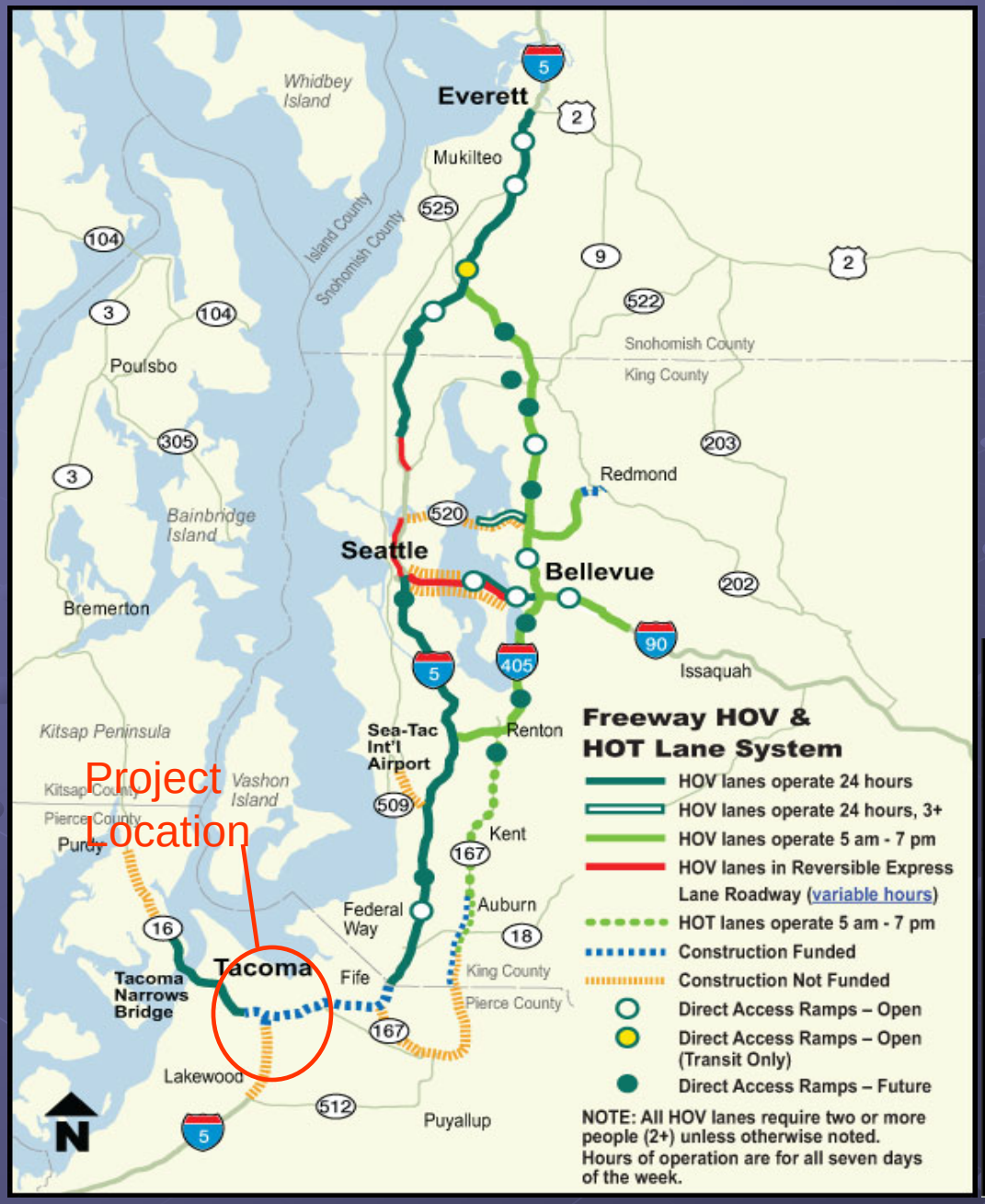
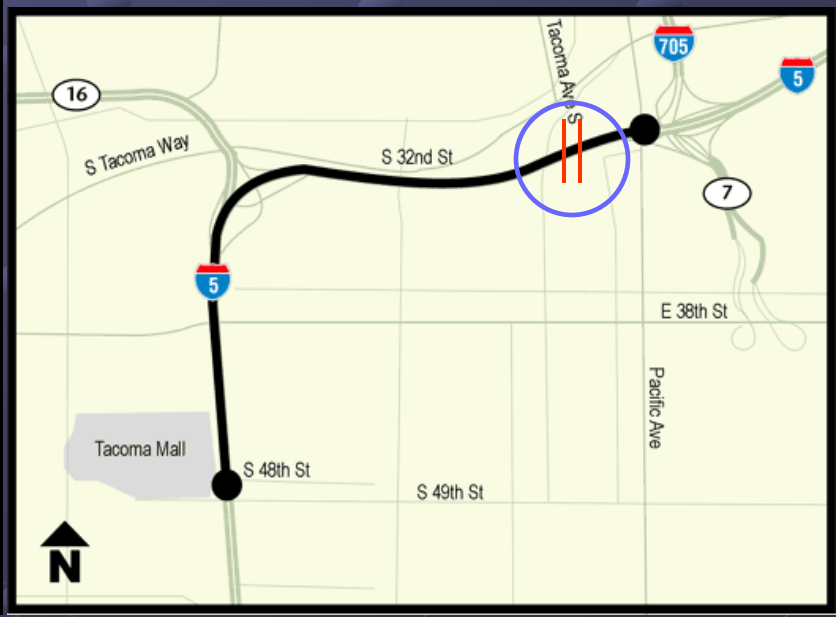
Design and Construction of Medium Span HPS Hybrid Box Girder Bridges over I-5 Mainline Traffic

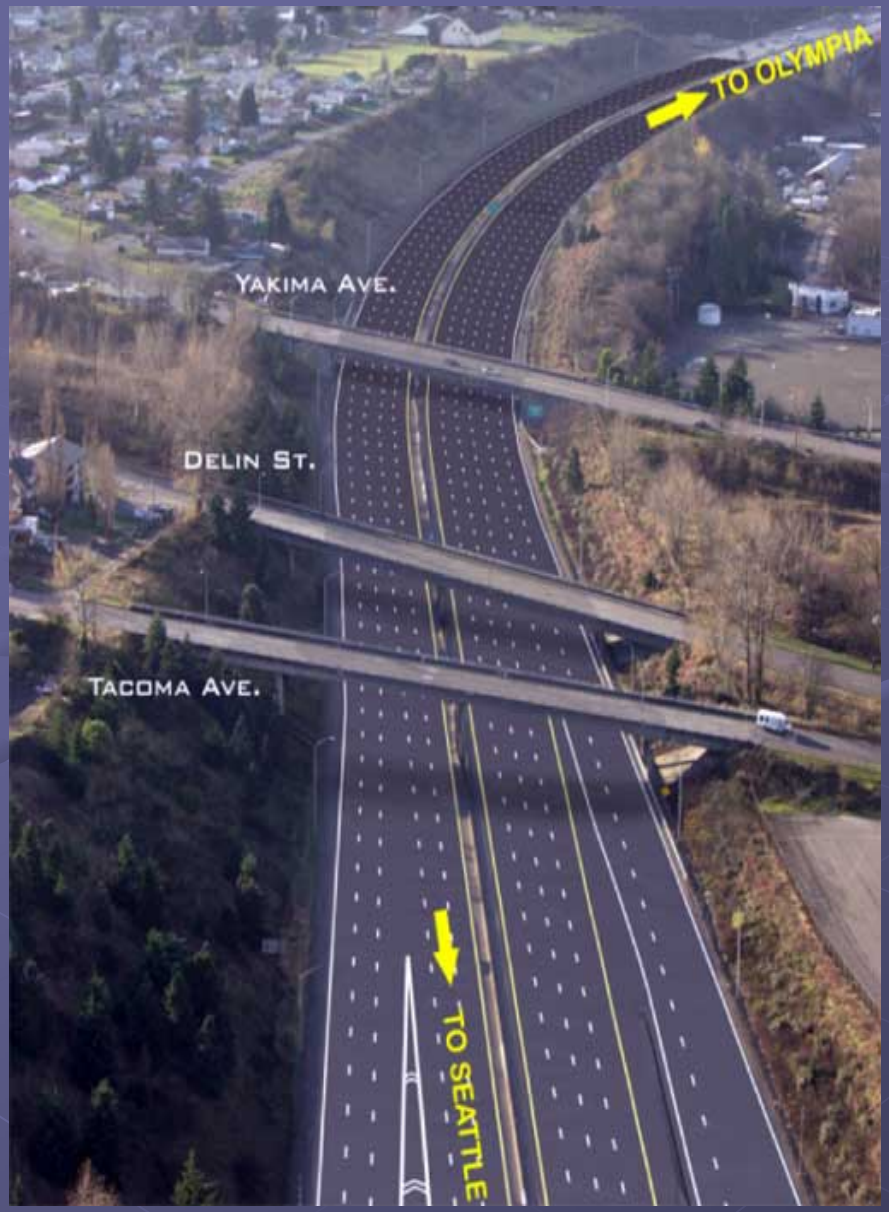
Lou H. Tran, P.E.
Senior Bridge Design Engineer
WSDOT

PROJECT LOCATION





BEFORE WIDENING CONDITION



BEFORE

AFTER

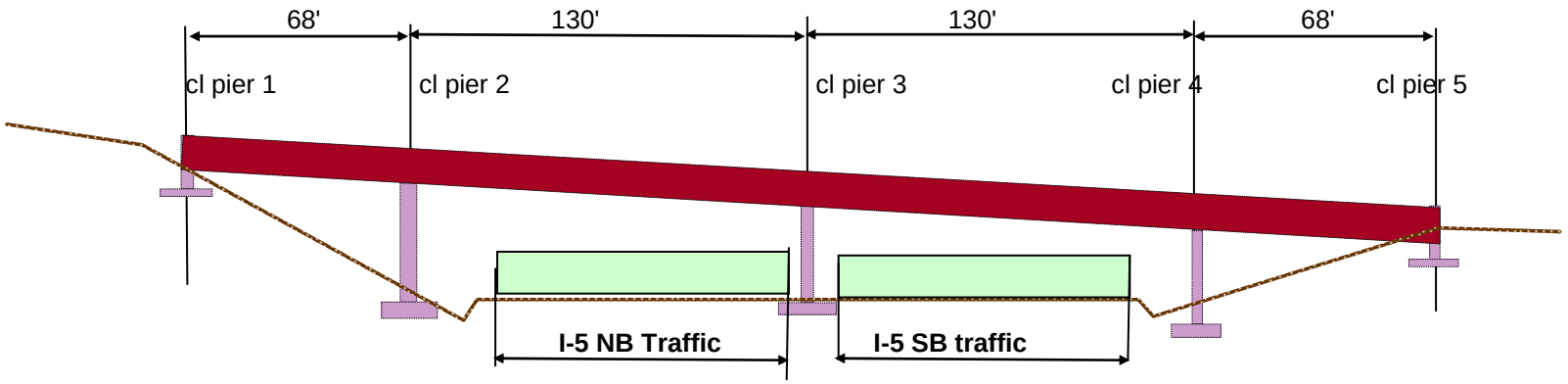
PROJECT CONSTRAINTS

- REMOVAL OF 3 CONCRETE BOX STRUCTURES CROSSING OVER I-5 INTERSTATE
- NO I-5 CLOSURE, ONLY ALLOWING TO CLOSE THE I-5 TO 3 LANES EACH DIRECTION
- CONSTRUCTING TWO NEW BRIDGES IN 10 MONTHS
- MATCHING WITH EXISTING CITY STREETS
- UTILITIES CROSSING I-5 AND ALONG THE RIGHT OF WAY

