

Constructions Database User Guide

<Virtual Environment> 5.9



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1. Introduction

This User Guide explains how to use the Constructions Database.

The Constructions Database (formerly called APcdb) provides facilities for viewing and editing constructions used in the thermal applications ApacheCalc, ApacheLoads, ApacheSim and Part L/J.

A construction defines the thermal properties of a building element such as a wall, ceiling or window. It consists of a number of layers of different materials, together with thermal properties of the materials, surface properties and other attributes used in thermal analysis.

There are two classes of construction, opaque and glazed, with different parameter sets. These classes are further broken down into categories – external walls, partitions, internal windows, rooflights and so on.

The purpose of the Constructions Database is to assemble a set of constructions for use in the project. It provides facilities for creating, viewing, editing and copying constructions, aided by access to central 'system' databases of constructions and materials. It also provides facilities for condensation analysis.

Project constructions created in the Constructions Database may be assigned to building elements, individually or collectively, in the Apache View.

At the room creation stage, in ModelIT, constructions may also be set using a Construction Template, which assigns a preset construction to each category of building element in the new room.

Routes into the Constructions Database are provided from the Apache View and the Template Manager. The Template Manager provides a facility for transferring constructions from one project to another.

Accurate construction data is critically important for the integrity of the thermal model. The function of the Constructions Database is to facilitate the process of setting up and checking this data.



2. Units

Construction attributes in the Constructions Database are displayed in the current Units System (metric or IP). The Units System may be changed using the <VE> menu option Settings > Preferences > Units.



3. Main Dialogue – Project Constructions

3.1. Outline

The main dialogue, headed *Project Constructions* (Figure 1), displays lists of the constructions in the project, organised in categories. By double-clicking on a construction you can display its properties and edit them. Icons on the toolbar provide further operations on the project constructions such as creating, deleting, copying and pasting.

The menus at the top of the dialogue provide access to features such as the system databases of constructions and materials, printing options and condensation analysis.

When you first enter the Constructions Database with a new project you will see a list of default constructions, together with any additional constructions that have been brought into the project via templates. The Constructions Database facilities allow you to add to and edit these constructions so that they accurately reflect the thermal properties of the elements in the building.

Ø	Project co	onstruc	tions				
Fi	le Edit View	Settings	Calculations	Help			
E	3 🛷 🛪 🗞	0 🖻 💼					
(Dpaque Constructio	ns Glazed (Constructions				
	Internal Ceilin	gs/Floors			C Doors	0	Internal Partitions
	C Roofs				Ground/Exposed Floors	۰	External Walls
	ID	Description				CIBSE U-value W/m²·K	EN-ISO U-value W/m²·K
	STD_WAL2	standard wa	all construction (20)02 regs)		0.3487	0.3495
	STEELP	sheet steel				5.6466	5.8817
	ALUMP	sheet alumir	nium			5.6470	5.8821
_							Close

Figure 1: Constructions Database main dialogue

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3.2. Construction Classes & Categories

Constructions are divided into two classes – opaque and glazed – with different thermal parameter sets. In the case of opaque constructions thermal capacity, as defined by density and specific heat capacity, is important. Glazed constructions, by contrast, are to a good approximation massless, but they require properties characterising their solar transmission properties.

The two classes of construction are further broken down into categories, as follows:

Opaque constructions:		
Internal Ceilings/Floors Partitions	Doors	Internal
Roofs	Ground/Exposed Floors	External Walls
Glazed constructions:		
External Windows	Internal Windows	Rooflights

The construction categories correspond to categories of building element used for construction assignment in the Apache View. The thermal parameter sets for constructions are broadly similar for categories belonging to the same class (opaque or glazed), but in some cases differ in respect of their Building Regulations parameters and default values for surface resistance.

Tabs on the dialogue allow you to switch between opaque and glazed constructions. Within each class, construction categories are selected using radio buttons.

3.3. Project Construction Lists

Within each category a list of project constructions is displayed, with the following summary information:

ID: a unique identifier assigned to the construction when it is created.

Description: a description of the construction in words.

CIBSE U-value: the U-value of the construction as calculated by the CIBSE method.

EN-ISO U-value: the U-value as calculated by the EN-ISO method.

In the case of glazed constructions these U-values are net U-values including the effect of the frame.

To edit a construction, double-click its entry on the list. Alternatively click once on the construction and then on the icon *Edit construction*.

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3.4. Toolbar Icons & Right-click Options

The icons on the toolbar perform the following operations, most of which are also available on a right-click menu:

Save project: saves the constructions and materials for the project.

Add a new construction to this category: creates a new construction in the current category. The new construction will be a copy of the currently selected construction.

Delete construction. Removes the selected construction from the project.

Edit construction. Pops up a dialogue to edit the construction.

Show rooms where construction is used. Displays a list of rooms that use the construction.

B Copy construction. Copies the construction into the clipboard.

Paste construction. Creates a new construction by pasting the contents of the clipboard. The clipboard may contain a project construction or a construction from the system database. It is permissible to copy a construction from one construction category to another, although in this case it is advisable to perform a dummy edit on the new construction to force a recalculation of its U-value using the appropriate surface resistances.

3.5. Menus

The menu options are described below. Some of these functions are also accessible from elsewhere in the interface.

File

Save: Saves the project constructions and materials.

Properties: Displays the project pathname and statistics on the project constructions and materials.

Print: Displays options for printing project constructions and copying them to the clipboard.

Exit: Exits the Constructions Database. You will be prompted to save your edits.

Edit

Find construction: Allows you to search for project or system constructions containing particular text strings in either their IDs or descriptions. Constructions containing the search strings are then listed and may be selected for editing.

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View

- *System materials*: Displays the materials in the system database and allows them to be copied to the clipboard for pasting into a project construction. See 'System materials' below.
- *System constructions*: Displays the constructions in the system database and allows these constructions and their materials to be copied to the clipboard for pasting into a project construction. See 'System constructions' below.
- *Project materials*: Displays the materials used in the project constructions and allows them to be copied to the clipboard for pasting into another project construction. See 'Project materials' below.
- *Review manager*. Provides facilities for viewing, printing or copying a textual description of selected project constructions.

Settings

- *Material colours:* Provides facilities for choosing and editing the colours used to display the various categories of materials in condensation analysis results.
- *Wind exposure*: Allows you to set the wind exposure index used in ApacheCalc to calculate external surface resistances. Choose from the following options:
 - Sheltered: sheltered from the wind
 - Normal: typical wind exposure
 - Severe: severe wind exposure (e.g. coastal)
 - The wind exposure index is used in ApacheCalc to calculate the external surface resistance of walls, windows, roofs etc. when a value is not explicitly entered in APcdb. This parameter may also be set in APlocate. Note that ApacheSim has its own method for calculating external surface heat transfer.

