Pull-out experimental testing on ribbed bars produced in coils

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Summary

One of the most important aspects in R/C structures is bond between steel and concrete. It allows the formation of the resistant mechanisms that characterizes the structural behavior of a reinforced concrete element. In the recent years, code specifications reduced the lower limits for the relative rib area (bond index). The previous values were based on a wide experimental campaign. In general the latter should guarantee a good level of bond in all the common situations. Moreover building industry increased the use of rebar straightening by means of bending machines used to straighten and shape straightened rebar in coils for use on construction sites. The straightening produces a damage on the ribs that modifies their geometrical properties, essentially due to the action of the cold rolling line for coils in which the rollers induce a permanent deformation to the bar in order to obtain the final straightening.

In the present work, the experimental results of pull-out tests, carried out according with the RILEM testing method, on ribbed reinforcing bars produced in coils and subsequently mechanically straightened are shown. Three different diameters are considered: 8, 12 and 16 mm. The behaviour in terms of bond strength response is compared to the Code provisions and then discussed.

Keywords: bond; relative rib area; straightening process, pull-out test, Codes.

1. Introduction

Bond between steel and concrete is the key mechanism that combines the features of the two materials so to create the composite structural material: the reinforced concrete. The bond mechanism is activated whenever a relative slip between steel and concrete is present. This mainly appears where, because of the internal actions, cracking of concrete is present and the crack is crossed by rebars. The latter connects the two surfaces of the crack and their stress is spread into the concrete by means of bond. Because of this, bond is definitely responsible of the structural behavior of the reinforced concrete elements. This role is exerted both in service and in ultimate conditions. Generally, in service conditions, a good level of bond ensures a small cracking and a reduced deformability of the structural elements. In particular, the cracking level is an important parameter for durability of structures, especially when they are in aggressive environment [1]. At ultimate conditions, it is very important to obtain high bond strength, both in anchorage zones and in the overlapping zones, with the aim to reduce the transmission length; on the other hand, good bond properties, after the yielding of the rebars, may be at odds with the plastic deformation and ductility requirements of the structural elements [2]. Indeed this phenomenon can reduce plastic rotation of reinforced concrete beams.

For ribbed bars, and for low bond-stress values, bond efficiency is exerted by chemical adhesion, while for higher bond stress values, the chemical adhesion breaks down and bond is developed by means of the mechanical interlock between concrete and ribs of the steel; therefore the rib profile

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