Bolt Toolkit

Eurocode 3 – Overview and Tutorials

2024 R1

Eurocode 3 Overview

- **Bolt (joint) evaluation according to Eurocode 3**
  Defines the needed checks on loading capacity on both the joint body and the connected parts.
  EN 1993-1-8 (2005) (English): Eurocode 3: Design of steel structures - Part 1-8: Design of joints [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]

- **Joint categories (Section 3.4)**
  The evaluation of bolt joints is based on selecting a joint category that defines the criteria to use.
  For rivet joints the category is not "defined" in the code as rivets per definition is a bearing type (A).

- **Shear connections (Section 3.4.1)**
  Category A-C; Bolted connections loaded in shear.

- **Tension connections (Section 3.4.2)**
  Category D-E; Bolted connections loaded in tension.

Shear connections (Section 3.4.1)

- **Bolted connections loaded in shear should be designed as one of the following:**

- **Category A: Bearing type**
  No preload required. Bolt classes from 4.6 to 10.9 may be used.

- **Category B: Slip-resistant at serviceability limit state**
  Preloaded 8.8 or 10.9 bolts should be used.

- **Category C: slip-resistant at ultimate**
  Preloaded 8.8 or 10.9 bolts should be used.

Tension connections (Section 3.4.2)

- **Bolted connections loaded in tension should be designed as one of the following:**

- **Category D: non-preloaded**
  No preload required. Bolt classes from 4.6 to 10.9 may be used.

- **Category E: preloaded**
  Preloaded 8.8 or 10.9 bolts should be used.

- **Combined Shear and Tension**
  Joints subjected to both shear and tensile force should also satisfy the combined criteria in Table 3.4.
  To evaluate according to all criteria one additional category is defined "Category F".
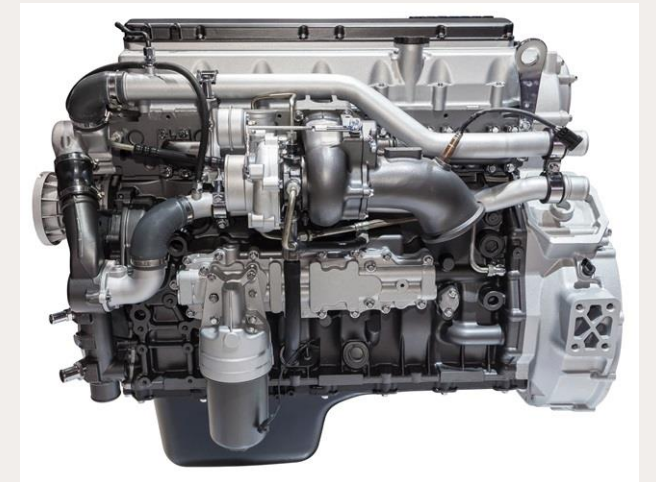
Utilization Criteria (Table 3.2)

- The "Utilization Factor", *Uf*, is calculated for each criterion in the selected category as the ratio between the design load, F_{Ed}, and design resistance, F_{Rd} .

- The maximum utilization, Uf_{max}, is saved from the evaluated criteria for each bolt or rivet.
  If $Uf_{max} > 1.0$ the joint does not fulfil the Eurocode 3 criteria.

Utilization Factor	Description	Category
Uf_{max}	Max Utilization Factor from evaluated *Uf* in selected Category	A,B,C,D,E,F
$Uf_{pretension}$	Pretension force, $Uf_{pretension} = F_p/F_{p.Cd}$	−,−,−,−,−,−
$Uf_{contact}$	Head contact force, $Uf_{contact} = F_t/F_{c.Rd}$	−,−,−,−,−,−
Uf_{shear}	Bolt shaft shear, $Uf_{shear} = F_{v.Ed}/F_{v.Rd}$	A,B,−,−,−,F
$Uf_{bearing}$	Bolt hole bearing, $Uf_{bearing} = F_{v.Ed}/F_{b.Rd}$	A,B,C,−,−,F
Uf_{slip}	Contact slip, $Uf_{slip} = F_{v.Ed}/F_{s.Rd}$	−,B,C,−,−,F
$Uf_{tension}$	Bolt shaft tension, $Uf_{tension} = F_{t.Ed}/F_{t.Rd}$	−,−,−,D,E,F
Uf_{punch}	Bolt head punch, $Uf_{punch} = F_{t.Ed}/B_{p.Rd}$	−,−,−,D,E,F
$Uf_{combined}$	Combined shear and tension, $Uf_{combined} = F_{v.Ed}/F_{v.Rd} + F_{t.Ed}/(1.4*F_{t.Rd})$	−,−,−,−,−,F

Workshops

- Tutorial 01 – Shear connections
  - Category A: Bearing type (Rivets)
  - Category B (or C): Slip resistant (Simplified Bolts)
- Tutorial 02 – Tension connections
  - Category D: Non-preloaded bolts (Simplified Bolts to Ground)
  - Category E: Preloaded bolts (Simplified Bolts to Ground)
- Tutorial 03 – Preloaded Tension connections
  - Category E: Preloaded bolts (Advanced Bolts)
- Tutorial 04 – Preloaded Shear and Tension connections
  - Category F: Combined shear and tension (Advanced Bolts)