
VDOT

2013 VIRGINIA CONCRETE CONFERENCE

LESSONS LEARNED /
CHALLENGES

NOVA MEGAPROJECTS PROGRAM

STRUCTURE AND BRIDGE
FIELD PERSPECTIVE

Fawaz K. Saraf, P.E.

CHALLANGES

- Poor Detailing a challenge on some bridge projects (both D-B and D-B-B)
- Challenge presents itself when a S&B standard is not available for a specific detail.
- At NOVA, almost every bridge constructed nowadays has some sort of an MSE wall system at abutments.
- No standard details available for MSE walls, or specifically, how MSE wall systems interface with abutments, details are developed by the various designers.
- Some of the generated details are good, some are OK, while others are unsatisfactory. OR defy basic structural engineering principles……

- Parapet mounted on moment slab and abutment backwall !!!!
- Two structural systems with two different vertical stiffnesses
- Parapet now a beam supporting moment slab.

Poor
Detailing

Poor Long Term
Performance

Poor detailing at interface with a fully integral abutment

- Single 150’ span with fully integral abutment.
- Parapet / coping mounted on approach slab.
- Parapet / coping mounted on sleeper pad.

Discrete elements locked in by cast-in-place coping.

Detailing Challenges on D-B Projects

In a Design-Build Environment:

- The challenge of making sure that good detailing practices are incorporated into the design is greater.
- Bound by the Design Build Contract.
- Schedules for developing plans / details are usually more aggressive than on D-B-B projects
- Critical details may not be included in Approved For Construction (AFC) plans but deferred to shop drawings phase (to be provided by vendors).

Detailing Challenges on D-B Projects

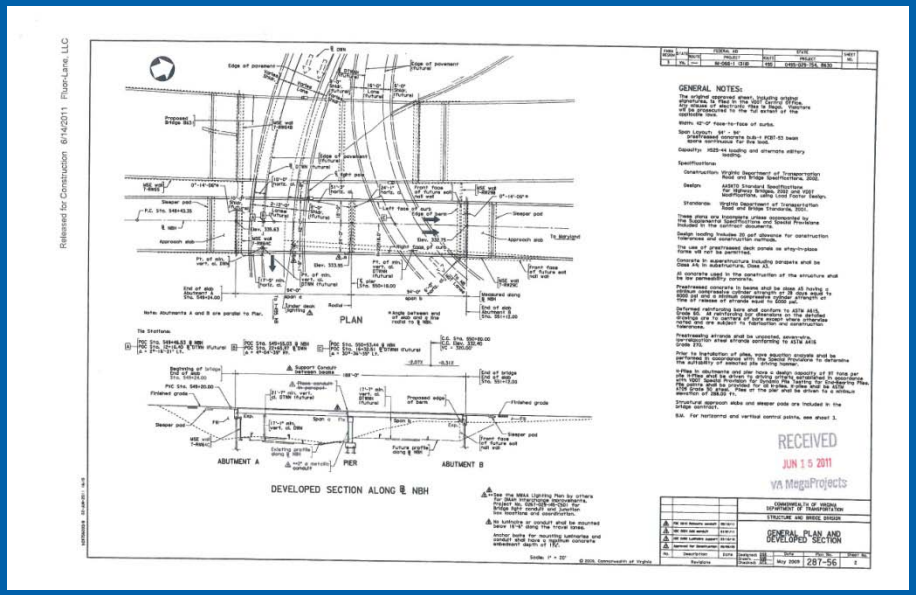
In a Design-Build Environment,

- Unless specific language or details are included in the Design-Build Contract / Technical Requirements, it will be difficult for the owner's engineers to require that the design-build EOR use specific / preferred details.

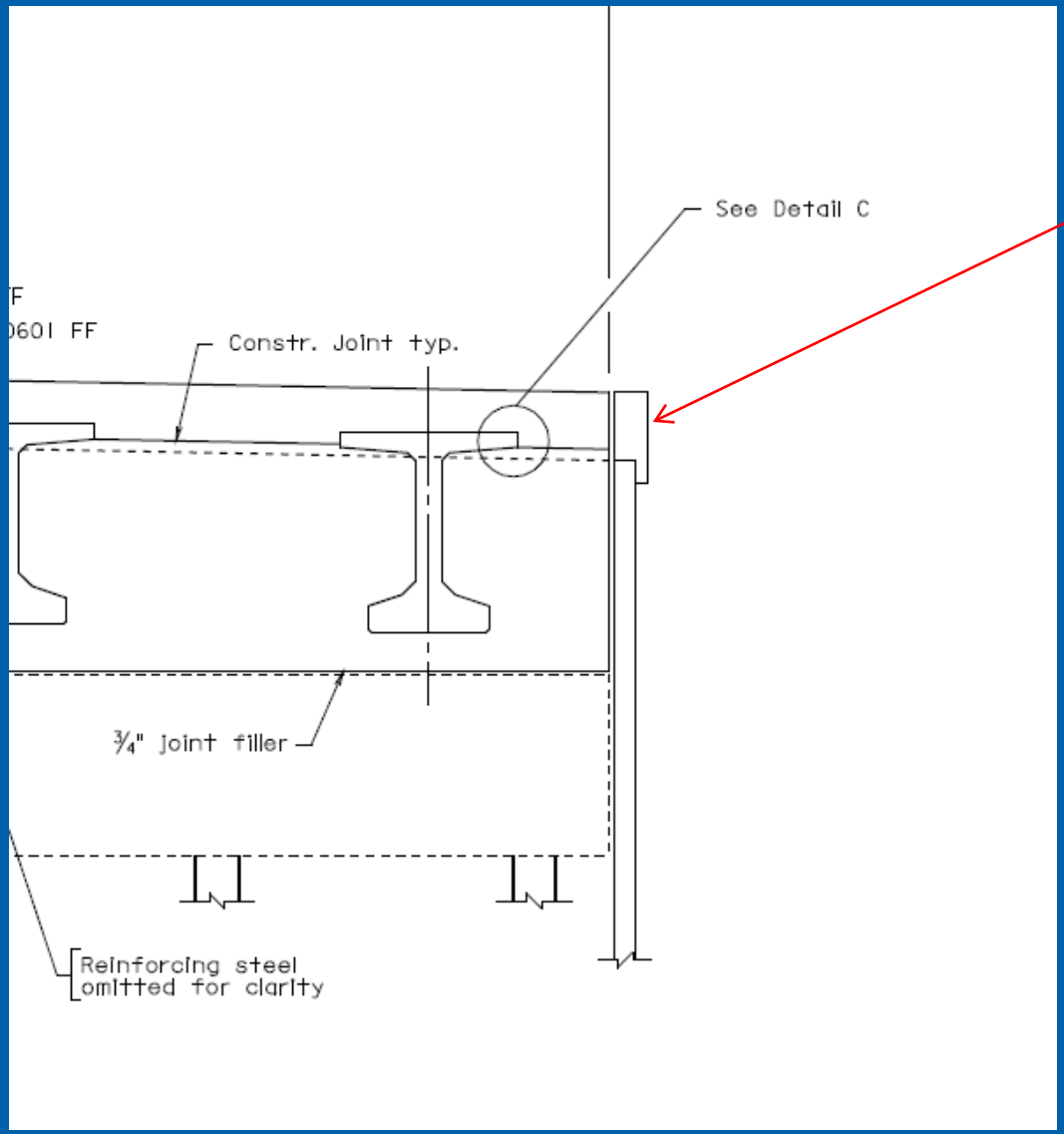
- The owner's engineer my prefer a detail because it provides superior long term performance / results in reduced maintenance, BUT, will have to very likely settle for a detail that meets AASHTO, VDOT S&B requirements, or "Industry Standards".

- If you're looking for a specific detail, include it in the design build contract.

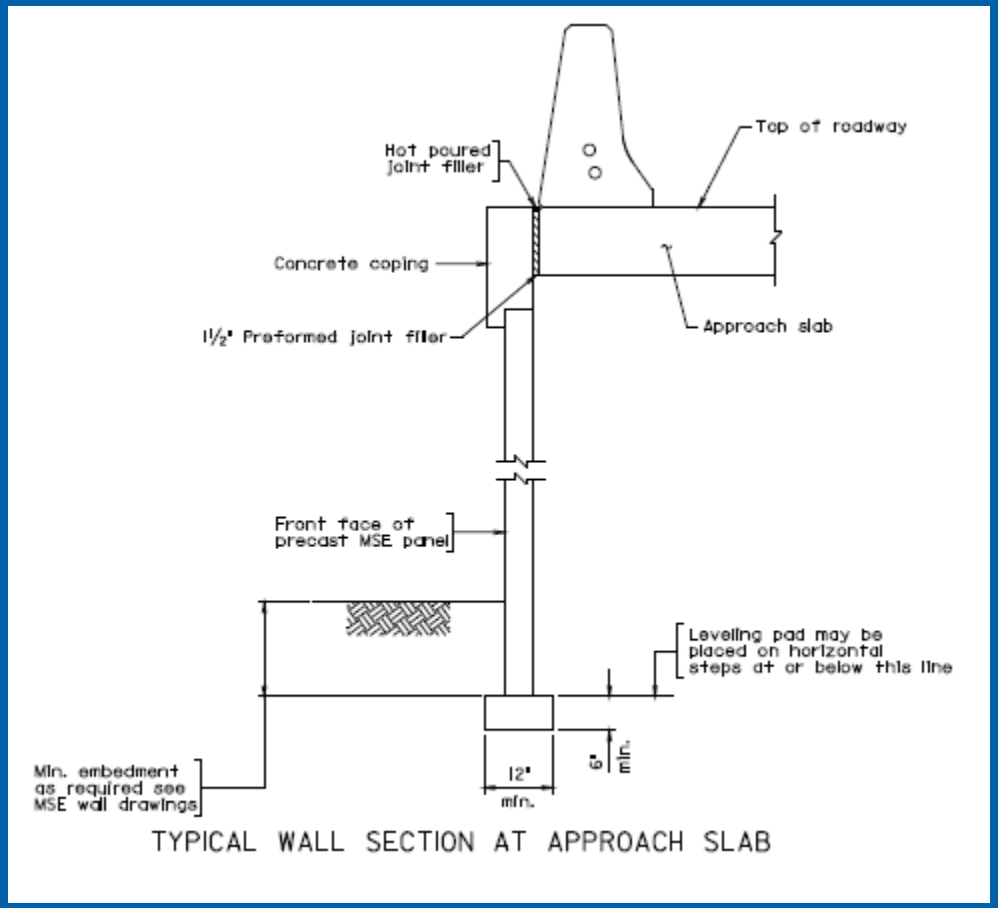
I-495 Express, B630: Improved Details



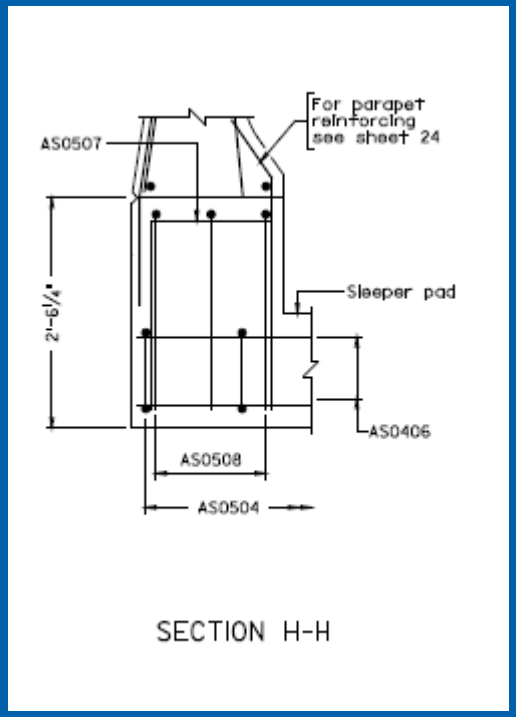
- Worked with DB Engineer to develop better details at MSE / Abutment interface.
- In some instances, contractual tool was photos of failed details.



