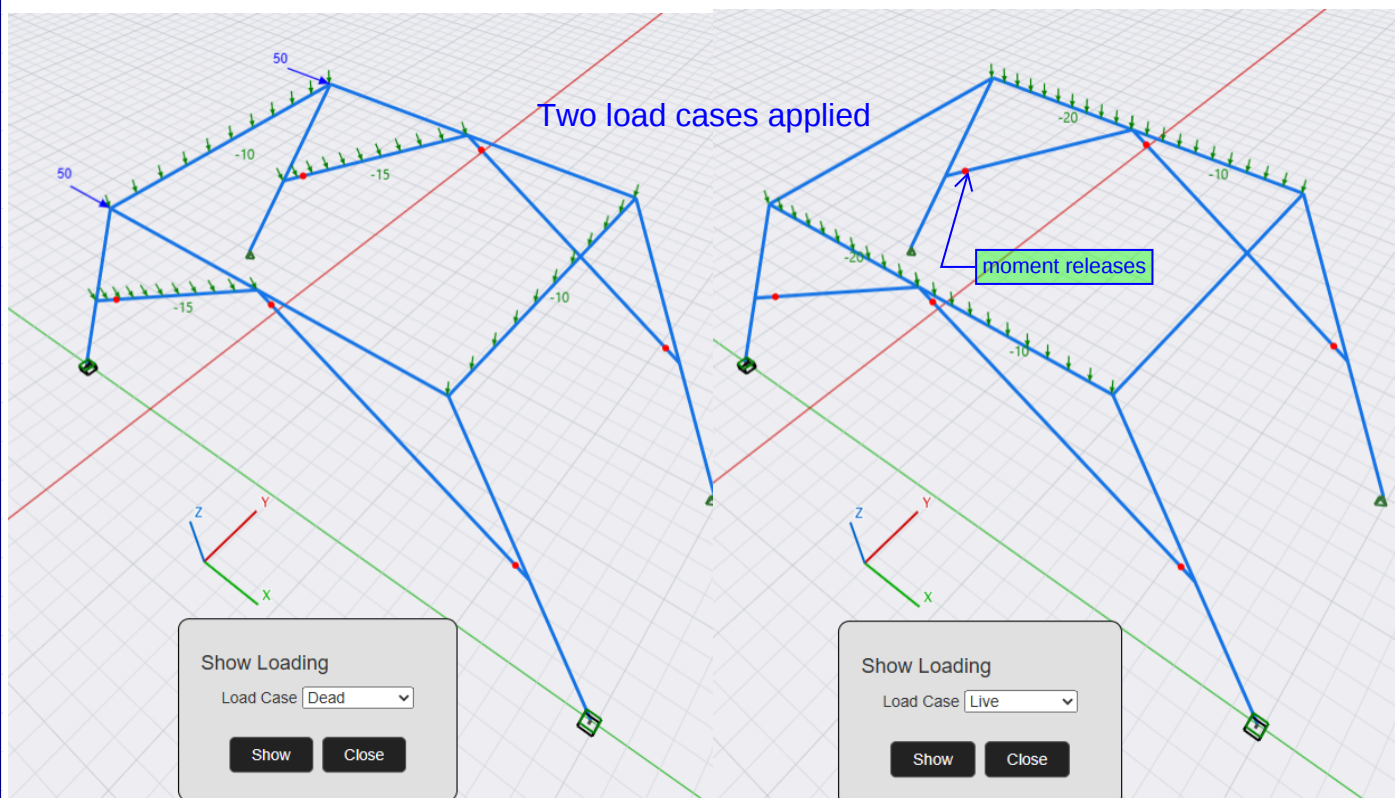
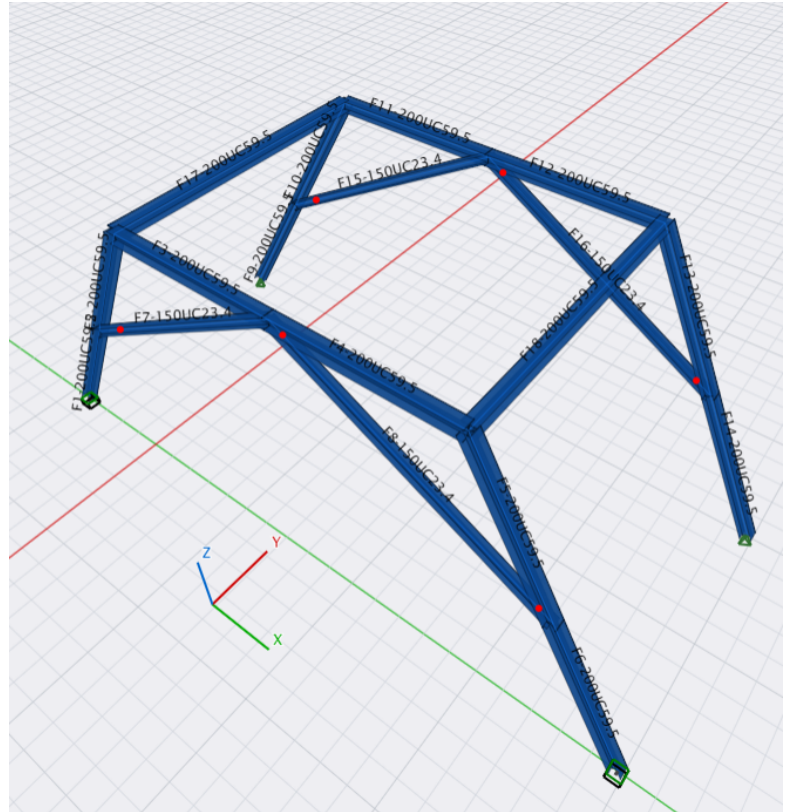


Verification example - FEAkalc 3D vs. ETABS

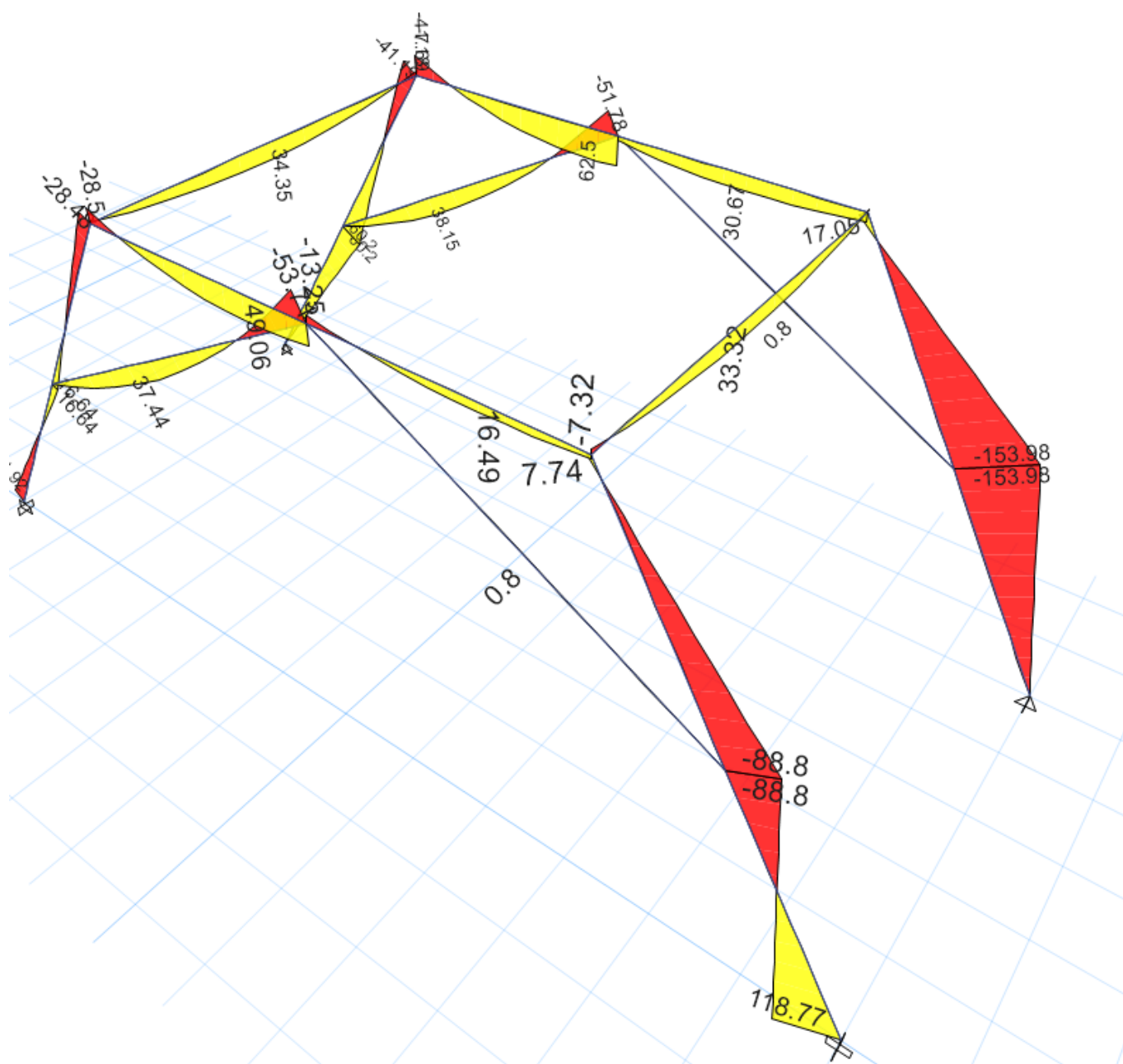
Verification Statement

This example compares FEAkalc 3D directly with ETABS for a representative steel space frame. Independent agreement is demonstrated for structural displacements, internal force distributions and support reactions, providing confidence that FEAkalc accurately reproduces established finite element solutions for three-dimensional frame analysis. The comparison validates the underlying finite element implementation rather than a single numerical result, showing consistent behaviour across the entire structural model





