In the first two articles of this introduction to the Passive House Planning Package (PHPP), we have looked at the first 8 tabs of the Excel workbook: Brief Instructions, Verification, Overview, Climate, U-Values, Areas, Ground, and Components.

Reminder: PHPP is an accurate method of calculating the energy performance of a building, and for assessing whether the building meets the criteria for being certified as a 'Passive House' (ie, one that requires very little energy for heating).

We continue with Windows, through which much heat flows, both inwards and outwards.

**Windows – Solar radiation reduction factor, and Window U-Value**

What is a window?
Most contemporary, energy efficient windows are comprised of one glazing unit held in a (wooden) frame, which is itself held by hinges in a fixed frame. If the component has two or more glazing units, then PHPP requires it to be considered as two or more 'windows', even though in common parlance it would be called a single window.

Identical windows (of the same type and size) which are in the same wall assembly, with the same orientation, and on the same storey can be entered on one line by assigning the appropriate number to 'Quantity'. But more simply and reliably, list each window on its own line, with '1' as its Quantity.

The next primrose cell (after Quantity) is 'Description', which you might want to use to describe the position of the window (eg, Upper floor, West wall) as much as the window itself. This cell is followed by three white cells for 'Deviation, Inclination and Orientation'. As they are white cells they require no input by the user. They will be automatically filled in later.

The next inputs are the 'Width' and 'Height' of the 'rough opening' for the window. It is common practice to allow about 1 cm clearance at the top, bottom and each side of a window. In that case, add 2 cm to the width and height of the window for the opening.

There follow three beige cells for making drop-down selections:

**Heat gains**
Solar and Internal Heat Gains satisfy nearly two thirds of the Heat demand.
(Source: Passivhaus Designer's Guide.)
• 'Installed in'
  Select one of your walls (or possibly a roof) where the window is to be installed.
  (This results in the aforementioned white cells for Deviation, Inclination and
  Orientation being automatically filled in.)

• 'Glazing'
  Select from the drop-down list. The list is derived from the Glazing table of the
  Components tab.

• 'Frame'
  The drop-down list is derived from the Window frames table of the Components
  tab.

There are four primrose cells for the 'Installation situation': for the left, right, top and
bottom of the window. Where a 'window' abuts another 'window', enter '0'. (See the top
paragraph of this section.) Elsewhere enter '1' – in this case there is some thermal
bridging to be taken into account by PHPP. The value of $\Psi_{\text{installation}}$ is copied from the
Components tab.

At the end of each input line are some green cells for 'Results', and these give in
particular the yearly 'Transmission losses' through the window and the yearly 'Solar
gains'. For south facing windows, the solar gains (ie, the useful gains in winter) are
likely to be greater than the transmission losses.

**Shading – Calculating shading factors**

The shading of the walls and roof has been dealt with in the Areas tab in a perfunctory
manner – these assemblies are so well insulated that the heat flows through them are
very small anyway. For the windows the heat flows are greater, and the shading needs to
be assessed more thoroughly. This is done in the Shading tab, which applies solely to
the windows.

Details of the windows are automatically copied from the Windows tab to the
Shading tab.

For each window, the details of its shading are to be entered by the user. If this seems
too finickety and you don't enter the details, PHPP assumes default figures for shading
– see later.

PHPP deals with shading by means of 'shading factors'. To quote from the manual:

'Each factor indicates the percentage of solar radiation reaching the glazing surface
as reduced by the respective shading element.'

So don't be mislead by the terminology: a shading factor of 100% corresponds to no
shading at all, and 0% to total shading.

What does 'shaded' mean in this context? It seems to mean that some part of the sky
is obscured/hidden/blocked out. Whether or not the sun could ever be in that part of the
sky is irrelevant. At a window on a ship out at sea a quarter sphere of sky can be visible
– that would rarely be the case at a window on land. The blocking may be by buildings,
including by parts of the house containing the window, by hills, by vegetation, by fences,
etc.

The reduction factors are calculated by PHPP for both winter and summer. The
calculation of the factors is complex and not explained in the manual. (Just as a hint of
the complexity: some solar radiation comes directly from the sun – which of course
moves across the sky – and some comes indirectly from the sky, whether cloudless or
clouded.)
The main shading factors are:

- **Horizontal reduction factor,** \( r_H \)
  This applies when there is a horizontal row of objects in front of the window, eg, terrace houses, a leylandii hedge, etc.
  The 'Height of the shading object' is the height above the bottom edge of the window. (Obviously, the height will be less for a window on the upper floor.)
  The distance away is also required. Some common sense is required for these figures; use the average height and average distance. It's all a bit of a fudge, really.
  When this information has been entered, two 'Horizontal shading reduction factors', \( r_H \), (for summer and winter) are displayed in green cells to the right, as percentages.

