

Passive Design Assistant (PDA)

Version 1.0

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Passive Design Assistant

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This document has been created to provide a guide for the use of the software. It does not provide engineering advice, nor is it a substitute for the use of standard references. The user is deemed to be conversant with standard engineering terms and codes of practice. It is the users responsibility to validate the program for the proposed design use and to select suitable input data.

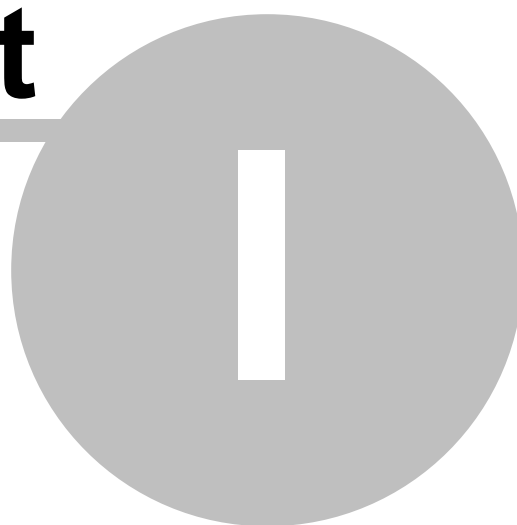
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Introduction and Getting Started

Part



1 Introduction and Getting Started

The Passive Design Assistant (PDA) is a software tool designed to elucidate the principles of passive thermal design of buildings to non-specialists.

This tool has been developed by Arup in collaboration with The Concrete Centre and AHMM Architects.

The target audiences for the tool are architects and other professionals and stakeholders involved in the design process who do not have specialist knowledge of building physics and who would not normally use thermal simulation software.

A key objective is that the software has a simple and intuitive user interface that enables the user to understand the influence of the key design parameters.

It is intended that the software could be used to inform early design stage decisions and, more generally, as an educative tool to communicate the principles of building physics. The tool could also be used to 'sanity check' the results of more complex thermal simulation models. An additional impact may be to influence the shape of future modelling tools used for Building Regulations compliance, which currently have a fairly crude representation of the building physics important for passive design.

The purpose of this manual is to describe how to use the PDA, not to repeat the well established underlying theory. The PDA uses the CIBSE Admittance Method, a full description of this theoretical model can be found in [\[1\]](#), sections A3 and A5.

1.1 Installing and Uninstalling

PDA will run on Microsoft Windows XP and Windows 7.

To install the PDA double click the installation file (PDA_1.0.msi). The installer will prompt the user for a location to which the PDA will be installed. The default location is C:\Program Files (x86)\ARUP\PDA_1.0

To uninstall go to Add/remove programs and locate the PDA installer and click remove.

It is possible that some files will be left in the installation directory (the default of which is C:\Program Files (x86)\ARUP\PDA_1.0). These files and the installation directory itself can be safely deleted after uninstalling.

1.2 Navigating and Getting Started

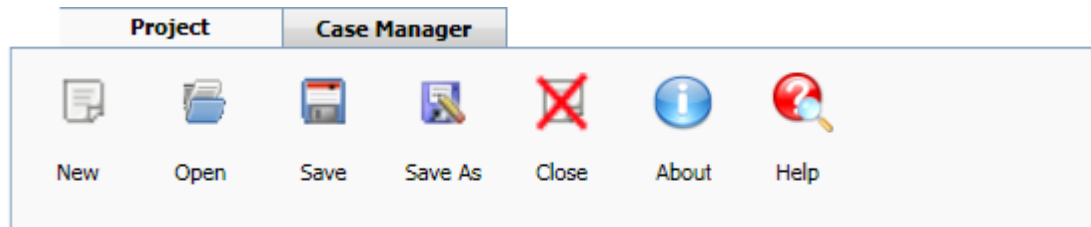
The PDA uses a standard Windows style user interface and many of the features common to Microsoft Windows style applications. It is assumed that the user is familiar with these functions, e.g. opening, closing, saving etc. so they will not be described here. Features specific to the PDA will be described in the following sections.

A PDA file is called a Project. Project level functions such as creating new, opening, saving and closing are available through the [Project](#) tab. Projects consists of one or more cases. This allows the user to easily switch between and compare different cases, often useful for parametric studies. The individual cases are viewed and edited through the [Case Manager](#) tab.

A welcome window is also visible on the initial screen. There are links to case studies and an option to email a link to the PDA.

An information bar at the bottom of the screen will display short help tips for the control that the mouse cursor is currently over.

1.3 Project Tab



Clicking the Help button or pressing the F1 key whilst the PDA application is in use will load this help file.

To view information and links to the project partners websites, click the About button. Clicking the logos in this window (and on the main page) will link to the company/institution website.



Projects can be saved at any point by pressing the Save or Save As buttons. PDA files are saved as eXtensible Markup Language (xml) files and the current file name is displayed in the bar at the top of the program. Saved projects can be opened with the Open button and closed with the Close button.

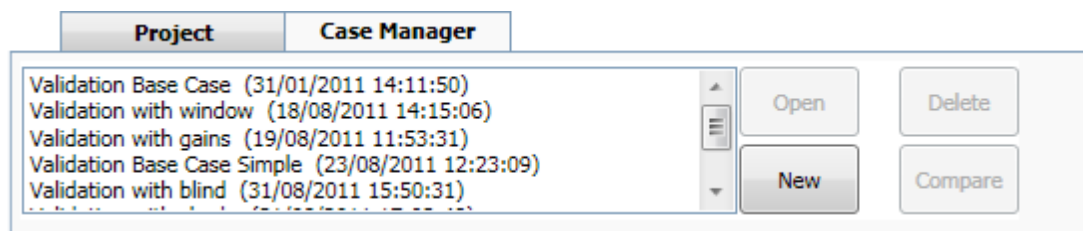
To begin using the PDA on a new project, click the New button. This switches to the [Case Manager](#)

tab.

1.4 Case Manager Tab

The PDA allows creation of multiple Cases which is useful for running parametric studies. For example, multiple cases can be created to examine the effects of different wall constructions or window shades on the temperatures or heating/cooling loads on a space.

The Case Manager window lists the Cases available in the current project. Note that a new project will have no Cases defined and the Case Manager will be empty.



A New case can be created by clicking the New Button, see [New Case](#).

On selecting a previously defined Case, the Open and Delete buttons are enabled, allowing editing or deletion of the highlighted Case.

