2D FRAME AND TRUSS ANALYSIS

Gable Portal Frame Analysis Calculation Report

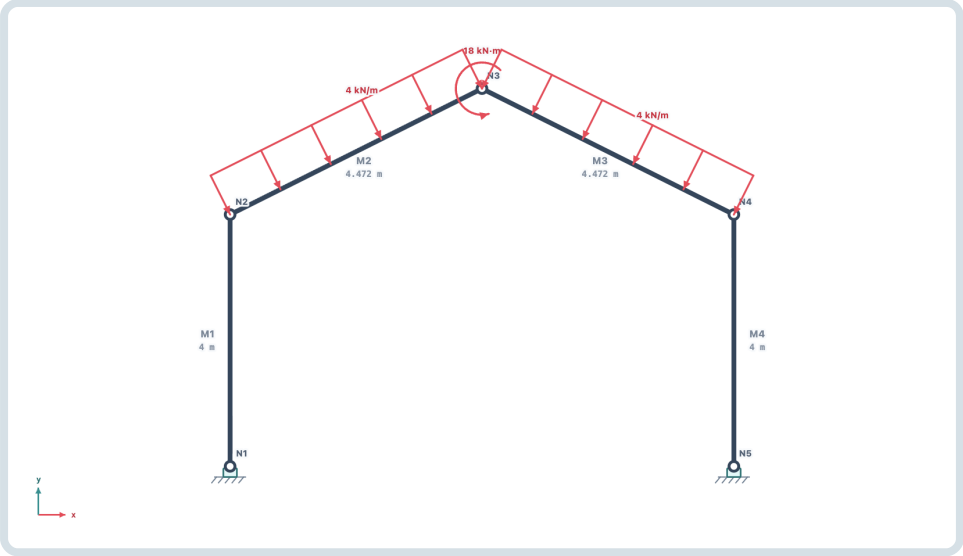
8 m fixed-base gable portal frame

Analyzed scenario: All applied loads

Working units: Metric · Solver: first-order linear elastic direct stiffness

Project field	Report value
Project / model	8 m fixed-base gable portal frame
Prepared by	Tamer Hijjawi, P.Eng.
Checked by	Tamer Hijjawi, P.Eng.
Generated	7/30/2026, 12:01:22 AM
Analyzed loading	All applied loads

Analysis model and defined loads



SECTION 1

Analysis basis and calculation scope

This report records the model and the applied loads solved immediately before export. Result tables apply to all loads shown in the model.

Item	Basis used in this analysis
Analysis method	Direct stiffness method for two-dimensional frame elements
Response type	First-order, static, linear elastic, small displacement
Degrees of freedom	Global translation UX and UY at connected nodes; RZ where at least one connected end transfers moment
Frame members	Prismatic axial and Euler-Bernoulli flexural stiffness using E, A and I
Pin-ended frame members	Frame elements with both member-end rotations released; joint-loaded models reproduce ideal pin-jointed truss axial response
Member loads	Concentrated and distributed loads converted to consistent equivalent nodal loads; internal stations recover member response
Internal calculation units	Metres, newtons and pascals; values below are converted to the selected working units
Global axes	+X right, +Y up, positive nodal moment counter-clockwise
Member axes and signs	Local x runs from node i to node j. Positive axial force denotes tension. Positive bending moment is sagging; shear and diagrams follow member local +y.
Not included	P-Delta, geometric or material nonlinearity, shear deformation, tension-only behavior, buckling, vibration, code design and connection checks

Model summary	Value
Structural behavior	Frame members
Nodes	5
Members	4
Supports	2
Defined loads	3
Analyzed loading	All applied loads

Project notes and assumptions supplied for this report

Fixed-base 2D gable portal frame. First-order linear-elastic analysis. Both inclined rafter loads act in member local negative-y.

SECTION 2

Nodes, coordinates and restraints

Node coordinates define the analysis geometry. UX, UY and RZ identify restrained global degrees of freedom.

Node	X	Y	Support	Restrained DOFs
N1	0 m	0 m	fixed	UX, UY, RZ
N2	0 m	4 m	free	Free
N3	4 m	6 m	free	Free
N4	8 m	4 m	free	Free
N5	8 m	0 m	fixed	UX, UY, RZ

SECTION 3

Materials and section properties

Elastic modulus, area and second moment of area provide the stiffness used by the solver. Material density contributes only where structural self-weight is enabled.

Material library

ID	Material	E	Density	Source
MAT1	Structural steel	200 GPa	7,850 kg/m^3	Typical carbon steel

Section library

ID	Section	Area A	Inertia I	Source
S1	Uniform frame section	5,000 mm^2	2.00000e+8 mm^4	User defined

SECTION 4

Member geometry, behavior and stiffness assignments

Member i and j ends follow the connectivity order below. End release descriptions and assigned stiffness properties are part of the solved analytical model.

