

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

Category: Large Deformation Analysis, Isotropic Linear Elasticity, Member

Verification Example: 0098 – Planar Truss Under Bending and Torsion

0098 – Planar Truss Under Bending and Torsion

Description

Planar truss consisting of four sloped members and one vertical member according to **Figure 1** is loaded at the upper node by means of the vertical force F_z and out of plane force F_y . Assuming large deformation analysis and neglecting self-weight, determine the normal forces of the members and the out of plane displacement of the upper node u_y .

Material	Steel	Modulus of Elasticity	E	210000.000	MPa
		Poisson Ratio	ν	0.296	—
Geometry	Sloped Member - IPE 300	Height	h_1	300.000	mm
		Width	b_1	150.000	mm
		Web Thickness	t_w	7.100	mm
		Flange Thickness	t_f	10.700	mm
		Length	L_1	6.708	m
	Vertical Member - QRO 120x5	Side Length	b_2	120.000	mm
		Wall Thickness	s_2	5.000	mm
Length		L_2	6.000	m	
Load	Force	Out of Plane	F_y	0.200	kN
		Vertical	F_z	24.000	kN

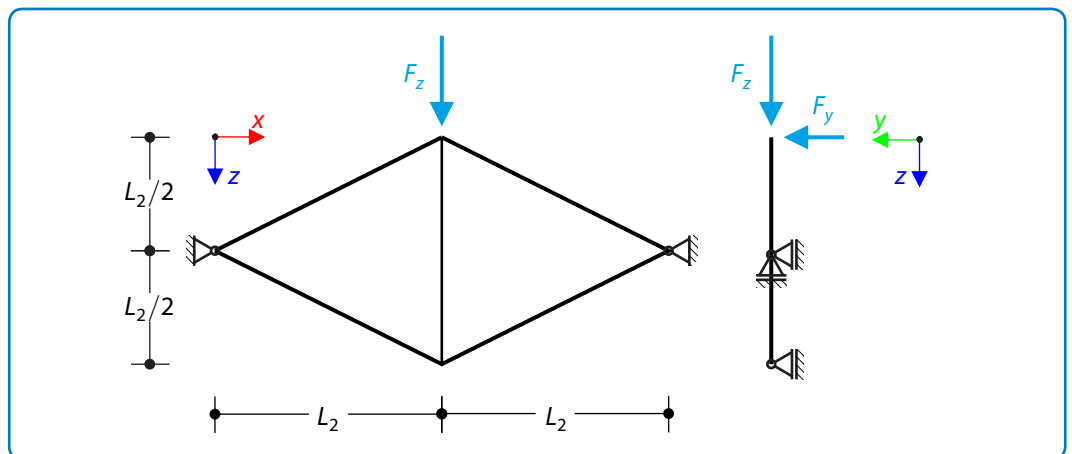


Figure 1: Problem sketch [1]

Analytical Solution

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

RFEM and RSTAB Settings

- Modeled in version RFEM 5.26.02, RSTAB 8.26.02 and RFEM 6.01, RSTAB 9.01
- The element size is $l_{FE} = 0.600$ m
- Large deformation analysis is considered
- The number of increments is 10
- Isotropic linear elastic material model is used

