InfraCore inside

RAMSSES

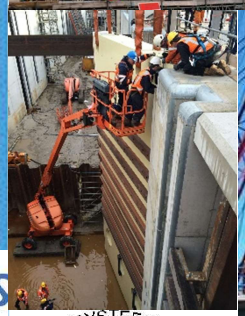
InfraCore company

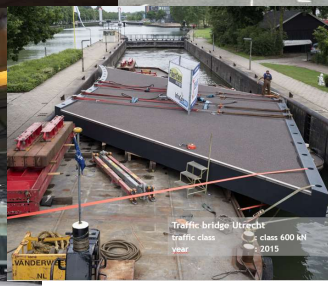
Technology Transfer Group: Infrastructure

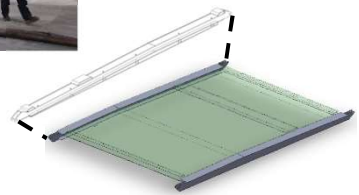
Quick assembly systems applied in FRP Infrastructural applications









CompositesNL E-LASS

FiberCore europe

MANAGEMENTSYSTEEM CERTIFICATIE DNV·GL ISO 9001

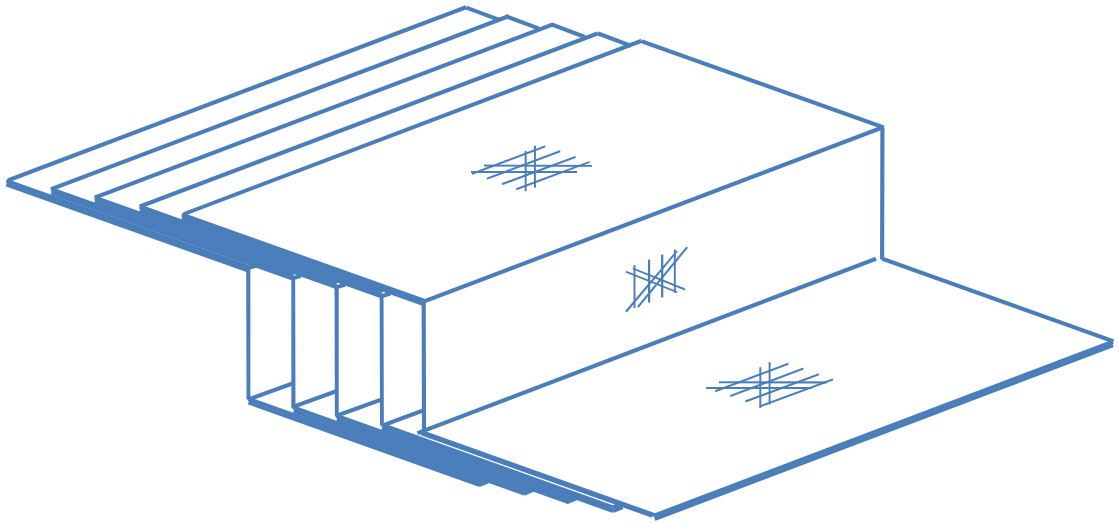
InfraCore inside

RAMSSES

InfraCore company

Corporate Presentation

- Typical Infrastructural applications
- Portfolio of connections
- *Japanese joinery techniques*
- Examples of connections

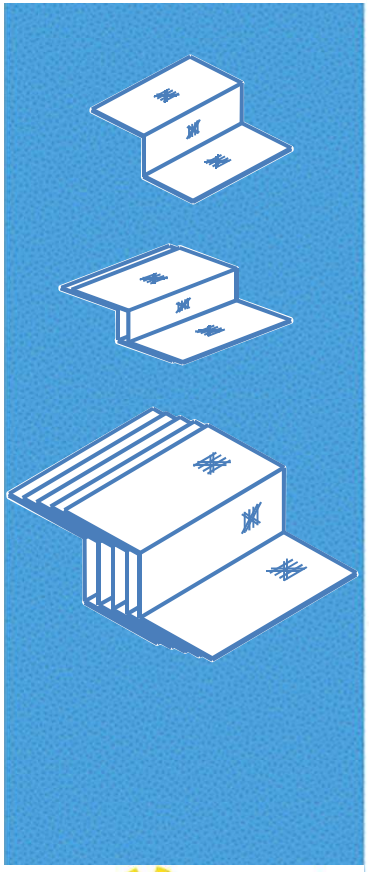


CompositesNL E-LASS

FiberCore europe

InfraCore inside

RAMSSES

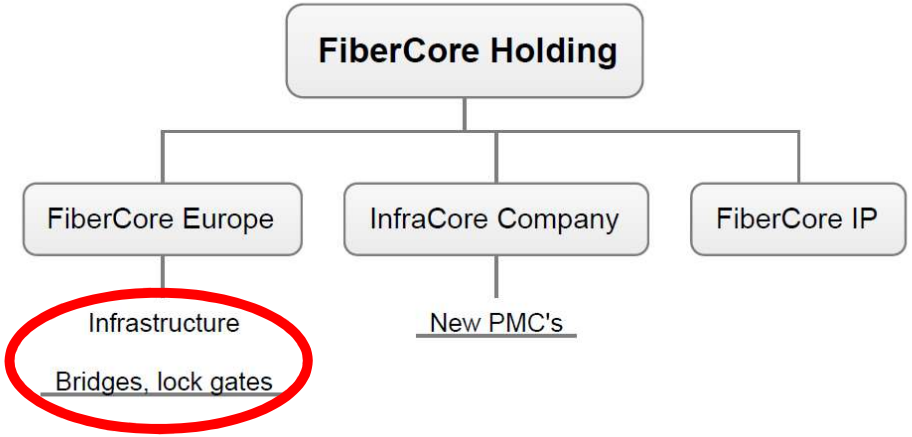


CompositesNL E-LASS

FiberCore europe

InfraCore company

Company



PMC: Product Market Combinations
FiberCore IP: worldwide patents on brand, technology & production.

Engineering & Industrial Production (6000 m²): Rotterdam/NL

FiberCore europe

- FRP-experts in building & infra (pioneer 1996)
- product- & process development
- R&D, engineering & production
- > 800 heavy duty structures installed


1997: First
FRP bridge in
The Netherlands
Bridge in docking pier
Concept, design, engineering: FiberCore Europe
dimensions : 15 x 2.5m
location : Harlingen
year : 1997
Principal : Bouwdienst RWS
FiberCore
europe

InfraCore inside

RAMSSES

FiberCore europe

> 800 structures with InfraCore inside

CompositesNL E-LASS

FiberCore europe


InfraCore inside
FiberCore europe
HOTEL
DE ZON
First FRP traffic bridge
conform Eurocode
NEN-EN 1991-2+C1/NB
Oosterwolde
dimensions : 12,5 x 12,5 m
span : 12 m
traffic class : class 600 kN / Eurocodes
year : 2010

InfraCore inside

FiberCore europe

InfraTech

Half-time award 2013

ProRail

heijmans

HILLEBRAND

Movares adviseurs & ingenieurs

FiberCore europe

Traffic bridge Utrecht, crossing highway A27

dimensions	: 142 x 6,2m
span	: 6,2 m
traffic class	: class 600 kN, Eurocode
year	: 2011-2012


InfraCore inside
FiberCore europe
World record
resin injection
21 ton
'single shot'
Traffic bridge Muiden, 2014
dimensions : 16,3 x 11,7 m
span : 11,5 m
traffic class : class 600 kN
year : 2014

Traffic bridge Utrecht

traffic class	: class 600 kN
year	: 2015

InfraCore inside

RAMSSES

FiberCore europe

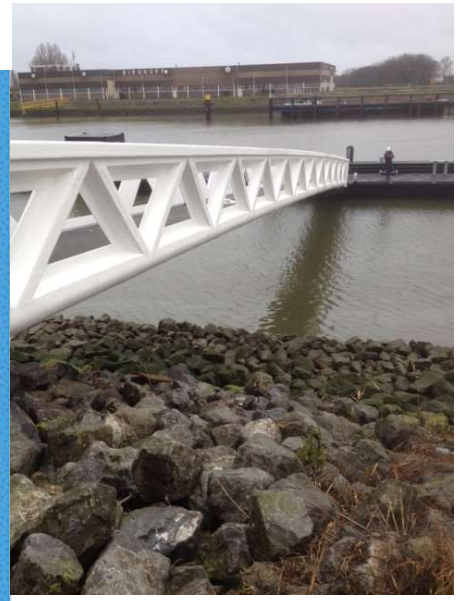
Lock gate IV
Tilburg
Year : 2016

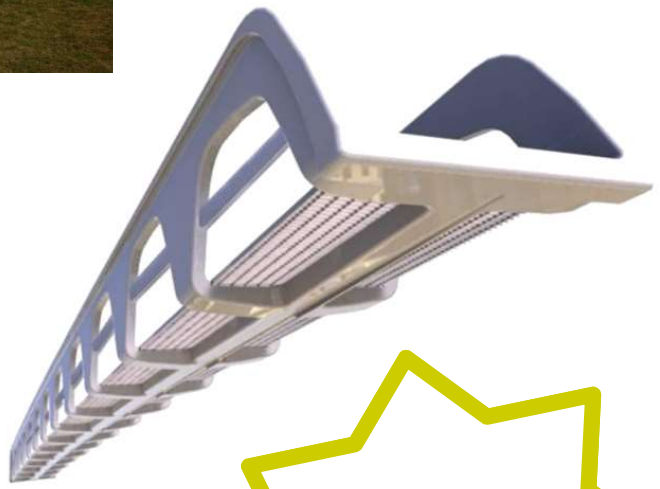
World's Largest FRP lock gates

CompositesNL E-LASS

FiberCore europe

‘Harbour bridges’

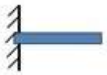


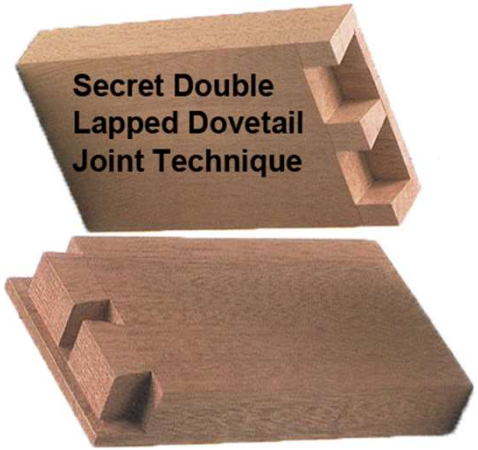


Span = 36 m

Portfolio of connections

Portfolio of > 14 connections				
Classification	Action	Type		
		Simply supported	Pinned	Clamped
Permanent joint	Shop	A	B	C
	Field	D	E	F
Dismountable	Shop	G	H	I
	Field	J	K	L

S.no	Types of Support	Representation by	Reaction Force	Resisting Load
1.	Roller Support		Vertical	Vertical loads
2.	Pinned Support		Horizontal and vertical	Vertical and horizontal loads
3.	Fixed Support		Horizontal, vertical and moments	All types of loads Horizontal, vertical and Moments
4.	Simple Support		Vertical	Vertical loads

