

Advanced Math & Problem Solving

Course Outline

- I.** Review of determining areas
- II.** Review of determining air velocity
- III.** Review of determining quantity of air
- IV.** Review of perimeters (square & circle)
- V.** Determining perimeter of trapezoids
- VI.** Determining rubbing surfaces
- VII.** Coefficient of friction
- VIII.** Inches of water gauge
- IX.** Total ventilating pressure
- X.** Unit ventilating pressure
- XI.** Total resistance of an airway
- XII.** Units of work
- XIII.** Horsepower
- XIV.** Depth of Shaft- Atmospheric air pressure
- XV.** Equivalent orifice
- XVI.** Water calculations
- XVII.** Barrier Pillar formula & calculations

Formula Terms & Equations

a = sectional area of airway measured in square feet (ft.²)

- *Rectangle or square*.....height x width = area
- *Trapezoid* $\frac{\text{top width} + \text{bottom width}}{2}$ x height = area
- *Circle*..... $\pi \times r^2$ = area

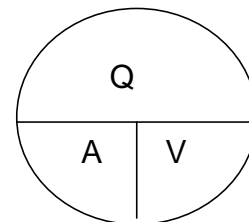
Note: $\pi = 3.1416$

v = velocity of air current measured in feet per minute (fpm)

- *Smoke tube*..... $\frac{\text{distance}}{\text{decimal time}}$ or
- *Anemometer*.....
- *Magnehelic*.....V.P. = $4003 \times \sqrt{P_i}$
(Velocity Pressure)
note: see page 6

q = quantity of air, in cubic feet per minute (cfm)

- *Quantity of air (cfm)*..... $q = a \times v$
- *Velocity of air*..... $v = \frac{q}{a}$ or
- *Area (when velocity and quantity are known)*..... $a = \frac{q}{v}$



Algebraic Circle

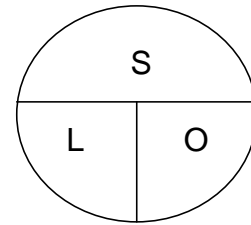
l = length of airway measured in linear feet

o = perimeter of airway measured in *linear feet*

- *Rectangle or Square*..... Top width +bottom width + side 1 + side 2
- Circle..... $\pi \times \text{diameter}$
- Trapezoid..... $Z = \frac{1}{2} (X + Y) \times H$
- (Pythagoras's Theorem) to find side Then: Top width +bottom width + side 1 + side 2
Note: see page 5

s = rubbing surface measured in square feet (ft²)

- **Rubbing surface**..... s = lo



Algebraic Circle

k = coefficient of friction,
(The resistance of one square foot of rubbing surface to an air current with a velocity of one foot per minute) **{.00000002}**

i = inches of water gauge; also given as w.g.

- **Water gauge**..... $i = \frac{p}{5.2}$

P = total ventilating pressure, in pounds (lbs.)

- **Total pressure**..... $P = pa$

p = unit ventilating pressure, in pounds per square feet (lb./ft.²)

- **Unit pressure, lbs. per sq ft**..... $p = \frac{ksv^2}{a}$

R = total resistance of an airway, in pounds; equals P

- **Resistance, lbs**..... $R = pa = P$

u = units of work, in foot-pounds per minute

- **Units of power, ft lbs per min.....** $u = ksv^3$
(The work performed each minute by a current of air with a velocity of a certain number of feet per minute.)

h = horsepower; also given as h.p. or H.P.

(One horsepower can move: 33,000 lbs. One foot vertically in one minute
: 330 lbs. 100 feet vertically in one minute
: 33 lbs. 1,000 feet vertically in one minute)

- **Horsepower.....** $h = \frac{u}{33,000}$

1 horsepower = 746 watts/electricity

1 horsepower = .746 kilowatts/electricity

Hg = inches of mercury

- **Atmospheric air pressure.....** 1 (mercury) inch = 876 feet in air column
(Depth of Shaft) (Barometric pressure)

Equivalent orifice..... $E.O. = \frac{.0004 \times Q}{\sqrt{i}}$
(Regulators) ^{New}

Water (gallons)..... 1 cubic foot = 7.5 gallons

Water (weight)..... 1 cubic foot = 62.5 lbs.