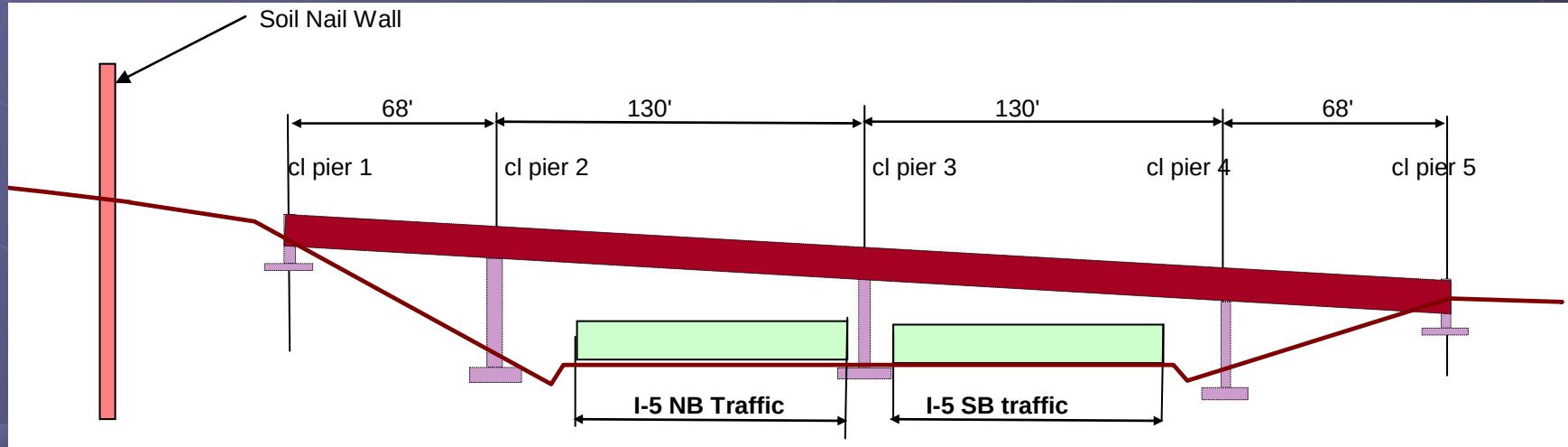
STRUCTURAL DESIGN AND CONSTRUCTION CHALLENGES

- TWO LONG SPANS - ONE CENTER PIER ONLY
- HIGH SKEW BRIDGES
- BOX SHAPE GIRDER WITH RAISED CONCRETE INTERMEDIATE CROSS-BEAM FOR AESTHETICS
- DESIGNING NEW BRIDGES WITH 7 TRAFFIC STAGES
- DESIGNING ABOUT 3/4 MILE LONG, 60’ HIGH SOIL NAIL WALL FOR STAGING THE TRAFFIC