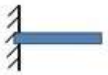


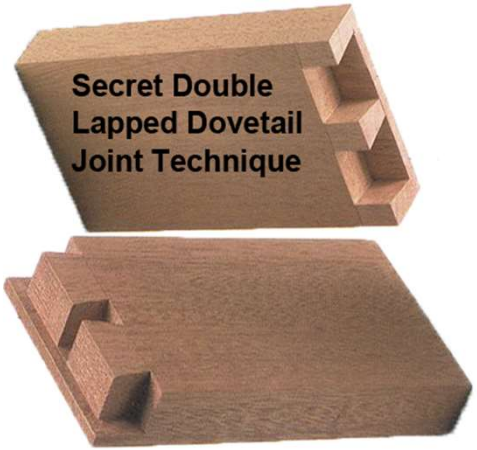
Portfolio of connections

Shop = Field

potentially other materials or other approach

Portfolio of > 14 connections				
Classification	Action	Type		
		Simply supported	Pinned	Clamped
Permanent joint	Shop	A	B	C
	Field	D	E	F
Dismountable	Shop	G	H	I
	Field	J	K	L

S.no	Types of Support	Representation by	Reaction Force	Resisting Load
1.	Roller Support		Vertical	Vertical loads
2.	Pinned Support		Horizontal and vertical	Vertical and horizontal loads
3.	Fixed Support		Horizontal, vertical and moments	All types of loads Horizontal, vertical and Moments
4.	Simple Support		Vertical	Vertical loads



Norms, Regulations, Rules

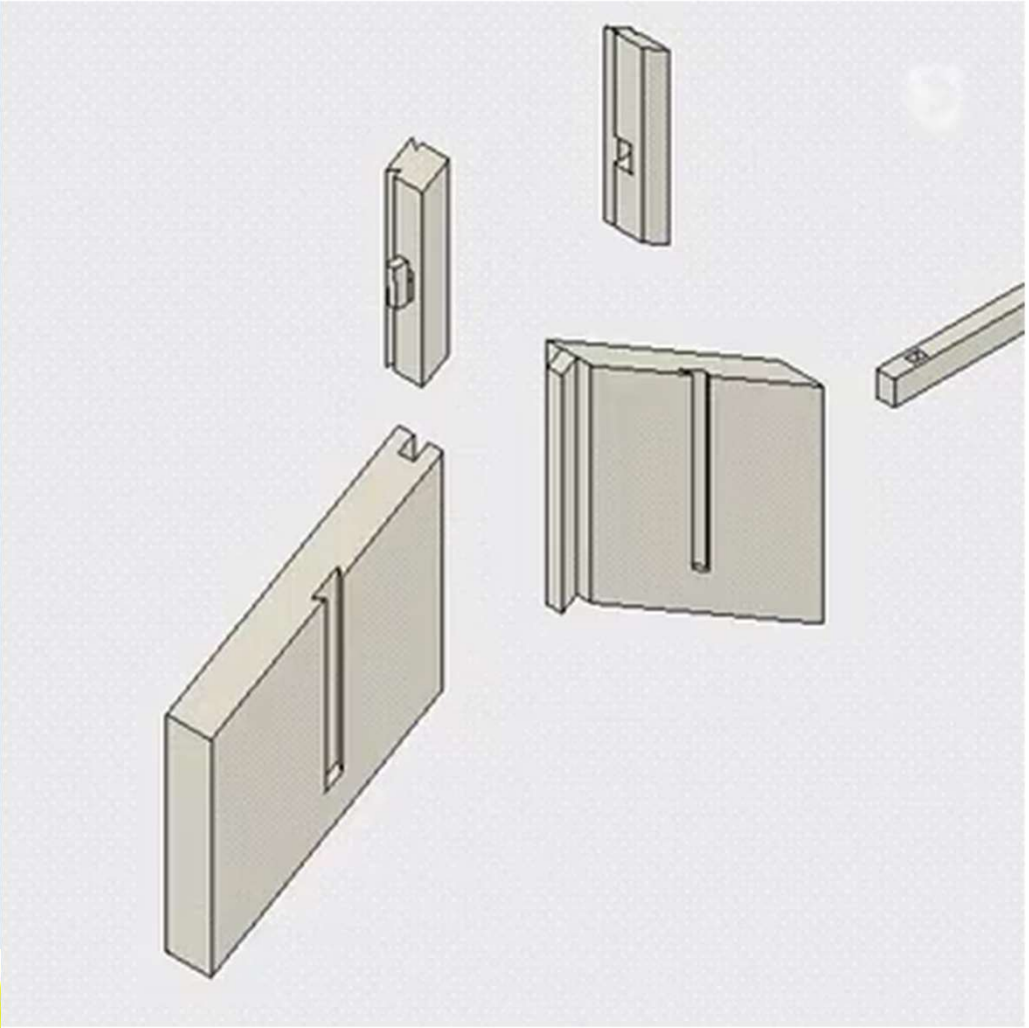
Cur96: 2015 Guideline, Chapter 8 “Joints

8.1 General
8.2 Bonded joints
8.3 Mechanical joints
8.4 Combinations of bolted and bonded joints

Cur96: 2017 Release in Feb 2018

To be implemented in Eurocode
By EN-commission

Japanese joinery techniques (> 80)



Dismountable
Inter-locking
Robust
Durable
Proven

No screws/rivets/glue

https://www.archdaily.com/796918/these-mesmerizing-gifs-illustrate-the-art-of-traditional-japanese-wood-joinery

Well-proven(redundant) connections

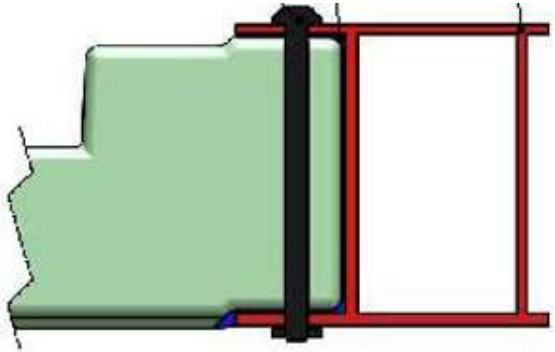
Laminated, Bonded, Shape-locked

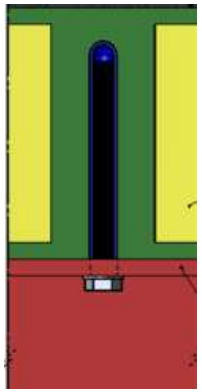
only, or combined with bolted or pinned joints

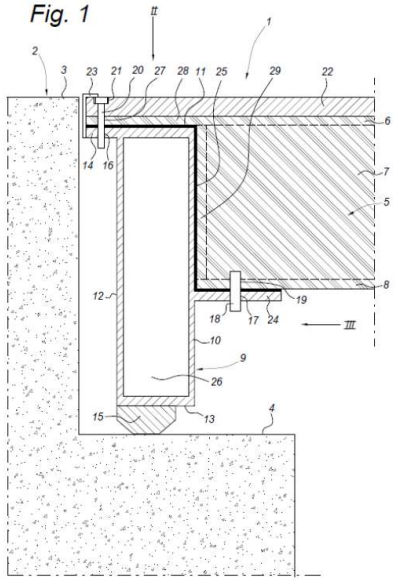
Company approach:

“ the safest connections contain 3 (redundant) features:

- **Shape-locked**
- **Chemically connected**
- **Passively connected**
- ***Line support preferred (i.r.t. creep)***



