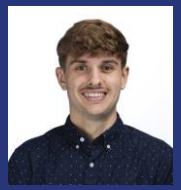
Dlubal

Structural Analysis & Design Software

www.dlubal.com

Amy Heilig, PE
Presenter/Moderator

CEO – USA Office



Alex Bacon, EIT
Trainer

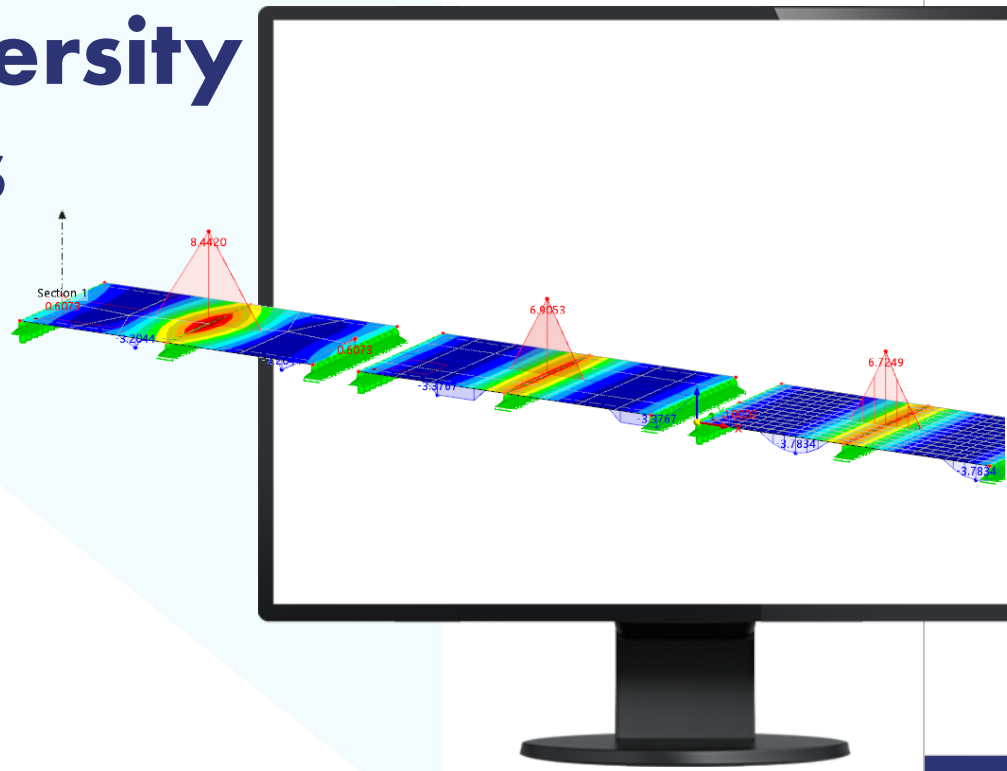
Technical Support Engineer

Cisca Tjoa, PE
Moderator

Technical Support Engineer

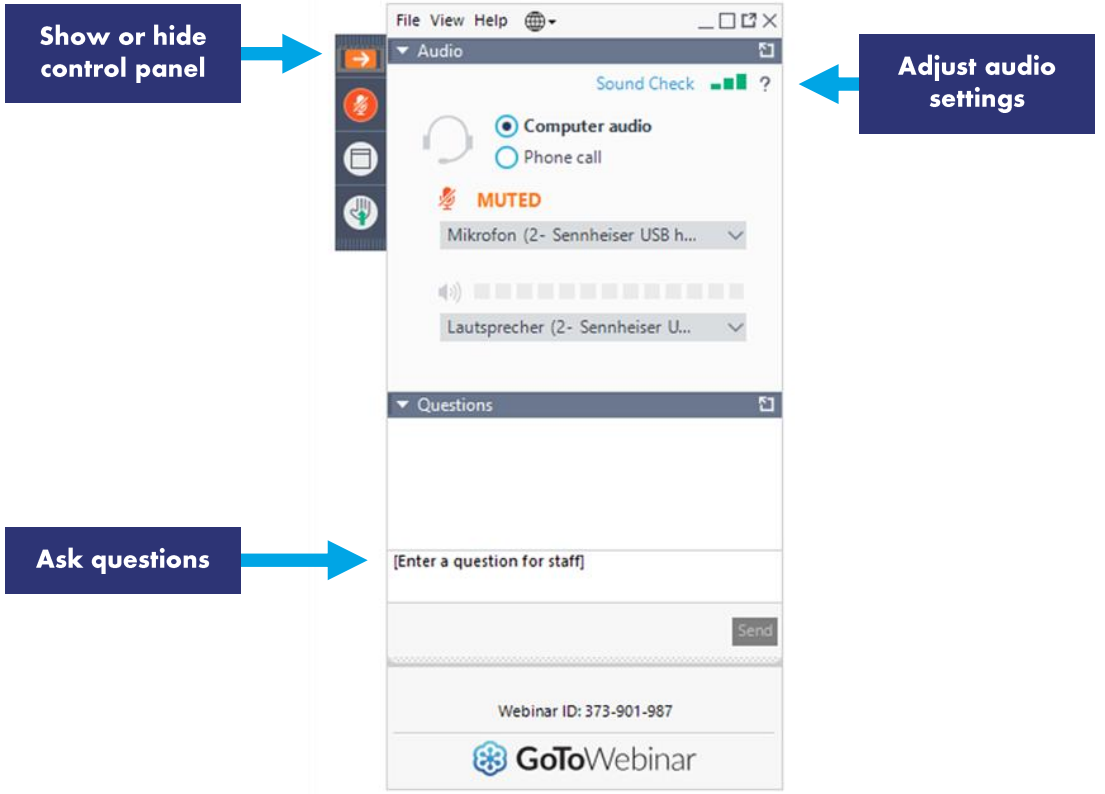
Online Training

University Days



