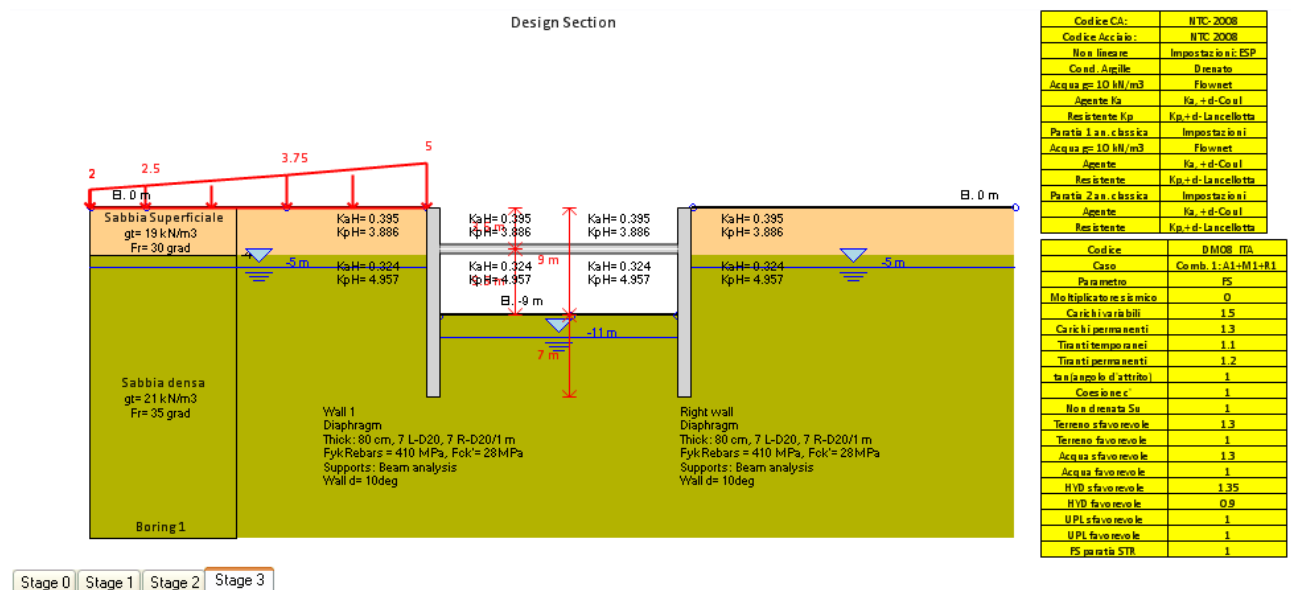


Verification of a double wall supported by a strut

The following model is given:



It concerns a double wall (concrete wall) model for which, during Stage 2, a strut support has been applied before realizing a further excavation. Aim of the following example is to lead the user through strut support check.

The soil properties are:

- *Superficial sand (from the surface to a depth of -4m)*

$$\gamma_{dry} = 19 \text{ kN/m}^3$$

$$\phi' = 30^\circ$$

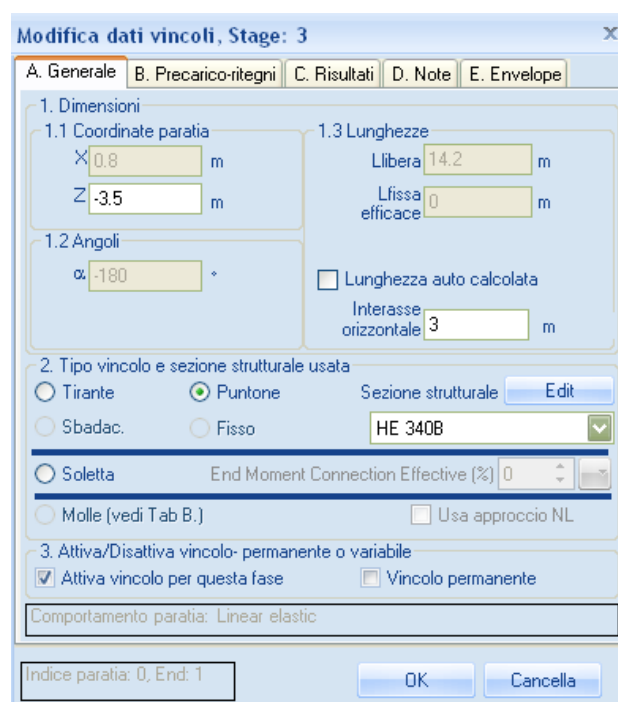
- *Dense sand*

$$\gamma_{\text{dry}} = 18 \text{ kN/m}^3$$

$$\gamma_t = 21 \text{ kN/m}^3$$

$$\phi' = 35^\circ$$

As strut support, steel profiles HE300B with an horizontal spacing of 3m have been used.



