

# Bijlagen

## Inhoudsopgave

|                                                                                    |    |
|------------------------------------------------------------------------------------|----|
| Bijlage 1 Analyseresultaten en ontwerp in ESA-PT en DBET .....                     | 4  |
| A. Algemene Gegevens .....                                                         | 5  |
| 1. Overzicht .....                                                                 | 5  |
| 2. Bovenaanzicht .....                                                             | 6  |
| 3. Doorsneden .....                                                                | 7  |
| 4. Materialen .....                                                                | 9  |
| 5. Belasting gevallen .....                                                        | 9  |
| 6. Combinaties .....                                                               | 9  |
| 7. Resultaat klassen .....                                                         | 10 |
| 8. Lijnbelasting op staaf .....                                                    | 10 |
| 9. Vrije oppervlaktebelasting .....                                                | 11 |
| 10. Belasting op oppervlakte .....                                                 | 12 |
| B. Analyseresultaten spanten en dak .....                                          | 13 |
| 1. Interne krachten op staven .....                                                | 13 |
| 2. Overzicht staven .....                                                          | 13 |
| 3. Normale kracht .....                                                            | 14 |
| 4. Dwarskracht in Y-richting .....                                                 | 15 |
| 5. Dwarskracht in Z-richting .....                                                 | 15 |
| 6. Moment in X-richting (torsie) .....                                             | 16 |
| 7. Moment in Y-richting .....                                                      | 16 |
| 8. Moment in Z-richting .....                                                      | 17 |
| 9. Vervorming van staven .....                                                     | 17 |
| 10. Vervorming in Y-richting .....                                                 | 18 |
| 11. Vervorming in X-richting .....                                                 | 18 |
| 12. 2D element - Interne krachten .....                                            | 19 |
| 13. Moment ter berekening van de wapening in de X-richting aan de bovenzijde ..... | 19 |
| 14. Moment ter berekening van de wapening in de X-richting aan de onderzijde ..... | 20 |
| 15. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde ..... | 20 |
| 16. Moment ter berekening van de wapening in de Y-richting aan de onderzijde ..... | 21 |
| 17. Vervorming van knopen .....                                                    | 21 |
| 18. Vervorming in Z-richting .....                                                 | 22 |
| C. Analyseresultaten Vloer, Kelderwand .....                                       | 23 |
| 1. Interne kracht - vloer .....                                                    | 23 |
| 2. Moment ter berekening van de wapening in de X-richting aan de bovenzijde .....  | 24 |
| 3. Moment ter berekening van de wapening in de X-richting aan de onderzijde .....  | 24 |
| 4. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde .....  | 25 |
| 5. Moment ter berekening van de wapening in de Y-richting aan de onderzijde .....  | 25 |
| 6. Vervorming van knopen - vloer .....                                             | 26 |
| 7. Vervorming in Z-richting .....                                                  | 27 |
| 8. Interne krachten - kelderwanden .....                                           | 27 |
| 9. Moment ter berekening van de wapening in de X-richting aan de bovenzijde .....  | 28 |
| 10. Moment ter berekening van de wapening in de X-richting aan de onderzijde ..... | 28 |
| 11. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde ..... | 29 |
| 12. Moment ter berekening van de wapening in de Y-richting aan de onderzijde ..... | 29 |
| 13. Vervorming van knopen kelderwanden .....                                       | 29 |

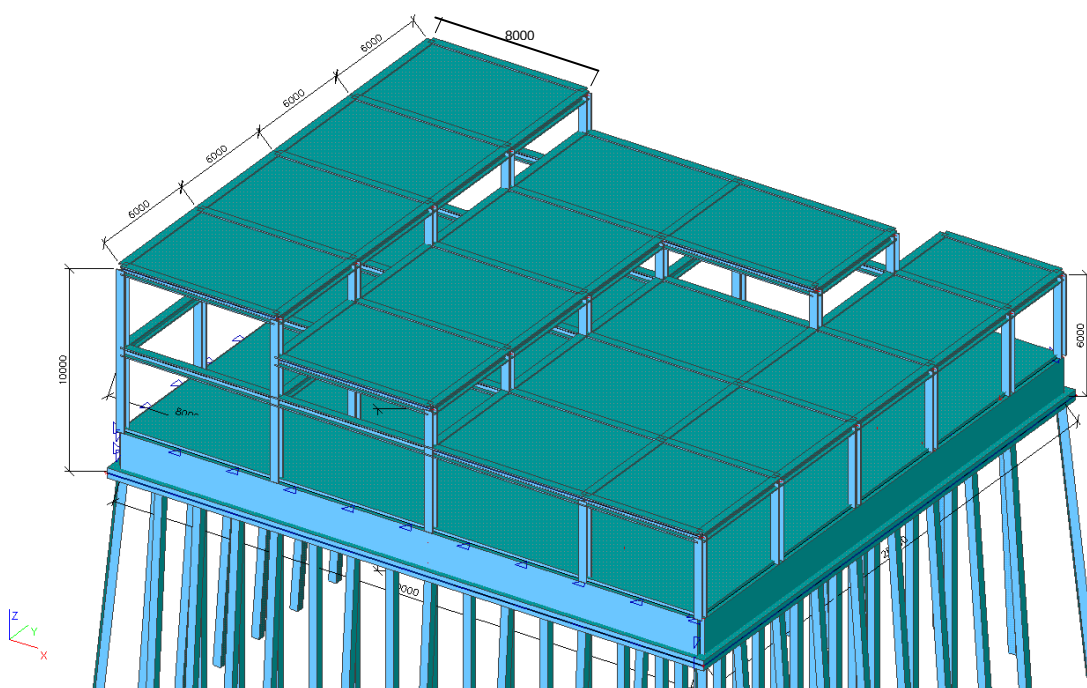
|     |                                                                                |    |
|-----|--------------------------------------------------------------------------------|----|
| 14. | Vervorming X-richting .....                                                    | 30 |
| 15. | Vervorming Y-richting.....                                                     | 30 |
| 16. | Vervorming Z-richting.....                                                     | 31 |
| D.  | Analyseresultaten palen en keldervloer .....                                   | 32 |
| 1.  | Bovenzicht palen .....                                                         | 32 |
| 2.  | Interne krachten op palen.....                                                 | 33 |
| 3.  | Moment Y-richting .....                                                        | 34 |
| 4.  | Moment Z-richting.....                                                         | 34 |
| 5.  | Vervorming van palen .....                                                     | 35 |
| 6.  | Vervorming in X-richting.....                                                  | 35 |
| 7.  | Vervorming in Y-richting.....                                                  | 36 |
| 8.  | Vervorming in Z-richting.....                                                  | 36 |
| 9.  | Reacties .....                                                                 | 37 |
| 10. | Reacties Z-richting .....                                                      | 37 |
| 11. | Reacties Y-richting .....                                                      | 38 |
| 12. | Reacties X-richting.....                                                       | 38 |
| 13. | Relatieve vervorming .....                                                     | 38 |
| 14. | Vervorming van knopen .....                                                    | 39 |
| 15. | Vervorming Z-richting.....                                                     | 39 |
| 16. | 2D element - Interne krachten keldervloer.....                                 | 39 |
| 17. | Moment ter berekening van de wapening in de X-richting aan de bovenzijde ..... | 40 |
| 18. | Moment ter berekening van de wapening in de X-richting aan de onderzijde ..... | 40 |
| 19. | Moment ter berekening van de wapening in de Y-richting aan de bovenzijde ..... | 41 |
| 20. | Moment ter berekening van de wapening in de Y-richting aan de onderzijde.....  | 41 |
| E.  | Analyseresultaten gevel.....                                                   | 42 |
| 1.  | 2D element – Interne krachten .....                                            | 42 |
| 2.  | Moment ter berekening van de wapening in de X-richting aan de bovenzijde ..... | 42 |
| 3.  | Moment ter berekening van de wapening in de X-richting aan de onderzijde ..... | 43 |
| 4.  | Moment ter berekening van de wapening in de Y-richting aan de bovenzijde ..... | 43 |
| 5.  | Moment ter berekening van de wapening in de Y-richting aan de onderzijde.....  | 44 |
| 6.  | Vervorming van knopen .....                                                    | 44 |
| 7.  | Vervorming in Z-richting.....                                                  | 44 |
| F.  | Analyseresultaten verbindingen .....                                           | 45 |
| 1.  | Dwarskracht in Y-richting voor knoop 36.....                                   | 45 |
| 2.  | Dwarskracht Z-richting voor knoop 36.....                                      | 45 |
| 3.  | Moment Y-richting knoop 36 .....                                               | 46 |
| 4.  | Moment Z-richting voor knoop 36 .....                                          | 46 |
| 5.  | Dwarskracht Y-richting voor knoop 16.....                                      | 47 |
| 6.  | Dwarskracht Z-richting voor knoop 16.....                                      | 47 |
| 7.  | Moment Y-richting voor knoop 16 .....                                          | 48 |
| 8.  | Moment Z-richting voor knoop 16 .....                                          | 48 |
| G.  | Ontwerp in ESA-PT .....                                                        | 49 |
| 1.  | Check van staal - kolom.....                                                   | 49 |
| 2.  | Check van staal - balk .....                                                   | 52 |
| H.  | Ontwerp in DBET .....                                                          | 57 |
|     | Bijlage 2 Trillingsberekening.....                                             | 64 |
| A.  | Trilling van spanten.....                                                      | 65 |
| 1.  | Berekening.....                                                                | 65 |

|                                                                     |                                              |    |
|---------------------------------------------------------------------|----------------------------------------------|----|
| 2.                                                                  | Vervorming spanten door eigengewicht .....   | 66 |
| B.                                                                  | Trilling van het dak .....                   | 67 |
| 1.                                                                  | Berekening .....                             | 67 |
| 2.                                                                  | Vervorming dak door eigengewicht .....       | 67 |
| C.                                                                  | Trilling van gevelpaneel .....               | 68 |
| 1.                                                                  | Berekening .....                             | 68 |
| 2.                                                                  | Vervorming gevel door eigengewicht .....     | 68 |
| Bijlage 3 Verbindingen .....                                        |                                              | 69 |
| A.                                                                  | Overzicht knopen .....                       | 70 |
| B.                                                                  | Berekeningen knoop 16 .....                  | 71 |
| 1.                                                                  | Kolom B3 .....                               | 71 |
| C.                                                                  | Berekeningen knoop 36 .....                  | 72 |
| 1.                                                                  | Ligger B87 .....                             | 72 |
| 2.                                                                  | Ligger B86 .....                             | 73 |
| D.                                                                  | Tekeningen .....                             | 74 |
| 1.                                                                  | Tekening verbinding kolom met ligger .....   | 74 |
| 2.                                                                  | Tekening verbinding kolom op fundering ..... | 75 |
| 3.                                                                  | Tekening plaatsing gevel .....               | 76 |
| Bijlage 4 Ontwerp en verificatie van palen volgens Eurocode 7 ..... |                                              | 77 |

## Bijlage 1 Analyseresultaten en ontwerp in ESA-PT en DBET

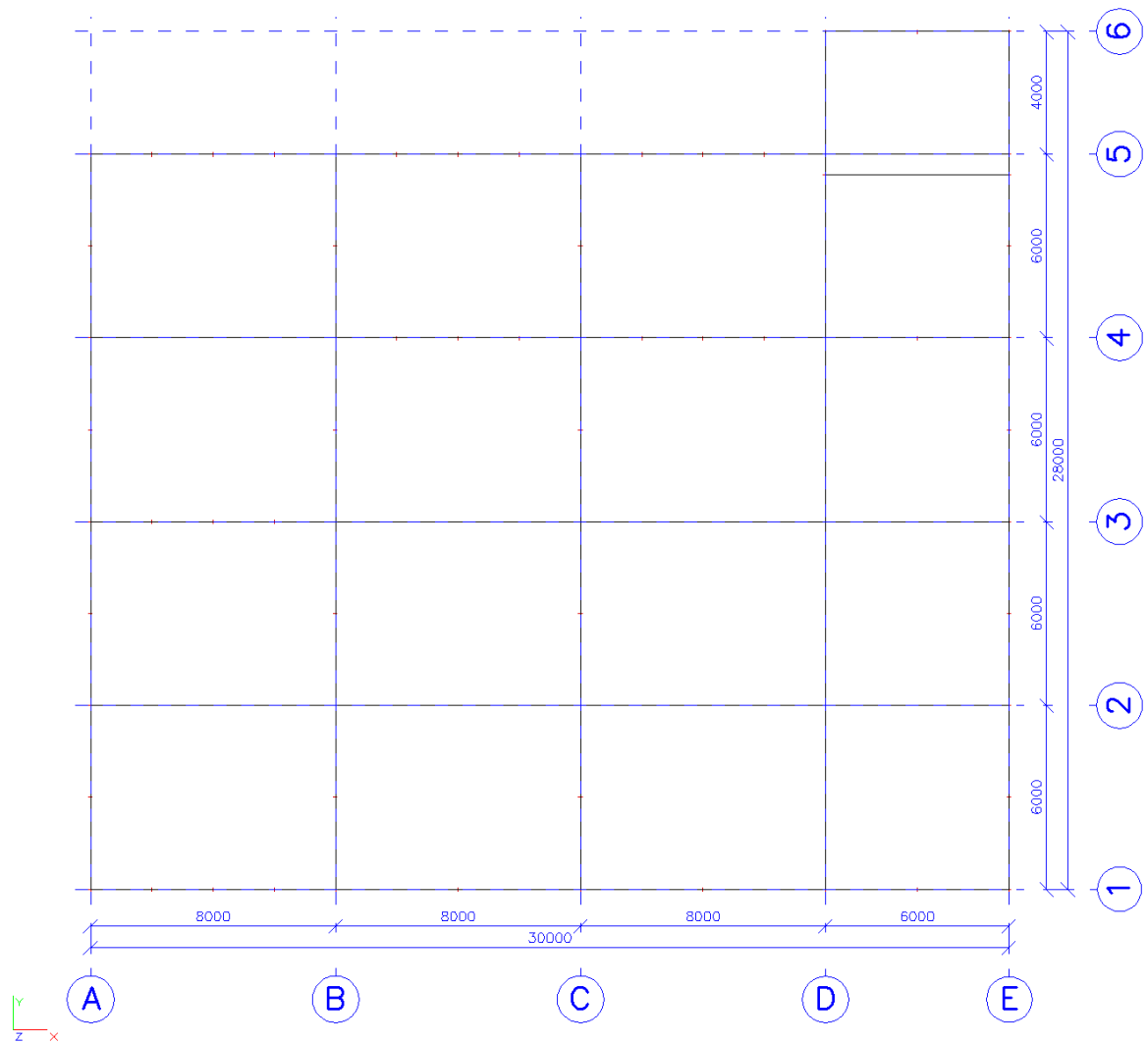
## A. Algemene Gegevens

### 1. Overzicht

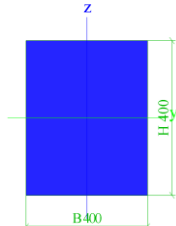
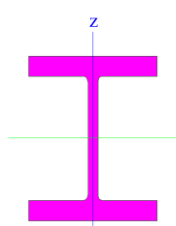


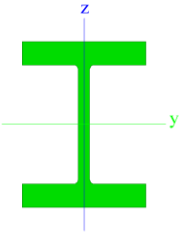
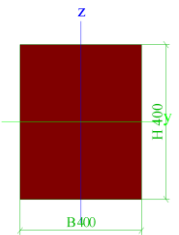
## 2. Bovenaanzicht

a



### 3. Doorsneden

|                                                         |  |                                                                                     |             |
|---------------------------------------------------------|--|-------------------------------------------------------------------------------------|-------------|
| <b>Name</b>                                             |  | balk-vloer                                                                          |             |
| <b>Detailed</b>                                         |  | 400; 400                                                                            |             |
| <b>Type</b>                                             |  | RECT                                                                                |             |
| <b>Material</b>                                         |  | C30/37                                                                              |             |
| <b>Fabrication</b>                                      |  | concrete                                                                            |             |
| <b>Buckling y-y, z-z</b>                                |  | b                                                                                   | b           |
| <b>FEM analysis</b>                                     |  | x                                                                                   |             |
| <b>Picture</b>                                          |  |    |             |
| <b>Material</b>                                         |  | C30/37                                                                              |             |
| <b>A [m<sup>2</sup>]</b>                                |  | 1,6000e-001                                                                         |             |
| <b>A<sub>y, z</sub> [m<sup>2</sup>]</b>                 |  | 1,3333e-001                                                                         | 1,3333e-001 |
| <b>I<sub>y, z</sub> [m<sup>4</sup>]</b>                 |  | 2,1333e-003                                                                         | 2,1333e-003 |
| <b>I<sub>t</sub> [m<sup>4</sup>], w [m<sup>6</sup>]</b> |  | 3,5994e-003                                                                         | 0,0000e+000 |
| <b>alpha [deg]</b>                                      |  | 0,00                                                                                |             |
| <b>W<sub>el y, z</sub> [m<sup>3</sup>]</b>              |  | 1,0667e-002                                                                         | 1,0667e-002 |
| <b>W<sub>pl y, z</sub> [m<sup>3</sup>]</b>              |  | 1,6000e-002                                                                         | 1,6000e-002 |
| <b>c YLCS, ZLCS [mm]</b>                                |  | 200                                                                                 | 200         |
| <b>d y, z [mm]</b>                                      |  | 0                                                                                   | 0           |
| <b>AL [m<sup>2</sup>/m]</b>                             |  | 1,6000e+000                                                                         |             |
| <b>Name</b>                                             |  | kolom-staal                                                                         |             |
| <b>Type</b>                                             |  | HHD400x421                                                                          |             |
| <b>Source description</b>                               |  | Stahlbau Zentrum Schweiz / Konstruktionstabellen / 9.Ausgabe 2005                   |             |
| <b>Type description</b>                                 |  | European wide flange beam                                                           |             |
| <b>Material</b>                                         |  | S 355                                                                               |             |
| <b>Fabrication</b>                                      |  | rolled                                                                              |             |
| <b>Buckling y-y, z-z</b>                                |  | b                                                                                   | c           |
| <b>Picture</b>                                          |  |  |             |
| <b>Material</b>                                         |  | S 355                                                                               |             |
| <b>A [m<sup>2</sup>]</b>                                |  | 5,3700e-002                                                                         |             |
| <b>A<sub>y, z</sub> [m<sup>2</sup>]</b>                 |  | 3,5062e-002                                                                         | 1,0833e-002 |
| <b>I<sub>y, z</sub> [m<sup>4</sup>]</b>                 |  | 1,5960e-003                                                                         | 6,0080e-004 |
| <b>I<sub>t</sub> [m<sup>4</sup>], w [m<sup>6</sup>]</b> |  | 4,4000e-005                                                                         | 2,0857e-005 |
| <b>alpha [deg]</b>                                      |  | 0,00                                                                                |             |
| <b>W<sub>el y, z</sub> [m<sup>3</sup>]</b>              |  | 7,5100e-003                                                                         | 2,9400e-003 |
| <b>W<sub>pl y, z</sub> [m<sup>3</sup>]</b>              |  | 8,8800e-003                                                                         | 4,4900e-003 |
| <b>c YLCS, ZLCS [mm]</b>                                |  | 205                                                                                 | 213         |

|                                            |                                                                                     |             |
|--------------------------------------------|-------------------------------------------------------------------------------------|-------------|
| d y, z [mm]                                | 0                                                                                   | 0           |
| AL [m <sup>2</sup> /m]                     | 2,3946e+000                                                                         |             |
|                                            |                                                                                     |             |
| Name                                       | balk-staal                                                                          |             |
| Type                                       | HHD400x509                                                                          |             |
| Source description                         | Stahlbau Zentrum Schweiz / Konstruktionstabellen / 9.Ausgabe 2005                   |             |
| Type description                           | European wide flange beam                                                           |             |
| Material                                   | S 355                                                                               |             |
| Fabrication                                | rolled                                                                              |             |
| Buckling y-y, z-z                          | b                                                                                   | c           |
| Picture                                    |    |             |
| Material                                   | S 355                                                                               |             |
| A [m <sup>2</sup> ]                        | 6,5200e-002                                                                         |             |
| A y, z [m <sup>2</sup> ]                   | 4,2458e-002                                                                         | 1,3291e-002 |
| I y, z [m <sup>4</sup> ]                   | 2,0450e-003                                                                         | 7,5400e-004 |
| I t [m <sup>4</sup> ], w [m <sup>6</sup> ] | 7,5100e-005                                                                         | 2,7714e-005 |
| alpha [deg]                                | 0,00                                                                                |             |
| Wel y, z [m <sup>3</sup> ]                 | 9,1700e-003                                                                         | 3,6300e-003 |
| Wpl y, z [m <sup>3</sup> ]                 | 1,1000e-002                                                                         | 5,5500e-003 |
| c YLCS, ZLCS [mm]                          | 208                                                                                 | 223         |
| d y, z [mm]                                | 0                                                                                   | 0           |
| AL [m <sup>2</sup> /m]                     | 2,4520e+000                                                                         |             |
|                                            |                                                                                     |             |
| Name                                       | paal400                                                                             |             |
| Detailed                                   | 400; 400                                                                            |             |
| Type                                       | RECT                                                                                |             |
| Material                                   | C30/37                                                                              |             |
| Fabrication                                | concrete                                                                            |             |
| Buckling y-y, z-z                          | b                                                                                   | b           |
| FEM analysis                               | x                                                                                   |             |
| Picture                                    |  |             |
| Material                                   | C30/37                                                                              |             |
| A [m <sup>2</sup> ]                        | 1,6000e-001                                                                         |             |
| A y, z [m <sup>2</sup> ]                   | 1,3333e-001                                                                         | 1,3333e-001 |
| I y, z [m <sup>4</sup> ]                   | 2,1333e-003                                                                         | 2,1333e-003 |
| I t [m <sup>4</sup> ], w [m <sup>6</sup> ] | 3,5994e-003                                                                         | 0,0000e+000 |
| alpha [deg]                                | 0,00                                                                                |             |
| Wel y, z [m <sup>3</sup> ]                 | 1,0667e-002                                                                         | 1,0667e-002 |
| Wpl y, z [m <sup>3</sup> ]                 | 1,6000e-002                                                                         | 1,6000e-002 |



|                        |             |     |
|------------------------|-------------|-----|
| c YLCS, ZLCS [mm]      | 200         | 200 |
| d y, z [mm]            | 0           | 0   |
| AL [m <sup>2</sup> /m] | 1,6000e+000 |     |

#### 4. Materialen

| Name  | Type  | Unit mass<br>[kg/m <sup>3</sup> ] | E mod<br>[MPa] | Poisson - nu | G mod<br>[MPa] | Thermal exp<br>[m/mK] |
|-------|-------|-----------------------------------|----------------|--------------|----------------|-----------------------|
| S 355 | Steel | 7850,00                           | 2,1000e+005    | 0,3          | 8,0769e+004    | 0,00                  |

| Name   | Type     | Unit mass<br>[kg/m <sup>3</sup> ] | E mod<br>[MPa] | Poisson - nu | G mod<br>[MPa] | Thermal exp<br>[m/mK] | Characteristic compressive<br>cylinder strength f <sub>ck</sub> (28)<br>[MPa] |
|--------|----------|-----------------------------------|----------------|--------------|----------------|-----------------------|-------------------------------------------------------------------------------|
| C30/37 | Concrete | 2500,00                           | 3,3000e+004    | 0,2          | 1,3750e+004    | 0,00                  | 30,00                                                                         |

#### 5. Belasting gevallen

| Name      | Action type | LoadGroup | Load type   | Spec     | Direction | Duration | Master load case |
|-----------|-------------|-----------|-------------|----------|-----------|----------|------------------|
| LC1       | Permanent   | LG1       | Self weight |          | -Z        |          |                  |
| exp,wand  | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| op dak    | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| op vloer  | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| win,wand  | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| exp,wand2 | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| win,wand2 | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| exp,wand3 | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| win,wand3 | Variable    | LG2       | Static      | Standard |           | Short    | None             |
| grond     | Variable    | LG2       | Static      | Standard |           | Short    | None             |

#### 6. Combinaties

| Name | Type              | Load cases                                                   | Coeff.<br>[1]                                |
|------|-------------------|--------------------------------------------------------------|----------------------------------------------|
| CO1  | Linear - ultimate | LC1<br>exp,wand<br>op dak<br>op vloer<br>win,wand<br>grond   | 1,00<br>1,00<br>1,00<br>1,00<br>0,33<br>1,00 |
| CO2  | Linear - ultimate | LC1<br>op dak<br>op vloer<br>exp,wand2<br>win,wand2          | 1,00<br>1,00<br>1,00<br>1,00<br>0,33         |
| CO3  | Linear - ultimate | LC1<br>op dak<br>op vloer<br>exp,wand3<br>win,wand3<br>grond | 1,00<br>1,00<br>1,00<br>1,00<br>0,33<br>1,00 |

## 7. Resultaat klassen

| Name    | List              |
|---------|-------------------|
| All ULS | CO1<br>CO2<br>CO3 |

## 8. Lijnbelasting op staaf

| Name | Member    | Type   | Dir          | P1<br>[kN/m] | x1    | Coor   | Orig        | Ecc ey<br>[m] |
|------|-----------|--------|--------------|--------------|-------|--------|-------------|---------------|
|      | Load case | System | Distribution | P2<br>[kN/m] | x2    | Loc    | Angle [deg] | Ecc ez<br>[m] |
| LF1  | B2        | Force  | Z            | -219,00      | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF2  | B3        | Force  | Z            | -219,00      | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF3  | B4        | Force  | Z            | -219,00      | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF4  | B1        | Force  | Z            | -110,00      | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF5  | B5        | Force  | Z            | -110,00      | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF6  | B9        | Force  | Y            | 292,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF7  | B30       | Force  | Y            | 292,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF8  | B26       | Force  | Y            | 255,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF9  | B27       | Force  | Y            | 110,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF10 | B1        | Force  | Y            | 146,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF11 | B9        | Force  | Y            | 7,00         | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF12 | B30       | Force  | Y            | 7,00         | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF13 | B26       | Force  | Y            | 6,20         | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF14 | B1        | Force  | Y            | 3,50         | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF15 | B27       | Force  | Y            | 2,70         | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand  | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF16 | B2        | Force  | Z            | -5,30        | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF17 | B3        | Force  | Z            | -5,30        | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF18 | B4        | Force  | Z            | -5,30        | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF19 | B1        | Force  | Z            | -2,70        | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF20 | B5        | Force  | Z            | -2,70        | 0,000 | Rela   | From start  | 0,000         |
|      | win,wand2 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF21 | B28       | Force  | Z            | 219,00       | 0,000 | Rela   | From start  | 0,000         |
|      | exp,wand3 | LCS    | Uniform      |              | 1,000 | Length |             | 0,000         |
| LF22 | B29       | Force  | Z            | 219,00       | 0,000 | Rela   | From start  | 0,000         |

|      |           |       |         |        |       |        |            |       |
|------|-----------|-------|---------|--------|-------|--------|------------|-------|
|      | exp,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF23 | B17       | Force | Z       | 219,00 | 0,000 | Rela   | From start | 0,000 |
|      | exp,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF25 | B27       | Force | Z       | 110,00 | 0,000 | Rela   | From start | 0,000 |
|      | exp,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF26 | B51       | Force | Z       | 182,00 | 0,000 | Rela   | From start | 0,000 |
|      | exp,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF27 | B15       | Force | Z       | 73,00  | 0,000 | Rela   | From start | 0,000 |
|      | exp,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF29 | B17       | Force | Z       | 5,30   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF30 | B29       | Force | Z       | 5,30   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF31 | B28       | Force | Z       | 5,30   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF28 | B27       | Force | Z       | 2,70   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF32 | B15       | Force | Z       | 1,80   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |
| LF33 | B51       | Force | Z       | 4,40   | 0,000 | Rela   | From start | 0,000 |
|      | win,wand3 | LCS   | Uniform |        | 1,000 | Length |            | 0,000 |

## 9. Vrije oppervlaktebelasting

| Name | Load case | Dir | Type  | Distribution | q<br>[kN/m <sup>2</sup> ] | q1<br>[kN/m <sup>2</sup> ] | q2<br>[kN/m <sup>2</sup> ] | Validity | Select | System        | Location |
|------|-----------|-----|-------|--------------|---------------------------|----------------------------|----------------------------|----------|--------|---------------|----------|
| FF1  | op vloer  | Z   | Force | Uniform      | -18,50                    |                            |                            | All      | Select | GCS           | Length   |
| FF2  | op vloer  | Z   | Force | Uniform      | -18,50                    |                            |                            | All      | Select | GCS           | Length   |
| FF3  | op vloer  | Z   | Force | Uniform      | -17,50                    |                            |                            | All      | Select | GCS           | Length   |
| FF4  | op vloer  | Z   | Force | Uniform      | -17,50                    |                            |                            | All      | Select | GCS           | Length   |
| FF5  | op vloer  | Z   | Force | Uniform      | -10,00                    |                            |                            | All      | Select | GCS           | Length   |
| FF6  | grond     | X   | Force | Dir Y        |                           | -19,00                     | 0,00                       | All      | Select | GCS           | Length   |
| FF7  | grond     | Y   | Force | Dir Y        |                           | 19,00                      | 0,00                       | All      | Select | GCS           | Length   |
| FF8  | grond     | Y   | Force | Dir Y        |                           | -19,00                     | 0,00                       | All      | Select | GCS           | Length   |
| FF9  | grond     | Z   | Force | Dir Y        |                           | 19,00                      | 0,00                       | All      | Select | Member<br>LCS | Length   |
| FF10 | grond     | Z   | Force | Dir Y        |                           | 19,00                      | 0,00                       | All      | Select | Member<br>LCS | Length   |
| FF11 | grond     | Z   | Force | Dir Y        |                           | 19,00                      | 0,00                       | All      | Select | Member<br>LCS | Length   |

## 10. Belasting op oppervlakte

| Name | Dir | Type  | Value<br>[kN/m <sup>2</sup> ] | 2D member | Load case | System |
|------|-----|-------|-------------------------------|-----------|-----------|--------|
| SF1  | Z   | Force | -36,50                        | S31       | op dak    | LCS    |
| SF2  | Z   | Force | -36,50                        | S29       | op dak    | LCS    |
| SF3  | Z   | Force | -36,50                        | S30       | op dak    | LCS    |
| SF5  | Z   | Force | -36,50                        | S35       | op dak    | LCS    |
| SF6  | Z   | Force | -36,50                        | S33       | op dak    | LCS    |
| SF7  | Z   | Force | -36,50                        | S34       | op dak    | LCS    |
| SF8  | Z   | Force | -36,50                        | S32       | op dak    | LCS    |
| SF9  | Z   | Force | -36,50                        | S36       | op dak    | LCS    |
| SF10 | Z   | Force | -36,50                        | S44       | op dak    | LCS    |
| SF11 | Z   | Force | -36,50                        | S45       | op dak    | LCS    |
| SF12 | Z   | Force | -36,50                        | S42       | op dak    | LCS    |
| SF13 | Z   | Force | -36,50                        | S43       | op dak    | LCS    |
| SF14 | Z   | Force | -36,50                        | S41       | op dak    | LCS    |
| SF15 | Z   | Force | -36,50                        | S37       | op dak    | LCS    |
| SF16 | Z   | Force | -36,50                        | S38       | op dak    | LCS    |
| SF17 | Z   | Force | -36,50                        | S39       | op dak    | LCS    |
| SF18 | Z   | Force | -36,50                        | S46       | op dak    | LCS    |