The Ctrl button can be used to select multiple cases which can then be compared by clicking the Compare button, see [Compare Cases](#).

1.5 New Case

In the New Case window the name of the new case should be entered in the Case Name field. This information is mandatory.

The name of the user creating the new case can be added to the Created By field. This information is not mandatory but useful for auditing purposes.

Case Name:

Created By:

Settings:

☒ Create blank case

☐ Create case from defaults

☐ Get settings from previous case:

Validation Base Case

Validation with window

Validation with gains

Validation Base Case Simple

Validation with blind

Validation with shade

Validation constant vent

Validation variable vent

There are three options for constructing a new case:

A new case which has no pre-loaded information can be created by selecting 'Create blank case';

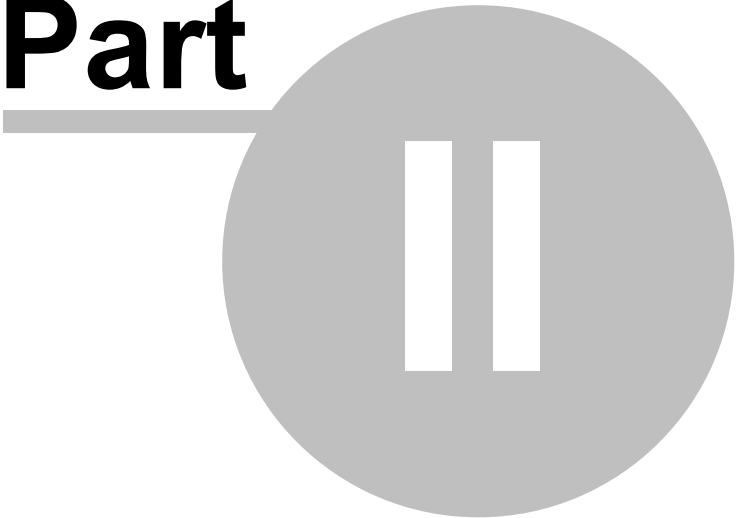
A new case loaded with some default values can be created by selecting 'Create case from defaults';

If some Cases already exist, the 'Get settings from previous case' option is enabled allowing creation of a new case based on those settings from the previous case selected from the list. This is particularly useful when conducting parametric studies.

Clicking OK will load the main [Case Data](#) form

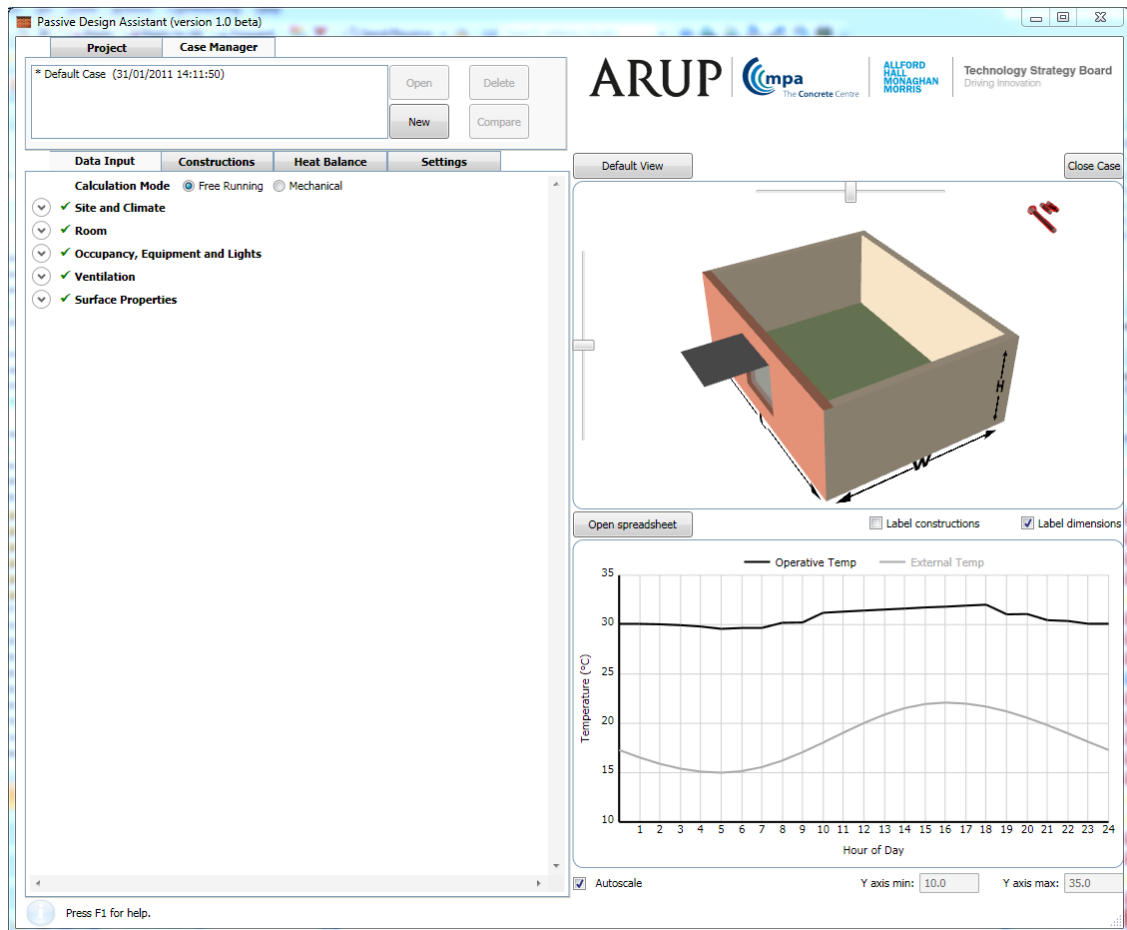
Case Data

Part



2 Case Data

The Case Data form consists of several tabbed pages (described below) used to enter or view input data and two viewers which (by default) show a 3D depiction of the geometry and the main results (space temperature or heating/cooling loads). Clicking Close Case will close this Case Data form. The Open spreadsheet button is enabled when all necessary inputs are valid and results are available. Clicking this button will load a spreadsheet version of the results in Microsoft Excel (or the default viewer for the csv file type). (These results are saved as comma separated variable (csv) files and by default are stored in the same location as the model files).



