

ULTRA-HIGH PERFORMANCE FIBER REINFORCED CONCRETE



**LONGSPAN
STRUCTURES**
LONGSPAN STRUCTURES PVT LTD

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 100 times more **durable** than conventional concrete
 - Longer service and design life
 - Lower carbon footprint

How UHPFRC Compare to Reinforced Concrete?

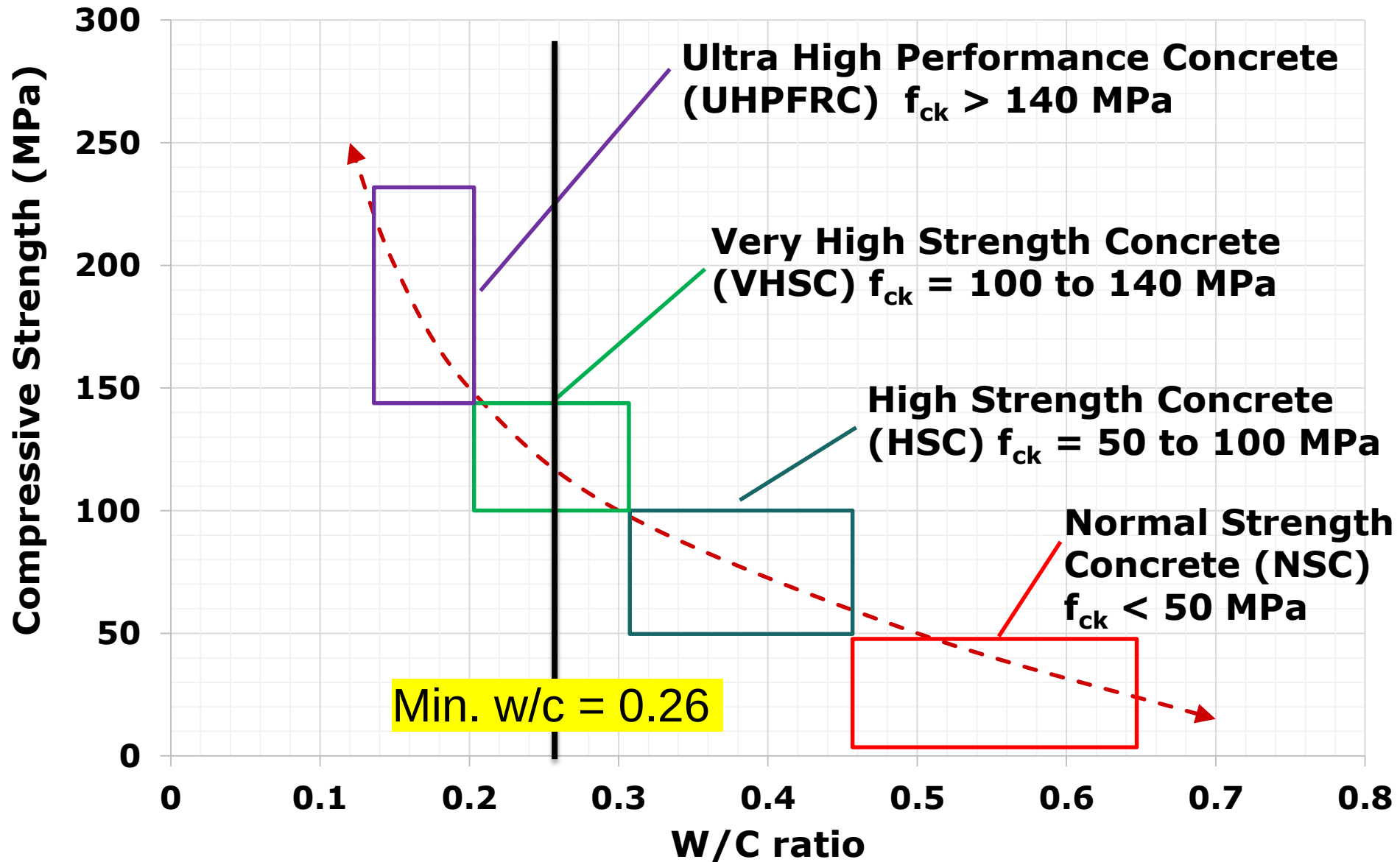
○ Reinforced Concrete

- 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

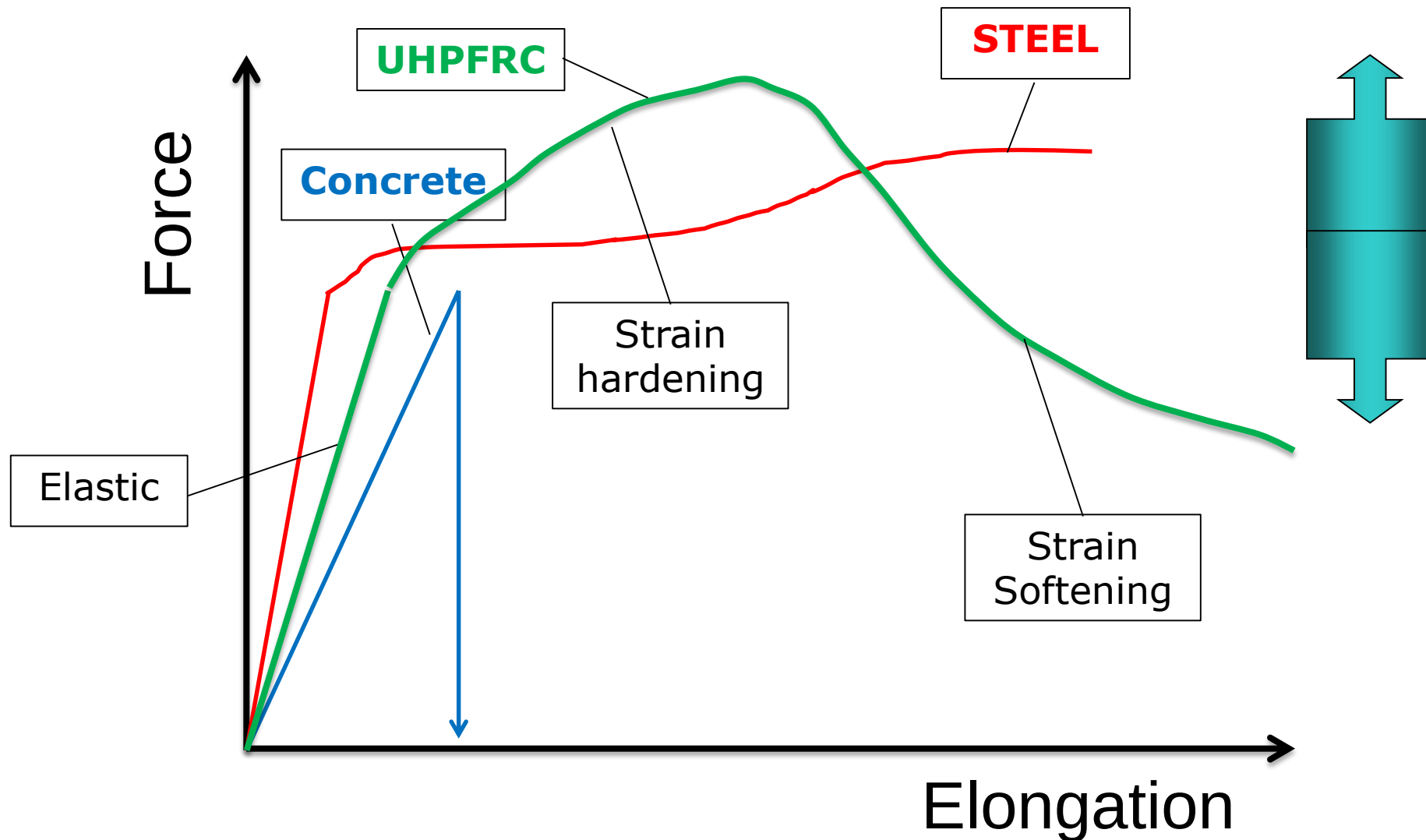
- Eliminate aggregate
- Mainly using steel fiber as reinforcement
- Steel bar is optional
- Concrete cover is not compulsory
- Highly flowable and mouldable
- Honeycomb almost impossible

