

2018 FTBA Construction Conference

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CFCC Update

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CFCC projects in the United States

	DOT		Name of the project or bridge	construction	application
1	Michigan DOT	1	● Bridge Street Bridge	2001	• Unbonded Transverse Post tensioning ● Externally Draped Longitudinal Post-tensioning
		2	● M-39	2011	● Unbonded Transverse Post tension
		3	● M-50	2012	● Unbonded Transverse Post tension
		4	• M-102	2013	• Longitudinal Prestressing strands • Deck reinforcement • Stirrups
		5	• M-102	2014	• Longitudinal Prestressing strands • Deck reinforcement • Stirrups
		6	● I-94	2014	● Unbonded Transverse Post Tensioning
		7	● I-94	2015	● Unbonded Transverse Post Tensioning
		8	• M-100	2016	• Longitudinal Prestressing strands
		9	• M-66 over the West Branch River	2015	• Longitudinal Prestressing strands
		10	• M-86 over the Prarie River	2016	• Longitudinal Prestressing strands
		11	• I-75 over Goddard and Sexton Kilfoil Drain	2017	• Longitudinal Prestressing strands
		12	• M-3	2018	• Longitudinal Prestressing strands
2	Maine DOT	13	● Little Pond Bridge	2012	• Unbonded Transverse Post Tensioning
		14	• Kittery Overpass Bridge	2014	• Longitudinal prestressing strands
3	Virginia DOT	15	• Nimmo Parkway	2012/2013	• PC piles (Strands and spirals)
		16	• RTE 49 over Aaron's Creek	2015	• Longitudinal Prestressing strands • Stirrups
4	Florida DOT	17	• Research project	2013	• PC piles (Strands and spirals)
		18	• Halls River Bridge Replacement Project	2016/2018	• PC piles (Strands and spirals) and sheet pile
5	Louisiana DOTD	19	● I-10 Littlewoods	2014	● External Post-tensioning
6	North Carolina DOT	20	• Research project (Cored Slab)	2014	• Longitudinal Prestressingl strands
7	Kentucky Transportation Cabinet	21	• Taylor County Bridge	2014	• Longitudinal Prestressing strands
8	Ohio DOT	22	• HAS 700	2016	• Longitudinal Prestressing strands
9	University of Miami	23	• Innovation Bridge	2015	• Longitudinal Prestressing strands



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CFCC Plant in the United States



Production start in September 2016

FRP for New Construction





Table of Contents

I . What is CFCC?

II . Application of CFCC

III . Benefit of CFCC



I .What is CFCC ?

- CFCC is Carbon Fiber Composite Cable.
- CFCC is a stranded CFRP. → **FLEXIBLE**
- CFCC consists of PAN (Polyacrylonitrile) based continuous carbon fibers, with epoxy resins used as a binding material.

- •**LIGHT WEIGHT**
- CORROSION FREE**
- HIGH TENSILE FATIGUE PERFORMANCE**
- •**HIGH TENSILE STRENGTH**
- HIGH TENSILE MODULUS**





Type of CFCC

■ Tendon

- Pre-tensioning cables
- Post-tensioning cables

■ Non-prestressing reinforcement

- Bars
- Stirrups
- Spirals



I .What is CFCC ?

***Reinforcement bars or
Pre-tensioning cables***



Post-tensioning cables

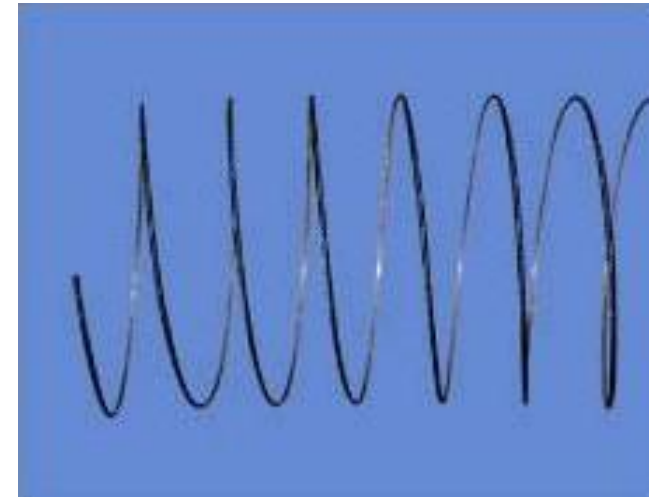
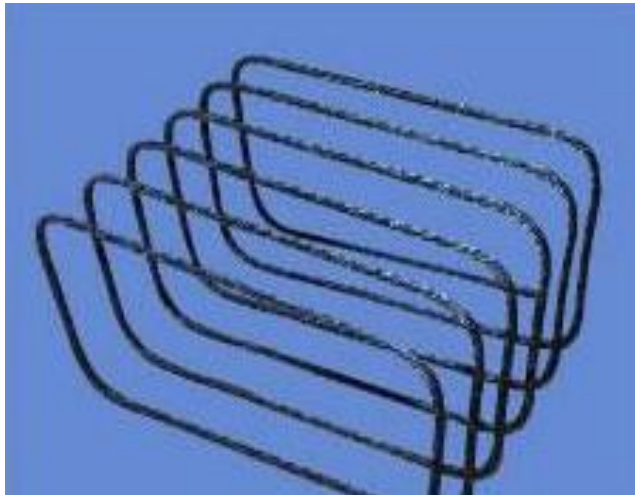


I .What is CFCC ?

Stirrups



Spirals



I .What is CFCC ?

