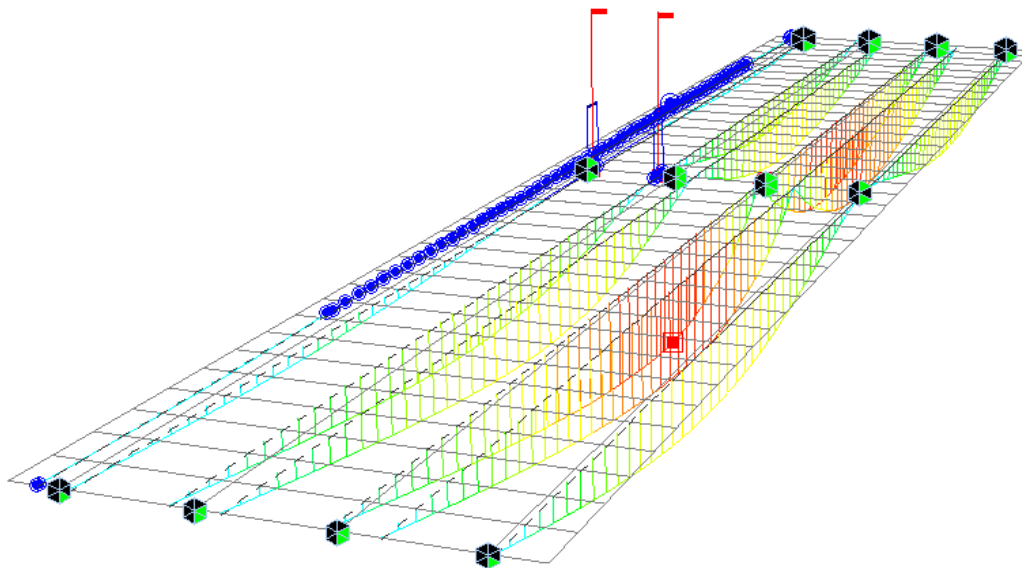


Moving load analysis (Eurocode 1-2:2003)



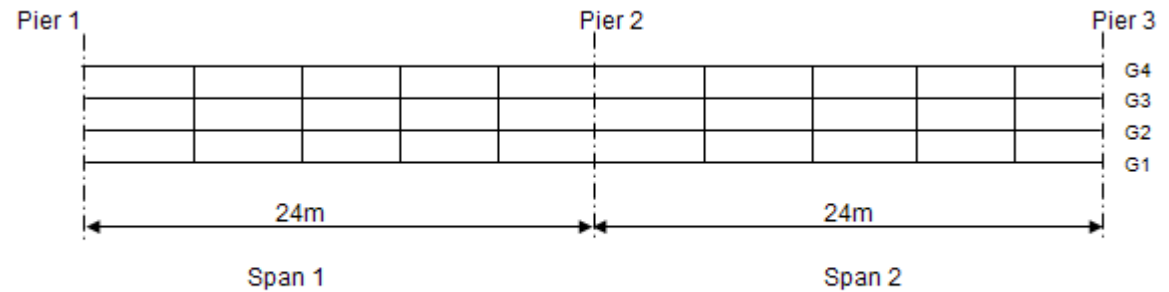
Program Version	V7.3.0
Program License	Registered, Trial
Revision Date	2012.7.24

Overview

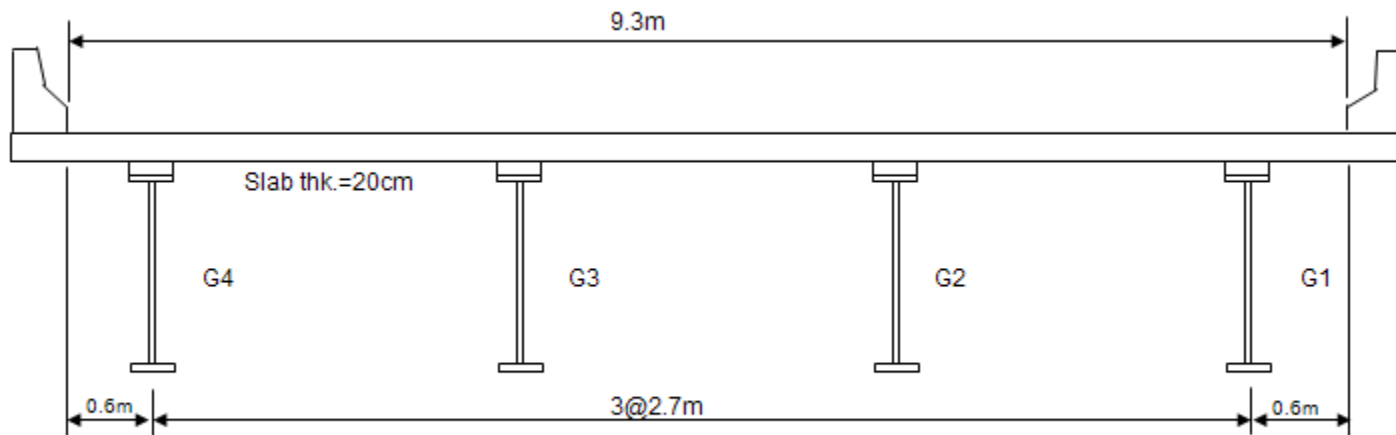
- **Bridge overview**
 - ✓ 2 span continuous composite girder bridge
 - ✓ Span length: 2@24 m
 - ✓ Carriageway width: 9.3 m
 - ✓ Unit system: kN, m
- **Lane definition**
 - ✓ Notional lanes & remaining area
 - ✓ Location and numbering of the lanes
- **Vehicle load**
 - ✓ Load Model 1
 - ✓ Load Model 2
 - ✓ Load Model 3
- **Moving load analysis option**
 - ✓ Concurrent forces
- **Result evaluation**
 - ✓ Influence line
 - ✓ Moving load tracer
 - ✓ Envelope of member forces

1. Bridge overview

- *Bridge type: Straight bridge*
- *Span length: 2@24 m*
- *Carriageway width: 9.3 m*
- *Spacing of cross beams: 4.8 m*



a) Plan view



b) Cross section

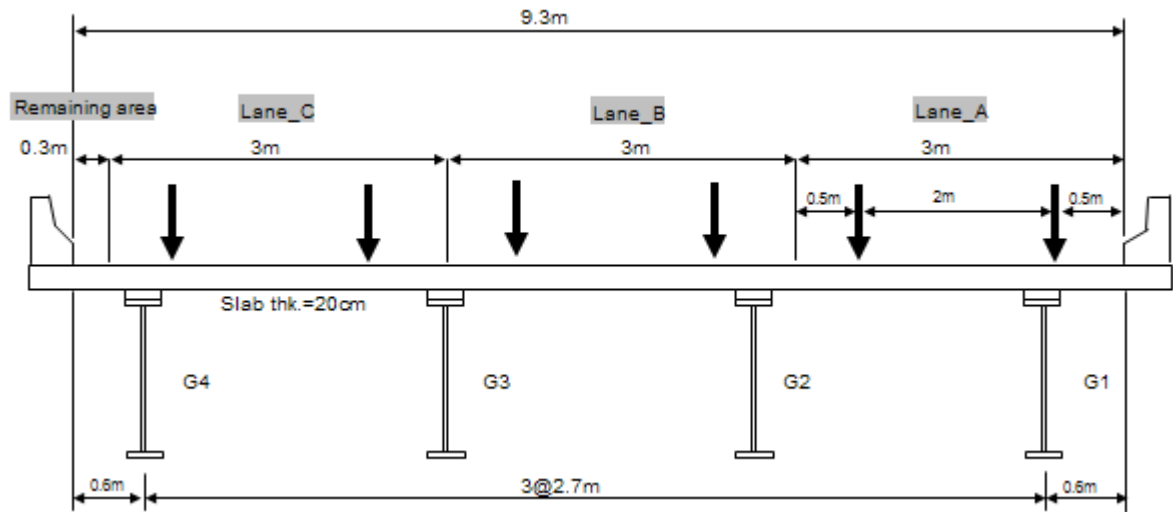
2. Number and width of notional lanes

EN 1991-2:2003. Table 4.1 Number and width of notional lanes

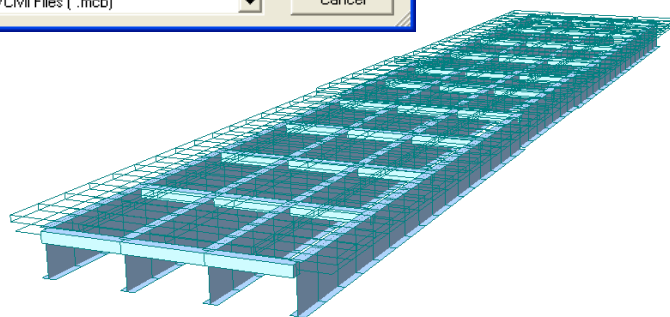
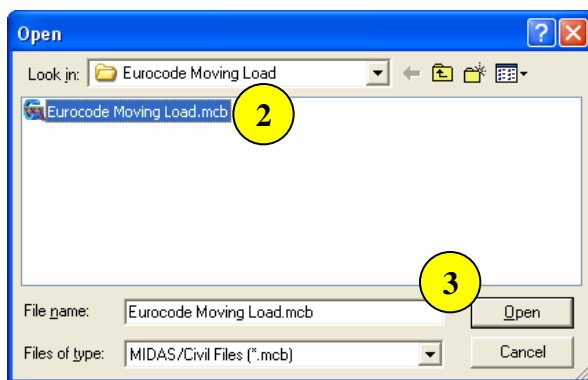
Carriageway width w	Number of notional lanes	Width of a notional lane w_l	Width of the remaining area
$w = 9.3\text{ m}$	$n_l = \text{Int}(w/3) = 3$	3 m	$w - 3 \times n_l = 0.3\text{ m}$


3. Location and numbering of the lanes of the bridge

- ✓ For each individual verification, the number of lanes to be taken into account as loaded, their locations on the carriageway and their numbering should be so chosen that the effects from the load models are the most adverse. (EN 1991-2:2003, 4.2.4(2))
- ✓ In midas Civil, the user directly defines the locations of lanes, and the numbering of the lanes for design is automatically performed. In this tutorial, the locations of the lanes are shown below.



Step 1. Open the model file.

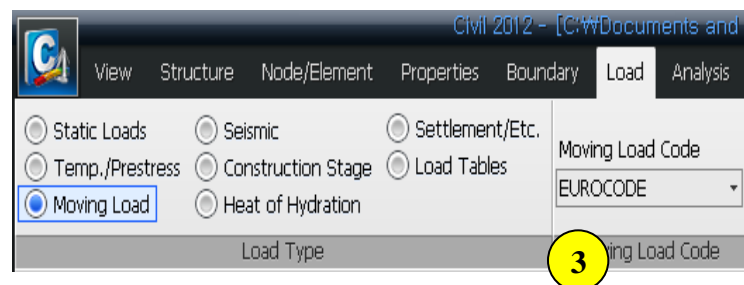


1. Click .
2. Select 'Eurocode Moving Load.mcb'.
3. Click [Open] button.

⚠ This tutorial is intended to introduce the functions of Moving load analysis. Therefore the procedures of creating elements, assigning static loads and boundary conditions are omitted here.

