Joint Elimination as a Preservation Technique

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Why Joint Elimination?

1. Degradation due to water penetration.
2. “Fixed” is not truly fixed.
   - Cantilever substructures are flexible.
3. Theoretical expansion is based on ambient air temperatures vs. beam temperature.
4. Continuous bridges respond better to seismic forces.
5. Can increase live load capacity.
6. More aesthetically pleasing.
7. Overall life cycle cost savings.

Longest Jointless Bridges in the US

Longest Jointless **Steel** Bridge in the U.S. – Bradley Ferry Road over Obion River, Dyer County, Tennessee.

538 feet

Longest Jointless Bridges in the US

Longest Jointless **Concrete** Bridge (Bulb T’s) in the U.S. – State Route 50 over Happy Hollow Creek, Hickman County, Tennessee.

1,975 feet

Longest Jointless Bridges in the US

Longest Continuous Bridge (PS Concrete) between Joints Bridge in the U.S. – I-26 over South Fork Holston River, Tennessee.

2,550 feet

Longest Jointless Bridges in the Pennsylvania

- Steel Superstructure – Integral abutments
  - District 1-0, SR 8 over Oil Creek

373 feet

- Concrete Superstructure – Integral abutments
  - District 2-0, I-99 over Laurel Run

679 feet

Limitations with Removing Joints?

- Empirically based standards that vary from state to state.
- Lack of simplified design procedures.
- Vague guidance from AASHTO LRFD Bridge Design Specification:

14.5.2.1—Number of Joints

"The number of movable deck joints in a structure should be minimized. Preference shall be given to continuous deck systems and superstructures and, where appropriate, integral bridges."

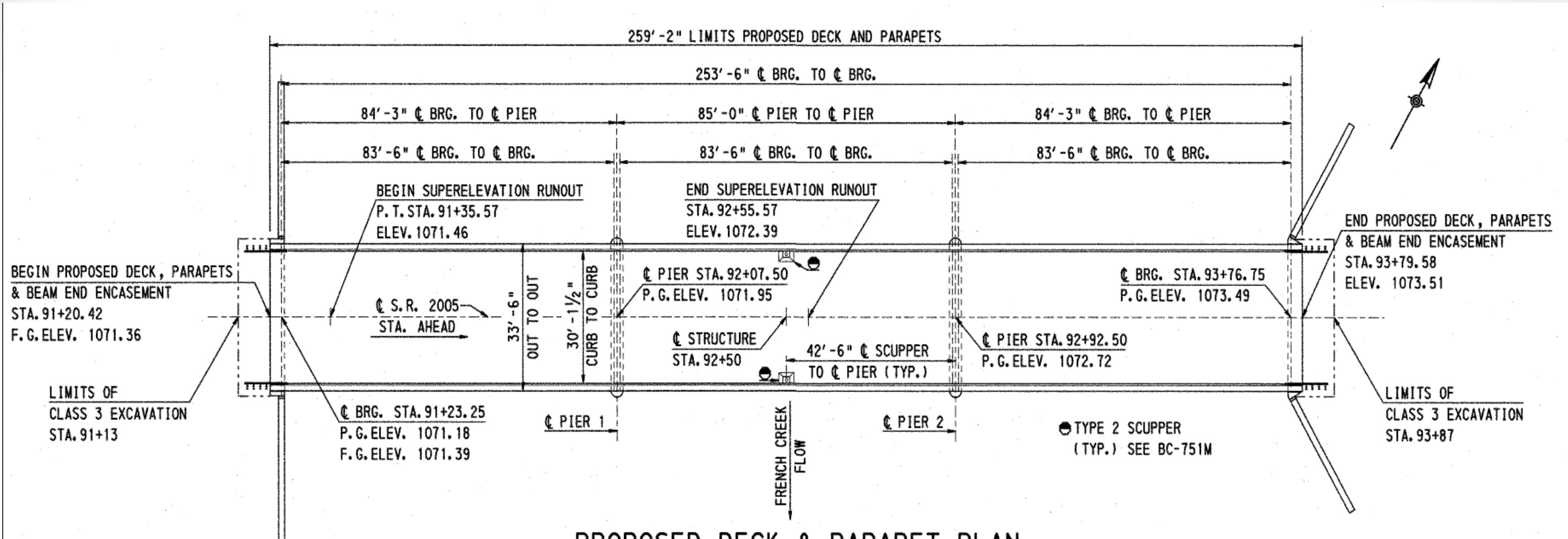
Example 1: Three Span, Simple Span Made Continuous for Live Load. <u>All 4 Joints Eliminated</u>

