EXPERIMENTAL TESTS ON BOND PERFORMANCE BETWEEN CORRODED STEEL REINFORCEMENTS AND CONCRETE

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The corrosion of steel bars in concrete is a dangerous and extremely costly problem, that causes losses of serviceability and structural capacity in buildings and bridges. Once that the depassivation occurs, as a result of concrete carbonation or chlorides attack, at the steel-concrete interface the iron oxides expand approximately 2–6 times in volume, causing cracks and bond-slip degradation. In particular, the reinforcement - concrete bond degradation, influences the deformability of the element and consequently its service behaviour. The present study is a part of an extensive research project, CONSTIN, between Oslo Metropolitan University and Niccolò Cusano University aiming to evaluate the steel-to-concrete interaction in the presence of corrosion and to establish a variation law for the bond strength as a function of the corrosion level. The research aims to assess the influence of different level of corrosion on the interface between the concrete and the most typical steel reinforcement typologies (the steel strands, and the smooth and the ribbed bars), characterized by the same diameter (equivalent to 12 mm) and bonded length. The different level of corrosion is reached with a specific duration of exposition of the embedded reinforcements to the accelerated electrolytic corrosion process. Some details about the laboratory procedure, the duration of exposition and the current density will be provided. The preliminary results of the experimental campaign will be presented.