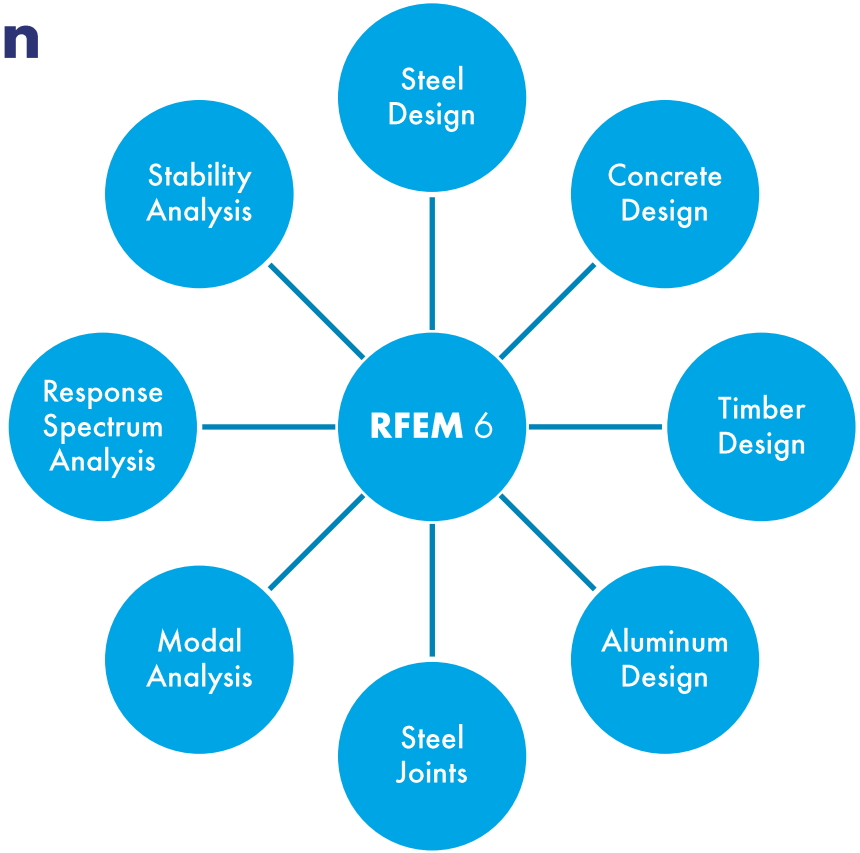
Questions During the Presentation

GoToWebinar Control Panel
Desktop



RFEM 6 Configuration

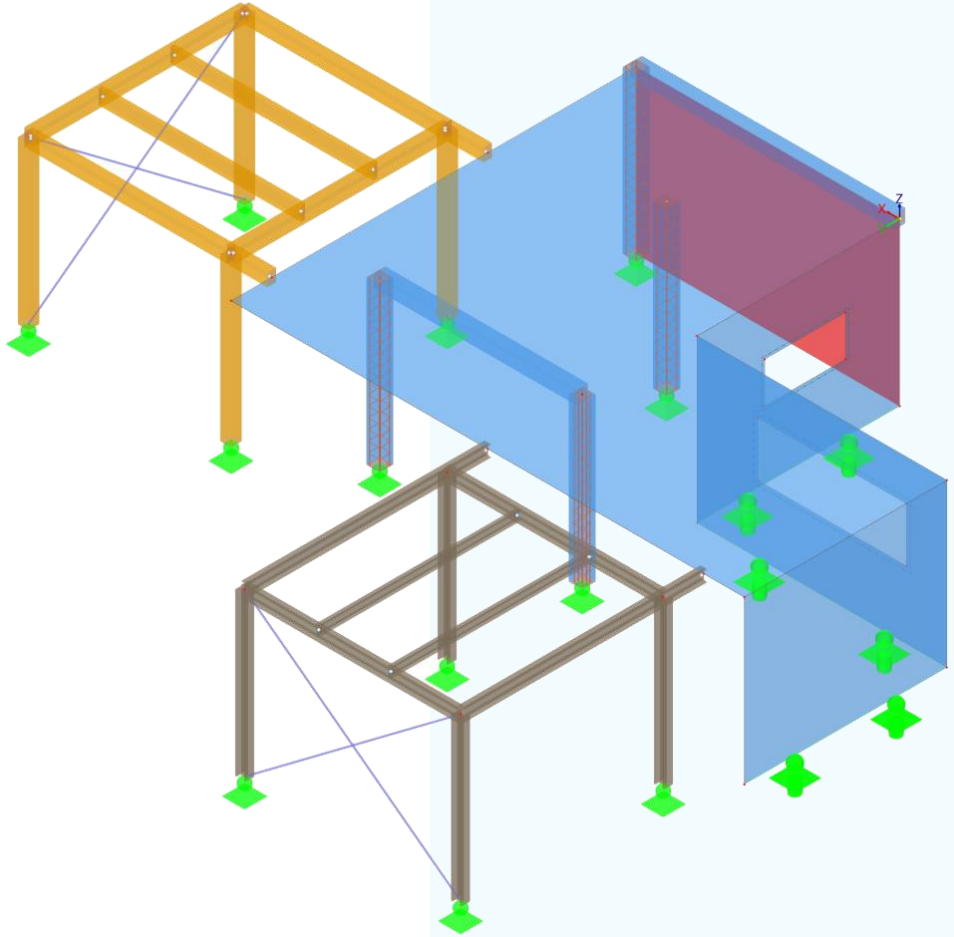
- **RFEM 6** (base program)
  - BIM integration
  - Modeling
  - Loading
  - Analysis
- **Add-ons**
  - Additional analysis
  - Dynamic analysis
  - Special solutions
  - Design
  - Connections



Universities, Professors, and Students

- Access to free, full RFEM 6 licenses
- Teaching or learning purposes
- Personal, school, or lab computers
- Valid for 1 year with renewal opportunity
- Access to program updates
- Free email technical support
- Request through www.dlubal.com

CONTENT



Dlubal Software

Coffee Break

Do you plan on modeling along?

Yes

No

Have you learned about FEA yet?

