

WORKSHOP ON RIVER-SEA TRANSPORT CCNR, DUISBURG, 11 SEPTEMBER 2019

THE SPECIAL CASE OF INLAND NAVIGATION VESSELS NAVIGATING AT SEA OPPORTUNITIES AND OBSTACLES

Marc VANTORRE
Emeritus Professor Ghent University
Knowledge Centre Manoeuvring in Shallow and Confined Water

OUTLINE

1. Coastal sea ports with limited hinterland connections
2. Inland navigation ↔ maritime navigation
3. River-sea connections for Belgian/Flemish sea ports
4. Concluding remarks - Discussion points

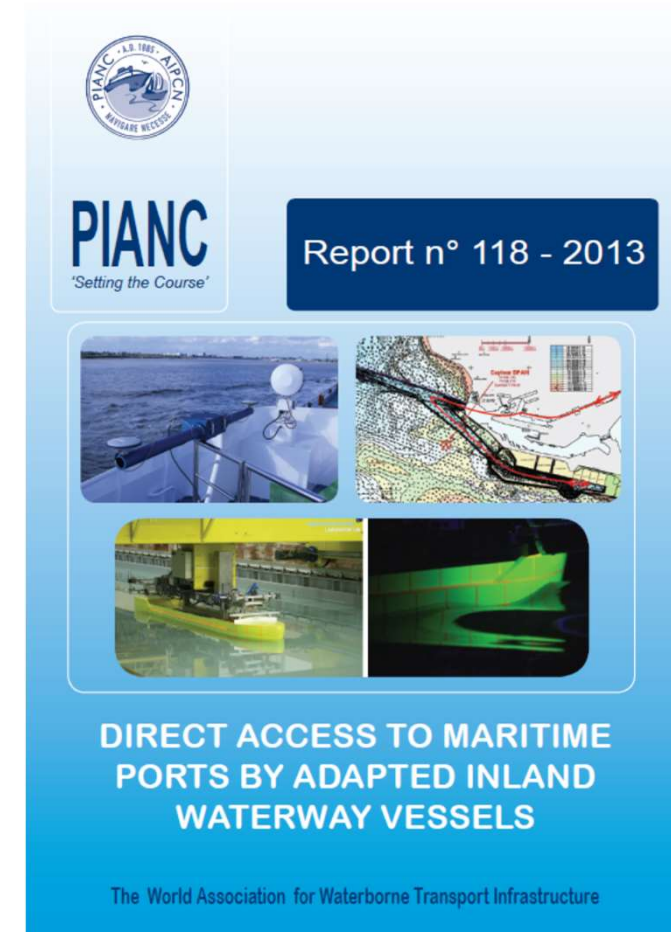
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COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

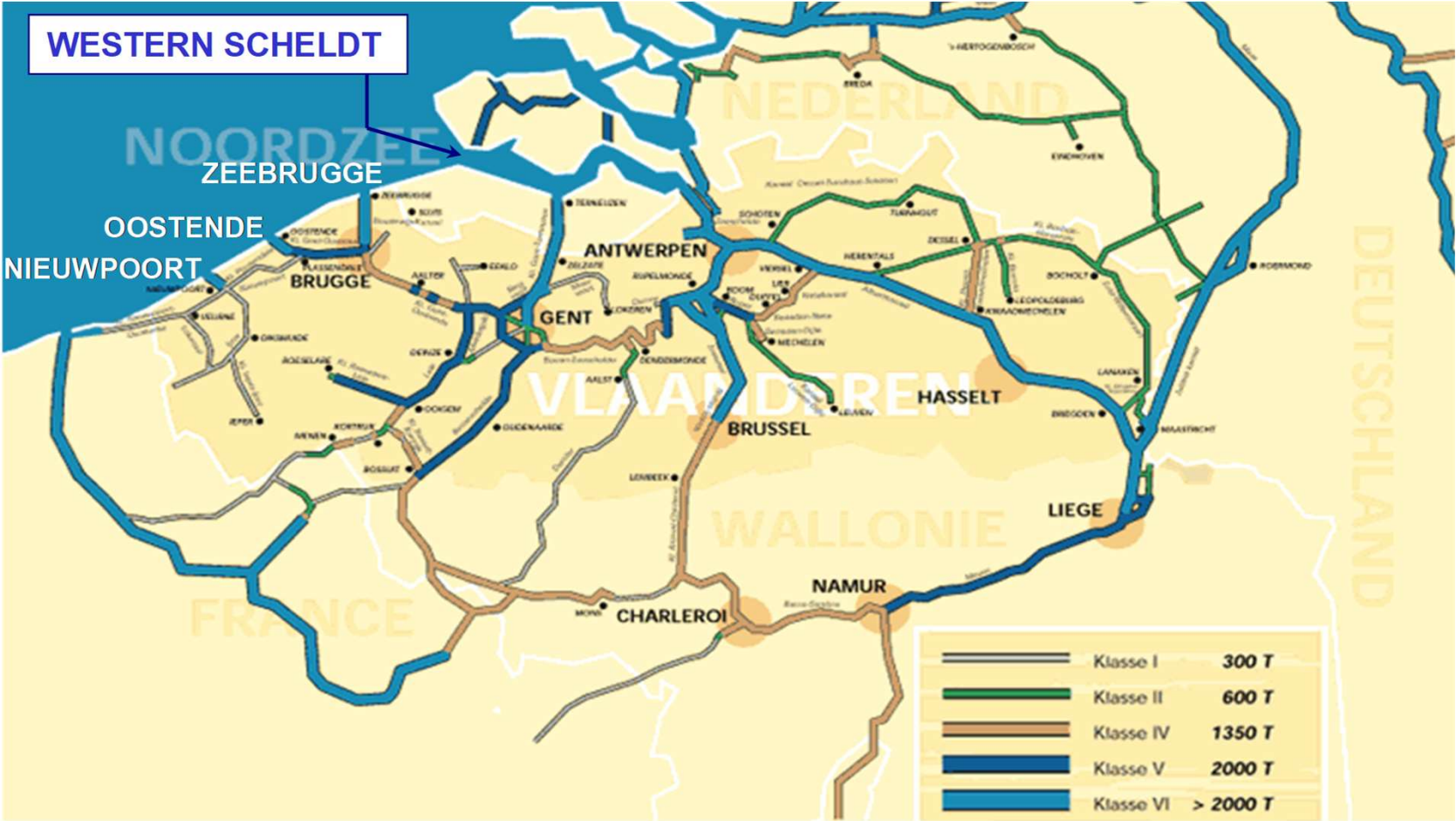
Ref: PIANC INCOM/MARCOM Expert Group “Direct Access to Maritime Ports by Adapted Inland Waterway Vessels” (2013)

- Maritime ports with no or insufficient connection with inland waterway system
- Solution: cover limited trajectory at sea by inland vessels
- Cases (in Europe):
 - Zeebrugge, Belgium
 - Le Havre, France
 - Marseille – Fos, France
 - Venice / Ravenna, Italy



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 1:
Zeebrugge (Belgium)



