APPENDIX B

NATIONAL SURVEY

Table of Contents

B.1 NATIONAL SURVEY

A Survey conducted for

NCHRP 18-14: Evaluation and Repair Procedures for Precast/Prestressed Concrete Girders with Longitudinal Cracking in the Web

Dear Colleagues:

The objective of NCHRP Project 18-14 is to establish procedures for the acceptance, repair, or rejection of precast/prestressed concrete girders with longitudinal web cracking. This survey is the first step in an information collection task to guide the project. Your response will be incorporated into a database, where all information will be kept confidential and will be used for this research project only. The entities to be surveyed include state DOTs, other owner agencies, selected bridge consultants, and precast concrete producers. The success of this project depends upon your participation in this survey and your candid responses will be greatly appreciated. You will be provided with a summary of the survey results when it is available. Thank you very much for sparing time from your busy schedule.

Please return this form to: mtadros@mail.unomaha.edu, by fax: (402) 554-3288, or by surface mail to: Department of Civil Engineering, Peter Kiewit Institute, 1110 South 67th Street, Omaha, NE 68182-0178. If you have any suggestions or comments, please contact Dr. Maher Tadros at (402) 554-4842 (office) or (402) 216-6222 (cell). Thank you.

Sincerely,

Maher K. Tadros, Principal Investigator

Professor of Civil Engineering, University of Nebraska-Lincoln

Note: this survey will take about 10 minutes to complete

1. What is your business affiliation?

   O State DOT O Consultant O Precast concrete producer O Researcher

   O Other: please specify _____

2. Approximately how many linear feet of precast/prestressed concrete bridge girders do you design, fabricate, or construct annually?

O Hundreds O Thousands O 10s of thousands O Other: _____

3. What type of precast/prestressed bridge girders do you oversee, design or produce?

O I girders and bulb tees O Box girders O Other (specify): _____

4. Have you observed longitudinal or diagonal cracks in the web in the end zones of precast/prestressed concrete girders? Generally end zone is defined as the region at the girder end, equal in length to approximately the member depth.

O No – end of survey, thank you for your time.

O Yes – please proceed to the next question

5. On which type of girder:_____

How frequently (specify percentage of cracked girders): _____

6. Do you have special end zone reinforcement details that you are willing to share with the research team?

O No

O Yes

If yes, please send to us by e-mail, fax or surface mail. Thanks.

7. Do you maintain records of girders with end zone cracking?

O No

O Yes

8. What are your current criteria for determining extent of end cracking?

O No established criteria

O Crack width (specify):_____

O Crack length (specify):_____

O Number of cracks (specify):_____

9. Do you use an instrument to determine extent of end cracking?

O Naked eyes O Magnifying scope O Impact echo O Ultrasound

O Crack comparators O Other methods (specify):_____

10. Do you have established criteria for deciding when to repair cracks?

O No established criteria

O Yes (specify): _____

11. What commercial products and procedures do you use to repair end zone cracking?

_____

_____

_____

12. Do you believe the repair product will restore the tensile strength of the girder across the repaired cracks?

O No

O Yes

O Partially (to what level): _____

13. Do you believe that it is necessary to restore the tensile strength of the girder across_the crack?

O No

O Yes

O If yes, why: _____

14. What criteria do you use to reject a cracked bridge girder from a precast concrete producer?

_____

_____

_____

15. Which strand release process do you specify/use?

O Hydraulic release (jack down) of all strands in one step

O Hydraulic release of individual strands

O Flame cutting of individual strands

O Other (specify): _____

16. Please specify the strand diameter you commonly specify?

O 0.5 in.; in the following products _____

O 0.6 in.; in the following products _____

O Other (specify): _____

17. What do you believe contributes to end zone cracking?

O Strand size

O Lifting method and insert location

O Strand distribution

O Detensioning (prestress transfer method)

O Concrete strength

O Other (specify): _____

Please elaborate: _____

18. Additional comments: _____ _____

_____

_____

Name of the respondent:_____

Title:	_____
Company/Agency:	_____
Address:	_____
	_____
Phone number:	_____
Fax number:	_____
E-mail:	_____

THANK YOU

B.2 LIST OF RESPONDENTS AND CONTACT INFORMATION

(The respondents list is put in the order they were received)

1. Alabama DOT
   Fred Conway, Bridge Engineer
   1409 Coliseum Blvd
   Montgomery, AL 36110
   Phone number: (334) 242-6007
   Fax Number: (334) 353-6502
   E-mail: conwayf@ddot.state.al.us

2. Alberta Infrastructure & Transportation
   Abdul Waheed, Fabrication Standards Specialist
   Technical Standards Branch, Bridge Section
   Twin Atria Building, 4999 – 98 Ave. Edmonton Alberta, Canada
   Phone number: 780 415-1019
   Fax number: 780 422-5426
   E-mail: Abdul.Waheed@gov.ab.ca

3. Hawaii DOT
   Paul Santo, Bridge Design Engineer
   601 Kamokila Blvd., Room 611
   Kapolei, HI 96707
   Phone number: 808 692-7611
   Fax number: 808 692-7617
   E-mail: paul.santo@hawaii.gov

4. Illinois Department of Transportation
   Kevin L. Riechers, Structural Standards Development Group Engineer
   2300 S. Dirksen Parkway Springfield Illinois 62764
   Phone number: (217) 782-9109

Fax number: (217) 782-7960
E-mail: Kevin.Riechers@Illinois.gov

5. Maine DOT
   Jim Tukey, Bridge Program Manager
   Phone number: 207-624-3421

6. North Dakota DOT Bridge Division
   Tim Schwagler, Design Section Head
   608 E Boulevard Ave
   Bismarck, ND 58505-4156
   701-328-4421
   701-328-0310
   tschwagl@nd.gov

7. Ohio DOT
   Tim Keller
   1980 West Broad Street

8. S&G Prestress
   Mike Means, President
   PO Box 540
   Phone number: 910-763-7702
   Fax number: 910-763-2064
   E-mail: mikem@flarock.com

9. Saskatchewan Highways and Transportation
   Howard Yea

10. South Carolina DOT
    Barry W. Bowers, Assistant Bridge Design Engineer
    PO Box 191
    Columbia SC, 29202
    Phone number: 803-737-4814
    Fax number: 803-737-1881
    E-mail: bowersbw@scdot.org

11. Tennessee Department of Transportation
    Edward P. Wasserman, Civil Engineering Director – Structures Division
    Suite 1100, James K. Polk Bldg.
    Nashville, TN 37243-0339
    Phone number: 615-741-3351
    Fax number: 615-532-7745
    E-mail: ed.wasserman@state.tn.us

