OUR TOWN HALL PROJECT

Lyndon SGB BY BRANDSAFWAY

Title:

ALBERT MEMORIAL, ACCESS SCAFFOLD, CALCULATIONS

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Lendlease - OTH, Manchester Town Hall
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3D calculation

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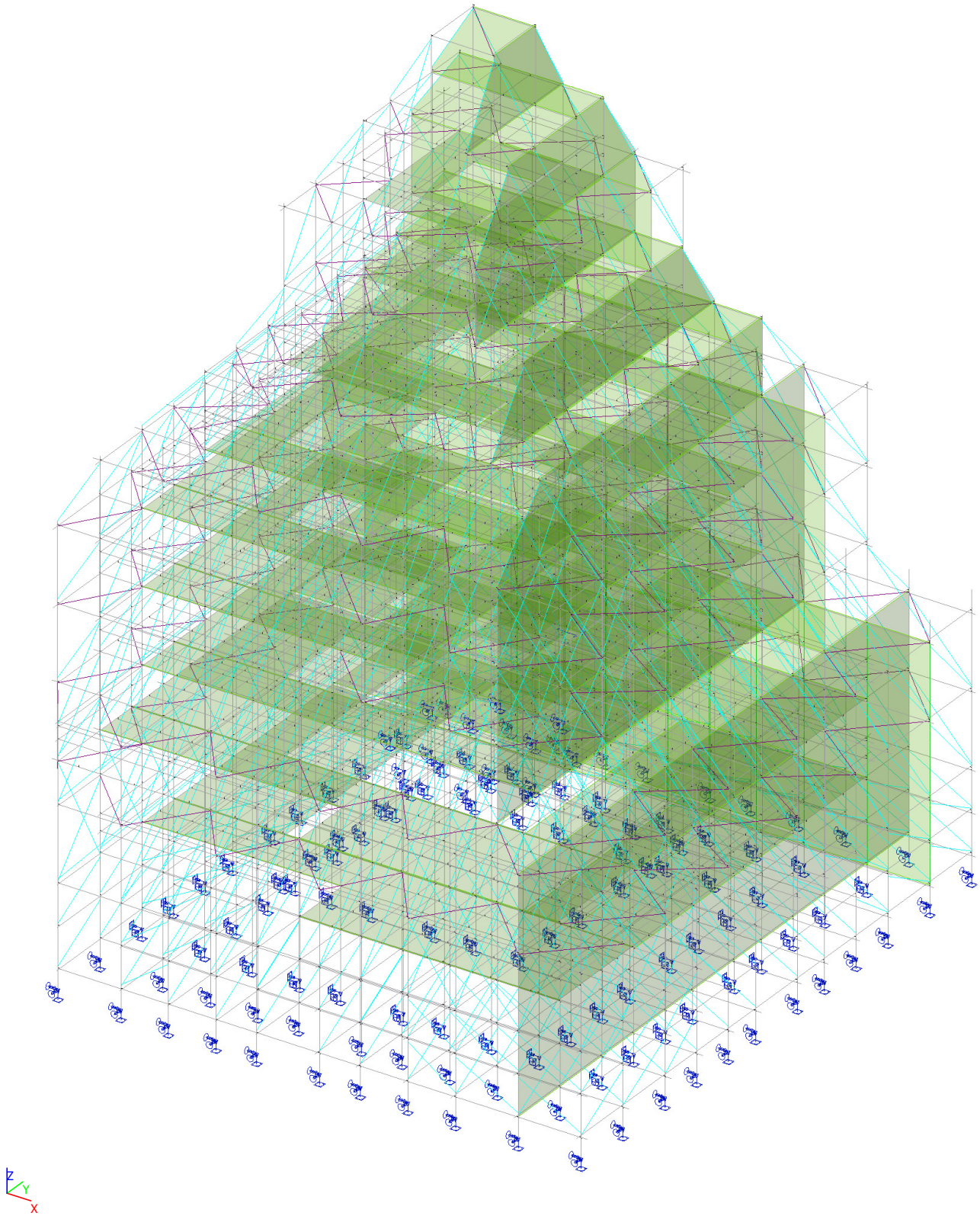
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2. Construction

2.1. 3D picture



3. Cross-sections

Name	Type	Detailed	Item material
AA00 Dummy		Numerical	
TR02 Tube	RO48.3X3.2		S 355 UK tube
TR03 Plan brace	RO48.3X3.2		S 355 UK tube
TR04 Brace DK	RO48.3X3.2		S 355 UK tube

4. Hinge type

Name	ux	uy	uz	fix	fiy	fiz	Hinge type	Nxk [kN]	Vyk [kN]	Vzk [kN]
								Mxk [kNm]	Myk [kNm]	Mzk [kNm]
DK op st	Flexible	Rigid	Flexible	Flexible	Free	Flexible	General	10,000	14,000	10,000
								0,130	0,000	0,130
KK doorg	Rigid	Flexible	Flexible	Nonlinear	Nonlinear	Nonlinear	General	30,000	15,000	15,000
								0,800	0,130	0,130
KK op st	Flexible	Rigid	Flexible	Flexible	Flexible	Flexible	Right angle	15,000	30,000	15,000
								0,130	0,800	0,130

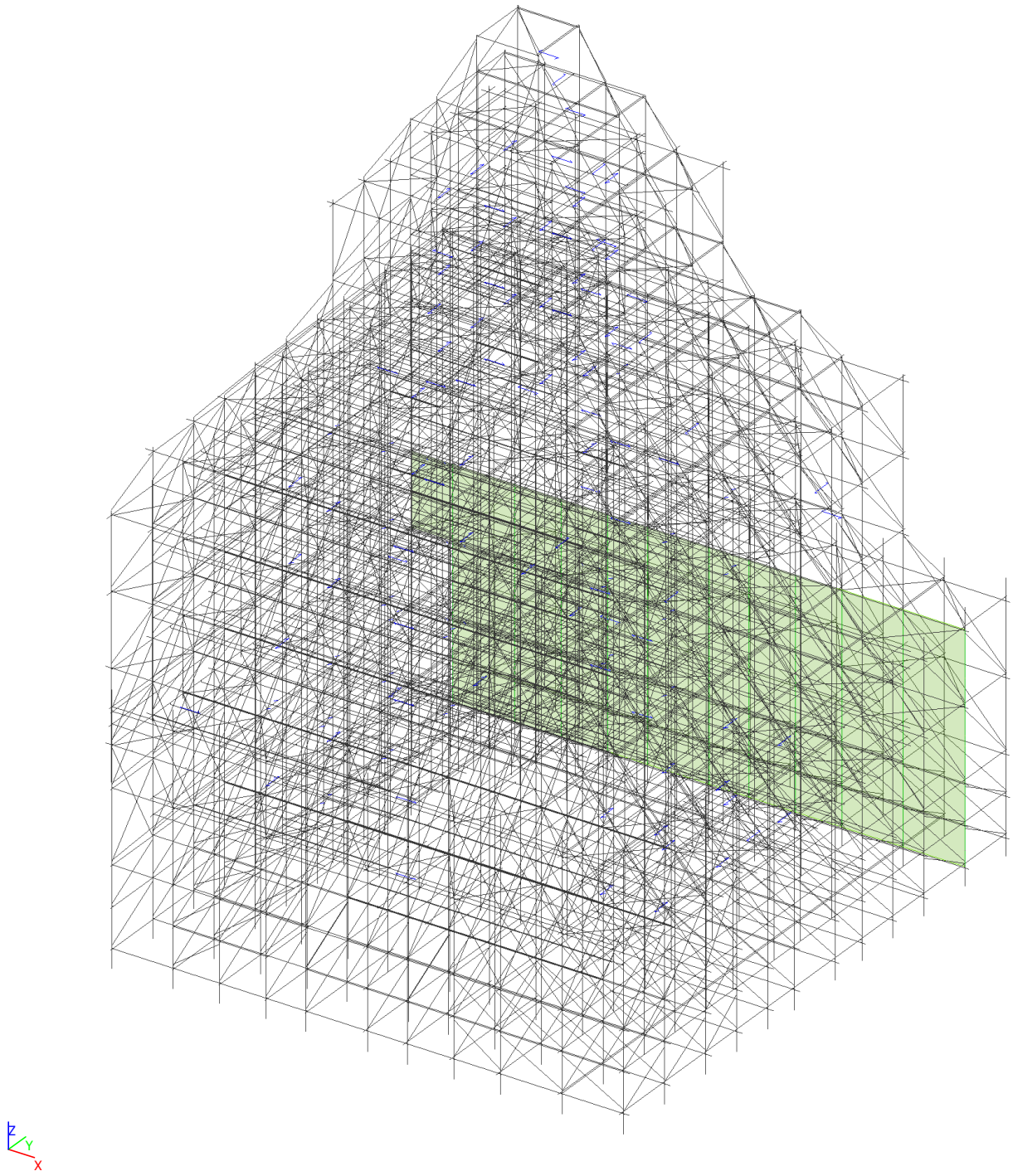
5. Load

5.1. Load cases

5.1.1. Load cases - SW

Name	Description	Action type	Load group	Load type	Direction
SW	Self weight	Permanent	LG1	Self weight	-Z

