APPENDIX I QUESTIONNAIRES

OWNERS QUESTIONNAIRE

NCHRP Project 12-88 System Performance of Accelerated Bridge Construction (ABC) Connections in Moderate-to-High Seismic Regions

QUESTIONNAIRE

NCHRP Project 12-88 System Performance of Accelerated Bridge Construction (ABC) Connections in Moderate-to-High Seismic Regions

Purpose of Questionnaire

As part of the research, we are contacting experts in academia and practice to learn about connections and systems that are currently being used or studied for use in accelerated or rapid bridge construction. The results of this study will be synthesized into a reference document that summarizes the current state-of-art and recommends specific connections and/or systems that warrant further study for use in higher seismic regions. The range of connections being studied is as follows:

- Pile to pile-cap connections
- Pile-cap , drill shafts, or spread footing to column
- Connections between column segments
- Column to pier cap or bent cap connections
- Substructure to superstructure joints and connections
- Connections between precast girders and pier diaphragms
- Superstructure-to-substructure connection using SPMT (Self-Propelled Modular Transporter) technology
- Other connection devices and technologies that optimize the economy and constructability between precast and cast-in-place elements

Examples of construction types that are being considered for connections include:

- Connections that emulate the behavior of cast-in-place construction
- Connections that use bars in grouted sleeves or connectors
- Connection by grouting or concreting an entire member into a socket of the adjacent member
- Connection with post-tensioning such as segmental post-tensioned columns
- Hinged connections, mechanical connections, or connections incorporating new materials or novel construction techniques

Please respond to the questions below, attach any relevant supporting information, include pertinent references, and return your responses to us at your earliest convenience. If you are not comfortable or not able to answer some of the questions below, please provide responses where possible. Since this project, very much like accelerated bridge construction, has a rapid schedule, we would appreciate responses by latest October 1, 2010.

For Questions, please contact anyone of the NCHRP 12-88 team members below:

- Lee Marsh (BergerABAM) Lee.Marsh@ABAM.com 206/431-2340
- Jim Guarre (BergerABAM) Jim.Guarre@ABAM.com 206/431-2324
- Markus Wernli (BergerABAM) Markus.Wernli@ABAM.com 206/357-5642
- John Stanton (U of Washington) Stanton@U.Washington.edu 206/543-6057
- Marc Eberhard (U of Washington) Eberhard@U.Washington.edu 206/543-4815

Name of Respondent and Contact Information
Name: Affiliation: Title: Email: Telephone:

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer:

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer:

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer:

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer:

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available test data supporting adequate seismic performance of systems, elements, or details** **b. Available design procedures or design guidelines** **c. Available construction methods, construction specifications, and inspection procedures** **d. Available data supporting durability**
Answer:

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following? **a. Only in capacity protected, non-energy dissipating elements** **b. Only in construction that emulates the seismic performance of cast-in-place construction** **c. Where novel types of construction are considered (e.g. rocking columns, other)**
Answer:

7. Which seismic design methodology do you currently use? **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?** **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**
Answer:

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories? **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading** **b. Please indicate whether the details researched have been constructed on actual bridge projects.**
Answer:

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer:

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer:

Thank you for your help.

Name of Respondent and Contact Information
Name: Elmer E. Marx, PE Affiliation: State of Alaska SOT&PF – Bridge Section Title: Technical Engineer II Email: elmer.marx@alaska.gov Telephone: (907) 465-6941

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer: Precast concrete bent cap beams have been used on past projects in remote locations. None of these bridges has been in high seismic (SDC "D") areas. Precast superstructures using decked bulb-tee girders are extensively used in Alaska – this type of structure does not require a CIP concrete deck which greatly accelerates construction.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: Research on precast, prestressed deck bulb-tee girders has been recently compiled in the NCHRP 12-69 project. This document contains an extensive list of relevant research and design recommendations. NCHRP 12-74 contains design recommendations for emulative (members that mimic details used in standard CIP construction) precast concrete bent caps similar to those used by the Alaska DOT&PF.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: Our experience has been that precast elements should be designed to accommodate greater construction tolerances than that of standard CIP construction. On the other hand, when using precast substructure and superstructure elements, a greater degree of geometry control is often required to ensure that the components fit properly.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: Based upon the results of the NCHRP 12-74 work, the emulative style precast concrete bent cap appeared to perform well under large deformation demands.

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   a. Available test data supporting adequate seismic performance of systems, elements, or details
   b. Available design procedures or design guidelines
   c. Available construction methods, construction specifications, and inspection procedures
   d. Available data supporting durability

Answer: A relatively small number of large scale tests on high-seismic assemblies have been validated by laboratory testing. Of particular concern is the long-term durability of the details that have been proposed to date.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: Provided that the details have been proven to be effective and durable, they would likely be permitted in both capacity-protected and hinging members.

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer: (a) The Alaska DOT&PF uses the displacement based seismic design as presented in the AASHTO Guide Specifications for LRFD Seismic Bridge Design. (b) The displacement-based design approach appears to be more appropriate in high seismic zones. Specifically, a lesser amount of reinforcing steel (longitudinal and transverse) appears to be required in SDC "D" zones. This reduction in reinforcement translates to lesser overstrength plastic moment demands on the capacity-protected elements.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: No research specific to ABC has been sponsored by the Alaska DOT&PF; however, research on column-cap beam connections has been sponsored. The results of this research are included in the

AASHTO seismic guide specifications. This research was referenced as part of the NCHRP 12-74 project. Sritharan, S. "Improved Seismic Design Procedure for Concrete Bridge Joints," *Journal of Structural Engineering*. American Society of Civil Engineers, Reston, VA, Vol. 131, No. 9, September 2005, pp. 1334-1344.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: No.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?

Answer: No.

