

THE GOLDEN GATE AND ITS BRIDGE
A CONDENSED HISTORY

Presentation to the Athenaeum Society

Of Hopkinsville, Kentucky

Thursday 6, October 2011

By member Peter K. Nicolos

Mr. President, Mr. Secretary, fellow presenter Willen, members of the Athenaeum Society. During two of my previous presentations the locale was California and the subject was the precious metal,- Gold. This evenings paper will return us to California and gold,- but not the metal. This evenings subject is the Golden Gate and its Bridge.

The Golden Gate is the North American strait connecting San Francisco Bay to the Pacific Ocean. Technically, the "Gate" is defined by the headlands of the San Francisco Peninsula and the Marin Peninsula, while the "strait" is the water flowing in between. The strait is approximately three miles long by one mile wide, with currents ranging from 4.5 to 7.5 knots. The strait is well known today for its depth and powerful tidal currents from the Pacific Ocean

The Gate is often shrouded by fog. During summer, heat in the California Central Valley causes air to rise creating strong winds which pull in cool moist air from the ocean through the break in the hills----the Gate. This event causes a stream of dense fog to enter the bay.

The strait was consistently elusive to early European explorers, presumably due to the persistent summer fog. Neither of the voyages of Juan Rodriguez Cabrillo, or Francis Drake, both of whom were exploring the nearby coast in the 16th century in search of the fabled Northwest Passage, recorded any mention of the strait.

Spanish galleons returning from the Philippines laid up in nearby Drakes Bay, 30 miles Northwest of the strait at Point Reyes, and did not report the strait, as they rarely passed east of the Farallon Islands, 27 miles to the west, fearing the possibility of rocks between the islands and the mainland.

The first observation of the strait occurred nearly two hundred years later. In 1769. Sgt. Jose Francisco Ortega, the leader of a scouting party sent north along the peninsula of present day San Francisco, reported he could proceed no farther because of the strait.

On the 5th of August 1775, Juan de Ayala and the crew of his ship the San Carlos became the first Europeans known to have passed through the strait and anchored in a cove behind present day Angel Island.

Until the 1840's the strait was called the "Boca del Puerto de San Francisco"----Mouth of the Port of San Francisco.

It is generally accepted that the strait was named Chrysopylae, or Golden Gate, in 1846, by Capt. John C. Fremont, topographical engineer of the U.S. Army. According to his memoirs, it reminded him of a harbor in Istanbul named Chrysoceras, or Golden Horn.

And now, a short description of the Golden Gate Bridge and how it came to be.

The Golden Gate Bridge is the suspension bridge spanning the Gate. As part of both U S Highway 101 and California Route 1, it connects the city of San Francisco on the Northern tip of the San Francisco Peninsula to Marin County.

The bridge featured the longest suspension bridge span in the world when it was completed in 1937, and has become an internationally recognized symbol of San Francisco and California.

Here are just a few facts:

The bridge clearance above the mean high water mark is 220 feet;

The two towers supporting the main cables are 500 feet above the roadbed, and 746 feet above the water;

Each tower is 33' x 54' feet, weighs 22,000 thousand tons, and supports a main cable;

The foundation of the south tower is 110' feet below the mean low water line;

In order to build the "fender" to contain the foundation of the south tower, 9.4 million gallons of water were pumped out of a football sized opening to the bedrock floor;

The main span between the two towers is 4,200 feet;

The towers deflect due to weather and sea conditions; In a transverse deflection up to 12.5" inches; In a longitudinal deflection up to 18" inches toward the shoreline and 22" inches out to sea;

And finally, what makes this bridge possible are the two main suspension cables passing over the top of the two towers;

Each main cable is 7,650' feet long , 36 and 3/8 inches in diameter, and made up of 61 bundles of smaller cables which consist of 27,572 strands of galvanized wire;

The galvanized steel wire have a minimum tensile breaking strength of 200,000 pounds per square inch;

Total length of wires in both main cables is 80,000 thousand miles;

total weight of the approaches, anchorages and bridge is 894,500 tons;

The fabricated steel used in the construction of the Golden Gate Bridge was manufactured by Bethlehem Steel plants in Trenton, New Jersey and Sparrows Point, Maryland, and three Pennsylvania towns, Bethlehem, Pottstown, and Steelton. The steel was loaded, in sections, onto rail cars, taken to Philadelphia and shipped through the Panama Canal to San Francisco.

