# Appendix J
# Survey Instruments and Results

This Appendix contains the following sections

J-1 Survey of Use of High-Strength Steel Reinforcement in BRIDGE Structures

J-2 Survey of Use of Stainless Steel Reinforcement in BRIDGE Structures

J-3 Jurisdictions Having High Strength Steel Reinforcing Deployed in Bridge Structures

**APPENDIX J-1 Survey of Use of High-Strength Steel Reinforcement in BRIDGE Structures**

State (Province): _____
District: _____

1. Has your department used steel reinforcement (not prestressing rods or tendons) with specified yield strengths greater than 60 ksi?
   - ☐ Yes (Please continue to question 2)
   - ☐ No (Please answer 1a only and return the survey)

   1.a Please indicate why yield strengths greater than 60 ksi are not used (please check all that apply).
   - ☐ Our specifications specifically prohibit yield strengths above 60 ksi.
   - ☐ Bars with yield strengths above 60 ksi have not been added the approved material list so it cannot be used.
   - ☐ The AASHTO Specifications do not cover bars with yield strengths above 60 ksi.
   - ☐ There is not enough data on performance to satisfy our performance requirements
   - ☐ It is not prohibited, we just have not used it.

2. What yield strengths are permitted? (Check all that apply)
   - ☐ 61 to 75 ksi
   - ☐ 76 to 100 ksi
   - ☐ ≥100 ksi

3. Please indicate how your Department uses high-strength reinforcement:

| | Used | Permitted but not used | Not Permitted |
|---|---|---|---|
| Main flexural reinforcement in beams | ☐ | ☐ | ☐ |
| Main flexural reinforcement in pier caps | ☐ | ☐ | ☐ |
| Transverse (shear) reinforcement in beams | ☐ | ☐ | ☐ |
| Transverse (shear) reinforcement in pier caps | ☐ | ☐ | ☐ |
| Main longitudinal reinforcement in piers | ☐ | ☐ | ☐ |
| Rectangular or circular ties in piers | ☐ | ☐ | ☐ |
| Spirals in piers | ☐ | ☐ | ☐ |
| Slab reinforcement | ☐ | ☐ | ☐ |
| Foundation element | ☐ | ☐ | ☐ |

4. What are the reasons for specifying high-strength reinforcement? (Check all that apply)
   - ☐ To reduce the amount of steel by taking advantage of the higher strength
   - ☐ To improve durability by enhancing corrosion resistance of reinforcement
   - ☐ Only for experimental/trial purposes at this time
   - ☐ Other, please briefly explain

5. How many bridges has your Department built with high-strength reinforcement?
   - ☐ Less than 10
   - ☐ Between 10 and 50
   - ☐ Between 50 and 100
   - ☐ Over 100
   - ☐ Don't know/Not applicable

6. High-strength reinforcement is not currently covered by the AASHTO LRFD Specifications. Which of the following design methods are permitted by your Department? (Check all that apply)
   - ☐ Our Department has its own, published design procedure
   - ☐ Design methods from published articles in the literature
   - ☐ Design methods published in the manufacturer's literature
   - ☐ The Engineer of Record is expected to use her/his best judgment in designing with high-strength reinforcement
   - ☐ Other, please briefly explain

7. Have the structures that use high-strength reinforcement experienced any of the following problems (Check all that apply)?
   - ☐ Cracking exceeded the amount expected
   - ☐ Cracking requiring repair/sealing
   - ☐ Corrosion of the bar not severe enough to require repair of the structure
   - ☐ Corrosion of the bar severe enough to require repair
   - ☐ Corrosion of the bar severe enough to require replacement of the structure
   - ☐ Other, please briefly explain

8. How frequent are problems in bridges with high-strength reinforcement that can be solely attributed to the use of high-strength reinforcement?
   - ☐ Not frequent, less than 20% of the bridges exhibit any problem
   - ☐ Somewhat infrequent, 20 – 50 % of the bridges exhibit some problems
   - ☐ Somewhat frequent, 50 – 80% of the bridges exhibit some problems
   - ☐ Very frequent, more than 80% of the bridges exhibit some problems

