# MANETTE BRIDGE REPLACEMENT

## LONG SPAN PARABOLIC SPLICED GIRDERS

**Anthony D. Messmer, PE, SE**

WASHINGTON STATE DOT

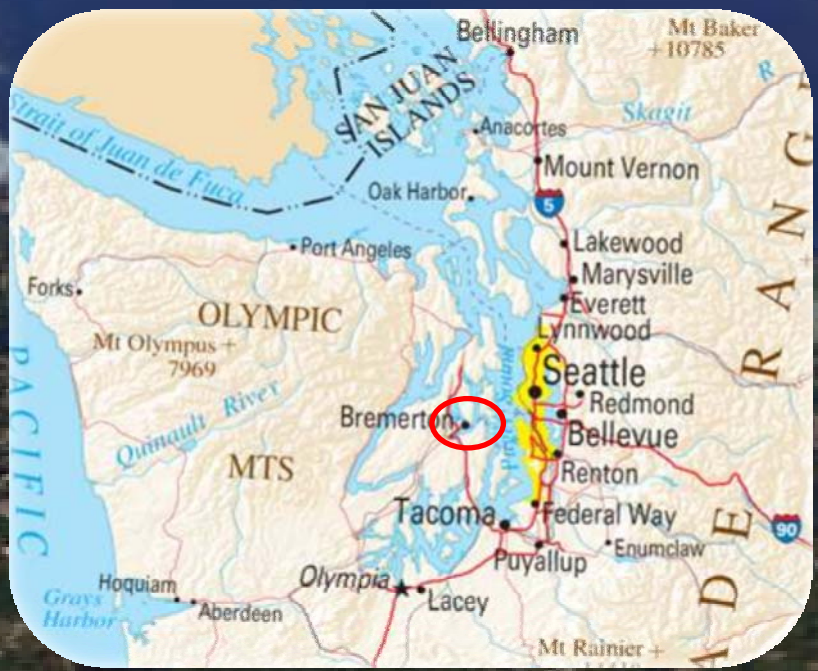
BRIDGE AND STRUCTURES OFFICE

# OVERVIEW

- GENERAL PROJECT INFORMATION
- BRIDGE AESTHETICS
- GIRDER DESIGN DETAILS
- POST-TENSIONING LAYOUT/SEQUENCE
- ANCHORAGE DESIGN DETAILS
- OTHER NOTABLE DESIGN FEATURES

City of Bremerton

Manette Bridge



# GENERAL PROJECT INFORMATION

EXISTING BRIDGE:

- ORIGINALLY BUILT IN 1930
- NARROW 2-LANE BRIDGE WITH SIDEWALK
- COMBINATION OF TRUSS & STEEL GIRDER SPANS
- APPROXIMATE TOTAL LENGTH – 1,573 FEET
- STRUCTURALLY DEFICIENT & FUNCTIONALLY OBSOLETE

# GENERAL PROJECT INFORMATION

- NEW BRIDGE:
  - TWO LANES, SHOULDERS, 12-FOOT SIDEWALK
  - SPLICED I-GIRDER CONSTRUCTION
  - 4 GIRDER LINES – 11’-7” SPACING
  - 7 SPANS (5 @ 250, 1 @ 140, 1 @ 160) = 1550 FT

TYPICAL SECTION

# BRIDGE AESTHETICS

STRONG SENSE THAT EXISTING BRIDGE PARTLY DEFINED MANETTE COMMUNITY


NOTICE
THIS BRIDGE
WILL BE
CLOSED
TO VEHICLES
FROM
TO

# BRIDGE AESTHETICS

- COMMUNTIY ADDAMENT THEY DIDN'T WANT TYPICAL "HIGHWAY" BRIDGE
- COMMUNITY STRONGLY PROTESTED CHORDED HAUNCHED GIRDERS LIKE NEARBY WARREN AVE. BRIDGE

