

BAYARC: A Tidal Responsive Barrier

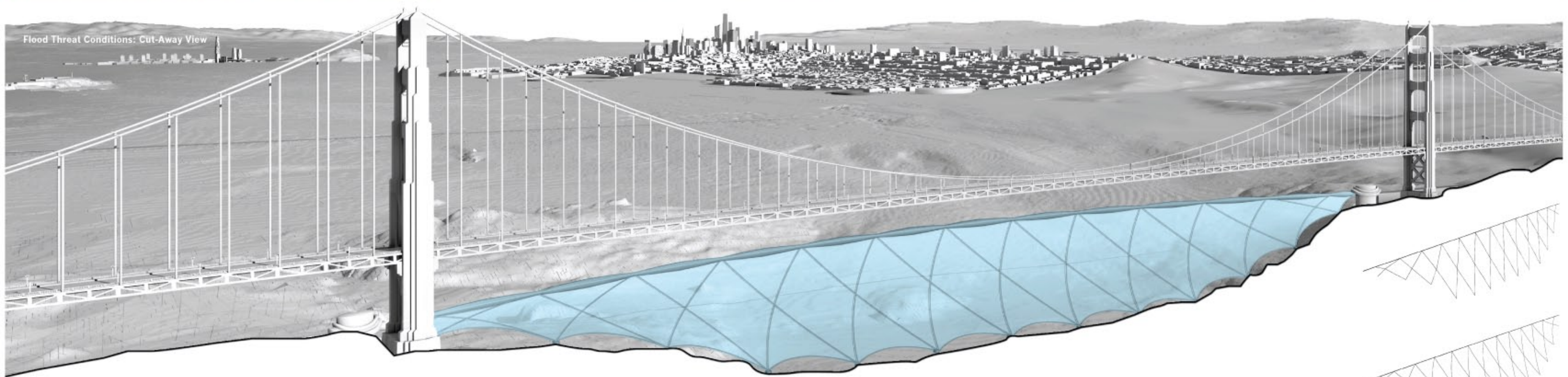
Typical Tidal Conditions



Flood Threat Conditions



Flood Threat Conditions: Cut-Away View



The BayArc is a minimal, lightweight and environmentally sensitive system designed to protect the San Francisco Bay Area from periodic high water levels associated with Sea Level rise. It operates on organic principles of buoyancy and the structural efficiency associated with net membranes and tension. It is a concept that has the potential to eliminate billions of dollars in permanent levees and localized Bay Area flood protection without compromising the Bay's system of ecology and commerce.