12. Virginia DOT

Julius F. J. Volgyi, Jr., Asst. State Structure & Bridge
1401 E. Broad Street
Richmond, VA 23219
Phone number: (804) 786-7537
Fax number: (804) 786-2988
E-mail: Julius.volgyi@vdot.virginia.gov

13. Washington State DOT
Bijan Khaleghi, Bridge Design Engineer/ Concrete Specialist
7345 Linderson Way SW
Tumwater , WA 98501
Phone number: (360) 705-7181
Fax number: (360) 705-6814
E-mail: khalegb@wsdot.wa.gov

14. West Virginia DOH – MCS&T Division
Mike Mance, Cement & Concrete Group Leader
190 Dry Branch Rd.
Charleston, WV 25306
Phone number: (304) 558-9846
Fax number: (304) 558-0253
E-mail: mmance@dot.state.wv.us

15. Wisconsin Department of Transportation
Finn K. Hubbard, P.E., Chief Structures Construction Engineer
Phone number: 608-266-8489
Cell number: 608-516-3563
Fax number: 608-261-6277
E-mail: finn.hubbard@dot.state.wi.us

16. Alaska DOT&PF
Elmer E. Marx, P.E., Technical Engineer II
3132 Channel Dr.
PO Box 112500
Juneau, AK 99811-2500
Phone number: 907 465-6941
Fax number: 907 465-6947
E-mail: elmer_marx@dot.state.ak.us

17. Arizona DOT
Pe-Shen Yaug, Assistant State Bridge Engineer
205 S. 17th Ave. Room 269E
Phoenix, AZ 85007
Phone number: 602 712-8606
Fax number: 602 712-3056
E-mail: pyaug@azdot.gov

18. Coreslab (Kansas)
    Bruno Burgess, Plant Engineer
    759 South 65 St.
    Kansas City, KS 66111
    Phone number: 913 287-5725
    Fax number: 913 287-8513
    E-mail: bburgess@corslab.com

19. Louisiana DOTD
    Arthur Wagner D'Andrea, Assistant Bridge Engineer
    1201 Capitol Access Road
    BR, LA
    Phone number: 225 379-1319
    Fax number: 225 379-1786
    E-mail: ArthurD'Andrea@dotd.la.gov

20. Massachusetts Highway Department – Bridge Section
    Edmund H. Newton
    10 Park Plaza,
    Boston, MA 02116
    Phone number: 617 973-8278
    Fax number: 617 973-7575
    E-mail: Edmund.Newton@MHD.State.ma,ma.us

21. Nebraska Coreslab Structures Inc
    Todd Culp, P.E., VP/Sales Manager
    802 Allied Road
    Bellvue, NE 68123
    Phone number: 402 291-0133
    Fax number: 402 291-2598
    E-mail: tculp@coreslab.com

22. New Hampshire DOT
    David L. Scott, In-House Design Chief
    PO Box 483
    Concord, NH 03302-0483
    Phone number: 603 271-2731
    Fax number: 603 271-2759
    E-mail: dscott@dot.state.nh.u

23. Oklahoma DOT
    Kenny Seward, Structural Materials Engineer
    200 NE 21st Street
    Oklahoma City, OK 73105
    Phone number: 405 522-4999

Fax number: 405 522-0552
E-mail: kseward@odot.org

24. Central Pre-Mix Prestress Co.
Chuck Prussak, GM
PO Box 3366
Spokane, WA 99220
Phone number: 509 536-3334
Fax number: 509 536-3313
E-mail: prussack@cprestress.com

25. Spancrete Inc.
Tim Holien, P.E., Manager, Transportation Products & Services
PO Box 10508
Green Bay, WI 54307-0508
Phone number: 920 965-9487
Fax number: 920 494-7901
E-mail: tholien@spancrete.com

26. Wyoming DOT
Gregg C. Fredrick, State Bridge Engineer
5300 Bishop Blvd
Cheyenne, WY 82009
Phone number: 307 777-4427
Fax number: 307 777-4279
E-mail: gregg.fredrick@dot.state.wy.us

27. Montana DOT
Kent Barnes, P.E., Bridge Bureau
PO Box 201001
2701 Prospect
Helena, MT 59620-1001
Phone number: 406-444-6260
Fax number: 406-444-6155

28. Con-Force Structures Ltd
John A C Moody, General Manager
4300-50th Ave. S.E.
Calgary Alberta Canada T2B 2T7
Phone number: 403-248-3171
Fax number: 403-248-0711
E-mail: moodyj@con-force.com

29. Arkansas Highway & Transp. Dept.
Phil Brand, Division Head-Bridge Division
P.O. Box 2261

Little Rock, AR 72203-2261
Phone number: 501-569-2361
Fax number: 501-569-2623
E-mail: phil.brand@arkansashighways.com

30. Kansas DOT
Kenneth F. Hurst, Engineering Manager-State Bridge Office
700 SW Harrison St
Topeka KS 66603-3754
Phone number: 785-296-3761
Fax number: 785-296-6946
E-mail: kenh@ksdot.org

31. Missouri DOT
Denis M. Glascock, Technical Support Engineer
P.O. Box 270,
Jefferson City, MO 65102
Phone number: 573-751-6735
Fax number: 573-526-5636
E-mail: Denis.Glascock@modot.mo.gov

32. North Carolina DOT
Gichuru Muchane, Project Design Engineer
Structure Design Unit, 1581 MSC
Raleigh, NC 27699 – 1581
Phone number: 919-250-4048
Fax number: 919-250-4082
E-mail: gmuchane@dot.state.nc.us

33. Ontario Ministry of Transportation
Ranko Mihaljevic, Head Quality Assurance Engineer
301 St Paul Street
St Catharines, ON L2R 7R4
Phone number: 905-704-2351
Fax number: 905-705-2060
E-mail: Ranko.Mihaljevic@Ontario.ca

34. Pennsylvania DOT
Robert D. Horwhat, P.E., Chief Structural Materials Engineer
P.O. Box 2926
Harrisburg, PA 17105
Phone number: 717-783-6710
Fax number: 717-705-5750
E-mail: rhorwhat@state.pa.us

35. South Dakota DOT

Kevin Goeden, Chief Bridge Engineer
700 E. Broadway Avenue
Pierre, SD 57501
Phone number: 605-773-3285
Fax number: 605-773-2614
E-mail: Kevin.goeden@state.sd.us

36. Heldenfels Enterprises, Inc.
Gavin Koepp, Production Manager, Bridge Products
5700 I.H.35 South
San Marcos, Tx. 78666
Phone number: 512-396-2376
Cell Phone number: 512-738-2287
Fax number: 512-396-2375
E-mail: gavin.koepp@heldenfels.com

37. University of Nebraska Lincoln
Andrzej Nowak, professor
W181 Nebraska Hall
Lincoln NE 68588-0531
Phone number: 402-472-1376
Fax number: 402 472-8934
E-mail: anowak2@unl.edu

