Construction Services

Building standard for mechanical and electrical installations

Design temperatures

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Environment Directorate
Construction Services - Building standard for mechanical and electrical installations

Design temperatures

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1.0 Introduction

1.1 Purpose of document

The purpose of this document is to provide information regarding Cornwall Council’s common standards, policies and requirements for building services to external Framework Consultants, Lead Consultants/Designers, Mechanical and Electrical (M&E) Services Design Engineers, Design and Build Contractors, M&E Contractors, M&E sub-Contractors, Specialists and Suppliers.

This document does not seek to replace industry-standard design guidance or practice. It is intended to provide designers with the Council’s specific standards and requirements, which are to be used as the basis of all building construction.

Although this document describes particular standards it is to be read in conjunction with all other supporting building works project specific requirements and documentation.

External Framework Consultants, Lead Consultants/Designers, M&E Services Design Engineers, Design and Build Contractors, M&E Contractors, M&E sub-Contractors, Specialists and Suppliers will be expected to comply with the following requirements when preparing any schemes for building construction works for all new build, extensions, refurbishment, maintenance and decommissioning works.

1.2 Standards generally

Cornwall Council has a significant property portfolio, which may require new, refurbishment, maintenance or demolition works to be carried out to meet a variety of requirements for various types of end users.

This document describes the employer’s particular requirements for design temperature that M&E consultants/designers will be responsible for completing, for mechanical and electrical services installations to any building construction works.

M&E consultants/designers are advised that any standards set by the client team are intended to assist the design process only and the adequacy or suitability of any information indicated there upon must be confirmed by the consultants.

Modern construction methods offer a wide range of materials and methods to create solutions for buildings. The majority are suitable and work well to provide an appropriate environment for the lifespan of the project and their efficacy can only be judged on a project-by-project basis at the design reviews or during the approval process. However, the following is fundamental issues which should be addressed to ensure that the preferred solution offers compliance to the Council’s expectations.
All works will be expected to meet the requirements of the Construction (Design and Management) Regulations 2007, as well as applicable Health and Safety legislation to execute the works on site.

The installation of a compatible building energy management system, allowing connection to core monitoring will be required. The provision of information technology systems shall comply with the existing policies of the Council.

The choice of materials for building designs, construction, maintenance, refurbishment and decommissioning works, are to be selected with particular reference to their ease of use, frequency of maintenance, ease of upgrading or renewal and their ability to offer future flexibility and adaptability.

Production of appropriate drawings and documentation, identifying and measuring the works to be undertaken are essential to ensure that the Council’s representatives can clearly identify and consider all materials, components and services involved in the project before the works are undertaken.

All materials shall comply with the relevant British and European Standards (BS/BS EN) where applicable and for materials not of UK manufacture, the relevant certificates of compliance will be required. Maximum use is to be made of re-used, re-useable, recycled and recyclable materials or renewable materials from sustainably managed sources in order that any environmental impact is kept to a minimum, with low carbon footprint materials used where practical.

Building construction techniques, material selections, services installations and finishes shall all represent the need to offer good value for money, and offer a solution that provides minimal environmental impact, good life expectancy and low maintenance.

1.3 Deviation from standards

Should designers and/or providers of building construction, maintenance, refurbishment and decommissioning works find it necessary to incorporate alternative standards or requirements to those stated within the following document or any other Council building construction standards then approval shall be sought in writing from the Councils’ Strategy Planning and Standards Manager.

Designers and/or providers of building construction works will be required to justify and demonstrate, with written documentation, that the alternative proposals will provide equivalent or better performance, result in the same or improved whole life costing and be of equal or better value.

2.0 Design temperatures generally

All design temperatures are to comply with the Client’s design brief for the particular use of the area and using the appropriate DfE design guide (for education premises) or The Chartered Institute of Building Services Engineers (CIBSE) design guidance.
The health & wellbeing section of BREEAM, requires thermal comfort levels to be assessed at design stage and this shall be used to evaluate the most appropriate servicing options and that the appropriate thermal comfort levels are achieved.

Advice must be given by the M&E consultants / designers to the design team to modify the design solution where the predicted summer time peak space temperature exceeds the criteria set for the building type.

The mechanical services system design and equipment selection shall achieve the appropriate design conditions required and allowance shall be included within the commissioning period to demonstrate all criteria can be achieved.

