

# LIQUID STEEL

Ultra-High Performance Concrete  
The break-through technology



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# What is it ?



## ULTRA-HIGH PERFORMANCE CONCRETE

- UHPC is an ultra-high performance concrete that exceeds the performance of conventional, high-performance, and very-high-performance concretes and grouts, with significantly greater compressive and tensile strengths, ductility, bond strength and durability. UHPC is formulated from fine granular particles with a very low water-to-cementitious materials ratio, which results in a dense matrix with a discontinuous pore structure, leading to extremely low permeability. The low permeability provides extreme resistance against water and chloride ingress, freeze-thaw damage, and chemical attack.



## APPLICATIONS

- UHPC is the result of nearly two decades of research and development and has been used for a wide variety of applications including bridge deck overlays, connections for precast deck panels for accelerated bridge deck replacement, precast/prestressed girders, repair of connections between precast concrete beams, steel column repairs, bridge joint header replacements, and architectural elements. Other construction applications include but are not limited to cladding panels, blast- and impact-resistant panels, precast piles, precast columns and pylons, tunnel liners, protection against caustic environments and salt spray zones.



## UNIQUE ATTRIBUTES

- UHPC is all white and can be color-modified to suit project needs. It is dry packaged and can be reliably mixed with a variety of mixing equipment including ready-mix trucks for larger volume projects. The 100% pre-blended dry mix reduces the need to measure ingredients on site and results in greater uniformity and predictability of the fresh and cured material properties. It works with a variety of time-saving placement capabilities unique to UHPC. These capabilities include direct-discharging from ready-mix trucks, flush-forming deck-level UHPC connections, curing deck overlays without covering the overlays with plastic sheeting, and pumping and spraying UHPC,

# Enhances Productivity

Deck projects mixing in ready-mix trucks and discharging directly to deck

To Mix and Transport Fresh UHPC, Contractor Must Provide:



**2** Workers for Mixing



**1** Standard Ready-Mix Truck,  
Mixing On-Site  
(2 to 7 Cubic Yards Per Truck)



**250** Gallons of Water  
per Batch for Mixing and  
Cleaning

# Conventional UHPC Process

Deck projects mixing in specialty mixers and transporting in buggies

To Mix and Transport Fresh UHPC, Contractor Must Provide:

**8**

Workers for Mixing and Transporting Fresh UHPC



**4**

Motorized Buggies



**2**

Specialty Stationary Mixers On Site  
(1.4 Cubic Yards Per Mixer)



**2**

50,000 kW Generators On Site



~200 More Gallons of Fuel

**1**



Flat Bed Truck to Deliver and  
Pickup Mixers



**2**

Extra Days to Setup  
and Breakdown Mixers

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# Reduces Complexity and Cost



Less Equipment

Less Wait Time Less Waste

Fewer Traffic Impacts

Fewer Workers

Increased Safety

Less Schedule Risk

Reduced Carbon Footprint

Increased Productivity

*For Overall **Cost Savings***



# BEST IN CLASS PROPERTIES = BEST PERFORMANCE

*Stronger, More Durable, Lasts Longer*

Property		UHPC ★ (FHWA or NYSDOT Standard)	
Compressive Strength (higher is better)		18 ksi ————— 22 ksi	★ 27
Flexural Strength (higher is better)	1 <sup>st</sup> Crack Stress	≥ 1.5 ksi →	★ 2.6
	Peak Stress	≥ 2.0 ksi →	★ 2.9
Linear Shrinkage (lower is better)		300 με ————— 1200 με	★ 427
Chloride Permeability (lower is better)		50 coulombs ————— 500 coulombs	★ 49
Freeze-Thaw Resistance (higher is better)		>96% ————— >98%	★ 104%
Scaling Resistance (lower is better)		Y=0 ————— Y<3 (moderate)	★

↔ = Range for UHPC materials set by agencies

# RECOMMENDATIONS & LAB CERTIFICATIONS

## TYPICAL MATERIAL PROPERTIES

According to ASTM C1856 / C1856M except where noted otherwise  
70°F (21°C) curing temp, 2% load of 0.5-inch x 0.008-inch (13mm x 0.2mm) steel fiber with 435 ksi (3 GPa) tensile strength

Compressive Strength:	1 day	≥ 11 ksi (76 MPa) <sup>1</sup>
	7 days	≥ 19 ksi (131 MPa)
	13 days	≥ 21 ksi (145 MPa)
	28 days	≥ 23 ksi (159 MPa)
	56 days	≥ 25 ksi (172 MPa)
Sustained Post-Cracking Tensile Strength (FHWA <sup>3</sup> )		1.07 ksi (7.38 MPa) minimum
		1.50 ksi (10.34 MPa) average
Static Modulus of Elasticity		8,250 ksi (57 GPa)
Chloride Ion Penetration (ASTM C1202)		49 coulombs at 56 days
Flow		7-inch (18-cm) to 10-inch (25-cm) diameter
Working Time		As needed <sup>2</sup>
Set Time (minimum values)		75 minutes initial, 87 minutes final <sup>2</sup>

<sup>1</sup> UHPC can be modified to reach 14 ksi compressive strength in as little as 12 hours.