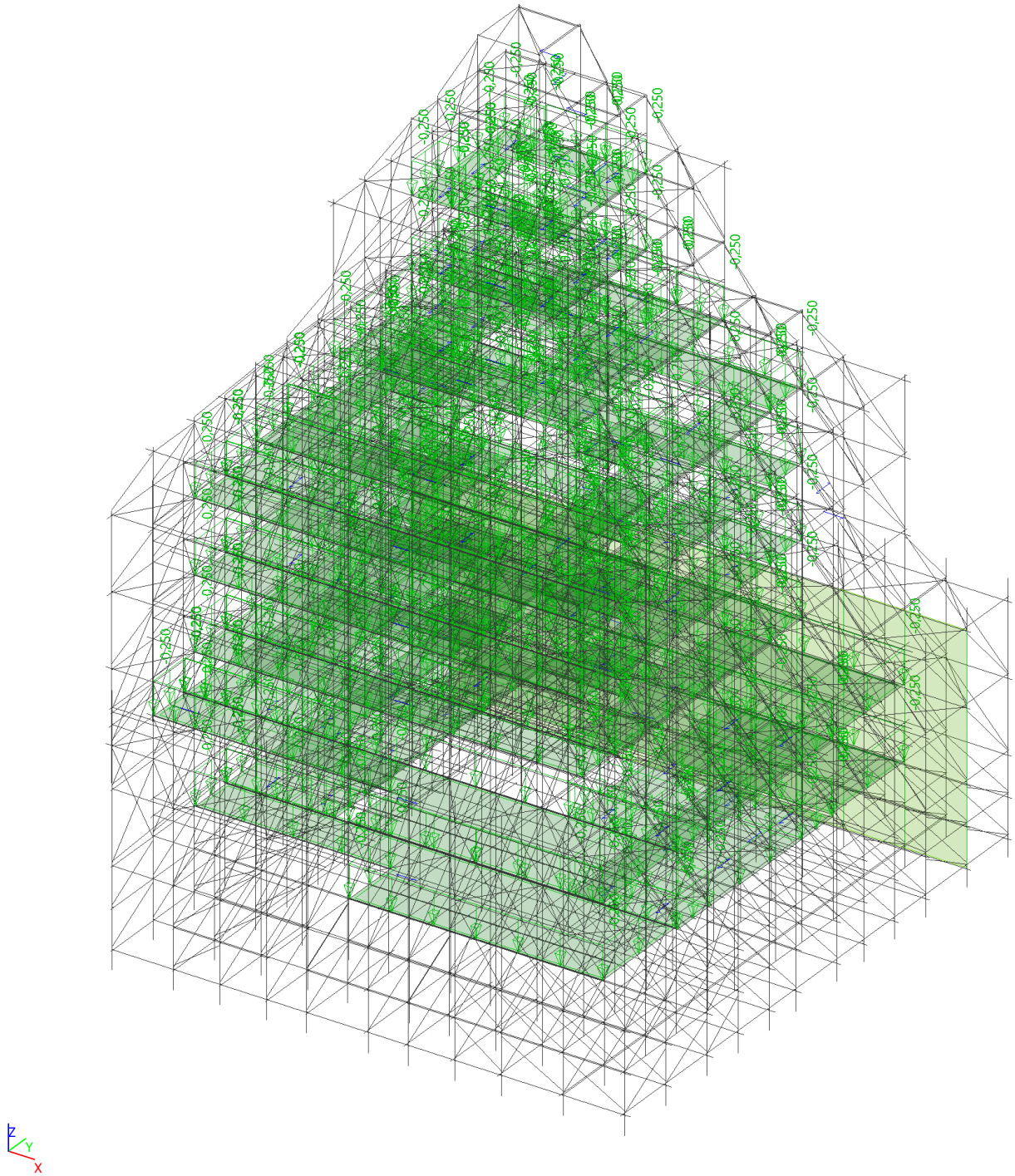
5.1.1.1. Load



5.1.2. Load cases - SW fl

Name	Description	Action type	Load group	Load type
SW fl	Self weight floors	Permanent	LG1	Standard

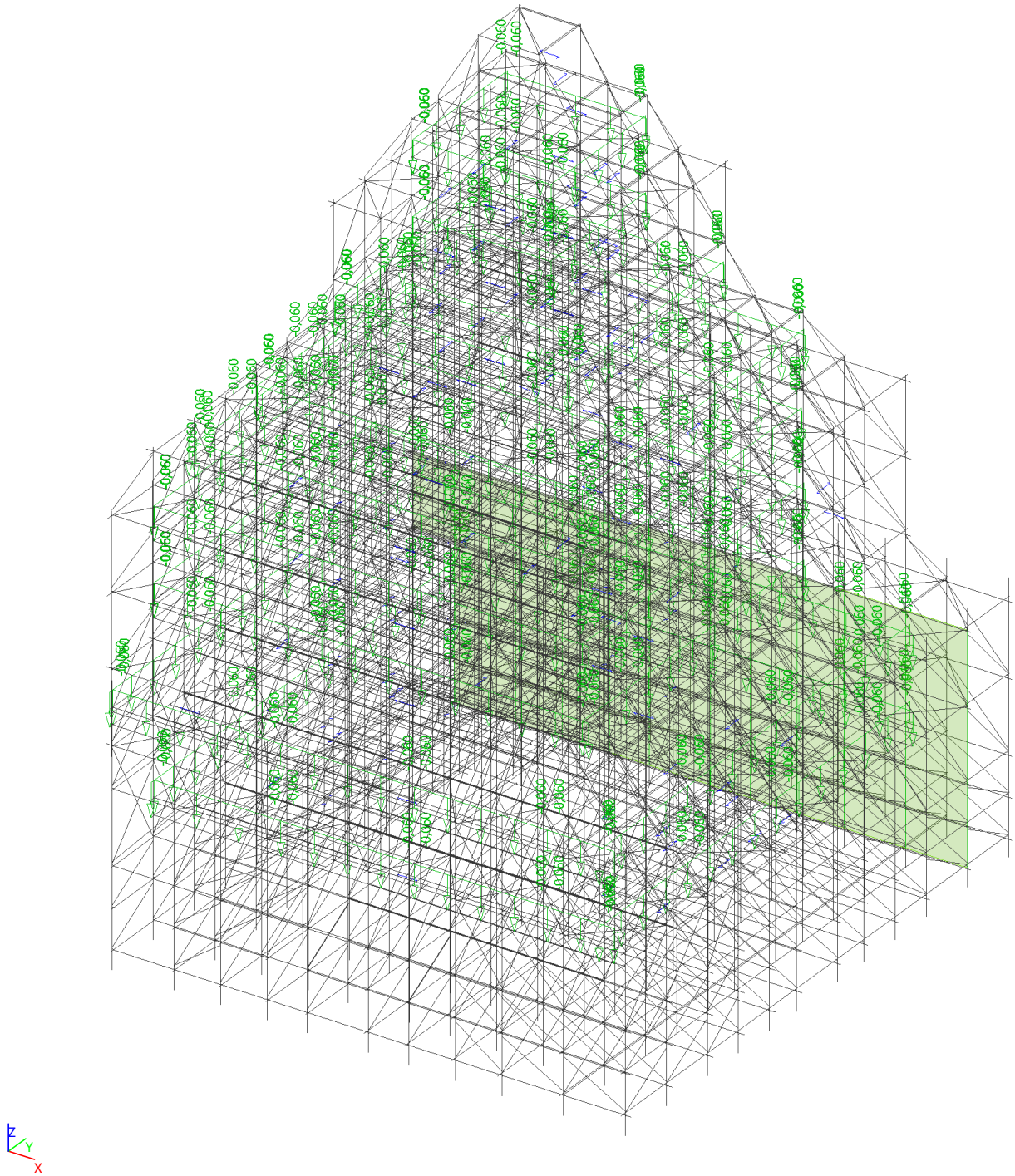
5.1.2.1. Load



5.1.3. Load cases - SW tb

Name	Description	Action type	Load group	Load type
SW tb	Self weight toeboards	Permanent	LG1	Standard

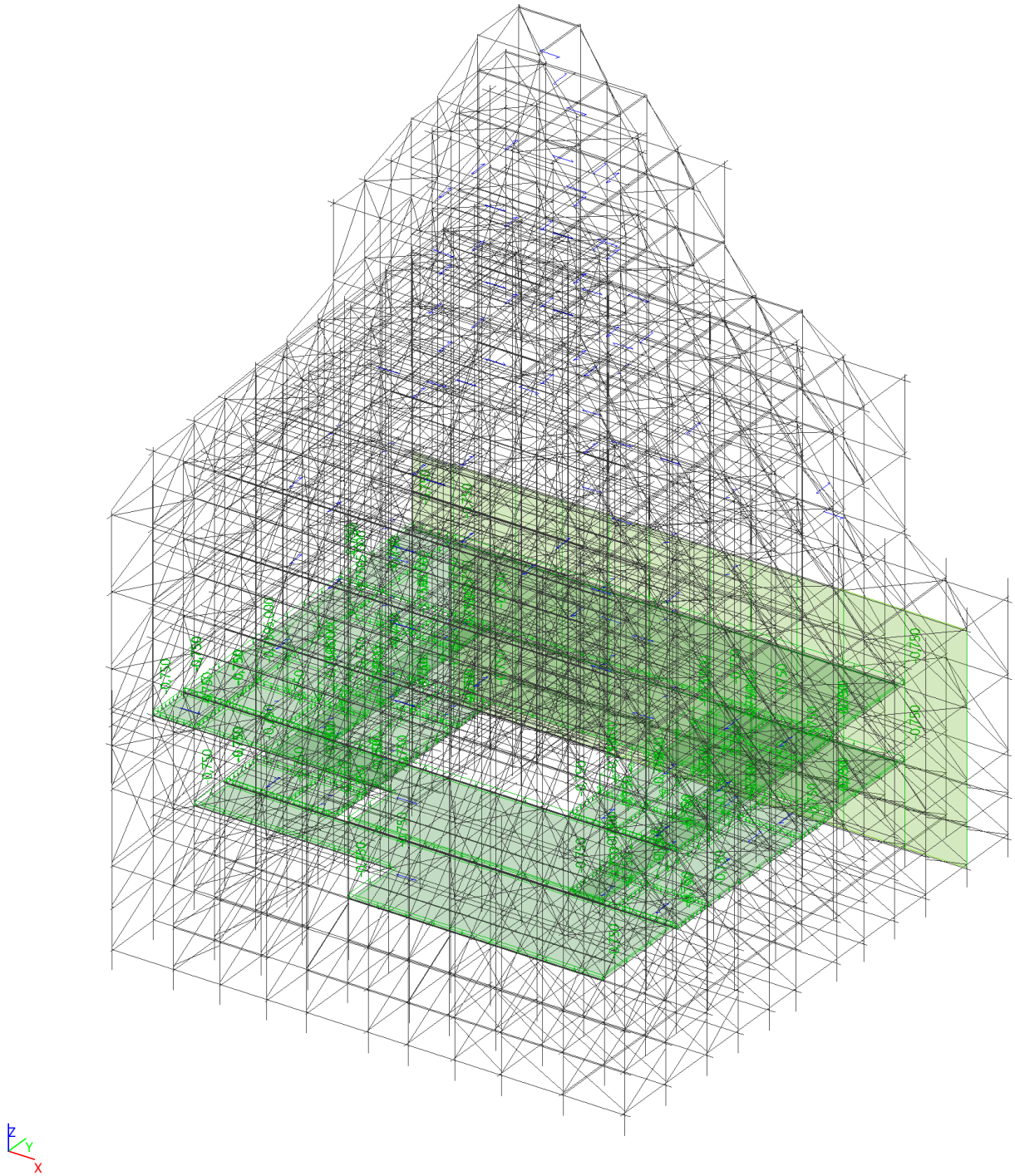
5.1.3.1. Load



5.1.4. Load cases - LS1 - lift 2

Name	Description	Action type	Load group	Load type
LS1 - lift 2	Just in time	Permanent	LG1	Standard

