Post-Disaster Management of Freight Transportation Networks

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Abstract: The Memphis Metropolitan Area (MMA) is a major intermodal transportation center. A major disaster such as an earthquake, hurricane, flood, or man-made hazard can have significant direct and indirect impacts on local, state, and national economies. The Memphis area transportation system relies heavily on numerous bridges many of which are old and in desperate need of retrofit. Furthermore, many bridges in central United States are inadequately designed to resist seismic loading. Therefore, it is critically important to develop a post-disaster freight transportation model of the MMA. Using a geographic information system (GIS) incorporating estimates of hazard impacts on the transportation system and temperature-controlled logistics services demand (cold-chain logistics) a freight transportation model could identify deficiencies in the transport network and provide alternative re-routing for freight traffic. A viable freight transportation system, responsive to information and conditions on the ground after a disaster, will provide valuable information to reduce the economic impact on the freight transportation system and will help evaluate supply chain strategies for improving operation efficiency of the transportation system.

In this study, the focus will be to use HAZUS-MH 2.2 to estimate effects of ground motions on the overall damage to transportation system infrastructure and assessment of those portions of the network that are critical to temperature-controlled logistics services. The risk to the transportation system will be estimated by considering the direct damage to major network components such as bridges and the connectivity between a set of predefined origin-destination routes. In addition, collateral loss estimates will be made on the damage and disruption to the utilities infrastructure (gas, water, waste-water, and electrical systems) that might have both direct and indirect effects on the efficiency and management of the freight transportation network. Future phase of this research will focus on multi-hazard such as flooding, tornados, man-made hazard, etc.

A database will be developed that will be specific to the MMA in order to produce more accurate loss estimations. Earthquake ground motions will be generated for the MMA will include probabilistic (2, 5, and 10 % in 50 years) and scenario (M 6.5 and 7.7) seismic hazard maps.

Phase 1 of this study is to both identify current resources and research on integrating hazard identification and assessment into a GIS database and to review the capabilities of inherent transportation network models. Phase 2 consists of two parts: (1) select an appropriate GIS (or other database management system) and a transportation modeling system; and (2) evaluate procedures to incorporate earthquake post-disaster analysis and cold-chain logistics in the modeling system. The objective of this phase of the project is to identify an operational framework in which to develop a post-disaster planning and management model of the freight transportation system in the MMA. In Phase 3, the results of this study will be shared with IFTI, FIT, and user and participant communities.