

Exercise 11: Strengthening of a bridge deck slab with reinforced UHPFRC

Background

The cross-section of a bridge deck slab (year of construction: 1969) has the following geometry after hydrojetting of chloride contaminated concrete: thickness: $h_{c, act} = 180$ mm.

This slab has steel reinforcing bars $A_{sc, act} = \varnothing 18/s=150$ mm in the upper part, with axis flush with the level of the upper concrete surface after hydrodemolition.

The updated values of the concrete compressive strength and steel bars strength are respectively $f_{ck, act} = 30$ MPa and $f_{sk, act} = 450$ MPa.

The load-bearing capacity of the slab is increased by a layer of reinforced UHPFRC of thickness $h_U = 40$ mm, with $A_{s,U} = \varnothing 12/s=100$ mm in the middle of the UHPFRC layer. The characteristic value of the uniaxial tensile strength of the UHPFRC is $f_{Utk} = 12$ MPa. The reinforcing steel used is B500B ($f_{suk} = 500$ MPa).

The effect of the reinforcement bars in the compression zone can be neglected for the negative moment resistance calculations. X is the position of the neutral axis in the composite R-UHPFRC-RC composite member.

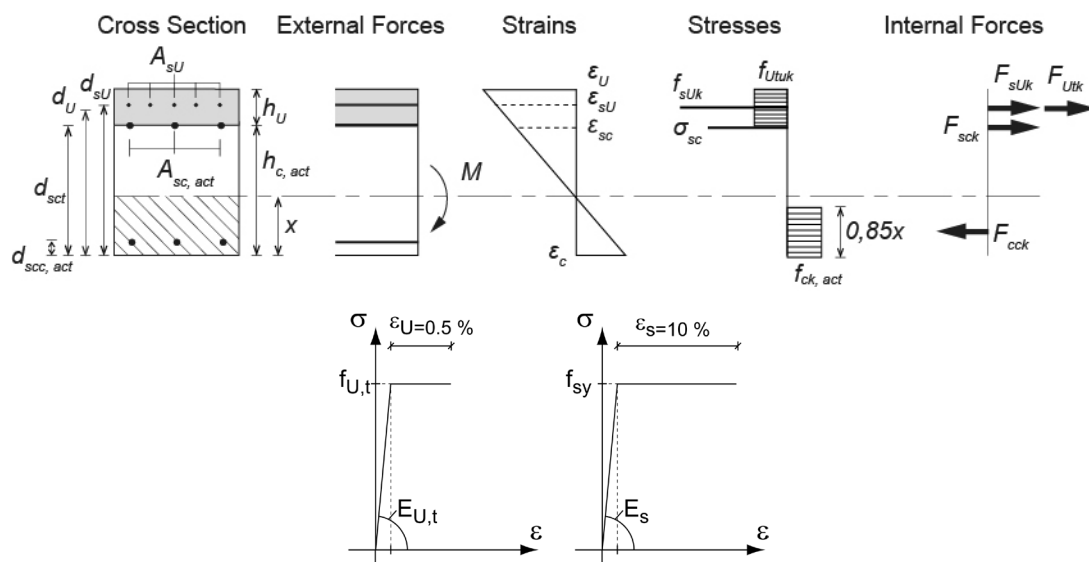


figure 1 Reinforced UHPFRC - Reinforced concrete composite system, calculation model.

Work to be carried out:

1. Calculate the bending resistance per unit length $m_{R,0, act}$ (ultimate limit state) of the reinforced concrete deck alone.
2. Determine the characteristic value of the bending resistance per unit length $m_{R,1, act}$ (ultimate limit state) of the composite section ("plastic calculation") and check the strength and deformation of the concrete (neglecting the contribution of rebar in compression zone).
3. Check the structural safety (degree of compliance) of the strengthened section, assuming that the value of the updated effect of the actions is: $m_{Ed, act} = 160$ kNm/m'.
4. Discuss the results.