



Monitoring structural behavior of reinforced concrete walls with openings using digital image correlation

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Abstract

Several measuring techniques based on digital image correlation (DIC) are nowadays used in many fields. DIC measurements can facilitate documentation of crack patterns on specimens subject to loading, valuable information, which would otherwise be hard to obtain, especially in the case of reinforced concrete elements. This can not only give a better insight into the failure mechanism of the element, but also evaluate cracking as measure of serviceability.

This article discusses existing serviceability limits and failure modes of reinforced concrete walls in buildings in light of results obtained using DIC on two half-scale reinforced concrete walls with openings tested to failure. Results suggest that cracks induced by a load level equivalent to 70% of ultimate load bearing capacity, do not exceed limits indicated in relevant guidelines.

The failure mode of two way walls with openings was found to be similar to that of two way slabs also with openings, however differences were identified in the development of the failure mechanism. Finally, two strengthening strategies of reinforced concrete walls are discussed.

Keywords: digital image correlation, DIC, crack mapping, reinforced concrete, walls, openings, serviceability.

1 Introduction

Displacements, deformations and cracking parameters of reinforced concrete (RC) structural elements are used to determine the resistance mechanisms, failure modes and serviceability characteristics. Ghorbani [1] advocates that traditional measuring methods used in laboratory tests (linear displacement transducer, crack opening gauges and strain gauges), become impractical and time consuming for higher spatial measurement resolution and suggest that optical full field measurements such as three-dimensional (3D) digital image correlation (DIC) measurements can overcome these limitations and provide qualitative and quantitative information to understand the load-resistance mechanisms and failure modes of concrete and masonry structures.

DIC has been proven a stable and reliable method for strain and displacement measurements of structural members and components tested in laboratory conditions [2, 3] and on large structures such as bridges [4].

Previous work carried out by the authors [5] indicated that there is a lack of reliable design and assessment tools for RC structural walls with openings. Furthermore, probably due to the complex failure mechanism very little information is provided by the research literature.

The aim of this paper is to present an approach using DIC to determine the failure modes and serviceability of RC structural walls with openings. Measurements were carried out on two wall panels with openings subjected to axial loads. These specimens are part of an experimental campaign described in [6]. The use of DIC to