Yes

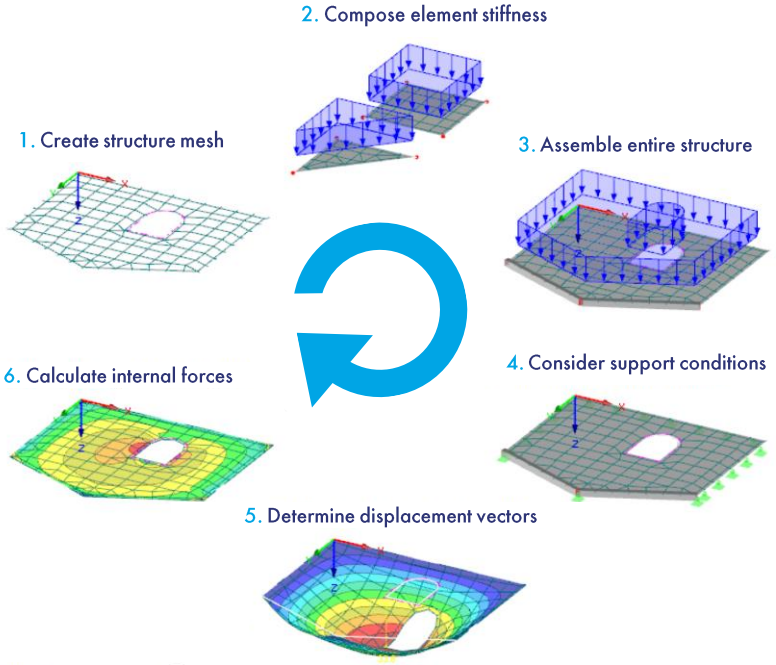
No

Basics of FEA

- Computer software is based on the displacement method
- Analytical solutions are difficult when it comes to large complicated structures
  - Structures are then modeled and converted into a finite interconnected element mesh
  - Material and cross-section properties are given at each FE node
  - Mechanical behavior is transferred between elements
- Discretization: Structures being submeshed into finite elements

FEA Calculation Workflow

1. Determine local element stiffness properties
2. Transfer stiffness properties to Global coordinate system
3. Assemble entire structure
4. Implement support conditions
5. Determine displacement vectors
6. Determine support forces and internal forces



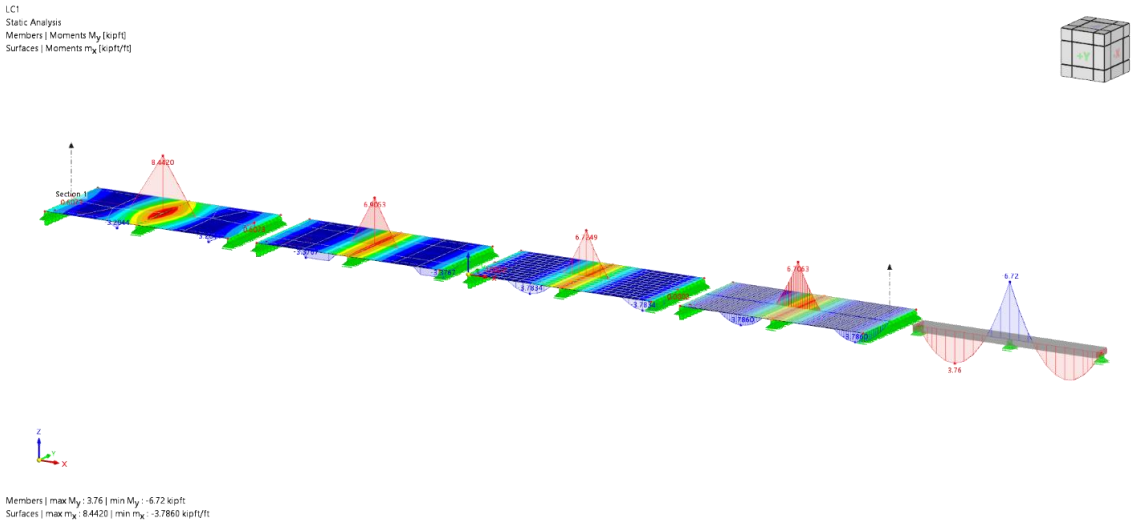
What is Discretization?

a) A structure that is converted into finite elements

b) The calculation of a structure according to the FEA method

c) Sub-meshing finite elements into smaller elements

Continuous Plate Example



Covered Topics

- FE mesh design
- Convergence behavior
- Comparison of beam / surface elements
- FE mesh size

Result Interpretation

- Distribution of internal forces
- Shear stiffnesses
- Result smoothing

FE mesh size should be...

a) as fine as necessary and as course as possible.

b) as course as necessary and as fine as possible.

c) as precise as possible and as course as necessary.