## B. Analyseresultaten spanten en dak

### 1. Interne krachten op staven

Linear calculation, Extreme : Global, System : Principal

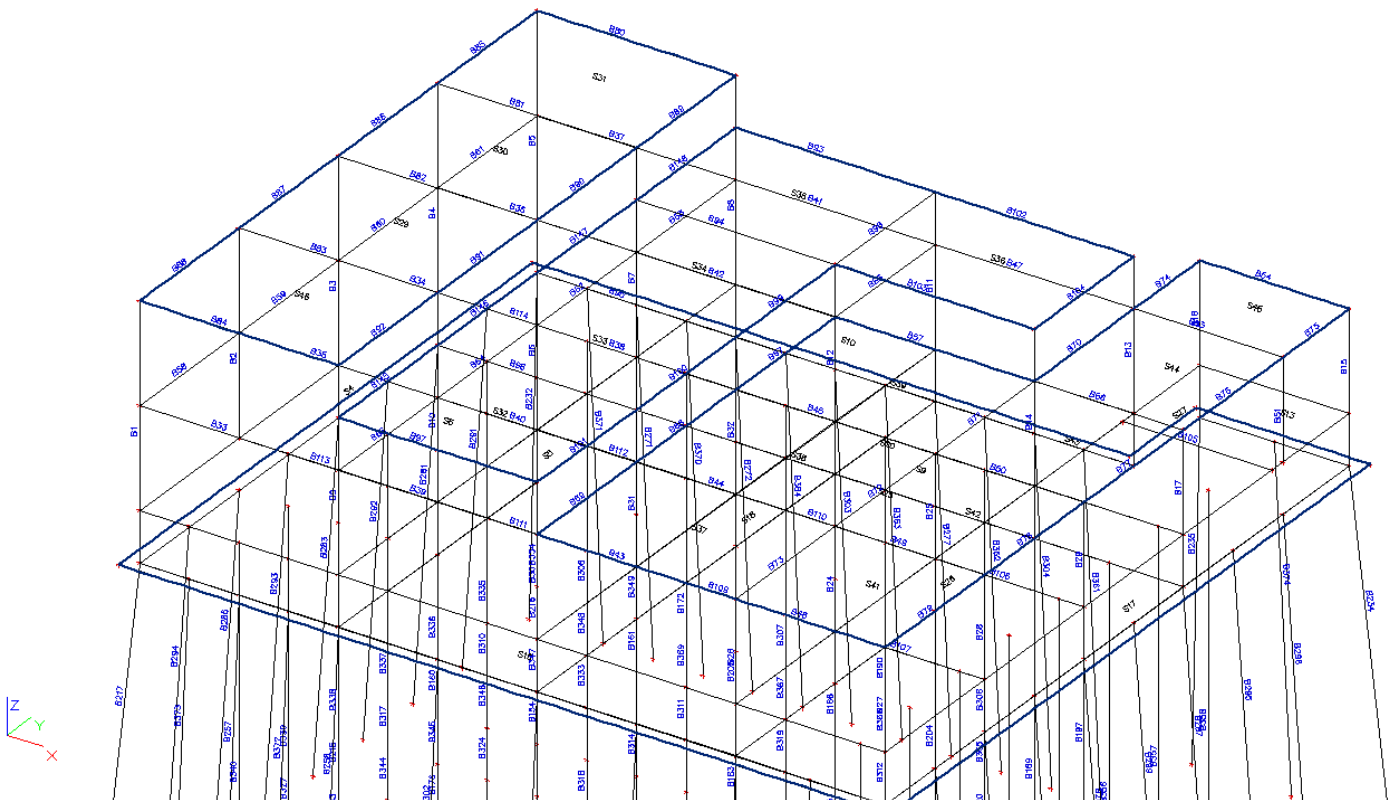
Selection : All

Class : All ULS

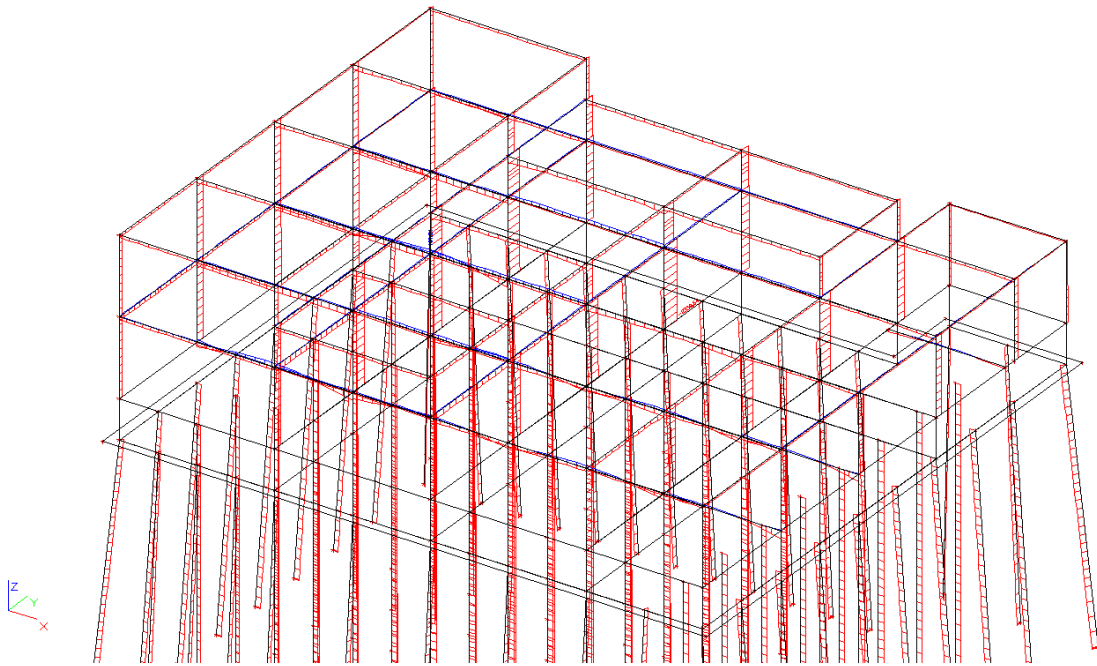
Material : S 355

| Member | Case  | dx<br>[m] | N<br>[kN]       | Vy<br>[kN]     | Vz<br>[kN]      | Mx<br>[kNm]   | My<br>[kNm]     | Mz<br>[kNm]    |
|--------|-------|-----------|-----------------|----------------|-----------------|---------------|-----------------|----------------|
| B12    | CO2/1 | 0,000     | <b>-2359,54</b> | 200,54         | 49,92           | -0,23         | -70,35          | -447,91        |
| B42    | CO1/2 | 0,000     | <b>368,60</b>   | 7,82           | -10,26          | -0,51         | 37,25           | -35,47         |
| B4     | CO2/1 | 8,000     | -1036,84        | <b>-512,40</b> | -3,22           | -0,13         | -14,50          | -508,46        |
| B3     | CO2/1 | 0,000     | -1015,61        | <b>627,60</b>  | -5,44           | -0,03         | 10,94           | <b>-676,69</b> |
| B44    | CO2/1 | 8,000     | -623,62         | -6,65          | <b>-1025,59</b> | -35,35        | <b>-1392,16</b> | -16,56         |
| B9     | CO1/2 | 0,000     | -952,89         | -19,43         | <b>848,30</b>   | -0,01         | -845,03         | 45,05          |
| B98    | CO3/3 | 0,000     | -214,42         | -3,02          | 575,60          | <b>-35,67</b> | -581,41         | 1,44           |
| B73    | CO3/3 | 6,000     | -105,68         | 5,82           | -607,50         | <b>32,20</b>  | -663,65         | -39,28         |
| B82    | CO3/3 | 4,000     | -93,48          | 0,09           | -8,68           | 0,13          | <b>965,53</b>   | -0,23          |
| B32    | CO2/1 | 6,000     | -1100,10        | 576,39         | 12,33           | -0,04         | 27,20           | <b>939,95</b>  |

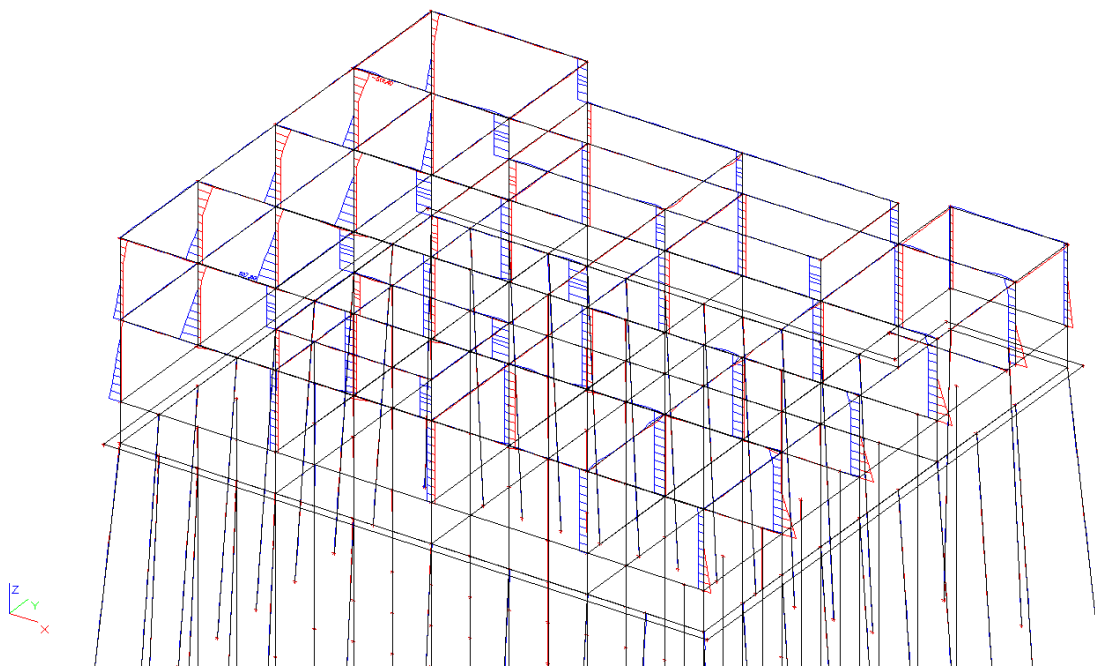
### 2. Overzicht staven



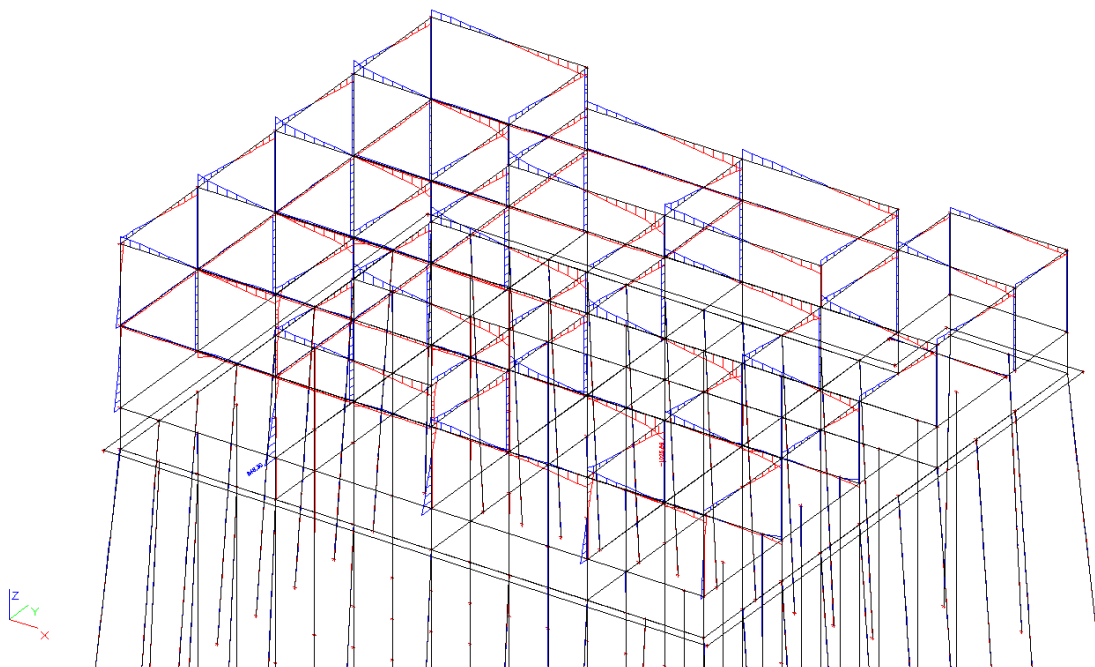
### 3. Normale kracht



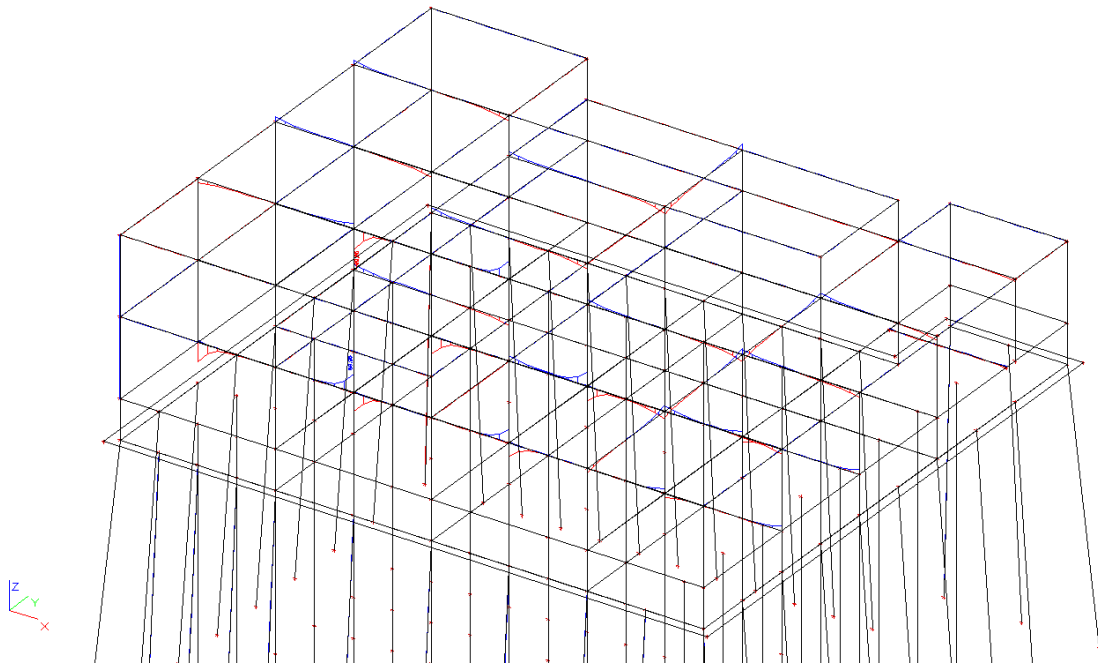
#### 4. Dwarskracht in Y-richting



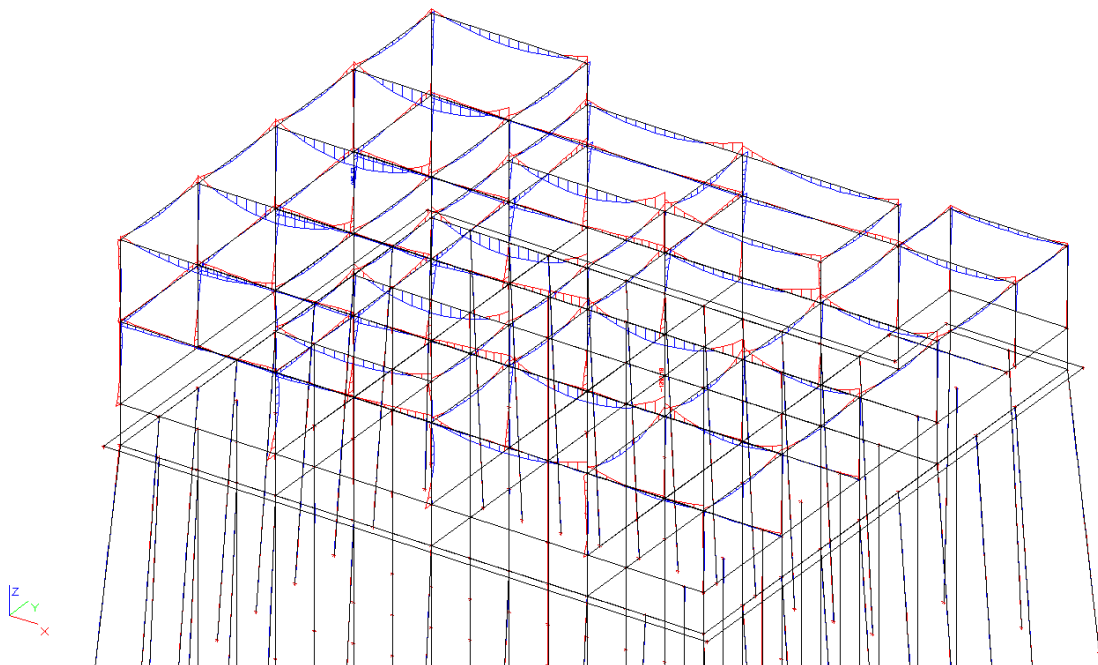
#### 5. Dwarskracht in Z-richting



## 6. Moment in X-richting (torsie)

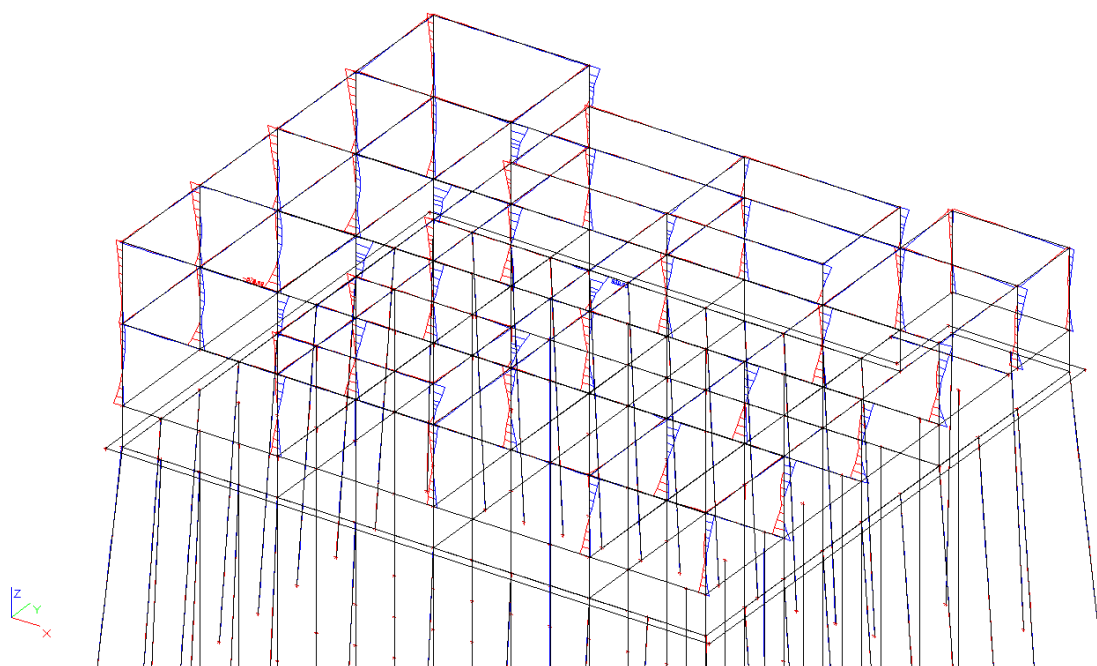


## 7. Moment in Y-richting





## 8. Moment in Z-richting



## 9. Vervorming van staven

Linear calculation, Extreme : Global, System : Principal

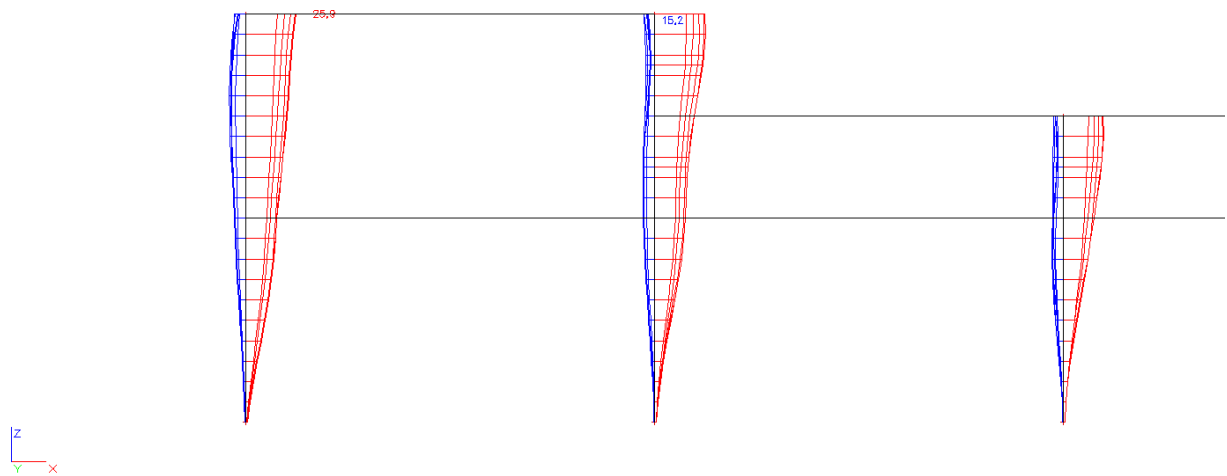
Selection : All

Class : All ULS

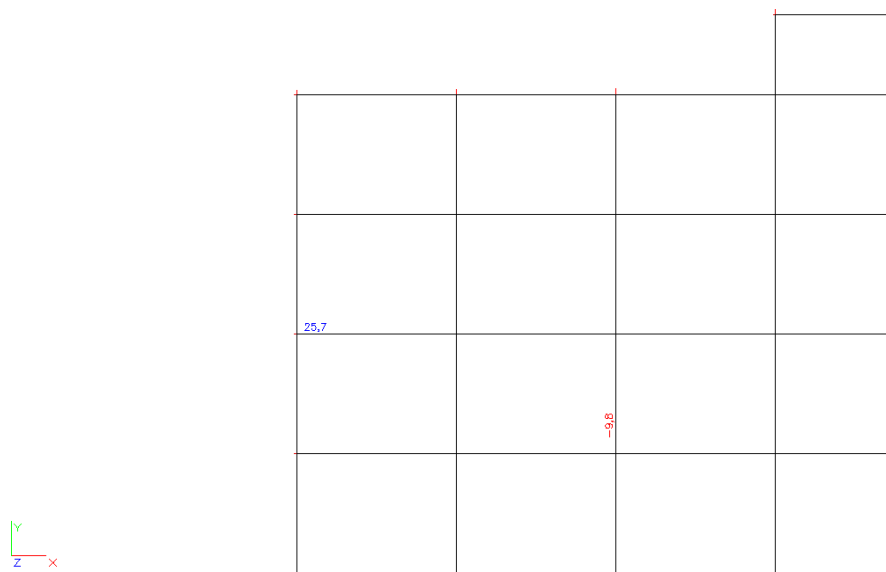
Material : S 355

| Member | Case  | dx<br>[m] | ux<br>[mm]  | uy<br>[mm]   | uz<br>[mm]   | fix<br>[mrad] | fiy<br>[mrad] | fiz<br>[mrad] |
|--------|-------|-----------|-------------|--------------|--------------|---------------|---------------|---------------|
| B31    | CO2/1 | 6,000     | <b>-9,8</b> | -19,7        | 0,4          | -0,2          | 0,0           | 2,4           |
| B82    | CO2/1 | 0,000     | <b>25,7</b> | -0,6         | -5,4         | 0,0           | 4,1           | 0,2           |
| B87    | CO2/1 | 4,000     | -0,6        | <b>-25,9</b> | -6,5         | 4,1           | -0,3          | 0,0           |
| B84    | CO1/2 | 8,000     | 1,0         | <b>15,2</b>  | -6,2         | -0,7          | -2,0          | 0,1           |
| B96    | CO2/1 | 4,000     | 19,9        | -0,3         | <b>-21,7</b> | -4,7          | -0,1          | 0,0           |
| B1     | CO2/1 | 6,800     | -4,4        | -17,5        | <b>0,9</b>   | -0,5          | 0,1           | -1,6          |
| B44    | CO1/2 | 4,500     | -0,6        | 5,7          | -17,8        | <b>-5,2</b>   | -1,1          | -0,7          |
| B98    | CO1/2 | 3,000     | 9,5         | -1,1         | -11,0        | <b>4,9</b>    | -0,2          | 0,1           |
| B82    | CO3/3 | 7,000     | -4,0        | -0,4         | -13,0        | -2,5          | <b>-4,5</b>   | 0,0           |
| B82    | CO1/2 | 0,500     | 1,7         | 12,7         | -9,0         | -1,7          | <b>5,0</b>    | 0,2           |
| B24    | CO2/1 | 2,000     | -8,4        | -8,6         | 0,0          | 0,0           | 0,0           | <b>-5,2</b>   |
| B6     | CO3/3 | 8,000     | -8,1        | 4,0          | 0,3          | 0,1           | 0,0           | <b>3,9</b>    |

## 10. Vervorming in Y-richting



## 11. Vervorming in X-richting



## 12.2D element - Interne krachten

Linear calculation, Extreme : Global

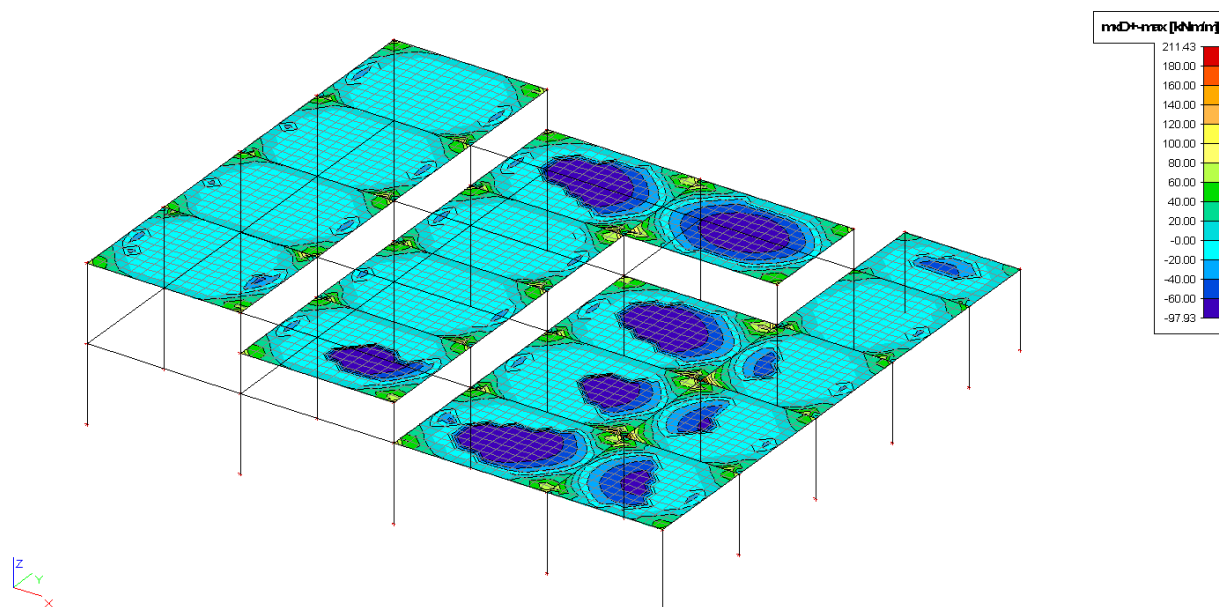
Selection : All

Class : All ULS

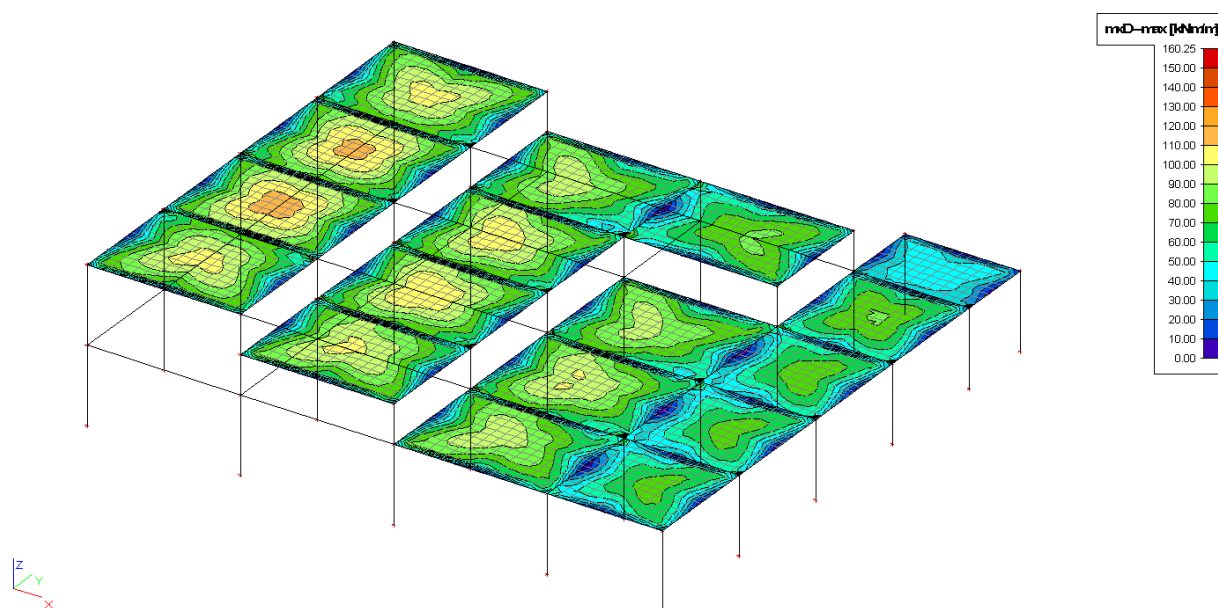
Dimensional magnitudes. In nodes, avg. on macro.

