# AES Sustainability Consultants

**OVERHEATING – APPROVED DOCUMENT O**

Impact Assessment based on Approved Document O

Requirement O1: Overheating mitigation

January 2022

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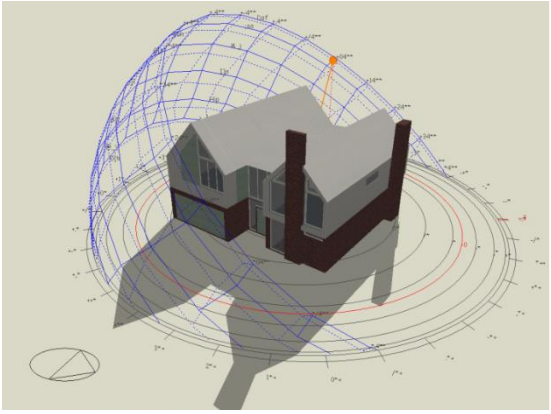
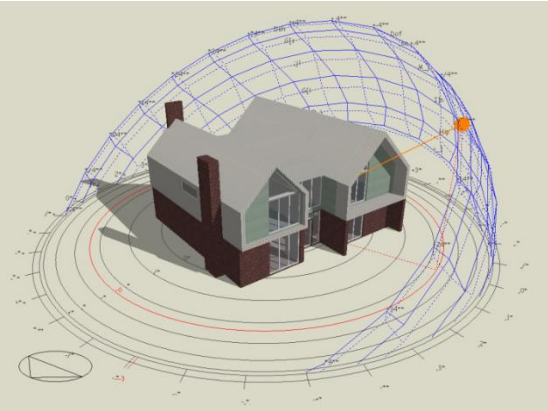
Sustainability
Consultants

# Overview

## Overheating Mitigation

The approved document was issued in December 2021, accompanying the publication of the 2021 edition of Part L and Part F of the Building Regulations for non domestic buildings and dwellings.





### Main changes proposed and findings

a) Requirement O1 is intended to be a stand-alone Approved Document O and has been disconnected from current methodology of assessing overheating risk in SAP.

b) The proposed **Simplified Method** is a risk based approach categorising building into **High & Moderate Risk Locations** and whether cross ventilation is present or not.

c) A maximum target is set for each category for the amount of glazing (**Minimising Solar Gains**) and a minimum free area requirement is introduced (**Removing Excess Heat**). For buildings in High Risk Locations, **Shading** needs to be applied across **North-East to North-West** facades.

d) The minimum free area requirement has been identified as potentially the most difficult criteria to comply with. Dwellings with restricted openings (**Noise, Security, Falling From Height / Entrapment**) are especially at risk and may require an alterative approach to remove excess heat securely.

e) **Communal Areas / Corridors** are included in the guidance. A passive or active ventilation strategy is required for each area on its own. Communal heating will require a dynamic simulation to be carried out.

f) The **Dynamic Simulation** option can always be chosen and is broadly in line with the requirements of TM 59

g) The **Site Context** needs to be taken into consideration. Planning requirements, e.g. noise must be considered in the overall overheating strategy.

h) **Detailed Evidence** is proposed to be provided to Building Control and the Home Owner.

i) 'Staying cool in hot weather', which provides non-technical advice on how to keep the dwelling cool in hot weather must be provided in **The Home User Guide**

# Requirement O1 - Overheating Mitigation

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Two approaches to demonstrate compliance are possible:

## 1. Simplified methodology

Risk-based assessment distinguishes between urban and some sub-urban parts of London and parts of central Manchester (High Risk) and remaining England (Moderate Risk). The specific requirements within these two location designations are then dictated by whether the dwelling has openings on opposite sites:

**Limit unwanted solar gains:** Maximum area of glazing based on the orientation of the building, the maximum allowable area for the highest glazed room and shading for buildings in high risk areas.

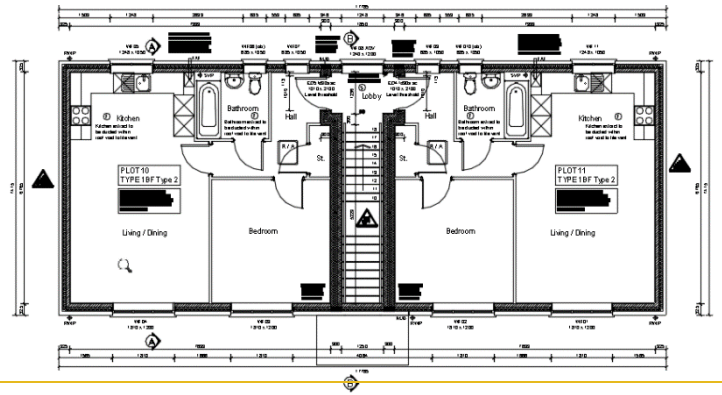
**Remove excess heat:** All buildings need to meet the minimum free areas required to remove heat. The requirements for purge ventilation from AD F must be met in any case.

**Limitations:** The simplified method is not suitable for buildings with more than one residential unit which use a communal heating or hot water system with significant amounts of horizontal heating or hot water distribution pipework.

## 2. Dynamic simulation

Alternatively, compliance can be proven with a dynamic simulation to demonstrate the design is meeting the parameters stated in CIBSE TM59. Following the dynamic route, comfort cooling is not prohibited but the design should meet the requirements without the need for mechanical ventilation.

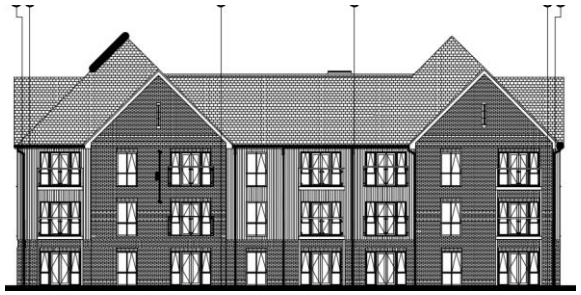
# Cross-Ventilation:
# Openings on opposite facades of a dwelling

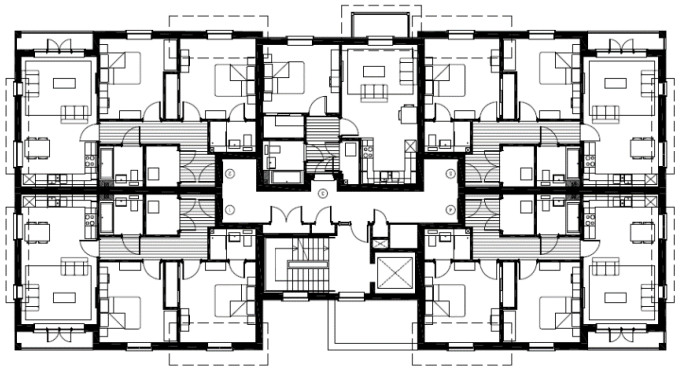



Most dwelling houses, residential units, shared communal rooms and common spaces do have openings on opposite sides.

