AVO Tool

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Overview, Disclaimer & Restrictions on Usage

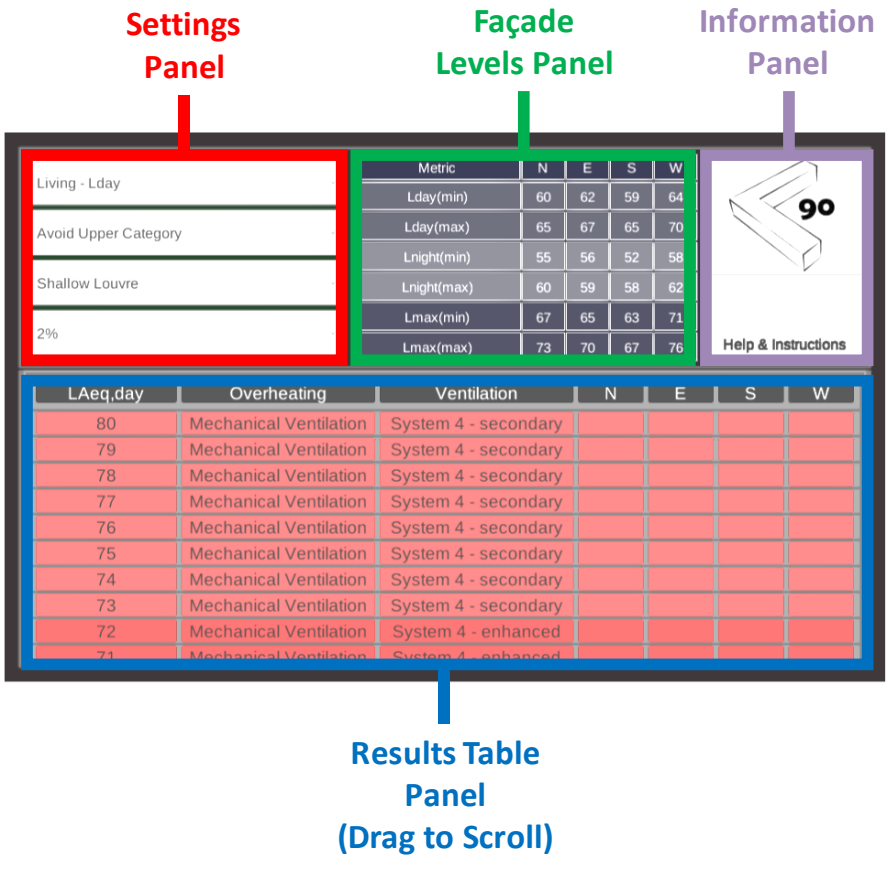
This tool is based on an implementation of the guidance contained in the *Acoustics Ventilation and Overheating – Residential Design Guide* ("The AVO Guide") published January 2020 by the Association of Noise Consultants in collaboration the Institute of Acoustics.

This tool is for information only. The author has exercised reasonable care that the tool works correctly and to describe, in this document, its underlying assumptions and limitations. The user bears any risk arising from the use of the tool.

No restrictions are placed on the use of this tool other than the request that its use is appropriately credited.

User Interface

The user interface includes four main panels as shown in the following image and described over-page.



Settings Panel

The Settings Panel has four drop down boxes that can be used to define the settings. These are:

Assessment parameter

Three options: Lday, Lnight, Lmax

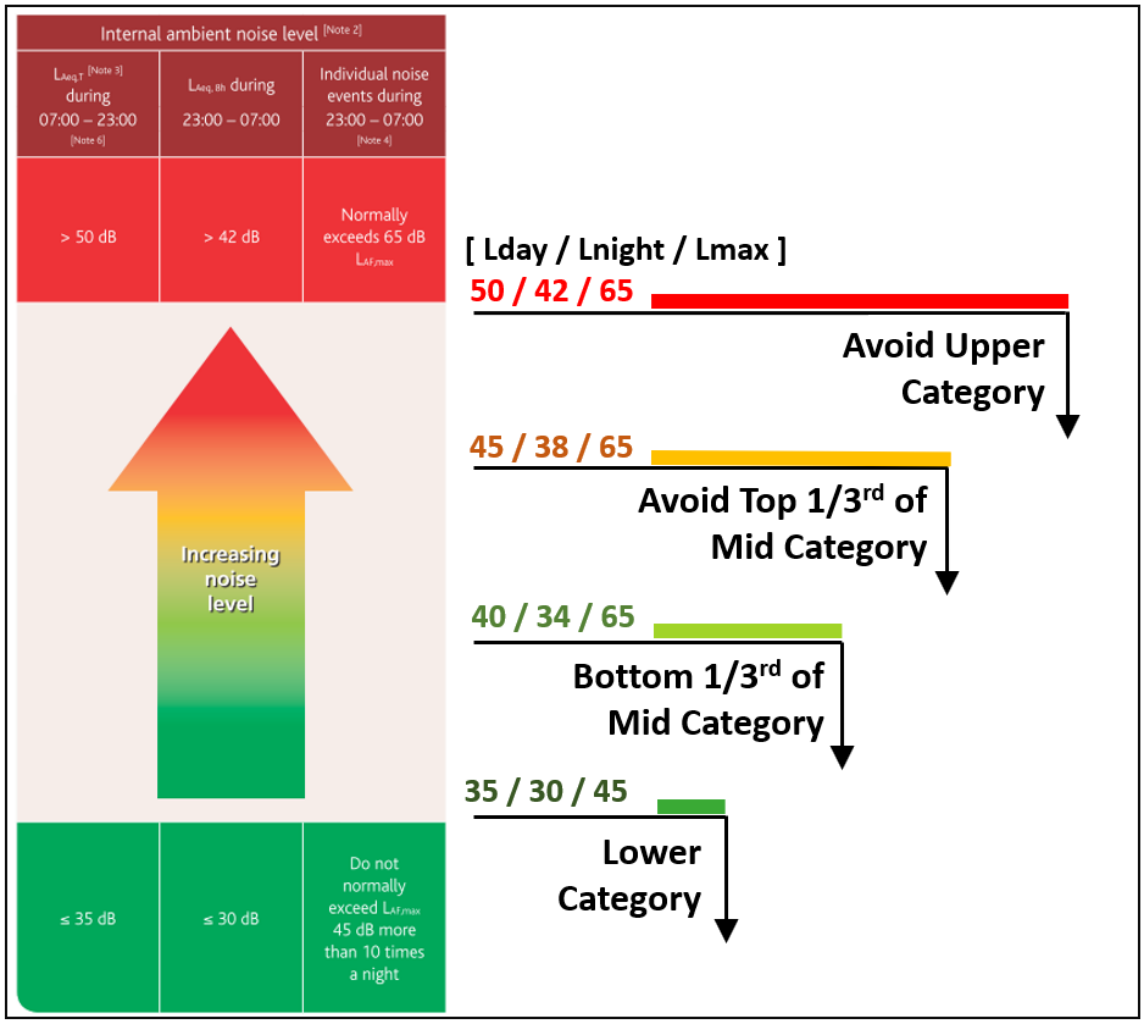
- Lday indicates $L_{Aeq,T}$ during 7am-11pm as noted in Tables 3-2 and 3-3 of the AVO Guide.
- Lnight indicates $L_{Aeq,8hr}$ during 11pm-7am as noted in Tables 3-2 and 3-3 of the AVO Guide.
- Lmax indicates $L_{AF,max}$ associated with individual noise events during 11pm-7am as noted in Tables 3-2 and 3-3 of the AVO Guide. The design case $L_{AF,max}$ should reflect the guidance given in Appendix B of the AVO Guide.

The selection made here affects the parameter that is shown in the Results Table.

Lday is applicable to both Living Rooms and Bedrooms. Lnight and Lmax are only applicable to Bedrooms.

Internal ambient noise target relating to overheating condition

Four options: Refer to image below (with reference to Figure 3-3 from AVO Guide).