| Case    | elem  | mxD+<br>[kNm/m] | myD+<br>[kNm/m] | mcD+<br>[kNm/m] | mxD-<br>[kNm/m] | myD-<br>[kNm/m] | mcD-<br>[kNm/m] | nxD<br>[kN/m]  | nyD<br>[kN/m]  | ncD<br>[kN/m]  |
|---------|-------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|
| All ULS | 8598  | <b>-100,32</b>  | 0,00            | -102,48         | 98,04           | 101,98          | -0,32           | 0,00           | 0,00           | 0,00           |
| All ULS | 10189 | <b>211,43</b>   | <b>190,75</b>   | -219,15         | 52,74           | 67,60           | -219,15         | 0,00           | 3,59           | -175,37        |
| All ULS | 8586  | -96,98          | <b>-100,09</b>  | -101,23         | 98,41           | 101,59          | -3,53           | 0,00           | 0,00           | 0,00           |
| All ULS | 10189 | 166,42          | 165,22          | <b>-258,09</b>  | 42,22           | 53,93           | <b>-258,09</b>  | -69,85         | -48,88         | -252,54        |
| All ULS | 8785  | 7,69            | 4,53            | <b>-0,02</b>    | 0,00            | -1,42           | -5,07           | 0,00           | -1,57          | -7,89          |
| All ULS | 8005  | 10,42           | 6,90            | -10,68          | <b>0,00</b>     | 0,34            | -10,68          | 0,00           | 0,00           | 0,00           |
| All ULS | 9852  | 0,00            | 7,80            | -119,62         | <b>160,25</b>   | 88,34           | -101,50         | 378,35         | 296,58         | -189,69        |
| All ULS | 8017  | 6,77            | 3,23            | -3,10           | 0,00            | <b>-2,69</b>    | -6,30           | 0,00           | 0,00           | 0,00           |
| All ULS | 9288  | 37,05           | 0,46            | -117,47         | 83,88           | <b>123,70</b>   | -117,22         | 170,56         | 136,30         | -79,66         |
| All ULS | 8419  | 0,00            | 0,00            | -96,90          | 101,50          | 96,90           | <b>0,00</b>     | -5,15          | 0,00           | -7,38          |
| All ULS | 10622 | 6,39            | 24,67           | -50,45          | 28,11           | 19,03           | -50,45          | <b>-101,73</b> | 0,00           | -297,68        |
| All ULS | 9276  | 0,00            | -7,12           | -110,55         | 144,31          | 72,02           | -80,24          | <b>565,01</b>  | 408,00         | -217,26        |
| All ULS | 8340  | 39,03           | 55,83           | -104,91         | 59,53           | 43,01           | -104,91         | 0,00           | <b>-145,23</b> | -291,54        |
| All ULS | 10621 | 45,53           | 39,12           | -63,54          | 41,15           | 43,30           | -63,54          | 159,81         | <b>461,71</b>  | -48,59         |
| All ULS | 10632 | 0,00            | -13,43          | -64,59          | 59,82           | 25,15           | -33,18          | 91,81          | 69,52          | <b>-730,10</b> |
| All ULS | 8121  | 23,66           | 26,27           | -46,47          | 27,92           | 25,31           | -46,47          | 0,00           | 0,00           | <b>0,00</b>    |

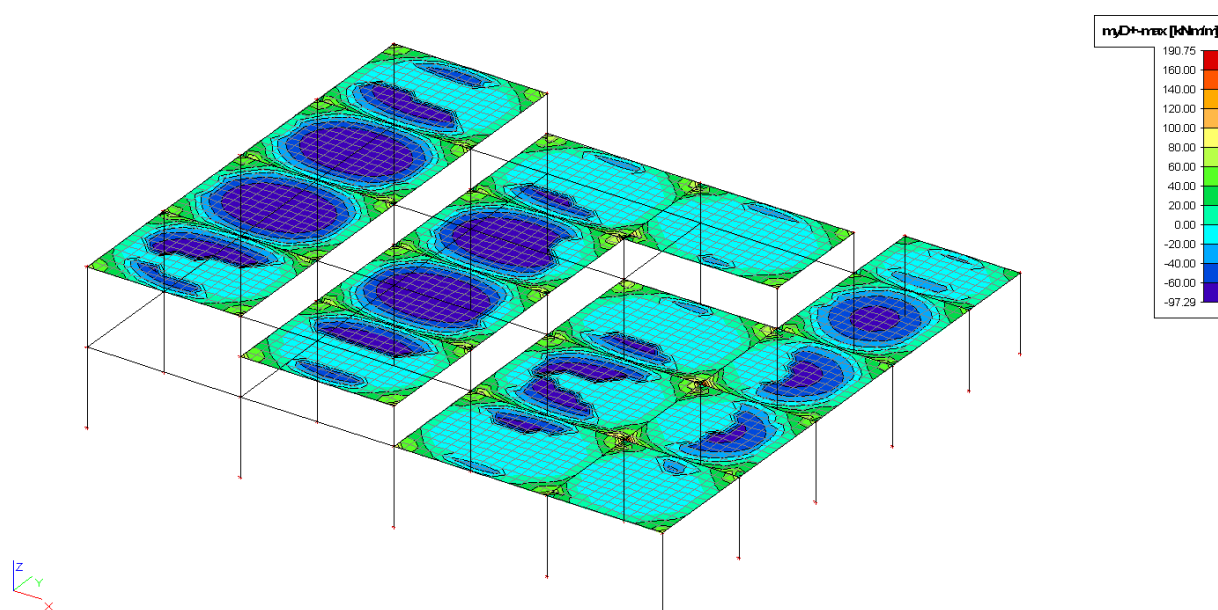
## 13.Moment ter berekening van de wapening in de X-richting aan de bovenzijde



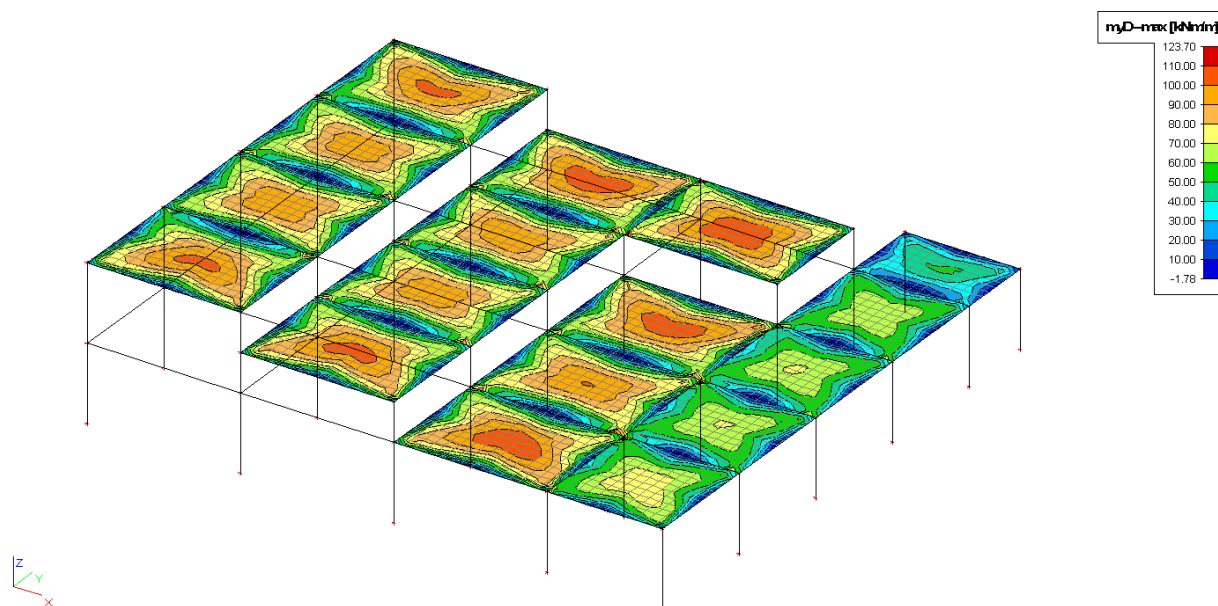
#### 14. Moment ter berekening van de wapening in de X-richting aan de onderzijde



#### 15. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde



## 16. Moment ter berekening van de wapening in de Y-richting aan de onderzijde



## 17. Vervorming van knopen

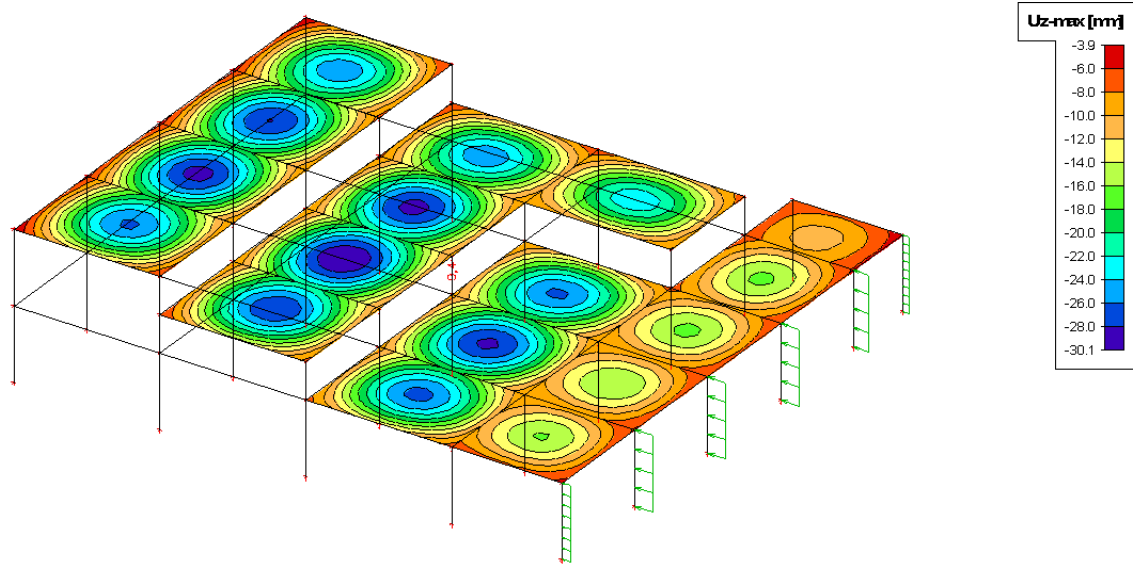
Linear calculation, Extreme : Global

Selection : All

Class : All ULS

| Case    | Node  | Ux<br>[mm]  | Uy<br>[mm]  | Uz<br>[mm]   | Fix<br>[mrad] | Fiy<br>[mrad] | Fiz<br>[mrad] |
|---------|-------|-------------|-------------|--------------|---------------|---------------|---------------|
| All ULS | N54   | <b>-5,9</b> | 0,0         | -6,2         | -0,1          | -1,1          | 0,0           |
| All ULS | 7722  | <b>25,9</b> | 12,6        | -6,5         | 0,4           | 4,7           | 0,1           |
| All ULS | 10144 | -4,0        | <b>-3,2</b> | -8,1         | -1,9          | -1,9          | -0,5          |
| All ULS | N43   | 19,5        | <b>15,2</b> | -6,2         | -0,6          | -0,9          | 0,1           |
| All ULS | 8666  | -3,8        | -0,3        | <b>-31,0</b> | -0,1          | 0,0           | -0,5          |
| All ULS | N249  | 0,0         | 0,0         | <b>-2,5</b>  | 0,0           | 0,0           | 0,0           |
| All ULS | 9499  | -4,3        | -0,2        | -17,4        | <b>-6,7</b>   | -0,4          | -0,4          |
| All ULS | 9080  | 18,3        | 11,5        | -14,2        | <b>6,9</b>    | -0,7          | 0,0           |
| All ULS | 7915  | -3,8        | -0,6        | -14,0        | 0,0           | <b>-8,6</b>   | 0,0           |
| All ULS | 7727  | 25,5        | 13,2        | -11,1        | 0,0           | <b>9,1</b>    | 0,2           |
| All ULS | 10915 | -3,2        | -0,4        | -9,4         | -0,5          | -2,8          | <b>-1,1</b>   |
| All ULS | 10653 | 7,9         | 3,2         | -6,7         | 0,3           | 1,4           | <b>1,6</b>    |

## 18. Vervorming in Z-richting



## C. Analyseresultaten Vloer, Kelderwand

### 1. Interne kracht - vloer

Linear calculation, Extreme : Global

Selection : All

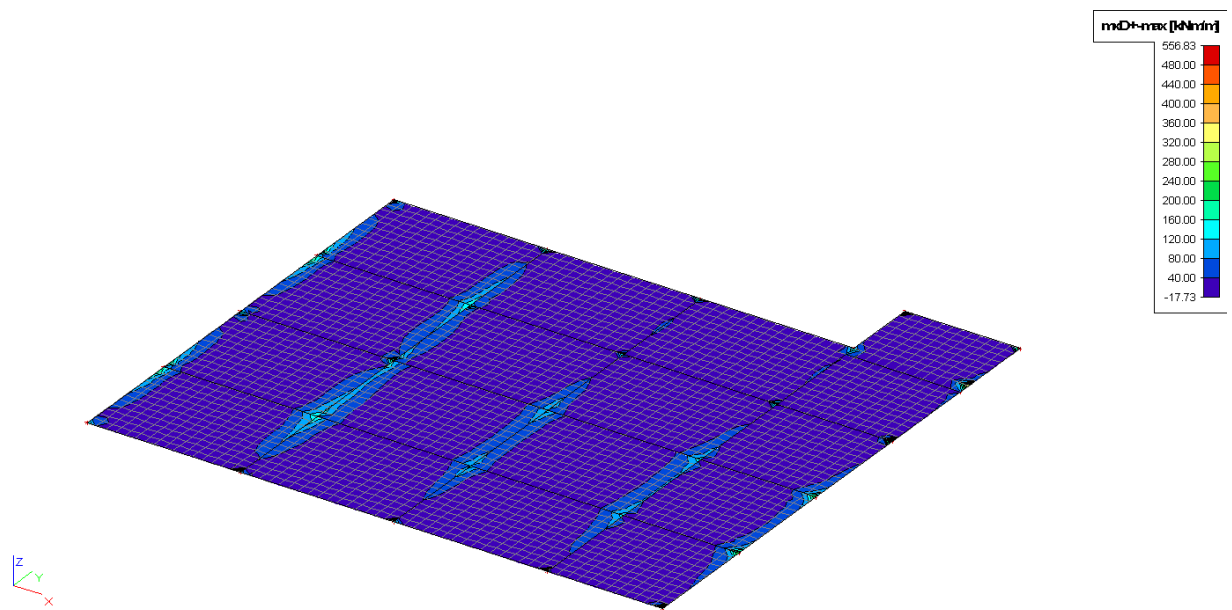
Class : All ULS

Dimensional magnitudes. In nodes, avg. on macro.

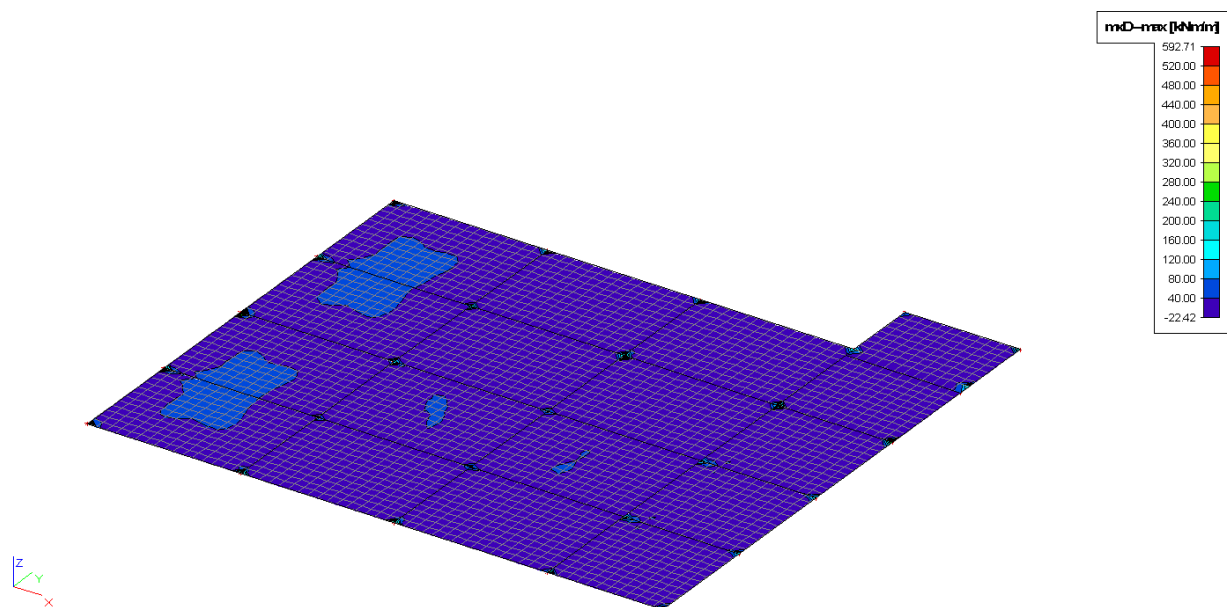
| Case    | elem | mxD+<br>[kNm/m] | myD+<br>[kNm/m] | mcD+<br>[kNm/m] | mxD-<br>[kNm/m] | myD-<br>[kNm/m] | mcD-<br>[kNm/m] | nxD<br>[kN/m]   | nyD<br>[kN/m]   | ncD<br>[kN/m]   |
|---------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| All ULS | 1697 | <b>-77,64</b>   | 0,00            | -117,96         | 0,00            | -23,37          | -59,77          | 0,00            | -18,71          | -1130,56        |
| All ULS | 3068 | <b>556,83</b>   | 247,57          | -182,30         | 232,08          | 217,68          | -101,89         | 3586,59         | 1767,28         | -1335,86        |
| All ULS | 3721 | 0,00            | <b>-77,98</b>   | -145,74         | 0,00            | 30,67           | -98,86          | -676,37         | -779,26         | -1259,11        |
| All ULS | 4128 | 231,87          | <b>520,72</b>   | -148,53         | 525,73          | 192,51          | -192,60         | 1701,73         | <b>3481,87</b>  | -992,47         |
| All ULS | 1536 | -60,70          | 0,00            | <b>-620,06</b>  | 0,00            | -19,08          | -446,78         | -1249,84        | -13,94          | -4018,89        |
| All ULS | 4001 | 22,55           | 3,41            | <b>0,00</b>     | 0,00            | -3,16           | -20,51          | 0,00            | 27,66           | -157,66         |
| All ULS | 1697 | 0,00            | -10,00          | -257,73         | <b>-78,33</b>   | 0,00            | -275,41         | 0,00            | <b>-1079,65</b> | -3027,77        |
| All ULS | 1713 | 181,51          | 373,12          | -77,92          | <b>592,71</b>   | 277,37          | -113,37         | 1126,07         | 1918,45         | -669,29         |
| All ULS | 1696 | 102,10          | 45,95           | -36,98          | 0,00            | <b>-70,09</b>   | -110,15         | 224,46          | 0,00            | -784,23         |
| All ULS | 1536 | 291,47          | 167,25          | -122,80         | 379,14          | <b>748,40</b>   | -58,74          | 1274,10         | 1045,44         | -1041,65        |
| All ULS | 3068 | 0,00            | 0,00            | -329,24         | 0,00            | -13,85          | <b>-461,30</b>  | 0,00            | -61,39          | -1619,01        |
| All ULS | 3262 | 0,00            | -2,94           | -18,93          | 26,68           | 9,96            | <b>-0,01</b>    | 0,00            | 42,28           | -84,48          |
| All ULS | 1920 | -73,88          | 0,00            | -494,11         | 0,00            | -36,30          | -372,44         | <b>-1550,83</b> | 0,00            | -3392,60        |
| All ULS | 3200 | 255,14          | 99,11           | -48,16          | 157,35          | 113,28          | -76,19          | <b>3738,46</b>  | 1679,87         | -996,38         |
| All ULS | 1905 | -12,05          | 0,00            | -594,54         | 0,00            | -15,04          | -410,22         | -779,85         | -61,53          | <b>-4048,65</b> |
| All ULS | 4186 | 0,00            | -17,84          | -31,15          | 41,21           | 32,02           | -17,40          | 72,38           | 0,32            | <b>-0,54</b>    |



## 2. Moment ter berekening van de wapening in de X-richting aan de bovenzijde

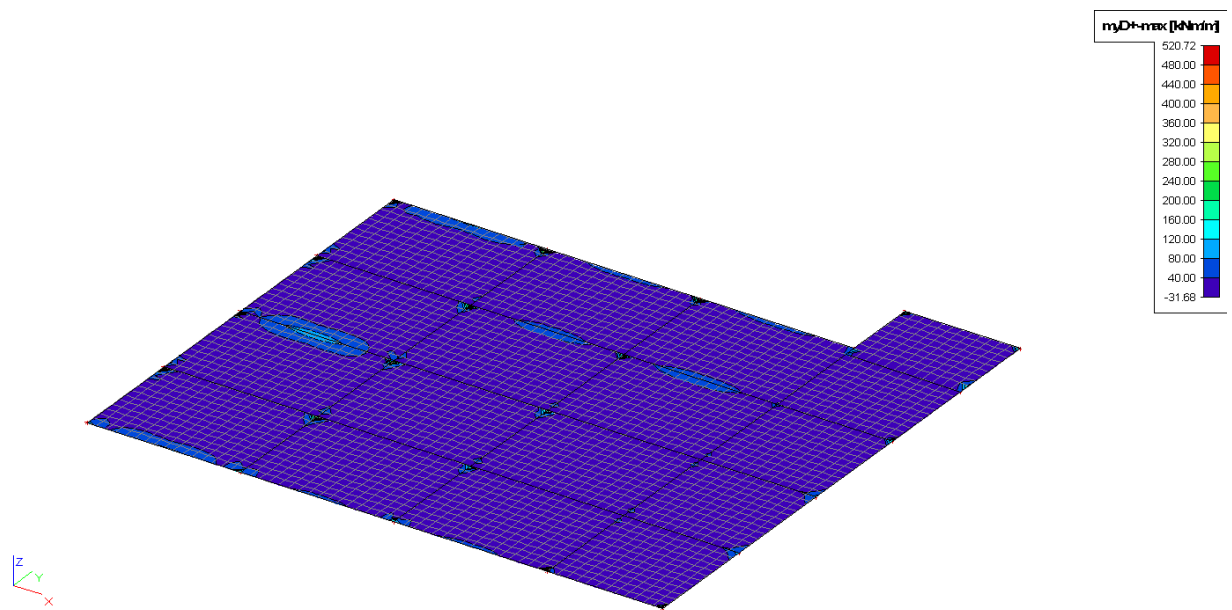


## 3. Moment ter berekening van de wapening in de X-richting aan de onderzijde

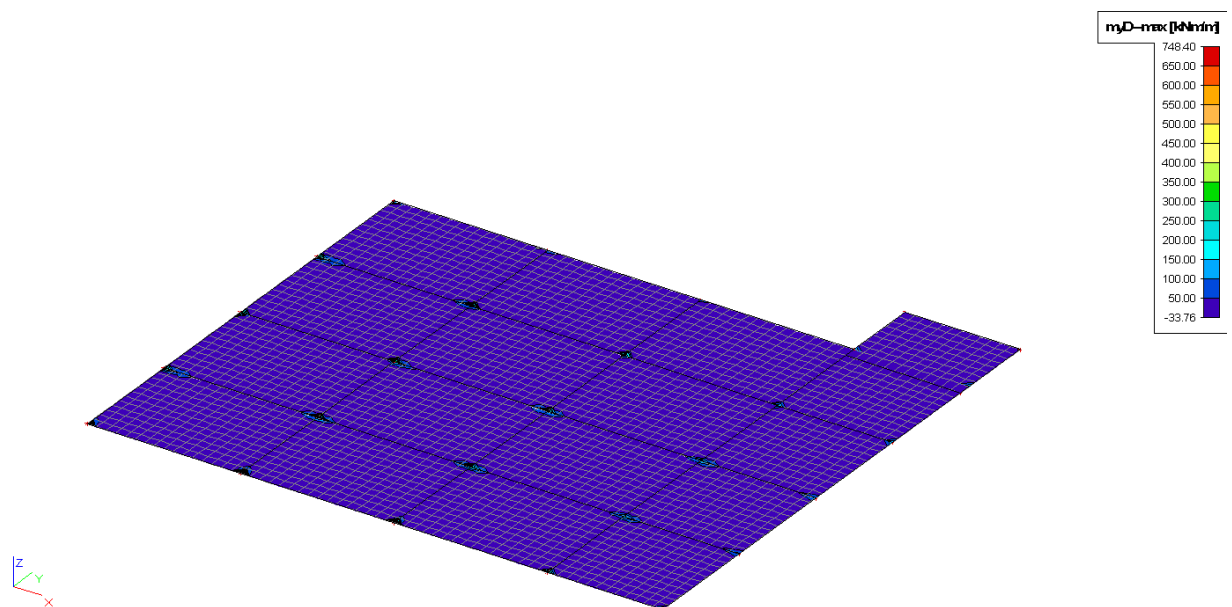




#### 4. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde



#### 5. Moment ter berekening van de wapening in de Y-richting aan de onderzijde



## 6. Vervorming van knopen - vloer

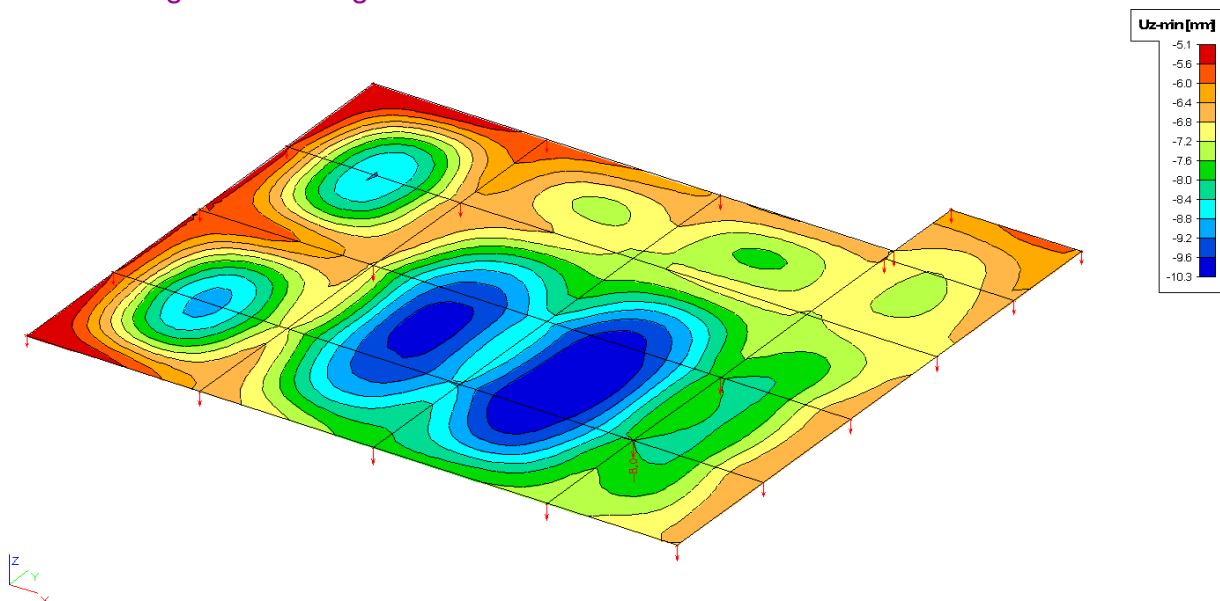
Linear calculation, Extreme : Global

Selection : All

Class : All ULS

| Case    | Node | Ux<br>[mm]  | Uy<br>[mm]  | Uz<br>[mm]   | Fix<br>[mrad] | Fiy<br>[mrad] | Fiz<br>[mrad] |
|---------|------|-------------|-------------|--------------|---------------|---------------|---------------|
| All ULS | N54  | <b>-5,9</b> | 0,0         | -6,2         | -0,1          | -1,1          | 0,0           |
| All ULS | N36  | <b>25,7</b> | 12,6        | -5,4         | 0,0           | <b>4,7</b>    | 0,2           |
| All ULS | N39  | -5,4        | <b>-0,7</b> | -5,7         | 0,3           | 2,3           | 0,0           |
| All ULS | N43  | 19,5        | <b>15,2</b> | -6,2         | -0,6          | -0,9          | 0,1           |
| All ULS | 3055 | -0,3        | 0,0         | <b>-10,3</b> | -0,1          | 0,0           | 0,0           |
| All ULS | N249 | 0,0         | 0,0         | <b>-2,5</b>  | 0,0           | 0,0           | 0,0           |
| All ULS | N12  | 0,0         | 0,0         | -6,5         | <b>-1,9</b>   | -0,1          | 0,0           |
| All ULS | N50  | 12,8        | 9,4         | -6,7         | <b>1,2</b>    | 0,3           | 0,4           |
| All ULS | N40  | -4,0        | -0,5        | -8,2         | -0,2          | <b>-3,9</b>   | 0,1           |
| All ULS | N43  | -2,9        | -0,3        | -7,2         | -0,7          | -2,1          | <b>-0,6</b>   |
| All ULS | N55  | 5,1         | 3,2         | -6,0         | 0,3           | 1,3           | <b>0,9</b>    |

