. When a cavity is defined as a vented cavity the vapour resistances of all layers to the outside of the cavity are set to zero. This is intended to model the effect of ventilation removing moisture from the cavity (for further information see section 17.4)<sup>4</sup>. Vented cavities require the following information:

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

<sup>3</sup>If the inner face of the cavity is a low emissivity surface you will need to adjust the resistance to take account of that.

<sup>4</sup>The methodology was described in BS 5250:1989, but is not included in later versions of the standard: the vented cavity type is included mainly for backward compatibility.

## Low emissivity cavities

A cavity with one or more faces lined with a material of low surface emissivity 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, which should usually be 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<sup>2</sup>K/W for walls, 0.34 m<sup>2</sup>K/W for roofs and 0.50 m<sup>2</sup>K/W for floors (see BR 443 paragraph 4.8.2). If you know the emissivity of the facing material you can also use the **Airspace Resistance Calculator** (section 7.3) to calculate the resistance.

## Calculating cavity resistances

The default resistances for cavities are not valid for cavities with one or more low emissivity surfaces, or those with a width which is less than ten times the thickness. You should therefore use the **Airspace Resistance Calculator** to calculate the correct resistance.

To calculate an airspace resistance:

1. Set the **Type** of layer to *Clear Cavity* or *Bridged Cavity*. The **Airspace Resistance Calculator** button appears beside the thermal resistance (see square 1 in Figure 7.4).
2. Click the button. The **Airspace Resistance Calculator** is displayed (Figure 7.4).
3. Set:
  - **Air space thickness, d**, in mm. This is measured in the direction of heat flow.
  - **Airspace width, b**, in mm. This is the width measured at right angles to the heat flow. For a wide cavity, such as that in a cavity wall enter a value at least ten times greater than the thickness.

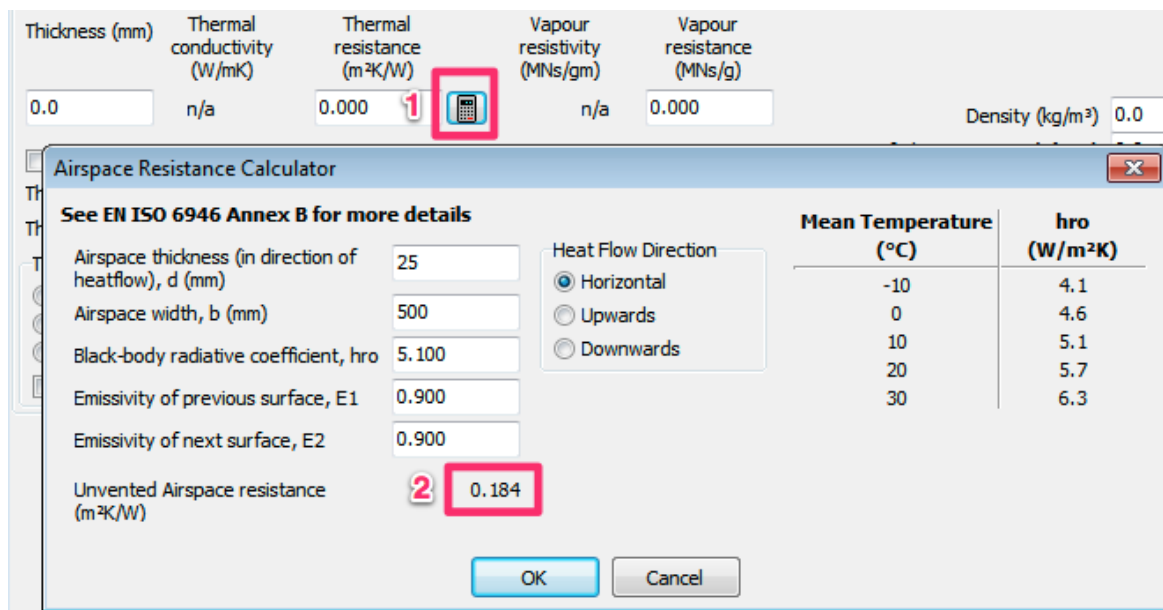


Figure 7.4: The Airspace Resistance Calculator: 1 shows the button on the Edit material dialogue; 2 shows the calculated resistance.

- **Black-body radiative coefficient,  $hr_0$** , in  $W/m^2K$ . Take the value from the table on the right, for the mean temperature. For the UK a mean temperature of  $10^\circ C$  is usually appropriate.
- The **emissivities** of the two surfaces of the cavity. Most materials have an emissivity around 0.90, but foil facings to insulation, and metalised membranes have much lower emissivities, typically 0.03–0.05.
- The heat flow direction.

4. The program now displays the resistance for the airspace (see square 2 in Figure 7.4).
5. Click **OK**. The calculated resistance is transferred to the **Thermal resistance** box of the **Edit Material** dialogue.

For two-directional heat flow cavities you should use the pair of resistance calculators adjacent to the heat-in and heat-out resistances.

## 7.4 Repeating thermal bridges

Thermal bridges are formed where the material in a layer is interrupted by a second material with different thermal conductivity, for example, insulation in a timber framed wall being interrupted (bridged) by the timber studs. In most cases thermal bridging increases heat loss through the bridged layer<sup>5</sup>. The effect of thermal bridges which occur regularly throughout a layer (repeating thermal bridges) is included in U-value calculations by added the details of the thermal bridge to each bridged layer using the **Repeating Thermal Bridges** tab of the **Edit Material** dialogue (Figure 7.5).

JPA Designer offers three different methods of entering thermal bridging:

<sup>5</sup>Hence the commonly used term 'cold bridge'. However, mortar in stone walls will usually reduce the rate of heat loss.

The screenshot shows the 'Repeating Thermal Bridges' tab. Under 'Thermal bridge type', '1 dimensional' is selected. The 'Thermal bridge details' section includes a 'Type' dropdown, 'New...' and 'Edit...' buttons, a 'Material' dropdown, an 'Angle' dropdown set to 0, and a 'Proportion bridged' input set to 1.00000. Below this are input fields for 'Bridge width (mm)', 'Non-bridge width (mm)', and 'Non-bridge height (mm)'. Further down are 'Bridge thermal conductivity (W/mK)' and 'Bridge thermal resistance (m²K/W)' fields. The 'Bridge thickness Z' section has two radio buttons: 'Follows material thickness' (selected) and 'Fixed at...' with a value of 160.0 mm. A 'Second bridge' checkbox is at the bottom.

Figure 7.5: The Repeating Thermal Bridges tab

- Using one of the built-in defaults to set the bridging fraction and material<sup>6</sup>;
- Setting the bridging fraction and bridging material directly;
- Entering the bridging dimensions and material.

The screenshot shows the 'Thermal bridge' section with the 'Type' dropdown menu open. The menu lists several options: 'Mortar joints, 440 x 215 mm blocks, , exte', 'Mortar joints, 440 x 215 mm blocks, , external leaf (BR 443 4.2)', 'Mortar joints, 440 x 215 mm, blocks, internal leaf (BR 443 4.2)', 'Steel studs, 1.2 mm, 600 mm centres', 'Steel studs, 1.2 mm, 400 mm centres', 'Timber-framed wall, prefabricated panels, default fraction (BR 443 4.5.1)', 'Timber-framed wall, prefabricated panels, lower fraction (BR 443 4.5.1)', 'Site-formed timber-framed wall, default fraction (BR 443 4.5.1)' (highlighted), and 'Site-formed timber-framed wall, lower fraction (BR 443 4.5.1)'. The 'Material' dropdown is set to 'Mortar'.

Figure 7.6: Using one of the default thermal bridging conditions

### To use a default thermal bridge:

1. Set the **Bridge type** to *1 dimensional*.
2. From the Thermal bridge **Type** list select one of the default bridging conditions (these are described in Figure 7.6).
3. The program sets:

<sup>6</sup>For R-value calculations the default bridging conditions may not match standard construction parameters. It may well be easier to set bridging using the second of the three methods.

Table 7.1: Default bridging fractions

Construction	Material	Conductivity	Fraction
Mortar joints, 440 x 215 mm blocks, , external leaf (BR 443 4.2)	Mortar	0.94	0.067
Mortar joints, 440 x 215 mm, blocks, internal leaf (BR 443 4.2)	Mortar	0.88	0.067
Steel studs, 1.2 mm, 600 mm centres	Steel	50	0.002
Steel studs, 1.2 mm, 400 mm centres	Steel	50	0.003
Timber-framed wall, prefabricated panels, default fraction (BR 443 4.5.1)	Prefab panels	0.12	0.150
Timber-framed wall, prefabricated panels, lower fraction (BR 443 4.5.1)	Prefab panels	0.12	0.125
Site-formed timber-framed wall, default fraction (BR 443 4.5.1)	Softwood	0.13	0.150
Site-formed timber-framed wall, lower fraction (BR 443 4.5.1)	Softwood	0.13	0.125
Ceiling, trussed rafters 35 mm, 600 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.068
Ceiling, 50 mm joists, 400 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.135
Ceiling, default: 48 mm, 600 mm cc + 1% other timbers (BR 443 4.6.1)	Softwood	0.13	0.090
Timber floor, default: 38 mm, 400 mm cc + 1% other timbers (BR 443 4.6.2)	Softwood	0.13	0.110
Plasterboard battens, 47 mm, 600 mm cc + rails (BR 443 4.7.2)	Softwood	0.13	0.118
I-beam flanges, 38 mm wide, default fraction (BR 443 4.5.2)	Softwood	0.13	0.150
I-beam flanges, 38 mm wide, lower fraction (BR 443 4.5.2)	Softwood	0.13	0.125
I-beam flanges, 48 mm wide, default fraction (BR 443 4.5.2)	Softwood	0.13	0.170
I-beam flanges, 48 mm wide, lower fraction (BR 443 4.5.2)	Softwood	0.13	0.145
I-beam web, 4 to 8 mm (BR 443 4.5.2)	OSB	0.13	0.040

- The bridge material;
  - The thermal conductivity of the bridge;
  - The fractional area of the bridge (referred to in JPA Designer as the *Proportion bridged*).
4. Check the **Bridge Thickness**: by default this is set to *Follows material thickness*, so the bridge will have the same thickness as the layer itself. You can set the bridge thickness to a different value using the *Fixed at* box.

#### To set the bridging material and proportion directly:

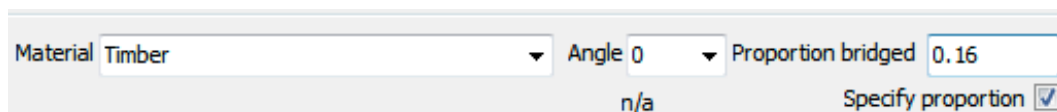


Figure 7.7: Setting the bridging proportion directly

1. Select the bridging **Material** (which sets the thermal conductivity of the bridge).
2. Tick the box **Specify proportion** (Figure 7.7).
3. Enter the **Proportion bridged**.
4. Check the **Bridge Thickness**: by default this is set to *Follows material thickness*, so the bridge will have the same thickness as the layer itself. You can set the bridge thickness to a different value using the *Fixed at* box.

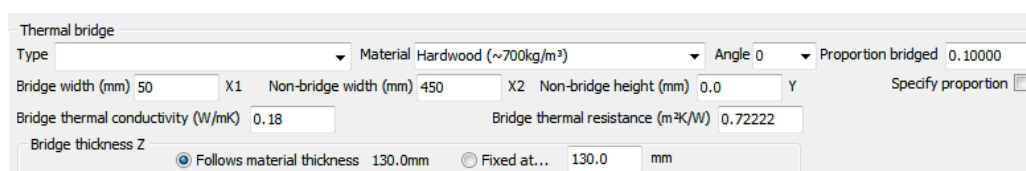


Figure 7.8: Entering thermal bridging using dimensions

#### To enter thermal bridging details using dimensions:

1. Use the **Bridge type** radio buttons to determine whether the bridging is *1 dimensional* or *2 dimensional*:
  - one-dimensional e.g. timbers running in one direction; or,
  - two-dimensional e.g. mortar joints which run vertically and horizontally. *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. In the **Thermal bridge** section of the dialogue (Figure 7.8) select the bridging material from the **Material** 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. 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.

*Note: You must specify the first bridge using dimensions. The second bridge option is not available if you have used **Specify proportion**.*

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.*

1. 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).*

2. 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.



### Cavity thickness and bridging

Many of the default values for cavities in the Products Database are for cavities without a set thickness, for example, a wall cavity with a thickness greater than 25 mm. Where such a cavity is being bridged you must either enter a thickness for the cavity on the **General** tab (which will not affect the resistance), or you must set the **Bridge thickness** using the *Fixed at* box. Without those, the program is unable to calculate the correct resistance of the bridge.

## 8 Correction factors and adjustments

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Although the rate of heat loss through a building element depends on the thermal resistances of the materials of which it is composed and the extent of any thermal bridging, other features of the construction will also affect it. Such features are addressed in the U-value calculation by the use of correction factors: the most important ones address:

- Mechanical fasteners which penetrate insulation,  $dU_f$  (section 8.1);
- Air gaps in insulation layers,  $dU_g$  (section 8.2).
- The effect of rainwater cooling on inverted roofs,  $dU_r$  (section 8.3);
- Brackets and rails in wall and soffit cladding systems (section 8.4);
- Wind posts in masonry (section 8.5);
- Loft hatches in pitched roofs (section 8.6).
- Insulation compression in built up metal roofing and cladding,  $dU_p$  (section 9.2).

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

U-value calculations should also be adjusted for the beneficial effect of an unheated space (such as a garage or corridor) to the cold side of the construction (section 8.7).

### 8.1 Mechanical fasteners

Where a layer of thermal insulation is penetrated by metal fasteners, such as screws and wall-ties, there is additional heat loss through the insulation which must be allowed for using the mechanical fasteners correction factor,  $\Delta U_f$ . The correction factor is required for common constructions such as:

- 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.

- 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 mechanical fasteners correction can be applied:

- once to a calculation, using the **U-value Construction** dialogue (see Figure 8.1; *This method must be used for light steel frame elements.*)
- to several layers in the construction, using the **Edit Material** dialogue for the affected layers.



### Multiple mechanical fastener corrections

There are several types of construction which contain two sets of mechanical fasteners. One of the most common occurs when a cavity wall, which already has some thermal insulation the cavity, is retrofitted with external wall insulation (EWI), which is usually mechanically fixed. Mechanical fasteners corrections must be applied to the insulation in the cavity and to the EWI.

Figure 8.1: Data entry boxes for the mechanical fasteners correction

The methods of entering data are similar whether the correction is applied to once to the construction or to individual layers. Corrections can be applied by:

- using a point thermal transmittance value;
- calculating the correction based on the fastener dimension and materials<sup>1</sup>.

Irrespective of the method being used, you should always enter the mechanical fasteners correction **after** you have entered the layers of the construction.

The calculated correction factor is displayed on the status bar as the  $dU_f$  value and is included on the U-value report.

<sup>1</sup>All versions of JPA Designer from 4.04b1 build 025 onward use the method in BS EN ISO 6946:2007. It is possible to use the method in BS EN ISO 6946:1997 by unticking the **Mechanical fasteners** box on the **Other** tab of the **Options** dialogue, but there is little reason to do so.

## Correcting using a point thermal transmittance

The point thermal transmittance is a measure of the additional heat loss resulting from a fixing or bracket. A value quoted for a particular fixing is valid only for that fixing and may well only be valid for a specified thickness of insulation.

The screenshot shows a software window with the following fields and options:

- A text input field labeled "Layer bridged by mechanical fasteners" with a dropdown arrow.
- A text input field labeled "Mechanical fasteners" with a dropdown arrow.
- A numeric input field labeled "No. per m<sup>2</sup>" with the value "5" entered.
- A numeric input field labeled "Point thermal transmittance" with the value "0.003" entered, followed by the unit "W/K".
- A checkbox labeled "Use point thermal transmittance" which is checked.

Figure 8.2: Entering details of the point thermal transmittance

### To apply a point thermal transmittance once in a whole calculation:

1. Open the **U-value Construction** dialogue in the **General** tab.
2. Select the **Layer bridged by mechanical fasteners** (Figure 8.2).
3. In the *Mechanical fasteners* section tick **Use point thermal transmittance**.
4. Enter the number of fasteners per m<sup>2</sup> in **No. per m<sup>2</sup>**.
5. Enter the **Point thermal transmittance**.

### To apply a point thermal transmittance to one layer:

1. Open the **Edit Material** dialogue for the insulation layer, then select the **Correction factors** tab.
2. In the *Mechanical fasteners* section tick **Use point thermal transmittance**.
3. Enter the number of fasteners per m<sup>2</sup> in **No. per m<sup>2</sup>**.
4. Enter the **Point thermal transmittance**.

## Correcting using fastener data

In most constructions the point thermal transmittance of the fastener is not known, so the effect of fasteners is calculated from the dimensions and performance of the fasteners (see Figure 8.1), using:

- the number of fasteners per square metre, labelled **No. per m<sup>2</sup>**;
- the thermal conductivity of the fasteners, in W/mK, labelled **Fastener lambda** (typically this will be 17 W/mK for stainless steel and 50 W/mK for mild steel);
- the alpha constant, this is 0.8 for most constructions, but 1.6 for light steel frame constructions: the value will be entered automatically by the software;
- the cross-sectional area of the fastener, in millimetres, labelled **Cross-section**.

- for fixings which are recessed and do not penetrate the whole of the insulation layer, for example, screws fitted with mushroom caps, the depth of the recess, in millimetres.

JPA Designer includes a number of standard fastener configurations which you can use to speed up data entry.

**To add a fastener correction once per calculation:**

1. Open the **U-value Construction** dialogue at the **General** tab.
2. Select the **Layer bridged by mechanical fasteners**.
3. Either:
  - Enter the fastener data, as described above; or,
  - Select one of the standard configurations from the **Mechanical fasteners** box.

**To add a fastener correction to a layer:**

1. Open the **Edit Material** dialogue for the layer at the **Correction factors** tab.
2. Either:
  - Enter the fastener data, as described above; or,
  - Select one of the standard configurations from the **Mechanical fasteners** box.

## **Saving fastener configurations**

If you frequently use a configuration of fasteners which is not in the **Mechanical fasteners** list you can add your configuration to the list, making it easy to access it.

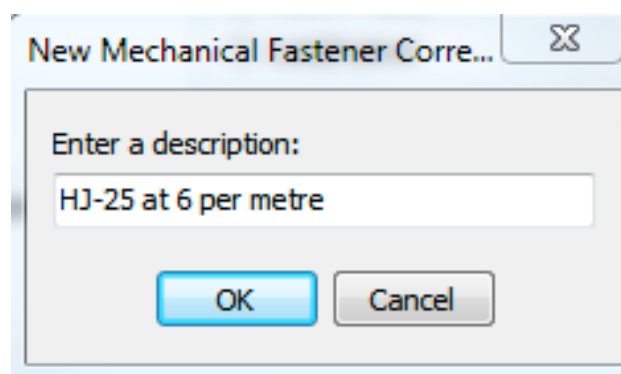


Figure 8.3: Naming a new mechanical fasteners configuration

To create a new configuration:

1. Open the **Edit Material** dialogue **Correction factors** tab, or the **U-value Construction** dialogue **General** tab.

Figure 8.4: Defining a new default configuration for mechanical fasteners

2. Click the **New** button which is next to the **Mechanical fasteners** list..
3. In the **New Mechanical Fastener Correction** dialogue enter a description of the configuration (Figure 8.3). This is the description which will appear in the **Mechanical fasteners** list.
4. In the **Correction for mechanical fasteners** dialogue (Figure 8.4) enter:
  - **Fasteners per square metre**.
  - Any **recess** figure.
  - **Fastener lambda** – the thermal conductivity of the fastener.
  - The **Fastener cross-sectional area**.
  - **Alpha** should be 0.8, except for cold or hybrid light steel framed constructions when it should be 1.6.
5. If you are using a point thermal transmittance, tick the box then enter the **transmittance** and number of **fasteners per square metre**.

You can also edit an existing configuration:

1. Select an entry in the **Mechanical fasteners** list.

1. Click **Edit**.
2. In the **Correction for mechanical fasteners** dialogue edit the values to match your requirements.

## 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,  $dU_g$ , 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  $dU''$  are:

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

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

A value for  $dU''$  must be set for *every* insulation layer. By default JPA Designer sets  $dU''$  to zero.

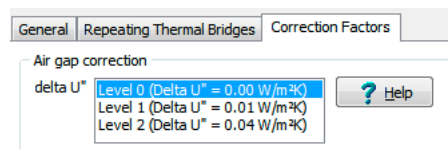


Figure 8.5: Correcting for air gaps in insulation layers

To correct for air gaps:

1. In the **Edit material** dialogue select the **Correction factors** tab.
2. Select the *Level* (and associated value for  $dU''$ ) in the  **$dU''$**  box (see Figure 8.5).

*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,  $dU_r$ , 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;
- A factor for increased heat loss caused by rainwater flowing on the membrane,  $\alpha$  ( $\text{Wday/m}^2\text{Kmm}$ ).

In JPA Designer the data is entered using the **U-value Construction** dialogue (Figure 8.6). 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*.

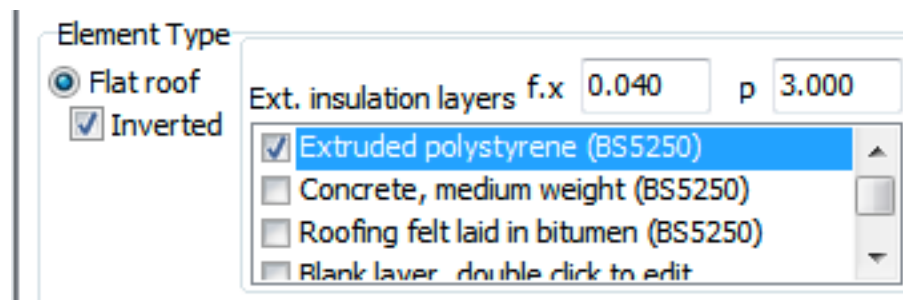


Figure 8.6: Setting the rainwater cooling correction for an inverted roof

3. Tick the **Inverted roof** box.
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.*

1. 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 Cladding brackets and rails

When calculating U-values for walls which include rainscreen cladding the results have to be adjusted to account for the effect of fixing brackets or rails which support the cladding and also penetrate the insulation. The same method can also be used for soffit fixings on exposed floors.

JPA Designer uses the methods in BR 443 section 4.9.5 to correct for the effect of one or more sets of fixing rails and brackets.

For rails systems, the calculation requires:

- the linear thermal transmittance of the rail,  $\psi$ ;
- the area of the wall,  $A$ ;
- the total length of bracket,  $L$ .

For bracket systems, the calculation requires:

- the point thermal transmittance of the bracket,  $\chi$ ;
- the number of brackets per square metre,  $n$ .

The values for  $\psi$  and  $\chi$  depend on the type of fixing and should be obtained from the fixing manufacturer.

The data is entered in the **U-value Construction** dialogue.

To correct for rails and brackets in rainscreen cladding:

Element Type  
2Wall

☒ Bracket systems

Fixing system 1: Rail Description Bloggex F21  
L 0.020 m A 2.770 m<sup>2</sup> Ψ 0.000 W/m.K

Fixing system 2: Bracket Description Fixxo QR45  
X 0.020 W/K n 2.770 No./m<sup>2</sup>

Figure 8.7: Data for rainscreen cladding correction

1. Set the **Element type** to *Wall* or *Floor other than ground floor*.
2. Tick the **bracket systems** box.
3. For the first fixing system use the dropdown to specify whether it is a *Rail* or *Bracket* system.
4. Enter a **Description** of the system. This will usually include the manufacturer's reference.
5. Enter details of the system, either:
  - Bracket system: point thermal transmittance value,  $\chi$  and number of fixings per square metre; or
  - Rail system: linear thermal transmittance value,  $\psi$ , wall area and total length of rail.
6. If there is a second system, repeat steps 2–4.

## 8.5 Windposts

In walls where masonry is restrained by vertical windposts or supported on horizontal brackets the posts and brackets can penetrate thermal insulation, reducing its effectiveness. Where that occurs the U-value calculation must be corrected for the presence of the posts or brackets.

☒ Windposts penetrate an insulation layer

L (m) 0.000 A (m<sup>2</sup>) 0.000 Psi Value (W/mK) 0.180

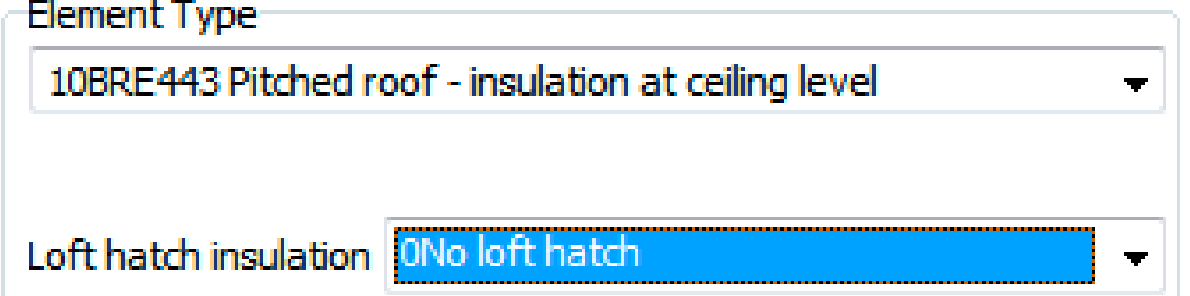
Figure 8.8: Setting the windpost correction

The correction is entered in the **U-value construction dialogue**:

1. Set **Element Type** to *Wall*.
2. Tick **Windposts penetrate an insulation layer** (see Figure 8.8).
3. Enter the length,  $L$ , of the posts or brackets in metres.
4. Enter the area,  $A$ , of the wall in square metres.
5. Enter the linear thermal transmittance,  $\psi$ , in W/mK.

## 8.6 Loft hatches

The presence of a loft hatch in a pitched roof with insulation at ceiling level will reduce the thermal performance of the roof. The extent of the reduction depends on the area of the roof hatch relative to the roof and the insulation (if any) on the hatch. BR 443 section 4.9.7 includes an approximate method for correcting for loft hatches based on the thickness of insulation on the hatch. In JPA Designer the correction is entered in the **U-value construction** dialogue (see Figure 8.9).



The image shows a software interface for setting U-value construction parameters. It has two dropdown menus. The first, labeled 'Element Type', is set to '10BRE443 Pitched roof - insulation at ceiling level'. The second, labeled 'Loft hatch insulation', is set to '0 No loft hatch'.

Figure 8.9: Correcting for loft hatches

To set the loft hatch correction:

1. Set the **Element Type** to either:
  - Pitch roof, horizontal ceiling (legacy); or
  - BR443 Pitched roof - insulation at ceiling level.
2. In the *Loft hatch insulation* list select the closest matching value.

## 8.7 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 by assigning a thermal resistance to the unheated space. The resistance is based on:

- the surface areas of the elements which separate the heated space from the unheated space,  $A_i$ , measured in  $\text{m}^2$ ;
- the surface areas and U-values of the elements which separate the unheated space from outside,  $A_e$ , measured in  $\text{m}^2$  and  $U_e$ , measured in  $\text{W}/\text{m}^2\text{K}$ ;
- The volume of the unheated space,  $V$ , measured in  $\text{m}^3$ ;
- The ventilation rate,  $n$ , measured in air changes per hour (ach).

Element Details   Unheated Spaces   Print Report Notes

Elements separating heated and small unheated spaces (see ISO 6946 sec. 5.4)

Total area of all elements between the internal environment and the unheated space,  $A_i$    20.00    $\text{m}^2$

Ventilation rate of the unheated space,  $n$    0.00   air changes per hour

Volume of the unheated space,  $V$    0.00    $\text{m}^3$

**External elements**

k	$A_{e,k}$	$U_{e,k}$
0		
1		
2		
3		
4		
5		
6		

$k$  is the element number

$A_{e,k}$  is the area of element  $k$  between the unheated space and the external environment in  $\text{m}^2$

$U_{e,k}$  is the thermal transmittance of element  $k$  between the unheated space and the external environment in  $\text{W}/(\text{m}^2\cdot\text{K})$

Figure 8.10: Data entry for elements separating heated and unheated spaces

When measuring  $A_i$  and  $A_e$ , you should include walls and intermediate floors (such as that over an integral garage) but exclude ground floors.