Please refer to the online manual for the detailed usage.

Step 2. Define moving load code



1. Load > Load Type > Moving load > Moving load code...
2. Moving Load Code: **EUROCODE**
3. Click [OK] button.

Step3-1. Define traffic line lane (Lane A)

Depending on the design members, Lane_A could be notional lane No. 1,2 or 3. The number of lanes is determined when performing analysis.

For detail information of Vehicular Load Distribution, refer to the next page.

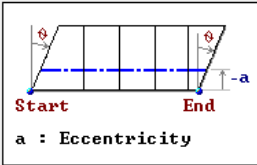
For the calculation of the eccentricity, refer to the page 7 in this tutorial.

Cross Beam group comprises of all the transverse elements.

Define Design Traffic Lin...

Lane Name :

Traffic Lane Properties


Start End
a : Eccentricity

Eccentricity : m

Wheel Spacing: m

Lane Width: m

Vehicular Load Distribution

☐ Lane Element ☒ Cross Beam

Cross Beam Group:

Skew: [deg]

Moving Direction

☐ Forward ☐ Backward ☒ Both

Selection by

☒ 2 Points ☐ Picking ☐ Number

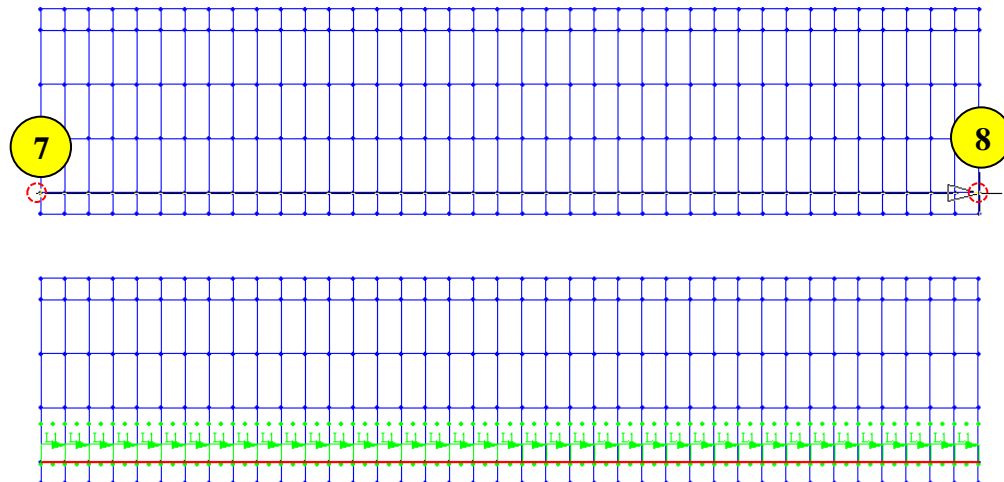
m

m

Operations

No	Elem	Eccen, (m)
1	82	-0.9
2	83	-0.9
3	84	-0.9
4	85	-0.9

1. Load > Load Type > Moving Load > Traffic Line Lane > Add
2. Lane Name: **Lane_A**
3. Eccentricity : **-0.9 m**
4. Vehicular Load Distribution : **Cross Beam**
5. Cross Beam Group: **Cross Beam**
6. Selection by : **2 Points**
7. Click (0,0,0).
8. Click (48,0,0).
9. Click [OK] button.



Tip 1. Vehicular load distribution

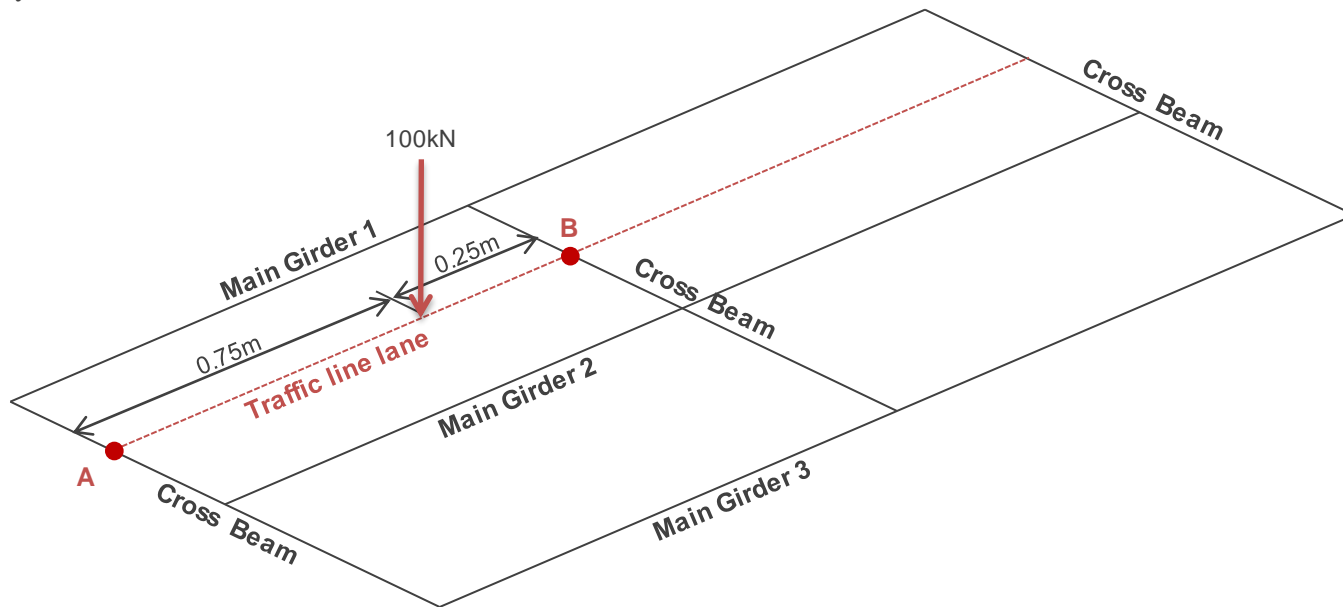
□ **Lane element:** Apply loads to the traffic line lane elements reflecting the eccentricity.

When defining lanes by the lane element type, the vertical load components (vehicle loads) and the moments due to the eccentricity are assigned only to the line lane elements. Even though the lanes can be located on cross beam elements, if the lane element type is selected, then the distribution of the loads onto the cross beams will not be considered.

□ **Cross beam:** Apply the traffic loads to the cross beams.

When using Cross Beam type, the eccentricity is used only for locating the lanes from the line lane elements. The vehicle loads are distributed to the girders via cross beam elements defined as a Cross Beam Group. If the user is modeling a bridge having multiple girders, the Cross Beam type is recommended for vehicular load distribution.

For example, an axle load of 100kN is located as shown below. Then, concentrated loads, 25kN and 75kN, are applied to point A and point B respectively. The cross beams themselves are loaded.

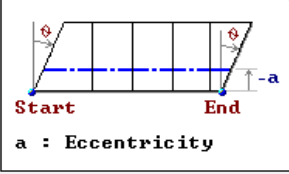


Step3-2. Define traffic line lane (Lane B)

Define Design Traffic Lin...

Lane Name :

Traffic Lane Properties

1 

2 Eccentricity :
Wheel Spacing :
Lane Width : m

3 Vehicular Load Distribution
☐ Lane Element ☒ Cross Beam
Cross Beam Group :

4 Skew
Start End [deg]

5 Moving Direction
☐ Forward ☐ Backward ☒ Both

Selection by
☒ 2 Points ☐ Picking ☐ Number
 m
 m

Operations

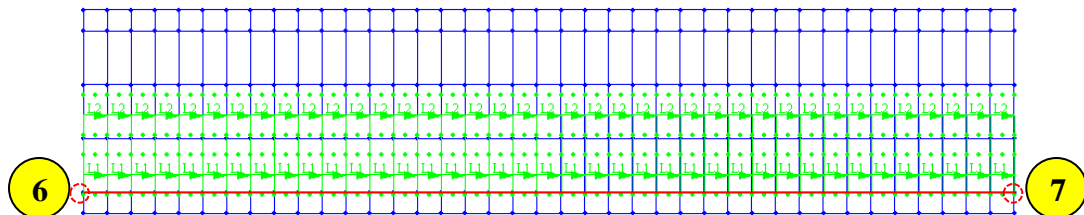
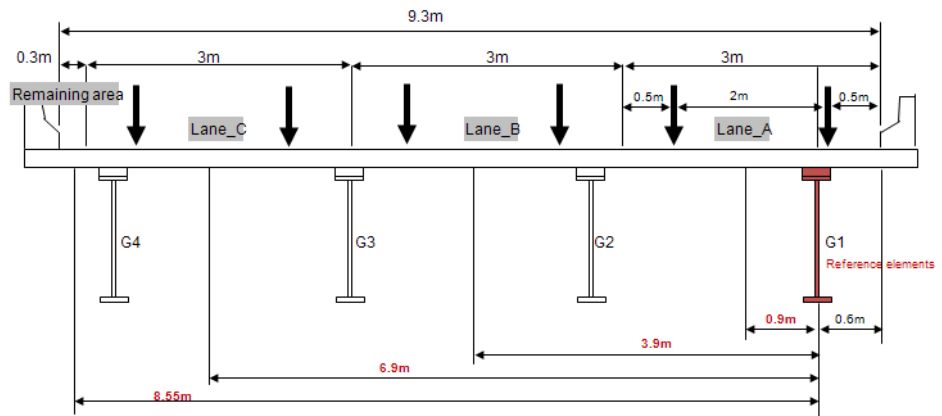
No	Elem	Eccen. (m)
1	82	-3.9
2	83	-3.9
3	84	-3.9
4	85	-3.9

8

Enter the eccentricity of a traffic line lane relative to a traffic line lane element. Traffic line lane elements are defined as the reference frame elements from which the eccentricity is measured.

In this tutorial, the eccentricities are calculated as shown in the right figure.

1. Lane Name: **Lane_B**
2. Eccentricity : **-3.9 m**
3. Vehicular Load Distribution : **Cross Beam**
4. Cross Beam Group: **Cross Beam**
5. Selection by : **2 Points**
6. Click (0,0,0).
7. Click (48,0,0).
8. Click [OK] button.




Step3-3. Define traffic line lane (Lane C)

Define Design Traffic Lin...

