

## Analysis of beam on elastic foundation

### Input data

#### Project

Date : 28.5.2010

#### Global settings

Loads and combinations : according to EN 1990  
Concrete structures : EN 1992 1-1 (EC2)  
Parameters of the analysis : calculation of C1 and C2  
FE subdivision : 20  
Calculate assuming tension cutoff of soils  
Compute geostatic stress : from ground  
Number of iterations of C1 and C2 : 3

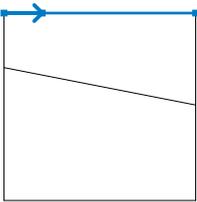
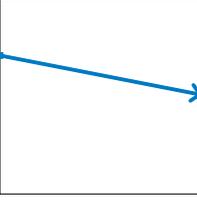
### Segments

| Number | Length<br>[m] | Width<br>[m] | Depth<br>[m] | Area of<br>cross-section<br>[m <sup>2</sup> ] | Moment of<br>inertia<br>[m <sup>4</sup> ] | Material |
|--------|---------------|--------------|--------------|---|---|----------|
| 1      | 10,00         | 1,00         | 0,30         |   |   | C 20/25  |

### Segments materials

| Number | Material | Elasticity<br>modulus<br>E <sub>cm</sub> [MPa] | Shear<br>modulus<br>G [MPa] | Specific<br>weight<br>γ [kN/m <sup>3</sup> ] |
|--------|----------|--|-----------------------------|--|
| 1      | C 20/25  | 29000,00                                       | 11340,00                    | 25,00  |

### Interface

| Number | Interface location  | Coordinates of interface points [m] |       |       |       |       |      |
|--------|---|-------------------------------------|-------|-------|-------|-------|------|
|        |   | x                                   | z     | x     | z     | x     | z    |
| 1      |  | 0,00                                | 1,00  | 2,00  | 1,00  | 10,00 | 1,00 |
|        |   |                                     |       |       |       |       |      |
| 2      |  | 0,00                                | -1,86 | 10,00 | -3,82 |       |      |
|        |   |                                     |       |       |       |       |      |

### Location

x : 0,00 m

z : 0,00 m

### Soil parameters

#### Písek

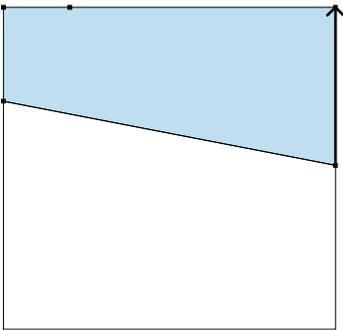
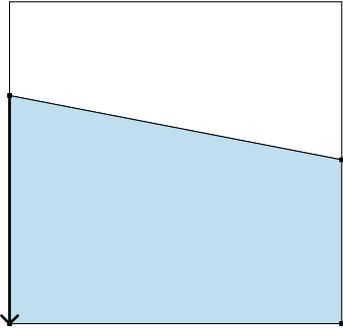
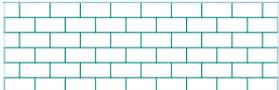
Unit weight :  $\gamma = 20,00 \text{ kN/m}^3$   
Deformation modulus :  $E_{\text{def}} = 75,00 \text{ MPa}$   
Poisson's ratio :  $\nu = 0,28$   
Coeff. of structural strength :  $m = 0,20$   
Saturated unit weight :  $\gamma_{\text{sat}} = 20,00 \text{ kN/m}^3$

#### Skalní podloží

Unit weight :  $\gamma = 20,00 \text{ kN/m}^3$   
Deformation modulus :  $E_{\text{def}} = 1200,00 \text{ MPa}$   
Poisson's ratio :  $\nu = 0,28$   
Coeff. of structural strength :  $m = 0,20$

Saturated unit weight :  $\gamma_{\text{sat}} = 20,00 \text{ kN/m}^3$

### Assigning and surfaces

| Number | Surface position   | Coordinates of surface points [m] |       |       |       | Assigned soil   |
|--------|--|-----------------------------------|-------|-------|-------|---|
|        |  | x                                 | z     | x     | z     |   |
| 1      |   | 10,00                             | -3,82 | 10,00 | 1,00  | Písek<br>          |
|        |  | 2,00                              | 1,00  | 0,00  | 1,00  |   |
|        |  | 0,00                              | -1,86 |       |       |   |
| 2      |  | 0,00                              | -1,86 | 0,00  | -8,82 | Skalní podloží<br> |
|        |  | 10,00                             | -8,82 | 10,00 | -3,82 |   |

