North Eastern States Materials Engineers Association Conference

Rita Seraderian, P.E., Precast Concrete Institute Northeast

Quality Control: Fabrication Procedures for Precast Elements

Program Outline and Learning Objectives

- PCI Northeast Bridge Technical Committee
  - Update on Committee Activity - Bridge Guidelines
- PCI National Updates
  - Discuss Strategic Partnership between PCI and NPCI as it relates to the certification programs.
  - QC Programs Overview
  - Discuss resources currently under development.
  - Regional QC research projects
- Examples of regional common issues for improvement
- Q/A

PCINE Bridge Technical Committee

- PCINE Technical Committee was established in 1990
- Members included State Department of Transportations Engineers from New England and New York, Consultants and Precastors
- Focus is on Updating and Developing Regional Standards for ABC Bridge Construction since 2004

PCINE Bridge Technical Committee

State DOT

- Rabih Barakat– CTDOT
- Bryan Reed - CTDOT
- Robert Bulger - Maine DOT
- Brian Reeves – Maine DOT
- Alex Bardow - MassDOT
- Maura Sullivan – MassDOT
- Edmund Newton - MassDOT
- Duane Carpenter – NYSDOT
- Michael Twiss – NYSDOT
- Jason Tremblay –NHDOT
- David Scott - NHDOT
- Mike Savella - Rhode Island DOT
- Rob Young – Vermont AOT

Precasters

- Rita Seraderian - PCI Northeast
- Joe Carrara - J. P. Carrara & Sons
- Ernie Brod - J. P. Carrara & Sons
- Chris Fowler - Oldcastle Precast
- Eric Schaffrick - Dailey Precast
- Scott Harrigan – Fort Miller
- Chris Moore – United Precast
- Bill Augustus – Oldcastle Precast

Consultants

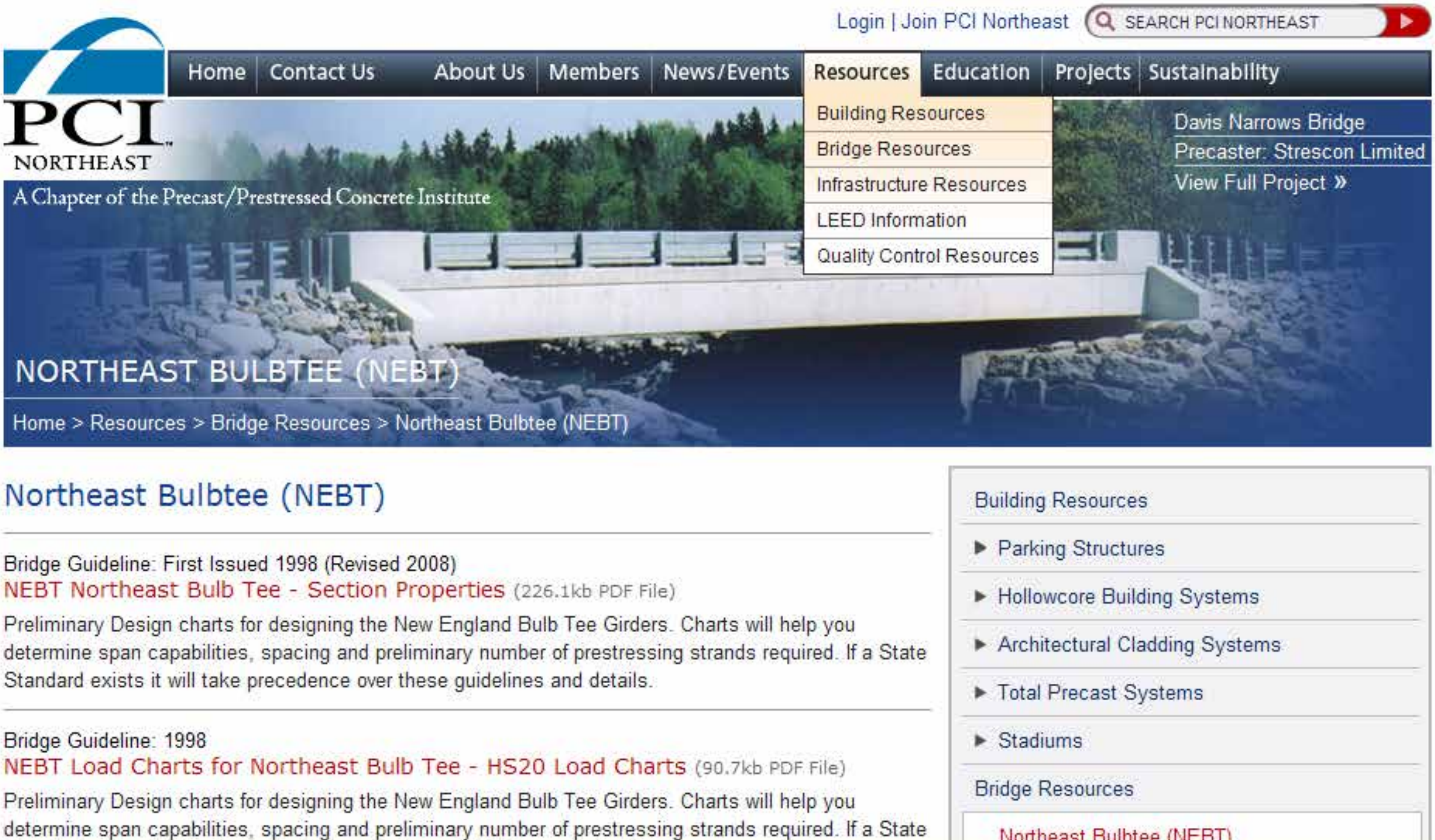
- **Michael P. Culmo - CME Associates, Inc.**
- **Eric Calderwood - Calderwood Eng.**
- **Vartan Sahakian -Commonwealth Eng.**
- **Darren Conboy - Jacobs Eng.**
- **Ed Barwicki - Lin Associates**

Reports Developed by the Technical Committee

- NEBT Preliminary Design Charts
- NEBT Post-Tensioned Design Guidelines
- High Performance Concrete Specification
- Prestressed Concrete Girder Continuity Connection
- Precast Deck Panel Guidelines
- Full Depth Precast Concrete Deck Slabs Guidelines
- Bridge Member Repair Guidelines
- Accelerated Bridge Construction Guidelines
- NEXT Beam Details and Design Charts

PCI

Reports are available at www.pcine.org



PCI

PCINE Bridge Technical Committee Focused it's work on Accelerated Bridge Construction starting in 2004.

Timeline:

- 2004 – Developed an Accelerated Bridge Guidelines Report
  Completed 2006
- 2006 – Begin Development of the NEXT "F" Beam
  Completed 2008 – First Bridge Built in 2010
- 2008 – Begin Development of NEXT "D" Beam
  Complete 2010 – First Bridge Built in 2011
- 2011 – 2nd Ed. Full Thickness Deck Panel Report Updated
- 2012 – Developed Prefabricated Bridge Elements & Systems Guide Details – Completed and Posted June -2012
- 2012 - Develop Guidelines for Precast Approach Slabs – Completed and Posted November- 2012

Current Work

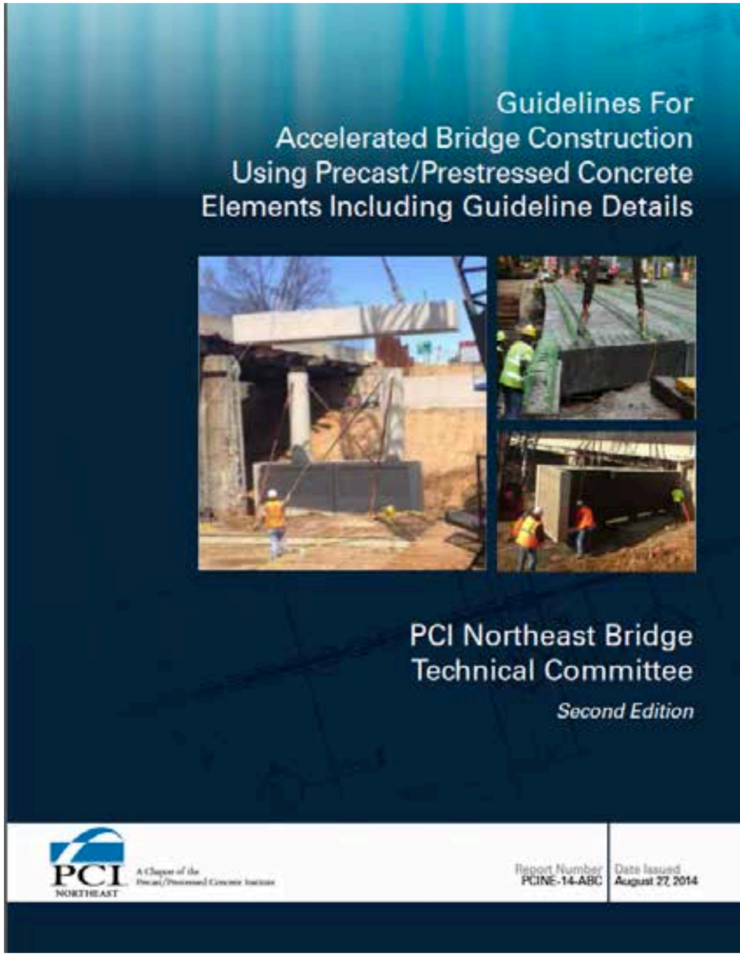
- Update the Accelerated Bridge Guideline Report
- Develop Standard Details for Deck Bulb Tees
- Development of NEXT E

Accelerated Bridge Guidelines Posted 2006

In 2004 the PCINE Committee began developing ABC Guidelines

"Guidelines for Accelerated Bridge Construction using Precast/Prestressed Concrete Components"

- Section 1: Application Overview
- Section 2: General Requirements
- Section 3: Precast Components
- Section 4: Joints
- Section 5: Grouting
- Section 6: Seismic
- Section 7: Fabrication & Construction



Accelerated Bridge Guidelines

Section 7: Fabrication/Construction

- Lifting Devices
- Shipping And Handling
- Assembly Plan
- Tolerances
- Fabrication Tolerance
- Erection Tolerances
- Repair Of Elements

7.3 Assembly Plan

This plan is created by the precaster and contractor and submitted to the owner and/or the engineer of record for approval. It provides detailed information on the contractor's means and methods for assembling the elements.

The assembly plan should at the very least, include all information required to complete the work such as:

- Engineer of record for the assembly plan.
- Shop drawings of all elements.
- Specific product names and other material requirements for all proprietary products proposed for use.
- Data on all materials that are the responsibility of the contractor.
- Details of all equipment to be used to lift elements including cranes, excavators, lifting slings, sling hooks, and jacks. Include crane locations, operation radii, and lifting calculations.
- Work area plan depicting items such as utilities overhead and below the work area, drainage inlet structures, and protective measures.
- Temporary support requirements for substructures including leveling screws and/or shims and lateral load and moment resistance requirements for vertical elements during assembly. Include methods of adjusting and securing the element after placement
- A detailed sequence of construction and a timeline for all operations. Account for setting and cure time for grouts, grouted splice couplers, and concrete closure pours.
- Procedures for controlling tolerance limits both horizontal and vertical. Include details of any alignment jigs including bi-level templates for reinforcing anchor dowels.
- A detailed installation procedure for connecting the grouted splice couplers (if required) including pre-grout and post-grout applications.
- A list of personnel that will be responsible for the grouting of the grouted splice couplers. Include proof of completion of two successful installations within the last two years. Training of new personnel within three months of installation by a manufacturer's technical representative is an acceptable substitution for this experience. In this case, provide proof of training.

The assembly plan is one piece of a project delivery concept devised for accelerated bridge construction. This concept allows the owner to design the structure and gives the contractor the ability to decide the most suitable means to assemble the elements.

The contract drawings provide a design and standard details for joints within the structure and performance requirements for materials that are used to assemble the elements.