Safety called for hard hats during construction. They were used exclusively on the bridge and were solely supplied by the family owned E. D. Bullard Company, headquartered in Cynthiana, Kentucky.

The bridge was originally painted with red lead primer and a lead based topcoat, which was touched up as required. In the mid 1960's, a program was started to improve corrosion protection by stripping the original paint and repainting the bridge with zinc silicate primer and Acrylic topcoats. The program was completed in 1995, and is now maintained by a rugged group of 17 ironworkers and 38 painters who replace corroding steel and rivets and touch up the paintwork when it becomes seriously eroded.

The bridge has only been closed three times due to weather conditions; in 1951, 1982, and 1983. Each closing was due to wind gusts

of 69 mph and higher. Modern knowledge of the effects of earthquakes has led to a program to retrofit the bridge to better resist seismic events, such as the Loma Prieta earthquake of 1989. Although heavy damage occurred in the bay area during that quake, including The San Francisco Oakland Bay Bridge, the Golden Gate was not damaged. A retrofit program costing \$392 million dollars is ongoing and scheduled for completion in 2012.

Now, how did the bridge get built?

Before the bridge, the only practical route between San Francisco and Marin County was by boat across a section of San Francisco Bay. San Francisco was the largest American city still served primarily by ferries. Many experts said that a bridge could not be built across the 6,700 foot strait. The strong swirling tides and currents, with water 500 feet in depth at the center of the channel and blinding fogs would prevent construction and operation.

Although the idea of a bridge spanning the Gate was not new, the proposal that eventually took place was made in a 1916 San Francisco Bulletin editorial. The City Engineer of San Francisco estimated the cost at \$100 million dollars, impractical for the time, and fielded the question to bridge engineers of whether it could be built for less. One who responded, Joseph Strauss, was an ambitious but dreamy engineer and poet, who had, for his graduate thesis, designed a 55 mile long railroad bridge across the Bering Strait. At that time, Strauss, president and chief engineer of a successful bridge company based in Chicago had completed numerous bridges in the United States and around the world, most of which were inland, but nothing on the scale of the new project. Strauss's initial drawings were for a massive cantilever on each side of the strait connected by a central suspension segment which Straus promised could be built for \$17 million dollars. Local authorities agreed to proceed only on the assurance that Strauss alter the design and except input from several consulting experts. A suspension bridge design was considered the most practical because of recent advances in metallurgy.

Strauss spent more than a decade drumming up support in Northern California. The bridge faced opposition, including litigation, from many sources. the Department of war was concerned that the bridge would

interfere with ship traffic; the Navy feared that a ship collision or sabotage to the bridge would block the entrance to one of its main harbors. Labor unions demanded guarantees that local workers would be favored for construction jobs. The Southern Pacific Railroad, one of the most powerful businesses interests in California, opposed the bridge as competition to its ferry fleet, which was at one time the largest in the world, and filed a lawsuit against the project, leading to a mass boycott of the ferry service. In May 1924, a hearing on the Bridge was held on behalf of the Secretary of War to address a request to use Federal land for construction. The Secretary of War, approved the transfer of land needed to the "Bridging the Golden Gate Association," and both San Francisco County and Marin County, pending further plans by Strauss. His efforts were aided by the fledgling automobile industry, which supported the development of roads and bridges to increase demand for automobiles..