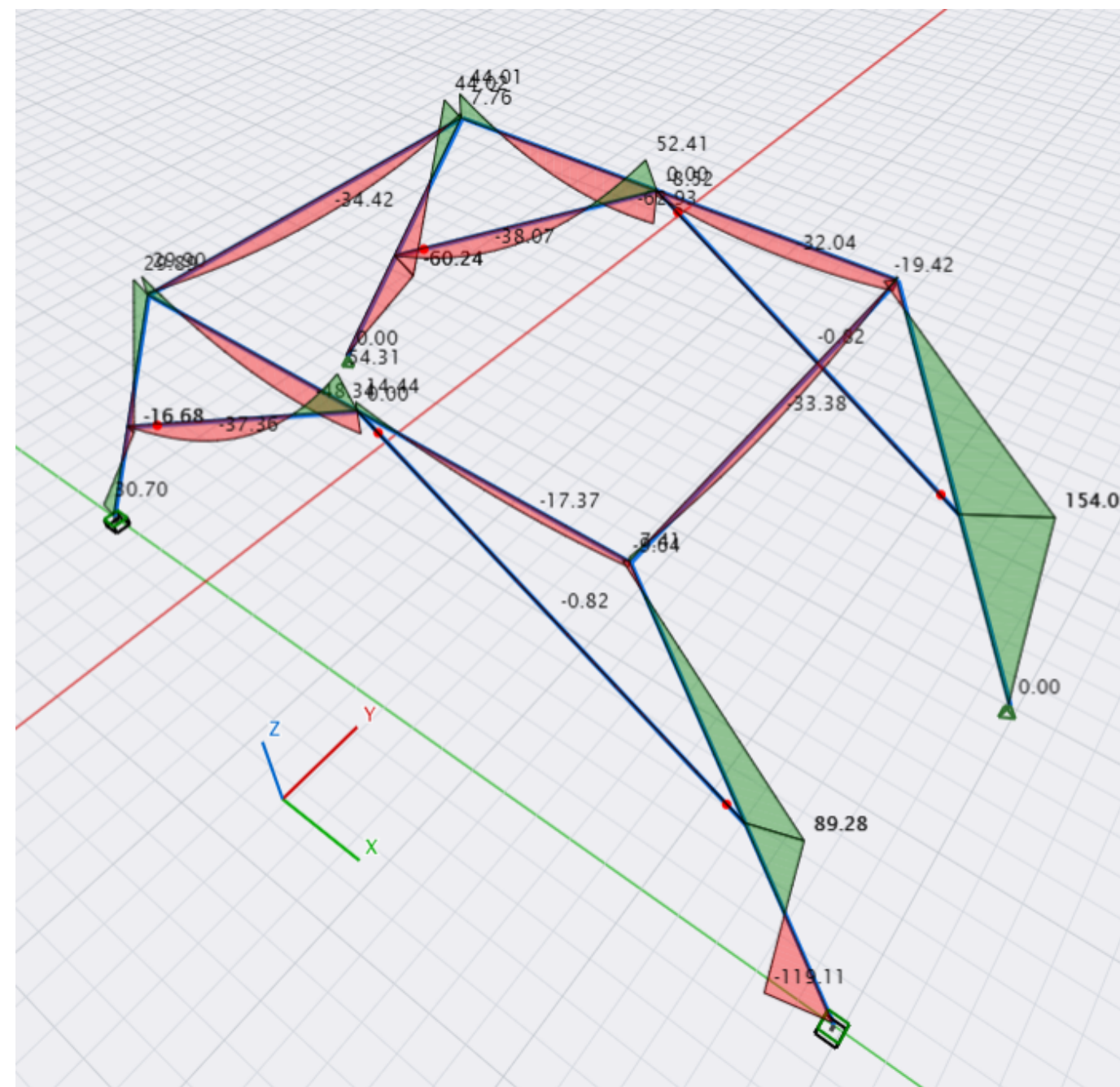
ETABS



Bending Moment Diagram M33

Load Combo : 1.2DL + 1.5LL

FEAKalc 3D

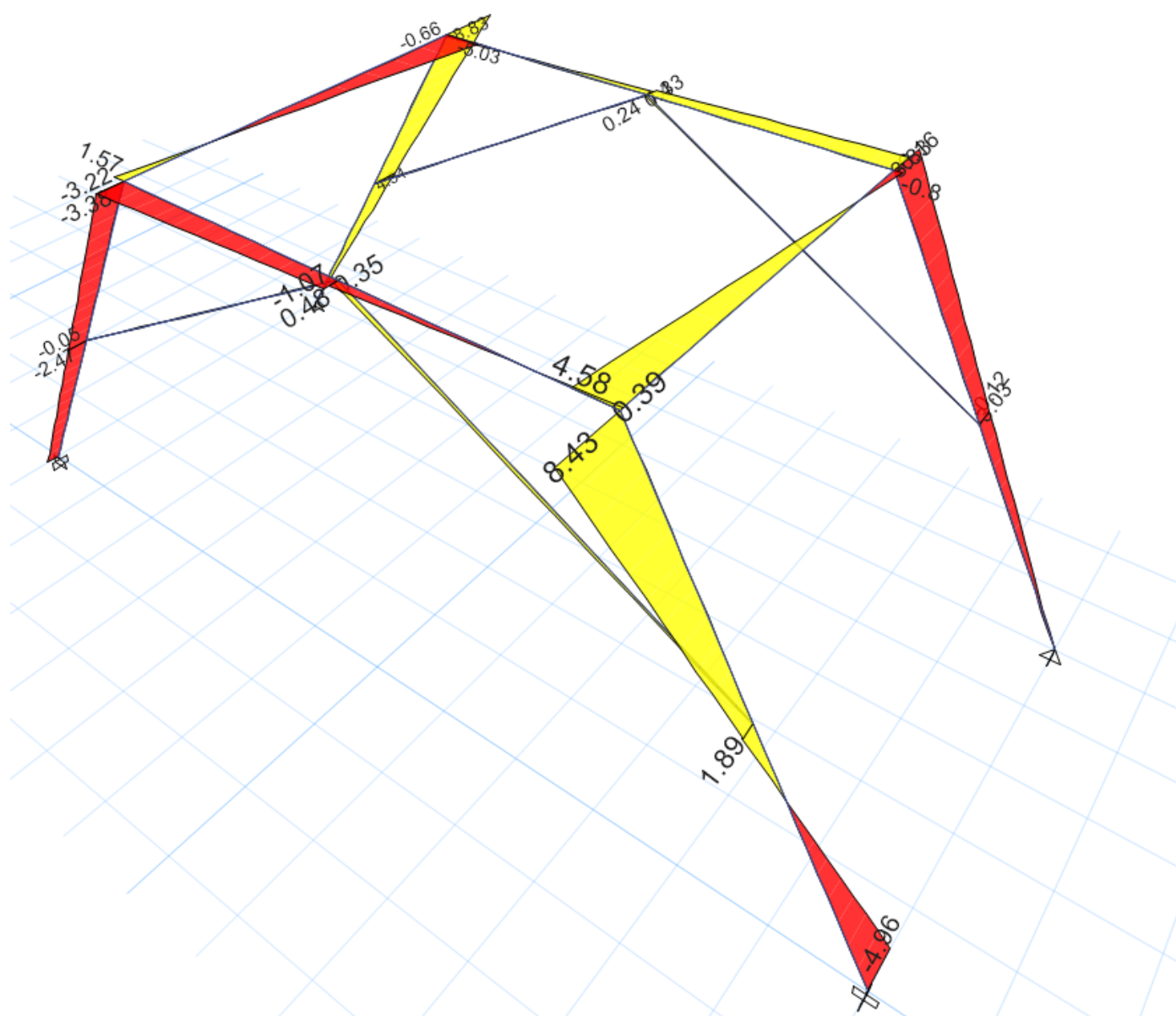


Bending Moment Diagram M33

Load Combo : 1.2DL + 1.5LL



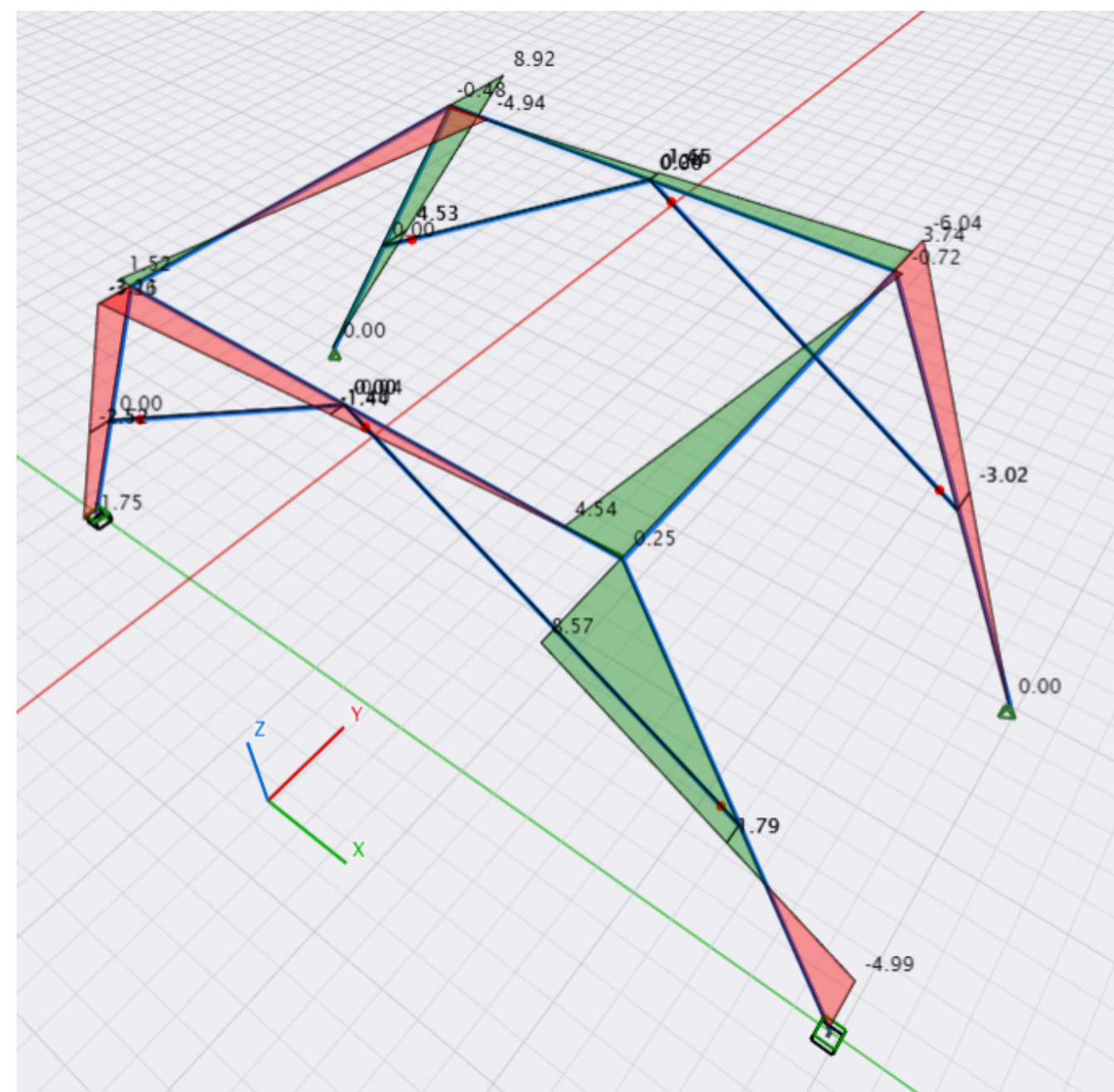
ETABS



Bending Moment Diagram M22

Load Combo : 1.2DL + 1.5LL

FEAKalc 3D

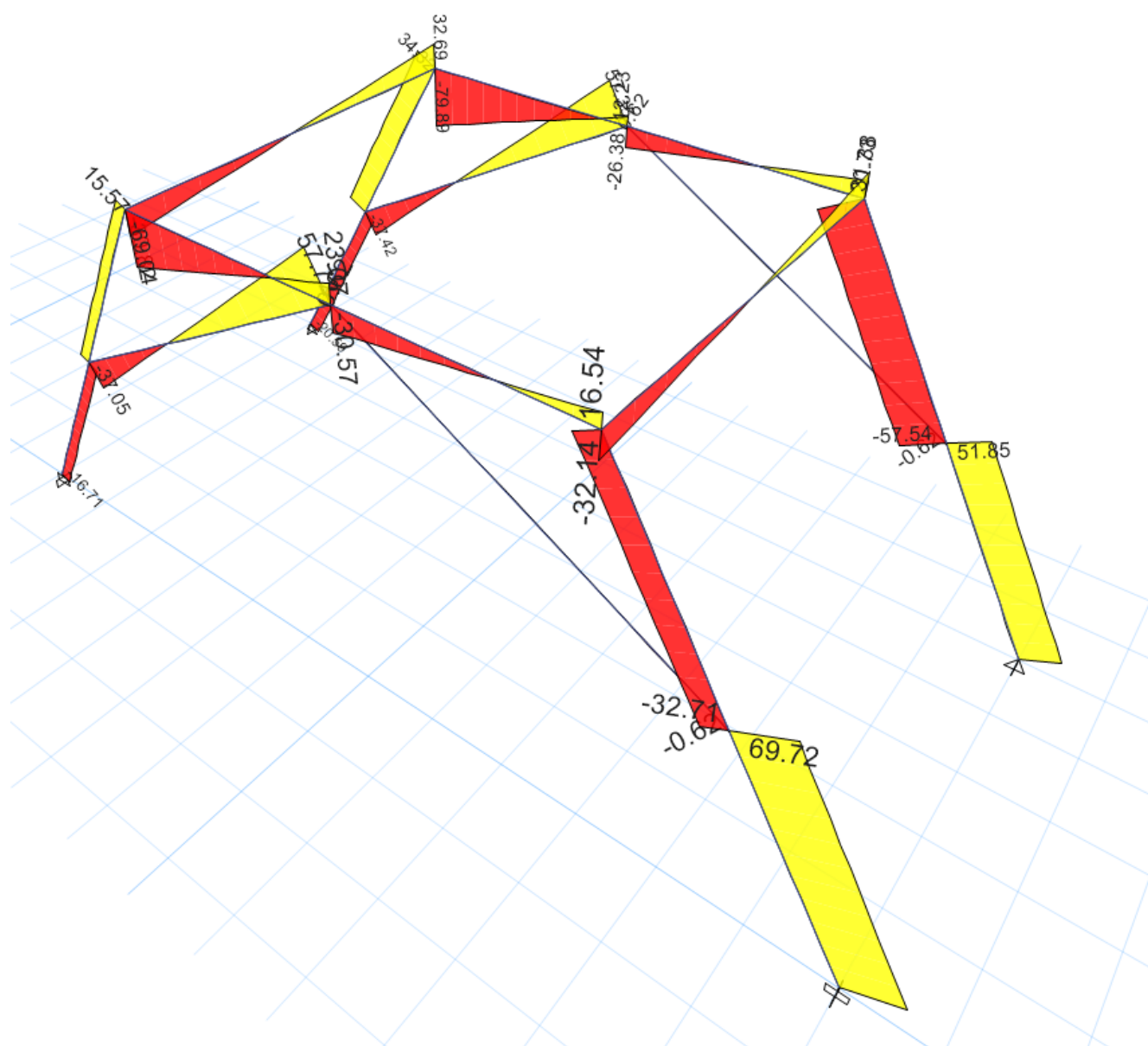


