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Hydronic Fan Coils coupled with air terminal devices (ATD) form the basis of one of the most popular systems for conditioning a space.

The correct selection of both items will ensure that optimum performance in terms of comfort and energy efficiency in the workspace occupied zone while maintaining a good balance between temperature control and air quality leading to consistent occupant productivity.

Let's assume the horizontal hydronic FCU is located within a ceiling void discharging air at high level.

The temperature difference ( $\Delta T$ ) between the air leaving the fan coil unit / air terminal unit and the room needs to be considered with respect to ATD selection and good air distribution. At RIBA stages 1 and 2; 6 or 7K may be used for FCU / ATD sizing. As the design progresses,  $\Delta T$  increases and FCU / ATD size reduces. In addition, the available choice of ATD reduces, primarily focussing on high induction designs. At RIBA stage 4 a maximum  $\Delta T$  of 10K for cooling and up to 15K for heating are usually specified.

Rearranging the specific cooling formula  $Q = \dot{V} \times \rho \times C_p \times \Delta T$ , we can calculate  $\Delta T$  from sensible cooling and volume flow rate

- $Q$  = Cooling capacity (e.g., in Watts or kW).
- $\dot{V}$  = Volume flow rate of the fluid (e.g., m<sup>3</sup>/s).
- $\rho$  = Density of the fluid (e.g., kg/m<sup>3</sup>).
- $C_p$  = Specific heat capacity of the fluid (e.g., kJ/kg·K).
- $\Delta T$  = Temperature difference between the fluid inlet and outlet ( $T_{in} - T_{out}$ ), converted to Kelvin.

$$\Delta T = Q / \dot{V} \times \rho \times C_p \quad 8K = 2 \text{ kW} / 0.204 \text{ m}^3/\text{s} \times 1.02 \times 1.2 \quad 10K = 2 \text{ kW} / 0.163 \text{ m}^3/\text{s} \times 1.02 \times 1.2$$

For heating mode, the temperature differential should be 8 to 10K (max 33 °C discharge temperature) to avoid warm air stratifying at high level and not entering the occupied zone. At high  $\Delta T$ , or dependent upon room height or application, variable geometry diffusers that can switch between horizontal (cooling) and vertical (heating) discharge patterns may be required

If we now, consider the ATD; HEVAC ADM group recommends that the cooling temperature differential between the room air temperature and the discharge air temperature from the discharge ceiling diffuser be in the range 8 – 12 K. This helps promote Coanda effect across the ceiling and minimises the potential for 'dumping' of cold air from the supply diffusers which would result in poor air distribution & complaints.

ISO7730 Economics of the thermal environment should be considered at the design stage. For a typical office category C should be the target for mixed airflow to avoid dissatisfied occupants and less complaints when the building is occupied.

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Table 1 gives typical air change rates, and air flow rates per square metre of floor area for different grille types and should be taken as a general guide

Class of ATD	Air change rate per hour	Air flow rate (litres/sec m <sup>2</sup> floor area)	
		3.6 x 3.6 x 2.5m high	7.2 x 3.6 x 3.5m high
Grilles	8	5.6	8
Linear Grilles	10	7	10
Slot and Linear Diffusers	15	10.5	15
Rectangular Diffusers	15	10.5	15
Perforated Diffusers	15	10.5	15
Circular Diffusers	20	14	20
Swirl Diffusers	20-30	14-21	20-30

Table 1: General guide for mixed flow (courtesy of HEVAC Air Distribution Group.)

Leaving air temperature expressed in °C dry bulb (db) of 14 °C db from the fan coil unit is often chosen but other temperatures can be specified. The main reason for 14 °C is to reduce the possibility of moisture condensing in the supply duct and on the discharge diffuser.

External air resistance, it is current good practice to allow 30 Pa external static pressure for ductwork resistance and the filter getting dirty.

Use the maximum number of discharge outlets possible to reduce air resistance over the unit and thereby reduce fan noise

Return air grilles should not be positioned directly under the inlet of the fan coil units but located some distance away

Let's assume the horizontal hydronic FCU is located within a floor void discharging air at low level.

Leaving air temperature expressed in °C dry bulb (db) of > 17 °C db from the fan coil unit is often chosen but higher temperatures can be specified. The main reason for 17 °C is to reduce the draughts, thermal gradient, etc.

By combining these **hydronic fan coil optimization techniques** with a **well-planned air distribution strategy** for the office grilles, you'll maximize comfort and energy efficiency in the workspace while maintaining a good balance between temperature control and air quality.

The documents referenced below will give further information.

As further guidance becomes available, this document will be revised.



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References

- i – Guide to Air Distribution technology for the Internal Environment Issus 2 March 2015.
- ii - TFS\_017 How to get the best out of fan coils.