Name of Respondent and Contact Information
Response to #1-4: Name:Paul Chung Affiliation: Caltrans/Structure Design Title: Senior Bridge Engineer Email: paul.chung@dot.ca.gov Telephone:909-595-4743 Response to #5-10: Name: Mike Keever Affiliation: Caltrans/Earthquake Engineering Title: Supervising Bridge Engineer Email:mike.keever@dot.ca.gov Telephone:916-227-8806

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer: a. Yes, most of the ABC projects are in moderate to high seismic zones. b. Most of the ABC components employed in ABC projects are precast superstructures or precast bent caps that are connected to columns. Thus, these precast elements are nearby the plastic hinge zones in the columns. c. Yes, most of the ABC techniques employ precast girders or bent caps that are capacity-protected members.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: The current design specifications are Caltrans Seismic Design Criteria (http://www.dot.ca.gov/hq/esc/techpubs/manual/othermanual/other-engin-manual/seismic-design-criteria/sdc.html) and AASHTO LRFD BDS and California Amendments.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: Please see Caltrans ABC Lessons-Learned Report as follows: http://www.dot.ca.gov/hq/esc/Structure_Design/accel_bridge_construction/documents/ABC_LessonsLearned_v1-1.pdf

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: Please see Caltrans ABC Lessons-Learned Report as follows:
http://www.dot.ca.gov/hq/esc/Structure_Design/accel_bridge_construction/documents/ABC_LessonsLearned_v1-1.pdf

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
- **a. Available test data supporting adequate seismic performance of systems, elements, or details**
- **b. Available design procedures or design guidelines**
- **c. Available construction methods, construction specifications, and inspection procedures**
- **d. Available data supporting durability**

Answer: Caltrans has begun implementing ABC per the Lessons Learned Report cited in #3. However application has been limited pending large scale testing and validation of moment resisting connections - particularly in or adjacent to inelastic plastic hinge zones. Caltrans is equipped to supplement AASHTO design specifications and develop construction specifications as necessary once applicable ABC connection details have been tested and approved for use. Durability issues are a concern for some of the proposed ABC details including unbonded post-tensioned columns and column to foundation connections below the ground line.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
- **a. Only in capacity protected, non-energy dissipating elements**
- **b. Only in construction that emulates the seismic performance of cast-in-place construction**
- **c. Where novel types of construction are considered (e.g. rocking columns, other)**

Answer: The current focus is to develop ABC designs that emulate CIP performance. However we are also reviewing and investigating more innovative types of systems for use in the future including: rocking columns, post-tensioned self-centering columns, concrete-filled-tubes (steel, FRP composite or concrete), replaceable inelastic elements (e.g. shear links). While Caltrans has used isolation bearings on past projects, we are also investigating the potential for broader use of isolation bearings for both improved seismic performance and ABC.

7. Which seismic design methodology do you currently use?
- **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?**
- **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**

Answer: Caltrans Seismic Design Criteria (SDC), which is a displacement-based methodology similar to the AASHTO Guide Specifications for LRFD Seismic Bridge Design. The use of Inelastic Static "pushover" analysis allows for an assessment of the demands on capacity protected elements, the ability to ensure plastic hinges occur in predetermined locations (typically columns), and the assessment of demands at connection locations. This can not be accomplished as effectively or efficiently using force-based

methods.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?

a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading

b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: UC-San Diego (Restrepo) SSRP 06/18 Seismic Response of Precast Segmental Superstructures

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer:

- University of Nevada – Reno (Saiidi) Design Guidelines for Pipe-Pin Connections
- University of Nevada-Reno (Saiidi)/UC-San Diego (Karbhari) Emergency Repair of Damaged Bridge Columns Using Fiber Reinforced Polymer Materials
- UC-Berkeley (Stojadinovic) Structural Systems for Smart California Bridges
- University of Nevada – Reno (Saiidi) Precast Pier Columns with Energy Dissipating Joints
- Iowa State University (Srithan) Seismic Performance of Precast I-Girder to Inverted-Tee Bent Cap Connection
- UC-San Diego (Restrepo) Developmet of Seismic Design Guidelines for Segmental Construction
- University of Washington (Lehman) Rapid Construction of Bridge Piers with Improved Seismic Performance
- UC-Berkeley (Mahin)/UC-Davis Design Guidelines for Foundation Rocking of Bridge Piers

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?

Answer:

- University of Nevada – Reno (Saiidi) Seismic Performance of Nest Generation Bridge Components for Accelerated Bridge Construction
- Caltrans put out a broad announcement for proposals associated with Accelerated Bridge Construction. These proposals are currently being evaluated, but no funding decisions have been made at this time.

Thomas A. Andres P.E.
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In the interest of time, I would prefer not responding directly to your survey, however I concur with the survey line of questioning: that one of the keys to accelerated construction in seismic regions is about making the connections between the various bridge components. I offer the following thoughts/ideas for your consideration:

1. Metallic stay-in-place (S.I.P.) bridge component formwork that also serves as confinement shells to the in-situ concrete that is poured inside. In the simplest application this may be permanent steel casing for a drilled shaft, or a permanent thin S.I.P. steel shell that forms a bridge column. Whereas circular S.I.P. form shapes offer the best confinement, other shapes such as rectangular shapes for a S.I.P. bridge pier cap form could be fabricated and reinforced with internal bracing as required to offer confinement to the in-situ concrete. Now-a-days, computerized flame cutting systems can allow the plates that make up the shell to be cut in the shape of prestressed girders so that the girders can penetrate the formwork. The in-situ fill concrete (with flowing concrete additives) could connect the integral cap to the girders. The form shells could be fabricated and assembled with the reinforcing cages already attached for various bridge components prior to placing and stressing the concrete. Also the steel shells could be designed to be composite with the concrete. In the case of steel girder bridges, the shells could also serve as structural members designed to support its self-weight and weight the of the steel beam deck framing system prior to casting and post-tensioning the integral pier cap or casting the bridge deck. This concept can eliminate/reduce temporary shoring. See attached detail from a past FDOT project.

2. Stay-in-place (S.I.P.) bridge component formwork made of other materials. Similar confinement shells described in Item #1 above made of carbon fiber or other non-metallic materials may be possible.

3. Equipment advances that increase segmental construction production rates. We have seen recent advances in erection equipment that can accelerate construction of balanced cantilever type segmental bridges, especially on interchange expansion projects. Segment lifters on rubber tired rollers allow for segments to be lifted from any point along the cantilever (the segment is actually suspended below the cantilever), then rolled out to the end so that it can be placed. This greatly increases the rate of production for the Contractor because the underlying roadways and ramps adversely affect where cranes can be placed or where segment can be delivered. Segment lifters will be utilized on the I-4 Cross-town Connector Project currently beginning constructed in Tampa, Florida. A segment lifter was also utilized on a recent Texas Project (photo attached). I thought the Dallas High-Five Project may be of

interest to you because of the fixed pier tables and the applicability to seismic regions. TxDOT may be able to provide additional information. See project information at URL link below.

http://www.engius.com/web/publications/casestudies/Zachry%20Dallas%20Hi5%20Case%20Study.pdf

The main issue with constructing balanced cantilever segmental bridges with fixed pier tables has to do with allowing for a reasonable construction tolerances in the design. Construction tolerances of the cantilever tips can overstress the reinforced columns when the tips are forced into alignment. See FDOT Structures Design Guidelines excerpted requirements below.