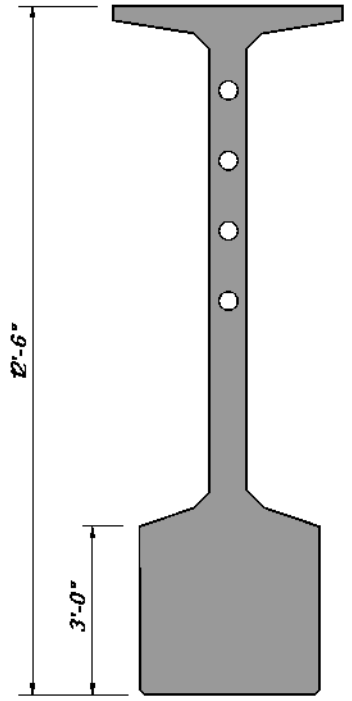
# BRIDGE AESTHETICS

- COMMUNITY WANTED “SIGNATURE” STRUCTURE
  - CABLED STRUCTURED WAS DESIRED
- FUNDING SOURCE WAS PRESERVATION
  - DID NOT ALLOW FOR TRULY “SIGNATURE” STRUCTURE
- MULTIPLE PUBLIC MEETINGS & MEETINGS WITH LOCAL PUBLIC WORKS DEPT.
- CONSTANT DEPTH AND CHORDED HAUNCHED GIRDERS OFF THE TABLE
- CURRENT DESIGN
  - SPLICED I-GIRDER, TRULY PARABOLIC BOTTOM FLANGE
  - PROVIDED REASONABLE COMPROMISE
  - AESTHETICALLY PLEASING

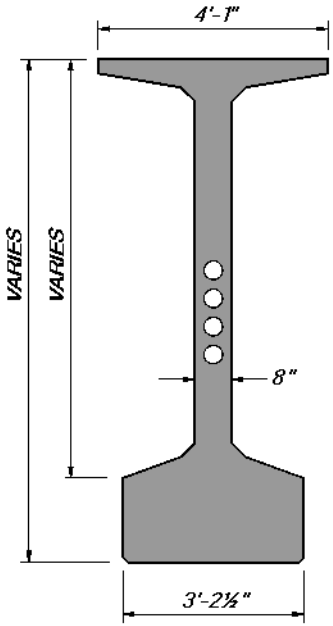
# GIRDER DESIGN DETAILS

- MODIFIED STANDARD WSDOT SPLICED GIRDER SECTION
- GIRDER $f'_{ci}$ = 6,000 PSI
- GIRDER $f'_{c}$ = 8,000 PSI
- CLOSURE $f'_{c=}$ 6,000 PSI
- 4 ~ 16-STRAND, 0.6" DIAMETER, TENDONS/GIRDER LINE
- SIGNIFICANT DIFFERENCES FROM "TYPICAL" SPLICED GIRDER DESIGN DETAILS
  - PARABOLIC BOTTOM FLANGE
  - VARYING WEB AND FLANGE DEPTH
  - OPPOSING P.T. ANCHORAGES IN SEGMENTS OVER PIERS

