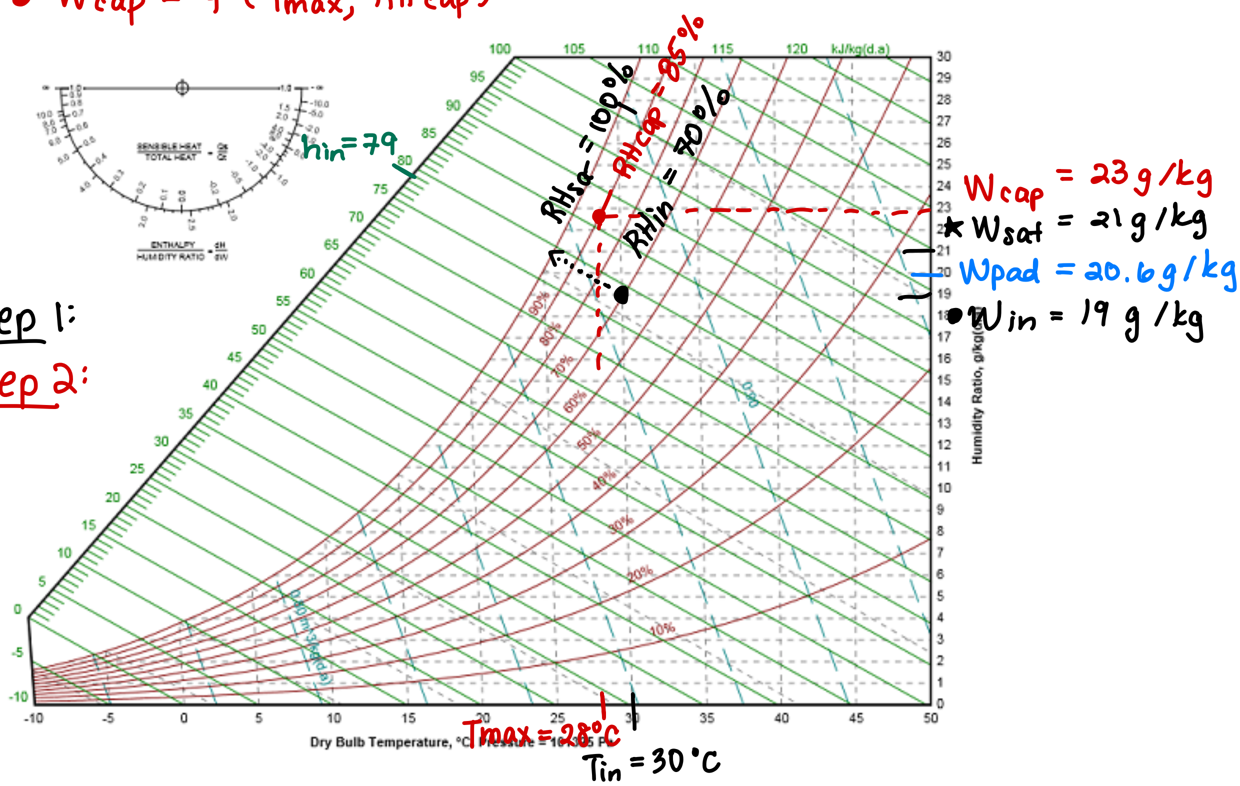
Padwall Cooling Calculations

- $W_{in} = f(T_{in}, RH_{in})$
- ★ W_{sat} => follow enthalpy line to saturation point
- $W_{cap} = f(T_{max}, RH_{cap})$

Step 1:

Step 2:



Step 3:

$$\text{eta} = \frac{W\_cap - W\_in}{W\_sat\_wb - W_{in}}$$

$W_{cap} > W_{sat}$

$\eta = 80\%$ by default

Step 4:

$$W_{padwall} = W_{in} + \eta\,(W_{sat'd} - W_{in})$$
$$= 19\,g/kg + 0.8\,(21\,g/kg - 19\,g/kg)$$