Apartments / flats with central stairs (or similar design) would have cross ventilation. Most apartments as currently designed will fall in the second category (no cross-ventilation).

# No Cross-Ventilation:
# No Openings on opposite facades / corner flats





Generally includes flats and residential units in care homes or student hall of residences

Also generally includes common areas in buildings that contain flats and residential units such as communal corridors, stairwells and shared living spaces.

# Key Terms

Approved document distinguishes between the **Structural Opening**, the **Glazed Area** and **Free Openable Area**.

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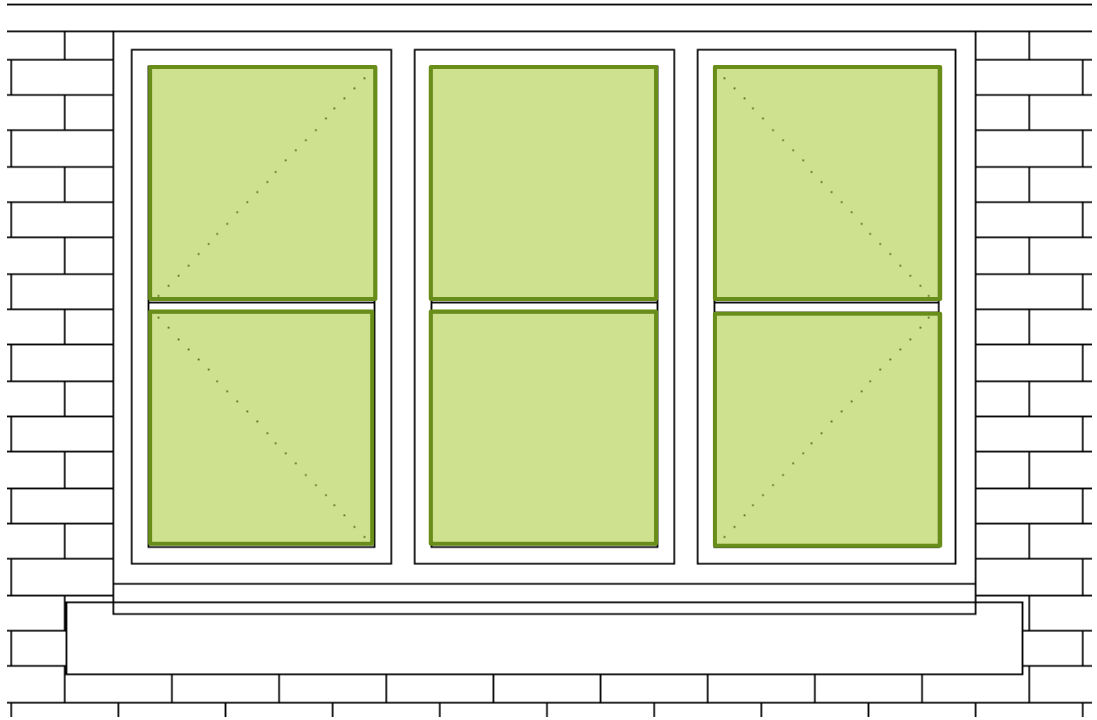
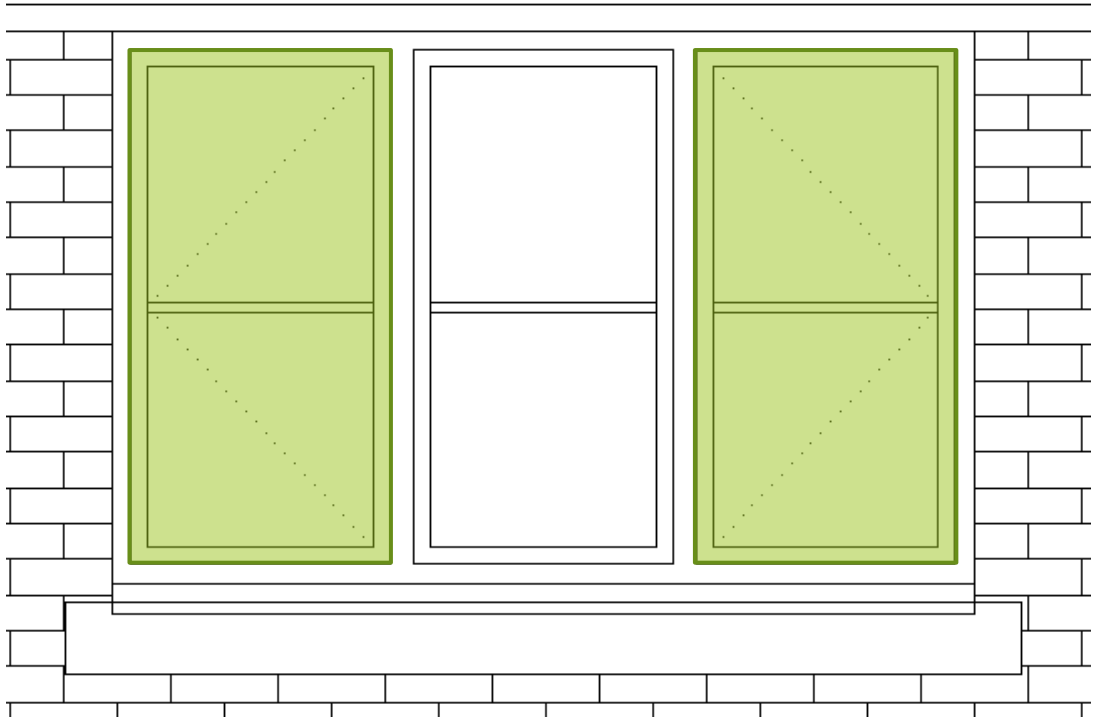
## Glazed Area



**Glazing area** is the area of transparent material, not including the window frame.

## Free Openable Area



**Free area** is the geometric open area of a ventilation opening. This are assumes a clear harp-edged orifice that would have a coefficient of discharge (Cd) of 0.62.

