



Innovative Climate Control Solutions

Andrew Bagnall
Leader –Building Engineering



ACCOMPLISH **MORE** TOGETHER



2007 – Green Building Concept of the Future?

- Net zero annual external energy consumption = net zero CO₂ production
- High performance building envelope
- Energy efficient HVAC design
- Mixed mode operation
- Solar hot water
- Micro wind
- Photovoltaic cells

ZERO



United Nations 'Green' One UN House' Hanoi, Vietnam

2011 – Green Building Reality!

Pilot for LOTUS Rating scheme for commercial building (5 Star equivalent)
Greenest building in Vietnam?
114kW solar installation



Design or sustainability?

Junee Library

Night Sky Cooling System

Details

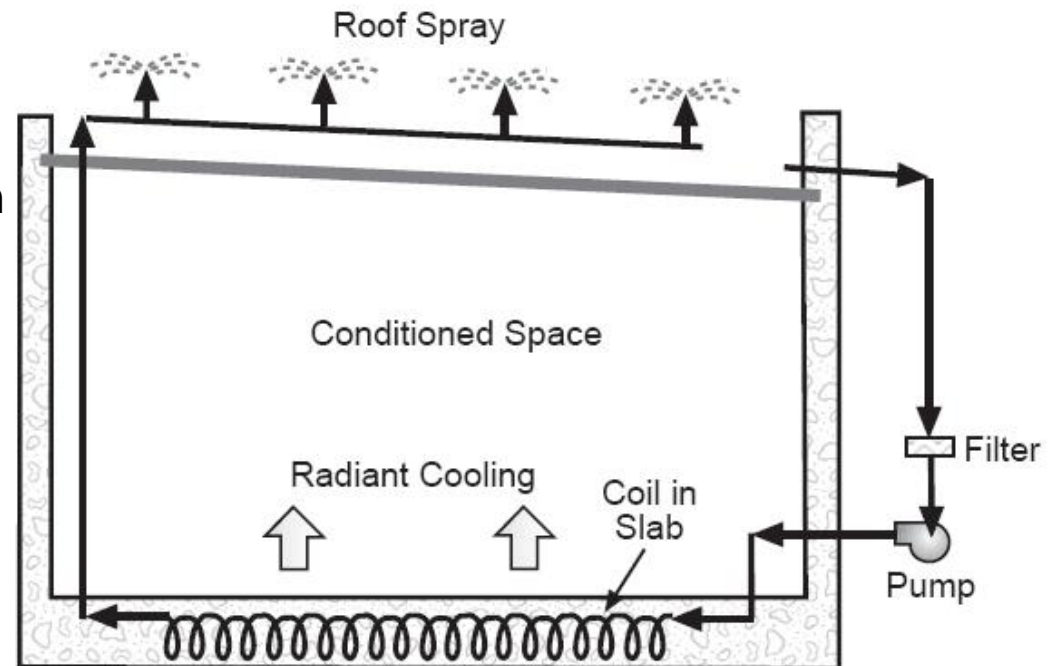
Location	Junee
Typology	Library
Size	700 m ²
Construction	2009



Junee Library

Night Sky Cooling System

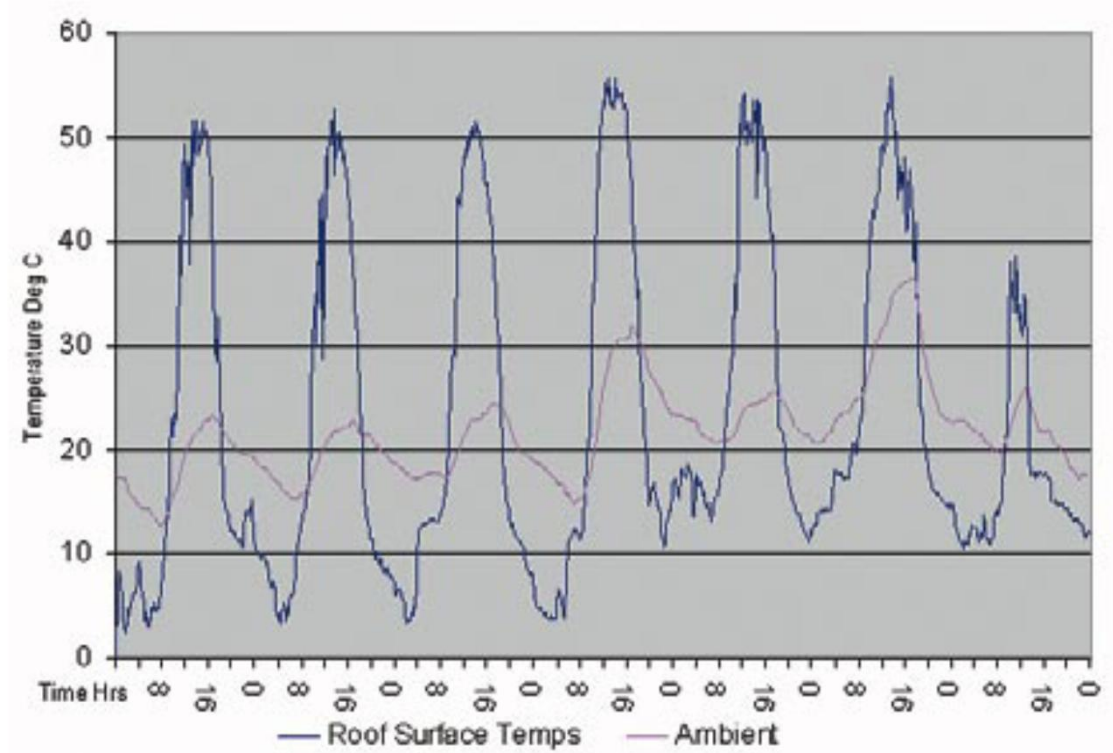
- Utilises the 'heat sink' effect of a clear night sky.
- Passively cools water by spraying on the roof surface at night.
- Can be coupled to an in-slab hydronic system to provide thermal storage



Junee Library

Night Sky Cooling System

- Effective night sky temp typically 10-12°C cooler than ambient.