Lane Name :

Traffic Lane Properties



a : Eccentricity

Eccentricity : m

Wheel Spacing : m

Lane Width : m

Vehicular Load Distribution

☐ Lane Element ☒ Cross Beam

Cross Beam Group

Skew

Start End [deg]

Moving Direction

☐ Forward ☐ Backward ☒ Both

Selection by

☒ 2 Points ☐ Picking ☐ Number

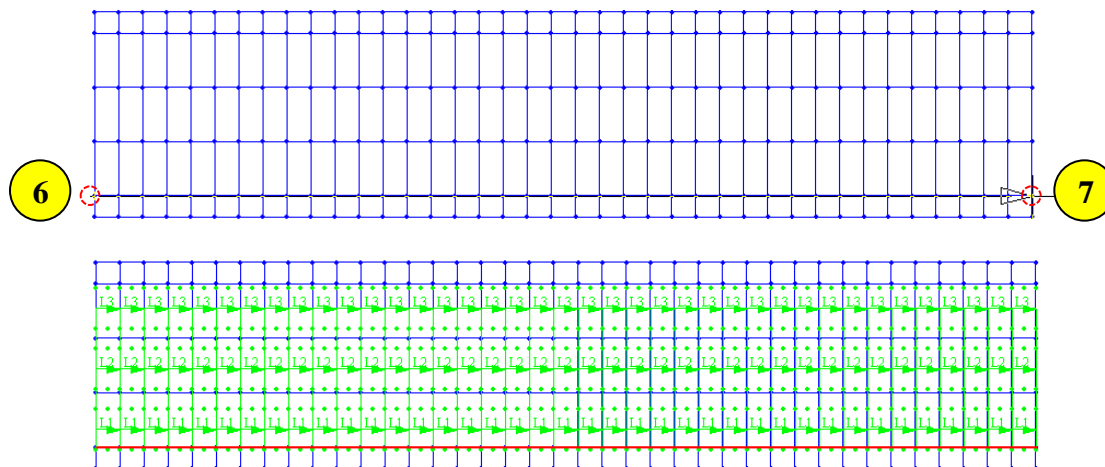
m

m

Operations

No	Elem	Eccen, (m)
1	82	-6.9
2	83	-6.9
3	84	-6.9
4	85	-6.9

1. Lane Name: **Lane_C**
2. Eccentricity : **-6.9 m**
3. Vehicular Load Distribution : **Cross Beam**
4. Cross Beam Group: **Cross Beam**
5. Selection by : **2 Points**
6. Click (0,0,0)
7. Click (48,0,0)
8. Click [OK] button.

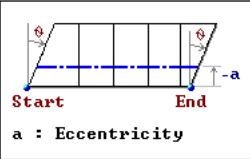


Step3-4. Define remaining area

Define Design Traffic Lin...

Lane Name : RA

Traffic Lane Properties



Start End
a : Eccentricity

Eccentricity : -8.55 m
Wheel Spacing: 0 m
Lane Width : .3 m

Vehicular Load Distribution

☐ Lane Element ☒ Cross Beam

Cross Beam Group

Cross Beam

Skew

Start 0 End 0 [deg]

Moving Direction

☐ Forward ☐ Backward ☒ Both

Selection by

☒ 2 Points ☐ Picking ☐ Number

27.6, -0.525, 0 m
48, 0, 0 m

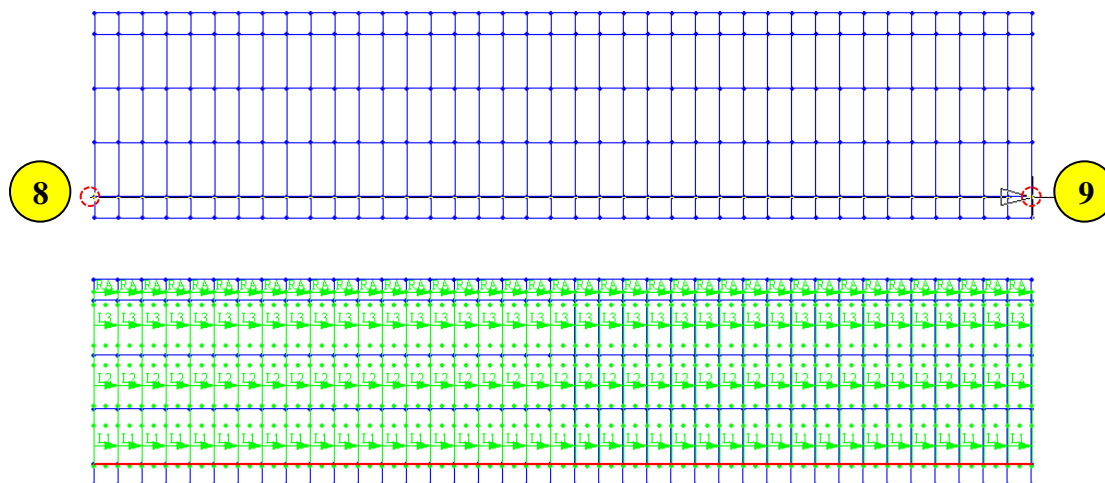
Operations

Add Insert Delete

No	Elem	Eccen. (m)
1	82	-8.55
2	83	-8.55
3	84	-8.55
4	85	-8.55

OK Cancel Apply

1. Lane Name: **RA**
2. Eccentricity : **-8.55 m**
3. Wheel Spacing : **0 m**
4. Lane Width : **0.3 m**
5. Vehicular Load Distribution : **Cross Beam**
6. Cross Beam Group: **Cross Beam**
7. Selection by : **2 Points**
8. Click **(0,0,0)**
9. Click **(48,0,0)**
10. Click **[OK]** button.



Step4. Define vehicular load
(Case 1. Check Load Model 1)

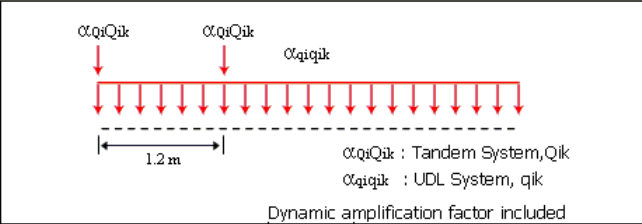
Define Standard Vehicular Load

Standard Name: **EN 1991-2:2003 - RoadBridge**

Vehicular Load Properties

Vehicular Load Name: **Load Model 1**

Vehicular Load Type: **Load Model 1**



Location	Tandem System		UDL System	
	Adjustment Factor	Axle Loads (kN)	Adjustment Factor	Uniformly Dist. Loads (kN/m²)
Lane Number1	1	300	1	9
Lane Number2	1	200	1	2.5
Lane Number3	1	100	1	2.5
Other Lanes & Remaining Area	0	0	1	2.5

Factor for Tandem System: **0,75**

ψ factor for UDL System: **0,4**

OK **Cancel** **Apply**

1. Load > Load Type > Moving Load > Vehicles > Add Standard
2. Standard Name : EN 1991-2:2003 – RoadBridge
3. Vehicular Load Type : Load Model 1
4. Click [OK] button.

Load Model 1 (LMI) : Concentrated and uniformly distributed loads, which cover most of the effects of the traffic of lorries and cars.

The user can directly change the Adjustment Factor given in the National Annex.

Recommended values of Ψ factors for road bridge

Symbol		Ψ ₀	Ψ ₁	Ψ ₂
grla (LMI+pedestrian or cycle-track loads)	TS	0.75	0.75	0
	UDL	0.40	0.40	0
	Pedestrian + cycle-track loads	0.40	0.40	0
gr1b(Single axle)		0	0.75	0
gr2 (Horizontal forces)		0	0	0
gr3 (Pedestrian loads)		0	0	0
gr4 (LM4-Crowd loading)		0	0.75	0
gr5 (LM3-Special vehicles)		0	0	0

Step5. Define moving load case (Case 1. Check Load Model 1)

Define Moving Load Case

Load Case Name : MV-LM1

Description :

Select Load Model

- ☒ LM 1, FLM 1
- ☐ LM 2,3,4 / FLM 2,3,4 / Footbridge
- ☐ LM 1 & 3 Multi
- ☐ LM1 & 3 Multi (Straddling)
- ☐ Railway Bridge

☐ Ignore Ψ Factor:

Load Case Data

Vehicle : Load Model 1

Assignment Lanes

Line of Lanes	Selected Lanes
Lane A	
Lane B	
Lane C	
RA	

OK Cancel

Define Moving Load Case

Load Case Name : MV-LM1

Description :

Select Load Model

- ☒ LM 1, FLM 1
- ☐ LM 2,3,4 / FLM 2,3,4 / Footbridge
- ☐ LM 1 & 3 Multi
- ☐ LM1 & 3 Multi (Straddling)
- ☐ Railway Bridge

☐ Ignore Ψ Factor:

Load Case Data

Vehicle : Load Model 1

Assignment Lanes

Line of Lanes	Selected Lanes	Remaining Area
	Lane A	RA
	Lane B	
	Lane C	

OK Cancel Apply

1. Load > Load Type > Moving Load > Moving Load Cases > Add

2. Load Case Name : MV-LM1

3. Select Load Model : LM 1, FLM 1

4. Vehicle : Load Model 1


5. Select Lane_A, Lane_B, Lane_C and RA.

6. Click .

7. Select RA.

8. Click .

9. Click [OK] button.

 Load Model 1 should be applied to each notional lane and to the remaining area. Load Model 1 is applied only to the unfavorable parts of the influence line, longitudinally and transversally.

Step6. Define vehicular load

(Case 2. Check Load Model 2)

Define Standard Vehicular Load

Standard Name
EN 1991-2:2003 - RoadBridge

Vehicular Load Properties

Vehicular Load Name : Load Model 2

Vehicular Load Type : Load Model 2

βQ_{ak}

βQ_{ak} : Single Axle Load
Q_{ak} = 400 kN

Dynamic amplification factor included

Adjustment Factor : 1

ψ factor : 0.75

OK Cancel Apply

1. Load > Load Type > Moving Load > Vehicles > Add Standard

2. Standard Name : EN 1991-2:2003 – RoadBridge

3. Vehicular Load Type : Load Model 2

4. Click [OK] button.

🔊 **Load Model 2 (LM2)** : A single axle load applied to specific tyre contact areas which covers the dynamic effects of the normal traffic on short structural members.

