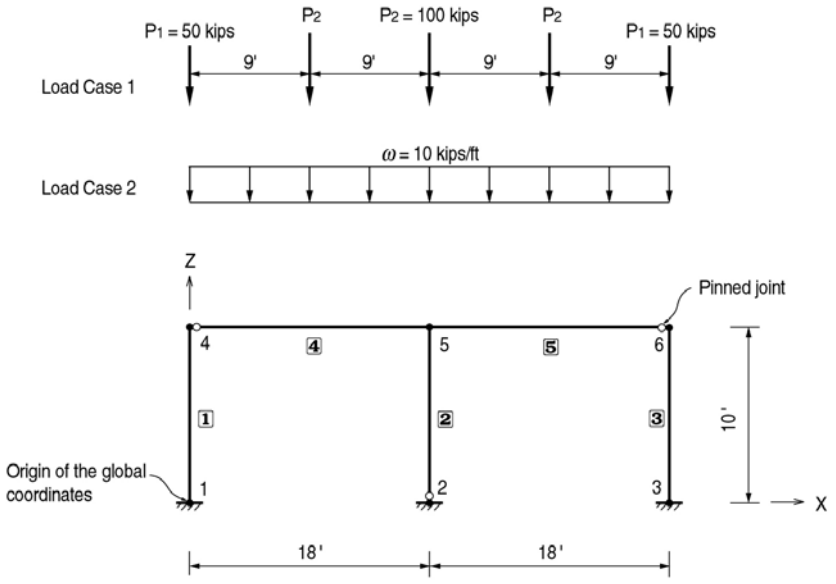
# Static-6

## Title

Plane frame with beam span loads

## Description

This is a 2-D frame subjected to vertical static loads. (concentrated and uniformly distributed loads)
Draw the shear force diagram and the bending moment diagram of the entire structure.




*Structural geometry and analysis model*

# Model

***Analysis Type***

2-D static analysis (X-Z plane)

***Unit System***

in, kip

***Dimension***

Length 36 × 12 in  Height 10 × 12 in

***Element***

Beam element

***Material***

Modulus of elasticity  E = 3000 ksi

***Section Property***

| | |
|---|---|
| Area (Columns) | A = 10000000 $in^2$ |
| Moment of inertia (Columns) | $I_{yy}$ = 13824 $in^4$ |
| Moment of inertia (Beams) | $I_{yy}$ = 27000 $in^4$ |

***Boundary Condition***

Nodes 1, 2 and 3 ; Constrain all DOFs.

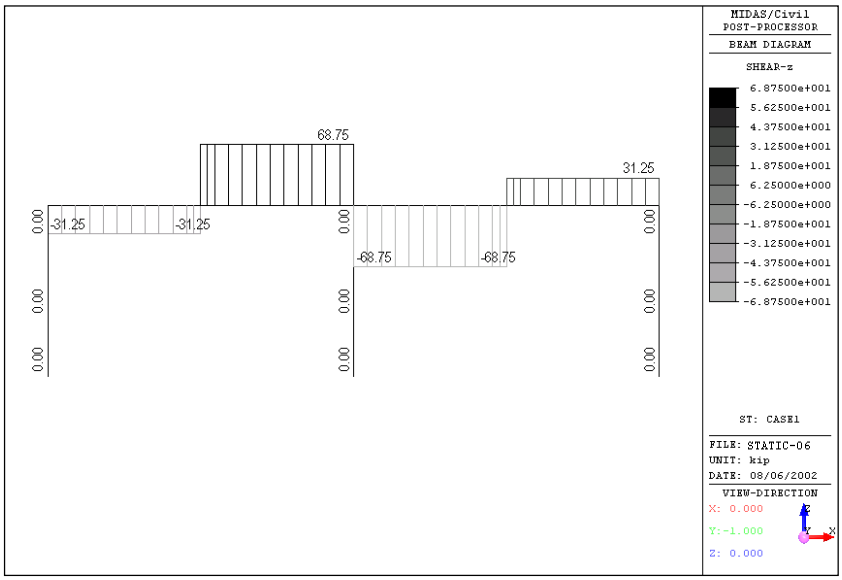
Node 2 of the element 2, node 4 of the element 4 and node 6 of the element 5 ; Release Ry in the element local coordinates.

