ULTRA-HIGH PERFORMANCE FIBER REINFORCED CONCRETE (U`HPFRC) TECHNOLOGY

Efficient solution towards sustainable infrastructure

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THE UHPFRC COMPANY

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Concrete Technology Break Through

- One of the biggest breakthrough in 21st century is the invention of ultra-high-performance fiber reinforced concrete (UHPFRC)
  - Concrete Grade 150/165 above
  - With usable structural ultimate **tensile strength** (> 8 MPa) and ultimate **flexural strength** more than 30 MPa.
  - at least 4 - 6 times stronger than normal concrete (in **compressive strength**)
  - at least 2 - 5 times more **durable** than conventional concrete
  - Longer service and design life
  - Lower carbon footprint

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EVOLUTION OF CONCRETE TECHNOLOGY

1824

Portland Cement First Developed (Joseph Aspdin)

1849

Reinforced Concrete Evolved With Addition of Metallic Reinforcement

1980s

High Performance Concrete Improves the Compressive Strength of Concrete

1994

The Term 'Ultra-High Performance Concrete' is Coined

1997

UHPC is first used in Pedestrian Bridge in Canada

Sherbrooke Pedestrian Bridge, Quebec, Canada



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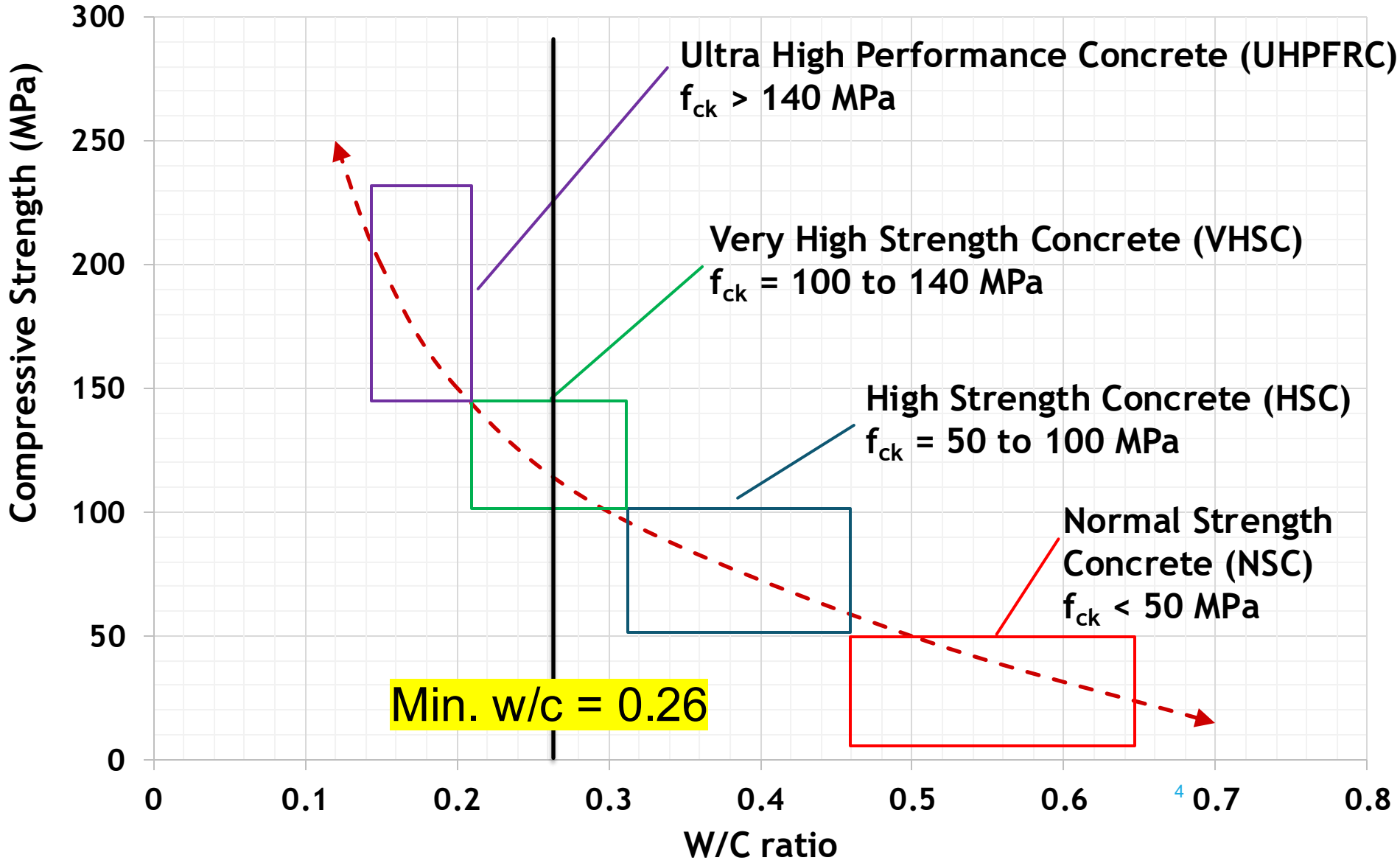
Evolution of Concrete



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How UHPFRC Compare to Reinforced Concrete?

- Reinforced Concrete
  - Aggregate up to 20mm
  - Mainly using steel bar as reinforcement
  - Steel bar is compulsory
  - Concrete cover detailing rules needed
  - Less workable in slender element
  - Honeycomb possible
- UHPFRC
  - Eliminate aggregate
  - Mainly using steel fiber as reinforcement
  - Steel bar is optional
  - Concrete cover is not compulsory
  - Highly flowable and moldable
  - Honeycomb almost impossible

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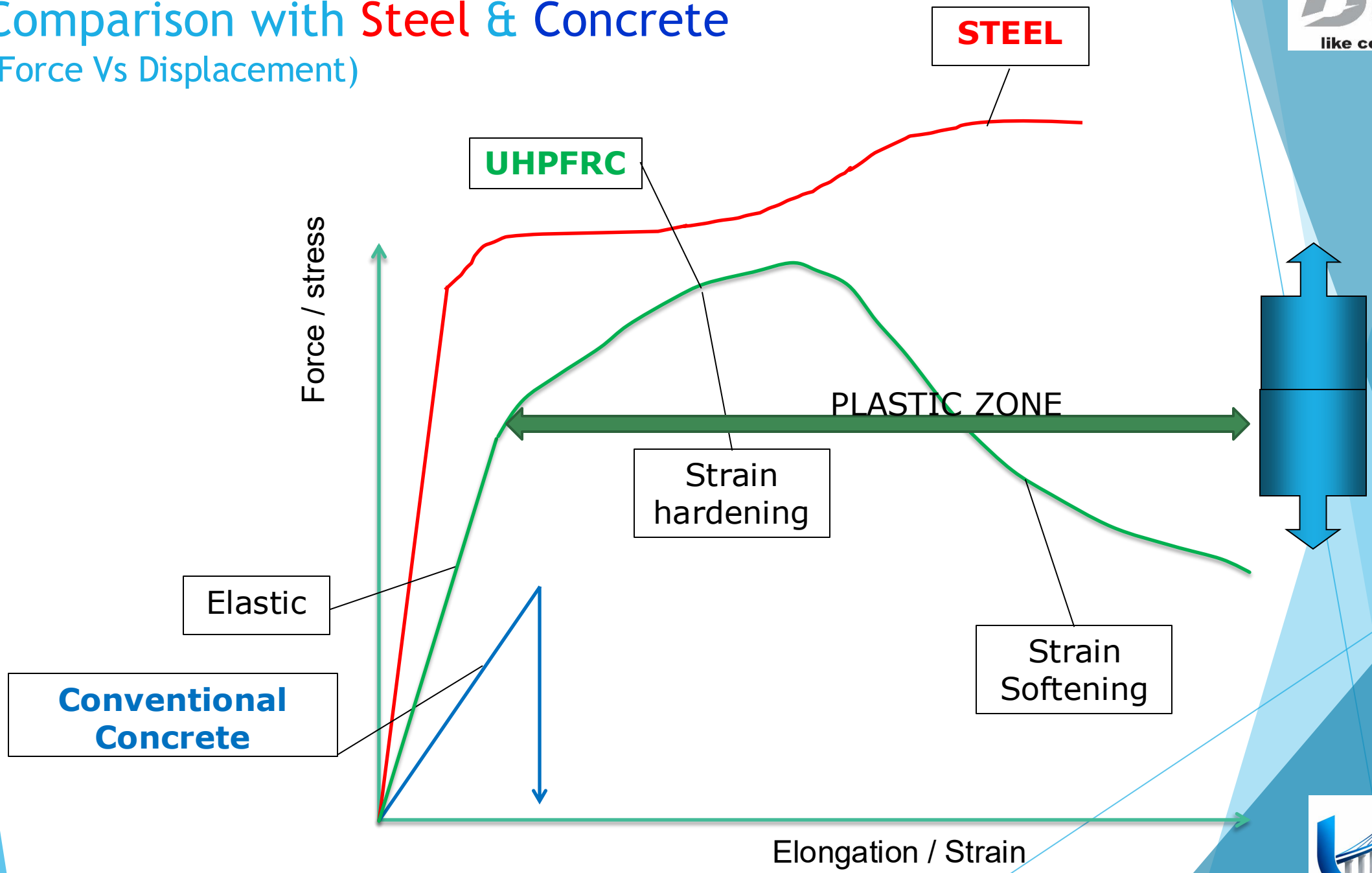
Comparison with Steel & Concrete

(Force Vs Displacement)



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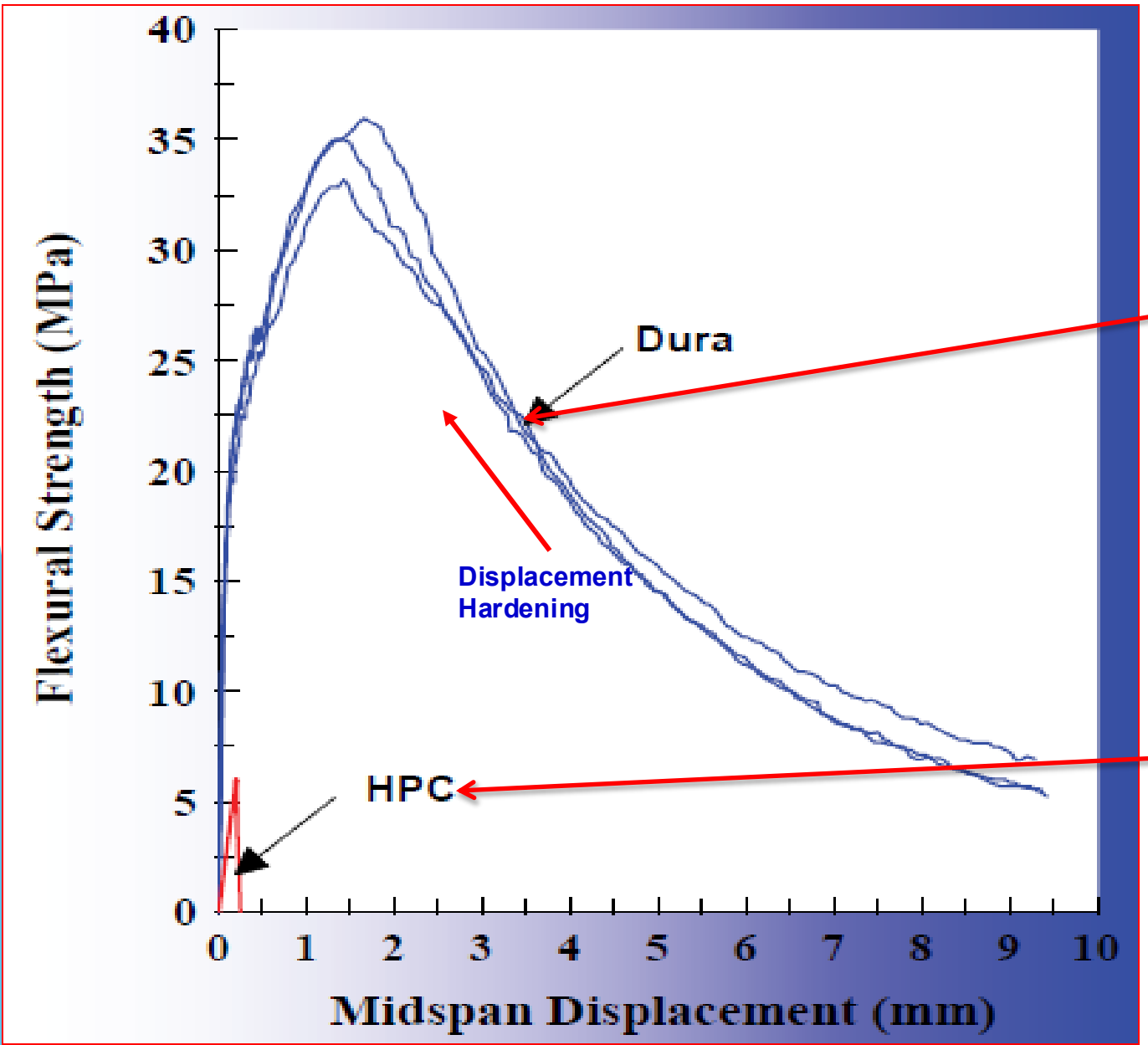
Flexural-Tensile 4 Point Test





