

Storebælt
Sund ≈ Bælt

WBBR: WEST BRIDGE BEARING REFURBISHMENT

25. September 2025

Sophie Juulsgård

SUND & BÆLT'S ACTIVITIES



THE ROAD LINK ACROSS STOREBÆLT



Total length: 17,540 km

East Bridge:

Total length: 6,790 m

Construction period: 1991- 1998

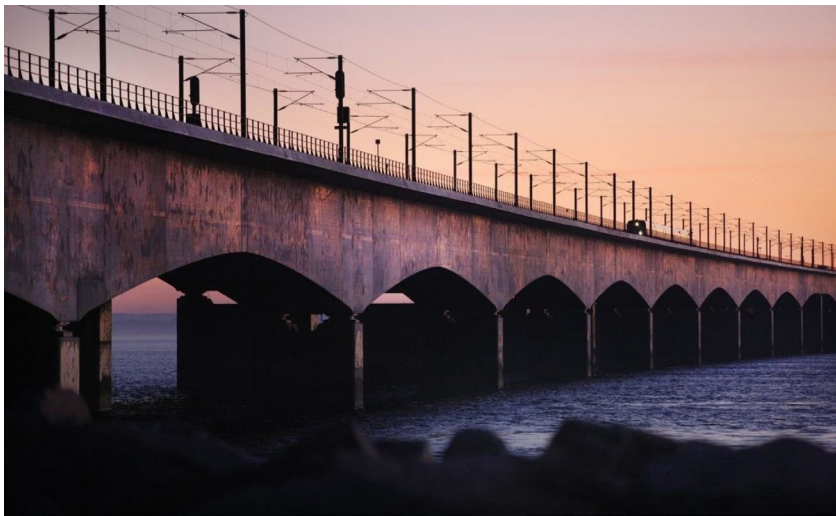
West Bridge:

2 parallel bridges (rail and road bridge)

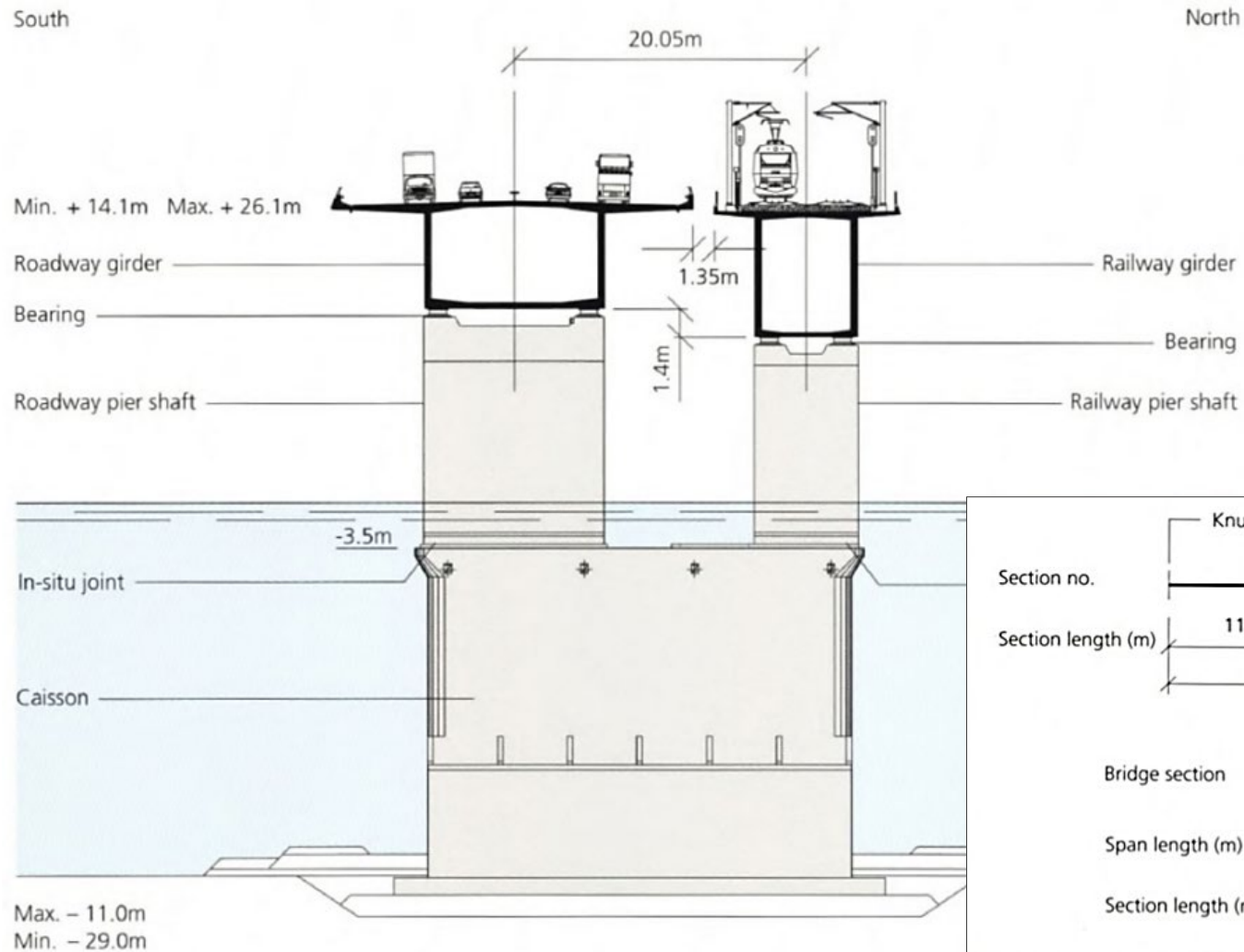
Total length: 6,611 m

Construction period: 1989- 1994

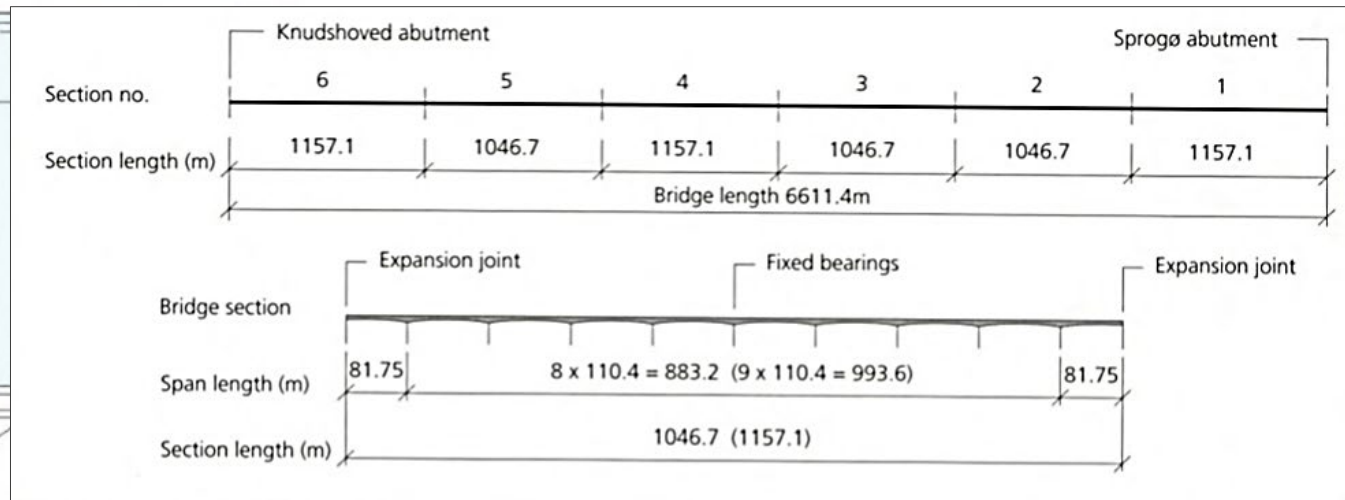
THE WEST BRIDGE



THE WEST BRIDGE LAYOUT

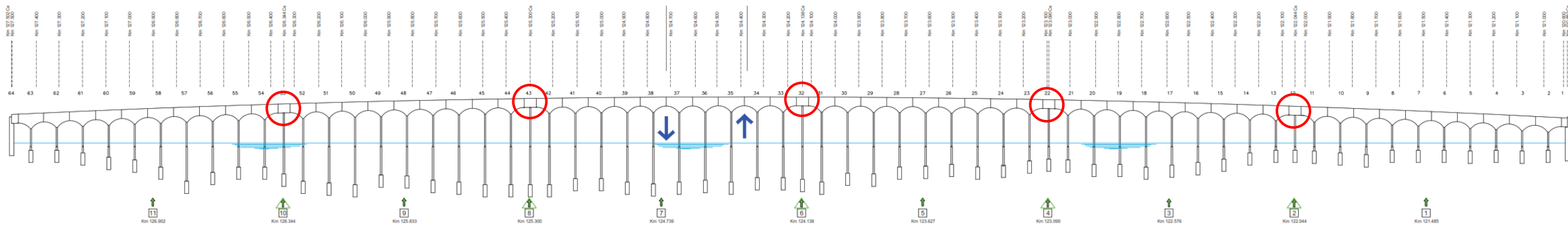


- 6,611 meters long
- 6 sections
- 276 bearings
- Opened in 1997 (trains) and 1998 (cars)
- 3 different overall bearing types
- 42 different sub types

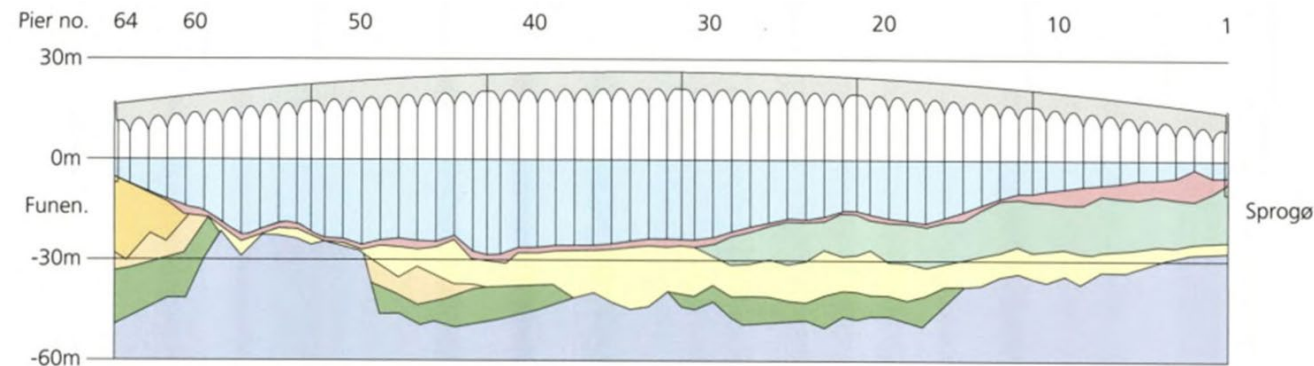


THE WEST BRIDGE LAYOUT

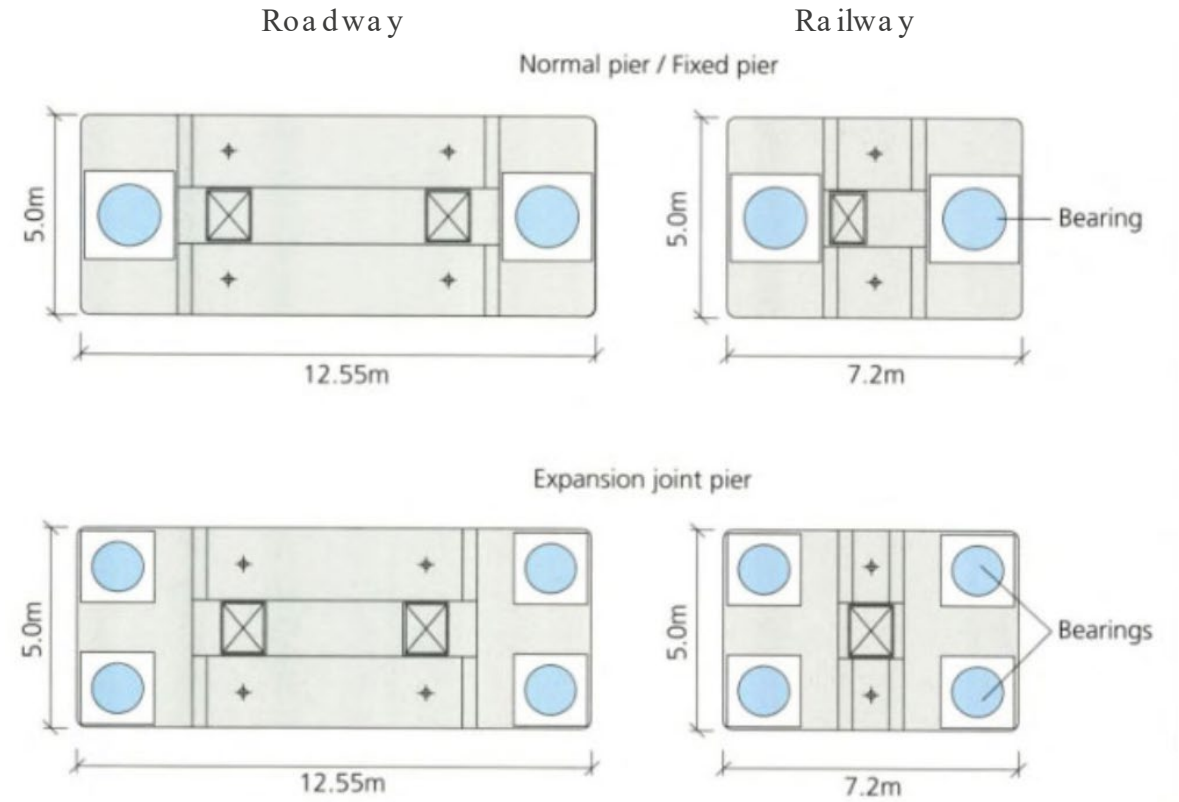
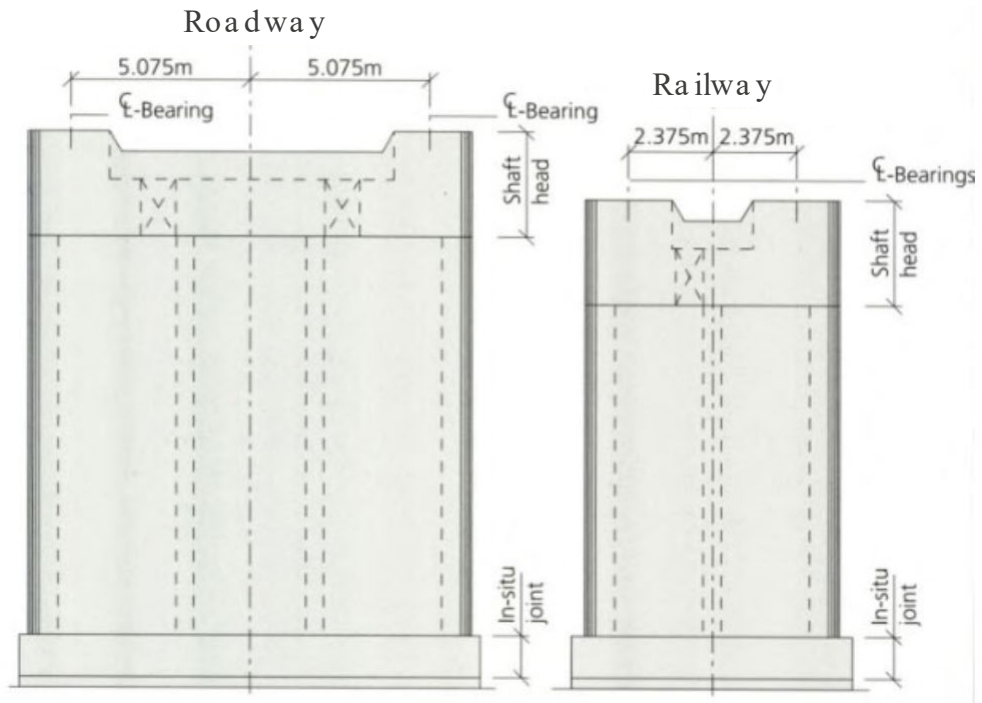
- Water depths varies from - 4,2 m (Pillar 2) to - 28,3 m (Pillar 43)
- From water level to the underside of the bridge, the height varies from 6,5 m (Pillar 2) to ~20 m (Pillar 32)
- Not considering tides and waves and referring to DVR90