4.6.4 Design Requirements for Cantilever Bridges with Fixed Pier Tables

A. Design superstructures and substructures to accommodate erection tolerances of L/1000 (where L is the cantilever length from center of pier to the cantilever tip) for precast superstructures. Structure stresses shall be enveloped assuming a worst case condition (LA/1000 high on Cantilever A and LB /1000 low on adjacent Cantilever B and vice-versa) assuming uncracked sections. Check the service limit state assuming these locked-in erection stresses, "EL" in LRFD Equation 3.4.1-2.

B. The service load stresses of the column and column-superstructure connection, including crack control of the column shall also be checked for both erection and final structure.

Commentary: Field correction for geometry control for framed bridges built in precast balanced cantilever can result in high stresses in both the superstructure and substructure. These stresses need to be accommodated for by the designer. The L/1000 value is consistent with the allowable erection tolerance per FDOT Specification 452. Cast-in-place construction with travelers is excluded, since geometry will be adjusted during cantilever erection.

Hopefully you find this information helpful. Feel free to contact me if you have any questions.

Name of Respondent and Contact Information	
Name:	Daniel H. Tobias
Affiliation:	Illinois Department of Transportation
Title:	Structural Development Engineer
Email:	daniel.tobias@illinois.gov
Telephone:	217-782-2912

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer: Illinois does not use ABC techniques.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: No.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: N/A

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: N/A

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   - **a. Available test data supporting adequate seismic performance of systems, elements, or details**
   - **b. Available design procedures or design guidelines**
   - **c. Available construction methods, construction specifications, and inspection procedures**
   - **d. Available data supporting durability**

Answer: N/A

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: N/A

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer: a. Force based for typical bridges and a mixture of force-based/displacement based for complex and major bridges. b. N/A.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: N/A

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: No.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?

Answer: No.

Name of Respondent and Contact Information	
Name:	Michael Merlis
Affiliation:	MassDOT
Title:	Assistant Bridge Engineer for Bridge Standards
Email:	michael.merlis@state.ma.us
Telephone:	617-973-7588

1. Have you employed any ABC techniques in your bridge structures? And
   a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?
   b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?
   c. Have any of these been in capacity-protected members (e.g. superstructure elements)?

Answer: Accelerated Bridge Program in our state relies on the use of innovative and accelerated construction techniques and thus we are trying to implement these techniques whenever possible. The vast majority of our bridges are to be classified as SDC A based on the new AASHTO Guide Specifications for LRFD Seismic Bridge Design.

a. No
b. No
c. No

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: Presently, the Bridge Section is developing a MassDOT manual for prefabricated bridge elements and connection details, which will be issued in the near future. In the meantime, the temporary working List of the MassDOT Preferred Connection Details for Prefabricated Precast Bridge Elements and Systems was issued and posted on our website and is based on the Publication No. FHWA-IF-09-010 "Connection Details for Prefabricated Elements and Systems" by the Federal Highway Administration dated March 30, 2009 and shall be used in conjunction with this document.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: The majority of bridges that utilize ABC techniques are presently under design and therefore we can't provide you with any lessons learned at this point.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: No. The vast majority of our bridges are to be classified as SDC A based on the new AASHTO

Guide Specifications for LRFD Seismic Bridge Design.

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   a. Available test data supporting adequate seismic performance of systems, elements, or details
   b. Available design procedures or design guidelines
   c. Available construction methods, construction specifications, and inspection procedures
   d. Available data supporting durability

Answer: No. The vast majority of our bridges are to be classified as SDC A based on the new AASHTO Guide Specifications for LRFD Seismic Bridge Design.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: No. The vast majority of our bridges are to be classified as SDC A based on the new AASHTO Guide Specifications for LRFD Seismic Bridge Design.

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer:
   a. Presently, seismic analysis of bridges in our state is performed based on the displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design.
   b. No.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: No.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer: No.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: No.

Name of Respondent and Contact Information
Name: Edmund H. Newton Affiliation: MassDOT Title: Email: Edmund.H.Newton@state.ma.us Telephone: 616-973-8278

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer:
a. we have recently been shifted from moderate to low.
b. and c. no

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: I with others from MassDOT have been working in the PCI-NE Technical Committee which developed a manual in 2006,"Guidelines for Accelerated Bridge Construction Using Precast/Prestresses Concrete Elements." This is available on the PCI-NE web site: http://www.pcine.org.

We are in the process of updating the complete document significantly and hope to have this new manual on line early next year. A draft copy may be available now.

As part of this effort the committee is revising and up dating the manual: "Design Guidelines, Full Depth Precast Concrete Deck Slabs" dated June 2002. This newly revised document is due out near the end of this year. It too will be available on the PCI-NE web site: http://www.pcine.org.

A view of the PCI-NE web site may reveal additional documents of interest to you.

At MassDOT we are currently in the process of adding precast details of sections and connections to our Bridge Manual. We have progressed significantly and hope to have a preliminary review copy available around the end of the year. A list of the chapters follows: Notes, Abutments, Piers, Integral Abutments, Approach Slabs, Full Depth Deck Panels, Highway Guardrail Transitions, and Tolerances.

Additional standards are in the process of being developed: NEXT Beam Details and MSE walls

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer:
Approximately 15 years ago we designed a bridge using precast abutment footings and walls made

integral with an adjacent precast box beam superstructure. The current rating for it is: Deck, Superstructure, and Substructure 7. or Good Condition.
We have just started an extensive push to use ABC for a large number of projects. However, the experience is still new to us. So, we have been using literature and other state's experience. To date we do not have our own standard and procedures.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: no

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
- **a. Available test data supporting adequate seismic performance of systems, elements, or details**
- **b. Available design procedures or design guidelines**
- **c. Available construction methods, construction specifications, and inspection procedures**
- **d. Available data supporting durability**

Answer:
We do not have high seismic areas in Massachusetts.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
- **a. Only in capacity protected, non-energy dissipating elements**
- **b. Only in construction that emulates the seismic performance of cast-in-place construction**
- **c. Where novel types of construction are considered (e.g. rocking columns, other)**

Answer:
We do not have high seismic areas in Massachusetts.