Dura® - UHPFRC



Grade60 HPC

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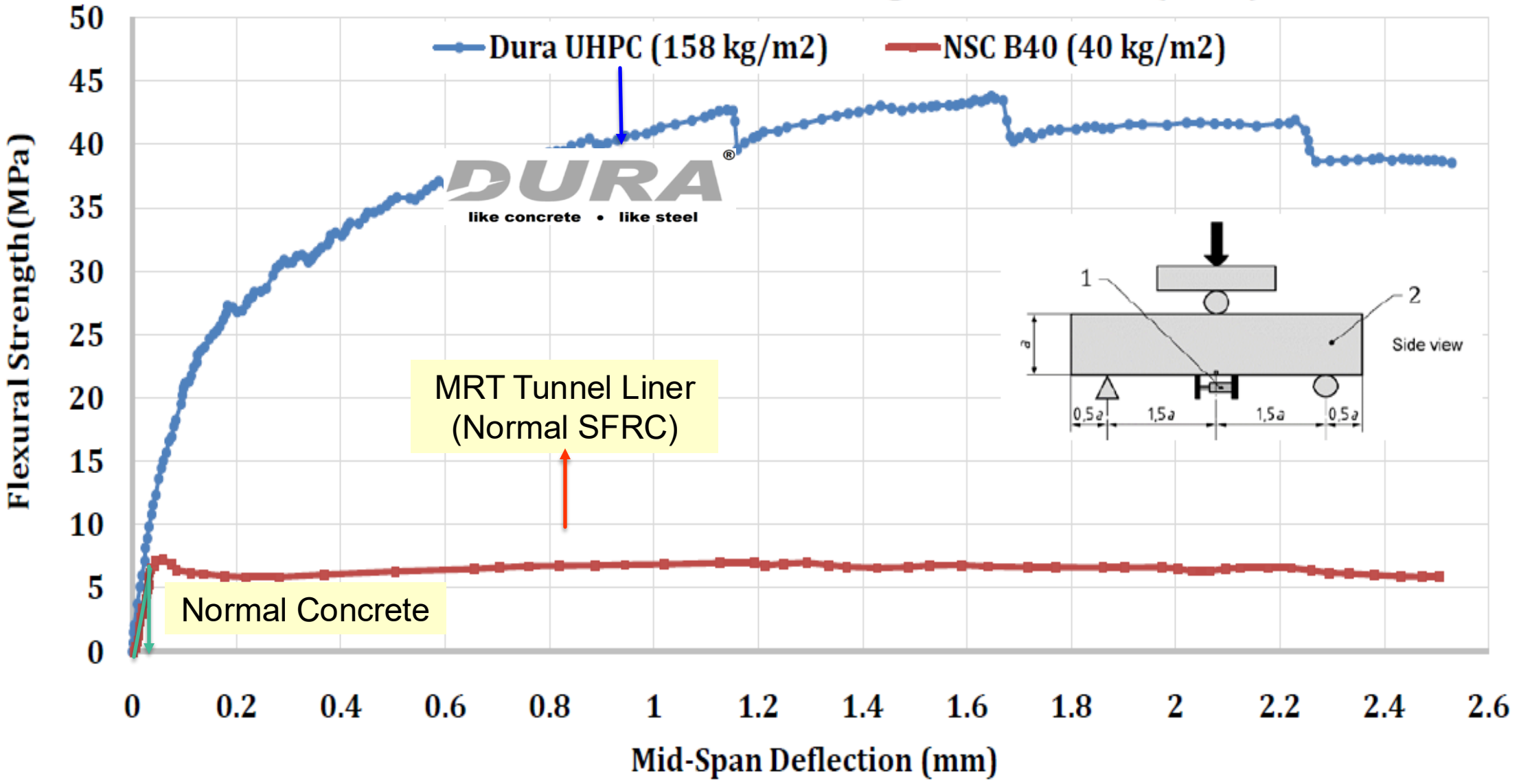
3-Point Test Curves _ According to NF P18-470 (2016)

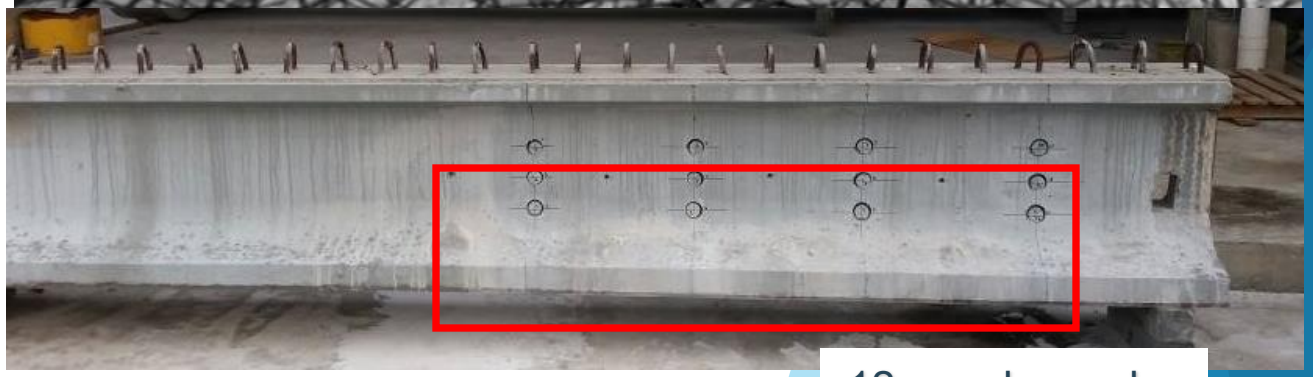


UNSW

CT Scan on core sample



X-Rays Scan on normal sample

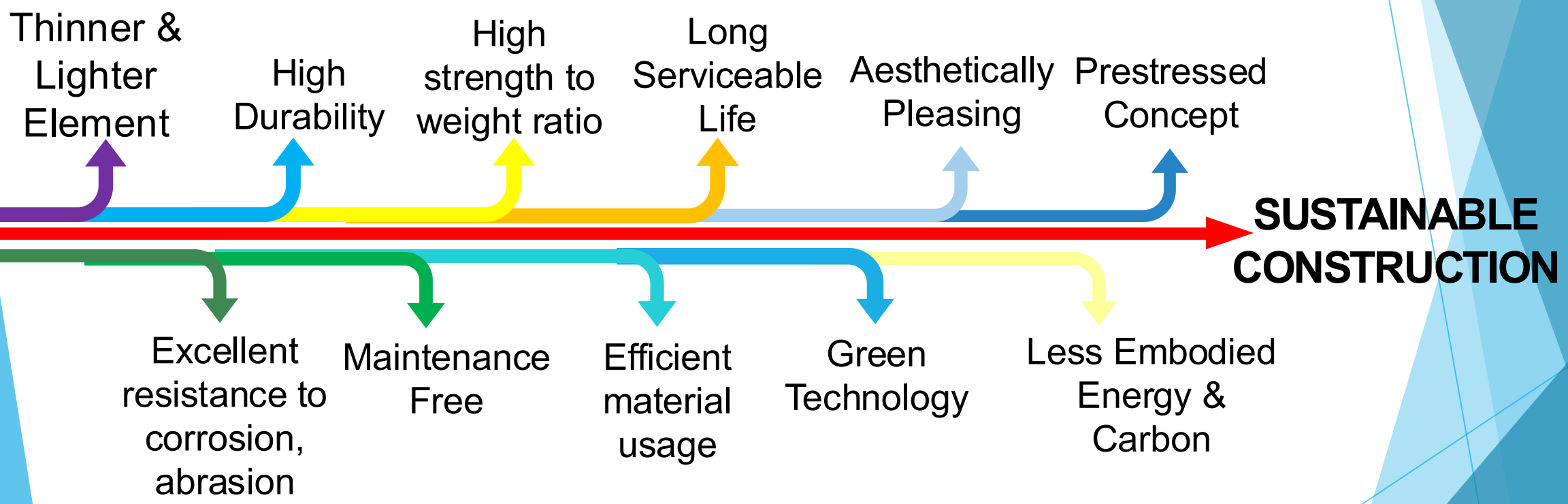


12 cored samples

Fiber QTY = 158kg/m^3 (2% vol.)

34 mil fibers; Total Length = 643 km/m^3

Advantages of UHPFRC Technology.



Other Advantages:
LSSPSL DURA UHPFRC doesn't shrink and minimal creep due to Steam Curing along with Heat Treatment provided.

The Advantage of using DURA®

- DURA UHPFRC doesn't shrink and minimal creep
- **Cost Saving;**
- Span up to 100m, thus **reduce foundation cost significantly**
- **Cheaper & better solution against Steel Structures**
- Lighter and thin sections
- Extremely Durable due to ultra denseness of concrete
- Better Bridge Material compare to conventional (Factory Product)
- Easier Handling & Transport (Lower Tonnage Crane Required)
- Shortened Construction Period. (more than 20%)
- **SUSTAINABLE ASSET**
- **Value for MONEY!!!**

UHPC Progress Around the World

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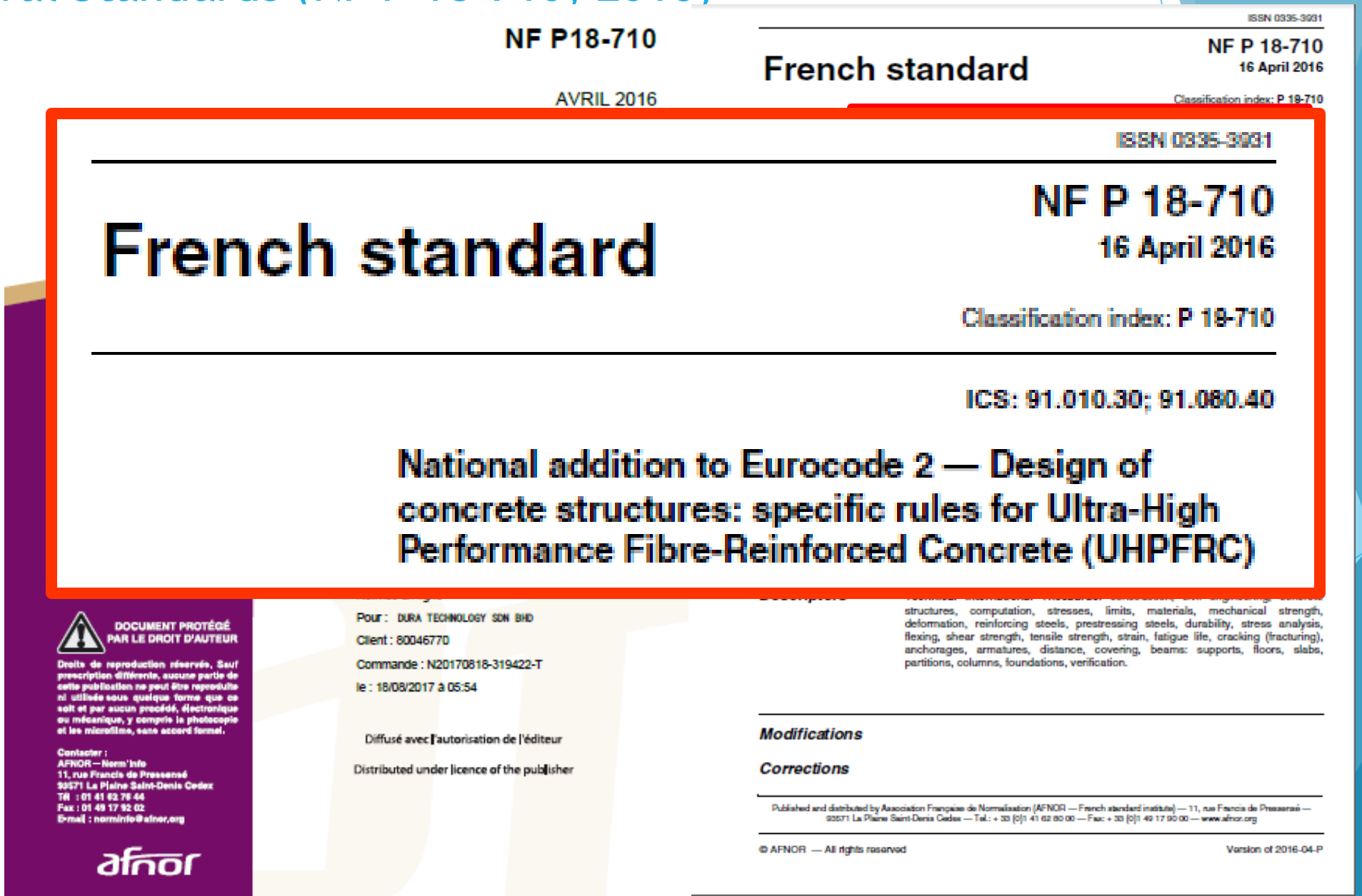
The usage of UHPC for bridges and bridge components can been seen in various countries including **Australia, Austria, Canada, China, Czech Republic, France, Germany, Italy, Japan, Malaysia, Netherlands, New Zealand, Slovenia, South Korea, Switzerland and the United States**

- **The French were early adopters and pioneers in building a strong foundation for using UHPC in a variety of bridge applications**
- **In Switzerland, UHPC is employed to address major rehabilitation needs**
- **The United States bridge sector has embraced UHPC for a variety of field-cast connections**
- **UHPC is being widely used in Malaysia to design & construct many bridges of different types and spans**
- **In South Korea, the unique characteristics of UHPC are being utilized to advance state-of-the-art in long-span bridges.**

Structural Standards (NF P 18-710, 2016)



NF P18-710

AVRIL 2016

French standard

NF P 18-710

16 April 2016

Classification index: P 18-710

ISSN 0335-3931

French standard

NF P 18-710

16 April 2016

Classification index: P 18-710

ICS: 91.010.30; 91.080.40

National addition to Eurocode 2 — Design of concrete structures: specific rules for Ultra-High Performance Fibre-Reinforced Concrete (UHPFRC)

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AFNOR — Norm'Info
11, rue Francis de Pressensé
93571 La Plaine Saint-Denis Cedex
Tél. : 01 41 62 76 44
Fax : 01 49 17 92 02
E-mail : norminfo@afnor.org

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structures, computation, stresses, limits, materials, mechanical strength, deformation, reinforcing steels, prestressing steels, durability, stress analysis, flexing, shear strength, tensile strength, strain, fatigue life, cracking (fracturing), anchorages, armatures, distance, covering, beams: supports, floors, slabs, partitions, columns, foundations, verification.

Modifications

Corrections

Published and distributed by Association Française de Normalisation (AFNOR — French standard institute) — 11, rue Francis de Pressensé — 93571 La Plaine Saint-Denis Cedex — Tel.: + 33 (0)1 41 62 80 00 — Fax: + 33 (0)1 49 17 90 00 — www.afnor.org

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Structural Design with Ultra-High Performance Concrete

PUBLICATION NO. FHWA-HRT-23-077

OCTOBER 2023

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
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Guide Specifications for Structural Design with ULTRA-HIGH PERFORMANCE CONCRETE

1st Edition | March 2024



ACI 239R-18

Ultra-High-Performance Concrete: An Emerging Technology Report

Reported by ACI Committee 239

Emerging Technology Series

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Concrete Engineering Series 82

Recommendations for Design and Construction of High Performance Fiber Reinforced Cement Composites with Multiple Fine Cracks (HPFRCC)

March, 2008

Japan Society of Civil Engineers

1st Draft

Design Guidelines for K-UHPC

2014. 2.

KICT 한국건설기술연구원

Applications in Brief:

- Bridges
- Pavements & Overlay Materials
- Repair & Rehabilitation Works
- Field-cast closure pours for pre-fabricated bridge elements
- Architectural Features
- High Rise Buildings
- Off-shore Structures

Bridges

Applications

MoRTH Circular dated 22nd Feb 2022.