CFCC REINFORCEMENT CAGE → Light weight

Easy to carry around by people

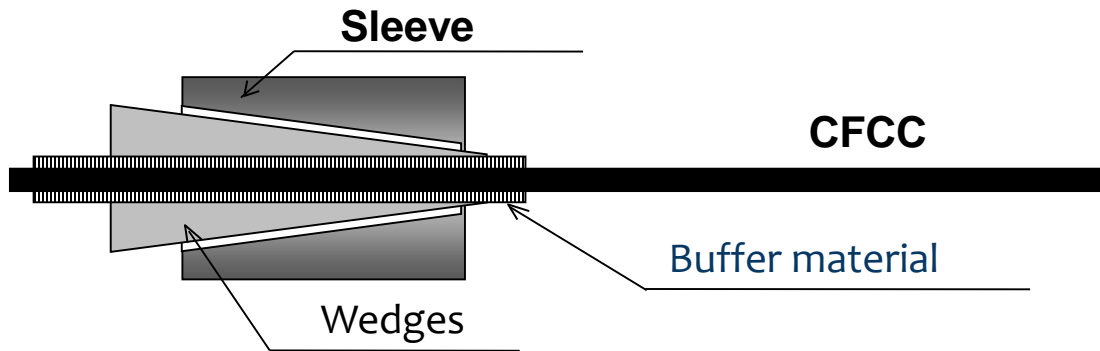


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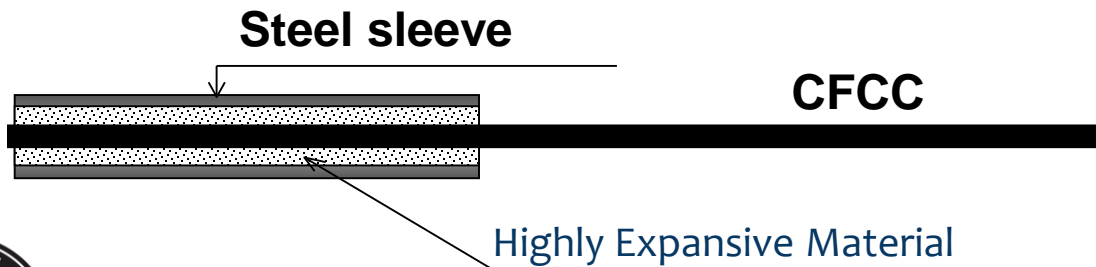
I .What is CFCC ?

Anchoring systems of CFCC

For Pre-tensioning



For Post-tensioning



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New wedges

- Developing the New wedges for pre-tension and
- Post-tension





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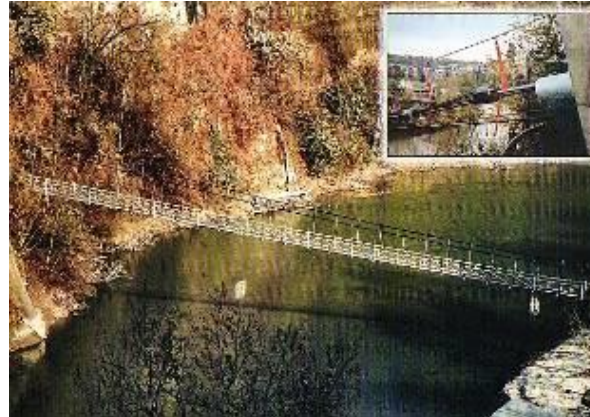
I . What is CFCC?

II . Application of CFCC

III. Benefit of CFCC



II . Applications of CFCC



There are about 200 applications. (by 2017)



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II . Application of CFCC

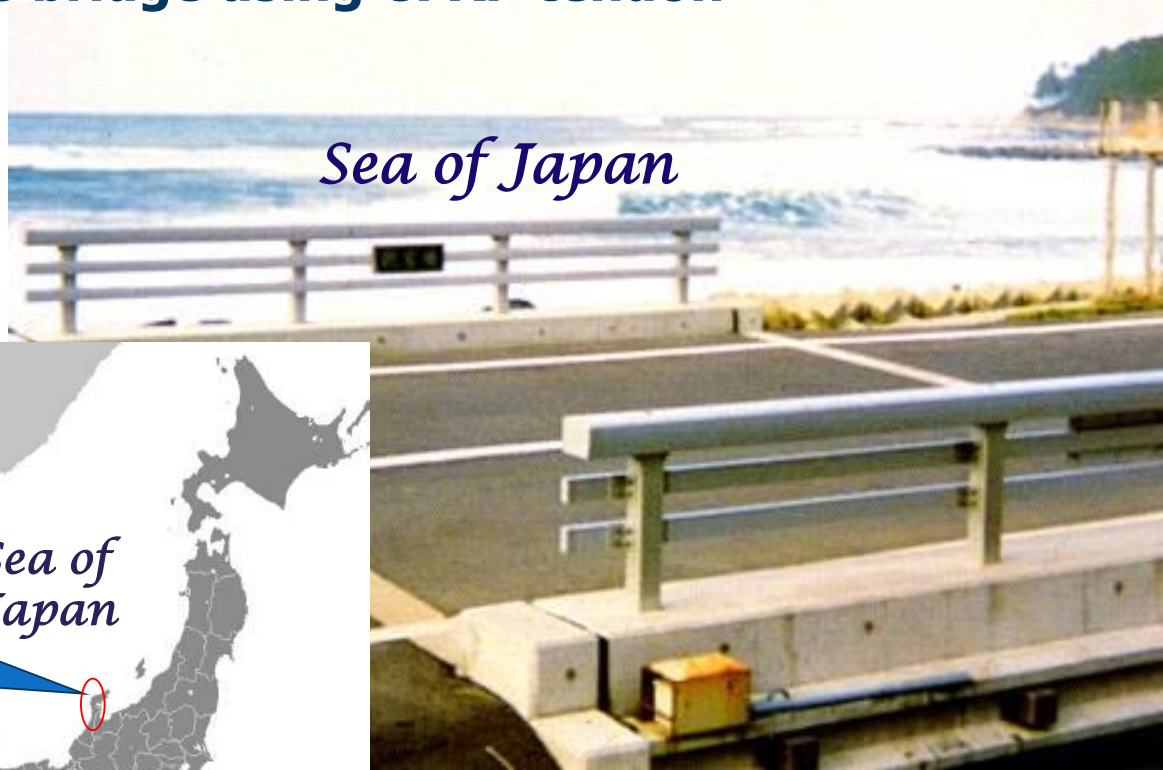
No.	Category	Number of Application
1	Concrete Structures (Reinforcement)	102
2	Cable for Bridges (Stay or Main Cable)	3
3	Ground Anchor	79
4	Other	14
Total		198



(1). Concrete Structures (Pre-tensioning)

