Analysis of plane frames with arbitrary cross-sections

Joint coordinates - xJ; yJ

,

Elements - [J1; J2]

,

Element endpoint coordinates

, , ,

Element length -

Element direction

,

Transformation matrix

Diagonal 3x3 block -

Generation of the full transformation matrix

Supports - [Joint; cx; cy; cr]

Loads - [Element, qx, qy]

Load values on elements

Scheme of the structure



Materials

Modules of elasticity -

Poisson coefficients -

Shear modules -

Assignments on elements -

Cross-sections

Section S1 - - circular -

Section S2 - , - rectangular -

General representation -

Cross section properties

Equations

Area -

First moment of area -

Centroid -

Second moment of area -

First moment of area below z -

Shear area -

Calculated results

Centroids -

Areas -

Shear areas -

Second moments of area -

Assignments on elements -

Element stiffness matrix

Elastic properties for element "e"

, ,

, ,

Stiffness matrix coefficients for element "e"

, ,

,

Assembling the 3x3 stiffness matrix blocks for element "e"

Full element stiffness matrix

Stiffness matrices obtained in local coordinates

Stiffness matrices obtained in global coordinates

Global stiffness matrix

Element load vector

Lateral load in local CS -

Axial load in local CS -

Equivalent loads at element endpoints

, ,

Load vector -

Results for elements

Element Е -

Element Е -

Element Е -

Element Е -

Global load vector

Results

**Solution of the system of equations by Cholesky decomposition**

**Joint displacements**

**Support reactions**

,

Joint **J1 -**

Joint **J5 -**

**Element end forces**

**Element internal forces**

,

**Axial forces diagram, kN**



**Shear forces diagram, kN**



**Bending moments diagram, kNm**



**Deformed shape**

Shape function in relative coordinates ξ = x/l (with account to shear deflections)

Element endpoint displacements and rotations

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, ,

Displacement functions

Deformed shape, mm