Reinforcement typologies

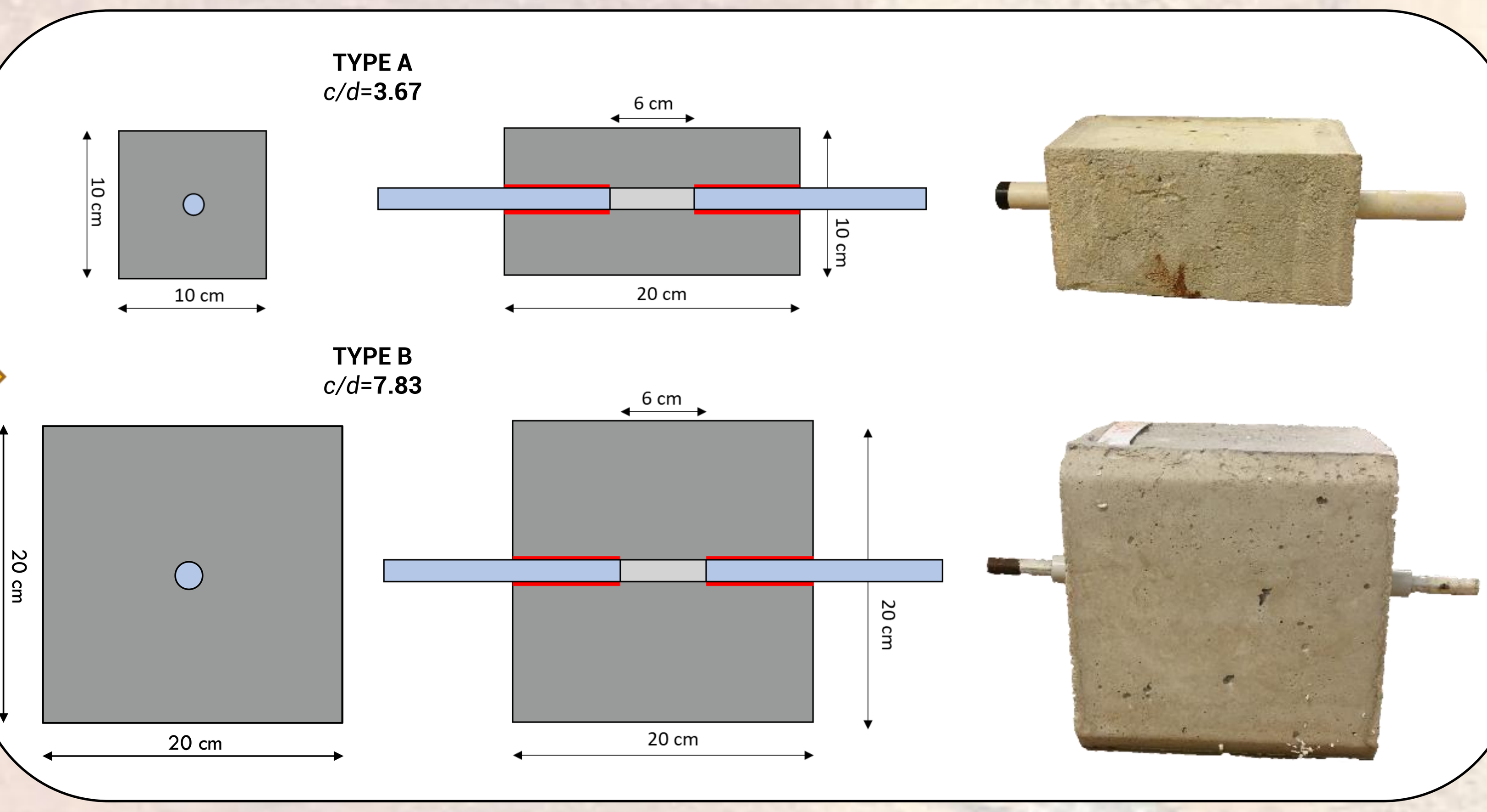
Ribbed bars

Smooth bars

Strands

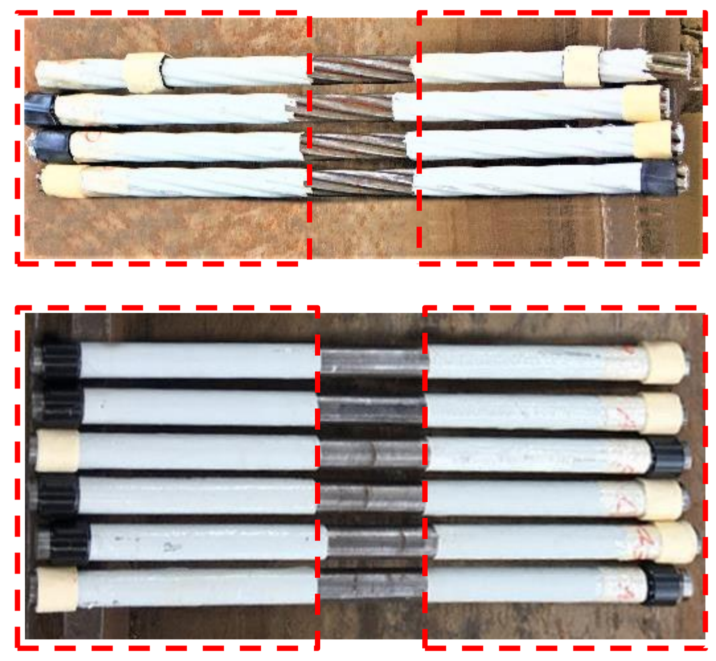
The research will assess the influence of the corrosion degradation on the interaction between the concrete and the most typical steel reinforcement typologies: the steel strands, and smooth and ribbed bars. To compare the results, the reinforcements are characterized by the same diameter (equivalent to 12 mm) and bonded length.

