

Potential Curvature Method - A New Approach for Corrosion Assessment in Concrete Structures

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ABSTRACT

The Half-cell potential survey is a widely used technique for corrosion evaluation in reinforced concrete structures. The standard ASTM C876 has appended some guidelines for corrosion assessment based on three given ranges of potential values. These criteria were devised empirically in the USA from reinforcement corrosion in bridge decks affected by de-icing salts. However, it has been found that the potential ranges that characterize the different levels of corrosion activity can vary significantly for concrete structures subjected to different environmental exposures. In many cases, the ASTM C876 criteria can be misleading when used for corrosion evaluation in concrete structures in marine environments or mainly affected by carbonation.

Some investigators have proposed the use of local differences in the potential value as a supplementary tool for identification of active corrosion sites. However, while greater potential gradients are found around both the anodic and cathodic regions of a potential map, the higher corrosion risks are found only to be associated with the more anodic sites with both higher potential gradients and more negative potential values.

This paper describes a new analytical tool, namely the Potential Curvature Method, developed for corrosion evaluation based on half-cell potential surveys. A potential curvature map is created based on the numeric second differential analysis of a potential field. The curvature map can effectively accentuate the more anodic sites which demonstrate higher potential gradients together with more negative potential values. The potential difference of 150 mV/m is adopted in the analysis as a criterion for “locations with moderate to high risks of active corrosion”. This method has been successfully used in many of the ACCI’s site investigations of concrete structures. Typical examples are given in this paper. The potential curvature method is found to be a powerful tool for corrosion evaluation in concrete structures regardless of whether the structure is in a marine environment or is mainly affected by carbonation.