100 YEARS TRB
MOVING IDEAS: ADVANCING SOCIETY

CENTENNIAL PAPERS

Standing Committee on Critical Issues and Emerging Technologies in Asphalt (AFK10)
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Celebrating a Centennial of Asphalt Advancements and Envisioning Emerging Paving Technologies

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INTRODUCTION

This paper was assembled as part of TRB's centennial celebration to summarize historic contributions and to identify critical issues to the profession for committee AFK10, Critical Issues and Emerging Technologies in Asphalt. First, the history of this longstanding committee is presented to summarize past accomplishments. Thereafter, attention shifts to critical issues and emerging technologies for asphalt where the committee is currently working. The paper concludes with discussion about possible future efforts within the committee's scope where opportunities exist to advance the asphalt pavement state-of-the-practice and state-of-the-art.

HISTORY

The National Advisory Board on Highway Research (NABHR) was formed in New York City in 1920, was re-named the Highway Research Board (HRB) in 1925 and the Transportation Research Board (TRB) in 1974. In 1955, the HRB directed the American Association of State Highway Officials (AASHO) Road Test, and this was the same time frame where AFK10 (as currently known) was formed. The Asphalt Institute (AI) was an early supporter and active participant in TRB's highway materials volunteer structure. Meeting minutes obtained from AI show the committee originating in 1955 as an "Ad Hoc Advisory Committee for Asphalt Research and Development". Table 1 summarizes previous committee chairs spanning roughly 60 years.

TRB's library provided directory information from the HRB dating back to 1967, which was examined to establish the lineage of AFK10. Of interest were the Department of Materials and Construction (MC) and the Bituminous Division (A). Codes for this area were MC-A1 to MC-A7. In the 1967 HRB directory, MC-A5 is missing and it is speculated this code was used to denote what is currently AFK10 since meetings during this time frame were held outside the HRB Annual Meeting (AM). This speculation is supported by the 1970 HRB directory where the first validated information appeared for what is currently AFK10 (A2D07: General Asphalt Problems), where the committee was the 7th committee (07) in the Bituminous Division. (Note that 1970 was the year MC codes were changed to A2D codes.) There were also seven committee codes in the 1967 HRB directory, so it seems that A2D07 was added into the directory in 1970 and listed as the 7th of the bituminous committees. The committee kept the designation A2D07 until February of 1974,

where it was re-numbered A2D05, "General Asphalt Problems". In June of 1998, A2D05 was re-named "General Issues in Asphalt Technology". Between April of 2003 and March of 2004, A2DO5 was changed to AFK10 but kept the designation "General Issues in Asphalt Technology". In the spring of 2016, AFK10 was re-named "Critical Issues and Emerging Technologies in Asphalt", which is the name and committee code in present day.

Table 1. Past Chairs of AFK10 (or Equivalent Committee Designation)

Name	Affiliation	Duration
Carl A. Carpenter	Bureau of Public Roads	1955 to unknown
Fred Benson	Texas A&M University	majority of 1960's, maybe some of 1950's-Note 1
William H. Goetz	Purdue University	prior to 1970 unknown, 1970-1974
J. York Welborn	Bureau of Public Roads	1974 to 1977
Ward K. Parr	Chicago Testing Laboratories	1977 to 1980
Jon Epps	Texas Transportation Institute	1980 to 1983 and 1986 to 1994
Leonard Wood	Purdue University	1983 to 1986
Byron E. Ruth	University of Florida	1994 to 2000
Joe W. Button	Texas Transportation Institute	2000 to 2006
Rebecca McDaniel	Purdue University	2006 to 2012
Harold Paul	Louisiana DoTD	2012 to 2018

Note 1: believed to have succeeded C. Carpenter and to have been succeeded by W. Goetz
Note 2: John A. Goshorn of AI served as the first committee Secretary

Originally, this committee provided a national user-producer exchange to discuss asphalt supply/demand issues throughout the US and leading edge technologies. Typical meetings were held outside the TRB annual meeting lasting for several days. The early years of this committee focused on the combined research needs of asphalt producers with AI participation and state highway department representatives. Notes from mid-1950's minutes document widely-held feelings that joint research with representatives of highway departments and asphalt producers on specific characteristics of asphalt that are related to performance or manufacturing processes would be worthwhile. Consistency, curing, adhesion, durability, and weathering changes were specifically mentioned. For example, documents obtained from AI that were recorded in June of 1957 stated that the state highway department engineer participants were also members of AASHO's Committee on Materials (chaired by F. V. Reagel of Missouri at that time).