# Cross Ventilation

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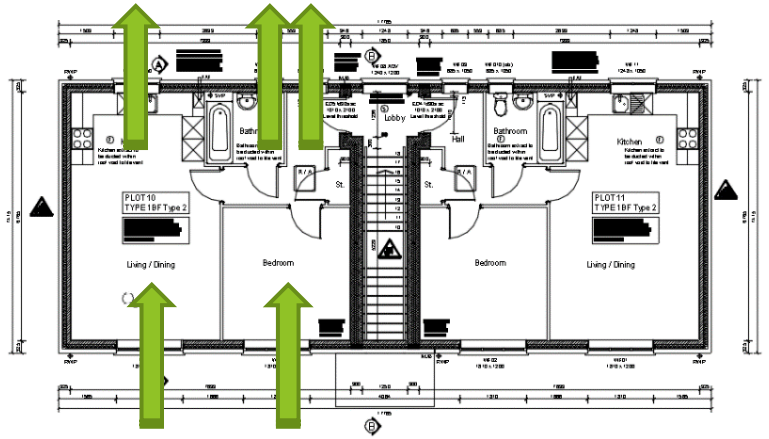
## Minimising Solar Gains

| Largest glazed façade orientation | High risk location: Maximum area of glazing (% floor area) | High risk location: Maximum area of glazing in the most glazed room (% floor area of room) | Moderate risk location: Maximum area of glazing (% floor area) | Moderate risk location: Maximum area of glazing in the most glazed room (% floor area of room) |
|---|---|---|---|---|
| North | 15 | 37 | 18 | 37 |
| East | 18 | 37 | 18 | 37 |
| South | 15 | 22 | 15 | 30 |
| West | 18 | 37 | 11 | 22 |




## Removing Excess Heat

| | High risk location | Moderate risk location |
|---|---|---|
| Total minimum free area[1] | The greater of the following:<br>a. 6% of the floor area[2]<br>b. 70% of the glazing area[3] | The greater of the following:<br>a. 9% of the floor area[2]<br>b. 55% of the glazing area[3] |
| Bedroom minimum free area | 13% of the floor area of the room[4] | 4% of the floor area of the room[4] |

It is likely that the **Minimum Free Area** provided will be larger than the maximum glazing required for **Minimising Solar Gains** when the area of the openable part of the window frame is considered.

## Shading (NE to NW via South)

a. External shutters with means of ventilation, or
b. Glazing with a max. g-value of 0.4 and a high light transmittance of 0.7, or
c. Overhangs with 50 degree altitude cut-off on due south-facing facades only

Residential buildings in the **high risk** location should, in addition to adhering to maximum glazing areas provide shading for glazed areas between compass points NE and NW.

*Screenshots are taken from the January 2022 update of ADO

# No Cross Ventilation

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## Minimising Solar Gains

| | High risk location | | Moderate risk location | |
|---|---|---|---|---|
| Largest glazed façade orientation | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) |
| North | 15 | 26 | 18 | 26 |
| East | 11 | 18 | 18 | 26 |
| South | 11 | 11 | 15 | 15 |
| West | 11 | 18 | 11 | 11 |

## Removing Excess Heat

| | High risk location | Moderate risk location |
|---|---|---|
| Total minimum free area[1] | The greater of the following:<br>a. 10% of the floor area[2]<br>b. 95% of the glazing area[3] | The greater of the following:<br>a. 12% of the floor area[2]<br>b. 80% of the glazing area[3] |
| Bedroom minimum free area | 13% of the floor area of the room[4] | 4% of the floor area of the room[4] |

It is likely that the **Minimum Free Area** provided will be larger than the maximum glazing required for **Minimising Solar Gains** when the area of the openable part of the window frame is considered.

## Shading (NE to NW via South)

a. External shutters with means of ventilation, or
b. Glazing with a max. g-value of 0.4 and a high light transmittance of 0.7, or
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Residential buildings in the **high risk** location should, in addition to adhering to maximum glazing areas provide shading for glazed areas between compass points NE and NW.

*Screenshots are taken from the January 2022 update of ADO

# Example: Detached House with cross-ventilation

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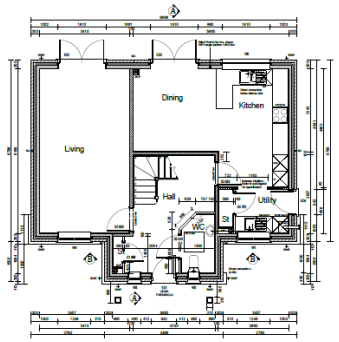
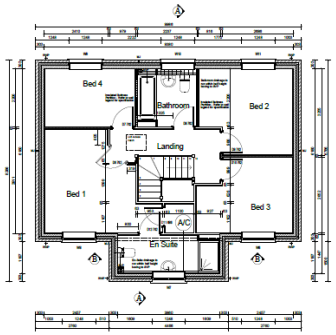
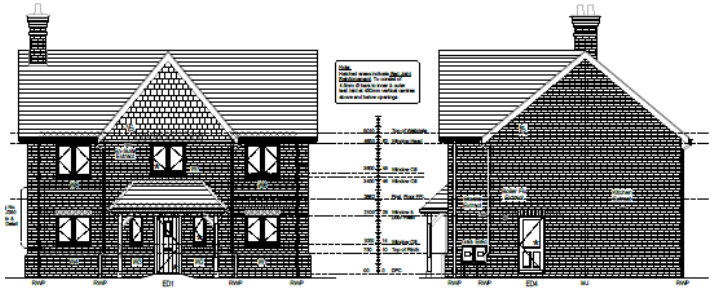