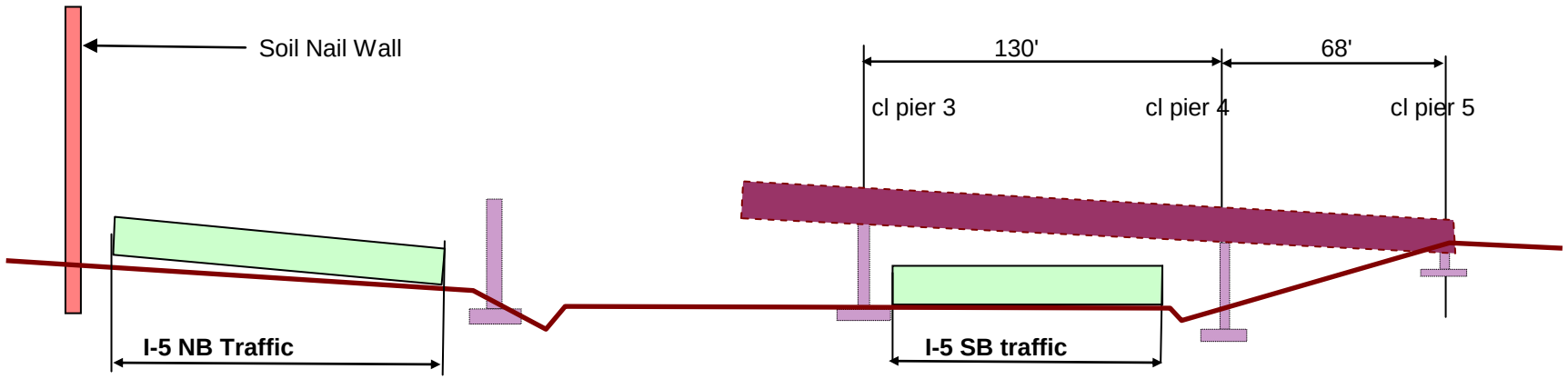
TRAFFIC STAGING
AND
STRUCTURE REMOVAL



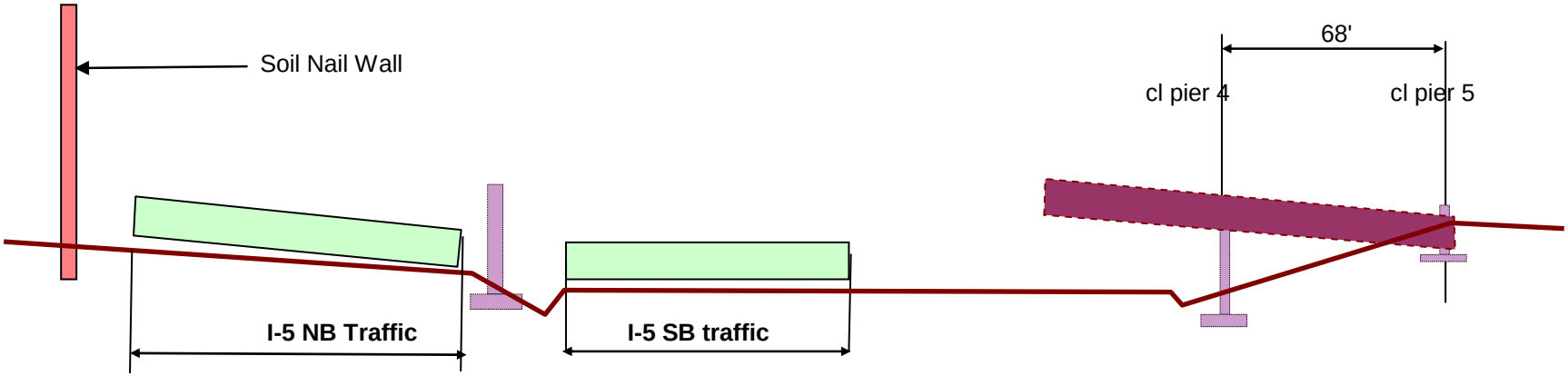
Traffic Staging and Bridge Removal



Traffic Staging and Bridge Removal

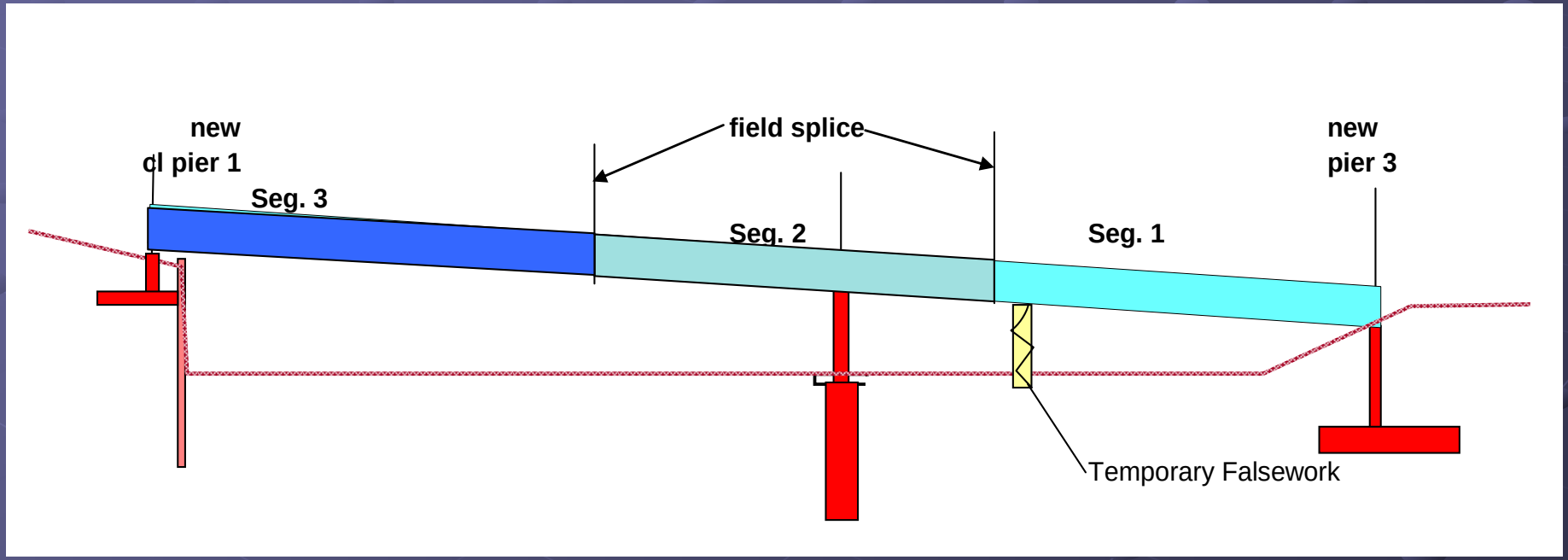


Traffic Staging and Bridge Removal



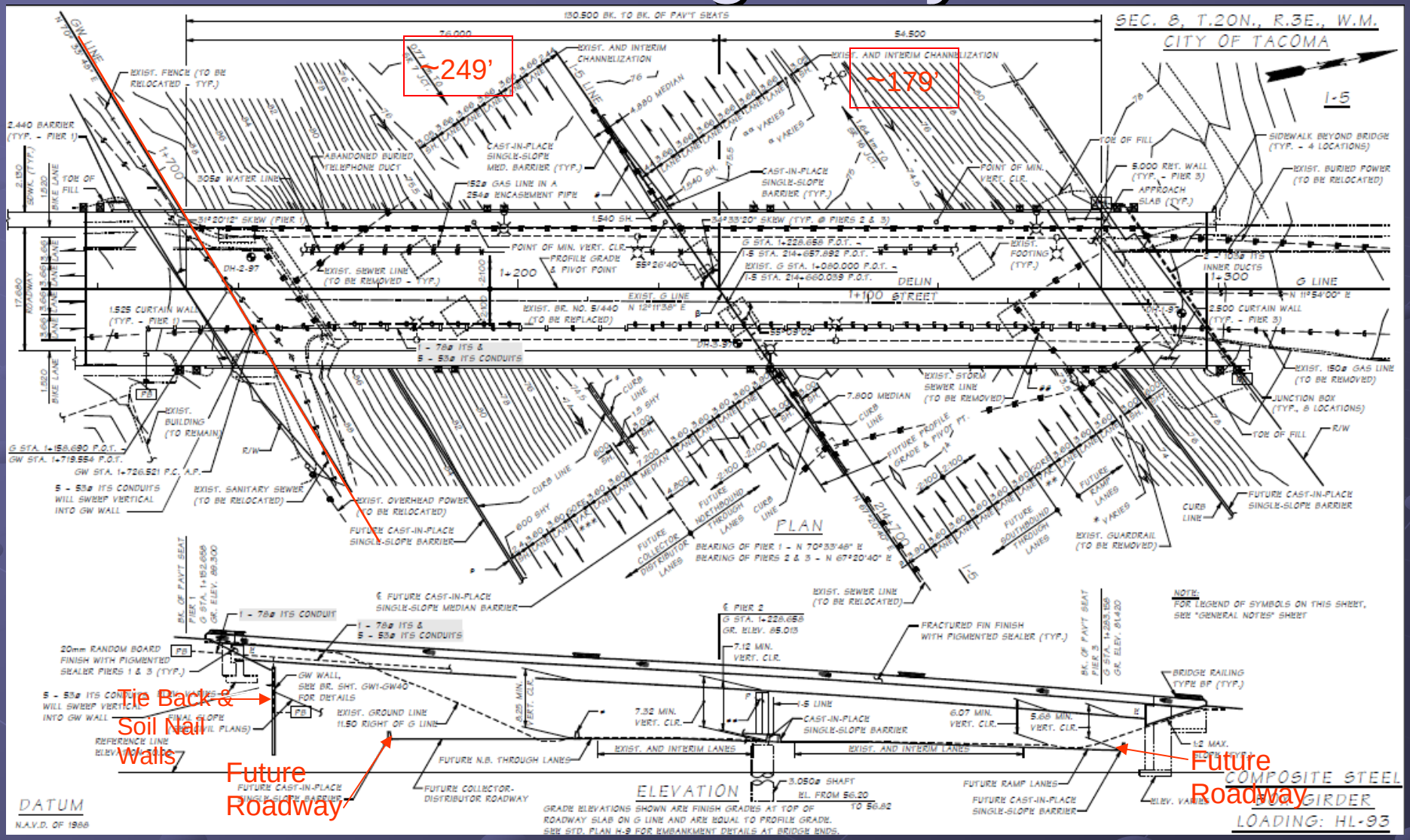
Traffic Staging and Bridge Removal

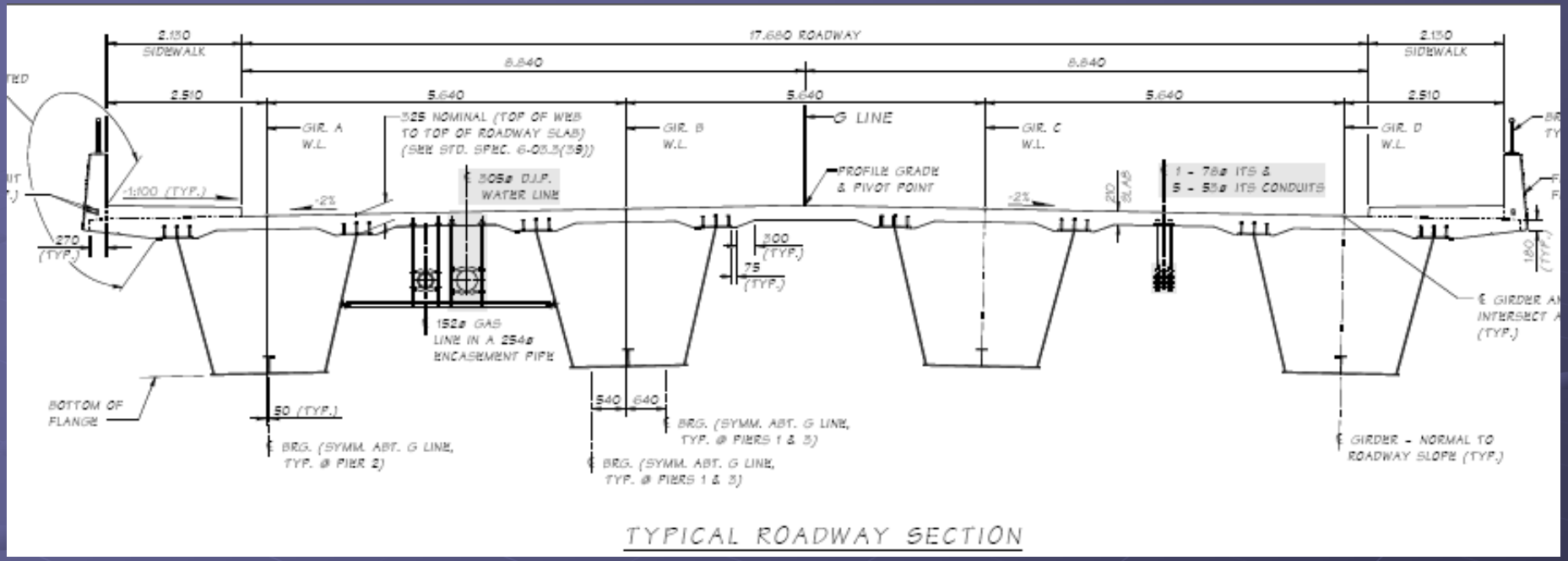
GIRDER ERECTING SEQUENCE



STRUCTURAL DESIGN

Delin Bridge Layout



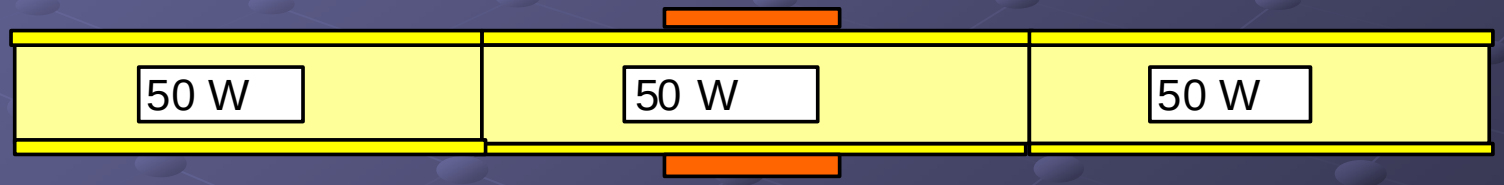


TYPICAL ROADWAY SECTION

TYPICAL SECTION

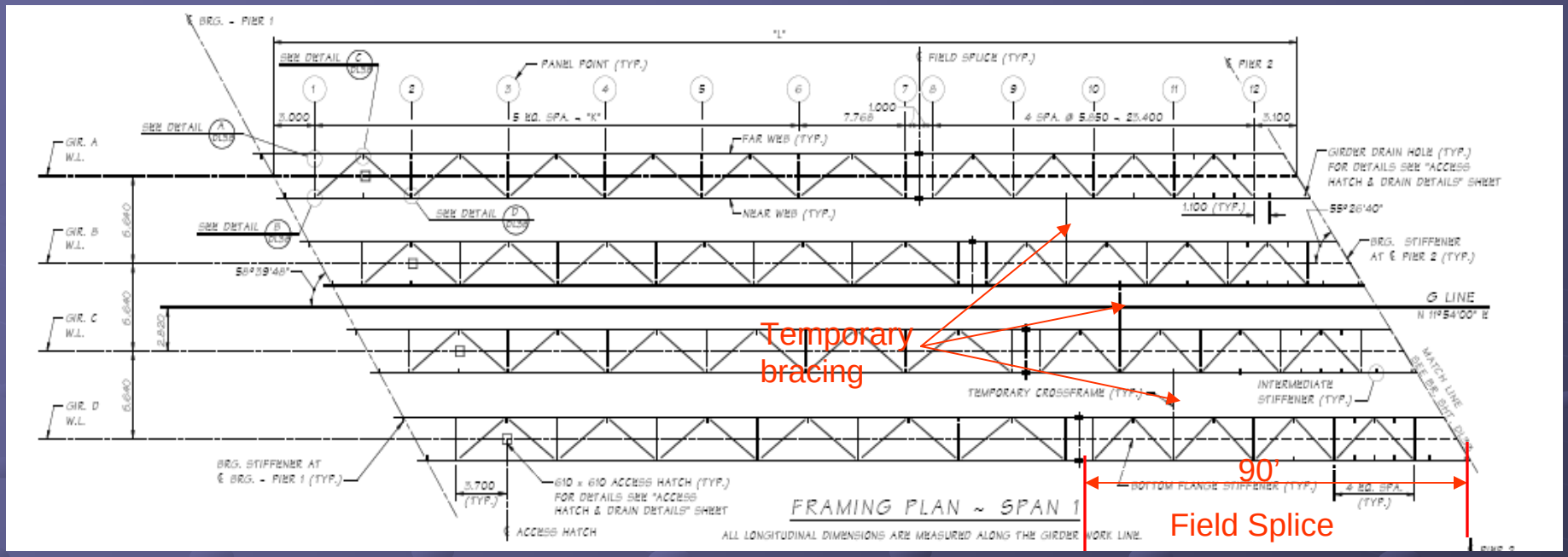
OPTIMIZING GIRDER DESIGN

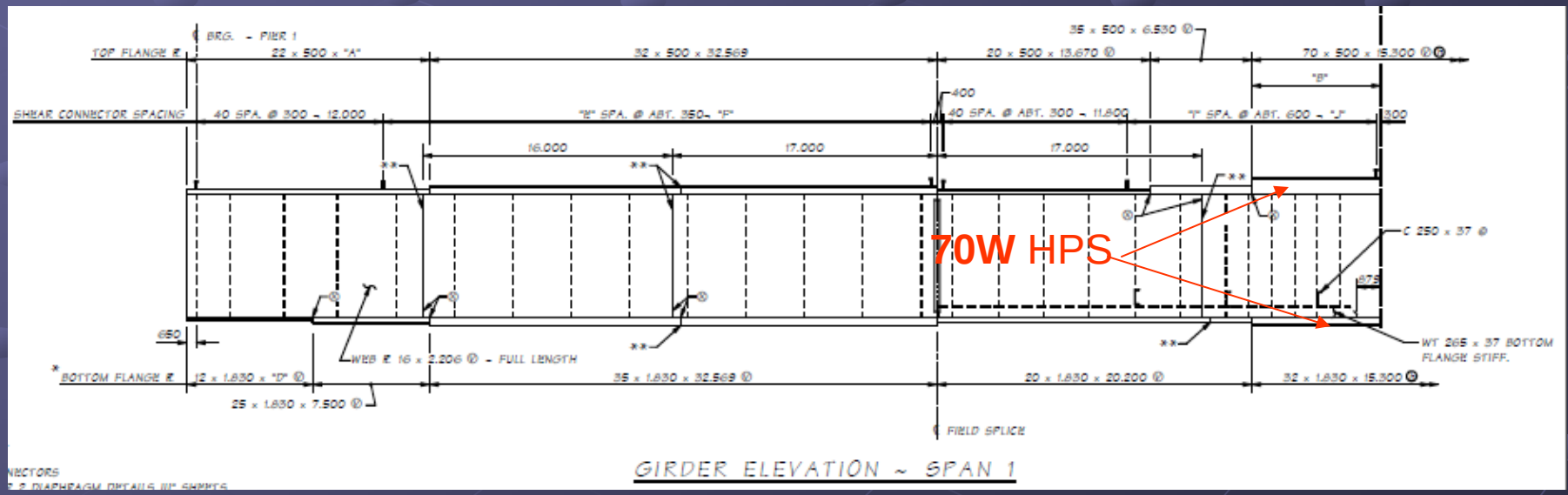
- USING HPS HYBRID SECTION TO FOR NEGATIVE MOMENT REGION WITH LONGITUDINAL BOTTOM STIFFENER

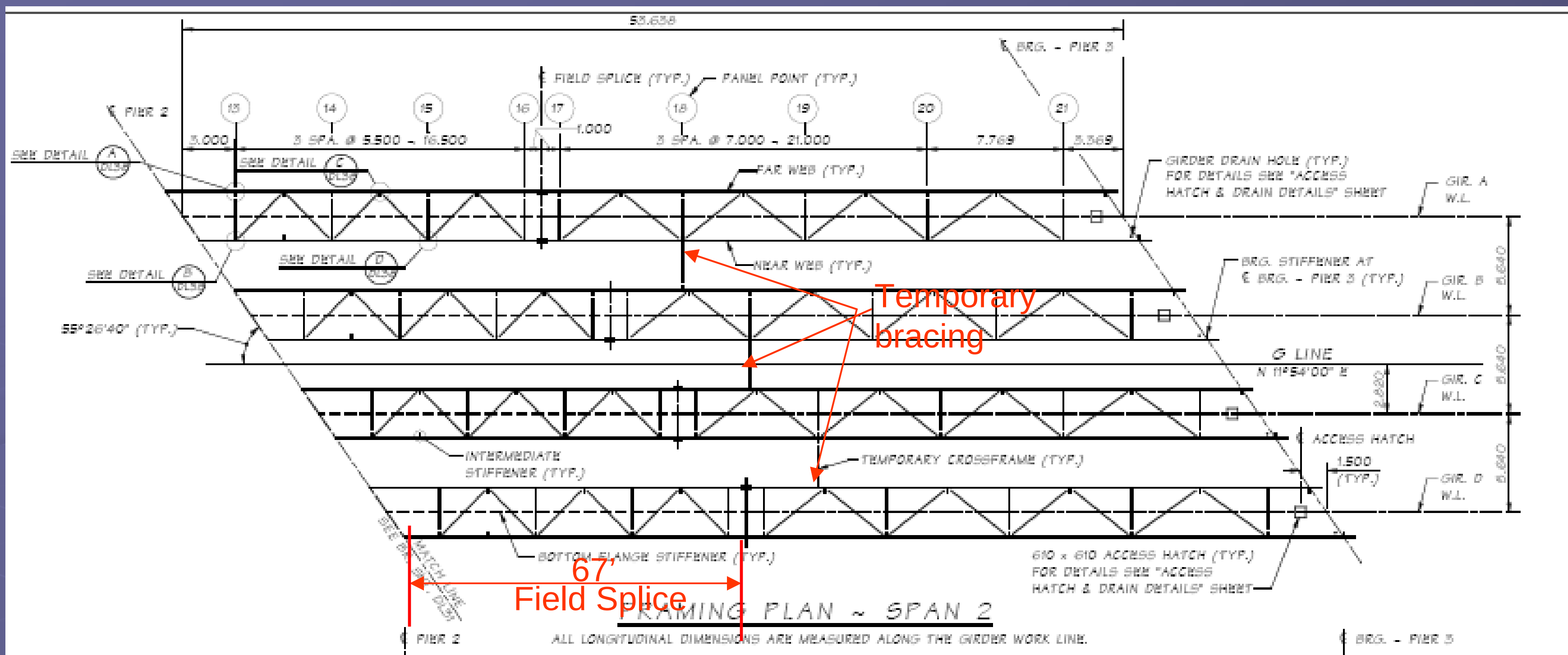


	FLANGE GRADE	
50W	50W	50W
HPS 70W	HPS 70W	HPS 70W
50W	HPS 70W	50W