Constructed 1968

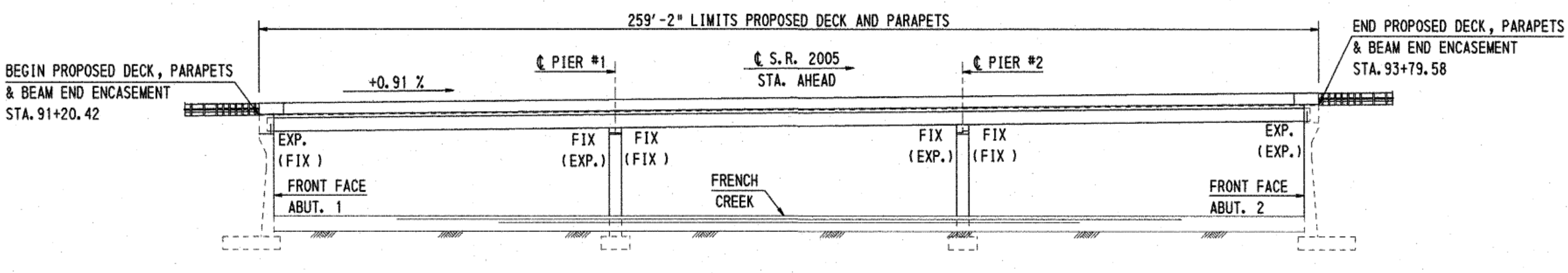
SCOPE OF WORK

1. Remove existing deck, backwalls and bearings.
2. Construct new pedestals.
3. Paint beam ends.
4. Retrofit Bridge for New Loading Configuration
    - Add cover plates and compression blocks to bottom flanges in negative moment regions.
5. Place new expansion bearings, new deck and beam end encasements.