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

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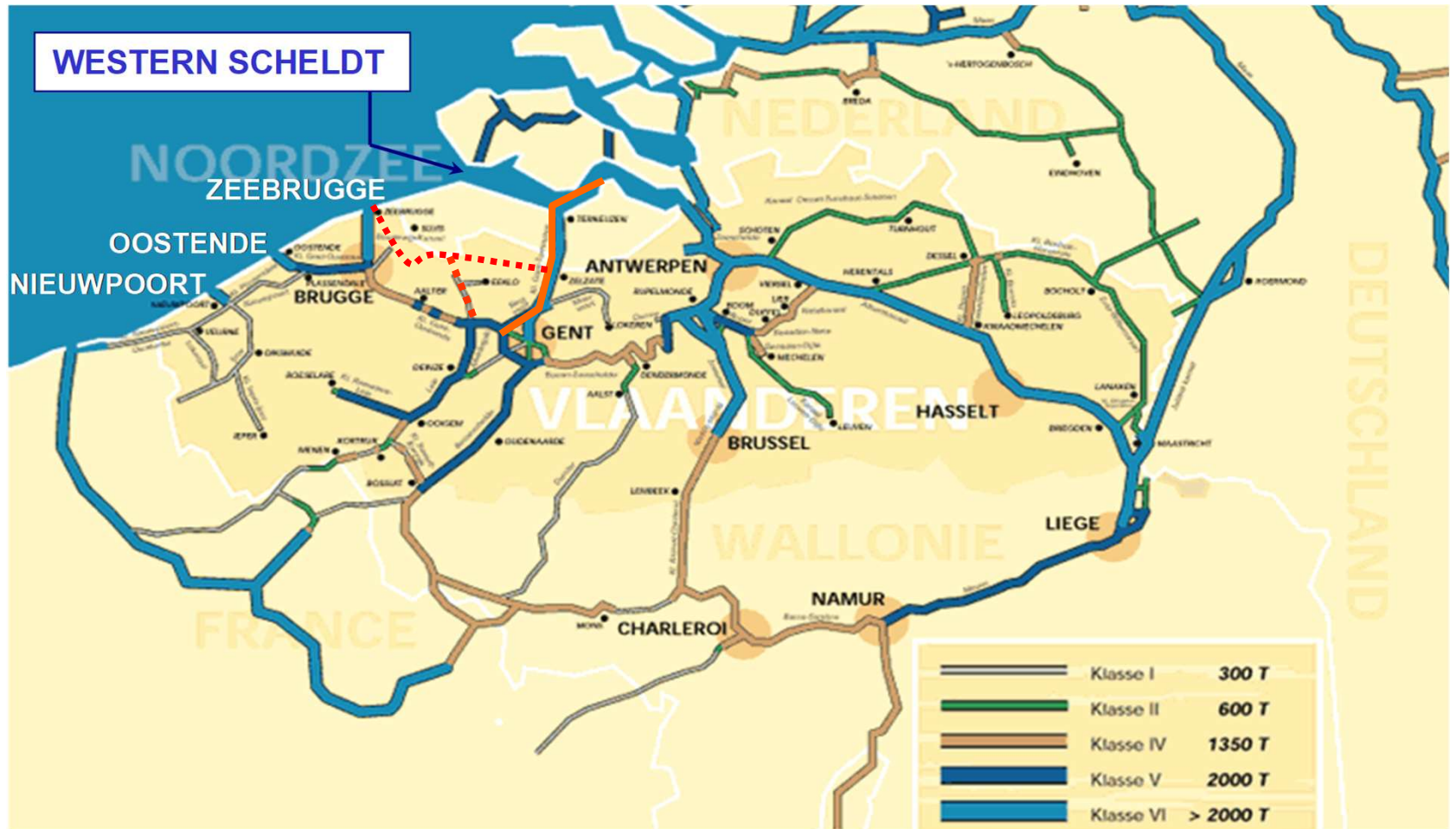
Connections to
inland waterways:
long voyage,
Class IV only



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 1:
Zeebrugge (Belgium)

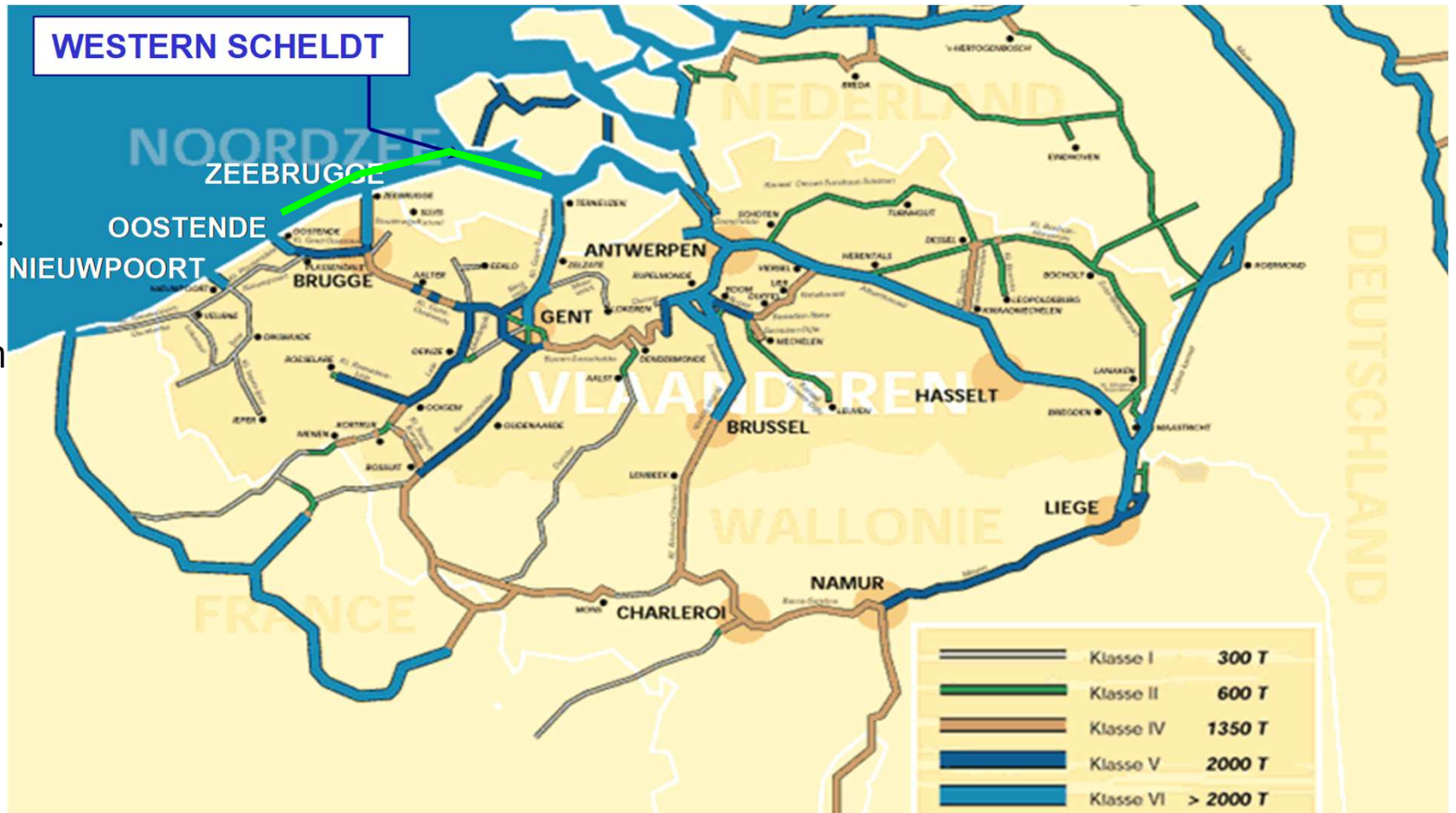
Projects for new
inland waterway
connection:
never realised



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 1:
Zeebrugge (Belgium)

Alternative connection:
Sea trajectory to
Western Scheldt mouth
(15 nm)



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 2:

Le Havre (France)

2005: container terminal *Port 2000*
(4.2 km quay wall)



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 2:

Le Havre (France)

2005: container terminal *Port 2000*

Lock & canal for inland navigation:
not realised!



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 2:

Le Havre (France)