## 7. Vervorming in Z-richting



## 8. Interne krachten - kelderwanden

Linear calculation, Extreme : Global

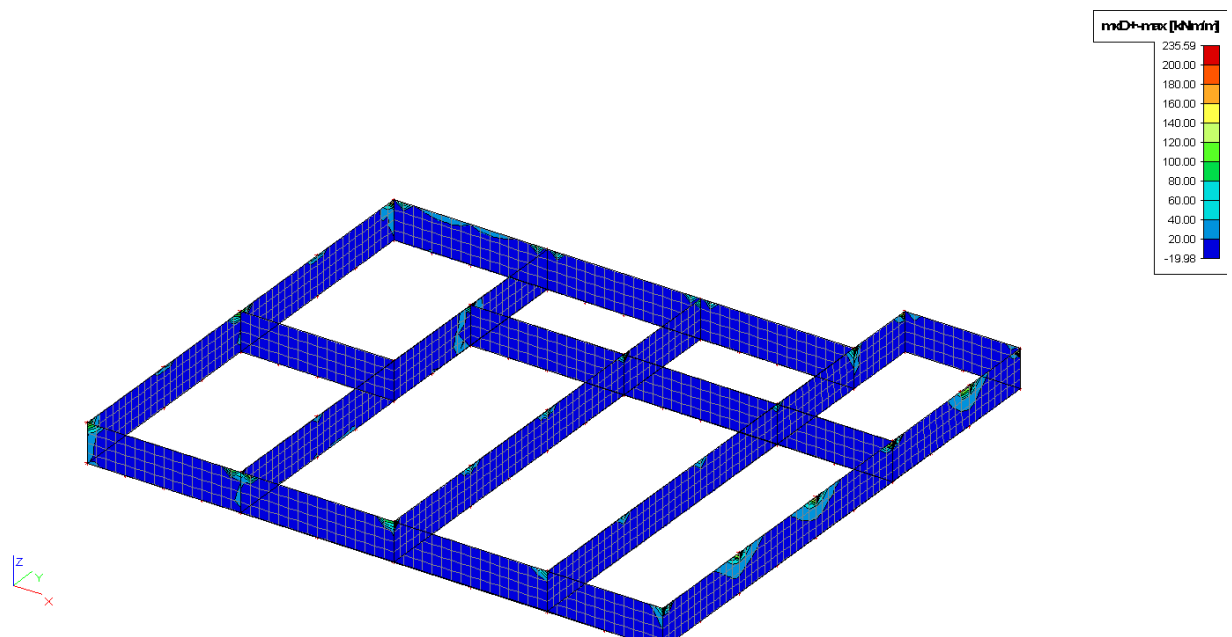
Selection : All

Class : All ULS

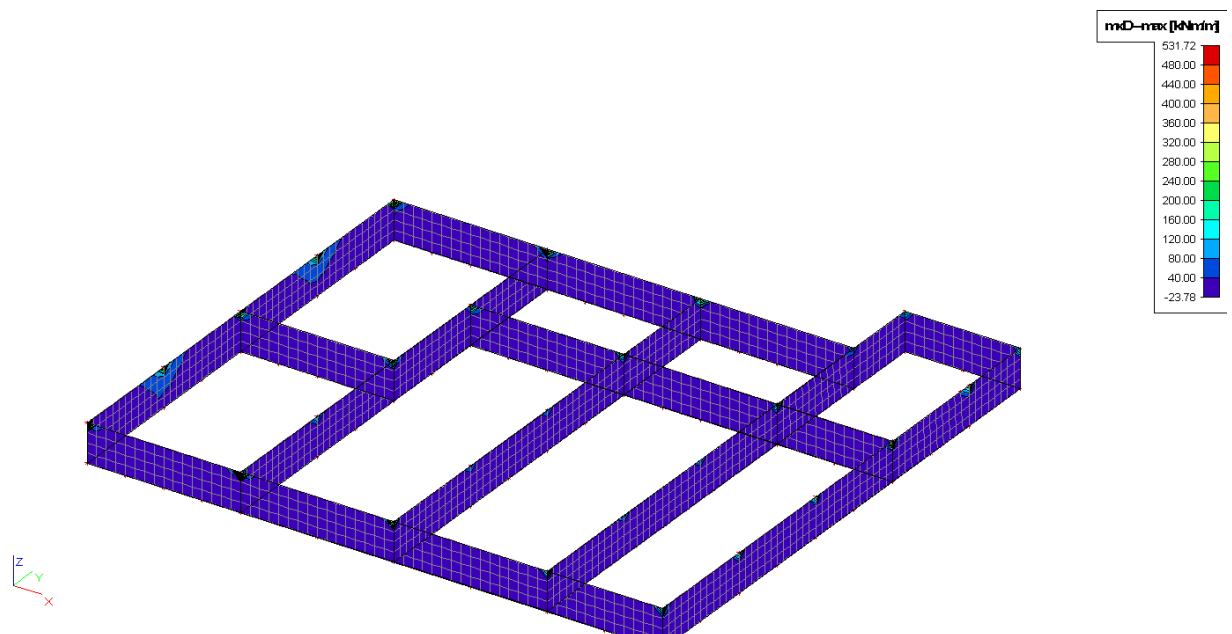
Dimensional magnitudes. In nodes, avg. on macro.

| Case    | elem | mxD+<br>[kNm/m] | myD+<br>[kNm/m] | mcD+<br>[kNm/m] | mxD-<br>[kNm/m] | myD-<br>[kNm/m] | mcD-<br>[kNm/m] | nxD<br>[kN/m]   | nyD<br>[kN/m]  | ncD<br>[kN/m]   |
|---------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------|
| All ULS | 60   | <b>-71,57</b>   | 0,00            | -364,75         | 13,59           | 33,56           | -0,75           | -242,72         | 0,00           | -2277,28        |
| All ULS | 1165 | <b>235,59</b>   | 498,39          | -300,41         | 215,34          | 486,71          | -285,56         | 769,23          | 1389,49        | -792,38         |
| All ULS | 673  | -32,63          | <b>-29,67</b>   | -824,01         | 12,86           | 83,42           | -588,22         | -427,38         | 0,00           | -5051,87        |
| All ULS | 1305 | 176,07          | <b>527,50</b>   | -26,21          | 182,01          | 490,04          | -44,94          | 628,74          | 0,00           | -1165,60        |
| All ULS | 977  | 20,80           | 0,00            | <b>-1051,04</b> | -18,84          | 0,00            | <b>-748,64</b>  | -1117,13        | 0,00           | -4127,57        |
| All ULS | 1286 | 9,98            | 39,25           | <b>0,00</b>     | -4,96           | 0,00            | -19,67          | 187,73          | 0,00           | -117,82         |
| All ULS | 1173 | -62,21          | 0,00            | -501,65         | <b>-61,29</b>   | 0,00            | -372,27         | -375,17         | 0,00           | -2651,00        |
| All ULS | 913  | 138,33          | 123,72          | -52,77          | <b>531,72</b>   | 1131,46         | -84,23          | 1530,55         | 3028,35        | -1584,54        |
| All ULS | 73   | -40,13          | 0,00            | -859,10         | -10,29          | <b>-50,77</b>   | -619,36         | -405,75         | 0,00           | -3066,77        |
| All ULS | 977  | 54,22           | 105,50          | -53,00          | 510,19          | <b>1268,69</b>  | -80,41          | 585,92          | 2610,49        | -1505,25        |
| All ULS | 920  | -18,68          | 0,00            | -80,90          | 20,56           | 85,08           | <b>0,00</b>     | 581,80          | 44,03          | -119,96         |
| All ULS | 1041 | 20,57           | 0,00            | -796,00         | -14,18          | 0,00            | -563,81         | <b>-1335,66</b> | <b>-698,59</b> | -4323,99        |
| All ULS | 241  | 10,47           | 38,18           | -3,96           | 39,31           | 113,10          | -12,55          | <b>4359,69</b>  | 1324,40        | -875,81         |
| All ULS | 383  | 13,40           | 46,63           | -6,93           | 42,47           | 24,88           | -6,93           | 1981,67         | <b>3110,61</b> | -57,03          |
| All ULS | 277  | -1,56           | 0,00            | -289,68         | -0,70           | 0,00            | -190,43         | -778,65         | 0,00           | <b>-7209,96</b> |
| All ULS | 1185 | 3,44            | 5,09            | -1,98           | 7,47            | 23,47           | -3,31           | 371,34          | 83,55          | <b>-3,22</b>    |

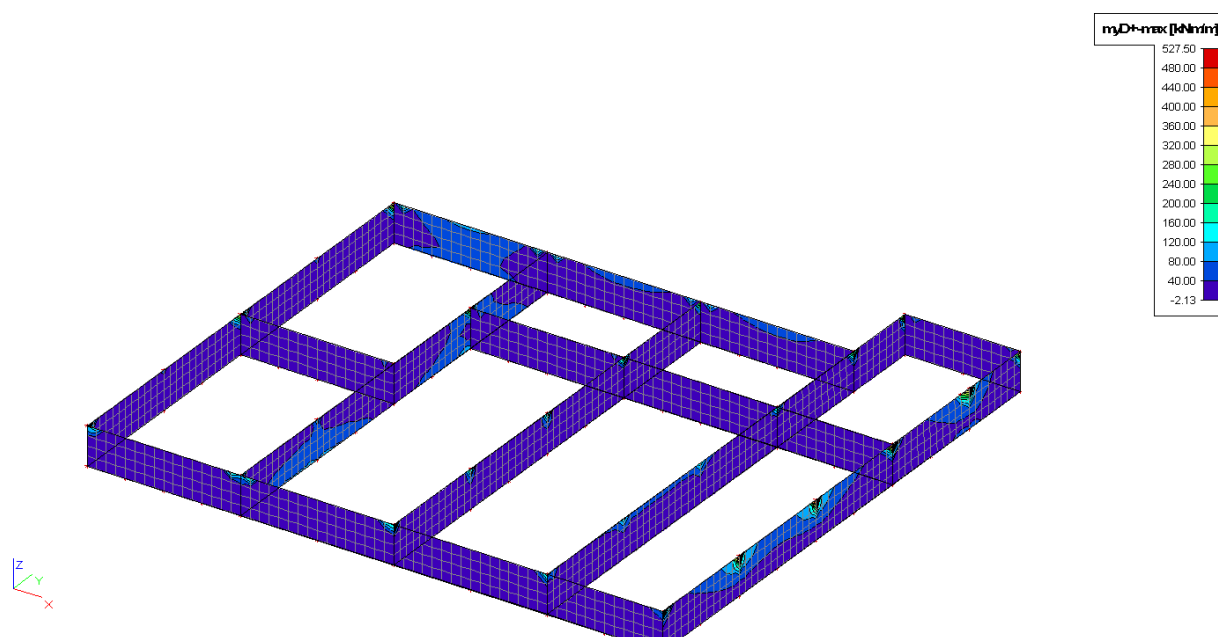
## 9. Moment ter berekening van de wapening in de X-richting aan de bovenzijde



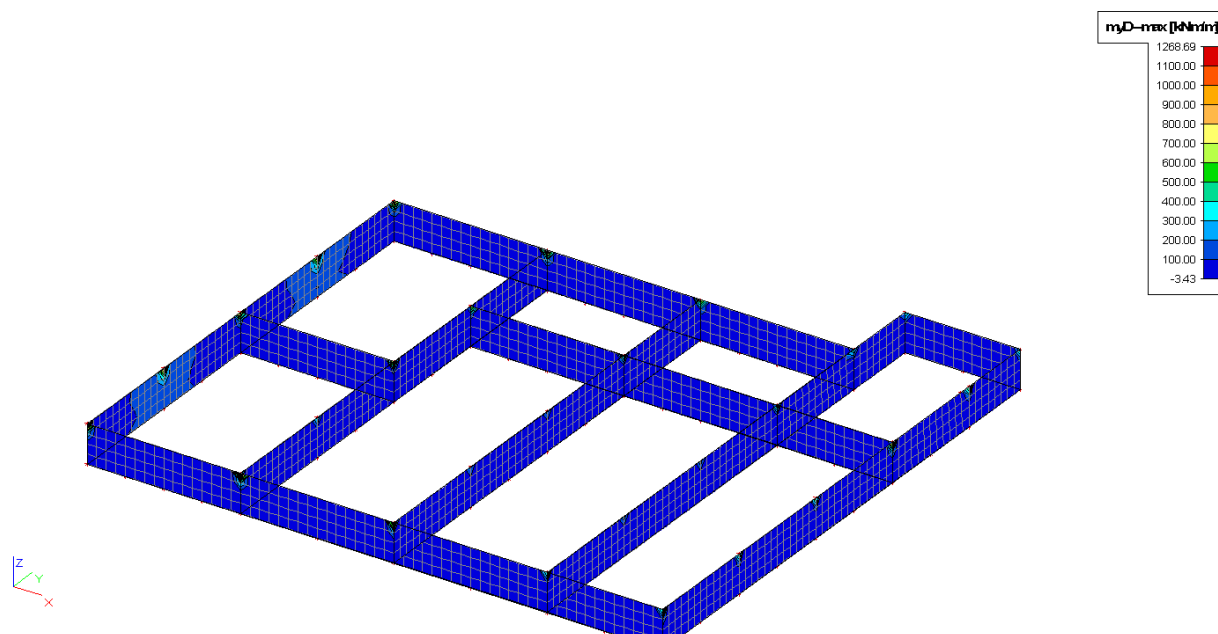
## 10. Moment ter berekening van de wapening in de X-richting aan de onderzijde



## 11. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde



## 12. Moment ter berekening van de wapening in de Y-richting aan de onderzijde



## 13. Vervorming van knopen kelderwanden

Linear calculation, Extreme : Global

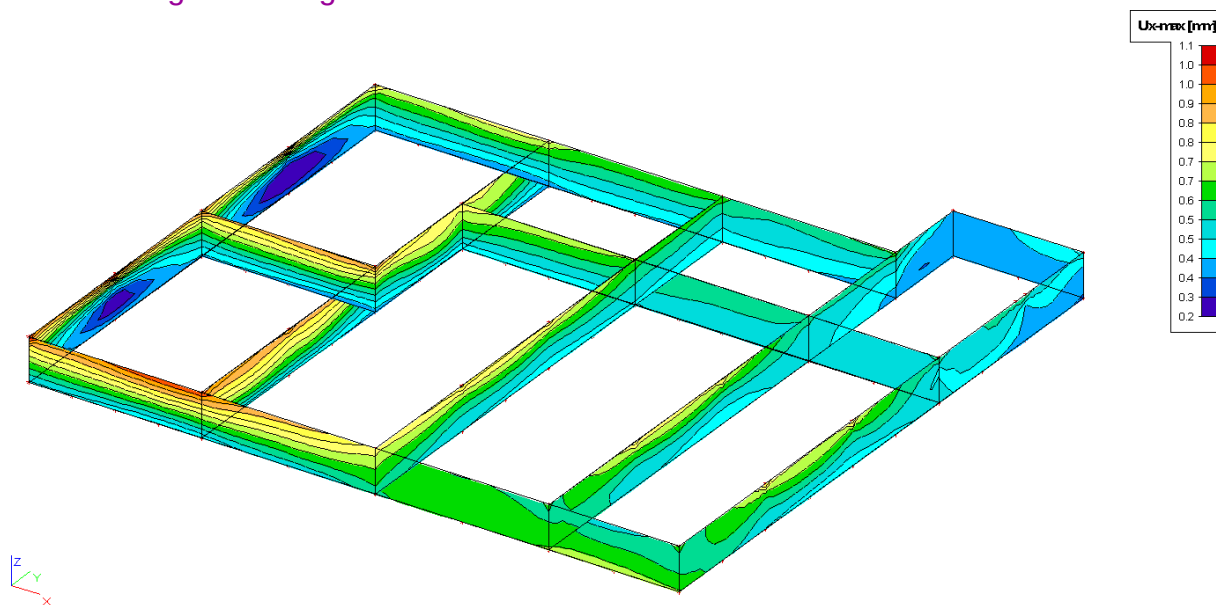
Selection : All

Class : All ULS

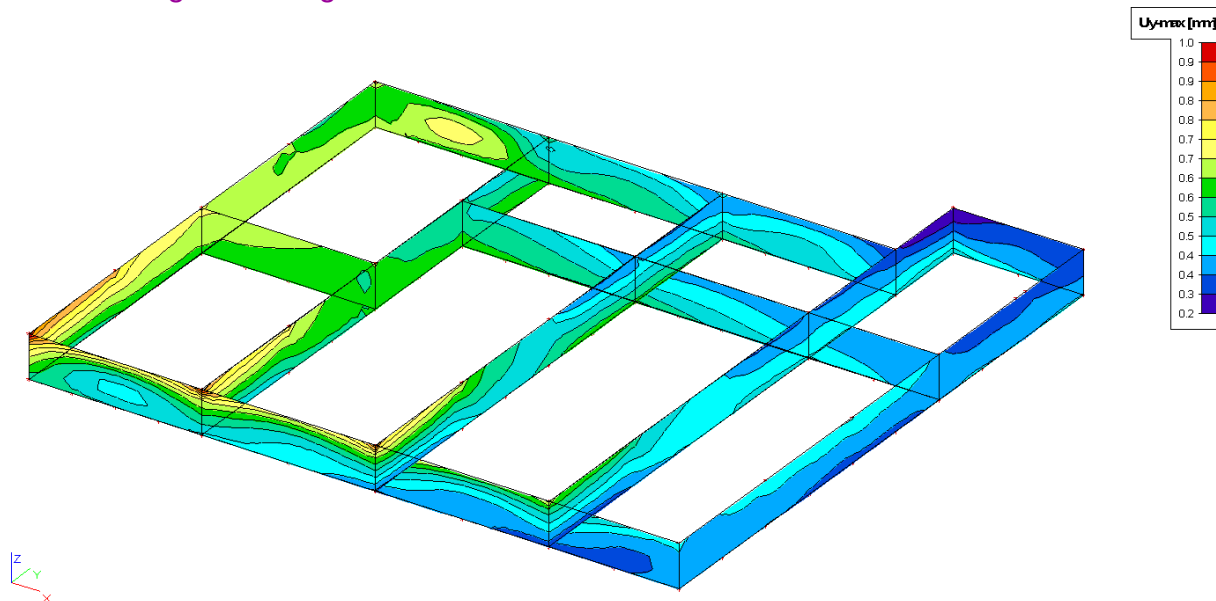
| Case    | Node | Ux<br>[mm]  | Uy<br>[mm]  | Uz<br>[mm] | Fix<br>[mrad] | Fiy<br>[mrad] | Fiz<br>[mrad] |
|---------|------|-------------|-------------|------------|---------------|---------------|---------------|
| All ULS | N54  | <b>-5,9</b> | 0,0         | -6,2       | -0,1          | -1,1          | 0,0           |
| All ULS | N36  | <b>25,7</b> | 12,6        | -5,4       | 0,0           | <b>4,7</b>    | 0,2           |
| All ULS | N39  | -5,4        | <b>-0,7</b> | -5,7       | 0,3           | 2,3           | 0,0           |
| All ULS | N43  | 19,5        | <b>15,2</b> | -6,2       | -0,6          | -0,9          | 0,1           |

|         |      |      |      |             |             |             |             |
|---------|------|------|------|-------------|-------------|-------------|-------------|
| All ULS | N82  | -3,8 | -0,4 | <b>-9,8</b> | -0,3        | -2,9        | -0,3        |
| All ULS | N249 | 0,0  | 0,0  | <b>-2,5</b> | 0,0         | 0,0         | 0,0         |
| All ULS | N12  | 0,0  | 0,0  | -6,5        | <b>-1,9</b> | -0,1        | 0,0         |
| All ULS | N50  | 12,8 | 9,4  | -6,7        | <b>1,2</b>  | 0,3         | 0,4         |
| All ULS | N40  | -4,0 | -0,5 | -8,2        | -0,2        | <b>-3,9</b> | 0,1         |
| All ULS | N43  | -2,9 | -0,3 | -7,2        | -0,7        | -2,1        | <b>-0,6</b> |
| All ULS | N55  | 5,1  | 3,2  | -6,0        | 0,3         | 1,3         | <b>0,9</b>  |

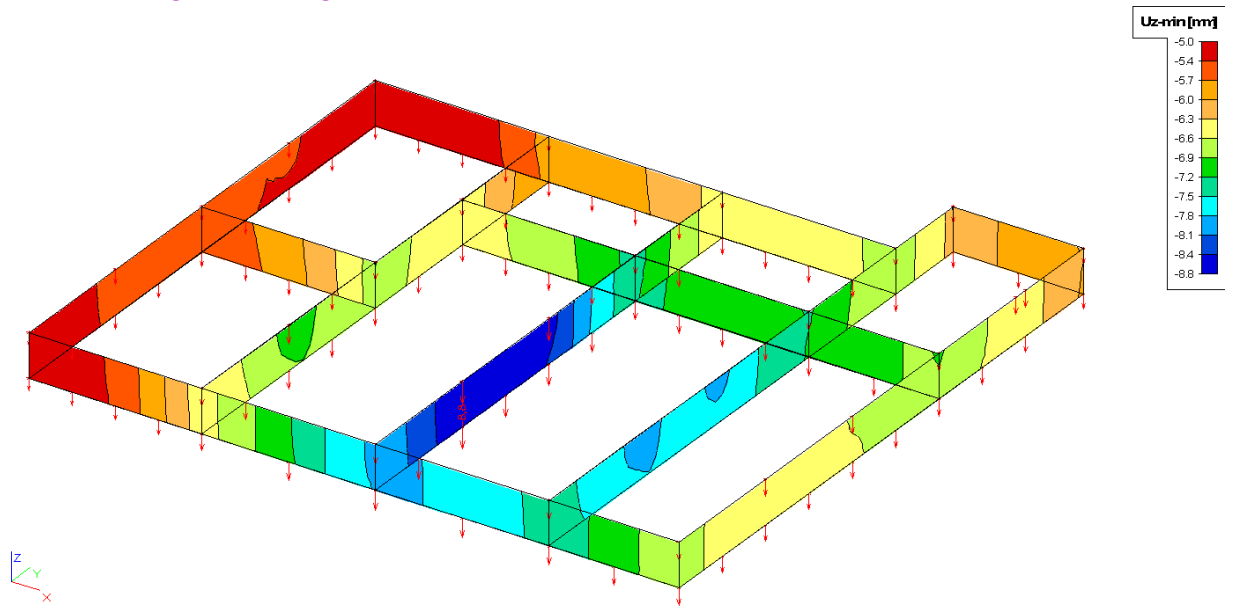
## 14.Vervorming X-richting



## 15.Vervorming Y-richting

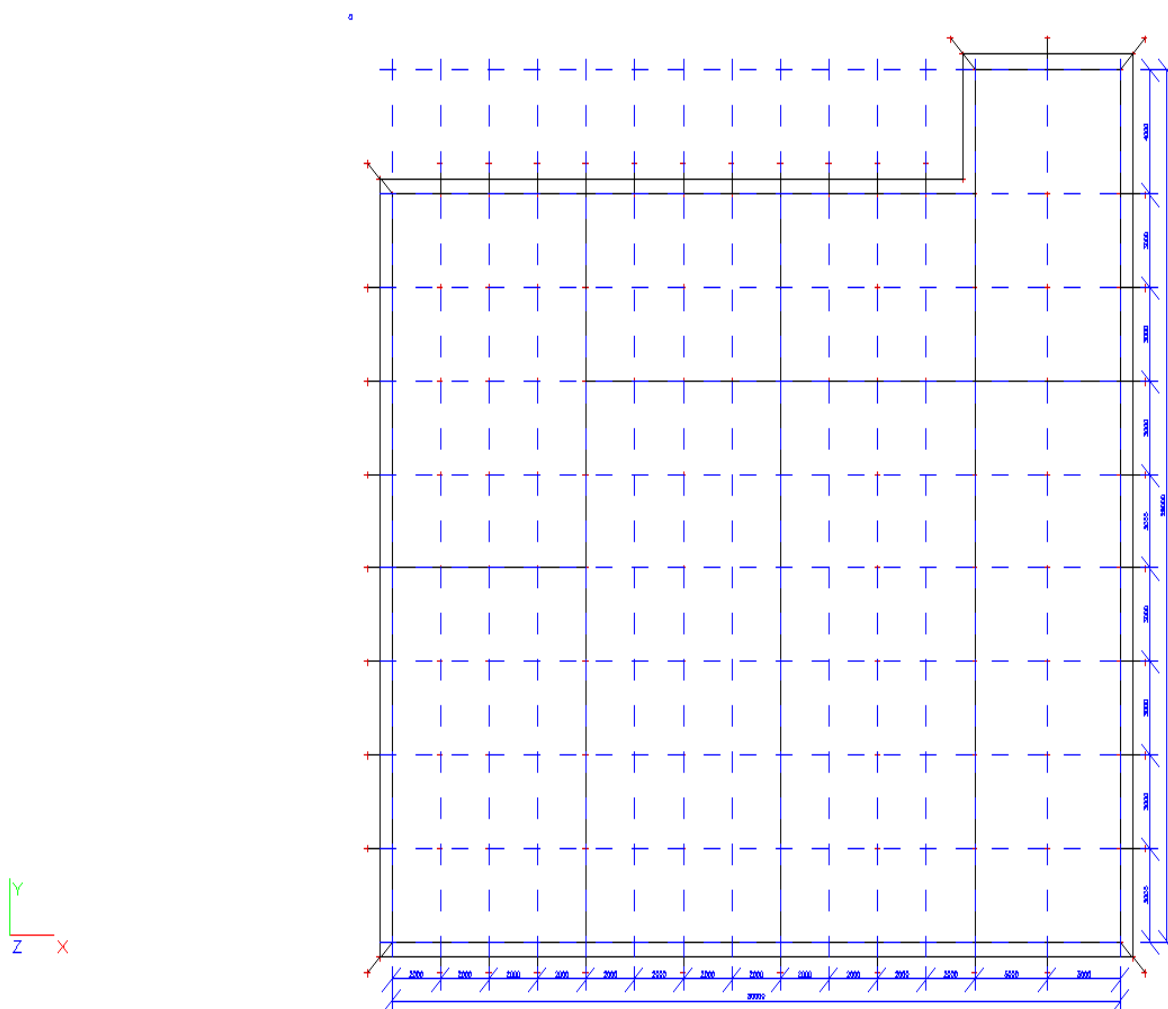


## 16. Vervorming Z-richting



## D. Analyseresultaten palen en keldervloer

### 1. Bovenzicht palen





## 2. Interne krachten op palen

Linear calculation, Extreme : Global, System : Principal

Selection : All

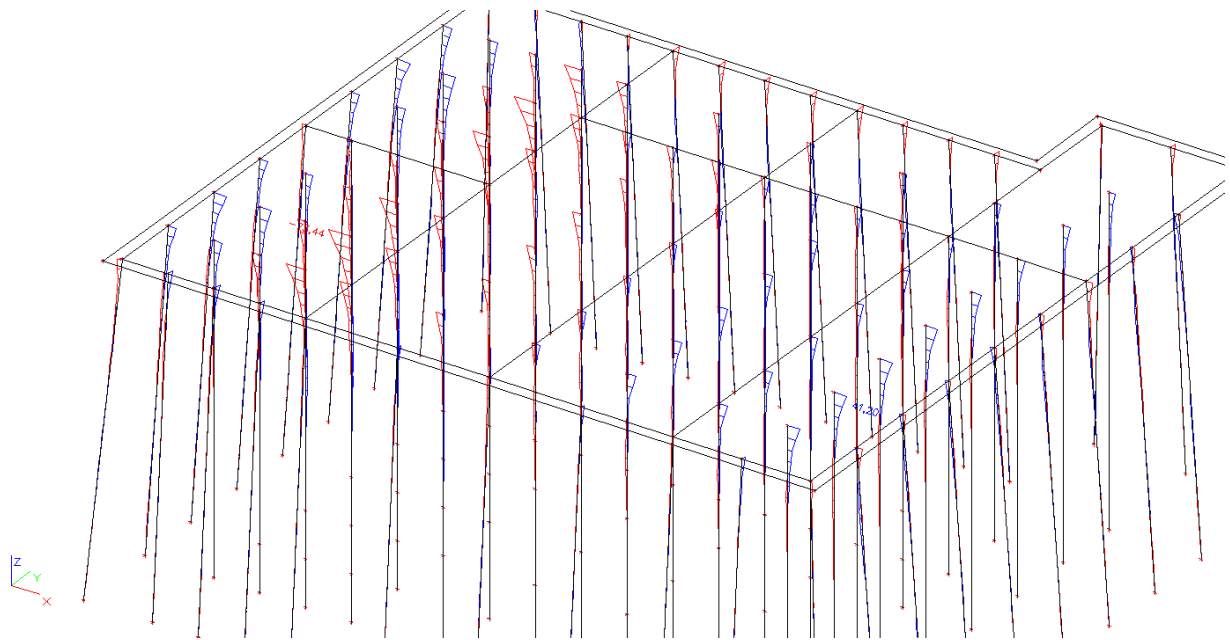
Class : All ULS

Layer : palen

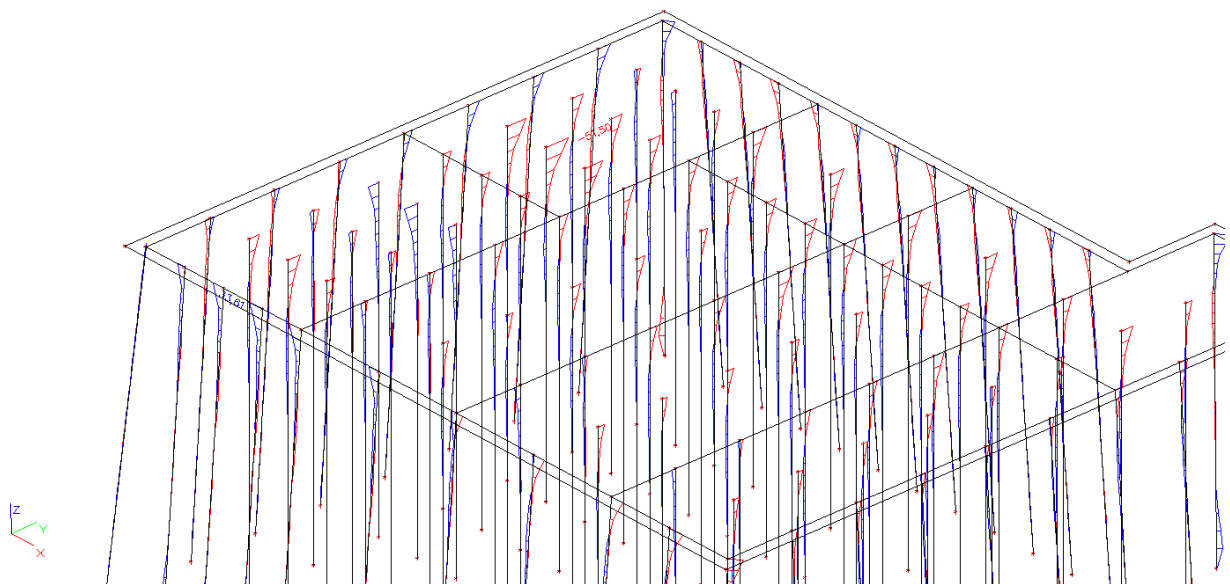
| Member | Case  | dx<br>[m] | N<br>[kN]      | Vy<br>[kN]    | Vz<br>[kN]    | Mx<br>[kNm] | My<br>[kNm]   | Mz<br>[kNm]   |
|--------|-------|-----------|----------------|---------------|---------------|-------------|---------------|---------------|
| B194   | CO2/1 | 0,000     | <b>-927,30</b> | 0,00          | 0,00          | 0,00        | 0,00          | 0,00          |
| B216   | CO2/1 | 14,000    | <b>-314,27</b> | -4,13         | 2,54          | 0,00        | -4,58         | -8,14         |
| B233   | CO2/1 | 14,000    | -713,82        | <b>-71,77</b> | 0,03          | 0,00        | 0,00          | 5,11          |
| B300   | CO2/1 | 0,000     | -692,65        | <b>27,94</b>  | -5,52         | 0,00        | 9,65          | -34,95        |
| B344   | CO3/3 | 13,000    | -503,66        | 0,46          | <b>-41,50</b> | 0,00        | -31,94        | 1,50          |
| B353   | CO2/1 | 13,000    | -633,60        | -1,71         | <b>27,46</b>  | 0,00        | 13,74         | -0,41         |
| B232   | CO1/2 | 11,000    | -533,71        | -3,15         | 3,31          | <b>0,00</b> | 0,89          | -0,89         |
| B233   | CO2/1 | 11,000    | -702,00        | 8,30          | 0,12          | <b>0,00</b> | -0,02         | 2,32          |
| B344   | CO3/3 | 14,000    | -499,74        | 0,46          | -41,50        | 0,00        | <b>-73,44</b> | 1,96          |
| B353   | CO2/1 | 14,000    | -629,67        | -1,71         | 27,46         | 0,00        | <b>41,20</b>  | -2,13         |
| B310   | CO1/2 | 14,000    | -433,01        | -33,88        | -7,34         | 0,00        | -13,77        | <b>-51,50</b> |
| B372   | CO3/3 | 0,000     | -576,02        | -23,13        | -6,24         | 0,00        | 11,56         | <b>33,61</b>  |

De palen aan de buitenkant zijn geschoord met een helling van 1 op 12.

