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Distortion in Weldments Formulas

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List of 25 Distortion in Weldments Formulas

Distortion in Weldments

Angular Distortion

1) Angular Change when there is Maximum Distortion of Fillet Welds

Open Calculator

fx $$\varphi = \frac{\delta_{max}}{0.25 \cdot L}$$

ex $$1.2\text{rad} = \frac{1.5\text{mm}}{0.25 \cdot 5\text{mm}}$$

2) Angular Distortion at x of Fillet Welds

Open Calculator

fx $$\delta = L \cdot \left(0.25 \cdot \varphi - \varphi \cdot \left(\frac{x}{L} - 0.5\right)^2\right)$$

ex $$0.54\text{mm} = 5\text{mm} \cdot \left(0.25 \cdot 1.2\text{rad} - 1.2\text{rad} \cdot \left(\frac{0.5\text{mm}}{5\text{mm}} - 0.5\right)^2\right)$$

3) Length of Span for Maximum Angular Distortion of Fillet Welds

Open Calculator

fx $$L = \frac{\delta_{max}}{0.25 \cdot \varphi}$$

ex $$5\text{mm} = \frac{1.5\text{mm}}{0.25 \cdot 1.2\text{rad}}$$

4) Maximum Angular Distortion of Fillet Welds

Open Calculator

fx $\delta_{max} = 0.25 \cdot \varphi \cdot L$

ex $1.5\text{mm} = 0.25 \cdot 1.2\text{rad} \cdot 5\text{mm}$

5) Rigidity of Fillet Welds

Open Calculator

fx $R = \frac{E \cdot p_{tb}^3}{12 + \left(1 - \nu^2\right)}$

ex $0.601313\text{Nm/rad} = \frac{15\text{N/m} \cdot (802.87\text{mm})^3}{12 + \left(1 - (0.3)^2\right)}$

Transverse Shrinkage in Joints

Butt Joints

6) Cross-sectional area of weld for given transverse shrinkage in butt joints

Open Calculator

fx $A_w = \frac{p_{tb} \cdot (S_b - 1.27 \cdot d)}{5.08}$

ex $5.499976\text{mm}^2 = \frac{802.87\text{mm} \cdot (0.365\text{mm} - 1.27 \cdot 0.26\text{mm})}{5.08}$

7) Degree of Restraint (Butt joints)

Open Calculator

$$k_s = \left(\frac{1000}{86} \cdot \left(\frac{S}{s} - 1\right)\right)^{\frac{1}{0.87}}$$

$$647.3872 = \left(\frac{1000}{86} \cdot \left(\frac{100\text{mm}}{4\text{mm}} - 1\right)\right)^{\frac{1}{0.87}}$$

8) Depth of First V-groove for Minimum Distortion of Butt Joint

Open Calculator

$$t_1 = \frac{0.62 \cdot t_2 + 0.12 \cdot t_3}{0.38}$$

$$6.294737\text{mm} = \frac{0.62 \cdot 2.6\text{mm} + 0.12 \cdot 6.5\text{mm}}{0.38}$$

9) Depth of Last V-groove for Minimum Distortion of Butt Joint

Open Calculator

$$t_2 = \frac{0.38 \cdot t_1 - 0.12 \cdot t_3}{0.62}$$

$$2.597097\text{mm} = \frac{0.38 \cdot 6.29\text{mm} - 0.12 \cdot 6.5\text{mm}}{0.62}$$

10) Depth of Root Face for Minimum Distortion of Butt Joint

Open Calculator

$$t_3 = \frac{0.38 \cdot t_1 - 0.62 \cdot t_2}{0.12}$$

$$6.485\text{mm} = \frac{0.38 \cdot 6.29\text{mm} - 0.62 \cdot 2.6\text{mm}}{0.12}$$

11) Metal Deposited in First Pass of Welding given Transverse Shrinkage

Open Calculator

$$w_0 = \frac{W}{10^{\frac{S_t - S_0}{b}}}$$

$$4.99\text{g} = \frac{5.14064\text{g}}{10^{\frac{5.30\text{mm} - 2.20\text{mm}}{0.24}}}$$

12) Plate Thickness for given Transverse Shrinkage in Butt Joints

Open Calculator

$$p_{tb} = \frac{5.08 \cdot A_w}{S_b - (1.27 \cdot d)}$$

$$802.8736\text{mm} = \frac{5.08 \cdot 5.5\text{mm}^2}{0.365\text{mm} - (1.27 \cdot 0.26\text{mm})}$$

13) Root Opening given Transverse Shrinkage

Open Calculator

$$d = \frac{S_b - 5.08 \cdot \left(\frac{A_w}{p_{tb}}\right)}{1.27}$$

$$0.26\text{mm} = \frac{0.365\text{mm} - 5.08 \cdot \left(\frac{5.5\text{mm}^2}{802.87\text{mm}}\right)}{1.27}$$

14) Shrinkage of Unrestrained Joint from given Shrinkage of Restrained Butt Joint

Open Calculator

$$S = s \cdot \left(1 + 0.086 \cdot k_s^{0.87}\right)$$

$$100\text{mm} = 4\text{mm} \cdot \left(1 + 0.086 \cdot (647.3872)^{0.87}\right)$$

15) Total Metal Deposited in Weld given Total Transverse Shrinkage

Open Calculator

$$w = w_0 \cdot \left(10^{\frac{S_t - S_0}{b}}\right)$$

$$5.14064\text{g} = 4.99\text{g} \cdot \left(10^{\frac{5.30\text{mm} - 2.20\text{mm}}{0.24}}\right)$$

