

2D FRAME AND TRUSS ANALYSIS

Structural Analysis Calculation Report

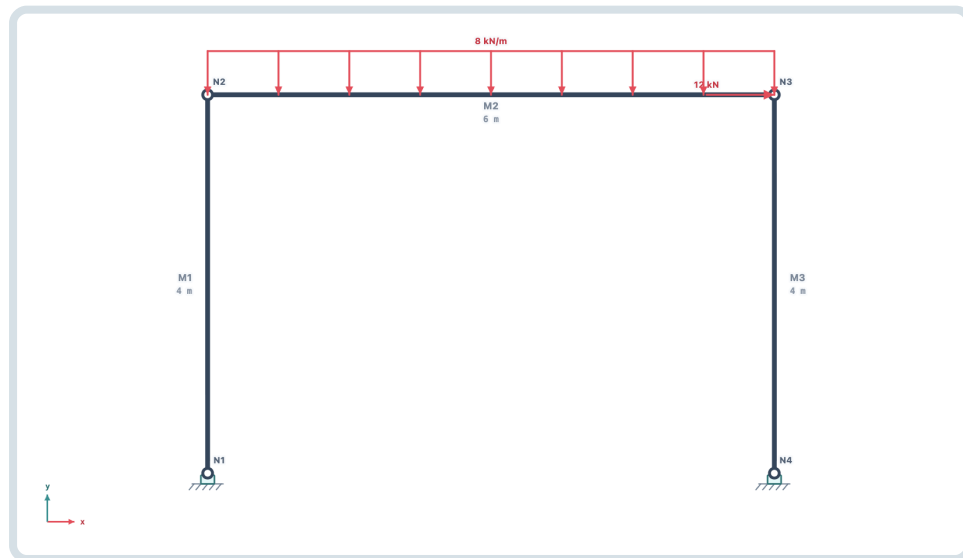
6 m × 4 m fixed-base portal frame

Analyzed scenario: All applied loads

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

Project field	Report value
Project / model	6 m × 4 m fixed-base portal frame
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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	4
Members	3
Supports	2
Defined loads	2
Analyzed loading	All applied loads

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	6 m	4 m	free	Free
N4	6 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	6 m	0°	Frame	Continuous
M3	N3	N4	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

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	$F_x = 12 \text{ kN}$ $F_y = 0 \text{ kN}$ $M_z = 0 \text{ kN}\cdot\text{m}$
L2	member distributed	Member 2 $x = 0 \text{ m to } 6 \text{ m}$	$q_1 = -8 \text{ kN/m}$ $q_2 = -8 \text{ kN/m}$ 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	1.94741 mm	M2 at x = 2.7469 m
Maximum signed reaction component	27.18866 kN	N4 · Ry
Peak signed axial force	-27.18866 kN	M3 at x = 0 m
Peak signed shear force	-27.18866 kN	M2 at x = 6 m
Peak signed bending moment	-27.55763 kN·m	M3 at x = 0 m

Solver diagnostics

Diagnostic	Value
Stability classification	stable
Active DOFs	12
Free DOFs solved	6
Constrained DOFs	6
Condition estimate	8.902904
Pivot ratio	0.112323
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	12 kN	-12 kN	0 kN
Sum Fy	-48 kN	48 kN	0 kN
Sum M about global origin	-192 kN·m	192 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	0.74269 kN	20.81134 kN	20.82459 kN	5.4549 kN·m
N4	fixed	-12.74269 kN	27.18866 kN	30.02665 kN	23.41312 kN·m

Nodal translations and rotations

Node	ux	uy	u	Rz
N1	0 mm	0 mm	0 mm	0 mrad
N2	1.289031 mm	-0.083245 mm	1.291716 mm	-0.694028 mrad
N3	1.284574 mm	-0.108755 mm	1.28917 mm	0.207225 mrad
N4	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	-20.81134 kN x = 0 m	-0.74269 kN x = 0 m	-8.42566 kN·m x = 4 m	1.291716 mm x = 4 m
M2	-0.74269 kN x = 0 m	-27.18866 kN x = 6 m	-27.55763 kN·m x = 6 m	1.94741 mm x = 2.7469 m
M3	-27.18866 kN x = 0 m	12.74269 kN x = 0 m	-27.55763 kN·m x = 0 m	1.321148 mm x = 0.3217 m