Calculations

- *Derived parameters:* Displays a set of derived parameters summarising the characteristics of the currently selected construction. See *Derived parameters* below.
- *Condensation analysis:* Accesses a facility for performing condensation analysis on the currently selected construction. See *Condensation analysis* below.

Help

Provides help on using the Constructions Database.

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4. Editing an Opaque Project Construction

ę	Project construction (opaque)							
1	ID STD_FL02 Description standard floor construction (2002 regs) Building Regulations Outvide vertices				0.035 🔽 default			
	Emissivity 0.900 Resistance (m²K/W) 0.0400	efault	Solar abs	orptance	0.700	Floor ar Expose	rea (m²) ed floor perime	100.0 eter (m) 40.0
	Inside surface Emissivity 0.900 Resistance (m²K/W) 0.1171	default	Solar abs	orptance	0.550	Externa Ground	al wall thickne I conductivity uninsulated I	ess (m) 0.300 (W/(m·K)) 1.500
	Metal Cladding F	This is a so	olid ground flo	or (i.e. not a	an exposed floo	r) (W/m²·	K)	
	Material	Thickness m	Conductivity W/(m·K)	Density kg/m³	Specific Heat Capacity J/(kg·K)	Resistance m²K/W	Vapour Resistivity GN·s/(kg·m	Category
	LONDON CLAY	0.7500	1.410	1900.0	1000.0			Sands, Stones and Soils
	BRICKWORK (OUTER LEAF)	0.2500	0.840	1700.0	800.0			Brick & Blockwork
	CAST CONCRETE	0.1000	1.130	2000.0	1000.0			Concretes
	DENSE EPS SLAB INSULATION - LIKE STYROFOAM	0.0635	0.025	30.0	1400.0			Insulating Materials
	CHIPBOARD	0.0250	0.150	800.0	2093.0			Timber
	SYNTHETIC CARPET	0.0100	0.060	160.0	2500.0			Carpets
	Copy Paste Cavity Insert Add Delete Flip System Materials Project Materials							
	- Ll-value (W/m²-K)							
	Construction thickness 1.1985 m	CI	BSE U-value	0.2533	W/m²·K	EN-IS	60 U-value	0.2499 W/m²·K
	Derived Parameters Condensation Analysis OK Cancel							

Figure 2: Opaque construction

The dialogue displaying the attributes of an opaque construction is shown in Figure 2. This dialogue appears when an opaque project construction is selected for editing by means of a double click or the *Edit selected construction* icon. It displays the properties of an opaque construction and allows them to be edited.

The fields and buttons displayed on the dialogue are described below. Fields appearing on a white background are editable. When setting this data is important to understand the conventions applied to the orientation of constructions and the ordering of their layers, which are described in the section headed *Construction Orientation*.

ID: a unique identifier assigned to the construction when it is created.

Description: a description of the construction in words.

Outside surface

Emissivity: the emissivity of the outside surface of the construction. Values are provided in Table 23 in the Apache Tables document. Most

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materials have an emissivity of about 0.9. Lower values apply to unpainted metals.

- *Solar absorptance*: the fraction of incident solar radiation absorbed by the surface. This is a function of the colour and surface finish. Typical values are given in Table 14 in the Apache Tables document or CIBSE Guide A.
- *Resistance*: the thermal resistance between the outside surface and its environment. This is the reciprocal of the outside heat transfer coefficient, which is made up of convective and radiative components. Ticking the default box displays a standard value determined from the construction category, together with the *Wind exposure* in the case of external adjacency. The default value is used in the ApacheCalc programs. In ApacheSim it is replaced by algorithms that take account of the changing heat transfer conditions at every time step. If the default box is not ticked, the entered value is used by all programs.

Inside surface

Emissivity: the emissivity of the inside surface of the construction.

Resistance: the thermal resistance between the inside surface and its environment. This is the reciprocal of the inside heat transfer coefficient, which is made up of convective and radiative components. Ticking the default box displays a standard value determined from the construction category. The displayed default value is used in the ApacheCalc programs. In ApacheSim it is replaced by algorithms dependent on simulation options. If the default box is not ticked, the entered value is used by all programs.

Metal Cladding

Constructions can be identified as 'Metal Clad'. This is used for thermal bridging in SBEM compliance testing.

Building Regulations

Thermal bridging coefficient: Part L2 (2006) requires an allowance to be made for non-repeating thermal bridging. In the <VE> implementation this is handled via a coefficient expressing this component of heat loss as a multiple of element area. This can be thought of as an addition to element U-value. The default value of 0.035 W/m²K represents a typical value for office spaces built to the standards of the *Robust construction details* defined in IP 17/01. In the notional building, thermal bridging coefficients are set to standard values laid down in the NCM methodology document.

If the construction belongs to the *Ground/Exposed Floors* category additional parameters must be set for compliance testing against Part L2 of the UK Building Regulations. The rules for the *notional building* state

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that where the U-value of an uninsulated floor of the same area and exposed perimeter is less than 0.25 W/m²K a floor with this U-value must be used in the *notional building*. In accordance with this the following inputs are requested (they will not be calculated automatically):

Floor area: The total internal area of the floors to which this construction is assigned.

- *Exposed floor perimeter*. The exposed perimeter length of the floors to which this construction is assigned.
- *External wall thickness*: The average thickness of the external walls along the floor perimeter.
- *Ground conductivity*: The thermal conductivity of the ground under the building.

Using these parameters the software will calculate and display the CIBSE uninsulated U-value. If this is less than 0.25 W/m²K it will be used to create a bespoke floor construction that will be assigned to the relevant floors in the *notional building*.

If the construction belongs to the *Door* category an additional parameter must be set for UK Building Regulations compliance testing.

Door Type: Select from the following options

Personnel door. standard door.

- Vehicle access or similar large door. a category of door to which special rules, including more stringent U-value requirements, are applied in the Building Regulations.
- *Wall or roof element*: select this option if you have used a door to represent elements of a wall or roof. This will place these elements in the correct category for Building Regulations purposes.
- Smoke vent: select this option for a roof ventilator.
- *High usage entrance door.* select this option to represent the entrance to a building with a high throughput of people (e.g. shopping centre, airport).

Construction layers (outside to inside)

The construction may consist of up to 10 homogeneous layers, which are listed in order from outside to inside. With the exception of air gaps, each layer has a thickness and a material. The material has a set of properties which are stored in the Project Materials database, but which may be edited within the layer. Any new materials created by edits of this kind will be added to the list of Project Materials. Air gaps (which can include cavities filled with other gases such as argon) are assigned a thermal resistance in place of a material.

Thickness: the thickness of the layer.

