I Project Description
The location of this project was on the US hwy 83 structure over I-90 south of Pierre, SD (structure number 43-026-195) near mile marker 212.

Owner: South Dakota Dept of Transportation (SDDOT)

• Placement Date: August 1994
• Features & Requirements: SD DOT requires Jersey Barriers constructed, replaced or rehabilitated with increased performance (especially impact resistance) and life cycle economy. 3M™ Scotchcast™ Polyolefin Fibers were compared to plain concrete to determine if they are a viable alternative for future projects.

• Why 3M Scotchcast Polyolefin Fibers Were Used: They offered the advantages of a non-metallic material combined with the structural property improvements and potential reduced crack width and increased life.

II Job Execution

• Preparation: No change in typical formwork and preparation was required.

• Concrete Mix and Fibers:

  Scotchcast fiber 50/63 was added to the ready mix truck at the batch plant. See back page for mix information.

  • Concrete Placement: Because of slump loss and rebar extra effort was required for consolidation into the forms.

  • Barrier Size: The West barrier (~372') was placed using Scotchcast fibers. The North half used 20 lbs./cu. yd. and the South half used 25 lbs./cu. yd. The East barrier had no fibers.

  • Observations: Although extra effort was required to place and consolidate the concrete, when one side form was removed it was noticed that the concrete has been well consolidated and there were no honeycombs. There was a significant difference between cracks in plain concrete and cracks in concrete containing Scotchcast fibers. Concrete containing Scotchcast fibers had 57% more cracks than the plain concrete. However, the cracks in the concrete containing Scotchcast fibers were on average 3.5 times smaller than the cracks in the plain concrete. Plus, the fibers in the concrete will help prevent cracks from becoming larger. The larger cracks in the plain concrete will cause future deterioration problems with the rebar. (See charts on this page and the next page for comparison.)

III Results/Conclusions

The 20 and 25 lbs./cu. yd. of Scotchcast fibers were added without making any mix proportion adjustments. The addition of the fibers at 20 or 25 lbs/cu.yd. enhanced the structural properties of the concrete.
As anticipated, the addition of 3M™ Scotchcast™ polyolefin fibers greatly increased the toughness of concrete. The ASTM toughness indices I5, I10 and I20 are approximately 4, 8 and 15 times higher than that of plain concrete. The histograms of the crack widths for plain concrete containing Scotchcast fibers show the benefits of the fibers and using the higher fiber dosage.

The cracks in plain concrete and concrete containing Scotchcast fibers were compared to the ACI 224 tolerable crack width of 4 mils for water retaining, 6 mils for sea water wet/dry cycles and 7 mils for deicing chemicals. If cracks are narrower than these widths, the potential for reinforcement corrosion due to moisture penetration is reduced or eliminated and concrete is more durable.

93% of cracks in concrete containing Scotchcast fibers were 7 mils or smaller while only 15% of plain concrete cracks were 7 mils or smaller. This means that most cracks (85%) in plain concrete were large enough to allow deicing chemicals to penetrate into the concrete. Most cracks in concrete containing Scotchcast fibers were small enough to meet ACI standards for deicing chemicals, exposure and even for water retaining structures. See charts below for more information.

This reduced crack width helps extend the durable life of the concrete and significantly improves the impact resistance, which is the main purpose of the Jersey barrier.

![Crack Width, mils](chart.png)

**Concrete Mixes and Proportions**

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<tbody>
<tr>
<td>Plain Concrete</td>
<td>NA</td>
<td>NA</td>
<td>0.31</td>
<td>670</td>
<td>1728</td>
<td>1189</td>
<td>none</td>
<td>272</td>
<td>12</td>
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<tr>
<td>3M FRC</td>
<td>0.63 mm</td>
<td>50 mm</td>
<td>0.31</td>
<td>670</td>
<td>1728</td>
<td>1189</td>
<td>25 (1.6%)</td>
<td>272</td>
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<td>20 (1.3%)</td>
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Information described herein is based on Interim Report SD94-04 "Evaluation of Non-Metallic Fiber Reinforced Concrete in PCC Pavements and Structures" prepared by Dr. V. Ramakrishnan, Sept 1995.

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