3.0 Legislation, regulations and advice documents

Various regulations, codes, standards and guidance on appropriate design temperatures are applicable and these include the following:-

- **BB87**, *Guidelines for environmental design in schools*, DfES 2nd edition (May 2003),
- *The Education (School Premises) Regulations 2012*
- **Building Bulleting 101** (BB101), *Ventilation of School Buildings*
- The Building Regulations, **Approved documents L2**, *Conservation of fuel and power*
- **CIBSE TM37** *Design for improved solar shading control*
- *The Workplace (Health, Safety and Welfare) Regulations 1992*
- **BS EN ISO 7730** *Ergonomics of the thermal environment. Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria*
- **BS EN ISO 10551:2001** *Ergonomics of the thermal environment. Assessment of the influence of the thermal environment using subjective judgement scales*

4.0 Design development for the heating system

The M&E consultants/designers shall submit proposed design margins for all elements of design and equipment selection, in order to establish the parameters for the internal heating loads due to use, to the relevant Cornwall Council representative at the appropriate design review stage. Clearly stating in the submitted calculations, all design margins allowed for in the development of the design, with supporting justification.

Advice must be given by the M&E consultant /designer to the Design Team to modify the design solution where the predicted summer time peak space temperature exceeds the criteria set for the building type, overheating criteria.

During the course of the design work consultants/designers will be expected to undertake risk assessments regarding such things as safe surface temperatures, safe water temperatures, etc. If he/she is unsure or has
doubt about a particular aspect of this he should seek clarification from the relevant Cornwall Council representative

5.0 Design temperatures

5.1 Design temperatures for offices and other workplaces

There is no statutory limit to the upper temperature in workplaces. The Workplace (Health, Safety and Welfare) Regulations 1992 only requires that: “During working hours, the temperature in all workplaces inside the building shall be reasonable.”

The law does not state a minimum temperature, but the temperature in workrooms should normally be at least 16°C, unless much of the work involves severe physical effort in which case the temperature should be at least 13°C.

CIBSE recommends the following temperatures for different working areas:

- Heavy work in factories: 13°C
- Light work in factories: 16°C
- Hospital wards and shops: 18°C
- Offices and dining rooms: 20°C

These temperatures may not, however, ensure reasonable comfort, depending on other factors such as air movement and relative humidity.

Where the temperature in a workroom would otherwise be uncomfortably high, for example because of hot processes or the design of an existing building, all reasonable steps should be taken to achieve a reasonably comfortable temperature, for example by:

- Insulating hot plants or pipes
- Shading windows
- Siting workstations away from places subject to solar gain
- Providing air-cooling plant (least preferred option)

Section 1 (Environmental criteria for design) of CIBSE Guide A: Environmental design, suggests for offices that the temperature range for comfort should be 21-23°C in winter and 22-24°C in summer. The latter range applies to air conditioned buildings.

Health and Safety regulations state that ‘thermometers should be available at a convenient distance from every part of the workplace to persons at work to enable temperatures to be measured throughout the workplace, but need not be provided in each workroom.’

5.2 Design temperatures for education establishments

Uncomfortably high temperatures can hinder effective teaching and learning and affect health, safety and welfare. Reference should be made to BB101
**Ventilation of School Buildings**, overheating criteria for teaching spaces, which requires the calculation to assume year-round occupancy.

Prediction of overheating in classrooms must be undertaken using software utilising an approved Test Reference Year.

Advice must be given to the design team to modify the design solution where the predicted summer time peak space temperature exceeds the criteria, with particular reference to **BB101 Ventilation of School Buildings**, overheating criteria.

All room design temperatures are to comply with the Council’s standard Room Data Sheets for room types in Primary Schools, Secondary Schools and Area Resource Bases. The appropriate DfE design guide or CIBSE design guidance shall be used for temperatures to other areas.

Areas where there is the normal level of physical activity associated with teaching, private study or examinations, the heating shall be capable of maintaining the air temperature at 18°C at a height of 0.5m above floor level when the external air temperature is –1°C.

For areas where there is a higher than normal level of physical activity, washrooms and circulation spaces, the heating shall be capable of maintaining the air temperature at 15°C at a height of 0.5m above floor level when the external air temperature is –1°C.

For areas where there is a lower than normal level of physical activity, because of sickness or physical disability including sick rooms and isolation rooms but not other sleeping accommodation, the heating shall be capable of maintaining the air temperature at 21°C at a height of 0.5m above floor level when the external air temperature is –1°C.

Excessive vertical temperature gradients should be avoided and the temperature at 2000mm shall not exceed that at floor level by more than 3°C.

If an area of a School is occupied, has a heating system, and it is colder than the temperature appropriate to its normal use then it must be brought up to the temperature appropriate to its normal use, and for as long as it is being used for its normal use.

### 6.0 Mechanical Design criteria for the heating system

The mechanical services system design and equipment selection shall achieve the appropriate design conditions as scheduled below. Due allowance shall be included within the commissioning period to demonstrate all criteria can be achieved.
6.1 External design conditions

Summer: 25°C db
Winter: +1°C
Saturated Values referenced in the CIBSE Guide A, Environmental design.