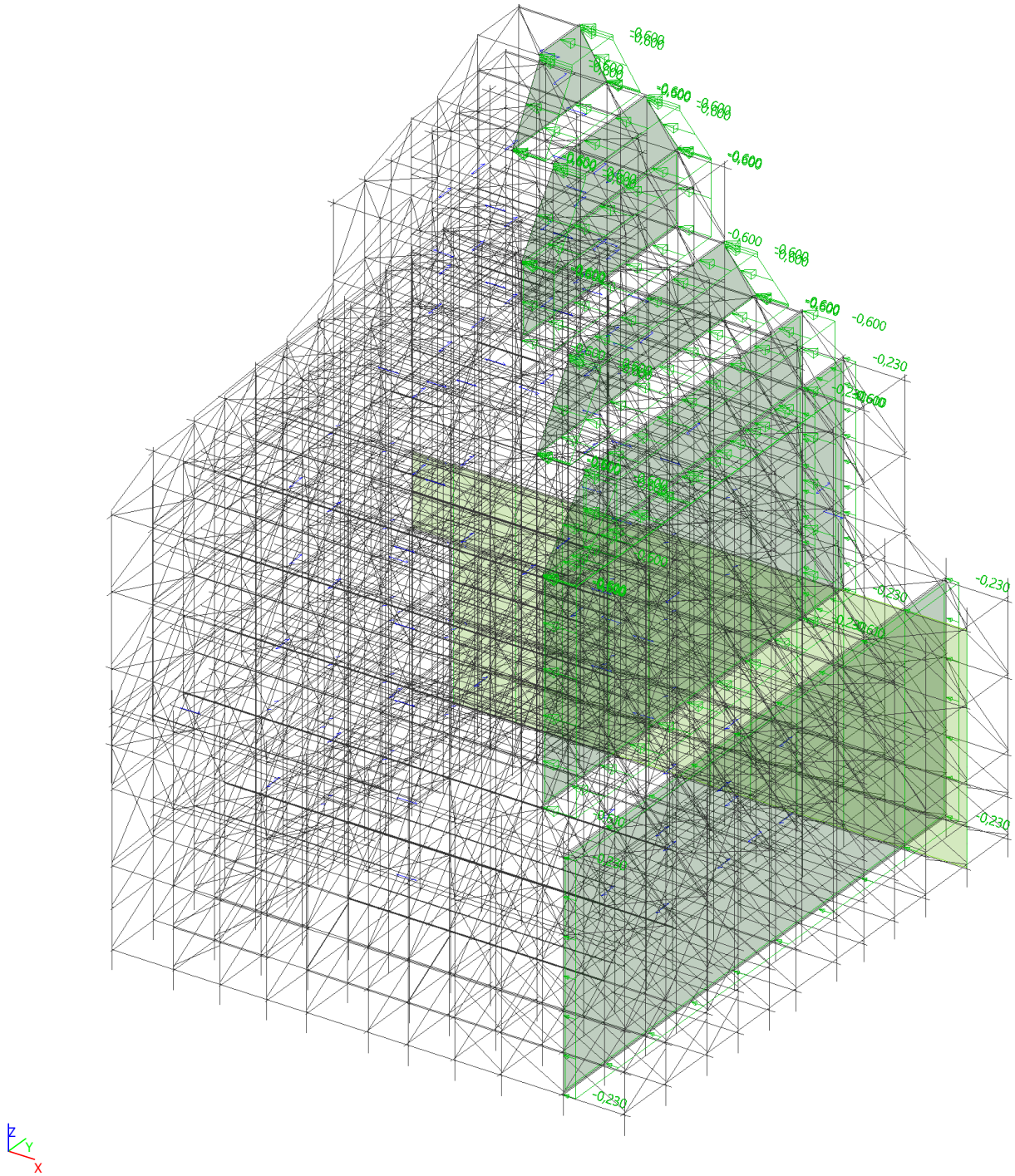
5.1.4.1. Load



5.1.5. Load cases - FW X

Name	Description	Action type	Load group	Load type
FW X	Full Wind +X direction	Permanent	LG1	Standard

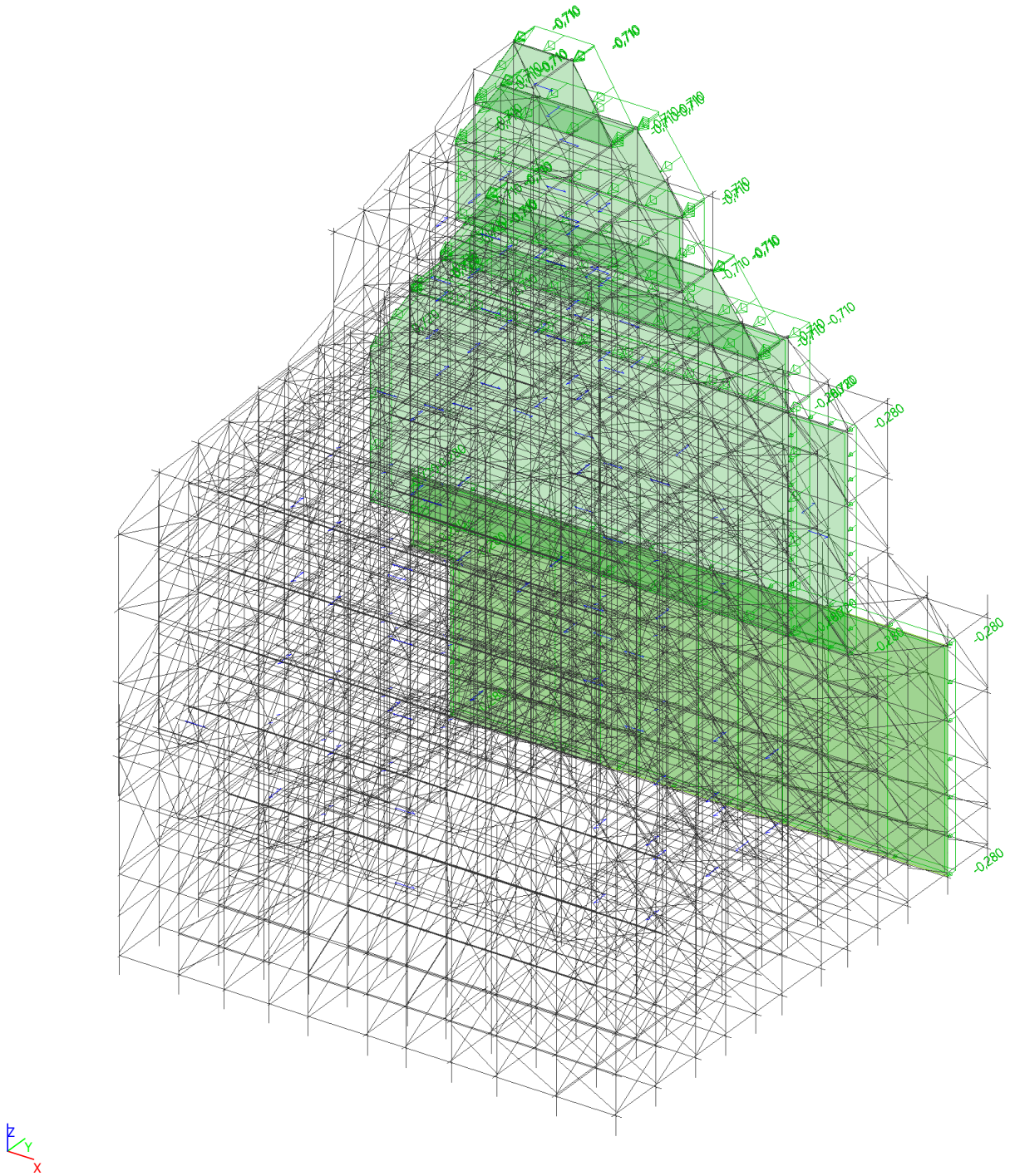
5.1.5.1. Load



5.1.6. Load cases - FW Y

Name	Description	Action type	Load group	Load type
FW Y	Full Wind +Y direction	Permanent	LG1	Standard