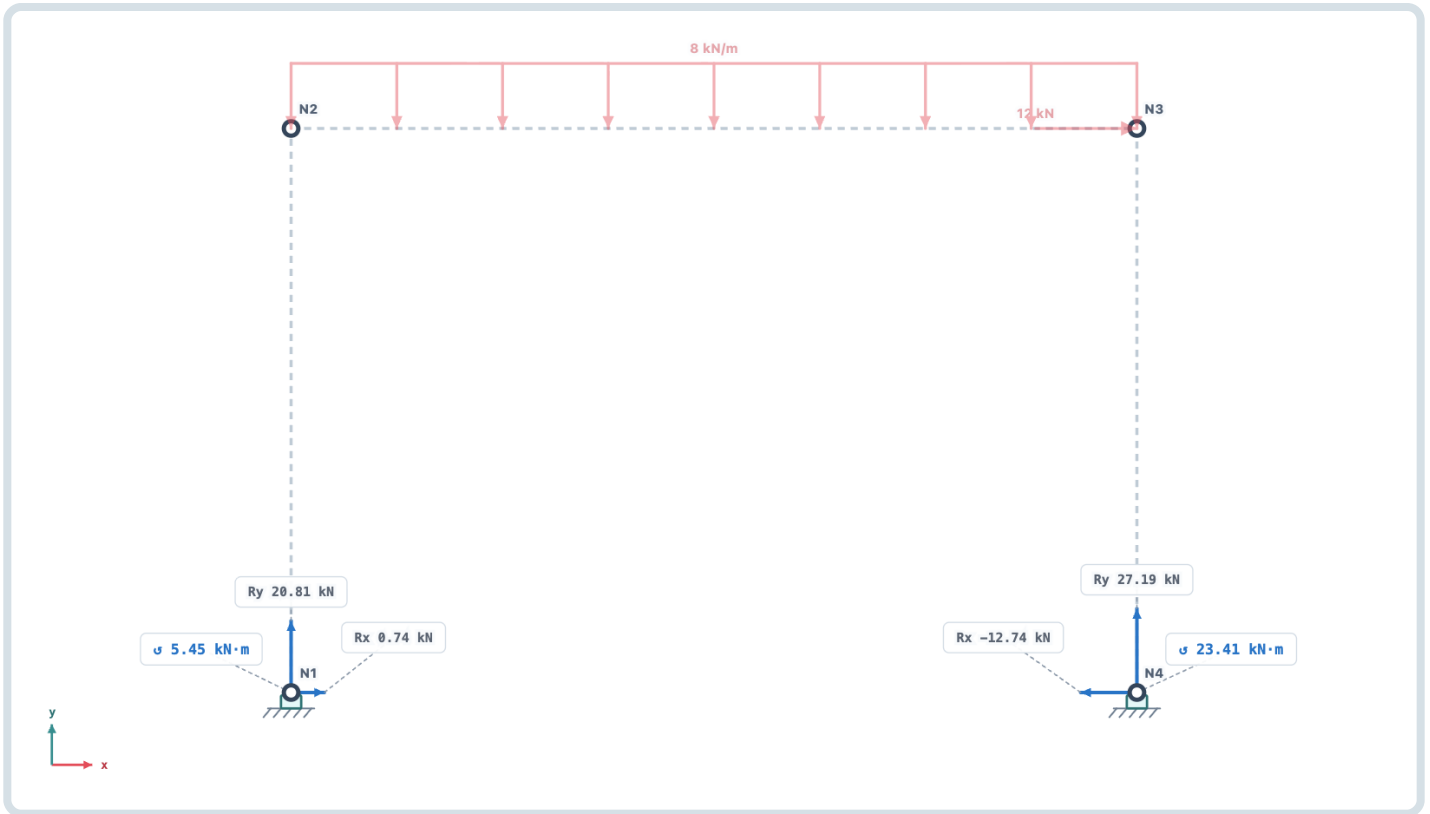
Local member end actions

Member	Ni	Vi	Mi	Nj	Vj	Mj
M1	20.81134 kN	-0.74269 kN	5.4549 kN·m	-20.81134 kN	0.74269 kN	-8.42566 kN·m
M2	0.74269 kN	20.81134 kN	8.42566 kN·m	-0.74269 kN	27.18866 kN	-27.55763 kN·m
M3	27.18866 kN	12.74269 kN	27.55763 kN·m	-27.18866 kN	-12.74269 kN	23.41312 kN·m

SECTION 9

Support reaction diagram

Signed reactions are shown in global X and Y directions.