The output graphs and geometry graphics are updated as relevant inputs are changed.

The geometry can be rotated by dragging the sliders. The mouse wheel can be used to zoom in and out (when the cursor is over the geometry). Alternatively use the Alt+Page Up or Down keys to zoom in and out.

The currently selected surface can be changed by left clicking on the surface in the 3D geometry viewer. Right clicking on a surface displays a menu where surfaces can be toggled between internal and external and windows added and removed (see [Surface Properties](#)).

More information can be displayed on the 3D depiction of the geometry by checking the Label constructions and Label dimensions boxes. Label constructions will print the surface number and name of the construction used for each surface (see [Constructions](#) and [Surface Properties](#)). Label

dimensions will display arrows and labels indicating the length (L), width (W) and height (H) of the space (see [Room](#)).

Clicking Default View will return the 3D depiction of the geometry to the default state.

The graph depicts space temperature or heating/cooling loads depending on whether the Calculation mode is set to Free Running or Mechanical (see [Data Input](#)). In Free Running mode the space (operative) temperature is shown in black and the external air temperature in grey. In Mechanical mode the cooling (negative and blue) or heating (positive and red) load is shown as a bar chart.

Checking the Autoscale box sets a sensible y-axis scale of this graph which will adjust as the results change. Alternatively, fixed values for the y-axis minimum and maximum can be set using the 'Y axis min' and 'Y axis max' fields. Clicking on the plot lines (or bar ends) will display the closest data point value.

The tabbed pages are described in the following sections:

[Data Input](#);

[Constructions](#);

[Heat Balance](#);

[Settings](#).

2.1 Data Input

The Data Input tab consists of a number of expanders which can be expanded or collapsed by clicking on the arrow to show or hide various data input fields.

A green tick next to an expander indicates that all data has been successfully entered for that particular section. A red exclamation mark indicates that there is missing or invalid data which must be corrected before results can be output.

The PDA can be run in two different calculation modes. The mode is selected by using the Calculation Mode option buttons.

In Free Running mode the room (operative) temperature will be calculated, assuming there is no mechanical heating or cooling equipment to control the space temperature.

In Mechanical mode the cooling/heating loads required to maintain the room (air) temperature to that specified in the Cooling/Heating section are calculated.

Data input fields under each of the expanders are described in the following sections:

[Site and Climate](#);

[Room](#);

[Occupancy, Equipment and Lights](#);

[Ventilation](#);

[Surface Properties;](#)

[Cooling/Heating.](#)

2.1.1 Site and Climate

Site and Climate

Location: ✓ LONDON New

Month: ✓ July

☒ Typical ☐ Warm (April - September only)

Adjust Temperature by: 0 °C

Climate (temperature) data for 14 locations in the United Kingdom (corresponding to the 14 CIBSE sites [1]) are included with the PDA. The location of the current case is selected using the Location drop-down box.

The month of the current case is selected from the Month drop-down box.

'Typical' temperature data for the selected month is available for all months of the year. 'Warm' temperature data is available for the summer months (April-September inclusive). The warm and typical climate data for the 14 default locations are based on the CIBSE Design Summer Year (DSY) and Test Reference Year (TRY) data respectively, see [1]. DSYs and TRYs consist of values of temperature (among other variables) for each hour of the year (8760 data points). To create the typical data, the average temperatures at each hour over each month of the TRY were calculated to give a 'typical' daily temperature profile for each month. The minimum and maximum of these daily temperature profiles (and the times at which they occur) were then used to plot a smoothly daily temperature curve for each month. To create the warm data, the maximum temperatures in each summer month (April to September inclusive) of the DSY was calculated. The corresponding minimum on the day containing the monthly maximum was also calculated. This minimum and maximum (and the times at which they occur) were then used to plot a smoothly daily temperature curve for each month.

The temperature of the current case can be adjusted using the 'Adjust temperature by' field. This can be used, for example, to examine trends resulting from a temperature rise (or fall) due to climate change.

Note that the PDA also makes use of solar radiation data. These data are calculated automatically by the program from the site location (latitude and altitude), time of year (the 15th day of the month is used) and some settings in the [Settings](#) tab (the defaults therein will be suitable for most applications).

It is possible to enter user-defined climate data by clicking the 'New' button. On clicking 'New' the user will be prompted for a name for the new climate data. This name will be added to the list of drop-down locations. The following extra data fields become visible and should be completed for user-defined climate data:

Latitude: The latitude of the location (in degrees). Used to calculate solar radiation data.

Altitude: The altitude (or height above sea-level) of the location (in metres). Used to calculate solar radiation data.


Ground Temperature: The (deep) ground temperature (in °C). Typically this is the annual average air temperature and only affects the results if an external floor is specified. Note that the ground temperature for each of the 14 CIBSE locations (typical and warm) is built in to the climate database and is assumed to be the annual average temperature of the DSY or TRY respectively.

Max Dry Bulb Temp: The maximum (dry bulb) temperature for the selected month.

Min Dry Bulb Temp: The minimum (dry bulb) temperature for the selected month.

Time Of Max Dry Bulb: The time at which the maximum (dry bulb) temperature occurs.

Time Of Min Dry Bulb: The time at which the minimum (dry bulb) temperature occurs.

 **✓ Site and Climate**

Location: ✓

Latitude: ✓ °
 90°S 0° 90°N

Altitude: ✓ m

Ground Temperature: ✓ °C

Month: ✓

☒ Typical ☐ Warm (April - September only)

Max Dry Bulb Temp: ✓ °C

Min Dry Bulb Temp: ✓ °C

Time Of Max Dry Bulb: ✓
 0 4 8 12 16 20

Time Of Min Dry Bulb: ✓

Adjust Temperature by: °C

The PDA then fits a smoothly varying curve through the maximum and minimum temperatures (at the times given) to calculate the temperature at every hour of the day. The above fields can contain different data for each month of the year.

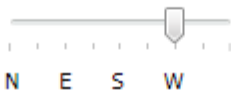
2.1.2 Room

⬆️ ✓ Room

Length (L): ✓ m

Width (W): ✓ m

Height (H): ✓ m

Orientation (wall 1): ✓  ° clockwise from North

N E S W

Dimensions of the space under examination are entered under the Room expander. Note that the wall dimensions must be greater than the dimensions of any windows assigned to that surface, see also [Surface Properties](#). The definition of Length (L) and Width (W) can be confirmed by labeling the dimensions in the geometry viewer, see [Case Data](#).