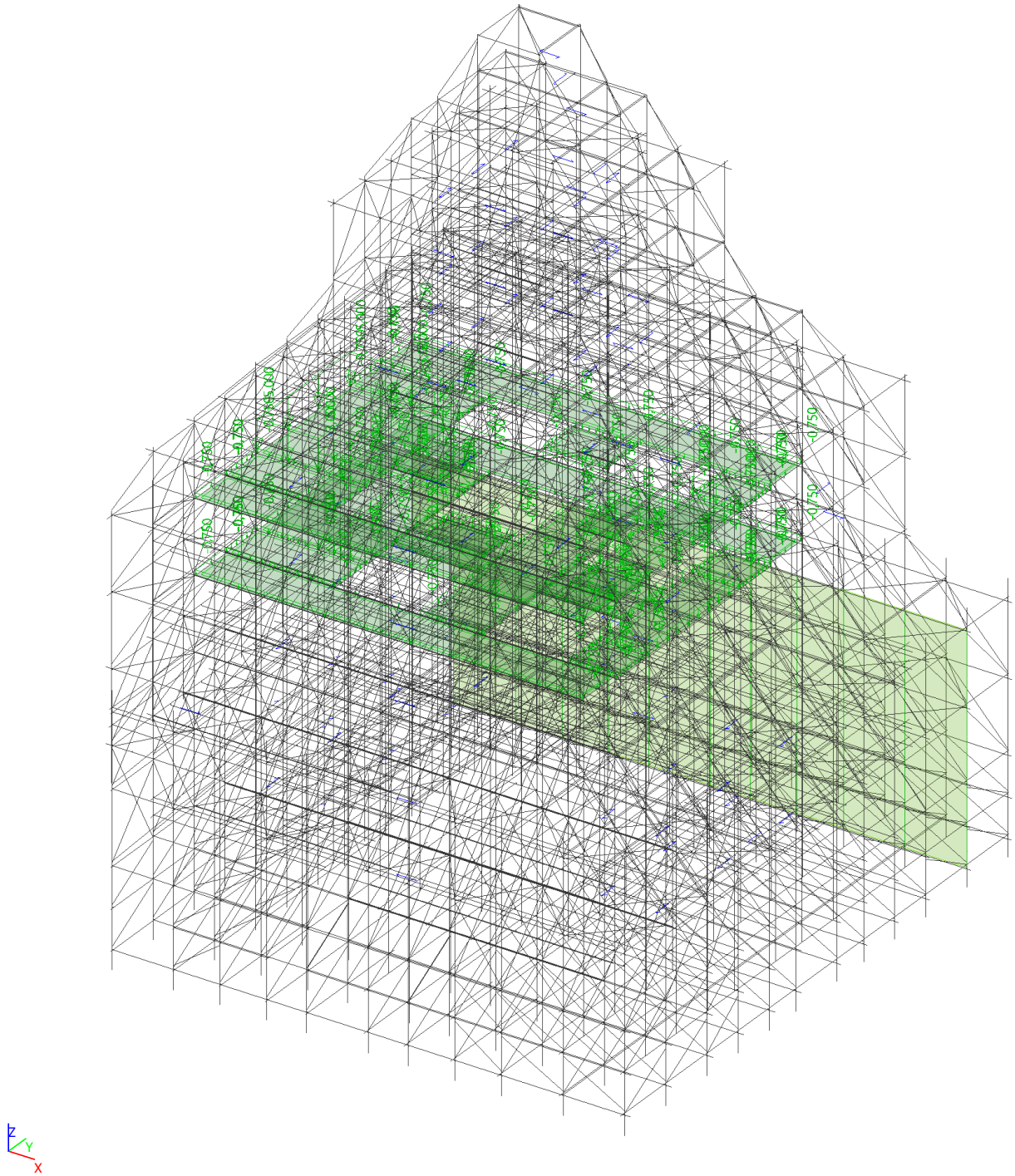
5.1.6.1. Load



5.1.7. Load cases - LS2 - lift 5

Name	Description	Action type	Load group	Load type
LS2 - lift 5	Pinnacle	Permanent	LG1	Standard

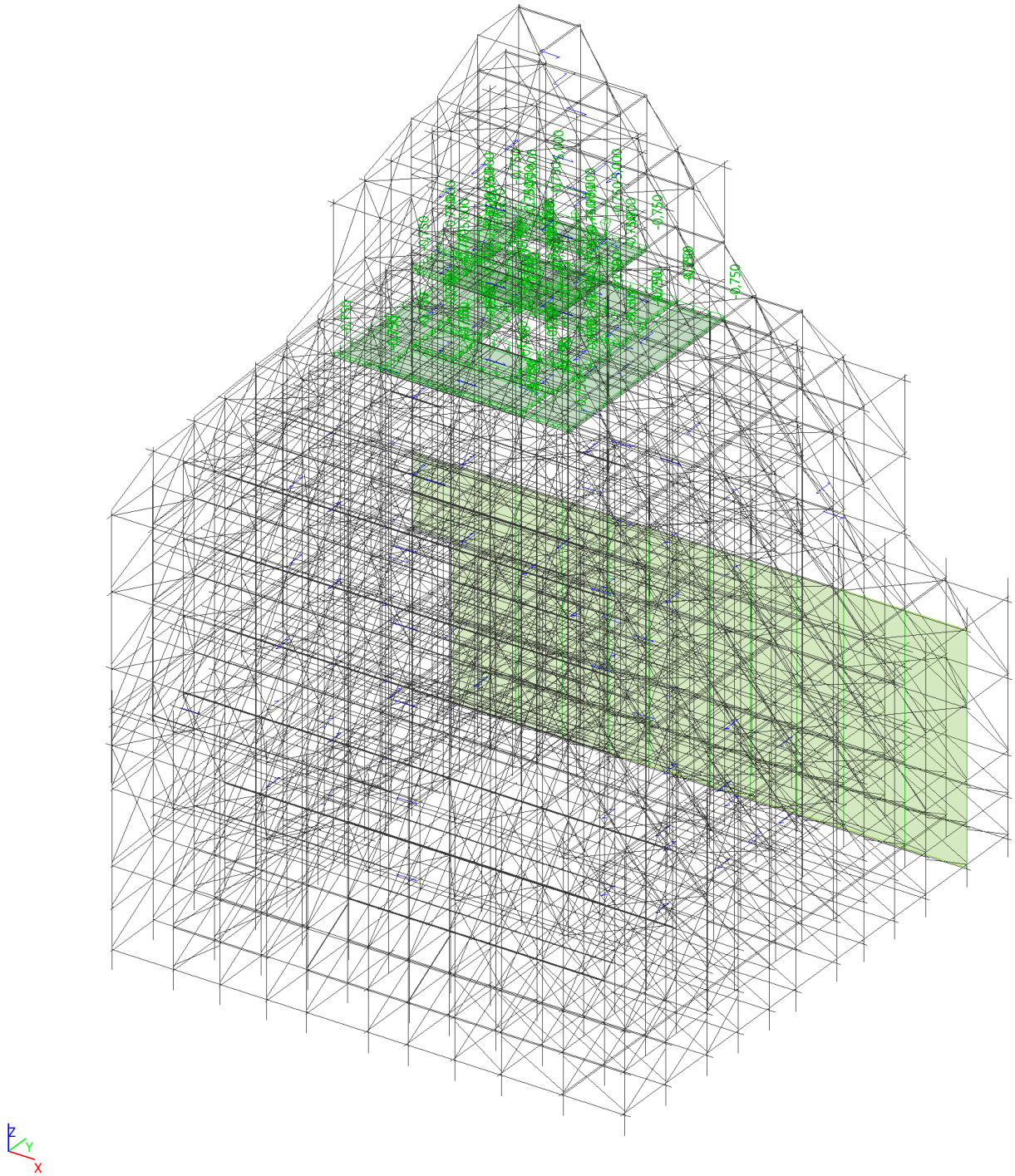
5.1.7.1. Load



5.1.8. Load cases - LS3 - lift 8

Name	Description	Action type	Load group	Load type
LS3 - lift 8	Spire	Permanent	LG1	Standard

