100 YEARS TRB
MOVING IDEAS: ADVANCING SOCIETY

CENTENNIAL PAPERS

Standing Committee on Concrete Bridges (AFF30)
Sam Fallaha, Chair

Concrete Bridges: Committee History and Outlook

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in collaboration with current and past Committee members

ORGANIZATION

Concrete bridges were included in the focus areas of the first bridge committee, the Committee on Bridges, established in 1949 in the Department of Highway Design of the Highway Research Board (HRB) *(1)*. The Committee on Bridges held its first meeting in May 1950 in Washington, D.C. At that meeting the committee developed plans for a session on highway structures for the January 1951 HRB Annual Meeting. That session included a paper on the design and construction of precast concrete bridges.

In 1962, the Subcommittee on Concrete Research, designated D-8(6), was one of six subcommittees organized under the Committee on Bridges *(1)*. In 1964 the HRB committees were reorganized. In that reorganization, the Subcommittee on Concrete Research became the Committee on Concrete Superstructures, designated D-C3, one of six committees that comprised the Bridge Division. In 1970, the Bridge Division became Section C-Bridges, and the Committee on Concrete Superstructures was given the designation A2C03. In 1973, the name of the HRB was changed to TRB. At that time, the section designation was changed to Section C-Structures, and the Committee on Concrete Superstructures became the Committee on Concrete Bridges.

In 2004, the designations changed to the current Structures Section (AFF00) and Standing Committee on Concrete Bridges (AFF30) under the Design and Construction Group in the Technical Activities Division.

SCOPE

The current scope of the committee is copied below:
"This committee is concerned with the performance of concrete bridges and their components; with relating existing knowledge of performance to design procedures and criteria; and with identifying and promoting innovative ideas that can improve concrete bridge engineering practice."

Retaining walls were specifically included in the scope from 1994 to 1999. However, in 2000, the committee recommended and received approval to remove retaining walls from its scope to avoid duplication with that of the Foundations of Bridges and Other Structures committee. The clause related to identifying and promoting innovative ideas to improve practice was recommended and approved in 2006, and editorial changes to simplify wording were approved in 2018.

MEMBERSHIP

Through the years a priority of the Committee remains a balanced volunteer membership relative to affiliation (government, industry, and academia), national and global geographical

distribution, race, gender, and age. Members are active in a number of other committees, technical societies, and organizations listed in the following section. Additionally, the Committee maintains a large "friends" group that supports Committee activities.

INTERACTIONS WITH OTHER GROUPS

A strength of the Committee is its collaboration with its concrete industry partners. The Committee's work is primarily in support of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Bridges and Structures (COBS, formerly Subcommittee on Bridges and Structures), in particular its Technical Committee for Concrete Design, T-10, in addition to other AASHTO committees. Collaboration is also maintained with a number of other TRB Committees and technical societies/organizations, including the Federal Highway Administration (FHWA), American Concrete Institute (ACI), American Society of Civil Engineers (ASCE), National Concrete Bridge Council (NCBC), and American Railway Engineering and Maintenance-of-Way Association (AREMA). The NCBC's industry membership includes the Precast/Prestressed Concrete Institute (PCI); American Segmental Bridge Institute (ASBI); Expanded Shale, Clay and Slate Institute (ESCSI); Portland Cement Association (PCA); Concrete Reinforcing Steel Institute (CRSI); National Ready Mixed Concrete Association (NRMCA); Post-Tensioning Institute (PTI); Silica Fume Association (SFA); and Wire Reinforcement Institute (WRI). These industry partners are critical to the success of the Committee's activities.

ANNUAL COMMITTEE MEETINGS

The Committee meets each year during the January TRB Annual Meeting. As shown in Table 1(a), the number of members in attendance at the Committee's annual meeting has ranged from 11 to 22 each year during the last 20 years. During the same period of time, the number of friends and guests of the Committee in attendance at the annual meeting has ranged from 29 to 67, as shown in Table 1(b).