Connectivity and releases

Member	Node i	Node j	Length	Angle	Behavior	End releases
M1	N1	N2	4 m	90°	Frame	Continuous
M2	N2	N3	4.47214 m	26.565°	Frame	Continuous
M3	N3	N4	4.47214 m	-26.565°	Frame	Continuous
M4	N4	N5	4 m	-90°	Frame	Continuous

Assigned member properties

Member	Material	Section	E	A	I
M1	Structural steel	Uniform frame section	200 GPa	5,000 mm^2	2.00000e+8 mm^4
M2	Structural steel	Uniform frame section	200 GPa	5,000 mm^2	2.00000e+8 mm^4
M3	Structural steel	Uniform frame section	200 GPa	5,000 mm^2	2.00000e+8 mm^4
M4	Structural steel	Uniform frame section	200 GPa	5,000 mm^2	2.00000e+8 mm^4

SECTION 5

Applied loads

Every applied nodal and member load in the solved model is listed below.

Load	Type	Target / position	Definition
L1	nodal	Node N3	Fx = 0 kN Fy = 0 kN Mz = 18 kN·m
L2	member distributed	Member 2 x = 0 m to 4.47214 m	q1 = -4 kN/m q2 = -4 kN/m local-y
L3	member distributed	Member 3 x = 0 m to 4.47214 m	q1 = -4 kN/m q2 = -4 kN/m local-y

SECTION 6

Results summary, diagnostics and equilibrium

The solver checks the reduced stiffness system and verifies numerical equilibrium before returning results. Small residuals are expected from floating-point arithmetic.

Governing response

Result	Signed value	Governing location
Maximum displacement	1.115 mm	M2 at x = 3.4044 m
Maximum signed reaction component	18.54975 kN	N1 · Ry
Peak signed axial force	-18.54975 kN	M1 at x = 0 m
Peak signed shear force	14.26693 kN	M2 at x = 0 m
Peak signed bending moment	-13.21683 kN·m	M1 at x = 4 m

Solver diagnostics

Diagnostic	Value
Stability classification	stable
Active DOFs	15
Free DOFs solved	9
Constrained DOFs	6
Condition estimate	7.911263
Pivot ratio	0.126402
Maximum stiffness residual	0 N
Relative equilibrium residual	0
Warnings	None reported

Global equilibrium about the model origin

Equation	Applied action	Support reaction	Residual
Sum Fx	0 kN	0 kN	0 kN
Sum Fy	-32 kN	32 kN	0 kN
Sum M about global origin	-110 kN·m	110 kN·m	0 kN·m

SECTION 7

Support reactions and nodal displacements

Reaction components use global axes. Nodal rotation is reported in milliradians; translations use the selected displacement unit.

Support reactions

Node	Support	Rx	Ry	|R|	Mz
N1	fixed	5.19768 kN	18.54975 kN	19.2642 kN	-7.57391 kN·m
N5	fixed	-5.19768 kN	13.45025 kN	14.41961 kN	9.97193 kN·m

Nodal translations and rotations

Node	ux	uy	|u|	Rz
N1	0 mm	0 mm	0 mm	0 mrad
N2	-0.128733 mm	-0.074199 mm	0.148586 mm	-0.282146 mrad
N3	0.229001 mm	-0.919113 mm	0.947212 mm	0.316188 mrad
N4	0.608336 mm	-0.053801 mm	0.610711 mm	0.042344 mrad
N5	0 mm	0 mm	0 mm	0 mrad

SECTION 8

Member actions and governing stations

Signed governing values are selected by absolute magnitude from the computed member stations. Local end-force components follow each member from node i to node j.

Governing station values

Member	Peak N	Peak V	Peak M	Max displacement
M1	-18.54975 kN x = 0 m	-5.19768 kN x = 0 m	-13.21683 kN·m x = 4 m	0.273468 mm x = 2.9341 m
M2	-12.94465 kN x = 0 m	14.26693 kN x = 0 m	-13.21683 kN·m x = 0 m	1.114998 mm x = 3.4044 m
M3	-10.66408 kN x = 0 m	-9.70579 kN x = 4.4721 m	-10.81881 kN·m x = 4.4721 m	0.947212 mm x = 0 m
M4	-13.45025 kN x = 0 m	5.19768 kN x = 0 m	-10.81881 kN·m x = 0 m	0.613915 mm x = 0.1584 m

