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Optimizing the multi-hazard resilience of bridge and building structures

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1 Abstract

As the expectations of populations all around the world continue to increase in relation to the resilience of their bridges and buildings to hazards such as seismic events, the need for appropriate solutions – which can be applied both to new structures and to existing ones – grows accordingly. A wide range of solutions is available, such as shock absorbers and shock transmission units which can be used to dampen or optimally transmit forces that would otherwise damage a structure, and seismic isolators which can protect buildings and bridges from destructive ground motions. Expansion joints can be equipped with features that protect a bridge, at its key movement nodes, from damage due to larger-than-expected movements, and structural health monitoring (SHM) can be used to enable hazards to be identified and to provide immediate notification of any event that might make a structure unsafe. Various such methods of enhancing resilience of structures to seismic and other hazards are described.

Keywords: Seismic; hazard; bridge; building; isolator; damper; shock absorber; STU; SHM; monitoring.

2 Introduction

Because structures such as bridges and key public buildings have a special significance in our built environment and perform vital societal functions, it is important to ensure that they will continue to serve their purpose, with little or no interruption, until they are no longer needed. Of course, this is just as true – if not more so – in the case of irregular or unexpected events such as strong earthquakes, in the aftermath of which bridges, and buildings such as hospitals, firehouses and police stations, are needed more than ever. Fortunately, much can be done to enhance the resilience of bridges and buildings to such hazards, either in the construction of a new structure or as a remedial measure in the case of an existing structure, using key structural components – such as dampers, shock transmission units and appropriately designed bearings and expansion joints – and structural health monitoring (SHM) technology. The potential contributions of such components and technology in enhancing the multi-hazard resilience of structures is discussed below – in the case of the components, with reference in some cases to the kind of laboratory testing that can help ensure proper performance when required to protect the structures in which they are used [1].

3 Dampers

Dampers are energy dissipation devices – often hydraulic – which are typically used to form a connection, with certain designed characteristics, between parts of a structure that may experience damaging relative movements due to sudden forces

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