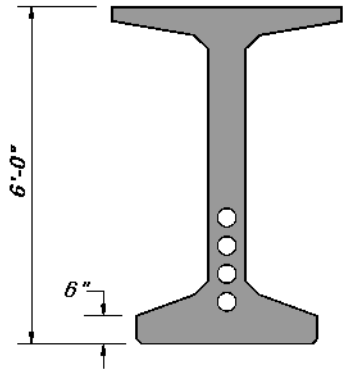
# GIRDER DESIGN DETAILS




ADJACENT TO PIER




BETWEEN PIER & MIDSPAN




AT MIDSPAN

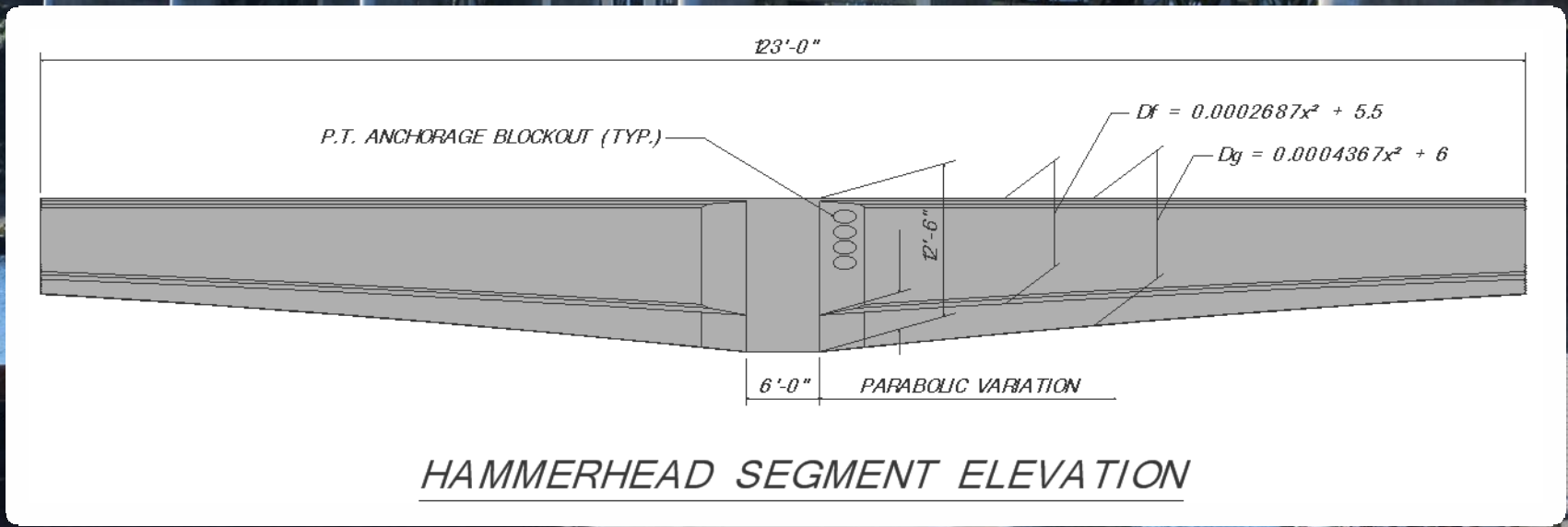
# GIRDER DESIGN DETAILS

4 GIRDER SEGMENT TYPES

- "HAMMERHEAD"
- "TYPICAL DROP-IN"
- "EAST END DROP-IN"
- "WEST END DROP-IN"

# GIRDER DESIGN DETAILS

- WEIGHT ~ 325 KIPS
- LARGEST SINGLE PRODUCT PRODUCED BY CONCRETE TECHNOLOGY CORPORATION (BY WEIGHT)
- 20 TOP FLANGE STRANDS
- 6 BOTTOM FLANGE STRANDS
- OPPOSING P.T. ANCHORAGES
- 24 TOTAL PIECES (6 PIERS, 4 / PIER)

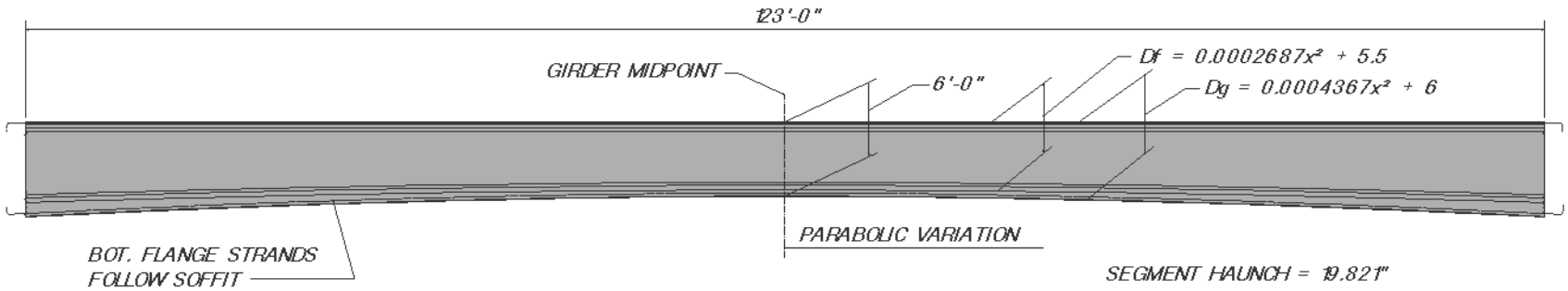



HAMMERHEAD SEGMENT ELEVATION


ASPEN
ASPEN

# GIRDER DESIGN DETAILS

- WEIGHT ~ 162 KIPS
- 4 TOP FLANGE STRANDS
- 24 BOTTOM FLANGE STRANDS
- 20 TOTAL PIECES (5 SPANS, 4 PER SPAN)