Plan & Elevation



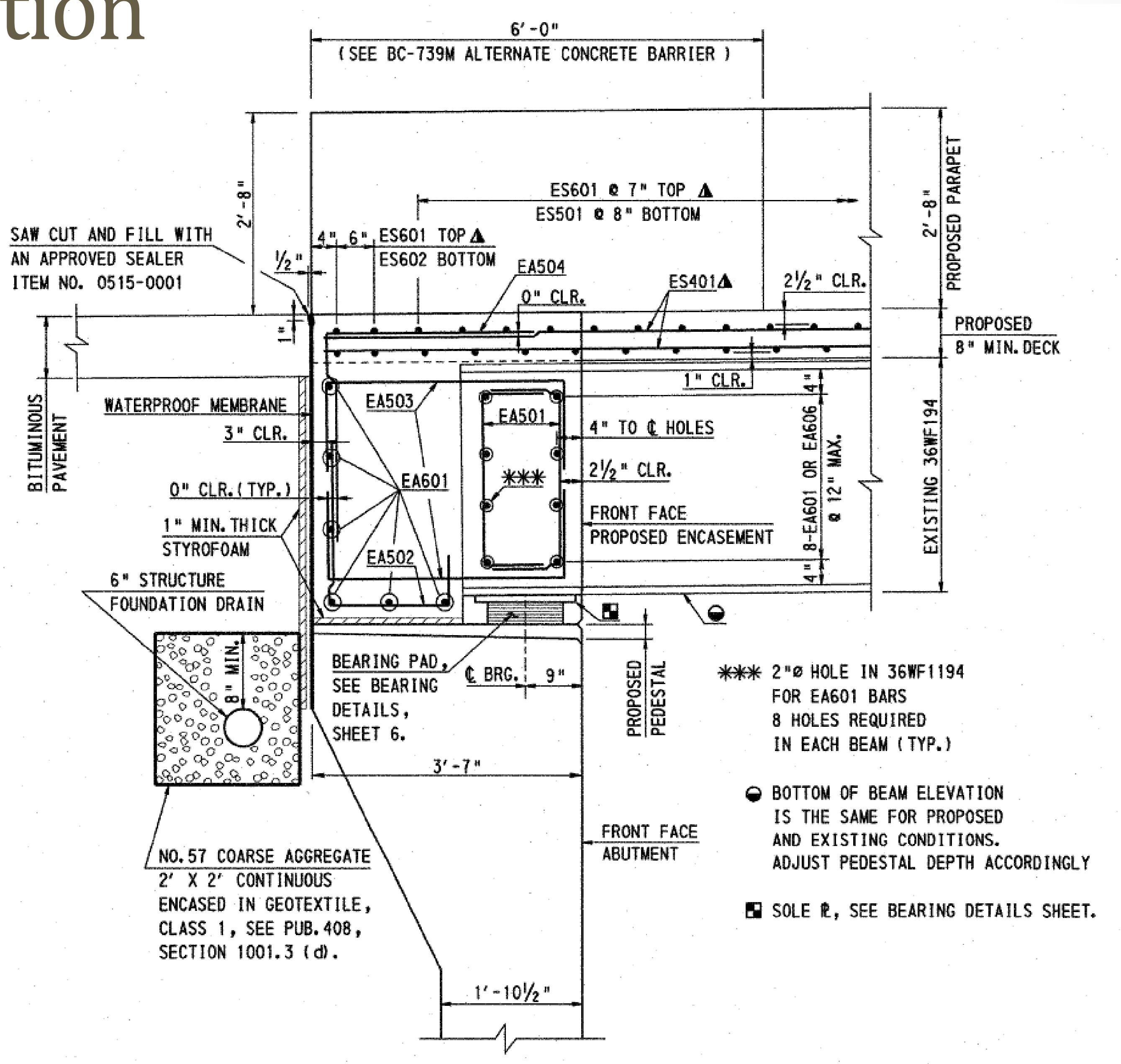
PROPOSED DECK & PARAPET PLAN



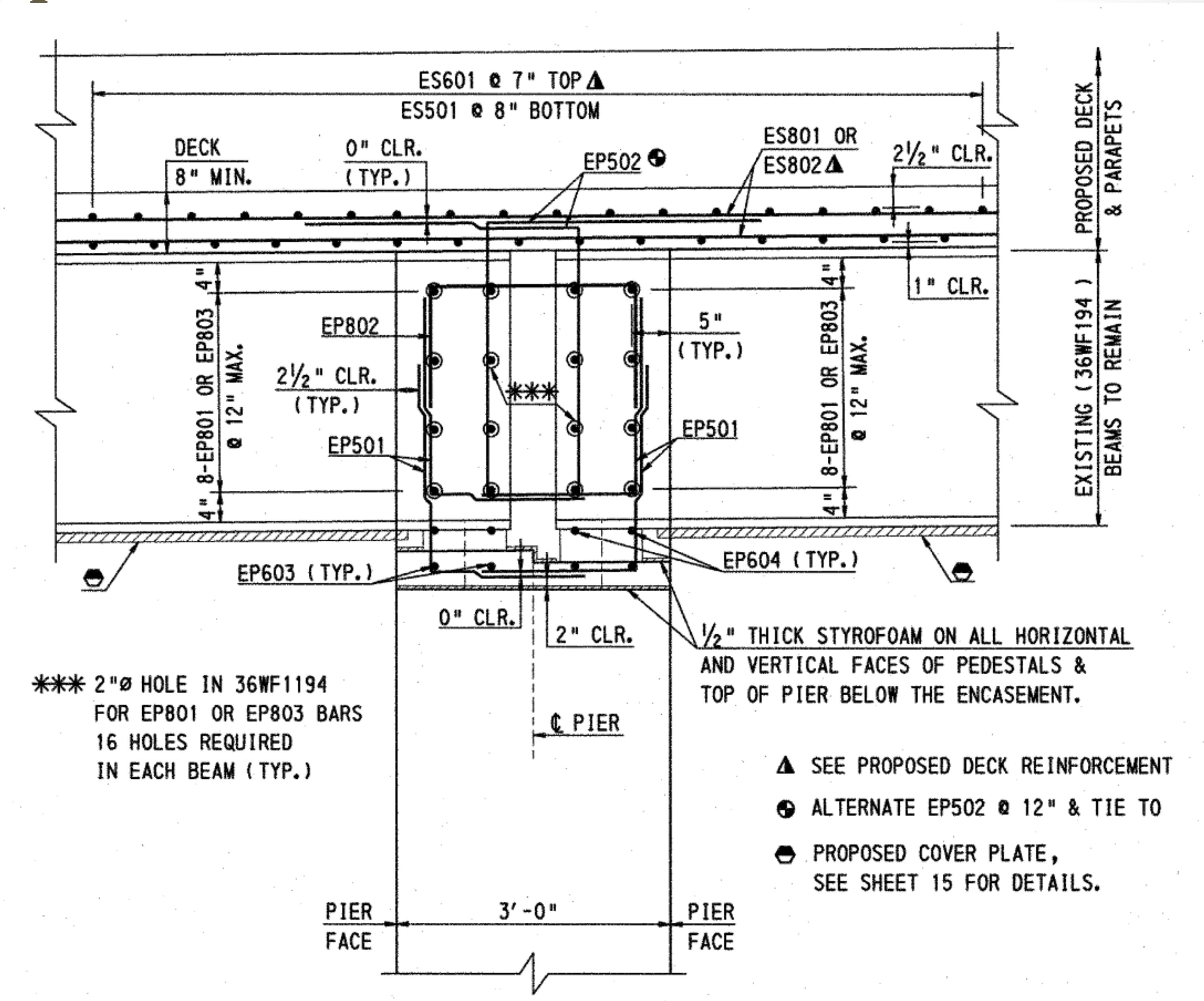
PROPOSED ELEVATION

NOTE: FIXITY IN ( ) INDICATES THE EXISTING CONDITION.
SEE EXISTING PLANS, (S-8022B).

Typical Abutment Encasement Section



Typical Pier Encasement Section






Compression Block

Beams marked for rebar holes

New Bottom Cover Plate

Painting

Diaphragm Steel

Deck Steel

Finished Product – End Bend 1

Finished Product – Bent 2

Finished Product

Finished Product – Cost $1,119,00

2-Span Steel Stringer Bridge – Previously Non-Composite Simple Spans made Composite and Continuous for LL by Tying Deck and filling Diaphragms