The Golden Gate Bridge and Highway District, authorized by an act of the California legislature, was incorporated in 1928 as the official entity to design, construct, and finance the Golden Gate Bridge. However, after the Wall Street Crash of 1929, the District was unable to raise the construction funds, so it lobbied for a \$30 million bond measure. The bonds were approved in November 1930, by votes in the counties affected by the bridge. The construction budget at the time of approval was \$27 million. However, the District was unable to sell the bonds until 1932, when Amedeo Giannini, the founder of San Francisco-based Bank of America, agreed on behalf of his bank to buy the entire issue in order to help the local economy.

Construction began on January 5th, 1933. The project cost was estimated at \$35 million dollars. The bridge was finished April 19th, 1937, at \$1.3 million dollars under budget.

Strauss was chief engineer in charge of overall design and construction. However, because he had little understanding or experience with cable suspension designs, responsibility for much of the engineering and architecture fell upon other experts. Strauss's initial design proposal the, double cantilever, was unacceptable from a visual standpoint.

The final graceful suspension design was conceived and championed by New York's Manhattan Bridge designer, Leon Moisseiff. Moisseiff produced the basic structural design, introducing his "deflection theory" by which a thin, flexible roadway would flex in the wind, thus greatly reducing stress by transmitting forces via suspension cables to the bridge towers.

Engineer Charles Alton Ellis, a Greek scholar and mathematician collaborated remotely with Moisseiff, and was the principal engineer of the project. He was an expert in structural design, and had written the standard textbook of the time. Ellis did much of the technical and theoretical work that built the bridge, but he received none of the credit in his lifetime.

And, in November 1931, Strauss fired Ellis, ostensibly for wasting too much money sending telegrams back and forth to Moisseiff, and replaced him with an understudy of his own. Ellis, obsessed with the project and unable to find work elsewhere during the Depression continued working 70 hours per week on an unpaid basis, eventually turning in ten volumes of hand calculations done on a circular slide rule.

Irving Morrow, a relatively unknown residential architect, designed the overall shape of the bridge towers, the lighting scheme, the streetlights, railing, and walkways. He is best remembered for selecting the orange vermillion color for the bridge, known as International Orange, instead of the standard silver or gray. The U.S. Navy had wanted it to be painted with black and yellow stripes to ensure visibility by passing ships.

Strauss remained head of the project, overseeing day-to-day construction and making a groundbreaking contribution. Specifically, he innovated the use of movable safety netting beneath the construction site, which saved the lives of many otherwise, unprotected steel workers. Of eleven men killed from falls during construction, ten were killed when the net failed under the stress of a scaffold that had fallen. Nineteen others, who were saved by the net over the course of construction became proud members of the informal Halfway to Hell Club.

With an eye towards self promotion and posterity, Strauss downplayed the contributions of his collaborators, who despite receiving little recognition or compensation, were largely responsible for the final form of the bridge. He succeeded in having himself credited as the person most responsible for the vision and design of the bridge. Only much later were the contributions of others on the design team properly appreciated. In May 2007, the Golden Gate Bridge District issued a formal report on 70 years of stewardship of the famous bridge and gave Charles Ellis major credit for design of the bridge.

The bridge opening celebration began on May 27, 1937 and lasted for one week. The day before vehicle traffic was allowed, 200,000 people crossed by foot and roller skate. San Francisco Mayor Angelo Rossi and other officials rode the ferry to Marin, then crossed the bridge in a motorcade. The next day, May 28th, President Roosevelt pressed a telegraph key in Washington, D. C. signaling the official start of vehicle traffic over the Bridge at noon.

As the only road to exit San Francisco to the north, the bridge is part of both U.S. Route 101 and California Route 1. The median markers between the lanes are moved to conform to traffic patterns. On weekday mornings, traffic flows mostly southbound into the city, so four of the six lanes run southbound. Conversely, on weekday afternoons, four lanes run northbound. The bridge is popular with pedestrians and bicyclists as well as cars, and was built with walkways on either side of the six traffic lanes. Railings between the walkways and the traffic lanes were added in 2003, primarily as a measure to prevent runaway cyclists from falling into the roadway. The speed limit is 45 miles an hour. Current toll is \$ 6 dollars for Southbound traffic into San Francisco; \$ 3 dollars for car pools. There is no fee for Northbound traffic to Marin County. In an effort to save \$19.2 million over the following 10 years, the Golden Gate District voted in January 2011 to eliminate all toll takers by 2012, and only use open road tolling.

