Important Cam and Follower Formulas PDF

Formulas
Examples
with Units

List of 19
Important Cam and Follower Formulas

1) Follower Motion Formulas

1.1) Condition for Maximum Acceleration of Follower Exhibiting Cycloidal Motion Formula

Evaluate Formula

Formula

$$\theta_{rotation} = \frac{\theta_o}{4}$$

Example with Units

$$0.349\,\text{rad} = \frac{1.396\,\text{rad}}{4}$$

1.2) Condition for Maximum Velocity of Follower Exhibiting Cycloidal Motion Formula

Evaluate Formula

Formula

$$\theta_{rotation} = \frac{\theta_o}{2}$$

Example with Units

$$0.698\,\text{rad} = \frac{1.396\,\text{rad}}{2}$$

1.3) Displacement of Follower after Time t for Cycloidal Motion Formula

Evaluate Formula

Formula

$$d_{follower} = S \cdot \left(\frac{\theta_{rotation}}{\theta_o} \cdot \frac{180}{\pi} - \sin\left(\frac{2 \cdot \pi \cdot \theta_{rotation}}{\theta_o} \right) \right)$$

Example with Units

$$266.4789\,\text{m} = 20\,\text{m} \cdot \left(\frac{0.349\,\text{rad}}{1.396\,\text{rad}} \cdot \frac{180}{3.1416} - \sin\left(\frac{2 \cdot 3.1416 \cdot 0.349\,\text{rad}}{1.396\,\text{rad}} \right) \right)$$

1.4) Displacement of Follower for Circular Arc Cam, there's Contact on Circular Flank Formula

Evaluate Formula

Formula

$$d_{follower} = \left(r_{Base} - r_1 \right) \cdot \left(1 - \cos\left(\theta_{turned} \right) \right)$$

Example with Units

$$266.4045\,\text{m} = \left(139.45\,\text{m} - 3\,\text{m} \right) \cdot \left(1 - \cos\left(2.8318\,\text{rad} \right) \right)$$

1.5) Mean Velocity of Follower during Outstroke at Uniform Acceleration Formula

Evaluate Formula

Formula

$$V_{mean} = \frac{S}{t_o}$$

Example with Units

$$386.8173\,\text{m/s} = \frac{20\,\text{m}}{0.051704\,\text{s}}$$

1.6) Mean Velocity of Follower during Return Stroke at Uniform Acceleration Formula

Evaluate Formula

Formula

$$V_{mean} = \frac{S}{t_R}$$

Example with Units

$$386.8472\,\text{m/s} = \frac{20\,\text{m}}{0.0517\,\text{s}}$$

1.7) Peripheral Speed of Projection of Point P' (Projection of Point P on Dia) for SHM of Follower Formula

Evaluate Formula

Formula

$$P_s = \frac{\pi \cdot S \cdot \omega}{2 \cdot \theta_o}$$

Example with Units

$$607.6146\,\text{m/s} = \frac{3.1416 \cdot 20\,\text{m} \cdot 27\,\text{rad/s}}{2 \cdot 1.396\,\text{rad}}$$

1.8) Peripheral Speed of Projection of Point P on Diameter for SHM of Follower Formula

Evaluate Formula

Formula

$$P_s = \frac{\pi \cdot S}{2 \cdot t_o}$$

Example with Units

$$607.6111\,\text{m/s} = \frac{3.1416 \cdot 20\,\text{m}}{2 \cdot 0.051704\,\text{s}}$$

1.9) Time Required by Follower for Return Stroke at Uniform Acceleration Formula

Evaluate Formula

Formula

$$t_R = \frac{\theta_R}{\omega}$$

Example with Units

$$0.0517\,\text{s} = \frac{1.3959\,\text{rad}}{27\,\text{rad/s}}$$

1.10) Time Required for Follower during Outstroke for Uniform Acceleration Formula

Evaluate Formula

Formula

$$t_o = \frac{\theta_o}{\omega}$$

Example with Units

$$0.0517\,\text{s} = \frac{1.396\,\text{rad}}{27\,\text{rad/s}}$$

1.11) Time Required for Out Stroke of Follower when Follower Moves with SHM Formula

Evaluate Formula

Formula

$$t_o = \frac{\theta_o}{\omega}$$

Example with Units

$$0.0517\,\text{s} = \frac{1.396\,\text{rad}}{27\,\text{rad/s}}$$

1.12) Velocity of Follower after Time t for Cycloidal Motion Formula

Evaluate Formula

Formula

$$v = \frac{\omega \cdot S}{\theta_o} \cdot \left(1 - \cos\left(\frac{2 \cdot \pi \cdot \theta_{rotation}}{\theta_o}\right)\right)$$

Example with Units

$$386.8195\,\text{m/s} = \frac{27\,\text{rad/s} \cdot 20\,\text{m}}{1.396\,\text{rad}} \cdot \left(1 - \cos\left(\frac{2 \cdot 3.1416 \cdot 0.349\,\text{rad}}{1.396\,\text{rad}}\right)\right)$$

1.13) Velocity of Follower for Circular Arc Cam if Contact is on Circular Flank Formula

Evaluate Formula

Formula

$$v = \omega \cdot \left(R - r_1\right) \cdot \sin\left(\theta_{turned}\right)$$

Example with Units

$$386.8688\,\text{m/s} = 27\,\text{rad/s} \cdot \left(50\,\text{m} - 3\,\text{m}\right) \cdot \sin\left(2.8318\,\text{rad}\right)$$

2) Tangent Cam Formulas

2.1) Condition for Contact of Roller if Straight Flank Merges into Nose Tangent Cam with Roller Follower Formula

