Foundation Calculation Report: «1750 OX Residences - 1750 N Oxford Ave. - Eau Claire, WI»

XC structural engineering

July 8, 2019

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1 Introduction and scope

This report describes the calculation procedure and data considered in order to design the foundation of a new apartment building in Eau Claire, Wisconsin.

The construction consists in a three-story apartment building with a first-floor footprint of about 19,500 square feet, a below-grade parking garage with a footprint of about 27,200 square feet, perimeter retaining walls, a slab-on-grade, and a conventional foundation system.

The first floor system is precast hollow core concrete plank on precast beams and columns. For the upper floors and roof, the system is wood-framed. Retaining walls and slab on grade are comprised of cast in place concrete, except for three reinforced CMU walls next to the garage aisles, that will be demolished during the second phase of construction.

The foundation uses conventional cast in place concrete footings to transfer axial compression and lateral loads to the ground.

2 Building codes

The following building and material codes were used for the design:

- Building code
  - International Building Code, 2018 Edition (IBC 2018) with reference to Minimum Design Loads for Buildings and Other Structures by the American Society of Civil Engineers, 2016 Edition (ASCE 7).
- Material codes
  - Reinforced Concrete: Building Code Requirements for Structural Concrete and Commentary by the American Concrete Institute, 2019 Edition (ACI 318).
  - Masonry: Building Code Requirements and Specification for Masonry Structures and Companion Commentaries, 2013 Edition (ACI 530/530).

3 Loading criteria

A summary of the project-specific loading criteria follows (see appendix A for a detailed list of load values).

3.1 Gravity loading

The gravity loads listed in Table 1 are in addition to the self weight of the structure. The minimum loading requirements were taken from ASCE 7 as well as the loading criteria supplied by the engineer of record. Loads are given in pounds per square foot (psf).

Table 1: **Gravity Loads**

Use	**Live Loading**	**Superimposed Dead Loading**
Parking Garage	40	3
Storage/HVAC	125	28
Stairways, exits	100	28
Level 1 residential	40	28
Level 1 corridors	100	28
Level 1 office, recreational	100	28
Level 1 courtyard (footprint)	150	150
Elevated levels residential	40	28
Elevated levels corridors	40	28
Cornices	60	-
Balconies	40	28
Roof	20	28

In addition to these uniform slab loads, a perimeter dead load of 12 psf was applied to the structure to account for the weight of the cladding system.

3.2 Wind design criteria

Wind loading is in accordance with the IBC and ASCE 7 requirements as shown in Table 2.

Table 2: **Wind Design Criteria**

Parameter	**Value**
Basic Wind Speed, 3-second gust (ultimate)	115 mph
Basic Wind Speed, 3-second gust (nominal)	90 mph
Exposure	B
Occupancy Category	II
Importance Factor (I_w)	1.0
Topographic Factor (K_{zt})	1.0
Enclosure Classification	Enclosed
Mean Roof Height (h)	33'

3.3 Snow loading

Wind loading is in accordance with the ASCE 7 requirements as shown in Table 3.

Table 3: **Snow Design Criteria**

Parameter	**Value**
Ground snow load p_g	60 psf
Terrain category	B
Exposure factor C_e	1.0
Thermal factor C_t	1.0
Occupancy Category	II
Snow load importance factor I_s	1.0
Snow load flat roof	42 psf

4 Seismic design criteria

Seismic loads are in accordance with the IBC requirements as shown in Table 4.

Table 4: **Seismic Design Criteria**

Parameter	**Value**
Building Latitude/Longitude	44^{o}49'01.8"N 91^{o}30'34.8"W
Occupancy Category	II
Importance Factor I_e	1.0
Mapped Spectral Acceleration	$S_s = 0.045$; $S_1 = 0.038$
Site Class	B
Site Class Coefficients	$F_a = 1.0$; $F_v = 1.0$
Spectral Response Coefficients	$S_{DS} = 0.03$; $S_{D1} = 0.025$
Seismic Design Category	A

5 Materials

The material properties used for the design are summarized in Tables 5 and 6.

Table 5: **Concrete properties**

Member	**Nominal f'$_c$**
Footings	3.0 ksi
Basement Walls	4.0 ksi
Foundation frost walls	4.0 ksi
Stair landings and treads	4.0 ksi
Slab on grade	4.0 ksi

Table 6: **Reinforcement properties**

Standard	**Nominal f_y**
All ASTM A615 Grade 60	60 ksi

6 Design and analysis software

The computer software employed for the analysis of the structure is the Finite Element Program called **XC** (see program description at `http://xcengineering.xyz/html_files/software.html`).

7 Load combinations

The load combinations shown in Tables 7 and 8 follow the strength design load combinations listed in IBC, section 1605.

Table 7: **Combinations Ultimate Limit States**

Identifier	**Load Combination**
ULS01:	1.4*D
ULS02_a:	1.2*D + 1.6*Lru + Lpu + 0.5*S
ULS02_b:	1.2*D + 1.6*Lrs + Lps + 0.5*S
ULS03_a:	1.2*D + 1.6*S + 0.5*Lru + Lpu
ULS03_b:	1.2*D + 1.6*S + 0.5*Lrs + Lps
ULS04_b:	1.2*D + 1.6*S + 0.5*W_NS
ULS04_a:	1.2*D + 1.6*S + 0.5*W_WE
ULS05_a:	1.2*D + W_WE + 0.5*Lru + Lpu
ULS05_b:	1.2*D + W_NS + 0.5*Lru + Lpu
ULS05_c:	1.2*D + W_WE + 0.5*Lrs + Lps
ULS05_d:	1.2*D + W_NS + 0.5*Lrs + Lps
ULS06_a:	1.2*D + 0.5*Lru + Lpu + 0.2*S
ULS06_b:	1.2*D + 0.5*Lrs + Lps + 0.2*S
ULS07_a:	0.9*D + W_WE
ULS07_b:	0.9*D + W_NS

Where:

D = dead load
Lru = live load (uniform on rooms)
Lrs = live load (staggered pattern on rooms)
Lpu = live load (uniform on patios)
Lps = live load (staggered pattern on patios)
S = snow load
W_WE = Wind West-East
W_NS = Wind North-South

Table 8: **Combinations Serviceability Limit States**

Identifier	Load Combination
SLS01:	1.0*D
SLS02_a:	1.0*D + 1.0*Lru + Lpu + 0.3*S
SLS02_b:	1.0*D + 1.0*Lrs + Lps + 0.3*S
SLS03_a:	1.0*D + 1.0*S + 0.3*Lru + 0.3*Lpu
SLS03_b:	1.0*D + 1.0*S + 0.3*Lrs + 0.3*Lps
SLS04_a:	1.0*D + W_WE + 1.0*Lru + Lpu
SLS04_b:	1.0*D + W_NS + 1.0*Lru + Lpu
SLS04_c:	1.0*D + W_WE + 1.0*Lrs + Lps
SLS04_d:	1.0*D + W_NS + 1.0*Lrs + Lps
SLS05_a:	1.0*D + W_WE
SLS05_b:	1.0*D + W_NS

Where:

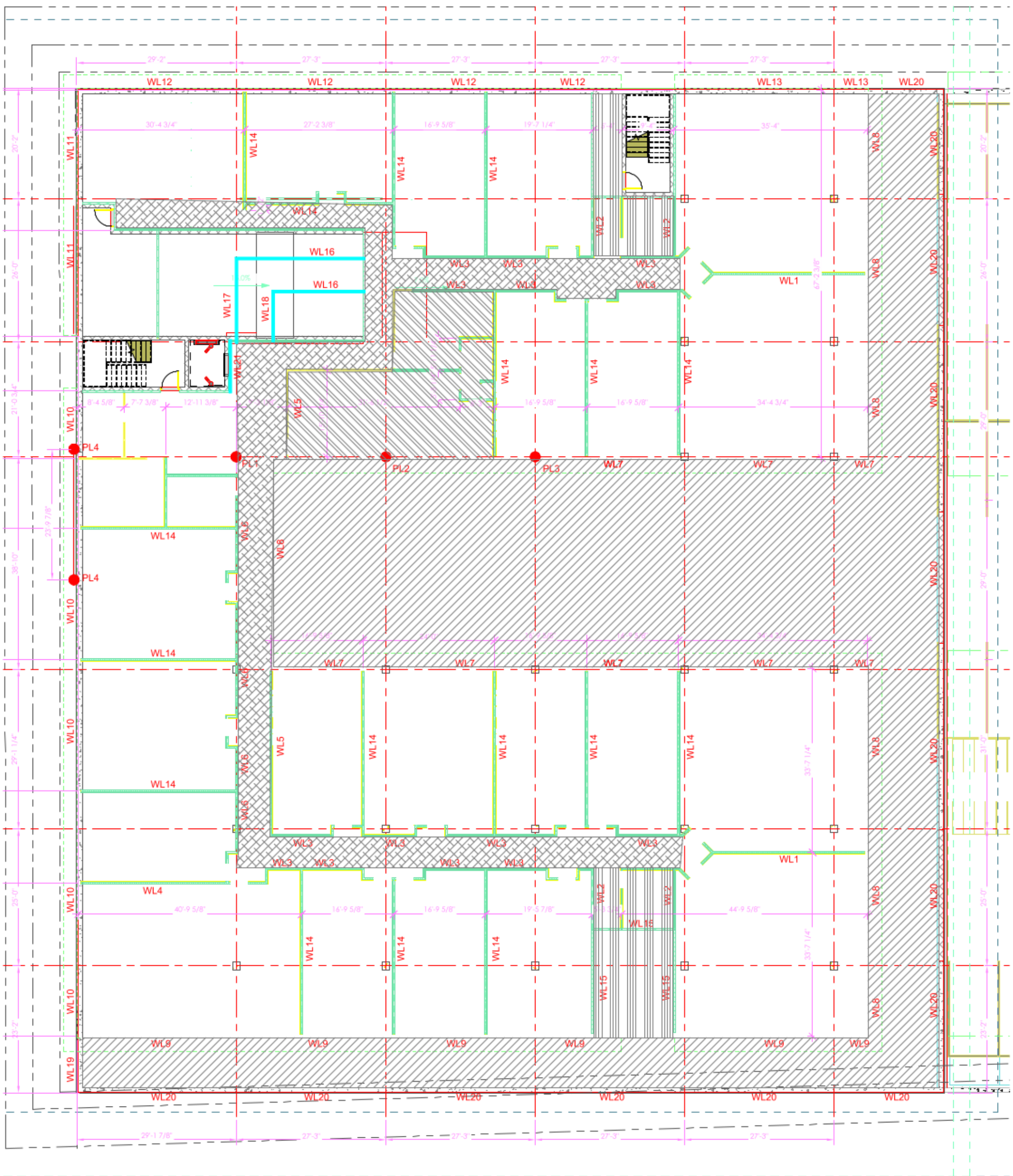
D = dead load
Lru = live load (uniform on rooms)
Lrs = live load (staggered pattern on rooms)
Lpu = live load (uniform on patios)
Lps = live load (staggered pattern on patios)
S = snow load
W_WE = Wind West-East
W_NS = Wind North-South

8 Structural model

A three-dimensional elastic computer model of the substructure is analyzed using XC. The model includes first floor frame and columns (see figure 2). The hollow core planks ar modelled using shell elements, while beams and columns are modelled using frame elements. Loads transmited by 2^{nd}, 3^{rd} floors and roof are applied to the 1^{st}. Load layout is shown in figure 1. See in figures 3 to 10 load distribution for each load case.

Linear loads are expressed in kN/m and surface loads in kN/m^2, where:

1 kN/m =	68.52178 lb/ft
1 kN/m^2 =	20.885434 psf



WALL LOAD SCHEDULE														
MARK	ELEV.	DEAD LOAD Klb/ft	LIVE LOAD Klb/ft	SNOW LOAD Klb/ft	W-E WIND LOAD			N-S WIND LOAD			EARTH PRES.	CHORD LOAD	
					UPLIFT Klb/ft	DOWN LIFT Klb/ft	IN PLANE Klb/ft	UPLIFT Klb/ft	DOWN LIFT Klb/ft	IN PLANE Klb/ft	IN PLANE Klb/ft	DEAD IN PLANE Klb/ft	LIVE IN PLANE Klb/ft
WL1	-0'-4"	1.51	3.35	2.01	0.40	N/A	N/A	0.40	N/A	0.15	N/A	N/A	N/A
WL2	-0'-4"	0.83	0.74	0.44	0.40	N/A	N/A	0.40	N/A	N/A	N/A	N/A	N/A
WL3	-0'-4"	1.12	1.84	1.10	0.40	N/A	N/A	0.40	N/A	0.15	N/A	N/A	N/A
WL4	-0'-4"	1.05	1.57	0.94	0.40	N/A	N/A	0.40	N/A	0.15	N/A	N/A	N/A
WL5	-0'-4"	0.72	0.33	0.20	0.40	N/A	0.39	0.40	N/A	N/A	N/A	N/A	N/A
WL6	-0'-4"	1.11	1.79	1.07	0.40	N/A	0.39	0.40	N/A	N/A	N/A	N/A	N/A
WL7	-0'-4"	1.58	1.67	1.00	1.61	2.39	N/A	N/A	N/A	0.15	N/A	N/A	N/A
WL8	-0'-4"	0.50	N/A	N/A	N/A	N/A	0.39	N/A	1.20	N/A	N/A	N/A	N/A
WL9	-0'-4"	1.73	2.26	1.36	1.86	N/A	N/A	N/A	N/A	0.15	N/A	N/A	N/A
WL10	-0'-4"	1.52	1.46	0.88	N/A	N/A	0.39	1.28	N/A	N/A	2.30	N/A	N/A
WL11	-0'-4"	0.50	N/A	N/A	N/A	N/A	0.39	1.28	N/A	N/A	2.30	N/A	N/A
WL12	-0'-4"	1.55	1.57	0.94	N/A	1.08	N/A	N/A	N/A	0.15	2.30	N/A	N/A
WL13	-0'-4"	1.58	1.67	1.00	N/A	1.08	N/A	N/A	N/A	0.15	2.30	N/A	N/A
WL14	-0'-4"	0.27	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WL15	-0'-4"	1.92	1.33	0.44	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
WL16	11'-2"	0.95	1.10	1.10	0.40	N/A	N/A	0.40	N/A	0.16	N/A	N/A	N/A
WL17	11'-2"	0.94	1.07	1.07	0.40	N/A	0.39	0.40	N/A	N/A	N/A	N/A	N/A
WL18	11'-2"	0.69	0.20	0.20	0.40	N/A	0.39	0.40	N/A	N/A	N/A	N/A	N/A
WL19	-1'-8"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.30	N/A	N/A
WL20	-1'-8"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2.30	N/A	N/A
WL21	-0'-4"	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.94	1.76

POINT LOAD SCHEDULE			
MARK	DEAD LOAD Klb	LIVE LOAD Klb	SNOW LOAD Klb
PL1	15.24	25.01	15.01
PL2	30.47	50.02	30.02
PL3	15.24	25.01	15.01
PL4	17.84	17.40	10.50

SUPERIMPOSED UNIFORM LOAD SCHEDULE				
MARK	DEAD LOAD PSF	LIVE LOAD PSF	SNOW LOAD PSF	COMMENTS
	150.00	150.00	42.00	YARDS AND TERRACES PEDESTRIAN
	20.00	100.00	N/A	CORRIDORS FIRST FLOOR
	20.00	100.00	N/A	STAIRS AND EXITS
	20.00	100.00	N/A	STORE FIRST FLOOR
	20.00	40.00	N/A	PRIVATE ROOMS MULTIFAMILY DWELLING

Figure 1: Load layout on first floor.

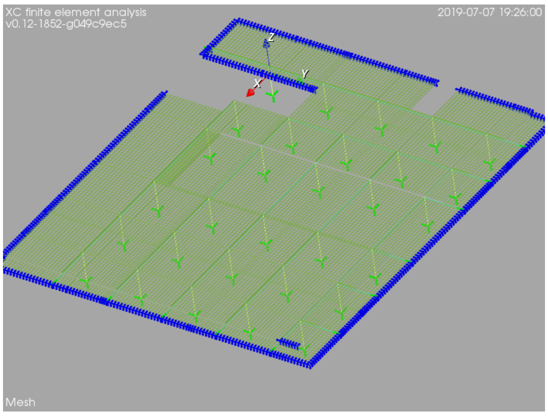


Figure 2: Elastic model, mesh.