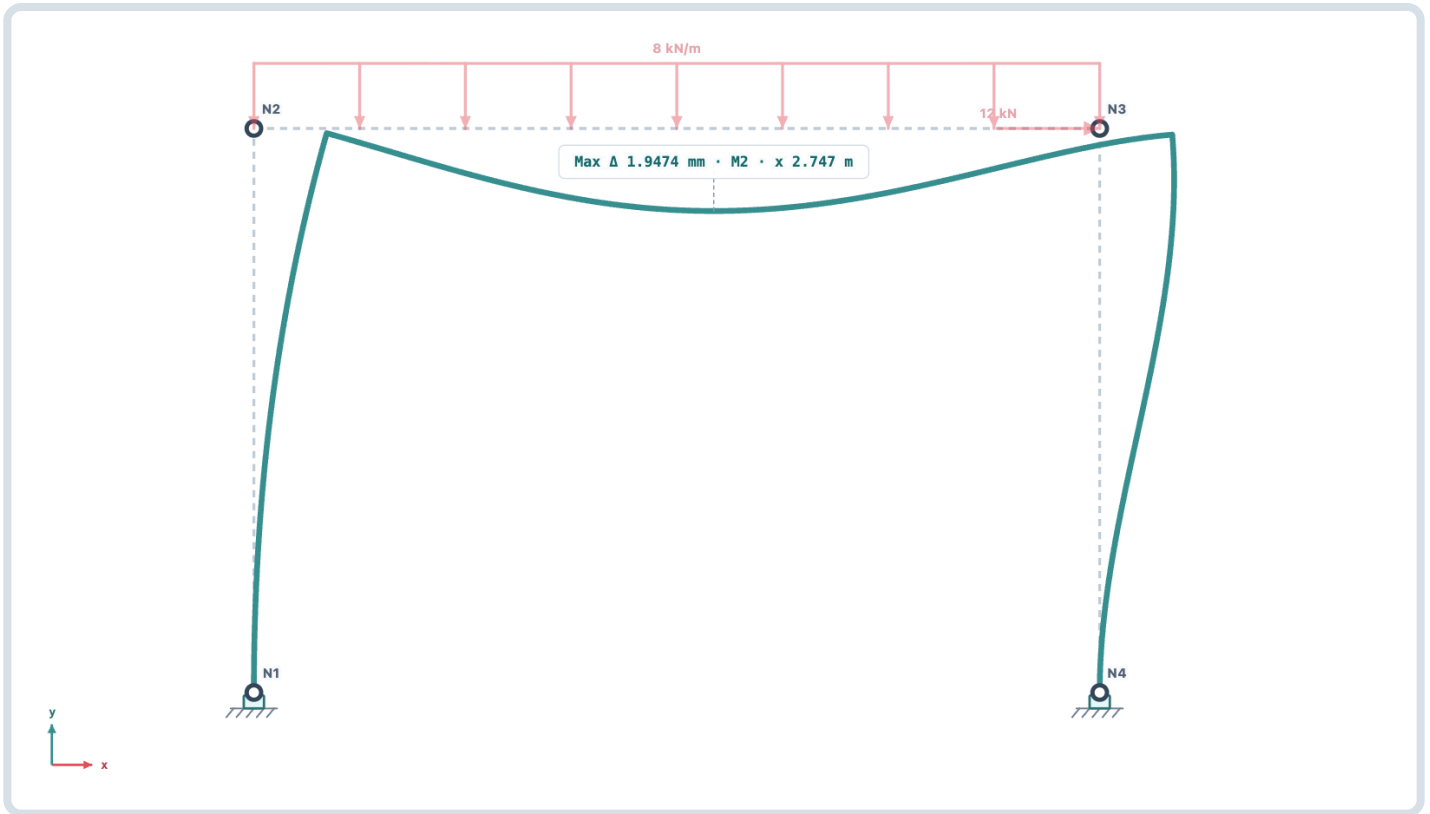
Support reactions · All applied loads · global X/Y · kN and kN·m · Arrow direction follows the signed reaction

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.



