

1

Since last time.....

- 2015 Prequalification (5 prequalified out of 7 applicants)
- **10.09.2015 Dansk Betondag 2015**
- 2016 Tender Documents (preliminary) Published
- 2017 Bids received
 - *Evaluation (Robustness, technical quality and price)*
- 2018 Contract Signed 26th February 2018



2

Ahead of us....

2018

Contract signed with SBJV
Construction Start

2019

Railway Lowering

2022

Bridge Open (road section)

2023

Railway open

Followed by demolition of the
existing bridge (2023-26)



Samfinansieret af EU
Det transeuropæiske transportnet (TEN-T)

Vejdirektoratet

3

New Storstrøm Bridge



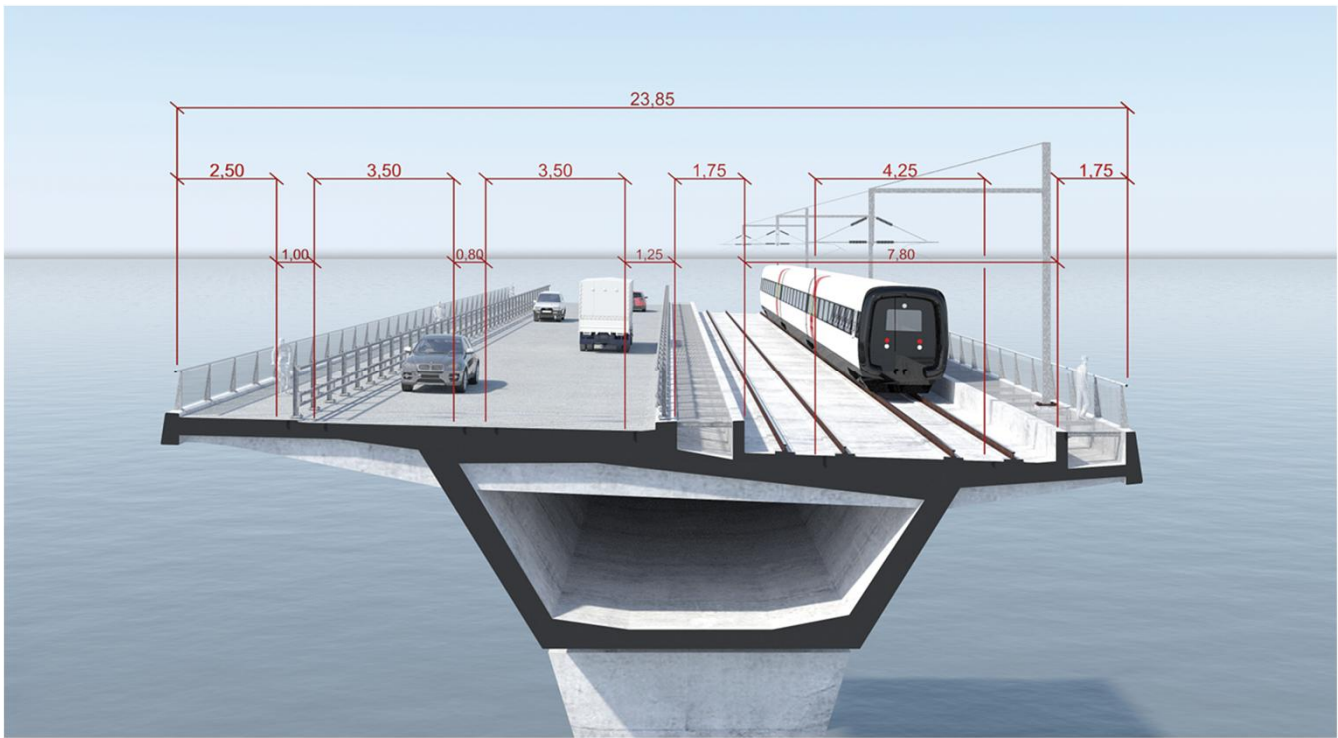
- Concrete Box Girder Bridge
- 80 m Viaduct Spans (44 no)
- 2 Navigational spans each 160 m (cable stayed bridge)
- Length 3840 m

