Photographic Interpretation Handbook, United States Forces: Section 05 Formulae

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CIRCUMFERENCE OF A CIRCLE = $2\pi R$

AREA OF A CIRCLE = $\pi R^2$

Where: $\pi = 3.1416$

$R =$ radius of circle

AREA OF A TRAPEZOID = $\frac{a + b}{2} h$

Where: $a$ and $b$ are the lengths of the parallel sides and $h$ is the distance between.

AREA OF AN ELLIPSE = $\pi ab$

Where: $a$ and $b$ are the semi-axes

SURFACE OF A CONE = $\pi Rs$

Where: $R =$ radius of base

$s =$ slant height

VOLUME OF A PYRAMID OR CONE = $\frac{1}{3} bh$

Where: $b =$ area of base

$h =$ height of pyramid or cone

SURFACE OF A CYLINDER = $2\pi Rh$

Where: $R =$ radius

$h =$ height

VOLUME OF A CYLINDER = $\pi R^2 h$

VOLUME OF A PRISM = $bh$

Where: $b =$ area of base

$h =$ height of prism

SURFACE OF A SPHERE = $4\pi R^2$

VOLUME OF A SPHERE = $\frac{4}{3} \pi R^3$
FORMULAE

TRIGONOMETRIC

RIGHT TRIANGLE

\[
\sin A = \frac{a}{c} = \cos B \quad \tan A = \frac{a}{b} = \cot B \quad \sec A = \frac{c}{a} = \csc B \\
\cos A = \frac{b}{c} = \sin B \quad \cot A = \frac{b}{a} = \tan B \quad \cosec A = \frac{c}{b} = \sec B \\
A + B = 90^\circ \quad a^2 + b^2 = c^2
\]

OBLIQUE TRIANGLE

If two angles and a side are known, or if three sides are known, the remaining angles and sides can be determined.

\[
A + B + C = 180^\circ \\
\sin A = \frac{a}{c} = \sin B \quad \sin C = \frac{c}{a} = \sin (A + C) = \sin (A + B) \\
s^2 = a^2 + b^2 - 2ab \cos C \\
A = \sqrt{(s-b)(s-c)} \\
Area = \frac{s(s-a)(s-b)(s-c)}{bc} = \frac{ab \sin B \sin C}{2 \sin A}
\]

GENERAL TRIGONOMETRIC RELATIONS

\[
\tan A = \frac{\sin A}{\cos A} \quad \tan A = \frac{\sin 2A}{1 + \cos 2A} \quad \tan 2A = \frac{2 \tan A}{1 - \tan^2 A} \\
\sin^2 A + \cos^2 A = 1 \quad \sin 2A = 2 \sin A \cos A \quad \cos 2A = \cos^2 A - \sin^2 A \\
\sin A = \cos (90^\circ - A) = \sin (180^\circ - A)
\]
FORMULAE
PHOTOGRAMMETRIC (CONT.)

HEIGHT FROM SHADOW

\[
\sin x = \cos a \times \cos b \times \cos c = \sin a \times \sin b
\]

\[
h_o = L \times \tan x
\]

\[
\frac{\sin c}{\sin N} = \frac{\cos x}{\cos a}
\]

\[
\sin x = \cos b \times \cos N \sqrt{\cos^2 a - \cos^2 b \times \sin^2 N} \quad \sin a \times \sin b
\]

\[
\frac{1 - \cos^2 b \times \sin^2 N}
\]

Where:
- \(x\) = angle of elevation of sun
- \(a\) = declination of latitude of sun
- \(b\) = latitude of photograph
- \(c\) = difference in longitude between sun and photograph
- \(h_o\) = height of object casting shadow
- \(L\) = length of shadow on level ground
- \(N\) = angle between shadow direction and north-south direction