Good resource for installation information:

1. PCI MNL-132: *Erection Safety for Precast and Prestressed Concrete.*
2. PCI MNL-127: *Erectors Manual—Standard and Guidelines for the Erection of Precast Concrete Products.*

PCI

7.5.1 Fabrication Tolerance
(Ref: PCINE Sheet SUB-11 & 12)

7.5.1 Fabrication Tolerance

(Ref: PCINE Sheet SUB-11 & 12)

All precast elements are manufactured to a tolerance. Designers should include element tolerance details in the plans or specifications.

The PCI Northeast Bridge Technical Committee has developed recommended tolerance drawings for typical precast elements. Details for typical element tolerances are included on **Sheets SUB-11 & 12**.

7.5.1.1 Inserts, Voids, and Projecting Reinforcing

(Ref: PCINE Sheet SUB-11 & 12)

The erection tolerance and hardware tolerances are interconnected. If a connection involves the insertion of a reinforcing bar into a device (coupler or duct), the specification for tolerances would be based on the assumption that the bar is installed to one side (say: to the left) and the coupler installed to the opposite side (say: to the right). The combination of these two potential installation tolerances needs to be kept within the tolerance of the insertion of the bar in the device.

The equation for the horizontal location of the specified projecting bar location tolerance would be:

$T_b = \frac{1}{2} * T_{id}$

Where:

T_b = Specified bar location tolerance

T_{id} = Insertion tolerance of the bar on the device based on the requirements of the manufacturer of the device

The equation for the specified device location tolerance would be:

$T_d = \frac{1}{2} * T_{id}$

Where:

T_d = Specified device location tolerance

T_{id} = Insertion tolerance of the bar on the device based on the requirements of the manufacturer of the device

7.5.2 Erection Tolerances

(Ref: PCINE Sheets SUB-3 & 4)

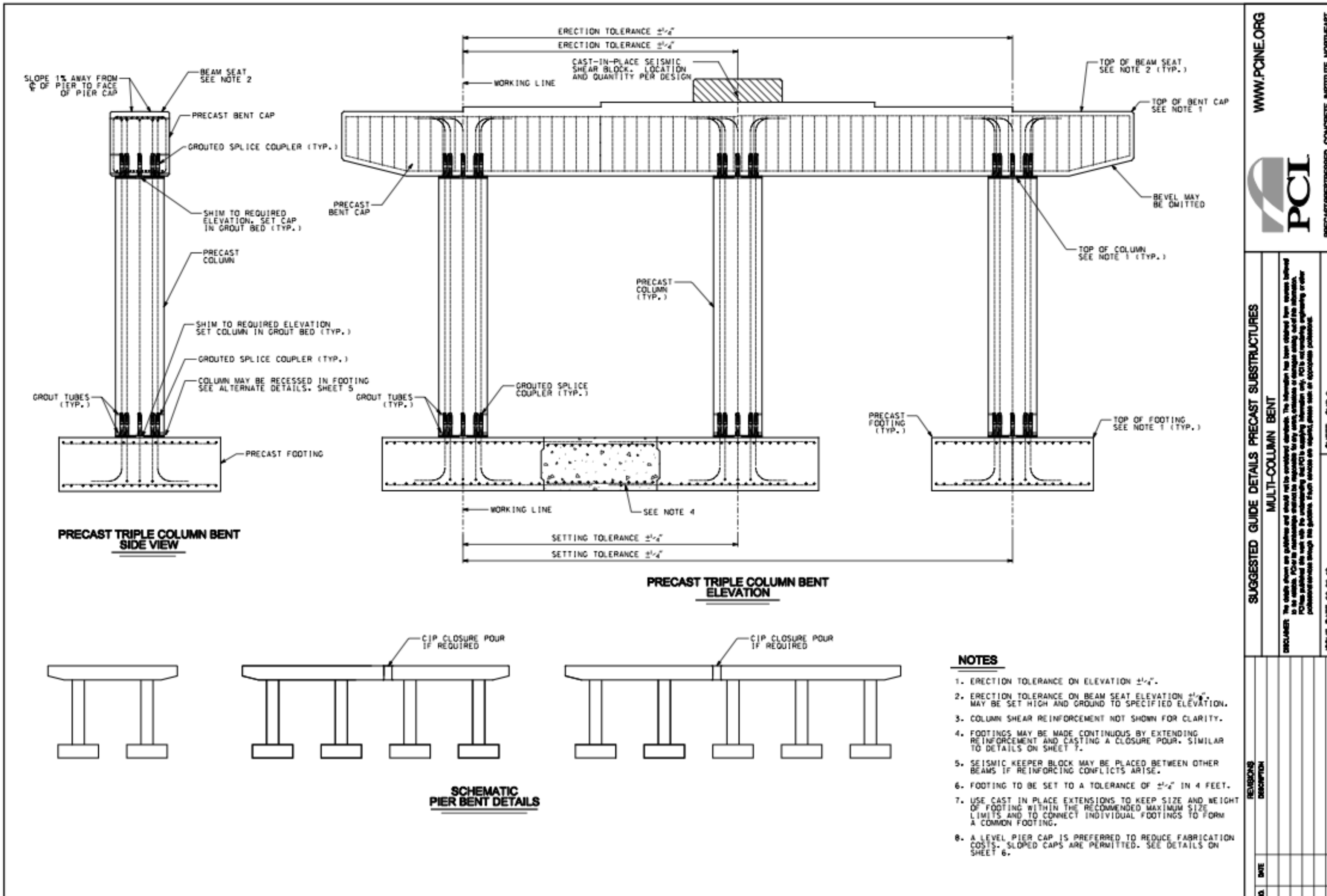
The erection and setting of heavy precast elements are controlled through the use of erection tolerances.

Designers should include element erection tolerances in the plans. Erection tolerances should be measured from a common working line that is shown on the plans.

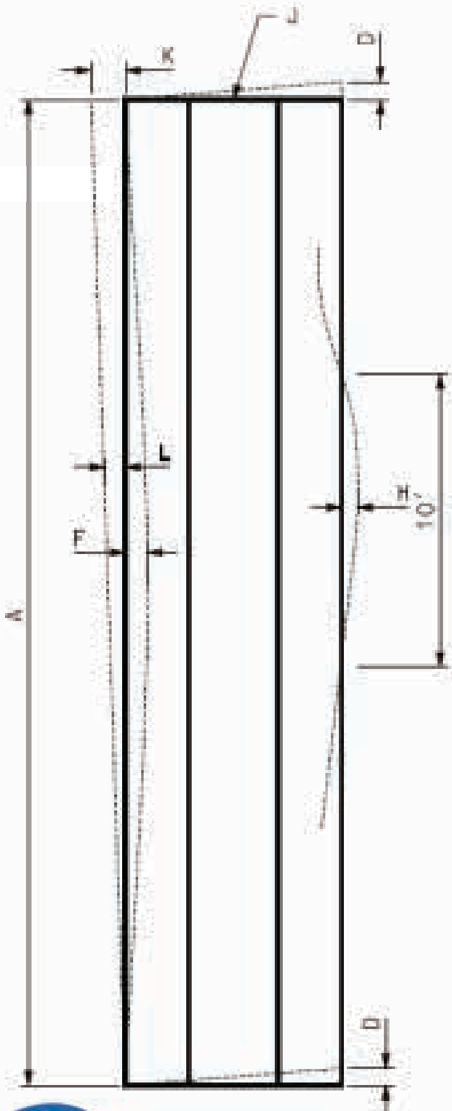
Erection of elements based on center-to-center spacing can result in a build-up of erection errors. The use of working lines is critical to prevent this build-up of errors.

PCI Northeast Guide Details posted 2012

– Based on experience in Utah and the NE region



Tolerance Details



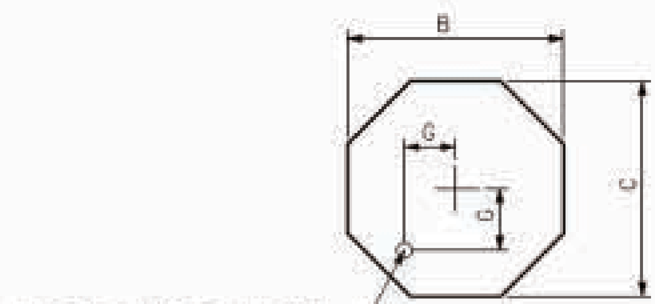
ELEVATION

COLUMN FABRICATION TOLERANCES

A	LENGTH	± 1/2"
B	WIDTH (OVERALL)	± 1/4"
C	DEPTH (OVERALL)	± 1/4"
D	VARIATION FROM SPECIFIED END SQUARENESS OR SKEW	± 1/8" PER 12 INCH WIDTH ± 3/8" MAXIMUM
F	SWEEP, FOR MEMBER LENGTH:	± 1/8" PER 10 FEET ± 1/2" MAXIMUM
G	LOCATION OF GROUTED SPLICE COUPLER MEASURED FROM A COMMON REFERENCE POINT	± 1/4"
H	LOCAL SMOOTHNESS OF ANY SURFACE	± 1/4" IN 10 FEET

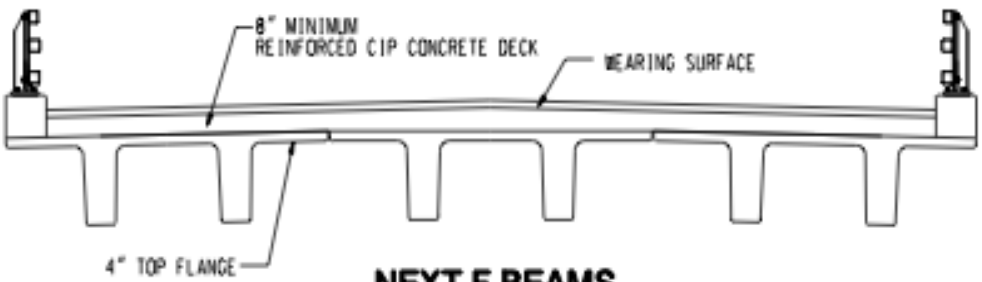
COLUMN ERECTION TOLERANCES

J	TOP ELEVATION FROM NOMINAL TOP ELEVATION MAXIMUM LOW MAXIMUM HIGH	 1/2" 1/4"
K	MAXIMUM PLUMB VARIATION OVER HEIGHT OF COLUMN	1/2"
L	PLUMB IN ANY 10 FEET OF COLUMN HEIGHT	1/4"



SECTION

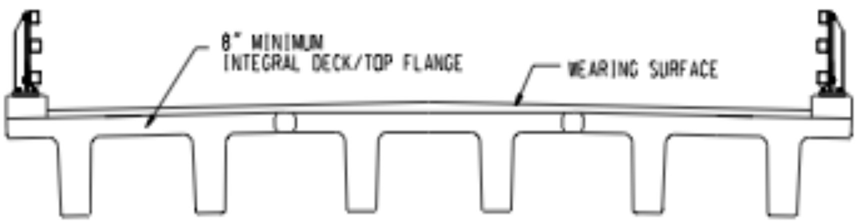
NEXT Beam Shapes



NEXT F BEAMS

- **<u>NEXT F plus 8" CIP Deck</u>**

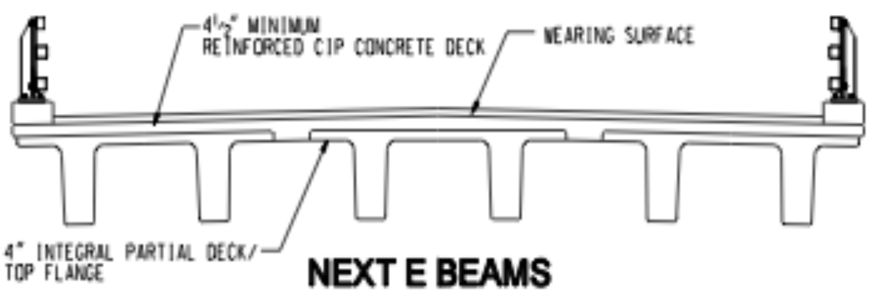
  - No Forming between Flanges
- - Easily accommodates Vertical
- Curves w/CIP Topping
- - Easily Handles Camber Variations
- between Members



NEXT D BEAMS

<u>NEXT D no CIP Deck</u>

- - No CIP Topping/Deck
- - Best Section For ABC
- - Special Concrete for Flange Conn
- - Harder to match adjacent members Skew/Design

