Using AASHTOWare BrR to Load Rate the Curved Girder Approach Spans of the Huey P. Long Bridge

2015 AASHTOWare RADBUG Conference

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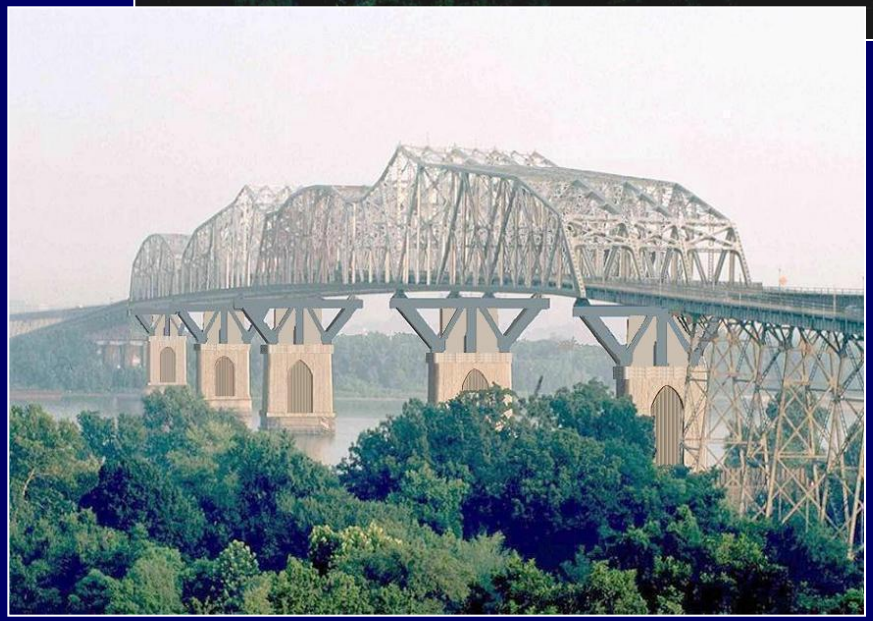
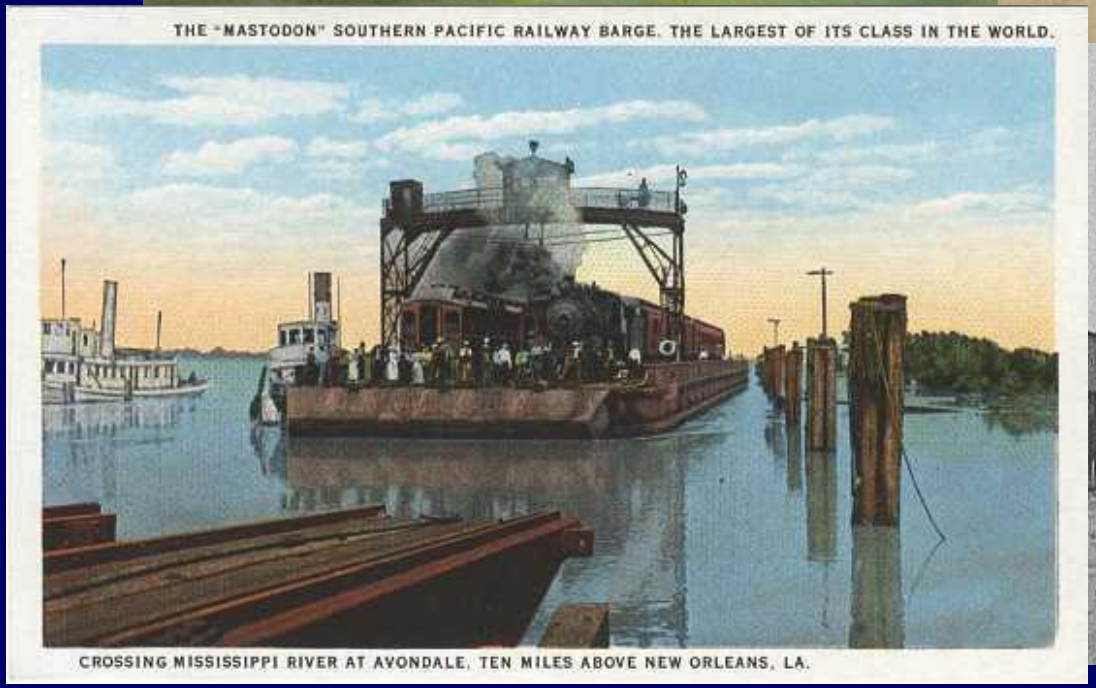
LOUISIANA'S ON THE MOVE...
DOTD
BUILDS THE WAY

Introduction

- Background
- Design Features
- Modeling Approach
  - Challenges
  - Solutions
- Overload Rating
- Possible Enhancements for BrR

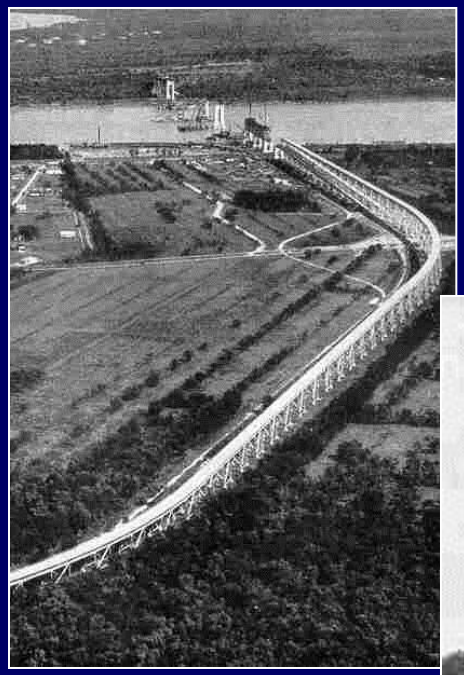


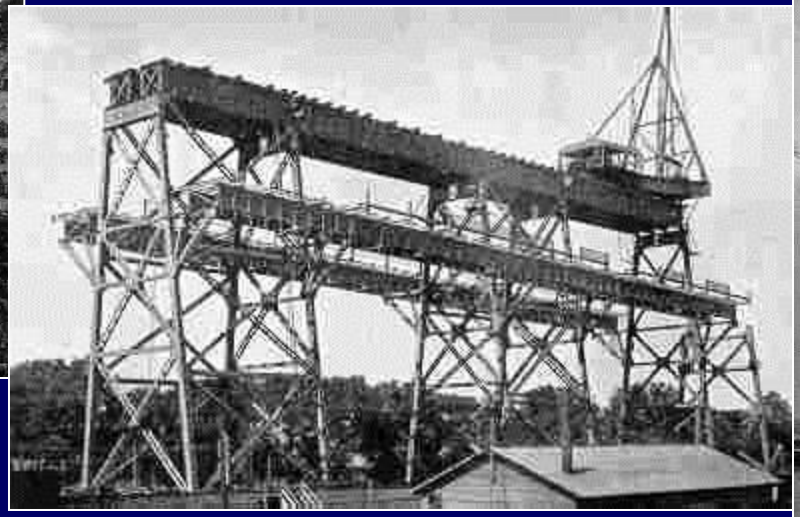
Before the Bridge



Before the Bridge

Background – Huey P. Long Bridge





- Completed in December 1935, the bridge is one of the longest railroad bridges in the world.

Project Background

2000 - 2007

- Completion of final design plans:
  - Main Bridge Pier Widening
  - Main Bridge Truss Widening
  - Railroad Modifications
  - West Bank Approach, Main Bridge Deck Widening, and East Bank Approach