Use of Ultra high performance fiber reinforced concrete in design and construction of structures/bridges of National Highways

File No.RW/NH-33049/01/2020-S&R (B) Pt.
Government of India
Ministry of Road Transport & Highways
(S&R (P&B/New Technology) Zone)
Transport Bhawan, 1, Parliament Street, New Delhi-110001

Dated: 22th February, 2022

CIRCULAR

To,

1. The Chief Secretaries of all the State Governments/ UTs.
2. The Principal Secretaries/ Secretaries of all States/ UTs Public Works Department/ Road Construction Department/ Highways Department (dealing with National Highways and other centrally sponsored schemes).
3. The Chairman, National Highways Authority of India, G-5 & 6, Sector-10, Dwarka, New Delhi-110 075.
4. The Managing Director, NHIDCL, PTI Building, New Delhi-110001.
5. The Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi- 110 010.
6. All Engineers-in-Chief and Chief Engineers of Public Works Department of States/ UTs/ Road Construction Department/ Highways Departments (dealing with National Highways and other centrally sponsored schemes).
7. All CE-ROs, ROs and ELOs of the Ministry.

Subject: - Use of Ultra High Performance Fiber Reinforced Concrete (UHPFRC) in Design & Construction of Structures/Bridges of National Highways - Regarding

Madam/Sir,

Advanced structural design guidelines IRC: 112-2020 "Code of Practice for Concrete Road Bridges" and analysis software are presently being used in India. These are in tune with the International codes. However, its full exploitation to design the durable cost-effective slender sections are being made in a very limited manner. Therefore, need is felt for adoption of State-of-Art advanced level of bridge technologies for use in National Highway projects so that widespread usages of more cost effective sustainable design solutions and implementation methodologies are encouraged.

2. Concrete up to M50 grade is generally being used for bridges and structures on National Highways in India. Indian Roads Congress (IRC) has published IRC: SP: 70-2016 "Guidelines for the Use of High Performance Concrete in Bridges" which provides for use of High Performance Concrete/Self-Compacted Concrete up to M90 grade. It is, however, observed that use of High Performance Concrete/Self-Compacted Concrete (M60 to M90 grade) is limited to a few long span extra dose/cable stayed bridges only.

Bidur Kant Jha

3. Properly designed Ultra-high-performance fiber reinforced concrete (UHPFRC) which have following superior characteristics are being used in some developed countries:

- Available up to Grade M150MPa
- Available up to ultimate tensile strength 8MPa and ultimate flexural strength 30MPa.
- At least 4-6 times stronger than normal concrete (in compressive strength)
- Much more durable than conventional concrete
- Longer service life
- Reduced deck height
- Lower carbon footprint

4. Recently UHPFRC girders have been used in Sole River Bridge at Km 42+050 of NH -752K near Latur (2x56m span). Few more bridges/viaducts of span varying from 50-72m have been approved for construction. A bridge over Ganga River parallel to JP Setu in Patna is under planning that envisages use of UHPFRC girders for 100m span.

5. On careful consideration of the advantages of UHPFRC, it is found that UHPFRC girders may be preferred in long span bridges i.e. span length ranging from 50m to 100m in India. In the urban viaduct structures, where generally 30m standard span is used, span length can be increased to 60m with use of UHPFRC. It can also be used for smaller span.

6. To promote use of UHPFRC girders in bridges and structures in India, following has been decided:

6.1. While preparing detailed project report, Consultants shall evaluate both traditional PSC girders and UHPFRC girders for elevated corridors/ viaduct sections and bridges having length 500 m and above and consider the preferred alternative in cost estimate and analysis. Similar exercise shall also be done if aggregate length of bridges having span length greater than 30m and viaduct sections is greater than 2000m in a single project.

6.2. The French design standard and material specification to be referred are NF P18-710- " National addition to Euro code 2 – Design of concrete structures: specific rules for Ultra-High Performance Fibre-Reinforced Concrete (UHPFRC) & NF P18-470- "Concrete - Ultra-High Performance Fiber-Reinforced Concrete - Specifications, Performance, Production and Conformity".

6.3. Concessionaire/Contractor is free to use UHPFRC girders in its design. IE/AE shall review and approve the design without any prejudice.

6.4. Although usage of UHPFRC is expected to result in significant cost savings and reduction in life cycle costs, it is decided at this stage that the cost implications of

Bidur Kant Jha.

using the technology may be fully absorbed within the Agreement cost of the project until further orders and the Authority (i.e. executing agency) shall neither demand for any share of cost reduction benefits nor pay/compensate for additional expenses incurred by the Concessionaire / EPC Contractors as per the Ministry's policy circulated vide letter No. RW/NH-33044/18/2020-S&R (P&B) dated 14.12.2020 even if the changes are accompanied by reduction in number of foundations and piers.

6.5. Defect liability period of such bridges/structures will be 10 years irrespective of whether defect liability period of the project is 5 years.

6.6 Concessionaire/contractor shall submit a detailed bridge inspection plan on completion of the construction works to the Ministry for approval. Concessionaire/contractor, IE/AE, Authority shall jointly conduct periodic inspection of the structure and will prepare a condition monitoring report. This report shall be prepared and submitted to the Ministry on half-yearly basis till completion of the defect liability period unless otherwise decided by the Ministry.

7. It is requested that the contents of the letter may be brought into the notice of all concerned for needful compliance.

8. This issues with the approval of Competent Authority.

विदुर कान्त झा / Bidur Kant Jha
निदेशक / Director
सड़क परिवहन एवं राजमार्ग मंत्रालय
Ministry of Road Transport & Highways
भारत सरकार / Government of India
नई दिल्ली / New Delhi-110001

Yours faithfully,

Bidur Kant Jha 22-02-2022

(Bidur Kant Jha)
Director
(New Technology for Highway development)
For DG (RD) & SS

Copy to:

1. All CEs in the Ministry of Road Transport & Highways
2. All ROs of the Ministry of Road Transport & Highways
3. The Secretary General, Indian Roads Congress
4. Technical circular file of S&R (P&B) Section
5. NIC-for uploading on Ministry's website under "What's new"

Copy for information and necessary action to:

1. Sr. PPS to Secretary (RT&H)
2. PPS to DG (RD) & SS
3. Sr. PPS/ PPS to Addl. Secretary (Road Safety)/ Addl. Secretary (RT&H & LA)
4. Sr. PPS/ PPS to AS&FA
5. Sr. PPS/ PPS to ADG (SKN) / ADG (RP)/ ADG(DS)
6. Sr. PPS/ PPS to JS (RT&MVL)/ JS (EIC) / JS (Logistics)/ JS (NHIDCL)

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RDSO GUIDELINES BS-136

RDSO Guidelines for the use of Ultra High-Performance Concrete in Railway Structures.

Issued on 08.03.2024

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THE UHPFRC COMPANY

वी.के. पाण्डेय
V.K. Pandey
कार्यकारी निदेशक/पु०एवंसं०-II
Executive Director/B&S-II

भारत सरकार–रेल मंत्रालय
अनुसन्धान अभिकल्प और मानक संगठन
लखनऊ–226011
Government of India-Ministry of Railways
Research Designs & Standards Organisation
Lucknow- 226011
Phone/ Fax: 0522-2465704
Email: edbns2rdso@gmail.com

पत्रांक सं: CBS/PCB

दिनांक: 08.03.2024

Principal Chief Engineers:

1. Central Railway, Mumbai CST - 400001
2. Eastern Railway, Fairlie Place, Kolkata - 700001
3. East Central Railway, Hazipur - 844101
4. East Coast Railway, Bhubaneshwar - 751016
5. Northern Railway, Baroda House, New Delhi - 110001
6. North Central Railway, Allahabad - 211001
7. North Eastern Railway, Gorakhpur - 273001
8. Northeast Frontier Railway, Maligaon, Guwahati - 781061
9. North Western Railway, Jaipur - 302001
10. Southern Railway, Park Town, Chennai - 600003
11. South Central Railway, Rail Nilayam, Secunderabad - 500371
12. South East Central Railway, Bilaspur - 495004
13. South Eastern Railway, Garden Reach, Kolkata - 700043
14. South West Railway, Hubli - 580023
15. Western Railway, Mumbai - 400020
16. West Central Railway, Jabalpur - 482001
17. Metro Railway, Jawaharlal Nehru Road, Kolkata – 700071

विषय: Guidelines for use of Ultra High Performance Concrete in Railway Structures

संदर्भ: 1. Railway Board's letter No 2022/19/CE-III/BR/RDSO/1 Dated 19.10.2023.
2. RDSO letter No. CBS/PCB Dated 13.02.2024.

1. Railway Board vide Ref.1 above had entrusted Bridge & Structure Directorate, RDSO to prepare a guideline for use of Ultra High Performance Concrete in Railway Structures.
2. The draft guideline was sent to all Zonal Railways and Railway PSU's for their Feedback/comment vide Ref.2 above. Guideline have been revised based on feedback received.
3. Please find enclosed herewith the "*Guidelines for use of Ultra High Performance Concrete in Railway Structures*" as BS-136. The copy of the same is enclosed herewith for information & necessary action please.
   It may also be accessed at Railnet link
   http://10.100.2.4/drawing/frmPage.aspx?id=15

संलग्नक: As above

08/03/24

(विनय कृष्ण पांडेय)
(Vinay Krishna Pandey)
कार्यकारी निदेशक /पुल एवं संरचना-II
Executive Director/B&S-II

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LIST OF UHPFRC Project Executed and Under Progress

Bridge No.	Bridge Name	Authority	Span Arrangement (m)	Total Length (m)	Total Width (m)	Status	GIRDER Type
1	Latur Br.	MORTH Through MSRDC	2 x 55.5	111	16	Completed	BBG2400-55.5m
2	Mahad Br. CH161+400	PWD NHAI Division	1 x 33.9	33.9	16	Completed	BT1500-33.9m
3	Kharwandi CH.18+889	PWD NHAI Division	2 x 30	60	16	Completed	BT1500-30m
4, 5	Samruddhi Br1. CH531+068 &107	MSRDC	1 x 52	52	35	Completed	UBG2250-51.8m
5 ,6	Samruddhi Br2. CH531+968	MSRDC	1 x 52	52	35	Completed	UBG2250-51.8m
7	Taloja Creek Br.	PWD Maharashtra	2 x 33	66	8.25	Completed	BT1500 - 32.6 m
8	Dharmapuri- 145+635	NHAI	1 x 102.6	102.6	16	Completed	UBG4000-102.6m
9	Dharampuri- 137+979	NHAI	1 x 60	60	32	Completed	UBG3000-57.5M
10, 11	Dharmapuri- 142+465 (MCW)	NHAI	3 x 35	105	21	Completed	BT1500-34m
	Dharmapuri- 142+465 (SR)	NHAI	3 x 35	105	21.6	Completed	BT1500-34m
12	Dharmapuri- 138+875	NHAI	1 x 60	60	16		UBG3000-57.5M
13	TNT - RTO Flyover Span 1	PWD NHAI Division	1 x 65	65	17.2	Completed - Erection Pending	UBG3000-65M
14	TNT - RTO Flyover Span 2	PWD NHAI Division	1 x 65	65	17.2	Completed - Erection Pending	UBG3000-65M
15, 16, 17	TURBHE ROB - Flyover	PWD Maharashtra	38 x 30	1140	11.6289	In Progress	BT1500 -30m
18, 19	Vehicular Overpass Chandni Chowk (Main span)	NHAI	1 x 57	57	38.6	Completed	UBG2250 - 57m
	Vehicular Overpass Chandni Chowk (Ramp)	NHAI	6 x 23 - 35m	193	16		BT1500 -30m
20	Pandoh Nerchwok 206+650	MoRTH	1 x 32	32	25	In Progress	BT1500 -32m
21	Pandoh Nerchwok 207+270	MoRTH	1 x 20	20	25	In Progress	BT1500 -20m
22	Pandoh Nerchwok 209+510	MoRTH	1 x 39	39	25	In Progress	BT1500 -39m
23	Raipur, Chhattisgarh 155+340	MoRTH	2 x 35	70	12.9	In Progress	BT1500 -35m
24	Raipur, Chhattisgarh 147+970	MoRTH	4 x 35	140	12.9	In Progress	BT1500 -35m
25	Raipur, Chhattisgarh 133+090	MoRTH	3 x 47	141	12.9	In Progress	UBG2250-47m
			1 x 35	35	12.9	In Progress	BT1500-35m
26	DHARAMPURI - 145+902	NHAI	1 x 34	34	32	In Progress	BT1500-34m
27,28	DHARAMPURI - 124+630 (MCW)	NHAI	2 x 30	60	21	In Progress	BT1500-30m
	DHARAMPURI - 124+630 (SR)		2 x 30	60	21.6	In Progress	BT1500-30m
29	DHARAMPURI - 127+538	NHAI	2 x 29	58	32	In Progress	BT1500-29m
30	DHARAMPURI - 129+506	NHAI	1 x 35	35	32	In Progress	BT1500-35m
31	DHARAMPURI - 141+350 - Flyover	NHAI	2 x 32.5	65	22	In Progress	BT1500-32.5m

Projects In India

Total Cumulative orders of - 21000 cum (in hand)

Total Cumulative orders of 63 Bridges (in hand)

LIST OF UHPFRC Project Executed and Under Progress

Bridge No.	Bridge Name	Authority	Span Arrangement (m)	Total Length (m)	Total Width (m)	Status	GIRDER Type
	DHARAMPURI - VUP Projects						
32	Ch. 119+160	NHAI	2 x 10.5	22	21.5	In Progress	IB850 - 21.5 m
33	Ch. 136+400	NHAI	2 x 10.5	22	21.5	In Progress	IB850 - 21.5 m
34	Ch. 152+700	NHAI	2 x 10.5	22	21.5	In Progress	IB850 - 21.5 m
35	Ch. 131+300	NHAI	2 x 10.5	22	21.5	In Progress	IB850 - 21.5 m
36	Mumbra Bridge overlay	PWD Maharashtra	50 x 30	1500	15	Completed	-
37	INDORA FLYOVER - NAGPUR	NHAI	VARIOUS spans of 60 m, 80m and 90 m with total bridge length of 5950 m			In Progress	Various
38	Thirunavaya Bridge, Kerala	RBDCK, Govt of Kerala	13 x 62	806	11	In Progress	mUBG3000
39	VUP on Solapur Hydrabad Highway (302+050)	NHAI	2 x 20	40	2 x 16	Completed	BT1500 - 20m
40	Extension to Major Bridge on Solapur Hydrabad Highway (322+450)	NHAI	2 x 32.24	64.48	3.5	Completed	BT1500-30m
41,42	Bridge at Ch. 175+075	TIPL - NHAI	1 x 55	55	2 x 16	In Progress	UBG2250
43,44,45,46,47,48,49,50	8 Nos of Major Bridges on Kolhapur-Ratnagiri 4 Lane Highway	NHAI				In Progress	BT1500-37.5
51,52,53,54	Missing Link Project on Mumbai Pune Expressway.	Navyuga - MSRDC	16 x 25 + 35	435	24.95 x 2	In Progress	BT1500-25m
55,56	2 Bridgs on Mumbai Goa Highway	MoRT&H	3 x 37.5	112.5	16 x 2	In Progress	BT1500-37.5
57	Taloja Creek Br. (New Reconstruction)	PWD, Maharashtra	2 x 67.06	134.12	13.55	In Progress	UBG3000 - 66.06
58	Taloja Creek Br.	PWD Maharashtra	2 x 33	66	8.25	In Progress	BT1500 - 32.6 m
59	Bhoj Morbe Pkg. 17 Major Bridge	NHAI	2 x 21.25	95	3 x 31.76	In Progress	BT1500 - 32.6 m
60	FORMULA 3 Race track Building	Private					
61	Marwah Towers Arches	Private					
62, 63	Firodia Township Bridges	Private					

UHPFRC PROJECTS IN INDIA AS ON DATE = 77 NOS
COMPLETED PROJECT TILL DATE = 24 NOS

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A Record Breaking 100m Span Bridge near Phaltan, Pune.

