



MIDAS *Technical
Material*

Tutorial



3-D Box Culvert using NZ vehicles and
Design as per AS 5100.5:2017



Specifications of the Bridge

Design of 3D Box Culvert 5.00 m X 3.50 m:

Clear Span of Box	= 5.00 m
Thickness of Side walls	= 0.35 m
Clear Height of the Box	= 3.50 m
Thickness of Deck and base Slabs	= 0.325 m
Idealized Span = $5000 + (350/2) + (350/2)$	= 5.35 m
Idealized Height = $(325/2) + 3500 + (350/2)$	= 3.8375 m
Clear Carriageway Width	= 8.75 m
Thickness of Crash Barriers	= 0.45 m
Width of structure $8750 + 2 \times 450$	= 9.65 m

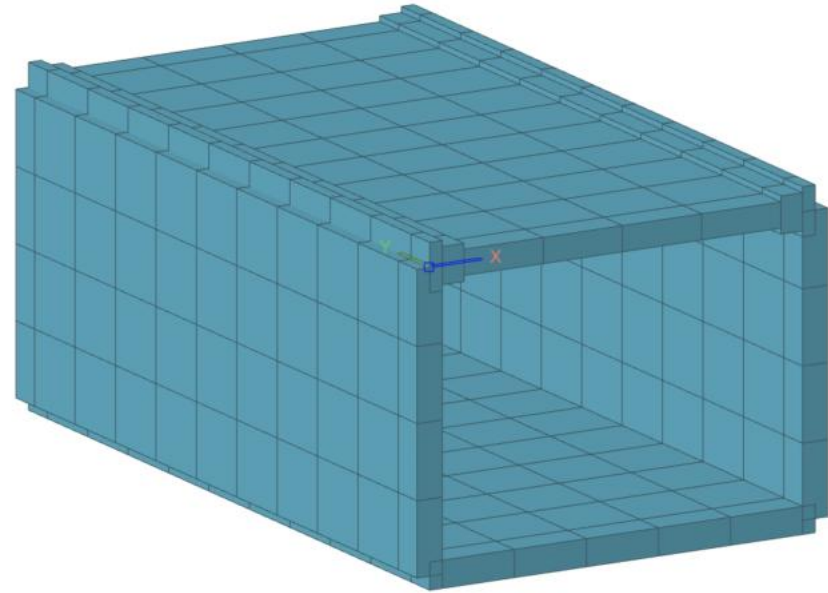


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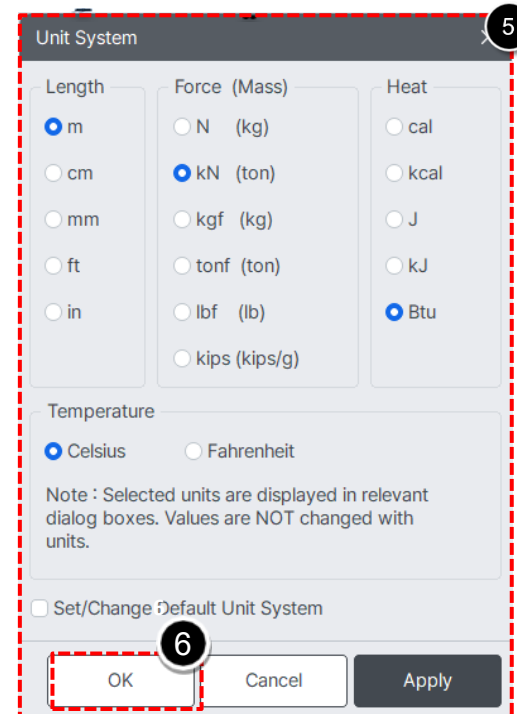
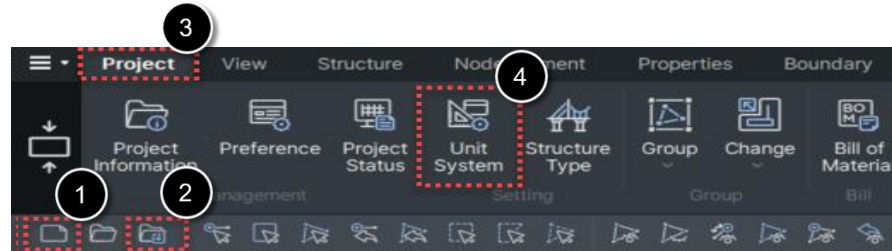
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Units Preference

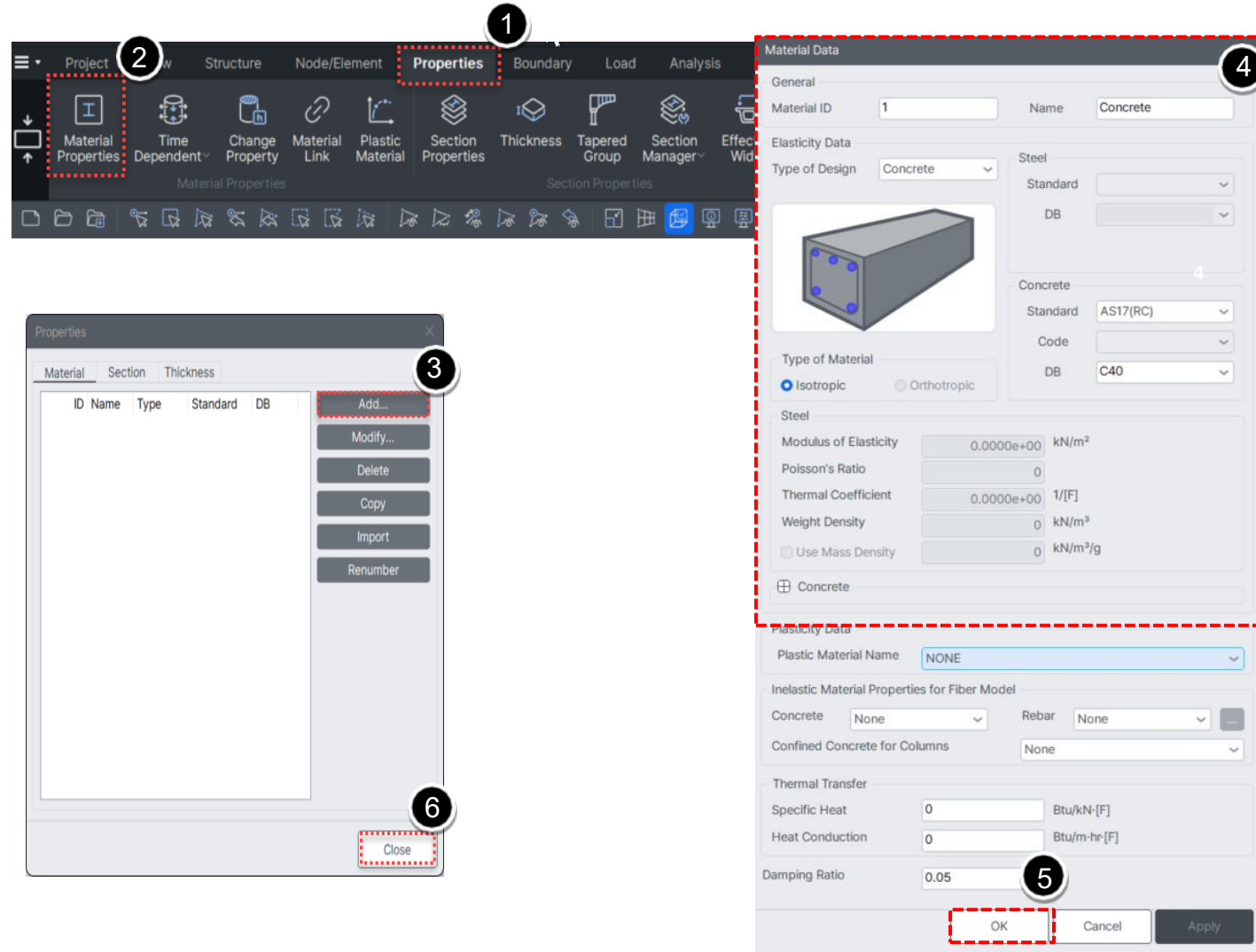
Invoke Midas Civil NX

- 1 Open New File
- 2 Save as “Box Culvert using wizard”
- 3 Go to > “Project”
- 4 Click on “Unit System”
- 5 Select the unit system [m, kN(ton), Celsius]
- 6 Click on OK



Material Definition

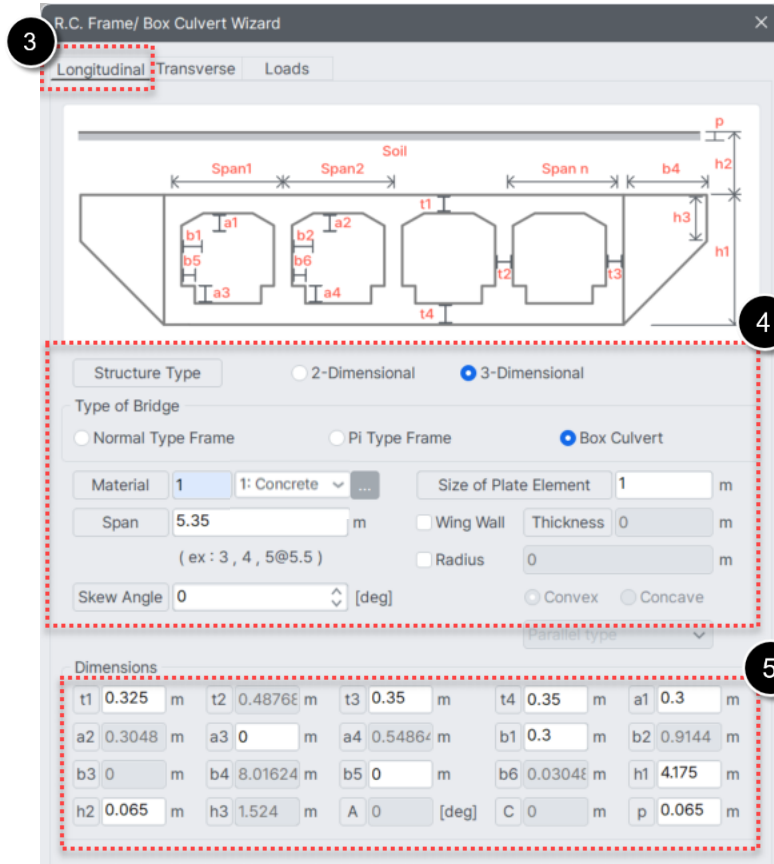
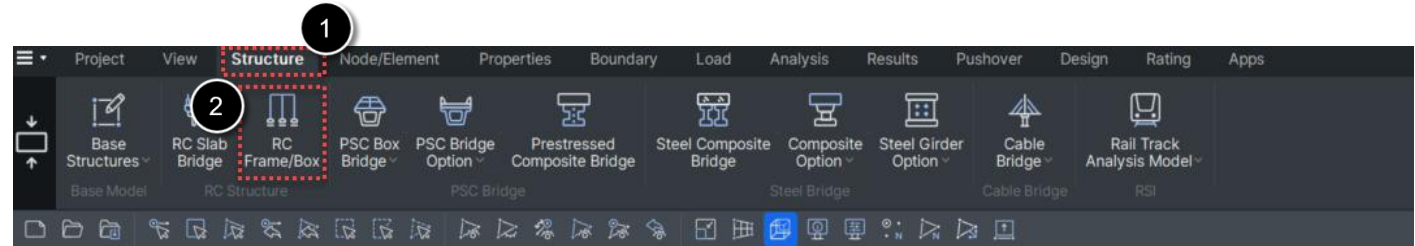
- 1 Go to > “Properties”
- 2 Click on “Material Properties”
- 3 Click on “Add” to define materials
- 4 Define Material data:
 - Name > **Concrete**
 - Type of design> **Concrete**
 - Concrete Standard > **AS17(RC)**
 - DB > **C40**
- 5 Click on **OK**
- 6 Click on **Close**



Note: When it is required to change some properties of material, the required database is selected and then standard is again set to None to alter the material Properties

Longitudinal Tab

- 1 Go to “Structure” tab
- 2 Click on “RC Frame/Box”
- 3 Go to “R.C.Frame/Box Culvert Wizard” tab
- 4 Define data:
 structure type > “3-Dimensional”
 Type of bridge > “Box Culvert”
 Material > “Concrete”
 Size of Plate Element > 1 m
 Span > 5.35 m
 Skew Angle > 0 (deg)
- 5 Define Dimension data:
 Refer the drawing and enter the section dimension parameters
 $t1 : 0.325\text{m}$, $t3 : 0.35\text{m}$, $t4 : 0.35\text{m}$, $a1 : 0.3\text{m}$, $a3 : 0\text{m}$, $b1 : 0.3\text{m}$, $b5 : 0$, $h1 : 4.175\text{m}$, $h2 : 0.065\text{m}$, $p : 0.065\text{m}$



Note: Click on 3 dots “...” icon and define the new material property.

Sample Calculations

Here, μ and E_s are Important parameters

. With reference to the “**Foundation Analysis and Design**” by Bowels (5th Edition), these values could be found out.

From these given **tables(2-7, 2-8,5-6)**, Poisson's ratio and Static Stress strain modulus can be found out. The value range for E_s is very large, hence shall not be averaged out.

For this, field tests like **SPT** or lab tests Could be Useful.

TABLE 2-7
Values or value ranges for Poisson's ratio μ

Type of soil	μ
Clay, saturated	0.4–0.5
Clay, unsaturated	0.1–0.3
Sandy clay	0.2–0.3
Silt	0.3–0.35
Sand, gravelly sand	–0.1–1.00
commonly used	0.3–0.4
Rock	0.1–0.4 (depends somewhat on type of rock)
Loess	0.1–0.3
Ice	0.36
Concrete	0.15
Steel	0.33

TABLE 2-8
Value range* for the static stress-strain modulus E_s for selected soils (see also Table 5-6)

Field values depend on stress history, water content, density, and age of deposit

Soil	E_s , MPa
Clay	
Very soft	2–15
Soft	5–25
Medium	15–50
Hard	50–100
Sandy	25–250
Glacial till	
Loose	10–150
Dense	150–720
Very dense	500–1440
Loess	15–60
Sand	
Silty	5–20
Loose	10–25
Dense	50–81
Sand and gravel	
Loose	50–150
Dense	100–200
Shale	150–5000
Silt	2–20

*Value range is too large to use an “average” value for design.

TABLE 5-6
Equations for stress-strain modulus E_s by several test methods

E_s in kPa for SPT and units of q_c for CPT; divide kPa by 50 to obtain ksf. The N values should be estimated as N_{65} and not N_{70} . Refer also to Tables 2-7 and 2-8.

Soil	SPT	CPT
Sand (normally consolidated)	$E_s = 500(N + 15)$ $= 7000 \sqrt{N}$ $= 6000N$	$E_s = (2 \text{ to } 4)q_u$ $= 8000 \sqrt{q_c}$ — — — $E_s = 1.2(3D_r^2 + 2)q_c$ $*E_s = (1 + D_r^2)q_c$
Sand (saturated)	$E_s = 250(N + 15)$ $\ddagger E_s = (15\,000 \text{ to } 22\,000) \cdot \ln N$	$E_s = F q_c$ $e = 1.0 \quad F = 3.5$ $e = 0.6 \quad F = 7.0$
Sands, all (norm. consol.)	$\S E_s = (2600 \text{ to } 2900)N$	
Sand (overconsolidated)	$\dagger E_s = 40\,000 + 1050N$ $E_{s(\text{OCR})} \approx E_{s,nc} \sqrt{\text{OCR}}$	$E_s = (6 \text{ to } 30)q_c$
Gravelly sand	$E_s = 1200(N + 6)$ $= 600(N + 6) \quad N \leq 15$ $= 600(N + 6) + 2000 \quad N > 15$	
Clayey sand	$E_s = 320(N + 15)$	$E_s = (3 \text{ to } 6)q_c$
Silts, sandy silt, or clayey silt	$E_s = 300(N + 6)$	$E_s = (1 \text{ to } 2)q_c$
	If $q_c < 2500$ kPa use $^5 E'_s = 2.5q_c$ 2500 < q_c < 5000 use $E'_s = 4q_c + 5000$ where $E'_s = \text{constrained modulus} = \frac{E_s(1 - \mu)}{(1 + \mu)(1 - 2\mu)} = \frac{1}{m_v}$	
Soft clay or clayey silt		$E_s = (3 \text{ to } 8)q_c$

Sample Calculations

Using Steinbrenner's equations the influence factors could be found out to calculate subgrade modulus for four corners and at the center of a rectangular base

Depth of Compressible soil = **H** = 14m

Breadth of the Base Slab = **B** = 5.7m Hence at **Center B'** = 2.85m

Length of the Base Slab = **L** = 11m Hence at **Center L'** = 5.5m

$$N = H/B' = 14/2.85 = 4.9$$

$$M = L'/B' = 5.5/2.85 = 1.9$$

These N and M are further used to calculate the influence factors using following equations and table 5-2 and graph mentioned in the next slide.

For Center

$I_1 =$	0.520
$I_2 =$	0.057
$I_s =$	0.552
$I_F =$	0.775

For Corner

$I_1 =$	0.347
$I_2 =$	0.092
$I_s =$	0.399
$I_F =$	0.775

Modulus of Subgrade Reactions:

$$\text{Modulus of subgrade reaction at center } K_{\text{center}} = \frac{1}{4B'E'I_sI_F} = 5632 \text{ kN/m}^2/\text{m}$$

$$\text{Modulus of subgrade reaction at corner } K_{\text{corner}} = \frac{1}{B'E'I_sI_F} = 15583 \text{ kN/m}^2/\text{m}$$

$$\text{Average subgrade modulus } K = \frac{4K_{\text{center}} + K_{\text{corner}}}{5} = 7622 \text{ kN/m}^2/\text{m}$$

Say **K = 7630 kN/m²/m**

Table, Equation and Graph used for the calculations of influence factors

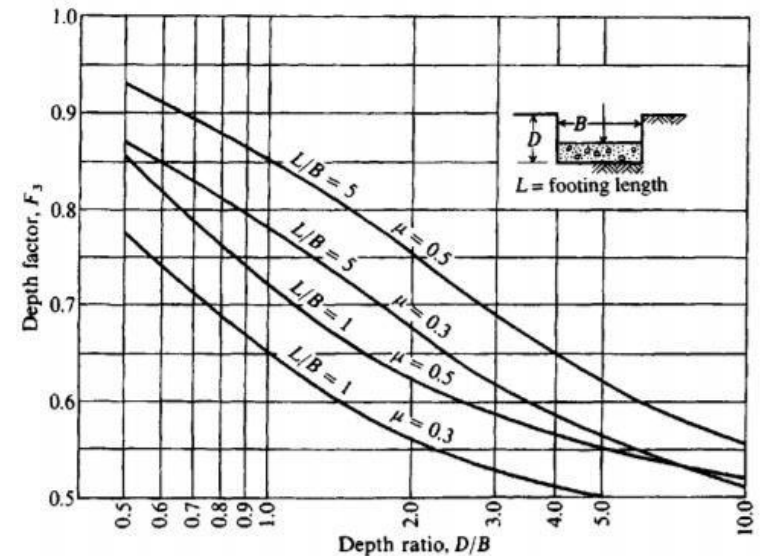
TABLE 5-2

Values of I_1 and I_2 to compute the Steinbrenner influence factor I_s for use in Eq. (5-16a) for several $N = H/B'$ and $M = L/B$ ratios

N	$M = 1.0$	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
0.2	$I_1 = 0.009$ $I_2 = 0.041$	0.008	0.008	0.008	0.008	0.008	0.007	0.007	0.007	0.007	0.007
0.4	0.033 0.066	0.032	0.031	0.030	0.029	0.028	0.028	0.027	0.027	0.027	0.027
0.6	0.066 0.079	0.064	0.063	0.061	0.060	0.059	0.058	0.057	0.056	0.056	0.055
0.8	0.104 0.083	0.102	0.100	0.098	0.096	0.095	0.093	0.092	0.091	0.090	0.089
1.0	0.142 0.083	0.140	0.138	0.136	0.134	0.132	0.130	0.129	0.127	0.126	0.125
1.5	0.224 0.075	0.224	0.224	0.223	0.222	0.220	0.219	0.217	0.216	0.214	0.213
2.0	0.285 0.064	0.288	0.290	0.292	0.292	0.292	0.292	0.292	0.291	0.290	0.289
3.0	0.363 0.048	0.372	0.379	0.384	0.389	0.393	0.396	0.398	0.400	0.401	0.402

$$I_s = I_1 + \frac{1 - 2\mu}{1 - \mu} I_2$$

For I_F calculations:



Transverse Tab

- 1 Go to “Transverse” tab
- 2 Select Type > “Type 1”
Size of Plate Element > 1m
Refer the drawing and enter the section dimension parameters
b3 : 0.45m, b4 : 0m, b5 : 8.75m, b6 : 0m, b7 : 0.45m
- 3 Define data for supports of culvert:
Spring Type > “General”
Modulus of Subgrade Reaction >
Lower > 7630 kN/m³
Length of Elastic Link > 1 m

RC. Frame/ Box Culvert

Longitudinal **Transverse** Loads

Diagram showing dimensions: b3, b4, b5, b6, b7, D.