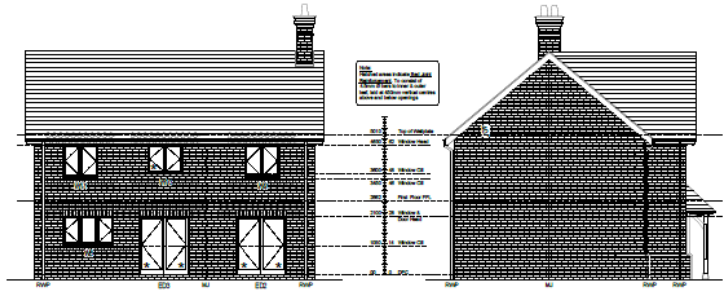
Ground Floor Plan



First Floor Plan


Front Elevation

Side Elevation


Rear Elevation

Side Elevation

| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 125.82 $m^2$ | 14.93 $m^2$ | 17.77 $m^2$ | 3.79 $m^2$ | 1.22 $m^2$ |

## Minimising Solar Gain

| | High risk location | | Moderate risk location | |
|---|---|---|---|---|
| | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) |
| North | 18.87 | 7.63 | 22.65 | 7.63 |
| East | 22.65 | 7.63 | 22.65 | 7.63 |
| South | 18.87 | 4.54 | 18.87 | 6.19 |
| West | 22.65 | 7.63 | 13.84 | 4.54 |

Pass for most regions except for largest glazed orientation facing west (Kitchen / Dining).

The maximum area of glazing (% floor area) is defined as 18% for high risk and 11% for moderate risk locations. At this stage, it could not be determined why a high risk location can achieve a pass on a larger glazed area for a western orientation.

# Example: Detached House with cross-ventilation

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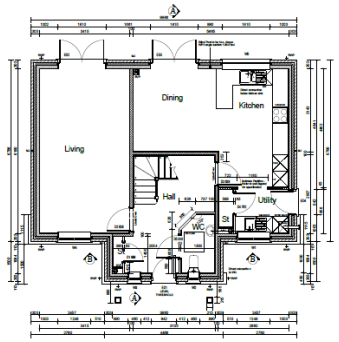
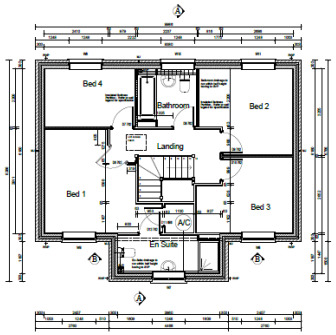
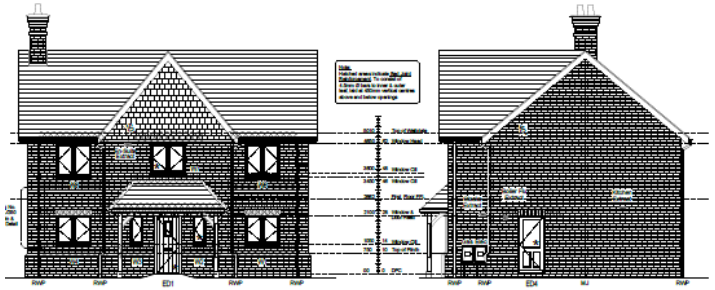


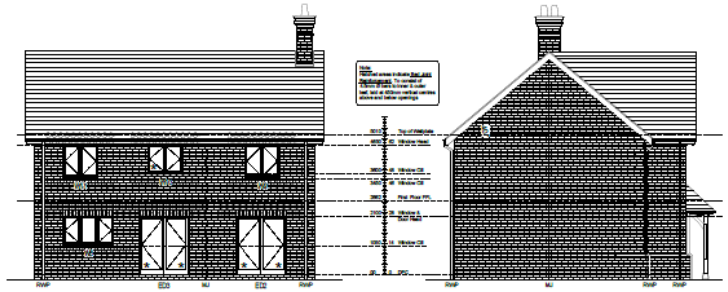
Ground Floor Plan



First Floor Plan


Front Elevation

Side Elevation


Rear Elevation

Side Elevation

| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 125.82 $m^2$ | 14.93 $m^2$ | 17.77 $m^2$ | 3.79 $m^2$ | 1.22 $m^2$ |

## Removing excess heat

| | | High risk location | Moderate risk location |
|---|---|---|---|
| Total minimum free area | Floor Area | 7.55 | 11.32 |
| | Glazed Area | 10.45 | 8.21 |
| Bedroom minimum free area | Bed 01 | 1.72 | 0.53 |
| | Bed 02 | 1.35 | 0.42 |
| | Bed 03 | 1.20 | 0.37 |
| | Bed 04 | 0.96 | 0.30 |

Pass for total minimum free area but Bedroom 01 & 02 would require larger openings to meet the minimum free area for bedrooms in high risk locations.

The minimum free area should always be read in conjunction with purge ventilation requirements from AD F for habitable rooms. 1/10 of the floor area is required for opening angles between 15 and 30 degree and 1/20 for greater than 30 degree, sash windows and external doors. Below 15 degrees, mechanical ventilation can be provided extracting at least 4 ACH per room directly to the outside.

The equivalent area of the opening can be significantly smaller depending on the opening angle of the window.

# Example: Terraced House with cross-ventilation

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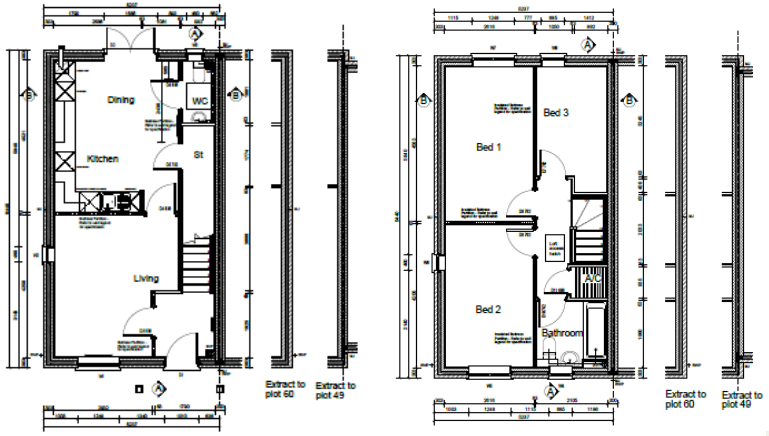