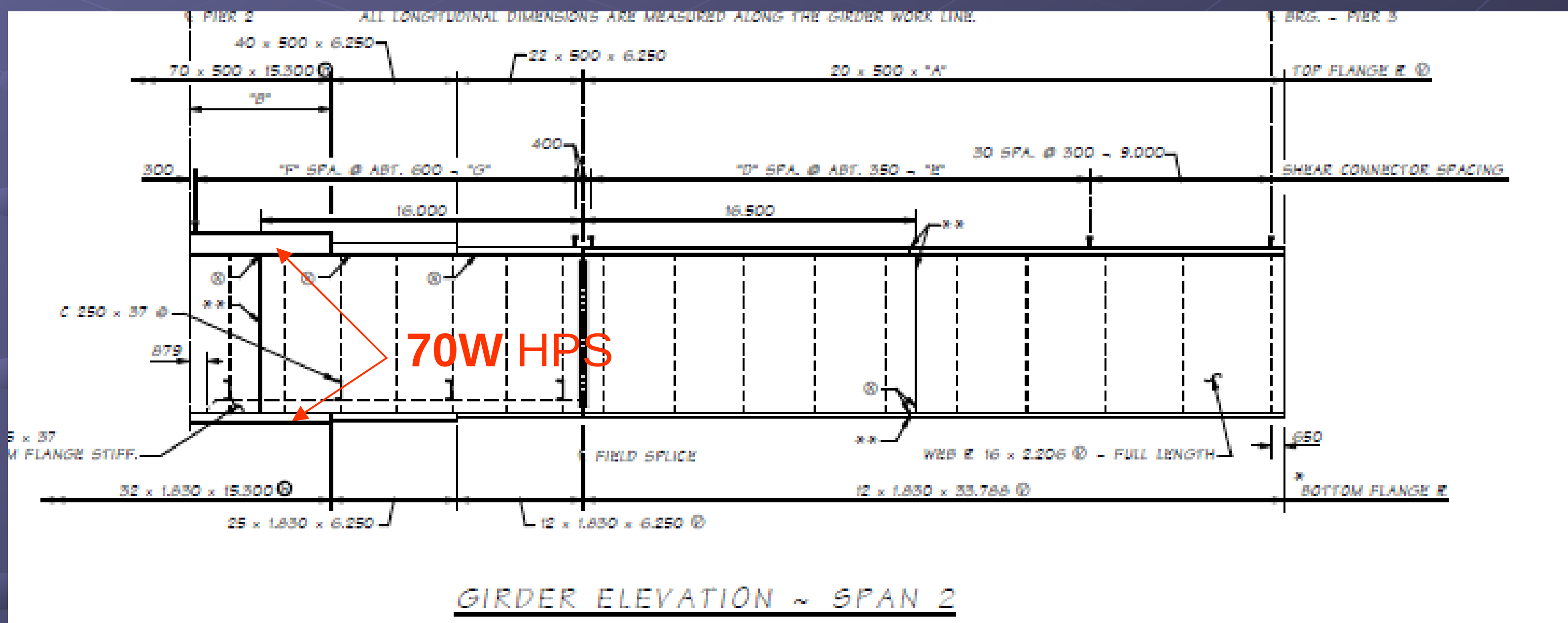
FRAMING PLAN







FRAMING PLAN ~ SPAN 2
ALL LONGITUDINAL DIMENSIONS ARE MEASURED ALONG THE GIRDER WORK LINE.
53.638
℄ BRG. - PIER 3
℄ FIELD SPLICE (TYP.)
PANEL POINT (TYP.)
℄ PIER 2
3.000
3 SPA. @ 5.500 = 16.500
1.000
3 SPA. @ 7.000 = 21.000
7.769
3.369
SEE DETAIL A
SEE DETAIL C
SEE DETAIL B
SEE DETAIL D
FAR WEB (TYP.)
NEAR WEB (TYP.)
GIRDER DRAIN HOLE (TYP.) FOR DETAILS SEE "ACCESS HATCH & DRAIN DETAILS" SHEET
GIR. A W.L.
GIR. B W.L.
GIR. C W.L.
GIR. D W.L.
BRG. STIFFENER AT ℄ BRG. - PIER 3 (TYP.)
55°26'40" (TYP.)
℄ LINE
N 11°54'00" E
℄ ACCESS HATCH
1.500 (TYP.)
INTERMEDIATE STIFFENER (TYP.)
TEMPORARY CROSSFRAME (TYP.)
BOTTOM FLANGE STIFFENER (TYP.)
610 x 610 ACCESS HATCH (TYP.) FOR DETAILS SEE "ACCESS HATCH & DRAIN DETAILS" SHEET
MATCH LINE
℄ PIER 2
℄ BRG. - PIER 3
Temporary bracing
67'
Field Splice