### 3. Moment Y-richting



### 4. Moment Z-richting



## 5. Vervorming van palen

Linear calculation, Extreme : Global, System : Principal

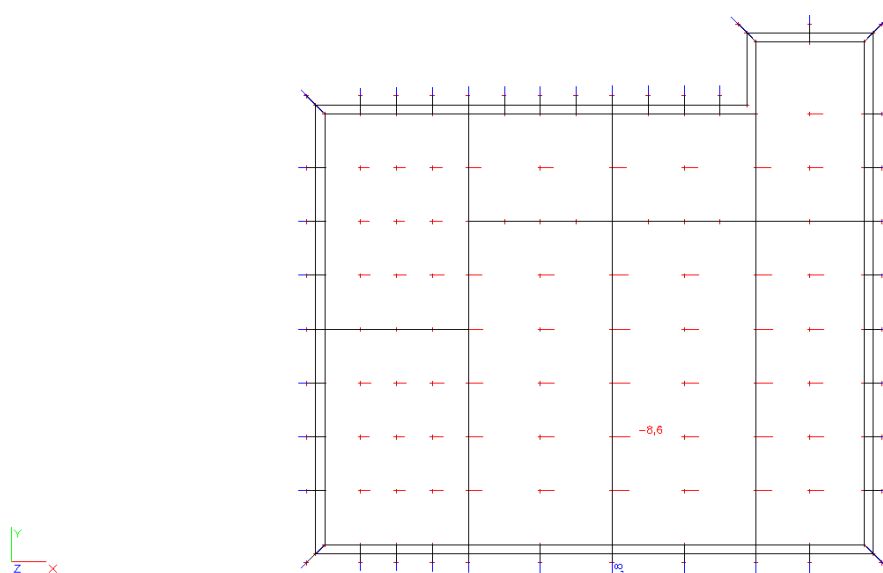
Selection : All

Class : All ULS

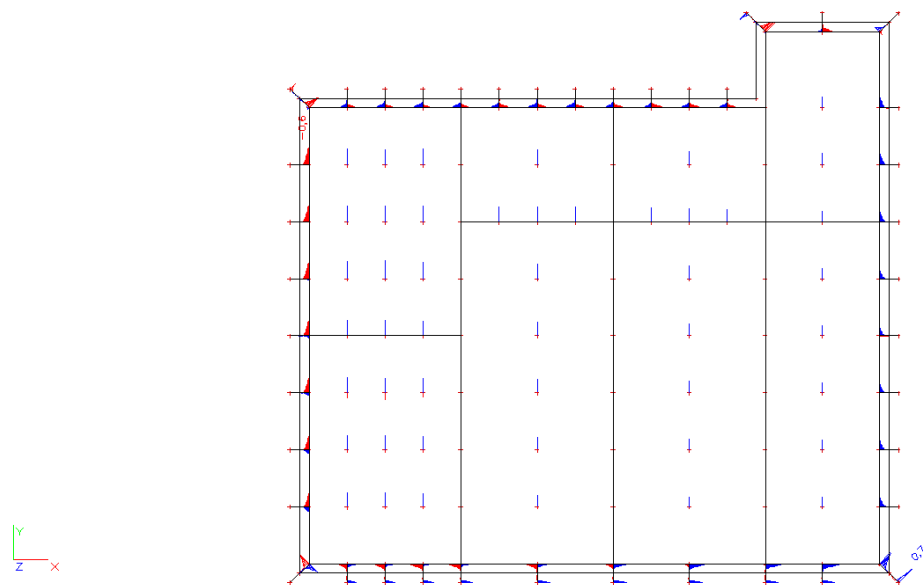
Layer : palen

| Member | Case  | dx<br>[m] | ux<br>[mm]  | uy<br>[mm]  | uz<br>[mm]  | fix<br>[mrad] | fiy<br>[mrad] | fiz<br>[mrad] |
|--------|-------|-----------|-------------|-------------|-------------|---------------|---------------|---------------|
| B194   | CO2/1 | 14,000    | <b>-8,6</b> | -0,1        | -0,5        | 0,0           | 0,1           | 0,1           |
| B261   | CO2/1 | 0,000     | <b>7,8</b>  | 0,6         | -0,5        | 0,0           | -0,1          | -0,1          |
| B291   | CO1/2 | 0,000     | 5,1         | <b>-0,6</b> | -0,4        | 0,0           | 0,3           | 0,0           |
| B233   | CO2/1 | 14,071    | 4,9         | <b>0,7</b>  | -0,5        | 0,0           | 0,0           | <b>0,6</b>    |
| B302   | CO1/2 | 0,000     | 6,2         | -0,2        | <b>-0,9</b> | 0,0           | 0,0           | -0,2          |
| B344   | CO3/3 | 13,000    | -5,0        | 0,0         | <b>0,7</b>  | 0,0           | 0,1           | 0,0           |
| B217   | CO2/1 | 0,000     | 4,0         | 0,4         | -0,6        | <b>0,0</b>    | -0,2          | -0,1          |
| B332   | CO2/1 | 0,000     | -5,4        | 0,0         | 0,0         | <b>0,0</b>    | 0,0           | 0,0           |
| B335   | CO3/3 | 14,000    | -4,1        | 0,1         | 0,3         | 0,0           | <b>-0,5</b>   | -0,1          |
| B344   | CO2/1 | 14,000    | -5,0        | -0,1        | -0,4        | 0,0           | <b>0,9</b>    | 0,1           |
| B310   | CO3/3 | 14,000    | -4,5        | 0,1         | 0,3         | 0,0           | 0,1           | <b>-0,4</b>   |

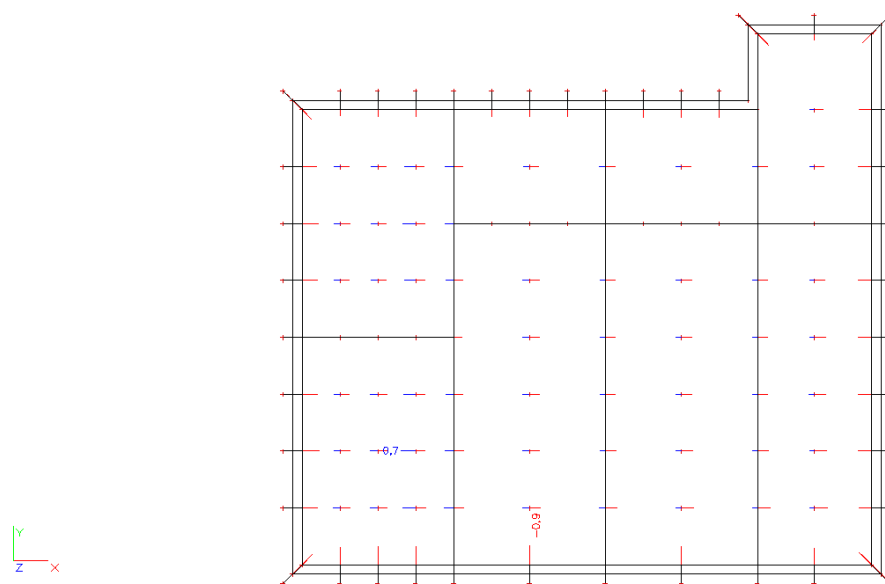
## 6. Vervorming in X-richting



## 7. Vervorming in Y-richting



## 8. Vervorming in Z-richting



## 9. Reacties

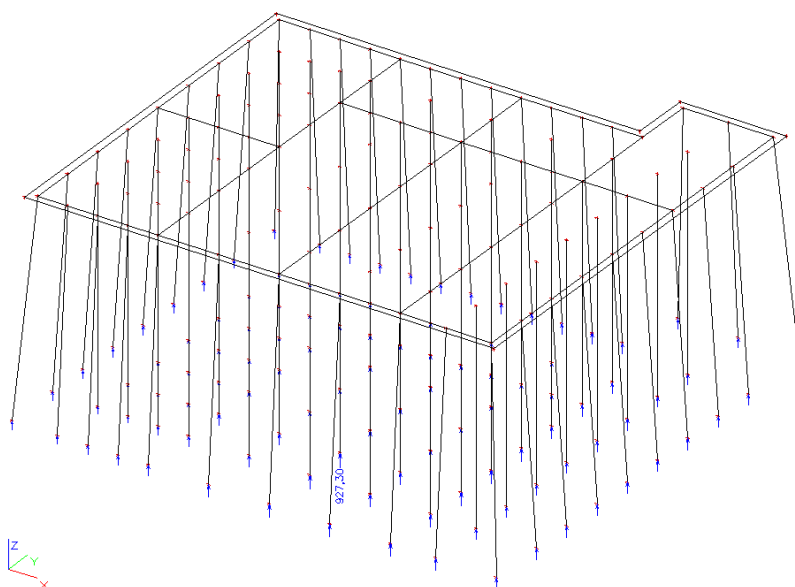
Linear calculation, Extreme : Global

Selection : All

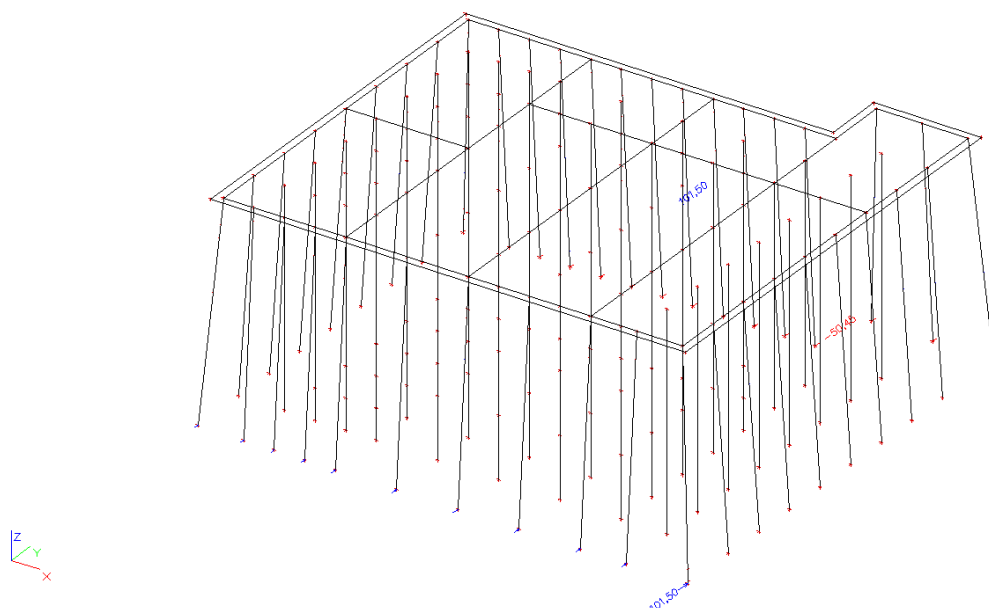
Class : All ULS

| Support    | Case  | dx<br>[m] | Rx<br>[kN]    | Ry<br>[kN]    | Rz<br>[kN]    | Mx<br>[kNm] | My<br>[kNm] | Mz<br>[kNm] |
|------------|-------|-----------|---------------|---------------|---------------|-------------|-------------|-------------|
| Sn66/N373  | CO2/1 |           | <b>-52,92</b> | 0,00          | 740,84        | 0,00        | 0,00        | 0,00        |
| Sn39/N326  | CO2/1 |           | <b>59,62</b>  | 59,62         | 834,65        | 0,00        | 0,00        | 0,00        |
| Sn194/N519 | CO1/2 |           | 0,00          | <b>-50,45</b> | 706,26        | 0,00        | 0,00        | 0,00        |
| Sn70/N278  | CO2/1 |           | 0,00          | <b>101,50</b> | 710,49        | 0,00        | 0,00        | 0,00        |
| Slb6/B217  | CO1/2 | 0,000     | 1,41          | -5,28         | <b>0,00</b>   | 0,00        | 0,00        | 0,00        |
| Sn108/N205 | CO2/1 |           | 0,00          | 0,00          | <b>927,30</b> | 0,00        | 0,00        | 0,00        |
| Sn33/N251  | CO1/2 |           | 31,47         | 31,47         | 440,52        | <b>0,00</b> | <b>0,00</b> | <b>0,00</b> |

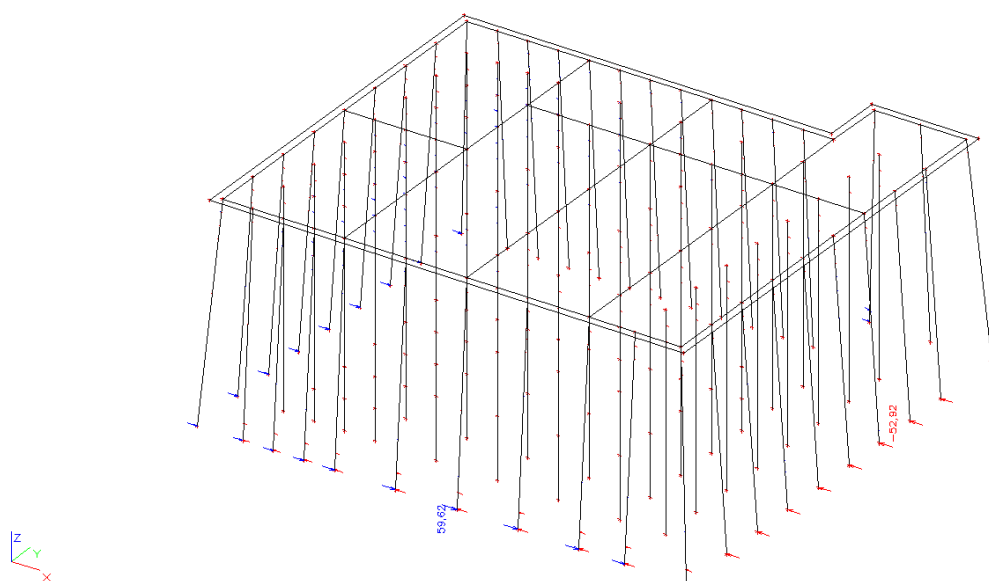
## 10. Reacties Z-richting



## 11. Reacties Y-richting



## 12. Reacties X-richting



## 13. Relatieve vervorming

Linear calculation, Extreme : Global, System : Principal

Selection : All

Class : All ULS

Layer : palen

| Case - combination | Member | dx<br>[m] | uy<br>[mm]  | Rel uy<br>[1/xx] | uz<br>[mm]  | Rel uz<br>[1/xx] |
|--------------------|--------|-----------|-------------|------------------|-------------|------------------|
| CO2/1              | B300   | 11,000    | <b>-0,7</b> | <b>1/10000</b>   | 0,2         | 1/10000          |
| CO3/3              | B302   | 14,036    | <b>0,8</b>  | <b>1/10000</b>   | 0,2         | 1/10000          |
| CO1/2              | B371   | 4,583     | 0,1         | 1/10000          | <b>-0,6</b> | <b>1/10000</b>   |
| CO2/1              | B344   | 12,000    | 0,0         | 1/10000          | <b>0,7</b>  | <b>1/10000</b>   |

## 14. Vervorming van knopen

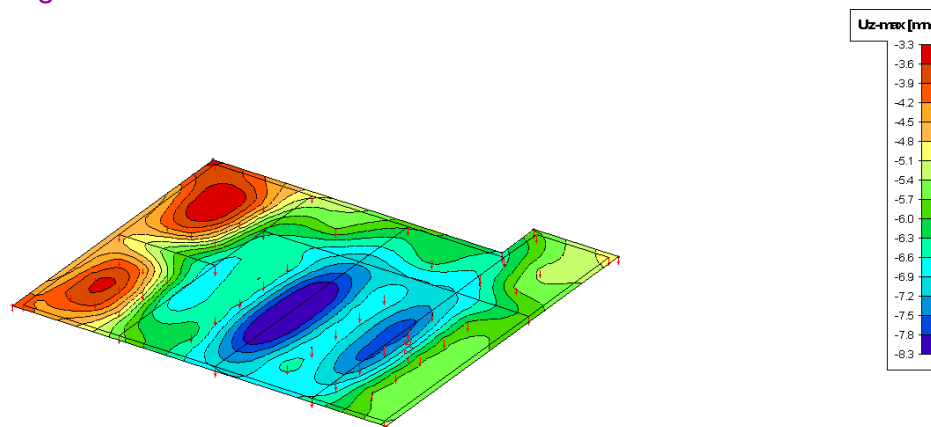
Linear calculation, Extreme : Global

Selection : All

Class : All ULS

| Case    | Node | Ux<br>[mm]  | Uy<br>[mm]  | Uz<br>[mm]  | Fix<br>[mrad] | Fiy<br>[mrad] | Fiz<br>[mrad] |
|---------|------|-------------|-------------|-------------|---------------|---------------|---------------|
| All ULS | N54  | <b>-5,9</b> | 0,0         | -6,2        | -0,1          | -1,1          | 0,0           |
| All ULS | N36  | <b>25,7</b> | 12,6        | -5,4        | 0,0           | <b>4,7</b>    | 0,2           |
| All ULS | N39  | -5,4        | <b>-0,7</b> | -5,7        | 0,3           | 2,3           | 0,0           |
| All ULS | N43  | 19,5        | <b>15,2</b> | -6,2        | -0,6          | -0,9          | 0,1           |
| All ULS | N82  | -3,8        | -0,4        | <b>-9,8</b> | -0,3          | -2,9          | -0,3          |
| All ULS | N249 | 0,0         | 0,0         | <b>-2,5</b> | 0,0           | 0,0           | 0,0           |
| All ULS | N12  | 0,0         | 0,0         | -6,5        | <b>-1,9</b>   | -0,1          | 0,0           |
| All ULS | N50  | 12,8        | 9,4         | -6,7        | <b>1,2</b>    | 0,3           | 0,4           |
| All ULS | N40  | -4,0        | -0,5        | -8,2        | -0,2          | <b>-3,9</b>   | 0,1           |
| All ULS | N43  | -2,9        | -0,3        | -7,2        | -0,7          | -2,1          | <b>-0,6</b>   |
| All ULS | N55  | 5,1         | 3,2         | -6,0        | 0,3           | 1,3           | <b>0,9</b>    |

## 15. Vervorming Z-richting



## 16. 2D element - Interne krachten keldervloer

Linear calculation, Extreme : Global

Selection : All

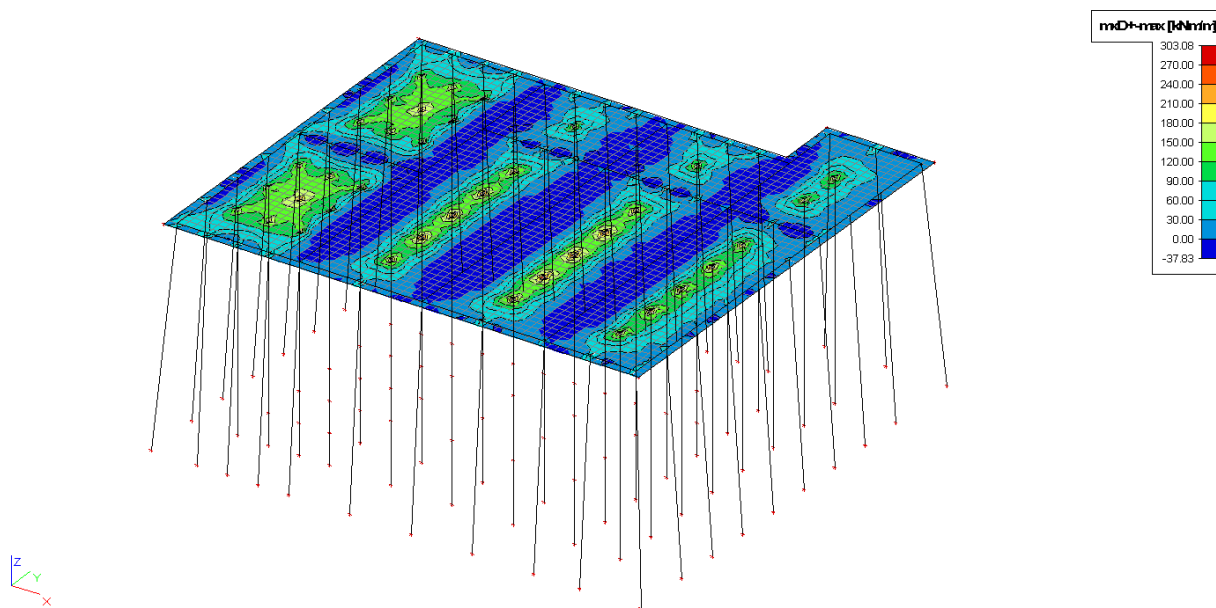
Class : All ULS

Dimensional magnitudes. In nodes, avg. on macro.

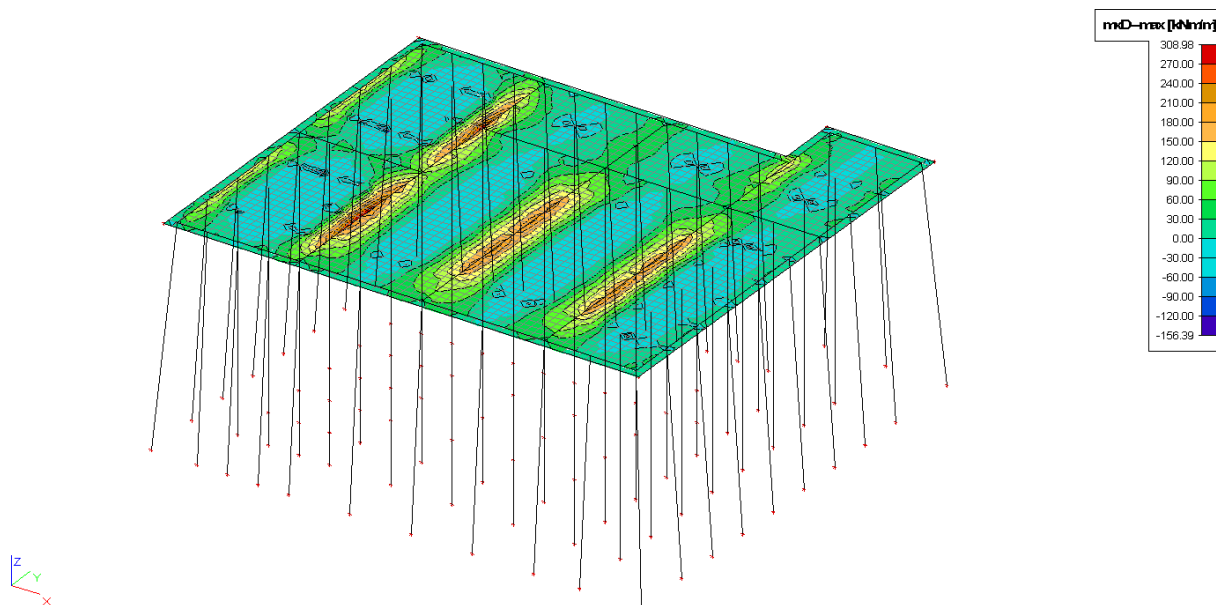
| Case    | elem | mxD+<br>[kNm/m] | myD+<br>[kNm/m] | mcD+<br>[kNm/m] | mxD-<br>[kNm/m] | myD-<br>[kNm/m] | mcD-<br>[kNm/m] | nxD<br>[kN/m] | nyD<br>[kN/m] | ncD<br>[kN/m] |
|---------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------------|---------------|---------------|
| All ULS | 7380 | <b>-41,44</b>   | 0,00            | -46,12          | 38,95           | 40,22           | -7,68           | 486,71        | 349,33        | -639,02       |
| All ULS | 5493 | <b>303,08</b>   | 171,89          | -3,86           | 0,00            | -155,00         | -263,08         | 131,25        | 234,16        | -33,37        |
| All ULS | 7018 | 0,00            | <b>-94,88</b>   | -287,15         | 277,96          | 89,02           | -7,72           | 0,00          | 314,86        | -41,14        |
| All ULS | 7446 | 219,35          | <b>223,46</b>   | -22,88          | 0,00            | 0,00            | -168,01         | 140,08        | 155,43        | -115,00       |
| All ULS | 7020 | 0,00            | -40,83          | <b>-291,05</b>  | 277,25          | 35,62           | -29,81          | 17,72         | 325,50        | -111,25       |
| All ULS | 6064 | 15,79           | 8,90            | <b>-0,01</b>    | 0,00            | -0,62           | -10,88          | 33,24         | 54,55         | -65,66        |
| All ULS | 7446 | 177,45          | 178,66          | -45,37          | <b>-194,11</b>  | -184,85         | -203,34         | 14,22         | 92,38         | -176,62       |
| All ULS | 7377 | 0,00            | -42,13          | -245,50         | <b>308,98</b>   | 81,11           | -21,88          | 167,99        | 353,65        | -153,40       |
| All ULS | 5501 | 222,63          | 175,15          | -13,92          | 0,00            | <b>-190,41</b>  | -259,82         | 193,47        | 90,59         | -236,46       |
| All ULS | 7001 | -31,47          | 0,00            | -186,08         | 38,63           | <b>199,23</b>   | -4,42           | 0,00          | 205,39        | -146,38       |
| All ULS | 5493 | 265,00          | 156,94          | -18,27          | 0,00            | -164,15         | <b>-294,22</b>  | 76,76         | 219,42        | -80,48        |
| All ULS | 5411 | 0,00            | -41,13          | -137,23         | 153,48          | 46,53           | <b>0,00</b>     | 270,96        | 446,13        | -314,46       |

|         |      |       |        |         |        |       |        |                |                |                |
|---------|------|-------|--------|---------|--------|-------|--------|----------------|----------------|----------------|
| All ULS | 5867 | 36,65 | 54,93  | -28,55  | -28,94 | 0,00  | -57,32 | <b>-134,78</b> | 0,00           | -378,02        |
| All ULS | 5469 | 4,98  | 47,20  | -37,23  | 51,41  | 16,40 | -35,70 | <b>717,22</b>  | 154,01         | -49,88         |
| All ULS | 5873 | 5,91  | 35,48  | -15,88  | -24,72 | 0,00  | -37,01 | -12,39         | <b>-152,39</b> | -178,30        |
| All ULS | 6594 | 0,00  | -65,32 | -184,13 | 192,69 | 74,98 | -4,96  | 266,20         | <b>668,71</b>  | -331,12        |
| All ULS | 4922 | 0,00  | 1,02   | -24,14  | 26,86  | 11,33 | -21,69 | 449,53         | 302,24         | <b>-714,26</b> |
| All ULS | 6306 | 30,12 | 0,00   | -10,92  | 0,00   | 14,65 | -26,31 | 145,35         | 207,92         | <b>-0,02</b>   |

## 17. Moment ter berekening van de wapening in de X-richting aan de bovenzijde

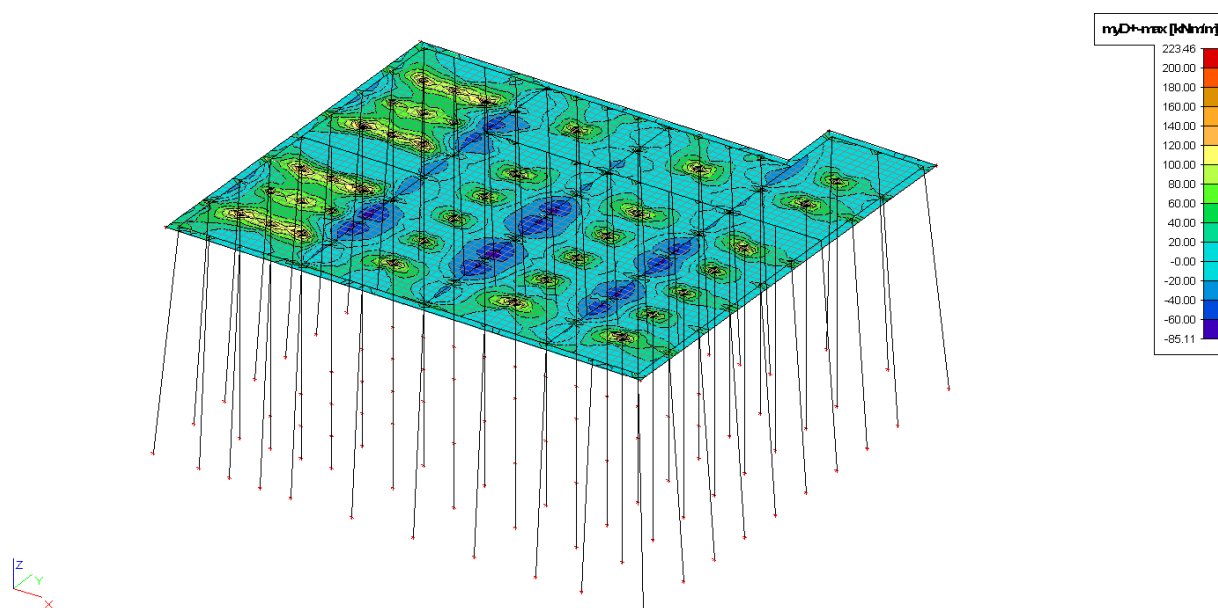


## 18. Moment ter berekening van de wapening in de X-richting aan de onderzijde

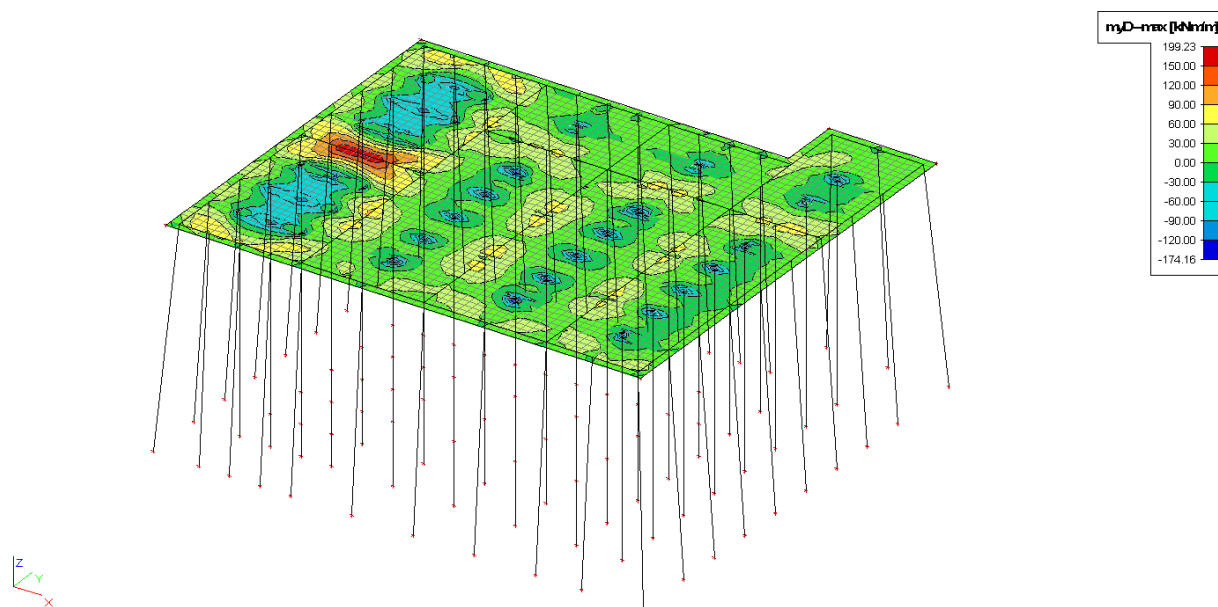




## 19. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde



## 20. Moment ter berekening van de wapening in de Y-richting aan de onderzijde



## E. Analyseresultaten gevel

### 1. 2D element – Interne krachten

Linear calculation, Extreme : Global

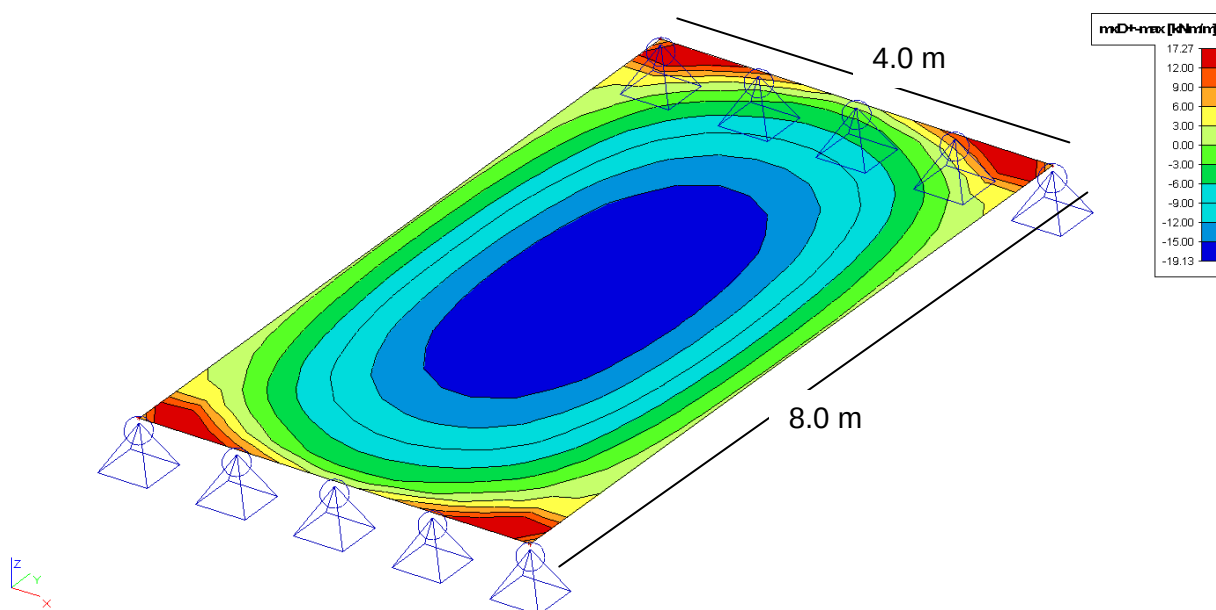
Selection : All

Class : All ULS

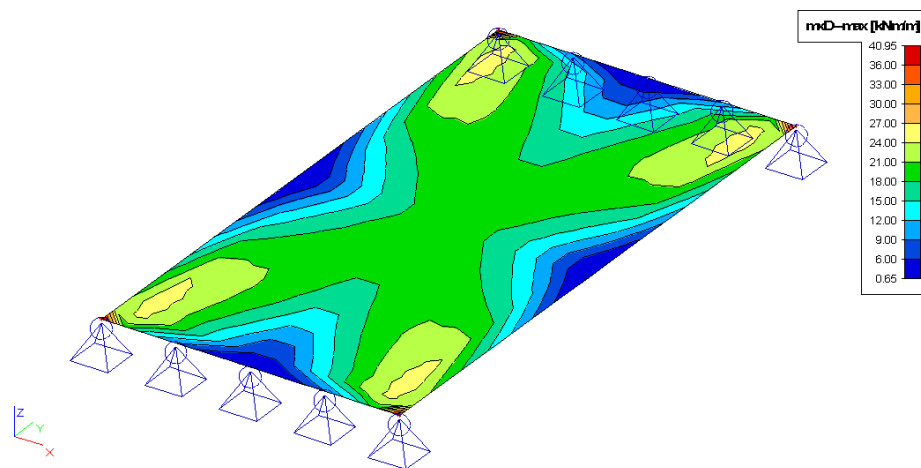
Dimensional magnitudes. In nodes, avg. on macro.

