

Home Heating Considerations and Options

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Overview

- Health
- Costs
- Convenience
- Comfort
- Options



Health: universally accepted standards



- WHO recommends ..

20deg C for young, old, infirm



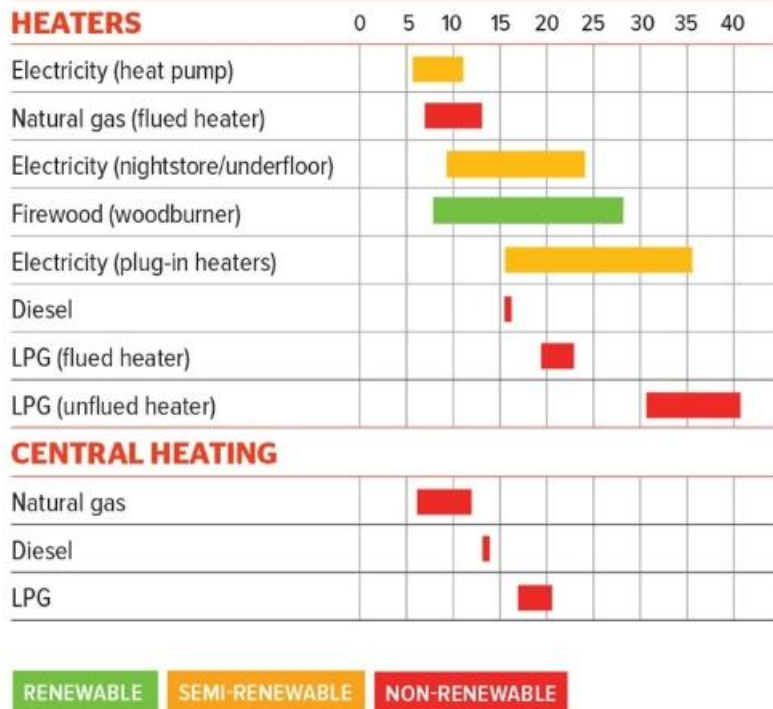
Capital Costs

Type	Cost Range
Working Oven	\$0
Electric Oil Column Heater	\$75-\$200
Heat Pump	\$1-3,000
Wood burner	\$2-5,000
Underfloor, Central Heating	\$10-20,000

Running Costs

Home heating costs 2015

(cents per kWh)



- Consumer NZ

Convenience



CONTROL YOUR HOME
FROM ANY SMARTPHONE OR TABLET

- Remotes
- Apps
- Home Automation

“Comfort” more complicated, but just as important in decision-making



Comfort




- Rocky Mountain Institute says .. “Seventy percent of whole home performance customers cited **comfort** as a reason for their upgrade.”

What is “Comfort”?

- Air Temp
- Mean Radiant Temp
- Relative Humidity
- Air Velocity
- Metabolic Rate
- Clothing



Can it be measured? Standardised?

- ANSI/ASHRAE 55-2013
 - EN 15251
 - PMV (Predictive Mean Vote)
 - PPD (Percentage People Dissatisfied)
 - Adaptive
- 

