AMETECS	**EOT CRANE STRUCTURE**		TAQA Water Solutions طاقة لحلول المياه KN INTERNATIONAL ARCHITECTS AND ENGINEERS LLC
Transmittal Title:	**EOT CRANE STRUCTURE**	Transmittal Date:	06-04-2026
Document Number:		Transmittal Number:	-

Item No.	Reference No./ Section	Client Comments	AMETECS Responses	Client Responses	STATUS
1.		UKC203x204x11x11 (UC203x203x46) was used as column section in base plate design. Kindly revise the base plate design and the calculation, as UC 203x203x46 was used instead of UC254x254x73. Check the bolt embedment depth if sufficient.	Incorporated		
2.		Design parameters such as seismic parameters shall be clearly stated in the report.	In the design, 20% and 10% of the vertical load have already been considered as horizontal loads. These applied loads include seismic effects and therefore govern the seismic loading.		
3.		Aside from the deflection checking for the beams, provide drift check for the framing system.	Incorporated		

AMETECS	**EOT CRANE STRUCTURE**		TAQA Water Solutions طاقة لحلول المياه KN INTERNATIONAL ARCHITECTS AND ENGINEERS LLC
Transmittal Title:	**EOT CRANE STRUCTURE**	Transmittal Date:	06-04-2026
Document Number:		Transmittal Number:	-

Item No.	Reference No./ Section	Client Comments	AMETECS Responses	Client Responses	STATUS
4.		Specify bolt grade for all the bolt connections in the drawings.	Incorporated in Sheet 1 of 8 (NOTE 5)		
5.		Refer to attached drawings for additional comments	Noted		
6.		HEA 300 to be revised to HEA 450	Incorporated		
7.		The contractor shall ensure that all final mechanical requirements are fully met	For action by contractor		
8.		Setting out and levels shall be fully coordinated with relevant discipline.	For action by contractor		
9.		Grade of anchor bolts shall be specify.	Mentioned in Sheet 2 of drawing (Galv)		

AMETECS	**EOT CRANE STRUCTURE**		TAQA Water Solutions طاقة لحلول المياه KN INTERNATIONAL ARCHITECTS AND ENGINEERS LLC
Transmittal Title:	**EOT CRANE STRUCTURE**	Transmittal Date:	06-04-2026
Document Number:		Transmittal Number:	-

Item No.	Reference No./ Section	Client Comments	AMETECS Responses	Client Responses	STATUS
10.		Ensure that weld thickness is less than the web/flange thickness of structural beam/column	Noted.		
11.		Fabrication drawings is main Contractor/Specialist responsibility.	Noted.		
12.		see other drawings for additional comments.	Noted.		
13.		ALL THE BEAM TAGGING ARE NOT MATCHING WITH ISOMETRIC VIEW SEE DWG.NO: O-15392-GCC-CX-SDW-KN-OHC-ME-GA-001_REV.01	Incorporated		
14.		PLAN AT LEVEL +8.00m	Incorporated		

AMETECS	**EOT CRANE STRUCTURE**	TAQA Water Solutions طاقة لحلول المياه KN INTERNATIONAL ARCHITECTS AND ENGINEERS LLC

Transmittal Title:	**EOT CRANE STRUCTURE**	Transmittal Date:	06-04-2026
Document Number:		Transmittal Number:	-

Item No.	Reference No./ Section	Client Comments	AMETECS Responses	Client Responses	STATUS
15.		Elevation along grid “A” to “E”	Incorporated		
16.		UB 254x254x73 Web thickness is 8.6mm Ensure weld thickness atleast not too closed with web thickness.	Noted; max. weld thickness will be 7 mm along web		
17.		UB 254x146x31	Incorporated		
18.					

CLIENT NAME:	**TAQA-WS**
PROJECT	**O-15392**
PROJECT DESCRIPTION	**6.5 T EOT CRANE STRUCTURE**
DOCUMENT TITLE:	**STRUCTURAL CALCULATION FOR STRUCTURE OF 6.5 T EOT CRANE**
DOCUMENT NUMBER:	**AM250505/DES/1**

Revision History

Rev#	Date of Issue	Status Description	Originator	Checker	Approver
0	29.01.2026	Issued for Approval	NS	NS	
1	17.02.2026	Issued for Approval	NS	NS	
2	04.04.2026	Issued for Approval	NS	NS	

TABLE OF CONTENTS

1. INTRODUCTION 3
2. STRUCTURE DETAILS 3
3. MATERIAL USED 3
4. DESIGN CRITERIA 4
5. REFERENCE STANDARDS 5
6. STATIC LOADS: 5
7. ALLOWABLE STRESSES 5
8. SUMMARY OF DISPLACEMENT: 6
9. LOAD COMBINATIONS 6
10. ANCHOR BOLT & BASEPLATE CALCULATIONS: 6
11. BEAM END FORCES FOR CONNECTION DESIGN 7
    - 11.1 BEAM TO COLUMN (UC254X254X73 to UB254X146X31) 7
    - 11.2 BEAM TO BEAM (UB254X146X31) 7
    - 11.3 CORBEL CONNECTION 8
12. CONCLUSION 8
    - 12.1 GENERAL 8
    - 12.2 MEMBER STRESS RATIOS 8

APPENDICES

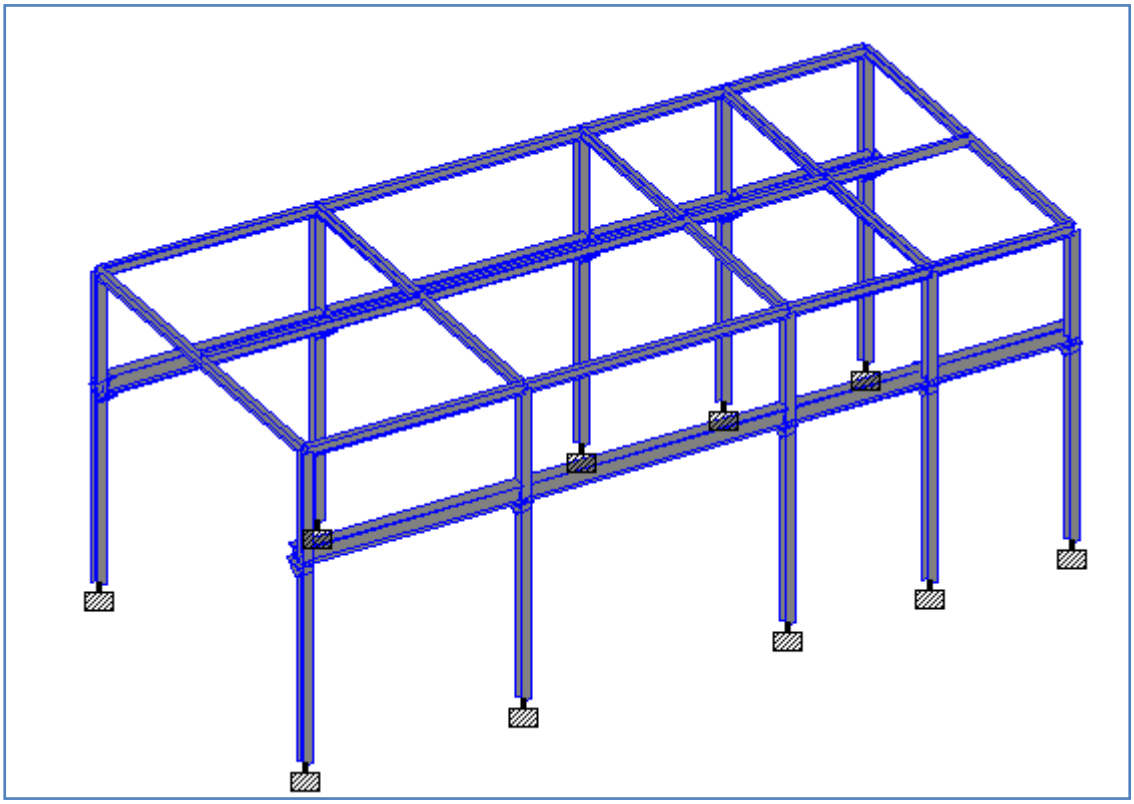
Appendix-A:Staad Report
Appendix-B: Anchor Bolt & Baseplate Calculation
Appendix-C: Connection Design
Appendix-D: Reference Drawings

1. INTRODUCTION

M/s.AL MAKKI ENGINEERING & TECHNICAL SERVICES (AMETECS) intended to design and fabricate **"EOT CRANE STRUCTURE** "conforming to the project specifications and **AISC 360 (LRFD)** code requirements.

This document deals with the design of the **"EOT CRANE STRUCTURE"** for operating conditions.

2. STRUCTURE DETAILS

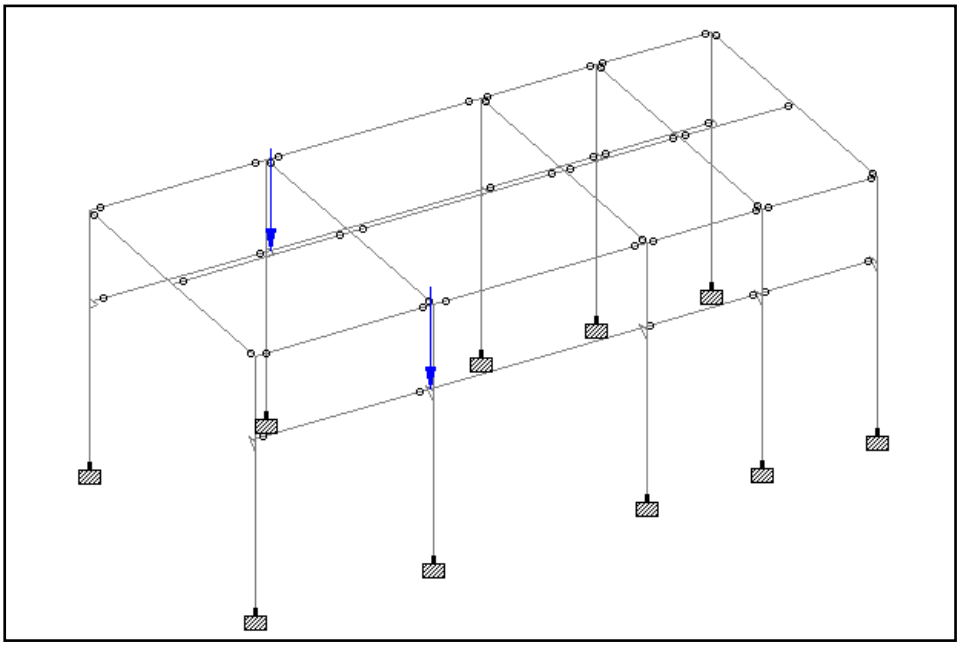


3. MATERIAL USED

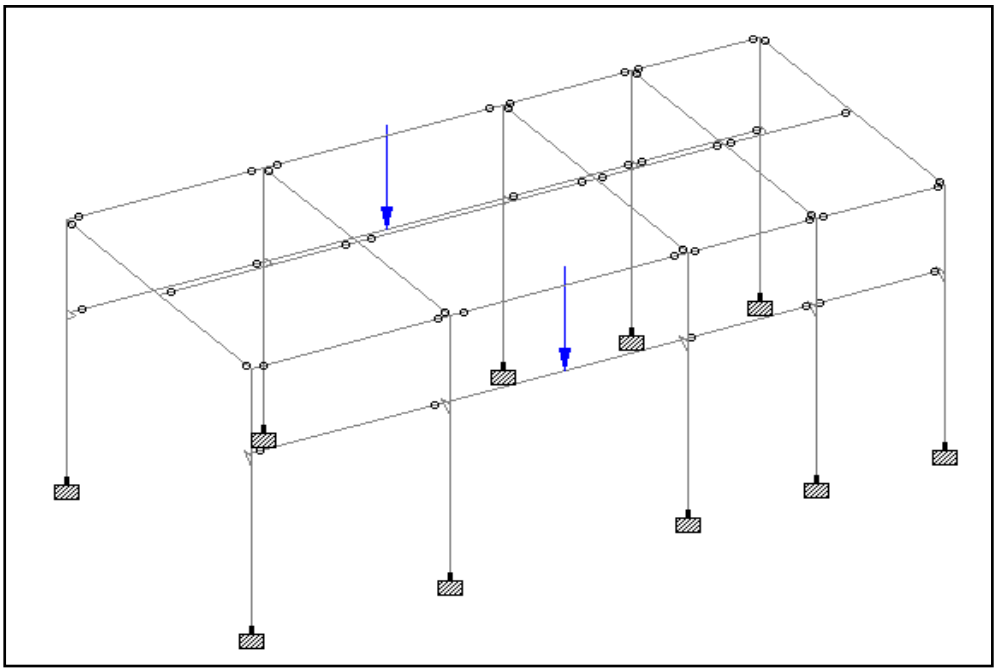
Monorail: Steel with yield strength: **275 MPa**.

4. DESIGN CRITERIA

Case 1



Case 2



STAAD Structural analysis software is used for the analysis.

AISC 360 (LRFD) code is used for the design and analysis of EOT Crane supporting structure.

5. REFERENCE STANDARDS

AISC 360 : Specification for Structural Steel Buildings

6. STATIC LOADS:

DEAD LOADS (DL)

SELF WEIGHT

Self-weight of the structure considered as inbuilt function of staad.

LOAD CALCULATION		
Capacity of EOT Crane structure	65	KN
Impact Factor for lifting equipment	1.5	
Vertical Imapct factor	1.25	
Total weight of EOT crane considering load factor	121.875	KN
Total Assembly weight	20	KN
Total weight of EOT crane + assembly weight	141.875	KN
No of points to which load is applied	2	
Vertical load to be considered in design (DLV)	**70.9**	KN
Lateral load = 20% of the sum of the rated capacity of the crane and the weight of the hoist and trolley (As per code ASCE 4.10.3)	17	KN
No of points to which load is applied	2	
Lateral load to be considered in design (DLL)	**8.5**	KN
Longitudinal force = 10% of the sum of the rated capacity of the crane and the weight of the hoist and trolley (As per code ASCE 4.10.4)	8.5	KN
No of points to which load is applied	2	
Longitudinal load to be considered in design (DLLONG)	**4.25**	KN

7. ALLOWABLE STRESSES

Allowable stresses for Operating condition checked against **AISC 360(LRFD)** and are within the allowable limits.

8. SUMMARY OF DISPLACEMENT:

The displacement summary taken from Staad analysis is given below.

			Horizontal	Vertical	Horizontal	Resultant
	Node	L/C	X mm	Y mm	Z mm	mm
Max X	35	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	**3.621**	-0.035	-0.227	3.628
Min X	1	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	**0.000**	0.000	0.000	0.000
Max Y	1	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	0.000	**0.000**	0.000	0.000
Min Y	63	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	3.165	**-1.854**	0.000	3.668
Max Z	34	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	2.833	-0.365	**0.912**	2.998
Min Z	39	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	2.833	-0.365	**-0.912**	2.998
Max rX	24	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	3.170	-0.240	-0.044	3.179
Min rX	23	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	3.170	-0.240	0.044	3.179
Max rY	28	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	1.958	-0.029	-0.227	1.971
Min rY	26	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	1.958	-0.029	0.228	1.971
Max rZ	53	203 1.0*DLV + 1.0DLL + 1.0DLLONG + 1.0*DL	2.749	-0.193	0.276	2.770
Min rZ	52	203 1.0*DLV + 1.0DLL + 1.0DLLONG + 1.0*DL	2.748	-0.202	0.291	2.771
Max Rst	63	103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL	3.165	-1.854	0.000	**3.668**

Maximum vertical deflection (node-64) = 1.854 mm
Allowable deflection = L/500 mm
= 8800/500
= 17.6 mm
Maximum horizontal deflection (node-35) = 3.621 mm
Allowable deflection = H/500 mm
= 7650/500
=15.3 mm

9. LOAD COMBINATIONS

Load combinations considered are as per ASCE -07.