Shinmiya Bridge 1988.10 in Japan

World's first PC bridge using CFRP tendon



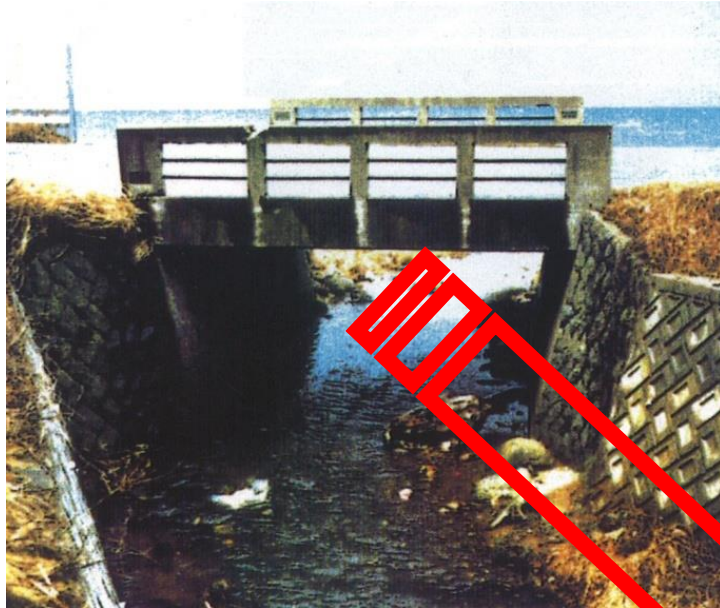
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Ishikawa,
JAPAN

PACIFIC
OCEAN

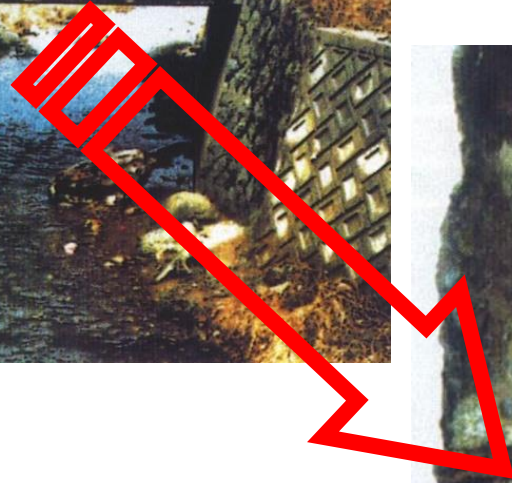
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Former Bridge

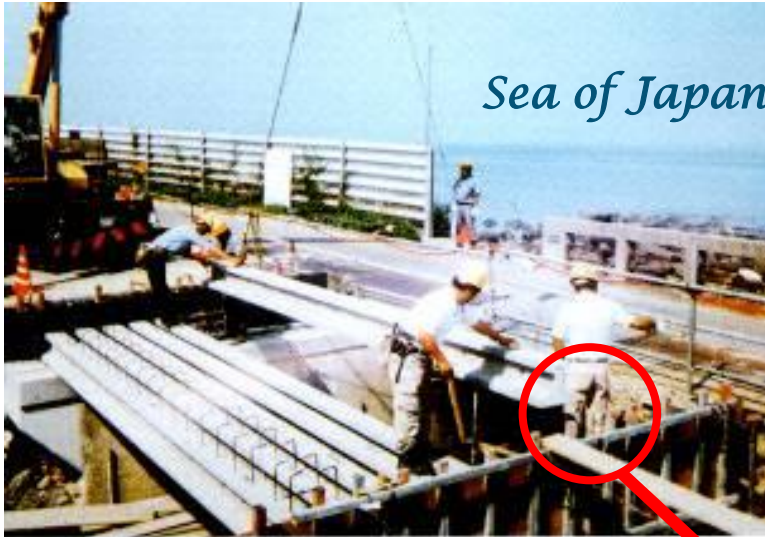


[After-construction 20 years]



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New Shinmiya Bridge

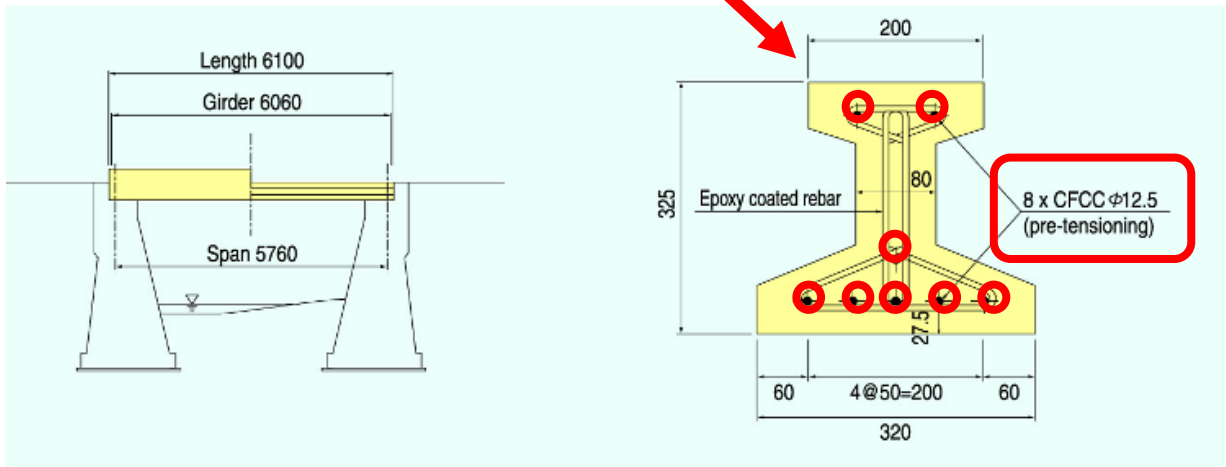


Pre-tensioned PC slab bridge

Bridge length: 6.1 m

Overall width: 8.2 m

CFCCs are used for pre-tensioning tendons.