Junee Library

Night Sky Cooling System

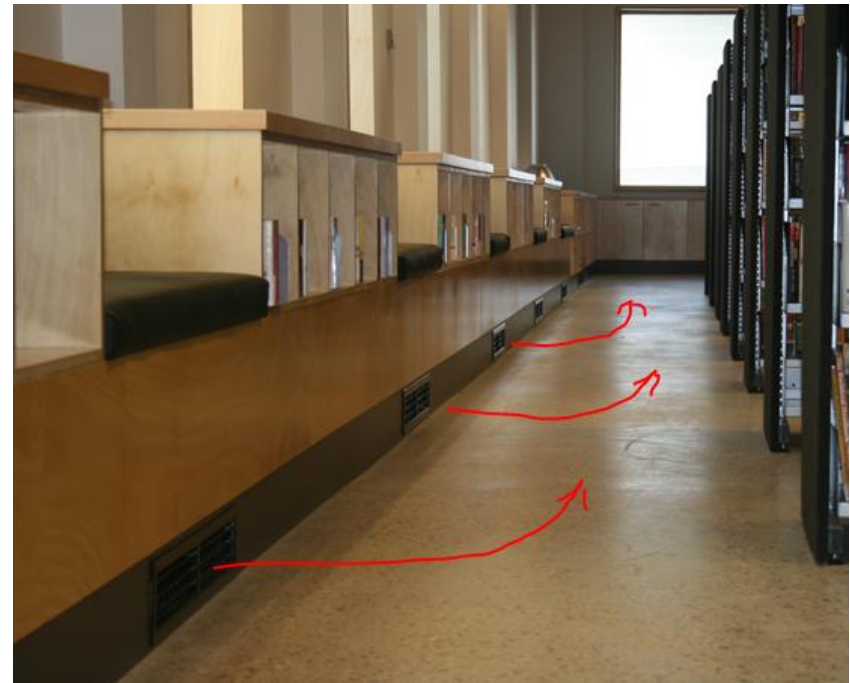
- Roof sprays operate between midnight and 6am.
- Turns off during rain and diverts to rainwater storage tanks.



Junee Library

Night Sky Cooling System

- Cooling delivered via in slab hydronic coils, and low level displacement grilles



Caroline Chisholm Centre

Solar Heating, Earth Pipe Cooling

Details

Location	Mount Druitt
Typology	Community Centre
Size	700 m ²
Construction	2009



Design or sustainability?

Caroline Chisholm Centre

Solar Heating, Earth Pipe Cooling

- Ventilation delivered via 300dia stormwater pipes 2m underground
- Stable ground temps of 15-18°C
- Tempering effect on incoming outside air.
- Delivered via floor grills in polished concrete slab.



Orange TAFE

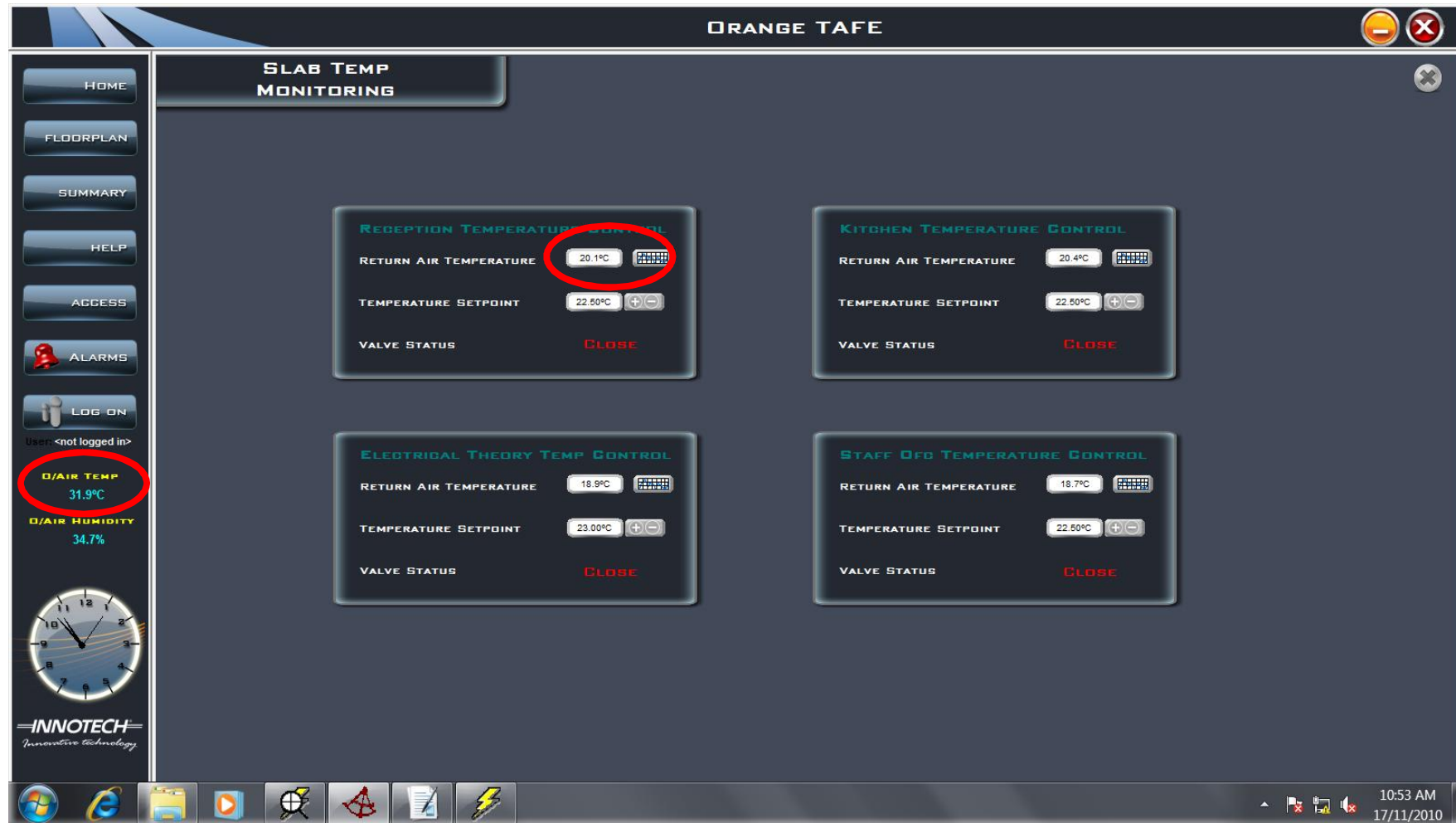
Earth Pipe Cooling - Results



Design or sustainability?