In May 1987, as part of the 50th anniversary celebration, the Golden Gate Bridge District closed the bridge to automobile traffic and allowed pedestrians to cross the bridge. The celebration attracted 750,000 to 1,000,000 people, but ineffective crowd control allowed the bridge to become congested with roughly 300,000 people, which caused the center span of the bridge to flatten out under the weight. Although the bridge

span of the bridge to flatten out under the weight. Although the bridge is designed to flex in that way under heavy loads and was estimated not to exceed 40% of the yielding stress of the suspension cables, bridge officials have stated that uncontrolled pedestrian access is not being considered as part of the 75th anniversary in 2012. (as an aside, the center span of the bridge can fall or rise up to 16 feet due to variation in temperature.)

Until February 17, 1937, there had only been one fatality, setting a new all-time record in a field where one man killed for every million dollars spent had been the norm. On February 17, 10 more men lost their lives when a section of scaffold carrying 12 men fell through the safety net. In an enormous, cascading spill, more than 2,000 feet of safety net, fell some 220 feet into the strait. 12 men, all but one of the crew that had been working on the platform and in the net, went spinning downward. The 13th crewman Tom Casey, was dangling in the air hanging above the strait from a beam in the bridge's suspended structure."I felt the scaffold start to go out from under me and I jumped. I grabbed a beam and hung on. I just hung on and kept hanging on."

The crew foreman, Slim Lambert, survived the fall. "As I was falling, a piece of lumber fell on my head. I was almost unconscious. Then the icy water of the channel brought me to." The tide carried him out to sea, in the general direction of Point Bonita, the second to last headland on the northern approach to San Francisco Bay. "I just about ready to give in, when a fishing boat came along side." At a San Francisco hospital he was treated for a broken shoulder, several broken ribs, and, fractures of several neck vertebrae.

Casey, meanwhile, was still hanging from the bottom of the bridge, both hands hugging a girder, a pipe still gripped tightly in his mouth. As men shouted to him to hang on, a rope was lowered down to him, but Casey refused to let go even the one hand necessary to grab the rope. So, a loop was rigged in the end of the rope and it was maneuvered between his legs. Then he was told to let go and ride on up. He let go, and was pulled up with that damn pipe still stuck in his face, and nothing between him and the bay, but the rope. Casey stood on the bridge deck, face white, legs trembling, pipe in mouth, then walked down to the Field Office, picked up his time, and never came back.

In a single catastrophe, Strauss's proudest achievement at the Gate, the project's near-perfect safety record, had been obliterated. Because of the spectacular nature of the accident, the fact that he had cut, by two-thirds, the "acceptable average" of high-steel fatalities would be largely forgotten. The safety net, caught, as it ripped, in a spectacular photograph by a freelance photographer named Joe Dearing, would forever be associated with the loss of ten lives, instead of the saving of nineteen. More ominously, the accident ushered in the association of the bridge and dramatic death, with its powerful attraction for potential suicides that has continued and grown up through the present day. To the bridge's embodiment of soaring aspirations have been added the dark, opposite lure of plummeting death.

More people die by suicide at the Golden Gate Bridge than any other site in the world. The deck is approximate 245 feet above water, and after a fall of approximate 4 seconds, jumpers hit the water at around 75 miles an hour. Most die from impact trauma. The few who survive the initial impact generally drown or die of hypothermia in the cold, 47 degree water. Most jumps occur on the side facing the bay. The side facing the Pacific is accessible only by bicycle.

There is no accurate figure on the number of suicides since 1937, because many were not witnessed. An official count through 2005, exceeded 1200, and new jumps were occurring about once every two weeks. Currents beneath the bridge are very strong, and some jumpers have undoubtedly been washed out to sea without ever having been seen. There were 34 suicides in 2006 whose bodies were recovered, four jumps that were witnessed, but whose bodies were never recovered, and several bodies recovered were suspected to be from bridge jumps. Additionally, the California Highway Patrol removed 70 suicidal people from the bridge in 2006.

