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Research Notes

Determination of Recovery Bridge Corridors by Comparing Post EQ Network

Bridge research to develop design heuristics that can be used to determine whether a bridge should be designed to a Recovery Bridge performance standard or an Ordinary Standard Bridge performance standard.

Geotechnical /Structures

May 2025

Project Title:

Determination of Recovery Bridge Corridors by Comparing Post EQ Network

Task Number: 3798

Start Date: June 1, 2022

Completion Date: February 28, 2025

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WHAT IS THE NEED?

Recently adopted Seismic Design Criteria (SDC) 2.0 create an optional seismic performance target that exceeds what is applied to Ordinary Standard Bridges (OSB), deemed a "Recovery Bridge (RB)". Bridges designed to the more stringent criteria can be expected to remain undamaged in a modest earthquake (Functional Evaluation Earthquake, FEE) and incur only moderate damage in a severe design level event (Safety Evaluation Earthquake, SEE). From the perspective of the California Department of Transportation's (Caltrans') Division of Engineering Services (DES), the choice of post-earthquake performance level is made at the District level since the benefits and costs of the project level design alternatives are evaluated at the District level. While there are guidelines and experience related to how to build Recovery Bridges, there is a knowledge gap related to deciding on when to build them. It is generally agreed upon that Recovery Bridges should be used when the consequences of being down for an extended period is severe. However, determining an objective measure of severity is challenging. What is needed is to develop regional highway network traffic models to identify simple, yet accurate, design heuristics that can be used to determine whether a bridge should be designed to a Recovery Bridge performance standard or an Ordinary Standard Bridge performance standard.

WHAT ARE WE DOING?

Through the PEER-Bridge Program, Caltrans is contracting with University of California, Berkeley, to develop traffic simulation model of the San Francisco Bay Area highway network. The project aimed to explore the different types of post-earthquake traffic corridors. Identify critical corridors serve as

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the main access to critical facilities and evacuation routs within 72 hours after an earthquake. Data collection on highway and major road network, bridge locations, critical facility locations, bridge characteristics, and site-specific earthquake hazard levels. Establish framework for recovery bridge selection and understand how the network functionalities can be improved based on bridge performance post-earthquake under simulations.

WHAT IS OUR GOAL?

The goal of this project is to identify simple, yet accurate, design heuristics that can be used to determine whether a bridge should be designed to a RB performance standard or an OSB performance standard.

WHAT IS THE BENEFIT?

Bridges play a critical role in our transportation system in enhancing California mobility and economy. Evaluating the performance of a traffic network given the uncertainty in bridge response under stochastic seismic events is a complex task. Understanding the post-earthquake traffic demand on the regional highway and major road network, which is different from the ordinary day traffic levels is critical to future strategic planning of transportation network. Understanding the spatial dependencies of bridge damage that occur due to the correlated ground motions in the region is critical in ensuring bridge performance meets capacity demand of the highway network during an emergency. The project aimed to establish a framework for improved bridge performance level selection criteria for bridge design.

WHAT IS THE PROGRESS TO DATE?

Determination of Recovery Bridge Corridors by Comparing Post EQ Network project will start on June 1, 2022 and operates for 33 months.

Transportation Analysis Zones (TAZs) has been identified for the determination of travel data from origin to destination (OD). TAZs are obtained from Metropolitan Transportation Commission (MTC) census data. MTC TAZs are being condensed to TAZs cluster for the ease of simulation time. Traffic demand model are built from the obtained OD data. Highway network model has been developed to include highway junctions, bridges, and on/off ramps. Spatial distribution of critical facilities has been assigned to identified TAZs clusters for traffic demand simulation. Traffic simulation has been initiated to estimate importance of various corridor and bridges in the network. Optimization of traffic simulation is ongoing to identify important corridors for travel demand and critical facility access. Preliminary assignment of bridge fragility functions per HAZUS and NBI data to estimate damage probability of bridges in the network.

The team developed a tool to identify critical route access for each critical facility type (hospital, fire station, policy station, airports, seaport, etc.) The tool will allow the user to identify in service bridge within the critical route and modify its the importance to varies critical facility by weight factors.

IMAGES

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Image 1: The TAZs in the Bay Area. Photo courtesy of UCB Project Team.

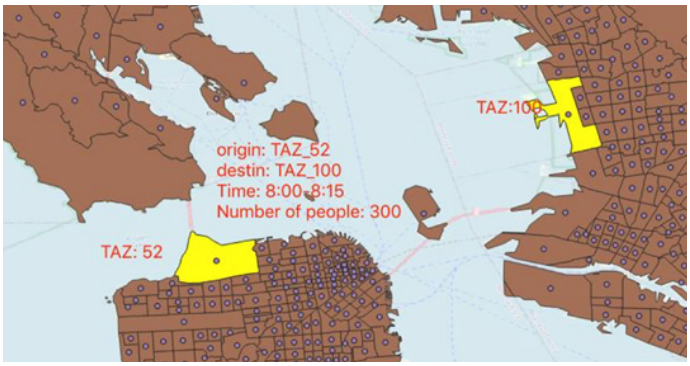

Image 2: An example of traffic OD data. Photo courtesy of UCB Project Team.

Image 3: The highway network. Photo courtesy of UCB Project Team.

Image 4: An example of on/off ramp nodes. Photo courtesy of UCB Project Team.

Image 5: The TAZs and highway in San Francisco. Photo courtesy of UCB Project Team.

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Image 6: The merged zones. Photo courtesy of UCB Project Team.

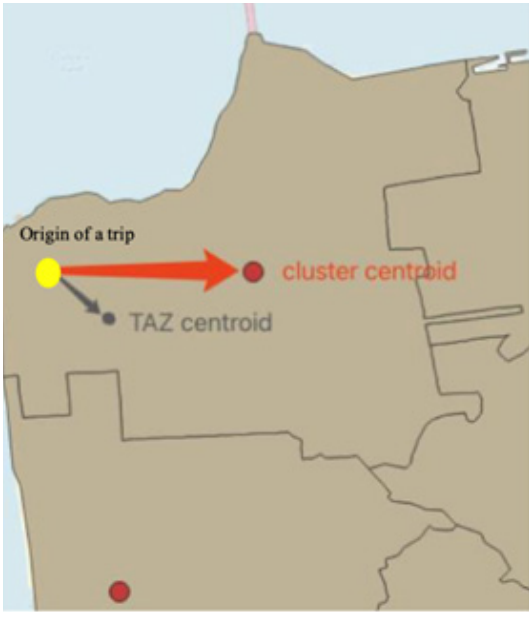

Image 7: An example (from TAZ level to cluster level). Photo courtesy of UCB Project Team.

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