

AEN 4131: FARM STRUCTURES

ASSIGNMENT 6

Due date: June 10, 2024

Question 1

- a) At an air temperature of 25°C, air in a farm building has a relative humidity (RH) of 30%. Use the psychrometric chart for 1500m (provided on the last page) above sea level to determine the following:
- Water vapour content in the air in kilograms per kilogram of dry air.
 - The specific volume of the air.
 - The heat content of the air.
 - The amount of water added to the air if an evaporative cooler reduces the temperature adiabatically to 18°C.
 - The temperature at which water will start condensing if the air is cooled without any change in water vapour content.
- b) A naturally ventilated pig building is 30 m long, 12 m wide and has a 2.4 m high side wall. The building has 120 mm eaves opening along one side, an 80 mm wide ridge opening, and no ceiling. The difference in height between the inlet and outlet is 2 m. The outside temperature is 15 °C, and the inside is 27 °C. Consider $E = 0.35$ and $\mu = 0.65$. The wind speed is 5.2 m/s. Making use of Figures Q1a and Q1b, determine:
- the ventilation air flow rate due to wind
 - the ventilation air flow rate due to thermal effects
 - the ventilation air flow rate due to combined effects

Note: Since the inlet and outlet areas are different, use the smaller areas in the equations and apply the increases in flow as shown in Figure Q1a.

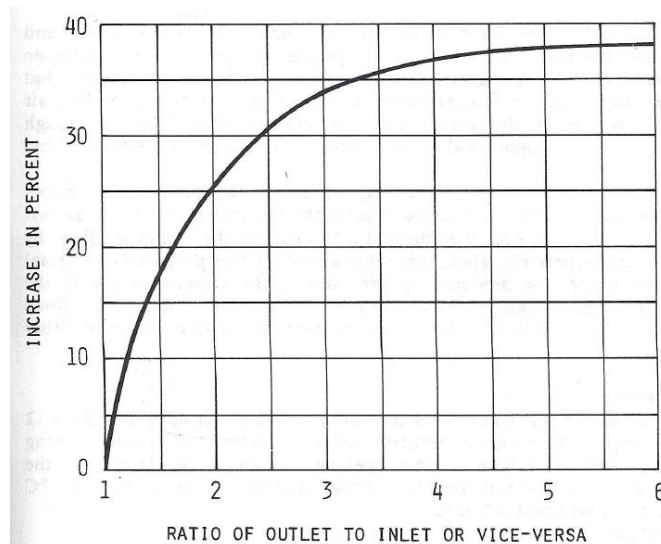


Figure Q1a. Increase in flow caused by excess of one opening over another (from ASHRAE)

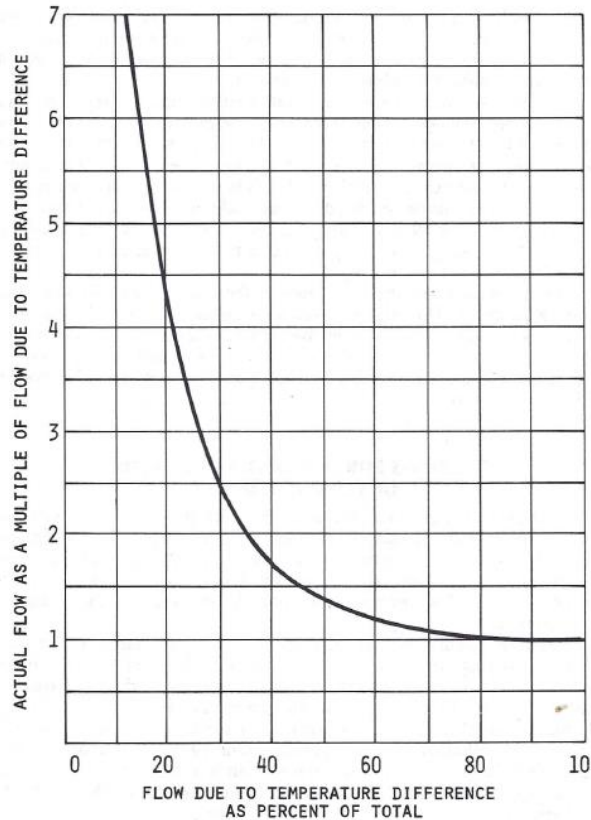


Figure Q1b. Determination of flow caused by combined forces of wind and temperature

QUESTION 2

A farmer is intending to invest in a pig production unit with 50 sows and will practice an eight (8) week weaning period. Each pen should be occupied at all times except for a period of one week for cleaning and sanitation. The farmer will also practice single stage finishing of pigs from 12 weeks to 27 weeks of age. The following periods must be considered:

- (i) An average weaning to conception period of 20 days;
- (ii) A gestation period of 114 days;
- (iii) A period of rearing of weaners in the farrowing pen of 28 days;
- (iv) Sows are brought to farrowing pens one week before farrowing; and
- (v) An extra period of 21 days for the last pig to reach marketable weight.
- (vi) The number of farrowings is the ration of the number of days in a year to the farrowing interval. The farrowing interval per sow is the sum of the average weaning-conception period, gestation period and the suckling period.

