Dlubal

Structural Analysis & Design Software

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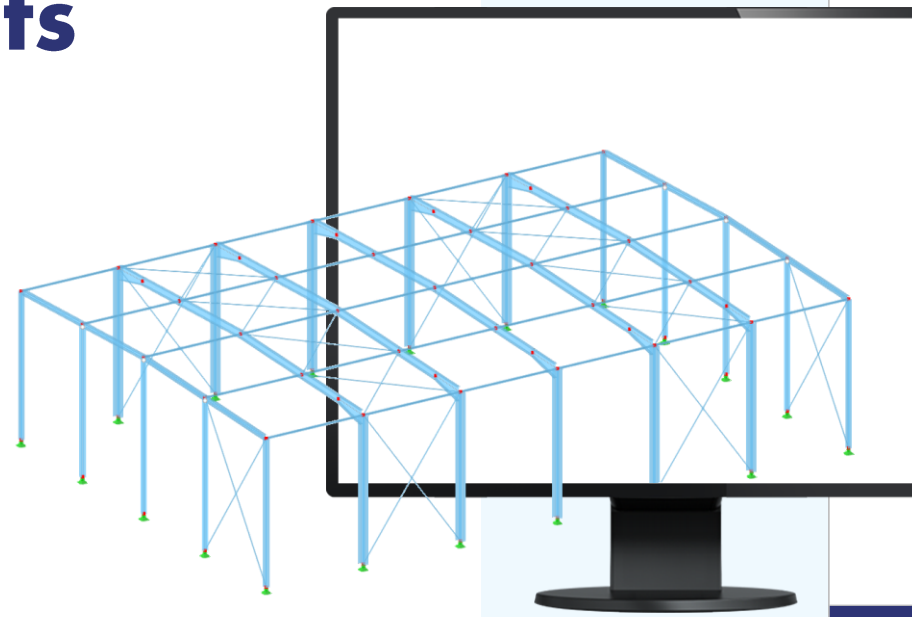
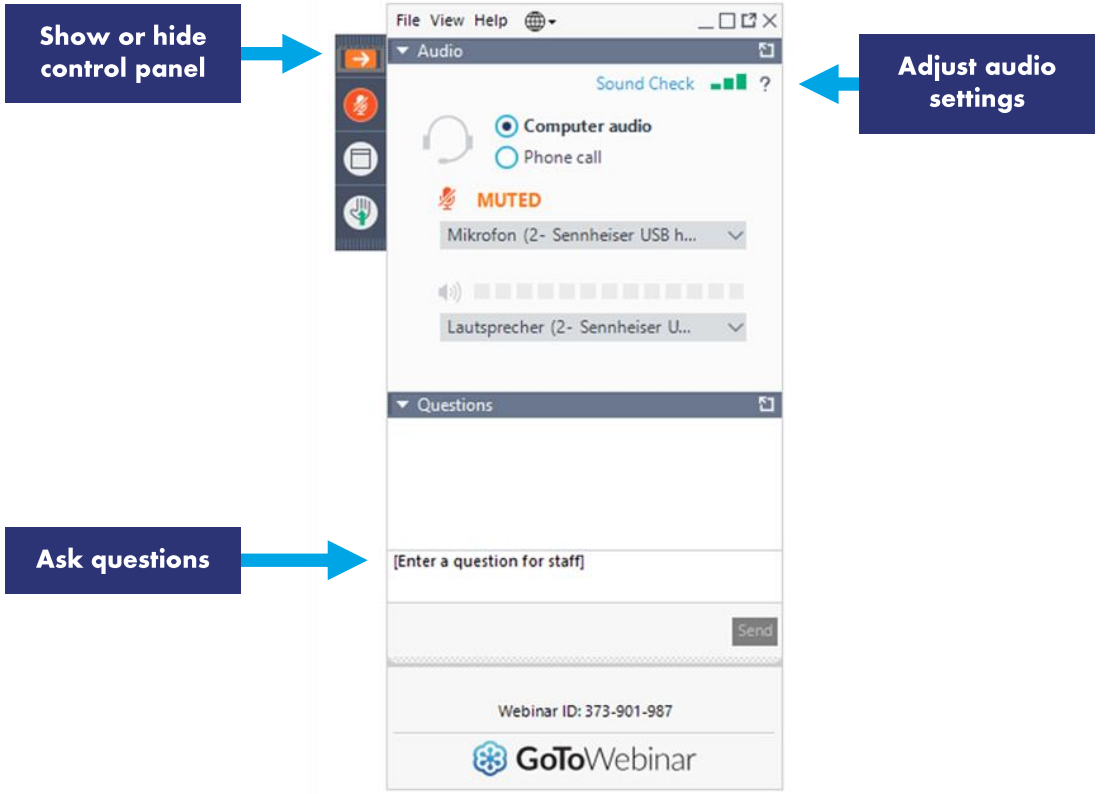
Part 4 | Introduction to Steel Design

