# Chalcots Flat, d+b facades

CIBSE TM59 Overheating Assessment Report (Ref. ZED2401

## TM59 Design Methodology to prevent overheating in homes (2017)

The health and wellbeing impacts of overheating can be significant for residents, resulting in stress, anxiety, sleep deprivation and even early deaths in heat waves, especially for vulnerable occupants. The situation is predicted to get worse. The committee on Climate Change has estimated the mortality rates arising from overheating could rise from 2000 per year in 2015 to 7000 per year by the 2050s.

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# Contents



| | | | | | |
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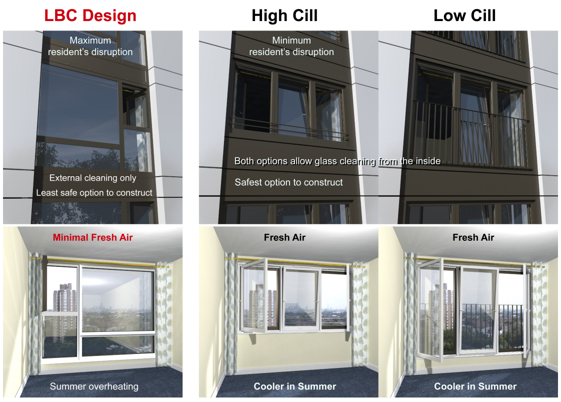
revision: Rev 02 – Results Table formatting

# Summary

**This report sets out the results of the CIBSE TM59 overheating assessment for d+b facades. It reviews the overheating potential of 3 apartments with different window openings.**

**d+b facades design options:**




ZED Ltd has compiled this report to provide a summary of the CIBSE TM59 overheating assessment carried out for d+b facades. Based on a single flat in the Chalcot building, it reviews the overheating potential of 3 different window openings: High Cill, Low Cill and Compliant.

Thermal modelling has been carried out using Government approved IES-VE Apache dynamic simulation software in accordance with CIBSE AM11.

Results show TM59 compliance to be achieved by both the Low Cill and High Cill window options. However the Compliant apartment fails for parts of both Criteria (a) and (b). This is demonstrated in Table 1.

| | Room Name | Criteria (a) (≤3%) | Pass/Fail | Criteria (b) (≤32hrs) | Pass/Fail |
|---|---|---|---|---|---|
| Low Cill Apartment | LC living room | 1.8 (40%) | pass | | |
| | LC bedroom 2 | 0.7 (76%) | pass | 21 (34%) | pass |
| | LC bedroom 1 | 0.6 (80%) | pass | 22 (31%) | pass |
| | LC kitchen | 1.3 (57%) | pass | | |
| High Cill Apartment | HC living room | 1.5 (50%) | pass | | |
| | HC bedroom 2 | 0.6 (80%) | pass | 23 (28%) | pass |
| | HC bedroom 1 | 0.6 (80%) | pass | 25 (22%) | pass |
| | HC kitchen | 1.5 (50%) | pass | | |
| Compliant Apartment | CC living room | 3.3 (10%) | fail | | |
| | CC bedroom 2 | 1.3 (57%) | pass | 39 (22%) | fail |
| | CC bedroom 1 | 1.3 (57%) | pass | 43 (34%) | fail |
| | CC kitchen | 3.7 (2.3%) | fail | | |

**Table 1. Results summary**

Please note that this analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues.