To allow for unheated spaces:

1. In the **U-value Construction** dialogue click the **Unheated Spaces** tab (Figure 8.10).
2. Enter:
  - The area,  **$A_i$**  ;
  - The ventilation rate,  **$n$** ; *Use a ventilation rate of 3 ach if the actual ach is not known.*
  - The volume of the unheated space,  **$V$** .
3. For each of the elements separating the unheated space from outside enter:
  - The area,  $A_{e,k}$ ;
  - The U-value,  $U_{e,k}$ .

*$U_{e,k}$  can be calculated in a separate calculation in JPA Designer. Use a value of  $2 \text{ W}/\text{m}^2\text{K}$  if the details of the element is not known.*

### Using the pre-2007 method

The 1997 edition of BS EN ISO 6946 included a different method to calculate the resistance of an unheated space. It is possible to use the older method in JPA Designer:

1. In the **Edit Construction** dialogue select the **Unheated spaces** tab.
2. Tick **Use BS 6946 pre-2007 method**.

3. In the **Ai** box enter the total area of all elements separating the internal environment from the unheated space.
4. In the **Ae for BS 6946 Pre 2007 method** box enter the total area of all elements separating the unheated space from outside.

## 9 Advanced calculations

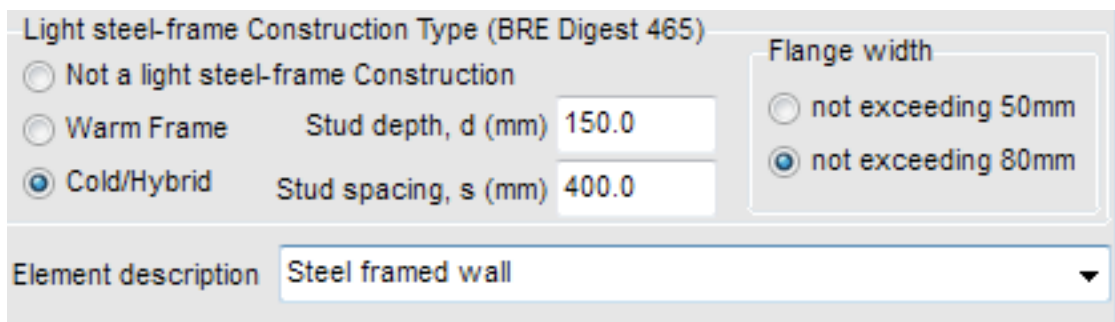
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### 9.1 Light steel framed structure

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.*

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.



Light steel-frame Construction Type (BRE Digest 465)

☐ Not a light steel-frame Construction

☐ Warm Frame      Stud depth, d (mm) 150.0

☒ Cold/Hybrid      Stud spacing, s (mm) 400.0

Flange width

☐ not exceeding 50mm

☒ not exceeding 80mm

Element description Steel framed wall ▼

Figure 9.1: Setting the type and details of 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:

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**.

- For a **Cold** or **Hybrid** construction 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* and *hybrid* elements some of the layers will be bridged by steel: see section 7.4 for guidance on entering bridged layers. 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.)
    - In *warm* elements the air space between the studs should be entered as a bridged cavity, with steel as the bridging material.
  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

Figure 9.2: Built-up metal wall or roof cladding

The additional heat loss resulting from thermal bridging in twin-skin metal roofing and cladding systems formed with rails and brackets requires a modification to the standard combined method. JPA Designer uses the method described in the Steel Construction Institute research paper SCI P312, which 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 or 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 uppermost layer being the insulation which is bridged by the rails and the underneath 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 7.4 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 **Airspace Resistance Calculator** dialogue opens (see Figure 7.4).
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. Leave the emissivity values at 0.9.
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**.
12. In the **U-value Construction** dialogue tick **Built up metal roof/wall**.
13. In the **Built-up metal roof/wall cladding** section enter the **Rail spacing** and **Rail width** (Figure 9.2). Use the drop-down to select the **Layer bridged by rail**.
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 100 mm).*

16. Enter the details for the brackets in the **Correction for mechanical fasteners** section. Enter:

- The **thermal conductivity of the brackets** (usually 50.00 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)
- 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.

17. Select the **Layer bridged by brackets**.

### 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 that a rainwater cooling correction factor,  $dU_r$ , has to be applied to inverted roof calculations (the rainwater cooling factor is described in section 8.3).

As the correction factor requires you to select the layers affected by rainwater cooling it is best to add the correction factor *after* you have defined the layers in the construction.

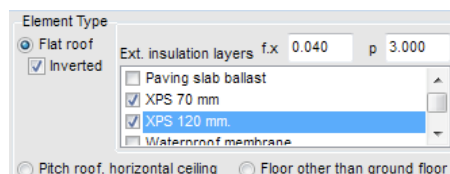


Figure 9.3: Inputting data for rainwater correction

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 9.3).
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 compare the performance of different materials in a construction, or of different thicknesses of the same material.

U-value Element 1 | Flat roof

Layer	Thickness (mm)	Thermal Conductivity (W/mK)	Thermal Resistance (m <sup>2</sup> K/W)	Vapour Resistivity (MN/gm)	Vapour Resistance (MN/g)	Pitch (°)	Bridge Details	Link brg.
1 Outside surface resistance	-	-	0.040	-	-			
2 Concrete, medium weight (BS5250)	150.0	0.590	0.254	150.00	22.50			
3 Roofing felt laid in bitumen (BS5250)	8.0	0.300	0.027	-	1000.00			
4 Variable layer	-	-	-	-	-			
5 Blank layer, double click to edit...	0.0	0.000	0.000	0.00	0.00			
6 Inside surface resistance	-	-	0.100	-	-			

Variable layers : 4

Layer	Thickness (mm)	Thermal Conductivity (W/mK)	U-value Proportional Area Method (1/m <sup>2</sup> K)	U-value Combined Method (1/m <sup>2</sup> K)	dU <sup>1</sup>	Bridge Details
1 Extruded polystyrene (BS5250)	150.0	0.027	0.167	0.167	0.000	
2 Rock fibre (BS5250)	150.0	0.040	0.240	0.240	0.000	
3 Polyisocyanurate (BS5250)	150.0	0.030	0.184	0.184	0.000	
4 Polyurethane (BS5250)	150.0	0.030	0.184	0.184	0.000	

Figure 9.4: U-value calculation with a variable layer

A calculation with a variable layer has a place-holder layer in the main window (item 1 in Figure 9.4, and has the additional **Variable layer** pane which accepts a number of different layers (item 2). 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 (item 3).

To use a variable layer:

1. In the main **U-value** window click the layer *below* the position for the variable layer.
2. On the **Insert** menu click **Variable layer**. The program inserts a variable layer in the calculation and displays the **Variable layer** pane (see Figure 9.4).
3. Select the blank layer in the **Variable layer** pane and add layers from the database, or by add and edit blank layers. 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.

*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.*

Once you have identified a configuration which gives the result you require you can convert the variable layer calculation into a standard U-value calculation:

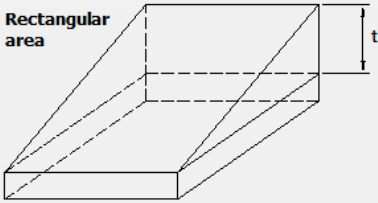
1. Click the layer in the **variable layer** pane which you want to use in the standard calculation.
2. On the **Edit** menu click **Move selected variable layer into construction**.
3. The variable layer is deleted and the selected layer is inserted as a standard layer.

**Tapered Areas**

Description: Tapered Insulation


Minimum tapered layer thickness,  $d0$  (mm): 50       $\lambda$  (W/m.K): 0.032

**Rectangular area**



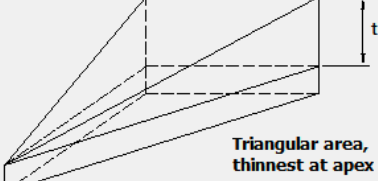
Description (optional)	Depth t (mm)	Area (m <sup>2</sup> )	$d0$ (mm)	$\lambda$ (W/m.K)
Back end	120	120	50	0.032

**Triangular area, thickest at apex**



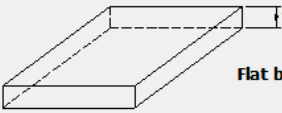
Description (optional)	Depth t (mm)	Area (m <sup>2</sup> )	$d0$ (mm)	$\lambda$ (W/m.K)
Front end	140	50	50	0.032

**Triangular area, thinnest at apex**



Description (optional)	Depth t (mm)	Area (m <sup>2</sup> )	$d0$ (mm)	$\lambda$ (W/m.K)

**Flat boards**



Description (optional)	Thickness (mm)	Area (m <sup>2</sup> )	$\lambda$ (W/m.K)

Calculations apply to roof pitches not exceeding 5%

OK Cancel      Total area: 170.00m<sup>2</sup>

Figure 9.5: The Tapered Areas dialogue

## 9.5 Tapered layers

Tapered insulation layers are commonly found on flat roofs, to create drainage falls on an otherwise flat deck. Because the thickness of the insulation varies across the roof the average U-value of the roof has to be calculated using the method in Annex C of BS EN ISO 6946:2007.<sup>1</sup>

The method requires the roof to be divided into a series of blocks, which will be of:

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

Each block in the calculation has a minimum thickness of insulation,  $d0$ , and a taper height,  $t$ . Depending on its size a roof may have several blocks of each type, each with different areas and, in some cases, different minimum thicknesses.

In JPA Designer a tapered layer calculation is entered in two parts;

<sup>1</sup>Note that simply calculating the U-value based on the average thickness of insulation will substantially over-estimate the thermal performance of the roof.

- all layers except the taper are added to the calculation;
- the individual blocks of the tapered layer are defined in the **Tapered Areas** dialogue (Figure 9.5).

The **Tapered Areas** 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:

- an optional **Description** which is useful for identifying sections of the roof;
- the taper depth, **t**, in mm.
- the area of the block, in m<sup>2</sup>;

If a block has a different minimum depth compared to the rest of the roof, or has insulation with a different thermal conductivity you can insert a different value for **d0** and **lambda**.

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).

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. On the **Insert** menu click **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.*

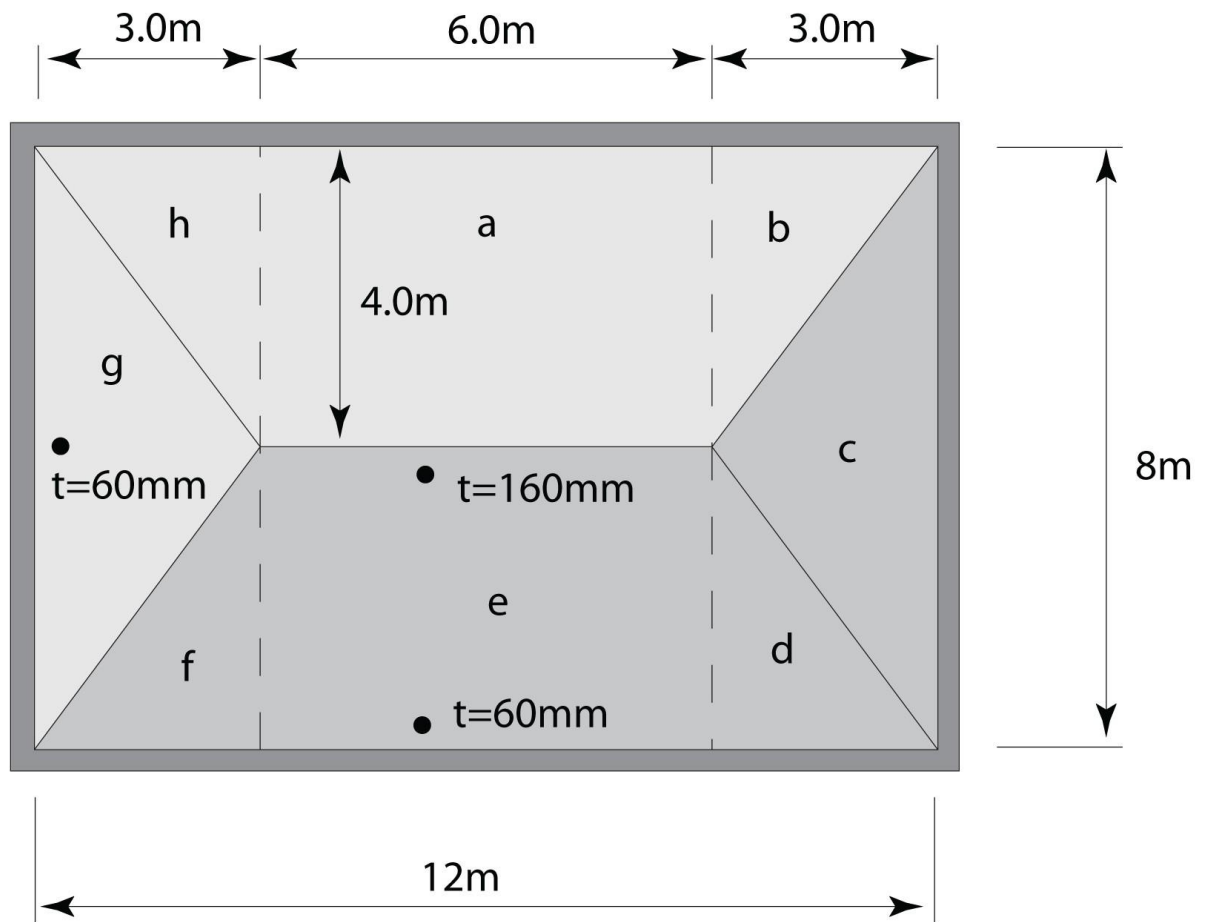


Figure 9.6: A typical roof with tapered insulation

## 10 Ground floor U-values

---

The standard method of calculating U-values has to be modified for ground floors and basements to take account of the thermal resistance of the ground using the method is set out in ISO 13370<sup>1</sup>. 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 3.7).
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:

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

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

**Ground Floor Details**

**1 Floor type**

☐ Solid

☒ Suspended block & beam

☐ Suspended

**2 Floor dimensions**

P/A 0.00000 Calculate it ☒

Perimeter (m) 0.00

Area (m²) 0.00

**3 Deck**

Resistance (m²K/W)

Description

Block

Width (mm) 440 Thickness (mm) 100

Conductivity (W/mK) 0.000

Beam

Web width (mm) 60

Beam conductivity (W/mK) 1.130

Screed

Screed depth (mm) 50

Screed conductivity (W/mK) 1.150

**4 Suspended Ground Floor Details for ISO 13370**

E (m²/m) 0.0015 h (m) 0.225 w (m) 0.300

Uw (W/m²K) 1.700 fw 0.050

lambda 1.500 V (m/s) 5.000 Default ? Help

Deck underside surface resistance (m²K/W) 0.170

Subfloor ground surface resistance (m²K/W) 0.170

Resistance of insulation on ground, Rg (m²K/W) 0.000

**5 Edge insulation**

☒ None ☐ Horizontal ☐ Vertical

Insulation name

Insulation thickness (mm) 0.0

Insulation conductivity (W/mK) 0.000

Insulation width (mm) 0

Description

OK Cancel

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) and has five sections:

- *Floor type* (section 10.1–1). The choice of floor type will determine how other parts of the dialogue appear.
- *Floor dimensions* (section 10.1–2). The size of the floor.
- *Deck* (section 10.1–3). The construction of a suspended floor deck.
- *Suspended ground floor details* (section 10.1–4). Additional information for suspended floors.
- *Edge insulation* (section 10.1–5). Details of any separate perimeter insulation.

### Floor type

JPA Designer recognises three types of ground floor:

- *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;

<sup>1</sup>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 and proceed as usual.

- *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.

If you have selected *solid ground floor* in the **U-value Construction** dialogue the **Floor Type** buttons will be greyed out. If you have selected *suspended ground floor* you will be able to choose between *Suspended block and beam* and *Suspended*.

## Floor dimensions

The thermal resistance of the ground for a particular floor is affected by the ratio of its perimeter and area. The perimeter length (expressed in metres) is measured along the finished internal surfaces of exposed and semi-exposed walls. The area (expressed in square metres, m<sup>2</sup>) is measured between the finished internal wall surfaces. Unheated spaces outside the insulated fabric should be excluded when calculating the perimeter and area.

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 **Perimeter** and **Area** dimensions.

## Deck

The data required for this section depends upon the type of construction specified in the **Floor Type** section:

- Solid floor: no deck data required.
- Suspended block and beam floor (Figure 10.2): the program calculates the resistance using the following data:
  - The block **Width**, **Thickness** and **Conductivity**.
  - The beam **Web width** and **Beam conductivity**.
  - The **Screed depth** and **Screed conductivity**.

*You can set the default thermal conductivity of the screed in a beam and block floor construction on the **Other** tab of the **Options** dialogue in **Project Manager**.*

- Suspended floor: you can enter a resistance for the deck, or select a material from the database (Figure 10.3) by clicking the database button (the procedure for selecting the material is the same as described in section 6.1. The deck in a suspended floor will typically be timber boards or particleboard: insulation between joists should be entered as a separate layer, bridged by timber (section 7.4).

Deck  
Resistance ( $\text{m}^2\text{K/W}$ )

Description

Block

Width (mm)  Thickness (mm)

Conductivity ( $\text{W/mK}$ )

Beam

Web width (mm)


Beam conductivity ( $\text{W/mK}$ )

Screed

Screed depth (mm)

Screed conductivity ( $\text{W/mK}$ )

Figure 10.2: Defining a beam and block deck

Deck  
Resistance ( $\text{m}^2\text{K/W}$ )  

Description

Figure 10.3: Set the deck resistance for a suspended floor

Suspended Ground Floor Details for ISO 13370

E ( $\text{m}^2/\text{m}$ )  h (m)  w (m)

Uw ( $\text{W/m}^2\text{K}$ )  fw

lambda  V (m/s)

Deck underside surface resistance ( $\text{m}^2\text{K/W}$ )

Subfloor ground surface resistance ( $\text{m}^2\text{K/W}$ )

Resistance of insulation on ground, Rg ( $\text{m}^2\text{K/W}$ )

Figure 10.4: Entering the details for a suspended ground floor

## Suspended ground floor details

In a suspended ground floor heat will be lost through the floor deck and ground; it will also be lost through the walls of the sub-floor void and as a result of ventilation of that void. JPA Designer calculates those latter heat losses using the data in **Suspended Ground Floor Details** section (Figure 10.4). The values required are:

- **E** - the area of ventilation openings in the walls of the sub-floor void, measured in square metres per metre ( $\text{m}^2/\text{m}$ ).
- **h** - the height of the upper surface of the floor above external ground level, in metres. The default value of 0.225 m represents three courses of brickwork
- **w** the thickness of the walls at the floor perimeter in metres.
- **Uw** - the U-value of the walls of the sub-floor void, calculated according to BS EN ISO 6946, in  $\text{W}/\text{m}^2\text{K}$ . This value can be obtained from a separate calculation in JPA Designer.
- **fw** - the wind shield factor, see Table 10.1. This converts the average wind speed, **V**, into the wind speed at ground level.
- **Lambda** - the conductivity of the type of ground: use 1.5  $\text{W}/\text{mK}$  for clay or silt, 2.0  $\text{W}/\text{mK}$  for sand or gravel and 3.5  $\text{W}/\text{mK}$  for homogeneous rock.
- **V** - the average wind speed at 10 m above ground level, in  $\text{m}/\text{s}$ . (BR 443 recommends a default value of 5  $\text{m}/\text{s}$  for the UK.)

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.

The surface resistances of the underside of the suspended deck and of the ground surface of the sub-floor void are included in the calculation. These are entered in **Deck underside surface resistance** and **Subfloor ground surface resistance**. In most cases a value of  $0.17 \text{ m}^2\text{K}/\text{W}$  is suitable, however, if the underside of the deck has a low emissivity surface (for example the foil facing of an insulation board), then a higher resistance may be used.

The resistance of any thermal insulation on the ground surface of the sub-floor void,  $R_g$ , should be entered at **Resistance of insulation on ground** (This insulation should *not* be entered as a normal layer in the calculation.)



### Details for solid ground floors

The U-value calculation for solid ground floors requires three pieces of data from the *Suspended ground floor details* section: the height of the floor surface above the ground (**h**), the width of the walls (**w**) and the conductivity of the ground (**Lambda**).

Table 10.1: Windshield factor

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

## 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<sup>2</sup>. Edge insulation can be:

- Horizontal: insulation installed around the perimeter of the floor in the same plane as the floor<sup>3</sup>.
- 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: *none*, *horizontal* or *vertical* then enter the details of any insulation (if you have selected *none* leave the rest of this section blank).

- **Insulation name.**
- **Insulation thickness:** board thickness, in mm.
- **Insulation conductivity:** the lambda value, in W/mK.
- **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.

<sup>2</sup>For suspended floors edge insulation refers only to insulation applied at the base of the subfloor void: insulation around the edge of the deck should not be included as edge insulation.

<sup>3</sup>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

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JPA Designer calculates U-values for basement walls and floors using the methods in BS EN ISO 13370. As the calculations for a basement's walls and floor are linked, with each calculation requiring data about the other element, it is beset to calculate the basement floor U-value first.

## 11.1 Basement floors



The image shows two overlapping dialog boxes. The left box, titled 'Basement floor dimensions', contains a text field for 'P/A' with the value '0.00000' and a 'Calculate it' checkbox. The right box, titled 'Basement Details for ISO 13370', contains three text fields: 'h (m)' with '0.225', 'w (m)' with '0.300', and 'lambda' with '1.500'. There is also a 'Default' button in the bottom right of the right box.

Figure 11.1: Entering data for 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,  $\lambda$ , in 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.
2. In the **U-value Construction** dialogue set the **Element Type** to *Basement Floor*, enter an **Element description** then click **OK**.
3. In the **Ground Floor Details** dialogue (Figure 11.1) enter:
  - the Perimeter/Area ratio, **P/A**, or check the box labelled 'calculate it' and enter the **Perimeter** and **Area** separately;

- the wall thickness,  $w$ ;
- the basement depth,  $h$ ; and,
- the thermal conductivity of the ground.

4. Enter the layers which make up the floor construction.

Include layers to represent:

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

Omit:

- Hardcore beneath a groundbearing slab.
- Groundbearing concrete slabs with density greater than  $1800 \text{ kg/m}^3$ .
- 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.
- The thermal conductivity of the ground:  $\lambda$ , in W/mK) (see Table 11.1 and annex G of BS EN ISO 13370).

To calculate a basement wall U-value:

**Ground Floor Details**

**Basement floor dimensions**

P/A 0.40000 ☒ Calculate it

Perimeter (m) 40


Area (m²) 100

**Basement Details for ISO 13370**

h (m) 2.2 w (m) 0.300

lambda 1.500

**Basement floor insulation**

Insulation name  

Insulation thickness (mm) 0.0

Insulation conductivity (W/mK) 0.000

Description

When calculating basement WALL U-values, add the basement walls and any insulation in to the main window as layers. ISO 13370 suggests you include the masonry wall 300mm thick with a conductivity of 1.7W/(m.K)

Calculation of basement WALL U-values requires details of the basement FLOOR including any insulation and the Perimeter and Area. When calculating basement WALL U-values, add any basement FLOOR insulation in to the box on the right.

Figure 11.2: Entering data for a basement wall calculation

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**.
6. Add the layers of the construction in the main **U-value** window.

## 12 Creating reports

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You can print calculation reports 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 report includes:

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

### To print results:

1. On the **File** menu click **Print** (or click the **Print** button on the tool bar). The **Sections To Print** dialogue opens (Figure 12.1).
2. If you have several user identities (see section 2.8) select the one you want to use in the **Identities** list.
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, and whether the calculation should show the logo of the BBA/TIMSA U-value accreditation scheme.
4. If you want to include a watermark over the calculation tick **Print watermark text**. You can also modify the wording, angle and font size of the default text.
5. Click **OK**. The **Print preview** window opens.
6. 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 calculation report:

1. On the **File** menu bar select **Create PDF** (or click the PDF button on the toolbar). 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).

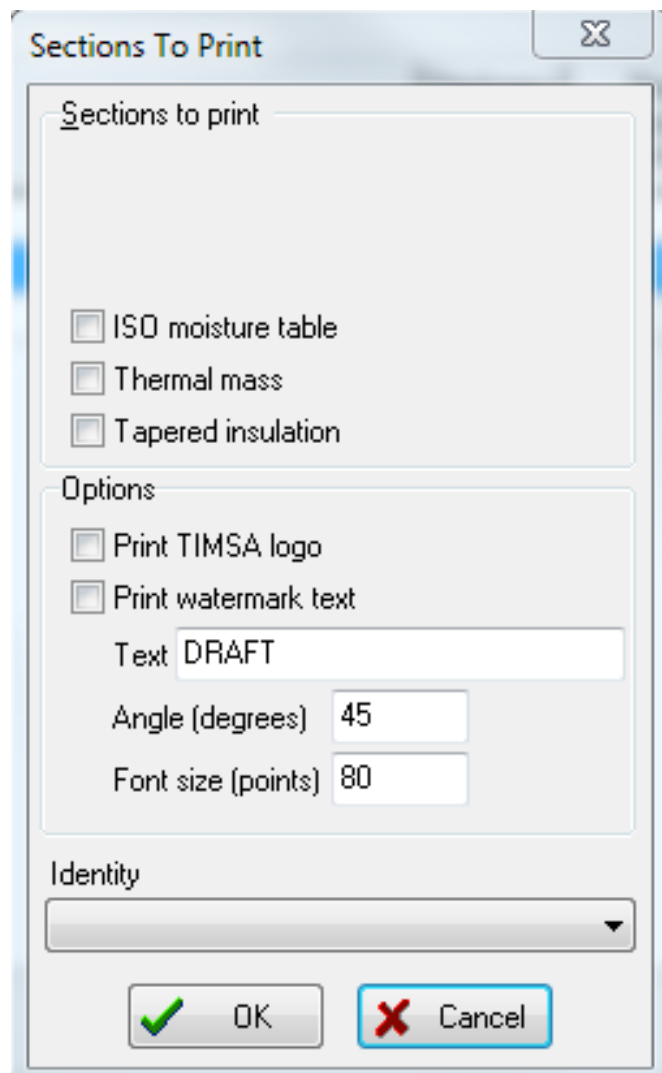


Figure 12.1: Sections To Print dialogue



Figure 12.2: Print preview controls

3. Use the tick boxes to select whether to print an additional page showing the details of the bridging calculations, tapered layers and, for condensation risk analysis, the ISO moisture table for condensation analysis. If you are a member of the BBA/TIMSA U-value accreditation scheme you can add the scheme logo to your reports.
4. If you want to include a watermark over the calculation tick **Print watermark text**. You can also modify the wording, angle and font size of the default text.
5. If you have several user identities (see section 2.8) select the one you want to use in the **Identities** list.
6. Click **OK**. The **Print preview** window opens.
7. 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**.*

8. The file will be saved into the JPA Designer program folder or in the start-up folder you have specified (see section 3.5).

**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. It is also possible to produce PDF reports of all the U-value calculations at once. In the **Project Manager** window on the **File** menu click **Print all U-value calculations in this project to PDFs**. The program will then offer the **Sections to Print** dialogue before creating the PDFs.