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- *Resistance*: (air gap only) the thermal resistance of the air gap, taking account of both convection and radiation across the gap.
- *Material*: a description of the material composing the layer, or alternatively 'Air gap'.
- *Specific heat capacity*: the specific heat capacity of the material. Values for commonly used building materials are listed in Table 6 in the Apache Tables document and in CIBSE Guide A.
- *Conductivity*: the thermal conductivity of the material. Values for commonly used building materials are listed in Table 6 in the Apache Tables document and in CIBSE Guide A.
- *Density*: the density of the material. Values for commonly used building materials are listed in Table 6 in the Apache Tables document and in CIBSE Guide A.
- Vapour Resistivity: the vapour resistivity of the material or air gap. This field is blank for many materials, but a value must be supplied before condensation analysis is carried out. Values for commonly used building materials are listed in Table 16 in the Apache Tables document.

Category: the material category from the system materials database.

Construction thickness: (non-editable) the thickness of the construction, calculated as the sum of the layer thicknesses. This is used in the setting of room inner volumes and surface areas in rooms for which the *Inner Volume* flag is turned on.

U-values

- *CIBSE U-value*: the U-value of the construction as calculated by the CIBSE method.
- *EN-ISO U-value*: the U-value as calculated by the EN-ISO method. Note that this method does not take account of the entered values for emissivity, surface resistance or wind exposure.

The following buttons, which are also available as right-click menu options, are provided for tasks related to layer editing:

Copy: copies the properties of the selected layer to the paste buffer.

Paste: copies the material properties (but not the layer thickness) from the clipboard to the selected layer. The contents of the clipboard may have been copied from another layer, from a layer of a system construction or from a project or system material.

Air. creates an air gap adjacent to and on the outer side of the selected layer.

Insert: inserts a layer adjacent to the selected layer on its outer side and assigns it the material properties stored in the clipboard. If the clipboard contains a construction layer, the new layer is also assigned the copied thickness.

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Add: adds a layer to the inside surface of the construction and assigns it the material properties stored in the clipboard. If the clipboard contains a construction layer, the new layer is also assigned the copied thickness.

Delete: deletes the selected layer.

Flip: reverses the order of the layers.

System Materials: displays the materials used in the project, with the option of copying them into the construction. See System Materials for details.

Project Materials: displays the materials in the system database, with the option of copying them into the construction. See *Project Materials* for details.

Two further buttons invoke perform analysis functions on the selected construction:

- *Derived Parameters*: displays, in a separate window, a set of derived parameters for the selected construction. These include U-values and parameters relating to the CIBSE admittance procedure. The derived parameters will be dynamically updated as the construction is edited. See *Derived Parameters* for details.
- *Condensation Analysis*: carries out an analysis of condensation risk for the construction under given temperature and humidity conditions. See *Condensation Analysis* for details.

The opaque construction editing session is completed by clicking on either the OK or the Cancel button:

OK: exits the opaque construction dialogue and keeps any changes.

Cancel: exits the opaque construction dialogue and discards any changes.

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5. Editing a Glazed Project Construction

🕴 Project construction (glazed)									
ID GDPK6 Description	ID GDPK6 Description low-e double glazing (6mm+6mm) (2002 regs)								
Shading devices Local None ? Ext	ternal None	? Internal	None	?					
Outside surface Emissivity 0.900 Resistance (mřK/W) 0.0600 5	✓ default Percen Resista	l Metal tage 10.00	▼ % m²K/W	Building Reg Display Glazing type (dwellings)	gulations window? Double	e glazed (low-E,	, hard coat)	•]
Inside surface Emissivity 0.900 Resistance (m²K/W) 0.1171	Absorpi	tance 0.55	W/m²∙K	(dwellings) Thermal brid coefficient (dging (W/m²·K)	% Average or ur).035	nknwn Ódefault	•	
Construction layers (outside to inside)		Conv							
Description	Thickness Conductivity (m) (W/(m·K))	Gas W/m²·K	Resistance (m²K/W)	Trans.	Outside refl.	Inside refl.	Refractive index	Outside emissivity	Inside emissivity
PILKINGTON K 6MM	0.0000 1.060			0.690	0.090	0.090	1.526		
Cavity	0.0120		0.3360						
CLEAR FLOAT 6MM	0.0000 1.060			0.780	0.070	0.070	1.526		
Copy Paste Insert Ad	dd Delete					System Ma	Iterials	Project M	faterials
Thermal transmittance (U-value) CIBSE U-value (glass only) 1.9490 W/m²-K EIBSE net U-value (including frame) 1.9500 W/m²-K EIN-ISO net U-value (including frame) 1.9773 W/m²-K									
Derived Parameters Condens	sation Analysis							ОК	Cancel

Figure 3: Glazed construction

The dialogue displaying the attributes of a glazed construction is shown in Figure 3. This dialogue is displayed when a glazed project construction is selected for editing by means of a double click or the *Edit selected construction* icon. Its purpose is to display the properties of a glazed construction and allow them to be edited.

All transparent constructions of whatever material, including transparent doors, should be defined as glazed constructions.

The fields and buttons displayed on the dialogue are as follows. Fields appearing on a white background are editable. When setting this data is important to understand the conventions applied to the orientation of constructions and the ordering of their layers, which are described in the section headed *Construction Orientation*.

ID:a unique identifier assigned to the construction when it is
created.Description:a description of the construction in words.

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Outside surface

- *Emissivity*: the emissivity of the outside surface of the construction. If the construction involves low-emissivity coatings these are usually applied to surfaces facing into an air gap, and do not therefore affect the outside or inside surface emissivities. If the outer pane has an emissivity for its outside surface, this sets the construction outside surface emissivity automatically.
- *Resistance*: the thermal resistance between the outside surface and its environment. This is the reciprocal of the outside heat transfer coefficient, which is made up of convective and radiative components. Ticking the default box displays a standard value determined from the construction category and, in the case of external adjacency, the *Wind exposure*. The displayed default value is used in the ApacheCalc programs. In ApacheSim it is replaced by algorithms that take account of the changing heat transfer conditions at every time step. If the default box is not ticked, the entered value is used by all programs.

Inside surface

- *Emissivity*: the emissivity of the inside surface of the construction. If the construction involves low-emissivity coatings these are usually applied to surfaces facing into an air gap, and do not therefore affect the outside or inside surface emissivities. If the inner pane has an emissivity for its inside surface, this sets the construction inside surface emissivity automatically.
- *Resistance*: the thermal resistance between the inside surface and its environment. This is the reciprocal of the inside heat transfer coefficient, which is made up of convective and radiative components. Ticking the default box displays a standard value determined from the construction category. The displayed default value is used in the ApacheCalc programs. In ApacheSim it is replaced by algorithms dependent on simulation options. If the default box is not ticked, the entered value is used by all programs.