<sup>2</sup> Set times and working times can be customized according to project needs.

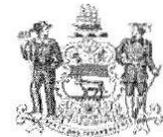
<sup>3</sup> Publication FHWA-HRT-17-053 *Tension Testing of Ultra-High Performance Concrete*



**pennsylvania**  
DEPARTMENT OF TRANSPORTATION



New Mexico DEPARTMENT OF  
**TRANSPORTATION**  
MOBILITY FOR EVERYONE



STATE OF DELAWARE  
DEPARTMENT OF TRANSPORTATION



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# 7 HOUR

## CONCRETE DRYING TIME

- The road surface can be used by heavy transport in just **under 7 hours** after laying.
- This means that the entire road can be used **on the same day** it is constructed.
- It is possible to lay **1-2 km of road surface per day** using minimal equipment and only four workers.



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# PAST PERFORMANCE

Our UHPC is pre-qualified\* with

NYSDO	DeIDOT
T FDOT	ODOT (Oregon)
PennDOT	NMDOT
CalTran	VDOT
WV DOT	WV DOT
	WSDOT (Washington State)**

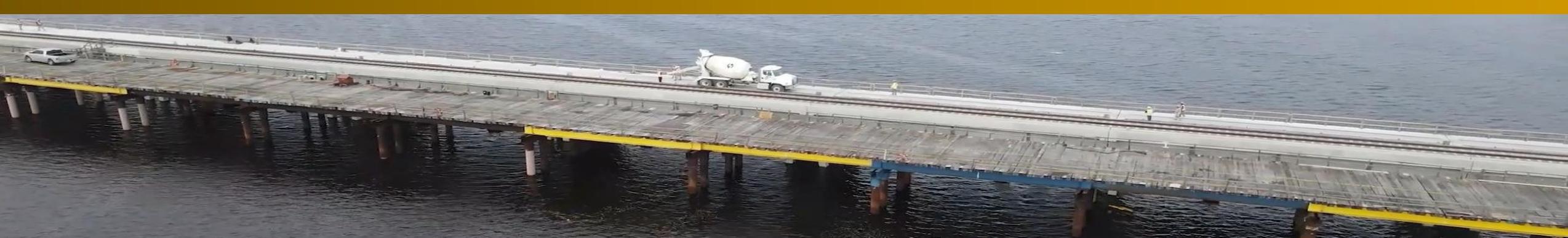
UHPC for Projects on nearly  
50 bridges in:

- Connecticut
- Delaware
- Florida
- Iowa
- Illinois
- New Jersey
- New York
- Oregon
- Pennsylvania
- Rhode Island
- West Virginia

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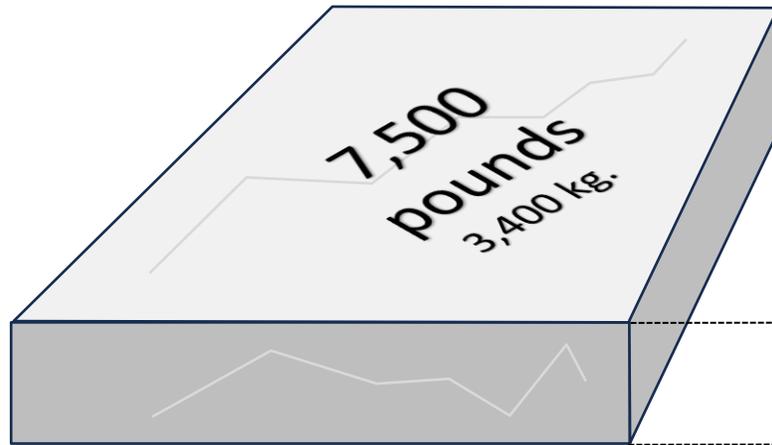
\*Not all states have a prequalification process of UHPC