10. ANCHOR BOLT & BASEPLATE CALCULATIONS:

Anchor bolt is designed based on the loads obtained from structural calculation

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	27	202 1.2*DLV + 1.2DLL + 1.2DLLONG + 1.2*DL	**-0.544**	15.743	0.779	1.792	-0.047	2.399
Min Fx	21	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	**-2.009**	78.584	0.368	-0.145	0.015	5.998
Max Fy	19	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-1.775	**128.425**	0.623	3.345	0.003	5.411
Min Fy	1	202 1.2*DLV + 1.2DLL + 1.2DLLONG + 1.2*DL	-0.730	**14.985**	-0.694	-1.624	0.034	2.874
Max Fz	15	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-1.760	25.233	**1.347**	3.041	-0.002	5.386
Min Fz	13	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-1.760	25.233	**-1.347**	-3.041	0.002	5.386
Max Mx	19	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-1.775	128.425	0.623	**3.345**	0.003	5.411
Min Mx	21	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-1.775	128.425	-0.623	**-3.345**	-0.003	5.411
Max My	25	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-0.645	18.206	-0.877	-2.012	**0.056**	2.829
Min My	27	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	-0.645	18.206	0.877	2.012	**-0.056**	2.829
Max Mz	21	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	-2.009	78.584	0.368	-0.145	0.015	**5.998**
Min Mz	25	202 1.2*DLV + 1.2DLL + 1.2DLLONG + 1.2*DL	-0.544	15.743	-0.779	-1.792	0.047	**2.399**

Fx = 2.009kN Mx = 3.345kNm
Fy = 128.425 kN My = 0.056kNm
Fz = 1.347kN Mz = 5.998kNm

Limcon software is used to analyze the base plate and anchor bolt as per AISC standard.

Bolt diameter: HST M20, 4 no's on each base plate of size 400X400X20thk.Refer Appendix B for bolt calculation.

11. BEAM END FORCES FOR CONNECTION DESIGN

11.1 BEAM TO COLUMN (UC254X254X73 to UB254X146X31)

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	18	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	23	**11.439**	3.859	-0.000	0.000	0.000	8.019
Min Fx	3	102 1.2*DLV + 1.2DLL +1.2DLLONG+1.2*DL	4	**0.683**	2.089	0.000	0.000	0.000	2.823
Max Fy	18	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	23	11.439	**3.859**	-0.000	0.000	0.000	8.019
Min Fy	85	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	24	11.439	**-3.859**	0.000	-0.000	-0.000	8.019
Max Fz	85	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	-1.549	**0.000**	0.000	-0.002	-4.810
Min Fz	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	23	6.482	3.616	**-0.000**	0.000	0.000	6.553
Max Mx	3	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	4	0.796	2.438	0.000	**0.000**	0.000	3.294
Min Mx	3	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	4	0.796	2.438	0.000	**0.000**	0.000	3.294
Max My	3	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	61	0.809	0.406	0.000	-0.000	**0.001**	-2.975
Min My	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	1.549	-0.000	-0.000	**-0.002**	-4.810
Max Mz	85	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	24	11.439	-3.859	0.000	-0.000	-0.000	**8.019**
Min Mz	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	1.549	-0.000	-0.000	-0.002	**-4.810**

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	19	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	20	**10.193**	-11.439	1.023	0.000	-3.228	-22.292
Min Fx	24	102 1.2*DLV + 1.2DLL +1.2DLLONG+1.2*DL	30	**2.661**	-0.752	-0.312	-0.000	-1.168	2.874
Max Fy	20	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	22	10.193	**11.439**	1.023	0.000	-3.228	22.292
Min Fy	19	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	20	10.193	**-11.439**	1.023	0.000	-3.228	-22.292
Max Fz	20	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	22	9.995	6.482	**1.961**	-0.000	-4.731	10.623
Min Fz	10	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	10	6.890	1.015	**-0.753**	0.000	-1.082	-1.083
Max Mx	5	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	6	7.375	0.796	-0.663	**0.000**	-0.937	-1.183
Min Mx	5	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	6	7.299	0.809	-0.653	**-0.000**	-0.904	-1.215
Max My	20	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	23	7.076	6.482	1.961	-0.000	**0.466**	-6.553
Min My	20	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	22	9.995	6.482	1.961	-0.000	**-4.731**	10.623
Max Mz	20	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	22	10.193	11.439	1.023	0.000	-3.228	**22.292**
Min Mz	19	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	20	10.193	-11.439	1.023	0.000	-3.228	**-22.292**

From the above beam end forces summary, maximum Fx, Fy & Fz values are taken for the design. **Limcon** software is used for the design.

11.2 BEAM TO BEAM (UB254X146X31)

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	18	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	23	**11.439**	3.859	-0.000	0.000	0.000	8.019
Min Fx	87	102 1.2*DLV + 1.2DLL +1.2DLLONG+1.2*DL	65	**0.000**	0.689	0.000	0.000	0.000	0.000
Max Fy	18	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	23	11.439	**3.859**	-0.000	0.000	0.000	8.019
Min Fy	85	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	24	11.439	**-3.859**	0.000	-0.000	-0.000	8.019
Max Fz	85	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	-1.549	**0.000**	0.000	-0.002	-4.810
Min Fz	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	23	6.482	3.616	**-0.000**	0.000	0.000	6.553
Max Mx	87	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	65	0.000	0.804	0.000	**0.000**	0.000	0.000
Min Mx	88	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	64	0.001	1.853	-0.000	**-0.000**	0.000	2.504
Max My	3	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	61	0.809	0.406	0.000	-0.000	**0.001**	-2.975
Min My	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	1.549	-0.000	-0.000	**-0.002**	-4.810
Max Mz	85	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	24	11.439	-3.859	0.000	-0.000	-0.000	**8.019**
Min Mz	18	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	64	6.482	1.549	-0.000	-0.000	-0.002	**-4.810**

From the above beam end forces summary, maximum Fx, Fy & Fz values are taken for the design. **Limcon** software is used for the design.

11.3 CORBEL CONNECTION

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	40	202 1.2*DLV + 1.2DLL + 1.2DLLONG + 1.2*DL	39	**-8.671**	17.320	-0.997	0.280	0.378	2.191
Min Fx	65	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	52	**-29.301**	-77.230	2.421	-0.111	-0.478	-1.894
Max Fy	35	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	34	-17.240	**34.724**	-0.377	0.124	0.154	5.050
Min Fy	65	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	22	-29.301	**-77.450**	2.421	-0.111	0.006	13.574
Max Fz	65	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	52	-16.230	-42.105	**5.133**	0.356	-1.018	-1.469
Min Fz	74	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	57	-16.230	-42.105	**-5.133**	-0.356	1.018	-1.469
Max Mx	65	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	52	-16.230	-42.105	5.133	**0.356**	-1.018	-1.469
Min Mx	74	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	57	-16.230	-42.105	-5.133	**-0.356**	1.018	-1.469
Max My	74	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	57	-16.230	-42.105	-5.133	-0.356	**1.018**	-1.469
Min My	65	201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL	52	-16.230	-42.105	5.133	0.356	**-1.018**	-1.469
Max Mz	65	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	22	-29.301	-77.450	2.421	-0.111	0.006	**13.574**
Min Mz	65	101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL	52	-29.301	-77.230	2.421	-0.111	-0.478	**-1.894**

12. CONCLUSION

12.1 GENERAL

The calculations proved that the structure meets the requirements of **AISC 360 (LRFD)** for operating conditions.

12.2 MEMBER STRESS RATIOS

The maximum stress ratio on the EOT Crane structure is less than 1.0

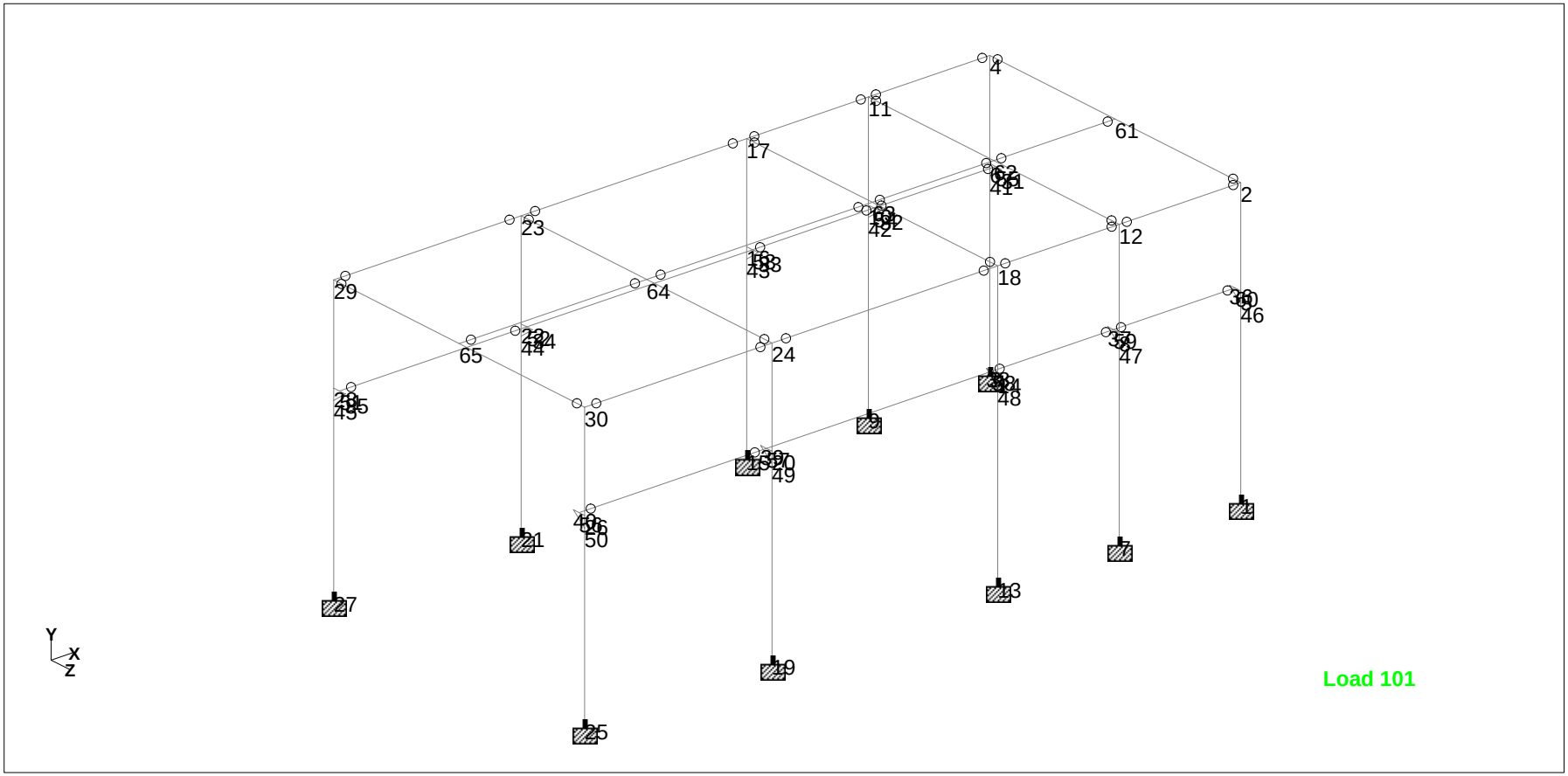
13. CONNECTION SUMMARY

Connection type	Members	Bolt	Plate details	Checks and status
beam to beam	UB254x146x31 to UB254X146X31	6 x M16 Bolts	End plate 220x160x10mm	End plate connection design and passed
beam to column	UC 254x254x73 to UB254X146X31	8 x M16 Bolts	End plate 391x160x12mm	End plate connection design and passed
corbel connection	UC 254x254x73 to HEA450	4 x M20 Bolts	HEA450 & UC 254X254X73 Flange	Shear check and passed
Baseplate/Anchor bolt	Column to Baseplate	4 x HST M20	400X400X20mm	Shear strength & pryout strength verified. Passed