***Load Case***

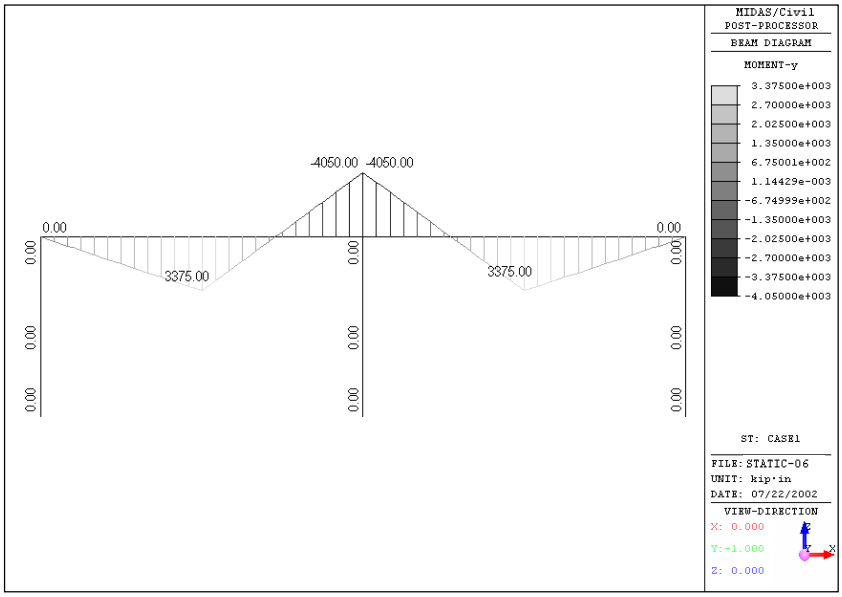
Load Case 1 ;A concentrated load, $P_1$ = 50 kips each is applied to the nodes 4and 6 in the -Z direction.
A concentrated load, $P_2$ =100 kips each is applied to the node 5 and the mid-points of the elements 4and 5 in the -Z direction.

Load Case 2 ;A uniformly distributed load, ω=10 kips/ft =10/12 kips/in is imposed on the elements 4 and 5 in the -Z direction.