Temperature conversion

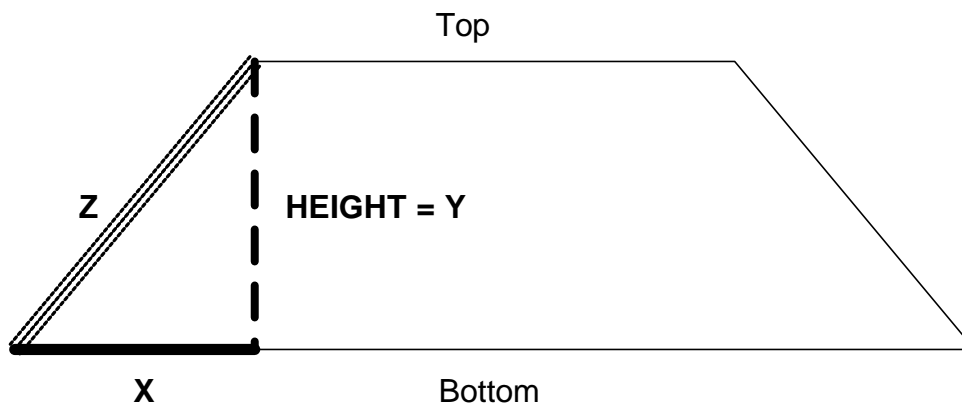
Fahrenheit to Centigrade..... $C^{\circ} = F^{\circ} \text{ temp.} \times .555$

Centigrade to Fahrenheit..... $F^{\circ} = C^{\circ} \times 1.8 + 32$

Barrier Pillar Formula.....

2 X (10' + (2' for every foot or part of a foot of seam height) + (5' for every 100' or part of 100' of cover))

TRAPEZOID



PYTHAGORAS'S THEOREM

$$Z = \sqrt{X^2 + Y^2}$$

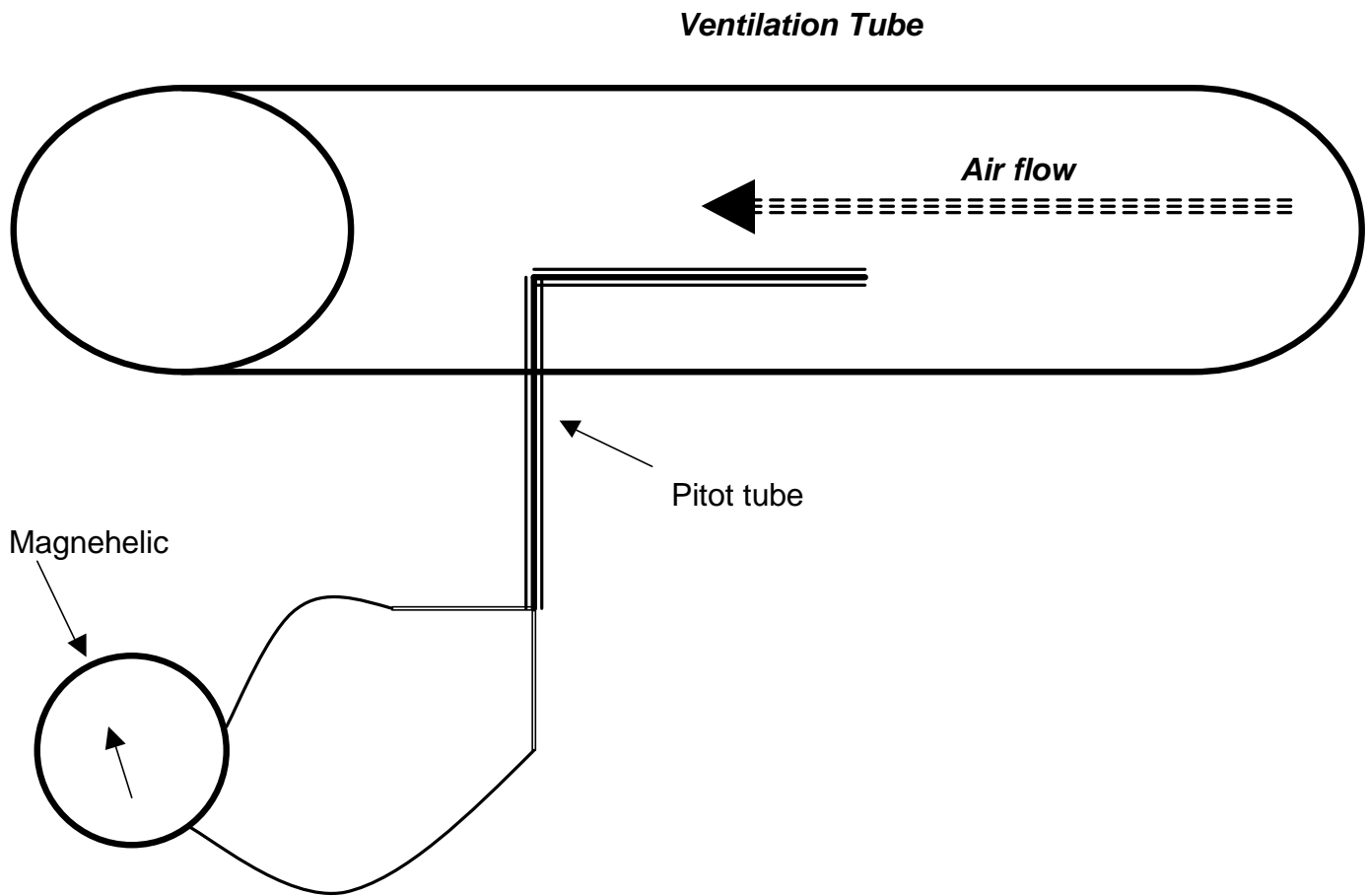
This formula is used to find the angle side of a right triangle. The height is given and the top and bottom portion of the trapezoid are given.