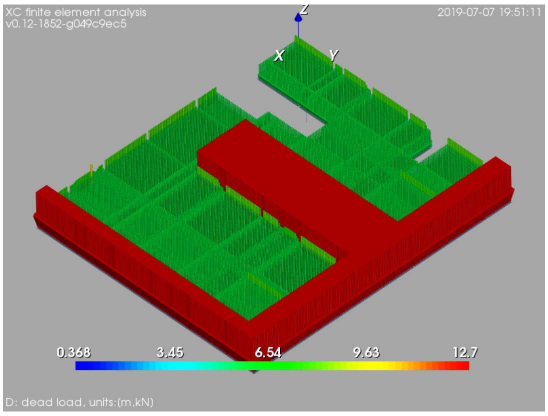


Figure 3: Load case D: dead load (include slab self-weight) [units: kN,m].

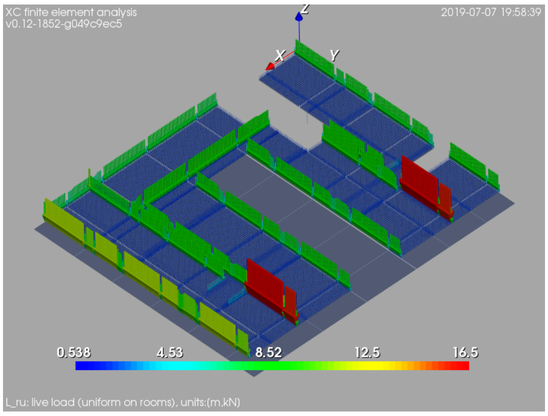


Figure 4: Load case Lru: live load (uniform on rooms) [units: kN,m].

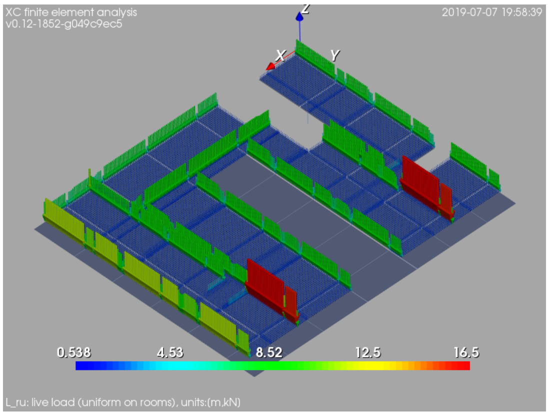


Figure 5: Load case Lrs: live load (staggered pattern on rooms) [units: kN,m].

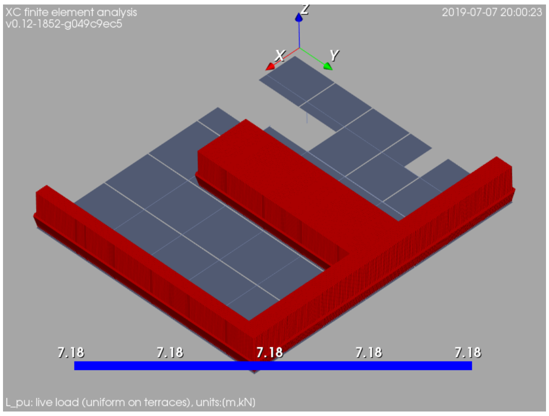


Figure 6: Load case Lpu: live load (uniform on patios) [units: kN,m].

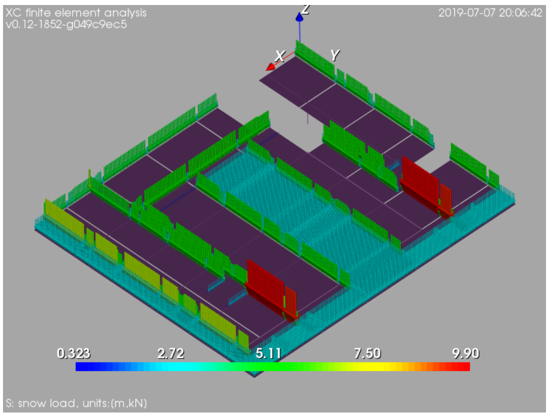


Figure 7: Load case S: snow [units: kN,m].

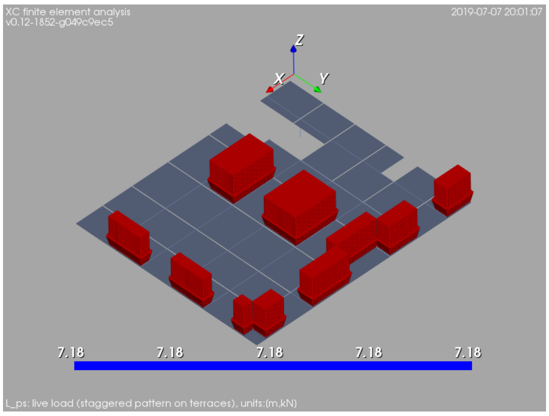


Figure 8: Load case Lps: live load (staggered pattern on patios) [units: kN,m].

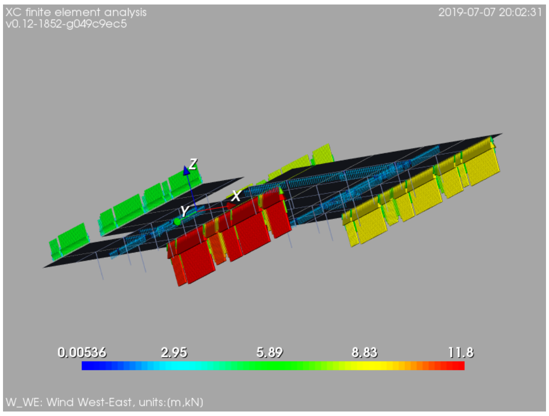


Figure 9: Load case W_WE: wind West-East [units: kN,m].

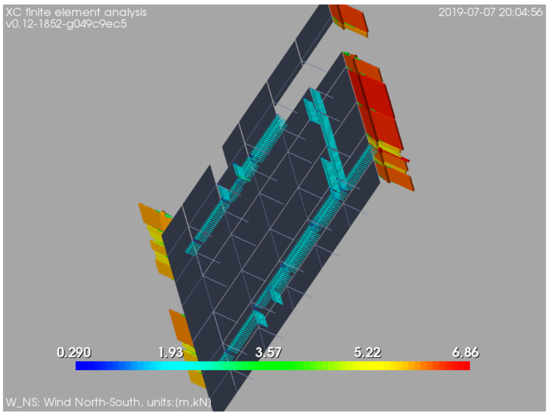


Figure 10: Load case W_NS: wind North-South [units: kN,m].

9 Basement walls

9.1 Introduction

The design is bassed in the following assumptions:

- Design wall with pinned base and pinned top.
- Neglect corner regions (wall spans one-way only).
- Top slab is in place and has achieved full strength prior to backfilling.
- Vehicular traffic around the building is represented by a uniform load of 250 psf (11.97 kN/m^2).
- The vertical response of the soil calculated using a Winkler model with a subgrade reaction module of set of 200 pounds per cubic inch ($54.29 \times 10^6\ N/m^3$).
- Water table deep below structure.

9.2 Load determination

9.2.1 Self weight

The self weight of the reinforced concrete is calculated from its density: 2500 kg/m^3.

9.2.2 Axial loads from building

The loads transferred by the top slab to the wall are as follows:

Building side	**Load**	**Phase 1** (kN/m)	**Phase 2** (kN/m)
North	SnowL	10.06	10.06
North	LiveL	21.67	21.67
North	Wind_NS	-15.12	-15.12
North	Wind_WE	-1.33	-1.33
North	DeadL	31.54	31.54
South	SnowL	8.04	16.08
South	LiveL	14.22	28.44
South	Wind_NS	4.97	9.95
South	Wind_WE	-0.23	-0.46
South	DeadL	20.58	41.15
East	SnowL	11.96	11.96
East	LiveL	23.75	23.75
East	Wind_NS	-0.07	-0.07
East	Wind_WE	12.97	12.97
East	DeadL	30.87	30.87
West	SnowL	15.02	15.02
West	LiveL	27.15	27.15
West	Wind_NS	-0.20	-0.20
West	Wind_WE	-13.20	-13.20
West	DeadL	29.81	29.81

CONCRETE WALL REINFORCING SCHEDULE					
MARK	TYPE	THICKNESS	REINFORCEMENT		REMARKS
			VERTICAL	HORIZONTAL	
W1	CONCRETE	10"	5#'s AT 18"o.c.	5#'s AT 12"o.c.	inside face
W2	CONCRETE	10"	5#'s AT 12"o.c.	5#'s AT 12"o.c.	inside face
W3	CONCRETE	10"	6#'s AT 12"o.c.	5#'s AT 12"o.c.	inside face
W4	CONCRETE	8"	4#'s AT 12"o.c.	3#'s AT 12"o.c.	centered in wall thickness

CONCRETE WALL REINFORCING SCHEDULE NOTES:
1. REFER TO STRUCTURAL NOTES SHEET FOR LAPS IN STEEL REINFORCEMENT.
2. COORDINATE AND VERIFY ALL DIMENSIONS WITH ARCHITECTURAL DRAWINGS AND EXIST. CONDITIONS

Table 9: Concrete walls reinforcing schedule

9.3 Load combinations

Serviceability limit states		
Equation 16-8	EQ1608	1.0*selfWeight+1.0*deadLoad
Equation 16-9	EQ1609A	1.0*selfWeight+1.0*deadLoad+1.0*trafficLoad
Equation 16-9	EQ1609B	1.0*selfWeight+1.0*deadLoad+1.0*liveLoad
Equation 16-10	EQ1610	1.0*selfWeight+1.0*deadLoad+1.0*snowLoad
Equation 16-11	EQ1611A	1.0*selfWeight+1.0*deadLoad+0.75*trafficLoad+0.75*snowLoad
Equation 16-11	EQ1611B	1.0*selfWeight+1.0*deadLoad+0.75*liveLoad+0.75*snowLoad
Equation 16-12	EQ1612	1.0*selfWeight+1.0*deadLoad+0.6*windLoad
Equation 16-13	EQ1613A	1.0*selfWeight+1.0*deadLoad+0.45*windLoad+0.75*trafficLoad+0.75*snowLoad
Equation 16-13	EQ1613B	1.0*selfWeight+1.0*deadLoad+0.45*windLoad+0.75*liveLoad+0.75*snowLoad
Equation 16-14	doesn't apply	
Equation 16-15	EQ1615	0.6*selfWeight+0.6*deadLoad+0.6*windLoad
Equation 16-16	doesn't apply	

Ultimate limit states.		
Equation 16-1	EQ1601	1.4*selfWeight+1.4*deadLoad
Equation 16-2	EQ1602A	1.2*selfWeight+1.2*deadLoad+1.6*trafficLoad+0.5*snowLoad
Equation 16-2	EQ1602B	1.2*selfWeight+1.2*deadLoad+1.6*liveLoad+0.5*snowLoad
Equation 16-3	EQ1603A	1.2*selfWeight+1.2*deadLoad+1.6*snowLoad+0.5*trafficLoad
Equation 16-3	EQ1603B	1.2*selfWeight+1.2*deadLoad+1.6*snowLoad+0.5*liveLoad
Equation 16-3	EQ1603C	1.2*selfWeight+1.2*deadLoad+1.6*snowLoad+0.5*windLoad
Equation 16-4	EQ1604A	1.2*selfWeight+1.2*deadLoad+1.0*windLoad+0.5*trafficLoad+0.5*snowLoad
Equation 16-4	EQ1604B	1.2*selfWeight+1.2*deadLoad+1.0*windLoad+0.5*liveLoad+0.5*snowLoad
Equation 16-5	EQ1605A	1.2*selfWeight+1.2*deadLoad+0.5*trafficLoad+0.7*snowLoad
Equation 16-5	EQ1605B	1.2*selfWeight+1.2*deadLoad+0.5*liveLoad+0.7*snowLoad
Equation 16-6	doesn't apply	
Equation 16-7	doesn't apply	

9.3.1 Earth pressure

The soil pressure over the wall has been calculated using the lateral pressure at rest with a coefficient $K_0 = 0.5$.

9.4 Stem dimensions and reinforcement

The thickness and the reinforcement for the walls are indicated in the table 9.

9.4.1 Wall types

For analysis purposes we have considered the following wall types:

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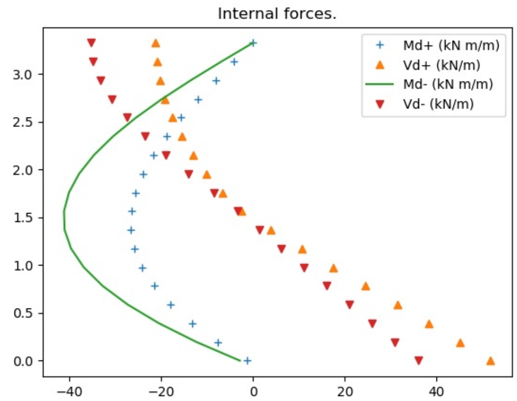
<tr><th colspan="2">T1</th></tr>
<tr><td>
</td>
<td>WALL GEOMETRY
Stem top thickness:
$b_{top} = 0.25\ m$
Stem height:
$h_{stem} = 3.15\ m$
Stem bottom thickness:
$b_{bottom} = 0.25\ m$
Footing thickness:
$b_{footing} = 0.36\ m$</td></tr>
<tr><td colspan="2">MATERIALS
Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm</td></tr>
</table>

Table 10: Wall materials and dimensions T1

Wall	**Stem height (m)**
T1	3.15
T2	2.74
T3	3.53
T4	3.12
T5	2.51
T6	3.43

9.4.2 Internal forces

The envelope of internal forces envelope for each of the walls are given in tables 10 to 15.

9.4.3 Reinforcement checks

WALL VERTICAL REINFORCEMENTS
T1 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 16 mm, spacing: 300 mm reinf. development L=0.34 m (22 diameters). area: As= 6.67 cm2/m areaMin: 4.56 cm2/m F(As)= 1.46 OK! Bending check: Md= 40.09 kN m, MR= 41.36kN m F(M)= 1.03 OK! Shear check: Vd= 7.61 kN, VR= 199.37 kN F(V)= 26.21 OK!
T2 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 16 mm, spacing: 400 mm reinf. development L=0.34 m (22 diameters). area: As= 5.00 cm2/m areaMin: 4.56 cm2/m F(As)= 1.10 OK! Bending check: Md= 29.02 kN m, MR= 31.02kN m F(M)= 1.07 OK!
../..