38. J. P. Carrara & Sons, Inc.
Joe Carrara, Precast General Manager
2464 Case St.
Middleburg, VT 05753
Phone number: 802-388-6363
Fax number: 802-388-9010
E-mail: joe@jpcarrara.com

39. Rhode Island DOT
Michael L. Savella, Principal Civil Engineer
Bridge Engineering Section, Rm 100
2 Capitol Hill
Providence, RI 02903
Phone number: 401-222-2053 x 4080
Fax number: 401-222-1271
E-mail: msavella@dot.ri.gov

40. Prestress Engineering Corp.
Michael Johnson, P.E., QC Manager
15606 E. 3200 North Road
Blackstone, IL 61313
Phone number: 815-586-4239
Fax number: 815-586-4653

E-mail: majohn71@gmail.com

41. CME Associates Inc.
    Michael P. Culmo, VP Trans & Structures
    333 E. River Drive, Suite 400
    E. Hartford, CT 06108
    Phone number: 860-290-4100
    Fax number: 860-290-4114
    E-mail: culmo@cmeengineering.com

42. Plum Creek Structures
    Howard Knapp, President
    9160 N. Moore Road
    Littleton, CO 80125
    Phone number: 303-471-1569
    Fax number: 303-471-9188
    E-mail: hknapp@plumcreekstructures.com

43. Minnesota DOT
    Steve Grover, Precast Inspection Engineer
    1400 Gervais Ave
    Maplewood, MN 55109
    Phone number: 651-366-5540
    Fax number: 651-366-5461
    E-mail: steve.grover@dot.state.mn.us

44. New York DOT
    Michael Twiss
    50 Wolf Road
    Albany, NY 12232
    Phone number: 518-457-4534
    Fax number:
    E-mail: mtwiss@dot.state.ny.us

B.3 NATIONAL SURVEY RESPONSES

Q1. What is your business affiliation?

1. State DOT
2. State DOT
3. State DOT
4. State DOT
5. State DOT
6. State DOT
7. State DOT
8. Precast Concrete Producer

9. Saskatchewan Highways and Transportation, Canada
10. State DOT
11. State DOT
12. State DOT
13. State DOT
14. State DOT
15. State DOT
16. State DOT
17. State DOT
18. Precast Concrete Producer
19. State DOT
20. State DOT
21. Precast Concrete Producer
22. State DOT
23. State DOT
24. Precast Concrete Producer
25. Precast Concrete Producer
26. State DOT
27. State DOT
28. Precast Concrete Producer
29. State DOT
30. State DOT
31. State DOT
32. State DOT
33. State DOT
34. State DOT
35. State DOT
36. Precast Concrete Producer
37. Researcher
38. Precast Concrete Producer
39. State DOT
40. Precast Concrete Producer
41. Consultant
42. Precast Concrete Producer
43. State DOT
44. State DOT

Q2. Approximately how many linear feet of precast/prestressed concrete bridge girders do you design, fabricate, or construct annually?

1. 10s of thousands
2. Thousands
3. Thousands
4. Thousands
5. Thousands
6. Hundreds
7. 10s of thousands

8. 10s of thousands
9. Thousands
10. 10s of thousands
11. 10s of thousands
12. Thousands
13. 10s of thousands
14. Thousands
15. 10s of thousands
16. 10s of thousands
17. 10s of thousands
18. 10s of thousands
19. 10s of thousands
20. Thousands
21. 10s of thousands
22. Hundreds
23. 10s of thousands
24. 10s of thousands
25. 10s of thousands
26. Hundreds
27. –
28. 10s of thousands
29. Hundreds
30. 10s of thousands
31. 10s of thousands
32. Thousands
33. 10s of thousands
34. Thousands
35. Thousands
36. 10s of thousands
37. N/A
38. 10s of thousands
39. Thousands
40. > 100,000 Linear Feet
41. Hundreds
42. 10s of thousands
43. 10s of thousands
44. Thousands

Q3. What type of precast/prestressed bridge girders do you oversee, design or produce?

1. I girders and bulb tees
2. Box girders, NU
3. I girders and bulb tees
4. I girders and bulb tees
5. I girders and bulb tees, box girders
6. I girders and bulb tees, box girders
7. I girders and bulb tees, box girders

8. I girders and bulb tees, box girders
9. I girders and bulb tees, box girders
10. I girders and bulb tees
11. I girders and bulb tees, box girders
12. I girders and bulb tees
13. I girders and bulb tees, Trapezoidal Tubs, Voided Slabs, Deck Bulb Tees
14. I girders and bulb tees, Box girders
15. I girders and bulb tees, Box girders
16. I girders and bulb tees, Decked Bulb Tee
17. I girders and bulb tees, Box girders
18. I girders and bulb tees, Box girders
19. I girders and bulb tees
20. I girders and bulb tees, Box girders, Deck Beams
21. I girders and bulb tees, Box girders
22. I girders and bulb tees, Box girders
23. I girders and bulb tees, Box girders, Double Tees
24. I girders and bulb tees, Box girders, Stemmed sections
25. I girders and bulb tees, Box girders
26. I girders and bulb tees, twin t's and tridecks
27. –
28. I girders and bulb tees, Box girders
29. I girders and bulb tees
30. I girders and bulb tees, Box girders
31. I girders and bulb tees
32. I girders and bulb tees, Box girders, Cored (voided) Slabs
33. I girders and bulb tees, Box girders, I girders with integral deck
34. I girders and bulb tees, Box girders
35. I girders and bulb tees
36. I girders and bulb tees, Box girders
37. I girders and bulb tees, Box girders
38. I girders and bulb tees (NEBT), Box girders, Voided Slabs, Soho Slabs, Full depth p/t Deck Slabs, S.I.P. Form Panels
39. I girders and bulb tees, Box girders
40. I girders and bulb tees, Box girders
41. I girders and bulb tees, Box girders
42. I girders and bulb tees, Box girders, Double Tees, Solid Slabs, Trapezoidal
43. I girders and bulb tees, Solid rectangular and Inverted Tee
44. I girders and bulb tees, Box girders, Slab Units

Q4. Have you observed longitudinal or diagonal cracks in the web in the end zones of precast/prestressed concrete girders? Generally end zone is defined as the region at the girder end, equal in length to approximately the member depth.