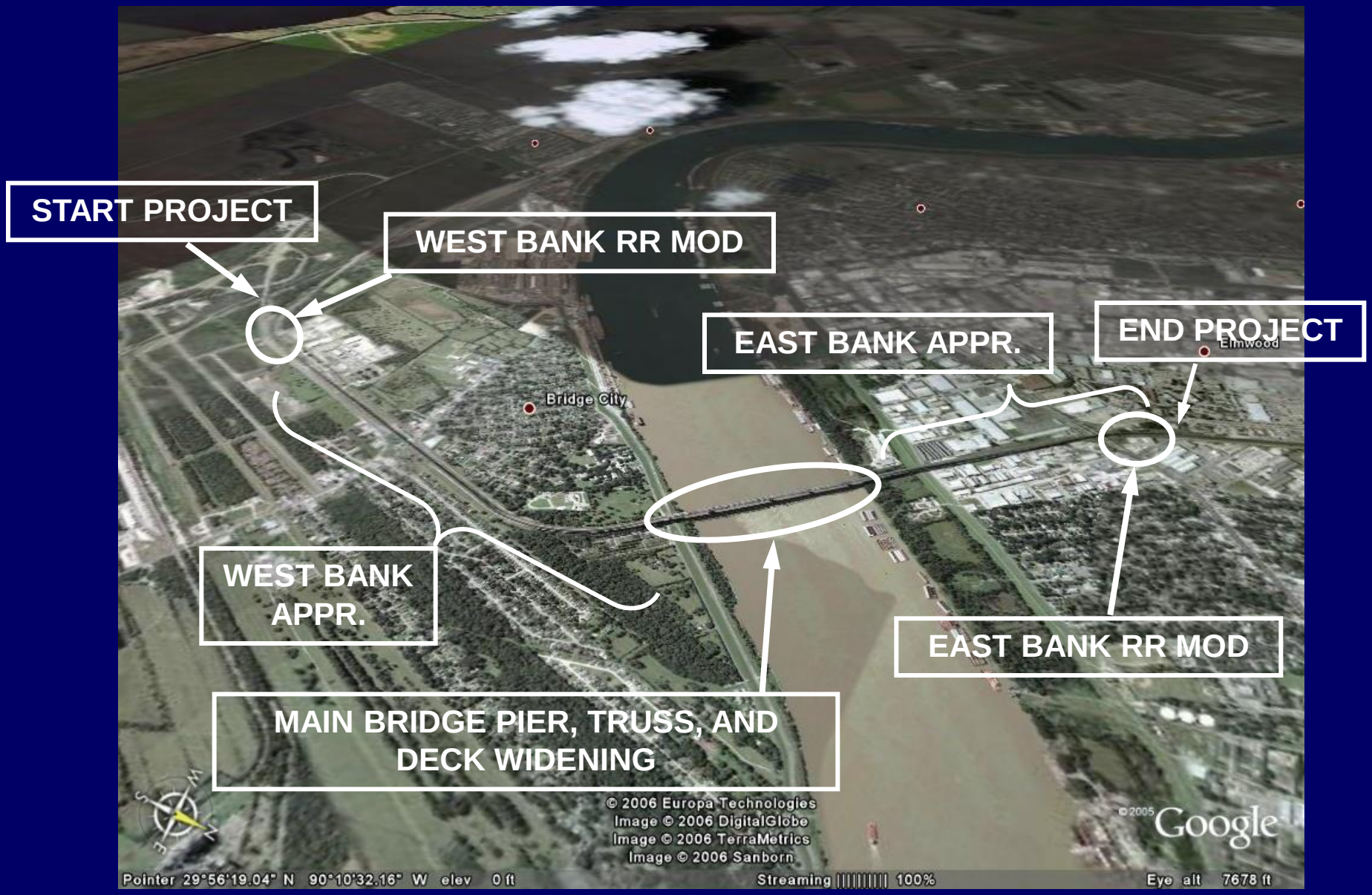
Background – Huey P. Long Bridge

- Combined railroad – highway bridge
- 2 tracks
- 4 lanes – 9 ft. width

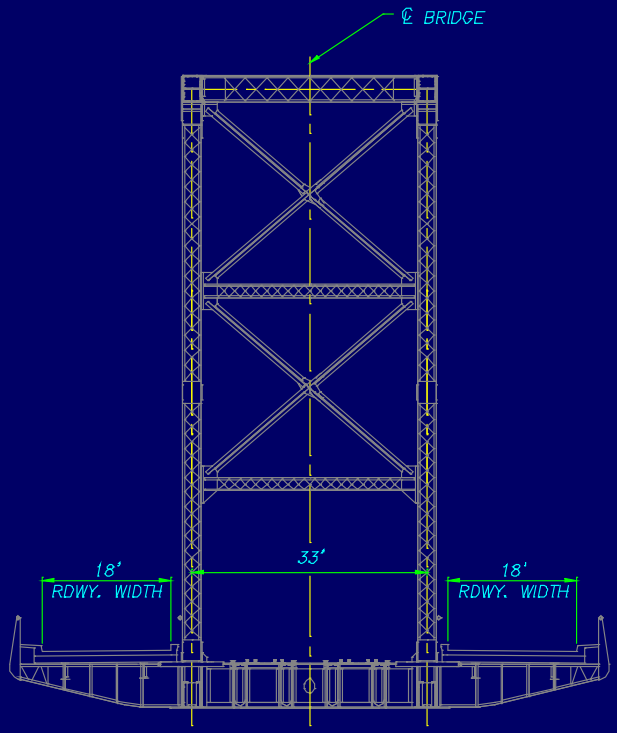
Background – Huey P. Long Bridge

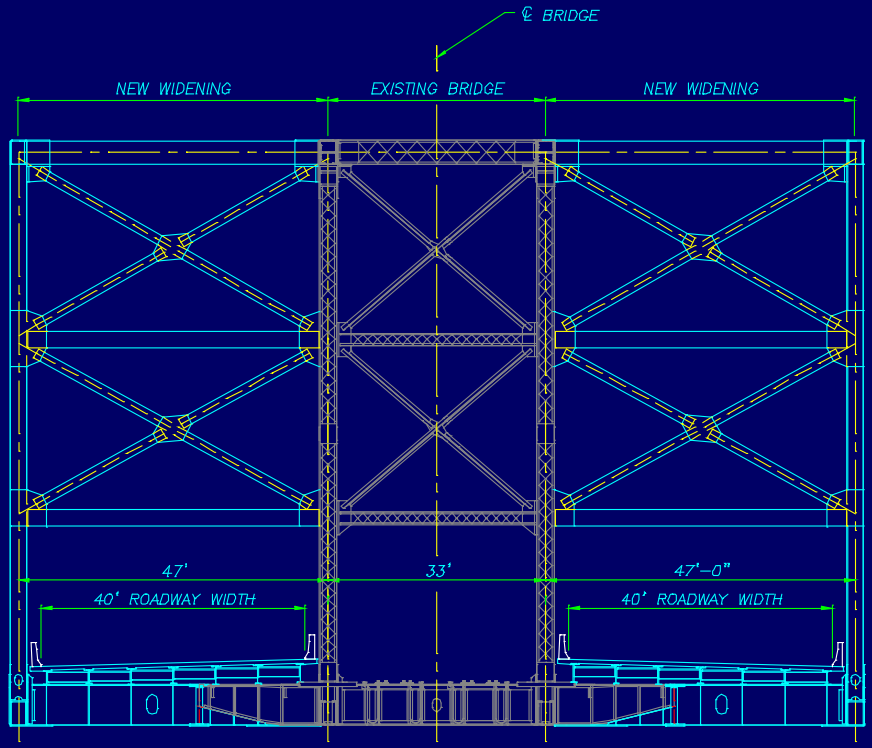
- Very heavily built
- Carries largest modern RR load without distress
- Many years of service life remaining