The Committee's annual meetings provide an opportunity for technology transfer to advance the state-of-practice of concrete bridges. During the last 20 years, the Committee has hosted from two to six technical presentations during each of its annual meetings, as shown in Table 1(c). Examples of presentation topics are provided below *(2)*:

- 1999 – New Deep WSDOT Standard Prestressed Concrete Girders
- 2004 – Lightweight and Ultra-High-Performance Concrete Bridges in Virginia
- 2009 – Summary of the NCHRP Synthesis on Adjacent Precast Box Beam Bridges
- 2014 – Innovative Connection Details for Prefabricated Bridge Components
- 2018 – Benefits of Using 0.7" Strands in Precast Pretensioned Girders: A Parametric Study

PAPER REVIEWS

An important Committee activity is the review of papers that are within its scope and submitted to TRB for proposed presentation and publication. Those submittals have been in response to the Committee's Calls for Papers for the January TRB Annual Meeting as well as papers that have been submitted independently. As shown in Table 1(d), in the last 20 years, the Committee has reviewed between 7 and 20 papers each year for the TRB Annual Meeting. Accepted papers are presented during the TRB Annual Meeting in technical sessions, workshops, or committee meetings.

In addition, the Committee reviews papers within their scope for TRB specialty conferences. Examples include the TRB 5th International Bridge Engineering Conference in 2000, the TRB 6th International Bridge Engineering Conference in 2005, and the TRB 7th International Bridge Engineering Conference in 2010.

TECHNICAL SESSIONS AT TRB ANNUAL MEETINGS

The Committee has sponsored and co-sponsored technical sessions at the January Annual Meetings since the HRB Committee on Bridge's participation in its first HRB Annual Meeting in January 1951. Most presentations are from papers reviewed and accepted by the Committee.

The following examples of presentations related to concrete bridges were given between 1951 and 1999 and are listed in chronological order *(1)*:

- Recent Developments in Precasting of Highway Bridges
- Comparative Costs of Prestressed and Conventional Bridges
- Prestressed Concrete Bridge Costs
- Prestressed Concrete in California
- Endurance of a Full-Scale Pretensioned Concrete Beam
- Rehabilitation of Deteriorated Bridge Slabs
- Prediction of Permanent Camber of Bridges
- Selection of Limit State Values for Segmental Concrete Bridges

The Committee's leadership in sponsoring sessions on timely topics of national significance has continued through the years. An example is two sessions on the durability of concrete bridges that were sponsored by the Committee and conducted during the January 1991 TRB Annual Meeting *(3)*. These sessions brought together major researchers from Europe, Canada, and the U.S. who were working on the issues related to alkali-silica reactivity and delayed ettringite formation and the contribution of alkali cements and reactive aggregates. The sessions' presentations and networking moved forward solutions to this concrete durability challenge.

The Committee has sponsored or co-sponsored from two to five technical sessions during each of the January TRB Annual Meetings for the last 20 years, as shown in Table 1(e). Example session titles are provided below *(2)*:

- 2000 – Precast Concrete Deck Elements for Rapid Bridge Construction
- 2002 – Software for Design of Concrete Bridges by AASHTO Load and Resistance Factor Specifications
- 2004 – Critical Issues for Post-Tensioned Concrete Bridges
- 2006 – Lessons Learned from Concrete Bridge Performance
- 2008 – Concrete Bridges: Understanding the Past and Preserving It for the Future
- 2010 – High-Performance Materials and Construction Techniques for Concrete Bridges
- 2012 – Long-Span, Spliced and Continuous Prestressed Girder Bridges
- 2014 – Field and Laboratory Studies of Concrete Bridges
- 2016 – Adjacent-Member Bridges
- 2018 – Concrete Bridge Topics: Parts 1, 2, and 3

TRB WORKSHOPS AND SPECIALTY CONFERENCES

The Committee sponsors and co-sponsors TRB workshops during the January TRB Annual Meetings, and also co-sponsors TRB specialty conferences within the Committee's scope, as shown in Table 1(f). Examples are provided below *(2)*:

- Co-sponsored TRB 5th International Bridge Engineering Conference in Tampa, Florida in April 2000, supported by FHWA.
- Sponsored January 2004 TRB Annual Meeting Workshop 138, "LRFD Design Examples for Concrete Bridge Superstructures"
- Co-sponsored TRB 6th International Bridge Engineering Conference in Boston, MA in July 2005, supported by FHWA.
- Sponsored January 2010 TRB Annual Meeting Workshop 104, "Fundamentals of Load and Resistance Factor Rating: Concrete Bridges"
- Co-sponsored TRB 7th International Bridge Engineering Conference in San Antonio, TX in December 2010, supported by FHWA.
- Co-sponsored January 2014 TRB Annual Meeting Workshop 009, "Prefabricated Bridge Elements and Systems for Accelerated Bridge Construction"
- Sponsored January 2016 TRB Annual Meeting Workshop, "Ultra-High-Performance Concrete Connections for Precast Bridge Elements"
- Sponsored January 2018 TRB Annual Meeting Workshop, "Corrosion-Resistant Prestressing Strands of Carbon Fiber-Reinforced Polymer and Stainless Steel in Highway Bridges"

