PROPOSAL FOR
SINGLE-TOWER CABLE-STAYED BRIDGE
EAST BAY REPLACEMENT

SUBMITTED TO
BAY BRIDGE DESIGN TASK FORCE
ENGINEERING & DESIGN ADVISORY PANEL
METROPOLITAN TRANSPORTATION COMMISSION

BY
T. Y. LIN,
BOARD CHAIRMAN, LTYC
MAY 5, 1997
May 5, 1997

Engineering and Design Advisory Panel
Bay Bridge Design Task Force

RE: Single-Tower at Treasure Island for Main Span of East Bay Replacement Bridge

Dear Sirs:

As we all know, San Francisco Chronicle through Mr. Allan Temko asked me to create an alternative for the solution of the subject span layout, which was published in the Chronicle March 10, 1997 - attached. Since then, several other alternatives have been proposed and are being considered. This memo is to briefly describe the basic ideas underlying the single-tower proposal and to name some of the issues involved for your consideration.

(1) This single tower concept for cable-stayed layout is intended to be a clear engineering statement, emphasizing the desirability to do away with piers over the deep bay-mud near Treasure Island, and to place a single tower on the edge rock of that island. At the same time, this will create a monumental mast on the Oakland side comparable to the suspension towers of the West Bay and the Golden Gate Bridge. Of course, such a tower must be designed to be absolutely safe, seismically or otherwise, and this is not difficult to achieve.

(2) 2 parallel plans of stay-cables 25-ft apart will run down the middle of the bridge so that drivers in either direction would have a city view on one side and a towering structure on the other.

(3) The 2-planes of cables will support a concrete box spine of 30-ft wide and 12-ft deep which will greatly increase the torsional and flexural rigidity of the deck, stiffening it for traffic, wind and earthquake.

(4) The bridge-deck cantilevering 80-ft on each side (for 5 lanes plus shoulders) will be post-tensioned by a horizontal plane of cables within the deck and rests on traverse floor beams spaced at 25-ft internals. These 18-in thick beams will be 2-ft deep at edge, increasing to 12-ft at the spine box. They can be further stiffened by bulbs, along their bottom edge if needed.

(5) The entire bridge deck of 190-ft width on a 1400-ft span has a high width/span ratio, thus possessing good resistance against wind or seismic forces.
(6) This concept is believed to be an economical and esthetic solution befitting its environmental requirements. It is laid out to follow the single-deck approach spans presented in the Value Engineering Analysis performed by Ventry Engineers submitted to Caltrans, November, 1996. It will fit into other approach layout assuming a one-deck structure, but will not fit into a double-deck approach. Bikeway can be provided by leaving a small tunnel through the tower just above the deck.

(7) This proposal is intended for a prestressed concrete deck, although it can be modified into a composite deck if needed. The all-concrete approach is proposed for economy in construction and maintenance.

(8) Construction of the bridge will use the usual double-cantilever erection, with some modification for the unbalanced or asymmetric spans. Since the deck will have cantilever floor beams at intervals, the conventional horizontal slip-forming should be modified, perhaps by using jumping forms. One could slip-form the central box spine first. Then it will be followed by lowering the steel forms on each side of the spine to be jumped forward. Or, precast 80-ft T-stems can be lifted into position and deck slabs poured to connect them to the spine.

(9) Although the bridge is inherently safe, dynamic studies should be conducted to determine the responses of the structure to live load, wind, and earthquakes, to be sure of its safety under all conditions. Vibration under traffic will be minimum on account of the heavy size and weight of the bridge deck.

(10) The bridge alignment is only approximately indicated in the plan attached.

(11) Architectural features for the tower, pier, railings, etc. will be incorporated as needed in the future.

(12) The tower pier under the deck is about 160-ft high above water, 50-ft x 50-ft square, having 5-ft reinforced walls designed to resist heavy earthquakes. The foundation shall be a spread footing on rock without piles.

It is suggested that the Panel consider the incorporation of this concept, in part or in whole, together with whatever layout adopted for this bridge.

Sincerely,

T.Y. Lin, Bd Chrmn, LTYC,
also Member of Task Force and CAPCD
TO OAKLAND

ELEVATION

500'  250'  1150'  700'

PLAN

EXISTING BRIDGE
PROPOSED BRIDGE

N
CONCEPTURAL QUANTITY ESTIMATE

Rough quantities of major materials are estimated as follows, using the plan, elevation, and sections shown on previous sheets:

(a) Average thickness of deck concrete including the box spine is about 30-in and the entire deck is prestressed in both directions, requiring only nominal re-bars. Total quantity of post-tensioning tendons, running transversely in the deck, amounts to about 1,000,000-lbs. Concrete $f'_c = 5,500$-psi ± .

