



Problem Set 3 – Solution

1. On the following Figure 1 the convergence-confinement curve ($\lambda - u$) for the Soil Unit (TE-1) is presented and the Figure 2 for the Rock Unit (TE-2) is presented.

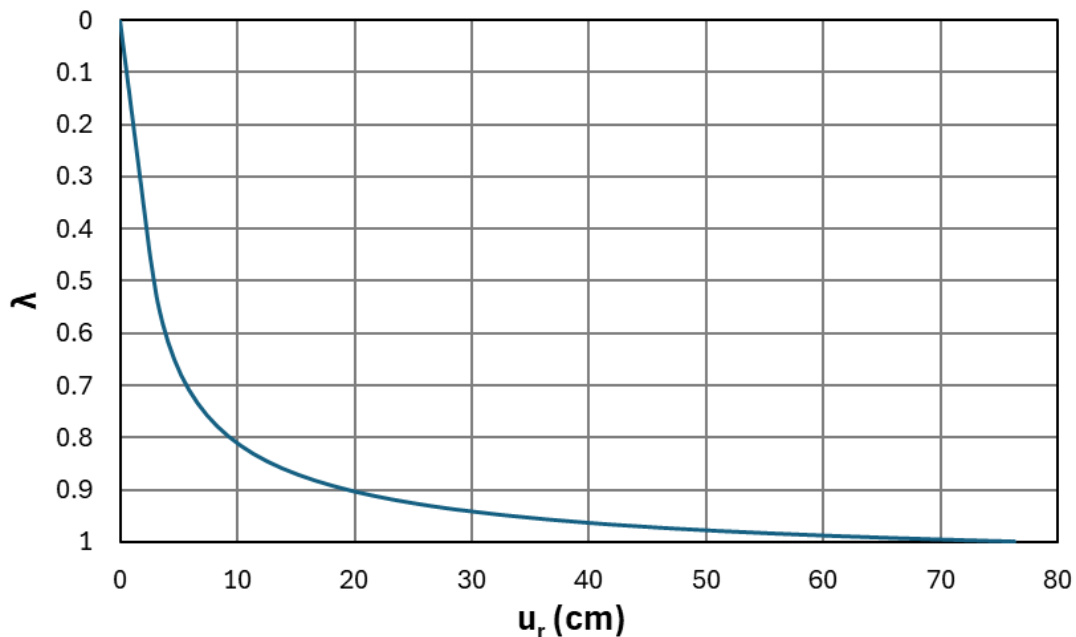


Figure 1. Convergence – confinement curve for Soil Unit (TE-1)

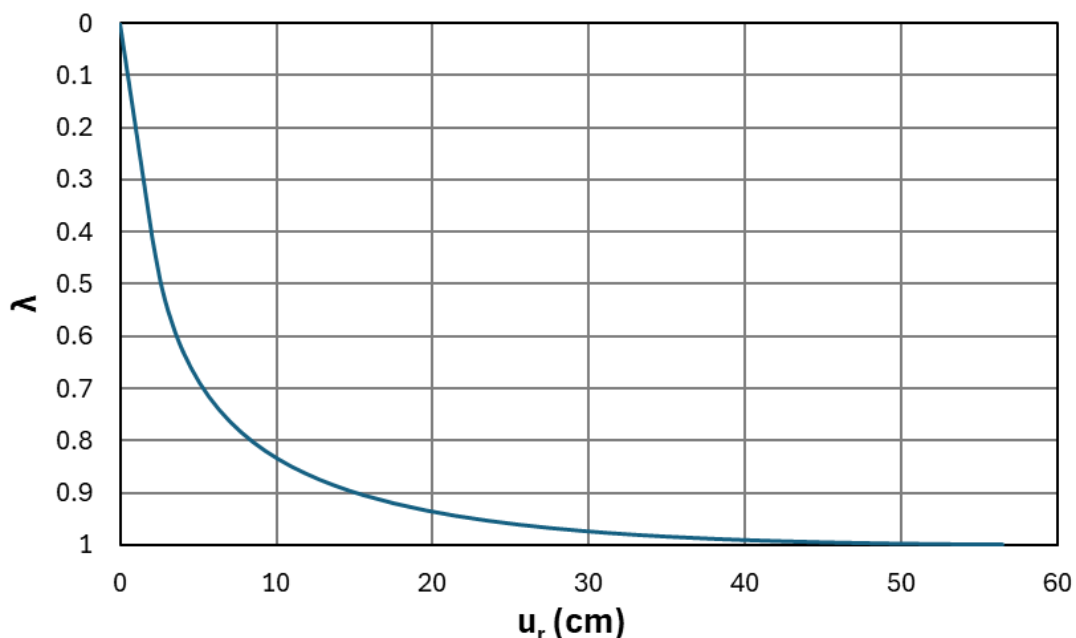


Figure 2. Convergence – confinement curve for Rock Unit (TE-2)

2.

Soil Unit (TE-1):

Based on the analysis by the RocSupport – Rocscience software, the following results calculated, taken into account the effect of the tunnel primary support:

- Tunnel wall convergence (u_r): Tunnel deformation on the tunnel face calculated 234.9mm and the final tunnel deformation calculated 331.1mm. Thus, the tunnel wall convergence is: $331.1\text{mm} - 234.9\text{mm} = 96.2\text{mm} = \mathbf{9.6\text{cm}}$.
- Radius of plastic zone (R_p): **12.8m**
- Safety factor of the tunnel support (SF): **37.6**

Rock Unit (TE-2):

Based on the analysis by the RocSupport – Rocscience software, the following results calculated, taken into account the effect of the tunnel primary support:

- Tunnel wall convergence (u_r): Tunnel deformation on the tunnel face calculated 173.7mm and the final tunnel deformation calculated 245.7mm. Thus, the tunnel wall convergence is: $245.7\text{mm} - 173.7\text{mm} = 72\text{mm} = \mathbf{7.2\text{cm}}$.
- Radius of plastic zone (R_p): **11.8m**
- Safety factor of the tunnel support (SF): **5.2**

3.

Soil Unit (TE-1):

Based on the analysis by the RocSupport – Rocscience software, the following results calculated, taken into account the effect of the tunnel primary support with steel sets HEB 140:

- Tunnel wall convergence (u_r): Tunnel deformation on the tunnel face calculated 234.9mm and the final tunnel deformation calculated 282mm. Thus, the tunnel wall convergence is: $282\text{mm} - 234.9\text{mm} = 47.1\text{mm} = \mathbf{4.7\text{cm}}$.
- Radius of plastic zone (R_p): **12.8m**
- Safety factor of the tunnel support (SF): **45.2**

Rock Unit (TE-2):

Based on the analysis by the RocSupport – Rocscience software, the following results calculated, taken into account the effect of the tunnel primary support with steel sets HEB 140:

- Tunnel wall convergence (u_r): Tunnel deformation on the tunnel face calculated 173.7mm and the final tunnel deformation calculated 245.6mm. Thus, the tunnel wall convergence is: $245.6\text{mm} - 173.7\text{mm} = 71.9\text{mm} = \mathbf{7.2\text{cm}}$.
- Radius of plastic zone (R_p): **11.8m**
- Safety factor of the tunnel support (SF): **6.2**

Conclusion: The effect of the steel sets is minor!!!