## 12.1 Adding notes to reports

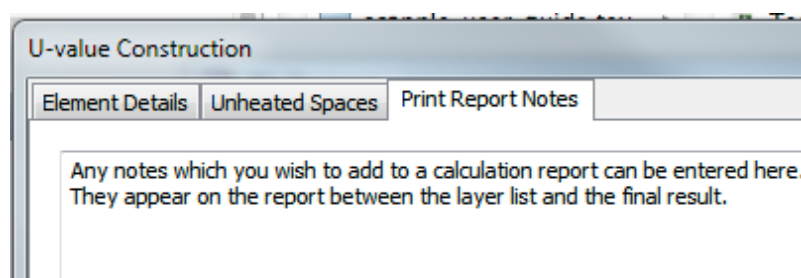


Figure 12.3: The Print Report Notes tab in the U-value Construction dialogue

You can add notes to the report of a calculation, which can be used to explain particular features of the calculation or to highlight assumptions made within it. To add notes open the **U-value construction** dialogue and click on the **Print Report Notes** tab. You can then enter your wording (Figure 12.3). The notes text will appear between the layers list and the final result.

## 12.2 Customising reports

You can control many aspects of the appearance of JPA Designer's calculation reports:

- Selecting the printer: In the U-value module select **File>Printer setup**. You can select the printer and paper source. It is possible to set the page orientation to landscape rather than portrait, but the reports are not designed for landscape format.
- Changing the font used in reports: In the U-value module select **File>Font**. Then in the **Font** dialogue, set the typeface, style and size. The default is Arial regular, 10 pt. Larger sizes may cause problems on the page with columns overflowing. Note also, that some fonts are wider than others, even at the same point size, so it worth testing font settings.
- Page margins: These are set in the **General** tab of the **Options** menu. There are two *Top* settings, one for the first page and one for the second page. This is to allow you to print calculations onto headed paper, with printing on the first sheet starting lower down the page.
- Adding your logo and address: You can add your logo and contact details to calculation reports: see section 2.8.
- Adding a disclaimer to be shown at the bottom of calculation reports: Enter the disclaimer text in the **U-value disclaimer** box on the **Options** dialogue **General** tab.
- Including the total construction thickness in the calculation report: In the **Other** tab of the **Options** dialogue tick **Print total thickness on U-value report**. The total thickness will then appear on calculation reports below the layer list.

# 13 Editing the Products database

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To make U-value calculations easier all JPA Designer U-value modules include the **Products database**, which provides key data on generic construction materials and cavities, as well as data on 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.

Whilst you can create, edit and delete user-defined categories and materials, you can not edit or delete branded or generic categories or materials. However, you can clone a generic or branded material and make changes to the clone, leaving the original untouched.

To make changes to the **Products database** you must first open the **Edit database** dialogue (Figure 13.1) 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:

1. Select the category to clone by clicking on it.

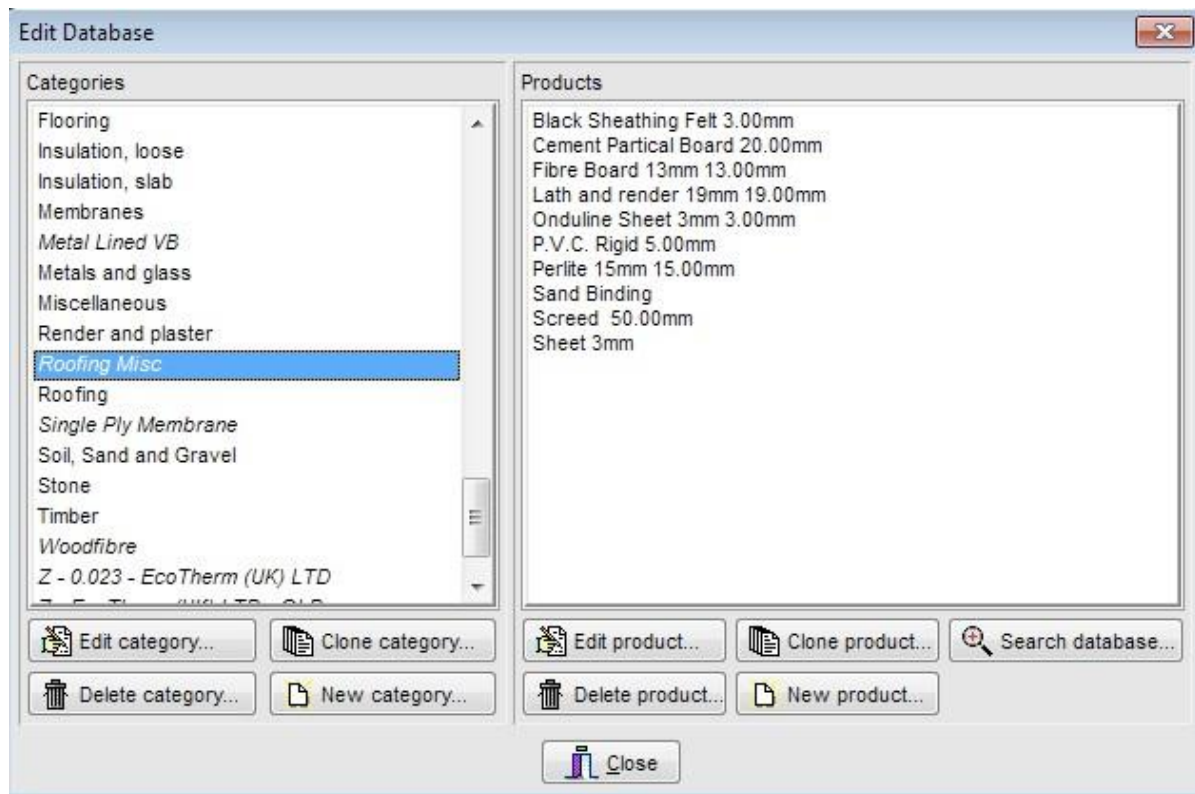


Figure 13.1: The Edit Database dialogue

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.

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.

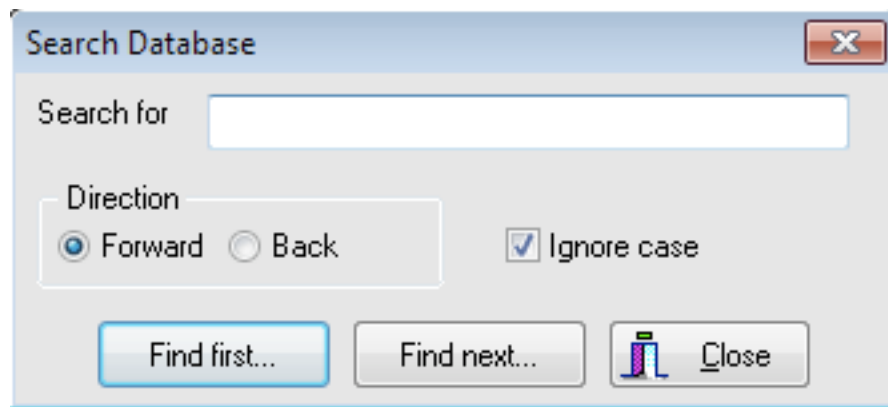


Figure 13.2: The Search Database dialogue

You can search the database to find specific products:

1. Click the **Search** button. The **Search Database** dialogue opens (Figure 13.2).
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.

## 13.1 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. 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 6.2).

## **Part III**

### **Thermal mass calculations**

# 14 Thermal mass in JPA Designer

---

The thermal mass of a building element is an expression of the amount of heat which it can store. Elements with high thermal mass store more energy than those with lower thermal mass. The thermal mass of a whole building will affect its energy efficiency.

The JPA Designer U-value modules can be used to carry out the two main thermal mass calculations for constructions:

- $\kappa$ -value (kappa-value) calculations, which give a steady-state measure of thermal mass.  $\kappa$ -values are used in SAP calculations from SAP 2009 onwards (see section 21.1 for further information on  $\kappa$ -values).
- admittance calculations, which give transient measures of thermal mass which can be used in dynamic simulation modelling (DSM) when assessing the energy performance of whole buildings.

Each calculation is carried out along side the U-value calculation, provided the necessary data is available for every layer in the construction. This section describes the additional data and how to produce a thermal mass report.

## 14.1 Additional data for thermal mass calculations

In addition to the standard data for each layer required for U-value or R-value calculations (thickness and thermal conductivity), thermal mass calculations require:

- density, in  $\text{kg/m}^3$ ;
- specific heat capacity, in  $\text{J/kgK}$ .

Generic materials in the revised product database have values for density and specific heat capacity.

```

U-value : 0.294W/m²K (dUf 0.0027, dUg 0.0000, dUp 0.0000, dUr 0.0000, dUrc 0.0000)
Admittance : 2.37 W/m²K  Decrement : 0.22 factor  Decrement delay : -8.99 hours Kappa m: 108.5 kJ/m²K

```

Figure 14.1: Thermal mass results showing in the status bar

## 14.2 Thermal mass results

The results of thermal mass calculations are displayed in the status bar of the U-value module (see Figure 14.1).

The figures shown are:

- *admittance*: a measure of how rapidly heat passes between the surface of an element and the building interior.
- *decrement factor*: the ratio of the temperature range at the internal surface of an element to the temperature range at the external surface.
- *decrement delay*: the time taken for heat to travel from one side of the structure to the other.
- $\kappa$ -value: the steady-state measure of thermal mass.

The results are updated whenever the layer data is changed.

## 14.3 Thermal mass report

A report of the thermal mass calculation can be printed or exported to PDF in the same way as other reports from the U-value module, by ticking the **Thermal mass** box in the **Sections To Print** dialogue.

The report shows the  $\kappa$ -value calculation and the results of the admittance calculations.

## **Part IV**

### **Condensation risk**

# 15 The problem of interstitial condensation

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Condensation occurring within building elements – interstitial condensation – can cause substantial damage to the building fabric and reduce the effectiveness of thermal insulation<sup>1</sup>. By carrying out condensation risk analysis (CRA) you can identify constructions which are likely to be at risk of condensation and, where necessary, make modifications to the design.

JPA Designer assesses the risk of interstitial condensation using the steady-state method defined in ISO 13788:2012<sup>2</sup>, which uses mean monthly temperatures and relative humidities to assess the risk of interstitial condensation over a twelve month period. The method provides a general assessment of suitability of the construction, but does not address air movement within the construction, nor does it take account of the effects of capillary moisture transfer.

---

<sup>1</sup>For further information on the causes and effects of condensation, and guidance on reducing problems see BS 5250:2011. Code of practice for control of condensation in buildings.

<sup>2</sup>ISO 13788:2012 Hygrothermal performance of building components and building elements – Internal surface temperature to avoid critical surface humidity and interstitial condensation – Calculation methods.

# 16 Condensation risk analysis in JPA Designer

---

Condensation risk analysis determines whether condensation is likely to occur at the interfaces between the layers of material which make up the construction<sup>1</sup>. Using the hygrothermal properties of the materials (section 16.1) and the environmental conditions (section 16.2) the program looks at each interface in the construction and calculates:

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

You can then use the results to assess the suitability of the construction for that environment.

To carry out condensation risk analysis:

1. Define the element in the same way as you would for a thermal calculation (section 16.1).
2. Set the environmental conditions (section 16.2);
3. View the results (section 16.3).

## 16.1 Defining the construction

To carry out condensation risk analysis you must set the thermal resistance and vapour resistance of each layer which makes up the element, using the appropriate methods for each type of layer:

- *Normal* materials: Enter the **thickness, thermal conductivity** and **vapour resistivity**. JPA Designer will calculate the **thermal resistance** and the **vapour resistance**.

---

<sup>1</sup>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.

- *Composite materials*: Enter the **thermal resistance** and **vapour resistance**. Although the **thickness** is not required for the calculation, setting the **thickness** ensures the Dewpoint graph (Figure 16.3) looks right.
- *Fixed vapour resistance materials*: These are designed to be used in condensation risk analysis to represent materials such as metals which have very high resistances even when used in thin layers. Enter the **thickness**, **thermal conductivity** and the **vapour resistance**.
- *Membranes*: Enter the **vapour resistance**.
- *Cavities*: Enter the **thermal resistance**. The vapour resistance of a cavity is always zero. Enter the **thickness** to ensure the appearance of the Dewpoint graph.

The data for each type of material and cavity is described in more detail in chapter 7. If you have already carried out thermal calculations on the same construction you need only check that the vapour resistivity or resistance figures are correct.

### Units of vapour resistance and resistivity

JPA Designer uses the vapour resistivity with units of MNs/gm and vapour resistance with units of MNs/g. If material data is quoted as  $\mu$  or  $s_d$  values, multiply by five to obtain the resistivity or resistance respectively. You can find guidance on converting from European units and from permeability and permeance figures in Annexes E.7 and E.8 of BS 5250:2011.

## 16.2 Environmental conditions

The condensation risk calculation requires mean monthly data for:

- **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 for a number of weather stations around the UK and Ireland, allowing you to select the nearest location to the project site<sup>2</sup>. Pick the nearest weather station to your site.

To view a map of locations click **View location of Google Maps**<sup>3</sup>. For a 'worst case' scenario select *Eskdalemuir*.

- **Internal relative humidity (Int RH)**; for buildings which are heated and naturally ventilated this is determined by the external relative humidity and moisture load generated by the activities taking place within the building. ISO 13788 defines five occupancy types with different humidity characteristics: BS 5250:2011 suggests relative humidity ranges for those types, see Table 16.1.

<sup>2</sup>The UK data is taken from Meteorological data 1961 –1990 published by the World Meteorological Office, while the data for the Republic of Ireland comes from the Met Éireann.

<sup>3</sup>Map courtesy of Andrzej Niedzielski.

**Environmental Conditions**

☒ Use 2003 Condensation Method

Internal & External Conditions

Building location: (UK) Eskdalemuir [View locations on Google Maps](#) (Thanks to Andrzej Niedzielski, Greenspan System Sales Ireland Ltd., Ballynahill, Co. Limerick, Ireland)

☒ Calculate internal conditions based on external conditions

☐ Use design data for internal conditions

Climate

☒ Maritime ☐ 'Continental' or tropical

Internal humidity class: 4 - Dwellings with high occupancy, sport halls, kitchens, canteens; buildings heated with unflued gas heaters

Internal temperature (°C): 20.0

Risk level: Average

	Int T	Int RH	Ext T	Ext RH
Jan	20.0	68.2	1.8	86.5
Feb	20.0	67.3	1.8	83.5
Mar	20.0	66.2	3.5	81.5
Apr	20.0	65.2	5.7	79.0
May	20.0	65.3	8.7	77.5
Jun	20.0	67.8	11.7	78.5
Jul	20.0	70.8	13.2	80.5
Aug	20.0	71.7	12.9	82.5
Sep	20.0	70.0	10.7	84.0
Oct	20.0	68.5	8.1	85.0
Nov	20.0	67.7	4.1	86.0
Dec	20.0	68.2	2.5	87.0

OK Cancel

Figure 16.1: The Environmental conditions dialogue

- **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 20°C as a default value for a UK building.

For fully conditioned buildings it is appropriate to use design internal conditions, rather than derive them from the external conditions and moisture load.

- **Risk level:** As the available climate data is based on mean values averaged over thirty year periods, there will be some years which have better conditions than the mean and some years which will have worse. It is possible that constructions which are predicted to be free of condensation in average conditions will suffer condensation in colder and more humid years. BS 5250:2011 gives a method for testing the likely effect of worse than average years by means of risk years, with corrections to replicate the worst conditions likely over five, ten, twenty and fifty years. The appropriate return period for a calculation will depend on the sensitivity of the project to condensation: for example, a computer data centre might require a fifty year return period, while a house might only merit a five year return period.

Environmental conditions data is entered using the **Environmental conditions** dialogue (Figure 16.1):

1. On the **Edit** menu click **Environmental conditions**.

2. Make sure the **Use 2003 Condensation Method** is ticked (see chapter 17 for a description of the previous method).
3. Select the location of the building from the **Building location** list. The **Ext T** and **Ext RH** columns will be completed. If you have site specific data you can type values directly into the table.
4. For a naturally ventilated building:
  - Tick **Calculate internal conditions based on external conditions**.
  - Set the **Climate** to *Maritime*.
  - Select the humidity class in the **Internal humidity class** list. The **Int RH** column is completed.
  - 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.
  - Set the **Risk level** from the list. Selecting a return period will make the external conditions more onerous, with longer periods being harsher than shorter ones.
5. For a conditioned building:
  - Tick **Use design data for internal conditions**.
  - From the list select a set of internal conditions. If you cannot find a suitable dataset in the list you may need to create the dataset before beginning analysis (see section 37.1).
6. Click **OK** to accept the data and close the dialogue.

Table 16.1: Humidity classes

Class	Building type	Relative humidity (%)		
		15°C	20°C	25°C
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

## 16.3 Viewing results

You can view the results of condensation risk analysis in three formats:

- As month by month data, in the ISO Condensation Table (section 16.3).
- As a graph, in the Dewpoint graph (section 16.3).
- In summary form, in the Results table (section 16.3).

## 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**: on the **View** menu select **ISO 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

Figure 16.2: ISO 13788 Condensation table

The upper part of the window (Figure 16.2) 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  $\text{g/m}^2$ . A negative amount of condensate indicates the amount of moisture predicted to evaporate in that month.

The results always start with the first month in which condensation is predicted: if no condensation is predicted in any month results start with January. Guidance on interpreting results is given in ISO 13788 and BS 5250.

## The Dewpoint graph

In condensation risk analysis the *dew point* is the temperature at which air would be saturated with vapour. Condensation occurs when the temperature at a point within the construction drops below dew point and the air cannot support all the water vapour, resulting in some of the excess being deposited as liquid water.

The **Dew point graph** is a visualisation of the relationship between the predicted temperature through an element and the dew point. The orientation of the **Dew point graph** is determined by the building element: walls are shown with layers running vertically and roofs with layers running horizontally.

The graph shows two lines:

- the temperature gradient through the construction, calculated for each interface, shown in red; and,
- the dew point at each interface, shown in blue.

The lines are plotted for the month with the worst condensation conditions.

Where the two lines do not touch the actual temperature is above dew point and no condensation is predicted at those interfaces. Condensation is predicted at any interface where the two lines touch (see Figure 16.3). Note that the actual temperature will never be lower than the dewpoint and the lines will never cross.

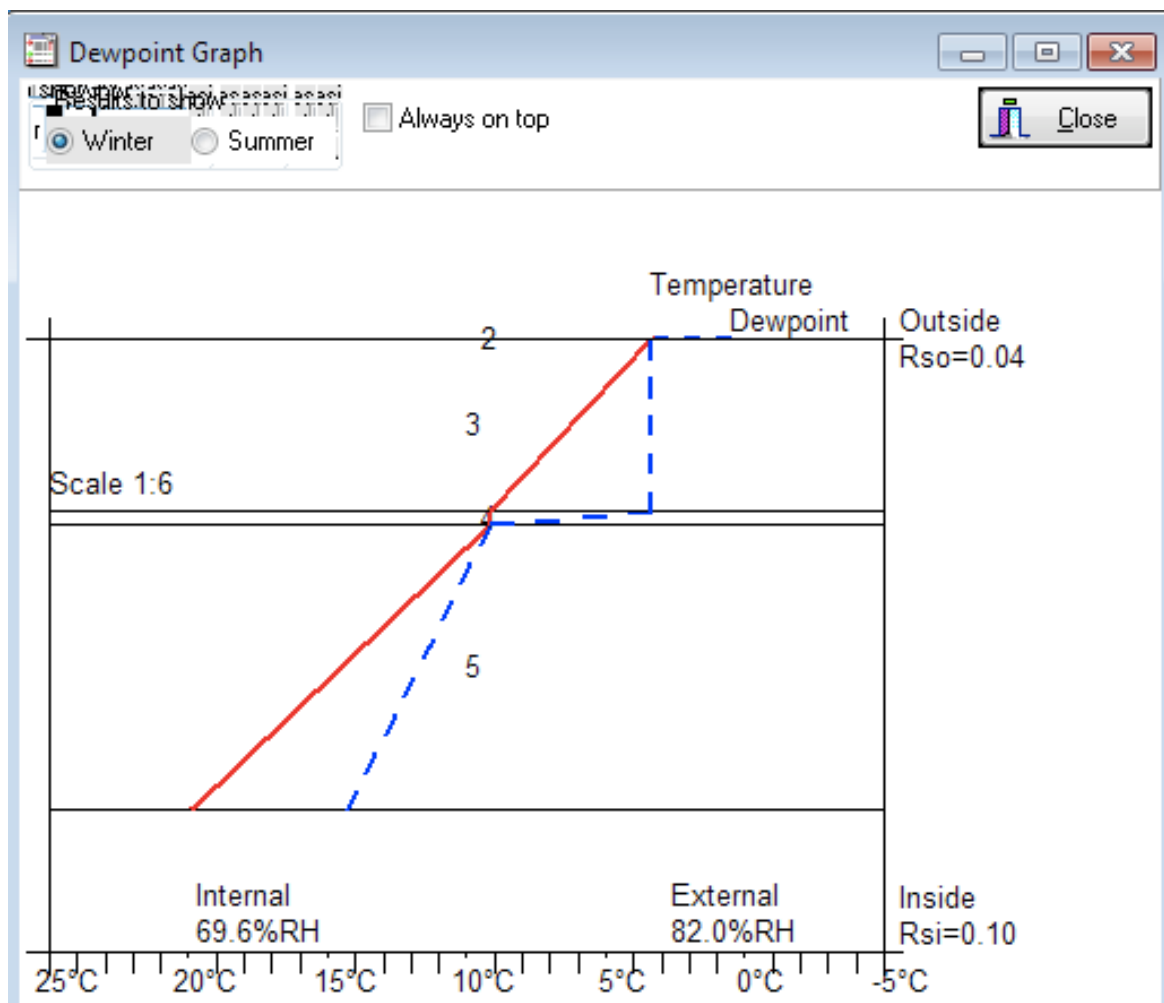


Figure 16.3: Dewpoint graph for a roof with condensation predicted at the interface between layers 4 and 5

To open the **Dewpoint graph**:

- on the **View** menu select **Dewpoint graph**; or,
- click the Dewpoint graph button on the tool bar.

To view the results for the month with the greatest evaporation, click the *Summer* button in the **Results to show** section.

## The Results table

The **Results Table** shows the headline results for each interface in the construction. To view the **Results table**: on the **View** menu click **Results Table**. When the table is 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  $\text{g/m}^2$ . The result *n/a* means no condensation is predicted at that interface. You can see more detailed results in the **ISO Condensation table**.

## Producing reports

The results of condensation risk analysis can be printed or produced as PDF files in the same way as the results of thermal calculations (chapter 12).

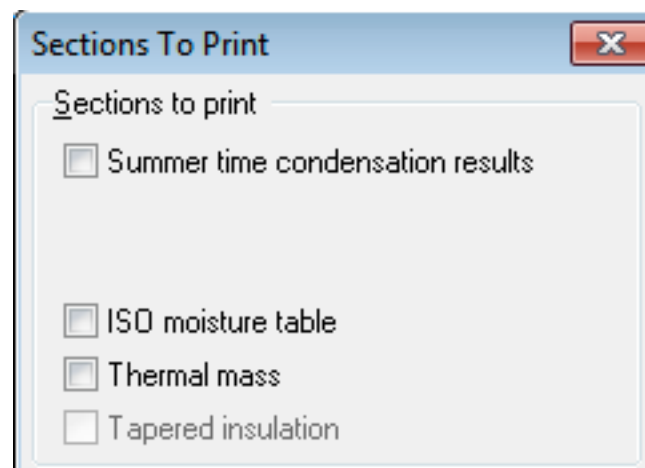


Figure 16.4: The Sections To Print dialogue for condensation risk reports

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.

# 17 Using the BS 5250:1989 calculation method

---

The BS 5250:1989 Appendix D method is based on the same underlying principles as the method set out in ISO 13788, but analyses condensation risk for a 60 period rather than the whole year and reports results in a different way. The Appendix D method is no longer referred to by building regulations and standards, but is still available within JPA Designer.

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

## 17.1 External conditions

The program sets standard values for external environmental conditions, following BS 6229:1982 and BS 5250:1989, which are:

- summer temperature: 18°C.
- winter temperature: 5°C.
- 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.

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.

## 17.2 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 **Building Use**, which are taken from BS 5250 and BS 6229, Table 7.

## 17.3 BS 5250:1989 results

Once you have set the environmental conditions you can view the calculation results using the **Results table** (section 16.3) and the **Dewpoint graph** (section 16.3). On the results table the important columns are:

- **Winter buildup** which shows the build up of condensate over the 60 day winter period; and,
- **Annual buildup** the amount of condensate carried over into the next year. A negative figure indicates there is no condensation carried forward.

Both figures are given in g/m<sup>2</sup>.

## 17.4 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 be 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 **Options** dialogue go to the **Other** tab.
2. Tick **Set vapour resistance of layers above vented cavity to zero**.
3. Open the condensation risk calculation.
4. Double click on the cavity layer.
5. In the **Edit material** dialogue set the cavity type to **vented cavity**.

The program will set the vapour resistance of the layers outside the cavity to zero.

**Part V**  
**SAP 2012**

# 18 The JPA Designer SAP 2012 module

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## 18.1 Overview of the SAP 2012 module

The JPA Designer SAP 2012 module enables you to carry out calculations to demonstrate a dwelling complies with the requirements of Part L 2013 (England), Part L 2014 (Wales) and Section 6, 2015 (Scotland)<sup>1</sup>. The module also lets you issue energy performance certificates (EPCs) for new dwellings<sup>2</sup>, whilst the results of calculations may be used as part of assessments under the Code for Sustainable Homes.

The SAP 2012 module uses the SAP 9.92 methodology to:

- calculate the Target Fabric Energy Efficiency (TFEE) and Dwelling Fabric Energy Efficiency (DFEE);
- calculate the Target Carbon Dioxide Emission Rate (TER) and the Dwelling Carbon Dioxide Emission Rate (DER).
- check 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 9.92 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/sap2012](http://www.bre.co.uk/sap2012)) together with the appropriate Approved Document or Technical Handbook.

## 18.2 Preparing to carry out a SAP 2012 calculation

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

- dwelling floor area;
- the ventilation strategy;

---

<sup>1</sup>For Northern Ireland you should continue to use SAP 2009 - V9.90, which is described in the JPA Designer 5.01 user manual.

<sup>2</sup>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.

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

### 18.3 Carrying out a SAP 2012 calculation

Carrying out a SAP 2012 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 you enter data in the **SAP Worksheet Values** dialogue. Once you have finished entering data you can print off the results or make adjustments to the data. The main steps are:

1. Create a new SAP 2012 calculation (section 3.7).
2. Open the calculation in the SAP module (section 3.9).
3. Enter the **Project Information** (section 18.5).
4. Open the **SAP Worksheet Values** dialogue and enter the dwelling data (section 18.6).
5. Check the compliance status on the main **SAP window** (section 18.4) and make any necessary changes.
6. Produce print-outs or PDF files of the calculation reports (section 29.2).
7. Save your project (section 3.5).

### 18.4 The SAP window

The **SAP window** lets you access the SAP menus and tool bar and displays the results of calculations (Figure 18.1). The main features are:

1. The menu bar.
2. The SAP 2012 toolbar: the buttons give direct access to key program functions and to the tabs on the **SAP Worksheet Values** dialogue.
3. The status indicators which show how much data you have entered for each section of the calculation (see below for a more detailed description).