1. Yes
2. Yes
3. No
4. Yes

5. No
6. Yes
7. Yes
8. Yes
9. No
10. Yes
11. Yes
12. Yes
13. Yes
14. Yes
15. Yes
16. Yes
17. No
18. Yes
19. Yes
20. Yes
21. Yes
22. Yes
23. Yes
24. Yes
25. Yes
26. No
27. No
28. Yes
29. Yes
30. Yes
31. Yes
32. Yes
33. Yes
34. Yes
35. No, Not aware of any end zone web cracking problems.
36. Yes
37. Yes
38. Yes
39. No
40. Yes
41. Yes
42. Yes
43. Yes
44. Yes

Q5. On which type of girder? How frequently (specify percentage of cracked girders):

1. I girders, 1%
2. NU, 100%
3. –

4. I beams and Bulb-T beams, before 2005 – quite frequently; after 2005 (new details and fabrication) – little to no problems.
5. –
6. I girder, one time
7. I beams – diagonal and longitudinal; Box beams –diagonal (from the notched out section) and longitudinal. I-beam diagonal cracks –98%; I-beam longitudinal cracks - 30%; Box beam diagonal cracks (on the notch out pier end) - 100%; Box beam longitudinal cracks – 25%
8. All I Beams & BTs draped and straight strand, very routine
9. –
10. Bulb Tees, ~10%
11. Primarily Bulb-T Sections, 5-10%
12. Bulb-T's, 100%
13. I-girders, and Voided Slabs, Less than 10%
14. I-Beams, Approximately 80% in I-beams (none in box beams)
15. 82" Deep, 25%
16. Bulb Tee and decked bulb tee, estimated ~25%
17. –
18. I girders 75%
    bulb tees 75%
    box girders10%
19. B7-78, 50%
20. Bulb Tees, 90%
21. I girders, 100%
22. New England bulb Tee, 100%
23. All I girders and bulb tees, 70-80%
24. Girders, Bulb T's, Probably all depending on how hard we look
25. I-girders and bulb tees, 98%
26. –
27. –
28. I girders, 80%
29. 72" BT, <10%
30. I webs, also flange/web of Inverted Tees, Single Tees, and Double Tees., Few times a year. Additional reinforcement is used to prevent.
31. I girder is most common, I cannot provide a reliable percentage however, I feel that it is a significant portion of the beams made. Typically the cracks are so small as to be virtually undetectable.
32. Bulb-Tee & AASHTO shapes, 1% - 5%
33. I girder, Rare in general. High percentage in specific contracts without well-fanned strands at ends. Diagonal web cracking at ends is not typically encountered
34. AASHTO I Beams, Occasionally, perhaps on the order of 5-10% of all I-beams
35. –
36. I Girders, Box Girders, 95%
37. Box Girders, two bridges
38. Bulb Tees & Box Beams, 95%!!
39. –

40. All types, 90% exhibit some cracking
41. Bulb Tees, 20% ±
42. Bulb Tee & Trapezoidal
43. I-girders, 75%
44. All types (I beams, Bulb Tees, Box Beams, Slab Units)

Q6. Do you have special end zone reinforcement details that you are willing to share with the research team?

1. No (Shielding of strands and added mild diagonal bars in the end anchorage zone)
2. Yes, We are adopting Tadros's rule, i.e. Provide vertical steel designed at 20 ksi for force equal to 2% of prestressing force and at girder end. Distribute this reinforcement over a length of H/8.
3. –
4. Yes, We have standard base sheets for our beams with bursting steel details which may be found at the following link. http://www.dot.il.gov/cell/prestressed.pdf
5. –
6. No
7. Yes See www.dot.state.oh.us pull down Design Reference Resource Center go to Standard Drawings go to PSBD-1-93 for Box Beams and PSID for AASHTO I Beams
8. Yes
9. –
10. No
11. Yes
12. Yes, These details are under their final stage of development
13. 1. Yes, Could be downloaded from WSDOT website at: http://www.wsdot.wa.gov/eesc/bridge/drawings/
14. 2.No
15. 3. No, Still working on this
16. 4.Yes, AASHTO LRFD Section 5
17. 5.-
18. 6.No, nothing special
19. 7. Yes
20. 8.Yes, Ok, attached Bridge Manual Drawings 6.1.5 and 6.1.6. In addition we are allowing (and encouraging) fabricators to debond 50% of all strand for 6" from the end of the beam.
21. 9. No
22. 10. No
23. 11. No
24. 12. Yes
25. 13. No, Vertical][bars within the web are provided to limit the crack widths (4-pairs of #6 bars). Nothing "special"
26. –
27. –
28. No
29. No

30. Yes
31. No, We have nothing to share. If we had something we would
32. No
33. Yes
34. Yes : http://www.dot.state.pa.us/Internet/BQADStandards.nsf/home?OpenFrameset
    Details available on above website: BD-600 series (BD 661 – box breams, BD662 – I beams)
35. –
36. Yes
37. No
38. Yes, Wire Mesh and Debonding 6", Hairpin Confinement Steel
39. –
40. Yes, See IDOT Bursting plate/rod assembly
41. No
42. Yes, CDOT Standard
43. No
44. Yes

Q7. Do you maintain records of girders with end zone cracking?

1. No
2. No
3. –
4. No, We have documentation on the correspondence file for each beam but we don't track a database which could list all of the beams we have had cracking problems.
5. –
6. No
7. No
8. No
9. –
10. No
11. No
12. No
13. No
14. No (We keep records of all beams produced and crack maps of all of these beams, but these are not filed specifically based on end zone cracking.)
15. No
16. No, Identify, mark, and date in the field, but no formal tracking program
17. –
18. No
19. No
20. Yes, noted in inspection reports
21. Yes
22. No, we document the cracks but do not "maintain" these records
23. No
24. Yes, Std OC Pkg
25. No

26. –
27. –
28. Yes
29. No
30. No
31. Yes, MoDOT inspectors have notes on each beam. There is currently no effort to consolidate the information from multiple locations
32. No
33. No
34. Yes
35. –
36. No
37. Yes
38. Yes
39. –
40. Yes
41. No
42. No, We do note on postpour report when they occur
43. No
44. No

Q8. What are your current criteria for determining extent of end cracking?

1. No established criteria (Visual Inspection)
2. Crack width (specify): Epoxy inject if crack width is 0.3 mm and over.
3. –
4. Crack width, See pages 40 through 43 from our Manual for Fabrication of Precast Prestressed Concrete Products dated January 1, 2007. This manual may be found online at the following link. http://www.dot.il.gov/materials/ppcproductsmanual.pdf
   Crack length
   Number of cracks
5. –
6. No established criteria
7. Crack width (specify): PCI – MNL – 137
8. No established criteria
9. –
10. Crack width: 0.01 inch
11. Generally we follow the new PCI "Manual For Evaluation and Repair of Precast, Prestressed Concrete Bridge Products"
12. No established criteria
13. No established criteria
14. Crack width (specify): Cracks greater than 0.016" in width need evaluated individually. Cracks of smaller widths are handled in a predetermined format
15. No established criteria, Handled case by case
16. No established criteria
17. –
18. No established criteria