GIRDER ELEVATION ~ SPAN 2
℄ PIER 2
ALL LONGITUDINAL DIMENSIONS ARE MEASURED ALONG THE GIRDER WORK LINE.
℄ BRG. - PIER 3
40 x 500 x 6.250
70 x 500 x 15.300
22 x 500 x 6.250
20 x 500 x "A"
TOP FLANGE
"B"
400
30 SPA. @ 300 = 9.000
300
"F" SPA. @ ABT. 600 = "G"
"D" SPA. @ ABT. 350 = "E"
SHEAR CONNECTOR SPACING
16.000
16.500
C 250 x 37
WEB 16 x 2.206 - FULL LENGTH
FIELD SPLICE
650
32 x 1.830 x 15.300
25 x 1.830 x 6.250
12 x 1.830 x 6.250
12 x 1.830 x 33.788
BOTTOM FLANGE
70W HPS

GENERAL DESIGN INFORMATION

CODE

- AASHTO LRFD 2004

GEOMETRY

- SPAN TO DEPTH RATIO = 20 to 30
- 4:1 SIDE SLOPE

MATERIALS

- GIRDERS: AASHTO M 270M, Grade 485W (70W)
- AASHTO M 270M, Grade 345W (50W)
- CROSS- FRAME: AASHTO M 270M, Grade 250 (36)

BEARINGS

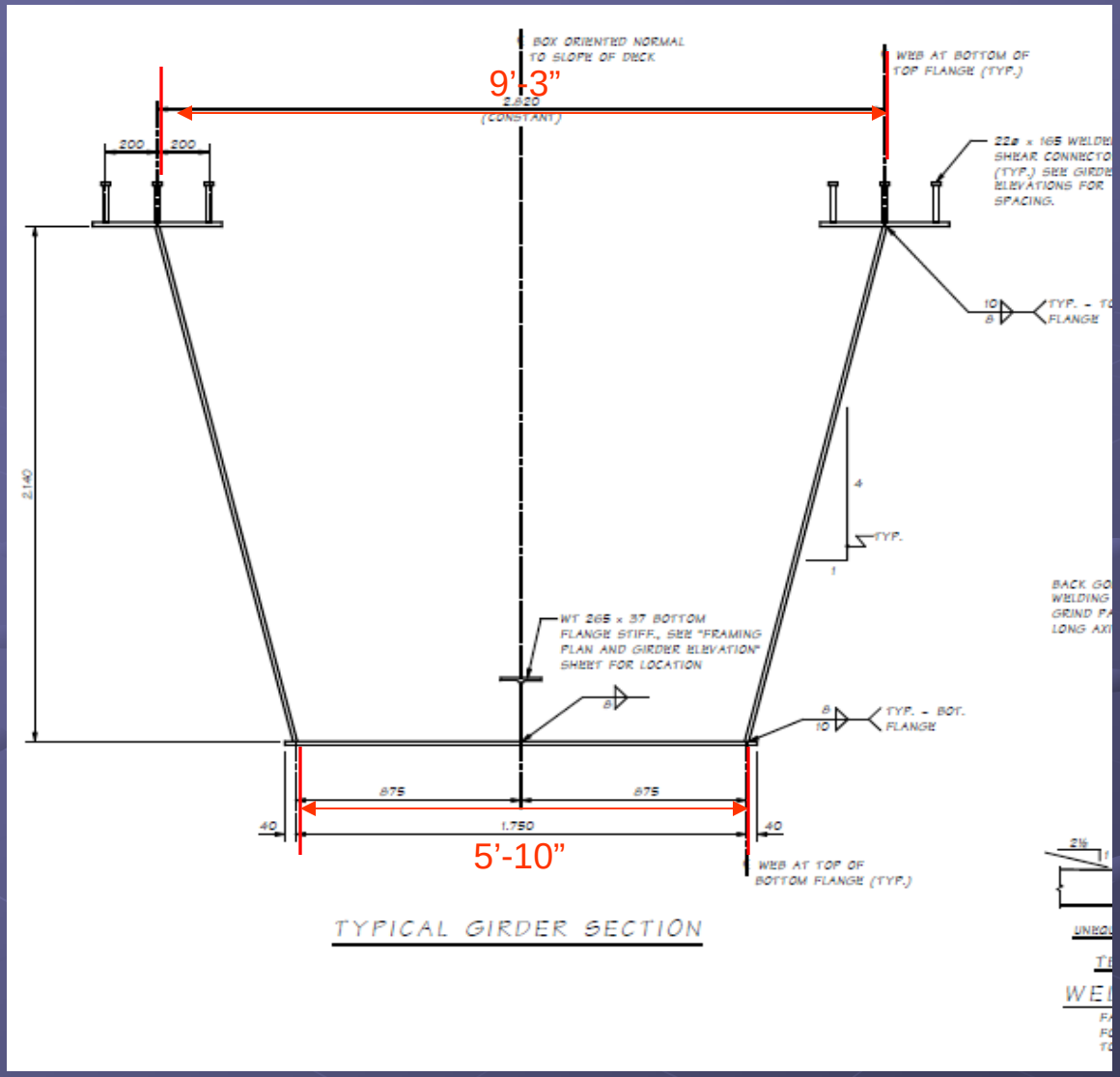
- SPHERICAL BEARINGS AT INT. PIER
- FABRIC PADS AT END PIERS

BRACINGS

- TOP LATERAL BRACING FOR SHIPPING AND ERECTING
- TEMPORARY BRACING BETWEEN BOXES DURING CONSTRUCTION

FOUNDATION

- SHAFT FOUNDATION AT INTERMEDIATE PIERS

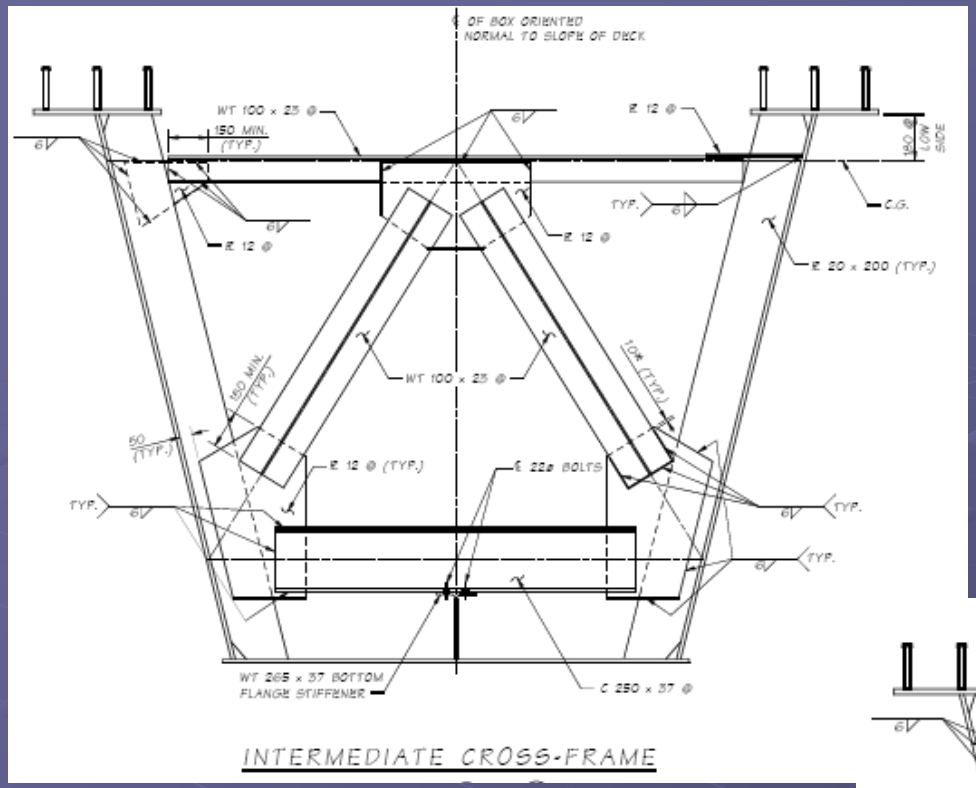


Height : 7'-3"

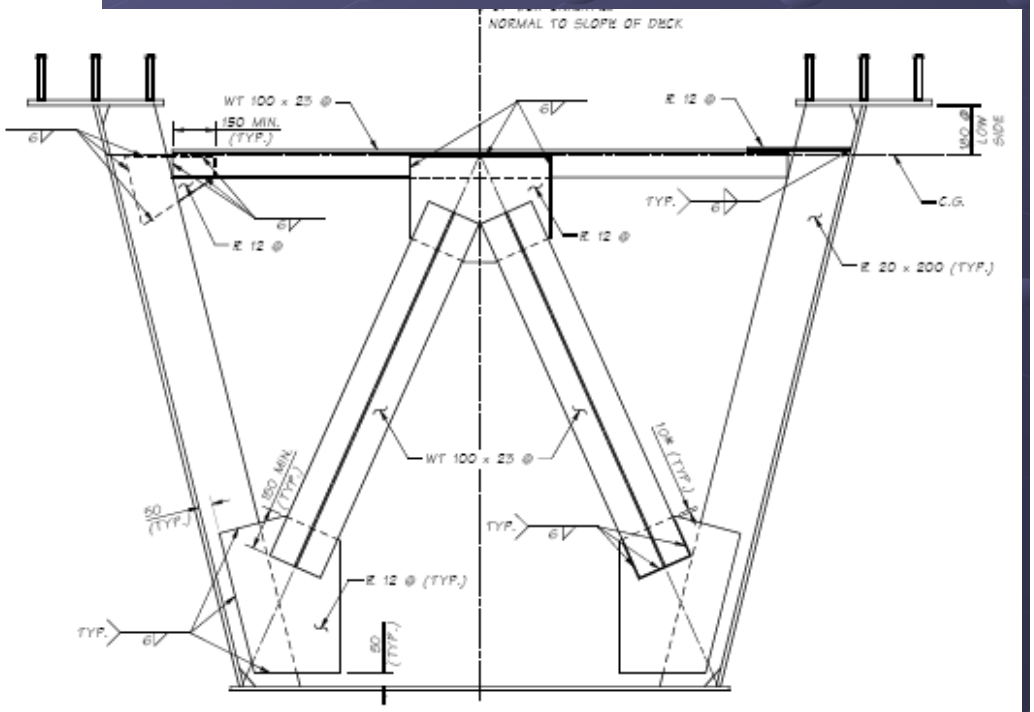
Web Size: 11/16"