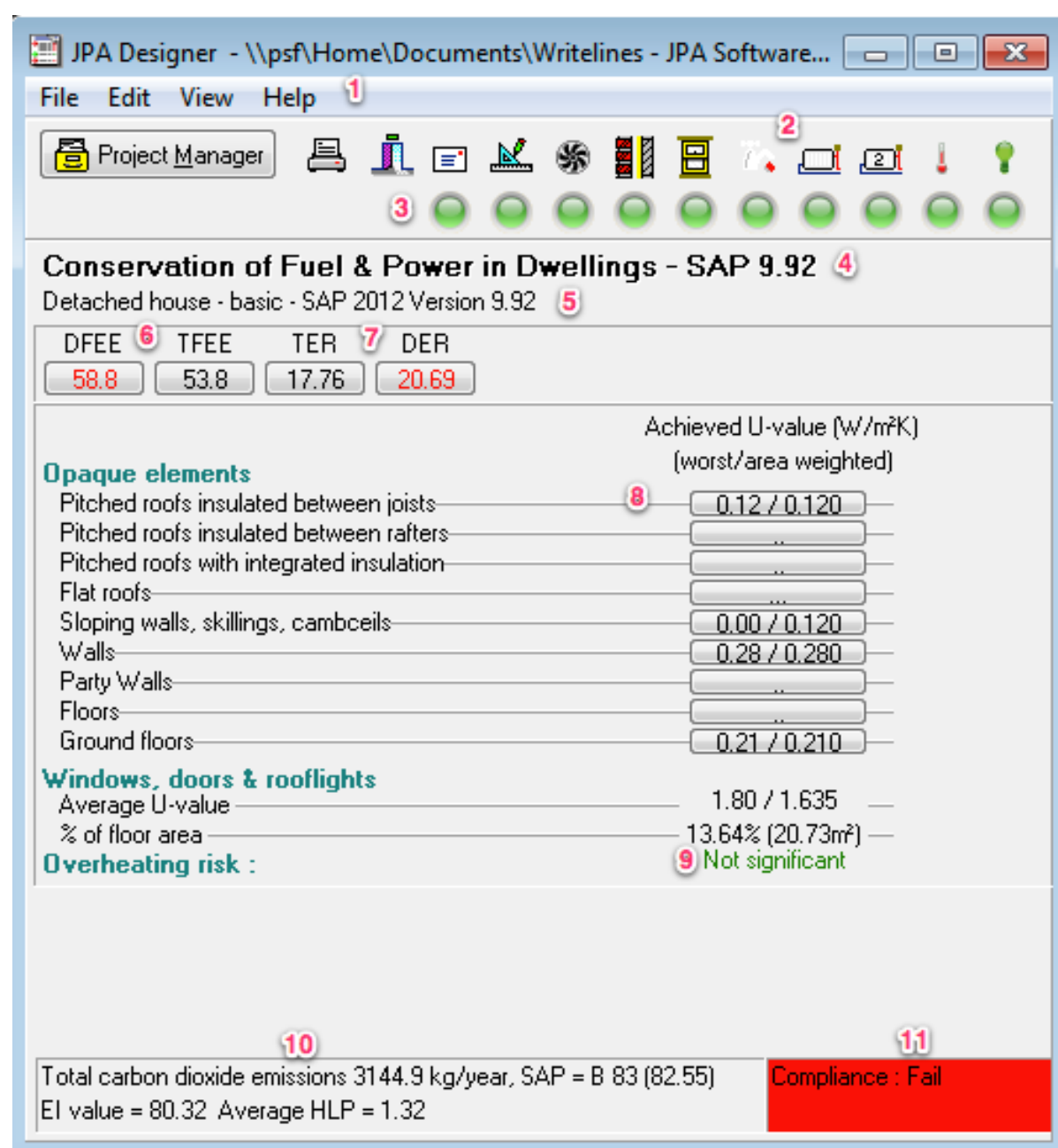


Figure 18.1: The main SAP window. 1 – Menu bar. 2 – Toolbar. 3 – Status indicators. 4 – SAP version. 5 – Calculation name. 6 – Fabric Energy Efficiency results. 7 – Dwelling emissions results. 8 – Fabric U-values. 9 – Overheating assessment. 10 – SAP rating. 11 – Compliance status.

4. The SAP version – in this case SAP 9.92, SAP 2012.
5. The calculation name, as entered in the **Project Manager** window.
6. The TFEE and DFEE results.
7. The TER and DER results.
8. 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.
9. Overheating risk assessment.
10. Carbon dioxide emission and SAP results, including the average Heat Loss Parameter (HLP).
11. 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 18.2). Double clicking on the zone will open the **Compliance Checklist**.



Figure 18.2: Tool tip showing the primary cause of failure



Figure 18.3: The SAP toolbar: 1 – Return to **Project Manager**. 2 – **Print**. 3 – Exit JPA Designer. 4 – *Project information* (section 18.5). 5 – *Dimensions* tab (chapter 19). 6 – *Ventilation* tab (chapter 20). 7 – *Walls, roofs and floors* tab (chapter 21). 8 – *Openings* tab (chapter 22). 9 – *Hot water* tab (chapter 23). 10 – *Primary heating* tab (chapter 24). 11 – *Secondary heating* tab – (chapter 25). 12 – *Overheating* tab (chapter 26). 13 – *Photovoltaic and alternative technologies* tab (chapter 28).

The toolbar buttons are shown in Figure 18.3; the majority of them open the **SAP 9.92 2012 Worksheet Values** dialogue at different tabs. The coloured status indicators below many of the toolbar buttons indicate the status of the data you have supplied for that part of the calculation:

- Red: There is none or very little data in that section.

- Orange: Most of the data is there, but one or two items in that section are still missing.
- Green: All the data necessary for completing the SAP calculation has been entered.

The indicators provide a quick way of seeing how far you have come in a calculation. However, you must remember the indicators refer only to the extent of data you have entered and have nothing to do with whether a dwelling will comply with regulations.

## 18.5 Project information in SAP

A SAP 2012 calculation requires general information about the project (such as the name and address of the client), the project address and basic information about the dwelling itself. All this information is entered in the **Project Information** dialogue (Figure 18.4), which is opened by selecting **Edit>Project Information** from the menu bar.

### Address details

The client and project address details are shown on calculation worksheets and reports. The location of the dwelling, which affects some parts of the SAP calculation, is set using the project address details.

The client name and address, and the dwelling address should be typed into the appropriate fields (items 1, 2 and 3 in Figure 18.4). Use the <Tab> key to move between fields. You can also use the **Inherit** button to use the address details for the project in the current calculation (see section 3.3 for instructions.) The **Pass down** button can be used to copy the address details to all other calculations in the project.

You can add plot numbers and drawing references to link the calculation to a set of drawings or a naming scheme. Note the **Date** (Figure 18.4 item 3) is used in an EPC lodgement as the survey date.

It is essential to enter a post code for the dwelling, as the EPC recommendations are based on local climate conditions, set by post code. Where the dwelling does not have a full post code – perhaps because it has not been assigned yet – you need only enter the first block, e.g. BT25. (However, the **UPRN** box and the **get UPRN** and **clear UPRN** buttons are only used when preparing to issue an EPC.)

### Dwelling details

**Project Information** contains general information about the dwelling:

- **Building type** (Figure 18.4 item 7): this is used in the Energy Performance Certificate. Select the closest matching value from the drop-down. It is particularly important to select the correct option for flats.
- **Country**: the regional authorities in the UK have implemented SAP in slightly different ways. You must use the **Country** drop-down to select the correct location to ensure the dwelling is tested against the appropriate regulations. If the country and the location (see below) do not match, the program will give a warning. This can be overridden using the **Relax country check** box (see section 18.5).

**Project Information & Options**

Client name & address

Mr R T Builder

The Old Yard

Tawnyville <sup>1</sup>

Suedeshire

Post Code: BN12 3DR

Phone Fax

Email

Add to clients Edit clients list...

Reference / certificate Date

<sup>4</sup> 9 August 2010 <sup>5</sup>

Project address

Brownfield Mews

Ochre

Suedeshire

<sup>2</sup>

Post Code: BN12 4SD <sup>3</sup> get UPRN

UPRN clear UPRN

Plot/drawing # Pot 15 <sup>6</sup>

Building type Detached house <sup>7</sup>

Country England or Wales EPC Language English <sup>8</sup>

Location North East England <sup>9</sup> Look-up... <sup>10</sup>

Project type New dwelling as built <sup>11</sup>

Related party disclosure No related party <sup>12</sup>

<sup>13</sup> ☐ Treat low-E glass coating as "soft" <sup>14</sup> ☒ Enter gross opaque element areas

<sup>15</sup> ☐ Boiler comes under the exception procedure allowed in Part L

Inherit OK Cancel

Figure 18.4: The Project Information dialogue

- **EPC language** (Figure 18.4 item 8): 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** (Figure 18.4 item 9): this is used to in the overheating assessment and in SAP calculations for dwellings with space cooling. To set the **Location** enter the Post code (Figure 18.4 item 3) , then click **Look-up** (Figure 18.4 item 10). The program then sets the region. There is a map of SAP regions in Table 10 of the SAP 2012 document.  
*Where the dwelling does not have a full post code – perhaps because it has not been assigned yet – you need only enter the first block – e.g. BT25 – for the **Location** look-up to work.*
- **Project type** (Figure 18.4 item 11): defines whether the calculation is for a *new build*, *existing dwelling* or *conversion*.
- **Related party disclosure** (Figure 18.4 item 12): overrides the default disclosure for EPCs for that calculation.

## SAP calculation options

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

- **Treat low e glass coating as ‘soft’** (Figure 18.4 item 13): this is a legacy setting which affected calculations in SAP 9.70 and 9.80/1. It has no effect on SAP 2012 calculations.
- **Enter gross opaque element areas** (Figure 18.4 item 14): the SAP 2012 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 as they are specified.

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.

You can only change this setting *before* you have started to enter data in the **SAP Worksheet** dialogue. Once you have entered data the tick box will be greyed-out and inaccessible. This is to prevent the setting being changed halfway through a calculation and so avoid errors.

- **Boiler comes under the exception procedure allowed in Part L** (Figure 18.4 item 12): 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 permitted if the situation meets the conditions in the government’s *Condensing boiler installation assessment procedure for dwellings*<sup>3</sup>. You may therefore only tick this box if the conditions of the assessment procedure are satisfied.

<sup>3</sup>Guide to the Condensing Boiler Installation Assessment Procedure for Dwellings. DCLG. 2005. [http://www.planningportal.gov.uk/uploads/br/BR\\_PDF\\_PTL\\_CONDBOILER.pdf](http://www.planningportal.gov.uk/uploads/br/BR_PDF_PTL_CONDBOILER.pdf)

- **Relax country check:** by default JPA Designer checks to see the selected country and region match, using the Post code for the dwelling. However, there are some post code areas which cross country boundaries, resulting in erroneous warning messages. Ticking this box disables the check between region and country, allowing the country to be set correctly.

Once you have entered all the necessary data, click **OK**.

## 18.6 Entering information about the dwelling

The data for the SAP calculation is entered using the **SAP 9.92 2012 Worksheet Values** dialogue. The dialogue has a series of tabs, each covering one part of the SAP input data:

- **Dwelling dimensions:** the basic configuration of the dwelling, including the proportion of low energy lighting (chapter 19).
- **Ventilation:** air infiltration rates, ventilation strategy and system efficiency (chapter 20).
- **Walls, roofs and floors:** heat loss and thermal mass of the opaque building fabric (chapter 21).
- **Openings:** heat loss, solar gain and daylighting information for windows, doors and rooflights (chapter 22).
- **Water heating:** the source of domestic hot water, its efficiency and fuel type, including details of any solar panels (chapter 23).
- **Primary heating:** the main heating system, controls and fuel (chapter 24).
- **Secondary heating:** any additional heating system (chapter 25).
- **Overheating and cooling:** details for summer overheating, and any fixed cooling systems (chapter 26 and chapter 27).
- **PV & Alt Tech:** Photo-voltaic panels, wind turbines, and new renewable technologies (chapter 28).

To open the dialogue at the start of a calculation, click on the **Dwelling dimensions** button on the toolbar or on the **Edit** menu click **Dwelling dimensions**.

The tabs are listed at the top of the dialogue in the same order as they appear in the **Edit** menu (Figure 18.5). To move between sections simply click on the tabs. We recommend you work from left to right, starting with **Dwelling Dimensions** and finishing with **PV & Alt Tech**.

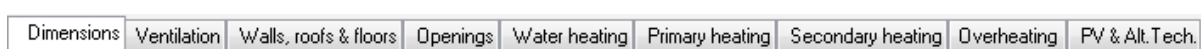


Figure 18.5: Tabs on the SAP 9.92 2012 Worksheet Values dialogue

At the bottom of the dialogue are a series of buttons (Figure 18.6):

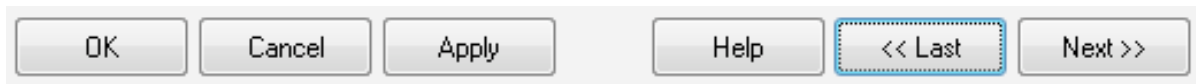


Figure 18.6: The buttons on the SAP Worksheet Values dialogue

- **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 9.92 2012 Worksheet Values** 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.
- **Next:** Takes you to the next tab.

# 19 Dwelling dimensions

The **Dimensions** tab (Figure 19.1) is used to enter data on the:

- area and volume of the dwelling;
- living area of the dwelling
- low energy lighting;
- dwelling orientation.
- position of a flat or maisonette in a block (Scotland only).

Dimensions	Ventilation	Walls, roofs & floors	Openings	Water heating	Primary heating	Secondary heating	Overheating & Cooling	PV & Alt. Tech.
			Area (m <sup>2</sup> )	x	Av. Storey height (m)	=	Volume (m <sup>3</sup> )	
Basement floor			0.00	x	0.00	=	0.00	
Ground floor <input type="checkbox"/> party			0.00	x	0.00	=	0.00	
Ground floor (2)			0.00	x	0.00	=	0.00	
Exposed floor			0.00	x	0.00	=	0.00	
First floor <input type="checkbox"/> party			0.00	x	0.00	=	0.00	
Second floor <input type="checkbox"/> party			0.00	x	0.00	=	0.00	
Third floor <input type="checkbox"/> party			0.00	x	0.00	=	0.00	
Fourth and other floors <input checked="" type="checkbox"/> party			38.42	x	2.50	=	96.05	Party floor storey <input type="text" value="6"/>
Total floor area			38.42					
Dwelling volume							96.05	
Total floor area (m <sup>2</sup> ) which is 'living area' i.e. is accessible from the living room without opening doors or using stairs					<input type="text" value="16.00"/>	or enter a fraction between 0 and 1		<input type="text" value="0.4164"/>
Total fixed lighting outlets		<input type="text" value="7"/>	Low energy fixed lighting outlets		<input type="text" value="7"/>			
Fraction of low energy lighting (Appendix L)		<input type="text" value="1.000"/>						
Front of dwelling faces		<input type="text" value="North"/>						
Application date		<input type="text" value="22/05/2014"/>						

Figure 19.1: The Dimensions tab

## 19.1 Dwelling area and volume

The area and volume of the dwelling 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 calculation requires the *floor area* of each storey and the *average storey height*.

- **Floor areas** are measured to the internal surfaces of the walls bounding the dwelling, and should include 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 storey height** for the lowest floor of a dwelling is measured from finished floor surface to ceiling surface. For every other storey, the height is measured from the ceiling of the floor below to its own ceiling. 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.

For each storey enter the **floor area**, in m<sup>2</sup>, and the **average room height**, in m), against the appropriate row in the list. 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. Note that:

- Values must be entered against the appropriate storey. This is particularly important for flats: do not use *ground floor* unless it actually is a ground floor flat. Assigning floor area to the wrong floor will not affect the results of the SAP calculation, but incompatibilities between storey and party floor values will prevent lodgement of the EPC.
- Enter data for storeys on the fourth floor and higher on the final line.
- Where a floor has a different occupancy beneath it (such as another flat, maisonette, or retail unit) tick the **party** box on that row.
- For party storeys on the fourth floor or higher enter the floor number in **Party floor storey**. The storey number is the floor number plus one: for example, the second floor has a storey number of three.
- The two lines for *Ground floors*, 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.

## 19.2 Living area

The SAP 2012 calculation divides a dwelling into two parts:

- the *living area* which is the part of the dwelling presumed to be used most frequently; and,
- the rest of the dwelling.

The living area 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.

Enter the living area, in (m<sup>2</sup>), in **Total floor area which is living area**. JPA Designer will calculate the living area fraction.

## 19.3 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, which currently require at least 3 out of 4 light fittings (a fraction 0.75) to be low energy. Enter:

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

JPA Designer displays the **Fraction of low energy lighting**.

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. An accurate value is required for the EPC submission.

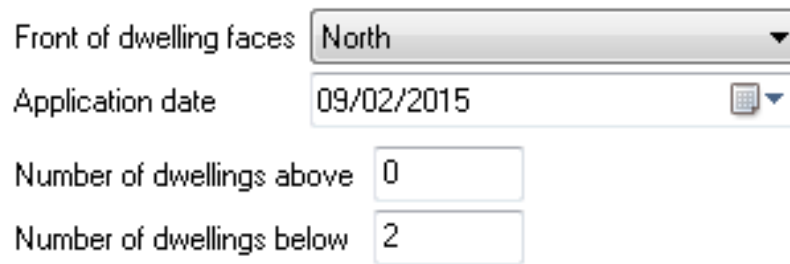
## 19.4 Orientation

The orientation of the dwelling is used with the data on openings for solar gain and overheating calculations.

To set the orientation, select a direction in the **Front of dwelling faces** list:

- 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.

The **Application date** is used in the EPC submission as the date on which the final EPC assessment was performed. Clicking the down arrow will open a calendar.



Front of dwelling faces	North
Application date	09/02/2015
Number of dwellings above	0
Number of dwellings below	2

Figure 19.2: Entering position in block for Scotland

## 19.5 Position in block

The TER calculation for section 6 in Scotland calculates the output of solar panels on the notional dwelling from the roof area of the actual dwelling. For flats and maisonettes that notional output is divided by the total number of dwellings beneath the roof area. In order to carry out this calculation the number of dwellings above and below a flat or maisonette must be entered in the Non-domestic premises in the same building are treated as one dwelling.

When the calculation region has been set to Scotland the **Dimensionstab** includes two addition boxes for the **Number of dwellings above** and **Number of dwellings below** boxes (Figure 19.2). JPA Designer will check the values entered into the two boxes against the definition of the flat or maisonette in the **Project Information** dialogue. It will warn you if the values are incompatible (e.g. a top floor flat with one or more flats above, or a mid floor flat with no flats above).

## 20 Ventilation

SAP determines the heat loss produced from air movement between the inside and outside of a dwelling by considering:

- air infiltration through the building fabric.
- details of the ventilation arrangements.

Data for air movement is entered using the **Ventilation** tab (Figure 20.1).

Dimensions Ventilation Walls, roofs & floors Openings Water heating Primary heating Secondary heating Overheating & Cooling PV & Alt. Tech.

Source of q50 value  
☒ Pressure Test ☐ Assumed ☐ Calculated (not suitable for Building Regulations compliance)

Pressurisation Test Result  
 Design q50 (m³/m².h) 10.00 ☐ as built ☒ as designed  
☒ This dwelling has been pressure tested

Ventilation

	main heating	secondary heating	other
Chimneys	0	0	0
Open flues	0	0	0
Flueless gas fires	0		
Sheltered sides	2.0		

Ventilation Type  
☐ Natural ventilation with intermittent extract fans  
☐ Natural ventilation with passive stack ventilators  
☐ Balanced whole house mechanical ventilation without heat recovery  
☒ Balanced whole house mechanical ventilation with heat recovery  
☐ Positive input ventilation from outside  
☐ Positive input ventilation from loft  
☐ Mechanical whole house extract ventilation  
☐ Decentralised mechanical whole house extract ventilation

☐ Approved installation scheme

Source of mechanical ventilation parameters  
☐ Default  
☐ User defined Enter details...  
☒ Database Lookup... Dantherm Air Handling A/S Dantherm Air Handling A/S HCH 5 500292  
☐ MEV or MVHR is part of exhaust air heat pump

☐ Duct from database Lookup...

% of windows & doors draught stripped \* 100.0  
 \* Enter 100 for new dwellings which are to comply with the Building Regulations

Figure 20.1: The Ventilation tab

## 20.1 Air infiltration

Air infiltration represents *unplanned* air movement. It is expressed as the volume of air which passes in one hour through a square metre of the surface of the building envelope:  $\text{m}^3/\text{hm}^2$ . The value is often referred to as the *q50* value, after the calculation result in BS EN 13829.

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

- Using the results of pressure testing.
- On developments of one or two houses, using an assumed value..
- Allow the software to calculate the infiltration rate from the construction type and building size.

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

### Pressure test data

Where air infiltration is being measured by pressure testing, the initial SAP calculation uses a design air permeability value, which is replaced by a final assessed permeability value once the dwelling has been completed.

To enter *design stage* air permeability:

1. At **Source of q50 value** select *Pressure test*.
2. Enter the air permeability in the **Design q50** box.
3. Set the radio buttons to *as designed*.
4. Tick **This dwelling has been pressure tested**.

The pressure testing regime set out in Approved Document L1A requires a proportion of dwellings on any site to be pressure tested<sup>1</sup>. The assessed air permeability used in the *as-built* SAP calculation depends on whether or not the dwelling in question has been tested itself:

- dwellings which have been tested: the assessed air permeability is the result from testing.
- dwellings which have not been tested: the assessed air permeability is the average results for that dwelling type, increased by two.

To enter *as-built* air pressure test data for a tested dwelling:

1. Enter the measured air permeability in the **Design q50** box.
2. Set the radio buttons to *as designed*.

---

<sup>1</sup>There are similar, but not identical requirements in place for Wales and for Scotland

3. Tick **This dwelling has been pressure tested**.

To enter *as-built* air pressure test data for a dwelling which has not been tested itself:

1. Enter the average air permeability for the dwelling type in the **Design q50** box.
2. Set the radio buttons to *as-built*.
3. Do **not** tick **This dwelling has been pressure tested**. JPA Designer will increase the entered pressure test value in the SAP and DER calculations by two.

### Small developments

Pressure testing is not required for developments of one or two houses, provided the DER calculation is carried out using an air permeability of  $15 \text{ m}^3/\text{hm}^2$ :

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  $15 \text{ m}^3/\text{hm}^2$ .

### 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. This is suitable for calculations for existing dwellings to Approved Document L1B.

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.

The software then calculates an air permeability rate based on the SAP defaults.

## 20.2 Ventilation openings

In the **Ventilation** section enter details of the ventilation openings 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.

*Chimneys and flues should be assigned to the main or secondary heating systems, or another appliance. There is no need to enter room-sealed and balanced flues to heating appliances, as they do not affect air movement in the occupied space.*

- **Flueless gas fires**<sup>2</sup>.

## 20.3 Sheltered sides

The rate of air infiltration resulting from the wind is affected by the number of exposed sides of the dwelling. SAP 2012 therefore adjusts infiltration according to the number of sheltered sides a dwelling has.

A sheltered side is:

- a party wall;
- a side which is sheltered by neighbouring buildings. The exact conditions are described in section 2.5 of the SAP 2012 document.

The number of sheltered sides is entered in the **Sheltered sides** box. If the local conditions are unknown, use a default value of two sheltered sides.

## 20.4 Ventilation type

There are two steps to defining the ventilation arrangements for the dwelling:

1. Use the **Ventilation Type** radio buttons to specify the type of ventilation in the dwelling (see section 2.6 of the SAP document for details of the different ventilation systems).
2. Specify the details of the system.

For all ventilation systems leave the box **100% draught-stripping** ticked.

The additional performance data for systems that require it can be set in three different ways:

- Use the *Default* performance values built into the SAP specification.  
*Although this is a valid option for calculation, the defaults values will give significantly poorer results than the other options.*

---

<sup>2</sup>Although the gas fires themselves are flueless, building regulations require specific ventilation provision for each appliance which will result in heat loss through air exchange.

Figure 20.2: Setting the source of mechanical ventilation data

- *User defined*: allows you to enter your own performance values, such as those supplied by product manufacturers.
- *Database*: performance values from the Product Characteristics Data File (PCDF) maintained by BRE.

*The PCDF values should be used wherever possible, as they will be most accurate.*

## Default performance values

To use default values select *Default* at **Source of mechanical ventilation parameters**. This will give a poor result for the dwelling as the default values are significantly worse than manufacturers' data.

If the ventilation system consists of intermittent extract fans or passive vents in bathrooms and toilets, enter the number of **intermittent fans** or **passive vents**.

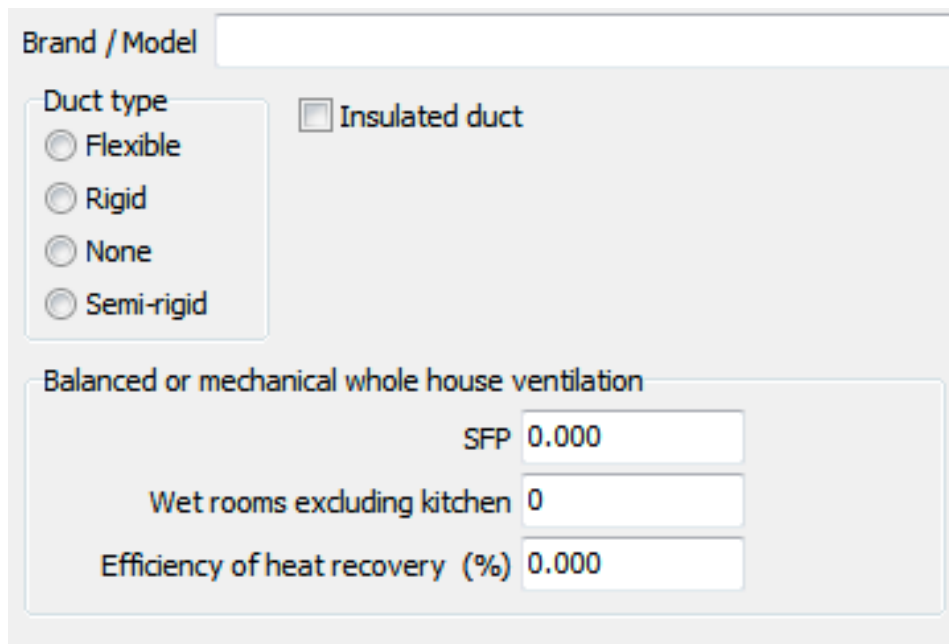
## Use-defined performance data

To enter user-defined performance data:

1. Select *User defined* at **Source of mechanical ventilation parameters**
2. Click **Enter details**.
3. Complete the details required for the specified system in the **User Defined Mechanical Ventilation** dialogue.

The parameters required for each ventilation type are:

- For balanced whole house mechanical ventilation (Figure 20.3):
  - Brand and model of system;
  - Duct type and whether or not the duct is insulated;



Brand / Model

Duct type

☐ Flexible

☐ Rigid

☐ None

☐ Semi-rigid

☐ Insulated duct

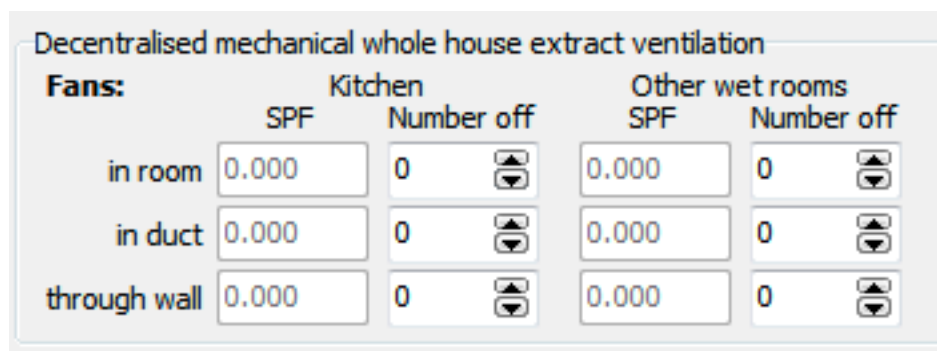
Balanced or mechanical whole house ventilation

SFP 0.000

Wet rooms excluding kitchen 0

Efficiency of heat recovery (%) 0.000

Figure 20.3: User defined data for balanced whole house mechanical ventilation



Decentralised mechanical whole house extract ventilation

	Kitchen		Other wet rooms	
	SPF	Number off	SPF	Number off
in room	0.000	0	0.000	0
in duct	0.000	0	0.000	0
through wall	0.000	0	0.000	0

Figure 20.4: User defined data for decentralised mechanical whole house extract ventilation

- Specific Fan Power (SFP);
- Number of wet rooms excluding the kitchen;
- Efficiency of heat recovery.
- For positive input ventilation from outside:
  - The duct configuration.
- For positive input ventilation from the loft:
  - No additional data.
- For centralised mechanical extract ventilation (MEV):
  - The Specific Fan Power (SFP);
  - whether the ducting is rigid or flexible.