$W_{padwall} = 20.6\,g/kg$

Moist Air Enthalpy

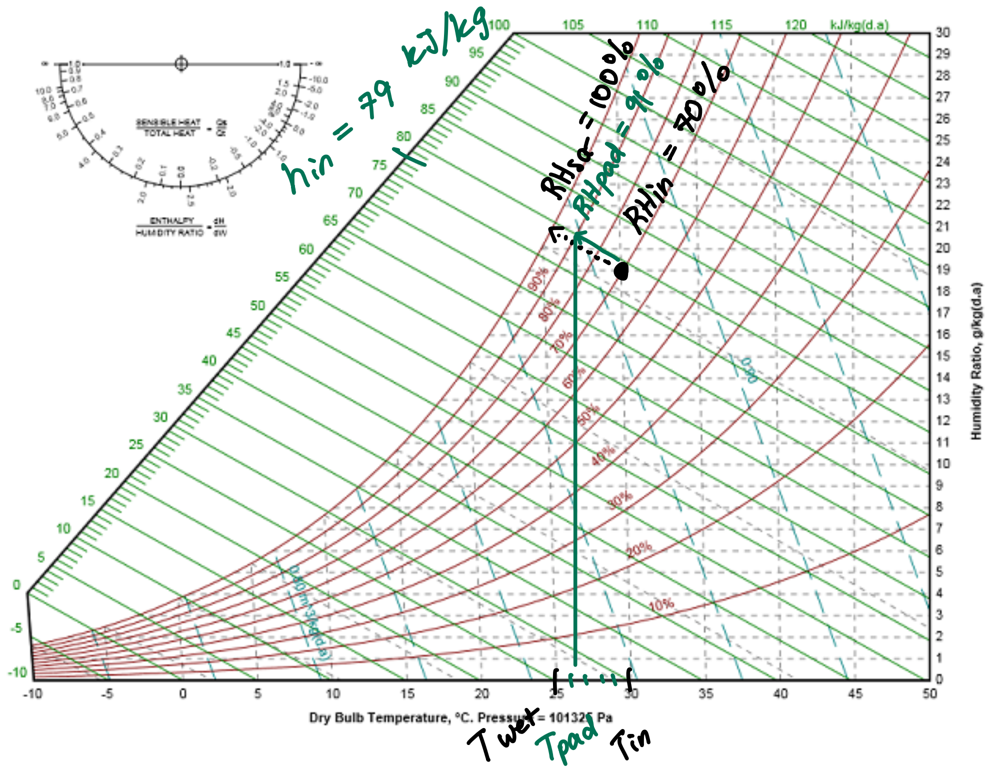
$h_{in} = f(T_{in}, W_{in})$

$$= 1.001\,\frac{kJ}{kg\,C} + W\left(1.86\,\frac{kJ}{kg\,C}\cdot T + 2501\,\frac{kg}{kJ}\right)$$

Enthalpy is constant for padwall evaporative cooling processes:

$h_{padwall} = h_{in}$

Step 1: Plot Win & mark Wsat (RH = 100% along enthalpy line)
Step 2: Plot Wcap (most likely not along enthalpy line)
Step 3: Calculate η. Over 80%? default to 80%
Step 4: Calculate Wpad using η



$T_{padwall}$ = dry bulb temp $f(\cancel{h_{pad}}\ h_{in}, W_{pad})$

∵ $\eta = 80\%$ and enthalpy constant,

$$T_{padwall} = T_{in} + \eta(T_{wetbulb} - T_{in})$$
$$= 30 + 0.8(26 - 30)$$
$$= 30 + 0.8(-4)$$

$$T_{padwall} = 26.8\,^\circ C$$

$RH_{padwall} = f(T_{padwall}, W_{pad})$

$RH_{pad} = 91\%$

OPTION 1: True Setpoint

$$Q = h_{padwall} - h_{setpoint}$$

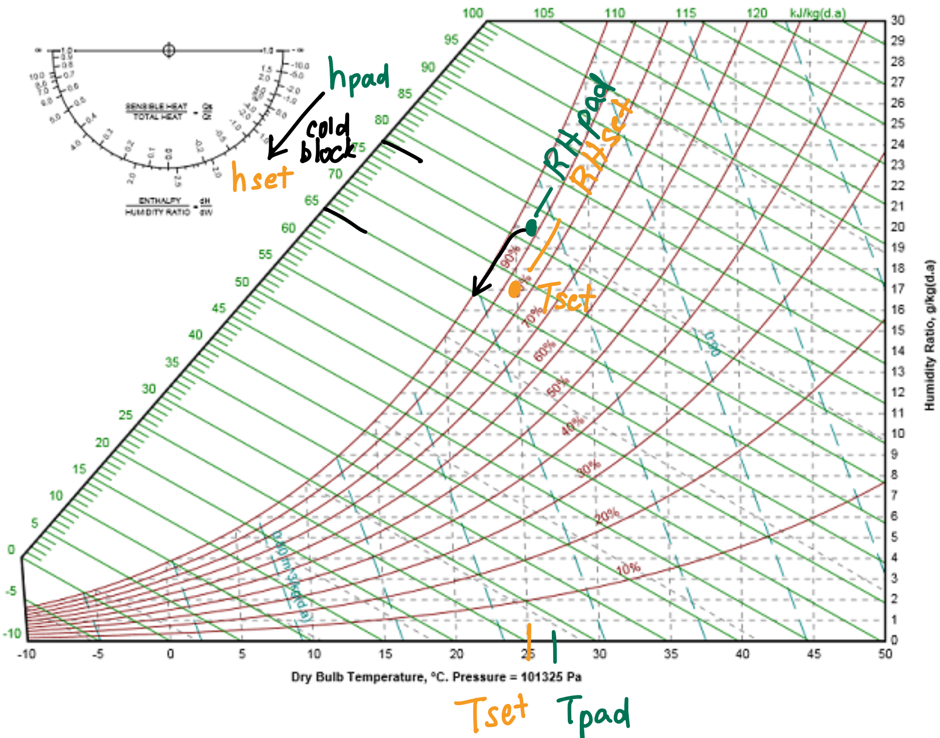
$T_{padwall} = 26.8\,°C$

$RH_{pad} = 91\,°C$

$T_{set} = 25\,°C$

$RH_{set} = 85\,°C$

} Ideal setpoints



OPTION 2: Max Allowed Temp

$$Q = h_{padwall} - h_{T,max}$$

$T_{padwall} = 26.8\,°C$

$RH_{pad} = 91\,°C$

$T_{max} = 28\,°C$

$W_{padwall} = 20.6\ g/kg$

No active cooling is needed because $T_{pad} < T_{max}$.