STRUCTURAL CALCULATIONS

MJC 3391
Christmas Installation
CHANEL Fine Jewellery– New Bond Street Store
173 New Bond Street, London W1S 4RF

Revision	Date	Changes
-	25.08.21	Initial Issue

General Construction Notes and Guidance on using these Calculations

1. Calculations are not to be used for the purpose of ordering materials and should only be used for Building Regulations submissions. All dimensions should be checked by the contractor on site.

2. All steelwork connections to use grade 8.8 bolts unless stated otherwise. These are to be spanner tightened using the appropriate podger spanner (min length 460mm) or suitable power tools in accordance with BS2583. If a torque wrench is used the torque applied should be around 90Nm for M16 bolts, 110Nm for M20 & 130Nm for M24.

3. The project requires the introduction of heavy structural elements. Although the Construction (Design and Management) Regulation 2015 would not normally apply to this type of construction, the designer still has an obligation to foresee risks and bring to the attention of the builder such risks. In consequence, the builder is to take into consideration the placement of all structural elements, ensuring that the method of lifting and placement is safely carried out. Responsibility for this element lies with the Contractor. Safe working procedures must be adopted. Responsibility for this element lies with the Contractor.

4. All construction products should be CE marked in accordance current legislation. This includes all fabricated structural steelwork in accordance with BS EN 1090-1 and BS EN 1090-2. The consequence class is CC2 unless noted otherwise. The service class is SC1 for all buildings, SC2 for all lifting beams, sculptures & fall arrest systems. Production category will be PC1 unless noted otherwise. All site welded items, S355 steelwork & CHS lattice girders will be PC2. As such the execution class for buildings will be EXC2.

5. CLIMATE CHANGE: The Building Research establishment have produced a document CBG 63 “Climate Change: impact on building design and construction”. Part of their recommendations are that designers and builders should give consideration to:
   a. Increased wind loading by providing additional laps and fixings to roof coverings

   b. Consider foundation depth on shrinkable clays and to avoid future problems, increase the depth above standard requirements if there is a risk. This should be in accordance with the NHBC Standards, Chapter 4.2 Guidance on Building near Trees. If the calculations do not specifically design the depths of the foundations to take into account any local trees, then this should be checked and agreed with the Building Inspector on site.

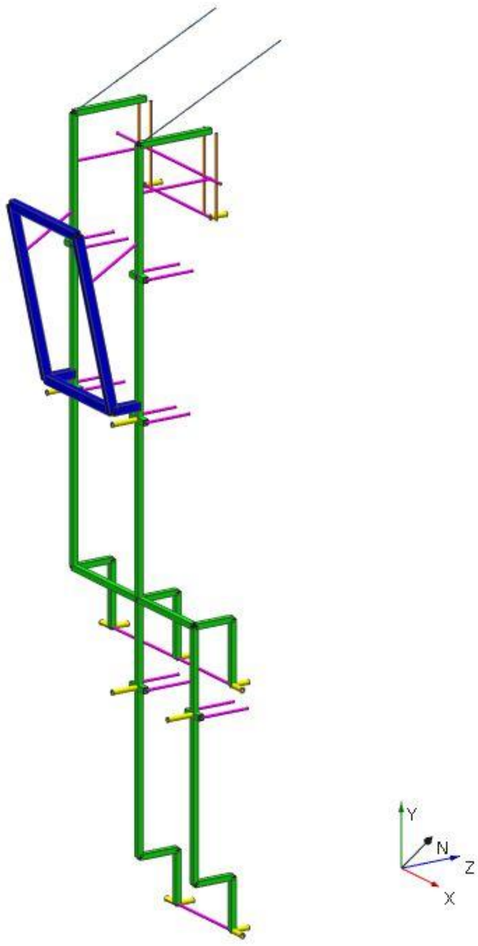
Brief description

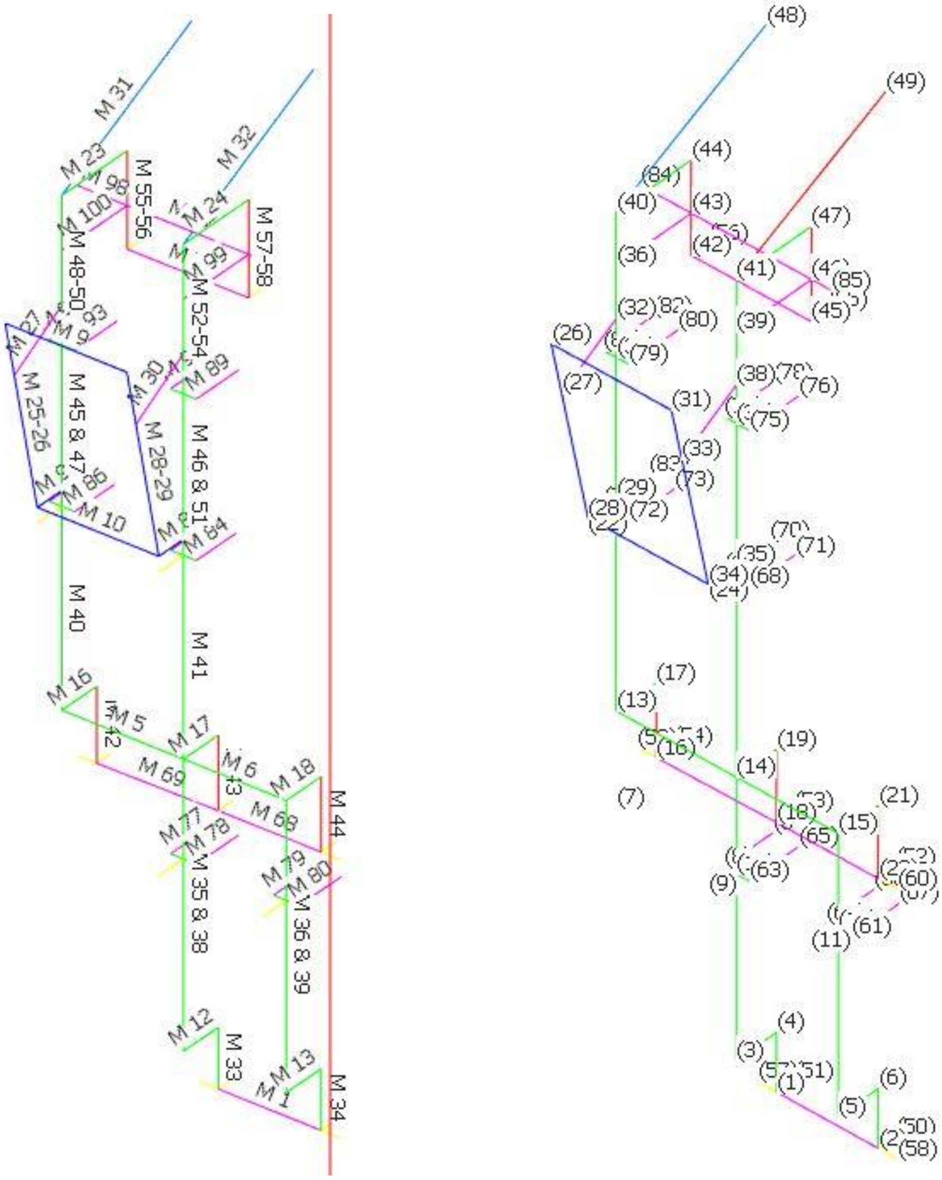
A new seasonal decoration will be installed at a shop in London. The installation will be in place from November 2021 until January 2022. It is made from 3mm aluminium powder coated discs of various sizes.

All these discs are fixed onto an aluminium truss frame which in turn is fixed onto the building wall via anchor bolts and rests on parts on it via aluminium (scaffold) legs.

It is expected wind load to be the governing action.

Analytical model





Member numbers and Node numbers

Loads:

<u>Dead loads</u>:

According to the latest information received the frame will support the following:

15@400mm Disk: 1.5kg

4@600mm Disk: 2.8kg

38@800mm Disk: 4.6kg

3@1000mm Disk: 7.5kg

4@1250mm Disk: 11kg

3@1500mm Disk: 15.5kg

Box on top of installation: 205kg

Clamps: 450kg

Lights: 60kg

Truss: 300kg *(assume s/w of a square 290x290 aluminium truss ≈6kg/m)*

Support arms: 70kg

Load application on model:

→ The bulk load of disks + clamps + lights + support arms =901.5kg ≈9.00kN on a total area of approximately 19.5m^2 applied as follows:

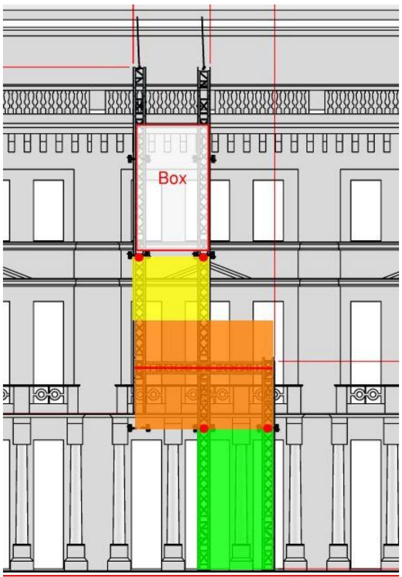
Yellow area ≈ 9.05kN * 3.00m^2 / 19.5m^2 =1.39kN => As 2no. point loads 0.695kN onto vertical members with a 500mm eccentricity.