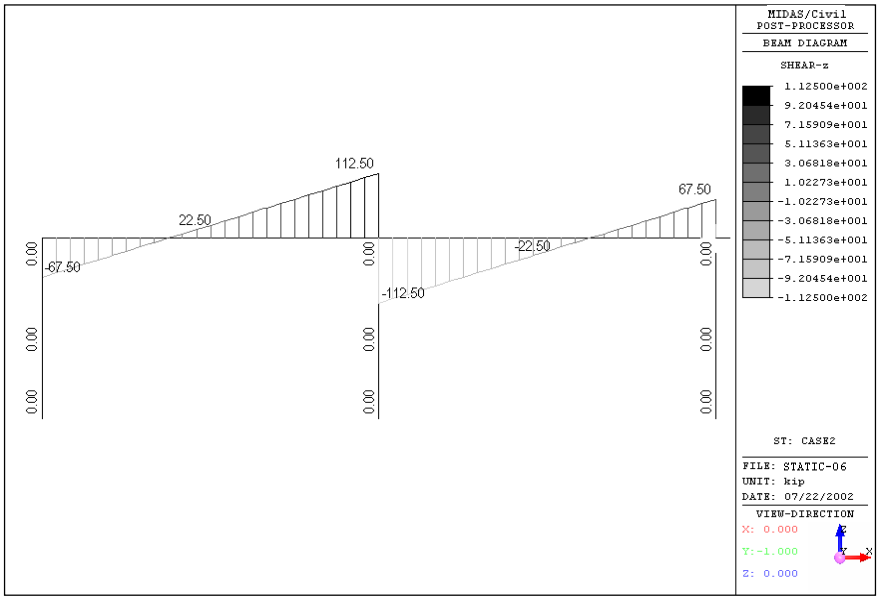
## Results



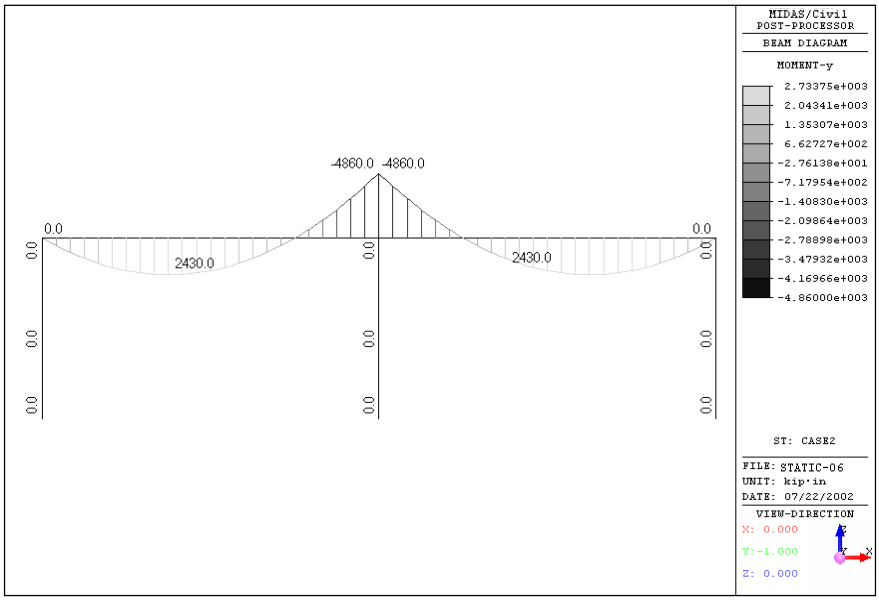

*Shear force diagram of the structure : Load Case 1*




*Bending moment diagram of the structure : Load Case 1*




*Shear force diagram of the structure : Load Case 2*




*Bending moment diagram of the structure : Load Case 2*

## Comparison of Results

Units: kip-in, kip

| Member Force | Location of the node | Load Case 1 (Concentrated load) | | | Load Case 2 (Uniformly distributed load) | | |
|---|---|---|---|---|---|---|---|
| | | Theoretical | ETABS | MIDAS/ Civil | Theoretical | ETABS | MIDAS/ Civil |
| Bending moment | End 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 1/4 point | 1687.50 | 1687.50 | 1687.50 | 2430.00 | 2430.00 | 2430.00 |
| | 1/2 point | 3375.00 | 3375.00 | 3375.00 | 2430.00 | 2430.00 | 2430.00 |
| | 3/4 point | -337.50 | -337.50 | -337.50 | 0.00 | 0.00 | 0.00 |
| | End 5 | -4050.00 | -4050.00 | -4050.00 | -4860.00 | -4860.00 | -4860.00 |
| Shear force | End 4 | -31.25 | -31.25 | -31.25 | -67.50 | -67.50 | -67.50 |
| | 1/4 point | -31.25 | -31.25 | -31.25 | -22.50 | -22.50 | -22.50 |
| | 1/2 point | 68.75 | 68.75 | 68.75 | 22.50 | 22.50 | 22.50 |
| | 3/4 point | 68.75 | 68.75 | 68.75 | 67.50 | 67.50 | 67.50 |
| | End 5 | 68.75 | 68.75 | 68.75 | 112.50 | 112.50 | 112.50 |

※ Under Load Case 2, the maximum bending moment of the structure is 2733.75 kips-in at the location of 81.0 in from the node 4 in the X direction. Refer to the figures shown above.

## References

"*Manual of Steel Construction - Allowable Stress Design*", American Institute of Steel Construction, Chicago, Illinois, 1989.

"*ETABS, Examples Manual*", Version 6.0, Computers and Structures, Inc., Berkeley, California, 1994, Example 1.