Nine years after construction, No Leaks or Cracks

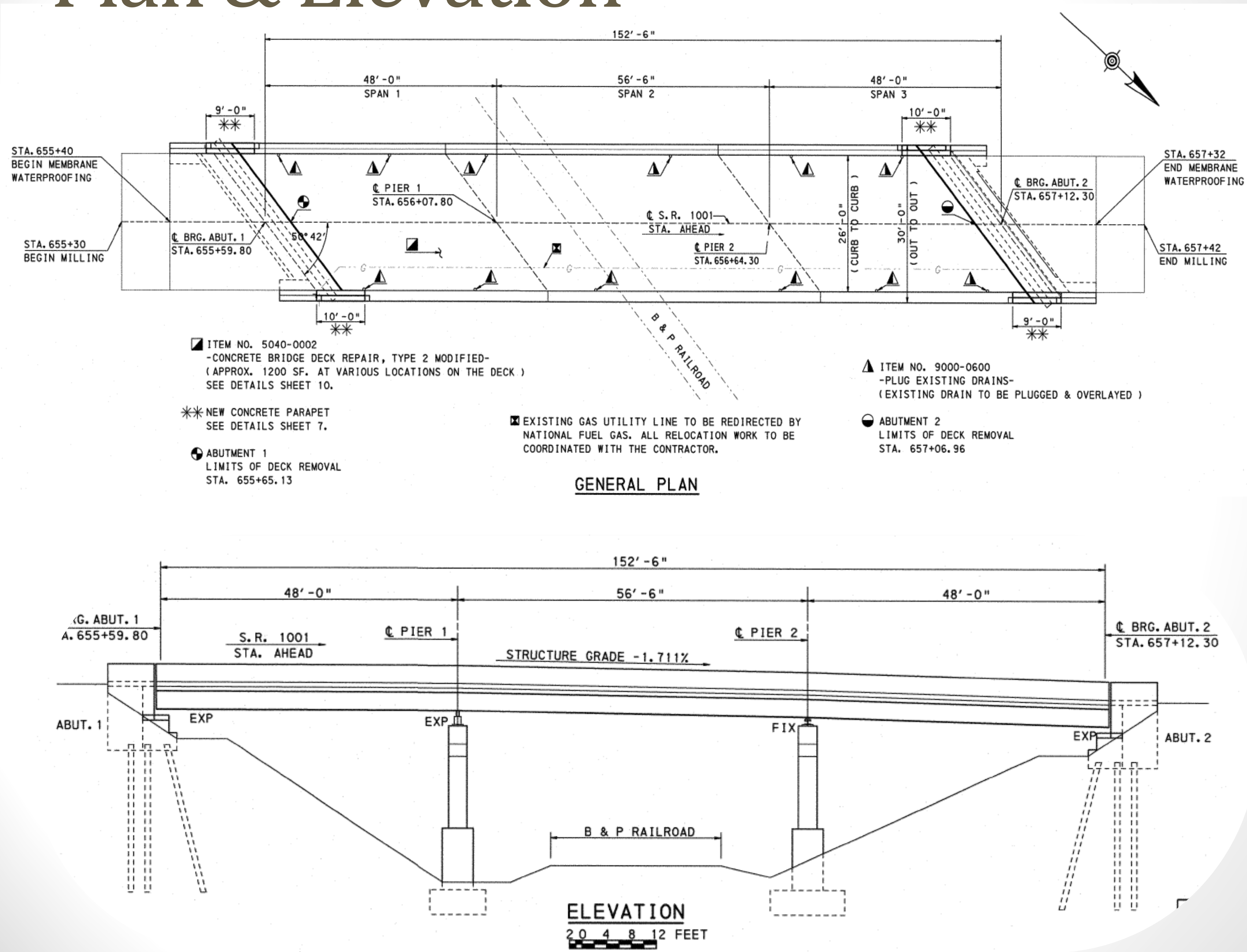
Example 2: Continuous Three Span Steel Beam Bridge over RR. <u>Both Exp. Joints Eliminated</u>