| Case    | elem | mxD+<br>[kNm/m] | myD+<br>[kNm/m] | mcD+<br>[kNm/m] | mxD-<br>[kNm/m] | myD-<br>[kNm/m] | mcD-<br>[kNm/m] | nxD<br>[kN/m] | nyD<br>[kN/m] | ncD<br>[kN/m] |
|---------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|---------------|---------------|---------------|
| All ULS | 162  | <b>-19,13</b>   | 0,00            | -291,23         | 19,24           | 291,33          | -0,22           | 0,00          | 0,00          | 0,00          |
| All ULS | 339  | <b>17,27</b>    | <b>17,47</b>    | -37,05          | 19,78           | 19,58           | -37,05          | 0,00          | 0,00          | 0,00          |
| All ULS | 1    | 14,30           | <b>0,00</b>     | -57,98          | 24,79           | 68,73           | <b>-49,84</b>   | 0,00          | 0,00          | 0,00          |
| All ULS | 157  | 0,44            | 0,00            | <b>-298,91</b>  | 0,65            | <b>299,99</b>   | -2,17           | 0,00          | 0,00          | 0,00          |
| All ULS | 6    | 2,11            | 1,53            | <b>-2,79</b>    | 0,68            | <b>1,26</b>     | -2,79           | 0,00          | 0,00          | 0,00          |
| All ULS | 182  | 0,44            | 0,00            | -298,91         | <b>0,65</b>     | 299,99          | -2,17           | 0,00          | 0,00          | 0,00          |
| All ULS | 1    | 6,15            | 13,12           | -47,10          | <b>40,95</b>    | 33,98           | -47,10          | <b>0,00</b>   | <b>0,00</b>   | <b>0,00</b>   |
| All ULS | 176  | -19,13          | 0,00            | -291,23         | 19,24           | 291,33          | <b>-0,22</b>    | 0,00          | 0,00          | 0,00          |

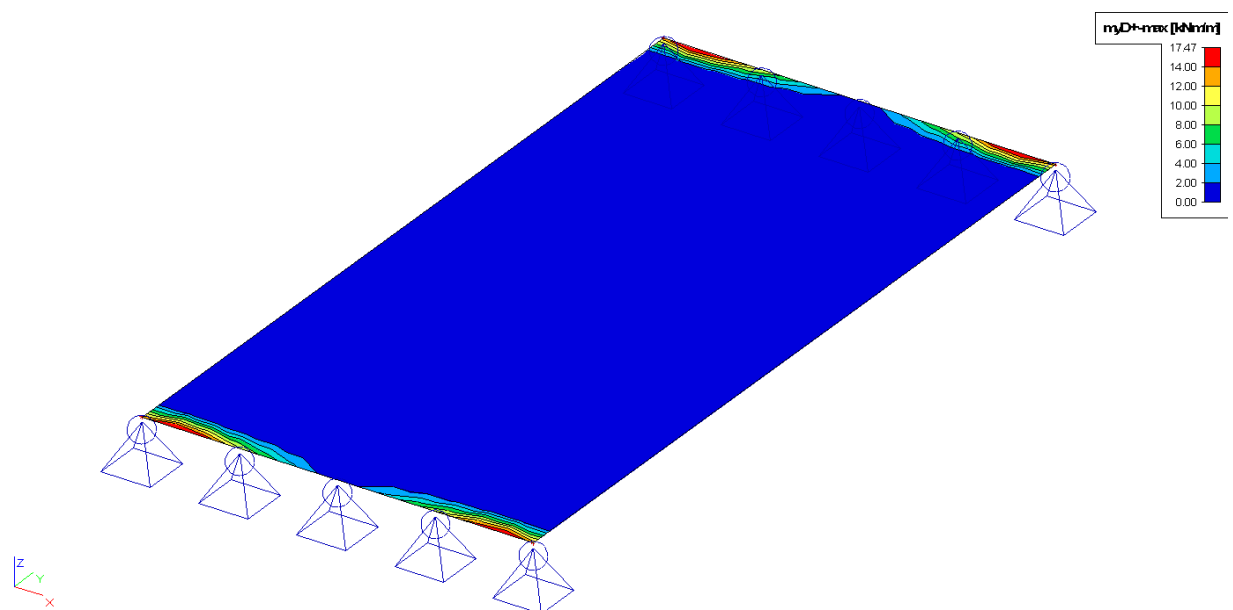
### 2. Moment ter berekening van de wapening in de X-richting aan de bovenzijde



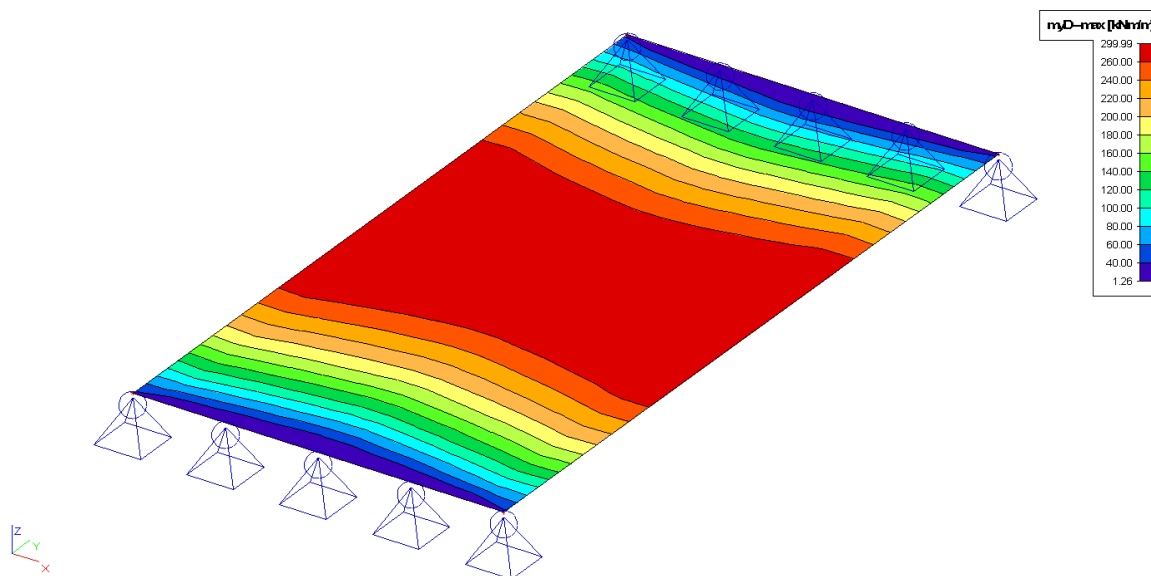
### 3. Moment ter berekening van de wapening in de X-richting aan de onderzijde



### 4. Moment ter berekening van de wapening in de Y-richting aan de bovenzijde



## 5. Moment ter berekening van de wapening in de Y-richting aan de onderzijde



## 6. Vervorming van knopen

Linear calculation, Extreme : Global

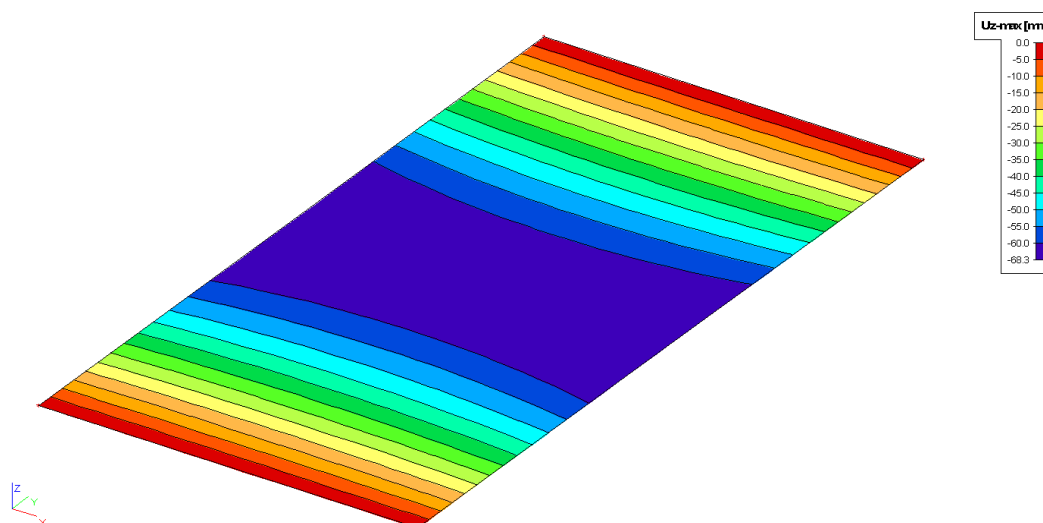
Selection : All

Class : All ULS

| Case    | Node | Ux<br>[mm] | Uy<br>[mm] | Uz<br>[mm] | Fix<br>[mrad] | Fiy<br>[mrad] | Fiz<br>[mrad] |
|---------|------|------------|------------|------------|---------------|---------------|---------------|
| All ULS | N1   | 0,0        | 0,0        | 0,0        | -27,3         | 0,0           | 0,0           |
| All ULS | 184  | 0,0        | 0,0        | -68,3      | -1,5          | -3,1          | 0,0           |
| All ULS | N3   | 0,0        | 0,0        | 0,0        | 27,3          | 0,0           | 0,0           |
| All ULS | 196  | 0,0        | 0,0        | -68,3      | -1,5          | 3,1           | 0,0           |

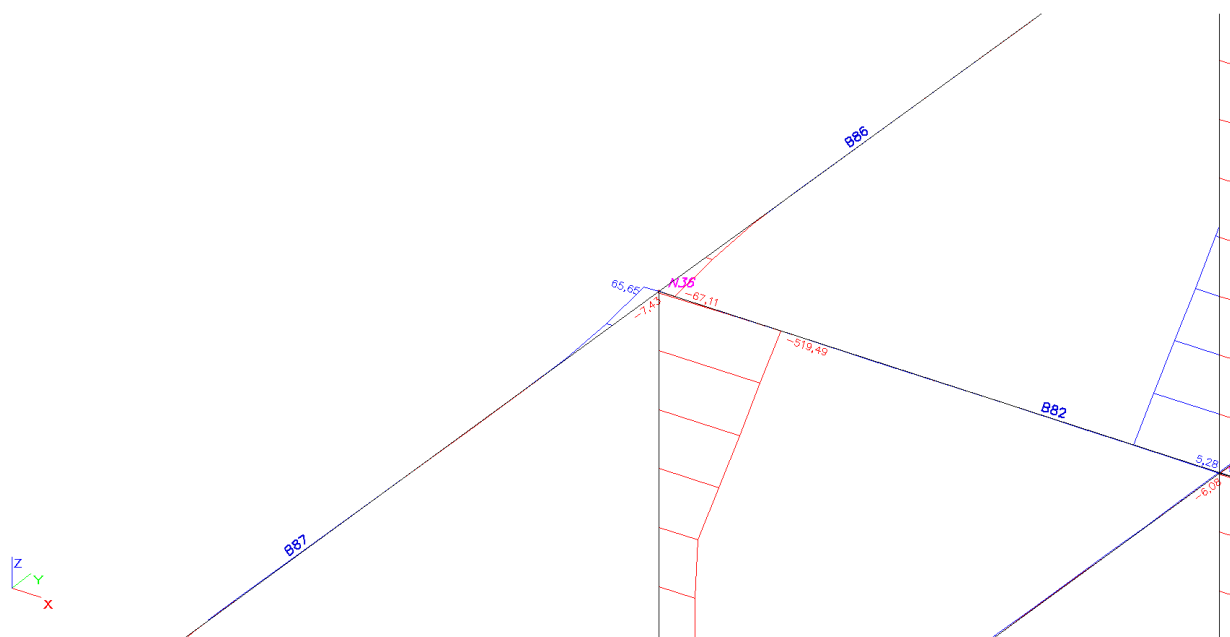
Op grond van de gegevens in de tabel is te zien dat de vervorming groter is dan de toegestane limiet. Dit zou opgelost kunnen worden door de gevels te laten steunen op de lange zijde. Dit is echter niet gedaan vanwege de trilling. Hier zou dus nog iets mee moeten gebeuren. Dit valt echter buiten het bereik van deze studie.

## 7. Vervorming in Z-richting

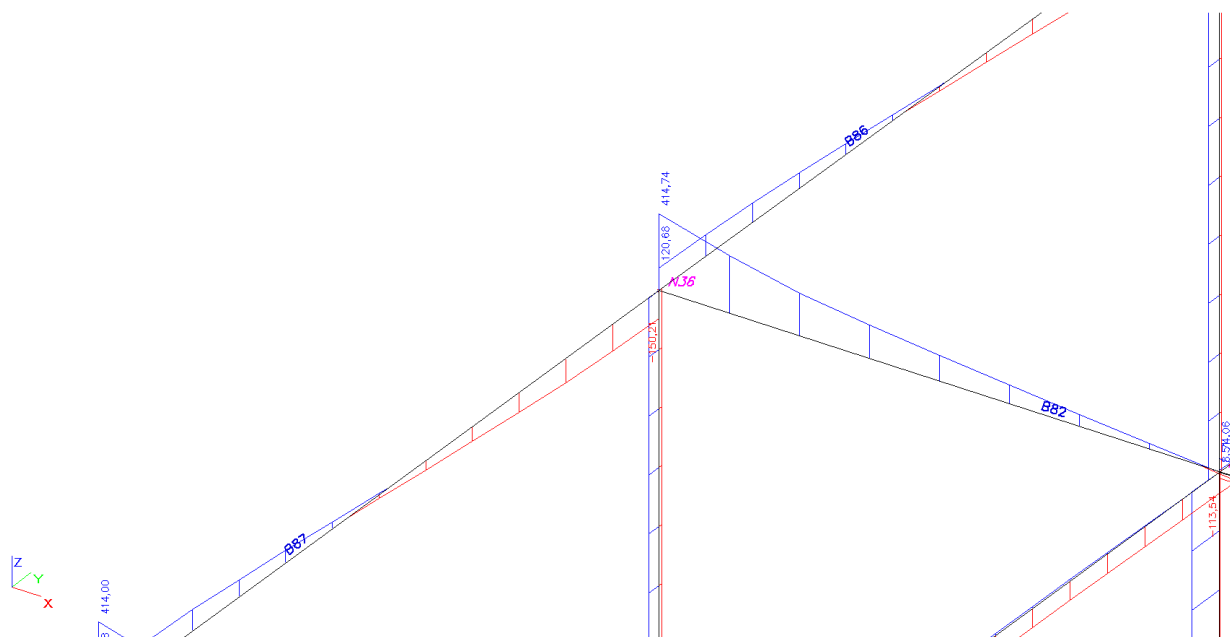


## F. Analyseresultaten verbindingen

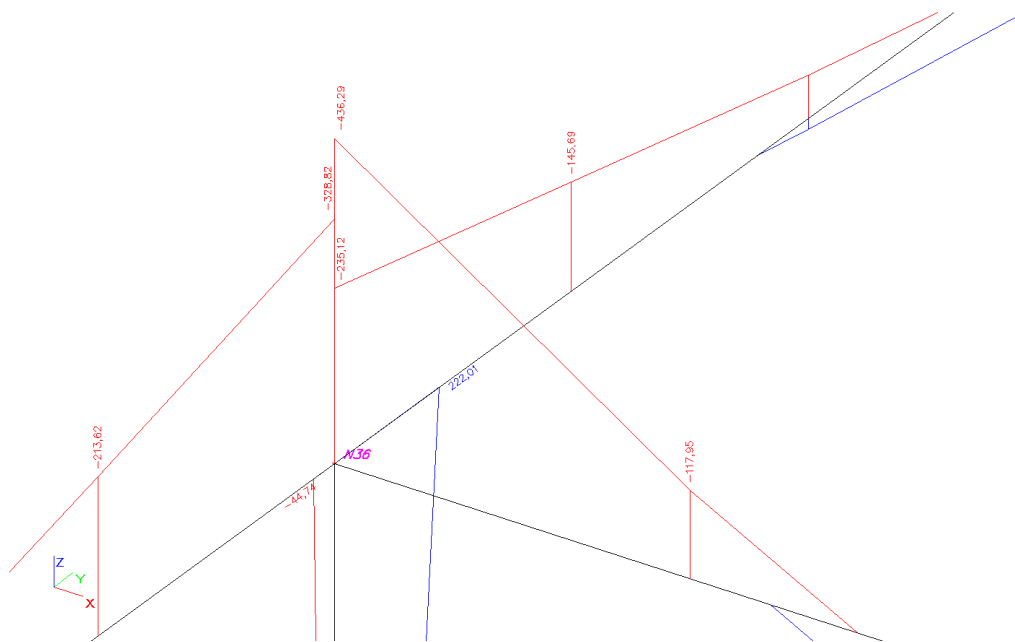
### 1. Dwarskracht in Y-richting voor knoop 36



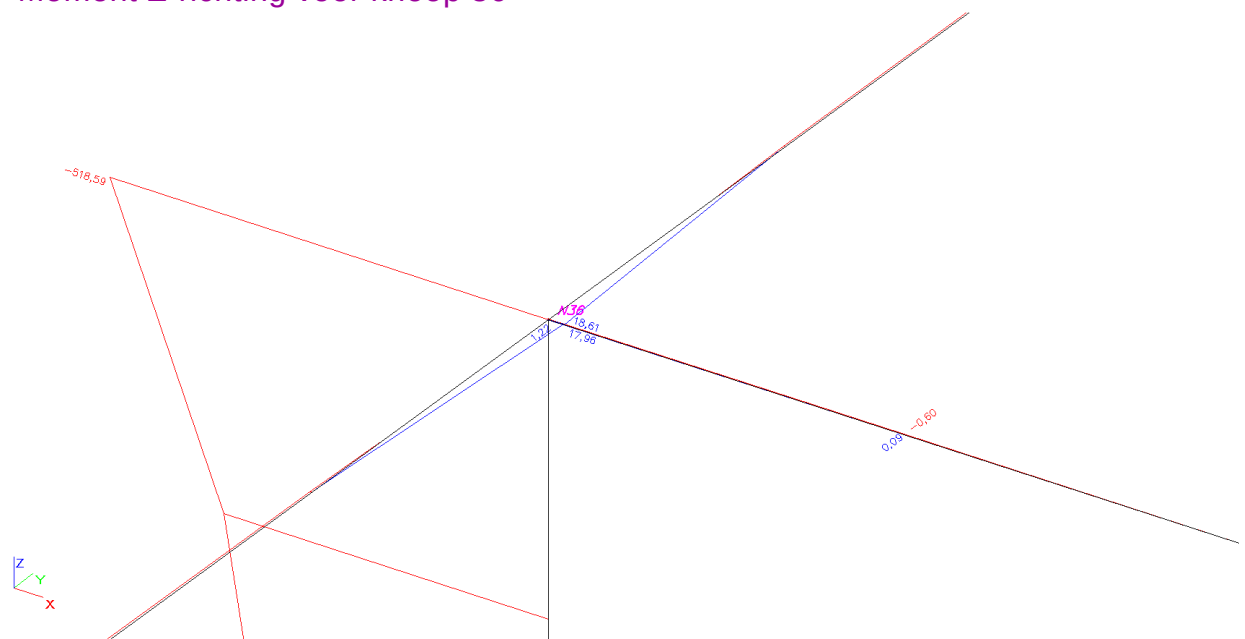
### 2. Dwarskracht Z-richting voor knoop 36



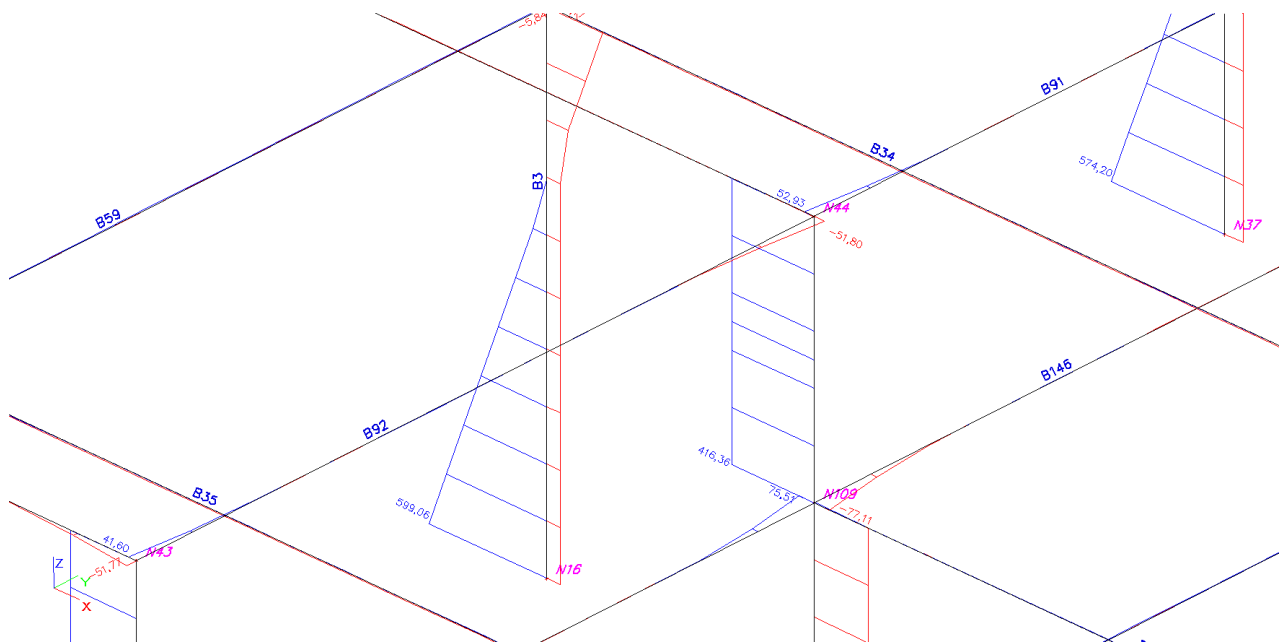
### 3. Moment Y-richting knoop 36



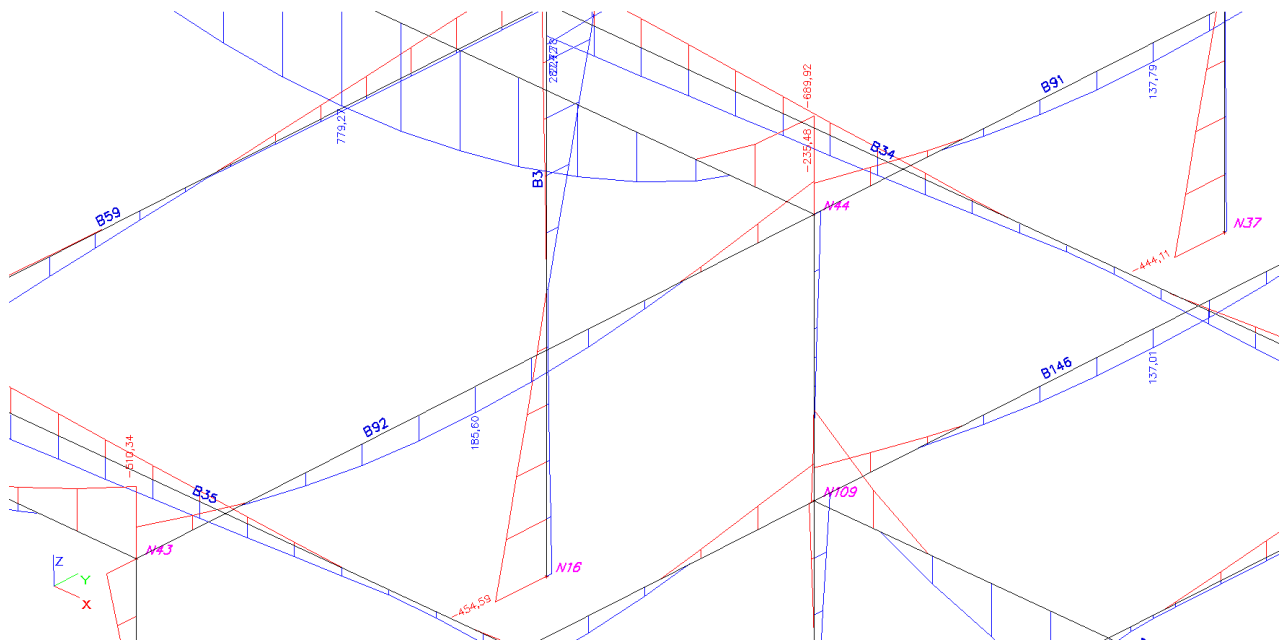
### 4. Moment Z-richting voor knoop 36



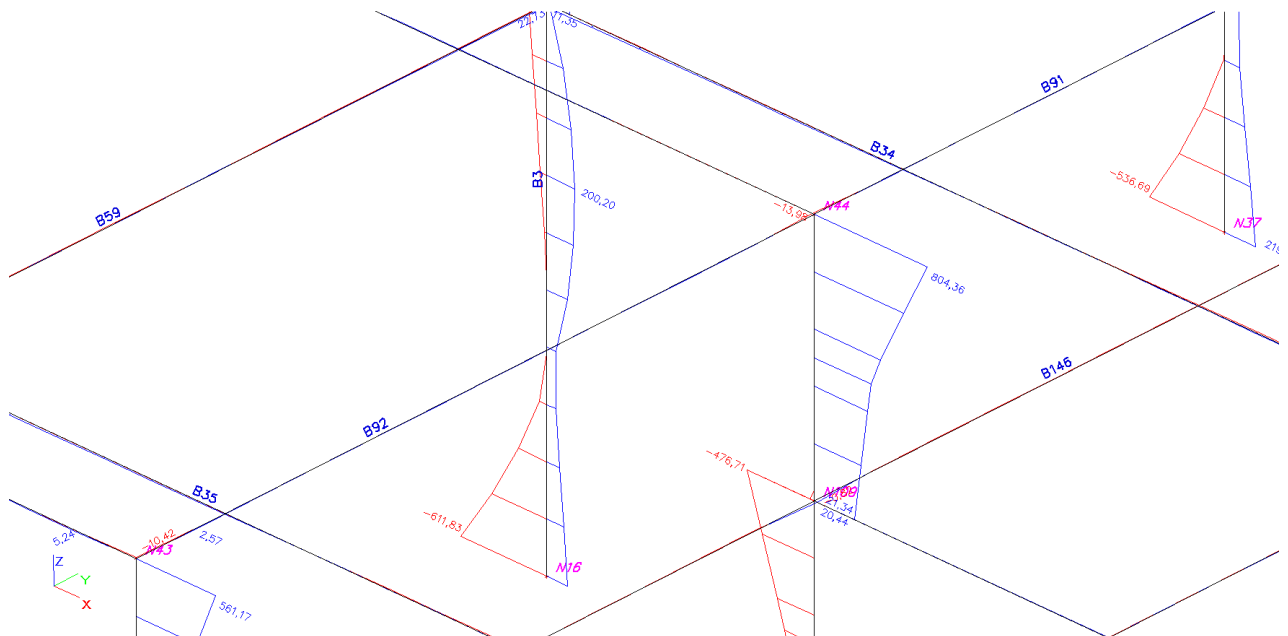
## 5. Dwarskracht Y-richting voor knoop 16



## 7. Moment Y-richting voor knoop 16



## 8. Moment Z-richting voor knoop 16





## G. Ontwerp in ESA-PT

### 1. Check van staal - kolom

Check of steel

EC3 : EN 1993 Code Check

|            |            |       |       |      |
|------------|------------|-------|-------|------|
| Member B32 | HHD400x421 | S 355 | CO2/1 | 0,64 |
|------------|------------|-------|-------|------|

| Basic data EC3 : EN 1993                                        |      |
|-----------------------------------------------------------------|------|
| partial safety factor Gamma M0 for resistance of cross-sections | 1,00 |
| partial safety factor Gamma M1 for resistance to instability    | 1,00 |
| partial safety factor Gamma M2 for resistance of net sections   | 1,25 |

| Material data       |        |     |
|---------------------|--------|-----|
| yield strength fy   | 335,00 | MPa |
| tension strength fu | 470,00 | MPa |
| fabrication         | rolled |     |

#### SECTION CHECK

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).

ratio 8,84 on position 4,00 m

| ratio         |   |       |
|---------------|---|-------|
| maximum ratio | 1 | 27,64 |
| maximum ratio | 2 | 31,83 |
| maximum ratio | 3 | 35,44 |

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).

ratio 3,29 on position 4,00 m

| ratio         |   |       |
|---------------|---|-------|
| maximum ratio | 1 | 7,54  |
| maximum ratio | 2 | 8,38  |
| maximum ratio | 3 | 12,70 |

==> Class cross-section 1

The critical check is on position 4,00 m

| Internal forces   |          |    |
|-------------------|----------|----|
| N <sub>Ed</sub>   | -1108,37 | kN |
| V <sub>y,Ed</sub> | 576,39   | kN |
| V <sub>z,Ed</sub> | 12,33    | kN |

|                   |         |         |
|-------------------|---------|---------|
| T <sub>Ed</sub>   | -0,04   | kN<br>m |
| M <sub>y,Ed</sub> | 2,54    | kN<br>m |
| M <sub>z,Ed</sub> | -212,82 | kN<br>m |

#### Compression check

according to article EN 1993-1-1 : 6.2.4 and formula EN 1993-1-1 : (6.9)

Section classification is 1.

| Table of values   |          |    |
|-------------------|----------|----|
| N <sub>c,Rd</sub> | 17989,50 | kN |
| unity check       | 0,06     |    |

#### Shear check (V<sub>y</sub>)

according to article EN 1993-1-1 : 6.2.6. and formula EN 1993-1-1 : (6.17)

| Table of values   |         |    |
|-------------------|---------|----|
| V <sub>c,Rd</sub> | 8357,45 | kN |
| unity check       | 0,07    |    |

#### Shear check (V<sub>z</sub>)

according to article EN 1993-1-1 : 6.2.6. and formula EN 1993-1-1 : (6.17)

| Table of values   |         |    |
|-------------------|---------|----|
| V <sub>c,Rd</sub> | 2703,22 | kN |
| unity check       | 0,00    |    |

#### Bending moment check (M<sub>y</sub>)

according to article EN 1993-1-1 : 6.2.5. and formula EN 1993-1-1 : (6.12)

Section classification is 1.

| Table of values   |         |         |
|-------------------|---------|---------|
| M <sub>c,Rd</sub> | 2974,80 | kN<br>m |
| unity check       | 0,00    |         |

#### Bending moment check (M<sub>z</sub>)

according to article EN 1993-1-1 : 6.2.5. and formula EN 1993-1-1 : (6.12)

Section classification is 1.

| Table of values   |         |         |
|-------------------|---------|---------|
| M <sub>c,Rd</sub> | 1504,15 | kN<br>m |
| unity check       | 0,14    |         |

#### Combined bending, axial force and shear force check

according to article EN 1993-1-1 : 6.2.9.1. and formula EN 1993-1-1 : (6.41)

Section classification is 1.

| Table of values      |         |         |
|----------------------|---------|---------|
| MN <sub>Vy</sub> .Rd | 2974,80 | kN<br>m |
| MN <sub>Vz</sub> .Rd | 1504,15 | kN<br>m |

alfa 2,00 beta 1,00

unity check 0,14

Element satisfies the section check !