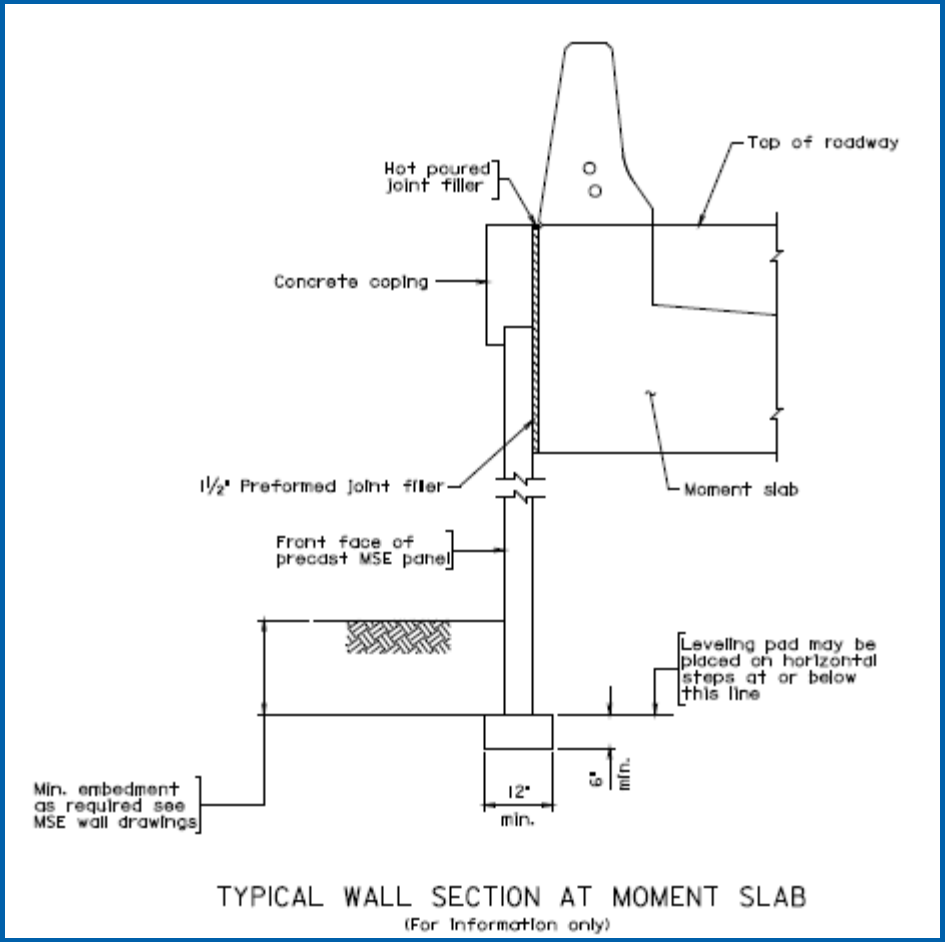
MSE wall placed outside fully-integral abutment (and not behind it)



Section at approach slab
(isolated coping from Parapet)



Section at sleeper pad



Section beyond sleeper pad

I-495 Express: Improved details were developed


Approach Slab
Sleeper Pad
Moment Slab

Typically, a 2” joint filled with EPS or preformed joint filler is used between coping and outside edge of barrier

Not quite there yet!!!

Cast-in-place vertical coping locks panels together and cracks may develop over time.

Sometimes, this detail results in excessive gaps between panel and backwall (When coping is not used). Also, Strap / EPS interference.

Prefered further improvements but bound by DB contract !!!

Lessons Learned

Example of language included in the I-95 Express Lanes project TR's to assist owner's engineers in rejecting details deemed to be undesirable:

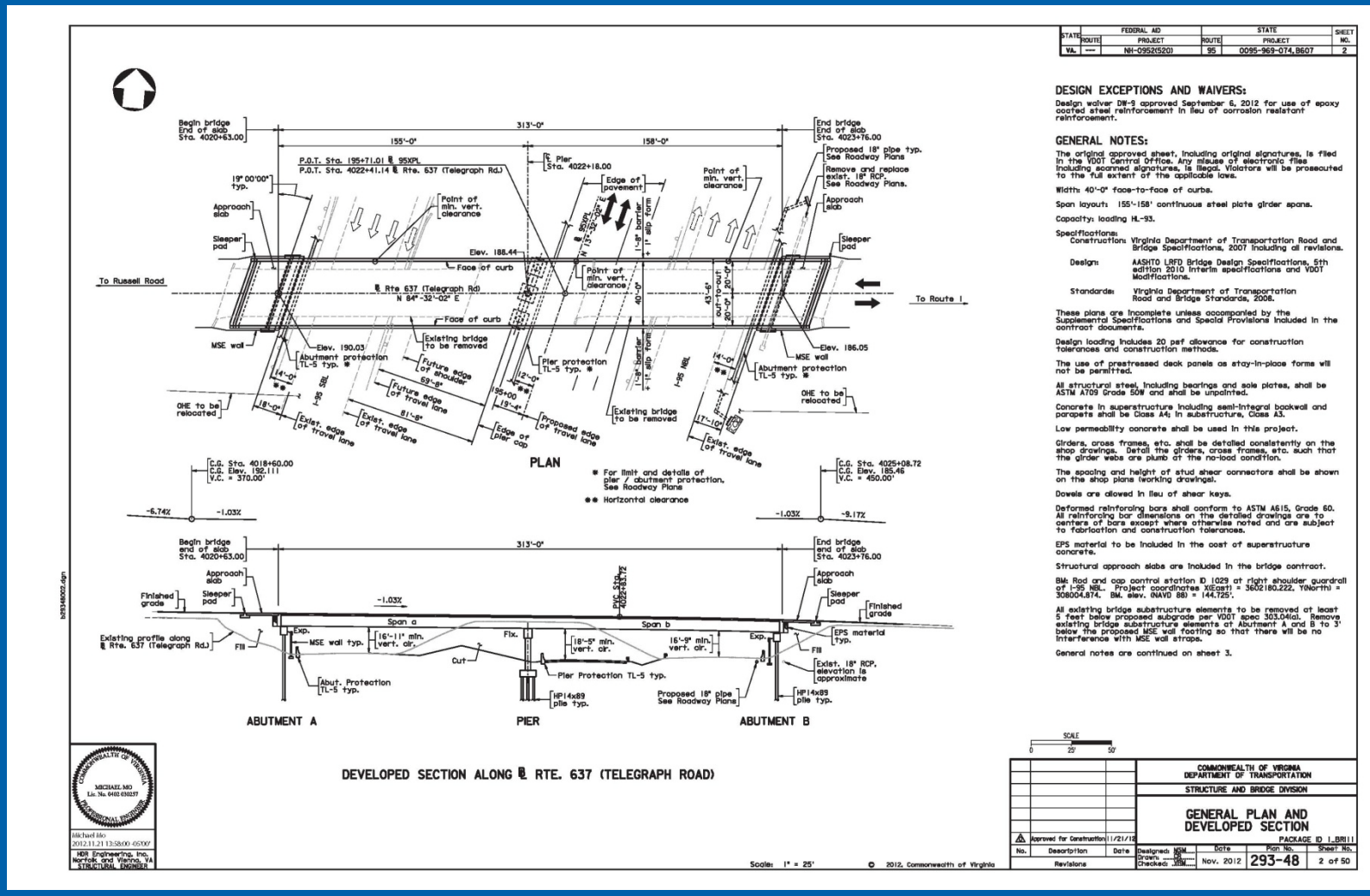
- All details and drawings should be in accordance with the Manuals of the Structure and Bridge Division – Volume V Series.

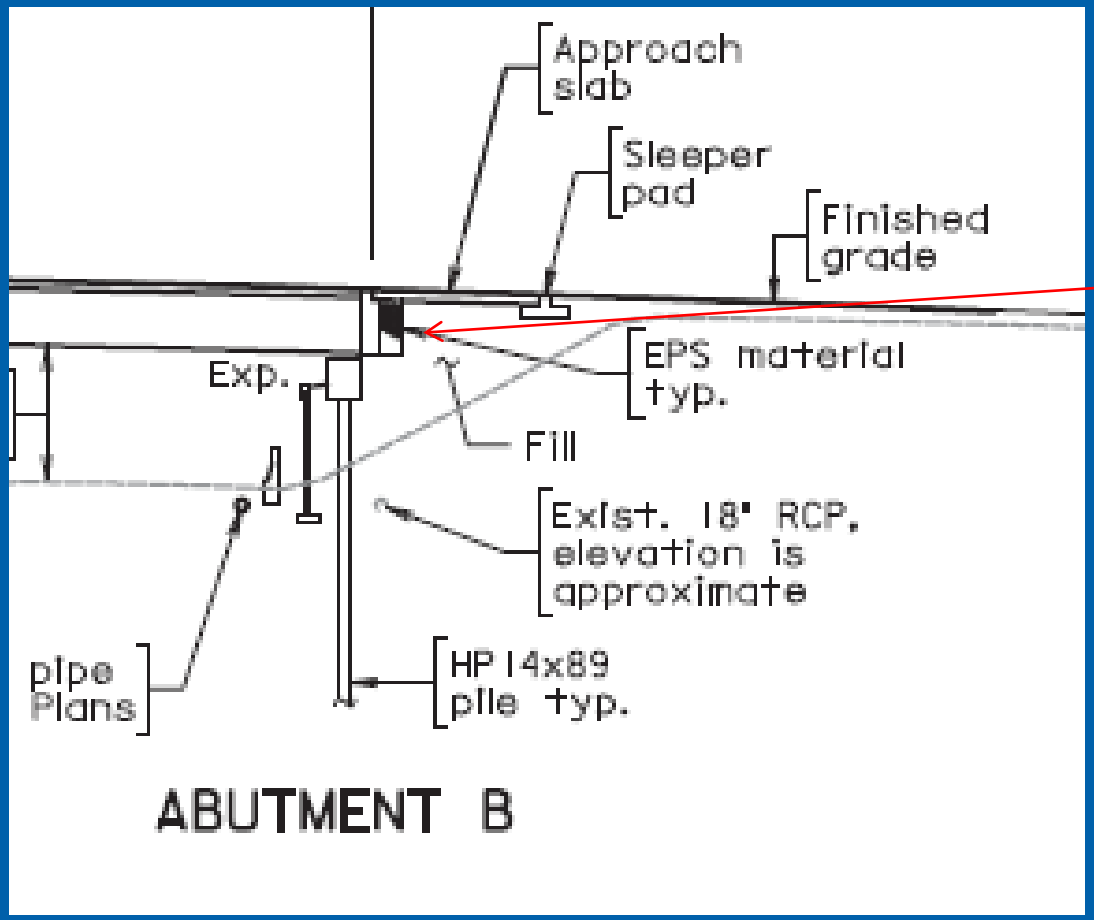
- Details and drawings not specifically included in the Manuals of Structure and Bridge Division – Volume V Series may only be included in structural plans and working drawings after review and approval by the Department. Should any such details not be acceptable, the Concessionaire shall make the necessary modifications or shall submit an alternate detail that is acceptable to the Department.