19. –
20. No established criteria, however, see the attached draft specification
21. No established criteria
22. Crack width: “cracks in excess of 0.01 in. may be cause for rejection” NHDOT Spec Book Section 528.3.17.2
23. No established criteria
24. No established criteria
25. No established criteria
26. –
27. –
28. Crack length: We record location and length
29. No established criteria
30. Crack length: Must be within diaphragm. If greater, epoxy inject.
31. No established criteria. Not certain how to answer this in context. When this problem occurs to the extent that the inspector considers it excessive, the inspector will provide the information indicated below, along with a picture or sketch
32. Crack width: W < 0.006"; 0.006" ≤ W ≤ 0.010"; W > 0.010"
33. Crack width: 0.3 mm
    Crack length: 300 mm
34. Refer to Publication 145 for Types of Cracks – Common causes, allowable lengths and widths: ftp://ftp.dot.state.pa.us/public/PubsForms/Publications/Pub%20145.pdf
35. –
36. No established criteria
37. No established criteria
38. Q/C Dept. Document Cracks
39. –
40. Crack width: > 0.002 are measured
    Crack length: Cumulative length of acceptable cracks is limited
41. The DOT inspectors identify the cracks. We as designers are not always notified.
42. No established criteria
43. No established criteria
44. Crack width: > 0.002 in.

Q9. Do you use an instrument to determine extent of end cracking?

1. Naked eyes, Crack comparators
2. Naked eyes, Crack comparators
3. –
4. Crack comparators
5. –
6. Naked eyes
7. Crack comparators
8. –
9. –
10. Magnifying Scope
11. Naked eyes, Crack comparators
12. Naked eyes, Crack comparators

13. Naked eyes
14. Magnifying scope, Crack comparators
15. Naked eyes
16. Naked eyes
17. –
18. Naked eyes
19. Naked eyes, Crack comparators
20. Naked eyes
21. Naked eyes
22. Naked eyes
23. Naked eyes
24. Naked eyes, Crack comparators
25. Naked eyes
26. –
27. –
28. Naked eyes
29. Naked eyes
30. dampen surface
31. Naked eyes
32. Crack comparators
33. Naked eyes, Magnifying Scope
34. Crack comparators
35. –
36. Naked eyes, Crack comparators
37. Naked eyes, Magnifying Scope, Crack comparators
38. Crack comparators
39. –
40. Crack comparators
41. Naked eyes, Crack comparators
42. Naked eyes
43. Naked eyes
44. Naked eyes, Magnifying Scope, Crack comparators

Q10. Do you have established criteria for deciding when to repair cracks?

1. Yes (specify): Aggressive Environment:: Surface sealant on cracks <0.006”; inject cracks >0.006” < 0.025”; >0.025” reject (accept w/repair subject to structural analysis)Non-aggressive Environment: <0.012” surface seal; >0.012” < 0.025” epoxy inject; >0-.025” Reject (accept w/repair and structural analysis) Reject any girder w/cracks through the bearing area.
2. Yes, Epoxy inject if crack width is 0.3 mm and over
3. –
4. Yes, See pages 40 through 43 from our Manual for Fabrication of Precast Prestressed Concrete Products dated January 1, 2007. This manual may be found online at the following link. http://www.dot.il.gov/materials/ppcproductsmanual.pdf
5. –
6. No established criteria

7. Yes: PCI – MNL-137
8. Yes, All cracks are painted with epoxy protective coating which re-cracks as the crack moves over time.
9. –
10. No established criteria
11. Yes, PCI “Manual for the Evaluation and Repair of Precast, Prestressed Concrete Bridge Products”
12. No established criteria
13. Yes, WSDOT Fabrication Manual, very similar to recently published PCI Repair manual
14. Yes, Crack repair method depends on crack width. We also follow the guidelines set forth in PCI Journal Vol. 30 #3 entitled “Fabrication and Shipment Cracks in Precast or Prestressed Beams and Columns”.
15. No established criteria
16. No established criteria, No formal policy but most crack width less than 0.005 in
17. –
18. No established criteria
19. Yes, over 4000/in needs to be pressure injected
20. Yes, see the attached draft specification
21. Yes, agreed upon patching procedure with state (owner)
22. Yes, “cracks less than 0.01 in. in width shall be sealed by an approved method.” NHDOT Spec Book Section 528.3.17.2
23. No established criteria
24. No established criteria
25. No established criteria
26. –
27. –
28. No established criteria
29. No established criteria
30. No established criteria
31. Yes, Informal, actually. When the inspector believes that the damage to the beam is outside that normally seen or expected, the inspector will require the manufacturer to provide written details of the damage and a proposed remedy
32. Yes W < 0.006" – No repair;
    0.006" ≤ W ≤ 0.010" – Epoxy seal cracks; _
    W > 0.010" – Follow PCI Repair Manual.
33. Yes, All cracks should be repaired to ensure adequate durability. Some exception may be permitted at integral abutment diaphragm location
34. Yes, refer to Publication 145 – web link above
35. –
36. No established criteria
37. No established criteria
38. Yes, Per DOT Request, Most endzones are cast into backwalls or diapa____?
39. –
40. Yes, Rub crack < 0.007” with epoxy & inject cracks ≥ 0.007”

41. Yes, We use the PCI Northeast girder repair document which is similar to the National PCI repair document
42. No established criteria
43. No established criteria
44. Yes, When cracks are judged to be excessively large and could impair long term durability and/or are considered structurally significant.

Q11. What commercial products and procedures do you use to repair end zone cracking?

1. Penetrant sealer (viscosity epoxy) or epoxy resin injection
2. The product shall meet the requirements of ASTM C881 Type IV, Grade 1, Class B or C. The viscosity shall not exceed 500 CPS. Duralcrete LV or approved equivalent shall be used.
3. –
4. See pages 40 through 43 from our Manual for Fabrication of Precast Prestressed Concrete Products dated January 1, 2007. This manual may be found online at the following link. http://www.dot.il.gov/materials/ppcproductsmanual.pdf
5. –
6. –
7. Epoxy injection materials – on ODOT Qualified Products List @ http://www.odotonline.org/materialsmanagement/qpl.asp?specref=705.26
8. E Bond 105
9. –
10. Two part epoxy conforming to ASTM C881
11. Epoxy injection of cracks and pre-packaged quick setting concrete with latex modifiers for bond for minor spalls. For large repairs, the concrete mix used in manufacturing the beam, itself, is used.
12. Epoxy injection
13. N/A
14. For very small crack widths (>0.004”), we specify a silane sealant. For crack widths larger than that, we specify epoxy injection
15. We have used epoxy injection grouting on some cracks
16. A variety of epoxy products have been used but the procedure is typically the same
17. –
18. Sometimes we rub cracks with cement paste-per state inspectors request
19. High strength epoxy from QPL “Qualified Products List”
20. see the attached draft specification
21. coat with RM800
22. Procedures and products are not dictated to the supplier. The supplier makes recommendations, which NHDOT must approve.
23. Depending on the extent of cracking we may apply an epoxy sealer
24. Epoxy injection used sometimes
25. None
26. –
27. –
28. Generally we do not repair
29. Epoxy Injection