Modifica dati vincoli, Stage: 3

A. Generale | B. Precarico-ritegni | C. Risultati | D. Note | E. Envelope

1. Dimensioni

1.1 Coordinate paratia

X: 0.8 m

Z: -3.5 m

1.2 Angoli

α : -180 °

1.3 Lunghezze

Libera: 14.2 m

Lfissa efficace: 0 m

Lunghezza auto calcolata

Interasse orizzontale: 3 m

2. Tipo vincolo e sezione strutturale usata

Tirante Puntone Sbadac. Fisso

Sezione strutturale: HE 340B

Soletta End Moment Connection Effective (%) 0

Molle (vedi Tab B.) Usa approccio NL

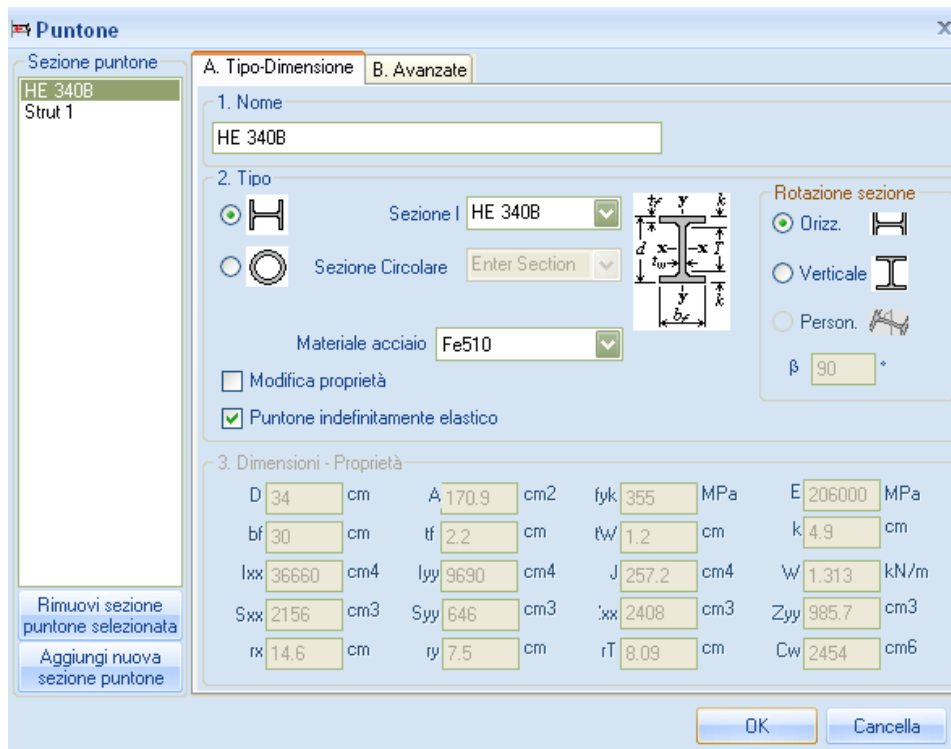
3. Attiva/Disattiva vincolo - permanente o variabile

Attiva vincolo per questa fase Vincolo permanente

Comportamento paratia: Linear elastic

Indice paratia: 0, End: 1

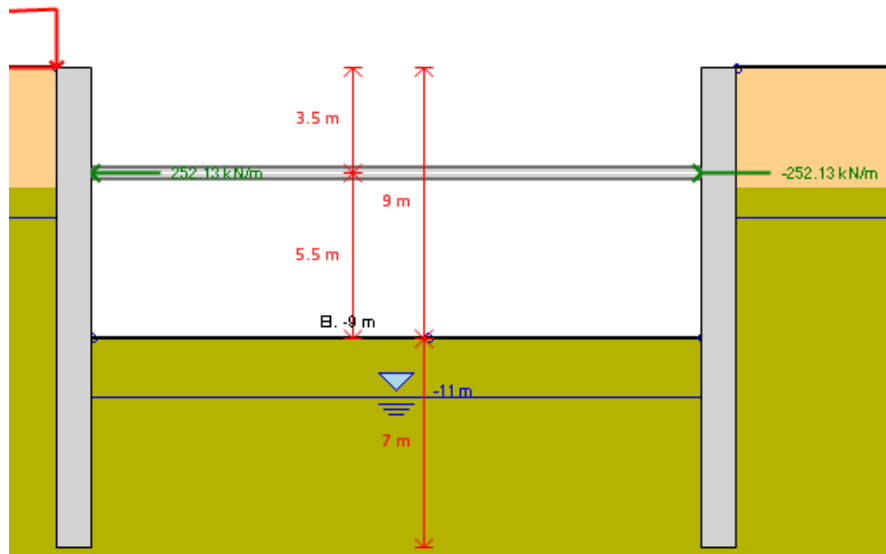
OK Cancell



Apply the Comb.1 of DM2008 (A1+M1+R1), more unfavourable to structural design, and use UNI EN 1993 1-1:2005 and the coefficients provided by DM2008 for check.