RFEM 6 for Students

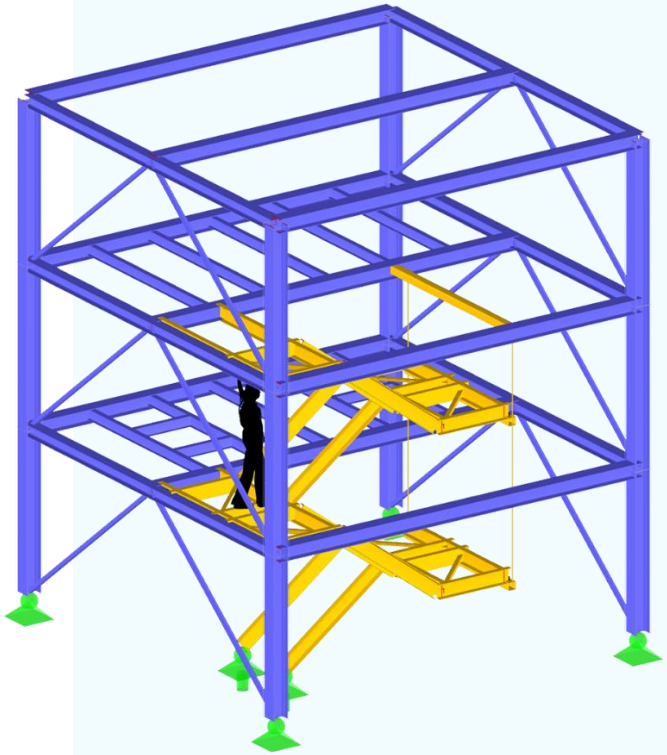


Questions During the Presentation

GoToWebinar Control Panel
Desktop



Training Series



01 Introduction to Member Design

02 Introduction to Strength of Materials

03 Introduction to FEM / FEA

04 Introduction to Steel Design

05 Introduction to Reinforced Concrete Design

06 Introduction to Timber Design

ONLINE TRAINING

Training Series

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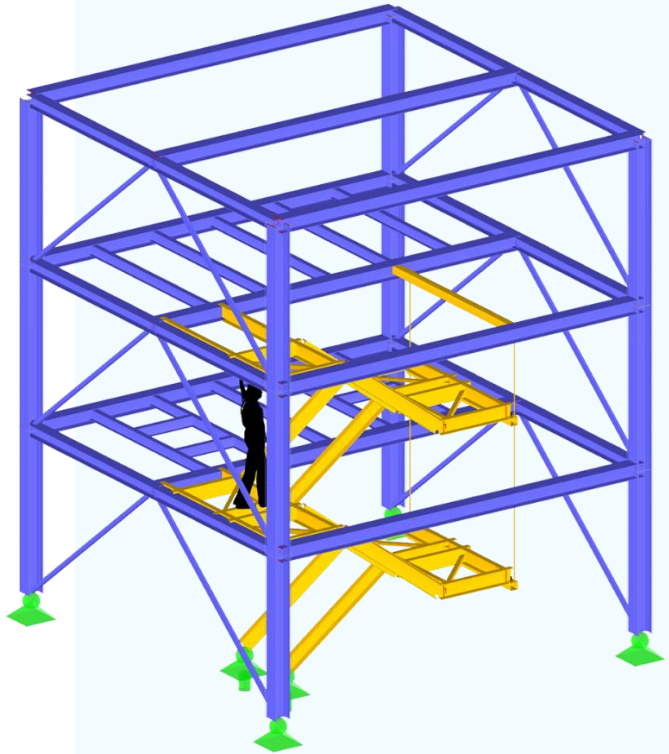