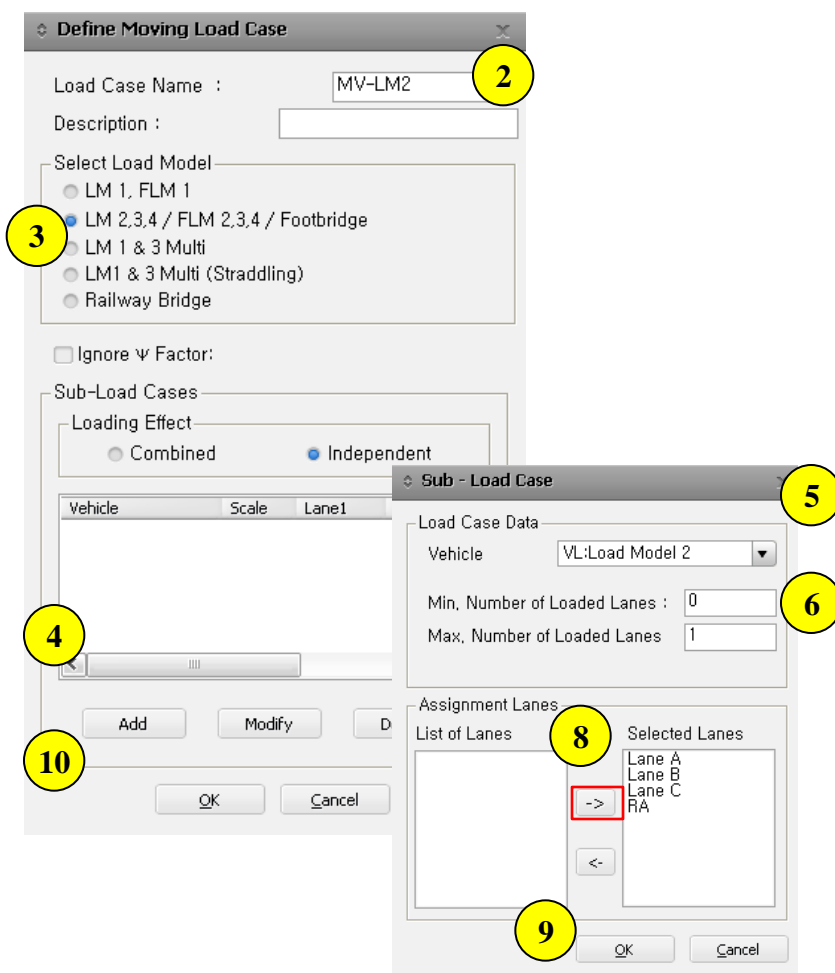
🔊 The user can directly change the Adjustment Factor given in the National Annex.

🔊 Additional dynamic amplification factor near expansion joints are not taken into account.

Step7. Define moving load case (Case 2. Check Load Model 2)

1. Load > Load Type > Moving Load > Moving Load Cases > Add
2. Load Case Name : MV-LM2
3. Select Load Model : LM 2,3,4 / FLM 2,3,4 / Footbridge
4. Click [Add] button.
5. Vehicle Class : VL:Load Model 2
6. Max. Number of Loaded Lanes: 1
7. Select Lane_A, Lane_B, Lane_C and RA.
8. Click [->].
9. Click [OK] button.
10. Click [OK] button.

⚠ Load Model 2 should be applied to any location on the carriageway.



Step8. Define vehicular load

(Case 3. Check Load Model 3 with the simultaneous presence of Load Model 1)

Define Standard Vehicular Load

Standard Name

EN 1991-2:2003 - RoadBridge

Vehicular Load Properties

Vehicular Load Name

Load Model 3 (3600/200)

Vehicular Load Type

Load Model 3 (3600/200)

P₁

P₂

P₃

.....

P_{n-2}

P_{n-1}

P_n

D₁

D₂

.....

D_{n-2}

D_{n-1}

Lane Special Vehicle Load : 2 Load Case Analysis

* 3600/200

No	P (kN)	D (m)
1	200	1.5
2	200	1.5
3	200	1.5
4	200	1.5
5	200	1.5
6	200	1.5

* 3600/200/200

No	P (kN)	D (m)
1	200	1.5
2	200	1.5
3	200	1.5
4	200	1.5
5	200	1.5
6	200	1.5

No	P (kN)	D (m)
----	--------	-------

☒ Dynamic Amplification Factor

Auto

User Input

$\phi = 1.40 - L / 500$ ($1 \leq \phi \leq 1.40$)

ϕ :

OK

Cancel

Apply

1. Load > Load Type > Moving Load > Vehicles > Add Standard
2. Standard Name : EN 1991-2:2003 – RoadBridge
3. Vehicular Load Type : Load Model 3(3600/200)
4. Click [OK] button.

Load Model 3 (LM3) : A set of assemblies of axle loads representing special vehicles which can travel on routes permitted for abnormal loads.

A dynamic amplification for Load Model 3 is taken into account automatically.

In this tutorial, special vehicle is assumed to move at normal speed.

Applicable Axle-lines in midas Civil

Axle-lines of 150kN	Axle-lines of 200kN	Axle-lines of 240kN
Available	Available	Not Available

Step9. Define moving load case

(Case 3. Check Load Model 3 with the simultaneous presence of Load Model 1)

Define Moving Load Case

Load Case Name : MV-LM3

Description :

Select Load Model

- ☐ LM 1, FLM 1
- ☐ LM 2,3,4 / FLM 2,3,4 / Footbridge
- ☒ LM 1 & 3 Multi
- ☐ LM1 & 3 Multi (Straddling)
- ☐ Railway Bridge

☐ Ignore Ψ Factor:

Load Case Data

LM1 : Load Model 1

LM3 : Load Model 3 (3600/200)

Assignment Lanes

Line of Lanes	Selected Lanes	Remaining Area
Lane A		
Lane B		
Lane C		
RA		

OK Cancel

Define Moving Load Case

Load Case Name : MV-LM3

Description :

Select Load Model

- ☐ LM 1, FLM 1
- ☐ LM 2,3,4 / FLM 2,3,4 / Footbridge
- ☒ LM 1 & 3 Multi
- ☐ LM1 & 3 Multi (Straddling)
- ☐ Railway Bridge

☐ Ignore Ψ Factor:

Load Case Data

LM1 : Load Model 1

LM3 : Load Model 3 (3600/200)

Assignment Lanes

Line of Lanes	Selected Lanes	Remaining Area
Lane A		
Lane B		
Lane C		
RA		

OK Cancel Apply

1. . Load > Load Type > Moving Load > Moving Load Cases > Add

2. Load Case Name : MV-LM3

3. Select Load Model : LM 1 & 3 Multi

4. LM1 : Load Model 1

5. LM3 : Load Model 3 (3600/200)

6. Select Lane_A, Lane_B, Lane_C and RA.

7. Click

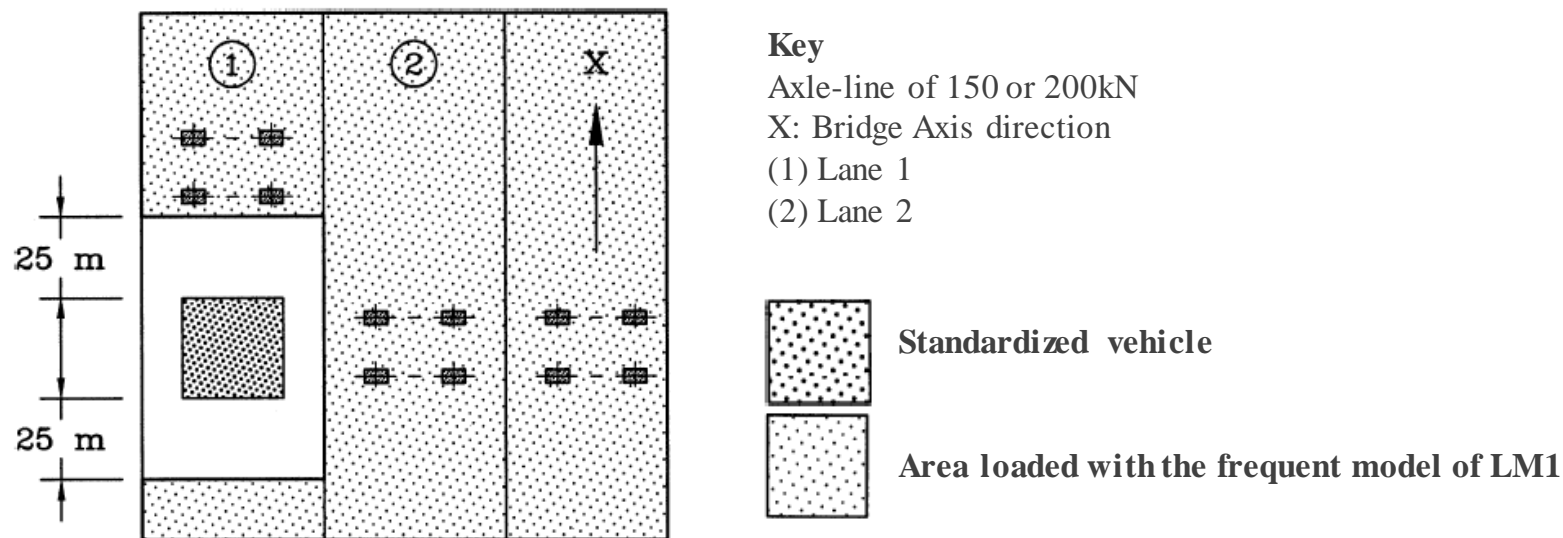
8. Select RA.

9. Click

10. Click [OK] button.

Load Model 3 is applied to Lane_A, Lane_B or Lane_C .

Tip 2. Simultaneity of Load Model 1 and special vehicle



Where special vehicles are assumed to move at normal speed, a pair of special vehicles should be used in the lane(s) occupied by these vehicles. On the other lanes and the remaining area, the bridge deck should be loaded by Load Model 1 with its frequent values.

Step10. Moving load analysis option

Moving Load Analysis Control Data

Truck/Train Load Control Option

Load Point Selection

☒ Influence Line Dependent Point ☐ All Points

Influence Generating Points

☒ Number/Line Element : 3 ☐ Distance between Points : 0.3 m

Analysis Results

Plate

☐ Center ☒ Center + Nodal ☐ Stress Calculation

Frame

☐ Normal ☒ Normal + Concurrent Force ☐ Combined Stress Calculation

Calculation Filters

☒ Reactions ☒ Displacements ☒ Forces/Moments

☒ All ☐ Group :

☒ All ☐ Group :

☒ All ☐ Group :

5

1. Analysis > Analysis Control > Moving Load

2. Frame : **Normal + Concurrent Force**

3. Displacements Group : **Results**

4. Forces/Moments Group : **Results**

5. Click [OK] button.

Number/Line Element : Assign the number of reference points on a line element for moving loads and drawing influence line in an influence line analysis. The accuracy of results increases with the increase in the number, but the analysis time may become excessive.

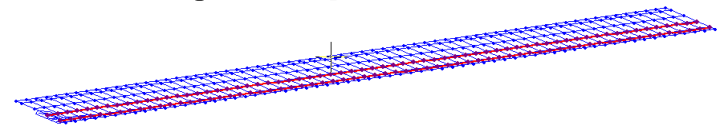
Normal + Concurrent Force : If the output of concurrent forces for max and min values is required for moving load analysis, select 「Normal + Concurrent Force」 .

Note

Concurrent forces are not calculated for LMI & 3 (Multi) model.

Select the specific group for which analysis results need to be checked in order to reduce analysis time.