Type: Type1 Size of Plate Element: 1 m

b1: 0 m b2: 0 m b3: 0.45 m b4: 0 m
b5: 8.75 m b6: 0 m b7: 0.45 m D: 6.096 m
n: 0

Supports of PI Frame
Transverse Fixed Support from left side

Supports of Culvert
Spring Type: ☒ General ☐ Compression Only
Modulus of Subgrade Reaction:
Lower: 7630 kN/m³
Lateral: 19635.9 kN/m³
Upper: 19635.9 kN/m³
Length of Elastic Link: 1 m

Open... Save As... OK Close

Load Tab

- 1 Go to “Load” tab
- 2 Define Load Combination :
Select code > “AASHTO-Std2K”
Click > Define Moving Load Code
Select Moving Load Code > “New Zealand”
- 3 Click > “Self Weight”
Click > “Pavement”
Weight Density > 22 kN/m²
Thickness > 0.065m
Click > “Soil”
Weight Density > 20 kN/m²
Surcharge > 0
Phi > 30 (deg)
Click > “Barrier”
Self Weight > 11.25 kN/m
Additional Load > 0
Click > “Temperature Gradient”:
Delta T > 17.5 [T]
Click > Shrinkage Strain > 0.00019997
Thermal Coefficient > 1.2 e-005 1/[T]

- 4 If required for further use, click on **Save As...** to save the wizard file. This file saves data input done in the wizard
- 5 Click on **OK**

R.C. Frame/ Box Culvert Wizard

Longitudinal Transverse **Loads**

Load Combinations: AASHTO-Std2K ☐ Factored ☐ Unfactored

Define Moving Load Code

☒ Self Weight

☒ Pavement: Weight Density: 22 kN/m³, Thickness: 0.065 m

☒ Soil: Weight Density: 20 kN/m³, Phi: 30 [deg], Surcharge: 0 kN/m², Submerged Weight Density: 10.9961 kN/m³, Load Slope: (L) 1 1.5, (R) 1 1.5

☐ Underground Water: GL: 0 m

☒ Barrier: Self Weight: 11.25 kN/m, Additional Load: 0 kN/m

☐ Median Strip: 0 kN/m

☐ SideWalk: Weight Density: 0 kN/m³, Thickness: 0.3 m, Crowd Load: 0 kN/m²

☐ Live Load: Class of Loading: H15-44, Eccentricity: ☐ left ☐ right

☐ Settlement: 0 m

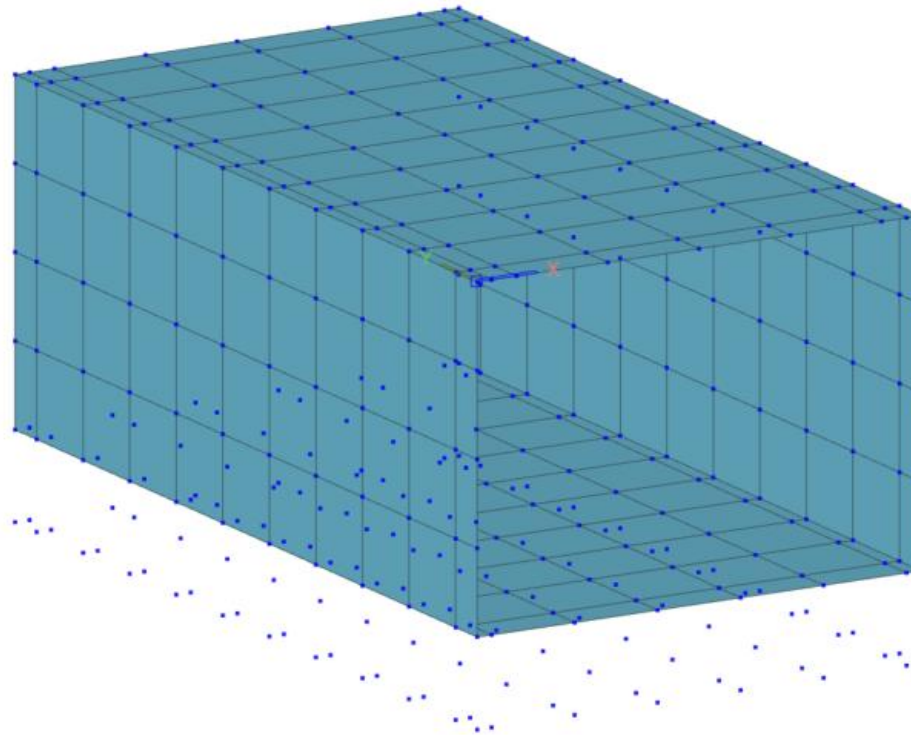
☐ System Temperature: T [+/-]: 0 [T]

☒ Temperature Gradient: Delta T: 17.5 [T]

☒ Shrinkage Strain: 0.0001999, Thermal Coefficient: 1.2e-05 1/[T]

Open... **Save As...** **OK** Close

Note: Assuming area of crash barriers as 0.45 m² SW of CB = 0.45X 25 = 11.25 kN/m

Generated Model

Boundary Conditions generated by wizard

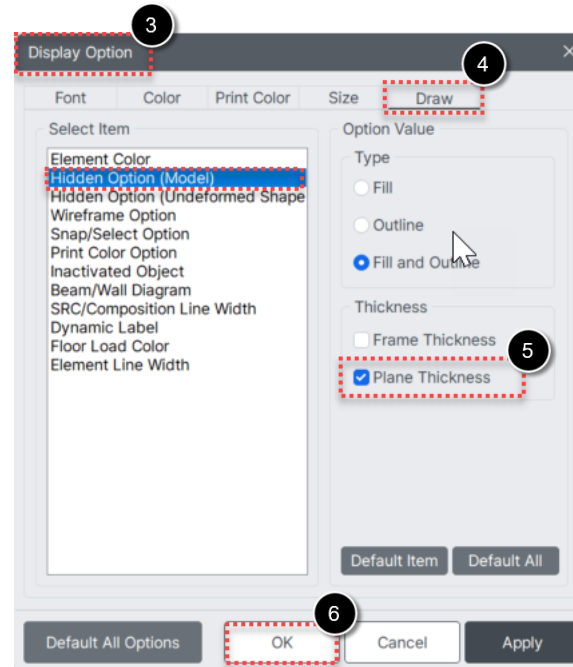
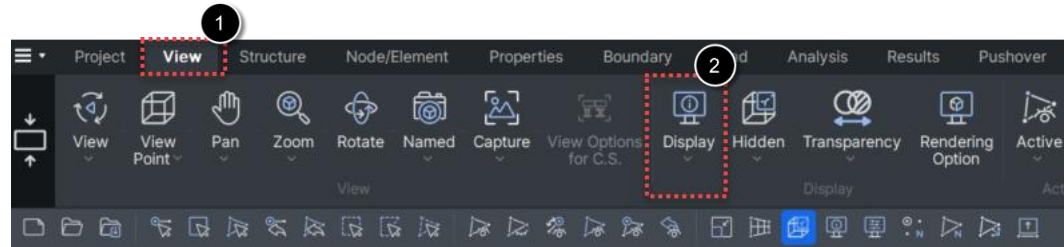
The boundary conditions created by the program are: **Elastic Links** and **Spring supports**

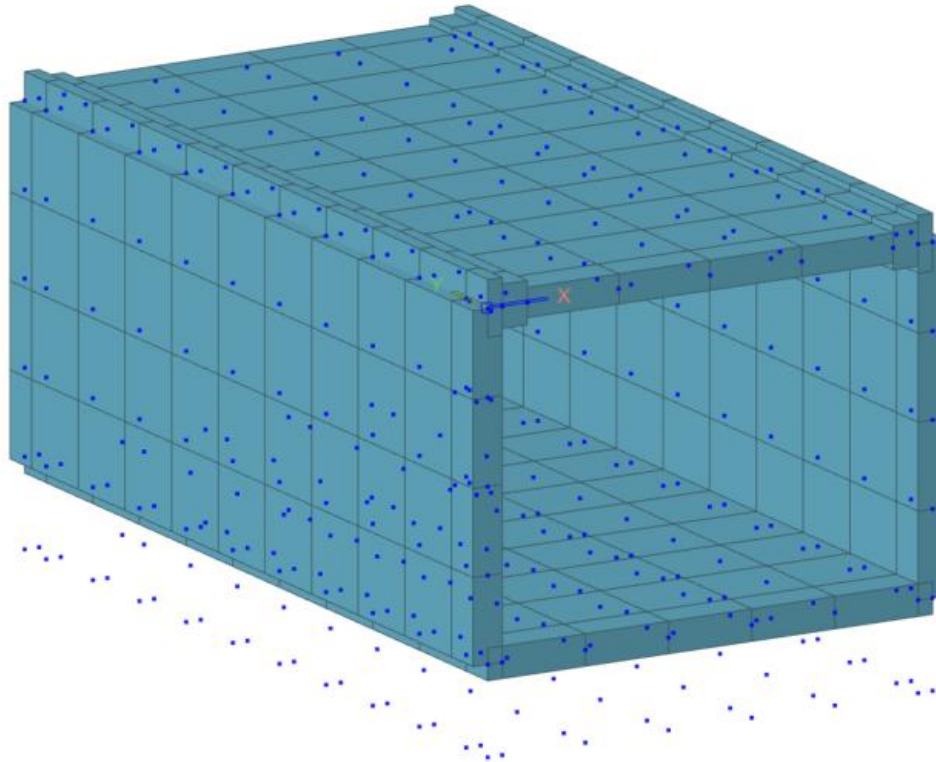
Vertical Stiffness (Local direction of the links) is calculated using: **modulus of subgrade reaction x effective area**

Elastic Links Numbers	Effective Area Calculations (L X B)		Area (m²)	Stiffness kN/m
1, 12 and 13, 24	$\left(\frac{0.175}{2} \times \frac{0.45}{2}\right)$	0.0875 x 0.225	0.01969	150.2156
2, 11 and 14, 23	$\frac{0.175}{2} \times \left(\frac{0.45}{2} + \frac{0.972222}{2}\right)$	0.0875 x 0.71111	0.06222	474.7556
3 to 10 and 15 to 22	$\left(\frac{0.175}{2} \times 2 \times \frac{0.972222}{2}\right)$	0.0875 x 0.972222	0.08507	649.0799
25, 36 and 85, 96	$\left(\frac{0.175}{2} + \frac{1}{2}\right) \times \frac{0.45}{2}$	0.5875 x 0.225	0.13219	1008.5906
26, 35 and 86, 95	$\left(\frac{0.175}{2} + \frac{1}{2}\right) \times \left(\frac{0.45}{2} + \frac{0.972222}{2}\right)$	0.5875 x 0.71111	0.41778	3187.6444
27 to 34 and 87 to 94	$\left(\frac{0.175}{2} + \frac{1}{2}\right) \times 2 \times \frac{0.972222}{2}$	0.5875 x 0.972222	0.57118	4358.1076
37, 48, 49, 60, 61, 72, 73, 84	$\frac{1}{2} \times \frac{0.45}{2}$	0.5 x 0.225	0.1125	1716.75
38, 47, 50, 59, 62, 71, 74, 83	$\left(\frac{1}{2} + \frac{1}{2}\right) \times \left(\frac{0.45}{2} + \frac{0.972222}{2}\right)$	1 x 0.71111	0.71111	5425.7769
39 to 46, 51 to 58, 63 to 70 and 75 to 82	$\left(\frac{1}{2} + \frac{1}{2}\right) \times \left(\frac{0.972222}{2} \times 2\right)$	1 X 0.972222	0.972222	7418.0539

PLANE THICKNESS

- 1 Go to “VIEW” tab
- 2 Click on “Display”
- 3 Click on “Display option”
- 4 Click on “Draw”
- 5 Select “Hidden Option (Model)”
- 6 Check on “Plane Thickness”
- 7 Click on “OK”



Generated Model

Boundary Conditions generated by wizard

No	Node1	Node2	Type	B Angle ([deg])	RIGID	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN·m/[rad])	SRy (kN·m/[rad])	SRz (kN·m/[rad])
1	277	145	GEN	0.00	000000	150.2156	0.0000	0.0000	0.00	0.00	0.00
2	278	146	GEN	0.00	000000	474.7556	0.0000	0.0000	0.00	0.00	0.00
3	279	147	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
4	280	148	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
5	281	149	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
6	282	150	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
7	283	151	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
8	284	152	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
9	285	153	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
10	286	154	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
11	287	155	GEN	0.00	000000	474.7556	0.0000	0.0000	0.00	0.00	0.00
12	288	156	GEN	0.00	000000	150.2156	0.0000	0.0000	0.00	0.00	0.00
13	289	193	GEN	0.00	000000	150.2156	0.0000	0.0000	0.00	0.00	0.00
14	290	194	GEN	0.00	000000	474.7556	0.0000	0.0000	0.00	0.00	0.00
15	291	195	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
16	292	196	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
17	293	197	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
18	294	198	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00

No	Node1	Node2	Type	B Angle ([deg])	RIGID	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN·m/[rad])	SRy (kN·m/[rad])	SRz (kN·m/[rad])
19	295	199	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
20	296	200	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
21	297	201	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
22	298	202	GEN	0.00	000000	649.0799	0.0000	0.0000	0.00	0.00	0.00
23	299	203	GEN	0.00	000000	474.7556	0.0000	0.0000	0.00	0.00	0.00
24	300	204	GEN	0.00	000000	150.2156	0.0000	0.0000	0.00	0.00	0.00
25	301	205	GEN	0.00	000000	1008.5906	0.0000	0.0000	0.00	0.00	0.00
26	302	206	GEN	0.00	000000	3187.6444	0.0000	0.0000	0.00	0.00	0.00
27	303	207	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
28	304	208	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
29	305	209	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
30	306	210	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
31	307	211	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
32	308	212	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
33	309	213	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
34	310	214	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
35	311	215	GEN	0.00	000000	3187.6444	0.0000	0.0000	0.00	0.00	0.00
36	312	216	GEN	0.00	000000	1008.5906	0.0000	0.0000	0.00	0.00	0.00
37	313	217	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
38	314	218	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
39	315	219	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
40	316	220	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
41	317	221	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
42	318	222	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00

Boundary Conditions generated by wizard

No	Node1	Node2	Type	B Angle [[deg]]	RIGID	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN·m/[rad])	SRy (kN·m/[rad])	SRz (kN·m/[rad])
31	307	211	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
32	308	212	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
33	309	213	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
34	310	214	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00
35	311	215	GEN	0.00	000000	3187.6444	0.0000	0.0000	0.00	0.00	0.00
36	312	216	GEN	0.00	000000	1008.5906	0.0000	0.0000	0.00	0.00	0.00
37	313	217	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
38	314	218	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
39	315	219	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
40	316	220	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
41	317	221	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
42	318	222	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
43	319	223	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
44	320	224	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
45	321	225	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
46	322	226	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
47	323	227	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
48	324	228	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
49	325	229	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
50	326	230	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
51	327	231	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
52	328	232	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
53	329	233	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
54	330	234	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
55	331	235	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
56	332	236	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
57	333	237	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00

No	Node1	Node2	Type	B Angle [[deg]]	RIGID	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN·m/[rad])	SRy (kN·m/[rad])	SRz (kN·m/[rad])
61	337	241	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
62	338	242	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
63	339	243	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
64	340	244	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
65	341	245	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
66	342	246	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
67	343	247	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
68	344	248	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
69	345	249	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
70	346	250	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
71	347	251	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
72	348	252	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
73	349	253	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
74	350	254	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
75	351	255	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
76	352	256	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
77	353	257	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
78	354	258	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
79	355	259	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
80	356	260	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
81	357	261	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
82	358	262	GEN	0.00	000000	7418.0556	0.0000	0.0000	0.00	0.00	0.00
83	359	263	GEN	0.00	000000	5425.7778	0.0000	0.0000	0.00	0.00	0.00
84	360	264	GEN	0.00	000000	1716.7500	0.0000	0.0000	0.00	0.00	0.00
85	361	265	GEN	0.00	000000	1008.5906	0.0000	0.0000	0.00	0.00	0.00
86	362	266	GEN	0.00	000000	3187.6444	0.0000	0.0000	0.00	0.00	0.00
87	363	267	GEN	0.00	000000	4358.1076	0.0000	0.0000	0.00	0.00	0.00

High lateral stiffness provided by the program for the stability: It would be around = modulus of subgrade reaction x 10⁷

Node	Type	Fixed	SDx (kN/m)	SDy (kN/m)	SDz (kN/m)	SRx (kN·m/[rad])	SRy (kN·m/[rad])	SRz (kN·m/[rad])
229	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
230	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
231	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
232	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
233	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
234	Linear	000000	763000000	763000000	0.0000	0.00	0.00	0.00
235	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
236	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
237	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
238	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
239	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00
240	Linear	000000	763000000	0.0000	0.0000	0.00	0.00	0.00

Loads generated by wizard

Pavement Loading = Weight Density x Area

Area of the loading = Thickness x width = 0.065×8.75

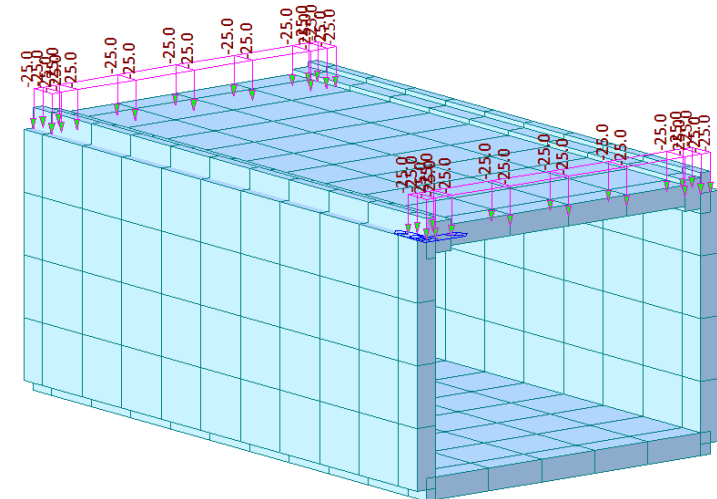
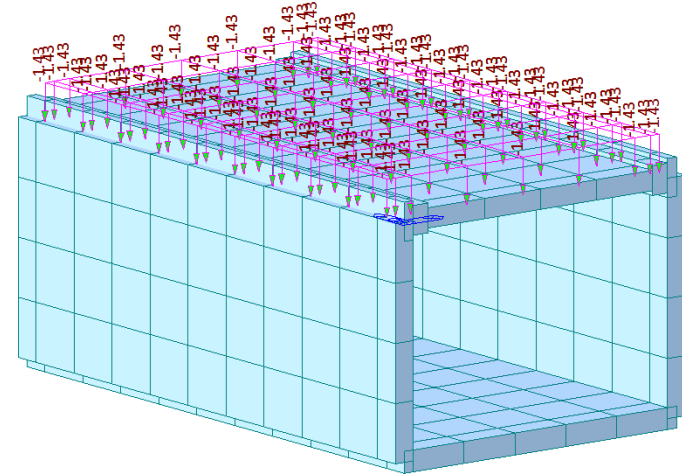
Hence intensity of Area or Pressure Load = Weight x Thickness = $22 \times 0.065 = 1.43 \text{ kN/m}^2$

Similarly, for any additional load or, crash barrier or median if present;

loadings will be calculated in similar fashion.