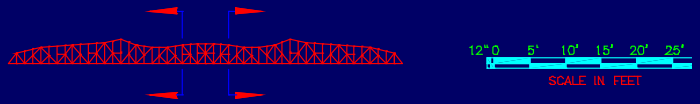
Huey P. Long Widening Project



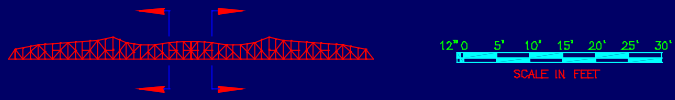
Project Background - 1986





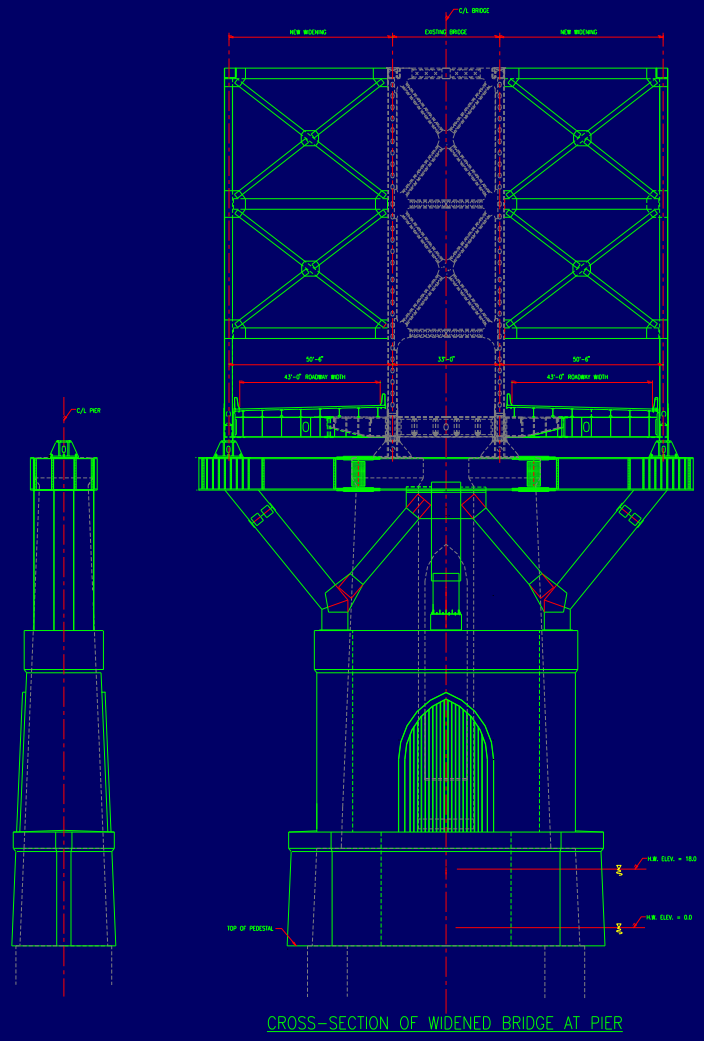


EXISTING



PROPOSED WIDENING

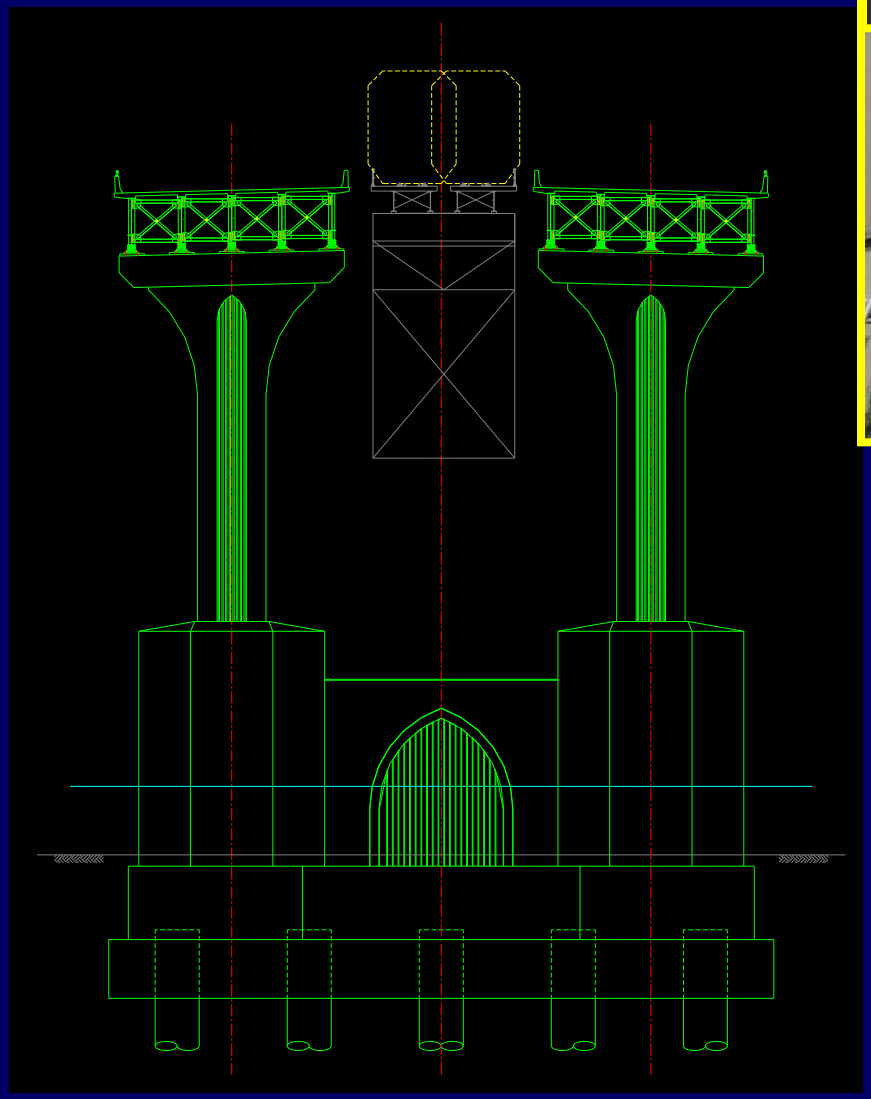
Widened Main Bridge Features

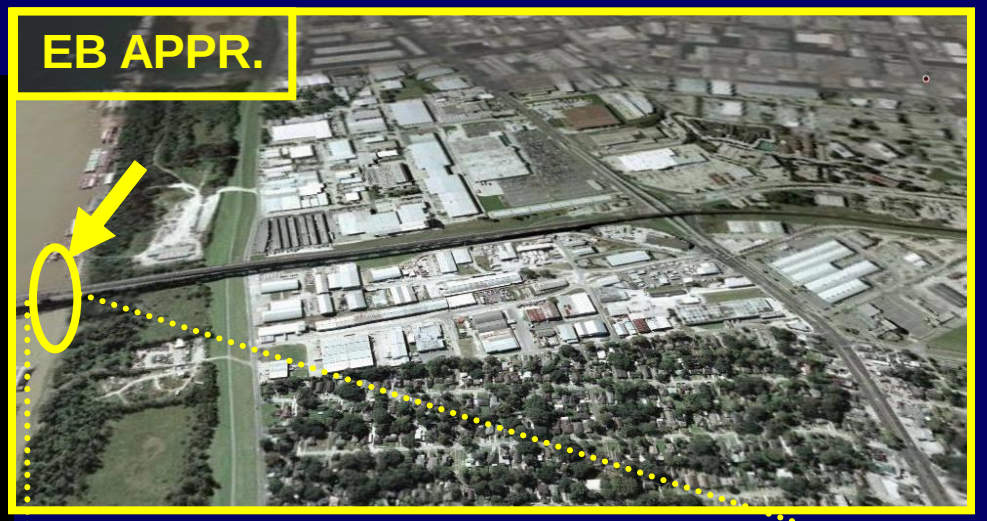


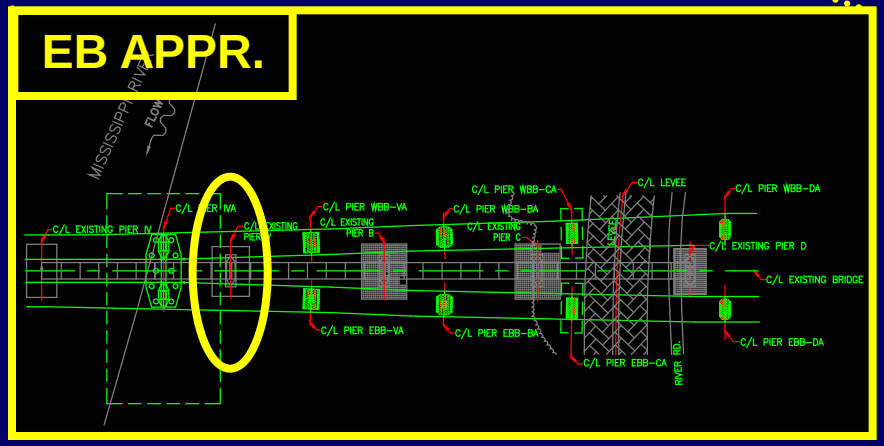
CROSS-SECTION OF WIDENED BRIDGE AT PIER

- 2 new trusses added, parallel to existing trusses.
- Roadways widened from 18 ft. to 43 ft.
- Currently: 2 – 9 ft. lanes
  No offset
- Proposed: 3 – 11 ft. lanes
  8 ft. shoulder
  2 ft. offset