9. Did you experience any difficulty in the design (Check all that apply)?
   - ☐ No
   - ☐ Problems finding information on bar properties
   - ☐ Problems finding a design method
   - ☐ Could not use high-strength reinforcement in some places due to excessive development length and/or lap splice length
   - ☐ Could not meet crack control requirements
   - ☐ Other, please briefly explain

Thank you for your time,
NCHRP 12-77 Research Team

**RESULTS:** Survey of Use of High-Strength Steel Reinforcement in **BRIDGE** Structures

| Survey Question | | | | Responses |
|---|---|---|---|---|
| 1. Has your department used steel reinforcement (not prestressing rods or tendons) with specified yield strengths greater than 60 ksi? | | | | **32** |
| Yes | | | | **5** |
| No | | | | 27 |
| 1.a Please indicate why yield strengths greater than 60 ksi are not used | | | | |
| Our specifications specifically prohibit yield strengths above 60 ksi. | | | | 5 |
| Bars with yield strengths above 60 ksi have not been added the approved material list so it cannot be used. | | | | 2 |
| The AASHTO Specifications do not cover bars with yield strengths above 60 ksi. | | | | 9 |
| There is not enough data on performance to satisfy our performance requirements | | | | 11 |
| It is not prohibited, we just have not used it. | | | | 15 |
| 2. What yield strengths are permitted? | | | | |
| 61 – 75 ksi | | | | 3 |
| 76- 100 ksi | | | | 0 |
| greater than 100 ksi | | | | 2 |
| 3. Please indicate how your Department uses high-strength reinforcement | used | permitted but not used | not permitted | |
| Main flexural reinforcement in beams | 2 | 2 | 0 | |
| Main flexural reinforcement in pier caps | 3 | 1 | 0 | |
| Transverse (shear) reinforcement in beams | 3 | 1 | 0 | |
| Transverse (shear) reinforcement in pier caps | 3 | 1 | 0 | |
| Main longitudinal reinforcement in piers | 2 | 1 | 0 | |
| Rectangular or circular ties in piers | 2 | 1 | 0 | |
| Spirals in piers | | 3 | 0 | |
| Slab reinforcement | 4 | 1 | 0 | |
| Foundation element | 1 | 2 | 0 | |
| 4. What are the reasons for specifying high-strength reinforcement? | | | | |
| To reduce the amount of steel by taking advantage of the higher strength | | | | 4 |
| To improve durability by enhancing corrosion resistance of reinforcement | | | | 2 |
| Only for experimental/trial purposes at this time | | | | 0 |
| Other, please briefly explain | | | | 0 |
| 5. How many bridges has your Department built with high-strength reinforcement | | | | |
| Less than 10 | | | | 4 |
| Between 10 and 50 | | | | 1 |
| Between 50 and 100 | | | | 0 |
| Over 100 | | | | 0 |
| Don't know/Not applicable | | | | 0 |
| 6. High-strength reinforcement is not currently covered by the AASHTO LRFD Specifications. Which of the following design methods are permitted by your Department? | | | | |
| Our Department has its own, published design procedure | | | | 0 |
| Design methods from published articles in the literature | | | | 0 |
| Design methods published in the manufacturer's literature | | | | 0 |
| The EOR is expected to use best judgment in designing with high-strength reinforcement | | | | 2 |
| Other, please briefly explain | | | | 3 |
| 7. Have the structures that use high-strength reinforcement experienced any of the following problems | | | | |
| Cracking exceeded the amount expected | | | | 0 |

| Survey Question | Responses |
|---|---|
| Cracking requiring repair/sealing | 0 |
| Corrosion of the bar not severe enough to require repair of the structure | 0 |
| Corrosion of the bar severe enough to require repair | 0 |
| Corrosion of the bar severe enough to require replacement of the structure | 0 |
| Other, please briefly explain | 2 |
| 8. How frequent are problems in bridges with high-strength reinforcement that can be solely attributed to the use of high-strength reinforcement? | |
| Not frequent | 3 |
| Somewhat infrequent | 0 |
| Somewhat frequent | 0 |
| Very frequent | 1 |
| 9. Did you experience any difficulty in the design | |
| No | 5 |
| Problems finding information on bar properties | 0 |
| Problems finding a design method | 0 |
| Could not use high-strength reinforcement in some places due to excessive development length and/or lap splice length | 0 |
| Could not meet crack control requirements | 0 |
| Other, please briefly explain | 0 |

responses to Questions 2 through 9 do not always add to 5 responding "yes" to Question 1 because some responses were incomplete.