[Structure Group: Results]



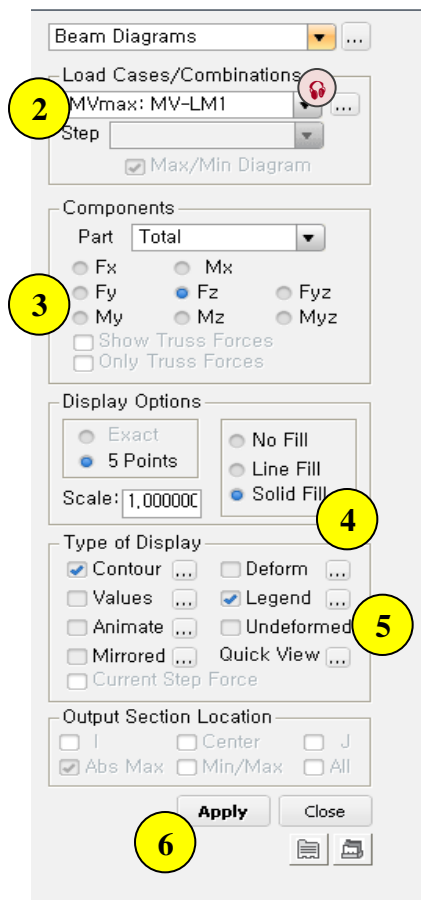
Step 11. Perform analysis

Step 12-1. Shear force diagrams

🔊 **MVmin** : The minimum force resulting from the vehicle load applied to the structure.

🔊 **MVmax** : The maximum force resulting from the vehicle load applied to the structure.

🔊 **MVall** : Both maximum and minimum force resulting from the vehicle load applied to the structure.



1. Click  .

1. Results > Forces > Beam Diagrams...

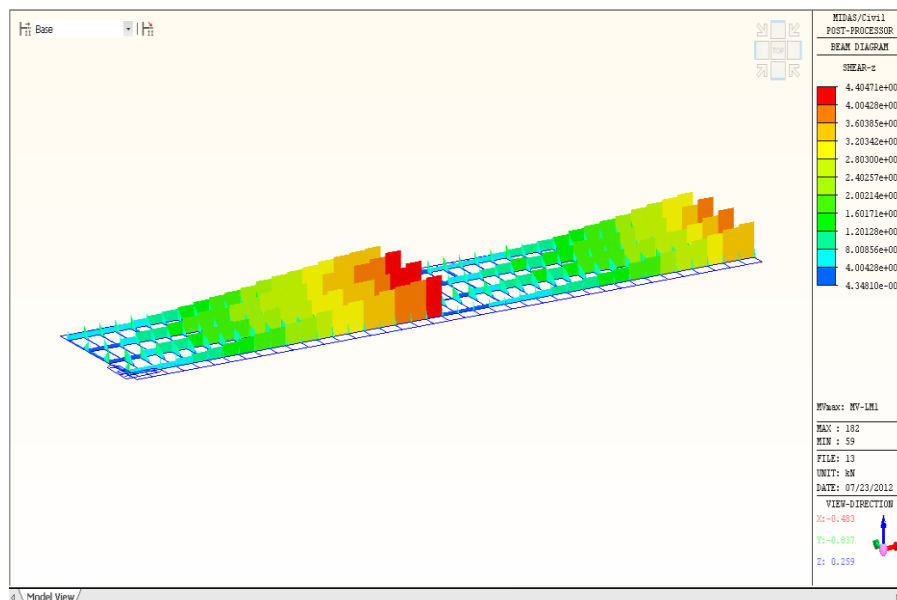
2. Load Cases/Combinations : **Mvall: MV-LM1**

3. Components : **Fz**

4. Display Options : **Solid Fill**

5. Check on **Contour**, **Legend**.

6. Click **[Apply]** button.



Step 12-2. Shear force tables

Beam Diagrams ... **1**

Load Cases/Combinations
MVall: MV-LM1 ...
Step
☒ Max/Min Diagram

Components
Part: Total
☐ Fx ☐ Mx
☐ Fy ☒ Fz ☐ Fyz
☐ My ☐ Mz ☐ Myz
☐ Show Truss Forces
☐ Only Truss Forces

Display Options
☐ Exact ☐ No Fill
☒ 5 Points ☐ Line Fill
☒ Solid Fill
 Scale: 1.000000

1. Click ...
2. Check on **MV-LM1(MV:all)**.
3. Click [OK] button.

Records Activation Dialog

Node or Element
All None Inverse **2**
Element: 1to445

Select Type
Element Type Add Delete Replace Intersect

Loadcase/Combination
☒ MV-LM1(MV:all)
☐ MV-LM1(MV:max)
☐ MV-LM1(MV:min)
☐ MV-LM2(MV:all)
☐ MV-LM2(MV:max)
☐ MV-LM2(MV:min)
☐ MV-LM3(MV:all)
☐ MV-LM3(MV:max)
☐ MV-LM3(MV:min)

Part Number
☒ Part i
☐ Part 1/4
☐ Part 2/4
☐ Part 3/4
☒ Part j

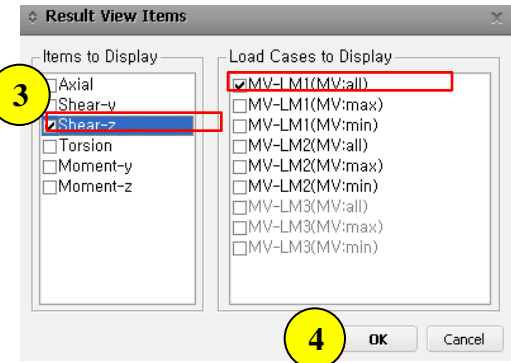
3 OK Cancel

	Elem	Load	Part	Axial (kN)	Shear-y (kN)	Shear-z (kN)	Torsion (kN-m)	Moment-y (kN-m)	Moment-z (kN-m)
	79	MV-LM1	I[39]	0,00	0,00	0,00	0,00	-0,00	0,00
	79	MV-LM1	J[80]	0,00	0,00	118,98	0,00	-11,87	0,00
	80	MV-LM1	I[40]	0,00	0,00	0,00	0,00	-0,00	0,00
	80	MV-LM1	J[81]	0,00	0,00	118,98	0,00	-11,87	0,00
	81	MV-LM1	I[41]	0,00	0,00	0,00	0,00	0,00	0,00
	81	MV-LM1	J[82]	0,00	0,00	115,74	0,00	-11,55	0,00
	82	MV-LM1	I[42]	0,00	0,00	-357,52	-9,52	0,00	0,00
	82	MV-LM1	J[43]	0,00	0,00	-357,52	-9,52	429,02	0,00
	83	MV-LM1	I[43]	0,00	0,00	-330,83	-8,68	425,57	0,00
	83	MV-LM1	J[44]	0,00	0,00	-330,83	-8,68	798,79	0,00
	84	MV-LM1	I[44]	0,00	0,00	-304,39	8,85	794,33	0,00
	84	MV-LM1	J[45]	0,00	0,00	-304,39	8,85	1111,87	0,00
	85	MV-LM1	I[45]	0,00	0,00	-278,64	10,91	1106,92	0,00
	85	MV-LM1	J[46]	0,00	0,00	-278,64	10,91	1369,88	0,00
	86	MV-LM1	I[46]	0,00	0,00	-241,84	-6,77	1369,88	0,00
	86	MV-LM1	J[47]	0,00	0,00	-241,84	-6,77	1563,96	0,00
	87	MV-LM1	I[47]	0,00	0,00	-218,25	6,71	1559,67	0,00
	87	MV-LM1	J[48]	0,00	0,00	-218,25	6,71	1703,76	0,00
	88	MV-LM1	I[48]	0,00	0,00	-195,63	7,90	1700,08	0,00

Step 12-3. Shear force tables (Concurrent forces)

1. Right-click on the Beam Force table.
2. Select **View by Max Value Item...**
3. Check on **Shear-z**.
4. Click [OK] button.

	Elem	Load	Part	Axial (kN)	Shear-y (kN)	Shear-z (kN)	Torsion (kN·m)	Moment-y (kN·m)	Moment-z (kN·m)
▶	79	MV-LM1	I[39]	0,00	0,00	0,00	0,00	-0,00	0,00
	79	MV-LM1	J[80]			9,98	0,00	-11,87	0,00
	80	MV-LM1	I[40]			0,00	0,00	-0,00	0,00
	80	MV-LM1	J[81]			9,98	0,00	-11,87	0,00
	81	MV-LM1	I[41]			0,00	0,00	0,00	0,00
	81	MV-LM1	J[82]			7,74	0,00	-11,55	0,00
	82	MV-LM1	I[42]			5,52	-9,52	0,00	0,00
	82	MV-LM1	J[43]			5,52	-9,52	429,02	0,00
	83	MV-LM1	I[43]			8,83	-8,68	425,57	0,00
	83	MV-LM1	J[44]			8,83	-8,68	798,79	0,00
	84	MV-LM1	I[44]			8,39	8,85	794,33	0,00
	84	MV-LM1	J[45]			8,39	8,85	1111,87	0,00
	85	MV-LM1	I[45]			10,64	10,91	1106,92	0,00
	85	MV-LM1	J[46]			10,64	10,91	1369,88	0,00
	86	MV-LM1	I[46]			8,84	-6,77	1369,88	0,00
	86	MV-LM1	J[47]			8,84	-6,77	1563,96	0,00
	87	MV-LM1	I[47]			6,25	6,71	1559,67	0,00
	87	MV-LM1	J[48]			6,25	6,71	1703,76	0,00



🔊 Calculate the corresponding member forces under the conditions where the maximum and minimum member forces occur at each position.