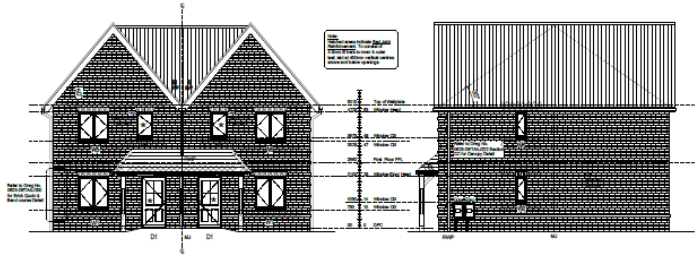


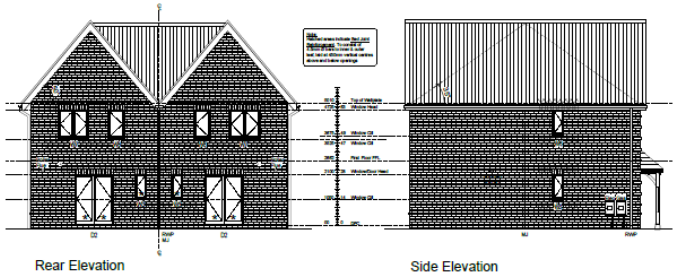


| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 83.17 m² | 7.87 m² | 9.14 m² | 2.29 m² | 1.22 / 1.57 / 0.65 m² |

## Minimising Solar Gain

| | High risk location | | Moderate risk location | |
|---|---|---|---|---|
| | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) |
| North | 12.48 | 5.15 | 14.97 | 5.15 |
| East | 14.97 | 5.15 | 14.97 | 5.15 |
| South | 12.48 | 3.06 | 12.48 | 4.17 |
| West | 14.97 | 5.15 | 9.15 | 3.06 |

Pass for all regions and orientations.

The maximum area of glazing (% floor area) is defined as 18% for high risk and 11% for moderate risk locations. At this stage, it could not be determined why a high risk location can achieve a pass on a larger glazed area for a western orientation.

# Example: Terraced House with cross-ventilation

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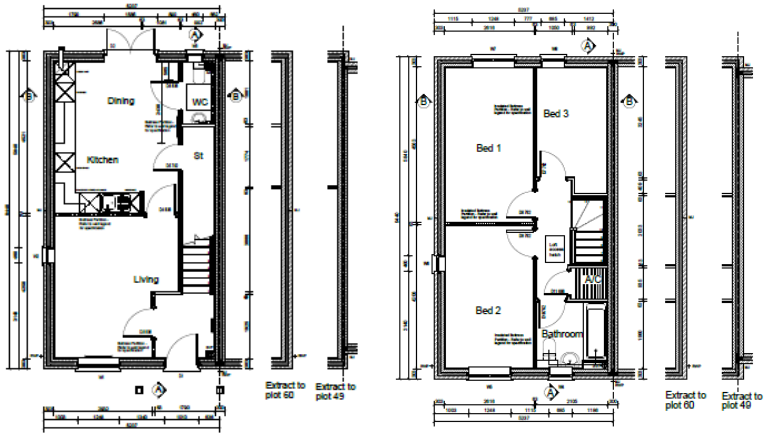
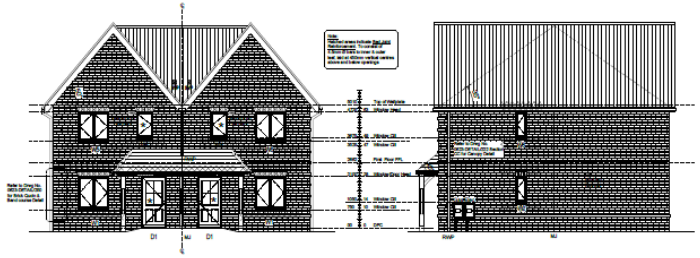
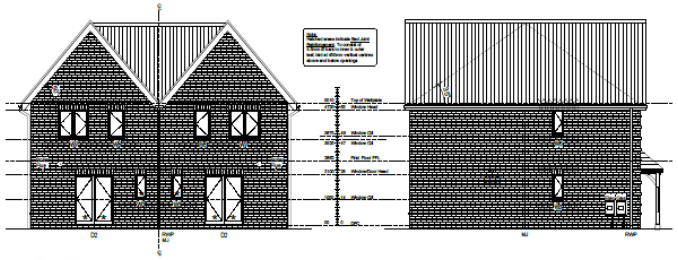


Front Elevation

Side Elevation



Rear Elevation

Side Elevation

| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 83.17 m² | 7.87 m² | 9.14 m² | 2.29 m² | 1.22 / 1.57 / 0.65 m² |

## Removing excess heat

| | | High risk location | Moderate risk location |
|---|---|---|---|
| Total minimum free area | Floor Area | 4.99 | 7.49 |
| | Glazed Area | 5.51 | 4.33 |
| Bedroom minimum free area | Bed 01 | 1.51 | 0.46 |
| | Bed 02 | 1.39 | 0.43 |
| | Bed 03 | 0.92 | 0.28 |

Pass for total minimum free area but Bedroom 01 & 03 would require larger openings to meet the minimum free area for bedrooms in high risk locations. Bedroom 02 would fail on a mid-terrace setting for a high risk location as well. House type connotations and planning restrictions could potentially lead to fails on standard house types.

The minimum free area should always be read in conjunction with purge ventilation requirements from AD F for habitable rooms. 1/10 of the floor area is required for opening angles between 15 and 30 degree and 1/20 for greater than 30 degree, sash windows and external doors. Below 15 degrees, mechanical ventilation can be provided extracting at least 4 ACH per room directly to the outside.

The equivalent area of the opening can be significantly smaller depending on the opening angle of the window.

# Example: Top Floor Flat with cross-ventilation

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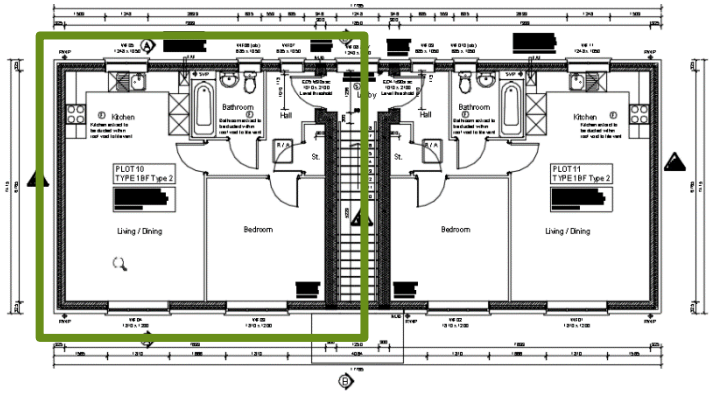



| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 50.46 $m^2$ | 4.64 $m^2$ | 4.52 $m^2$ | 2.28 $m^2$ | 1.17 $m^2$ |

## Minimising Solar Gain

| | High risk location | | Moderate risk location | |
|---|---|---|---|---|
| | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) |
| North | 7.57 | 9.75 | 9.08 | 9.75 |
| East | 9.08 | 9.75 | 9.08 | 9.75 |
| South | 7.57 | 5.80 | 7.57 | 7.91 |
| West | 9.08 | 9.75 | 5.55 | 5.80 |

Pass for all regions and orientations.