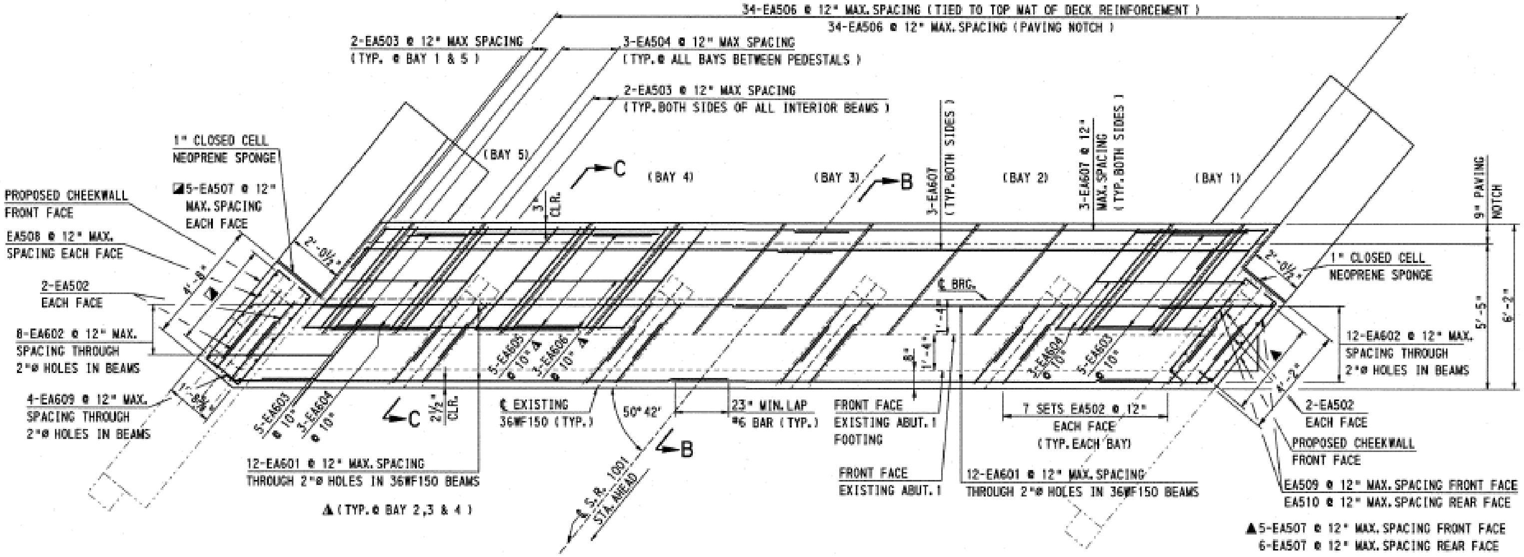
Constructed 1954

SCOPE OF WORK

1. Remove existing AWS, repair concrete deck.
2. Removal of the existing expansion joint and end of the deck and parapets (~7ft).
3. Removal of the backwall, rocker bearings, sole plates and steel diaphragms.
4. Paint beam ends.
5. Construct new concrete pedestals, place new elastomeric bearing pads and encase beam ends in concrete.