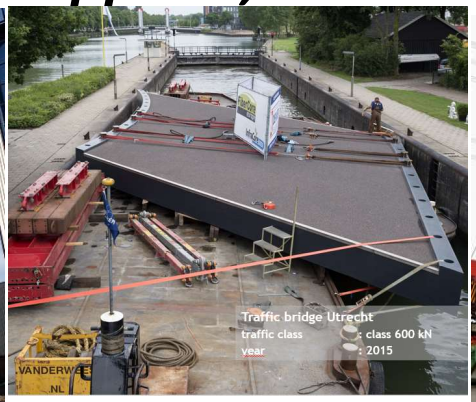


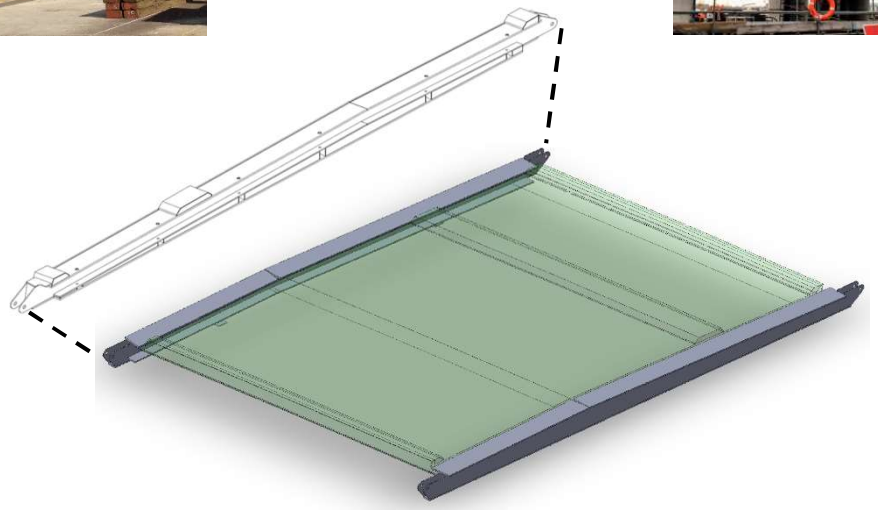


Permanent shop clamped connection

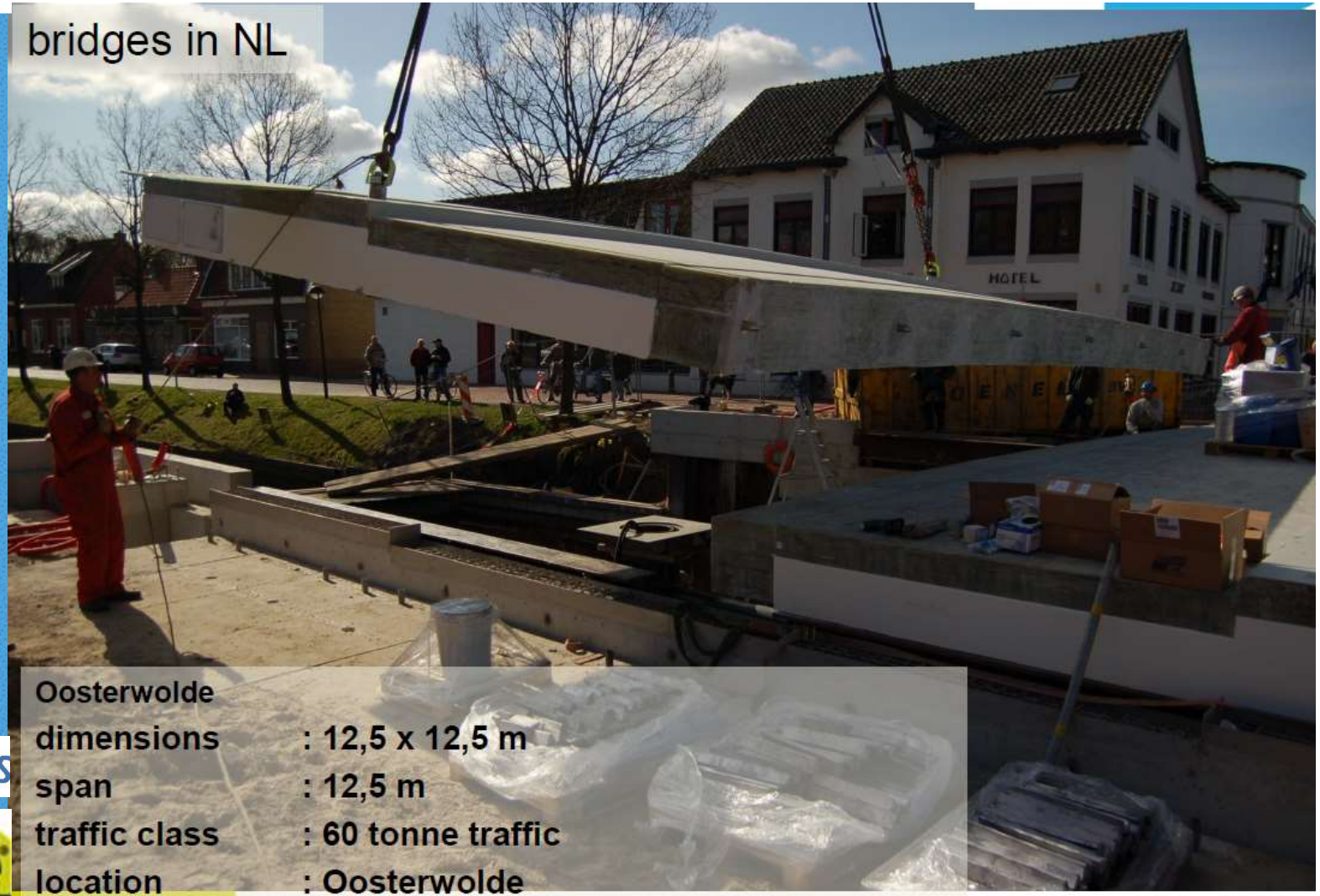
Adhesively bonded, pinned and shape-locked

Actively hinged supports, no contra-weight





Permanent field laminated connections



Permanent field laminated connections

Three basic principle solutions, in order of preference:

- 1. Resin injection of dry fibres
- 2. Resin injection between two laminates
- 3. Adhesive bonding of two laminates
- Apply shear locks for proper load transfer

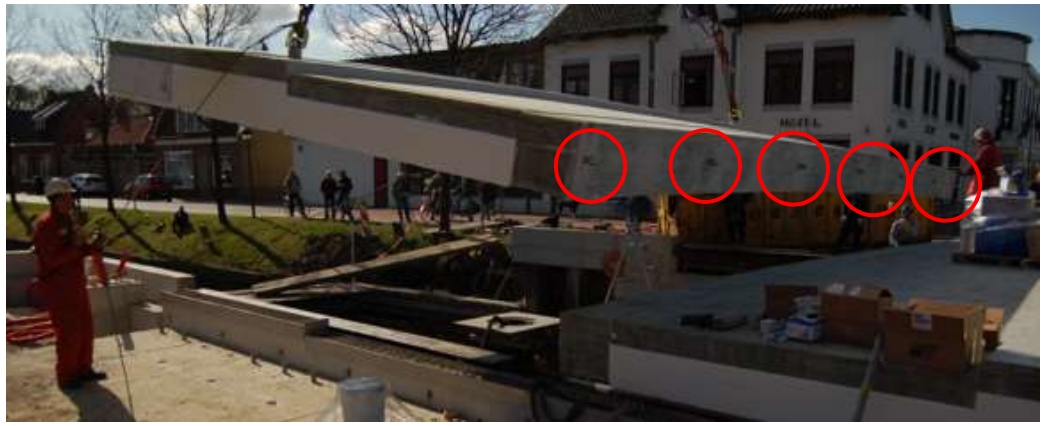
- Always VARTM: hand lamination never been applied

Basic approach:

- If field surface preparation is doable → resin injection
- Otherwise → adhesively bond

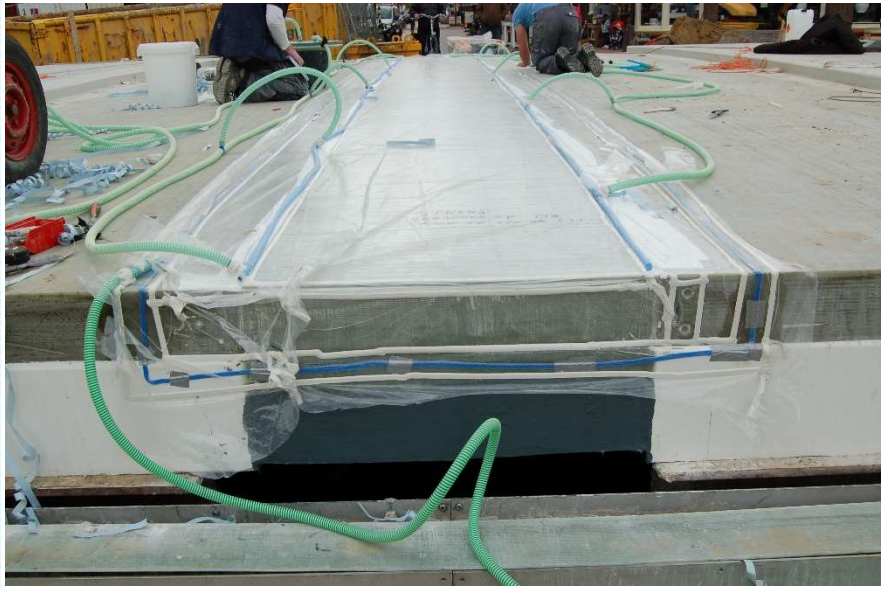
- Bonding also puts more pressure on project planning

Permanent field laminated connections

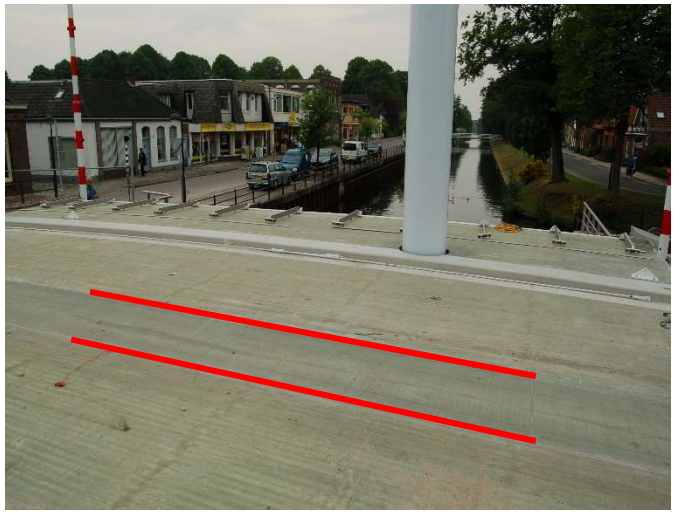


Shear locking

Resin injection between laminates

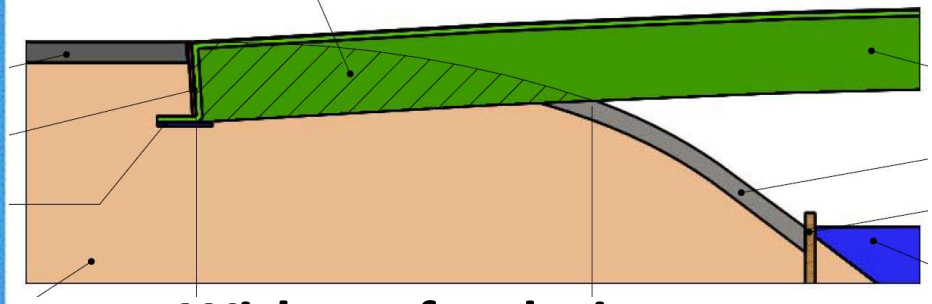


Adhesive bonding of laminates

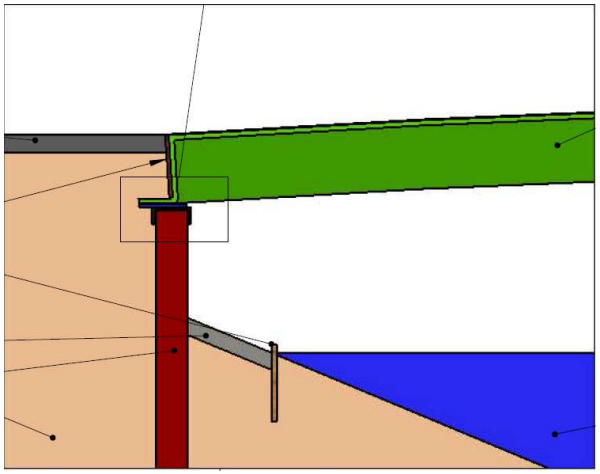


Dismountable field single supported conn.

