FOR PROJECT:

S4-Gronext-ASG

DOCUMENT NUMBER

CSU01 Foundation calculation

		Project Revisions		
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CONTENT:

1. GENERAL

Introduction

This document consists the static calculation of the foundation for the building CSU01.

This building will be positioned on a shallow foundation.

Starting points

1.1.1 Used regulations

NEN-EN 1990	Basis of design.
NEN-EN 1991	Loadings on constructions.
NEN-EN 1992-reeks	Design and calculation of Concrete structures.
NEN-EN 1993-reeks	Design and calculation of Structural steel structures.
NEN-EN 1997-reeks	Geotechnical Design.

1.1.2 References

Design live time class 2 ➔ 20 jaar
The calculations for his foundation have been done according the concequence class 1 and the reliability class 1

(CC1 = Consequence Class 1 en RC1 = Reliability Classes 1 ➔ K_{fi} = 0,90)

Load factors:		yf;g	yf;q	Ψ	
(Safety factors)	ULS	1,10	1,35	-	(= Ultimate Limit State)
	ULS	1,20	1,35	Ψ_0	
	SLS	1,00	1,00	$\Psi_{1/2}$	(= Serviceability Limit State)

For the calculation only the factor Ψ = 1,0 used. This is a conservative approach.

Tabel NB.5 — Partiële factoren voor gevolgklassen 1 en 3 voor belastingen (STR/GEO) (groep B)

CC	Blijvende en tijdelijke ontwerpsituaties	Blijvende belastingen		Overheersende veranderlijke belasting	Veranderlijke belastingen gelijktijdig met de overheersende	
		Ongunstig	Gunstig		Belangrijkste (indien aanwezig)	Andere
1	(Vgl. 6.10a)	1,2 $G_{k,j,sup}$ [a]	0,9 $G_{k,j,inf}$		1,35 $\psi_{0,1} Q_{k,1}$	1,35 $\psi_{0,i} Q_{k,i}$ (i >1)
	(Vgl. 6.10b)	1,1 $G_{k,j,sup}$ [b]	0,9 $G_{k,j,inf}$	1,35 $Q_{k,1}$		1,35 $\psi_{0,i} Q_{k,i}$ (i >1)
3	(Vgl. 6.10a)	1,5 $G_{k,j,sup}$ [a]	0,9 $G_{k,j,inf}$		1,65 $\psi_{0,1} Q_{k,1}$	1,65 $\psi_{0,i} Q_{k,i}$ (i >1)
	(Vgl. 6.10b)	1,3 $G_{k,j,sup}$ [b]	0,9 $G_{k,j,inf}$	1,65 $Q_{k,1}$		1,65 $\psi_{0,i} Q_{k,i}$ (i >1)

NEN-EN 1990+A1+A1/C2:2011/NB:2011

Tabel NB.6 – A1.2(C) — Rekenwaarden van belastingen (STR/GEO) (groep C)

Blijvende en tijdelijke ontwerpsituaties	Blijvende belastingen		Overheersende veranderlijke belasting	Veranderlijke belastingen gelijktijdig met de overheersende	
	Ongunstig	Gunstig		Belangrijkste (indien aanwezig)	Andere
(Vgl. 6.10)	1,0 $G_{k,j,sup}$	1,0 $G_{k,j,inf}$	1,3 $Q_{k,1}$		1,3 $\psi_{0,i}$ $Q_{k,i}$ (i >1)

1.1.3 Materials

- Sand / Clay / Backfill sand

1.1.4 Reference documents

The following drawing is part of this calculation :

- CSU01 Dimension al drawing & weight
- Soil investigation report by Wiertsema & Partners. (Order number : VN-77409-1) With the results of these cone penetration tests in that area the allowable soil pressure has been calculated.(= 50 kN/m^2) CPN: DKM004 most coverning cone penetration in the surrounding of the building CSU01
- Main dimensions of CSU01-building :

  Length * width * height = 3,86 * 3,06 * 4,30 m.

  1,10 meter of the building will be positioned below grade, to bring in the cable into the cellar.