### Water

Water type : No water

### Load case 1

| Name                  | Load case   |  | Type      | Coefficient             |                         | Active load case |
|-----------------------|-------------|--|-----------|-------------------------|-------------------------|------------------|
|                       | Code        |  |           | $\gamma_{f,\text{sup}}$ | $\gamma_{f,\text{inf}}$ |                  |
| G1 vlastní tíha-stálé | Self-weight |  | Permanent | 1,35                    | 0,90                    |                  |

| Number | Type of load                   | Origin x [m] | Length l [m] | Magnitude               |                |        |
|--------|--------------------------------|--------------|--------------|-------------------------|----------------|--------|
|        |                                |              |              | f, m, q, q <sub>1</sub> | q <sub>2</sub> | unit   |
| 1      | distr. uniform on beam segment | 0,00         | 10,00        | 7,50                    |                | [kN/m] |

### Load case 2

| Name | Load case |  | Type      | Coefficient             |                         | Active load case |
|------|-----------|--|-----------|-------------------------|-------------------------|------------------|
|      | Code      |  |           | $\gamma_{f,\text{sup}}$ | $\gamma_{f,\text{inf}}$ |                  |
| G2   | Force     |  | Permanent | 1,35                    | 0,90                    |                  |

| Number | Type of load                   | Origin x [m] | Length l [m] | Magnitude               |                |        |
|--------|--------------------------------|--------------|--------------|-------------------------|----------------|--------|
|        |                                |              |              | f, m, q, q <sub>1</sub> | q <sub>2</sub> | unit   |
| 1      | distr. uniform on beam segment | 0,00         | 10,00        | 10,00                   |                | [kN/m] |

### Load case 3

| Name | Load case |  | Type     | Coefficient             |                         | Active load case |
|------|-----------|--|----------|-------------------------|-------------------------|------------------|
|      | Code      |  |          | $\gamma_{f,\text{sup}}$ | $\gamma_{f,\text{inf}}$ |                  |
| Q3   | Force     |  | Variable | 1,50                    |                         | Yes              |

| Number | Type of load       | Origin x [m] | Length l [m] | Magnitude               |                |      |
|--------|--------------------|--------------|--------------|-------------------------|----------------|------|
|        |                    |              |              | f, m, q, q <sub>1</sub> | q <sub>2</sub> | unit |
| 1      | concentrated force | 3,00         |              | 120,00                  |                | [kN] |
| 2      | concentrated force | 6,00         |              | 120,00                  |                | [kN] |
| 3      | concentrated force | 7,00         |              | 120,00                  |                | [kN] |

### Load case 4



| Name | Load case |          | Coefficient      |                  | Active load case |
|------|-----------|----------|------------------|------------------|------------------|
|      | Code      | Type     | $\gamma_{f,sup}$ | $\gamma_{f,inf}$ |                  |
| Q4   | Force     | Variable | 1,50             |                  |                  |

| Number | Type of load                   | Origin x [m] | Length l [m] | Magnitude               |                | unit   |
|--------|--------------------------------|--------------|--------------|-------------------------|----------------|--------|
|        |                                |              |              | f, m, q, q <sub>1</sub> | q <sub>2</sub> |        |
| 1      | distr. uniform on beam segment | 0,00         | 10,00        | 12,00                   |                | [kN/m] |

### Combination ULS

| Number | Design and type of combination | Assembly  |
|--------|--------------------------------|---|
| 3      | Q4:G1+G2                       | $\gamma_{f,sup,1} * [G1 \text{ vlastní tíha-stálé}] + \gamma_{f,sup,2} * [G2] + \gamma_{f,sup,4} * [Q4]$  |
| 4      | Q3:G1+G2+Q4                    | $\gamma_{f,sup,1} * [G1 \text{ vlastní tíha-stálé}] + \gamma_{f,sup,2} * [G2] + \gamma_{f,sup,3} * [Q3] + \gamma_{f,sup,4} * \psi_{0,4} * [Q4]$ |
| 5      | Q4:G1+G2+Q3                    | $\gamma_{f,sup,1} * [G1 \text{ vlastní tíha-stálé}] + \gamma_{f,sup,2} * [G2] + \gamma_{f,sup,3} * \psi_{0,3} * [Q3] + \gamma_{f,sup,4} * [Q4]$ |
| 6      | Q3:G1+G2                       | $\gamma_{f,sup,1} * [G1 \text{ vlastní tíha-stálé}] + \gamma_{f,sup,2} * [G2] + \gamma_{f,sup,3} * [Q3]$  |