Evolution of Concrete

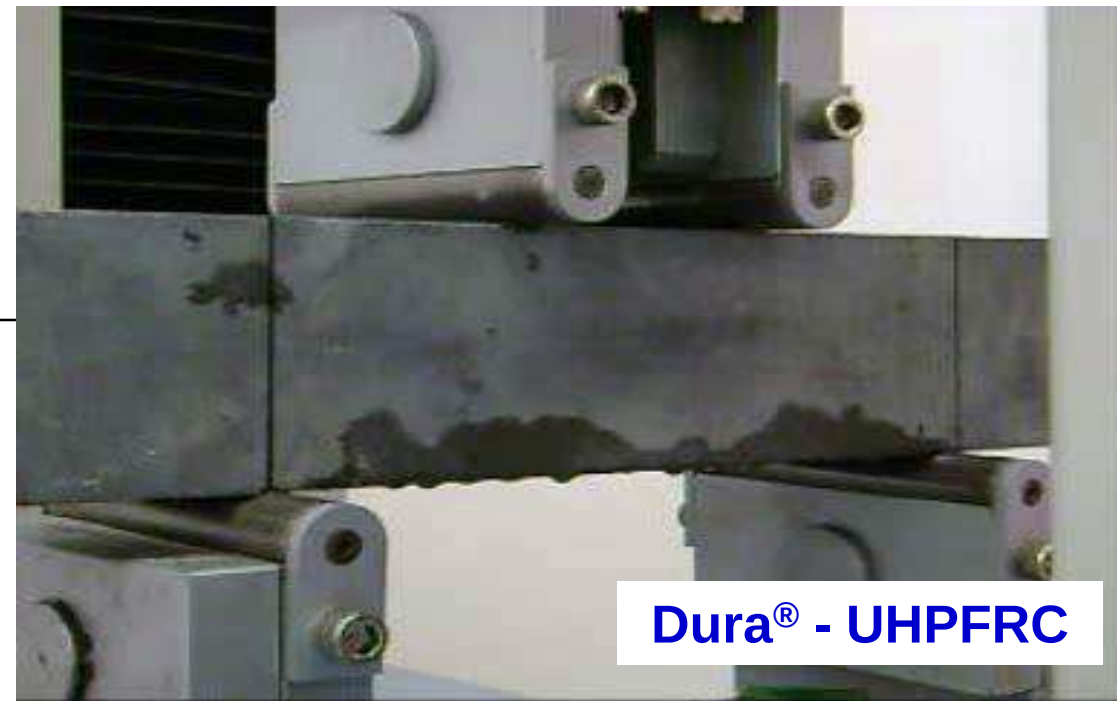
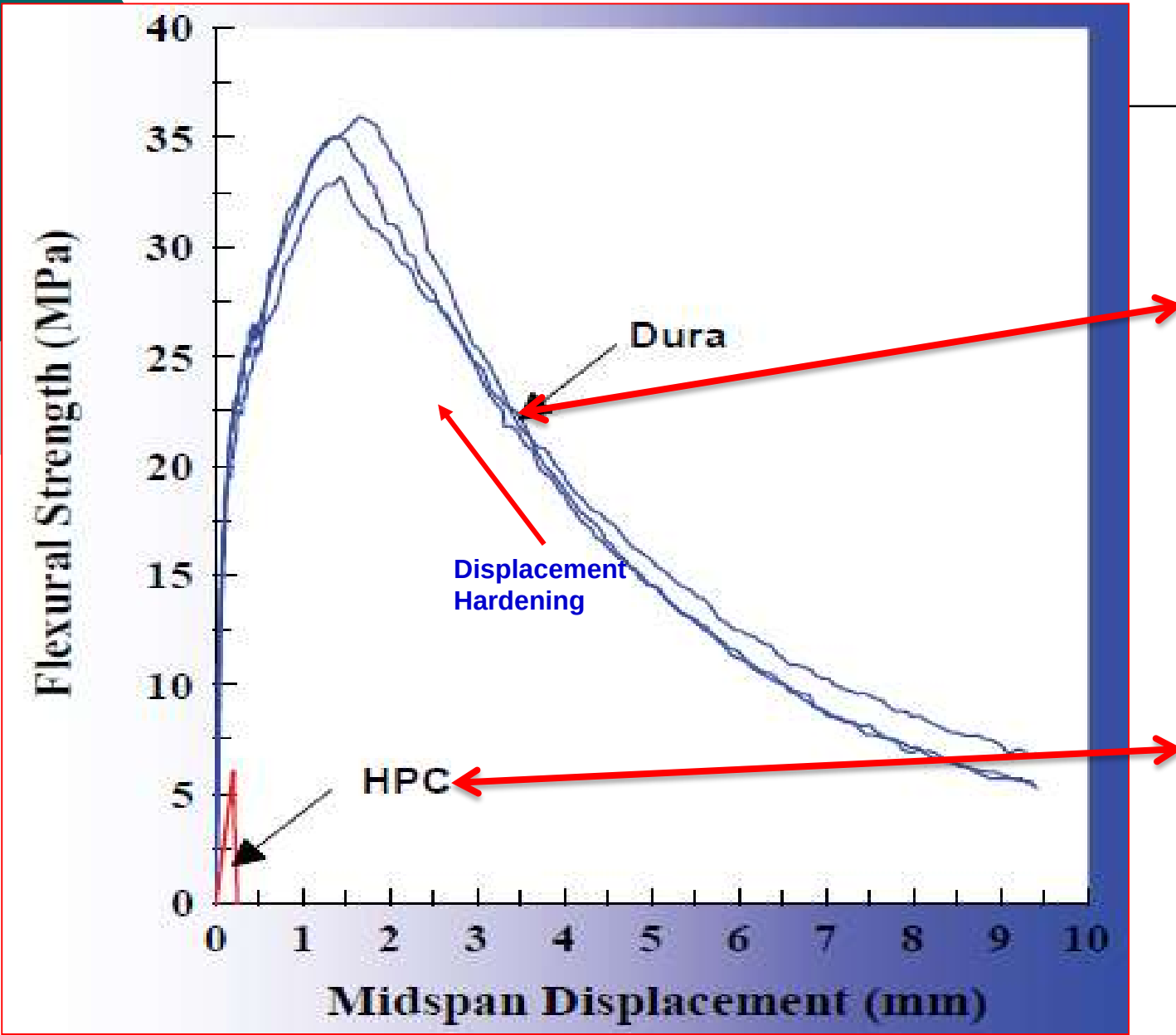


How **UHPC** Compare to **Steel** & **Concrete**?