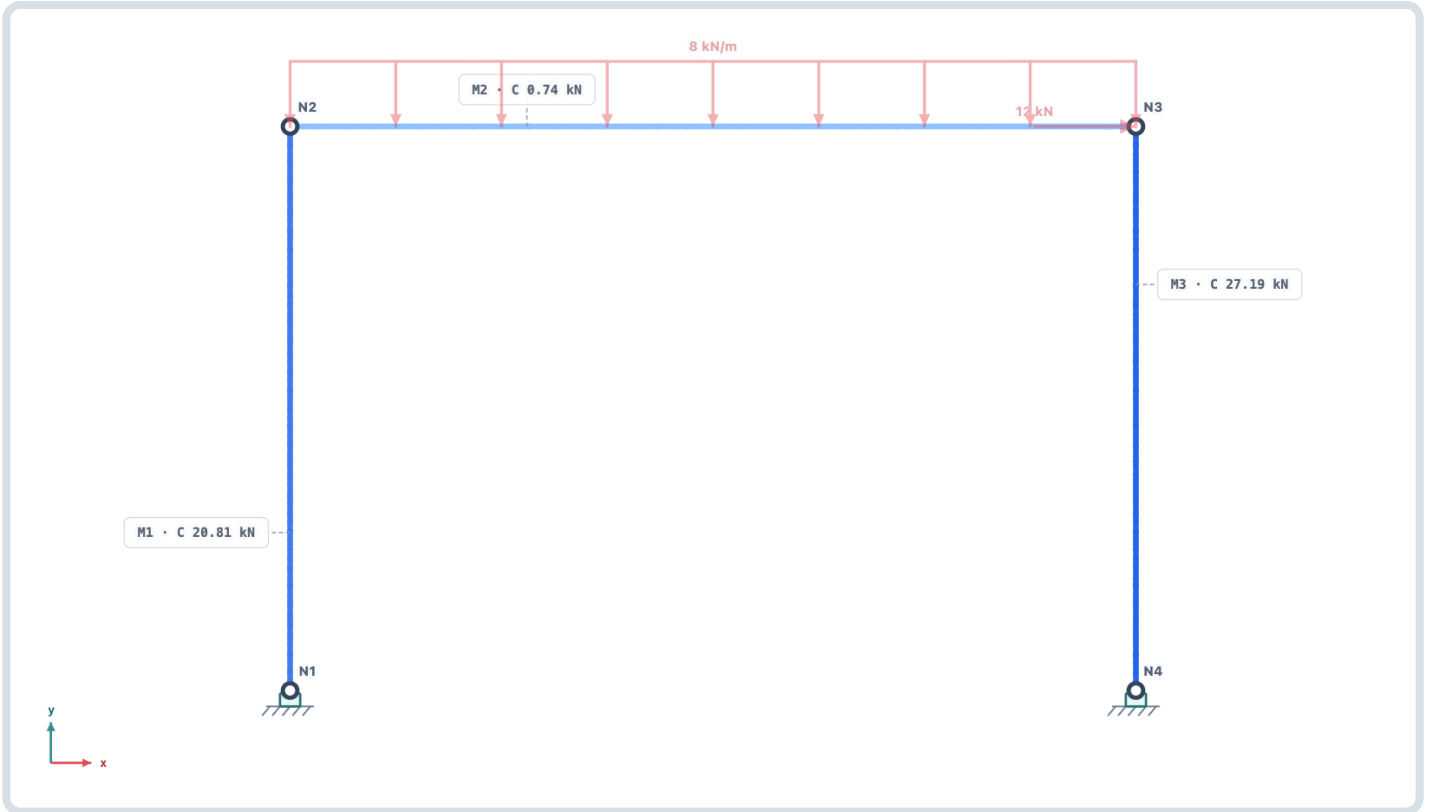
Deflected shape · All applied loads · Auto amplification ×401 · Original geometry shown dashed · values remain unamplified

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.