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Stressing Activity for Kashedi Ghat Project – Mumbai Goa Highway



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Erection Works in Progress at Kashedi Ghat Project

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USE OF T GIRDER (BT1500) – BEED, Maharashtra



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BT1500 – 35 m SPAN Girder Erection

(Palkhi Marg Project)





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BT1500 GIRDERS AT BHOJ MORBE PROJECT

- 2 BRIDGES 3 x 30 m MAJOR BRIDGE AT Ch 69+940
- 1 FLYOVER – 1 x 30 m at Ch. 79+000





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Bridges on SAMRUDDHI EXPRESSWAY

(Use of UBG2250)

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GIRDER LAUNCHING IN PROGRESS @ Ch. 531+90[illegible]

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RTO FLYOVER AT NAGPUR-

65 m span





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CHANDNI CHOWK INTERCHANGE

BUSIEST INTERCHANGE IN PUNE – CROSSING MORE THAN 1,00,000 PCU’s per day.

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Transportation and Handling of U Girder



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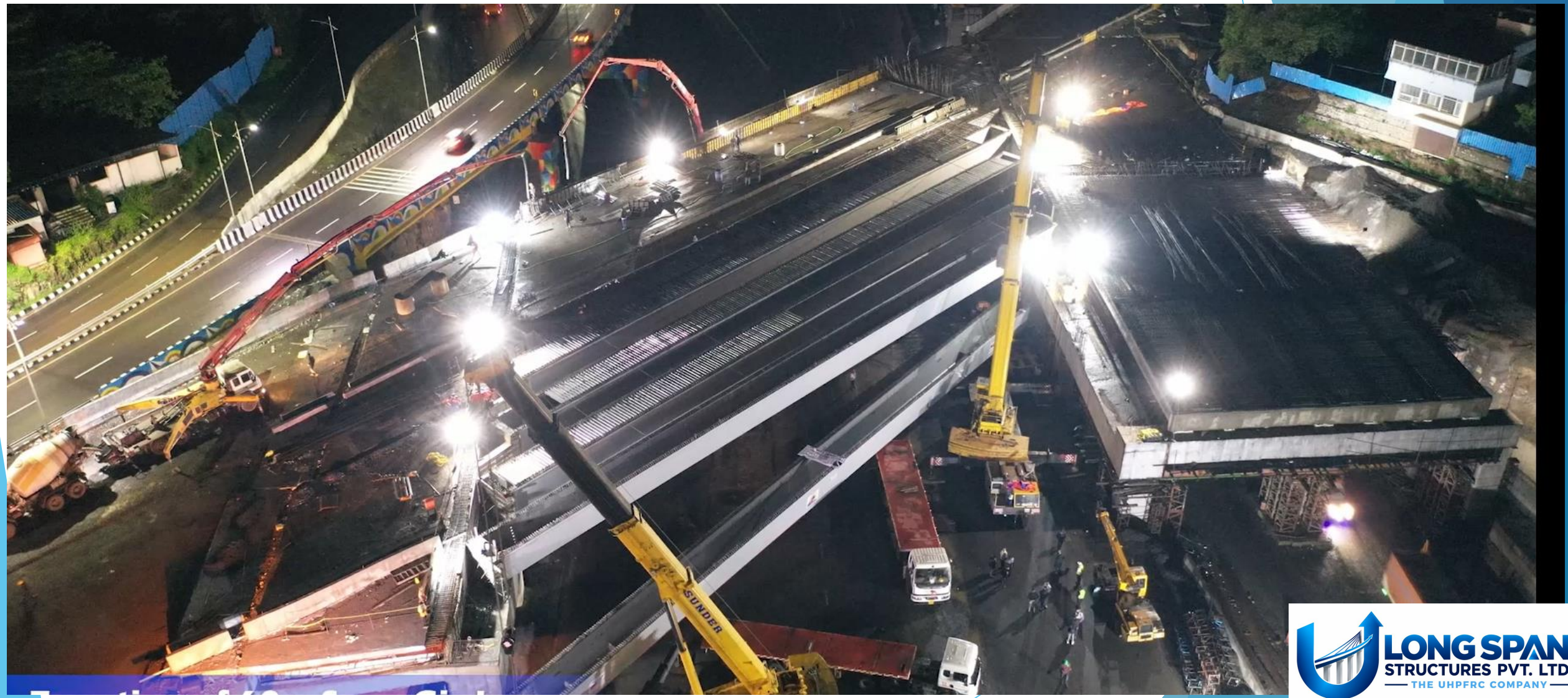
Erection of Chandni Chowk Girders



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Missing Link Project on Mumbai – Pune Expressway

- **35m span UHPFRC girders for elevated viaduct**





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INDORA FLYOVER in NAGPUR - 2.36 km in length

World Longest UHPFRC Structure once completed- 2.36 km

- 34 Girders of 60 m span
- and two spans of 90 m each.





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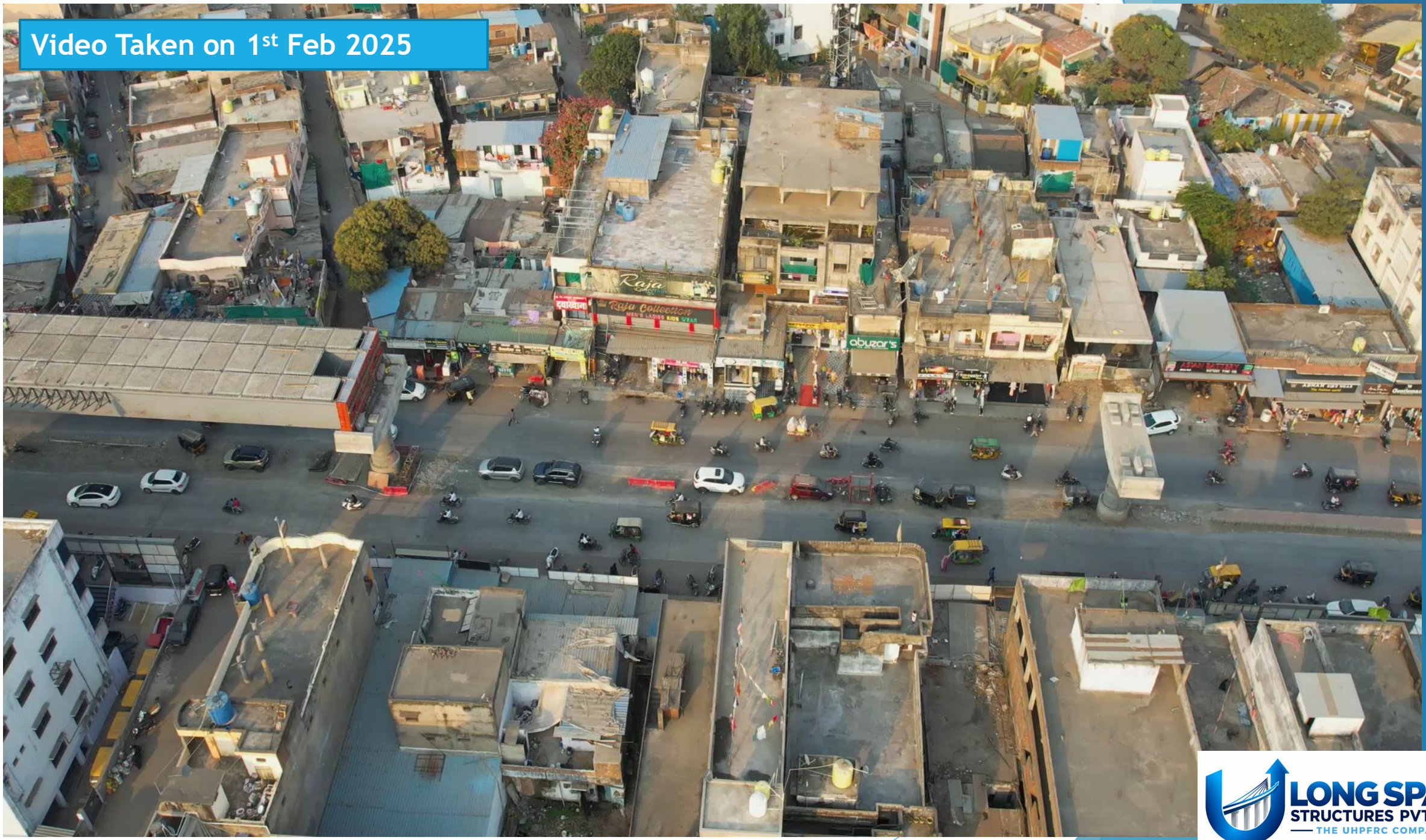
Video Taken on 1st Feb 2025



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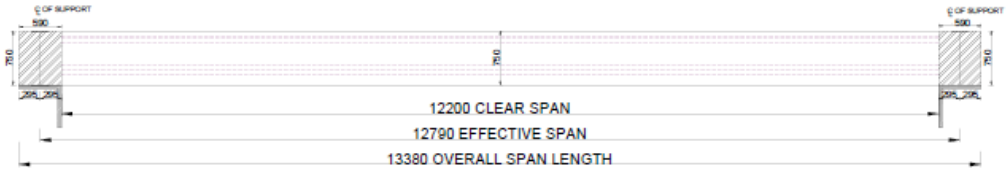
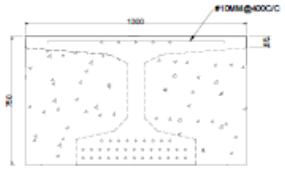
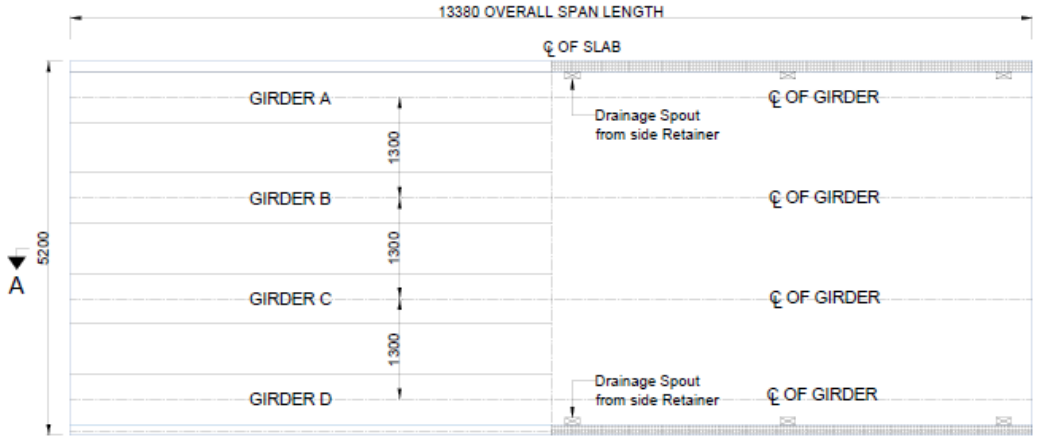
Relevance of UHPFRC for Railways / Metros



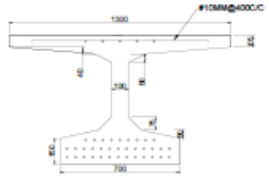
SECTION A-A



SECTION AT SUPPORT



PLAN



SECTION AT MID

UHPFRC SECTION DETAILS

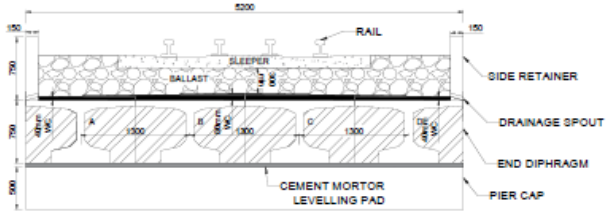
GENERAL NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. ALL CORNERS SHALL HAVE A CHAMFER OF 25 mm.
3. CONCRETE FOR BALLAST RETAINERS SHALL BE OF GRADE M45.
4. CONCRETING SHALL BE DONE IN ACCORDANCE WITH IRS: CONCRETE BRIDGE CODE WITH 20 mm MAXIMUM SIZE AGGREGATE. (FOR NORMAL CONCRETE)
5. ALL PRESTRESSING STEEL BE OF 15.24mm NOMINAL DIA. UNCOATED, STRESS RELIVED LOW RELAXATION SEVEN-PLY STANDS (CLASS II) CONFORMING TO IS:14268 WITH MINIMUM ULTIMATE TENSILE STRENGTH 1860 MPa. INITIAL PRESTRESS SHALL BE 78.3% UTS.
6. APPLIED INITIAL PRESTRESSING FORCE AND CORRESPONDING THEORETICAL VALUE OF TENDON ELONGATION AT THE JACKING END GIVEN IN TABLE 1.THE THEORETICAL VALUE OF TENDON ELONGATION IS BASED ON ASSUMED VALUES OF NOMINAL AREA OF EACH STRAND AND MODULUS OF ELASTICITY OF STEEL (E) AS 140 mm² AND 195 kN/mm² RESPECTIVELY. THE THEORETICAL VALUE OF TENDON ELONGATION SHALL, HOWEVER, BE CALCULATED FROM ACTUAL AND MODULUS OF ELASTICITY OF STEEL (ES) BASED ON MANUFACTURER'S TEST CERTIFICATE.THE ELONGATION GIVEN IN THE TABLE.
7. SUITABLE SPACERS AT A SPACING OF 1.0 m C/C SHALL BE PROVIDED TO MAINTAIN THE CABLE PROFILE AS STIPULATED.
8. NON-PRESTRESSING STEEL SHALL BE OF HIGH STRENGTH DEFORMED (HSD)/TMT BARS FE500D CONFORMING TO IS:1786.
9. THE DESIGN IS SUITABLE FOR LOCATIONS OF MODERATE AND SEVERE ENVIRONMENT EXPOSURE CONDITION AS DEFINED IN CLAUSE 5.4.1 OF IRS CONCRETE BRIDGE CODE.
10. THE DESIGN IS SUITABLE ONLY FOR TYPE-I SLEEPER. MONOBLOCK SLEEPERS.
11. THE DESIGN HAS BEEN DONE CONSIDERING 300 mm TO 400 mm BALLAST CUSHION BELOW SLEEPER.
12. THE DESIGN IS SUITABLE FOR STRAIGHT TRACK ONLY WITH MAXIMUM 100 mm MISALIGNMENT.
13. PIER AND ABUTMENT STRUCTURE SHALL BE RAISED AS SHOWN IN GENERAL ARRANGEMENT TO RESTRAIN SEPARATION OF UNITS FOR ZONEII & III.
14. DATE OF CASTING AND DRAWING No. SHALL BE ENGRAVED ON EACH UNIT.
15. ELASTOMERIC BEARINGS MAY BE DESIGNED & PROVIDED IN CASE STRENGTHENING OF SUB-STRUCTURE IS NOT DESIRED.
16. FOR SEISMIC ZONE IV & V BEARING SHOULD BE AVOIDED ELSE THESE SHOULD BE SUITABLY DESIGNED FOR ADDITIONAL SEISMIC FORCES.