Designed by Cowi and Dissing + Weitling

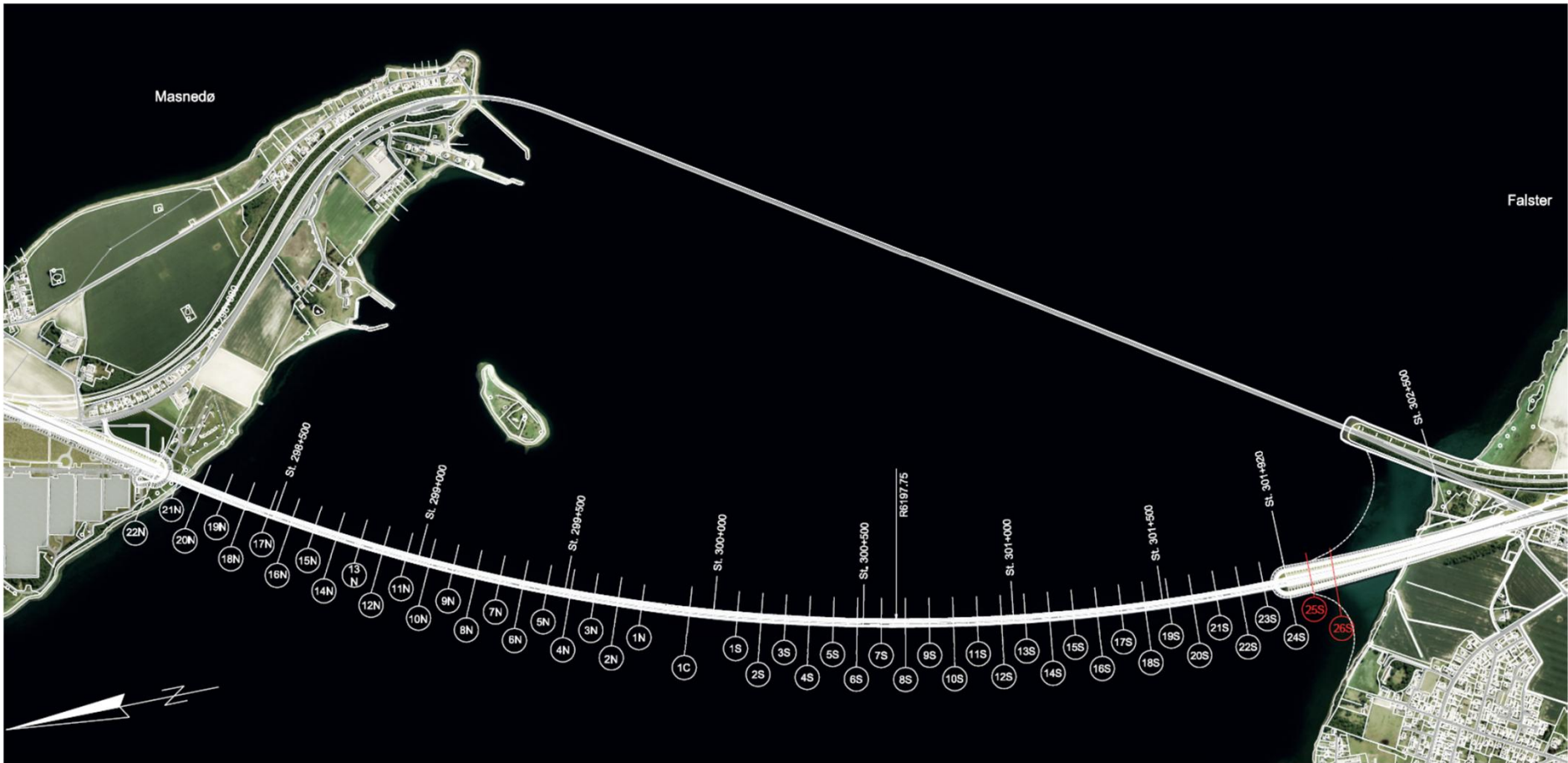
Vejdirektoratet

4

Cross Section



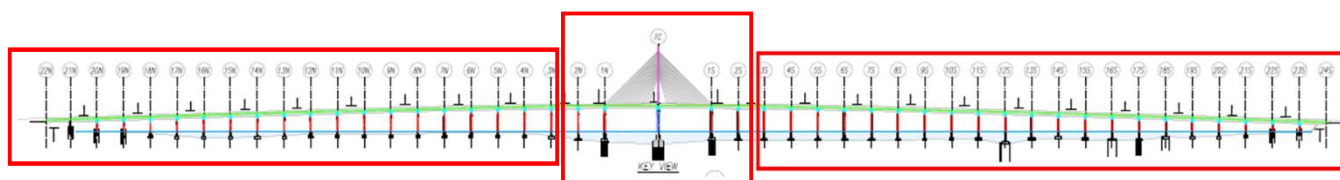
- Combined Cycle and footpath
- Local Road
- Railway 2 Tracks
- Emergency Walkways



Design & Build

Basic & Detailed Design

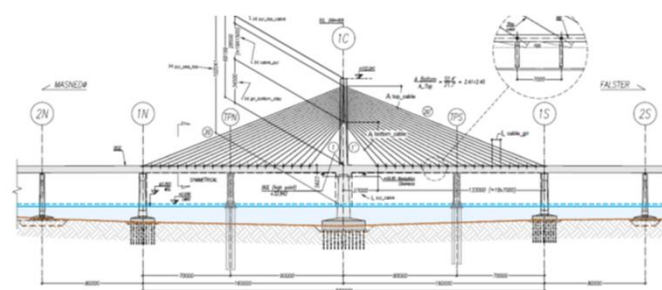
Basic Design



- DP 0002 General Drawings
- DP 0012 Construction Methods
- DP 0017 Viaduct Spans
- DP 0018 CSB

34 Design Packages

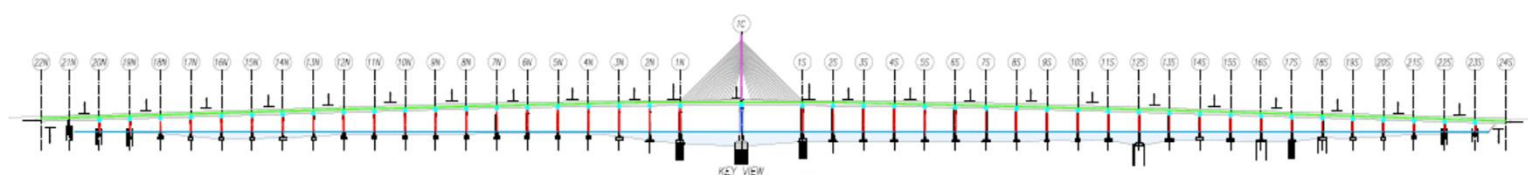
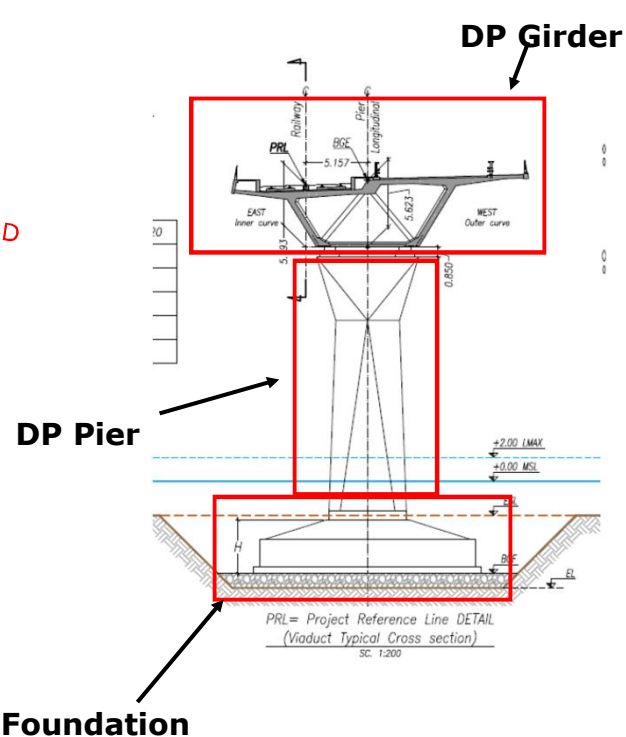
Approved in accordance with SAB 01