Open Discussion

Any Questions

Dlubal Software

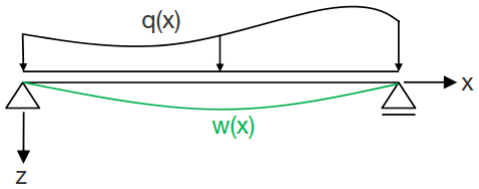
Coffee Break

Plate Theory

Analogy using beam elements:

Bernoulli

- Cross-sections remain in-plane and perpendicular to the member axis
- No consideration of shear deformations
- Completely rigid shear stiffness



Timoshenko

- Cross-sections remain in-plane but don't remain perpendicular to the member axis
- Shear deformations are taken into consideration
- Shear stiffness is limited and isn't completely rigid

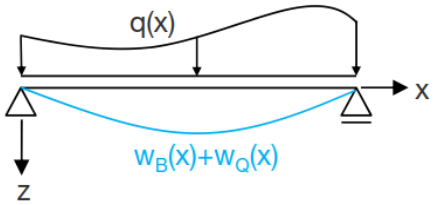


Plate Theory

Analogy using beam elements:

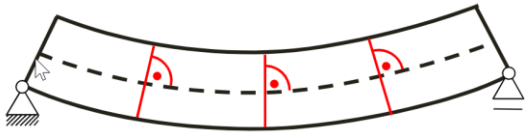
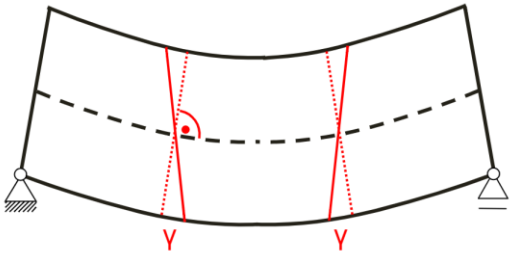
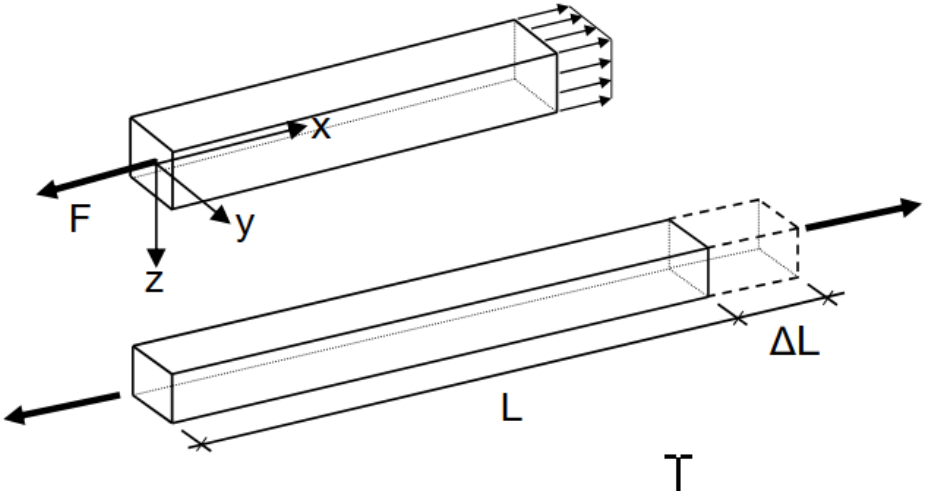
Bernoulli	Timoshenko
	

Plate Theory

Equivalent analogy for plate elements:

Kirchhoff	Reissner/Mindlin
▪ Geometrically linear: small deformations	▪ Geometrically linear: small deformations
▪ Linear elastic material: Hooke's law	▪ Linear elastic material: Hooke's law
▪ Cross-sections remain flat, no warping	▪ Cross-sections remain flat, no warping
▪ Constant thickness	▪ Constant thickness
▪ **No consideration of shear deformations**	▪ **Consideration of shear deformations**
	▪ **Consideration of transverse/lateral strains**