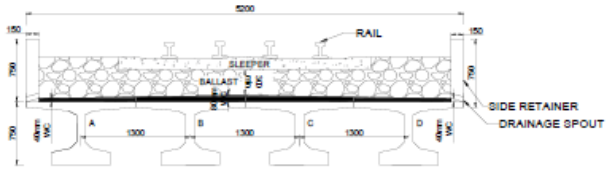
Table 1:

PRESTRESSING SCHEDULE

Sr. No.	TYPE	STRAND DIA.(mm)	JACKING FORCE (KN)	LENGTH OF STRAND	ELONGATION BEFORE SLIP (MM)	CUTTING LENGTH OF STRAND (MM)
1	13S15	15.24	2653.66	13380	100.31	16380
2	13S15	15.24	2653.66	13380	100.31	16380
3	9S15	15.24	2449.53	13380	100.31	16380
4	5S15	15.24	926.0	13380	100.31	16380



CROSS SECTION AT SUPPORT



CROSS SECTION AT MID

Table 2: Stress Chart

Description	Stresses in Concrete				Permissible Stress (N/mm2)	
	Support(N/mm2)		Mid Span(N/mm2)			
	Top	Bottom	Top	Bottom	Tension	Compression
At Transfer	-0.19	-5.50	-2.2	-43.8	8	-84
At Final Stage for Serviceability Limit Stress	-0.643	-4.745	-26.8	-13.0	4	-84
For Ultimate Limit Stress	Ultimate Design Bending Moment of Girder At Mid = 4046 KNm					
	Ultimate Moment of resistance of Girder at Mid = 4681 KNm					

(+) Positive Values represents Tension
(-) Negative Values represents Compression

Proof Checked & Approved By:
Dr. ANANTH RAMASWAMY
PROFESSOR
DEPT. OF CIVIL ENGINEERING
Indian Institute of Science
Bangalore - 560 012

LEGEND:

UHPFRC = Ultra-high Performance Fibre Reinforced Concrte.
℄ = Center line.

REV.	DATE	
R0	03.08.2024	FOR REVIEW
CHECKED BY	SPJ	
CONCEPT BY	SPJ	
DRAWN BY	NAG	

RDSO
Research Design & Standard Organisation
2- DGMTinance,RDSO, Manak Nagar-Lucknow-226011
CLIENT

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ADD: SR. NO. 85/5/1, OFF MUMBAI PUNE EXPRESSWAY,KIWALE, PUNE, MAHARASHTRA- 412101

NAME OF PROJECT :
STANDARD DEATILS FOR IB 750(R) UHPFRC GIRDER FOR 5.2 M WIDTH & 13.38 M SPAN

TITLE :
GENERAL ARRANGEMENT & DETAILED DRAWING FOR 12.2M UHPFRC GIRDER

DRAWING NO: LSSPL/RDSO/12.2/1001
REVISION R0

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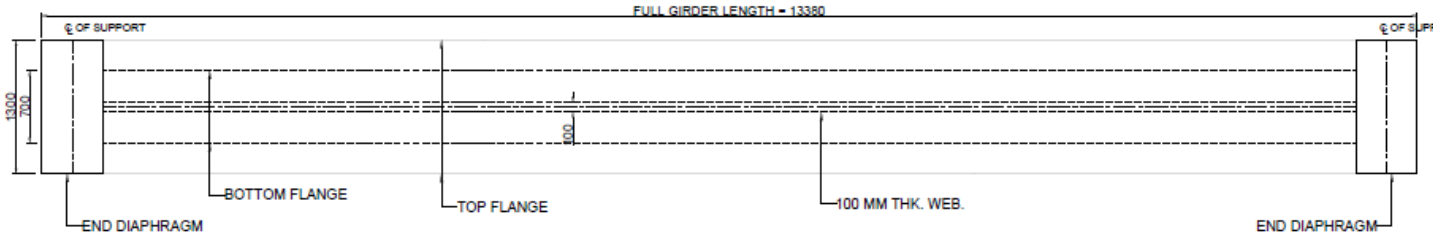
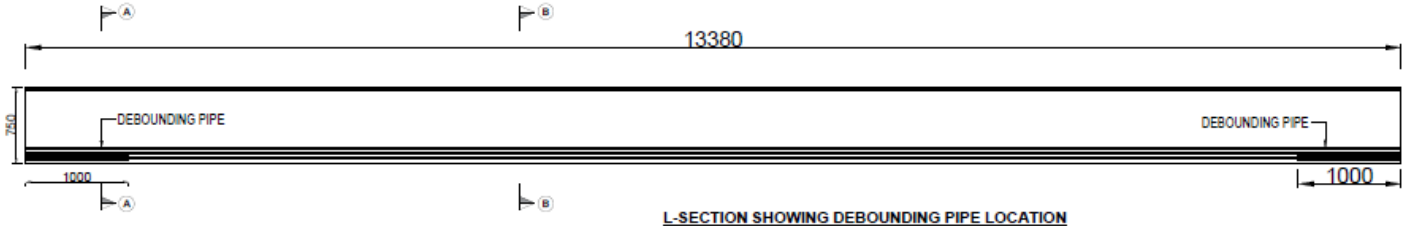
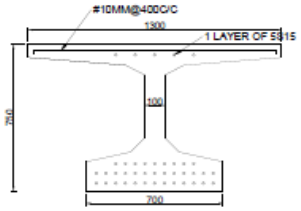


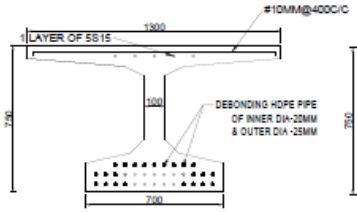
PLAN



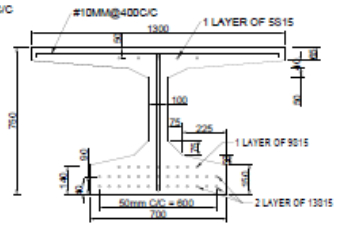
L-SECTION SHOWING DEBOUNDING PIPE LOCATION



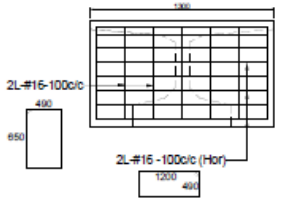
DE-BONDING DETAILS OF TOP STRANDS - (B-B)



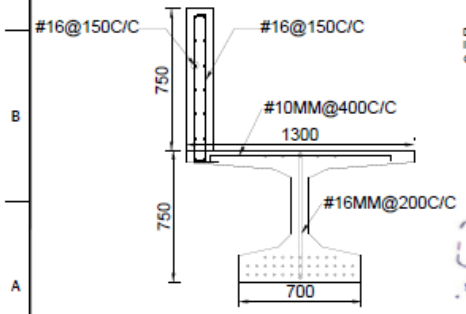
DE-BONDING DETAILS OF BOTTOM STRANDS - (A-A)



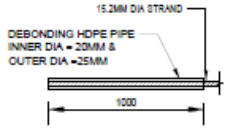
TOP AND BOTTOM STRAND ARRANGEMENT



END DIAPHRAGM R/F DETAILS



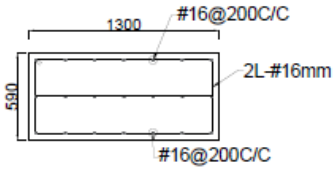
SIDE RETAINER REINFORCEMENT DETAILS



DE-BONDING PIPE DETAILS

Table 3: Theoretical Deflection Sequence:

Sr.No.	Description of Stages	Cumulative Deflection At Mid for Various Stages(mm)
1	Self Weight	2.66
2	Prestressing with Initial Losses	28
3	Laying of Ballast & Track Wearing Coat	21.4
4	Without Live Load In Service	14.7
5	With Live Load	7.7



PLAN OF END DIAPHRAGM

Proof Checked & Approved By:
Dr. ANANTH RAMASWAMY
PROFESSOR
DEPT. OF CIVIL ENGINEERING
Indian Institute of Science
Bangalore - 560 012

SPECIAL NOTES ON UHPFRC :

SPECIFICATIONS.PERFORMANCE,PRODUCTION AND CONFORMITY NFP. 18 470-2016: FRENCH STANDARD: CONCRETE ULTRA-HIGH PERFORMANCE FIBRE REINFORCED CONCRETE (UHPERC):

1. THE UHPFRC USED SHALL BE STEEL FIBER REINFORCED GRADE 140/155 CONCRETE. THE UHPFRC USED SHALL COMPOSE OF THE FOLLOWING RAW MATERIALS
   a. ORDINARY PORTLAND CEMENT COMPLY WITH THERE REQUIREMENT OF MS522-PART2;
   b. FINE SAND WITH MAXIMUM GRANULAR SIZE NOT LARGER THAN 1.5 mm AND COMPLY WITH THE REQUIREMENT OF ASTM C-33;
   c. DENSIFIED SILICA FUME (CEMENT REPLACEMENT SHALL NOT LESS THAN 10% AND SHALL NOT MORE THAN 25%) COMPLY WITH THE REQUIREMENT OF ASTM C-1240,
   d. STEEL MICRO-STEEL FIBER WITH TENSILE STRENGTH ABOVE 2500 MPa WHICH MANUFACTURED FROM HIGH CARBON STEEL WIRE COMPLY WITH THE REQUIREMENT OF ASTM A 820-2006. ALL THE STEEL FIBER USED MUST COME WITH CE CERTIFICATE;
   e. POLYCARBOXYLATE BASED HIGH-RANGE WATER REDUCER WITH MIN 30% OF SOLID,
2. THE WATER-TO-BINDER RATIO OF THE CONCRETE MIX SHALL NOT MORE THAN 0.18.
3. THE AMOUNT OF STEEL FIBER INCLUDE IN THE CONCRETE MIX DESIGN SHALL NOT LESS THAN 1.5% BY VOLUME, (Ie, 120 kg/m³).
4. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL BE OF GRADE C130/145 AND HAS 28 DAYS CHARACTERISTIC CYLINDER COMPRESSIVE STRENGTH OF f-140 MPa: OR CHARACTERISTIC CUBE COMPRESSIVE STRENGTH OF 155 MPa, COMPLY TO REQUIREMENT OF BS EN 12390-3: 2012.
5. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL HAS 1 DAY AND 28 DAYS MEAN CUBE COMPRESSIVE STRENGTH OF f_{arme}- 70 MPa AND 155 MPa AND ABOVE, RESPECTIVELY. COMPLY TO REQUIREMENT OF Bs EN 12390-3: 2012.
6. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL HAS THE FOLLOWING 28 DAYS CHARACTERISTIC VALUE OF THE LIMIT OF ELASTICITY UNDER TENSION - 5 MPa AND ABOVE: AND CHARACTERISTIC VALUE OF POST-CRACKING TENSILE STRENGTH f_{ext} 7 MPa AND ABOVE, COMPLY WITH ANNEX D OF NF P18-470: 2016-07.
7. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL BE WATER TIGHT. THEREFORE THE 28 DAYS MEAN WATER ABSORPTION SHALL BE LESS THAN 0.5% COMPLY TO BS 1881-PART 121, 1983; WATER
8. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL BE WATE TIGHT. THEREFORE THE 28 DAYS MEAN DEPTH OF PENETRATION OF LESS THAN 5mm, COMPLY TO BS EN 12390-8: 2009
9. THE UHPFRC USED IN THE PRECAST ELEMENTS SHALL HAVE SUPERIOR DURABILITY. THEREFORE THE RAPID CHLORIDE PERMEABILITY TEST (RCPT) VALUE SHALL NOT BE MORE THAN 100 COULOMB) UNDER PRESSURE AS PER ASTM C1202-2017.

SEQUENCE OF CONSTRUCTION :

1. STRESSING OF STRANDS SHALL BE DONE BEFORE UHPFRC CONCRETING.
2. PROVIDING LAYING OF CEMENT MORTOR LEVELLING PAD OVER PIERS/ABUTMENT.
3. ALL THE UNITS SHALL BE PRELAID WITH WEARING COAT OF CEMENT MORTAR (M25 GRADE) OF SPECIFIED THICKNESS AS PER THIS DRAWING.
4. SIDE RETAINER SHALL BE CASTED BEFORE LAUNCHING.
5. LAUNCHING AND PLACING OF UNITS IN POSITION OVER PIERS/ABUTMENTS BY SUITABLE METHOD.
6. BALLASTING OVER BRIDGE GIRDER AND PLACEMENT OF SLEEPER
7. LAYING AND LINKING OF TRACK.