Example of Improved Abutment / MSE interface details used on I-95 Express Lanes Project

Proposed Bridge on Telegraph Road over I-95
Proj. 0095-969-074, B607
Stafford County

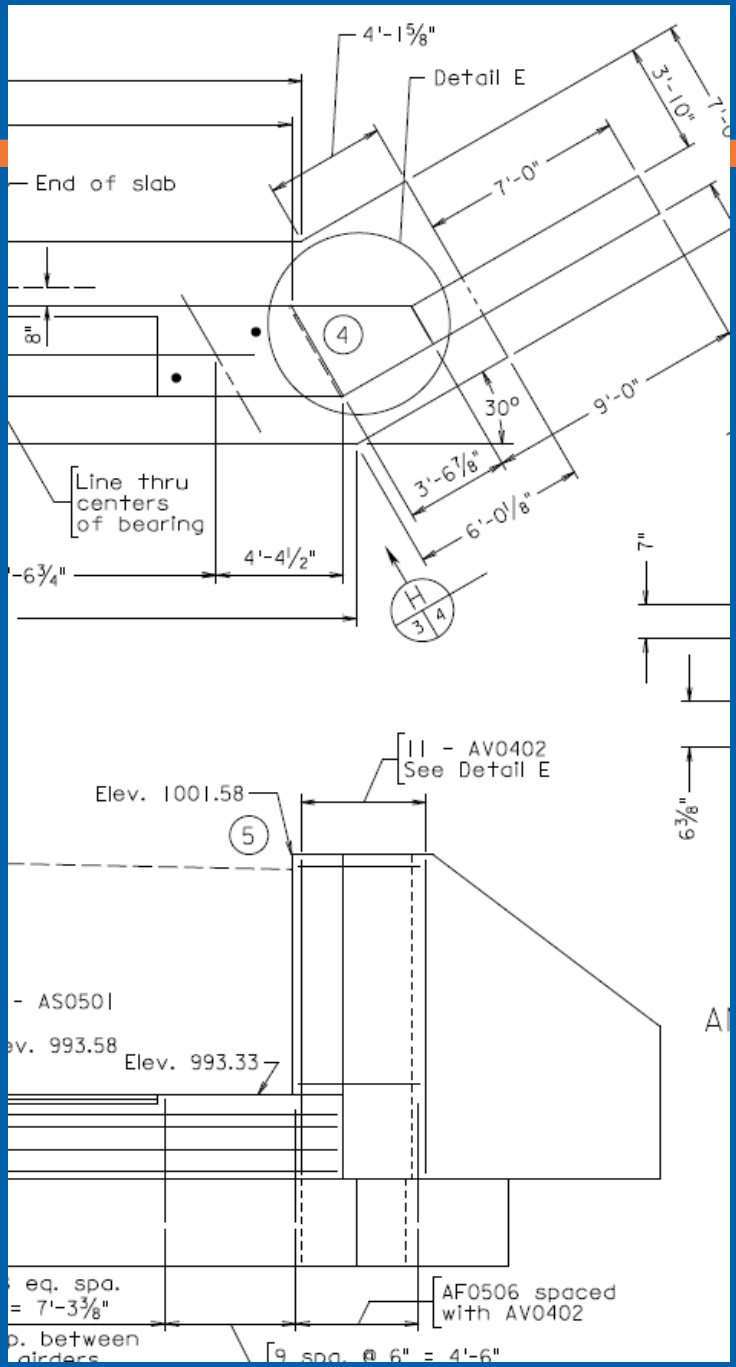
I-95 Express, B607, Telegraph Road over I-95

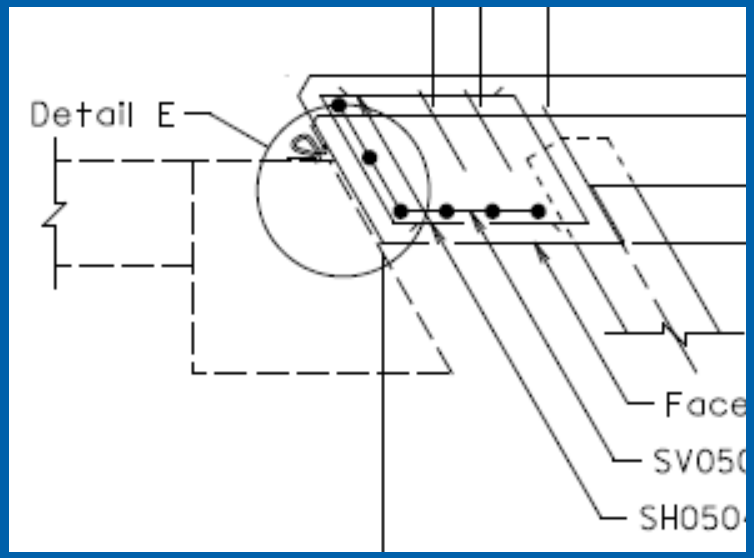


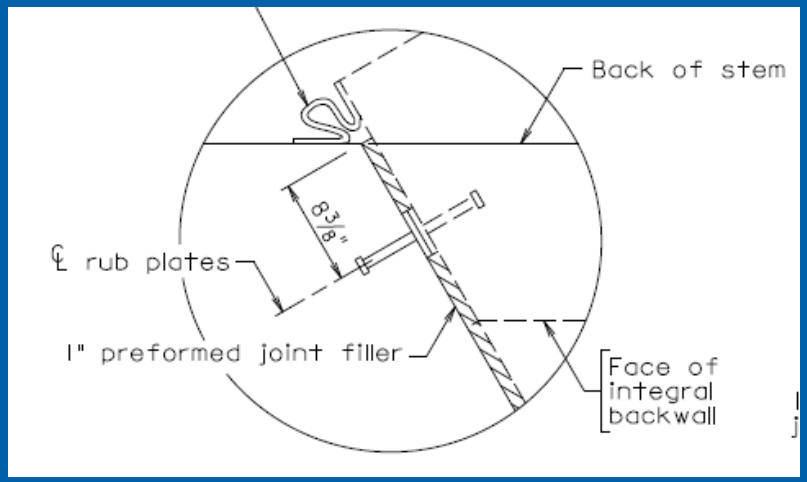


Semi-Integral Abutment with wrap-around MSE wall

Sample plans in the VDOT S&B design manuals only show details for a semi-integral abutment with wingwalls. No standard details are available showing abutments with wrap-around MSE walls.



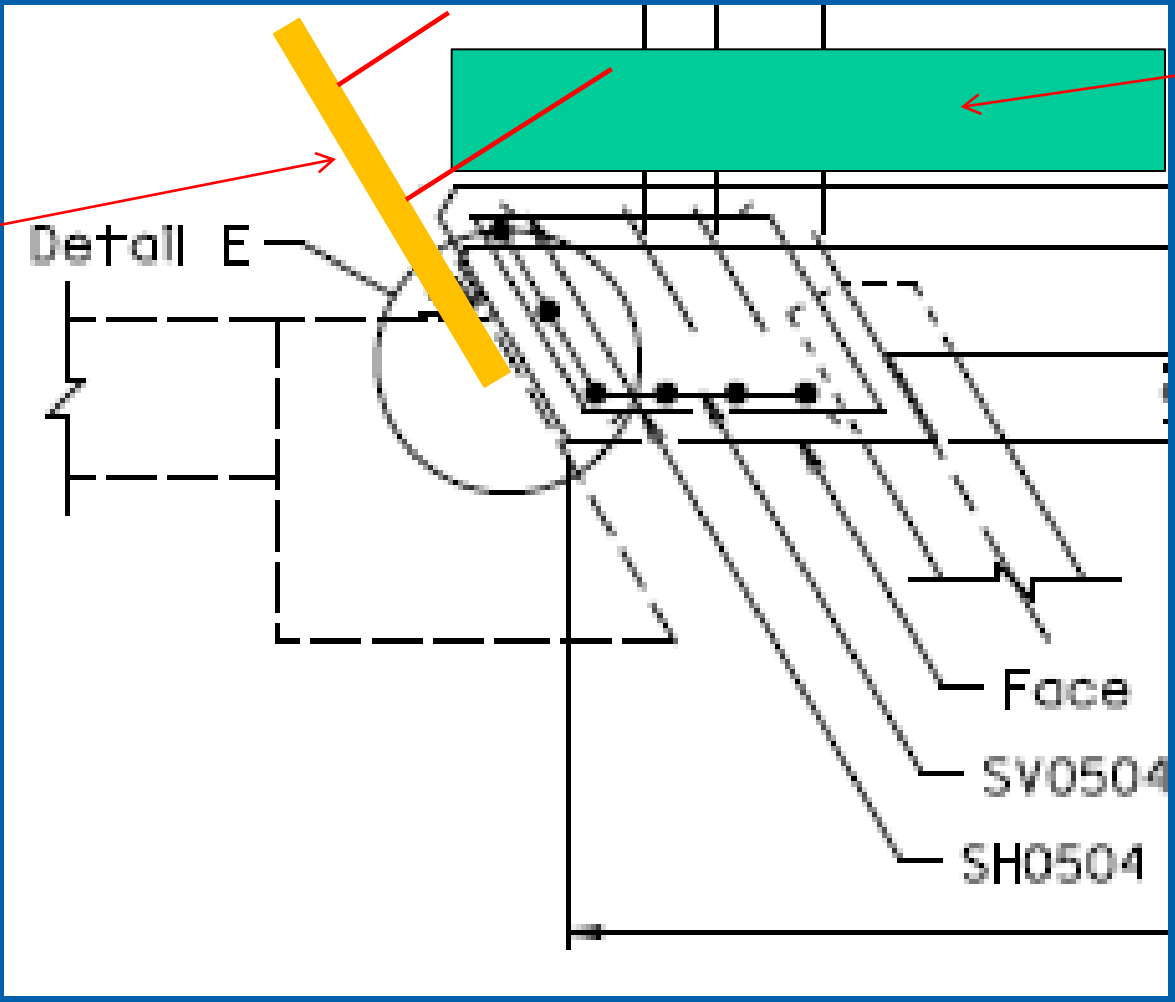




Detail of rub plate installation in S&B manual Sample Plans.

MSE panel, conflict between strap and EPS block

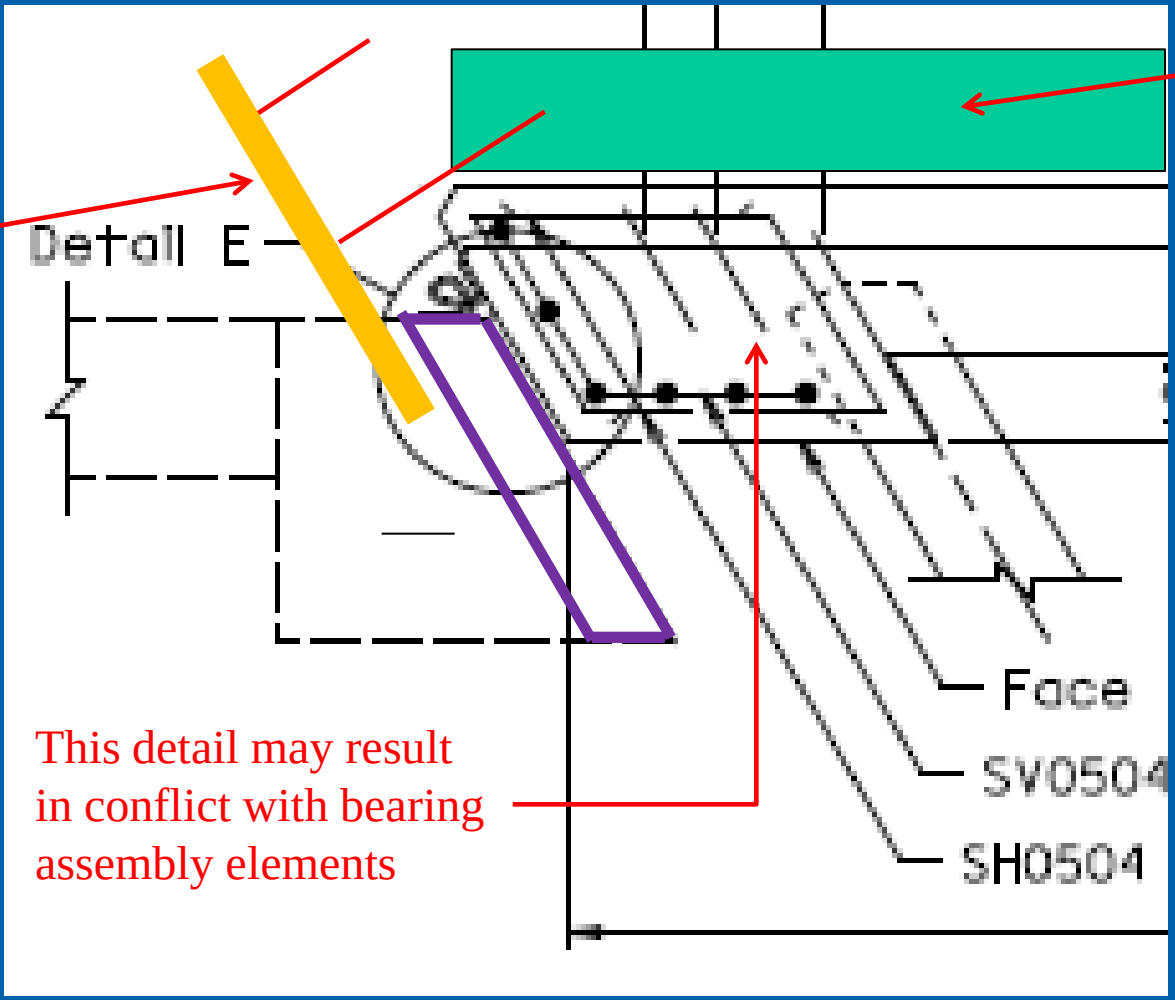
Option 1: Install MSE panel as shown and move rub plate to an interior bearing.