Orange TAFE

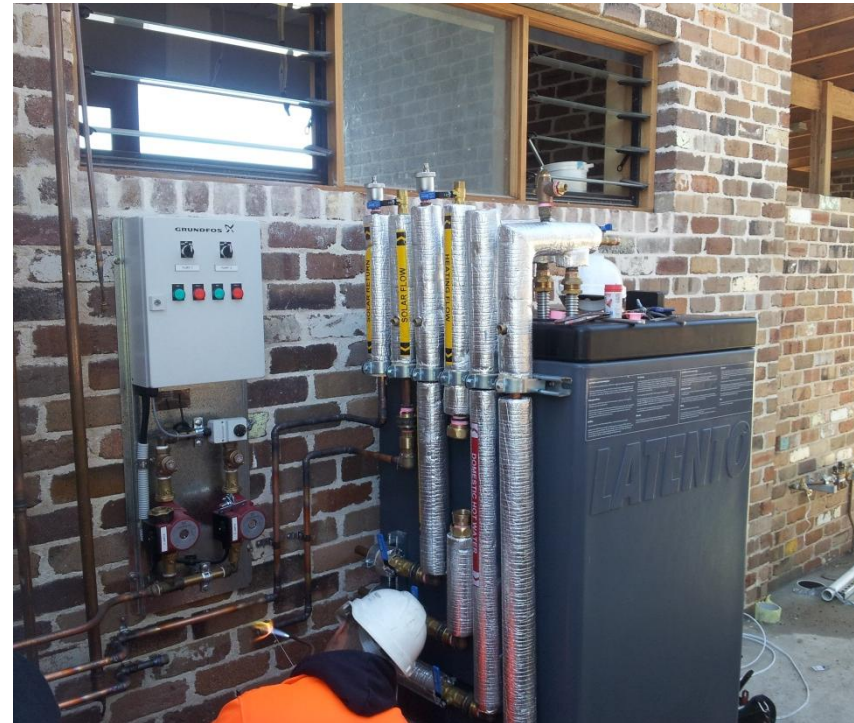
Earth Pipe Cooling - Results



Design or sustainability?

