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Design of Bevel Gears Formulas

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List of 20 Design of Bevel Gears Formulas

Design of Bevel Gears

Force Distribution

1) Axial or Thrust Component of Force on Bevel Gear

Open Calculator

fx $$P_a = P_t \cdot \tan(\alpha_{Bevel}) \cdot \sin(\gamma)$$

ex $$260.0084\text{N} = 743.1\text{N} \cdot \tan(22^\circ) \cdot \sin(60^\circ)$$

2) Radial Force Component Acting on Bevel Gear

Open Calculator

fx $$P_r = P_t \cdot \tan(\alpha_{Bevel}) \cdot \cos(\gamma)$$

ex $$150.1159\text{N} = 743.1\text{N} \cdot \tan(22^\circ) \cdot \cos(60^\circ)$$

3) Range ratio in preferred Series

Open Calculator

fx $$R = \frac{UL}{LL}$$

ex $$9.90099 = \frac{100}{10.1\text{m}}$$

4) Tangential Force on Bevel Gear Teeth

Open Calculator

fx $$P_t = \frac{M_t}{r_m}$$

ex $$743.1304\text{N} = \frac{17092\text{N*mm}}{23\text{mm}}$$

Geometric Properties

5) Actual Number of Teeth on Bevel Gear

Open Calculator

$$z_g = z' \cdot \cos(\gamma)$$

$$12 = 24 \cdot \cos(60°)$$

6) Back Cone Radius of Bevel Gear

Open Calculator

$$r_b = \frac{m \cdot z'}{2}$$

$$66.024\text{mm} = \frac{5.502\text{mm} \cdot 24}{2}$$

7) Cone Distance of Bevel Gear

Open Calculator

$$A_0 = \sqrt{\left(\frac{D_p}{2}\right)^2 + \left(\frac{D_g}{2}\right)^2}$$

$$70.0206\text{mm} = \sqrt{\left(\frac{76.5\text{mm}}{2}\right)^2 + \left(\frac{117.3\text{mm}}{2}\right)^2}$$

8) Geometric step ratio

Open Calculator

$$a = R^{\frac{1}{n-1}}$$

$$1.584893 = (10)^{\frac{1}{6-1}}$$

9) Radius of Pinion at Midpoint along Face Width for Bevel Gear

Open Calculator

fx $$r_m = \frac{D_p - (b \cdot \sin(\gamma))}{2}$$

ex $$23.09456\text{mm} = \frac{76.5\text{mm} - (35\text{mm} \cdot \sin(60^\circ))}{2}$$

10) Radius of Pinion at Midpoint given Torque and Tangential Force for Bevel Gear

Open Calculator

fx $$r_m = \frac{M_t}{P_t}$$

ex $$23.00094\text{mm} = \frac{17092\text{N*mm}}{743.1\text{N}}$$

11) Virtual or Formative Number of Teeth of Bevel Gear

Open Calculator

fx $$z' = \frac{2 \cdot r_b}{m}$$

ex $$23.99128 = \frac{2 \cdot 66\text{mm}}{5.502\text{mm}}$$

Material Properties

12) Beam Strength of Tooth of Bevel Gear

Open Calculator

fx $$S_b = m \cdot b \cdot \sigma_b \cdot Y \cdot \left(1 - \frac{b}{A_0}\right)$$

ex $$5700.072\text{N} = 5.502\text{mm} \cdot 35\text{mm} \cdot 185\text{N/mm}^2 \cdot 0.320 \cdot \left(1 - \frac{35\text{mm}}{70\text{mm}}\right)$$

13) Material Constant for Bevel Gear Wear Strength

Open Calculator

fx $$K = \frac{\sigma_c^2 \cdot \sin(\alpha_{Bevel}) \cdot \cos(\alpha_{Bevel}) \cdot \left(\frac{1}{E_p} + \frac{1}{E_g}\right)}{1.4}$$

ex $$2.50552\text{N/mm}^2 = \frac{(350\text{N/mm}^2)^2 \cdot \sin(22^\circ) \cdot \cos(22^\circ) \cdot \left(\frac{1}{20600\text{N/mm}^2} + \frac{1}{29500\text{N/mm}^2}\right)}{1.4}$$

14) Material Constant for Bevel Gear Wear Strength given Brinell Hardness Number

Open Calculator

fx $$K = 0.16 \cdot \left(\frac{BHN}{100}\right)^2$$

ex $$2.509056\text{N/mm}^2 = 0.16 \cdot \left(\frac{396}{100}\right)^2$$

15) Wear Strength of Bevel Gear by Buckingham's Equation

Open Calculator

fx $$S_w = \frac{0.75 \cdot b \cdot Q_b \cdot D_p \cdot K}{\cos(\gamma)}$$

ex $$15060.94\text{N} = \frac{0.75 \cdot 35\text{mm} \cdot 1.5 \cdot 76.5\text{mm} \cdot 2.5\text{N/mm}^2}{\cos(60^\circ)}$$