Detailed Design

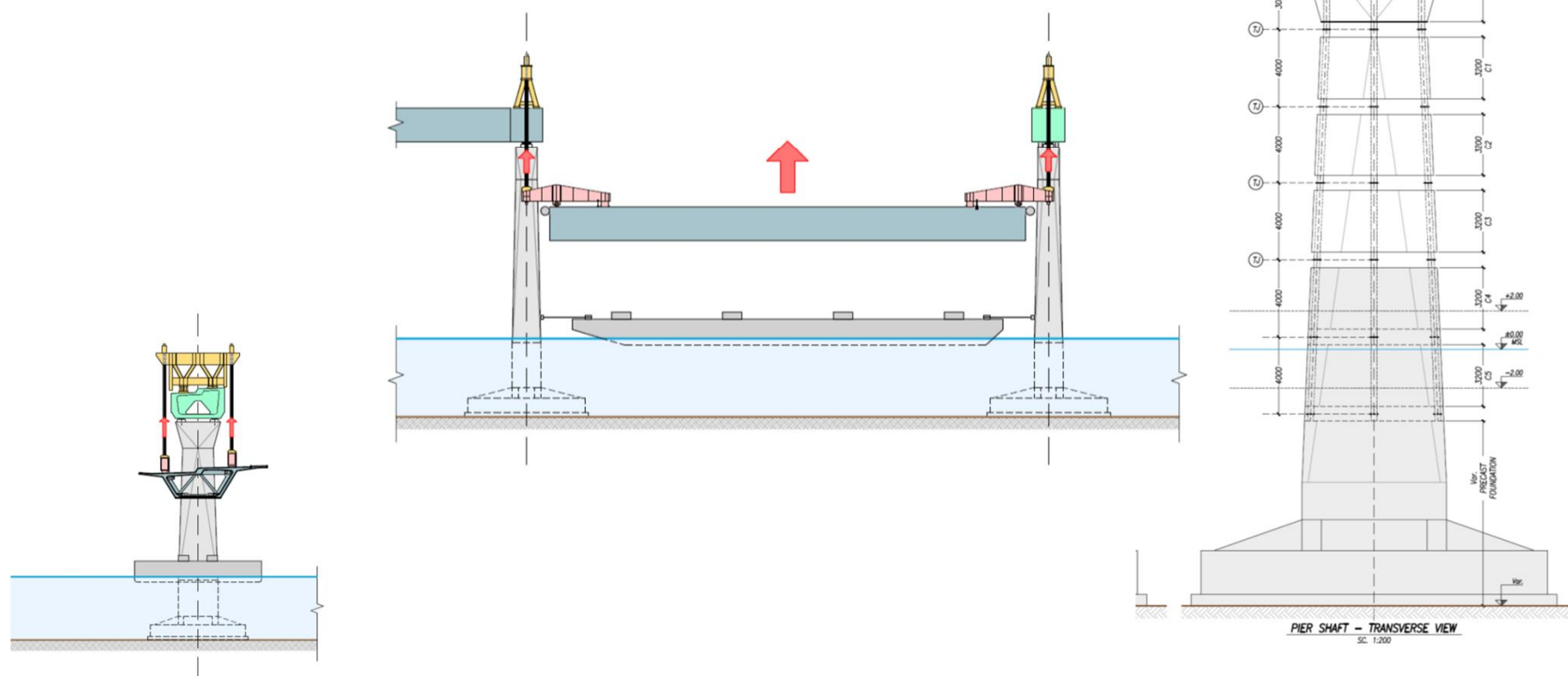
- DP 1000 General Drawings
-
- DP xxxx Foundation
- DP xxxx Pier
- DP xxxx Girder
-

We start again 'from scratch'
No DP can be submitted until BD is Approved
188 Design Packages (approx)