Type of specimens analysed

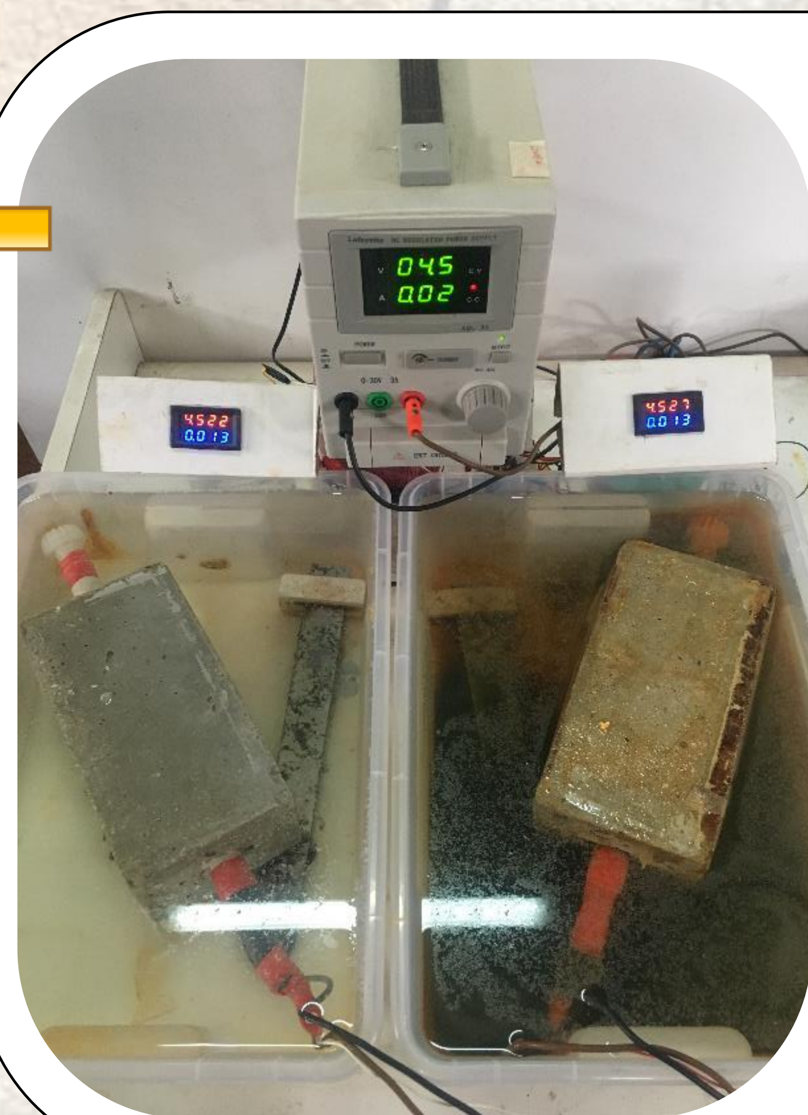


Particular of specimen preparation

To prevent any corrosion localization, the un-bonded parts were protected with a proper antirust after removal of any surface impurity.

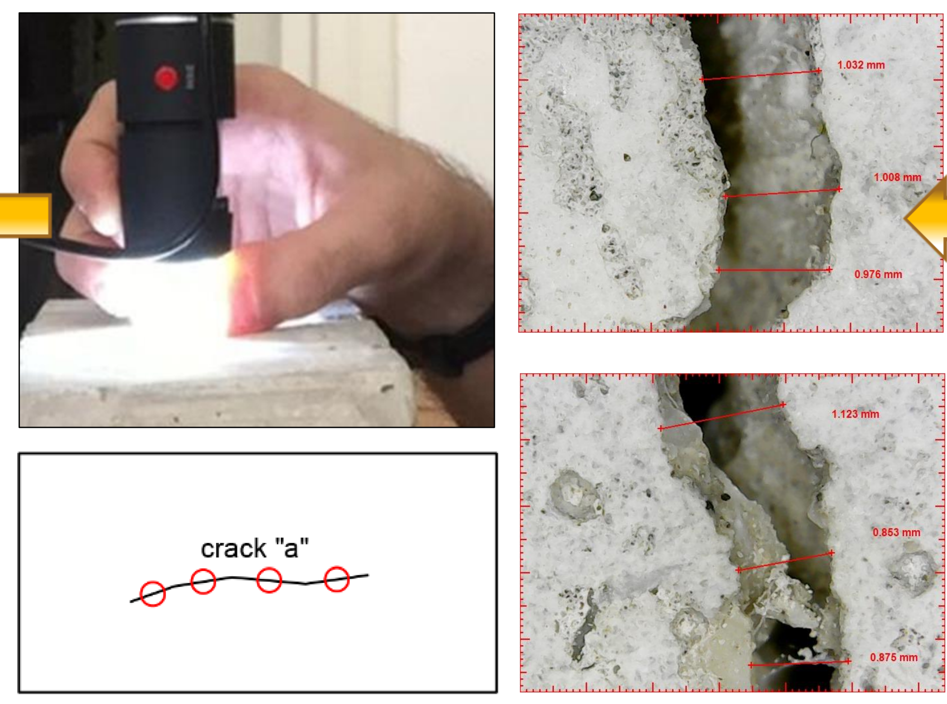


Accelerated Corrosion Process



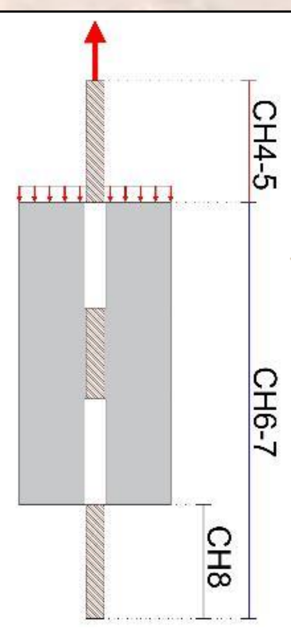
The adopted artificial deterioration process was the **electrolytic corrosion**. The current density was limited to about 250 μA/cm². The circuit is closed by an electrolytic solution, consisting of 3% NaCl aqueous solution.

Crack Width Mesuring Process



Through the use of a digital microscope, it was possible to accurately detect each crack width and then calculate the average of all sides.