\*\*Steelike UHPC listed on WSDOT Qualified Product List for UHPC

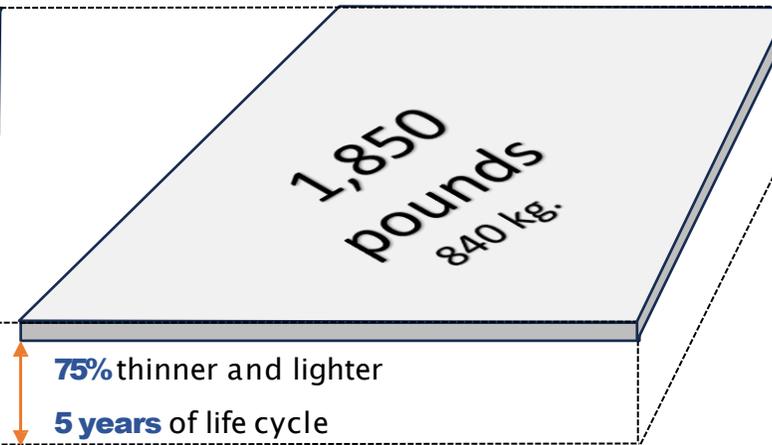


# CONCRETE SLABS – TECHNOLOGY COMPARISON

## TRADITIONAL ROAD CONCRETE SLAB



## LIQUID STEEL CONCRETE ROAD SLAB



**75%** lower  
cost of transport



# USACE RECOMMEND AND APPROVES THE SOLUTION AND USES ULTRA HIGH PERFORMANCE CONCRETE



**US Army Corps  
of Engineers®**



[Link to the USACE Article](#)



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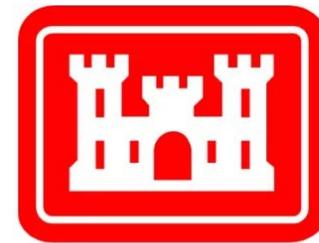
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# USACE RECOMMEND AND APPROVES THE SOLUTION AND USES ULTRA HIGH PERFORMANCE CONCRETE

“Panels using conventional concrete are traditionally 6-to-8 inches thick, which makes them pretty heavy and cumbersome.

This requires USACE teams to have a very large crane on site to put them in place,” Wood said. “Not only does it take up a large footprint on site, but often times the crane requires just as many truck loads to haul it to the site as the panels themselves, which was the impetus of the statement of need from Rock Island.”

**UHPC panels are no thicker than three inches and cure to a strength of 22,000 PSI in just 28 days.** Using tests and data from more than three decades of research, ERDC tested the UHPC panels, including simulating what would happen if the panels were struck by a barge. The results validated the exceptional strength and durability of the UHPC panel.



**US Army Corps  
of Engineers®**



[Link to the USACE Article](#)



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# SHORT CURING TIME

## ULTRA HIGH PERFORMANCE CONCRETE

Accelerated cure with  
54 C°/130°F

**7Hours** 96.5 Mpa / 14.000 PSI

Accelerated cure with  
51.6 C°/125°F

**10Hours** 82.7 Mpa / 12,000 PSI

Accelerated cure with  
43.3C°/110°F

**12Hours** 82.7 Mpa / 12,000 PSI

ADDING  
**HEAT** INCREASES  
TIME CURE



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# MILITARY APPLICATIONS

*THE break-through technology*



## CONCRETE PADS:

- 75% thinner than traditional concrete pads.
- 75% lighter than traditional concrete pads, making them easy to install and remove due to reduced weight.
- Highly efficient for transportation, allowing you to carry 3-6 times more concrete pads than conventional ones.
- Exceptional durability: Does not crack and withstands extreme low and high temperatures.
- The colder the temperature, the harder it becomes.
- Available in various masking colors to suit different applications.
- Multi-use: Used concrete pads can be repurposed to construct temporary structures, including force protection elements or buildings for combat training exercises.



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# MILITARY APPLICATIONS

*THE **break-through** technology*



## WALLS FOR TEMPORARY STRUCTURES:

- Versatile design: Can be molded for various structures, including window and door openings.
- Convenient transportation and reusability: Easily stacked on trucks for transport and can be reused.
- Longevity: Provides up to 50 life cycles for extended use.
- Durable and weather-resistant: Highly resistant to rust and various weather conditions.
- Easy maintenance: Simple to clean and maintain.
- Enhanced security: Steel-concrete construction offers increased resistance to ballistic impact.
- Crack-free performance: Maintains structural integrity without cracking.
- Multi-purpose use: Walls can be repurposed as temporary road pads when needed.



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# MILITARY APPLICATIONS

## THE *break-through* technology



### CONCRETE BUNKERS:

- Walls and weight are 75% thinner compared to traditional concrete.
- Easily moldable into any desired shape.
- Bullet-resistant.
- Convenient for transportation and demobilization.
- Reusable for up to 50 times.
- Mass production is achievable in a minimal amount of time. No need for the steel concrete to dry extensively to harden (a couple of hours are sufficient).

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# MILITARY APPLICATIONS

THE *break-through* technology



## INSTANT REPAIR FOR EXISTING ROADS:

- Quickly restore roads constructed with asphalt, concrete pads, or compacted gravel.
- Apply a durable surface layer that resists cracking in extreme temperatures.
- The new surface can withstand heavy traffic.
- Since it demands minimal equipment and labor, these repairs can be executed in remote, hard-to-reach areas, even in forested regions.



