Golden Gate Bridge

The Golden Gate Bridge is a suspension bridge spanning the Golden Gate, the one-mile-wide (1.6 km) strait connecting San Francisco Bay and the Pacific Ocean. The structure links the U.S. city of San Francisco, California—the northern tip of the San Francisco Peninsula—to Marin County, carrying both U.S. Route 101 and California State Route 1 across the strait. It also carries pedestrian and bicycle traffic, and is designated as part of U.S. Bicycle Route 95. Recognized by the American Society of Civil Engineers as one of the Wonders of the Modern World,[7] the bridge is one of the most internationally recognized symbols of San Francisco and California.

The idea of a fixed link between San Francisco and Marin had gained increasing popularity during the late 19th century, but it was not until the early 20th century that such a link became feasible. Joseph Strauss served as chief engineer for the project, with Leon Moisseiff, Irving Morrow and Charles Ellis making significant contributions to its design. The bridge opened to the public in 1937 and has undergone various retrofits and other improvement projects in the decades since..

HISTORY CONSTRUCTION

History

Before the bridge was built, the only practical short route between San Francisco and what is now Marin County was by boat across a section of San Francisco Bay. A ferry service began as early as 1820, with a regularly scheduled service beginning in the 1840s for the purpose of transporting water to San Francisco.[11]

In 1867, the Sausalito Land and Ferry Company opened. In 1920, the service was taken over by the Golden Gate Ferry Company, which merged in 1929 with the ferry system of the Southern Pacific Railroad, becoming the Southern Pacific-Golden Gate Ferries, Ltd., the largest ferry operation in the world.[11][12] Once for railroad passengers and customers only, Southern Pacific's automobile ferries became very profitable and important to the regional economy.[13] The ferry crossing between the Hyde Street Pier in San Francisco and Sausalito Ferry Terminal in Marin County took approximately 20 minutes and cost $1.00 per vehicle prior to 1937, when the price was reduced to compete with the new bridge.[14][15] The trip from the San Francisco Ferry Building took 27 minutes.

Conception

Although the idea of a bridge spanning the Golden Gate was not new, the proposal that eventually took hold was made in a 1916 San Francisco Bulletin article by former engineering student James Wilkins.[18] San Francisco's City Engineer estimated the cost at $100 million (equivalent to $2.8 billion in 2023), and impractical for the time. He asked bridge engineers whether it could be built for less.[11] One who responded, Joseph Strauss, was an

ambitious engineer and poet who had, for his graduate thesis, designed a 55-mile-long (89 km) railroad bridge across the Bering Strait.[19] At the time, Strauss had completed some 400 drawbridges—most of which were inland—and nothing on the scale of the new project.[3] Strauss's initial drawings[20] were for a massive cantilever on each side of the strait, connected by a central suspension segment, which Strauss promised could be built for $17 million (equivalent to $476 million in 2023).[11]

n May 1924, Colonel Herbert Deakyne held the second hearing on the Bridge on behalf of the Secretary of War in a request to use federal land for construction. Deakyne, on behalf of the Secretary of War, approved the transfer of land needed for the bridge structure and leading roads to the "Bridging the Golden Gate Association" and both San Francisco County and Marin County, pending further bridge plans by Strauss.[22] Another ally was the fledgling automobile industry, which supported the development of roads and bridges to increase demand for automobiles.[14]

Strauss spent more than a decade drumming up support in Northern California.[21] The bridge faced opposition, including litigation, from many sources. The Department of War was concerned that the bridge would interfere with ship traffic. The US Navy feared that a ship collision or sabotage to the bridge could block the entrance to one of its main harbors. Unions demanded guarantees that local workers would be favored for construction jobs. Southern Pacific Railroad, one of the most powerful business interests in California, opposed the bridge as competition

to its ferry fleet and filed a lawsuit against the project, leading to a mass boycott of the ferry service.[11]

Design

Design

Strauss was the chief engineer in charge of the overall design and construction of the bridge project.[16] However, because he had little understanding or experience with cable-suspension designs,[25] responsibility for much of the engineering and architecture fell on other experts. Strauss's initial design proposal (two double cantilever spans linked by a central suspension segment) was unacceptable from a visual standpoint.[20] The final suspension design was conceived and championed by Leon Moisseiff, the engineer of the Manhattan Bridge in New York City.[26]

Irving Morrow, a relatively unknown residential architect, designed the overall shape of the bridge towers, the lighting scheme, and Art Deco elements, such as the tower decorations, streetlights, railing, and walkways. The famous International Orange color was Morrow's personal selection, winning out over other possibilities, including the US Navy's suggestion that it be painted with black and yellow stripes to ensure visibility by passing ships.[16][27]

Senior engineer Charles Alton Ellis, collaborating remotely with Moisseiff, was the principal engineer of the project.[28] Moisseiff produced the basic structural design, introducing his "deflection theory" by which a thin, flexible roadway would

flex in the wind, greatly reducing stress by transmitting forces via suspension cables to the bridge towers.[28] Although the Golden Gate Bridge design has proved sound, a later Moisseiff design

Constrcution

Construction began on January 5, 1933.[11] The project cost more than $35 million[33] ($610 million in 2023 dollars[34]), and was completed ahead of schedule and $1.3 million under budget (equivalent to $28.9 million today).[35] The Golden Gate Bridge construction project was carried out by the McClintic-Marshall Construction Co., a subsidiary of Bethlehem Steel Corporation founded by Howard H. McClintic and Charles D. Marshall, both of Lehigh University.

Strauss remained head of the project, overseeing day-to-day construction and making some groundbreaking contributions. A graduate of the University of Cincinnati, he placed a brick from his alma mater's demolished McMicken Hall in the south anchorage before the concrete was poured.