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A Proposed Model for Estimating the Relative Bond Strength of RC Beams with Corroded Lap Spliced Steel Bars, Considering C/d_b

Yaser Moodi[1] Mohammadreza Sohrabi[2]
Seyed Roohollah Mousavi [3]

1. Introduction

Steel bar corrosion is the main failure cause of RC structures. When rebars get corroded, they expand volumetrically (because of the composition of the corroded materials) and become several times the ordinary rebars in volume. This corrosion-caused volume increase results in tension in the concrete around rebars which, in turn, causes the cracking and splitting of the concrete cover.

The ratio of the bond strength in the corrosion state to the value of its corresponding in the absence of corrosion is called the relative bond strength. The results of the relative bond strength are different in Pullout test, Tension stiffening test, and Beams with lap spliced bars test.

In this study, a model was proposed using tension stiffening tests, for determining the relative bond strength of corroded steel bars in the descending branch. Then it was optimized using genetic algorithm for determining the relative bond strength of RC Beams with corroded lap spliced steel bars.

2. Proposed model

First, the results of mentioned tests are compared. As shown in Figure 1, the results of the Tension stiffening test is more similar to those of Beams with lap spliced bars test. Therefore, the results of the Tension stiffening test are used for the purpose of this study, which is to propose a model for determining the relative bond strength of RC Beam with corroded lap spliced steel bars.

Then, the following relationship has been proposed using tension stiffening tests, for determining the relative bond strength of corroded steel bars in the descending branch:

$$R_\tau = \begin{cases} 1 & C_w \le 1.2 \\ 1+[0.845(\frac{c}{d_b})^3 - 7.646(\frac{c}{d_b})^2 + 23.25(\frac{c}{d_b}) - 27.2](C_w - 1.2) & C_w > 1.2 \end{cases} \quad (1)$$

In order to use the proposed model for the relative bond strength of RC Beams with corroded lap spliced steel bars, the proposed model needs to be calibrated with the results of Beams with lap spliced bars test. After calibration, the relative bond strength of RC Beams with corroded lap spliced steel bars are estimated by using Eq. (2):

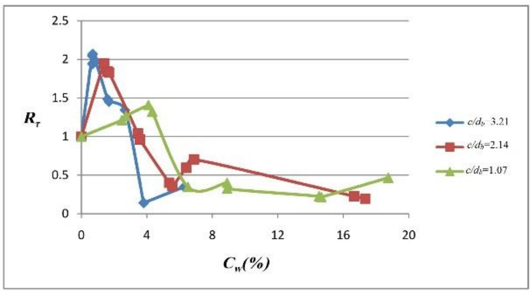
$$R_\tau = \begin{cases} 1 & C_w \le 1.2 \\ 1+3[0.845(\frac{c}{d})^3 - 7.646(\frac{c}{d})^2 + 23.25(\frac{c}{d}) - 27.2](C_w - 1.2) & C_w > 1.2 \end{cases} \quad (2)$$

3. Evaluating the proposed model

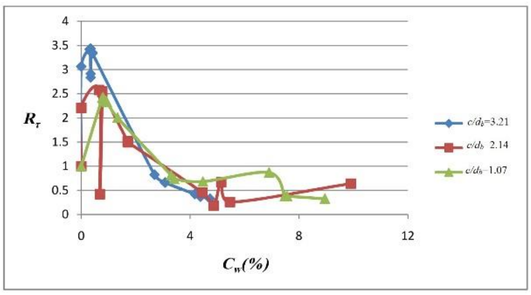
Statistical indices (total error, mean square error, average absolute magnitude error, standard deviation) for the proposed and Shihata models are calculated and are presented in Table 1 to compare the proposed model with Shiata model.

4. Conclusion

- The results of the Tension stiffening test is more similar to those of Beams with lap spliced bars test, in comparison with those of Pullout test.
- The use of proposed model for estimating the relative bond strength of RC beams with corroded lap spliced steel bars, leads to about 16 percent reduction in the total error, compared with Shihata model.

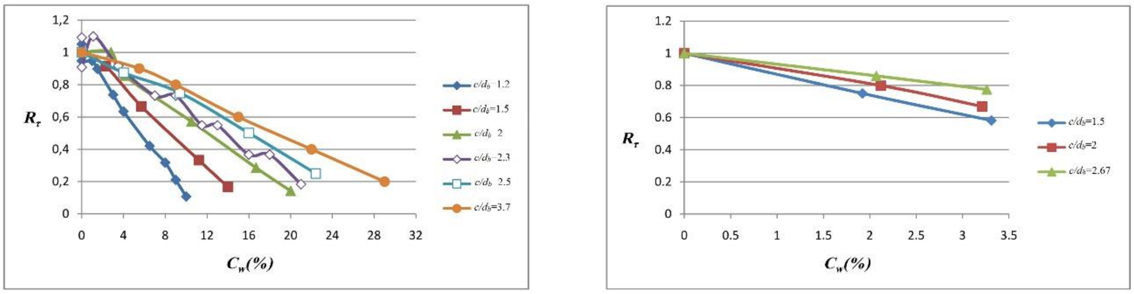


A. Pollout test (w/c=0.75)



B. Pollout test (w/c=0.75)

[1] PhD Student, Department of Civil Engineering, University of Sistan and Baluchestan, Zahedan, Iran.
[2] Associate Professor, Department of Civil Engineering, University of Sistan and Baluchestan, Zahedan, Iran.
[3] Corresponding Author: Associate Professor, Department of Civil Engineering, University of Sistan and Baluchestan, Zahedan, Iran.
Email: s.r.mousavi@eng.usb.ac.ir



C. Tension stiffening test D. Beams with lap spliced bars test

Fig. 1. The relative bond strength-percentage of corrosion

Table 1. Statistical parameters for bond strength of RC beam with corroded lap spliced steel bars

model	e_{tot}	*MSE*	*AAE*	*SD*
Shihata	4.48	0.58	5.14	8.04
Proposed model	3.77	0.35	3.89	4.95