

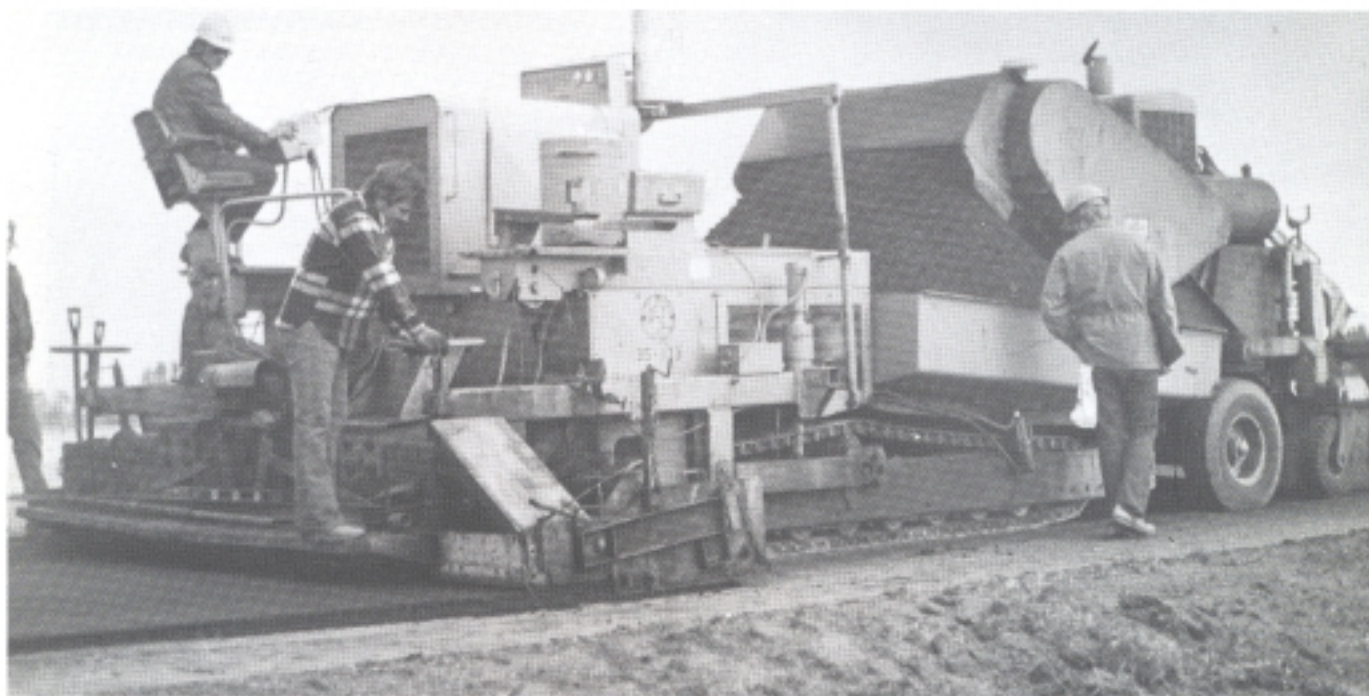
## RESEARCH PAYS OFF

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### Another Day—Another \$20,000 of Savings Realized From Kansas DOT Research and Development Studies

CARL F. CRUMPTON



Bituminous recycling saves millions for Kansas DOT. Recycle mix picked up with a windrow elevator and relaid with a bituminous paver.

*Documented 1-year research savings by the Kansas Department of Transportation exceed 1-year research costs by some \$7.5 million, representing a savings of more than \$20,500 dollars per day and more than \$1,025 dollars per day for each person currently in the department's Research Unit—and the savings are expected to continue to recur year after year.*

In the stream of human activity, it is wise to pause now and then for reflection and

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evaluation. Where have we been? What has been accomplished? Was it worthwhile? Has it paid off and, if so, how well?

While completing studies and writing reports, researchers begin to contemplate new or different areas for study. Frequently, neither time nor effort is expended to document how the earlier studies have been used and whether the work has paid off. In addition, it is common for the everyday users of products or processes to question the value of ongoing research, not recognizing that essentially all present practices are the results of earlier research.

