

A study of the size-effect of corroded reinforced concrete beams in prediction of residual strength

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Abstract:

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This study is a continuation of a previous study in which a procedure for analytical prediction of residual flexural strength of corroded beams was presented. The primary aim of this work is to examine the applicability and accuracy of the proposed method in a relatively large size beam, so as to assess, if there is any size effect on the prediction model, as the modeling in the previous study was based on a smaller-size beams.

Considering all variables, a total of 48 reinforced concrete beams having 200 mm width, 1100 mm length and 40 mm cover thickness constant with varying depth were cast using a common concrete mix, of which 12 beams were tested in four-point bend test as control beams and the remaining 36 beams were subjected to accelerated rebar corrosion and then tested in flexure. After flexural testing, gravimetric test was carried out on the corroded rebar samples, extracted from the tested beams, to measure the weight loss of bars.

It has been observed, among others, that the product of corrosion current density and corrosion period, $I_{corr}T$, is a key factor affecting the flexural strength of a corroded beam. Diameter of rebar has also been found to have an effect on the percentage of metal loss for identical $I_{corr}T$. The effect of beam depth in the loss of flexural strength is found to be small for a given beam at constant $I_{corr}T$. A comparison of the residual flexural strength of corroded beams with the theoretical strength predicted by using only reduced cross-sectional area of bars due to corrosion indicates that such a theoretical prediction would be acceptable only at a lesser value of $I_{corr}T$ for which implication of bond strength can be ignored. However, at a higher value of $I_{corr}T$, the loss of bond is significant, a factor that must be accounted for in the theoretical strength prediction.

The extensive experimental work carried out in this study shows that the proposed model (Azad and Ahmad, 2004) consistently yields predicted values of residual strength of corroded beams that are lower than the actual strength. This is due to the fact that the model did not account well for the size effect of the tension bars. This study has shown that the size of the bars has an impact on the residual strength of the corroded beams. In view of this, a new correction factor C_f has been proposed which shows a better correlation with experimental data. The proposed method can therefore be used as a safe analytical tool for prediction of the residual strength.