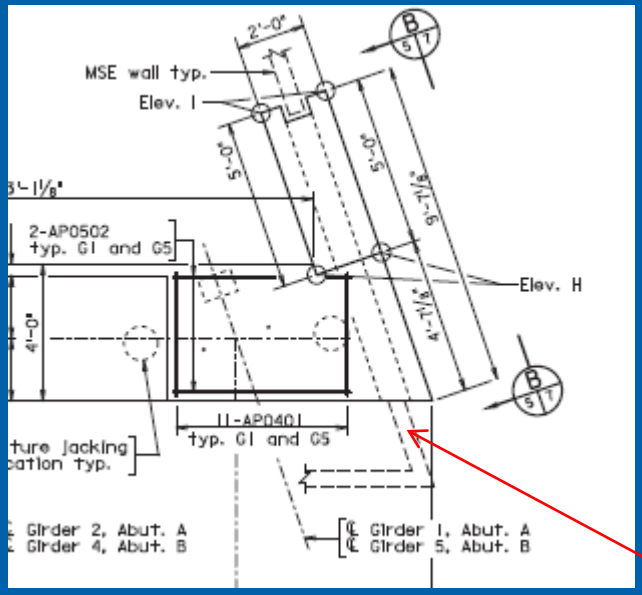
EPS material (1' - 7" thick at this case)

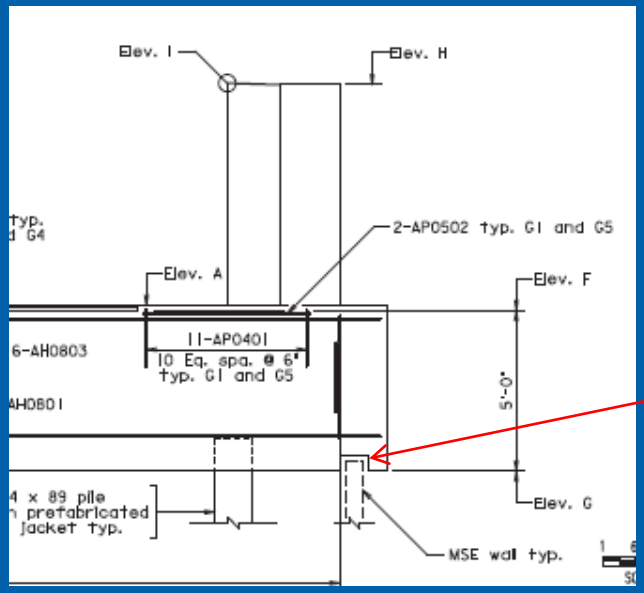
MSE panel, conflict between strap and EPS block

Option 2: Modify end block and install MSE panel as shown.



EPS material (1' - 7" thick at this abutment)

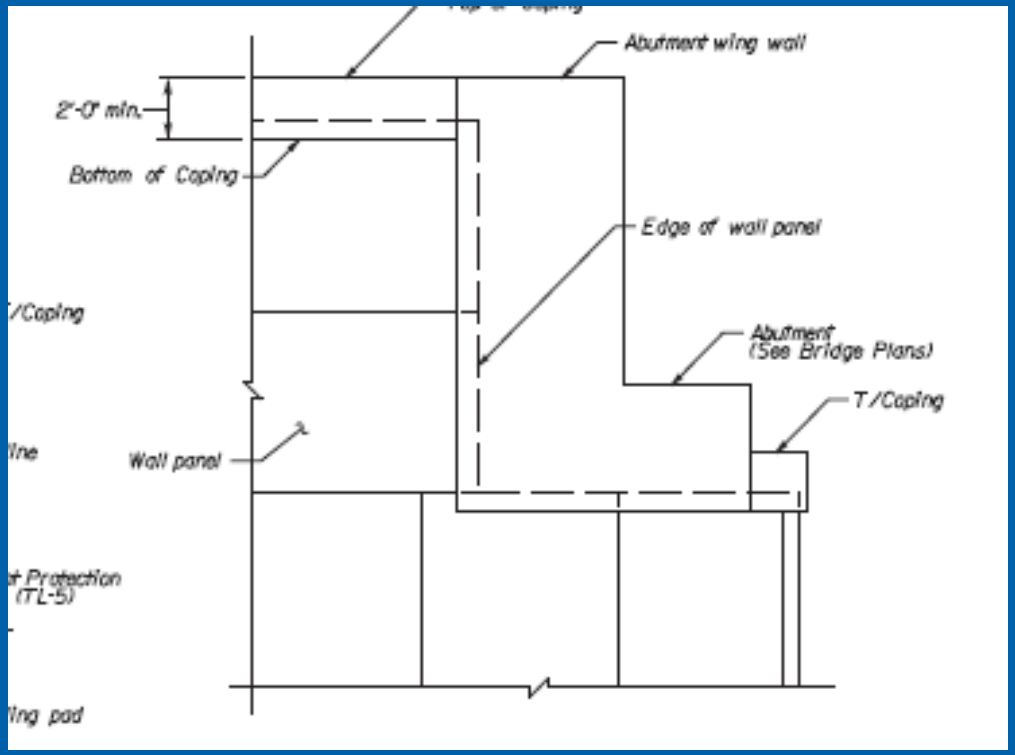


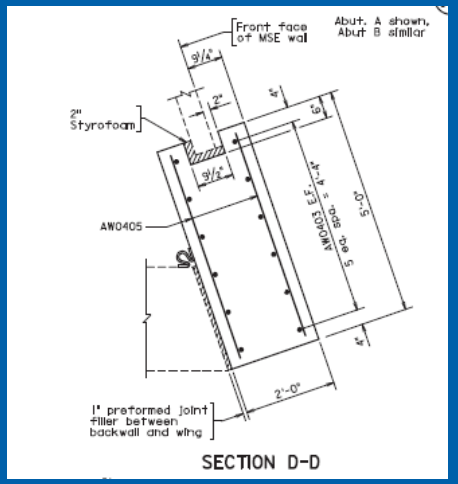


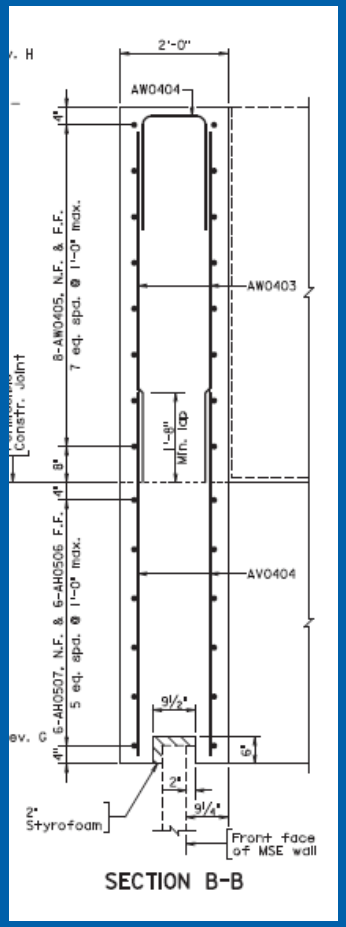
- Extended cap such that MSE panels are installed below extended cap and within a 6” x 9” notch.
- Introduced a wingwall. End of wingwall extends a min. of 6” beyond limits of EPS material

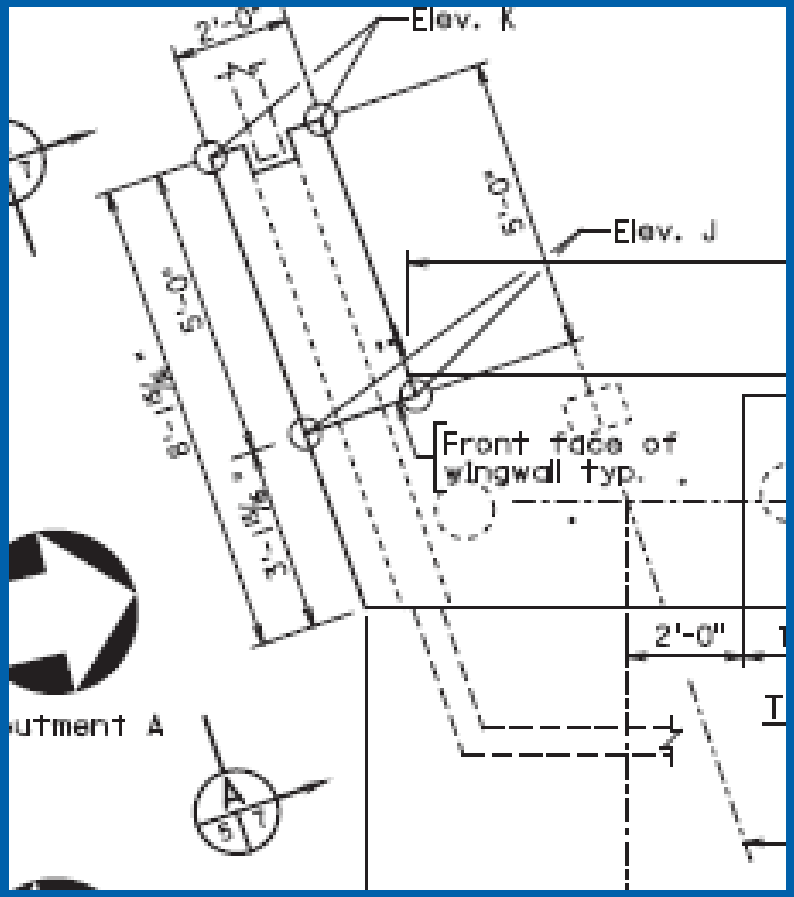
Outline of MSE wall panel

MSE wall panels interface with abutment thru a 6” x 9” notch in cap and wingwall.


Abutment wing wall
2'-0" min.
Bottom of Coping
Edge of wall panel
/Coping
Abutment
(See Bridge Plans)
T/Coping
ine
Wall panel
t Protection
(TL-5)
ing pad


Front face of MSE wal
Abut. A shown, Abut B similar
2" Styrofoam
AW0405
2'-0"
1" preformed joint filler between backwall and wing
SECTION D-D

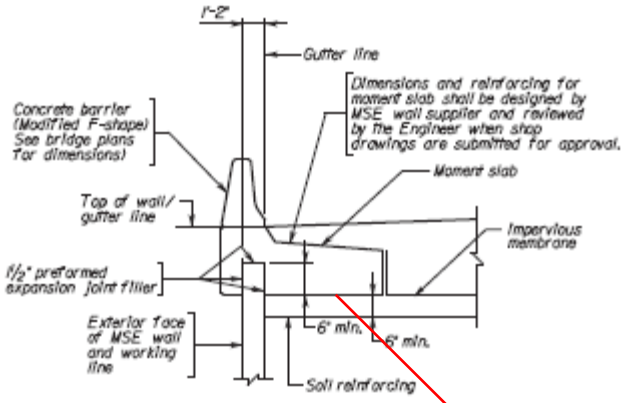

2'-0"
AW0404
AW0403
AW0404
8-AW0405, N.F. & F.F.
7 eq. spa. @ 1'-0" max.
6-AH0507, N.F. & 6-AH0506 F.F.
5 eq. spa. @ 1'-0" max.
Constr. Joint
1'-8" Min. lap
2" Styrofoam
Front face of MSE wall
SECTION B-B



This wingwall detail also offers the following advantages:

- ❑ Provides a better detail for the installation of the rub plate on skewed bridges (avoids the need to introduce a blister at end of backwall. Such blisters typically result in a conflict with bridge bearings).

