Effect of resin injection on bond recovery for damaged reinforced concrete structure

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1. Introduction

It is currently important to make best use of many existing reinforced concrete (RC) buildings for years by effective maintenance of them. For instance, rebar corrosion in concrete causes bond degradation between rebar and concrete, resulting in decreasing structural performance of the RC structures. In our previous experiment in 2014A0087, it is found that splitting cracks induced by swelling of corrosion products around rebar degrade the bond stress between rebar and concrete. One of available methods to protect against further corrosion is a resin injection technique, which is widely utilized for RC structures to repair cracks damaged by earthquakes and aged degradation. This technique can inhibit the intrusion of degradation factors, such as water and oxygen, into concrete from outside by filling resin into cracks. In addition, it is expected to recover from bond degradation between rebar and concrete by filling resin into the cracks, since the resin reaching around rebar would play a role of adhesive between them. In this experiment, filling state of the resin in cracks in the RC specimen subjected to corrosion test was observed by the neutron CT technique using BL22 (RADEN) in J-PARC MLF.

2. Experiment

The RC specimen used in this study is schematically illustrated in Fig. 1(a). A ferritic steel deformed-bar with 9.53 mm in nominal diameter was embedded in a cylindrical concrete with 51 mm in diameter and 460 mm in length. The embedded depth of the rebar was 430 mm, and un-bonded region with 110 mm in length was artificially introduced.

The electrical corrosion method was utilized to provide corrosion on the rebar in concrete. The current with 34.56 Ah in total was applied to the RC specimen for 24 days. Figure 1(b) shows the surface and inside views of specimens experienced the corrosion test. Large splitting cracks induced by swelling of corrosion products can be observed.

The specimen was mounted on a sample stage of RADEN, and 181 projection images were taken by sample rotation with 1° step, to reconstruct the CT image. The resolution, L/D, was set to be 400.

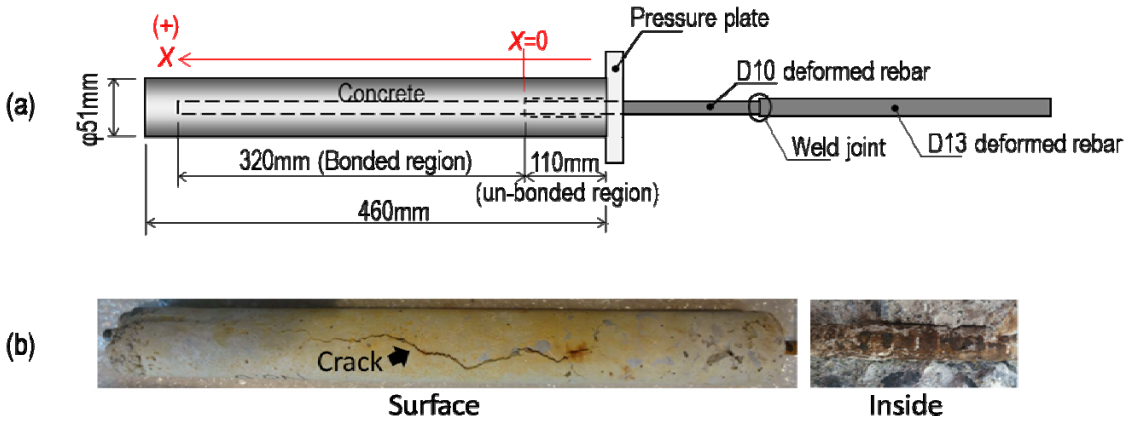

Fig. 1 (a) Schematic illustration of the RC specimen used in this study and (b) the surface view of the specimen and inside view of the another specimen with the same treatment.

3. Results

Figure 2 shows the cross-sectional image of the repaired RC specimen taken from neutron CT. Coarse aggregates, cement matrix and rebar can be observed in the cross-sectional image of the RC specimen. As shown in Fig. 2(a). two cracks propagated radially from rebar can be found in the region from 7.51 mm to 16.26 mm, and increase to three from 25.02 mm. White color in Fig. 2(b) indicates epoxy resin, which is filled in all cracks from 68.79 mm, and epoxy resin can be found even around rebar.