As the committee progressed into the 1970's, its scope expanded somewhat to include all parties concerned with production and use of asphalt materials. The importance of research continued with priorities being properties of asphalt materials with subsequent application of research findings. The importance of referring detailed technical information and topics also continued within other HRB (or later TRB) committees and outside organizations (e.g., AASHTO). These same general priorities continued for many years.

To celebrate the new millennium, some TRB committees authored papers intended to capture the state of the art and practice alongside their perspectives on future directions in their respective focus areas. A millennium paper (*1*) was written for this committee and took the perspective that the goal of a highway network has been and will continue to be to achieve ultimate comfort, safety, and efficiency for users in a cost-effective way (i.e., an overarching and leadership perspective of comparable nature to years past). As seen later in this document, several of the areas of emphasis outlined almost twenty years ago in the millennium paper (*1*) are still of interest to this committee. One example is integrated test methods where mix design, quality control, and

quality assurance provide continuity among different functions (in other words, better interfacing of design and construction). A second example is construction innovations (material transfer vehicles were used as an example and are also discussed later in this document). A third example is vehicle automation (also discussed later in this document) and how computer-controlled vehicles might accentuate loading severity by reducing vehicle wander and concentrating loads within a narrower zone of the pavement.

The roughly twenty years from the millennium paper to present day observed the same overall operational structure for the committee, with some new emerging topics. Recycling became progressively more integrated into committee business, as did warm mixed asphalt (WMA), which was addressed by the committee as early as 2003. Pavement considerations for dedicated truck lanes, moisture susceptibility, and warranties were also recurring topics in meeting minutes.

Past Accomplishments

As evidenced by the accomplishments summarized in this section, AFK10 is sometimes informally referred to within the group as an "application committee" or a "take action committee" since a focus over the years (and into present day) has been to take innovative concepts and determine how to use them in practice, while also providing a forum for emerging topics or for fundamental knowledge transfer. An example of an emerging topic that was addressed by this committee was the use of re-refined engine oil bottoms (REOB). A session was held at the 2015 TRB Annual Meeting to a standing room only crowd to address rapidly escalating concerns about REOB and multiple northeastern states taking very strong action relative to its use.

This committee has utilized TRB Circulars to transfer timely messages to the paving community (emerging topics or fundamental knowledge transfer). Table 2 is a partial list of Circulars led by this committee since the millennium. One of these topics (perpetual bituminous pavements), is further discussed in the following paragraph.

Table 2. TRB Circulars and E-Circulars Led by AFK10 (Partial List)

Reference	Year	Topic
Circular 503 (2)	2001	Perpetual Bituminous Pavements
E-C068 (3)	2004	Simple Asphalt Mix Performance Tests
E-C105 (4)	2006	Asphalt Compaction
E-C124 (5)	2007	Mix Design and Production Quality Control Testing
E-C160 (6)	2012	Polyphosphoric Acid Modified Asphalt Binders
E-C186 (*7*)	2014	Asphalt Pavement Durability
E-C188 (*8*)	2014	Recycling Pavement and Shingles
E-C189 (*9*)	2014	Performance-Based Specifications
E-C234 (*10*)	2018	Laboratory Mixture Aging and Mixture Performance
E-C237 (*11*)	2018	Asphalt Mixture Design Innovations

Notes: The last print Transportation Research Circular was number 503 in December of 2001 and electronic circulars were published beginning in February of 1998.

Members of this committee played a leadership role in the late 1980's through the 1990's with the concept of perpetual bituminous pavements (PBPs), which are designed to have service life expectancies of at least 50 years. PBP concepts became more mainstream in the early 2000's, which are based on limiting stresses and strains in pavement layers so that underlying materials are not damaged over time. The bottom asphalt layer is designed for optimal fatigue and moisture

resistance, and a relatively impermeable wear-resistant top structural layer is combined with a rut-resistant and durable intermediate layer. With these layers in place, only periodic surface restoration is intended to be necessary. PBP concepts extended full depth asphalt pavement concepts that date to the 1960's.

At the 1999 spring meeting of the committee there was discussion about PBP's that led to two back-to-back sessions (9 presenters) at the 2000 TRB Annual Meeting. Well over a hundred attendees were present and the content was well received, as evidenced by multiple requests to make documents available with this content. In response, the committee facilitated presenters develop formal papers based on their presentations that are housed in Circular 503 (*2*). The committee continued this model of developing invited sessions for presentation on cutting edge issues and then producing E-Circulars of them (see Table 2).