<table>
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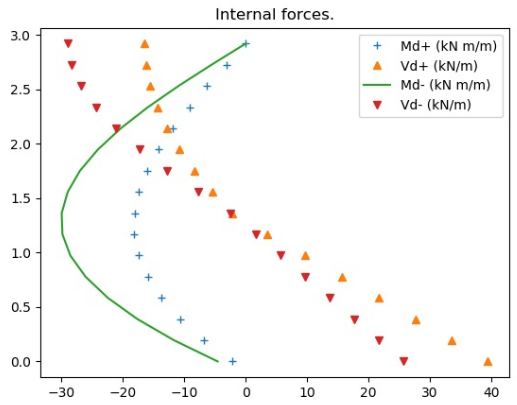
<tr><td>
</td><td>WALL GEOMETRY
Stem top thickness:
$b_{top} = 0.25\ m$
Stem height:
$h_{stem} = 2.74\ m$
Stem bottom thickness:
$b_{bottom} = 0.25\ m$
Footing thickness:
$b_{footing} = 0.36\ m$</td></tr>
<tr><td colspan="2">MATERIALS
Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm</td></tr>
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Table 11: Wall materials and dimensions T2

<table>
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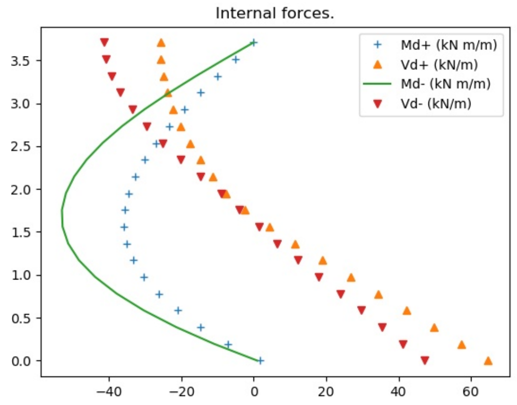
<tr><td>
</td><td>WALL GEOMETRY
Stem top thickness:
$b_{top} = 0.25\ m$
Stem height:
$h_{stem} = 3.53\ m$
Stem bottom thickness:
$b_{bottom} = 0.25\ m$
Footing thickness:
$b_{footing} = 0.36\ m$</td></tr>
<tr><td colspan="2">MATERIALS
Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm</td></tr>
</table>

Table 12: Wall materials and dimensions T3

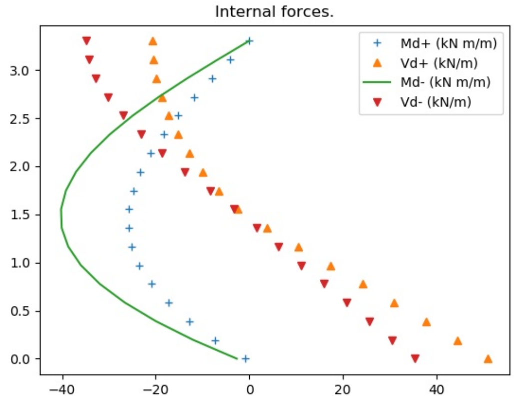
<table>
<tr><th colspan="2">T4</th></tr>
<tr><td>
</td>
<td>WALL GEOMETRY
Stem top thickness:
$b_{top} = 0.25\ m$
Stem height:
$h_{stem} = 3.12\ m$
Stem bottom thickness:
$b_{bottom} = 0.25\ m$
Footing thickness:
$b_{footing} = 0.36\ m$</td></tr>
<tr><td colspan="2">MATERIALS
Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm</td></tr>
</table>

Table 13: Wall materials and dimensions T4

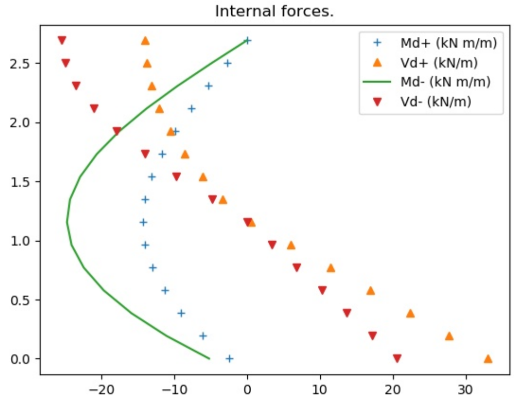
<table>
<tr><th colspan="2">T5</th></tr>
<tr><td>
</td>
<td>WALL GEOMETRY
Stem top thickness:
$b_{top} = 0.25\ m$
Stem height:
$h_{stem} = 2.51\ m$
Stem bottom thickness:
$b_{bottom} = 0.25\ m$
Footing thickness:
$b_{footing} = 0.36\ m$</td></tr>
<tr><td colspan="2">MATERIALS
Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm</td></tr>
</table>

Table 14: Wall materials and dimensions T5

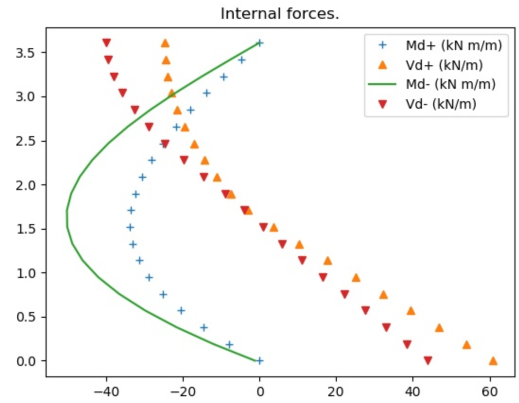
T6	
	Wall geometry Stem top thickness: $b_{top} = 0.25\ m$ Stem height: $h_{stem} = 3.43\ m$ Stem bottom thickness: $b_{bottom} = 0.25\ m$ Footing thickness: $b_{footing} = 0.36\ m$
Materials Concrete: C4000 Steel: A615G60 Concrete cover: 55 mm	

Table 15: Wall materials and dimensions T6

wall vertical reinforcements (cont.)
Shear check: Vd= 6.84 kN, VR= 199.37 kN F(V)= 29.15 OK!
T3 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 19 mm, spacing: 300 mm reinf. development L=0.61 m (32 diameters). area: As= 9.47 cm2/m areaMin: 4.56 cm2/m F(As)= 2.08 OK! Bending check: Md= 51.88 kN m, MR= 58.26kN m F(M)= 1.12 OK! Shear check: Vd= 7.98 kN, VR= 199.37 kN F(V)= 24.98 OK!
T4 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 16 mm, spacing: 300 mm reinf. development L=0.34 m (22 diameters). area: As= 6.67 cm2/m areaMin: 4.56 cm2/m F(As)= 1.46 OK! Bending check: Md= 39.19 kN m, MR= 41.36kN m F(M)= 1.06 OK! Shear check: Vd= 7.46 kN, VR= 199.37 kN F(V)= 26.73 OK!
T5 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 16 mm, spacing: 400 mm reinf. development L=0.34 m (22 diameters). area: As= 5.00 cm2/m areaMin: 4.56 cm2/m F(As)= 1.10 OK! Bending check: Md= 23.62 kN m, MR= 31.02kN m F(M)= 1.31 OK! Shear check: Vd= 6.42 kN, VR= 199.37 kN F(V)= 31.05 OK!
T6 wall. Inside stem reinforcement: RC section dimensions; b= 1.00 m, h= 0.25 m diam: 19 mm, spacing: 300 mm reinf. development L=0.61 m (32 diameters). area: As= 9.47 cm2/m areaMin: 4.56 cm2/m F(As)= 2.08 OK! Bending check: Md= 49.02 kN m, MR= 58.26kN m F(M)= 1.19 OK!
../..

WALL VERTICAL REINFORCEMENTS (CONT.)
Shear check: Vd= 8.13 kN, VR= 199.37 kN F(V)= 24.54 OK!

SHEAR CHECK
T1 wall. Shear check: Shear check: Vd= 42.99 kN, VR= 199.37 kN F(V)= 4.64 OK!
T2 wall. Shear check: Shear check: Vd= 31.78 kN, VR= 199.37 kN F(V)= 6.27 OK!
T3 wall. Shear check: Shear check: Vd= 55.00 kN, VR= 199.37 kN F(V)= 3.63 OK!
T4 wall. Shear check: Shear check: Vd= 42.35 kN, VR= 199.37 kN F(V)= 4.71 OK!
T5 wall. Shear check: Shear check: Vd= 26.03 kN, VR= 199.37 kN F(V)= 7.66 OK!
T6 wall. Shear check: Shear check: Vd= 51.43 kN, VR= 199.37 kN F(V)= 3.88 OK!

9.4.4 Wall foundations

The results obtained for the verifications of the footing stability and the soil-bearing capacity. According to the geotechnical report the allowable soil bearing pressure is 3000 psf (143.64 kN/m^2).

WALL FOUNDATION: T1			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1609A
Sliding:	1.23	1.00	EQ1609A
Adm. pressure:	1.09	1.00	EQ1613B
WALL FOUNDATION: T2			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1613B
Sliding:	1.46	1.00	EQ1609A
Adm. pressure:	1.13	1.00	EQ1613B
WALL FOUNDATTION: T3			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1609A
Sliding:	1.13	1.00	EQ1609A
Adm. pressure:	1.12	1.00	EQ1613B
WALL FOUNDATION: T4			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1613B
Sliding:	1.45	1.00	EQ1609A
Adm. pressure:	1.08	1.00	EQ1613B
WALL FOUNDATION: T5			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1613B
Sliding:	1.69	1.00	EQ1609A
Adm. pressure:	1.22	1.00	EQ1613B
WALL FOUNDATION: T6			
Vérification:	F_{disp}	F_{req}	Combination
Overturning:	$\gg 1$	1.00	EQ1609A
Sliding:	1.10	1.00	EQ1609A
Adm. pressure:	1.03	1.00	EQ1613B
$F_{avail.}$: available security.			
F_{req}: required security.			

Appendices

A Loading criteria

A.1 Dead loads

Materials	
Wood structural panel	36.0 pcf $= 5655 \frac{\text{newton}}{\text{meter}^3}$
Concrete reinforced stone (including gravel)	150.0 pcf $= 23563 \frac{\text{newton}}{\text{meter}^3}$
Steel	489.0 pcf $= 76816 \frac{\text{newton}}{\text{meter}^3}$
Gypsum crete	115.0 pcf $= 18065 \frac{\text{newton}}{\text{meter}^3}$
Gypsum,loose	70.0 pcf $= 10996 \frac{\text{newton}}{\text{meter}^3}$
Earth (not submerged) sand and gravel (wet)	120.0 pcf $= 18850 \frac{\text{newton}}{\text{meter}^3}$
Water	62.4 pcf $= 9802 \frac{\text{newton}}{\text{meter}^3}$
Frame partitions	
Wood or steel studs, $\frac{1}{2}$in gypsum board inside	8 psf = 383 pascal
Wood studs, 2x4 unplastered	4 psf = 192 pascal
Wood studs, 2x4 plastered one side	12 psf = 575 pascal
Wood studs, 2x4 plastered two sides	20 psf = 958 pascal
Movable steel partitions	4 psf = 192 pascal
Frame walls	
Exterior stud wall 2x4 @ 16in, $\frac{5}{8}$ gypsum insulated, $\frac{3}{8}$ in siding	11 psf = 526 pascal
Exterior stud wall 2x6 @ 16in, $\frac{5}{8}$ gypsum insulated, $\frac{3}{8}$ in siding	12 psf = 575 pascal
Exterior stud wall with brick veneer	48 psf = 2298 pascal
CMU wall 8in	60 psf = 9425 pascal
Window, glass, frame and sash	8 psf = 383 pascal
Cladding	
Fiber cement panels, large format 38.4in × 102in	3.2 psf = 153 pascal
Fiber cement panels, small scale 9.6in × 102in	3.2 psf = 153 pascal
Perforated metal panel at exterior HVAC location	
Floor truss	
Single chord @ 24in o.c. spacing	3.2 psf = 153 pascal
Double chord @ 24in o.c. spacing	4.25 psf = 203 pascal
Sheating	
Roof sheating	3.5 psf = 167 pascal
Floor sheating	2.5 psf = 120 pascal
Ceilings	2.5 psf = 120 pascal
Deck composite sleeperes (3in)	9.00 psf = 431 pascal

A.2 Live loads

Occupancy or use	Uniform	Concentrated	Notes
Private rooms and corridors serving them in multifamily dwelling	40.0 psf = 1915 pascal	-	*IBC-2018 Table 1607.1*
Stairs and exits	100.0 psf = 4788 pascal	300 pound = 1334 newton	*IBC-2018 Table 1607.1. Concentrated load on stair treads applied on an area of 2 inches by 2 inches*
Balconies and decks	same as occupancy served	-	*IBC-2018 Table 1607.1*
Garages (passenger vehicles only)	40.0 psf = 1915 pascal	-	*IBC-2018 Table 1607.1*
Cornices	60.0 psf = 2873 pascal	-	*IBC-2018 Table 1607.1*
Elevator machine room and control room grating	-	300 pound = 1334 newton	*IBC-2018 Table 1607.1. Concentrated load applied on an area of 2 inches by 2 inches*
Flat roof (not occupiable) + maintenace	20.0 psf = 958 pascal	300 pound = 1334 newton	*IBC-2018 Table 1607.1*
Yards and terraces, pedestrians	100.0 psf = 4788 pascal	-	*IBC-2018 Table 1607.1*
Sidewalks, vehicular driveways and yards, subject to trucking	250.0 psf = 11970 pascal	8000 pound = 35586 newton	*IBC-2018 Table 1607.1*
Corridors first floor	100.0 psf = 4788 pascal	-	*IBC-2018 Table 1607.1*
Store first floor	100.0 psf = 4788 pascal	-	*IBC-2018 Table 1607.1*

A.3 Snow loads

Ground snow load	$p_g = 60.0$ psf = 2873 pascal	*ASCE 7. Figure 7.1*
Exposure factor	$C_e = 1.0$	*ASCE 7. Table 7-2. Terrain category B, roof partially exposed*
Thermal factor	$C_t = 1.0$	*ASCE 7. Table 7-3.*
Snow load importance factor	$I_s = 1.0$	*ASCE 7. Table 7-4. Structure risk category II*
Snow load flat roof	$p_f = 0.7 \times C_e \times C_t \times I_s \times p_g = 0.7 \times 1.0 \times 1.0 \times 1.0 \times 60.0 = 42.0$ psf = 2873 pascal	*ASCE 7. Sect. 7.3*

A.4 Wind loads

Alternate all-heights method.		*IBC-2018, sect. 1609.6. Regularly shaped building, less than 75 feet in height, not sensitive to dynamic effects, not channeling effects or buffeting, simple diaphragm building*
Ultimate design wind speed	$V_{ult} = 115 \frac{\text{miles}}{\text{hour}} = 51 \frac{\text{meters}}{\text{second}}$	*IBC-2018, figure 1609.3(1). Risk category II building*
Velocity pressure exposure coefficient	$K_z = 0.72$	*ASCE 7, table 27.3.1. Exposure B, height above ground level $z \approx$ 33 feet*
Topographic factor	$K_{zt} = 1.0$	*ASCE 7, sect. 26.8*

Net pressure coefficients C_{net}. Main windforce-resisting frames and systems

IBC-2018, Table 1609.6.2, enclosed

Description	C_{net} + Internal pressure	C_{net} - Internal presure
Windward wall	0.43	0.73
Leeward wall	-0.51	-0.21
Sidewall	-0.66	-0.35
Parapet windward wall	1.28	
Parapet leeward wall	-0.85	
Flat roof	-1.09	-0.79

Design wind pressures P_{net}. Main windforce-resisting frames and systems

IBC-2018, sect. 1609.6.3

$P_{net} = 0.00256 \times V^2 \times K_z \times C_{net} \times K_{zt}$

Description	P_{net} + Internal pressure	P_{net} - Internal presure
Windward wall	10.5 psf = 501 pascal	17.8 psf = 852 pascal
Leeward wall	-12.4 psf = -595 pascal	-5.1 psf = -245 pascal
Sidewall	-16.1 psf = -770 pascal	-8.5 psf = -409 pascal
Parapet windward wall	31.2 psf = 1494 pascal	
Parapet leeward wall	-20.7 psf = -992 pascal	
Flat roof	-26.6 psf = -1272 pascal	-19.3 psf = -992 pascal

A.5 Earthquake loads

Parameter 0.2-second spectral response acceleration	$S_s = 0.045$	*IBC-2018, figure 1613.3.1(1). Site class B*
Parameter 1-second spectral response acceleration	$S_1 = 0.038$	*IBC-2018, figure 1613.3.1(2). Site class B*
Seismic design category	$S_1 \leq 0.04$ *and* $S_s \leq 0.15 \rightarrow$ SDS A	*IBC-2018, sect. 1613.3.1*
Site coefficients	$F_a = 1.0$, $F_v = 1.0$	*IBC-2018, tables 1613.3.3(1) and 1613.3.3(2). Site class B*
Maximum considered earthquake spectral response acceleration for short periods	$S_{MS} = F_a \cdot S_s = 0.045$	*IBC-2018, sect. 163.3.3*
	$S_{M1} = F_a \cdot S_1 = 0.038$	*IBC-2018, sect. 163.3.3*
Design spectral response acceleration parameters	$S_{DS} = \frac{2}{3} S_{MS} = 0.03$	*IBC-2018, sect. 163.3.4*
	$S_{D1} = \frac{2}{3} S_{M1} = 0.025$	*IBC-2018, sect. 163.3.4*

