Important Saddle Support Formulas PDF

Formulas
Examples
with Units

List of 12
Important Saddle Support Formulas

1) Bending Moment at Centre of Vessel Span Formula

Evaluate Formula

Formula

$$M_2 = \frac{Q \cdot L}{4} \cdot \left(\left(\frac{1 + 2 \cdot \left(\frac{\left(R_{vessel} \right)^2 - \left(Depth_{Head} \right)^2}{L^2} \right)}{1 + \left(\frac{4}{3} \right) \cdot \left(\frac{Depth_{Head}}{L} \right)} \right) - \frac{4 \cdot A}{L} \right)$$

Example with Units

$$2.8E{+}12\,\text{N*mm} = \frac{675098\,\text{N} \cdot 23399\,\text{mm}}{4} \cdot \left(\left(\frac{1 + 2 \cdot \left(\frac{\left(1539\,\text{mm} \right)^2 - \left(1581\,\text{mm} \right)^2}{23399\,\text{mm}^2} \right)}{1 + \left(\frac{4}{3} \right) \cdot \left(\frac{1581\,\text{mm}}{23399\,\text{mm}} \right)} \right) - \frac{4 \cdot 1210\,\text{mm}}{23399\,\text{mm}} \right)$$

2) Bending Moment at Support Formula

Evaluate Formula

Formula

$$M_1 = Q \cdot A \cdot \left((1) - \left(\frac{1 - \left(\frac{A}{L} \right) + \left(\frac{\left(R_{vessel} \right)^2 - \left(Depth_{Head} \right)^2}{2 \cdot A \cdot L} \right)}{1 + \left(\frac{4}{3} \right) \cdot \left(\frac{Depth_{Head}}{L} \right)} \right) \right)$$

Example with Units

$$1.1E{+}8\,\text{N*mm} = 675098\,\text{N} \cdot 1210\,\text{mm} \cdot \left((1) - \left(\frac{1 - \left(\frac{1210\,\text{mm}}{23399\,\text{mm}} \right) + \left(\frac{\left(1539\,\text{mm} \right)^2 - \left(1581\,\text{mm} \right)^2}{2 \cdot 1210\,\text{mm} \cdot 23399\,\text{mm}} \right)}{1 + \left(\frac{4}{3} \right) \cdot \left(\frac{1581\,\text{mm}}{23399\,\text{mm}} \right)} \right) \right)$$

3) Combined Stresses at Bottommost Fibre of Cross Section Formula

Evaluate Formula

Formula

$$f_{cs2} = f_{cs1} - f_2$$

Example with Units

$$61.19\,\text{N/mm²} = 61.19\,\text{N/mm²} - 0.0000044\,\text{N/mm²}$$

4) Combined Stresses at Mid Span Formula

Evaluate Formula

Formula

$$f_{cs3} = f_{cs1} + f_3$$

Example with Units

$$87.19\,\text{N/mm}^2 = 61.19\,\text{N/mm}^2 + 26\,\text{N/mm}^2$$

5) Combined Stresses at Topmost Fibre of Cross Section Formula

Evaluate Formula

Formula

$$f_{1cs} = f_{cs1} + f_1$$

Example with Units

$$61.197\,\text{N/mm}^2 = 61.19\,\text{N/mm}^2 + 0.007\,\text{N/mm}^2$$

6) Corresponding Bending Stress with Section Modulus Formula

Evaluate Formula

Formula

$$f_{wb} = \frac{M_w}{Z}$$

Example with Units

$$0.9013\,\text{N/mm}^2 = \frac{370440000\,\text{N*mm}}{411000000\,\text{mm}^3}$$

7) Period of Vibration at Dead Weight Formula

Evaluate Formula

Formula

$$T = 6.35 \cdot 10^{-5} \cdot \left(\frac{H}{D}\right)^{\frac{3}{2}} \cdot \left(\frac{\Sigma Weight}{t_{vesselwall}}\right)^{\frac{1}{2}}$$

Example with Units

$$0.0128\,\text{s} = 6.35 \cdot 10^{-5} \cdot \left(\frac{12000\,\text{mm}}{600\,\text{mm}}\right)^{\frac{3}{2}} \cdot \left(\frac{35000\,\text{N}}{6890\,\text{mm}}\right)^{\frac{1}{2}}$$

8) Stability Coefficient of Vessel Formula

Evaluate Formula

Formula

$$Y = \frac{M_{weight}}{M_w}$$

Example with Units

$$0.0006 = \frac{234999\,\text{N*mm}}{370440000\,\text{N*mm}}$$

9) Stress due to Longitudinal Bending at Bottom most Fibre of Cross Section Formula