- For decentralised mechanical whole house extract ventilation (Figure 20.4:
  - The **Specific Fan Power** (SFP) and number of fans; differentiating between fans in the kitchen and other wet rooms, and between *in room*, *in duct* and *through wall* fans.

## Using the Product Characteristics Data File

Mechanical Ventilation Database

Manufacturer: Greenwood

Database date 29/10/2010  
Database revision 302

Available

Ref.	Manufacturer id	Manufacturer	Brand	Model	Qualifier	1st Year Made	Final Year Made
500138	20004	Greenwood Air Management Ltd	Greenwood	Fusion HRV2		2009	current
500012	20004	Greenwood Air Management	Greenwood	Fusion HVR1			current
500052	20004	Greenwood Air Management Ltd	Greenwood	HRV95		2007	current
500005	20004	Greenwood Air Management	Greenwood	MVHR 90R			current

☐ Insulated duct

Balanced or mechanical whole house ventilation

Wet rooms excluding kitchen: 3

Use the selected system Cancel

Figure 20.5: The Mechanical Ventilation Database dialogue

To select value from the database:

1. Select *Database* at **Source of mechanical ventilation parameters**.
2. Click **Lookup**.
3. In the **Mechanical Ventilation Database** dialogue (Figure 20.5) 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. For decentralised mechanical whole house extract ventilation, instead of steps 5 and 6, enter the number of fans in kitchens and other wet rooms (Figure 20.4) against the appropriate fan type.
8. Click the **Use the selected system** button. The dialogue closes and the summary of the system is displayed next to the *Database* radio button.

If the ventilation system consists of mechanical extract ventilation (MEV) or balanced whole house ventilation with heat recovery (MVHR) which feeds an exhaust air heat pump you must tick the **MEV or MVHR is part of exhaust air heat pump** before opening the database, otherwise the products will not be displayed.

## Ducted systems

MVHR Duct

Manufacturer: Air Excellent

Database date: 27/1/2015

Database revision: 373

Table: \$341,441

Available

Ref.	Manufacturer id	Status	Manufacturer	Brand	Model	1st Year Made	Final Year Made	Duct type
520001	20023	Ubbink (UK) Ltd	Air Excellent	AE35		2011	current	semi-rigid

Use the selected duct Cancel

Figure 20.6: The MVHR Duct dialogue

The configuration of ductwork will affect the efficiency of ducted systems, as rigid ducts are more efficient than flexible ducts: this is reflected in the in-use factors for ductwork. Semi-rigid duct should be treated as flexible ducts, unless they have been demonstrated to work as well as rigid ducts and are listed in the PCDF.

To add a semi-rigid duct to the calculation:

- Tick **Duct from database** (Figure 20.2).
- Click **Lookup**. The **MVHR Duct** dialogue opens (Figure 20.6).
- Select the **Manufacturer**.
- Select a duct from the list shown for that manufacturer.
- Click **Use the selected duct**.
- The duct is now shown in the **Ventilation** tab.

### Approved installation schemes

Theoretically, a ventilation system fitted under an approved installation scheme will be more efficient than one fitted without quality control. Therefore, ticking **Approved installation scheme** improves the efficiency of a whole house ventilation system. However, at the time of writing (2015–11–02) there is no such scheme in place and consequently no reason to tick the box.

## 21 Walls, roofs and floors

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

- the rate of fabric heat loss for the dwelling through building elements;
- the rate of heat loss through junctions between elements;
- the thermal mass of the dwelling.

The data is entered using the **Walls, roofs & floors** tab of the **SAP Worksheet values** dialogue (Figure 21.1).

### 21.1 Defining building elements

SAP 2012 requires data for *all* elements of the building fabric, including:

- 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  $\text{m}^2$ , 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.*

- **U-value:** the rate of heat transfer through the element. U-values should be calculated to *BR 443 Conventions for U-value calculations*. The JPA Designer U-value module may be used for this. The requirements for U-values for different elements are summarised in Table 21.2. Note that for party walls between dwellings the U-values must be taken from Table 21.1.
- **$\kappa$ -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  $\kappa$ -values.

Dimensions | Ventilation | Walls, roofs & floors | Openings | Water heating | Primary heating | Secondary heating | Overheating & Cooling | F

Thermal Bridging  
☐ Enter Htb value manually Htb 0.0000   
☒ Enter y value manually ☒ Imported SAP 9.81/9.90 for EPC issue only y 0.0800 Calc Ref   
☐ Not accredited construction details

TMP Thermal mass  
☐ User defined Thermal Mass Parameter 0.00

No.	Element type	Net Area (m <sup>2</sup> )	U-value (W/m <sup>2</sup> K)	A x U (W/K)	Factored UA (W/K)	kappa-value (kJ/m <sup>2</sup> K)	A x K (kJ/K)
0	Pitched roofs insulated between joists	56.000	0.130	7.280	7.280	9.00	504.00
1	Walls	156.000	0.190	29.640	29.640	135.00	21060.00
2	Ground floors	50.000	0.160	8.000	8.000	20.00	1000.00
3	Party wall	23.000	0.000	0.000	0.000	70.00	1610.00

Figure 21.1: The Walls, Roofs and Floors tab

Table 21.1: U-values for party walls

Party wall construction	U-value (W/m <sup>2</sup> 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 21.2: 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 21.1	
Party wall – similar heating pattern	0.00 W/m <sup>2</sup> K	
Party wall – different heating pattern	Half calculated value	
Party floor – similar heating pattern	0.00 W/m <sup>2</sup> K	
Party floor – different heating pattern	Half calculated value	
Party ceiling – similar heating pattern	0.00 W/m <sup>2</sup> K	
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	

## The Element dialogue

The **Element** Dialogue is used to enter data on each of the dwelling's opaque elements (see Figure 21.2): 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. Select the appropriate construction: that will also set the **U-value**.
- **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) The storey number is the floor number plus one: for example, first floor is storey 2.
- 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 should therefore define the internal ceiling elements before you enter the internal floors.*
- **Heat capacity:** enter the heat capacity ( $\kappa$ -value) for the element: if you have selected a **Construction** its default heat capacity will already be entered.

**New Element**

Element: Walls

☐ Curtain wall

Construction:

Heat capacity (kJ/m²K):

**Enter areas INcluding doors, windows rooflights**

Area (including glazing) (m²):

U-value (W/m²K):

Effective thermal resistance of unheated space (Ru): 0 [? Help](#)

Link to this U-value calculation:

Perimeter (m):

Cost (£/m²):

...

Description:

OK Cancel

Figure 21.2: ElementDialogue

- **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. Click **Select Ru** to open the **Effective Thermal Resistance** dialogue, then pick the garage configuration in the dialogue. Further values for are given in section 3.3 of the SAP 2012 document.

- **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:** Ignore these boxes.

## 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.

The summary data on all the elements defined for a dwelling can be exported to an Excel spreadsheet by clicking **Send to Excel**.

## 21.2 Linear thermal bridging

SAP calculates the heat loss from thermal bridging at junctions between elements, which is usually referred to as **H<sub>tb</sub>** (heat loss by thermal bridging)<sup>1</sup>. There are three methods of calculating H<sub>tb</sub> for a dwelling:

1. Calculating the total heat loss from the length and linear thermal transmittance value for each junction type (section 21.2).
2. Use a simplified method based on a calculated **y-factor** (section 21.2). **This method is not valid for compliance calculations for new dwellings.**
3. Use a simplified method based on a default **y-factor** (section 21.2). **This method is not valid for compliance calculations for new dwellings in Scotland.**

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



### **New in SAP 2012: Thermal bridging at junctions**

With SAP 2012 as implemented in Part L 2013 (England), Part L 2014 (Wales) and Section 6 2015 (Scotland) user-defined y-factors are no longer permitted in compliance calculations. In Scotland it is also no longer permitted to use a default y-factor for thermal bridging if accredited construction details have not been used.

However, where a calculation is being upgraded to SAP 2012 in order to lodge and EPC, and the original compliance calculation is to SAP 2009 or earlier, it is permissible to use the same y-factor as the original calculation.

### **The H<sub>tb</sub> calculation**

The linear thermal transmittance, or  $\psi$ -value (pronounced *psi*-value) for a junction is the rate of heat loss through a one metre length of the junction, measured in units of W/mK. Junctions are categorised as junctions between walls and other elements or components (e.g. windows).

$\psi$ -values can be obtained from three sources:

1. Where an accredited construction detail<sup>2</sup> is used, you can use the  $\psi$ -value which has been calculated for that detail. Table K.1 in the SAP 2012 document lists values for accredited construction details.
2. Where a  $\psi$ -value has been calculated for a specific construction detail, by suitably qualified person, you can use that  $\psi$ -value. That might be a detail supplied by a manufacturer of a construction product featured in the detail.

<sup>1</sup>This is heat loss additional to that which takes place through the elements.

<sup>2</sup>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>.

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)
E1 Steel lintel with perforated steel base plate [D] E1	0.500	1.000	0.000	0.000
E10 Eaves (insulation at ceiling level) [D] E10	0.060	0.120	0.000	0.000
E11 Eaves (insulation at rafter level) [D] E11	0.040	0.080	0.000	0.000
E12 Gable (insulation at ceiling level) [D] E12	0.240	0.480	0.000	0.000
E13 Gable (insulation at rafter level) [D] E13	0.040	0.080	0.000	0.000
E14 Flat roof [D] E14	0.000	0.080	0.000	0.000
E15 Flat roof with parapet [D] E15	0.000	0.560	0.000	0.000
E16 Corner (normal) [D] E16	0.090	0.180	0.000	0.000
E17 Corner (inverted – internal area greater than external area) [D] E17	-0.090	0.000	0.000	0.000

Total : 0.000

[T] from Table K1, [A] from approved source, [N] calculated/from non-approved source, [D] default  
 E – Junction with an external wall. P – Junction with a party wall. R – Junction within a roof or with a room-in-roof. O – Other type  
 \* For these junctions, half the value of linear thermal transmittance is applied to each dwelling.  
 \* This is an externally supported balcony (the balcony slab is not a continuation of the floor slab) where the wall insulation is continuous and not bridged by the balcony slab.

Add... Edit... Delete Flush OK Cancel

Figure 21.3: The Calculate Htb dialogue

3. The default  $\psi$ -value from the final column of table K.1 in the SAP 2012 document. The defaults are *worst-case* values which represent constructions where little attention has been paid to continuity of insulation or airtightness.

To calculate **Htb** requires the length and  $\psi$ -value of each junction in the dwelling. The junction 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 data for the Htb calculation is entered using the **Calculate HTB** dialogue (Figure 21.3) which lists all the junction types assigned to the dwelling, showing for each one:

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

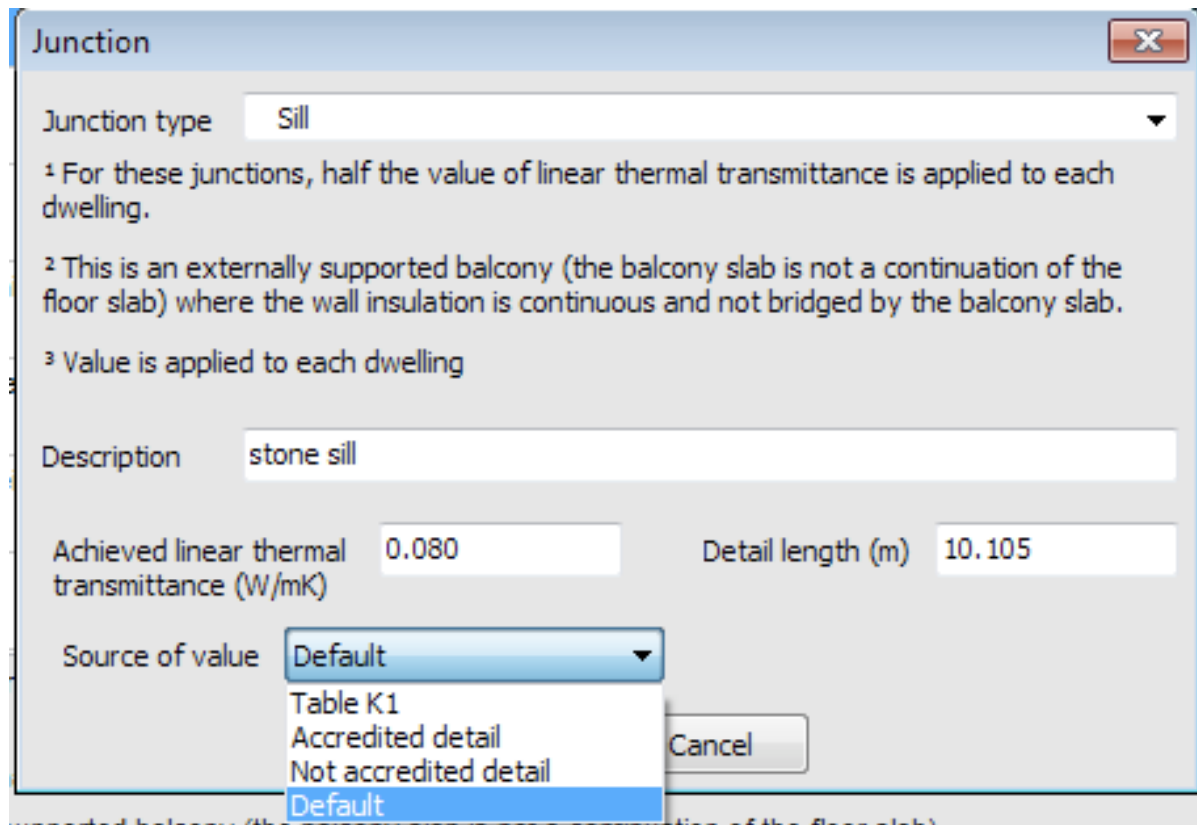


Figure 21.4: The Junction dialogue

When you first open the **Calculate Htb** dialogue the program adds one of each junction type in the junction list, with the length at zero and the  $\psi$ -value set to that of the corresponding accredited detail. The buttons at the bottom of the dialogue allow you to **Add**, **Edit** and **Delete** junctions. The **Flush** button can be removed unused junctions from the standard set.

To use the **Calculate Htb** dialogue:

1. In the **Thermal Bridging** section select *Enter HTB value manually*.
2. Click the **Calculate it** button. The **Calculate Htb** dialogue opens.
3. Edit the **length** of each junction which is found in the dwelling, and adjust the  $\psi$ -value if necessary.
4. Click **Flush** to remove all unused junctions.

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  $\psi$ -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**, which will be one of:
  - *Table K1*: the value for an accredited detail from Table K1 of the SAP 2012 document. The value is based on the junction type and cannot be edited.
  - *Accredited detail*: An accredited detail from a source other than Table K1. This can be used for a detail accredited by a third party scheme.
  - *Not accredited detail*: use this for a calculated  $\psi$ -value.
  - *Default*: the value for the non-accredited detail in Table K1. The value is based on the junction type and cannot be edited.
7. Click **OK**. The junction is added to the **Calculate Htb** dialogue.

A report summarising the junction data can be included in the calculation outputs (see section 29.2).

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  $\psi$ -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.

## User-calculated $\gamma$ 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,  $\gamma$ . However, with the introduction of Part L 2013 (England), Part L 2014 (Wales) and Section 6 2015 (Scotland) *the method is not valid for building regulations compliance for new dwellings*.

The method may be used for dwellings where the original SAP 9.81 or 9.90 calculation has been upgraded to SAP 9.92 in order to lodge an EPC. To use a user-defined  $\gamma$ -value: This procedure may be used where  $\gamma$  has been calculated for that type and configuration of dwelling. To use a calculated value for  $\gamma$ :

1. In the **Thermal Bridging** section select *Enter  $\gamma$  value manually*.
2. Tick **Imported SAP 9.81/9.90 for EPC issue only**
3. Enter the value for  $\gamma$  in the box.
4. Enter a reference for the calculated value of  $\gamma$  in the **Calc ref** box. The reference must refer to the calculation used to obtain the stated value.

If you choose this option the program will not display the TER worksheet nor the Compliance report as it is presumed you are producing an EPC for the dwelling, so will not require those two documents.

### Default $\psi$ factor

An approximate value for **Htb** may be obtained by using the simplified calculation method with a  $\psi$  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.

In Scotland this method is not valid for dwellings with building warrants issued on or after 1 October 2015. It may only be used for lodging EPCs for dwellings which have the original building warrant issued before 30 September 2015.

## 21.3 Thermal mass

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

1. Set the  $\kappa$ -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 (see Table 1e of the SAP 2012 document for definitions of the categories).

## 22 Openings

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Openings in walls and roofs – windows, doors and rooflights – 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 22.1). The tab lists the dwelling's windows, doors and rooflights, grouping them according to the building element in they sit. 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.

The buttons below the openings list allow you to create, edit and delete openings. For each opening the data is entered using the **Doors, Windows & Rooflights** dialogue (section 22.1).

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:

Dimensions		Ventilation	Walls, roofs & floors	Openings	Water heating	Primary heating	Secondary heating	Overheating & Co
No.	Element type	Area	U-value	Orientation	Frame	Air gap		
		(m <sup>2</sup> )	(W/m <sup>2</sup> )			mm		
	<i>Fitted roofs insulated between joists, roof</i>							
	<i>Walls, External walls</i>							
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, hard coat (East), W10	1.44	1.70	Back	PVC-u	12mm		





 New...
  Edit...
  Duplicate
  Delete...

Figure 22.1: The Openings tab

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.

You can export the summary data for all openings to an Excel spreadsheet by clicking **Send to Excel**.

**Edit Doors, Windows & Rooflights**

Opening type:

Opening within:

Glazing:

**Double-glazing air gap**

☐ 6mm ☐ Other ☒ 12mm ☐ 16mm

**Frame type**

☐ Wood ☐ Metal, 4mm thermal break ☐ Metal, 20mm thermal break

☒ PVC-u ☐ Metal, 8mm thermal break ☐ Metal, 32mm thermal break

☐ Metal, no thermalbreak ☐ Metal, 12mm thermal break

☐ Use user-defined frame factor user-defined frame factor

U-value (W/m²K)

Area (m²)

**Source of U-value**

☐ Default ☒ Manufacturer ☐ BFRC data

**g window value:-** Light transmittance is determined by glazing type (single, double or triple) so make sure you select the correct glazing

Description

**Opening Orientation**

☐ Front ☐ Right front ☐ Right ☐ Right back ☒ Back ☐ NorthWest ☐ Unspecified

**Window size**  Width (mm)  Height (mm)

**Overhang (used for overheating assessment)** Width (mm)  Depth (mm)

**Blinds, curtains & external shutters**

Fraction of daylight hours closed

**Overshading**

☐ Heavy (>80 % sky blocked)

☐ More than average (60-80 % sky blocked)

☒ Average or unknown (20-60 % sky blocked)

☐ Very little (<20 % sky blocked)

Figure 22.2: The Edit Doors, Windows &amp; Rooflights dialogue

## 22.1 Adding and editing openings

The **Doors, Windows & Rooflights** dialogue (Figure 22.2) is used to enter the data about the openings within the dwelling: 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 the 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.*

- If you have selected a rooflight at a pitch of less than 70° there will be an additional **Pitch** box which must be completed. It is enough to give the window pitch to the nearest 5°.
- **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.
- **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:** there are three configurations for the U-value and g window values:
  - *Default:* the software will use the built-in values for the U-value and solar transmittance based on the glazing, double glazing air gap and frame type selection.
  - *Manufacturer:* you should enter a U-value for the opening, but the solar transmittance will be based on the glazing and frame type.
  - *BFRC data:* you should 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, otherwise leave the default value.
- **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 overshadowing 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 set the source of U-value to *manufacturer* or *BFRC* you must enter 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 overhanging balconies or *brise soleil* will reduce the amount of sunlight falling on an opening in summer, and so reduce the solar gain. Where there is 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 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.



### Default over shading for openings

You can use the **Defaults** tab of the **Options** dialogue to set a default over shading value for openings.

## 22.2 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 22.2).
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.*

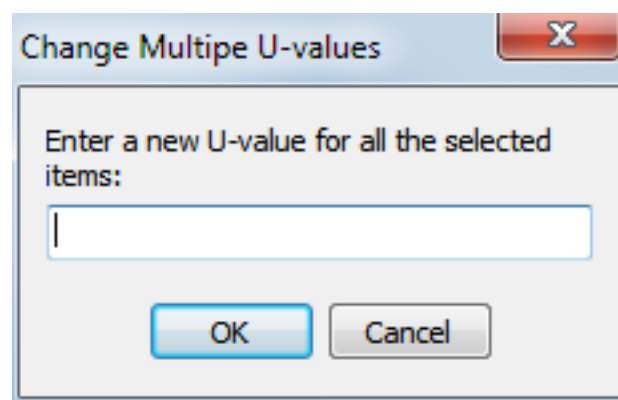


Figure 22.3: The *Change Multiple U-values* dialogue

You can also change the U-values of several openings at the same time, without adjusting any of the other settings:

1. In the **Openings** tab click on the first opening you want to change. Press and hold the <Shift> key then click the last opening to change. Those two openings, and all the ones between will be selected.
2. Click **Change U-value of selected**.
3. In the **Change Multiple U-values** dialogue (Figure 22.3) enter a new U-value and click **OK**. The U-values will be set to the new value.

## 23 Water heating

The screenshot shows the 'Water heating' tab in the SAP software interface. The 'Source of domestic hot water' is set to 'Hot water storage tank'. The 'Hot water tank' section includes a volume of 300.0 and a declared loss factor. The 'Storage tank insulation' is set to 'Factory' with a thickness of 100.00 mm. The 'Hot water tank heater' is set to 'Boiler feed'. The 'Hot water only boiler' is selected, and the fuel is set to 'Gas'. The 'Cylinder in heated space' and 'Cylinder thermostat' are checked. The 'DHW vessel within micro-CHP' is unchecked, and 'Separate timer for domestic hot water' is checked. The 'Primary insulation' is set to 'Uninsulated primary pipework'. The 'Solar panel details' section includes a table of collector properties and a table of solar collector types. The 'Direction' is set to 'South' and the 'Pitch' is set to '45 degrees'. The 'Overshading' is set to 'None or very little (<20 % sky blocked)'. The 'Solar powered pump' is checked, and the 'Showers' are set to 'Showers'. The 'Total water use of not more than 125 litres/person/day' is checked. A note at the bottom right states '\* Required by the Building Regulations'.

Solar panel details	
Aperture area of collector (net) (m²)	3.56
Zero-loss collector efficiency $\eta_p$	0.78
Collector heat loss coefficient $U_L$	3.91
2nd order collector heat loss coef. $U_{L2}$	0.01200
Dedicated solar storage (litres)	300.00

Solar collector type	
<input type="radio"/> Evacuated tube collector	
<input checked="" type="radio"/> Flat plate collector	
<input type="radio"/> Unglazed	

Pitch	
<input type="radio"/> Horizontal	<input type="radio"/> 60 degrees
<input type="radio"/> 30 degrees	<input type="radio"/> Vertical
<input checked="" type="radio"/> 45 degrees	

Figure 23.1: The Water heating tab, showing settings for a hot water storage tank

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 23.1).

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 24.2. For all other heat pumps use **Hot water storage tank**.*

- Community heating scheme providing domestic hot water only.

## 23.1 Hot water storage tank

Select this system for 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 23.1). 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.
- **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 2012.

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. The initial presumption is that the primary space heating system which is providing the domestic hot water, but this may be modified by using one of the tick boxes to indicate:
  - the hot water is provided by the second main heating system (see section 24.1);
  - the hot water is provided by the secondary heating system, which might be a solid fuel room heater with a back boiler (see chapter 25);
  - a default efficiency heat pump is supplemented by an immersion heater in the summer.
- *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 three lower boxes to indicate whether:

- the hot water tank (cylinder) is in the heated space;
- there is a thermostat in the hot water tank or cylinder (this is required by the Domestic Building Services Compliance Guides);
- there is a separate timer for domestic hot water.

Use the **Primary insulation** list to specify the extent of insulation to the primary pipework (the pipework between the heat source and the hot water storage vessel).



### New in SAP 2012: insulating pipework

The calculation of heat losses from pipework between the heat source and water storage tank or cylinder has been revised. You must now specify the extent of the insulation to that pipework – referred to as the *primary pipework*. Fully insulated pipework will perform best, followed by having all accessible pipework insulated, the first 1m of pipework insulated, while uninsulated pipework has the worst performance.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

## 23.2 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.

Figure 23.2: Entering an instantaneous hot water heater

## 23.3 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 2012 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.

Source of domestic hot water

Combination boiler

<p>Hot water tank</p> <p>Volume (l) <input type="text" value="210.0"/></p> <p>Declared loss factor if known (kWh/day) <input type="text"/></p>	<p>Storage tank insulation</p> <p><input checked="" type="radio"/> Factory <input type="radio"/> Jacket</p> <p>Thickness (mm) <input type="text" value="50.00"/></p>	<p>Combination boiler type</p> <p><input type="radio"/> Instantaneous</p> <p><input checked="" type="radio"/> Storage with a primary store</p> <p><input type="radio"/> Storage with secondary store</p>
--	--	--

Figure 23.3: 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 2012.

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (see section 23.10).

## 23.4 Community heating scheme

The hot water for dwellings heated by community heating schemes can be 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**;
  - enter the tank details (section 23.1);
  - tick **DHW cylinder within dwelling**;
- If there is no tank and the hot water is provided by a heat exchanger: tick **Plate heat exchanger in Community Heating**;
  - tick **DHW cylinder within dwelling**;
  - enter the volume of the heat exchanger in the *Hot water tank* **Volume** box;
  - enter the insulation type and thickness;

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

Figure 23.4: Data entry for gas water heaters or heat exchangers

## 23.5 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:

- **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 2012.

Use the three 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);
- there is a separate timer for the domestic hot water.

Use the **Primary insulation** list to specify the extent of insulation to the primary pipework (the pipework between the heat source and the hot water storage vessel).

If the dwelling has solar panels complete the **Solar panel details** section of the **Water heating** tab (section 23.10).

## 23.6 Boiler with thermal store

Use this option for thermal stores containing 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:

The screenshot shows a software interface for entering data for a thermal store hot water system. The main title is 'Source of domestic hot water'. Below it is a dropdown menu set to 'Boiler with a thermal store'. The form is divided into several sections:

- Hot water tank:** Includes a 'Volume (l)' dropdown set to 210.0, a 'Declared loss factor if known (kWh/day)' text box, and a 'Heat pump heat exchanger area' text box set to 0.00.
- Storage tank insulation:** Features radio buttons for 'Factory' (selected) and 'Jacket', and a 'Thickness (mm)' text box set to 50.00.
- Thermal store type:** Includes radio buttons for 'Hot water only' and 'Integrated' (selected).
- Is the Thermal Store close coupled?:** Includes radio buttons for 'Yes' (selected) and 'No'.
- CPSU/Thermal store in airing cupboard:** Includes radio buttons for 'Yes' and 'No' (selected).
- Hot water tank heater:** Includes radio buttons for 'Single electric immersion heater', 'Dual electric immersion heater', and 'Boiler feed' (selected). There are also checkboxes for 'From 2nd main heating system' and 'Summer immersion heater'.
- Fuel:** A dropdown menu.
- Additional options:** Includes checkboxes for 'Thermal store or CPSU has separate timer for heating store', 'Cylinder in heated space' (checked), 'Cylinder thermostat\*' (checked), 'Override heat pump database values', 'DHW vessel within micro-CHP', 'Insulated primary\*' (checked), and 'Separate timer for domestic hot water' (checked).

Figure 23.5: Data entry for a thermal store hot water system

- **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 2012.

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 1.5 m of insulated pipework.*

- There is a separate timer to the thermal store for the heating store.

Use the three 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);
- 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 23.10).