# TM59 Criteria

**CIBSE TM59 (2017) defines a procedural standard to assess the risk of summertime overheating in dwellings.**

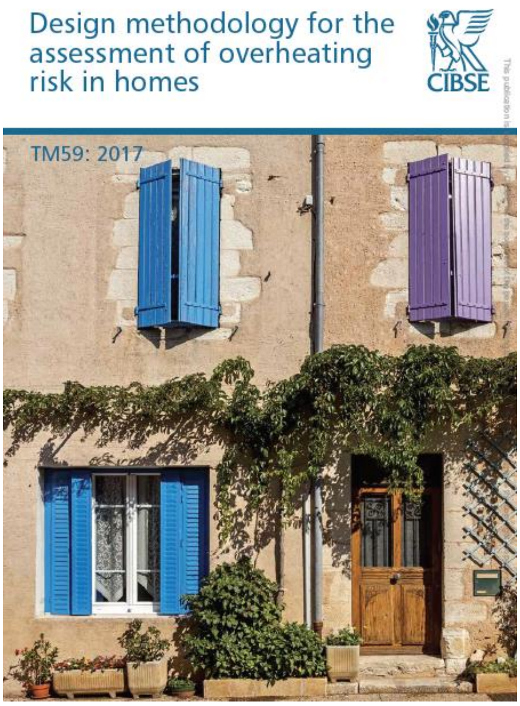



**Figure 1. CIBSE TM59: 2017**

Recent evidence has shown that overheating risk needs to be taken seriously in the residential sector. Many new or refurbished homes have designs that contribute to overheating risk by, for example, having high proportions of glazing (resulting in excessive solar heat gains), inadequate natural ventilation strategies or mechanical ventilation systems that are not delivering intended air change rates.

Many factors influence overheating in homes, including the intensity of heat gains, occupancy patterns, orientation, dwelling layout, shading strategy and ventilation method. Dynamic thermal modelling can be used to simulate the internal temperature conditions and will therefore help establish whether threshold conditions of discomfort will be reached. Given the complexity of the factors influencing overheating it is important that a standardised methodology is used to assess risk and hence the need for a technical memorandum. It can be applied to dwellings, care homes and student residences. Early analysis of overheating risk is recommended so that mitigation strategies can be reviewed in design proposals.

This is a standardised approach to predicting overheating risk for residential building designs (new-build or major refurbishment) using dynamic thermal analysis. The testing of the methodology has focused on flats, as they tend to represent a higher overheating risk than houses.

Developments should refer to the latest CIBSE design summer year (DSY) weather files and be required to Pass using the DSY1 file most appropriate to the site location, for the 2020's, high emissions, 50% percentile scenario.

The following weather file has been selected as the most appropriate to the site location of Chalcots Flats, located in Camden, London.

Closest available simulation weather file:
London_LHR_DSY1_2020High50.epw

# TM59 Criteria

**In guidance with CIBSE TM59 (2017) the worst case dwellings were selected.**

In addition it was agreed with d+b facades that the likely worst case dwelling within the sample would be assessed following the guidance within CIBSE TM59:

*These are likely to be those (a) with large glazing areas, (b) on the topmost floor, (c) having less shading, (d) having large, sun-facing windows, (e) having a single aspect, or (f) having limited opening windows.*

Accordingly Flat F has been chosen as the basis for the sample flat. This is due to it having dual aspects, and with it being predominantly South facing it is likely to experience the most solar gain. A topmost floor flat was considered but it was not found to be the worst case dwelling.

Compliance has been assessed against the criteria for homes predominantly naturally ventilated as set out within CIBSE TM59:

(a) *For living rooms, kitchens and bedrooms: the number of hours which ΔT is greater than or equal to one degree (K) during the period May to September inclusive shall not be more than 3 percent of occupied hours. (CIBSE TM52 Criterion 1: Hours of exceedance).*

This criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature - 22°C) by 1 K or more during the occupied hours of a typical non-heating season (1 May to 30 September).

(a) *For bedrooms only: to guarantee comfort during the sleeping hours the operative temperature in the bedroom from 10pm to 7am shall not exceed 26°C for more than 1% of annual hours. (Note: 1% of the annual hours between 22:00 and 7:00 for bedrooms is 32hrs, so 33 or more hours above 26°C will be recorded as a fail).*

# Thermal Model

**A thermal model has been constructed for all 3 variation in window structure using IES-VE software.**

A geometric model has been constructed from the drawings provided by d+b facades and BPA Architecture. Building fabric types and corresponding thermal performance have been taken from the information provided where available and where not; from regulatory guidance.