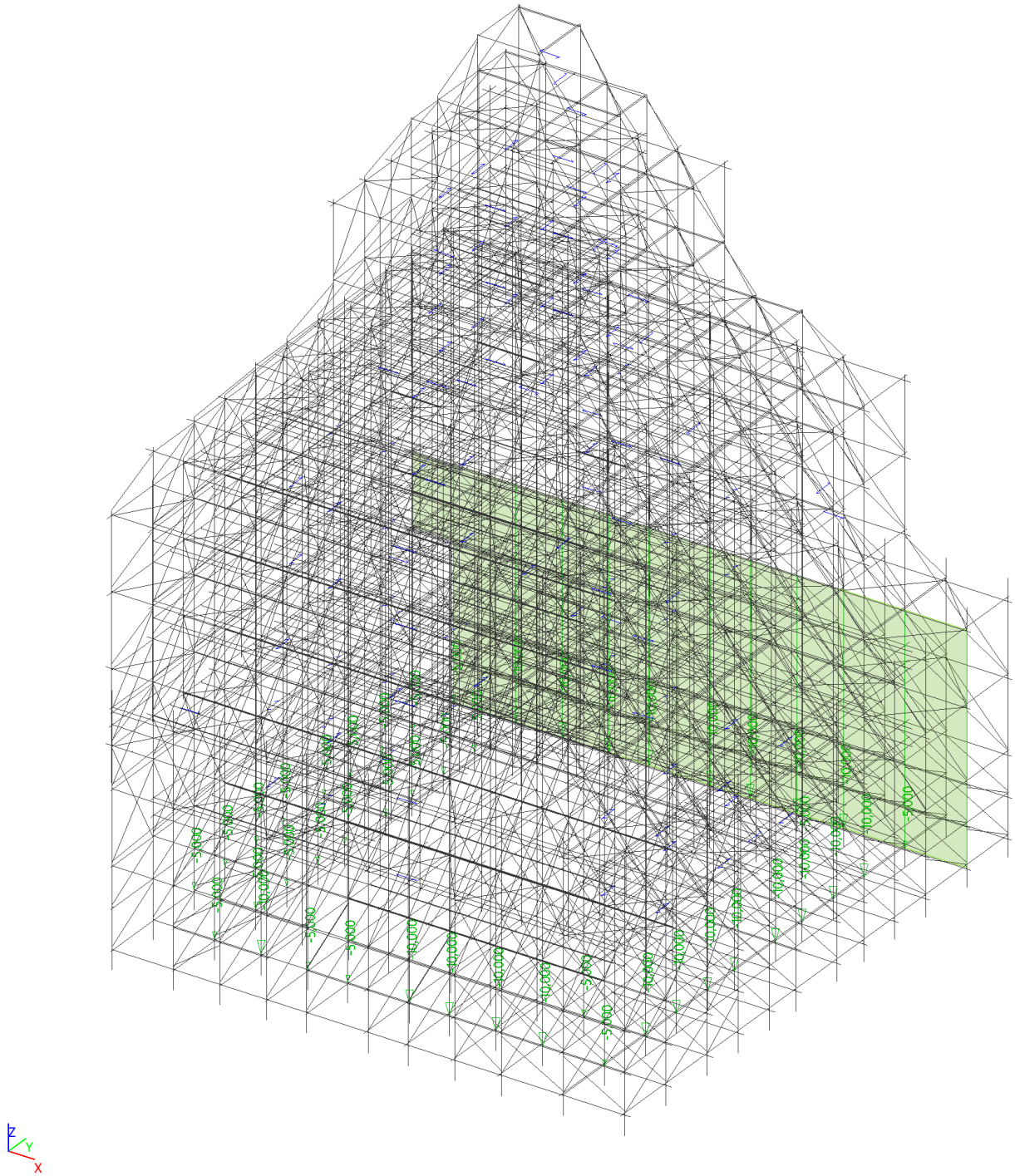
5.1.8.1. Load



5.1.9. Load cases - CW

Name	Description	Action type	Load group	Load type
CW	Counterweight	Permanent	LG1	Standard

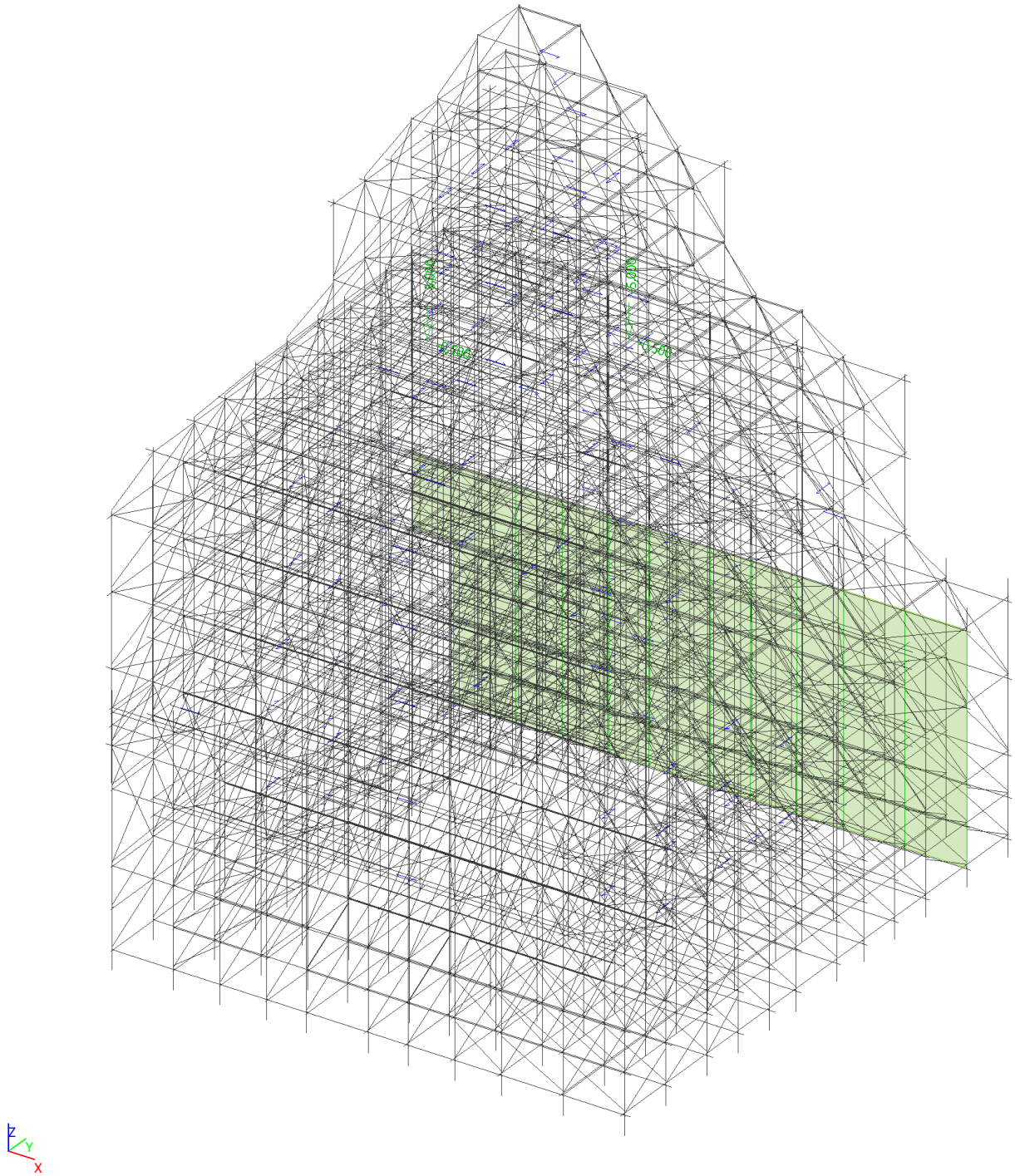
5.1.9.1. Load



5.1.10. Load cases - NIKO7

Name	Description	Action type	Load group	Load type
NIKO7	Niko lift system level 7	Permanent	LG1	Standard

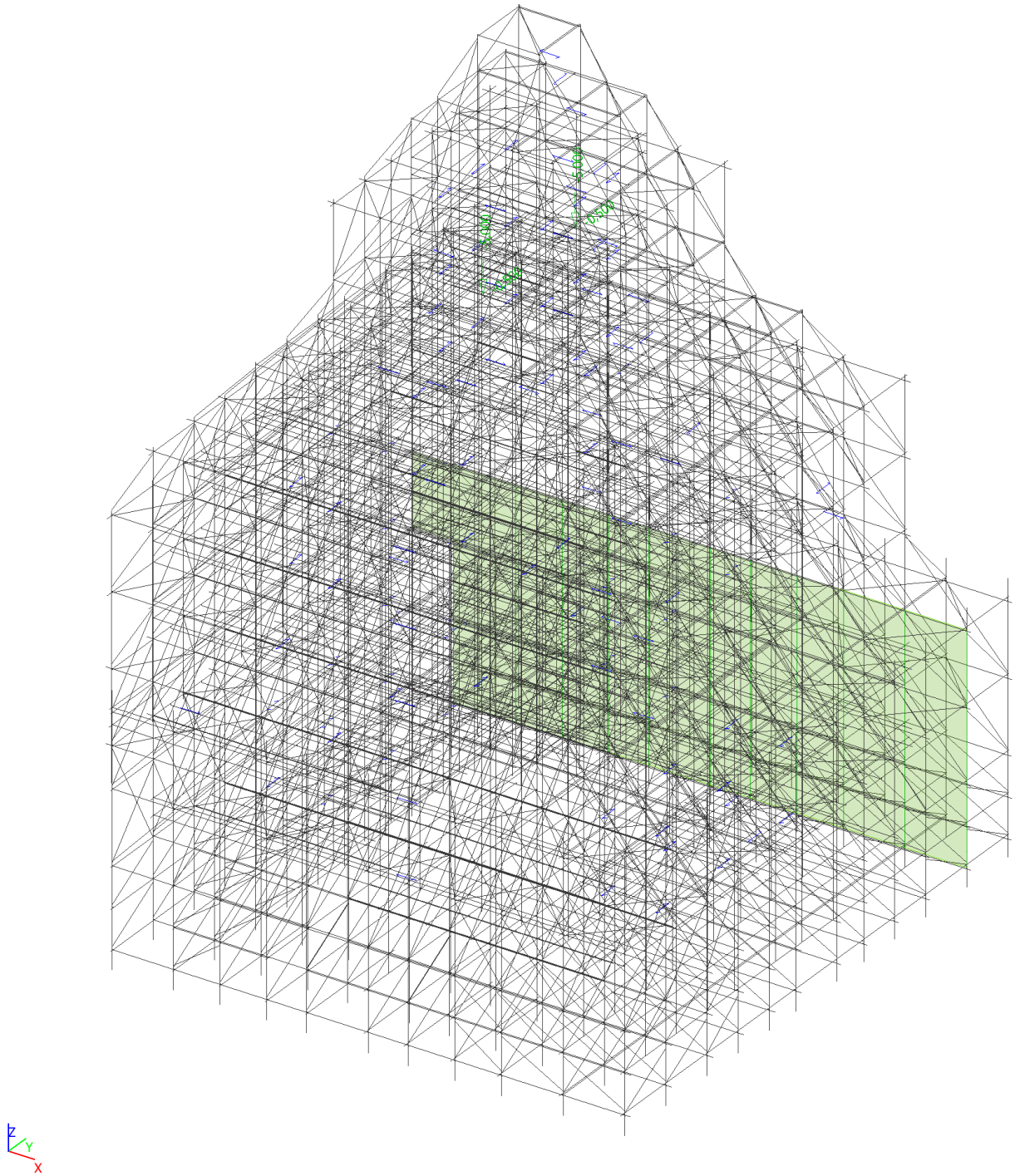
5.1.10.1. Load



5.1.11. Load cases - NIKO8

Name	Description	Action type	Load group	Load type
NIKO8	Niko lift system level 8	Permanent	LG1	Standard