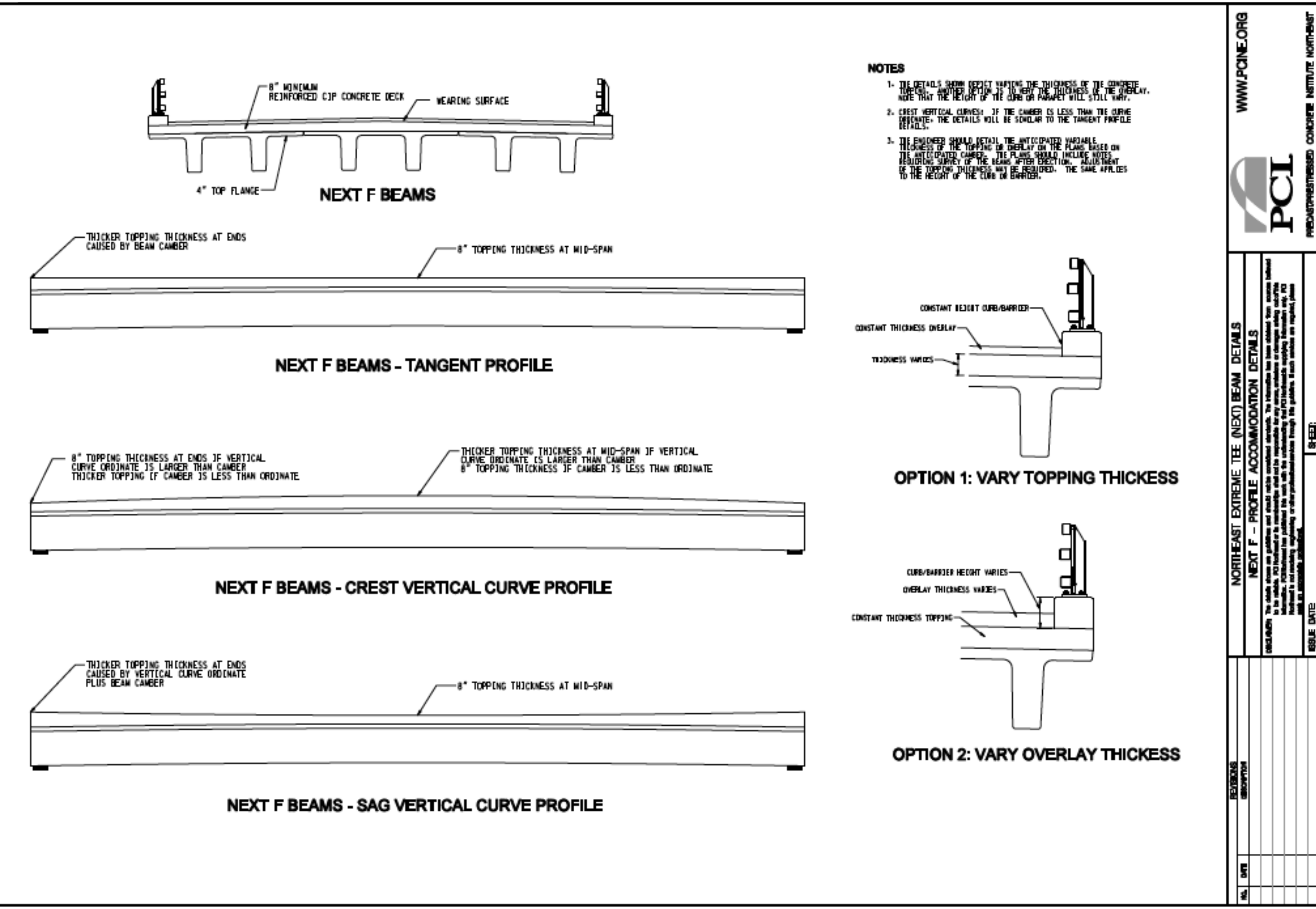


NEXT E BEAMS

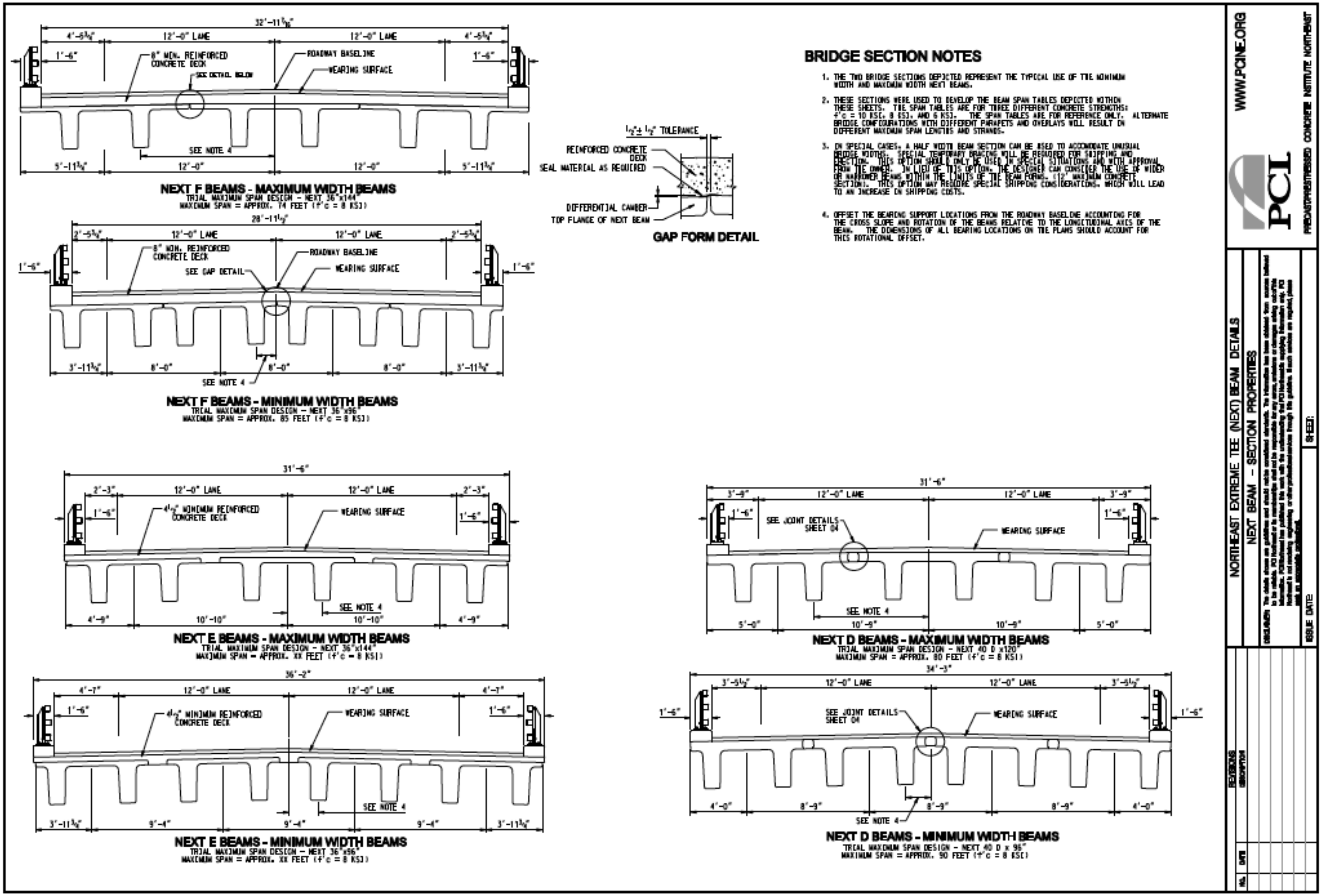
<u>NEXT E plus 4" CIP Deck</u>

- - Uses Less Topping & Reinforcement
- - Flange Connection Made with CIP
- - Easily Accommodates Vertical Curve
- - Easily Accommodates Camber Variations between members

NEXT Beam Shapes

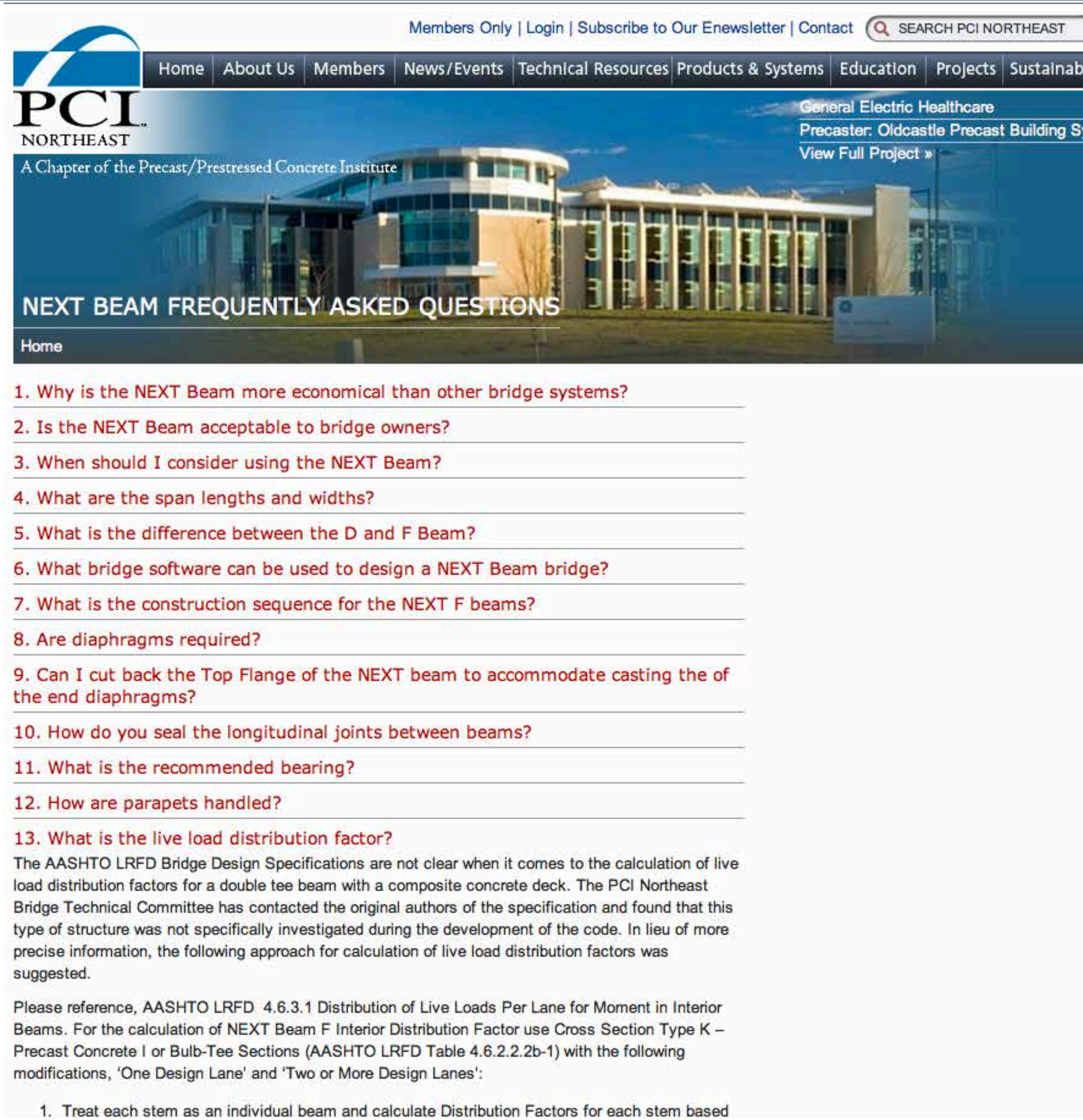


NEXT Beam Combinations



Additional Guidance on website www.pcine.org

- FAQ
- Design Assumptions



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PCI NORTHEAST
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General Electric Healthcare
Precaster: Oldcastle Precast Building S
View Full Project »

NEXT BEAM FREQUENTLY ASKED QUESTIONS

Home

1. Why is the NEXT Beam more economical than other bridge systems?
2. Is the NEXT Beam acceptable to bridge owners?
3. When should I consider using the NEXT Beam?
4. What are the span lengths and widths?
5. What is the difference between the D and F Beam?
6. What bridge software can be used to design a NEXT Beam bridge?
7. What is the construction sequence for the NEXT F beams?
8. Are diaphragms required?
9. Can I cut back the Top Flange of the NEXT beam to accommodate casting the of the end diaphragms?
10. How do you seal the longitudinal joints between beams?
11. What is the recommended bearing?
12. How are parapets handled?
13. What is the live load distribution factor?

