



**KLENTNICE – NAPOJENÍ STÁVAJÍCÍ ČOV
NA P.P.Č. 392/1 NA OBEČNÍ KANALIZACI
K.Ú. KLENTNICE**

E.4 Dokladová část – statika potrubí

Zadávací podmínky

Použité potrubí: RC Protect PE 100 RC, PN 10, SN 16, De 63

Krytí nad vrcholem potrubí: 0,8 m

Zatížení provozem: D 400

Hladina spodní vody: 2 m pod povrchem

Obsypový materiál: lomová prosívka 0-8

Stupeň zhutnění obsypu: 95% PS

Result

Calculation OK

Given values

| | | | |
|---|--|--|--------|
| Pipe type | PE 100 RC | Pipe dimension (mm) | 63 |
| Soil type | Sand | Please note: the chosen pipe diameter is below 110 mm, but has been set at 110 mm for calculation purpose | |
| Safety class | Normal | Control class | Normal |
| Partial coefficient - safety class | 2.27 | Partial coefficient - control class | 1.50 |
| Max. negative pressure in pipe (kPa) | Compression class Normal > 95% SP | | |
| Installation type | Normal trench and normal up to high compaction | Installation factor % | 1.0 % |
| Bedding/bedding layer | Normal levelling layer | Bedding factor % | 2.00 % |
| Traffic load | Heavy traffic load | Max. negative pressure in pipe (kPa) | 0.00 |
| Soil cover above pipe top (m) = H | 0.80 | Distance from ground level to ground-water level (m) = Hw | 2.00 |
| Relative density - below ground-water level (kN/m³) | 10.00 | Relative density - above ground-water level (kN/m³) | 20.00 |
| Calculated diameter of pipe (mm) | 63.00 | Pipe ring stiffness | 16.00 |

Load combination 1.1 Deformation calculation serviceability limit state

| | | | |
|--|-------|--|-------|
| Average stress from traffic load (q_{tm}) kN/m² | 63.19 | Short-term deformation from variable load (traffic) | 0.9 % |
| Load factor C regarding the stiffness ratio of pipe to backfilling material (applied) | 1.13 | Short-term deformation from permanent load (soil) | 0.2 % |

| | | | |
|--|-------|---|--------------|
| Characteristic traffic load q_{tk} kN/m ² (Formula 9) | 71.20 | Deformation from installation (Table 2.9) | 1.0 % |
| Additional soil cover for determination of soil modulus E_{td} when influenced by heavy road traffic load (Table 2.8) | 3.00 | Average deformation | 2.1 % |
| delta H factor dependent on type of road traffic load | 1.0 | Short-term maximum deformation (Page 42) | <u>4.1 %</u> |
| Tangent modulus of backfill above ground-water E_{td} (Formula 11) - kN/m ² | 5376 | Long-term deformation from load (formula 16) | 1.7 % |
| Secant modulus of backfill above ground-water E_{sd} (Formula 12) - kN/m ² | 3495 | Long-term max. deformation (Formula 15) | 5.3 % |
| Reduction factor for ground-water influence on soil E-moduli (formula 13) | 1.60 | | |
| Tangent modulus of backfill below ground-water E_{td} (Formula 11 x Formula 13) - kN/m ² | 8602 | | |
| Secant modulus of backfill below ground-water E_{sd} (Formula 12 x Formula 13) - kN/m ² | 5592 | | |

Short-term maximum deformation (Page 42) 4.1 % < 9.0 % (Pipematerial: PE100) - OK

Load deformation 2.1 Deformation calculation ultimate limit state

| | | | |
|---|---------|---|---------|
| Calculated ring stiffness (kN/m ²) | 13.33 | Calculated max. buckling pressure (kN/m ²) | 1004.93 |
| Calculated tangent modulus (kN/m ²) | 3796.28 | Design load (kN/m ²) | 132.56 |
| Reduction factor beta | 0.84 | Design buckling pressure (kN/m ²) | 845.69 |

Buckling load combination 2.1 - q_d (Formula 20) kN/m² 132.56 < Buckling load combination 2.1 - $\beta x q_b$ (Formula 22) 845.69 - OK

Při dodržení zadávacích podmínek potrubí RC Protect PE 100 RC, PN 10, SN 16, De 63 vyhoví a jeho deformace nepřesáhne hodnotu 4,1%. Tato deformace je počítána při prázdném potrubí bez vnitřního přetlaku.