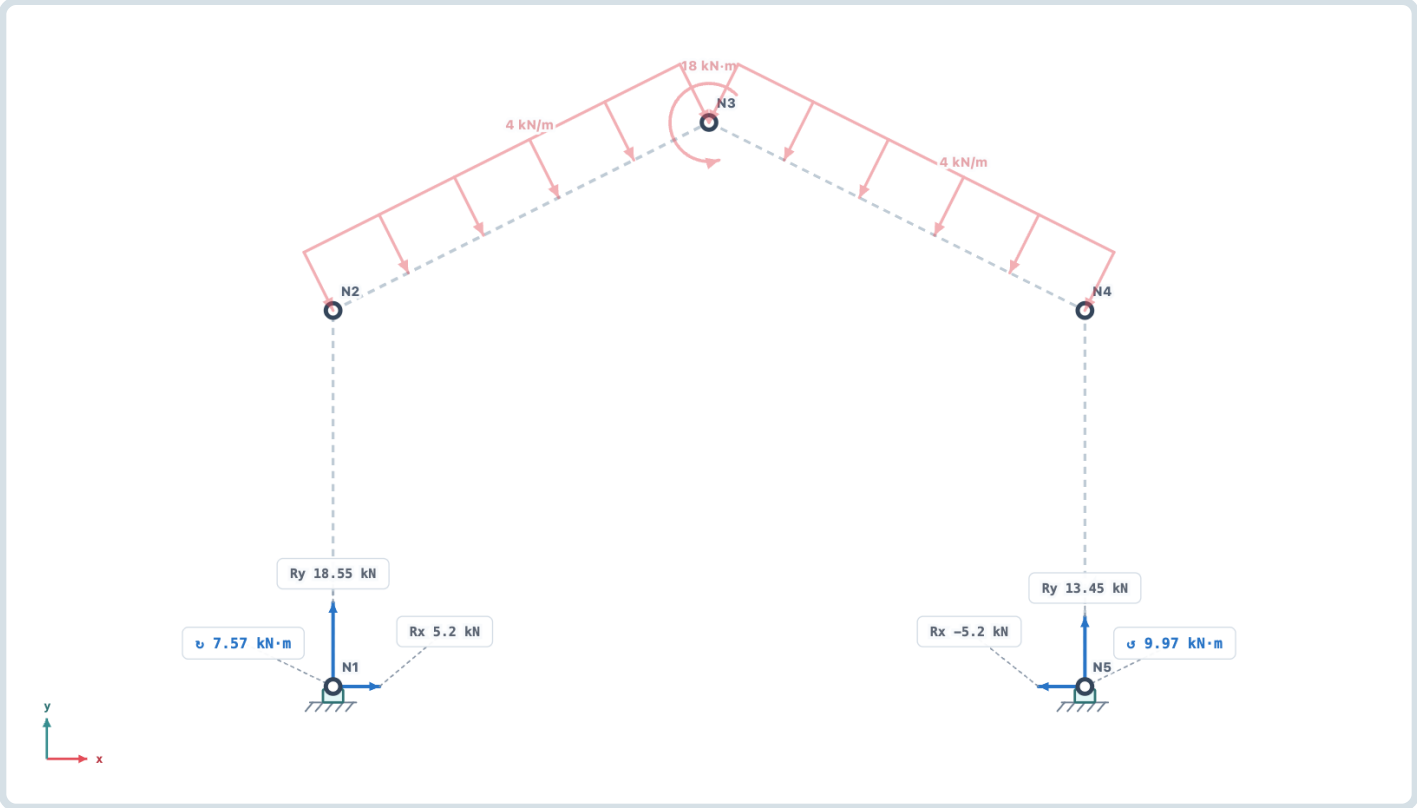
Local member end actions

Member	Ni	Vi	Mi	Nj	Vj	Mj
M1	18.54975 kN	-5.19768 kN	-7.57391 kN·m	-18.54975 kN	5.19768 kN	-13.21683 kN·m
M2	12.94465 kN	14.26693 kN	13.21683 kN·m	-12.94465 kN	3.62162 kN	10.58681 kN·m
M3	10.66408 kN	8.18275 kN	7.41319 kN·m	-10.66408 kN	9.70579 kN	-10.81881 kN·m
M4	13.45025 kN	5.19768 kN	10.81881 kN·m	-13.45025 kN	-5.19768 kN	9.97193 kN·m

SECTION 9

Support reaction diagram

Signed reactions are shown in global X and Y directions.