Choosing then DM2008 under the *Design* menu, the software will run check in keeping with UNI EN 1993 1-1:2005 but using (gamma factors) prescribed by the Italian code.

When the analysis is over the following results (about the reaction on the struts in the last excavation step) will be retrieved:



The compression reaction on the strut is worth 252,13 kN/m.

The FS prescribed by DM2008 are:

$\gamma_0 = 1,05$

$\gamma_1 = 1,05$

An extract of the file . EXT (output file provided after the steel beams checking step) about Step 3 (last excavation) is given.

EC3: START RESISTANCE CHECKS

Section no. 1 at x= 0.000000 [mm]

selected class for current cross section = 1

6.2.4 Compression for class 1 cross sections

Ratio = -756.4 / 6061. = 0.1248

$$\max n = 0.9640$$

Paragraph 6.2.4 of UNI EN 1993 1-1:2005 is about compression.

The axial load on each strut is worth $252,13 \text{ kN/m} \cdot 3 \text{ m} = 756,39 \text{ kN}$

So:

$$\text{TSF} = 756,39 / (A \cdot f_y / \gamma_{m0}) = 0,1248$$

6.2.9.1 Bending and axial force check for Class 1 and 2 sections

Shape type H

$$N_{\max My} = 600.5 \quad N_{\max Mz} = 1201.$$

$$y_{red My} = \quad T y_{red Mz} = \quad F$$

Interaction between M and N is account for

(for notation see paragraph 6.2.9.1)

$$a_w = 0.2637 \quad a_f = 0.000$$

$$\alpha = 2.000 \quad \beta = 1.000$$

$$M V N y R_d = 814.1 \quad M V N z R_d = 333.3 \quad \text{ratio} = 0.4065E-01 \quad (\text{eqn. 6.31} \quad)$$

5.5 Shear buckling resistance check

no shear buckling resistance is necessary

according to 5.1(2) EN 1993-1-5

Section no. 1 at x= 0.000000 [mm]

selected class for current cross section = 1

resist. ratio according to 6.2.3 = 0.000

resist. ratio according to 6.2.4 = 0.125

resist. ratio according to 6.2.6 (2) = 0.000

resist. ratio according to 6.2.6 (3) = 0.000

resist. ratio according to 6.2.7 = 0.000



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resist. ratio according to 6.2.9.1 = 0.041 eqn. 6.31
resist. ratio according to 6.2.9.2 = 0.000 (not applicable)
resist. ratio according to 6.2.9.3 = 0.000 (not applicable)
max. resist. ratio (max. among above)= 0.125
web buckling ratio (section 5.6) = 0.000

Section no. 2 at x= 14200.00 [mm]
selected class for current cross section = 1

6.2.4 Compression for class 1 cross sections

Ratio = -756.4 / 6061. = 0.1248

max n= 0.9640

6.2.9.1 Bending and axial force check for Class 1 and 2 sections

Shape type H

$N_{maxMy} = 600.5$ $N_{maxMz} = 1201.$

$y_{redMy} = T$ $y_{redMz} = F$

Interaction between M and N is account for
(for notation see paragraph 6.2.9.1)

$a_w = 0.2637$ $a_f = 0.000$

$\alpha = 2.000$ $\beta = 1.000$

$MV_{NyRd} = 814.1$ $MV_{NzRd} = 333.3$ $ratio = 0.4065E-01$

(eqn. 6.31)

5.5 Shear buckling resistance check

no shear buckling resistance is necessary

according to 5.1(2) EN 1993-1-5

Section no. 2 at x= 14200.00 [mm]

selected class for current cross section = 1

resist. ratio according to 6.2.3 = 0.000

resist. ratio according to 6.2.4 = 0.125

resist. ratio according to 6.2.6 (2) = 0.000

resist. ratio according to 6.2.6 (3) = 0.000

resist. ratio according to 6.2.7 = 0.000

resist. ratio according to 6.2.9.1 = 0.041 eqn. 6.31

resist. ratio according to 6.2.9.2 = 0.000 (not applicable)

resist. ratio according to 6.2.9.3 = 0.000 (not applicable)

max. resist. ratio (max. among above)= 0.125

web buckling ratio (section 5.6) = 0.000

Summary of resistance checks over all the sections

max selected class: 1, at station no. 2

maximum resistance ratio = 0.125

maximum web buckling ratio = 0.000

Besides the compression check, also a combined check bending-axial load in keeping with paragraph 6.2.9.1 (concerning class 1 and 2 sections) of UNI EN 1993 1-1:2005 has been made and it wasn't necessary to carry out an instability shear check, according to UNI EN 1993-1-5.

