

Thermal Comfort

Aim of the Credit

To encourage and recognise projects that achieve high levels of thermal comfort.

Credit Criteria

1	Thermal Comfort*	<p>1 point is awarded where:</p> <ul style="list-style-type: none"> For 95% of the nominated area and 98% of the year: The internal temperatures are within 80% of Acceptability Limit 1 of ASHRAE Standard 55-2010. OR The Predicted Mean Vote (PMV) levels are between -1 and +1, inclusive. This may be demonstrated through application of the Deemed-to-Satisfy criteria. AND/OR In residential spaces, an average NatHERS rating of 7 Stars or greater is achieved. <p>2 points are awarded where:</p> <ul style="list-style-type: none"> For 95% of the nominated area and 98% of the year: The internal temperatures are within 90% of Acceptability Limit 1 of ASHRAE Standard 55-2010. OR The Predicted Mean Vote (PMV) levels are between -0.5 and +0.5, inclusive. AND/OR In residential spaces, an average NatHERS rating of 8 Stars or greater is achieved. <p>For retail spaces, the second point is 'Not Applicable'</p>
2	Individual Comfort Control	<p>1 additional point is awarded where individual comfort control is provided in Primary Areas as follows:</p> <ul style="list-style-type: none"> In work areas, individual comfort control is provided for every 30m² (where final workstation layout is unknown), or every two workstations (where known). For residential, hotel or healthcare projects, 50% of individual spaces must also be provided with comfort control to serve that space. <p>For Retail spaces and Industrial Spaces the additional point for Individual Comfort Control is 'Not Applicable'</p>

* For spaces where HVAC systems will not be fully installed at the time of submission, 1 point may be awarded where the compliance requirements outlined below are met.

Compliance Requirements

1. Thermal Comfort

Naturally ventilated spaces

For naturally ventilated spaces, as per standard ASHRAE 55-2010, it must be shown that occupants have direct control over the opening and closing of windows, and that these are the main sources of ventilation. However, these spaces can contain ceiling fans or a heating system (see ASHRAE 55-2010 section 5.3 for more information).

The acceptability limits cannot be extrapolated where the mean monthly outdoor temperature is less than 10°C or more than 33.5°C. Where the project is located in areas where the mean monthly temperature is lower, or higher, than those stipulated in the standard, it must be demonstrated that the space complies with the credit criteria through the use of mechanical systems (e.g. radiant heating). Where the mechanical systems are present to address temperatures outside the range of 10°C or 33.5°C this space will be considered mixed mode.

Mechanically ventilated spaces: thermal modelling requirements

PMV levels must be calculated in accordance with either ISO7730 or ASHRAE Standard 55-2010.

For equitable assessment the model must comply with the following

- Perimeter zones shall have a maximum depth of 4 meters
- Zoning shall match the air conditioning zones (with the exception of perimeter zones which must be 4m in depth)
- Each perimeter shall be reported independently (e.g. North, South, East and West)
- Perimeter zones shall be reported independently of interior zones
- Model shall be completed with all systems assessed simultaneously
- Comfort predictions shall be measured at the midpoint of each zone, i.e. if the perimeter zone is 4m deep then the comfort prediction will be 2m from the perimeter; OR comfort predictions shall be taken as an average across the zone. For the purpose of comfort condition measurement, no perimeter zone can serve more than one orientation unless the second orientation is negligible (<4m perimeter length).
- Comfort predictions shall be measured at a height of between 0.8 and 1.5m above FFL OR Comfort predictions shall be taken as an average across the zone

Mechanically ventilated spaces: Deemed to Satisfy (DTS) requirements.

The following is the Deemed to Satisfy approach for demonstrating PMV values of between +1 and -1. This approach can only be applied to fully air-conditioned spaces. Thermal modelling is still required to demonstrate PMV values of between ± 0.5 (inclusive), or for naturally ventilated or mechanically-assisted naturally ventilated spaces.

This DTS approach can only be applied in BCA climate zones 1-7; projects in BCA Climate Zone 8 are required to demonstrate compliance via thermal modelling.