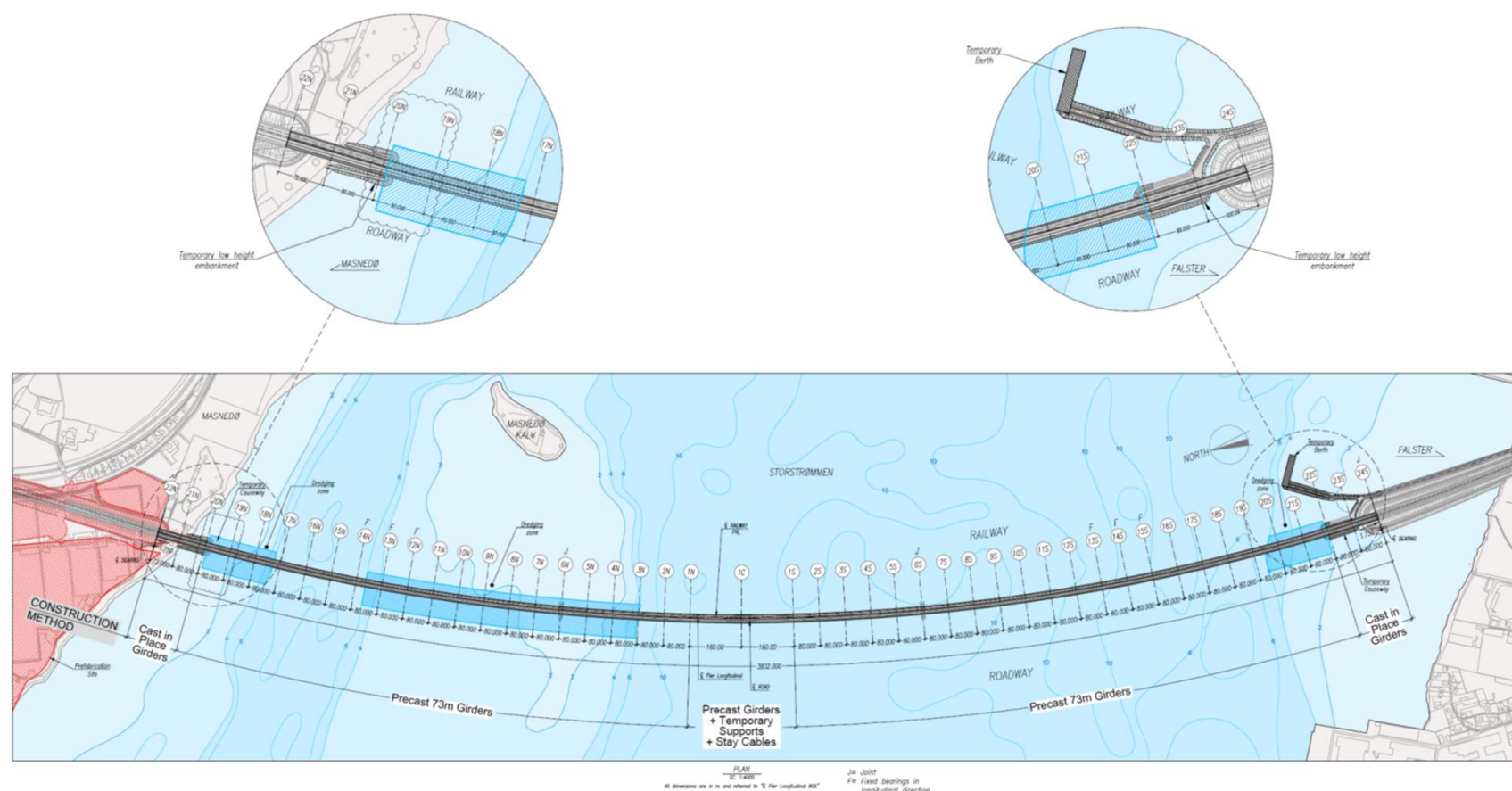


Status September 2019

Precast Elements

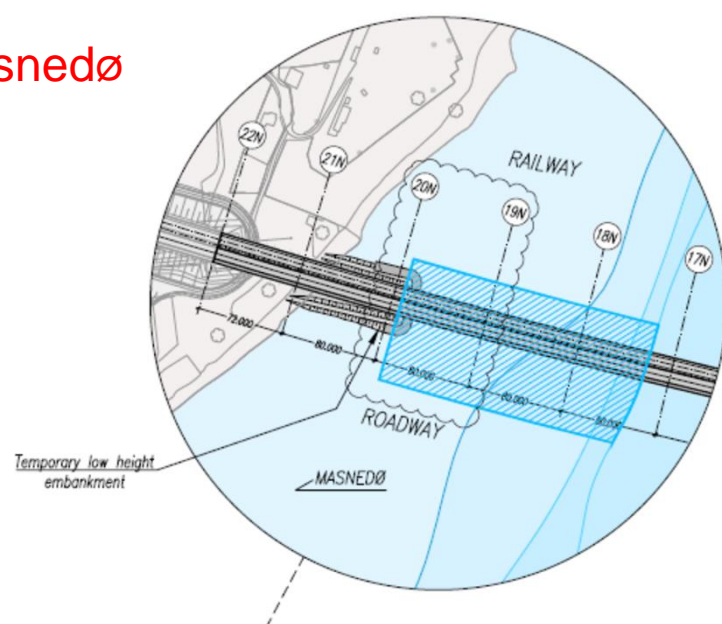


11

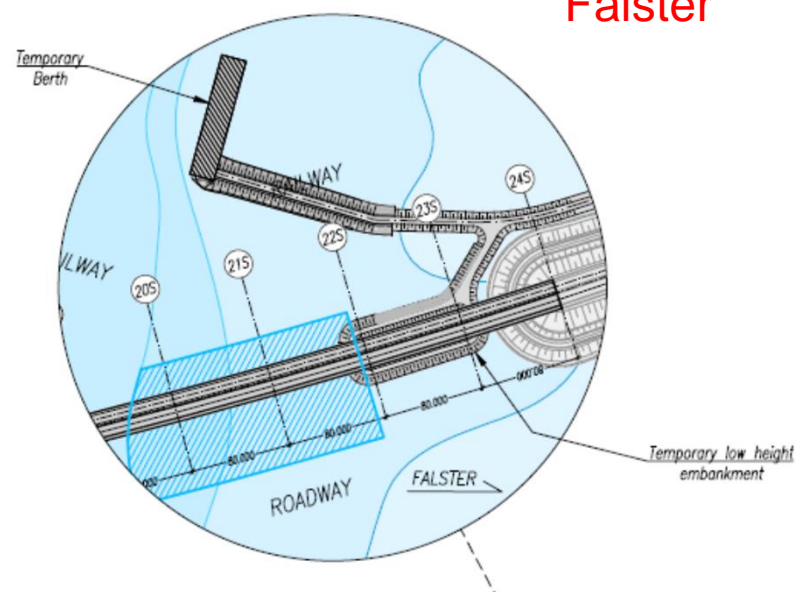


12

Masnedø



Falster



13

Falster



14



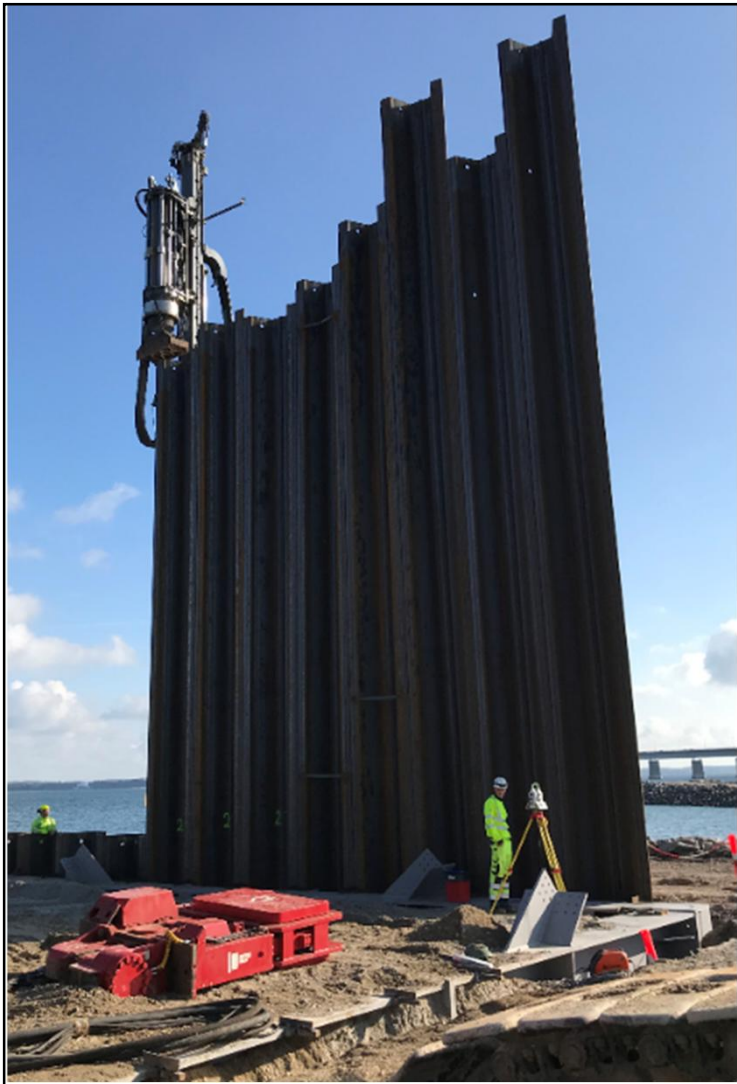
15

Interim Embankment Falster



16

16



Interim Embankment Falster



Samfinansieret af EU
Det transeuropæiske transportnet (TEN-T)