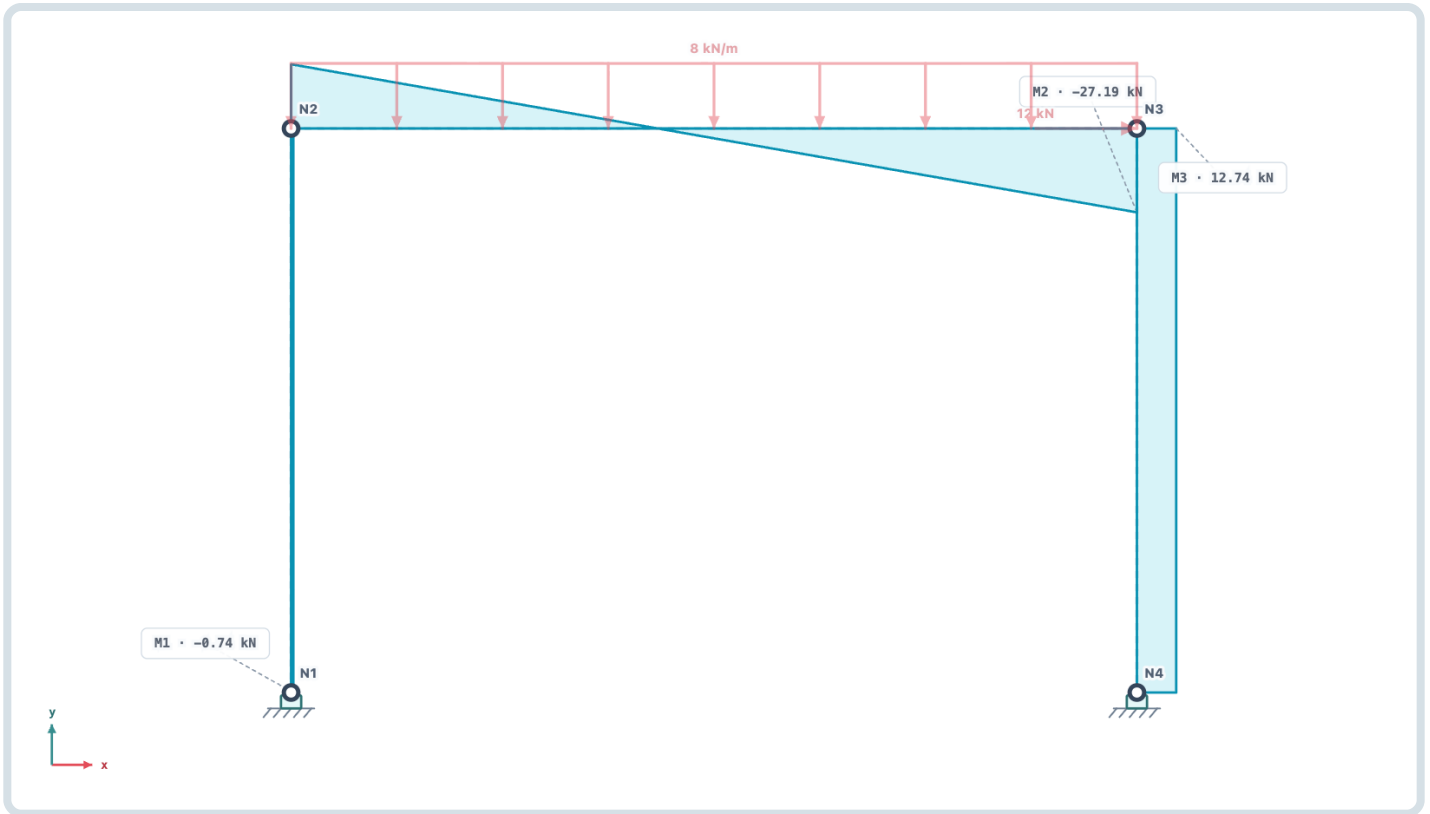
Axial force · All applied loads · Compression to Tension

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.