7. Which seismic design methodology do you currently use?
- **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?**
- **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**

Answer:
- a. Displacement-based design based on the AASHTO Guide Specifications for LRFD Seismic Bridge Design.
- b. No

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories? **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading** **b. Please indicate whether the details researched have been constructed on actual bridge projects.**
Answer: no

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer: no

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: no

Name of Respondent and Contact Information
Name: Suresh Patel Affiliation: MoDOT Title: Senior Structural Engineer Email: suresh.patel@modot.mo.gov Telephone: 573.526.3030

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer: Not used in seismic area bridge.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: We have used precast beam cap option in one Non seismic area bridge.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: The design of the beam cap was largely unchanged from cast-in-place beam cap. Extra consideration needs to be given to the bar spacing, reinforcing details, grout tubes, and lifting loops. The best use of this option would be economical where time considerations exceed those of cost. Projects with a large number of bents are the best possibility where the time saving would be great enough to overcome any delays possible with this option. Transporting the beam caps needs to be considered. Routes with posted bridges, county roads and residential streets may not be viable. Reducing costs would make this option more viable. Wide spread use and increased experience gained by fabricators and contractors, and cost would come down. It is too early to tell how this option will perform in long run and any type of maintenance issues that will arise. (See Report on subject matter e-attached)

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: Not used in higher seismic area.

5. **Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?**
    a. **Available test data supporting adequate seismic performance of systems, elements, or details**
    b. **Available design procedures or design guidelines**
    c. **Available construction methods, construction specifications, and inspection procedures**
    d. **Available data supporting durability**

Answer: If above listed information are available then it would help in choosing ABC techniques for higher seismic categories. Use of this option will be determined based on cost and other issues.

6. **Do you have preferences for ABC use in seismic regions? Do they include any of the following?**
    a. **Only in capacity protected, non-energy dissipating elements**
    b. **Only in construction that emulates the seismic performance of cast-in-place construction**
    c. **Where novel types of construction are considered (e.g. rocking columns, other)**

Answer: ABC use in seismic regions not considered at this time.

7. **Which seismic design methodology do you currently use?**
    a. **Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?**
    b. **Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**

Answer:

a. Displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design will be used.

b. ABC option not used in seismic area bridge.

8. **Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?**
    a. **Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading**
    b. **Please indicate whether the details researched have been constructed on actual bridge projects.**

Answer: Not sponsored or performed tests on ABC systems or connection details.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer: Not aware of any ongoing research or implementation of ABC that has not yet been published.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: None.

Name of Respondent and Contact Information
Name: Stephanie Brandenberger Affiliation: Montana Dept. of Transp. Title: Bridge Area Engineer – Great Falls Dist and Seismic Email: stbrandenberger@mt.gov Telephone: 406-444-7675

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer: MDT has not constructed bridges using ABC techniques described above. Plans are currently being developed for two structures using these types of ABC connections; one of them is in a moderate seismic zone. The design concept for the bridge in zone 3/C is to use the soil/structure interaction at the abutments as the primary seismic force resisting element and isolate the ABC connections at the intermediate bents from seismic forces as much as possible.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: MDT does not have specific information to share at this time since ABC construction plans are still under development.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: NA

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: NA

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available test data supporting adequate seismic performance of systems, elements, or details** **b. Available design procedures or design guidelines** **c. Available construction methods, construction specifications, and inspection procedures**

d. Available data supporting durability
Answer: MDT does share the concerns expressed in items a-d above. Particular concerns include: appropriate material properties and specifications for grouts at connections; continuity between precast elements (e.g. fixed or pinned connection); ability to retrofit or repair ABC connection after a damaging seismic event.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following? **a. Only in capacity protected, non-energy dissipating elements** **b. Only in construction that emulates the seismic performance of cast-in-place construction** **c. Where novel types of construction are considered (e.g. rocking columns, other)**
Answer: The use of ABC is most often considered for capacity protected elements.

7. Which seismic design methodology do you currently use? **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?** **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**
Answer: MDT primarily uses the AASHTO LRFD Specifications, although the use of the Guide Specifications are allowed and encouraged. For the ABC bridge in development, the Guide Specifications are being used to evaluate the system, elements and connections. Because the performance of ABC connections is not well understood, we assumed certain boundary conditions for the connections and could directly evaluate the displacements of the system, and elements within the system, under those conditions. This would have been much more difficult using a force based approach.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories? **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading** **b. Please indicate whether the details researched have been constructed on actual bridge projects.**
Answer: No

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: No

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: No

Name of Respondent and Contact Information
Name: Brian Hanks Affiliation: NCDOT Title: Project Engineer Email: bhanks@ncdot.gov Telephone: 919-250-4046

1. Have you employed any ABC techniques in your bridge structures? And **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?** **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?** **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**
Answer: Yes to employing ABC techniques in our bridge structures. No to "a", "b" and "c".

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: We have plan details for a precast deck bulb tee, precast deck with steel girders and precast deck slabs. A link to the plans will be provided. Also, a research report for the deck bulb tee project is available.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: On a few projects, the grout at the connections is performing poorly. A grout provision for ABC components is going to be developed to remedy this problem.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: N/A

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available test data supporting adequate seismic performance of systems, elements, or details** **b. Available design procedures or design guidelines** **c. Available construction methods, construction specifications, and inspection procedures** **d. Available data supporting durability**

Answer: N/A

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following? **a. Only in capacity protected, non-energy dissipating elements** **b. Only in construction that emulates the seismic performance of cast-in-place construction** **c. Where novel types of construction are considered (e.g. rocking columns, other)**
Answer: No specific preference.

7. Which seismic design methodology do you currently use? **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?** **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**
Answer: a. Force-based design b. N/A

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories? **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading** **b. Please indicate whether the details researched have been constructed on actual bridge projects.**
Answer: No

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer: No

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: We do not have any information at the time.

