Developments in berth layout

Recent examples in the Port of Rotterdam

Willem Hoebée

9th International Harbour Masters Congress | Bruges - Ghent, Belgium | 26th - 30th May 2014

Agenda

- Introduction
- Components of mooring system
- Mooring plan
- Design of berth layout
- Recent examples in the Port of Rotterdam

Introduction

Safe mooring is paramount for vessel, port and terminal

- Breaking loose of vessels may damage other vessels and infrastructure
- Poorly moored vessels may slow down cargo operations, even may damage cranes and cause personal injuries

Developments

- Larger vessels with smaller crews, not always well trained
- Berth lay-out not always up to standard (not always a common understanding of various mooring components)

CMA CGM Marco Polo

Lateral area approximately: 400 * 42,50 m = 17.000 m2
Area of three soccer fields: 3 * 100 * 50 m = 15.000 m2

Wind force 5 Beaufort: lateral force: 105 ton = 3 tugs
Wind force 6 Beaufort: lateral force: 170 ton = 4 tugs (operational limit)
Wind force 10 Beaufort: lateral force: 650 ton = survival conditions

Introduction - aspects of mooring in a port

Different stakeholders in different worlds with different interests and different standards

Vessel
- different types
- mooring equipment

Interface

Infrastructure
- quays/ jetties/ buoys
- bollards/ fenders

	Design phase		Operational phase
Vessel	- Ship owner - Naval architect - Classification	OCIMF/ NI SNAME IACS	- Ship owner - Mariner (safe mooring)
Interface	- Harbourmaster	IHMA	- Harbourmaster (port safety/ efficiency)
Infrastructure	- Port Authority - Terminal - Civil engineer	OCIMF PIANC/ EAU	- Port authority - Terminal (maintenance aspects)

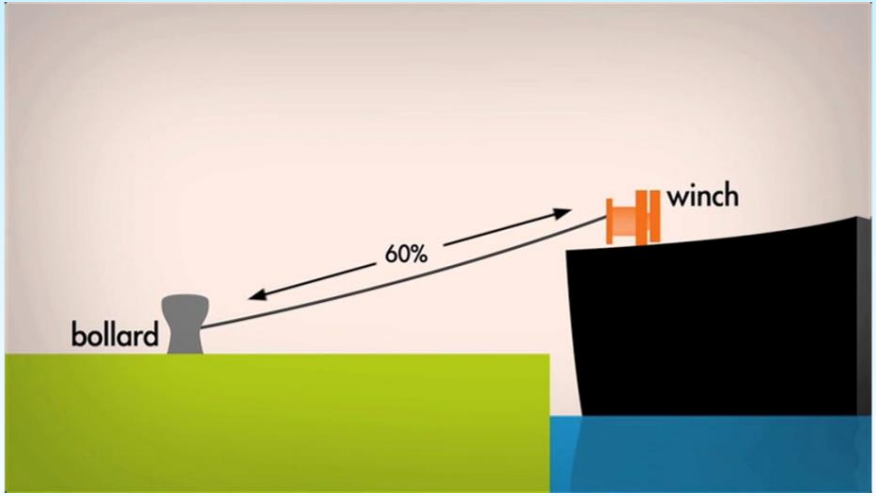
Components of mooring system and mooring plan

Components of mooring system (1)

1. **Mooring winch on board vessel**
   - Maximum Holding Capacity (MHC)
   - Winch will render when MHC is exceeded
2. **Mooring line**
   - Minimum Breaking Load (MBL) on certificate (when new!)
   - Practise: MBL less for older mooring lines (wear and tear)
3. **Mooring bollard or Quick Release Hook (QRH) ashore**
   - Safe Working Load (SWL)
     up to maximum angle of mooring line e.g. 45 degrees

Components of mooring system (2)

- Brake of winch: **weakest** link
- If brake fails: first mooring line will break
- Bollard ashore: **strongest** component



Break of winch should render before reaching 60% of MBL of mooring lines

Mooring plan (1)

A good mooring plan complies with the following:

- Length of mooring lines between fairlead and bollard / QRH between 35 and 50 meters