Caroline Chisholm Centre

Solar hot water and space heating



Yarra Valley Water HQ

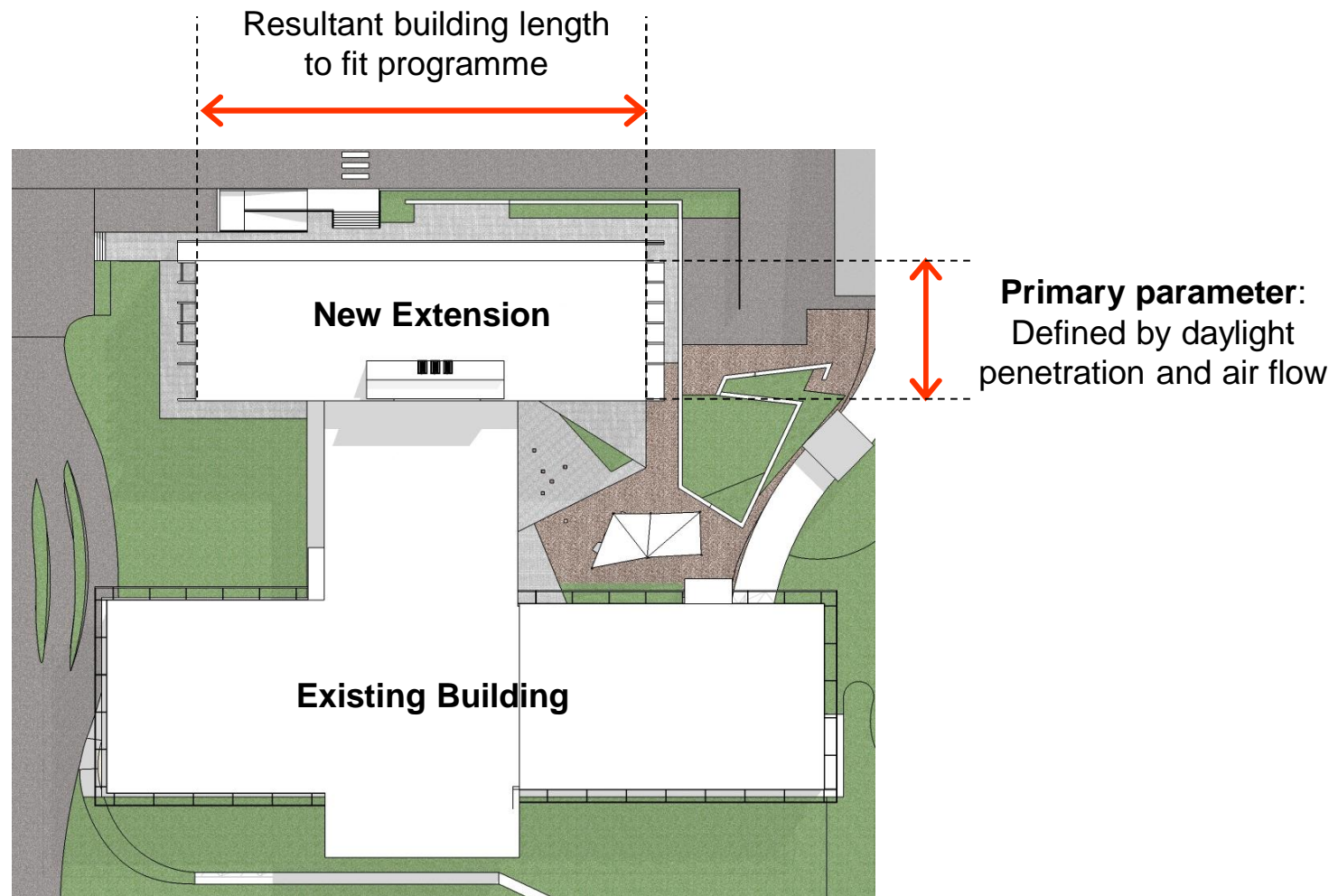
New Office Extension, Mitcham

Details	
Location	Melbourne
Typology	Office