○ = expansion joint

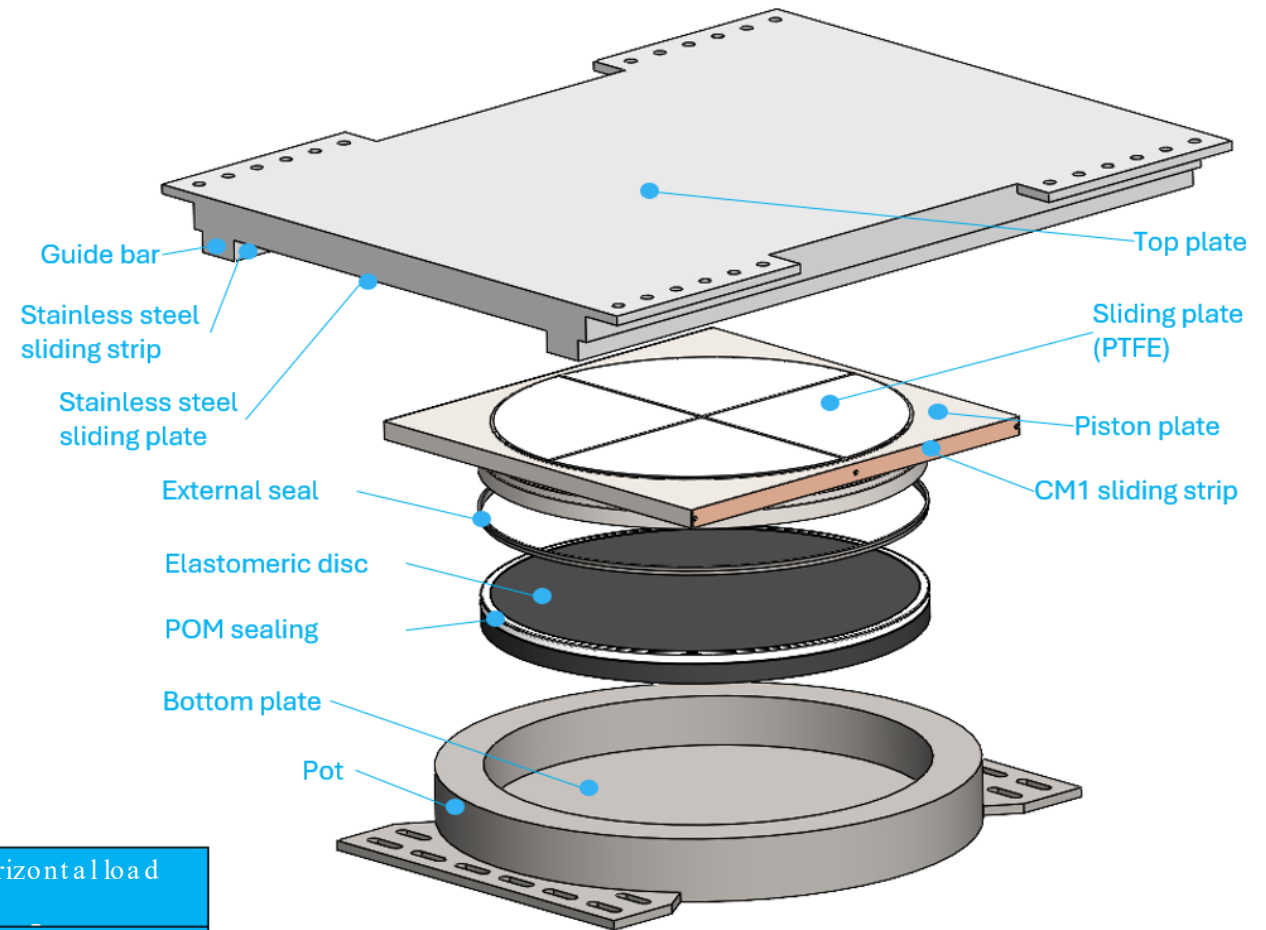
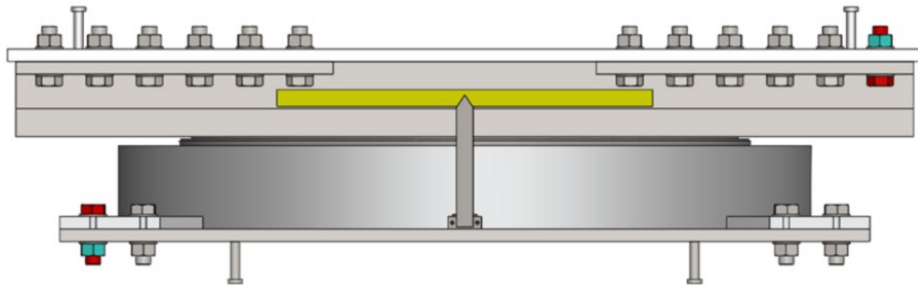


WEST BRIDGE PIER LAYOUT



POT BEARINGS

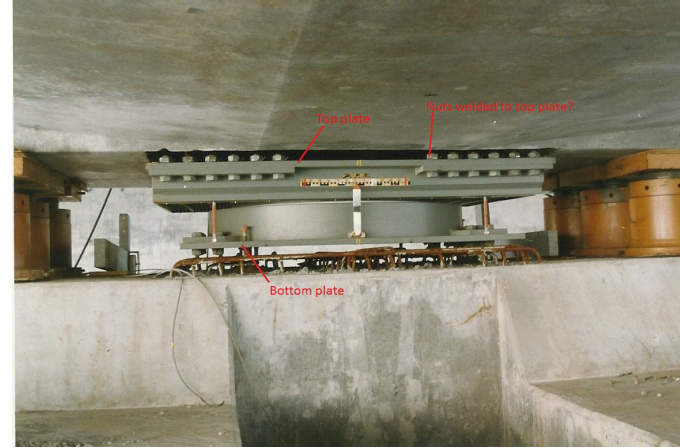
- Producer: Mageba
- Transvers, longitudinal and rotational movement
- Vertical and horizontal loads



Bearing types		Characteristic vertical load [kN]		Characteristic horizontal load [kN]	
		Permanent	Max.	Longitudinal	Transvers
Rail bridge	TE12	6.695	9.927	-	562
	TE20	29.309	35.294	-	2400
	TE20F	29.309	35.294	2275	2400
Road bridge	TE12	7.480	9.558	-	280
	TE19	32.765	36.995	-	1300
	TE19F	32.765	36.995	2500	1300

POT BEARINGS

- Then:



- Now:

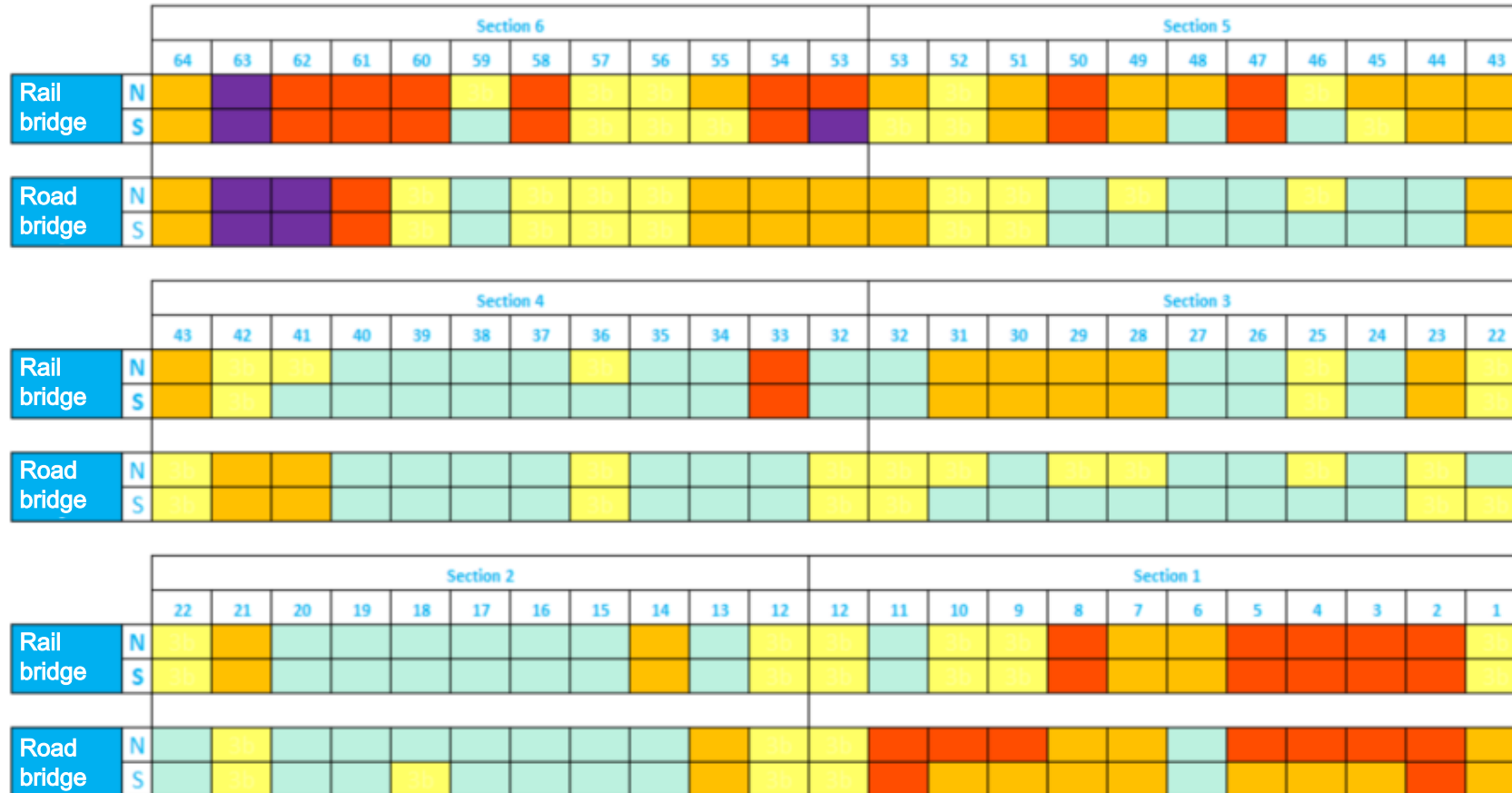


PROJECT

- **Condition** : What is the expected lifetime?
 - General inspection in 2022
 - Special inspection in 2023
- **Strategy** : Which bearings needs replacing/refurbishment?
 - New bearings
 - Partly refurbished
 - Fully refurbished
 - Location of refurbishments
 - Dialogue with manufacturers
- **Execution** : How could we be doing this?
 - Platforms for access due to difficult conditions
 - Tools
 - Minimize impact on traffic
 - Time planning
- **Market Dialogue** : Collaboration and learn by your experience. A chance to influence the tender
- **Trial lifts** in October/November 2024 and April 2025
- **Tender** : Coming next (October 2025)

BEARING CONDITION

- Remaining lifetime based on the PTFE-thickness and corrosion conditions



Category	Lifetime from 2023
1	4- 8 years
2	6- 12 years
3a	12- 20 years
3b	20- 30 years
4	30 + years

STRATEGY

- Maximum cost benefit by changing all bearings in a bearing line



Category	Lifetime from 2023
1	4- 8 years
2	6- 12 years
3a	12- 20 years
3b	20- 30 years
4	30 + years