Crash Barrier Loading intensity = Weight density x Crash barrier area

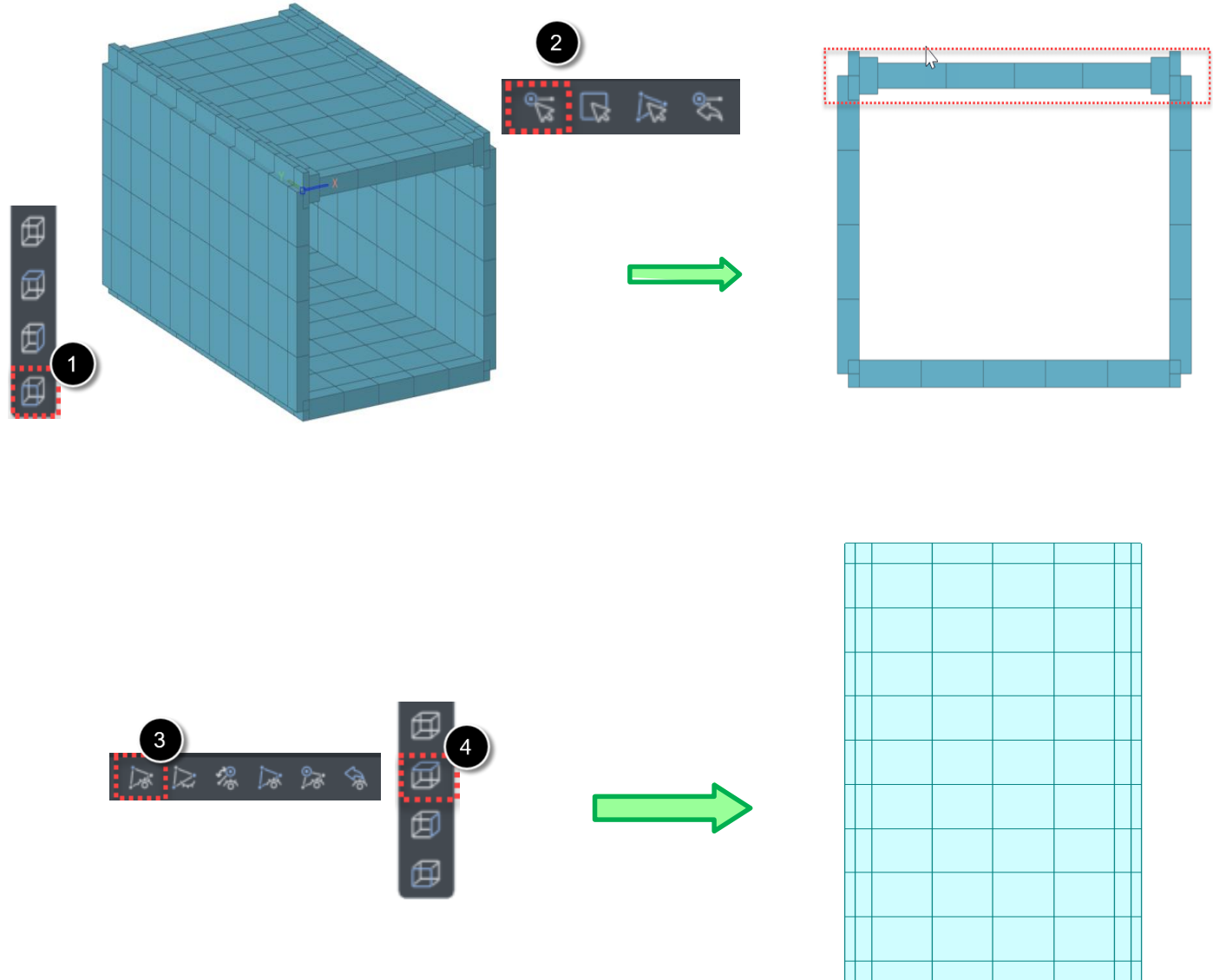
Hence intensity of Area or Pressure Load = $\frac{\text{Intensity}}{\text{Width of Crash Barrier}} = \frac{11.25}{0.45} = 25 \text{ kN/m}^2$



Activation of Slab Elements

- 1 To view the model in Front view
Click on
- 2 Click on “Select Single” and
Select the top portion as shown
- 3 Click on “Activate” button
- 4 To view the model in top view
Click on

Click on “Display  > Node > Uncheck the node option to undisplay the nodes



Traffic Surface Lanes

- 1 Go to “Load” > “Moving Load” > Moving load code – “New Zealand”
- 2 Click “Traffic Surface Lanes”
- 3 Click “Add”
- 4 Lane Name > “Lane 1”
Lane Width “3”m
Wheel Spacing “1.8”m
Offset Distance to Lane Center “2.115”m
- 5 Moving Direction > Both
Select Selection by “2 Points”
Click on node no. 12
Click on Node no. 108
- 6 Click “OK”
- 7 Similarly define remaining lanes as per the table

Traffic Surface Lanes

Lane Name: Lane 1

Lane Width: 3 m

Wheel Spacing: 1.8 m

Offset Distance to Lane Center: 2.115 m

Moving Direction: Both

Selection by: 2 Points

Click on node no. 12

Click on Node no. 108

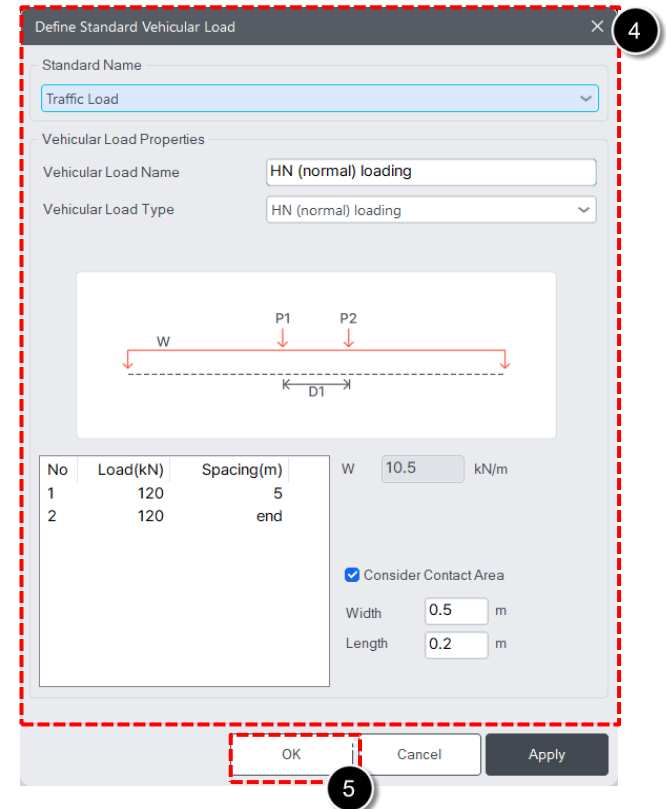
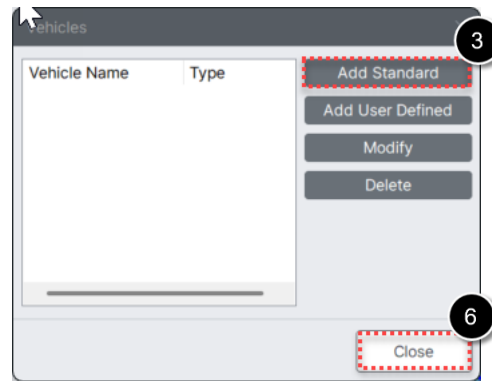
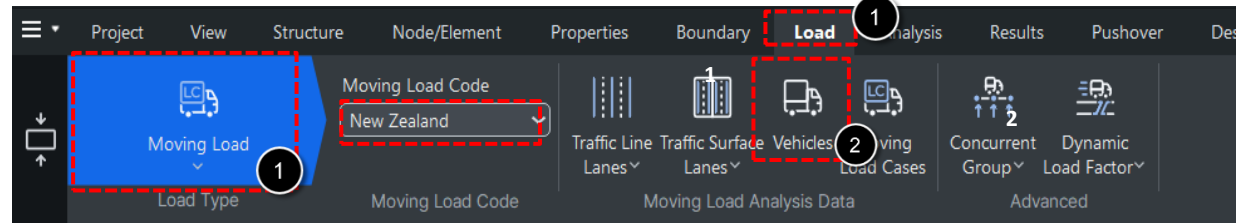
Click “OK”

Similarly define remaining lanes as per the table

Lane Name	Lane Width	Wheel Spacing	Offset Distance
Lane 1	3m	1.8m	2.115m
Lane 2	3m	1.8m	5.445m

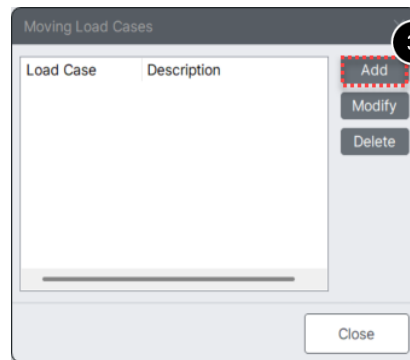
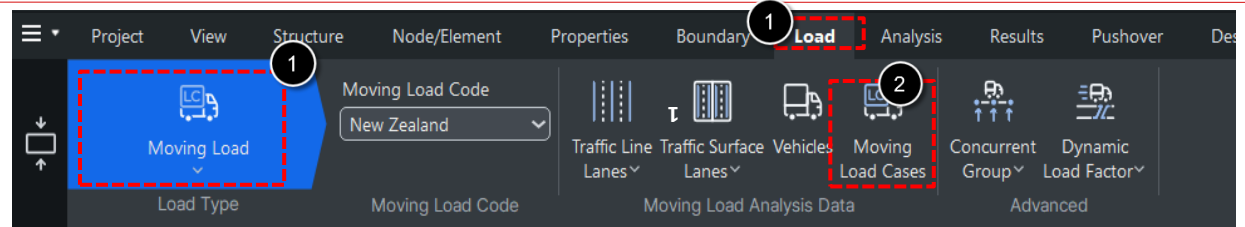
Define Vehicles

- 1 Go to “Load” > “Moving Load”
- 2 Click “Vehicles”
- 3 Click “Add Standard”
- 4 Select “Standard Name” > “Traffic Load”
 - Select Vehicular Load Type > “HN (Normal) loading”
 - Check on “Consider Contact Area”
- 5 Click “Apply”
- 6 Click “Close”



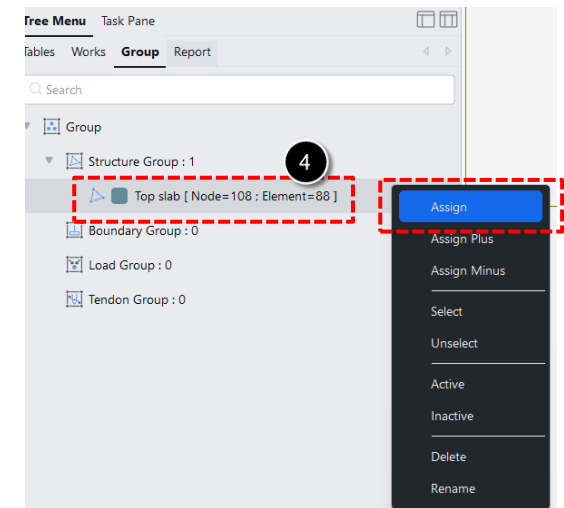
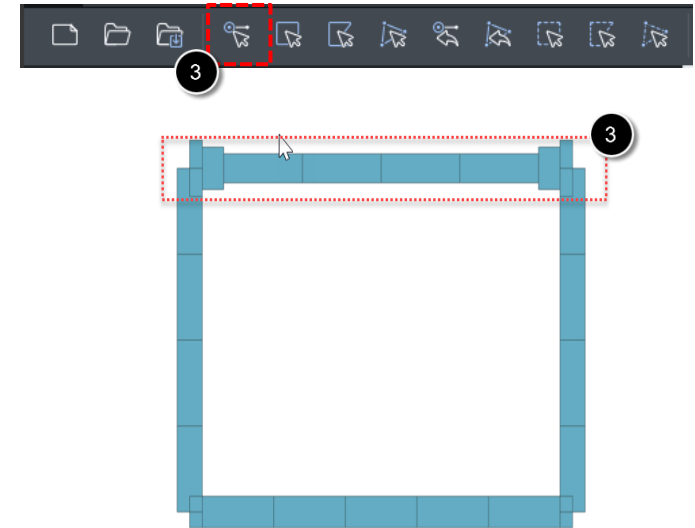
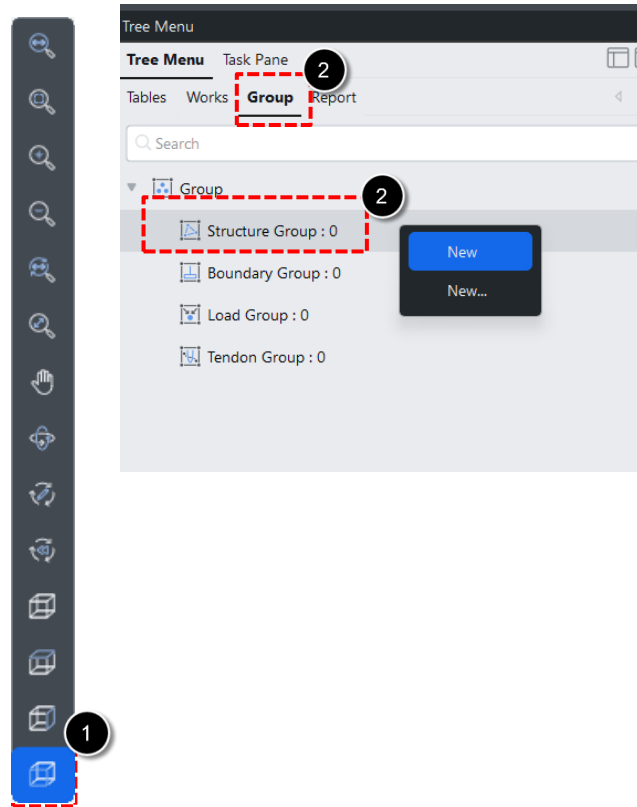
Moving Load Case

- 1 Go to “Load” > “Moving Load”
- 2 Click “Moving Load Cases”
- 3 Click “Add”
- 4 Enter Load Case Name “MLC 1”
- 5 Select: **New Bridge Design** (HN and HO)
- 6 Select: vehicle under **HN** loading
- 7 Move all lanes to **Selected Lanes** side
- 8 Click “OK”



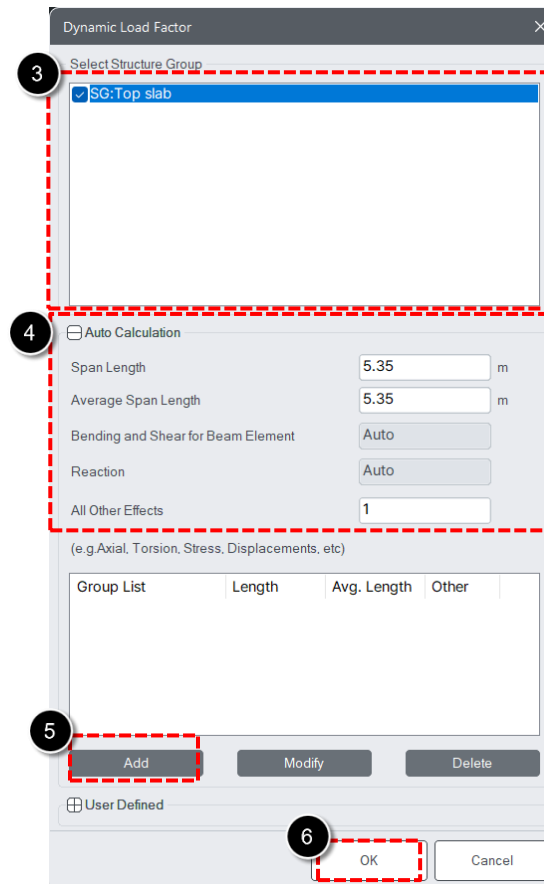
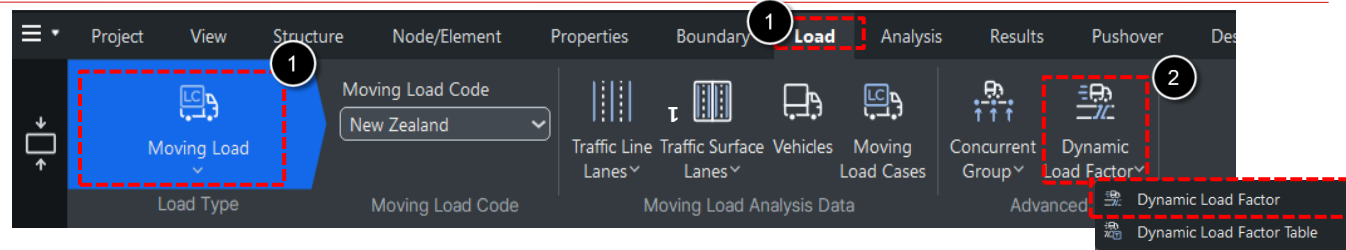
Structure group

- 1 To view the model in Front view
Click on as shown
- 2 Click: Group tab
 - Right click on Structure group
 - Click: New
 - Name: Top slab
- 3 Click on “**Select Single**” and Select the top portion as shown from left to right
- 4 Right click on “Top slab” in structure group and click assign



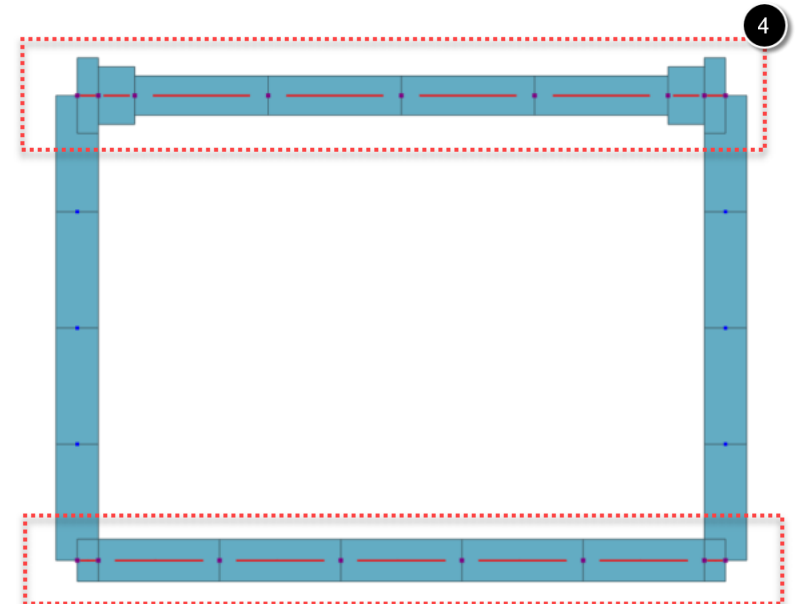
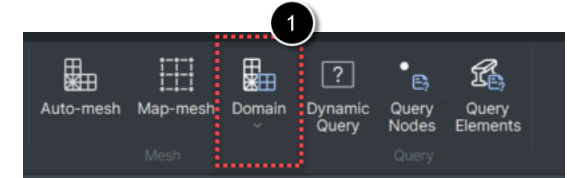
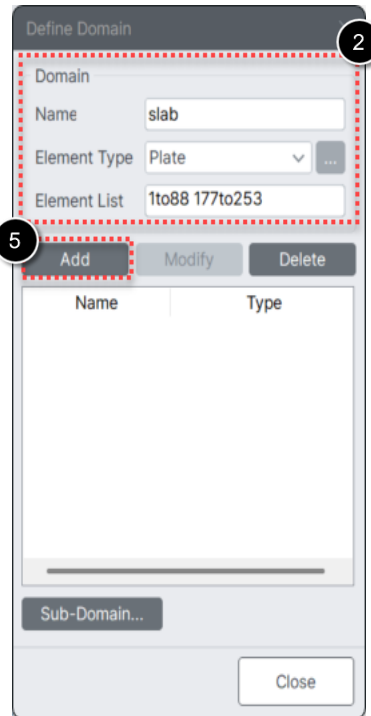
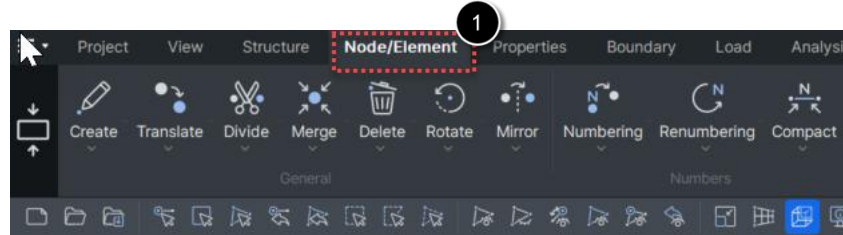
Dynamic Load Factor

