

ULTRA HIGH PERFORMANCE CONCRETE: An Opportunity to Reinvent Steel and ReImagIne Concrete

JP BINARD, PE
PRECAST SYSTEMS ENGINEERING
2021

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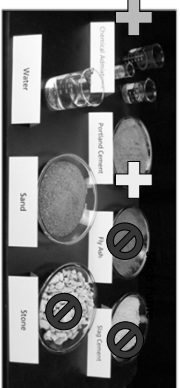
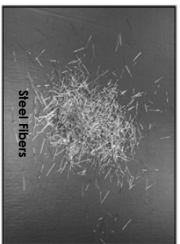
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DISCUSSION TOPICS:

- What is Ultra High Performance Concrete (UHPC)?
- Where is UHPC being utilized in the US?
- Who else is using UHPC?
- Where could we use UHPC?

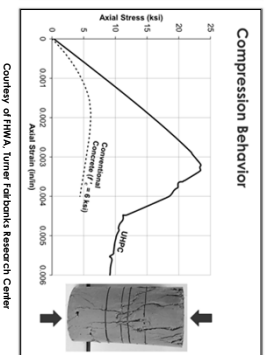
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WHAT IS UHPC? THE MIX



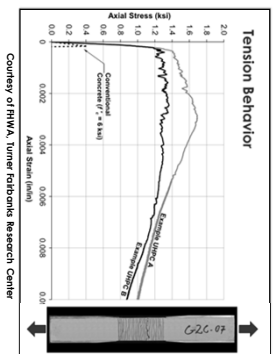
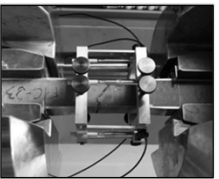
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WHAT IS UHPC? THE BEHAVIOR



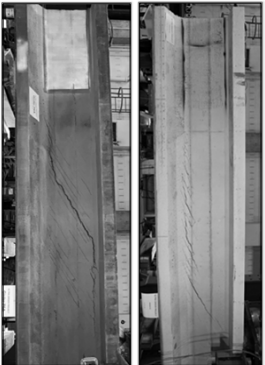
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WHAT IS UHPC? THE BEHAVIOR

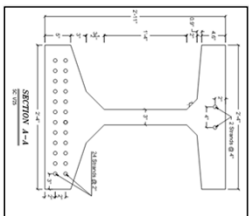


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WHAT IS UHPC? THE BEHAVIOR



Courtesy of FHWA, Turner Fairbank Research Center



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WHAT IS UHPC? DURABILITY

- UHPC Formability
- Chloride Ion Penetration Coefficient
- 2 x 10⁻¹² m²/s for conventional concrete
- 2 x 10⁻¹⁷ m²/s for UHPC

Competition of Chloride Ion Diffusion (Courtesy: FHWA)

Durability

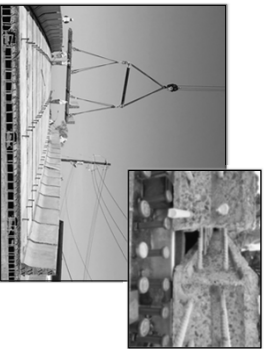


UHPC Bridge at Trestle Road
1st International International Symposium on UHPC

- Standard Practice for Fabricating and Testing Specimens of Ultra-High Performance Concrete
- Companion Specification 17

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WHERE IS UHPC BEING USED DOMESTICALLY? ACCELERATED CONSTRUCTION



Technomic
Design and Construction of Field-Cast UHPC Connectors

Technomic is a leading provider of design and construction services for UHPC connectors. Our team of experts has extensive experience in the design and construction of UHPC connectors for a wide range of applications, including bridges, tunnels, and industrial structures. We provide a full range of services, from design and engineering to construction and maintenance. Our UHPC connectors are designed to provide high strength and durability, and are easy to install and maintain. We are committed to providing the highest quality service to our clients, and we have a proven track record of successful projects. Contact us today to learn more about our UHPC connector solutions.