Plan & Elevation

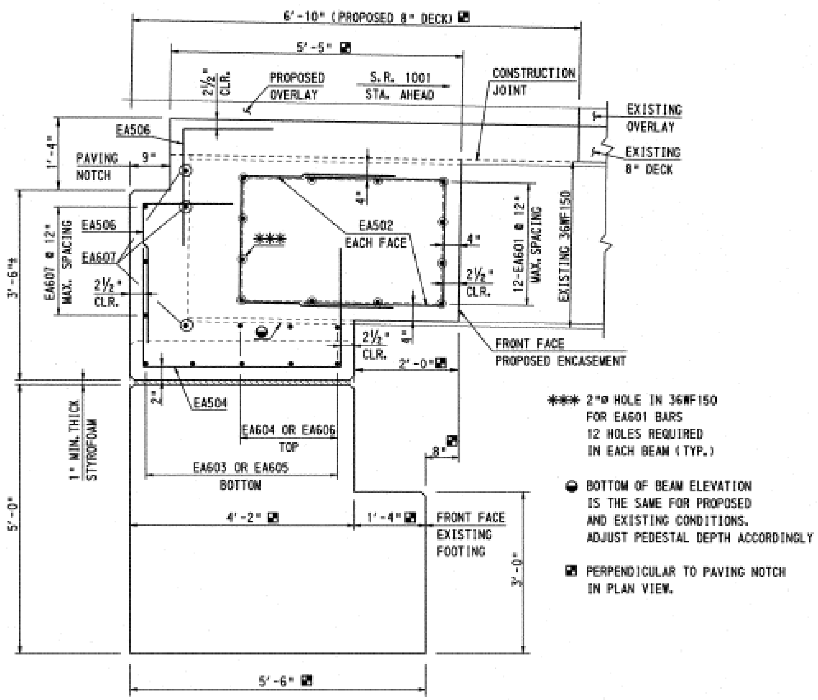




PROPOSED ENCASEMENT REINFORCEMENT PLAN AT ABUTMENT 1

(ABUTMENT 1 SHOWN, ABUTMENT 2 SIMILAR)

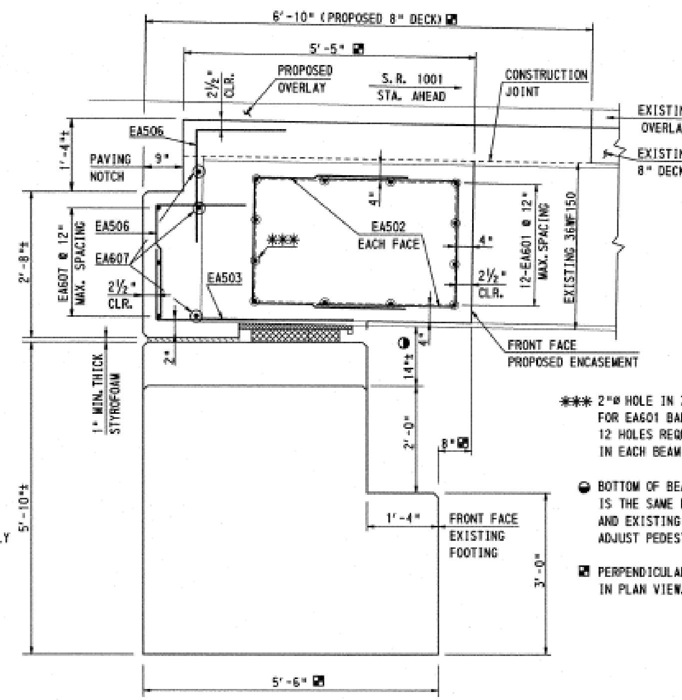
1 0 1 2 3 FEET



SECTION B-B

(ABUTMENT 1 SHOWN, ABUTMENT 2 SIMILAR)

NO SCALE



SECTION C-C

NO SCALE

Deck Repair

Before Concrete Encasement

New Concrete Pedestals

Beam Ends Painted – New Elastomeric Bearings

Reinforcing for Concrete Encasement

Concrete Encasement

Concrete Encasement – Side View

Concrete Encasement – Elevation View
Cost - $730,000

Other Projects

- “Link Slabs” – Deck connection only
- Also called “Partial Continuity”, “Tied Decks” and “Po-Man’s Continuity”.
  - Most Common.
  - Cheapest & Fastest.
  - Quantitative way of calculating the longitudinal tensile stress in deck.
    - (~20% of the full continuity moment)

231FT – 4 SPAN - INTERSTATE OVERPASS WITH NO JOINT

For longer spans, can use expansion joints at the end of integral approach slabs or backwall.

Link Slab w/ Encased Diaphragms

Link Slab w/ Encased Diaphragms

Link Slab w/ Encased Diaphragms

Conclusions

- Typical overpasses are candidates for Joint Elimination.
- Joint Elimination is an accepted preservation practice on bridges up to 300ft for steel and over 400ft for concrete.
- There is a growing body of literature to quantitatively assist the engineer in deciding where to eliminate joints.