Performance Factors

16) Bevel Factor

Open Calculator

fx $$B_f = 1 - \frac{b}{A_0}$$

ex $$0.5 = 1 - \frac{35\text{mm}}{70\text{mm}}$$

17) Power Transmitted

Open Calculator

fx $$W_{shaft} = 2 \cdot \pi \cdot N \cdot \tau$$

ex $$4.913451\text{kW} = 2 \cdot \pi \cdot 17/\text{s} \cdot 46\text{N*m}$$

18) Ratio Factor for Bevel Gear

Open Calculator

fx $$Q_b = \frac{2 \cdot z_g}{z_g + z_p \cdot \tan(\gamma)}$$

ex $$1.071797 = \frac{2 \cdot 12}{12 + 6 \cdot \tan(60^\circ)}$$

19) Velocity Factor for Cut Teeth of Bevel Gear

Open Calculator

fx $$C_{v\ cut} = \frac{6}{6 + v}$$

ex $$0.75 = \frac{6}{6 + 2\text{m/s}}$$

20) Velocity Factor for Generated Teeth of Bevel Gear

Open Calculator

fx $$C_{v\ gen} = \frac{5.6}{5.6 + \sqrt{v}}$$

ex $$0.798379 = \frac{5.6}{5.6 + \sqrt{2\text{m/s}}}$$

Variables Used

- **a** Geometric step ratio
- **A_0** Cone Distance *(Millimeter)*
- **b** Face Width of Bevel Gear Tooth *(Millimeter)*
- **B_f** Bevel Factor
- **BHN** Brinell Hardness Number for Bevel Gear
- **$C_{v\ cut}$** Velocity Factor for Cut Teeth
- **$C_{v\ gen}$** Velocity Factor for Generated Teeth
- **D_g** Pitch Circle Diameter of Gear *(Millimeter)*
- **D_p** Pitch Circle Diameter of Bevel Pinion *(Millimeter)*
- **E_g** Modulus of Elasticity of Spur Gear *(Newton per Square Millimeter)*
- **E_p** Modulus of Elasticity of Spur Pinion *(Newton per Square Millimeter)*
- **K** Material Constant *(Newton per Square Millimeter)*
- **LL** Minimum dimension/rating of product *(Meter)*
- **m** Module of Bevel Gear *(Millimeter)*
- **M_t** Torque Transmitted by Bevel Pinion *(Newton Millimeter)*
- **n** Quantity of product
- **N** Speed of Rotation *(1 per Second)*
- **P_a** Axial or Thrust Component on Bevel Gear *(Newton)*
- **P_r** Radial Force on Bevel Gear *(Newton)*
- **P_t** Tangential Force Transmitted by Bevel Gear *(Newton)*
- **Q_b** Ratio Factor for Bevel Gear
- **R** Range ratio in preferred Series
- **r_b** Back Cone Radius *(Millimeter)*
- **r_m** Radius of Pinion at Midpoint *(Millimeter)*
- **S_b** Beam Strength of Bevel Gear Teeth *(Newton)*

- S_w Wear Strength of Bevel Gear Tooth *(Newton)*
- **UL** Maximum dimension/rating of product
- **v** Pitch Line Velocity of Bevel Gear *(Meter per Second)*
- W_{shaft} Shaft Power *(Kilowatt)*
- **Y** Lewis Form Factor
- z_g Number of Teeth on Bevel Gear
- z_p Number of Teeth on Pinion
- z' Virtual Number of Teeth for Bevel Gear
- α_{Bevel} Pressure Angle *(Degree)*
- γ Pitch Angle for Bevel Gear *(Degree)*
- σ_b Bending Stress in Bevel Gear Teeth *(Newton per Square Millimeter)*
- σ_c Compressive Stress in Bevel Gear Tooth *(Newton per Square Millimeter)*
- **T** Torque applied *(Newton Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Function: **cos**, cos(Angle)
  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: **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.
- Function: **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.
- Function: **tan**, tan(Angle)
  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: **Length** in Meter (m), Millimeter (mm)
  Length Unit Conversion
- Measurement: **Pressure** in Newton per Square Millimeter (N/mm²)
  Pressure Unit Conversion
- Measurement: **Speed** in Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Power** in Kilowatt (kW)
  Power Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Angle** in Degree (°)
  Angle Unit Conversion
- Measurement: **Torque** in Newton Millimeter (N*mm), Newton Meter (N*m)
  Torque Unit Conversion
- Measurement: **Vorticity** in 1 per Second (1/s)
  Vorticity Unit Conversion

- Measurement: **Stress** in Newton per Square Millimeter (N/mm²)
  Stress Unit Conversion

Check other formula lists

- **Design of Bevel Gears Formulas**
- **Design of Helical Gears Formulas**

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