

# IABSE-JSCE INTERNATIONAL CONFERENCE ON ADVANCES IN BRIDGE ENGINEERING IV,

26-27 AUGUST 2020

Will the **COVID-19 pandemic** change the way we think,  
plan and work as civil- and structural Engineers?

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**Klaus H. Ostenfeld**, Expert consultant, past president COWI  
A/S, past president IABSE and chair IABSE Foundation,  
Denmark



Facing the New Age!  
How do Structural Engineers tackle  
the COVID-19 era?  
2-3 September 2020

1<sup>st</sup> IABSE Online Conference

Facing the New Age!

September 2-3, 2020

Klaus H. Ostenfeld, Will the COVID-19 pandemic change the work as structural Engineers



# CHALLENGES FOLLOWING THE COVID-19

- The world has suffered severe set-back
- Business and public services heavily affected
- All modes of transportation has been reduced to minimum
- International travel by plane reduced to a fraction of previous
- Work at office often replaced by on-line work at home
- Many businesses suffering and possibly disappearing
- Interaction amongst businesses and social gatherings changed.
- Etc Etc.



# QUESTIONS WE ASK OURSELVES?

- Will the global development resume after the crisis?
- Will the COVID-19 era have cause permanent changes to business- and social life on Earth?
- Will the development curve change permanently in the future?
- Will the exponential growth finally come to a stop?
- How about climate changes and actions to reduce?
- How will the developing countries develop after the crisis?

**Is this the ultimate disruption that requires total rethinking?**



# ROLE OF CIVIL- & STRUCTURAL ENGINEERS?

- Civil and structural engineers have the purpose of building and maintaining buildings and infrastructure for milleniums.
- Housing, industrial, hospitals, plants, facilities etc etc.
- Roads, railways, bridges, harbours and ports, airports,
- Aerospace structures
- Energy systems offshore, windfarms, solar etc.
- Etc.

In other words: We facilitate the basis for societal development and economical growth with emphasis on decent human life for all.

**What will the future look like when and if the growth stops? - and will the direction for the future change? Is this a permanent disruption?**



# PONT DU GARD, FRANCE – 2000 YEARS OLD.

Roman aquaduct built  
of natural stone.

Served the basic need  
for **water** to people



# THE LITTLE BELT BRIDGE, DENMARK - 1970

- Aerodynamic bridge girder
- Dehumidification for corrosion protection
- Underground anchorages
- Probabilistic shipcollision design
- Prefab main cables
- International cooperation
- Serves the basic need for **transportation**



# FARO BRIDGES, DENMARK - 1985

Modern Danish  
bridge built by  
industrialized  
methods of steel  
and concrete.

Serves the basic  
need for  
**transportation**



# OTHER COMPONENTS IN THE CHALLENGE

- Growing world population up to 2050, 7.5 => 9.5 billion!
- The climate change and how to meet the goals of the Paris agreement 2015
- The 17 UN Sustainable Development Goals goals (SDG's) of 2015, the STI & GSDR 2019 as reviewed after COVID-19 2020
- Saturation of traffic infrastructure in many cities
- Severe air, water and ground pollution problems and waste
- Limited resources –

## Limits to growth globally





# CAN WE PREPARE OUR PROFESSION?

- Traditionally civil & structural engineers and their activities comprise a substantial part of the total economy and global infrastructure value, maybe 1/3?
- We have a responsibility to think about how we can respond to the changes.
- The problem is that the changes are not known, so we have to imagine different scenarios and be prepared to act and react.
- **IABSE** seems to be the perfect forum to take part and possibly take the lead in relevant discussions amongst professionals and serve the society.



# I DO NOT HAVE THE ANSWERS!! - DO YOU?

- No single individual is likely to be able to provide all the answers.
- However, COVID–19 provides maybe the **opportunity to stop and think!!** – because obviously continued exponential growth on a planet of a constant size and limited resources and growing population is not possible
- So no more sticking the head in the bush - as the ostrich!

**We need to get the head up, and realise the reality!!**

**Hope this conference may be the start for permanent awareness and discussion of the subject and provide elements for answers**





# LET'S LOOK AT SOME SURROUNDING ELEMENTS.

- The UN has in 2015 developed 17 Sustainable Development Goals (SDG's) adopted by the World Leaders.
- Progress was reviewed in 2019 at STI & GSDR 2019 report with disappointing results: Little progress.
- The UN and ECOSOC has convened a 10 day Forum in July 2020 to discuss the devastating effects of the COVID-19, and review and discuss **how the world can respond to the pandemic.**
- All of the 17 SDG's and the review have direct or indirect implications for our profession.
- However, some seem to be the most directly relevant to study for predicting the future requirements for our profession.



# UN SUSTAINABLE DEVELOPMENT GOALS

- SDG's are a vision for how we want to share the Earth's limited resources!



# THE 17 UN SDG'S – VISION

- In September 2015, the General Assembly adopted the 2030 Agenda for Sustainable Development that includes 17 Sustainable Development Goals (SDGs). Building on the principle of “leaving no one behind”, the new Agenda emphasizes a holistic approach to achieving sustainable development for all.