Zadávací podmínky

Použité potrubí: RC Protect PE 100 RC, PN 10, SN 16, De 63

Krytí nad vrcholem potrubí: 1,5 m

Zatížení provozem: D 400

Hladina spodní vody: 2 m pod povrchem

Obsypový materiál: lomová prosívka 0-8

Stupeň zhutnění obsypu: 95% PS

Result

Calculation OK

Given values

| | | | |
|---|--|--|--------|
| Pipe type | PE 100 RC | Pipe dimension (mm) | 63 |
| Soil type | Sand | Please note: the chosen pipe diameter is below 110 mm, but has been set at 110 mm for calculation purpose | |
| Safety class | Normal | Control class | Normal |
| Partial coefficient - safety class | 2.27 | Partial coefficient - control class | 1.50 |
| Max. negative pressure in pipe (kPa) | Compression class Normal > 95% SP | | |
| Installation type | Normal trench and normal up to high compaction | Installation factor % | 1.0 % |
| Bedding/bedding layer | Normal levelling layer | Bedding factor % | 2.00 % |
| Traffic load | Heavy traffic load | Max. negative pressure in pipe (kPa) | 0.00 |
| Soil cover above pipe top (m) = H | 1.50 | Distance from ground level to ground-water level (m) = H_w | 2.00 |
| Relative density - below ground-water level (kN/m³) | 10.00 | Relative density - above ground-water level (kN/m³) | 20.00 |
| Calculated diameter of pipe (mm) | 63.00 | Pipe ring stiffness | 16.00 |

Load combination 1.1 Deformation calculation serviceability limit state

| | | | |
|--|-------|--|-------|
| Average stress from traffic load (q_{tm}) kN/m² | 30.29 | Short-term deformation from variable load (traffic) | 0.5 % |
| Load factor C regarding the stiffness ratio of pipe to backfilling material (applied) | 1.01 | Short-term deformation from permanent load (soil) | 0.5 % |
| Characteristic traffic load q_{tk} kN/m² (Formula 9) | 30.69 | Deformation from installation (Table 2.9) | 1.0 % |
| Additional soil cover for | 1.55 | Average deformation | 1.9 % |

determination of soil modulus E_{td}
when influenced by heavy road
traffic load (Table 2.8)

| | | | |
|--|------|--|--------------|
| delta H factor dependent on type of road traffic load | 1.0 | Short-term maximum deformation (Page 42) | <u>3.9 %</u> |
| Tangent modulus of backfill above ground-water E_{td} (Formula 11) - kN/m^2 | 4552 | Long-term deformation from load (formula 16) | 1.4 % |
| Secant modulus of backfill above ground-water E_{sd} (Formula 12) - kN/m^2 | 2959 | Long-term max. deformation (Formula 15) | 4.9 % |
| Reduction factor for ground-water influence on soil E-moduli (formula 13) | 1.13 | | |
| Tangent modulus of backfill below ground-water E_{td} (Formula 11 x Formula 13) - kN/m^2 | 5158 | | |
| Secant modulus of backfill below ground-water E_{sd} (Formula 12 x Formula 13) - kN/m^2 | 3353 | | |

Short-term maximum deformation (Page 42) 3.9 % < 9.0 % (Pipematerial: PE100) - OK

Load deformation 2.1 Deformation calculation ultimate limit state

| | | | |
|---|---------|--|--------|
| Calculated ring stiffness (kN/m^2) | 13.33 | Calculated max. buckling pressure (kN/m^2) | 924.63 |
| Calculated tangent modulus (kN/m^2) | 2276.46 | Design load (kN/m^2) | 79.90 |
| Reduction factor beta | 0.85 | Design buckling pressure (kN/m^2) | 789.59 |

Buckling load combination 2.1 - q_d (Formula 20) kN/m^2 79.90 < Buckling load combination 2.1 - $\beta x q_b$ (Formula 22) 789.59 - OK

Při dodržení zadávacích podmínek potrubí RC Protect PE 100 RC, PN 10, SN 16, De 63 vyhoví a jeho deformace nepřesáhne hodnotu 3,9 %. Tato deformace je počítána při prázdném potrubí bez vnitřního přetlaku.