The orientation of (wall 1) is also specified here in degrees clockwise from North. Check the compass in the geometry viewer to ensure correct orientation of the room. Surface numbers can also be shown by selecting the Label constructions box, see [Case Data](#).

The geometry viewer is updated as each of these fields is altered.

2.1.3 Occupancy, Equipment and Lights

⬆️ ✓ **Occupancy, Equipment and Lights**

Occupancy Level: ✓ Average 10 m²/person

Occupants In: ✓ 9

0 4 8 12 16 20 24

Occupants Out: ✓ 18

Small Power Density: ✓ Average 15 W/m²

Small Power On: ✓ 9

0 4 8 12 16 20 24

Small Power Off: ✓ 18

Lighting Power Density: ✓ Average 10 W/m²

Lights On: ✓ 7

0 4 8 12 16 20 24

Lights Off: ✓ 20

The occupancy level, small power density (e.g. computer, TVs) and lighting power density are entered under this expander. These inputs comprise the internal gains of the space. Typical High, Average and Low values can be selected by using the drop down box or User defined values can be entered. The typical values are based on data from CIBSE Guide A [1].

The times at which each of these gains is turned on and off should also be specified.

One method of specifying a constant gain would be to set the On time to be 0 hours and the Off time to be 24 hours.

Note that the default power per occupant (occupant sensible heat gain) can be modified in the [Settings](#) tab.

2.1.4 Ventilation

☒ **Ventilation**

Air Tightness: ☒ User defined 3.6 m³/m²/h at 50 Pa
 Equivalent to 0.24 ac/h

Cooling Ventilation: ☒ Poor 1 ac/h
 Equivalent to 0.75 l/s/m²
 or 7.50 l/s/person

Cooling Ventilation On: ☒ 18
 0 4 8 12 16 20 24

Cooling Ventilation Off: ☒ 5

The Air Tightness field is used to specify a constant flow of air from outside into the space throughout the 24 hour period. Good, Average and Poor Air Tightness values can be selected based on data in CIBSE Guide A [1]. Alternatively a user defined value can be supplied. The value entered (in m³/m²/h at a pressure of 50 Pa) is usually determined from a pressure test and is converted to an equivalent infiltration rate (in air changes per hour) displayed below the text box (for which valid room dimensions are required, see [Room](#)).

The Cooling Ventilation field can be used to define any extra ventilation that may be present, e.g. that due to night time purging. Again Good, Average, Poor or User Defined options are available. For information purposes the cooling ventilation rate is also given in litres per second per square metre (for which valid room dimensions are required, see [Room](#)) and litres per second per person (for which some occupants are required, see [Occupancy, Equipment and Lights](#)).

Note that a minimum fresh air field is also defined in the [Settings](#) tab.

Extra ventilation is added in order to meet the Minimum Fresh Air rate if that from the Infiltration Rate and the Cooling Ventilation is insufficient. Minimum Fresh Air is not used if there are no occupants in the space.

2.1.5 Surface Properties

☒ **Surface Properties**

Selected Surface: ☒ Wall 1

☒ Internal ☒ External

Surface Construction: Default Solid brick v Copy to All Surfaces

Copy to Internal Copy to External

☒ Surface Contains Window

The currently selected surface can be changed using the Selected Surface drop down box.

The selected surface can then be defined as internal or external, i.e. exposed to the outside conditions (temperature and solar radiation defined in the [Site and Climate](#) section). There must be at least one external surface for results to be output. Surfaces default to internal. Surfaces can also be toggled between internal and external through the geometry viewer menu, see [Case Data](#).

The Surface Construction drop down box is used to define what the surface is made of. The list is automatically populated with two default constructions and any user-defined constructions that are built in the [Constructions](#) tab. The material labels in the geometry viewer are updated with the name of the Surface Construction, see [Case Data](#).

The three Copy buttons can be used to copy the construction assigned to the currently selected surface to all other surfaces, all internal surfaces or all external surfaces. This allows the user to quickly assign the same construction to multiple surfaces.

The 'Surface Contains Window' checkbox is enabled for walls defined as External. Note that at present the Ceiling and Floor cannot contain windows and this checkbox is unavailable for these surfaces. The Window Data expander is shown or hidden depending on whether the 'Surface Contains Window' checkbox is checked or not.

Window characteristics are defined under the Window Data expander. Windows can also be added and removed through the geometry viewer menu, see [Case Data](#). (Different surfaces may have different window characteristics.)

The screenshot shows the 'Window Data' expander with the following fields and values:

- Window Length:** 2.00 m
- Window Height:** 2.00 m
- Window Multiplier:** 1
- Glazing Type:** Double Glazing (with a green checkmark icon)
- Window U-Value:** 1.54 W/m²K (with a slider from 0 to 5)
- Window g-Value:** 0.600 (with a slider from 0 to 1)

The window dimensions are defined in the Window Length and Window Height fields. The Window Multiplier allows more than one window to be added to the surface. At present, windows are centred on the surface to which they belong and multiple windows are spaced evenly in one row. Windows on the same surface will all have the same characteristics, e.g. same glazing, shades and blinds. Note that the window dimensions and multiplier must be compatible with the corresponding wall dimensions, i.e. windows cannot be larger than the wall that they are sited on. A warning will appear if this is the case and results will not be output until the error is corrected.

The properties of the window glazing are assigned through the Glazing Type drop down box. A default Double or Triple Glazing can be selected, or a User defined glazing can be entered. The

default glazings have built in characteristics with associated U-values and g-values. A U-value and g-value must be specified for User defined glazing using the Window U-Value and Window g-value fields. Not all combinations of U-value and g-value are permissible. If an invalid combination of these parameters is selected a warning will be shown and results will not appear until a valid combination is entered.

The Window Data section contains two further expanders for defining shades and blinds for the windows on the currently selected surface. (Windows on different surfaces may have different shade and blind characteristics.)

Shade Data

	Depth (m)	Distance (m)
Left fin (from inside):	<input type="text" value=""/>	<input type="text" value=""/>
Right fin (from inside):	<input type="text" value=""/>	<input type="text" value=""/>
Overhang:	<input type="text" value="2.00"/>	<input type="text" value="0"/>

Shading characteristics are defined under the Shade Data expander. The data fields consist of depth and distance for the left fin, right fin and overhang.