To find "X", use the following:

$$\frac{\text{BOTTOM} - \text{TOP}}{2} = X$$

Complete by finding the perimeter by adding the top + the bottom + the right side + the left side.

Taking an air reading using a Magnehelic and a Pitot tube: When high velocity air movement will damage the anemometer.



Take magnehelic reading (inches of water), and then use the formula;

$$4003 \times \sqrt{i.} = \text{V.P. or ventilation pressure, which is in fpm}$$

FORMULAS FOR METHANE EVALUATION

Q_G = Quantity of Methane Gas (cfm)

Q_R = Quantity of Return Air(cfm)

$\%_G$ = Percentage of Gas (methane detector reading)

Q_r = Quantity of Intake Air(cfm)

METHANOMETER CONVERSION (2 decimal places)

(detector) (decimal equivalent)

.5% of methane = .005

1.0% OF methane = .01

For quantity of methane in a 24 hour period:

$Q_G \times 60 \text{ (minutes)} \times 24 \text{ (hours)} = CF/CH_4/24$

The formula to find the quantity of gas when the percent of gas and the quantity of return air are known:

$$Q_G = Q_R \times \%_G$$

The formula to find the percent of gas when the quantity of gas and the quantity of return air are known:

$$\%_G = \frac{Q_G}{Q_R}$$

The formula to find the quantity of return air when the quantity of gas and the percent of gas are known:

$$Q_R = \frac{Q_G}{\%_G}$$

The formula to find the quantity of return air when the quantity of gas and quantity of intake air are known:

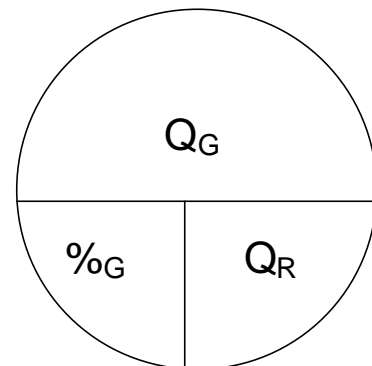
$$Q_R = Q_G + Q_r$$

Dilution Formula

The formula to find the amount of **air to add** to reduce the percent of gas in an air current:

$$\text{Air to add} = \frac{Q_G}{\%_{G(\text{new gas reading})}} - Q_R$$

To find the **total volume** of air, do not subtract the return air volume.



Algebraic Circle