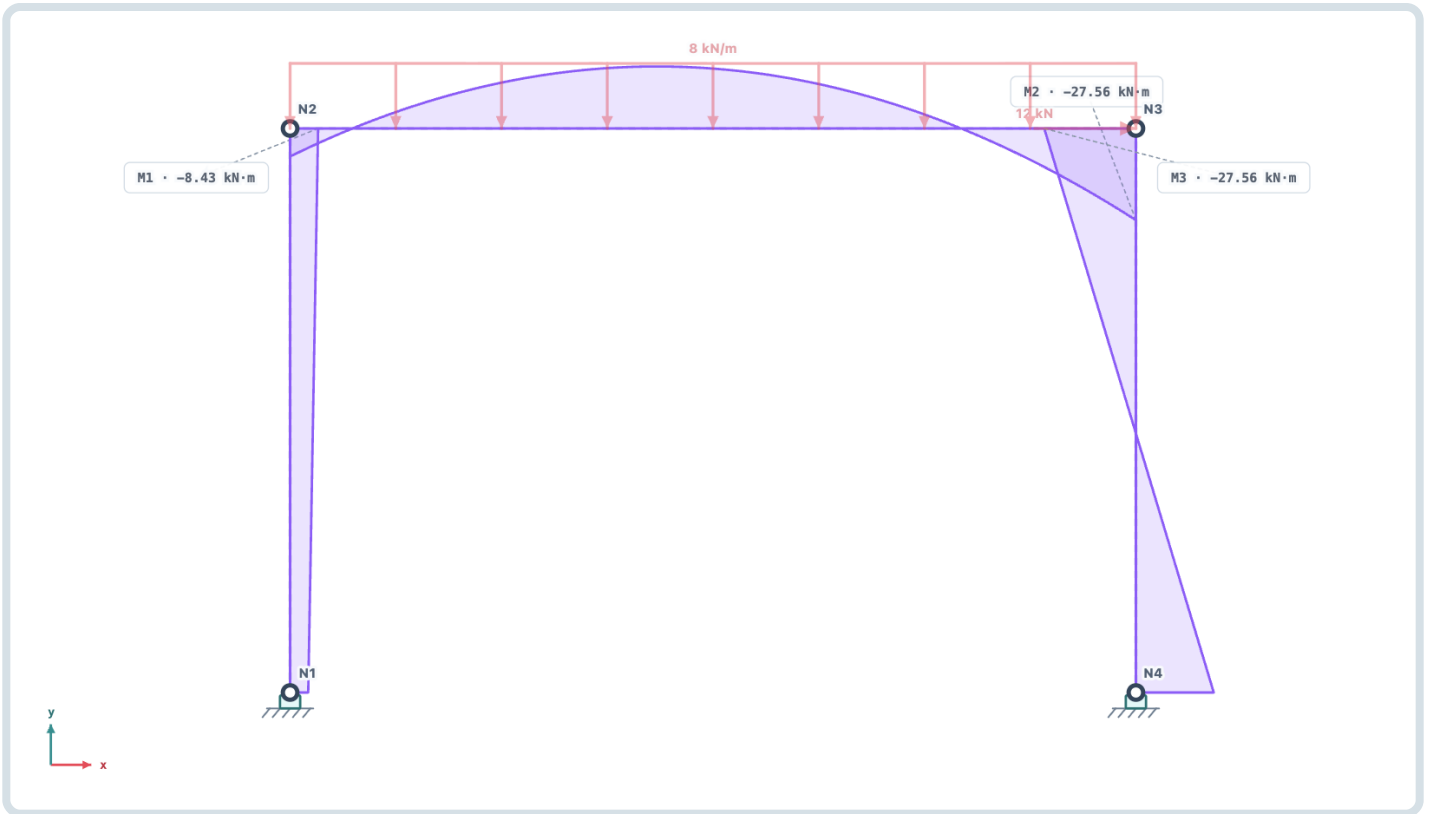
Shear force · All applied loads · kN · +V plotted on member local +y

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

-20.81134 kN

x = 0 m

PEAK SHEAR FORCE V

-0.74269 kN

x = 0 m

PEAK BENDING MOMENT M

-8.42566 kN·m

x = 4 m

MAXIMUM RESULTANT DISPLACEMENT

1.291716 mm

x = 4 m

Local member end actions

End	Node	Axial N	Shear V	Moment M
i	N1	20.81134 kN	-0.74269 kN	5.4549 kN·m
j	N2	-20.81134 kN	0.74269 kN	-8.42566 kN·m