Bending Moment Diagram M22

Load Combo : 1.2DL + 1.5LL



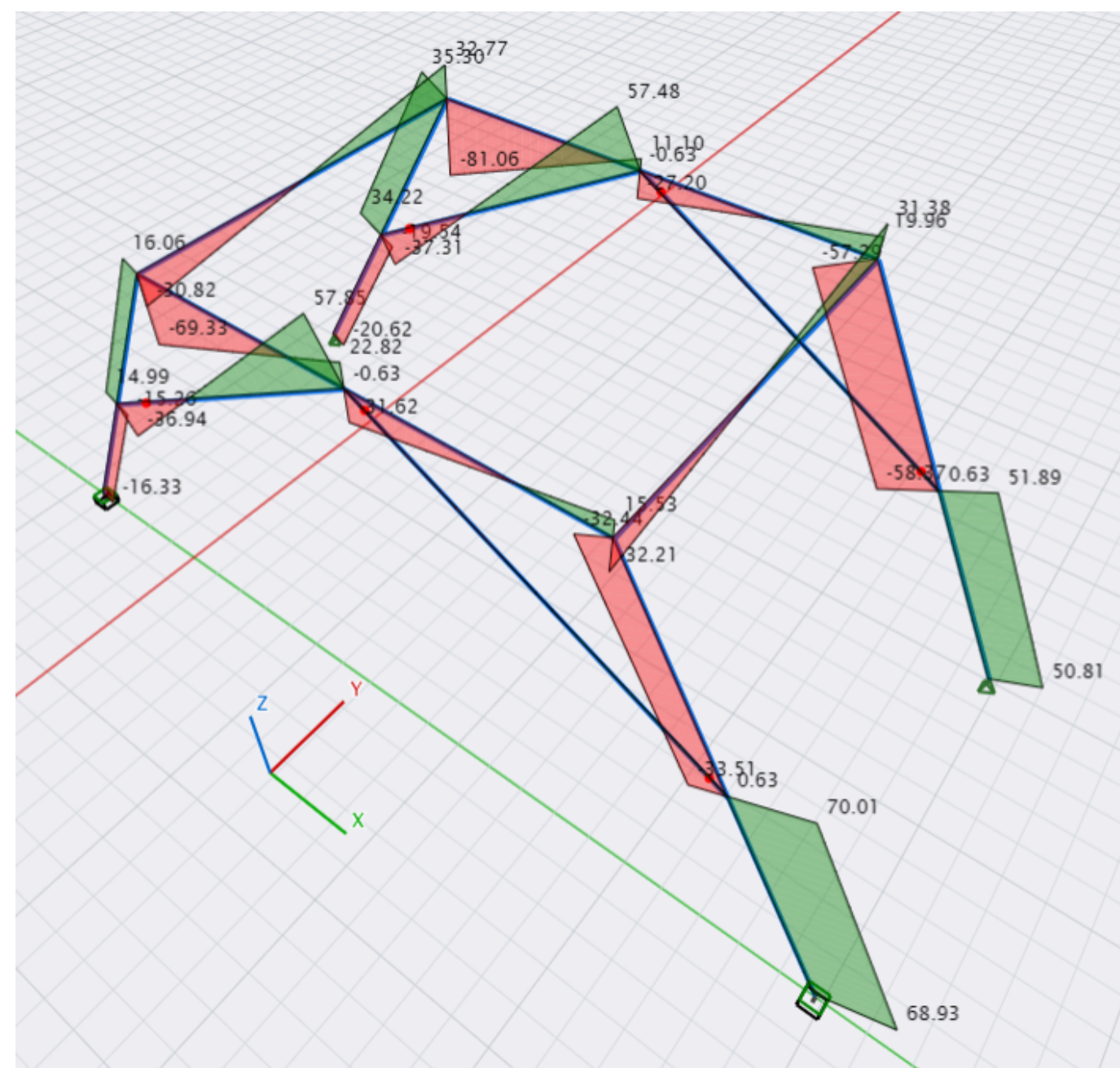
ETABS



Shear Diagram V22

Load Combo : 1.2DL + 1.5LL

FEAKalc 3D

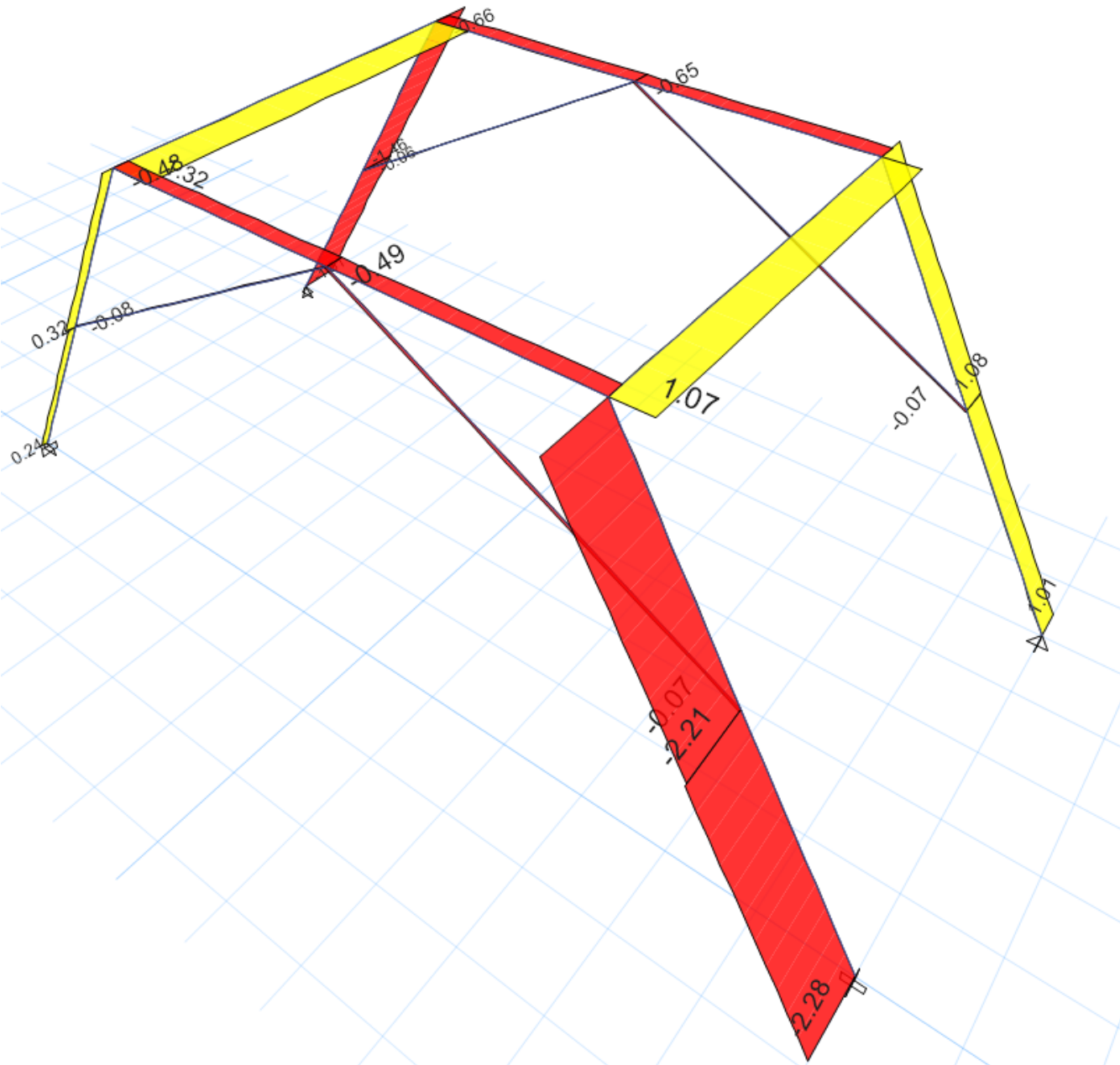


Shear Diagram V22

Load Combo : 1.2DL + 1.5LL



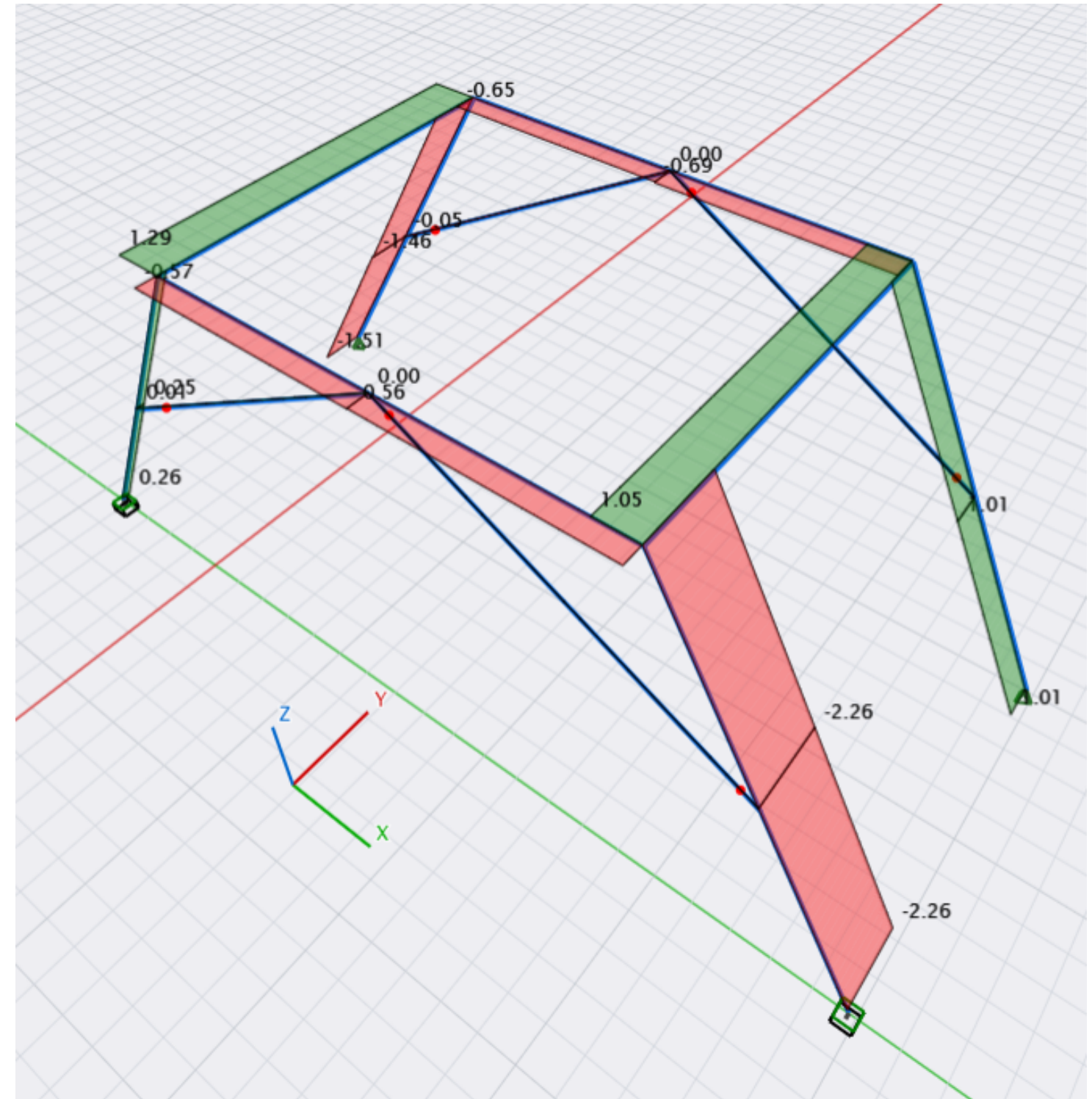
ETABS



Shear Diagram V33

Load Combo : 1.2DL + 1.5LL

FEAKalc 3D

