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Determination of concrete cover thickness in a reinforced concrete pillar by observation of the scattered electromagnetic field

Pietro Paolo Di Gregorio, Fabrizio Frezza, Fabio Mangini, and Lara Pajewski

Department of Information Engineering, Electronics and Telecommunications, “La Sapienza” University of Rome, Via Eudossiana 18, 00184 Roma, Italy (pietropaolo.digregorio@uniroma1.it)

The electromagnetic scattered field by a reinforced concrete structure is calculated by means of frequency-domain numerical simulations and by making use of the scattered-field formulation.
The concrete pillar, used as supporting architectural element, is modelled as a parallelepiped shell made of concrete material inside which are present steel bars. In order to make the model simpler, the steel bars are supposed running parallel to the air-pillar interface. To excite the model, a linearly-polarized plane wave impinging normally with respect to the pillars surface, is adopted. We consider two different polarizations in order to determine the most useful in terms of scattered-field sensitivity. Moreover, a preliminary frequency sweep allows us to choose the most suitable operating frequency depending on the dimensions of the pillar cross-section, the steel bars cross-section and the concrete cover. All the three components of the scattered field are monitored along a line just above the interface air-pillar. The electromagnetic properties of the materials employed in this study are present in the literature and, since a frequency-domain technique is adopted, no further approximation is needed. The results obtained for different values of the concrete cover are compared, with the goal of determining the scattered field dependence on the concrete cover thickness. Considering different concrete cover thicknesses, we want to provide an electromagnetic method to obtain this useful parameter by observation of the scattered electromagnetic field. One of the practical applications of this study in the field of Civil Engineering may be the use of ground penetrating radar (GPR) techniques to monitor the thickness of the concrete that separates the metal bars embedded in the pillar from the outer surface. A correct distance is useful because the concrete cover serves as a protection against external agents avoiding corrosion of the bars that might prejudice the reinforced concrete; it ensures also an optimal transmission and distribution of the adhesion forces in the pillar.

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