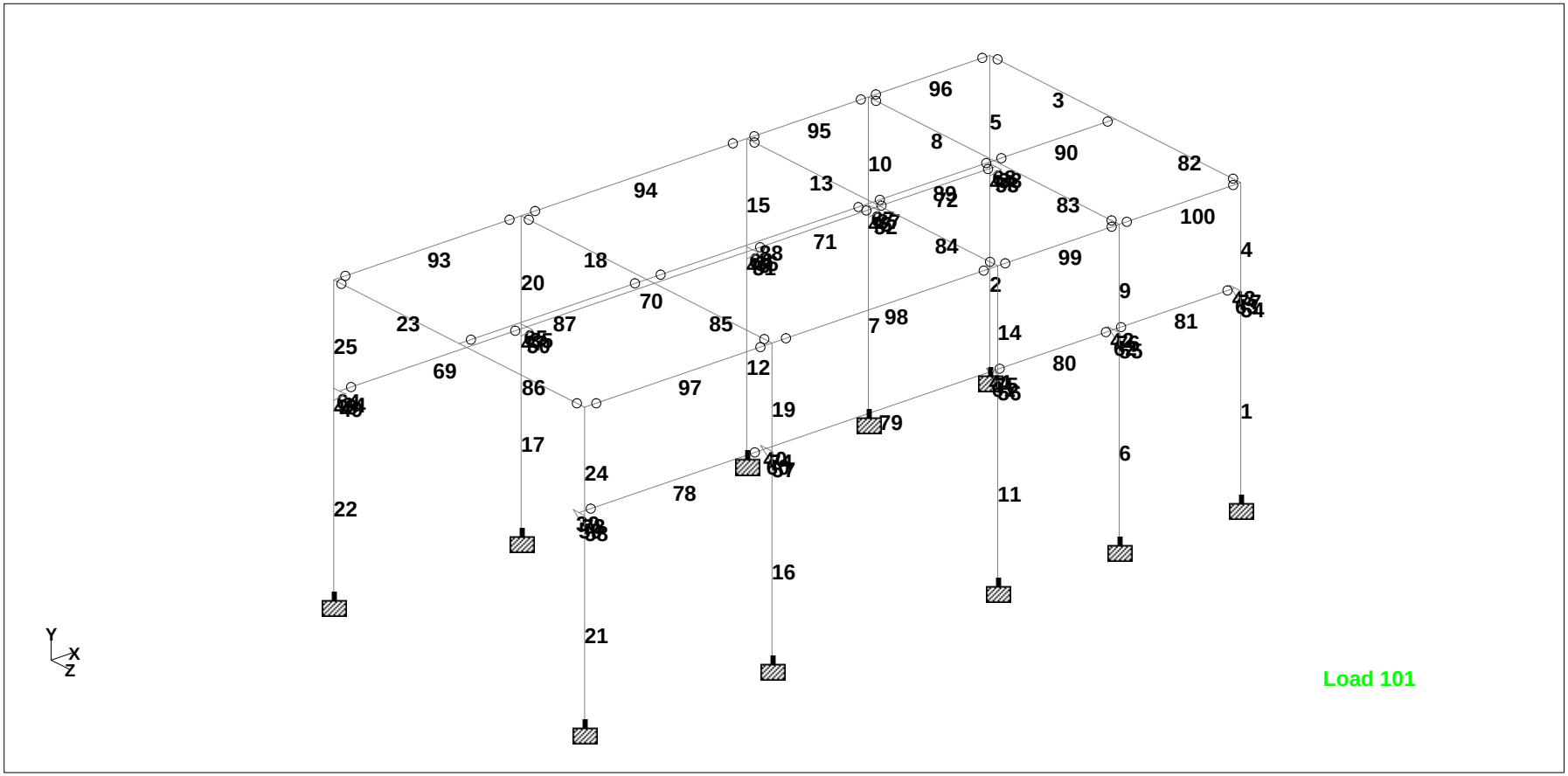
Appendix-A

Staad Report

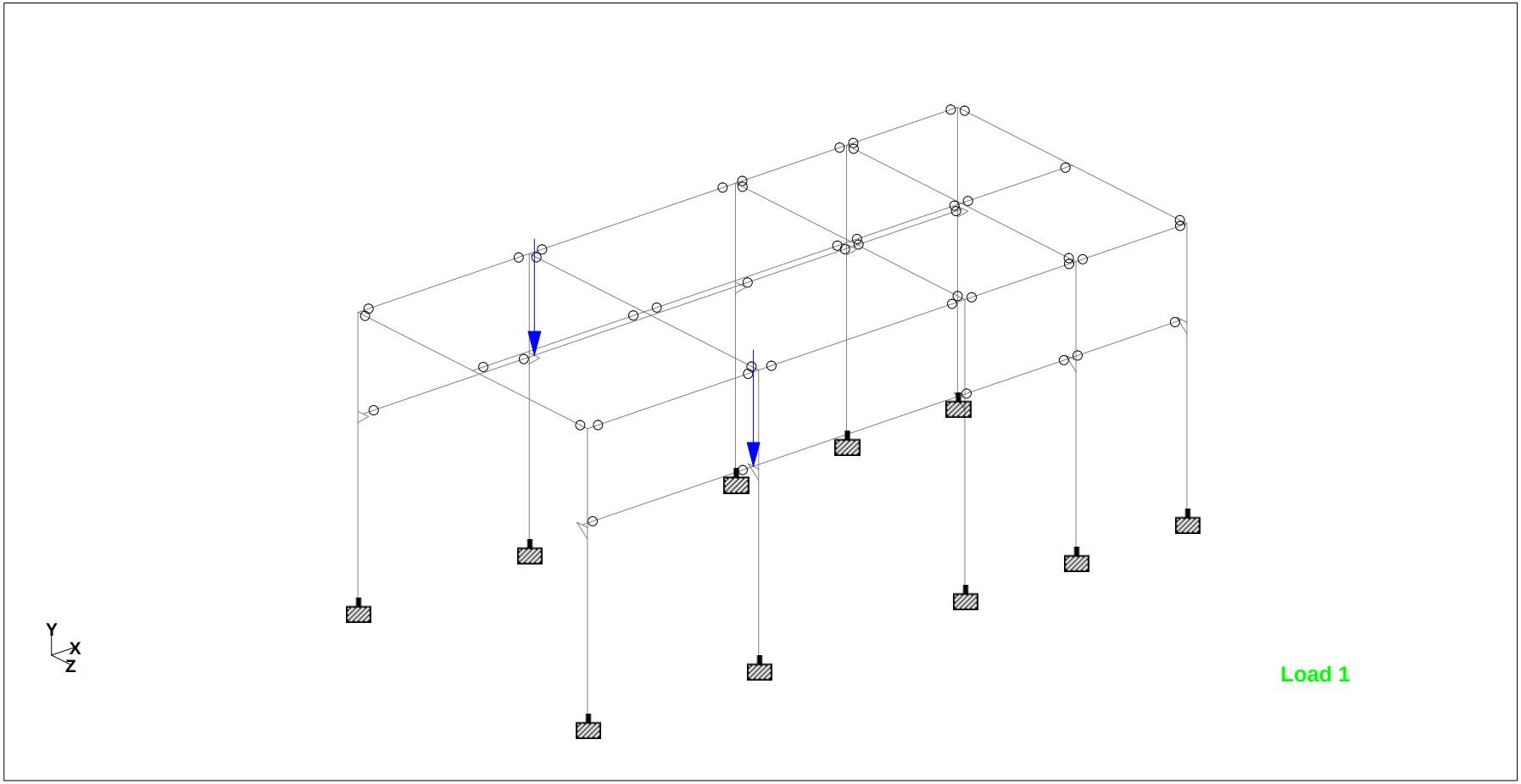
Software licensed to	Job No 25334	Sheet No 1	Rev 1
	Part		
Job Title monorail	Ref		
	By	Date 16.02.2026	Chd
Client ametecs	File monorail 6.5 ton_25.02.2(	Date/Time 25-Feb-2026 13:41	



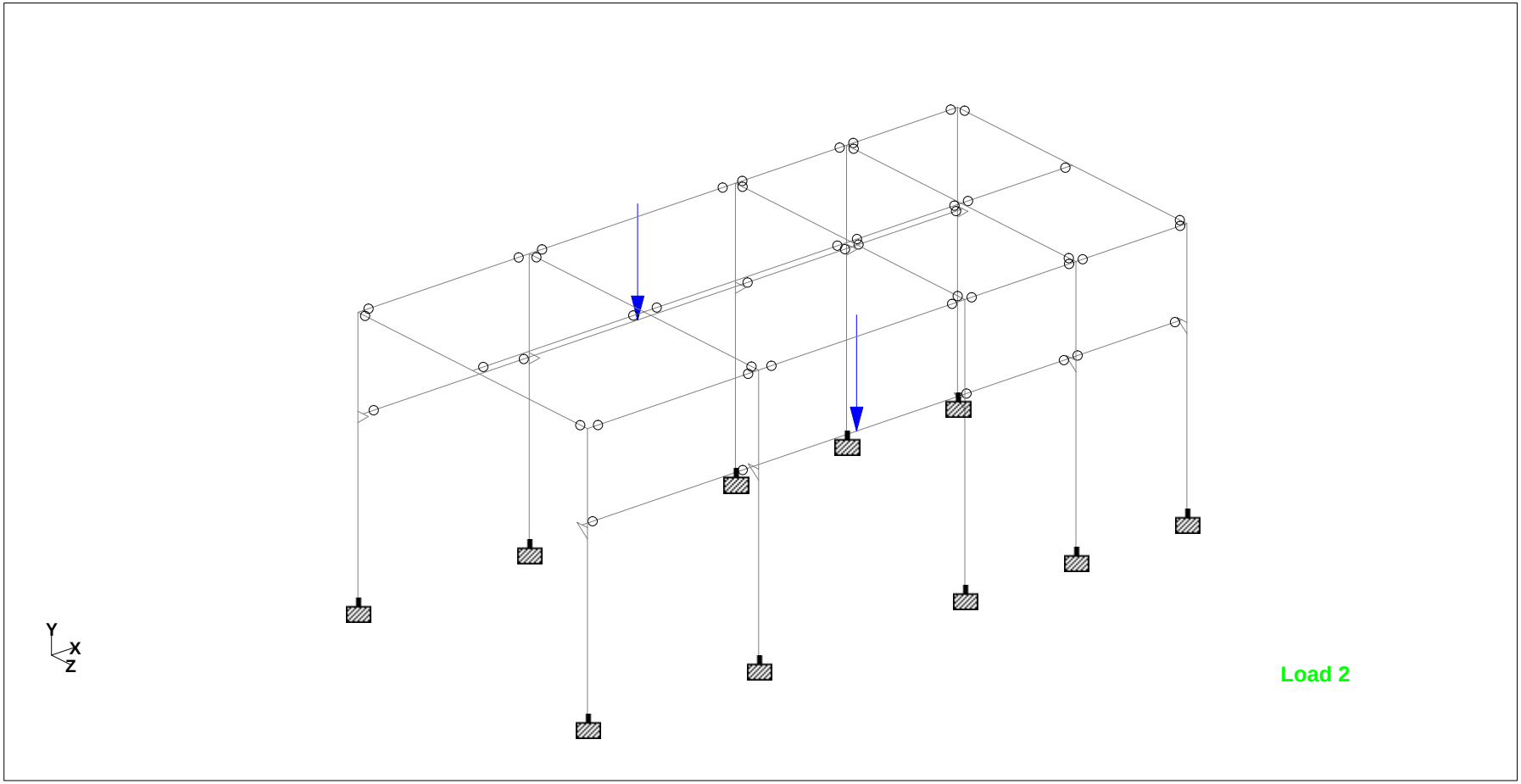
NODE NUMBERS



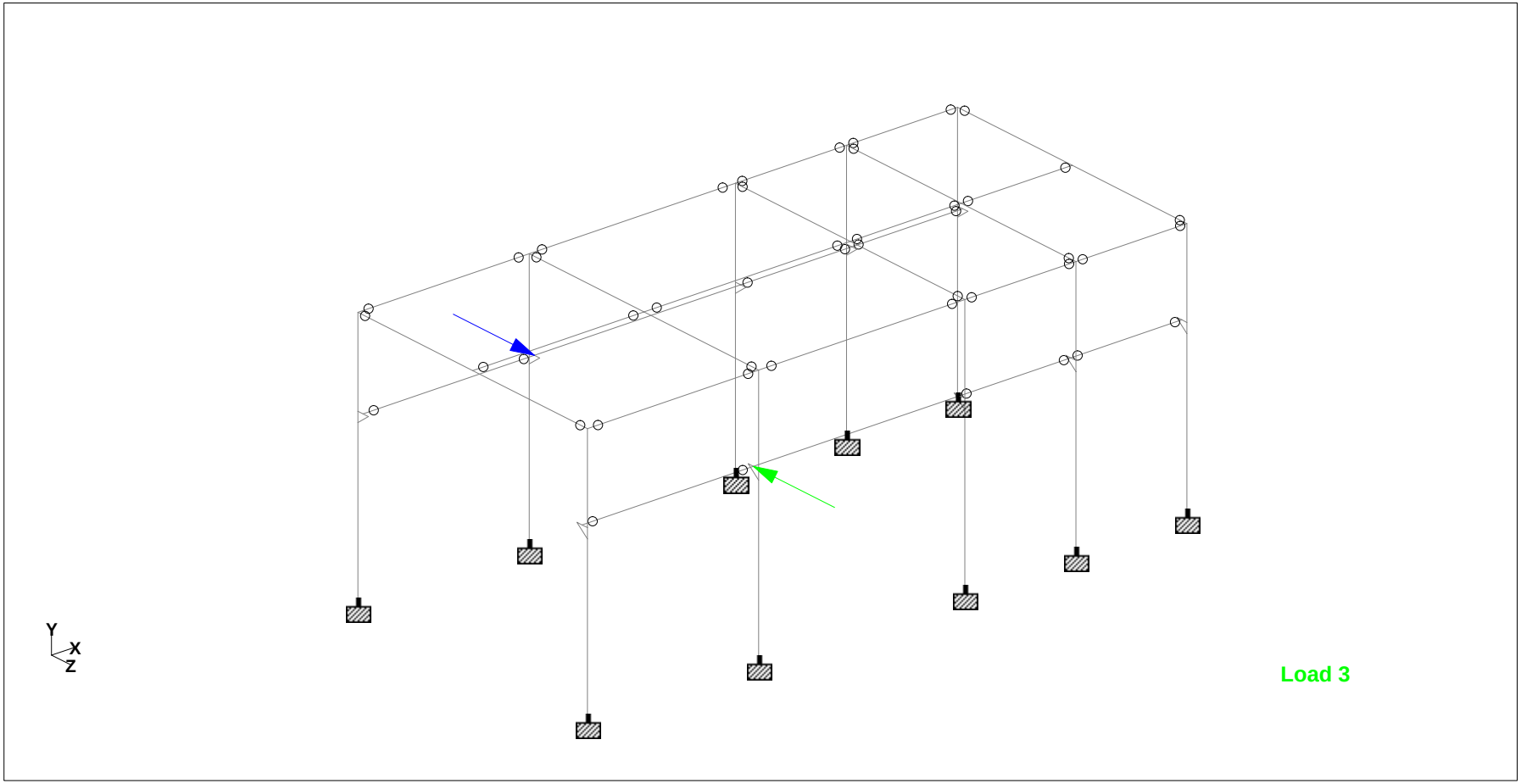
BEAM NUMBERS



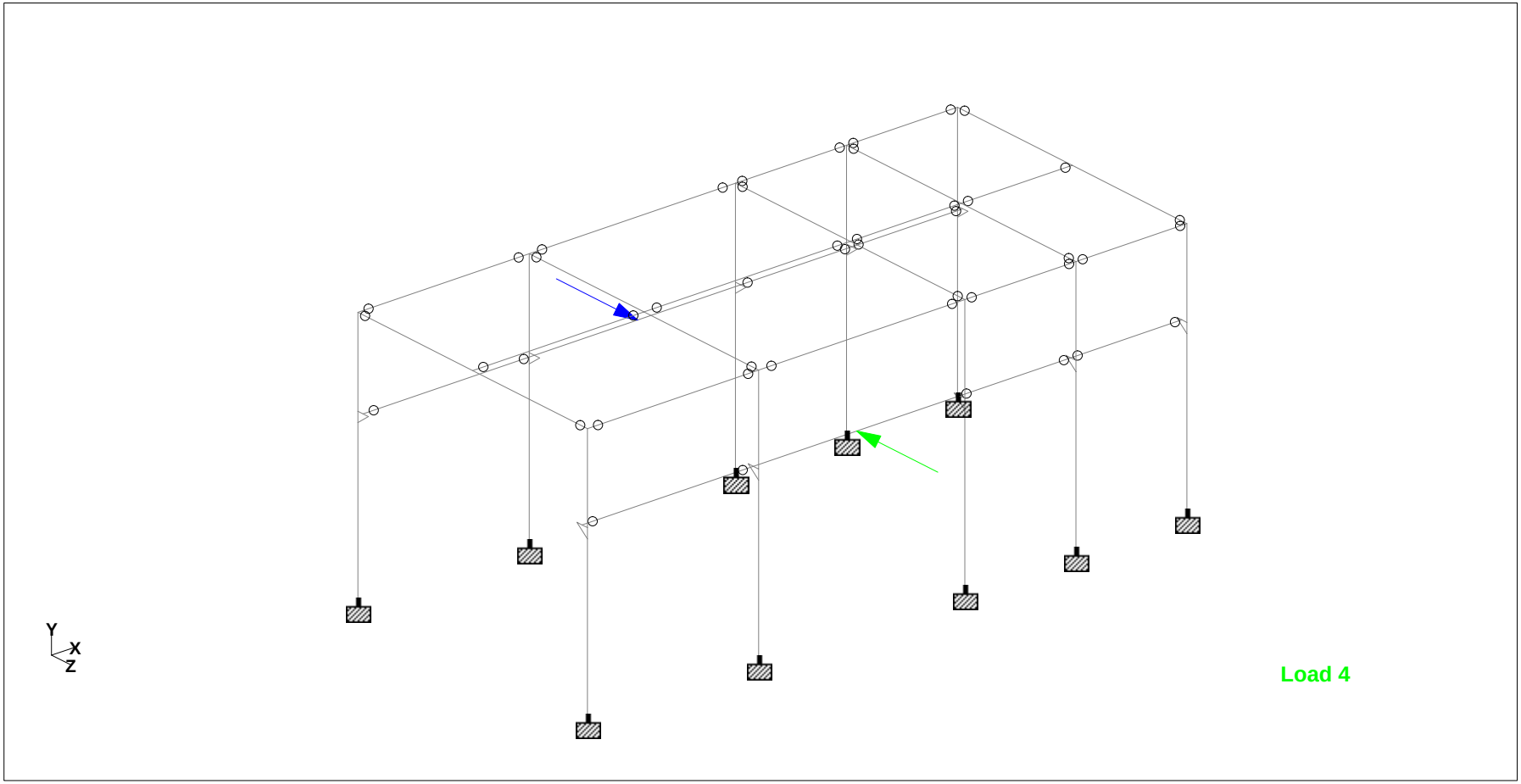
CASE 1 CRANE LOAD VERTICAL (DLV)