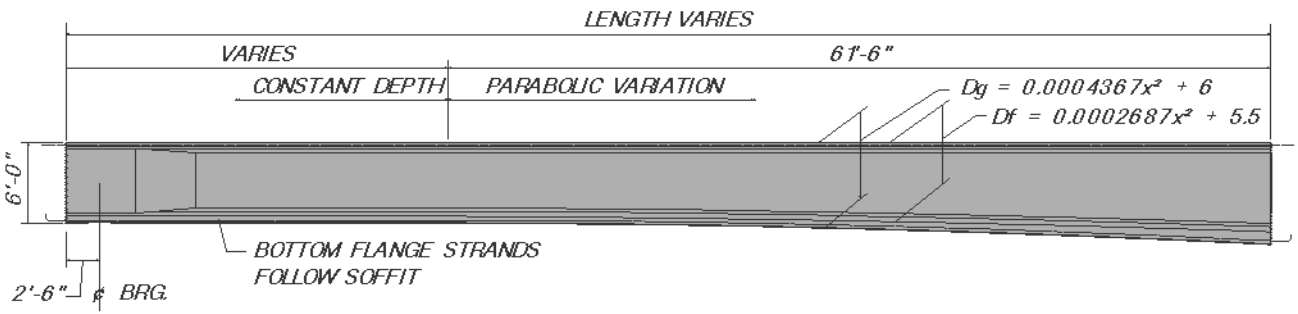



TYPICAL DROP-IN SEGMENT ELEVATION


I.D.A.
INC.
TRUCK EQ
KENT, W

# GIRDER DESIGN DETAILS

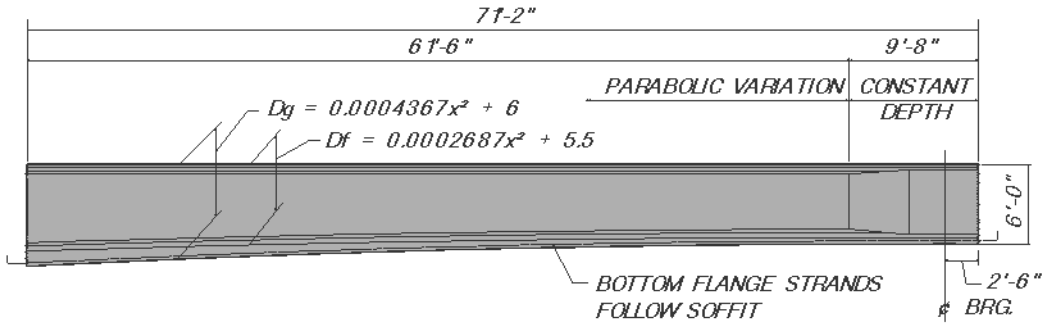
- NOT SYMMETRICAL ABOUT THE GIRDER MIDPOINT
- LENGTH VARIED DUE TO GIRDER SPLAY ~ 90’ TO ~ 93’
- WEIGHT VARIED ~ 121 TO ~ 147 KIPS
- 2 TOP FLANGE STRANDS
- 12 OR 14 BOTTOM FLANGE STRANDS
- 4 TOTAL PIECES




TYPICAL WEST-END SEGMENT ELEVATION

# GIRDER DESIGN DETAILS

- NOT SYMMETRICAL ABOUT THE GIRDER MIDPOINT
- WEIGHT ~ 92 KIPS
- 0 TOP FLANGE STRANDS
- 8 BOTTOM FLANGE STRANDS
- 4 TOTAL PIECES