GIRDER SECTION

INTERMEDIATE CROSS-FRAME

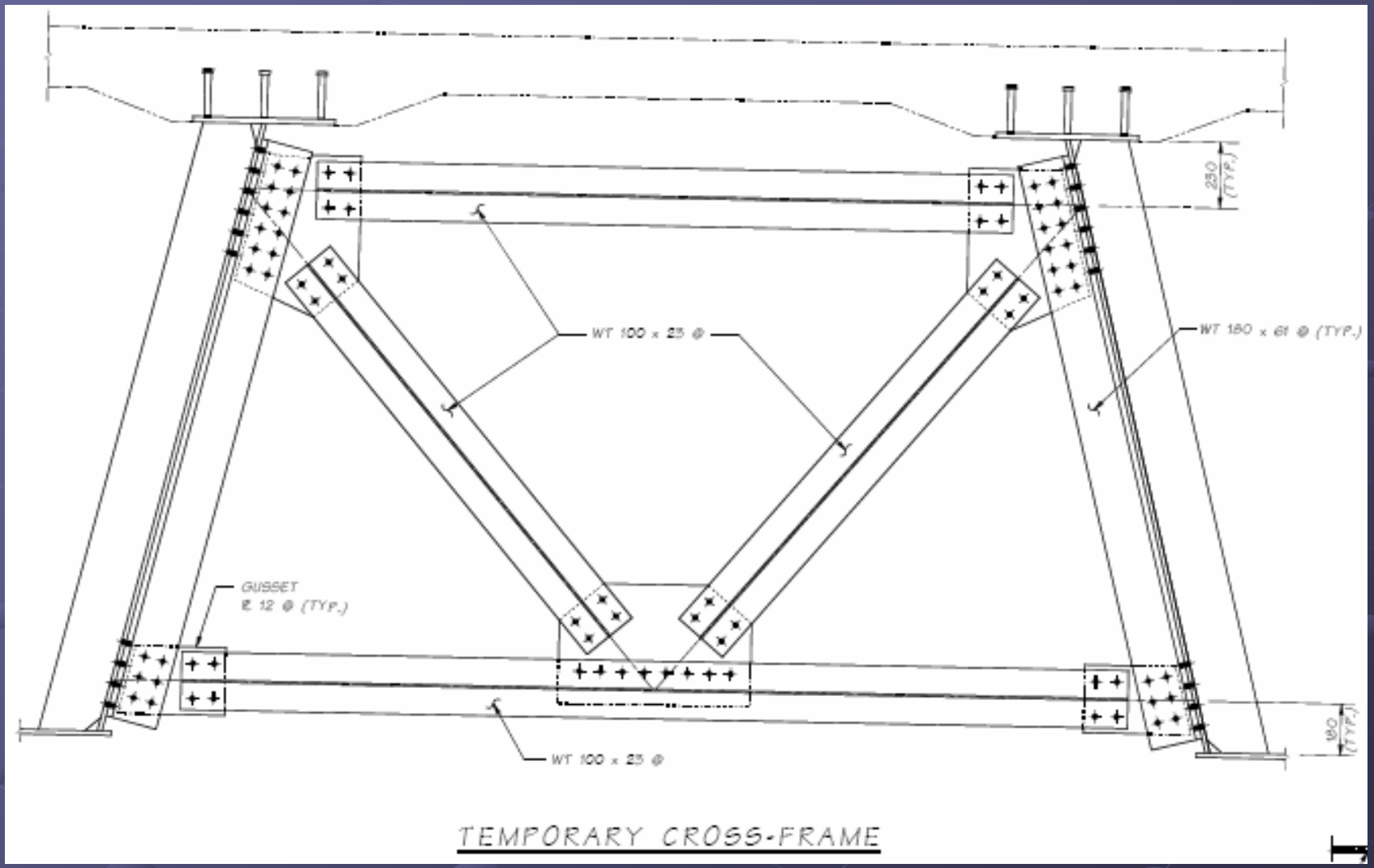


INTERMEDIATE CROSS-FRAME

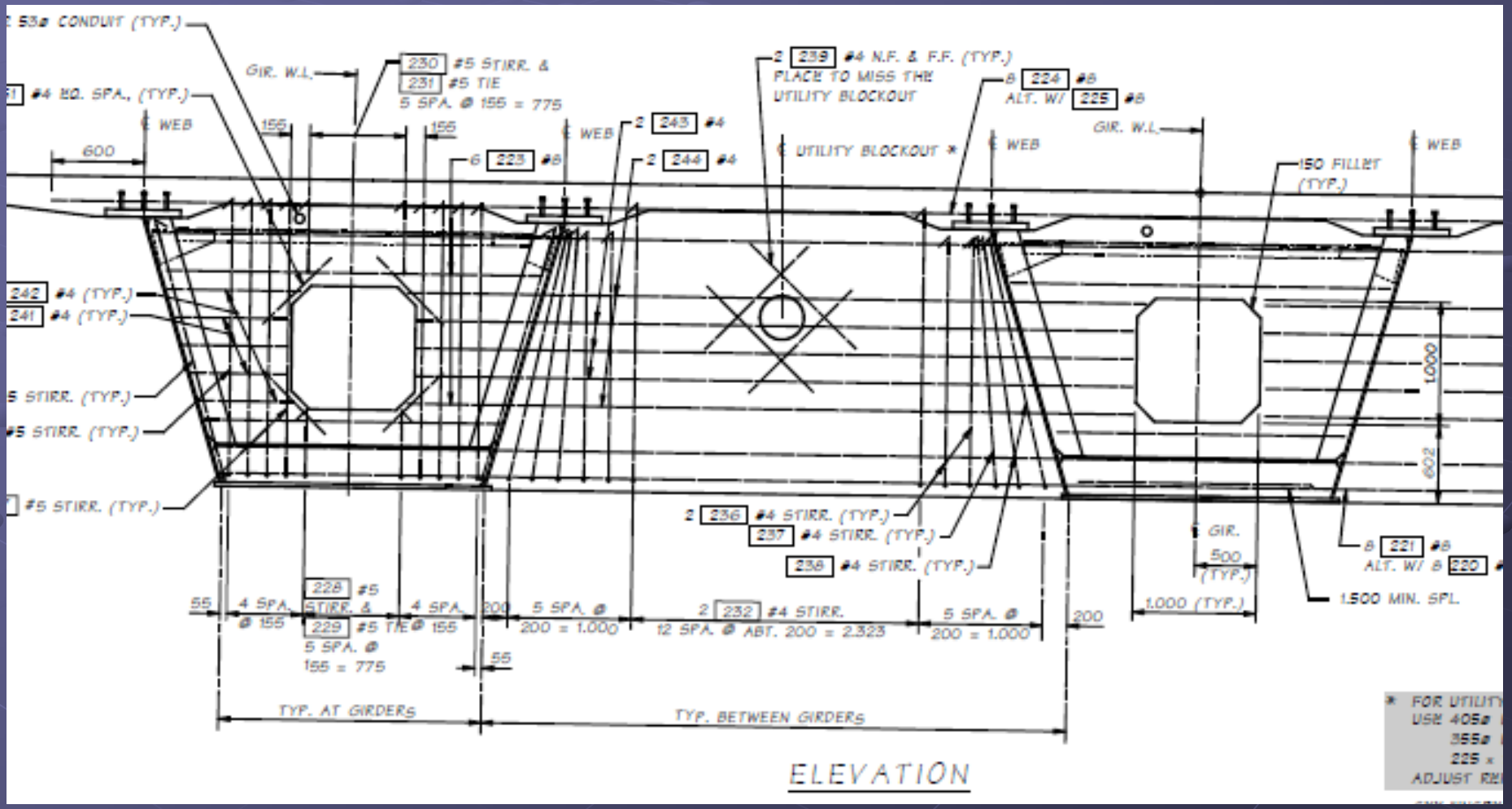


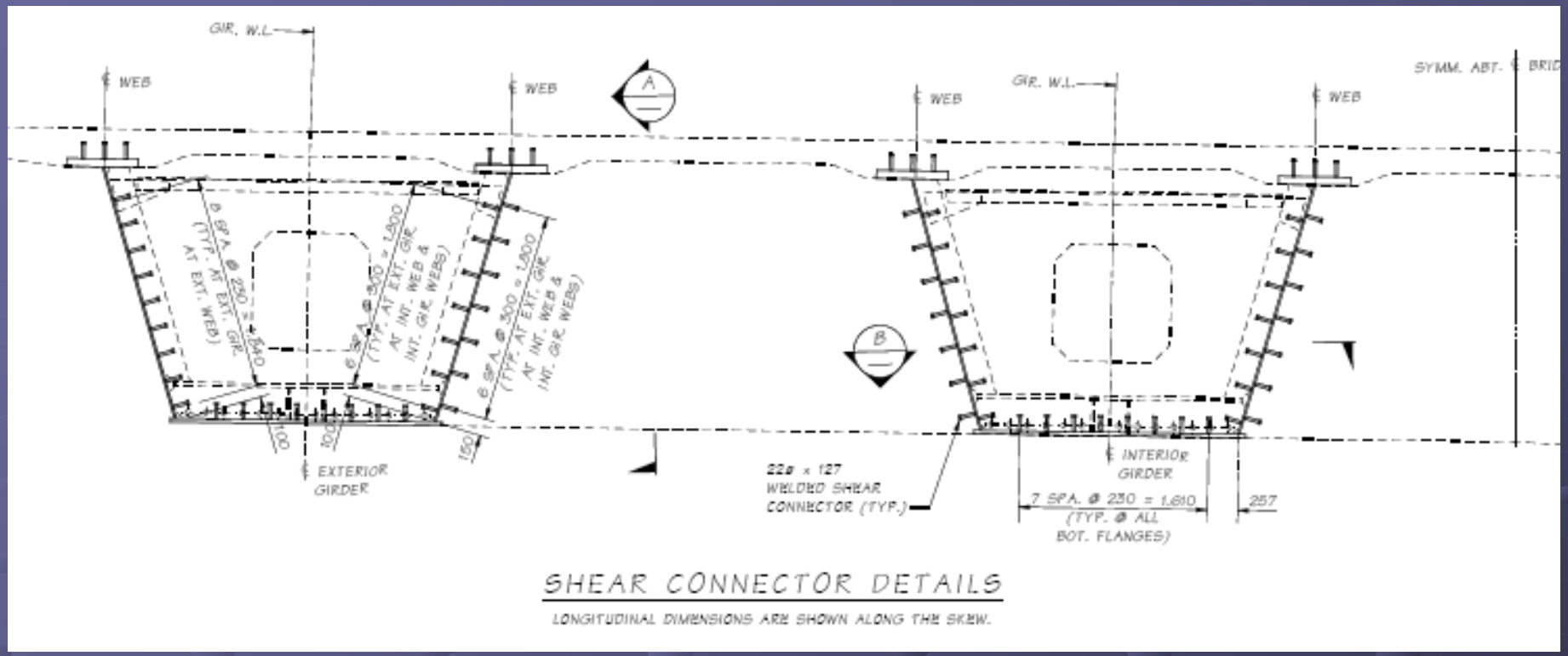
INTERMEDIATE CROSS-FRAME

TEMPORARY CROSS-FRAME