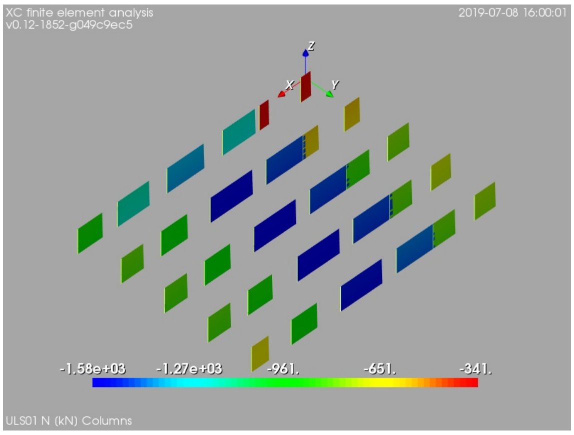


Figure 11: ULS01: 1.4*D. Columns, internal axial force [kN]

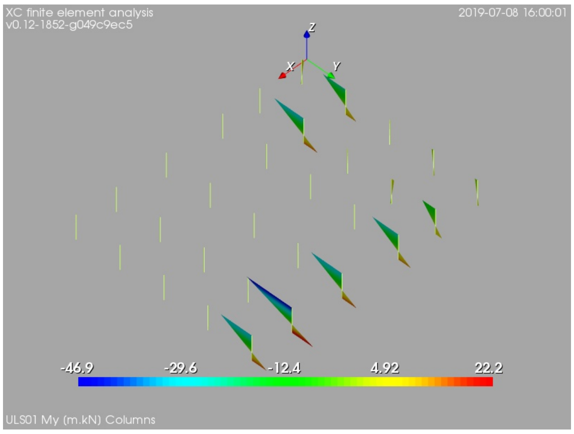


Figure 12: ULS01: 1.4*D. Columns, bending moment about local axis y [m.kN]

B Calculation results. Internal forces on columns

B.1 Ultimate limit states

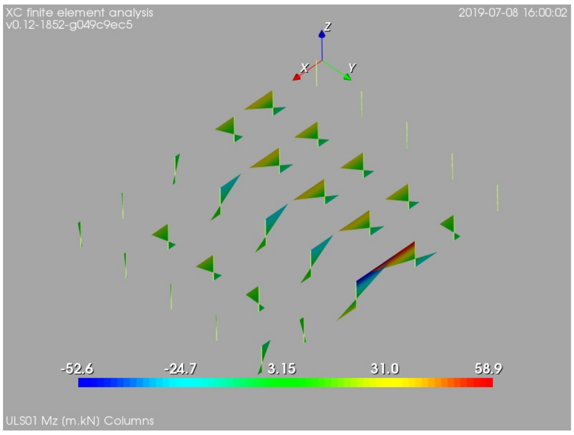


Figure 13: ULS01: 1.4*D. Columns, bending moment about local axis z [m.kN]

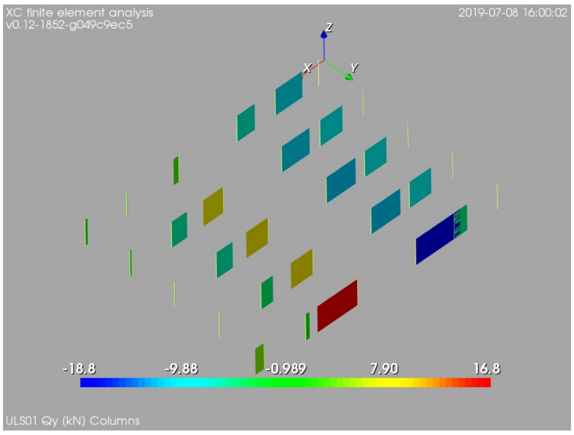


Figure 14: ULS01: 1.4*D. Columns, internal shear force in local direction y [kN]

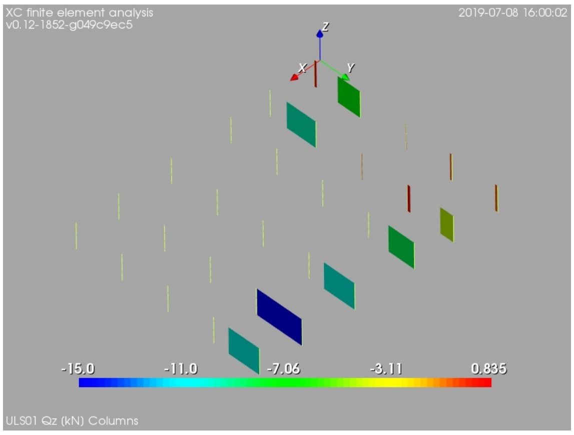


Figure 15: ULS01: 1.4*D. Columns, internal shear force in local direction z [kN]

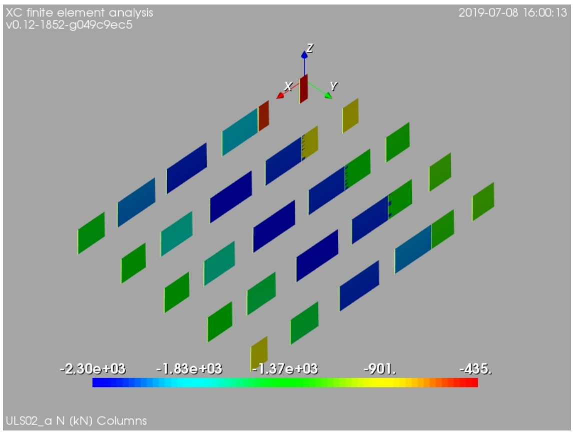


Figure 16: ULS02_a: 1.2*D + 1.6*Lru + Lpu + 0.5*S. Columns, internal axial force [kN]

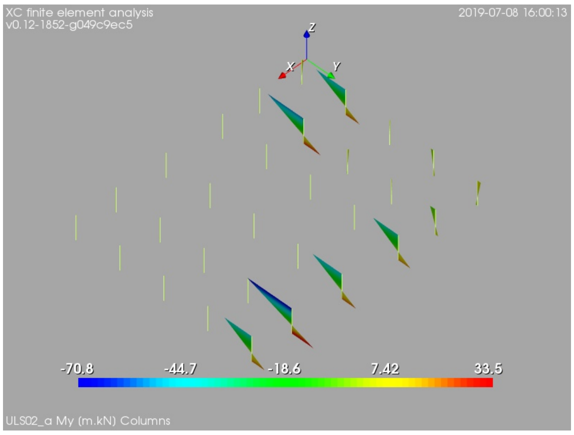


Figure 17: ULS02_a: 1.2*D + 1.6*Lru + Lpu + 0.5*S. Columns, bending moment about local axis y [m.kN]

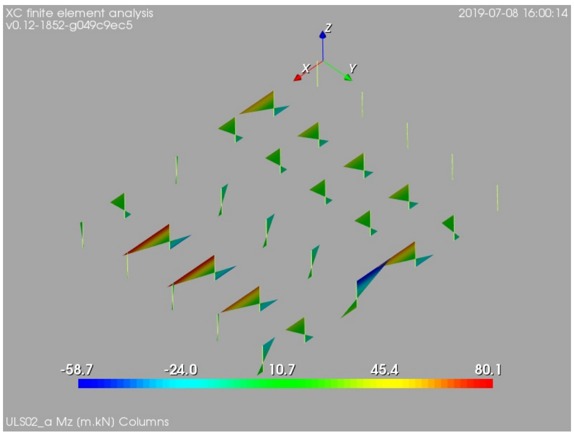


Figure 18: ULS02_a: 1.2*D + 1.6*Lru + Lpu + 0.5*S. Columns, bending moment about local axis z [m.kN]

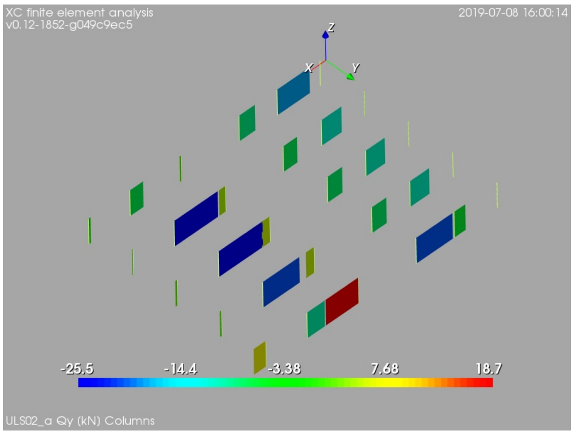


Figure 19: ULS02_a: 1.2*D + 1.6*Lru + Lpu + 0.5*S. Columns, internal shear force in local direction y [kN]

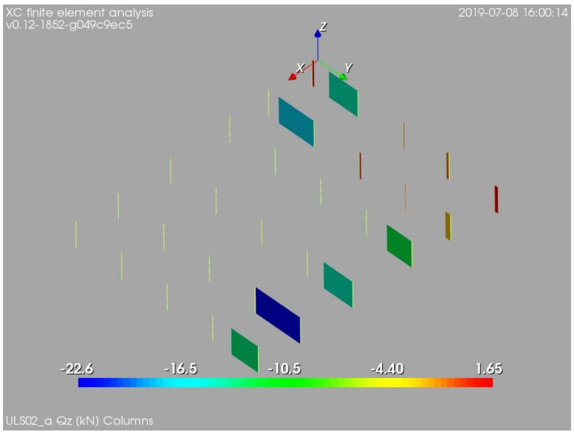


Figure 20: ULS02_a: 1.2*D + 1.6*Lru + Lpu + 0.5*S. Columns, internal shear force in local direction z [kN]

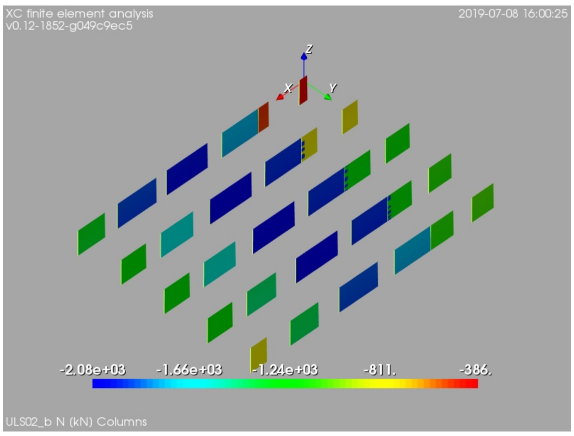


Figure 21: ULS02_b: 1.2*D + 1.6*Lrs + Lps + 0.5*S. Columns, internal axial force [kN]

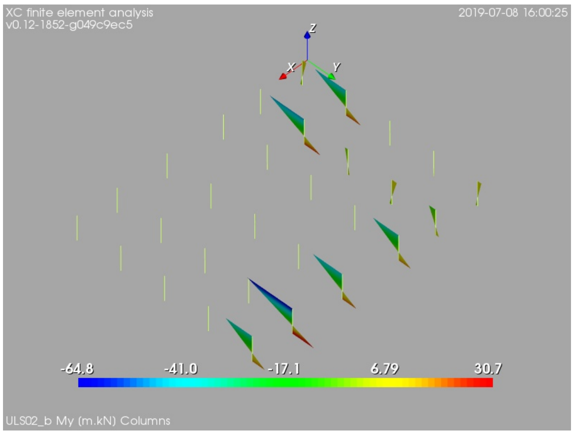


Figure 22: ULS02_b: 1.2*D + 1.6*Lrs + Lps + 0.5*S. Columns, bending moment about local axis y [m.kN]

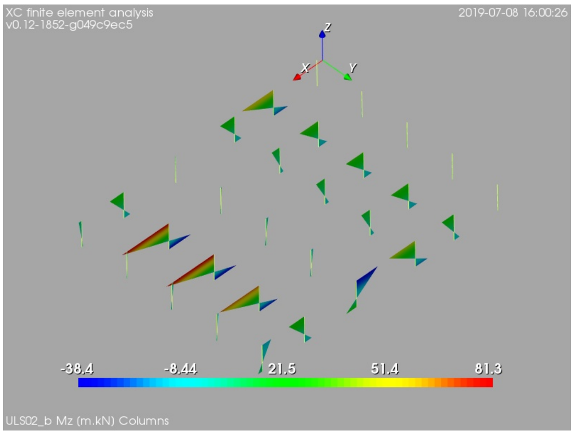


Figure 23: ULS02_b: 1.2*D + 1.6*Lrs + Lps + 0.5*S. Columns, bending moment about local axis z [m.kN]

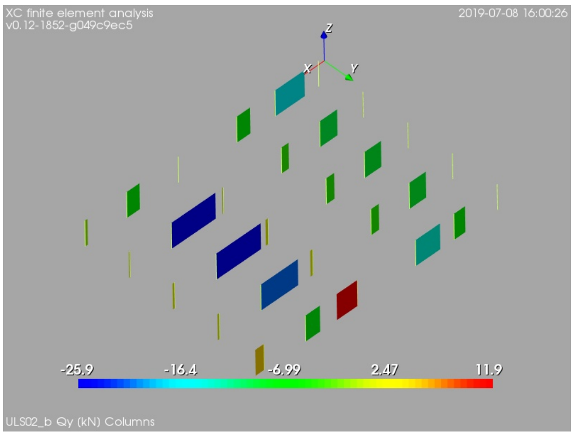


Figure 24: ULS02_b: 1.2*D + 1.6*Lrs + Lps + 0.5*S. Columns, internal shear force in local direction y [kN]

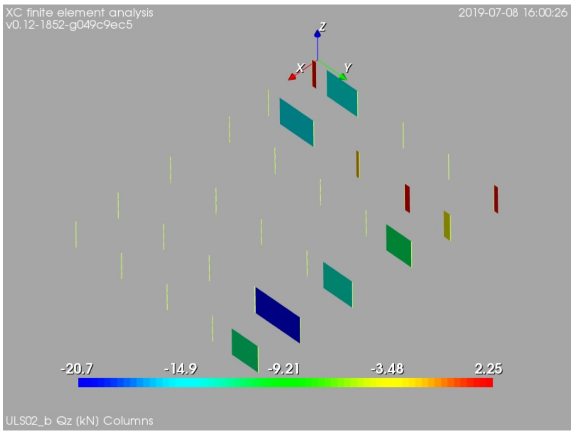


Figure 25: ULS02_b: 1.2*D + 1.6*Lrs + Lps + 0.5*S. Columns, internal shear force in local direction z [kN]

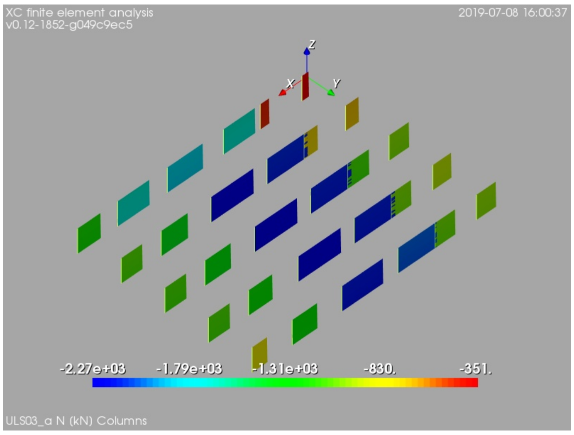


Figure 26: ULS03_a: 1.2*D + 1.6*S + 0.5*Lru + Lpu. Columns, internal axial force [kN]

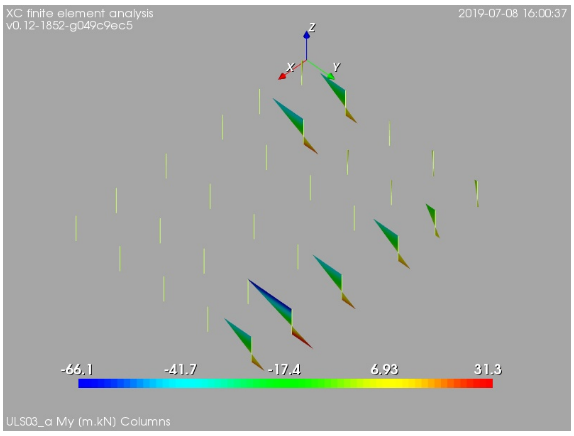


Figure 27: ULS03_a: 1.2*D + 1.6*S + 0.5*Lru + Lpu. Columns, bending moment about local axis y [m.kN]