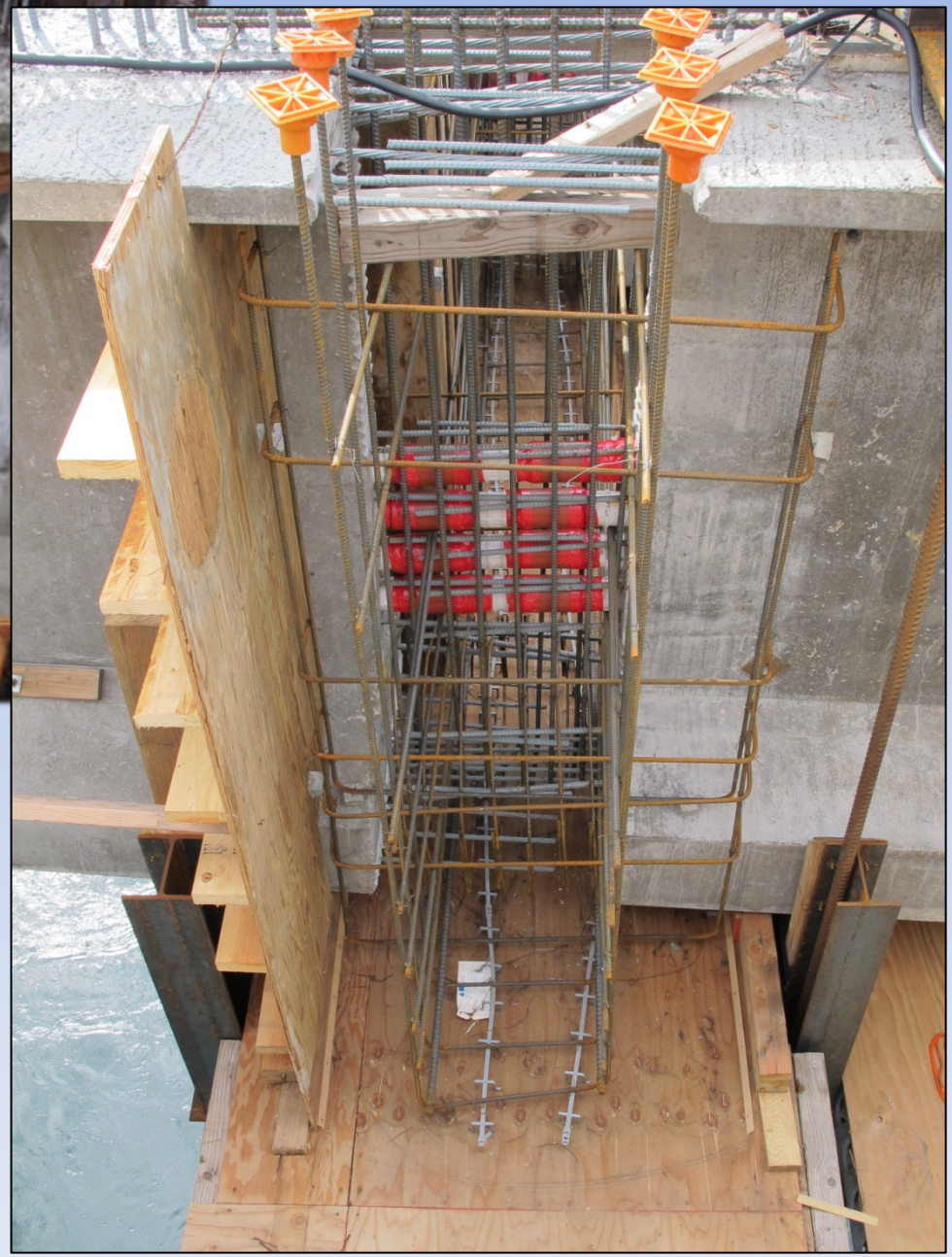

TYPICAL EAST-END SEGMENT ELEVATION

# POST-TENSIONING LAYOUT/SEQUENCE

- SPAN-BY-SPAN POST-TENSION SEQUENCE
  - PROXIMITY OF BRIDGES REQUIRES CLOSURE OF EXISTING BRIDGE TO COMPLETE NEW BRIDGE
  - COMMITTED TO 4.5 MONTH CLOSURE PERIOD
  - ALLOWS MAJORITY OF SPANS TO BE POST-TENSIONED AND DECK TO BE PLACED PRIOR TO BRIDGE CLOSURE
  - REDUCES CLOSURE TIME
  - REDUCES LOSSES