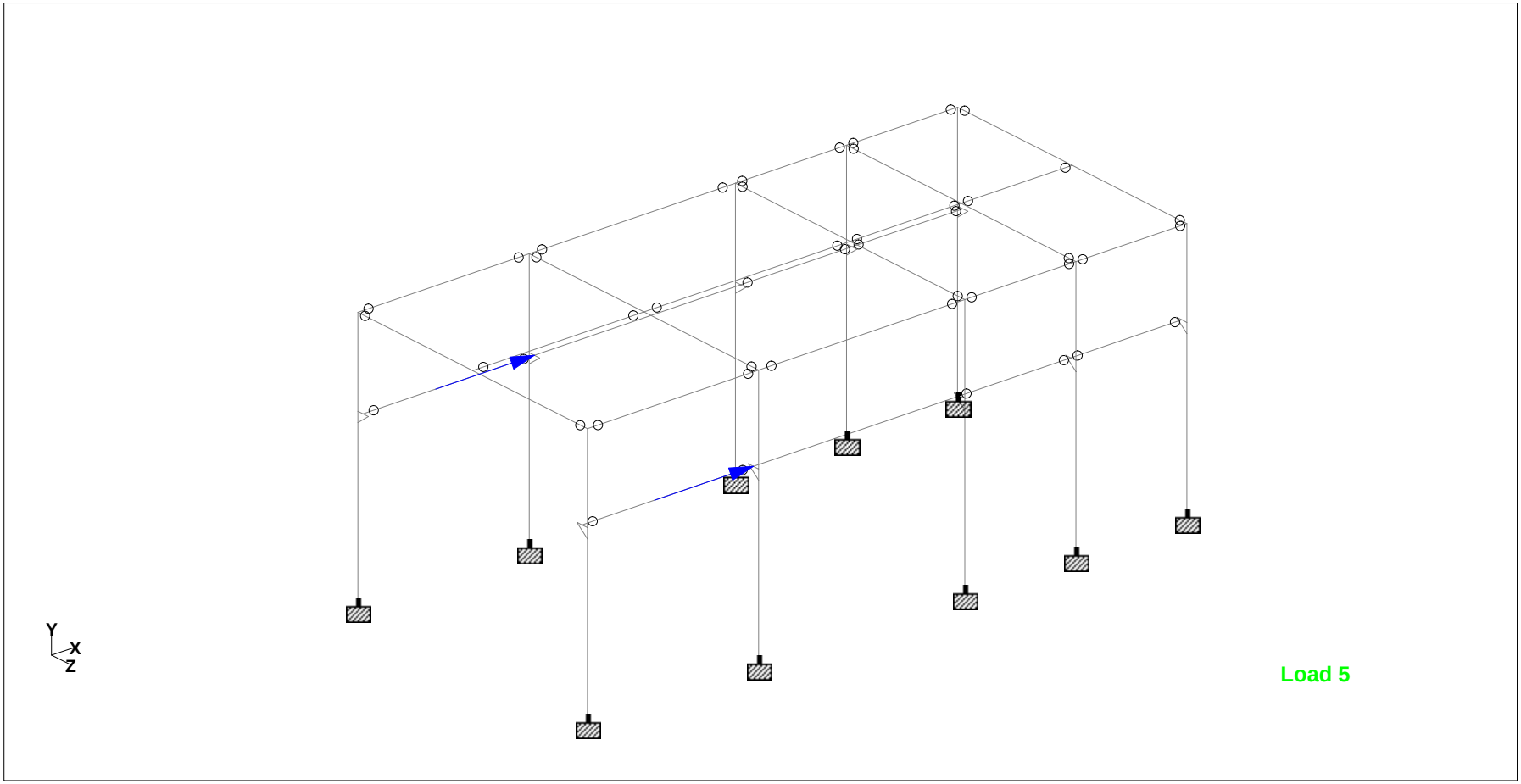
CASE 2 CRANE LOAD VERTICAL (DLV)



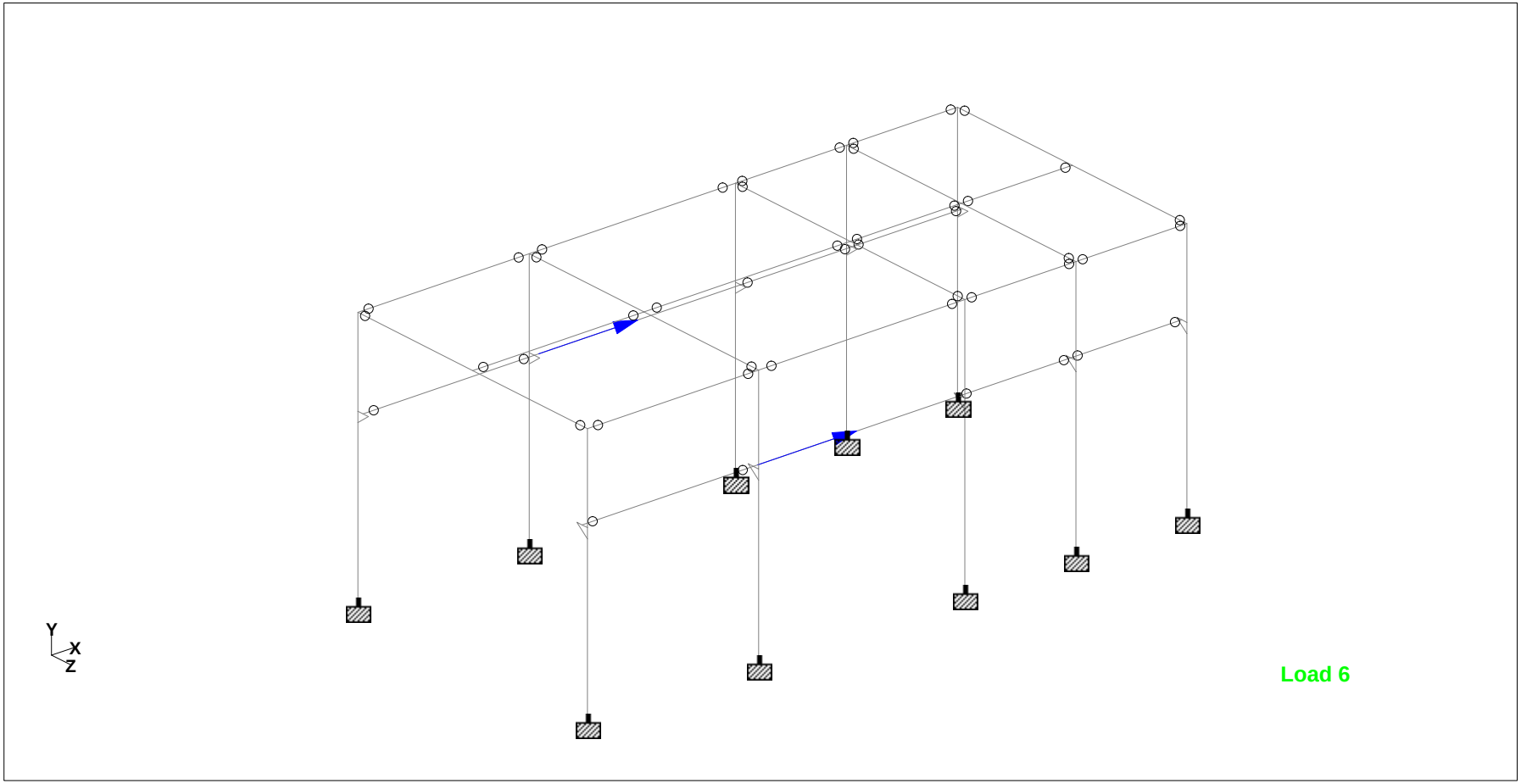
CASE 1 DEAD LOAD LATERAL (DLL)



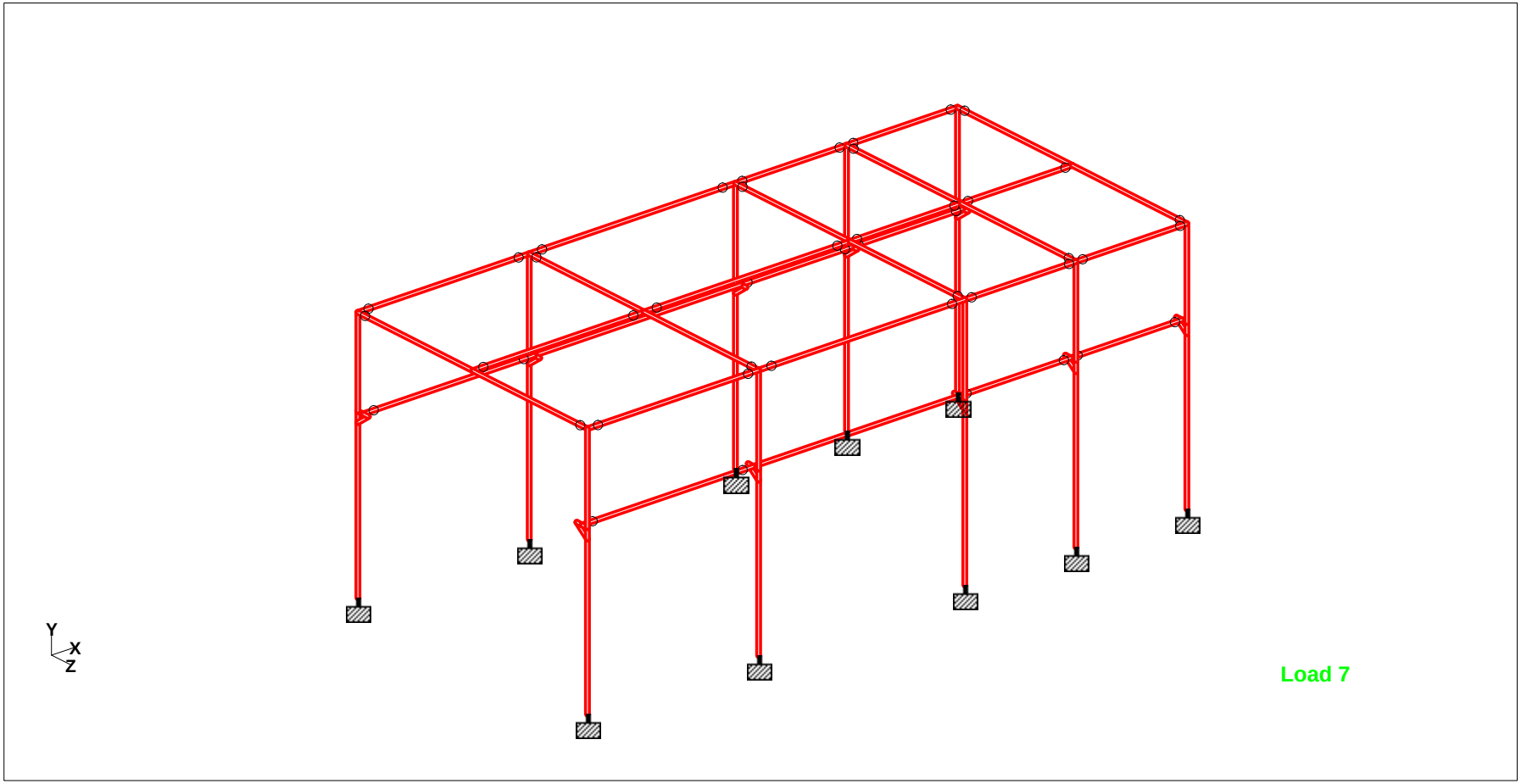
CASE 2 DEAD LOAD LATERAL (DLL)



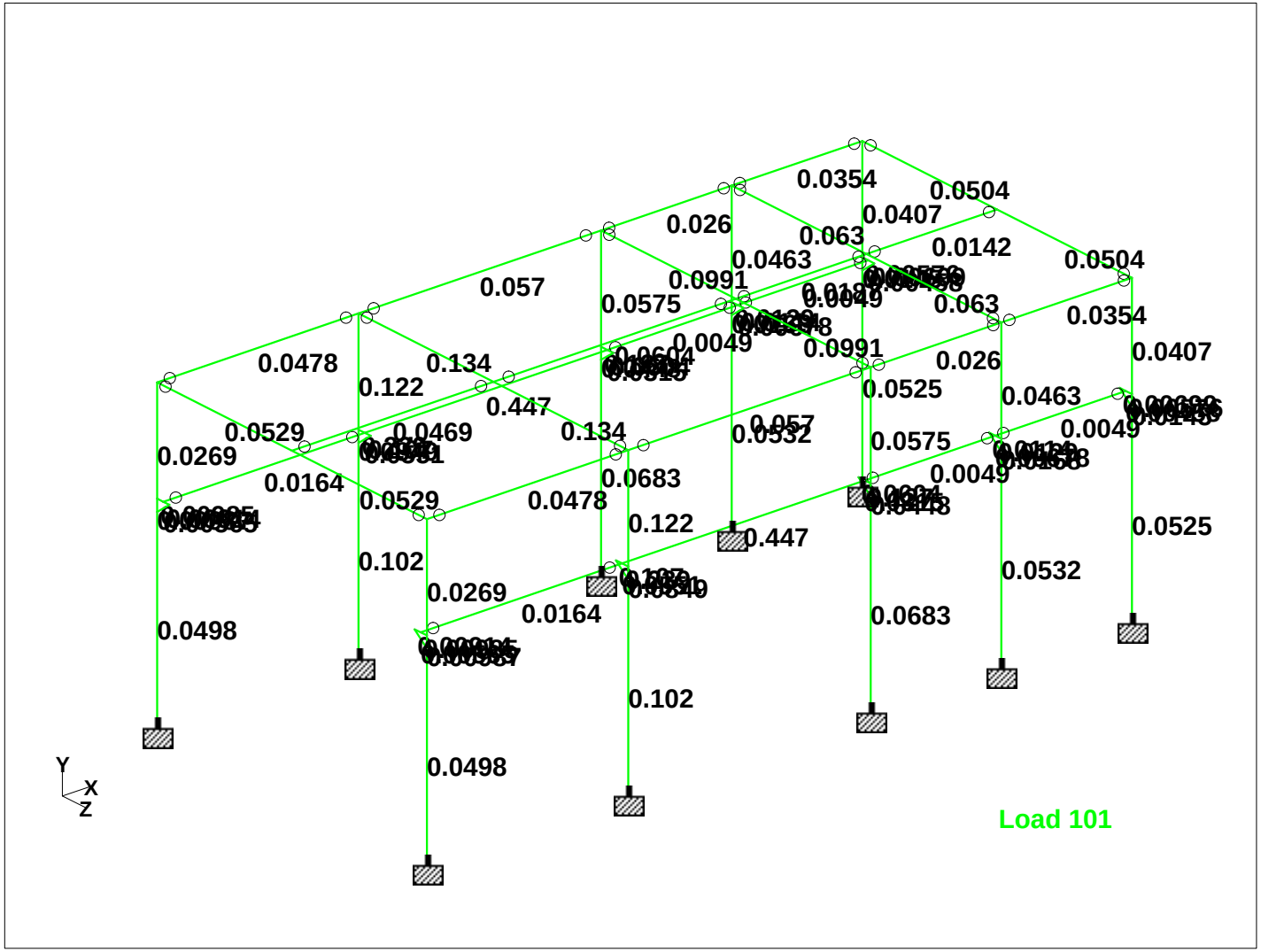
CASE 1 DEAD LOAD LONGITUDINAL (DLLONG)



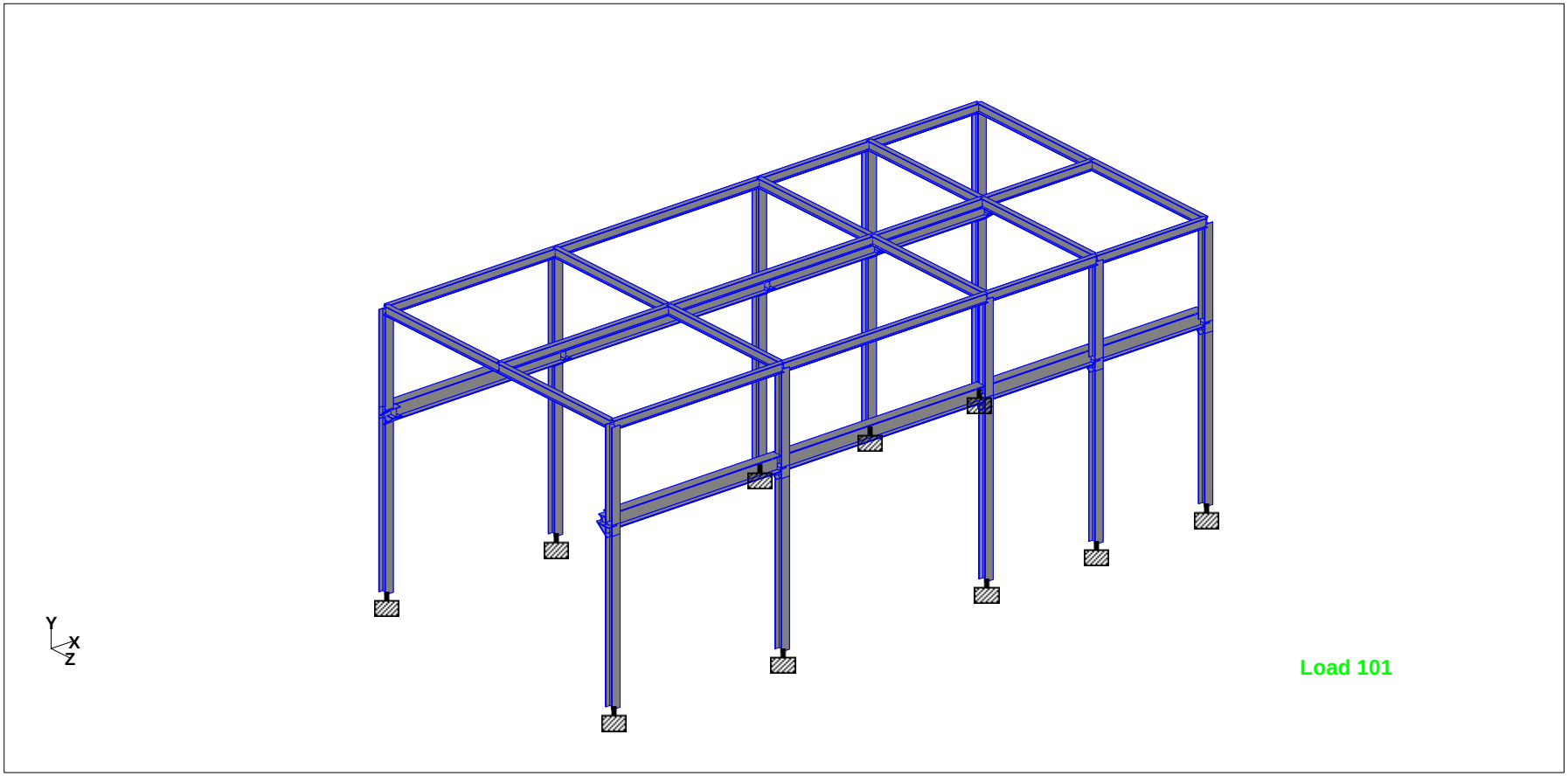
CASE 2 DEAD LOAD LONGITUDINAL (DLLONG)