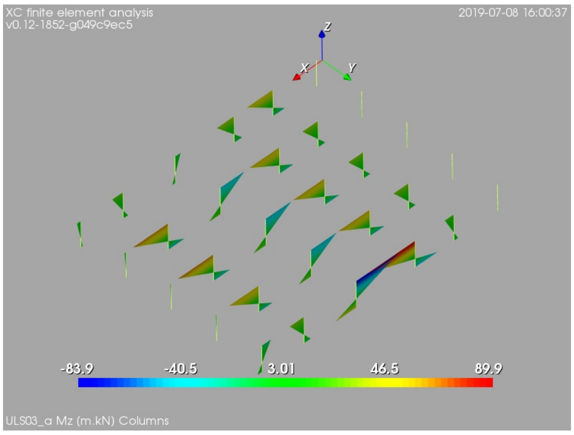


Figure 28: ULS03_a: 1.2*D + 1.6*S + 0.5*Lru + Lpu. Columns, bending moment about local axis z [m.kN]

Figure 29: ULS03_a: 1.2*D + 1.6*S + 0.5*Lru + Lpu. Columns, internal shear force in local direction y [kN]

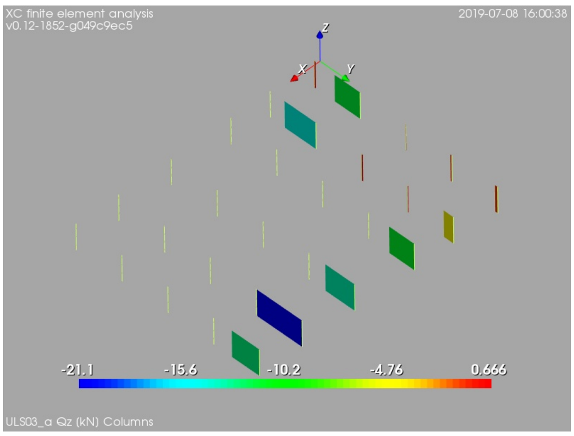


Figure 30: ULS03_a: 1.2*D + 1.6*S + 0.5*Lru + Lpu. Columns, internal shear force in local direction z [kN]

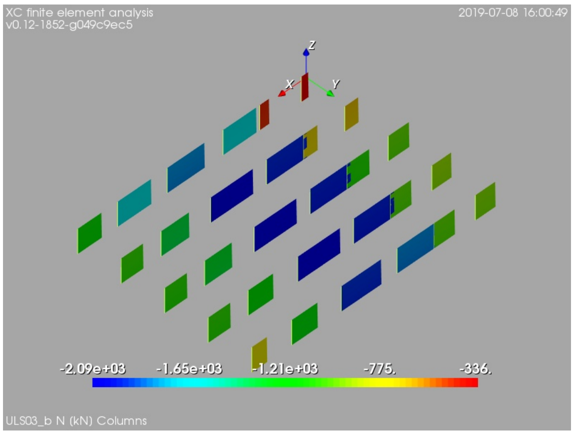


Figure 31: ULS03_b: 1.2*D + 1.6*S + 0.5*Lrs + Lps. Columns, internal axial force [kN]

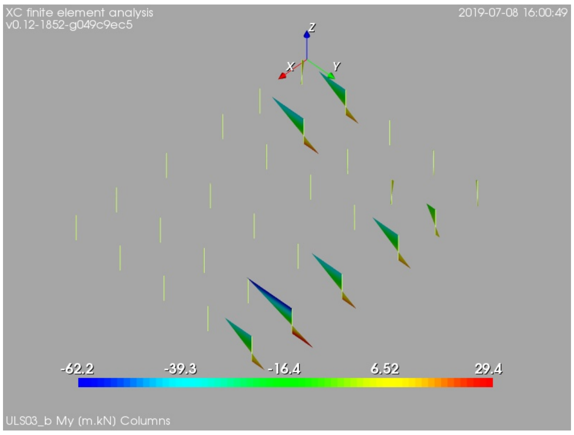


Figure 32: ULS03_b: 1.2*D + 1.6*S + 0.5*Lrs + Lps. Columns, bending moment about local axis y [m.kN]

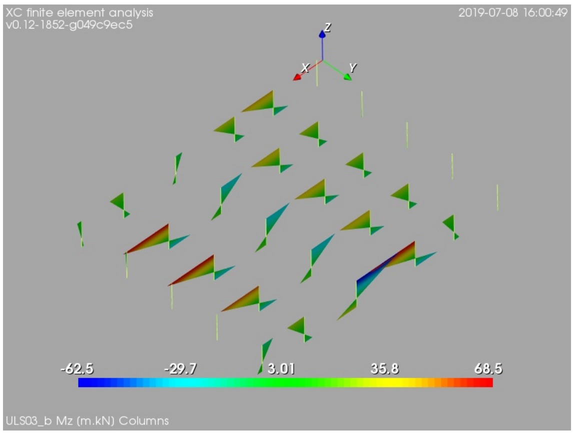


Figure 33: ULS03_b: 1.2*D + 1.6*S + 0.5*Lrs + Lps. Columns, bending moment about local axis z [m.kN]

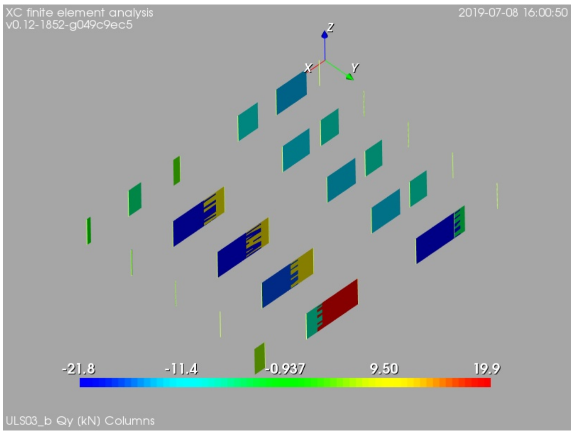


Figure 34: ULS03_b: 1.2*D + 1.6*S + 0.5*Lrs + Lps. Columns, internal shear force in local direction y [kN]

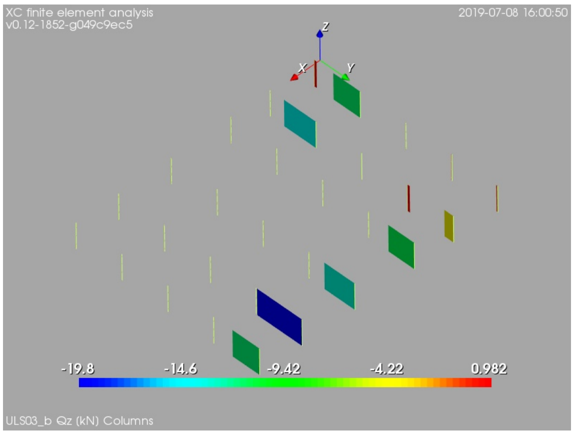


Figure 35: ULS03_b: 1.2*D + 1.6*S + 0.5*Lrs + Lps. Columns, internal shear force in local direction z [kN]

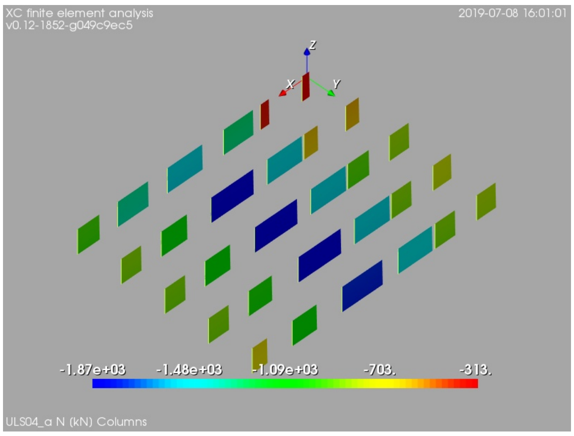


Figure 36: ULS04_a: 1.2*D + 1.6*S + 0.5*W_WE. Columns, internal axial force [kN]

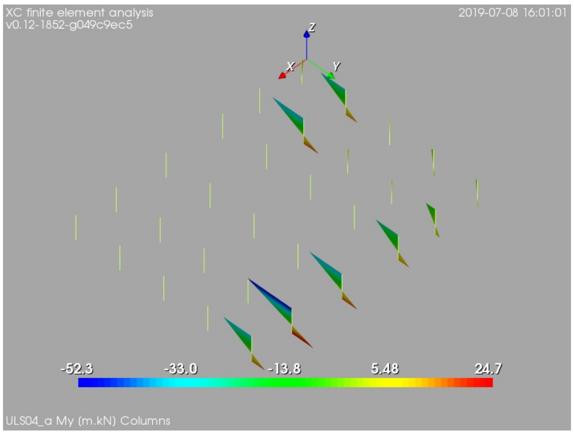


Figure 37: ULS04_a: 1.2*D + 1.6*S + 0.5*W_WE. Columns, bending moment about local axis y [m.kN]

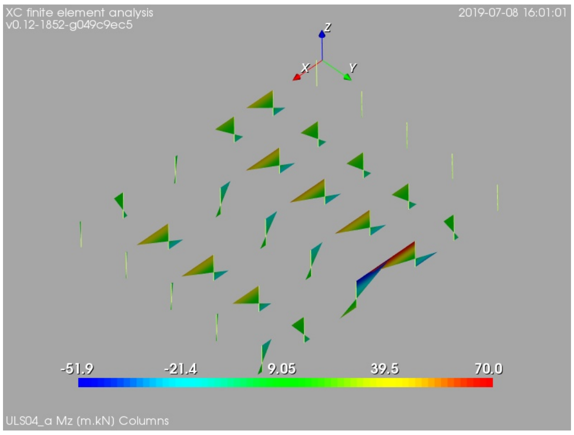


Figure 38: ULS04_a: 1.2*D + 1.6*S + 0.5*W_WE. Columns, bending moment about local axis z [m.kN]

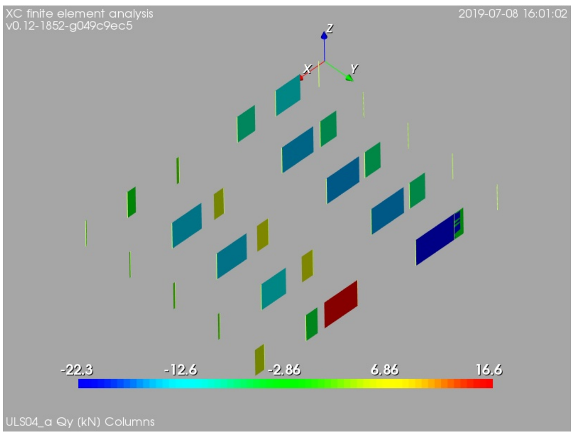


Figure 39: ULS04_a: 1.2*D + 1.6*S + 0.5*W_WE. Columns, internal shear force in local direction y [kN]

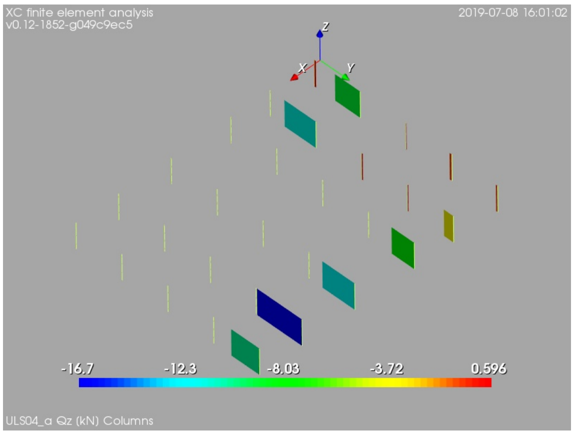


Figure 40: ULS04_a: 1.2*D + 1.6*S + 0.5*W_WE. Columns, internal shear force in local direction z [kN]

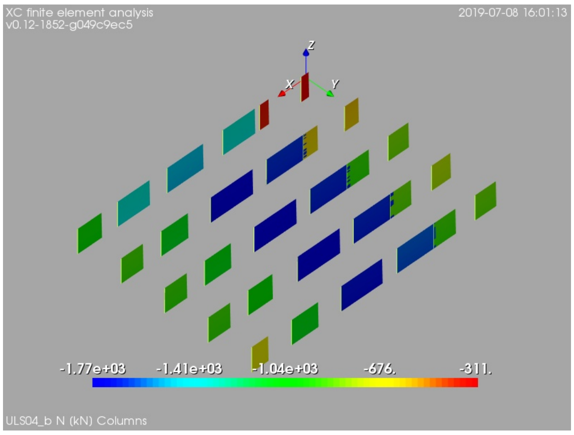


Figure 41: ULS04_b: 1.2*D + 1.6*S + 0.5*W_NS. Columns, internal axial force [kN]

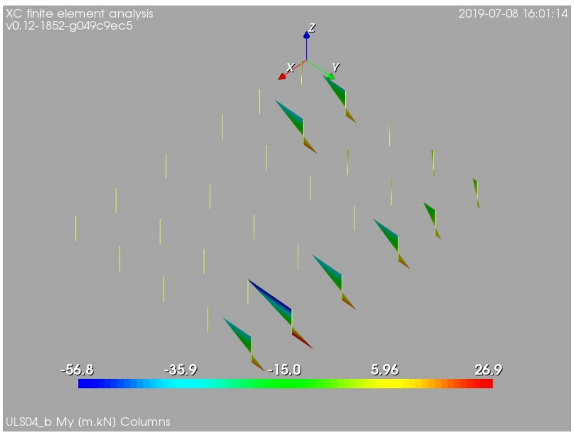


Figure 42: ULS04_b: 1.2*D + 1.6*S + 0.5*W_NS. Columns, bending moment about local axis y [m.kN]

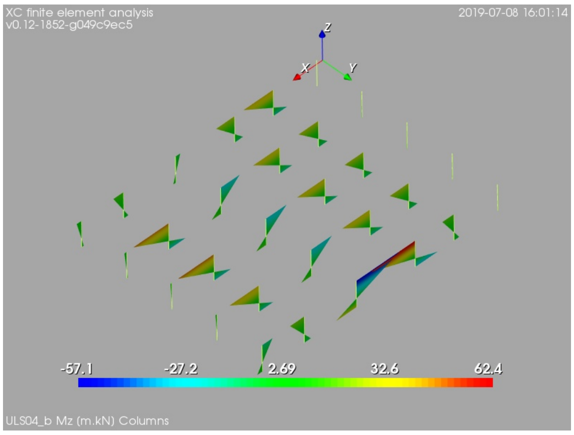


Figure 43: ULS04_b: 1.2*D + 1.6*S + 0.5*W_NS. Columns, bending moment about local axis z [m.kN]

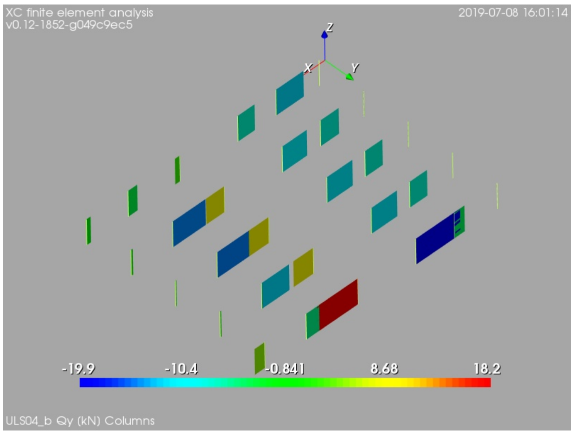


Figure 44: ULS04_b: 1.2*D + 1.6*S + 0.5*W_NS. Columns, internal shear force in local direction y [kN]

