Delta intervention in Embarcadero
I DON'T BELIEVE IN GLOBAL WARMING.
My focuses

1. The sea-level rise in 2100
   (1.5m)

2. The renovation of coastal cities
   (CBD)
Content

Urban design
Embarcadero

Architectural design
Terminal site

Building technology
Seawall
Floating fragment
Part 1

Urban design
Embarcadero
History

Embarcadero

1850

1920

2000

Embarcadero

1850

1920

2000
1850-1920
Gold rush: new settlement, small port

1920-1940
Development: cargo port

1940-1950
World war II: military port

1950-1980
After war: abandoned port

1980-now
CBD: redevelopment, tourism & recreation port
Inundation 2100

Occupation

Landfill

Inundation 2100

current area at risk
area at risk with a 1.4m sea-level rise
December 2016, Embarcadero
San Francisco Bay

72% Probability of Major Earthquake by 2044

San Andreas fault
Existed situation: Landfill + seawall
1910-now
Situations in disasters

Earthquake 2044

Inundation 2100
Solution

Combined with new seawall
Conceptual diagram

Docks

Seawall

Urban functions

Floating areas
Potentials
Situation 1: old piers
Feature 1: Important urban structure
1910s Cargo terminals
1944 Military piers
1960s Demolishment
1980s Parking lots
2010 Pier 1 Office
2017 Pier 31 Cafe
2018 Pier 29 Restaurant

Now
4 renovated
12 to be renovated

Feature 2: Great historic value
Feature 3: Iconic facades
Feature 4: Large-span structures are good for public programs
Tourism services (cruise-related)
Waterfront recreation
Urban icon
Waterfront sports

Future plannings of the old piers

High density offices
Low density offices
Existed situation
Inundation
Earthquake
New seawall
Situation 2: particular sites
Cruise terminal

2013
The starting point of San Francisco's cruise industry
One of the only two places that deep enough for a cruise ship
The only place for shuttle buses
Present

Old pier (not in use)  Cruise Terminal  Shuttle bus circulation

Future

Rebuilt as floating area  Seawall  Kept as it is now

Cost $92 million

Landfill + Hydraulic fill

330,000m³

$18 million
Present

Future

Tourism attractions
Rebuilt floating area
Seawall
AT&T park

Present

Future

Sports center

Kept as it is now
Part 2

Architectural design
Terminal site
Passengers (tourists)
avg 2500 in one day

Other tourists & citizens

Users
Future plannings

Tourism services (cruise-related) & Public activities
Concept: a public loop

Architecture

Landscape
Vehicle circulations
Pedestrian circulations
Part 3

Building technology
The construction process of seawall
Existing situation.
Dismantle the structure for future uses.
Demolish the deck and pilings.
Build sheet pile wall; dewater.
Blend precipitation with concrete (DSM).
Cast cellular concrete; hydraulic fill (strong concrete).
A combined new seawall.
Renovate the front part of the old pier.
Assemble the dismantled structure on a new floating foundation (concrete box) somewhere else, drag it to the site.
Build the connection.
Connection
The floating building
Case: Brooke street pier
San francisco’s shipyards
(assemble place)
## Floating calculation

<table>
<thead>
<tr>
<th>Building Materials</th>
<th>Weight</th>
<th>Sinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>42000t</td>
<td>6m</td>
</tr>
<tr>
<td>Concrete box</td>
<td>80%</td>
<td></td>
</tr>
<tr>
<td>Metal structure</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>Wood roof &amp; wall</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Other elements</td>
<td>6%</td>
<td></td>
</tr>
<tr>
<td>300 people</td>
<td>0.006%</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compartments</th>
<th>Weight</th>
<th>Sinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>3500t</td>
<td>0.5m</td>
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</tbody>
</table>

Total weight: 42000t ~ 45500t, Sinking depth: 6m ~ 6.5m
Isokorb (a component dealing with thermal bridge)
Concrete foundation

Reinforced concrete

Prestressed concrete
Mechanical Ventilation

- Air out
- Air in

Heating & Cooling system

- Heating pipes

Air flows

- → Direction
- High pressure
- Low pressure

Heating & cooling:
In winter, the hot coolant produced by the solar panels will be used by floor pipe system to warm the interiors. Cooling is not needed in the building.

Ventilation:
The sea water could be used to exchange the heat with the fresh air in both summer and winter. In winter, the cold fresh air will also exchange the heat with the warm exhausted air after the exchange with sea water.
Solar energy

$70,860 per year

RESULTS

$789,082 kWh per Year*

System output may range from $780,730 to $806,430/kWh per year near this location.

<table>
<thead>
<tr>
<th>Month</th>
<th>Solar Radiation (kWh/m²/day)</th>
<th>AC Energy (kWh)</th>
<th>Energy Value ($)</th>
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</thead>
<tbody>
<tr>
<td>January</td>
<td>1.15</td>
<td>39,460</td>
<td>3,546</td>
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<tr>
<td>February</td>
<td>4.11</td>
<td>47,040</td>
<td>4,224</td>
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<tr>
<td>March</td>
<td>4.94</td>
<td>63,000</td>
<td>5,693</td>
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<tr>
<td>April</td>
<td>9.19</td>
<td>79,200</td>
<td>7,784</td>
</tr>
<tr>
<td>May</td>
<td>6.93</td>
<td>85,044</td>
<td>7,882</td>
</tr>
<tr>
<td>June</td>
<td>7.09</td>
<td>85,756</td>
<td>7,989</td>
</tr>
<tr>
<td>July</td>
<td>7.59</td>
<td>83,800</td>
<td>8,425</td>
</tr>
<tr>
<td>August</td>
<td>6.93</td>
<td>85,205</td>
<td>7,657</td>
</tr>
<tr>
<td>September</td>
<td>6.40</td>
<td>75,900</td>
<td>6,917</td>
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<tr>
<td>October</td>
<td>6.93</td>
<td>80,054</td>
<td>7,428</td>
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<tr>
<td>November</td>
<td>5.34</td>
<td>48,920</td>
<td>4,475</td>
</tr>
<tr>
<td>December</td>
<td>6.60</td>
<td>86,200</td>
<td>7,059</td>
</tr>
<tr>
<td>Annual</td>
<td>5.35</td>
<td>789,082</td>
<td>70,860</td>
</tr>
</tbody>
</table>

Location and Station Identification

Requestor Location: San Francisco
Weather Data Source: (TMY3) SAN FRANCISCO, CA, 11 mi
Latitude: 37.82° N
Longitude: 122.36° W

PV System Specifications (Commercial)

DC System Size: 567.8 kW
Module Type: Standard
Array Type: Fixed (open rack)
Array Tilt: 28°
Array Azimuth: 180°
System Losses: 14%
Inverter Efficiency: 94%
DC to AC Box Ratio: 1.1

Economics

Average Cost of Electricity Purchased from utility: $0.10 kWh

Performance Metrics

Capacity Factor: 17.1%
Conclusion
A sustainable solution for all coastal cities