# Crossbolt

With the following program based on the groundwork calculations of Roloff/Matek, Maschinenelemente, transverse bolts will be dimensioned and calculated.

Considered will be bolts without heads accord. to DIN EN 22340 (Form A and B), bolts with heads accord. to DIN EN 22341, as well as bolts with heads pins and with threads accord. to DIN 1445.

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**Input data:**

**Crossbolt**

**Geometry**

| | | |
|---|---|---|
| Pole Width | $t_S$ : 10 | mm |
| Fork Width | $t_G$ : 5 | mm |
| Crossbolt Diameter | d : 10 | mm |
| Width of Web | b : 60 | mm |
| Diameter of Bore | $d_L$ : 10 | mm |

**Loading Data**

| | | |
|---|---|---|
| Loading Type | static loading | |
| Operational Factor | $c_B$ : 1,4 | |
| Pole Force | F : 1500 | N |

**Material Data**

| | | |
|---|---|---|
| **Crossbolt - Material (strength values) according to** | MDESIGN database | |
| International materials | no | |
| Material designation | E295 | |
| Material number | 1.0050 | |
| Material group | Unalloyed structural steel | |
| Heat treatment / State | none | |
| Standard dimension | $d_{Nm}$ = 40 | mm |
| Standard dimension | $d_{Np}$ = 40 | mm |
| Ultimate strength for $d_{Nm}$ | $R_{mN}$ = 490 | N/mm² |
| Yield point for $d_{Np}$ | $R_{pN}$ = 295 | N/mm² |
| Temperature | T = 40 | °C |

# Crossbolt

| | | |
|---|---|---|
| Material, surface hardened | no | |
| Loads mainly crosswise to the preferred direction of machining (rolling) | no | |
| **Fork - Material (strength values) according to** | MDESIGN database | |
| International materials | no | |
| Material designation | S235JR | |
| Material number | 1.0038 | |
| Material group | Unalloyed structural steel | |
| Heat treatment / State | none | |
| Standard dimension | $d_{Nm}$ = 40 | mm |
| Standard dimension | $d_{Np}$ = 40 | mm |
| Ultimate strength for $d_{Nm}$ | $R_{mN}$ = 360 | N/mm² |
| Yield point for $d_{Np}$ | $R_{pN}$ = 235 | N/mm² |
| Temperature | T = 40 | °C |
| Material, surface hardened | no | |
| Loads mainly crosswise to the preferred direction of machining (rolling) | no | |
| **Pole - Material (strength values) according to** | MDESIGN database | |
| International materials | no | |
| Material designation | S235JR | |
| Material number | 1.0038 | |
| Material group | Unalloyed structural steel | |
| Heat treatment / State | none | |
| Standard dimension | $d_{Nm}$ = 40 | mm |
| Standard dimension | $d_{Np}$ = 40 | mm |
| Ultimate strength for $d_{Nm}$ | $R_{mN}$ = 360 | N/mm² |
| Yield point for $d_{Np}$ | $R_{pN}$ = 235 | N/mm² |
| Temperature | T = 40 | °C |

# Crossbolt

| | |
|---|---|
| Material, surface hardened | no |
| Loads mainly crosswise to the preferred direction of machining (rolling) | no |

**Results:**

**Loading Data**

**Existing Loadings**

| **Building Case** | | | **1** | **2** | **3** | |
|---|---|---|---|---|---|---|
| Bending Moment | $M_b$ | = | 3,75 | 1,88 | 1,88 | N·m |
| Existing Bending Stress | $\sigma_{bvorh}$ | = | 53,48 | 26,74 | 26,74 | N/mm² |
| Existing Shear Stress | $\tau_{vorh}$ | = | 17,83 | 17,83 | 17,83 | N/mm² |
| Mean Surf. Pressure (Pole) | $p_{svorh}$ | = | 21 | 21 | 21 | N/mm² |
| Mean Surf. Pressure (Fork) | $p_{gvorh}$ | = | 21 | 21 | 21 | N/mm² |

**Allowable Loadings**

| | | | | |
|---|---|---|---|---|
| Allowable Bending Stress ($0.30 \cdot R_m$) | $\sigma_{bzul}$ | = | 147 | N/mm² |
| Allowable Shear Stress ($0.20 \cdot R_m$) | $\tau_{bzul}$ | = | 98 | N/mm² |
| Allowable Surface Pressure for Crossbolt ($0.35 \cdot R_m$) | $p_{zul}$ | = | 171,5 | N/mm² |
| Allowable Surface Pressure for Fork ($0.35 \cdot R_m$) | $p_{zul}$ | = | 126 | N/mm² |
| Allowable Surface Pressure for Pole ($0.35 \cdot R_m$) | $p_{zul}$ | = | 126 | N/mm² |

**Safeties**

| **Building Case** | | | **1** | **2** | **3** |
|---|---|---|---|---|---|
| For Bending | $S_b$ | = | 2,75 | 5,5 | 5,5 |
| For Shearing | $S_t$ | = | 5,5 | 5,5 | 5,5 |
| For Surface Pressure (Pole) | $S_{ps}$ | = | 6 | 6 | 6 |
| For Surface Pressure (fork) | $S_{pg}$ | = | 6 | 6 | 6 |

| | | | | |
|---|---|---|---|---|
| Max. Normal Stress (Cheek Profile) | $\sigma_w$ | = | 26,04 | N/mm² |
| Allowable Normal Stress (Cheek Profile) | $\sigma_{wzul}$ | = | 117,5 | N/mm² |

**Material Data**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ultimate Strength for Crossbolt | $R_m$ | = | 490 | N/mm² | (for $d_{eff}$ = | 10 | mm | ) |
| Ultimate Strength for Fork | $R_m$ | = | 360 | N/mm² | (for $d_{eff}$ = | 10 | mm | ) |
| Ultimate Strength for Pole | $R_m$ | = | 360 | N/mm² | (for $d_{eff}$ = | 10 | mm | ) |
| Yielding Point for Pole | $R_e$ | = | 235 | N/mm² | (for $d_{eff}$ = | 10 | mm | ) |

# Crossbolt

**Notice:**

- For cheek diameter D normally the following values are used:

  * For $S_t$ bzw. GS: D = (2...2.5) · d
  * For GG : D = (3...3.5) · d

- Building Case 1 : Bolt - Fork = Clearance Fit
  Bolt - Pole = Clearance Fit

- Building Case 2 : Bolt - Fork = Pressure Fit
  Bolt - Pole = Clearance Fit

- Building Case 3 : Bolt - Fork = Clearance Fit
  Bolt - Pole = Pressure Fit