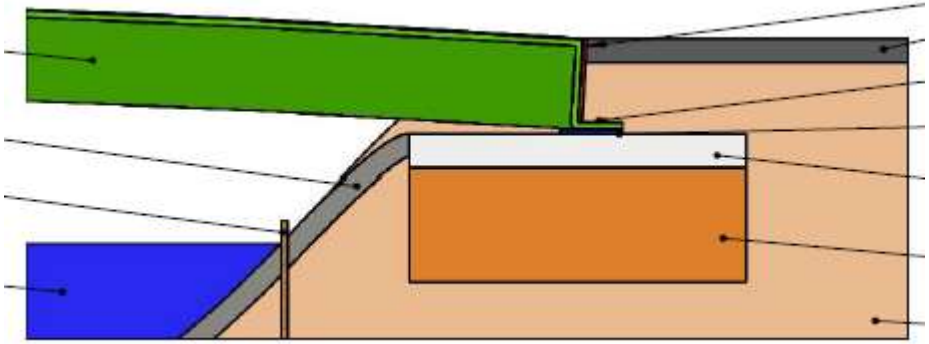
No attachments.
optional



Without fundation support



With pillar support

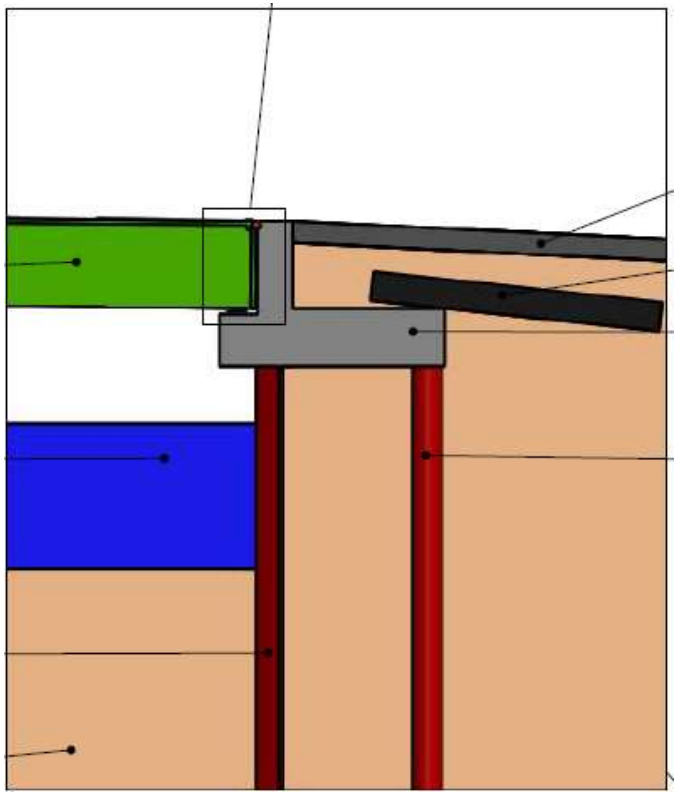


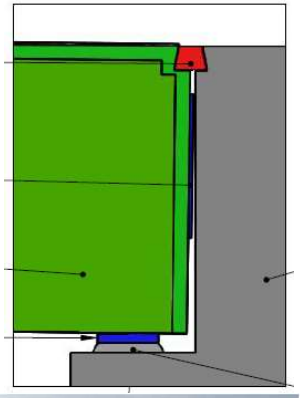
With fundation support

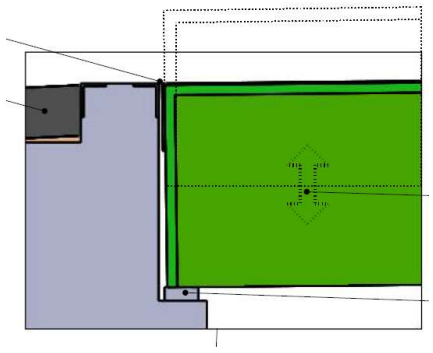
Dismountable field single supported conn.

No attachments: optional

Vertical movement possible



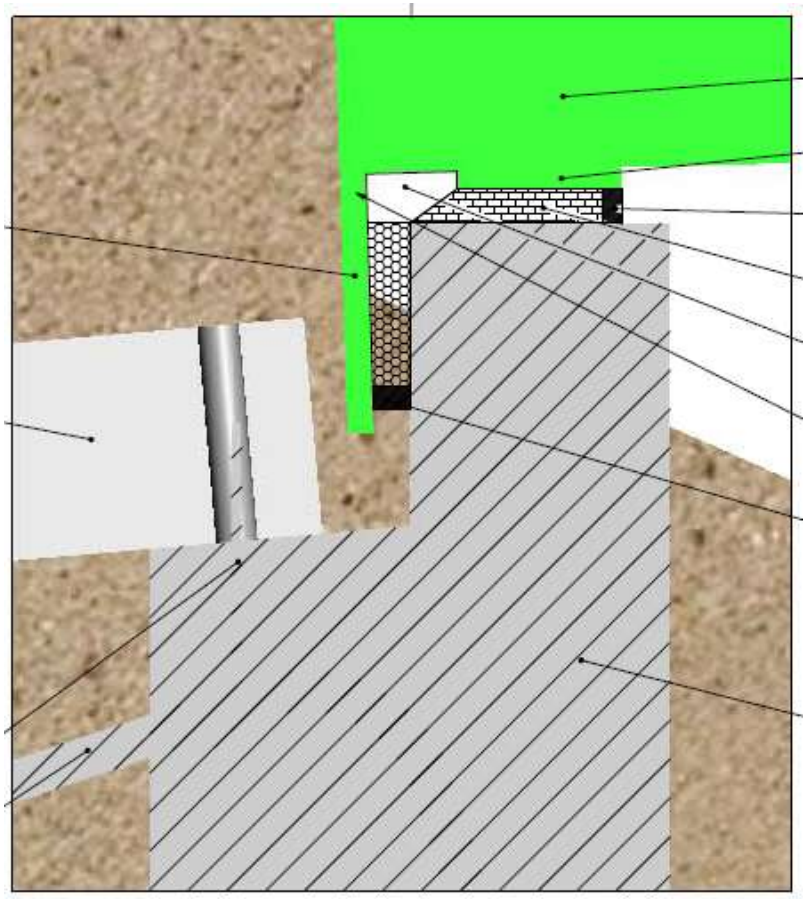


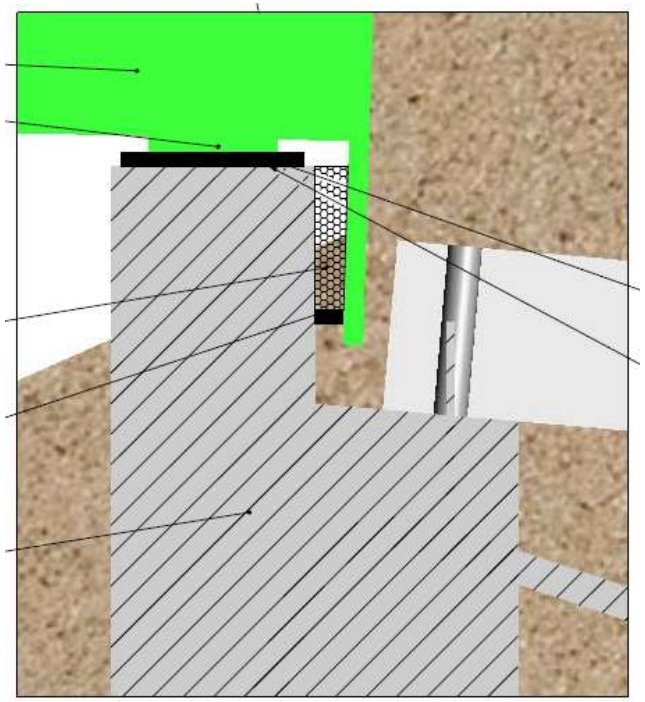


With foundation support

Dismountable field pinned connection

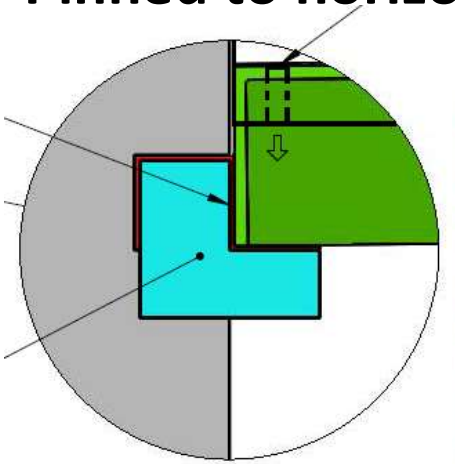
Vertical locking flange
Gap filling with grouting