INTERMEDIATE PIER CONCRETE CROSS-BEAM



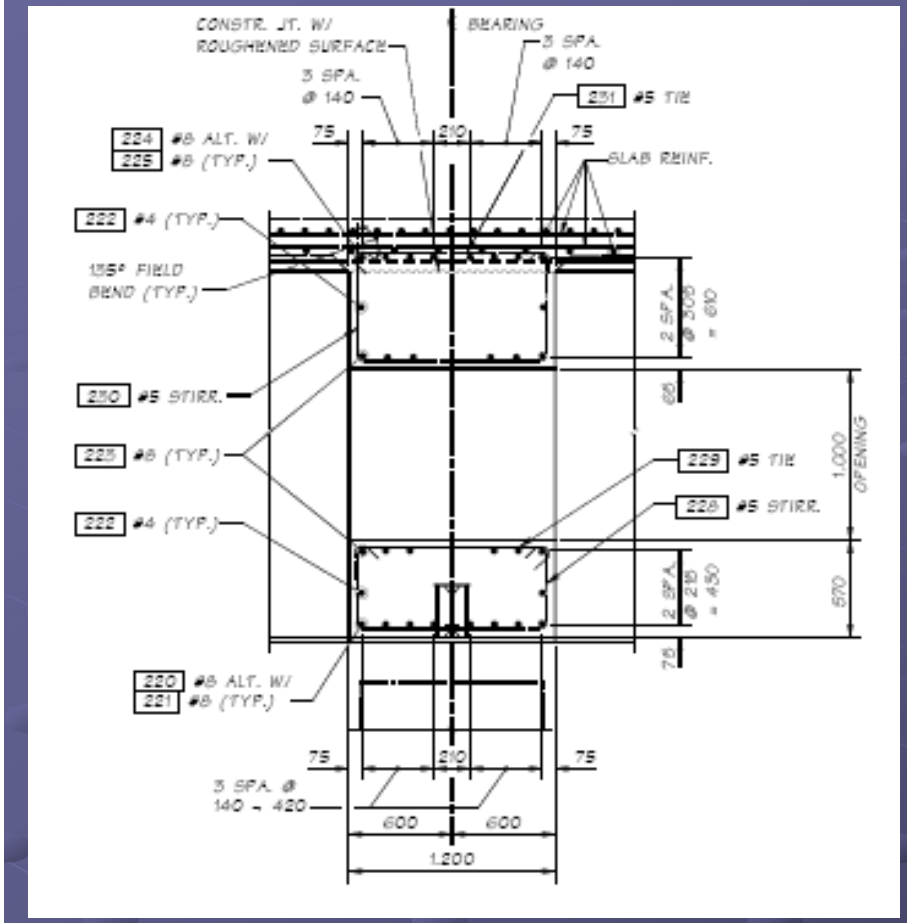


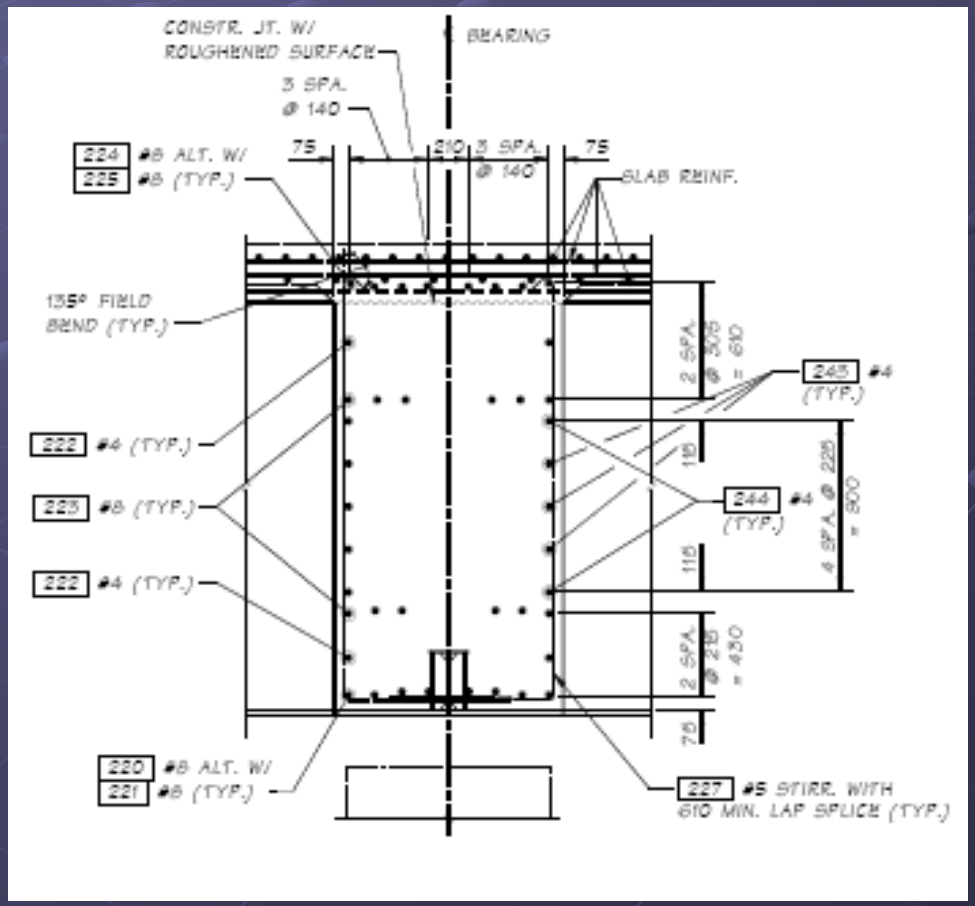
SHEAR CONNECTOR DETAILS

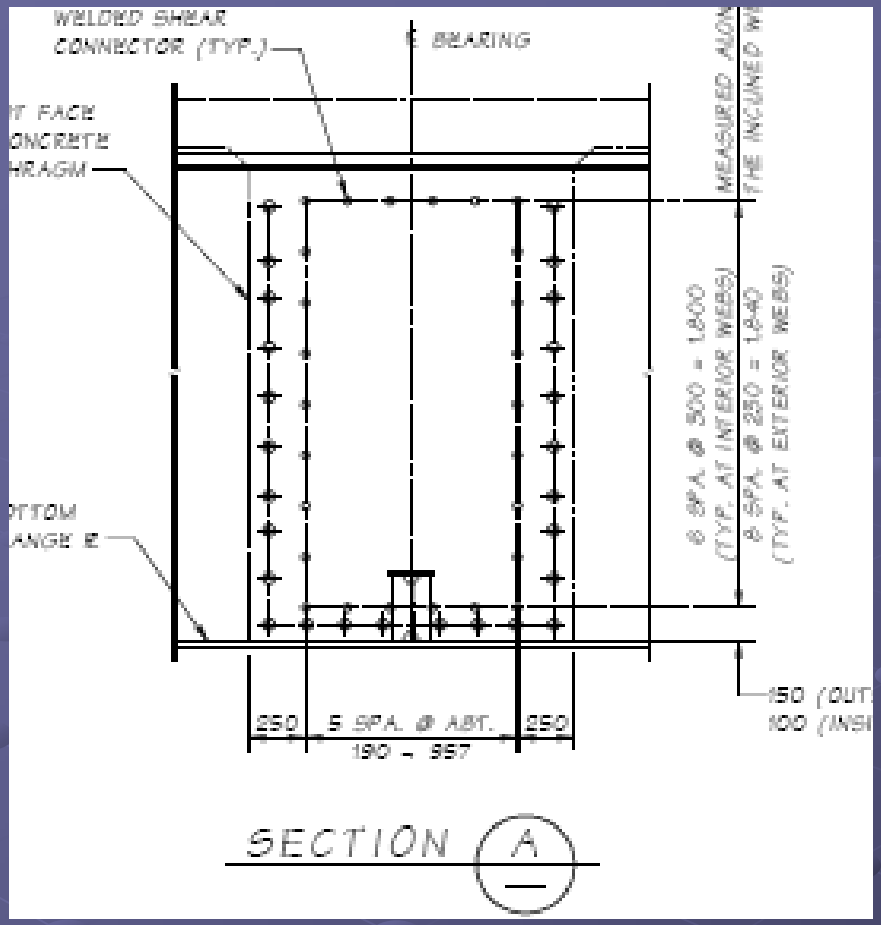
LONGITUDINAL DIMENSIONS ARE SHOWN ALONG THE SKEW.