Vejdirektoratet

17

17



Falster – August 2019

Vejdirektoratet

18

Interim Road Falster



19

19

Masnedø



20

Prefabrication on Masnedø

- Foundations
- Pier
- Segments
- Full span girders (nearly)



21



22



Construction Site Masnedø August 2019

23

Rebar Foundation Shed 4 (pier segments)



24

24



25



Concrete Batching Plant

26

26

Storstrømsbroen

Vejdirektoratet




Storstrømsbroen
Project - Concrete



27

STORSTRØMSBROEN




Concrete requirements

- Min cement content 320/300 kg/m³ depending on environmental class
- Min concrete filler content 375 kg/m³
- Max fly ash/cement ratio 0,33 %
- Min fly ash/cement ratio 0,17 %
- Max microsilica/cement ratio 0,06
- Min microsilica/cement ratio 0,03 (only for environmental class:E-splash)
- Chloride content class CL 0,1%
- Air content in hardened concrete 3,5 spacing factor <0,20 mm or in alternative frost test «Good»
- Chloride migration at 120 days less than $5 \times 10^{-12} \text{ m}^2/\text{s}$

GENERAL WORK SPECIFICATION
CONCRETE BRIDGE – CONCRETE – GWS
TENDER SPECIFICATION

Særlige Arbejdsbeskrivelser
(Special Works Specification)
Storstrømsbroen
Entreprise 93200.001
Totalentreprise
SAB 43 - Betonbro, Beton
Juli 2016

Vejdirektoratet

28

14

Concrete mix design and their field of application

Mix ID – SBJV-E 40SCC16

Strength class – C 40/50

Consistency – SCC SF1

D max – 16 mm

Exposure class – E-splash

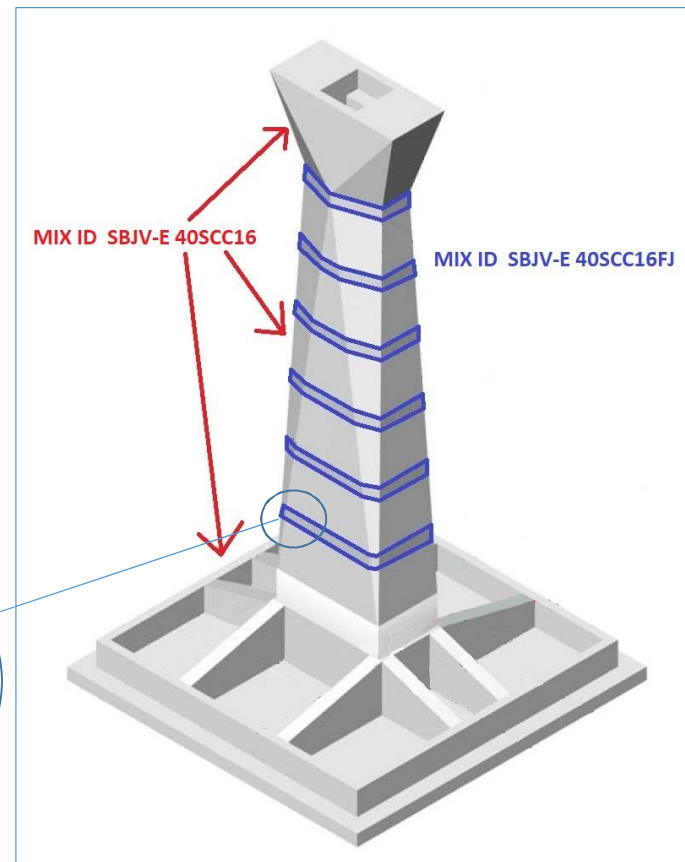
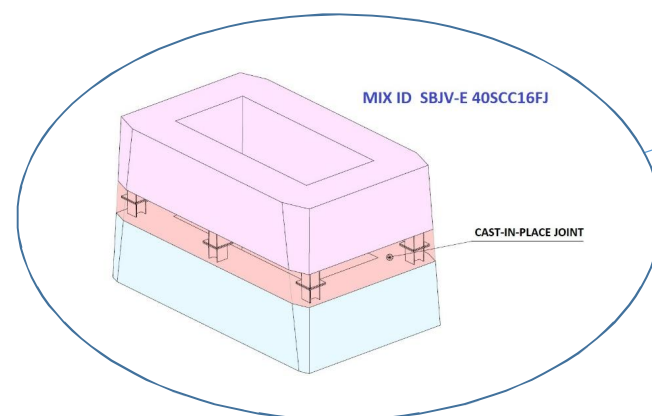
Mix ID – SBJV-E 40SCC16FJ

Strength class – C 40/50

Consistency – SCC SF1

D max – 16

Exposure class – E-splash



29

Concrete mix design and their field of application

Mix ID – SBJV-E 60SCC16

Strength class – C 60/75

Consistency – SCC SF1

D max – 16 mm

Exposure class – E-splash

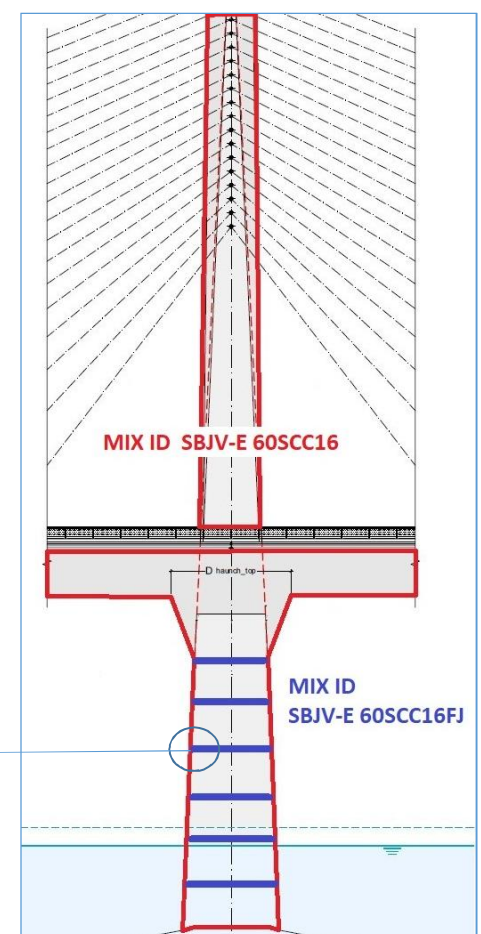
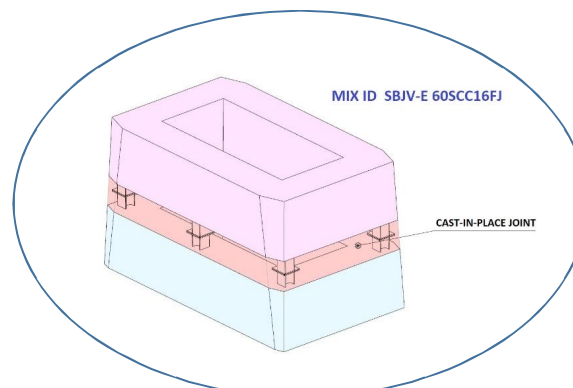
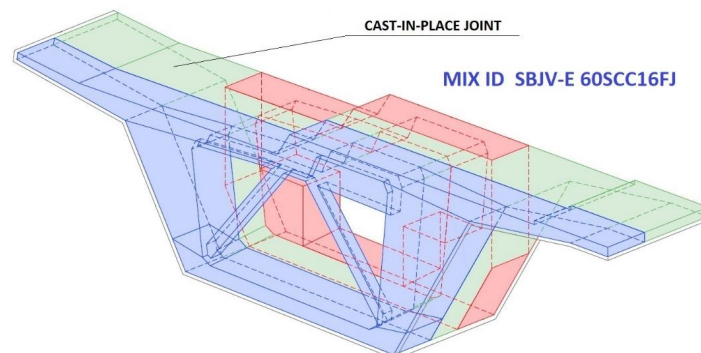
Mix ID – SBJV-E 60SCC16FJ