Tools

CBE Thermal Comfort Tool

Select method: PMV method

Air temperature: 25 °C Use operative temperature

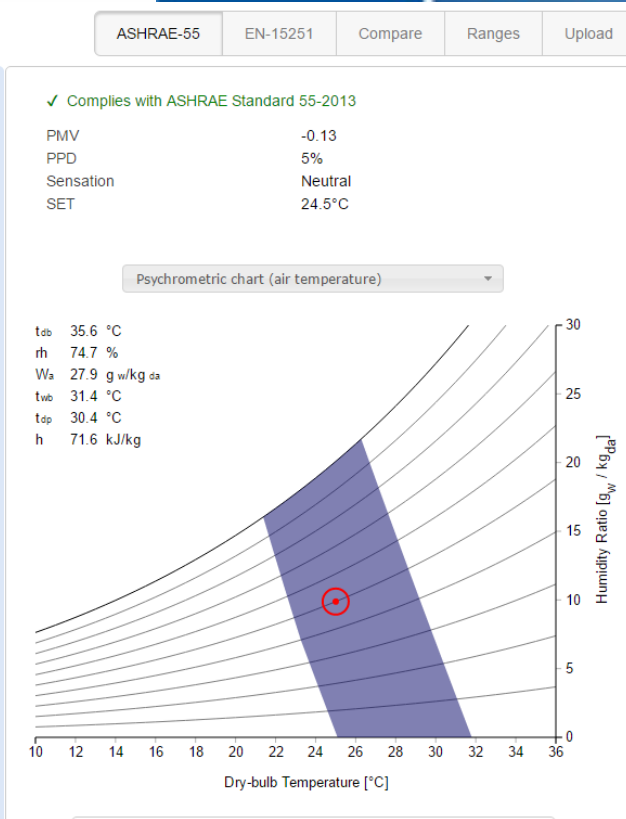
Mean radiant temperature: 25 °C

Air speed: 0.1 m/s Local air speed control

Humidity: 50 % Relative humidity

Metabolic rate: 1.1 met Typing: 1.1

Clothing level: 0.5 clo Typical summer indoor



Comfort Calculator (ISO7730-1993)

Air Temperature (°C): 24.8

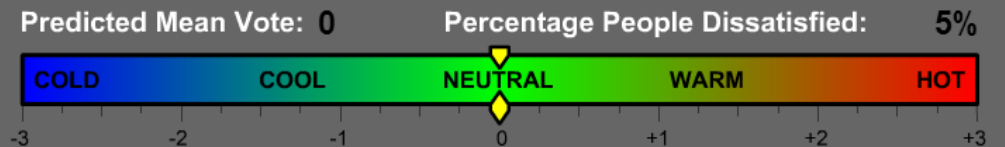
Radiant Temperature (°C): 24.8

Relative Humidity (%): 50

Air Velocity (m/s): Pleasant 0.5

Activity Rate (met): Sedentary activity 1

Clothing Level (clo): Light business suit 1



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Relative influence, Baseline

Select method:

Air temperature
 °C

Mean radiant temperature
 °C

Air speed
 m/s

Humidity
 %

Metabolic rate
 met

Clothing level
 clo

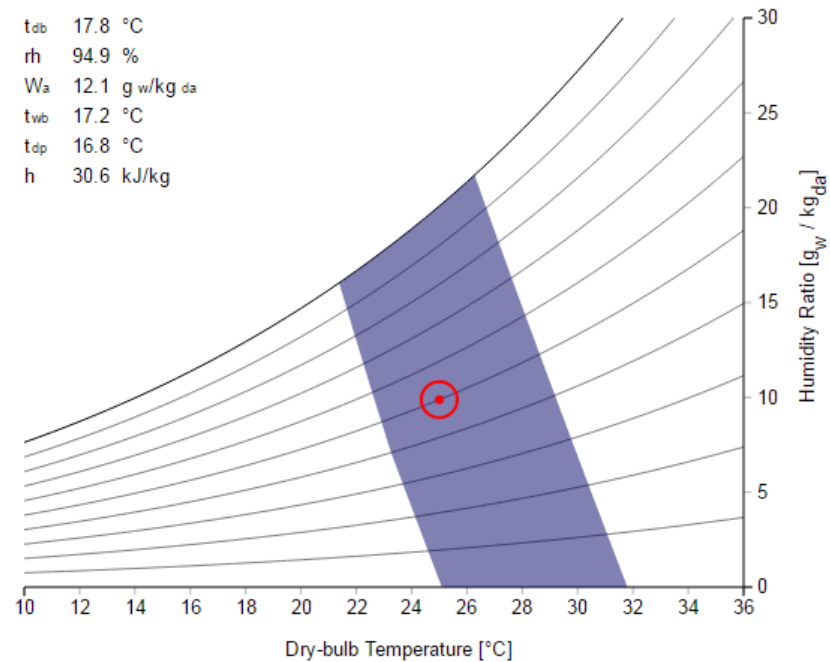
Globe temp	SolarCal	Specify pressure	SI IP	Local discomfort	? Help
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✓ Complies with ASHRAE Standard 55-2013

PMV -0.13
PPD 5%
Sensation Neutral
SET 24.6°C

Psychrometric chart (air temperature)

t_{db} 17.8 °C
 rh 94.9 %
 W_a 12.1 g w/kg da
 t_{wb} 17.2 °C
 t_{dp} 16.8 °C
 h 30.6 kJ/kg



