

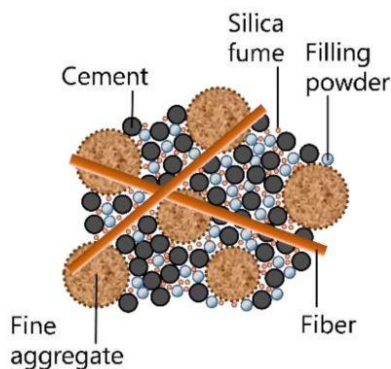
Repair and Strengthening of an existing bridge using UHPFRC

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How to repair and strengthen an existing prefabricated girder bridge in Northern Scotland using UHPFRC? Here is a first answer! In addition to the structure analysis, many other subjects were studied: the intervention, the cost, the carbon footprint, the possibilities for the deck to evolve in the future under a load increase or the apparition of two additional lanes.

First, what is UHPFRC? It is an Ultra High-Performance Fiber Reinforced Cementitious-Based Composite that has the following microstructure:



What are the principal problems encountered by prefab prestressed girder bridges which can be solved thanks to the use of (R-)UHPFRC?

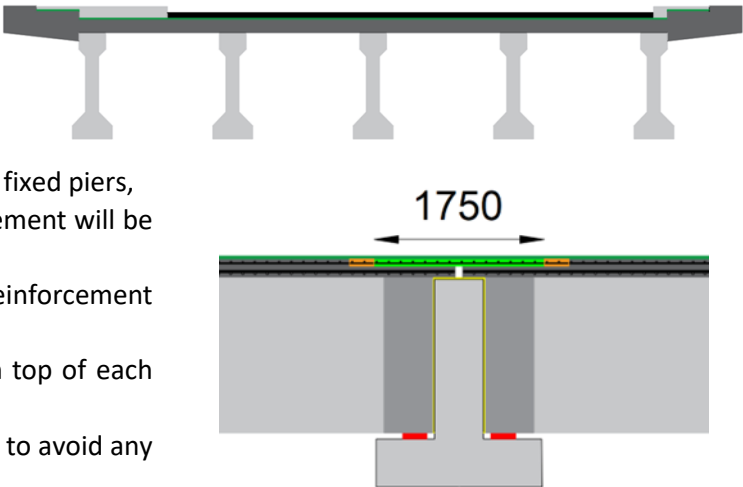
- Corrosion of the most exposed parts (often located underneath expansion joints),
- Damage of the waterproofing layer creating issues in the deck,
- Lack of resistance to support the evolution of traffic throughout the years,
- Fatigue problems when the bridge considered is part of a major road.

The two main methods using that material to solve those problems that are studied here are the creation of link slabs and the addition of an overlay on the entire deck. The influence of all parameters has been studied to determine how to design a repair that is optimized for the case study.



For that bridge, here are the conclusion that were obtained:

- Partial depth UHPFRC link slabs will be placed on each one of the fixed piers,
- A structural UHPFRC overlay of 30 mm with transversal reinforcement will be placed all over the surface.
- An additional 10 mm overlay to ensure durability (for the reinforcement cover to be at least 15-20 millimeters).
- minimum 80 mm movement Sentinel EMR joints will be put on top of each one of the free piers,
- dowels will be severed to let only one of them every three spans to avoid any tensile forces in the deck due to temperature difference.



Regarding intervention, cost and carbon footprints, the use of UHPFRC is very competitive:

- with an intervention period of 2,5 months, it is quite fast in comparison with a standard concrete operation where the curing time is already of 28 days,
- with a price of CHF 430/m2, It is way more competitive than the repair cost of 2018,
- when looking on the long term, the carbon footprint for example of an UHPFRC link slab is very similar to the one of a RC link slab even if the material emits way more CO2 during its production, the fact that it lasts longer compensates the difference.

UHPFRC can finally also help to change completely the design of the deck in case of load increase or if the government wants to wider that bridge: changing the static system or widen the deck using only UHPFRC have non negligible advantages in comparison with standard methods.