Blinds Data

Blind Type:

Location: ☒ Internal ☐ External

Blind Deployment: W/m²

Slat Angle: °
 -90 -60 -30 0 30 60 90

Slat Width: mm

Slat Spacing: mm

Blind characteristics are defined under the Blinds Data expander. Horizontal slatted, Vertical slatted or Roller blinds (or no blind) can be added to the currently selected window.

The Location options can be used to locate the blind either internal (inside the space) or external to the window. The Location can affect the temperature within the space.

For the slatted blind options, the slat angle, slat width and slat spacing must be defined.

For all blind types the Blind Deployment must be specified. Either choose from the drop down box (Always, When sun on window or Never) or select User Defined to enter a value for the level of direct solar radiation that must be incident on the outside of the window before the blind is deployed. (A value of 0 W/m² will have the same effect as selecting Always.) This parameter applies to all blinds on all surfaces.

2.1.6 Cooling/Heating

This expander is only available when running in Mechanical Calculation mode (see [Data Input](#)).

The image shows a software interface for the 'Cooling/Heating' expander. It features several input fields and sliders, each preceded by a green checkmark icon. The 'Set Point' is a text box with the value '23' and a unit '°C'. 'Plant On' and 'Plant Off' are sliders with numerical input boxes showing '9' and '17' respectively, with a time scale from 0 to 24. 'Plant Type' is a dropdown menu currently set to 'Chilled Ceiling'. 'Plant Radiant %age' is a slider with a numerical input box showing '50' and a percentage sign, with a scale from 0% to 100%.

✓ **Cooling/Heating**

Set Point: ✓ 23 °C

Plant On: ✓ 9

Plant Off: ✓ 17

Plant Type: ✓ Chilled Ceiling

Plant Radiant %age: ✓ 50 %

The Cooling/Heating characteristics are set in the Cooling/Heating expander.

The 'Set Point' field defines the temperature to which the space should be conditioned.

The 'Plant On' and 'Plant Off' fields define the times between which the space should be conditioned. One way to set continuous conditioning is to set the Plant On time to 0 and the Plant Off time to 24. Note that outside the conditioning hours the space will be unconditioned and the Cooling/Heating Load results will be zero.

The 'Plant Type' drop down box contains several default heating/cooling systems. These define the Plant Radiant percentage. If User defined is selected, the Plant Radiant percentage must be entered in the 'Plant Radiant %age' field.

2.2 Constructions

The Constructions tab allows creation, editing and viewing of Constructions which can then be added to the surfaces in the [Surface Properties](#) section.

Default Solid brick ▾ New Define by: ☒ Layers ☐ U and Y-Values

Material (listed from inside to outside)	Thickness (mm)
SURFACE_FINISHES-Plaster_dense	13
MASONRY-Brick_exposed	220

Show Materials

U-Value: 1.99 W/m²K

Y-Value: 4.71 W/m²K

Existing constructions (including the two defaults) are listed in the drop down box (Note that the materials grid cannot be modified for default constructions.). Selecting (valid) existing constructions from this list will populate the U and Y-Value fields and the materials grid (if the construction is defined by layers). The Admittance details boxes will also be filled and an associated admittance graph drawn, see below.

Clicking the 'New' button initiates creation of a new construction. First a (unique) construction name must be entered.

The 'Define by' option specifies whether the currently selected Construction is defined by listing the Layers of material that it is made up of or by specifying the U-Value and Y-Value. (Default constructions are defined by layers.)

If the currently selected construction is defined by layers, the material grid is enabled and the layers that comprise the construction can be specified. Clicking in the first column causes a drop down box to appear which lists the materials included in the PDA database. To view a list of the materials used in the PDA, click the Show Materials button.

Description	ThermalConductivity	SpecificHeat	Density	SW_Abs_In	Source
CONCRETE-Block_aircrete_(460kg_m-3)	0.11	1000	460	63	Aircrete_Bureau-'Use_of_Aircrete_Products'_table_6_(2004)
CONCRETE-Block_aircrete_(600kg_m-3)	0.15	1000	600	63	Aircrete_Bureau-'Use_of_Aircrete_Products'_table_6_(2004)
CONCRETE-Block_dense	1.33	1000	2000	63	Mineral_Products_Association
CONCRETE-Block_lightweight_aggregate	0.47	1000	1450	63	Mineral_Products_Association
CONCRETE-Block_ultralightweight_aggregate	0.36	1000	1000	63	Mineral_Products_Association
CONCRETE-Foam_(1000kg_m-3)	0.265	1000	1000	63	Concrete_Society-Foamed_Concrete-Application_and_specification_(2009)
CONCRETE-Foam_(600kg_m-3)	0.11	1000	600	63	Concrete_Society-Foamed_Concrete-Application_and_specification_(2009)
CONCRETE-Hollowcore_slab	1.23	1000	1600	63	Mineral_Products_Association_(based_on_150mm)
CONCRETE-Insitu	1.75	1000	2300	63	CIBSE_Guide_A-Table_3.47
CONCRETE-Precast	1.46	1000	2100	63	CIBSE_Guide_A-Table_3.47
FLOORING-Carpet_or_Underlay	0.6	1300	200	95	CIBSE_Guide_A-Table_3.47
FLOORING-Ceramic_tiles	0.8	850	1700	40	Inventory_of_Carbon_and_Energy_(ICE)_version_2.0_University_of_Bath
FLOORING-Rubber	0.13	2010	1100	95	The_Engineering_Toolbox
FLOORING-Screed	0.46	1000	1200	73	CIBSE_Guide_A-Table_3.47
FLOORING-Timber_hardwood	0.18	1260	700	95	SBSA_technical_guide_2007-Table_6A.18
FLOORING-Timber_softwood_plywood_chipboard	0.13	1600	500	95	CIBSE_Guide_A-Table_3.47
FLOORING-Vinyl_covering	0.17	900	1390	95	CIBSE_Guide_A-Table_3.47
INSULATION-British_wool	0.038	1800	23	95	www.thermafleece.com
INSULATION-Cellulose_(recycled_newspaper)	0.039	2000	32	95	Greenspec_(shc_value:_constructionresources.com)
INSULATION-Expanded_polystyrene_(EPS)	0.036	1450	25	95	Greenspec_(shc_value:_CIBSE_Guide_A_Table_3.47)
INSULATION-External_woodfibre_board	0.043	2100	180	95	Pavatex_Diffutherm_product_information_(www.natural-building.co.uk)
INSULATION-Extruded_polystyrene_(XPS)	0.032	1400	30	95	Greenspec_(shc_value:_CIBSE_Guide_A_Table_3.47)
INSULATION-Flax	0.037	1600	30	95	Construction_Resources_(www.constructionresources.com)
INSULATION-Foam_glas	0.041	830	120	95	www.foamglas.co.uk_and_www.unitedperlite.net
INSULATION-Glass_wool	0.04	670	25	95	The_Engineering_Toolbox
INSULATION-Hemp	0.04	1700	40	95	www.burdensenvironmental.com
INSULATION-Mineral_wool_batts	0.038	1030	25	95	CIBSE_Guide_A-Table_3.47
INSULATION-Phenolic	0.021	1400	40	95	Kingspan_(thermal_conductivity_value_for_insulation_>_45mm)
INSULATION-PIR_board_(foil_faced)	0.022	1400	32	95	Kingspan
INSULATION-Rock_wool	0.04	840	120	95	www.williams.com.my
MASONRY-Brick_exposed	0.77	1000	1750	49	CIBSE_Guide_A-Table_3.47
MASONRY-Brick_protected	0.56	1000	1750	49	CIBSE_Guide_A-Table_3.47
MASONRY-Perforated_clay_block	0.29	1000	950	63	www.porothermuk.co.uk_and_de.wikipedia.org_(based_on_100mm)
MASONRY-Portland	1.7	840	2200	63	The_Engineering_Toolbox_and_www.albionstonequarries.com
MASONRY-Sandstone	1.8	1000	2300	65	CIBSE_Guide_A-Table_3.47
METAL-Aluminium	215	870	2712	20	The_Engineering_Toolbox
METAL-Copper	370	390	8930	20	The_Engineering_Toolbox
METAL-Structural_steel	50	450	7800	20	CIBSE_Guide_A-Table_3.47

