

THE MATHEMATICS OF MINE VENTILATION

Mathematics is used continuously in underground mines from simple tonnage figures to complex hydrostatic flow calculations. For the most part the foreman will use math to calculate ventilation quantities. The foreman's test will include all types of ventilation as well as other math problems that may come up in mining.

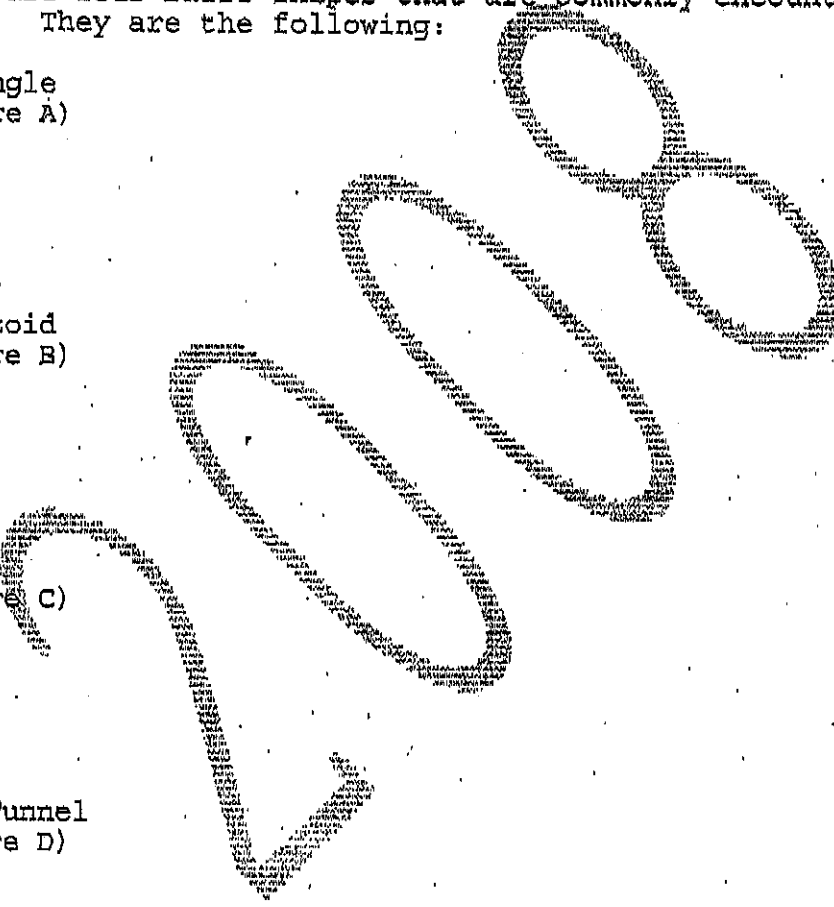
There are four basic shapes that are commonly encountered in mines. They are the following:

Rectangle
(Figure A)

Trapezoid
(Figure B)

Circle
(Figure C)

Arch Tunnel
(Figure D)



The formula for an arch tunnel (fig. D) combines calculations for both the circle and the rectangle.

$$O = \frac{\text{perimeter of circle}}{2} + w + h + h$$

(example)

Find the perimeter of an arch tunnel with a height of 8' on the side and a width of 18'. From this problem we know that the value h will equal 8', and that the perimeter is the same as the width which is 18. We first find the perimeter of the circle which is

$$O = \pi (18)$$

$$O = 56.5 \text{ and } 56.5 \div 2 = 28.25 \text{ Now we use the formula}$$

$$O = \frac{\text{perimeter of circle}}{2} + w + h + h$$

$$O = 28.25 + 18 + 8 + 8$$

$$O = 62.25 \text{ feet}$$

AREA

The area of a figure is measured in square units, this is sometimes written as ft² or square feet.

The formula for finding the area of a rectangle (fig. A) is h x w

(example)

Find the area of an entry that is 18' wide and 9' high.

$$A = h \times w$$

$$A = 9 \times 18$$

$$A = 162 \text{ ft}^2$$

The formula for area of a trapezoid is $\frac{w_1 + w_2}{2} \times h$

(example)

Find the area of an entry where the roof is 18 feet wide and the floor is 22 feet wide with a height of 9 feet.

$$A = \frac{w_1 + w_2}{2} \times h$$

$$A = \left\{ \frac{(18 + 22)}{2} \right\} \times 9 \quad A = \frac{18 + 22}{2} \times 9$$

$$A = 90 \text{ ft}^2$$

The formula for the area of a circle is $\pi \times r^2$
 r meaning radius is the distance from the center of a circle to the outside. Radius is half the distance of the diameter.

(example)

Find the area of a bore hole that has a diameter of 12 foot. Since r is half of d and the diameter of the borehole is 12 then the r is 6. Using the formula:

$$A = \pi r^2$$

$$A = \pi 6^2 \text{ or } A = \pi \times (6 \times 6)$$

$$A = 3.14 \times 36$$

$$A = 113.10 \text{ ft}^2$$

The area of an arch tunnel can be calculated by the formula

$$A = \frac{\pi r^2}{2} + (h \times w)$$

(example)

Find the area of an arch tunnel that has a width of 18' and a side height of 8'

$$A = \frac{\pi r^2}{2} + (h \times w)$$

$$A = \frac{3.14 \times 8^2}{2} + (8 \times 18)$$

$$A = 100.53 + 144$$

$$A = 244.53 \text{ ft}^2$$

QUANTITY

Quantity is measured in cubic feet per minute written as ft^3/min .

This can be calculated by taking the area of an entry and multiplying it by the velocity of the air in that entry. The formula for this is $Q = A \times V$, with Q meaning Quantity, and V meaning Velocity.

(example)

Find the quantity of air in an arch entry that is 18' wide and 8' high on the side that has a velocity of 215 feet per minute. By calculating the area of this entry we know that it is equal to 244.53 and then multiplying this by the velocity of 215 feet per minute we get our answer of 52,574 ft^3/min .

$$Q = A \times V$$

$$Q = 244.53 \times 215$$

$$Q = 52,574 \text{ ft}^3/\text{min}$$

PERIMETER

When calculating the perimeter of any shape you are measuring the distance around the outside of that shape.

The formula for a rectangle (fig. A) is $O = w + h + w + h$
 w standing for the width of the entry
 h standing for the height of the entry
 O standing for the perimeter

(example)

Find the perimeter of an entry that is 18' wide and 8' high.

$$O = w + h + w + h$$

$$O = 18' + 8' + 18' + 8'$$

$$O = 52 \text{ feet}$$

The formula for a trapezoid (fig. B) is $O = w_1 + w_2 + s_1 + s_2$
 s stands for the side
 The 1 and 2 differentiate between sides of the same figure.

(example)

Find the perimeter of a trapezoid with the following measurements:

$$w_1 = 21' \quad w_2 = 18' \quad s_1 = 8' \quad s_2 = 9'$$

$$O = 21' + 18' + 8' + 9'$$

$$O = 56 \text{ feet}$$

The formula for a circle (fig. C) is $\pi \times d$.
 π standing for a set number of 1.1415927..., however most often the value used is 3.14.
 "d" stands for diameter or the distance from one side to the opposite through the center of a circle.

(example)

Find the perimeter of a circle with a diameter of 8'

$$O = \pi \times 8'$$

$$O = 3.14 \times 8'$$

$$O = 25.13 \text{ feet}$$