The AASHTO LRFD Bridge Design Specifications are not clear when it comes to the calculation of live load distribution factors for a double tee beam with a composite concrete deck. The PCI Northeast Bridge Technical Committee has contacted the original authors of the specification and found that this type of structure was not specifically investigated during the development of the code. In lieu of more precise information, the following approach for calculation of live load distribution factors was suggested.

Please reference, AASHTO LRFD 4.6.3.1 Distribution of Live Loads Per Lane for Moment in Interior Beams. For the calculation of NEXT Beam F Interior Distribution Factor use Cross Section Type K – Precast Concrete I or Bulb-Tee Sections (AASHTO LRFD Table 4.6.2.2.2b-1) with the following modifications, 'One Design Lane' and 'Two or More Design Lanes':

1. Treat each stem as an individual beam and calculate Distribution Factors for each stem based

TIMELINE NEXT Beam Developed in 2008

2009

First NEXT Beam Cast

2010

First NEXT F Bridges Built York ME and Kittery ME

2 Bridges

2011

7 Bridges

First NEXT D bridges are Built in Maine & Vermont
MA and NY Build first Bridges

First Curved Flange Project

NJ and RI build their first projects

2012

18 Bridges

2011-12

Logan Airport uses NEXT beams for Runway Extension and new Airport Viaduct

NY built First Lateral Slide

2013

25+ Projects

PCI

NEXT Beam Acceptance - States with NEXT Beams

- Massachusetts DOT
- Vermont AOT
- Maine DOT
- Rhode Island DOT
- New Hampshire DOT
- New York State DOT and New York City DOT
- New Jersey DOT
- Delaware DOT
- Pennsylvania DOT
- Virginia DOT

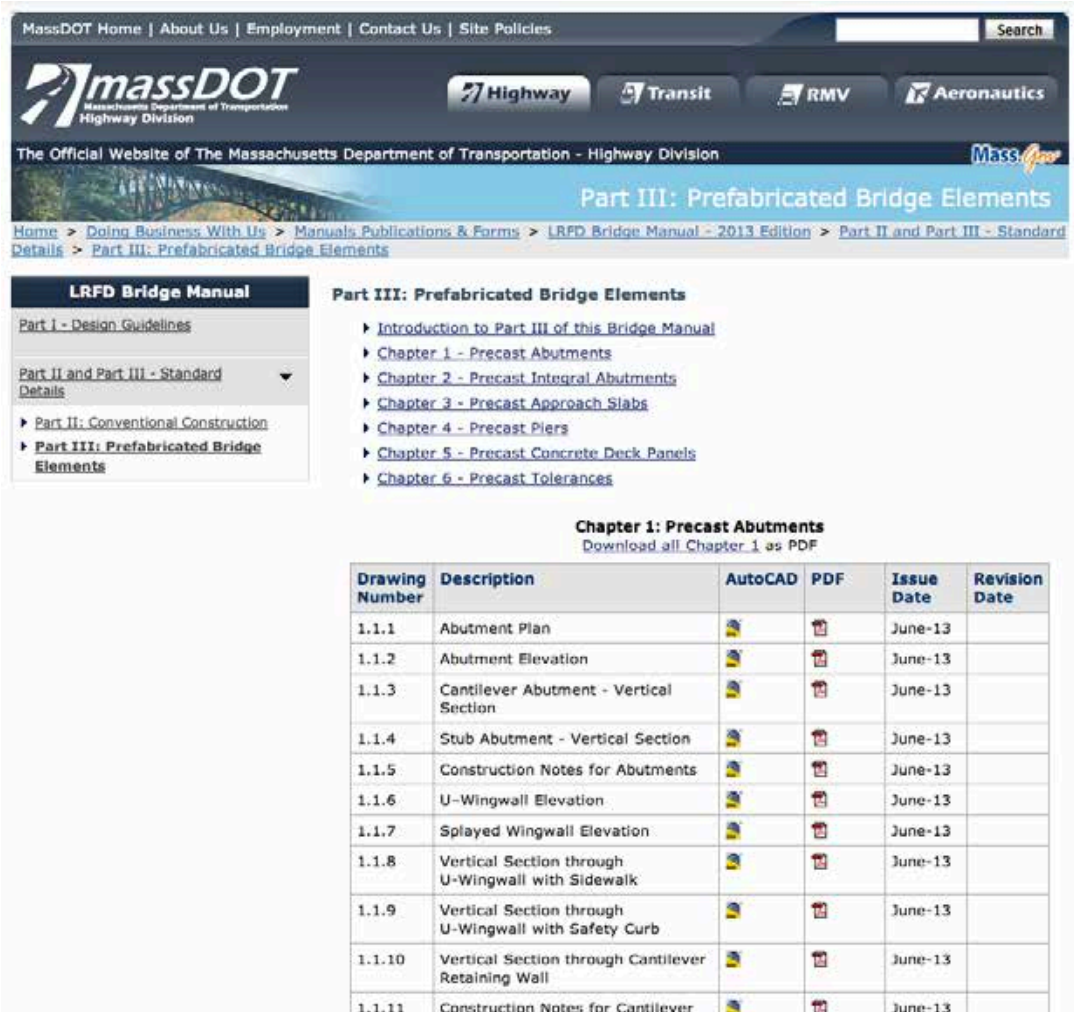
States with NEXT Beam in Design/Construction:

- Connecticut DOT

New Brunswick has also adopted the new shape for Canada

States using Accelerated Construction

- **States using ABC**
- MassDOT
- VAOT
- MEDOT
- CTDOT
- RIDOT
- NHDOT
- NYSDOT
- NJDOT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massDOT Massachusetts Department of Transportation Highway Division

Highway | Transit | RMV | Aeronautics

The Official Website of The Massachusetts Department of Transportation - Highway Division

Part III: Prefabricated Bridge Elements

Home > Doing Business With Us > Manuals Publications & Forms > LRFD Bridge Manual - 2013 Edition > Part II and Part III - Standard Details > Part III: Prefabricated Bridge Elements

LRFD Bridge Manual
- Part I - Design Guidelines
- Part II and Part III - Standard Details
  - Part II: Conventional Construction
  - **Part III: Prefabricated Bridge Elements**

Part III: Prefabricated Bridge Elements
- Introduction to Part III of this Bridge Manual
- Chapter 1 - Precast Abutments
- Chapter 2 - Precast Integral Abutments
- Chapter 3 - Precast Approach Slabs
- Chapter 4 - Precast Piers
- Chapter 5 - Precast Concrete Deck Panels
- Chapter 6 - Precast Tolerances

Chapter 1: Precast Abutments
Download all Chapter 1 as PDF

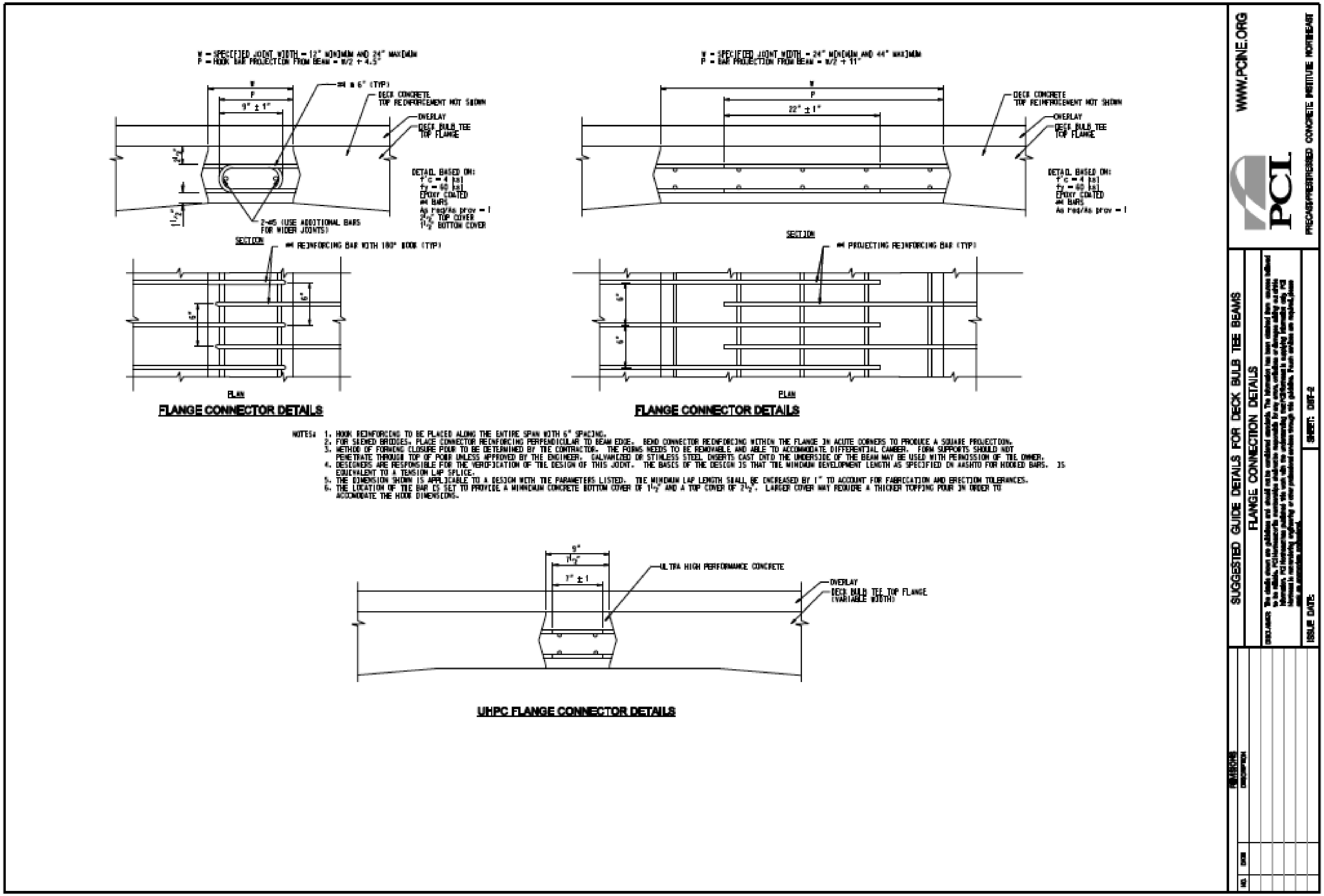
Drawing Number	Description	AutoCAD	PDF	Issue Date	Revision Date
1.1.1	Abutment Plan			June-13	
1.1.2	Abutment Elevation			June-13	
1.1.3	Cantilever Abutment - Vertical Section			June-13	
1.1.4	Stub Abutment - Vertical Section			June-13	
1.1.5	Construction Notes for Abutments			June-13	
1.1.6	U-Wingwall Elevation			June-13	
1.1.7	Splayed Wingwall Elevation			June-13	
1.1.8	Vertical Section through U-Wingwall with Sidewalk			June-13	
1.1.9	Vertical Section through U-Wingwall with Safety Curb			June-13	
1.1.10	Vertical Section through Cantilever Retaining Wall			June-13	
1.1.11	Construction Notes for Cantilever			June-13	

MassDOT Released Part III of their bridge design manual – Prefabricated Bridge Elements