The appropriate material for the innermost layer should be selected. In the second column of the material grid, the thickness of this layer should be entered. Continue entering materials and thicknesses in subsequent rows until all layers have been entered. The U and Y-Values (and admittance parameters and graph) for the completed construction will be shown.

If the currently selected construction is defined by U and Y-Values, the U-Value and Y-Value for the construction should be entered in the corresponding fields. (Note the material grid will be hidden.) Not all combinations of U-Value and Y-Value are permissible. If an invalid combination of these parameters is selected a warning will be shown.

UserDefinedUY ▼
New

Define by:
☐ Layers
☒ U and Y-Values

Using the U and Y-Value sliders creates a specific construction. See help for more information.

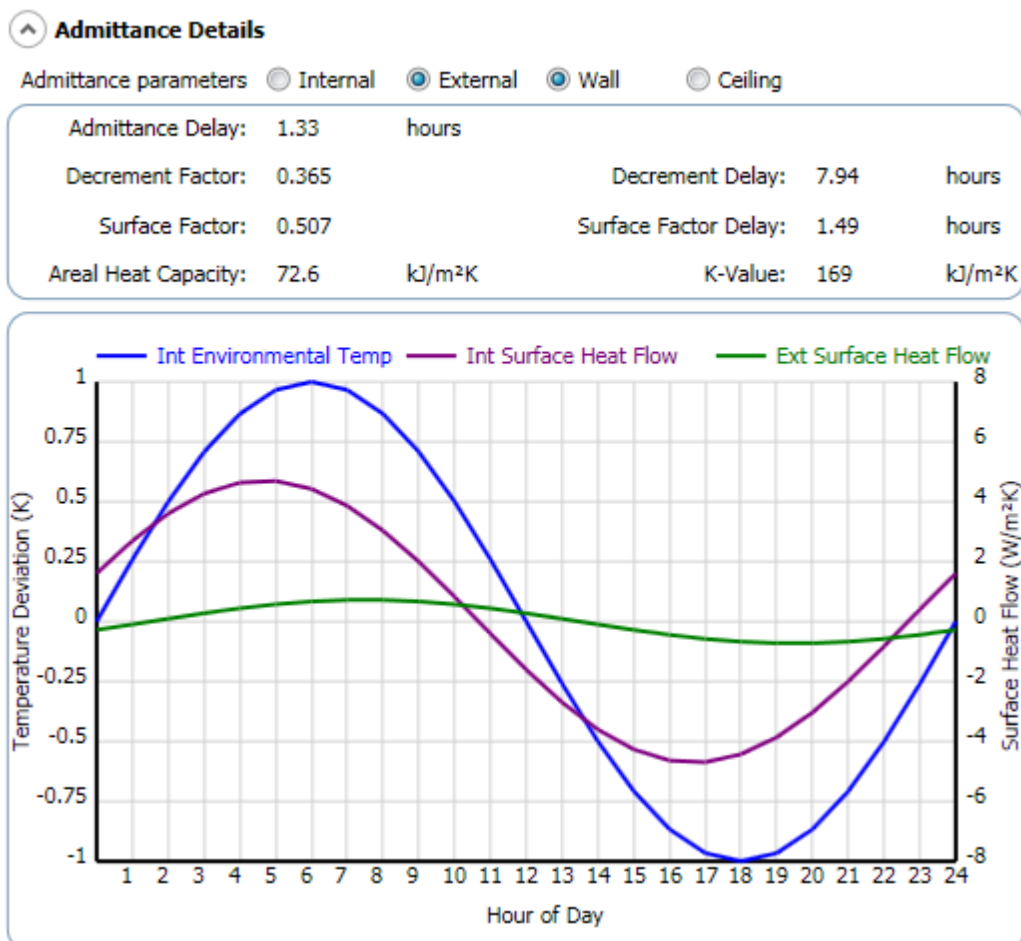
U-Value: 2.00 W/m²K
Insulated
Not Insulated

Y-Value: 3.00 W/m²K
Low Mass
High Mass

Provided the construction is valid, it will be listed in the Surface Construction drop down on the Data Input tab and available to assign to surfaces (see [Surface Properties](#)).

Constructions that have already been assigned to surfaces may be edited and the effect on the results observed, e.g. the effect of varying the U-Value of the construction that has been assigned to all the external walls can be observed.

Clicking on the Admittance Details expander will show (or hide) the admittance details and the associated admittance graph for the currently selected construction.

