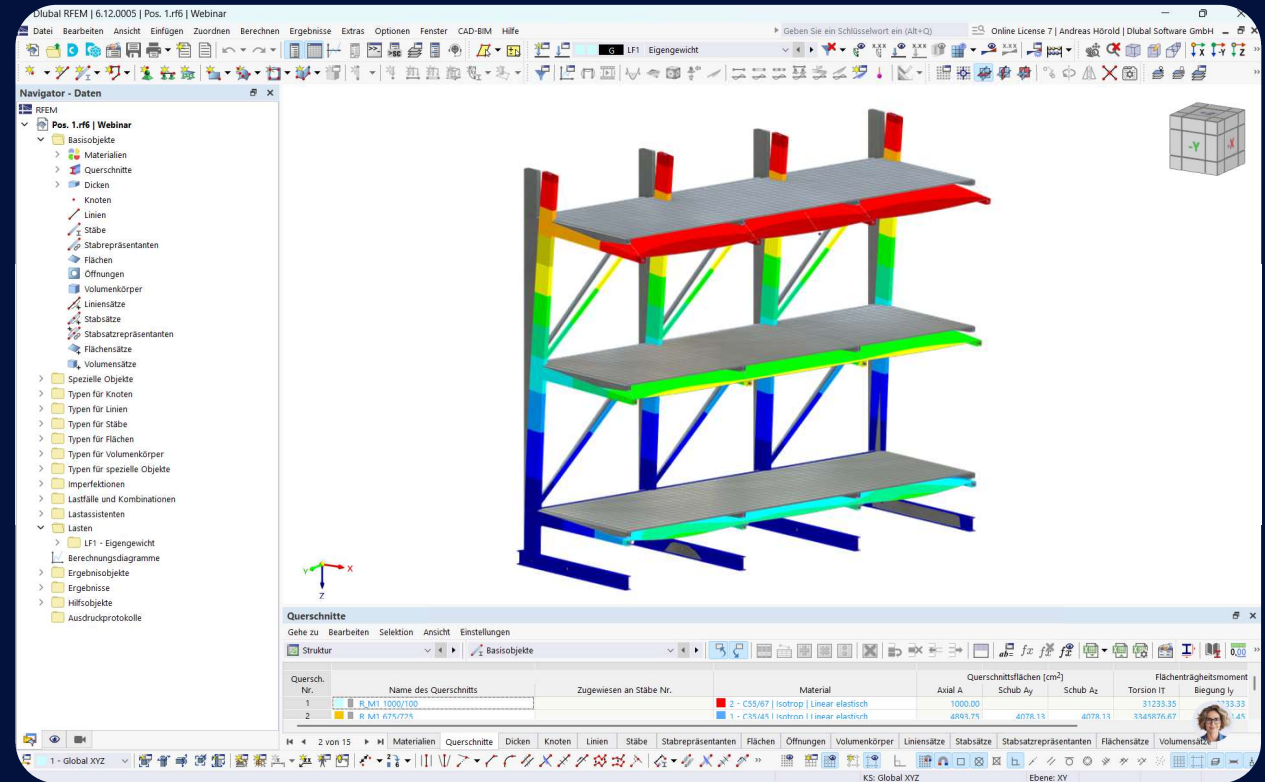


Webinar

DLUBAL

Steel Design at the Serviceability Limit State

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Today with



Dipl.-Ing. (FH)
Andreas Hörold
Organizer

Marketing & Public Relations
Dlubal Software GmbH

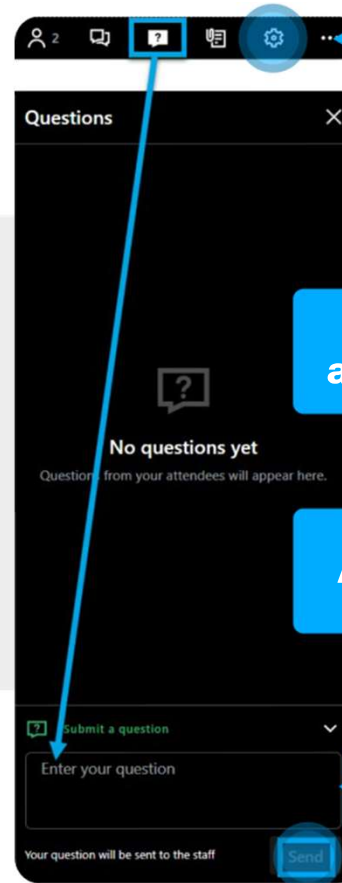


Niklas Wanke
M.Sc.
Co-Organizer

Product Engineering & Customer Support
Dlubal Software GmbH

Questions During the Presentation

1
**Webinar Control
Panel Desktop**



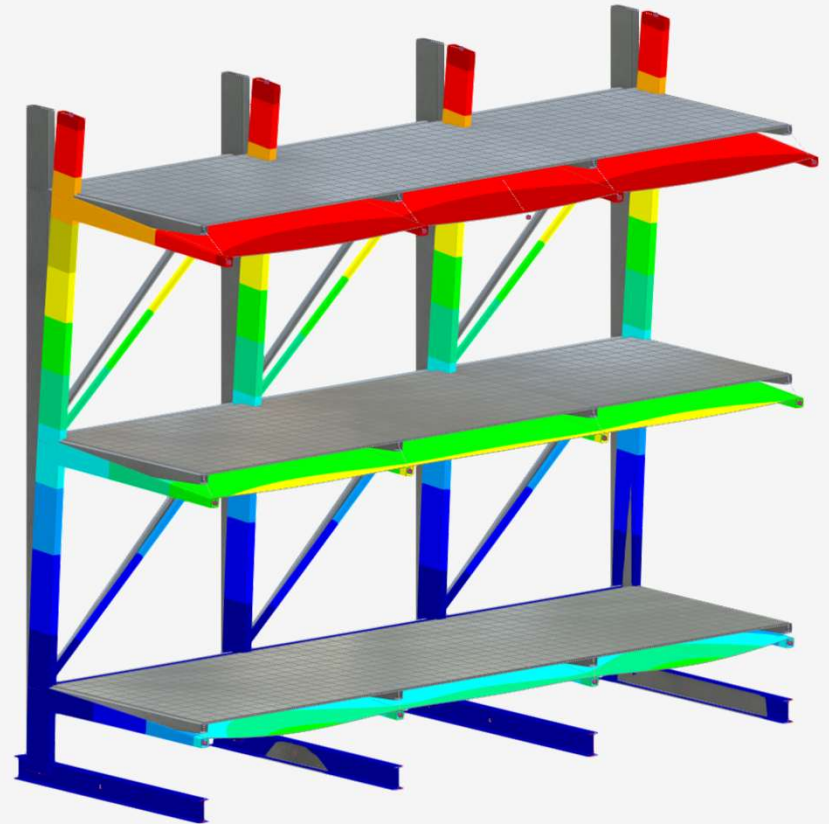
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Ask question

or **2**
info@dlubal.com

Content

- 1 Normative Basis
- 2 Verification of Serviceability in RFEM 6