Bearings undergoing works from 2027 and going forward

20+ years will be

STRATEGY

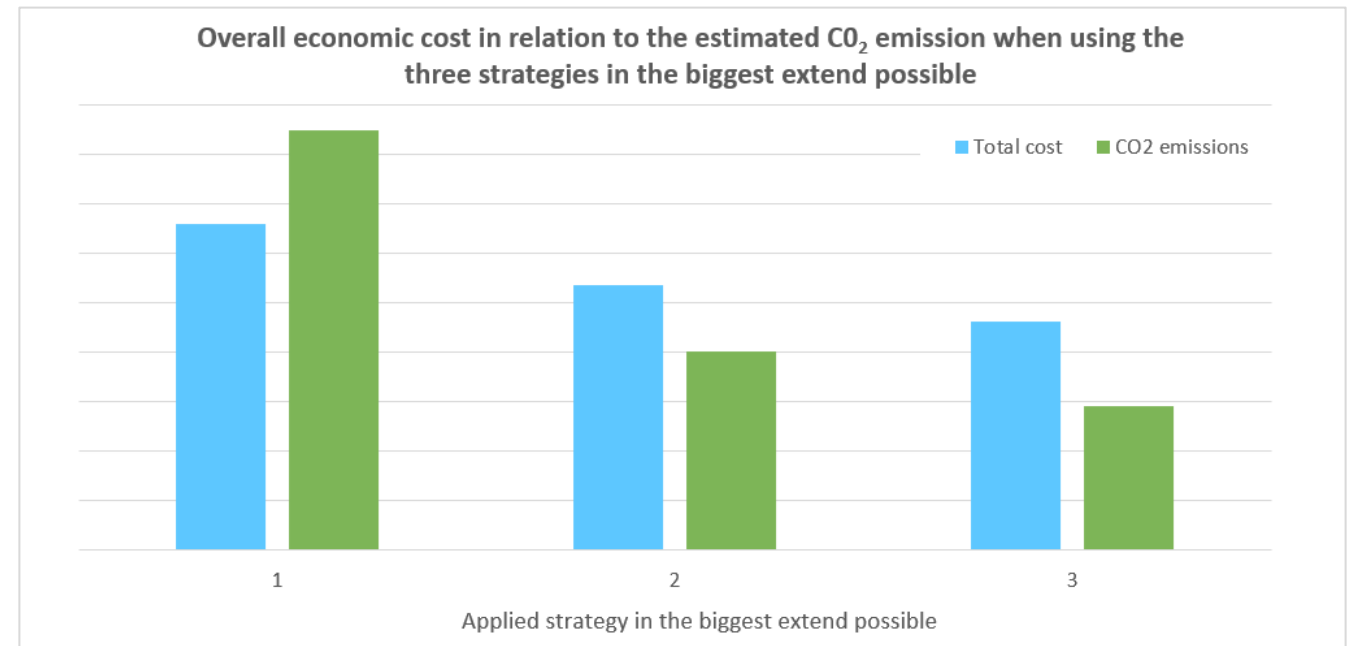
- Investigations has been made to determine the optimal strategy with regards to mainly:
 - Price
 - Time
 - Sustainability
- Three main strategies has been examined:
 - Strategy 1: Purchasing new bearings
 - Strategy 2: Purchasing only new top plates and renovating the remaining bearing
 - Strategy 3: Fully refurbishing all bearings
- With the three main focuses, none of the three strategies are ideal.
- A combination gives the most ideal balance.

Final Project scope:

Approx. 60 % of the bearings

41 bearing lines

172 bearings in total



STRATEGY

- 44 new bearings new
 - 64 partly refurbished bearings (new top plates) B
 - 64 fully refurbished bearings C
- } Must also consider 42 different bearing types due to varying top plate sliding lengths

Scenario 1

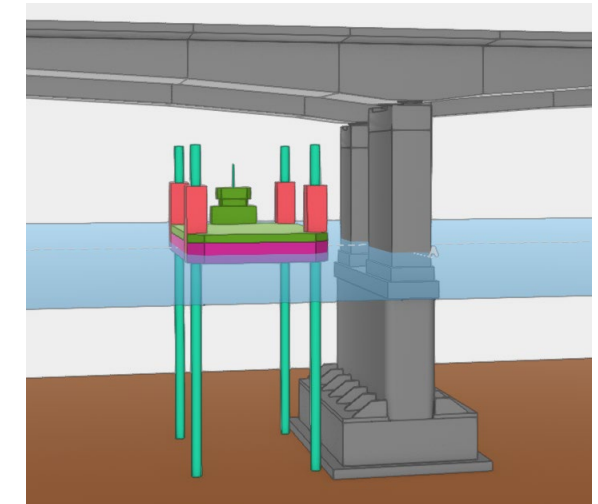
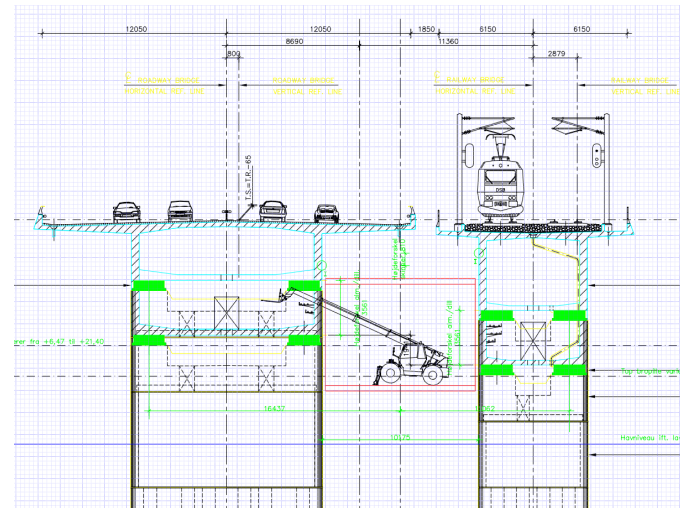
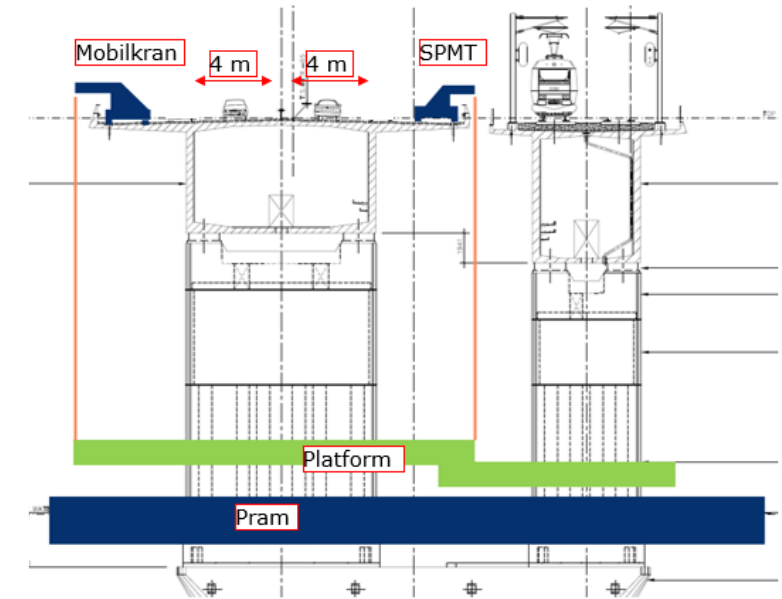
		Section 6												Section 5											
		64	63	62	61	60	59	58	57	56	55	54	53V	53Ø	52	51	50	49	48	47	46	45	44	43V	
Banebro	N		New	New	New	New		New	New	New	New	New	New	New	B	B	C	B		B	C	C	C	B	
	S		New	New	New	New		New	New	New	New	New	New	New	B	B	C	B		B	C	C	C	B	
Schedule Number:		1	2	3	4		5	6	7	8	9	10	11	12	13	14	15		16	17	18	19	20		
Vejbro	N		New	New	New	New		New	New	New	New	New	New	New	B	B	C	B		B	C	C	C	B	
	S		New	New	New	New		New	New	New	New	New	New	New	B	B	C	B		B	C	C	C	B	

		Section 4												Section 3											
		43Ø	42	41	40	39	38	37	36	35	34	33	32V	32Ø	31	30	29	28	27	26	25	24	23	22V	
Banebro	N	B	B	B								B			C	C	B	B					C		
	S	B	B	B								B			C	C	B	B					C		
		21	22	23								24			25	26	27	28					29		
Vejbro	N	B	B	B								B			C	C	B	B					C		
	S	B	B	B								B			C	C	B	B					C		

		Section 2												Section 1											
		22Ø	21	20	19	18	17	16	15	14	13	12V	12Ø	11	10	9	8	7	6	5	4	3	2	1	
Banebro	N		B							C	C	B	B	B	C	C	C	C		B	C	C	C		
	S		B							C	C	B	B	B	C	C	C	C		B	C	C	C		
		30								31	32	33	34	35	36	37	38	39		40	41	42	43		
Vejbro	N		B							C	C	B	B	B	C	C	C	C		B	C	C	C		
	S		B							C	C	B	B	B	C	C	C	C		B	C	C	C		

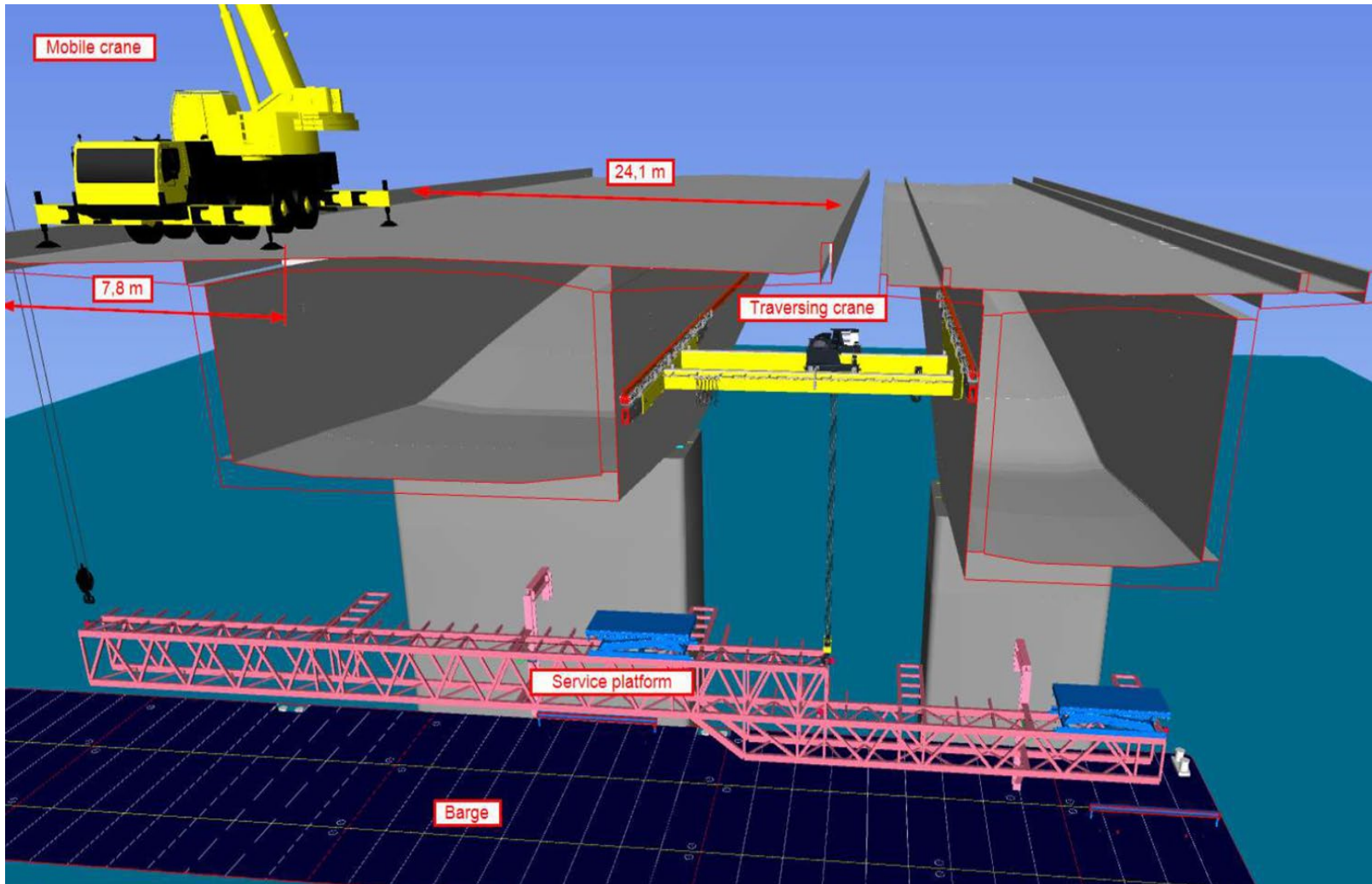
EXPLORED PROJECT PROPOSALS

- SPMT-crane to replace crane on rails
- Platform on existing rails
- Service vehicle on existing rails
- Jack-up barge