Assuming that eight (8) pigs per litter survive to 12 weeks, **determine**:

- (a) Number of farrowings per year leaving your answer to 1 decimal place;
- (b) Number of farrowing pens;
- (c) Number of dry sow/gestation pens with 5 pigs in one pen;
- (d) Number of growing/finishing pens assuming each litter occupies one pen.



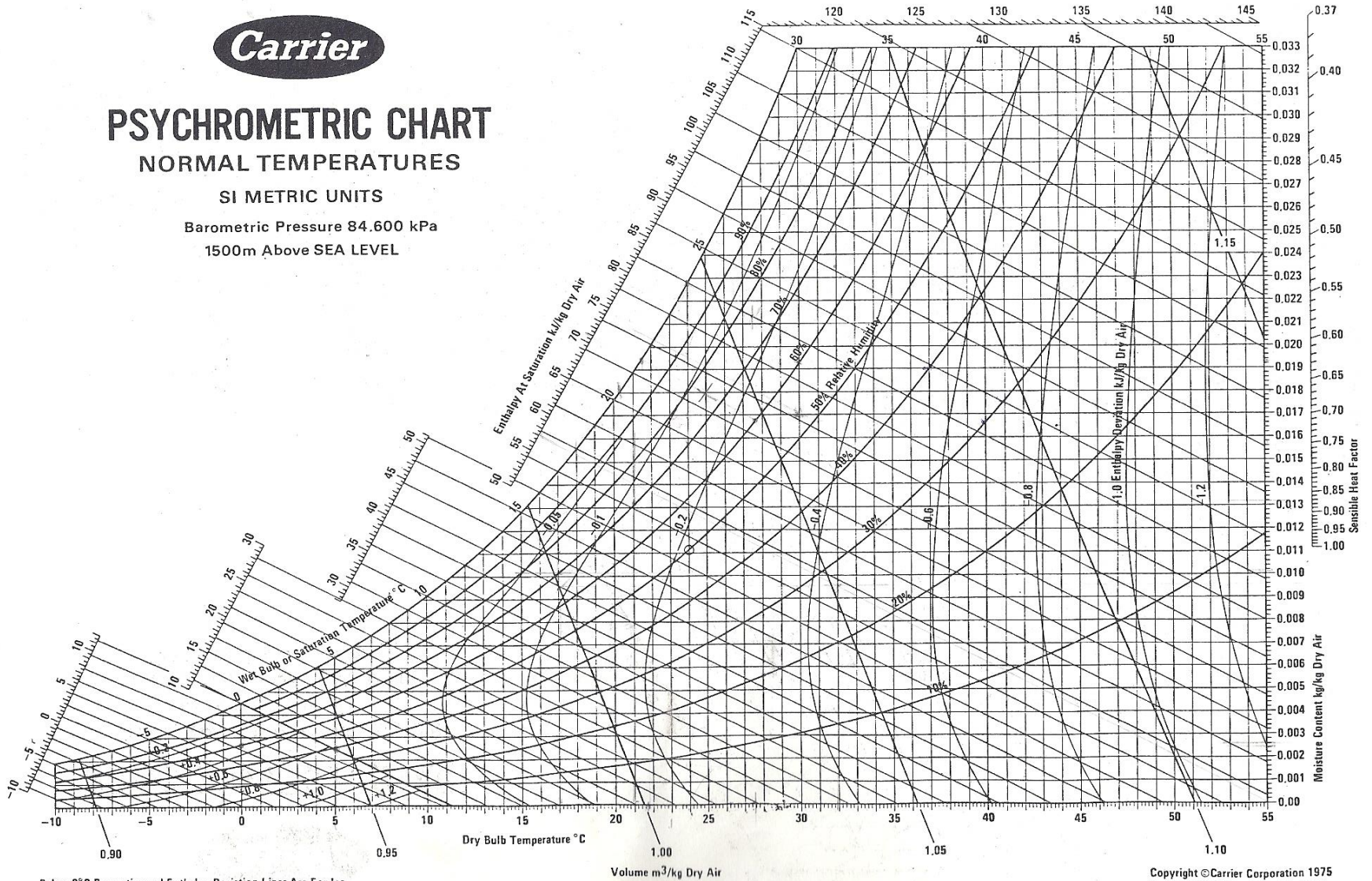
PSYCHROMETRIC CHART

NORMAL TEMPERATURES

SI METRIC UNITS

Barometric Pressure 84.600 kPa

1500m Above SEA LEVEL



Below 0°C Properties and Enthalpy Deviation Lines Are For Ice

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