- 1 Go to “Load” > “Moving Load”
- 2 Click “Dynamic Load Factor”
- 3 Check: SG: Top slab
- 4 Under Auto Calculation
 - Span Length : 5.35 m
 - Average Span Length : 5.35 m
- 5 Click “Add”
- 6 Click “OK”



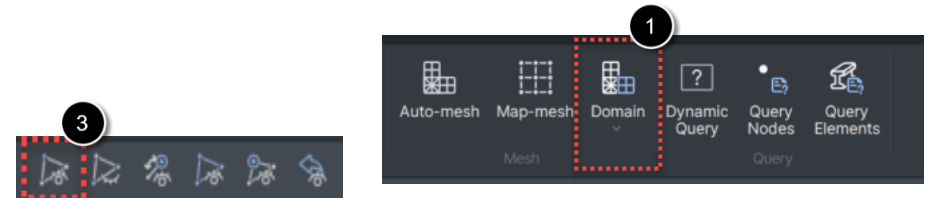
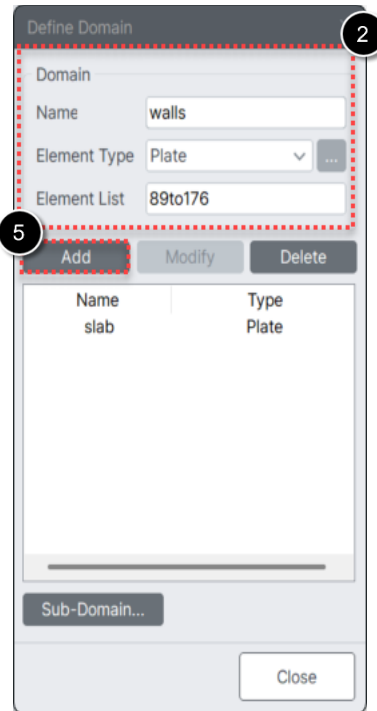
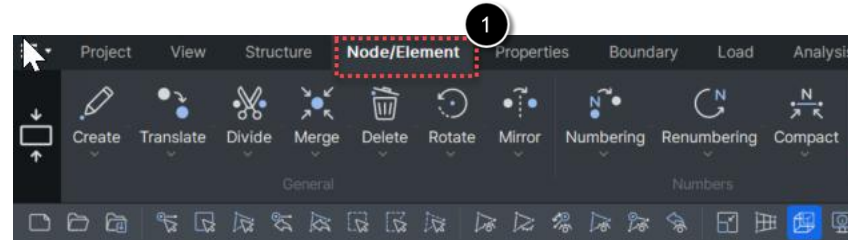
Domain for Slab

- 1 Go to Node/Elements > Define Domain
- 2 Domain Name > **Slabs**
- 3 Click on > Select Single
- 4 Select top and bottom slab Elements as in image
- 5 Click on > **Add**



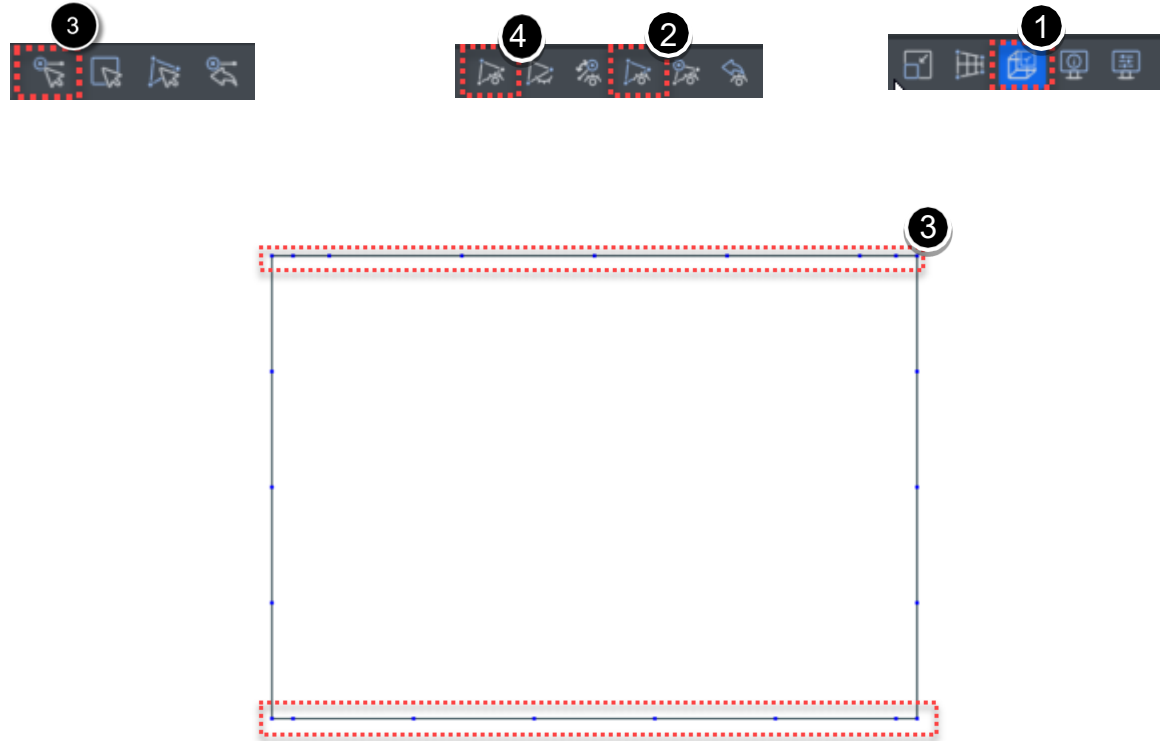
Domain for Walls

- 1 Go to Node/Elements > Define Domain
- 2 Domain Name > **walls**
- 3 Click on > Select Single
- 4 Select top and bottom slab Elements as in image
- 5 Click on > Add
Click on “Display  > Node > **Uncheck the node option** to display the nodes



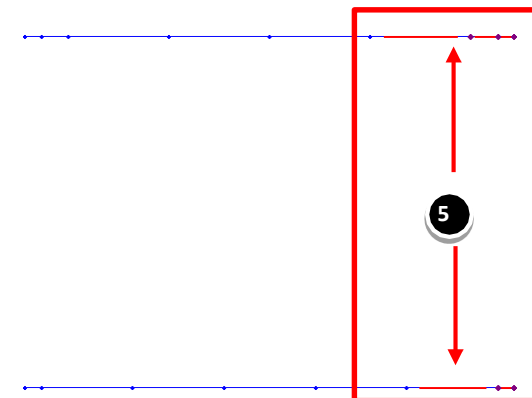
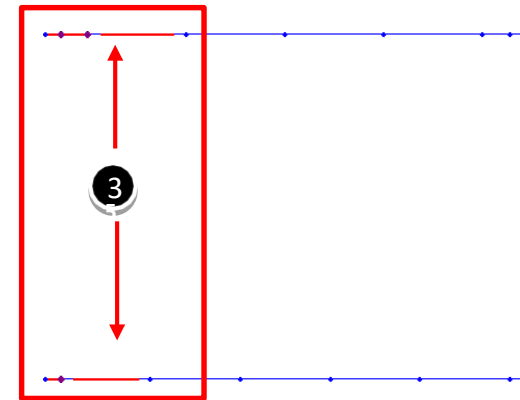
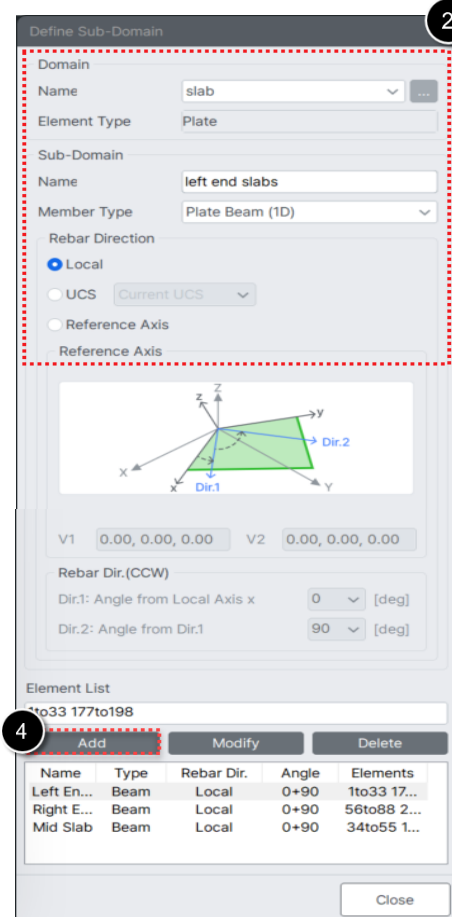
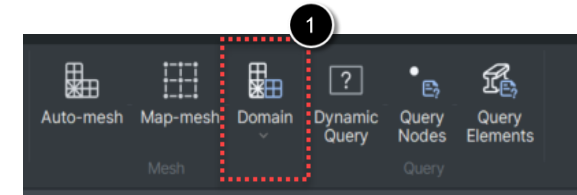
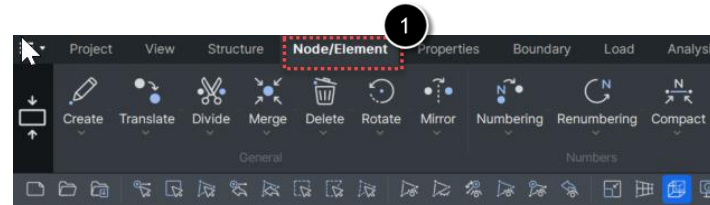
Activation of Slabs

- 1 Click on Hidden
- 2 Click on **Activate All**
- 3 Click on > **Select Single**
- 3 Select Side wall Elements as in image
- 4 click on activate



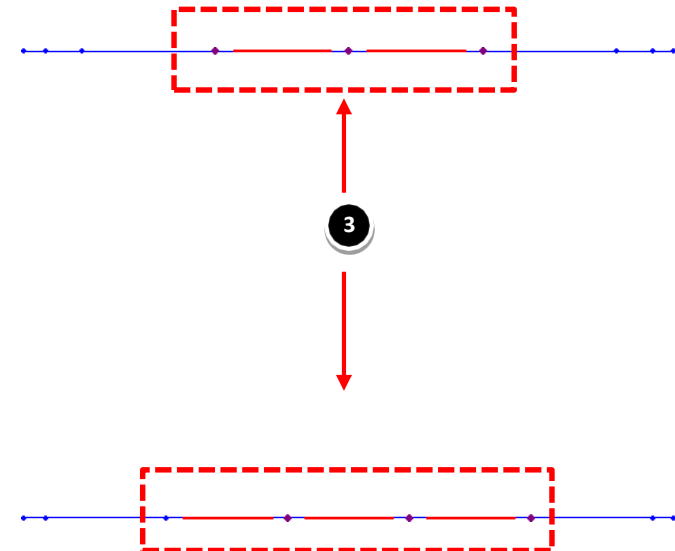
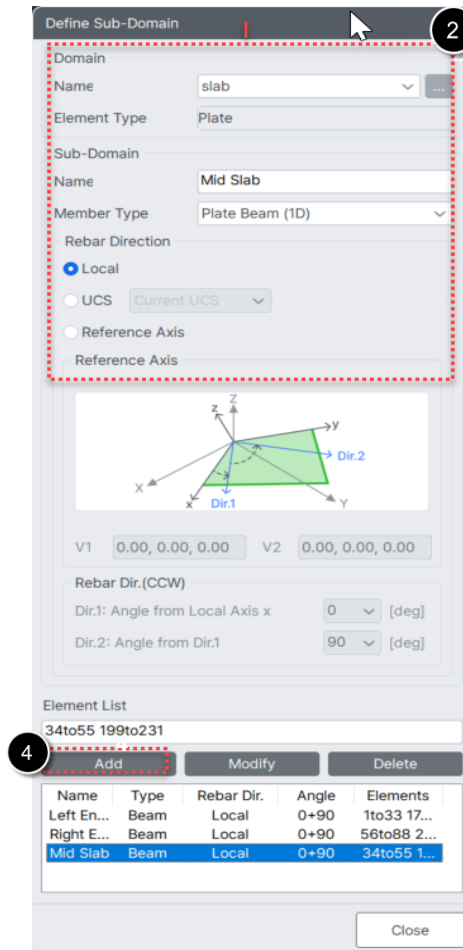
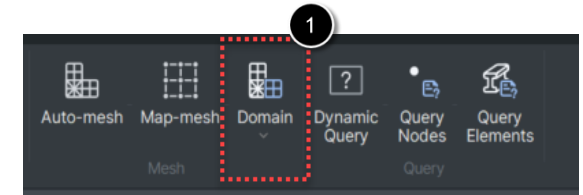
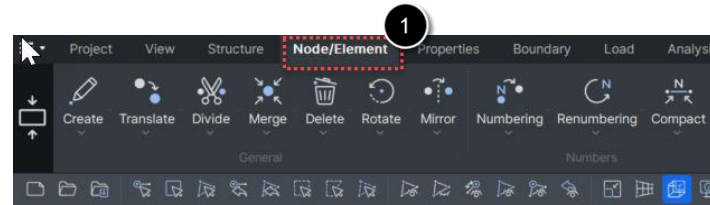
Sub-Domain for End slabs

- 1 Go to Node/Elements > Define Sub-Domain
- 2 Domain Name > **Slabs**
 Sub Domain Name > **Left End Slabs**
 Member Type > **Plate Beam (1D)**
 Rebar Direction > **Local**
- 3 Select Left end Elements as in image
- 4 Click on > **Add**
- 5 Repeat the **steps 1 to 5** to add **Right End Slabs**



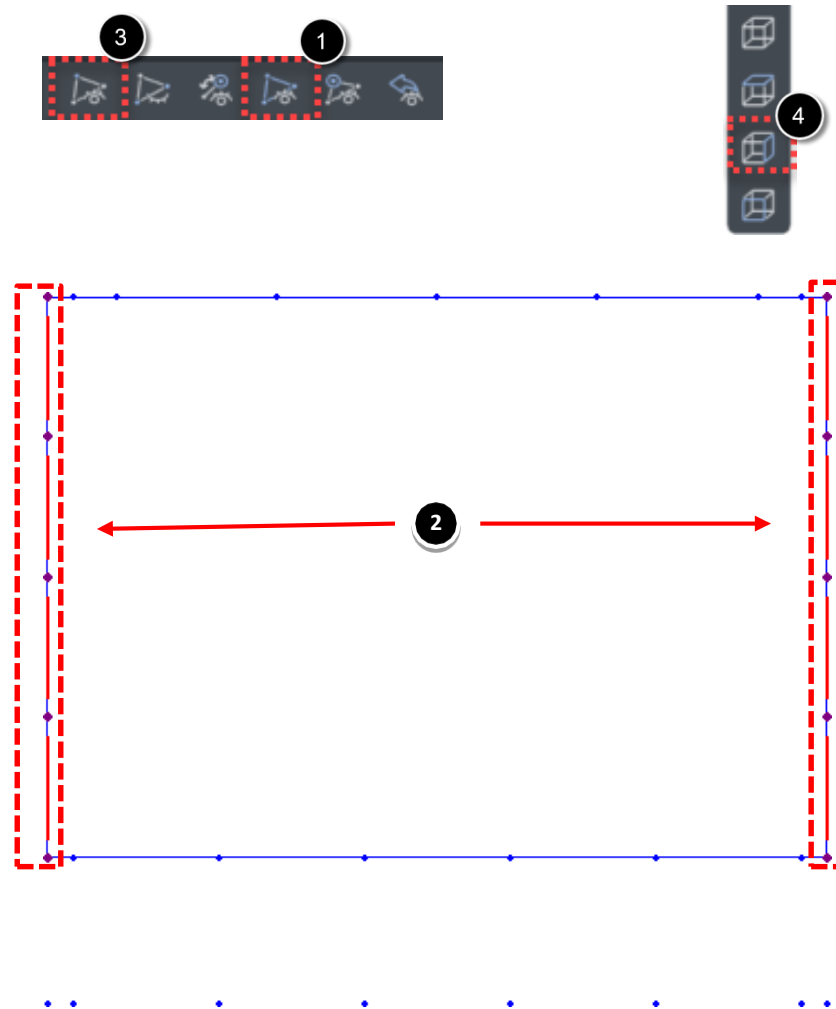
Sub-Domain for Mid slabs

- 1 Go to Node/Elements > Define Sub-Domain
- 2 Domain Name > **Slabs**
 Sub Domain Name > **Mid Slabs**
 Member Type > **Plate Beam (1D)**
 Rebar Direction > **Local**
- 3 Select top and bottom slab Elements as in image
- 4 Click on > **Add**



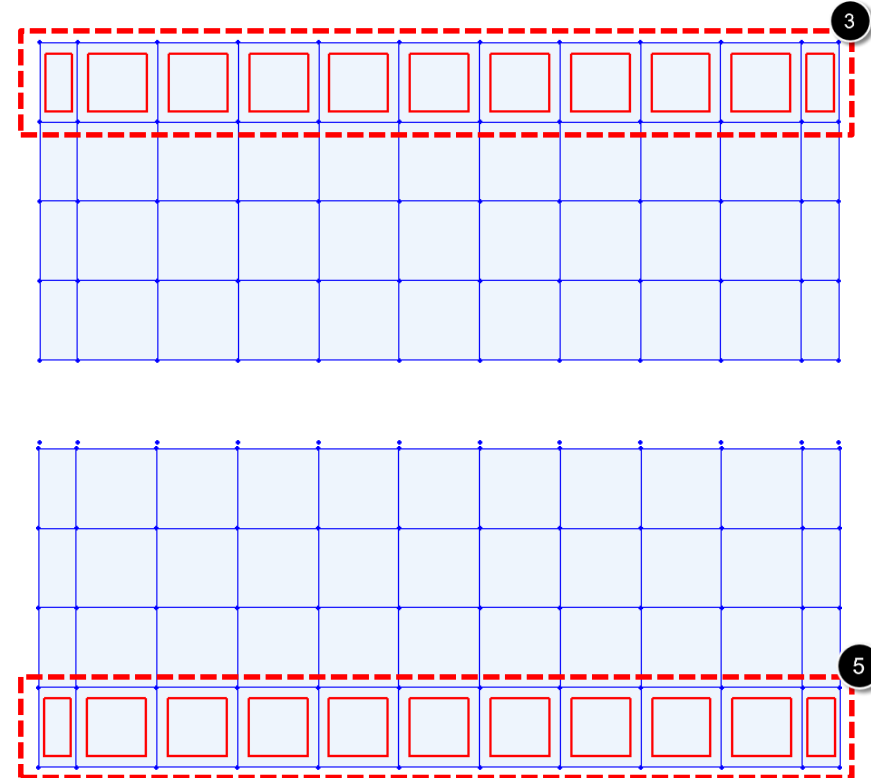
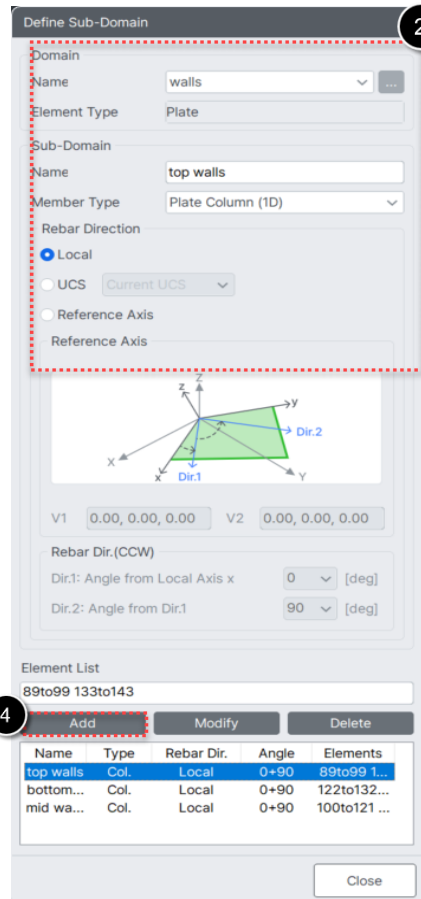
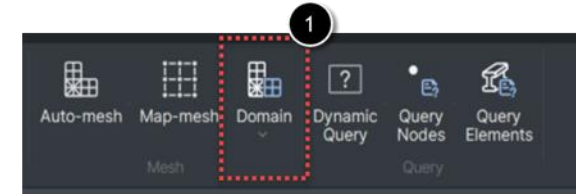
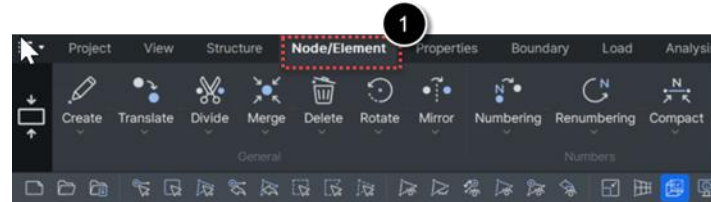
Activation of Walls