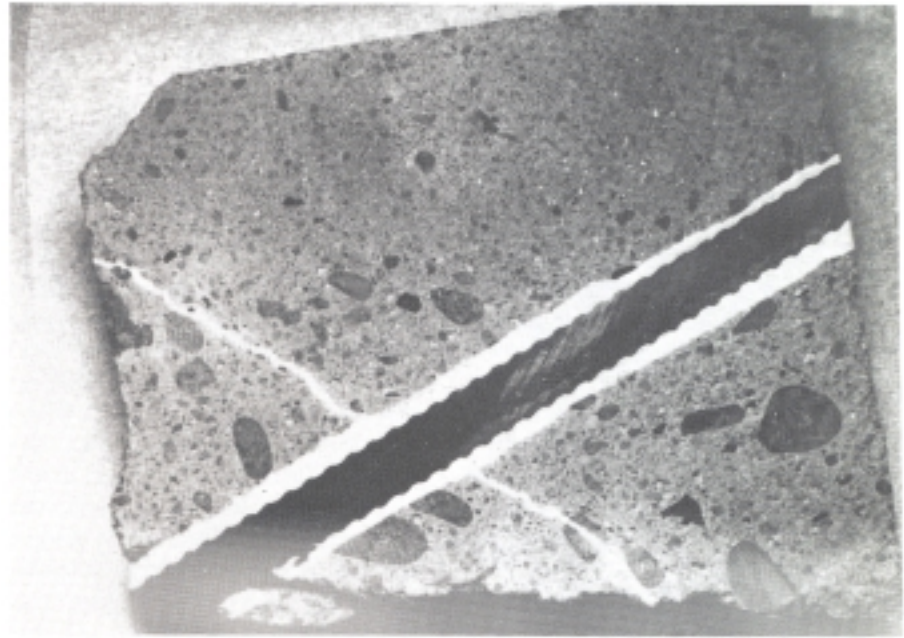
## Research Evaluation

In late spring 1984, the Kansas Department of Transportation's Office of the Inspector General began an evaluation of the department's Research Unit (1). [The report of the evaluator, R. Jordan Seitz, was included in *NCHRP Synthesis of Highway Practice 113* as Appendix B (2).] Seitz contacted many professionals from Kansas DOT, the surrounding states, the Federal Highway Administration, the Transportation Research Board, and other organizations. He interviewed Kansas DOT researchers, studied their reports and publications, visited field-study sites, and reviewed letters of commendation and letters or records of telephone calls requesting copies of reports or additional information.

## Four Successes

It has been estimated that only about 13 percent of industrial research projects ever produce profits (3). And it should be noted that these projects must be sufficiently profitable to carry all the other research studies that do not completely pay off, even though the commercial failures usually were technical successes.

Seitz made financial calculations for four studies, finding that in only 1 year the studies had produced a savings of



Post reinforcement extends life of Kansas bridges. Epoxy fills shear crack in concrete and bonds rebar to sides of hole (photographed in ultraviolet light).

more than \$8.3 million. The four studies (technically, these were development studies) chosen by Seitz for evaluation involved snowplow blades, pavement marking, rebar insertion, and asphalt recycling.

In 1966–1967, Kansas conducted a cost-effectiveness study of standard steel snowplow blades then being used and other, more expensive blades. Carbide insert blades were the most expensive but were shown by the study to be the most cost-effective of those tested. The study results were implemented immediately, and since that time carbide insert blades have been used. It was found that in fiscal year 1983 the purchase of carbide-tipped blades effected a savings of \$146,400 for that 1 year alone. The cost of the original study had been less than \$5,000 in state research funds.

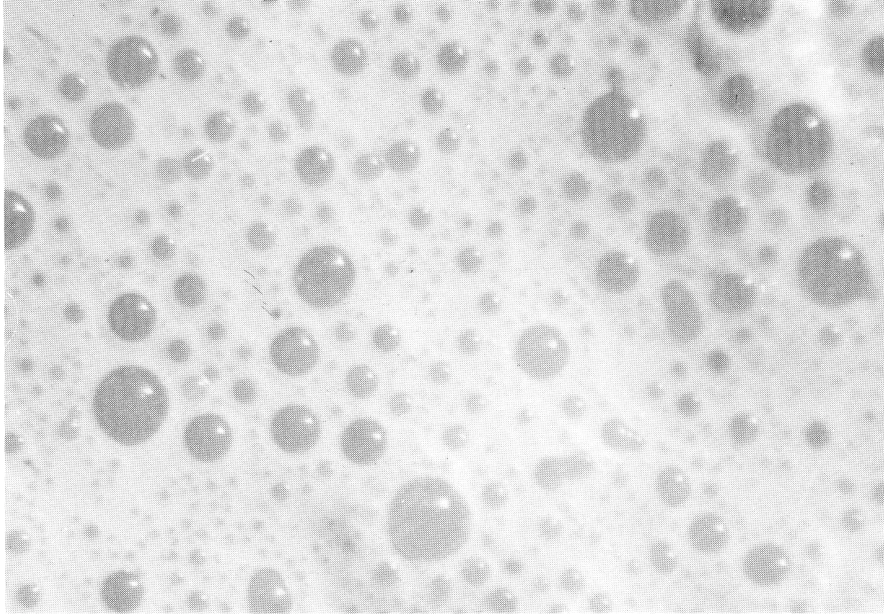
In 1967 the Kansas DOT initiated a study on pavement marking (paint stripes and glass beads), which eventually

cost almost \$20,000 in Federal Highway Administration HPR funds. The results of that study were fully implemented by 1970. Savings during fiscal year 1982 alone were calculated to be \$750,000.

A concrete girder, rebar insertion study was initiated in 1976, at a total cost of nearly \$100,000 in HPR funds for research, development, and implementation. Seitz calculated the savings through 1984 to be \$8,910,504. Inasmuch as savings through 1983 had been shown to be \$4,500,000 (4), the 1-year (1984) savings for this study was \$4,410,504.