	Elem	Load	Part	Component	Axial (kN)	Shear-y (kN)	Shear-z (kN)	Torsion (kN·m)	Moment-y (kN·m)	Moment-z (kN·m)
	82	MV-LM1	I[42]	Shear-z	0,00	0,00	-357,52	-4,06	0,00	0,00
	82	MV-LM1	J[43]	Shear-z	0,00	0,00	-357,52	-4,06	429,02	0,00
	83	MV-LM1	I[43]	Shear-z	0,00	0,00	-330,83	-1,66	396,98	0,00
	83	MV-LM1	J[44]	Shear-z	0,00	0,00	-330,83	-1,66	793,97	0,00
	84	MV-LM1	I[44]	Shear-z	0,00	0,00	-304,39	0,24	728,87	0,00
	84	MV-LM1	J[45]	Shear-z	0,00	0,00	-304,39	0,24	1094,14	0,00
	85	MV-LM1	I[45]	Shear-z	0,00	0,00	-278,64	2,47	999,08	0,00
	85	MV-LM1	J[46]	Shear-z	0,00	0,00	-278,64	2,47	1333,45	0,00

◀ ▶ Result By Max Value-[Beam Force] /

◀ ▶ Model View Result-[Beam Force] Result By Max Value-[Beam Force] /

Step 13. Bending moment diagrams

Reactions Deformat... **Forces** Stresses

2 Beam Diagrams ...

Load Cases/Combinations
MVmax: MV-LM1 ...
Step ...
☒ Max/Min Diagram

Components
Part Total ...
☐ Fx ☐ Mx ☐ Fyz
☐ Fy ☐ Fz ☐ Myz
☒ My ☐ Mz
☐ Show Truss Forces
☐ Only Truss Forces

Display Options
☐ Exact ☐ No Fill
☒ 5 Points ☐ Line Fill
Scale: 1.000000 ☒ Solid Fill 4

Type of Display
☒ Contour ... ☐ Deform ...
☐ Values ... ☒ Legend ... 5
☐ Animate ... ☐ Undeformed ...
☐ Mirrored ... Quick View ...
☐ Current Step Force

Output Section Location
☐ I ☐ Center ☐ J
☒ Abs Max ☐ Min/Max ☐ All

6 **Apply** **Close**

1. Results > Forces > Beam Diagrams...

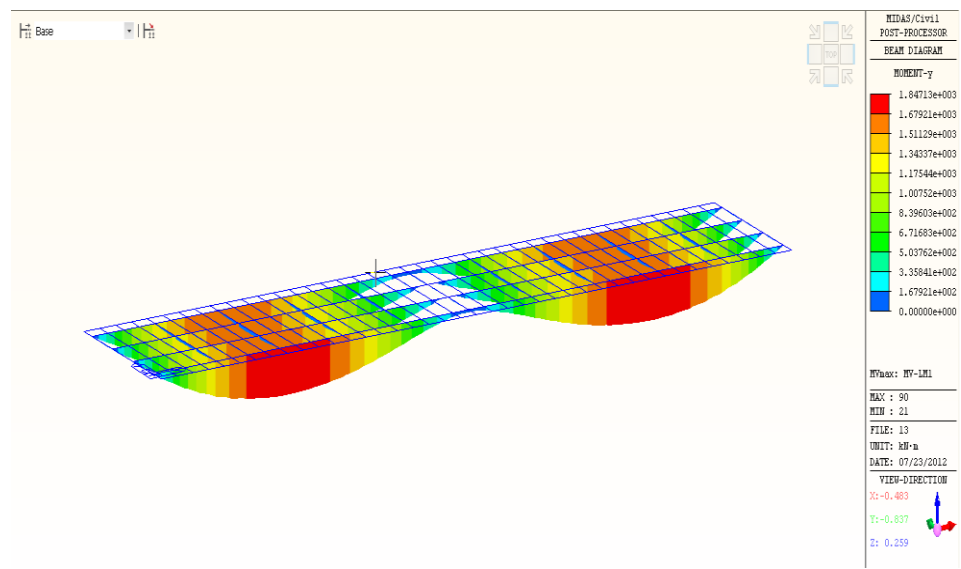
2. Load Cases/Combinations : MVall: MV-LM1

3. Components : My

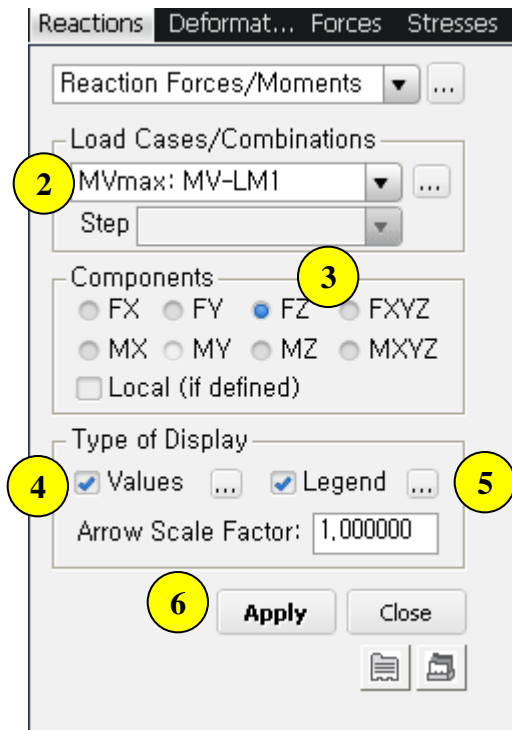
4. Display Options : Solid Fill

5. Check on Legend.

6. Click [Apply] button.



Step 14. Reactions



1. Results > Reactions > Reaction Forces /Moments...

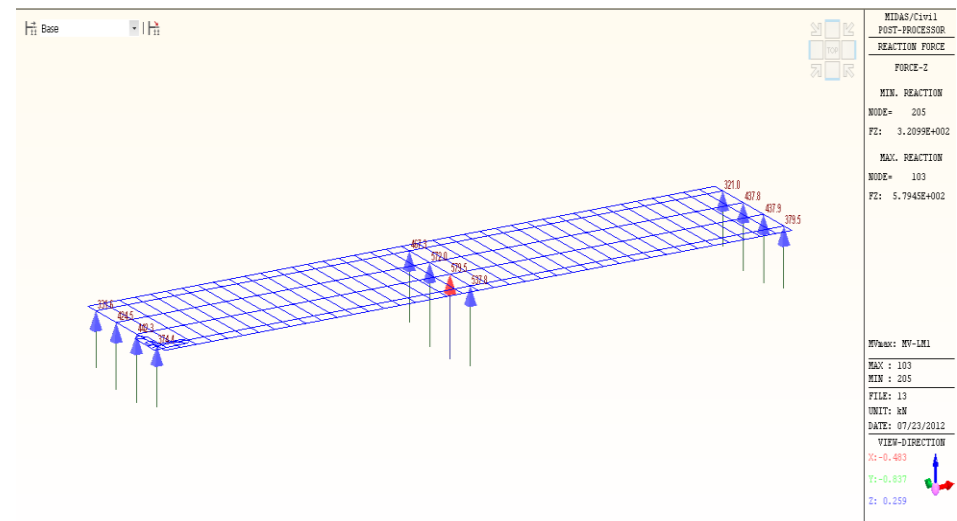
2. Load Cases/Combinations : MVmax: MV-LM1

3. Components : Fz

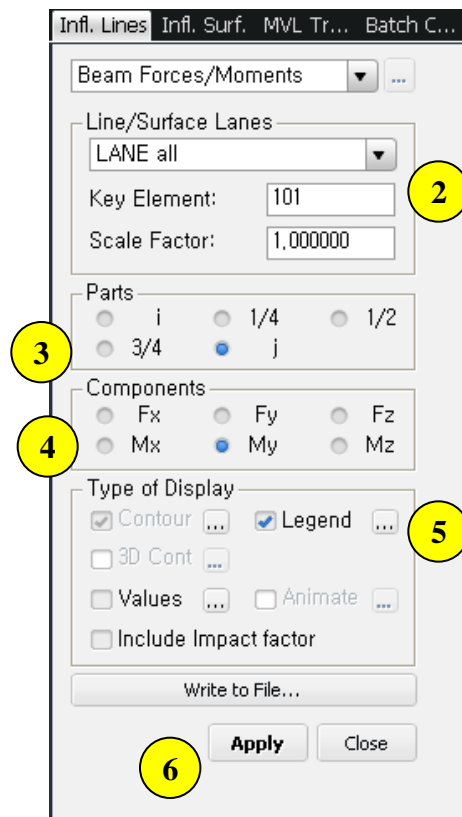
4. Check on **Values**.

5. Check on **Legend**.

6. Click [Apply] button.



Step 15. Influence lines



1. Results > Influence Lines > Beam Forces/Moments...

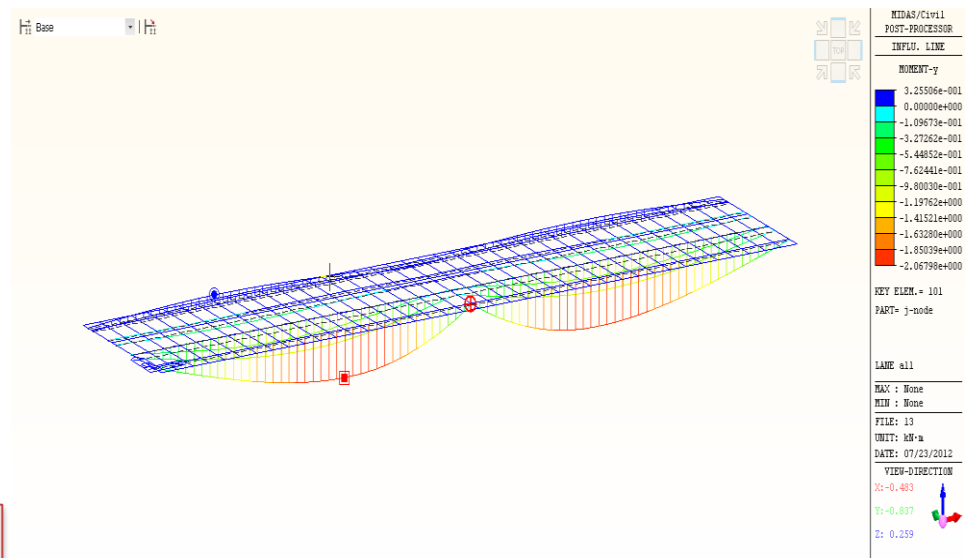
2. Key Element: 101

3. Parts: j

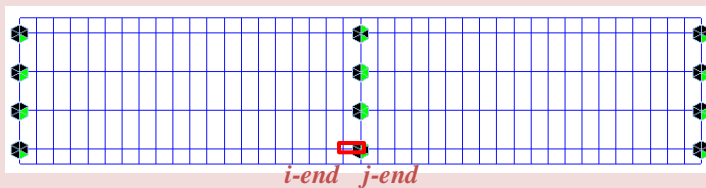
4. Components: My

5. Check on Legend

6. Click [Apply] button.



Key Element: 101



Step 16-1. Moving load tracer

Display moving load location that results in the minimum moment at the j-end of the element no. 101 due to the "MV-LM2" load case.

Trace and graphically display the vehicle loading condition (corresponding moving load case and location) that results in the maximum/ minimum force of a beam element. The loading condition is converted into a static loading and produced as a model file of the MCT type by clicking [Write Min/Max Load to File] button.

Inf. Lines Inf. Surf. MVL Tr... Batch C...

