DRISI
Caltrans Division of Research,
Innovation and System Information

Research Results

Load Testing Bay Bridge Expansion Joints

Testing whether a new type of thermal and seismic expansion joint can withstand heavy traffic on the Bay Bridge

Geotech/
Structures

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Project Title:
Load Testing Bay Bridge Expansion Joints

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WHAT IS THE NEED?

The new Bay Bridge consists of three completely different structures. To link these distinct parts requires expansion joints that act in harmony during seismic activity. The type of joints planned for the eastern portion of the Bay Bridge have never been used in California. The new expansion joints are installed lane-by-lane rather than spanning the entire width of the bridge. With the previous expansion joints, all lanes needed to be shut down when maintenance was required.

This new technology, designed by Caltrans and T.Y. Lin International Group, incorporates a Trelleborg Transflex 2400 expansion joint, a steel connector plate, and fastening systems. With these joints, lanes can be closed one at a time, minimizing the disruption of traffic flow. To ensure that the joints are robust enough for California traffic, Caltrans Design Engineers tested the load-bearing capabilities with a Heavy Vehicle Simulator (HVS).

WHAT WAS OUR GOAL?

The goal was to ensure that the new expansion joints for the Bay Bridge are robust enough to withstand heavy truck traffic.

WHAT DID WE DO?

Caltrans, in partnership with the University of California Pavement Research Center, used an HVS to gain a quick indication of how the joints would perform under truck traffic.
A test structure incorporating a full-scale joint was constructed close to the bridge. A total of 1.36 million load repetitions, equating to about 46 million standard axle loads on a highway pavement, were applied in seven phases during the three-month test. During this test, no seismic or structural testing was undertaken.

WHAT WAS THE OUTCOME?

No structural damage was recorded by any of the linear variable differential transducers (LVDTs) or strain gauges that were installed on the steel plates, steel frames, bolts, and washers. There was also no visible damage on any of these components. In the last phase of the test, excessive overloading with a 150 kN half-axle load on an aircraft tire, which is approximately four times the standard axle load, caused some damage to the Trelleborg unit in the joint. The damage included abrasion, tearing, shoving, and permanent deformation of the rubber inserts, as well as deformation and shearing of one of the steel supports directly under the wheel load.

Although only limited bounce and no speed effects were considered, based on the results of this limited testing, it was concluded that the expansion joints would perform adequately under typical Bay Bridge traffic. The distresses observed on the Trelleborg unit under high loads in the last phase of testing are unlikely to occur under normal traffic. As expected, the Trelleborg unit was found to be the weakest point of the expansion joint, and these units should be checked periodically to confirm the findings of this study and to assess any effects of higher speeds and vehicle dynamics that were not identified. The joints will require periodic maintenance and replacement in line with the manufacturer's specifications.

WHAT IS THE BENEFIT?

The findings from this study indicate that the Caltrans seismic expansion joint, when properly installed, are appropriate for typical Bay Bridge traffic. The new joints offer more flexibility during maintenance and repairs because individual lanes can be closed rather than the entire bridge, minimizing traffic disruptions.

LEARN MORE

To view the report:
www.ucprc.ucdavis.edu/PDF/UCPRC-RR-2011-06.pdf

IMAGES

IMAGE 1: HVS testing on the deck joint

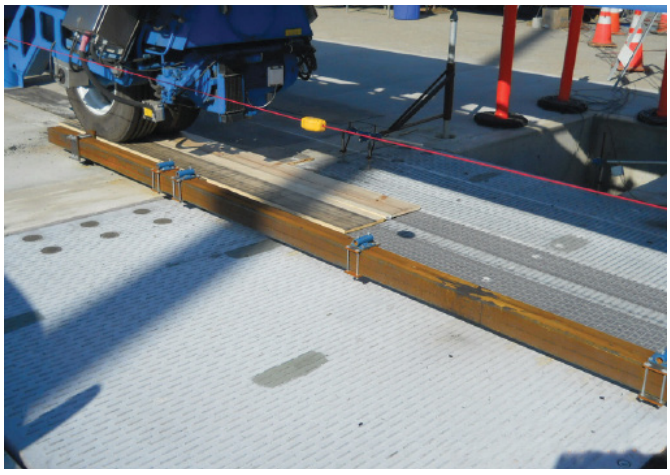

IMAGE 2: Close-up view of HVS testing on the deck joint