Seitz also cited \$3 million in savings for bituminous recycling work being done in 1984. This savings was realized by utilizing the results of findings through the Federal Highway Administration HPR technology-sharing process. Savings from hot recycling are estimated to average \$8 million for 1985 and future years.





Glass beads in paint. Thinner stripes with fewer beads have performed well while increasing production and lowering costs (large beads are about 0.030 inches in diameter).

### Cooperation From Many

The pavement marking study and the snowplow blade study were conducted in conjunction with maintenance, materials, and district forces responsible for those operations. The rebar insertion study was conducted with close cooperation among design, maintenance, materials, industry, district, and, at times, contractor personnel. The recycling work was completed with materials, construction, district, and contractor personnel involvement. Obviously, management and fiscal support was necessary for all of the projects. Three of the studies involved federal funds under the HPR Program.

### Benefits Versus Costs

The calculated savings for 1 year (albeit a different base year in some cases) was \$8,306,904. Kansas DOT

research costs for fiscal year 1984 were \$818,511; therefore the benefit-cost ratio is 10:1, based on the 1-year savings resulting from only four studies. Kansas HPR research expenditures for fiscal year 1984 were \$262,676; 1-year savings from the three HPR studies were \$8,160,504. Hence, the benefit-cost ratio is 31:1 for HPR-funded research activities during 1 year.

The 1-year savings of \$8,306,904 is almost equal to the total amount (\$8,373,476) used for the conduct of research by Kansas DOT during the 21 fiscal years from 1963 through 1983. Thus, 1 year of savings realized through research and development financed nearly 21 years of research. The 1-year savings averages out to about \$415,000 per person currently employed in the Research Unit. If the total research expenditures for fiscal year 1984 are deducted from the savings, the result is \$7,488,393 savings profit, which results in an average of \$1,025 saved each day

of the year for each person currently in the research unit.

Other benefit-cost ratios can be cited. For instance, the \$3 million in savings from recycling in Kansas in 1984 was made possible by implementing work done by others through the FHWA technology transfer and implementation program. The expenditures by Kansas for technology transfer and implementation projects during fiscal year 1984 totaled \$164,987. Comparing the savings for 1 year with the expenditures for 1 year results in a benefit-cost ratio of 18:1. Because less than one-half of the expense was used for evaluating the earlier recycling projects, the ratio is closer to 36:1.

The 1-year savings realized from the rebar insertion study totaled \$4,410,504, providing a benefit-cost ratio of 44:1 when compared with the study's research and development costs of \$100,000. If the \$100,000 in study costs are compared with the total calculated savings of \$8,910,504, the benefit-cost ratio is 89:1. The savings have continued to accrue.

The pavement marking study resulted in a 1-year savings of \$750,000. The total cost of the study was \$20,000; thus, the benefit-cost ratio is 37.5:1. Savings have occurred every year since 1969.

The snowplow blade study resulted in a savings of \$146,400 in the 1 year cited by Seitz. Taking into account the \$5,000 expended on the study, the benefit-cost ratio is 29:1.

Hence, no matter what method of calculation is used, a minimum of \$10 is saved for every \$1 spent on Kansas DOT research each year. [A 71 to 104 percent return per year on R&D investment has been called "real golden eggs" (5). It is suggested that a 1,000 percent yearly return represents diamond-studded golden eggs.]

For fiscal years 1981 and 1982, Kansas was reported to be the fourth highest loser on federal grants (6). For every dollar that comes back to the state, Kansas sends \$1.28 to \$1.29 in taxes to the federal government; that is, a 0.78 to 1 grant-to-taxes benefit-cost ratio. The state-federal highway research program in Kansas, with a benefit-to-cost ratio of more than 10:1, is proportionally much more cost-effective to Kansas. Furthermore, similar to taxes, the savings recur year after year.

### Acknowledgments

The author wishes to express appreciation to the 20 staff members, professional

and technical, in the Kansas DOT Research Unit who participated in the studies. Many others also took part but have since left the unit; their efforts are also appreciated. Gratitude is also expressed to staff members of the Federal Highway Administration; much of the work and savings discussed here would not have been accomplished without their aid. The interactions with researchers from other states, the FHWA, the TRB staff, and other organizations have been most helpful in the conduct of the studies. Kansas DOT management was responsible for making the decisions to implement the work. The operations, design, and planning divisions personnel in the districts, the labs, and headquarters

must be credited for seeing that the proper design, materials, and methods were used correctly to allow the research to pay off. Thanks are especially due to R. Jordan Seitz for his persistence in conducting the evaluation of the Research Unit.

This article is dedicated to John E. Bukovatz, Kansas DOT Concrete Research Engineer, who died in September 1985. For 19 years, his research efforts contributed to the successes of the Research Unit.

### References

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4. Post-Reinforcement. In *Research Pays Off—the Return on Investment in Research and Development*, TRB, National Research Council, Washington, D.C., 1983, p. 2.
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6. Kansas Is Fourth-Highest Loser on Federal Grants. *The Capital-Journal*, July 2, 1983, p. 2.



Long-lasting snowplow blades allow plow to stay on job through entire snow storm, saving time and money, and keeping roads open.