Name of Respondent and Contact Information	
Name:	Todd Stefonowicz
Affiliation:	NV DOT
Title:	Asst Chief Structures Eng
Email:	tstefonowicz@dot.state.nv.us
Telephone:	775.888.7550

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer: We've completed two projects using spliced concrete tub girders, 1 each in zones C and D. Precast tub girders are integral with bent cap.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: ABC specific guidelines or standards have not been developed.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: Splicing of post-tensioning ducts in the first spliced tub girder project proved to be a challenge. We actually had to re-fabricate pieces due to this issue. No durability issues noted to date (approx 3 years in service). Second project is under construction.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: Nothing to add.

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   - **a. Available test data supporting adequate seismic performance of systems, elements, or details**
   - **b. Available design procedures or design guidelines**
   - **c. Available construction methods, construction specifications, and inspection procedures**
   - **d. Available data supporting durability**

Answer: All of the issues noted above are of concern, primarily item B. However, none of these issues would prevent our use of ABC techniques for the "right" project. We are aware the body of ABC study/knowledge is steadily increasing.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: We'd be more inclined to use ABC for items a) and b) but would not necessarily preclude use in energy dissipating elements.

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer: Currently using the force-based methodology of the LRFD Specs. Considering parallel designs or pilot designs using the Guide Spec.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: Sponsored research at Nevada – Reno on the seismic performance of integral concrete tub girder to pier cap connections. Final report not published - contact Dr. David Sanders (sanders@unr.edu). Research results have not been applied to a construction project.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: Nothing to add.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: Nothing to add.

Name of Respondent and Contact Information	
Name:	Lucero E. Mesa
Affiliation:	SCDOT
Title:	Seismic Support Engineer
Email:	mesale@scdot.org
Telephone:	803-737-1765

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer: Yes.
a. Yes, as per the SCDOT Seismic Hazard and Seismic Specifications
b. Yes.
c. Yes. Precast Cap/PCP as columns; very common in South Carolina.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: Not yet.

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: No.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: The testing on the research/design bridge project pre-cast cap to PCP connection is underway at the USC in Columbia. It seems at this time that the cap size will be large.

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   - **a. Available test data supporting adequate seismic performance of systems, elements, or details**
   - **b. Available design procedures or design guidelines**
   - **c. Available construction methods, construction specifications, and inspection procedures**
   - **d. Available data supporting durability**

Answer: All the above.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: a and b.

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer:
a. Displacement based design/Performance based design as per the SCDOT Seismic Design Requirements.
b. The displacement –based design is the SCDOT preferred method due to the capability to predict desirable performance of members and connections.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: No tests.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: Yes. Dr. Jose Restrepo, UCSD; NCHRP 12-74. I do not know if the funding agency would consider funding for preliminary dissemination of this work.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not

yet started, that you could share with this NCHRP synthesis project?
Answer: The only one is the SCDOT/IBRD project on pre-cast bent cap. Please find the Problem Statement in the attached file.

Name of Respondent and Contact Information	
Name:	Edward P. Wasserman
Affiliation:	Tennessee Department of Transportation
Title:	Civil Engineering Director – Structures Division
Email:	Ed.Wasserman@tn.gov
Telephone:	615-741-3351

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer: No, to all.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: No

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: No

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: No

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?
   - **a. Available test data supporting adequate seismic performance of systems, elements, or details**
   - **b. Available design procedures or design guidelines**
   - **c. Available construction methods, construction specifications, and inspection procedures**
   - **d. Available data supporting durability**

Answer: No. I believe that any details that mimic cast-in-place construction and seismic reinforcement will perform adequately.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
   a. Only in capacity protected, non-energy dissipating elements
   b. Only in construction that emulates the seismic performance of cast-in-place construction
   c. Where novel types of construction are considered (e.g. rocking columns, other)

Answer: No.

7. Which seismic design methodology do you currently use?
   a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?
   b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?

Answer: a. We use displacement-based except in the case of routine short span bridges where force-based designs are satisfactory.
b. No experience that would allow a judgment.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
   a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading
   b. Please indicate whether the details researched have been constructed on actual bridge projects.

Answer: No.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer: No.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?

Answer: No.

Name of Respondent and Contact Information	
Name:	Carmen Swanwick
Affiliation:	Utah Department of Transportation
Title:	Chief Structural Engineer
Email:	Cswanwick@utah.gov
Telephone:	801.965.4981

1. Have you employed any ABC techniques in your bridge structures? And
   - **a. Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
   - **b. Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
   - **c. Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer:
Yes, over 100 bridges in the state have utilized ABC techniques. The majority of these construction sites are in high seismic zones.

a. Yes, many different ABC techniques have been used in seismic design category (SDC) D
b. Yes
c. Yes, pier caps are capacity protected. Superstructure elements are also typically capacity protected.

2. Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer:
Yes, UDOT has developed a manual on the use of SPMTs. UDOT also has developed standard drawings, specs and manuals for precast footings, precast piers, precast abutments, precast approach slabs, precast sleeper slabs, precast end diaphragms, precast full depth deck panels as well as precast prestressed bulb tee girders and precast box culverts. This information can be provided upon request. See the UDOT Website.

http://www.udot.utah.gov/main/f?p=100:pg:0::::1:T,V:1991

3. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: UDOT has prepared several lessons learned reports from construction projects. UDOT also performs a yearly lessons learned report on the ABC bridges. However, the lessons learned reports do specifically address connections. This information can be provided upon request.

4. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: UDOT has prepared several lessons learned reports from construction projects. UDOT also performs a yearly lessons learned report on the ABC bridges. This information can be provided upon request.

5. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?

- **a. Available test data supporting adequate seismic performance of systems, elements, or details**
- **b. Available design procedures or design guidelines**
- **c. Available construction methods, construction specifications, and inspection procedures**
- **d. Available data supporting durability**

Answer: UDOT has not been prevented from employing ABC techniques in higher seismic areas to date. The testing of grouted splice sleeves for seismic is desirable for us since we currently use them for connecting precast components.

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?

- **a. Only in capacity protected, non-energy dissipating elements**
- **b. Only in construction that emulates the seismic performance of cast-in-place construction**
- **c. Where novel types of construction are considered (e.g. rocking columns, other)**

Answer: ABC use in seismic regions is not limited in general; however, it is expected to be designed and constructed to emulate cast-in-place concrete.

7. Which seismic design methodology do you currently use?

- **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?**
- **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**

Answer: UDOT's current practice is the displacement based design used in the Guide Specification. We have not performed any direct comparisons between the two design approaches.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?