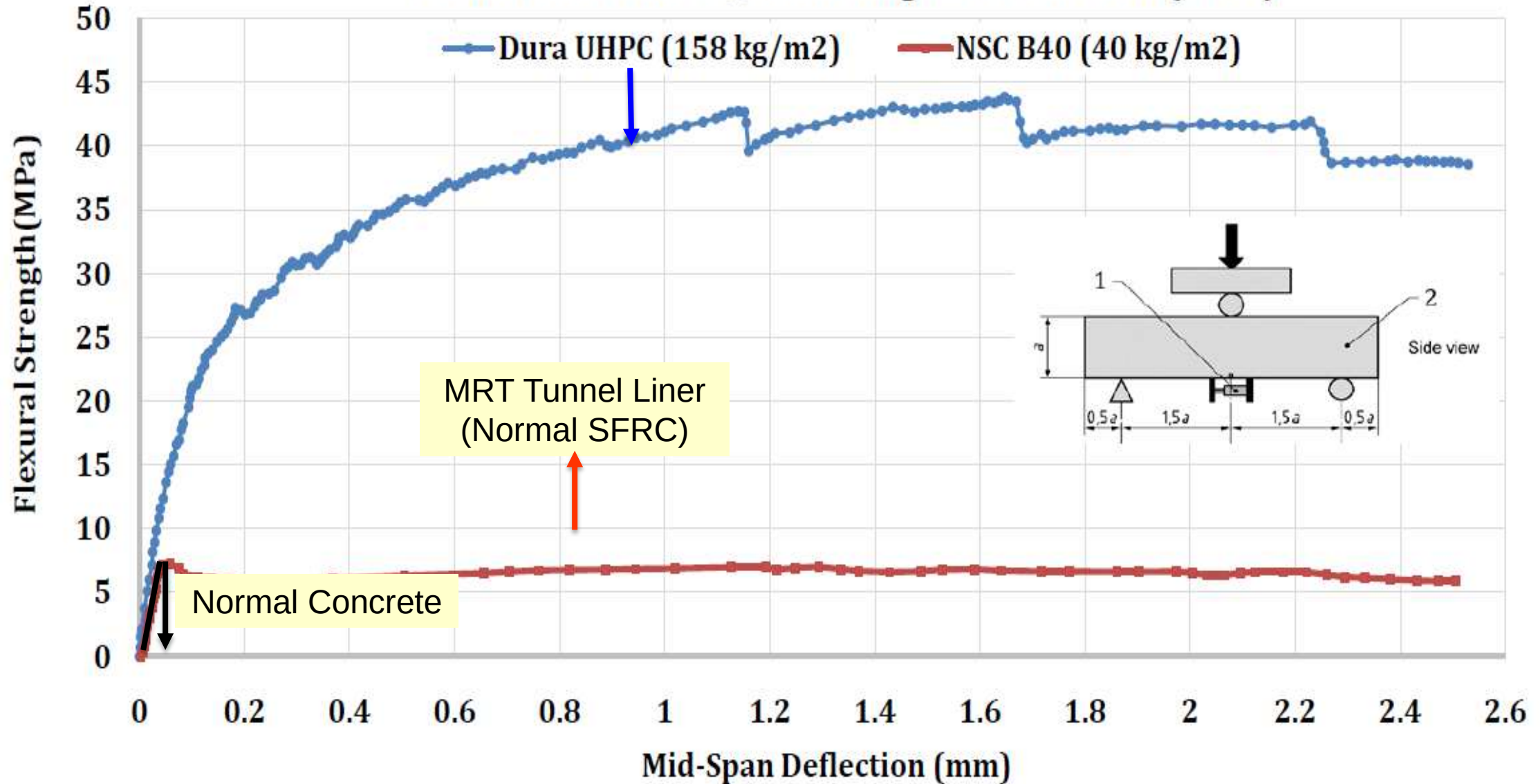
(Force Vs Displacement)



Flexural-Tensile 4 Point Test



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



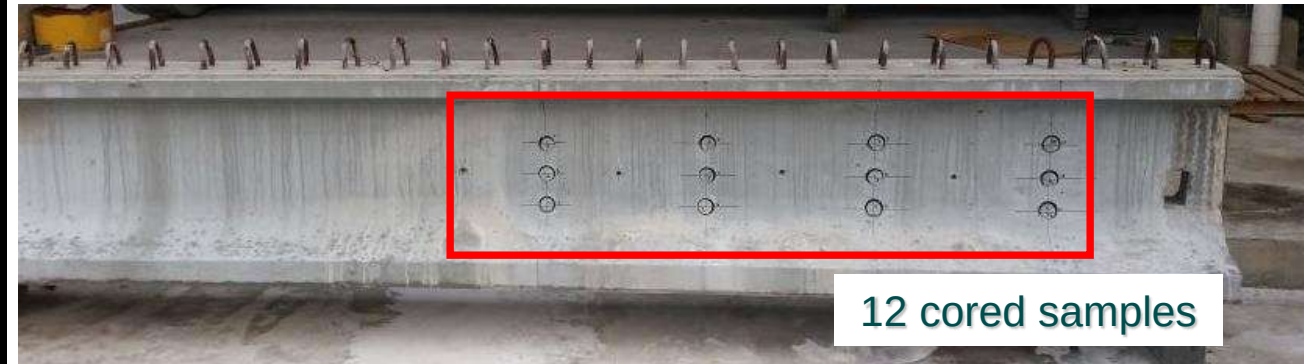
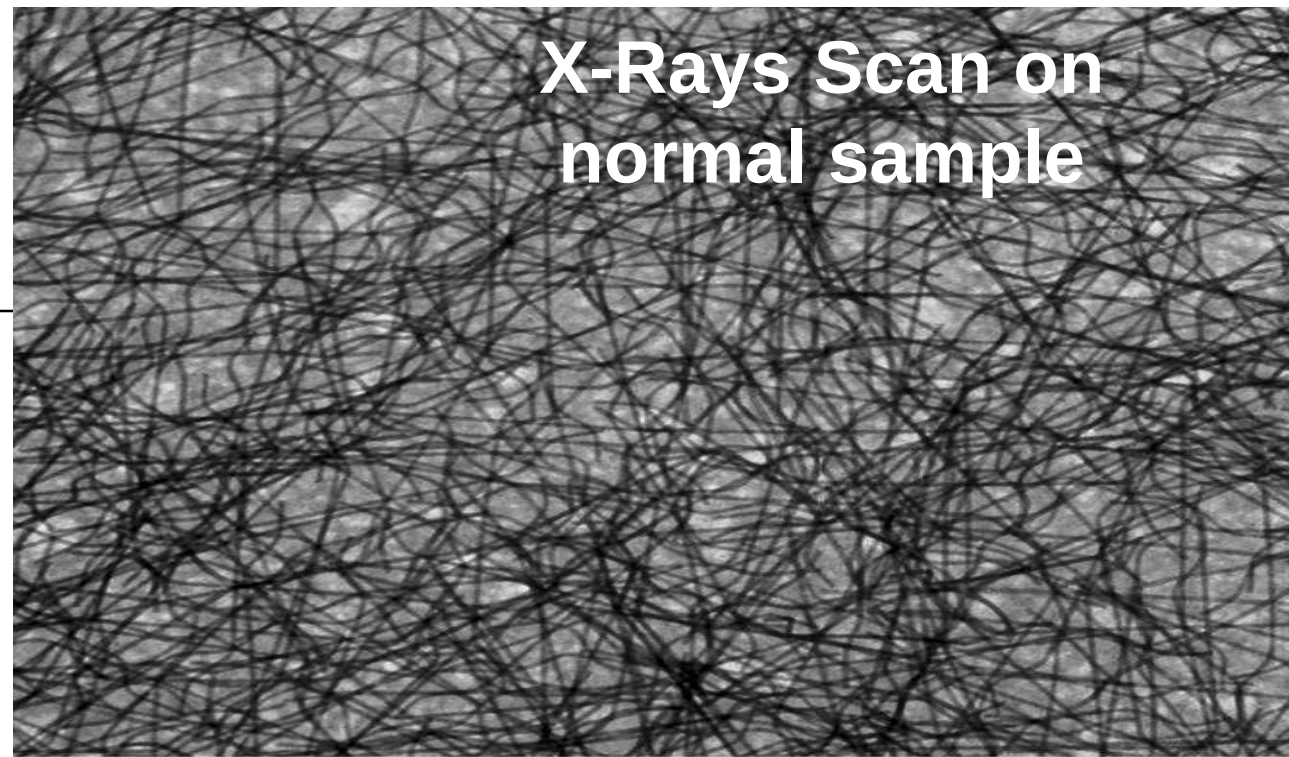


CT Scan on
core sample



10.00 mm

X-Rays Scan on
normal sample



12 cored samples

Fiber QTY = 158 kg/m^3 (2% vol.)
34 mil fibers; Total Length = 643 km/m^3

The Advantage of using UHPFRC

- UHPFRC doesn't shrink and minimal creep
- **Cost Saving;**
- Span up to 110m, 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!!!**

UHPFRC- ESG Compliance

With lower Carbon foot print, UHPFRC is **ESG** Complying Concrete application

- **E**- Environmental friendly since lower concrete quantities are consumed with longer service life
- **S**- Social benefits since lower project Duration
- **G**- Good Governance since the product is made in factory controlled environment ensuring highest degree of Quality and following best industry practices

Structural Standards (NF P 18-710, 2016)

NF P18-710

French standard

AVRIL 2016

NF P 18-710

16 April 2016

Classification index: P 18-710

ISSN 0335-3931

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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le : 18/08/2017 à 05:54

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anchorage, 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 48 17 90 00 — www.afnor.org

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Version of 2016-04-P

Porosity / Capillary Absorption (NF P18-459)

POROSITY, APPARENT DENSITY AND CAPILLARY ABSORPTION IN ACCORDANCE WITH NF P 18-459

Property	Typical requirements for waterproof concrete *	Typical performances of waterproof concrete*	DURA® mix**
Porosity (% by volume)	Porosity < 10%	8%	2.3%
Apparent dry density (kg/m ³)	N.A.	N.A.	2440
Water absorption coefficient (g/m ²)	N.A.	N.A.	3.8 ***

* Reference: Kuala Lumpur Metro Line 1 and Line 2, waterproofing concrete (treated with pore blockers) for underground works;

**Average of three specimens;

***After 30 minutes of immersion in water

Chloride Migration Coefficient (XP P 18 462)

The results are reported in the following table against typical requirements for concrete exhibiting very low chloride ion penetrability.