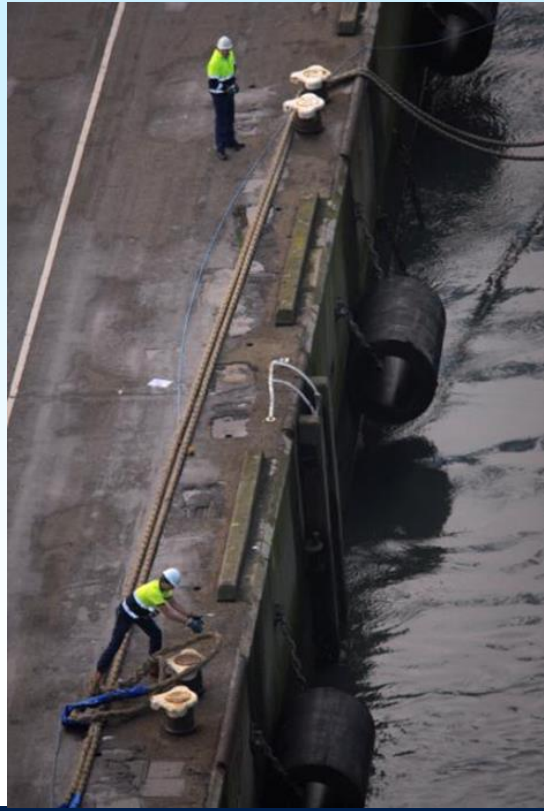
  = > **sufficient elasticity** for mooring lines

- Same length, elasticity and tension for mooring lines in the same service (e.g. all breast lines or spring lines)

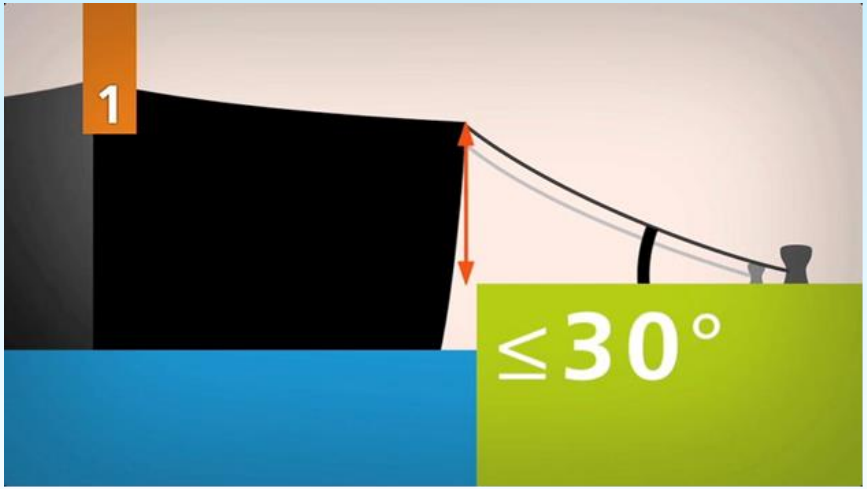
  => mooring lines **work together**

- Maximum vertical angle of mooring lines 30 degrees

  = > **horizontal component sufficient** to keep vessel alongside



Mooring plan (2)



Maximum vertical angle of mooring lines: 30 degrees

Mooring lines 1 and 2 should have same specifications: length, elasticity and tension

Mooring plan (3)

- **Spring lines** positioned parallel to longitudinal centre line of the vessel
- **Breast lines** positioned as **perpendicular** as possible to longitudinal centre line of vessel
- Sometimes (at container and dry bulk terminals) **impossible** to meet both ideal horizontal and vertical angles of mooring lines due to location of bollards ashore.
  =>In that case **focus** first on meeting **maximum vertical angles**

Additional means for mooring vessels
- when e.g. expecting strong winds

- **Paying out additional lines from vessel to shore**
  - Additional lines should have same length and tension
  - Extra lines to “storm bollards” are not very effective
- **Ordering tugs to keep the vessel alongside (pushing)**
  - Note: availability of tugs, costs and emissions
- **Paying out shore lines to the vessel and tensioning these ashore with hydraulic cylinders (ShoreTension system)**