2005: container terminal *Port 2000*

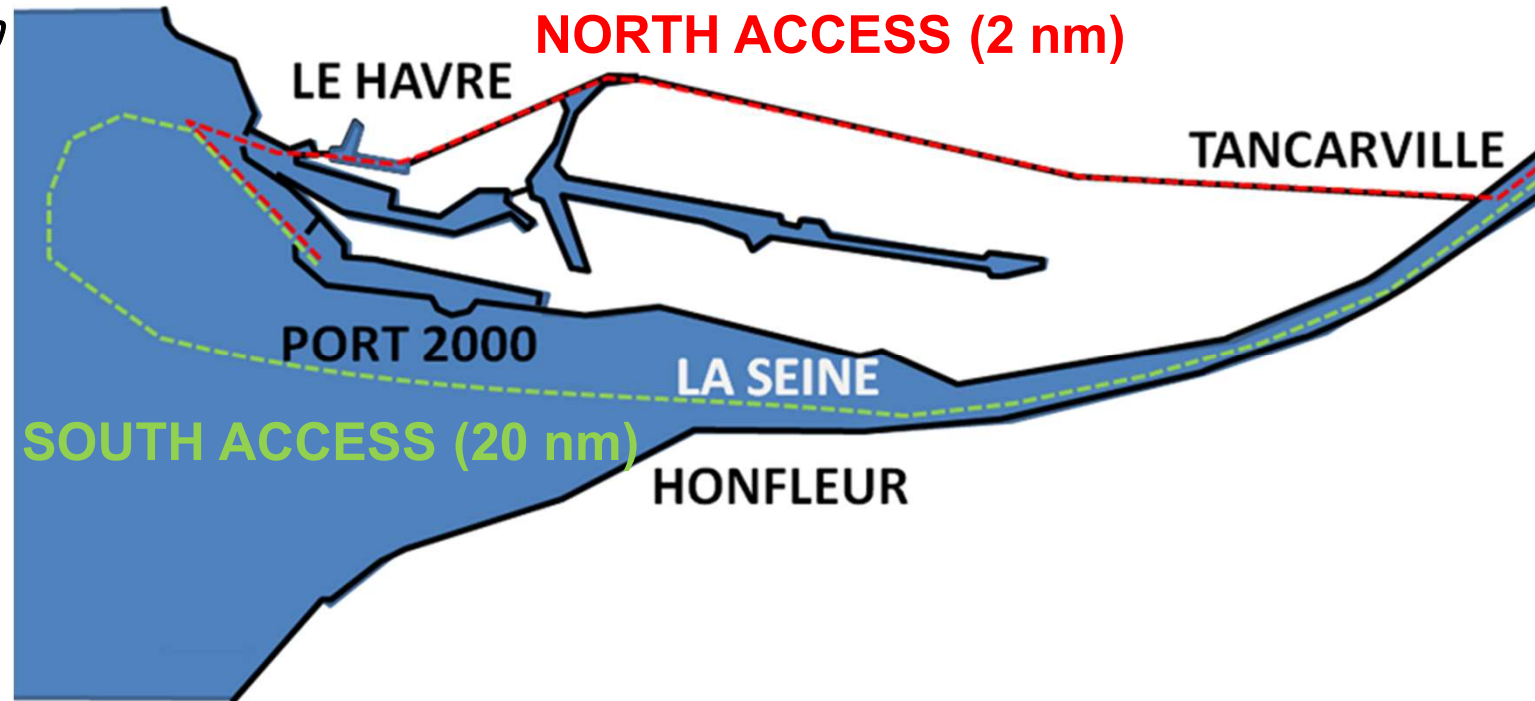
Alternative connections:

sea trajectories

to historic port of Le Havre (N)

or

to mouth of river Seine (S)



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 2:

Le Havre (France)

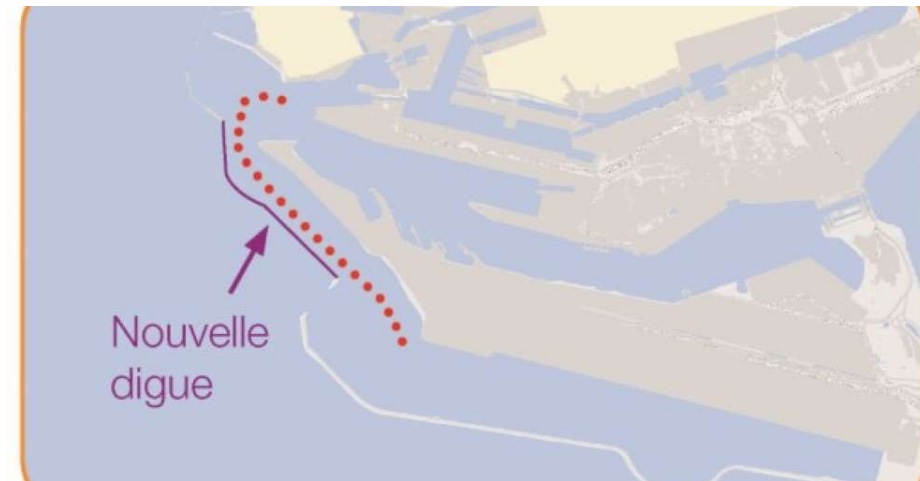
2005: container terminal

Port 2000

Future developments (2023):

direct river access

(accès fluvial direct – “chatière”)



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 3:
Marseille-Fos (France)

Connection to river Rhône by
Golfe de Fos



COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 3:

Marseille-Fos (France)

Connection to river Rhône by
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COASTAL SEA PORTS WITH LIMITED HINTERLAND CONNECTIONS

Case 4:

Mantova-Valdaro (Italy)

Inland port connected to ports of Venice, Ravenna, other Adriatic sea ports by Porto Levante



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2. **Inland navigation** ↔ **maritime navigation**
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INLAND NAVIGATION ↔ MARITIME NAVIGATION

Maritime shipping



Inland shipping

International conventions
(IMO)



National legislation / Regional conventions
(e.g. CCNR, ESTRIN)

Less standardized ship dimensions
(exceptions due to important waterways)



More standardized ship dimensions
(cf. lock dimensions)

Designed for steady course-keeping at full sea



Designed for confined/shallow water

Navigation areas exposed to wind/waves



Navigation areas not/less exposed to wind/waves

Flag state – national register (crew / environment)

Classification society (ship)

INLAND NAVIGATION ↔ MARITIME NAVIGATION

Ship design: strength

Ships (inland & maritime) have to withstand external bending moments

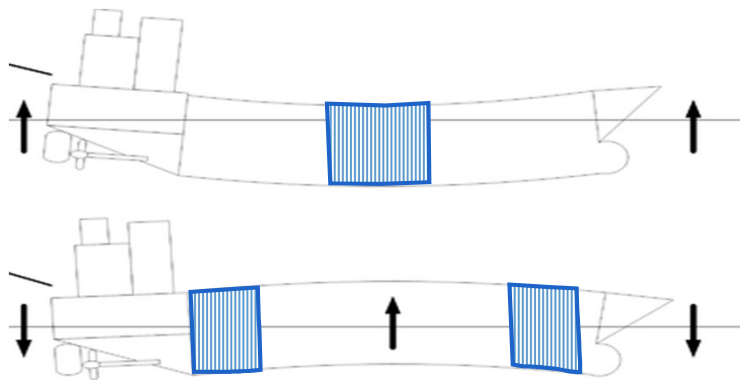


INLAND NAVIGATION ↔ MARITIME NAVIGATION

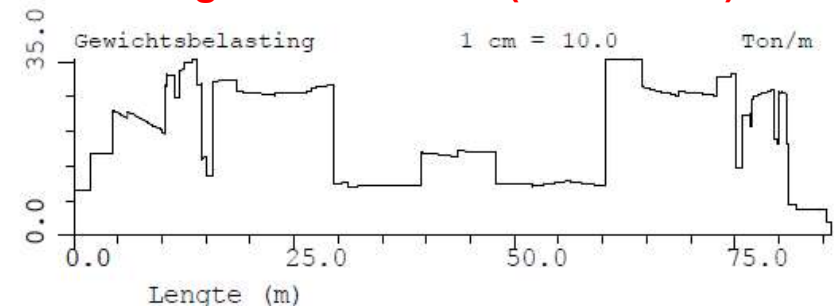
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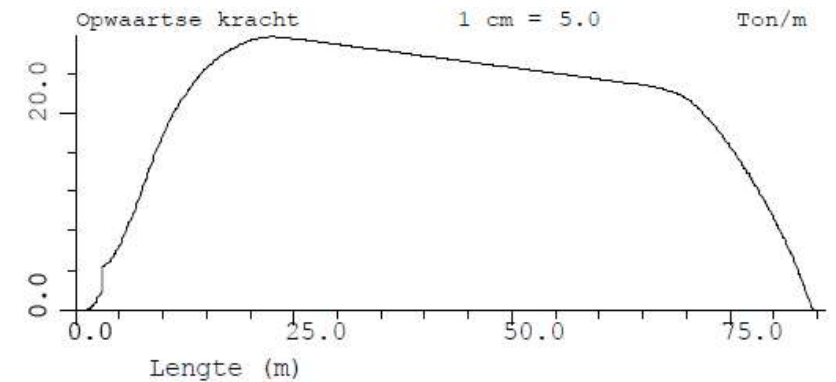
- Still-water bending moments
 - Loading/unloading
 - During navigation



weight distribution (downward)



buoyancy distribution (upward)