Orange area ≈ 9.05kN * 9.10m^2 /19.5m^2 =4.22kN/3.5m=1.20kN/m applied as a UDL with 500mm eccentricity.

Green area ≈ 9.05kN * 7.40m^2 /19.5m^2 =3.43kN => As 2no. point loads 1.71kN onto vertical members with a 500mm eccentricity.

→ Truss self-weight is applied through the choice of a member with similar weight (*≈6kg/m*) + 3mm aluminium plate at two sides of each 290mm truss *(≈4.7kg/m)* =10.7kg/m in total (chosen member for simulation 90x90x4 – 10.7kg/m)

→ Box on top of installation, self-weight of 205kg simulated by approx. 9.2m of 150x100x6 RHS – 21.7kg/m



Imposed loads:

A nominal imposed load will be assumed in the form of snow. Due to the complexity of the installation layout, it will be assumed that the snow will be applied as follows.

Load application on model:

→ On the top member of the top box as on a 0.60m width x 0.60kN/m^2 =0.36kN/m

→ On horizontal truss members and the width of each horizontal member (0.290m) plus an additional 0.310m for snow built-up on disks etc* i.e. 0.60m width x 0.60kN/m^2 =0.36kN/m

*It is understood from the layout of the installation and the building that snow drift is not an issue. However, snow load assumptions were made slightly conservative to take into account such event.

It is upon the building engineer to check any entrance canopies, /balconies etc against snow drift.

Wind load:

Location:

173 New Bond Street, London W1S 4RF

E: 529032 N: 180621

National Grid: TQ290806 / TQ2903280621

Wind loads on model members as linear loads

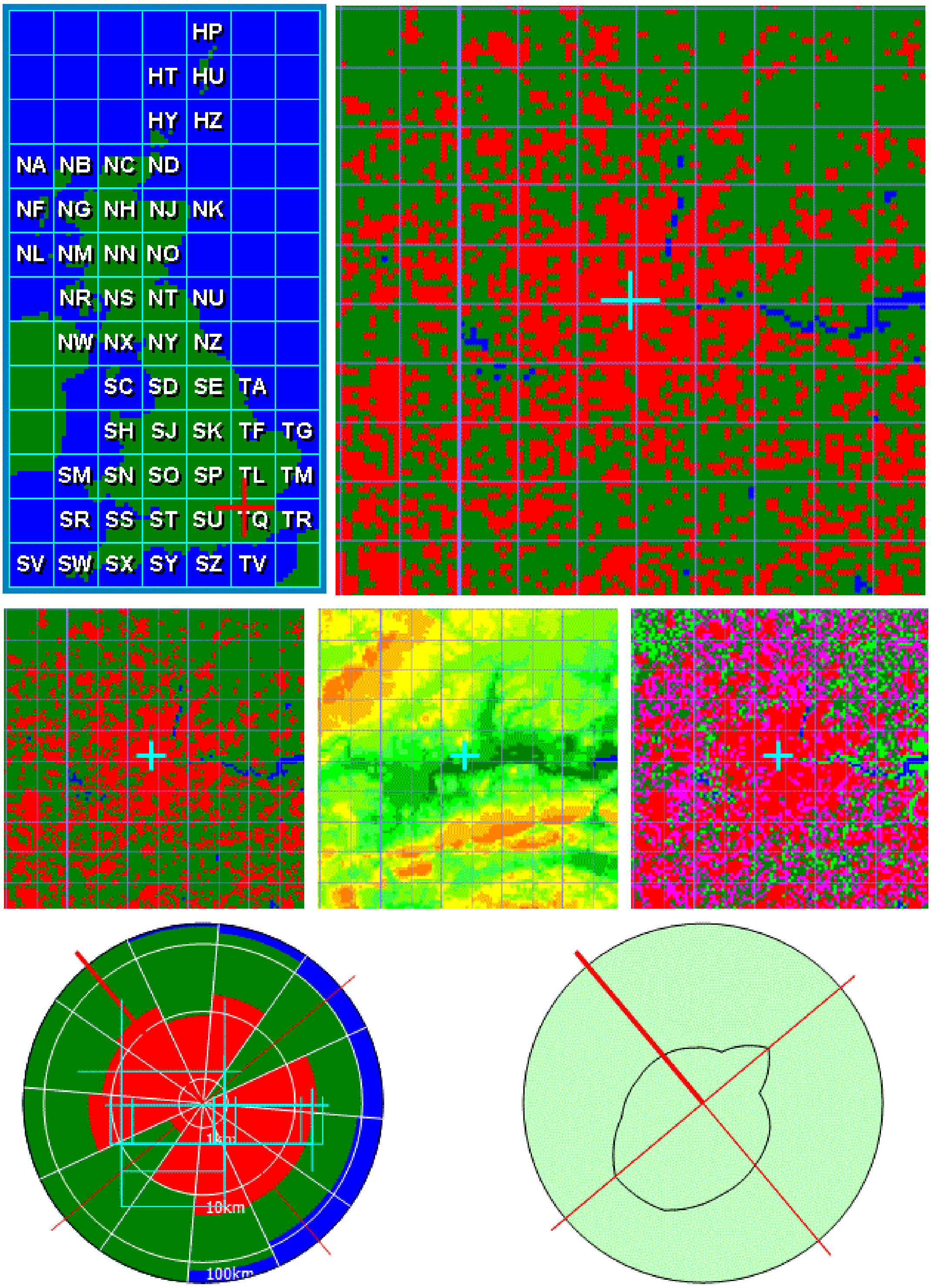
Apart from the automatic area wind loading applied from MasterSeries software, an additional load of q=0.448kN/m^2 (maximum pressure value) will be applied on the most of model members simulating aluminium truss members since they are covered with aluminium plates creating an area of pressure contact. Assume the plates are 300mm deep.

An assumed universal C_p factor of 1.2 will be used over a i.e. load applied, W =0.448*0.30*1.2 =0.16kN/m

A wind load will be applied on the sides of the box for 500mm. W=0.448*0.50*1.2 =0.26kN/m

That load will be applied only at W1 (Northwest) and W3 (Southeast) directions.

WIND LOADING TO BS 6399 - PART 2
Results for site at TQ290806 - Altitude 38 m
Wind Reference 1
Using the Directional Method



Site Basic Data

Location and Base wind speed	BREVe site data for TQ290806 - Base wind speed, Vb 20.5 m/s
Site Range	500 m
Altitude and Obstructions	Site altitude 38 m - Shelter effect from obstructions is included
Seasonal factor, Ss	Season length is Winter - Seasonal factor, Ss 1.000
Annual risk and probability factor	Design annual risk 0.1 - Probability factor, Sp 0.902
Topographic Increments	Topographic increment from internal parameters
Heights and Diagonals (m)	Heights above ground 13.905, Diagonals 5

Direction Factors - Using UK direction Factors

Direction (°N)	0	30	60	90	120	150	180	210	240	270	300	330
Direction factor, Sd	0.780	0.730	0.730	0.740	0.730	0.800	0.850	0.930	1.000	0.990	0.910	0.820

Topography

Crest Height (m)	1.0	2.0	1.0	9.0	29.0	21.3	22.7	19.0	12.0	9.0	7.0	2.0
Site Location (m)	999.0	999.0	999.0	999.0	0.0	0.0	0.0	0.0	0.0	999.0	999.0	999.0
Upwind Length (m)	17.0	160.0	80.0	360.0	552.0	356.0	378.0	317.0	200.0	360.0	215.0	50.0
Downwind Length (m)	17.0	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
Base Altitude (m)	35.0	34.0	35.0	29.0	10.0	12.7	13.3	15.0	22.0	29.0	29.0	34.0
Upwind Slope	0.059	0.013	0.013	0.025	0.053	0.060	0.060	0.060	0.060	0.025	0.033	0.040

Directional Method

Direction (°N)	0	30	60	90	120	150	180	210	240	270	300	330
Direction factor, Sd	0.780	0.730	0.730	0.740	0.730	0.800	0.850	0.930	1.000	0.990	0.910	0.820
Distance to Sea (km)	200.0	178.0	146.0	102.0	95.8	83.3	80.0	130.0	200.0	200.0	200.0	200.0
Distance in Town (km)	16.5	8.5	17.5	0.0	20.5	18.5	18.5	19.5	9.5	1.5	21.5	13.5
Altitude factor, Sa	1.035	1.034	1.035	1.029	1.010	1.013	1.013	1.015	1.022	1.029	1.029	1.034
Obstructions Height, Ho (m)	10.0	10.0	10.0	2.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Obstructions Spacing, Xo (m)	20.0	20.0	20.0	4.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Displacement Height, Hd (m)	8.0	8.0	8.0	2.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

Height Above Ground = 13.905 m

Direction (°N)	0	30	60	90	120	150	180	210	240	270	300	330
Effective height, He (m)	5.91	5.91	5.91	11.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91	5.91
Topographic increment, Sh	0.000	0.000	0.000	0.006	0.104	0.117	0.118	0.117	0.115	0.006	0.000	0.000
Fetch factor, Sc	0.912	0.912	0.912	1.035	0.914	0.923	0.925	0.912	0.912	0.912	0.912	0.912
Turbulence factor, St	0.188	0.188	0.188	0.174	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188
Fetch adjustment factor, Tc	0.722	0.734	0.721	1.000	0.718	0.720	0.720	0.719	0.731	0.773	0.717	0.725
Turbulence adjustment factor, Tt	1.593	1.593	1.593	1.000	1.593	1.593	1.593	1.593	1.593	1.593	1.593	1.593
a = 5.000, gt	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440	3.440
a = 5.000, Sb	1.335	1.357	1.333	1.661	1.401	1.426	1.430	1.407	1.429	1.434	1.327	1.341
a = 5.000, Ve (m/s)	19.9	18.9	18.6	23.4	19.1	21.4	22.8	24.6	27.0	27.0	23.0	21.0
a = 5.000, q (N/m²)	243.6	220.0	212.8	335.8	223.8	279.9	318.1	369.9	447.7	448.0	323.9	271.3

MASTERFRAME WIND PRESSURE VALUES

Dynamic Pressure Values, q (N/m²) for a = 5

Wind Direction to X Axis	0	90	180	270
q (N/m²) for H = 13.905	448.0	448.0	335.8	315.3

Ground level

Ground Level has been set by the user as always being at the bottom of the model

Notes on loading & modelling -Method statement:

Wind uplift is considered as unlikely. Though there is some area crated by the disks that could potentially lead to some up-uplifting due to wind pressures, it is assumed that the load of the structure and how that is applied will not allow for such action.