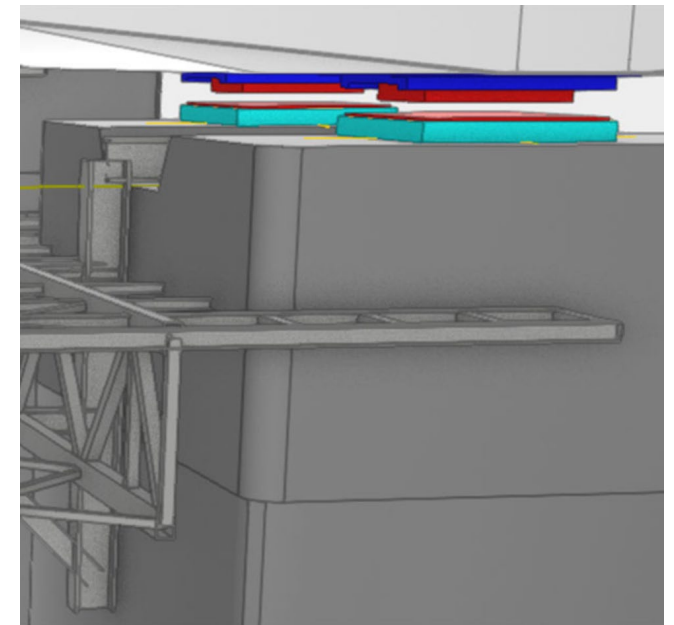
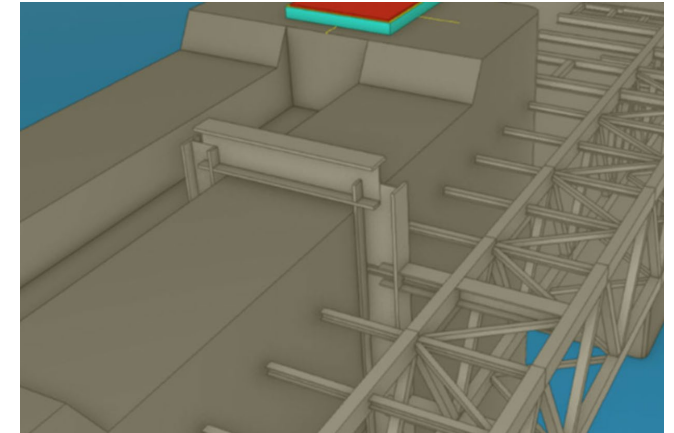
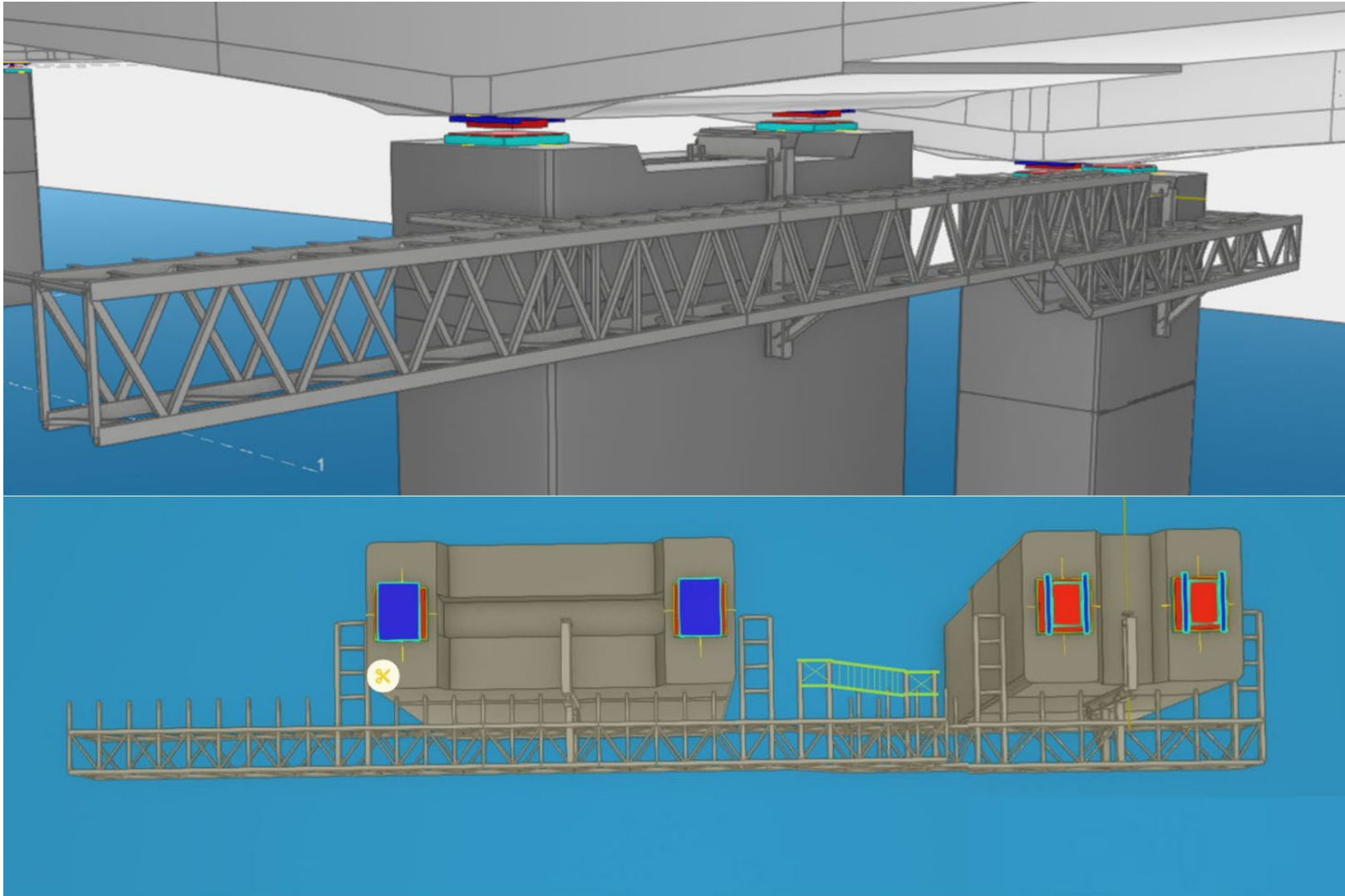


FINAL PROJECT PROPOSAL

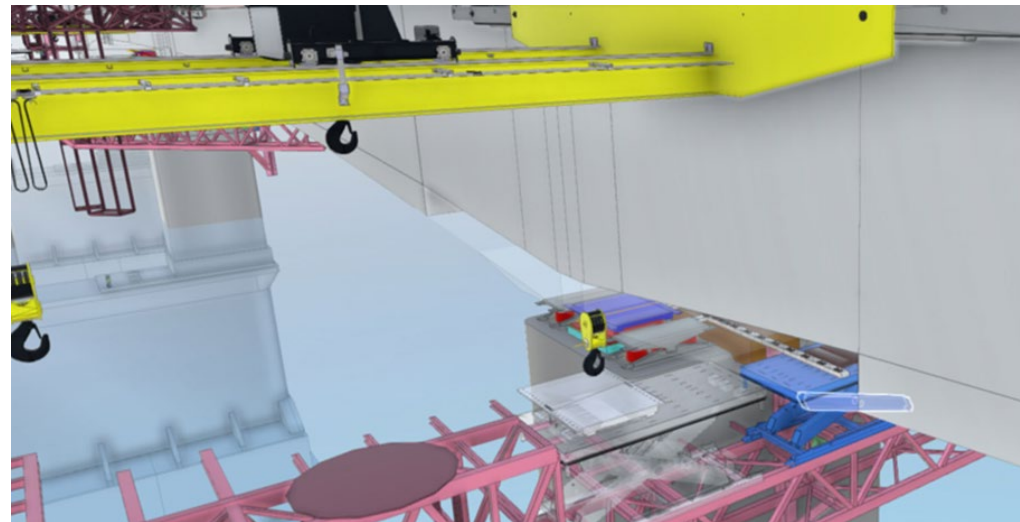
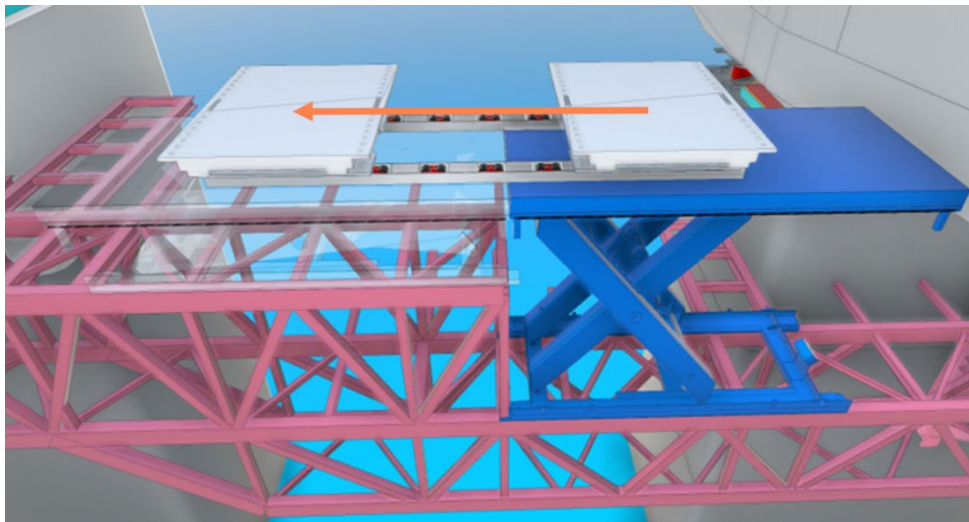
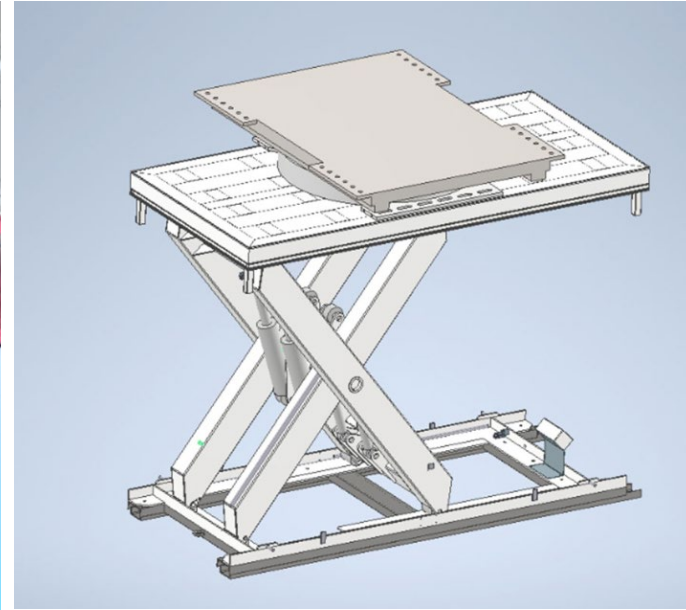
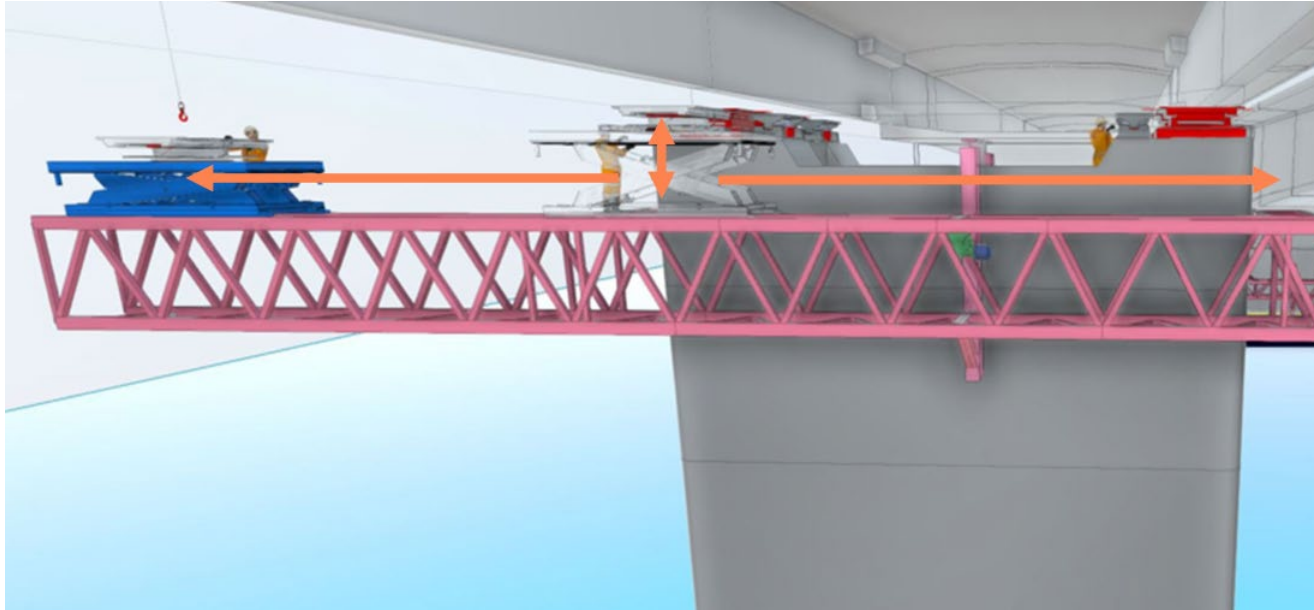
- Investigation of many different methods resulting in a combination of several methods