The maximum area of glazing (% floor area) is defined as 18% for high risk and 11% for moderate risk locations. At this stage, it could not be determined why a high risk location can achieve a pass on a larger glazed area for a western orientation.

# Example: Top Floor Flat with cross-ventilation

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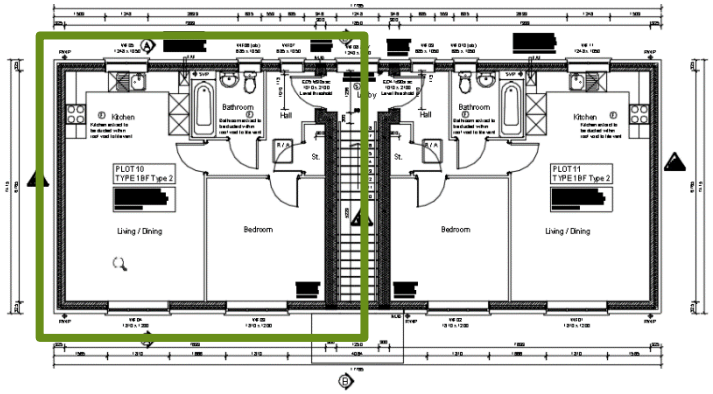



| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 50.46 $m^2$ | 4.64 $m^2$ | 4.52 $m^2$ | 2.28 $m^2$ | 1.17 $m^2$ |

## Removing excess heat

| | | High risk location | Moderate risk location |
|---|---|---|---|
| Total minimum free area | Floor Area | 3.03 | 4.54 |
| | Glazed Area | 3.25 | 2.55 |
| Bedroom minimum free area | Bed 01 | 1.61 | 0.50 |

The results show a fail for the total minimum free area (moderate risk) and Bedroom free area (high risk). At this stage, it could not be determined why a high risk location (6% of total floor area) can achieve a pass on a larger glazed area when compared to a moderate risk location (9% of the total floor area).

The minimum free area should always be read in conjunction with purge ventilation requirements from AD F for habitable rooms. 1/10 of the floor area is required for opening angles between 15 and 30 degree and 1/20 for greater than 30 degree, sash windows and external doors. Below 15 degrees, mechanical ventilation can be provided extracting at least 4 ACH per room directly to the outside.

The equivalent area of the opening can be significantly smaller depending on the opening angle of the window.

# Top Floor Flat **without** cross-ventilation

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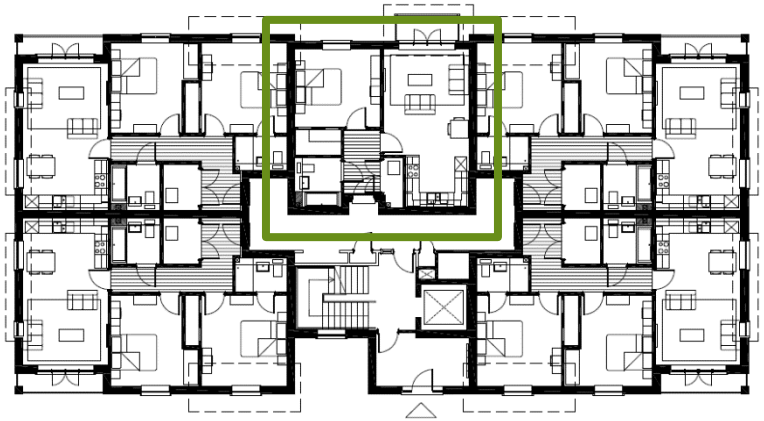
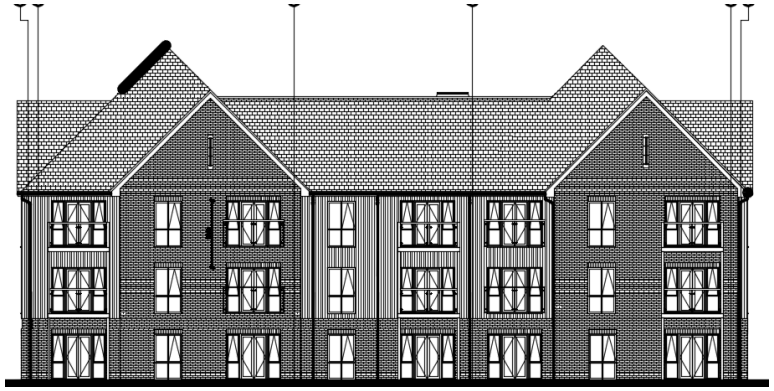
| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 51.46 $m^2$ | 4.99 $m^2$ | 4.26 $m^2$ | 3.03 $m^2$ | 0.76 $m^2$ |





## Minimising Solar Gain

| | High risk location | | Moderate risk location | |
|---|---|---|---|---|
| | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) | Maximum area of glazing (% floor area) | Maximum area of glazing in the most glazed room (% floor area of room) |
| North | 7.72 | 4.41 | 9.26 | 4.41 |
| East | 5.66 | 3.05 | 9.26 | 4.41 |
| South | 5.66 | 1.87 | 7.72 | 2.55 |
| West | 5.66 | 3.05 | 5.66 | 1.87 |

Pass for most regions except for largest glazed orientation facing south (high risk) and south or west (moderate risk) living / dining / kitchen.

The maximum area of glazing (% floor area) is defined as 18% for high risk and 11% for moderate risk locations. At this stage, it could not be determined why a high risk location can achieve a pass on a larger glazed area for a western orientation.