Main truss members are modelled as single steel members with similar weight and incorporating the cross sectional area of the members (for wind panels).

Other members are also simulated with similar weight model members. Their capacity (and reactions induced) are checked accordingly.

The analysis results are compared then with capacities from technical data (certificates) published for trusses with the same characteristics as those indicated in the drawings.

The forces on the anchor fixings to the building wall are evaluated and specific fixings are suggested.

The forces on the rest of supports onto the building are indicated for the building engineer to use.

Members:

Aluminium truss members

From received information, trusses are typical 290x290 aluminium square trusses.

Truss members by inspection will be OK given that the vertical members will be restrained in regular intervals along their length.

Since the section is symmetrical, the capacities against moments about "major" and "minor" axes are equal and therefore

$M_{app(x)}/M_{R(x)} + M_{app(y)}/M_{R(y)} \leq 1$

The maximum moment is observed at member M35 Under Load Case 013:

M_{xx}=0.25kNm, M_{yy}=3.54kNm

Assume a normal capacity truss. From EUROTRUSS truss FD34 Performance Certificate:

Bemessungsschnitt-größen der Bauteile: *Design internal normal forces of parts:*	**Normalkraft im Gurtrohr:** *Mainchord normal force:*	N_{Rd} = 35,71 kN
	Normalkraft vertikale Diagonalstrebe: *Vertical member normal force:*	N_{Rd} = 13,39 kN
	Normalkraft horizontale Diagonalstrebe: *Horizontal member normal force:*	N_{Rd} = 13,39 kN
Bemessungsschnitt-größen der Gesamt-traverse: *Design internal forces complete truss:*	**Traverse Normalkraft:** *Truss normal force:*	N_{Rd} = 142,83 kN
	Biegemoment: *Bending moment:*	$M_{y,Rd}$ = 17,14 kNm
	Biegemoment: *Bending moment:*	$M_{z,Rd}$ = 17,14 kNm
	Querkraft: *Shear force:*	$V_{z,Rd}$ = 16,85 kN
	Querkraft: *Shear force:*	$V_{y,Rd}$ = 16,85 kN

Die Bemessungswerte der Tragfähigkeit wurden auf der Grundlage der Grenzzustände ermittelt.
The design resistance have been calculated according to the ultimate limit states.

From the above, truss members are deemed as OK.

Legs resting onto structure

Maximum forces observed:

Model member M42 - Load Case 015 (Dead + Live + Wind 2):

F_{axial}=4.71kN

$F_{shear(x-x)}$=0.14kN

$F_{shear(y-y)}$=1.83kN

M_{x-x}=0.16kNm

M_{y-y}=2.04kNm

The above forces are taken in reality by 4no. Ø48.3mm tube members forming a square 240mm x 240mm, therefore, by inspection OK.

Model member M57-58 - Load Case 013 (Dead + Live + Wind 1):

F_{axial}=3.00kN

$F_{shear(x-x)}$=0.55kN

$F_{shear(y-y)}$=0.01kN

M_{x-x}=0.35kNm

The above forces are taken in reality by 2no. Ø48.3mm tube members, therefore, by inspection OK.

Supports:

ALL LOADS FACTORED (ULS)

Supports to wall

Assume brick wall about 235mm wide with plaster.

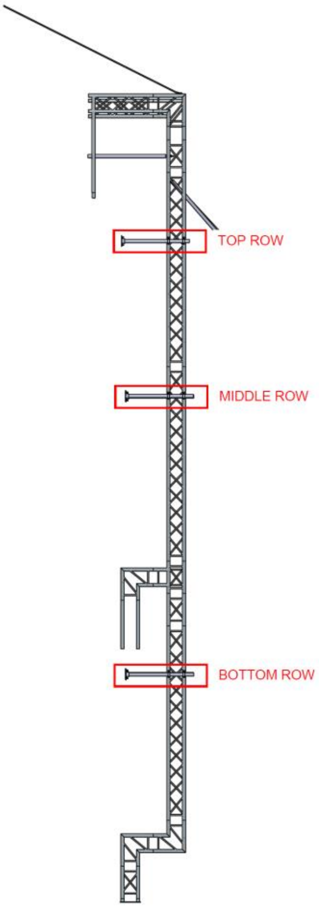
A) Anchor fixings to the wall

Joints in model:

64, 65, 66, 67 (Bottom row) = 4no. HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment

83, 73, 70, 71 (Middle row) = 4no. HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment

82, 80, 78, 76 (Top row) = 2no. HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment



- Load Case 021: Dead + Live + Wind 1

Joint 64:

Rx=0.417kN (horizontal Shear)

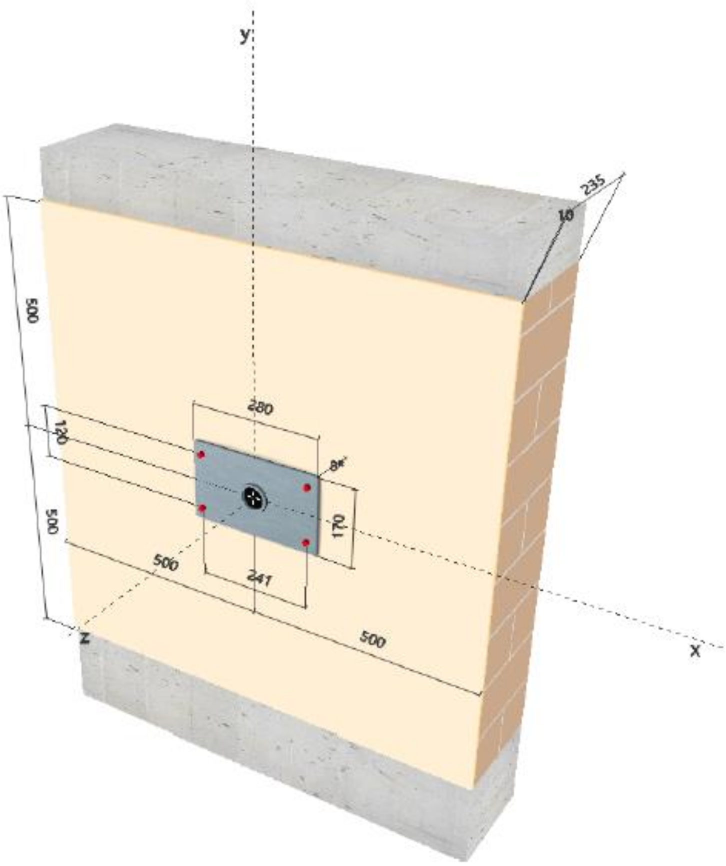
Rz=4.957kN (Tension)

The 2no. bolts connections are not adequate.

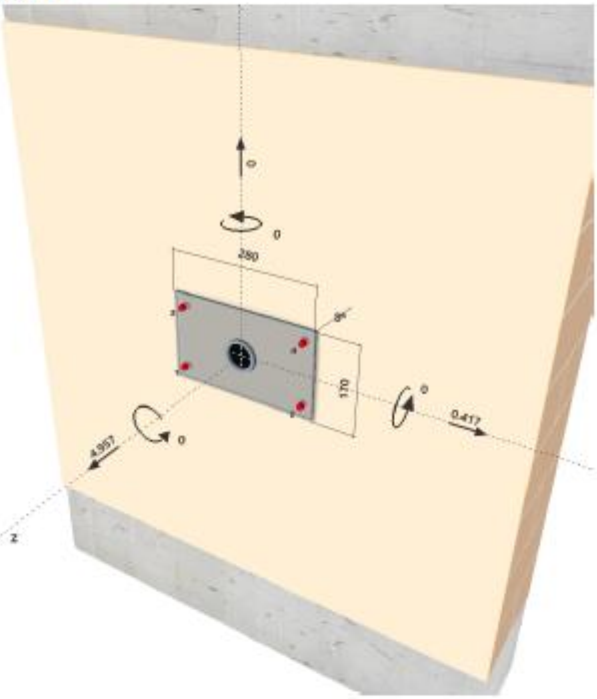
1 Input data

Anchor type and size:	**HIT-HY 270 + HAS-U A4 M12**
Effective embedment depth:	$h_{ef,act}$ = 120 mm
Material:	A4
Approval No.:	-
Issued I Valid:	- | -
Proof:	Design method ETAG 029, Annex C
Stand-off installation:	e_b = 0 mm (no stand-off); t = 8 mm
Baseplate^R:	l_x x l_y x t = 280 mm x 170 mm x 8 mm; (Recommended plate thickness: not calculated
Profile:	Pipe, 60,3 x 6,3; (L x W x T) = 60 mm x 60 mm x 6 mm
Base material:	Brick layout : Double Stretcher; Brick: Mz, 2DF, f=12 (solid brick), Clay, L x W x H: 240 mm x 115 mm x 113 mm;
	$f_{b,v}$ = 12.00 N/mm^2; E_{wall} = 3,131.77 N/mm^2
	Mortar: M2,5 - M9; Vertical joints filled: YES; vertical: 5 mm; horizontal: 5 mm
Plaster	$E_{plaster}$ = 1,000.00 N/mm^2
Installation/Use:	Installation condition: Dry; Use condition: Dry;
	Cleaning: compressed air
	Temp. short/long: 40/24 °C

