Study of Rebar Localization in Concrete Based on Magnetic Reluctance Technique Using COMSOL Multiphysics®

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INTRODUCTION: Conventional techniques used for the locating rebars in concrete are often inadequate in detecting intersecting rebars. We propose a modified magnetic reluctance technique to overcome this challenge.

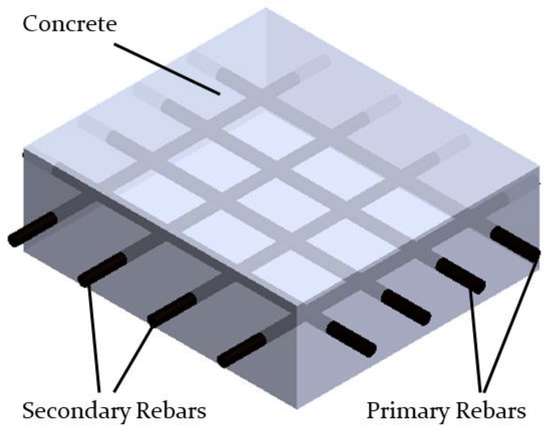

Figure 1. Array of intersecting rebars in concrete

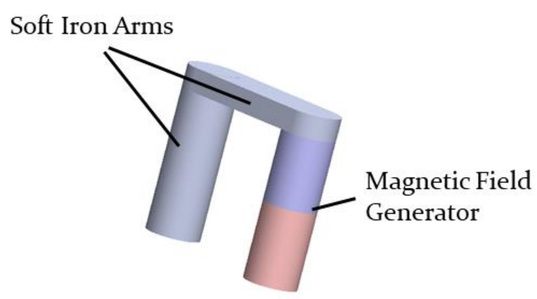

Figure 2. Conventional cover-meter

COMPUTATIONAL METHODS: By implementing the Magnetic Fields interface and Stationary study in the AC/DC module, the profile of magnetic flux density is studied both for conventional and modified configuration. With the use of Domain Point Probe under the soft iron arm, we plot the change in magnetic field density with respect to the rebars.

The scanning of the rebars is effected by using parametric sweep of the rebars thus generating a magnetic field profile in different Cut-Planes of the geometry allowing us to calibrate our method for locating the rebars.

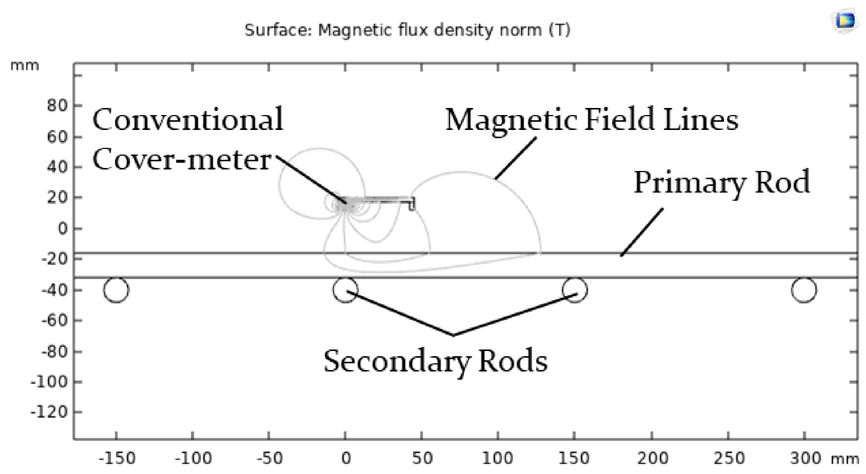

Figure 3. 1x4 array of rebars. Screening of magnetic field by the primary rod that prevents the detection of secondary rods by conventional cover-meters

RESULTS: Magnetic flux density as detected by both sensors (X-axis and Y-axis sensors) is shown for various simulation parameters.

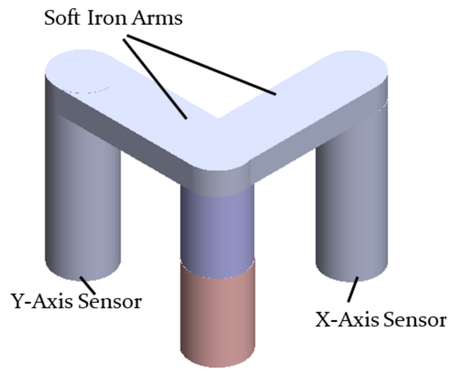

Figure 4. Modified cover-meter with 2-axis sensing

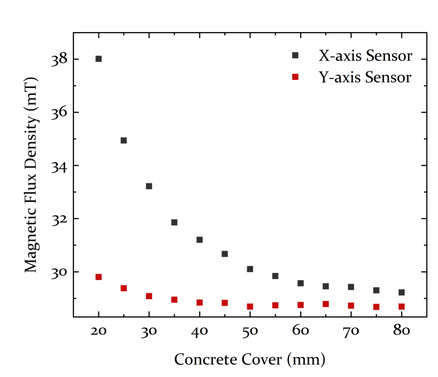

Figure 5. Effect of intersecting rebars (16 mm) on X-axis and Y-axis sensors for varying concrete cover

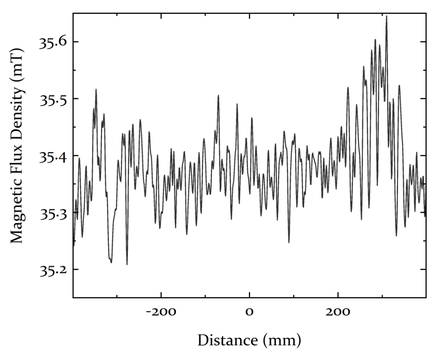

Figure 6. X-axis sensor data when scanned over an array of 1x4 rebars

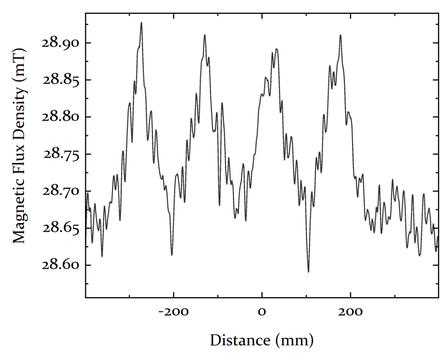

Figure 7. Y-axis sensor data when scanned over an array of 1x4 rebars

CONCLUSIONS: With conventional cover meter, the magnetic field is screened by the primary rod (Figure 3) and thus the cover-meter cannot detect the underlying secondary rods. With the inclusion of an orthogonal soft iron arm (Figure 4) it is found that the modified design is sensitive to both primary and secondary rods (Figure 5). This modified model is scanned over 1x4 array and the X-axis sensor and Y-axis response is plotted (Figure 6 & 7). From these plots it can be concluded that our modified model can locate intersecting rebars in concrete.

REFERENCES:

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