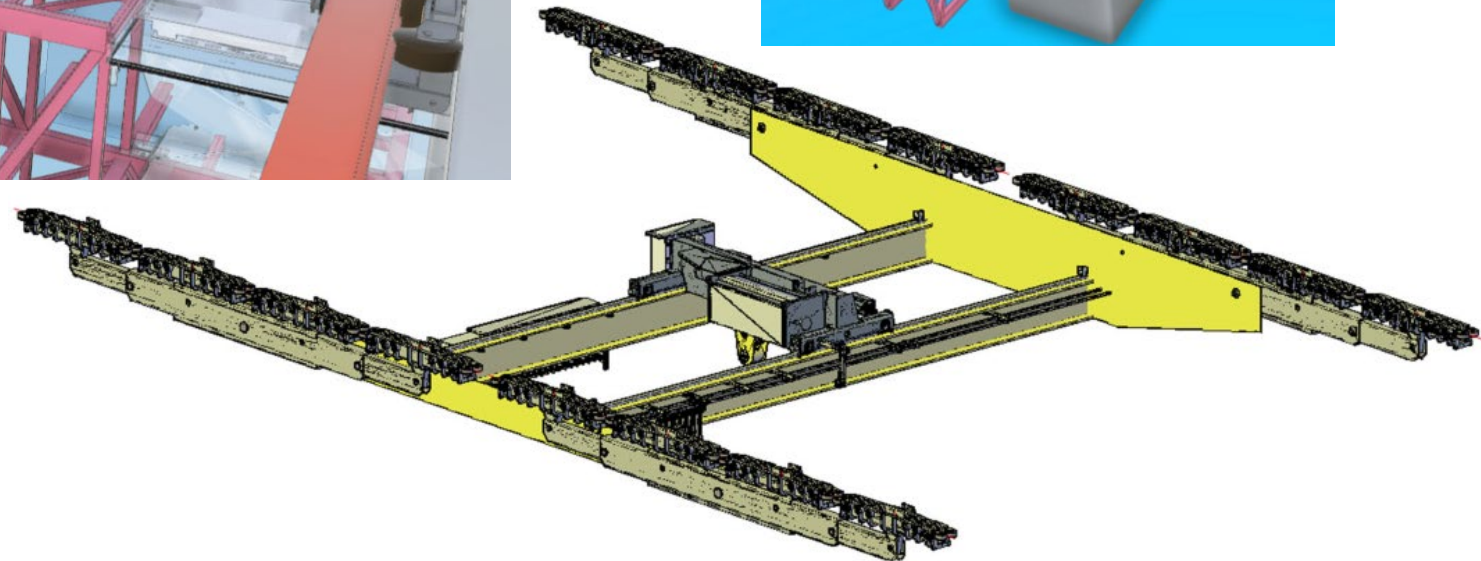
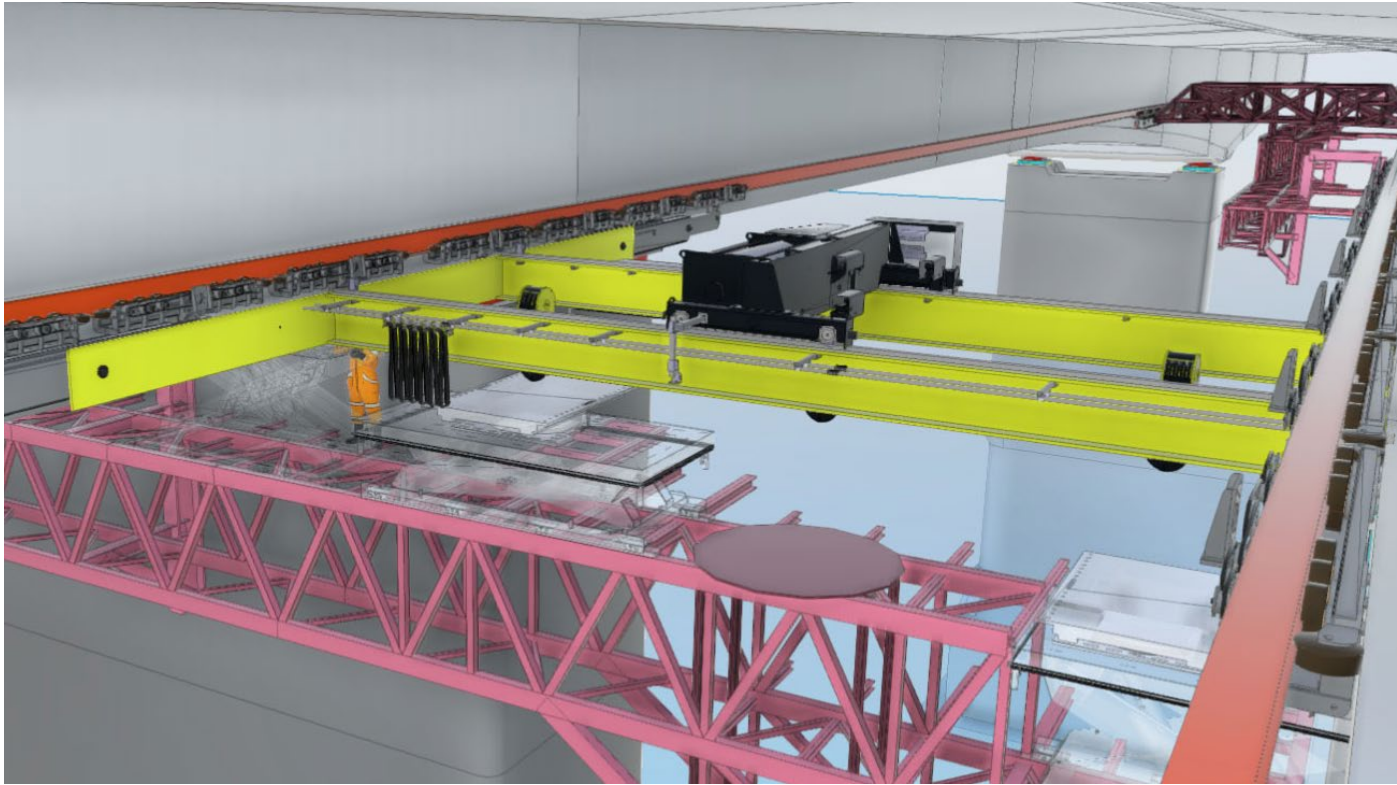
SERVICE PLATFORMS - 360° ACCESS OF PIERS



SERVICE PLATFORMS – MOVING THE BEARINGS

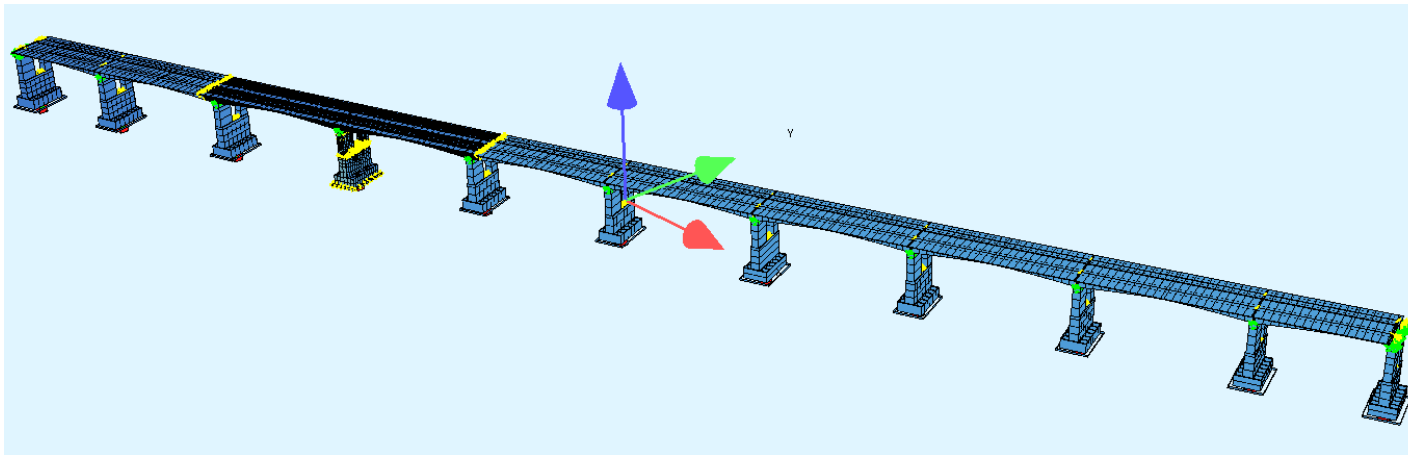


PORTAL CRANE - LIFTING AND TRANSPORTATION

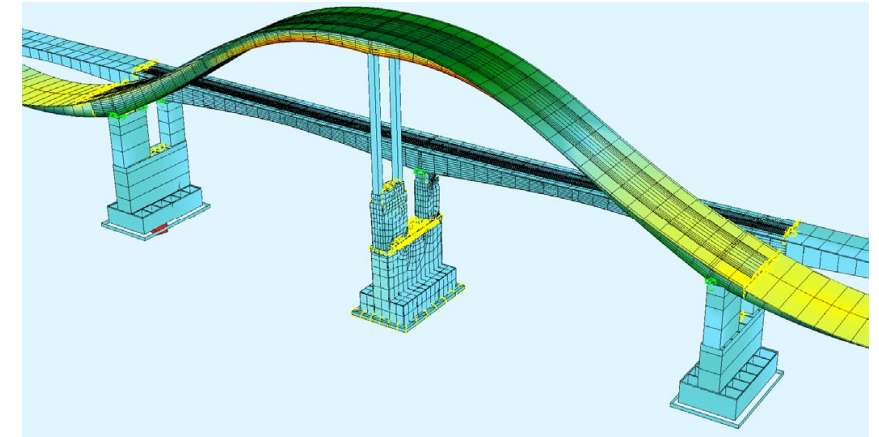


FE MODEL

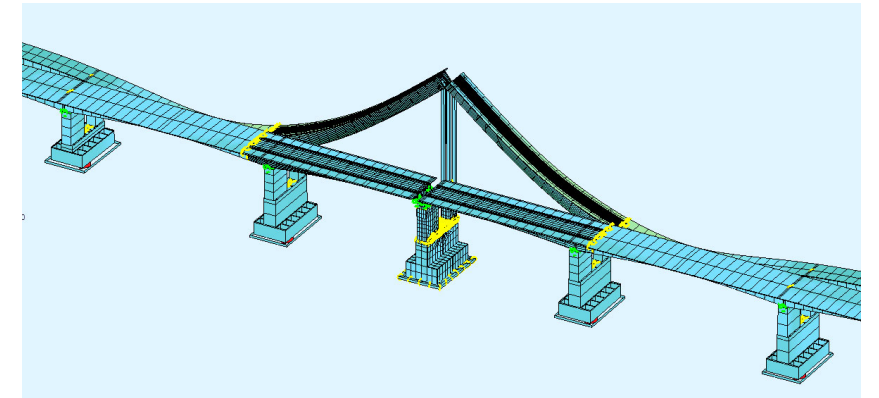
- One section of the bridge is modelled to investigate:
 - Omfordeling af kræfter mellem lejer på samme pille
 - Beregning af tvangskræfter i lejer/donkrafte i forbindelse med sideskub
 - Beregning af tvangskræfter fra sætninger/bevægelser af piller
 - Mulighed for at reducere lejestørrelserne?
 - Situation ved dilatationspillerne omkring up-lift grundet tog.
 - Reducering af nye lejer med op til 30 %
 - Speciel situation ved dilatationspillerne



Plot af anvendt FE - model, bestående af 1 sektion med 10 fag



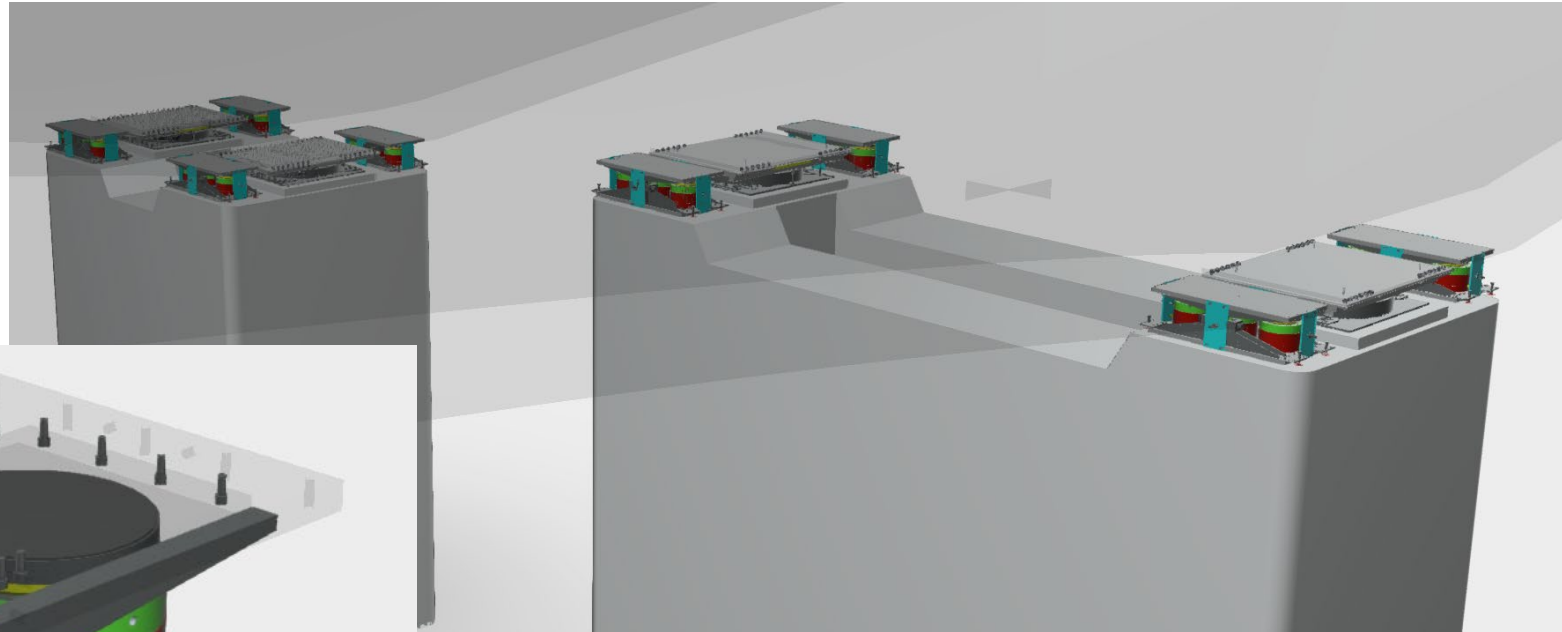
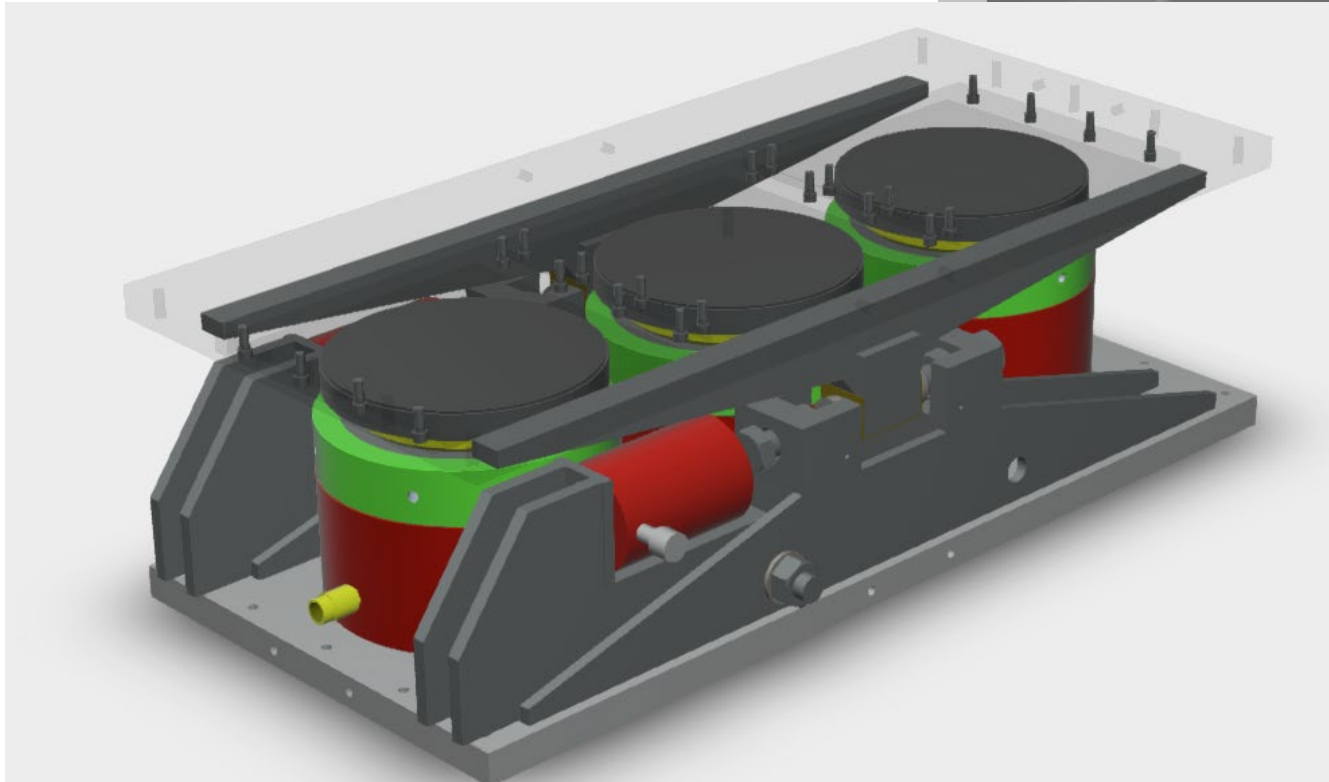
Deformationsfigur for symmetrisk løft af Vejbroen, alm. pille