- 3 Cross-Section Optimization for SLS



Normative Basis

EN 1990

Basis of structural design

A.1.4.2(2): “The serviceability criteria should be specified for each project and agreed with the client.”

A.1.4.2(2) Note: “The serviceability criteria may be defined in the National annex.”

6.5.3(2): Definition of action combinations

- Characteristic (for irreversible states)
- Frequent (for reversible states)
- Quasi-permanent (for long-term effects)

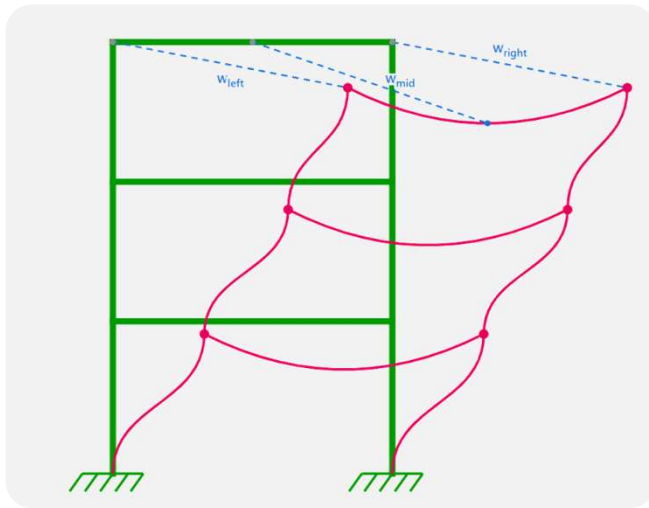
EN 1993

Design of steel structures

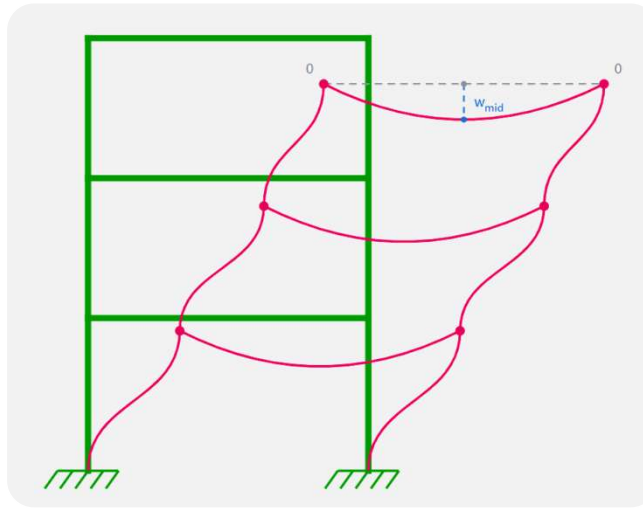
7.1(1): “A steel structure should be designed and constructed such that all relevant serviceability criteria are satisfied.”