Building Regulations

These parameters are required only for UK Building Regulations compliance testing.

Glazing type (dwellings): (applies only to dwellings) select a glazing type. % Sky blocked (dwellings): (applies only to dwellings) select a category from the list to indicate the degree of shading.

Thermal bridging coefficient: Part L2 (2006) requires an allowance to be made for non-repeating thermal bridging. In the <VE> implementation this is handled via a coefficient expressing this component of heat loss as a multiple of element area. This can be thought of as an addition to element U-value. The default value of 0.035 W/m²K represents a typical value for office spaces built to the standards of the *Robust construction*

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details defined in IP 17/01. In the notional building, thermal bridging coefficients are set to standard values laid down in the NCM methodology document.

Shading devices

Internal

Click on the question mark to specify an internal shading device (curtain or blind). See *Shading Devices* for details.

External

Click on the question mark to specify an external shading device (shutter or louvre). See *Shading Devices* for details.

Local

Click on the question mark to specify a local shading device. See *Shading Devices* for details.

Frame:

The material percentage of the glazing element taken up by the frame. This is used in solar calculations and affects net U-value.

Construction layers (outside to inside)

The construction may consist of up to 4 glazing panes separated by air gaps. The panes are listed in order from outside to inside. With the exception of air gaps, each layer is assigned a pane type, consisting of a description and a set of optical properties describing the pane. Unlike an opaque material, a pane type describes the properties of the layer (pane) rather than the substance of which it is made. The pane properties are stored in the Project Materials database, but may be edited within the layer. Any new pane type created by edits of this kind will be added to the list of Project Materials. Cavity layers (air gaps and other gas-filled cavities) can be described in three different ways: in terms of a gas, a convection coefficient or a cavity resistance.

Description: a description of the pane, or alternatively 'Cavity'.

Thickness: thickness of the pane or cavity.

Conductivity: conductivity of the pane.

Type of glass or blind: denotes whether the pane has a coating, or whether it represents a blind.

Gas (optional): gas type of the cavity. If set, this is used to calculate the cavity convection coefficient.

Cavity convection coefficient (optional): the convection coefficient for heat transfer across the cavity. If set (or calculated from *Gas*), this is used, with the adjacent pane surface emissivities, to calculate the cavity resistance.

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- *Resistance* (optional, air gap only): the thermal resistance of the air gap, taking account of both convection and radiation across the gap. The air gap resistance will be higher if a low-emissivity coating is applied to either of the surfaces facing into the cavity. If *Cavity convection coeffici*ent is set, it is used, with the adjacent pane surface emissivities, to calculate the cavity resistance. For guidance on setting air gap resistance and other glazing parameters, see the *Hints & Tips* section.
- *Transmittance*: The transmittance of the pane for solar radiation at normal incidence.
- *Outside reflectance*: the reflectance of the outside surface of the pane for solar radiation at normal incidence.
- *Inside reflectance*: the reflectance of the inside surface of the pane for solar radiation at normal incidence.
- *Refractive index*: The refractive index of the material composing the pane.
- *Outside emissivity*: the emissivity of the outside surface of the pane. This is used to calculate the thermal resistance of the adjacent surface or cavity (unless this resistance has been specified explicitly).
- *Inside emissivity*: the emissivity of the inside surface of the pane. This is used to calculate the thermal resistance of the adjacent surface or cavity (unless this resistance has been specified explicitly).

U-values

Four U-values are displayed for a glazing construction, corresponding to combinations of the two methods for calculating U-value and the inclusion or exclusion of the effects of the frame.

- *CIBSE U-value (glass only)*: the centre-pane U-value of the construction as calculated by the CIBSE method.
- *EN-ISO U-value (glass only)*: the centre-pane U-value as calculated by the EN-ISO method. Note that this method does not take account of the entered values for emissivity, surface resistance or wind exposure.
- *CIBSE net U-value (including frame)*: the U-value as calculated by the CIBSE method with a correction applied for the effect of the frame.
- *EN-ISO net U-value (including frame)*: the U-value as calculated by the EN-ISO method with a correction applied for the effect of the frame. The net U-value is calculated as an average of the EN-ISO centre-pane and frame U-values, weighted according to the frame percentage. For this calculation the frame conductance is derived from the frame CIBSE U-value and EN-ISO surface resistances are applied.

The following buttons, which are also available as right-click menu options, are provided for tasks related to layer editing:

Copy: copies the properties of the selected pane to the clipboard.

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Paste: copies the pane properties from the clipboard to the selected layer. The contents of the clipboard may have been copied from another pane, from a pane of a system construction or from a project or system material (pane type).

- *Insert*: inserts a pane adjacent to the selected layer on its outer side and assigns it the material properties stored in the clipboard. An air gap will be created automatically and assigned a default resistance.
- *Add*: adds a pane to the inside surface of the construction and assigns it the material properties stored in the clipboard. An air gap will be created automatically.
- *Delete*: deletes the selected pane and an adjacent air gap. If the pane is enclosed within the construction the deleted air gap will be the one to its inside.

Flip: reverses the order of the panes and air gaps.

System Materials: display the materials used in the project, with the option of copying them into the construction. See System Materials for details.

Project Materials: display the materials in the system database, with the option of copying them into the construction. See *Project Materials* for details.

Two further buttons invoke perform analysis functions on the selected construction:

- *Derived Parameters*: displays, in a separate window, a set of derived parameters for the selected construction. These include U-values and optical properties. The derived parameters will be dynamically updated as the construction is edited. See *Derived Parameters* for details.
- *Condensation Analysis*: carries out an analysis of condensation risk for the construction under given temperature and humidity conditions. See *Condensation Analysis* for details.

The opaque construction editing session is completed by clicking on either the OK or the Cancel button:

OK: exits the opaque construction dialogue and keeps any changes.

Cancel: exits the opaque construction dialogue and discards any changes.

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6. Construction Orientation

The orientation of both opaque and glazed constructions is important thermally and is governed by the following rules.

- 1. The layers of a construction are listed in order from outside to inside.
- 2. For Roofs, External walls, Ground/Exposed Floors, External Windows and Rooflights, the outside of the construction faces the external environment (or in the case of a Ground Floor the ground).
- 3. Internal Ceiling/Floors are defined as ceilings, so the outside of the construction is the upper side. Note that as a consequence, these constructions are displayed in the reverse orientation to ground or exposed floors.
- 4. The orientation of Internal Partitions and Internal Windows depends on the particular instance in the building, and is determined from the relative ordering of the adjacent spaces in the room browser. The convention is that the inside of the Internal Partition or Window, as defined in the Constructions Database, is the side facing the space that appears first on the browser.
- 5. Doors are treated in the same way as external constructions or internal partitions, depending on whether they have internal or external adjacency.