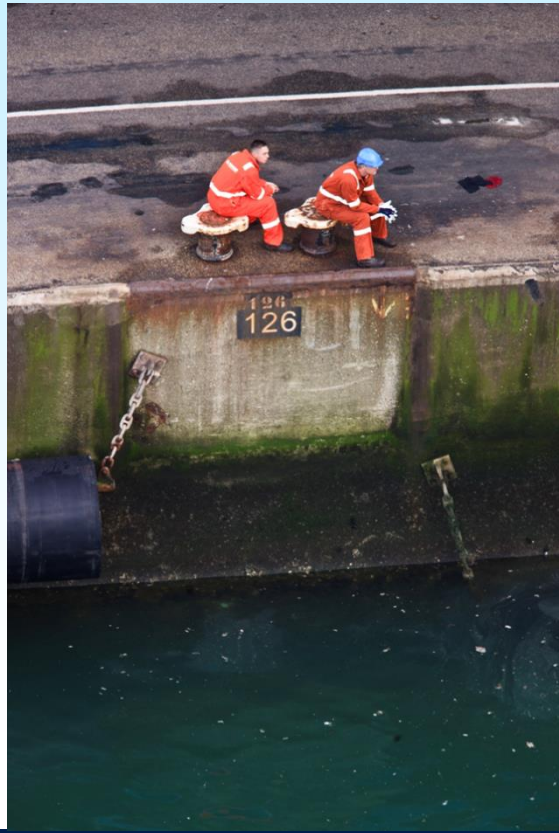
Design of berth layout

Design of berth layout (1)

- Safe working load of bollards / hooks

- **Tanker berths: Mooring Equipment Guidelines (OCIMF)**
  - Hooks as strong as MBL of strongest line anticipated
    (one line per hook)

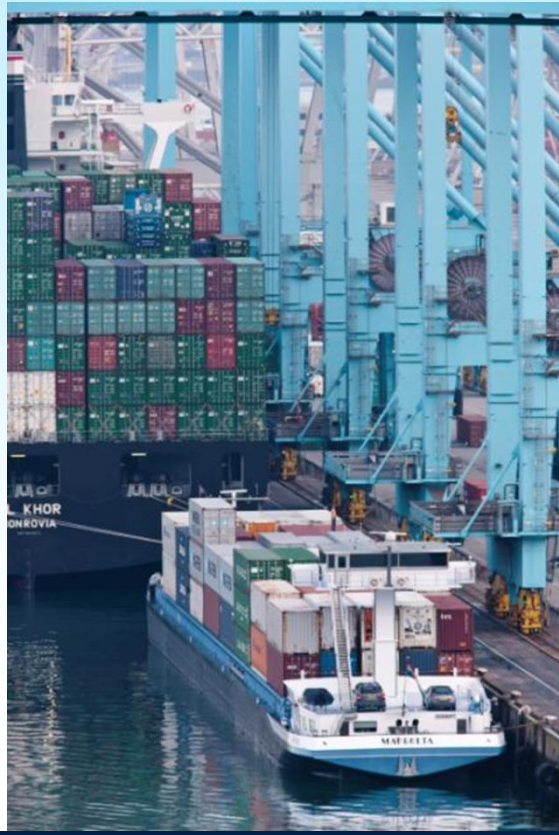
- **Dry bulk / container berths: no international rules**
  - Bollards as strong as MBL of strongest line anticipated
  - More lines on one bollard: SWL to be increased accordingly
  - Note: MBL of mooring lines of new container vessels 130 tons!



Design of berth layout (2)

- Position and number of bollards / hooks

- **Mooring plan(s) of design ship(s) starting point for berth design**
  - Dictates position and number of bollards or hooks
- **Tanker berths (jetties): Mooring Equipment Guidelines (OCIMF)**
  - Discuss details (access ladders, railings etc.) with linesmen
- **Dry bulk / container berths: “Mooring and Anchoring Ships” (Nautical Institute)**
  - Optimise intermediate distance between bollards
  - Use double bollards (pairs), allowing vessels more flexibility
  - Locate bollards land inwards improving vertical angle of (head) lines



Design of berth layout (3)