**Jurisdictions Responding to Survey (32):**

Alaska
Alberta
Arizona
Arkansas
Delaware
Hawaii
Illinois
Indiana
Maine
Maryland
Michigan
Minnesota
Mississippi
Montana
Nebraska
New Jersey
New Mexico
New York
New York Bridge Authority
Oklahoma
Ontario
Oregon
Pennsylvania
Saskatchewan
South Carolina
South Dakota
Tennessee
US Forest Service
Utah
Virginia
Washington
Wyoming

**APPENDIX J-2 Survey of Use of Stainless Steel Reinforcement in BRIDGE Structures**

State (Province): _____

1. Has your Department used stainless steel reinforcement?
   - ☐ Yes (Please continue to question 2)
   - ☐ No (Thank you for your time, please return the survey)

2. Please indicate how your Department uses stainless steel reinforcement:

| | Used | Permitted but not used | Not Permitted |
|---|---|---|---|
| Main flexural reinforcement in beams | ☐ | ☐ | ☐ |
| Main flexural reinforcement in pier caps | ☐ | ☐ | ☐ |
| Transverse (shear) reinforcement in beams | ☐ | ☐ | ☐ |
| Transverse (shear) reinforcement in pier caps | ☐ | ☐ | ☐ |
| Main longitudinal reinforcement in piers | ☐ | ☐ | ☐ |
| Rectangular or circular ties in piers | ☐ | ☐ | ☐ |
| Spirals in piers | ☐ | ☐ | ☐ |
| Slab reinforcement | ☐ | ☐ | ☐ |
| Foundation element | ☐ | ☐ | ☐ |

3. What are the reasons for specifying stainless steel reinforcement? (Check all that apply)
   - ☐ To improve durability by enhancing corrosion resistance of reinforcement
   - ☐ Only for experimental/trial purposes at this time
   - ☐ Other, please briefly explain

4. How many bridges has your Department built with stainless steel reinforcement?
   - ☐ Less than 10
   - ☐ Between 10 and 50
   - ☐ Between 50 and 100
   - ☐ Over 100
   - ☐ Don't know/Not applicable

5. Did you experience any difficulty in the design? (Check all that apply)
   - ☐ No
   - ☐ Problems finding information on bar properties
   - ☐ Problems finding a design method
   - ☐ Other, please briefly explain

6. Which of the following design methods are permitted by your Department? (Check all that apply)
   - ☐ Our Department has its own, published design procedure
   - ☐ Design methods from published articles in the literature
   - ☐ Design methods published in the manufacturer's literature
   - ☐ The Engineer of Record is expected to use her/his best judgment in designing with stainless steel reinforcement
   - ☐ Other, please briefly explain