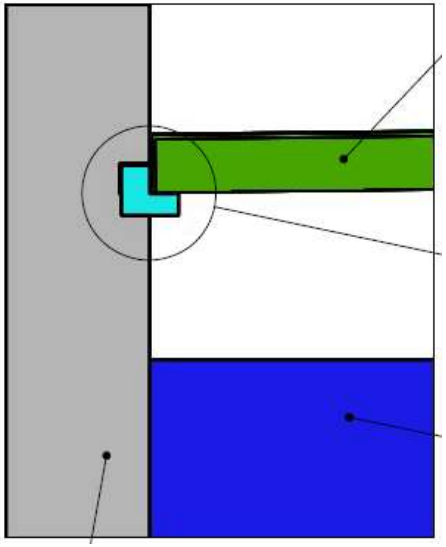




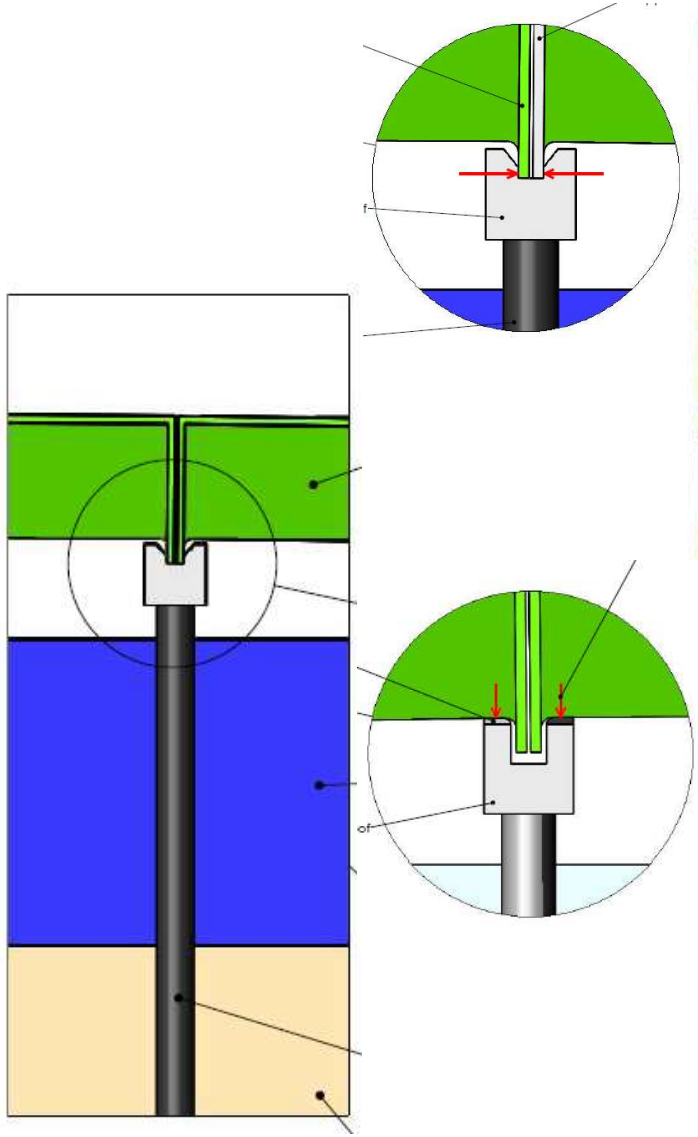
Dismountable field clamped connection

Pinned to horizontal support flange anchored in wall

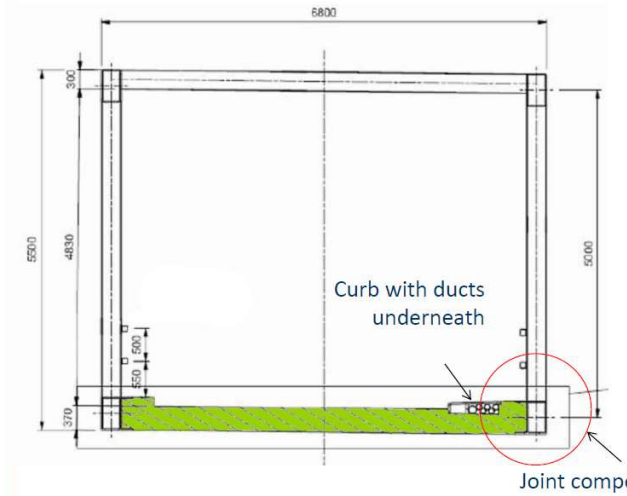


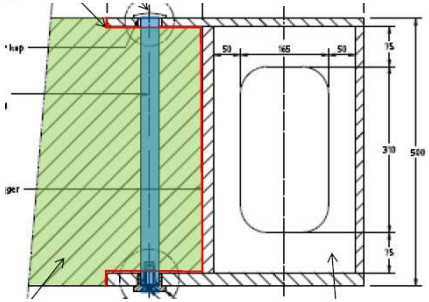


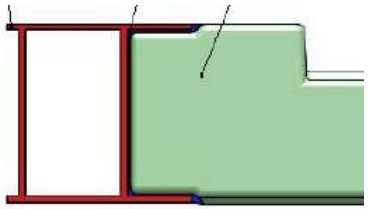
Dismountable field pinned connection



Permanent field clamped connection







InfraCore inside

RAMSSES

CompositesNL E-LASS

FiberCore europe

InfraCore® inside

Approval test: fatigue after impact

InfraCore FRP panel adhesively bonded in steel gutter

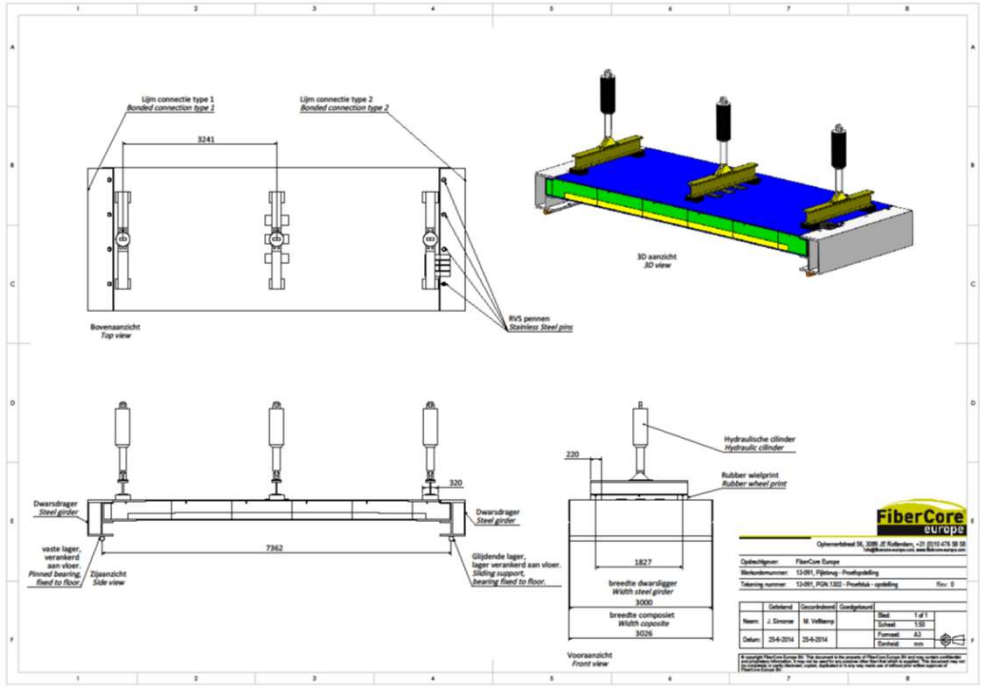
2015: Real scale test at WMC & TNO

Eurocode InfraCore traffic deck 3m x 7m

30 M fatigue cycles 60 tons <u>after serious impact</u>

No structural damage propagation, if any…

Bridge installed with 50 years of Future Lifetime, without repair

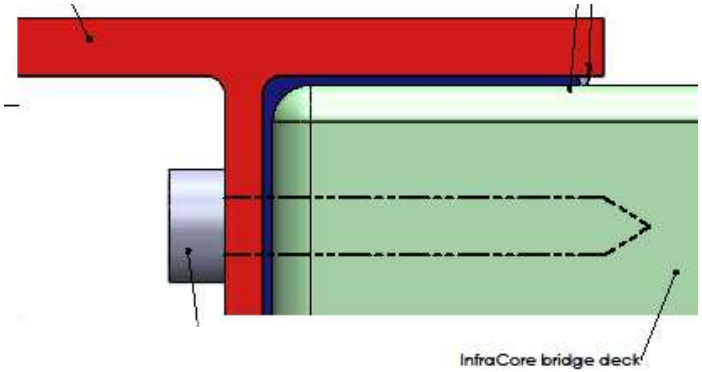


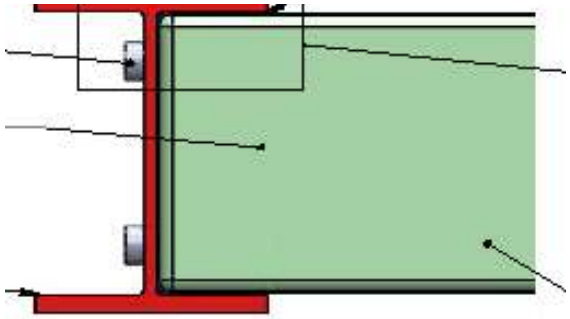
PROVEN TECHNOLOGY

Witnessed by DNV-GL

Permanent field clamped connection

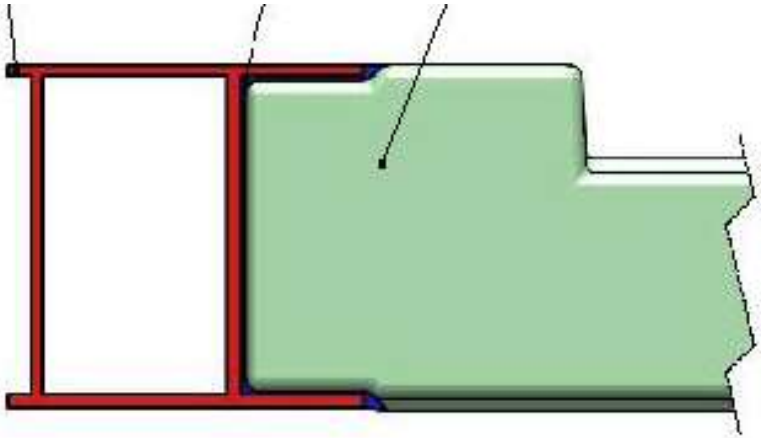
Adhesively bonded (+ pinned hor./vert.) on both sides

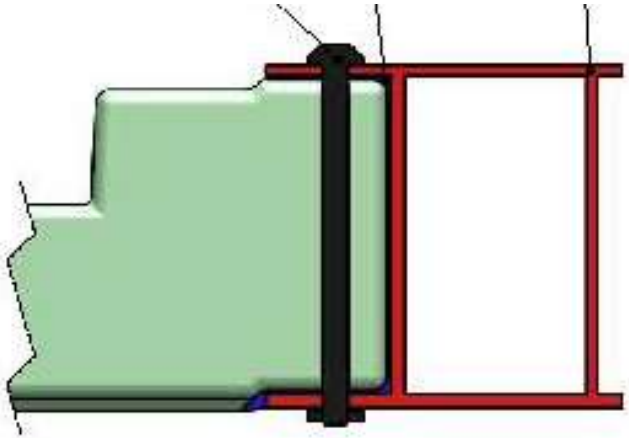




Pin

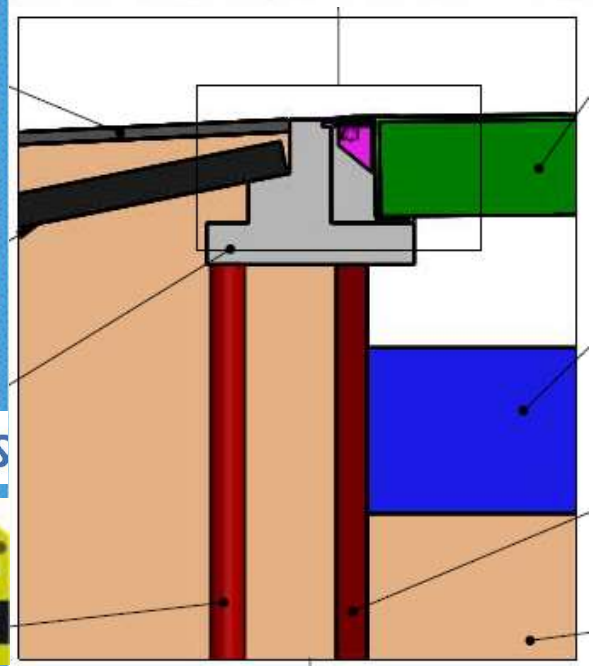
Shape-locked

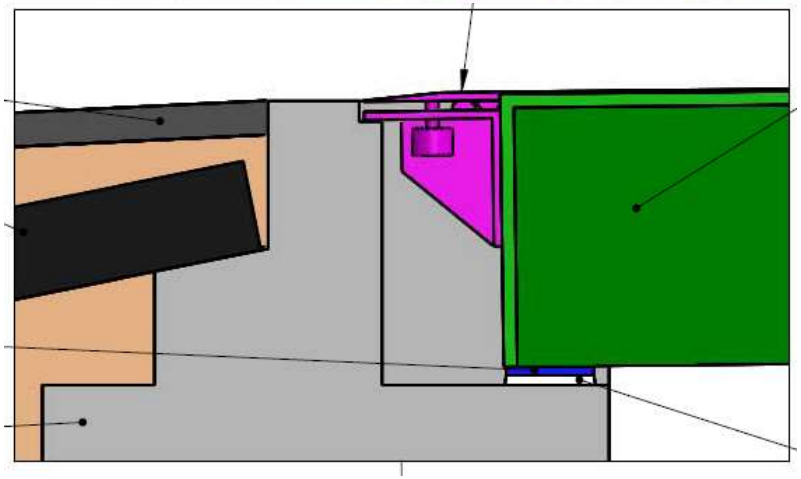




Permanent field clamped connection

Active dilatation compensation (~ spring)

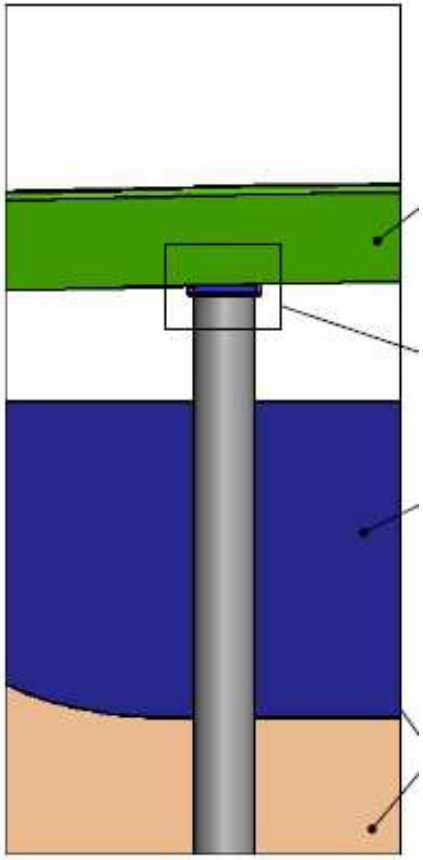


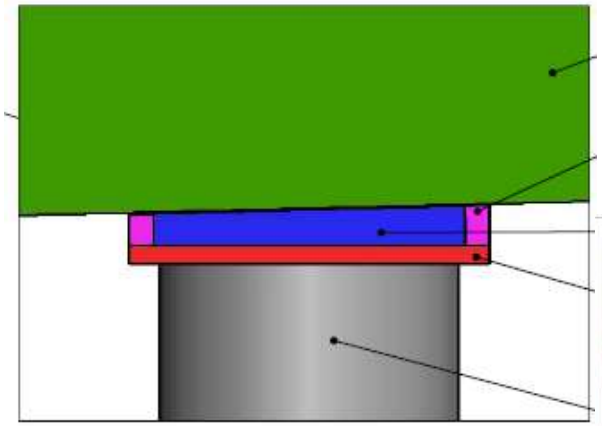


Gap is closed for fluent roll-on/roll-of

Permanent field pinned connection

In field adhesive bonding on support pillars
(~ constructive fibre paste)