# STI and Sustainable Development: *2019 GSDR*

Katherine Richardson, Professor

Leader, Sustainability Science Centre  
Member, IGS authors of 2019 GSDR

KØBENHAVNS UNIVERSITET



# SDG'S OF INTEREST FOR OUR PROFESSION

- Goal 4 Quality Education
- Goal 6 Clean water and Sanitation
- Goal 7 Affordable and Clean Energy
- Goal 9 Industries, Innovation and Infrastructure
- Goal 12 Responsible Consumption and Production
- Goal 13 Climate Action
- Goal 14 Life below Water
- Goal 17 Partnerships for the Goals



# GOAL 9: LONG TEXT VERSION

- **Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation**



# GOAL 9 – FULL TEXT

- Inclusive and sustainable industrialization, together with [innovation and infrastructure](#), can unleash dynamic and competitive economic forces that generate employment and income. They play a key role in introducing and promoting new technologies, facilitating international trade and enabling the efficient use of resources.
- However, the world still has a long way to go to fully tap this potential. Least developed countries, in particular, need to accelerate the development of their manufacturing sector if they are to meet the 2030 target, and scale up investment in scientific research and innovation.
- Global manufacturing growth has been steadily declining, even before the outbreak of the COVID-19 pandemic. The pandemic is [hitting manufacturing industries](#) hard and causing disruptions in global value chains and the supply of products.
- Innovation and technological progress are key to finding lasting solutions to both economic and environmental challenges, such as increased resource and energy-efficiency. Globally, [investment in research and development](#) (R&D) as a proportion of GDP increased from 1.5 per cent in 2000 to 1.7 per cent in 2015 and remained almost unchanged in 2017, but was only less than 1 per cent in developing regions.
- In terms of communications infrastructure, more than half of the world's population is now online and almost the entire world population lives in an area covered by a mobile network. It is estimated that in 2019, [96.5 per cent were covered by at least a 2G network](#).
- The coronavirus pandemic has revealed the urgent [need for resilient infrastructure](#). The Asian Development Bank notes that critical infrastructure in the region remains far from adequate in many countries, despite the rapid economic growth and development the region has experienced over the past decade. The [Economic and Social Survey of Asia and the Pacific](#) highlights that making infrastructure resilient to disasters and climate change will require an additional investment of \$434 billion per year. This sum may need to be even greater in some subregions, such as the Pacific small island developing states.



# GOAL 9 – COVID-19 RESPONSE – JUNE 2020

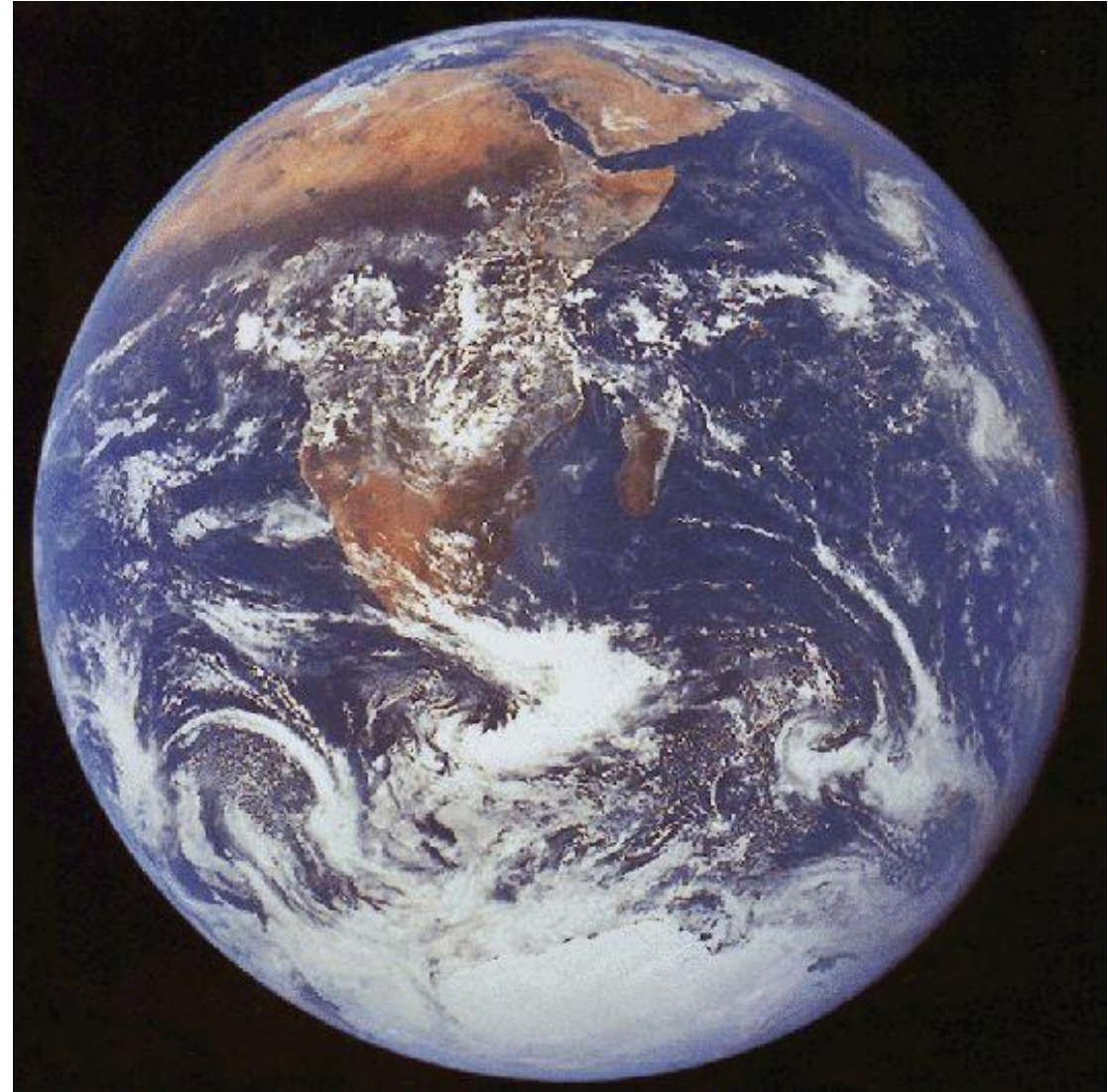
- Information and communication technologies have been on the frontlines of the COVID-19 response. The crisis has accelerated the digitalization of many businesses and services, including teleworking and video conferencing systems in and out of the workplace, as well as access to healthcare, education and essential goods and services
- As the pandemic reshapes the way in which we work, keep in touch, go to school and shop for essentials, it has never been more important to [bridge the digital divide](#) for the 3.6 billion people who remain offline, unable to access online education, employment or critical health and sanitation advice. The [2020 Financing for Sustainable Development Report](#) provides policy options to harness the potential of digital technologies.
- **Once the acute phase of the COVID-19 crisis is over, governments will need [investments in infrastructure](#) more than ever to accelerate economic recovery, create jobs, reduce poverty, and stimulate productive investment.**
- [The World Bank estimates](#) that developing countries need to invest around 4.5 per cent of GDP to achieve the Sustainable Development Goals and at the same time limit global warming to no more than 2 degrees Celsius.



