Shotcrete with Steel Fiber Helps Reinforce Mount St. Helens Project Savings

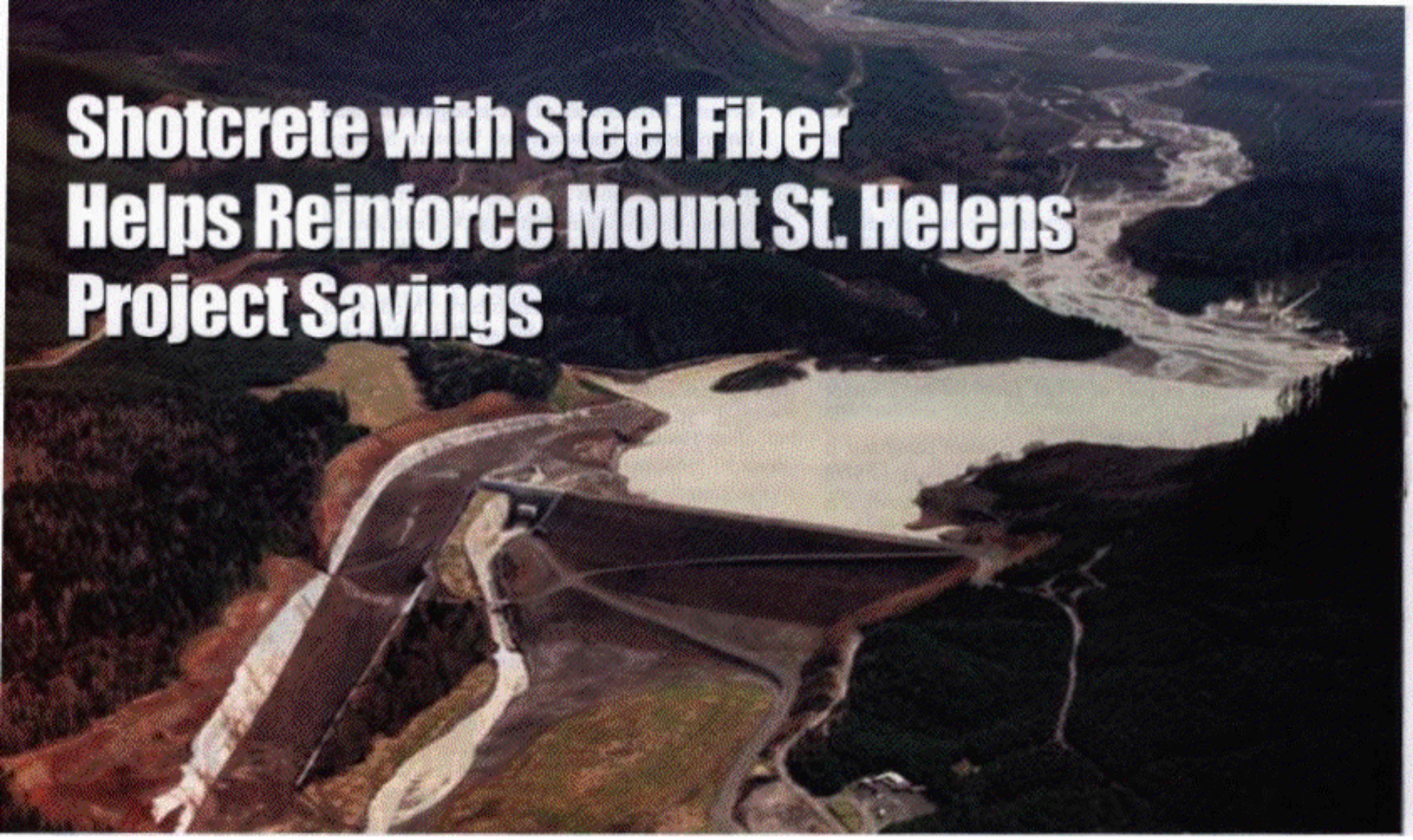

Figure 1. Mount St. Helens sediment retention structure.