- Dimensions of typical design vessels

Vessel type	L x B x T (in ballast) [m]	Number of spring lines	Number of breast lines	MHC winch brake [ton]	MBL lines [ton]	Fairlead forward above waterline [m]	Fairlead aft above waterline [m]
Handymax	183 x 32 x 6.0	2	4	30	60	10.90	8.80
Aframax tanker	251 x 43 x 8.0	2	6	35	72	15.00	12.50
VLCC	334 x 58 x 11.0	2	8	50	103	22.00	13.70
Suezmax tanker	276 x 45 x 9.0	2	6	42	83	18.00	13.10
Panamax tanker	246 x 32 x 6.6	2	6	32	64	12.50	10.80
Container vessel > 8,000 TEU < 12,000 TEU	346 x 43 x 10.0	2	4	75	130	20.00	17.50
Container vessel > 12,000 TEU	400 x 56 x 11.0	2	6	75	130	23.00	20.50

Recent examples in the Port of Rotterdam

Examples in the Port of Rotterdam

- Container terminals
- Tanker berths
- Dolphins/ buoys

Examples in the Port of Rotterdam

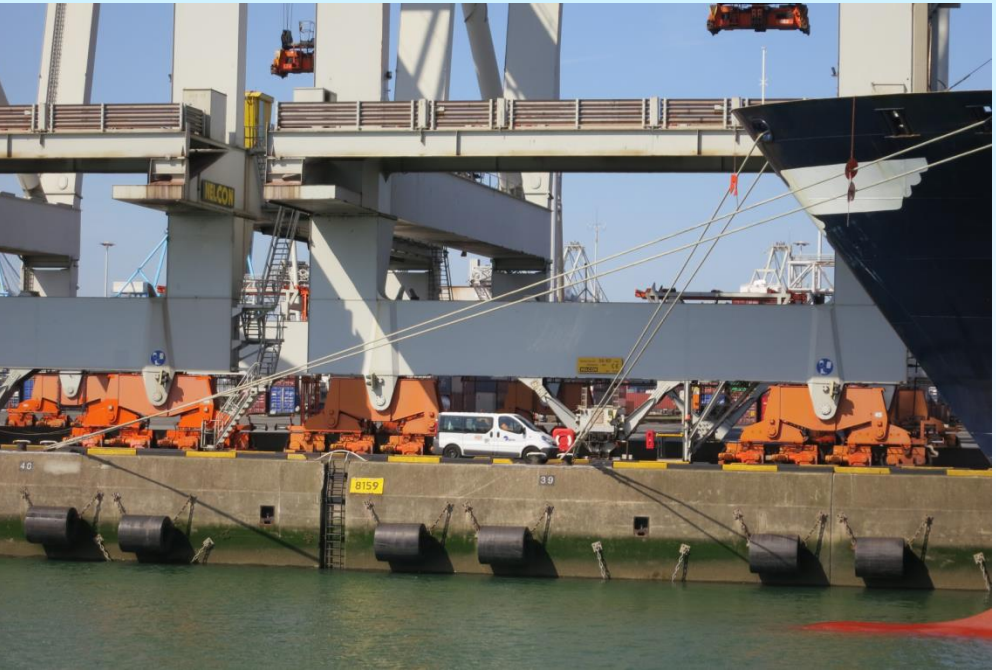
- Container terminals

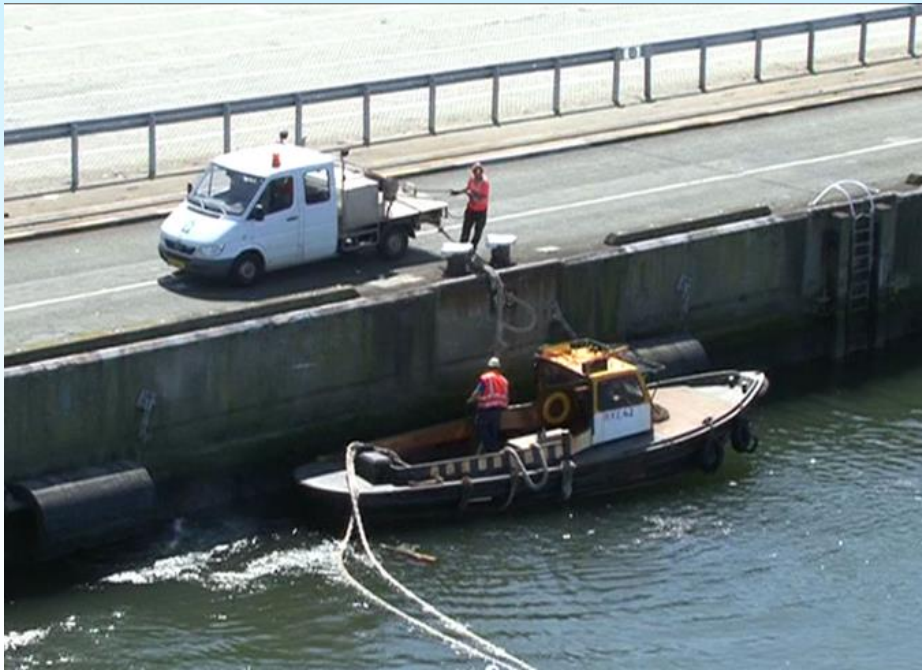
Location	Year of Construction	Bollard type	Spacing of Bollards	SWL [tons]
Europahaven	1980ies	in pairs	20 m	100 tons