- **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading**
- **b. Please indicate whether the details researched have been constructed on actual bridge**

projects.
Answer: Utah State University has commissioned by UDOT to evaluate several precast bridge deck connections. UDOT Research Report, UT-10.14, "Laboratory Testing and Finite Element Modeling of Precast Bridge Deck Panel Transverse Connections" is available on UDOT Research website. This report is very new, published in October, 2010. It has not been practiced in actual construction.

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?
Answer: Caltrans has been talking about the ABC connections evaluation for seismic events. Please contact them for detail. In Utah, we do not have ongoing and not published ABC projects now.

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?
Answer: No.

Name:	Jugesh Kapur/Bijan Khaleghi
Affiliation:	Washington State DOT
Title:	State Bridge Design Engineer
Email:	khalegb@wsdot.wa.gov
Telephone:	360 352 2941

1. **Have you employed any ABC techniques in your bridge structures? And**
    a. **Have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?**
    b. **Have any of these been in, or adjacent to, expected energy dissipation locations (e.g. plastic hinge zones)?**
    c. **Have any of these been in capacity-protected members (e.g. superstructure elements)?**

Answer: 1- yes, a – yes, b- yes, c-yes

2. **Do you have any design specifications, design guidelines, reports, standard plans or details, construction special provisions, or design examples that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.**

Answer: yes, we have ABC design example, specifications and details for WSDOT HFL project. development of a new ABC chapter for Bridge Design Manual is in progress

3. **Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?**

Answer: Bridge contactors are not familiar with ABC substructure yet. The estimated cost for prefabricated substructure is higher than the conventional construction. The ABC connections are emulative to CIP connections therefore durability should be equivalent

4. **Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?**

Answer: We have not yet experienced any design level EQ event with bridges built with ABC techniques.

5. **Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?**
    a. **Available test data supporting adequate seismic performance of systems, elements, or details**
    b. **Available design procedures or design guidelines**
    c. **Available construction methods, construction specifications, and inspection procedures**
    d. **Available data supporting durability**

Answer: yes to all:

a. yes, more test data on the connections would be beneficial for ABC implementation.
b. yes, AASHTO should adopt design procedures and guidelines for ABC applications.
c. construction method should be developed and adopted by the LRFD Bridge Construction Manual.
d. durability needs to be monitored over the years. There are only few completed ABC projects but in the near future, with more ABC projects, collecting durability data is essential

6. Do you have preferences for ABC use in seismic regions? Do they include any of the following?
- **a. Only in capacity protected, non-energy dissipating elements**
- **b. Only in construction that emulates the seismic performance of cast-in-place construction**
- **c. Where novel types of construction are considered (e.g. rocking columns, other)**

Answer: yes to a and b, but not sure about c. we are in favor of using innovative methods using energy dissipating systems within the column plastic hinging zone

7. Which seismic design methodology do you currently use?
- **a. Force-based design as outlined in the AASHTO LRFD Bridge Design Specifications, displacement-based design as outlined in the AASHTO Guide Specifications for LRFD Seismic Bridge Design, or other?**
- **b. Have you found one of these methods to be more conducive to the use of ABC in higher seismic categories? If so, please explain?**

Answer: We use displacement based design method per LRFD Seismic Design Guide Specifications. To our opinion the displacement based design is more conducive to the use of ABC in higher seismic zones.

8. Have you sponsored or performed tests on ABC systems or connection details that might be used in higher seismic categories?
- **a. Please provide references to any relevant information on the tests and indicate if seismic performance was investigated or considered and if testing has been performed on representative large scale specimens under cyclic loading**
- **b. Please indicate whether the details researched have been constructed on actual bridge projects.**

Answer: Yes, WSDOT has sponsored ABC research projects with the University of Washington. The following reports are available:
684.1: Anchorage of Large-Diameter Reinforcing Bars Grouted into Ducts
Author(s): Kyle P. Steuck, Jason B.K. Pang, Marc O. Eberhard, John F. Stanton.
Originator: Washington State Transportation Center (TRAC)
Publish Date: March, 2009

611.1: Precast Concrete Pier Systems for Rapid Construction of Bridges in Seismic Regions
Author(s): David G. Hieber, Jonathan M. Wacker, Marc O. Eberhard, John F. Stanton.
Originator: Washington State Transportation Center (TRAC)
Publish Date: December, 2005

594.1: State-of-the-Art Report on Precast Concrete Systems for Rapid Construction of Bridges
Author(s): David G. Hieber, Jonathan M. Wacker, Marc O. Eberhard, John F. Stanton.
Originator: Washington State Transportation Center (TRAC)
Publish Date: March, 2005
684.3: A Precast Concrete Bridge Bent Designed to Re-Center After an Earthquake

Author(s): Laila Cohagen, Jason B.K. Pang, Marc O. Eberhard, John F. Stanton.
Originator: Transportation Northwest Regional Center X (TransNow), Washington State Transportation Center (TRAC)
Publish Date: October, 2008

684.2: Rapidly Constructible Large-Bar Precast Bridge-Bent Seismic Connection
Abstract Full Report
Author(s): Jason B.K. Pang, Kyle P. Steuck, Laila Cohagen, Marc O. Eberhard, John F. Stanton.
Originator: Washington State Transportation Center (TRAC)
Publish Date: October, 2008

9. Are you aware of any ongoing research or implementation of ABC that has not yet been published? If so, please provide a contact name and email address for the person conducting the work. If the work is not complete, and thus not publically available, do you know if the funding agency would consider preliminary dissemination of the work for this NCHRP project?

Answer:
NCHRP Project No. 12-74, DEVELOPMENT OF PRECAST BENT CAP SYSTEMS FOR SEISMIC REGIONS José I. Restrepo, Ph.D., Matthew J. Tobolski, Ph.D., P.E., University of California, San Diego La Jolla, CA
Eric E. Matsumoto, Ph.D., P.E., California State University, Sacramento, Sacramento, CA

Highways For Life Project: DTFH61-08-RA-00010, Fully Precast Bridge Bents for Use in Seismic Regions
Dr. Lee Marsh, BERGER/ABAM Engineers Inc. 33301 Ninth Avenue South, Federal Way, WA 98003
Tel: (206)-431-2300, Fax (206)-431-2250, email: Lee.Marsh@abam.com

Seismic Performance of Bridge Systems with Conventional and Innovative DesignPI: M. Saiid Saiidi (UNR), M. Saiid Saiidi, Marsha Read, University of Nevada, Reno

10. Do you or any of your colleagues have information on ABC research planned or funded, but not yet started, that you could share with this NCHRP synthesis project?