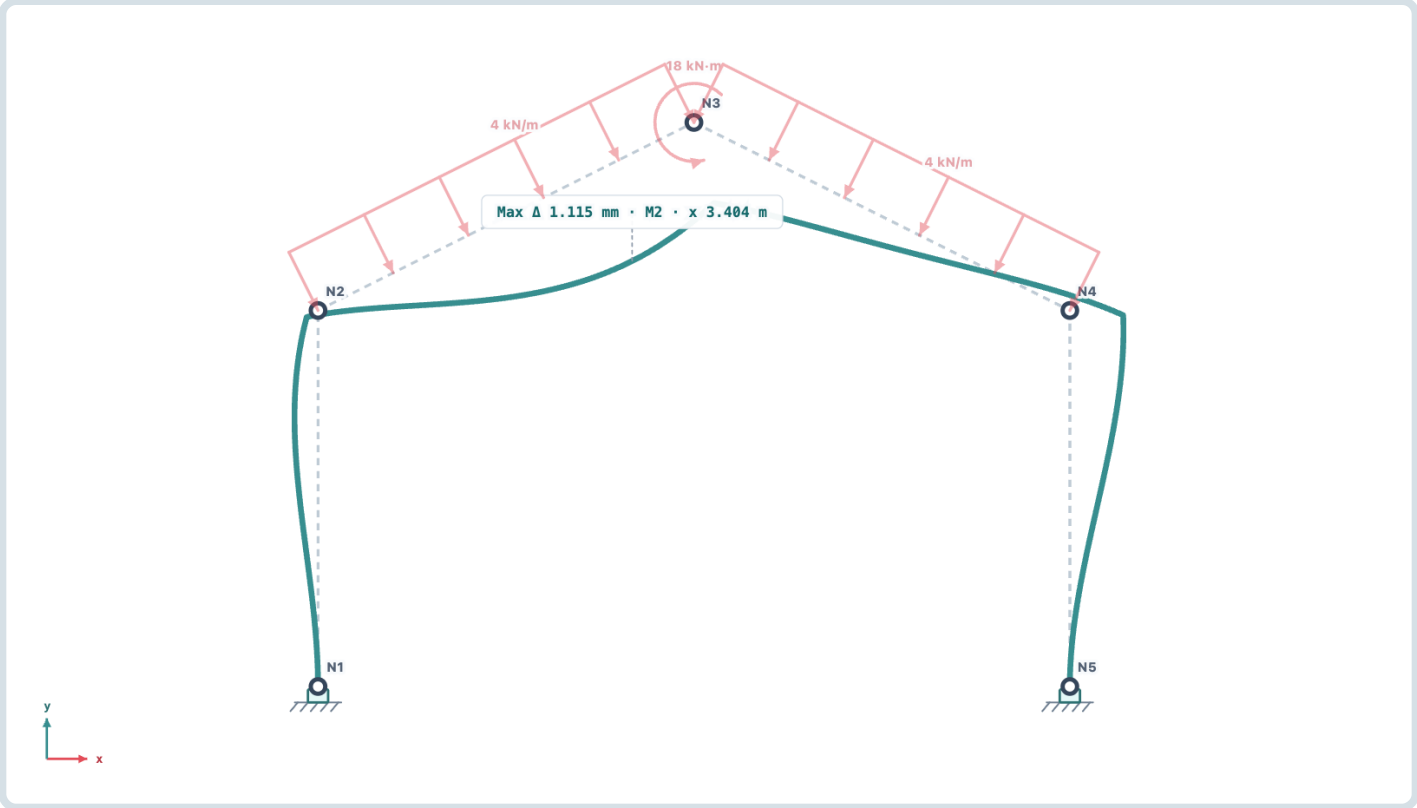
Support reactions · All applied loads · global X/Y · kN and kN·m · Arrow direction follows the signed reaction

Scenario: All applied loads. Diagram scale affects visualization only and does not change the tabulated analysis results.

SECTION 9

Deflected shape

The displaced shape uses the canvas amplification selected for visibility; numeric displacement tables remain unamplified.



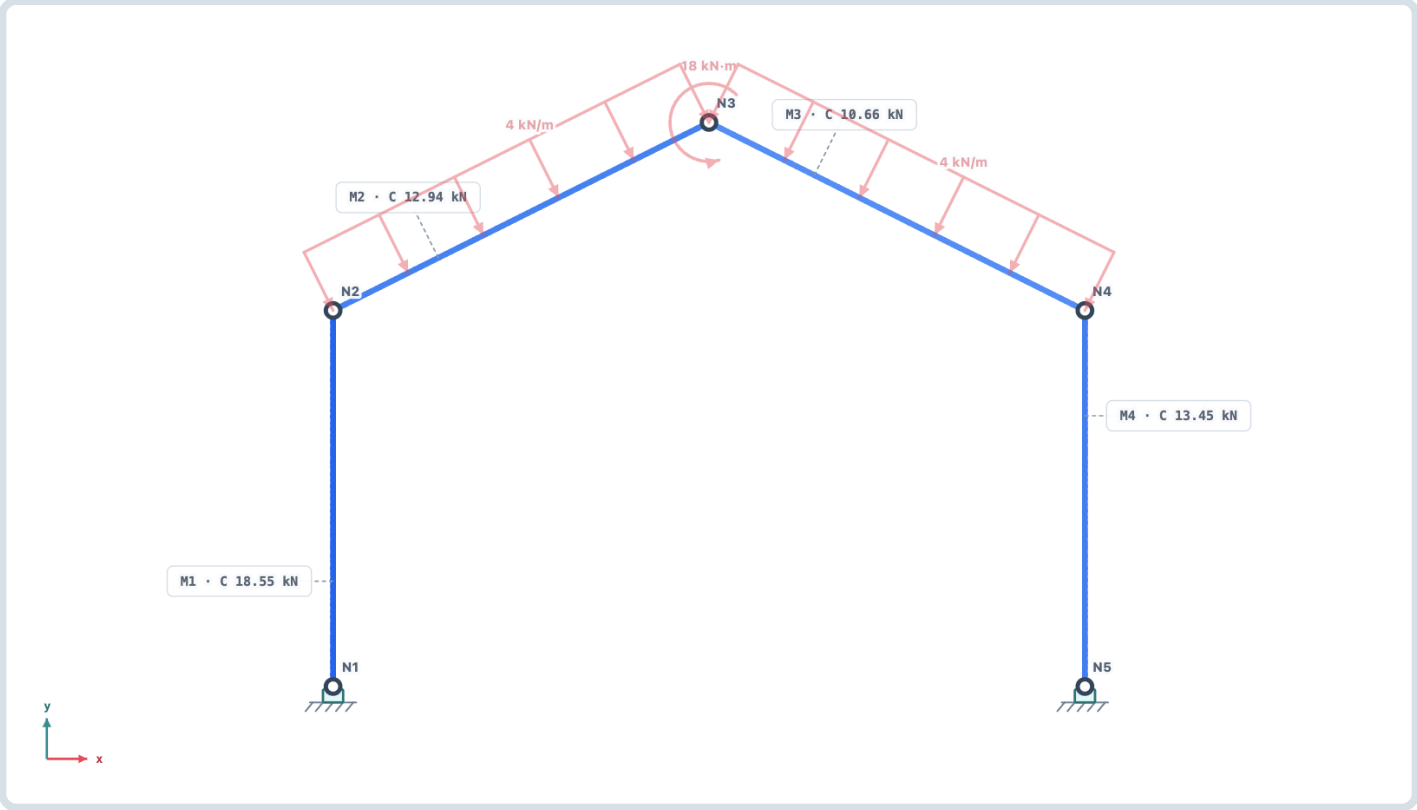
Deflected shape · All applied loads · Auto amplification ×933 · Original geometry shown dashed · values remain unamplified

