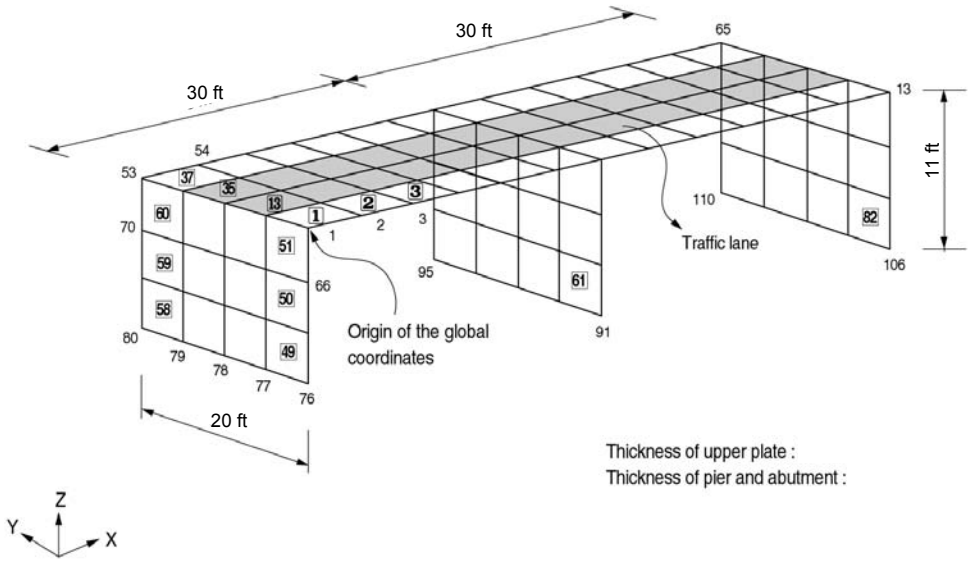
ML-2

Title

Rahmen (plate- frame) bridge subjected to a moving load
(Moving Load Module available upon request)

Description

Analyze a rahmen (plate- frame) bridge under a moving load. Find the maximum moments. Refer to the figure shown below.



Structural geometry and analysis model

Model

Analysis Type

3-D moving load analysis

Unit System

ft, lbf

Dimension

Length 60 ft

Element

Plate element (Thick type)

Material

Concrete Modulus of elasticity $E = 4.3 \times 10^8$ lbf/ft^2

Poisson's ratio $\nu = 0.167$

Section Property

Thickness Upper plate 0.8 m

Pier and abutment 0.1 m

Boundary Condition

Nodes76 ~ 80, 91 ~ 95 and 106 ~ 110 ; Constrain all DOFs. (Fixed supports)

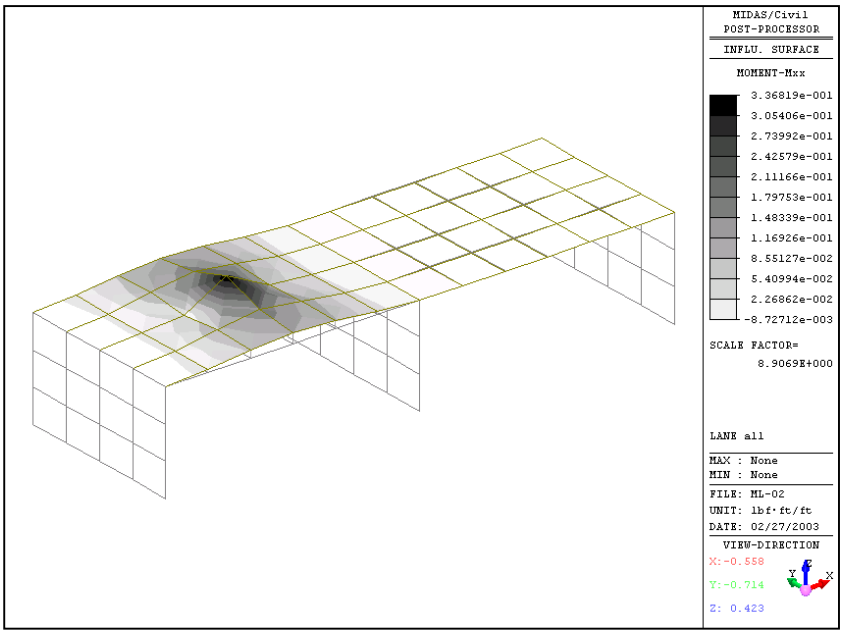
Load Case

Moving loads HS20-44 and HS20-44L specified in the AASHTO standard specification for bridges are applied