Thank you for your time,
NCHRP 12-77 Research Team

**RESULTS:** Survey of Use of Stainless Steel Reinforcement in **BRIDGE** Structures

| Survey Question | | | | Responses |
|---|---|---|---|---|
| 1. Has your Department used stainless steel reinforcement? | | | | **28** |
| Yes | | | | **13** |
| No | | | | 15 |
| 2. Please indicate how your Department uses stainless steel reinforcement | used | permitted but not used | not permitted | |
| Main flexural reinforcement in beams | 1 | 2 | 2 | |
| Main flexural reinforcement in pier caps | 3 | 1 | 2 | |
| Transverse (shear) reinforcement in beams | 1 | 2 | 2 | |
| Transverse (shear) reinforcement in pier caps | 2 | 2 | 2 | |
| Main longitudinal reinforcement in piers | 0 | 2 | 2 | |
| Rectangular or circular ties in piers | 0 | 2 | 2 | |
| Spirals in piers | 0 | 2 | 2 | |
| Slab reinforcement | 11 | 0 | 2 | |
| Foundation element | 0 | 2 | 2 | |
| 3. What are the reasons for specifying stainless steel reinforcement? | | | | |
| To improve durability by enhancing corrosion resistance of reinforcement | | | | 8 |
| Only for experimental/trial purposes at this time | | | | 7 |
| Other, please briefly explain | | | | 0 |
| 4. How many bridges has your Department built with stainless steel reinforcement | | | | |
| Less than 10 | | | | 11 |
| Between 10 and 50 | | | | 1 |
| Between 50 and 100 | | | | 1 |
| Over 100 | | | | 0 |
| Don't know/Not applicable | | | | 0 |
| 5. Did you experience any difficulty in the design | | | | |
| No | | | | 12 |
| Problems finding information on bar properties | | | | 1 |
| Problems finding a design method | | | | 0 |
| Other, please briefly explain | | | | 0 |
| 6. Which of the following design methods are permitted by your Department? | | | | |
| Our Department has its own, published design procedure | | | | 0 |
| Design methods from published articles in the literature | | | | 2 |
| Design methods published in the manufacturer's literature | | | | 4 |
| The EOR is expected to use best judgment in designing with high-strength reinforcement | | | | 8 |
| Other, please briefly explain | | | | 4 |

responses to Questions 2 through 6 do not always add to 13 responding "yes" to Question 1 because some responses were incomplete.

**Jurisdictions Responding to Survey (28):**

| | | | | |
|---|---|---|---|---|
| Alabama | Iowa | Missouri | Ontario | US Forest Service |
| Alaska | Kansas | Montana | Oregon | Utah |
| Alberta | Louisiana | Nevada | Saskatchewan | Washington |
| Arkansas | Michigan | New Mexico | South Carolina | Wyoming |
| Hawaii | Minnesota | New York | South Dakota | |
| Illinois | Mississippi | Ohio | Tennessee | |

**APPENDIX J-3 Jurisdictions Having High Strength Steel Reinforcing Deployed in Bridge Structures**

Information in the following Table was obtained from MMFX Inc. and is believed to be current through the end of 2009. Jurisdictions in bold face reportedly have high strength reinforcing steel deployed in existing structures. Some jurisdictions have reported "planned" uses of high strength reinforcing steel; these are not included in the following table.

| Jurisdiction | Returned Survey? | Response to Question #1 | Applications | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Deck | Beams | Columns | Abutments | Walkway | Precast unit |
| | | | | | | | | |
| Alabama | | | | | | | | |
| Alaska | y | n | | | | | | |
| **Arizona** | y | n | 1 | | | | | |
| Arkasas | y | n | | | | | | |
| **California** | | | | 1 | 1 | 1 | | |
| Colorado | | | | | | | | |
| **Connecticut** | | | 2 | | | | 1 | |
| **Delaware** | y | y | 2 | 1 | | | | |
| DC | | | | | | | | |
| **Florida** | | | 1 | 1 | 1 | | | ** |
| Georgia | | | | | | | | |
| Hawaii | y | n | | | | | | |
| **Idaho** | | | 10 | | | | | 2 |
| Illinois | y | n | | | | | | |
| **Indiana** | y | n | 1 | | | 1 | | |
| **Iowa** | | | 1 | | | | | |
| Kansas | | | | | | | | |
| **Kentucky** | | | 1 | | | | | |
| Louisiana | | | | | | | | |
| **Maine** | y | y | 5 | | | 2 | 1* | |
| Maryland | y | | | | | | | |
| **Massachusetts** | | | 1 | | | | | |
| **Michigan** | y | n | 1 | | | | | |
| Minnesota | y | n | | | | | | |
| Mississippi | y | | | | | | | |
| Missouri | | | | | | | | |
| Montana | y | n | | | | | | |
| Nebraska | y | n | | | | | | |
| Nevada | | | | | | | | |
| **New Hampshire** | | | 2 | | | | | |
| New Jersey | y | n | | | | | | |
| **New Mexico** | y | y | 6 | 1 | 1 | 2 | | ** |
| **New York** | y | n | 1 | | | 1 | | |
| **North Carolina** | | | 1 | | | | | |