30. Generic epoxy for injection
31. Any repairs, when authorized, are the responsibility of the manufacturer. We will review their choice of products and confirm that it is labeled for the intended use. We also confirm that we have not previously seen the product and experienced unacceptable results.
32. Epoxy painting or epoxy injection
33. No fixed procedure. Each case requires a proposal
    Cracks >= 0.15mm: epoxy (eg Sikadur 35 Hi-mod LV) inject under pressure and seal (eg CPD Saltguard) surrounding area
    Cracks < 0.15mm: fill with epoxy (e.g. Sika Top 123 plus) and seal surrounding area
34. Yes, refer to Publication 145 – web link above
35. –
36. None
37. Epoxy compound
38. <= 0.01 – Silane Sealer ???
    >= 0.1 – Sikadur S2 ???
39. –
40. Sikadur 52 & low-pressure injection
41. Usually a DOT approved product
42. Low Viscosity Epoxy
43. Normally not repaired
44. Two component, non-shrink epoxy resin systems such as EVA-POX LOW VISCOSITY INJECTION RESIN NO. 5 pressure injected in to the cracks.

Q12. Do you believe the repair product will restore the tensile strength of the girder across the repaired cracks?

1. Yes
2. Partially
3. –
4. No
5. –
6. No
7. Yes
8. No
9. –
10. No
11. Partially (to what level): Our expectation is that properly injected cracks can sustain tension to the allowable design limit 6 sq root f'c
12. Yes
13. No
14. No (We are just looking to seal these cracks.)
15. No
16. Partially, unknown
17. –
18. No
19. Yes

20. No
21. No
22. No
23. No
24. Yes
25. No
26. –
27. –
28. No
29. No
30. Partially: Protected by diaphragm to extent needed.
31. Partially: We rarely require repair. When we allow/require repair we are assuming that we gain something from the repair that exceeds any detrimental effects associated with the product that is used.
32. Partially: Only if the crack is repaired by injection.
33. No
34. No intended to seal the crack only against water/chloride penetration
35. –
36. No
37. No
38. Yes, Epoxy Sealed
39. –
40. No
41. Yes, for epoxy injection
42. Yes
43. No
44. Partially: 25% - 50%

Q13. Do you believe that it is necessary to restore the tensile strength of the girder across the crack?

1. No
2. No
3. –
4. No
5. –
6. No
7. No
8. No
9. –
10. No
11. No
12. Yes, Working cracks at splice girder ends show spalling.
13. No (these cracks will be closed after slab casting)
14. No
15. Yes Depending on crack location and orientation, shear issues
16. No, depends upon the situation

17. –
18. No
19. Yes, Designed as non-crack member
20. No
21. No
22. No
23. No
24. No
25. No
26. –
27. –
28. No
29. No
30. No
31. No
32. No, Depending on severity of the crack
33. –
34. No
35. –
36. No
37. No
38. No, If the girder is properly designed it will have sufficient reinforcement to meet structural requirements. Sealing of the cracks should be considered for durability concerns.
39. –
40. No
41. No, for most repairs
42. No
43. No
44. No

Q14. What criteria do you use to reject a cracked bridge girder from a precast concrete producer?

1. Acceptance criteria for PSC members. Members not meeting criteria are rejected. Fabricator may propose repair and structural analysis.
2. We have not rejected any girders because of cracking
3. –
4. See pages 40 through 43 from our Manual for Fabrication of Precast Prestressed Concrete Products dated January 1, 2007. This manual may be found online at the following link. http://www.dot.il.gov/materials/ppcproductsmanual.pdf
5. –
6. No defined criteria
7. Interception with strand and evidence of strand slippage
8. –
9. –
10. The producer must submit information regarding cracks and a repair procedure to the designer of record. After reviewing the procedure, the designer of record accepts or rejects the repair procedure.
11. If we feel that a beam cannot be repaired to satisfy the rigors of everyday service for its design life, we will reject it. However, rejections are very rare.
12. Currently none. Rejection criteria for severe cases is under development.
13. This seldom happens, however, inspectors could reject and girders cracked beyond the limits
14. Rejection is based on a individual engineering analysis and is based on crack width, length, location, estimated reduction in service life, and other possible structural losses
15. Excessive cracking that will affect the shear capacity near the end of the girder will be rejected
16. Have not rejected girders due to “normal” end cracking
17. –
18. –
19. case by case
20. see the attached draft specification, particularly section 930.63 I
21. Crack width, plus evaluate internally and with owner
22. I assume “cracked” still refers to longitudinally or diagonally cracked. We may reject, per specification, at 0.01” crack width. Our spec also reference PCI New England Region Bridge Member Repair Guidelines Report Number PCINER-01-BMRG, which discusses rejection if the beam has “capacity reduced to unacceptable levels”
23. It depends on where it’s cracked and the width of the cracks
24. Rarely reject a girder unless design/durability sompromised to an extent girder is not repairable
25. Girders are not rejected for end zone cracking
26. –
27. –
28. N/A
29. –

30. Continuous bad results, cracks beyond the diaphragm, or in combination with consolidation problems (honeycomb).
31. Rejection occurs when the cracks spall severely or obviously extend along the girder for an excessive distance (outside the area of the beam that is cast into the structure.)
32. Crack width after detensioning, number of cracks, and proximity of cracks to each other.
33. Structural and/or durability concerns. Generally, this is based on the designer's recommendations
34. Beams that exceed our allowable limits are rejected.
35. –
36. Beams are rejected based on crack width and length. They are also rejected based on the location of the crack, Ends verse the middle third of the beam
37. Presence and width of cracks
38. Possibly – If a crack existed thru the entire girder section close enough from the end of the girder and the reinforcement across the crack could not be properly anchored, may cause concert for rejection
39. –
40. As a producer, we will recommend repair for any and all cracks that are not the result of some trauma (e.g. design issue)
41. I have yet to find a girder that could not be repaired.
42. We have never rejected a girder for diagonal end cracking
43. More than a minimal amount of cracks in the top flange, either from plastic shrinkage or other cause, will result in rejection. Out-of-the-ordinary cracks elsewhere also cause concern.
44. If cracks are judged to be structurally severe and are not reasonably repairable.

Q15. Which strand release process do you specify/use?