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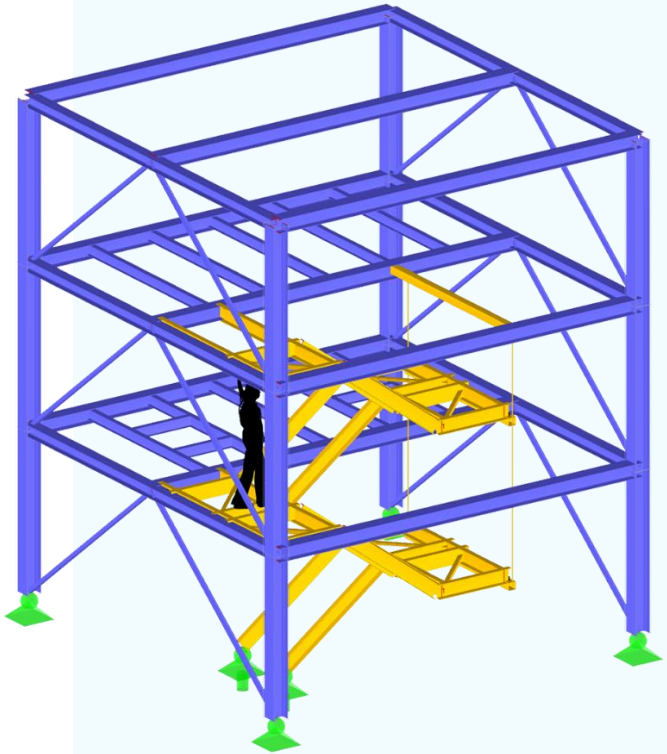
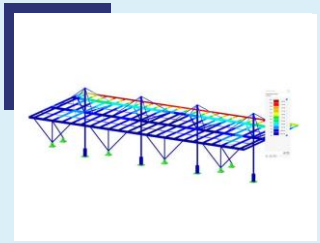
CONTENT



Products for Design according to Eurocode 3

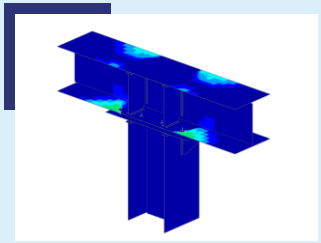


Steel Design

- Add-On | RFEM/RSTAB
- Design of steel members acc. to international standards, like EC, AISC,...

Torsional Warping (7 DOF)

- Add-On | RFEM/RSTAB
- Consideration of torsional warping in global solver



Steel Joints

- Add-On | RFEM
- Analysis of steel joints based on finite element method

Other Add-Ons & Stand-Alone Programs

- RSECTION
- Structure Stability
- Nonlinear Material Behavior
- Stress-Strain Analysis

More information:
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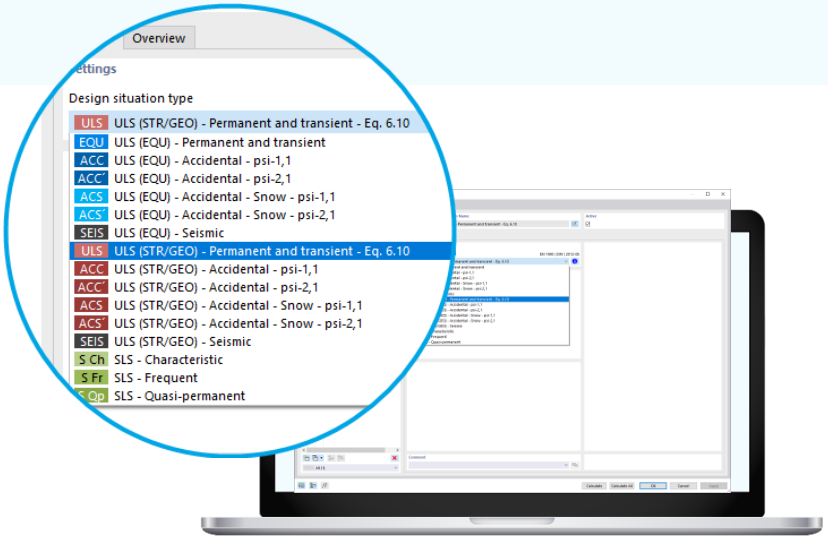
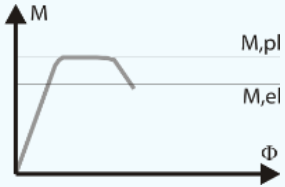
Safety Concept