| Jurisdiction | Returned Survey? | Response to Question #1 | Applications | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Deck | Beams | Columns | Abutments | Walkway | Precast unit |
| North Dakota | | | | | | | | |
| **Ohio** | | | 2 | 1 | 1 | 1 | | |
| **Oklahoma** | y | n | 2 | 2 | 1 | 1 | | |
| Oregon | y | y | | | | | | |
| **Pennsylvania** | y | y | 4 | | | | | |
| **Puerto Rico** | | | 1 | | | 1 | | |
| Rhode Island | | | | | | | | |
| **South Carolina** | y | n | 1 | | | | | |
| South Dakota | y | n | | | | | | |
| Tennessee | y | n | | | | | | |
| **Texas** | | | 1 | 1 | 1 | 1 | | |
| **Utah** | y | | 3 | | | | | |
| **Vermont** | | | 1 | | | | | |
| **Virginia** | y | n | 6 | | | | | |
| Washington | y | n | | | | | | |
| West Virginia | | | | | | | | |
| Wisconsin | | | | | | | | |
| Wyoming | y | n | | | | | | |
| | | | | | | | | |
| **Alberta** | y | n | 1 | 1 | | | | |
| **British Columbia** | | | 2 | 1 | | | | 2 |
| **Manitoba** | | | 11 | | | | | |
| **New Brunswick** | | | 1 | | | | 1* | |
| Newfoundland | | | | | | | | |
| Nova Scotia | | | | | | | | |
| Nunavat | | | | | | | | |
| NWT | | | | | | | | |
| Ontario | y | n | | | | | | |
| PEI | | | | | | | | |
| Quebec | | | | | | | | |
| Saskatchewan | y | n | | | | | | |
| | | | | | | | | |
| **Bahamas Islands** | | | 1 | 1 | 1 | 1 | | |
| **Private owner** | | | | | | | | ** |
| | | | | | | | | |
| **TOTAL** | **30** | | **71** | **11** | **7** | **12** | **1** | ** |

* Maine and New Brunswick joint project

**Precast material orders – bridge locations/numbers unknown

The following table summarizes those projects reported by MMFX Inc. that are known to have used A1035 reinforcing steel and a value of $f_y$ in design greater than 60 ksi.

| Project Name | Application | Owner/ Developer | $f_y$ used in design (ksi) | Year |
|---|---|---|---|---|
| Great Exuma Bridge | Entire Structure | Murphy International Development Ltd (Bahamas) | 80 | 2007 |
| Light Rail Transit System over Alder Creek | Beams, Columns and Abutments | Sacramento (CA) Regional Transit | 100 | 2004 |
| Daggett Bridge | Girders | Port of Stockton (CA) | 100 | 2006 |
| Fred Howard Causeway Bridges | Superstructure | Pinellas County (FL) | 75 | 2008 |
| East Parkcenter Bridge | Deck | Ada Co. Highway Dist (ID). | 75 | 2008 |
| Rte 1 NB over I-95 | Deck and Barriers | Massachusetts DOT | 75 | 2007 |
| Bailey Island Bridge | Deck | Maine DOT | 75 | 2008 |
| Rte 1 Narraquagus River Bridges | | Maine DOT | 75 | 2008 |
| Norridgewock Bridge Project | Deck | Maine DOT | 75 | 2009 |
| MDOT Project BHT0711(340) | Deck | Michigan DOT | 75 | 2008 |
| Richibucto River Bridge No. 1 | Deck | New Brunswick DOT | 80 | 2009 |
| US 64 over Gobernador Arroy River | Entire Structure | New Mexico DOT | 75 | 2004 |
| Bridge No D5037 I-25 @ MP 308.7 | Deck | New Mexico DOT | 75 | 2008 |
| Buckley Road over NY Thruway | Abutments and Slab | NY Thruway Authority | 70 | 2008 |
| Shaker Heights Culvert Bridge 165 | Entire Bridge | Cuyahoga County (OH) | 75 | 2008 |
| State Hwy 100 over Illinois River - Lake Tenkiller | Deck, Columns and Abutments | USACE - Tulsa District | 75 | 2004 |
| Washington Avenue over I-40 Bridge | Columns, Beams, Abutment and Deck | Texas DOT | 75 | 2004 |