

**F**rank Drake got his start in the asphalt business after graduating from the University of Kansas with a BS in Civil Engineering in 1938. He was immediately hired by the Kansas Highway Commission (KHC).

At that time, most of the roads in Kansas were surfaced with gravel or with road-mixed asphalt.

Drake became interested in aggregate gradations because good rock was scarce in western Kansas and materials engineers found it difficult to design a good road mix using local aggregates. While Drake was with KHC, he helped change their mix design procedure from the "Nebraska Formula" to the Marshall mix design system.

Drake literally grew up with the KHC. He began as inspector; was soon made survey crew chief, then resident engineer,

and finally field construction engineer. He was also Project Engineer and Materials Engineer for KHC. After many years with KHC, Drake joined the Asphalt Institute (AI) staff in 1963 as District Engineer and later was promoted to Regional Engineer and Assistant Division Managing Engineer. While he was with AI, Drake promoted the proper use of asphalt all over the country, especially in the Midwest.

### **Drake Cross-Slope Screed Control**

While working with KHC, Drake invented one of the most important pieces of equipment in asphalt paving. He invented and developed the Drake Device, a mechanism for cross-slope control of asphalt paving machine screeds. His attachments, which were adaptable to the major paving machines in use in the late 1950s, enabled contractors to improve the riding quality of the pavements while simultaneously increasing their productivity. The Drake Device became the basis for the linkage of the automatic, electronic screed controls now incorporated in all modern pavers.

Drake also developed, and published articles on, grade-line control techniques. He developed the mobile stringline, which traces the roadway's profile, senses changes in elevations, and transmits the information to the paver controls. His revolutionary methods reduced, and in some cases eliminated, the need for skin patching, and made it possible to place true-to-grade pavement courses directly by the paving machine.

### **Stone-filled Mix**

In addition to his cross-slope screed control device,

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Drake is recognized for developing a mix that resisted rutting, shoving and cracking. The gradation of his mix differed significantly from standard mixes.

Drake's stone-filled mix approximately doubled the percentage of maximum size stone specified in standard mixes. Stone-filled mix, as the name implies, means the stone is surrounded by a standard asphalt mixture—usually designed by the Marshall method—except it contains a higher percentage of asphalt-filled voids.

### **Gladstone Project**

The stone-filled mix was used on two jobs, the Gladstone project and the Coal Road project. The Gladstone project was a major in-city project in Overland Park, Kansas. It was five miles in length and four lanes wide. The two original lanes were old concrete overlaid with Drake's stone-filled mix and the two added lanes were Full-Depth Asphalt. The overlay consisted of a four-inch-thick asphalt base course and a one-inch-thick surface course.

Before the stone-filled mix overlay was placed, there had been some major shoving of an earlier overlay in the decelerating lanes. Drake suggested that the shoving problem could be corrected with a stone-filled mix.

“We didn't use bigger rock, we used more stone than was called for in the standard specification—perhaps a total of 25 to 30 percent more stone,” says Drake. “The mix rolled easily and didn't segregate. The vibrator on the paving machine's screed probably obtained 85 or 90 percent density. We used two rollers—one rubber-tired roller and the other steel-wheeled in the static mode. The pavement looked good when we finished.”

### **Long-lasting Performance**

“When I inspected that pavement 15 years later, my analysis showed that the asphalt cement was in exactly the same condition as it was when it was placed, particularly the penetration grade.

“The Gladstone project was a success. It showed how minimal voids could protect the asphalt cement from oxidation and pavement cracking. Rutting, shoving and washboarding were eliminated by adding stone to the mix. During a 1998 inspection, more than 25 years after the pavement was placed, I saw no cracks or ruts. Increasing the amount of maximum size stone along with the low voids eliminated both those problems.”

### **Coal Road Project**

A stretch of a coalmine road in Paonia, Colorado, offered another

opportunity to prove the stone-filled mix. Drake consulted with the contractor's hot mix plant operator and asked him to increase the top-size stone content by 15 percent and reduce the smaller stone and sand fractions accordingly. They also reduced the asphalt content to accommodate the reduced surface area of the coarse mix.

“The project showed the simplicity of changing from standard specifications to the stone-filled mix,” says Drake. “The road is performing well after 23 years.”

Cracking was a major problem during the road mix era of the 1960s and 1970s. “Sometimes you saw cracks 1 inch wide every 100 feet,” says Drake. “That's what I wanted to fix,” he says, “and that's why I recommended the stone-filled mix.”

### **Recognition**

A description of Drake's automatic screed-control device appeared in the American Road Builder and Transportation's (ARTBA's) 1972 *Pictorial History of Roadbuilding*. He was inducted into NAPA's *Hot Mix Asphalt Hall of Fame* for his work on screed controls and stone-filled mixes. Drake was named to the Asphalt Institute's *Roll of Honor* for his lifetime achievements in asphalt. ▲

# Frank Drake