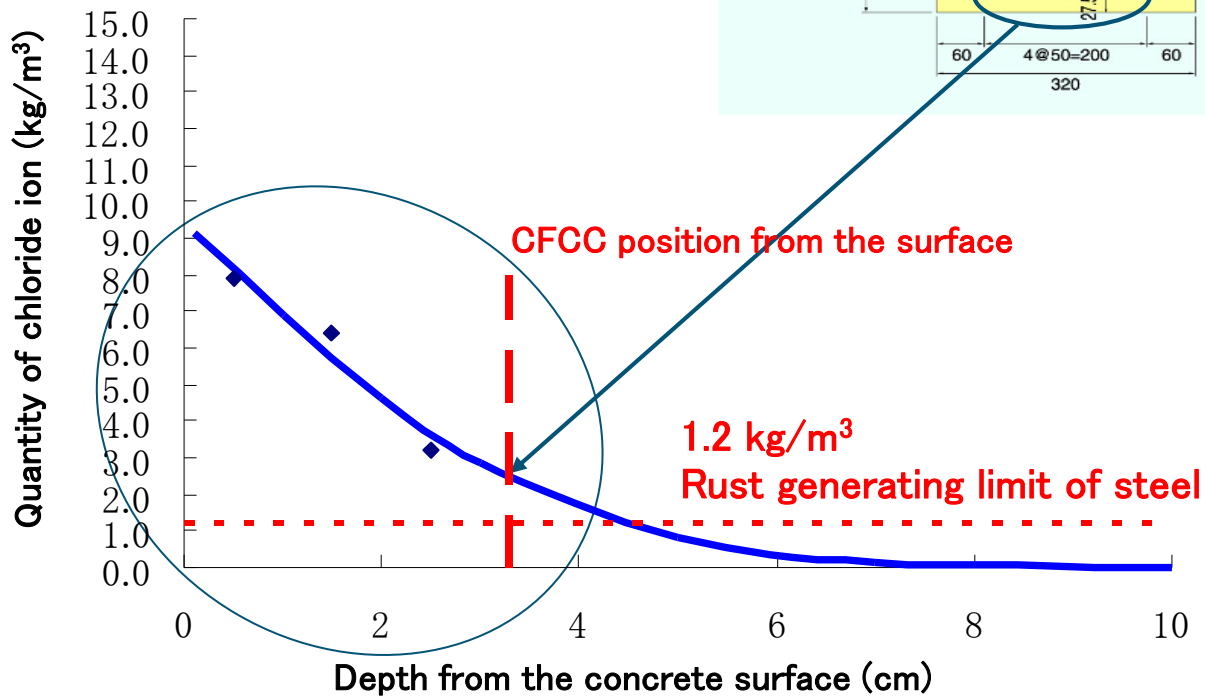
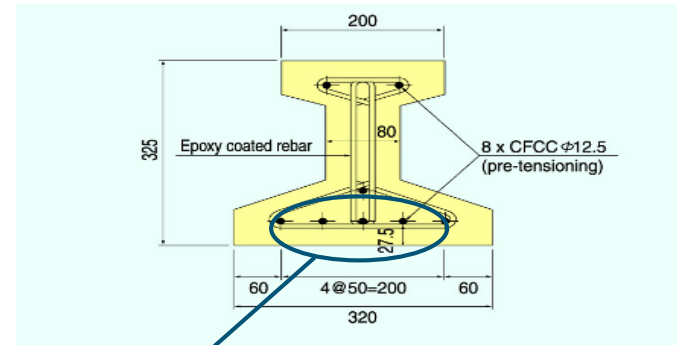
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Quantity of chloride ion in the concrete beam

New Shinmiya Bridge

[After-construction 23 years]



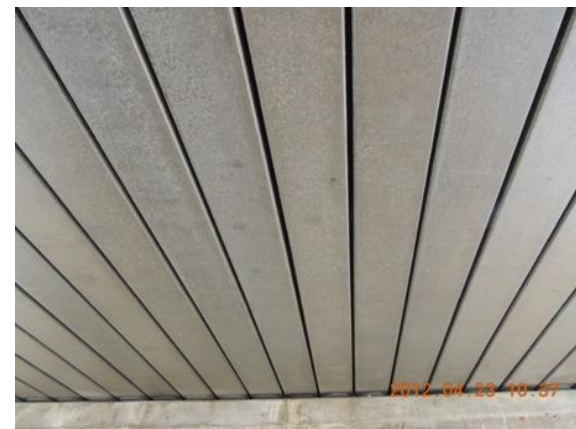
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Former Bridge [After-construction 20 years]



New Shinmiya Bridge [After-construction 23 years]



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(2). Concrete Structures (Post-tensioning)

Bridge Street Bridge May. 2001 in Southfield, Michigan

Funded by **FHWA** and **MDOT** **United States's first bridge** constructed **using CFRP**



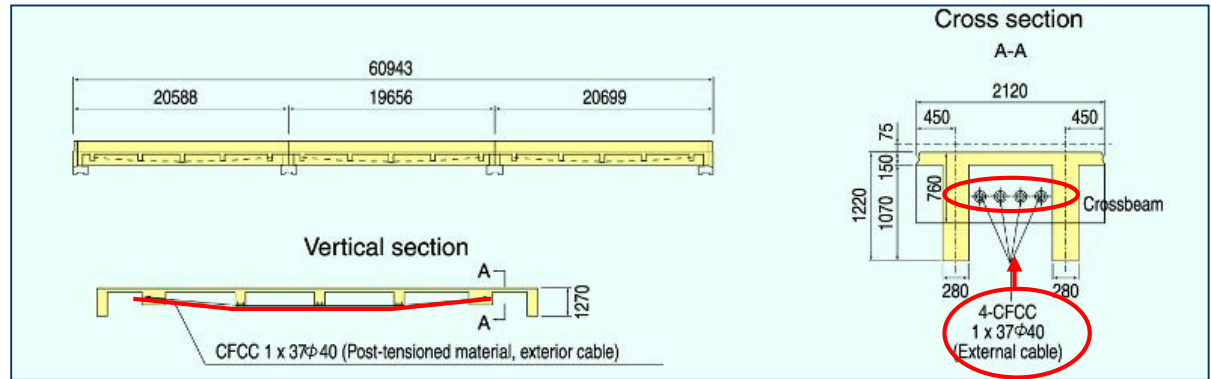
Transverse Cables

TPT
 CFCC 1x37 40.0φ : 9.2 m x 10 tendons,
 9.4 m x 7 tendons
 CFCC 1x19 21.8φ : 9.0 m x 6 tendons