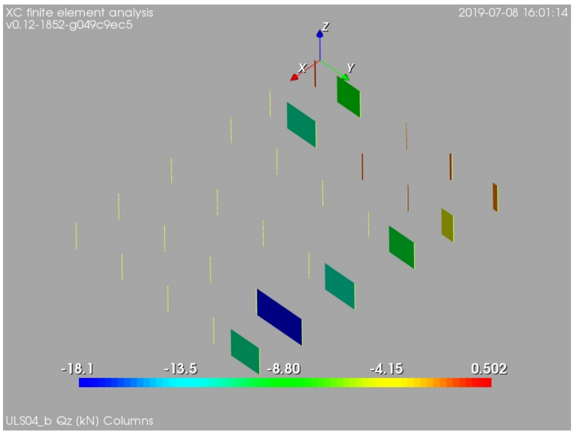


Figure 45: ULS04_b: 1.2*D + 1.6*S + 0.5*W_NS. Columns, internal shear force in local direction z [kN]

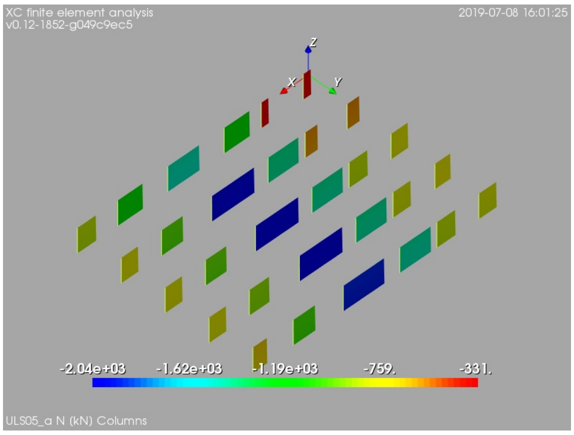


Figure 46: ULS05_a: 1.2*D + W_WE + 0.5*Lru + Lpu. Columns, internal axial force [kN]

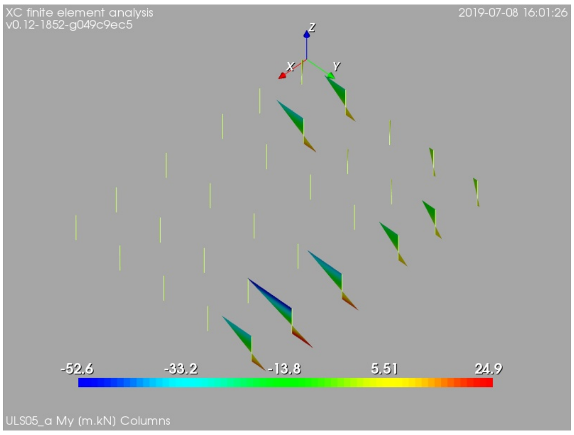


Figure 47: ULS05_a: 1.2*D + W_WE + 0.5*Lru + Lpu. Columns, bending moment about local axis y [m.kN]

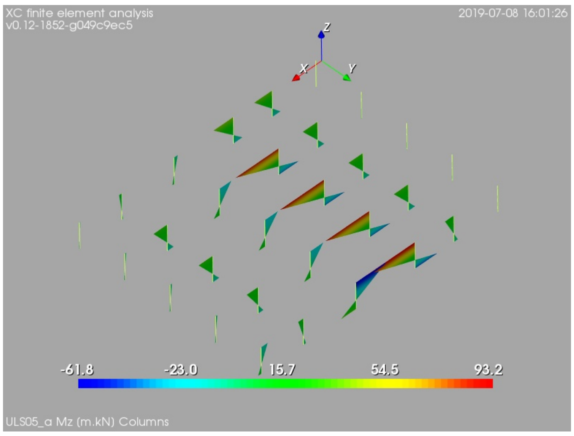


Figure 48: ULS05_a: 1.2*D + W_WE + 0.5*Lru + Lpu. Columns, bending moment about local axis z [m.kN]

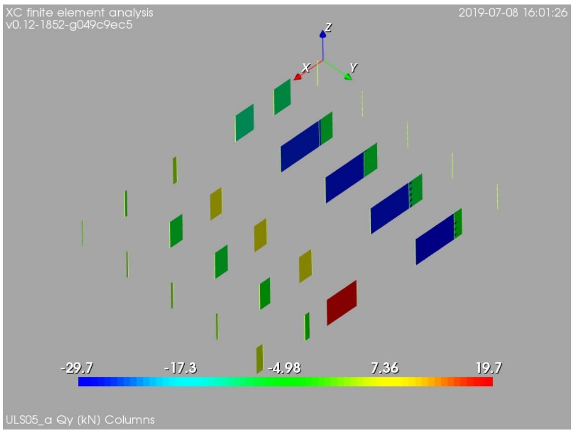


Figure 49: ULS05_a: 1.2*D + W_WE + 0.5*Lru + Lpu. Columns, internal shear force in local direction y [kN]

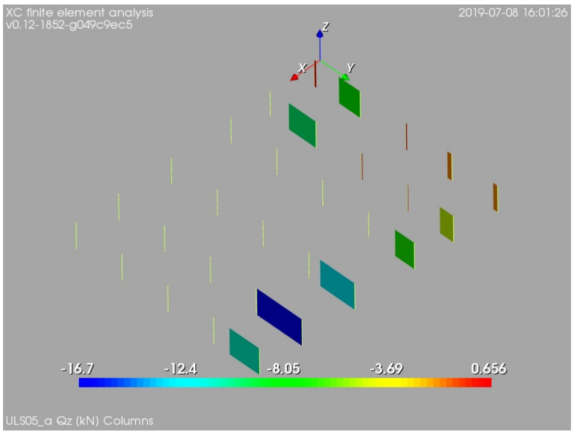


Figure 50: ULS05_a: 1.2*D + W_WE + 0.5*Lru + Lpu. Columns, internal shear force in local direction z [kN]

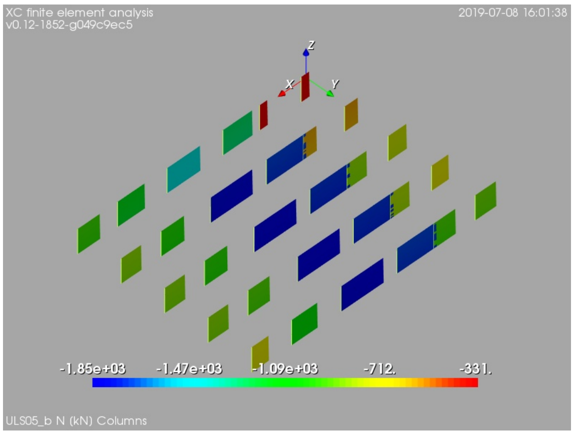


Figure 51: ULS05_b: 1.2*D + W_NS + 0.5*Lru + Lpu. Columns, internal axial force [kN]

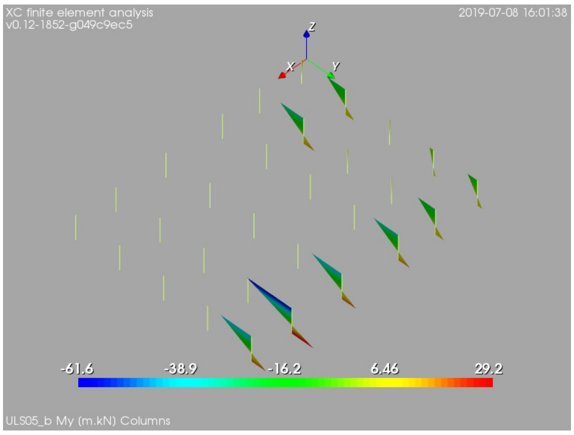


Figure 52: ULS05_b: 1.2*D + W_NS + 0.5*Lru + Lpu. Columns, bending moment about local axis y [m.kN]

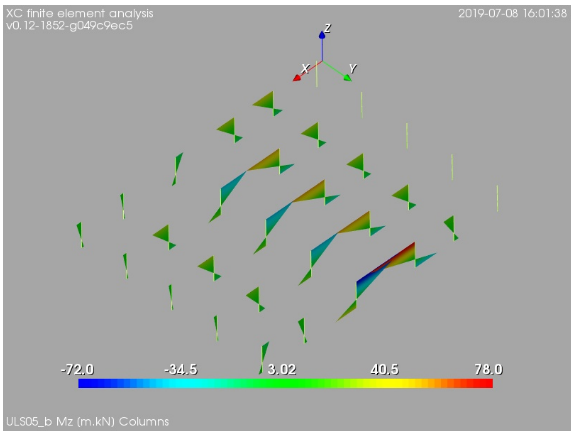


Figure 53: ULS05_b: 1.2*D + W_NS + 0.5*Lru + Lpu. Columns, bending moment about local axis z [m.kN]

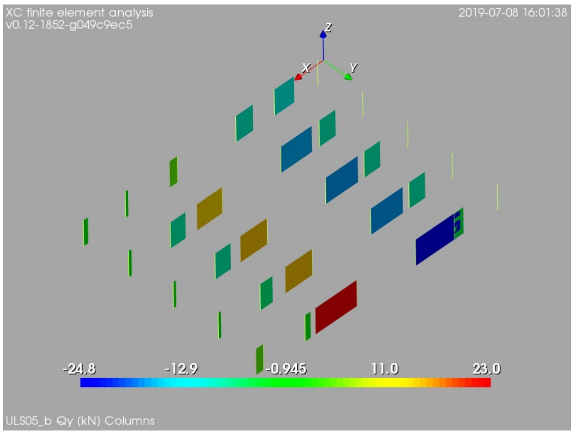


Figure 54: ULS05_b: 1.2*D + W_NS + 0.5*Lru + Lpu. Columns, internal shear force in local direction y [kN]

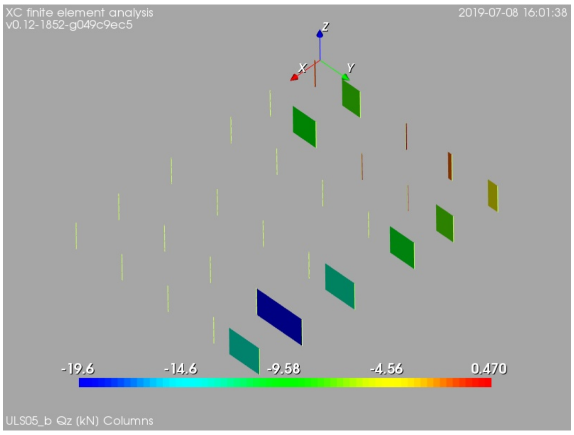


Figure 55: ULS05_b: 1.2*D + W_NS + 0.5*Lru + Lpu. Columns, internal shear force in local direction z [kN]

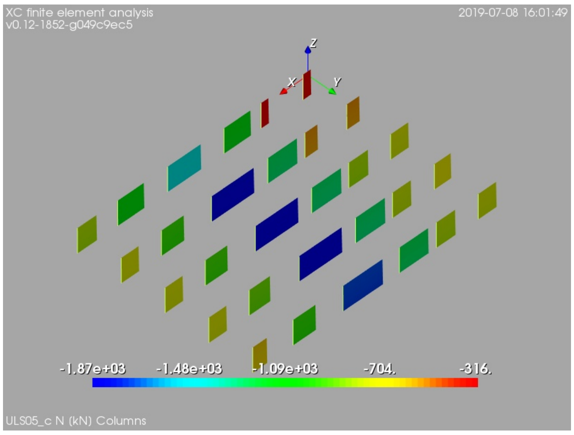


Figure 56: ULS05_c: 1.2*D + W_WE + 0.5*Lrs + Lps. Columns, internal axial force [kN]

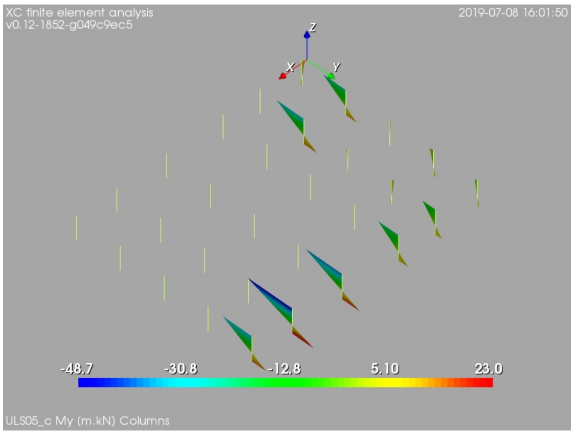


Figure 57: ULS05_c: 1.2*D + W_WE + 0.5*Lrs + Lps. Columns, bending moment about local axis y [m.kN]

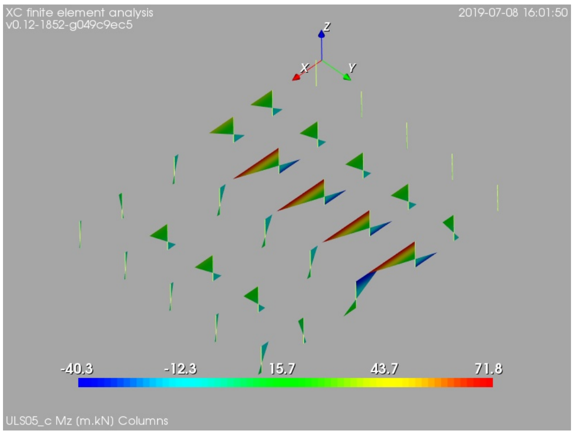


Figure 58: ULS05_c: 1.2*D + W_WE + 0.5*Lrs + Lps. Columns, bending moment about local axis z [m.kN]

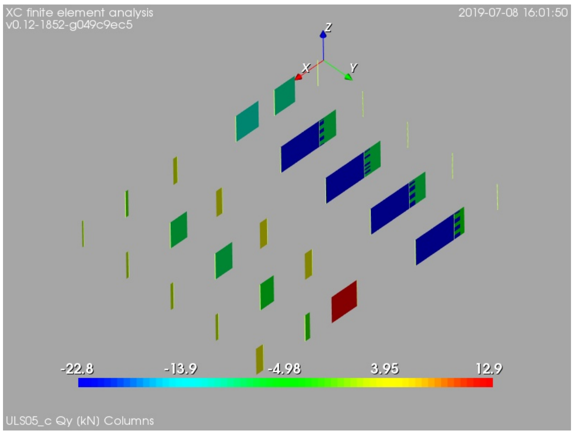


Figure 59: ULS05_c: 1.2*D + W_WE + 0.5*Lrs + Lps. Columns, internal shear force in local direction y [kN]

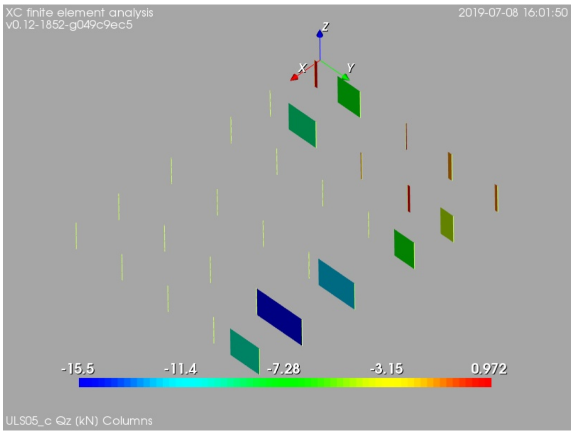


Figure 60: ULS05_c: 1.2*D + W_WE + 0.5*Lrs + Lps. Columns, internal shear force in local direction z [kN]

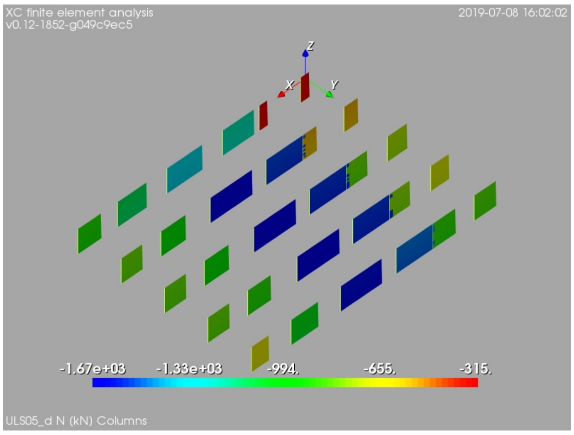


Figure 61: ULS05_d: 1.2*D + W_NS + 0.5*Lrs + Lps. Columns, internal axial force [kN]