Buckling check:



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Struts check is made according to paragraph 6.3.3 of UNI EN 1993 1-1:2005 (in particular formula number 6.61 and 6.62). Lateral instability is not considered according to chapter 6.3.2.2 point (4).

A double pinned element is considered; pins are localized on the axis of the walls.

To calculate the critical moment, since in the new Eurocode there isn't a plain reference to the method that has to be used, the checker uses appendix F of ENV 1993 1-1: 1992.

Two ratios concerning equations 6.61 e 6.62 di UNI EN 1993 1-1:2005 are then calculated and the higher is considered.

EC3: START BUCKLING CHECKS

CSTVEREC3: STABILITY CHECKS FOR PARTIAL SPAN NO. 1

$z_{start} = 0.000000$ [mm] $z_{end} = 14200.00$ [mm]

buckl. length about x-x = 14200.00 [mm]

buckl. length about y-y = 14200.00 [mm]

buckl. length about m-m = 14200.00 [mm] (only for angles)

buckl. length about n-n = 14200.00 [mm] (only for angles)

lateral torsion buckl. length = 14200.00 [mm]

warping buckling length = 14200.00 [mm]

CSTVEREC3: CRITICAL MOMENT CALCULATION (ANNEX F)

ANNEX F: GENERAL FORMULA F.1.2 - (EQN F 2)

$M_{cr y} = 479.579351927$ [kN*m]

L.T. LENGTH = 14200. [mm]

WARP LENGTH = 14200. [mm]

PATTERN MOM. = LINEAR

C1 = 1.0000

C2 = 0.0000



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$$C3 = 1.0000$$

$$Zg (Za-Zs) = 0.0000 \text{ [mm]}$$

$$Zj \text{ " } = 0.0000 \text{ [mm]}$$

$$\text{Torsional Inertia} = 0.28995E+07 \text{ [mm}^4\text{]}$$

$$\text{Warping constant} = 0.24540E+10 \text{ [mm}^6\text{]}$$

TABLE 6.6: Correction factor K_c

$$\text{Axe} = y \quad K_c = 1.000$$

$$\text{Member class (classification was made before)} = 1$$

Tab 6.2 SHAPE TYPE=H

Axis =Y; Curve B

6.3.1.1: FOR BUCKLING ABOUT AXIS Y

$$\text{SLENDERNESS (L/i)} = 97.12778$$

$$\text{LAMBDA sup} = 1.283436$$

$$\text{PHI} = 1.507788$$

$$\text{CHI} = 0.4349478$$

$$\text{NBRD} = 2636.257 \text{ [kN] (max. buckling load)}$$

Tab 6.2 SHAPE TYPE=H

Axis =Z; Curve C

6.3.1.1: FOR BUCKLING ABOUT AXIS Z

$$\text{SLENDERNESS (L/i)} = 190.8136$$

$$\text{LAMBDA sup} = 2.521390$$

$$\text{PHI} = 4.247445$$

$$\text{CHI} = 0.1304539$$

$$\text{NBRD} = 790.6928 \text{ [kN] (max. buckling load)}$$



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$$\text{LAMBDA SUP} < \text{LAMBDA SUP } 0 : 1.3351 < 0.40000$$

$$\begin{aligned} \text{Med/Mcr} < (\text{LAMBDA SUP } 0)^2 : 0.33094\text{E}+08 / 0.47958\text{E}+09 \\ = 0.69006\text{E}-01 < 0.16000 \end{aligned}$$

*Lateral buckling can be neglected due to
clause (4) of item 6.3.2.2*

Annex B: TABLE B.1

Interaction factor $K_{yy} = 1.2295$

Interaction factor $K_{yz} = 0.0000$

Interaction factor $K_{zy} = 0.73772$

Interaction factor $K_{zz} = 0.0000$

EC 3 - SECTION 6.3.3

NSD (MAX COMPRESSION FORCE [KN]) -756.40

RATIOB (STABILTY WITHOUT LATERAL TORSION) EQ 6.61 0.33690

RATIOB1 (STABILTY WITHOUT LATERAL TORSION) EQ 6.62 0.98662

RATIO = max {RATIOB,RATIOB1} 0.98662

EC3_EN_1993-1-1: RESISTANCE RATIO 0.125

AXIAL BUCKLING RATIO 0.987

Grafico STR.:

