TRANSPORTATION NETWORK RESILIENCY AS A MEASURE OF PERFORMANCE THROUGHOUT EARTHQUAKE, A PARADIGM SHIFT

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Evaluating the transportation network performance throughout earthquakes, the term "Resiliency", in its most simplified version, can be defined as the ratio of a measure of performance like "average speed of the network" after and before the earthquake. During the comprehensive definition period and introduction to transportation Eng. over the past decade, encompassing more parameters involved, resiliency became a very useful complex index which is indeed complicated to analyze, but its use is rapidly expanding as an alternative to traditional simplification modeling.

"Average speed" (as an example) can be considered as a measure of performance when the earthquake is not so intense, however in the severe cases of ground motion, one does not care the speed comparing to the parameters like access. For the different scenarios of the intensities of the earthquakes, different parameters will be of interest; and we need the earthquake Eng. to define these scenarios. This chose of variables become more complicated when other parameters like "time of earthquake" are taken into account. At the morning peak hour for instance, there will be a different reaction of the drivers to the earthquake comparing to the midnight time (e.g. at the midnight the family are most likely to be at home and will perform an evacuation trip rather than the morning time when they are looking for each other). Thereupon, defining complex new O-D matrixes are of great interest and again needs both the earthquake and transportation Eng. Profession.

Currently, simulation modeling is widely used to measure the variables over the network, but on the contrary of typical traffic analysis, at the disasters like earthquakes, the network will miss some of its links and may have some links with reduced lines (i.e. the incident management component in simulation models) and after all, there are some new added demands of emergency trips which need the fastest access to the needed zones (based on the land use classification like hospitals), and so many forced mode shifts (the drivers facing the block roads will produce huge pedestrian trips while their abandoned cars will block more and more lines and links) and so on. This "n dimensional" matrix of variables has to be analyzed using new approaches in simulation.

The need for paradigm shift in analysis becomes more highlighted when one consider the whole network performance and seeks the ways of improvement. A road itself consists of parts (i.e. the main road, bridges, ramps…) each of which needs its own resiliency analysis, so a transportation road network consist of so many of such parts (mainly links) with different behavior (i.e. highway acting as an access road). In some cases, one can develop fragility curves for each component to perform a correct simulation.

The aim of this research is to introduce the term resiliency and the necessity of a paradigm shift in current analysis of transportation network performance throughout earthquake by using this concept. To do so, a considerable part is dedicated to literature review followed by discussions on the limitations and deficiencies of traditional modeling with simplification assumptions. Third part of the paper will proceed with the essential simulation modeling requirements. The term resiliency

and its components will be further discussed and a final conclusion part is devoted to discuss the necessity of using this index over simplification methods.

This paper concludes that as an inevitable consequence, based on the flourishing of simulation modeling softwares and technics, more complex parameters can be taken into account regarding the highway performance evaluation throughout earthquakes, from which "resiliency" is widely considered and developed recently using the procedures introduced briefly in this research.

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