Beam Forces/Moments

Moving Load Cases
MVmin: MV-LM2

Key Element: 101

Scale Factor: 1.000000

Parts
☐ i ☐ 1/4 ☐ 1/2
☐ 3/4 ☒ j

Components
☐ Fx ☐ Fy ☐ Fz
☐ Mx ☒ My ☐ Mz

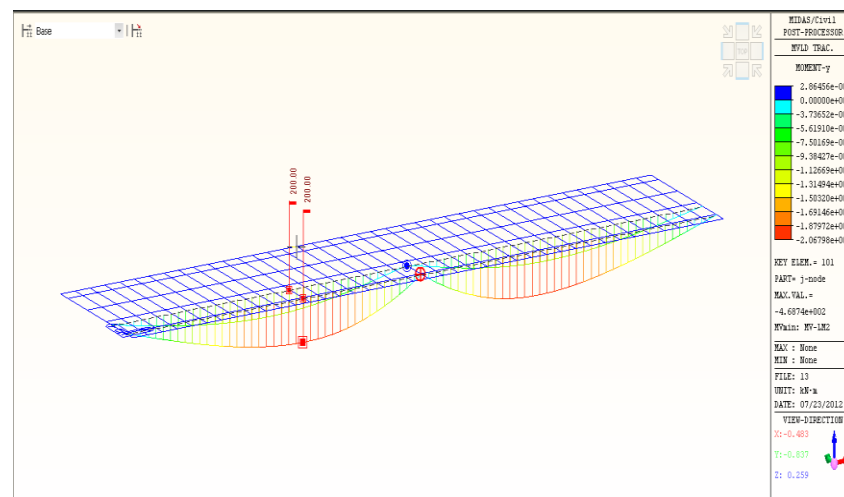
Type of Display
☒ Contour ☒ Legend
☒ Applied Loads
☐ Include Impact factor

Maximum Value : -4.6874e+002

Write Min/Max Load to File

Apply Close

1. Results > Moving Load Tracer > Beam Forces/Moment
2. Moving Load Cases: MVmin: MV-LM2
3. Key Element: 101
4. Parts: j
5. Components: My
6. Check on Contour, Legend and Applied Loads.
7. Click [Apply] button.



Step 16-2. Moving load tracer

Display moving load location that results in the minimum moment at the j-end of the element no. 101 due to the "MV-LM3" load case.

Inf. Lines Inf. Surf. **MVL Tr...** Batch C...

Beam Forces/Moments

Moving Load Cases
 2 MVmin: MV-LM3

Key Element: 101 3

Scale Factor: 1,000000

Parts
 4 i 1/4 1/2
 3/4 j

Components
 5 Fx Fy Fz
 Mx My Mz

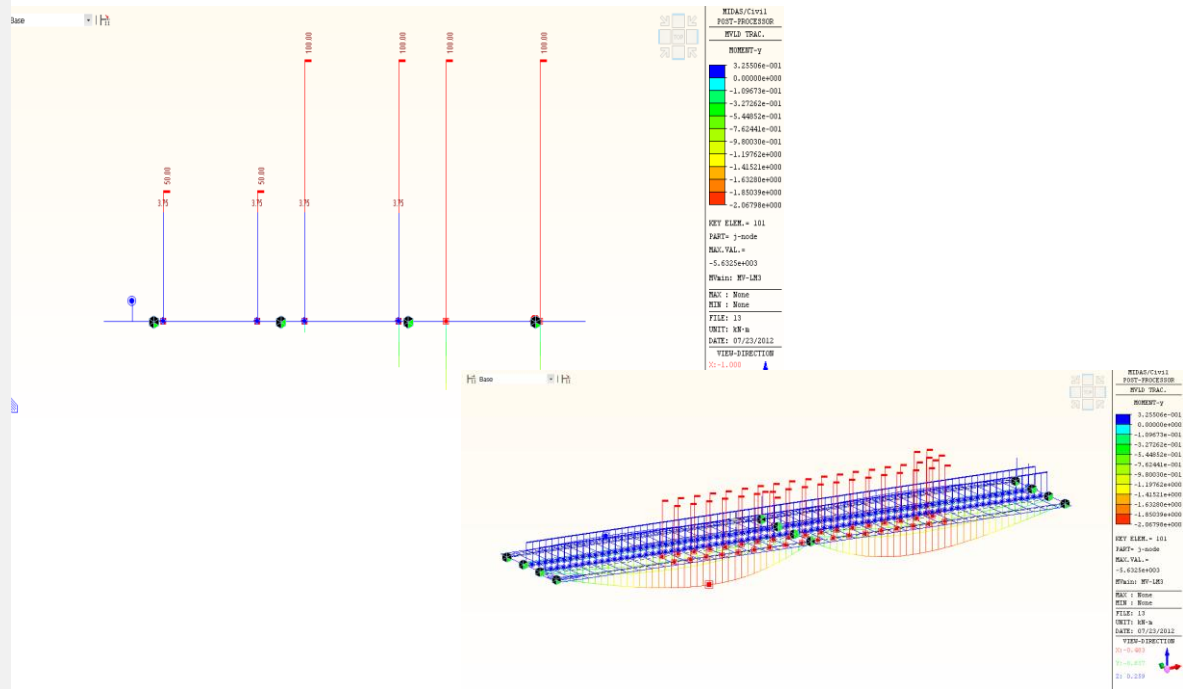
Type of Display
 6 ☒ Contour ☒ Legend
☒ Applied Loads
☐ Include Impact factor

Maximum Value : -5,6325e+003

Write Min/Max Load to File

7 **Apply** Close

1. Results > Moving Load Tracer > Beam Forces/Moment
2. Moving Load Cases: MVmin: MV-LM3
3. Key Element: 101
4. Parts: j
5. Components: My
6. Check on Contour, Legend and Applied Loads.
7. Click [Apply] button.



Step 16-3. Moving load tracer

Display moving load location that results in the maximum reaction of the node no. 103 due to the "MV-LM1" load case.

1. Results > Moving Load Tracer > Reactions...
2. Moving Load Cases: MVmax: MV-LM1
3. Key Node: 103
4. Components: Fz
5. Check on Contour, Legend and Applied Loads.
6. Click [Apply] button.

Reactions

Moving Load Cases
MVmax: MV-LM1

Key Node: 103

Scale Factor: 1,000000

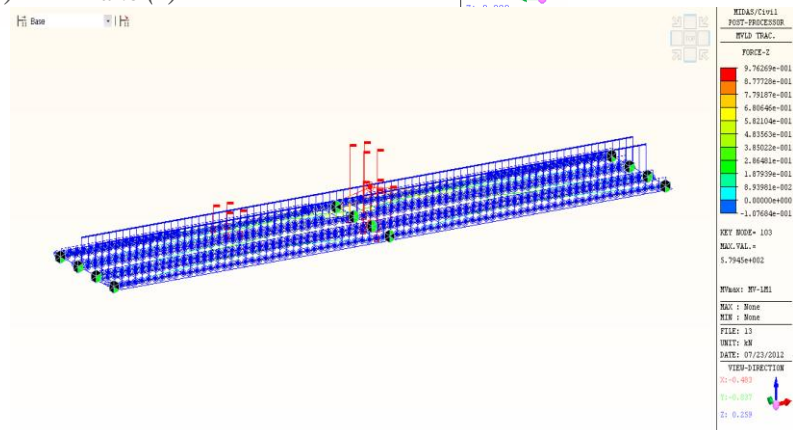
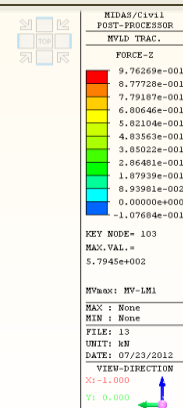
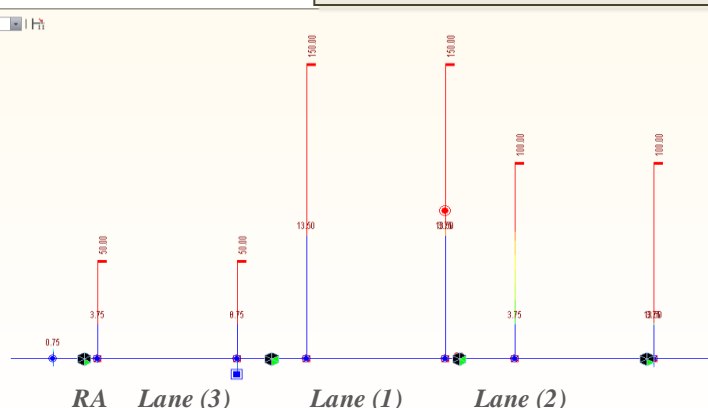
Components
☐ FX ☐ FY ☒ FZ
☐ MX ☐ MY ☐ MZ
☐ Local (if defined)

Type of Display
☒ Contour ☒ Legend ☐ Applied Loads
☐ Include Impact factor

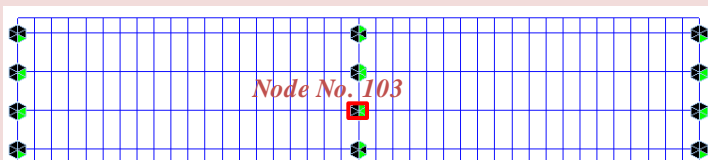
Maximum Value : 5,7945e+002

Write Min/Max Load to File

Apply Close



Key Node: 103



Step 17-1. Converting the moving load into a static load

Reactions ▼ ...

Moving Load Cases
MVmax: MV-LM1 ▼

Key Node: 103

Scale Factor: 1.000000

Components
☐ FX ☐ FY ☒ FZ
☐ MX ☐ MY ☐ MZ
☐ Local (if defined)

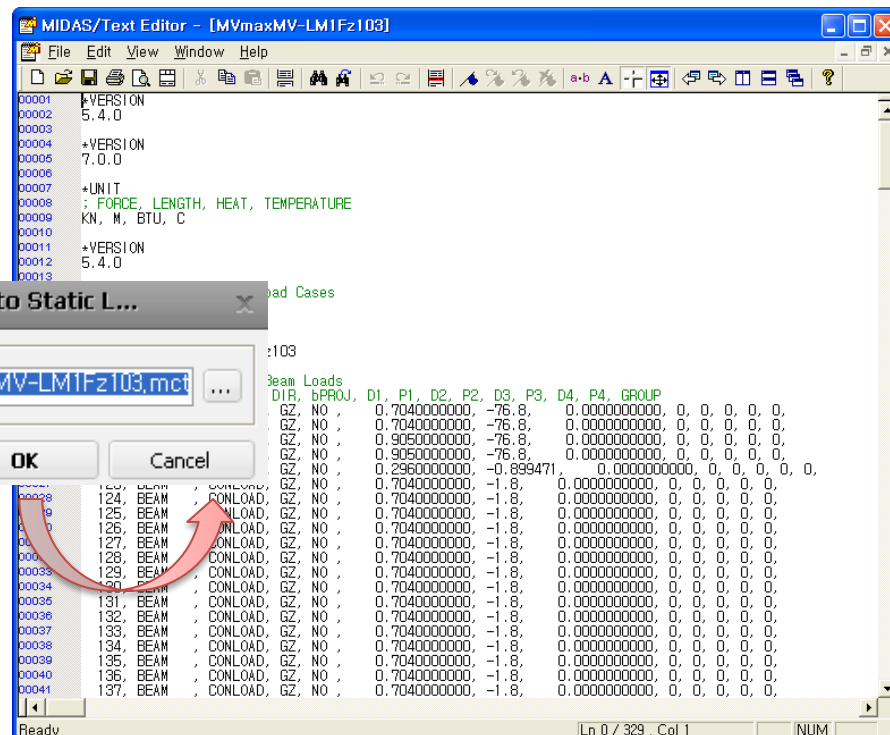
Type of Display
☒ Contour ... ☒ Legend ...
☒ Applied Loads ...
☐ Include Impact factor

