Steel Design to Eurocode 3

Introduction

Development of Eurocode 3

Aim: to create a common structural language
– And make allowances for National Choice through the use of a National Annex

National Annex

• Eurocode 3 allows some parameters and design methods to be determined at a national level.
• Where a national choice is allowed, this is indicated in the Eurocodes under the relevant clause.
– values or methods to be used in a particular country are given in the National Annex.

Nationally Determined Parameters (NDPs)

• The recommended values of the parameters and design methods are collectively referred to as Nationally Determined Parameters (NDPs).
• NDPs determine various aspects of design but perhaps most importantly the level of safety of structures during construction and service.

Structure of Eurocode 3

Eurocode 3 is broken into 6 parts:
• EN 1993-1 Generic rules
• EN 1993-2 Bridges
• EN 1993-3 Towers, masts and chimneys
• EN 1993-4 Silos, tanks and pipelines
• EN 1993-5 Piling
• EN 1993-6 Crane supporting structures

Eurocode 3 Part 1 has 12 sub-parts:
• EN 1993-1-1 General Rules
• EN 1993-1-2 Fire
• EN 1993-1-3 Cold-formed thin gauge
• EN 1993-1-4 Stainless steel
• EN 1993-1-5 Plated elements
• EN 1993-1-6 Shells
• EN 1993-1-7 Plates transversely loaded
• EN 1993-1-8 Joints
• EN 1993-1-9 Fatigue
• EN 1993-1-10 Fracture Toughness
• EN 1993-1-11 Cables
• EN 1993-1-12 High strength steels

Key Differences between EC3 and BS 5950

There are several differences between EC3 and BS 5950:

<table>
<thead>
<tr>
<th>BS 5950 Structure</th>
<th>EC3 Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separate sections for different elements types e.g. Beams, Plate Girders, Compression members...</td>
<td>Sub-parts are based on structural phenomena e.g. Tension, Compression, Bending, Shear</td>
</tr>
<tr>
<td>Sub-parts can be applied to any element</td>
<td>The arrangement of the sub-parts means less duplication of rules</td>
</tr>
</tbody>
</table>
Different Axes

<table>
<thead>
<tr>
<th>BS 5950</th>
<th>Eurocode 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Along the member</td>
<td>X</td>
</tr>
<tr>
<td>Major Axis</td>
<td>X</td>
</tr>
<tr>
<td>Minor Axis</td>
<td>Y</td>
</tr>
</tbody>
</table>

![Figure 1 (Source: Arya (2009) Design of Structural Elements Pg.377)](image)

Different Wording

‘Action’ – force or imposed displacement
- Permanent action (Dead Load)
- Variable action (Live Load)

‘Effect’ – internal force or moment, deflections

‘Verification’ – check

‘Resistance’ – capacity

Informative subscripts

‘Ed’ means design effect
‘Rd’ means design resistance

Therefore:

\( N_{Ed} \) is an design axial force
\( N_{Rd} \) is the design resistance to the axial force

Gamma Factors

<table>
<thead>
<tr>
<th>Partial factor</th>
<th>UK NA value</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \gamma_M )</td>
<td>1.00</td>
<td>Cross-sections</td>
</tr>
<tr>
<td>( \gamma_M1 )</td>
<td>1.00</td>
<td>Member Buckling</td>
</tr>
<tr>
<td>( \gamma_M2 )</td>
<td>1.25</td>
<td>Fracture</td>
</tr>
</tbody>
</table>

Omissions

Notable omissions:
- Effective lengths
  - Use BS 5950 effective lengths
- Formulae for \( M_{cr} \)
  - Use SN003 NCCI Document
- Deflection limits
  - Refer to National Annex