1. Flame cutting of individual strands
2. Flame cutting of individual strands
3. –
4. Flame cutting of individual strands
5. –
6. Flame cutting of individual strands
7. Flame cutting of individual strands, This is what is used. ODOT does not specify the method.
8. Flame cutting of individual strands
9. –
10. Flame cutting of individual strands
11. Other (specify): _We do not specify, however all precast suppliers for Tennessee contractors use flame cutting
12. Flame cutting of individual strands
13. Hydraulic release (jack down) of all strands in one step, Flame cutting of individual strands
14. Flame cutting of individual strands
15. Flame cutting of individual strands

16. Hydraulic release (jack down) of all strands in one step: most common Each fabricator is a bit different from the next
17. –
18. Flame cutting of individual strands
19. Flame cutting of individual strands and anneal them before separation
20. Flame cutting of individual strands
21. Hydraulic release (jack down) of all strands in one step, draped strands are flame cut
22. Flame cutting of individual strands
23. Flame cutting of individual strands
24. Hydraulic release (jack down) of all strands in one step, Hydraulic release of individual strands, Flame cutting of individual strands, depends on bed
25. One production line:Hydraulic release (jack down) of all strands in one step
    Balance of production lines (6): Hydraulic release of individual strands, Flame cutting of individual strands
26. –
27. –
28. Flame cutting of individual strands
29. Flame cutting of individual strands
30. Flame cutting of individual strands
31. Flame cutting of individual strands
32. Flame cutting of individual strands
33. End result. We specify that transfer should be gradual and cause minimal lateral eccentricity.
34. Hydraulic release (jack down) of all strands in one step, Flame cutting of individual strands – following PCI procedures to limit force eccentricity
35. –
36. Hydraulic release (jack down) of all strands in one step
37. –
38. Flame cutting of individual strands
39. –
40. Flame cutting of individual strands
41. Flame cutting of individual strands, This is typical in our region
42. Flame cutting of individual strands
43. Flame cutting of individual strands
44. Hydraulic release (jack down) of all strands in one step, Flame cutting of individual strands, Depends on fabricators equipment and procedures.

Q15. Please specify the strand diameter you commonly specify?

1. 0.5 in.; in the following products I Girders
   0.6 in.; in the following products Modified Bulb Tees
2. 0.6 in.; Low relaxation strand
3. –
4. 0.5 in
5. –
6. 0.6 in
7. 0.5 in.; 0.5 or .5 oversize strand

8. 0.5 in.; All
   0.6 in.: All
9. –
10. 0.5 in, 0.6 in
11. 0.5 in.; Any
    0.6 in.; Any
12. 0.5 in, 0.6 in
13. 0.6 in, 3/8” and 7/116” strands are used for deck panels
14. 0.5 in.; Box beams & I-beams (oversized strand is also commonly specified)
    0.6 in.; Used in box beams & I-beams on a more limited basis.
15. 0.5 in
    0.6 in.; More of this
16. 0.5 in.; becked bulb-tee
    0.6 in.; bulb-tee and “WA” series
17. –
18. –
19. 0.5 in and 0.6 in
20. 0.6 in
21. 0.6 in
22. 0.5 in.; butted box beams
    0.6 in.; New England Bulb Tee
23. 0.6 in.; almost all beams
24. 0.5 in.; bulb t’s, stemmed sections girders
    0.6 in.; “supergirders”, voided slabs
25. 0.5 in.; Box girders and I-girders =< 36” deep
    I-girders => 45” deep & Au bulb tees
    Note: draped strand are used in I-girders & bulb tees > 95% of the time
26. –
27. –
28. 0.6
29. 0.5
30. 0.5 in.; most P/S types
    0.6 in.; Bulb Tees (72”+), and P-T Slabs
31. 0.5 in.; Mostly I Girders
    0.6 in.; Typically Bulb Tees
32. 0.5 in.; All products
    0.6 in.; All products
33. 0.5 in.
34. 0.5 in.; allow larger half inch nominal (0.167 sq. In.)
35. –
36. 0.5 in.; I-girders, Box girders
    0.6 in.; I-girders, Box girders
37. 0.5 in., 0.6 in.
38. 0.5 in.; Bulb Tees, Box & Voided
    0.6 in.; Bulb Tees & Box Bon’s
39. –

40. 0.5 in.; Box Beams and I-beams and some Bulb-T's
    0.6 in.; Some Bulb-T's 90", 102", &120"
41. 0.5 in.; Bulb Tees, Box Beams
42. 0.6 in.
43. 0.5 in.; some I-girders, all rectangular beams
    0.6 in,; most I-girders
44. 0.6 in.: Prestressed beams (I shapes & Boxes)

Q16. What do you believe contributes to end zone cracking?

1. Strand distribution
2. Detensioning, Possibly also thermal and shrinkage stresses
3. –
4. Detensioning, Lifting method and insert location, Insufficient bursting steel reinforcement
   Also poor fabrication techniques: Cutting strands too quickly; using large hammers and force to remove the bulk heads; uneven support of beams right after detensioning, etc.
5. –
6. Amount of reinforcing supplied
7. Detensioning, Concrete Strength, Strand distribution
8. More strands in bottom flange cause that part of the section to shorten different from the web. This creates tension that cracks the concrete so the end zone reinforcement can accept force.
9. –
10. Stress from curing of concrete and stresses created from the transfer of the prestressing forces
11. Detensioning, Lifting method and insert location, Strand distribution. We are by no means certain of the cause, or causes, otherwise we would craft our designs and specifications to minimize or eliminate these cracks.
12. Lifting method and insert location, Concrete strength, Strand distribution, Density and distribution of vertical beam end reinforcement. Eccentricity of prestress strand groups. Total prestress force. Concrete strength at transfer.
13. Detensioning, Strand distribution, Release of prestressing strands creates a tensile zone at girder ends. The code prescribed methodology and reinforcement requirement is inadequate (As = 4% Fps/20ksi). This becomes more critical with long span girders with significant increase in the amount of prestressing.
14. Detensioning, Strand distribution, We believe that a combination of several factors including detensioning procedure, strand (amount, size, location, distribution, etc.), and design factors.
15. Unknown at this time
16. Strand distribution, Perhaps shear lag due to unstressed top flange restraint; perhaps restraint of forms during curing
17. –
18. Strand distribution
19. Prestress force