- 1 Click on **Activate All**
- 2 Select Side wall Elements
as in image
- 3 Click on **Activate**
- 4 Go to Side View



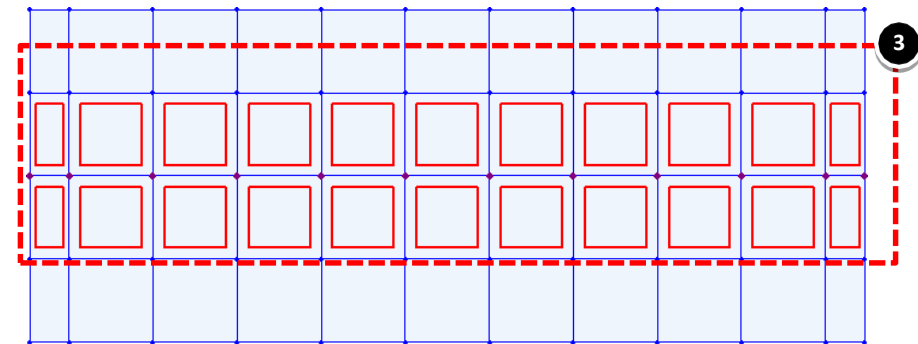
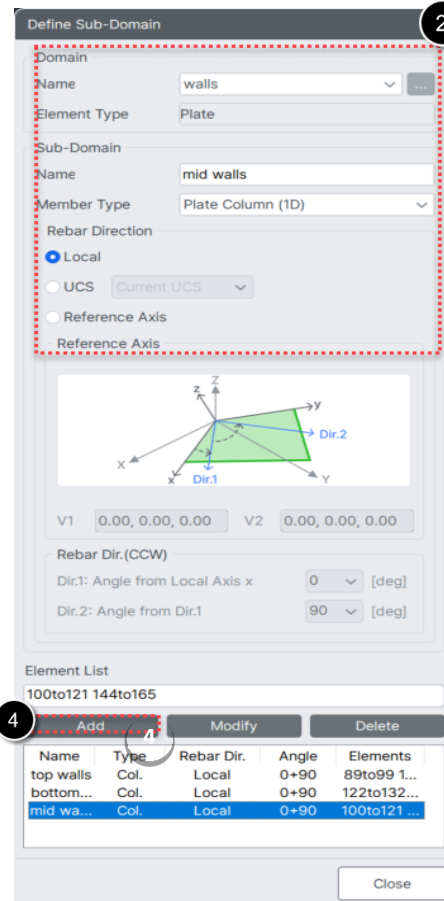
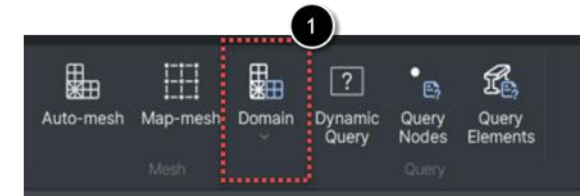
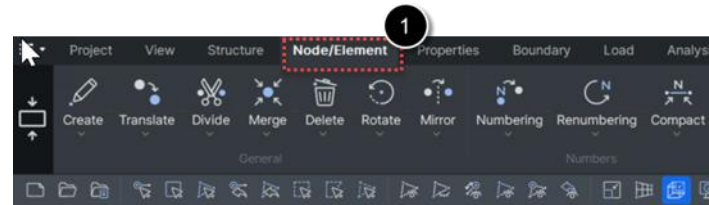
Sub-Domain for Top & Bottom walls

- 1 Go to Node/Elements > Define Sub-Domain
- 2 Domain Name > **walls**
 Sub Domain Name > **Top walls**
 Member Type > **Plate Column (1D)**
 Rebar Direction > **Local**
- 3 Select top wall Elements as in image
- 4 Click on > **Add**
- 5 Repeat Steps 4 to 6 to add **Bottom Walls**



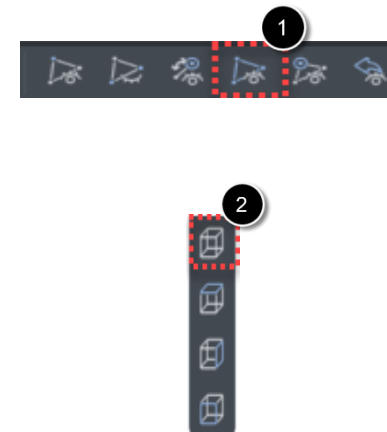
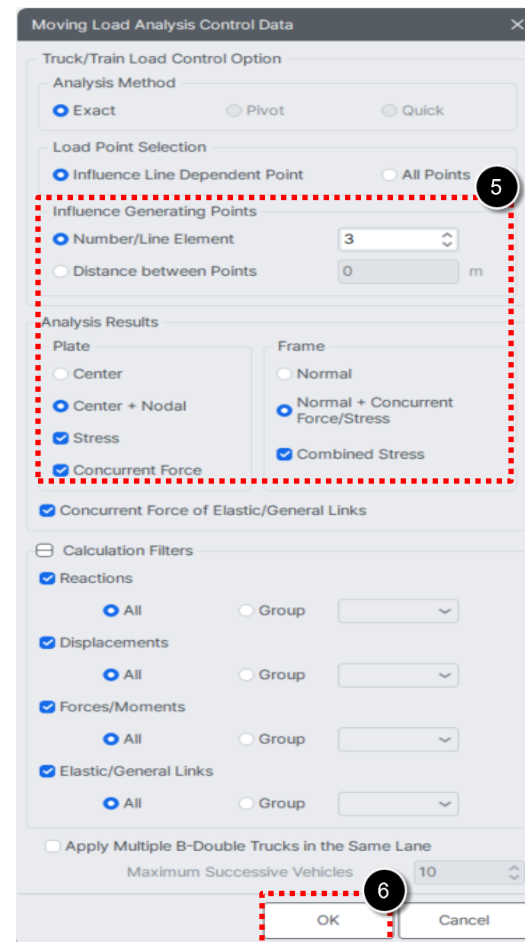
Sub-Domain for Mid walls

- 1 Go to Node/Elements > Define Sub-Domain
- 2 Domain Name > **walls**
 Sub Domain Name > **Mid walls**
 Member Type > **Plate Column (1D)**
 Rebar Direction > **Local**
- 3 Select Mid wall Elements as in image
- 4 Click on > **Add**



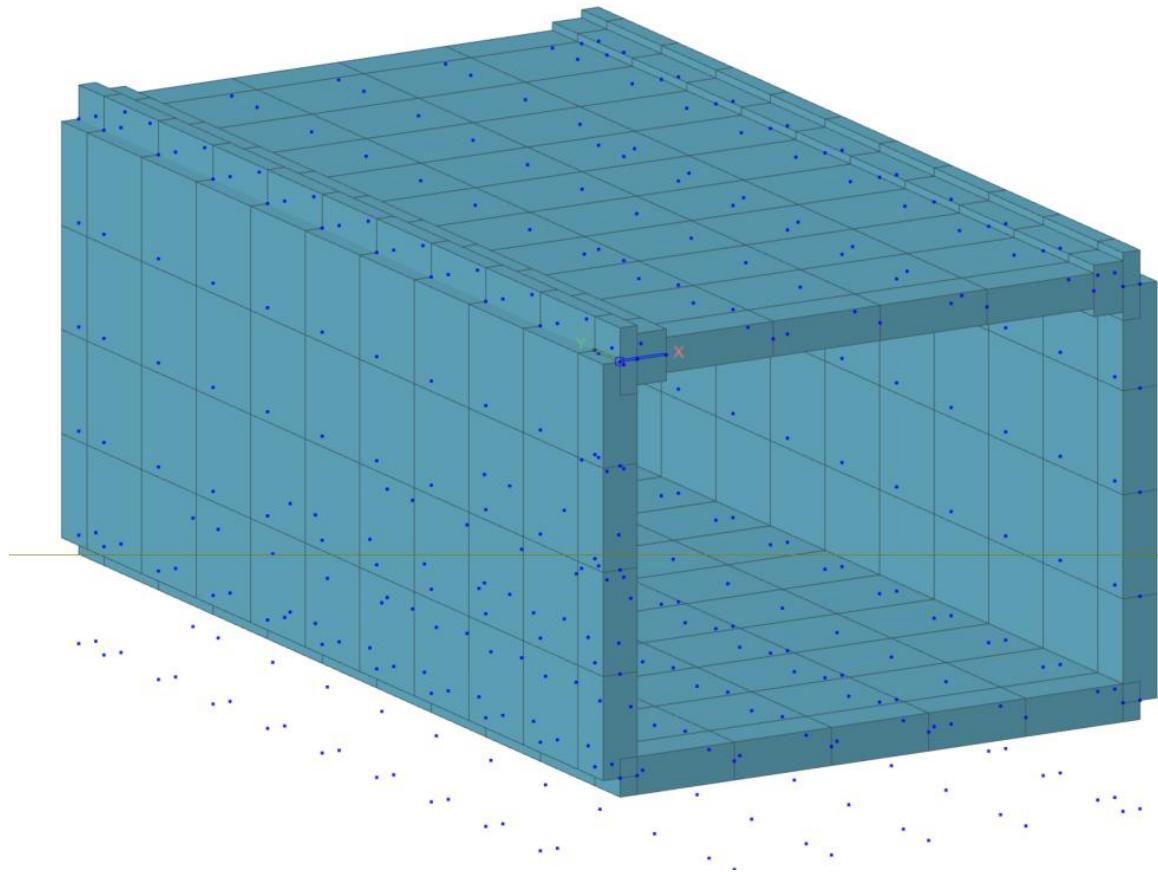
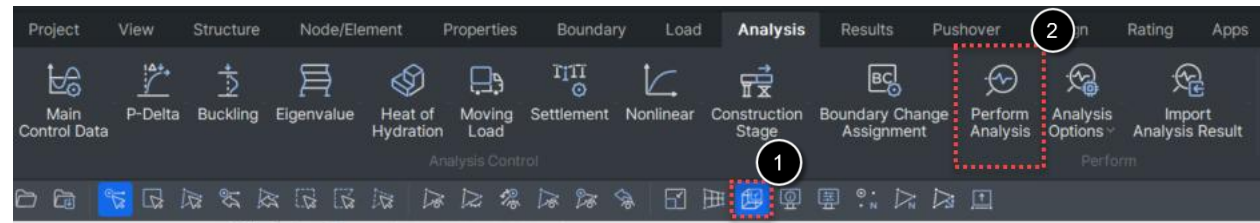
Moving Load Analysis Control

- 1 Click on > “Activate All”
- 2 Go to Iso View
- 3 Go to “Analysis” tab
- 4 Click “Moving Load”
- 5 In moving Load Analysis Control Data Window:
 - Enter Number/Line Elements > 3
 - Under Analysis Results > Plate
 - Select “Center + Nodal” and
 - Check **Stress and concurrent force**
- 6 Click “OK”



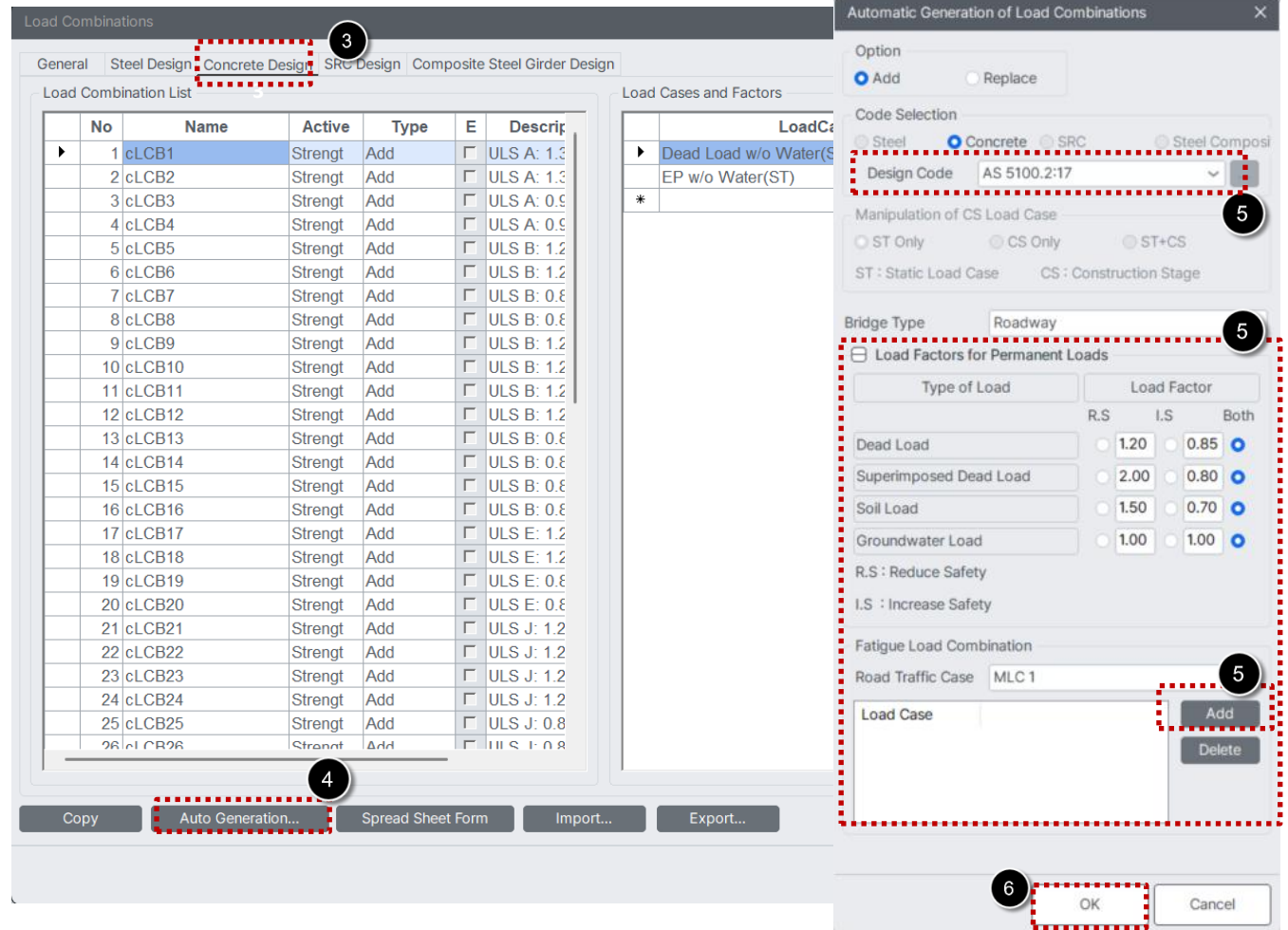
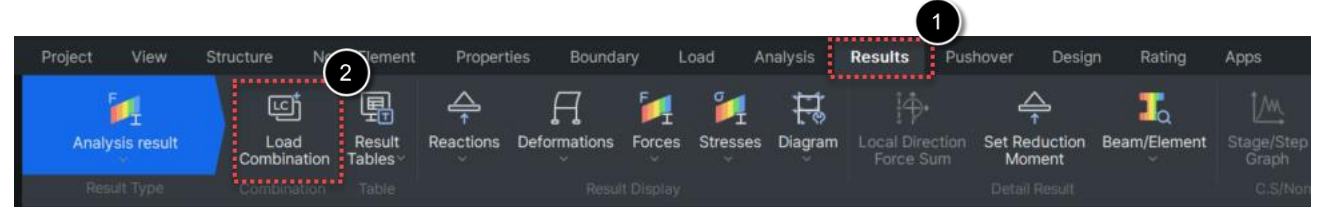
Perform Analysis

- 1 Click on > Hidden
- 2 Click “Perform Analysis” to Run Analysis



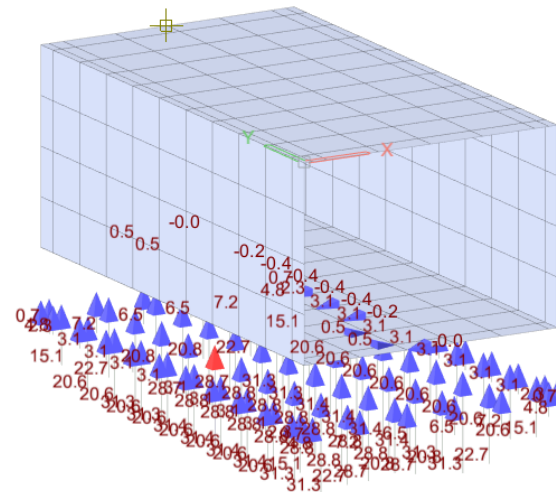
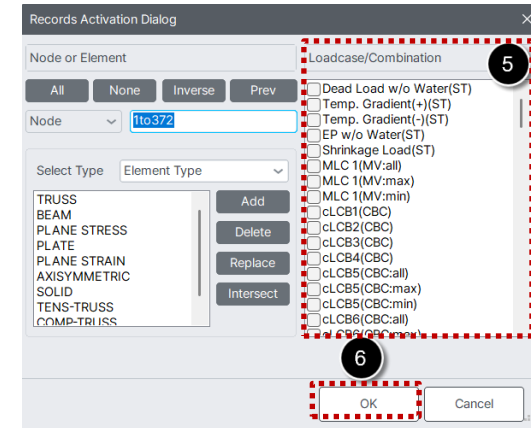
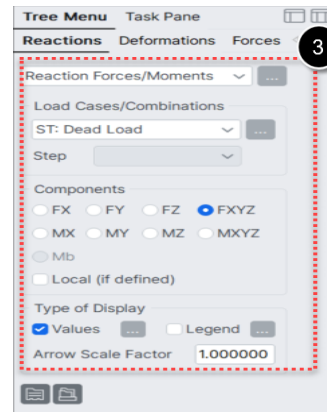
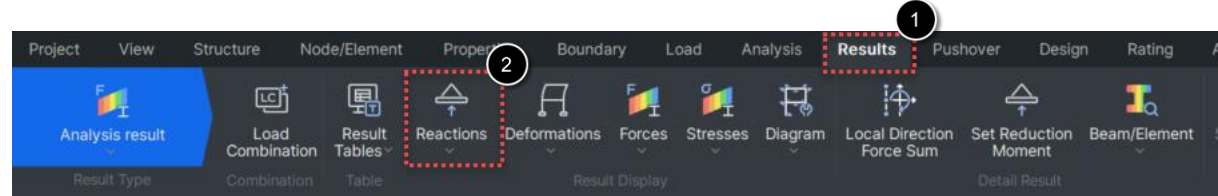
Auto Generation of LCB

- 1 Go to “Results” tab
- 2 Click “Load Combinations”
- 3 Go to > Concrete Design
- 4 Click on > Auto Generation
- 5 Select code > AS5100.2:17 & add
- 6 Click “OK”