### Combination SLS

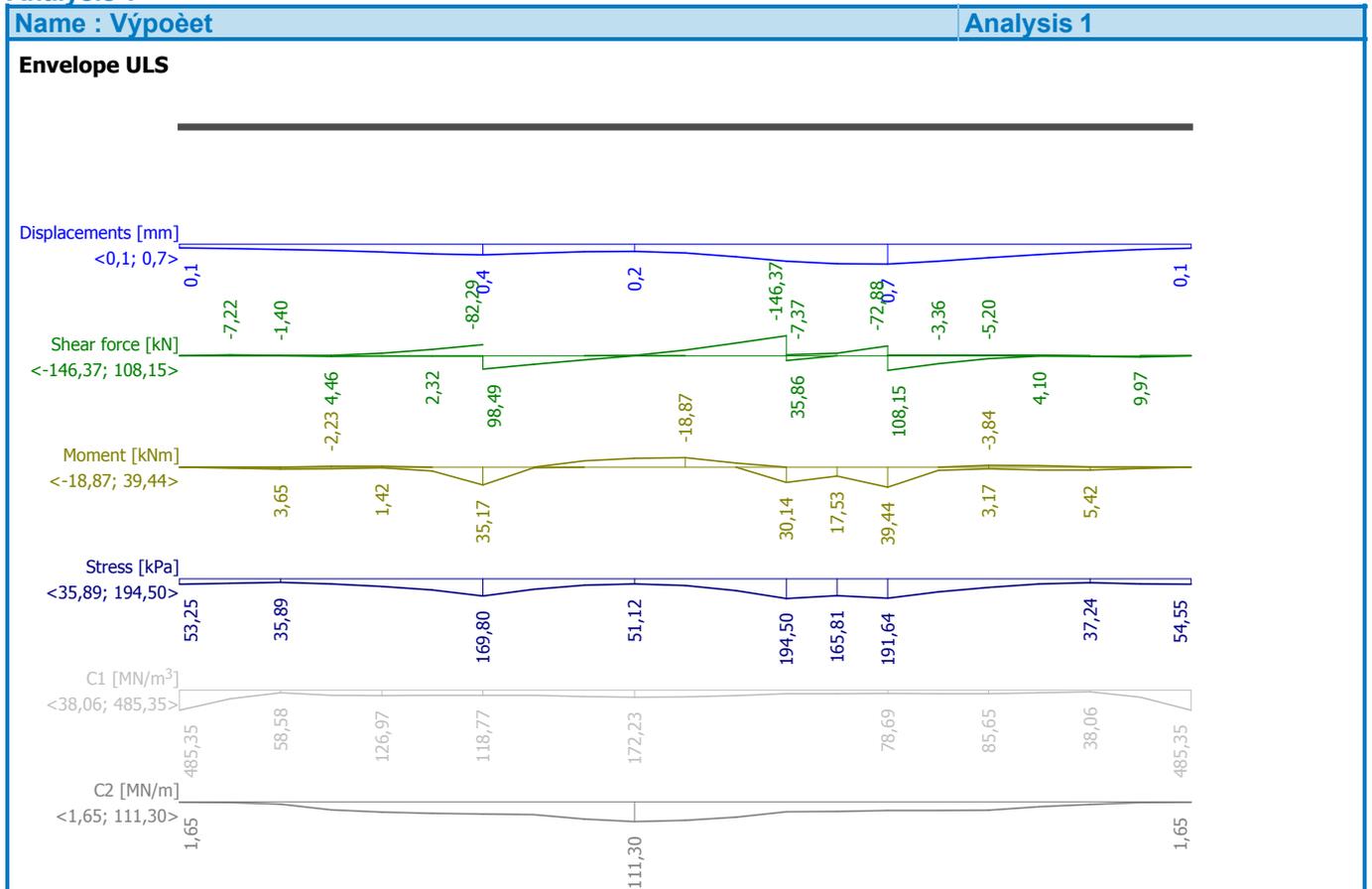
| Number | Design and type of combination | Assembly  |
|--------|--------------------------------|---|
| 1      | Q4:G1+G2+Q3                    | $[G1 \text{ vlastní tíha-stálé}] + [G2] + \psi_{0,3} * [Q3] + [Q4]$ |
| 2      | Q3:G1+G2+Q4                    | $[G1 \text{ vlastní tíha-stálé}] + [G2] + [Q3] + \psi_{0,4} * [Q4]$ |