Geometry [mm]

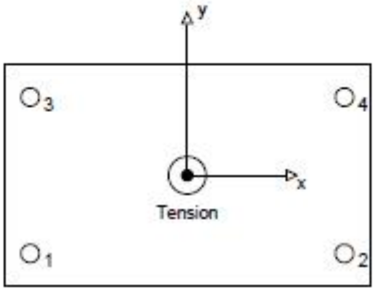


Geometry [mm] & Loading [kN, kNm]



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	1.239	0.104	0.104	0.000
2	1.239	0.104	0.104	0.000
3	1.239	0.104	0.104	0.000
4	1.239	0.104	0.104	0.000

max. compressive strain: - [‰]
max. compressive stress : - [N/mm²]
resulting tension force in (x/y)=(0/0): 4.957 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]

3 Tension load (ETAG 029 Annex C, Section C.5.2.1)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	1.239	31.551	4	OK
Pull-out failure*	1.239	2.100	60	OK
Brick breakout**	4.957	8.400	60	OK
Pullout of one brick**	4.957	6.495	77	OK

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
59.000	1.870	31.551	1.239

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	α_j	$\gamma_{M,m}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
7.000	0.750	2.500	2.100	1.239

3.3 Brick breakout

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
241	120	240	113	380	115

$N_{Rk,b}$ [kN]	α_j	$\alpha_{g,N}$	$\gamma_{M,m}$	$N_{Rd,b}$ [kN]	N_{Sd} [kN]
7.000	0.750	4.000	2.500	8.400	4.957

3.4 Pullout of one brick

A^H_{act} [mm²]	A^V_{act} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
110,400	51,980	0.20	0.00

$N_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$N_{Rd,pb}$ [kN]	N_{Sd} [kN]
16.238	2.500	6.495	4.957

4 Shear load (ETAG 029 Annex C, Section C.5.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	0.104	2.824	4	OK
Local brick failure**	0.417	4.800	9	OK
Brick edge failure in direction x+**	0.417	28.121	2	OK
Pushing out of one brick in direction x+**	0.417	6.624	7	OK

* most unfavourable anchor   **anchor group (relevant anchors)

4.1 Steel failure (with lever arm)

l [mm]	α_M
20	1.00

$N_{Sd} / N_{Rd,s}$	$1 - N_{Sd} / N_{Rd,s}$	$M^0_{Rk,s}$ [kNm]	$M_{Rk,s} = M^0_{Rk,s}(1 - N_{Sd}/N_{Rd,s})$ [kNm]
0.039	0.961	0.092	0.088

$V^M_{Rk,s} = \alpha_M * M_{Rk,s} / l$ [kN]	$\gamma_{Ms,b,V}$	$V^M_{Rd,s}$ [kN]	V_{Sd} [kN]
4.405	1.560	2.824	0.104

4.2 Local brick failure

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
241	120	240	113	380	115

$\alpha_{g,V}$	α_j	$V_{Rk,b}$ [kN]	$\gamma_{M,m}$	$V_{Rd,b}$ [kN]	V_{Sd} [kN]
4.000	0.750	4.000	2.500	4.800	0.417

4.3 Brick edge failure in direction x+

k	d_{nom} [mm]	h_{ef} [mm]	$f_{b,V}$ [N/mm²]	c_1 [mm]
0.25	12	120	12.00	380

$V_{Rk,c}$ [kN]	$\alpha_{g,V}$	$\gamma_{M,m}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
35.151	2.000	2.500	28.121	0.417

4.4 Pushing out of one brick in direction x+

A^H_{act} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
165,600	0.20	0.00

$V_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$V_{Rd,pb}$ [kN]	V_{Sd} [kN]
16.560	2.500	6.624	0.417

5 Combined tension and shear loads (ETAG 029 Annex C, Section C.5.2.3)

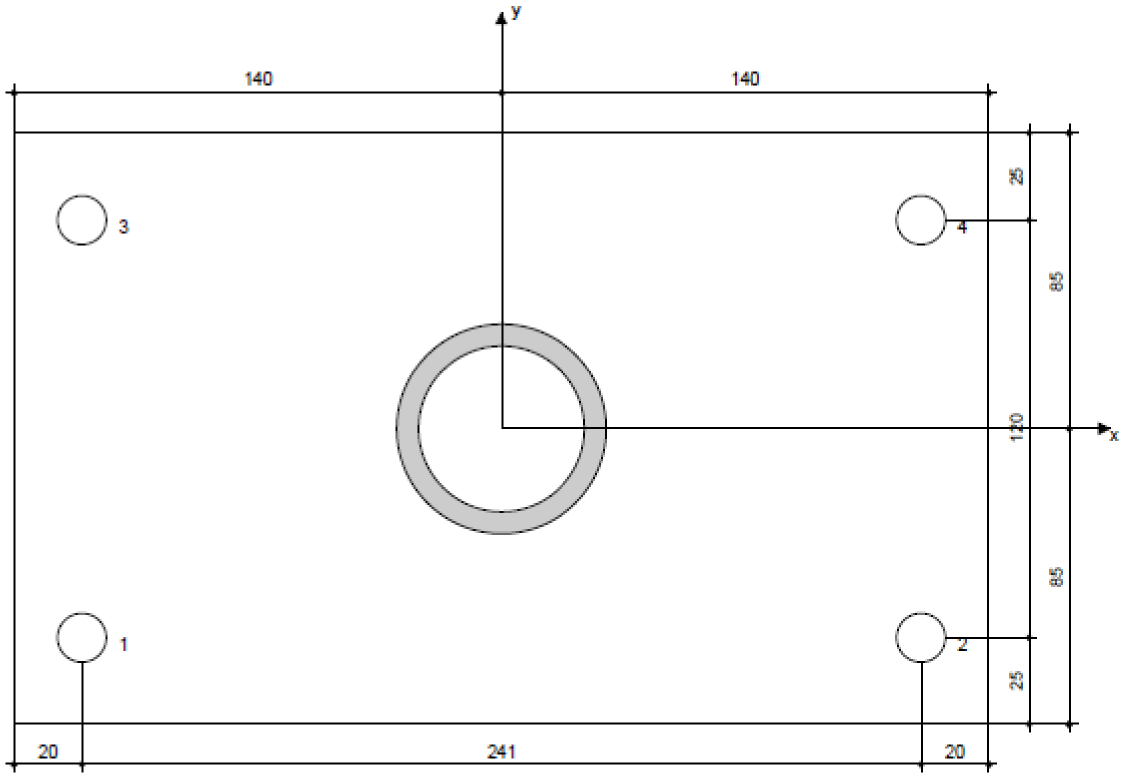
β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
0.763	0.087	1.000	71	OK

$(\beta_N + \beta_V) / 1.2 \leq 1$

7 Installation data

Baseplate, steel: -
Profile: Pipe, 60,3 x 6,3; (L x W x T) = 60 mm x 60 mm x 6 mm
Hole diameter in the fixture (pre-setting) : d_f = 14 mm
Hole diameter in the fixture (through fastening) : d_f = 0 mm
Plate thickness (input)[8]: 8 mm
Recommended plate thickness[8]: not calculated
Drilling method: Drilled in rotary mode
Cleaning: compressed air

Anchor type and size: HIT-HY 270 + HAS-U A4 M12
Maximum installation torque: 0.010 kNm
Hole diameter in the base material: 14 mm
Hole depth in the base material: 120 mm
Minimum thickness of the base material: 150 mm



HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment

Adopt the above connection for bottom and middle row of wall fixings.