Project Details:

- Project Name: [Redacted]
- Location: [Redacted]
- Start Date: [Redacted]
- End Date: [Redacted]
- Project Manager: [Redacted]
- Design Engineer: [Redacted]
- Construction Manager: [Redacted]

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WHERE ELSE IS UHPC BEING USED DOMESTICALLY?

- Bridge deck link slabs to eliminate expansion joints.
- Bridge deck overlays to rehabilitate existing concrete bridge decks.
- Repair of concrete bridge piers
- Repair of corroded steel girder ends.

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GLOBAL

French standard

NF P 18-710
14 April 2016
Circulation: 10000 + 10 000
EN 19 181:2016 19 088:09

National addition to Eurocode 2 – Design of concrete structures – Part 2 – Design of Performance Fibre-Reinforced Concrete (PFRCC)

1) Performance based design
2) Design of concrete structures
3) Design of concrete structures
4) Design of concrete structures
5) Design of concrete structures
6) Design of concrete structures
7) Design of concrete structures
8) Design of concrete structures
9) Design of concrete structures
10) Design of concrete structures

French standard approved by the Committee of the European Standards of France

CSA A231.19/CSA A23.2.19
National Standard of Canada

Concrete materials and methods of concrete construction/ Test methods and standards practices for concrete

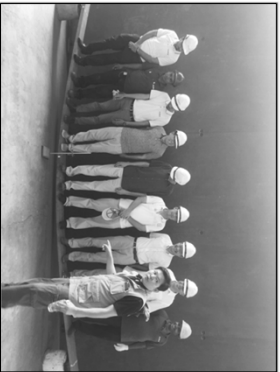

MCS
MATERIALS CONSTRUCTION SOCIETY
NATIONAL CONCRETE CENTER
RESEARCH IN CONCRETE

IFCC
INTERNATIONAL FIBRE REINFORCED CONCRETE CONFERENCE

Standard:
Ultra-High Performance Fibre Reinforced Cementitious Composites (UHPC)
Construction material, dimensioning and application

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MALAYSIA

UHPFC: A game-changing material for PCI bridge producers

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MALAYSIA



- 180 ft Span
- Spacing = 13'-2" o.c.
- 55" Deep Tub w/ 4" Webs



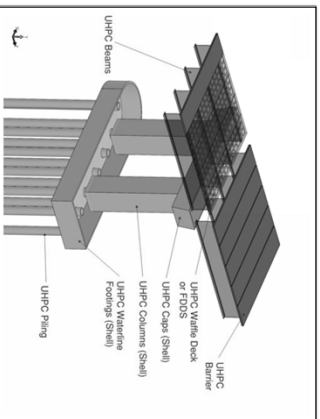
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MALAYSIA



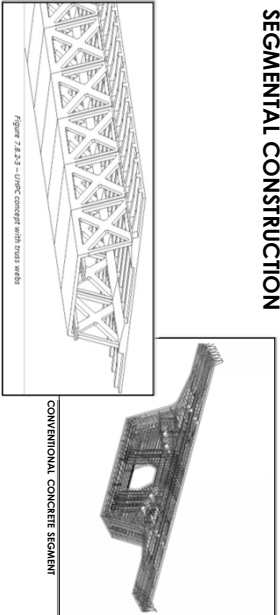
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WHERE CAN WE USE UHPC FOR STRUCTURAL ELEMENTS?



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IDEAL UHPC COMPONENTS SEGMENTAL CONSTRUCTION



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IDEAL UHPC COMPONENTS HYBRID ELEMENTS

The top part of the image shows a cross-section of a hybrid element. It consists of a central 'UHPC Web Zone' and two 'Normal Weight Concrete' zones on either side. A caption below reads: '5" Web No Shear Reinforcement! 20 tons lighter Straight Stands'.

The middle part shows a photograph of a large concrete component being lifted by a crane. The component is labeled 'UHPC' and '20 TONS LIGHTER'.