NON-STEADY STATE CHLORIDE MIGRATION COEFFICIENT IN CONCRETE IN ACCORDANCE WITH XP P 18 462

Typical requirements for concrete with very low chloride ion penetrability*	Typical performances of concrete with very low chloride ion penetrability*	Typical requirements for Ultra-High Performance Concrete	DURA® mix**
$D_{NSS} < 7.5 \times 10^{-12} \text{ m}^2/\text{s}$	$5 \times 10^{-12} \text{ m}^2/\text{s}$	$D_{NSS} < 1.0 \times 10^{-13} \text{ m}^2/\text{s}$	$0.51 \times 10^{-13} \text{ m}^2/\text{s}$

* Reference: Kuala Lumpur Metro Line 1 and Line 2, chloride resistant concrete for underground works;

**Average of three specimens;

Water Absorption (BS 1881 – 121)

The results are reported in the following table against typical requirements for waterproof concrete treated with pore blockers.

WATER ABSORPTION IN ACCORDANCE WITH BS 1881-121		
Typical requirements for waterproof concrete *	Typical performances of waterproof concrete*	DURA® mix**
1% maximum absorption after 30' immersion in water for concrete aged 7 days	0.9%	0.34%

* Reference: Kuala Lumpur Metro Line 1 and Line 2, waterproofing concrete (treated with pore blockers) for underground works;

**Average of three specimens;

Water Penetration (BS EN 12390-8)

The results are reported in the following table against typical requirements for waterproof concrete treated with pore blockers.

DEPTH OF PENETRATION OF WATER UNDER PRESSURE IN ACCORDANCE WITH BS EN 12390-8

Typical requirements for waterproof concrete treated with pore blockers*	Typical performances of waterproof concrete*	DURA® mix**
Depth of penetration of water < 15 mm	10 mm	2 mm

* Reference: Kuala Lumpur Metro Line 1 and Line 2, waterproofing concrete (treated with pore blockers) for underground works;

**Average of five specimens;

RCPT (ASTM C1202-17)

Rapid Chloride Penetration Test (RCPT) in accordance with ASTM C1202-17

The results are reported in the following table against typical requirements for concrete exhibiting very low chloride ion penetrability.

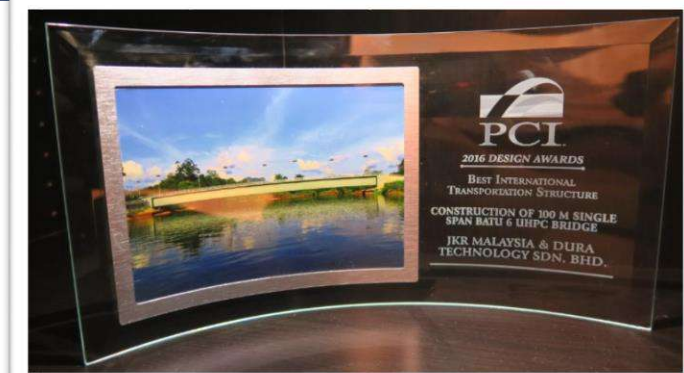
RAPID CHLORIDE PENETRATION TEST IN ACCORDANCE WITH ASTM C1202-17		
Typical requirements for concrete with very low chloride ion penetrability*	Typical performances of concrete with very low chloride ion penetrability*	DURA® mix**
Charged Passed (Coulombs) < 1,000	100 - 500	35

* Reference: Kuala Lumpur Metro Line 1 and Line 2, chloride resistant concrete for underground works;

**Average of three specimens;

Batu 6 Bridge, Single Span 100m

PCI 2016 Design Award – Best International Transportation Structure



Mixing of Concrete



Pouring of Concrete



Match Casting





Bridge 3:
25m span come with
2 segments per beam



Transportation Using Normal 12m Lorry



Unloading using
20t all terrain crane



Unload Segments at
Site using 45t crane



45t mobile
crane

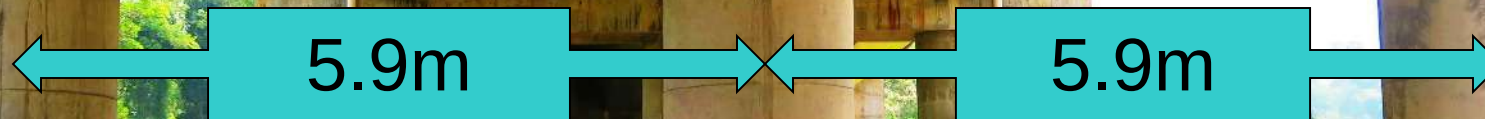


17.6m wide RC deck
Supported by 3 beams per span

**Fully Integral bridge
without expansion joint**



Fully Integral Bridge





**To-date, Malaysia longest
UHPC composite bridge
(13.7m wide x 420m long)**



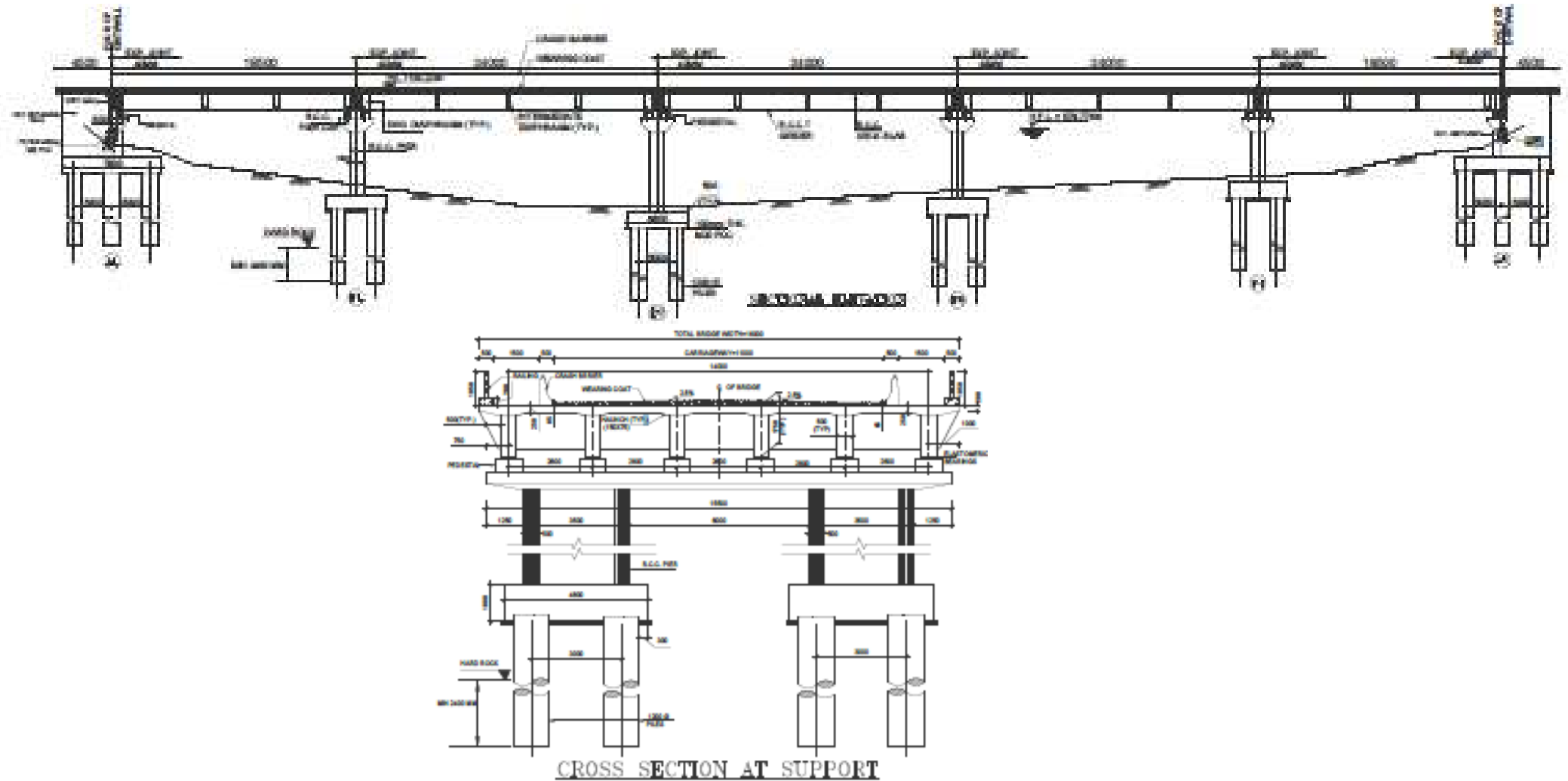
**Integral bridge with
one expansion joint**