Approaches & Deck Widening







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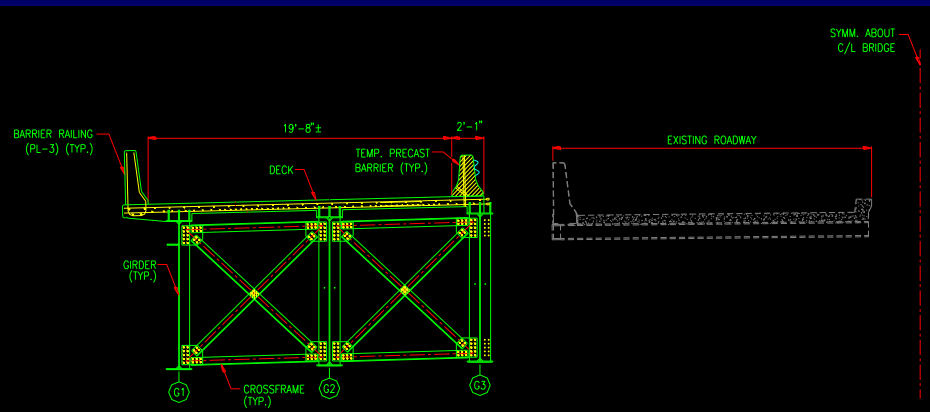
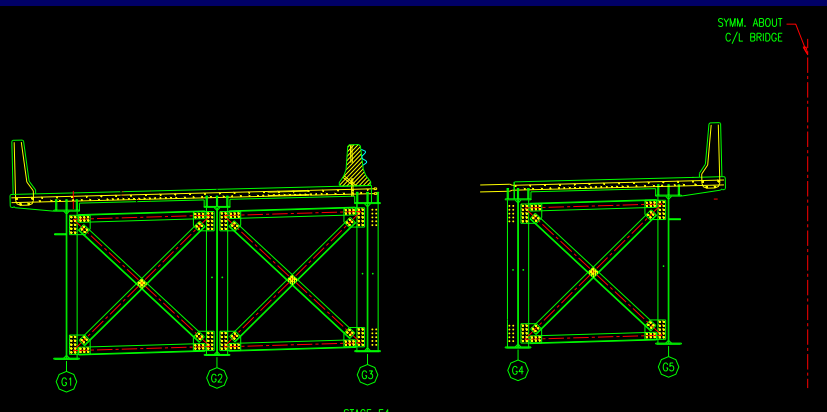


STAGE E1
(LOOKING UPSTATION)

SUGGESTED SEQUENCE OF CONSTRUCTION

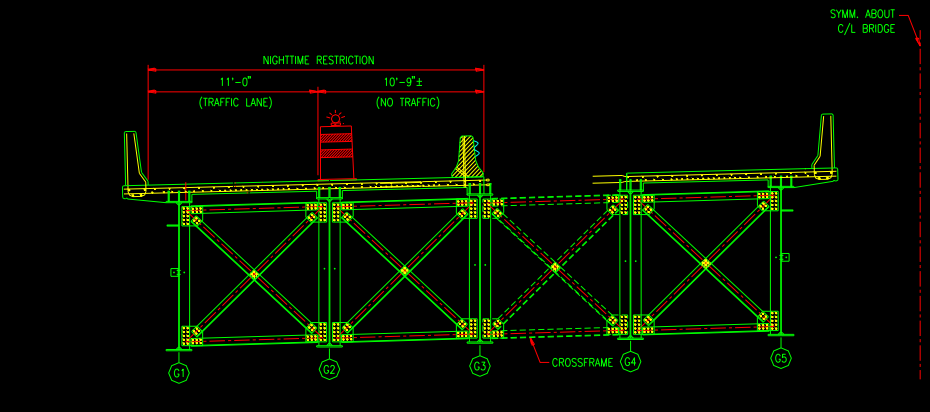
1. ERECT THREE (3) GIRDER UNIT (G1, G2, G3) WITH CROSSFRAMES.
2. INSTALL LATERAL BRACING BETWEEN G1 & G2.
3. POUR THREE (3) GIRDER DECK SECTION.



STAGE E4
(LOOKING UPSTATION)

SUGGESTED SEQUENCE OF CONSTRUCTION

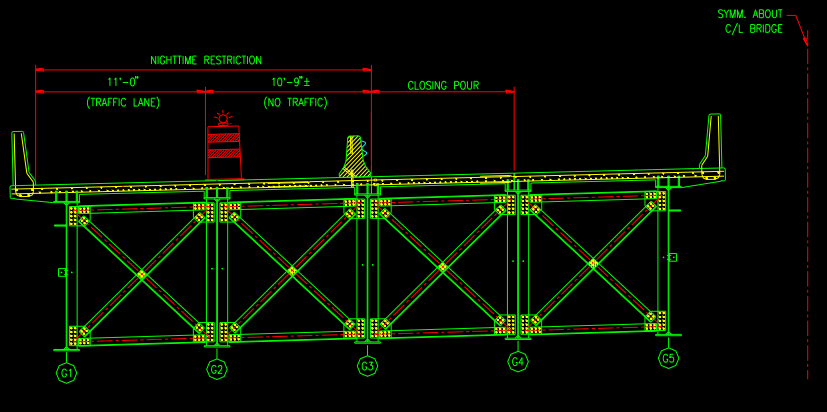
1. DEMOLISH EXISTING ROADWAY.
2. ERECT TWO (2) GIRDER UNIT WITH CROSSFRAMES BETWEEN G4 & G5.
3. INSTALL LATERAL BRACING BETWEEN G4 & G5.
4. POUR TWO (2) GIRDER DECK SECTION.



STAGE E4
(LOOKING UPSTATION)

SUGGESTED SEQUENCE OF CONSTRUCTION

1. PROVIDE CROSSFRAMES BETWEEN G3 AND G4 DURING NIGHTTIME RESTRICTION.

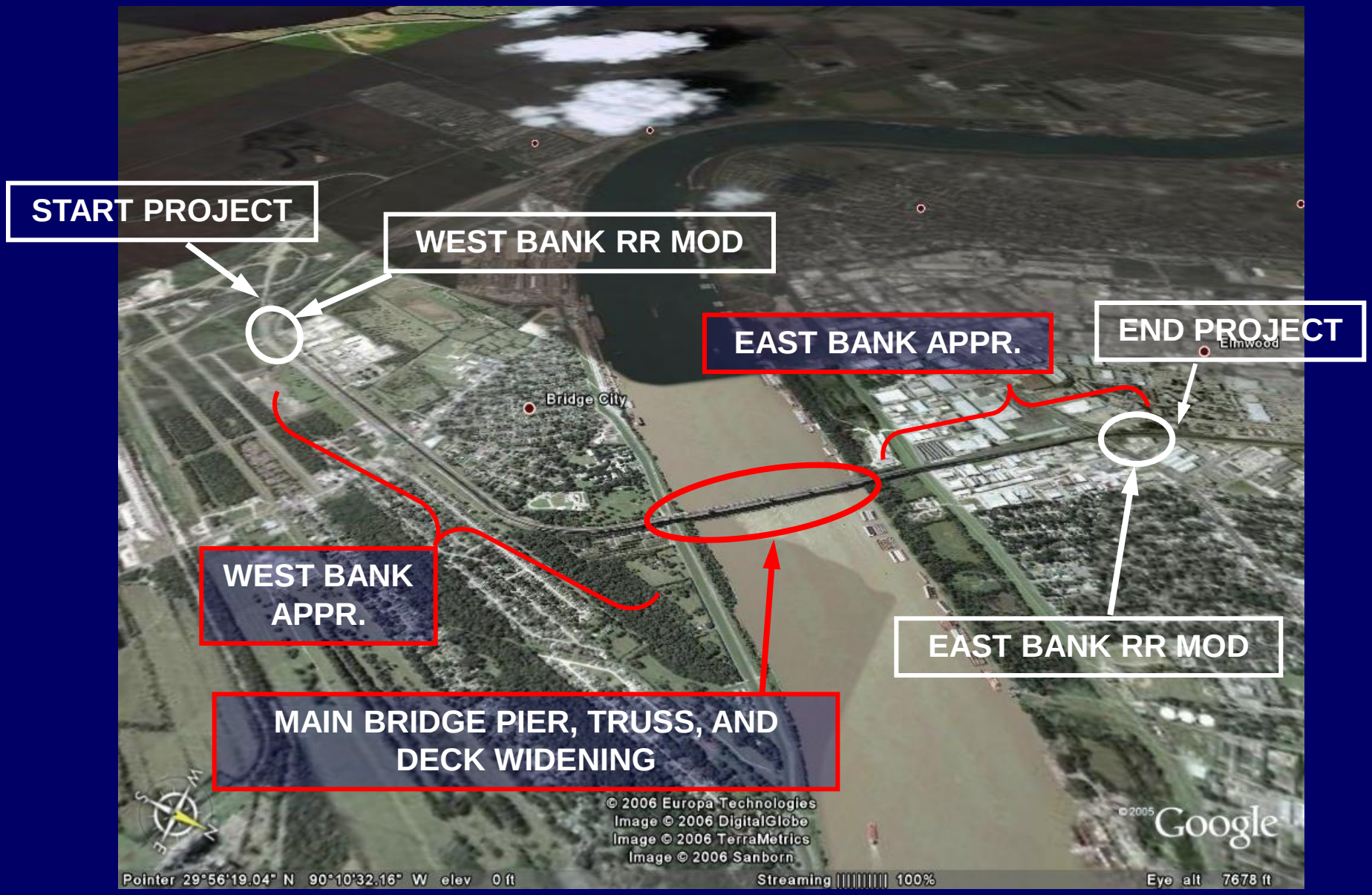


STAGE E4
(LOOKING UPSTATION)