- **Limit State Designs**
- $E_d < R_d = R_k / \gamma_M$
- R_k – characteristic resistance
- R_d – design resistance



Factor of safety	Usage	EN 1993-1-1		DIN EN 1993-1-1/NA	
		FUN	ACC	FUN	ACC
γ_{M0}	Cross-section design	1.0	-	1.0	1.0
γ_{M1}	Stability analysis	1.0	-	1.1	1.0
γ_{M2}	Failure due to tension	1.25	-	1.25	1.15

Elastic or Plastic global analysis

CC	1	2	3	4
Moment-Rotation Behavior				
Rotation capacity	high	low	-	-
Global Analysis	P	E	E	E
Cross-Section Resistance	P	P	E	E*

* reduced

Two-span beam

Information

- Beam: IPE 550, S235
- Geometry: see image
- Self-Weight: LC1: g_k = 8,00 kN/m
- Imposed Load: LC2: q_k = 12,00 kN/m

Tasks

- Cross-Section Classification
- Cross-Section Design Checks
- Difference between elastic and plastic cross-section resistance
- Design check: EL-EL and EL-PL

Effects of deformed geometry of the structure

Criterion

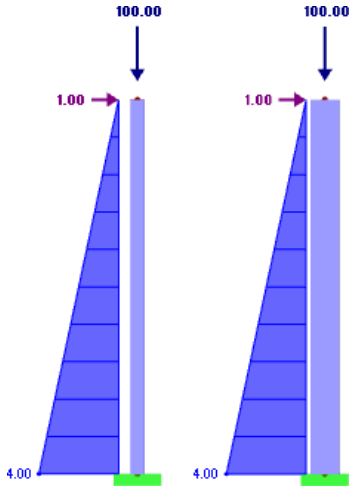
$$\alpha_{cr} = \frac{F_{cr}}{F_{Ed}}$$

Geometrically linear analysis is sufficient if

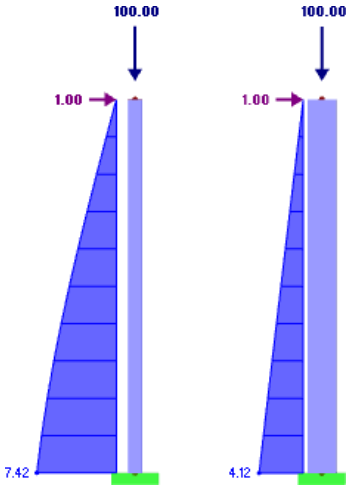
α_{cr} > 10 for elastic global analysis

α_{cr} > 15 for plastic global analysis

Geometrically Linear Analysis

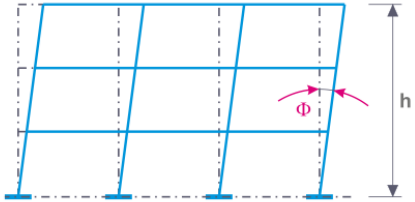


Second-Order Analysis



Equivalent geometric imperfections

Initial sway imperfection