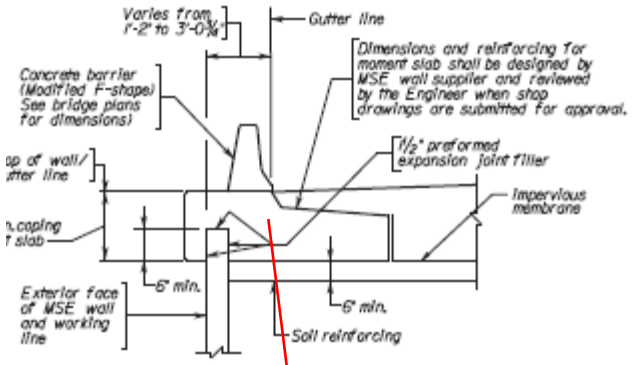
- ❑ Avoids conflict between panel straps and EPS material.



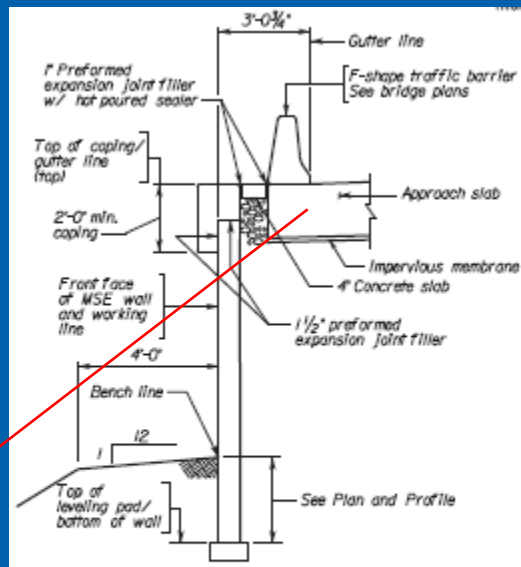
SECTION C-C
TYP. AT MOMENT SLAB

(Not to Scale)

For additional info., see SECTIONS A-A and B-B.



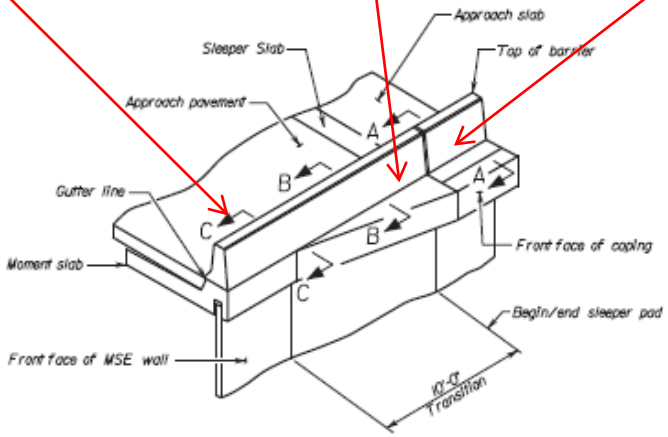
SECTION B-B
TRANSITION AT MOMENT SLAB



SECTION A-A
TYP. SECTION AT APPROACH SLAB

(Not to Scale)

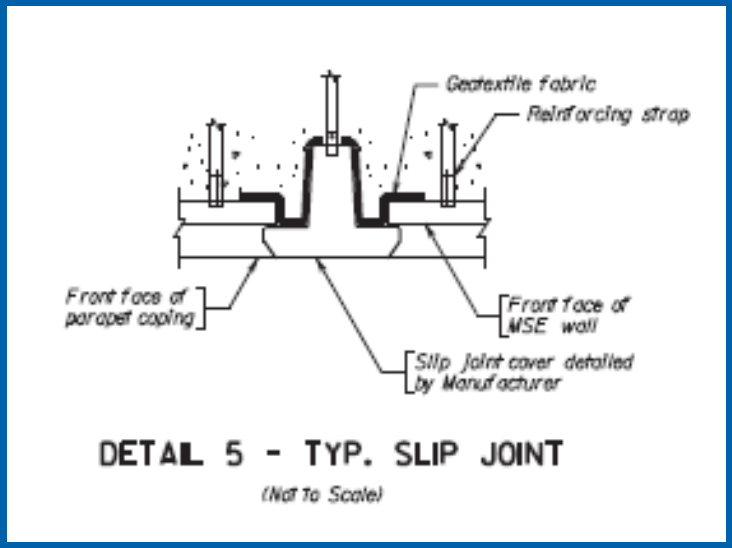
MSE straps are not shown for clarity.

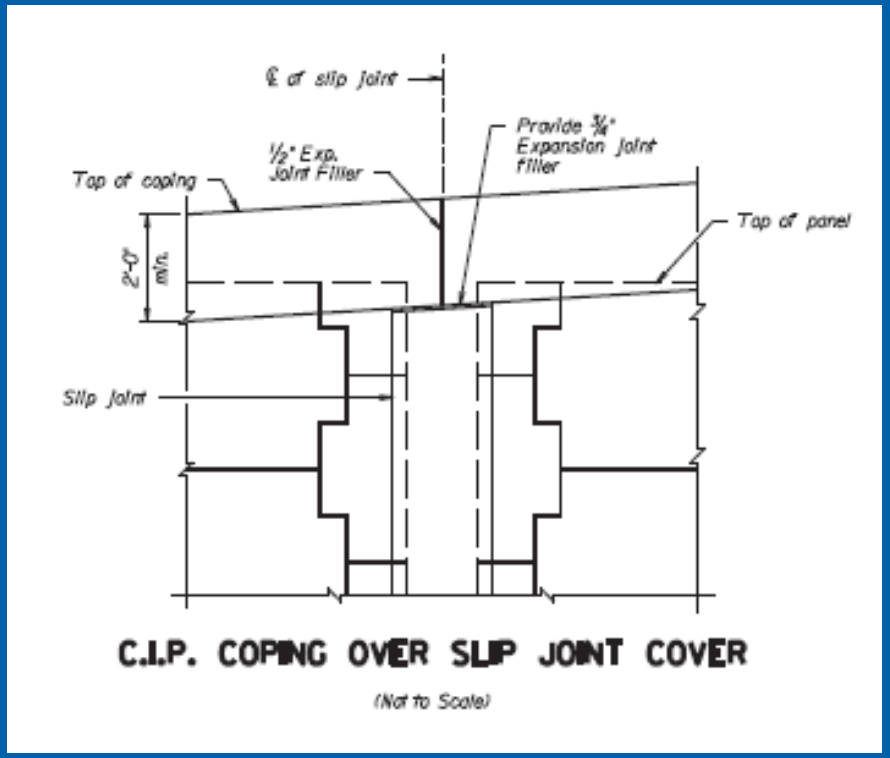


DETAIL 1 - ISOMETRIC VIEW
TYPICAL MSE WALL TRANSITION AT APPROACH SLAB

(Not to Scale)

Sleeper pad is not shown for clarity.

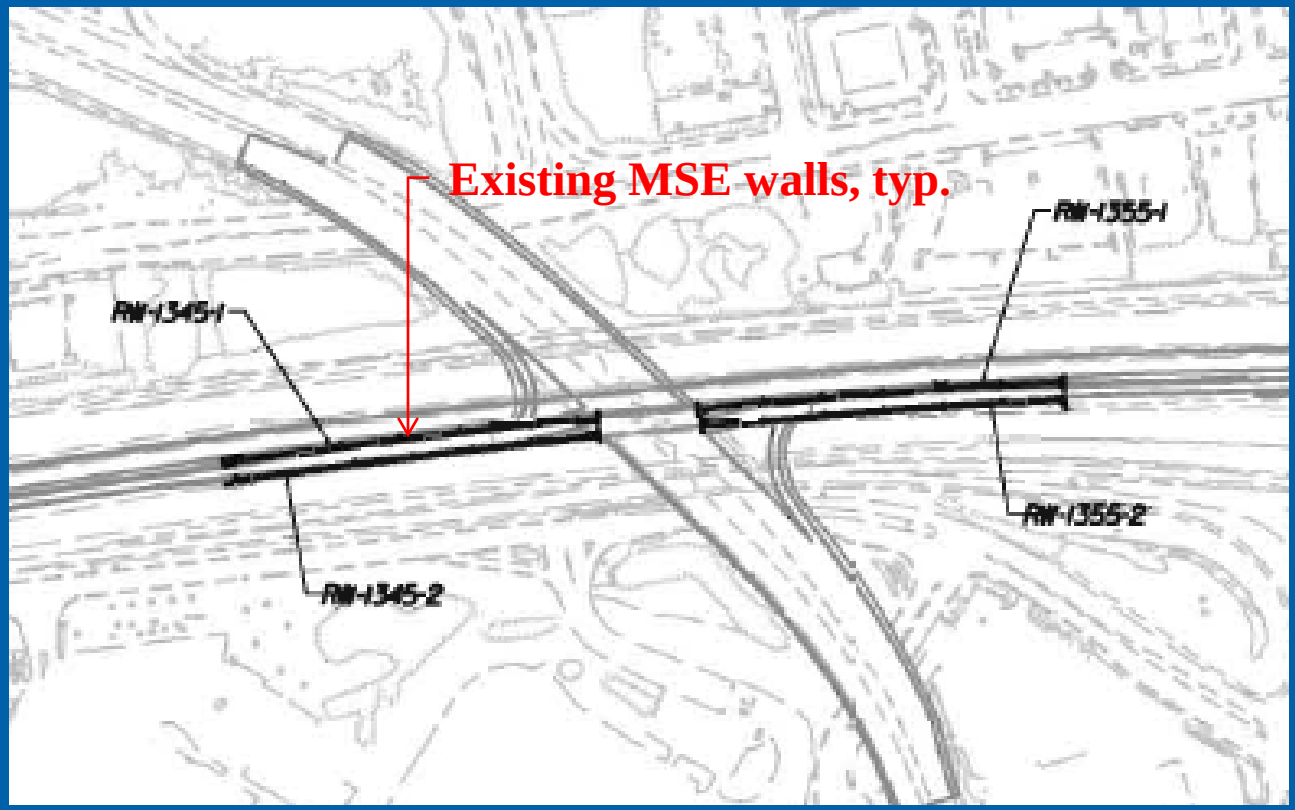




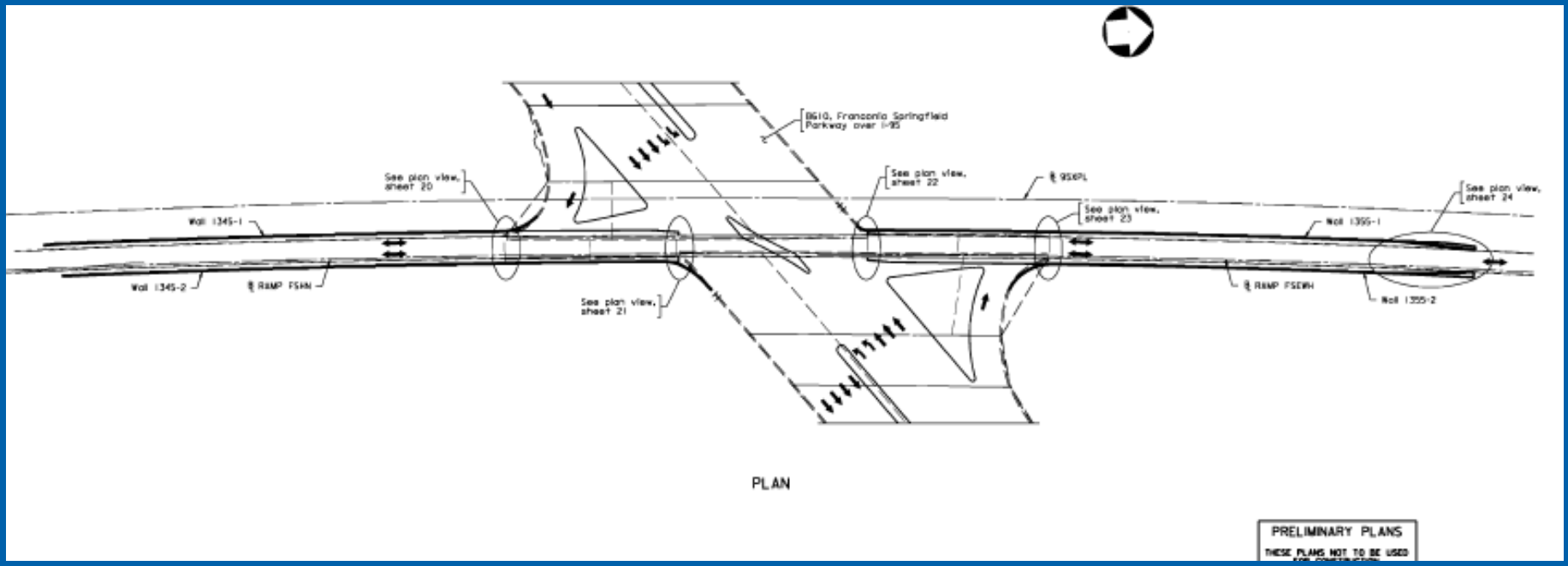
On past projects details such this one were not included in AFC plans or shop drawing. Typically, the consequence is a poorly constructed detail.