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7. Project Materials

The project materials database (Figure 4) provides a list of materials used in the project. It is accessed via the *Project materials* option on the View menu, or alternatively from buttons on the construction editing dialogues.

22	I Proje	ct Materials				×
	B			Mater	al Category	laterials
	ID	Description	Conductivity W/(m·K)	Density kg/m³	Specific Heat Capacity J/(kg:K)	Vapour Resistance GN:s/(kg:m)
	GFQ	GLASS-FIBRE QUILT	0.040	12.0	840.0	
	SFOAM	DENSE EPS SLAB INSULATION - LIKE	0.025	30.0	1400.0	
						Close

Figure 4: Project materials

Materials in the database are organised in categories such as Concretes, Insulating Materials and Glass. The Material Category is selected from a list.

The materials in the chosen category, together with their properties, are displayed in a list. The materials may be sorted according to any of their properties. For example to sort concretes by density click on the label 'Density'. The first click arranges the materials in ascending order, the second in descending order. To restore the original order, click on the description label.

Icons on the toolbar provide the following options operating on the selected construction:

Depresentation Copy material: Copies the selected material to the clipboard, ready for pasting into a project construction.

Show material references: Displays a list of project constructions referencing the selected material.

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8. System Constructions

The system constructions database (Figure 5) is a central store of constructions available for copying into projects. Materials and glazing pane types in the system constructions may also be copied. This database is accessed via the *System constructions* option on the View menu. You can keep the database open while you work on project constructions.

🏶 System constructions (non-editable)							
🖻 🔒 😵							
Opaque Construction	IS Glazed Constructions						
C Internal Ceiling	s/Floors C Doors	C	Internal Partitions				
C Roofs	 Ground/Exposed Flo 	oors 📀	External Walls				
ID	Description		EN-ISO U-value W/m²-K				
STD_WAL2	L2 standard wall construction (2002 regs)		0.3495				
STD_WAL3	standard wall construction (2002 regs Scotland)	0.2987	0.2993				
STD_WALL	standard wall construction (insulated to 1995 regs)	0.3956	0.3967				
BBW90-D	brick/block wall	0.4382	0.4396				
TFW90-D	timber-frame wall	0.4479	0.4493				
CURTWALL	lightweight curtain wall (insulated to 1995 regs)	0.4508	0.4522				
MCLADW	metal-clad wall (insulated to 1995 regs)	0.4531	0.4546				
BBWALL90	brick/block wall (insulated to 1995 regs)	0.3956	0.3967				
BBW85-D	brick/block wall 0.5395		0.5416				
TFW85-D timber-frame wall 0.5756 0.5779							
		l	Close				

Figure 5: System constructions database

This dialogue works in a similar way to the main Project Constructions dialogue and organises the constructions using the same classes and categories. The main difference is that, unlike project constructions, system constructions may not be edited, only viewed and copied,

The following functions are available on the toolbar:

Copy construction: copies the selected construction to the clipboard.

Copy construction to project: copies the selected construction to the project.

View construction: displays the selected construction.

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9. System Materials

The system materials database (Figure 6) is a central store of materials and glazing pane types available for copying into projects. This database is accessed via the *System materials* option on the View menu, or alternatively from buttons on the construction editing dialogues. You can keep the database open while you work on project constructions.

syster	n Materials (non editable)				
ð 🗳			Mater	ial Category Asphalts & (Other Roofing
ID	Description	Conductivity W/(m·K)	Density kg/m³	Specific Heat Capacity J/(kg·K)	Vapour Resistance GN:s/(kg·m)
ED	ASBESTOS CEMENT DECKING	0.360	1500.0	1050.0	
SH	ASBESTOS CEMENT SHEET	0.360	700.0	1050.0	
P	ASPHALT	0.500	1700.0	1000.0	
В	FELT/BITUMEN LAYERS	0.500	1700.0	1000.0	
	ROOFING FELT	0.190	960.0	837.0	
					Close
	ID ID ID ID ID ID ID ID ID ID ID ID ID I	ID Description ED ASBESTOS CEMENT DECKING CSH ASBESTOS CEMENT SHEET SP ASPHALT B FELT/BITUMEN LAYERS F ROOFING FELT	ID Description Conductivity W/(m:K) EED ASBESTOS CEMENT DECKING 0.360 CSH ASBESTOS CEMENT SHEET 0.360 SP ASPHALT 0.500 B FELT/BITUMEN LAYERS 0.500 F ROOFING FELT 0.190	ID Description Conductivity W/(m:K) Density kg/m³ ID ASBESTOS CEMENT DECKING 0.360 1500.0 ID ASBESTOS CEMENT DECKING 0.360 700.0 ID ASBESTOS CEMENT SHEET 0.360 700.0 ID ASPHALT 0.500 1700.0 ID FELT/BITUMEN LAYERS 0.190 360.0	ID Description Conductivity W/(m:K) Density kg/m³ Specific Heat Capacity J/(kg:K) ZED ASBESTOS CEMENT DECKING 0.360 1500.0 1050.0 CSH ASBESTOS CEMENT SHEET 0.360 700.0 1050.0 SP ASPHALT 0.500 1700.0 1000.0 SP FELT/BITUMEN LAYERS 0.500 1700.0 1000.0 SR ROOFING FELT 0.190 960.0 837.0

Figure 6: System materials database

Materials in the database are organised in categories such as Concretes, Insulating Materials and Glass. The Material Category is selected from a list.

The materials in the chosen category, together with their properties, are displayed in a list. The materials may be sorted according to any of their properties. For example to sort concretes by density click on the label 'Density'. The first click arranges the materials in ascending order, the second in descending order. To restore the original order, click on the description label.

Icons on the toolbar provide the following options operating on the selected construction:

Deputy material: Copies the selected material to the clipboard, ready for pasting into a project construction.

Show material references: Displays a list of project constructions referencing the selected material.

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10. Shading Devices

Shading devices of three kinds – internal, external and local – may be attached to glazed constructions. This is a quick way to specify shading features to all instances of a glazing construction. The results of the shading calculations performed for these shading devices are combined with those carried out by SunCast.

The three types of shading device are suitable for representing the following types of shading:

Internal: curtains, blinds.

External: shutters, louvres, brise soleils.

Local: side-fins, overhangs, balconies, window recesses.

10.1.1. Internal Shading

The input dialogue window for an internal shading device is shown in Figure 7. Descriptions of the data fields are given below.