The bottom part is a table with columns for 'Span', 'Type', 'Length', 'Weight', 'Volume', 'Area', 'Perimeter', 'Surface Area', and 'Volume of Concrete'. The table lists various components and their properties.

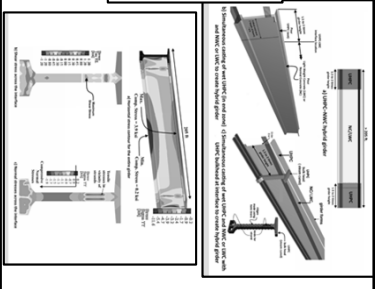
Span	Type	Length	Weight	Volume	Area	Perimeter	Surface Area	Volume of Concrete
10000	1	10000	10000	10000	10000	10000	10000	10000
10000	2	10000	10000	10000	10000	10000	10000	10000
10000	3	10000	10000	10000	10000	10000	10000	10000
10000	4	10000	10000	10000	10000	10000	10000	10000
10000	5	10000	10000	10000	10000	10000	10000	10000
10000	6	10000	10000	10000	10000	10000	10000	10000
10000	7	10000	10000	10000	10000	10000	10000	10000
10000	8	10000	10000	10000	10000	10000	10000	10000
10000	9	10000	10000	10000	10000	10000	10000	10000
10000	10	10000	10000	10000	10000	10000	10000	10000
10000	11	10000	10000	10000	10000	10000	10000	10000
10000	12	10000	10000	10000	10000	10000	10000	10000
10000	13	10000	10000	10000	10000	10000	10000	10000
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10000	20	10000	10000	10000	10000	10000	10000	10000
10000	21	10000	10000	10000	10000	10000	10000	10000
10000	22	10000	10000	10000	10000	10000	10000	10000
10000	23	10000	10000	10000	10000	10000	10000	10000
10000	24	10000	10000	10000	10000	10000	10000	10000
10000	25	10000	10000	10000	10000	10000	10000	10000
10000	26	10000	10000	10000	10000	10000	10000	10000
10000	27	10000	10000	10000	10000	10000	10000	10000
10000	28	10000	10000	10000	10000	10000	10000	10000
10000	29	10000	10000	10000	10000	10000	10000	10000
10000	30	10000	10000	10000	10000	10000	10000	10000

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HYBRID COMPONENT GIRDERS

Long-span hybrid precast concrete
bridge girder using
ultra-high-performance concrete
and normalweight concrete

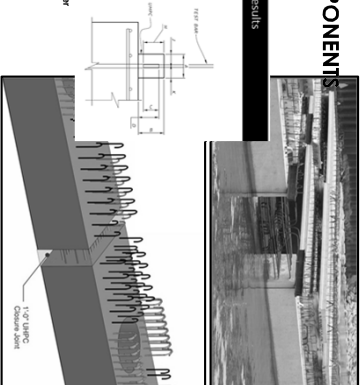
Viggo Sagar Romark, Simon Aabel, and J. P. Bizard



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IDEAL UHPC COMPONENTS CAPS & CLOSURES

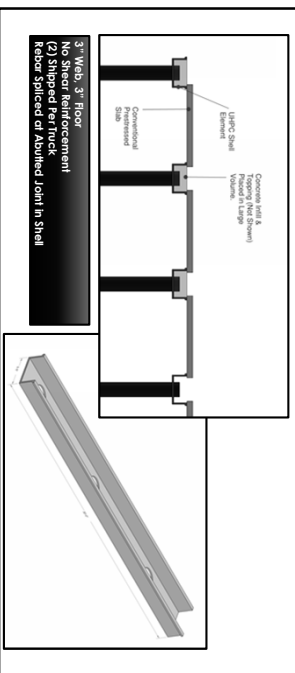
Preliminary Results



Courtesy of ROST Structures Research Center

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IDEAL UHPC COMPONENTS FORMING SOLUTIONS, NON-COMPOSITE OR COMPOSITE



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