### Results

#### Calculation is carried out.

Characteristic combinations for subsoil analysis : SLS: Q3:G1+G2+Q4

#### Analysis 1

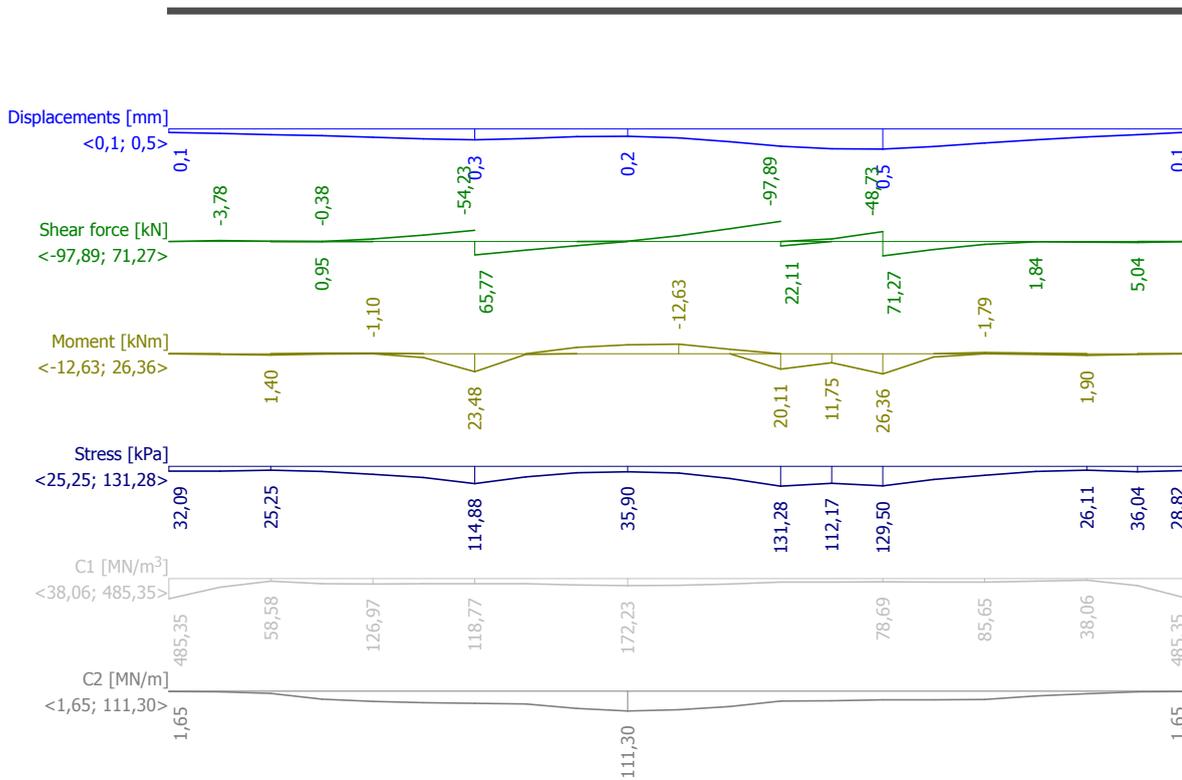


#### Analysis 2

Name : Výpočet

Analysis 2

Envelope SLS



Distributions - C1 and C2

| x [m] | C1 [MN/m³] | C2 [MN/m] |
|-------|------------|-----------|
| 0.00  | 485.35     | 1.65      |
| 0.50  | 207.03     | 3.52      |
| 1.00  | 58.58      | 12.62     |
| 1.50  | 119.70     | 44.53     |
| 2.00  | 126.97     | 58.25     |
| 2.50  | 123.28     | 64.19     |
| 3.00  | 118.77     | 67.35     |
| 3.50  | 119.83     | 72.18     |
| 4.00  | 154.31     | 96.96     |
| 4.50  | 172.23     | 111.30    |
| 5.00  | 157.69     | 103.53    |
| 5.50  | 129.73     | 85.57     |
| 6.00  | 85.86      | 56.28     |
| 6.50  | 83.70      | 53.87     |
| 7.00  | 78.69      | 49.03     |
| 7.50  | 82.45      | 48.89     |
| 8.00  | 85.65      | 47.06     |
| 8.50  | 56.54      | 27.49     |
| 9.00  | 38.06      | 14.50     |
| 9.50  | 172.13     | 4.10      |
| 10.00 | 485.35     | 1.65      |

Overall results - Envelope ULS



Maximum structure moment : 39,44 kNm  
Minimum structure moment : -18,87 kNm  
Maximum structure shear force : 108,15 kN  
Maximum structure deflection : 0,68 mm  
Maximum interfacial stress : 194,50 kPa

**Overall results - Envelope SLS**

Maximum structure moment : 26,36 kNm  
Minimum structure moment : -12,63 kNm  
Maximum structure shear force : 71,27 kN  
Maximum structure deflection : 0,46 mm  
Maximum interfacial stress : 131,28 kPa