

Shear capacity of existing concrete bridges with bent-up bars with or without smooth shear reinforcement



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Background

Many existing concrete bridges built before the 1970s use reinforcement designs that include bent-up bars. These designs place longitudinal reinforcement in areas where the bending moment induces tension, while also increasing the shear capacity at the locations where the bars are bent up, as exemplified in *Figure 1*. The shear reinforcement in these bridges is either non-existent or is produced from smooth bars. The problem that arises when calculating the shear capacity of these bridges is twofold. Firstly, the shear reinforcement ratio may be too low according to the minimum requirements in the current design standards. Secondly, when the shear capacity contribution of the bent-up bars is considered, only the tensile capacity of the bent-up bars is taken into account, see *Figure 2*. This may lead to conservative estimates of the shear capacities, potentially resulting in unnecessary strengthening or demolition of existing bridges. Both of these outcomes would have a significant environmental impact.

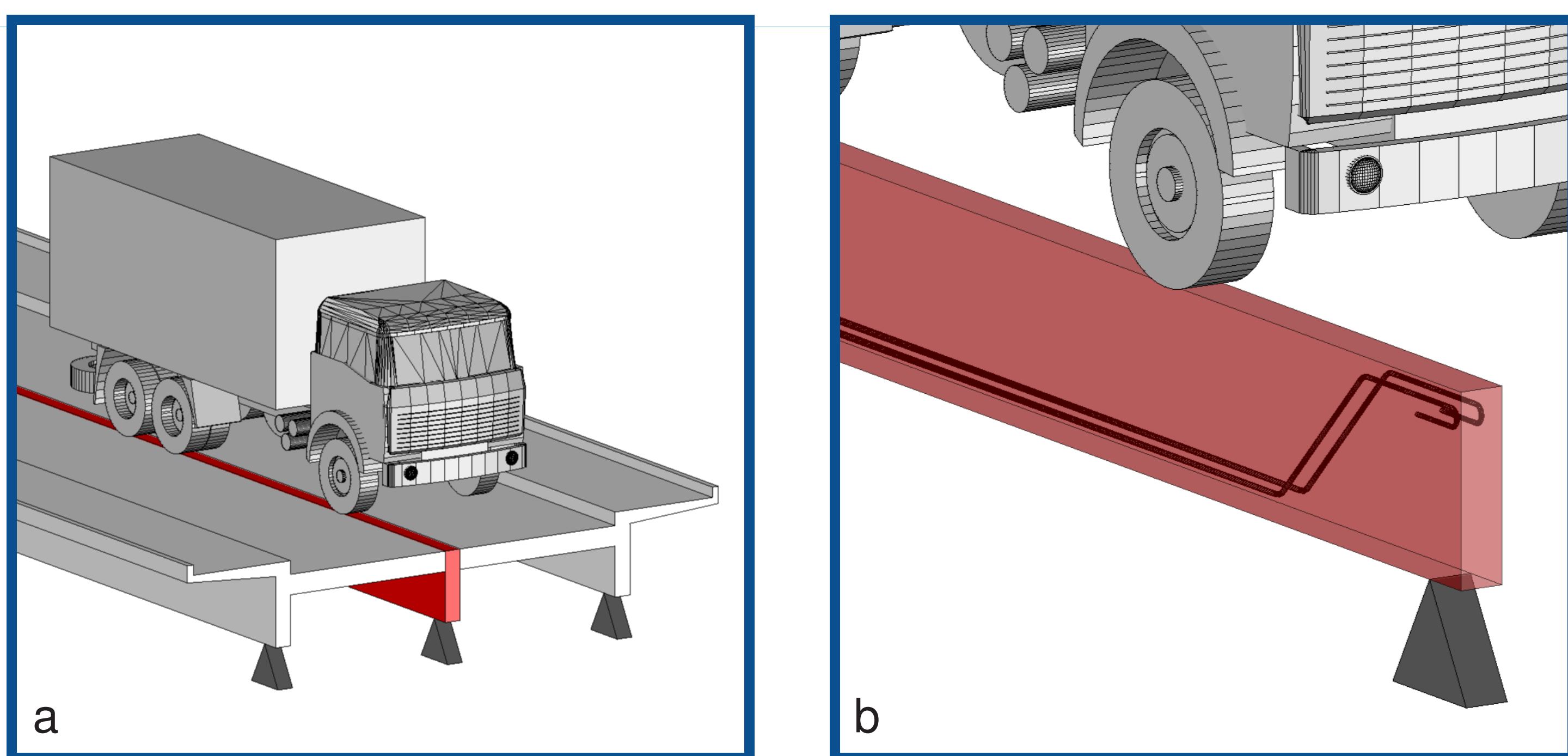


Figure 1a: A truck passing a bridge with longitudinal beams. 1b: A closer look at the beam, showing a reinforcement design using bent-up bars.