(b) Steel for the stayed-cables totals 5,000,000-lbs, assuming mostly lightweight concrete for the deck.

(c) Tower concrete amounts to 16,000-yd$^3$. It can be easily slip-formed.

(d) 2 sets of horizontal steel slip-forms (area 190 x 25-ft) will be needed, to be designed and built by the contractor.
Renowned engineer T.Y. Lin offers a plan that's nobler and costs $200 million less

Caltrans has given the public an impossible choice between two extremes in rebuilding the eastern span of the Bay Bridge — and neither is nearly good enough for this key setting at the heart of the bay.

One proposal is for a dull, towerless "skyway" that has been likened to an outsized freeway ramp. The other is a madly extravagant "signature bridge," slung from two melodramatic towers, that would be a mockery of the great suspension spans to the west between Yerba Buena Island and San Francisco.

But these schemes are authentic dogs.

And there's no reason for us to settle for either of them.

That's why The Chronicle asked the renowned structural designer T.Y. Lin to create a true alternative. And he has responded with a masterpiece that would give the East Bay one of the noblest and most daring cable-stayed bridges in the world.

Under Professor Lin's bold concept, a 200-foot-wide concrete deck — gloriously open to the sky — would span the 1,400-foot main channel in a breathtaking display of clarity and confidence. The deck would hang from a single powerful concrete mast 600 feet high, firmly socketed in rock at the edge of the island.

Lin's idea is very preliminary, and it...
Bay Area Deserves Better, Less Expensive Bridge Design

By Leo Chien/Special to The Chronicle

Parallel cables are anchored to the spine that divides the span.

Lin's Designs Unify Eastern, Western Views

T.Y. Lin is a builder of bridges between and beyond places. Not only has he conceived visionary (but technically feasible) structures, but he has also sought to incorporate them with both Eastern and Western philosophies.

When he was honored as the University of California's Alumni of the Year in 1985, his acceptance speech characteristically was a tribute to both Confucius and Isaac Newton, whose principles exist in his unified world view.

Born in Foochow, China, in 1911, Tung-Yen Lin—always called "T.Y." by family and friends—came to UC Berkeley as an engineering graduate student in the 1930s and quickly distinguished himself as a structural theorist with a bent for practical building.

He returned to China in the 1930s as a railroad engineer, then was invited back to Berkeley by World War II. He soon became a mainstay of one of the most brilliant engineering faculties in the world, where for the past two decades he has been professor emeritus.

He became internationally famous in the 1950s as the foremost U.S. developer of prestressed concrete. Taking advantage of this revolutionary material, he pushed building technology beyond existing limits in bridges, arenas, convention facilities and other long-span structures of surpassing lightness and grace in Asia and Latin America as well as the United States.

In San Francisco, the 300-foot arches of the Moscone Center are his most spectacular achievement. But his single most poetic design, still unbuilt, is the for the Ruck-a-Chucky Bridge in the Sierras foothills above Auburn, whose slender 1,300-foot deck—hung from cables anchored in the surrounding mountainsides—would curve freely above a gorge of the American River.

In some ways, it was a forerunner of the daring cable-stayed concept he now proposes for the eastern spans of the Bay Bridge.

That want of vision, that refusal to seek a higher unity, is why we do not trust Caltrans, aesthetically or otherwise.

The whole idea of the citizenry choosing between two inadequate bridge schemes, as State Senator Pro-Tide Bill Lockyer would like us to do on the Internet, amounts to something close to a hoax.

Caltrans has virtually conceded its ineptitude by offering to consider any suggestions that independent engineers and architects may submit. Professor Lin's concept should be a formidable contender, for it in fact would enhance rather than compete with the suspension bridges on the San Francisco side.

But the public has the right to see other alternatives, and people will not put up with much more dithering by the hapless crew in Sacramento. It's time to end the farce.

Allan Temko won the Pulitzer Prize for Criticism in 1990. He has fought against designs by the state's engineering bureaucracy since his Chronicle articles in the 1960s helped stop freeway construction in San Francisco and led to the redesign of the San Mateo-Hayward Bridge.

T.Y. Lin is renowned for functional and beautiful public works.
Box 6, Folder 15

Item 1

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