External Tendons
 CFCC 1x37 40.0φ : 16.8 m x 24 tendons,
 17.0 m x 30 tendons



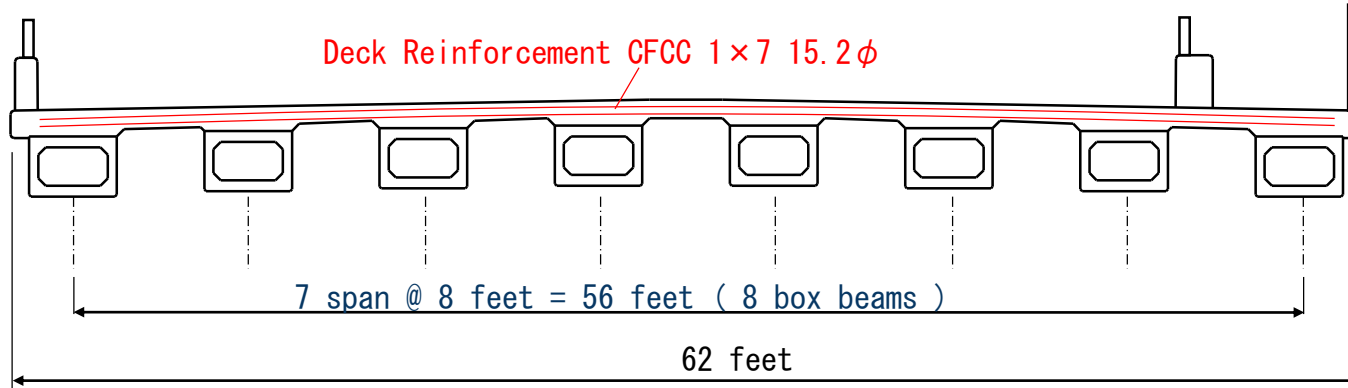
External Cables



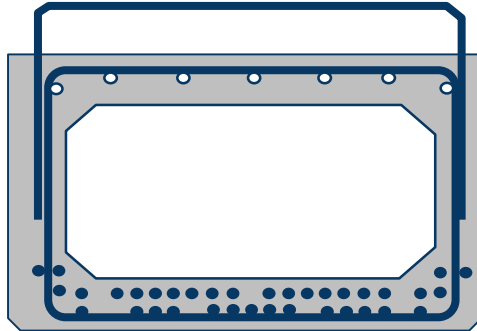
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(3). Concrete Structures (Pre-tensioning & Deck Reinforcement)

M-102 over Plum Creek Jun. 2013 in Michigan



8 beams × 2 bridges = 16 beams

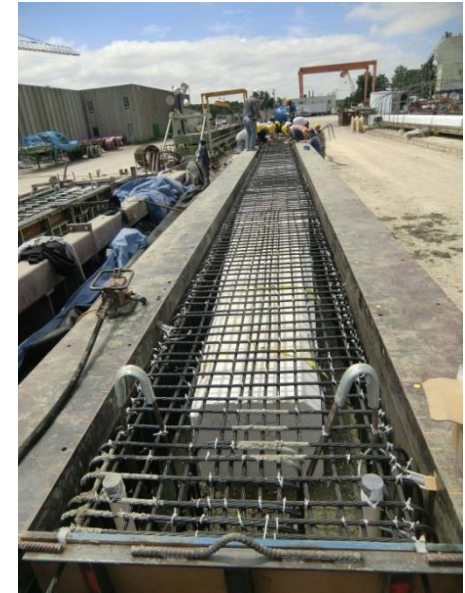


4' × 2'-9" Box beam

37 strands: CFCC 1×7 15.2φ

Stirrups: CFCC 1×7 15.2φ

Top rebar : CFCC 1×7 15.2φ



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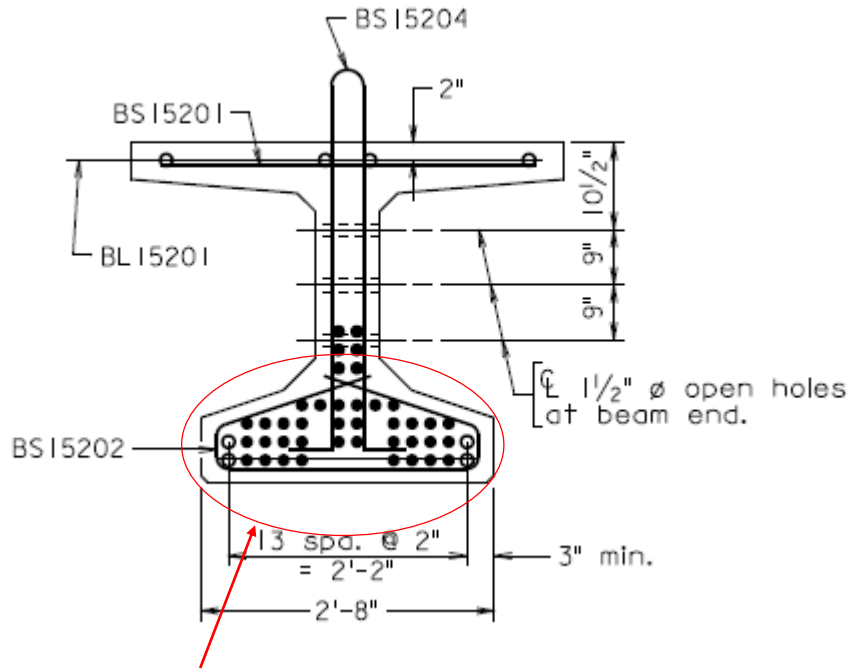
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(4). Concrete Structures (Pre-tensioning)

RTE. 49 Bridge over Aaron's Creek (Bulb-T beam)