# ONLY ONE GLOBE AND ONE SET OF RESOURCES

The current way of life will require 3 globes to fulfill the requirements for 9.5 billion people!

**Who can solve this?**





## Climate/Sustainability Challenge:

**To bring and maintain the  
human demand for Earth  
resources to within their  
supply!**

**Sustainable development is a "need to have" not a "nice to have" ....**



# THE EARTH BEHAVES AS A SYSTEM

Amsterdam Declaration on  
Global Change (2001):

”The Earth System behaves as a  
single, self-regulating system  
comprised of **physical,  
chemical, human and  
biological components...**”

***Humans are a part of that system and  
our activities influence the state of  
the Earth at the global level!***

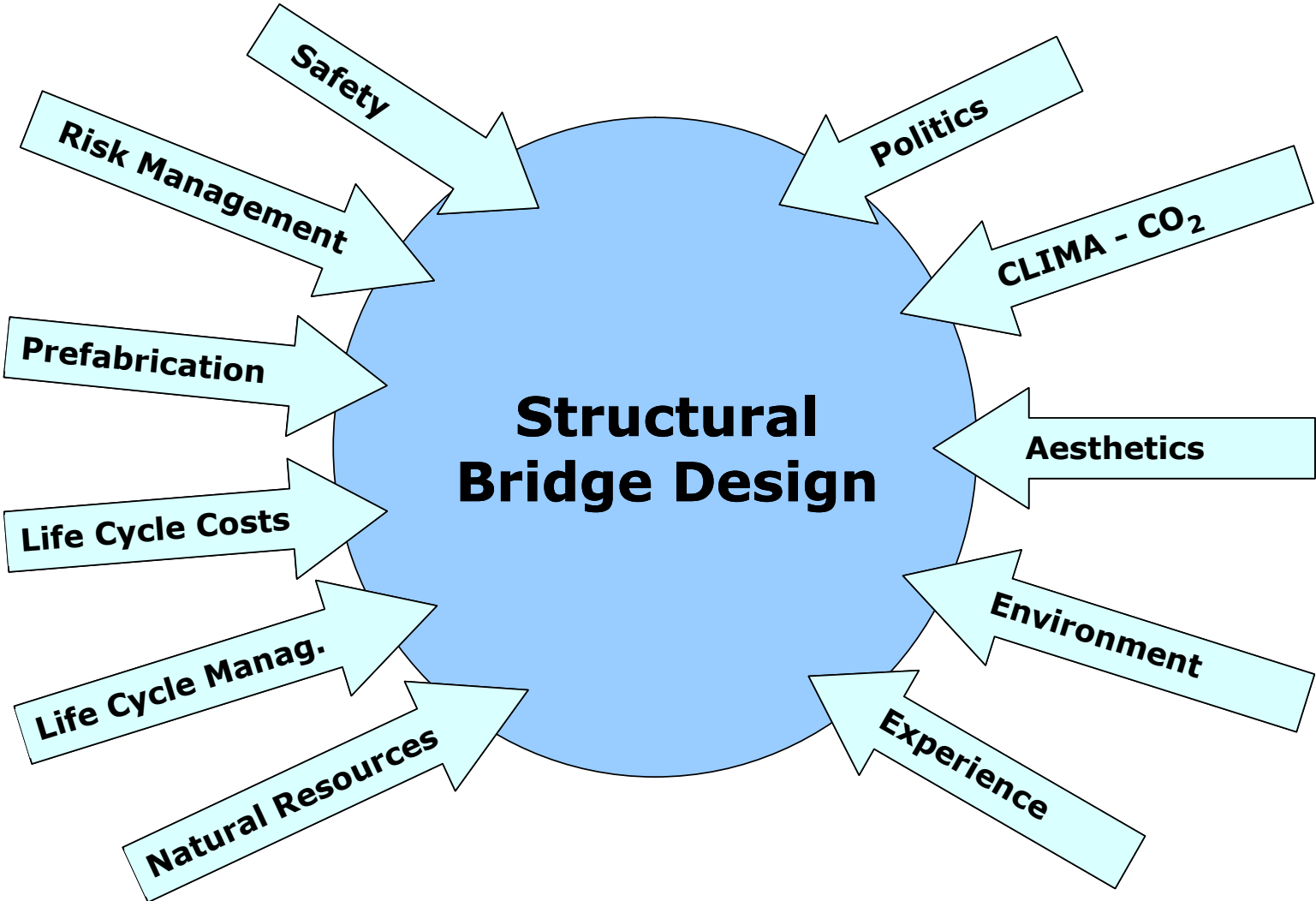


# HOW DO WE RESPOND TO THE NEW REQUIREMENTS?

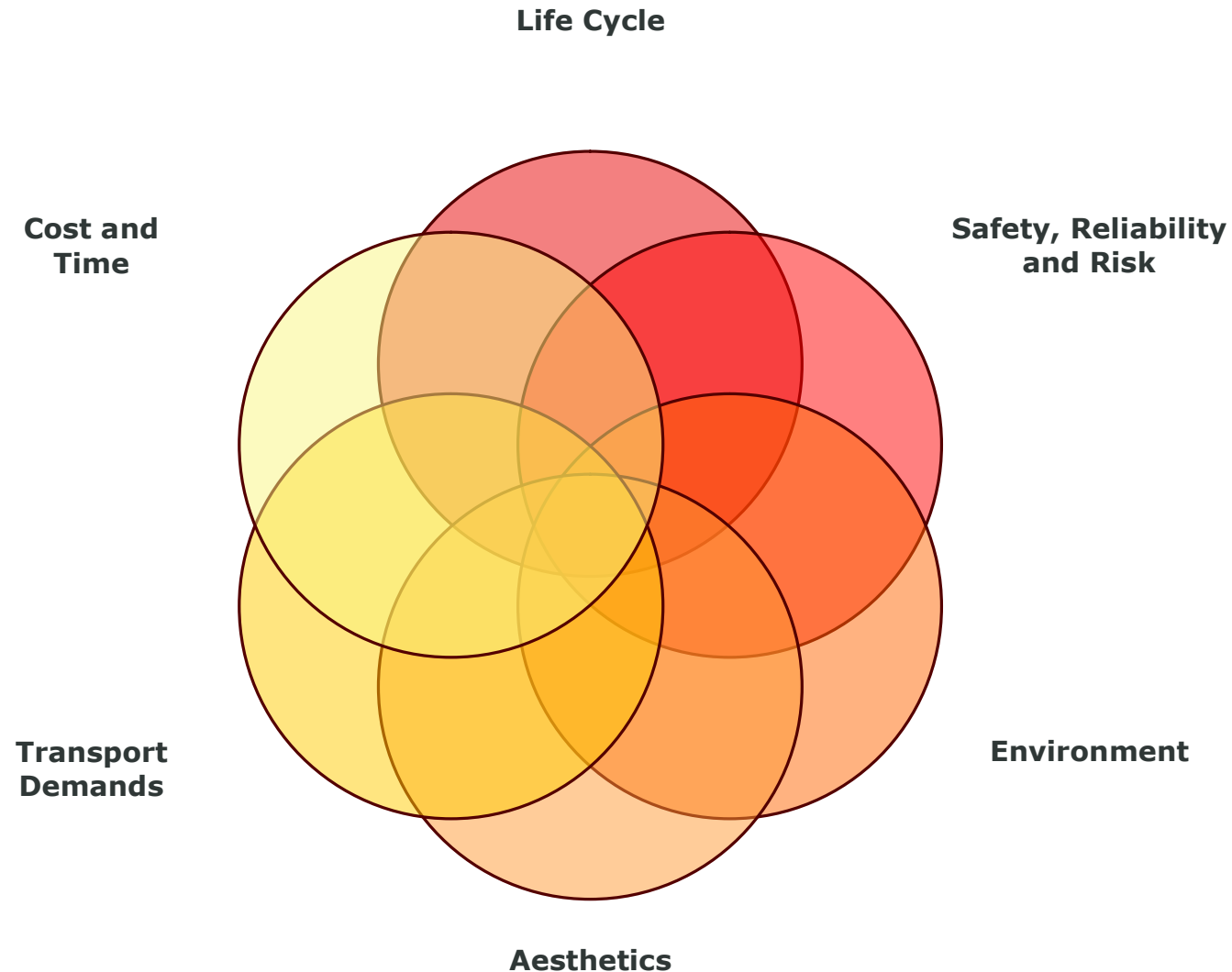
- New technologies, Automation, Artificial Intelligence (AI)
- New materials, GFRP, CFRP, Aluminium, carbon fibre cables
- Minimize material consumption – better designs
- Automated fabrication protected in shop
- Minimum work on site exposed to climate and weather
- Lighter structures with associated dynamic issues to solve
- Floating structures for deep water crossings
- Prepare bridges for new traffic modes, also electromagnetic requirements
- but most important:
- **Focus on the un-foreseen!!**
- **Now, is the time to be a real creative ‘Engineer’ in its basic understanding**