Window opening locations are taken from the architectural elevation drawings. The 'tilt and turn' windows are taken to be unrestricted, opening to a maximum throw of 90°. The 'top hung' windows are restricted to 20°.

| Fabrics & Openings | Compliant | High Cill | Low Cill |
|---|---|---|---|
| Cladding (U-value $W/m^2.K$) | 0.3 | 0.23 | 0.23 |
| Under window cladding (U-value $W/m^2.K$) | 1.2 | 0.14 | 0.14 |
| Window (U-value $W/m^2.K$) | 1.2 | 1.2 | 1.2 |
| Window (g value) | 0.34 | 0.35 | 0.35 |

**Table 2. Thermal envelope performance**

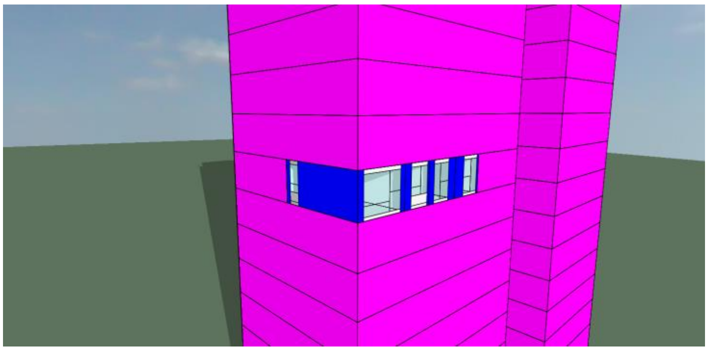


**Figure 2.1 Thermal model geometry Compliant**

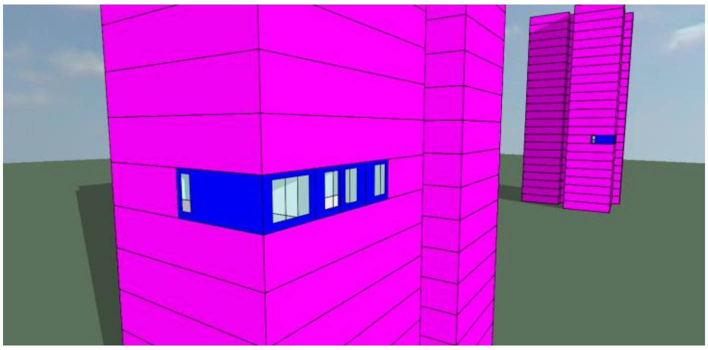


**Figure 2.2 Thermal model geometry Low Cill**

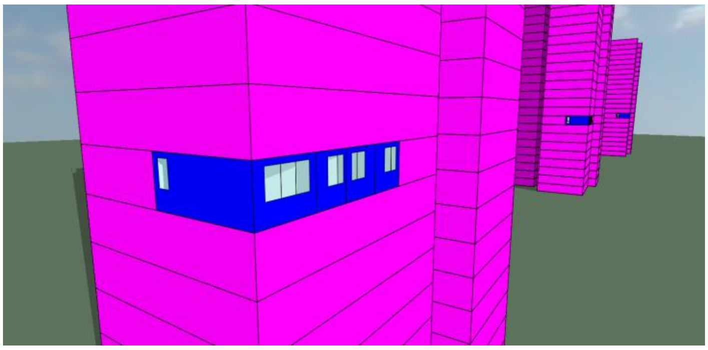


**Figure 2.3 Thermal model geometry High Cill**

# Window Openings

**Purge ventilation will be provided by manually opening windows.**

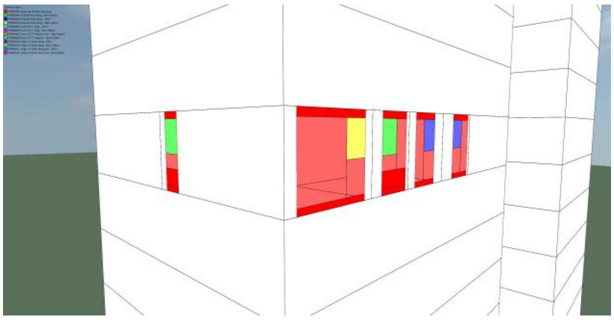


**Figure 3.1 Window openings – Compliant**

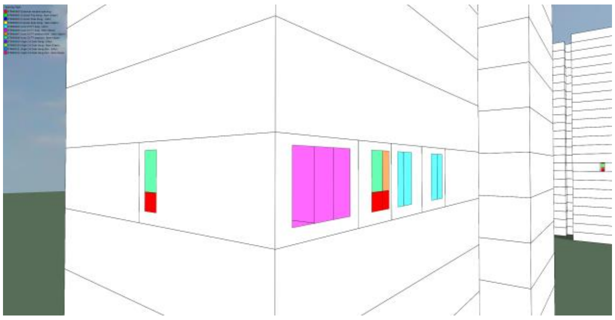


**Figure 3.2 Window openings – Low Cill**

Bulk airflow movement through opening windows from buoyancy and wind-driven forces has been calculated using IES MacroFlo.

As advised by the architects, windows are taken to be opened to a maximum throw of 90° (aside from 'top hung' windows which are restricted to 20°). This will happen when the internal temperature exceeds 22°C during occupied hours, in accordance with CIBSE TM59.

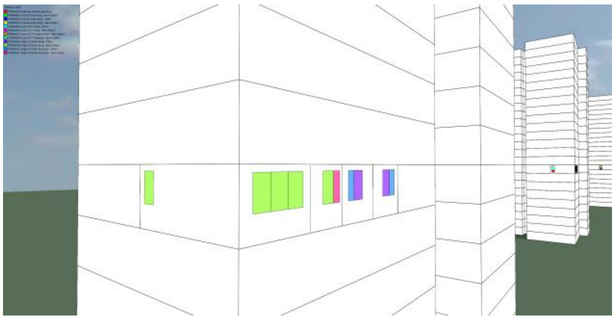


**Figure 3.3 Window openings – High Cill**

| | Description | Opening | Openable Area % | Max Angle Open ° | Proportions | Degree of Opening |
|---|---|---|---|---|---|---|
| Compliance Apartment | Current Top Hung - 9am-10pm | Window - top hung | 90 | 20 | 0.5 =< Length/Height <1 | 9am-10pm (week) |