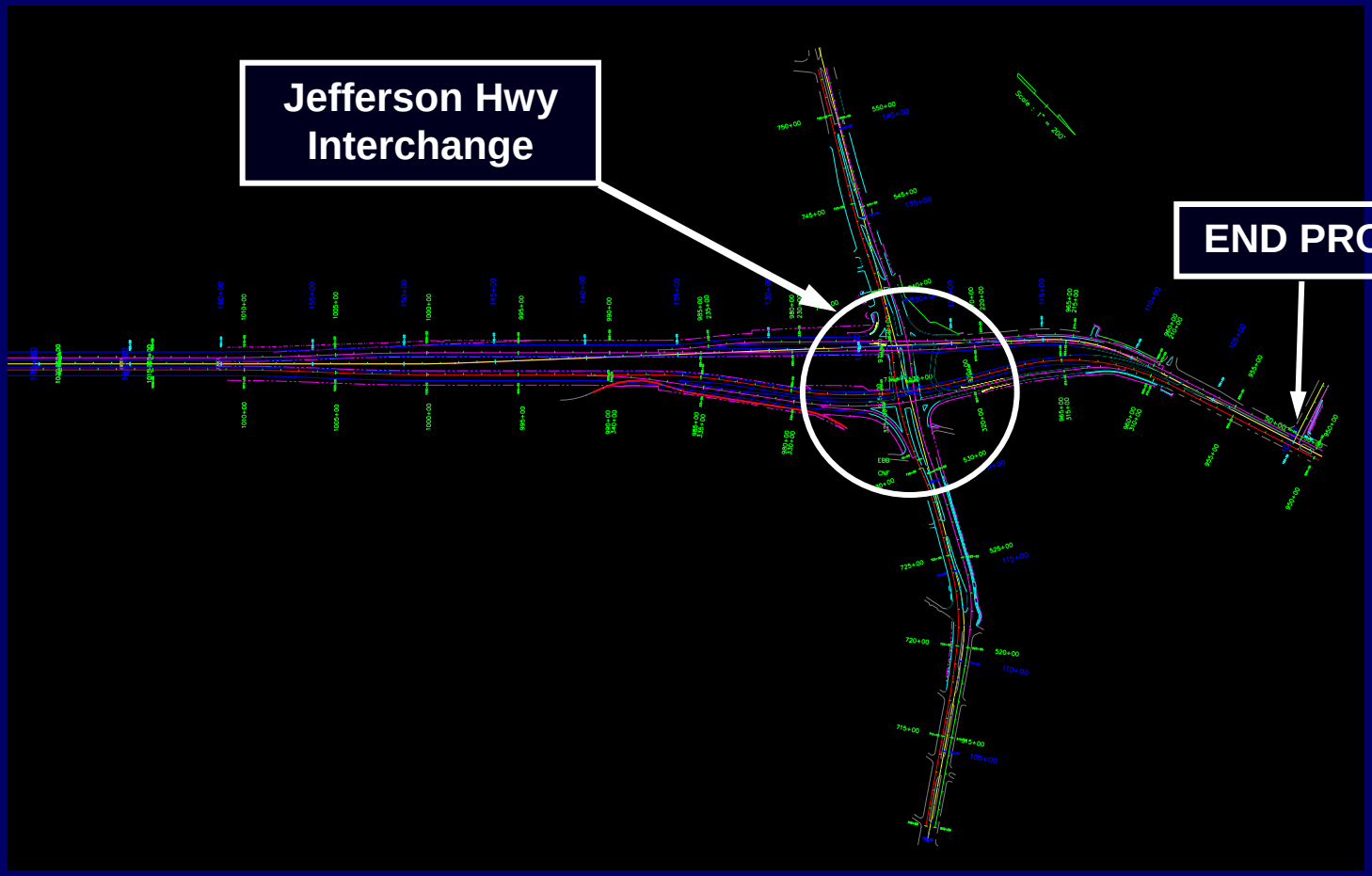
SUGGESTED SEQUENCE OF CONSTRUCTION

1. PROVIDE CLOSING POUR DURING NIGHTTIME RESTRICTION.

Approaches & Deck Widening



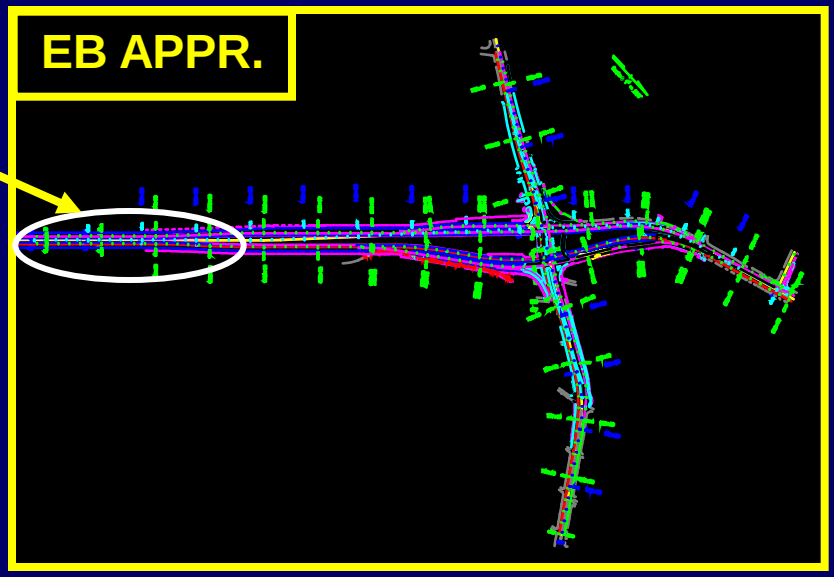
Approaches & Deck Widening

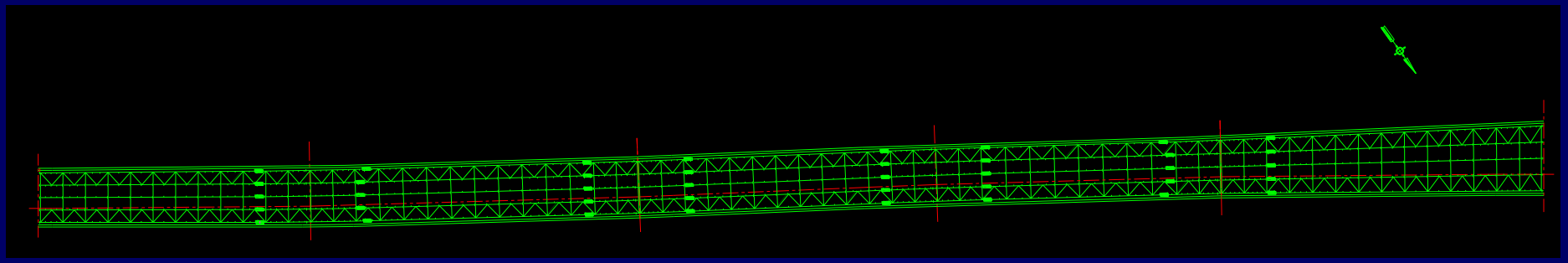


East bank Approach

Approaches & Deck Widening

Location of East Bank Steel Girder Spans

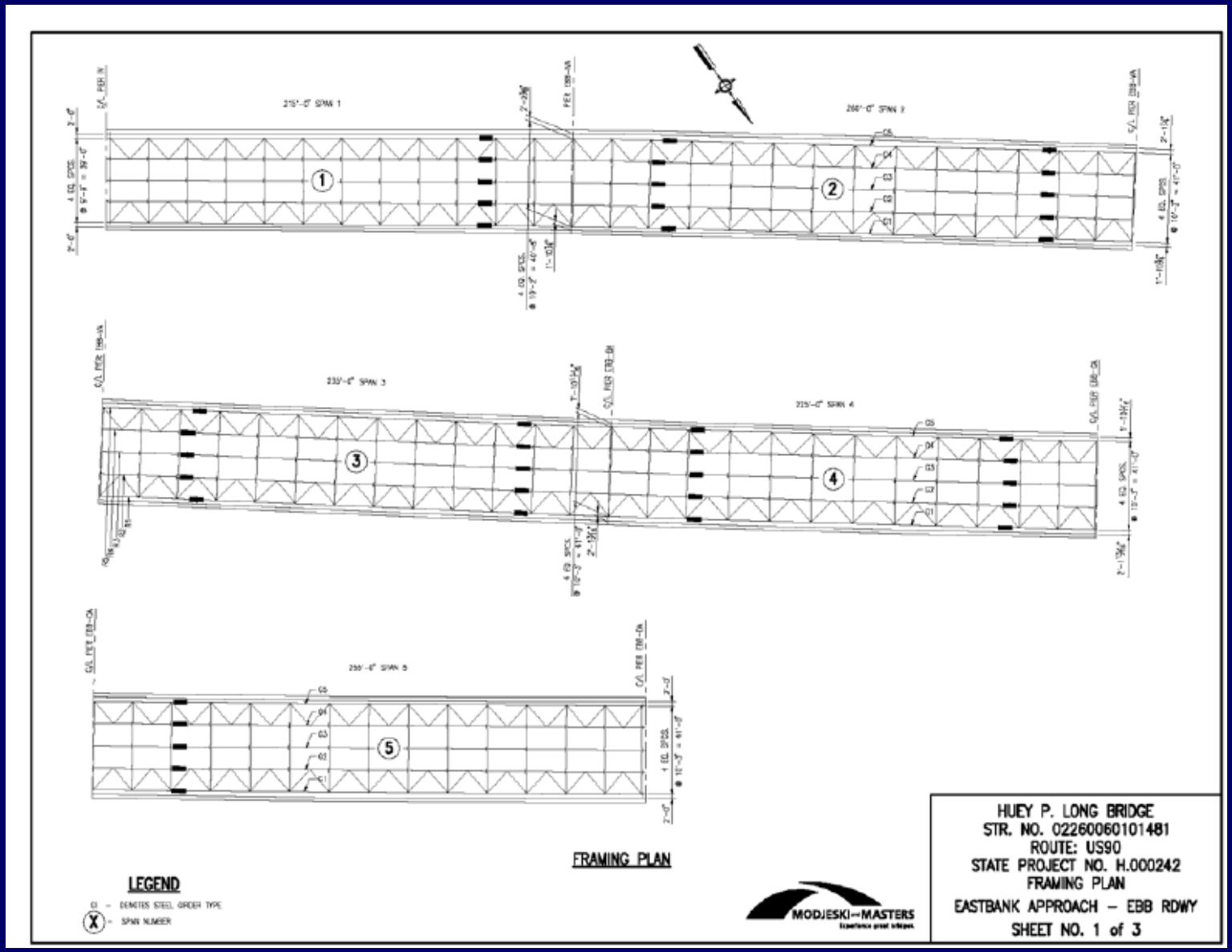




East Bank Approach

West Bank Bound

Approach Geometry - EB



Modeling Approach - EB

- Girders only curved at 60-foot long sections at piers
- Allowed them to be modeled as straight
- Splayed girders
  - BrR allows girders to be splayed
  - Only allows for uniform splay from beginning to end