RDSO — Research Design & Standard Organisation, 2- DDITfinance,RDSO, Manak Nagar-Lucknow-226011 — CLIENT

LONG SPAN STRUCTURES PVT LTD — LONGSPAN STRUCTURE PVT.LTD ADD: SR. NO. 85/5/1, OFF MUMBAI PUNE EXPRESSWAY, KIWALE, PUNE, MAHARASHTRA- 412101

REV.	DATE	
R0	03.06.2024	FOR REVIEW
	CHECKED BY	SPJ
	CONCEPT BY	SPJ
	DRAWN BY	NAG

NAME OF PROJECT : STANDARD DEATILS FOR IB 750(R) UHPFRC GIRDER FOR 5.2 M WIDTH & 13.38 M SPAN

TITLE : REINFORCEMENT & HT STRAND DETAILS FOR 12.2M UHPFRC GIRDER.

DRAWING NO: LSSPL/RDSO/12.2/1/002 — REVISION R0

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80 m Span – MRT Line – Railway Girder.





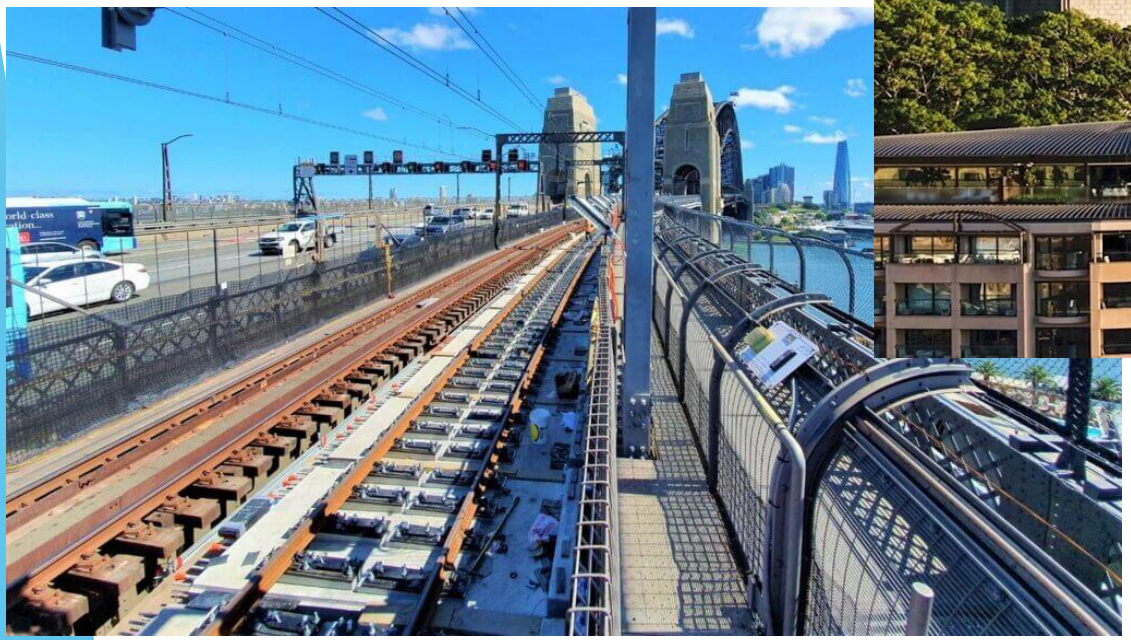
40m Span Mono-Rail Girder in Japan





Sydney Harbour bridge – Replacement of wooden sleepers with Ballast Less Track





Sydney Harbour bridge (Contd..)







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Railway Bridges in Malaysia





Project Title:	**Design and Built for permanent rectification of Keretapi Tanah Melayu Berhad's (KTMB) bridge over New Klang Valley Expressway (NKVE) at KM 11.25 East Bound in Section C4**
GPS Coordinate:	**3.098421 N, 101.567234 E**
Structure Type:	**Single Spans 25.5m by 12m Wide Composite Bridge System**
Superstructure Type:	**20 pieces of DURA® IB850-25.5m, with Cast In-Situ RC Deck**
Loading Type:	**Railway Loading**

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Application for Metro Station Buildings







- Typical Length of Station Building is 140 m
- Under limitation of conventional concrete and difficulties in erection, 13m to 17 m short spans are adopted.
- This requires, main metro viaduct piers also at shorter span.
- Thus, 8 Piers with 8 pier arms needed for both concourse and platform level.
- These additional piers and pier arms results increase in construction time and cost.
- Even for such short spans, steel girders are used which are very costly.

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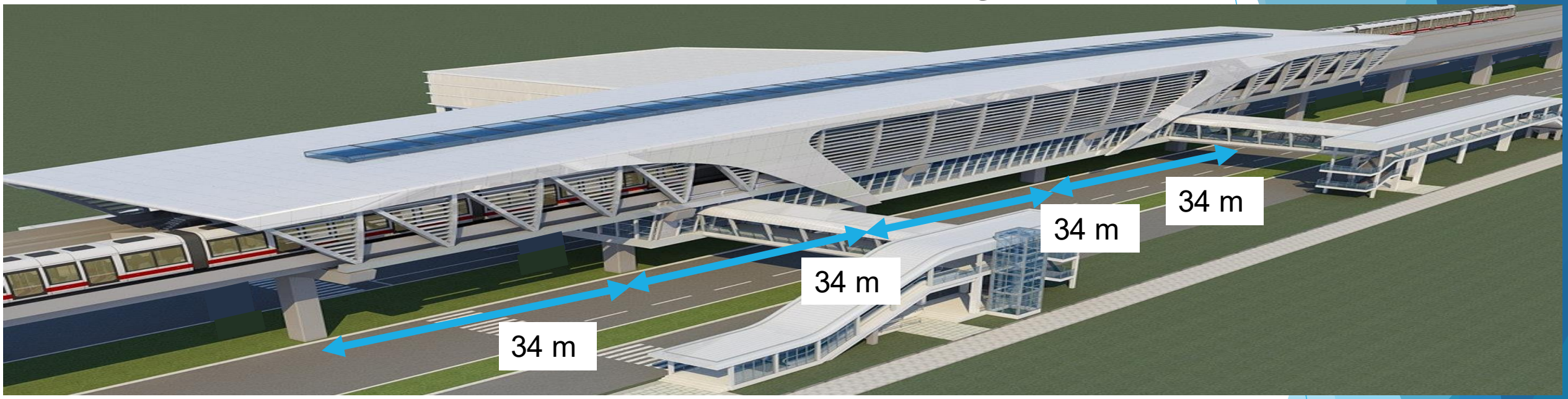
Use of Long span lightweight UHPFRC Girders for Metro Station Buildings



- Typical Length of Station Building is 140 m
- For Station Building, Main viaduct spans can be adopted using UHPFRC girders with span of 34 m. (2 x times the existing span)
- This enables, main metro viaduct piers at regular span of 34 m interval. No need of additional piers, pier arms, for both at concourse and platform leve.
- Thus, against 8 Piers / pier arms, only 4 piers / pier arms are needed for both concourse and platform level.
- These reduction piers and pier arms results saving in construction time and cost.
- UHPFRC Girders are very economical against steel girders.

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Application for Metro Station Buildings

Adoption of UHPFRC Girder system enables advantages as follows:

1. Reduction in 40% of concourse cross arms using long spans.
2. Being lighter weight concourse girders, cross arm will be same as of shorter span
3. Entry & Exit Steel FOB's can be converted to UHPFRC: zero maintenance cost, light weight structure
4. Portal stations can be made in precast UHPFRC beams will reduce number of concourse levels cross arms to 50%
5. Concourse and platform girders to be made in UHPFRC so that depth of the structure will be reduced. Overall impact in station height.
6. Cost reduction by 10% to 20%.
7. Construction time reduction by 20 to 25%.

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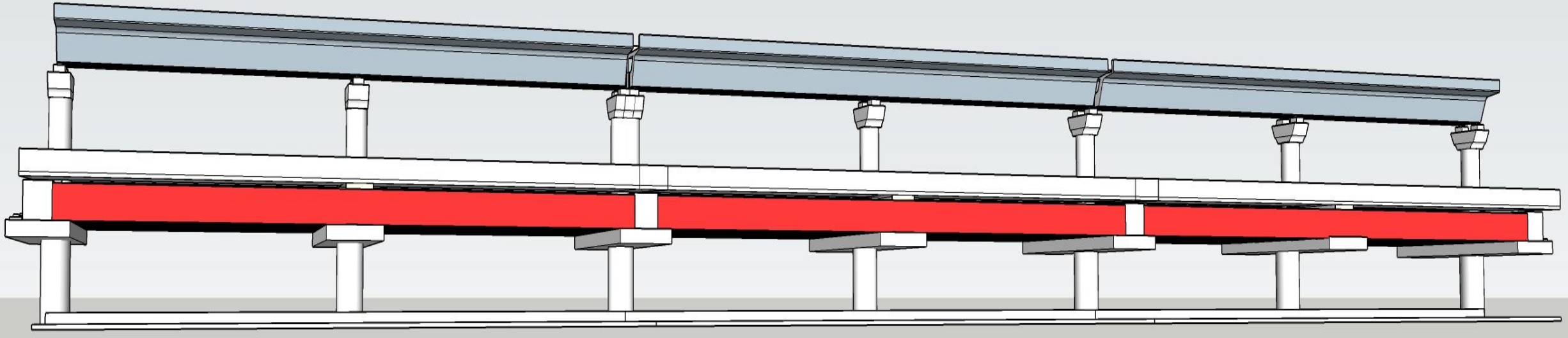
Application for Multi-level Elevated structures (Metro + Flyover)

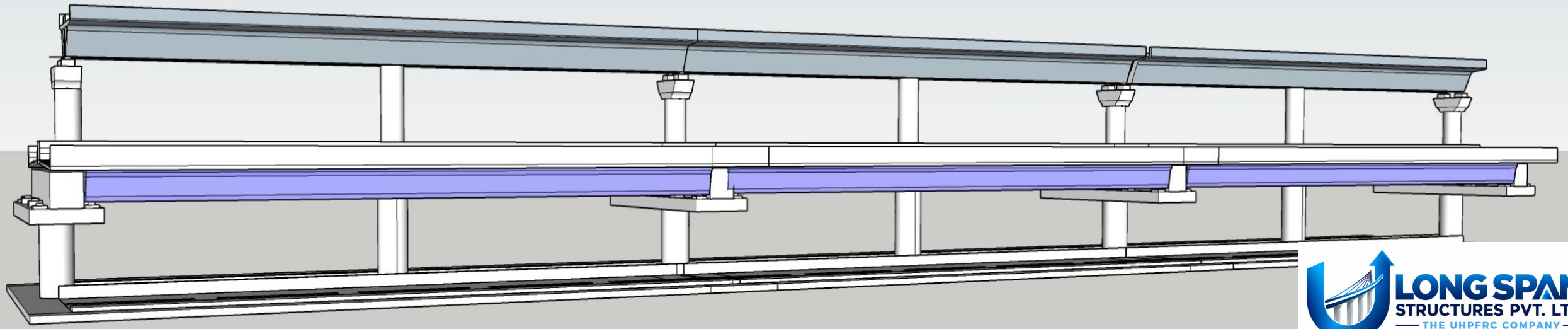
- Presently, Level 1 Road Flyover need to adopt metro span arrangement.
- Long spans for elevated structures results economy. However, metro span compulsion for flyover restricts this economy.
- If Longer spans for flyover are to be adopted, current option is Steel which is must costlier.
- With UHPFRC Long spans of flyover with common pier of metro, both economy as well as reduction in construction time can be achieved.

LONG SPAN STRUCTURES PVT. LTD.
THE UHPFRC COMPANY

PSC GIRDER ARRANGEMENT - With Cross Arms at Every Piers



UHPFRC GIRDER ARRANGEMENT - With Alternate Cross Arms



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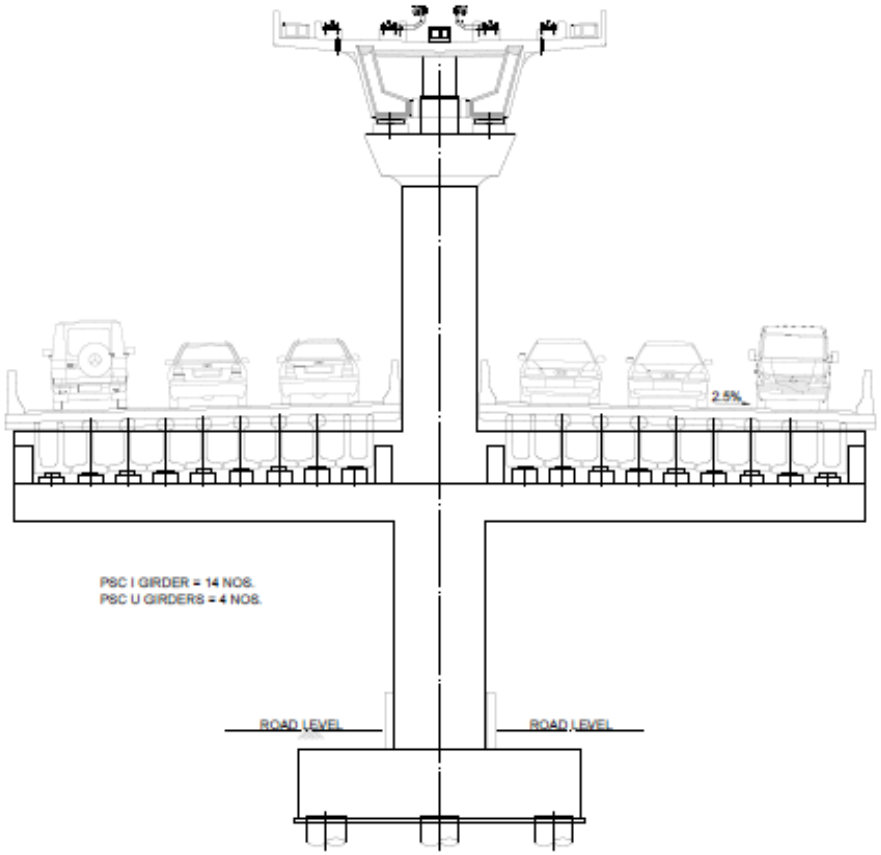
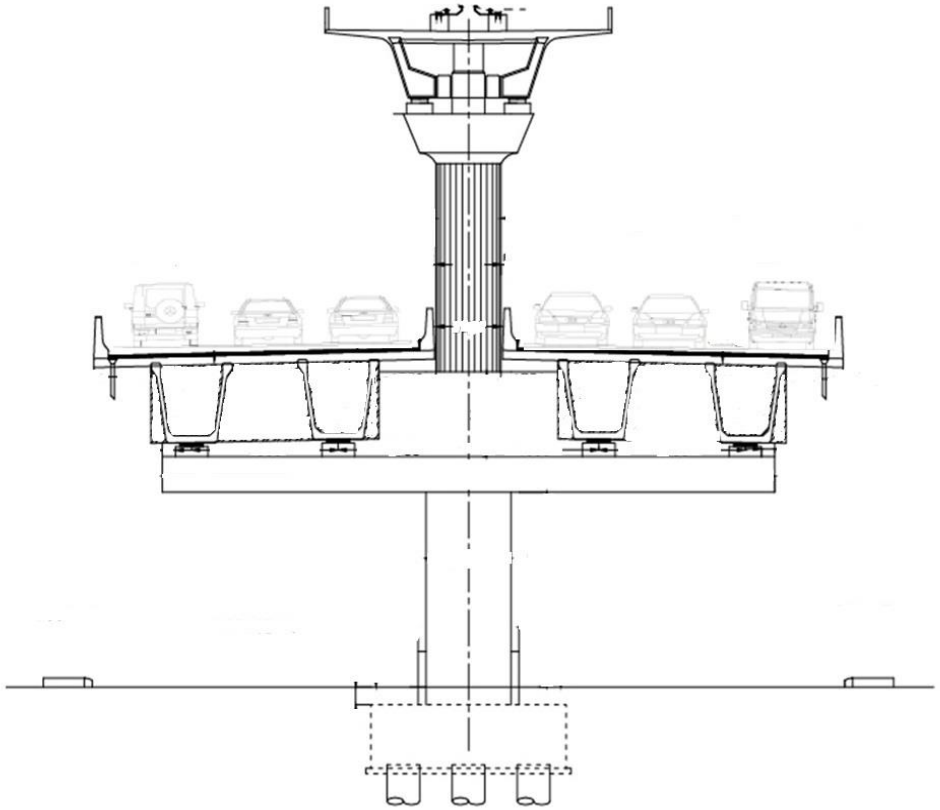
THE UHPFRC COMPANY