Note: building engineer to check building's fixings parameters

- Load Case 025: Dead + Live + Wind 3

Joint 76:

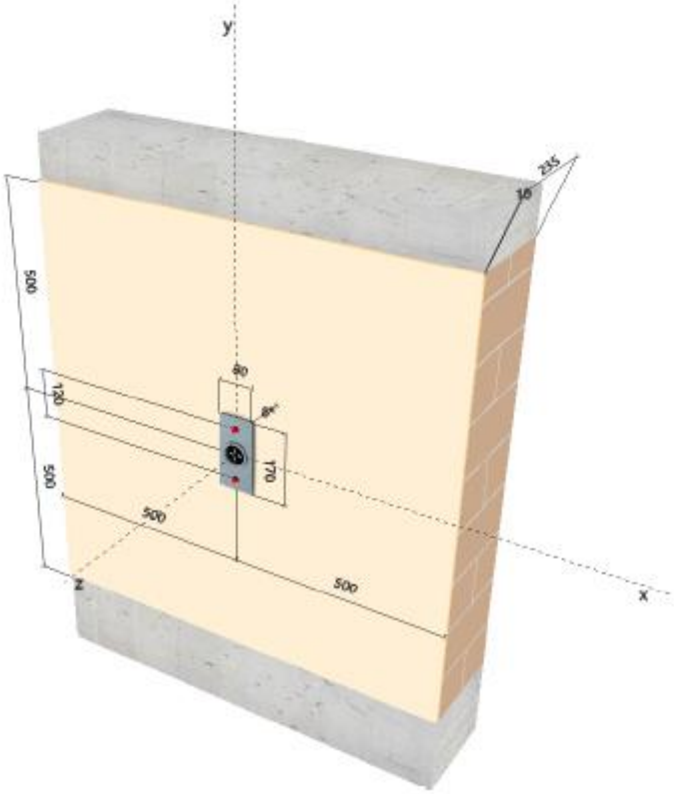
Rx=0.388kN (horizontal Shear)

Rz=2.475kN (Tension)

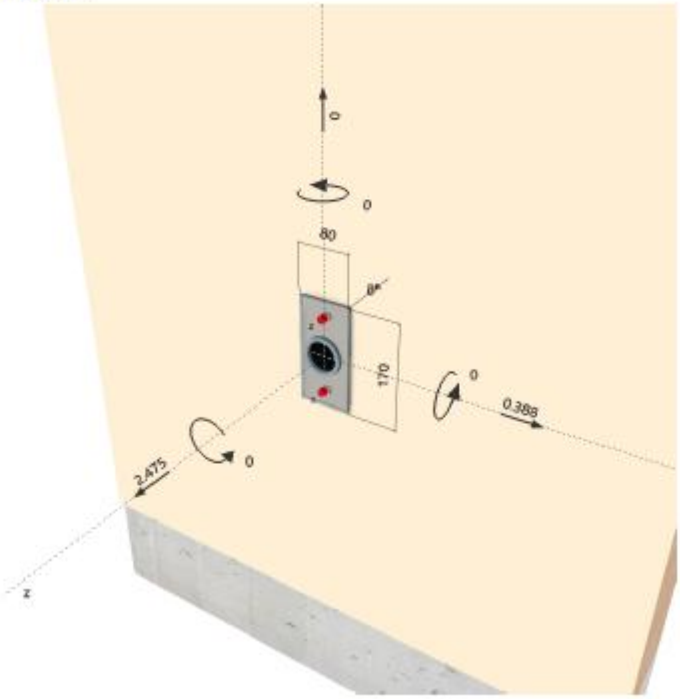
1 Input data

Anchor type and size:	**HIT-HY 270 + HAS-U A4 M12**
Effective embedment depth:	$h_{ef,act}$ = 120 mm
Material:	A4
Approval No.:	-
Issued I Valid:	- I -
Proof:	Design method ETAG 029, Annex C
Stand-off installation:	e_b = 0 mm (no stand-off); t = 8 mm
Baseplate[R]:	l_x x l_y x t = 80 mm x 170 mm x 8 mm; (Recommended plate thickness: not calculated
Profile:	Pipe, 60,3 x 6,3; (L x W x T) = 60 mm x 60 mm x 6 mm
Base material:	Brick layout : Double Stretcher; Brick: Mz, 2DF, f=12 (solid brick), Clay, L x W x H: 240 mm x 115 mm x 113 mm; $f_{b,v}$ = 12.00 N/mm²; E_{wall} = 3,131.77 N/mm² Mortar: M2,5 - M9; Vertical joints filled: YES; vertical: 5 mm; horizontal: 5 mm
Plaster	$E_{plaster}$ = 1,000.00 N/mm²
Installation/Use:	Installation condition: Dry; Use condition: Dry; Cleaning: compressed air Temp. short/long: 40/24 °C

Geometry [mm]



Geometry [mm] & Loading [kN, kNm]



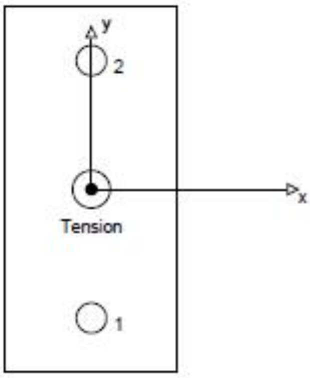
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	1.238	0.194	0.194	0.000
2	1.238	0.194	0.194	0.000

max. compressive strain: - [‰]
max. compressive stress : - [N/mm²]
resulting tension force in (x/y)=(0/0): 2.475 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]



3 Tension load (ETAG 029 Annex C, Section C.5.2.1)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	1.238	31.551	4	OK
Pull-out failure*	1.238	2.100	59	OK
Brick breakout**	2.475	4.200	59	OK
Pullout of one brick**	2.475	4.287	58	OK

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
59.000	1.870	31.551	1.238

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	α_j	$\gamma_{M,m}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
7.000	0.750	2.500	2.100	1.238

3.3 Brick breakout

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
0	120	240	113	500	115

$N_{Rk,b}$ [kN]	α_j	$\alpha_{g,N}$	$\gamma_{M,m}$	$N_{Rd,b}$ [kN]	N_{Sd} [kN]
7.000	0.750	2.000	2.500	4.200	2.475

3.4 Pullout of one brick

A^{H}_{ed} [mm²]	A^{V}_{ed} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
55,200	51,980	0.20	0.00

$N_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$N_{Rd,pb}$ [kN]	N_{Sd} [kN]
10.718	2.500	4.287	2.475

4 Shear load (ETAG 029 Annex C, Section C.5.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	0.194	2.824	7	OK
Local brick failure**	0.388	2.400	17	OK
Brick edge failure in direction x+**	0.388	42.527	1	OK
Pushing out of one brick in direction x+**	0.388	6.624	6	OK

* most unfavourable anchor **anchor group (relevant anchors)

4.1 Steel failure (with lever arm)

l [mm]	α_M
20	1.00

N_{Sd} / $N_{Rd,s}$	1 - N_{Sd} / $N_{Rd,s}$	$M^0_{Rk,s}$ [kNm]	$M_{Rk,s} = M^0_{Rk,s}\,(1 - N_{Sd}/N_{Rd,s})$ [kNm]
0.039	0.961	0.092	0.088

$V^M_{Rk,s} = \alpha_M \cdot M_{Rk,s} / l$ [kN]	$\gamma_{Ms,b,V}$	$V^M_{Rd,s}$ [kN]	V_{Sd} [kN]
4.405	1.560	2.824	0.194

4.2 Local brick failure

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
0	120	240	113	500	115

$\alpha_{g,V}$	α_j	$V_{Rk,b}$ [kN]	$\gamma_{M,m}$	$V_{Rd,b}$ [kN]	V_{Sd} [kN]
2.000	0.750	4.000	2.500	2.400	0.388

4.3 Brick edge failure in direction x+

k	d_{nom} [mm]	h_{ef} [mm]	$f_{b,V}$ [N/mm²]	c_1 [mm]
0.25	12	120	12.00	500

$V_{Rk,c}$ [kN]	$\alpha_{g,V}$	$\gamma_{M,m}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
53.159	2.000	2.500	42.527	0.388

4.4 Pushing out of one brick in direction x+

A^{H}_{ed} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
165,600	0.20	0.00

$V_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$V_{Rd,pb}$ [kN]	V_{Sd} [kN]
16.560	2.500	6.624	0.388

5 Combined tension and shear loads (ETAG 029 Annex C, Section C.5.2.3)

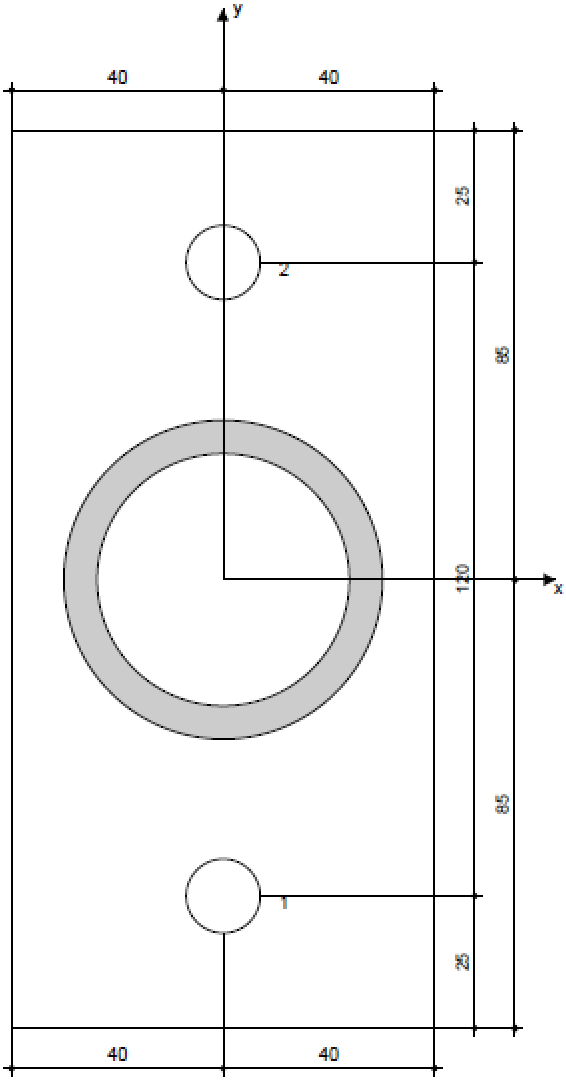
β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
0.589	0.162	1.000	63	OK

$(\beta_N + \beta_V) / 1.2 \leq 1$

7 Installation data

Baseplate, steel: -
Profile: Pipe, 60,3 x 6,3; (L x W x T) = 60 mm x 60 mm x 6 mm
Hole diameter in the fixture (pre-setting) : d_f = 14 mm
Hole diameter in the fixture (through fastening) : d_f = 0 mm
Plate thickness (input)[R]: 8 mm
Recommended plate thickness[R]: not calculated
Drilling method: Drilled in rotary mode
Cleaning: compressed air

Anchor type and size: HIT-HY 270 + HAS-U A4 M12
Maximum installation torque: 0.010 kNm
Hole diameter in the base material: 14 mm
Hole depth in the base material: 120 mm
Minimum thickness of the base material: 150 mm



HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment

Adopt the above connection for top row of wall fixings.