Size	2000 m ²
Construction	2011



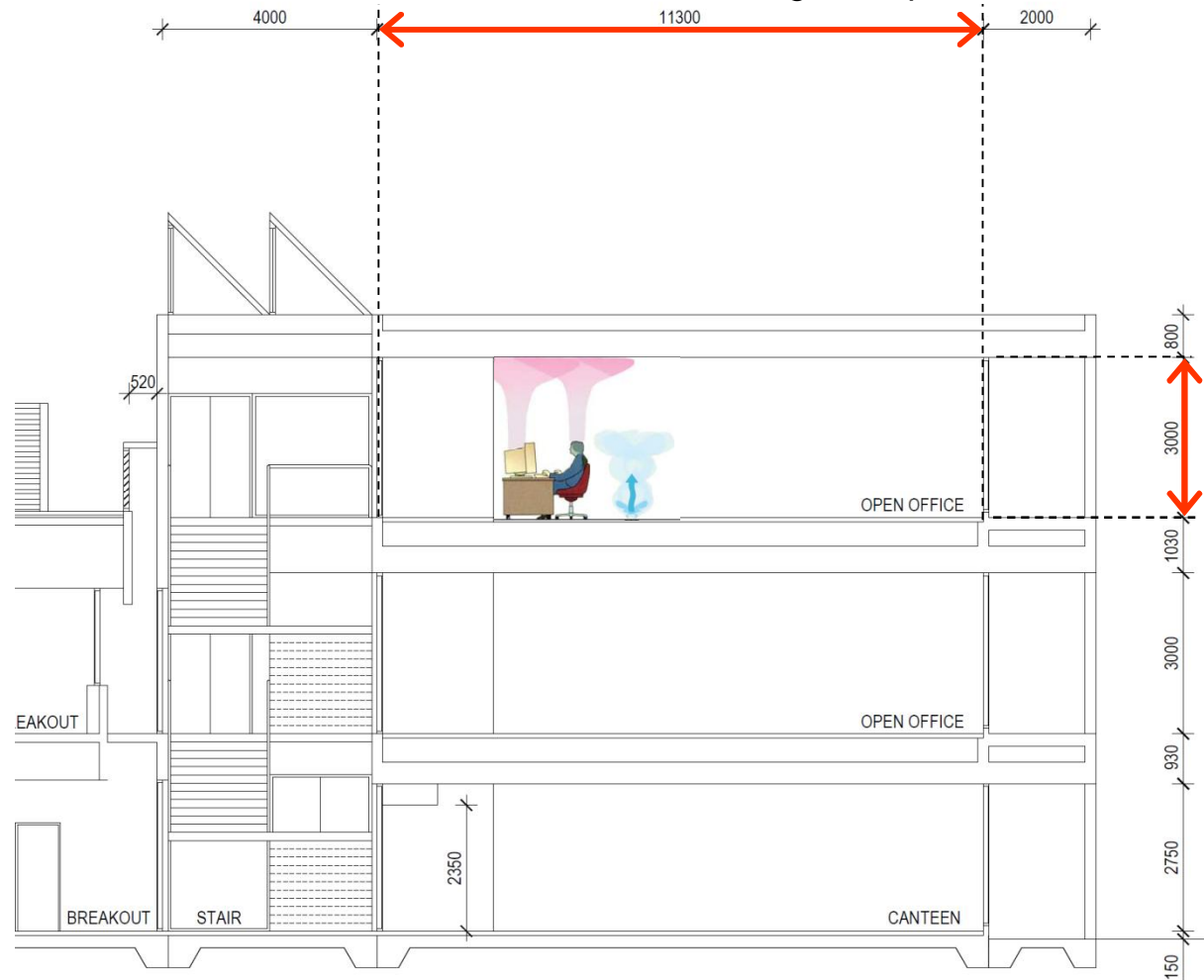
Design or sustainability?

Form



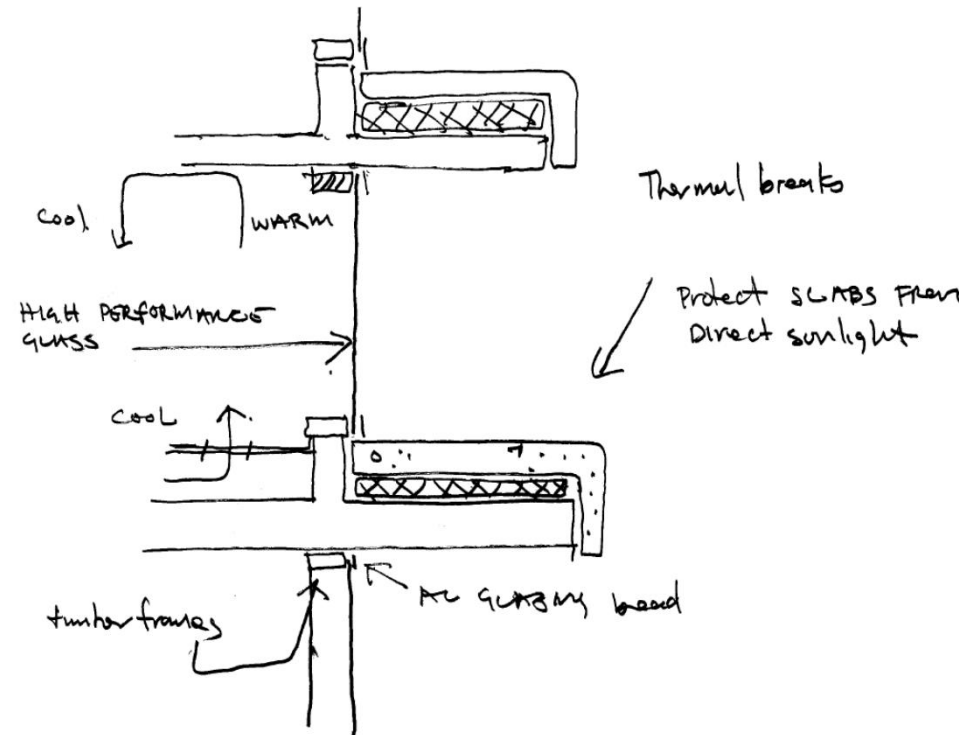
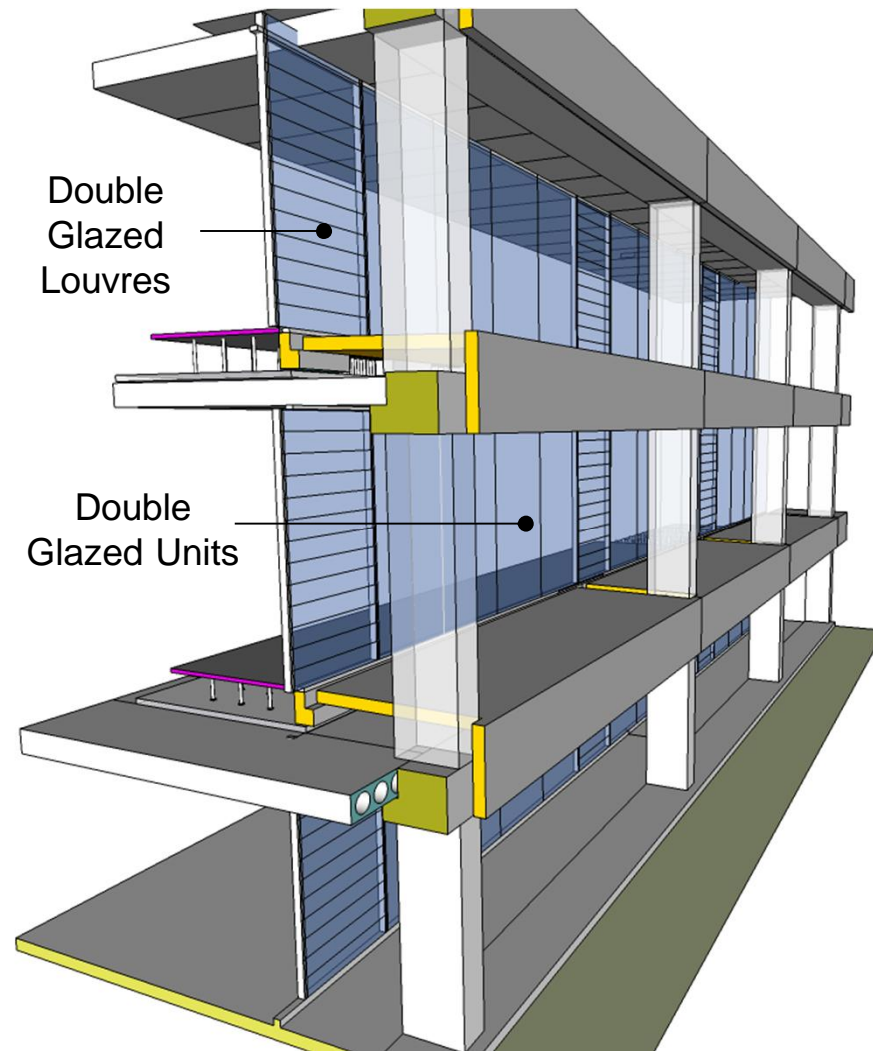
Form: Air