- **Reveal reduction factor,** \( r_R \)
  'Reveal' is a building term for the exposed vertical edge of an opening in a wall, in this case, at each side of a window. The 'Window reveal depth' is the distance between the plane of the outside of the glazing and the plane of the outside of the wall.
  Winter and summer values for \( r_R \) are automatically calculated.

- **Overhang reduction factor,** \( r_O \)
  While the Reveal reduction factor applies to shading from the side, the Overhang reduction factor applies to shading from above. For a ground floor window, this might be from the soffit of the window opening or possibly from a balcony above; for an upper floor window the shading might be from the soffit of the opening or from overhanging eaves, including possibly from guttering.
  The overhang depth is the distance by which the soffit (say) juts out beyond the plane of the glazing.
  Also required is the vertical distance from the top of the glazing to the overhang (eg, soffit).
  Winter and summer values for \( r_O \) are automatically calculated.

In the buildings of yesteryear, window frames were generally fixed within the brick face of a wall, and any shading by the brickwork on the glazing was negligible. But with much thicker Passive House walls and with the frame ideally being placed midway in the thickness of the insulation, windows are being set further back into the wall – hence the shading from the reveal and soffit becomes significant.

It is likely that all three of the reduction factors above apply to a window. The overall reduction factor (calculated by PHPP) is then simply the product of the three individual factors: \( r_H \cdot r_R \cdot r_O \) – again with separate calculations for winter and summer.

But the finickety nature of this worksheet is not finished yet. There are yet more reduction factors to be considered:

- **Other reduction factors** for winter and summer, \( r_{\text{other},w} \), \( r_{\text{other},s} \)
  These factors allow diverse other sources of shading to be taken into account, eg, a tree. Separate factors apply in winter and summer. In wintertime a deciduous tree may be bare of leaves – the manual suggests it might be 50% - 80% 'transparent'.

- **Temporary shading,** \( z \)
  In summertime, householders might use shading devices to prevent overheating.
The manual gives values for the reduction factor, z, for various types of device. For white roller binds, for example, fitted inside or possibly outside the window, the manual shows:

<table>
<thead>
<tr>
<th>Triple glazing</th>
<th>Double glazing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside</td>
<td>Inside</td>
</tr>
<tr>
<td>0.24</td>
<td>0.6</td>
</tr>
</tbody>
</table>

**Reduction factor, z, for white roller blinds (fitted outside or inside)**

If the blind is manually operated, the manual suggests the blind may be in place for only 70% of the time. In which case the reduction factor should be modified:

\[
z \text{ (modified)} = 0.3 + 0.7 z
\]

If no entries are made on this worksheet, PHPP assumes a default figure of 75% for winter shading – a rather pessimistic default to encourage the user to enter the many values required.

The final outputs for this tab are shown in green cells at the top of the sheet. Reduction factors are shown for both summer and winter, and for the areas of the four cardinal orientations.

**Ventilation – Ventilation data**

The PHPP manual advises that the ventilation system should be optimised for the normal air change rate, and not for the maximum rate. And it gives some advice on the initial balancing of the system, ie, the airflows to/from different rooms. Advice is also given about subsoil heat exchangers (referred to as 'SHX'), but these are seldom installed in the UK, with its temperate, maritime climate.

The general height of rooms is required. PHPP suggests entering 2.5 m, irrespective of the actual heights, in order that the air exchange rates of different dwellings can be the more easily compared.

Values for two wind protection coefficients, 'e' and 'f', are required. The table above their primrose cells suggests values for these according to the exposure and screening of the site. With those suggestions in mind, enter values for e and f.

The next input required, in contrast, is objective – the air change rate, \( n_{50} \), as measured by the air tests. (For a Passive House, \( n_{50} \) should be less than 0.6 air changes per hour.)

Along with this, enter the net volume of the envelope. Note that word, 'net'. The volumes of internal walls and upper floor(s) are to be excluded.

Most houses have just one HRV unit, in which case choose the 'Standard design' by entering 'x' into the appropriate primrose cell. And carry on entering data down the sheet, under 'Standard Input for Balanced Ventilation'. (The next tab is for multiple HRV units, and is not required for most houses.)

A figure is required for the Supply Air per Person – this is usually taken to be 30 m\(^3\) per hour per person.

List the rooms with extract ventilation, and their required extraction rates: eg, Kitchen (60 cubic metres per hour), Bathroom (40 m\(^3\)/h), WC (20 m\(^3\)/h), Ensuite (20 m\(^3\)/h), etc. Also required is the maximum Design air flow rate.

**Additional vent – Extended data input for balanced ventilation**

This tab only requires input if there is more than one ventilation unit in the building – which is unlikely in a domestic house.
Next month: The remaining tabs.

FURTHER INFO:

Passivhaus primer: Designer's guide
– A guide for the design team and local authorities
Published by BRE as a free pdf.
www.passivhaus.org.uk.

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