#### STABILITY CHECK

| Buckling parameters | yy        | zz        |    |
|---------------------|-----------|-----------|----|
| type                | sway      | sway      |    |
| Slenderness         | 24,54     | 28,22     |    |
| Reduced slenderness | 0,31      | 0,36      |    |
| Buckling curve      | b         | c         |    |
| Imperfection        | 0,34      | 0,49      |    |
| Reduction factor    | 0,96      | 0,92      |    |
| Length              | 2,00      | 2,00      | m  |
| Buckling factor     | 2,12      | 1,49      |    |
| Buckling length     | 4,23      | 2,99      | m  |
| Critical Euler load | 184855,89 | 139719,94 | kN |

#### Buckling check

according to article EN 1993-1-1 : 6.3.1.1. and formula EN 1993-1-1 : (6.46)

| Table of values |          |    |
|-----------------|----------|----|
| Nb.Rd           | 16530,42 | kN |
| unity check     | 0,07     |    |

#### LTB check

according to article EN 1993-1-1 : 6.3.2.1. and formula EN 1993-1-1 : (6.54)

| Table of values      |               |                 |
|----------------------|---------------|-----------------|
| Mb.Rd                | 2974,80       | kNm             |
| Wy                   | 8880000,00    | mm <sup>3</sup> |
| reduction            | 1,00          |                 |
| imperfection         | 0,21          |                 |
| reduced slenderness  | 0,16          |                 |
| method for LTB curve | Art. 6.3.2.2. |                 |
| Mcr                  | 117244,10     | kNm             |
| unity check          | 0,00          |                 |

| LTB        |      |   |
|------------|------|---|
| LTB length | 2,00 | m |
| k          | 1,00 |   |
| kw         | 1,00 |   |
| C1         | 1,75 |   |
| C2         | 0,00 |   |
| C3         | 0,94 |   |

load in center of gravity

**Compression and bending check**

according to article EN 1993-1-1 : 6.3.3. and formula EN 1993-1-1 : (6.61) (6.62)

**Interaction Method 2**

| Table of values      |            |                 |
|----------------------|------------|-----------------|
| kyy                  | 0,906      |                 |
| kyz                  | 0,544      |                 |
| kzy                  | 0,959      |                 |
| kzz                  | 0,907      |                 |
| Delta My             | 0,00       | kNm             |
| Delta Mz             | 0,00       | kNm             |
| A                    | 53700,00   | mm <sup>2</sup> |
| Wy                   | 8880000,00 | mm <sup>3</sup> |
| Wz                   | 4490000,00 | mm <sup>3</sup> |
| NRk                  | 17989,50   | kN              |
| My,Rk                | 2974,80    | kNm             |
| Mz,Rk                | 1504,15    | kNm             |
| My,Ed                | 27,20      | kNm             |
| Mz,Ed                | 939,95     | kNm             |
| Interaction Method 2 |            |                 |
| Cmy                  | 0,900      |                 |
| Cmz                  | 0,900      |                 |
| CmLT                 | 0,637      |                 |

unity check = 0,06 + 0,01 + 0,34 = 0,41

unity check = 0,07 + 0,01 + 0,57 = 0,64

Element satisfies the stability check !

**2. Check van staal - balk**

Check of steel

**EC3 : EN 1993 Code Check**

|            |            |       |       |      |
|------------|------------|-------|-------|------|
| Member B94 | HHD400x509 | S 355 | CO2/1 | 0,49 |
|------------|------------|-------|-------|------|

| Basic data EC3 : EN 1993                                        |      |
|-----------------------------------------------------------------|------|
| partial safety factor Gamma M0 for resistance of cross-sections | 1,00 |
| partial safety factor Gamma M1 for resistance to instability    | 1,00 |
| partial safety factor Gamma M2 for resistance of net sections   | 1,25 |

| Material data       |        |     |
|---------------------|--------|-----|
| yield strength fy   | 335,00 | MPa |
| tension strength fu | 470,00 | MPa |
| fabrication         | rolled |     |

**SECTION CHECK**

Width-to-thickness ratio for internal compression parts (EN 1993-1-1 : Tab.5.2. sheet 1).  
ratio 7,43 on position 0,00 m

| ratio         |   |       |
|---------------|---|-------|
| maximum ratio | 1 | 49,42 |
| maximum ratio | 2 | 56,91 |
| maximum ratio | 3 | 64,96 |

==> Class cross-section 1

Width-to-thickness ratio for outstand flanges (EN 1993-1-1 : Tab.5.2. sheet 2).  
ratio 2,77 on position 0,00 m

| ratio         |   |       |
|---------------|---|-------|
| maximum ratio | 1 | 7,54  |
| maximum ratio | 2 | 8,38  |
| maximum ratio | 3 | 11,95 |

==> Class cross-section 1

**The critical check is on position 8,00 m**

| Internal forces   |          |         |
|-------------------|----------|---------|
| N <sub>Ed</sub>   | -749,25  | kN      |
| V <sub>y,Ed</sub> | -26,15   | kN      |
| V <sub>z,Ed</sub> | -996,67  | kN      |
| T <sub>Ed</sub>   | -33,76   | kN<br>m |
| M <sub>y,Ed</sub> | -1300,73 | kN<br>m |
| M <sub>z,Ed</sub> | 95,46    | kN<br>m |

**Compression check**

according to article EN 1993-1-1 : 6.2.4 and formula EN 1993-1-1 : (6.9)  
Section classification is 1.

| Table of values   |          |    |
|-------------------|----------|----|
| N <sub>c,Rd</sub> | 21842,00 | kN |
| unity check       | 0,03     |    |

**Torsion check**

according to article EN 1993-1-1 : 6.2.7. and formula EN 1993-1-1 : (6.23)

| Table of values |        |     |
|-----------------|--------|-----|
| tau t,Rd        | 194,30 | MPa |
| tau t, Ed       | 28,18  | MPa |
| unity check     | 0,15   |     |

**Shear check (Vy)**

according to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula EN 1993-1-1 : (6.25)

| Table of values |             |    |
|-----------------|-------------|----|
| Vc,Rd           | 9576,7<br>4 | kN |
| unity check     | 0,00        |    |

**Shear check (Vz)**

according to article EN 1993-1-1 : 6.2.6. & 6.2.7 and formula EN 1993-1-1 : (6.25)

| Table of values |             |    |
|-----------------|-------------|----|
| Vc,Rd           | 3157,9<br>4 | kN |
| unity check     | 0,32        |    |

**Bending moment check (My)**

according to article EN 1993-1-1 : 6.2.5. and formula EN 1993-1-1 : (6.12)

Section classification is 1.

| Table of values |             |         |
|-----------------|-------------|---------|
| Mc,Rd           | 3685,0<br>0 | kN<br>m |
| unity check     | 0,35        |         |

**Bending moment check (Mz)**

according to article EN 1993-1-1 : 6.2.5. and formula EN 1993-1-1 : (6.12)

Section classification is 1.

| Table of values |             |         |
|-----------------|-------------|---------|
| Mc,Rd           | 1859,2<br>5 | kN<br>m |
| unity check     | 0,05        |         |

**Combined bending, axial force and shear force check**

according to article EN 1993-1-1 : 6.2.9.1. and formula EN 1993-1-1 : (6.41)

Section classification is 1.

| Table of values |             |         |
|-----------------|-------------|---------|
| MNVy.Rd         | 3685,0<br>0 | kN<br>m |
| MNVz.Rd         | 1859,2<br>5 | kN<br>m |

alfa 2,00 beta 1,00

unity check 0,18

Element satisfies the section check !

**STABILITY CHECK**

| Buckling parameters | yy    | zz    |   |
|---------------------|-------|-------|---|
| type                | sway  | sway  |   |
| Slenderness         | 57,78 | 88,19 |   |
| Reduced slenderness | 0,73  | 1,12  |   |
| Buckling curve      | b     | c     |   |
| Imperfection        | 0,34  | 0,49  |   |
| Reduction factor    | 0,76  | 0,47  |   |
| Length              | 8,00  | 8,00  | m |

|                     |          |          |    |
|---------------------|----------|----------|----|
| Buckling factor     | 1,28     | 1,19     |    |
| Buckling length     | 10,23    | 9,48     | m  |
| Critical Euler load | 40480,61 | 17374,53 | kN |

#### Buckling check

according to article EN 1993-1-1 : 6.3.1.1. and formula EN 1993-1-1 : (6.46)

| Table of values |          |    |
|-----------------|----------|----|
| Nb.Rd           | 10333,05 | kN |
| unity check     | 0,07     |    |

#### LTB check

according to article EN 1993-1-1 : 6.3.2.1. and formula EN 1993-1-1 : (6.54)

| Table of values      |               |                 |
|----------------------|---------------|-----------------|
| Mb.Rd                | 3469,54       | kNm             |
| Wy                   | 11000000,00   | mm <sup>3</sup> |
| reduction            | 0,94          |                 |
| imperfection         | 0,21          |                 |
| reduced slenderness  | 0,44          |                 |
| method for LTB curve | Art. 6.3.2.2. |                 |
| Mcr                  | 18908,67      | kNm             |
| unity check          | 0,37          |                 |

| LTB        |      |   |
|------------|------|---|
| LTB length | 8,00 | m |
| k          | 1,00 |   |
| kw         | 1,00 |   |
| C1         | 1,45 |   |
| C2         | 0,96 |   |
| C3         | 1,73 |   |

load in center of gravity

#### Compression and bending check

according to article EN 1993-1-1 : 6.3.3. and formula EN 1993-1-1 : (6.61) (6.62)

Interaction Method 2

| Table of values |             |                 |
|-----------------|-------------|-----------------|
| kyy             | 0,922       |                 |
| kyz             | 0,595       |                 |
| kzy             | 0,977       |                 |
| kzz             | 0,991       |                 |
| Delta My        | 0,00        | kNm             |
| Delta Mz        | 0,00        | kNm             |
| A               | 65200,00    | mm <sup>2</sup> |
| Wy              | 11000000,00 | mm <sup>3</sup> |
| Wz              | 5550000,0   | mm <sup>3</sup> |

|                         |          |     |
|-------------------------|----------|-----|
|                         | 0        |     |
| NRk                     | 21842,00 | kN  |
| My,Rk                   | 3685,00  | kNm |
| Mz,Rk                   | 1859,25  | kNm |
| My,Ed                   | 1300,73  | kNm |
| Mz,Ed                   | 95,46    | kNm |
| Interaction<br>Method 2 |          |     |
| Cmy                     | 0,900    |     |
| Cmz                     | 0,900    |     |
| CmLT                    | 0,570    |     |

unity check =  $0,04 + 0,35 + 0,03 = 0,42$

unity check =  $0,07 + 0,37 + 0,05 = 0,49$

Element satisfies the stability check !



## H. Ontwerp in DBET

(PDF bestanden, te openen door dubbel op te klikken)  
De berekeningen zijn op hoofdlijnen.

**MOVARES NEDERLAND BV**  
Wapening-dak-boven

pagina: 1



ONTWERPGEGEVENS

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000

h 220

Zijde: 1 Beugeldiameter: 8,0 mm

Laag Materiaal: C: CL: CR: Diameter1: Diameter2: HoH: Aantal: Aanhechtfactor:

1 FeB 500 HWL 30 0 0 25,0 25,0 130,0 strip 1,00

Details van de strip

Strip: Xb[mm]: Yb[mm]: Xs[mm]: Ys[mm]: At[mm<sup>2</sup>]: Lengte[mm]: Materiaal:

1 0 50,5 1000,0 50,5 3776 1000,0 FeB 500 HWL

Gebruikte Materialen uit de DataBase

Beton f'ck f'b fbm E'b Esg

C30,0/37,5 38 23 1,46 2,87 31625 12857

Betonstaal fsrep fs esu[o/o] Esg

FeB 500 HWL 500 435 3,25 200000

Statische grootheden van de vormen

Vorm X[mm] Y[mm] A[mm<sup>2</sup>] Ixx [mm<sup>4</sup>] Iyy [mm<sup>4</sup>] Ixy [mm<sup>4</sup>]

v1 500 110 2,20000e+05 8,87333e+08 1,83333e+10 0

E-zware doorsnede grootheden [Effektieve E-Modulus EA/A = 16069 MPa]

X[mm] Y[mm] E-A[N] E-Ixx[Nmm<sup>2</sup>] E-Iyy[Nmm<sup>2</sup>] E-Ixy[Nmm<sup>2</sup>]

500 98 3,53521e+09 1,34102e+13 2,94601e+14 0

datum: 26-2-11 tijd: 16:33:35

DBET versie 4.2.0 © FENMASSE BV

Y:\NL\Data\Personal\Yousif\DBETateunpunt-dak.DST


**ONTWERPGEGEVENS**

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

 b 1000  
h 220

Zijde: 1 Beugeldiameter: 8,0 mm

| Laag | Materiaal:  | C: | CL: | CR: | Diameter1: | Diameter2: | HoH:  | Aantal: | Aanhechtfactor: |
|------|-------------|----|-----|-----|------------|------------|-------|---------|-----------------|
| 1    | FeB 500 HWL | 30 | 0   | 0   | 25,0       | 25,0       | 175,0 | strip   | 1,00            |

Details van de streppen

| Strip: | Xb[mm]: | Yb[mm]: | Xe[mm]: | Ye[mm]: | At[mm2]: | Lengte[mm]: | Materiaal:  |
|--------|---------|---------|---------|---------|----------|-------------|-------------|
| 1      | 0       | 50,5    | 1000,0  | 50,5    | 2805     | 1000,0      | FeB 500 HWL |

Gebruikte Materialen uit de DataBase

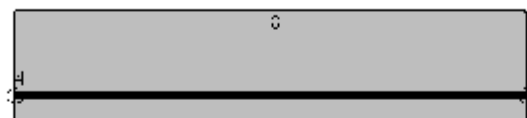
| Beton       | f'ck  | f'b | fb       | fbm  | E'b   | Esg    |
|-------------|-------|-----|----------|------|-------|--------|
| B37.5       | 38    | 23  | 1,46     | 2,87 | 31625 | 12857  |
| Betonstaal  | fsrep | fs  | esu[o/o] |      |       | Esg    |
| FeB 500 HWL | 500   | 435 | 3,25     |      |       | 200000 |

Statistische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm2]      | Ixx [mm4]   | Iyy [mm4]   | Ixy [mm4] |
|------|-------|-------|-------------|-------------|-------------|-----------|
| v1   | 500   | 110   | 2,20000e+05 | 8,87333e+08 | 1,83333e+10 | 0         |

E-zware doorsnede grootheden [Effektieve E-Modulus EA/A = 15243 MPa]

| X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm2] | E-Iyy[Nmm2] | E-Ixy[Nmm2] |
|-------|-------|-------------|-------------|-------------|-------------|
| 500   | 101   | 3,35351e+09 | 1,29761e+13 | 2,79459e+14 | 0           |



#### ONTWERPGEGEVEN

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000

h 220

Zijde: 1 Beugeldiameter: 8,0 mm

Laag Materiaal: C: CL: CR: Diameter1: Diameter2: HoH: Aantal: Aanhechtfactor:  
1 FeB 500 HWL 30 0 0 32,0 32,0 125,0 strip 1,00

Details van de strip

Strip: Xb[mm]: Yb[mm]: Xe[mm]: Ye[mm]: At[mm<sup>2</sup>]: Lengte[mm]: Materiaal:  
1 0 54,0 1000,0 54,0 6434 1000,0 FeB 500 HWL

Gebruikte Materialen uit de DataBase

| Beton      | f'ck | f'b | fb   | fbm  | E'b   | Esg   |
|------------|------|-----|------|------|-------|-------|
| C45,0/55,0 | 55   | 33  | 1,90 | 3,72 | 36000 | 18857 |

| Betonstaal  | fsrep | fs  | esu[o/o] | Esg    |
|-------------|-------|-----|----------|--------|
| FeB 500 HWL | 500   | 435 | 3,25     | 200000 |

Statische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm <sup>2</sup> ] | Ixx [mm <sup>4</sup> ] | Iyy [mm <sup>4</sup> ] | Ixy [mm <sup>4</sup> ] |
|------|-------|-------|---------------------|------------------------|------------------------|------------------------|
| v1   | 500   | 110   | 2,20000e+05         | 8,87333e+08            | 1,83333e+10            | 0                      |

E-zware dooranede grootheden [Effektieve E-Modulus EA/A = 24155 MPa]

| X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm <sup>2</sup> ] | E-Iyy[Nmm <sup>2</sup> ] | E-Ixy[Nmm <sup>2</sup> ] |
|-------|-------|-------------|--------------------------|--------------------------|--------------------------|
| 500   | 98    | 5,31404e+09 | 1,95859e+13              | 4,42837e+14              | 0                        |



#### ONTWERPGEGEVENS

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000  
h 300

Zijde: 1 Beugeldiameter: 8,0 mm

Laag Materiaal: C: CL: CR: Diameter1: Diameter2: HoH: Aantal: Aanhechtfactor:  
1 FeB 500 HWL 30 0 0 25,0 25,0 200,0 strip 1,00

Details van de strippen

Strip: Xb[mm]: Yb[mm]: Xe[mm]: Ye[mm]: At[mm<sup>2</sup>]: Lengte[mm]: Materiaal:  
1 0 50,5 1000,0 50,5 2454 1000,0 FeB 500 HWL

Gebruikte Materialen uit de DataBase

| Beton       | f'ck  | f'b | fb       | fbm  | E'b   | Esg    |
|-------------|-------|-----|----------|------|-------|--------|
| C30,0/37,5  | 38    | 23  | 1,46     | 2,87 | 31625 | 12857  |
| Betonstaal  | fsrep | fs  | esu[o/o] |      |       | Esg    |
| FeB 500 HWL | 500   | 435 | 3,25     |      |       | 200000 |

Statische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm <sup>2</sup> ] | Ixx [mm <sup>4</sup> ] | Iyy [mm <sup>4</sup> ] | Ixy [mm <sup>4</sup> ] |
|------|-------|-------|---------------------|------------------------|------------------------|------------------------|
| v1   | 500   | 150   | 3,00000e+05         | 2,25000e+09            | 2,50000e+10            | 0                      |

E-zware doorsnede grootheden [Effektieve E-Modulus EA/A = 14388 MPa]

| X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm <sup>2</sup> ] | E-Iyy[Nmm <sup>2</sup> ] | E-Ixy[Nmm <sup>2</sup> ] |
|-------|-------|-------------|--------------------------|--------------------------|--------------------------|
| 500   | 139   | 4,31646e+09 | 3,29920e+13              | 3,59705e+14              | 0                        |



#### ONTWERPGEGEVEN

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000  
h 300

Zijde: 1 Beugeldiameter: 8,0 mm

Laag Materiaal: C: CL: CR: Diameter1: Diameter2: HoH: Aantal: Aanhechtfactor:  
1 FeB 500 HWL 50 0 0 25,0 25,0 200,0 strip 1,00

Details van de strip

Strip: Xb[mm]: Yb[mm]: Xe[mm]: Ye[mm]: At[mm<sup>2</sup>]: Lengte[mm]: Materiaal:  
1 0 70,5 1000,0 70,5 2454 1000,0 FeB 500 HWL

Gebruikte Materialen uit de DataBase

| Beton | f'ck | f'b | fb   | fbm  | E'b   | Esg   |
|-------|------|-----|------|------|-------|-------|
| B37.5 | 38   | 23  | 1,46 | 2,87 | 31625 | 12857 |

| Betonstaal  | fsrep | fs  | esu[o/o] | Esg    |
|-------------|-------|-----|----------|--------|
| FeB 500 HWL | 500   | 435 | 3,25     | 200000 |

Statische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm <sup>2</sup> ] | Ixx [mm <sup>4</sup> ] | Iyy [mm <sup>4</sup> ] | Ixy [mm <sup>4</sup> ] |
|------|-------|-------|---------------------|------------------------|------------------------|------------------------|
| v1   | 500   | 150   | 3,00000e+05         | 2,25000e+09            | 2,50000e+10            | 0                      |

E-zware doorsnede grootheden [Effectieve E-Modulus EA/A = 14388 MPa]

| X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm <sup>2</sup> ] | E-Iyy[Nmm <sup>2</sup> ] | E-Ixy[Nmm <sup>2</sup> ] |
|-------|-------|-------------|--------------------------|--------------------------|--------------------------|
| 500   | 142   | 4,31646e+09 | 3,15227e+13              | 3,59705e+14              | 0                        |


**ONTWERPGEGEVEN**

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000  
h 500

Zijde: 1

Laag Materiaal: C: CL: CR: Diameter1: Diameter2: HoH: Aantal: Aanhechtfactor:  
1 FeB 500 HWL 50 0 0 25,0 25,0 200,0 strip 1,00

Details van de strip

Strip: Xb[mm]: Yb[mm]: Xe[mm]: Ye[mm]: At[mm<sup>2</sup>]: Lengte[mm]: Materiaal:  
1 0 62,5 1000,0 62,5 2454 1000,0 FeB 500 HWL

Gebruikte Materialen uit de DataBase

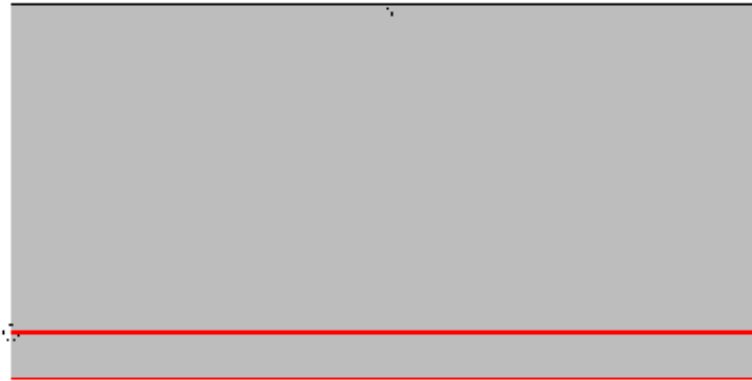
| Beton       | f'ck  | f'b | fb       | fbm  | E'b   | Esg    |
|-------------|-------|-----|----------|------|-------|--------|
| C30,0/37,5  | 38    | 23  | 1,46     | 2,87 | 31625 | 12857  |
| Betonstaal  | fsrep | fs  | esu[o/o] |      |       | Esg    |
| FeB 500 HWL | 500   | 435 | 3,25     |      |       | 200000 |

Statische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm <sup>2</sup> ] | Ixx [mm <sup>4</sup> ] | Iyy [mm <sup>4</sup> ] | Ixy [mm <sup>4</sup> ] |
|------|-------|-------|---------------------|------------------------|------------------------|------------------------|
| v1   | 500   | 250   | 5,00000e+05         | 1,04167e+10            | 4,16667e+10            | 0                      |

E-zware doorsnede grootheden [Effectieve E-Modulus EA/A = 13776 MPa]

| X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm <sup>2</sup> ] | E-Iyy[Nmm <sup>2</sup> ] | E-Ixy[Nmm <sup>2</sup> ] |
|-------|-------|-------------|--------------------------|--------------------------|--------------------------|
| 500   | 237   | 6,88789e+09 | 1,49000e+14              | 5,73991e+14              | 0                        |



#### ONTWERPGEGEVENS

Macro: Categorie: Plaat / Type: rechthoekig

Topic: Waarde [mm]:

b 1000

h 500

Zijde: 1

| Laag | Materiaal:  | C: | CL: | CR: | Diameter1: | Diameter2: | HoH:  | Aantal: | Aanhechtfactor: |
|------|-------------|----|-----|-----|------------|------------|-------|---------|-----------------|
| 1    | FeB 500 HWL | 50 | 0   | 0   | 25,0       | 25,0       | 150,0 | strip   | 1,00            |

Details van de strippen

| Strip: | Xb[mm]: | Yb[mm]: | Xe[mm]: | Ye[mm]: | At[mm2]: | Lengte[mm]: | Materiaal:  |
|--------|---------|---------|---------|---------|----------|-------------|-------------|
| 1      | 0       | 62,5    | 1000,0  | 62,5    | 3272     | 1000,0      | FeB 500 HWL |

Gebruikte Materialen uit de DataBase

|             | f'ck  | f'b | f'b      | f'bm | E'b   | Esg    |
|-------------|-------|-----|----------|------|-------|--------|
| Beton       | 38    | 23  | 1,46     | 2,87 | 31625 | 12857  |
| Betonstaal  | fsrep | fs  | esu[o/o] |      |       | Esg    |
| FeB 500 HWL | 500   | 435 | 3,25     |      |       | 200000 |

Statische grootheden van de vormen

| Vorm | X[mm] | Y[mm] | A[mm2]      | Ixx [mm4]   | Iyy [mm4]   | Ixy [mm4] |
|------|-------|-------|-------------|-------------|-------------|-----------|
| v1   | 500   | 250   | 5,00000e+05 | 1,04167e+10 | 4,16667e+10 | 0         |

E-zware doorsnede grootheden [Effektieve E-Modulus EA/A = 14082 MPa]

|  | X[mm] | Y[mm] | E-A[N]      | E-Ixx[Nmm2] | E-Iyy[Nmm2] | E-Ixy[Nmm2] |
|--|-------|-------|-------------|-------------|-------------|-------------|
|  | 500   | 234   | 7,04099e+09 | 1,53586e+14 | 5,86750e+14 | 0           |

