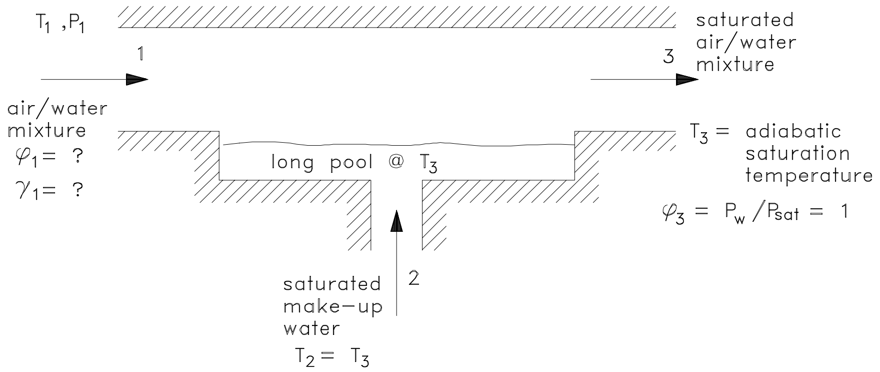
ME 354 Lecture Summary

Week 11: Lecture 1

An Adiabatic Saturator



- used to measure humidity
- two inlet, single exit device through which moist air passes
- air-water mixture of unknown humidity enters at a known pressure and temperature
- if air/water mixture is not saturated, some water from the pool will evaporate
- the energy required to evaporate the water comes from the moist air $\rightarrow$ mixture temperature decreases
- for a sufficient long duct, the moisture exits with $\phi = 1$
- the temperature of the exiting mixture is called the adiabatic saturation temperature

Mass and energy balances lead to:

$$\gamma_1 = \frac{c_{p_a}(T_3 - T_1) + \gamma_3(h_{fg}(T_3))}{(h_{w_1} - h_{w_2})}$$

If we assume that h_{w_1} is very close to the enthalpy for the saturated vapour at T_1 and h_{w_2} is close to the enthalpy of the saturated liquid at T_1 (this assumption can be made with confidence since $h_f << h_g$), we can write γ_1 as

$$\gamma_1 = \frac{c_{p_a}(T_3 - T_1) + \gamma_3(h_{fg}(T_3))}{(h_{fg}(T_1))}$$

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Dry Bulb Temperature - the temperature measured by a thermometer placed in a mixture of air and water vapour

Wet Bulb Temperature

- thermometer surrounded by a saturated wick
- if air/water vapour mixture is not saturated, some water in the wick evaporates and diffuses into the air $\rightarrow$ cooling the water in the wick
- at the temperature of the water drops, heat is transferred to the water from both the air and the thermometer
- the steady state temperature is the wet-bulb temperature

Sling Thermometer - a rotating set of thermometers one of which measures wet bulb temperature and the other dry bulb temperature. T_{DB} and T_{WB} are sufficient to fix the state of the mixture.