Scenario: All applied loads. Diagram scale affects visualization only and does not change the tabulated analysis results.

SECTION 9

Axial-force diagram

Tension and compression are differentiated by color, with signed peak labels at governing member stations.



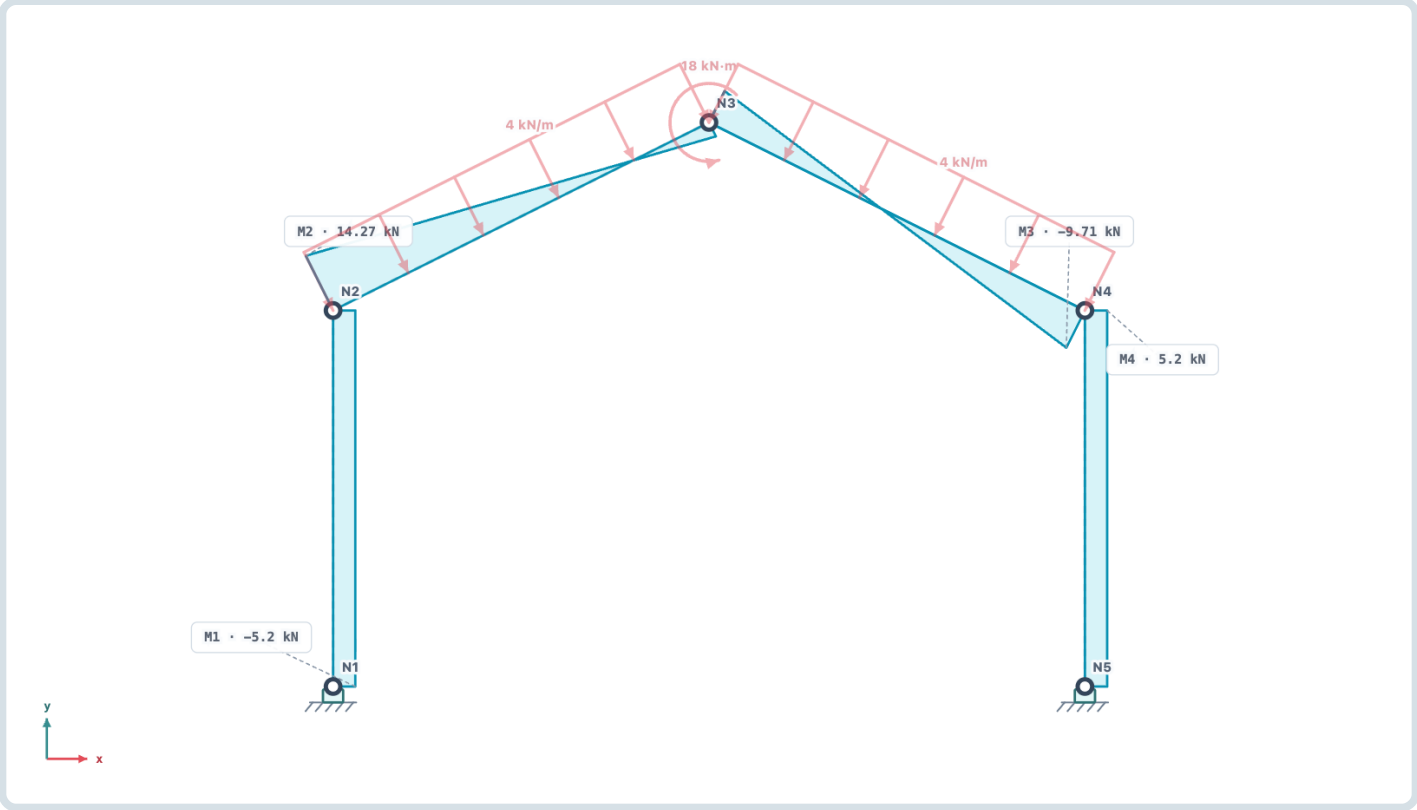
Axial force · All applied loads · Compression to Tension

Scenario: All applied loads. Diagram scale affects visualization only and does not change the tabulated analysis results.