Zadávací podmínky

Použité potrubí: RC Protect PE 100 RC, PN 10, SN 16, De 63

Krytí nad vrcholem potrubí: 1,5 m

Zatížení provozem: D 400

Hladina spodní vody: 0,5 m pod povrchem

Obsypový materiál: lomová prosívka 0-8 mm

Stupeň zhutnění obsypu: 95% PS

Result

Calculation OK

Given values

| | | | |
|---|--|--|--------|
| Pipe type | PE 100 RC | Pipe dimension (mm) | 63 |
| Soil type | Sand | Please note: the chosen pipe diameter is below 110 mm, but has been set at 110 mm for calculation purpose | |
| Safety class | Normal | Control class | Normal |
| Partial coefficient - safety class | 2.27 | Partial coefficient - control class | 1.50 |
| Max. negative pressure in pipe (kPa) | Compression class Normal > 95% SP | | |
| Installation type | Normal trench and normal up to high compaction | Installation factor % | 1.0 % |
| Bedding/bedding layer | Normal levelling layer | Bedding factor % | 2.00 % |
| Traffic load | Heavy traffic load | Max. negative pressure in pipe (kPa) | 0.00 |
| Soil cover above pipe top (m) = H | 1.50 | Distance from ground level to ground-water level (m) = Hw | 0.50 |
| Relative density - below ground-water level (kN/m³) | 10.00 | Relative density - above ground-water level (kN/m³) | 20.00 |
| Calculated diameter of pipe (mm) | 63.00 | Pipe ring stiffness | 16.00 |

Load combination 1.1 Deformation calculation serviceability limit state

| | | | |
|--|-------|--|-------|
| Average stress from traffic load (q_{tm}) kN/m² | 30.29 | Short-term deformation from variable load (traffic) | 0.6 % |
| Load factor C regarding the stiffness ratio of pipe to backfilling material (applied) | 1.01 | Short-term deformation from permanent load (soil) | 0.6 % |
| Characteristic traffic load q_{tk} kN/m² (Formula 9) | 30.69 | Deformation from installation (Table 2.9) | 1.0 % |
| Additional soil cover for | 1.55 | Average deformation | 2.2 % |

determination of soil modulus E_{td}
when influenced by heavy road
traffic load (Table 2.8)

| | | | |
|--|------|--|--------------|
| delta H factor dependent on type of road traffic load | 1.0 | Short-term maximum deformation (Page 42) | <u>4.2 %</u> |
| Tangent modulus of backfill above ground-water E_{td} (Formula 11) - kN/m^2 | 4552 | Long-term deformation from load (formula 16) | 1.8 % |
| Secant modulus of backfill above ground-water E_{sd} (Formula 12) - kN/m^2 | 2959 | Long-term max. deformation (Formula 15) | 5.4 % |
| Reduction factor for ground-water influence on soil E-moduli (formula 13) | 0.73 | | |
| Tangent modulus of backfill below ground-water E_{td} (Formula 11 x Formula 13) - kN/m^2 | 3338 | | |
| Secant modulus of backfill below ground-water E_{sd} (Formula 12 x Formula 13) - kN/m^2 | 2170 | | |

Short-term maximum deformation (Page 42) 4.2 % < 9.0 % (Pipematerial: PE100) - OK

Load deformation 2.1 Deformation calculation ultimate limit state

| | | | |
|---|---------|--|--------|
| Calculated ring stiffness (kN/m^2) | 13.33 | Calculated max. buckling pressure (kN/m^2) | 791.81 |
| Calculated tangent modulus (kN/m^2) | 1473.00 | Design load (kN/m^2) | 70.22 |
| Reduction factor beta | 0.84 | Design buckling pressure (kN/m^2) | 663.90 |

Buckling load combination 2.1 - q_d (Formula 20) kN/m^2 70.22 < Buckling load combination 2.1 - $\beta x q_b$ (Formula 22) 663.90 - OK

Při dodržení zadávacích podmínek potrubí RC Protect PE 100 RC, PN 10, SN 16, De 63 vyhoví a jeho deformace nepřesáhne hodnotu 4,2 %. Tato deformace je počítána při prázdném potrubí bez vnitřního přetlaku.