# PARAMETERS INFLUENCING DESIGN DECISIONS



# INTEGRATED MULTIDISCIPLINARY APPROACH



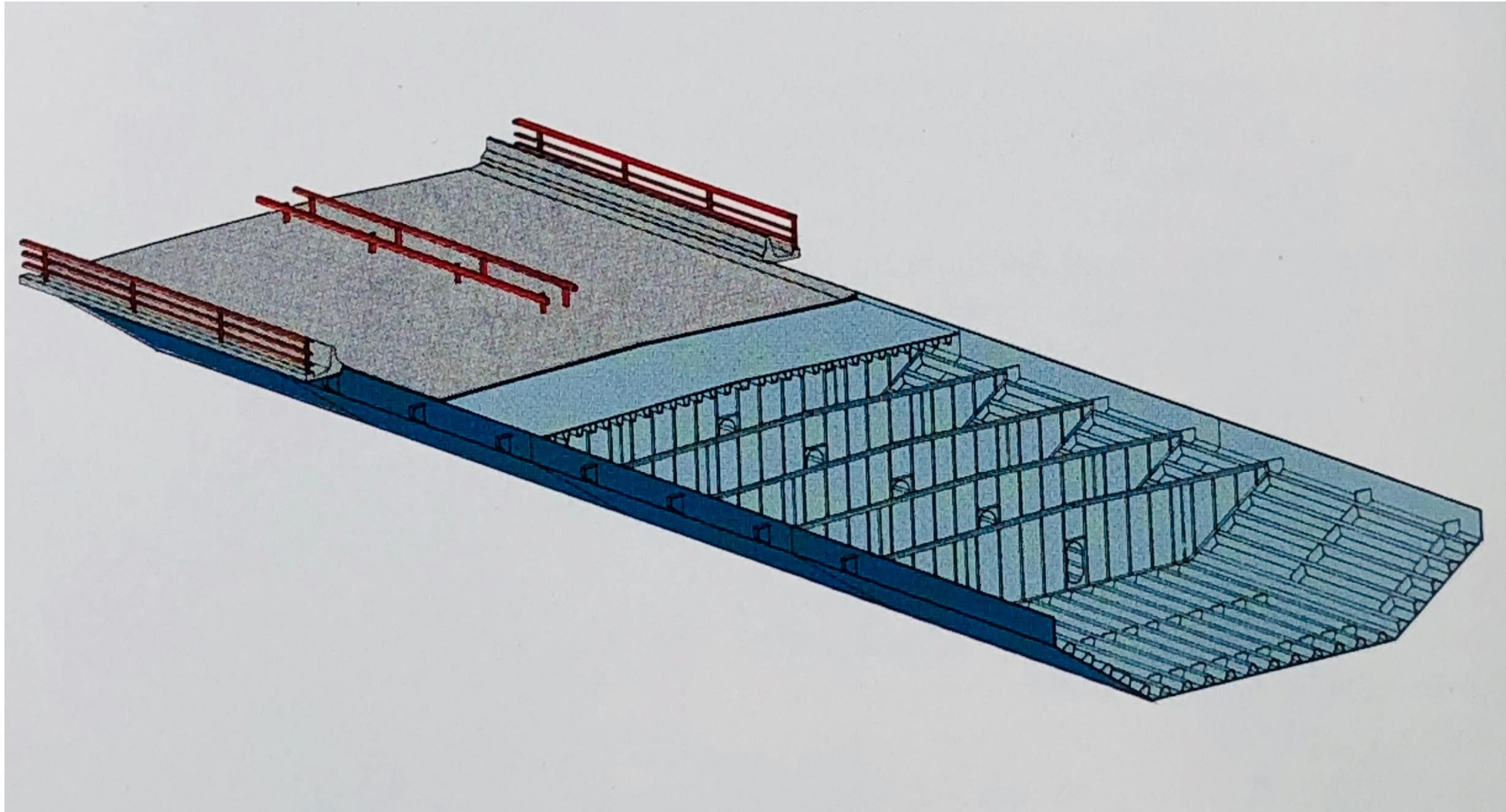


# FARO BRIDGES, DENMARK - 1985

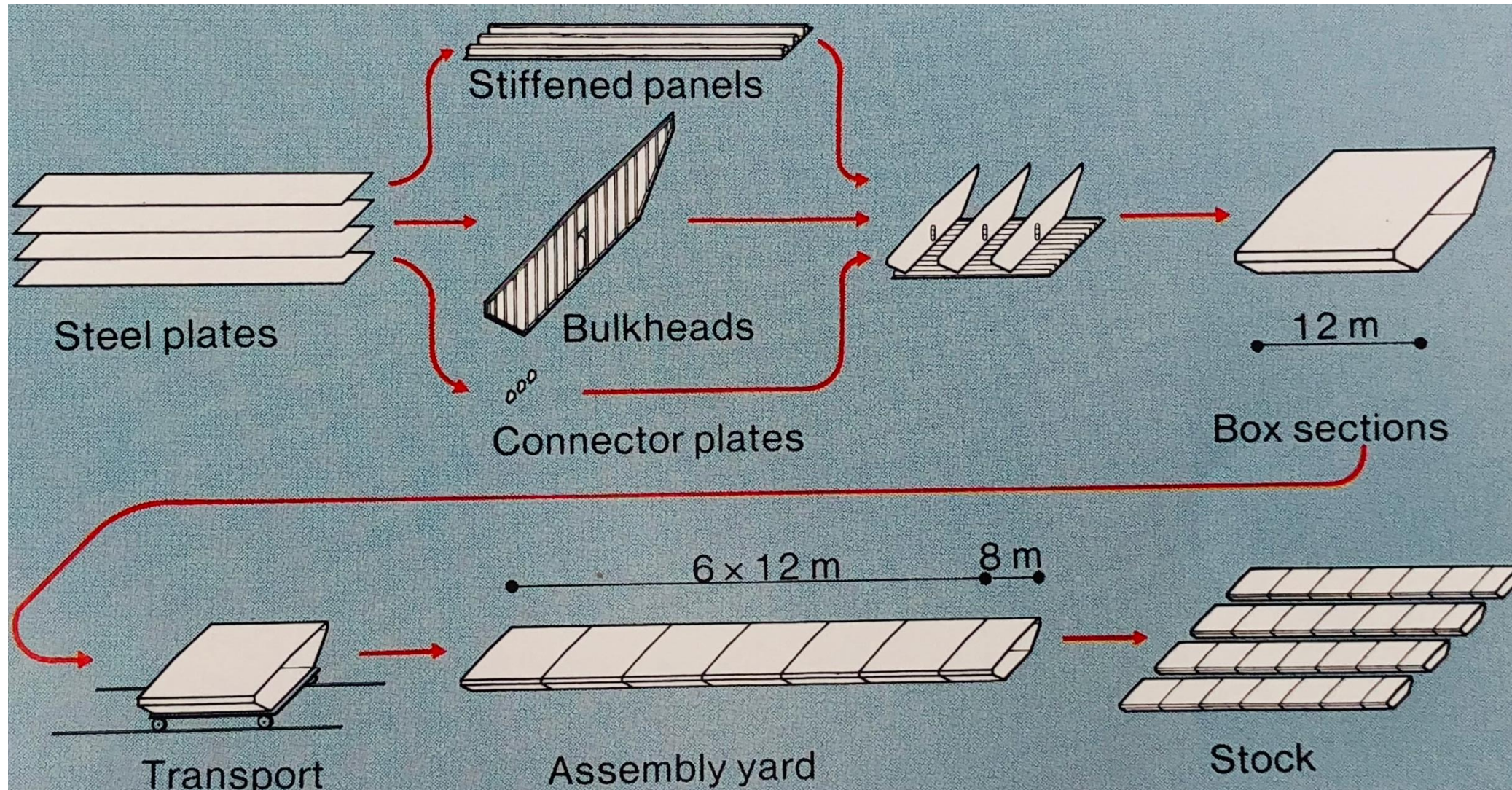
Modern Danish  
bridge built by  
industrialized  
methods of steel  
and concrete



# FARØ BRIDGES, GIRDER CONCEPT FOR INDUSTRIAL PRODUCTION (1)