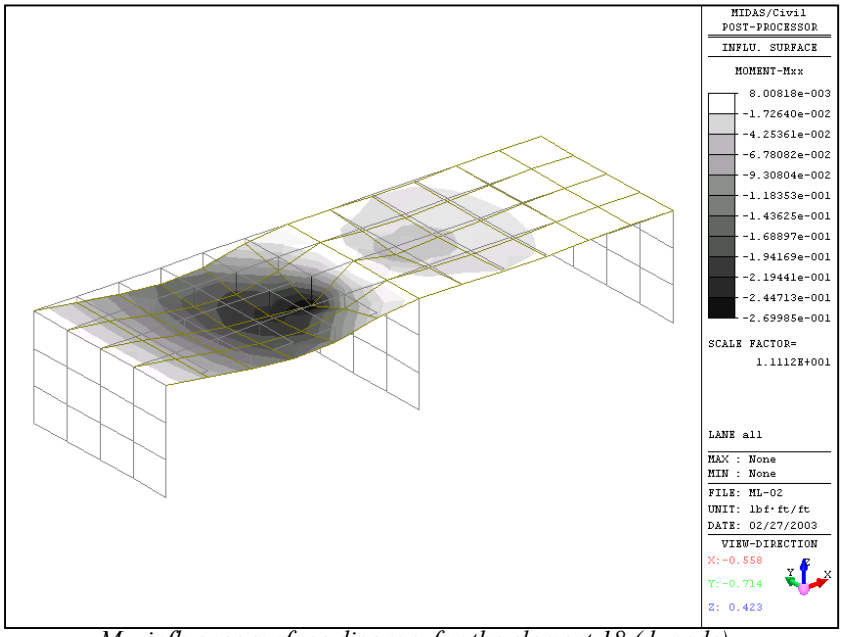
Results

Displacements

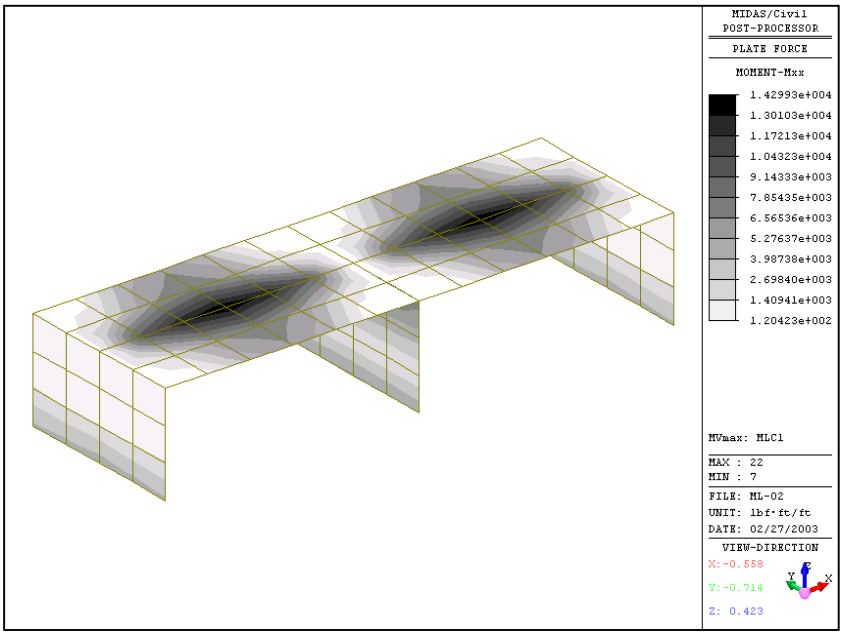
	Node	Load	DX (ft)	DY (ft)	DZ (ft)	RX ([rad])	RY ([rad])	RZ ([rad])
▶	1	MLC1(max)	0,002477	0,000018	0,000002	0,000011	0,000761	0,000005
	2	MLC1(max)	0,002481	0,000005	0,000944	0,000013	0,001875	0,000000
	3	MLC1(max)	0,002482	0,000001	0,002007	0,000005	0,001440	0,000000
	4	MLC1(max)	0,002478	0,000001	0,002991	0,000000	0,000278	0,000000
	5	MLC1(max)	0,002472	0,000002	0,003336	0,000000	0,000063	0,000000
	6	MLC1(max)	0,002466	0,000005	0,002403	0,000013	0,000347	0,000000
	1	MLC1(min)	-0,002416	-0,000000	-0,000013	-0,000115	-0,000168	-0,000055
	2	MLC1(min)	-0,002422	-0,000008	-0,007111	-0,000445	-0,000215	0,000000
	3	MLC1(min)	-0,002429	-0,000010	-0,016028	-0,000629	-0,000242	0,000000
	4	MLC1(min)	-0,002436	-0,000009	-0,019616	-0,000644	-0,000480	0,000000
	5	MLC1(min)	-0,002443	-0,000008	-0,015577	-0,000636	-0,001511	0,000000
	6	MLC1(min)	-0,002448	-0,000006	-0,006533	-0,000466	-0,001834	0,000000



