Gerald Desmond Bridge
Replacement Project

Caltrans • Metro • Port of Long Beach • US Department of Transportation

Building a Seismic-Ready Bridge

Advanced seismic features and design help ensure the new bridge withstands stronger quakes and returns to operation within days.

Cable Dampers: Specially designed dampers are located where each of the 80 cables is anchored to the main span to suppress vibrations in the cables.

Hinges: Hinges connect different sections of the bridge and allow each one to move independently to avoid structural damage during a seismic event. Within the hinges are shear keys to restrain seismic forces between bridge sections. Bearings located atop each column enable a sliding movement between the bridge deck and column, along with flexibility between the column-supported approaches and the cable-supported main span.

Expansion Joints & Dampers: Specially designed expansion joints and dampers will enable controlled-swivel movements in three directions – vertical, longitudinal, and lateral – to enable flexibility between the column-supported approaches and the cable-supported main span.

Bridge Foundation: The bridge's seismic resiliency begins with its foundation, which is custom-designed to absorb an earthquake's initial energy waves.

Seismic Sensors: 77 accelerographs are built into the bridge to monitor and record the bridge's response during an earthquake.

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LB Bridge (App)

A Resilient Bridge in Earthquake Country

Latest in seismic technology and design advances important to 100-year lifespan

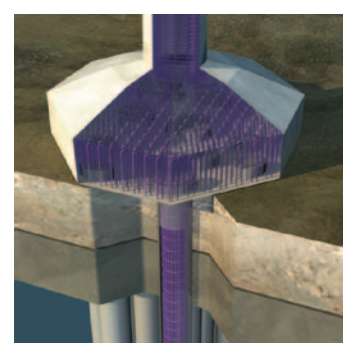
Southern California is earthquake country. Small and moderate quakes occur every year, and larger ones are predicted during the 100-year lifespan of the new bridge at the Port of Long Beach.

Given the importance of the Port of Long Beach to the U.S. economy, the goal is to keep goods moving after a large earthquake.* The bridge is designed so that such an earthquake will cause little or no damage to the bridge structure, and it will reopen quickly to trucks and cars.

Design Strategy

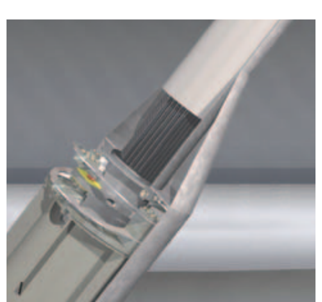
Akin to high-rises in downtown Los Angeles, the new bridge is designed to move with the ground. It will include elastic "points of isolation" that enable various segments of the bridge to move independently without causing significant damage, as well as "fuses" that are designed to deliberately burst under sufficient seismic energy to protect the bridge's primary superstructure.

A Good Foundation and Substructure



The bridge's seismic resiliency begins with its foundation – more than 350 concrete piles reaching more than 17 stories underground. These piles are custom designed to absorb some of an earthquake's initial energy waves.

Sitting on top of these piles are two massive towers that support the main span and more than 100 columns that support the approaches. These steel-reinforced concrete towers and columns are built to enable maximum flexibility while maintaining the structure's strength and shape during a major earthquake.



Main Span (Cable-stayed)

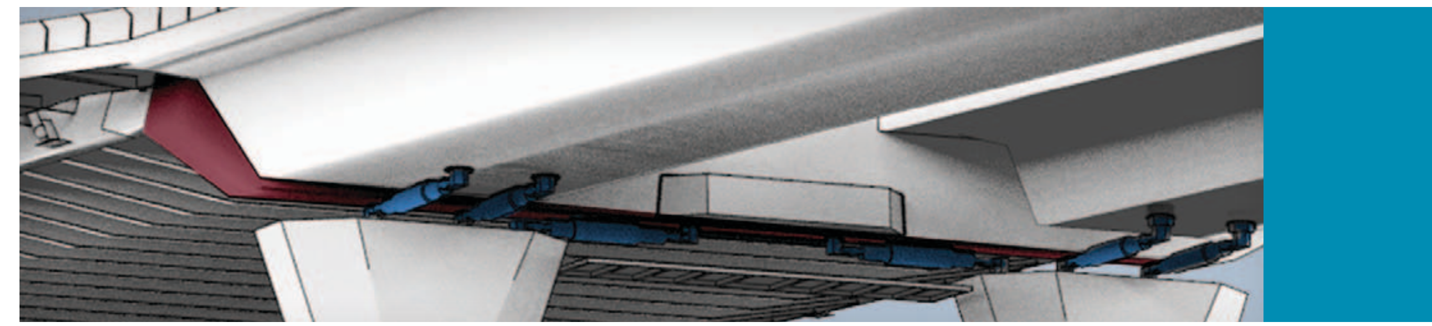
With 80 cables and two towers supporting the center portion of the bridge deck, the main span will be very flexible during a large earthquake. Specially designed dampers that are located where each cable is anchored to the main span create a state-of-the-art system that will suppress vibrations in the cables.

Diaphragms built inside the towers at the road deck level will help disperse seismic energy to avoid major structural impacts.

End Bents – A First for California

One of the most intriguing areas of the new bridge is where the east and west approaches connect to the main span of the bridge. At these "end bents," the column-supported approaches meet the cable-supported main span. These two types of structures will react differently in an earthquake, and flexible connections are a must.

Special joints, designed by the MAURER company of Germany, and built by D.S. Brown based in Ohio, will enable controlled-swivel movements in three directions (vertical, longitudinal, and lateral) at these junctures to compensate for movements between adjacent structures. This will be the first application of this sophisticated joint for a bridge in California.



Expansion Joints, Hinges, Shear Keys and Bearings

Between each section of bridge road deck are expansion joints and hinges, allowing each section to move without damaging its adjoining sections during an earthquake.

Within the hinges are shear keys. Similar to an electrical fuse, shear keys are a sacrificial, replaceable element to absorb the bulk of seismic forces. At certain energy levels, they are designed to "trip" to release the force of the quake.

Atop each column are spherical bearings to enable a sliding movement between the superstructure (the bridge deck) and the substructure (the columns).

A "Wired" Bridge for Research

The new bridge will be a giant seismic sensor, fitted with 77 accelerographs to monitor and record its response during any earthquake. Information will pinpoint possible issues along the bridge after a seismic event. In addition, data will be sent to the California Strong Motion Instrumentation Program where engineers and geologists around the world can analyze the bridge's performance to help improve earthquake resistance and recovery for future bridges, buildings, and other structures.

The largest earthquake likely to occur in the greater Long Beach area in 1,000 years is in the range of 6.5 to 7.5 on the magnitude scale.

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For additional details about the seismic features of the new bridge, visit the project website at **www.newgdbridge.com**