

# Research Results

## Pavement

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## Implementation of Recycled Fibers from Novel and Existing Source Materials in Concrete Pavements

Surveyed manufacturers and reviewed literature to identify recycled and natural fibers with potential for use in Caltrans concrete pavements.

### WHAT WAS THE NEED?

Concrete has low tensile strength and is prone to shrinkage cracking, which negatively impacts its durability and performance. Incorporating fibers has been shown to enhance the strength and durability of concrete pavements and bridge decks by improving their structural properties. However, despite these potential benefits, fibers are not commonly used in concrete pavements due to limited research and a lack of comprehensive technical performance data. This study investigates the feasibility of using recycled and natural fibers to improve the structural integrity of concrete pavements and bridge decks.

### WHAT WAS OUR GOAL?

This project aims to develop guidance for Caltrans to incorporate both virgin and recycled fiber-reinforced concrete technologies into pavement design and construction, promoting sustainable and durable concrete infrastructure.

### WHAT DID WE DO?

This research examined the feasibility of incorporating recycled and natural fibers into concrete pavements and bridge decks through the following tasks:

- Surveyed concrete fiber suppliers to identify manufacturers producing recycled polymeric, steel, cellulose, glass, basalt, and composite fibers.
- Interviewed suppliers to collect detailed information on feedstock materials, recycling processes, fiber geometric and mechanical properties, recommended applications, costs, and environmental impacts.



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- Conducted a comprehensive literature review on fiber performance in concrete, focusing on fiber dispersion, effects on workability, plastic and drying shrinkage control, mechanical strength, post-cracking behavior, and durability.

## WHAT WAS THE OUTCOME?

The research study identified several commercially available recycled and natural fibers suitable for concrete pavements and bridge decks. Supplier surveys provided data on feedstock, recycling processes, fiber properties, applications, costs, and environmental impacts. Key findings include the potential cost-effectiveness of recycled steel and carbon fibers, as well as the ability of cellulosic fibers to reduce plastic shrinkage cracking in concrete, thereby enhancing durability and performance. These results support Caltrans' goals by updating technical data and identifying viable supply chains. Future research will focus on laboratory and field testing to confirm performance and integrate findings into pavement design tools.

## WHAT IS THE BENEFIT?

Using recycled fibers, especially steel and carbon, in concrete pavements can significantly reduce construction costs for Caltrans by lowering material expenses. Incorporating recycled and natural fibers supports sustainability goals by reducing waste, conserving raw materials, and decreasing the environmental footprint of concrete production. Additionally, fibers improve concrete performance by enhancing durability, shrinkage control, and crack resistance, leading to longer-lasting pavements and bridge decks. This reduces the frequency and cost of repairs and maintenance, resulting in smoother roads with fewer disruptions for the public. Other transportation agencies and the private sector can also benefit from these cost savings and sustainability advancements.

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