| | Current Side Hung - 9am-10pm | Window / door - side hung | 90 | 90 | 0.5 =< Length/Height <1 | 9am-10pm (week) |
| | Current Side Hung - 24hr | Window / door - side hung | 90 | 90 | 0.5 =< Length/Height <1 | bedroom window opening profile - 24hr |
| Low Cill Apartment | Low Cill Side Hung long - 9am-10pm | Window / door - side hung | 90 | 90 | Length/Height < 0.5 | 9am-10pm (week) |
| | Low Cill Side Hung medium thin - 9am-10pm | Window / door - side hung | 90 | 90 | Length/Height < 0.5 | 9am-10pm (week) |
| | Low Cill Side Hung medium - 9am-10pm | Window / door - side hung | 90 | 90 | 0.5 =< Length/Height <1 | 9am-10pm (week) |
| | Low Cill Side Hung long - 24hr | Window / door - side hung | 90 | 90 | Length/Height < 0.5 | bedroom window opening profile - 24hr |
| High Cill Apartment | High Cill Side Hung - 24hr | Window / door - side hung | 90 | 90 | 0.5 =< Length/Height <1 | bedroom window opening profile - 24hr |
| | High Cill Side Hung thin - 24hr | Window / door - side hung | 90 | 90 | Length/Height < 0.5 | bedroom window opening profile - 24hr |
| | High Cill Side Hung - 9am-10pm | Window / door - side hung | 90 | 90 | 0.5 =< Length/Height <1 | 9am-10pm (week) |
| | High Cill Side Hung thin - 9am-10pm | Window / door - side hung | 90 | 90 | Length/Height < 0.5 | 9am-10pm (week) |

**Table 3. Window opening details**

# Internal Heat Gain

**Internal heat gain and room occupancy profiles are taken from the CIBSE guidance.**

The occupancy, equipment gains and profiles have been developed for the purpose of the TM59 methodology. They represent a robust test that ensures the key aspects of overheating are captured, namely the hours when risk is highest (i.e. the middle of the day and early afternoon). Also at night time hours when, if rooms do not cool down, sleep can be disrupted.