# FARØ BRIDGES, GIRDER CONCEPT FOR INDUSTRIAL PRODUCTION (2)



# FARØ FULL SPAN GIRDERS, 80 M, 600 T EA. AT SHIP YARD

Stockyard for finished 80 m steel box girders ready for transport and erection



# FULL SPAN TRANSPORT

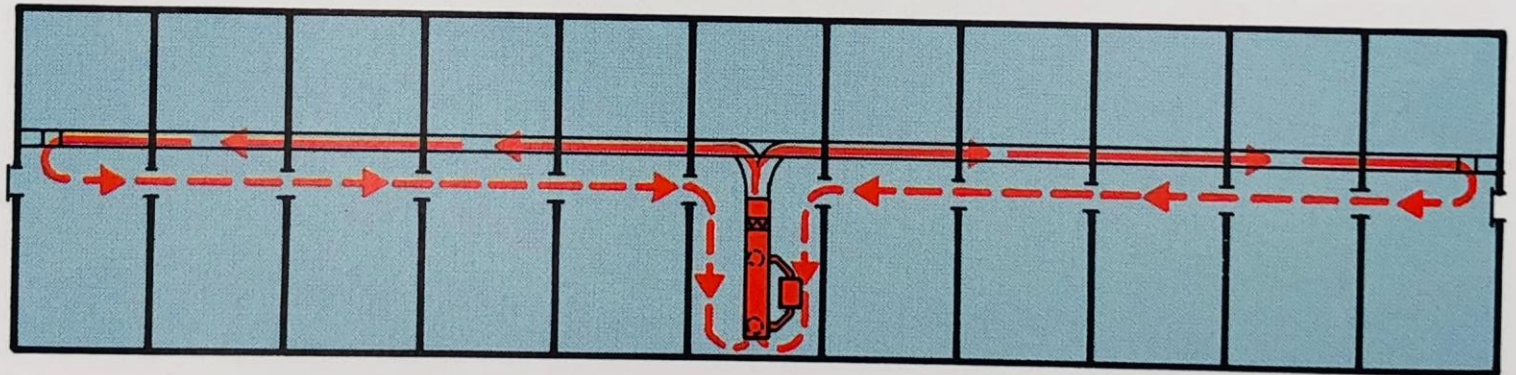
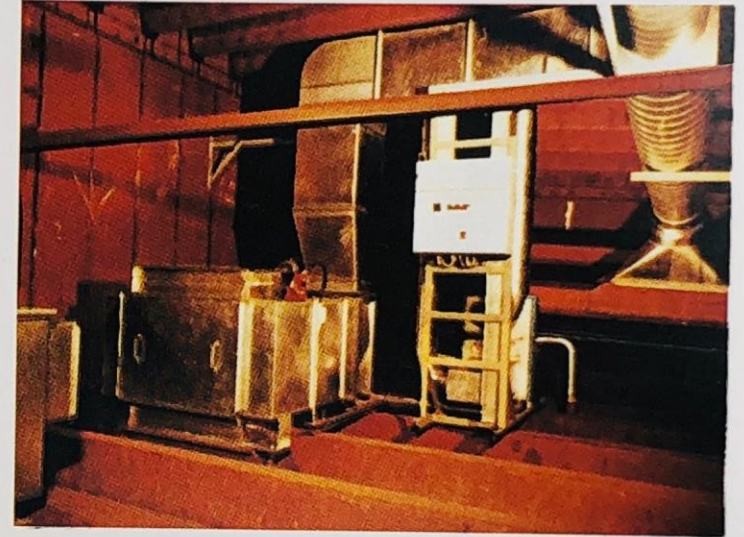
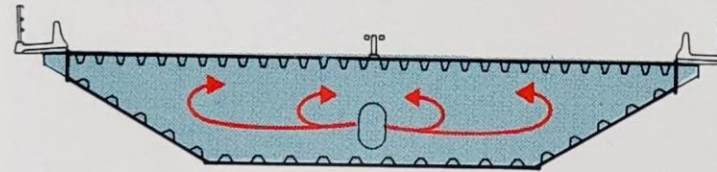