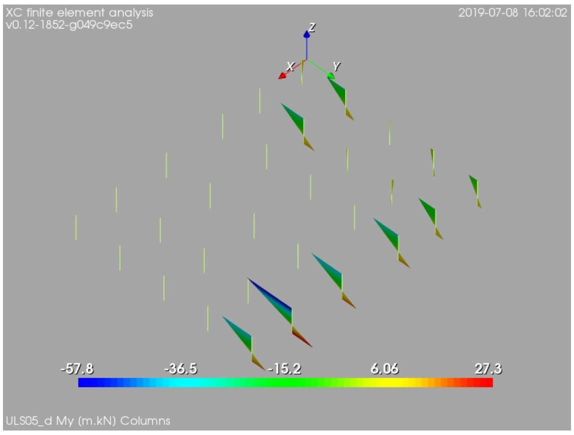


Figure 62: ULS05_d: 1.2*D + W_NS + 0.5*Lrs + Lps. Columns, bending moment about local axis y [m.kN]

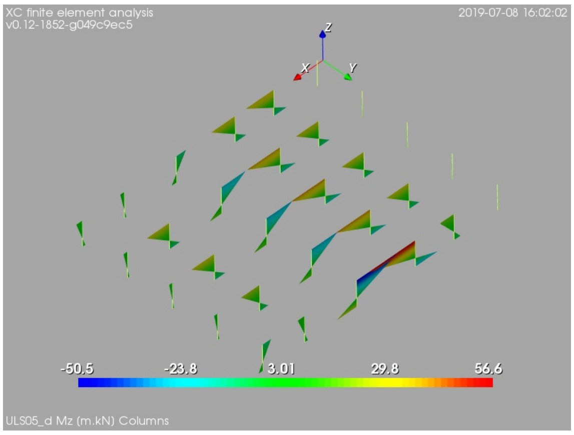


Figure 63: ULS05_d: 1.2*D + W_NS + 0.5*Lrs + Lps. Columns, bending moment about local axis z [m.kN]

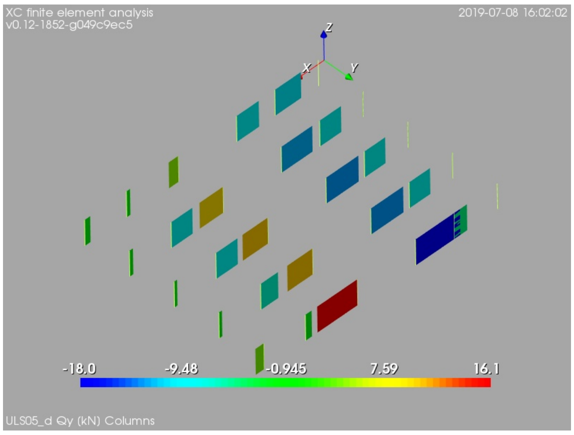


Figure 64: ULS05_d: 1.2*D + W_NS + 0.5*Lrs + Lps. Columns, internal shear force in local direction y [kN]

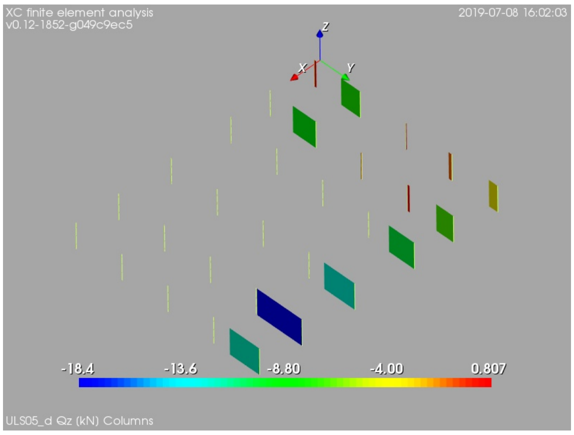


Figure 65: ULS05_d: 1.2*D + W_NS + 0.5*Lrs + Lps. Columns, internal shear force in local direction z [kN]

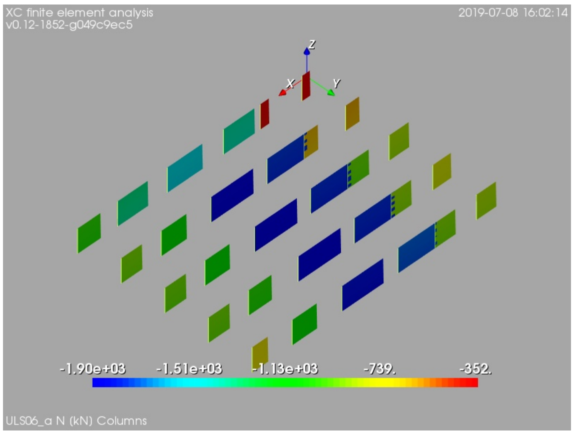


Figure 66: ULS06_a: 1.2*D + 0.5*Lru + Lpu + 0.2*S. Columns, internal axial force [kN]

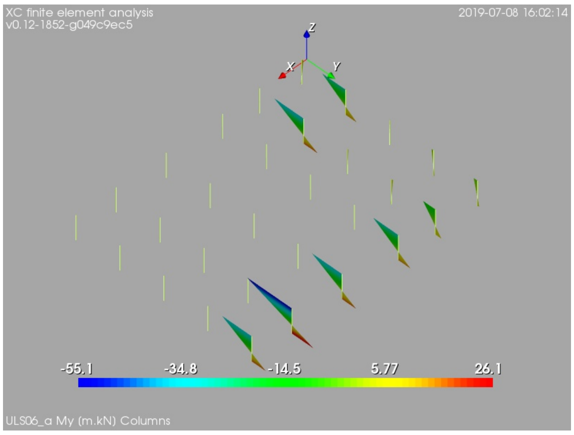


Figure 67: ULS06_a: 1.2*D + 0.5*Lru + Lpu + 0.2*S. Columns, bending moment about local axis y [m.kN]

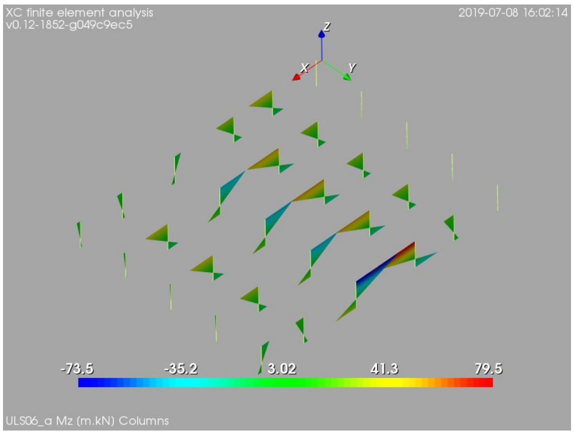


Figure 68: ULS06_a: 1.2*D + 0.5*Lru + Lpu + 0.2*S. Columns, bending moment about local axis z [m.kN]

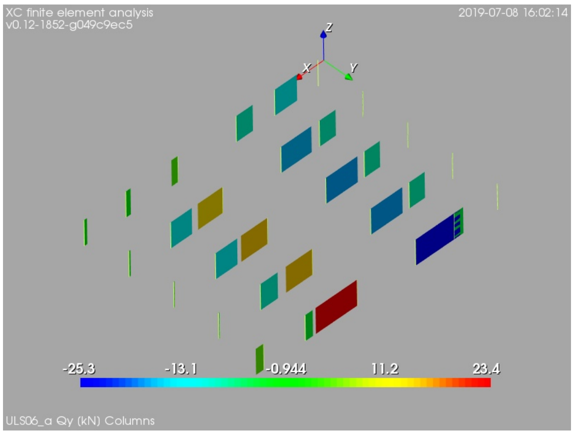


Figure 69: ULS06_a: 1.2*D + 0.5*Lru + Lpu + 0.2*S. Columns, internal shear force in local direction y [kN]

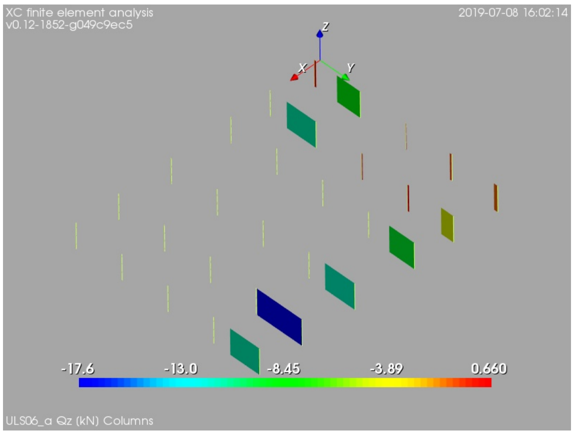


Figure 70: ULS06_a: 1.2*D + 0.5*Lru + Lpu + 0.2*S. Columns, internal shear force in local direction z [kN]

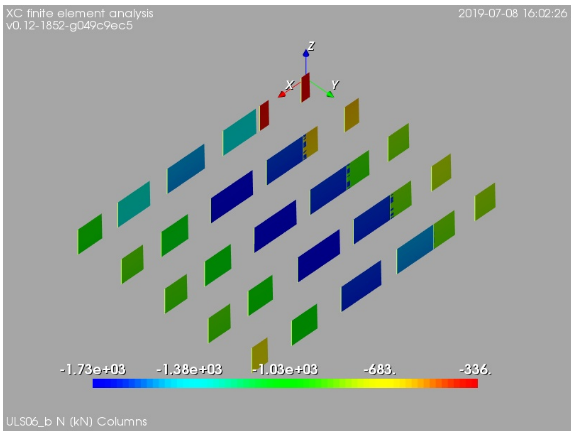


Figure 71: ULS06_b: 1.2*D + 0.5*Lrs + Lps + 0.2*S. Columns, internal axial force [kN]

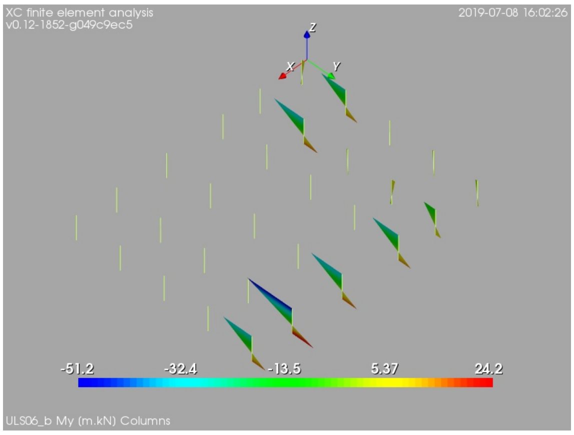


Figure 72: ULS06_b: 1.2*D + 0.5*Lrs + Lps + 0.2*S. Columns, bending moment about local axis y [m.kN]

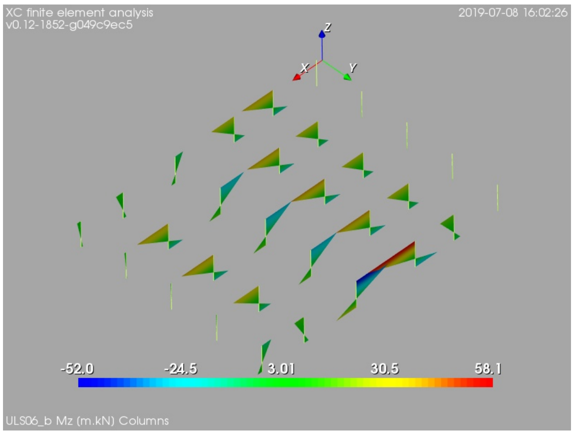


Figure 73: ULS06_b: 1.2*D + 0.5*Lrs + Lps + 0.2*S. Columns, bending moment about local axis z [m.kN]

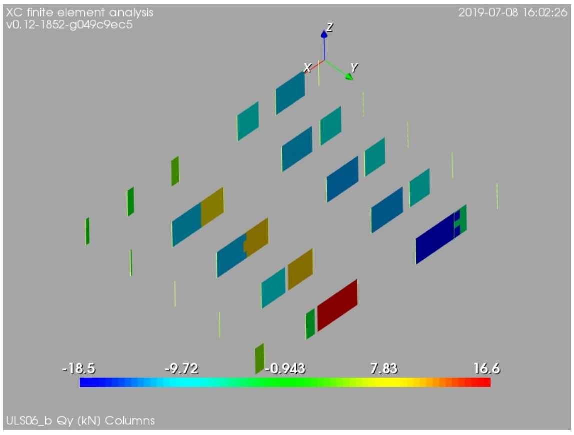


Figure 74: ULS06_b: 1.2*D + 0.5*Lrs + Lps + 0.2*S. Columns, internal shear force in local direction y [kN]

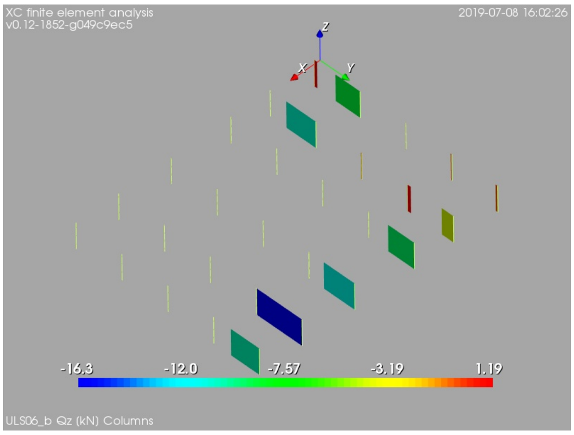


Figure 75: ULS06_b: 1.2*D + 0.5*Lrs + Lps + 0.2*S. Columns, internal shear force in local direction z [kN]

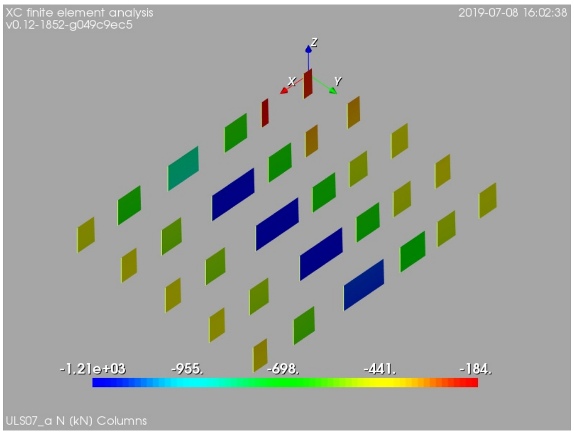


Figure 76: ULS07_a: 0.9*D + W_WE. Columns, internal axial force [kN]

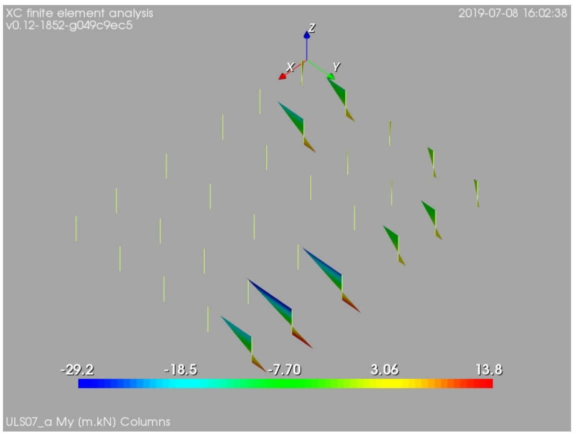


Figure 77: ULS07_a: 0.9*D + W_WE. Columns, bending moment about local axis y [m.kN]