Strength class – C 60/75

Consistency – SCC SF1

D max – 16 mm

Exposure class – E-splash



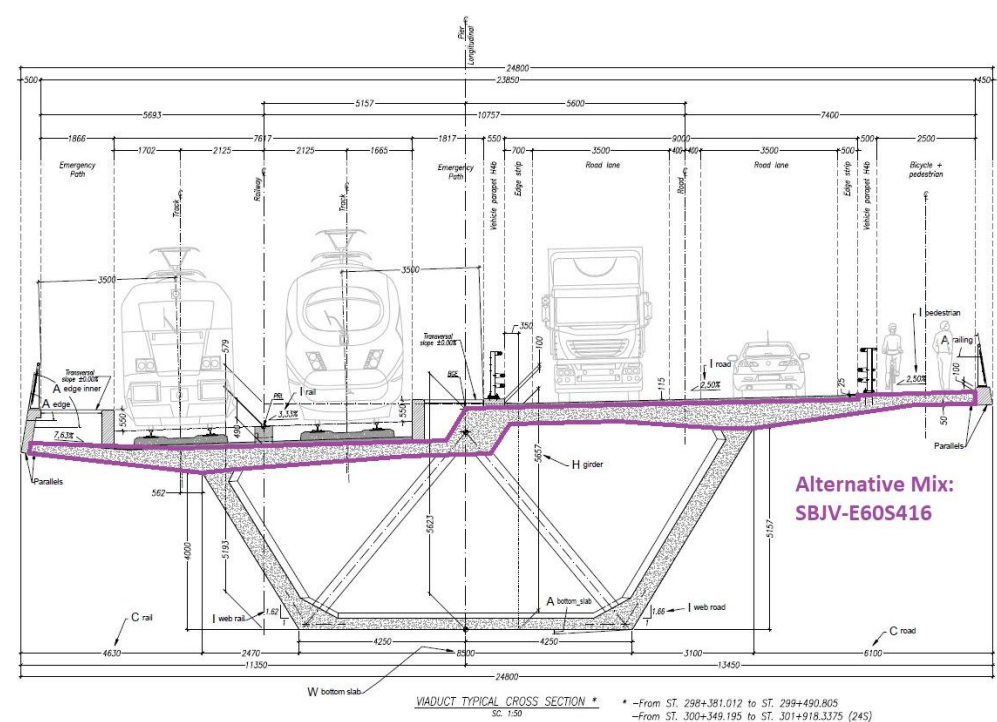
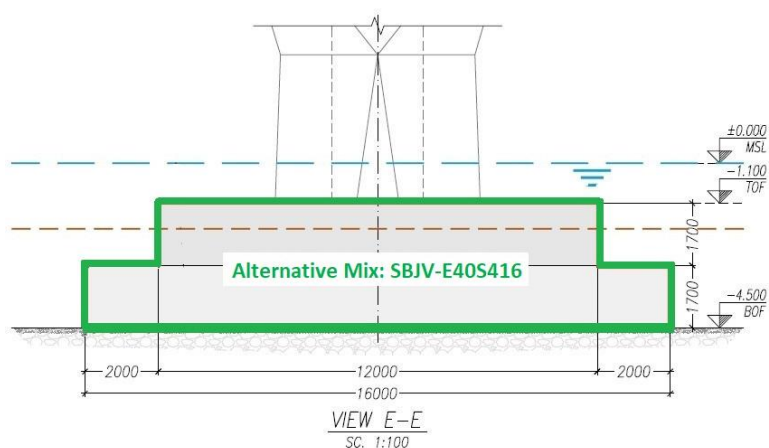
30

- Quicker casting times (specially in prefabrication)
- Less labor hours and less work operations
- Better surface finishing
- Better filling ability in the high congestion reinforced structures and in complex formwork geometries
- Filling ability in the Cast In Place Joint



31

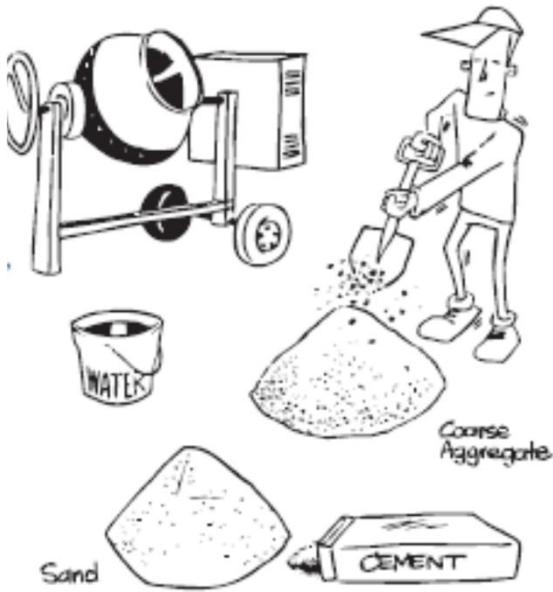
- **SBJV-E40S416** – as alternative in site foundation and abutment and for walls and curbs
- **SBJV-E60S416** – as alternative for top slab box girder



32

Process of mix design definition

- DTI Mix design and laboratory trial mixes
- Concrete pretesting at the batching plant
- Full scale trial casting program