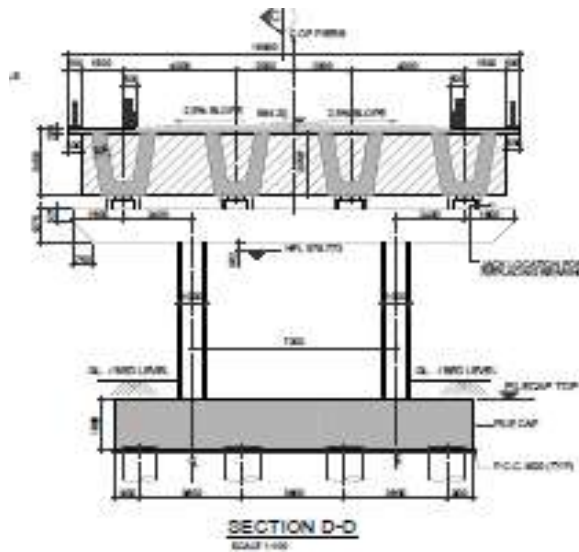
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- Establishment for dedicated Specialized casting yard at Pune and is fully operational from 01.11.2021
 - Production set up is with facility of UHPFRC 2 Nos of concrete plant of 8 Cum batch capacity each.
 - 1 Nos 1.5 cum mobile UHPFRC production plant is operational
 - Specialized Quality Control laboratory established.
 - Trained Design & Development team for UHPC projects is in place along with Association of HSS Engineering, Malaysia and Indian Associate Designer SPA, Mumbai

Introduction of UHPFRC Bridge Construction Technique in India

- We **LONGSPAN STRUCTURES PVT LTD.** have done Technology Transfer Arrangements with DURA TECHNOLOGY SDN. BHD. for UHPFRC applications in INDIA and SAARC Nations.
- Proposal for construction of first UHPFRC bridge in India was approved by MoRT&H, Govt of India through National Panel of Experts Committee.
- Design and Drawings are approved by IIT, Mumbai and bridge is successfully completed and opened for traffic near Latur, Maharashtra where we are EPC Contractor.
- Original proposal was of 112m bridge length with span arrangements as 19.5m x 2 Nos and 24m x 3 Nos
- Present proposal is UHPFRC superstructure with 2 Nos of 56m span

Original GAD





Conventional Vs UHPC (Tender GAD) Vs UHPC (Designed)

Sr No	Concrete Quantity	UOM	Conventional concrete superstructure (RCC Composite I-Girder)	DURA superstructure (UHPC) U Girder - 4 Nos	DURA superstructure (UHPC)U Girder - 3 Nos	% reduction in scope
1	Piles(1.2m dia.)	Nos	56 nos(596 RM)	24 nos(242 RM)	24 nos(242 RM)	57%
2	Pilecap	Cum	789	434	434	45%
3	PCC below pilecap	Cum	40	21	21	48%
4	piers (intermediate)	Cum	100	30	30	70%
5	Abutement pier	Cum	112	9.27	9.27	91%
6	piercap	Cum	181	72	72	60%
7	Pedestal	Nos	60	16	12	80%
8	Bearings	Nos	60	16	12	80%
9	Superstructure	Cum	1070	751	661.4	38%

Inaugural Meeting for Introduction of UHPFRC Technology



NPE Visit





STAGE 1 (b) : ARRIVAL OF SEGMENT ON SITE



STAGE 2 : ERECTION OF SEGMENTS ON STAGING



STAGE 3 : PRE STRESSING OF SEGMENTS



Completed Photo of Bridge



Inauguration of Bridge by **Hon'ble Minister Shri Nitinji Gadkari**
on **25th November 2021**



Projects Currently Execution

- Major Creek Bridge of 182.50 length at Mangalore Karnataka with UHPC Span arrangement (50 m + 65 m + 67.50 m)
- 2 Bridges with single spans of 52 m on the prestigious Samruddhi Mahamarg for Canal and highway crossing.
- Viaducts with UHPC spans 72m on NH17 at Kashedi Ghat Section
- 9 Bridges including record breaking 118 m span bridge for M/s R.K. Chavan Infrastructure Pvt Ltd.
- 1 Major Bridge and Minor Bridge awarded to us by M/s A.C. Shaikh Constructions Pvt. Ltd.
- 1 Major Bridge and 2 Minor Bridges along Mumbai Goa (NH66) National Highway
- Successfully completed Repair and Rehabilitation of rigid pavement damaged panels 10 no's on trial on Mumbai-Pune Expressway, Maharashtra

**Total Cumulative orders of - 8000
cum (in hand)**

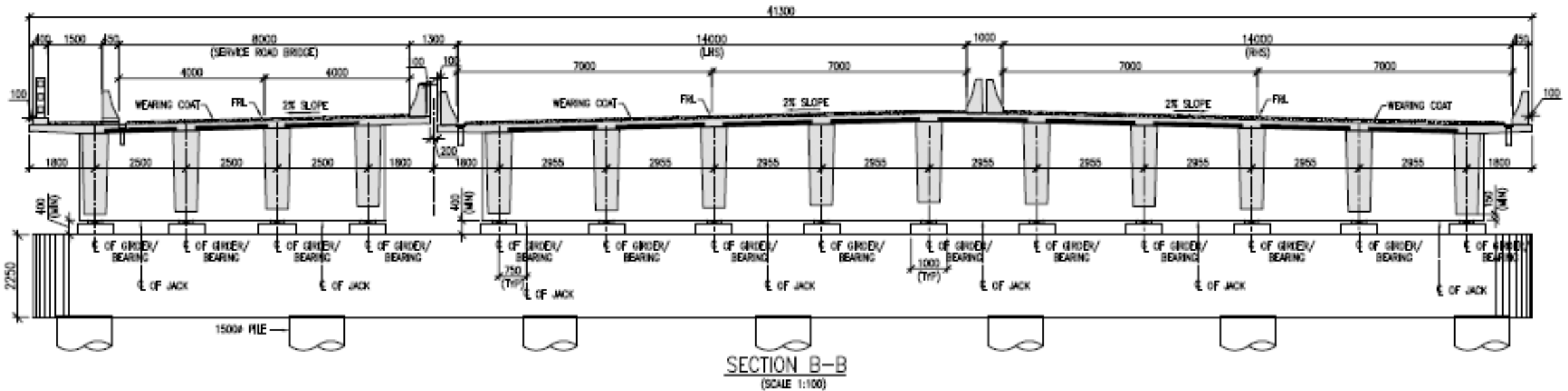
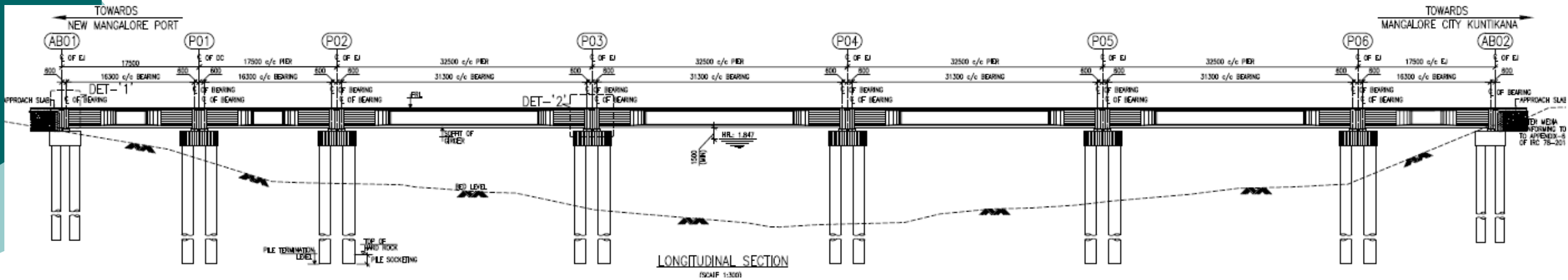
**Total Cumulative orders of 21
Bridges (in hand)**

