

Structures: Truss elements

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Structural applications: Examples

• Example 1

Cables



Photo by Leila Zimmermann

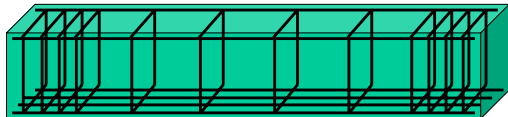
Remark: Large displacements for structures and continuum are supported ()



Structural applications: Examples

- **Example 2**

Discrete reinforcement

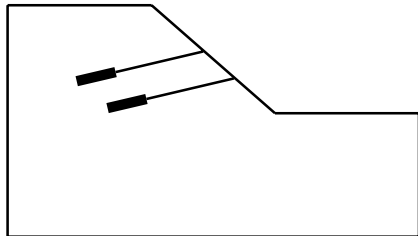




Soil-structure interaction: Example

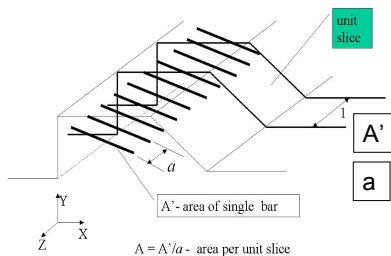
- **Example**

Prestressed anchors

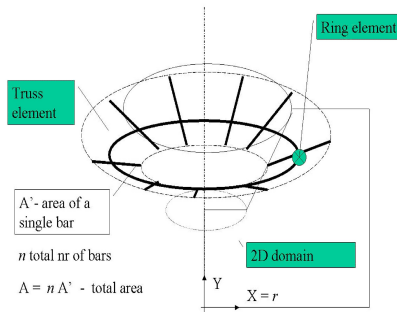




Geometrical model: 2D vs Axisymmetry



2D (plane-strain)



Axisymmetry



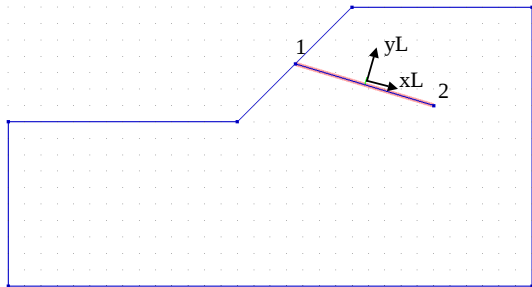
Geometrical model: Macro level

- **Create truss on objects**

Step:A Select objects:
Macro-model/Objects/Select/....

Step:B Create trusses :
Macro-model/Subdomain/Create/Truss(s) on
objects

NB. Split preserves the initial curved truss geometry





Geometrical model: Macro level

- **Linking truss to the background mesh**

Step:A Option: Update/Parameters/Geometry (tab)

Anchor definition

Geometry | Prestress

Node 1

X: 50769230769231
Y: 2.707692307692
Z: 0
[m]

Node 2

X: 5.2
Y: 2.2
Z: 0
[m]

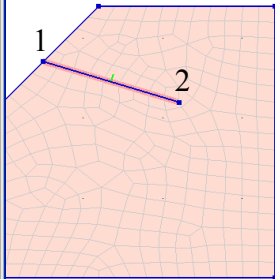
☐ Link node 1 with background continuum element

☒ Link node 2 with background continuum element

Parameters

Initial material: 2
1-st replacement mat.: 0
2-nd replacement mat.: 0
Existence function: 0
Unloading function: 0

Cancel OK





Geometrical model: Macro level

• Prestressing

Option: Update/Parameters/Prestress (tab)

Anchor definition

Geometry | **Prestress**

Prestress

☒ Prestress

Value: 100 [kN/m²]

Load function: 1

Existence Function: 2

Cancel OK

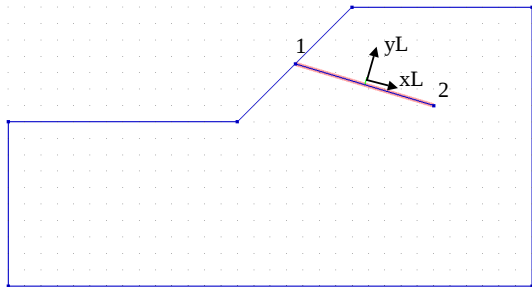
Remarks

- 1 Prestress force should be checked vs plasticity limit
- 2 Prestress is active (force is always equal to the declared one) only in active periods of the existence function; if ex.f. index=0 then it remains under permanent control



Geometrical model: FE level

- 1 Create truss
- 2 Linking truss to the background mesh
- 3 Prestress

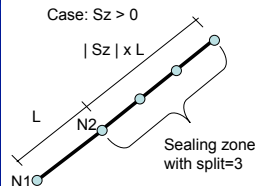
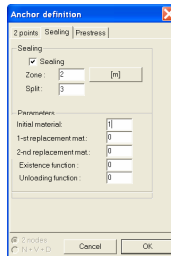
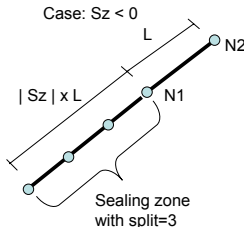
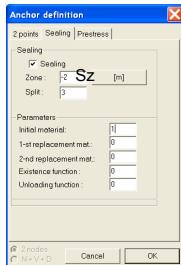


- A All methods are similar to the ones designed for Macro-model level but geometry is restricted only to the straight line segment
- B Other methods including import from the external file also are available