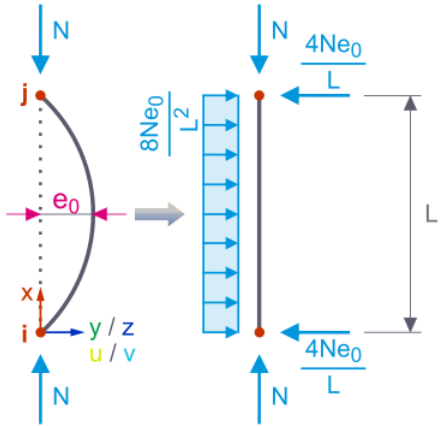


$$\Phi = \Phi_0 \cdot \alpha_h \cdot \alpha_m$$

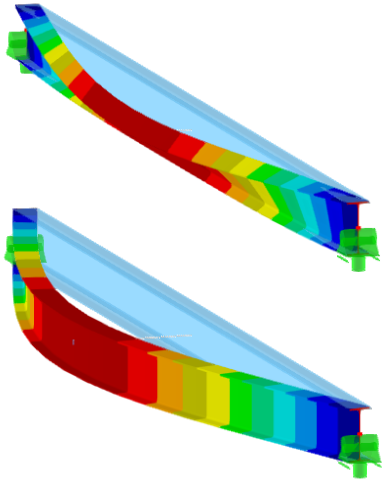
$$\Phi_0 = 1/200$$

$$\alpha_m = \sqrt{0.5(1 + \frac{1}{m})} \qquad \alpha_h = \frac{2}{\sqrt{h}}$$

Initial bow imperfection



Scaled Mode Shape



Application of equivalent horizontal forces

Pre-deformation

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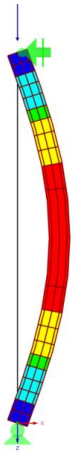
Stability Analysis

$$\alpha_{cr} = \frac{N_{cr,min}}{N_{Ed}}$$

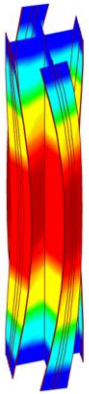
or

$$\alpha_{cr} = \frac{M_{cr}}{M_{Ed}}$$



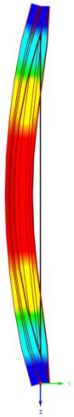
Flexural Buckling

$N_{cr,y/z}$; $N_{cr,u/v}$



Torsional Buckling

$N_{cr,T}$



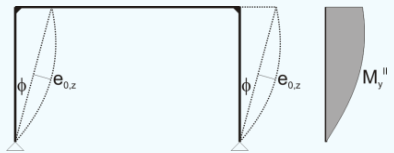
Lateral-torsional Buckling

$N_{cr,FTB}$; M_{cr}

Methods for Stability Analysis

Method A

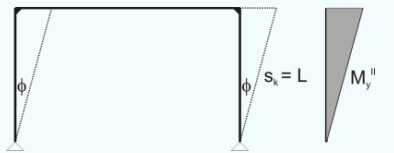
Global and local imp + structural analysis acc. to second-order analysis



Cross-section design checks with internal forces acc. to second-order analysis

Method B

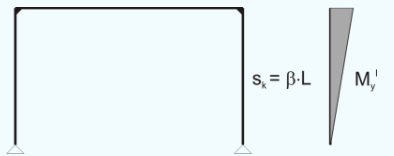
Global imp + structural analysis acc. to second-order analysis



Structural component design on equivalent member according to Section 6.3 but with s_k=member length