Deformationsfigur for symmetrisk løft af Banebroen, dilatationspille

TRIAL LIFT

- 3 trial lifts in October/November 2024 and April 2025
- Steel structure to act as temporary sidebar and bearing (also during future works)



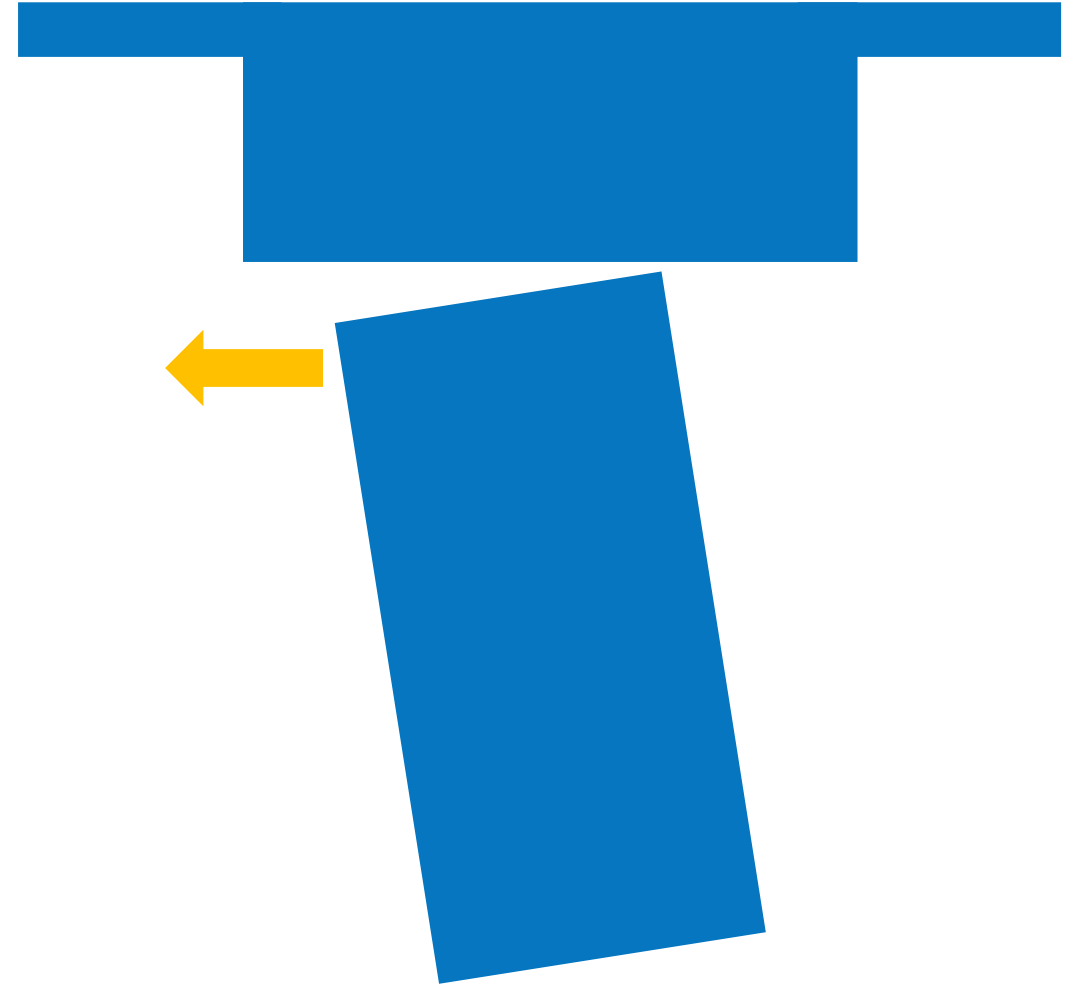
TEMPORARY SIDEBAR AND SIDE PUSH - WHY?

- During lifting, built-up internal stresses can be released and cause the bridge and pier to misalign.



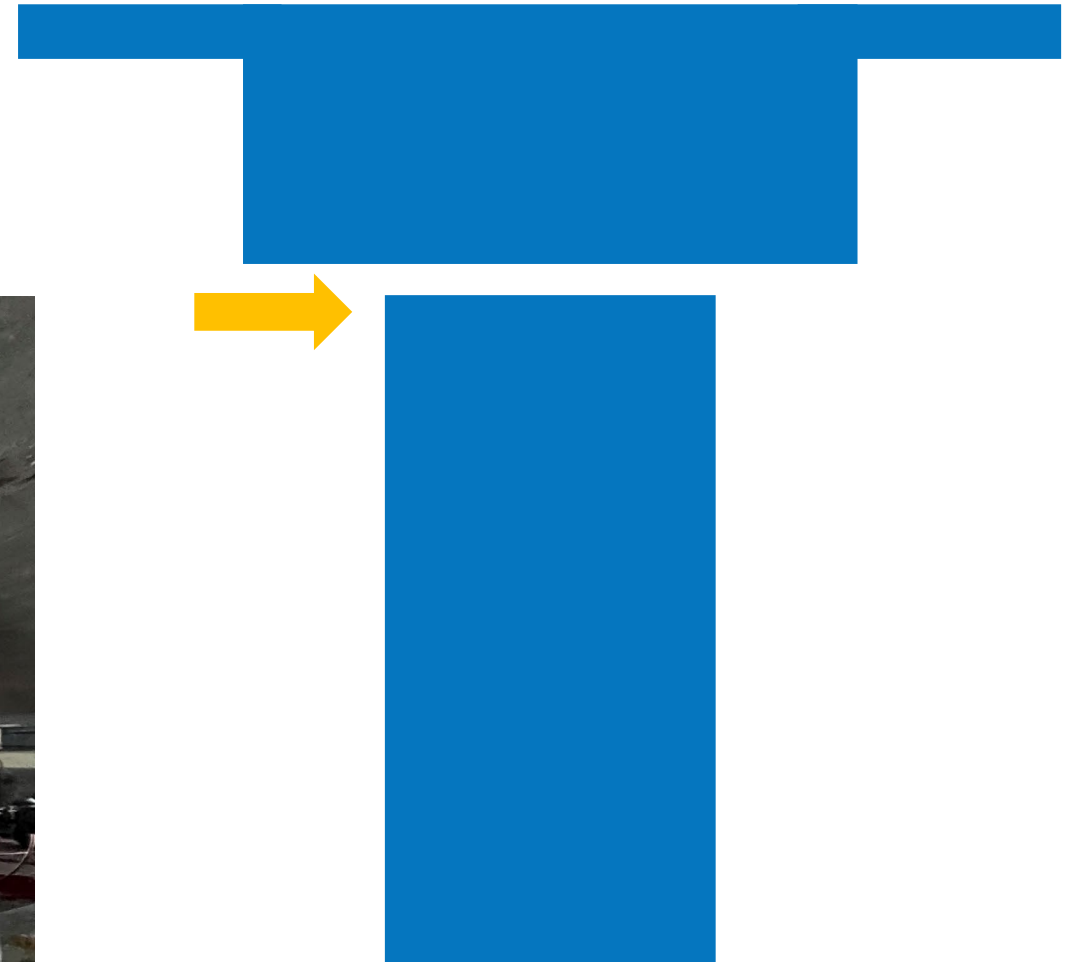
TEMPORARY SIDEBAR AND SIDE PUSH - WHY?

- The mis-alignment could be caused by for example settlements



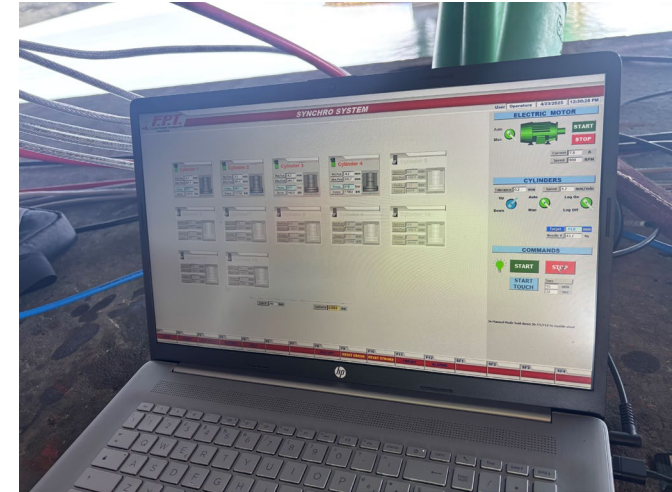
TEMPORARY SIDEBAR AND SIDE PUSH - WHY?

- With the temporary sidebars, we can make sure that we can re-align the bridge via the “side-push”.



LIFTING EQUIPMENT

- 12 x 750 tonnes jacks
- 4 specially designed steel structure to act as temporary sidebars
- 4 x 50 tonnes smaller jacks for sideways push
- Hydraulic pumps (Synchro Lifting System + two stage compact pump)
- Hand tools, hoses, couplers, linear transducers etc..



RAILWAY TRIAL LIFT – 27. OKT. 20 24



- Linear transducers in place

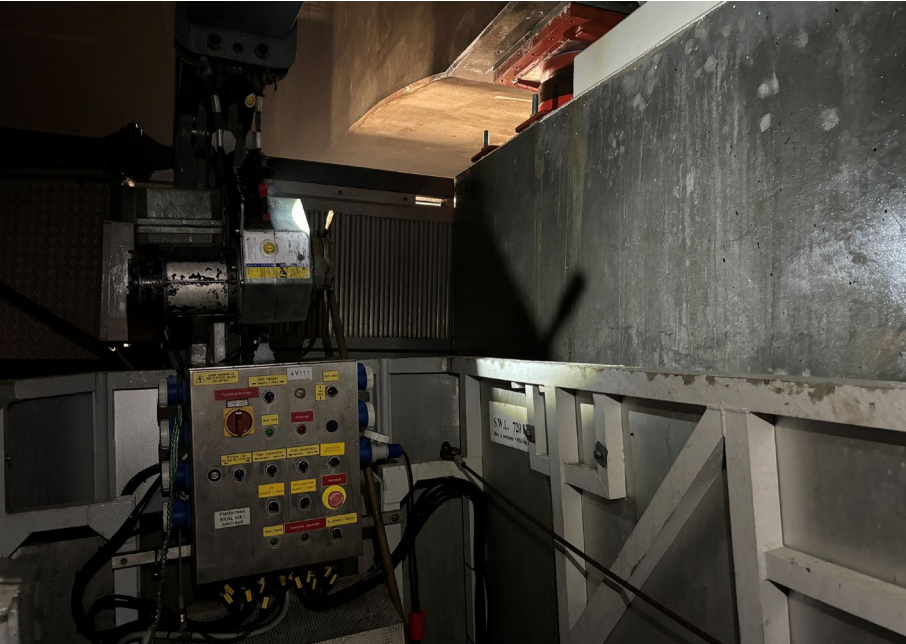


- Temporary sidebar and jacks in place



- Lifting is controlled and surveilled via pc.