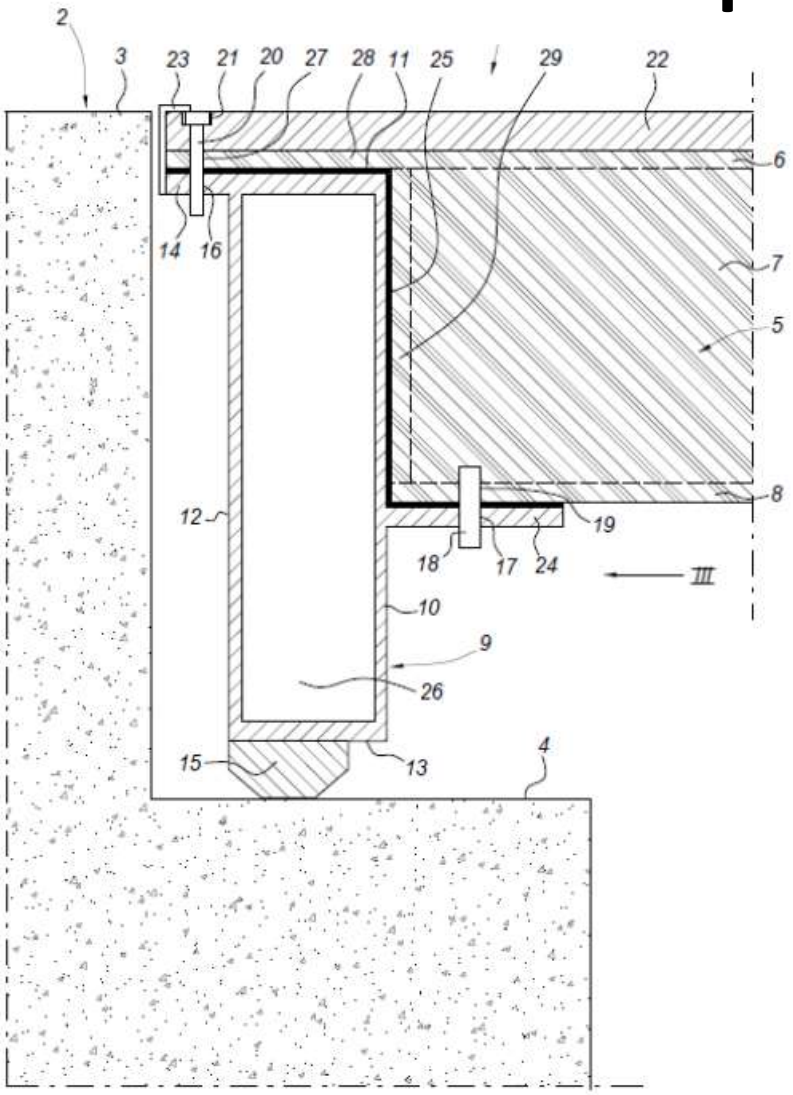


InfraCore inside

RAMSSES

InfraCore® inside

Dismountable field simply support. connect.



Dismountable

Shape-locked

Concrete

Steel

FRP

Proven

CompositesNL

E-LASS

FiberCore europe

InfraCore inside

RAMSSES

Dismountable field sliding connection

Sliding supports through InfraCore Deck
Guiding cylinders bonded & anchored in monolithic FRP

M30 chemically bonded anchors
Required: 74 kN, measured 166 kN (no failure)

CompositesNL E-LASS

FiberCore europe

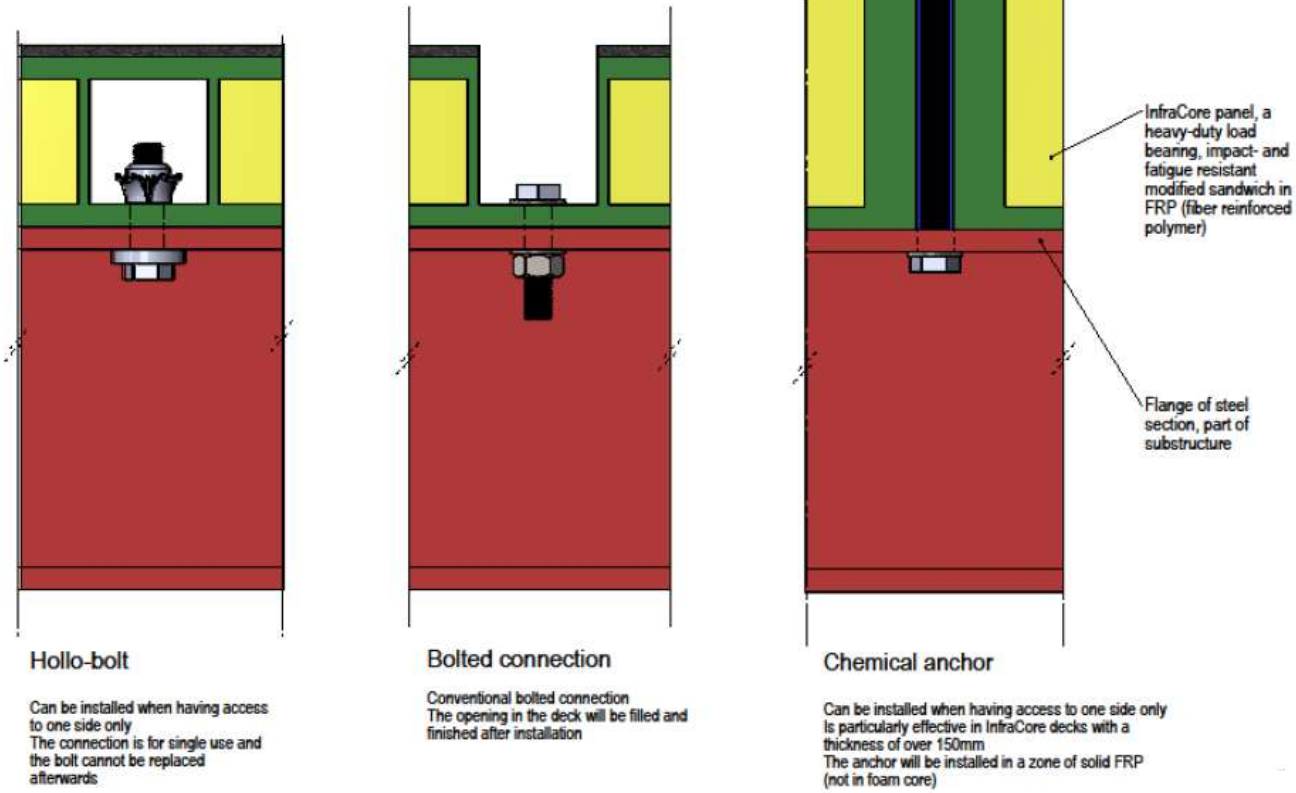
InfraCore inside

RAMSSES

InfraCore® inside

Dismountable field pinned connection

Connection alternatives InfraCore deck to steel substructure



Hollo-bolt

Can be installed when having access to one side only
The connection is for single use and the bolt cannot be replaced afterwards

Bolted connection

Conventional bolted connection
The opening in the deck will be filled and finished after installation

Chemical anchor

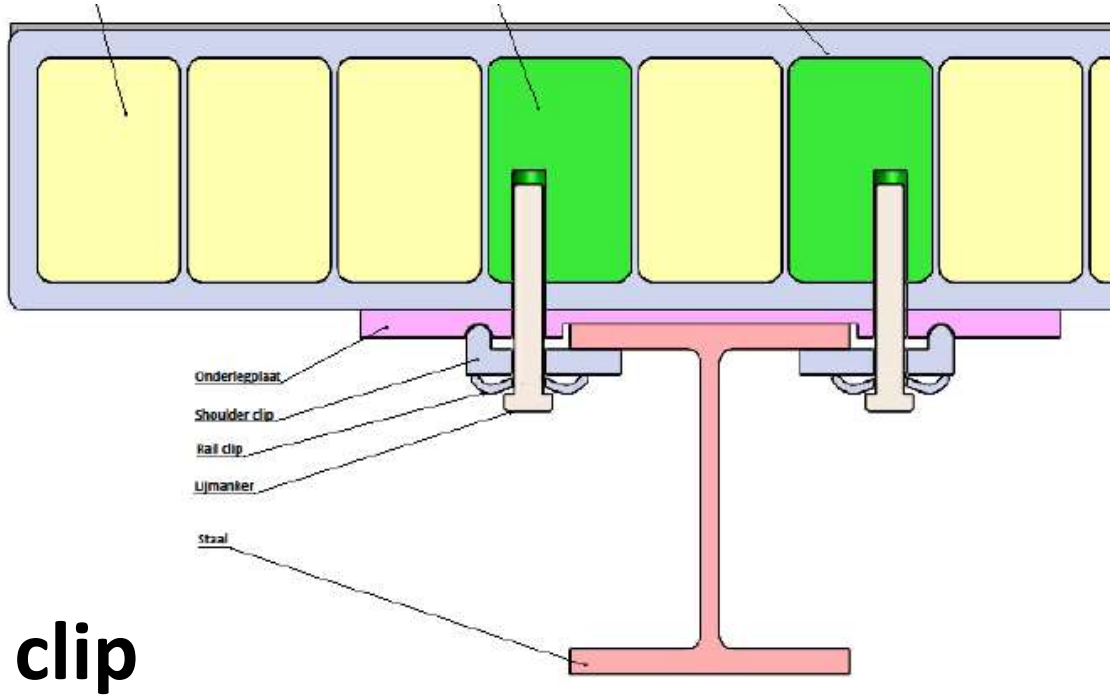
Can be installed when having access to one side only
Is particularly effective in InfraCore decks with a thickness of over 150mm
The anchor will be installed in a zone of solid FRP (not in foam core)

FiberCore europe

FRP decks on steel bridges

(~ refurbishment)