# CORROSION PROTECTION BY DEHUMIDIFICATION

Dehumidification of interior of box saves paint, cost, environment and ensures occupational safety

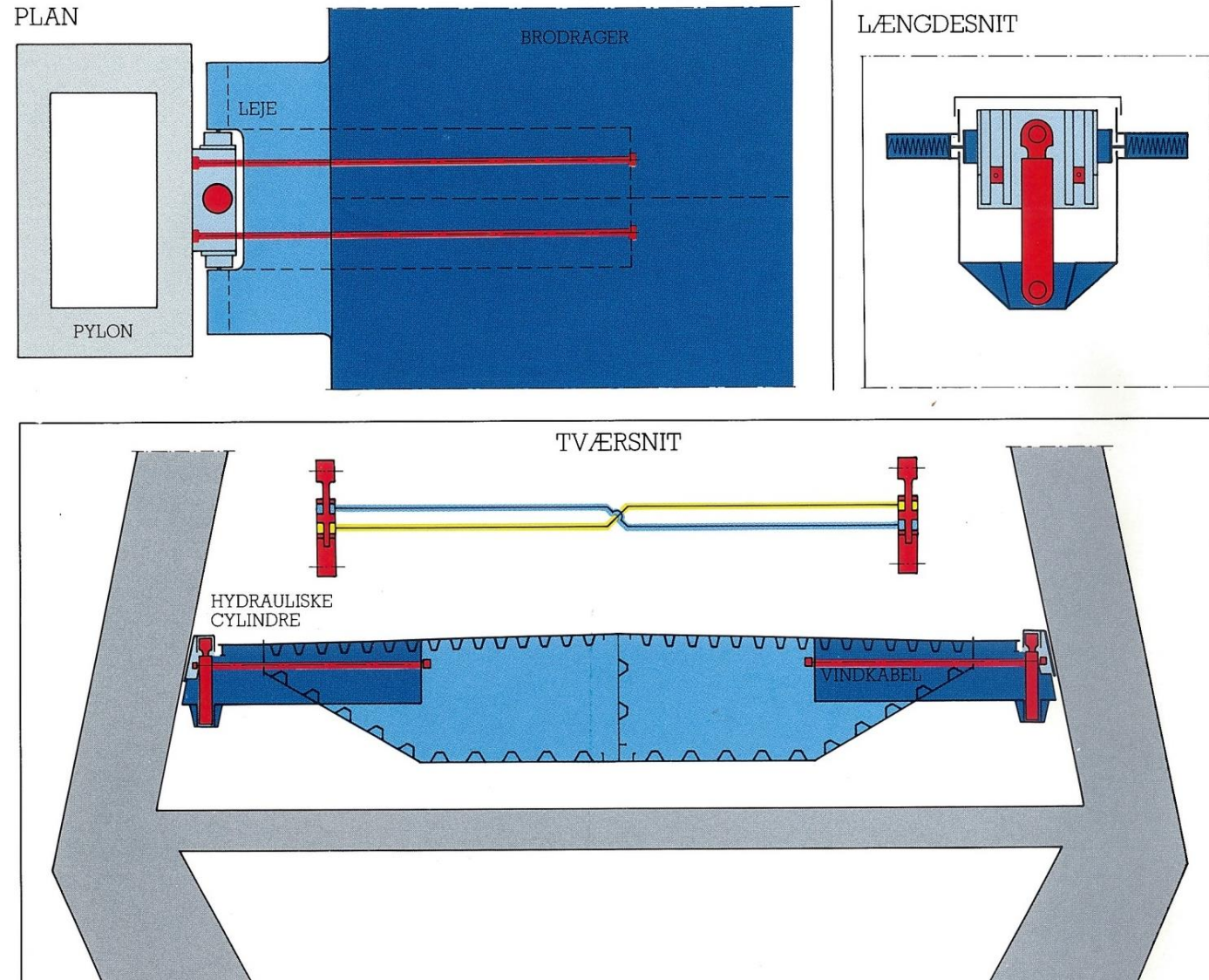
Dehumidification plant for internal corrosion protection.

Principle for box interior dehumidification.