Jun. 2015 in Virginia



48 strands - CFCC 1x7 15.2φ

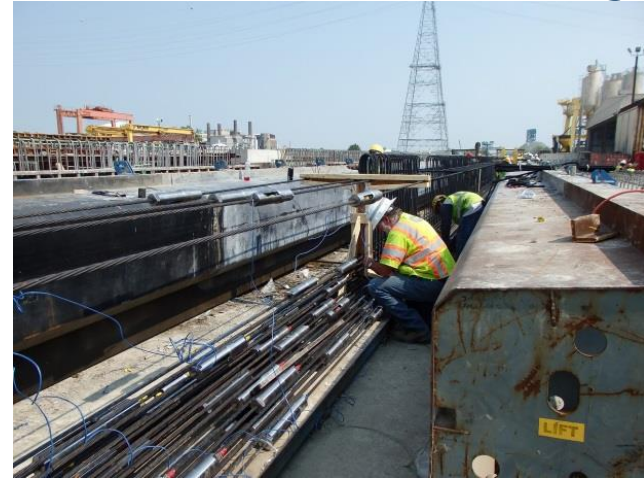
Stirrups - CFCC 1x7 15.2φ, CFCC 1x7 17.2φ

Bridge Length : 168' - 10"

Bridge Width : 32' - 4"

48 strands × 8 beams

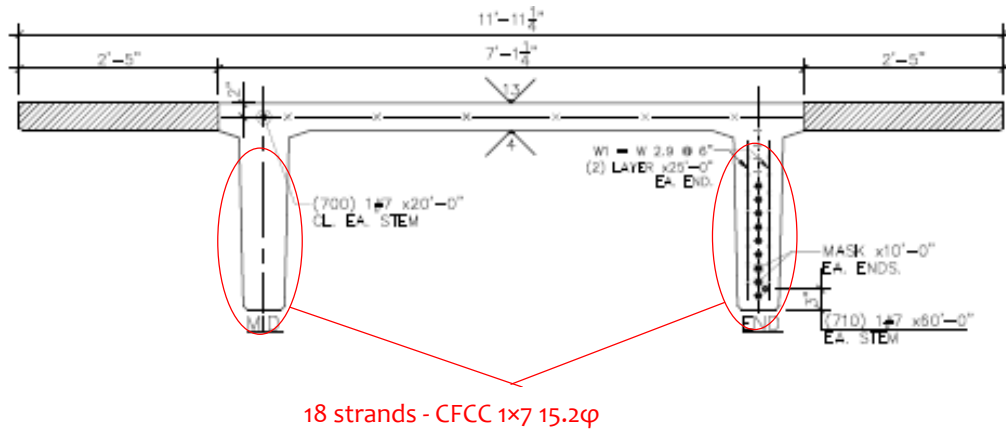
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(5). Concrete Structures (Pre-tensioning)

Innovation Bridge (Hecht Athletics Pedestrian Bridge)

Oct. 2015 in Miami



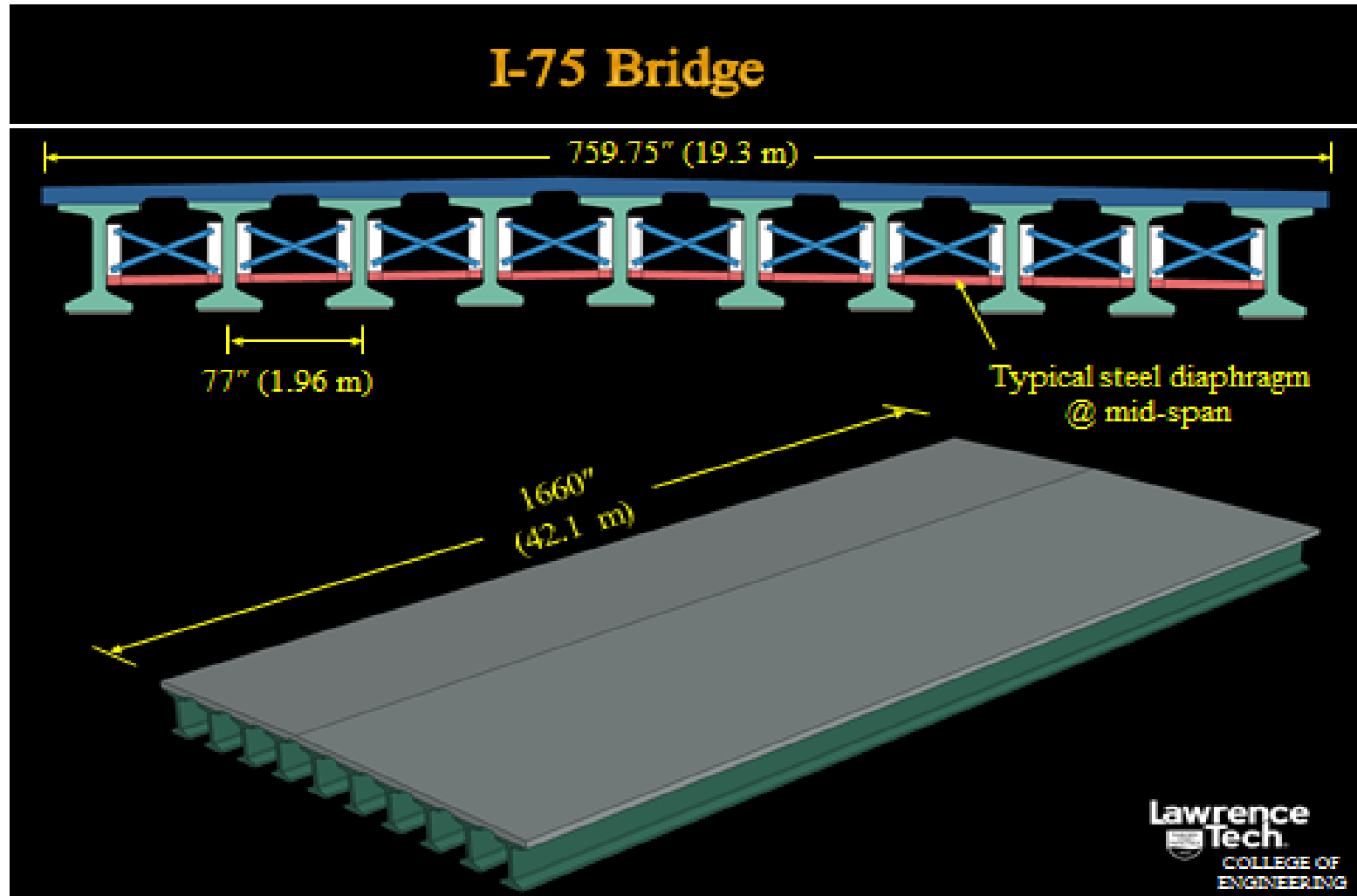
Bridge Length : 70' - 0"
 Bridge Width : 14' - 3"