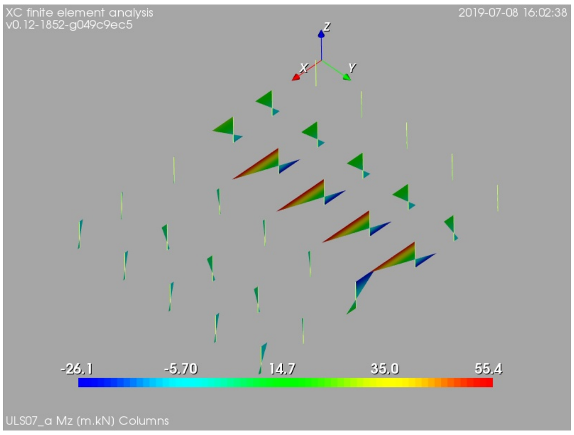


Figure 78: ULS07_a: 0.9*D + W_WE. Columns, bending moment about local axis z [m.kN]

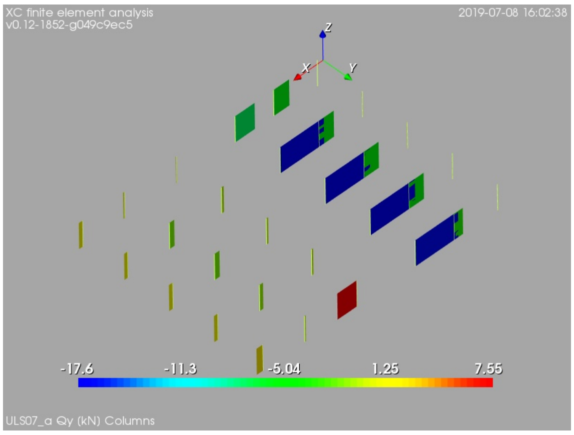


Figure 79: ULS07_a: 0.9*D + W_WE. Columns, internal shear force in local direction y [kN]

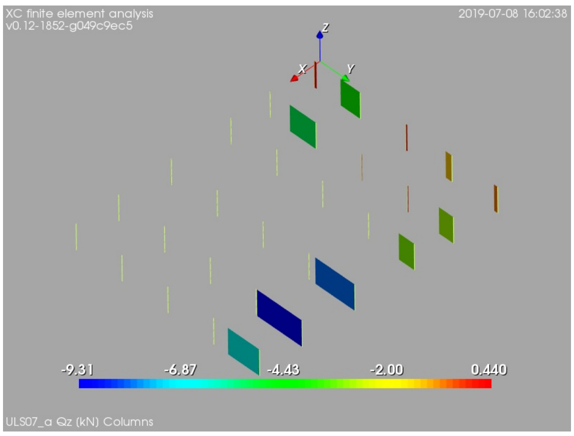


Figure 80: ULS07_a: 0.9*D + W_WE. Columns, internal shear force in local direction z [kN]

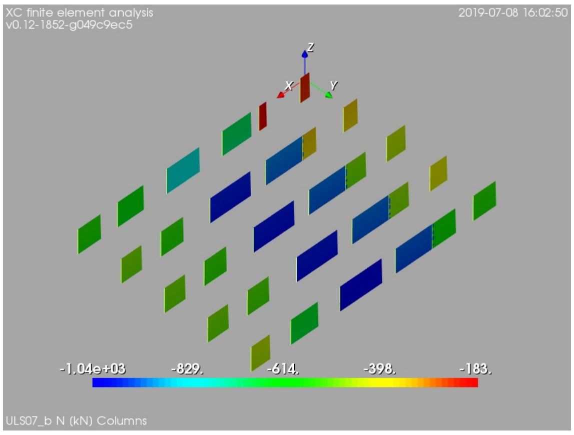


Figure 81: ULS07_b: 0.9*D + W_NS. Columns, internal axial force [kN]

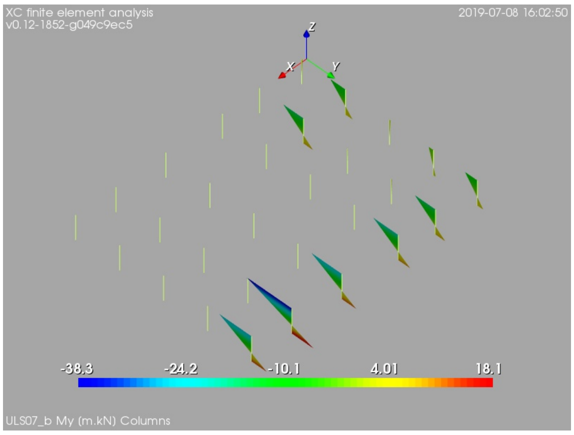


Figure 82: ULS07_b: 0.9*D + W_NS. Columns, bending moment about local axis y [m.kN]

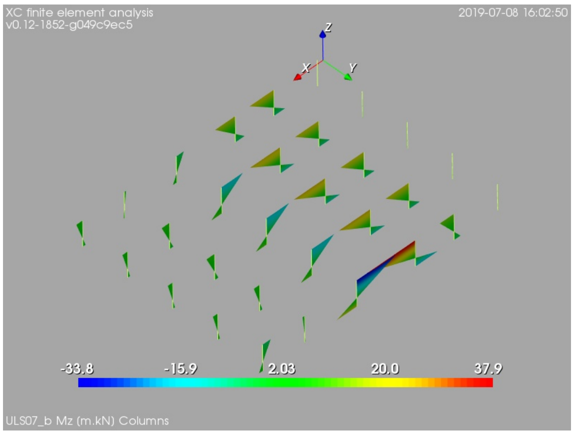


Figure 83: ULS07_b: 0.9*D + W_NS. Columns, bending moment about local axis z [m.kN]

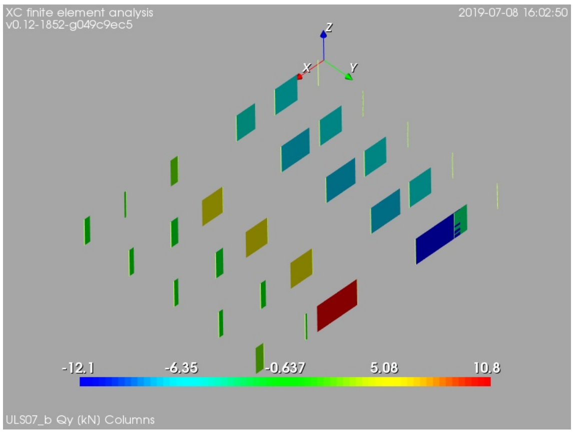


Figure 84: ULS07_b: 0.9*D + W_NS. Columns, internal shear force in local direction y [kN]

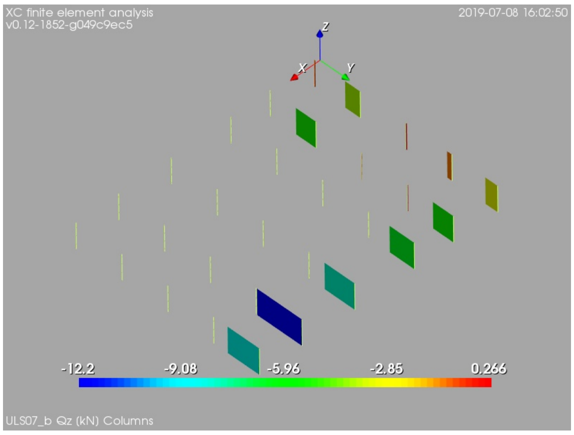


Figure 85: ULS07_b: 0.9*D + W_NS. Columns, internal shear force in local direction z [kN]

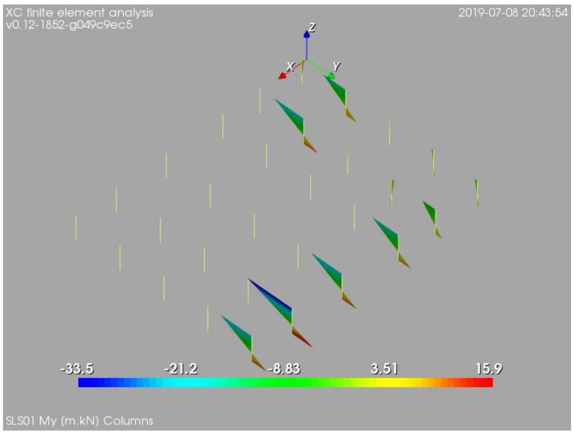


Figure 86: SLS01: 1.0*D. Columns, bending moment about local axis y [m.kN]

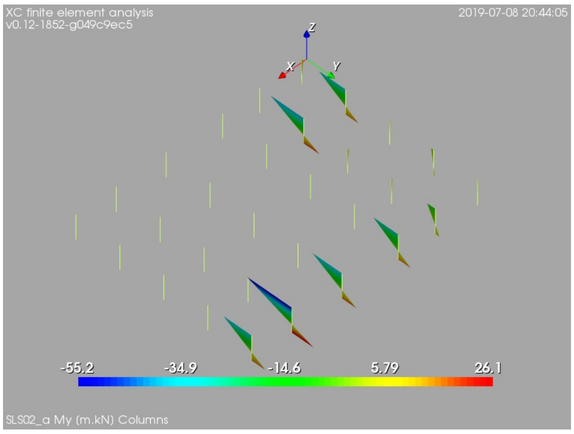


Figure 87: SLS02_a: 1.0*D + 1.0*Lru + Lpu + 0.3*S. Columns, bending moment about local axis y [m.kN]

B.2 Serviceability limit states

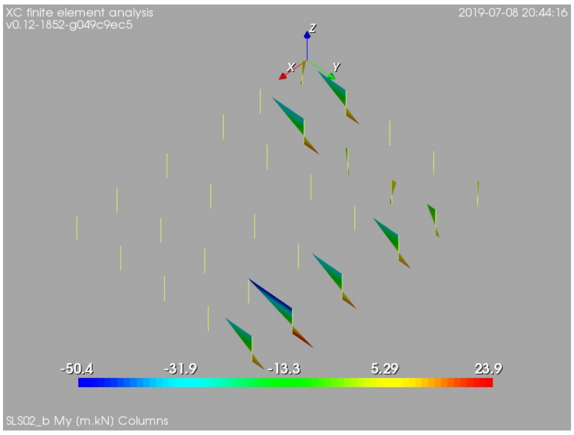


Figure 88: SLS02_b: 1.0*D + 1.0*Lrs + Lps + 0.3*S. Columns, bending moment about local axis y [m.kN]

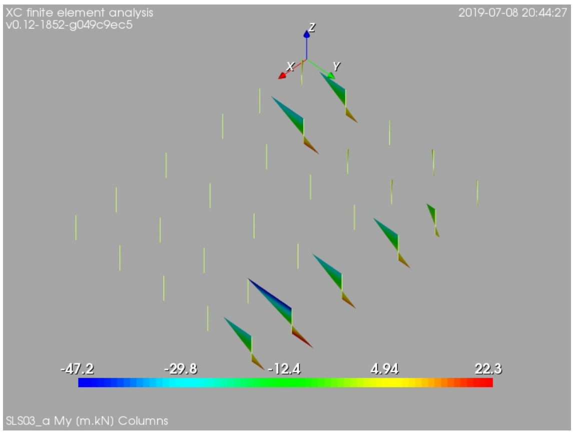


Figure 89: SLS03_a: 1.0*D + 1.0*S + 0.3*Lru + 0.3*Lpu. Columns, bending moment about local axis y [m.kN]

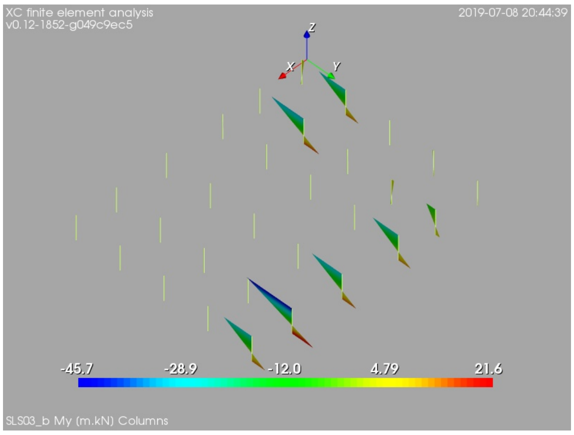


Figure 90: SLS03_b: 1.0*D + 1.0*S + 0.3*Lrs + 0.3*Lps. Columns, bending moment about local axis y [m.kN]

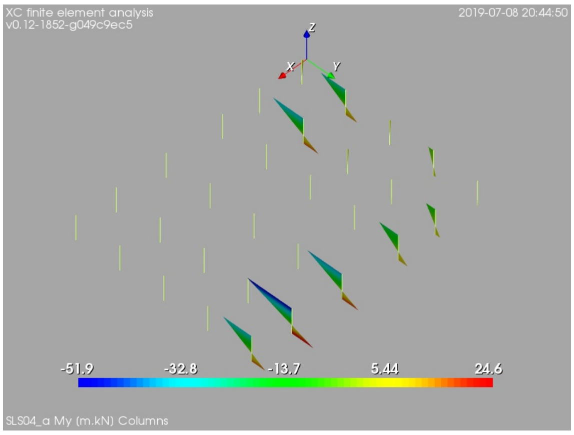


Figure 91: SLS04_a: 1.0*D + W_WE + 1.0*Lru + Lpu. Columns, bending moment about local axis y [m.kN]

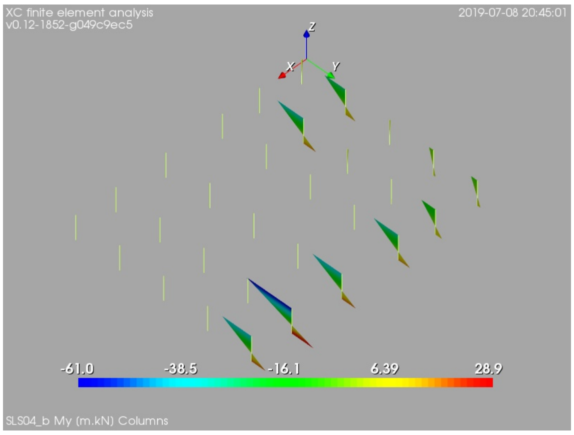


Figure 92: SLS04_b: 1.0*D + W_NS + 1.0*Lru + Lpu. Columns, bending moment about local axis y [m.kN]

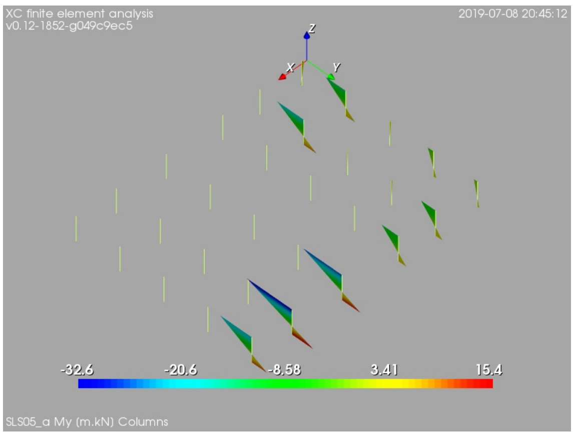


Figure 93: SLS05_a: 1.0*D + W_WE. Columns, bending moment about local axis y [m.kN]

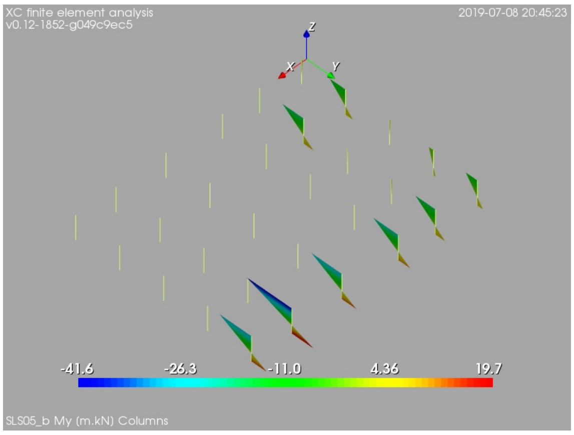


Figure 94: SLS05_b: 1.0*D + W_NS. Columns, bending moment about local axis y [m.kN]