Geometrical model: FE level: Anchor head

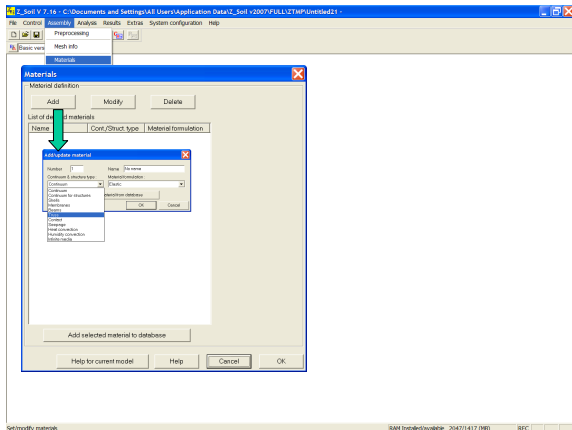
Automatic generation of an anchor head during creation of a truss element between 2 nodes/points





Add new material for truss

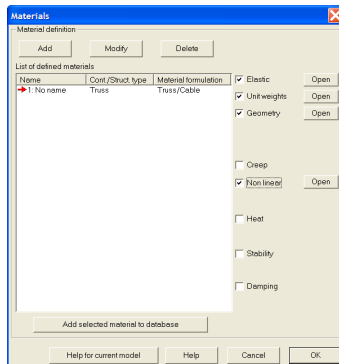
- 1 **Add new truss material**
- 2 **Set linear/non-linear mode**





Add new material for truss

- 1 Add new truss material
- 2 Set linear/non-linear mode





Materials for linear truss: data groups

- 1 **Elastic**
- 2 Unit weight
- 3 Geometry
- 4 Creep
- 5 Heat
- 6 Damping

Obligatory

Material

Elastic parameters

Young modulus E 100000 [kN/m²]

Poisson ratio v 0.3 []

OK

Cancel

Help

Data mode Standard

Next slide



Materials for linear truss: data groups

- 1 Elastic
- 2 **Unit weight**
- 3 Geometry
- 4 Creep
- 5 Heat
- 6 Damping

Optional

Unit weight/mass

Unit weight/mass

Weight / unit volume

γ 0 [kN/m³]

γ multiplier for body forces 1

Mass / unit volume

ρ 0 [kg/m³]

ρ multiplier for mass matrix 1

Global gravity direction

Data mode Standard

OK Cancel Help

Next slide

NB. Mass and body force multipliers visible only if Dynamics is activated in the project preselection



Materials for linear truss: data groups

- 1 Elastic
- 2 Unit weight
- 3 **Geometry**
- 4 Creep
- 5 Heat
- 6 Damping

Obligatory
2D/3D

The Material dialog box contains the following fields and controls:

- Area: Input field with value 1, unit button [m²]
- Interval between anchors: Input field with value 1, unit button [m]
- OK button
- Cancel button

Axisymmetric case

The Geometry dialog box for the 2D case contains the following fields and controls:

- Area: Input field with value 20, unit button [m²]
- treated as:
 - ☒ Total along whole circumference
 - ☐ Per unit length of circumference
- OK button
- Cancel button

The Geometry dialog box for the axisymmetric case contains the following fields and controls:

- Area: Input field with value 20, unit button [m]
- treated as:
 - ☐ Total along whole circumference
 - ☒ Per unit length of circumference
- OK button
- Cancel button

Next slide



Materials for linear truss: data groups

- 1 Elastic
- 2 Unit weight
- 3 Geometry
- 4 **Creep**
- 5 Heat
- 6 Damping

Optional

The screenshot shows a 'Creep' dialog box with a blue title bar and a close button (X) in the top right corner. The dialog contains the following fields and controls:

- Curve type :** A dropdown menu currently set to 'Power'.
- A :** A text input field containing '0', followed by a unit box containing '[1/kN*m^2]'.
- B :** A text input field containing '0', followed by a unit box containing an empty space.
- Existence fct :** A text input field containing '0'.
- Advanced:** A checkbox located at the bottom left, which is currently unchecked.
- Buttons:** 'Help', 'Ok', and 'Cancel' buttons are located at the bottom right.

Next slide

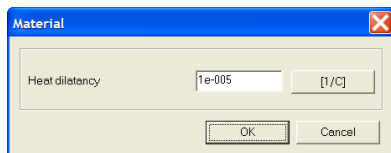
Remarks



Materials for linear truss: data groups

Optional

- 1 Elastic
- 2 Unit weight
- 3 Geometry
- 4 Creep
- 5 **Heat**
- 6 Damping



NB. Preprocessed thermal strains (by Heat project) are handled by truss elements

Next slide



Materials for linear truss: data groups

Optional

- 1 Elastic
- 2 Unit weight
- 3 Geometry
- 4 Creep
- 5 Heat
- 6 **Damping**

Damping

α_0 [0] [1/day]

β_0 [0] [day]

☐ Evaluate damping coefficients from imposed values

OK Cancel

Evaluate damping coefficients from imposed values

ω_1 [0] [1/day] ζ_1 [0] ☐

ω_2 [0] [1/day] ζ_2 [0] ☐

Calculate

α_0 [0] [1/day] β_0 [0] [day]

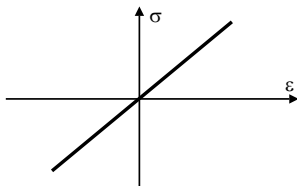
OK Cancel

Next slide

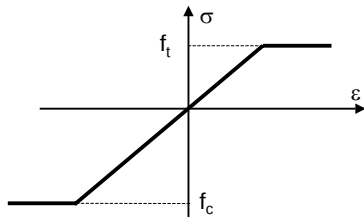
NB. Meaningful only for Dynamics



Constitutive models for truss



Elastic



Elastic-perfectly plastic