Predicting strains in embedded reinforcement based on surface deformation obtained by digital image correlation technique

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Abstract

This study is carried out to assess the applicability of using a digital image correlation (DIC) system in structural inspection, leading to deploy innovative instruments for strain/stress estimation along embedded rebars. A semi-empirical equation is proposed to predict the strain in embedded rebars as a function of surface strain in RC members. The proposed equation is validated by monitoring the surface strain in ten concrete tensile members, which are instrumented by strain gauges along the internal steel rebar. One advantage with this proposed model is the possibility to predict the local strain along the rebar, unlike previous models that only monitored average strain on the rebar. The results show the feasibility of strain prediction in embedded reinforcement using surface strain obtained by DIC.

Keywords: digital image correlation (DIC); reinforcement concrete; strain; surface strain; semi-empirical equation.

1 Introduction

Concrete cracking is usually an indicator of RC structures performance, this is why mapping and evaluating cracks in concrete is an important step during assessment inspection. In addition to cracks, reinforcement strain has particular importance in evaluating the structures state and safety, as high levels of reinforcement strain indicate structure overloading or if a failure is about to occur.

The focus of the current study is to estimate the strains in embedded reinforcement bars by measuring surface strain of RC members obtained by Digital Image Correlation (DIC) system. According to Hoult et al. [1], DIC has the potential to be a new alternative to traditional technologies used to assess RC structures. DIC is a technique that has been initiated since the ’80s [2], and used in a number of recent studies, such as embedded rebar assessment using surface deformation. There are some models proposed by Mahal et al. [3], Hoult et al. [1], Fayyad and Lees [4] [5], Madadi et al. [6], Krishna et al. [7], and Huang et al. [8], but they could just monitor average strain on the rebar. The advantage of the proposed model, presented in this paper, is that the local strain along the embedded rebar is predicted. The two main objectives of this study are to collect experimental data through laboratory tests and establish an experimental correlation between surface deformation and strains in the embedded reinforcement.

2 Laboratory and testing procedure

Ten concrete tension members with one reinforcement bar in the center of the cross section

https://doi.org/10.2749/ghent.2021.0425
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