33

Laboratory Trial Mixes

FRESH CONCRETE PROPERTIES		
TEST:	TARGET VALUES:	
Slump flow test	SF 1	
Viscosity (T 500)	VS2	
Concrete temperature	-	
Fresh concrete density	-	
Air content in fresh concrete	For E40 mixes	6.5 ± 0.5 %
	For E60 mixes	5.5 ± 0.5 %
Initial setting time	-	
Heat development	-	



HARDENED CONCRETE PROPERTIES	
TEST:	TARGET VALUES:
Compressive strength at 28 days	fc _m ≥ f _{ck} + 6 N/mm ²
Hardened concrete density	-
Air void structure	Air content > 3.5% Spacing factor < 0.2 mm
Chloride migration coefficient	< 5*10 ⁻¹² m ² /s at 120 days
Shrinkage compensation evaluation (difference between standard concrete and concrete for joint)	> 0.00015 m/m
Development of E-modulus	-
Development of tensile splitting strength	-
Coefficient of thermal expansion	-
Autogenous early age shrinkage and creep	-

34

Concrete Pre-Testing at the Batching Plant

FRESH CONCRETE	
TEST	ACCEPTANCE LIMITS
Slump flow test	Comply with target value established during laboratory trial mix Slump Flow : Target ± 50 mm
Viscosity (T 500)	Comply with target value established during laboratory trial mix Viscosity class VS2
Viscosity (V-FUNNEL TEST)	Target: Vf = 6 ± 3 s
L-Box test	Target: PL ≥ 0,6
Sieve segregation test	Class SR2
Air content	Comply with target value established during laboratory trial mix Air content: Target ± 1 %
Density	None. Record value to be use during production
Temperature	Record the value
Initial setting time	-



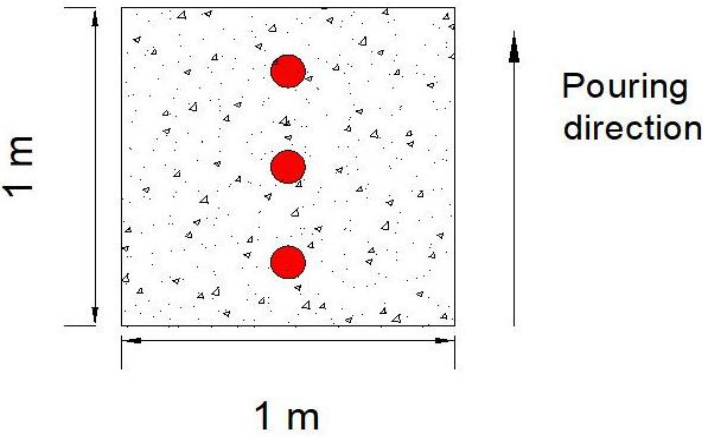
HARDENED CONCRETE	
TEST	ACCEPTANCE CRITERIA
Compressive strength at 28 days	Individual result tested: fci ≥ fck - 4 N/mm² Mean result: fcm ≥ fck + 6 N/mm²
Hardened concrete density	-
Air void structure	Spacing factor ≤ 0.20 mm Air content > 3.5 %
Chloride migration coefficient	At 120 DAYS ≤ 5*10 ⁻¹² m²/s
HARDENED CONCRETE: EARLY AGE PROPERTIES	
TEST	ACCEPTANCE CRITERIA
Development of E-modulus	-
Development of tensile splitting strength	-
Coefficient of thermal expansion	-
Autogenous early age shrinkage and creep	-

35

Trial Casting - 1 m3 trial blocks

Sensitive analysis of the air voids structure

- Different level of air percentage in fresh concrete
- Different transportation time
- Different pumping system
- Different mixing time at the Batching Plant



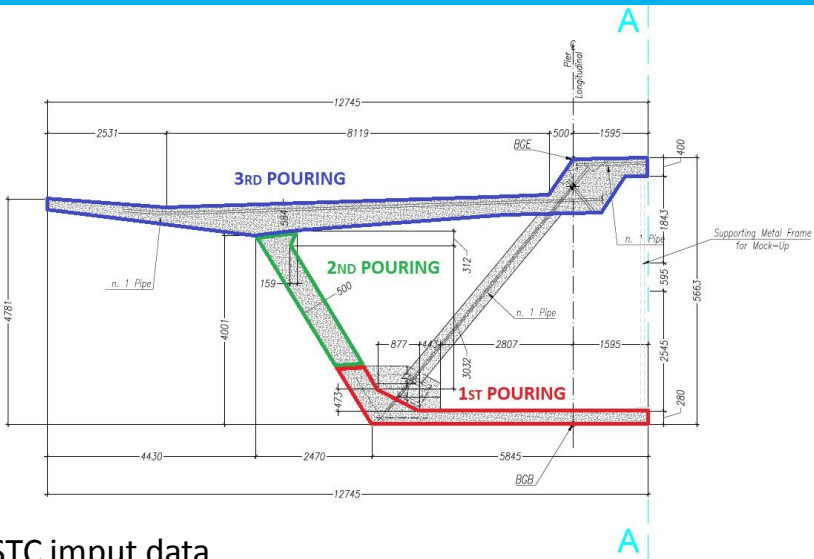
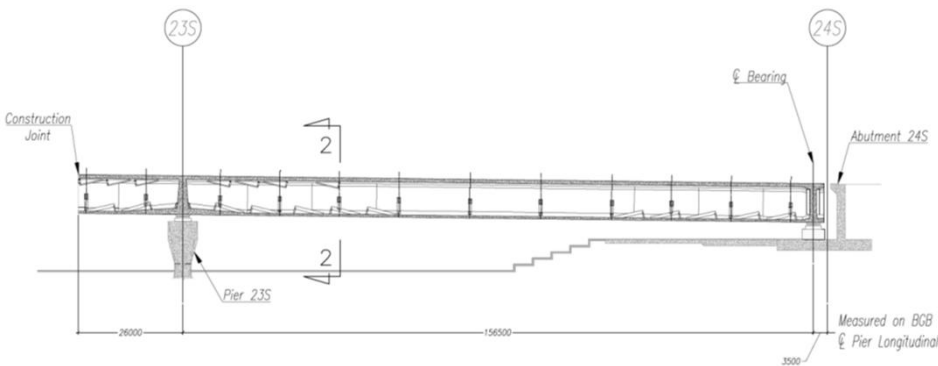
- Testing of Air Void Structure on 3 cores for each trial block
- Evaluation of trends (if any)
- Definition of air content requirement to be used during production