  - HPL EB has splay transition to uniform spacing

Modeling Approach - EB

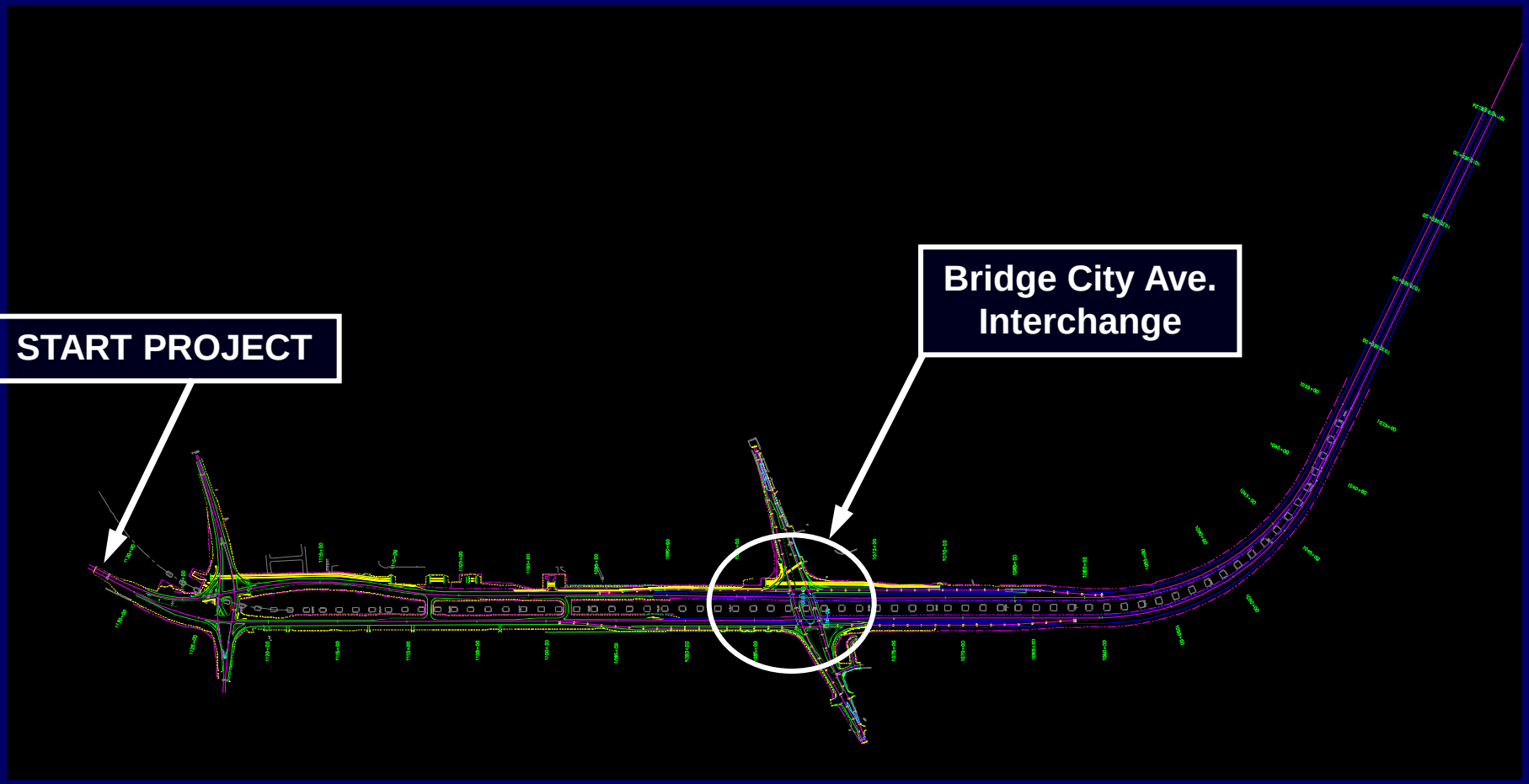
- Splayed girders (cont)
  - Modeled constant girder spacing
  - Adjusted DL
  - Adjusted LL Distribution Factors
- Issue with Computed Distribution Factors
  - Longitudinal Stiffness Parameter K_g
  - Spec says Lever Rule may be used in lieu of DF equations

Modeling Approach - EB

- Issue with Computed Distribution Factors (cont.)
  - Lever Rule use resulted in low ratings
  - Resorted to 3D FEA analysis
  - Client wanted to use simplified line girder analyses when possible
  - Generated a revised model with computed/user defined DF
  - Ratings improved, close to 3D FEA

