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Planning for the Next Big Earthquake: A New Tool for Transportation Agencies

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Issue

Earthquakes pose a persistent and significant threat to the movement of people, goods, and services. While agencies have made progress on emergency response, planning for recovery (how quickly transportation systems can be restored after a major event) remains limited. A key challenge is that earthquake modeling and transportation system modeling have remained largely separate efforts, making it difficult for agencies to anticipate disruptions, prioritize investments, and coordinate recovery across jurisdictions.

To address this gap, we worked with agency stakeholders, such as BART and Caltrans, and the geotechnical and structural earthquake engineers at UCLA to develop an integrated modeling tool that links earthquake impacts to transportation system performance and recovery. We applied it to the Berkeley Hills corridor, a critical connection between the inner East Bay and Contra Costa County served by the BART Berkeley Hills Tunnel and the parallel Caldecott Tunnel on State Route 24. This region has a 72 percent probability of at least one earthquake of magnitude 6.7 or larger by 2043.[1] We tested four scenarios of increasing severity, from minor tunnel damage lasting a few weeks to full closure lasting a year or more, focusing on the busy weekday morning commute. The tool is designed to support recovery planning in other corridors as well.

Key Research Findings

Tunnel disruptions can sharply increase travel times across the Berkeley Hills, with the heaviest burden on transit-dependent riders. Even with post-earthquake travel demand assumed at 25 percent of normal, the average morning-peak trip across the hills rises from about 9 minutes in the mildest scenario (lining cracks patched) to about 41 minutes in the most severe (full tunnel closure). These estimated travel times can nearly double if the actual damage is more severe than assumed. Transit-dependent riders are hit hardest because many lack a personal vehicle and no parallel transit serves the corridor, leaving them a slower bus bridge, where one exists, or a more expensive ride-hail trip.

Alternative routes around the main tunnel deserve more analytical attention. Detailed seismic analysis is expensive, so it is usually only available for the single most critical structure, such as a major tunnel or bridge. The alternative routes are usually evaluated only with the Federal Emergency Management Agency's (FEMA) standardized national estimates or not analyzed at all. This gap matters here. When both the BART Berkeley Hills Tunnel and the Caldecott Tunnel are severely damaged, local roads may carry most of the rerouted traffic, yet how those roads would fail and recover is known only from generic estimates. Without route-specific data, agencies can misjudge how severe and how long a disruption would

be. Collecting route-specific data on the main alternatives before an earthquake would make pre-disaster planning and investment more reliable.

Operational mitigations such as bus bridging, shared-ride partnerships, and travel-demand management can meaningfully reduce delays, but each depends on multi-agency coordination that current arrangements rarely provide. At the most severe scenario, a temporary bus bridge could cut the worst-case cross-hills travel time by up to 30 percent and ease the strain, but it is difficult to deliver. The corridor sits at the Alameda and Contra Costa County boundary, where AC Transit and County Connection each serve one side, and no fixed bus route crosses it today. Our interviews found that even where mutual-aid arrangements exist, agencies often lack formal recovery plans and clear cross-jurisdictional roles. Bus bridging requires multi-operator alignment, travel-demand management depends on employer cooperation, and ride-hail partnerships face emergency contracting constraints. Without stronger pre-event coordination, real-world benefits will fall well below the modeled potential.

Application to Practice

Our integrated model is a practical tool for agencies planning transportation recovery in earthquake-prone corridors such as the Berkeley Hills. Agencies can use it to trace how disruptions cascade across rail and roadway systems, to weigh mitigation strategies such as bus bridging, shared-ride partnerships, and travel-demand management, and to test how different restoration timelines and reopening sequences would affect travel time. It can also surface the disproportionate burden that disruption places on transit-dependent riders and compare how operational choices such as bus-bridge routing affect them. As agencies gather better local data on how tunnels and roads would be damaged and how travel would shift after an earthquake, they can update the model and sharpen its estimates.

More Information

This policy brief is drawn from the report "Transportation Impacts of Berkeley Hills Tunnel Disruption by Earthquakes," available at www.ucits.org/research-project/2024-14. For more information, please contact Kenichi Soga at soga@berkeley.edu.

[1]United States Geological Survey (USGS). (2016). Earthquake outlook for the San Francisco Bay region 2014-2043 (Fact Sheet 2016-3020). https://pubs.usgs.gov/fs/2016/3020/fs20163020.pdf.

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