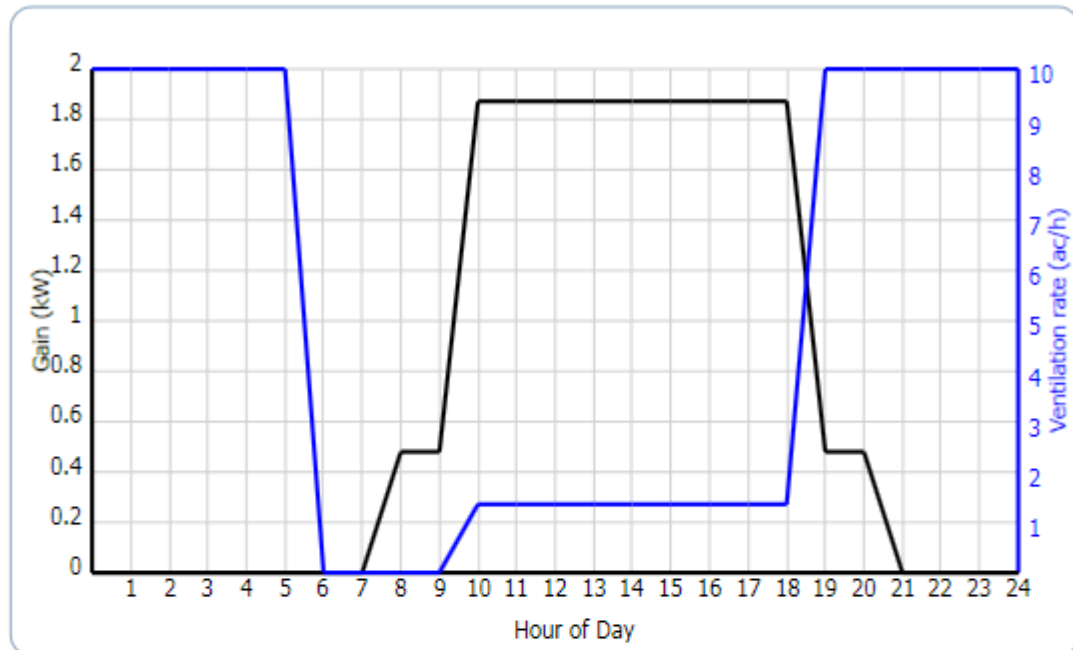


The Admittance parameters and graph are dependent on whether the construction will be located internally or externally and whether it will be used for a wall or ceiling. Admittance parameters for each of these surface types may be viewed by selecting Internal or External and Wall or Ceiling from the appropriate option buttons. (Specifically the admittance parameters are dependent on the surface resistance values which are set in the [Settings](#) tab. For most applications the default values of the surface resistances should be sufficient.)

For an explanation of the admittance parameters see [\[1\]](#).

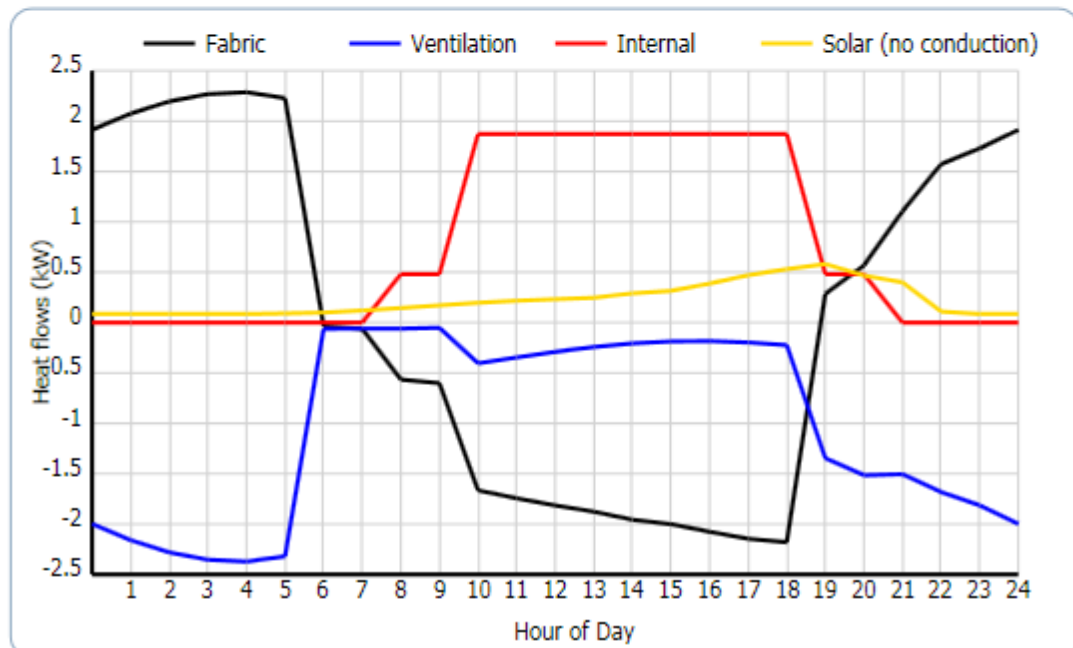
2.3 Heat Balance

The Heat Balance tab contains two further graphs. The top one shows the internal gains (black) and the overall ventilation rate (blue) which incorporates any minimum fresh air requirement (see [Settings](#)). The bottom plot shows the heat flows into the space due to fabric conduction, ventilation, internal gains and solar.

☒ Autoscale

Y axis min: 0

Y axis max: 2.000

☒ Autoscale

Y axis min: -2.5

Y axis max: 2.5

The graphs have an Autoscale checkbox which when checked set a sensible y-axis scale of the corresponding graph. Alternatively, fixed values for the y-axis minimum and maximum can be set for each graph using the 'Y axis min' and 'Y axis max' fields.

Clicking on the plot lines will display the closest data point value.

2.4 Settings

The Settings tab contains values that the experienced user may wish to change but for most applications the default values are likely to be sufficient.

✓ **Settings**

Occupant Sensible Heat Gain: ✓ W/person

Ground Reflectance: ✓

Internal surface resistance: ✓ Walls Floor/Ceiling m² K/W

External surface resistance: ✓ m² K/W

Turbidity (Haziness): ✓

Radiant Percentage of Gain: ✓ 0% 50% 100% %

Minimum Fresh Air: ✓ l/s/person

The default occupant sensible heat gain can be modified (see [Occupancy, Equipment and Lights](#)).