Air Temp

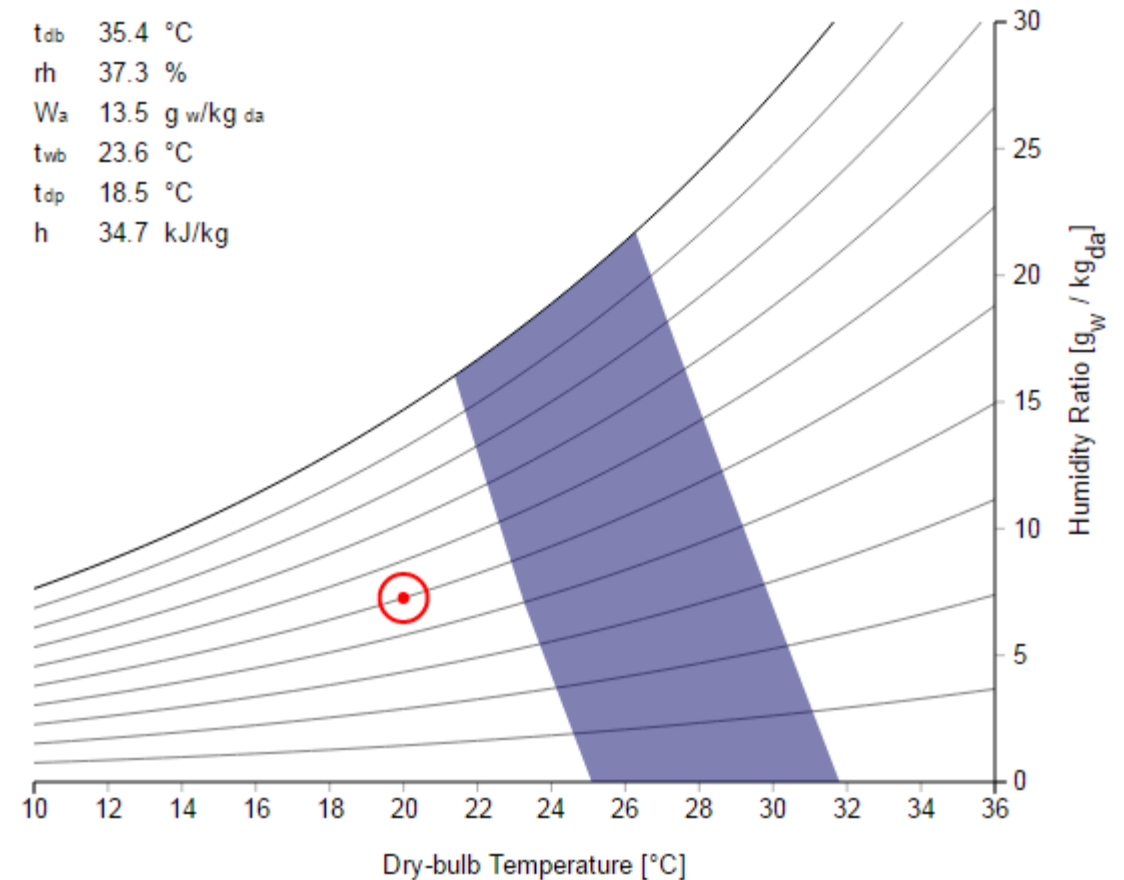
- Air Temp 20 deg C
(WHO recommended minimum)

X Does not comply with ASHRAE Standard 55-2013

PMV	-1.09
PPD	30%
Sensation	Slightly Cool
SET	22.4°C

Psychrometric chart (air temperature)

t_{db}	35.4 °C
rh	37.3 %
W_a	13.5 g w/kg da
t_{wb}	23.6 °C
t_{dp}	18.5 °C
h	34.7 kJ/kg



