I Project Description
Owner: South Dakota Dept of Transportation (SDDOT)
• Placement Date: June/July 1994
• Features & Requirements: Pavements need to be replaced or rehabilitated with increased performance and life cycle economy. This project evaluated performance of 3M™ Scotchcast™ Polyolefin Fibers compared to steel fibers and plain concrete to determine if 3M fibers are a viable alternative for future projects.
• Why 3M Scotchcast Polyolefin Fibers Were Used: They offer the advantages of a non-metallic material combined with the structural property improvement and potential for thinner slab sections and reduced life cycle cost.

II Job Execution
• Preparation: Excavation was reduced due to reduced slab thickness.
• Concrete Mix and Fibers: 3M Scotchcast polyolefin fiber 50/63 was added at the concrete batching facility. See back page for mix information.
• Concrete Placement: The concrete was placed using a slip form paver machine. With re-tempering in the field or super plasticizer added at the plant the fiber reinforced concrete placed and finished with no problems in mixing, handling or finishing.
• Slab Size: 75’ long by 4-12’ lanes wide and 5 1/2” thick with 15’ sections on each end as transitions to and from the thicker slab depth.
• Observations: Concrete using Scotchcast fibers placed, consolidated and finished satisfactorily compared to steel fiber reinforced concrete and plain concrete.

III Results/Conclusions
Based on observations made in this and other field applications, it was learned that the new Scotchcast fiber system had combined the structural benefits of steel fibers and the material benefits of synthetics.
It is possible to incorporate the Scotchcast fibers in concrete at 25 lbs/cu. yd. without causing any balling, clogging and segregation. The advantages of adding Scotchcast fibers compared to the best available steel fibers were:
1. Four times greater number of fibers are added in concrete ensuring more uniform distribution and consistent results.
2. Less chance for balling, segregation, bleeding or causing any other construction problems during mixing, placing, consolidation, finishing and tining operations.
3. Fibers are non-corrosive, non-hazardous, and non-magnetic. They do not protrude from the surface; if they do, they could be easily burned off.
The 25 lbs/cu. yd. of Scotchcast fibers were added without making any mix proportion adjustments.
Required workability and finishability could be achieved.
The addition of Scotchcast fibers at 20 or 25 lbs/cu. yd. enhanced the structural properties of concrete.
There was a slight increase in flexural strength, and a considerable increase in toughness, impact, fatigue, endurance limit and post crack load carrying capacity. This improvement was the same or in some cases (such as impact) better than the enhancement that could be achieved with the addition of 66 lbs./cu. yd of the best available steel fiber in the market.

This feasibility study has confirmed that 3M™ Scotchcast™ polyolefin fibers with 25 lbs./cu. yd. could be used in the construction of full depth pavements with 30 percent reduction in the thickness and other added benefits. Concrete pavements containing Scotchcast fibers would enhance the performance and structural efficiency with a potential for longer life with less maintenance.

Concrete pavements containing Scotchcast fibers could be used in urban, rural, or interstate highways with either high or low density traffic.

**Summary of Test Results:**

**Toughness** (ASTM and JCI Standards) Results based on the load/deflection curve shows elastic/plastic behavior of concrete containing Scotchcast fibers and post-crack load carrying capacity similar to steel fiber reinforced concrete.

**Flexural Strength** - Concrete containing Scotchcast fibers increased the ability of concrete to withstand loads in flexure by approximately 13%.

**Fatigue Strength/Endurance** - Concrete containing Scotchcast fibers was able to endure two million fatigue cycles at a load similar to concrete containing steel. (~ 30% greater than plain concrete)

**Impact Strength** - Concrete containing Scotchcast fibers was over two times greater than concrete containing steel for resistance to failure due to impact and almost 14 times greater than plain concrete.

**Compressive Strength** - Scotchcast fibers do not significantly affect compressive strength.

![Graph showing load carrying capacity of concrete](image)

**Concrete Mixes and Proportions**

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</thead>
<tbody>
<tr>
<td>Plain Concrete</td>
<td>NA</td>
<td>NA</td>
<td>0.47</td>
<td>519</td>
<td>114</td>
<td>1770</td>
<td>1270</td>
<td>0</td>
<td>242</td>
<td>15.0</td>
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<tr>
<td>Steel FRC</td>
<td>0.8 mm</td>
<td>59 mm</td>
<td>0.50</td>
<td>525</td>
<td>113</td>
<td>1634</td>
<td>1331</td>
<td>66 (0.5%)</td>
<td>263</td>
<td>11.5</td>
</tr>
<tr>
<td>3M FRC</td>
<td>0.63 mm</td>
<td>50 mm</td>
<td>0.50</td>
<td>525</td>
<td>113</td>
<td>1634</td>
<td>1331</td>
<td>25 (1.6%)</td>
<td>263</td>
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