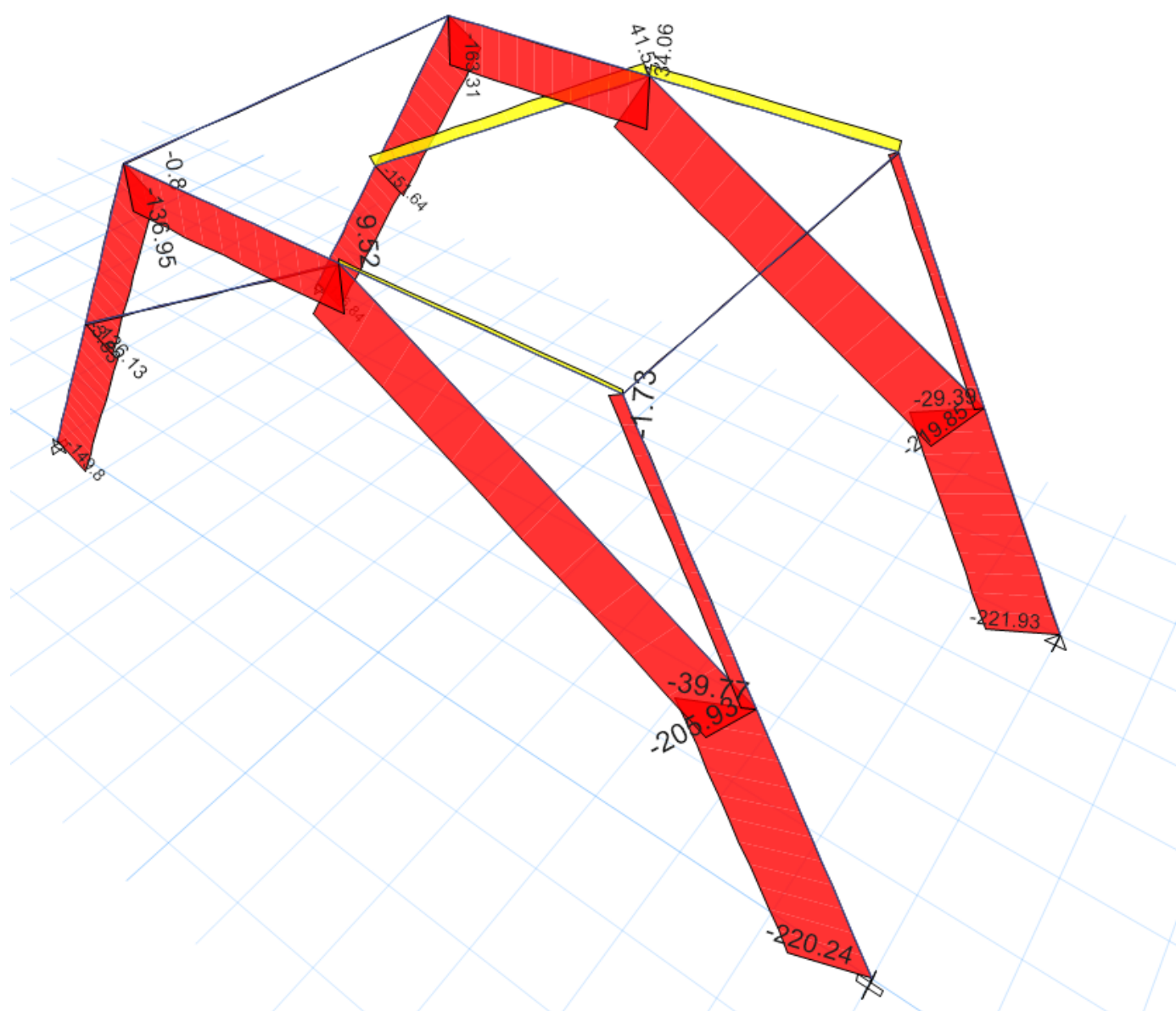


Shear Diagram V33

Load Combo : 1.2DL + 1.5LL



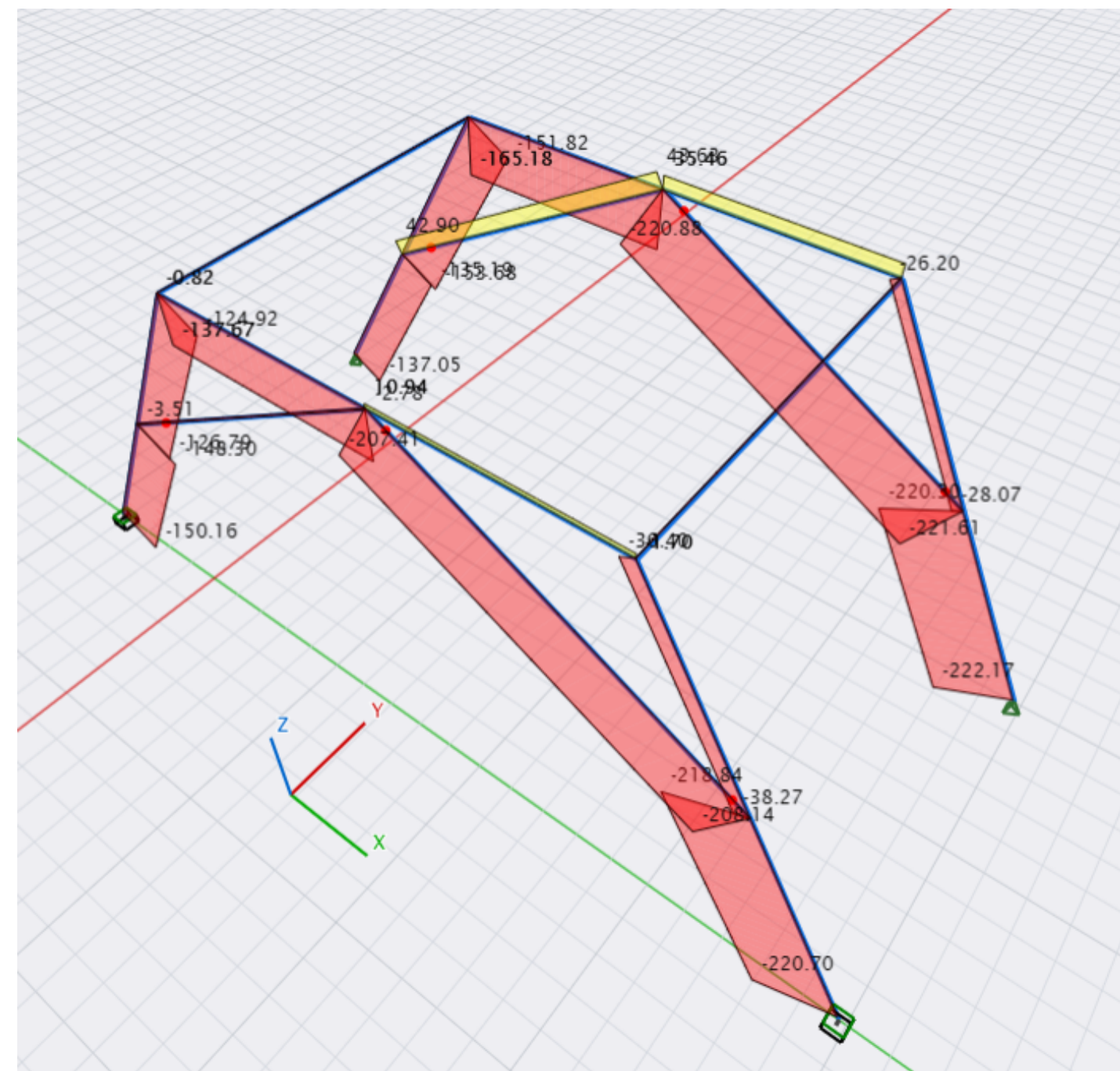
ETABS



Axial Force Diagram

Load Combo : 1.2DL + 1.5LL

FEAKalc 3D

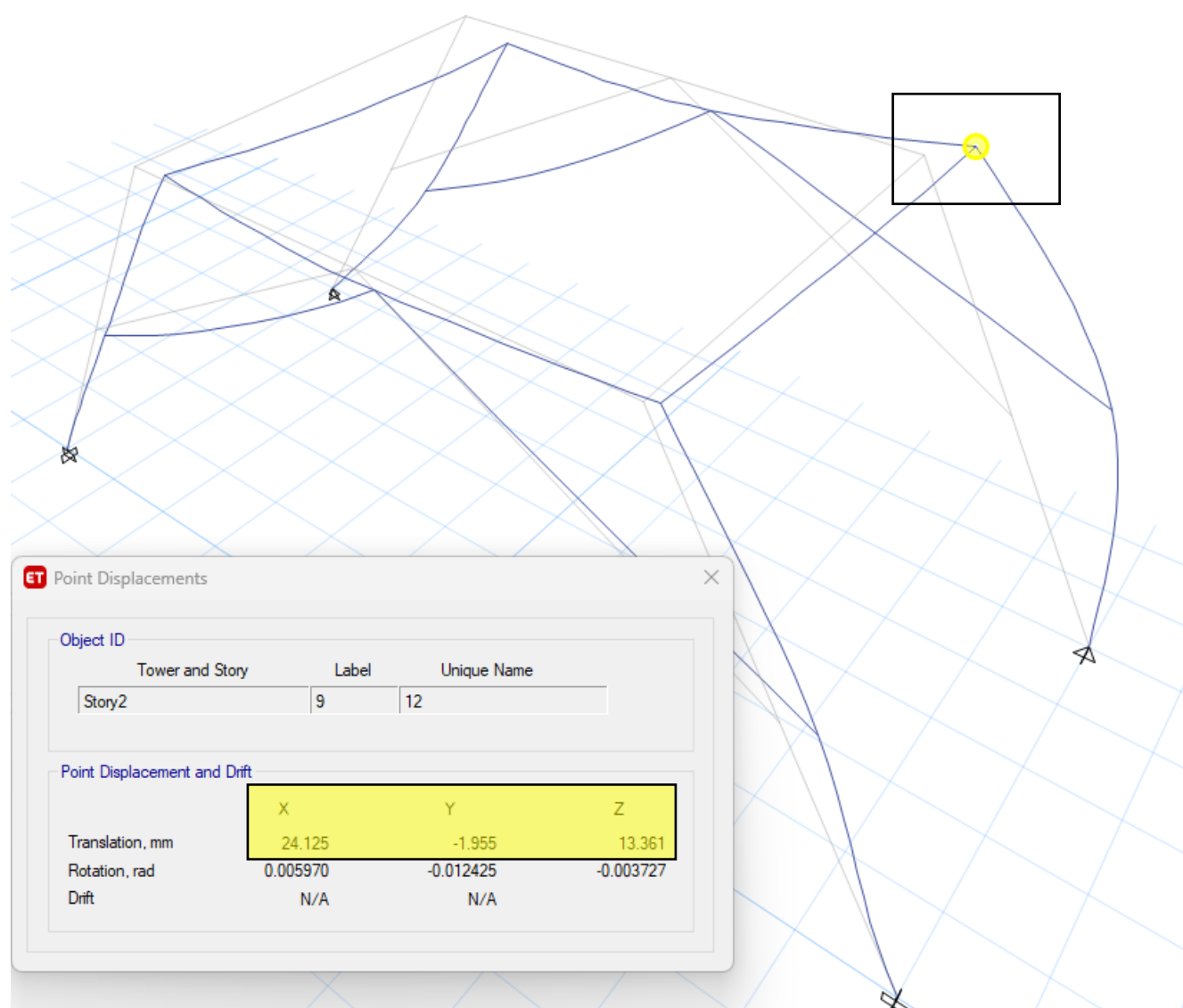


Axial Force Diagram

Load Combo : 1.2DL + 1.5LL

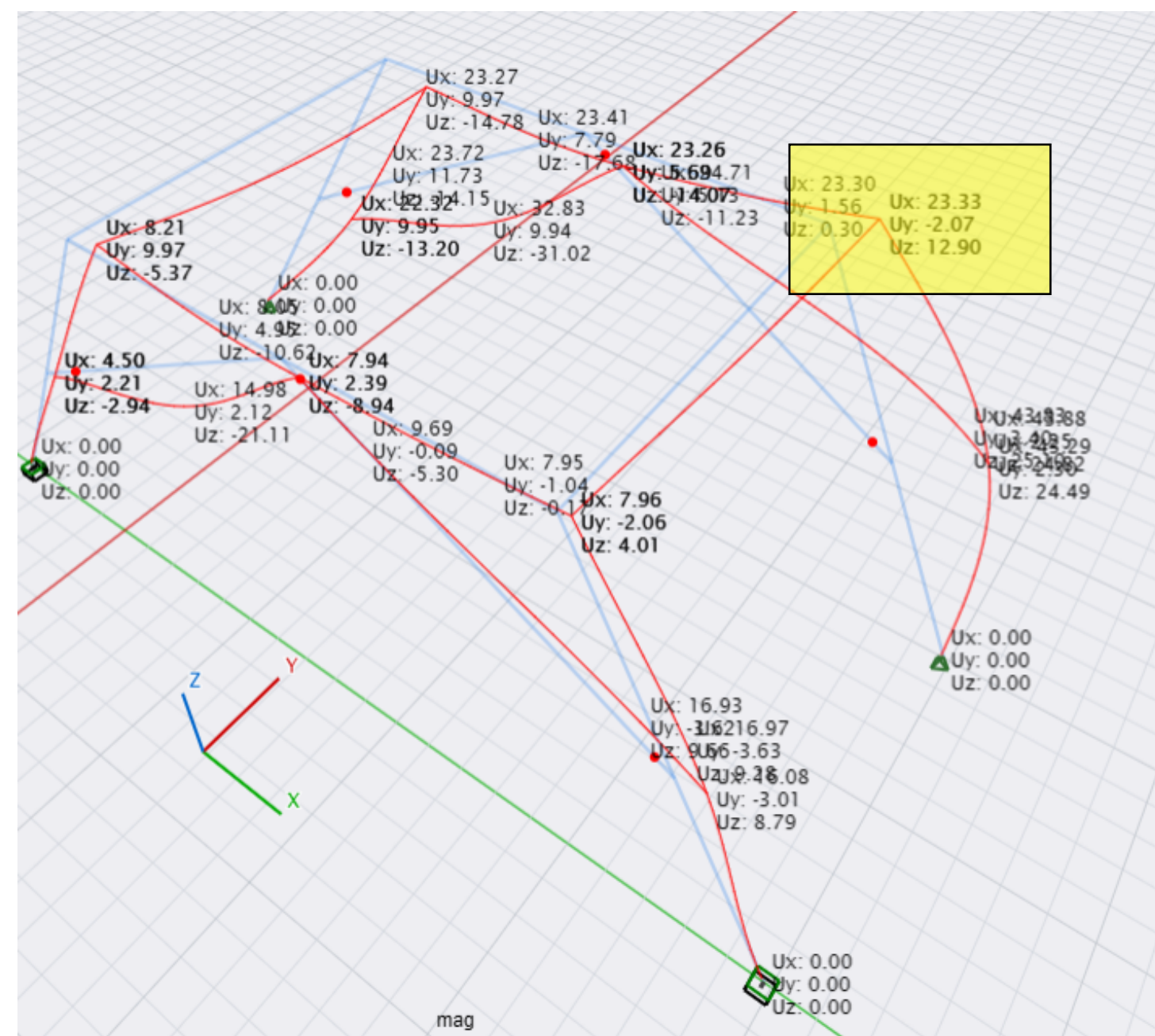


ETABS



Load Combo : 1.2DL + 1.5LL

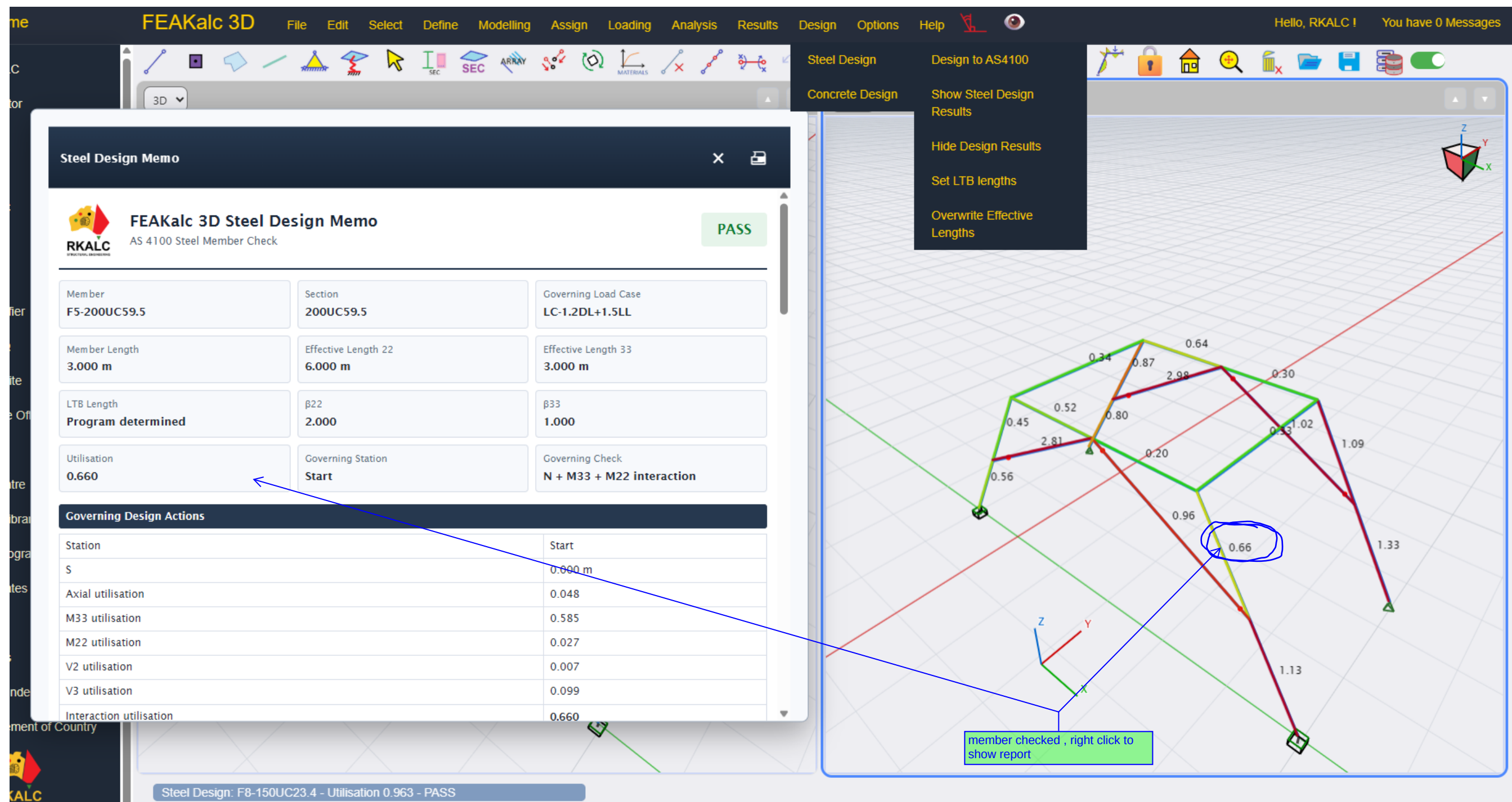
