Network-level seismic risk management of regional road infrastructure

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Summary

This paper presents the results of seismic evaluation carried out on the road network of the Autonomous Province of Trento (APT). The APT Bridge Management System (BMS) incorporates seismic vulnerability analysis capability based on the definition of fragility curves for all the bridges inventoried. Currently in the APT-BMS, fragility curves are developed by capacity-spectrum approach according to HAZUS guidelines. We show that, in the case of the APT stock, the direct seismic risk involving collapse or loss of life is moderate. In contrast, we expect a critical problem in network operation in a post-earthquake situation, when it will be necessary to identify the safest path between any two places in APT region. This problem is addressed using Dijkstra's graph search algorithm. The results can be used by decision makers to prepare a pre-earthquake plan, and for the post-earthquake emergency response. Google Earth and GIS tools are used to present the results.

Keywords: Network, bridge management system, fragility curves, Dijkstra's algorithm.

1. Introduction

Due to the political devolution process in Italy in the nineteen seventies, the number of bridges under APT responsibility doubled without an adequate transition period. (For more details of the APT stock, see Zonta et al. [1]). Currently, the APT manages approximately 2340 kilometres of roadways and 936 bridges. Most of the APT bridges were built or rebuilt after the Second World War, the age distribution diagram showing a peak in the 70's.

Given the great quantity and variety of bridge types in the APT-BMS, a systematic and quick method is needed to develop fragility curves. The HAZUS model [2] meets this requirement; it is a rapid approach seeking to establish dependable fragility curves [3]. In contrast to other methods that have been used in the past, such as empirical fragility curves [4, 5] or analytical fragility curves [6, 7, 8] that require much previous damage data or extensive computation, only limited information is needed for this model.

The results show that, in the case of the APT stock, the direct seismic risk involving collapse or loss of life is moderate. In contrast, we expect a critical problem in network operation in a post-earthquake situation, when it will be necessary to identify the safest path between any two places in the APT region. This problem is addressed by Dijkstra's algorithm [9] which is a graph search algorithm to find the shortest path between any source-destination pair for a non-directional and non-negative cost path graph.

The remainder of this paper is as follows. In section 2, we introduce the HAZUS model and this

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