SEISMIC RETROFIT AND REHABILITATION OF GEORGIA STREET BRIDGE & WALLS

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Outline

- History of Georgia Street Grade Separation
- Rehabilitation and Retrofit of Bridges
- Recent Timeline and Designation
- Existing Condition (Seismic/Service/Condition)
- Seismic Analysis
- Retrofit vs. Replace
- Preservation of Historic Resource
- Retrofit/Rehabilitation/Reconstruction
1892 – SDER Established by Spreckels
1905 – Adams Avenue in Normal Heights
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1910 – Begin Major Expansion of SDER
- 1892 – SDER Established by Spreckels
- 1905 – Adams Avenue in Normal Heights
- 1910 – Begin Major Expansion of SDER
- 1914 – Georgia Street Bridge Built
- 1915 – Begin Panama-California Expo
1910 looking east  1911 looking east
1923 looking east
2014 looking east
Life of a Bridge

- Typical Bridge life expectancy is similar to a person
- Design life of 50-100 years
- Without proper care could require major rehab at 50
Bridge Rehabilitation

- Approximately 75 new bridges/year
- Rehabilitation per year (assuming age 50)
  - Inventory 45y-55y = 6700
  - Approximately 670 / year
Retrofit

- State adopted prioritization
  - Importance and vulnerability
  - Life Safety or better

- 1971 San Fernando →
  - 1986 Caltrans Phase 1 (completed in 2000)

- 1989 Loma Prieta →
  - Caltrans increased research

- 1994 Northridge
  - Caltrans Phase 2, Caltrans toll, CA Local
This list was created from early 1990’s knowledge…
Future Retrofit Needs in CA

Revised Fault Maps
Liquefaction
Lateral Spreading
Near Fault Ground Accelerations
• Correct Seismic Deficiencies
• Rehabilitate to Remove from EBL
• Provide Minimum 50 Years Additional Life
• Avoid Adverse Effect to Historic Resource
Georgia Street Timeline

- Built in 1914 in San Diego, CA
- Two 640-Foot Long Anchor Block Retaining Walls
- 3-Hinge Concrete Arch Bridge
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- Early 1990’s Caltrans Identified
- 1995 Repair/Retrofit /Replace Reports by Others
- 1999 Placed on Historic Register
- 2002 Vulnerability Study to Replace by Others
- 2009 Begin New Retrofit/Replace Studies
- 2012 Caltrans Approved Rehabilitation/Retrofit
- 2015 Begin Construction

25 years!
Bridge Components

Half Elevation

Typical Section
Bridge Components

Abutment Front Perspective

Abutment Back Perspective
Wall As-Built Plans
Functional Deficiencies

- Barrier rails not sufficient
- No sidewalk ADA ramps
- Asphalt paving at sidewalk elevation
- Substandard vertical and horizontal clearance
- *Bridge width is substandard*
- *Bridge does not support modern live loads*
Existing Condition

Structurally Deficient
Sufficiency Rating = 44.9
Seismic Analysis

- CQC frequency with secant stiffness
  - Arch, spandrel, superstructure displacement demands
- Elastic element demands
- Influence of foundation stiffness

Longitudinal  Transverse
○ System pushover analysis
  ○ Arch displacement capacity and force demands
  ○ Bent displacement capacities and force demands

○ Local bent pushover analysis
  ○ Bent displacement capacities
  ○ Cap beam and joint shear checks
Seismic Vulnerabilities

- **Global Analysis**
  - Floating slabs need to be continuous
  - Abutment restraint will lower superstructure demand
  - Ensure stability of hinges (axial and bending)

- **Component Analysis**
  - Spandrel columns have insufficient shear capacity
  - Center spandrels have very high shear
  - Arch-ribs insufficient shear/torsion steel
  - Abutment and retaining walls need strengthening
# Wall D/C Analysis

## Element of Abutment or Attached Wall Beam

<table>
<thead>
<tr>
<th>Element of Abutment or Attached Wall Beam</th>
<th>Unit</th>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 2</th>
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**Diagram:**
- **Deadman:** Arrow pointing to the left near the base of the wall.
- **Toe:** Arrow pointing to the right near the base of the wall.
Retrofit Alternative 1