Another example from the I-95 Express Lanes project where the language below, included in the contract, was very helpful.

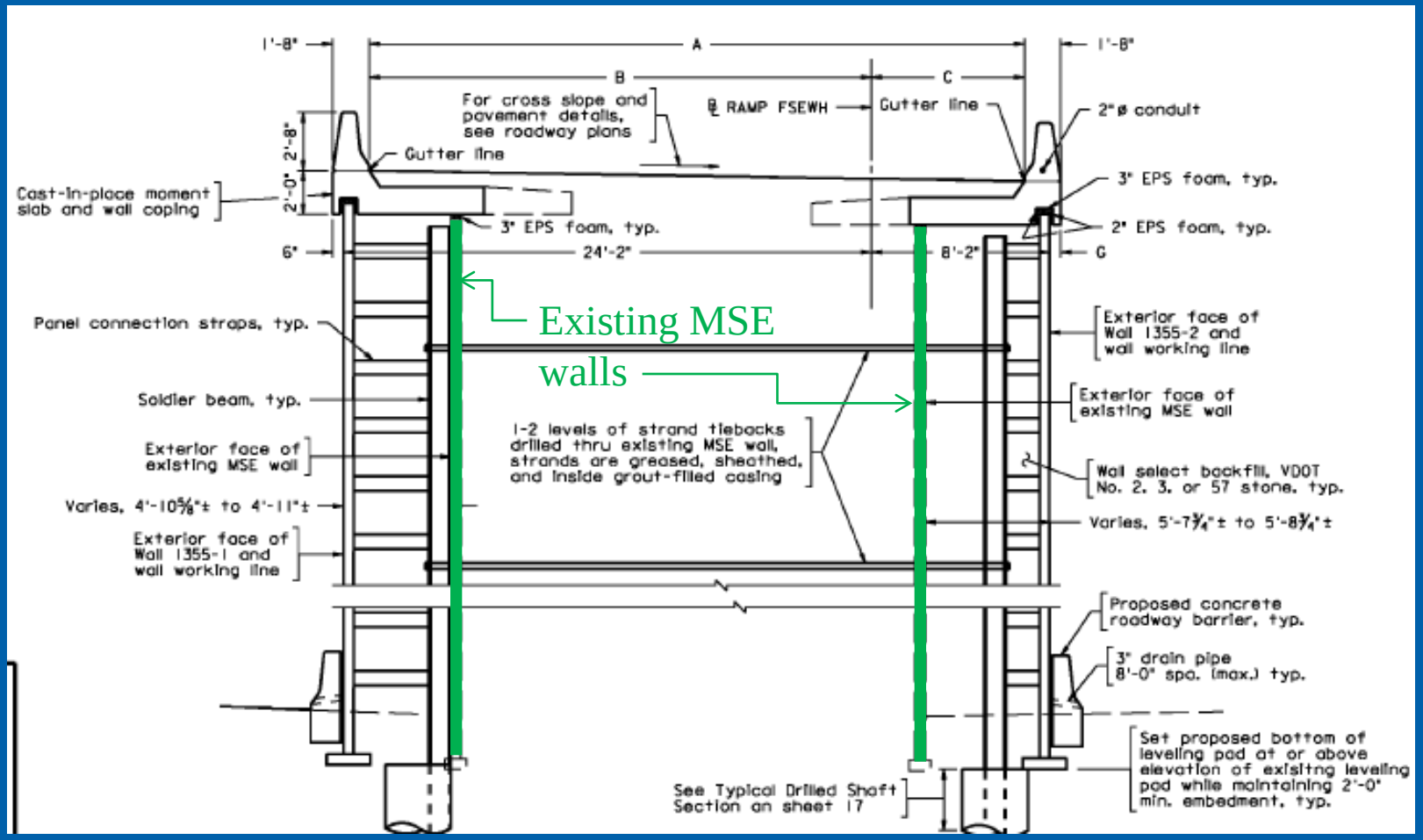
- Details and drawings not specifically included in the Manuals of Structure and Bridge Division – Volume V Series may only be included in structural plans and working drawings after review and approval by the Department. Should any such details not be acceptable, the Concessionaire shall make the necessary modifications or shall submit an alternate detail that is acceptable to the Department



Existing single lane ramps to / from I-95 HOV to Franconia Springfield Parkway.



Proposed widening of the existing MSE wall supported single lane ramps to two lanes .



Typical section showing proposed widening details

CRITICAL CONNECTION DETAILS WERE MISSING FROM AFC PLANS

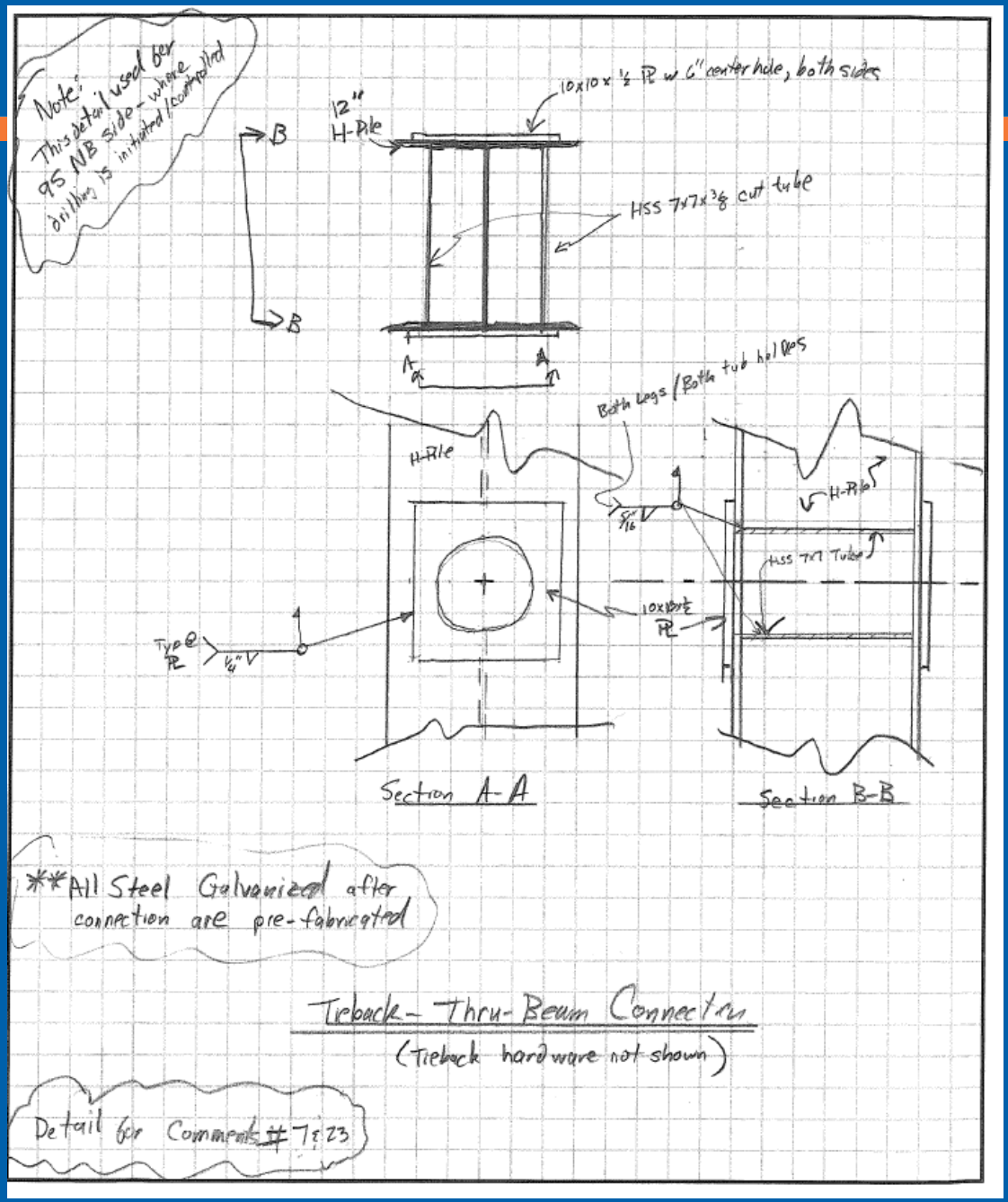
- Submitted plans did not include critical connection details.

- Design Builder Engineer stated that details will be developed by the vendor constructing the wall and will therefore be included in the shop drawings.

- Missing connection details have significant impacts on the long-term performance of the wall system.

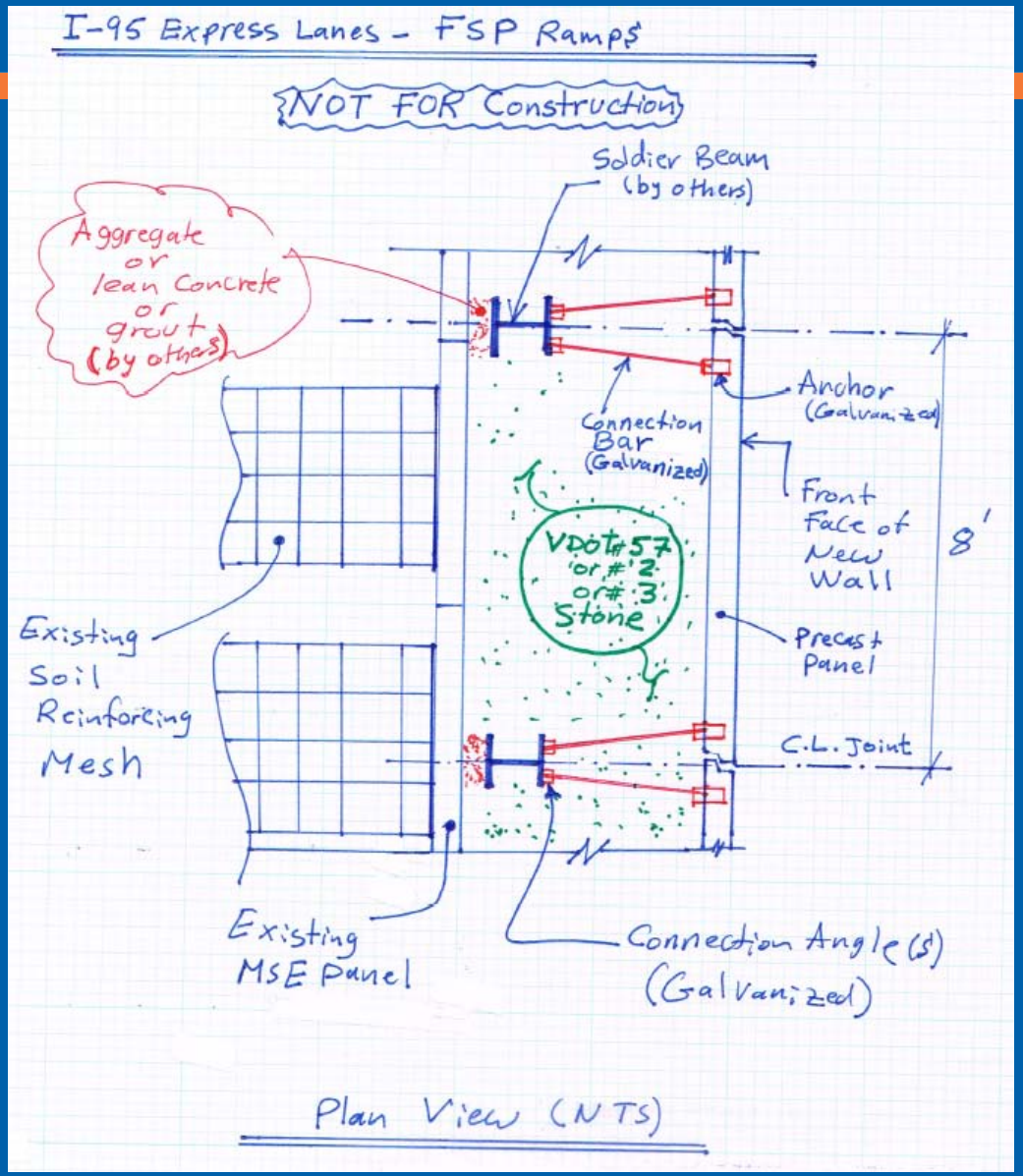
Preliminary sketches were submitted by the vendor showing some of the details to be included in the shop drawings for the walls.