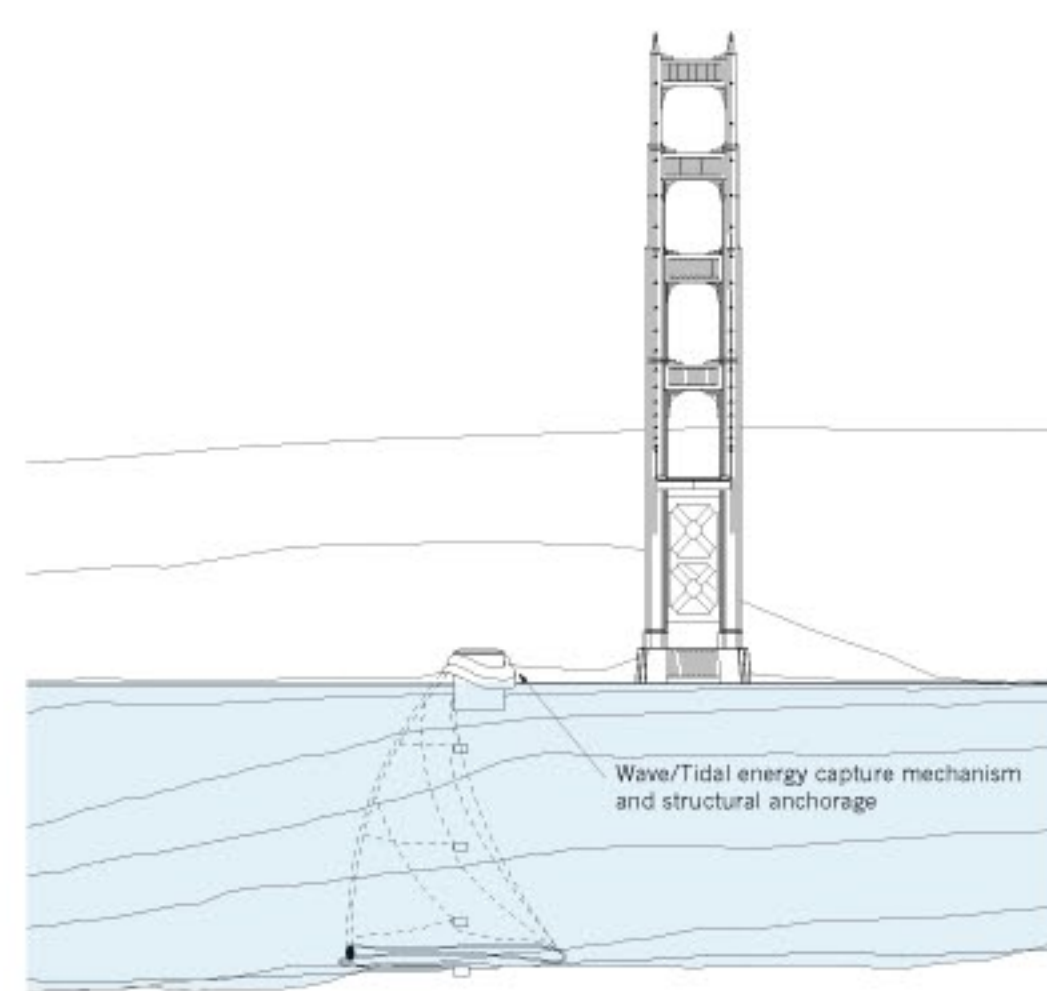
Typically, low-lying areas around the Bay are protected from tidal flooding. FEMA has established extreme high water guidelines and monitors communities that are potentially in danger. In fact, the principle threat of flooding in the next century is not from the rise in the sea level itself, but from the increase in extremes during high tides which create breaches of existing flood defenses for relatively brief periods.

The objective of the BayArc is to prevent the peak of extreme tide events while maintaining a natural tidal exchange between the ocean and the bay.