Internal Shading De	Internal Shading Device 🛛 🔀				
Device	C None	C Curtain	 Blind 		
Percentage profile group	None		•		
Incident radiation to lower device	0	Typically between 0 and	600		
Incident radiation to raise device	0	Typically between 0 and	600		
Nighttime resistance	0	Typically between 0 and	2.5		
Daytime resistance	0	Typically between 0 and	2.5		
Shading coefficient	0	Typically between 0.2 an	d 0.95		
Short-wave radiant fraction	0	Typically between 0 and	1		
Building Regulations L1:					
Blind or curtain type	Net curtain	(covering whole window)	•		
Fraction of daylight hours closed	0.10				
		ОК	Cancel		

Figure 7: Internal Shading Device parameters



10.1.1.1. Device:

Selecting *Curtains* or *Blinds* activates the device and allows the parameters to be edited. No distinction is made between curtains and blinds in terms of the performance of the device.

10.1.1.2. Percentage Profile Group:

A percentage profile specifying the timing of the blind operation. Percentage values greater than 50% are interpreted as 'on' and other values as 'off'. When the profile is on, the device operates (i.e. is lowered into position). When the profile is off, or set to 'none', the device is controlled by incident solar radiation, as specified by the following two parameters.

10.1.1.3. Incident Radiation to Lower Device:

This parameter comes into play when the profile is off. The shading device starts operating (i.e. is lowered into position) when the total incident solar radiation flux rises through this value. If *Incident Radiation to Raise Device* and *Incident Radiation to Lower Device* are both set to zero the device is assumed to operate only according to the timed operation profile and its operation is not affected by solar radiation.

10.1.1.4. Incident Radiation to Raise Device:

This parameter comes into play when the profile is off. The shading device stops operating (i.e. is raised) when the intensity of total incident solar radiation falls below this value. This value must be less than or equal to the *Incident Radiation to Lower Device*. For incident radiation fluxes between the two thresholds the blind remains in its previous state. If *Incident Radiation to Raise Device* and *Incident Radiation to Lower Device* are both set to zero the device is assumed to operate only according to the timed operation profile and its operation is not affected by solar radiation.

10.1.1.5. Night-time Resistance:

The additional thermal resistance (if any) associated with the device when it is in operation at night (taken to be when the sun is below the horizon). This parameter allows you to make allowance for the night-time closing of curtains or blinds.

A value of zero is appropriate in most cases. Net curtains and most types of blind have minimal insulation effect on the glazing. Their can therefore be ignored for most applications. However, the effect of heavyweight curtains and blinds should be included.

10.1.1.6. Daytime Resistance:

The additional thermal resistance (if any) associated with the device when it is in operation during the day (taken to be when the sun is above the horizon). This extra resistance affects not only the U-value, but also the retransmitted component of absorbed solar radiation.

A value of zero is appropriate in most cases. Net curtains and most types of blind have minimal insulation effect on the glazing. Their thermal effect can therefore be ignored for most applications. However, the effect of heavyweight curtains and blinds should be included.

10.1.1.7. Shading Coefficient:

Blinds and curtains reduce solar penetration into the space by reflecting and absorbing short-wave solar radiation. A proportion of the absorbed heat (sometimes called re-transmitted heat) is transferred into the room by convection and long-wave radiation.

The shading coefficient specifies the degree to which the blind reduces the short-wave component of room solar gain that passes through the glazing panes. A value of 1 means no shading and a value of 0 perfect shading. Typical values are listed in Table 8 of the Apache Tables document. The internal blind is not considered to affect the long wave radiation and convective heat transfer from the glazing to the room.

If the solar transmittance (T) and absorptance (A) are known for the blind, values for the shading coefficient (SC) and short-wave radiant fraction (SWRF) can be obtained using

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 $SC = T + 0.87^*A$

SWRF = T/SC

These formulae apply to a blind consisting of a single sheet of material, such as a roller blind or a closed slatted blind. They can be applied to open or partially open slatted blinds if an allowance is made in the T and A values for inter-reflection between the slats.

10.1.1.8. Short-Wave Radiant Fraction:

The short-wave radiant fraction specifies the proportion of the room heat gain associated with the blind that passes through it as short-wave radiation.

Typical values are listed in Table 8 in the Apache Tables document. A method for deriving values from blind properties is described under *Shading Coefficient*.

10.1.1.9. Building Regulations L1:

Used for defining local shading in conjunction with Part L1 for dwellings. See the SAP 2005 document for more details on these settings in relation to overheating.

10.1.2. External Shading

The input dialogue window for an external shading device such as a shutter, louvre or brise soleil is shown in Figure 8. Descriptions of the data fields are given below.

External Shading D	evice			×
Device	O None	C Shutter	Couvre	
Percentage profile group	None			•
Incident radiation to lower device	0	Typically betweer	n 0 and 600	
Incident radiation to raise device	0	Typically betweer	n 0 and 600	
Nighttime resistance	0	Typically betweer	n 0 and 2.5	
Daytime resistance	0	Typically betweer	0 and 2.5	
Ground diffuse transmission factor	0	🗹 Calculate Ty	pically between 0 and	1
Sky diffuse transmission factor	0	🗹 Calculate Ty	pically between 0 and	1
Transmission Factors at 15 degree	increments (v	values in range -0.1	00 - 1.00)	
0° 15° 30° 0.00 0.00 0.00	45° 0.00	60° 7	75° 90° 0.00 0.00	Ŧ
	,		OK Cancel	

Figure 8: External Shading Device parameters

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10.1.2.1. Device:

Selecting Shutters or Louvres activates the device and allows the parameters to be edited. No distinction is made between shutters and louvres in terms of the performance of the device.

10.1.2.2. Percentage Profile Group:

A percentage profile specifying the timing of the operation of the shade. Percentage values greater than 50% are interpreted as 'on' and other values as 'off'. When the profile is on, the device operates (i.e. is lowered into position). When the profile is off, or set to 'none', the device is controlled by incident solar radiation, as specified by the following two parameters.

10.1.2.3. Incident Radiation to Lower Device:

This parameter comes into play when the profile is off. The shading device starts operating (i.e. is lowered into position) when the total incident solar radiation flux rises through this value. If Incident Radiation to Raise Device and Incident Radiation to Lower Device are both set to zero the device is assumed to operate only according to the timed operation profile and its operation is not affected by solar radiation.

10.1.2.4. Incident Radiation to Raise Device:

This parameter comes into play when the profile is off. The shading device stops operating (i.e. is raised) when the intensity of total incident solar radiation falls below this value. This value must be less than or equal to the Incident Radiation to Lower Device. For incident radiation fluxes between the two thresholds the blind remains in its previous state. If Incident Radiation to Raise Device and Incident Radiation to Lower Device are both set to zero the device is assumed to operate only according to the timed operation profile and its operation is not affected by solar radiation.

10.1.2.5. Night-time Resistance:

The additional thermal resistance (if any) associated with the device when it is in operation at night (taken to be when the sun is below the horizon). This parameter allows you to make allowance for the night-time closing of shutters. A value of zero is appropriate in most cases.

