GOLDEN GATE BRIDGE

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Figure 1. Golden Gate Bridge

The Golden Gate Bridge was completed in 1937. Joseph B. Strauss was the chief engineer. It is located on Interstate 101 between San Francisco and Marin Counties

The weight of the bridge is 419,800 tons including suspended structure, towers, piers and fenders; but not including anchorages and north and south approaches. The equivalent mass is 3.808 (10^8) kg.

The Golden Gate Bridge is a suspension bridge. It is constructed of steel. Key dimensions are given in Table 1.

The bridge is mounted on concrete piers which extend down to bedrock.

Table 1. Golden Gate Bridge Dimensions		
Dimension	meters	feet
Total Length	2740	8980
Suspended Span Length (Distance between Towers)	1280	4200
Tower Height	228	748
Span Height above Strait	67	220
Height of each Tower above Roadway	152	500
Width	27.4	90

In addition to traffic loading, the Golden Gate Bridge must withstand the following environments:

1. Earthquakes, primarily originating on the San Andreas and Hayward faults.
2. Winds of up to 70 miles per hour.
3. Strong ocean currents.

The Golden Gate Bridge has performed well in all earthquakes to date, including the 1989 Loma Prieta Earthquake. Several phases of seismic retrofitting have been performed since the initial construction.

Note that current Caltrans standards require bridges to withstand an equivalent static earthquake force (EQ) of 2.0 g.

The retrofit measures have focused on keeping the Bridge open to emergency vehicles immediately following a major earthquake and to all traffic within one month.

Seismic analysis of the bridge must account for the bridge's natural frequencies. The natural frequencies are shown in Table 2, as taken from Reference 1.

Table 2. Golden Gate Bridge Natural Frequencies		
Mode Type	Period of vibration (sec)	Natural Frequency (Hz)
Transverse	18.2	0.055
Vertical	10.9	0.092
Longitudinal	3.81	0.262
Torsional	4.43	0.226

References

1. Anil K. Chopra, Dynamics of Structures: Theory and Applications of Earthquake Engineering Prentice Hall, 1996.