Answer: None

CONTRACTORS QUESTIONNAIRE

NCHRP Project 12-88 System Performance of Accelerated Bridge Construction (ABC) Connections in Moderate-to-High Seismic Regions

QUESTIONNAIRE

NCHRP Project 12-88 System Performance of Accelerated Bridge Construction (ABC) Connections in Moderate-to-High Seismic Regions

Purpose of Questionnaire

As part of the research, we are contacting experts in academia and practice to learn about connections and systems that are currently being used or studied for use in accelerated or rapid bridge construction. The results of this study will be synthesized into a reference document that summarizes the current state-of-art and recommends specific connections and/or systems that warrant further study for use in higher seismic regions. The range of connections being studied is as follows:

- Pile to pile-cap connections
- Pile-cap , drill shafts, or spread footing to column
- Connections between column segments
- Column to pier cap or bent cap connections
- Substructure to superstructure joints and connections
- Connections between precast girders and pier diaphragms
- Superstructure-to-substructure connection using SPMT (Self-Propelled Modular Transporter) technology
- Other connection devices and technologies that optimize the economy and constructability between precast and cast-in-place elements

Examples of construction types that are being considered for connections include:

- Connections that emulate the behavior of cast-in-place construction
- Connections that use bars in grouted sleeves or connectors
- Connection by grouting or concreting an entire member into a socket of the adjacent member
- Connection with post-tensioning such as segmental post-tensioned columns
- Hinged connections, mechanical connections, or connections incorporating new materials or novel construction techniques

Please respond to the questions below, attach any relevant supporting information, include pertinent references, and return your responses to us at your earliest convenience. If you are not comfortable or not able to answer some of the questions below, please provide responses where possible. Since this project, very much like accelerated bridge construction, has a rapid schedule, we would appreciate responses by latest October 1, 2010.

For Questions, please contact anyone of the NCHRP 12-88 team members below:

- Lee Marsh (BergerABAM) Lee.Marsh@ABAM.com 206/431-2340
- Jim Guarre (BergerABAM) Jim.Guarre@ABAM.com 206/431-2324
- Markus Wernli (BergerABAM) Markus.Wernli@ABAM.com 206/357-5642
- Brian Garrett (BergerABAM) Brian.Garrett@ABAM.com 206/431-2321
- John Stanton (U of Washington) Stanton@U.Washington.edu 206/543-6057
- Marc Eberhard (U of Washington) Eberhard@U.Washington.edu 206/543-4815

Name of Respondent and Contact Information
Name: Affiliation: Title: Email: Telephone:

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?
Answer:

2. Please provide names of owners and designers that were specifying such ABC techniques?
Answer:

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer:

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer:

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer:

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability** **e. Owner and/or designer acceptance on use of ABC techniques**
Answer:

Thank you for your help.

Name of Respondent and Contact Information	
Name:	Bob Coupe
Affiliation:	C.C. Myers, Inc.
Title:	
Email:	bcoupe@ccmyersinc.com
Telephone:	916-635-9370

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?

Answer: C.C. Myers, Inc. has completed several bridge replacement projects using ABC techniques in high seismic zones, primarily using roll-out/roll-in methods. For example, for Caltrans and the San Francisco Oakland Bay Bridge east span of the viaduct connecting to the Yerba Buena Island tunnel, they demolished the existing bridge span and, using Mammoet equipment, transferred a completed 6,700 ton replacement superstructure into place, all within a 2.5-day time period. For the Caltrans I-580 / I-880 MacArthur Maze Emergency Repair project, C.C. Myers, Inc. removed the collapsed bridge section. They provided a new 55.5-foot long precast bent cap weighing 122 tons, and bolted it into place on two existing columns retrofitted with steel jackets. Steel girders and a CIP concrete deck and barriers were added to complete the structure. For Caltrans and the San Francisco Oakland Bay Bridge, a 300-foot double-decked section of the existing bridge was replaced with two 150-foot long sections weighing about 3600 tons each. They were transported using a hydraulic jack and track skidding system. The bridge replacement was accomplished during one weekend. To date, C.C. Myers, Inc. has not employed precast columns or footings for bridge construction projects.

2. Please provide names of owners and designers that were specifying such ABC techniques?

Answer:

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer:

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer:

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer:

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability** **e. Owner and/or designer acceptance on use of ABC techniques**
Answer:

Name of Respondent and Contact Information
Name: Steve Seguirant Affiliation: Concrete Technology Corporation Title: VP and Director of Engineering Email: sseguirant@concretetech.com Telephone: 253-383-3545

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?
Answer: Yes, I can think of two fairly recent projects that used precast columns or bent caps. One was a bridge in Bellevue (precast columns) and the other a pier trestle at the ARCO Cherry Point refinery (bent caps). Of course we just got the Maytown ABC project with WSDOT that your team is intimately familiar with.

2. Please provide names of owners and designers that were specifying such ABC techniques?
Answer: WSDOT is the owner of the Bellevue Direct Access project. WSDOT did not specify the precast columns – they were a CRIP from Atkinson (the contractor), and were an emulation of the CIP columns where projecting reinforcement was cast into both the CIP footing and bent caps. The columns were 24" x 32" and therefore not as large in cross section as most bridge columns. ARCO is the owner of the Cherry Point trestle (I can't remember who the engineer was). The bent caps sat on driven steel cans and were welded off to both the piles and superstructure. The trestle superstructure spans were assembled at the plant and shipped by barge to the site, where the entire span was erected in one piece. This was done for speed of construction.

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: Selected drawings from both projects are attached.

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: My understanding is that both projects went together well. We have no information on durability, though I suspect the precast columns will be at least as durable as CIP columns. The welding and exposed steel on the bent caps for the ARCO project could become a maintenance issue in the future.

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: Nothing specific.

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability** **e. Owner and/or designer acceptance on use of ABC techniques**
Answer: Large diameter solid columns will be difficult to ship from plant to jobsite, even in short pieces. Contractors generally feel that by the time they are stacked and connected, it would be easier and less expensive to simply pour them in place. Hollow precast columns that are made and shipped in one piece, then filled with CIP concrete at the jobsite, would be a better option. The same is true of solid bent caps, which also tend to get heavy very quickly. A U-shaped trough cap designed to carry the dead load of the girders and CIP closure would be better. The girders can incorporate precast end diaphragms which serve as forms for the closures, minimizing the forming the contractor must do in the field.