Source of domestic hot water  
Combined primary storage unit (CPSU)

**Hot water tank**  
 Volume (l)   
 Declared loss factor if known (kWh/day)   
 Heat pump heat exchanger area

**Storage tank insulation**  
☒ Factory Thickness (mm)   
☐ Jacket

**Hot water tank heater**  
☐ Single electric immersion heater  
☐ Dual electric immersion heater  
☒ Boiler feed ☐ From 2nd main heating system  
☐ Summer immersion heater  
☐ Hot water only boiler  
 Fuel

**CPSU/Thermal store in airing cupboard**  
☐ Yes ☒ No

**CPSU Winter operating temperature**  
☒ 85°C ☐ 90°C ☐ 95°C  
 Other (°C)

**CPSU Cylinder size**  
☐ 270 litres ☐ 300 litres ☐ 330 litres  
 Other (litres)

☐ Thermal store or CPSU has separate timer for heating store  
☒ Cylinder in heated space  
☒ Cylinder thermostat\* ☐ Override heat pump database values

☐ DHW vessel within micro-CHP  
☒ Insulated primary\* ☒ Separate timer for domestic hot water

Figure 23.6: Data entry for CPSU hot water supply

## 23.7 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 2012.

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);
- 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 23.10).

## 23.8 MicroCHP or heat pump

Use this option for systems in which the hot water is provided either by a domestic-sized combined heat and power (microCHP) system or by a heat pump with efficiency data from the Product Characteristics Database (section 24.2). (If 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.)

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 2012.
- **Heat pump heat exchanger area:** Enter the area of the heat exchanger plates in m<sup>2</sup>.

If the dwelling has solar panels complete the **Solar panel** section of the **Water heating** tab (section 23.10).

Figure 23.7: Settings for a community heating scheme which supplies only domestic hot water

## 23.9 Community heating scheme providing domestic hot water only

Use this option for a community heating scheme which provides domestic hot water, but does **not** provide the space heating. Typically, such system are found in flats or sheltered housing.

To specify a system:

- Set the **Source of domestic hot water** to **Community heating - domestic hot water only** (Figure 23.7).
- Set the **Heat Sources** for the system (section 23.9).
- 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 23.10).
- 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 2012.
- If there hot water is provided by means of plate heat exchangers:

- Tick the box **Plate heat exchanger in community heating**.
- Tick **DHW cylinder within dwelling**.
- Enter the volume and insulation details of the heat exchangers as the hot water tank.

## Heat sources

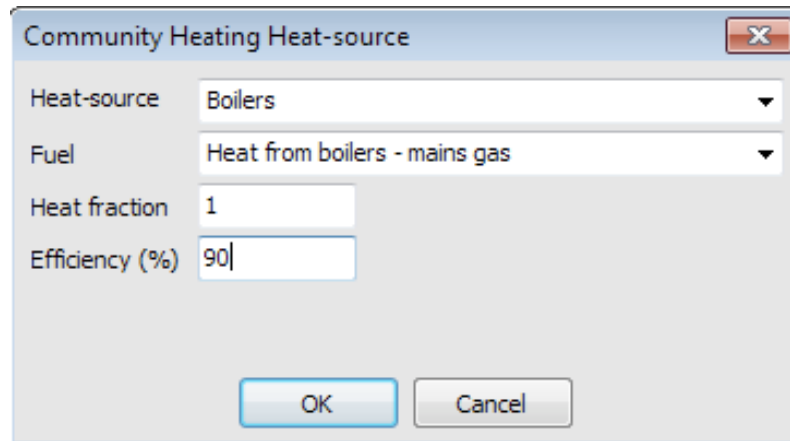


Figure 23.8: Setting a heat source for community heating/hot water

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 23.7): 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 23.8) 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.*

## 23.10 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.

Figure 23.9: Data entry for solar panel water heating



### New in SAP 2012: solar panels

In SAP 212 the usage of solar hot water is now modified by the configuration of showers in the dwelling. The best performance comes with non-electric showers only, while electric showers only will be worst. SAP 2012 also revised the calculation of output from solar hot water panels and has introduced the *second order heat loss coefficient*,  $a_2$ , which improves the accuracy of results for panels with less insulation.

Where a dwelling has solar panels, specify:

- The net **Aperture area of solar collector**, in square metres.
- The **Zero-loss efficiency of the collector**,  $\eta_0$ .
- The **heat loss coefficient** of the collector,  $a_1$ .
- The **second order collector heat loss coefficient**,  $a_2$ .
- 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.
- The configuration of **Showers**.

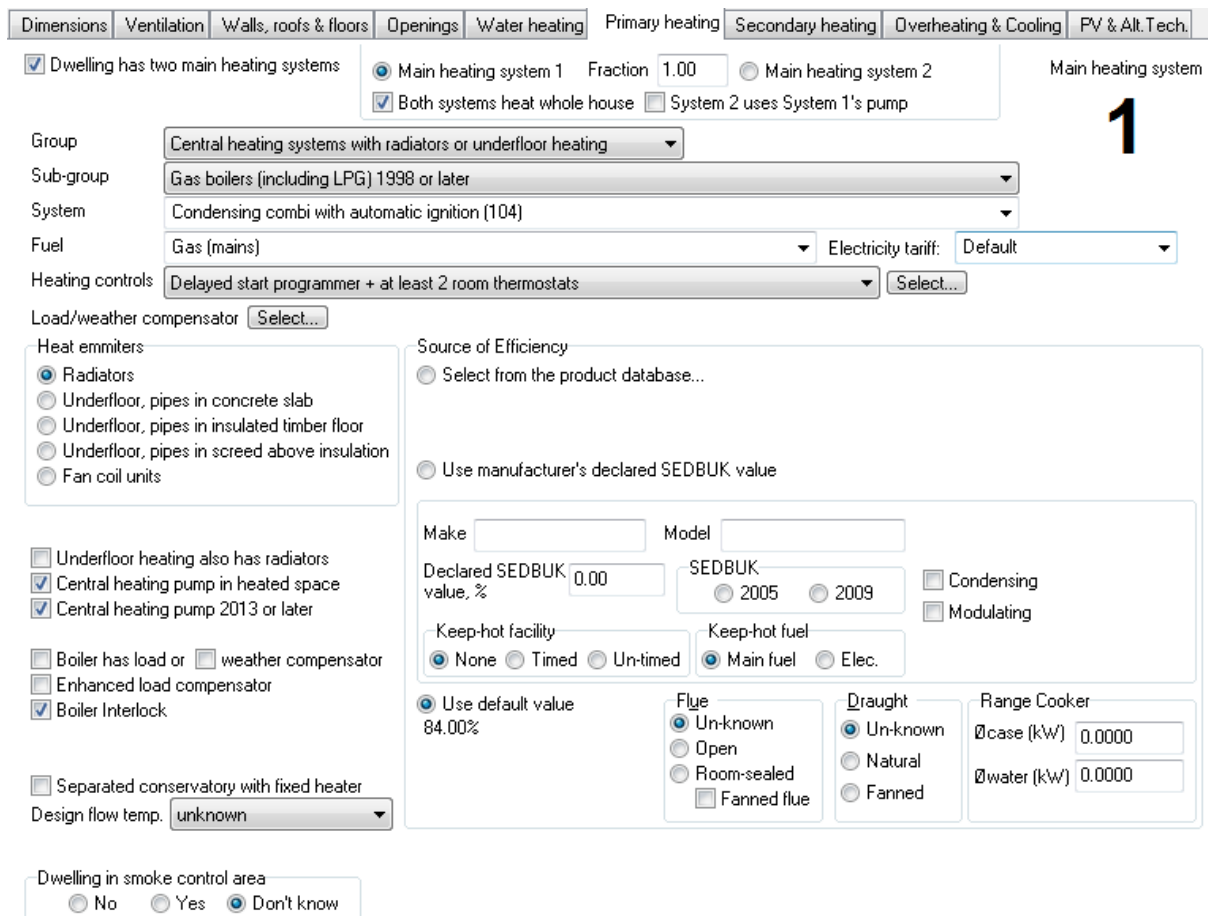


### Default over shading for solar panels

You can use the **Defaults** tab of the **Options** dialogue to set a default over shading value for solar panels.

## 24 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 24.1).



The screenshot shows the 'Primary heating' tab in a software interface. The interface includes several tabs at the top: Dimensions, Ventilation, Walls, roofs & floors, Openings, Water heating, Primary heating (selected), Secondary heating, Overheating & Cooling, and PV & Alt. Tech.

Key settings and options visible include:

- ☒ Dwelling has two main heating systems
- ☒ Main heating system 1 (Fraction: 1.00) and ☐ Main heating system 2
- ☒ Both systems heat whole house and ☐ System 2 uses System 1's pump
- Group: Central heating systems with radiators or underfloor heating
- Sub-group: Gas boilers (including LPG) 1998 or later
- System: Condensing combi with automatic ignition (104)
- Fuel: Gas (mains)
- Electricity tariff: Default
- Heating controls: Delayed start programmer + at least 2 room thermostats
- Load/weather compensator: Select...
- Heat emitters:
  - ☒ Radiators
  - ☐ Underfloor, pipes in concrete slab
  - ☐ Underfloor, pipes in insulated timber floor
  - ☐ Underfloor, pipes in screed above insulation
  - ☐ Fan coil units
- Source of Efficiency:
  - ☐ Select from the product database...
  - ☐ Use manufacturer's declared SEDBUK value
- Make: [ ] Model: [ ]
- Declared SEDBUK value, %: 0.00
- SEDBUK: ☐ 2005 ☐ 2009
- Condensing: ☐ Modulating: ☐
- Keep-hot facility: ☒ None ☐ Timed ☐ Un-timed
- Keep-hot fuel: ☒ Main fuel ☐ Elec.
- ☒ Use default value 84.00%
- Flue: ☒ Un-known ☐ Open ☐ Room-sealed ☐ Fanned flue
- Draught: ☒ Un-known ☐ Natural ☐ Fanned
- Range Cooker:
  - Øcase (kW): 0.0000
  - Øwater (kW): 0.0000
- Underfloor heating also has radiators: ☐
- Central heating pump in heated space: ☒
- Central heating pump 2013 or later: ☒
- Boiler has load or weather compensator: ☐
- Enhanced load compensator: ☐
- Boiler Interlock: ☒
- Separated conservatory with fixed heater: ☐
- Design flow temp.: unknown
- Dwelling in smoke control area: ☐ No ☐ Yes ☒ Don't know

Figure 24.1: The primary heating tab showing two main heating systems

## 24.1 Dwellings with two main heating systems

SAP 2012 can account for the uncommon case of a dwelling having two main heating systems, which are designed to heat the house together<sup>1</sup>. The two systems may be configured to heat the all the dwelling together, or to heat parts of it separately.

☒ Dwelling has two main heating systems
 
☒ Main heating system 1    Fraction: 0.50    ☐ Main heating system 2
 
Main heating system **1**

☐ Both systems heat whole house

Group: Central heating systems with radiators or underfloor heating

Figure 24.2: Configuring a dwelling with two main heating systems

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 24.2).
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. If the systems share the same pump tick **System 2 uses System 1's pump**.  
*This affects electricity use and heat gains for pumps.*
5. Specify the first system in the **Primary heating** tab.
6. 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.



### Setting the second system for hot water only

For large houses there may be a dedicated boiler or water heater for hot water. This can be specified in SAP 2012 by setting up two heating systems and assigning the hot water only system as system 2. The fraction for system 1 is then set to 1.00. Then in the **Water heating** tab set the **Source of domestic hot water** to *Hot water storage tank*. In the *Hot water tank heater* section tick **From 2nd main heating system**.

<sup>1</sup>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.

## 24.2 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 2012 document.
- data from the Product Characteristics Data File (the PCDF, see below): this gives the most accurate values for specific appliances.
- user-entered efficiencies: this can be useful at the design stage when no appliance has been specified. User-entered efficiencies may not be used for gas and oil boilers in final 'as-built' SAP calculations and EPCs: the values must be replaced by PCDF figures.

For some systems (for example, gas-fired warm air systems) only the default SAP 2012 efficiencies may be used, whilst for others (for example, gas condensing boilers) any of the three sources is acceptable. Note that heat pumps can be specified either using the PCDF, or by accepting the default efficiencies: microCHP systems can only be specified by means of the PCDF.

### The Product Characteristics Data File

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 28.4). The database is maintained by the BRE and a revised 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 prompt a check of the PCDF: on the **File** menu click **Download and re-load Product Characteristics Data File**.

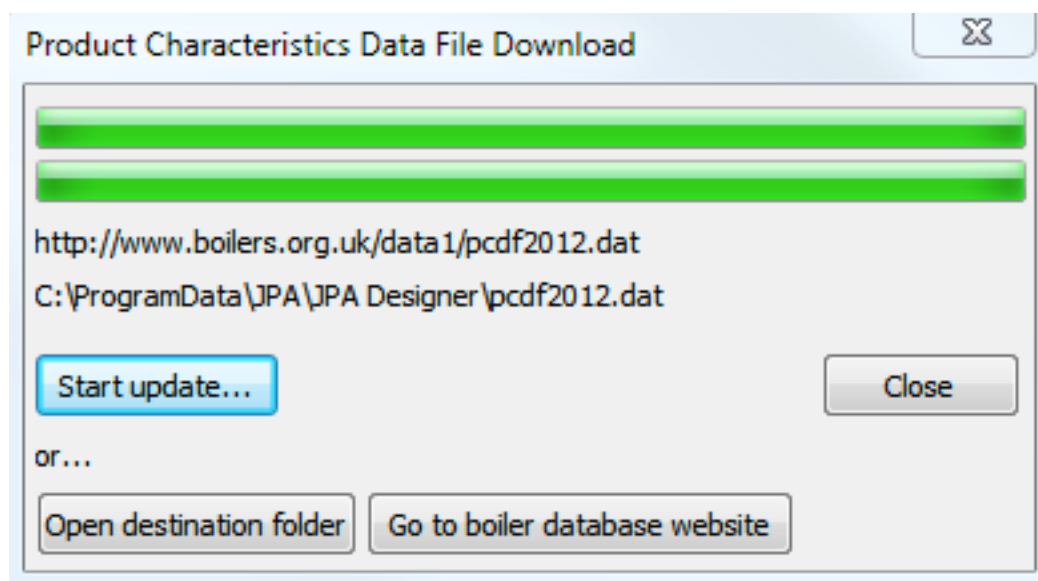


Figure 24.3: Updating the PCDF

The procedure for updating the PCDF is the same for automatic or manual checks:

1. In the **Product Characteristics Data File Download** dialogue click **Start update**. JPA Designer downloads the latest data files for SAP 9.90 and SAP 9.92 and displays an *Update complete* message.
2. Click **OK**.
3. At the information dialogue which asks *Would you like to load the new database* click **Yes**. JPA Designer loads the new data file.
4. Click **Close** to finish the process.

The data in the PCDF can be viewed at <http://www.ncm-pcdb.org.uk/sap/>

## SEDBUK efficiencies

One measure of boiler efficiency used in SAP is the SEDBUK rating (Seasonal Efficiency of Domestic Boilers in the UK). There was a change in the calculation method for SEDBUK efficiency ratings with the introduction of SAP 2009 which resulted in a general lowering of efficiencies. Whilst JPA Designer allows you to enter either 2005 or 2009 SEDBUK ratings, you should 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.

## 24.3 The main primary heating systems

There are seven main groups of primary heating system<sup>2</sup>: 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:

- **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 type of heating, then enter any additional data.

---

<sup>2</sup>Note that *none* is not an acceptable heating option for a new dwelling.

## Heating controls

The heating controls for the primary heating system is set using the **Heating controls** list. The control options listed will depend on the **Group**, **Sub-group**, **System** and **Fuel** settings.

The SAP 2012 document contains descriptions of control options in section 9.4. Broadly speaking, in JPA Designer, the control options towards the bottom of the list will do better than those at the top of the list. For dwellings with a floor area greater than 150 m<sup>2</sup> the heating controls must include time and temperature zone controls.



### New for SAP 2012: specifying heating controls

In SAP 2012 it is theoretically possible to select the heating controls from the PCDF (see section 24.2), to give more accurate results. This would be done by setting the **Heating controls** then using the **select** button to the right of the list to open the **Heating Controls Database** dialogue, then selecting the **Manufacturer** and **Model** of controls. At the time of writing (2015 11 02) there are no controls in the database to select.

The efficiency of some heating systems may be improved by load or weather compensators. These may be specified using the **load**, **weather** or **enhanced load compensator** boxes.



### New for SAP 2012: specifying compensators

In SAP 2012 it is possible to select the load or weather compensator from the PCDF (see section 24.2), to give more accurate results using the **Load/weather compensator select** button, then in the **Heating Controls Database** selecting the **Manufacturer** and **Model** of controls.

## Central heating systems with radiators or underfloor heating

This group covers wet central heating systems with radiators, underfloor pipes, or fan coil units, with 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**;  
*To combine underfloor heating on the ground floor with radiators on the first floor set the **Heat emitters** to one of the underfloor options and tick **Underfloor heating also has radiators**.*
- the efficiency of the boiler (section 24.3);
- additional items such as heating controls (see section 24.3) and:
  - is the central heating pump in a heated space?
  - is the central heating pump manufactured in 2013 or later? Always tick the box for a new dwelling.
  - for an oil-fired boiler, is the oil pump in the heated space?
  - is there a boiler interlock? That is, the system is configured to prevent the boiler firing when there is no demand for heat.

## Boiler efficiency

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

BRE Boilers Database

Brand: Baxi

Database date: 23/9/2015

Database revision: 367

Table: 5105,210

Available boilers/heat pumps

Ref.	Manufacturer id	Manufacturer	Brand	Model	Qualifier	ID	SAP winter seasonal efficiency
17073	5	Remeha	Baxi	Avanta Plus 28c Combi		47-673-02	90.0%
17071	5	Remeha	Baxi	Avanta Plus 35c Combi		47-673-03	90.4%
17072	5	Remeha	Baxi	Avanta Plus 39c Combi		47-673-04	90.6%
10031	5	Baxi Potterton	Baxi	Combi	100 HE Plus	GC No. 41-075-15	90.3%
10030	5	Baxi Potterton	Baxi	Combi	80 HE Plus	GC No. 41-075-16	90.3%
17326	5	Baxi Heating UK	Baxi	MainEco Combi	28		90.1%
17325	5	Baxi Heating UK	Baxi	MainEco Combi	24		90.2%

Filters

Min. SAP winter seasonal efficiency (%) 90

Mounting position wall

☒ Filter

Use the selected appliance Cancel

Figure 24.4: Using the Product Characteristics Database to set the boiler efficiency

To use the PCDF:

1. Select the *Select from the boiler database* radio button.
2. Click the **Select boiler** button. The **BRE Boilers Database** dialogue opens (section 24.2).
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.

You can use the *Filters* to ensure the program shows only boilers over a certain efficiency, or with a specified mounting position. Ticking and unpicking the **Filter** box activates and deactivates the filtering.

*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.*

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  $\phi$ **case** and  $\phi$ **water**.



### **New for SAP 2012: boiler efficiency**

It is no longer permissible to use a directly-entered SEDBUK value for final *as-built* calculations for Building Regulations approval. A directly-entered value must be replaced by a boiler selected from the PCDF for the *as-built* calculation.

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  $\phi$ **case** and  $\phi$ **water**.

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

## Storage radiator systems

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



### New for SAP 2012: high heat retention storage heaters

SAP 2012 has introduced a new category of *high heat retention storage heaters* which can be specified using the PCDF.

To specify high retention storage heaters:

1. Set :
  - **Group** to *Storage radiator systems*;
  - **Sub-group** to *Off-peak tariff*;
  - **System** to *High heat retention storage heaters*;
  - **Fuel** to the appropriate tariff.
  - **Heating controls** to *Controls for high heat retention storage heaters*.
2. At **Source of efficiency** click *Select from the product database*.
3. Click **Select product**. The **BRE Boilers Database** dialogue opens.
4. Select the manufacturer from the **Brand** list.
5. Click on the model then click **Add storage heater to list**.
6. In the **Quantity** dialogue enter the **number** of that model of storage heater.
7. If there is another model of storage heater in the dwelling repeat steps 4–6.  
*Note there cannot be more than five storage heaters in the dwelling.*
8. Click **OK**.

If you need to remove a storage heater from the calculation, select it in the **Selected storage heaters** list then click **Delete selected storage heater**.

## Warm air systems

The heat for warm air systems is provided by gas, oil, electricity or heat pumps. For most systems the only data required is that from the primary heating drop boxes.

If you are specifying a warm air system powered by a condensing gas heater or a heat pump it is possible to use efficiency data from the PCDF (see section 24.3 for guidance on the procedure).

## Room heater systems

This group includes room heaters such as gas or solid fuel fires<sup>3</sup>. 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.

## 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.

## 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 2012 document contains further information on the treatment of community heating schemes in SAP.

Group: Community Heating Scheme

Electricity tariff: Default

Heating controls: Charging system linked to use of community heating, programmer and at least two room ther

Load/weather compensator: Select...

Community heating

Heat distribution system: Calculated 1.08

Heat sources:

- Source : Boilers Fuel : Heat from boilers - biomass Heat fraction : 0.8000 Efficiency 89.0000%
- Source : Boilers Fuel : Heat from boilers - mains gas Heat fraction : 0.2000 Efficiency 93.0000%

New... Edit... Delete...

Figure 24.5: Data entry for a community heating scheme with two heat sources

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 24.5).
- set the heat sources;
- set the heating controls;
- set the heat distribution system.

To set the heat sources:

<sup>3</sup>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.

Figure 24.6: Setting a heat source for community heating

- Click the **New** button: the **Heat source** dialogue opens (Figure 24.6).
- Select the type of heat source from the **Heat source** drop-down.
- Select the **Fuel** from the drop-down.  
*When specifying a fuel which is not listed, use the **Special fuel name**, **emission factor** and **primary energy factor** to enter its details.*
- 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.*
- Enter the percentage **Efficiency** of the heat source.  
*Note the efficiency should be entered as a percentage.*
- For a CHP system enter the heat to power ratio, which will typically be in a range of 1.25–1.5.
- 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:

- 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.*

The heat distribution setting is used to determine the distribution losses for the system. You can either:

- Use a default value based on the type of pipes used to circulate hot water: select the pipe configuration from the **Heat distribution system** list.
- Use a calculated distribution loss factor which is specific to the project (there is guidance on calculating such a loss factor in Appendix C of the SAP 2012 document): select *calculated* from the **Heat distribution system** list, then enter the loss factor in the neighbouring box.

## Electric underfloor heating

This option represents 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.

## 24.4 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 <http://smokecontrol.defra.gov.uk/index.php><sup>4</sup>. Tick the box if the dwelling is within a smoke control area.

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<sup>4</sup>There does not appear to be a central source on smoke control areas: the only means of finding out is to contact the local authority.

## 25 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 2.14. The fraction of space heating provided by the secondary system is defined in table 11 of the SAP 2012 document. Data on secondary heating is specified using the **Secondary heating** tab (Figure 25.1).

The screenshot shows the 'Secondary heating' tab selected among several other tabs: Dimensions, Ventilation, Walls, roofs & floors, Openings, Water heating, Primary heating, Secondary heating, Overheating & Cooling, and PV & Alt. Tech. The form contains the following fields:

- Group:** Room heater systems (dropdown)
- Sub-group:** Solid fuel (dropdown)
- System:** Closed room heater (633) (dropdown)
- Fuel:** Wood logs (dropdown)
- ☐ Solid fuel room heater is HETAS approved
- ☒ Use manufacturer's declared efficiency
- Make:** Morso (text input)
- Model:** Badger (text input)
- Declared efficiency, %:** 82 (text input)
- BS Test Method:** BS EN 13229 (dropdown)

Figure 25.1: The Secondary heating tab

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**.

If the solid fuel room heater has been **approved by HETAS**<sup>1</sup> 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.

<sup>1</sup>Heating Equipment Testing and Approval Scheme.

## 26 Overheating

Location in country : Undefined

Effective air change rate

☐ Enter value  ach

☐ Night ventilation

Building

Window opening

Cross ventilation can be assumed only if the at least half of the storeys in the dwelling have windows on opposite sides and there is a route for the ventilation air. Normally bungalows and two storey houses can be cross ventilated because internal doors can be left open. Three storey houses or other situations with two connected storeys of which one is more than 4.5 m above ground level often have floors which have fire doors on to stairs that prevent cross ventilation.

Slightly open refers to windows that can be securely locked with a gap of about 50 mm. Often this option will not give sufficient ventilation.

Figure 26.1: Overheating data on the Overheating and cooling tab

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 2012 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** list to set default values.



### Setting default window opening conditions

You can use the **Defaults** tab of the **Options** dialogue to set the default window opening condition for the overheating test. The drop down allows you to set the open gin to the same standard conditions as the Window opening\*\* list on the Overheating tab.

## 27 Cooling

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☒ Dwelling has fixed air conditioning system

Cooling

Cooled fraction (enter 0 if there is no cooling)

Energy label class

☐ User defined Energy Efficiency Ratio EER

System type

☒ Split or multi-split

☐ Packaged

Compressor control

☐ On/off

☒ Modulating

Figure 27.1: Settings for air conditioning systems

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 27.1). The **Cooled 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.

## 28 Renewables and special features

Photovoltaics					
	Peak kW	Pitch	Direction	Overshading	
1.	0.00			Modest (20-60 % sky blocked)	<input checked="" type="checkbox"/> Connected to electricity meter
2.	0.00			Heavy (>80 % sky blocked)	<input checked="" type="checkbox"/> Connected to electricity meter
3.	0.00			Heavy (>80 % sky blocked)	<input checked="" type="checkbox"/> Connected to electricity meter

Special features / new energy-saving technologies (Appendix Q)			
Description of new technology			
Energy saved (kWh/year)	0.00	Type of fuel saved	
Energy used (kWh/year)	0.00	Type of fuel used	
Other Appendix Q Technologies			
<div style="text-align: right;"> <input type="button" value="New..."/> <input type="button" value="Edit..."/> <input type="button" value="Delete..."/> </div>			

Additional allowable electricity generation for box (ZC6) (kg/m <sup>2</sup> /year)	0.000	Hydro-electric generation (kWh/year)	0.00
---	-------	--------------------------------------	------

Micro wind turbines on the building or within its curtilage		<input type="checkbox"/> WWHRS <input type="button" value="Lookup..."/> /	
Number of turbines	0	WWHRS Dedicated storage volume (l)	
Rotor diameter (m)	0.000	0.00	
Terrain type		<input type="checkbox"/> FGHRs <input type="button" value="Lookup..."/>	
Height of turbine hub above ridge of roof (m)	0.000	FGHRs PV Module:	
		Peak kW	Direction
		0.00	
			Overshading
			Heavy (>80 % sky blocked)

Figure 28.1: The Photovoltaics and Alternative Technologies tab

SAP 2012 takes account of the contribution of certain renewable sources of energy and some heat recovery technologies, including:

- photovoltaic panels (section 28.1);
- wind turbines linked to one dwelling (section 28.2);
- hydro-electric generators (section 28.3);
- waste water heat recovery units (WWHRS) (section 28.4);
- flue gas heat recovery systems (FGHRs) (section 28.5).

The data for all those systems is entered in the **Photovoltaics and Alternative Technologies** tab (abbreviated to **PV & Alt Tech**, Figure 28.1). That tab is also used for entering the amount of any additional energy generated by other means (section 28.6).

## 28.1 Photovoltaic panels

Photovoltaic panels (PV) generate electricity from sunlight. JPA Designer enables you to include three different sets of panel, which may be at different orientations or pitches. For blocks of flats the benefits from PV are applied as follows:

- where the PV is connected to an individual flat the output contributes to CO<sub>2</sub> emissions calculations and ratings calculations.
- where the PV is connected to all dwellings (usually by the landlord supply) the benefit is applied CO<sub>2</sub> emissions calculations, but not to ratings calculations. The total PV rating – the **Peak kW** value – should be divided between the dwellings in proportion to their total floor areas.

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 is likely to be less than that of any windows facing in the same direction.);
5. If the PV array is connected directly to the electricity supply of the dwelling tick **Connected to electricity meter**. Do not tick the box for a flat where the PV output feed to the landlord supply.

## 28.2 Wind turbines

The electricity generated by a wind turbine attached to a building or on a mast within its curtilage (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 M3 of the SAP 2012 document for further details.