Dismountable field pinned connection



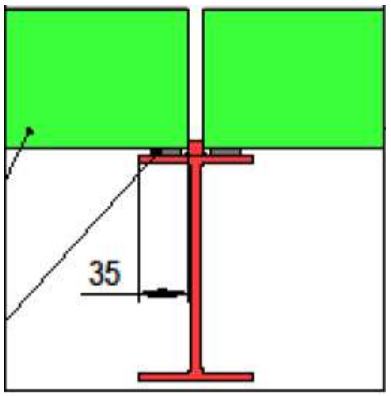
Rail clip

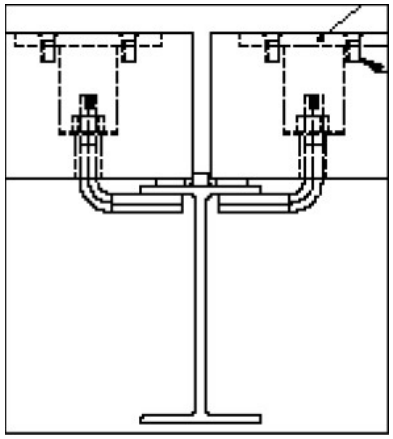
Rail clip

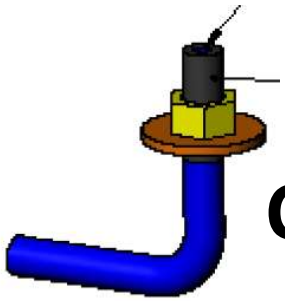
Shoulder clip

FRP decks on steel bridges (~ refurbishment)

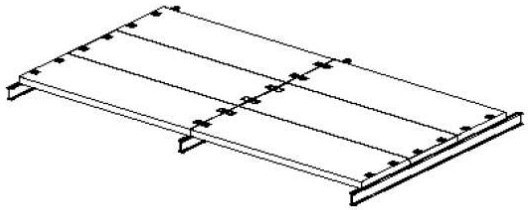
Dismountable field pinned connection

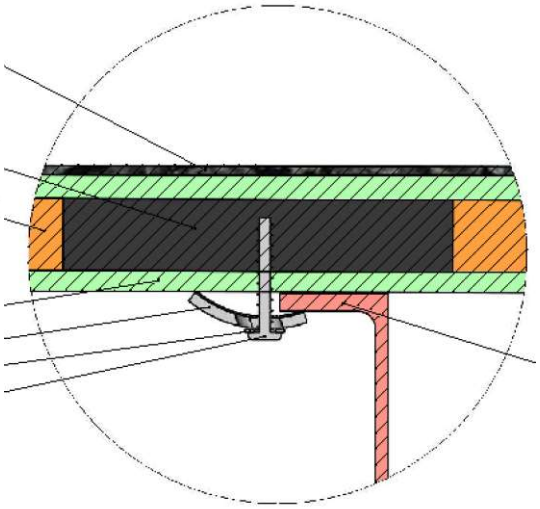


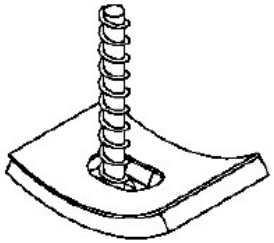




Clamping hook







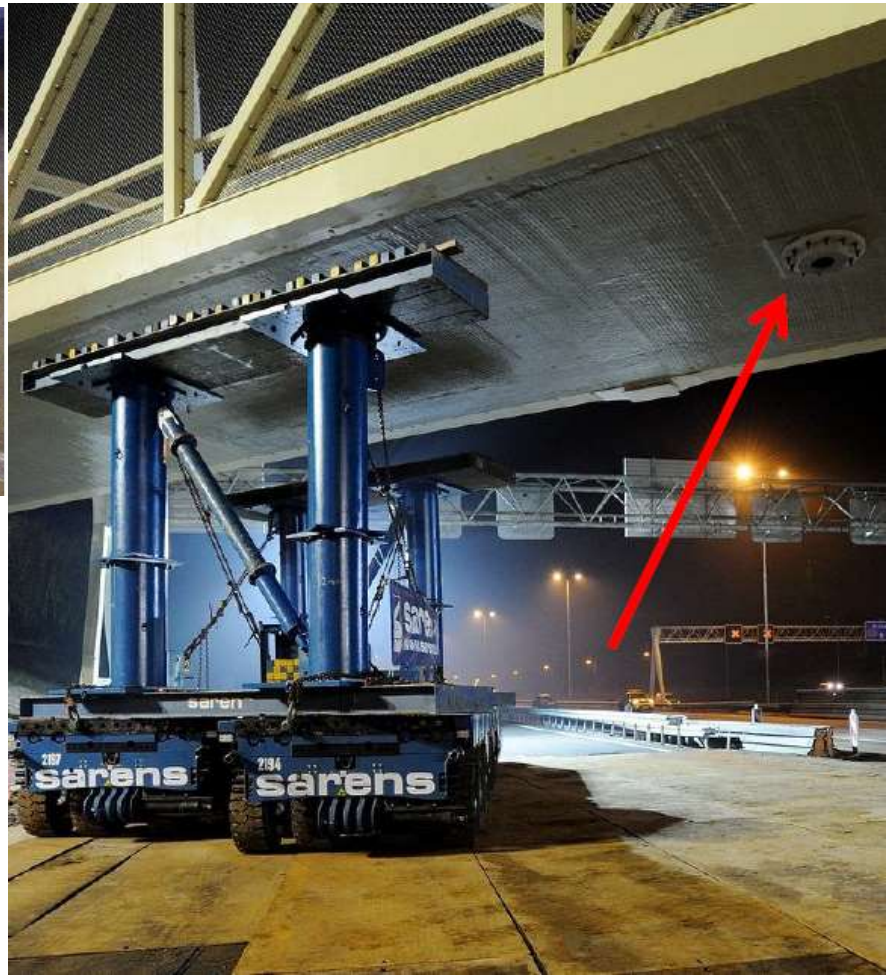
Clamping plate

FRP decks on steel bridges (~ refurbishment)

Dismountable field pinned connection

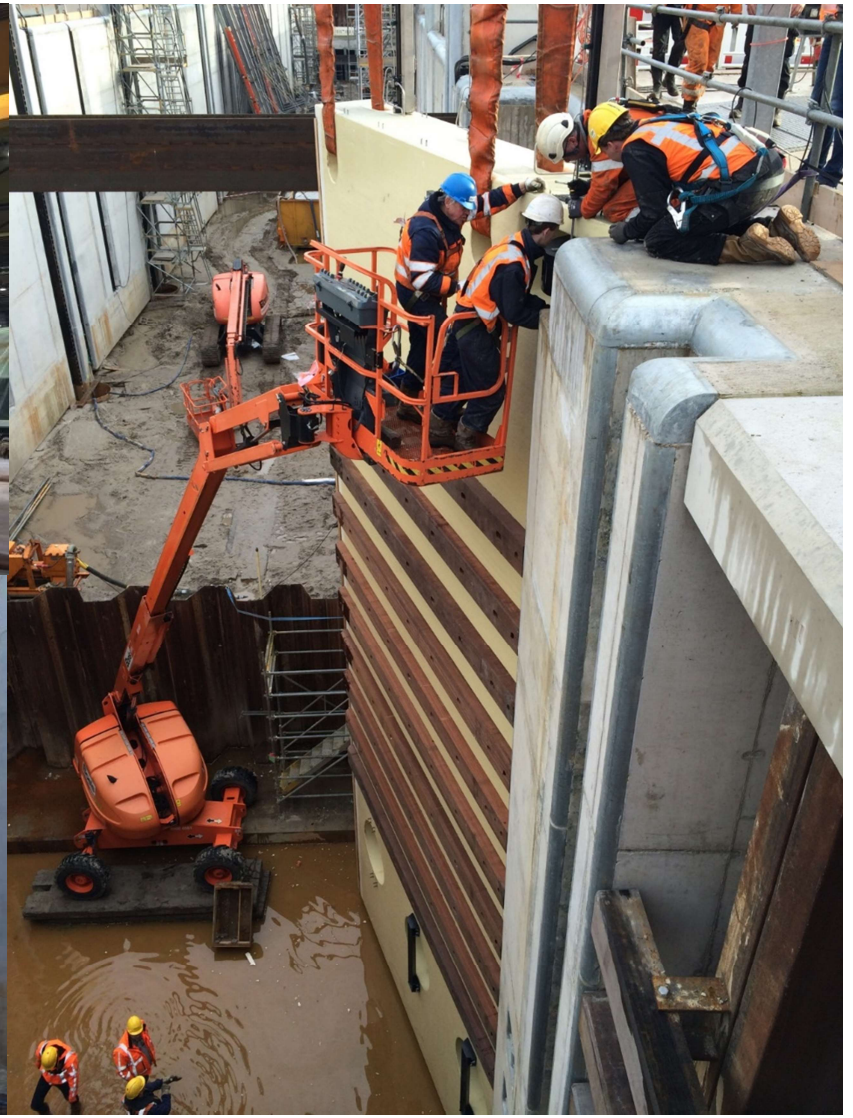
FRP decks on steel bridges (~ refurbishment)

Dismountable field clamped connection



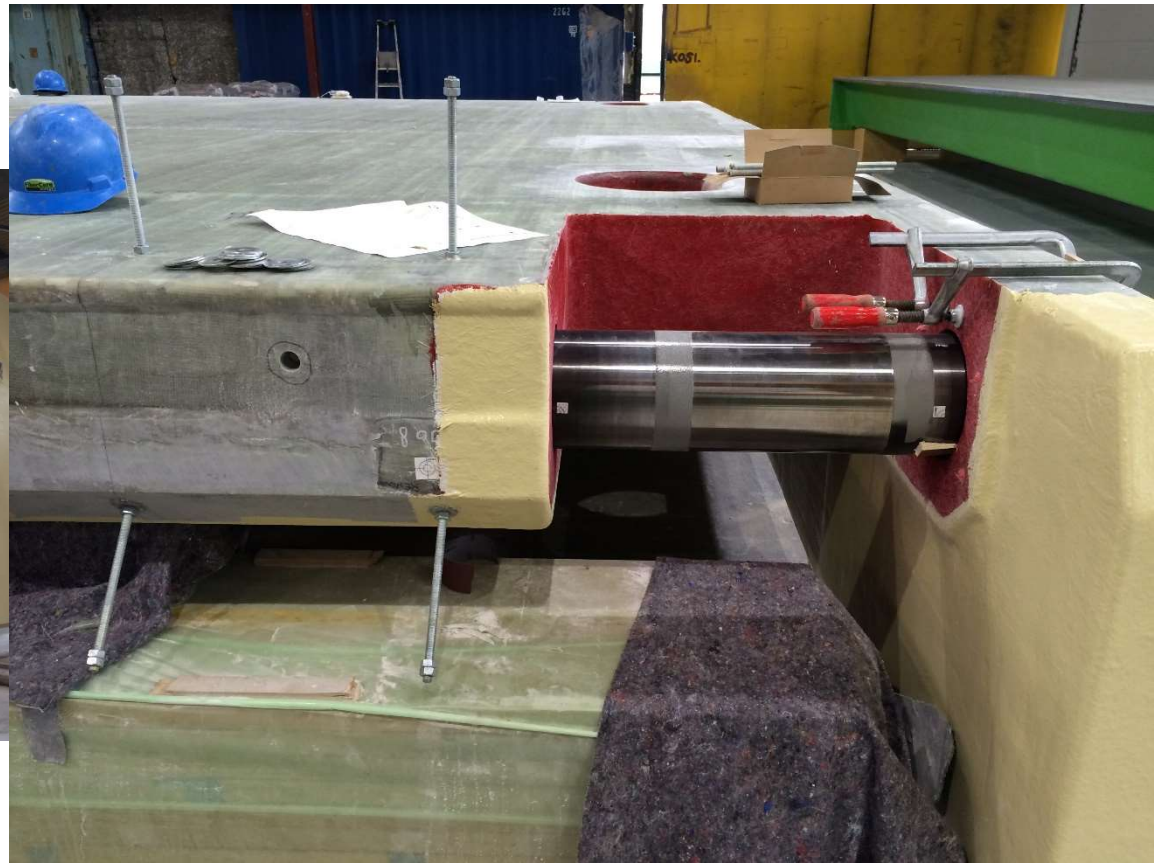
FRP decks on steel pillars

Dismountable field pinned connection



Dismountable field pinned connection

Steel cylinders adhesively bonded within InfraCore
Guiding rods are positoned on sight