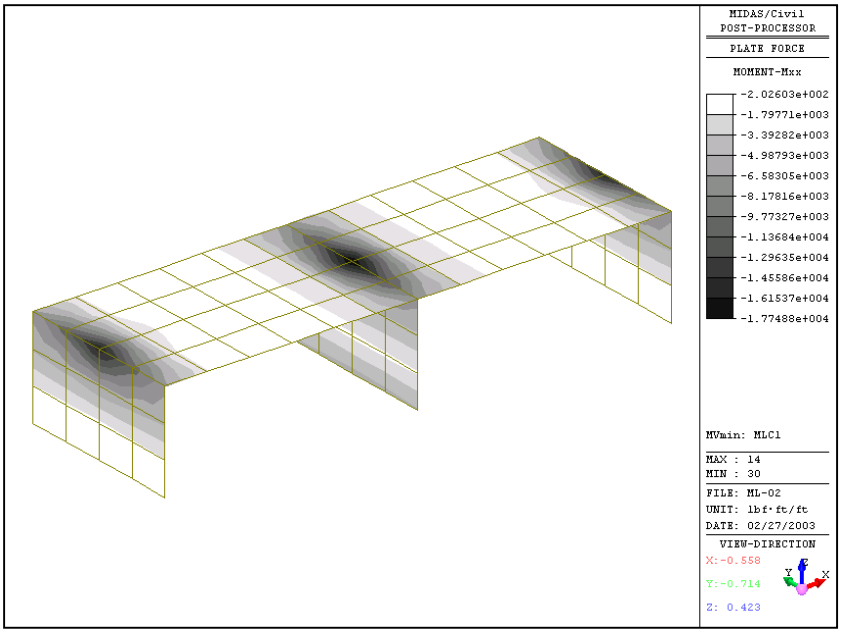
M_{xx} influence surface diagram for the element 15 (k-node)



M_{xx} influence surface diagram for the element 18 (k-node)



Maximum positive moment of the structure in the X direction due to HS20-44(M_{xx})



Maximum negative moment of the structure in the X direction due to HS20-44(M_{xx})

Comparison of Results

Unit : ft, lbf

Result		Moment due to HS20-44		Moment due to HS20-44L	
		Location (Element - Node)	Moment	Location (Element - Node)	Moment
Maximum moment (M_{xx})	Positive	15-30	14299.28	16-30	8502.54
	Negative	18-33	-17748.82	18-33	-7478.87
Maximum moment (M_{yy})	Positive	15-30	10294.98	16-30	5973.39
	Negative	18-33	-2941.12	18-33	-1251.56
Maximum shear force (V_{xx})	Positive	18-33	4738.97	18-33	3390.40
	Negative	31-33	-4738.97	19-33	-3390.40
Maximum shear force (V_{xx})	Positive	34-49	775.22	27-30	1545.73
	Negative	15-30	-2262.11	15-30	-1876.04
Maximum vertical displacement (Dz)	Positive	5	0.003336	5	0.002320
	Negative	30	-0.025175	30	-0.020289
Maximum vertical reaction (Fz)	Positive	93	20404.67	93	12297.56
	Negative	78	-402.73	78	-329.83

Reference

"*Standard Specifications for Highway Bridges*", AASHTO(American Association of State Highway and Transportation Officials), 1996