The Committee occasionally assists in planning and participates in specialty conferences sponsored by other organizations. Examples are provided below *(2)*:

- 2007 FHWA Workshop on Seismic Accelerated Bridge Construction
- 2011 ACI 7th World Congress on Joints, Bearings and Seismic Systems for Concrete Structures

SPECIAL PUBLICATIONS

The Committee participates in the development of special publications, as shown in Table 1(g). Examples are provided below *(2)*:

- "Concrete Bridges" Committee paper, *TRB Year 2000 Millennium Report*, 1999 *(4)*.
- Committee member authorship of papers published in the TRB *Transportation Research Record*; examples include *(2)*:
  - "Field Performance of Integral Abutment Bridges," Volume 1740, 2000, pp. 108-117 *(5)*
  - "Field Investigation of High-Performance Concrete Bridge Decks in South Carolina," Volume 1770, 2001, pp. 12-19 *(6)*
  - "Effect of Diaphragms on Load Distribution of Prestressed Concrete Bridges," Volume 1814, 2002, pp. 47-54 *(7)*
- "The Interstate Highway System and the Development of Prestressed Concrete Bridges" Committee paper, *50 Years of Interstate Structures: Past, Present, and Future. TRB Transportation Research Circular*, E-C104, 2006 *(8)*.
- "Concrete Bridges" Committee paper, *Toward a Durable and Sustainable Infrastructure: Highway Design and Construction 2020 and Beyond. TR News*, No. 253, November-December 2007 (9).

RESEARCH NEEDS STATEMENTS

Another important activity of the Committee is the development of Research Needs Statements (RNSs) in support of the AASHTO Committee on Bridges and Structures (COBS), in particular the Technical Committee for Concrete Design, T-10. The Committee works closely with the COBS committees to ensure its understanding of the state Departments of Transportation needs related to concrete bridge research and, thereby, its effectiveness in developing relevant RNSs. Committee members attend the COBS Annual Meeting and assist T-10 and other AASHTO committees as requested.

Each year the Committee develops new RNSs and updates or removes old RNSs from the TRB RNS Database. As shown in Table 1(h), the Committee has developed one or more new RNSs each year in most of the last 20 years.

Table 2 provides examples of RNSs developed by the Committee in support of AASHTO and funded through the TRB National Cooperative Highway Research Program (NCHRP), the primary funding entity for Committee RNSs. The Committee has had significant success in the development of funded RNSs. It was particularly successful in obtaining funding for its RNSs in the late 1990s to early 2000s, when it collaborated with T-10 on a strategic program of high-strength concrete research needs. As noted in Table 2, a series of high-strength concrete RNSs developed by the Committee were funded under the NCHRP as shown below:

- FY01 NCHRP 12-56, "Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete: Shear Provisions," Report 579
- FY02 NCHRP 12-60, "Transfer and Development Length of Prestressing Strand and Development and Splice Length of Reinforcement in High-Strength Concrete," Report 603
- FY03 NCHRP 12-64, "Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete: Flexure and Compression Provisions," Report 595

COMMITTEE OUTLOOK

Every three years the Committee considers the outlook for concrete bridges as part of the TRB triennial process to ensure relevance of its committees' scopes and vibrant committee activity.

Outlook – Past to Present

Precast bridge elements have been a focus area since the first bridge committee held its first meeting in 1950 *(1)*. The need for enhanced safety and mobility has continued this focus to achieve rapid onsite construction of concrete bridges. The need for research to improve concrete bridge performance and durability, and thereby reduce costs, also continues to the present.

A past focus area was application of the new LRFD specifications. The mandatory implementation date for the LRFD specifications was 2007, and the major work of that effort has been completed. Specification changes continue to be a focus area as new materials and methods are developed for concrete bridges.