# Top Floor Flat **without** cross-ventilation

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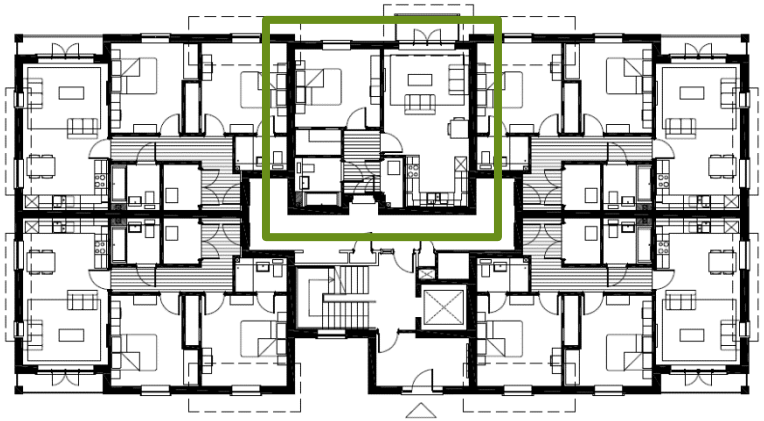
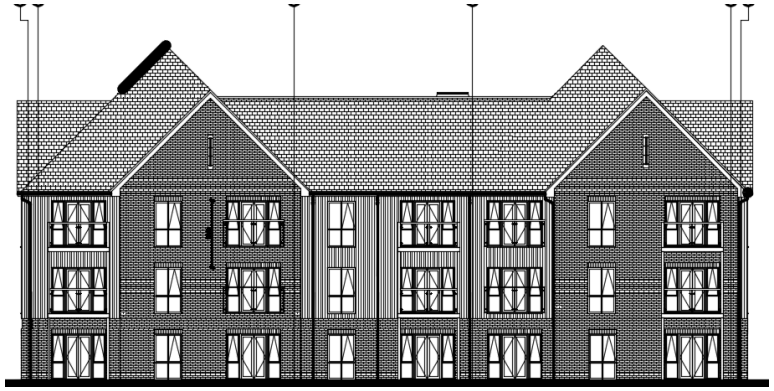
| Floor Area: | Glazed Area: | Free Area: | Most glazed room: | Free Area Bedrooms: |
|---|---|---|---|---|
| 51.46 $m^2$ | 4.99 $m^2$ | 4.26 $m^2$ | 3.03 $m^2$ | 0.76 $m^2$ |





| Removing excess heat | | | |
|---|---|---|---|
| | | High risk location | Moderate risk location |
| Total minimum free area | Floor Area | 5.15 | 6.18 |
| | Glazed Area | 4.74 | 3.99 |
| Bedroom minimum free area | Bed 01 | 1.68 | 0.52 |

The results show a fail for the total minimum free area and Bedroom free area (high risk). At this stage, it could not be determined why a high risk location (6% of total floor area) can achieve a pass on a larger glazed area when compared to a moderate risk location (9% of the total floor area).

The minimum free area should always be read in conjunction with purge ventilation requirements from AD F for habitable rooms. 1/10 of the floor area is required for opening angles between 15 and 30 degree and 1/20 for greater than 30 degree, sash windows and external doors. Below 15 degrees, mechanical ventilation can be provided extracting at least 4 ACH per room directly to the outside.

The equivalent area of the opening can be significantly smaller depending on the opening angle of the window.

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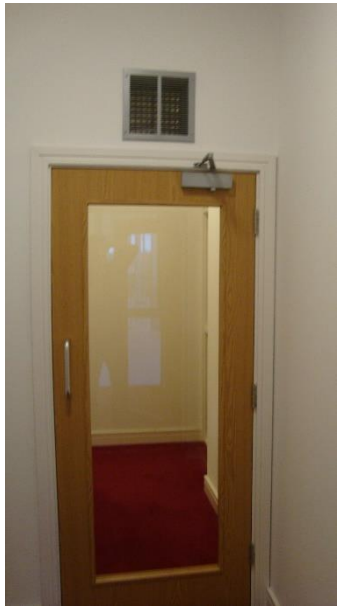
# Corridors

**Common areas** are rooms which are available for use by more than one person (or household) and circulation spaces in buildings that contain more than one residential unit. Examples of these include, but are not limited to, corridors between dwellings and communal living rooms or kitchens .




**Bottom pictures:** https://www.specifiedby.com/se-controls/seco-n-25-actuators/residential-corridor-overheating-hot-corridors_fe5c9df1.pdf

Distribution pipework of communal heating systems can often contribute to overheating in unventilated corridors. Fans or a well thought through passive ventilation strategy is required to prevent heat building up in poorly ventilated areas.

**Common Spaces**
(mainly for circulation, e.g. a corridor or lift lobby.

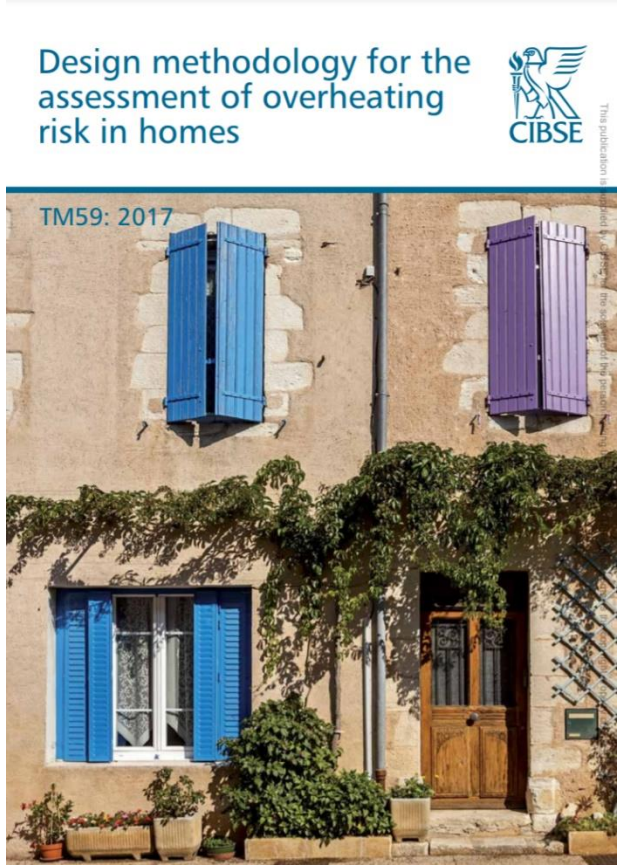
a. Communal heating, or
b. Hot water system with significant amount of horizontal heating, or
c. Hot water distribution pipework