Retrofit Legend:
- Soil Improvement
- Abutment Passive Retrofit
- Shear Wall
- Arch Shear Retrofit
- Spandrel Replacement
- Arch End Guides Integral with New Facing
- Deck/Sidewalk/BARRIER Replacement, Remove AC
- Abutment and Wall Retrofit
- Replacement of Decorative Lighting
- Thrust Block Stabilization
Retrofit Alternative 2

RETROFIT LEGEND:

1 - SOIL IMPROVEMENT
2 - ABUTMENT PASSIVE RETROFIT
3 - SHEAR WALL
4 - ARCH SHEAR RETROFIT
5 - SPANDREL REPLACEMENT
6 - ARCH END GUIDES
7 - DECK/BARRIER REPLACEMENT, REMOVE AC
8 - ARCH HINGE SHEAR GUIDE
9 - ABUTMENT WALL RETROFIT
10 - REPLACEMENT OF DECORATIVE LIGHTING
Replacement Alternative 1

[Diagram of a bridge with dimensions and annotations]

GEORGIA STREET

PROFILE GRADE

-2%

2'-0" TYP

2'-0" SPANDREL CAP TYP

SPANDREL COLUMN TYP

CAST-IN-PLACE REINFORCED CONCRETE ARCH - TOTAL 4

UNIVERSITY AVENUE

MIN VERT CLR

70'-5" ±
Replacement Alternative 2
Historic Preservation

- Community Meetings
  - SOHO, North Park Planning Committee, Uptown Planners

- NEPA CE – CEQA IS/MND Finding of no Adverse Effect with Standard Conditions – Rehabilitation
  - Arch ribs to remain
  - Historic corner lighting
  - Wall facing
  - Barrier rails
  - Shear panel design
  - Geometry, texture, color to match as-built
  - Replace sidewalks (historic scoring)
  - Remove street lighting
Retrofit Alternative 1 (preferred)

- Deck, Columns and Barrier Replacement
- Soil Improvement
- Ground Anchors
- Concrete Facing
- Arch Rib Shear Strengthening
- Infill Panel
- Lower Roadway
Construction Phasing

- Major Construction Stages
  - Stage 1 – 3
    - Stabilize Walls
    - Partially Stabilize Abutments
    - Lower University Avenue
  - Stage 4A: Partial Demolition of Bridge
  - Stage 4B: Retrofit Abutment Walls
  - Stage 4C: Retrofit Arch-Ribs
  - Stage 4D: Partial Superstructure Reconstruction
STAGE 1
BRIDGE ELEVATION

NOT TO SCALE
STAGE 1
SOUTH ABUTMENT ELEVATION
STAGE 2
BRIDGE ELEVATION
NOT TO SCALE
STAGE 3
BRIDGE ELEVATION

NOT TO SCALE
STAGE 4A
BRIDGE ELEVATION
NOT TO SCALE
SOUTH ABUTMENT

TEMPORARY BARRIER (TYPE K) TYP

TYP

TRAFFIC PROTECTIVE COVER

NORTH ABUTMENT

2'0"

17'-5"

STAGE 4C

12'-0"

12'-0"

17'-5"

STAGE 4C

EXISTING SHOTCRETE (2/3"
THICK)

1" SQ @ 24"
- TOTAL 2 (BUNDLED)

3/4" TM - TOTAL 10

2" CLR (TYP ALL AROUND)

EXISTING ARCH RIB PERIMETER - SEE NOTE 1

SECTION

1 1/2' = 1'-0"

EXISTING CONDITION

RETROFIT BLOCK STEP A

RETROFIT BLOCK STEP B

SEE NOTE 3

SEE NOTE 2

SEE NOTE 4

ORIGINAL ARCH RIB PERIMETER

3/4" TYP

3/4" TYP
NOTES:
1. THE CONTRACTOR MUST SUBMIT DETAILS OF THE RECONSTRUCTION OF THE BRIDGE DECK, BENT CAPS, AND COLUMNS TO THE ENGINEER FOR APPROVAL.

STAGE 4D
BRIDGE ELEVATION
NOT TO SCALE
Summary

- Unique Solution to Challenging Project
- Critical Point for Aging Bridges
- Retrofit and Rehabilitation Needs
- Historic Bridges Require Active PDT and Champion
- Listen to Voice of Community
- Bidding Lessons
Thank You