Projects must meet the following HVAC system and façade requirements.

HVAC system requirements:

1. Dry Bulb Temperature in space is controlled to minimum 20°C to maximum 24°C;
2. Relative humidity controlled between 40% and 60%;
3. The HVAC may be assumed to have separate internal and perimeter zones with independent temperature control which meet the following maximum zone size requirements (for at least 95% of NLA): 85m² perimeter zone, 120m² internal zone. No perimeter zone can serve more than one orientation unless the second orientation is negligible (<4m perimeter length).
4. Each HVAC zone contains its own temperature sensor(s);
5. Air velocity is not more than 0.2 m/s with no supply directed at occupants (unless they have direct control over air flow and/or direction);

Facade requirements:

1. SHGC of façade glazing is 0.3 or lower; OR
2. Maximum solar heat gain through the glass is calculated to be no greater than 250W/m² of glazed façade area.

Mechanically ventilated spaces: Spaces where HVAC is not fully installed at time of submission for assessment

It is acknowledged that where there is a clear distinction between building owner and tenants, often some spaces are delivered as 'shell and core' or as a 'warm shell'. Under these circumstances some tenants choose to manage the design and installation of on floor HVAC services for their tenancy.

In spaces where there is a clear distinction between tenant and building owner, and HVAC systems are not installed at time of as-built submission, thermal comfort modelling may be carried out in line with the following:

- Internal tenant loads including lighting and small power must be modelled using a notional fit out assuming the most energy intensive fit out allowable by NCC Section J.
- HVAC system zoning, cooling capacity, delivered air velocity and delivered air temperature may be assumed as aligned with other like spaces or floors within the building. If present in HVAC systems that have been installed in the building it may be assumed that an HVAC system has separate internal and perimeter zones with independent temperature control.
- All other modelling attributes are modelled in line with the above compliance requirement for 'mechanically ventilated spaces: thermal modelling requirements'.

Note, the above is drawn from and aligned with the GHG emissions calculator guide used in energy modelling for GHG-emissions and Peak Demand credits within the energy category.

The spaces using this compliance pathway must collectively account for less than 40% of the nominated area. If your project has a higher proportion of space delivered as 'shell and core' or 'warm shell' without HVAC systems please contact the GBCA

Please provide feedback on this point. If you have suggestions on how to better handle 'shell and core' or 'warm shell' delivery for thermal comfort that provides a consistent modelling approach with energy modelling, we would like to hear your thoughts.

Mixed-Mode Spaces

For mixed-mode spaces, the mechanical and natural ventilation thermal comfort Credit Criteria must be achieved for the time that each mode of operation is expected to run.

Please provide feedback on this point. If you have suggestions on how to better handle mixed-mode spaces for thermal comfort that provides a consistent modelling approach with energy modelling, we would like to hear your thoughts.

Residential Spaces

The thermal performance modelling must be undertaken using a NatHERS (second generation) approved software. The following software is currently approved:

- Accurate
- BERS professional
- FirstRate 5

The modelling must be undertaken by a NatHERS Accredited Assessor, in line with all relevant protocols and regulatory requirements.

Rooms with specific temperature control requirements

Rooms that, for functional reasons, have specific temperature requirements can be excluded from this credit.

Work Areas

Individual comfort control is only required to be provided in areas where a user will be performing an activity for a long period of time. Areas such as predominantly work spaces (workshops, office areas, back of house occupied areas, staff rooms, meeting rooms, study rooms), and learning spaces (computer rooms, classrooms) are all expected to contain or be provided with individual comfort control solutions. Large event spaces are not required to provide an individual comfort control solution.

To exclude a space from assessment, the project team must submit a Credit Interpretation Request (CIR).

Work areas are only found in the nominated area, any work areas that are not in nominated area may be excluded.

Modelling requirements

All inputs into the modelling or calculations (e.g. building form, materials and air-conditioning system(s), shading, internal loads, etc.) must be clearly justified and referenced consistently throughout the rest of the submission (i.e. in related credits such as Ene-1 'Greenhouse Gas Emissions' or IEQ-1 'Ventilation Rates'). Modelling must be carried out in accordance with ASHRAE Standard 55-2010.