Note: building engineer to check building's fixings parameters

B) Eyelet wall fixings for SWRs (at the very top)

Joints in model: 48, 49

- Load Case 013: Dead + Live + Wind 1

Joint 48:

Ry=1.109N (vertical Shear)

Rz=2.342kN (Tension)

On each eyelet:

F_{shear}=1.109kN /2no. eyelets=0.55kN

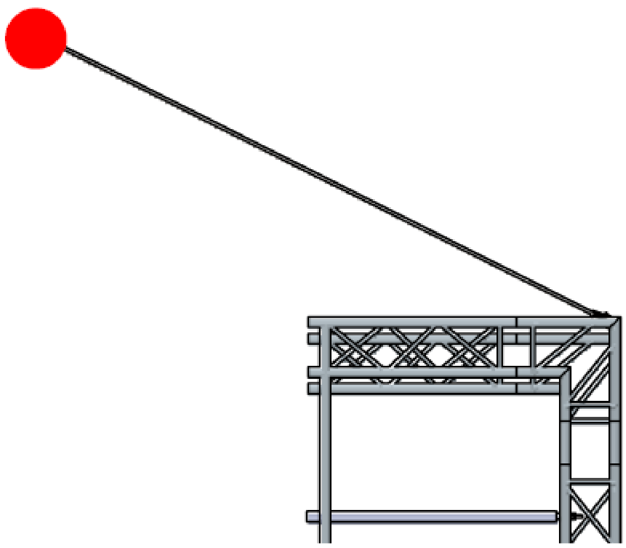
$F_{tension}$=2.342kN /2no. eyelets=1.17kN

In order to have spare capacity and some redundancy in relation with using 1no. bolt, use 2no. bolts/eyelet. Then:

On each bolt:

F_{shear}=0.55kN /2no. eyelets=0.275kN

$F_{tension}$=1.17kN /2no. eyelets=0.585kN

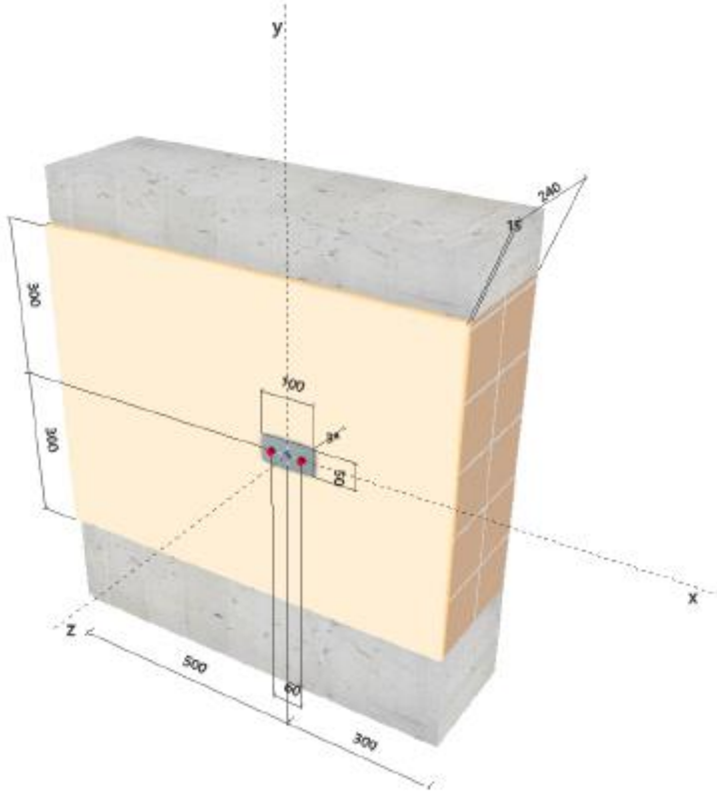


Suggested connection:

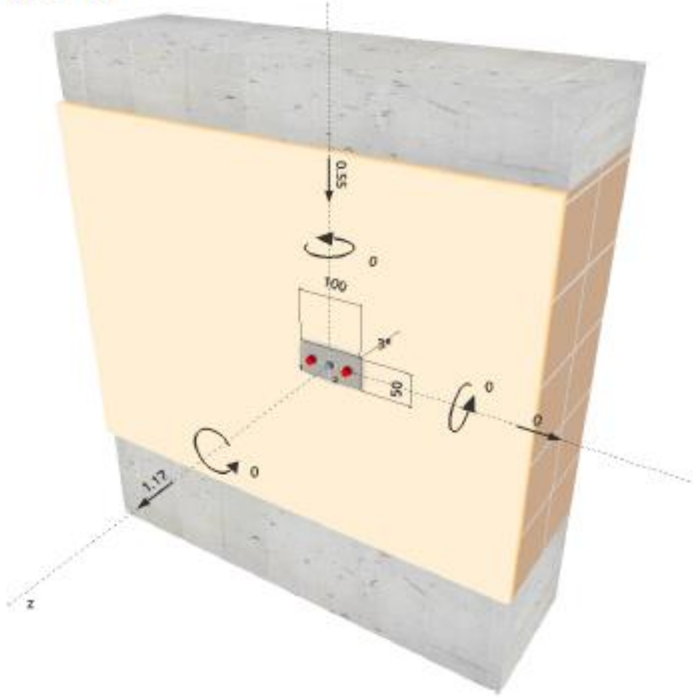
1 Input data

Anchor type and size:	**HIT-HY 270 + HAS-U A4 M12**
Effective embedment depth:	$h_{ef,act}$ = 120 mm
Material:	A4
Approval No.:	-
Issued I Valid:	- I -
Proof:	Design method ETAG 029, Annex C
Stand-off installation:	e_b = 0 mm (no stand-off); t = 3 mm
Baseplate[R]:	l_x x l_y x t = 100 mm x 50 mm x 3 mm; (Recommended plate thickness: not calculated
Profile:	Cylinder, ; (L x W x T) = 12 mm x 12 mm
Base material:	Brick layout : Flemish; Brick: Mz, 2DF, f=12 (solid brick), Clay, L x W x H: 240 mm x 115 mm x 113 mm; $f_{b,v}$ = 12.00 N/mm^2; E_{wall} = 3,131.77 N/mm^2 Mortar: M2,5 - M9; Vertical joints filled: YES; vertical: 5 mm; horizontal: 5 mm
Plaster	$E_{plaster}$ = 1,000.00 N/mm^2
Installation/Use:	Installation condition: Dry; Use condition: Dry; Cleaning: compressed air Temp. short/long: 40/24 °C

Geometry [mm]



Geometry [mm] & Loading [kN, kNm]



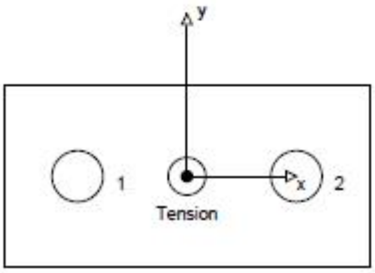
2 Load case/Resulting anchor forces

Load case: Design loads

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

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0.585	0.275	0.000	-0.275
2	0.585	0.275	0.000	-0.275

max. compressive strain: - [‰]
max. compressive stress : - [N/mm²]
resulting tension force in (x/y)=(0/0): 1.170 [kN]
resulting compression force in (x/y)=(0/0): 0.000 [kN]



3 Tension load (ETAG 029 Annex C, Section C.5.2.1)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	0.585	31.551	2	OK
Pull-out failure*	0.585	2.100	28	OK
Brick breakout**	1.170	2.100	56	OK
Pullout of one brick**	1.170	4.378	27	OK

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
59.000	1.870	31.551	0.585

3.2 Pull-out failure

$N_{Rk,p}$ [kN]	α_j	$\gamma_{M,m}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]
7.000	0.750	2.500	2.100	0.585

3.3 Brick breakout

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
60	0	115	113	270	115

$N_{Rk,b}$ [kN]	α_j	$\alpha_{g,N}$	$\gamma_{M,m}$	$N_{Rd,b}$ [kN]	N_{Sd} [kN]
7.000	0.750	1.000	2.500	2.100	1.170

3.4 Pullout of one brick

A^{H}_{ect} [mm²]	A^{V}_{ect} [mm²]	f_{vko} [N/mm²]	σ_d [N/mm²]
55,200	54,240	0.20	0.00