Easthampton MA Deck Bulb Tee

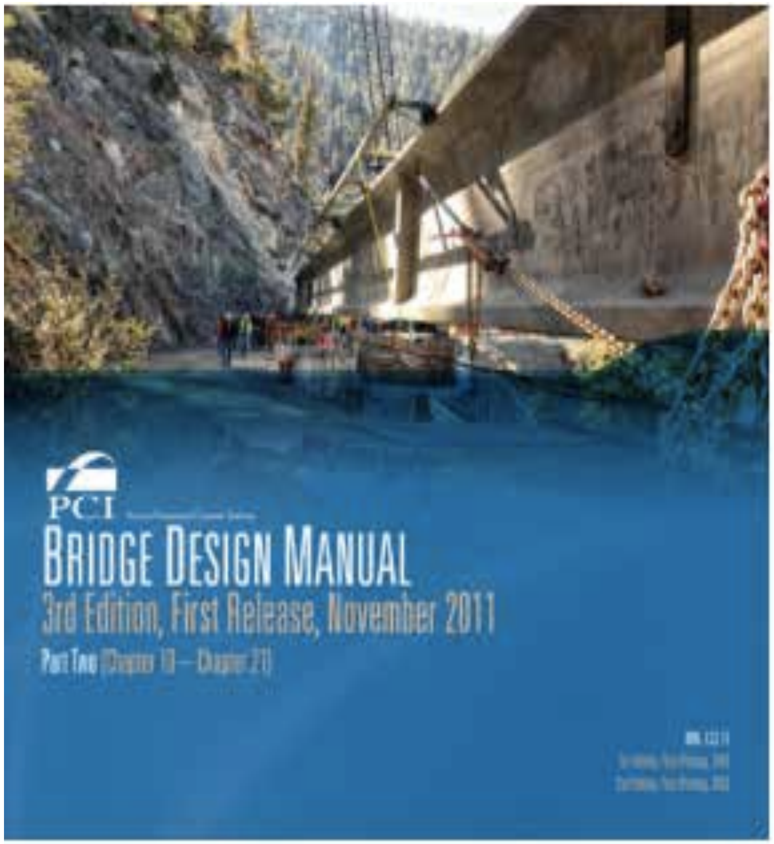
Eight – 1220 mm NEBT 5' wide 95' long Deck Bulb Tees   8000 psi Concrete – UHPC Joint

Deck Bulb Tee Guidelines



Resources

Precast Prestressed Concrete Institute www.pci.org



Resources

Precast Prestressed Concrete Institute www.pci.org

Precast Prestressed Concrete Institute Northeast www.pcine.org

Quality Control Plant

Quality Control Field

PCI and NPCA Strategic Partnership

As of June 30, 2014

- NPCA is no longer offering certification of prestressed product.
- Plants can maintain dual PCI and NPCA certifications.
- Ross Bryan Associates will Audit PCI and NPCA Plants
- Precast Substructures fall under BI PCI Certification

Quality Control Plant

Plants

PCI's Plant Certification Program ensures that each plant has developed and documented an in-depth, in-house quality system based on time-tested, national industry standards.

Personnel

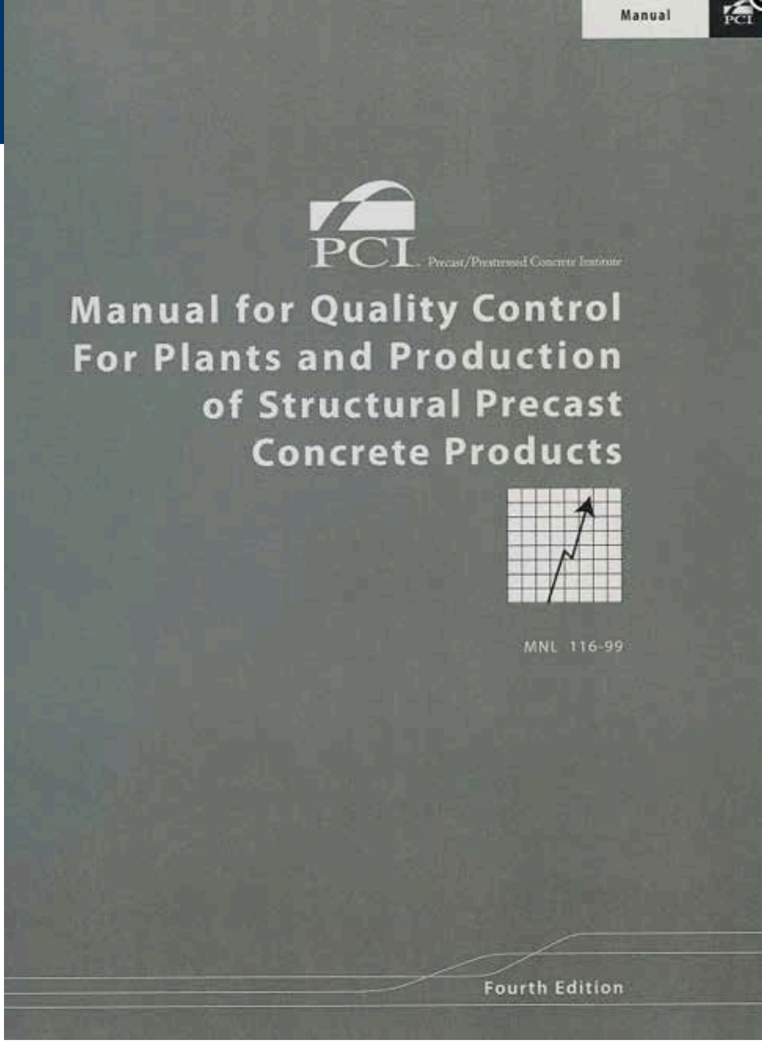
Three Levels of instruction and evaluation for certified quality-control personnel.

PCI

PCI CERTIFICATION

Plant Quality Control Manual

B1 – Precast Bridge Products (No Prestressed Reinforcement)
B2 – Prestressed Miscellaneous Bridge Products (Non-Superstructure)
B3 – Prestressed Straight-Strand Bridge Beams (Superstructure)
B4 – Prestressed Deflected-Strand Bridge Beams (Superstructure)
BA – Bridge Products with an Architectural



Manual for Quality Control for Plants and Production of Structural Precast Concrete Products, 4th Edition - (MNL-116)

Plant Quality Control Technicians Level I, II, & III

Training Manual 101 (TM-101)

Recertification every 5 yrs

Continuously certified for 15 years will no longer have to meet the examination requirement.

Training Manual 103 (TM-103)

The concepts are advanced and require considerable experience in a precast plant or an advance CE or technology

Recertification every 5 yrs.

Expired Level III certification will require re-examination.

Plant Quality Control Technicians

2014 Registration PCI Plant Quality Control Schools

Holiday Inn Express Downtown Nashville

November 17 - 22, 2014

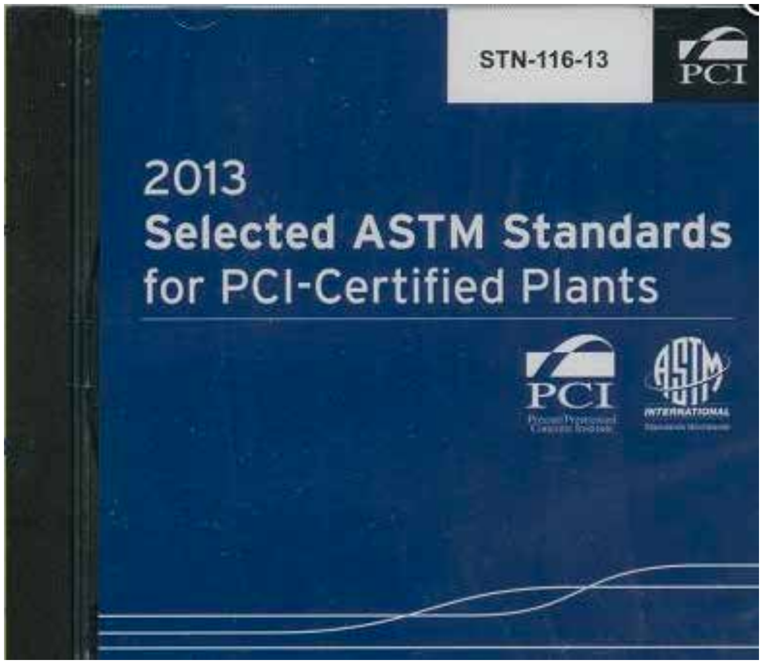
- Level I & II: November 17- 19, 2014
- Level III: Nov 19 – 22, 2014

- Regional Workshops can be arranged
- NETTCP also offers Level I and II next year

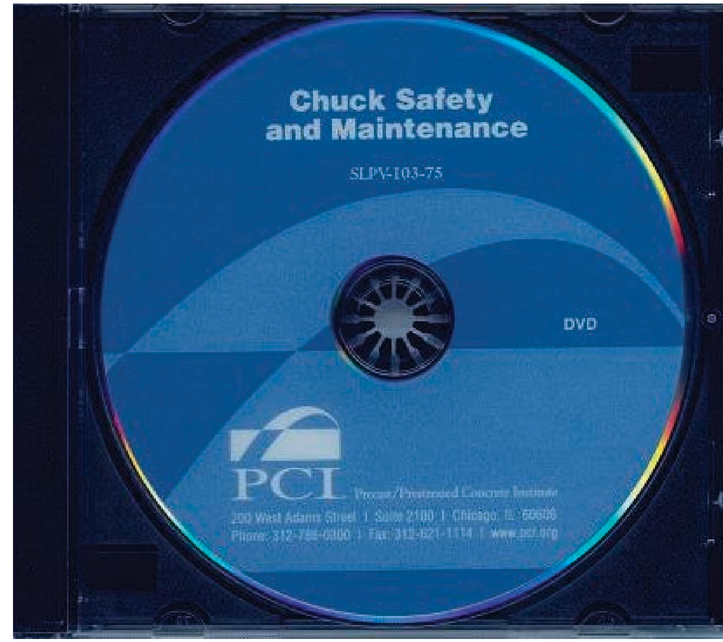
PCI

Plant Quality Control

ASTM Standards for PCI Certified Plants, 1st Edition - CD - (STN-116)



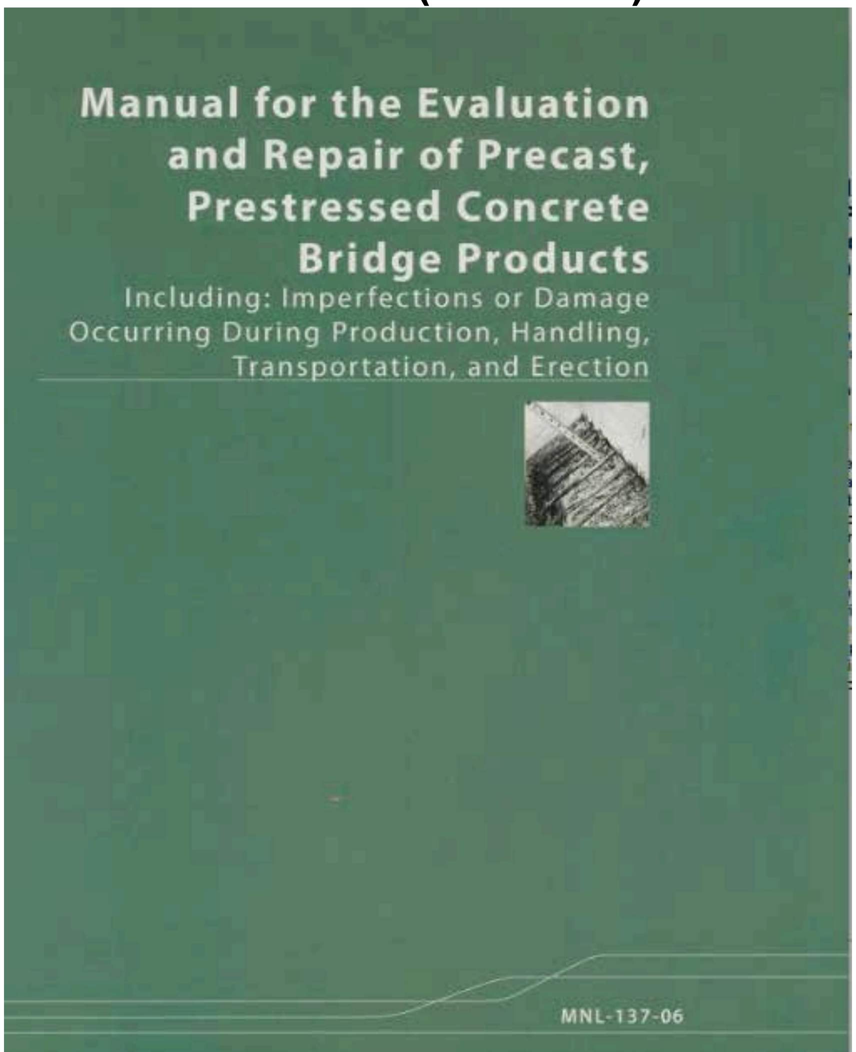
Chuck Safety & Maintenance DVD



75 ASTM specifications referenced in PCI Quality Control Manuals 116 and 117.

Beam Quality Control - Repair

Manual for the Evaluation and Repair of Precast, Prestressed Concrete Bridge Products, 1st Edition - (MNL-137)



Bridge Member Repair Guidelines By PCI Northeast PCINER-01-MBRG

Report No:
PCINER-01-BMRG

Title:
Bridge Member Repair Guidelines

Developing Organization:
Precast/Prestressed Concrete Institute Northeast Region
Technical Committee
Phone – 888-700-5670
Email – contact@pcine.org

Report Date:	**Revision Dates:**
October 2001	July 2002, Nov. 2002, Jan. 2003, Oct. 2012

Status of Report: Final

Abstract:

This report is intended to serve as a guide to identify defects that may occur during the fabrication and handling of bridge elements. The report gives guidance on possible cause and prevention. It will help determine the consequences of the defects and assist in making a judgment as to acceptance/repair or rejection.