Amazonehaven	1990ies	in pairs	20 m	150 tons
Euromax terminal	2008	in pairs	15 m	240 tons
APMT and RWG (Maasvlakte 2)	2013	in pairs	15 m	240 tons

Spacing of bollards (pairs)

Examples in the Port of Rotterdam

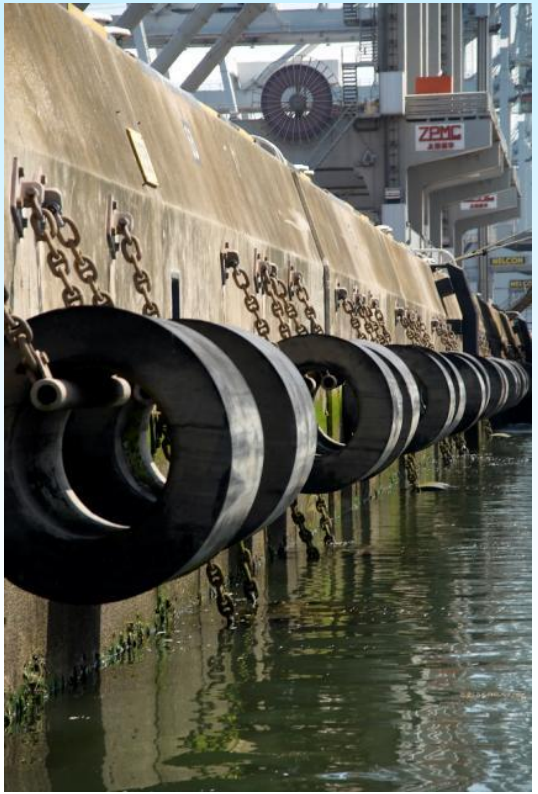
- Container terminals 80ies and 90ies





Examples in the Port of Rotterdam

- Container terminals 80ies and 90ies



Examples in the Port of Rotterdam

- Container terminal - 2008

Examples in the Port of Rotterdam

- Container terminals - 2014

Details quay wall

Bollards in pairs

Cone fenders with panels

“Protection caps” preventing ropes with eye splice falling on “inland barge Bollards”

Ladders for barges
Ladders for drowning persons

AMPT terminal
under
construction
2014

RWG terminal
under
construction
2014

Examples in the Port of Rotterdam

- Tanker berth along the Nieuwe Maas – Argos quay 8 - 2013

- Sufficient distance bollards from quayside
- Bollards for breasting lines
- Quick release hooks for spring lines

Calandkanaal (1)

