Verification Example

Program: RFEM 5, RFEM 6, RSTAB 8, RSTAB 9

Category: Large Deformation Analysis, Isotropic Linear Elasticity, Member

Verification Example: 0047 – Snap Through with Spring Supports

0047 – Snap Through with Spring Supports

Description

A structure made of I-profile trusses is supported on the both ends by the spring sliding supports and loaded by the transversal forces according to the **Figure 1** [1]. The problem is described by the following set of parameters.

Material	Steel	Modulus of Elasticity	E	210000.000	MPa
		Poisson's Ratio	ν	0.300	–
Geometry	Structure	Section Length 2	L_1	2.000	m
		Section Length 2	L_2	4.000	m
		Section Length 3	L_3	4.000	m
		Height 1	h_1	0.130	m
		Height 2	h_2	0.520	m
	Cross-Section	Height	h	400.000	mm
		Width	b	180.000	mm
		Web Thickness	s	10.000	mm
		Flange Thickness	t	14.000	mm
Load		Transverse Force	F_1	10.000	kN
		Spring Stiffness	$c_{u,X}$	84000.000	kN/m

The self-weight is neglected in this example. Determine the deflection of the structure at point 1 (u_{z1}), the bending moment at point 2 (M_{y2}) , the normal force in the truss (N) and horizontal deflection of the spring support at point 3 (u_{x3}).

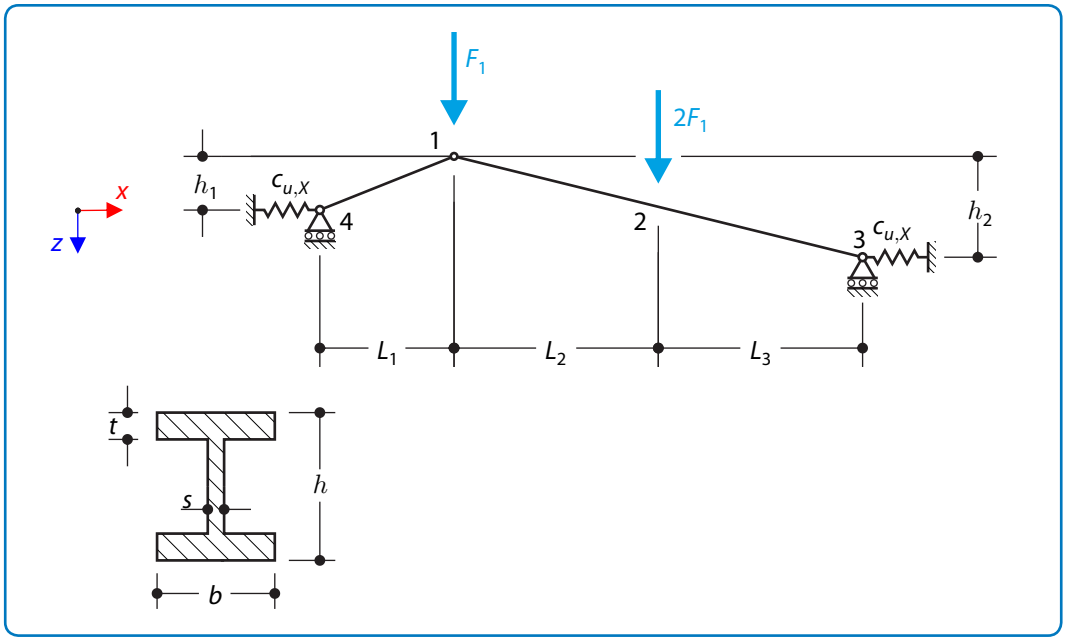

Figure 1: Problem sketch

Analytical Solution

Analytical solution is not available, results given in [1] are taken as a reference.

RFEM 5 Settings

- Modeled in version RFEM 5.26.02, RSTAB 8.26.02 and RFEM 6.01, RSTAB 9.01
- The element size is $l_{FE} = 0.200$ m
- The number of increments is 5
- Isotropic linear elastic material model is used
- The structure is modeled using members (Trusses)
- Shear stiffness of the members is neglected
- Large deformation analysis is used

Results

Structure Files	Program
0047.01	RFEM 5, RFEM 6
0047.02	RSTAB 8, RSTAB 9

Quantity	S3D [2]	RFEM 5	Ratio [-]	RSTAB 8	Ratio [-]
u_{z1} [mm]	53.8	53.7	0.998	53.8	1.000
M_{y2} [kNm]	41.0	41.0	1.000	41.0	1.000
N [N]	-209.0	-208.4	0.997	-208.6	0.998
u_{x3} [mm]	2.47	2.47	1.000	2.47	1.000

Quantity	S3D [2]	RFEM 6	Ratio [-]	RSTAB 9	Ratio [-]
u_{z1} [mm]	53.8	53.6	0.996	53.7	0.998
M_{y2} [kNm]	41.0	41.0	1.000	41.0	1.000
N [N]	-209.0	-208.4	0.997	-208.6	0.998
u_{x3} [mm]	2.47	2.47	1.000	2.47	1.000

References

[1] LUMPE, G. and GENSICHEN, V. *Evaluierung der linearen und nichtlinearen Stabstatik in Theorie und Software: Prüfbeispiele, Fehlerursachen, genaue Theorie*. Ernst, 2014.

[2] LUMPE, G. *S3D (Vers. 25.09.2011)*. Hochschule Biberach, 2011.