Transverse/Lateral Strain



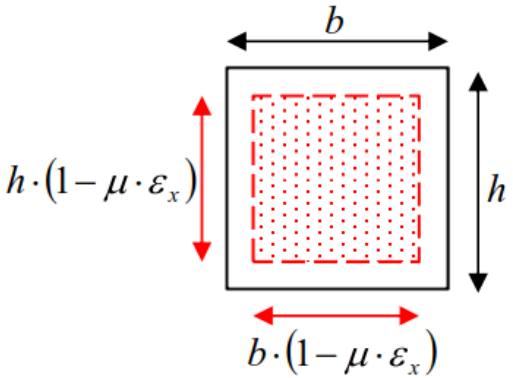


Plate Theory

Transfer to plate elements:

Kirchhoff-Theory

- **No consideration of shear deformations**
- Theory of thin plates
- Pure bending and load bearing capacity
- Simplified approach

Reissner/Mindlin-Theory

- **Consideration of shear deformations**
- Theory of thick plates
- Shear influence component is relatively high
- Significant error when neglecting shear force
- Higher-value approach
- More accurate shear forces

The plate theory of Kirchoff does not consider any shear deformation.

a) True

b) False

Where are member and surface modifications such a I_{cr} (concrete cracked moment of inertia) set?

a) Load Cases/Combinations dialog – Stiffness Modifications

b) Navigating to File - Insert

c) Member/Surface Edit dialog

Member unbraced lengths are set under which of the following?

a) Navigating to File - Insert

b) Member Edit dialog – Effective Lengths tab

c) Steel Design – Serviceability Configurations

It’s possible to edit an existing image in the printout report instead of deleting and creating a new image.

a) True

b) False

Open Discussion

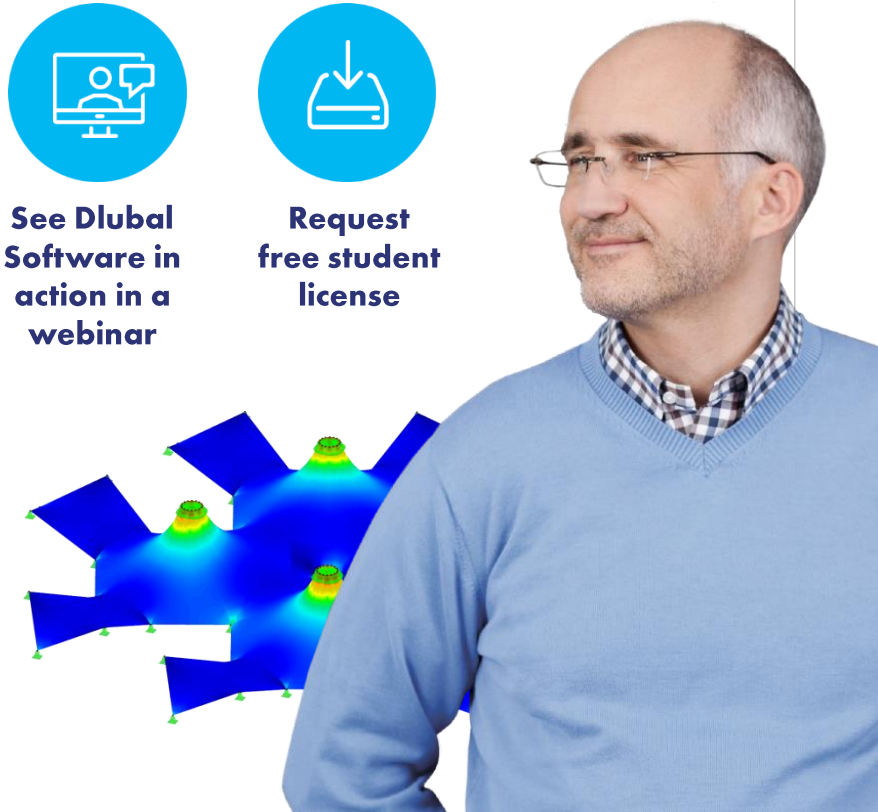
Any Questions

Visit website
www.dlubal.com

- Videos and recorded webinars
- Newsletters
- Events and conferences
- Knowledge Base articles

See Dlubal Software in action in a webinar

Request free student license



Dlubal Software, Inc.
The Graham Building, 30 South 15th Street,
15th Floor, Philadelphia, PA 19102

Phone: (267) 702-2815
E-mail: info-us@dlubal.com

www.dlubal.com