PREVENTING CONDENSATION ON DUCTS AND AIR HANDLING PLANT

INTRODUCTION

Condensation on mechanical ducts and plant can lead to corrosion, damage to building materials and microbial growth. This TECHnote deals with the use of insulation to prevent condensation on ducts and air handling plant.

BASIC PRINCIPLES

The risk of condensation is greatest when the air adjacent to the duct has a combination of high dew point temperature (i.e. it is close to saturation) and relatively low dry bulb temperature.

Cooling load outside design data, intended for air conditioning load calculations may underestimate condensation risk as it does not reflect this high dew point temperature and relatively low dry bulb combination. The Monthly Design Wet Bulb and Mean Coincident Dry Bulb Temperature data published with ASHRAE *Handbook - Fundamentals* for the project location may be used for condensation calculations.

DUCTS

BCA (2022) Volume One J6D6 mandates duct insulation R-Values for air conditioning ducts in the range of 1.2 to 3.0. The NCC R-Values appear to be based on heat loss only and not intended to prevent condensation.

Even in temperate climates, there is a risk of condensation with the R-Values mandated by NCC. The risk can be checked using common techniques for calculating the temperature profile through composite construction (e.g. ASHRAE, AIRAH, CIBSE).

AIR HANDLING PLANT

Condensation risk for air handling plant can be calculated in the same way as for ducts, but an alternative approach for air handling plant is available in EN 1886 This deals with condensation on mechanical plant by defining a thermal bridging factor K_b that considers the effect of stiffeners and metal joints etc. K_b is defined as:

$$K_b = (T_o - t_i) / (t_o - t_i)$$

Where:

T_o = plant external surface temperature.

t_o = mean external air temperature. (Normally ambient dry bulb but may be higher in some situations like unventilated roof top plant rooms).

t_i = plant mean internal temperature.

For no condensation to occur, T_o must be higher than the ambient dew point. Some forms of construction, notably sandwich panels, have difficulty achieving this either because the insulation thickness (usually 25 mm) is not sufficient or because of cold bridging through the aluminium extrusions joining the panels.

The advantage of specifying the thermal bridging factor K_b is that it relates to the whole assembly, not just the insulation. The required minimum K_b can be calculated using the plant supply air temperature for t_i and suitable climatic data such as that from ASHRAE *Handbook - Fundamentals*.

If specifying K_b, the insulation thickness and R-Value are not required, as they are included in the calculation of K_b.

CONCLUSION

- Normal air conditioning load design conditions should not be used to calculate condensation risk.

0744 Ductwork insulation specifies minimum R-Values to BCA (2022) Volume One J6D6. Check NCC minimum insulation total R-Values for the risk of condensation, even for temperate locations. If higher R-Values are required they can be specified in **SELECTIONS** in *0744 Ductwork insulation*.

- For condensation sensitive situations, air handling unit thermal performance can be specified using K_b to EN 1886 in **SELECTIONS** in *0724 Air handling plant - combined, 0725 Air handling plant - built-up, 0726 Air handling plant - minor* and *0727 Air handling plant - packaged.*

Relevant standards

EN 1886 *Ventilation for buildings. Air handling units. Mechanical performance.*

Relevant documents

AIRAH DA09 *Air conditioning load estimation and psychrometrics,* The Australian Institute of Refrigeration, Air Conditioning and Heating. www.airah.org.au

ASHRAE *handbook - Fundamentals,* American Society of Heating, Refrigerating and Air-Conditioning Engineers. www.ashrae.org

BCA J6D6 *Energy efficiency - Air-conditioning and ventilation - Ductwork insulation.*

CIBSE Guide A*: Environmental Design.*

NATSPEC TECHnote DES 004 *Air, moisture and condensation.*

Relevant worksections

0702 Mechanical design and install

0721 Packaged air conditioning

0724 Air handling plant - combined

0725 Air handling plant - built-up

0726 Air handling plant - minor

0727 Air handling plant - packaged

0744 Ductwork insulation