2. LOADINGS

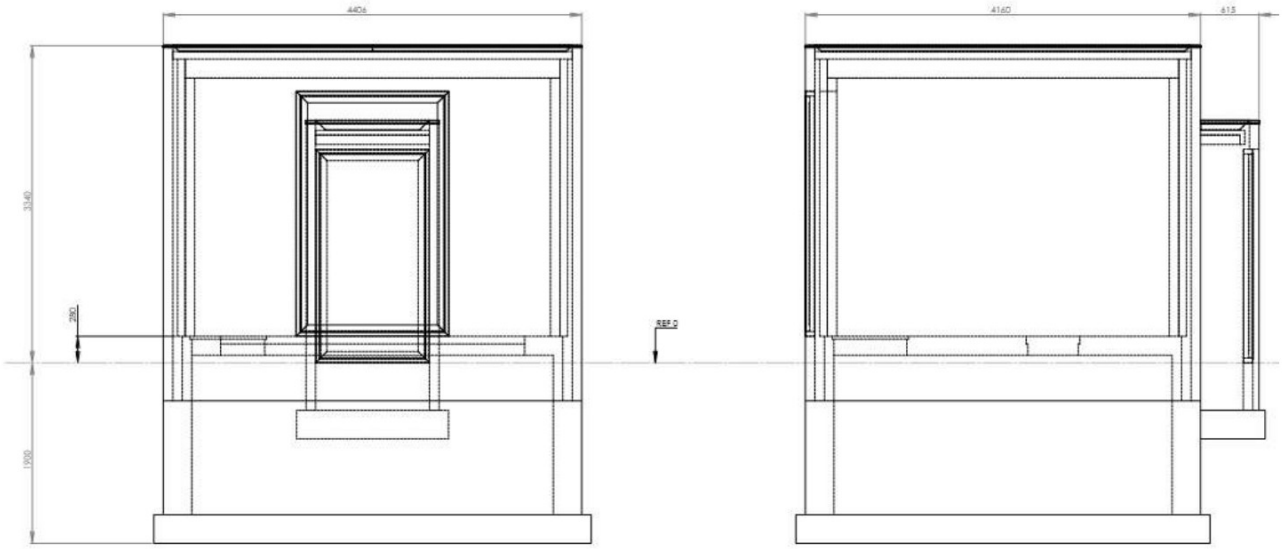
For the calculation of the foundation there are two basic loadings investigated namely:

2.1.1 Own weight

The own weight is built-up out of two elements namely :

- Concrete building
- Internals inside the building.

The selfweight of this CSU01 building is 690 kN. And the weight of the internals 10 kN



2.1.2 Wind Loading

For the windloading it is choosen for the area II Un-built. (Eemshaven) In this case a windpressure of 0,60 kN/m2 has to be calculated at a height of 3,34 meter.

With a width of 4,40 meter and a height of 3,34 meter the total wind area will be 14,70 m^2

With a C_{pe} for windpressure / underpressure = 2,0 (Conservative approach)

Total horizontal windload on CSU01 :

Area x windpressure x C_{pe} = 14,70 [m^2] x 0,60 [kN/m^2] x 2,0 = 17,63 kN.

2.1.3 Snow loading

For snow only a loading of 0,56 kN/m2 occurs on top of the CSU01-building. Because this loading is so low compared with the windload, that this load has been neglected for this calculation.

3. LOAD COMBINATIONS

Combinations

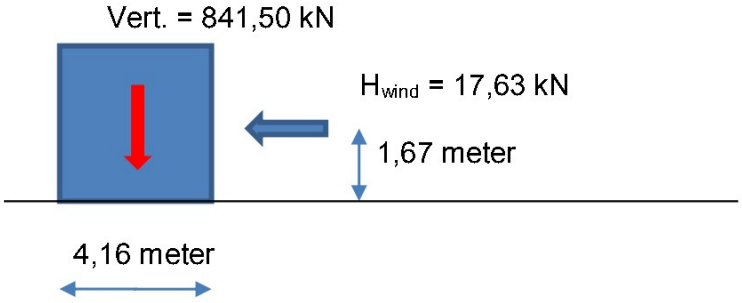
The following combinations has been investigated :

