2012 Domestic Scan on ABC Connections
Findings & Recommendations

SUMMARY REPORT OF THE
NCHRP 20–68A – US Domestic Scan Program
Scan 11–02: Best Practices Regarding Performance of
Accelerated Bridge Construction (ABC) Connections in Bridges
Subjected To Multi–Hazard and Extreme Events

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SPECIAL NOTE:

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This report IS NOT an official report of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies. This report was prepared by the scan team for Scan 11–02 Best Practices Regarding Performance of Accelerated Bridge Construction (ABC) Connections in Bridges Subjected To Multi-Hazard and Extreme Events, whose members are listed herein. Scan planning and logistics are managed by Arora and Associates, P. C.; Harry Capers is the Principal Investigator. NCHRP Project 20–68A is guided by a technical project panel and managed by Andrew C. Lemer, Ph.D., NCHRP Senior Program Officer.
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Objective

- Identify connection details that are used in the United States for ABC and which have performed well under extreme events, natural or man-made, such as waves and tidal action or storm-surge, seismic events, blast, and other large forces.
Scan Team Events

- Several conference calls prior, in between, and subsequent to scans
- Desk Scan
- Organizational meeting: November 17, 2011
- Scan Week 1: March 25–31, 2012
- Scan Week 2: April 22–28, 2012
Desk Scan Objective

- Acquire information of value to the transportation community
- Increase cost–effectiveness of the full scan by advising the team where to best commit its time during travel
Desk Scan Tasks

- Review the most relevant reports, papers, and web materials
- Collect and organize amplifying questions from scan team members
- Summarize desk scan findings in a report
- Recommend list of states and institutions to be visited or included in the scan through conference calls
Organizational Meeting – Nov. 2011

- Refined and finalized amplifying questions
- Finalized list of states and institutions to be visited or participate through conference calls

**Week 1: March 25–31, 2012**
- Visit Massachusetts* and Florida DOTs;
- Web conference participation by University of Buffalo and Texas and S. Carolina DOTs

**Week 2: April 22–28, 2012**
- Visit Utah, Washington*, and Nevada DOTs;
- Caltrans engineers/researchers participation while team meets in Nevada
- Visit University of Washington, Seattle, and University of Nevada, Reno, laboratories

* Several bridge site visits in Massachusetts and Washington
Scan Meeting Participants

- DOT Management Officials
- Engineers
- Contractors
- Fabricators
- Suppliers
- Researchers at selected institutions studying ABC connections under extreme events
Summary of Amplifying Questions

- General Issues on Design for Multi-Hazard Loading
- ABC Design for Multi-Hazard Loading
- Decision and Design Tools for ABC Use
- Past ABC Application
- Partnership with Industry and Research Institutions
- ABC Inspection and Maintenance
Findings: Extreme Load Consideration for ABC Connections

- MH loads considered only to a limited extent due to low probability of simultaneous occurrence
- No specific design criteria for ABC connection design under MH loading
- Despite maturity of seismic, no AASHTO seismic design guidelines for ABC.
- Current AASHTO Guide restriction on splicing in SDC C and D – major hurdle for ABC in high seismic zones
Extreme Load Consideration for ABC Connections (Cont’d)

- FHWA funded study to develop MH design guidelines for bridges in progress at U. of Buffalo – not specific to ABC.

- Examples of current MH load combination used in practice:
  - Combined seismic and scour loads
  - Wave action, wind, anchorage breakage, and vessel collision for floating bridge

- Advanced materials should allow for higher performance levels than conventional bridges under MH loading
Many ABC connection types have been and continue to be developed.

Superstructure connection examples:

- Unrestrained joints under lateral loads
- Unrestrained joints under uplift due to storm surge
- CIP concrete at closure pours between precast girders and at abutments.
Substructure connection examples:

I. Precast column embedded into spread footing, or cap beam
Substructure connection examples (Cont’d):

II. Grouted couplers embedded in precast column or in pile shaft, footing, or cap beam
ABC Connection Details (Cont’d)

- Substructure connection examples (Cont’d):
  - III. Precast columns with extended bars inserted in grouted metal sleeves
ABC Connection Maintenance

- Insufficient history to make a call (if maintenance issues are different for ABC connections)

- In one state ABC projects are inspected annually to address issues
Examples of manuals for standard details:
  ◦ PCI – Northeast
  ◦ Several states utilizing FHWA 2011 ABC report
  ◦ Manuals for each precast element type
  ◦ Manuals for SPMT moves
  ◦ List of preapproved grouted couplers
Standardization of ABC Connection Details and Processes (Cont’d)

- National effort: Oregon study

- Many states have or are developing their own process

- User costs are generally included and can help justify ABC

- Initial ABC cost may be higher because of financial risk to contractors; but the gap narrows over time
ABC Connection Research

- Seismic studies may serve as a guide for other extreme load studies

- Two categories of seismic ABC connection research: emulative and non-emulative
Successful non-emulative ABC connections
  ◦ Motivated by versatility of precast members
  ◦ Performance level exceeds conventional construction
  ◦ Post-tensioned segmental columns
Successful non-emulative ABC connections (Cont’d)

- Energy dissipation with advanced materials and details: e.g. shape memory alloys, HPC, built-in rubber, FRP wrapping, and concrete-filled steel and FRP tubes

- Research continues
Innovative ABC Connections

- Other innovation possible through ABC
- Innovative precast double-T precast girders
- Folded plate girders
- Concrete-filled tube arches
- Post-tensioned bridge decks, abutments, cap beams
- Base isolation to simplify ABC connections
- FHWA–HfL good mechanism to bring innovation to practice
Other Findings

- Key to success in ABC: COMMUNICATION among top management, designers, contractors, fabricators, industry and public

- Early involvement of contractors and fabricators in design and planning

- Shift of role: from CONSTRUCTION to INSTALLATION – contractors need to be open
Recommendations

- Continue research into MH load combinations and ABC connections

- Establish a full time national center on ABC under MH as a central resource for collecting on-going research, detailing, construction and ABC performance

- Build on FHWA Everyday Counts vision to reach out to AGC, decision makers, and others to promote ABC
Implementation Actions

- Seminars and webinars at venues attended by bridge engineers, contractors, suppliers, fabricators, etc., such as AASHTO SCOBS, TRB Annual Meeting and TRB conferences, and websites (FHWA, NCHRP 20–68, Florida IU ABC site)

- Identify champions in relevant AASHTO Technical Committees and follow up on implementation of recommendations

- Express support for current FHWA MH loading studies to FHWA management
Problem statement to develop Performance Based Design guidelines of emulative and non-emulative ABC connections

Coordinate with FHWA and others to help implement the scan recommendations