On May 18, 1980, at 8:32AM Pacific Daylight Time, a magnitude 5.1 earthquake shook Mount St. Helens. The bulge and surrounding area slid away in a gigantic rockslide and debris avalanche, releasing pressure and triggering a major pumice and ash eruption of the volcano.

by Alex Keffalas

Thirteen-hundred feet (400 m) of the peak collapsed or blew outwards. As a result, 24 square miles (62 square km) of valley was filled by a debris avalanche; 250 square miles (650 square km) of recreation, timber, and private lands were damaged by a lateral blast; and an estimated 200 million cubic yards (150 million cubic meters) of material was deposited directly by lahars (volcanic mudflows) into the river channels. Fifty-seven people were killed or are still missing.

Steel fiber reinforced shotcrete (SFRS) is offering proven, cost effective performance and increased longevity for dams, spillways and other waterway construction applications. SFRS was used successfully on the $72.8 million Mount St. Helens Sediment Retention Structure built by Granite Construction Company from 1986 to 1989.

Over 2 million lb (908 000 kg) of steel fibers were used in shotcrete channel linings and slope stabilization structures on the permanent project. Steel fiber-reinforced shotcrete was specified after field tests demonstrated its superiority over conventional wire mesh reinforcement.

Steel fiber-reinforced shotcrete saved time and money by eliminating a portion of the labor required to install wire-mesh reinforcement without sacrificing shotcrete strength. SFRS provided an opportunity to speed up the installation and

Figure 2. Shotcrete applied for slope stabilization.

provide greater longevity for the finished structure.

Located on the Toutle River in Cowlitz County, WA, the pioneering Mount St. Helens project aims at allowing silt to accumulate behind an earthen dam, reducing its reservoir capacity and preventing down-river dredging. Should another volcanic eruption occur, a spillway was designed to pass another mud flow.

The Steel Fiber Advantage

The Mount St. Helens Sediment Retention Structure required a minimum of 700 lb/yd^3 (415 kg/m^3) of cement and 100 lb/yd^3 (59 kg/m^3) of steel fiber in the shotcrete. The function of steel fiber reinforcement in shotcrete is to impart ductility to a normally brittle material. The steel fibers provide an energy absorption capability as well as a load bearing capacity after cracking, which leads to enhanced static, impact, and fatigue resistance.

In situations involving large volumes of fast moving, debris laden water and mud-like the Mt. St. Helens silt retention effort—these benefits can significantly improve longevity for the concrete structures involved.

Since steel fiber reinforcement substantially strengthens shotcrete, proper mixing is critical. In either dry or wet shotcrete processes with standard equipment, steel fiber technology ensures random dispersion of the fibers throughout the matrix.

