SAN FRANCISCO - OAKLAND BAY BRIDGE
EAST SPAN REPLACEMENT ALTERNATIVES

May 1997

California Department of Transportation
Cable-Stayed Replacement
Alternatives

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Outline

- Assumptions & Constraints
- Design Guidelines
- Alignment
- Analysis
- Cable-Stayed Alternatives
  - Substructure
  - Towers & Superstructure
    - Alternative 1
    - Alternatives 2, & 3

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SF-OBB EAST SPANS REPLACEMENT PROJECT
Assumptions & Constraints

- straight alignment
- maintain existing vertical clearance in shipping channel
- locate deepest cable-stayed foundation in the approximate location of existing E3
- keep tower height at or below tallest tower on west SFOBB
Design Guidelines

- investigate higher strength concrete where necessary; 8000 to 10,000 psi
- contact industry representatives with expertise
- use other cable-stayed bridges as guides
- look at offshore industry for substructure design
- investigate appropriate erection methods
- utilize simplicity and repetition
- loadings
  - size towers and foundations for seismic
  - size superstructures for dead and live loads

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SFOBB EAST SPANS REPLACEMENT PROJECT
Alignment

- Northern extended (Alternatives 1 & 2)
  - tangent out of the tunnel
  - locate deepest foundation at approximate location of existing E3
  - straight cable-stayed segment, curved viaduct

- Southern adjacent (Alternative 3)
  - proposed as a shorter route
  - less impacts on historic military buildings
  - significant utility conflicts

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SFOBB EAST SPANS REPLACEMENT PROJECT
NORTHERN EXTENDED ALIGNMENT
(STRUCTURE ALTERNATIVES 1 & 2)

NORTHERN ADJACENT ALIGNMENT
(STRUCTURE ALTERNATIVES 6 & 7)

EXISTING SPOBB ALIGNMENT

SOUTHERN ADJACENT ALIGNMENT
(STRUCTURE ALTERNATIVES 3, 4, & 5)
Analysis

➡️ Superstructure
   ➡️ linear elastic model for cable forces due to factored dead + live loads

➡️ Towers
   ➡️ linear elastic static push for seismic loads, target ductility 1.5 (essentially elastic)

➡️ Foundations
   ➡️ nonlinear soil properties, linear pile properties modeled (GROUP) for tower plastic moment

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SF-OBB EAST SPANS REPLACEMENT PROJECT
Cable-Stayed Alternatives

† Alternative 1
  † single level PC/PS concrete cable-stayed bridge
  † single level PC/PS concrete viaduct

† Alternative 2
  † double deck steel cable-stayed bridge
  † double deck steel warren truss viaduct

† Alternative 3
  † double deck steel cable-stayed bridge
  † double deck CIP prestressed concrete viaduct

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SFOBB EAST SPANS REPLACEMENT PROJECT
CABLE-STAYED ALTERNATIVES FOR A NEW EAST SF OBB

ALTERNATIVE 1

ALTERNATIVE 2

ALTERNATIVE 3
Substructures

- Offshore type foundation construction
  - Precast, cellular pile cap to be floated to location, sunk and used as a driving template (10,000 psi)

- E2 location: (~ 40’ to rock)
  - End bearing
  - 9’ diameter steel pile embedded in and tied down to rock, filled with concrete

- E3 location: (~ 305’ to rock)
  - Friction and end bearing
  - 10’ diameter steel pile with 9’ diameter pile inside, grout in between
Design Notes:
1. Pile caps are hallow cell prestressed concrete with 24" deck and spilt flanges.
2. 3' diameter shells will extend 23' 3" into the pile cap and will extend 13' 6" into back foundation.
3. Reinforced concrete will be required in each of the piles.

NOTES:
Pile E2 left shown. Pile cap right similar.
For details not shown see "Pile E2 Foundation Details" sheet.

Columns pile cap detail where concrete after placement of pile.

U.S.G.S. map base.
Water Elev 0.0

PILe CAP PLAN

PART SECTION B-B

PART ELEVATION

PIER 20

PIECE CAP CELL: PILE LAYOUT

PIECE CAP PLAN

PILe CAP PLAN

PART SECTION B-B

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION DIVISION OF STRUCTURES STRUCTURE DESIGN SA SFOBB REPLACEMENT - ALTERNATIVE 1 PIER E2 FOUNDATION DETAILS

DESIGNER D. W. SANDERS  3/84
CHECKER G. H. SANDERS  3/84
DRAWER  3/84
PRINTED  3/84

DATE:  3/84
SFOBB REPLACEMENT - ALTERNATIVE 1
PIER E2 FOUNDATION DETAILS

MATERIALS:  STRUCTURAL STEEL

CONTRACTOR:

DATE:  3/84

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PART ELEVATION

Design Notes:
1. Pile caps are hollow cell precast prestressed concrete with 24" deck and stiff sections.
2. Outer 10" diameter shells will extend 15'-0" into the piles and will extend to bedrock.
3. Inner 9" diameter shells will extend 23'-6" into the piles and will extend 10'-0" into bedrock.
4. A concrete plug will be required at the top of the piles.
5. The hollow portion between steel shells will be filled with high strength grout.

NOTES:
- Pile E3 left shown. Pile E3 right similar.
- For details not shown see "Pier Elevation Details" sheet.
- Denotes pile cap cell filled with concrete after placement of piles.

Dedrocr. pile cap cell filled with concrete after placement of piles.

PART SECTION C-C

PILE CAP PLAN

1'-20'

PILE CAP CELL, PILE LAYOUT

1'-20'

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SFOBB REPLACEMENT - ALTERNATIVE 1
PIER E3 FOUNDATION DETAILS

20'-0"
Towers; Alternative 1

- Vertically prestressed cellular CIP concrete towers
- Geometry based on literature search of other cable-stayed bridges around the world
  - Luling Bridge, Louisiana (tower configuration)
  - Baytown Bridge, Texas, alternative (width)
- $T = 3.5$ sec (both longitudinal and transverse)
- $f'_c = 6000$ psi
Note:
For details not shown see "Pier E2 Foundation Details" and "Pier E3 Foundation Details" sheets.

ELEVATION - PIERS E2, E3
1" = 40'
Superstructure; Alternative 1

- 1400’ main span precast, prestressed, segmentally constructed cable-stayed bridge
- Cables are closely spaced in a modified fan configuration
- Balanced cantilever erection; max. pick = 150 tons
- FHWA concerns about width addressed:
  - Transversely prestressed deck (maintenance)
  - Torsion of edge girders
TYPICAL SECTION

VIEW A-A

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DIVISION OF STRUCTURE
STRUCTURE DESIGN SA
SFOBB REPLACEMENT - ALTERNATIVE 1
TYPICAL SECTION
Towers; Alternatives 2 & 3

- four legged inverted Y
- spire & legs are tapered cellular steel sections
- $T = 1.6$ seconds (both longitudinal & transverse)
Superstructure; Alternatives

2 & 3

- 1600’ main span, double deck warren truss cable-stayed bridge
- Cables are closely spaced in a modified fan configuration
- Modeled after the Yokohama Bay, Ohashi-Seto, and Higashi-Kobe Bridges
- Deck is orthotropic steel with AC riding surface
Evolution of Alternatives

- **DOUBLE TOWER CABLE-STAYED**
  - alternative #1

- **SINGLE TOWER CABLE-STAYED**
  - alternative #1 with 1 main tower, lowered 40'

- **SKYWAY**
  - alternative #1 viaduct for entire length, lowered 40'

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SFOBB EAST SPANS REPLACEMENT PROJECT
Box 2, Folder 3

Item 1

ACCNO_000021