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 the improvement recommendations for an EPC, JPA Designer must calculate the notional benefit gained from installing a wind turbine. You must therefore specify the **Terrain type** even if there is no wind turbine on the dwelling.



### Setting the default terrain type

The SAP module always requires a terrain type for the wind turbine for determining the improvement recommendations, even if there is no wind turbine. You use the **Defaults** tab of the **Options** dialogue to set a default value for the terrain, which will then be used in every subsequent SAP calculation. For example, you may find that virtually all the projects you work on can be classified as *Low-rise urban/suburban*. You can always override the default for calculations which do not fit the default.

## 28.3 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 2012 document for further details.

## 28.4 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. WWHRS are either:

- *Instantaneous*, recovering heat from waste water from mixer showers as it is discharged, in one of three ways<sup>1</sup>:
  - System A: output of the heat exchanger is fed to both the shower and the combi boiler or hot water system
  - System B: output of the heat exchanger is fed to the shower only
  - System C: output of the heat exchanger is fed to the combi boiler or hot water system but not to the shower
- *Storage*, recovering heat from multiple appliances to a store which then pre-heats cold water to combi boiler or hot water system.

To specify instantaneous WWHRS:

- In the **PV & Alt Tech** tab tick **WWHRS** and click the **Lookup** button. The **WWHR Database** dialogue opens (Figure 28.2).

<sup>1</sup>See Figure G1 in the SAP 2012 document for illustrations of these systems.

WWHR Database

Manufacturer

Database date 18/12/2014

Database revision 372

Table: \$353,453

Available

Ref.	Manufacturer id	Manufacturer	Brand	Model	Qualifier	1st Year Made	Final Year Made	Efficiency	Utilisation

Select as instantaneous system 1

Select as instantaneous system 2

Select as storage system

Total rooms with shower and/or bath 

0

**Instantaneous System 1:**

Number of mixer showers in rooms with a bath 

0

Number of mixer showers in rooms without a bath 

0

Clear

**Instantaneous System 2:**

Number of mixer showers in rooms with a bath 

0

Number of mixer showers in rooms without a bath 

0

Clear

**Storage System 1:**

Total number of baths and showers (any type) 

0

Number of baths and showers whose waste water is routed through the WWHRS 

0

Dedicated WWHRS storage volume (litres) 

0.00

Clear

OK

Cancel

Figure 28.2: Entering data on WWHR systems

- 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**.
- 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** (do not count instantaneous electric showers in the number of mixer showers).
- Click **OK**.

To specify storage WWHRs:

- In the **PV & Alt Tech** tab tick **WWHRs** and click the **Lookup** button. The **WWHR Database** dialogue opens (Figure 28.2).
- Use the **Manufacturer** drop-down to select the manufacturer, then highlight the specified product in the list and click **Select as storage system**.
- In the *Storage System 1* section enter:
  - the **Total number of baths and showers**
  - the **Number of baths and showers whose waste water is routed through the WWHRs**.
  - the **Dedicated WWHRs storage volume** in litres.
- Click **OK**.

## 28.5 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 28.3).
2. Select the **Manufacturer**.
3. Select the type from the **Available** list.
4. 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.

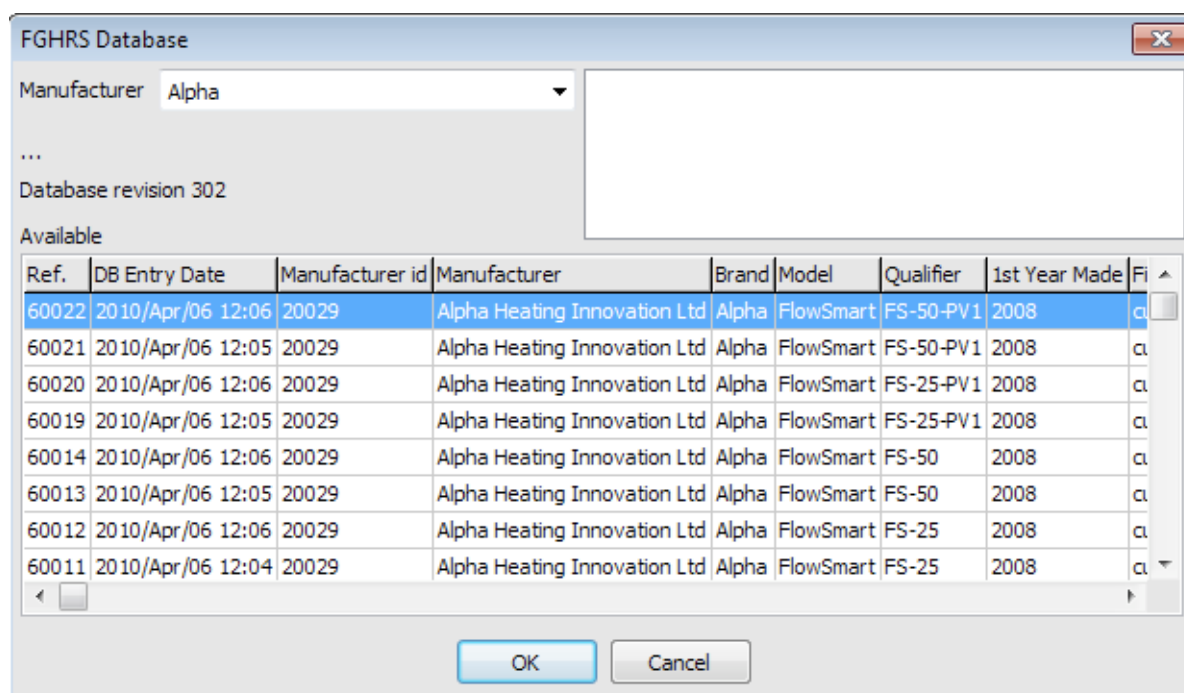


Figure 28.3: The flue gas heat recovery systems (FGHRS) database

## 28.6 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 20012 document). Electricity generated by wind turbines linked to a development by private wire may be entered here.

## 28.7 Special features

SAP 2012 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.ncm-pcdb.org.uk/sap/page.jsp?id=18>. The web site has a calculation spreadsheet for the various product types<sup>2</sup> 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.

<sup>2</sup>There are separate spreadsheets for different versions of SAP: make sure you use the appropriate version.

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. The Appendix Q spreadsheet will contain instructions specific to the calculation.
3. Transfer the results from the spreadsheet to the **Special features** section of the **Photovoltaics and Alternative Technologies** tab (Figure 28.1), entering:
  4. a brief **Description** of the technology.
  5. the **Energy saved** figure, using the drop-down to select the **Type of fuel saved**.
  6. 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 2012.

## 29 Compliance and reports

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Once you have entered all the data for the dwelling you can check its compliance status and produce worksheets and compliance reports as PDFs or in hard copy.

### 29.1 Checking compliance

Once the program has enough data to complete a SAP calculation it will show the calculation results– including the TER and DER – and 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 cursor over over the **compliance zone** and the software will display a tool-tip will show the primary cause of failure (see Figure 18.2).

You can see a more detailed report on the compliance status on 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.

To open the compliance checklist double click on the **Compliance zone** or on the **View** menu click **Compliance checklist**. You can use the tabs at the bottom of the **Compliance Checklist** to view all the calculation worksheets and reports.

JPA Designer checks:

1. The TFEE and TER status for England and TER status for Wales and Scotland.
2. Backstop values for fabric and services including:
  - maximum permissible fabric U-values;
  - maximum permissible air leakage rates;
  - design limits for fixed building services.
3. Summer overheating.

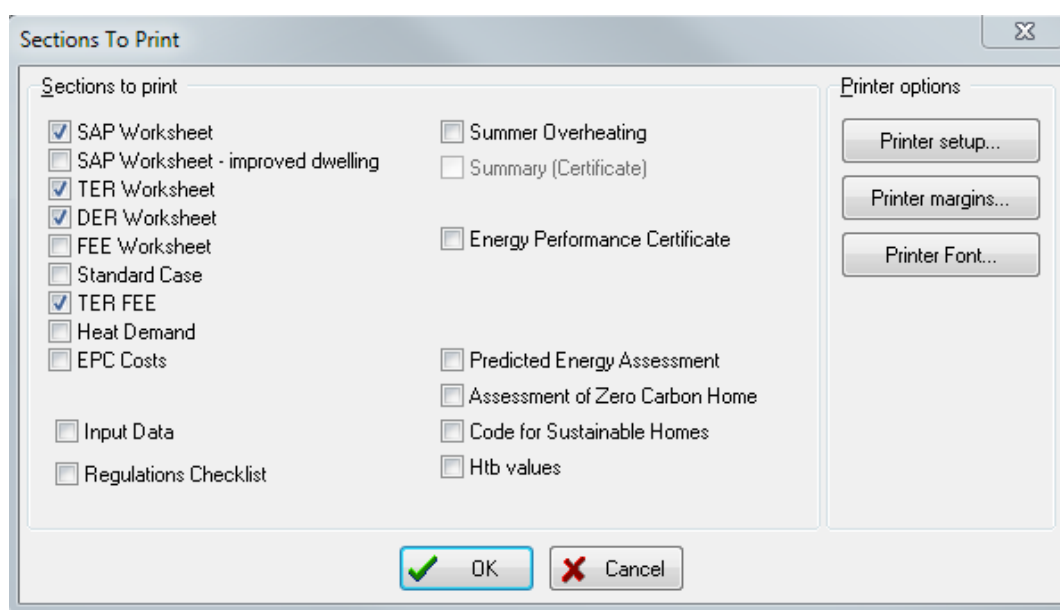


Figure 29.1: The Sections To Print dialogue for SAP 2012

## 29.2 Outputting SAP results

You can print the results of SAP calculations or produce a PDF file which is ideal for emailing. The results<sup>1</sup> can include:

- SAP worksheet: the worksheet for the SAP calculation. The figures here are used in the EPC.
- SAP worksheet for improved dwelling: the SAP calculation with EPC recommendations implemented.
- TER worksheet: the worksheet for the TER calculation for the notional dwelling.
- DER worksheet: the worksheet for the DER calculation for the actual dwelling.
- FEE worksheet: the worksheet for the DFFE calculation for the dwelling.
- Standard case: the SAP worksheet for the CSH Ene7 standard case. This is no longer relevant and the CSH is being abandoned.
- TFEE: the worksheet for the notional dwelling fabric energy efficiency.
- Heat demand: worksheet for the calculation of space and water heating energy demand. The results are used in the EPC
- EPC costs: worksheet for the calculation of EPC costs, emissions and primary energy.
- Input data: a reflection of the information you have entered into the software.

<sup>1</sup>Because the calculations in the various worksheets are based on slightly different assumptions for climate and heat gains the results will differ, even for the same dwelling.

- Regulations checklist: shows the compliance status of the dwelling in a checklist which follows the criteria in Approved Documents L1A 2013 (England) and L1A 2014 (Wales) and Section 6 of the Scottish Technical Standards (2015).
- Summer overheating: results of the overheating assessment.
- Energy performance certificate (EPC): a draft energy performance certificate. As the SAP 2012 EPCs are produced by the Landmark or EST registers JPA Designer is no longer able to produce a draft EPC.

*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: a calculation of the total emissions from a dwelling, including emissions associated with appliances.
- Code for Sustainable Homes: a calculation of items Ene1, Ene2 and Ene7. Again, is largely redundant.
- Htb values: calculation of linear thermal bridging for the dwelling.

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 ‘/ \ \* ? > | .’.

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).

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

## 30 Multiple dwellings

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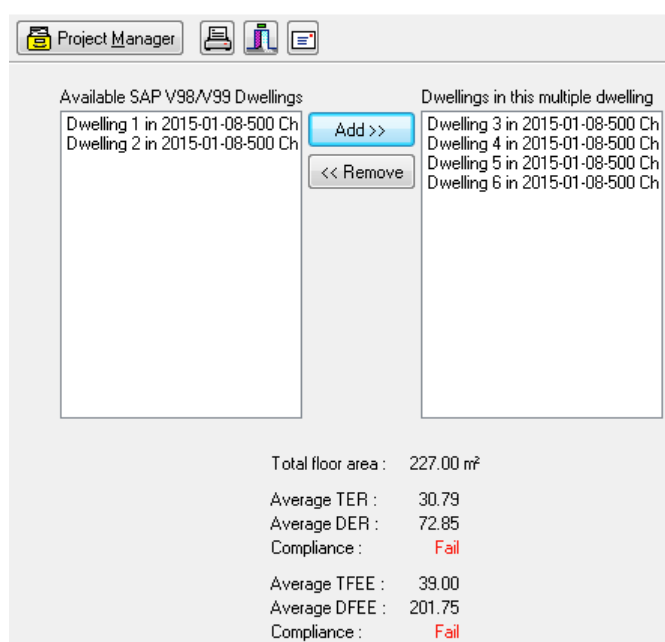


Figure 30.1: The SAP window for a multiple dwellings calculation

The comparative compliance methods specified in Approved Document L1A can make it more difficult for mid-floor flats and mid-terrace houses to pass, even with the same fabric and services standards as ground and top-floor flats and detached houses. The multiple dwelling calculation allows you to test the compliance on a whole block or terrace using average TFEE/DFEE and TER/DER values for the dwellings which comprise the block or terrace. The multiple dwellings calculation enables end-terrace houses or ground and top floor flats to compensate for mid-floor flats or mid-terrace houses.

JPA Designer includes a *multiple dwelling* feature to carry out the average TER and DER calculations. The **Multiple dwellings SAP** window (Figure 30.1) has two panes: the left-hand one (labelled **Available SAP V99 Dwellings**) lists all the SAP 9.92 dwellings within the project which are eligible for inclusion in the multiple dwellings calculation. The right-hand pane (labelled **Dwellings in this multiple dwelling**) lists all the dwellings which are currently included in the multiple dwellings calculation.

The **Add** and **Remove** buttons transfer selected dwellings between the panes. The results of the multiple dwellings calculation are shown below the panes, together with the compliance status. In order to pass the *Average DFEE* and *Average DER* must be equal to or less than the *Average TFEE* and *Average TER* respectively.

To carry out a multiple dwelling calculation:

1. Carry out normal SAP calculations for *all* the units in the block.
2. On the **Project Manager Insert** menu click **Dwelling > SAP (v9.92) 2012 calculation > Multiple dwelling**.
3. Type a name for the calculation in the **Description** dialogue, e.g. *Block B all flats*, and click **OK**. The new calculation is added to the project.
4. In **Project Manager**, double click on the new calculation. The **Multiple dwellings SAP** window opens (Figure 30.1).
5. Click on a dwelling in the **Available SAP v99 Dwellings** pane to select it, then click the **Add** button. The dwelling is transferred to the **Dwellings in this multiple dwelling** pane.
6. Repeat the previous step until you have all the dwellings you need in the right-hand pane.

*If you need to remove a dwelling from the multiple dwelling calculation simply select it and click the **Remove** button.*

You can print the results of multiple dwelling calculations and produce PDFs by following the procedures in section 29.2.

## **Part VI**

# **Importing dwelling data from IES Virtual Environment**

## 31 Overview of VE import

---

The IES Virtual Environment software (VE) can be used to demonstrate Part L compliance for non-domestic buildings according to Approved Document L2A but does not directly address compliance for dwellings. Instead, VE processes the data for dwellings into a format which the JPA Designer SAP module can import. JPA Designer then creates a SAP calculation for each of the dwellings, which can then be used to demonstrate compliance with Part L.

There are three stages to the import process:

1. Creating the model in VE. While this for most part follows the standard methods for modelling in VE, there are several additional points which are explained in chapter 32).
2. Sending the data from VE to JPA Designer (see chapter 33).
3. Finalising calculations in JPA Designer and checking compliance. This step is required because the data formats for building services differ between VE and the SAP methodology. chapter 34 describes the additional data required in JPA Designer.

The import process is particularly useful for apartment blocks, including schemes where part of a block falls under Approved Document L2A and part under L1A.

Note that the procedure does not make any changes to the VE model.

## 32 Preparing a VE model for SAP

The VE model is defined in the normal way in ModelIT, with the geometry and constructions. A model may include one or more dwellings and may also include non-domestic spaces for mixed use schemes.

Once the model has been constructed there are two additional settings required for the conversion procedure:

- assigning rooms to dwellings using the UK dwellings room groups;
- identifying the dwelling living area.

### 32.1 Defining dwellings with room groups

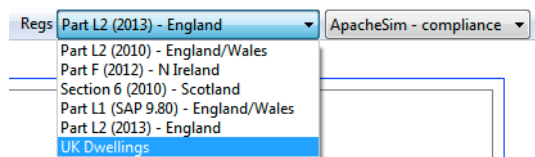


Figure 32.1: Setting the regulations to UK Dwellings for export

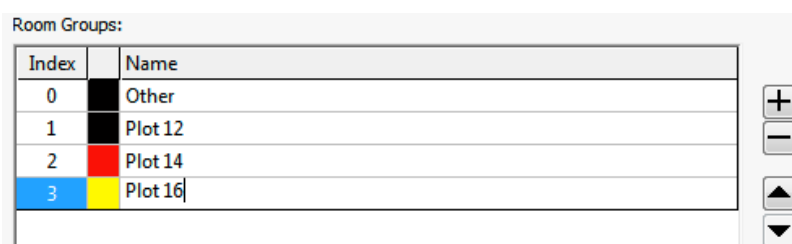


Figure 32.2: Adding room groups

Prior to export the rooms in each dwelling have to be assigned to the appropriate dwelling in the UK Dwellings room grouping scheme. To define dwellings:

1. Save the project and switch to the **VE Compliance (UK & Ireland)** module.
2. On the toolbar set the **Regs** list to *UK Dwellings* (see Figure 32.1). VE now adds a new room group scheme: *UK Dwellings*.

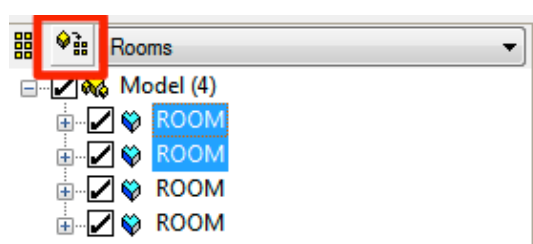


Figure 32.3: The assign button for assigning rooms to a room group

3. Click the **Edit Room Groups** button.
4. In the **Edit Room Groups** dialogue create a room group for each of the dwellings in the model in the *UK Dwellings* scheme: Click the plus button to add room group and assign it a name (Figure 32.2).
5. Select the rooms which comprise the first dwelling.
6. Click the **Assign** button (Figure 32.3).
7. In the **Assign Room Group** dialogue make sure the *Room Grouping Scheme* is set to *UK Dwellings*, then select the group (dwelling) . Click OK.
8. Repeat the previous three steps to assign rooms to other dwellings.

Once you have assigned all the rooms you intend to export (which may well only be a fraction of the rooms in the model) you can review the assignments by setting the Room group list to *UK Dwellings*.

## 32.2 Identifying the dwelling living area

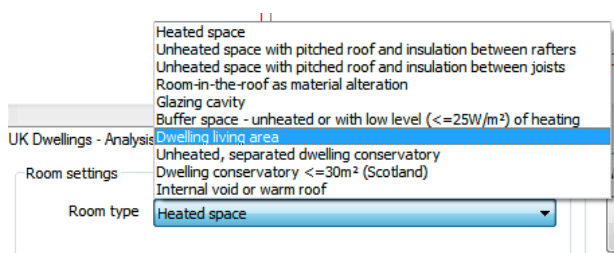


Figure 32.4: Defining the living area

For SAP calculations one part of the dwelling is defined as the *living area* (see section 19.2), which is heated to a slightly higher temperature than the rest of the dwelling. Before export, you must identify the room, or rooms, within each dwelling which will be treated as the living area in JPA Designer by changing the **Room type** from *Heated space* (the standard setting for rooms in a dwelling) to *Dwelling living area*.

For each dwelling:

1. Select the room(s) which will form the living area.
2. In the *Room settings* section set the **Room type** to *Dwelling living area* (Figure 32.4).

## 33 Exporting from VE

---

In the export process VE creates a several files containing the geometry data for the selected dwellings and passes them to JPA Designer, which then imports the data and creates a SAP calculation for each dwelling. During import stage JPA Designer offers two options which affect the import format:

- the SAP version, and
- how individual elements of the VE model are treated.

### 33.1 SAP version

Currently, there are two different versions of SAP in use across the UK:

- SAP V9.90 (2009): this version is valid for Scotland (until October 2015) and for Northern Ireland.
- SAP V9.92 (2012): valid for England to Part L 2013, and for Wales to Part L 2014. SAP V9.92 will be used in Scotland from October 2015, although it may be used for preliminary calculations prior to that date.

### 33.2 Consolidation of elements

VE defines each bounding surface of a room as a separate element, potentially producing a large number of elements in the JPA Designer **Walls, roofs and floors** tab. JPA Designer can reduce the number of elements by consolidating elements of the same type into one element with an area equal to the total area of the originals. There are three ways of importing elements:

- Each element in VE becomes an element in JPA Designer. This one-to-one correlation produces a large number of elements in the **Walls, roofs and floors** tab, but allows individual elements to be tracked between the two programs.
- All the VE fabric elements of the same type within a *room* are consolidated into one element in JPA Designer. For example, if a room is bounded by two internal partition elements of the same construction with areas of 10 and 15 m<sup>2</sup> then in JPA Designer there will be one internal wall element with an area of 25 m<sup>2</sup>. This option reduces the number of elements in JPA Designer while allowing bounding elements of rooms to be distinguished.

- All the VE fabric elements of the same type within a *dwelling* are consolidated into one element in JPA Designer. For example, all the internal partition elements of the same construction within all rooms of the dwelling will be consolidated. This minimises the number of elements produced in JPA Designer, making it easier to see the overall picture and to adjust the U-values of elements when required.

However, no matter which consolidation option is chosen, JPA Designer does not consolidate wall elements which contain openings.

### 33.3 The export procedure

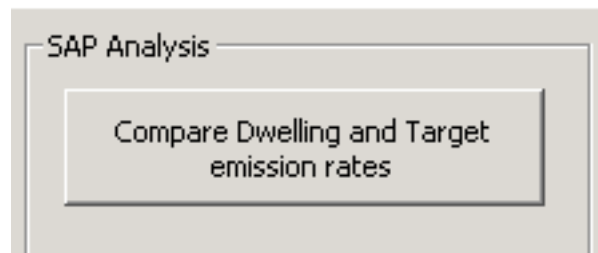


Figure 33.1: Starting the export process

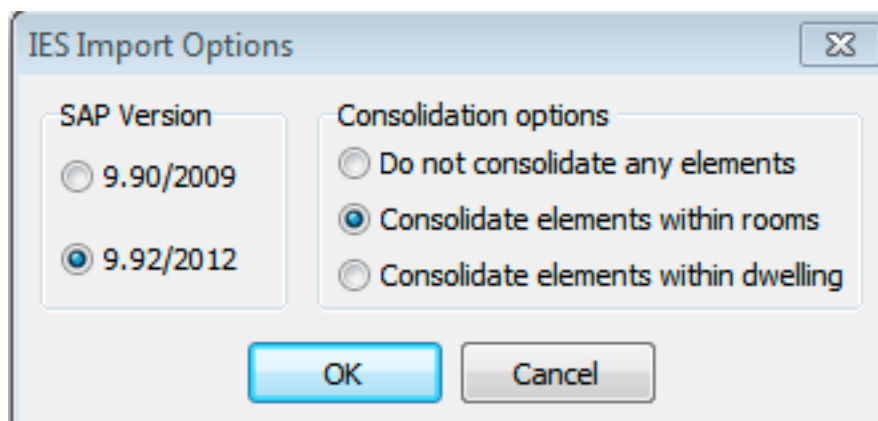


Figure 33.2: The IES Import Options dialogue

To export a dwelling or set of dwellings:

1. In VE, in the **UK Dwellings - Analysis** tab click **Compare Dwelling and Target Emission rates** (Figure 33.1).
2. At the **IES Import Options** dialogue (Figure 33.2):
  - a) Select the version of SAP which you want to be used to create the SAP calculation.
  - b) Select the consolidation method.
  - c) Click OK.

3. The import is completed.

*You may see a warning about the boiler database being out of date. You can ignore the warning at this stage. There are instructions for updating the boiler database at*

4. JPA Designer displays the **Description** dialogue (see Figure 3.5). Either accept the suggested name for the calculation (which is derived from the VE file name), or type your own and click **OK** (see section 3.7 for more details about adding calculations to projects).
5. A SAP calculation is created for each dwelling, and is listed in the JPA Designer **Project Manager** window.

## 34 Completing the calculation

---

Because of the differences in data structure between VE and SAP the export process does not transfer all the information required for a SAP calculation, the additional data has to be entered to complete the calculation. This section identifies the additional data required.

### 34.1 Dwelling dimensions

For England and for Wales the only additional data required in the **Dimensions** tab is the fraction of low energy lighting. Enter the **total number of lamps** and the number of **low energy lamps**. Lighting conventions are described in section 19.3.

In addition, for Scotland, the number of dwellings above and below a flat or maisonette are also required. These values are entered in the **Number of dwellings above** and **Number of dwellings below** boxes (see section 19.5).

### 34.2 Ventilation

Most of the data in the **Ventilation** tab has to be entered in JPA Designer, including:

- Pressure testing details;
- Ventilation strategy; and, where relevant,
- Ventilation efficiency data.

Ventilation data is described in chapter 20.

### 34.3 Walls, roofs and floors

There are three sets of data for the building fabric which are entered in the **Walls, roofs and floors** tab:

- *Element areas and U-values*: These are imported from VE. The only time further data will be required is if the U-value of an element has to be adjusted to take account of the effect of an adjoining unheated space. This can be done using the procedure described in section 21.1.

- *Thermal mass data*: This is currently not exported from VE so has to be entered in JPA Designer. The simplest method is to set the *Thermal Mass Parameter* to one of the default values offered in the **Thermal mass** list:
  - Tick **User defined Thermal Mass Parameter**.
  - Set the **Thermal Mass** to *low*, *medium* or *heavy*.  
*Those categories are defined in Table 1e of the SAP 2012 document.*
- *Junction heat loss data*: this is currently not imported from VE. It should be entered either:
  - using the default  $\gamma$ -value of 0.15 for the dwelling; or,
  - by entering the length and  $\psi$ -value for all junctions in the dwelling using the **Calculate Htb** dialogue, which is accessed from the **Calculate it** button.

## 34.4 Openings



Figure 34.1: The *Copy* buttons for openings

The import process brings in much of the data about openings. For each opening in the dwelling that includes:

- the element the opening belongs in;
- its area;
- its U-value;
- the glazing type.

The remaining data, which has to be entered in JPA Designer, is:

- the frame type;
- the width of the air gap in double glazing;
- the g-window value (a measure of the transmission of solar energy through the glazing).
- the over shading;
- data on blinds, curtains and internal shutters.

As setting these items can be time-consuming – particularly if you are working on several dwellings at the same time – there are two buttons in JPA Designer which allow you to copy settings from one opening to:

- all the other openings in the same dwelling; or,
- all the other openings in the same project.

The buttons are found at the bottom of the **Doors, windows and rooflights** dialogue (Figure 34.1).

The screenshot shows the 'Edit Doors, Windows & Rooflights' dialog box. The 'Opening type' is set to 'Window', 'Opening within' is 'Walls, External walls, upstairs', and 'Glazing' is 'Double-glazed, air-filled, low-E, En=0.2, hard coat'. The 'Double-glazing air gap' section has '12mm' selected. The 'Frame type' section has 'PVC-u' selected. The 'Source of U-value' section has 'Manufacturer' selected, and the 'BFRC data' is '0.72'. The 'Opening orientation' section has 'Left' selected. The 'Window size' section has 'Width (mm)' 690 and 'Height (mm)' 1050. The 'Overhang (used for overheating assessment)' section has 'Width (mm)' 690 and 'Depth (mm)' 0. The 'Blinds, curtains & external shutters' section has 'None' selected. The 'Overshading' section has 'Average or unknown (20-60 % sky blocked)' selected. The 'Copy' buttons are at the bottom.