SELFWEIGHT(DL)



UTILIZATION RATIO



WHOLE STRUCTURE

```
*****************************************************
*                                                   *
*           STAAD.Pro V8i SELECTseries6             *
*           Version  20.07.11.33                    *
*           Proprietary Program of                  *
*           Bentley Systems, Inc.                   *
*           Date=    FEB 25, 2026                   *
*           Time=    17:43: 9                       *
*                                                   *
*      USER ID:                                     *
*****************************************************
```

```
    1. STAAD SPACE
INPUT FILE: W:\project new\25334_Ametcs_Design_of_steel_structure_\staad\monorail 6.5 ton_25.02.2026.STD
    2. START JOB INFORMATION
    3. ENGINEER DATE 16.02.2026
    4. JOB NAME MONORAIL
    5. JOB CLIENT AMETECS
    6. JOB NO 25334
    7. JOB REV 1
    8. END JOB INFORMATION
    9. INPUT WIDTH 79
   10. UNIT MMS KN
   11. JOINT COORDINATES
   12. 1 0 0 0; 2 0 7650 0; 3 0 0 -8800; 4 0 7650 -8800; 5 0 5000 0; 6 0 5000 -8800
   13. 7 -3500 0 0; 8 -3500 5000 0; 9 -3500 0 -8800; 10 -3500 5000 -8800
   14. 11 -3500 7650 -8800; 12 -3500 7650 0; 13 -7000 0 0; 14 -7000 5000 0
   15. 15 -7000 0 -8800; 16 -7000 5000 -8800; 17 -7000 7650 -8800; 18 -7000 7650 0
   16. 19 -13500 0 0; 20 -13500 5000 0; 21 -13500 0 -8800; 22 -13500 5000 -8800
   17. 23 -13500 7650 -8800; 24 -13500 7650 0; 25 -18900 0 0; 26 -18900 5000 0
   18. 27 -18900 0 -8800; 28 -18900 5000 -8800; 29 -18900 7650 -8800
   19. 30 -18900 7650 0; 31 0 5000 -8400; 32 -3500 5000 -8400; 33 -7000 5000 -8400
   20. 34 -13500 5000 -8400; 35 -18900 5000 -8400; 36 0 5000 -400; 37 -3500 5000 -400
   21. 38 -7000 5000 -400; 39 -13500 5000 -400; 40 -18900 5000 -400; 41 0 4700 -8800
   22. 42 -3500 4700 -8800; 43 -7000 4700 -8800; 44 -13500 4700 -8800
   23. 45 -18900 4700 -8800; 46 0 4700 0; 47 -3500 4700 0; 48 -7000 4700 0
   24. 49 -13500 4700 0; 50 -18900 4700 0; 51 -18900 5000 -8600; 52 -13500 5000 -8600
   25. 53 -7000 5000 -8600; 54 -3500 5000 -8600; 55 0 5000 -8600; 56 -18900 5000 -200
   26. 57 -13500 5000 -200; 58 -7000 5000 -200; 59 -3500 5000 -200; 60 0 5000 -200
   27. 61 0 7650 -4400; 62 -3500 7650 -4400; 63 -7000 7650 -4400
   28. 64 -13500 7650 -4400; 65 -18900 7650 -4400
   29. MEMBER INCIDENCES
   30. 1 1 46; 2 3 41; 3 4 61; 4 5 2; 5 6 4; 6 7 47; 7 9 42; 8 11 62; 9 8 12
   31. 10 10 11; 11 13 48; 12 15 43; 13 17 63; 14 14 18; 15 16 17; 16 19 49; 17 21 44
   32. 18 23 64; 19 20 24; 20 22 23; 21 25 50; 22 27 45; 23 29 65; 24 26 30; 25 28 29
   33. 34 35 51; 35 34 52; 36 33 53; 37 32 54; 38 31 55; 39 40 56; 40 39 57; 41 38 58
   34. 42 37 59; 43 36 60; 44 41 6; 45 42 10; 46 43 16; 47 44 22; 48 45 28; 49 45 35
   35. 50 44 34; 51 43 33; 52 42 32; 53 41 31; 54 46 5; 55 47 8; 56 48 14; 57 49 20
   36. 58 50 26; 59 50 40; 60 49 39; 61 48 38; 62 47 37; 63 46 36; 64 51 28; 65 52 22
   37. 66 53 16; 67 54 10; 68 55 6; 69 51 52; 70 52 53; 71 53 54; 72 54 55; 73 56 26
   38. 74 57 20; 75 58 14; 76 59 8; 77 60 5; 78 56 57; 79 57 58; 80 58 59; 81 59 60
```

```
39. 82 61 2; 83 62 12; 84 63 18; 85 64 24; 86 65 30; 87 65 64; 88 64 63; 89 63 62
40. 90 62 61; 93 29 23; 94 23 17; 95 17 11; 96 11 4; 97 30 24; 98 24 18; 99 18 12
41. 100 12 2
42. START GROUP DEFINITION
43. MEMBER
44. _COLUMN 4 5 9 10 14 15 19 20 24 25
45. _BEAM 3 8 13 18 23 82 TO 86
46. _TOPBRACING 3 8 13 18 23 82 TO 90
47. END GROUP DEFINITION
48. DEFINE MATERIAL START
49. ISOTROPIC STEEL
50. E 205
51. POISSON 0.3
52. DENSITY 7.68195E-008
53. ALPHA 1.2E-005
54. DAMP 0.03
55. TYPE STEEL
56. STRENGTH FY 0.2532 FU 0.4078 RY 1.5 RT 1.2
57. END DEFINE MATERIAL
58. MEMBER PROPERTY BRITISH
59. 1 2 4 TO 7 9 TO 12 14 TO 17 19 TO 22 24 25 34 TO 68 73 TO 76 -
60. 77 TABLE ST UC254X254X73
61. MEMBER PROPERTY EUROPEAN
62. 69 TO 72 78 TO 81 TABLE ST HE450A
63. MEMBER PROPERTY BRITISH
64. 3 8 13 18 23 82 TO 90 93 TO 100 TABLE ST UB254X146X31
65. CONSTANTS
66. BETA 90 MEMB 1 2 4 TO 7 9 TO 12 14 TO 17 19 TO 22 24 25 44 TO 48 54 TO 58
67. MATERIAL STEEL ALL
68. SUPPORTS
69. 1 3 7 9 13 15 19 21 25 27 FIXED
70. MEMBER RELEASE
71. 69 71 72 78 80 81 START MY MZ
72. 69 71 72 78 80 81 END MY MZ
73. 87 TO 90 93 TO 100 START MY
74. 87 TO 90 93 TO 100 END MY
75. 3 8 13 18 23 START MX MY
76. 82 TO 86 END MX MY
77. LOAD 1 LOADTYPE NONE  TITLE CASE 1 CRANE LOAD VERTICAL (DLV)
78. JOINT LOAD
79. 52 57 FY -70.93
80. LOAD 2 LOADTYPE NONE  TITLE CASE 2 CRANE LOAD VERTICAL (DLV)
81. MEMBER LOAD
82. 70 79 CON GY -70.93 3250
83. LOAD 3 LOADTYPE NONE  TITLE CASE 1 DEAD LOAD LATERAL (DLL)
84. JOINT LOAD
85. 52 FZ 8.5
86. 57 FZ -8.5
87. LOAD 4 LOADTYPE NONE  TITLE CASE 2 DEAD LOAD LATERAL (DLL)
88. MEMBER LOAD
89. 70 CON GZ 8.5 3250
90. 79 CON GZ -8.5 3250
91. LOAD 5 LOADTYPE NONE  TITLE CASE 1 DEAD LOAD LONGITUDINAL (DLLONG)
92. JOINT LOAD
93. 52 57 FX 4.25
94. LOAD 6 LOADTYPE NONE  TITLE CASE 2 DEAD LOAD LONGITUDINAL (DLLONG)
```

```
 95. MEMBER LOAD
 96. 70 79 CON GX 4.25 3250
 97. LOAD 7 LOADTYPE NONE  TITLE SELFWEIGHT(DL)
 98. SELFWEIGHT Y -1.1
 99. LOAD COMB 101 1.4*DLV +1.4DLL +1.4DLLONG + 1.4 *DL
100. 1 1.4 3 1.4 5 1.4 7 1.4
101. LOAD COMB 102 1.2*DLV + 1.2DLL +1.2DLLONG+1.2*DL
102. 1 1.2 3 1.2 5 1.2 7 1.2
103. LOAD COMB 103 1.0*DLV + 1.0DLL + 1.0DLLONG +1.0*DL
104. 1 1.0 3 1.0 5 1.0 7 1.0
105. LOAD COMB 201 1.4*DLV + 1.4DLL + 1.4DLLONG + 1.4 *DL
106. 2 1.4 4 1.4 6 1.4 7 1.4
107. LOAD COMB 202 1.2*DLV + 1.2DLL + 1.2DLLONG + 1.2*DL
108. 2 1.2 4 1.2 6 1.2 7 1.2
109. LOAD COMB 203 1.0*DLV + 1.0DLL + 1.0DLLONG + 1.0*DL
110. 2 1.0 4 1.0 6 1.0 7 1.0
111. PERFORM ANALYSIS
```

P R O B L E M S T A T I S T I C S

NUMBER OF JOINTS	**65**	**NUMBER OF MEMBERS**	**90**
NUMBER OF PLATES	**0**	**NUMBER OF SOLIDS**	**0**
NUMBER OF SURFACES	**0**	**NUMBER OF SUPPORTS**	**10**

SOLVER USED IS THE OUT-OF-CORE BASIC SOLVER

ORIGINAL/FINAL BAND-WIDTH= 59/ 10/ 60 DOF
TOTAL PRIMARY LOAD CASES = 7, TOTAL DEGREES OF FREEDOM = 330
TOTAL LOAD COMBINATION CASES = 6 SO FAR.
SIZE OF STIFFNESS MATRIX = 20 DOUBLE KILO-WORDS
REQRD/AVAIL. DISK SPACE = 12.4/ 52120.5 MB

```
112. PARAMETER 1
113. CODE LRFD
114. FYLD 0.275 ALL
115. DFF 500 ALL
116. CHECK CODE ALL
```

STAAD.Pro CODE CHECKING - (LRFD 3RD EDITION) v1.0
****

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
1	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.053	101
		17.56 C	3398.20	-1862.37	1958.33
2	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.053	101
		17.56 C	3398.20	1862.37	1958.33
3	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.050	201
		0.81 C	0.00	3359.65	0.00
4	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.041	101
		7.37 C	-936.92	1183.35	1325.00
5	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.041	101
		7.37 C	-936.92	-1183.35	1325.00
6	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.053	201
		20.76 C	3545.12	-2311.66	1958.33
7	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.053	201
		20.76 C	3545.12	2311.66	1958.33
8	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.063	101
		1.10 C	0.00	4192.83	0.00
9	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.046	201
		6.89 C	-1082.21	1082.57	1545.83
10	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.046	201
		6.89 C	-1082.21	-1082.56	1545.83
11	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.068	101
		25.23 C	5385.80	-3040.57	0.00
12	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.068	101
		25.23 C	5385.80	3040.57	0.00
13	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.099	201
		6.18 C	0.00	6159.31	0.00
14	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.057	201
		7.88 C	-1582.13	-10213.88	0.00
15	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.057	201
		7.88 C	-1582.13	10213.88	0.00

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
16	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.102		101
	128.42 C	5411.11	3344.85		0.00
17	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.102		101
	128.42 C	5411.11	-3344.87		0.00
18	ST UB254X146X31	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.134		101
	11.44 C	0.00	8018.75		0.00
19	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.122		101
	10.19 C	-3227.55	-22292.38		0.00
20	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.122		101
	10.19 C	-3227.55	22292.39		0.00
21	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	DEFLECTION	0.050		101
	18.21 C	2829.16	-2011.85		1958.33
22	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	DEFLECTION	0.050		101
	18.21 C	2829.16	2011.85		1958.33
23	ST UB254X146X31	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.053		201
	0.91 C	0.00	3519.40		0.00
24	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.027		201
	3.26 C	-1336.39	3518.98		2650.00
25	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	LRFD-H1-1B-C	0.027		201
	3.26 C	-1336.39	-3518.98		2650.00
34	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	SHEAR-Y	0.009		201
	1.64 T	0.43	-63.81		0.00
35	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	SHEAR-Y	0.107		101
	17.24 T	154.17	5049.96		0.00
36	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	SHEAR-Y	0.060		201
	9.82 T	821.64	2453.67		0.00
37	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	SHEAR-Y	0.011		101
	2.01 T	0.25	-64.56		0.00
38	ST UC254X254X73	(BRITISH SECTIONS)			
	PASS	SHEAR-Y	0.007		201
	1.28 T	0.28	-97.44		0.00

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
39	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.009	201
		1.64 T	-0.43	-63.81	0.00
40	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.107	101
		17.24 T	-154.17	5049.96	0.00
41	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.060	201
		9.82 T	-821.64	2453.66	0.00
42	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.011	101
		2.01 T	-0.25	-64.56	0.00
43	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.007	201
		1.28 T	-0.28	-97.44	0.00
44	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.014	101
		9.24 C	-934.84	-1014.42	300.00
45	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.017	201
		11.07 C	-1079.84	-1166.87	300.00
46	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.045	201
		48.99 C	-2215.77	3464.31	300.00
47	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.085	101
		87.64 C	-3338.35	8717.92	300.00
48	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.010	201
		9.34 C	-373.25	-1092.03	300.00
49	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.006	201
		3.42 C	-66.50	869.74	0.00
50	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.055	101
		34.96 C	9.21	3777.78	0.00
51	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.032	201
		19.94 C	-7.16	2547.66	0.00
52	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.007	101
		4.16 C	-44.20	1053.90	0.00
53	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.005	201
		2.72 C	-46.49	729.74	0.00

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
54	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.014	101
		9.24 C	-934.84	1014.42	300.00
55	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.017	201
		11.07 C	-1079.84	1166.87	300.00
56	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.045	201
		48.99 C	-2215.77	-3464.32	300.00
57	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.085	101
		87.64 C	-3338.35	-8717.92	300.00
58	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.010	201
		9.34 C	-373.25	1092.03	300.00
59	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.006	201
		3.42 C	66.50	869.74	0.00
60	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.055	101
		34.96 C	-9.21	3777.77	0.00
61	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.032	201
		19.94 C	7.16	2547.65	0.00
62	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.007	101
		4.16 C	44.20	1053.90	0.00
63	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.005	201
		2.72 C	46.49	729.74	0.00
64	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.010	101
		1.62 T	0.89	10.71	200.00
65	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.239	101
		29.30 T	6.10	13574.47	200.00
66	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.127	201
		15.61 T	3.53	6749.56	200.00
67	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.013	201
		1.97 T	1.96	84.31	200.00
68	ST UC254X254X73	(BRITISH SECTIONS)			
		PASS	SHEAR-Y	0.006	101
		1.28 T	1.74	-168.93	200.00