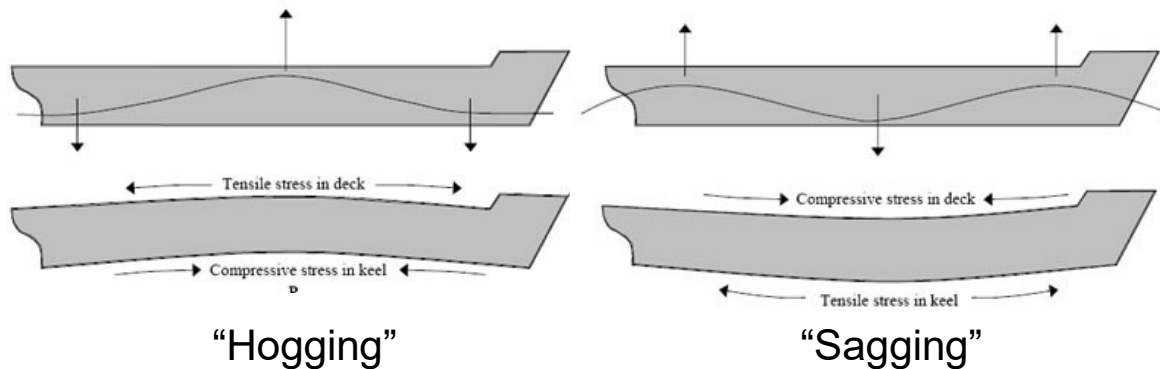


INLAND NAVIGATION ↔ MARITIME NAVIGATION

Ship design: strength

Ships (inland & maritime) have to withstand external bending moments:

- Still-water bending moments
- Wave bending moments



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INLAND NAVIGATION ↔ MARITIME NAVIGATION

Ship design: strength

Ships (inland & maritime) have to withstand external bending moments:

- Still-water bending moments
- Wave bending moments

➔ CLASS RULES & REGULATIONS

INLAND NAVIGATION ↔ MARITIME NAVIGATION

Ship design: strength

Bureau Veritas: “range of navigation”

11.2 Range of navigation IN(0)

11.2.1 The range of navigation IN(0) is assigned to a vessel having a structure with scantlings deemed suitable to navigate on still and smooth stretches of water.

→ downgrade

11.3 Range of navigation IN(0,6)

11.3.1 The range of navigation IN(0,6) is assigned to a vessel having a structure with scantlings deemed suitable to navigate on stretches of water where there may be strong currents and a certain roughness of the surface on which a maximum wave height of 0,6 m can develop.

→ standard

11.4 Range of navigation IN(0,6 < x ≤ 2)

11.4.1 The range of navigation IN(0,6 < x ≤ 2) is assigned to a vessel having structure scantlings and other design features deemed suitable to navigate on stretches of water on which a maximum significant wave height x, ranging between 0,6 m and 2,0 m, can develop, e.g., estuaries, lakes and restricted maritime stretches of water.

→ upgrade

Lloyd's Register of Shipping: “navigation zones”

2.1.1 **Zone 1.** A zone where the maximum significant wave height based on long-term significant wave height statistics, excluding the highest five per cent of the observed waves, does not exceed 1,6 m.

→ upgrade

2.1.2 **Zone 2.** A zone where the maximum significant wave height based on long-term significant wave height statistics, excluding the highest five per cent of the observed waves, does not exceed 1,0 m.

→ upgrade

2.1.3 **Zone 3.** A zone where the maximum significant wave height based on long-term significant wave height statistics, excluding the highest five per cent of the observed waves, does not exceed 0,5 m.

→ standard

INLAND NAVIGATION ↔ MARITIME NAVIGATION

Ship operation: loading condition



Inland waters: hardly any freeboard



MarineTraffic.com



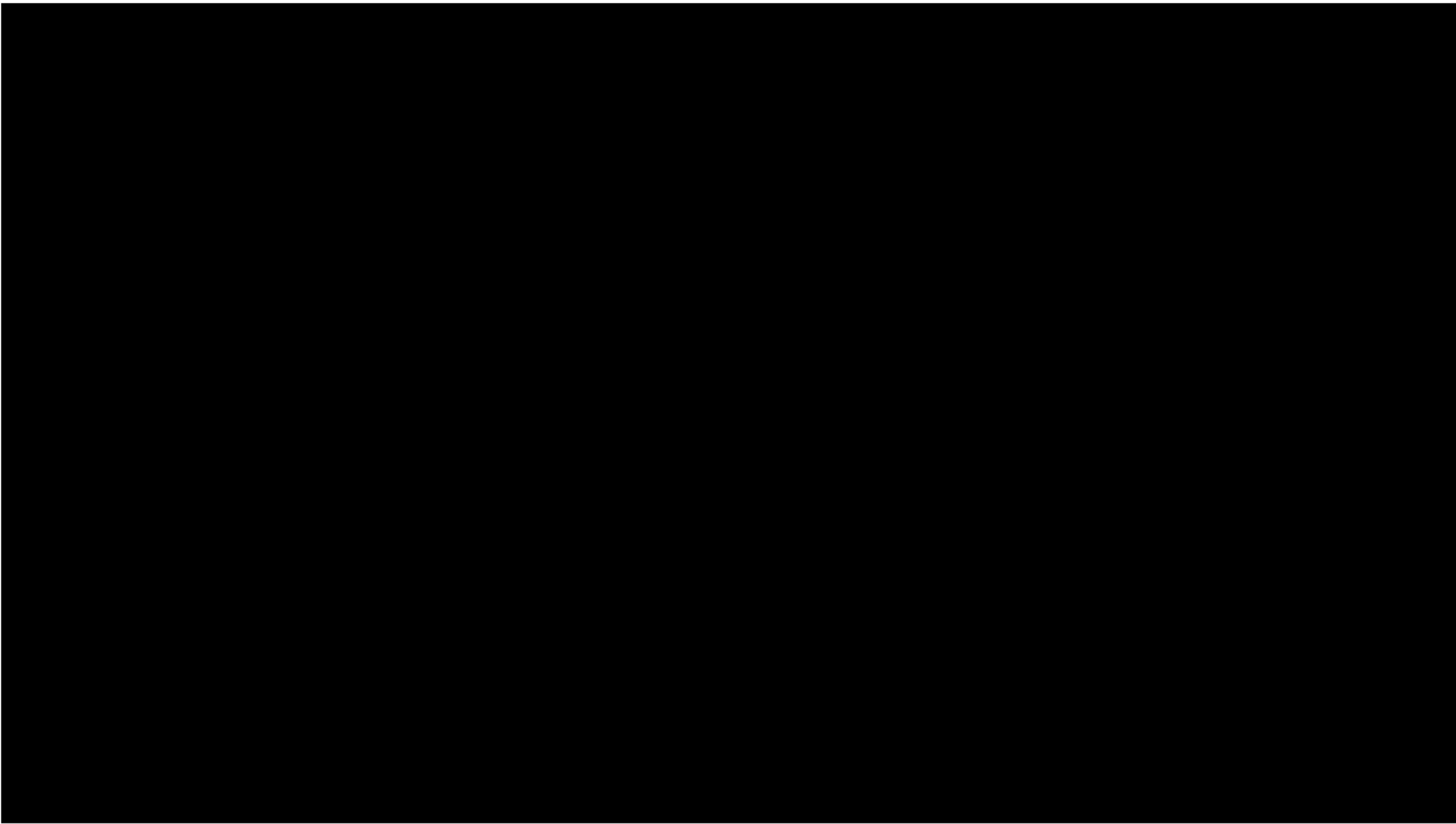
Flanders Hydraulics Research



Flanders State of the Art

©schiepsspotter

vesseltracker.com
maxima photo gallery



INLAND NAVIGATION ↔ MARITIME NAVIGATION

Specific design aspects: level of aft deck



INLAND NAVIGATION ↔ MARITIME NAVIGATION

Specific design aspects: bow shape



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SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

1962: Service Rule on estuary traffic (BSI)

