Seismic strengthening of columns with deficient ductility and capacity

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Abstract

Many existing buildings in seismic prone areas designed according to older codes have deficient seismic capacity due to a lack of ductility and inadequate lap splices in the longitudinal bars of the columns. This article evaluates models that are proposed by Eurocode 8, the Greek Code of Structural Interventions and other researchers for strengthening with the aim of restoring the above deficiencies by applying external confinement using fibre reinforced polymers. Through an extensive analytical work, results from different models are compared in order to gain insights and draw useful conclusions. For local ductility, the deviation of results from different models increases as the confinement level increases. In all cases it is found that the Eurocode model behaves abnormally for high values of thickness of the confining material. Revised expressions proposed by other researchers appear to correct the above response.
Keywords: existing buildings; confinement; fibre reinforced polymers; columns; ductility; lap-splices.

1 Introduction

Nowadays, in seismic prone areas, all reinforced concrete buildings are constructed in order to be sustainable structures with seismic capacity. Unfortunately, much of the infrastructure has already been built and, hence, most existing buildings have deficient seismic capacity. Lack of ductility and inadequate column lap spliced bars are some of the more crucial common deficiencies. Strengthen of such weak columns could be performed by applying reinforced concrete jackets or external confinement reinforcement (in the form of jackets, collars or external fasteners). The material that is usually used for the external confinement is either steel or composite materials such as fibre reinforced polymers (FRP), which are the most popular. This article investigates the strengthening of weak reinforced concrete columns with deficient ductility and lap splice lengths by applying confinement using FRP jackets.

In the literature, a number of models are proposed to determine the required amount of confinement material required to increase the local ductility or to rectify inadequate lap splice lengths. For local ductility, models are proposed by Eurocode 8-Part 3 (EC8-3) [1] and the Greek Code of Structural Interventions (GCSI) [2]. Concerning deficient lap splices, models are presented by Eurocode 8-Part 3 [1], the Greek Code [2] and other researchers such as Pristley et al. [3], Elsanadedy and Haroun [4] and Harajli et al. [5]. Moreover, there are models derived from experimental data such as a model adopted by Eurocode 8 [1] as an alternative procedure, or models that are proposed by researchers such as Fardis [6] and Harajli et al. [5]. In this article, all the above models are presented, compared and evaluated in order to derive conclusions. Specifically, the models are examined in order to

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