SECTION 9

Shear-force diagram

Shear is plotted on member local +y for frame members and directly loaded released spans.



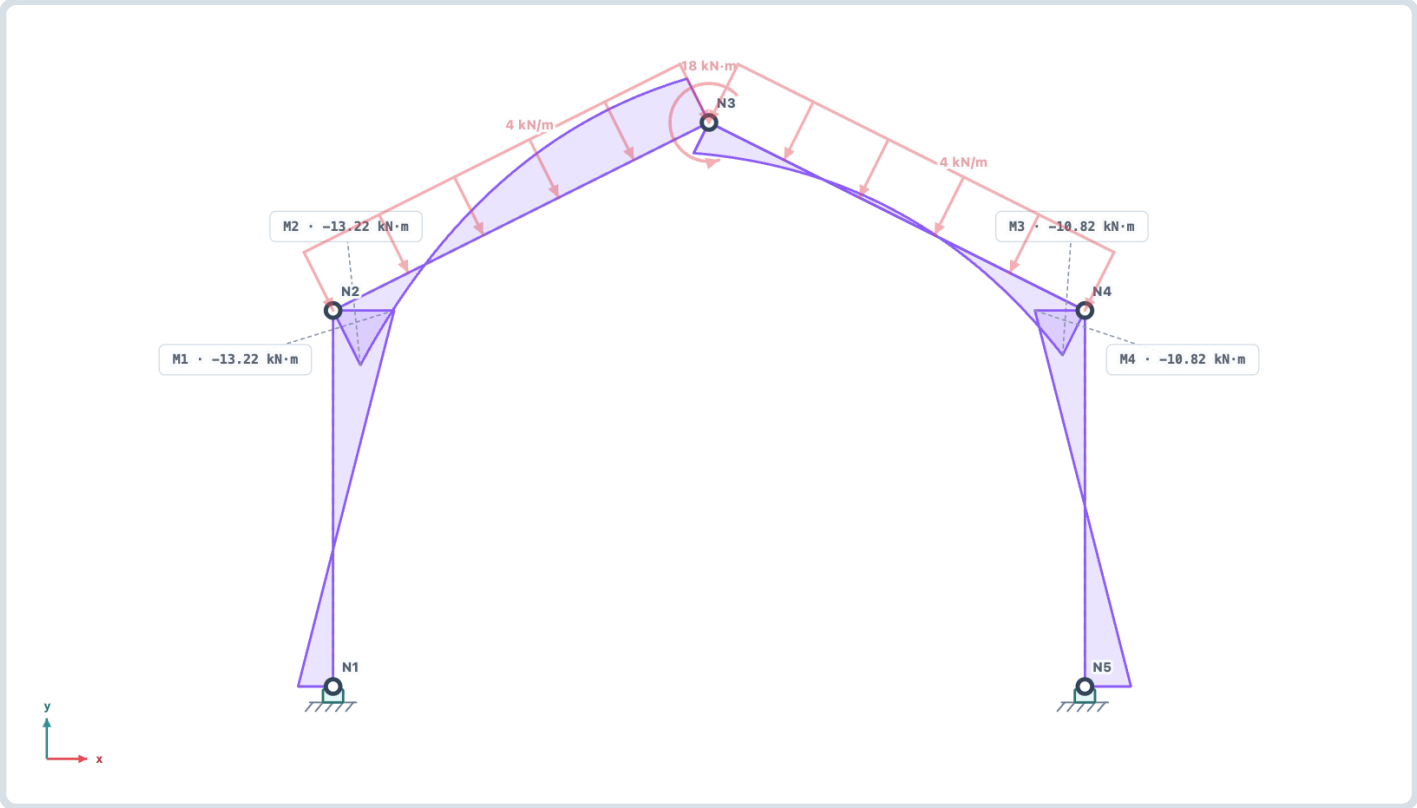
Shear force · All applied loads · kN · +V plotted on member local +y

Scenario: All applied loads. Diagram scale affects visualization only and does not change the tabulated analysis results.

SECTION 9

Bending-moment diagram

Positive sagging moment is plotted using the member local-axis convention.



Bending moment · All applied loads · kN·m · Sagging +M plotted on member local +y

Scenario: All applied loads. Diagram scale affects visualization only and does not change the tabulated analysis results.

SECTION 10 · M1

M1 member result summary

Frame · N1 to N2 · length 4 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N
-18.54975 kN
x = 0 m

PEAK SHEAR FORCE V
-5.19768 kN
x = 0 m

PEAK BENDING MOMENT M
-13.21683 kN·m
x = 4 m

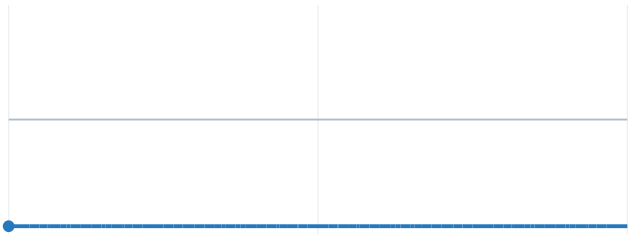
MAXIMUM RESULTANT DISPLACEMENT
0.273468 mm
x = 2.9341 m