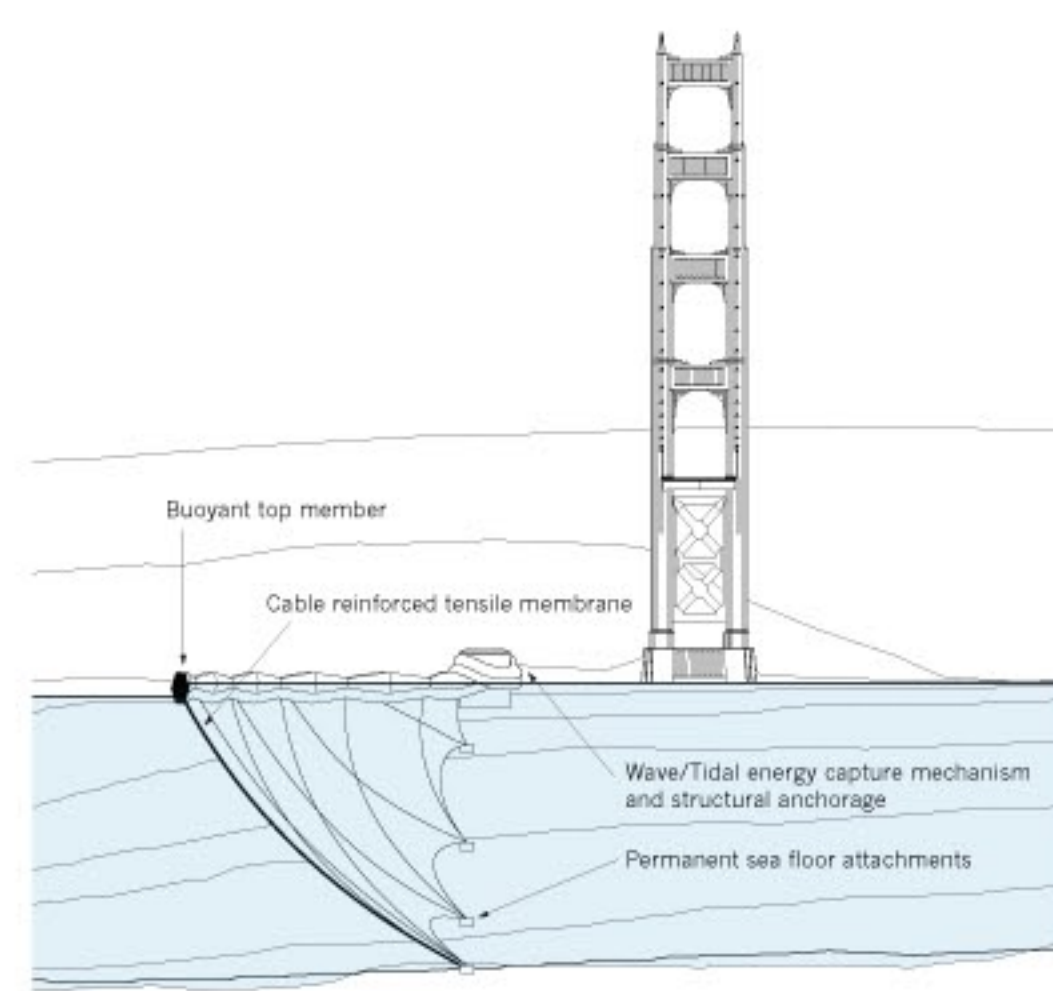
The BayArc consists of a submerged, cable-reinforced membrane anchored to the seabed that utilizes a bladder embedded in a tensile leading edge fastened to structural pylons at the water's edge. When deployed, the BayArc floats to the surface and its tensile membrane creates a barrier stretching from the water's edge to the sea floor. When it is not needed, the bladder is deflated, the BayArc sinks and rests on the sea floor.

The top cable of the BayArc is connected to anchors on each side of the Golden Gate Bridge – holding the membrane in place. A small amount of tidal or wave energy is captured by flotation devices at each anchor. This energy is used to compress air over time and is released quickly when the BayArc is deployed. The principle forces on the membrane result from drag during deployment as well as the hydrostatic imbalance due to the differential water level between the ocean and bay. The resulting gentle arc is a direct consequence of these forces. The arc's curvature in plan directly echoes the arc of the Golden Gate Bridge's primary cables. The curvature is derived from the bay's depth, the arc's material properties and span.