Mean Radiant Temp

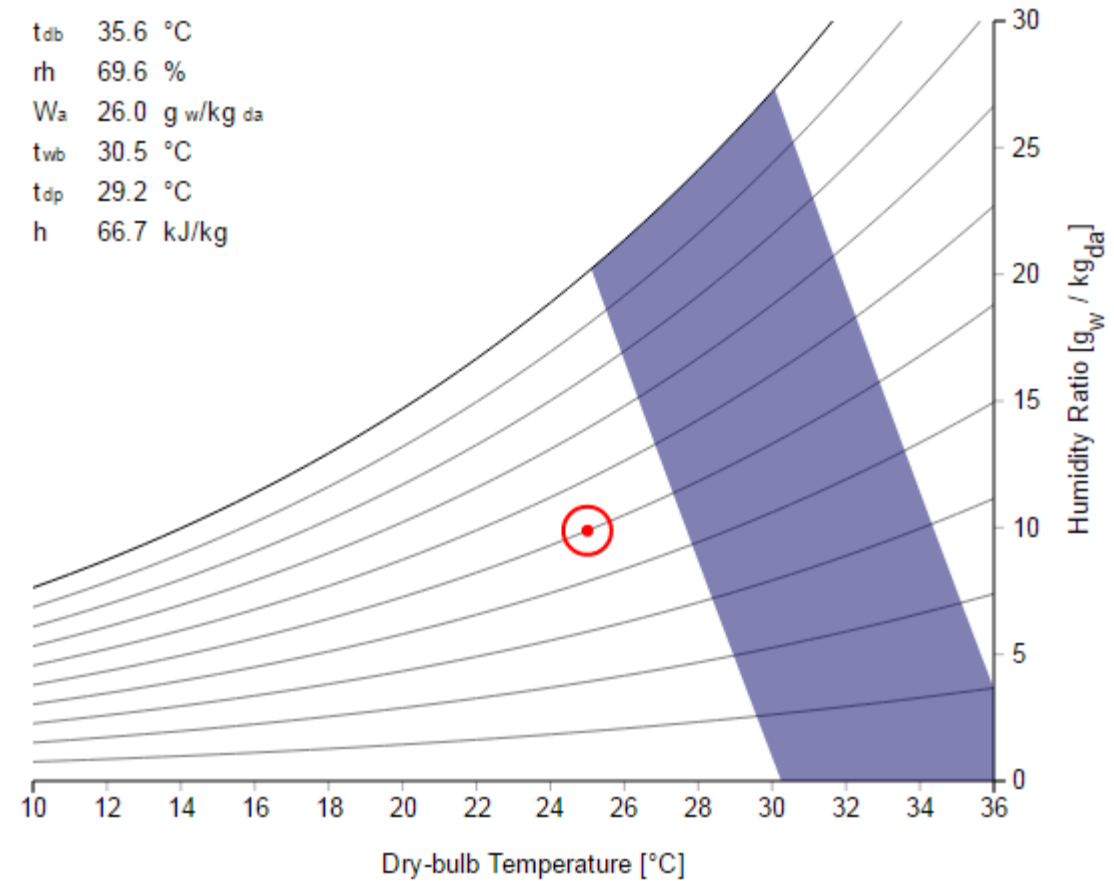
- MRT 20 deg C

X Does not comply with ASHRAE Standard 55-2013

PMV	-0.90
PPD	22%
Sensation	Slightly Cool
SET	21.6°C

Psychrometric chart (air temperature)

t_{db} 35.6 °C
 rh 69.6 %
 W_a 26.0 g w/kg da
 t_{wb} 30.5 °C
 t_{dp} 29.2 °C
 h 66.7 kJ/kg



