

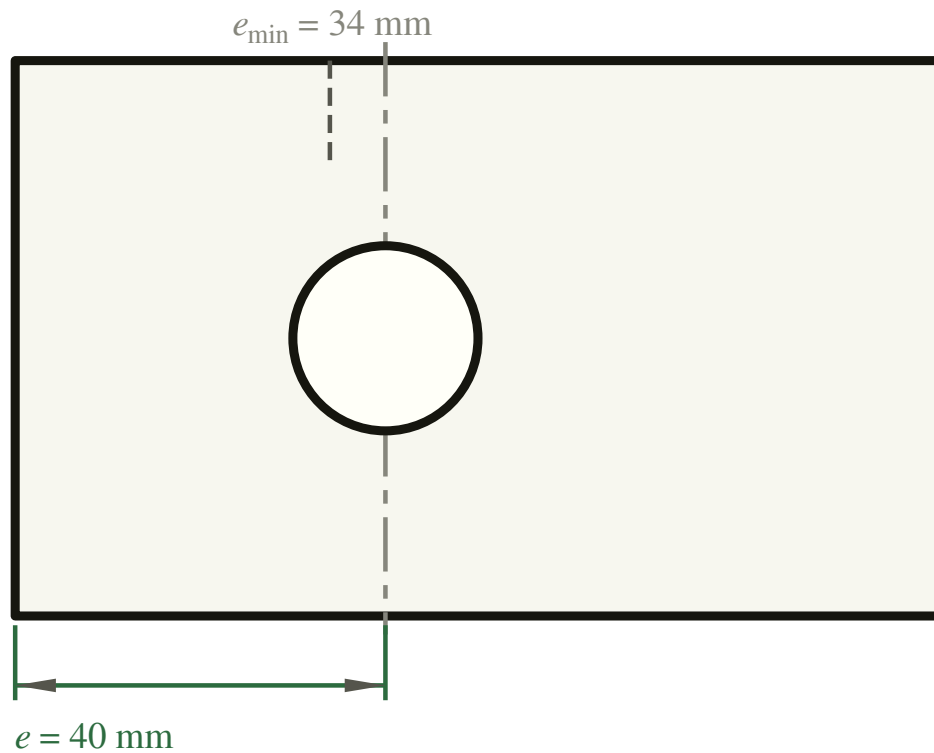
Bolt capacity

Factored shear and tensile resistance of a structural bolt to CSA S16-19.

Inputs

Symbol	Value	Unit	Description
d	20	mm	Bolt diameter
m_{shear}	1		Number of shear planes
k	0.7		Threads-intercepted factor
F_{ub}	825	MPa	Bolt ultimate tensile strength
t	10	mm	Connected plate thickness
e	40	mm	Edge distance
F_u	450	MPa	Plate ultimate strength
F_y	300	MPa	Plate yield strength
$\text{edge}_{\text{type}}$	Sheared		Plate edge preparation

Figures



Bolt at its edge distance, drawn from the values above.

Checks

Name	Check	Result
Edge distance adequate	$e \geq e_{\text{min}} \Rightarrow 40 \text{ mm} \geq 34 \text{ mm}$	PASS

Results

Quantity	Description	Value	Unit
V_{rb}	Factored shear resistance, smallest of the three modes	87.08	kN
T_{rb}	Factored tensile resistance	155.5	kN
e_{min}	Minimum edge distance required	34	mm

Derivation

$$\begin{aligned}
 V_{rb1} &= \frac{0.6 \cdot 0.8 \cdot m_{\text{shear}} \cdot k \cdot F_{ub} \cdot \pi \cdot d^2}{4} && \text{Cl. 13.12.1.2 (c), } \phi_b = 0.80 \text{ per Cl. 13.1 c)} \\
 &= \frac{0.6 \cdot 0.8 \cdot 1 \cdot 0.7 \cdot 825 \text{ MPa} \cdot \pi \cdot (20 \text{ mm})^2}{4} \\
 &= 87.08 \text{ kN}
 \end{aligned}$$

$$\begin{aligned}
 V_{rb2} &= 3 \cdot t \cdot d \cdot 0.8 \cdot F_u && \text{Cl. 13.12.1.2 (a), } \phi_{br} = 0.80 \text{ per Cl. 13.12.1.2} \\
 &= 3 \cdot 10 \text{ mm} \cdot 20 \text{ mm} \cdot 0.8 \cdot 450 \text{ MPa} \\
 &= 216 \text{ kN}
 \end{aligned}$$

$$\begin{aligned}
 V_{rb3} &= \frac{2 \cdot 0.6 \cdot e \cdot t \cdot 0.75 \cdot (F_u + F_y)}{2} && \text{Cl. 13.11, } \phi_u = 0.75 \text{ per Cl. 13.1 a)} \\
 &= \frac{2 \cdot 0.6 \cdot 40 \text{ mm} \cdot 10 \text{ mm} \cdot 0.75 \cdot (450 \text{ MPa} + 300 \text{ MPa})}{2} \\
 &= 135 \text{ kN}
 \end{aligned}$$

$$\begin{aligned}
 V_{rb} &= \min(V_{rb1}, V_{rb2}, V_{rb3}) \\
 &= \min(87.08 \text{ kN}, 216 \text{ kN}, 135 \text{ kN}) \\
 &= 87.08 \text{ kN}
 \end{aligned}$$

$$\begin{aligned}
 T_{rb} &= \frac{0.75 \cdot F_{ub} \cdot 0.8 \cdot \pi \cdot d^2}{4} && \text{Cl. 13.12.1.3, } \phi_b = 0.80 \text{ per Cl. 13.1 c)} \\
 &= \frac{0.75 \cdot 825 \text{ MPa} \cdot 0.8 \cdot \pi \cdot (20 \text{ mm})^2}{4} \\
 &= 155.5 \text{ kN}
 \end{aligned}$$

Branch: $d \leq 36 \text{ mm}$ held

$$e_{min} = 34 \text{ mm}$$

Cl. 22.3.2, Table 5

Sheared edge, 20 mm bolt