



Considerations for Active Chilled Beam Designs

Defining Zones and Air Handler Strategy

Before starting the Active Chilled Beam design, obvious project parameters must first be established.

Determine the design Room Conditions (typically 23 or 24°C, 45-50% relative humidity)

Determine the design Ventilation Strategy (BCA Code Compliance, AS1668.2, GBCA Green Star guidelines or other design considerations). This guidance on outside air quantity can be used later to assist in determining target minimum primary air requirements.

Cooling & Heating Loads

Complete Cooling/Heating Load Calculations (Total & Sensible loads) as you would do for any system design. Nominate loads as Adjusted Sensible Cooling Loads or cooling loads EXCLUDING outside air and return air duct heat gains.

Reason: Active Chilled Beams are terminal devices and should be selected only for the terminal loads in the room they will serve. The primary air handler will deal with all outside air loads separate to the room loads.

How should the zones be separated for the purpose of applying Active Chilled Beams?

Perimeter spaces will likely have higher sensible loads per m² than internal zones. Therefore, it is sensible to define the perimeter zones as being 3.6 – 4.0 meters deep from the façade and treat anything further in from the façade as an internal zone.

In this way, the designer can avoid over-sizing ACB's for the internal zone component of a large zone while inadvertently under-sizing the ACB units actually installed closest to the façade where the loads are greatest. Keep the zones separated for design purposes even if the zones are not actually separated by walls.

What is the best primary air handler layout or strategy?

The ideal primary air strategy would have one primary air handler for each exposed façade of the building and a separate primary air handler or multiple air handlers for internal zones.

Very simply, where different facades or zones are likely to see differing conditions or experience coincidental heating & cooling calls, it is difficult and energy inefficient to try to deliver these different performance parameters from a single primary air condition or unit.

If required, allow primary air zones of similar loads and diversity profile to be served by the same air handler.

Internal zones are often in cooling mode regardless of what is being experienced at the perimeter. Therefore, it is difficult to ensure adequate cooling performance in the internal zones where the primary air condition is being controlled by perimeter zones in heating mode and even more difficult to ensure heating at the perimeter where primary air is controlled by an internal zone in the cooling mode.

Keep the internal zone primary air control separate from the perimeter zone primary air where possible

What can be done where different zones or floors from the same primary air handler require different heating capacities or primary air quantities?

There are simple ways to solve this problem if all zones do not coincidentally dictate the same primary air temperature or quantity for heating. Design the primary air heating temperature at the AHU to be the lower of the required temperatures for all zones on the AHU and use localised trim hot water heating at the zone branch requiring a higher primary air temperature.

This requires hot water to be available on the floor and an additional control point but eliminates the possible scenario of using secondary chilled water cooling in the ACB to overcome excessive heating capacity delivered by too warm a primary air temperature.

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Considerations for Active Chilled Beam Designs

What can be done where different zones or floors from the same primary air handler require different heating capacities or primary air quantities? (Continued)

There are some less efficient alternatives for controlling over-heating where one primary air temperature is used for different zones requiring differing primary air heating temperatures.

a) Consider using the higher of the required primary air temperatures for all zones and use secondary chilled water to 're-cool' the zones where lower primary air temperatures would have been preferred. For more detail on this scenario see Design Bulletin 7.

NOTE: This scenario must be used carefully to avoid complications where some zones may enter coincidental heating/cooling call and create conflicts with other zones.

b) If heating requirement is high enough Consider using thermally neutral primary air and heating secondary water through either a 2-pipe changeover system of 4-pipe ACB units to achieve higher heating capacities. For more detail on these scenarios see Design Bulletin 5—Heating.

How do I determine how many ACB units should be used in a typical space?

Conducting trials with a reasonable layout to the reflected ceiling plan is best, but is not always possible.

A simple method is to establish how the space will be used and controlled. i.e.

Perimeter Zones:

Assume the perimeter zone is to eventually be churned out into small offices of roughly 13m² each. Therefore it is fair to assume that 13m² is a reasonable denominator for a layout and dividing the perimeter floor perimeter area by 13 should suggest a reasonable number of units for starting the design.

or,

Examine the construction grid of the building to determine what the typical construction bays look like (usually 7.5 – 8.6 meters of façade length per construction bay). Assume each uniform construction bay will have 3 or 4 ACB units in it and then multiply the number of construction bays by 3 or 4 to determine a starting quantity of ACB units for the perimeter.

or,

Where the final perimeter fitout design is known, review how the spaces will be used against the control strategy and select ACB units to suit the individual spaces along the perimeter.

Internal Zones:

For base building or open plan offices, assume the internal zones are to be controlled in 80-100m² of floor area per control zone depending on the control strategy and zone sizes of how the building is to be used on completion. If the internal zone ventilation strategy is 2 L/s/m², this suggests 160-200 L/s of primary air per internal zone control area. The number of control zones per floor will then give an indication of the total primary air requirement per typical floor.

Since 35-40 L/s of primary air is a reasonable design value for a 600x1200mm ACB unit, and should result in a sensible capacity selection reasonably well suited to larger internal zone loads, the size of the internal zone can be divided by the target primary air quantity of 35-40 L/s to roughly determine the number of units required where the internal zone is to be delivered with all outside air as primary air.

$$\frac{\text{Internal Zone Area (m}^2\text{)} \times \text{Ventilation Strategy (L/s/m}^2\text{)}}{35\text{-}40 \text{ L/s per ACB unit}} = \text{Number of Internal Zone Units per Zone}$$

Ideally, each ACB unit would serve approximately 20-25m² of floor area if internal zone sensible loads are less than 60 W/m².

Taking this as an assumption, trial the layout of ACB's to the internal zone spaces to see if this is a reasonable fit before defining the final number of units.

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For more design considerations, see other issues of the Design Bulletin