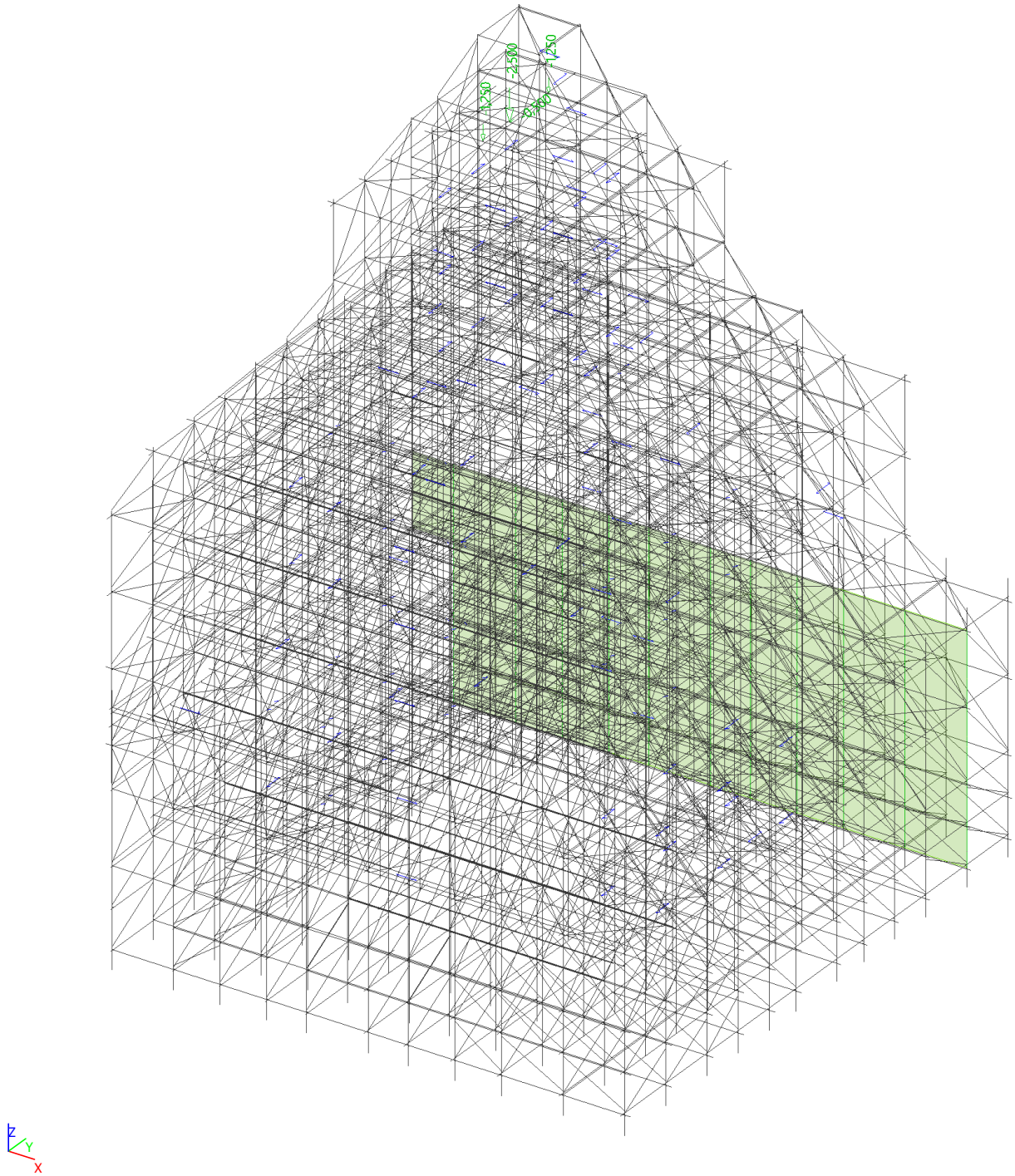
5.1.11.1. Load



5.1.12. Load cases - NIKO10

Name	Description	Action type	Load group	Load type
NIKO10	Niko lift system level 10	Permanent	LG1	Standard

5.1.12.1. Load



5.2. Nonlinear combinations

Name	Description	Type	Load cases	Coeff. [-]
SW	Self weight	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			CW - Counterweight	1,35
LS1 X	Load situation lift 2 +X direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			LS1 - lift 2 - Just in time	1,50
			FW X - Full Wind +X direction	0,81
			CW - Counterweight	1,35
LS1 Y	Load situation lift 2 +Y direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			LS1 - lift 2 - Just in time	1,50
			FW Y - Full Wind +Y direction	0,68
			CW - Counterweight	1,35
LS2 X	Load situation lift 5 +X direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			FW X - Full Wind +X direction	0,81
			LS2 - lift 5 - Pinnacle	1,50
			CW - Counterweight	1,35
			NIKO7 - Niko lift system level 7	1,80
			NIKO8 - Niko lift system level 8	1,80
LS2 Y	Load situation lift 5 +Y direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			FW Y - Full Wind +Y direction	0,68
			LS2 - lift 5 - Pinnacle	1,50
			CW - Counterweight	1,35
			NIKO7 - Niko lift system level 7	1,80
			NIKO8 - Niko lift system level 8	1,80
LS3 X	Load situation lift 8 +X direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			FW X - Full Wind +X direction	0,81
			LS3 - lift 8 - Spire	1,50
			CW - Counterweight	1,35
			NIKO10 - Niko lift system level 10	1,80
LS3 Y	Load situation lift 8 +Y direction	Ultimate	SW - Self weight	1,35
			SW fl - Self weight floors	1,35
			SW tb - Self weight toeboards	1,35
			FW Y - Full Wind +Y direction	0,68
			LS3 - lift 8 - Spire	1,50
			CW - Counterweight	1,35
			NIKO10 - Niko lift system level 10	1,80
Wmax X - LS1	Maximum wind situation +X direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22
			LS1 - lift 2 - Just in time	0,68
			FW X - Full Wind +X direction	1,35
			CW - Counterweight	1,22
Wmax Y - LS1	Maximum wind situation +Y direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22
			LS1 - lift 2 - Just in time	0,68
			FW Y - Full Wind +Y direction	1,35
			CW - Counterweight	1,22
Wmax X - LS2	Maximum wind situation +X direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22
			FW X - Full Wind +X direction	1,35
			LS2 - lift 5 - Pinnacle	0,68
			CW - Counterweight	1,22
Wmax Y - LS2	Maximum wind situation +Y direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22

Name	Description	Type	Load cases	Coeff. [-]
			FW Y - Full Wind +Y direction	1,35
			LS2 - lift 5 - Pinnacle	0,68
			CW - Counterweight	1,22
Wmax X - LS3	Maximum wind situation +X direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22
			FW X - Full Wind +X direction	1,35
			LS3 - lift 8 - Spire	0,68
			CW - Counterweight	1,22
Wmax Y - LS3	Maximum wind situation +Y direction	Ultimate	SW - Self weight	1,22
			SW fl - Self weight floors	1,22
			SW tb - Self weight toeboards	1,22
			FW Y - Full Wind +Y direction	1,35
			LS3 - lift 8 - Spire	0,68
			CW - Counterweight	1,22
Osu X	Overturning slide uplift +X direction	Ultimate	SW - Self weight	0,90
			SW fl - Self weight floors	0,90
			SW tb - Self weight toeboards	0,90
			FW X - Full Wind +X direction	1,35
			CW - Counterweight	0,90
Osu Y	Overturning slide uplift +Y direction	Ultimate	SW - Self weight	0,90
			SW fl - Self weight floors	0,90
			SW tb - Self weight toeboards	0,90
			FW Y - Full Wind +Y direction	1,35
			CW - Counterweight	0,90