Local member end actions

End	Node	Axial N	Shear V	Moment M
i	N1	18.54975 kN	-5.19768 kN	-7.57391 kN·m
j	N2	-18.54975 kN	5.19768 kN	-13.21683 kN·m

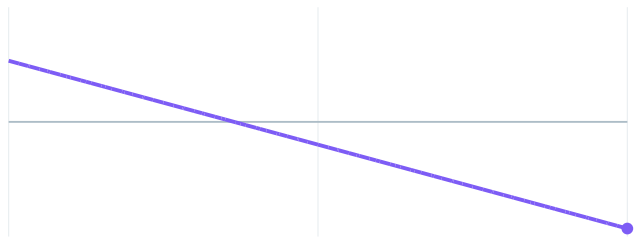
Local response diagrams

Axial force N — Peak -18.5498 kN at x = 0 m



Shear force V — Peak -5.1977 kN at x = 0 m

Bending moment M — Peak -13.2168 kN·m at x = 4 m



Transverse displacement v — Peak 0.268 mm at x = 2.933 m

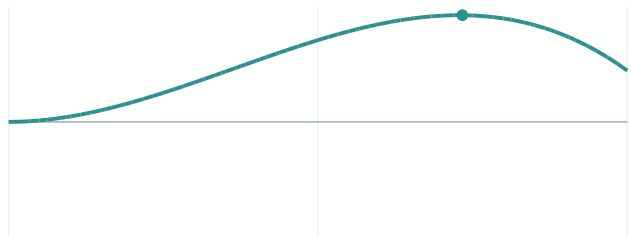


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

SECTION 10 · M2

M2 member result summary

Frame · N2 to N3 · length 4.47214 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N
-12.94465 kN
x = 0 m

PEAK SHEAR FORCE V
14.26693 kN
x = 0 m

PEAK BENDING MOMENT M
-13.21683 kN·m
x = 0 m

MAXIMUM RESULTANT DISPLACEMENT
1.114998 mm
x = 3.4044 m

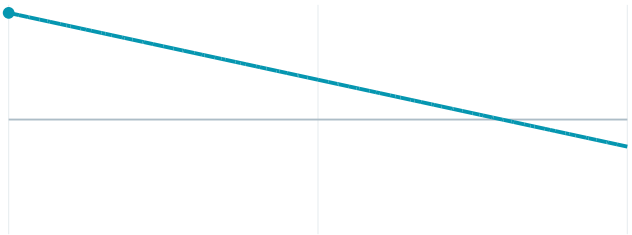
Local member end actions

End	Node	Axial N	Shear V	Moment M
i	N2	12.94465 kN	14.26693 kN	13.21683 kN·m
j	N3	-12.94465 kN	3.62162 kN	10.58681 kN·m

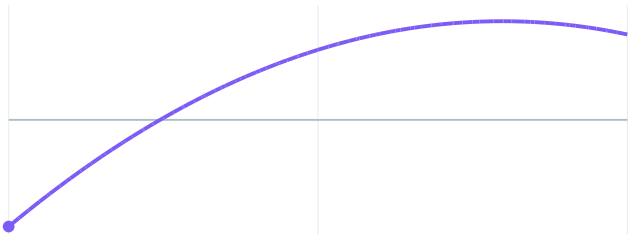
Local response diagrams

Axial force N — Peak -12.9447 kN at x = 0 m

Shear force V — Peak 14.2669 kN at x = 0 m



Bending moment M — Peak -13.2168 kN·m at x = 0 m



Transverse displacement v — Peak -1.09827 mm at x = 3.404 m

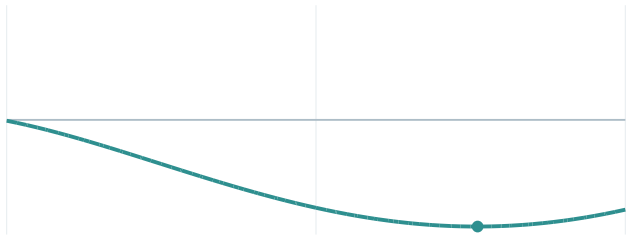


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

SECTION 10 · M3

M3 member result summary

Frame · N3 to N4 · length 4.47214 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N
-10.66408 kN
x = 0 m

PEAK SHEAR FORCE V
-9.70579 kN
x = 4.4721 m

PEAK BENDING MOMENT M
-10.81881 kN·m
x = 4.4721 m

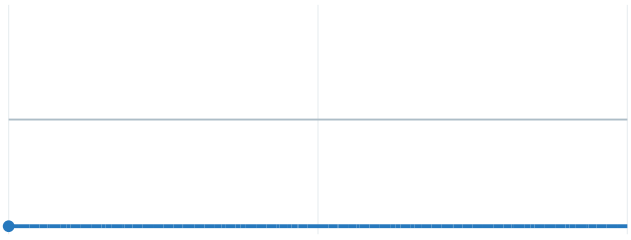
MAXIMUM RESULTANT DISPLACEMENT
0.947212 mm
x = 0 m