6.2 Internal design conditions

Note that the internal design conditions for every room shall be taken from the room data sheets, but generic conditions are shown here in general terms to provide an indication. Note that the room data sheets take precedent in all cases.

Below is example design criteria for typical space types, refer to the room data sheets where available for design criteria in all cases:

6.3 Naturally Ventilated Spaces with uncontrolled humidity

All
• Minimum occupied hours temperature = 18°C
• Maximum occupied hours temperature = in accordance with the overheating criteria

6.4 Mechanically Ventilated Spaces with uncontrolled humidity

Offices and Teaching Spaces
• Minimum occupied hours temperature = 18°C
• Maximum occupied hours temperature = 27°C

Circulation Space
• Minimum occupied hours temperature = 16°C
• Maximum occupied hours temperature = not controlled

Toilets
• Minimum occupied hours temperature = 16°C
• Maximum occupied hours temperature = not controlled

7.0 Temperatures and overheating

Temperatures should feel “comfortable” to occupants, and although the heating system may be controlled via the building energy management system, M&E consultants/designers should strive to make reasonable provision of local controls, balancing the benefits to the occupants with the risk of vandalism, tampering and misuse by unauthorised persons. When provided, this limited local control should allow occupants to vary their local conditions by approximately 1-2°C
Engineering control should be the first choice to control temperature. Although the initial cost of engineering controls seems high, it has been found that the implementation cost is often offset by the resulting improvements to production and decrease in downtime, with reduced absenteeism and improved motivation.

It is important to stress that any practical solution to controlling thermal comfort is likely to require a combination of different options alongside consultation between employers, employees and their representatives.

The following design criteria highlights the requirements for heating and avoidance of summertime overheating and is based on advice in Building Regulations and Building Bulletins and does not require anything in excess of these requirements.

### 8.0 Control of summertime heating in buildings

To control summertime overheating in offices, designers should refer to The Building Regulations, Approved documents L2A, Conservation of fuel and power and calculation method shown in CIBSE TM37 Design for improved solar shading control.

Provisions should be made to limit solar gains. In buildings other than schools, reasonable provision would be to:

- Limit solar and internal casual gains to 35 W/m² or
- Demonstrate that internal temperatures do not exceed 28°C for more than a reasonable number of hours (e.g. 20 hrs/annum for offices).

To control summer overheating in schools, consultants/designers should refer to guidance in section 8 of BB101.

Only one of the following parameters can be exceeded:

- There should be no more than 120 hours when the temperature in the classroom rises above 28°C
- The average internal to external temperature difference should not exceed 5°C (i.e. the internal temperature should be no more than 5°C above the external temperature on average)
- The internal temperature

Design and engineering controls and solar shading (see also CC briefing document “Solar gains and shading to avoid air-conditioning”) should be the first choice to control overheating temperatures. In existing buildings the following alternative methods may have be considered to reduce overheating, provided only after approval in writing from the relevant Council representative.
8.1 Air movement

Large diameter fans suspended from the ceiling can provide a swirling air movement that is effective over a wide area. Exhaust fans, mounted in the roofs and walls, are useful for removing heated air; however, while improving general air movement, they may have little effect on thermal comfort and also impact on the energy performance and consumption.

8.2 Air conditioning

The Council does not promote the use of air-conditioning. The Council’s policy states that the Council will provide ventilation within buildings by natural means under the control of the building occupants, unless exceptional circumstances exist.

Air conditioning units can range from small units, which lower the air temperature but do not control humidity levels or air movement, to large units that can cope with extreme conditions as well as humidity and air movement.

When air conditioning systems are used, care should be taken to ensure uniform air distribution throughout the workplace, otherwise some workers may complain of feeling cold while others are feeling hot and should be operated as per the manufacturer’s instructions.

8.3 Evaporative cooling

Evaporative coolers produce a moderate reduction in air temperature and increase humidity. They operate by passing hot air over water-saturated pads and the water evaporation effect reduces the air temperature.

8.4 Thermal insulation

There are many different types of thermal insulation materials, e.g. loose fills, rock wool and boards. The material acts as a barrier, which slows heat flow in the summer and heat loss in the winter, but it is only effective where there is a temperature difference between the inside and the outside of the building or between two areas inside a building.

9.0 Design temperatures completion and handover of the heating system

For each room type, M&E consultants / designers must provide the detailed information for inclusion in The Building Log Book for:-

Winter:-

- Reducing space temperature, both centrally and locally
- Increasing space temperature, both centrally and locally
Summer:-

- If provided, decreasing night cooling provision if the rooms are over-cooled by morning;
- Reducing space temperatures if possible, given the outside conditions. The designers should provide guidance to the occupants regarding the use of their ventilation strategy to alter the temperatures and/or increase air movement for comfort when needed.

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