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
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
Major Earthquake by 2044

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
Floating areas

Urban functions

Seawall

Docks

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

1930s

Present
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
- Seawall

Cost: $92 million

**Future**

- Rebuilt as floating area
- Seawall
- Kept as it is now

Landfill + Hydraulic fill
330,000 m³

Cost: $18 million
Ferry building

Present

Future

Heritage Plaza

Kept as it is now

Seawall

Kept as it is now
Tourism attractions

Rebuilt floating area

Seawall
AT&T park

Present

Future

Sports center

Kept as it is now
Part 2

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

Other tourists & citizens
Services
- hotels
- restaurants
- shops
- market

Core programs
- terminal
- transportation
- activities
- public spaces

Tourism services (cruise-related)
&
Public activities

Future plannings
Concept: a public loop

Architecture

Landscape

CITY

SEAWALL

ICON

RESTAURANTS

TERMINAL

MUSEUM
Vehicle circulations
New landfill
Old landfill
New seawall
Old seawall
New reinforcement
Precipitate
Firm soil
Shuttle bus station & park
Passage
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
(assembly 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>
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<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>
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<tr>
<td>300 people</td>
<td>0.006%</td>
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</table>

<table>
<thead>
<tr>
<th>COMPARTMENTS</th>
<th>WEIGHT</th>
<th>SINKING</th>
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</thead>
<tbody>
<tr>
<td>Water</td>
<td>3500t</td>
<td>0.5m</td>
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</tbody>
</table>

TOTAL 42000t – 45500t 6m – 6.5m
Isokorb (a component dealing with thermal bridge)
Mechanical Ventilation

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.
$70,860 per year

RESULTS

789,082 kWh per Year *

System output may range from 780,230 to 802,868 per year based on 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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<tbody>
<tr>
<td>January</td>
<td>5.15</td>
<td>19,485</td>
<td>3,096</td>
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<tr>
<td>February</td>
<td>4.11</td>
<td>14,540</td>
<td>2,294</td>
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<td>March</td>
<td>4.34</td>
<td>16,052</td>
<td>5,053</td>
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<tr>
<td>April</td>
<td>5.19</td>
<td>19,328</td>
<td>4,764</td>
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<td>May</td>
<td>6.03</td>
<td>21,544</td>
<td>7,082</td>
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<td>June</td>
<td>7.09</td>
<td>25,739</td>
<td>7,088</td>
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<tr>
<td>July</td>
<td>7.29</td>
<td>26,510</td>
<td>8,235</td>
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<tr>
<td>August</td>
<td>6.93</td>
<td>25,205</td>
<td>7,657</td>
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<tr>
<td>September</td>
<td>6.30</td>
<td>23,808</td>
<td>6,917</td>
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<tr>
<td>October</td>
<td>6.23</td>
<td>23,504</td>
<td>5,428</td>
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<tr>
<td>November</td>
<td>5.34</td>
<td>20,929</td>
<td>5,978</td>
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<tr>
<td>December</td>
<td>4.83</td>
<td>18,760</td>
<td>3,288</td>
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<tr>
<td>Annual</td>
<td>5.35</td>
<td>789,082</td>
<td>$70,860</td>
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</tbody>
</table>

Location and Station Identification

Requested Location: San Francisco
Weather Data Source: (NREL) SAN FRANCISCO, CA 11 mi
Latitude: 37.322° N
Longitude: 122.96° W

PV System Specifications (Commercial)

DC System Size: 367.8 kW
Module Type: Standard
Array Type: Fixed (open rack)
Array Tilt: 25°
Array Azimuth: 180°
System Losses: 15%
Inverter Efficiency: 94%
DC to AC Box Ratio: 1:1

Economics

Average Cost of Electricity Purchased from Utility: $0.12/kWh

Performance Metrics

Capacity Factor: 47.1%
Conclusion
New York 2400
A sustainable solution for all coastal cities

Koen Olthuis
Architect, The Hague