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
69	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	DEFLECTION	0.016	101
		0.28 T	0.00	0.00	2700.00
70	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	DEFLECTION	0.447	201
		4.24 T	809.34	682.73	3250.00
71	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	SHEAR-Y	0.005	101
		0.39 C	0.00	0.00	0.00
72	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	SHEAR-Y	0.005	101
		0.20 C	0.00	0.00	0.00
73	ST UC254X254X73		(BRITISH SECTIONS)		
		PASS	SHEAR-Y	0.010	101
		1.62 T	-0.89	10.70	200.00
74	ST UC254X254X73		(BRITISH SECTIONS)		
		PASS	SHEAR-Y	0.239	101
		29.30 T	-6.10	13574.46	200.00
75	ST UC254X254X73		(BRITISH SECTIONS)		
		PASS	SHEAR-Y	0.127	201
		15.61 T	-3.53	6749.56	200.00
76	ST UC254X254X73		(BRITISH SECTIONS)		
		PASS	SHEAR-Y	0.013	201
		1.97 T	-1.96	84.31	200.00
77	ST UC254X254X73		(BRITISH SECTIONS)		
		PASS	SHEAR-Y	0.006	101
		1.28 T	-1.74	-168.93	200.00
78	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	DEFLECTION	0.016	101
		0.28 T	0.00	0.00	2700.00
79	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	DEFLECTION	0.447	201
		4.24 T	-809.34	682.73	3250.00
80	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	SHEAR-Y	0.005	101
		0.39 C	0.00	0.00	0.00
81	ST HE450A		(EUROPEAN SECTIONS)		
		PASS	SHEAR-Y	0.005	101
		0.20 C	0.00	0.00	0.00
82	ST UB254X146X31		(BRITISH SECTIONS)		
		PASS	LRFD-H1-1B-C	0.050	201
		0.81 C	0.00	3359.65	4400.00
83	ST UB254X146X31		(BRITISH SECTIONS)		
		PASS	LRFD-H1-1B-C	0.063	101
		1.10 C	0.00	4192.83	4400.00

ALL UNITS ARE - KN MMS (UNLESS OTHERWISE Noted)

MEMBER	TABLE	RESULT/ FX	CRITICAL COND/ MY	RATIO/ MZ	LOADING/ LOCATION
84	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.099	201
		6.18 C	0.00	6159.32	4400.00
85	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.134	101
		11.44 C	0.00	8018.76	4400.00
86	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.053	201
		0.91 C	0.00	3519.40	4400.00
87	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.047	101
		0.00 C	0.00	2503.84	5400.00
88	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.060	101
		0.00 C	0.00	2503.84	0.00
89	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.019	201
		0.00 C	0.00	1450.39	0.00
90	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.014	201
		0.00 C	0.00	32.16	1750.00
93	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.048	201
		0.36 T	0.00	-1336.39	2250.00
94	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.057	201
		1.60 C	0.00	2158.15	0.00
95	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.026	201
		1.40 C	0.00	1911.62	3500.00
96	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.035	101
		0.66 C	0.00	2694.44	3500.00
97	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	DEFLECTION	0.048	201
		0.36 T	0.00	-1336.39	2250.00
98	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.057	201
		1.60 C	0.00	2158.15	0.00
99	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.026	201
		1.40 C	0.00	1911.62	3500.00
100	ST UB254X146X31	(BRITISH SECTIONS)			
		PASS	LRFD-H1-1B-C	0.035	101
		0.66 C	0.00	2694.44	3500.00

********** END OF TABULATED RESULT OF DESIGN **********

117. STEEL TAKE OFF ALL

STEEL TAKE-OFF

	PROFILE	**LENGTH(MMS)**	**WEIGHT(KN)**
ST	UC254X254X73	85500.01	61.149
ST	UB254X146X31	100699.98	30.711
ST	HE450A	37800.00	51.687
		TOTAL =	143.547

********** END OF DATA FROM INTERNAL STORAGE **********

118. FINISH

********** END OF THE STAAD.Pro RUN **********

**** DATE= FEB 25,2026 TIME= 17:43:12 ****

```
*************************************************************
*   For technical assistance on STAAD.Pro, please visit     *
*   http://selectservices.bentley.com/en-US/                *
*                                                           *
*   Details about additional assistance from                *
*   Bentley and Partners can be found at program menu       *
*   Help->Technical Support                                 *
*                                                           *
*      Copyright (c) 1997-2015 Bentley Systems, Inc.
*                http://www.bentley.com                     *
*************************************************************
```

Appendix-B

Anchor Bolt & Baseplate Calculation

Company:		Page:	1
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	04-Apr-26
E-Mail:			

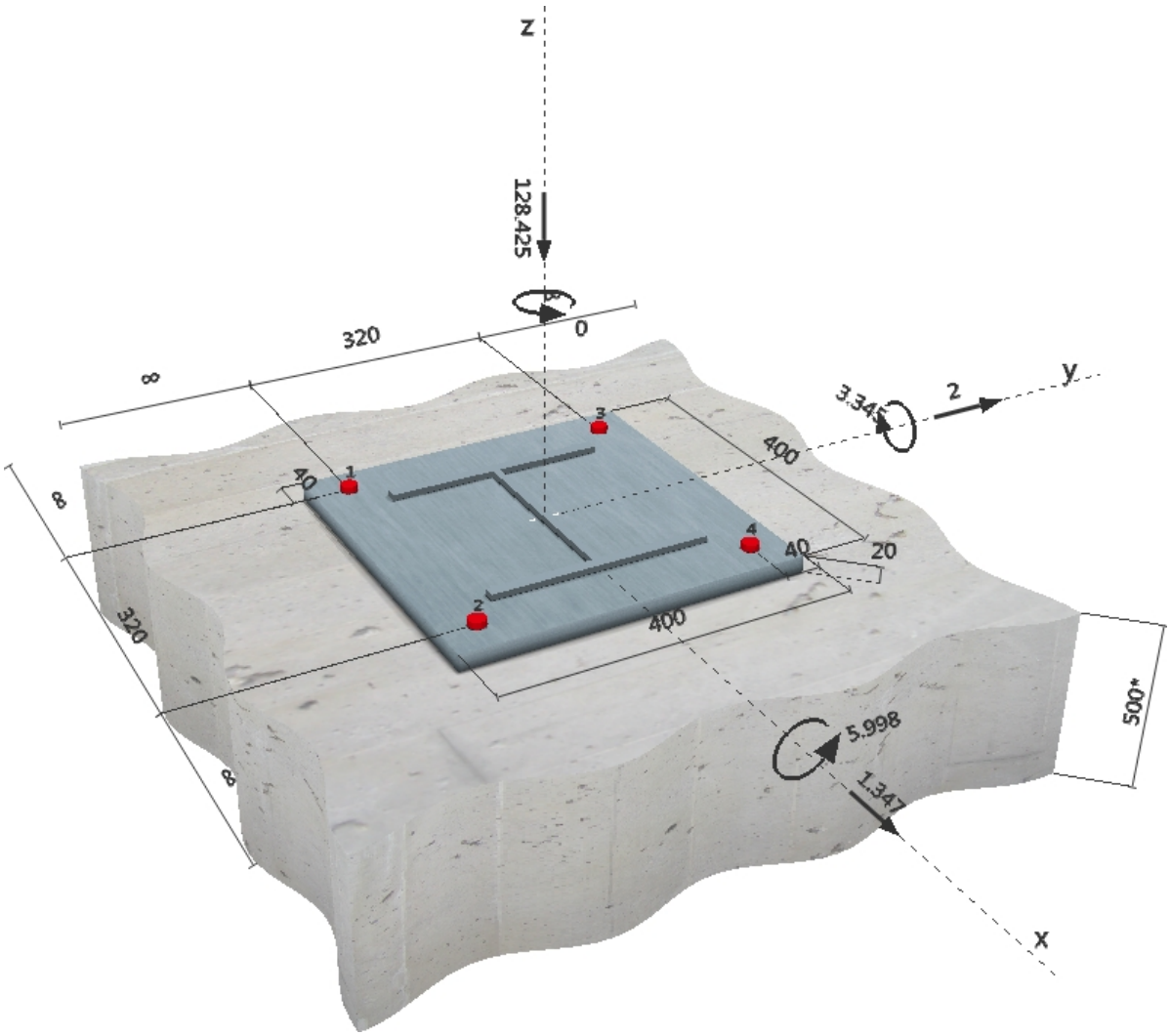
Specifier's comments:

1 Input data



Anchor type and diameter:	**HST M20**
Effective embedment depth:	h_{ef} = 101 mm, h_{nom} = 117 mm
Material:	
Evaluation Service Report:	ETA 98/0001
Issued I Valid:	06-Nov-15 | 06-Nov-20
Proof:	Design method ETAG (No. 001 Annex C/2010)
Stand-off installation:	e_b = 0 mm (no stand-off); t = 20 mm
Anchor plate:	S 235 (St 37); E = 210000.00 N/mm^2; f_{yk} = 235.00 N/mm^2; γ_{Ms} = 1.100 l_x x l_y x t = 400 mm x 400 mm x 20 mm; (Recommended plate thickness: calculated (20 mm))
Profile:	Advance UKC; (L x W x T x FT) = 254 mm x 255 mm x 9 mm x 14 mm
Base material:	cracked concrete, C40/50, f_{cc} = 50.00 N/mm^2; h = 500 mm
Installation:	**hammer drilled hole, Installation condition: Dry**
Reinforcement:	no reinforcement or reinforcement spacing >= 150 mm (any Ø) or >= 100 mm (Ø <= 10 mm) no longitudinal edge reinforcement

Geometry [mm] & Loading [kN, kNm]



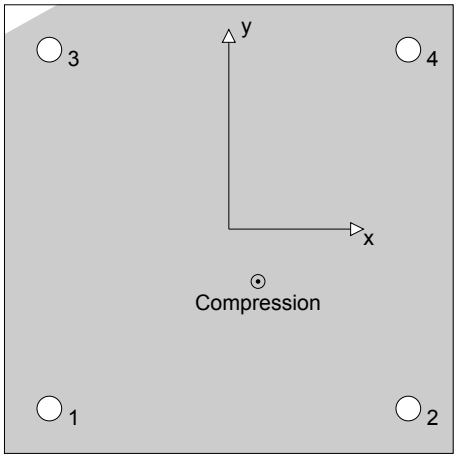
PROFIS Anchor (c) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

Page: 2
Project:
Sub-Project I Pos. No.:
Date: 04-Apr-26

2 Load case/Resulting anchor forces

Load case: Design loads



Anchor reactions [kN]
Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.000	0.603	0.337	0.500
2	0.000	0.603	0.337	0.500
3	0.000	0.603	0.337	0.500
4	0.000	0.603	0.337	0.500

max. concrete compressive strain: 0.06 [‰]
max. concrete compressive stress: 1.68 [N/mm^2]
resulting tension force in (x/y)=(0/0): 0.000 [kN]
resulting compression force in (x/y)=(26/-47): 128.425 [kN]

3 Tension load (ETAG, Annex C, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilization β_N [%]	Status
Steel Strength*	N/A	N/A	N/A	N/A
Pullout Strength*	N/A	N/A	N/A	N/A
Concrete Breakout Strength**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (anchors in tension)

Input data and results must be checked for agreement with the existing conditions and for plausibility!
PROFIS Anchor (c) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

4 Shear load (ETAG, Annex C, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilization β_V [%]	Status
Steel Strength (without lever arm)*	0.603	67.200	1	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout Strength**	2.411	344.515	1	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* anchor having the highest loading **anchor group (relevant anchors)

4.1 Steel Strength (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
84.000	1.250	67.200	0.603

4.2 Pryout Strength

$A_{c,N}$ [mm²]	$A^0_{c,N}$ [mm²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor
367236	91809	152	303	2.500

$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0	1.000	0	1.000	1.000	1.000

$N^0_{Rk,c}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]
51.677	1.500	344.515	2.411

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk} = 0.000 [kN] δ_N = 0.000 [mm]

V_{Sk} = 0.447 [kN] δ_V = 0.025 [mm]

δ_{NV} = 0.025 [mm]

Long term loading:

N_{Sk} = 0.000 [kN] δ_N = 0.000 [mm]

V_{Sk} = 0.447 [kN] δ_V = 0.038 [mm]

δ_{NV} = 0.038 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the anchor plate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

6 Warnings

- Load re-distributions on the anchors due to elastic deformations of the anchor plate are not considered. The anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the loading! Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with ETAG 001, Annex C(2010)Section 7! The software considers that the grout is installed under the anchor plate without creating air voids and before application of the loads.
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of ETAG 001, Annex C! For larger diameters of the clearance hole see Chapter 1.1. of ETAG 001, Annex C!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.

Fastening meets the design criteria!

PROFIS Anchor (c) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:
Specifier:
Address:
Phone I Fax: |
E-Mail:

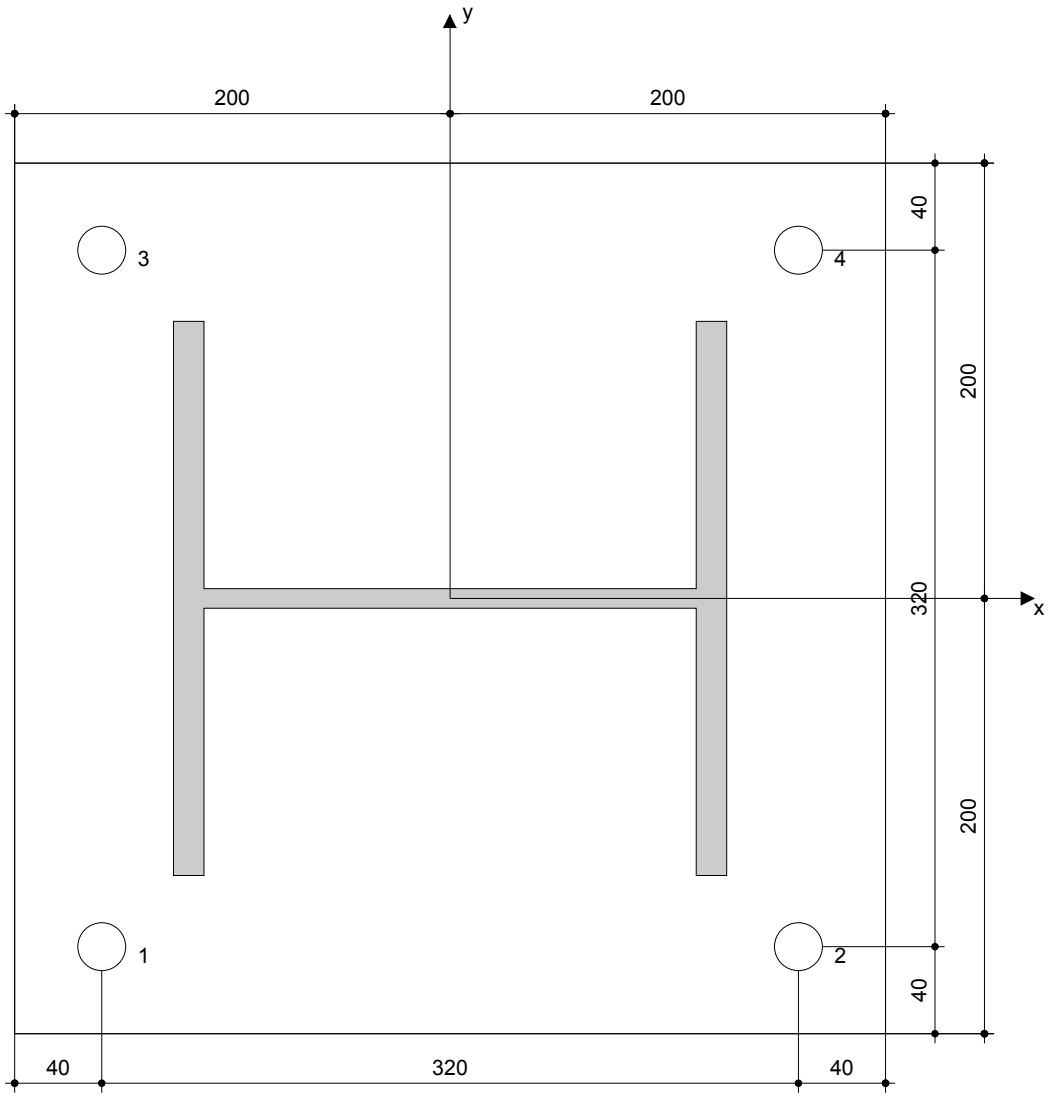
7 Installation data

Anchor plate, steel: S 235 (St 37); E = 210000.00 N/mm^2; f_{yk} = 235.00 N/mm^2
Profile: Advance UKC; 254 x 255 x 9 x 14 mm
Hole diameter in the fixture: d_f = 22 mm
Plate thickness (input): 20 mm
Recommended plate thickness: calculated (20 mm)
Drilling method: Hammer drilled
Cleaning: Manual cleaning of the drilled hole according to instructions for use is required.