MANSON
SEATTLE WA

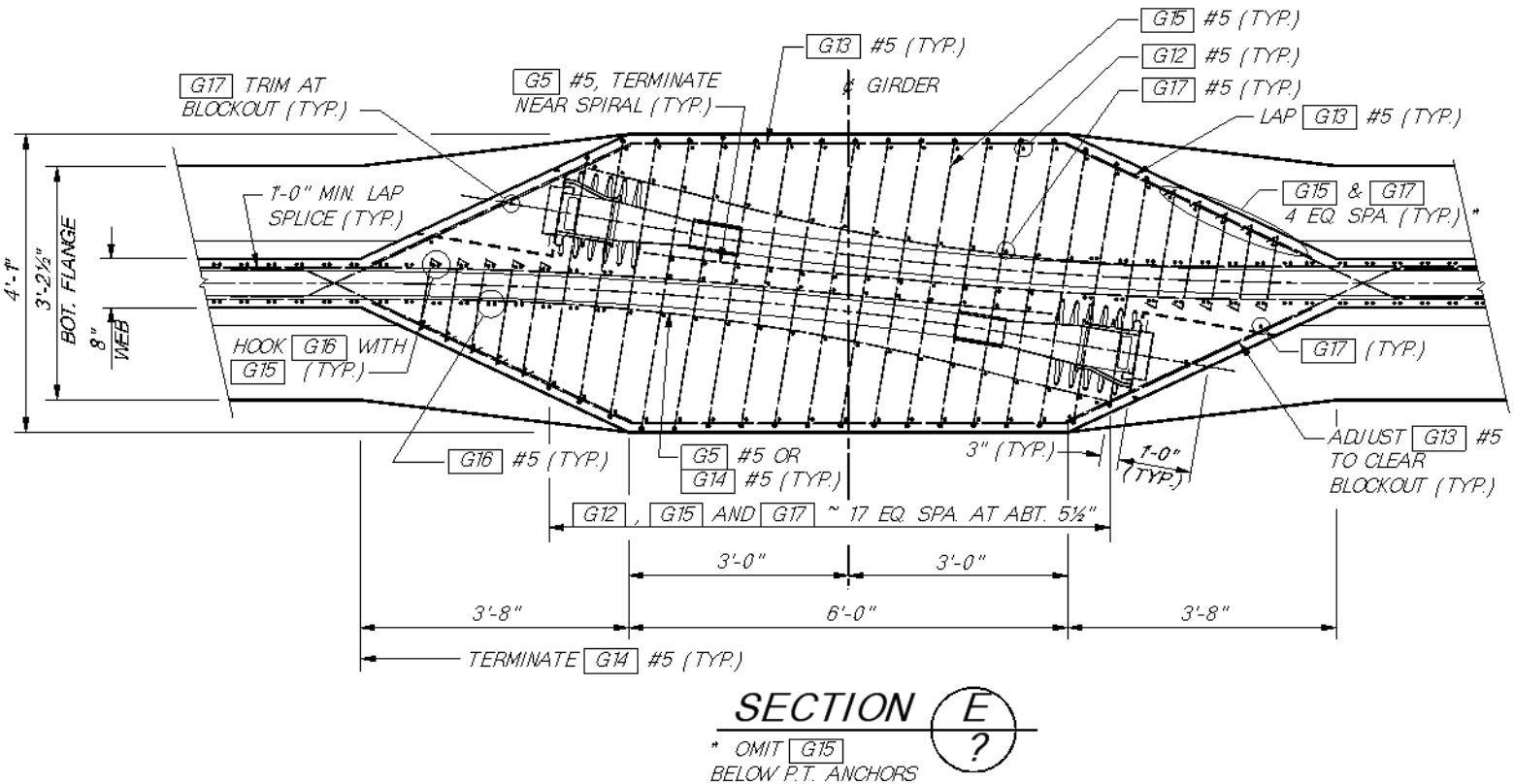

P6E
P6E




SOUTHMAN

# ANCHORAGE DESIGN DETAILS

- ANCHORAGES CONTAINED IN HAMMERHEAD SEGMENTS
- TWO OPPOSSING ANCHORAGES IN CLOSE PROXIMITY
  - RESULTS IN UNIQUE ANCHORAGE DESIGN
  - AASHTO "APPROXIMATE ELASTIC STRESS ANALYSIS" METHOD OF ARTICLE 5.10.9.6 NOT APPLICABLE
  - STRUT AND TIE USED FOR DESIGN (AASHTO 5.10.9.4)