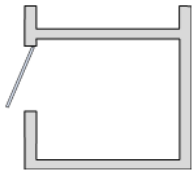
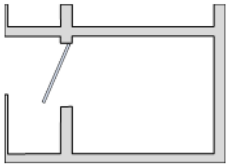
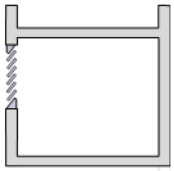
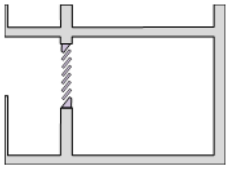
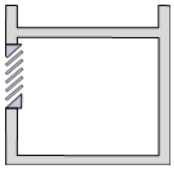
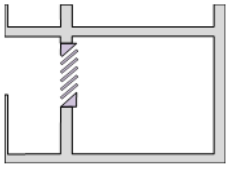


The AVO Guide does not give prescriptive targets, but instead indicates outcomes resulting from different levels of internal ambient noise level resulting from transport noise sources (see Figure 3-3 in AVO Guide).

The practitioner is encouraged to use their judgment in the selection of an appropriate internal noise level dependent on context and, in particular, how frequently and for what duration the overheating condition occurs.

For the purposes of this tool, four options for the indoor ambient noise target are given as indicated in the figure.

Attenuated passive solution for mitigation of overheating
Five options as shown (together with standard window) in the image below.

Schematic	Description	Outside-to-inside Level Difference	Improvement relative to window providing similar amount of ventilation
	Window	13dB	0dB
	Window with Balcony	16dB	3dB
	Shallow Louvre	18dB	5dB
	Shallow Louvre & Balcony	21dB	8dB
	Deep Louvre	23dB	10dB
	Deep Louvre & Balcony	26dB	13dB

The outside-to-inside level difference values shown in the table are generally consistent with those given in Table B-5 of the AVO guide. Further discussion is given below:

- Window: The value for a partially open window is taken directly from the AVO guide. Refer to paragraphs 3.24 and 3.25 of the AVO guide.
- Balcony: The improvement associated with a balcony is slightly lower than the range indicated in Table B-5 of the AVO guide. The value given is intended to represent a fairly conservative situation where the balcony balustrade effectively blocks the line of sight from noise source to window opening. Refer also to Table C.1 of BS EN ISO 12354-3:2017.
- Shallow Louvre: The value for the shallow louvre is taken from the performance of a 100mm deep IAC Slimshield SL-100 louvre giving similar ventilation performance to the open window.
- Deep Louvre: The value for the deep louvre is taken from the performance of a 300mm deep IAC Slimshield SL-300 louvre giving similar ventilation performance to the open window.
- Where a balcony is used together with an acoustic louvre, it is assumed that the effect is additive.

Note that the options for attenuated passive solutions are only indicative and the actual improvement in outside-to-inside level difference (relative to an open window) will depend on the details of the design.

Note that window is not one of the options that can be selected from the dropdown list as this is taken as the default strategy. The solution selected from the dropdown list affects that which is shown in the Results Table.

The ventilation area

Options: 1% through 10% inclusive (integer values only).

As discussed in paragraph 3.24 of the AVO guide, it is assumed that a "partially open window" giving an open area of around 2% of the room's floor area will provide an outside-to-inside level difference of 13dB.

In reality, the open area that is required to mitigate overheating will be dependent on the various overheating risk factors and the duration for which the window (or ventilator) is open.

It is recommended that the standard value of 2% is selected from the dropdown list unless further information is available from a dynamic thermal model (refer to Table A-2 of the AVO guide).

Note that the value selected here applies a simple correction of $10.\log_{10}(X\%/2\%)$ to the outside-to-inside level difference values, where X% is the value selected.

Façade Levels Panel

This panel allows the external free-field noise levels at each façade to be defined.

Elevations

The format assumes that the building has four elevations (North, East, South and West) noting that this will not always be applicable and assuming that the user can use the four columns in a way that is appropriate for the actual building.

Parameters

Lday, Lnight, Lmax can be defined for each façade. The meanings of these parameters is as discussed earlier in this document with reference to Tables 3-2 and 3-3 of the AVO guide.