Relative Humidity

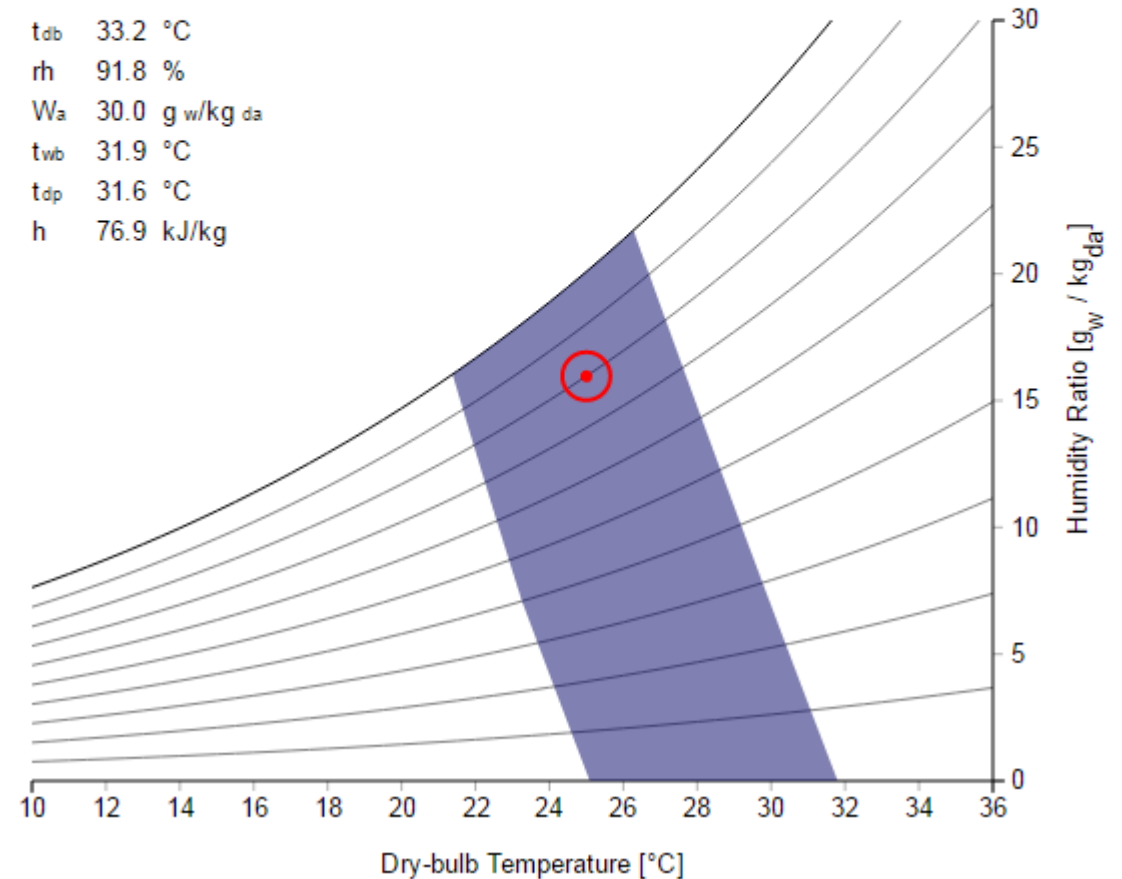
✓ Complies with ASHRAE Standard 55-2013

PMV	0.10
PPD	5%
Sensation	Neutral
SET	25.6°C

- RH 80%

Psychrometric chart (air temperature)

t_{db}	33.2 °C
rh	91.8 %
W_a	30.0 g _w /kg _{da}
t_{wb}	31.9 °C
t_{dp}	31.6 °C
h	76.9 kJ/kg