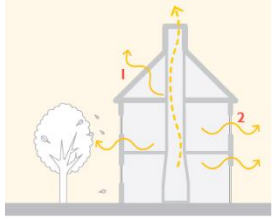
**PRESENT ?**

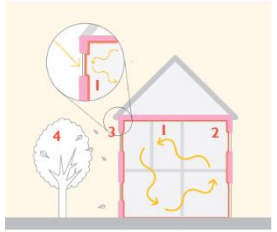
YES → **Dynamic thermal modelling**

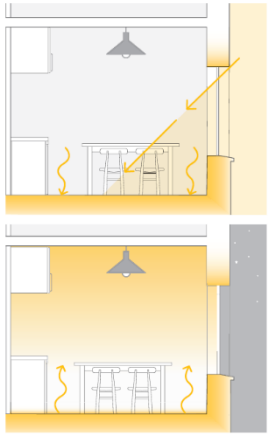
NO → **Simplified Method**

# Dynamic Method



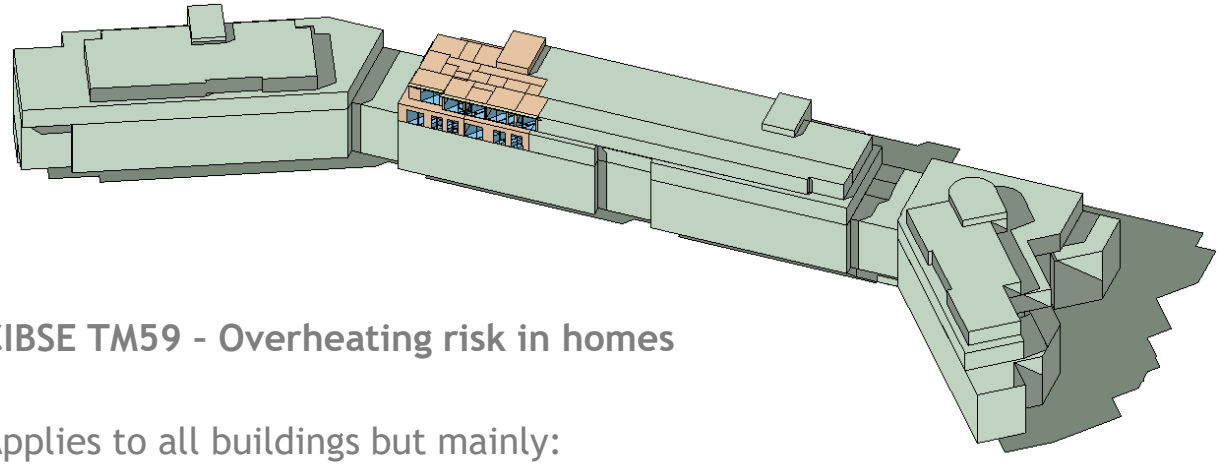




CIBSE TM59 & NHBC NF44 Understanding overheating.

**CIBSE TM59 - Overheating risk in homes**

The dynamic method offers much more flexibility than the simplified method.



**CIBSE TM59 - Overheating risk in homes**

Applies to all buildings but mainly:

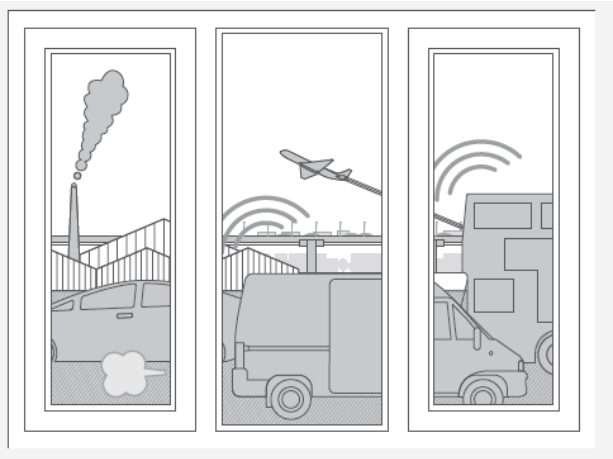
a. Residential buildings with very high levels of insulation and air-tightness.

b. Residential buildings with specific site conditions that mean the building is not well represented by the two locations (urban & suburban parts of London and some parts of central Manchester).

c. Residential buildings that are highly shaded by neighbouring properties, structures or landscape.

**A report needs to be made available to building control. AES Sustainability Consultants use IES VE and can help to assess your house type range with the aim of achieving type approval.**

# Site Context



NHBC NF44 Understanding overheating.

**Ensuring the overheating strategy is usable.**

Every site is different and the context of the site needs to be taken into account. An overheating strategy is only successful if all external links are considered.

**Noise**

The overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am)

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits:

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)
b. 55dB $L_{AFmax}$, more than 10 times a night (between 11pm and 7am).

**Pollution**

Buildings located near to significant local pollution sources should be designed to minimise the intake of external air pollutants.

**Security**

Where openings, such as windows, are used in the overheating mitigation strategy, they should be made secure in order to resist physical attack by an opportunistic burglar during night time hours.

**Protection from Falling / Entrapment**

Where openings, such as windows, are used in the overheating mitigation strategy, the risk of occupants falling from height should be mitigated.

Louvered shutters, window railings and ventilation grills should not allow body parts to become trapped.

# Providing Information

**Providing Information**

Sufficient information about the overheating strategy and its maintenance requirements must be given to owners so that it can be used effectively. The information should be provided in a clear manner, for a non-technical audience.

**The following information should be provided where relevant.**

a) The overall overheating risk reduction strategy. For example, appropriately sized windows that do not let in too much direct sun and therefore increase the internal temperature, but which open fully to allow cool air in. Or, roller shutters with ventilation louvres.

b) The location of each element of the overheating mitigation strategy.

c) Instructions to operate each element of the overheating mitigation strategy.

d) The time of day that different parts of the strategy should be used. For example, the shutters should be used during the day and the windows opened only when it is cooler outside.

e) The time of year the strategy should be used. For example, all summer from May to September or only in hot weather.

f) Manufacturer's contact details.

g) Location of controls and instructions for setting of controls e.g. timer controls.

h) The location of sensors and how to recalibrate them.

i) Cleaning and maintenance instructions.