The 'Ground Reflectance' field allows the ground reflectance (or albedo) to be modified. This will affect the amount of solar radiation hitting the external surfaces and transmitted through any windows.

The internal and external surface resistances for walls and ceilings can be modified. This will affect the admittance (see [Constructions](#)) and hence the overall results.

The effect of pollution levels/amount of particles in the air can be examined by changing the values in the 'Turbidity (Haziness)' drop down. This will affect the amount of solar radiation hitting the external surfaces and transmitted through any windows.

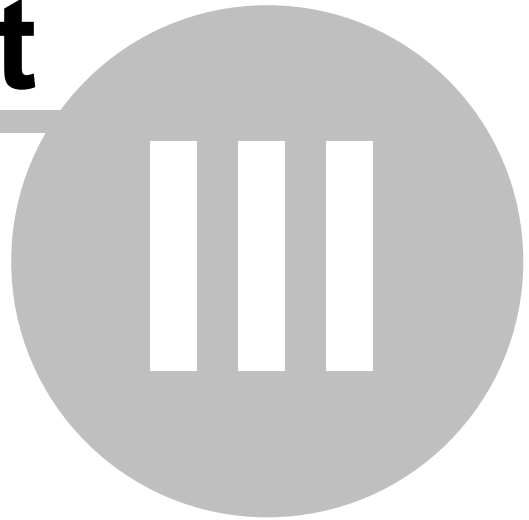
The Radiant Percentage of Gain field allows the to convective-radiant split of the space loads to be altered.

The Minimum Fresh Air field defines the minimum fresh air required by occupants of the space, e.g. that which must be satisfied by building regulations. Extra ventilation is added in order to meet the Minimum Fresh Air rate if that from the Infiltration Rate and the Cooling Ventilation is insufficient (see [Ventilation](#)). Minimum Fresh Air is not used if there are no occupants in the space.

The 'Restore' button will restore the values in the Settings tab to their default values.

Compare Cases

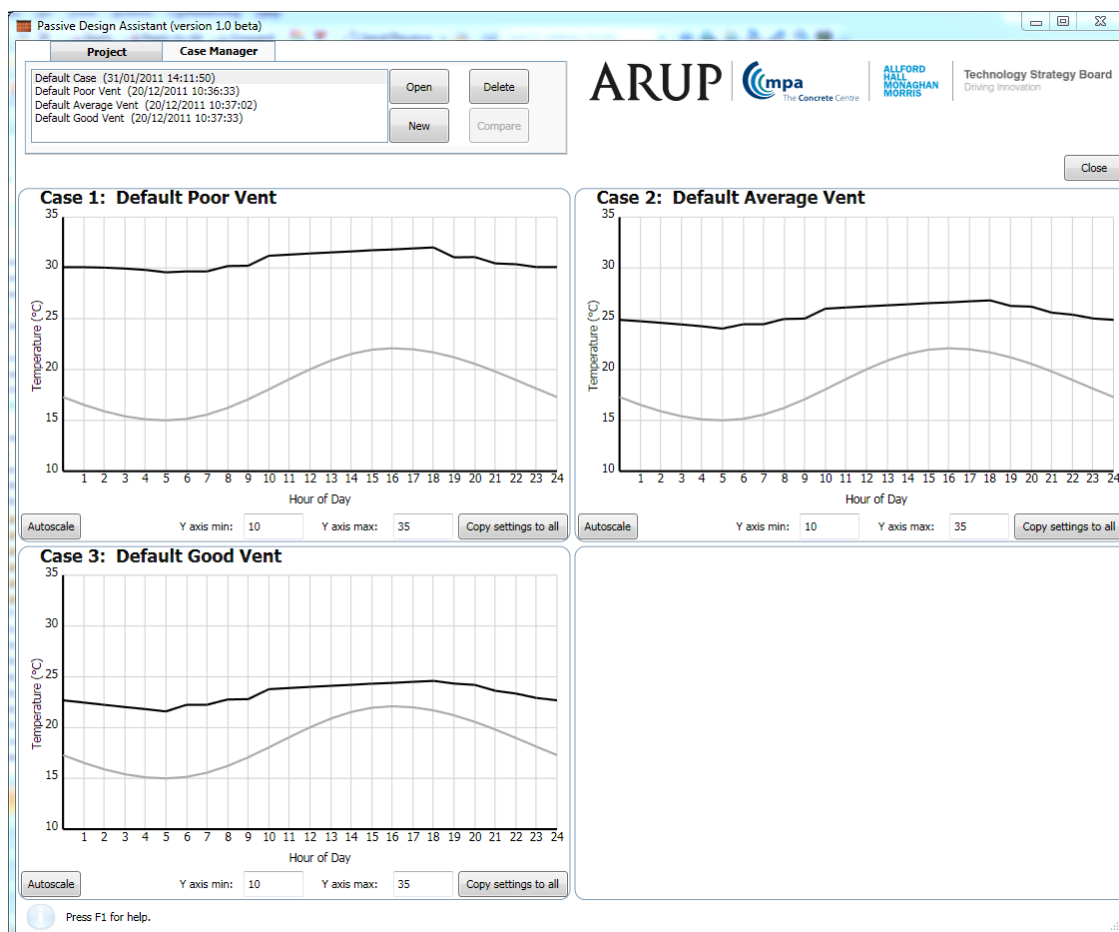
Part



3 Compare Cases

The results of up to four Cases can be compared. Use the Ctrl button to select multiple cases from the [Case Manager](#) list and click the Compare button.

The graphs are shown in the order that they are selected from the Case Manager.



The graphs are initially displayed all with the same y-axis scale, which has been determined by setting a sensible scale for the graph with the largest range.

Each graph has an Autoscale button which can be used to set a sensible y-axis scale of that graph only.

Alternatively, fixed values for the y-axis minimum and maximum can be set for each graph using the 'Y axis min' and 'Y axis max' fields.

The 'Copy settings to all' buttons can be used to copy the y-axis scale parameters of the corresponding graph to all other graphs, i.e. to set all graphs to the same scale for easy comparison.

Clicking on the plot lines (or bar ends) will display the closest data point value.

References

Part



IV

4 References

- [1] The Chartered Institute of Building Services Engineers, London. *CIBSE Guide A: Environmental Design*, 2006.