Reaction

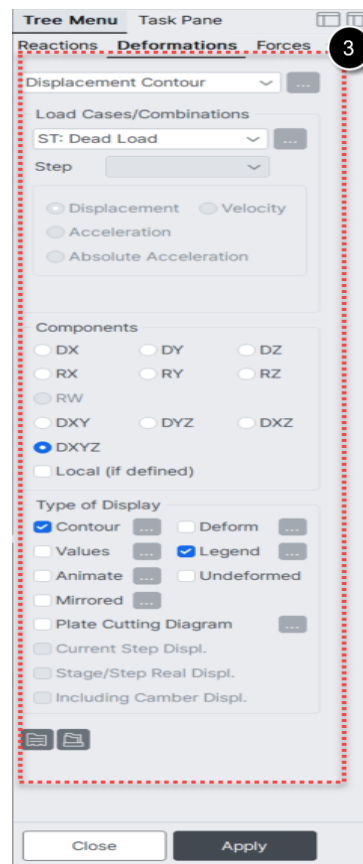
- 1 Go to “Results” tab
- 2 Click “Reactions” > “Reaction Forces/Moments”
- 3 Select “Load Cases/Combinations” > ST:Dead Load
 Select “Components” > Fxyz
 Select “Type of Display” > “Values”
 Click “Apply”
- 4 To View results in Tabular format,
 Go to “Result” > “Results Tables”>
- 5 “Reactions”
 Select “Load Cases/Combination”
- 6 Click “OK”
 Check the values in new window
 “Result-[Reaction]”



Node	Load	FX (kN)	FY (kN)	FZ (kN)	MX (kN-m)	MY (kN-m)	MZ (kN-m)
349	c.LCB54(a)	0.000000	0.000000	4.867900	0.000000	0.000000	0.000000
350	c.LCB54(a)	0.000000	0.000000	15.860201	0.000000	0.000000	0.000000
351	c.LCB54(a)	0.000000	0.000000	23.112861	0.000000	0.000000	0.000000
352	c.LCB54(a)	0.000000	0.000000	25.069441	0.000000	0.000000	0.000000
353	c.LCB54(a)	0.000000	0.000000	27.251830	0.000000	0.000000	0.000000
354	c.LCB54(a)	0.000000	0.000000	29.437250	0.000000	0.000000	0.000000
355	c.LCB54(a)	0.000000	0.000000	32.026066	0.000000	0.000000	0.000000
356	c.LCB54(a)	0.000000	0.000000	35.038539	0.000000	0.000000	0.000000
357	c.LCB54(a)	0.000000	0.000000	38.092590	0.000000	0.000000	0.000000
358	c.LCB54(a)	0.000000	0.000000	41.148086	0.000000	0.000000	0.000000
359	c.LCB54(a)	0.000000	0.000000	44.204188	0.000000	0.000000	0.000000
360	c.LCB54(a)	0.000000	0.000000	47.260890	0.000000	0.000000	0.000000
361	c.LCB54(a)	0.000000	0.000000	50.318192	0.000000	0.000000	0.000000
362	c.LCB54(a)	0.000000	0.000000	53.376094	0.000000	0.000000	0.000000
363	c.LCB54(a)	0.000000	0.000000	56.434596	0.000000	0.000000	0.000000
364	c.LCB54(a)	0.000000	0.000000	59.493698	0.000000	0.000000	0.000000
365	c.LCB54(a)	0.000000	0.000000	62.553300	0.000000	0.000000	0.000000
366	c.LCB54(a)	0.000000	0.000000	65.613402	0.000000	0.000000	0.000000
367	c.LCB54(a)	0.000000	0.000000	68.674004	0.000000	0.000000	0.000000
368	c.LCB54(a)	0.000000	0.000000	71.735106	0.000000	0.000000	0.000000
369	c.LCB54(a)	0.000000	0.000000	74.796708	0.000000	0.000000	0.000000
370	c.LCB54(a)	0.000000	0.000000	77.858810	0.000000	0.000000	0.000000
371	c.LCB54(a)	0.000000	0.000000	80.921412	0.000000	0.000000	0.000000
372	c.LCB54(a)	0.000000	0.000000	83.984514	0.000000	0.000000	0.000000
SUMMATION OF REACTION FORCES PRINTOUT							
Load	FX (kN)	FY (kN)	FZ (kN)				
Dead Loa	0.000000	0.000000	1661.906551				

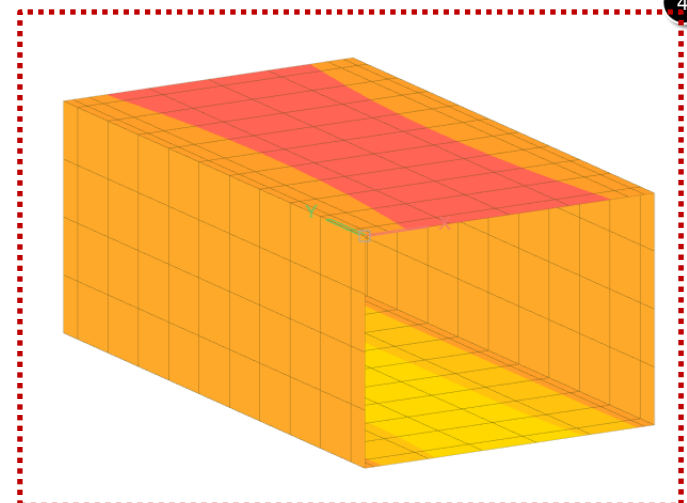
Displacement Contour

- 1 Go to “Results” tab
- 2 Click “Deformations” > “Displacement Contour”
- 3 Select “Load Cases/Combinations” > ST:Dead Load
 - Select “Components”
 - Click Type of Display > “Contour”
 - and “Legend”
 - Click “Apply”
- 4 See the Contour diagram in the “Model View” window



MIDAS CIVIL NX	
POST-PROCESSOR	
DISPLACEMENT	
RESULTANT	
	5.67579e-03
	5.15981e-03
	4.64383e-03
	4.12785e-03
	3.61187e-03
	3.09588e-03
	2.57990e-03
	2.06392e-03
	1.54794e-03
	1.03196e-03
	5.15981e-04
	0.00000e+00

ST: DEAD LOAD ~	
MAX :	60
MIN :	277
FILE: BOX CULVE-	
UNIT: m	
DATE: 01/08/2026	
VIEW-DIRECTION	
X:-0.483	
Y:-0.837	
Z: 0.259	



Note: By Invoking “ ” the tables of any component of result and load cases can be checked.

Plate Forces/Moments

- 1 Go to “Results” tab
- 2 Click “Forces” > “Plate Forces/Moments”
- 3 Select “Load Cases/Combinations” > ST:Dead Load
 - Select “Components”
 - Click Type of Display > “Cutting Diagram”
- 4 Click on “Top View”
- 5 Select desired portion using “Select Single”
- 6 Click on “Activate”
- Click on > Display Node Numbers
- 7 Click on “Iso view”

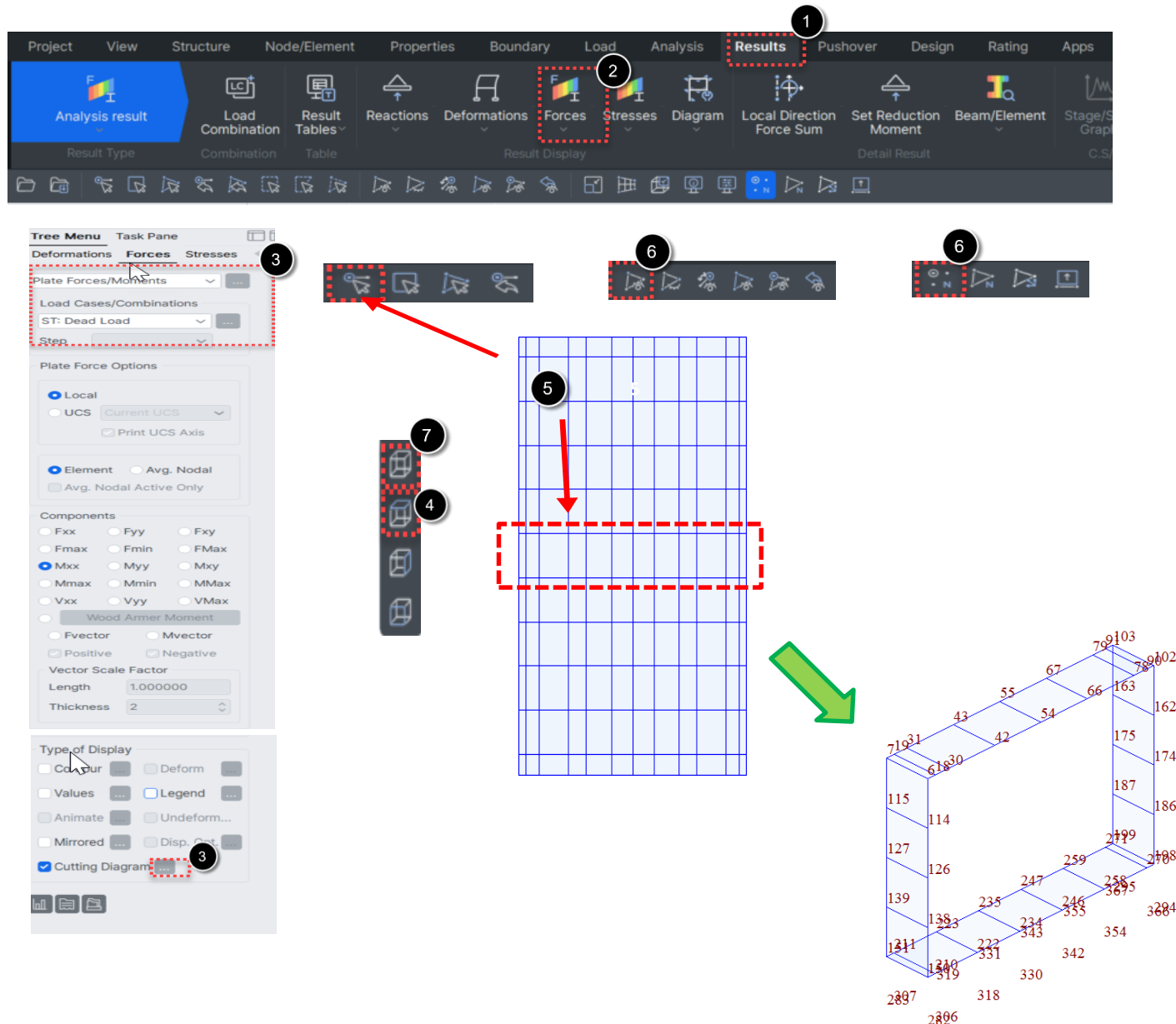


Plate Cutting Diagram

- 1 Click on  and go to **Cutting Diagram** Tab

Enter Name: **Top**

Click in **Pnt1** text box
Click node **6** then **102** in model
Click on **Add**

Enter Name: **Right**

Click in **Pnt1**: text box
Click node **102** then **198** in model
Click on **Add**

Enter Name: **Bottom**

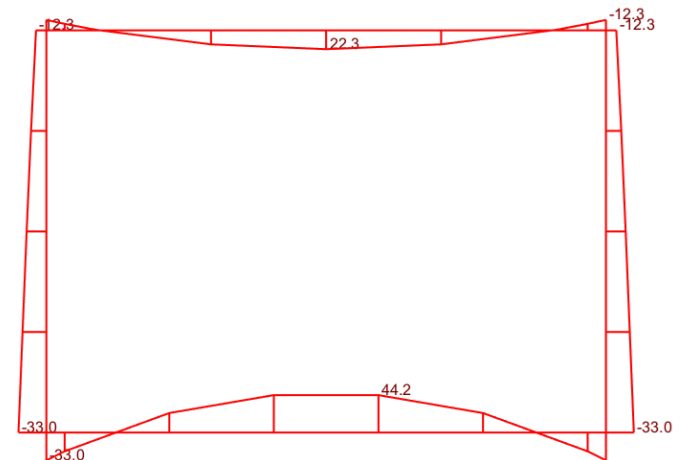
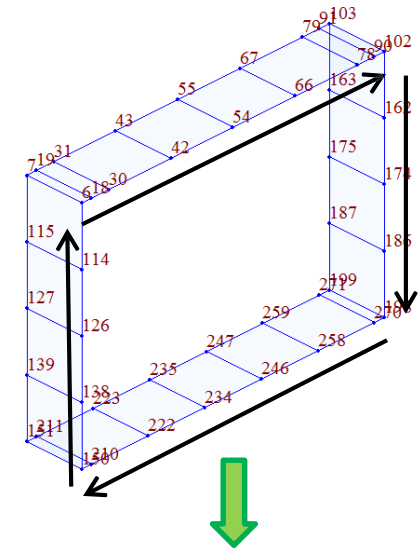
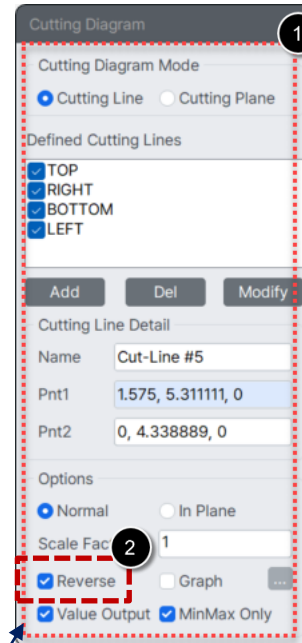
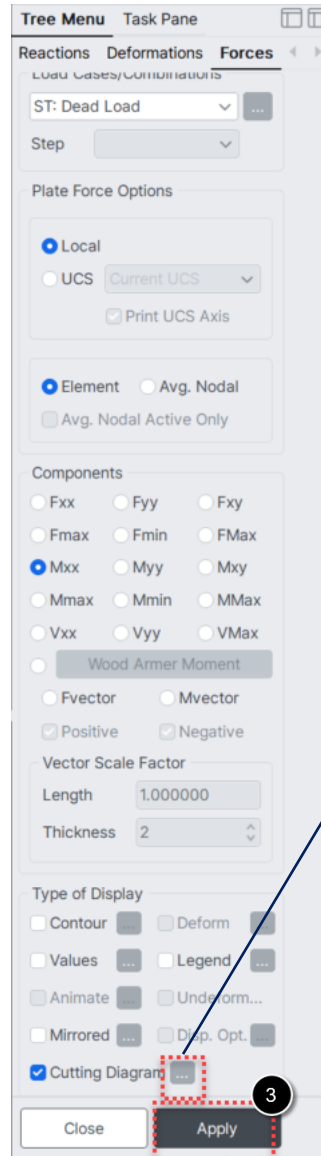
Click in **Pnt1**: text box
Click node **198** then **150** model
Click on **Add**

Enter Name: **Left**

Click in **Pnt1**: text box
Click node **150** then **6** in model
Click on **Add**

- 2 Click > **“Reverse”**
- 3 Click > **“Apply”**
- 4 Click on **“Front View”**

See the cutting diagram in the **“Model View”** window



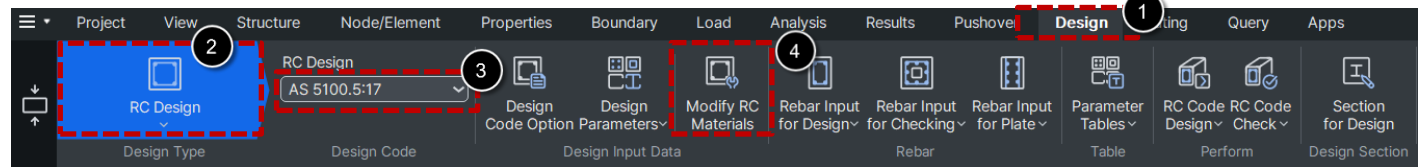
Moving Load Tracer

- 1 Click on “Activate All”
- 2 Click on “Iso view”
- 3 Click on > “Display node numbers”
- 4 Go to “Results” tab
- 5 Click “Moving Load Tracer” > “Plate Forces/Moments...”
- 6 Go to Tree Menu
 - Select Moving load case > “MVmax : Mvmax:MLC 1”
 - Select Key Element > “82”
 - Select Part > “i”
 - Select Component > “Myy”
 - Click > “Apply”
 - See in “Model View” window the Vehicle position

The screenshot displays the software interface for the Results tab. The 'Results' tab is highlighted with a red dashed box and a circled 4. The 'Tree Menu' panel is also highlighted with a red dashed box and a circled 6. The 'Tree Menu' panel shows the 'MVL Tracer' tab selected, with 'Plate Forces/Moments' chosen. The 'Moving Load Cases' dropdown is set to 'MVmax: MLC 1', and the 'Key Element' is set to '82'. The 'Parts' section has 'i' selected, and the 'Components' section has 'Myy' selected. The 'Type of Display' section has 'Contour' and 'Applied Loads' checked. The 'Maximum Value' field is empty. The 'Write Min/Max Load to File' and 'Detail result' buttons are visible. The 'Close' and 'Apply' buttons are at the bottom. To the right of the Tree Menu panel, there are three small icons: a cube (circled 2), a cube with a red dashed box (circled 1), and a cube with a red dashed box (circled 3). Below these icons is a 3D plot of the bridge deck showing the vehicle position and the resulting stresses. The plot is a rectangular grid with a color scale from 0.00 to 60.00. The vehicle is shown as a red rectangle on the grid. The plot is labeled with 'X' and 'Y' axes.

Modify Concrete Material

- 1 Go to “Design” tab
- 2 Click “RC Design”
- 3 Select “AS 5100.5:17”
- 4 Select “Modify Concrete Material”
- 5 Click on Material Name “C40”
 - Under Concrete Material Selection
 - Select Code: **AS17(RC)**
 - Select Grade: **C40**
 - Under Rebar Selection
 - Select Code: **AS17(RC)**
 - Select Grade of Main Rebar: **D500E**
 - Select Grade of Sub-Rebar: **D500E**
- 6 Click **Modify & Close**



The 'Modify Concrete Materials' dialog box is shown. It contains a 'Material List' table with one row selected (ID 1, Name C40, fc/fck/R 40000, Chk X, λ 1, Main-bar D500E, Sub-bar D500E), highlighted with a red dashed box and a circled '5'. Below the table are sections for 'Concrete Material Selection' and 'Rebar Selection'. In the 'Concrete Material Selection' section, 'Code' is set to 'AS17(RC)' and 'Grade' is set to 'C40'. In the 'Rebar Selection' section, 'Code' is set to 'AS17(RC)', 'Grade of Main Rebar' is set to 'D500E', and 'Grade of Sub-Rebar' is set to 'D500E'. At the bottom right, the 'Modify' button is highlighted with a red dashed box and a circled '6'.

