Railway Bridge Brunngraben

Special Session:
Austrian experience of using Eurocodes for bridge design
Challenges and opportunities
Brunngraben Bridge – Styria
single span steel bridge with open rail track

Workshop „Bridge Design to Eurocodes – Background and Applications“

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longitudinal cut \[ M=1:50 \text{ (in Brückenaachse)} \]

effective span = 14,44 m

rail track

clearance

lowest line of old structure + 630,50 m

lowest line of new structure + 630,42 m

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- straight bridge with straight and curved railway track
- min. 5000 mm clear width between top flanges
- max. construction height 1220 mm
- width of top flanges 500 mm
- lack of stiffeners
- span range from 10 – 20 m

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
principle cross section for a span range of 10 – 20 m

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]

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- self weight and dead loads (road bed, sleepers, rails)
- load model LM71, SW/2 and “unloaded train”
- starting and breaking force
- nosing force
- wind force
- temperature
- derailment force
- earthquake force


[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
Load model LM71 for local dimensioning

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
standard cross section - end supporting detail

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
additional degrees of freedom

natural mode for lateral torsional buckling

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
bending moments for the transversal bridge direction [kNm/m]

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
three critical problems

- loading of the web about the weak axis
- filled welds are stressed about their weak axis
- much severe detail category for the weld

[Fink J., Kuss St., NEW RAILWAY TROUGH BRIDGES, 2007]
welding detail
deck plate

transition in direction of force
execute free from notches

transition in direction of force
execute free from notches
welding detail
connection
deck plate to web

Detailed planning

transition grinding
free from notches

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Global family of standards for steel constructions

- Eurocodes
  - EN 1990-EN 1999
    - Design
- Execution-standards
  - z.B. EN 1090
    - Specification of components
- Materialstandards
  - z.B. EN 10025-2
    - Material, products, testing methods
Specifications and dokumentation

EN 1090-2, 4.1.1: Execution Specification – General

The necessary information and technical requirements for execution of each part of the works shall be agreed and complete before commencement of execution of that part of the works.

- additional information, as listed in A.1
- options, as listed in A.2
- execution classes, see 4.1.2
- preparation grades, see 4.1.3
- tolerance classes, see 4.1.4
EN 1990

EN 1090-2

Matrix for choice of execution class

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### EN 1990, Annex B

<table>
<thead>
<tr>
<th>Inspection during execution</th>
<th>Design supervision differentiation</th>
<th>Reliability Class</th>
<th>Consequences classes</th>
<th>Description</th>
<th>Examples of buildings and civil engineering works</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL 3</td>
<td>DSL 3</td>
<td>RC 3</td>
<td>CC 3</td>
<td>High consequence for loss of human life, or economic, social or environmental consequences very great</td>
<td>Grandstands, public buildings where consequences of failure are high (e.g. a concert hall)</td>
</tr>
<tr>
<td>IL 2</td>
<td>DSL 2</td>
<td>RC 2</td>
<td>CC 2</td>
<td>Medium consequence for loss of human life, economic, social or environmental consequences considerable</td>
<td>Residential and office buildings, public buildings where consequences of failure are medium (e.g. an office building)</td>
</tr>
<tr>
<td>IL 1</td>
<td>DSL 1</td>
<td>RC 1</td>
<td>CC 1</td>
<td>Low consequence for loss of human life, and economic, social or environmental consequences small or negligible</td>
<td>Agricultural buildings where people do not normally enter (e.g. storage buildings), greenhouses</td>
</tr>
</tbody>
</table>
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Execution
Thank you for your attention!