

Bond Strength of Plain Round Bars Repaired by Epoxy Resin Injection

Hideo ARAKI

Associate Professor
Hiroshima University
Higashi-Hiroshima,
JAPAN
araki@hiroshima-u.ac.jp

Hideo ARAKI, born 1953, received his civil engineering degree from the Hiroshima University, Japan. His main area of research is related to earthquake and structural engineering.



Jun-ichi KAGAWA

Company executive
SG Engineering
Hiroshima, JAPAN

Junichi KAGAWA, born 1947. He worked for chemical company in Japan before the present post. His main area of interest is retrofitting method for the existing building.



Summary

This paper summarizes an experimental study designed to evaluate the bond characteristics of the plain round bars in low strength concrete of less than 10MPa. A total of 161 pull-out tests were performed to examine the bond strength and the effect of repair with the epoxy resin injection method. The strength levels of the manufactured concrete were between 5 and 8MPa. The other variables were the direction of the steel bars, the thickness of the concrete cover under the bar etc. The test results show that the approximate bond strength of plain bars in low strength concrete was much lower than the allowable design strength in Japan and that the bond strength of plain bars was significantly increased with the injection of epoxy resin.

Keywords: bond strength; low strength concrete; plain bar; strengthen; epoxy resin.

1. Introduction

Seismic evaluations in Japan have found many RC buildings with very low concrete strength, *i.e.* less than half of the design concrete strength. Many of the buildings with low strength concrete (less than 10MPa) have been constructed in the 1960s and 1970s, although a design concrete strength of 18MPa was usually used at this time. Research projects concerning low strength concrete have since been conducted in Japan, and according to several reports, the observed flexural strength of RC members with plain round bars (below: plain bar) did not reach the calculated flexural strength, despite the fact that the specimens were designed as flexural failure type. It is estimated that the bond strength of plain bars deteriorated at an early stage, and that bond slip failure occurred before the yielding of the bars. These results exposed serious problems in the lateral load carrying capacity of these older existing buildings.

In order to clarify the resistance mechanism of those RC members, it is necessary to evaluate the bond characteristics of plain bars in low strength concrete under the lower limit of 13.5MPa recommended in the Standard [1] and to develop the repair method to improve the bond characteristics of the plain bars. Studies [2] [3] on the bond characteristics of plain bars were conducted long ago in the early part of the 20th century. In this paper, an experimental investigation was performed by means of pull-out tests to obtain the bond stress slip curves of plain bars in low strength concrete with some variables. Strength levels of the manufactured concrete were between 7 and 9MPa. The other variables were the concrete casting position and diameter of bars. The maximum bond strengths observed were compared with the allowable bond strength in the RC Code [4] of Japan Architectural Institute in 1971. The increase in bond strength of the plain bars injected with epoxy resin was discussed.

2. Bond Strength of Plain Round Bar

The allowable bond strength of plain bars as the longitudinal bars does not appear in the present