People have been known to travel to San Francisco specifically to jump off the bridge, and may take a bus or cab to the site. Police sometimes find abandoned rental cars in the parking lot. As of 2006 only 26 people are known to survive the jump. One young woman survived, but returned to jump again and died the second time. One young man survived in 1979, swam to shore, and drove himself to a hospital. On March 10th, 2011, a 17-year-old survived a jump breaking

his tailbone and puncturing one lung, though saying his attempt was for “fun” and not suicide.

Various methods have been proposed and implemented to reduce the number of suicides. The bridge is fitted with suicide hotline telephones, and staff patrol the bridge in carts, looking for people who appear to be planning to jump. The bridge is now closed to pedestrians at night. Cyclists are still permitted across at night, but must be buzzed in and out through remote control security gates. One recurring proposal had been to build a barrier to replace or augment the low railing, but is opposed for reasons of cost, aesthetics, and safety, as a poorly designed barrier could significantly affect the bridge's structural integrity during a strong windstorm.

On October 10, 2008 the Golden Gate Bridge Board of Directors voted 14 to 1 to install a plastic covered stainless steel net below the bridge as a suicide deterrent. The net will extend 20 feet on either side of bridge and is expected to cost \$40-\$50 million to complete. However lack of funding could delay the net's deployment.

Let me end this presentation with one writer's thoughts on the Golden Gate Bridge, hearkening back to the opening day in 1937, and forward to the present day.

"Onto the span, led by an escort of Highway Patrol motorcycles, sirens screaming, rolled flag-flying official limousines, police cars, fire trucks, and military vehicles, forming, with the mass over flight of 400 Navy planes, a concentration of machinery likely to test the limits of Charles Ellis's estimate of the bridge's live-load capacity. Photographs from this time, with the tiny, swarming planes outlined against the great, dark Art Deco towers of the bridge, the people and vehicles on the span, reduced to teeming figures far below, suggest the climax of the original King Kong, with Kong trapped on top of the Empire State building, fighting off, like attacking mosquitoes, a squadron of strafing army planes. Only this was real. And it was bigger.

That afternoon, the largest fleet of American capital ships ever concentrated in a single harbor in peacetime sailed beneath the bridge into San Francisco Bay. The demonstration designed, in part to quell any remaining fears about the bridge as a defense or navigation hazard,

some 19 battleships and heavy cruisers, led by the U.S.S. Pennsylvania, steamed in formation beneath the great, striping shadow of the bridge, accompanied by 23 other major vessels, including all three of the country's operating aircraft carriers. And it fixed the bridge in the nation's imagination as the Pacific Ocean entrance to America.

Other structures, more difficult and challenging to engineers, have since been built. Yet this one retains its deep and powerful hold upon us. It is believed to be the most photographed man-made structure in the world.

There is something beyond mere admiration in this, a suggestion of the possibility that mankind at its most practical, most ambitious, and most technologically advanced need not inevitably intrude upon and destroy nature but might compliment, or even, as happened here, enhance it.

In its natural state, before it was ever bridged, the Golden Gate was one of most inspiring sites of all the world. Artists painted its climatic convergence of mountains, bay, and ocean. Photographers took pictures of it, writers at least attempted poetry about it. Documentary evidence remains of the dramatic beauty of the unabridged Gate. It was a stirring sight, and those earlier pictures still move us emotionally. Yet they provoke no nostalgia, no sense of loss. There is no urge to return to a time before the bridge, nor even an itch to alter or improve upon its design. The feeling we are left with, upon seeing the unabridged Golden Gate, is not regret, but incompleteness, as if all this, beautiful as it was, was prelude, in waiting for the bridge itself to satisfy our hunger for fulfillment. To furnish the body of the work.

Of what other man-made structure, imposed upon so naturally beautiful a setting, can such a thing be said? "

Thank you.