Figure 34.2: Import status for the sections of the *Doors, windows and rooflights* dialogue. Sections in blue are imported from VE. Sections in red need to be checked. The section in green contains the *Copy* buttons.

To enter the additional data on openings:

1. In the **Openings** tab double click on one of the listed openings. The **Doors, Windows and Rooflights** dialogue opens (Figure 34.2).
2. The following items will already be completed: **Opening type, Opening within, Glazing, U-value, Area, Opening orientation**. There is no need to change the values.

3. Set the **Double glazing air gap** and the **Frame type**.
4. Check the **g-window value**, which is usually defined automatically from the **Glazing**. If you have specific values for the project set the **Source of U-value** to *BFRC data* and enter a g-window value.
5. The **Overshading** (which is the extent to which the sky is obscured by trees and neighbouring buildings) may be left at *Average or unknown*: you need only adjust this if the degree of overshading is greater.  
*You should never reduce the overshading to **Very little** for a new dwelling: there is no way of telling this will be the case throughout the life of the dwelling.*
6. The **Blinds, curtains and external shutters** settings affect the amount solar flux reaching the inside of the dwelling. Adjusting the settings can reduce the risk of solar gain. However, unless initial analysis indicates there is a significant risk of overheating there is no need to inserting this data.
7. With the changes made click either **Copy these values to all this building's windows** or **Copy these values to all the buildings in this project**.
8. Click OK.

## 34.5 Building services

The parameters for building services are different in VE and SAP, so you must enter building services data in JPA Designer, following the guidance in the SAP section of this manual:

- Water heating: chapter 23.
- Primary heating: chapter 24.
- Secondary heating: chapter 25.
- Overheating: chapter 26.
- Cooling: chapter 27.
- Renewables: chapter 28.

## 34.6 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 cursor over the **compliance zone** and the software will display a tool-tip will show the primary cause of failure (see Figure 18.2).

Click on the **compliance zone** to open the **Compliance Checklist** which lists the status of the dwelling against each of the criteria defined in Approved Document L1A. This is particularly useful when the dwelling has failed on one of the secondary criteria, such as the efficiency of heating controls.

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. Changes to the building services can be carried out within JPA Designer. Changes to the building geometry should be made in VE and then re-importing the dwelling into JPA Designer.

On exporting the dwelling a second time JPA Designer will give you an option to either re-import the data into the selected dwelling or create a new dwelling.

## **34.7 Reporting results**

You can print the results of SAP calculations 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. For both print and PDF you can select which parts of the results you want to include in your output.

## 35 Exporting several dwellings at once

---

One of the benefits of the VE import is the ability create SAP calculations for many dwellings at once. However, the services and other parameters have to be set in JPA Designer to complete the calculations. To speed up that process JPA Designer includes a number of functions which can copy data between several dwellings.

### 35.1 Openings

As section 34.4 explains, incompatibilities between the definitions of openings in VE and JPA Designer means several of the items for openings have to be set in JPA Designer. As each dwelling in a project will have six or more openings that could be a time consuming process, but there are two buttons on the **Edit Doors, Windows and Rooflights** which can speed up the process:

- **Copy these values to all this buildings windows:** using this button copies the following items to all other other windows in the dwelling:
  - **Double-glazing air gap.**
  - **Frame type.**
  - **BFRC g-window value.**
  - **Overshading.** It does not change the **Glazing, U-value** or **Orientation**.
- **Copy these values to all the buildings in this project:** using this button copies the same items to all other windows in all other dwellings in a project. That allows you to define those items once, but have the setting applied to multiple dwellings.

Also, if you need to adjust the U-values of several openings you can select the openings (use the <Shift> key to make a multiple selection) then click **Change U-value of selected openings** to re-set the U-values.

### 35.2 Building services

Once you have set up the building services (hot water, primary and secondary heating) for one dwelling you can return to the **Project Manager** window and copy those values to all the other dwellings:

1. In the **Project Manager** window click once on the dwelling which has its services configured.
2. On the **Edit** menu click **Copy non-geometry details to all other 9.90 dwellings**.
3. At the confirm dialogue click **OK**.
4. The building services data for that dwelling will be copied to all the other dwellings.

**Note: the copy non-geometry option should only be used on 9.90 calculations, not 9.92 calculations. There is a separate option for 9.81 calculations.**

## **Part VII**

### **Program options and reference**

## 36 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.

The Options dialogue box has five tabs:

- General;
- Logo and signature;
- Email;
- Other;
- Defaults.

The tabs are described in the following sections.

Above the tabs is the **Identity** selector which is used to switch between identities for editing (see section 2.8).

To open the **Options** dialogue, in **Project Manager** select **Options** from the menu bar. Any changes you make to the program options will be saved when you click **OK**. If you close the dialogue by clicking **Cancel** the changes will not be saved.

### 36.1 General

The **General** tab has the following controls (those shown in blue in the dialogue are associated with user identities (see section 2.8)::

- **Printer margins:** enables you to set the page margins for printing and for PDFs. 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. The data which appears here depends on the identity which has been selected at the top of the **Options** dialogue.
- **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. There is unlikely to be a need to

- **CSH Assessor Name** and **CSH Assessor No**: Code for Sustainable Homes assessors can enter their details here to have them appear on CSH reports in the SAP module.
- **Uvalue Disclaimer**: the disclaimer text to appear on print outs and PDFs of U-value and calculations.
- **SAP/Nondwell disclaimer**: the disclaimer text to appear on print outs and PDFs of SAP calculations.
- **Default SAP location**: determines the country which will be used for all new SAP calculations. This setting can be overwritten for individual calculations.
- **Start-up folder**: sets the default folder for saving and opening JPA Designer files. Use the **Select** button to set the start-up folder.
- **User data folder**: Specifies the folder in which user configured data is stored. This includes user categories and materials for U-value calculations, client address data, and user defined mechanical fixing and bridging defaults. By default, for Windows 7 onwards this will be *C:\ProgramData\JPA\JPA Designer*.  
You can view the folder using the **Open** button, or change its location with the **Select** button. However, you must be sure to have permissions for your chosen folder. It is best to keep the user data folder on the PC and not on a network drive.
- **Show start-up dialogue**: determines whether the program will display the dialogue offering different actions when the program is launched.
- **Open destination folder after print to PDF**: if this option is ticked then after creating a PDF from a calculation JPA Designer will open a window for the folder which contains the new PDF.
- **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.
- **Suppress project region message**: prevents JPA Designer asking if you want to use the same project region when inheriting user data which has been defined at the project level. If you work exclusively in one region then it is best to tick this option.
- **Use proxy server**: in some organisations access to the internet, which JPA Designer requires for licence checking, is managed through a proxy server. It may be necessary to enter the proxy server details in order to enable licence checking.

## 36.2 Logo and signature

The *Logo and signature* tab contains the following controls (those shown in blue in the dialogue are associated with user identities (see section 2.8)):

- **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*).

The logo details can be different for each identity you have set up in JPA Designer, enabling you to customise reports for each one.

- **Address position:** These settings determine the position of your company address on print outs and PDFs. Enter the address itself in the **General** tab.

Used together the logo and address positions can be used to match company stationery.

**Certificate signature position:** originally used to add a scanned in signature to the SAP certificate these option now has no function.

**TIMSA Logo:** if you are issuing U-value calculations under the BBA/TIMSA U-value competency scheme you can use these boxes to include the scheme logo on reports. If you tick the **default** box the logo will be selected for all reports in the **Sections to Print** dialogue: you can override the default option for individual calculations.

### 36.3 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.

### 36.4 Other

The **Other** tab lets you set various calculation options. The options for U-value calculations are:

- **Beam and block screed conductivity:** sets the default conductivity used for suspended ground floors. The standard conductivity of 1.15 W/mK represents a standard cement:sand screed.
- **Mechanical fastener calculations:** JPA Designer can calculate the correction for mechanical fasteners using the method in ISO 6946:1997 or ISO 6946:2007. There is no reason not to use the latest version.
- **Two directional heat flow:** building codes and standards in Australia and New Zealand require the thermal resistance of fibrous insulation to be adjusted downwards at temperatures above 23°C to allow for the observed decrease in performance at higher temperatures. This feature is not applicable to the UK.
- **Round thermal resistance down:** the ISO product standards for factory formed insulation require resistances for those products to be rounded down to the nearest 0.05 m<sup>2</sup>K/W. Ticking this box activates rounding for products which are marked as thermal insulation (see section 7.2).
- **Set vapour resistance of layers above vented cavity to zero:** when this option is chosen adding a vented cavity to a calculation will result in the vapour resistances of all layers outside of the cavity being reduced to zero. The option is derived from BS 5250:1989 and is intended to replicate the effect of ventilation in reducing the risk of interstitial condensation.

As the approach was not included in subsequent editions of BS 5250 it is best not to use the option unless you have a good reason to do so, and are aware of the effects on condensation risk analysis.

- **Print total thickness:** when selected, the U-value report will show the thickness of the construction, based on the total thickness of the individual layers.
- **Print water mark text:** prints the selected text as a light grey watermark across the calculation report. Specify the **wording**, **angle** and **size** of the watermark. Typically used to show 'draft' across a calculation.

The options for SAP calculations:

- **Move preview form to top left of screen:** changes the default location of the results preview window.
- **Very long preview form:** a long preview form gives enough space to see all the data for dwellings with numerous elements and openings.
- **Omit SAP worksheet box numbers:** the SAP worksheets, such as those for the TER and DER normally include the box numbers, to make it easier to track through the calculations. Use this option to prevent the box numbers from being displayed.

**EPC test environment:** used when testing EPC lodgement systems. For normal lodgements leave this box unpicked.

**XML version:** sets the format of the data submitted for EPC lodgements. This should always be set at *V15 17*.

## 36.5 Defaults

The **Defaults** tab allows default values to be set for some items in U-value and SAP calculations. Any values set here will automatically applied to any new calculation.

Currently there are no values which apply to U-value calculations, but for SAP calculations you can set default values for:


- Solar panel over shading: see section 23.10;
- Over shading of openings: see chapter 22;
- Window opening condition for the overheating assessment: see chapter 26;
- Terrain type for wind turbines: see section 28.2.

## 37 Customising JPA Designer

### 37.1 Creating environmental conditions data sets

You can build up and save sets of internal and external environmental conditions to use in condensation risk analysis. This is particularly useful when examining air-conditioned buildings which have design values for temperature and humidity.

User data is stored in a file **Env\_user.txt** which is kept with the other user data files in **c:\ProgramData\JPA\JPA Designer** (file location correct for Windows 7 - see Technical note 2012/01 for other versions of Windows). Currently, the only way to add data sets is to edit **Env\_user.txt** in a text editor, such as Notepad (Figure 37.1). Before editing **Env\_user.txt** make sure JPA Designer is not running.



Env\_user.txt - Notepad

File	Edit	Format	View	Help										
0	0	Internal	25/50	25	50	25	50	25	50	25	50	25	50	25
1	0	External	25/50	25	50	25	50	25	50	25	50	25	50	25
0	1	Internal	30/90	30	90	30	90	30	90	30	90	30	90	30
1	1	External	30/90	30	90	30	90	30	90	30	90	30	90	30

Figure 37.1: Editing the **Env\_user.txt** file

Within **Env\_user.txt** the data for an external location or an internal design condition is on one line, with each line separated by a return. On each line, the different items of data are separated by the pipe character, |, with no spaces before or after the pipe. The final character on every line is also a pipe.

The data items are:

- Item 1: whether the set is for internal conditions, 0, or external conditions, 1.
- Item 2: whether the set is system data, 0, or user data, 1.
- Item 3: a text description of the data set. This appears in the **Building location** or **internal conditions** lists, which are sorted alphabetically using the text description. This item can start with the tilde character (~), which does not appear on lists, but controls the way in which items 4–27 are interpreted.

- Items 4–27: these are the monthly temperature and relative humidity figures. Temperatures should be entered in degrees centigrade and relative humidity as a percentage. The order of the data depends on whether item 3 starts with a tilde (~).
  - If item 3 has a tilde the mean monthly temperatures should be entered in a sequence starting with January, followed by the relative humidity figures, starting with January (so: Jan temp|Feb temp| ... |December temp|Jan %rh|Feb %rh| etc.)
  - If item 3 has no tilde the temperature and relative humidity values for each month should follow each other (so: Jan temp|Jan rh|Feb temp|Feb %rh| etc.).
- Item 28: the country code. UK, 0. Republic of Ireland, 1. Australia, 2. New Zealand, 3. Asia, 4. Middle East, 5.
- Item 29: applies to external environmental sets and indicates whether internal conditions should be calculated on the basis of continental conditions, 1, or maritime conditions, any other value. This item is used only when internal conditions are to be derived from the external conditions: it is not used if fixed internal conditions are specified.

As an example:

```
1|1|Newcastle Airport|3.4|92|...|4.2|89|0|0|
```

This shows:

- External data (1).
- User data (1)
- Location, with no tilde.
- Paired monthly values for temperature (3.4 and 4.2) and relative humidity (92 and 89).
- UK (0)
- Maritime climate (0).

Once the environmental conditions have been entered and saved in **Env\_user.txt** and JPA Designer started, the new data sets will show up in the **internal conditions** list. Note that the conditions will only show if their region matches the region selected for analysis. If there are several users of JPA Designer within the same organisation the **Env\_user.txt** file can be set up on one PC then copied to the others, ensuring everyone is using the same data sets.

## 37.2 Sharing a user-defined materials between computers

The user-defined database of materials in the JPA Designer U-value module enables users to build a library of commonly-used materials. Where there are several users running JPA Designer in the same organisation it is helpful for everyone to use the same material library to provide consistently in calculations. This section describes how to do that. The user categories and materials are stored in two files: **USERCATS.TXT** and **USERMATS.TXT**<sup>1</sup>. By default these files are stored in the JPA Designer program data folder,

<sup>1</sup>Depending on how Windows is configured the TXT extension may not be visible: that doesn't matter.

which is usually (Windows 7) in *c:\ProgramData\JPA\JPA Designer*. The easiest way of ensuring to computers have the same user-defined materials is to copy those two files from one PC and then paste them into the corresponding folder on the other.

You can transfer the files by email, across a network, or by using a plug-in USB stick drive (also known as a ‘thumb drive’).

To copy the files between PCs using a USB stick:

1. Make sure JPA Designer is not running on either computer.
2. Open **Windows Explorer** on the PC with the data and go to **c:\ProgramData\JPA\JPA Designer**.
3. Select and copy USERCATS.TXT and USERMATS.TXT.
4. Insert a USB stick and paste the two files onto it.
5. Remove the USB stick from the first PC and insert it into the second.
6. Open **Windows Explorer** on the PC and go to the USB stick.
7. Copy USERCATS.TXT and USERMATS.TXT.
8. In **Windows explorer** go to **c:\ProgramData\JPA\JPA Designer**.
9. Past the two files into the folder. Windows will ask if you want to replace the existing files with the same name. Select *replace*.
10. Open JPA Designer: the products database will now include the copied user-defined products.

If you want to transfer the files by email, copy and paste the files into an email and send it to the second PC, then copy and past the files from the email onto the second PC.

You may find that your PC seems to be missing **c:\ProgramData\JPA\JPA Designer**: this is because the Windows ProgramData folder as a hidden folder, so by default it is not shown in the folder list. If you can’t see the folder you will need to set Windows to show hidden folders before copying the data across. The following instructions apply to Windows 7, but similar procedures will apply to other versions of Windows:

- Open the **Folder Options** Control panel.
- Select the **View** tab (Figure 37.2).
- In the **Advanced settings** list set **Hidden files and folders** to *Show hidden files, folders and drives*.

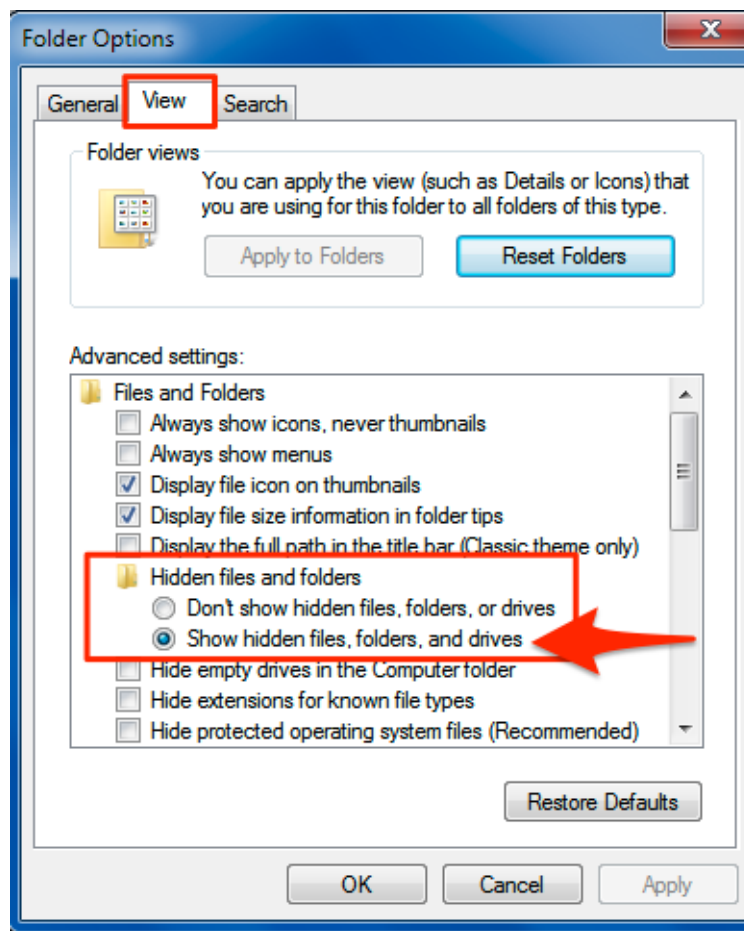


Figure 37.2: Changing the View settings for hidden folders

## 38 Menu reference

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### 38.1 Project manager window

#### File:

- New project: Creates a blank JPA Designer project.
- Open project: Opens an existing JPA Designer project.
- Save project: Saves the current project.
- Save project as: Saves the current project with a different name.
- Save project as Template: allows you to save the project as template file for use with the template feature, see section 3.8.
- Merge a project from disk into this Project: Copies all the calculations from the selected calculation to the calculation which is currently open.
- Print all U-value calculations in this project to PDF: produces PDF reports of all U-value calculations.
- Import JPA U-value file into this Project: Imports a U-value calculation from **JPA Uvalue**  
*As JPA Uvalue was superseded by JPA Designer in 2002 this function is unlikely to be used.*
- Import JPA SAP file into this Project: Imports a SAP 9.60 calculation from **JPA SAP v2** into JPA Designer as a SAP 9.70 calculation.  
*As JPA SAP v2 was superseded in 2002 this function is unlikely to be used.*
- Import IES file: Imports data from IES' VE software into JPA Designer SAP calculations.
- Import XML: imports SAP EPC lodgement data in XML format as a SAP 2009 or SAP 2012 calculation.
- Download and re-load product characteristics datafile: downloads the latest version of the SAP product data files (SAP 2005 boiler database, SAP 2009 and SAP 2012 PCDF) and loads them.

- Re-load Product Characteristics Data File: loads a new copy of the data files from an existing download.
- Exit: closes JPA Designer.
- Export all SAP summaries to Excel: Exports the summary data for all SAP calculations in the project to an Excel spreadsheet.
- Export selected to XML: Exports the data for the selected SAP calculation to the XML format used for lodging EPCs.
- Export all to XML: Exports the data for all SAP calculations in the project to the XML format used for lodging EPCs.
- Export Condensation to Excel: exports the results of a condensation risk analysis to an Excel spreadsheet
- Journal path: Sets the path for storing the Journal file used by JPA Designer to store some user data.
- Clear journal: Deletes the user data stored in the journal.

The menu finishes with a list of recently opened files.

### Edit

- Project address: Opens the **Project address** dialogue.
- Edit selected item: Opens the selected calculation.
- Duplicate item: Creates a copy of the selected calculation, offering you the opportunity to rename it.
- Rename selected item: Changes the name of the selected calculation.
- Copy non-geometry details to all other 9.81 dwellings: Sets the building services for all SAP 9.81 calculations to those of selected calculation.  
*Used when importing multiple dwellings from VE.*
- Copy selected SAP 9.70 2001 dwelling to a V9.80 2005 dwelling: creates a copy of the selected SAP 9.70 calculation and updates it to version 9.80 of SAP.
- Copy selected SAP 9.8x 2005 dwelling to a V9.90 2009 dwelling: creates a copy of the selected SAP 9.80 or 9.81 calculation and updates it version 9.90 of SAP.
- Copy selected SAP 9.90 2009 dwelling to a V9.92 2012 dwelling: creates a copy of the selected SAP 9.90 calculation and updates it version 9.92 of SAP.
- Copy selected SAP 9.90 2009 dwelling to a V9.8x 2005 dwelling: creates a copy of the selected SAP 9.90 calculation and downgrades it to version 9.8x of SAP.
- Copy selected SAP 9.92 2012 dwelling to a V9.90 2009 dwelling: creates a copy of the selected SAP 9.92 calculation and downgrades it to version 9.90 of SAP.
- Main screen font: Changes the font used in JPA Designer.

- User & Security codes: Opens the **User & Security codes** dialogue.

### Insert

- U-value calculation: Adds a blank U-value or R-value calculation to the project.
- Psi-value calculation: adds a blank psi-value assistant calculation to the project.
- Dwelling/SAP (V9.92/2012) calculation
  - Single dwelling: adds a blank SAP 9.92 calculation to the project.
  - Building containing multiple dwellings: adds a blank calculation for average TFEE/DFEE and TER/DER to the project.
- Dwelling/SAP (V9.90/2009) calculation
  - Single dwelling: adds a blank SAP 9.90 calculation to the project.
  - Building containing multiple dwellings: adds a blank calculation for average TFEE/DFEE and TER/DER to the project.
- Dwelling/SAP (V9.81/2005) calculation
  - Single dwelling: adds a blank SAP 9.81 calculation to the project.
  - Building containing multiple dwellings: adds a blank calculation for average TFEE/DFEE and TER/DER to the project.
- Dwelling/SAP (V9.80 2005) calculation
  - Single dwelling: Adds a blank SAP 9.80 calculation to the project.
  - Scottish simplified approach single dwelling: Adds a blank SAP 9.80 calculation using reduced data set for Scotland.
  - Building containing multiple dwellings: Adds a blank calculation for average TER/DER calculations for flats or terraces.
- Dwelling/SAP (V9.70 2001) calculation: adds a blank SAP 9.70 calculation to the project.
- rdSAP: adds a blank rdSAP calculation to the project.  
*Feature in development*
- Water efficiency calculation: adds a blank water efficiency calculation to the project.  
*Feature in development.*
- Solar Panel & Wind Turbine payback calculation: adds a payback calculation to the project.

### Options

Opens the **Options** dialogue.

### Help

- Help: opens the on-line help for JPA Designer.
- About: displays program version and build number and registration details.

## 38.2 U-value module

### File

- Return to project manager: exits U-value calculation and returns to Project Manager window.
- New project: Creates a blank JPA Designer project.
- Open project: Opens an existing JPA Designer project.
- Save project: Saves the current project.
- Save project as: Saves the current project with a different name.
- Print: print the calculation report.
- Create PDF: create a PDF of the calculation report.
- Printer setup: set up a printer for use with JPA Designer.
- Font: select the font used for printing and for PDFs.
- Exit: closes JPA Designer.
- About: displays program version and build number and registration details.
- Journal path: Sets the path for storing the Journal file used by JPA Designer to store some user data.
- Clear journal: Deletes the user data stored in the journal.
- Help: Opens the on-line help system.

### Edit

- Project information: opens the **Project information** dialogue.
- Construction type: opens the *\*Edit construction* dialogue.
- Environmental conditions: opens the **Environmental conditions** dialogue.
- Layer: opens the **Edit material** dialogue for the layer selected in the layer list.
- Move selected variable layer into construction: converts a variable layer calculation into a normal calculation by transferring the selected layer into the layer list and removing the variable layer place holder.
- Database: opens the **Edit database** dialogue for editing.
- Cut layer to clipboard: removes the selected layer from the layer list but leaves the information on the clipboard.
- Delete layer: removes the selected layer from the layer list without saving the information to the clipboard.

- Copy layer to clipboard: copies the data on the selected layer into the clipboard.
- Paste layer from clipboard: creates a new layer above the selected one, using the layer data held in the clipboard.

### **Insert**

- Layer from database: opens the Product database dialogue for adding layers.
- Variable layer: inserts a variable layer into the layer list above the selected layer.
- Tapered layer: inserts a tapered layer into the layer list above the selected layer.
- Blank layer: inserts a blank layer into the layer list above the selected layer.

### **View**

- Dewpoint graph: opens the dewpoint window to show the dewpoint graph.
- Results table: opens the pre–2003 condensation results window.
- ISO 13788 Condensation table: opens the results window for the latest condensation risk method.

### **Help**

Opens the on-line help for JPA Designer.

## **38.3 Psi-value assistant**

### **File**

- Return to project manager: exits psi-value calculation and returns to Project Manager window.
- Print: prints a calculation report.

### **Edit**

- Project Information: opens the project information dialogue.

## 38.4 SAP modules – single dwellings

### New

- Return to project manager: exits SAP calculation and returns to Project Manager window.
- New project: Creates a blank JPA Designer project.
- Open project: Opens an existing JPA Designer project.
- Save project: Saves the current project.
- Save project as: Saves the current project with a different name.
- Print: print the calculation report.
- Printer setup: set up a printer for use with JPA Designer.
- Create PDF: create a PDF of the calculation report.
- Export checklist to RTF: creates an RTF file of the regulations compliance checklist (RTF = Rich Text Format, which can be opened by Word and other word processors).
- Export XML: create and XML file of the calculation data.
- Font: select the font used for printing and for PDFs.
- Exit: closes JPA Designer.
- Journal path: Sets the path for storing the Journal file used by JPA Designer to store some user data.
- Clear journal: Deletes the user data stored in the journal.

### Edit

- Project information: opens the project information dialogue.
- Dwelling dimensions: opens the Dwelling dimensions tab of the SAP Worksheet dialogue.
- Ventilation: opens the Ventilation tab of the SAP Worksheet dialogue.
- Walls, roofs and floors: opens the Walls, roofs and floors tab of the SAP Worksheet dialogue.
- Windows, doors and rooflights: opens the Openings tab of the SAP Worksheet dialogue.
- Water heating: opens the Water heating tab of the SAP Worksheet dialogue.
- Primary heating: opens Primary heating tab of the SAP Worksheet dialogue.
- Secondary heating system: opens the Secondary heating tab of the SAP Worksheet dialogue.

- Summer overheating: opens the Overheating tab of the SAP Worksheet dialogue.
- Photovoltaic and alternative technologies: opens the PV & Alt Tech tab of the SAP Worksheet dialogue.

## **View**

- Compliance checklist: opens the Results window at the compliance checklist.
- SAP worksheet: opens the Results window at the SAP rating worksheet.
- TER worksheet: opens the Results window at the TER worksheet.
- DER worksheet: opens the Results window at the DER worksheet.

## **Help**

- Help: opens the on-line help for JPA Designer.
- About: displays program version and build number and registration details.

# **38.5 SAP modules – multiple dwellings**

## **File**

- Return to project manager: exits the multiple dwellings calculation and returns to Project Manager window.
- Open project: Opens an existing JPA Designer project.
- Save project: Saves the current project.
- Save project as: Saves the current project with a different name.
- Print: print the calculation report.
- Printer setup: set up a printer for use with JPA Designer.
- Create PDF: create a PDF of the calculation report.
- Font: select the font used for printing and for PDFs.
- Exit: closes JPA Designer.
- About: shows version number and registration details for JPA Designer.
- Journal path: Sets the path for storing the Journal file used by JPA Designer to store some user data.
- Clear journal: Deletes the user data stored in the journal.
- Help: opens on-line help.