Tie-back detail.



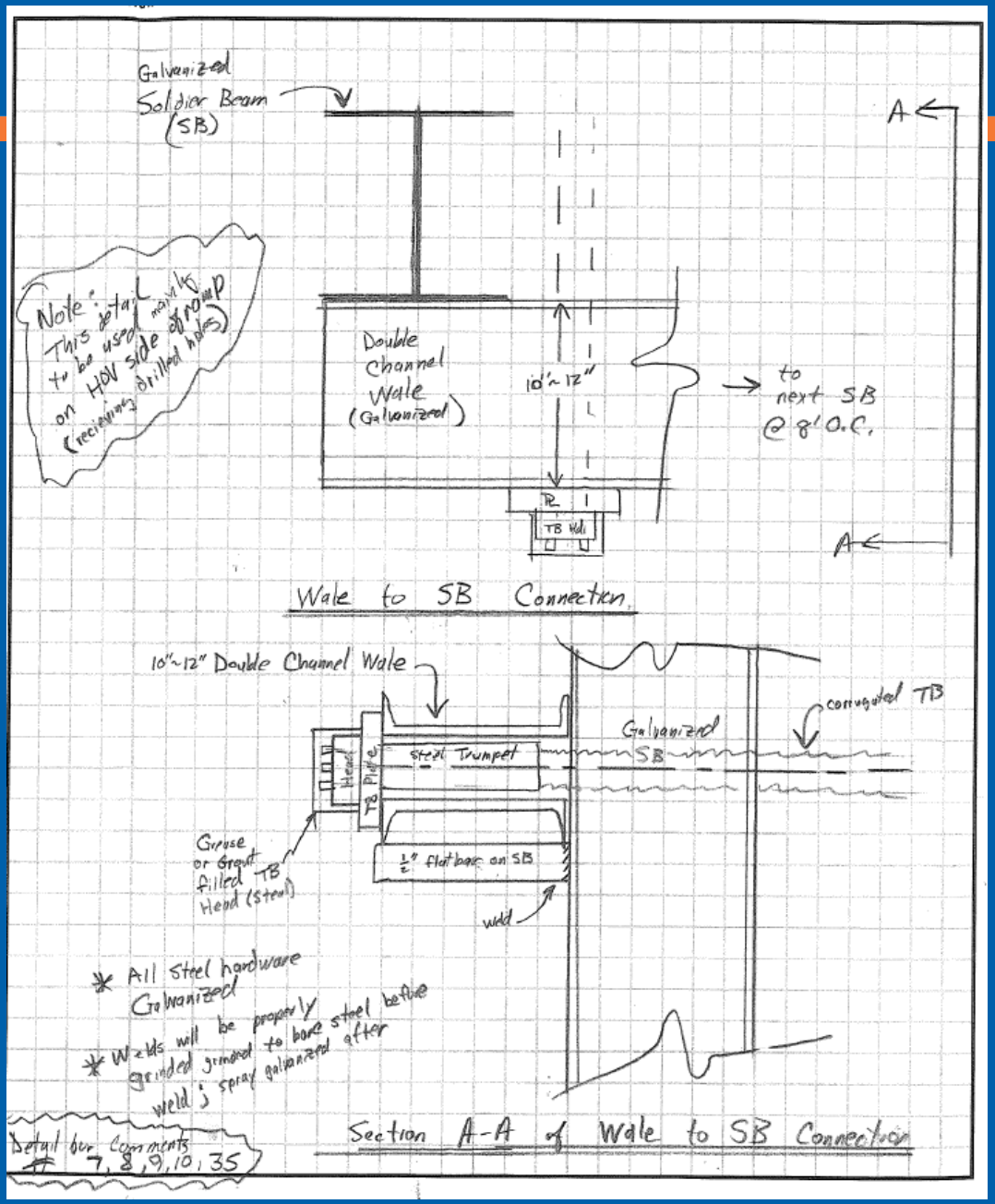
Preliminary sketches were submitted by the vendor showing some of the details to be included in the shop drawings for the walls.

Concrete panel connection to post detail.



Additional connection details.

The Department required that details / material specs for all critical connections are submitted and included in the AFC plan package. Actual member sizes / weld sizes etc. may be left out and included in the shop drawings submittal.

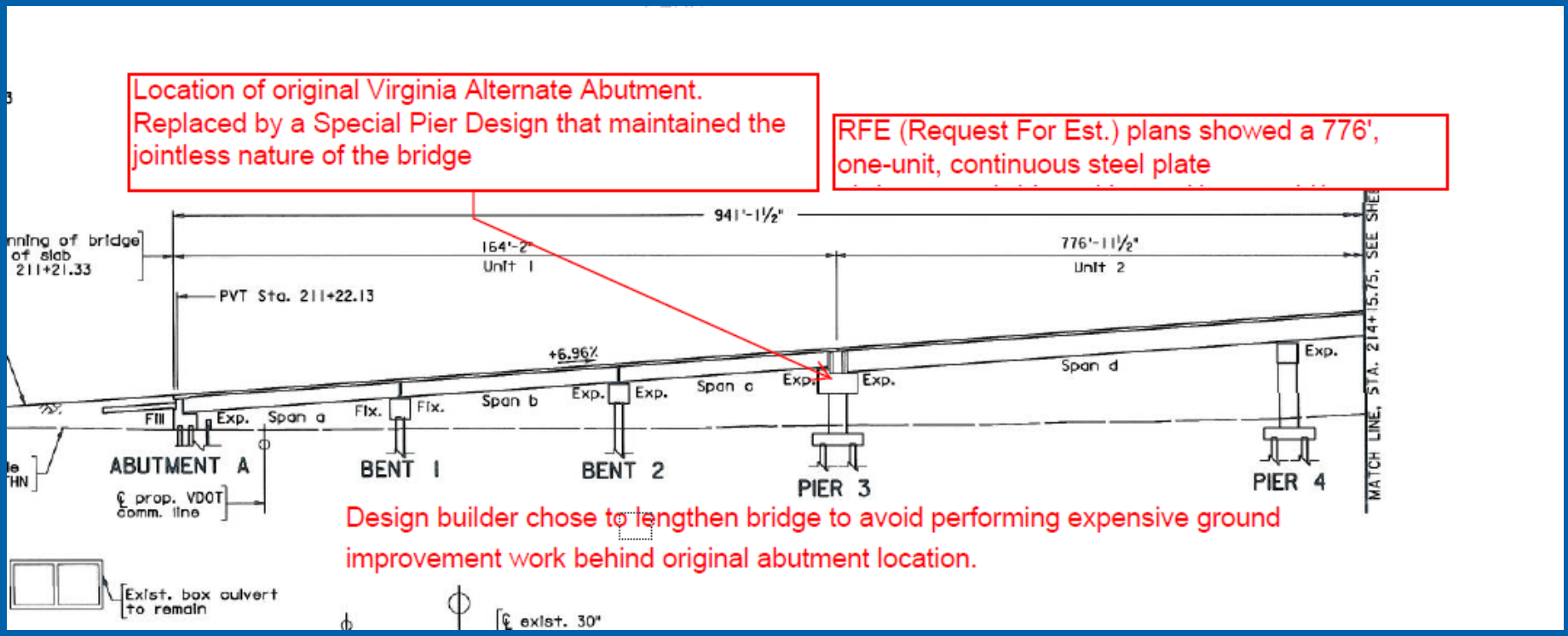


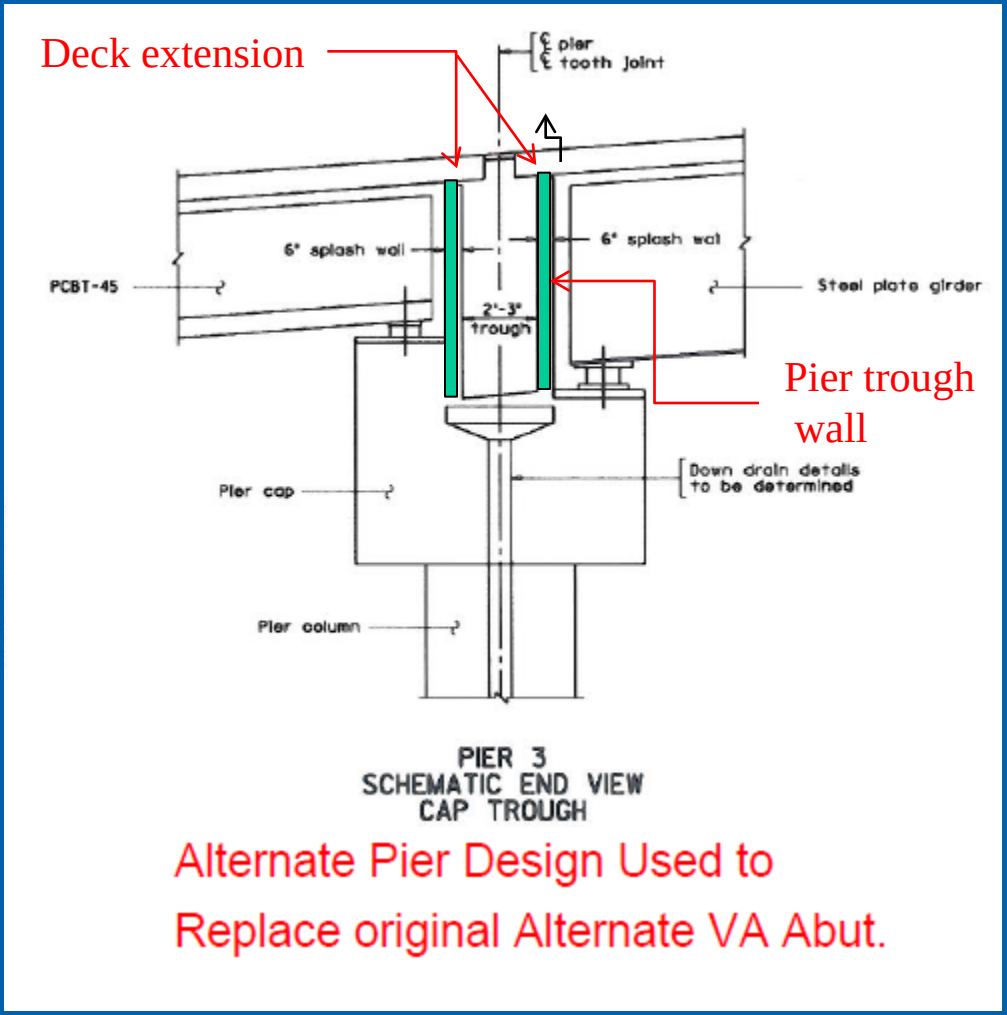
Another example from the I-95 Express Lanes project where the language included in the contract was very helpful:

- Preliminary plans used to develop project estimate for this P3 project showed a single unit continuous steel plate girder spans with two Virginia Alternate abutments for the flyover bridge on Ramp THN over I-395.
- Very desirable concept as it will result in a “jointless” Bridge.
- D-B decided to lengthen bridge to avoid expensive soil improvement work behind Abutment A.
- A 164’ unit of 3 – 55’ Bulb T spans continuous for LL was added.
- Joint introduced between at interface between units.

