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Are our Transit Systems Ready for Earthquakes?

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Issue

Located on the tectonic boundary with multiple active faults, the San Francisco Bay Area is highly vulnerable to earthquakes. The United States Geological Survey (USGS) has estimated a 72% probability of an earthquake with a magnitude of 6.7 or greater striking the region within the next 30 years. Historical seismic events have demonstrated the profound impact earthquakes can have on transportation systems. During the 1989 Loma Prieta Earthquake, the closure of the San Francisco-Oakland Bay Bridge, a critical transit route for San Francisco commuters, left nearly 400,000 commuters and approximately 245,000 vehicles daily with limited alternative routes.

In response to this and other disasters, governments and transportation agencies have actively initiated measures to reinforce critical transportation infrastructure. However, there is a lack of detailed plans for responding to, and recovering from, major earthquakes. To bridge this gap, our team carried out interviews with relevant stakeholders to better understand the problem. We then developed a multimodal traffic simulation tool to evaluate the potential impact of closing a Bay Area Rapid Transit (BART) station on surrounding traffic flow if a major earthquake disrupts travel on the system. The model was applied to the MacArthur station on the BART Orange Line, which runs from Richmond to Berryessa, a distance of 51 miles.

Key Research Findings

Few California local governments or transportation agencies have publicly released post-disaster recovery plans. Although there is a push from the federal government, many local governments and transportation agencies have not released post-disaster strategies for public review. This lack of public information may result in confusion and delays in responding in the aftermath of a significant earthquake. A targeted and well-communicated plan at the local level is vital for efficient disaster response and recovery, and for ensuring the safety and travel needs of the population.

There is a deficiency in post-earthquake traffic simulation models for the Bay Area. At present, only a handful of entities, such as the Metropolitan Transportation Commission (MTC), certain consulting companies, and a few non-governmental organizations (NGOs), possess traffic simulation tools for the region. However, none of these tools are tailored to address the unique challenges posed by seismic hazards, especially for the recovery stage.

BART passengers are likely to face longer commute times or higher costs after a major earthquake. In our model, when we assumed the MacArthur BART station in the East Bay might be shut down due to earthquake damage, we found that even if bus shuttles can ferry passengers around the closure, passenger travel time would increase significantly. Conversely, if passengers

opt to drive or use ride-sharing services, like Uber/Lyft, their travel expenses could surge, and the added vehicles would increase road congestion.

Application to Practice

The simulation model we developed could be used by public agencies and policymakers in several ways. It can be used for scenario-based planning for potential post-disaster traffic plans, especially to understand and mitigate impacts on low-income populations that heavily rely on public transit for commuting or daily travel. Our model can also provide guidance for emergency funding allocation. For many government entities and agencies, a critical aspect of their post-disaster recovery revolves around the effective allocation of funding. Our model offers a robust mechanism to guide decision-makers to design effective funding allocation strategies and channel limited resources to the most critical areas. Lastly, our model could be expanded to include more transportation modes and applied to other areas. For simplicity, the current model only considered highway and rail transit systems in the Bay Area. The model could be adapted to regions outside the Bay Area, and enhanced to consider other transportation modes, such as buses and ferries.

More Information

This policy brief is drawn from the report "Assessing the Functionality of Transit and Shared Mobility Systems after Earthquakes" available at www.ucits.org/research-project/rimi-4k. For more information about findings presented in this brief, please contact Kenichi Soga at soga@berkeley.edu.

[1]United States Geological Survey (USGS). (2023). What is the probability that an earthquake will occur in the Los Angeles Area? In the San Francisco Bay area? Available: https://www.usgs.gov/faqs/what-probability-earthquake-will-occur-los-angeles-area-san-francisco-bay-area

[2]Deakin, E. (1991). Transportation Impacts of the 1989 Loma Prieta Earthquake: The Bay Bridge Closure. UC Berkeley: University of California Transportation Center. Available: https://escholarship.org/uc/item/6rb2j9pf

[3]Bay Area Rapid Transit (BART) (2023). System Map. Available: https://www.bart.gov/system-map

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