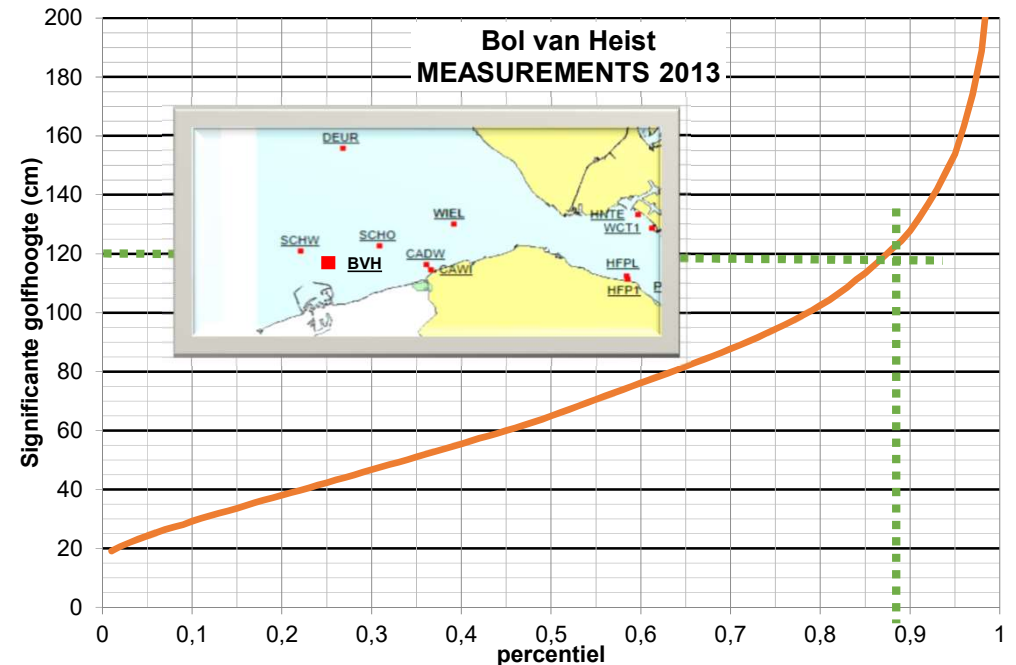
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- Class: range of navigation – suitable scantlings
- Additional requirements:
 - Freeboard
 - Strength
 - ...
- Operational limitations
 - Significant wave height $H_s < 1.2$ m
 - In practice: wind ≤ 5 Beaufort
- Mostly (bunkering) tankers



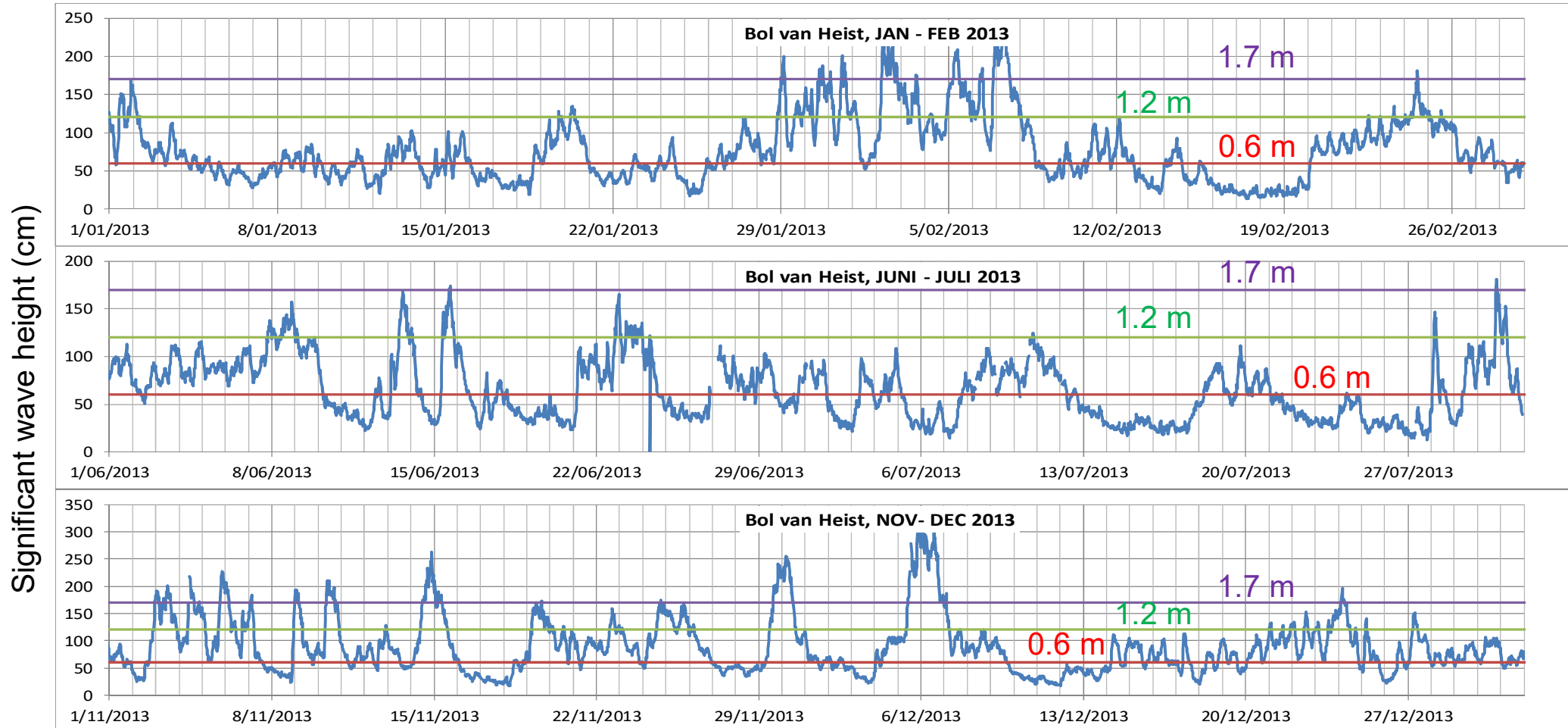
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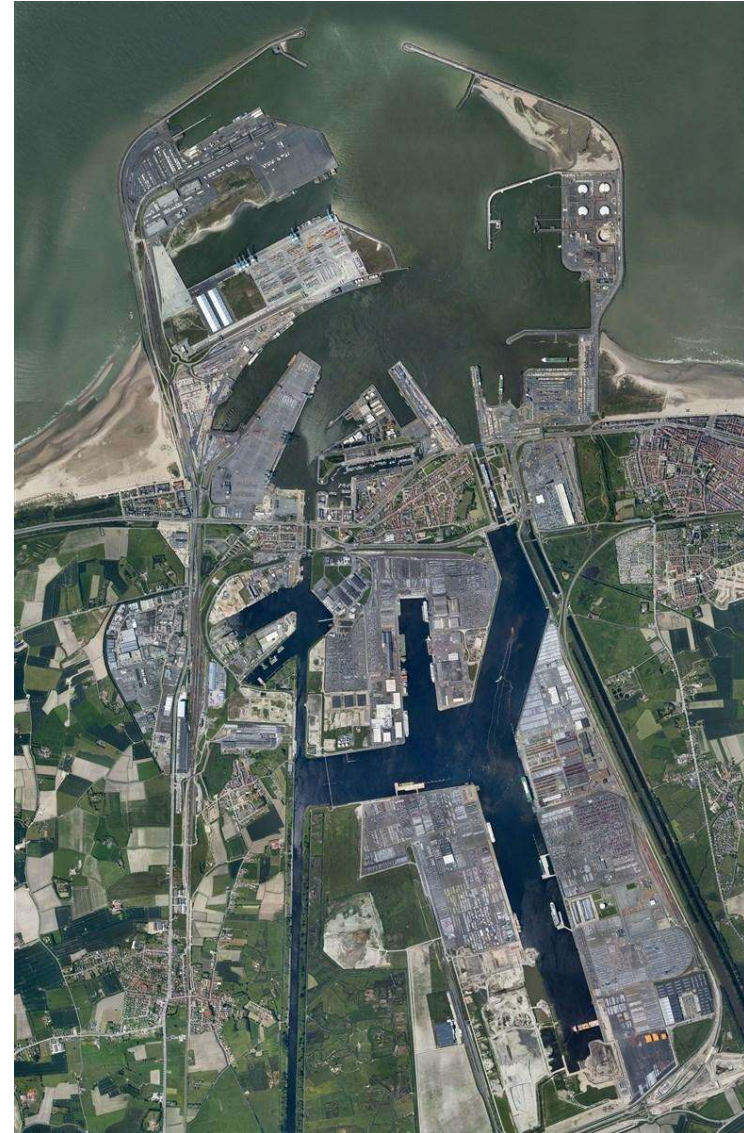
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1980s: harbour expansion Zeebrugge

➔ more bunker activities

2000s: increasing container traffic

➔ more adequate hinterland connections needed



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2004 – 2007: individual studies – $H_s \leq 1.60 - 1.75$ m
(tankers, roro, container carriers)



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1962: Service Rule on estuary traffic (BSI)

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2004 – 2007: individual studies – $H_s \leq 1.60 - 1.75$ m
(tankers, ro-ro, container carriers)

2007:

- legal framework (Belgian federal government)
- financial support (Flemish government)

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2007: legal framework: Royal Decree

MONITEUR BELGE — 16.03.2007 — Ed. 2 — BELGISCH STAATSBLAD

14699

SERVICE PUBLIC FEDERAL MOBILITE ET TRANSPORTS

F. 2007 — 1187 [C – 2007/14083]

8 MARS 2007. — Arrêté royal relatif aux bateaux de navigation intérieure qui sont aussi utilisés pour effectuer des voyages non internationaux par mer

ALBERT II, Roi des Belges,

A tous, présents et à venir, Salut.

