SB10 · STATIC-TRUSS

Asymmetric determinate two-bar truss (brace axial force)

Brace axial force, apex displacement & reactions — determinate bar absolute check

PASS

error 0.00% · tol 0%

§2 TECHNICAL FEATURES TESTED

- **element Truss** — linear (small-displacement) bar
- memberType **brace**, two-sided, no P-Delta
- Orthonormal braces ⇒ **K = (EA/L)·I**
- Statically determinate ⇒ exact closed form
- Axial from `elem_force.out` localForce

§3 PROBLEM DESCRIPTION

Two prismatic braces span from a free apex N3 up to two fully fixed supports N1 and N2. A single apex point load with components along global −X and −Z puts both braces in tension. Because the two bar directions are mutually orthogonal, the assembled apex stiffness is diagonal, and the configuration is statically determinate — so the member axial forces, the apex displacement, and the two support reactions all follow from equilibrium and the EA/L bar law in closed form. A two-sided brace with P-Delta off is emitted as a linear `Truss`, which carries no geometric offset, so STRIX must reproduce every quantity to machine precision.

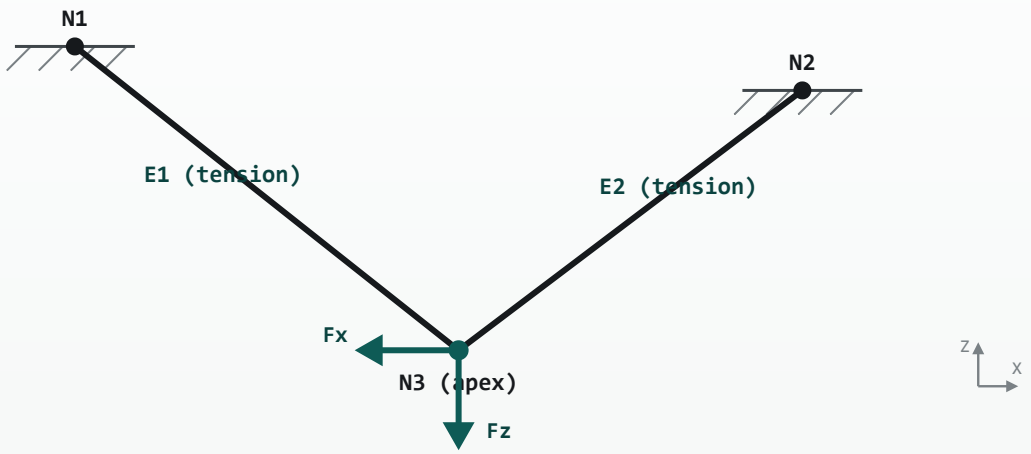

Figure SB10. Asymmetric two-bar truss: fixed supports N1, N2 and loaded free apex N3 (both braces in tension).

§4 GEOMETRY, PROPERTIES & LOADING

GEOMETRY		MATERIAL		LOADING & BC	
Braces	2 (E1, E2)	Model	Elastic	N1, N2	fixed 6-DOF
Length L	5000 mm	E	200000 MPa	N3 load	Fx −10 kN, Fz −20 kN
Area A	1000 mm²	ν	0.3	N3 fixity	UY + rot fixed
Dir û1 (N3→N1)	(−0.6, 0, 0.8)	Units	N · mm	Self-weight	off
Dir û2 (N3→N2)	(0.8, 0, 0.6)			Analysis	Linear static

§5 REFERENCE SOLUTION

Brace E1 axial N: N1 = -(Fx*u1x + Fz*u1z) = 10000 N

Brace E2 axial N: N2 = -(Fx*u2x + Fz*u2z) = 20000 N

Apex displacement u_z: uz = Fz / (E*A/L) = -0.5 mm

Statically-determinate truss closed form — joint equilibrium (method of joints) gives the member axial forces and EA/L bar stiffness gives the apex displacement; a linear (small-displacement) bar carries no geometric offset, so every quantity is exact.

§6 RESULTS COMPARISON

RESPONSE QUANTITY	PROBE	STRIX	REFERENCE	DIFF	VERDICT
Brace E1 axial N (N)	E1.Ni	10000	10000	0.00%	PASS
Brace E2 axial N (N)	E2.Ni	20000	20000	0.00%	PASS
Apex displacement u_x (mm)	N3.ux	−0.25	−0.25	0.00%	PASS
Apex displacement u_z (mm)	N3.uz	−0.5	−0.5	0.00%	PASS
Support N1 reaction R_x (N)	N1.Fx	−6000	−6000	0.00%	PASS
Support N1 reaction R_z (N)	N1.Fz	8000	8000	0.00%	PASS
Support N2 reaction R_x (N)	N2.Fx	16000	16000	0.00%	PASS
Support N2 reaction R_z (N)	N2.Fz	12000	12000	0.00%	PASS

§7 EXACTNESS

DISCRETIZATION	BRACE E1 N (N)	DIFF
2 bars (exact)	10000	0.00%

A statically-determinate truss needs no compatibility relations: the member forces follow from nodal equilibrium alone, and one linear `Truss` per member represents each bar exactly. There is nothing to refine — the response is `discretization-exact`, and every reference value is reproduced to machine precision (0 error against a 10^{-6}% tolerance).

§8 CONCLUSION

PASS STRIX reproduces the reference solution to **0.00%** (tolerance 0%). The tested element and its formulation are verified against the reference.

§9 REFERENCES & ANALYSIS FILES

1. Hibbeler, R. C. — *Structural Analysis.* Method of joints for statically-determinate trusses; bar elongation δ = NL/EA.
2. OpenSees — `element Truss` (linear, small-displacement bar).
3. STRIX headless harness: `generatePyForLoadCase → python.exe → parseAll`.

EVIDENCE ARCHIVE `verif-evidence-eng1.0.6-win-x64.zip · SB10/` `sha256 (pending publish)`