ID	Name	fc/fck/R	Chk	λ	Main-bar	Sub-bar
1	C40	40000	X	1	D500E	D500E

Concrete Material Selection

Code: AS17(RC) Grade: C40

Specified Compressive Strength (fc/fck): 40000 kN/m²

☐ Light Weight Concrete Factor (Lambda): 1

Rebar Selection

Code: AS17(RC)

Grade of Main Rebar: D500E Fy: 500000 kN/m²

Grade of Sub-Rebar: D500E Fys: 500000 kN/m²

Close Modify

Plate Beam Data for Design

- 1 Go to “Design” tab
 - 2 Select “RC Design”
 - 3 Select “AS 5100:5:17”
 - 4 Select “Rebar Input for Plate” > “Plate Beam Data for Design”
 - 5 Sub Domain Name > **Left End Plates**
 Plate Force Option > **Element**
 Main Rebar Direction > **Dir. 1**
 Dt > **0.045 m**
 Db > **0.045 m**
 Click on > **Add**
 - 6 Click on > **Close**
 - 7 Repeat **Step 5** to add Right End and Mid Slabs
- Slabs

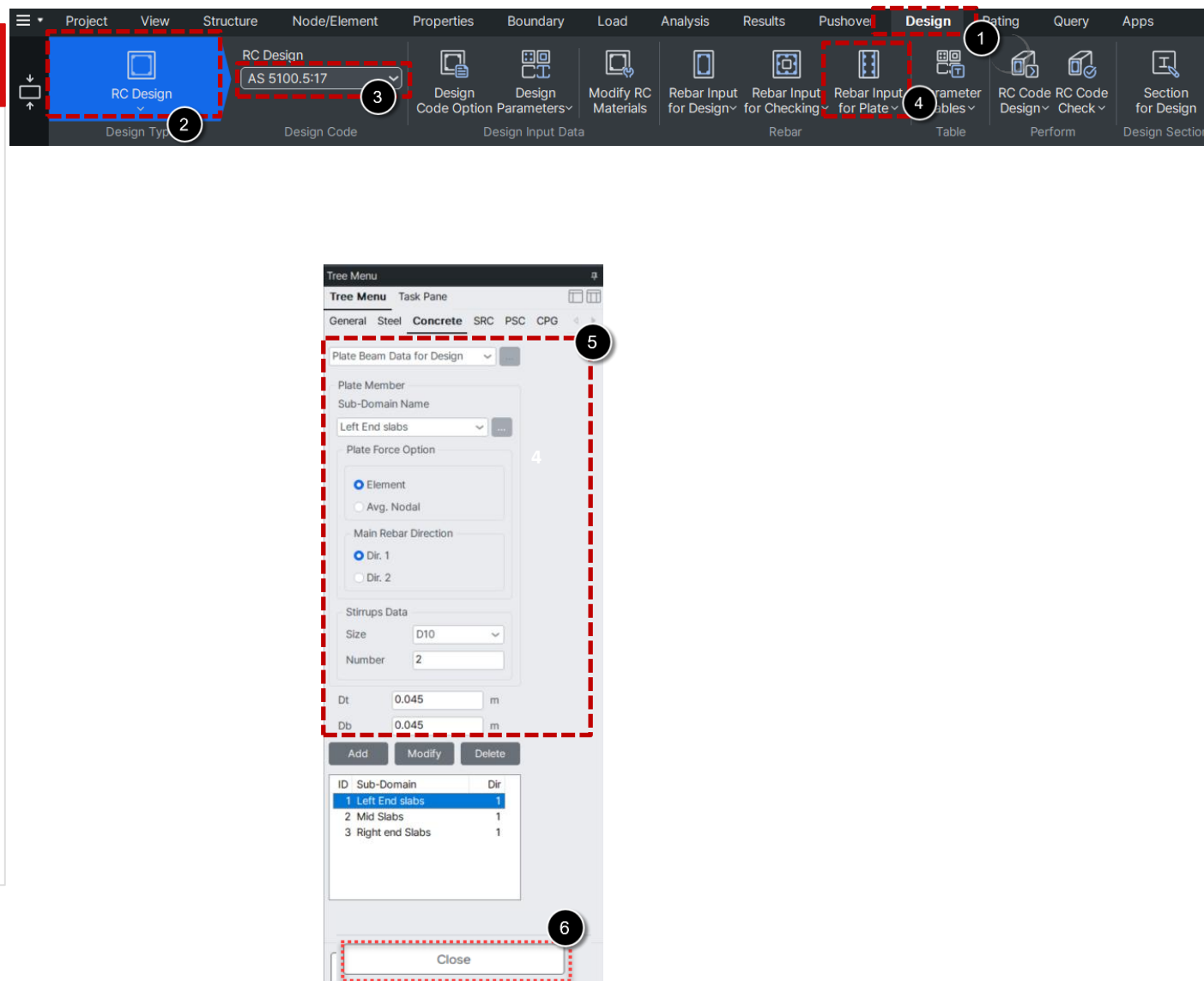


Plate Beam Design

- 1 RC Code Design > Plate Beam Design
- 2 Select Left End slabs sub-Domain
- 3 Click on > **Graphic**

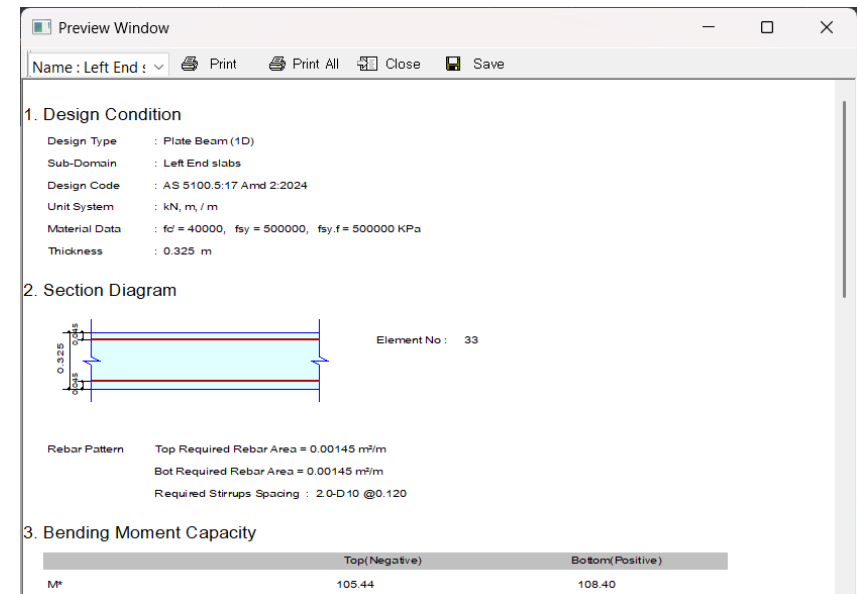
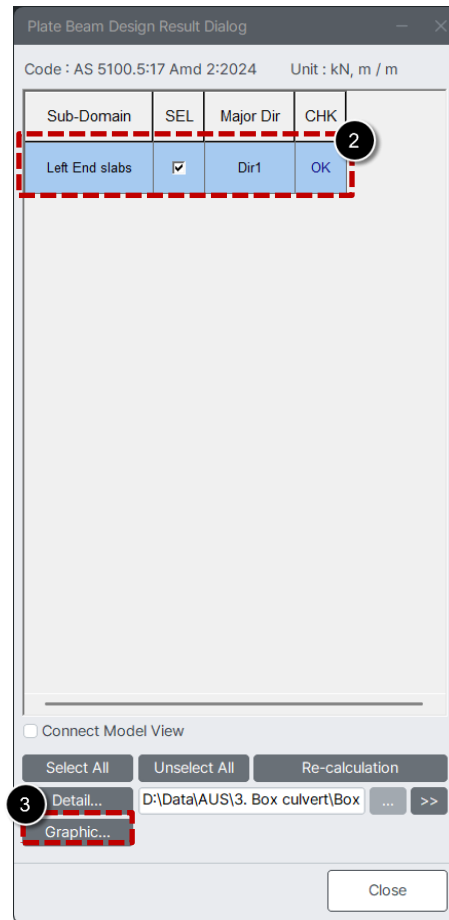
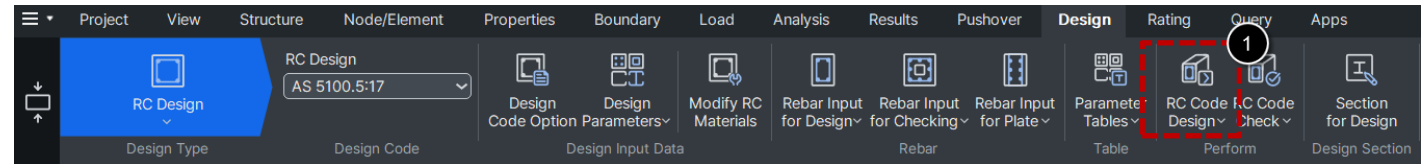
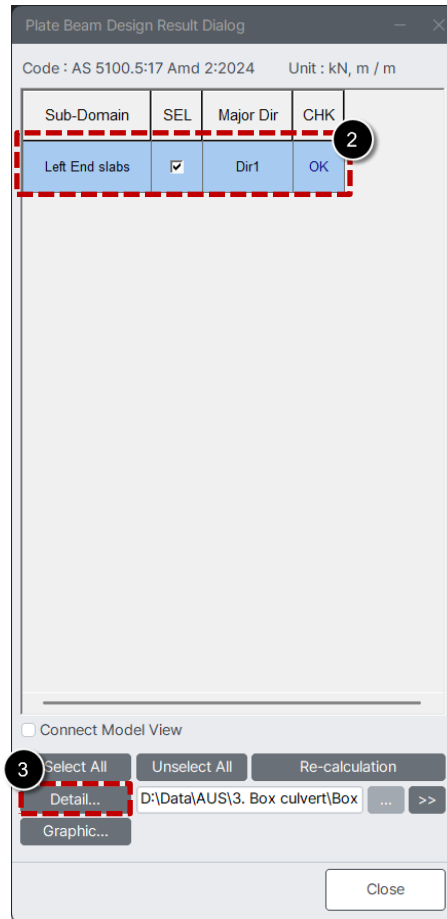
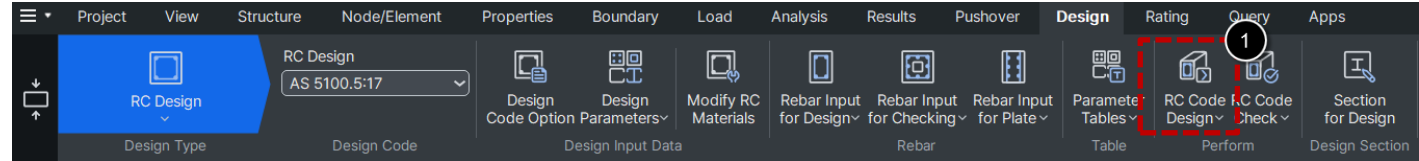


Plate Beam Design

- 1 RC Code Design > Plate Beam Design
- 2 Select Left End slabs sub-Domain
- 3 Click on > Detail



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MEMBER NAME : Left End slabs

1. General Information

(1) Design Code : AS 5100.5:17 Amd 2:2024

(2) Code Unit : N, mm

2. Material

(1) Concrete

- f_c : 40.00MPa

- E_c : 32,800MPa

(2) Reinforcement

- f_y : 500MPa

- f_{yk} : 500MPa

- E_s : 200,000MPa

3. Design Data

(1) Aggregate size : 16.00mm

4. Reinforcement

Top	Bottom	Stirrup
2,314mm ²	2,314mm ²	4-512@200mm

5. Calculation Summary

(1) Bending Moment Strength (Positive)

Category	Value	Criteria	Ratio	Note
Moment strength (M _u /M _{u,lim} , %)	0.000	0.000	0.000	$f_y < 1.25 f_c$
Minimum required stirrup strength (M _{u,lim} , %)	0.000	0.000	0.000	

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Shrinkage and temperature effects (Top, mm²)

Value	Criteria	Ratio	Note
2,083	4,200	2.038	

Shrinkage and temperature effects (Bottom, mm²)

Value	Criteria	Ratio	Note
2,083	4,200	2.038	

Control for cracking (A_{s,lim}, mm²)

Value	Criteria	Ratio	Note
2,083	500	0.240	

Control for cracking (A_{s,lim}, mm²)

Value	Criteria	Ratio	Note
393	500	0.278	

Control for cracking (A_{s,lim}, mm²)

Value	Criteria	Ratio	Note
393	500	0.278	

(2) stress of reinforcement

Category	Value	Criteria	Ratio	Note
Maximum stress of reinforcement by diameter (MPa)	52.75	225	0.234	
Maximum stress of reinforcement by spacing (MPa)	52.75	272	0.194	

6. Calculate Compression Stress Block Factor

(1) Uniform compressive stress factor

Value	Criteria	Ratio	Note
0.850	0.850	0.850	

$\alpha_1 = 1.0 - 0.003 f_c$

(2) Uniform compressive stress depth factor

Value	Criteria	Ratio	Note
0.770	0.850	0.770	

$\gamma = 1.00 - 0.007 f_c$

7. Check Bending Moment Capacity (Negative)

(1) Load Combination

- cLCB10 (Element ID : 16, Node ID : 4)

Value	Criteria	Ratio	Note
-2083.0	-2083.0	-2083.0	

(2) Search for neutral axis depth (X_n, d)

Step	X _n (mm)	F ₁ (kN)	F ₂ (kN)	F ₃ (kN)	F ₄ (kN)
1	113	0.181	0.181	1.199	0.620
2	196	0.091	0.091	1.199	0.413
3	279.3	0.041	0.041	1.199	0.266
4	362.6	0.023	0.023	1.199	0.163
5	445.9	0.014	0.014	1.199	0.100
6	529.2	0.008	0.008	1.199	0.062
7	612.5	0.005	0.005	1.199	0.040
8	695.8	0.003	0.003	1.199	0.025
9	779.1	0.002	0.002	1.199	0.016
10	862.4	0.001	0.001	1.199	0.010
11	945.7	0.001	0.001	1.199	0.007

Plate Column Data for Design

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Select “AS 5100:5:17”
- 4 Select “Rebar Input for Plate” > “Plate Column Data for Design”
- 5 Sub Domain Name > **Top walls**
 Plate Force Option > **Element**
 Main Rebar Direction > **Dir. 1**
 Dt > **0.045 m**
 Db > **0.045 m**
 Click on > **Add**
- 6 Click on > **Close**
- 7 Repeat **Step 5** to add Right End and Mid Slabs

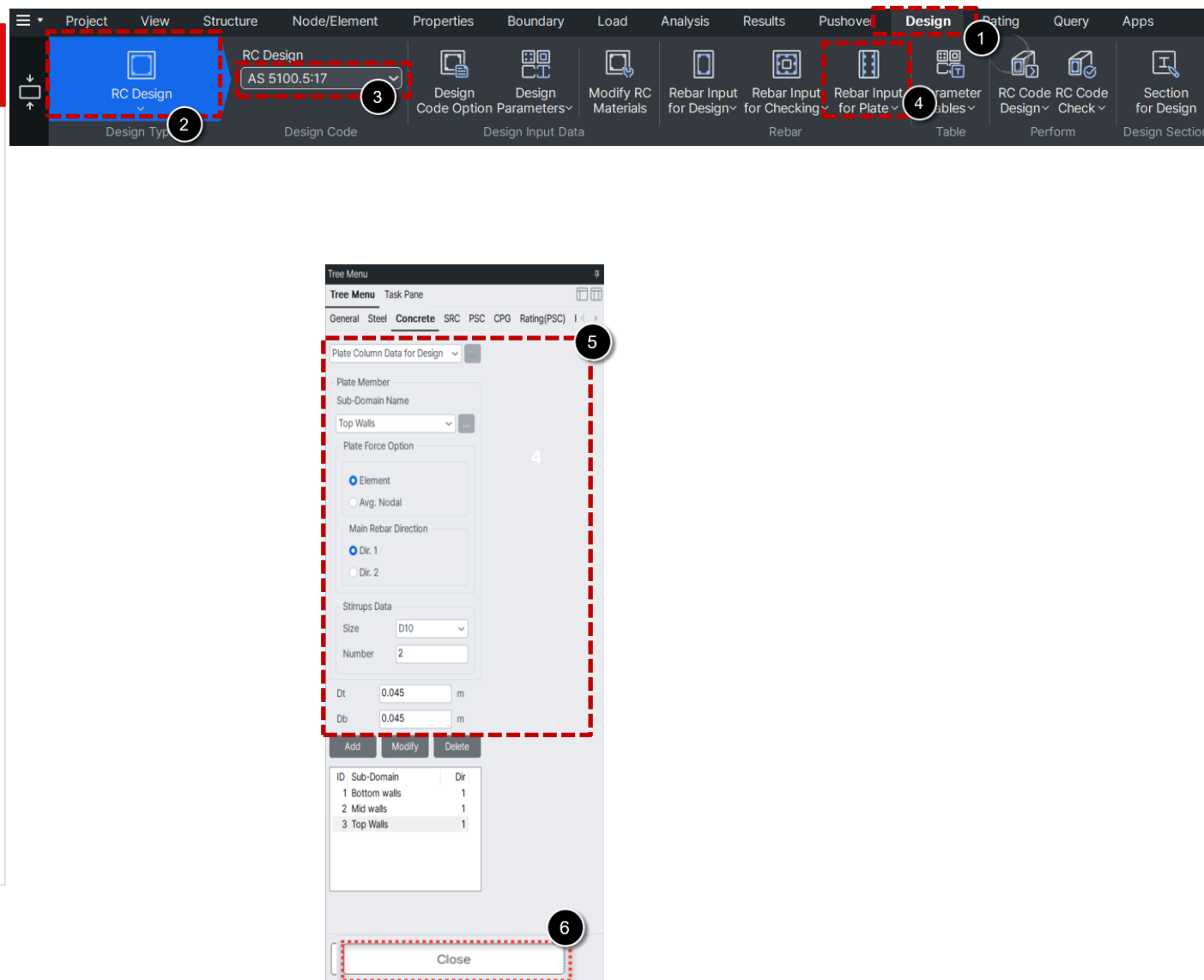
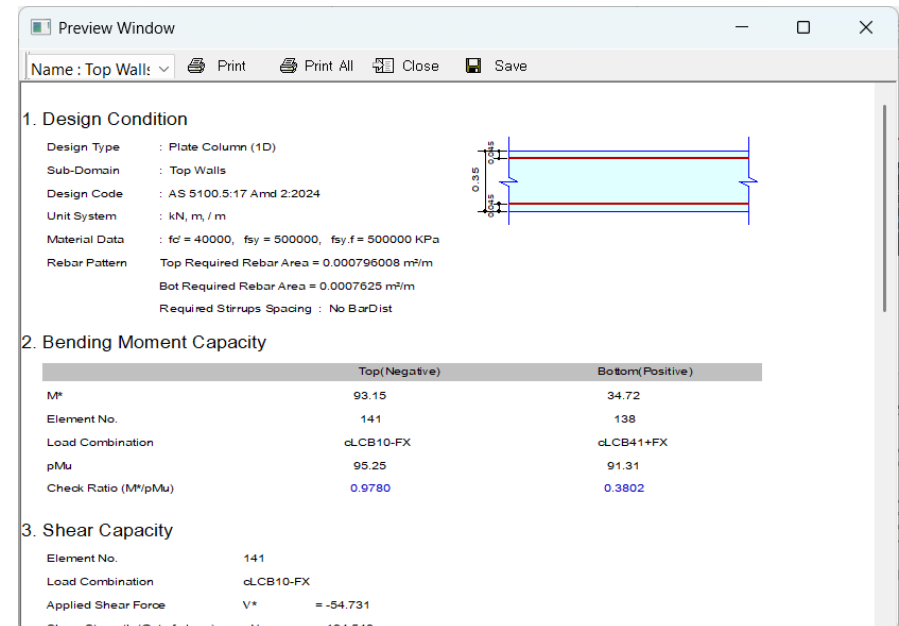
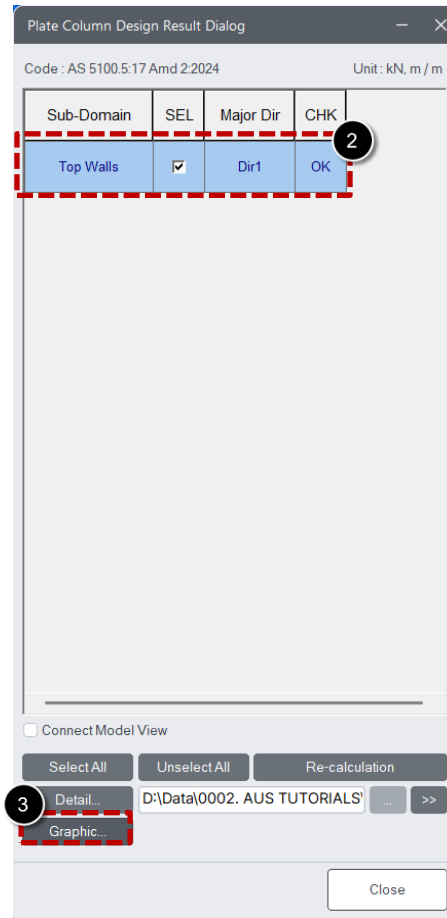
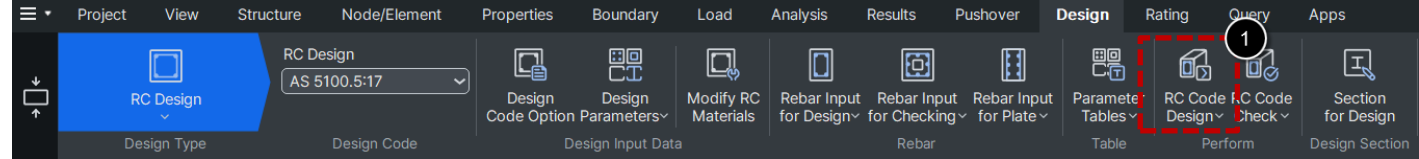


Plate Column Design

- 1 RC Code Design > Plate Column Design
- 2 Select **Top walls** sub-Domain
- 3 Click on > **Graphic**



End Slabs

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100 5:17”
- 4 Select “Rebar Input for plate Beam”
- 5 Name > End Slabs

Under Main Rebar > CTC > Top

CTC > 0.15; Size 1 > D22; Size 2 > D20

Dt > 0.045

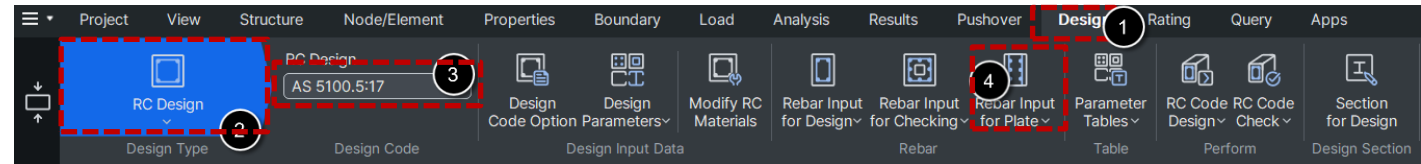
Bottom > CTC > 0.15; Size 1 > D22; Size 2 > D20 ;Dt > 0.045

Select “Stirrup” > size > D12;
Spacing > 0.1 ; Number>4
- 6 Under Distribution Rebar > CTC > Top

CTC > 0.2; Size 1 > D10

Bottom >

CTC > 0.2; Size 1 > D10
- 7 Click on > Add



This screenshot shows the 'Rebar Input for Plate Beam' dialog box. The 'Main Rebar' tab is selected. The 'Name' field is set to 'End slabs'. The 'Top' section shows 'As' as 33333333 m²/m and 'Layer' as 1. The 'Bottom' section shows 'As' as 0.0023143 m²/m and 'Layer' as 1. The 'Stirrup' section is checked, with 'Size' set to D12, 'Spacing' set to 0.1 m, and 'Number' set to 4. The 'Add', 'Modify', and 'Delete' buttons are visible at the bottom. A red dashed box highlights the entire dialog box, with a circled '5' in the top right corner.