Vu la loi du 5 juin 1972 sur la sécurité des bâtiments de navigation, notamment l'article 17^{ter}, § 1^{er}, inséré par la loi du 22 janvier 2007;

Vu la loi du 24 novembre 1975 portant approbation et exécution de la Convention sur le règlement international de 1972 pour prévenir les abordages en mer;
Vu la loi du 20 c

requirements for obtaining an “annotated supplementary Community certificate”

allowing INLAND vessels to navigate between the Western Scheldt and the ports on the Belgian coast

Vu la loi du 21 décembre 1990 relative à l'enregistrement des navires, notamment l'article 1^{er}, § 2;

Vu la loi du 6 avril 1995 relative à la prévention de la pollution par les

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ALBERT II, Koning der Belgen,

Aan allen die nu zijn en hierna wezen zullen, Onze Groet.

Gelet op de wet van 5 juni 1972 op de veiligheid van de vaartuigen, inzonderheid op artikel 17^{ter}, § 1, ingevoegd bij de wet van 22 januari 2007;

Gelet op de wet van 24 november 1975 houdende goedkeuring en uitvoering van het Verdrag inzake de internationale bepalingen ter voorkoming van botsingen op zee;
Gelet op de wet van 20 c

ent en
erheid

Gelet op de wet van 21 december 1990 betreffende de registratie van zeeschepen, inzonderheid op artikel 1, § 2;

Gelet op de wet van 6 april 1995 betreffende de voorkoming van

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 requirements

- Full ADNR certification
- Crew: specific STCW certification
- “Restricted seaworthiness” (upgraded inland vessel)
 - Equipment, MARPOL, COLREG
 - STABILITY: almost identical criteria to IMO Code
 - Fire safety: e.g.
 - e.g. class A-60 bulkheads & decks between wheelhouse, accommodation spaces & machine rooms

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Full ADNR certification
- Crew: specific STCW certification
- “Restricted seaworthiness” (upgraded inland vessel)
 - Equipment, MARPOL, COLREG
 - STABILITY
 - Fire safety
 - Container stowage, structural strength, draft scales, manoeuvrability, navigation aids, communication equipment, propulsion, bilge pumps, electrical installations, fire fighting, anchor, personal life savings, bulwarks, railings

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Full ADNR certification
- Crew: specific STCW certification
- “Restricted seaworthiness”
- Operating restrictions regarding swell, freeboard, speed and loading condition
 - ➔ probabilistic (seakeeping) study (*“risk analysis”*)
 - ➔ not required for vessels with watertight steel hatches or with a watertight deck (tankers)
restricted to $H_s \leq 1.2$ m (minimum freeboard / height of hatches instead)

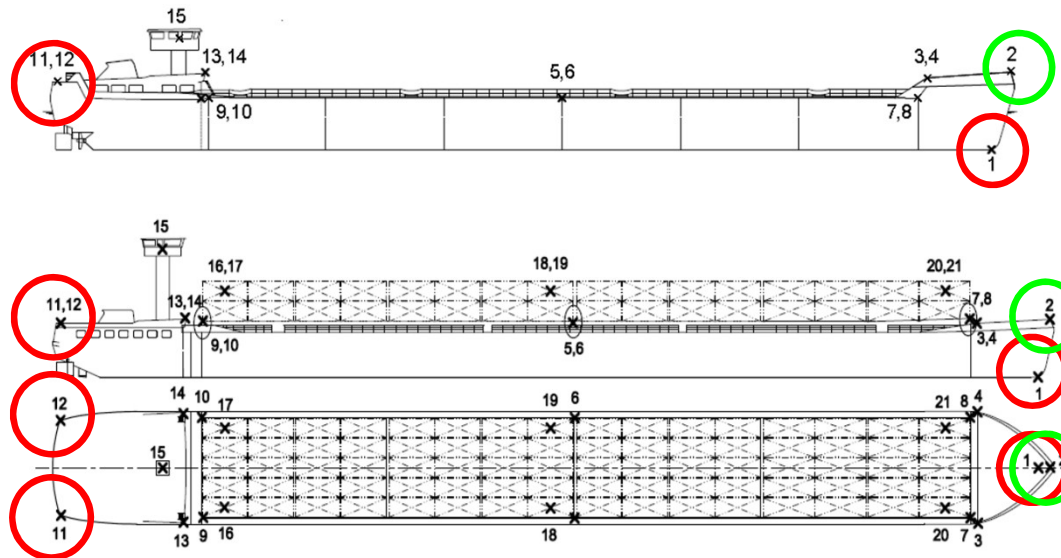
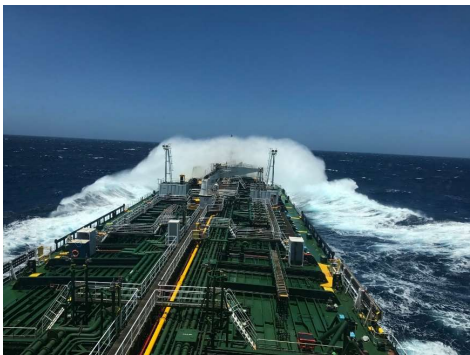
SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Operating restrictions: "risk analysis"

green water
(foredeck & aftdeck):
 ≤ 1 / lifetime

slamming (bow
emergence):
 ≤ 1 / year

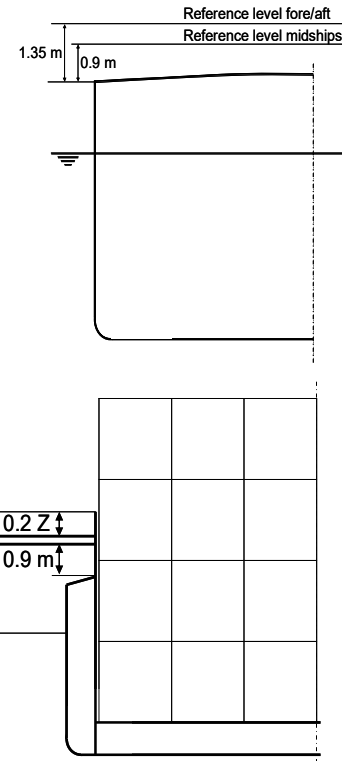
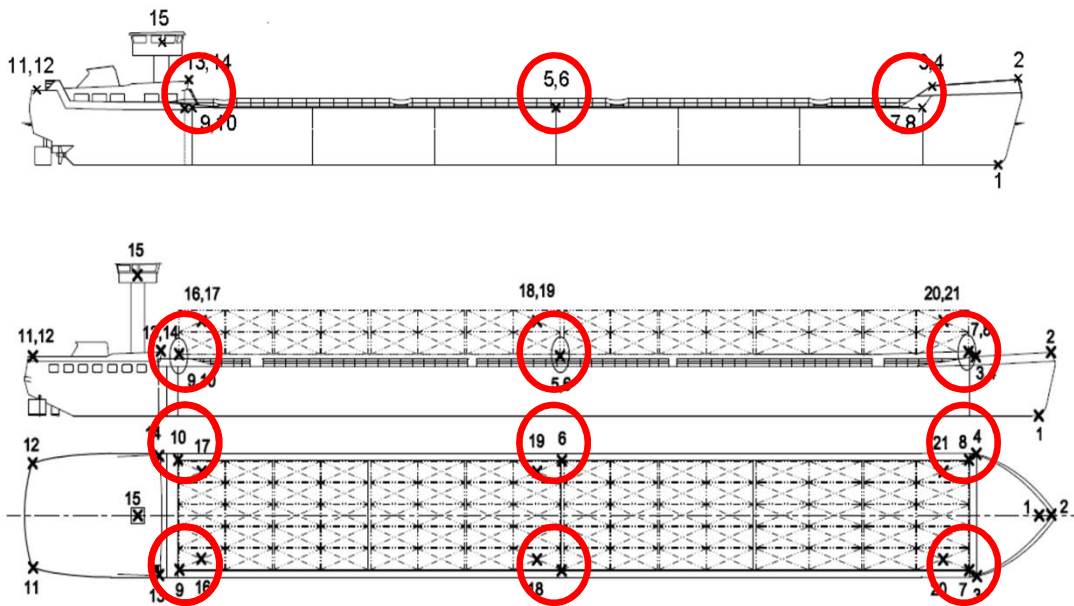


SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Operating restrictions: "risk analysis"

Cargo holds/tanks:
Exceedance of reference level ≤ 1 / lifetime



SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

— Operating restrictions : “risk analysis”

- ⌚ Roll angle
 - ⌚ 2/3 of flooding angle
 - ⌚ or maximum in stability curve
 - ⌚ or 15 deg :
 - ⌚ Wave bending moment
 - ⌚ Wave torsional moment
 - ⌚ Lateral acceleration
- } limited to 1/lifetime
- } 1/lifetime values to be determined

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Full ADNR certification
- Crew: specific STCW certification
- “Restricted seaworthiness”
- Operating restrictions regarding swell, freeboard, speed and loading condition
- **Assessment procedures for captain:**
 - “go / no go”
 - based on actual measurements and forecast of weather conditions and wave height

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

RD 2007 Requirements:

- Full ADNR certification
- Crew: specific STCW certification
- “Restricted seaworthiness”
- Operating restrictions regarding swell, freeboard, speed and loading condition
- Assessment procedures for captain
- Important role for classification society:

The inland waterway vessel must be registered with an approved organisation. It must be classified, for the hull and the machine installations, in the highest class of its category. The classification must also state that the construction and strength of the inland waterway vessel comply with the regulations [...].

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

1962: Service Rule on estuary traffic (BSI)

1980s: harbour expansion Zeebrugge

→ increased bunker activities

2000s: increased importance of container traffic

→ need for more adequate hinterland connections

2004 – 2007: individual studies – $H_s \leq 1.60 - 1.75$ m
(tankers, roro, container carriers)

2007: legal framework (Belgian federal government)



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(tankers, roro, container carriers)

2007: legal framework (Belgian federal government)

2019: amendments (Flemish government – provisional)

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2019 Amendments:

- Certificate possible for lower range of wave heights:

An annotated supplementary Community certificate shall be issued for a significant wave height between 0.6 m and 2.0 m.

- Less strict class registration for lower wave height range:

The inland waterway vessel must be registered with an approved organisation. It must be classified, for the hull and the machine installations, in the highest class of its category. A vessel with operating restriction regarding swell less than or equal to a significant wave height of 1,2 m must be classified for the machine installations, but not in the highest class of its category.

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2019 Amendments:

- Dry dock surveys ⇔ underwater surveys:

... the annotated supplementary Community certificate shall be valid for 5 years. The validity shall also depend on an annual confirmation by the Inspection Committee, subsequent to the following surveys carried out by said Committee:

- *an annual survey within a period of three months before or after the anniversary of the annotated supplementary Community certificate and*
- *a survey in dry dock between the second and third anniversaries of the annotated supplementary Community certificate.*

The survey in dry dock can be replaced by an underwater survey under the condition that the approved organisation [...] has explicitly approved this replacement in writing prior to the survey.

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2019 Amendments:

- Risk analysis – probabilistic criteria:
 - Not required for operating limitation w.r.t. significant wave height (H_s) of 1.2 m and less;
 - New set of deterministic freeboard values for $H_s \leq 1.2$ m, for
 - Vessels with a closed watertight deck (tankers);
 - Vessels with hatches closed by means of watertight steel hatch covers;
 - Vessels with open hatches.

SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2019 Amendments:

- Risk analysis – probabilistic criteria:
 - more realistic number of round trips per year:
 - 300 round trips per year → ≥ 100 round trips per year
 - free distribution of number among different trajectories

[...] the lifetime is assumed to be 20 years, and it is assumed that the inland waterway vessel will make 100 voyages in each direction in the restricted area [...].

In case the inland vessel performs more than 100 voyages in each direction, the actual number of planned voyages has to be considered. In that case the certificate [...] will be issued based on that number of voyages and will only be valid if that number is not exceeded.

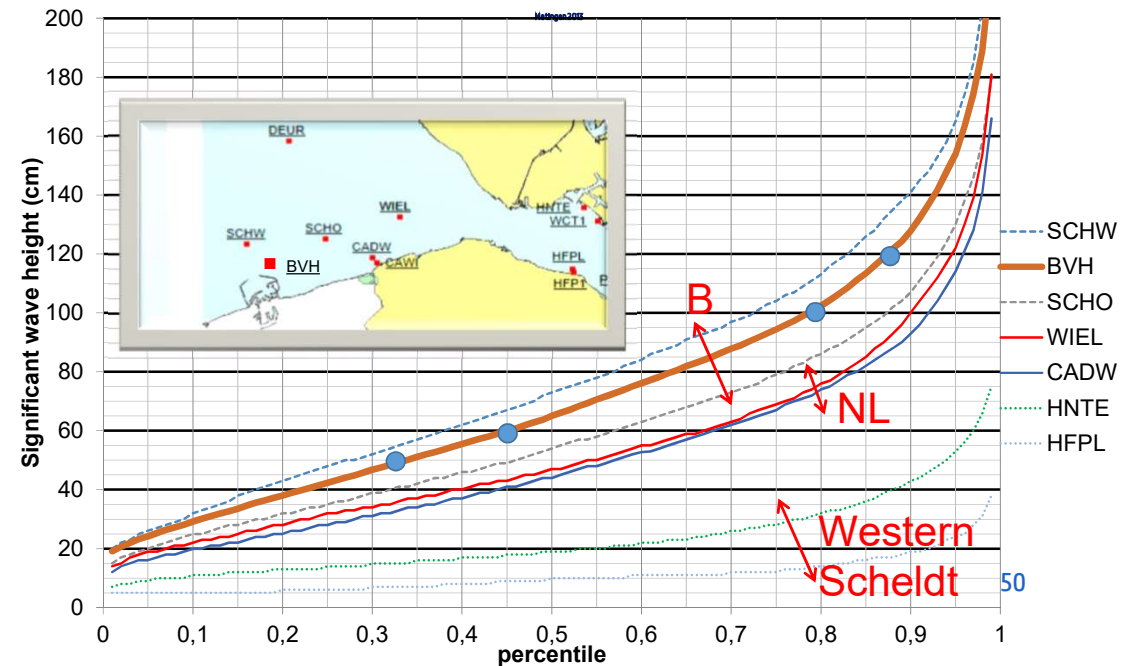
The number of planned voyages can be freely distributed among different trajectories between the mouth of the Western Scheldt and a coastal harbour, or between two coastal harbours.



SEA-RIVER CONNECTIONS FOR THE BELGIAN/FLEMISH COASTAL SEAPORTS

2019 Amendments:

- **Stability requirements:** adapted to realistic wind and wave conditions
- **Navigation equipment:** nautical radar only required for $H_s > 1.2$ m
- **Wave data for risk analysis:**
 - 2007: measured data only
 - 2019: measured data
+ results of validated numerical calculations



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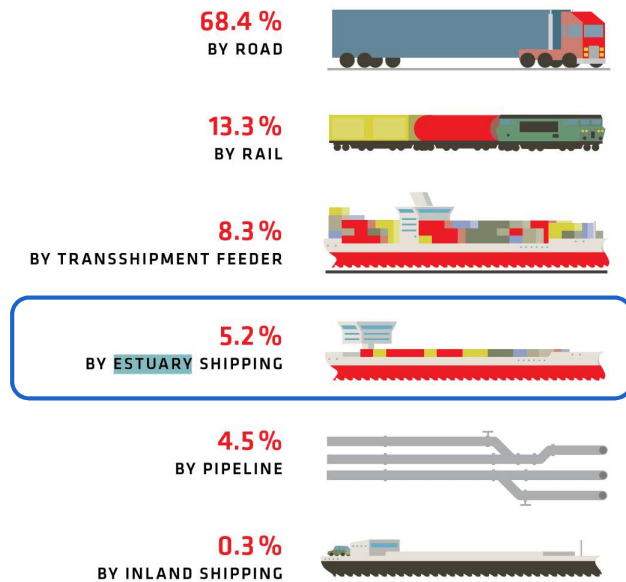
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CONCLUDING REMARKS - DISCUSSION POINTS

Modal split Zeebrugge: is there room for a larger share for estuary traffic?

