

Golden Gate [Bridge] by Kevin Star (2010)

The Golden Gate Bridge [GGB] is one of the 7 wonders of the modern world [including Panama Canal & Empire State Bldg]. Other amazing engineering projects are: The Great Pyramids, Wall of China, Taj Mahal, & Hoover Dam.

1906 SPRR built a bridge across the bay between Dumbarton & Palo Alto. 1912 El Camino Real was the 1st hwy to be paved in CA. SF city engineer, Michael O'Shaughnessy, ran the Hetch-Hetchy project [bringing water from Tuolumne to SF] & helped promote the GGB. The ferry business in the 1920s moved 50,000 workers back & forth to SF each weekday. Obviously, they opposed any bridges, but too many cars were clogging the system & change was coming. 86,000 cars on 1930 Labor Day weekend brought the ferry system to a standstill.

Joseph Strauss [of Chicago] came to the 1915 SF expo & became the big promoter [& Frank Doyle of Santa Rosa] behind the GGB [& took much of the design credit]. Jack London described the counties north of SF as Switzerland of North America [GGB would help tourism there]. 1924 Allen Rush came up with the idea of a suspension bridge for the GGB. 1928 GGB & Hwy District was formed.

The district wanted a team of the best engineers. Strauss got them together. Charles Ellis was a brilliant engineer & did most of the work, but was fired by Strauss in '31 for taking too long. Leon Moisseiff [designed Manhattan Bridge]; Hermann Ammann [designed Geo. Wash. Bridge & later Verrazano-Narrows Bridge]; Charles Derleth Jr [local engineer]; Andrew Lawson [geologist]; John Ebersson & Irving Morrow [architects]; Russell Cone [onsite engineer]; Clifford Paine [had a patent on vertical lift bridges, replaced Ellis & const supervising engr].

The color: "International Orange" was actually from the primer [lead based] they used, but they liked the color so much, they kept the color. They located the south tower 1000' offshore to preserve Fort Point. The towers were of the art deco style. During construction Strauss became absent & Paine ran the show [& became his partner]. The GGB was designed for 11' downward deflection; 6' upward & 10' side due to 80mph gusts.

Herbert Hoover [of Palo Alto, CA] played a key role in the national highway system & getting \$72m federal funding for the SF-Oakland Bay Bridge [BB] [none for GGB]. It was not easy to raise money in the depression, but labor was cheap. Amadeo Giannini [founder of Bank of Italy in 1904 ... aka Bank of America in 1929] would help sell the bonds.

GGB started Jan 1933 & finished May 1937 [bay Bridge was about the same time]. There were no major steel plants on the west coast [until 1942 with Kaiser] so the steel contract went to Bethlehem Steel [PA] & cables were done by Roebling's Sons Co [NY]. 150'x300' oval-shaped fenders were installed & water pumped out to work on the south tower foundation [divers could only work 24-minutes per day].

1940 failure of Tacoma Narrows Bridge was a warning to reinforce the GGB [which they finally did after damage from a 1951 storm]. 28M cars went across the GGB in 1967 [40M in 2009 + 10M pedestrians] & soon shuttle busses were being used to lessen the traffic. 1989 Loma

Prieta earthquake was another wake-up call & more seismic retrofits were done. They are constantly painting it to keep ahead of the corrosion caused by the salt water.

1962 BART [Bay Area Rapid transit] wanted to add a lower level, but were rejected. 1958 rail service was removed from the lower deck of the BB & replaced with eastbound cars. 1987 [50-yr ann.] 250,000 people crowded the closed GGB & the district was glad they replaced the deck with a lighter material [increasing the capacity to 5800 plf.

Stats: the roadway is 220' above the water & the 2 towers [90' wide] reach 746' [4200' apart], with a total length of 8980'. 250 pairs of suspender ropes 50' apart hung from the main cables to hold the deck. 3.25M cf of earth was removed & 270M # of concrete was used as the main cable anchors. Elevators went up inside the towers. 80,000 miles of 0.2" wires were spun back & forth across the bridge [by the ferries it would replace]. 450 of these wires would go into a hexagon strand, and then 61 strands were compressed & encased in wire [36" diameter total].

Trivia: 1921 Strauss design was rejected. Waldo Tunnel leads to the GGB from the north & Doyle Drive viaduct from the south. Tides [2x a day] empty 1/6 of the bay into the ocean [3.5x the volume of the Mississippi River]. One death per \$M spent on bridge construction at the time was norm, but they installed a safety net that saved countless lives. 27 people per yr jump off the GGB to their death [hitting the water at 75 mph]. So, in 2009 a net was placed below it extending out 20'.

Books: The Golden Gate Bridge [1937 report to the district articulated some of the math involved]; World's Greatest Bridges [1997] (Shirley Smith); History of the World's Most Famous Bridges [1995] (Judith Dupre)

Movie: The Bridge (2006); Golden Gate Bridge [2004 PBS documentary]

Links: www.art.com

Other facts [not in book]: 1965 the paint was removed & replaced & 1972 lights were installed. GGB was the world's longest span until 1967 [Verrazano Narrows Bridge].

Note: see Sir Isaac Newton for early engineering.