This report can be utilized by State Inspectors, Designers, Plant Production Managers, Plant Quality Control Inspectors and Plant Engineers.

Number of Pages: 49

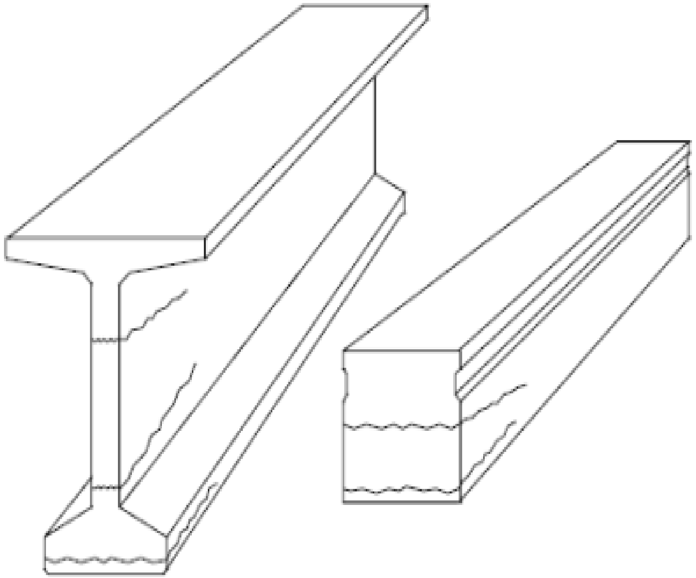
PCI
Northeast Region

Bridge Member Repair Guidelines

Report Number PCINER-01-BMRG

Bridge Member Repair Guidelines

- For Newly Cast Precast
- 14 Common Crack and Repair Procedures



Bridge Member Repair Guidelines

- Cause
- Prevention

- Engineering Effects
- Repair Considerations

TS #4
TROUBLE SHOOTING HORIZONTAL END CRACKS IN WEBS AND FLANGES

Description – This crack usually begins at the end of the beam and extends across the end of the beam and is visible on both sides.

CAUSE

A. Detensioning

1. Improper procedures for detensioning strands
2. Improper detensioning sequence

B. Design

1. Low release strength specified
2. Inadequate end vertical reinforcing
3. Excessive prestress force or concentration of force
4. Excessive number of debonded strands in the bottom plane and/or lack of confining stirrups
5. Excessive vertical force from deflected strands

C. Production

1. Concrete binding in forms
2. Bottom plates, sleeves or inserts at end of beam
3. Shrinkage and curing
4. Improper removal of header or strand caught in header
5. Settlement of wet concrete below a concentration of strand or mild reinforcing near the top at beam end
6. For box beams, delayed web pours causing a cold joint

PREVENTION

A. Proper Release Procedure

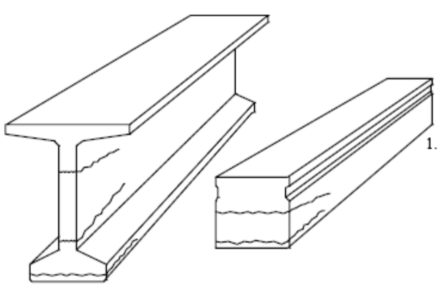
1. Heat strand to allow slow elongation (annealing) and avoid sudden release
2. Keep prestress forces balanced using a pre-stablished procedure[1]

B. Improve Design

1. Establish adequate release strength
2. Use adequate anchorage zone end reinforcement to control width and length of cracks
3. Properly space and distribute strand at beam ends
4. Debonding strands for a short distance is effective in reducing stress concentrations. Debonding of an entire row of strand or debonding the outer strand in a layer are not recommended. Provide confinement reinforcement near beam ends
5. Fan out deflected strands or combine debonding and deflecting strand

C. Improve Production Technique

1. Keep forms well oiled
2. Assure forms will not interfere with hardware if forms expand or during detensioning
3. Provide uniform heat and humidity during curing
4. Separate header from forms before lifting
5. Improve vibration techniques
6. Pour webs prior to set of bottom slab of box beams



1. Balancing of prestress force is key to minimizing the potential for horizontal cracks. See "Release Methodology of Prestress Strands", Kannel J., French C. and Stolurski, H., PCI Journal Vol. 42, No. 1, Jan-Feb. 1997, pp. 42-55

TS #4
TROUBLE SHOOTING HORIZONTAL END CRACKS IN WEBS AND FLANGES

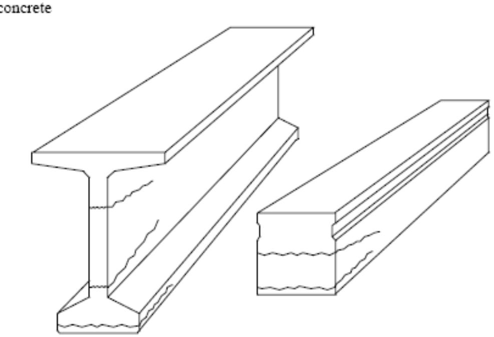
Description – This crack usually begins at the end of the beam and extends across the end of the beam and is visible on both sides.

ENGINEERING EFFECTS

1. Cracks not intercepting strand are not of structural consequence, provided the area of vertical shear reinforcement in the webs meets horizontal shear requirements. After installation of the beams, the cracks would not be expected to grow, given adequate reinforcement against horizontal shear, since the dead load weight of the slab and other dead loads will induce vertical compression in the beams ends.
2. For cracks that intercept or are co-linear with strands, the shear and moment capacity will require recomputation due to a change in location of transfer length of affected strands.
3. Cracks in beam ends under expansion joints, should be considered for epoxy injection to avoid future deterioration from water and salt intrusion. Cracks in box beams, in side-by-side (butted) configurations should be epoxy injected in any case due to potential leakage through grouted joints.
4. In deciding whether to inject cracks or leave them unfilled, ACI Committee 224 report "Control of Cracking in Concrete Structures" states that tolerable crack widths are 0.006-in. for concrete exposed to seawater spray with wetting and drying, 0.007-in. for concrete subject to de-icing chemicals and 0.012-in. for concrete exposed to humidity.

REPAIR CONSIDERATIONS

1. No repairs to beams used in composite construction in accordance with the discussion in ENGINEERING EFFECTS 1.
2. For cracks discussed in ENGINEERING EFFECTS 2:
   a. Cracks that have been verified by the owner to not have diminished the beam capacity below acceptable levels should be injected, in accordance with Standard Repair Procedure #10.
   b. Beams verified by the engineer to have capacity reduced to unacceptable levels will be rejected.
3. Durability concerns, discussed in ENGINEERING EFFECTS 3 and 4 may favor epoxy injection, in accordance with Standard Repair Procedure #10. The surface of cracks narrower than 0.006-inches should be sealed. See Repair Procedure #14.

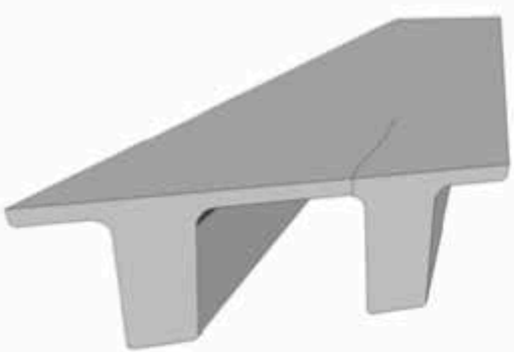


NEXT Beam Quality Control Repair

TS #12
TROUBLE SHOOTING PARTIALLY CRACKED TOP FLANGES – NEXT BEAMS

Description – Crack running parallel to beam centerline along inside face of stem.
This crack is expected in obtuse corners of skewed beams adjacent to the interior face of the stem, but can occur in any beam.

CAUSE	PREVENTION
A. Detensioning	A. Adjust Reinforcement and detensioning sequence
1. Release stresses brought on by skew effects. Uneven lift-off of beam stems brought on by skew.	1. Place additional transverse steel reinforcement in flange to intercept and minimize crack width. The bars should be located as close to the bottom of the top flange as allowed by state specifications for deck reinforcement (1" is recommended). Consider adding FRP reinforcement along inside radius with minimal (1/2") cover to intercept crack near surface of concrete. Note: The reinforcement described above was added to the typical details on October 25, 2012.
2. Release stresses due to uneven detensioning sequence between beam stems.	2. Release one strand at a time alternating from stem to stem.
3. Binding in forms during stripping	3. Keep forms clean and well oiled. Keep forms in good repair, free of dents and dimples.
B. Shrinkage	B. Modify Fabrication Methods
1. Shrinkage of top flange concrete restricted by the fixed 2 stem form.	1. Avoid rapid cooling, after curing has stopped and until beam is removed from form. 2. Place additional transverse reinforcement in flange to intercept and minimize crack width.



TS #12
TROUBLE SHOOTING PARTIALLY CRACKED TOP FLANGES – NEXT BEAMS

Description – Crack running parallel to beam centerline along inside face of stem.
This crack is expected in obtuse corners of skewed beams adjacent to the interior face of the stem, but can occur in any beam.

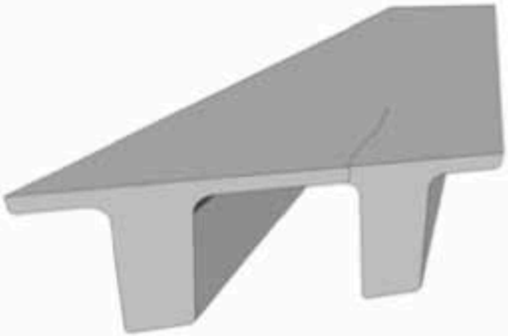
ENGINEERING EFFECT

1. For beams that will be topped with a composite concrete slab (NEXT F), there are no concerns. These cracks will be covered by the slab in composite construction.
2. For beams whose top flange is to be used as the riding surface of the completed bridge (NEXT D), cracks in the top flange can affect durability, if not repaired

REPAIR CONSIDERATIONS

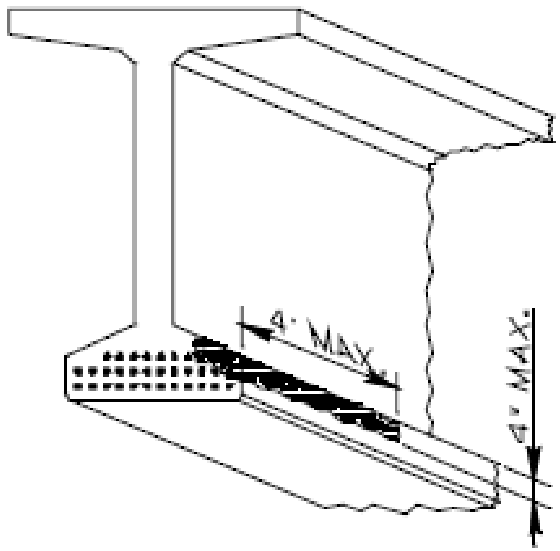
1. Where a composite concrete deck is embedded in concrete in the finished structure (integral abutment), no structural repairs are needed.
2. NEXT F: If the crack is exposed on the underside of the finished structure and the bridge is in a corrosive environment:
   - Cracks less than 0.006 inch wide should be ignored (See Note).
   - Cracks greater than or equal to 0.006 inch wide and less than 0.016 inch wide should be sealed with epoxy paste. See Repair Procedure #14.
   - Cracks greater than or equal to 0.016" wide should be sealed using epoxy injection by the pressure injection method. See Repair Procedure #10.
3. NEXT D: Where the top flange will be the riding surface and the crack width is greater than 0.006 inches, the crack at the top surface of the deck can be sealed with a low viscosity epoxy or methylmethacrylate product. See Standard Repair Procedure 14.