40.1 MILLION TONS

The majority of cargo leaves or arrives at the port by lorry. However, transport by rail is increasing. Many goods arrive by one ship and leave in another ship. This is called transshipment.



	transshipment feeder	estuary shipping	inland shipping	rail	road	pipeline	total
ro/ro	190	30	0	384	15.315	0	15.919
containers	1.696	849	0	4.478	8.151	0	15.174
break bulk	5	0	38	448	546	0	1.037
liquid bulk	1.440	1.219	0	0	2.264	1.816	6.739
solid bulk	0	0	84	0	1.148	0	1.232
total	3.331	2.098	122	5.310	27.424	1.816	40.101
% total	8,3%	5,2%	0,3%	13,2%	68,4%	4,5%	
% inland	-	5,7%	0,3%	14,4%	74,6%	4,9%	
ro/ro	1,2%	0,2%	0,0%	2,4%	96,2%	0,0%	100,0%
containers	11,2%	5,6%	0,0%	29,5%	53,7%	0,0%	100,0%
break bulk	0,5%	0,0%	3,7%	43,2%	52,7%	0,0%	100,0%
liquid bulk	21,4%	18,1%	0,0%	0,0%	33,6%	26,9%	100,0%
solid bulk	0,0%	0,0%	6,8%	0,0%	93,2%	0,0%	100,0%
total	8,3%	5,2%	0,3%	13,2%	68,4%	4,5%	100,0%

CONCLUDING REMARKS - DISCUSSION POINTS

Non-international ↔ international voyages?

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ALBERT II, Roi des Belges,
A tous, présents et à venir, Salut.

Vu la loi du
notamment l'a

Royal Decree concerning inland waterways vessels

Vu la loi du
Convention sur
abordages en L...
le 20 octobre 1972, notamment l'article 2, § 1^{er};

Vu la loi du 21 décembre 1990 relative à l'enregistrement des navires,
notamment l'article 1^{er}, § 2;

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de vaartuigen,
de wet van

also used for non-international sea voyages

bedkeuring en
bepalingen ter
Reglement en
zijn Bijlagen, opgemaakt te Londen op 20 oktober 1972, inzonderheid
op artikel 2, § 1;

Gelet op de wet van 21 december 1990 betreffende de registratie van
zeeschepen, inzonderheid op artikel 1, § 2;

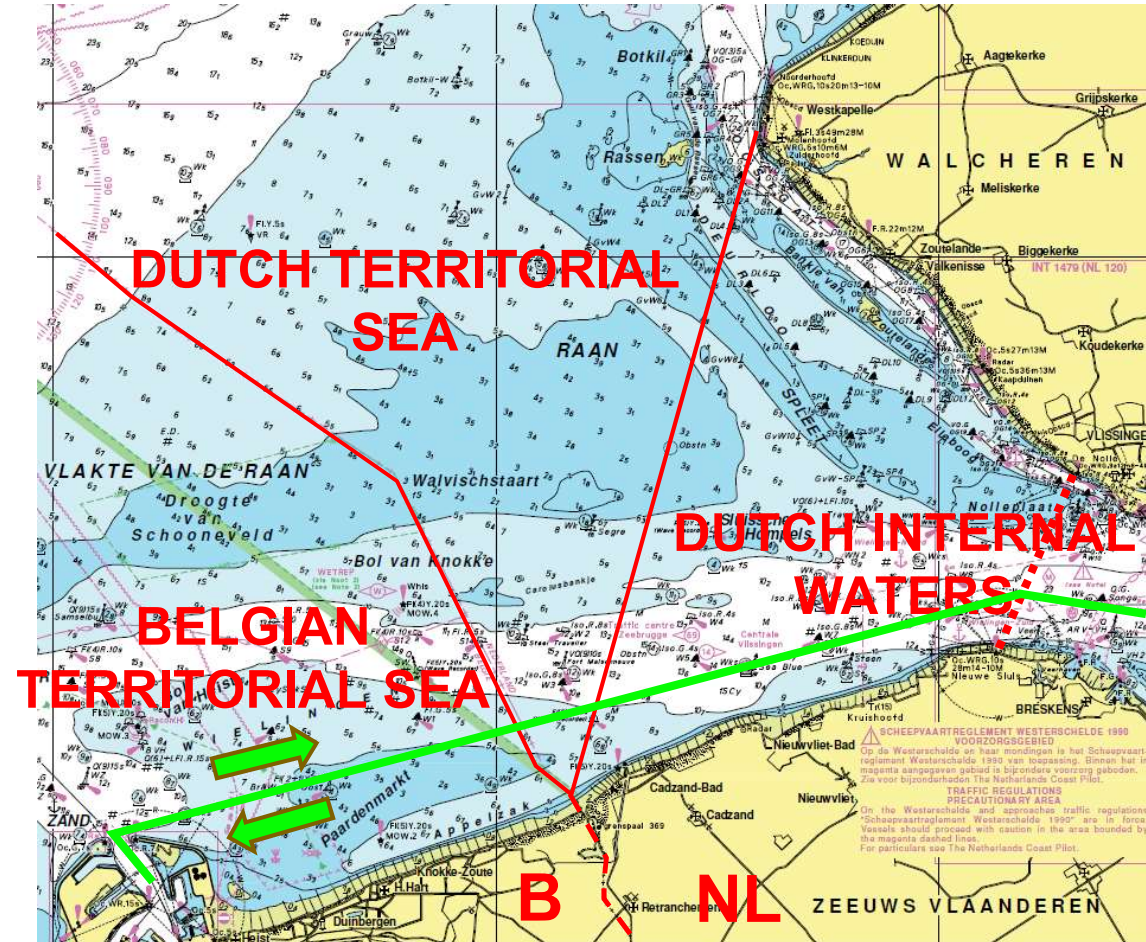
Gelet op de wet van 6 april 1995 betreffende de voorkoming van

CONCLUDING REMARKS - DISCUSSION POINTS

Non-international ⇔ international voyages?

Royal Decree concerning inland waterways vessels

also used for **non-international** sea voyages



CONCLUDING REMARKS - DISCUSSION POINTS

Non-international ↔ international voyages?

Non-international voyage:

- Port of departure = Belgian port
- Port of arrival = Belgian port



CONCLUDING REMARKS - DISCUSSION POINTS

Non-international ↔ international voyages?

Non-international voyage

- Port of departure = Belgian port
- Port of arrival = Belgian port

International voyage



CONCLUDING REMARKS - DISCUSSION POINTS

Non international voyage ⇔ International voyage:

is there any legal way out for exceptions?

- Within EU?
- Bilateral agreement?
- Within member states of CCNR?

CONCLUDING REMARKS - DISCUSSION POINTS

Is there a lack of standardisation?

- (non-)uniformity of legislations / regulations:
 - National legislation: case-specific
 - Similarities: Zeebrugge – Le Havre
 - Classification societies
- Discussion point:
 - More uniformity required?
 - More attention to local situation?

CONCLUDING REMARKS - DISCUSSION POINTS

Is significant wave height the best criterion?

1962 Service Rule: Beaufort number



2007 Royal Decree: significant wave height



????: Full directional wave spectrum + wind speed & direction

WORKSHOP ON RIVER-SEA TRANSPORT CCNR, DUISBURG, 11 SEPTEMBER 2019

THE SPECIAL CASE OF INLAND NAVIGATION VESSELS NAVIGATING AT SEA OPPORTUNITIES AND OBSTACLES

Marc VANTORRE
Emeritus Professor Ghent University
Knowledge Centre Manoeuvring in Shallow and Confined Water