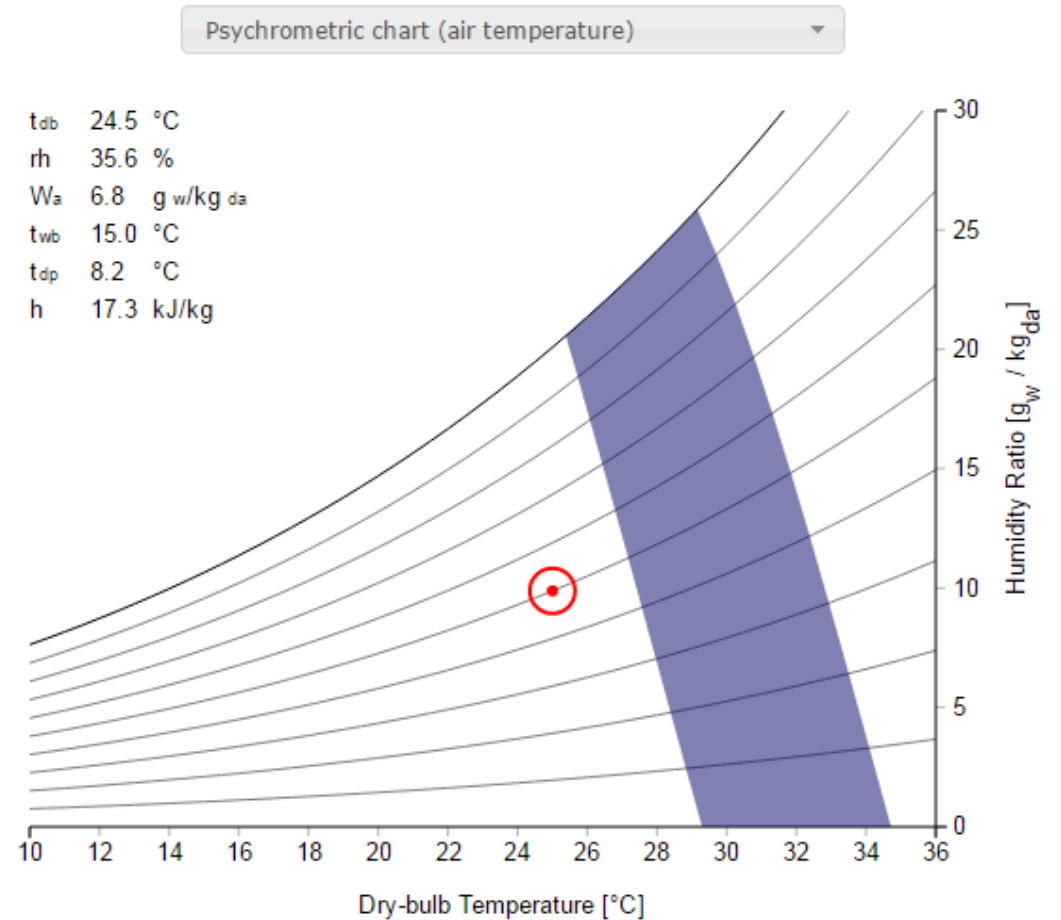
Air Velocity

- Air Velocity 0.6m/s
(Light breeze)

X Does not comply with ASHRAE Standard 55-2013

PMV with elevated air speed	-1.00
PPD with elevated air speed	26%
Sensation	Slightly Cool
SET	21.8°C

Drybulb temperature at still air	22.4°C
Cooling effect	2.6°C



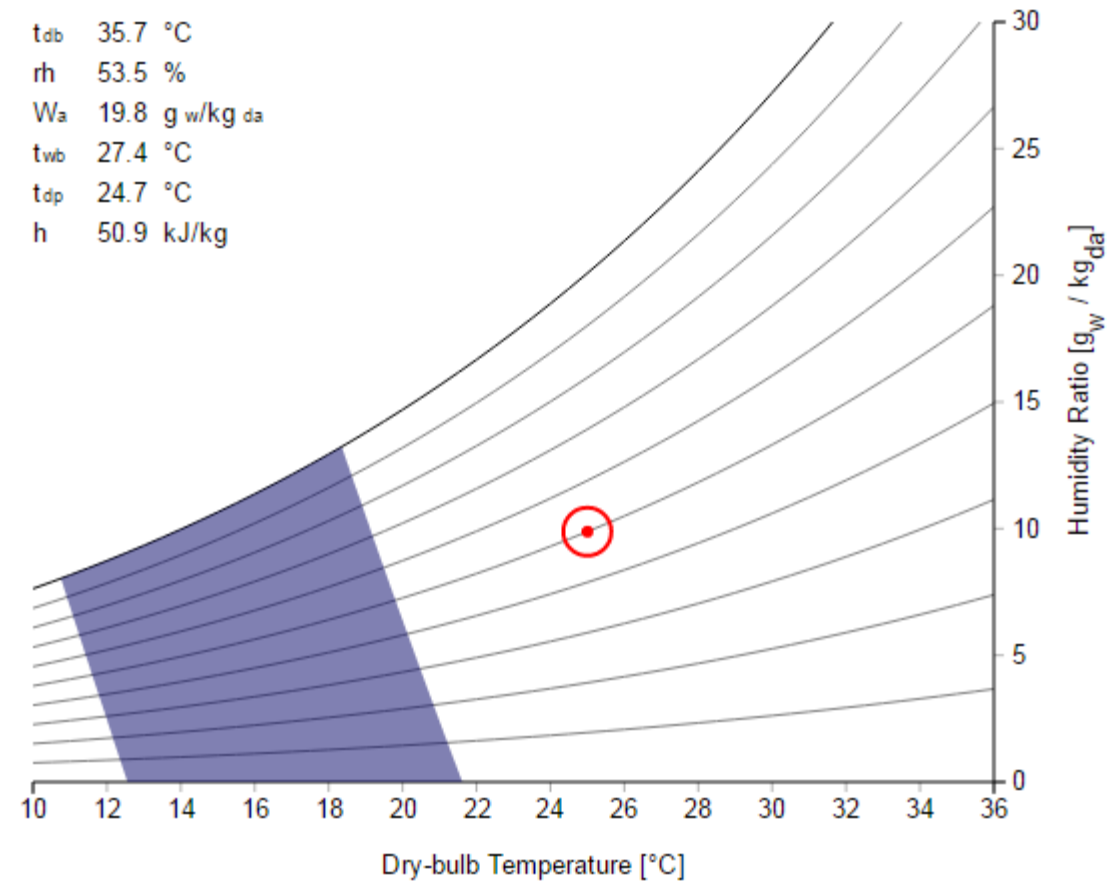
Metabolic Rate

- Slow walk

PMV	1.06
PPD	29%
Sensation	Slightly Warm
SET	30.0°C

Psychrometric chart (air temperature)

t_{db}	35.7 °C
rh	53.5 %
W_a	19.8 g w/kg da
t_{wb}	27.4 °C
t_{dp}	24.7 °C
h	50.9 kJ/kg



