

## Plane Geometry

**Circle**

Circumference =  $2\pi r$   
 Area =  $\pi r^2$



**Ellipse**

Area =  $\pi ab$



**Rectangle**

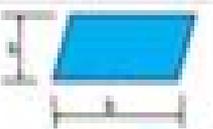
Perimeter =  $2a + 2b$   
 Area =  $ab$



## Material Properties

**Parallelogram**

Area =  $ab$



**Triangle**

Area =  $\frac{1}{2}bh$

$a^2 = b^2 + c^2 - 2bc \cos A$   
 $b^2 = a^2 + c^2 - 2ac \cos B$   
 $c^2 = a^2 + b^2 - 2ab \cos C$

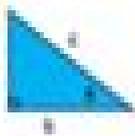


**Stress (axial)**

$\sigma = \frac{F}{A}$

**Right Triangle**

$a^2 + b^2 = c^2$   
 $\sin \theta = \frac{a}{c}$   
 $\cos \theta = \frac{b}{c}$   
 $\tan \theta = \frac{a}{b}$



**Regular Polygon**

Area =  $\frac{n \cdot s^2}{4 \cdot \tan(\frac{\pi}{n})}$

n = number of sides



$\sigma$  = stress  
 $F$  = axial force  
 $A$  = cross-sectional area

**Trapezoid**

Area =  $\frac{1}{2}(a+b)h$



**Strain (axial)**

$\epsilon = \frac{\Delta L}{L_0}$

$\epsilon$  = strain  
 $L_0$  = original length  
 $\Delta$  = change in length

## Solid Geometry

**Cube**

Volume =  $s^3$   
 Surface Area =  $6s^2$



**Sphere**

Volume =  $\frac{4}{3}\pi r^3$   
 Surface Area =  $4\pi r^2$



## Modulus of Elasticity

**Rectangular Prism**

Volume =  $whl$   
 Surface Area =  $2(wh + wl + hl)$



**Cylinder**

Volume =  $\pi r^2 h$   
 Surface Area =  $2\pi r^2 + 2\pi rh$



$E = \frac{\sigma}{\epsilon}$

$E = \frac{dF/dL}{(L_1 - L_0)/L_0}$

$E$  = modulus of elasticity  
 $\sigma$  = stress  
 $\epsilon$  = strain

**Right Circular Cone**

Volume =  $\frac{\pi r^2 h}{3}$   
 Surface Area =  $\pi r \sqrt{r^2 + h^2}$



**Angular Prism**

Volume =  $ah$

A = area of base



$E$  = modulus of elasticity  
 $\sigma$  = stress  
 $\epsilon$  = strain  
 $A$  = cross-sectional area  
 $F$  = axial force  
 $L_0$  = original length  
 $\Delta$  = deformation

**Pyramid**

Volume =  $\frac{Ah}{3}$

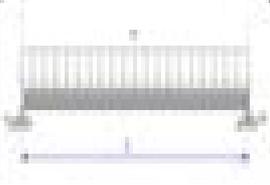
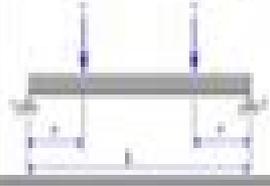
A = area of base



**Constants**

$g = 9.8 \text{ m/s}^2 = 32.17 \text{ ft/s}^2$   
 $G = 6.67 \times 10^{-11} \text{ m}^3/\text{kg s}^2$   
 $\pi = 3.14159$

## Structural Analysis

Beam Formula	Reaction	Moment	Deflection
	$R_1 = R_2 = \frac{P}{2}$	$M_{max} = \frac{Pa}{2}$ (at point of load)	$\Delta_{max} = \frac{Pa^2}{6EI}$ (at point of load)
	$R_1 = R_2 = \frac{wL}{2}$	$M_{max} = \frac{wL^2}{8}$ (at center)	$\Delta_{max} = \frac{5wL^4}{384EI}$ (at center)
	$R_1 = R_2 = P$	$M_{max} = P_1 a$ (between loads)	$\Delta_{max} = \frac{P_1 a^2}{24EI} (3L^2 - 4a^2)$ (at center)
	$R_1 = \frac{Pb}{L}$ and $R_2 = \frac{Pa}{L}$	$M_{max} = \frac{Pab}{L}$ (at Point of Load)	$\Delta_{max} = \frac{Pab(L^2 - a^2 - b^2)}{24EI}$ (at $x = \sqrt{\frac{a^2 b^2}{L}}$ when $a > b$ )

**Deformation: Axial**

$\Delta = \frac{FL_0}{AE}$

$\Delta$  = deformation  
 $F$  = axial force  
 $L_0$  = original length  
 $A$  = cross-sectional area  
 $E$  = modulus of elasticity

**Truss Analysis**

$2J = M + R$

J = number of joints  
 M = number of members  
 R = number of reaction forces

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web release set screws b and c place 2 wood block k in the position shown and withdraw spindle in direction of arrow x the pulley will side off the spindle when it abuls against the wood block if any difficulty is experienced the spindle should be given a sharp knock re assemble new spindle passing it through the front bearing and

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