16) Total Transverse Shrinkage during Multi-Pass Welding of Butt Joint

Open Calculator

$$S_t = S_0 + b \cdot \left(\log 10\left(\frac{w}{w_0}\right)\right)$$

$$5.299995\text{mm} = 2.20\text{mm} + 0.24 \cdot \left(\log 10\left(\frac{5.14064\text{g}}{4.99\text{g}}\right)\right)$$

17) Transverse Shrinkage in Butt Joints

Open Calculator

$$S_b = \left(5.08 \cdot \left(\frac{A_w}{p_{tb}}\right)\right) + (1.27 \cdot d)$$

$$0.365\text{mm} = \left(5.08 \cdot \left(\frac{5.5\text{mm}^2}{802.87\text{mm}}\right)\right) + (1.27 \cdot 0.26\text{mm})$$

18) Transverse Shrinkage in First Pass given Total Shrinkage

Open Calculator

fx $$S_0 = S_t - b \cdot \left(\log 10 \left(\frac{w}{w_0} \right) \right)$$

ex $$2.200005\text{mm} = 5.30\text{mm} - 0.24 \cdot \left(\log 10 \left(\frac{5.14064\text{g}}{4.99\text{g}} \right) \right)$$

19) Transverse Shrinkage of Restrained Joint

Open Calculator

fx $$s = \frac{S}{1 + 0.086 \cdot k_s^{0.87}}$$

ex $$4\text{mm} = \frac{100\text{mm}}{1 + 0.086 \cdot (647.3872)^{0.87}}$$

Lap Joint with Fillets

20) Length of Fillet Leg in Lap Joints from Shrinkage

Open Calculator

fx $$h = \frac{s \cdot p_{tl}}{1.52}$$

ex $$2.105711\text{mm} = \frac{4\text{mm} \cdot 800.17\text{mm}}{1.52}$$

21) Thickness of Plates in Lap Joints

Open Calculator

$$p_{tl} = \frac{1.52 \cdot h}{s}$$

$$908.2\text{mm} = \frac{1.52 \cdot 2.39\text{mm}}{4\text{mm}}$$

22) Transverse Shrinkage in Lap Joint with Fillets

Open Calculator

$$s = \frac{1.52 \cdot h}{p_{tl}}$$

$$4.540035\text{mm} = \frac{1.52 \cdot 2.39\text{mm}}{800.17\text{mm}}$$

T-Joint with Two Fillets

23) Length of Fillet Leg from Transverse Shrinkage in T-Joints

Open Calculator

$$h_t = \frac{s \cdot t_b}{1.02}$$

$$0.011765\text{mm} = \frac{4\text{mm} \cdot 3\text{mm}}{1.02}$$

24) Thickness of Bottom Plate in T-Joints

Open Calculator

$$t_b = \frac{1.02 \cdot h_t}{s}$$

$$2.55\text{mm} = \frac{1.02 \cdot .01\text{mm}}{4\text{mm}}$$

25) Transverse Shrinkage in T-Joint with Two Fillets

Open Calculator

fx $$s = \frac{1.02 \cdot h_t}{t_b}$$

ex $$3.4\text{mm} = \frac{1.02 \cdot .01\text{mm}}{3\text{mm}}$$

Variables Used

- A_w Cross Sectional Area of Weld *(Square Millimeter)*
- **b** Constant For Multi Pass Shrinkage
- **d** Root Opening *(Millimeter)*
- **E** Young's Modulus *(Newton per Meter)*
- **h** Length of Fillet Leg *(Millimeter)*
- h_t Length of Fillet Leg in T Joint *(Millimeter)*
- k_s Degree of Restraint
- **L** Length of Span of The Fillet Welds *(Millimeter)*
- p_{tb} Plate Thickness in Butt Joint *(Millimeter)*
- p_{tl} Plate Thickness in Lap Joint *(Millimeter)*
- **R** Rigidity of Fillet Weld *(Newton Meter per Radian)*
- **s** Transverse Shrinkage *(Millimeter)*
- **S** Transverse Shrinkage of Unrestrained Joint *(Millimeter)*
- S_0 Transverse Shrinkage in First Pass *(Millimeter)*
- S_b Transverse Shrinkage of Butt Joint *(Millimeter)*
- S_t Total Transverse Shrinkage *(Millimeter)*
- t_1 Depth of The First V Groove *(Millimeter)*
- t_2 Depth of The Last V Groove *(Millimeter)*
- t_3 Depth of Root Face *(Millimeter)*
- t_b Thickness of Bottom Plate *(Millimeter)*
- **w** Total Weight of Weld Metal Deposited *(Gram)*
- w_0 Weld Metal Deposited in First Pass *(Gram)*

- **x** Distance from the Center Line of the Frame *(Millimeter)*
- **δ** Distortion at Some Distance *(Millimeter)*
- δ_{max} Maximum Distortion *(Millimeter)*
- **φ** Angular Change in Restrained Joints *(Radian)*
- **ν** Poisson's Ratio

Constants, Functions, Measurements used

- Function: **log10**, log10(Number)
  The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Measurement: **Length** in Millimeter (mm)
  Length Unit Conversion
- Measurement: **Weight** in Gram (g)
  Weight Unit Conversion
- Measurement: **Area** in Square Millimeter (mm²)
  Area Unit Conversion
- Measurement: **Angle** in Radian (rad)
  Angle Unit Conversion
- Measurement: **Torsion Constant** in Newton Meter per Radian (Nm/rad)
  Torsion Constant Unit Conversion
- Measurement: **Stiffness Constant** in Newton per Meter (N/m)
  Stiffness Constant Unit Conversion

Check other formula lists

- **Distortion in Weldments Formulas**
- **Heat Flow in Welded Joints Formulas**
- **Heat Input in Welding Formulas**

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