# FARØ BRIDGE – HYDRAULIC CONTROL SYSTEM

Huge savings by using hydraulics for torsional fixation compared to any possible mechanical system

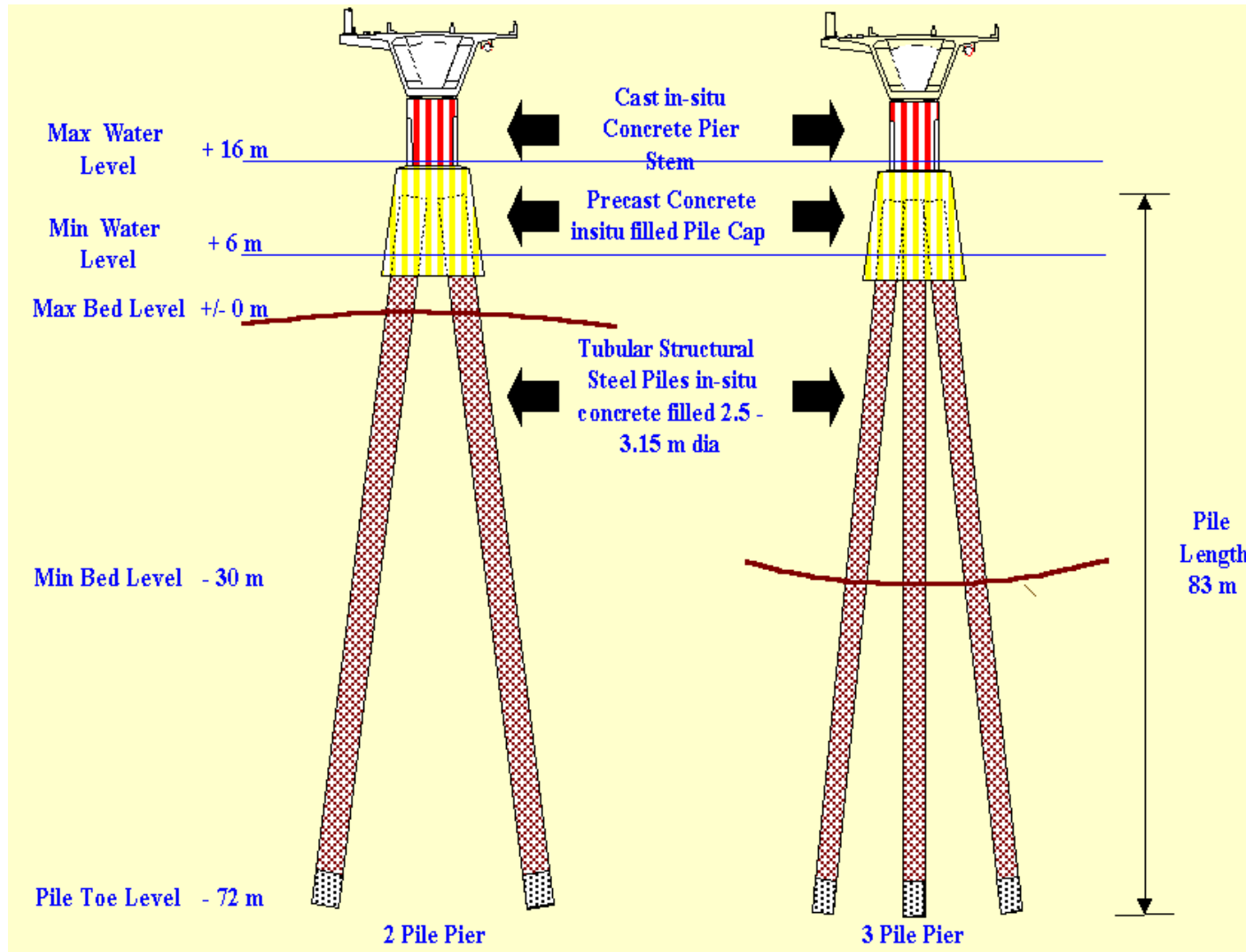


# BANGABANDHU BRIDGE, (JAMUNA), BANGLADESH (WB)





# BANGABANDHU BRIDGE, BANGLADESH “TRI-POD” FOUNDATION Ø 2.5 M STEEL PILES, 83 M LONG.



# THE 6 KM GREAT BELT WEST BRIDGE, DENMARK

Serial production of 324  
superstructure- and  
substructure elements up  
to 7,100 t ea.



# GREAT BELT WEST BRIDGE, FULL SPAN CONSTRUCTION, 5,700 T LIFT



# ORESUND BRIDGE – 100 % PREFAB



# PADMA MULTIPURPOSE BRIDGE, BANGLADESH

Fullspan  
erection of  
prefab steel  
trusses and  
prefab deck  
slabs



# PADMA MULTIPURPOSE BRIDGE, BANGLADESH

Pile driving of  $\varnothing$  3 m, 120 m long steel piles (500t) with world's biggest Menck 3500 KJ Hammer



# HERNING PEDESTRIAN BRIDGE – DENMARK 1995

Experimental use of:

- Carbon fibre stays
- Carbon posttensioning
- Carbon slack reinforcement



# BASCULE BRIDGE – COMPOSITE DECK





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# THE BRIDGE TO BUILD?

- The Politicians, Governments, and Owners have the **Power**, - but no solutions.
- The Civil- and structural engineers have the **solutions**, - but no power.
- Challenge: Build the the **bridge** between the two parties!
- So we need to get our act together as engineers and seek influence. **How?**

**IABSE can probably help facilitate such bridgebuilding!**



# FINAL REMARK

- Let us, as Engineers, get back to responsible **‘Engineering’** in the real sense of the word, for the benefit of a sustainable and resilient world for humanity
- **IABSE** can facilitate this!

# THANK YOU!

I hope this may form basis for discussion?

-Specific actions

-R&D

-New concepts and use of materials

-Adapted technologies?

-Etc etc.