CONVENTIONAL PROPOSAL



18 No of girders with short span of 28m

UHPFRC PROPOSAL



4 No of girders with long span of 56m
Eliminating alternate pier Arm

Application for Foot-Over Bridges with longer span (Road/ Railways Crossing)

Conventional Method:

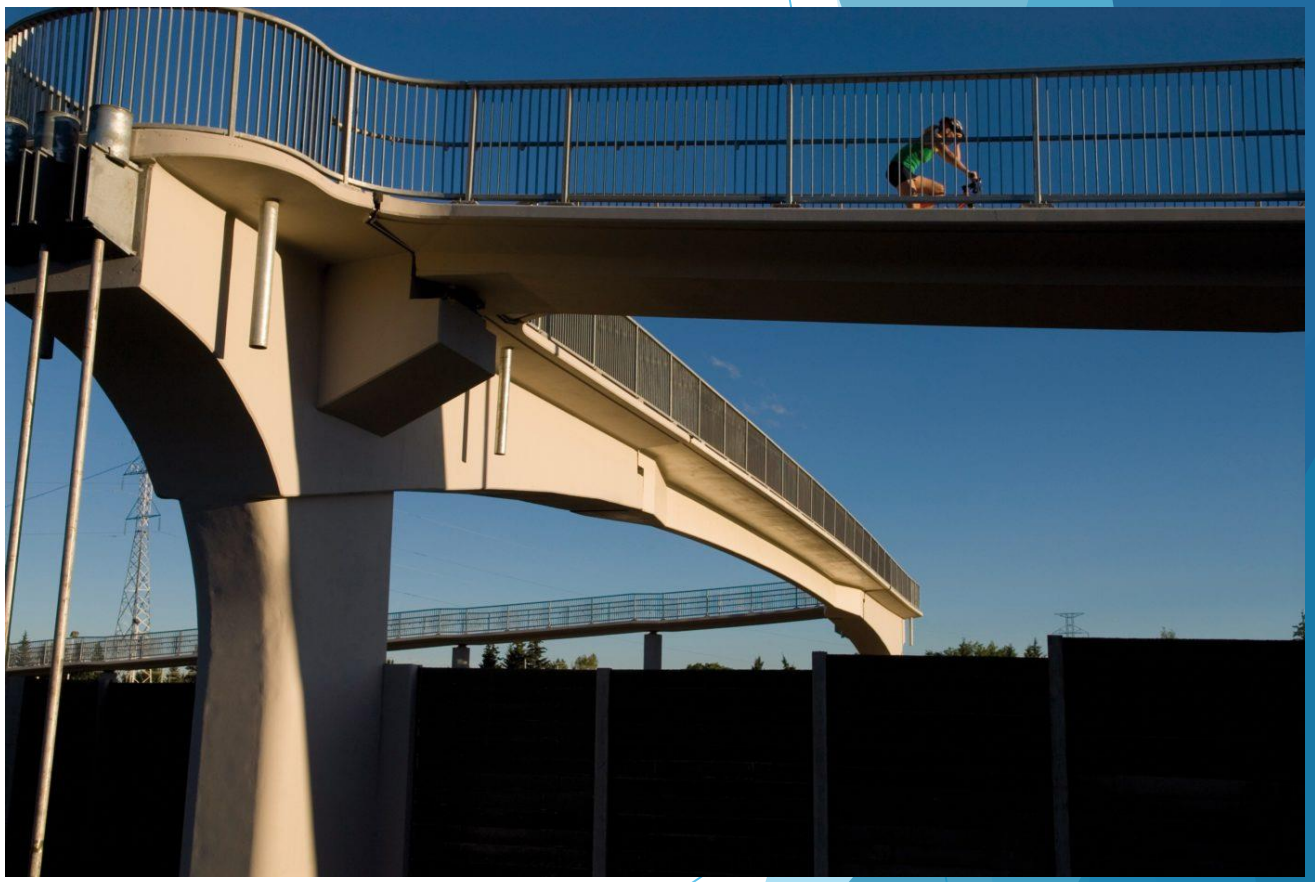
- Presently, FOB's crossing Roads & Railways are constructed with steel superstructure.
- Steel Superstructure- Initial High cost, Periodic maintenance required.
- Bulky and raw causing unpleasant appearance

UHPFRC Solution:

- Cost-Effective Solution.
- No Maintenance required.
- Reduction in construction period by 20% approx.
- Aesthetically pleasing appearance

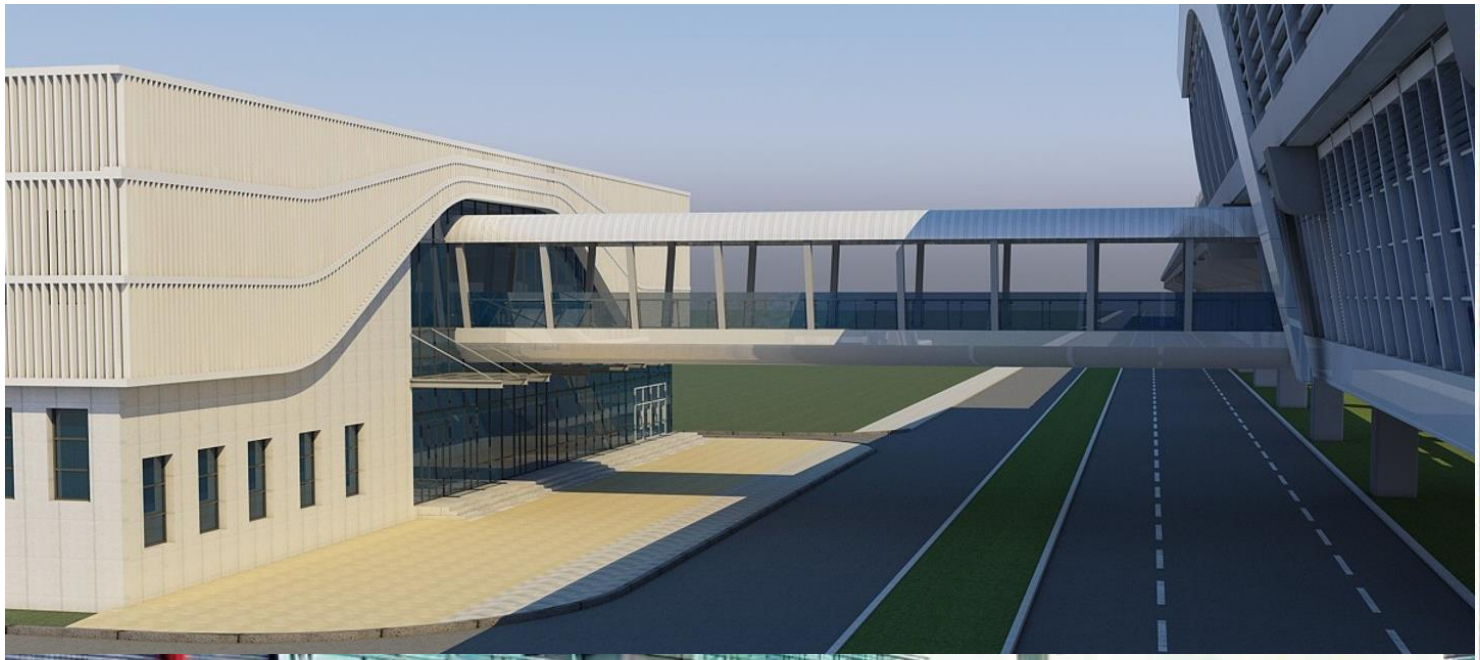
LONG SPAN STRUCTURES PVT. LTD.
THE UHPFRC COMPANY







LONG SPAN STRUCTURES PVT. LTD.
THE UHPFRC COMPANY







LONG SPAN
STRUCTURES PVT. LTD.
THE UHPFRC COMPANY

Mumbra Bridge Overlay



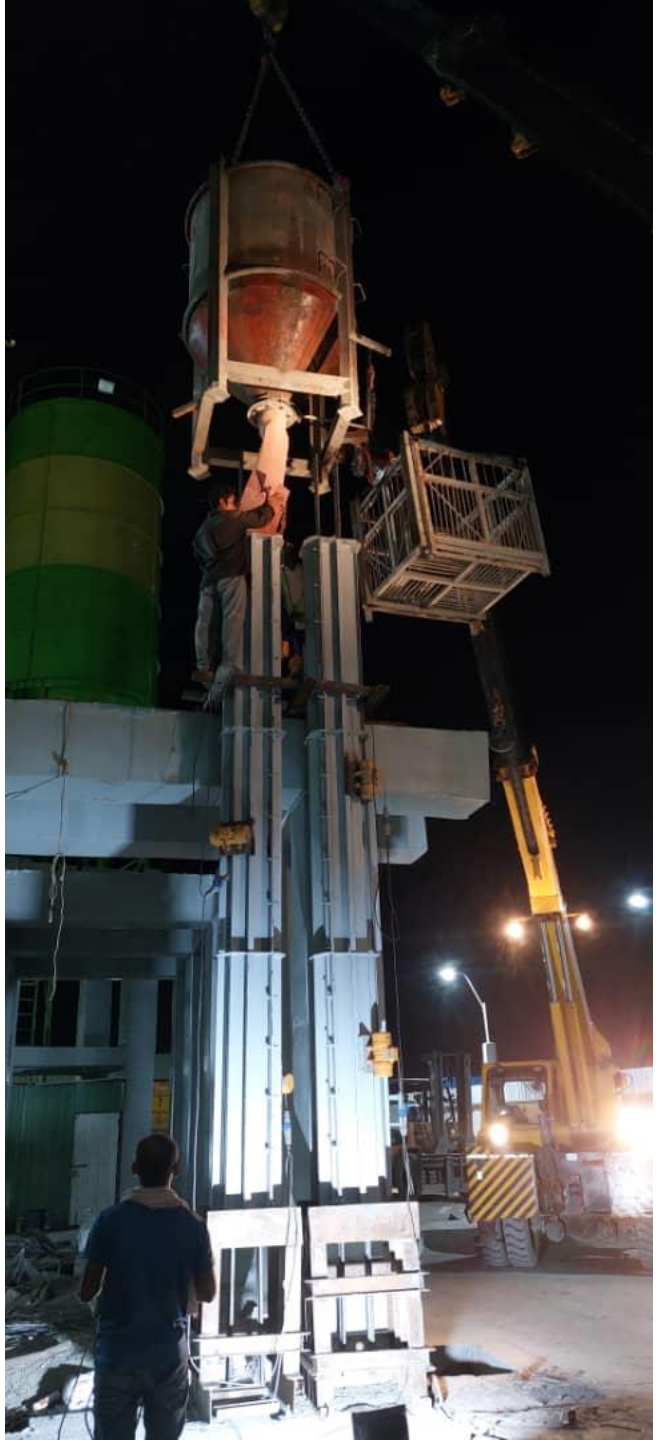
1478
Cum in
27 DAYS

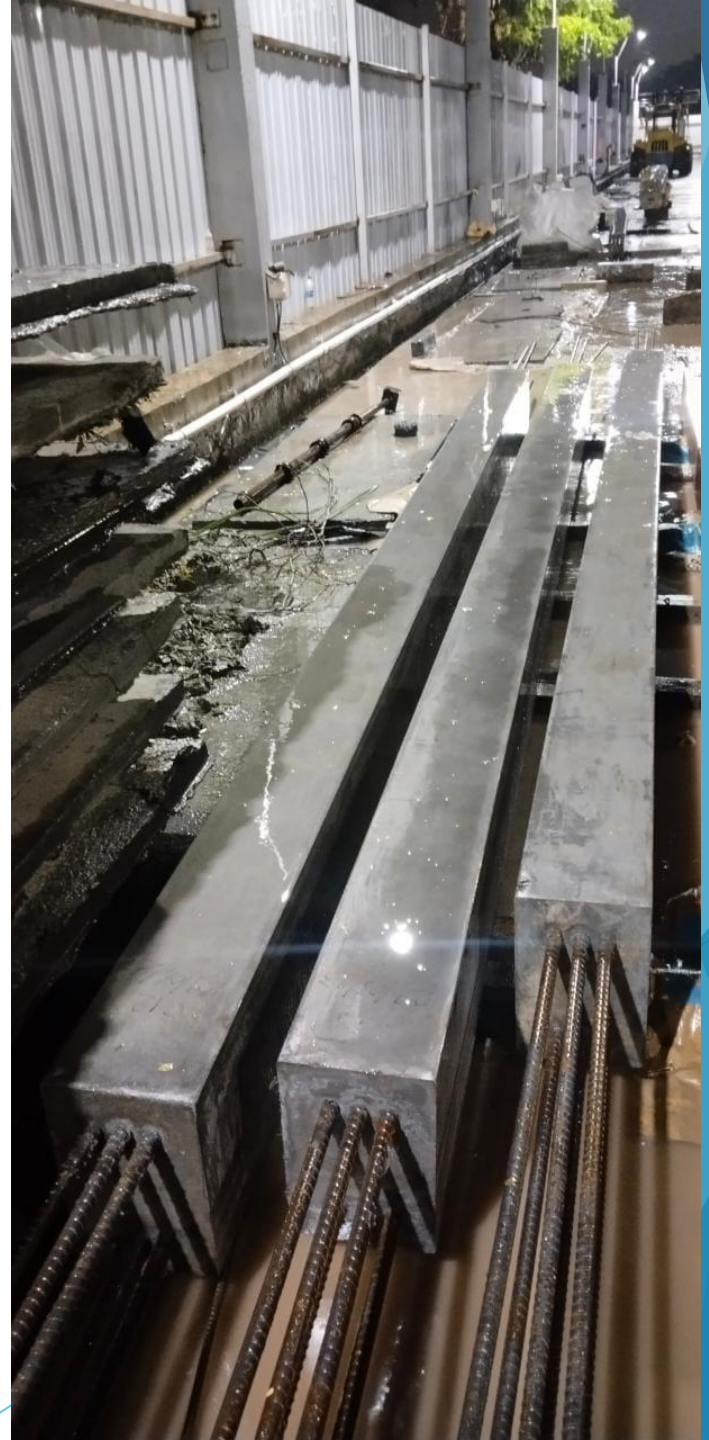
OTHER APPLICTIONS - Innovative Products Development

FORMULA F3 – PIT BUILDING

COLUMNS, beam and rafters.