Name of Respondent and Contact Information	
Name:	Chad Van Kampen / Jim Fabinski
Affiliation:	Encon United Companies - Utah
Title:	Sr. Preconstruction Engineer / Bridge Plant Manager
Email:	cvankampen@EnconUnited.com
Telephone:	(303) 298-1900

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?

Answer: We have employed precast prestressed concrete girders and precast full-depth deck panels for use in projects in Utah and Colorado. We have constructing pretensioned precast cap beams for a design-build project in Colorado. These use grouted ducts in the cap beam in this low seismic zone.

2. Please provide names of owners and designers that were specifying such ABC techniques?

Answer: Colorado DOT with Tsiouvaras Simmons Holderness

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: NA

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer: Precast pretensioned cap beams can be constructed in the plant at a rate of about seven units per day, and can be placed at about the same rate in the field, saving considerable time versus CIP cap beams.

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: No

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following?

- **a. Available cost and schedule data on ABC techniques**
- **b. Available construction methods, construction specifications, and inspection procedures**
- **c. Available in-house experience and skills related to ABC techniques**
- **d. Available data supporting durability**
- **e. Owner and/or designer acceptance on use of ABC techniques**

Answer: NA

Name of Respondent and Contact Information	
Name:	Loet Schartman
Affiliation:	Mammoet USA - Utah
Title:	
Email:	loet.schartman@mammoet.com
Telephone:	801-576-0466

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?

Answer: Yes, we have employed either Self-Propelled Modular Transporters and/or skids for six bridges in Utah, as well as for bridges in Louisiana and Florida. All bridges were single-span bridges. We are aware of a 300-foot-long, two-span bridge being constructed now in Utah that will be transported to the bridge site this year.

2. Please provide names of owners and designers that were specifying such ABC techniques?

Answer: Utah DOT

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.

Answer: No. We have subcontracted to general contractors such as Kiewit, Ralph L. Wadsworth, and Wadsworth Brothers Construction for projects in Utah. The contractors have provided the parameters under which the SPMT's operate to support the bridges along the travel path.

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?

Answer:

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?

Answer: SPMT's have been used to transport and erect complete single-span bridges with precast concrete girders, reinforced concrete diaphragms, decks and barriers, with spans up to 189 feet, all within a 10 to 12-hour night closure window. Mammoet transported seven separate single-span bridges along a new road through Salt Lake City, Utah, using SPMT's to move bridges, then lowering the bridges onto skidding equipment, removing supports, and lowering into place using climbing jacks. The finished bridge allowed the next bridge to be moved across it and down the road to the next bridge location. SPMT's allowed a for significantly reduced road closure times. For two projects in the mountains in Utah, no detours were possible. The old bridge was removed and the new bridge installed in less than a 12-hour night closure period. SPMT's have been used for bridges with as much as a 37-

degree skew.

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability** **e. Owner and/or designer acceptance on use of ABC techniques**
Answer:

Name of Respondent and Contact Information
Name: Ryan Olson Affiliation: Mowat Construction Company Title: Washington Area Manager Email: ryan.olson@mowatco.com Telephone: (206) 793-8110

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?
Answer: We launched the Sauk River Bridge. It could be considered a ABC technique, but the impetus was for environmental reasons. I believe that is a moderate seismic zone. Scott Branlund would be a good reference for that.

2. Please provide names of owners and designers that were specifying such ABC techniques?
Answer: Snohomish County and Berger ABAM specified using a Transi-lift crane to set the two span single truss. We launched the bridge instead.

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: The final design was not changed due to the launching technique.

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: The launching technique work well for this specific bridge style (two span single truss). It would be less usable with most bridge types.

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: The seismic region did not affect the launching design.

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability** **e. Owner and/or designer acceptance on use of ABC techniques**

Answer: I am guessing that the launching system is not what you are exactly looking for. There was a couple million dollar savings to use it versus the transi-lift crane. Since this time we have bid and cost out the ABC techniques for precasting concrete columns and pier caps. Generally, I can say that if there is not a needed time savings that we can't work around in other ways, we would opt not to use the precast columns and caps. It is usually more expensive to use the precast method. The time savings on the columns is pretty much non-existent. The caps can save time by precasting.

Name of Respondent and Contact Information
Name: Ryan Hamrick Affiliation: PCL Civil Constructors, Inc Title: Project Manager Email: rchamrick@pcl.com Telephone: 813-264-9500

1. Have you employed any ABC techniques in your bridge structures? And have any of these been in moderate to high seismic zones (i.e. the two highest zones or categories in AASHTO)?
Answer: Yes, we have employed ABC in previous projects. The project entailed major superstructure replacement and seismic retrofit of isolation bearings. We are not sure of the seismic zone. The project was located in Charleston, SC.

2. Please provide names of owners and designers that were specifying such ABC techniques?
Answer: South Carolina Department of Transportation.

3. Do you have any construction documentation such as standard detail drawings, specifications, or construction special provisions that relate to the use of ABC (seismic or non seismic) and can be shared with this NCHRP synthesis project? Please provide references.
Answer: This was a Design Build project so that information is not available at this time.

4. Can you share any lessons learned from the use of ABC techniques in terms of constructability and durability?
Answer: Constructability is always a concern when it comes to ABC. Our history with ABC involved a Design Build project, so we were involved from the beginning with planning the design and construction. Having the ability to plan the design around the accelerated construction process was invaluable.

5. Can you share any lessons learned specifically from the use of ABC techniques on projects in higher seismic regions?
Answer: Our substructure retrofit was minor on this project. Isolation bearings were installed during the ABC.

6. Are there any specific concerns that, unless adequately addressed, prevent you from employing ABC techniques for higher seismic categories? Do any of the concerns include the following? **a. Available cost and schedule data on ABC techniques** **b. Available construction methods, construction specifications, and inspection procedures** **c. Available in-house experience and skills related to ABC techniques** **d. Available data supporting durability**

e. Owner and/or designer acceptance on use of ABC techniques
Answer: Construction methods, specifications and inspections should be considered for ABC. The Owner should consider the Design Build contract method when using ABC. This allows the contractor and design to coordinate all aspects of the design with ABC.