Bond strength development of blended concretes using hot-dip galvanized steel reinforcement

Francisco Javier LUNA MOLINA
Researcher
Eduardo Torroja Institute for Construction Sciences
Madrid, Spain
j.luna@ietcc.csic.es

María Cruz ALONSO ALONSO
Research Professor
Eduardo Torroja Institute for Construction Sciences
Madrid, Spain
mcalonso@ietcc.csic.es

Cecilio LÓPEZ HOMBRADOS
Bachelor Degree
Eduardo Torroja Institute for Construction Sciences
Madrid, Spain
clhombrados@ietcc.csic.es

Enrique HERNÁNDEZ MONTES
University Professor
University of Granada
Granada, Spain
emontes@ugr.es

Summary

The building of more sustainable structures is becoming a mandatory requirement. Different alternative are followed, as the use of blended cements to diminish the CO_2 emissions and energy saving, as of new reinforcement, as hot-dip galvanized, to increase the service life of reinforced concrete structures. But the effects of these changes on the technical performance of concrete structures are not determined yet. Mineral additions in high content decrease concrete mechanical strength at early ages, while the interaction between concrete and galvanized steel is different to that of carbon steel, what questions its bond strength. The present paper studies the bond developing stress of conventional and hot-dip galvanized steel reinforcement embedded in concrete made with ordinary Portland cement (OPC) and with a type of ternary blended cement containing 36% filler plus blast furnace slag. A detailed analysis of the rebars superficial geometry and pull-out tests have been carried out. Results indicate that the ribs of a hot-dip galvanized rebar are lightly wider and rounder than the ones of a conventional rebar and they present a smaller height because of the galvanized coating heterogeneity. Maximum bond stress measured for galvanized steel is similar to that of conventional reinforcement. Furthermore, greater stresses are developed when OPC concrete is used.

Keywords: bond, strength, blended, concrete, hot-dip galvanized, pull-out.

1. Introduction

Equal strains at the same fiber level regardless of if it is out of steel or if it is out of concrete is one of the main hypothesis in RC structures. It is essential to guarantee a perfect functionality of both materials in particular when reinforced concrete works under bending conditions. This is the main reason that made bond strength an important concern since reinforced concrete was conceived as a material with structural functions. The initial interaction between steel and concrete was carried out in smooth rebars with an elastic limit of around 215 MPa, demonstrating the mechanical advantages from combination of both materials. Later, steels with higher elastic limit, around 400 MPa, were developed to improve the bond interaction. The experience turned into longer bond lengths, so that ribbed rebars were invented.

A lot of uncertainties with the knowledge in bond strength are found in literature [8-13]. The materials and testing conditions are different, what make difficult the comparison of results; furthermore, not all investigations have been performed in concretes but using bars embedded in cement pastes or mortars and not always ribbed reinforcement were employed [14-15].

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