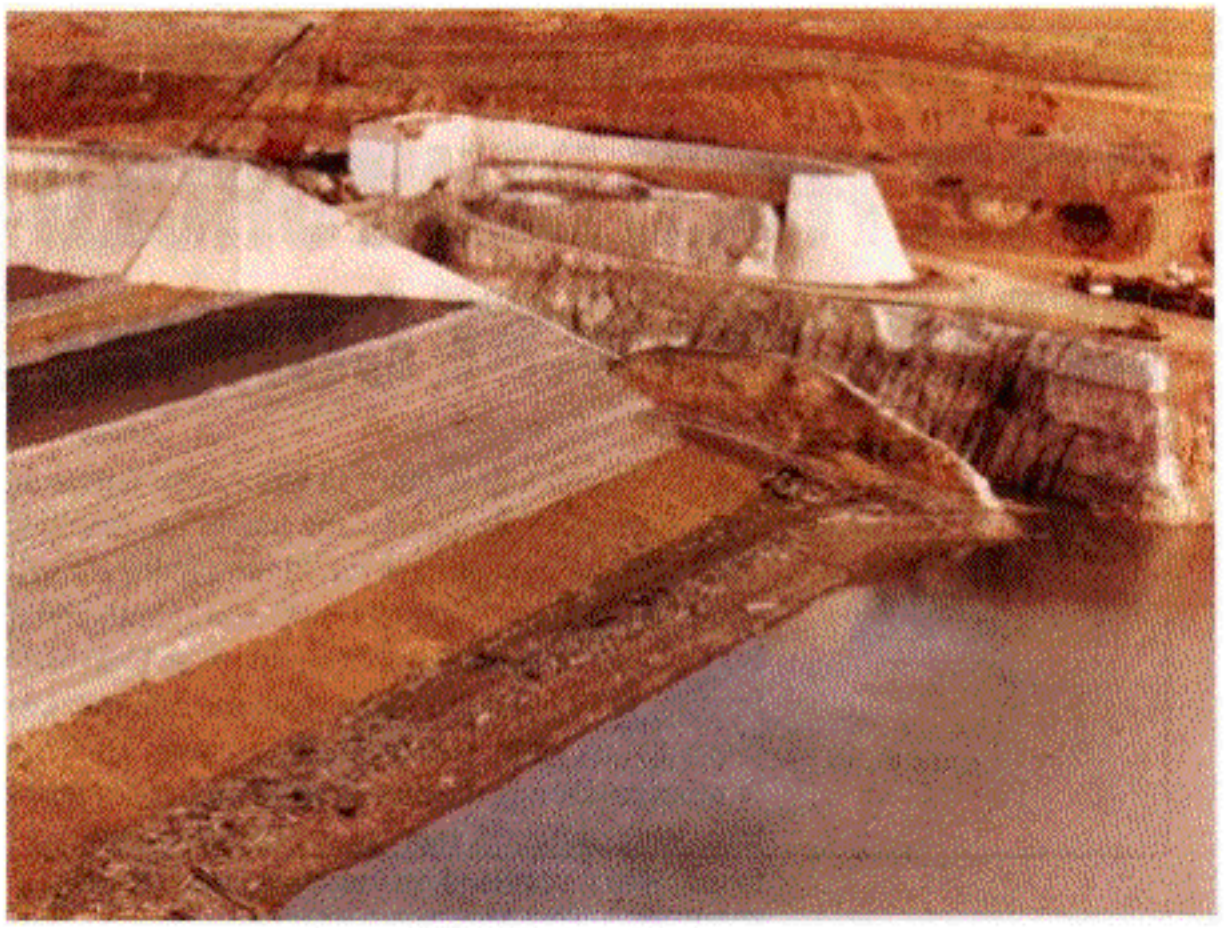

Figure 3. Initial stages of the sediment retention structure.

At Mount St. Helens, for instance, the project general contractor simply batched the shotcrete on site and delivered it to the point of application by transit mixers. Placement remained substantially the same as that for conventionally reinforced shotcrete. The production capacity of the steel fibers was also a key factor in maintaining project schedules. Contracts initially called for 730,000 lb (331 000 kg) of steel fiber product, but needs eventually tripled to over 2 million lb (908 000 kg).

Savings Projected

Steel fiber reinforced materials offer demonstrably superior toughness and impact resistance for better durability and reduced long-term maintenance—especially when probable maintenance, repair, and replacement costs are factored into original project estimates.

As engineering river bed surveys evidently indicate, the $72.8 million cost of a permanent Mount St. Helens Sediment Retention Structure should prove minimal compared to the $175 million spent in temporary solutions and $400 million projected in dredging over the next 50 years.

Reinforced Effectiveness

Over a decade has passed since the construction has been completed, and the Mount St. Helens Sediment Retention Structure continues to receive good reviews from the engineers who monitor the project. Steel fiber has proven to be a cost effective long-term solution for shotcrete reinforcement in channel linings and slope stabilization structures.

Acknowledgements

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Fibercon International, Inc.
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Project Design:
U.S. Army Corps of Engineers
Portland District, Portland, OR

General Contractor:
Granite Construction Company
Watsonville, CA