RAILWAY TRIAL LIFT – 27. OKT. 20 24



- Monitoring of possible crack formation from skyclimber and inspection platform

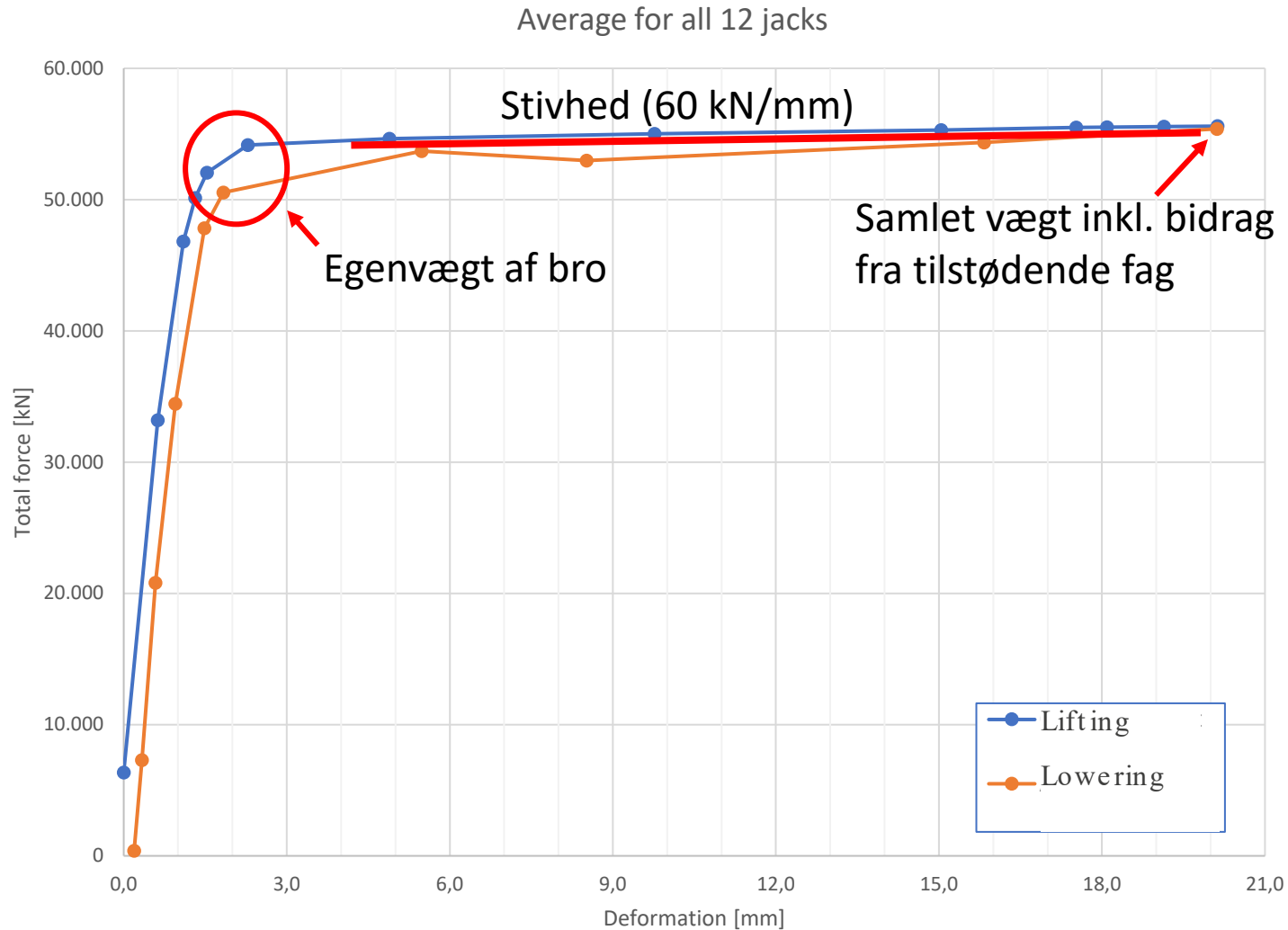


- The bridge is here raised 20 mm – so there is air above the bearing piston



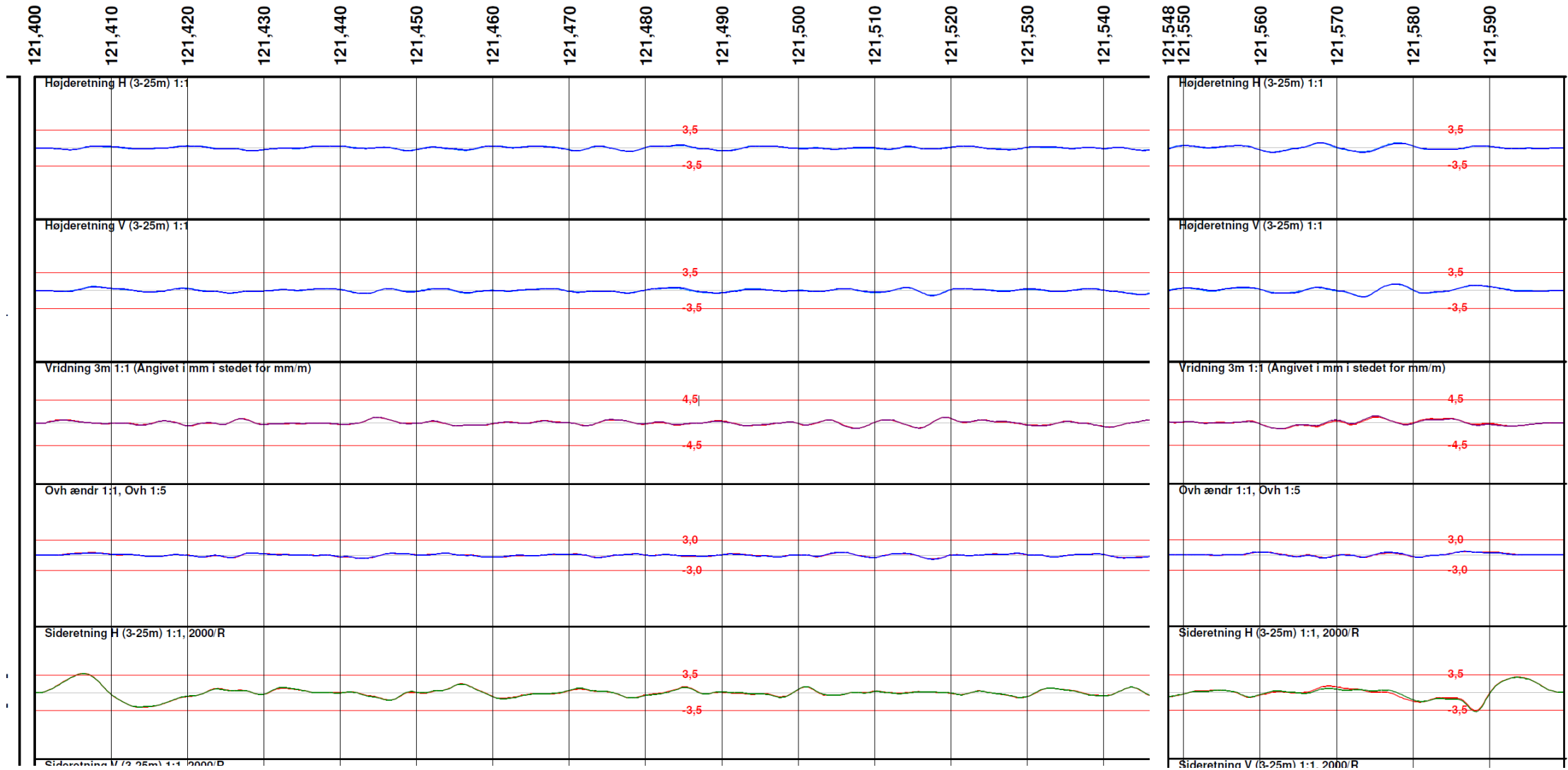
- The trial lift is over, and everyone is tired as it was carried out at night during track closures – but also happy!

TRIAL LIFT – AVERAGE LIFTING CURVE



- Total weight: 5.594 tons
- Maximal lifting height: 20,2 mm
- Curve is based on average data from all 12 jacks

RAIL MEASUREMENTS – DURING AND UNDER TRIAL LIFT ON THE RAILWAY BRIDGE



PREPARATION OF TRIAL LIFT ON THE ROAD BRIDGE

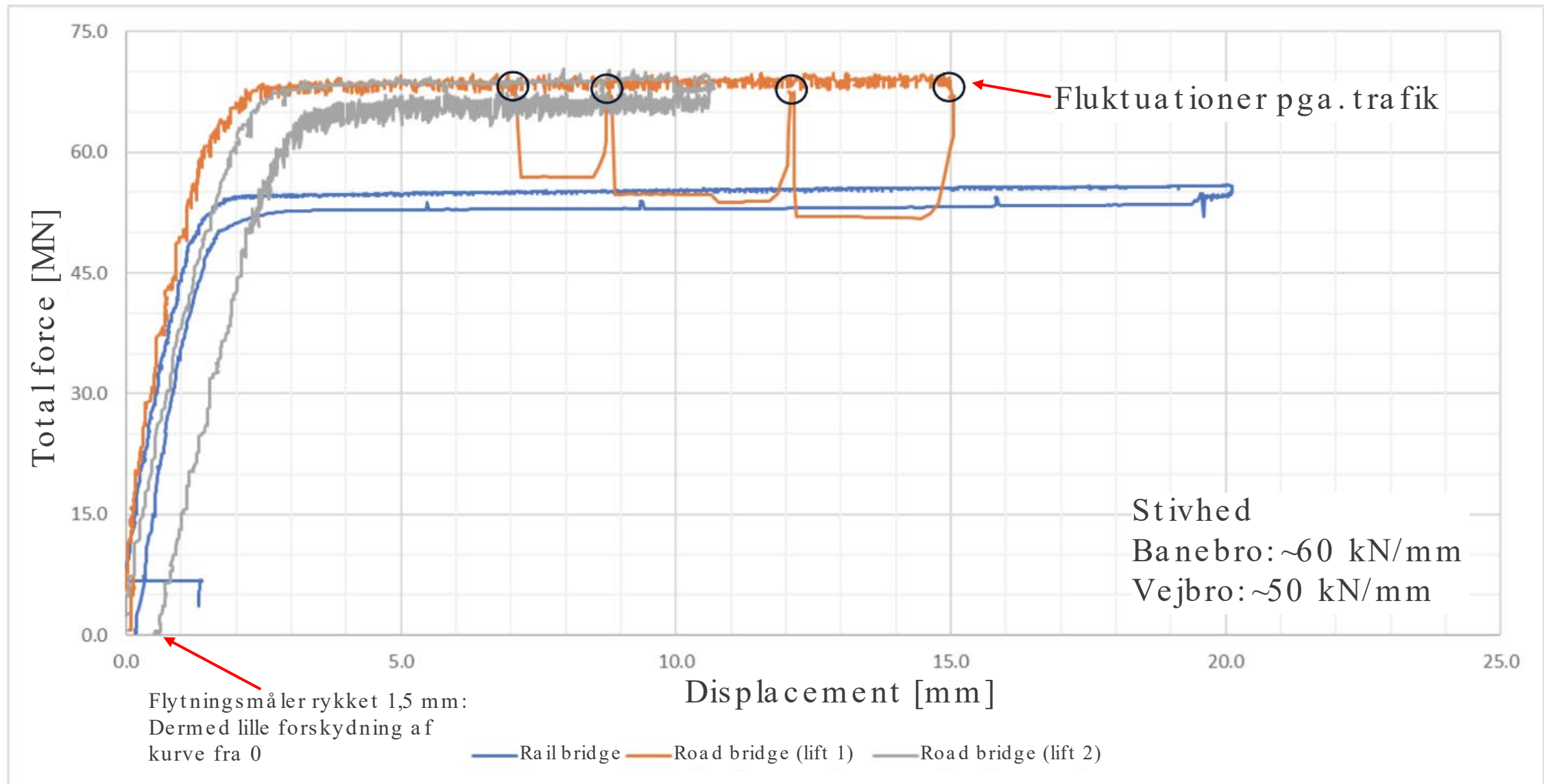
Preparation for the trial lift of the road bridge in November 2024 and April 2025. The lifts were done during daytime with traffic and with the same equipment as the rail bridge.