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# MILITARY APPLICATIONS

THE *break-through* technology



## INSTANT REPAIR FOR RUNWAYS:

- Quickly restore roads constructed with asphalt, concrete pads, or compacted gravel.
- Apply a durable surface layer that resists cracking in extreme temperatures.
- The new surface can withstand heavy traffic.
- **Levels the Surface instantly**



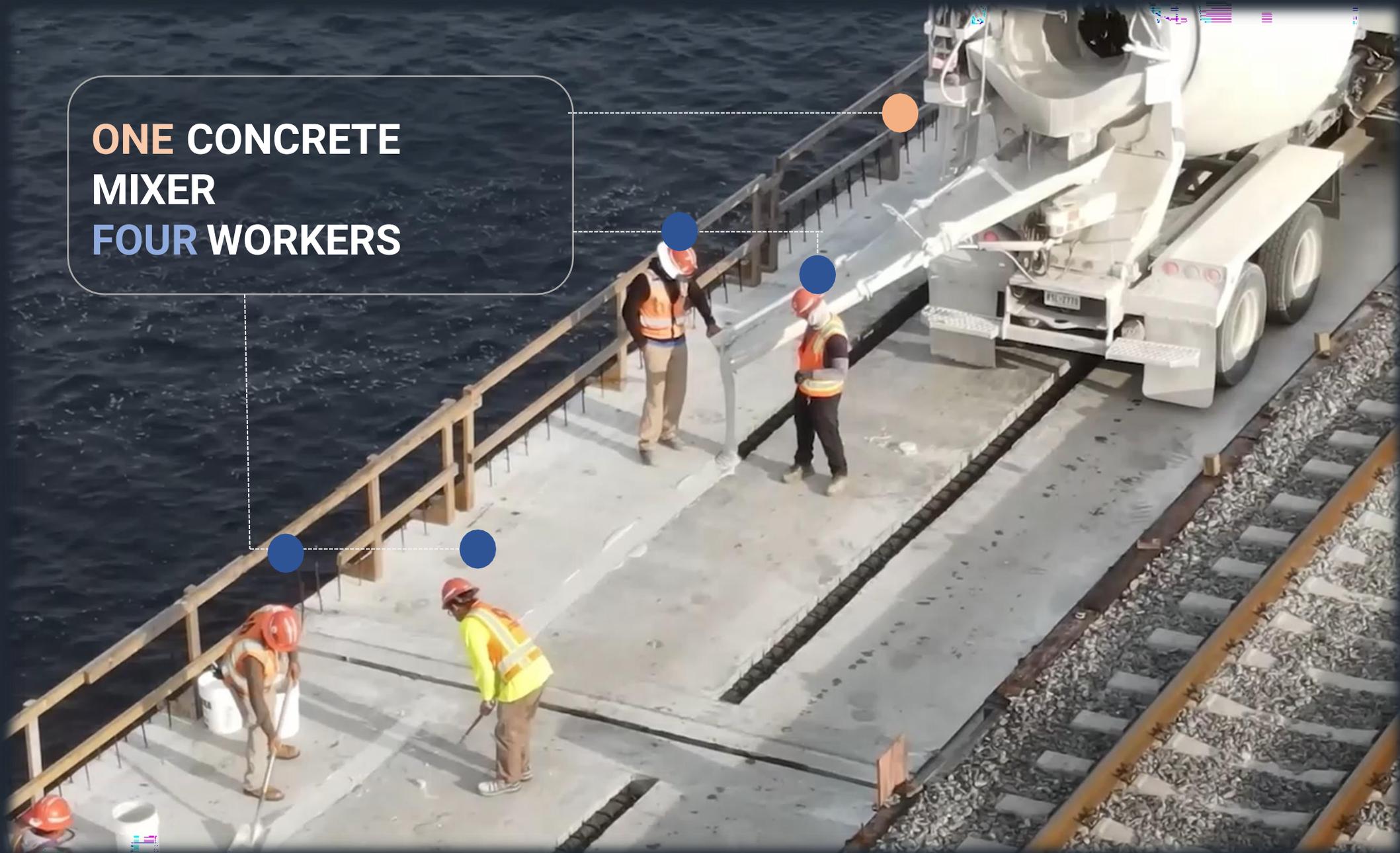
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**ONE CONCRETE  
MIXER  
FOUR WORKERS**



**EASY APPLICATION**

THIN LAYER SURFACE





**SMOOTH SURFACE**



**SPRAYED FOR MOLDS**



# FAST CRACK REPAIR





**THANK YOU FOR  
YOUR TIME**



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