Works in progrss

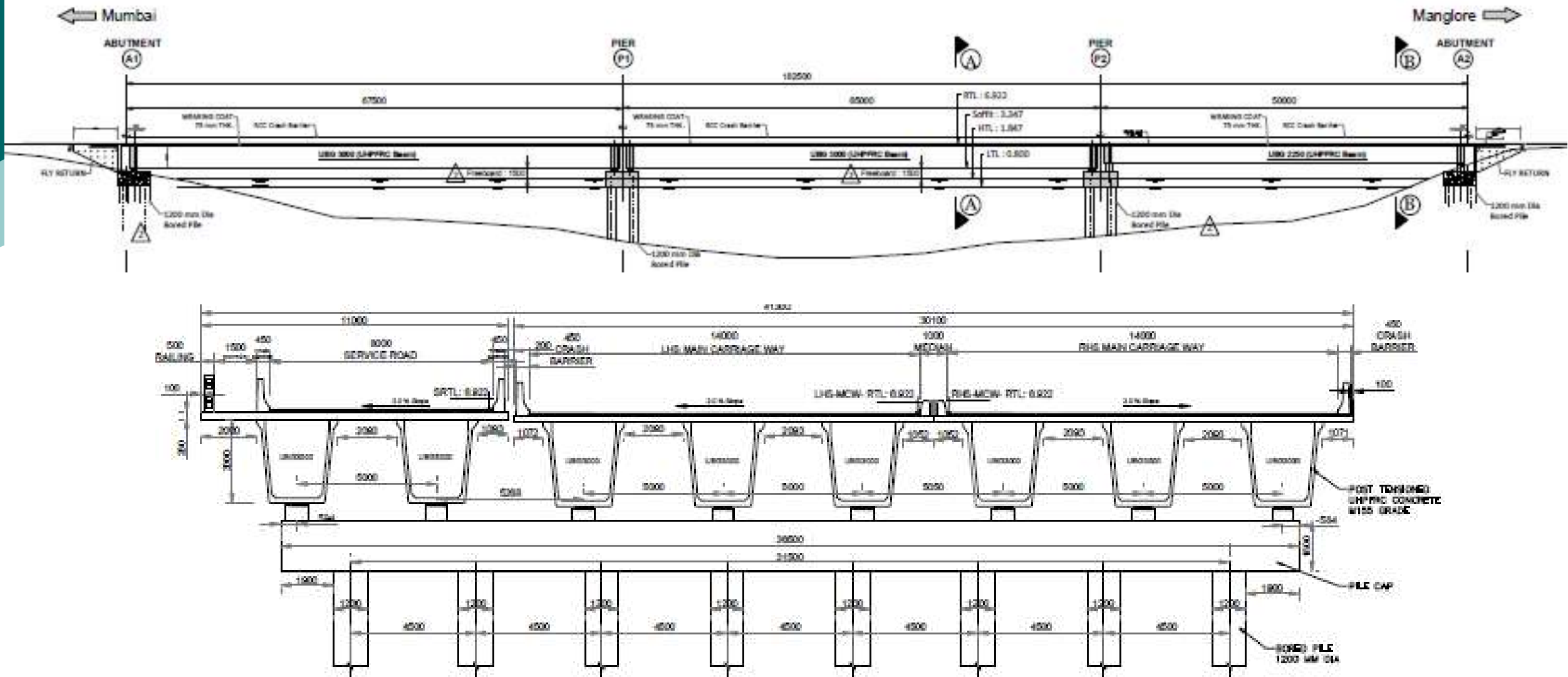
Ongoing Projects in hand								
Sr No	Location	Client	EPC Contractor	Length of Bridge	Type of Girder	Girder Length (m)	Total No's of Girders	Current Stage
Kullur Bridge, Manglore								
1	Manglore, Karnataka	NHAI	SDPL	182.5 m	UBG 2250	48.625	8	
1	Manglore, Karnataka	NHAI	SDPL		UBG 3000	63.85	8	
1	Manglore, Karnataka	NHAI	SDPL		UBG 3000	66.85	8	
3 Additional Bridges on Mumbai Goa Highway								
2	Mahad, Maharashtra	PWD (NH Division) and MoRT&H	SDPL	35 m	TBG 1500	33.9	5	Completed
3	Mahad, Maharashtra	PWD (NH Division) and MoRT&H	SDPL	105 m	TBG 1500	35.0	15	
4	Mahad, Maharashtra	PWD (NH Division) and MoRT&H	SDPL	35 m	TBG 1500	33.9	5	
Beed - Parbhani - Aundha Nagnath & Akola - Akot Stretch								
5	Beed, Maharashtra	PWD (NH Division) and MoRT&H	A.C. Shaikh	60 m	TBG 1500	30	10	50 % Completed
6	Beed, Maharashtra	PWD (NH Division) and MoRT&H	A.C. Shaikh	40 m	TBG 1500	37	5	
7	Akola, Maharashtra	PWD (NH Division) and MoRT&H	A.C. Shaikh	105 m	TBG 1500	37	15	
Mumbai - Goa Highway - New NH 66 (Greenfeild) - Pkg 3								
8	Kashedi Ghat, Maharashtra	PWD (NH Division) and MoRT&H	SDPL	71.2 m	UBG 3000	71.2	6	
9	Kashedi Ghat, Maharashtra	PWD (NH Division) and MoRT&H	SDPL	71.2 m	UBG 3000	71.2	6	
Palkhi Marg -Dharampuri - Lonanad- Pkg 5								
10	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	60 m	UBG 2250	57.5	8	
11	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	60 m	UBG 2250	57.5	6	
12	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	102 m	UBG 4000	101.6	6	
13	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	35 m	TBG 1500	34	10	
14	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	35 m	TBG 1500	34	10	
15	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	35 m	TBG 1500	34	12	
16	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	35 m	TBG 1500	34	36	
17	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	40 m	TBG 1500	37.5	10	
18	Dharampuri bypass, Maharashtra	NHAI	R.K. Chavan	32 m	TBG 1500	31.6	16	
Samruddhi Mahamarg - Mumbai - Nagpur 8 Lane Expressway								
19	Nashik, Maharashtra	MSRDC	Raj Infra	52 m	UBG 2250	51.8	8	Casting in Progress
20	Nashik, Maharashtra	MSRDC	Raj Infra	52 m	UBG 2250	51.8	8	Casting in Progress
Taloja Creek Bridge								
21	Mumbai, Maharashtra	PWD, Maharashtra	SDPL	66 m	TBG 1500	32.6	6	Casting in Progress