Evaluate Formula

Formula

$$f_2 = \frac{M_1}{k_2 \cdot \pi \cdot (R)^2 \cdot t}$$

Example with Units

$$4.4\text{E-}6\,\text{N/mm}^2 = \frac{1000000\,\text{N*mm}}{0.192 \cdot 3.1416 \cdot (1380\,\text{mm})^2 \cdot 200\,\text{mm}}$$

10) Stress due to Longitudinal Bending at Mid-Span Formula

Evaluate Formula

Formula

$$f_3 = \frac{M_2}{\pi \cdot (R)^2 \cdot t}$$

Example with Units

$$26.122\,\text{N/mm}^2 = \frac{31256789045\,\text{N*mm}}{3.1416 \cdot (1380\,\text{mm})^2 \cdot 200\,\text{mm}}$$

11) Stress due to Longitudinal Bending at Top most Fibre of Cross Section Formula

Evaluate Formula

Formula

$$f_1 = \frac{M_1}{k_1 \cdot \pi \cdot \left(R\right)^2 \cdot t}$$

Example with Units

$$0.0078\,\text{N/mm}^2 = \frac{1000000\,\text{N*mm}}{0.107 \cdot 3.1416 \cdot \left(1380\,\text{mm}\right)^2 \cdot 200\,\text{mm}}$$

12) Stress due to Seismic Bending Moment Formula

Evaluate Formula

Formula

$$f_{bendingmoment} = \frac{4 \cdot M_s}{\pi \cdot \left(D_{sk}^{\,2}\right) \cdot t_{sk}}$$

Example with Units

$$0.0131\,\text{N/mm}^2 = \frac{4 \cdot 4400000\,\text{N*mm}}{3.1416 \cdot \left(601.2\,\text{mm}^2\right) \cdot 1.18\,\text{mm}}$$

Variables used in list of Saddle Support Formulas above

- **A** Distance from Tangent Line to Saddle Centre *(Millimeter)*
- **D** Diameter of Shell Vessel Support *(Millimeter)*
- D_{sk} Mean Diameter of Skirt *(Millimeter)*
- $Depth_{Head}$ Depth of Head *(Millimeter)*
- f_1 Stress Bending Moment at Topmost of Cross Section *(Newton per Square Millimeter)*
- f_{1cs} Combined Stresses Topmost Fibre Cross Section *(Newton per Square Millimeter)*
- f_2 Stress at Bottom most Fibre of Cross Section *(Newton per Square Millimeter)*
- f_3 Stress due to Longitudinal Bending at Mid-Span *(Newton per Square Millimeter)*
- $f_{bendingmoment}$ Stress due to Seismic Bending Moment *(Newton per Square Millimeter)*
- f_{cs1} Stress due to Internal Pressure *(Newton per Square Millimeter)*
- f_{cs2} Combined Stresses Bottommost Fibre Cross Section *(Newton per Square Millimeter)*
- f_{cs3} Combined Stresses at Mid Span *(Newton per Square Millimeter)*
- f_{wb} Axial Bending Stress at Base of Vessel *(Newton per Square Millimeter)*
- **H** Overall Height of Vessel *(Millimeter)*
- k_1 Value of k1 depending on Saddle Angle
- k_2 Value of k2 depending on Saddle Angle
- **L** Tangent to Tangent Length of Vessel *(Millimeter)*
- M_1 Bending Moment at Support *(Newton Millimeter)*
- M_2 Bending Moment at Centre of Vessel Span *(Newton Millimeter)*
- M_s Maximum Seismic Moment *(Newton Millimeter)*
- M_w Maximum Wind Moment *(Newton Millimeter)*

Constants, Functions, Measurements used in list of Saddle Support Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Time** in Second (s)
  Time Unit Conversion
- Measurement: **Volume** in Cubic Millimeter (mm^3)
  Volume Unit Conversion
- Measurement: **Force** in Newton (N)
  Force Unit Conversion
- Measurement: **Moment of Force** in Newton Millimeter (N*mm)
  Moment of Force Unit Conversion
- Measurement: **Bending Moment** in Newton Millimeter (N*mm)
  Bending Moment Unit Conversion
- Measurement: **Stress** in Newton per Square Millimeter (N/mm^2)
  Stress Unit Conversion

- M_{weight} Bending Moment due to Minimum Weight of Vessel *(Newton Millimeter)*
- **Q** Total Load per Saddle *(Newton)*
- **R** Shell Radius *(Millimeter)*
- R_{vessel} Vessel Radius *(Millimeter)*
- **t** Shell Thickness *(Millimeter)*
- **T** Period of Vibration at Dead Weight *(Second)*
- t_{sk} Thickness of Skirt *(Millimeter)*
- $t_{vesselwall}$ Corroded Vessel Wall Thickness *(Millimeter)*
- **Y** Stability Coefficient of Vessel
- **Z** Section Modulus of Skirt Cross Section *(Cubic Millimeter)*
- **ΣWeight** Weight of Vessel with Attachments and Contents *(Newton)*

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