FEAKalc 3D



Load Combo : 1.2DL + 1.5LL



Following is user interface - design ratios shown below and deliberately left in case of over-stress, for example





Member being checked is subject to $N=38.27$ / $M22= 1.793$ / $M33=89.283$ / $V = 33.515$

Member capacities shown below

Global Ratios

At $M33 = 38.27 / 153 = 58.3\%$

At $M22 = 1.793/67 = 2.7\%$

At $N = 38.27 / 793 = 4.8\%$

66%

I Sections

Your Design Package is valid until 30/03/2030 10:44:38 PM

Geometry

Steel Grade

Section Family

Section

Length - Axis X (mm)

Length - Axis Y (mm)

length at strong axis

length at weak axis

Axis X

Key Values

α_s	0.862	α_m	1	M_{oa}	603
λ	36.64	ξ	3.744	α_a	17.16
α_c	0.918	K_f	1	η	0.075
λ_n	36.64	α_b	0	M_b/M_s	86 %

Axis Y

Key Values

α_s	0.835	α_m	1	M_{oa}	234
λ	127.029	ξ	0.844	α_a	14.678
α_c	0.385	K_f	1	η	0.37
λ_n	127.029	α_b	0	M_b/M_s	83 %

Key Properties

f_y (N/mm ²)	300	f_u (N/mm ²)	440
Class (X)	Compact	Class (Y)	Compact
Z_e (X)	656000	Z_e (Y)	298537

Capacities

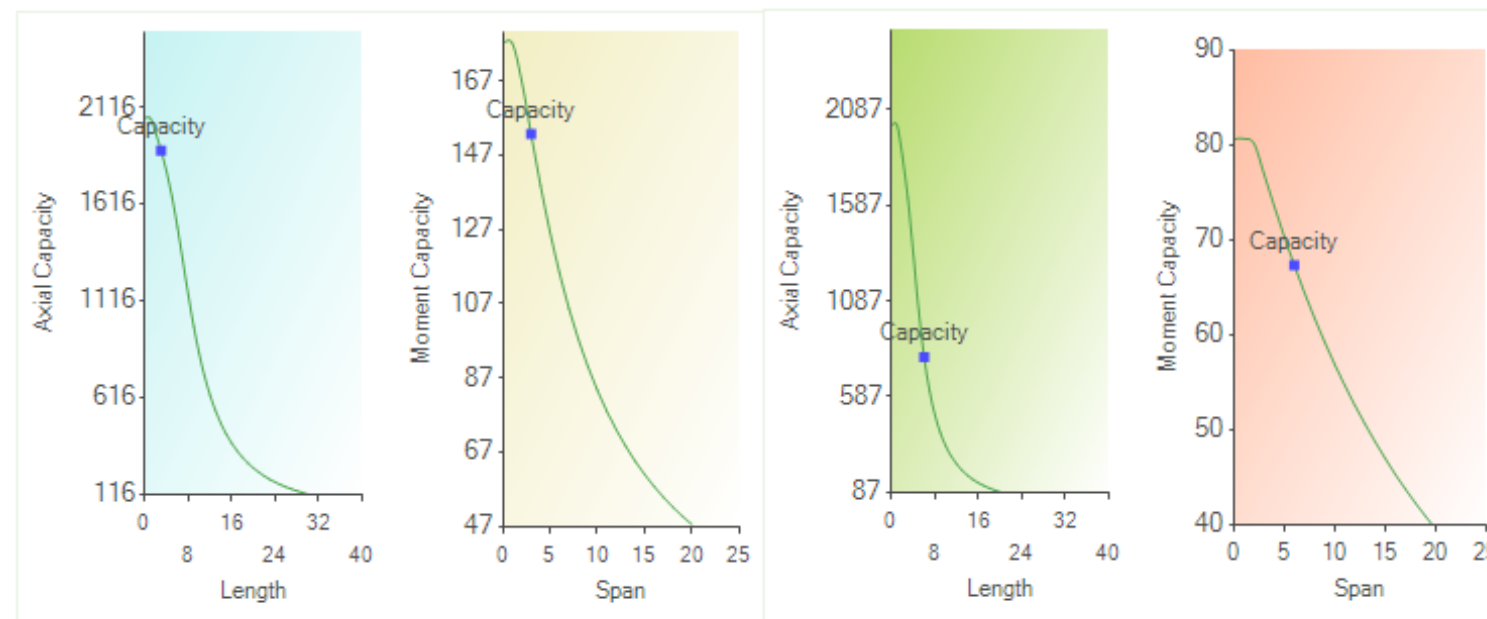
ΦM_{sx} (KN.m)	177	ΦN_{sx} (KN)	2057
ΦM_{bx} (KN.m)	153	ΦN_{cx} (KN)	1889
ΦV_{web} (KN)	337		

