Key aspects of digital image correlation in impact tests of reinforced concrete beams

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Abstract

This paper studies 2-D high speed photography combined with digital image correlation (DIC) applied to experimental research of reinforced concrete beams at moderate loading rates. The aim of the present research is to understand the influence of 2-D DIC set-up parameters in the results. Drop-weight tests have been completed in 1180 × 100 × 100 mm longitudinally reinforced concrete beams. The study has confirmed results sensitivity to image subdivision and mesh properties. While smaller subdivision sizes allow to obtain results nearby boundaries, being more suitable to study local effects, larger sizes enhance computational cost, increase mesh stability and accuracy. A discussion of key aspects of 2-D DIC for measuring different parameters (such as acceleration, displacements, strains and strain-rate) is presented along this paper.

Keywords: impact; digital image correlation; beams; concrete; sensitivity; facet.

1. Introduction

Hazardous events and antagonistic activities are part of our daily challenging society. The need for understanding the response of impact-loaded concrete structures has increased for the last years. These structures have shown high sensitivity to develop brittle failure when subjected to impact loading [1, 2].

Numerous experimental investigations on the impact performance of reinforced concrete (RC) have been carried out by different authors [3–5], with purpose of increasing the knowledge on concrete dynamic behaviour. Valuable cinematic measurements might be found among scientific literature, such as accelerations, displacements or strain at representative discrete points, as well impact force, support reactions or dissipated energy. Nevertheless, it is unclear how the distribution of the former parameters evolves over the surface of concrete elements when subjected to impact loading. Consequently, there is a lack of generalized understanding of some relevant dynamic effects, such as the propagation of impact loads along the tested element [6, 7], the distribution of inertia forces [4, 8] or the strain-rate effects at the failure mechanism [9].

An interesting way to study these effects is the use of optical full-field measurement methods. This technique might be divided into two main groups, interferometric methodologies and non-interferometric techniques, according to their

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