Local response diagrams

Axial force N

Peak -20.8113 kN at x = 0 m



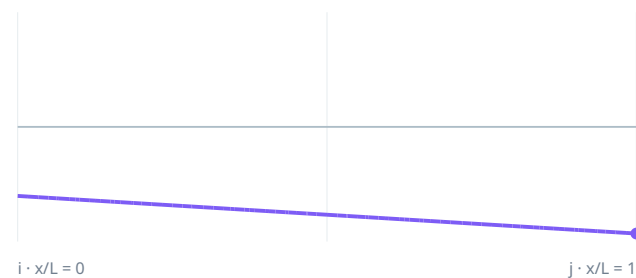
Shear force V

Peak -0.7427 kN at x = 0 m



Bending moment M

Peak -8.4257 kN·m at x = 4 m



Transverse displacement v

Peak -1.28903 mm at x = 4 m

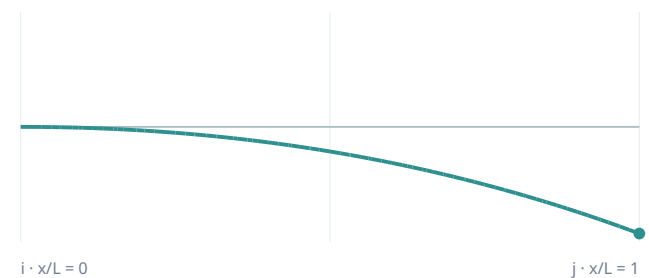


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

SECTION 10 · M2

M2 member result summary

Frame · N2 to N3 · length 6 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N

-0.74269 kN

x = 0 m

PEAK SHEAR FORCE V

-27.18866 kN

x = 6 m

PEAK BENDING MOMENT M

-27.55763 kN·m

x = 6 m

MAXIMUM RESULTANT DISPLACEMENT

1.94741 mm

x = 2.7469 m

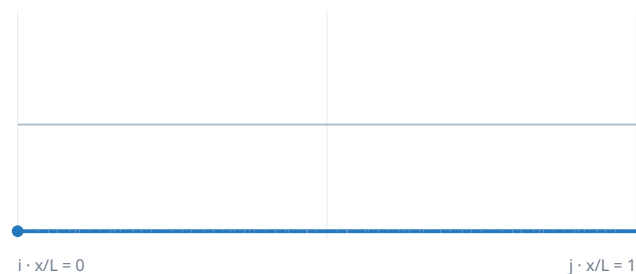
Local member end actions

End	Node	Axial N	Shear V	Moment M
i	N2	0.74269 kN	20.81134 kN	8.42566 kN·m
j	N3	-0.74269 kN	27.18866 kN	-27.55763 kN·m