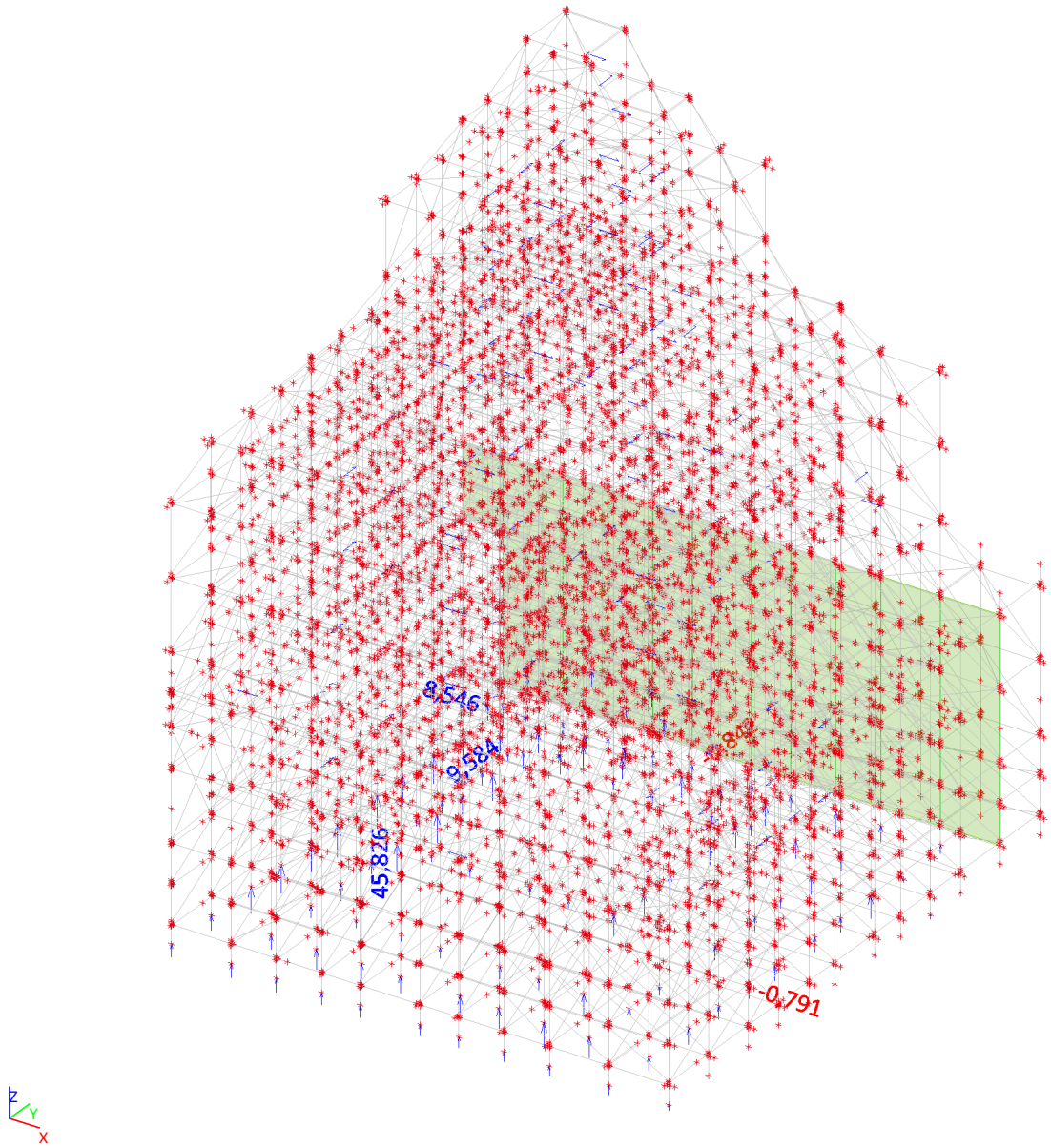
6. Results

6.1. Max Reactions

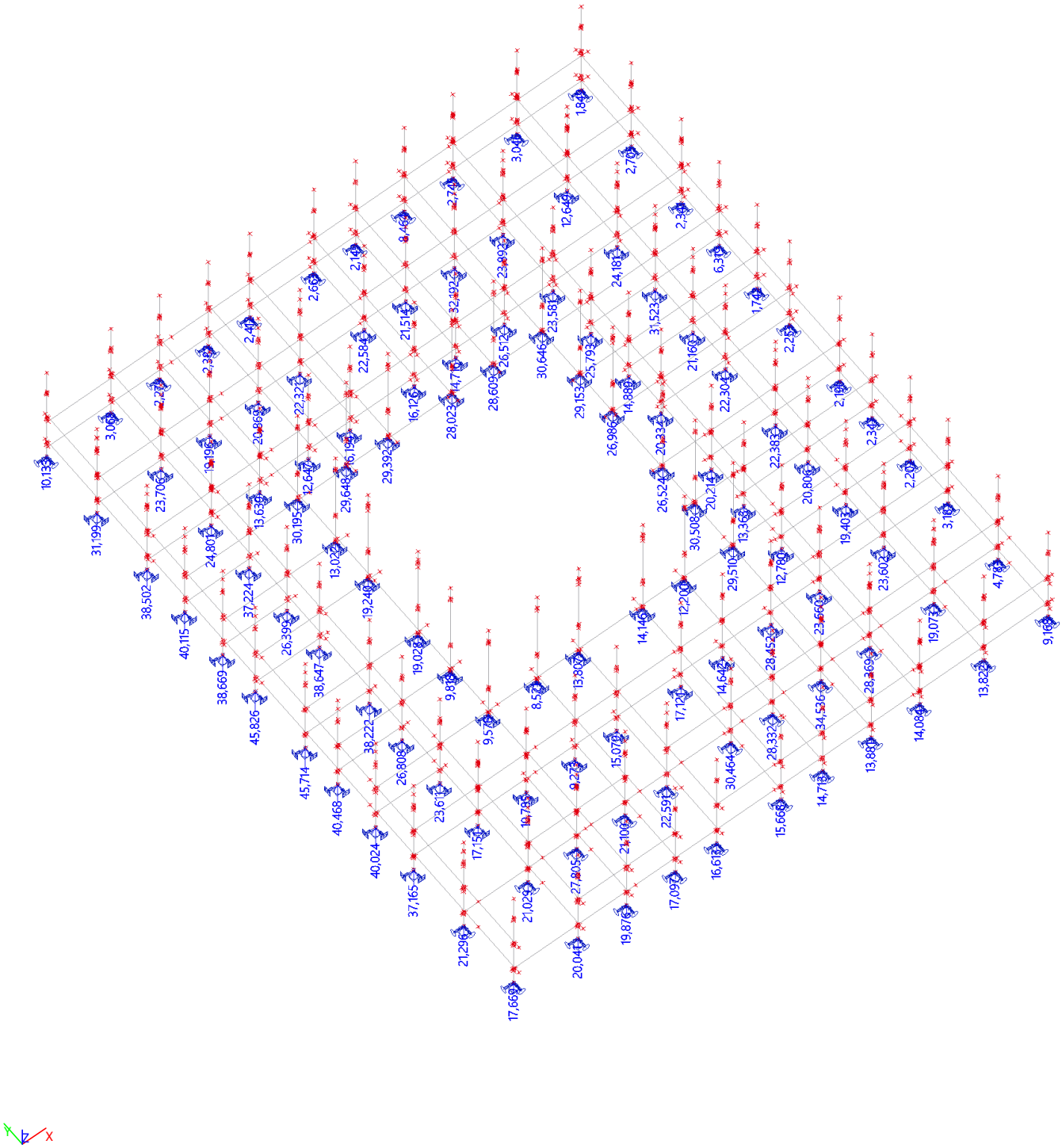
Nonlinear calculation, Extreme : Global
Selection : All
Class : NL-comb

Support	Case	Rx [kN]	Ry [kN]	Rz [kN]
Sn45/K347	Osu X	**-0,791**	0,076	0,000
Sn131/K402	Osu X	**8,546**	-0,230	0,000
Sn16/K211	Osu Y	0,231	**-0,842**	0,000
Sn122/K178	Osu Y	0,171	**9,584**	0,000
Sn70/K426	Osu Y	0,000	0,000	**0,000**
Sn92/K511	LS1 X	0,298	0,281	**45,826**

6.2. Max. Reactions (Picture)



6.3. Reactions; Rz



6.4. EC-EN 1993 UGT: Scaffolding- steel check per cross-section

Nonlinear calculation
Class: NL-comb
Coordinate system: Principal
Extreme 1D: Cross-section
Selection: All
Overall Unity Check

Name	dx [mm]	Case	Cross-section	Material	$UC_{Overall}$ [-]	UC_{Sec} [-]	UC_{Stab} [-]
S8001	2475,0+	LS2 X	TR02 Tube - RO48.3X3.2	S 355 UK tube	**1,06**	1,06	0,00
S7657	2545,6+	Osu X	TR03 Plan brace - RO48.3X3.2	S 355 UK tube	**0,22**	0,22	0,00
S2834	1453,0	Osu Y	TR04 Brace DK - RO48.3X3.2	S 355 UK tube	**0,10**	0,10	0,00
S5158	0,0	LS2 Y	AA00 Dummy - (Numeriek)	Dummy	**0,15**	0,15	0,00

6.5. EC-EN 1993 UGT: Scaffolding - steel check max.

Nonlinear calculation
Class: NL-comb
Coordinate system: Principal
Extreme 1D: Global
Selection: All

EN 1993-1-1 Code Check
EN 12811-1 Scaffolding Check
National annex: Nederlandse NEN-EN NA

Member S8001	**2,475 / 6,700 m**	**RO48.3X3.2**	**S 355 UK tube**	**NL-comb**	**1,06 -**

Combination key
NL-comb / LS2 X

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,10
γ_{M1} for resistance to instability	1,10
γ_{M2} for resistance of net sections	1,25

Material			
Yield strength	f_y	355,0	MPa
Ultimate strength	f_u	490,0	MPa
Fabrication		Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,475 m

Internal forces		**Calculated**	**Unit**
Normal force	N_{Ed}	-0,368	kN
Shear force	$V_{y,Ed}$	-0,242	kN
Shear force	$V_{z,Ed}$	7,161	kN
Torsion	T_{Ed}	0,011	kNm
Bending moment	$M_{y,Ed}$	-2,043	kNm
Bending moment	$M_{z,Ed}$	0,072	kNm