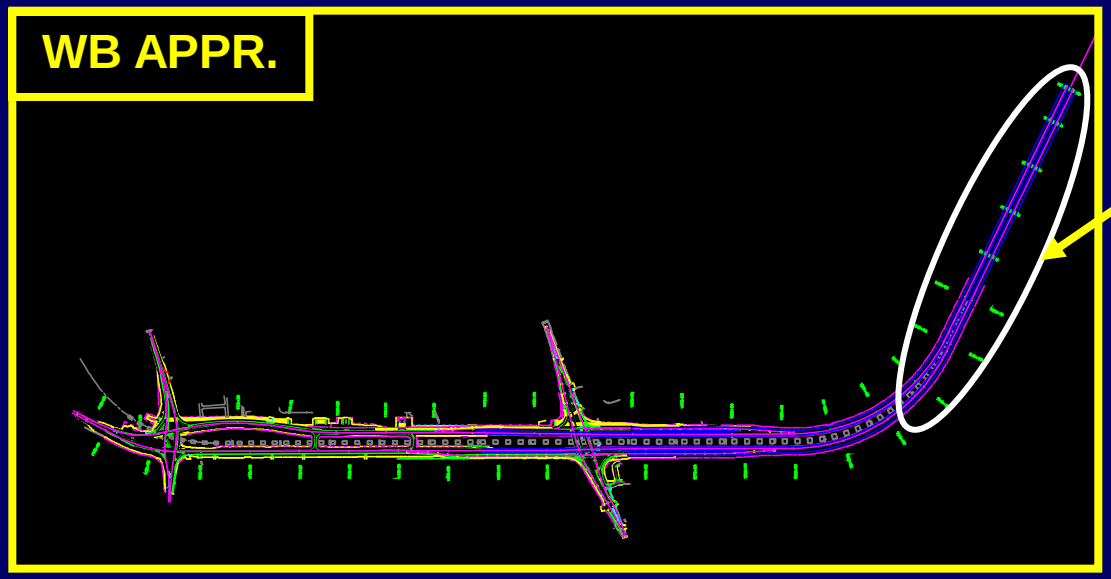
Approaches & Deck Widening

Approaches & Deck Widening

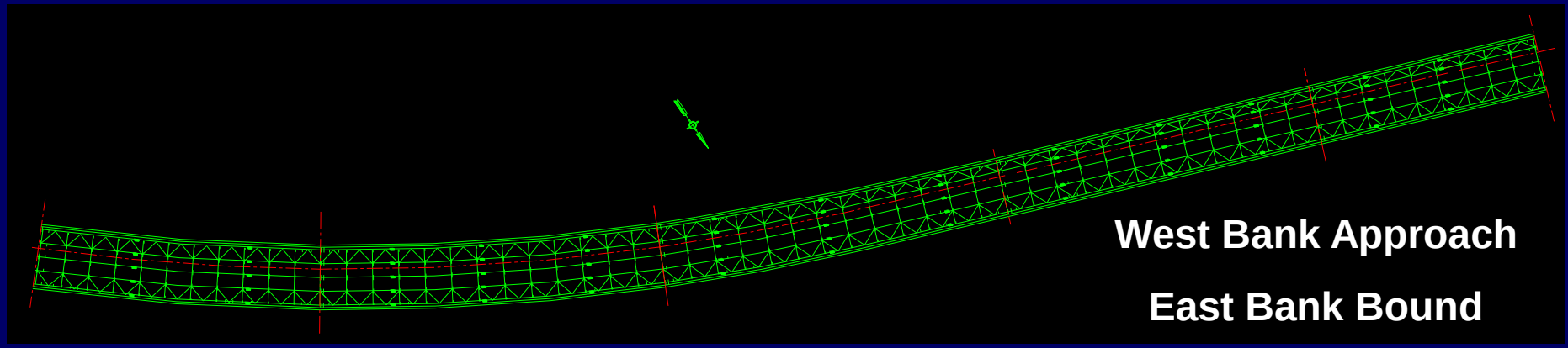


West bank Approach

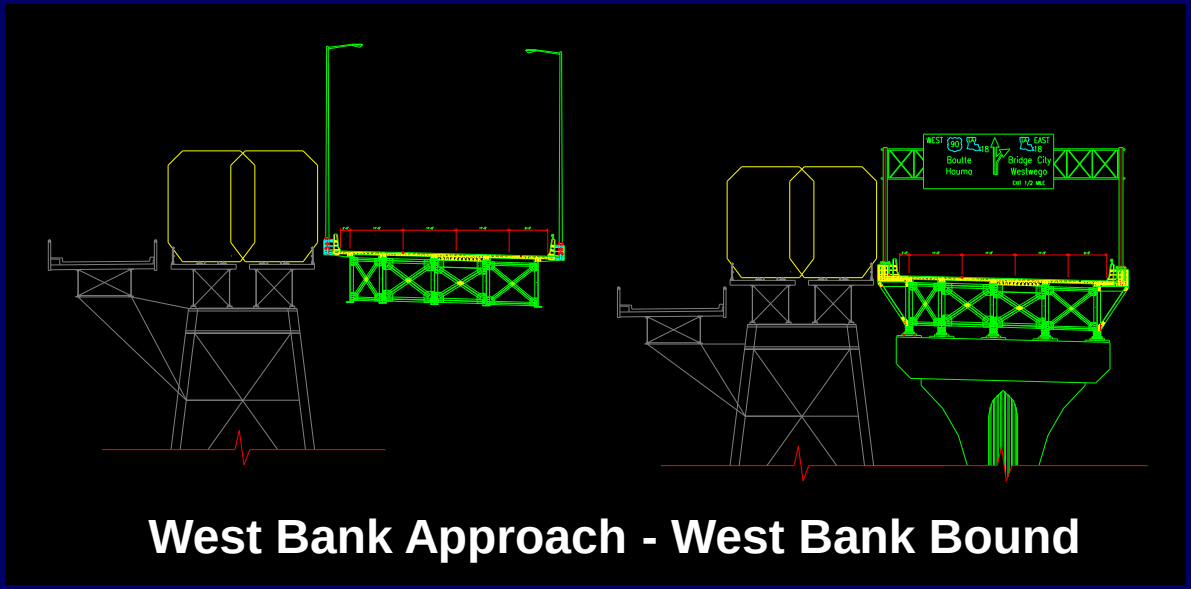
Approaches & Deck Widening



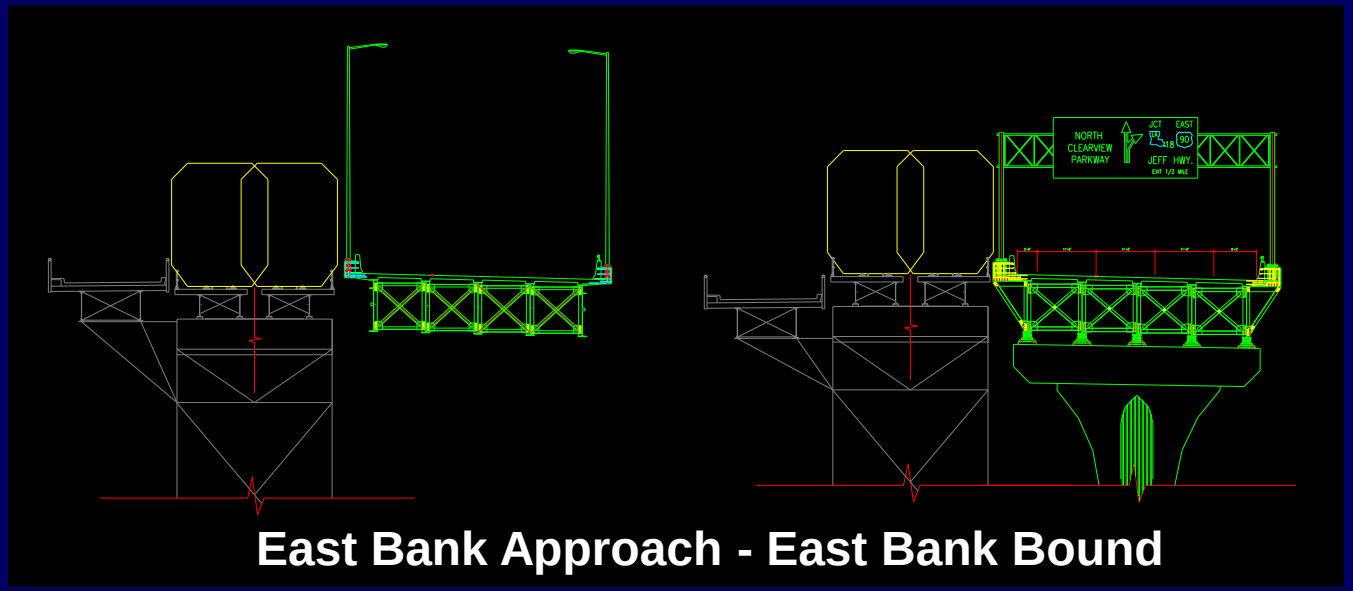
Location of West Bank Steel Girder Spans