CASE

Facades





Precast Driven Pile for Solar Projects







Anti-climb Walls




Partition Walls

1.5m High Retaining Wall (Ipoh, 2010)

DURA®
like concrete • like steel



Retaining Wall





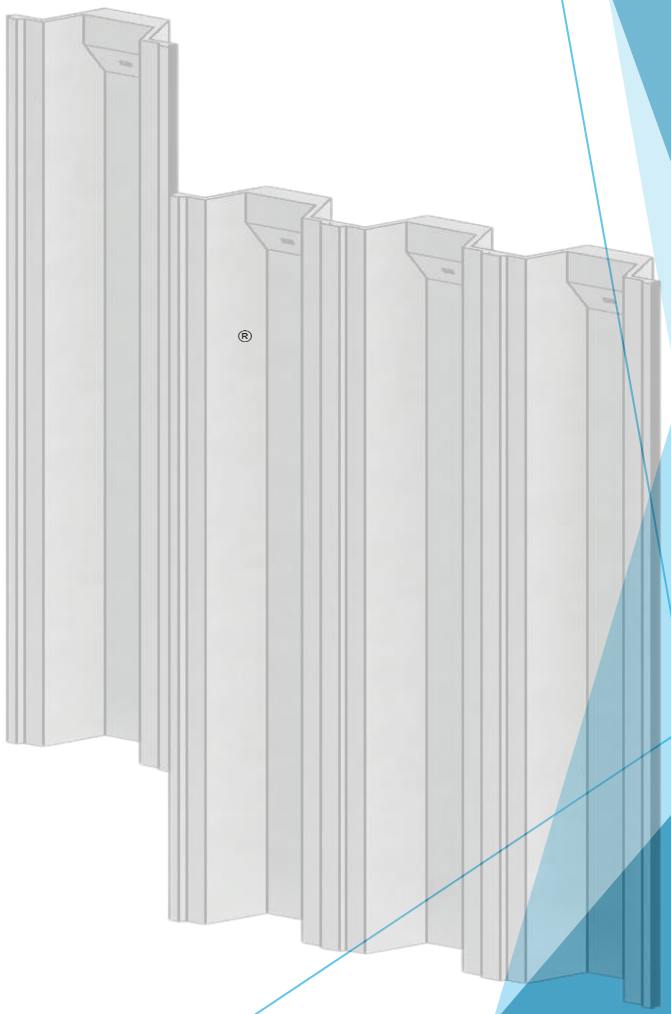
LONG SPAN STRUCTURES PVT. LTD.
THE UHPFRC COMPANY

CORRUGATED PRESTRESSED UHPFRC SHEET PILE (DURA PSP)



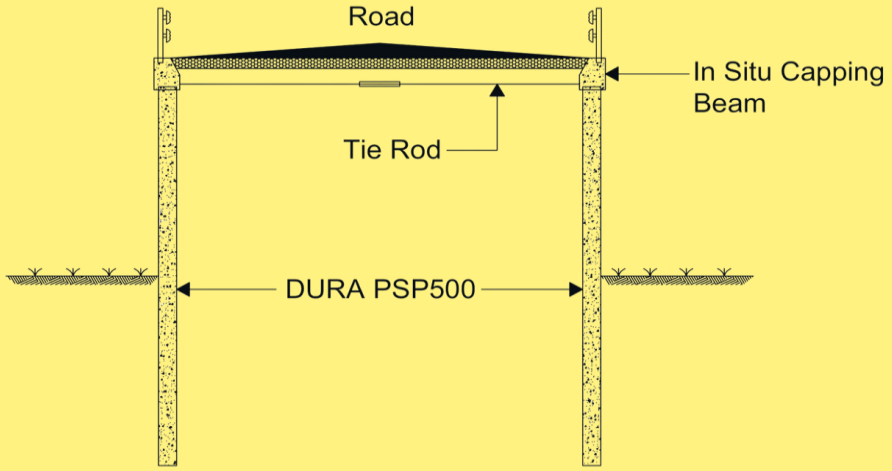
Introduction of DURA PSP

DURA UHPC (Ultra-High Performance Concrete) prestressed concrete sheet pile is an advanced and innovative type of sheet piles. These sheet pile is constructed using steel fibre reinforced UHPC, which is a sustainable specialized concrete material known for its exceptional strength, durability, and performance.

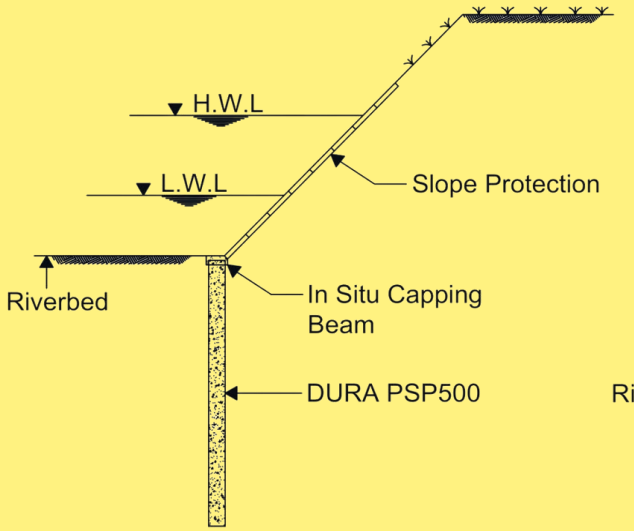


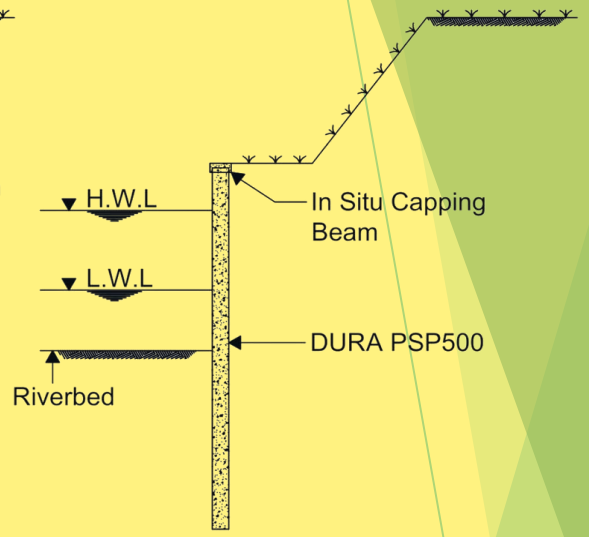
- Made from above grade 130/145 UHPFRC.
- Thinner and lighter elements
- Superior strength and durability
- Enhance in load-carrying capacity and resistance to bending and deformation
- High structural integrity and load-bearing capabilities
- Suitable for challenging environments, including harsh coastal conditions and corrosive marine environments.

Application of DURA PSP

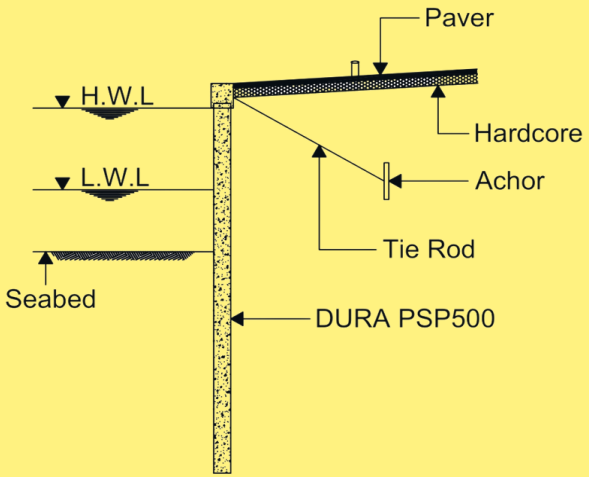


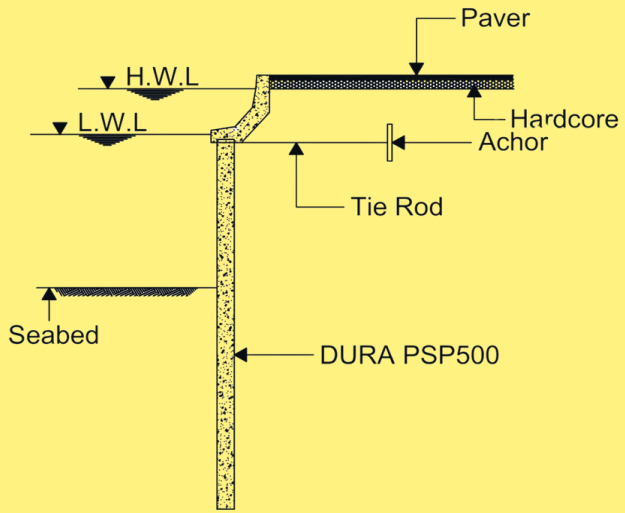
ROAD / RAILWAY EMBANKMENT



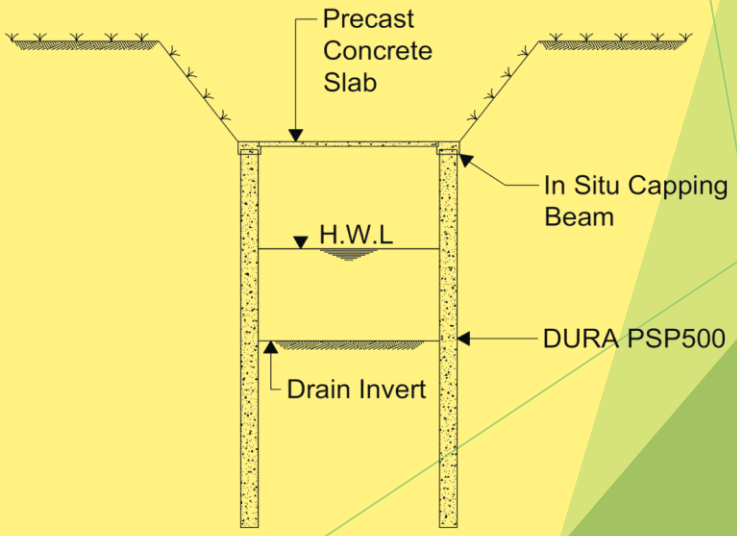


RIVER EMBANKMENT



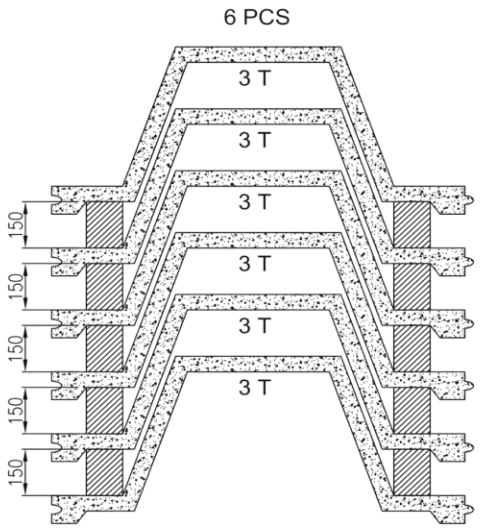


PORT STRUCTURE



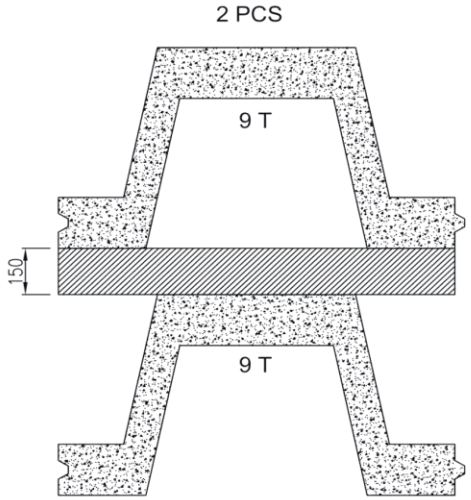
DRAIN / CULVERT

DURA PSP500: THIN AND LIGHT WEIGHT



DURA PSP500

CONVENTIONAL RC SP: THICK SECTION AND HEAVY



NORMAL PRECAST SP

Ease of Handling & Driving







LONG SPAN STRUCTURES PVT. LTD.
THE UHPFRC COMPANY

Production Sequence of DURA PSP®



Setting Up Mould



Placing and Prestressing



Concreting



Release of Pre-tensioning



QA/QC Strength Test



Inspection



Handling and storage



Transport to site



Driving of sheet pile



Final product of
DURA PSP

CORRUGATED PRESTRESSED UHPFRC SHEET PILE (DURA PSP)









DURA®
like concrete • like steel

Thank You