Anchor type and diameter: HST M20
Installation torque: 0.240 kNm
Hole diameter in the base material: 20 mm
Hole depth in the base material: 140 mm
Minimum thickness of the base material: 200 mm

7.1 Recommended accessories

Drilling	Cleaning	Setting
• Suitable Rotary Hammer	• Manual blow-out pump	• Torque wrench
• Properly sized drill bit		• Hammer



Coordinates Anchor [mm]

Anchor	x	y	c_{-x}	c_{+x}	c_{-y}	c_{+y}
1	-160	-160	-	-	-	-
2	160	-160	-	-	-	-
3	-160	160	-	-	-	-
4	160	160	-	-	-	-

Input data and results must be checked for agreement with the existing conditions and for plausibility!
PROFIS Anchor (c) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Company:		Page:	5
Specifier:		Project:	
Address:		Sub-Project I Pos. No.:	
Phone I Fax:	|	Date:	04-Apr-26
E-Mail:			

8 Remarks; Your Cooperation Duties

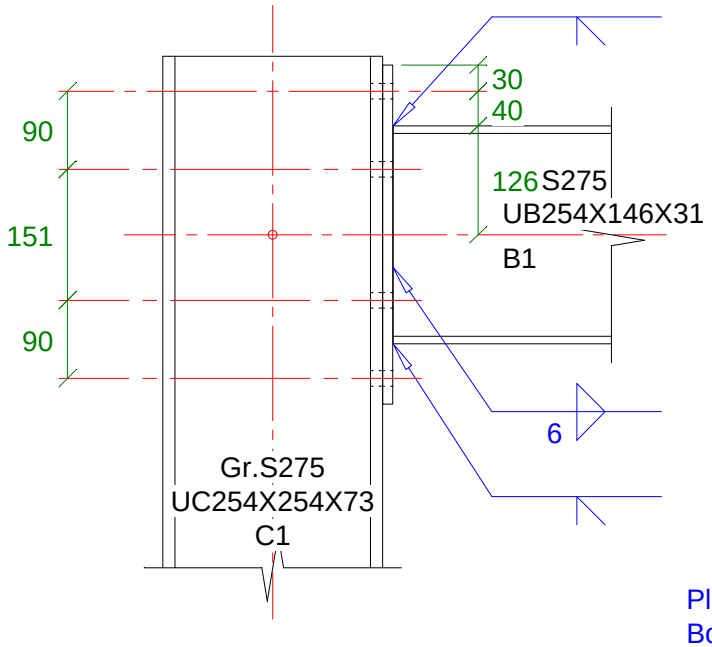
- Any and all information and data contained in the Software concern solely the use of Hilti products and are based on the principles, formulas and security regulations in accordance with Hilti's technical directions and operating, mounting and assembly instructions, etc., that must be strictly complied with by the user. All figures contained therein are average figures, and therefore use-specific tests are to be conducted prior to using the relevant Hilti product. The results of the calculations carried out by means of the Software are based essentially on the data you put in. Therefore, you bear the sole responsibility for the absence of errors, the completeness and the relevance of the data to be put in by you. Moreover, you bear sole responsibility for having the results of the calculation checked and cleared by an expert, particularly with regard to compliance with applicable norms and permits, prior to using them for your specific facility. The Software serves only as an aid to interpret norms and permits without any guarantee as to the absence of errors, the correctness and the relevance of the results or suitability for a specific application.
- You must take all necessary and reasonable steps to prevent or limit damage caused by the Software. In particular, you must arrange for the regular backup of programs and data and, if applicable, carry out the updates of the Software offered by Hilti on a regular basis. If you do not use the AutoUpdate function of the Software, you must ensure that you are using the current and thus up-to-date version of the Software in each case by carrying out manual updates via the Hilti Website. Hilti will not be liable for consequences, such as the recovery of lost or damaged data or programs, arising from a culpable breach of duty by you.

PROFIS Anchor (c) 2003-2009 Hilti AG, FL-9494 Schaan Hilti is a registered Trademark of Hilti AG, Schaan

Appendix-C

Connection Design

CONNECTION: CONNECTIONCOLTOBEAM - Bolted Moment End Plate
End plate: 160x12x391 Gr.S275
Flange weld: CJPGW/440 - Web weld: 6 FW/440
Bolts: 8 x M16 8.8E/N in 2 cols. at 80 gauge



Plates: 5.9 kg
Bolts: 2.0 kg
Welds: 0.2 kg

```
LIMCON V3.63.1.11 {0}                                                    25-FEB-26
                                                                          14:44:51
 Connection: CONNECTIONCOLTOBEAM
       Type: Bolted Moment End Plate
             A - End plate square to beam
    Country: Europe
      Units: SI metric
Design code: ANSI/AISC 360 (ASD)

Beam 1:  Mark=B1  Section=UB254X146X31   Grade=S275   Angle= 0.00°
     d =    251 mm   Root rad. =      8 mm    Fyf =  275 N/mm2
     b =    146 mm        Area =    3970      Fyw =  275 N/mm2
    tf =    8.6 mm          Sx =  351000       Fu =  430 N/mm2
    tw =    6.0 mm          Zx =  393000
 .Section moment strength  . . . .    64.7 kN.m                          Note 1
 .Section shear strength . . . . .   165.6 kN                            A360 (G2-1)
 .Section tension strength . . . .   653.7 kN                            A360-(D2-1)
 .Section compression strength . .   653.7 kN                            A360 E7

Column:  Mark=C1  Section=UC254X254X73   Grade=S275
     d =    254 mm   Root rad. =     13 mm    Fyf =  275 N/mm2
     b =    255 mm        Area =    9310      Fyw =  275 N/mm2
    tf =   14.2 mm          Sx =  898000       Fu =  430 N/mm2
    tw =    8.6 mm          Zx =  992000
 .Section moment strength  . . . .   163.4 kN.m                          Note 1
 .Section shear strength . . . . .   239.9 kN                            A360 (G2-1)
 .Section compression strength . .  1533.1 kN                            A360 E7
 Column terminates...
  Top flange to end of column  . .      80 mm

End plate:
 391x160x12  Gr./Fy/Fu=S275/27/430MPa
 Beam to end plate angle . . . . .   90.00°
```

```
End plate welds:
 CJPGW/440MPa flanges.
 6 FW/440MPa web.

Bolts:
 4 x M16 8.8E/N top flange, 80 gauge.
 4 x M16 8.8E/N btm. flange, 80 gauge.

BILL OF MATERIALS
Plates:
 1 no. - 391x160x12 Grade=S275 . . . . . .    5.9 kg
Bolts:
 8 no. - M16 8.8E/N x 60 long  . . . . . .    2.0 kg
Welds:
 292 mm - CJPGW 9x9x50% fu=440MPa  . . . . .    0.1 kg
 468 mm - FW 6 fu=440MPa . . . . . .    0.1 kg
 Total mass of welds . . . . . .    0.2 kg

MINIMUM ACTION CHECK
(Minima are based on section capacity, not member capacity.)
Specified minimum design actions:
 Bending       50% of Ms/Ω (   64.7)  =   32.4 kN.m
 Shear          0% of Vs/Ω (  165.9)  =    0.0 kN
                                      40.0 kN
 Tension        0% of Ns/Ω (  653.7)  =    0.0 kN
 Compression    0% of Nc/Ω (  653.7)  =    0.0 kN
 NOTE: Input design actions are not automatically increased if they are less than
       the specified minimum actions. Minimum actions may be set in any load case.
       This check warns if any design action is less than the specified minimum
       for all load cases.
 WARNING: Design bending moment is less than specified minimum.
 WARNING: Design shear force is less than specified minimum.

INPUT DESIGN ACTIONS
 Beam 1:  Moment, M  . . . . . .    8.00 kN.m
          Shear, V . . . . . .     3.9 kN
          Axial, P . . . . . .    11.5 kN  (tens.)
 Column:  Shear, Vc  . . . . . .   -10.1 kN
          Compression, Pc  . . . .    11.5 kN

SECTION ANALYSIS RESULT
Simplified analysis:
 Beam 1...            Pft  =    38.7t   Pfc  =    27.2c
                      Pwt  =     0.0    Pwc  =     0.0
                      Mw   =    0.00
                      Vw   =     3.9
Elastic analysis:
 Beam 1...            Pft  =    31.9t   Pfc  =    24.4c
                      Pwt  =     4.1t   Pwc  =     0.0
                      Mw   =    1.16
                      Vw   =     3.9
Plastic analysis:
 Beam 1...            Pft  =    31.3t   Pfc  =    24.0c
                      Pwt  =     4.2t   Pwc  =     0.0
                      Mw   =    1.28
                      Vw   =     3.9

NOTE: Elastic analysis results used.

BOLT ARRANGEMENT
 4-Bolt Extended End Plate - Unstiffened
 Connection checked for tension at top flange.

Using AISC/ASI model...

 Ref. 18: Steel Design Guide 16 (SDG16)
          Flush and Extended Multiple Row Moment End Plate Connections
          T.M. Murray & W.L. Shoemaker - AISC - 2002
 Ref. 19: Steel Design Guide 4 (SDG4)
          Extended End Plate Moment Connections - Seismic and Wind Applications
          T.M. Murray & E.A. Sumner - AISC - 2004
 Ref. 43: Design Guide 12 - Bolted End Plate to Column Moment Connections (DG12)
          T.J. Hogan & N. van der Kreek - ASI - 2009
```

GEOMETRY CHECKS
CHECK 1 - Detailing Requirements:

Bolt UTS	800	≥	800	Yes	
End plate width, bi	160	≥	159	Yes	
	160	≤	280	Yes	

NOTE: Clearances should be checked in virtual reality view.

ASD STRENGTH CHECKS

		Strength ratio: Required strength		ASD strength			Reference
Axial force	11.5 kN						
Effective depth	242.8 mm						
Axial force equiv. moment	1.40 kN.m						
Fraction of BM	17%						
Section Bending/Axial:							
Flange tension yield strength	206.9	≥	Pft	31.3	6.60	Pass	Manual p.55
Flange tension rupture strength	270.1	≥	Pft	31.3	8.62	Pass	
Flange compression strength	206.9	≥	Pft	24.0	8.63	Pass	

CHECK 2 - Flange Welds:
Check not required for CJPGW.

CHECK 3 - Web Welds:

Web shear force	3.9 kN						
Web axial force	4.1 kN						
Web bending moment	1.16 kN.m						
Length of web weld	234 mm						
For 6 FW/440MPa both sides...							
Web fillet weld strength	0.560	≥	vmax	0.073	7.69	Pass	

NOTE: Weld checked by linear elastic method.

CHECK 4 - Bolts at Tension Flange:

Single bolt tension strength	62.3 kN						A360-T:J3.2
No. bolts effective at flange	4						
Sum of bolt lever arms	484 mm						
End plate design moment, Meq	9.40 kN.m						
Tension bolt moment strength, Mnp/Ω	60.4	≥	Meq	9.40	6.43	Pass	

CHECK 5 - Bolts in Shear:

Total shear resisted by bolts	3.9 kN						
Single bolt shear strength	37.4 kN						A360-T:J3.2
No. bolts effective in shear	4						
Bolt shear strength, Rn/Ω	149.6	≥	Vb	3.9	38.4	Pass	SDG4 (3.17)
End plate bolt bearing strength, Rn/Ω	396.3	≥	Vb	3.9	>100	Pass	SDG4 (3.18)

CHECK 6 - End Plate in Bending:

End plate design moment, Meq	9.40 kN.m						
Yield line parameter, Yp	1677 mm						
End plate yield strength, Mpl/Ω	39.8	≥	Meq	9.40	4.23	Pass	
Bolt moment strength, Mbt/Ω	60.4 kN.m						
» No prying strength, Mmin	67.0 kN.m						
» End plate no prying thickness	16 mm						SDG4 (3.10)
Is plate strong enough for no prying?	59.8	≥	100.5			No	
» Bolt prying does occur.							
Single bolt tension strength	62.3 kN						A360-T:J3.2
Specified minimum tension	87.9 kN						
Bolt max. prying force, Qmax,i	15.8 kN						SDG16 p.31
Bolt max. prying force, Qmax,o	19.5 kN						SDG16 p.31
Bolt rupture strength (prying)	51.7	≥	Meq	9.40	5.50	Pass	
Prying factor	0.26						Informative
Bolt efficiency	86%						Informative

CHECK 7 - End Plate in Shear:

Horiz. shear	19.3 kN						
Horiz. shear yield strength, Rn/Ω	211.2	≥	Vh	19.3	10.9	Pass	SDG4 (3.12)
Horiz. shear rupture strength, Rn/Ω	185.8	≥	Vh	19.3	9.60	Pass	SDG4 (3.13)

CHECK 8 - End Plate Stiffener:
No stiffener.

CHECK 9 - End Plate Stiffener Welds:

No stiffener.

COLUMN-SIDE CHECKS...
Ref. 19: Steel Design Guide 4 (SDG4)
Extended End Plate Moment Connections - Seismic and Wind Applications
T.M. Murray & E.A. Sumner - AISC - 2004

CHECK 10/16 - Unstiffened Column Flange Bending at Beam Tension Flange:
Using method from AISC SDG 4 (Ref.19)...
Capacity reduced if column terminates within 150mm of top bolt row.

Top bolt row to end of column . .	40	≥	150			No	
» Capacity reduced for terminating column.							
End plate design moment, Meq . .	9.40 kN.m						
Yield line parameter, Yc	2107 mm						
Col. flange no prying thickness .	14 mm						SDG4 (3.20)
Column flange strength	70.0 kN.m						
Equivalent flange force, Rn/Ω . .	288.1 kN						SDG4 (3.22)
End plate design moment, Meq . .	9.40 kN.m						
No prying strength, Mmin	66.9 kN.m						
Unstiffened col. flange strength, Mcf/Ω . .	70.0	≥	Meq =	9.40	7.45	Pass	SDG4 (3.21)
Is col. flange strong enough for no prying?	105.1	≥	100.5			Yes	
» Bolt prying may not occur.							

CHECK 11 - Unstiffened Column Web Yielding at Beam Tension Flange:
Capacity reduced if column terminates within Dc of top flange.

Top flange to end of column . . .	80	≥	254			No	
» Capacity reduced for terminating column.							
Unstiffened col. web yield strength, Rn/Ω .	152.9	≥	Pft =	38.7	3.95	Pass	SDG4 (3.24)

CHECK 12 - Unstiffened Column Web Yielding at Beam Compression Flange:

Unstiffened col. web yield strength, Rn/Ω .	305.9	≥	Pfc =	27.2	11.2	Pass	SDG4 (3.24)

CHECK 13 - Unstiffened Column Web Crippling at Beam Compression Flange:

Column web crippling strength, Rn/Ω	333.0	≥	Pfc =	27.2	12.2	Pass	SDG13 (2.2-12)

CHECK 14 - Unstiffened Column Web Buckling at Beam Compression Flange:

Column web buckling strength, Rn/Ω	338.4	≥	Pfc =	27.2	12.4	Pass	SDG4 (3.26)

CHECK 15/21 - Unstiffened Column Web Panel in Shear:

Column nominal axial capacity, Py	2560.2 kN						Note 4
Ratio Pu/Py	0.01						
Column web panel shear	28.6 kN						
Column web panel shear strength, Rv/Ω . . .	215.9	≥	Vp =	28.6	7.55	Pass	SDG13 (2.2-1)

CHECK 22 - Transverse Stiffeners at Beam Tension Flange:
No tension flange stiffeners.