Dolphins 80

- *Layby berth*
- STS transfer

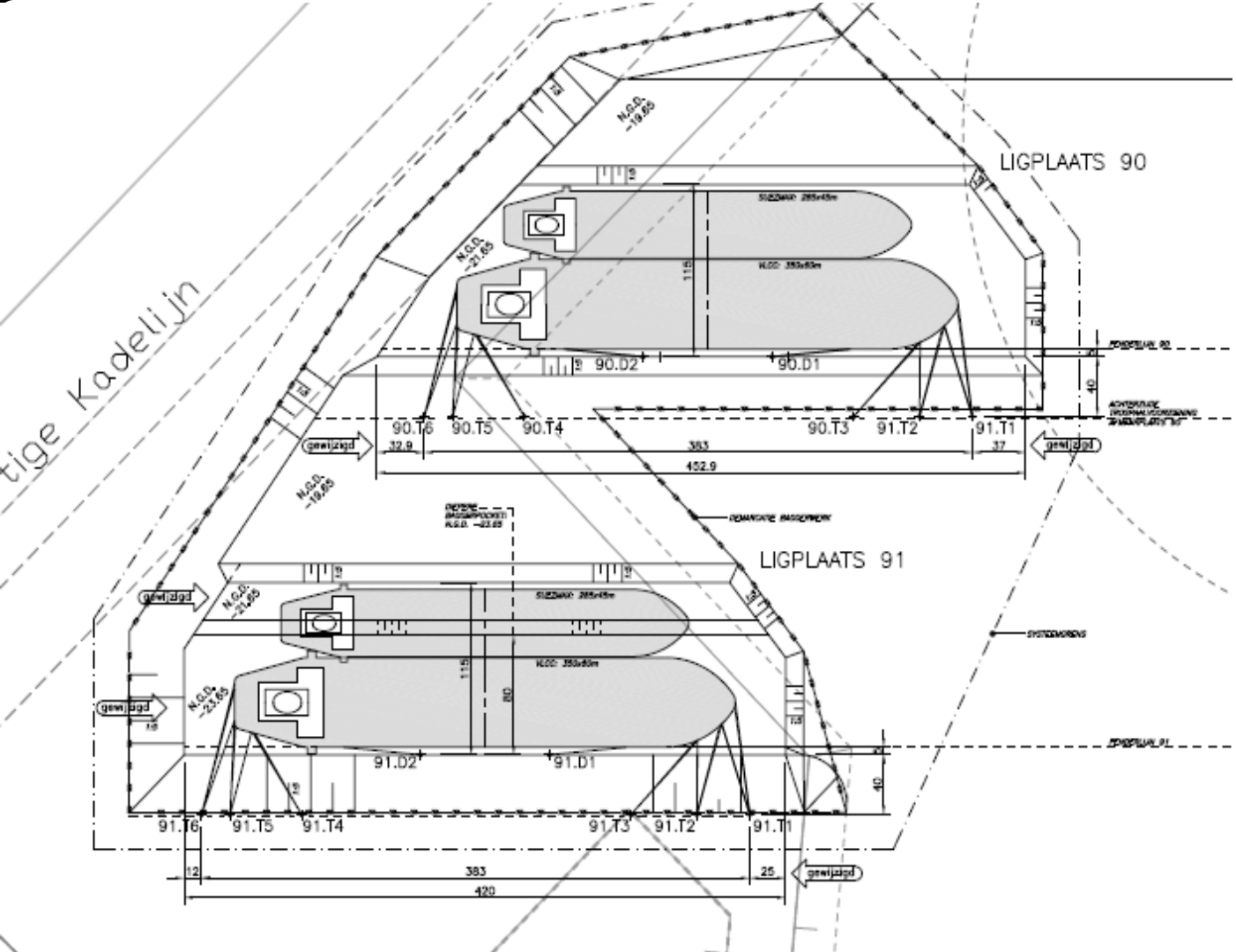
- Design for flexible usage according to OCIMF MEG3

Calandkanaal (2)

Dolphins 80

- Layby berth
- *STS transfer*

- Design for flexible usage according to OCIMF MEG3



Dolphins 90 and 91

at Maasvlakte 2

(under construction)

Layout - OCIMF

2 breasting dolphins

2 * 3 mooring dolphins


90.D2
90.D1

Concluding remarks

- In these examples the harbourmaster has been involved from conceptual design up until delivery of infrastructure advising according to international standards (OCIMF, NI, Handbook Quay walls)

- In various stages of the project the harbourmaster also mobilises pilots, tug masters and boatmen providing (operational) nautical knowledge

- In this way – in our view - optimal infrastructure will be constructed ready to daily service our customers