Original GAD

SPAN ARRANGEMENT – 16.8 + 16.8 + 32.5 + 32.5 + 32.5 + 32.5 + 16.8



Present UHPFRC Superstructure GAD





Specialised UHPC Production Plant

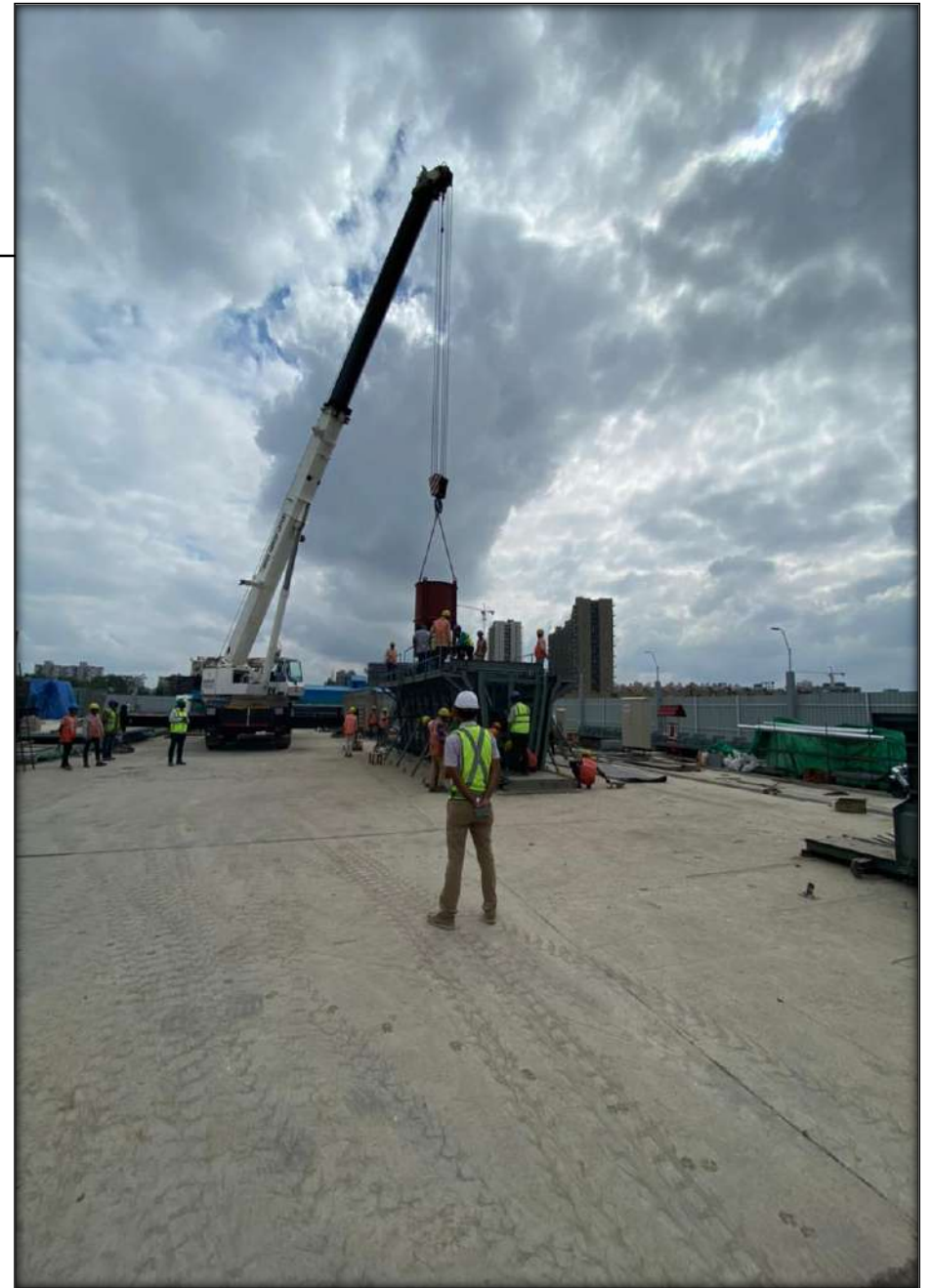
@ Kiwale, Pune



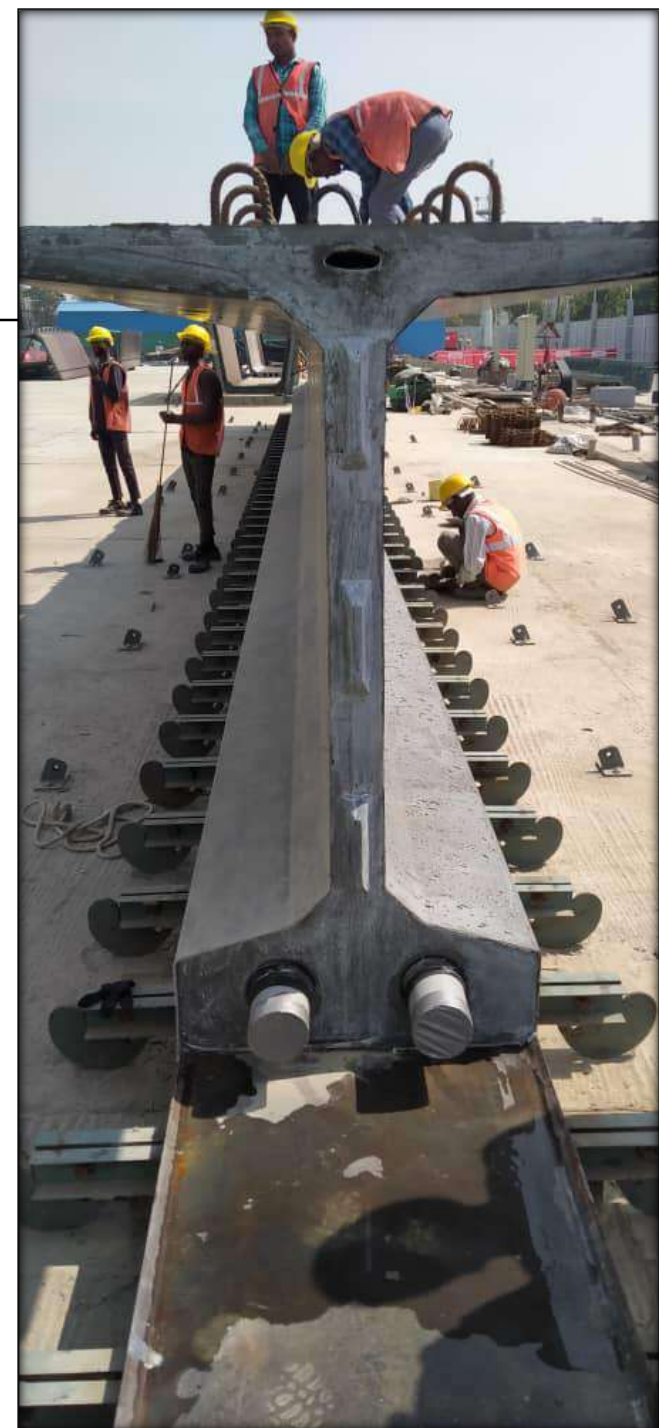
T-Beam (BT1500) Casting in progress



U-Beam (UBG2250) Casting in progress







SAMRUDDHI EXPRESSWAY BRIDGE SUPERSTRUCTURE CASTING

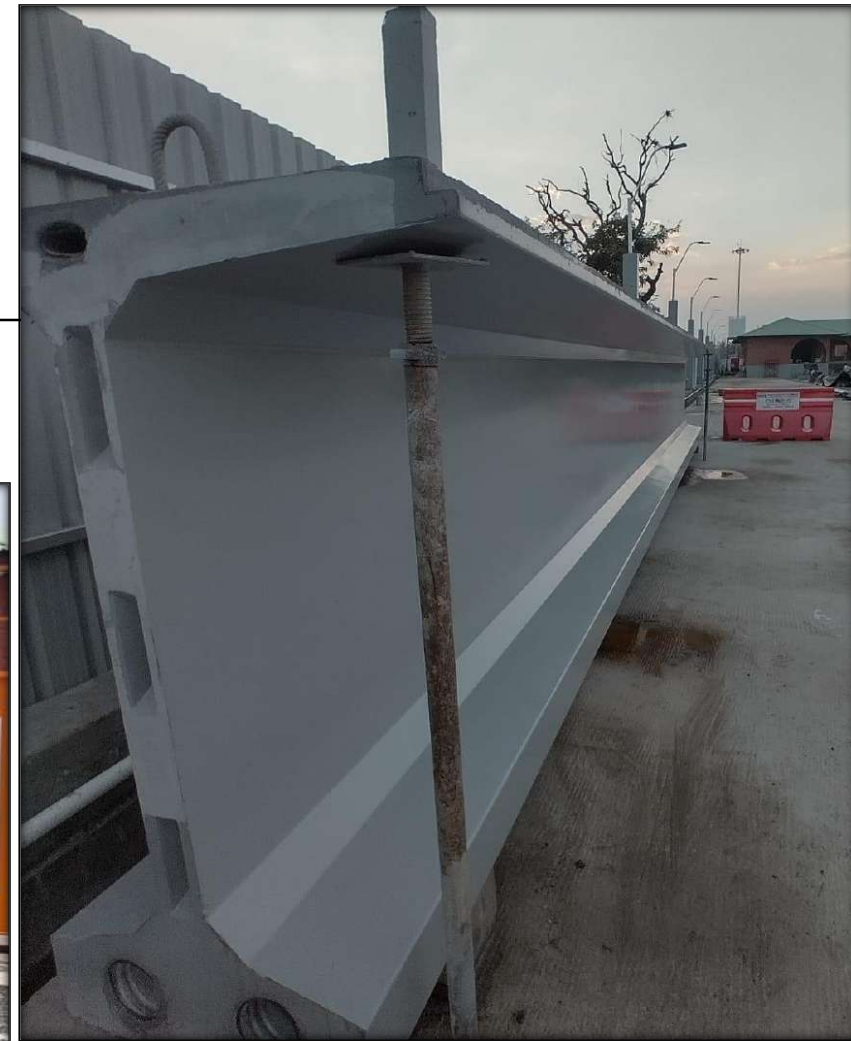




Finished Product

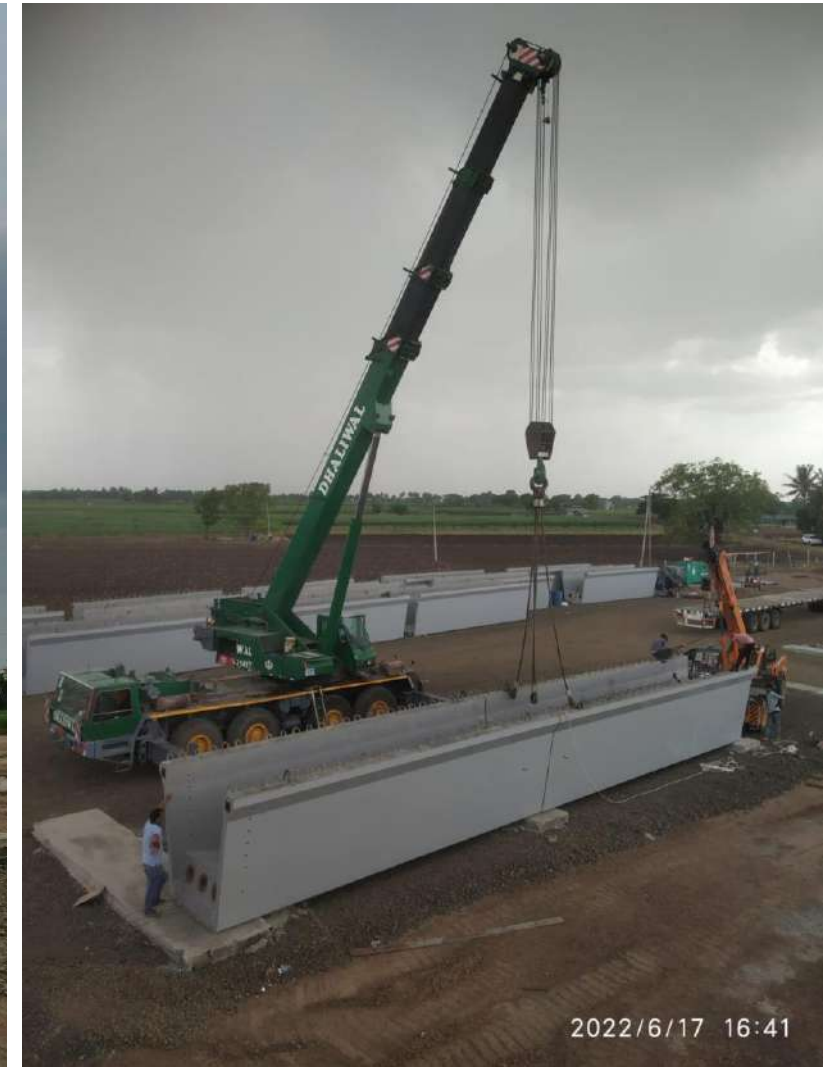


UBG 2250 - For 50 m Span at Phalguni River (Kullur Bridge)



BT 1500 – Mumbai Goa
Highway

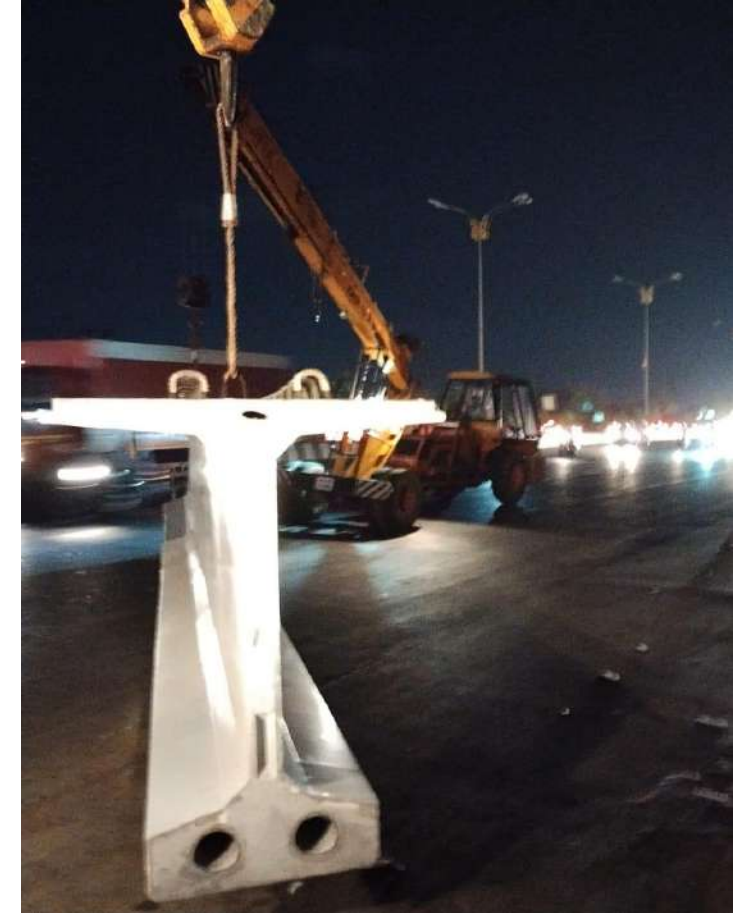
Bridges at Samruddhi Mahamarg (Mumbai to Nagpur)



Bridge on NH66 (Mumbai Goa) Highway



Taloja Creek Bridge (Sion Panvel Highway) – Mumbai.



UHPFRC Manufacturers suggestions

- Standardization of UHPFRC products
 - Span wise and bridge length & foundation type wise the design standardization will optimise the design costs and approval process timelines.
- Indian Standards and specifications for UHPFRC designs, production and Implementation
 - The Codal provisions for Ingredient material specifications, design procedures, manufacture standards will enable Indian designers for consideration of technology for ease of acceptance and implementation
- Incorporation of specifications and Rates in State/Central schedule of rates
 - Availability of UHPFRC specifications and Applicable rates will help the estimators for considering the subject technology implementation in DPR and Detailed estimate.



UHPFRC Manufacturers suggestions

○ Carbon Credit

- UHPFRC Technology implementation results in to lower Carbon footprint
- Mechanism shall be established for manufacturers to avail the carbon credit to make the products most economically viable