18 strands × 2 beams



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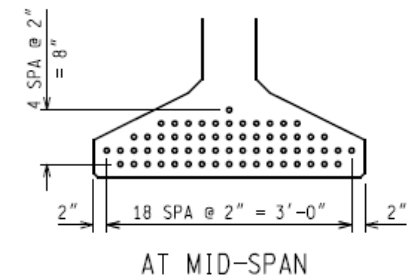
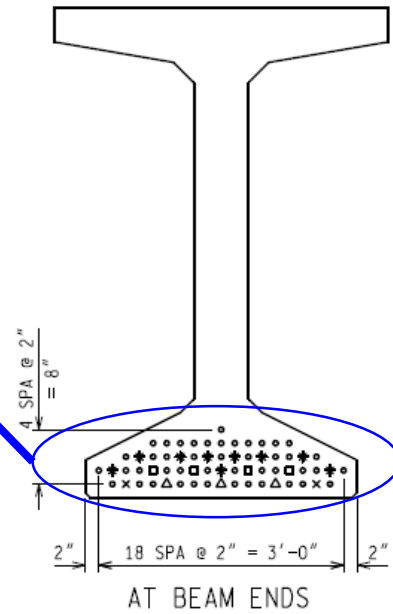
(6). Concrete Structures (Pre-tensioning)



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Other beams

63 strands

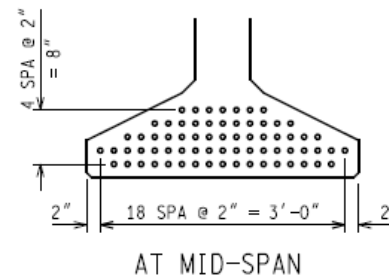
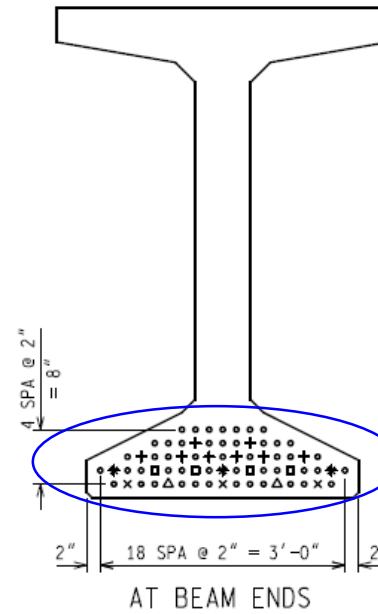


INTERIOR BEAMS B-J
MEDIAN FASCIA BEAM K
STRAND LOCATIONS

- + DEBOND 6 FT EACH END
- ◆ DEBOND 8 FT EACH END
- DEBOND 12 FT EACH END
- △ DEBOND 16 FT EACH END
- × DEBOND 20 FT EACH END

West fascia beam (WFB)

69 strands



WEST FASCIA BEAM A
STRAND LOCATIONS

- + DEBOND 3 FT EACH END
- ◆ DEBOND 22 FT EACH END
- DEBOND 15 FT EACH END
- △ DEBOND 28 FT EACH END
- × DEBOND 6 FT EACH END



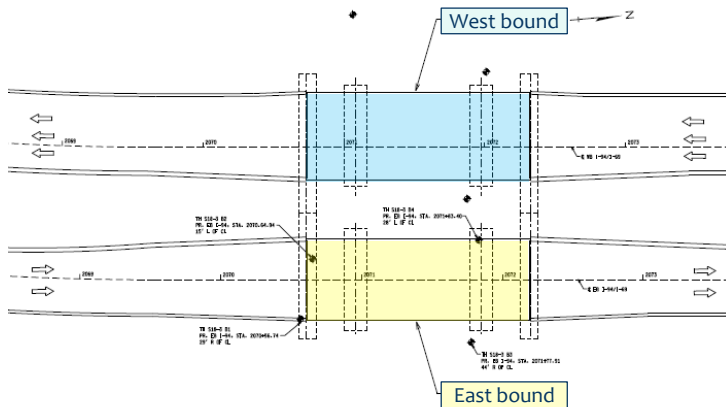
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(7). Concrete Structures (Post-tensioning)

I-94 Bridge over Lapeer Rd. Jun. 2015 in Port Huron, Michigan



TPT CFCC 1x37 40.0φ

East bound : 59' - 2" (18.0 m) × 20 tendons

West bound : 63' - 3.5" (19.3 m) × 20 tendons

East bound (14 box beams)

Bridge Length : 164' - 0" , Bridge Width : 57' - 7.5"

West bound (15 box beams)

Bridge Length : 164' - 0" , Bridge Width : 61' - 9"



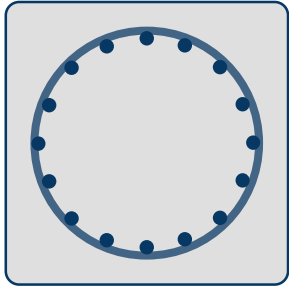
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(8). Concrete Structures (Prestressed Concrete Pile)