Local response diagrams

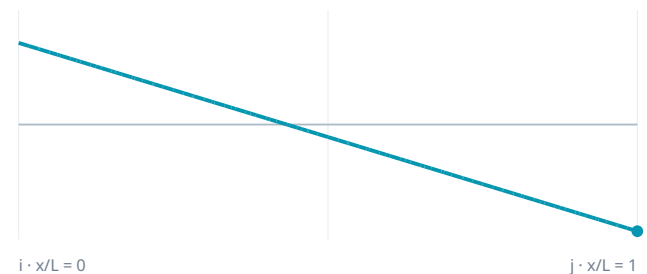
Axial force N

Peak -0.7427 kN at x = 0 m



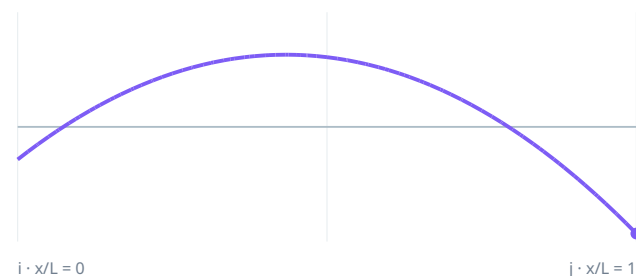
Shear force V

Peak -27.1887 kN at x = 6 m



Bending moment M

Peak -27.5576 kN·m at x = 6 m



Transverse displacement v

Peak -1.46153 mm at x = 2.747 m

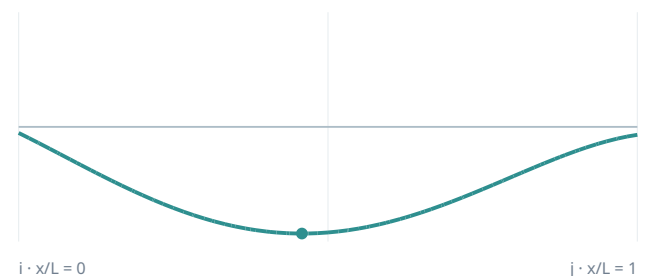


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

SECTION 10 · M3

M3 member result summary

Frame · N3 to N4 · length 4 m · Structural steel · Uniform frame section. Local x runs from end i to end j.

PEAK AXIAL FORCE N

-27.18866 kN

x = 0 m

PEAK SHEAR FORCE V

12.74269 kN

x = 0 m

PEAK BENDING MOMENT M

-27.55763 kN·m

x = 0 m

MAXIMUM RESULTANT DISPLACEMENT

1.321148 mm

x = 0.3217 m

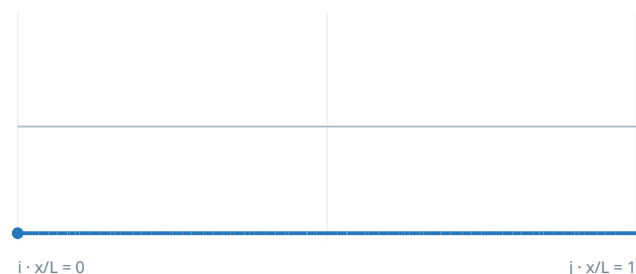
Local member end actions

End	Node	Axial N	Shear V	Moment M
i	N3	27.18866 kN	12.74269 kN	27.55763 kN·m
j	N4	-27.18866 kN	-12.74269 kN	23.41312 kN·m

Local response diagrams

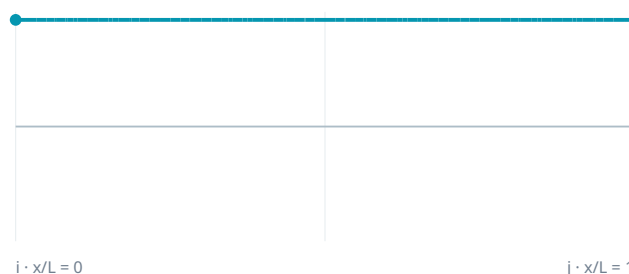
Axial force N

Peak -27.1887 kN at x = 0 m



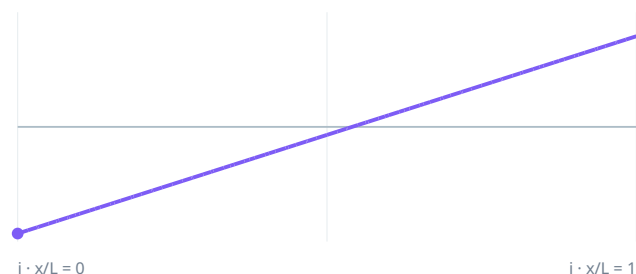
Shear force V

Peak 12.7427 kN at x = 0 m



Bending moment M

Peak -27.5576 kN·m at x = 0 m



Transverse displacement v

Peak 1.31736 mm at x = 0.322 m

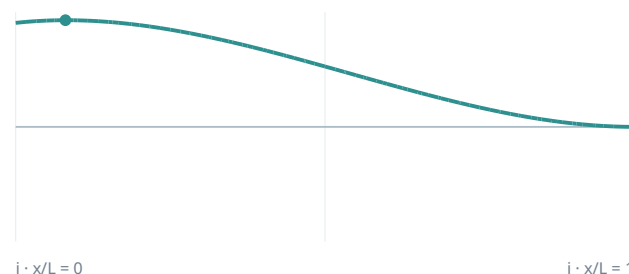


Diagram ordinates are plotted from the computed solver stations. Values and signs use the member local-axis convention stated in Section 1.

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.