10.1.2.6. Daytime Resistance:

The additional thermal resistance (if any) associated with the device when it is in operation during the day (taken to be when the sun is above the horizon). This extra resistance affects not only the U-value, but also the retransmitted component of absorbed solar radiation. A value of zero is appropriate in most cases.

10.1.2.7. Ground diffuse transmission factor:

The degree to which the ground is shaded by the device as viewed from the glazing construction. This affects the amount of diffuse ground-scattered solar radiation incident on the window. Ticking the Calculate check box sets a default value of 1.

10.1.2.8. Sky diffuse transmission factor:

The degree to which the sky is shaded by the device as viewed from the window. This affects the amount of diffuse solar radiation incident on the window from the sky. Ticking the Calculate calculates a value for this parameter as a suitably weighted average of the transmission factors for direct solar radiation.

10.1.2.9. Transmission Factors at 15 degree increments:

Values of the transmittance of the shading device for direct solar radiation, at 15 degree angular increments. The angle in question is the solar altitude measured in a vertical plane perpendicular to the glazing construction.

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10.1.3. Local Shading

The input dialogue window for local shading features such as projections and window recesses is shown in Figure 9. Descriptions of the data fields are given below.

Local Shading Device 🛛 🔀					
Device (O None	C Pr	ojections 💿 Re	cess	
Window width	1	m	Window height	1	m
Balcony projection	0	m	Balcony height	0	m
Overhang projection	0	m	Overhang offset	0	m
Left fin projection	0	m	Left fin offset	0	m
Right fin projection	0	m	Right fin offset	0	m
Building Regulations	L1:				
Overhang ty	y pe Wide	(>2x v	vindow width)	-	
Depth	vH 0.00				
			OK	Cancel	

Figure 9: Local Shading Device parameters

10.1.3.1. Device:

Selecting Projections or Window Recesses activates the device and allows the parameters to be edited. No distinction is made between projections and window recesses in terms of the performance of the device. Enter the value 0 for parameters relating to any shading features that are not present.

10.1.3.2. Window width:

The width of the windows to which the construction is to be assigned. The shading calculations will only be correct if applied to a rectangular window of the given dimensions.

10.1.3.3. Window height:

The height (top to bottom) of the windows to which the construction is to be applied. The shading calculations will only be correct if applied to a rectangular window of the given dimensions.

10.1.3.4. Balcony projection:

If there is a balcony, enter the distance it projects from the plane of the window.

10.1.3.5. Balcony height:

The height of the top edge of the balcony measured from the lower edge of the window.

10.1.3.6. Overhang projection:

If there is an overhang or recess soffit, enter the distance it projects from the plane of the window.

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10.1.3.7. Overhang offset:

The distance between the overhang and the top of the window.

10.1.3.8. Left fin projection:

If there is a left side-fin or a left wall of a window recess (as viewed from the outside), enter the distance it projects from the plane of the window.

10.1.3.9. Left fin offset:

The distance between the left fin or left recess wall from the adjacent window edge.

10.1.3.10. Right fin projection:

If there is a right side-fin or a right recess wall (as viewed from the outside), enter the distance it projects from the plane of the window.

10.1.3.11. Right fin offset:

The distance between the right fin or right recess wall from the adjacent window edge.

10.1.3.12. Building Regulations L1:

Used for defining local shading in conjunction with Part L1 for dwellings. See the SAP 2005 document for more details on these settings in relation to overheating.

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11. Derived Parameters

By clicking on the Derived Parameters button on a Construction dialogue or using the *Derived Parameters* option on the *Calculations* menu, you can bring up a window displaying parameters derived from the current construction's data. These include U-values, CIBSE admittance parameters and optical properties of glazed constructions. The derived parameters are dynamically updated in response to edits made to the construction.

11.1. Derived Parameters (opaque construction)

The derived parameters for an opaque construction are as follows:

- *Outside surface resistance*: the thermal resistance between the outside surface and its environment, as set in the construction data.
- *Inside surface resistance:* the thermal resistance between the inside surface and its environment, as set in the construction data.
- *Outside convective heat transfer coefficient*: the convective heat transfer coefficient for the outside surface, calculated from the surface resistance and emissivity.
- *Inside convective heat transfer coefficient*: the convective heat transfer coefficient for the inside surface, calculated from the surface resistance and emissivity.
- *Outside radiative heat transfer coefficient*: the radiative heat transfer coefficient for the outside surface, calculated from the emissivity.
- *Inside radiative heat transfer coefficient*: the radiative heat transfer coefficient for the inside surface, calculated from the emissivity.
- *CIBSE U-Value*: the U-value of the construction as calculated by the CIBSE method.
- *EN-ISO U-Value*: the U-value of the construction as calculated by the EN-ISO method.
- Admittance: the CIBSE admittance of the construction, which relates inside surface heat transfer to inside environmental temperature.
- Admittance time lead: the time lead associated with the admittance
- *Internal admittance*: (for partitions and ceilings only) the combined admittance of both surfaces of the construction, which features in CIBSE calculations for partitions contained entirely within a room.

Decrement factor: the CIBSE decrement factor, which, taken together with the admittance, relates inside surface heat transfer to outside environmental temperature.

Decrement factor time lag: the time lag associated with the decrement factor.

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- *Surface factor*: the CIBSE surface factor for the inside surface of the construction.
- *Internal surface factor.* (for partitions and ceilings only) the combined surface factor of both surfaces of the construction, which features in CIBSE calculations for partitions contained entirely within a room.

Buttons and a check box at the foot of the dialogue provide the following functions:

- *Include construction properties in printed output*?: adds the construction to the list of those to be printed from the main *Print* facility.
- *Copy*: copies the derived parameters to the clipboard for pasting into other applications.

Print: prints the derived parameters.

11.2. Derived Parameters (glazed construction)

The derived parameters for an opaque construction are as follows:

- *Outside surface resistance*: the thermal resistance between the outside surface and its environment, as set in the construction data.
- *Inside resistance:* the thermal resistance between the inside surface and its environment, as set in the construction data.
- *Outside convective heat transfer coefficient*: the convective heat transfer coefficient for the outside surface, calculated from the surface resistance and emissivity.
- *Inside convective heat transfer coefficient*: the convective heat transfer coefficient for the inside surface, calculated from the surface resistance and emissivity.
- *Outside radiative heat transfer coefficient*: the radiative heat transfer coefficient for the outside surface, calculated from the emissivity.
- *Inside radiative heat transfer coefficient*: the radiative heat transfer coefficient for the inside surface, calculated from the emissivity.
- *CIBSE U-value (glass only)*: the centre-pane U-value of the construction as calculated by the CIBSE method.
- *CIBSE net U-value (including frame)*: the U-value as calculated by the CIBSE method with a correction applied for the effect of the frame.
- *EN-ISO U-value*: the U-value centre-pane as calculated by the EN-ISO method.
- *EN-ISO net U-value (including frame)*: the U-value as calculated by the EN-ISO method with a correction applied for the effect of the frame.
- *g-value (BS EN 410)*: the g-value of the glazing construction as calculated by BS EN 410. This is the total solar transmittance at normal incidence under specified conditions.