Ranges

For each of Lday, Lnight and Lmax, an upper and lower limit can be defined. This is to allow for the variation in noise exposure across a particular façade. The upper and lower limit can be set to the same value if preferred.

Restrictions on values

The tool places some restrictions on the values which can be entered as follows:

- For each parameter and façade, the upper limit (max) value must be greater than or equal to the lower limit (min) value.
- Lday cannot be set higher than 80dB or lower than 45dB. These are the extents of the values tabulated in the Results Table.
- Lnight cannot be set higher than 75dB or lower than 40dB. These are the extents of the values tabulated in the Results Table.
- Lmax cannot be set higher than 95dB or lower than 55dB. These are the extents of the values tabulated in the Results Table.

Effect on Results Table

The range of façade levels is shown for each of the façades in the relevant column of the results table. Refer to later section of this document for more information.

Information Panel

The information panel provides a link to this document via the L90 website (http://l90.uk/).

Results Table Panel

This panel displays the results table.

Scrolling

It is not practical to show the full extent of the table. To scroll the display, click and drag the table.

Noise level column

The noise level column will display Lday, Lnight or Lmax depending on the user settings.

By default, the range displayed is as follows:

- Lday: 45dB to 80dB inclusive.
- Lnight: 40dB to 75dB inclusive.
- Lmax: 55dB to 95dB inclusive.

Overheating Column

This column indicates the least onerous overheating solution for each noise level.

The three solutions shown are as follows:

- Opening Windows. Shown Green.
- Attenuated Passive Solution. Shown Orange. The type of attenuated passive solution is determined by the user settings as described earlier in this document.
- Mechanical Cooling. Shown Red.

Note that the overheating solution shown is the least onerous one and that it would also be acceptable to use a solution that provides a higher level of sound insulation. For example, an attenuated passive solution could be used in place of an opening window. Similarly, mechanical cooling could be used in place of either an attenuated passive solution or an opening window.

Ventilation Column

This column indicates the least onerous ventilation solution for each noise level. The seven solutions shown are as follows:

- System 1 – standard
- System 3 – standard
- System 4 – standard
- System 1 – enhanced
- System 3 – enhanced
- System 4 – enhanced
- System 4 – secondary

The outside-to-inside level difference for each solution is assumed to be as described in Table B-2 of the AVO guide. This table is reproduced below with annotation in black to indicate how the terminology used in the tool relates to the values in the table.

Ventilation System from ADF	Cont. equiv. (L_{Aeq}) or events (L_{AFmax})	Level Difference, external free field level – internal reverberant level, dB	
		Typical windows and vent ("Standard")	Higher acoustic performance windows and vent ("Enhanced")
1, 2 ("System 1")	L_{Aeq}	21	31
	L_{AFmax}	22	35
3 (with trickle vent) ("System 3")	L_{Aeq}	23	33
	L_{AFmax}	24	38
4 (no trickle vent) ("System 4")	L_{Aeq}	27	38
	L_{AFmax}	31	45

The “System 4 – secondary” solution is suggested in situations requiring a higher level of sound insulation than can be provided by “System 4 – enhanced”.

Note that the ventilation solution shown is the least onerous one and that it would also be acceptable to use a solution that provides a higher level of sound insulation. For example, “System 4 – enhanced” could be used in place of “System 3 – enhanced”.

Colour Coding

The rows of the results table are colour-coded according to the overheating solution as follows:

- Green = Opening windows
- Orange = Attenuated passive solution
- Red = Mechanical cooling

The brightness of each row is set according to the ventilation solution as follows:

- System 1 – standard = Dark
- System 3 – standard = Mid
- System 4 – standard = Bright
- System 1 – enhanced = Mid
- System 3 – enhanced = Dark
- System 4 – enhanced = Mid
- System 4 – secondary = Bright

Façade Level Columns (N, E, S, W)

These four columns display the range of façade levels for the relevant façade.

The range is indicated by the table cells containing an asterisk (*).

As discussed earlier, these values are free-field external noise levels.

The ranges are determined by the user settings in the Façade Levels Panel (refer to earlier section).

The idea of these columns is to give an indication as to what solution (or solutions) might be applied to each façade of the building.