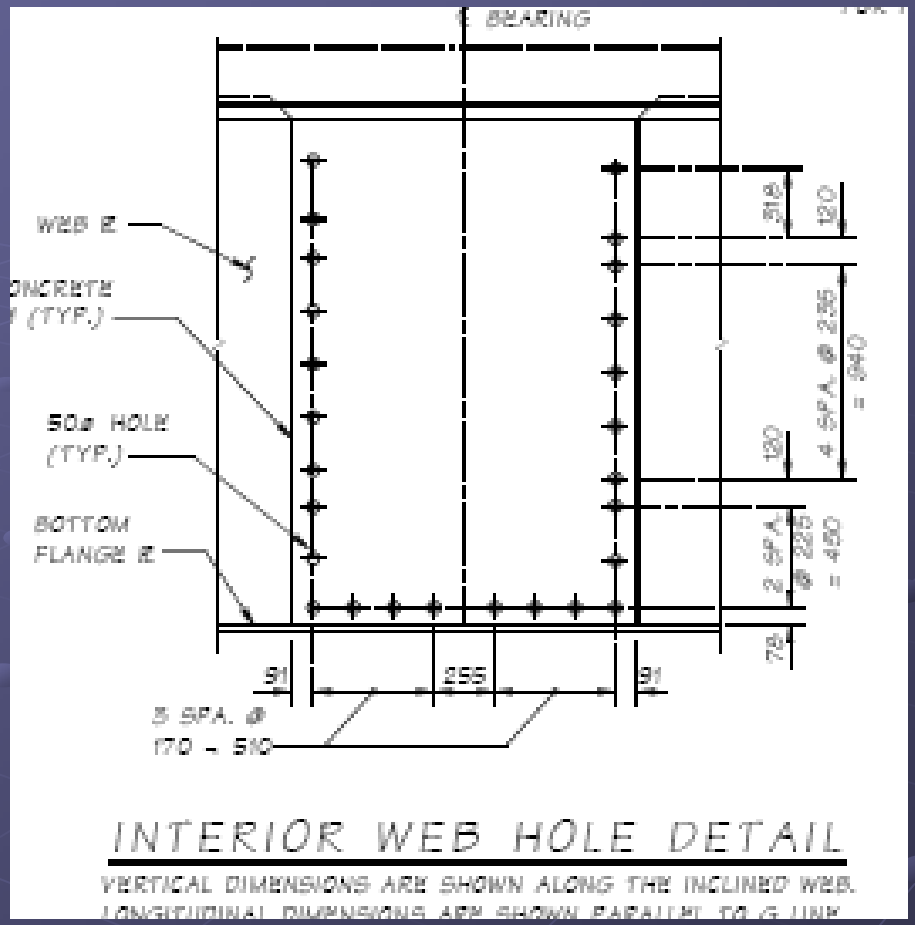
CROSS-BEAM STUD DETAILS

CROSS-BEAM SECTIONS



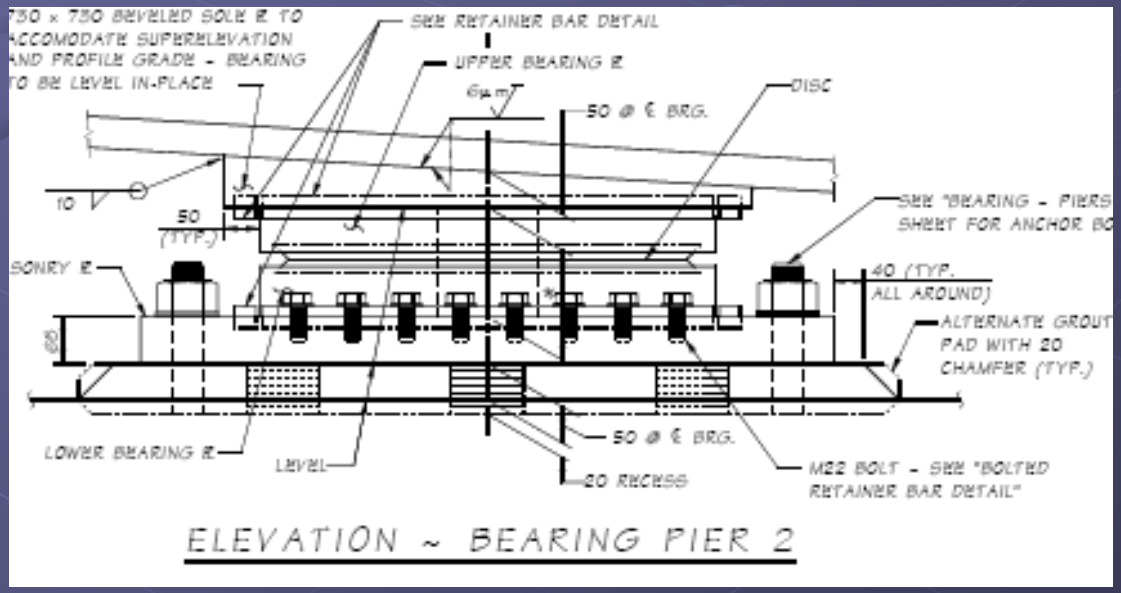


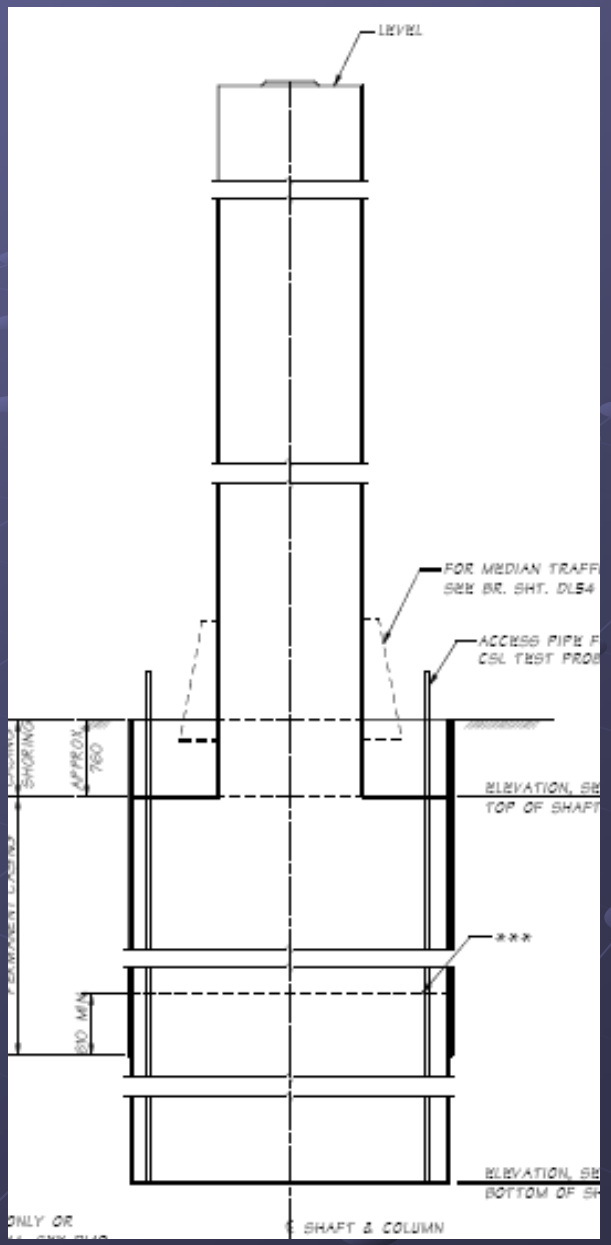




GIRDER HOLE AND STUD DETAILS

BEARING AND COLUMN





WALL CONSTRUCTION

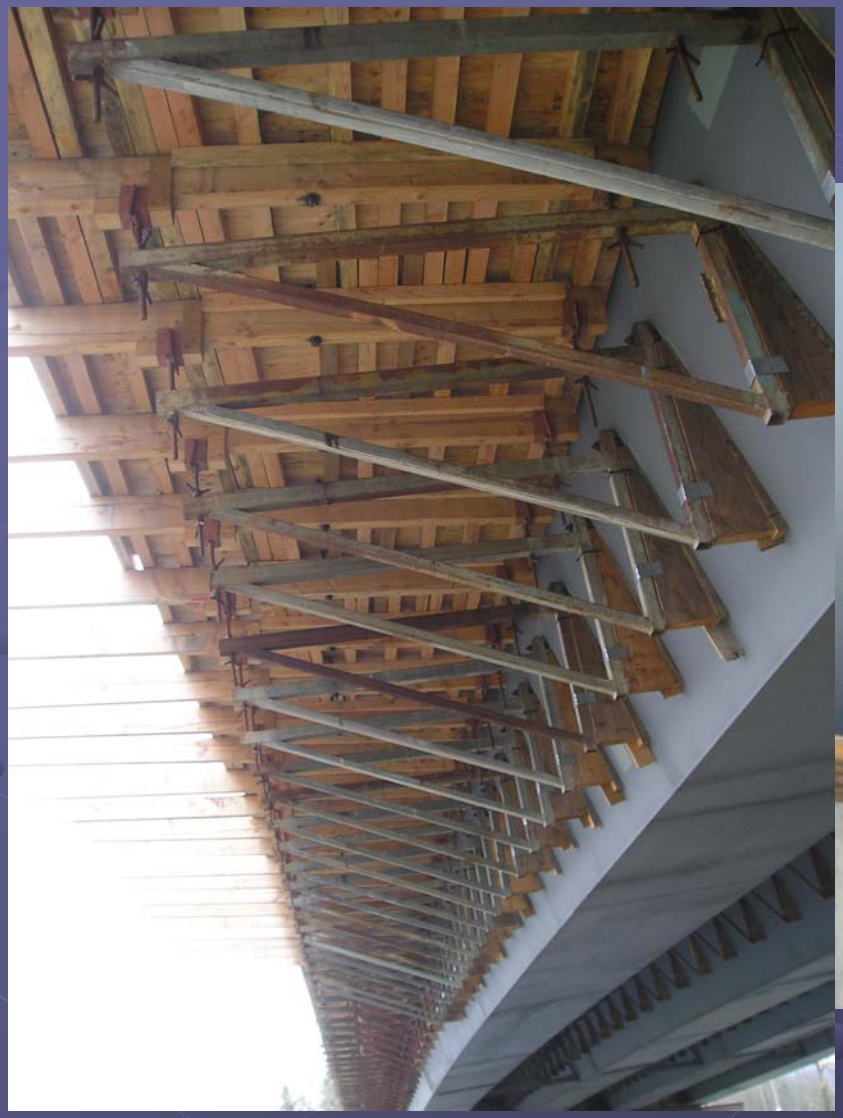

08.18.2006 08:38

STAGING THE TRAFFIC TO ONE SIDE

BRIDGE REMOVAL


50

BRIDGE CONSTRUCTION




WSDT
08.15.2007 22:31


BIDWELL


LBC

FASCIA WALL CONSTRUCTION

COST OF STRUCTURES AND WALL

- STEEL BOX STRUCTURE: $285/sf
  - YAKIMA – 4.65 mil.
  - DELIN – 4.80 mil.
- SOIL NAIL WALL: $62/sf

LESSONS LEARNED

CIVIL

- HAVE THE TRAFFIC ENGINEERS WORK OUT THE STAGING IN THE PRELIMINARY DESIGN
- HAVE AGREEMENT WITH MUNICIPALS ON IMPORTANT ISSUES
- SURVEY ALL EXISTING UTILITIES

LESSON LEARNED

STRUCTURAL

- WORK OUT THE STAGING AND REMOVAL PLANS AS EARLY AS POSSIBLE AND BE FLEXIBLE WITH THE DESIGN
- KEEP SIMPLE FOR VERTICAL CURVE AND SUPERELEVATION
- PROVIDE STIFFENER FOR THE BOTTOM PLATE AT END PIERS
- USE SQUARE CONCRETE END DIAPHRAGMS
- PROVIDE ACCESS IN DECK FOR FORMWORK REMOVAL

ACKNOWLEDGEMENTS

- PRIME CONTRACTOR: KIEWIT CONSTRUCTION CO.
- SUB CONTRACTOR: DONALD B. MURPHY (BDM)
- FABRICATOR: UNIVERSAL STRUCTURAL INC.
- CITY OF TACOMA
- WSDOT TRAFFIC AND CONSTRUCTION OFFICES

THANK YOU