○ Certification of the UHPFRC production facilities

- At Govt Authority level, the UHPFRC production facility/Precast yard certification facility and implementation shall be in place for ensuring more confidence among the end users for the products.

○ Periodic Audits and authorised Renewals to Certified UHPFRC precast Facilities

- Will ensure the conformity to standards and specification implementations in regards to production and quality products.

UHPFRC Manufacturers suggestions

○ Major Ingredient Material is Steel Fibre

- Authority Support is required to insistence to Steel Manufacturers for manufacture and supply of required Steel fibres.
- Currently procuring from our own Indian market, but manufacture capabilities are less.
- Looking into future demand of larger scale, steel fibre supply from in-house sources in India are required.

○ Relaxation in Taxes to Major material procurement

- In the Initial stage till the technology gets fully martialized, to minimize cost of production & supply ,the Tax relaxation of major materials such as Steel fibre and Silica fume will support



UHPFRC Manufacturers suggestions

○ Research & Development

- With specialized UHPFRC production facility and Test laboratory available with Manufacturer, MorT&H, industry players and academia's can jointly work together for undertaking continuous improvement process and exploration of possibilities in other applications

○ UHPFRC Production facility establishment support

- The Capex Support for establishment of various production facilities across the country will support in fulfilment of supply demands

○ Trainings

- Joint training programmes will support in making the pool of skilled personals for design, manufacture and execution.



Thank You