In line with the TM59 methodology, internal conditions are taken from the guidance document. Rooms have been taken from the dwelling category '2 bedroom apartment'.

| Unit/ room type | Occupancy | Equipment load |
|---|---|---|
| Studio | 2 people at 70% gains from 11 pm to 8 am<br>2 people at 100% gains from 8 am to 11 pm | Peak load of 450 W from 6 pm to 8 pm*.<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 1-bedroom apartment: living room/kitchen | 1 person from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 1-bedroom apartment: living room | 1 person at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day |
| 1-bedroom apartment: kitchen | 1 person at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 300 W from 6 pm to 8 pm<br>Base load of 50 W for the rest of the day |
| 2-bedroom apartment: living room/kitchen | 2 people from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200 W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 2-bedroom apartment: living room | 2 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day |
| 2-bedroom apartment: kitchen | 2 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 300 W from 6 pm to 8 pm<br>Base load of 50 W for the rest of the day |
| 3-bedroom apartment: living room/kitchen | 3 people from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 450 W from 6 pm to 8 pm<br>200W from 8 pm to 10 pm<br>110 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 85 W for the rest of the day |
| 3-bedroom apartment: living room | 3 people at 75% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 150 W from 6 pm to 10 pm<br>60 W from 9 am to 6 pm and from 10 pm to 12 pm<br>Base load of 35 W for the rest of the day |
| 3-bedroom apartment: kitchen | 3 people at 25% gains from 9 am to 10 pm; room is unoccupied for the rest of the day | Peak load of 300 W from 6 pm to 8 pm<br>base load of 50 W for the rest of the day |
| Double bedroom | 2 people at 70% gains from 11 pm to 8 am<br>2 people at full gains from 8 am to 9 am and from 10 pm to 11 pm<br>1 person at full gains in the bedroom from 9 am to 10 pm | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during the sleeping hours |
| Single bedroom (too small to accommodate double bed) | 1 person at 70% gains from 11 pm to 8 am<br>1 person at full gains from 8 am to 11 pm | Peak load of 80 W from 8 am to 11 pm<br>Base load of 10 W during sleeping hours |
| Communal corridors | Assumed to be zero | Pipework heat loss only; see section 3.1 above |

**Table 4. CIBSE TM59 room template data**

# Results

**Results of the thermal modelling assessment show compliance to be achieved against both TM59 criteria.**

| | Room Name | Criteria (a) (≤3%) | Pass/Fail | Criteria (b) (≤32hrs) | Pass/Fail |
|---|---|---|---|---|---|
| Low Cill Apartment | LC living room | 1.8 (40%) | pass | | |
| | LC bedroom 2 | 0.7 (76%) | pass | 21 (34%) | pass |
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| High Cill Apartment | HC living room | 1.5 (50%) | pass | | |
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| Compliant Apartment | CC living room | 3.3 (10%) | fail | | |
| | CC bedroom 2 | 1.3 (57%) | pass | 39 (22%) | fail |
| | CC bedroom 1 | 1.3 (57%) | pass | 43 (34%) | fail |
| | CC kitchen | 3.7 (2.3%) | fail | | |

**Table 5. Results summary**

As seen in Table 5 the Low Cill and High Cill apartment pass both Criteria (a) and Criteria (b) for all rooms. However, within the Compliant apartment the living room and kitchen fail Criteria (a). The Compliant apartment then also fails Criteria (b) for both bedrooms.

The results therefore show the Compliant apartment does not meet TM59 criteria and therefore is susceptible to overheating risk.

Please note that this analysis provides an assessment of comfort compliance based on bulk air modelling i.e. each space is considered idealised and the air in the space perfectly mixed. The assessment does not assess placement of space features e.g. windows & openings, airflow patterns or discomfort issues.

# Drawing Register

| Drawing Title | Drawing Number | Revision |
|---|---|---|
| COMPLIANT– FLAT F – THERMAL | 979(SK)300 | - |
| LOW CILL – FLAT F – THERMAL | 979(SK)301 | - |
| HIGH CILL – FLAT F – THERMAL | 979(SK)302 | - |

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