Zadávací podmínky

Použité potrubí: RC Protect PE 100 RC, PN 10, SN 16, De 63

Krytí nad vrcholem potrubí: 0,8 m

Zatížení provozem: D 400

Hladina spodní vody: 0,5 m pod povrchem

Obsypový materiál: lomová prosívka 0-8 mm

Stupeň zhutnění obsypu: 95% PS

Result

Calculation OK

Given values

| | | | |
|---|--|--|--------|
| Pipe type | PE 100 RC | Pipe dimension (mm) | 63 |
| Soil type | Sand | Please note: the chosen pipe diameter is below 110 mm, but has been set at 110 mm for calculation purpose | |
| Safety class | Normal | Control class | Normal |
| Partial coefficient - safety class | 2.27 | Partial coefficient - control class | 1.50 |
| Max. negative pressure in pipe (kPa) | Compression class Normal > 95% SP | | |
| Installation type | Normal trench and normal up to high compaction | Installation factor % | 1.0 % |
| Bedding/bedding layer | Normal levelling layer | Bedding factor % | 2.00 % |
| Traffic load | Heavy traffic load | Max. negative pressure in pipe (kPa) | 0.00 |
| Soil cover above pipe top (m) = H | 0.80 | Distance from ground level to ground-water level (m) = H_w | 0.50 |
| Relative density - below ground-water level (kN/m³) | 10.00 | Relative density - above ground-water level (kN/m³) | 20.00 |
| Calculated diameter of pipe (mm) | 63.00 | Pipe ring stiffness | 16.00 |

Load combination 1.1 Deformation calculation serviceability limit state

| | | | |
|--|-------|--|-------|
| Average stress from traffic load (q_{tm}) kN/m² | 63.19 | Short-term deformation from variable load (traffic) | 1.4 % |
| Load factor C regarding the stiffness ratio of pipe to backfilling material (applied) | 1.13 | Short-term deformation from permanent load (soil) | 0.4 % |
| Characteristic traffic load q_{tk} kN/m² (Formula 9) | 71.20 | Deformation from installation (Table 2.9) | 1.0 % |
| Additional soil cover for | 3.00 | Average deformation | 2.8 % |

determination of soil modulus E_{td}
when influenced by heavy road
traffic load (Table 2.8)

| | | | |
|--|------|--|--------------|
| delta H factor dependent on type of road traffic load | 1.0 | Short-term maximum deformation (Page 42) | <u>4.8 %</u> |
| Tangent modulus of backfill above ground-water E_{td} (Formula 11) - kN/m^2 | 5376 | Long-term deformation from load (formula 16) | 2.6 % |
| Secant modulus of backfill above ground-water E_{sd} (Formula 12) - kN/m^2 | 3495 | Long-term max. deformation (Formula 15) | 6.5 % |
| Reduction factor for ground-water influence on soil E-moduli (formula 13) | 0.85 | | |
| Tangent modulus of backfill below ground-water E_{td} (Formula 11 x Formula 13) - kN/m^2 | 4570 | | |
| Secant modulus of backfill below ground-water E_{sd} (Formula 12 x Formula 13) - kN/m^2 | 2971 | | |

Short-term maximum deformation (Page 42) 4.8 % < 9.0 % (Pipematerial: PE100) - OK

Load deformation 2.1 Deformation calculation ultimate limit state

| | | | |
|---|---------|--|--------|
| Calculated ring stiffness (kN/m^2) | 13.33 | Calculated max. buckling pressure (kN/m^2) | 926.50 |
| Calculated tangent modulus (kN/m^2) | 2016.77 | Design load (kN/m^2) | 108.87 |
| Reduction factor beta | 0.80 | Design buckling pressure (kN/m^2) | 745.36 |

Buckling load combination 2.1 - q_d (Formula 20) kN/m^2 108.87 < Buckling load combination 2.1 - $\beta x q_b$ (Formula 22) 745.36 - OK

Při dodržení zadávacích podmínek potrubí RC Protect PE 100 RC, PN 10, SN 16, De 63 vyhoví a jeho deformace nepřesáhne hodnotu 4,8%. Tato deformace je počítána při prázdném potrubí bez vnitřního přetlaku.