Seismic Resilience of Deteriorating RC Bridges and Road Networks under Climate Change

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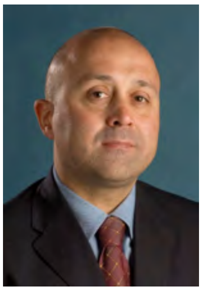

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1 Abstract

This paper investigates the life-cycle seismic resilience of aging road networks with reinforced concrete (RC) bridges under the effects of climate change. The physical damage suffered by the exposed bridges is related to traffic limitations implemented over the network. A probabilistic framework is proposed to aggregate the time-variant seismic capacity assessment of RC structures exposed to chloride-induced corrosion with the traffic response of the transportation network. The life-cycle seismic resilience of a simple road network is evaluated based on the restoration of the network functionality guaranteed by the post-event recovery of the damaged bridge. The results highlight the detrimental effects of the progressive increase in the deterioration rate induced by climate change, impairing the seismic capacity of single bridges and, in turn, the seismic resilience of the overall transportation system.

Keywords: system resilience; climate change; bridges; corrosion; seismic fragility.

2 Introduction

Addressing lifetime vulnerability of infrastructure systems is a crucial issue for urban planners and policy makers, since widespread damage of key assets may induce large-scale economic losses in terms of direct costs of damage repair and indirect costs of operational downtime [1]. Resilience of road networks exposed to sudden hazards is related to the capability of bridges to sustain the impact of extreme events without suffering damage that would force infrastructure managers to impose prolonged traffic restrictions for the users' safety.

For bridges exposed to an aggressive environment, structural damage can also arise continuously in time [2,3]. In this context, global warming may significantly affect the long-term performance of infrastructure systems, altering the lifetime exposure of structures to environmental conditions [4]. This may pose a significant threat to infrastructure systems, exacerbating the exposure to hazardous events as well as their deterioration rate [5]. The strong implications on the lifetime vulnerability of key infrastructure networks should

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