36

Full Scale Trial Casting Program

Definition of structural element, or representative part thereof, for the FSTC

- Type of casting condition expected (in –situ or pre-cast)
- Most representative condition with reference to flowability, segregation resistance
- Most representative condition with reference of surface finiscing
- Inclusion of consruction joint



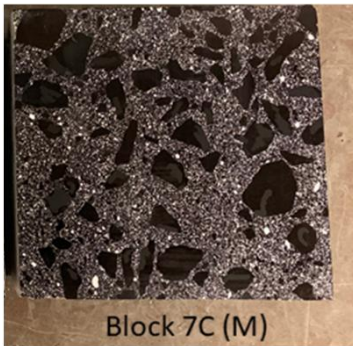
FSTC input data

- Pumping sistem/trasnportation time
- Contruction sequence
- Pouring (casting rate, inlet point, pouring sequence)
- Temperature and Stress Simulation
- Cooling sistem/heating sistem (if any)
- Fromwork and insulation
- Curing sistem

Full Scale Trial Casting - Tests

FRESH CONCRETE	
TEST	ACCEPTANCE LIMITS
Slump flow test	Slump Flow : Target ± 50 mm
Viscosity (T 500)	Target: Vf = 6 ± 3 s
Air content	For E40 mixes 6.5± 2 % For E60 mixes: 5.5%± under investigation
L-Box	Target: Vf = 6 ± 3 s
V-Funnel	Target: PL ≥ 0,6
Sieve segregation test	Class SR2
Fresh concrete density	-
Initial setting time	-
Temperature	Record the value

HARDENED CONCRETE	
TEST	ACCEPTANCE LIMITS
Compressive strength	fc _m ≥ f _{ck} + 6 N/mm ²
Hardened concrete density	-
Air void structure	Spacing factor ≤ 0.20 mm Air content > 3.5 %
Chloride migration coefficient	At 120 days ≤ 5*10 ⁻¹² m ² /s



CORE DRILLED IN FULL-SCALE TRIAL	
TEST	ACCEPTANCE LIMITS
Air void structure	Spacing factor ≤ 0.20 mm Air content > 3.5 %
Chloride migration coefficient	At 120 maturity days ≤ 5*10 ⁻¹² m ² /s
Construction joint documentation	No detrimental effect of the connection on the concrete and sufficient embedment
Concrete spacer	Good bonding between spacer and new concrete. No serious detrimental effects



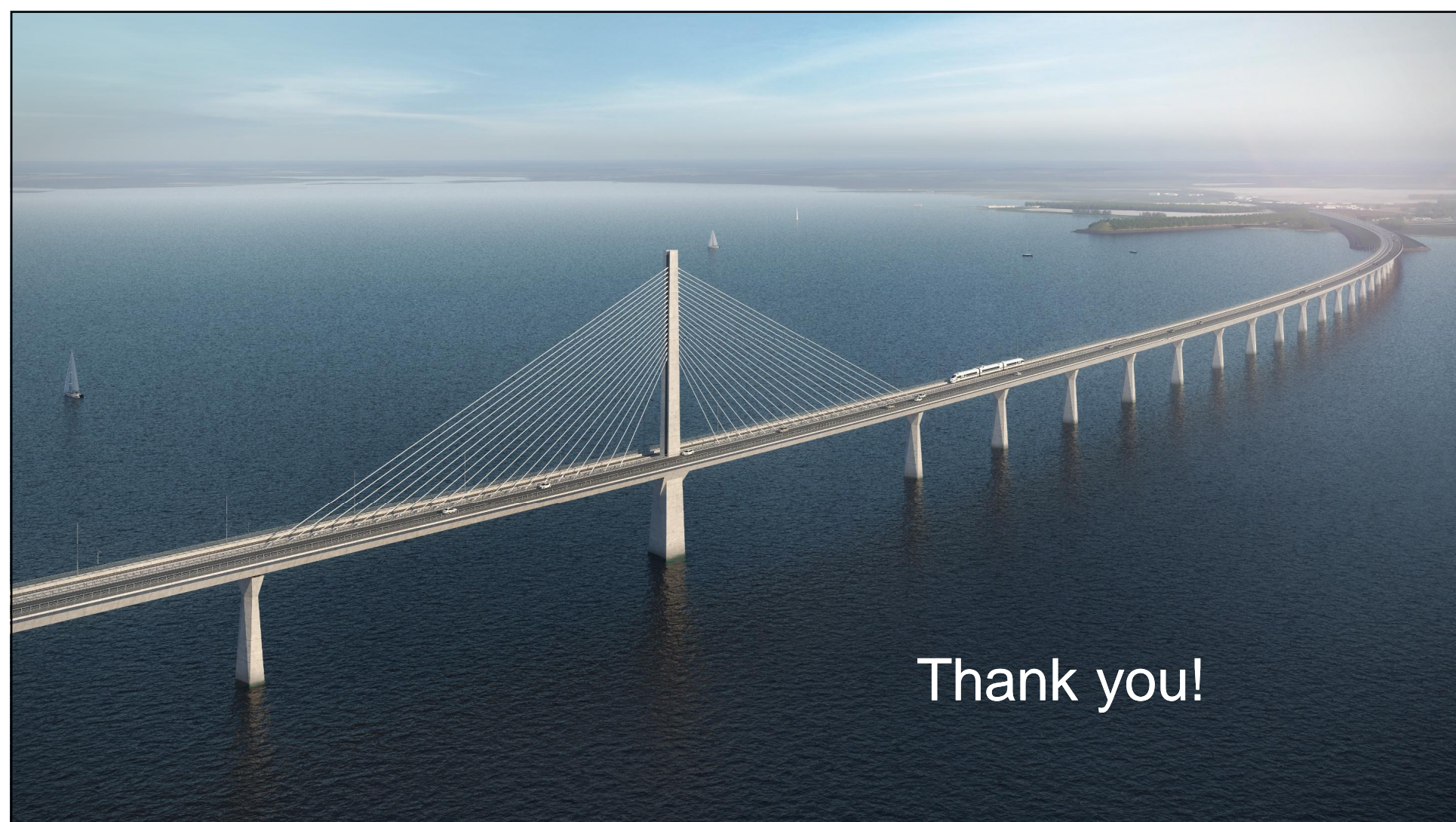
Invitation – IABSE DK

Mini seminar

New Storstrøm Bridge, Batching Plant and Prefabrication Yard

Wednesday 9th October 2019, 15:00 -19:00

Storstrøm Bridge Construction Site and Visitor Center,
Brovejen 16, 4760 Vordingborg



Thank you!