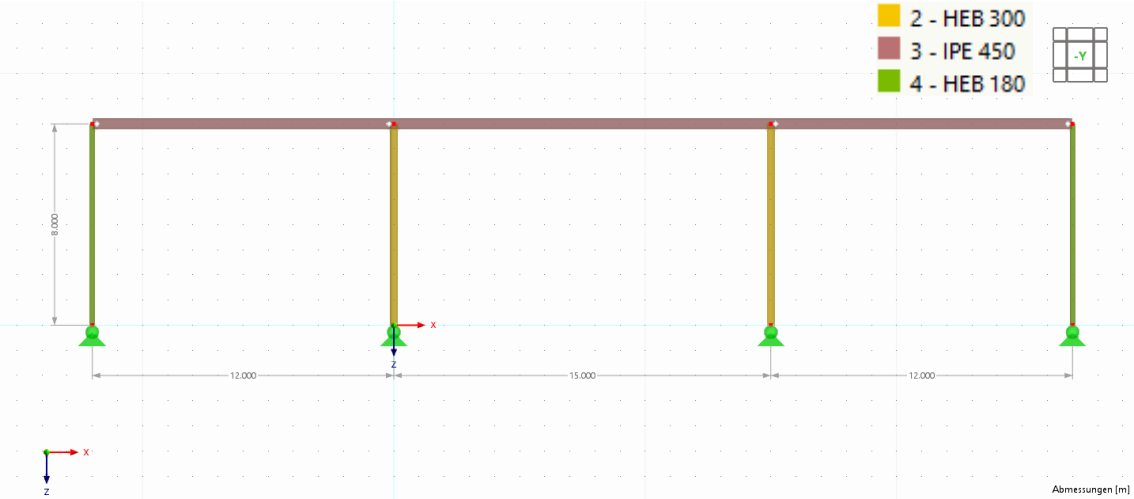
Method C

Structural analysis acc. to geometrically linear analysis on ideal structure



Structural component design on equivalent member according to Section 6.3

Flat Hall Frame

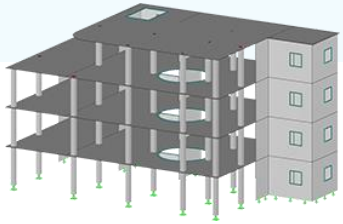


Information

- Cross-Sections: see image
- Material: S235
- H= 8m; L1= 12m; L2= 15m; L3= 12m
- LC1 | Self-Weight: active
- LC2 | Snow: s_{kinner} = 20 kN; s_{kouter} = 10 kN
- LC3 | Wind: w_{kl} = 2 kN/m; w_{kr} = 1 kN/m

Tasks

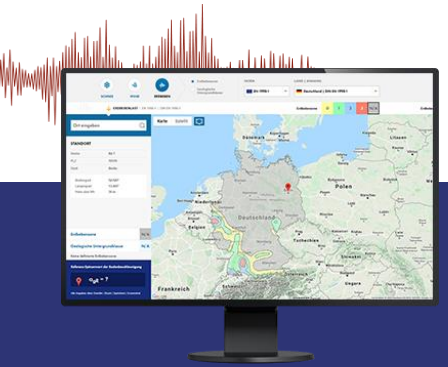
- Apply Imperfections
- Stability analysis according to method B and method C



Free Online Services

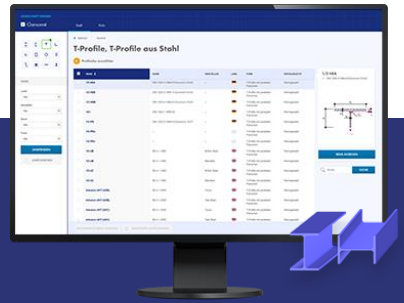
Geo-Zone Tool

Dlubal Software provides an online tool with snow, wind and seismic zone maps.



Cross-Section Properties

With this free online tool, you can select standardized sections from an extensive section library, define parametrized cross-sections and calculate its cross-section properties.



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Models to Download

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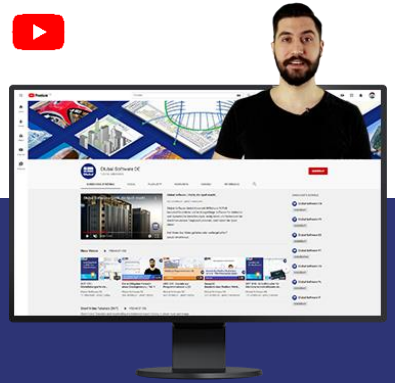
Youtube Channel - Webinars, Videos

Videos and webinars about the structural engineering software.



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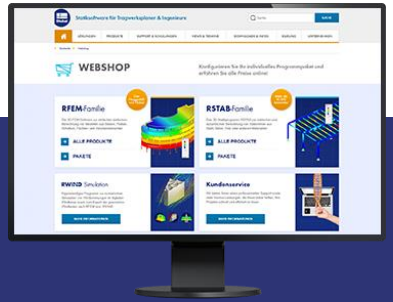

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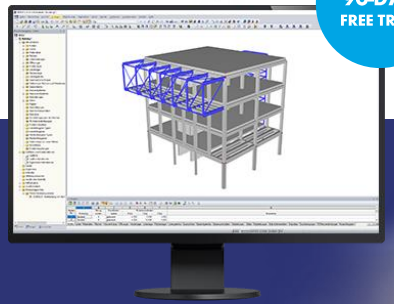
The best way how to learn using our programs is to simply test them for yourself. Download a 90-day free trial version of our structural analysis & design software.



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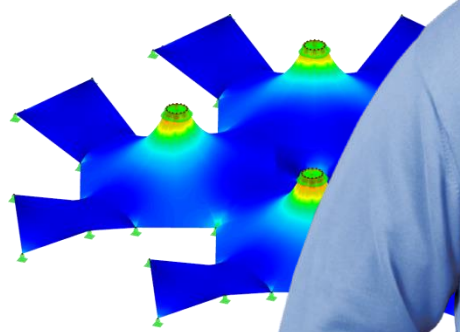

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