TRB was involved with the Strategic Highway Research Program (SHRP) that began in 1984, and this committee (through work of individual members and also collectively) participated from the beginning. According to Epps (*12*), initial work on SHRP research needs started in 1983 with the formation of the Strategic Transportation Research Study (STRS) Committee. By the summer of 1984, The STRS Report, a.k.a. the Blue Book (*13*), was available, and by the spring of 1986, the SHRP Report (a.k.a. the Brown Book) was available. Members of AFK10 (then A2D05) played a modest role in spawning STRS, which was responsible for SHRP. These activities were conducted while Jon Epps was chair of A2D05 who collaborated with Claine Peterson to help develop an early draft of portions of the research program ultimately suggested by STRS as outlined in Special Report 202 (*13*). This draft research program was influenced, in part, by information and discussions that occurred in AFK10 (A2D05) meetings and symposia. Special Report 202 actually references the March 1983 meeting minutes of A2D05.

During the early to mid-1980's, there was considerable discussion about the magnitude of funds for asphalt binder research and that considerably less was being invested into mixture research. Members of this committee during this time period were a voice behind testing "the whole product"; i.e.; transitioning to mixture property testing. AFK10 (A2D05) played a part in developing the volumetric principles that still are used on a widespread basis for mixture design and quality control – members of this committee were key participants in several of the changes that took place. One example is Federal Highway Administration (FHWA) Demonstration Project 74 (DP74), where a mobile testing laboratory was developed and taken to asphalt plants for direct measurement of the full suite of volumetric properties during mixture production (*14*). The mobile trailer visited most US states, and started many highway agencies on their path to field mixture verification and adoption of volumetric quality control (both are currently the industry standards). The mobile trailer utilized Marshall Mix Design principles during the early years, but later on during the SHRP program shifted to Superpave and was a driving force to its implementation. The mixture portion of these efforts occurred in the mobile trailer, while the binder portion occurred at a permanent station. The binder work within DP74 provided considerable amounts of information that was ultimately used for the Multi-Stress Creep and Recovery (MSCR) protocols currently housed in AASHTO T 332.

The Material Transfer Vehicle (MTV) shown in Figure 1 was conceptualized during an AFK10 (A2D05) committee meeting in 1986. The late Don Brock, founder of ASTEC Industries, was a member of the committee and during conversations about the need to limit physical and thermal segregation, sketched the concept of an MTV on a napkin. The prototype was on the road less than one year later. The first MTV, informally known as a shuttle buggy, was built in 1987 (MTV3500) and sent to APAC to pave a test track in Georgetown, KY. In the years since its

development, the MTV has been a proven innovation to help minimize physical and thermal mixture segregation. MTVs are now a common sight on medium- to large-scale paving projects.

FIGURE 1. Example Photograph of a Material Transfer Vehicle (MTV)

Individually, several members have accumulated accomplishments within TRB's structure. Of the thirty people selected for TRB's *Dialogue with Leaders in the Design and Construction of Transportation Facilities* over the fifteen year time period from 2005 through 2019, three have been past chairs or emeritus members of AFK10: Jon Epps, 2006, topic of Achieving Quality in Highway Construction; Harold R. Paul, 2012, Deploying Asphalt Technology: It's What's Important; and Frank Fee, 2016, Turning Asphalt Research into Implementable Practice. In addition, Jon Epps gave the 2019 Deen Lecture titled Innovative Asphalt Pavement Technology: Paving the Way for the World's Roadways. The topics discussed within these lectures or forums align fully with the overall mission of this committee since the 1950's.

PRESENT

Since its inception, AFK10 has always been tasked with looking at the big picture of the asphalt industry; e.g., what is missing, is there something new that should be implemented or does a new solution need to be developed for an existing problem? The committee's current scope entails a leadership role in asphalt and providing a national discussion forum for all segments of the asphalt community with a focus on more overarching problems. The committee continues to have a traditional mid-year meeting, typically lasting two full days, where members can spend considerable time in more thought provoking discussion than is permitted in a 2 to 4 hour meeting as part of the TRB Annual Meeting. Figure 2 provides some example photographs from the 2018 mid-year meeting held in Massachusetts. Holding these mid-year meetings at various locations around the country allows the committee to interact with industry and agency representatives from the surrounding areas to learn what issues they are facing and potential solutions.