$N_{Rk,pb}$ [kN]	$\gamma_{M,m}$	$N_{Rd,pb}$ [kN]	N_{Sd} [kN]
10.944	2.500	4.378	1.170

4 Shear load (ETAG 029 Annex C, Section C.5.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_V [%]	Status
Steel failure (without lever arm)*	N/A	N/A	N/A	N/A
Steel failure (with lever arm)*	0.275	2.564	11	OK
Local brick failure**	0.550	1.200	46	OK
Brick edge failure in direction x+**	0.275	15.188	2	OK
Pushing out of one brick in direction **	N/A	N/A	N/A	N/A

* most unfavourable anchor   **anchor group (relevant anchors)

4.1 Steel failure (with lever arm)

l [mm]	α_M
23	1.00

N_{Sd} / $N_{Rd,s}$	1 - N_{Sd} / $N_{Rd,s}$	$M^0_{Rk,s}$ [kNm]	$M_{Rk,s} = M^0_{Rk,s}$ (1 - $N_{Sd}/N_{Rd,s}$) [kNm]
0.019	0.981	0.092	0.090

$V^M_{Rk,s} = \alpha_M * M_{Rk,s}$ / l [kN]	$\gamma_{Ms,b,V}$	$V^M_{Rd,s}$ [kN]	V_{Sd} [kN]
4.000	1.560	2.564	0.275

4.2 Local brick failure

$s_{\parallel}$ [mm]	$s_{\perp}$ [mm]	$s_{cr,\parallel}$ [mm]	$s_{cr,\perp}$ [mm]	c [mm]	c_{cr} [mm]
60	0	115	113	270	115

$\alpha_{g,V}$	α_j	$V_{Rk,b}$ [kN]	$\gamma_{M,m}$	$V_{Rd,b}$ [kN]	V_{Sd} [kN]
1.000	0.750	4.000	2.500	1.200	0.550

4.3 Brick edge failure in direction x+

k	d_{nom} [mm]	h_{ef} [mm]	$f_{b,v}$ [N/mm²]	c_1 [mm]
0.45	12	120	12.00	270

$V_{Rk,c}$ [kN]	$\alpha_{g,V}$	$\gamma_{M,m}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]
37.970	1.000	2.500	15.188	0.275

5 Combined tension and shear loads (ETAG 029 Annex C, Section C.5.2.3)

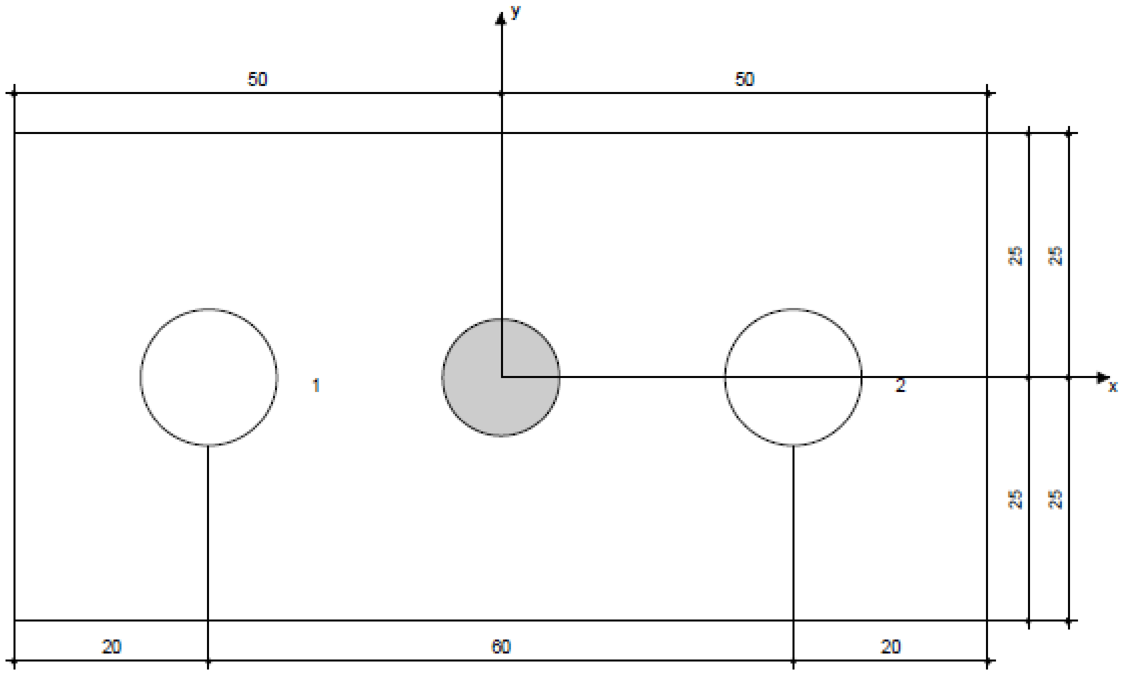
β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
0.557	0.458	1.000	85	OK

$(\beta_N + \beta_V) / 1.2 \leq 1$

7 Installation data

Baseplate, steel: -
Profile: Cylinder, ; (L x W x T) = 12 mm x 12 mm
Hole diameter in the fixture (pre-setting) : d_f = 14 mm
Hole diameter in the fixture (through fastening) : d_f = 0 mm
Plate thickness (input)[R]: 3 mm
Recommended plate thickness[R]: not calculated
Drilling method: Drilled in rotary mode
Cleaning: compressed air

Anchor type and size: HIT-HY 270 + HAS-U A4 M12
Maximum installation torque: 0.010 kNm
Hole diameter in the base material: 14 mm
Hole depth in the base material: 120 mm
Minimum thickness of the base material: 150 mm



HIT-HY 270 + HAS-U A4 M12 with 120mm effective depth embedment

Adopt the above connection for each eyelet fixing.

Note: building engineer to check building's fixings parameters

Legs resting on existing structure

Joints in model: 1, 2, 16, 18, 20, 42, 45

Maximum forces onto structure (ULS)

Bottom row legs:

Joint 1: Load Case 21 (Dead +Wind1) =6.69kN

Joint 2: Load Case 21 (Dead +Wind1) =5.80kN

Middle row legs:

Joint 16: Load Case 27 (Dead +Wind4) =5.20kN

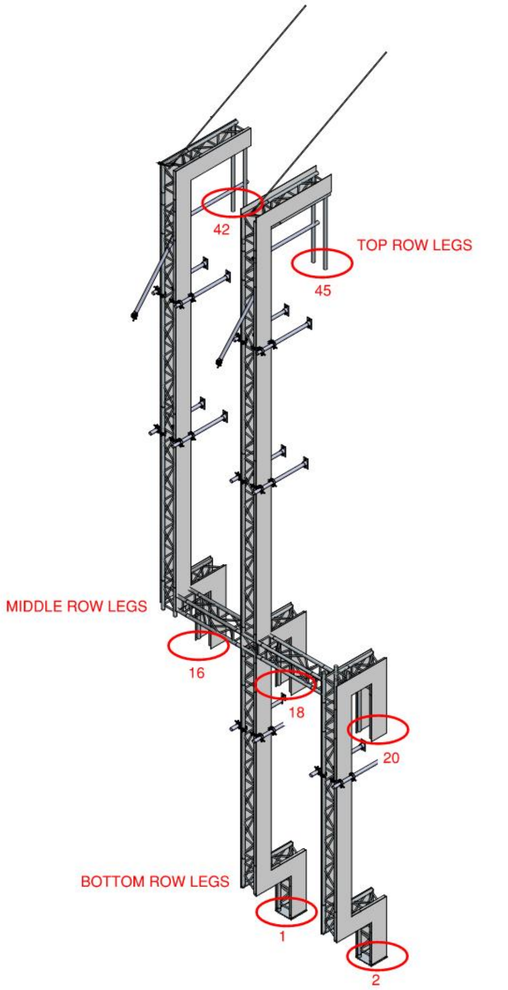
Joint 18: Load Case 13 (Dead + Live + Wind1) =5.10kN

Joint 20: Load Case 13 Dead + Live + Wind1) =1.04kN

Top row legs:

Joint 42: Load Case 017: Dead + Live + Wind4 =3.13kN

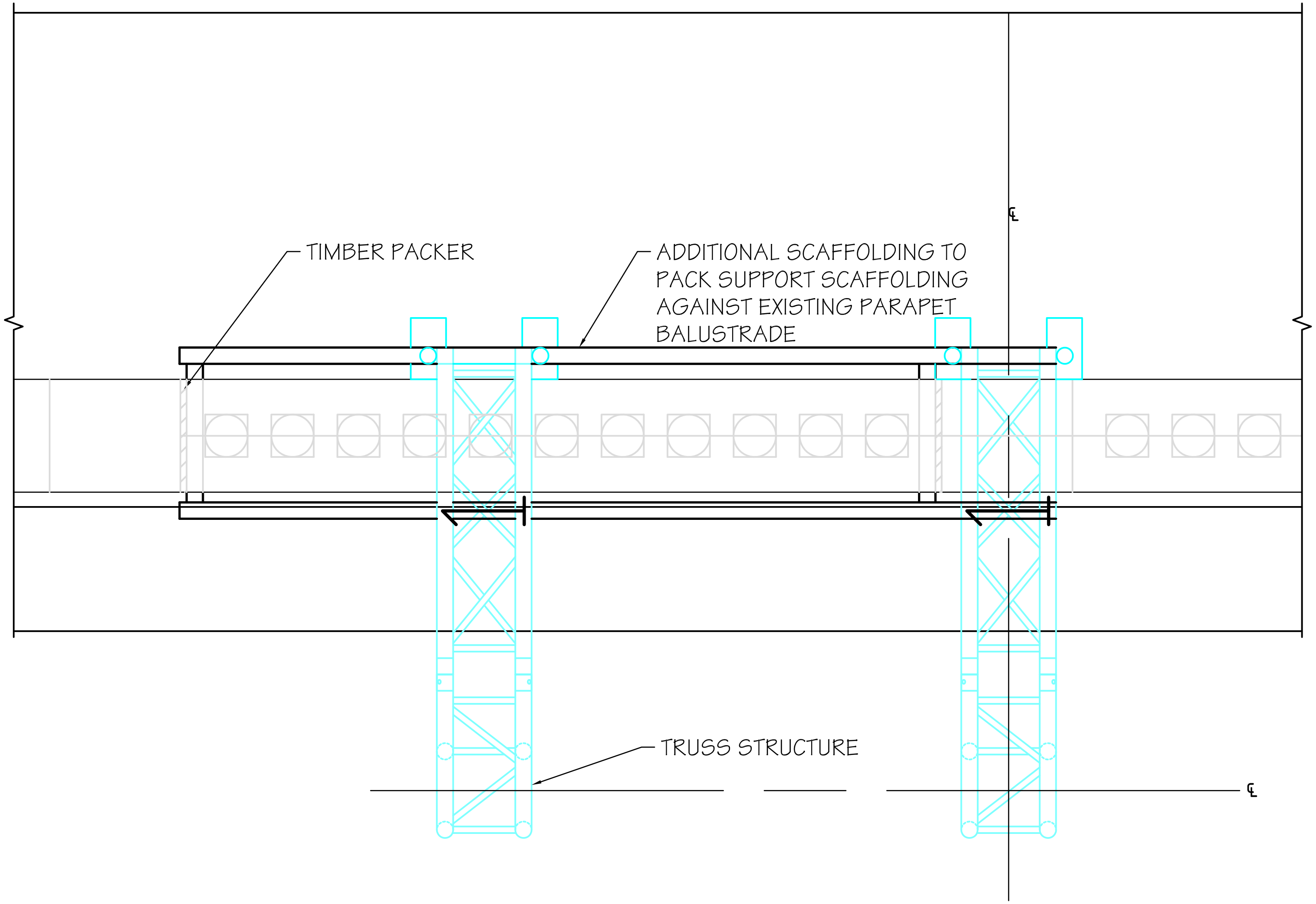
Joint 45: Load Case 013: Dead + Live + Wind1 =3.16kN



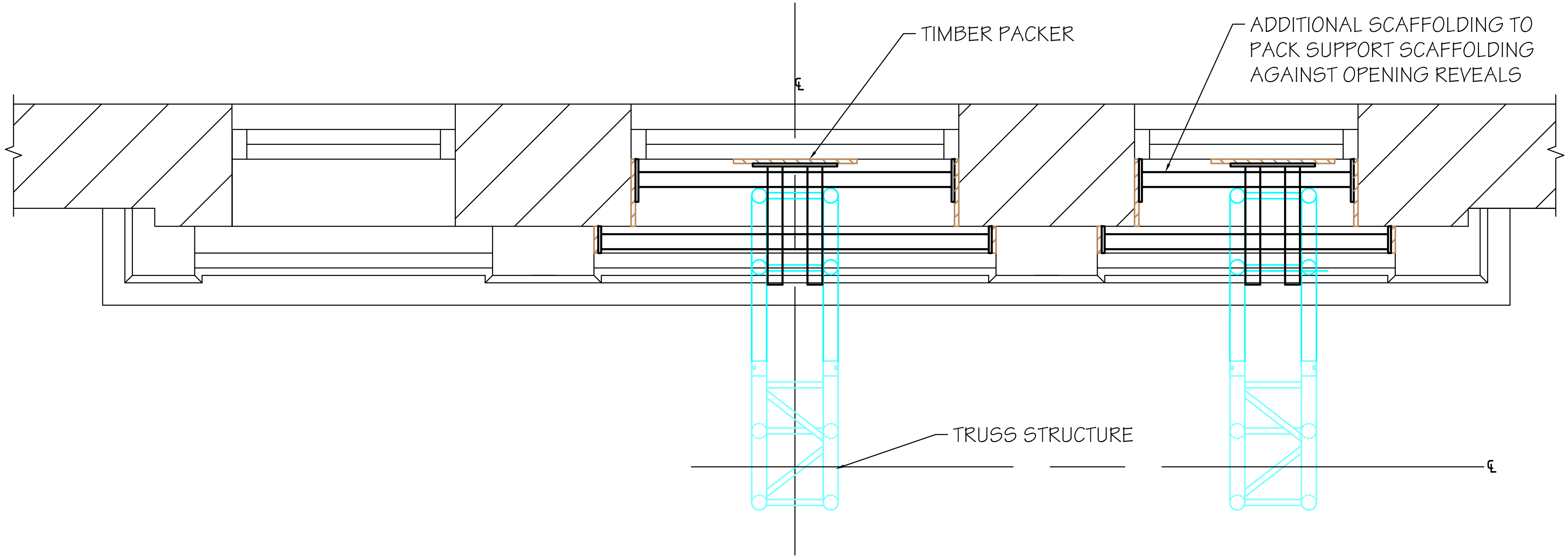
Building engineer to check the existing building against the above loads.

HORIZONTAL RESTRAINTS OF TRUSS STRUCTURE TO THE BUILDING

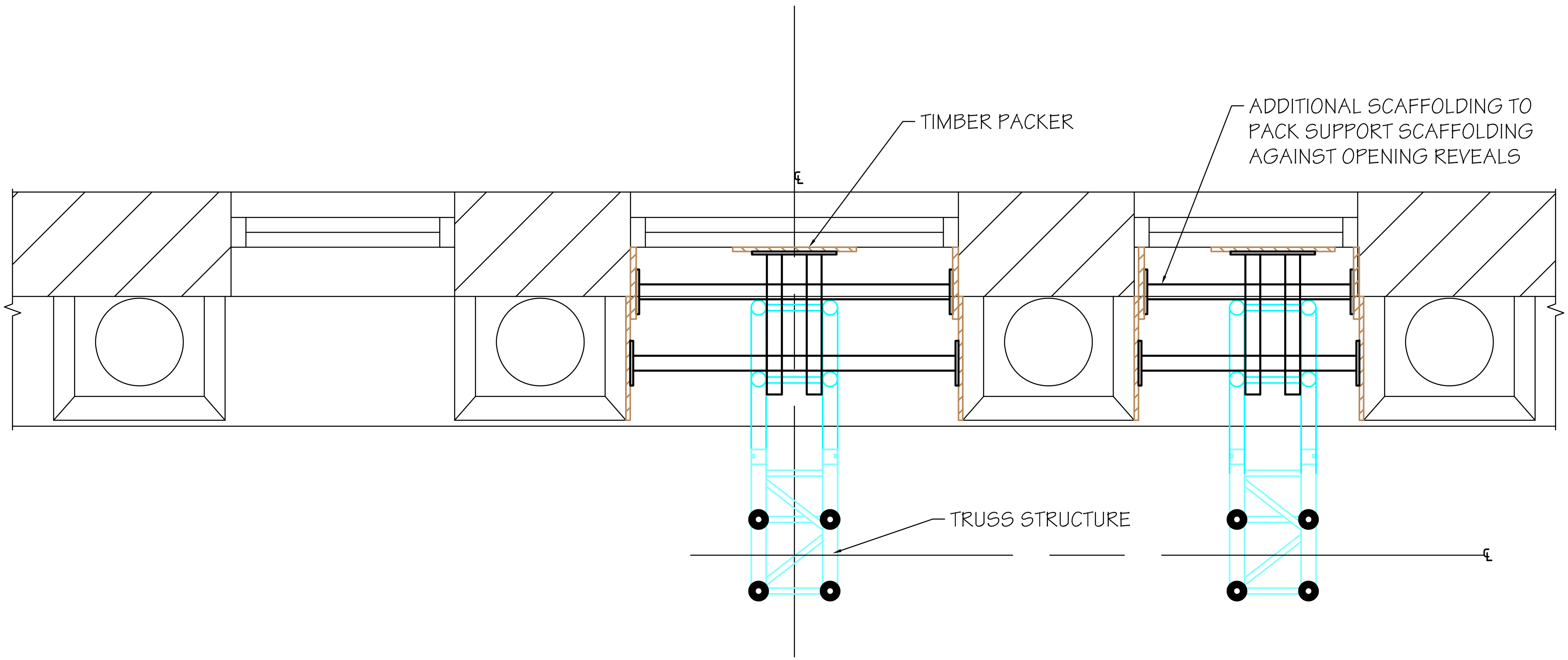
In order to enhance horizontal stability of the frame, the following packs are going to be used (as per model)



SECTIONAL PLAN A-A
SHOWING PARAPET FACADE
(SCALE 1:20 AT A1)



SECTIONAL PLAN B-B
SHOWING SECOND FLOOR BALCONY
(SCALE 1:20 AT A1)



SECTIONAL PLAN C-C
SHOWING FIRST FLOOR BALCONY
(SCALE 1:20 AT A1)