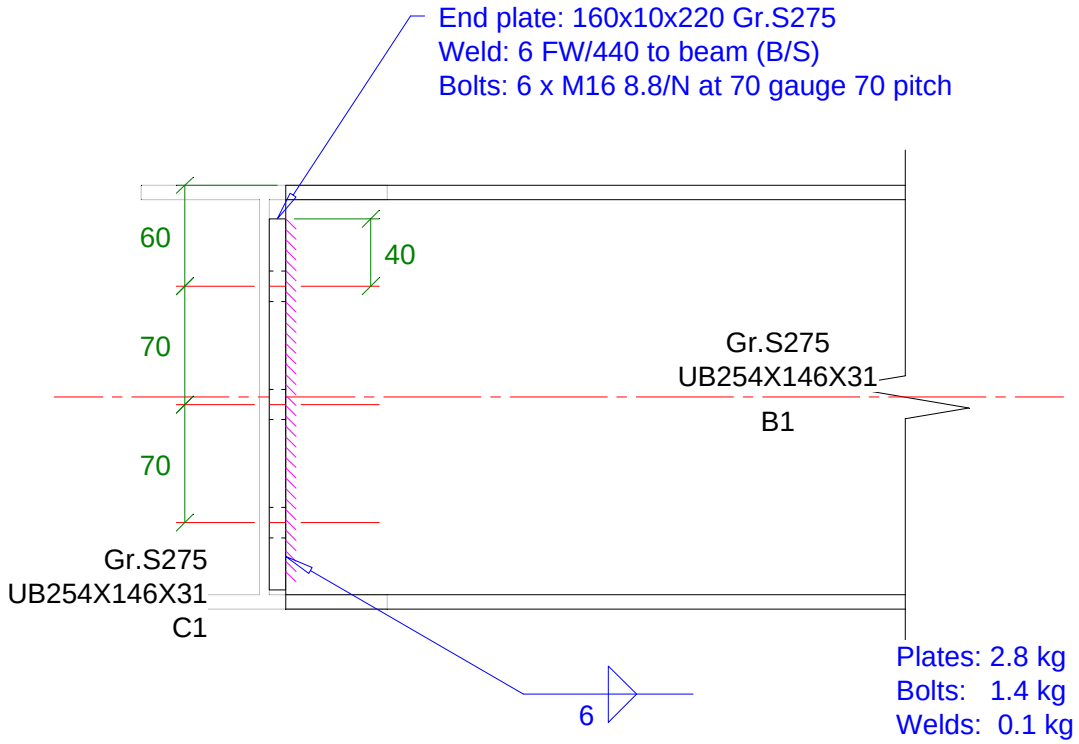
CHECK 23 - Transverse Stiffeners at Beam Compression Flange:
No compression flange stiffeners.

CHECK 24 - Diagonal Shear Stiffeners:
No diagonal shear stiffeners.

NOTES:
1. Flexural yield capacity ignoring section slenderness.
4. Compression yield capacity of section ignoring slenderness.

CRITICAL LIMIT STATE . . . Unstiffened col. web yield strength, Rn/Ω
UTILIZATION RATIO 25%
STRENGTH RATIO . . . . . 3.952 Pass

CONNECTION: BEAMTOBEAMCONNECTION - Flexible End Plate




```
LIMCON V3.63.1.11 {0}                                                    25-FEB-26
                                                                          14:04:56
 Connection: BEAMTOBEAMCONNECTION
       Type: Flexible End Plate
    Country: Europe
      Units: SI metric
Design code: ANSI/AISC 360 (ASD)

Beam:  Mark=B1  Section=UB254X146X31   Grade=S275
     d =    251 mm   Root rad. =      8 mm    Fyf =  275 N/mm2
     b =    146 mm        Area =    3970      Fyw =  275 N/mm2
    tf =    8.6 mm          Sx =  351000       Fu =  430 N/mm2
    tw =    6.0 mm          Zx =  393000
 .Section shear strength . . . . .   165.6 kN                          A360 (G2-1)
 .Section tension strength . . . .   653.7 kN                          A360-(D2-1)
 .Section compression strength . .   653.7 kN                          A360 E7

Support:  Mark=C1  Section=UB254X146X31   Grade=S275
     d =    251 mm   Root rad. =      8 mm    Fyf =  275 N/mm2
     b =    146 mm        Area =    3970      Fyw =  275 N/mm2
    tf =    8.6 mm          Sx =  351000       Fu =  430 N/mm2
    tw =    6.0 mm          Zx =  393000
 .Section compression strength . .   653.7 kN                          A360 E7
 Connection to beam web.

End plate:
 220x160x10  Gr./Fy/Fu=S275/27/430MPa
 Weld 6 FW/440MPa to web of beam.
 Bolts 6 x M16 8.8/N in 3 rows at 70 pitch and 70 gauge.
```

BILL OF MATERIALS
Plates:
 1 no. - 220x160x10 Grade=S275 . . . . . 2.8 kg
Bolts:
 6 no. - M16 8.8/N x 50 long . . . . . 1.4 kg
Welds:
 430 mm - FW 6 fu=440MPa . . . . . 0.1 kg

MINIMUM SHEAR FORCE CHECK
 Input design actions are not automatically increased if they are less than the specified
 minimum actions. Minimum actions may be set in any load case. This check warns if the
 shear force is less than the specified minimum (40 kN) for all load cases.
 WARNING: Design shear force is less than specified minimum.

INPUT DESIGN ACTIONS
 Shear, V . . . . . 3.9 kN
 Axial, P . . . . . 11.5 kN (tens.)

Using AISC SCM 14th model...

GEOMETRY CHECKS
CHECK 1 - Detailing Requirements:
 Ref. 6: Steel Construction Manual - 14th Edition - AISC - 2011 (SCM14)
 Length of plate . . . . . 220 ≥ 110 Yes SCM14 p.10-49

ASD STRENGTH CHECKS

							Strength ratio = Required strength / ASD strength		Reference
CHECK 2 - Weld:									
Weld length (each side)	203 mm								SCM13 p.10-50
Weld shear strength	227.6	≥	V	=	3.9	59.1	Pass		
Weld strength (including axial force) . . .	0.560	≥	vmax	=	0.030	18.8	Pass		
CHECK 3 - Bolts:									
Bolt group: 6 x M16 8.8/N									
Single bolt shear strength . . .	37.4 kN								A360-T:J3.2
Bolt group shear strength	224.4	≥	V	=	3.9	58.3	Pass		
Plate bolt bearing strength	490.2	≥	V	=	3.9	>100	Pass		A360 J3.10
Single bolt tension strength . .	62.3 kN								A360-T:J3.2
PRYING ACTION CHECK (AISC SCM 14th p.9-10)									
Single bolt tension strength . .	62.3 kN								A360-T:J3.2
Required tension per bolt, T . .	1.9 kN								
Shear force per bolt, V	0.6 kN								
Tributary length	64 mm								SCM14 p.9-11
b	32.0 mm								
b'	24.0 mm								
NOTE: a exceeds 1.25 x b									
a	45.0 mm								
a'	48.0 mm								
d'	18.0 mm								
δ	0.719								
rho	0.500								
Single bolt shear strength . . .	37.4 kN								A360-T:J3.2
fv	3.2 N/mm2								
Shear utilization ratio	2%								
Combined tension and shear in the bolts does not have to be checked.									A360-05 J3.7
ß	63.232								
α'	1.000								
Min. thickness with prying . . .	2.5 mm								SCM14 (9-23)
Zero prying thickness	3.3 mm								SCM14 (9-20)
Full bolt strength thickness . .	19.0 mm								SCM14 (9-30)
alpha	0.00								SCM14 (9-29)
q	0.0 kN								SCM14 (9-28)
Angle/plate thickness	10	≥			3	3.94	Pass		
AISC combined bolt/plate check...									
α to maximize bolt strength . .	2.430								SCM14 (9-35)
» Fitting has insufficient strength to develop the full bolt tensile strength.									
Q	0.47								SCM14 (9-34)
T avail = B x Q	29.6	≥			1.9	15.5	Pass		SCM14 (9-31)
CHECK 4 - Plate:									
End plate shear yield strength	484.0	≥	V	=	3.9	>100	Pass		A360 (J4-3)

```
 End plate shear rupture strength  . . . . .   412.8  ≥  V     =    3.9  >100  Pass  A360 (J4-4)
 Plate block shear strength  . . . . . . . .   447.5  ≥  V     =    3.9  >100  Pass
 End plate combined shear strength . . . . .   412.8  ≥  V+N   =   15.3  26.9  Pass
  NOTE: Axial tension bending strength reported in CHECK 3, above.

CHECK 5 - Beam Web at End Plate:
 Beam web shear strength at weld . . . . . .   134.1  ≥  V     =    3.9  34.8  Pass  A360 (J4-3)
 Beam web tension strength at weld . . . . .   200.8  ≥  P     =   11.5  17.5  Pass  A360 (J4-1)
 Shear utilization ratio . . . . .       2%
 Tension utilization ratio . . . .       4%
 Web combined shear/tension strength . . . .    0.67  ≥  V+N   =   0.04  15.6  Pass  Note 11

CHECK 6 - Beam Shear:
 Shear strength  . . . . . . . . . . . . . .   165.9  ≥  V     =    3.9  43.1  Pass  A360 (G2-1)

CHECK 7 - Coped Beam Bending:
 Beam not coped » check not required.

CHECK 8 - Beam Rotation:
 Rotation for UDL (rad.) . . . . .   0.000

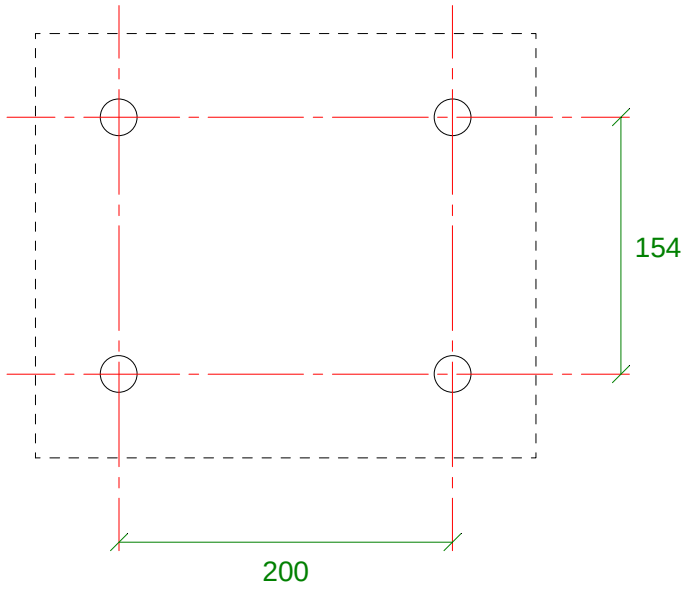
CHECK 9 - Coped Beam Buckling:
 Beam not coped » check not required.

CHECK 10 - Support Member:
 Depth of shear surface  . . . . .     235 mm
 Girder web local shear strength . . . . . .   310.2  ≥  V     =    3.9  80.5  Pass  P212 p.95
 Girder web bearing strength . . . . . . . .   297.2  ≥  V     =    3.9  77.2  Pass
 Girder web internal tearing strength  . . .   483.0  ≥  V     =    3.9  >100  Pass
 Informative checks for single-sided connection...
  Girder web yielding (normal) strength  . .    48.0  ≥  P     =   11.5  4.18  Pass  Approx.
 Informative checks for double-sided connection...
  Local shear strength for beam both sides .   310.2  ≥  2V    =    7.7  40.3  Pass
  Bearing strength for beam both sides . . .   297.2  ≥  2V    =    7.7  38.6  Pass
  Tearing strength for beam both sides . . .   483.0  ≥  2V    =    7.7  62.7  Pass

NOTES:
 11. Using elliptical interaction equation for combined shear and tension.

CRITICAL CONDITION . . . .    T avail = B x Q
RATIO  . . . . . .  15.485   Pass
```

CONNECTION: connectioncorbel - Bolt Group
Gusset plate (min.): 300x20x254 Gr.S275
Bolts: 4 x M20 8.8A/N in 2 cols.




```
LIMCON V3.63.1.11 {0}                                          25-FEB-26
                                                               17:52:07

 Connection: connectioncorbel
       Type: Bolt Group
    Country: Europe
      Units: SI metric
Design code: ANSI/AISC 360 (ASD)

Plate (min.):
 254x300x20  Gr./Fy/Fu=S275/27/430MPa

Bolts:
 4 x M20 8.8A/N in 2 cols. and 2 rows at 200 gauge and 154 pitch.
 Min. X direction edge distance  .      50 mm
 Min. Y direction edge distance  .      50 mm
 No. shear planes  . . . . . .          1

Design actions:
 Horiz. force, F*x . . . . . .    29.0 kN
 Vert.  force, F*y . . . . . .     5.1 kN
 Moment, M*z . . . . . .          13.6 kN.m

 Angle of load from vert.  . . . .  80.03°
 Eccentricity  . . . . . .          461.9 mm

ANALYSIS RESULT
Using elastic method for in-plane checks...
 No. bolts . . . . . .              4
 Bolt centroid measured from bottom left bolt:
  Centroid x coordinate, xc  . . .     100 mm
  Centroid y coordinate, yc  . . .      77 mm
 Moment of inertia about XX  . . . 2.3716E+04 mm2
 Moment of inertia about YY  . . . 4.0000E+04 mm2
 Polar moment of inertia . . . . . 6.3716E+04 mm2
```

WARNING: Block shear is not checked.

ASD STRENGTH CHECKS

		Strength ratio: Required strength / ASD strength						Reference
BEARING/TEARING IN PART 1...								
Resultants in cartesian axis directions:								
(These are statically equivalent to bolt group actions.)								
Horiz. resultant	29.0 kN							
Vert. resultant	5.1 kN							
Moment resultant	13.6 kN.m							
Bolt shear (critical bolt row, column)...								
(1,1) is top left (Row,Col.)								
Bolt shear . . . . . (2,2)	58.4	≥	Vres	=	32.8	1.78	Pass	
Bolt bearing/tearing (critical bolt row, column)...								
Bolt bearing . . . . . (2,2)	206.4	≥	Vres	=	32.8	6.30	Pass	
Bolt group ext. tearing (btm.) . . . (2,1)	201.2	≥	Vv	=	20.1	10.0	Pass	A360 (J3-6a)
Bolt group ext. tearing (top) . . . (1,2)	201.2	≥	Vv	=	22.6	8.90	Pass	A360 (J3-6a)
Bolt group ext. tearing (right) . . (2,2)	201.2	≥	Vh	=	23.7	8.50	Pass	A360 (J3-6a)
Bolt group int. tearing (vert.) . . (2,2)	681.1	≥	Vv	=	22.6	30.1	Pass	A360 (J3-6a)
Bolt group int. tearing (horiz.) . . (2,1)	918.5	≥	Vh	=	23.7	38.8	Pass	A360 (J3-6a)
BEARING/TEARING IN PART 2...								
Resultants in cartesian axis directions:								
(These equilibrate bolt group actions.)								
Horiz. resultant	-29.0 kN							
Vert. resultant	-5.1 kN							
Moment resultant	-13.6 kN.m							
Bolt shear (critical bolt row, column)...								
(1,1) is top left (Row,Col.)								
Bolt shear . . . . . (2,2)	58.4	≥	Vres	=	32.8	1.78	Pass	
Bolt bearing/tearing (critical bolt row, column)...								
Bolt bearing . . . . . (2,2)	206.4	≥	Vres	=	32.8	6.30	Pass	
Bolt group ext. tearing (btm.) . . . (2,2)	201.2	≥	Vv	=	22.6	8.90	Pass	A360 (J3-6a)
Bolt group ext. tearing (top) . . . (1,1)	201.2	≥	Vv	=	20.1	10.0	Pass	A360 (J3-6a)
Bolt group ext. tearing (left) . . . (2,1)	201.2	≥	Vh	=	23.7	8.50	Pass	A360 (J3-6a)
Bolt group int. tearing (vert.) . . (1,2)	681.1	≥	Vv	=	22.6	30.1	Pass	A360 (J3-6a)
Bolt group int. tearing (horiz.) . . (2,2)	918.5	≥	Vh	=	23.7	38.8	Pass	A360 (J3-6a)

CRITICAL LIMIT STATE . . . Bolt shear
UTILIZATION RATIO 56%
STRENGTH RATIO . . . . . 1.784 Pass

Appendix-D

Reference Drawings