Metabolic Rate

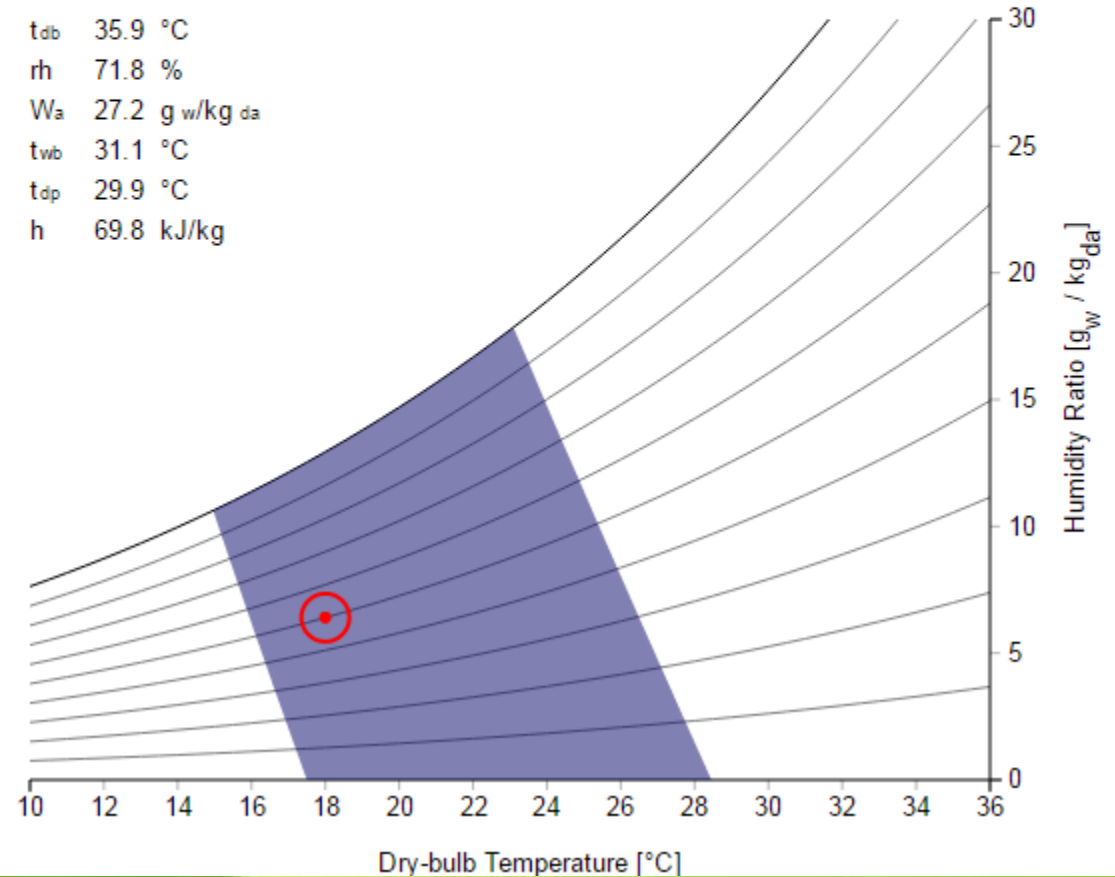
- Slow walk, 18deg C

✓ Complies with ASHRAE Standard 55-2013

PMV	-0.28
PPD	7%
Sensation	Neutral
SET	23.7°C

Psychrometric chart (air temperature)

t_{db} 35.9 °C
 rh 71.8 %
 W_a 27.2 g w/kg da
 t_{wb} 31.1 °C
 t_{dp} 29.9 °C
 h 69.8 kJ/kg