## Bijlage 2 Trillingsberekening



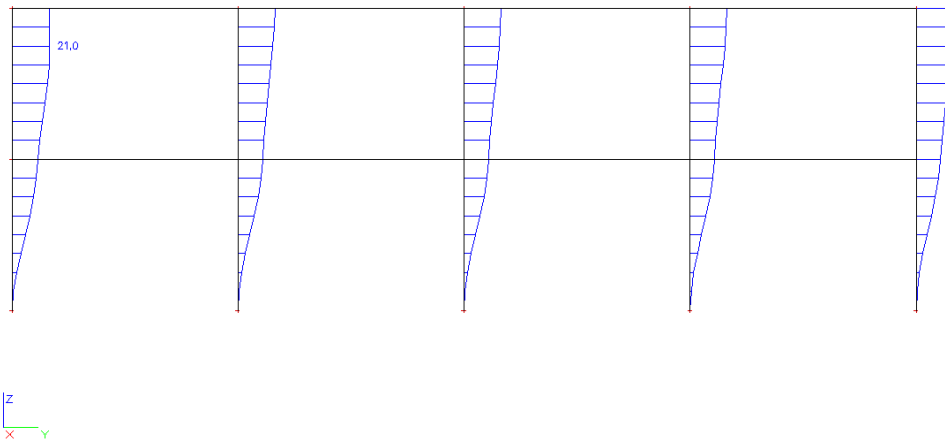
## A. Trilling van spanten

### 1. Berekening

(Excel bestanden, te openen door dubbel op te klikken)

|                         |                                                                                     |                   |                 |      |  |  |  |
|-------------------------|-------------------------------------------------------------------------------------|-------------------|-----------------|------|--|--|--|
|                         |                                                                                     |                   |                 |      |  |  |  |
| Afstand tussen spanten  |                                                                                     |                   | 8               | m    |  |  |  |
| Hoogte spanten          |                                                                                     |                   | 8               | m    |  |  |  |
| Diepte gebouw           |                                                                                     |                   | 24              | m    |  |  |  |
| Dikte plaat             |                                                                                     |                   | 0,22            | m    |  |  |  |
| $\Delta$ (ESA)          |                                                                                     |                   | 21              | mm   |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| Gewicht                 |                                                                                     |                   | 1760            | kN   |  |  |  |
| Horizontaal belasting = |                                                                                     |                   | 220             | kN/m |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| F=                      | 27,5                                                                                | kN/m <sup>2</sup> |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| K=                      | F/ $\Delta$                                                                         |                   |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| K=                      | 1309,524                                                                            | kN/m <sup>3</sup> |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| m=                      | 2750                                                                                | Kg/m <sup>2</sup> |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $\omega$ =              |  |                   |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $\omega$ =              | 21,82179                                                                            |                   |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $F_e$ =                 | $\omega/2\pi$                                                                       | Hz                |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $F_e$ =                 | 3,473046                                                                            |                   |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $T_e$ =                 | 1/ $F_e$                                                                            | s                 |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $T_e$ =                 | 0,287932                                                                            |                   |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $t_p$ =                 | 0,0704                                                                              | s                 |                 |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| $t_p/T_e$               | 0,244502                                                                            |                   | Impulsbelasting |      |  |  |  |
|                         |                                                                                     |                   |                 |      |  |  |  |
| Conclusie: 'slap'       |                                                                                     |                   |                 |      |  |  |  |

## 2. Vervorming spanten door eigengewicht

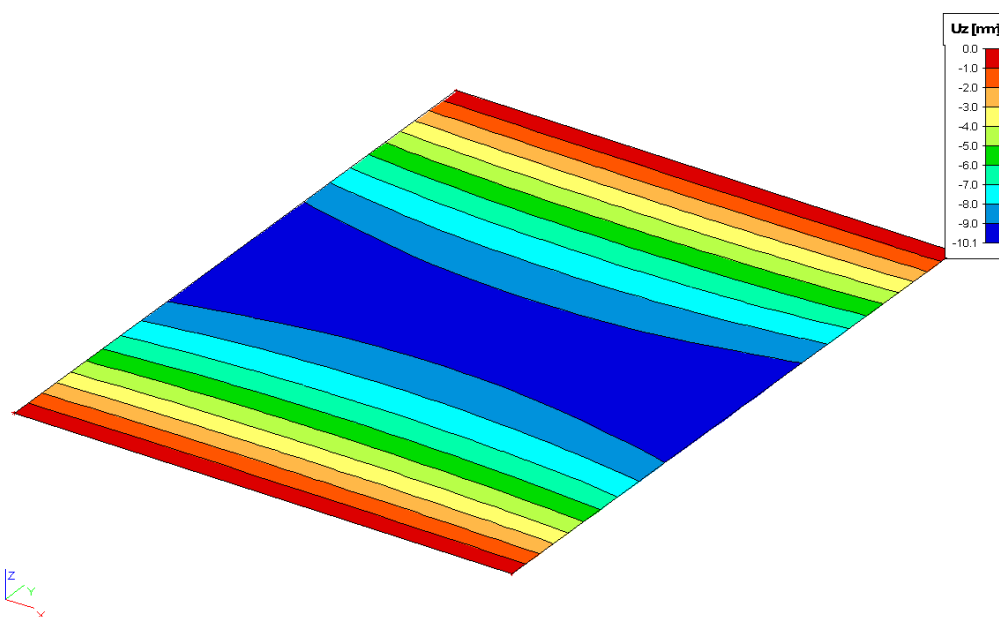


## B. Trilling van het dak

### 1. Berekening

|                   |                                                                                   |                  |          |  |  |  |  |
|-------------------|-----------------------------------------------------------------------------------|------------------|----------|--|--|--|--|
| $\Delta$ (ESA)    | 0,01                                                                              | m                |          |  |  |  |  |
| a=                | 0,315                                                                             | m/s <sup>2</sup> | NEN 6702 |  |  |  |  |
| $F_e =$           |  | Hz               |          |  |  |  |  |
| $F_e =$           | 5,612486                                                                          |                  |          |  |  |  |  |
| $T_e =$           | 1/ $F_e$                                                                          | s                |          |  |  |  |  |
| $T_e =$           | 0,178174                                                                          |                  |          |  |  |  |  |
| $t_p =$           | 0,0704                                                                            | s                |          |  |  |  |  |
| $t_p/T_e$         | 0,395119                                                                          | Impulsbelasting  |          |  |  |  |  |
| Conclusie: 'slap' |                                                                                   |                  |          |  |  |  |  |
|                   |                                                                                   |                  |          |  |  |  |  |
|                   |                                                                                   |                  |          |  |  |  |  |

### 2. Vervorming dak door eigengewicht

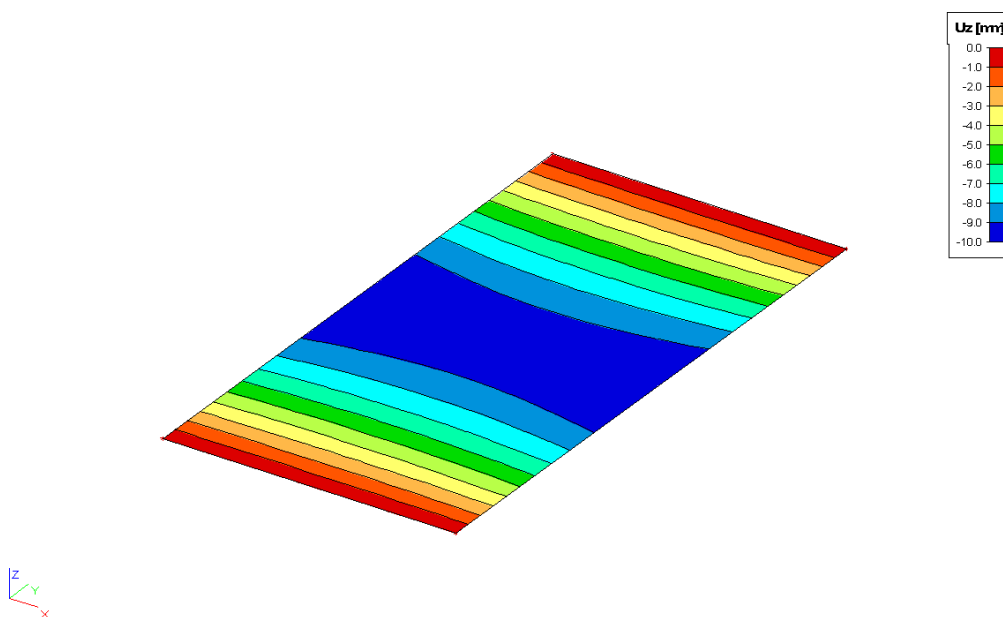


## C. Trilling van gevelpaneel

### 1. Berekening

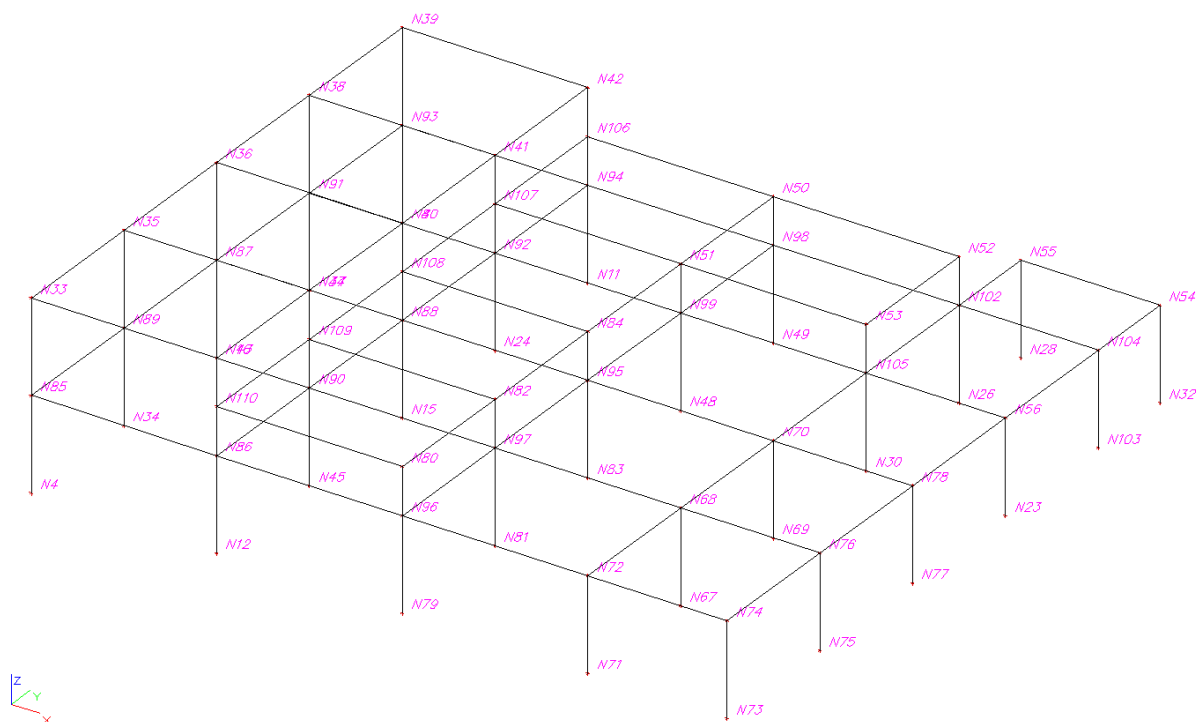
|                   |                                                                                   |                  |          |  |  |  |  |
|-------------------|-----------------------------------------------------------------------------------|------------------|----------|--|--|--|--|
| $\Delta$ (ESA)    | 0,01                                                                              | m                |          |  |  |  |  |
| a=                | 0,315                                                                             | m/s <sup>2</sup> | NEN 6702 |  |  |  |  |
| $F_e =$           |  | Hz               |          |  |  |  |  |
| $F_e =$           | 5,612486                                                                          |                  |          |  |  |  |  |
| $T_e =$           | 1/ $F_e$                                                                          | s                |          |  |  |  |  |
| $T_e =$           | 0,178174                                                                          |                  |          |  |  |  |  |
| $t_p =$           | 0,0704                                                                            | s                |          |  |  |  |  |
| $t_p/T_e$         | 0,395119                                                                          | Impulsbelasting  |          |  |  |  |  |
| conclusie: 'slap' |                                                                                   |                  |          |  |  |  |  |

### 2. Vervorming gevel door eigengewicht



## Bijlage 3 Verbindingen

## A. Overzicht knopen



## B. Berekeningen knoop 16

Voor V en M waarden zie bijlage 1 resultaten-verbindingen

### 1. Kolom B3

|      |          |    |
|------|----------|----|
| Vy = | 600      | kN |
| Vz = | 233      | kN |
| Sum  | 643,6529 | kN |

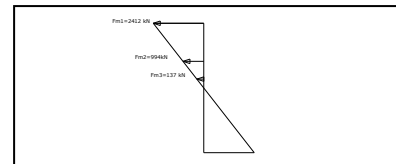
|      |     |      |
|------|-----|------|
| My = | 455 | kN.m |
| Mz = | 612 | kN.m |

Dus trek in twee richting

Hier neem ik één van de twee gevallen (grootste, Mz)

$$F_m = M_z / 0,255$$

|       |          |    |          |             |
|-------|----------|----|----------|-------------|
| Fm1 = | 2400     | kN | 480      | kN per bout |
| Fm2 = | 988,2353 | kN | 247,0588 | kN per bout |
| Fm3 = | 135,6401 | kN | 33,91003 | kN per bout |



|                    |                          |                                         |
|--------------------|--------------------------|-----------------------------------------|
| <b>Afschuiving</b> | $F_{vsd}/F_{vud} \leq 1$ |                                         |
| Fvud =             | 215                      | kN per bout (construeren A: tabel 3.30) |
| Fvsd =             | 24,75588                 | kN per bout                             |
| $F_{vsd}/F_{vud}$  | =                        | 0,115144 O.K                            |

|                   |                          |                                         |
|-------------------|--------------------------|-----------------------------------------|
| <b>Trek</b>       | $F_{tsd}/F_{tud} \leq 1$ |                                         |
| Ftud =            | 320                      | kN per bout (construeren A: tabel 3.30) |
| Ftsd =            | 253,6563                 | kN per bout                             |
| $F_{tsd}/F_{tud}$ | =                        | 0,792676 O.K                            |

|                   |                          |                                         |
|-------------------|--------------------------|-----------------------------------------|
| <b>Stuik</b>      | $F_{csd}/F_{cud} \leq 1$ |                                         |
| Fcud =            | 144                      | kN per bout (construeren A: tabel 3.30) |
| Fcsd =            | 24,75588                 | kN per bout                             |
| $F_{tsd}/F_{tud}$ | =                        | 0,171916 O.K                            |

### Combinatie Trek en Afschuiving

|                   |   |                      |          |              |
|-------------------|---|----------------------|----------|--------------|
| $F_{vsd}/F_{vud}$ | + | $F_{tsd}/1.4F_{tud}$ | $\leq 1$ |              |
| 0,115144          | + | 0,566197             | =        | 0,681341 O.K |

### Controle min. boutafstanden

|      |            |      |   |        |
|------|------------|------|---|--------|
| e1 = | 1,2dg      |      |   |        |
| e1 = | 1,2 x 32 = | 38,4 | < | 60 O.K |
| e2 = | 1,5dg      |      |   |        |
| e2 = | 1,5 x 32 = | 48   | < | 60 O.K |

$$\begin{aligned}
 s1 &= 2,2dg \\
 s1 &= 2,2 \times 32 = 70,4 \approx 70 \quad \text{O.K} \\
 s2 &= 3dg \\
 s2 &= 3 \times 32 = 96 \approx 95 \quad \text{O.K}
 \end{aligned}$$

## C. Berekeningen knoop 36

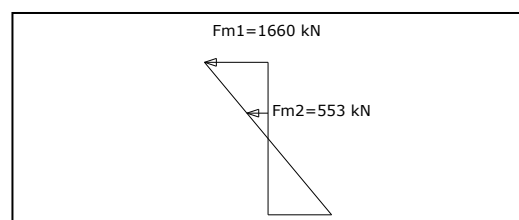
Voor V en M waarden zie bijlage 1 resultaten-verbindingen

### 1. Ligger B87

$$\begin{aligned}
 Vy &= 66 \quad \text{kN} \\
 Vz &= 151 \quad \text{kN} \\
 \text{Sum} &= 164,7938 \quad \text{kN}
 \end{aligned}$$

$$\begin{aligned}
 My &= 330 \quad \text{kN.m} \\
 Mz &= \text{verwaarloos} \\
 Fm &= My/0,2
 \end{aligned}$$

$$\begin{aligned}
 Fm1 &= 1650 \quad \text{kN} \quad 412,5 \quad \text{kN per bout} \\
 Fm2 &= 550 \quad \text{kN} \quad 137,5 \quad \text{kN per bout}
 \end{aligned}$$



**Afschuiving**  $F_{vsd}/F_{vud} \leq 1$

$$\begin{aligned}
 F_{vud} &= 215 \quad \text{kN per bout} \quad (\text{construeren A: tabel 3.30}) \\
 F_{vsd} &= 10,29961 \quad \text{kN per bout} \\
 F_{vsd}/F_{vud} &= 0,047905 \quad \text{O.K}
 \end{aligned}$$

**Trek**  $F_{tsd}/F_{tud} \leq 1$

$$\begin{aligned}
 F_{tud} &= 320 \quad \text{kN per bout} \quad (\text{construeren A: tabel 3.30}) \\
 F_{tsd} &= 275 \quad \text{kN per bout} \\
 F_{tsd}/F_{tud} &= 0,859375 \quad \text{O.K}
 \end{aligned}$$

**Stuik**  $F_{csd}/F_{cud} \leq 1$

$$\begin{aligned}
 F_{cud} &= 144 \quad \text{kN per bout} \quad (\text{construeren A: tabel 3.30}) \\
 F_{csd} &= 10,29961 \quad \text{kN per bout} \\
 F_{tsd}/F_{tud} &= 0,071525 \quad \text{O.K}
 \end{aligned}$$

### Combinatie Trek en Afschuiving

$$\begin{aligned}
 F_{vsd}/F_{vud} &+ F_{tsd}/1.4F_{tud} \leq 1 \\
 0,047905 &+ 0,613839 = 0,661744 \quad \text{O.K}
 \end{aligned}$$



## 2. Ligger B86

$V_y = 68$  kN  
 $V_z = 121$  kN  
 $\text{Sum} = 138,7984$  kN

$M_y = 236$  kN.m  
 $M_z = \text{verwaarloos}$   
 $F_m = M_y/0,2$   
 $F_m = 1180$  kN      295  
 $F_{m2} = 393,3333$  kN      98,33333 kN per bout

**Afschuiving**       $F_{vsd}/F_{vud} \leq 1$   
 $F_{vud} = 215$  kN per bout      (construeren A: tabel 3.30)  
 $F_{vsd} = 8,674901$  kN per bout  
 $F_{vsd}/F_{vud} = 0,040348$  O.K

**Trek**       $F_{tsd}/F_{tud} \leq 1$   
 $F_{tud} = 320$  kN per bout      (construeren A: tabel 3.30)  
 $F_{tsd} = 196,6667$  kN per bout  
 $F_{tsd}/F_{tud} = 0,614583$  O.K

**Stuik**       $F_{csd}/F_{cud} \leq 1$   
 $F_{cud} = 144$  kN per bout      (construeren A: tabel 3.30)  
 $F_{csd} = 8,674901$  kN per bout  
 $F_{tsd}/F_{tud} = 0,060242$  O.K

### Combinatie Trek en Afschuiving

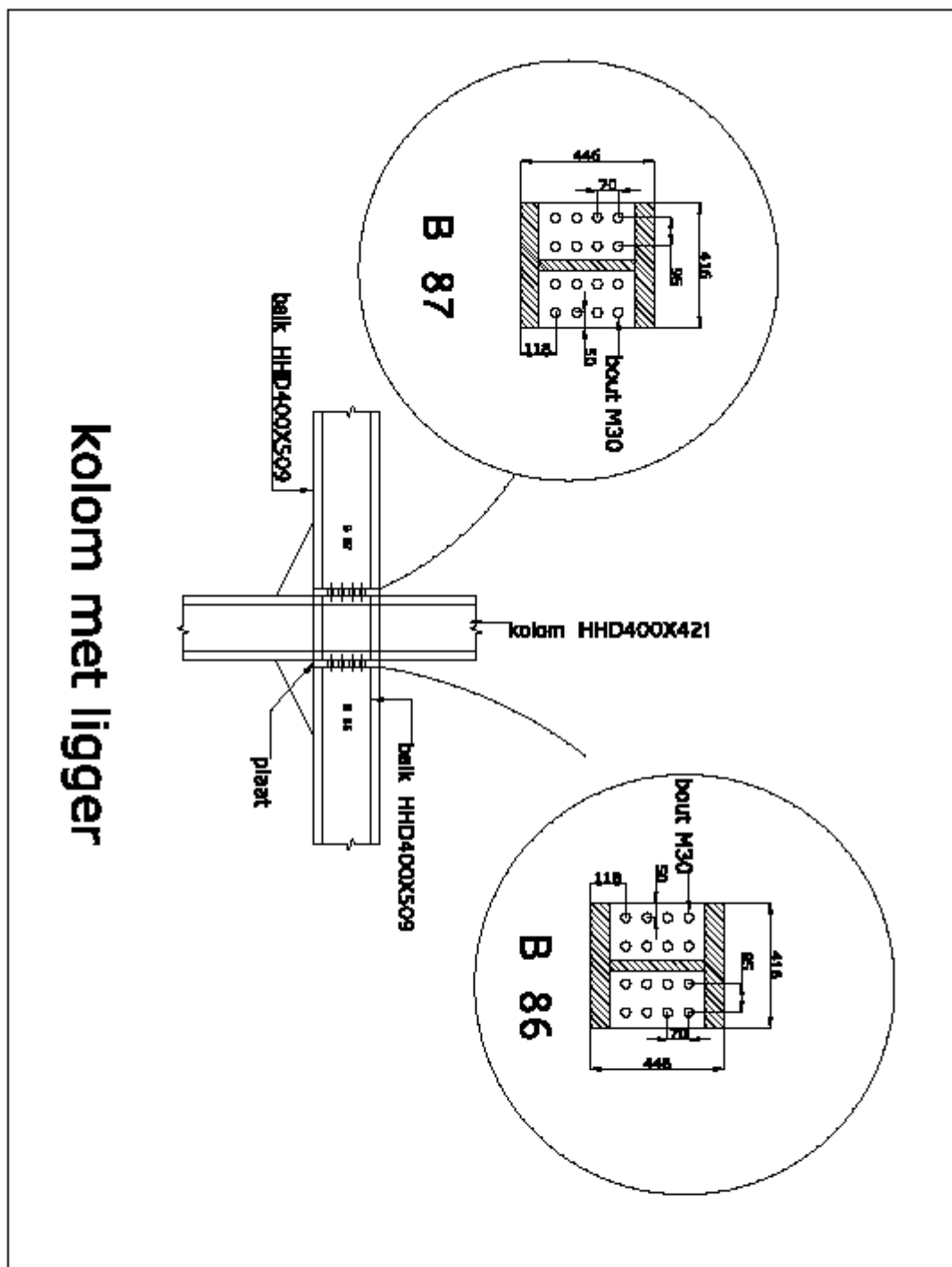
$F_{vsd}/F_{vud} + F_{tsd}/1.4F_{tud} \leq 1$   
 $0,040348 + 0,438988 = 0,479336$  O.K

### Controle min. boutafstanden

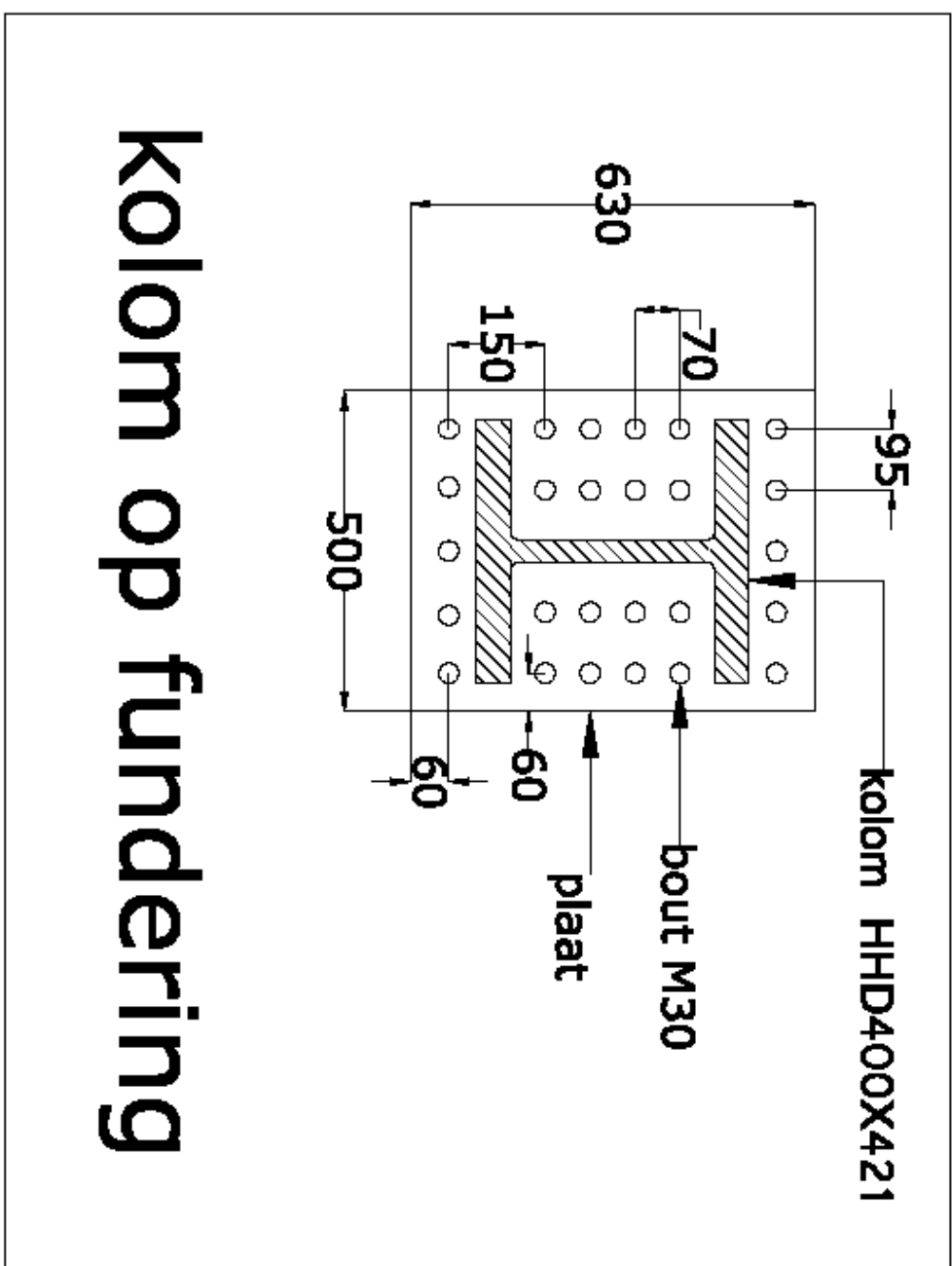
$e_1 = 1,2d_g$   
 $e_1 = 1,2 \times 32 = 38,4 < 118$  O.K  
 $e_2 = 1,5d_g$   
 $e_2 = 1,5 \times 32 = 48 < 50$  O.K  
 $s_1 = 2,2d_g$   
 $s_1 = 2,2 \times 32 = 70,4 \approx 70$  O.K  
 $s_2 = 3d_g$   
 $s_2 = 3 \times 32 = 96 \approx 95$  O.K

## D. Tekeningen

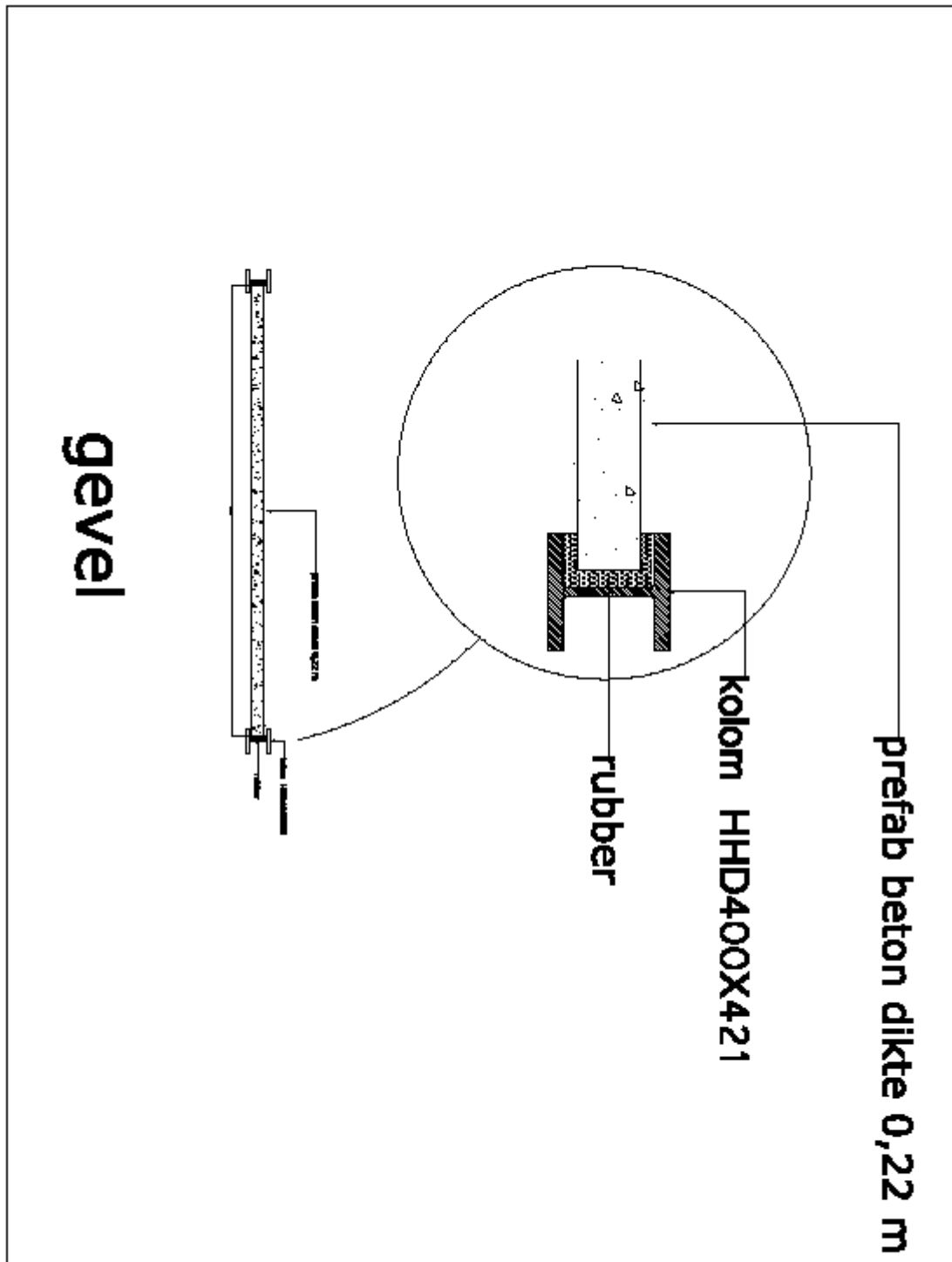
### 1. Tekening verbinding kolom met ligger



## 2. Tekening verbinding kolom op fundering



### 3. Tekening plaatsing gevel



## Bijlage 4 Ontwerp en verificatie van palen volgens Eurocode 7

(PDF bestanden, te openen door dubbel op te klikken)

## Report for MFoundation 7.1

Design and Verification according to Eurocode 7 of Bearing/Tension Piles and Shallow Foundations  
Developed by Deltares



|                         |                                                      |
|-------------------------|------------------------------------------------------|
| Company:                | Movares Nederland B.V.                               |
| Date of report:         | 18-01-2011                                           |
| Time of report:         | 16:08:59                                             |
| Date of calculation:    | 18-01-2011                                           |
| Time of calculation:    | 16:03:18                                             |
| Filename:               | \\NL\Data\Personal\oskamwn\Settings\Desktop\Project1 |
| Project identification: | Explosie bestendig gebouw                            |
|                         | MFoundation Project1                                 |