3.1.1 Dead load. (Prefab building + Internal)

Total dead load : (690 x 1,2) + (10 x1,35) = 841,50 kN

3.1.2 Dead load + Wind

Due to the wind we have a overturning moment on the foundation of :
= wind load * safety factor * ½ height of CSU01 = 17,63 * 1,35 * 1,67 = 39,75 kNm



4. SOIL PRESSURE

Allowable soil pressure

The acting soil-pressure below the CSU01 will be:

$\sigma = F / A \pm M / W =$
$= \{[(690 * 1,2) + (10 * 1,35)] / (4,40 * 4,16)\} \pm [(39,75 * 1,35) / (1/6 * 4,40 * 4,16^2)] =$

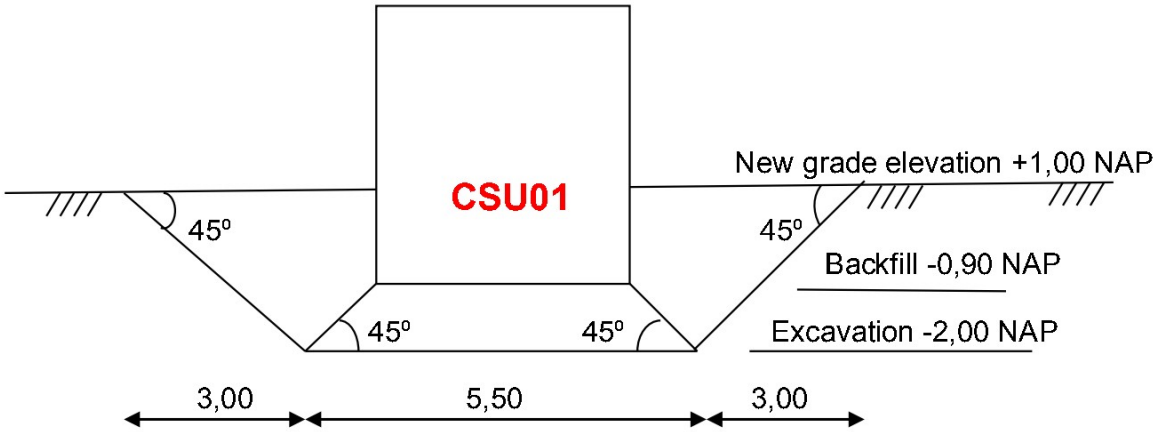
$= 45,97 \pm 4,23$ ➔ Max. soilpressure 50,20 kN/m^2 Min. soilpressure 41,74 kN/m^2

Both are < 60 kN/m^2

5. SOIL PREPARATION

Excavation / Backfill

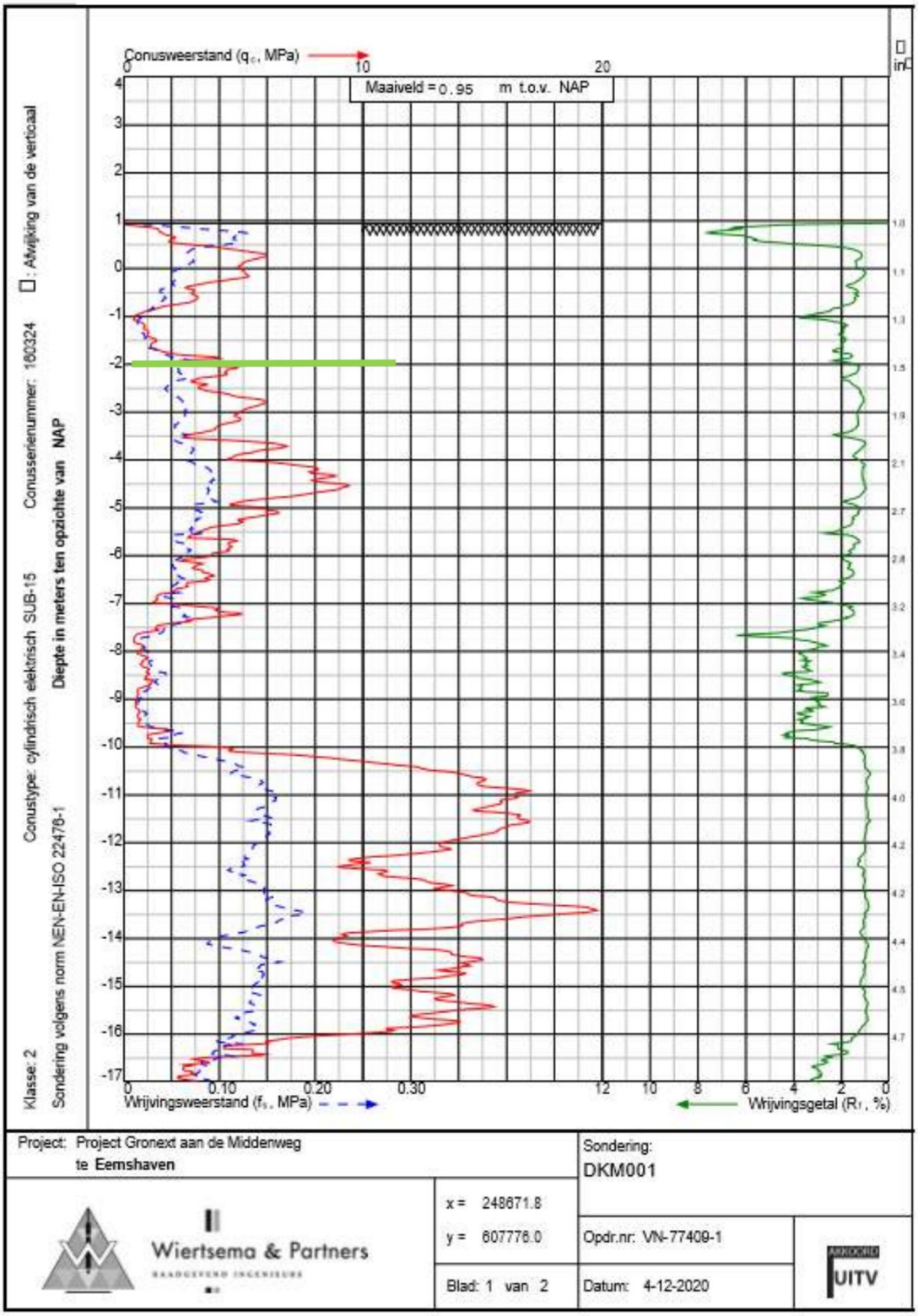
Because of the cellar under the CSU01 building to install the cables, the existing soil has to be excavated locally till -4,50 NAP
Then a backfill with sand has to be done till the level -2,80 NAP
On this sand layer the CSU01 buildig will be positioned, so that the floor level of the building has a level of -1,50 NAP this elevation is some higher then the existing level.



Backfill in layers of maximum 150 mm. sand and to be compacted to 95 % Proctor-value.

At excavation level -2,00 NAP the value from the CPT is about 5 MPa, so with a layer of 1,10 meter of compacted sand, the spread will reduce the soil pressure and will become < 50,00 kN as calculated

CPT DKM001


Conusweerstand (qc, MPa)
0
10
20
Maaiveld = 0.95 m t.o.v. NAP
Conustype: cylindrisch elektrisch SUB-15
Conusserienummer: 160324
Diepte in meters ten opzichte van NAP
Klasse: 2
Sondering volgens norm NEN-EN-ISO 22476-1
Wrijvingsweerstand (fs, MPa)
0
0.10
0.20
0.30
Wrijvingsgetal (Rf, %)
12
10
8
6
4
2
0
Project: Project Gronext aan de Middenweg te Eemshaven
Sondering: DKM001
Wiertsema & Partners
x = 248671.8
y = 607776.0
Opdr.nr: VN-77409-1
Blad: 1 van 2
Datum: 4-12-2020
UITV

6. CALCULATION RESULTS

Stability

It is concluded that the stability of the unit itself correct.

Settlement

By using a shallow foundation there will be some settlement in the future. Some centimeters in the coming years, that's why the CSU01 has been positioned some higher than the surrounding ground level. (+1,00 Meter NAP instead of the +0,95 Meter NAP)

7. CONCLUSION

In this document the foundation for the CSU01 has been calculated. The acting soilpressure is less than the allowable soil pressure, due to the layer of compacted sand. The stability of the total unit is within the regular limitations.

Also the expected settlement for the next 20 year will be maximized to approx. 100 mm.