Capacities

ΦM_{sy} (KN.m)	81	ΦN_{sy} (KN)	2057
ΦM_{by} (KN.m)	67	ΦN_{cy} (KN)	793

Section Properties

Depth	210	Width	205
t_w	9.3	t_f	14.2
Weight (kg/m)	59.82	Area	7620
I_x	6.13E+07	I_y	2.04E+07
Z_x	583809.5	Z_y	199024.4
S_x	656000	S_y	303000
r_x	89.6918	r_y	51.74133
I_w	1.96E+11	J	477000



Member F5-200UC59.5	Section 200UC59.5	Governing Load Case LC-1.2DL+1.5LL
Member Length 3.000 m	Effective Length 22 6.000 m	Effective Length 33 3.000 m
LTB Length Program determined	β_{22} 2.000	β_{33} 1.000
Utilisation 0.660	Governing Station Start	Governing Check N + M33 + M22 interaction

Governing Design Actions

Station	Start
S	0.000 m
Axial utilisation	0.048
M33 utilisation	0.585
M22 utilisation	0.027
V2 utilisation	0.007
V3 utilisation	0.099
Interaction utilisation	0.660

Capacities

Ncx	1889.297 kN
Ncy	793.045 kN
Nc	793.045 kN
Mbx	152.586 kNm
Mby	67.267 kNm
Vv	337.478 kN

Section Classification

Major axis class	Compact
Minor axis class	Compact
λ web	22.092
λ flange	7.549
Kf	1.000

Applied Actions at Stations

Station	S m	N* kN	M33* kNm	M22* kNm	V3* kN	V2* kN	T* kNm
Start	0.000	-38.270	89.283	1.793	-33.515	-2.260	-0.001
Station 2	0.125	-38.193	85.097	2.075	-33.470	-2.260	-0.001
Station 3	0.250	-38.115	80.916	2.358	-33.425	-2.260	-0.001
Station 4	0.375	-38.037	76.741	2.641	-33.380	-2.260	-0.001
Station 5	0.500	-37.959	72.571	2.923	-33.335	-2.260	-0.001
Station 6	0.625	-37.882	68.407	3.206	-33.291	-2.260	-0.001
Station 7	0.750	-37.804	64.249	3.488	-33.246	-2.260	-0.001
Station 8	0.875	-37.726	60.096	3.771	-33.201	-2.260	-0.001
Station 9	1.000	-37.649	55.949	4.053	-33.156	-2.260	-0.001
Station 10	1.125	-37.571	51.807	4.336	-33.111	-2.260	-0.001
Station 11	1.250	-37.493	47.671	4.618	-33.066	-2.260	-0.001
Station 12	1.375	-37.415	43.541	4.901	-33.021	-2.260	-0.001
Middle	1.500	-37.337	39.416	5.184	-32.976	-2.260	-0.001
Station 14	1.625	-37.260	35.297	5.466	-32.931	-2.260	-0.001
Station 15	1.750	-37.182	31.183	5.749	-32.886	-2.260	-0.001
Station 16	1.875	-37.104	27.075	6.031	-32.842	-2.260	-0.001
Station 17	2.000	-37.027	22.973	6.314	-32.797	-2.260	-0.001
Station 18	2.125	-36.949	18.876	6.596	-32.752	-2.260	-0.001
Station 19	2.250	-36.871	14.785	6.879	-32.707	-2.260	-0.001
Station 20	2.375	-36.793	10.700	7.161	-32.662	-2.260	-0.001
Station 21	2.500	-36.716	6.620	7.444	-32.617	-2.260	-0.001
Station 22	2.625	-36.638	2.546	7.726	-32.572	-2.260	-0.001
Station 23	2.750	-36.560	-1.523	8.009	-32.527	-2.260	-0.001
Station 24	2.875	-36.482	-5.586	8.292	-32.483	-2.260	-0.001
End	3.000	-36.405	-9.643	8.574	-32.438	-2.260	-0.001

Station-by-Station Check

Station	S	Status	Util.	Axial	M33	M22	V2	V3	Governing Check
Start	0.000	PASS	0.660	0.048	0.585	0.027	0.007	0.099	N + M33 + M22 interaction
Station 2	0.125	PASS	0.637	0.048	0.558	0.031	0.007	0.099	N + M33 + M22 interaction
Station 3	0.250	PASS	0.613	0.048	0.530	0.035	0.007	0.099	N + M33 + M22 interaction
Station 4	0.375	PASS	0.590	0.048	0.503	0.039	0.007	0.099	N + M33 + M22 interaction
Station 5	0.500	PASS	0.567	0.048	0.476	0.043	0.007	0.099	N + M33 + M22 interaction
Station 6	0.625	PASS	0.544	0.048	0.448	0.048	0.007	0.099	N + M33 + M22 interaction
Station 7	0.750	PASS	0.521	0.048	0.421	0.052	0.007	0.099	N + M33 + M22 interaction
Station 8	0.875	PASS	0.497	0.048	0.394	0.056	0.007	0.098	N + M33 + M22 interaction
Station 9	1.000	PASS	0.474	0.047	0.367	0.060	0.007	0.098	N + M33 + M22 interaction
Station 10	1.125	PASS	0.451	0.047	0.340	0.064	0.007	0.098	N + M33 + M22 interaction
Station 11	1.250	PASS	0.428	0.047	0.312	0.069	0.007	0.098	N + M33 + M22 interaction
Station 12	1.375	PASS	0.405	0.047	0.285	0.073	0.007	0.098	N + M33 + M22 interaction
Middle	1.500	PASS	0.382	0.047	0.258	0.077	0.007	0.098	N + M33 + M22 interaction
Station 14	1.625	PASS	0.360	0.047	0.231	0.081	0.007	0.098	N + M33 + M22 interaction
Station 15	1.750	PASS	0.337	0.047	0.204	0.085	0.007	0.097	N + M33 + M22 interaction
Station 16	1.875	PASS	0.314	0.047	0.177	0.090	0.007	0.097	N + M33 + M22 interaction
Station 17	2.000	PASS	0.291	0.047	0.151	0.094	0.007	0.097	N + M33 + M22 interaction
Station 18	2.125	PASS	0.268	0.047	0.124	0.098	0.007	0.097	N + M33 + M22 interaction
Station 19	2.250	PASS	0.246	0.046	0.097	0.102	0.007	0.097	N + M33 + M22 interaction
Station 20	2.375	PASS	0.223	0.046	0.070	0.106	0.007	0.097	N + M33 + M22 interaction
Station 21	2.500	PASS	0.200	0.046	0.043	0.111	0.007	0.097	N + M33 + M22 interaction
Station 22	2.625	PASS	0.178	0.046	0.017	0.115	0.007	0.097	N + M33 + M22 interaction
Station 23	2.750	PASS	0.175	0.046	0.010	0.119	0.007	0.096	N + M33 + M22 interaction
Station 24	2.875	PASS	0.206	0.046	0.037	0.123	0.007	0.096	N + M33 + M22 interaction
End	3.000	PASS	0.237	0.046	0.063	0.127	0.007	0.096	N + M33 + M22 interaction

Design Notes

Compression capacity check based on member effective length.

Bending capacity check based on section effective modulus and member bending capacity.

Interaction check currently reported as axial + M33 + M22 utilisation.

Governing result is taken as the maximum utilisation from all FEAKalc stations.