NIMMO PARKWAY

in Virginia

2 Test Piles Nov. 2012
16 Piles Nov. 2013



24" square pile

16 strands: CFCC 1x7 15.2mm

Spiral: CFCC U 5.7mm

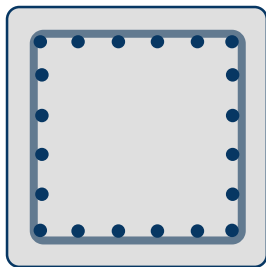
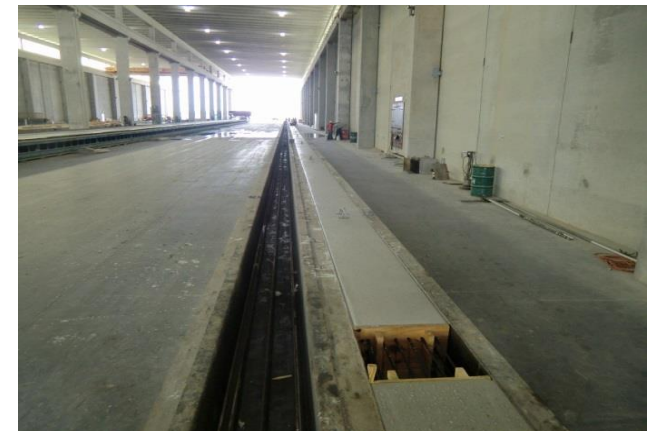
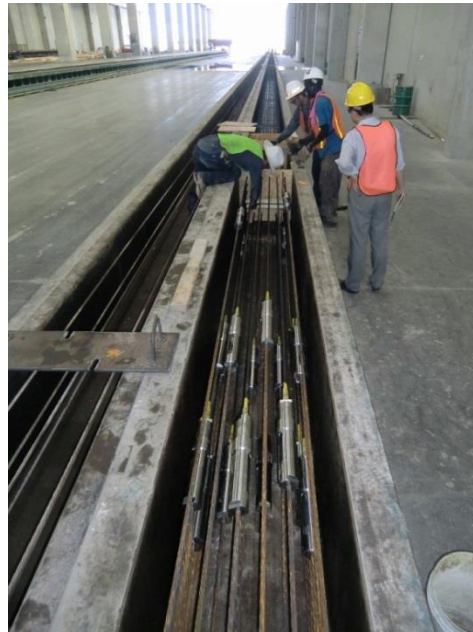


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(9). Concrete Structures (Prestressed Concrete Pile)

Pilot project Jul. 2013 in Florida



24" square pile
 20 strands: CFCC 1x7 15.2φ
 Spiral: CFCC U 5.0φ
 Pile length:
 40 feet x 3 beams
 100 feet x 2 beams



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(10). Concrete Structures (Prestressed Concrete Pile)

Halls River Bridge project

2017 in Florida



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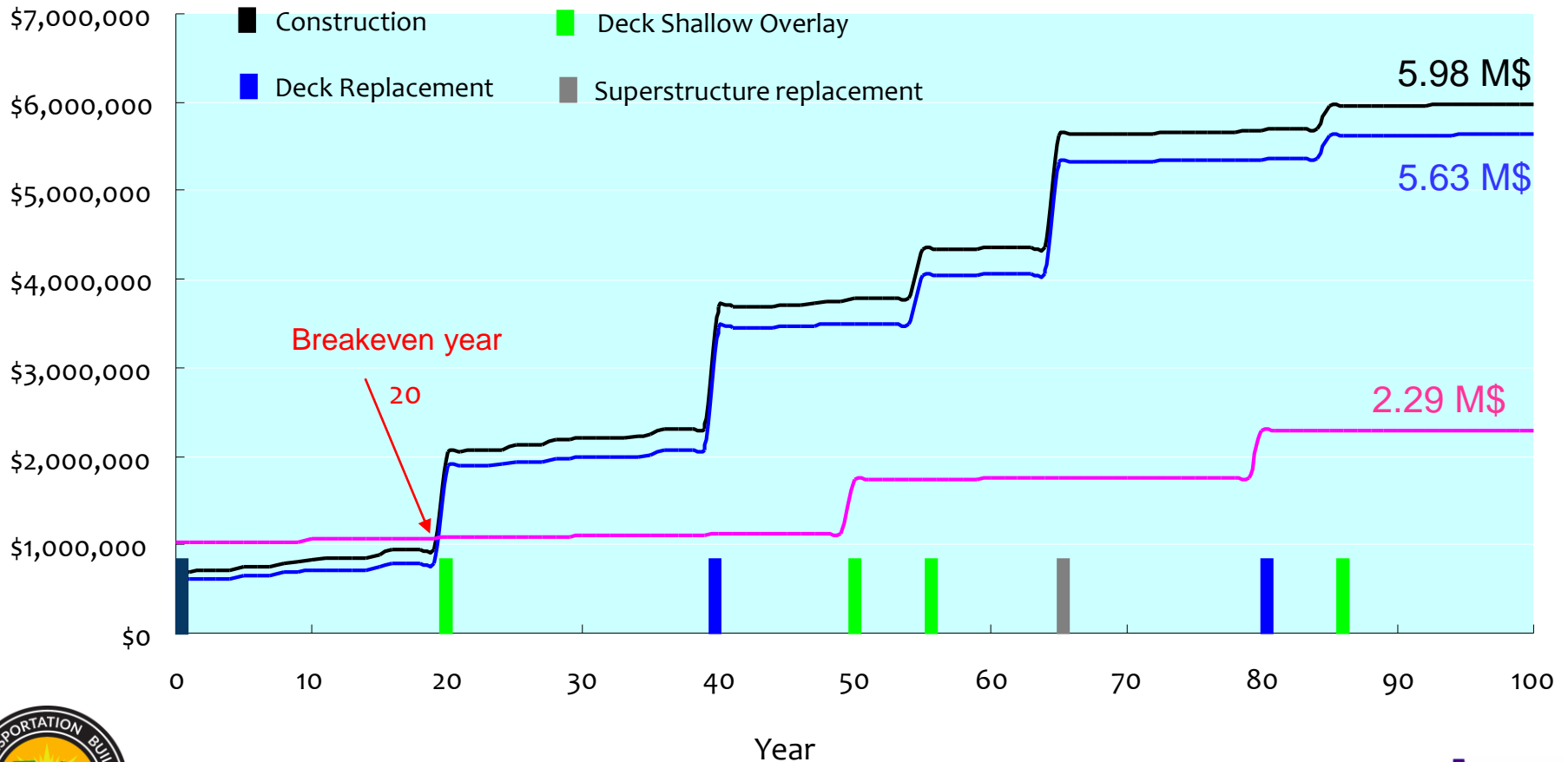


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III. Benefit of CFCC

Bridge Life Cycle Cost

— Black Steel Bridge — Epoxy-Coated Steel Bridge — CFRP Bridge



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Thank you



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