20. Strand distribution, Form geometry could also be one of the contributing factors. Particularly the two curves at the top and bottom of the web. These could be creating anchor points which are inducing tension in the web during drying.
21. Number of strands and geometry of section
22. Too much stress, not enough rebar
23. Strand size, Detensioning, Strand distribution, We are releasing so much stress into the ends of the beams they can't help but crack down to the rebar
24. Detensioning, Concrete Strength, Strand distribution, I think the concrete surrounding the strand tries to "shorten" more than the concrete further away from the strand. This causes "strains" which creates cracking. Objective should be to control size of cracks to more smaller cracks. As force is "dragged" from stem to flanges, cracking will occur.
25. Strand distribution, The draped strand are very high at the ends of girders and the straight strand quantity is very high. (often times 32-straight/Bottom Strand & 8-Draped/High Strand)
26. –
27. –
28. Detensioning, Strand Distribution, Large Bottom strand groups with light top strand grouping causing out of balance forces also the shape to the end i.e. Flat against toothed. To some extent detensioning if very sharp loading application
29. Lifting method and insert location
30. Strand size, Detensioning, Strand distribution, Most I-Beams have the tendency to crack at the end with harped strand. This has been around since prestressing began. AASHTO has specified additional anchorage reinforcement with the elimination of end-blocks being used.
31. Strand distribution: (Most likely) It seems logical to me that we have forces placing the concrete in tension in that area of the girder. It follows that strands, and therefore strand distribution may have something to do with this situation. Vertical reinforcement takes the load immediately, in most situations.
    Detensioning: (Perhaps?) Detensioning one strand at a time by flame cutting seems to apply significant localized impact on the girder as the strand contracts to a relaxed condition. Usually the cracks are away from a strand, so it is more difficult to argue that a particular strand is related to a particular crack.
    Concrete strength: (Not much science here->) I have always been concerned about how quickly we gain strength in the concrete in the artificially perfect environment provided in a precast plant. I have no evidence to support the theory, but I have a feeling that concrete strength gained more slowly is superior to the strength gained over a few hours, which we measure as compressive strength. There are other characteristics of the concrete that are not indicated very well by compressive strength alone. Certainly the forces are there to crack the concrete, so the capability of the concrete to withstand this loading is secondary to the fact that the loading exists.
32. Strand size, Concrete strength, Strand distribution
33. Detensioning, Strand distribution, Generally don't have problems with achieving transfer strength. Cracking has been evidenced in girders with poor strand distribution. Flawed detensioning procedures may also contribute to cracking

34. Detensioning, Strand distribution, inability to adequately distribute force or reduce stresses by limitations of debonding. Insufficient endblock reinforcement.
35. –
36. Detensioning, Strand distribution, When releasing the line with gang stressing, all the forces are released into the ends of the beam at once. The other factor that contributes is the cracking is when releasing the line the beams slide down the soffit which causes friction and at some points the beam jumps when it gets in a bind on the soffit
37. Concrete strength, Strand distribution
38. Detensioning, Insert Location, Strand distribution, Improper Design! Stress level too high. Drapped strands increase probability of cracking. Use of lightweight concrete… Insufficient confinement steel at ends.
39. –
40. Strand distribution
41. Strand Distribution, I believe the larger dimensions and forces in bulb-tees causes unusual stresses in the girder ends
42. Detensioning, Strand distribution, Out production personnel believe that cast-in inserts have an influence on extent of cracking
43. Detensioning, Strand distribution
44. Detensioning, Concrete strength, Strand distribution, Lack of end zone reinforcement can contribute to cracking. Also, the temperature or rapid temperature change during curing can contribute to cracking

Q17. Additional comments:

1. –
2. –
3. –
4. The Illinois Department of Transportation has studied beam end cracking problems extensively because we had numerous problems. We developed new details which were issued in July of 2005 and we have had very good success with these. The new details were developed by reviewing other state practices and previous research from Maher K. Tadros. The new details and procedures included 3 primary phases: Evaluating and improving fabrication techniques; evaluating and improving design details; setting tolerances based on the new details and fabrication techniques.
5. –
6. –
7. –
8. Have seen this kind of cracks for over 20 years and have never seen any resulting problems in structures.
9. –
10. –
11. –
12. We are just completing the development of new beam end reinforcement details, and acceptance and repair criteria for inspectors and fabricators. New beams constructed with these details have shown to have end cracking of acceptably low widths and lengths. We also have miles of longitudinal web cracking in new beams that is not located at the beam ends if this is relevant to your study.

13. The LRFD bursting/splitting design philosophy should be looked at. These provisions are based on some assumed force (4% Fps) and some allowable rebar tensile stress (20 ksi). This approach is not designed to prevent concrete cracking in the end region (Concrete cracks before rebars get engaged). Adding more bars may not prevent cracking but will certainly increase congestion at girder end. Other methods of confining girder ends shall be looked at.
14. -
15. We have had very little issue with cracking outside of our relatively new 82” deep wide flange girder. We are currently studying the issue to see what is causing the cracks and what reinforcement might solve the problem
    Here is some information form Wisconsin for your survey. Hope things are going well for you in Nebraska. The cracking issue we have experienced with our 82" girder has been a perplexing challenge. The cracking near the very end of the girder we have a handle on but we are getting a few girders with cracking within the depth of the end of the girder also at this time. The girder production process is currently be reviewed to see what effects that might have on the issue.
16. Although this type of cracking is occurring, our conclusion is that it is not resulting in a strength or serviceability problem.
17. –
18. –
19. –
20. We have been studying bulb tee and box beam cracking with the PCI-NE Bridge Tech. Committee for the past several years. The attached draft specification is based on this. The draft is near acceptance and will be published shortly.
21. –
22. We rely heavily on recommendations found in _____. We have never to my knowledge, ever needed to reject a beam for this type of crack.
23. Partial or full release of the stressing force by hydraulic means does help but does not solve the problem
24. –
25. Given the complex tensile/compressive stress distribution at girder ends, I feel that cracking cannot be totally stopped. (Given our DOT’s design/detailing procedures). With proper and adequate reinforcing that crosses end zone cracks, their widths can be satisfactorily controlled.
    Please, do not hesitate to contact me directly if you would like further clarification on my responses
26. –
27. –
28. –
29. –
30. Without end-blocks, and with the thin webs used today, expect cracking to continue. Extra reinforcing can be used to control the crack length/width. Elimination is probably not feasible; minimizing/controlling deleterious effects is the best that can be accomplished.
    (see bridge design manual below)
31. –

32. For our Bulb-Tee shapes we preemptively debond up to 50% of the stands at the end of the girder; 25% for 2'-0" and 25% for 4'-0" lengths.
33. –
34. –
35. –
36. –
37. –
38. Please, Keep me posted…
39. –
40. Concrete cracks. Sealing a crack (i.e. filling it with epoxy) when it is open before it is in service will keep it from closing when the state of loading changes. I have heard of water repelling materials that prevent water from entering cracks without filling them this is where I'd like to see research
41. I think strut and tie studies may explain some of the common cracking
42. All of the observed diagonal end cracking has been of the hairline variety and we have never been requested by CDOT or any other organization to repair
43. We often see diagonal cracks in the web at the ends, which develop after detensioning. There is often additional very fine cracking that may be longitudinal or may extend from the end of the web toward (but not reaching) a point approximately the "width" of the web in from the end, about mid-height. This cracking is normally only visible after being wet and then drying on the surface, leaving the crack visible.
44. –

----------END OF RESPONSES----------