Note: The AASHTO LRFD Bridge Design Specifications limits crack widths in Class 2 exposure conditions (bridge decks) to 0.0085 inches (Article 5.7.3.4). Therefore these recommendations are conservative.



Bridge Member Repair Guidelines

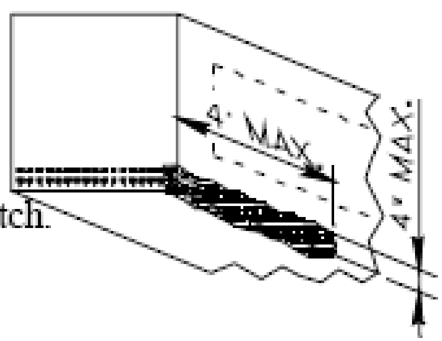
FOR
SPALLS AND VOIDS IN THE BOTTOM FLANGE THAT
EXPOSE PRESTRESSING STRAND



NOTE: This repair applies only to those voids which do not exceed 4 inches in depth, 4 feet in length and expose no more than 2 strands, and when no more than one spall or void appears in a given section of the girder. A section is defined as ¼ the length of the girder. No two such spalls or voids shall have their closest dimensions nearer than two beam depth apart. With the prior approval of the owner/engineer, this repair may be made, in the presence of the owners inspector without submitting the repair for formal approval.

Repairs at beam ends should be made after detensioning because any repairs made prior to detensioning will most likely fail due to high transfer stresses.

Repairs away from beam ends should be made prior to detensioning so that precompression stresses are induced in the patch material



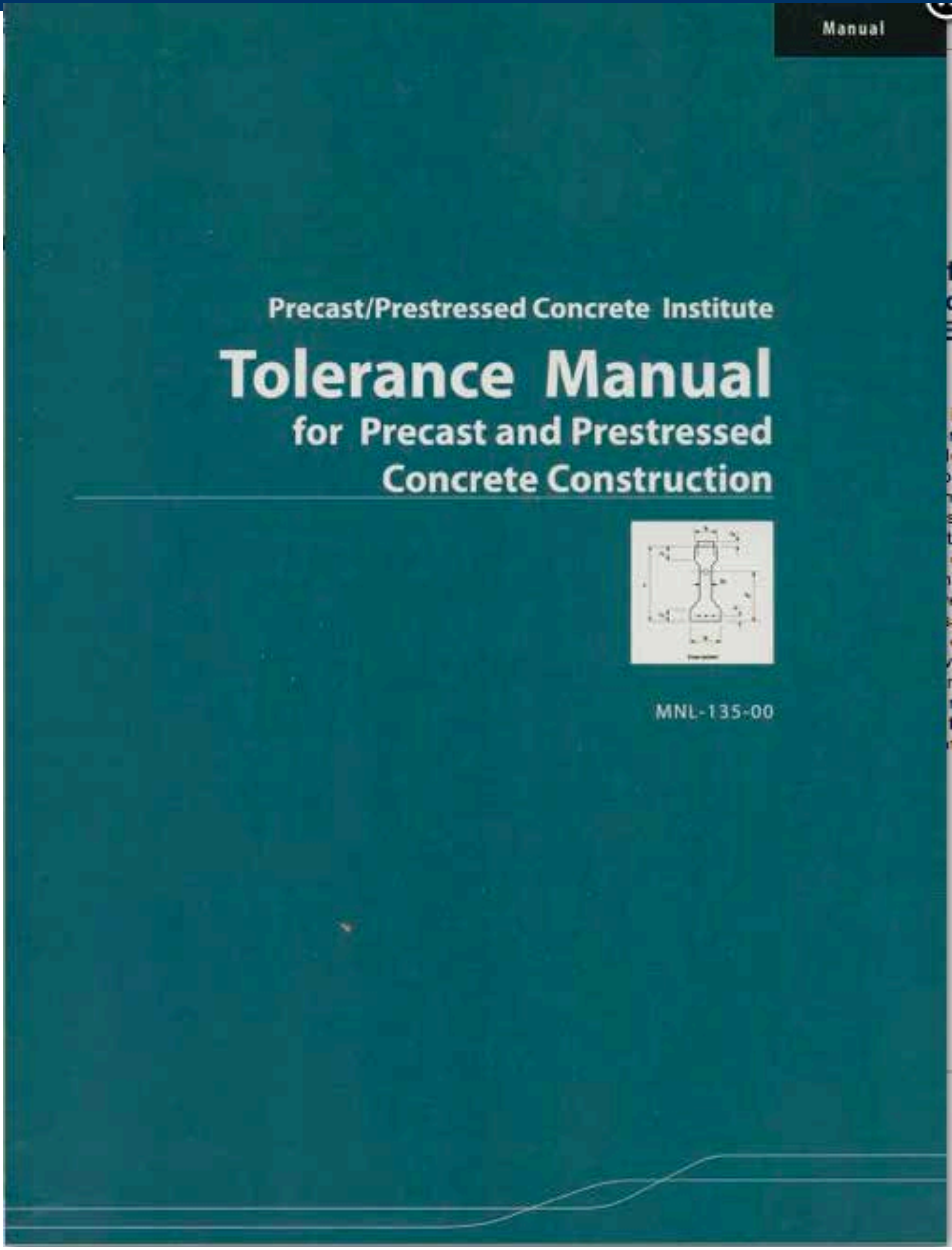
A. Remove all loose concrete.

B. Square interfaces with existing concrete to be in contact with the patch.

C. Clean the excavated area, blowing away dust.

Plant Quality Control Manuals

Tolerance Manual for Precast and Prestressed Concrete Construction, 1st Edition - (MNL-135)



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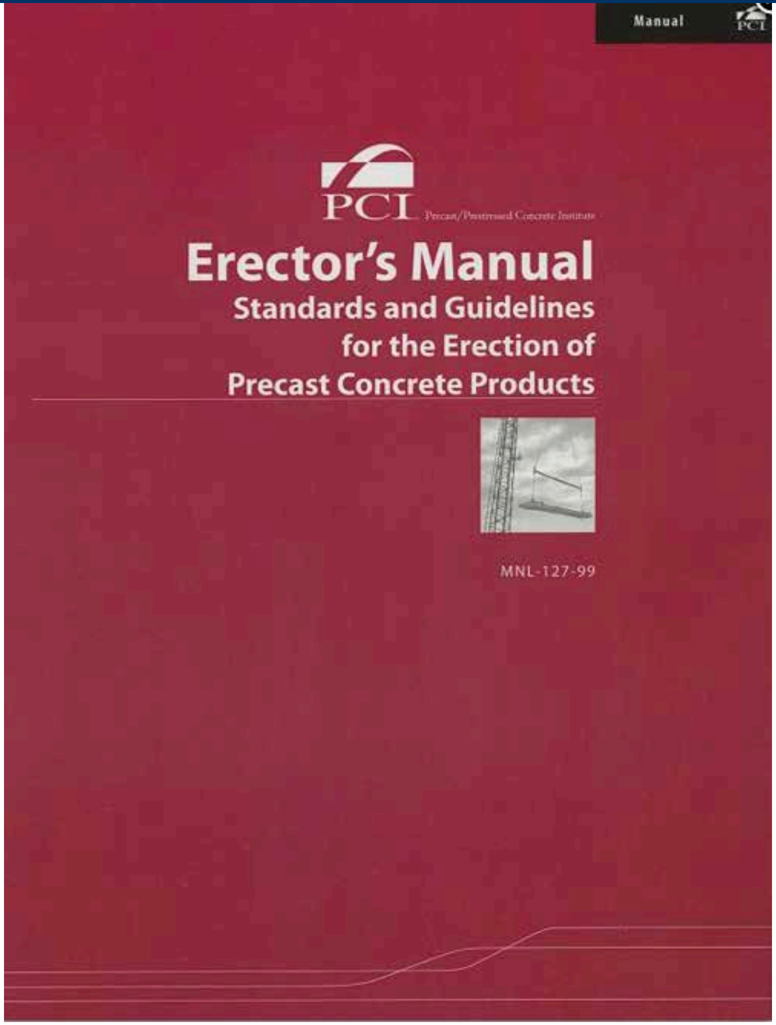
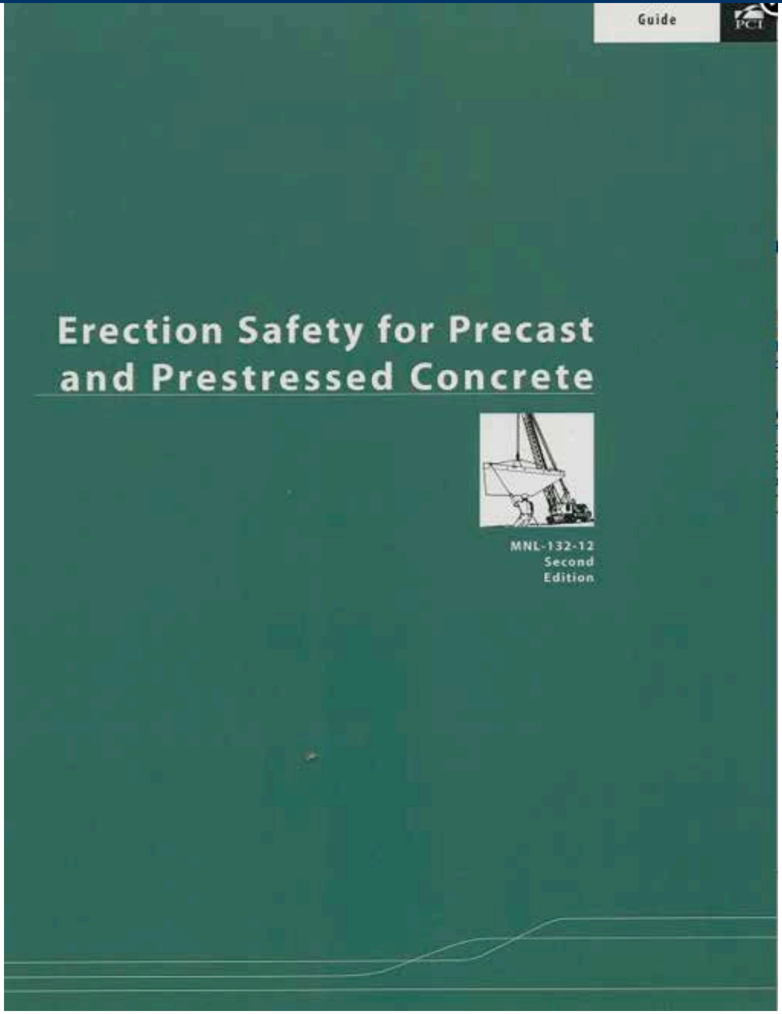
Erector Manuals



Erector's Manual - Standards and Guidelines for the Erection of Precast Concrete Products - (MNL-127)



Erection Safety for Precast and Prestressed Concrete (MNL-132)

The PCI-Certified Erector Program

- Audited 2/yr by a PCI-Certified Field Auditor.
- Items Audited
  - Safety Procedures
  - Erection Procedures
  - Personnel Qualification records
  - Project Files
  - Equipment Management records

- Category S1-Simple Structural Systems
  - Horizontal decking members
- Category S2- Complex Structural Systems
  - Total precast concrete systems, multi-product structures (those that combine vertical and horizontal members), architectural finishes.
- Category A- Architectural Systems

Project Sponsor: New England Transportation Consortium (NETC)

Project Title: Development of High Early-Strength Concrete for Accelerated Bridge Construction Closure Pour Connections – # NETC – 31

Conducted by: University of Mass; Amherst, MA - Sergio F. Breña
Status: Just under way
Project Duration/Funding: 24 months/$174,923

PCINE Bridge Technical Committee supported project in an advisory role.