## SECTION E ?

* OMIT G15 BELOW P.T. ANCHORS

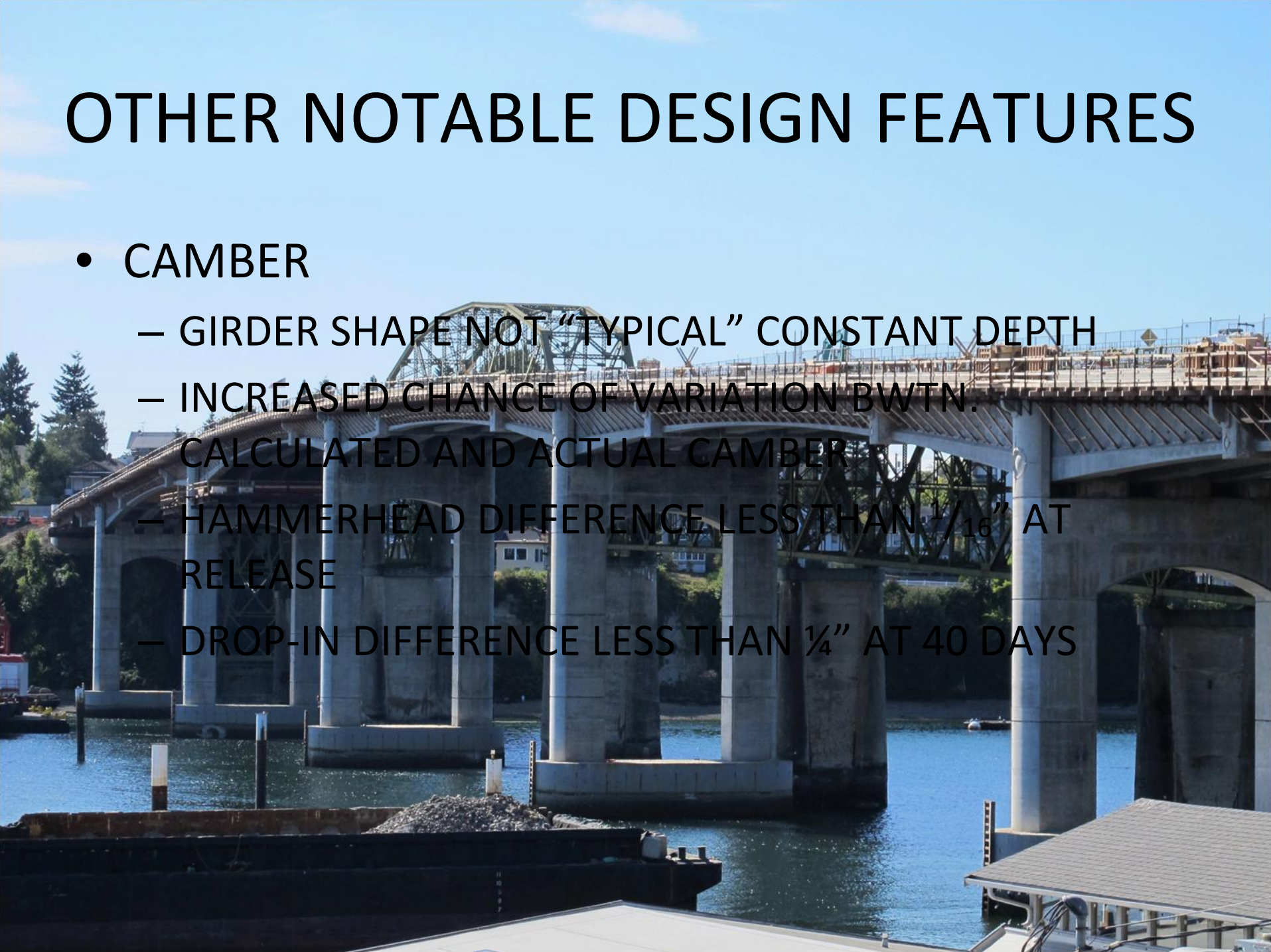

ASPEN
ASPEN


CH-500-6-

# OTHER NOTABLE DESIGN FEATURES

- SHEAR DUE TO PRESTRESS, $V_P$
  - HARPED STRANDS IN TYPICAL (CONSTANT DEPTH) PRESTRESSED GIRDERS
    - $V_P$ IS OPPOSITE SIGN OF APPLIED SHEAR LOADS
    - HELPS, EFFECTIVELY REDUCES SHEAR ON GIRDER SECTION
  - MANETTE BOTTOM FLANGE STRANDS
    - FOLLOW PARABOLIC BOTTOM FLANGE SOFFIT
    - $V_P$ IS SAME SIGN AS APPLIED SHEAR
    - HURTS, EFFECTIVELY ADDS TO SHEAR ON GIRDER SECTION

# OTHER NOTABLE DESIGN FEATURES



- CAMBER
  - GIRDER SHAPE NOT “TYPICAL” CONSTANT DEPTH
  - INCREASED CHANCE OF VARIATION BWTN. CALCULATED AND ACTUAL CAMBER
  - HAMMERHEAD DIFFERENCE LESS THAN $^{1}/_{16}$” AT RELEASE
  - DROP-IN DIFFERENCE LESS THAN ¼” AT 40 DAYS

# QUESTIONS?