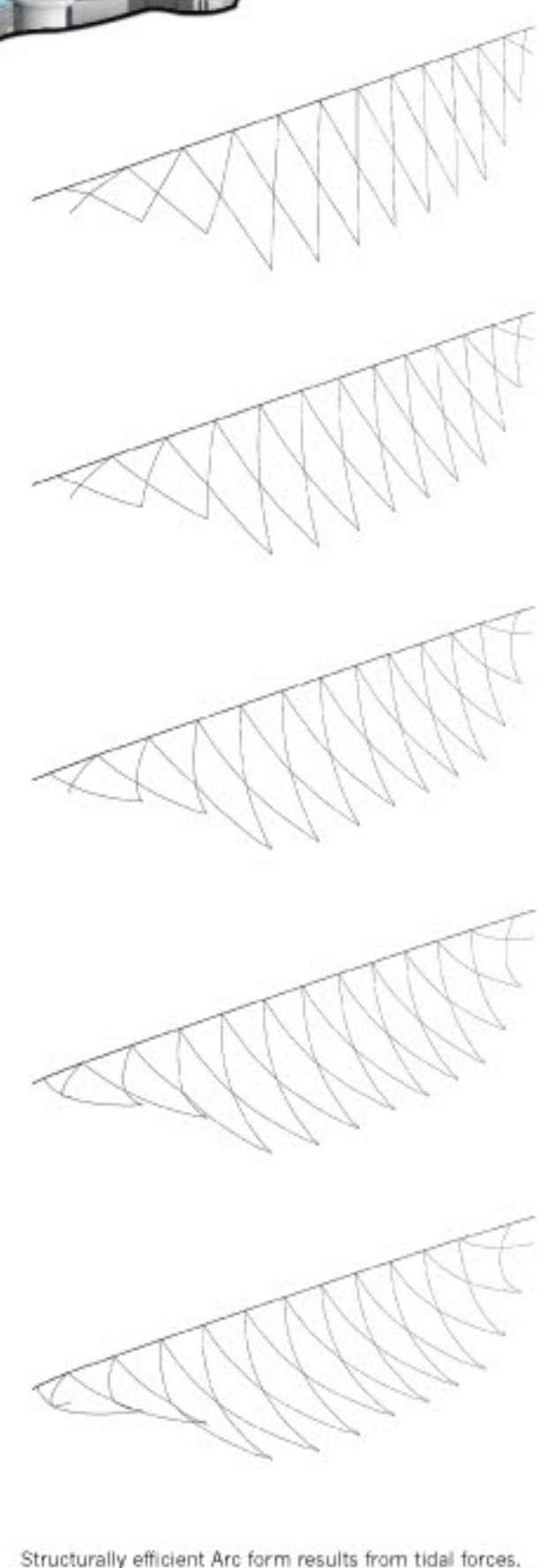
When the peak tide is projected to rise above a threat level, the BayArc is deployed. It remains deployed only until the high-tide peak has passed, "shaving off" the peak into the bay. As the falling ocean tide approaches the bay, the BayArc drops and rests on the sea floor as the currents begin to reverse flow. As noted below, projections for Sea Level rise by 2050 would require deployment for only a few hours per day and only a few times per year.



Cross section through Golden Gate during typical condition.



Cross section through Golden Gate while deployed.



Structurally efficient Arc form results from tidal forces.



Tensile Membrane Stress diagram showing relatively modest stress levels; greatest at center and least at ends.

Elevation Above (FL MLLW)	Hours Per Year
9	0.00
8.8	0.02
8	0.80
7.8	2.00
7.4	5.10
7	20.40
6	324.90
5	1369.40
4	3211.00
3	5063.50
2	6416.70
1	7452.60
0	8281.80
-1	8688.60
-2	8763.10
-3	8764.80

Verified hourly water level in Presidio
Time Period: 1998-2007 (10 years)
Datum: Feet, MLLW
Time in UTC

3717503

Change in Tidal Screen Deployment for Various Sea Level Rise Scenarios at the Presidio

Mean Sea Level Scenario	100 Year High Tide Level (Feet)	Total Hrs/Year Above Present High Tide Level	Total Events/Year Above Present High Tide Level	Average Hrs/Event Above Present High Tide Level
Present	8.8'	2	2	2
Year 2050 CAT Low ² (12 in. Rise)	9.8	2.0	1.2	1.7
Year 2050 CAT Low ² (17 in. Rise)	10.2	5.1	2.5	2.0

¹ U.S. Army Corps of Engineers, San Francisco District, San Francisco Bay Tidal Stage versus Frequency Study, October 1984
² Present condition requires no Tidal Screen Deployments.
³ State of California, Climate Action Team, Biennial Assessment Report (Draft), March 2008.