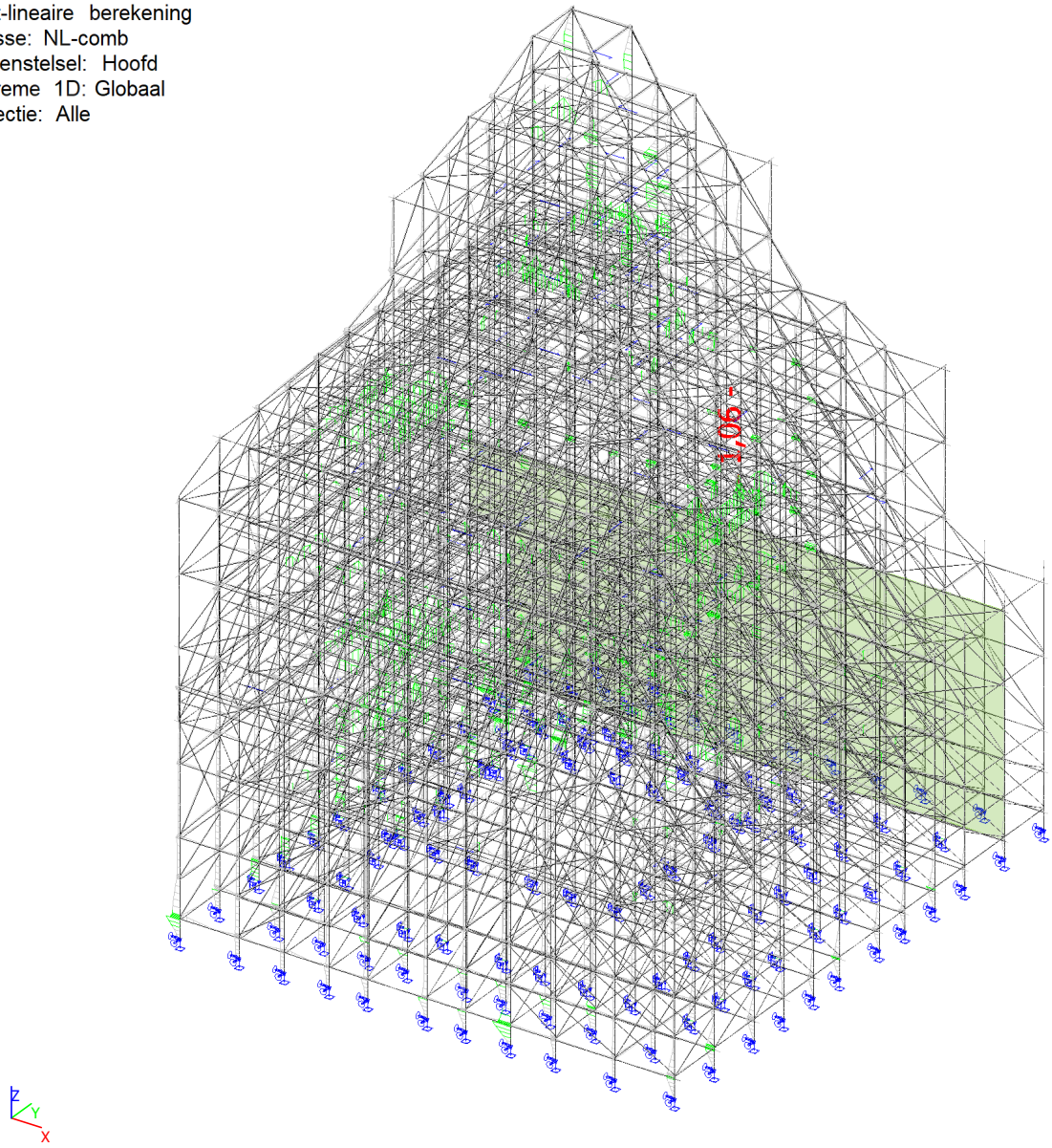
Scaffolding check for tubular members
According to EN 12811-1 & DIN 4420 Teil 1 article 5.4.7.4 and table 7

Normal force resistance	$N_{pl,d}$	146,195	kN
Shear resistance	$V_{pl,d}$	53,735	kN
Bending resistance	$M_{pl,d}$	1,936	kNm
Unity check N		0,00	-
Unity check V		0,15	-
Unity check M		**1,06**	-
Unity check Interaction		**1,06**	-
Unity check Max		**1,06**	-

The member does NOT satisfy the section check!

6.6. EC-EN 1993 UGT: Scaffolding - steel check (Picture)

Waardes: **Algehele eenheidscontrole**
Niet-lineaire berekening
Klasse: NL-comb
Assenstelsel: Hoofd
Extreme 1D: Globaal
Selectie: Alle



6.7. Scaffolding - Coupler check per type

Nonlinear calculation, Extreme : Cross-section
Selection : All
Class : NL-comb
Verification of coupler

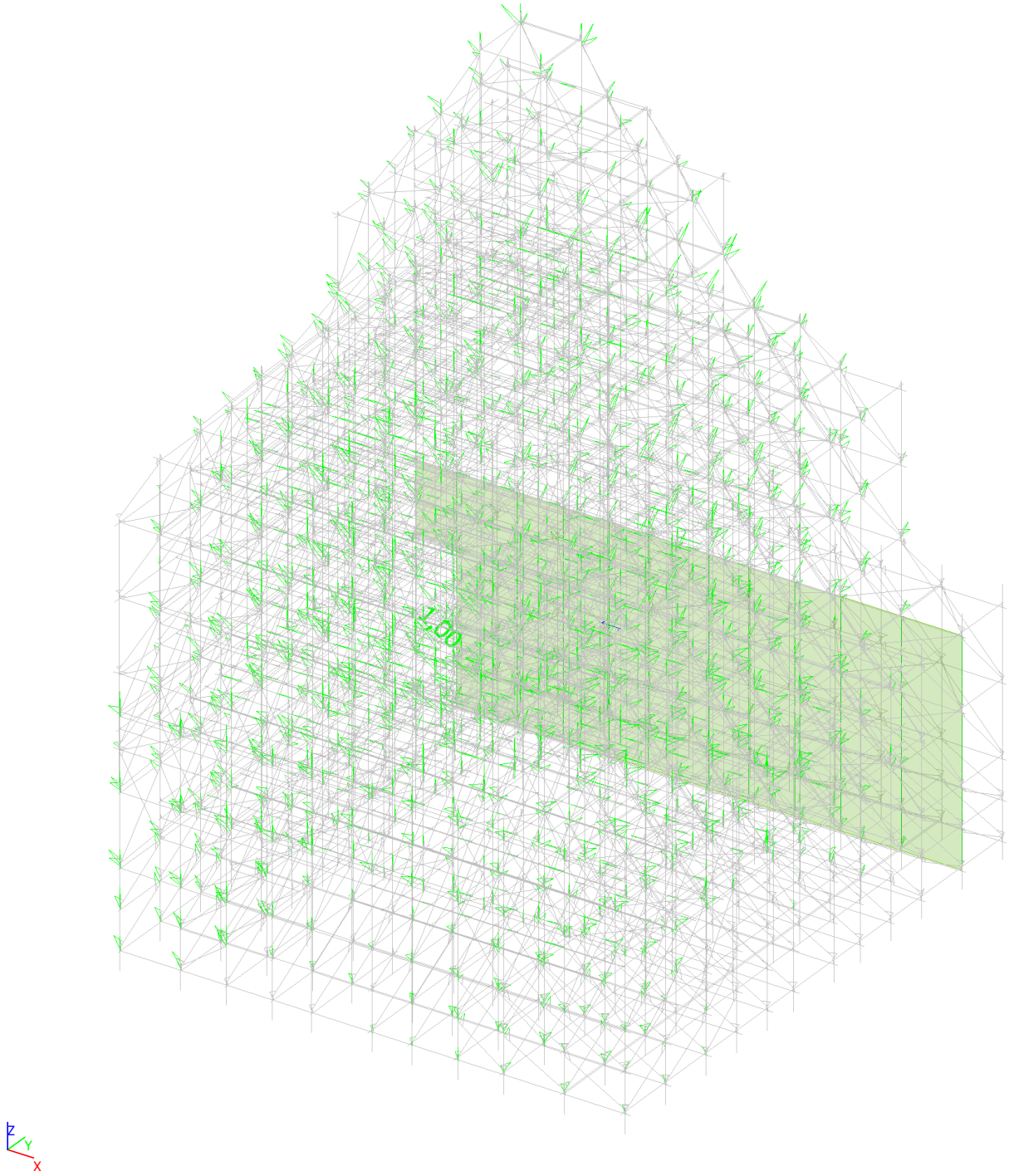
Name	Member position	UC - Max [-]	UC - Fx [-]	UC - Mx [-]	UC - Interaction [-]
			UC - Fy [-]	UC - My [-]	UC - Interaction 2 [-]
			UC - Fz [-]	UC - Mz [-]	
KK op st	S7491-Both(end)	0,65	0,29	0,03	0,15
			0,00	0,01	
			0,00	0,65	
DK op st	S7263-Both(end)	1,00	0,06	0,31	
			0,00	0,00	
			0,00	1,00	
KK doorg	S5167 -Begin	0,94	0,00	0,28	
			0,06	0,94	
			0,41	0,17	

6.8. Scaffolding - Coupler check max.

Nonlinear calculation, Extreme : Global
Selection : All
Class : NL-comb
Verification of coupler

Name	Coupler type	Member position	UC - Max [-]	UC - Fx [-]	UC - Mx [-]
				UC - Fy [-]	UC - My [-]
				UC - Fz [-]	UC - Mz [-]
DK op st	General	S7263-Both(end)	1,00	0,06	0,31
				0,00	0,00
				0,00	1,00

6.9. Scaffolding - Coupler check (Picture)



6.10. Calculation protocol

Linear calculation

Number of 2D elements **Number of 1D elements** **Number of mesh nodes** **Number of equations**	**0** **48143** **43403** **260418**
Loadcases	SW
	SW fl
	SW tb
	LS1 - lift 2
	FW X
	FW Y
	LS2 - lift 5
	LS3 - lift 8
	CW
	NIKO7
	NIKO8
	NIKO10
Start of calculation	28.05.2021 09:49
End of calculation	28.05.2021 09:50

Sum of loads and reactions.

	[kN]	X	Y	Z
Loadcase SW	loads	-0.0	0.0	-460.3
	reactions in nodes	0.0	0.0	460.3
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase SW fl	loads	0.0	0.0	-158.8
	reactions in nodes	0.0	0.0	158.8
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase SW tb	loads	0.0	0.0	-21.1
	reactions in nodes	0.0	0.0	21.1
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LS1 - lift 2	loads	0.0	0.0	-261.0
	reactions in nodes	0.0	0.0	261.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase FW X	loads	-122.8	0.0	0.0
	reactions in nodes	122.8	0.0	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase FW Y	loads	0.0	-149.2	0.0
	reactions in nodes	0.0	149.2	0.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase LS2 - lift 5	loads	0.0	0.0	-189.3
	reactions in nodes	0.0	0.0	189.3
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0

	[kN]	X	Y	Z
	contact 2D	0.0	0.0	0.0
Loadcase LS3 - lift 8	loads	0.0	0.0	-78.2
	reactions in nodes	0.0	0.0	78.2
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase CW	loads	0.0	0.0	-330.0
	reactions in nodes	0.0	0.0	330.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase NIKO7	loads	-1.0	0.0	-10.0
	reactions in nodes	1.0	0.0	10.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase NIKO8	loads	0.0	-1.0	-10.0
	reactions in nodes	0.0	1.0	10.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0
Loadcase NIKO10	loads	0.0	-0.5	-5.0
	reactions in nodes	0.0	0.5	5.0
	reactions on lines	0.0	0.0	0.0
	contact 1D	0.0	0.0	0.0
	contact 2D	0.0	0.0	0.0