Evaluate Formula

Formula

$$\theta_1 = \alpha - \varphi$$

Example with Units

$$0.785\,\text{rad} = 1.285\,\text{rad} - 0.5\,\text{rad}$$

2.2) Displacement of Needle for Tangent Cam with Needle-Bearing Follower Formula

Evaluate Formula

Formula

$$d_{needle} = \left(r_1 + r_{roller}\right) \cdot \left(\frac{1 - \cos\left(\theta\right)}{\cos\left(\theta\right)}\right)$$

Example with Units

$$2.4042\,\text{m} = \left(3\,\text{m} + 33.37\,\text{m}\right) \cdot \left(\frac{1 - \cos\left(170\,\text{rad}\right)}{\cos\left(170\,\text{rad}\right)}\right)$$

2.3) Displacement of Roller of Tangent Cam with Roller Follower, when there's Nose Contact Formula

Evaluate Formula

Formula

$$d_{roller} = L + r - r \cdot \cos\left(\theta_1\right) - \sqrt{L^2 - r^2 \cdot \left(\sin\left(\theta_1\right)\right)^2}$$

Example with Units

$$6.1915\,\text{m} = 33.89\,\text{m} + 15.192\,\text{m} - 15.192\,\text{m} \cdot \cos\left(0.785\,\text{rad}\right) - \sqrt{33.89\,\text{m}^2 - 15.192\,\text{m}^2 \cdot \left(\sin\left(0.785\,\text{rad}\right)\right)^2}$$

2.4) Distance between Roller Center and Nose Center of Tangent Cam with Roller Follower Formula

Evaluate Formula

Formula

$$L = r_{roller} + r_{nose}$$

Example with Units

$$33.89\,\text{m} = 33.37\,\text{m} + 0.52\,\text{m}$$

2.5) Velocity of Follower for Roller Follower Tangent Cam if Contact is with Straight Flanks Formula

Evaluate Formula

Formula

$$v = \omega \cdot \left(r_1 + r_{roller} \right) \cdot \frac{\sin\left(\theta \right)}{\left(\cos\left(\theta \right) \right)^2}$$

Example with Units

$$386.8983\,\text{m/s} = 27\,\text{rad/s} \cdot \left(3\,\text{m} + 33.37\,\text{m} \right) \cdot \frac{\sin\left(170\,\text{rad} \right)}{\left(\cos\left(170\,\text{rad} \right) \right)^2}$$

2.6) Velocity of Follower of Roller Follower Tangent Cam for Contact with Nose Formula

Evaluate Formula

Formula

$$v = \omega \cdot r \cdot \left(\sin\left(\theta_1 \right) + \frac{r \cdot \sin\left(2 \cdot \theta_1 \right)}{2 \cdot \sqrt{L^2 - r^2 \cdot \left(\sin\left(\theta_1 \right) \right)^2}} \right)$$

Example with Units

$$386.8601\,\text{m/s} = 27\,\text{rad/s} \cdot 15.192\,\text{m} \cdot \left(\sin\left(0.785\,\text{rad} \right) + \frac{15.192\,\text{m} \cdot \sin\left(2 \cdot 0.785\,\text{rad} \right)}{2 \cdot \sqrt{33.89\,\text{m}^2 - 15.192\,\text{m}^2 \cdot \left(\sin\left(0.785\,\text{rad} \right) \right)^2}} \right)$$

Variables used in list of Cam and Follower Formulas above

- $d_{follower}$ Displacement of Follower *(Meter)*
- d_{needle} Displacement of Needle *(Meter)*
- d_{roller} Displacement of Roller *(Meter)*
- **L** Distance b/w Roller Centre and Nose Centre *(Meter)*
- P_s Peripheral Speed *(Meter per Second)*
- **r** Distance b/w Cam Center and Nose Center *(Meter)*
- **R** Radius of Circular Flank *(Meter)*
- r_1 Radius of the Base Circle *(Meter)*
- r_{Base} Base Radius of Truncated Cone *(Meter)*
- r_{nose} Radius of Nose *(Meter)*
- r_{roller} Radius of Roller *(Meter)*
- **S** Stroke of Follower *(Meter)*
- t_o Time Required for the Outstroke *(Second)*
- t_R Time Required for the Return Stroke *(Second)*
- **v** Velocity *(Meter per Second)*
- V_{mean} Mean Velocity *(Meter per Second)*
- **α** Angle of Ascent *(Radian)*
- **θ** Angle Turned by Cam from Beginning of Roller *(Radian)*
- θ_1 Angle Turned by Cam when Roller is at Nose Top *(Radian)*
- θ_o Angular Displacement of Cam during Out Stroke *(Radian)*
- θ_R Angular Displacement of Cam during Return Stroke *(Radian)*
- $\theta_{rotation}$ Angle through Cam Rotates *(Radian)*
- θ_{turned} Angle Turned by Cam *(Radian)*
- **φ** Angle Turned by the Cam for Contact of Roller *(Radian)*
- **ω** Angular Velocity of Cam *(Radian per Second)*

Constants, Functions, Measurements used in list of Cam and Follower Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **cos**, cos(Angle) *Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.*
- Functions: **sin**, sin(Angle) *Sine is a trigonometric function that describes the ratio of the length of the opposite side of a right triangle to the length of the hypotenuse.*
- Functions: **sqrt**, sqrt(Number) *A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- Measurement: **Length** in Meter (m) *Length Unit Conversion*
- Measurement: **Time** in Second (s) *Time Unit Conversion*
- Measurement: **Speed** in Meter per Second (m/s) *Speed Unit Conversion*
- Measurement: **Angle** in Radian (rad) *Angle Unit Conversion*
- Measurement: **Angular Velocity** in Radian per Second (rad/s) *Angular Velocity Unit Conversion*

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