Maximum Value : 5.79490002

1 Write Min/Max Load to File

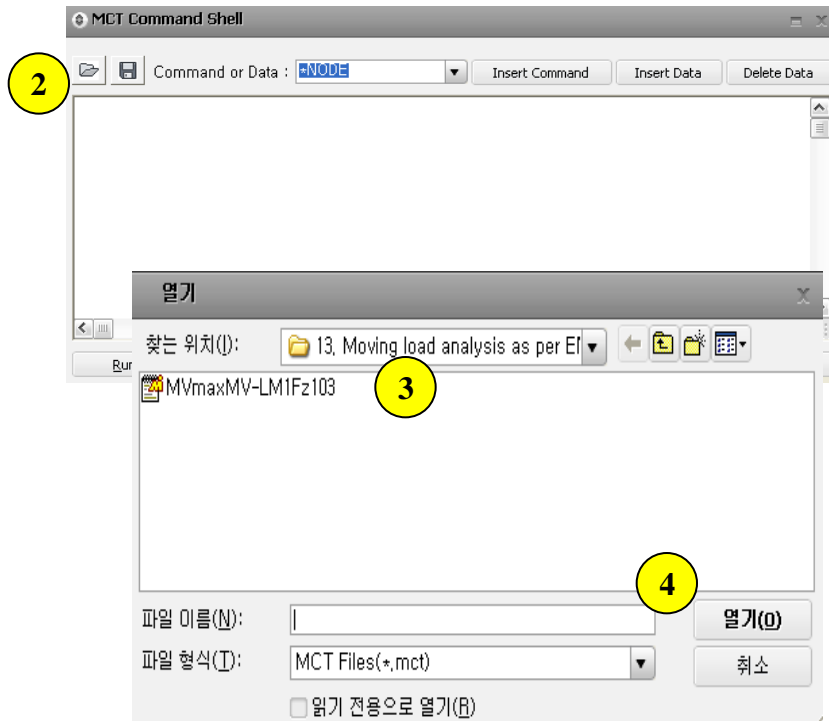
Apply Close

1. Click [Write Min/Max Load to File] button.
2. Click [OK] button.
3. Select **File>Exit** in the **MIDAS/Text Editor**.



Where moving load analysis has been carried out, the moving load case, which produces the maximum or minimum results, is converted into a static loading and produced as the MCT type.

Step 17-2. Converting the moving load into a static load



1. Tools>MCT Command Shell

2. Click .

3. Select the file name "MVmaxMV-LM1Fz103.mct".

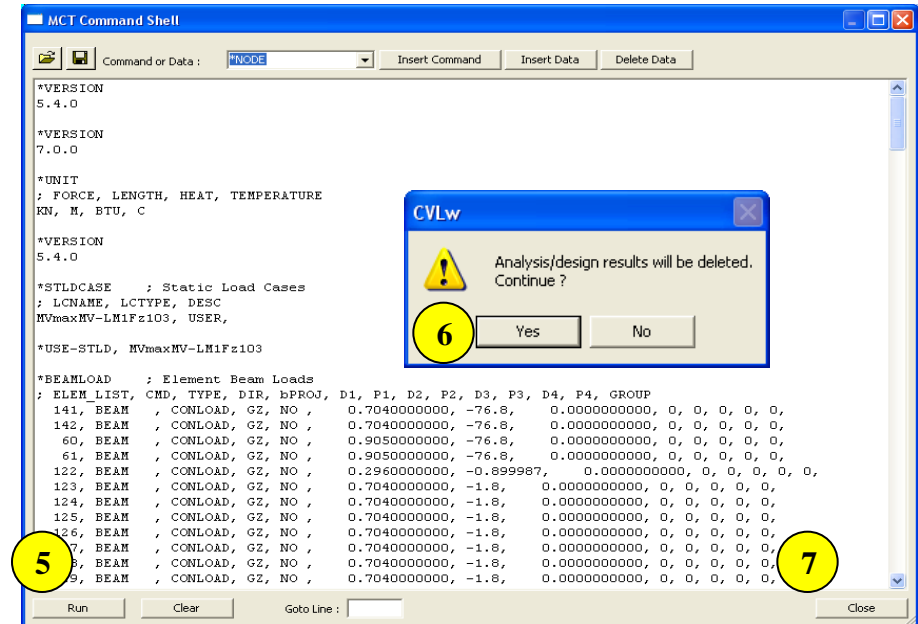
4. Click [Open] button.

5. Click [Run] button.

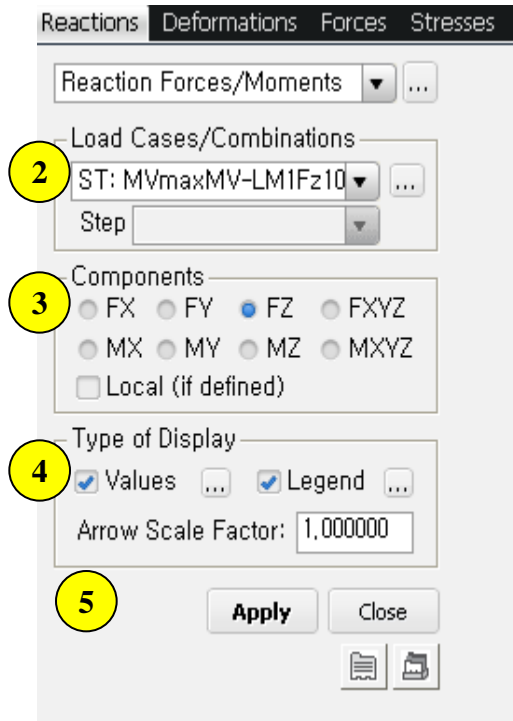
6. Click [Yes] button.

7. Click [Close] button.

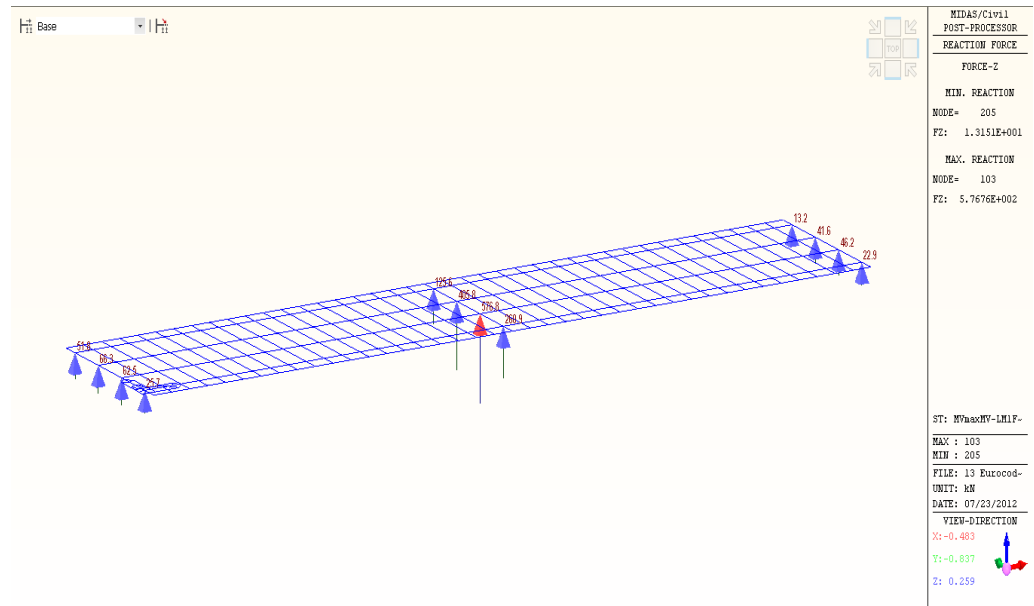
8. Click .



Step 18-1. Check beam reactions due to the converted static load



1. Results>Reactions>Reaction Forces/Moments...
2. Load Cases/Combinations: ST: MVmaxMV-LM1Fz103
3. Components: Fz
4. Check on **Values** and **Legend**.
5. Click [Apply] button.



Step 18-2. Check reaction table due to the static load

Reactions Deformations Forces **1**

Reaction Forces/Moments ...

Load Cases/Combinations
ST: MVmaxMV-LM1Fz103 ...

Step

Components
☐ FX ☐ FY ☒ FZ ☐ FXYZ
☐ MX ☐ MY ☐ MZ ☐ MXYZ
☐ Local (if defined)

Type of Display
☒ Values ... ☒ Legend ...
Arrow Scale Factor: 1.000000

Apply Close

1. Click ...
2. Check on **MVmaxMV-LM1Fz103(ST)**.
3. Click [OK] button.

	Node	Load	FX (kN)	FY (kN)	FZ (kN)	MX (kN·m)	MY (kN·m)	MZ (kN·m)
	42	MVmax	0.000000	0.000000	25.696130	0.000000	0.000000	0.000000
	62	MVmax	0.000000	0.000000	260.902532	0.000000	0.000000	0.000000
	82	MVmax	0.000000	0.000000	22.872948	0.000000	0.000000	0.000000
	83	MVmax	0.000000	0.000000	62.533833	0.000000	0.000000	0.000000
	103	MVmax	0.000000	0.000000	576.758556	0.000000	0.000000	0.000000
	123	MVmax	0.000000	0.000000	46.164514	0.000000	0.000000	0.000000
	124	MVmax	0.000000	0.000000	66.253440	0.000000	0.000000	0.000000
	144	MVmax	0.000000	0.000000	405.801639	0.000000	0.000000	0.000000
	164	MVmax	0.000000	0.000000	41.599590	0.000000	0.000000	0.000000
	165	MVmax	0.000000	0.000000	51.804898	0.000000	0.000000	0.000000
	185	MVmax	0.000000	0.000000	125.606723	0.000000	0.000000	0.000000
	205	MVmax	0.000000	0.000000	13.151248	0.000000	0.000000	0.000000
SUMMATION OF REACTION FORCES PRINTOUT								
			FX (kN)	FY (kN)	FZ (kN)			
			0.000000	0.000000	1699.146051			

Records Activation Dialog

Node or Element
All None Inverse Prev

Node 1to246

Select Type
Element Type

TRUSS
BEAM
PLANE STRESS
PLATE
PLANE STRAIN
AXISYMMETRIC
SOLID

Loadcase/Combination
☐ SW of Girders(ST)
☐ SW of CFs(ST)
☐ SW of Deck Slab(ST)
☐ SW of Haunch(ST)
☐ SW of Forms(ST)
☐ SDL Parapets(ST)
☐ SDL FWS(ST)
☒ MVmaxMV-LM1Fz103(ST)
☐ MV-LM1(MV:all)
☐ MV-LM1(MV:max)
☐ MV-LM1(MV:min)
☐ MV-LM2(MV:all)

2 Add Delete Replace Intersect

3 OK Cancel

Reaction table due to static load case 'MVmaxMV-LM1Fz103' displays the concurrent reactions due to the moving load case 'MV-LM1' when the reaction of the node no. 103 is maximum.