Local member end actions

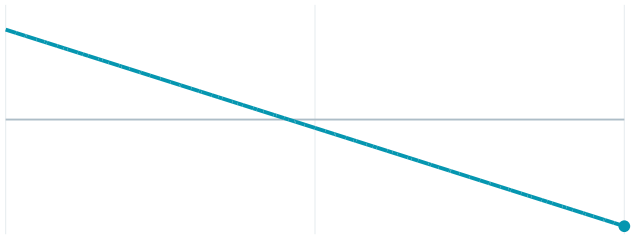
End	Node	Axial N	Shear V	Moment M
i	N3	10.66408 kN	8.18275 kN	7.41319 kN·m
j	N4	-10.66408 kN	9.70579 kN	-10.81881 kN·m

Local response diagrams

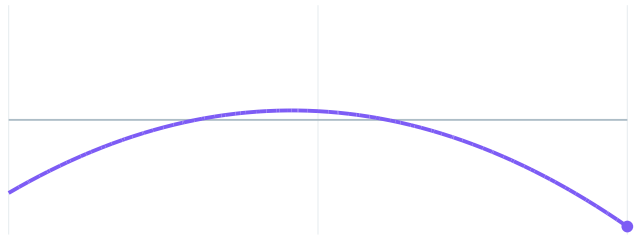
Axial force N — Peak -10.6641 kN at x = 0 m



Shear force V — Peak -9.7058 kN at x = 4.472 m



Bending moment M — Peak -10.8188 kN·m at x = 4.472 m



Transverse displacement v — Peak -0.71967 mm at x = 0 m

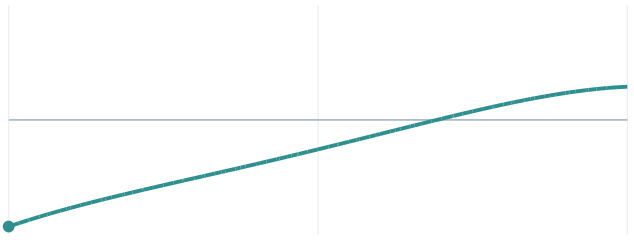


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

SECTION 10 · M4

M4 member result summary

Frame · N4 to N5 · length 4 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N
-13.45025 kN
x = 0 m

PEAK SHEAR FORCE V
5.19768 kN
x = 0 m

PEAK BENDING MOMENT M
-10.81881 kN·m
x = 0 m

MAXIMUM RESULTANT DISPLACEMENT
0.613915 mm
x = 0.1584 m

Local member end actions

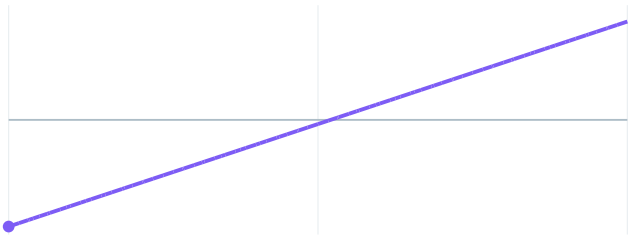
End	Node	Axial N	Shear V	Moment M
i	N4	13.45025 kN	5.19768 kN	10.81881 kN·m
j	N5	-13.45025 kN	-5.19768 kN	9.97193 kN·m

Local response diagrams

Axial force N — Peak -13.4502 kN at x = 0 m

Shear force V — Peak 5.1977 kN at x = 0 m

Bending moment M — Peak -10.8188 kN·m at x = 0 m



Transverse displacement v — Peak 0.61174 mm at x = 0.158 m

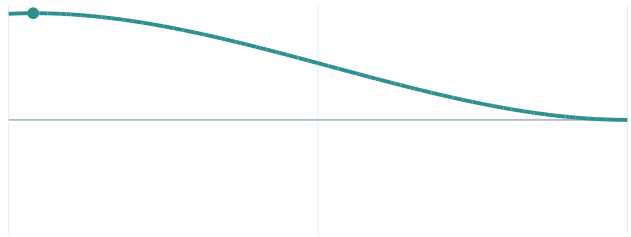


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

FINAL NOTES

Review responsibility and use of results

This report is a reproducible record of the browser model and its most recent solved scenario, not a sealed design document or a substitute for engineering judgment.

Review item	Engineer check
Geometry and connectivity	Confirm every analytical node, member intersection, orientation and end release matches the intended structural idealization.
Supports	Confirm translation and rotation restraints represent the real boundary conditions without unintended instability or over-restraint.
Stiffness	Confirm E, A, I, density, section orientation and member behavior are appropriate for the intended analysis.
Loading	Confirm load magnitudes, signs, axes and positions against the governing project criteria.
Analysis scope	Evaluate second-order response, nonlinear behavior, stability, buckling, dynamics, connection behavior and code requirements separately where applicable.
Results	Independently review equilibrium, deflected shape, governing actions and sensitivity to modeling assumptions before design use.

Report-specific notes

Fixed-base 2D gable portal frame. First-order linear-elastic analysis. Both inclined rafter loads act in member local negative-y.