Committee membership has historically been synonymous with a reputation of sustained accomplishment in the asphalt arena. Committee members include leaders from many facets of the asphalt community. It was not until 2011 that the first member younger than 35 years of age was appointed to the committee. There are past presidents of the Association of Asphalt Paving Technologists (AAPT), senior leadership of the National Asphalt Pavement Association (NAPA), experienced engineers from FHWA and AI, current or former chairs of ASTM, AASHTO, and TRB committees, current or former chairs of FHWA Expert Task Groups (ETGs), company executives, faculty holding endowed positions, and consultants who have been called upon in numerous countries serving this committee. Going forward, the committee aims to maintain historical standards for membership, while also having young members who have demonstrated outstanding accomplishments for early career individuals. As of the most current committee

rotation in the spring of 2019, AFK10 has multiple young members, international members, DOT representatives, and an overall diverse representation. This broad participation of accomplished professionals is expected to maintain this committee's leadership role in asphalt paving in the present and the future.

FIGURE 2. Example Photographs from 2018 Mid-Year Meeting

FUTURE

The foreseeable future for AFK10 is to continue the same overall approach that has been in place since the 1950's, while allowing specific topics to come and go as needs warrant. The topics below are expected to be taken up by the committee over the next few years; this is not intended to be an exhaustive list and items are listed in no particular order.

Workforce, Training, and Adherence to Proven Fundamental Principles: This committee always has placed, and is expected to continue to place, emphasis on fundamental principles while innovation is occurring. Everything that is new is not better, and this committee believes a balance between maintaining well established and proven principles and implementing new innovations is the best manner to lead asphalt paving into the future. A major area of concern with asphalt paving technologists is the large turnover of administrators, managers, engineers, technicians, and overall workforce. The committee envisions a massive need to provide technology transfer and workshops on fundamental topics that those leaving the industry may already know, but that those entering the industry must know to avoid reductions in pavement quality.

Address Implementation Barriers: Implementing new ideas, materials, or methods is vital for the survival of any industry, so long as proven fundamentals are not being replaced with wishful thinking (i.e., the items being implemented need to be carefully assessed). Barriers to carefully evaluated ideas, materials or methods often exist, and in some cases the barriers were not necessarily intended. This is a matter of interest for this committee going forward as it has been in years past. For example, members of AFK10 also associated with the National Asphalt Pavement Association (NAPA) routinely provide input and guidance on potential regulatory and rulemaking proposals that could impact the asphalt pavement industry and limit innovation (e.g.

Docket No. FHWA-2018-0036 that includes an option to allow proprietary and patented products on Federal Aid highway projects). Rationale from those involved is that the current challenge the industry faces is the speed at which innovation can occur and be implemented (i.e., not that there is a lack of innovation to implement). AFK10 envisions working toward ways to facilitate innovation into practice while simultaneously giving due consideration to performance, economic, and environmental considerations.

Construction Equipment Innovations: An area with many opportunities that has developed some momentum within the committee is the future of construction equipment and the workforce who would operate this equipment. Both are envisioned to be progressively changing over time and there are expected to be opportunities to attract technology minded individuals, or for example individuals interested in augmented reality, to work with the new and advanced smart construction equipment of the future. Equipment improvements are also needed for accelerated construction. Construction is highly visible to the public, it affects safety of workers and the driving public, and it has major economic ramifications.

Improved Interface Between Design and Construction: SHRP developed some mixture tests, but most were not widely used in practice because of their complexity and time requirements. Over time, improved work toward fundamental property characterization tests that are suitable for mixture design, pavement layer thickness design, and construction quality control are still needed. Work with these tests should interface with laboratory conditioning protocols to capture combined environmental effects (e.g., binder oxidation and moisture sensitivity). These fundamental tests should improve the ability to consider rutting, cracking, and overall durability of mixtures and do so in a way that project risk is minimized and returns on investment are maximized.

Asphalt and Future Vehicles: The role of asphalt in a changing vehicle world (e.g., autonomous freight lanes (or dedicated truck lanes for high volume routes such as interstates), battery operated vehicles, sensor driven vehicles and more) and how their travel patterns (e.g., lateral wander), spacing on the roadway (platooning), and weight/tire pressure characteristics may change how to design asphalt pavements that optimally suit the needs of future vehicle fleets.

Asphalt Mixture Design and Performance: E-C068 (*3*) in Table 2 was in response to two concerns raised in 1995 about Superpave volumetric mix design methods: 1) they were too complicated and time consuming for routine mix design and a simple and practical test should be present to validate mixture performance; 2) effects of binder stiffness on mixture performance are not defined. The belief was that a "performance" test would allow total mixture evaluation, determine how much binder a mix can tolerate before it becomes unstable, and aid in producing more durable mixes. This committee responded to needs of the mid-1990's, which have some notable differences to needs of the present day; i.e. rutting was much more of a concern then than present day where brittleness and cracking are often the primary concern (*15*). As in the mid-1990's, this committee intends to continue to respond to needs that arise in the asphalt paving arena.

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