Outlook – Future

In 2018, the Committee identified the following emerging, critical, and cross-cutting issues within the Committee's scope *(2)*:

- Safety and mobility – Continuing work related to precast elements for rapid construction of concrete bridges is needed, particularly in the areas of connections, constructability, and durability.

- Sustainability – The use of innovative, high-performance, durable, and long-lasting materials is needed in the construction of bridges to achieve sustainability. Focus areas for concrete bridge research related to structurally efficient materials include ultra-high-performance concrete for various bridge applications; internally-curing concrete; various corrosion-resistant reinforcing bars; and larger diameter (0.7 in.) and higher strength (300 ksi) prestressing tendons. Code provisions may need modification to address the behaviors of these innovative materials, thus requiring additional research to answer various design questions.
- Application of new design philosophies – Recent research has identified new approaches to achieving long-term durability and improved reliability of bridge structures. New design philosophies include Service Life Design, a SHRP2 R19A product, and also Performance-Based Design Specifications.
- Building information modeling (BIM) for bridges and structures – The integration of BIM for bridges and structures into the design, fabrication, construction, and asset management of concrete bridges will reduce design errors, improve constructability, and make life-cycle management more efficient.
- Non-destructive evaluation (NDE) – The use of NDE tools, as identified by SHRP2 R06, will improve the durability of concrete structures and aid in bridge inspection and maintenance.

In 2018, the Committee also identified the following emerging, critical, and cross-cutting issues that are on the fringe of the Committee's scope *(2)*:

- Workforce development – Retirement of experienced workforce across all transportation entities requires accelerated knowledge transfer to a new generation of transportation professionals. The Committee can engage young professionals through participation in committee activities and providing training.
- Funding for aging transportation infrastructure – The nation's aging bridge infrastructure must compete for the limited funding available for infrastructure renewal. The Committee can collaborate with stakeholders on the importance of maintaining safe structures.

FUTURE PLANS

To address the above emerging, critical, and cross-cutting issues within the Committee scope, the Committee will continue to work with the AASHTO COBS technical committees to identify and develop RNSs in support of these issues. Other committee activities will include sponsorship of workshops and sessions on innovative materials, design, and construction; sustainability; accelerated bridge construction (ABC), BIM for bridges and structures, and NDE *(2)*.

The Committee will work to encourage research and technology transfer in the areas described above, and will also be alert to emerging issues in the future. The Committee will continue to promote and maintain membership diversity, encourage all members to participate and contribute, plan and sponsor webinars and workshops in addition to sessions, encourage and invite RNSs, encourage and promote the publication of high-quality research papers, and invite speakers to the TRB Annual Meeting.

SUMMARY

The Standing Committee on Concrete Bridges is concerned with the performance of concrete bridges and their components; with relating existing knowledge of performance to design

procedures and criteria; and with identifying and promoting innovative ideas that can improve concrete bridge engineering practice. Since the Committee's origin in the mid-1900s, its volunteer membership has solicited calls for papers and presentations to advance concrete bridges. Members and friends of the Committee review papers; attend collaborative meetings; sponsor and co-sponsor sessions, workshops, and specialty conferences; author papers and special publications; and develop RNSs within its Committee scope. The Committee continues its work to advance safety and mobility, sustainability, application of new design philosophies, integration of BIM for bridges and structures, and use of NDE tools to improve the state-of-the-art in concrete bridges.

ACKNOWLEDGMENTS
The authors express their gratitude to Stephen Maher, Associate Director – Design with TRB's Technical Activities Division, for providing historical materials for the preparation of this paper.

Table 1. Various Statistics for AFF30 from 1999 to 2018

a. No. of Members in Attendance at Committee's Annual Meeting, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
21	20	13	17	22	15	13	20	18	16	16	12	13	12	11	17	19	18	20	18
b. No. of Visitors in Attendance at Committee's Annual Meeting, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
64	52	41	58	56	45	59	64	52	46	54	50	52	67	40	52	29	32	35	42
c. No. of Presentations at Committee's Annual Meeting, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
5	4	5	5	6	3	4	4	4	4	4	2	4	4	6	5	5	3	3	2
d. No. of Papers Reviewed, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
7	14	10	15	16	8	17	11	17	7	11	13	18	13	8	11	14	14	16	20
e. No. of Sponsored/Cosponsored Sessions at TRB Annual Meeting, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
5	4	5	4	4	3	3	3	4	2	2	4	4	3	2	3	3	2	3	3
f. No. of TRB Workshops/Specialty Conferences Sponsored/Cosponsored, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
0	1	0	1	1	1	3	1	1	1	0	2	1	0	0	1	1	1	0	1
g. No. of Circulars/State-of-the-Art/etc., Published, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
h. No. of New Research Needs Statements Posted in TRB's RNS Database, 1999-2018																			
99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
10	*10*	*10*	*14*	8	4	3	0	6	5	6	6	5	1	0	1	5	1	4	0