Results

Structure File	Program
0098.01	RFEM 5, RFEM 6
0098.02	RSTAB 8, RSTAB 9

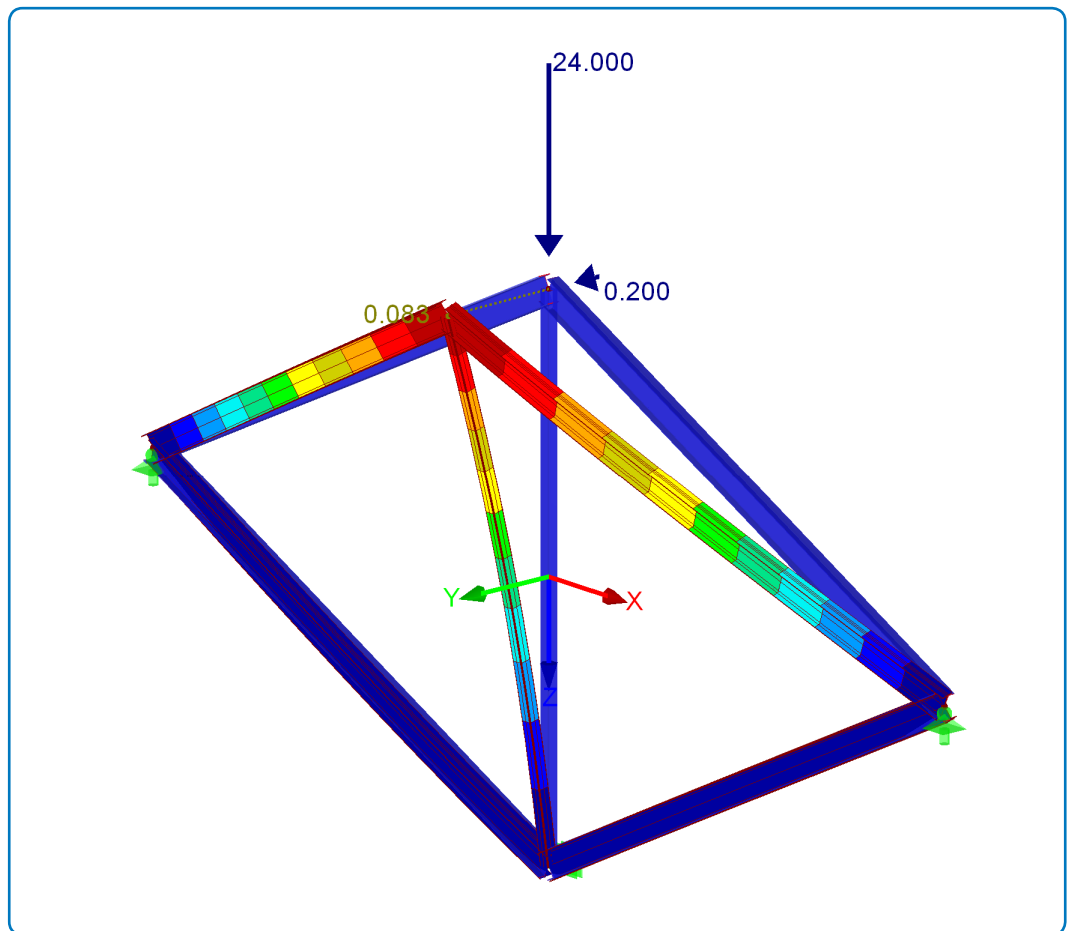


Figure 2: RFEM 5 results

S3D [2]	RFEM 5		RSTAB 8	
$u_{y,max}$ [m]	$u_{y,max}$ [m]	Ratio [-]	$u_{y,max}$ [m]	Ratio [-]
0.082	0.083	0.988	0.083	0.988

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Normal Force	S3D [2]	RFEM 5		RSTAB 8	
	N [kN]	N [kN]	Ratio [-]	N [kN]	Ratio [-]
Upper Sloped Member	-3.7	-3.5	1.057	-3.5	1.057
Lower Sloped Member	23.0	23.2	0.991	23.2	0.991
Vertical Member	-20.5	-20.6	0.995	-20.7	0.990

S3D [2]	RFEM 6		RSTAB 9	
$u_{y,max}$ [m]	$u_{y,max}$ [m]	Ratio [-]	$u_{y,max}$ [m]	Ratio [-]
0.082	0.083	0.988	0.083	0.988

Normal Force	S3D [2]	RFEM 6		RSTAB 9	
	N [kN]	N [kN]	Ratio [-]	N [kN]	Ratio [-]
Upper Sloped Member	-3.7	-3.4	1.088	-3.5	1.057
Lower Sloped Member	23.0	23.2	0.991	23.2	0.991
Vertical Member	-20.5	-20.7	0.990	-20.7	0.990

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.