Approaches & Deck Widening

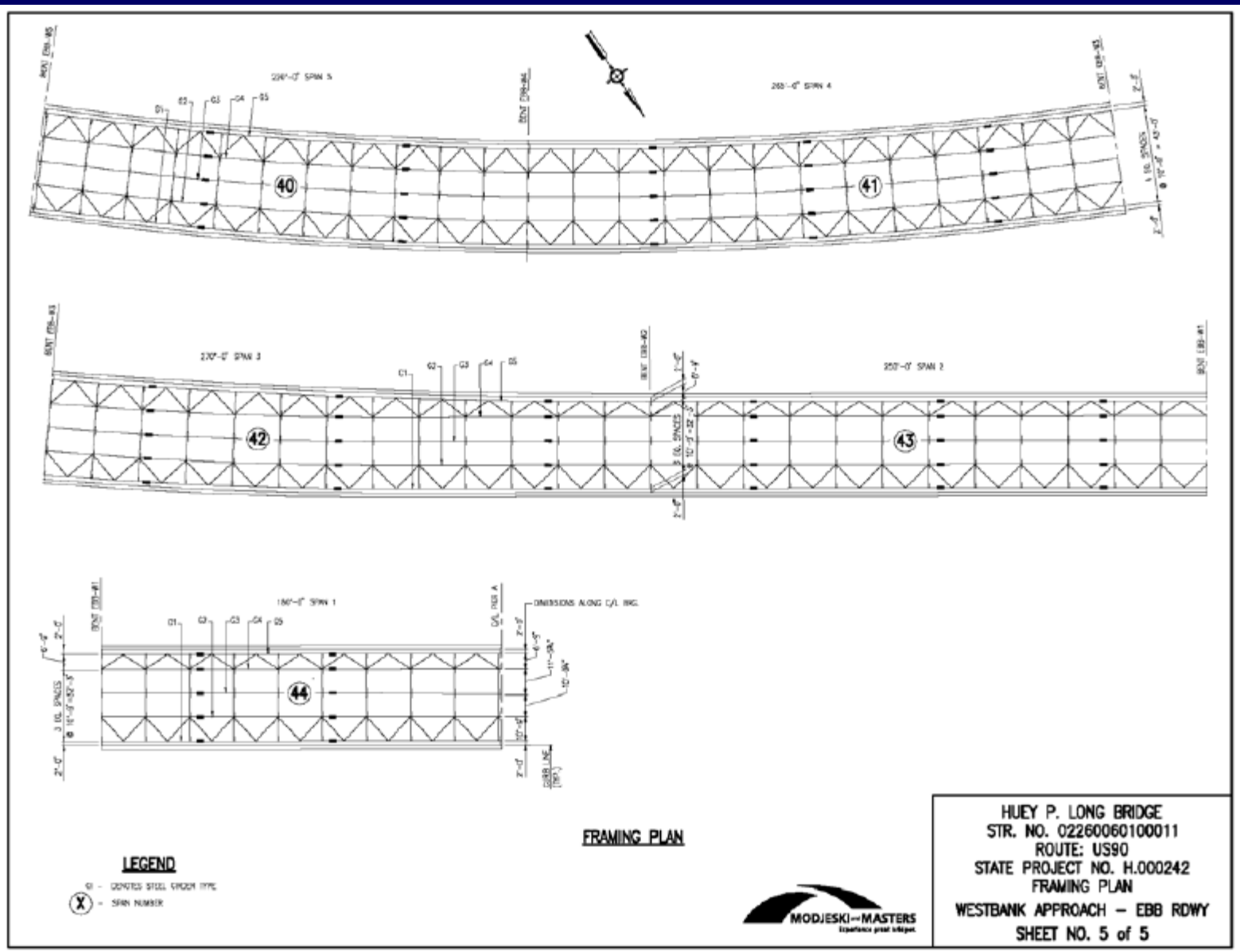


West Bank Approach - West Bank Bound



East Bank Approach - East Bank Bound

Approach Geometry - WB



Modeling Approach - WB

- Bridge Curved with Tangent
  - 2 Straight, Splayed Spans
  - 3 Curved Spans
  - Needed two separate models, each containing 5-spans
  - Straight model with splayed spans
  - Curved model with tangent spans
  - Neither model entirely representative

Modeling Approach - WB

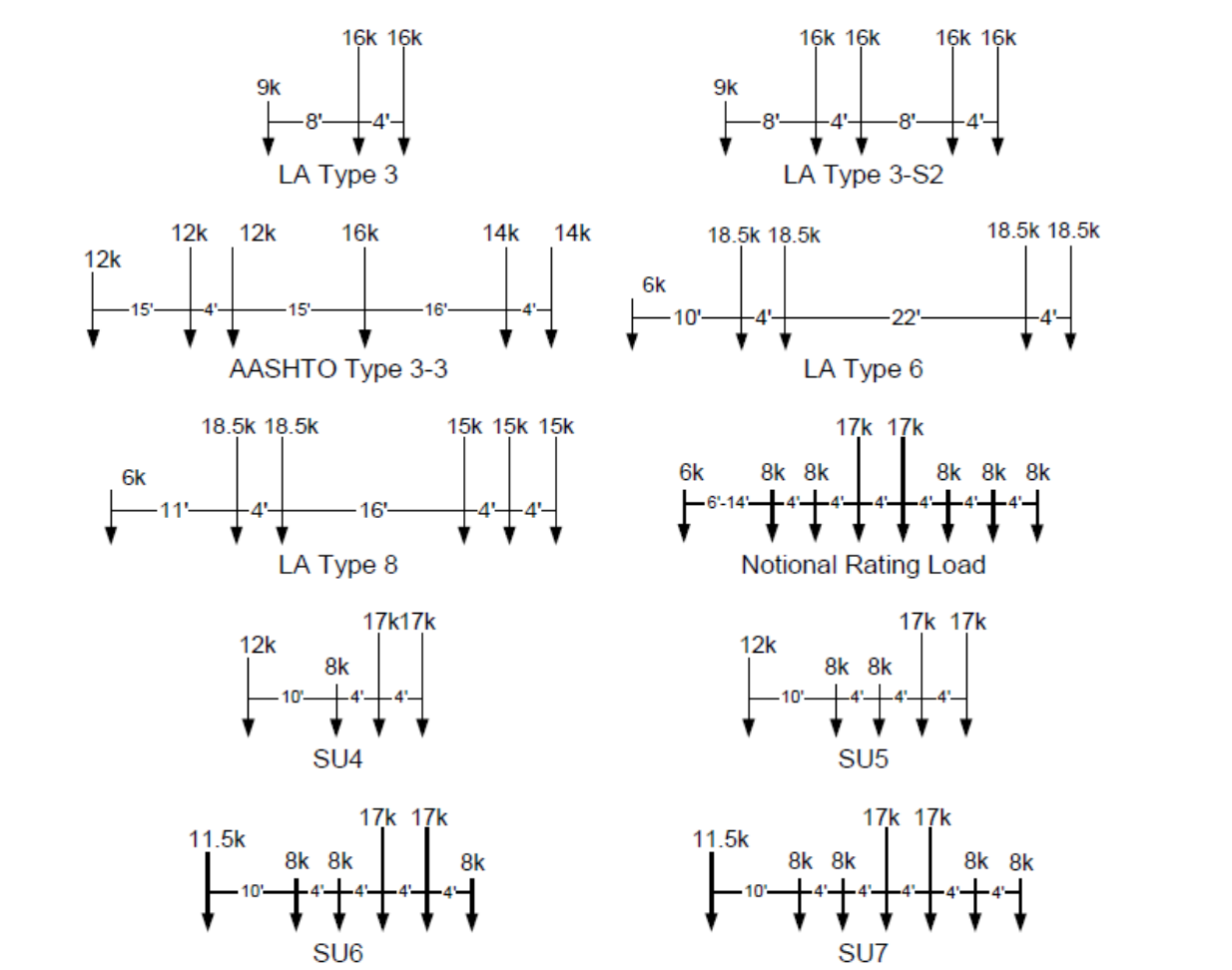
- Bridge Curved with Tangent
  - Defined geometry of each “submodel” such that geometry of section of interest was close to “as-built”
  - Modified dead loads
  - Used 3D FEA for curved submodel
  - Girder lengths in model differ from plans
    - Used proportional distances
    - Affects plate lengths, cross frames, stiffeners…

Rating Criteria

- 2nd Ed MBE up to 2014 Interims
- LRFR
- HL-93 Live Load
- LA State Legal Loads and SHVs
  - 10 additional trucks
  - Plus special lane loads for Spans > 200 ft

Rating Criteria

- LA State Legal Loads and SHVs



Rating Challenges

- Large Volume of Input
  - Four Separate Parallel 5-span, 5-Girder structures
  - Sub-Models increased number of structures to six
- Modeling approximations
  - Plans did not match models
- Performed Strength and Fatigue Ratings
  - EB Structure longitudinally and vertically stiffened
- Very large volume of output

Rating Challenges

- Input data
  - Used extensive spreadsheet calculations for input geometry
  - Cut and paste would have been big time saver
  - Found way to automate
  - Precision an issue
    - Small gaps
    - program generated nodes

Rating Challenges

- Output data
  - Lots of data to sort through
  - Client wanted controlling capacity and ratings for each span and vehicle
  - Imported XML reports into Excel
  - Macros to process
  - Fatigue
    - Many points generated
    - Needed to use POI for Cat “C” shear connectors at pier
    - Method to get Fatigue Report data in XML
    - Macros and XML Data big time saver

Rating Challenges

- Run Time
  - Up to 5+ Hours per run per girder
  - Going to be an issue for quick turnaround of permit ratings
  - Better hardware
  - Software modernization (parallel processing)
- Some unexplained program crashes
- RF=99 error
- NSG for Rating Vehicle
  - Could not use
  - Reverted to Standard Gauge

Possible Enhancements

- Cut-and-Paste tabular input
- Framing plan geometry
  - Varying girder splays
  - Define girder spacing at each pier
- Fatigue reports – more user friendly
- NSG fixes

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