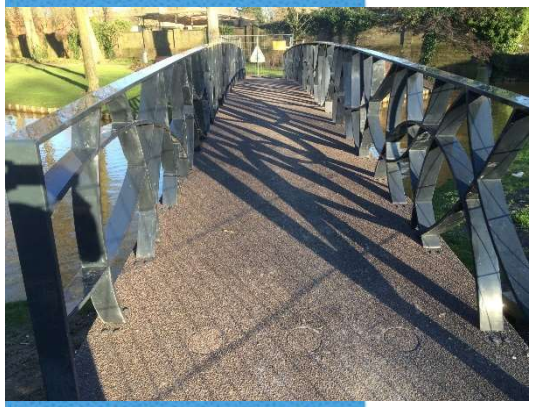


Dismountable simply supported connection

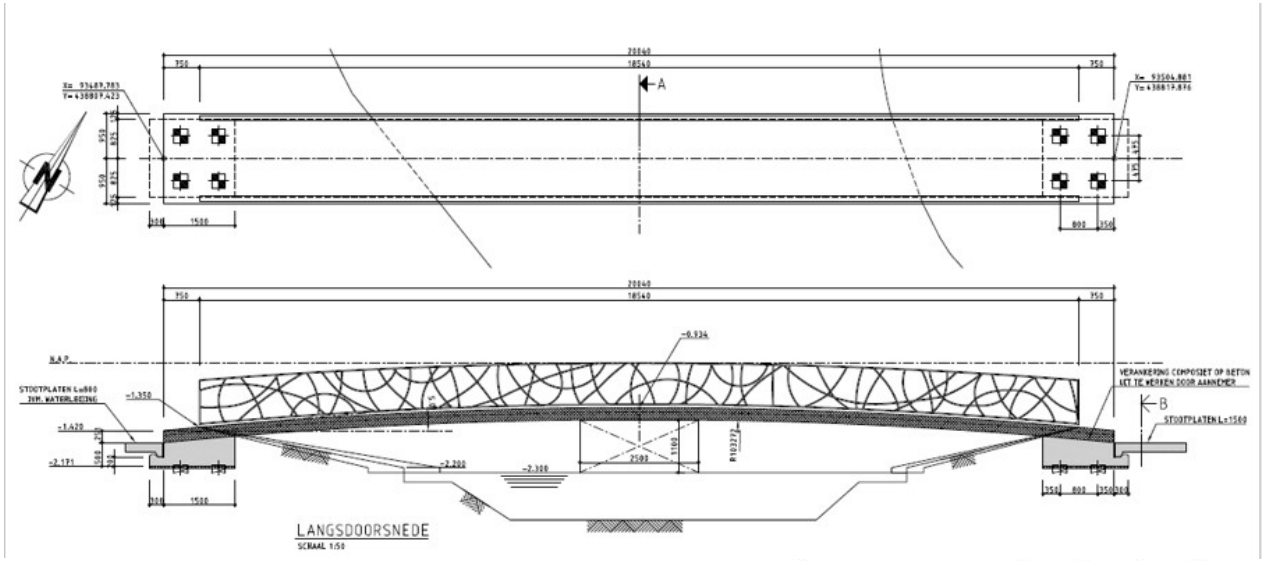
‘Harbour bridges’

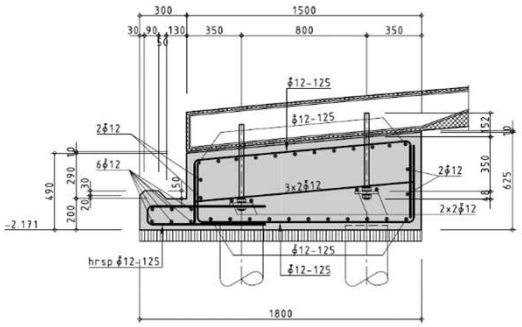
Floating support

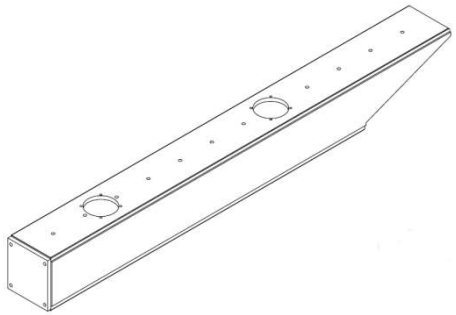
Dismountable fully clamped connection

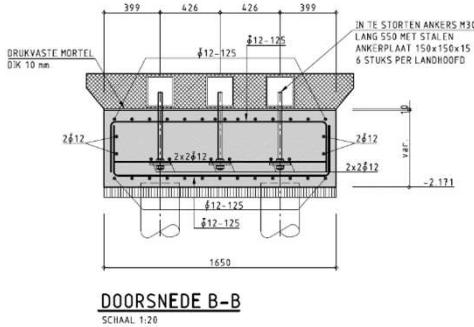


A clamped bridge is the most slender bridge





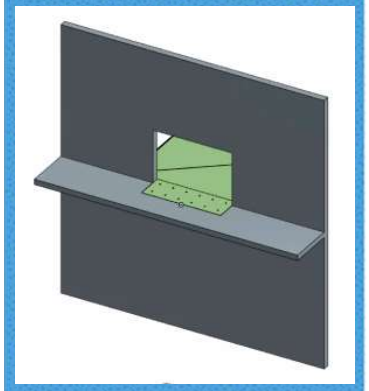


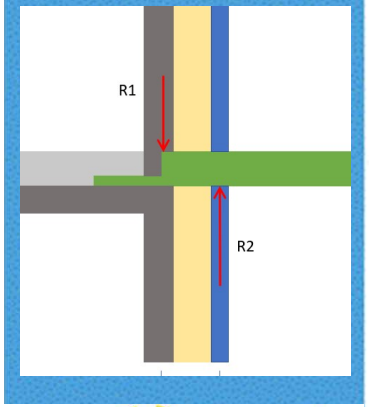


Steel inserts within InfraCore

InfraCore inside

RAMSSES





CompositesNL E-LASS

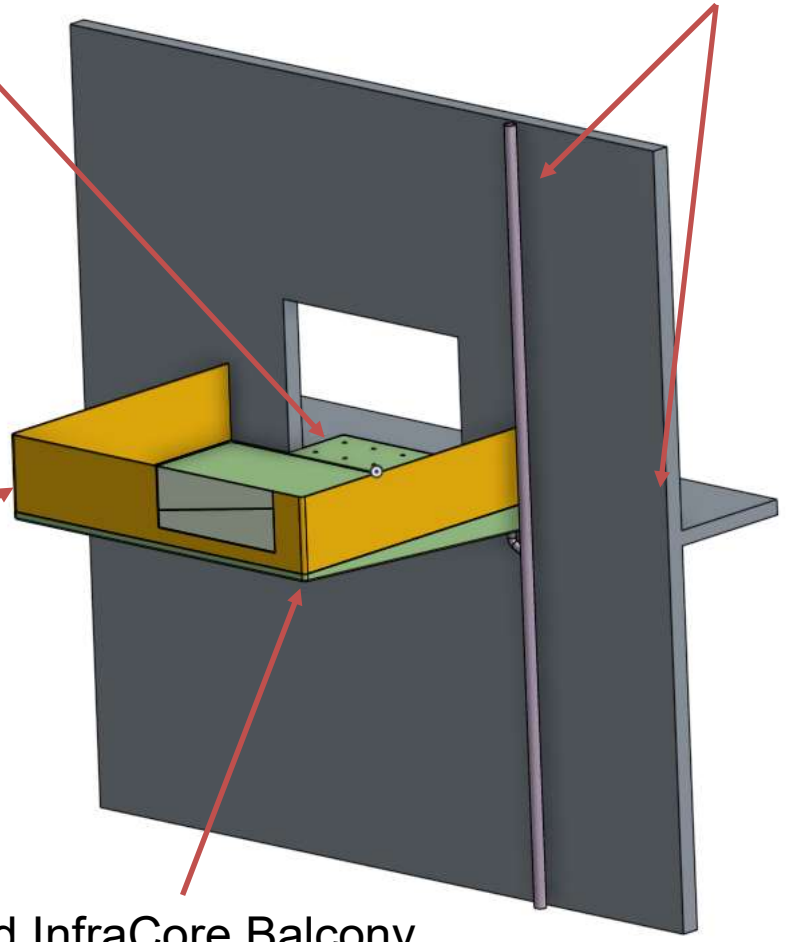
FiberCore europe

InfraCore® inside

Permanent clamped connection

Integrated lip connection, adhesively bonded and pinned to floor
! no cold bridge !

(Existing) wall and floor

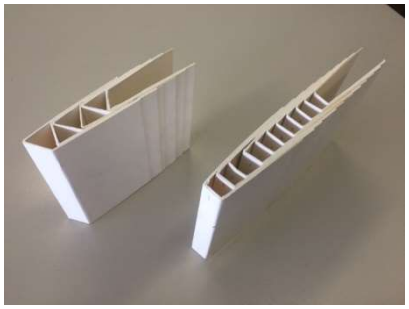
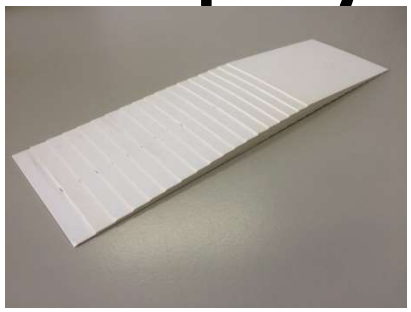
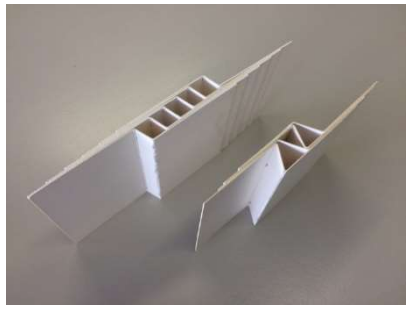


Bolted pre-fabricated handrail

Pre-fabricated InfraCore Balcony with integrated water run-off

InfraCore® Balcony

InfraCore Company

Contact

- Postal address: Oostdijk 25, 3077 CP Rotterdam/NL
- Office address: Marconistraat 16, 3029 AK Rotterdam /NL
- Email: info@infracore-company.com
- Internet: www.infracore-company.com
- Phone: 0031-624628868