The acceptable weather data for use in this credit is TRY, RMY or IWEC. Where other weather data is to be used, the applicant must demonstrate that the data is typical of the locality.

Default Values

Occupancy Rates must be consistent with the Quality of Internal Air credit

Nominated 'Hours of Occupancy' should be defined per project. As per ISO7730, 'Standard Hours of Occupancy' are defined as 8am to 6pm, Monday to Friday (50 hours per week). Hours used in the assessment must correlate to the use of the space. Any deviation from 'Standard Hours' should be justified with proper documentation and sourcing.

Values used for clothing and metabolic rate must be justified and sourced from either ISO7730 or ASHRAE Standard 55-2010.

All other values must be justified and sourced from either ASHRAE Standard 55-2010 or ISO 7730. Alternative values may be accepted with proper justification and sourcing.

2. Individual Comfort Control

One additional point is to be awarded where the project has achieved either the first or second Thermal Comfort point and it meets the requirements of the Individual Comfort Control criterion.

Naturally ventilated spaces can be provided with individual control by allowing occupants to adjust individual ventilation openings. The opening size must be no less than 0.75m² (free area). Individual control over shading devices is to be considered to allow control of

mean radiant temperatures. Ceiling fans are also acceptable (1 metre diameter minimum).

For mechanically ventilated spaces to comply with the additional point, the individual comfort control elements must be installed at the time of practical completion. A contractual requirement for future installation is not acceptable. The individual comfort control system must allow control over at least one of the following: air velocity, temperature (whether radiant or from direct air temperature), or direction. A least one individual control system must be provided in meeting rooms, private rooms, or enclosed areas less than 100m².

Guidance

Existing buildings

An approximation of the estimated thermal and visual properties of an existing façade (e.g., the U-values and shading coefficients of walls/glazing) can be used, provided that all assumptions made are conservative, i.e. described the 'worst case scenario'. Projects may submit a CIR to confirm that their assumptions are sufficiently conservative.

Definitions

Primary Space

All areas where a person is expected to work, or remain for an extended period of time, including, but not limited to:

- Living Spaces
- Kitchens
- Offices, either open plan or private;
- Classrooms, laboratories, computer labs;
- Ward rooms, nurse's stations, clinic rooms;
- Inpatient spaces
- Kitchen and preparation areas where food is being sold;
- Retail / sales floor, exhibition halls, galleries (unless exclusion is justified), multi-purpose rooms (as a general setting); and
- Industrial spaces, warehouse areas, shop floors, work stations.

These examples are indicative, and the project is encouraged to submit a Credit Interpretation Request to ensure that all spaces have been accurately defined.

The predominant use of the space determines the space type classification. Where the functional requirements of the space demand specific ventilation conditions (e.g. laboratories, auditoriums, cinemas, or archives) the exclusion must be justified by the project team in a Credit Interpretation Request.

Secondary Space

All areas used to support the principal activity of the primary space. These spaces will be regularly occupied, though a single person is unlikely to remain within for more than 2 hours. Examples of secondary space include:

- Meeting rooms, boardrooms;
- Auditoriums, gyms, seminar rooms (if not intended for regular classes);
- Waiting rooms and any diagnostic area where no specific lighting requirements exist;
- Cafeterias, restaurants, seating areas, office breakout areas, food courts; and
- Stock or store rooms.

Where the project team is unsure of whether a space is primary or secondary, it is recommended that the project team either submits a Credit Interpretation Request for confirmation, or classify the space as a primary space.

Corridors that are exclusively used for transit between spaces (i.e. do not act as a foyer, lounge, waiting space, or reception), and are bound on both sides by a wall these are excluded from the nominated area. Where a corridor is part of a shared space, this corridor, or section of a corridor, cannot be excluded and is considered part of the adjacent space.

Tertiary space

All areas which are either transient spaces, or accessed intermittently. Examples of these areas include: back of house areas, corridors, hallways, plant rooms, storage facilities, or similar.