Alternate Pier Detail To Accommodate A "Jointless" Bridge Construction

I-95 Express Lanes Project
Ramp THN Flyover Bridge


Location of original Virginia Alternate Abutment. Replaced by a Special Pier Design that maintained the jointless nature of the bridge
RFE (Request For Est.) plans showed a 776', one-unit, continuous steel plate
941'-1½"
164'-2"
Unit 1
776'-11½"
Unit 2
PVT Sta. 211+22.13
+6.96%
Fill
Exp.
Span a
Fix.
Fix.
Span b
Exp.
Exp.
Span c
Exp.
Exp.
Span d
Exp.
ABUTMENT A
BENT 1
BENT 2
PIER 3
PIER 4
℄ prop. VDOT comm. line
Exist. box culvert to remain
℄ exist. 30"
MATCH LINE, STA. 214+15.75, SEE SHE
Design builder chose to lengthen bridge to avoid performing expensive ground improvement work behind original abutment location.



By introducing this alternate pier design, the original design concept was maintained. At the new abutment A location, a deck extension design was used. At abutment B, the original alternate VA abutment designed was maintained.

Painting of steel girder ends / fascia girders was not necessary due to the “jointless” nature of the final design concept.

Bridge Aesthetics

In A Design-Build Environment

Unless the aesthetics of bridge / wall elements are clearly specified in the contract, the design-builder is under no obligation to provide details that will enhance the aesthetics of a structure.

Aesthetic Details specified for I-95 Express Lanes Project Bridge Elements.

I-95 HOV/HOT Lanes Project

Exhibit C

Technical Requirements
Attachment 3.11
Aesthetic Treatments for Bridges

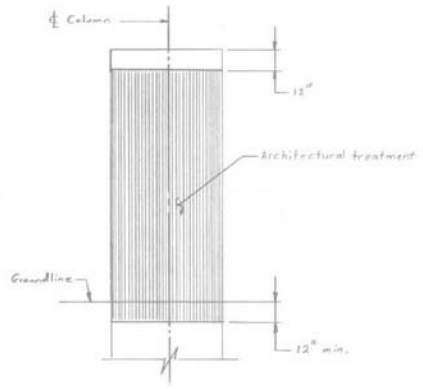
Revision No.	Dated
REV-0	4/29/2011
REV-1	9/13/2011
REV-2	12/20/2011

1 Aesthetic Treatments for Bridges

The aesthetic treatments of bridges shall be as outlined in Aesthetics, Section 3.11, of the Technical Requirements. The following bridge pier aesthetic details are provided to supplement the requirements listed in the section above.

Architectural Treatment on Pier Columns

1.1 Straddle Bent Piers with Round Columns



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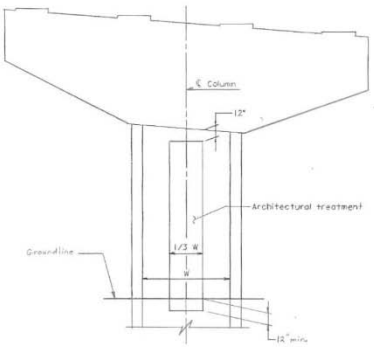
1.2 Hammerhead Piers with Rectangular Column



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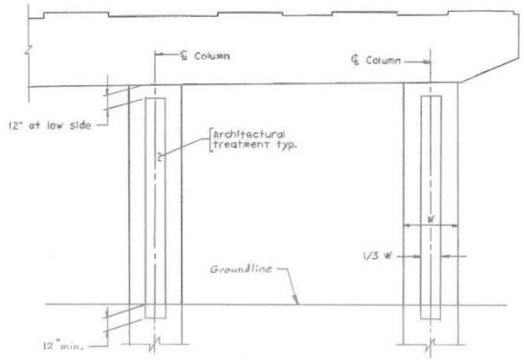
1.3 Multi Column Pier with Square Columns



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TRB 92nd Annual Meeting, January 2013

Session 245: Structure Aesthetics and Design-Build Projects

- Aesthetics of Hastings Bridge Design-Build Project
  Frederick Gottemoeller, Bridgescape, LLC, presenter
  Bradley Touchstone, Touchstone Architecture, presenter

- Veterans Memorial Bridge: Post Award Context-Sensitive Design-Build Process
  Jeffrey Andrews, TY Lin International, presenter

- Bridge Aesthetics Using Design-Build: Three Case Studies in Maryland
  Robert J. Healy, Rummel, Klepper & Kahl, LLP, presenter

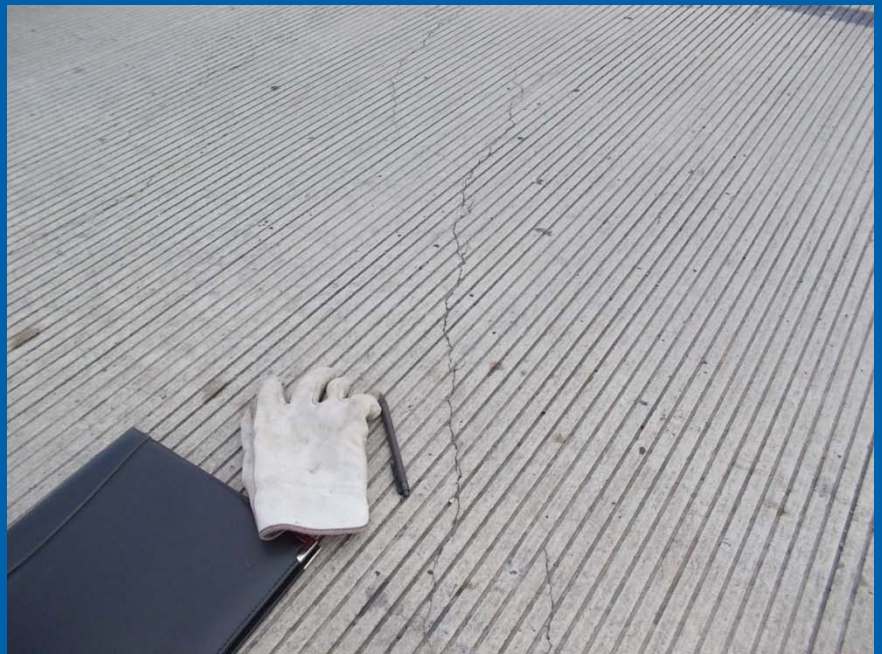
Concrete Cracking In

Bridge Decks

Bridge Parapets

and Median Barriers

Map cracking: Contractors rarely dispute that such cracking is primarily due to poor curing techniques and are generally ready to work with the owner to implement remedial actions.



Transverse cracks in decks, up to 0.03” in width: Contractors / Design-builders may dispute an owner’s assertion that the contractor is responsible for repairing such cracks.

When Transverse deck cracks are observed in newly constructed decks , Contractors / Design-Builders are typically resistant to accepting responsibility for the development of such cracking. Generally they claim:

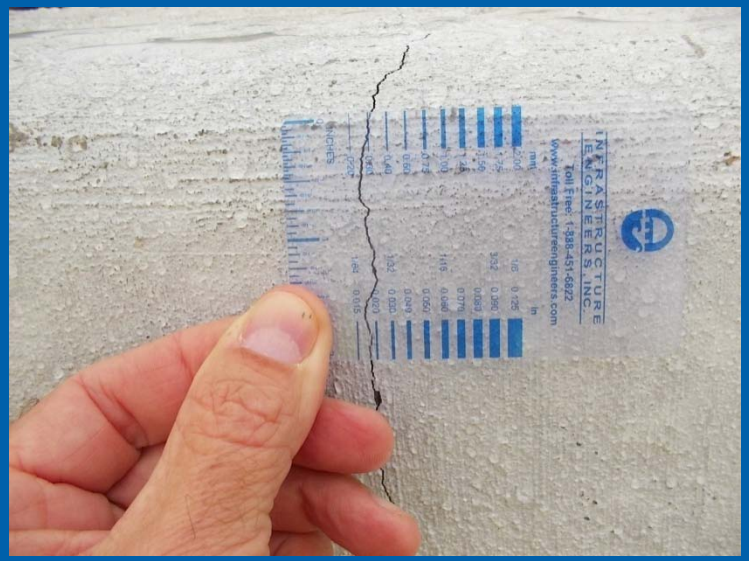
- The bridges were designed per the specifications included in the contract.
- The bridge decks were placed and cured per specifications and VDOT approved mix designs.
- There is nothing in the Contract that limits the maximum allowable crack size OR crack spacing (indeed, a contractor argued that cracks smaller than 0.05” in width will not be repaired without additional compensation) .

- Especially on Design-build projects, including provisions in the contract that limit crack size / spacing (for decks and other bridge elements) is recommended. Such provisions will encourage:

  - Design-Builder Engineer to introduce details that limits the development of cracks

  - The use of admixtures, such as SRA, to limit drying shrinkage cracking

  - More attentiveness to concrete placement practices (curing, placement sequence etc.)



Cracks in parapet, up to 0.05” in width, are commonly encountered: Some may be attributed to poor consolidation of slipped - form concrete. Again, a contractor argued that cracks in bridge parapets larger than 1/16” in size will not be repaired without additional compensation.

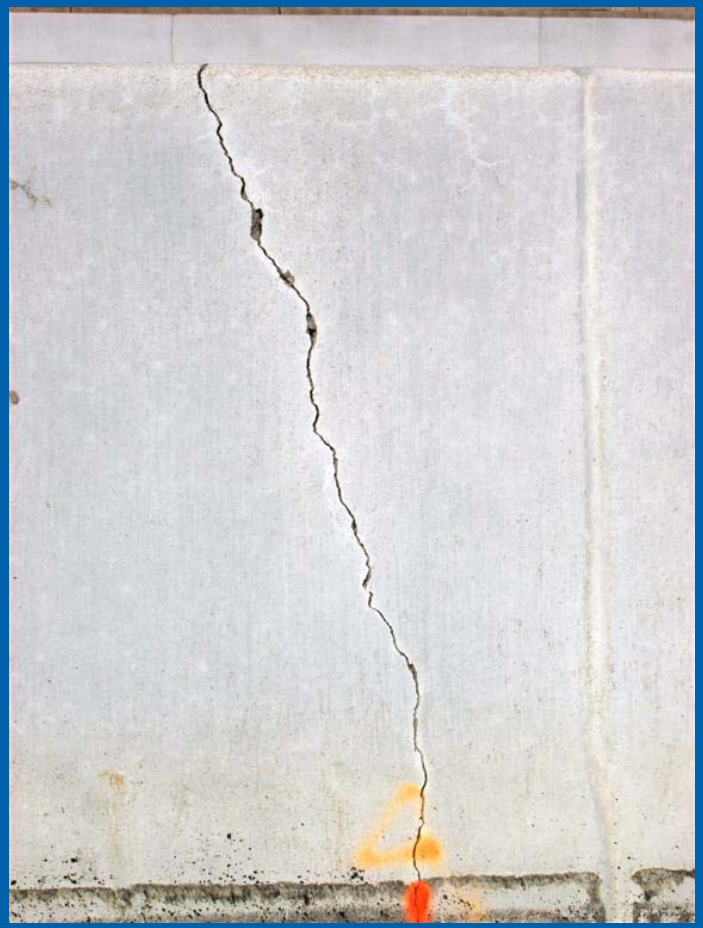
Cores were made at several crack locations


Voids in parapet concrete observed around vertical reinforcement


Voids in concrete around parapet reinforcement

In the second core, while the magnitude and number of voids were less significant, they were observed nevertheless.

Parapet cracks > 0.02” in width can in some instances be attributed to poor consolidation in the slipped-formed concrete. In most cases, it was also observed that the wider cracks were located at vertical parapet reinforcement.



Cracks , > 0.1”, in unreinforced median barriers: Modify details in standard?? Again, a contractor was reluctant to repair cracks less than 1/8” in width w/o compensation.

Construction Joints

Should step for beam seat along backwall be eliminated?

Poorly consolidated shear key!!!!

Poorly finished construction joint, not an uncommon encounter.

More examples of poorly finished construction joints.

Better Construction Joint?

Spec. requirement:

"…After the concrete in the second placement has set, a V-groove shall be formed along the top of the joint by sandblasting to a depth of at least ¼" and shall be sealed with epoxy……"

In most instances, a saw-cut is made along the CJ, and not infrequently, the saw-cut is not made along the top of the joint!!!!

MORE TRAINING NEEDED??

QUESTIONS