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g-value (BFRC): the g-value of the glazing construction as defined under the conventions of the British Fenestration Rating Council:

g-value (BFRC) = 0.9 * (1 – frame fraction) * g-value (BS EN 410)

- *Frame occupies...*: the percentage of the glazing element taken up by the frame
- T(D): the short wave solar transmittance at 10 angles of incidence

T(R): the solar transmittance at 10 angles of incidence arising from absorption in the glazing construction and subsequent conduction, convection and long-wave radiation into the room.

- Short-wave shading coefficient: the shading coefficient for directly transmitted short-wave solar radiation, defined as T(D)/0.87, where T(D) is the value at 0° (normal) incidence.
- *Long-wave shading coefficient:* the shading coefficient for absorbed solar that enters the room by conduction, convection and radiation, defined as T(R)/0.87, where T(R) is the value at 0° (normal) incidence.
- *Total shading coefficient*: the sum of the short-wave and the long-wave shading coefficients.

Buttons and a check box at the foot of the dialogue provide the following functions:

- *Include construction properties in printed output*?: adds the construction to the list of those to be printed from the main *Print* facility.
- *Copy*: copies the derived parameters to the clipboard for pasting into other applications.

Print: prints the derived parameters.

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12. Condensation Analysis

This facility allows you to perform a condensation analysis on the currently selected construction. It is accessed either from the Calculations menu option *Condensation analysis* or by via a button on the construction editing dialogue.

Before condensation analysis can be carried out, all layers of the construction must be assigned a vapour resistivity. You will be prompted to supply any missing values.

Conditions on each side of the construction are specified using the following parameters:

- *Ext. T:* The external air temperature to be used in the analysis
- *Ext. RH:* The external air relative humidity to be used in the analysis
- Int. T: The internal air temperature to be used in the analysis
- Int. RH: The internal air relative humidity to be used in the analysis

If condensation is predicted, a chart is displayed showing the variation of the following variables through the construction:

Sat. VP:	Saturated vapour pressure
VP:	Vapour pressure
Dry Bulb Temp.:	Dry bulb temperature

A blue dot indicates where condensation occurs.

Toolbar icons provide the following options:

Copy to clipboard: clipboard.	Copy the condensation chart to the
Save condensation chart: file.	Save the condensation chart as a bitmap
Print condensation chart:	Print the condensation chart.
Text representation:	Display the results in text form (with options to copy and print).

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13. Hints & Tips

13.1. Manufacturers' Data

The properties of glazing panes and constructions are published by manufacturers. The salient properties for an individual pane are the solar direct transmittance, reflectance and absorptance. These values should sum to one.

When creating a glass pane type (material) the direct transmittance, reflectance and absorptance may be used directly with no modification. However, for a double glazed unit you will find that the solar radiant properties are usually given for the full unit rather than the individual layers. The properties given are typically U-value, short-wave shading coefficient and total shading coefficient. Separate U-values may be specified for the mid-pane properties and the unit as a whole, including the frame.

The procedure for matching glazing properties for a complete glazing unit is as follows:

- 1. For any known glazing panes (for instance 6mm clear float), assign properties from the materials database.
- 2. Make a guess for the properties of panes for which no specific data is available.
- 3. Match the manufacturer's mid-pane U-value by suitable choice of air gap resistance. The air gap resistance includes the effect of low emissivity coatings facing into the glazing cavity. Do not adjust the CIBSE Net U-value (including frame) or the emissivities of the outside or inside surface.
- 4. Click on Derived Parameters to display the derived properties of the glazing and compare the shading coefficients displayed with those provided by the manufacturer. Adjust the reflectance, absorptance and transmittance of the unknown panes to match these parameters. Be careful to ensure that the sum of the reflectance, absorptance and transmittance is 1. If the manufacturer's data is in the form of transmittances rather than shading coefficients, use the displayed values for T(D) and T(R) at 0° incidence. These transmittances are related to the shading coefficients by a factor of 0.87.
- 5. Adjust the CIBSE Net U-value (including frame) to match the manufacturer's value for this parameter. This operation must be done last, as the Net U-value is automatically updated to the calculated mid-pane U-value after edits to any other parameters.

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13.2. Interstitial Blinds and Ventilated Cavities

Blinds within a glazing cavity (which may be ventilated) can be modelled in one of two ways. The example given below assumes triple glazing:

Method 1

The blind may be modelled by using a fourth layer of glass but assigning the properties of the blind to this pane.

Using a fourth pane of glass to model the blind. In this case, the manufacturer's blind transmittance, absorptance, reflectance data can be used to set up a glazing material. Set the refractive index to 1.0.

The manufacturers' blind transmittance of short-wave solar radiation value can be entered directly as the transmittance of the blind material.

The absorptance is calculated by reducing the absorptance of the actual blind by a factor to account for the convection of the absorbed heat by natural ventilation in the cavity.

If the ventilation is 100% effective in removing heat absorbed by the blind, enter 0.0 as the absorptance of BLIND.

If there is no ventilation enter the manufacturers' value directly. The actual value will lie somewhere between 0 and 100% of the manufacturer's value.

You will have to estimate the actual value to use based on the likely flow of air through the cavity and the heat removal rate from the blinds.

It is likely that the proper value to use is between 40 and 95% of the manufacturers' absorptance value.

Method 2

Alternatively, the outer cavity may be modelled as a separate room. In this case the blind can be modelled in the normal way, by attaching an internal shading device to the outer pane.

The double-glazed unit between the outer cavity and the room is now an internal window.

13.3. Air Partitions

If a space is subdivided with the option *Remove partition* set, the partition between the spaces is automatically replaced by a hole. Holes are completely transparent to solar radiation and MacroFlo treats them as open to the passage of air. In some instances it is appropriate to adjust the MacroFlo characteristics of such an opening (as described in the MacroFlo Methods manual), and to make this possible the hole must be replaced by a window. To ensure the correct characteristics for solar and long-wave radiation exchange

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the window should be constructed as a single pane with the following properties:

Outside surface
Emissivity: 1.0Inside surface
Emissivity: 1.0Frame: 0.0Construction layer
Reflectance: 0.0
Absorptance: 0.0
Transmittance: 1.0
Refractive index: 1.0