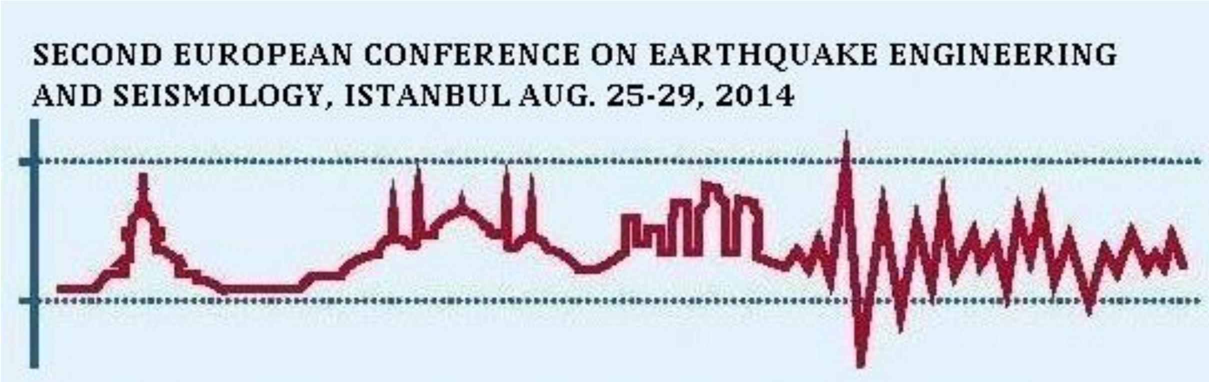

MITIGATING SEISMIC RISK OF HIGHWAY OVERPASSES THROUGH ALTERNATIVE RETROFITTING STRATEGIES

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In the recent past, a considerable number of ordinary bridges or highway overpasses worldwide have experienced significant damage or even collapsed, during strong intensity ground excitations. Based on the existing literature, spectacular failures may be identified as a result of insufficient design practices or inappropriate strengthening strategies. On the other hand, recognizing that design and retrofit issues are usually related to long term financial and maintenance costs during the entire life cycle of the structure, simplified rehabilitation methodologies are often deemed preferable compared to more complicated and expensive solutions. In this context, the Integral Bridge Concept (IBC) is considered to an attractive upgrading/retrofitting technique for existing jointed Reinforced Concrete (RC) bridges (UDoT 2009, Kunin and Alampalli 1999, Burke 1987). The main idea is that durability and vulnerability may be improved through the implementation of joint elimination strategies, as it is well known that non-structural, high cost elements such as thermal expansion/seismic joints and bearings, are susceptible to climate and loading conditions and therefore their elimination could result in considerably reduced long-term maintenance costs. Furthermore, many researchers have supported the idea of engaging the abutments with the superstructure of existing bridges in order to improve the seismic performance of the entire system through the mobilization of the backfill soil. The above mentioned strategies are being implemented successfully for decades in the United States, based mainly on empirical procedures, as there is a lack of relative provisions and codes.

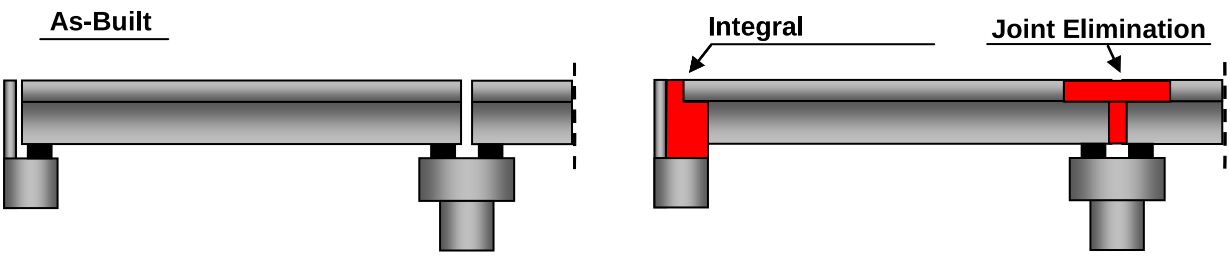

Figure 1. Conversion of ordinary jointed bridges to Integral

Although durability and maintenance issues are considered to have been improved as a result of the Integral Bridge Concept implementation, there is still no experimental or numerical evidence regarding the impact of the method on the performance of the system under earthquake loading. An additional issue is that, particularly for the case of integral bridges, soil-structure interaction (SSI) effects are expected to affect more substantially the entire dynamic response of the system. Along

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these lines, the main objective of the present work is to comparatively assess the seismic performance of a typical Greek Highway Overpass, after various possible retrofit strategies (inclusive of conventional strength- and ductility-based schemes as well as joint elimination methods). To account for the seismic response of the engaged bridge-abutment-backfill-embankment system, detailed computational models are examined with emphasis to both inertial and kinematic interaction effects between the backfill soil and the two abutments (Kotsoglou and Pantazopoulou 2007, Taskari and Sextos 2012). Based on established methodologies, a wide range of seismic fragility curves is developed and the effectiveness of each retrofit strategy in mitigating seismic risk is quantitatively assessed, Practical recommendations are also provided to eliminate unfavorable design implications and improving the seismic performance of the system as a whole.

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