Pull Out Test Setup

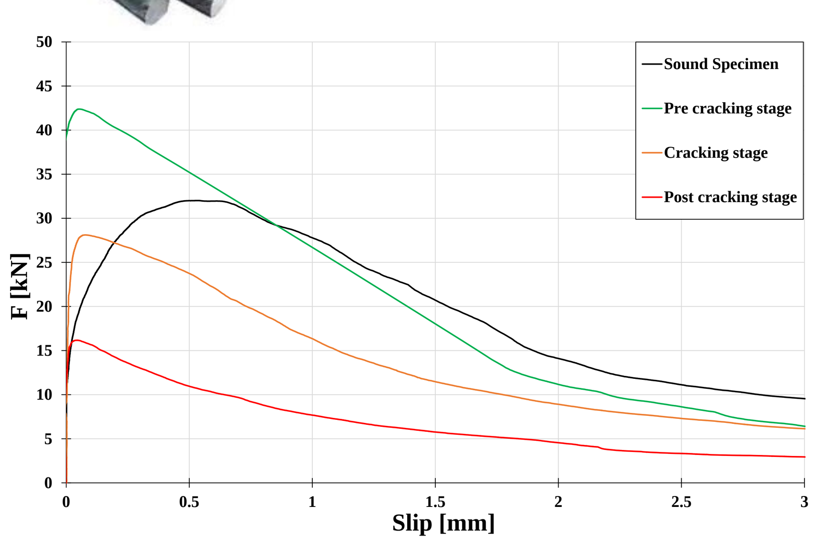


Each specimen was instrumented with **5 Potentiometric Linear Transducers (PLT):**

- CH8 measures the bar slip at the bottom free end.
- CH6 and CH7 measures the displacement, which contains, besides a rate of slip, the specimen deformation.
- CH4 and CH5 measures the loaded upper end displacement of the bar with respect to the concrete.

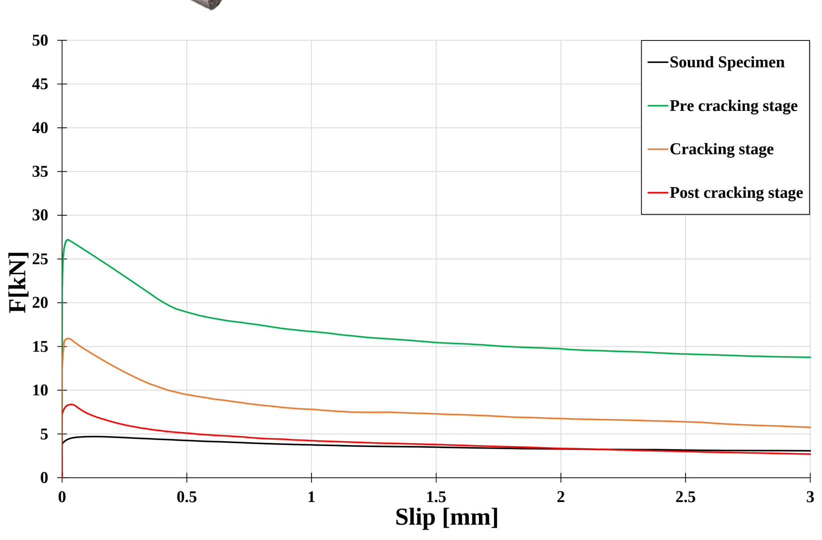
Main Experimental Results

RIBBED BARS



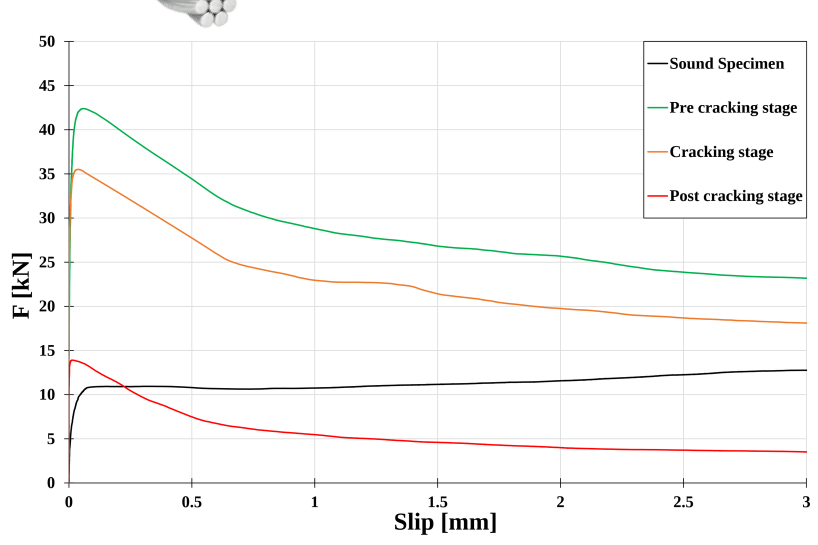
Corrosion modified the bond performance of ribbed bars reducing the pull-out force already in the pre-cracking stage.

SMOOTH BARS



In smooth bars all stages of corrosion causes an increment in the peak of pull-out force. Only in the post cracking stage the softening branch intercept the performance of sound specimen.

STRANDS



The bond performance of reinforcing strands is highly affected by corrosion. In fact the sound specimen is characterised by an hardening branch whilst corroded specimens are characterised by a softening behaviour.

References

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