Scope:

- Develop & validate non-proprietary high early concrete mixtures .
- Intended for use in closure pours in accelerated bridge construction projects in New England.

Development of High Early-Strength Concrete for Accelerated Bridge Construction Closure Pour Connections – # NETC – 31

- Task 1: Literature Review
  - Databases/journals
  - Survey Concrete mixtures from DOTs
- Task 2 – Develop Mixture Design Specification
  - Specification requirements?
- Task 3 – Develop Mix Design
  - Trial batches tested for strength
  - Select mixture(s) for wider array of tests
- Task 4 – Test Mixture
  - Large number of short-term and long-term tests

Development of High Early-Strength Concrete for Accelerated Bridge Construction Closure Pour Connections – # NETC – 31

Concrete Property	Performance Category	Applicable Standard(s)
Set time	Workability	AASHTO T197 / ASTM C403
Air Content (pressure method)	Durability	AASHTO T152 / ASTM C231
Slump	Workability	AASHTO T119 / ASTM C143
Compressive strength	Strength	AASHTO T22 / ASTM C39
Bar Pullout	Strength	AASHTO NA /ASTM A944
Confined Shrinkage (Ring test)	Serviceability	AASHTO T334 / ASTM C1581
Freeze-Thaw Resistance	Durability	AASHTO T161 / ASTM C666
Chloride Permeability	Durability	AASHTO T259, T260 / ASTM C1543, C672
Alkali Silica Reactivity	Durability	AASHTO T303 / ASTM C1260

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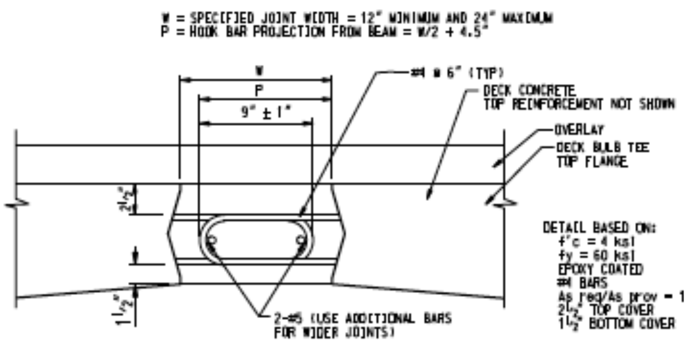
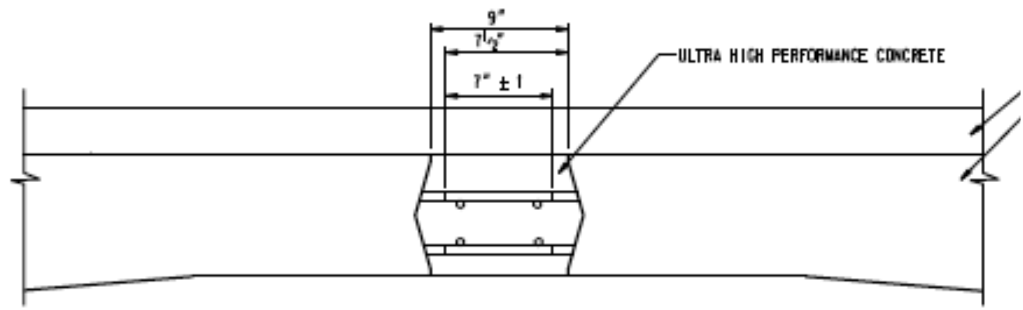
Precast Joints for Closure Pours

PCINE Bridge Committee is developing two types of joints

Deck NEXT Beams – Beck Bulb Tees – Deck Panels

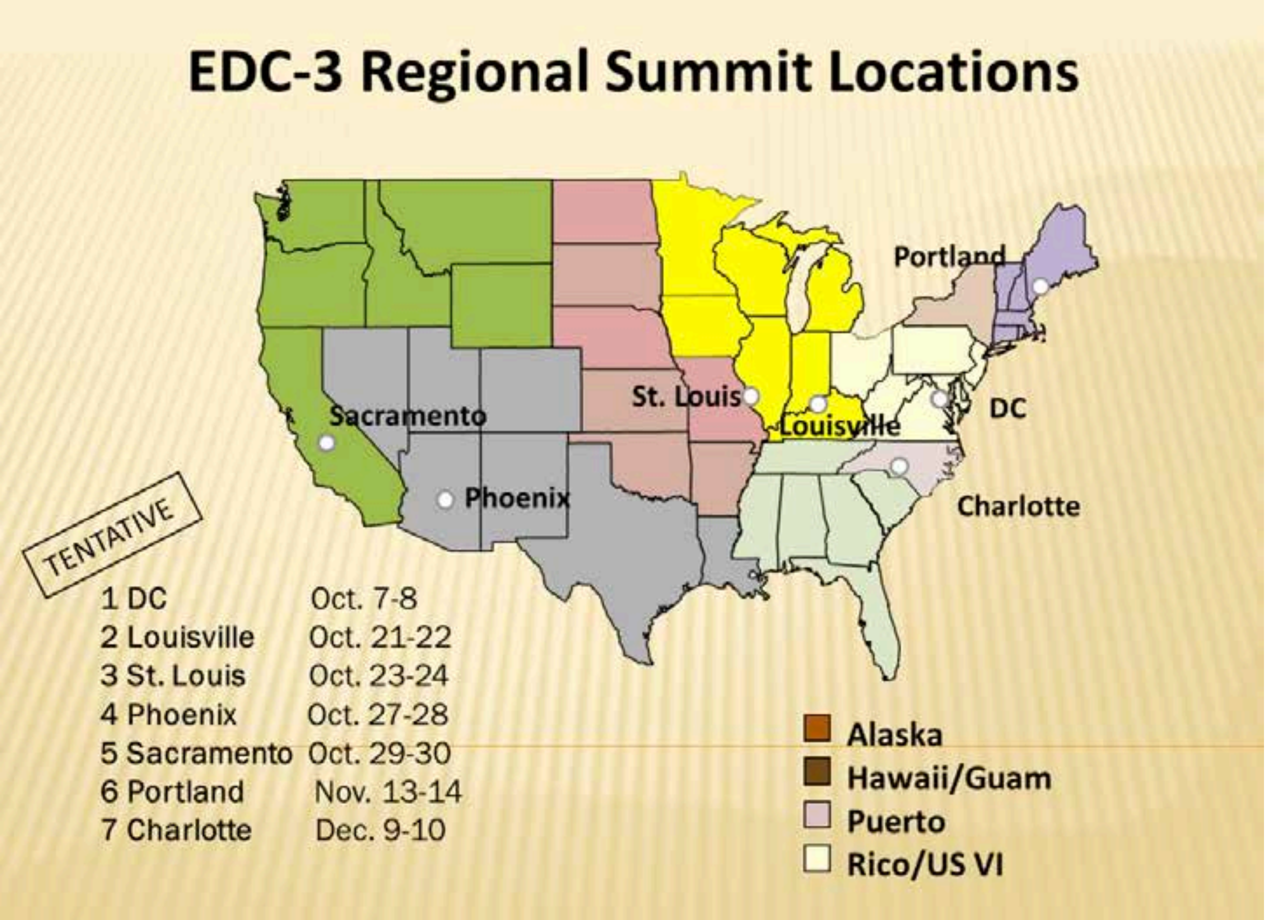




Normal Concrete

UHPC Concrete

Ultra High Performance Concrete Connections for Prefabricated Bridge Element Connections



Ben Graybeal, PE
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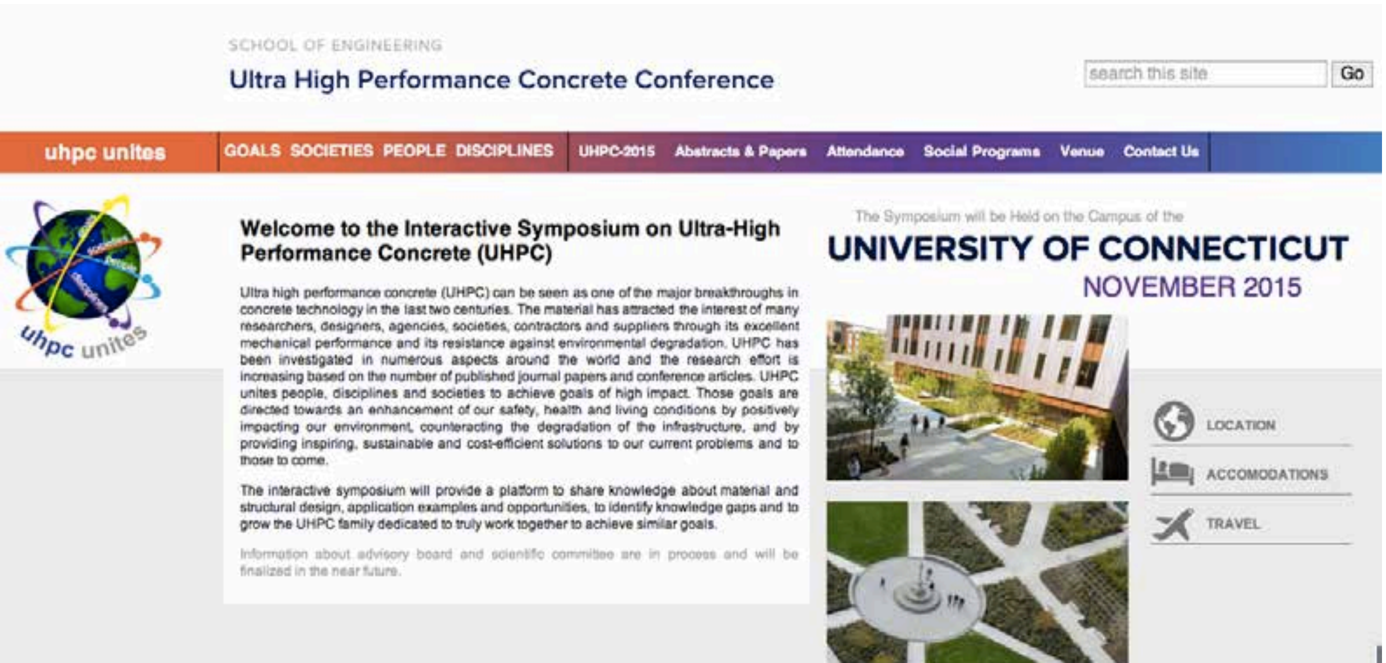
Atlanta, GA
(404) 562-3930

PCI

Bridge Conferences

First In **Interactive Symposium on Ultra-High Performance Concrete (UHPC)**
November 19 – 22, 2015
University of Connecitcut
Storrs, CT

Organizing Committee Members:
Kay Wille, UCONN, Co-chair
Ben Graybeal, FHWA, Co-Chair
Vic Perry, Treasurer
Michael McDonagh, Tours
Devin Harris, Student Program
Tess Ahlborn, Technical Chair
Eric Steinberg
Michael Culmo
Rita Seraderian
Sri Sritharan



Research Projects

Title: NETC 13-3: Improved Regionalization of Quality Assurance (QA) Functions

- Sponsor: New England Transportation Consortium
- Conducted by: University of New Hampshire, Durham, NH
- Status: Just under way
- Scope:
- Develop common acceptance standards for the PCE/PSE for New England State Transportation Agencies
- Cost-sharing mechanism for use of resources from one agency for conducting QA on behalf of another agency.

Developing Regional Acceptance Standards

Example of why do we need to change?
Producer works in 14 states & has 72 mix designs approved

- Concrete Strength – 6 – 8 - 10 ksi

Specifications

Shrinkage

- ASR
- Freeze Thaw
- Chloride Penetration
- Material Testing

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PCI

Thank-You for your Attention
Questions?

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