Verification of Serviceability in RFEM 6

Displacement reference - Members



Undeformed system

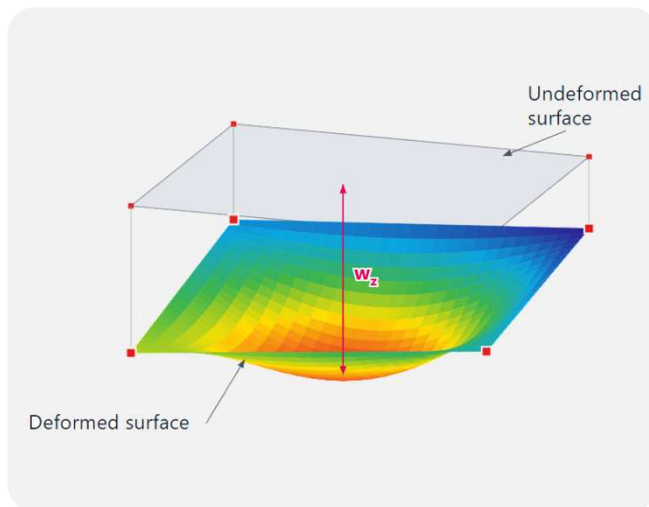


Deformed segment ends

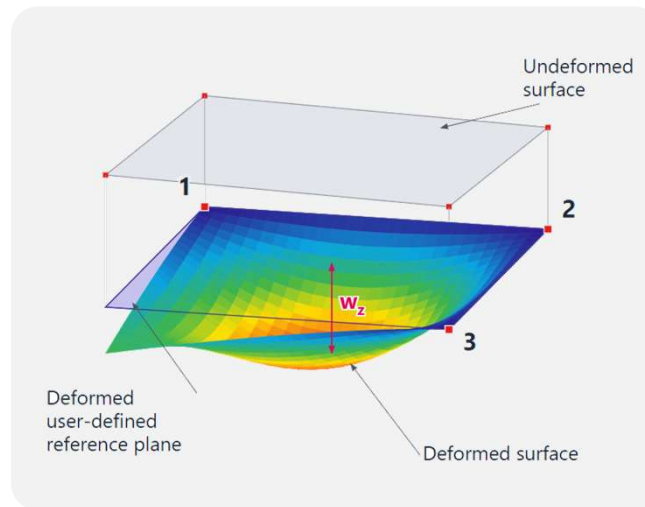
Special case:
Cantilever with deformed
segment ends
Only the supported segment
end will act as displacement
reference

Verification of Serviceability in RFEM 6

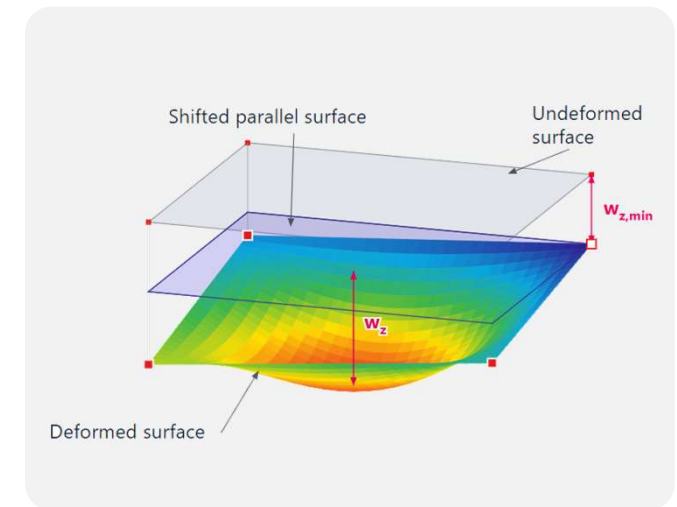
Displacement reference - Surfaces



Undeformed system



Deformed user-defined reference plane



Parallel surfaces at the point of minimum nodal deformation

Cross-Section Optimization for SLS

How it works

Challenge

- Cross-section values are not included in the SLS design checks
- Deformation values are not calculated iteratively

Solution

- Ratio of moments of inertia as a scaling factor

Note

- Cross-section optimization = approximation

$$\alpha = \frac{I_{y,orig}}{I_y}; \quad \alpha = \frac{I_{z,orig}}{I_z}$$

Check direction local z/y- axis

$$\alpha = (1 - \lambda) \cdot \left(\frac{I_{y,orig}}{I_y} \right) + \lambda \cdot \left(\frac{I_{z,orig}}{I_z} \right)$$
$$\lambda = \frac{w_{tot,y}^2}{w_{tot,y}^2 + w_{tot,z}^2}$$

Check direction resulting axis

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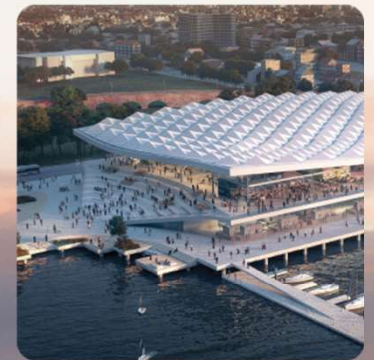


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