Aim of project

- ☛ To obtain a deeper understanding of the governing failure mechanism in concrete structures containing bent-up bars, and smooth shear reinforcement.
- ☛ To establish an analytical model that can reliably predict the shear capacity of structures containing bent-up bars and smooth shear reinforcement.

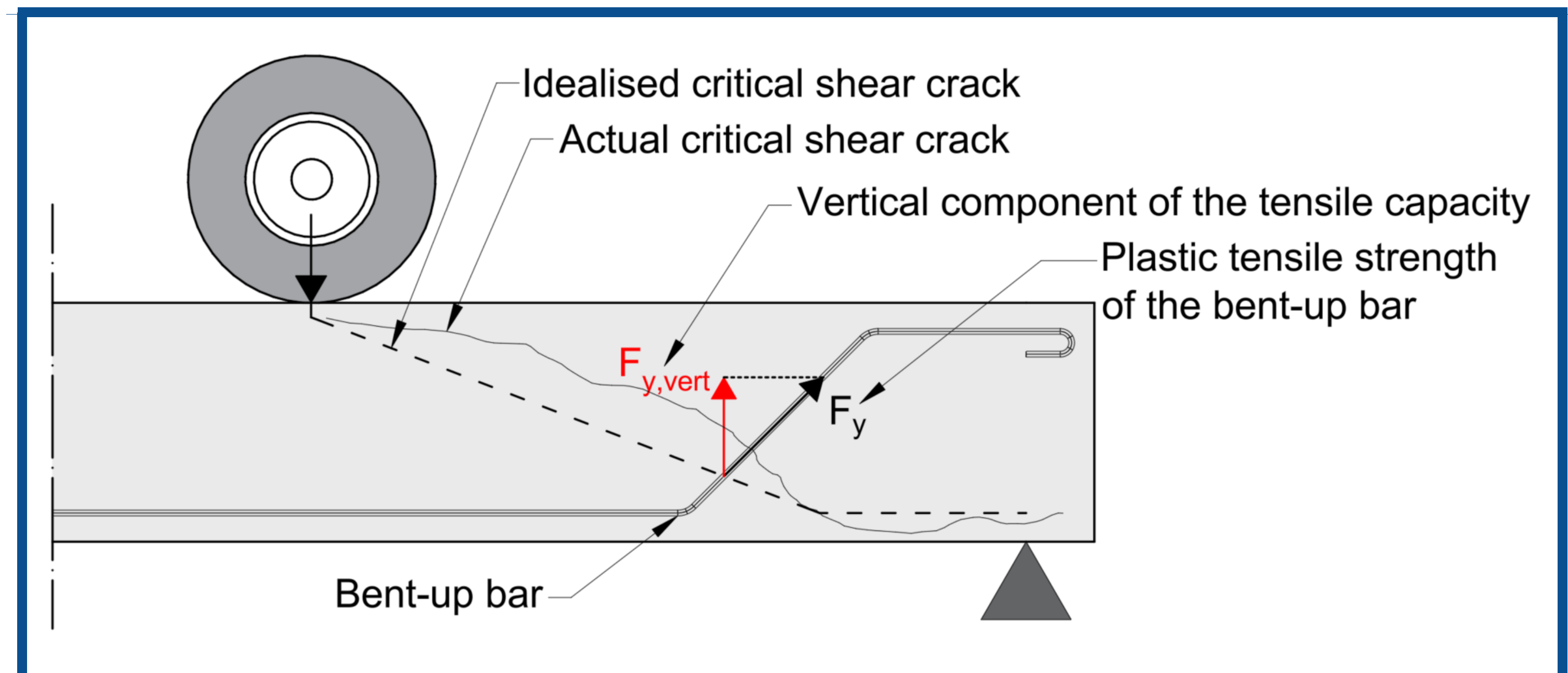


Figure 2: Idealised critical shear crack crossing the bent-up bars. Shear contribution from bent-up bars simplified as the vertical component of the plastic tensile capacity.

Research questions

- ☛ What is the shear-transfer action of bent-up bars?
- ☛ What is the shear-transfer action of smooth shear reinforcement?
- ☛ How do bent-up bars influence the shear capacity of beams and slabs?
- ☛ Can we modify or develop a mechanical model for the shear contribution from the bent-up bars?
- ☛ Can the failure mechanism be modelled, and the shear capacity be calculated with sufficient accuracy?

Method

Literature study on bent-up bars and smooth shear reinforcement.

Database of tested beams with bent-up bars.

Experimental investigation.

Develop a shear model.

Verify the shear model using the database.

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F O N D E N

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MORE INFORMATION



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