Note: Numbers of RNSs for 1999-2002 include all prioritized RNSs.

Table 2. Example AFF30 Research Needs Statements and Funded Research Projects

AFF30 Research Needs Statement	Funded Research Project
* Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete: Shear Provisions	FY01 NCHRP 12-56, "Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete: Shear Provisions," Report 579
* Application of LRFD Bridge Design Specs to HPC Members (Phase 2 – Transfer and Development Length of Prestressing Strand and Development and Splice Length of Reinforcement in High-Strength Concrete	FY02 NCHRP 12-60, "Transfer and Development Length of Prestressing Strand and Development and Splice Length of Reinforcement in High-Strength Concrete," Report 603
Simplified Shear Design of Structural Concrete Members	FY02 NCHRP 12-61, "Simplified Shear Design of Structural Concrete Members," Report 549
* Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete, Excluding Shear and Bond (Phase 3 – Flexure and Axial Loads)	FY03 NCHRP 12-64, "Application of the LRFD Bridge Design Specifications to High-Strength Structural Concrete: Flexure and Compression Provisions," Report 595
Development of Design and Construction Specifications for Self-Compacting Concrete	FY04 NCHRP 18-12, "Self-Consolidating Concrete for Precast, Prestressed Concrete Bridge Elements," Report 628
Develop Design and Construction Specifications for Horizontally Curved Concrete Highway Bridges (with Special Considerations for Post-Tensioned Systems)	FY05 NCHRP 12-71, "Design Specifications and Commentary for Horizontally Curved Concrete Box-Girder Highway Bridges," Report 620
Development of a Precast Bent Cap System for Seismic Regions	FY05 NCHRP 12-74, "Development of Precast Bent Cap Systems for Seismic Regions," Report 681
Application of LRFD Bridge Design Specifications to High-Strength Structural Concrete: Final Project	FY06 NCHRP 20-07/Task 216, "Application of LRFD Bridge Design Specifications to High-Strength Structural Concrete: Final Project – Phase I"
Verification and Implementation of Strut-and-Tie Model in LRFD Bridge Design Specifications	FY06 NCHRP 20-07/Task 217, "Verification and Implementation of Strut-and-Tie Model in LRFD Bridge Design Specifications"
Evaluation of CIP Reinforced Joints for Full-Depth Precast Concrete Bridge Decks	FY06 NCHRP 10-71, "Evaluation of CIP Reinforced Joints for Full-Depth Precast Concrete Bridge Decks," Web-Only Document 173
Analysis and Control of Cracking at Ends of Pretensioned Concrete Girders	FY07 NCHRP 18-14, "Evaluation and Repair Procedures for Precast/Prestressed Concrete Girders with Longitudinal Cracking in the Web," Report 654
High Performance/High Strength Lightweight Concrete for Prestressed Girders	FY07 NCHRP 18-15, "High-Performance/High-Strength Lightweight Concrete for Bridge Girders and Decks," Report 733
Calibration for Serviceability	FY09 NCHRP 12-83, "Calibration of LRFD Concrete Bridge Design Specifications for Serviceability," Web-Only Document 201
High Performance Concrete Specifications for Bridges	FY11 NCHRP Synthesis 20-05/Topic 43-02, "High Performance Concrete Specifications and Practices for Bridges," Synthesis 441
Strand Debonding Guidelines for Pretensioned Girders	FY12 NCHRP 12-91, "Strand Debonding for Pretensioned Girders," Report 849
Design Guidelines for Connection Details of Adjacent Precast Concrete Box Beam Bridges	FY13 NCHRP 12-95, "Connection Details of Adjacent Precast Concrete Box Beam Bridges"

* Strategic Program of High-Strength Concrete Research Needs

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