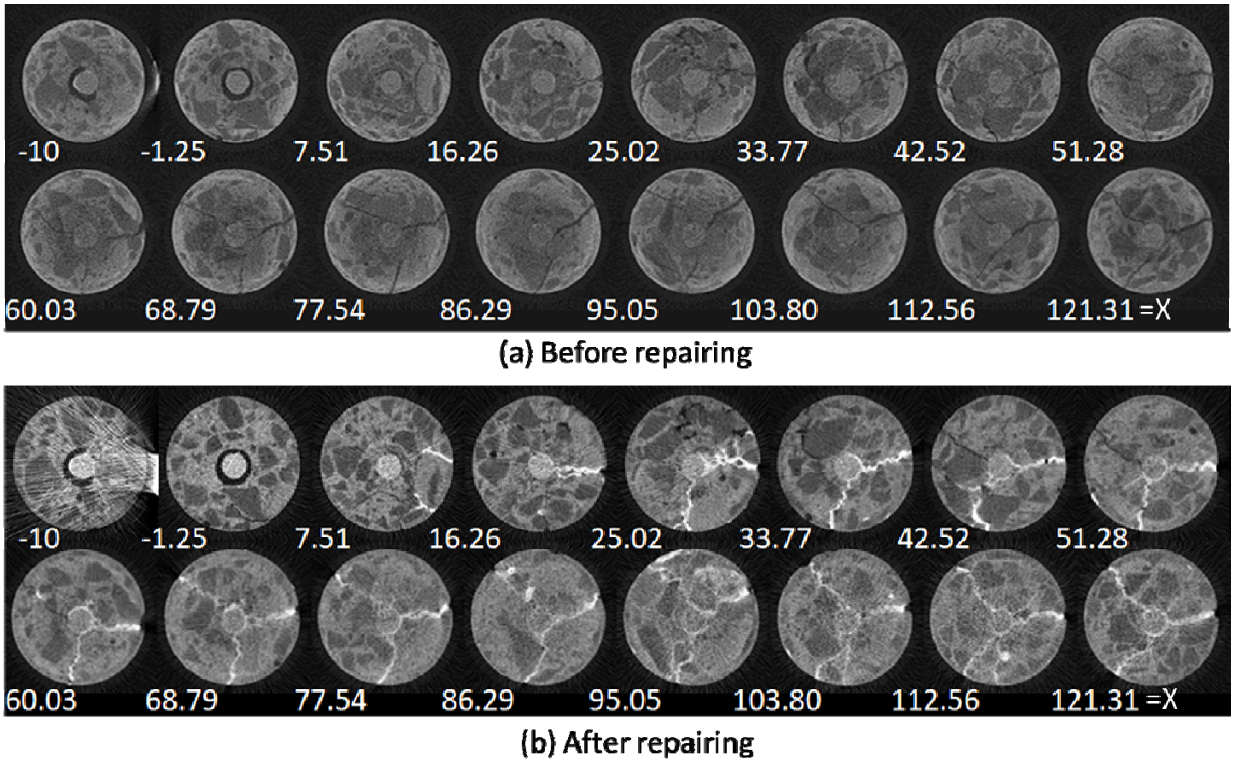

Fig. 2 Cross-section images of the RC specimen repaired by resin injection.

4. Conclusion

In this experiment, filling state of epoxy resin in cracks in RC specimen subjected to corrosion test was observed by the neutron CT technique using BL22 (RADEN) in J-PARC MLF. As a result, the cross-section of the RC sample was observed, and cracks in concrete evolved by rebar corrosion can be found as well. Furthermore, epoxy resin filled in cracks was well observed.

In relevant experiment performed in 2017A0156, the effect of resin injection to cracks on bond resistance between concrete and rebar were investigated by measuring change in axial stress distribution using neutron diffraction. The recovering mechanism of bond resistance will be discussed by comparing the direct image inside the RC specimen with the axial stress distribution.