2. Maximum allowable for double sided ventilation is 5 times height of space

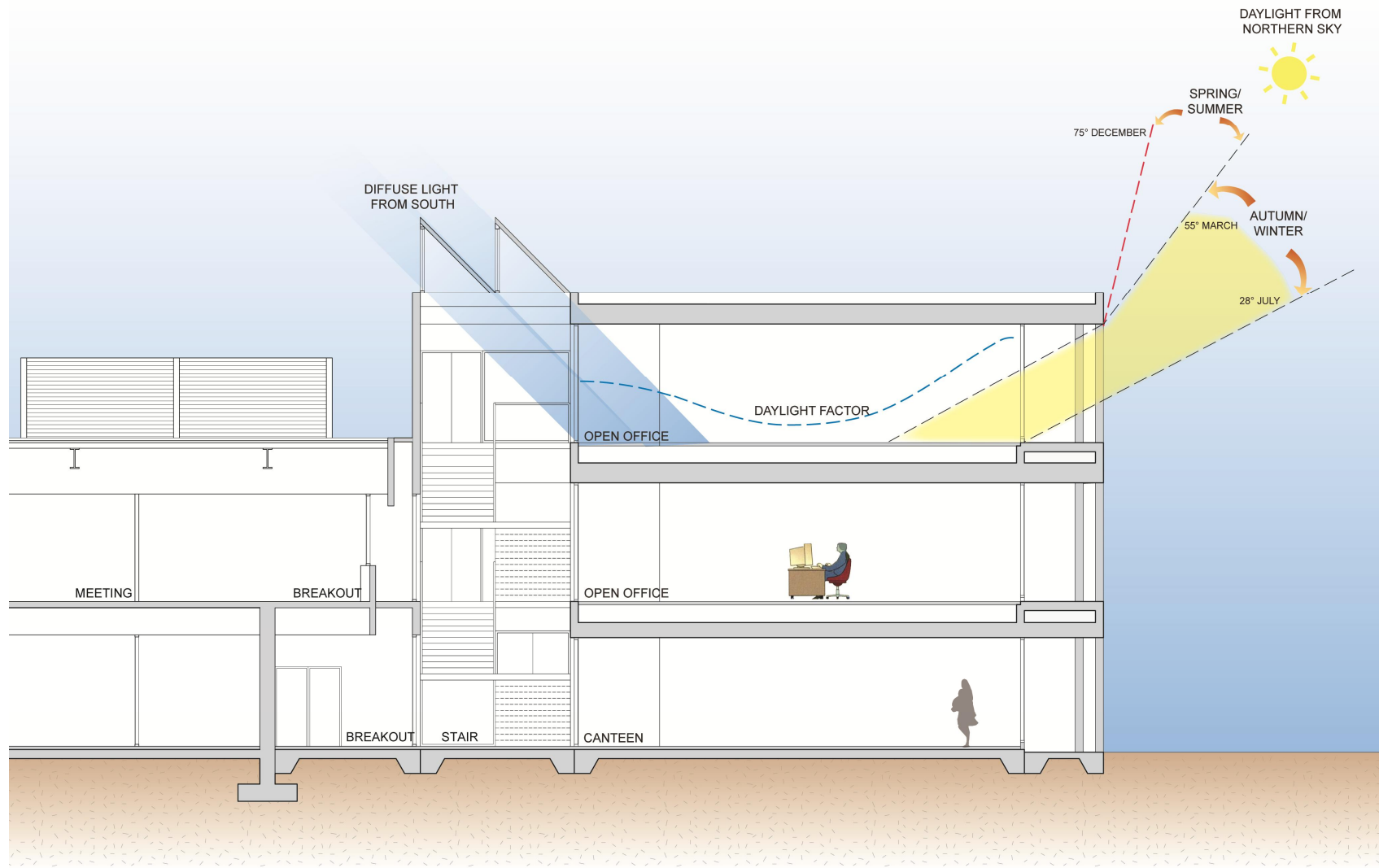


1. Minimum height defined by displacement ventilation performance

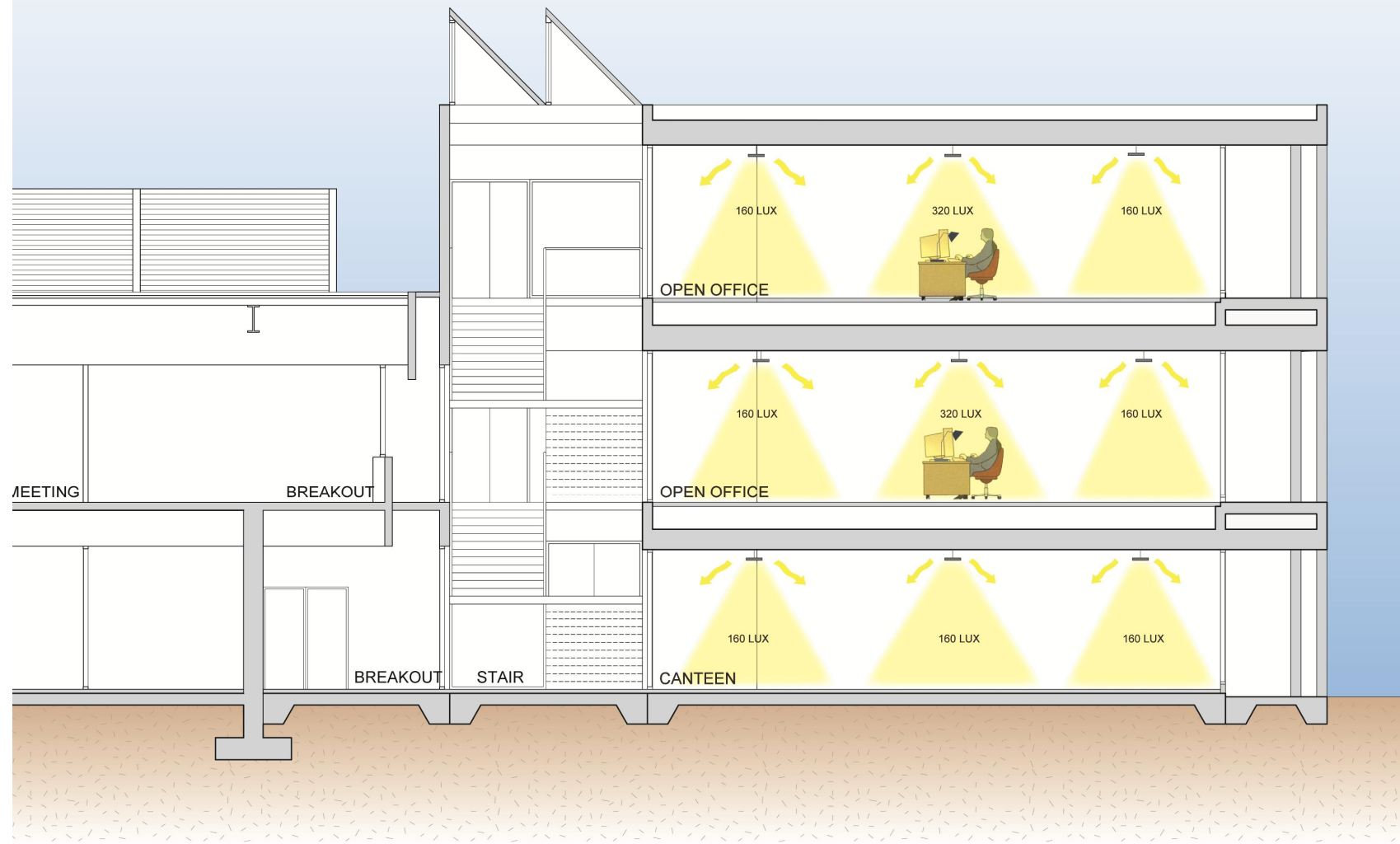
Skin: Multi-modal



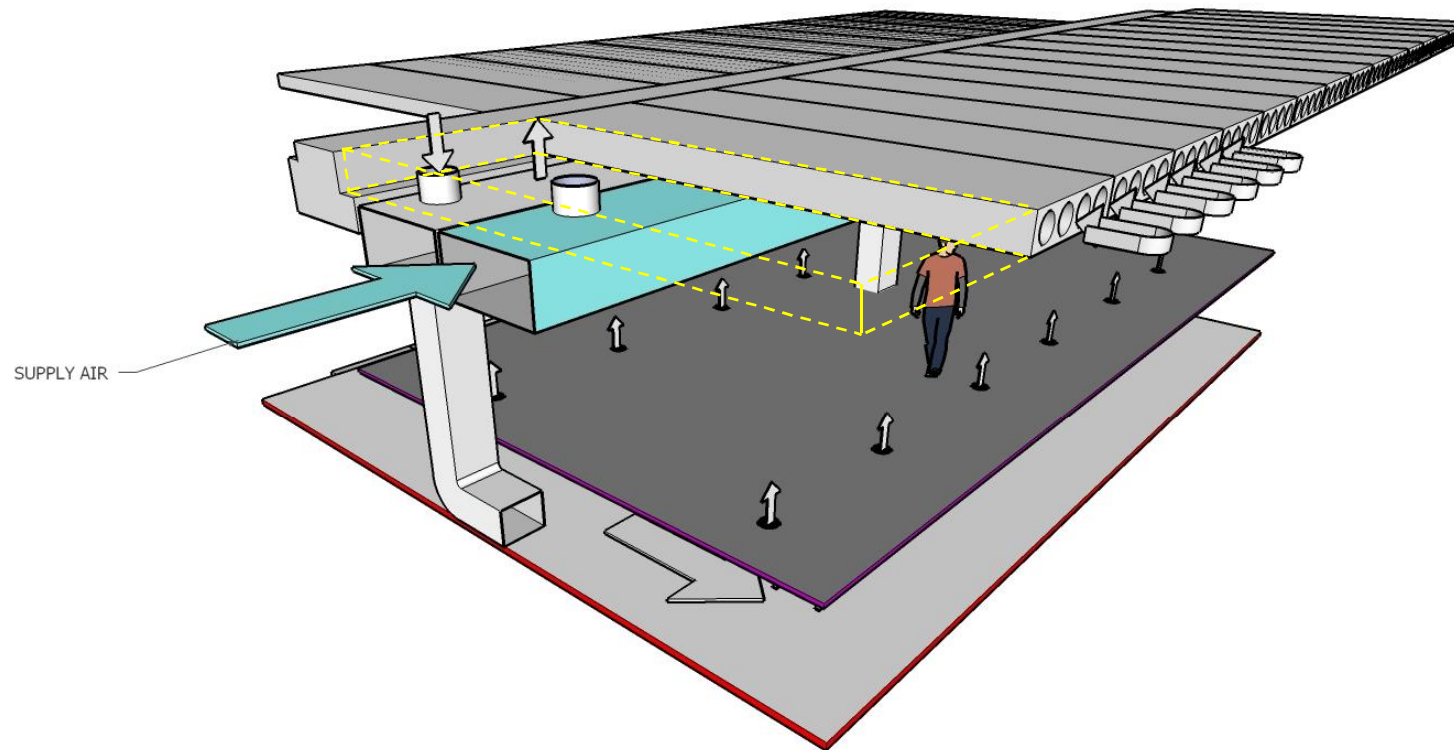
Light: Natural



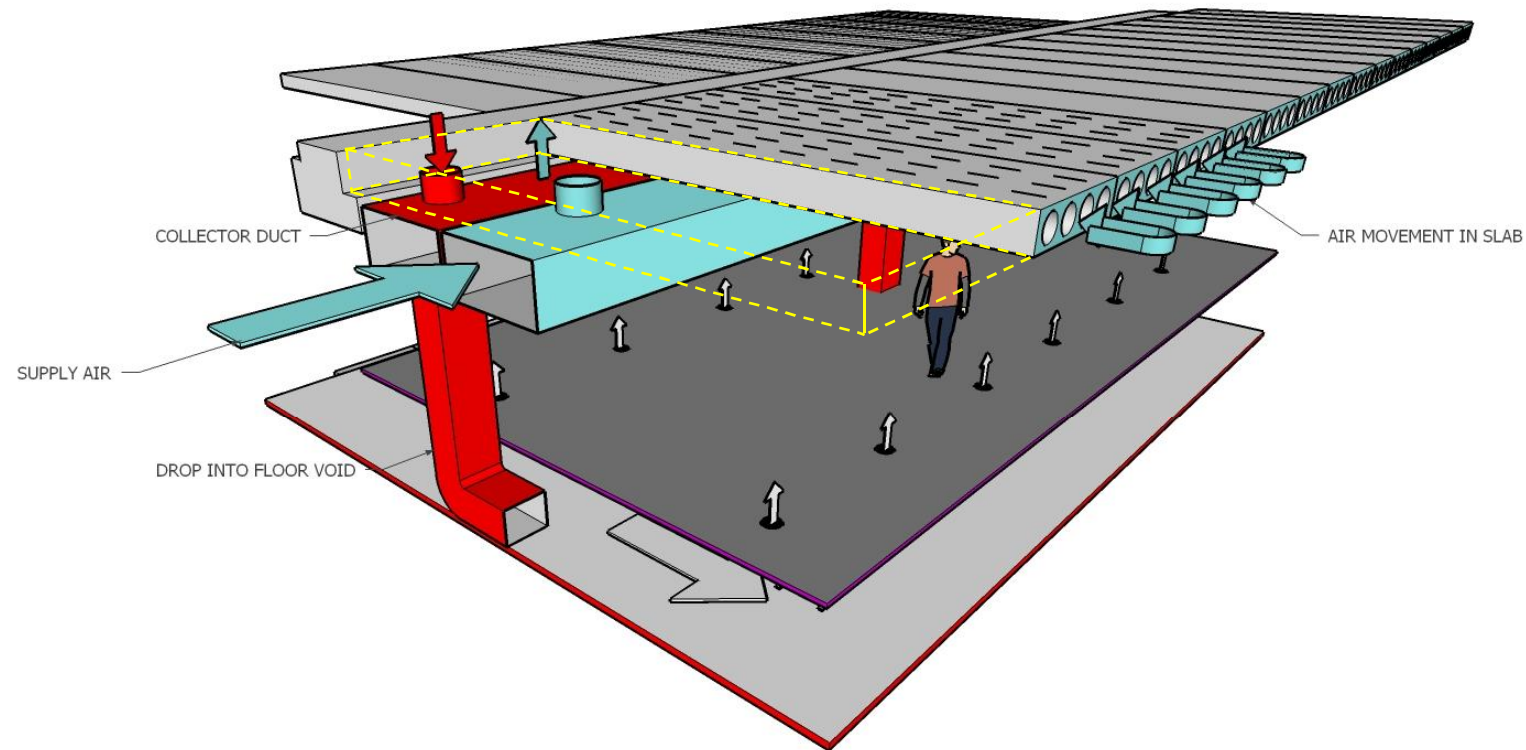
Light: Electric



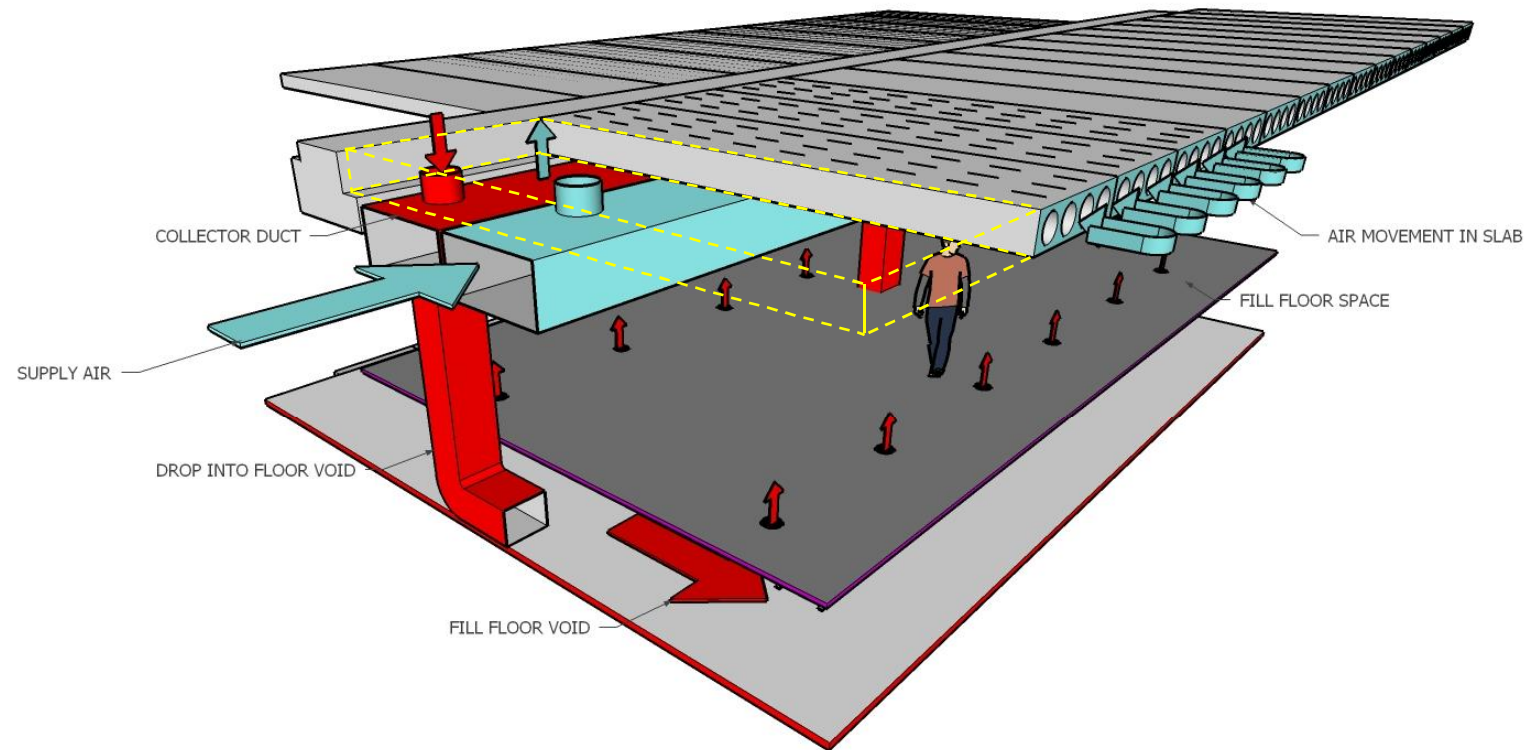
Active System: air + comfort



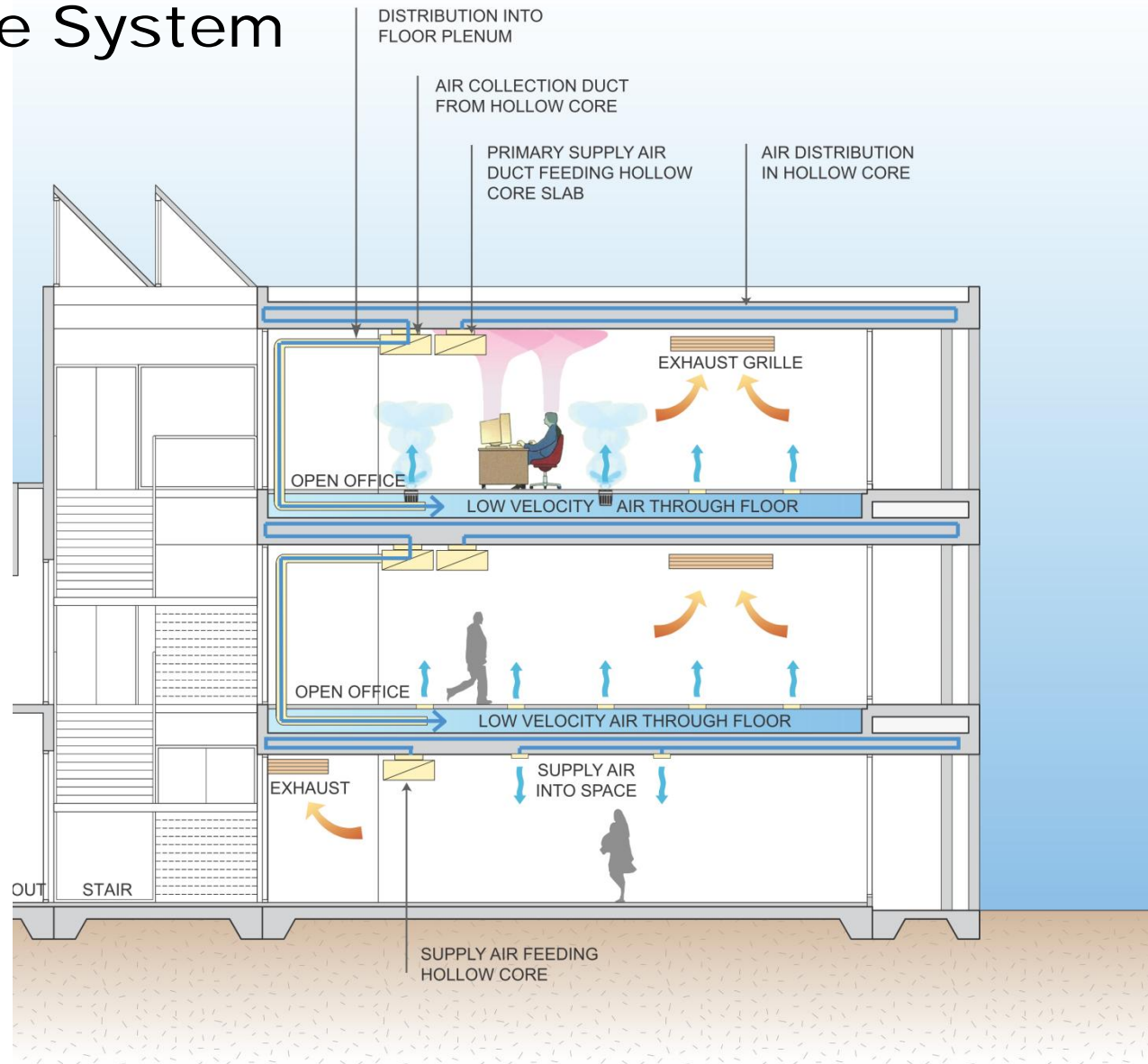
Active System: air + comfort



Active System: air + comfort



Active System



So what?



5 Star Green Star Office In Design V3



5 Star NABERS Energy in operation

NABERS ENERGY FOR OFFICES