References and Standards Noted in this Credit

American Society of Heating, Refrigerating and Air-conditioning Engineers (ASHRAE) (2010), ASHRAE Standard 55: *Thermal Environmental conditions for Human Occupancy*, Atlanta, www.ashrae.org

Chartered Institution of Building Services Engineers, UK (CIBSE) Applications Manual 10-2005, *Natural Ventilation in Non-Domestic Buildings*

Green Guide for Healthcare (GGHC) (2007), Green Guide for Healthcare Version 2.2, www.gghc.org

International Organisation for Standardisation (ISO) (2005), *ISO 7730:2005 Ergonomics of the thermal environment – Analytical determination and interpretation of thermal comfort using calculation of the PMV and PDD indices and local thermal comfort criteria*, www.iso.org

Wyon, D. (2001), 'Enhancing productivity while reducing energy use in buildings', in *E-Vision 2000: Key issues that will shape our energy future*, Conference Proceedings, Science and Technology Policy Institute, Washington, D.C., June 2000, www.rand.org/scitech/stpi/Evision/Supplement/wyon.pdf

Documentation Requirements

'Design Review' Submission (Optional)

Project teams are to submit information/documentation marked with an asterisk*

As Built Submission

All project teams are to submit the following documentation:

Submission Template*

- *To demonstrate compliance with Acceptability Limits method**
 - A summary of the thermal comfort modelling report or calculations for the space*
 - A description of how the space meets the acceptability limits as per ASHRAE Standard 55-2010*
- *To demonstrate compliance with PMV levels**
 - A summary of the thermal comfort calculations for the project design and demonstrating that the PMV targets are achieved*
 - A description of the methodology, weather data, and software package used for determining the thermal comfort levels*
 - A description of the HVAC system, and including details of temperature, humidity, air rates, infiltration rates, control and zoning strategy*
 - The internal loads used, the usage profiles, the clothing, metabolic rate, and air movement values used, and relevant characteristics of building materials (including U-values)*
 - A summary of the hourly thermal comfort results, mean radiant temperatures, air temperatures and humidity for each zone. The summary must include a tabulation of the hours where the system is within the designed range, and the hours where this is exceeded.
- *To demonstrate NatHERS average heating and cooling load*
 - A summary of modelling outputs demonstrating the NatHERS Star ratings achieved
 - A summary of modelling inputs and assumptions
 - Which compliant software has been used
 - Confirmation that the modelling was undertaken by a HERS Accredited Assessor, in line with all relevant protocols and regulatory requirements
- *To demonstrate compliance with the Individual Comfort Control provisions**
 - A description of either the control strategies or the quantity of openings (and accessibility in relation to the building occupants) in relation to the floor area or workstations*
- *To demonstrate compliance with the Deemed-to-Satisfy criteria**

- Details of all of the HVAC Design and Building Fabric Performance criteria of the Deemed-to-Satisfy approach, and referencing and appending any justification, tender drawings and evidence necessary*
- A summary of how each of the above criteria has been met, referencing supporting information*

Project teams are required to provide documentation supporting credit compliance. The following documents may be used to demonstrate credit compliance:

- **As-built drawings** showing:
 - Façade, roof and, wherever relevant, section drawings showing the materials and their thermal properties in the design.
 - For naturally ventilated spaces, indicating and dimensioning all ventilation openings, inlets and outlets and types of openings.
 - For mechanically air-conditioned spaces, drawings showing:
 - All zones assessed for thermal comfort;
 - The configuration of the HVAC system, location of diffusers and thermostats or other individual control devices and extent of the nominated area that is served by those devices. For the Deemed-to-Satisfy solution, these must be marked up to demonstrate that the mechanical zoning criteria listed have been met.
 - Where local environment controls are present, the location and design of the systems.
- **Modelling reports**
- **Confirmation from the relevant sub-contractors** that all services have been installed and commissioned in line with the listed DTS criteria
- **Extract(s) from the Commissioning report** demonstrating via commissioning results that the building has been commissioned and the installed systems operate as intended by the design.

Please provide feedback on the technical content of this credit:

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