Layer	CTC	Size1	Size2	Dt
1	0.15	D22	D20	0.045

Layer	CTC	Size1	Size2	Db
1	0.15	D22	D20	0.045

This screenshot shows the 'Rebar Input for Plate Beam' dialog box. The 'Distribution Bar' tab is selected. The 'Name' field is set to 'End slabs'. The 'Top' section shows 'As' as 0.0003925 m²/m and 'Layer' as 1. The 'Bottom' section shows 'As' as 0.0003925 m²/m and 'Layer' as 1. The 'Stirrup' section is checked, with 'Size' set to D12, 'Spacing' set to 0.1 m, and 'Number' set to 4. The 'Add', 'Modify', and 'Delete' buttons are visible at the bottom. A red dashed box highlights the entire dialog box, with a circled '6' in the top right corner and a circled '7' in the bottom left corner.

Layer	CTC	Size1
1	0.2	D10

Layer	CTC	Size1
1	0.2	D10

Mid Slabs

1 Name > **Mid Slabs**

Under Main Rebar > **CTC** > **Top**

CTC > 0.15; Size 1 > **D20**; Size 2 > **D20**

Dt > **0.045**

Bottom >

CTC > 0.15; Size 1 > **D20**; Size 2 > **D20**

Dt > **0.045**

Under Distribution Rebar > **CTC** >

Top

CTC > 0.2; Size 1 > **D10**

Bottom >

CTC > 0.2; Size 1 > **D10**

Click on > **Add**

Rebar Input for Plate Beam

Name: Mid slabs

Main Rebar Distribution Bar

☐ Num ☒ CTC

Top

As: 0.000666667 m²/m

Layer: 1

Layer	CTC	Size1	Size2	Dt
1	0.15	D20	D20	0.045

Bottom

As: 0.0020946 m²/m

Layer: 1

Layer	CTC	Size1	Size2	Db
1	0.15	D20	D20	0.045

Rebar Input for Plate Beam

Name: Mid slabs

Main Rebar Distribution Bar

☐ Num ☒ CTC

Top

As: 0.0003925 m²/m

Layer: 1

Layer	CTC	Size1
1	0.2	D10

Bottom

As: 0.0003925 m²/m

Layer: 1

Layer	CTC	Size1
1	0.2	D10

3

Add Modify Delete

ID	Name
1	End slabs
2	mid slabs

Close

Top and Bottom Walls

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100:5:17”
- 4 Select “Rebar Input for Plate Column”
- 5 Name > Top and Bottom Walls

Under Main Rebar > CTC > Top

CTC > 0.2; Size 1 > D16; Dt > 0.045

Bottom > CTC > 0.2; Size 2 > D16 Dt > 0.045

Select “Stirrup” > size > D10; Spacing > 0.2 ; Number>2

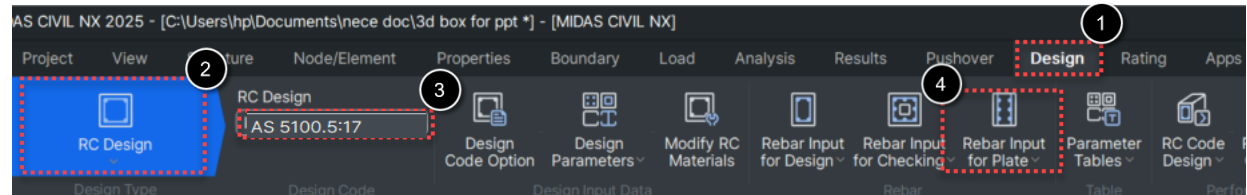
- 6 Under Distribution Rebar > CTC >

Top CTC > 0.2; Size 1 > D10

Bottom CTC > 0.2; Size 1 > D10

Select “Stirrup” > size > D10; Spacing > 0.2 ; Number>2

Click on > Add



Layer	CTC	Size1	Size2	Dt
1	0.2	D16		0.045

Layer	CTC	Size1	Size2	Db
1	0.2	D16		0.045

Layer	CTC	Size1
1	0.2	D10

Layer	CTC	Size1
1	0.2	D10

Mid Walls

1 Name > Mid Walls

Under Main Rebar > CTC > Top

CTC > 0.2; Size 1 > D12; Dt > 0.045

Bottom >

CTC > 0.2; Size 1 > D12; Dt > 0.045

2 Under Distribution Rebar > CTC >

Top

CTC > 0.2; Size 1 > D10

Bottom >

CTC > 0.2; Size 1 > D10

3 Click on > Add

Rebar Input for Plate Column

Name: Mid walls

Main Rebar: Distribution Bar

☐ Num ☒ CTC

Top

As: 0.0007855 m²/m

Layer: 1

Layer	CTC	Size1	Size2	Dt
1	0.2	D12	D16	0.045

Bottom

As: 0.0007855 m²/m

Layer: 1

Layer	CTC	Size1	Size2	Db
1	0.2	D12	D16	0.045

☐ Stirrup

Size: D10

Spacing: 0.2 m

Number: 2

Add Modify Delete

ID	Name
1	Top and bottom walls
2	Mid walls

Close

Rebar Input for Plate Column

Name: Mid walls

Main Rebar: Distribution Bar

☐ Num ☒ CTC

Top

As: 0.0003925 m²/m

Layer: 1

Layer	CTC	Size1
1	0.2	D10

Bottom

As: 0.0003925 m²/m

Layer: 1

Layer	CTC	Size1
1	0.2	D10

☐ Stirrup

Size: D10

Spacing: 0.2 m

Number: 2

Add Modify Delete

ID	Name
1	Top and bottom walls
2	Mid walls

Close

Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100 5:17”
- 4 Select Rebar input data >
- 5 Plate Beam Data for Checking
- 6 Select The Left End sub –Domain and End slabs – Rebar data and repeat the same for mid slabs

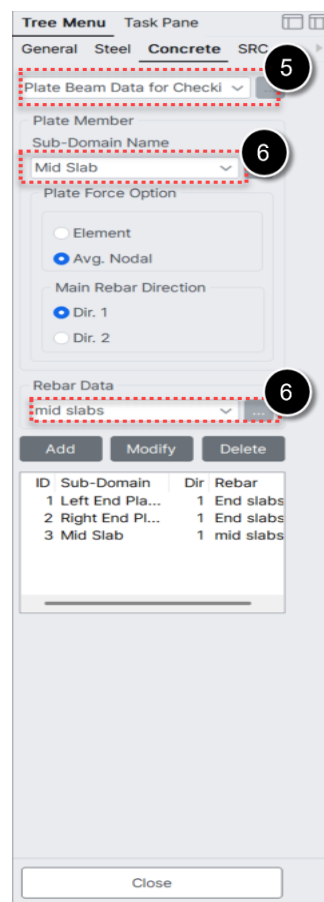


Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100 5:17”
- 4 Select Rebar input data for Plate
- 5 Plate Column Data for Checking
- 6 Select Bottom walls –Domain and Top and bottom walls– Rebar data and repeat the same for mid walls

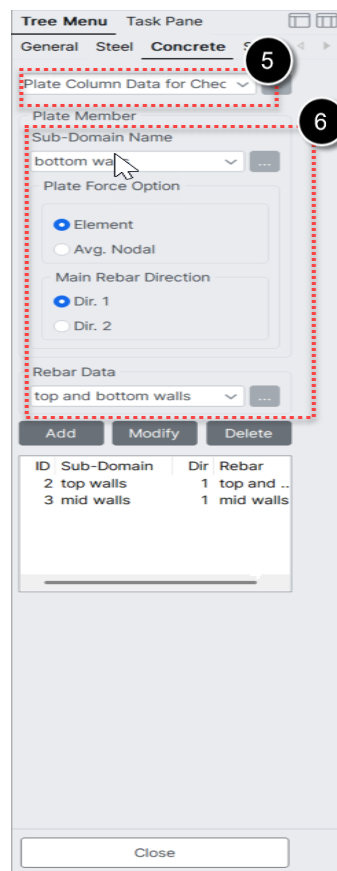
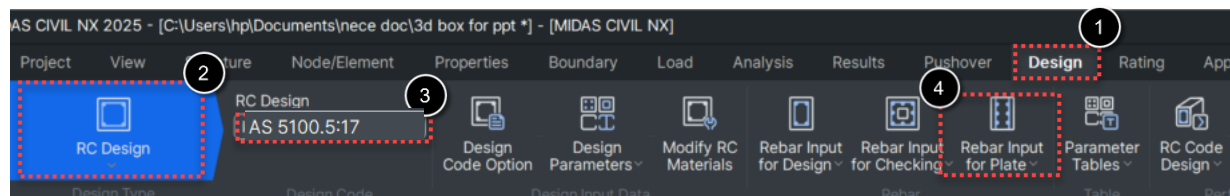


Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100.5:17”
- 4 Select Concrete Code Checking >
- 5 Select The **Mid Slab** sub-Domain
- 6 Click on > **Graphic**

The screenshot shows the software interface with the Design tab selected. The Design Code is set to AS 5100.5:17. The Plate Beam Check Result Dialog is open, showing the results for the Mid Slab sub-Domain. The dialog includes a table for Sub-Domain, SEL, Major Dir, and CHK. The Mid Slab sub-Domain is selected, and the results show OK for Dir1. The dialog also includes a section for Rebar Pattern and a table for Rebar Area.

Plate Beam Check Result Dialog

Code : AS 5100.5:17 Amd 2:2024 Unit : kN, m / m

Results : ☒ Strength ☐ Serviceability

Sub-Domain	SEL	Major Dir	CHK
Mid Slabs	☒	Dir1	OK

Element No : 55

Rebar Pattern

	Top(Negative)	Bottom(Positive)
Layer 1	D20,20@0.15	D20,20@0.15

Total Rebar Area Ast = 0.0043988 m²/m

Using Stirrups Spacing : 2.0-D10 @0.150

Connect Model View

Select All Unselect All Re-calculation

Graphic...

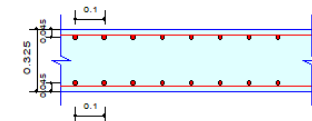
Preview Window

Name : Mid Slab:

1. Design Condition

Design Type : Plate Beam (1D)
 Sub-Domain : Mid Slabs
 Design Code : AS 5100.5:17 Amd 2:2024
 Unit System : kN, m / m
 Material Data : $f_c' = 40000$, $f_y = 500000$, $f_{ys} = 500000$ KPa
 Thickness : 0.325 m

2. Section Diagram



Element No : 55

3. Bending Moment Capacity

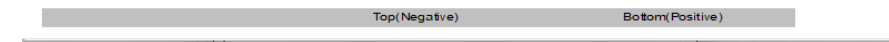


Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100.5:17”
- 4 Select Concrete Code Checking >
- 5 Select The **Mid Slab** sub-Domain
- 6 Click on > **Detail**

Plate Beam Check Result Dialog

Code : AS 5100.5:17 Amd 2:2024 Unit : kN, m / m

Results : ☒ Strength ☐ Serviceability

Sub-Domain	SEL	Major Dir	CHK
Mid Slabs	☒	Dir1	OK

MEMBER NAME : Mid Slabs

1. General Information

(1) Design Code : AS 5100.5:17 Amd 2:2024

(2) Code Unit : N, mm

2. Material

(1) Concrete

- f_c : 40.00MPa
- f_{ct} : 32.800MPa

(2) Reinforcement

- f_{yk} : 500MPa
- f_{td} : 500MPa
- E_s : 200,000MPa

3. Design Data

(1) Aggregate size : 16.00mm

4. Reinforcement

	Top	Bottom	Stirrup
Area	2,055mm ²	2,055mm ²	2,055mm ²

5. Calculation Summary

(1) Bending Moment Strength (Positive)

Category	Value	Criteria	Ratio	Note
Moment strength (M ⁺) (kN·m)	180	252	0.715	$M_u < 0.360$
Minimum required strength (M _{req}) (kN·m)	285	80.31	0.255	
Minimum required flexural tension reinforcement (%)	2,189	579	0.240	

6. Calculate Compression Stress Block Factor

(1) Uniform compressive stress factor

Category	Value	Criteria	Ratio	Note
Maximum stress of reinforcement by diameter (MPa)	173	242	0.715	
Maximum stress of reinforcement by spacing (MPa)	173	272	0.636	

(2) Uniform compressive stress depth factor

Category	Value	Criteria	Ratio	Note
β_1	0.775	0.875	0.886	

$\gamma = 1.05 - 0.007 F_c$

7. Check Bending Moment Capacity (Negative)

(1) Load Combination

Category	Value	Criteria	Ratio	Note
Moment	0.000kN·m	0.000kN·m	0.000	

(2) Calculate force components at the neutral axis

- $k_u d = 0.000mm$
- $F_{cu} = 0. F_c$ (Compression force by concrete)
- $F_{st} = \sum (A_s f_{yk}) = 0.000kN$ (Compression force by reinforcement based on singly reinforced design)
- $F_c = F_{cu} + F_{st} = 0.000kN$ (Compression force)
- $F_t = 2 (A_s f_{yk}) = 0.000kN$ (Tensile force by reinforcement)
- $F_t / F_c = 0.000$

(3) Calculate strength reduction factor ($\phi_u < 0.360$)

- $\phi_u = 0.000mm$
- $\phi_u = k_u d / (k_u + 0.000)$
- $\phi = 1.19 - (13.0 * k_u / 12.0) + 0.000 (0.00 < \phi < 0.00)$

Detail...

Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100.5:17”
- 4 Select Concrete Code Checking >

Plate Column checking

- 5 Select The **Top Wall** sub-Domain
- 6 Click on > **Graphic**

The screenshot shows the software interface with the Design tab selected. The RC Design sub-domain is chosen, and the AS 5100.5:17 code is selected. The Plate Column Check Result Dialog is open, showing the Top Walls sub-domain selected for checking. The dialog also displays the design code, unit system, and material data.

Plate Column Check Result Dialog

Code : AS 5100.5:17 Amd 2:2024 Unit : kN, m

Results : ☒ Strength ☐ Serviceability

Sub-Domain	SEL	Major Dir	CHK
Bottom walls	☐	Dir1	OK
Top Walls	☒	Dir1	OK
Mid walls	☐	Dir1	OK

Connect Model View

Select All Unselect All Re-calculation

Detail... C:\Users\mk152\Downloads\Ma ... >>

Graphic... Close

Preview Window

Name : Top Wall: Print Print All Close Save

1. Design Condition

Design Type : Plate Column (1D)
 Sub-Domain : Top Walls
 Design Code : AS 5100.5:17 Amd 2:2024
 Unit System : kN, m / m
 Material Data : $f_c = 40000$, $f_{sy} = 500000$, $f_{sy} = 500000$ KPa
 Rebar Pattern

Layer	Top(Negative)	Bottom(Positive)
Layer 1	D20@0.20	D20@0.20

Total Rebar Area Ast = 0.003142 m²/m
 Using Stirrups Spacing : 2.0-D10 @0.200

2. Bending Moment Capacity

	Top(Negative)	Bottom(Positive)
M*	93.15	34.72
Element No.	141	138
Load Combination	cLCB10-FX	cLCB41+FX
pMu	184.40	184.40
Check Ratio (M*/pMu)	0.5052	0.1883
Rebar Area(As)	0.0016	0.0016

3. Axial Force Resistance Check

Element No.	-
Load Combination	-

Plate Beam Checking

- 1 Go to “Design” tab
- 2 Select “RC Design”
- 3 Click “AS 5100.5:17”
- 4 Select Concrete Code Checking >
- 5 Select The Top Walls sub-Domain
- 6 Click on > Detail

Plate Column checking

Plate Column Check Result Dialog

Code : AS 5100.5:17 Amd 2:2024 Unit : kN, m

Results : ☒ Strength ☐ Serviceability

Sub-Domain	SEL	Major Dir	CHK
Bottom walls	☐	Dir1	OK
Top Walls	☒	Dir1	OK
Mid walls	☐	Dir1	OK

MEMBER NAME : Top Walls

1. General Information
 (1) Design Code : AS 5100.5:17 Amd 2:2024
 (2) Code Unit : N, mm

2. Material
 (1) Concrete
 - f_c : 40,00MPa
 - f_{tk} : 32,800MPa
 (2) Reinforcement
 - f_y : 500MPa
 - f_{tk} : 500MPa
 - E_s : 200,000MPa

3. Design Data
 (1) Aggregate size : 16.00mm

4. Reinforcement

5. Calculation Summary

Category	Value	Critera	Ratio	Not
(1) Bending Moment Strength (Positive)				
Moment strength ($10^4 \text{ kN}\cdot\text{m}$)	0.000	0.000	0.000	Not
Minimum required strength ($10^4 \text{ kN}\cdot\text{m}$)	0.000	0.000	0.000	Not
Minimum required flexure tension	0.000	0.000	0.000	Not

6. Check Bending Moment Capacity (Negative)

(1) Load Combination
 - CLC010 (Element ID: 141, Node ID: 4)

(2) Search for neutral axis depth (ξ_u, d)

Step	ξ_u (mm)	ξ_u (mm)	ξ_u (mm)	ξ_u (mm)
1	275	4581	4581	750
2	87.50	2.291	2.291	789
3	49.75	1.145	1.145	789
4	21.88	573	573	789
5	12.61	309	309	789
6	27.34	736	736	789
7	36.58	787	787	789
8	28.73	752	752	789
9	29.36	770	770	789
10	29.36	770	770	789
11	16.91	743	743	789

Connect Model View

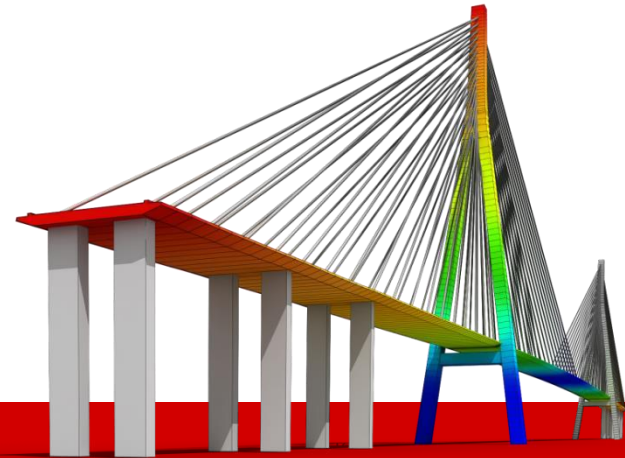
Select All Unselect All Re-calculation

Detail... Graphic...

Close



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