Clothing/20°C

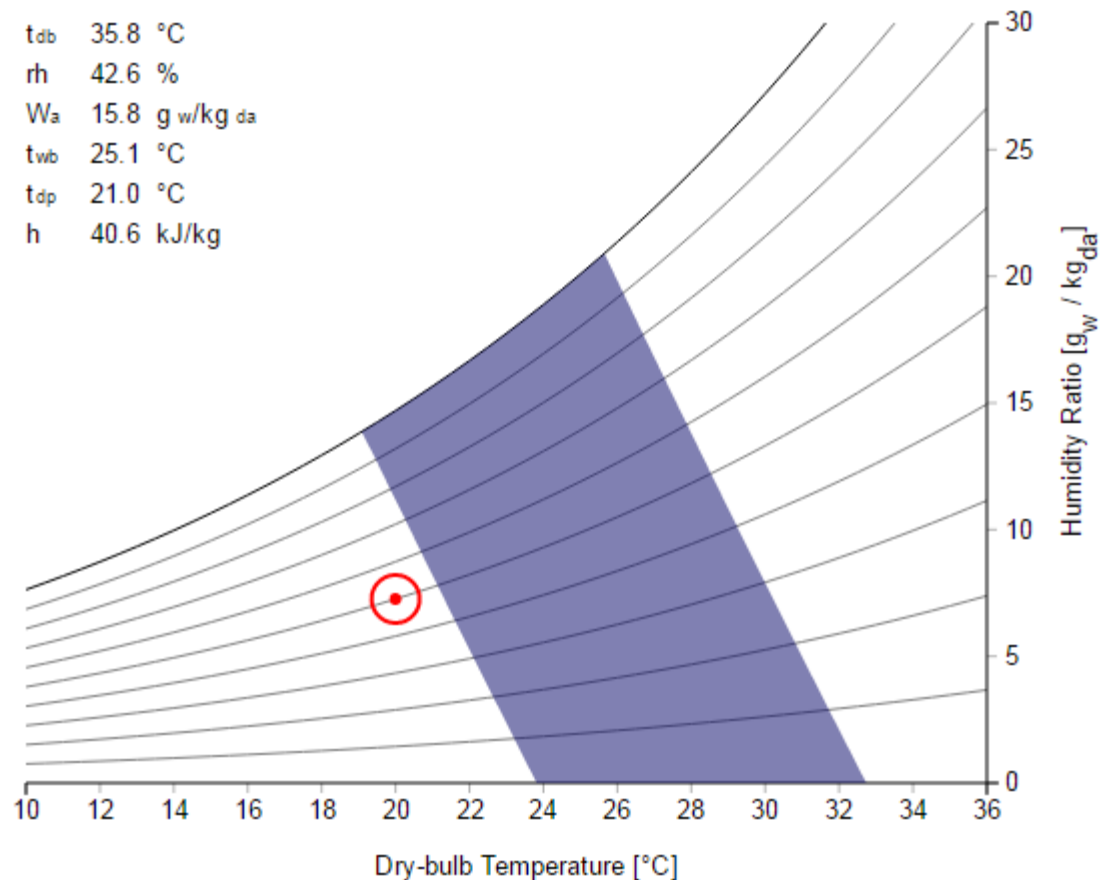
- Jacket, long sleeve shirt, trousers

X Does not comply with ASHRAE Standard 55-2013


PMV	-0.65
PPD	14%
Sensation	Slightly Cool
SET	23.0°C

Psychrometric chart (air temperature)

t_{db}	35.8 °C
rh	42.6 %
W_a	15.8 g w/kg da
t_{wb}	25.1 °C
t_{dp}	21.0 °C
h	40.6 kJ/kg



Heating Options

- Get it
 - Store it
 - Keep it
 - Add it
- 

Get it

Maximise winter sun through ..

- Orientation
- Layout
- Shading
- Glazing



Store it

Increase Mean Radiant
Temps through ..

- Thermal Mass (eg
Concrete)




Keep it

Retain Air Temp, reduce MRT losses and reduce air speeds through ..

- Insulation
- Draught proofing
- Wind breaks
- Curtains
- Clothing
- Glazing

Add it

Increase Air temps through ..

- Wood burner, Pellet burner
 - Heat Pump
 - Central Heating, Radiators
 - Panel Heaters, Oil Column Heaters
- 

Add it

Increase Metabolic rate through ..

- Exercise!



The best thermal mass ..



Thank you