- ☒ Energy consumption data
- ☒ Net lettable area
- ☒ Number of computers
- ☒ Hours of occupancy



Design or sustainability?

Metrics for comparable buildings

	Yarra Valley Water	Australian Best Practice	OECD Countries
Energy Consumption	80.8 kwh/m ² /year	~38% or ~55% 131/182 kwh/m ² /year	~74% 320 kwh/m ² /year
Carbon Emissions	58 kgCO ₂ -e/m ² /year	~61% 152 kgCO ₂ -e/m ² /year	
Glass U-value	2.0	3.2 – 4.0	1.0 – 2.0
Roof U-value	R24	R3.5	~R5
Lighting Energy Intensity	2.4 W/m ² + 2.5 W/m ²	-50% ~10 W/m ²	-50% ~10 W/m ²
Water Consumption	0.47 litres/day/m ²	-90% ~5 litres/day/m ²	-80% ~3 – 5 litres/day/m ²
Outside Air Provision	18.75 litres/second/person	+150%	Approx + 50%

References

AIRAH Technical Handbook, International Energy Agency, Organisation for Economic Co-operation and Development, US EPA, QDNRM, GBCA, NABERS



Design or sustainability?

Conclusion

- Study the climate / topology / geology – use it, don't fight it!
- Start with optimising the architecture / passive solar design
- Look for passive heating/cooling opportunities first, then active if necessary
- Match appropriate climate control solutions to the intended use of the building
- Use technology to augment good design **not** to counteract poor design
- Pay attention to commissioning and automatic controls
- Incorporate sensors and data-logging for feedback and tuning