VIDEO OF LIFT

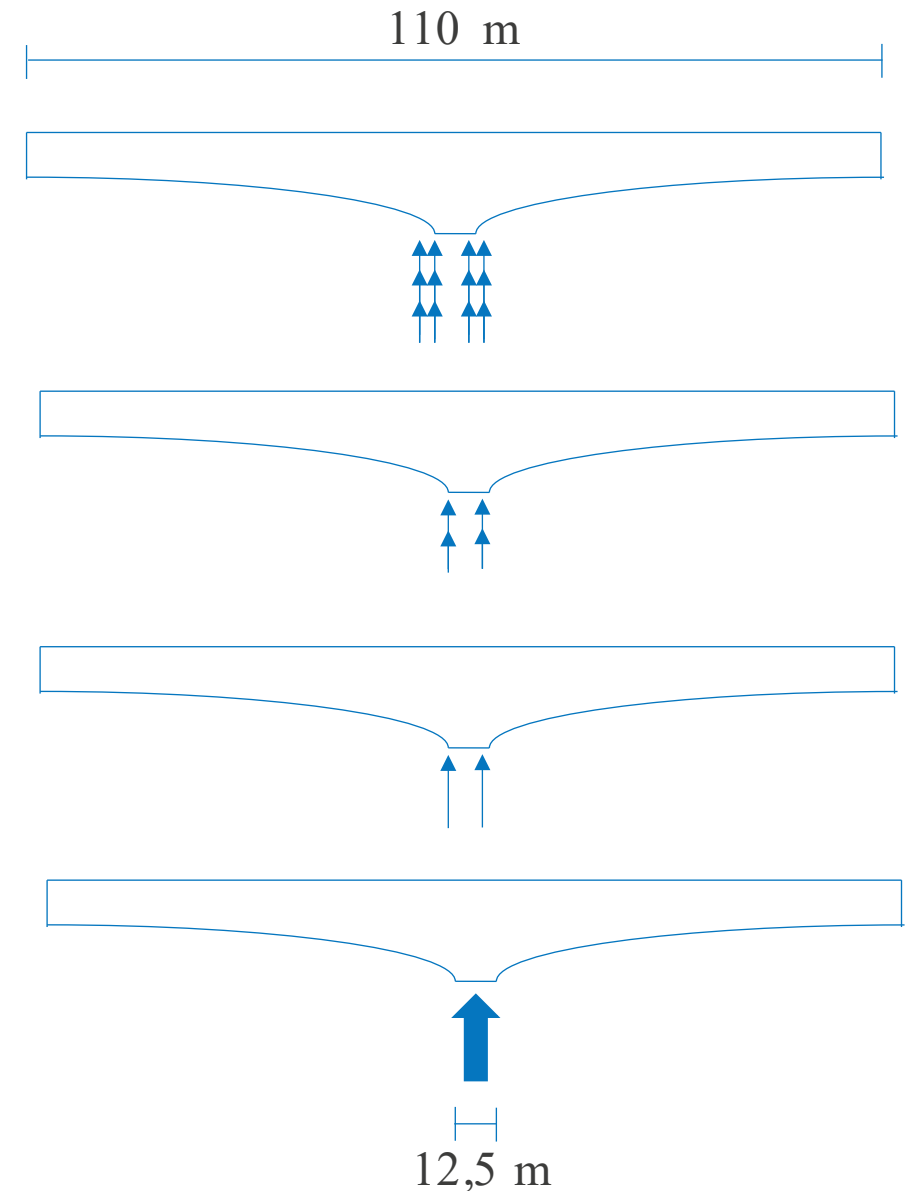


TRIAL LIFT – RESULTS (ALL)



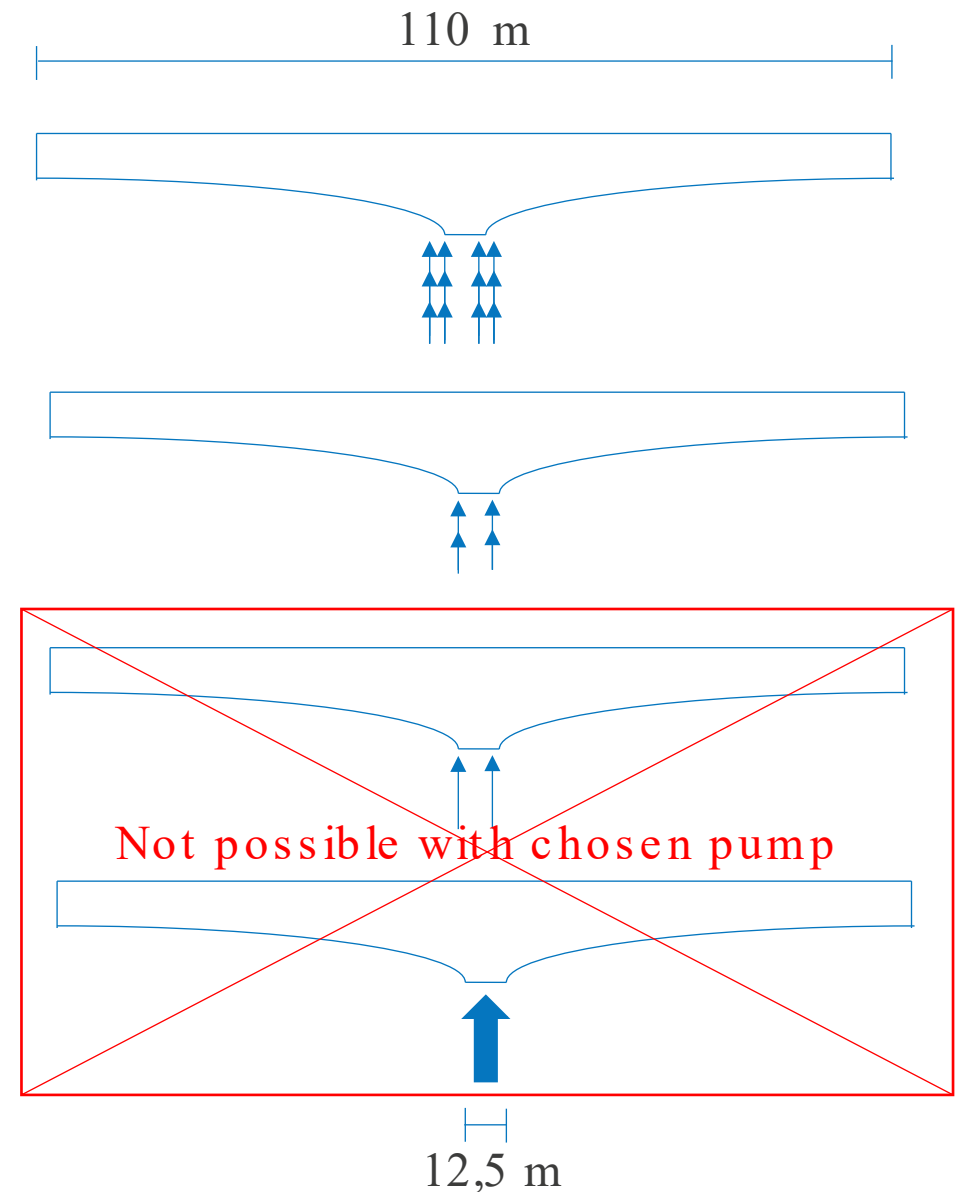
TRIAL LIFTS – CONCLUSION

- 1. trial lift
 - 12 jacks, 12 channels, 12 transducers
- 2. trial lift
 - 12 jacks, 4 channels, 4 transducers
- 3. trial lift
 - Wish: Connect all 12 jacks to 1 channel or 6 jacks on two channels
 - The pump was not made to handle such big oil flows
 - We therefore used the same setup as 2. lift
- Force controlled vs. deformation controlled
 - Wish: Force controlled until the point, where the load is on the jacks



TRIAL LIFTS – CONCLUSION

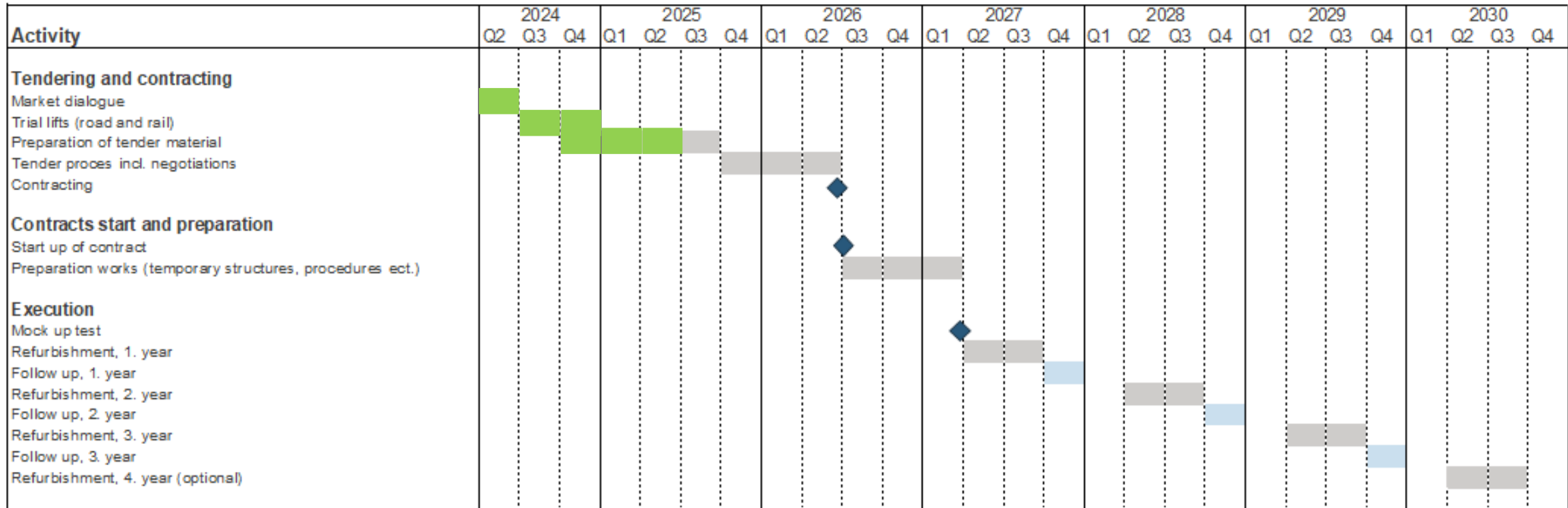
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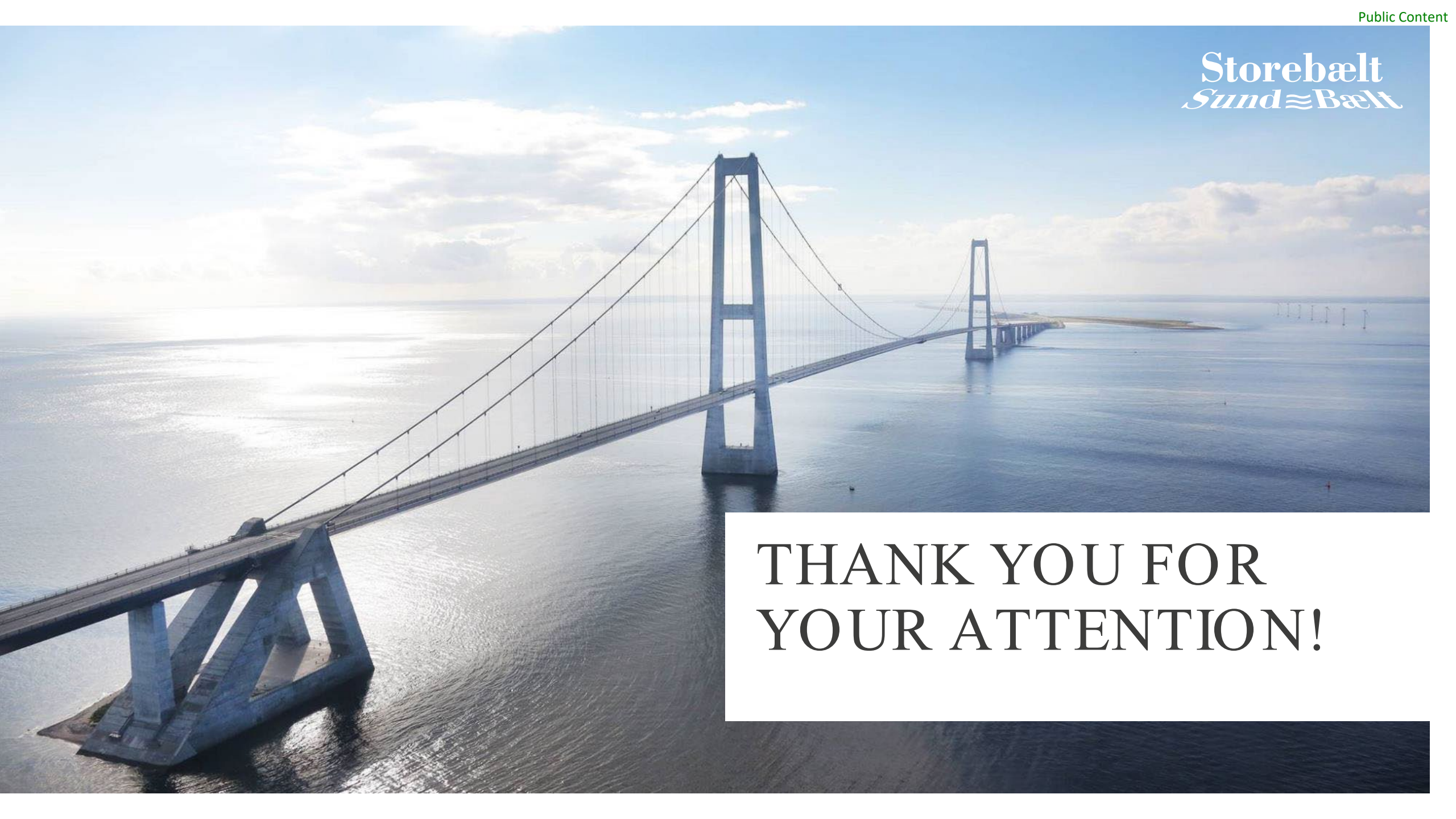
TRIAL LIFTS – CONCLUSION

- Lifting has no measurable impact on the tracks (Track gauge measurement before, under and after lifting)
- No cracks or signs of overloading of structures when lifting to 20 mm
- Issues with the purchased Hydro Lifting System from FPT – Pump will not be used, but need to be delivered by the contractor
- Sideways push is possible in case of built-up internal stresses due to for example settlements
- Required total lifting force:
 - Road bridge 66.800 kN (or approx. 6.800 tonnes)
 - Rail bridge 54.000 kN (or approx. 5.500 tonnes)
- We may need two different lifting set-ups – one for the rail bridge and one for the road bridge.

PRELIMINARY TIME- SCHEDULE



Storebælt
Sund ≈ Bælt

An aerial photograph of the Storebælt suspension bridge, showing its two main towers and the long suspension cables. The bridge spans a large body of water under a blue sky with scattered clouds. The sun is low on the horizon, creating a bright reflection on the water's surface. In the distance, a series of wind turbines are visible on the horizon line.

THANK YOU FOR
YOUR ATTENTION!