Vooruitgangstraat 56

B - 1210 Brussels

Belgium

Report 2017 - 01

Report on the investigation into the capsizing of the fishing vessel

Z 582 ASSANAT

off the British coast near Margate with the loss of two lives

on 27 December 2016

Federal Bureau for the Investigation of Maritime Accidents

Extract from the European Directive 2009/18/EC

(26) Since the aim of the technical safety investigation is the prevention of marine casualties and incidents, the conclusions and the safety recommendations should under no circumstances determine liability or apportion blame.

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3 Glossary of abbreviations and acronyms

Bhp	Brake horse power
CEPT	Conférence européenne des administrations des postes et télécommunications
DG	Directorate General
E	Easter longitude
fv	fishing vessel
GM	Metacentric height
GMDSS	Global Maritime Distress and Safety System
GOC	General Operator's Certificate
IMO	International Maritime Organisation
kW	kilowatt
m	metres
MHz	Megahertz
N	Northern Latitude
ROC	Restricted Operator's Certificate
VHF	Very High Frequency
W	Western longitude

4 Marine Casualty Information

4.1 Classification of accident

According to Resolution A.849(20) of the IMO Assembly of 27 November 1997, Code for the investigation of Marine Casualties and Incidents, a *very serious marine casualty* means a marine casualty involving the total loss of the ship or a death or severe damage to the environment, consequentially, the incident was classified as

VERY SERIOUS

4.2 Accident details

Time and Date	27 December 2016
Location	off the British coast near Margate
Persons on board	3
Deceased	2

5 Synopsis

On December 27th 2016, around noon time the fv Z582 ASSANAT had left the Port of Ostend, manned with three crewmembers, for an overnight fishing trip off the British coast near Margate, with the intent to return to Ostend on 28 December 2016.

The weather conditions were particularly favourable for the time of year.

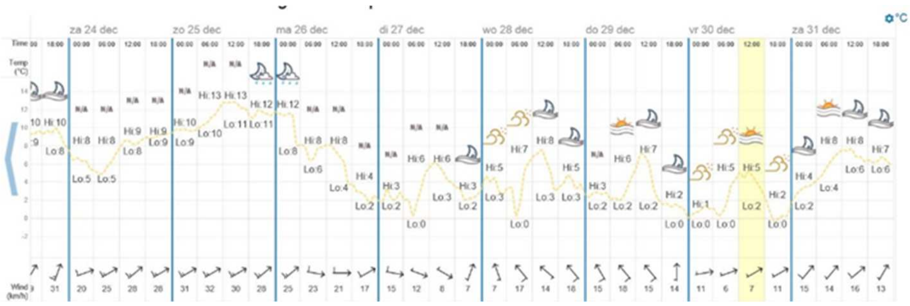


Figure 1 - Weather observations for area of fishing

(www.timeanddate.com)

The owner of the fv Z 582 ASSANAT had granted the crew members days off for the Christmas holiday season, but seen the particular favourable weather forecast, the crew, partially a relief crew, had decided to undertake an additional voyage towards the English coast.

No incidents were recorded during the journey from the Port of Ostend towards the British fishing grounds.

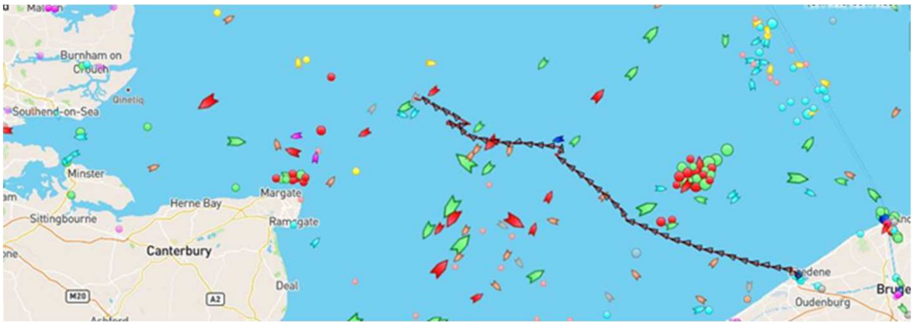


Figure 2 - Track of the fatal voyage of the Z582 ASSANAT

After the third trawl, after having arrived at the fishing grounds, the propulsion of the fv Z582 ASSANAT was reportedly stopped and the three crewmembers were mustered on deck, since a minimum of three persons were needed to safely operate the fishing gear. Reportedly none of the crewmembers was wearing a life jacket. The wheelhouse was left abandoned.

Soon thereafter, the fv Z 582 ASSANAT, when in reported position N51°34'00.57 and E001°48'35.99[1], had reportedly hoisted the fishing nets, both on starboard and portside, prior to taking the nets on board. Once the nets were topped against the booms, a crewmember reportedly secured a spring line onto the starboard net, and hoisted the cod end over the starboard bulwark of the vessel. The other two crewmembers were reportedly busy on the vessel's portside with the portside fishing net when the crewmember, working the deck on starboard side of the vessel, reportedly heard a noise coming from the water which he did not recognise, but which reportedly resembled a screeching sound and was followed by a bang, sounding like an explosion.

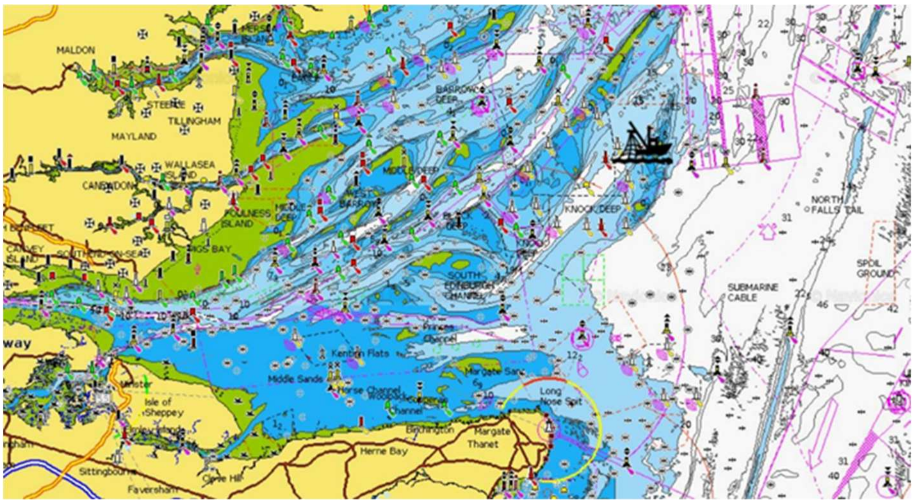


Figure 3 - Approximate reported position of capsizing of fv Z582 ASSANAT

[1]Figure 3 - Approximate reported position of capsizing of fv Z582 ASSANAT, page 9

Seconds later, at 21:50:22 later the vessel reportedly quickly rolled to portside and capsized during which, reportedly, the frame of the starboard net smashed into the wooden superstructure of the wheelhouse, completely destroying the upper part of it. The three crewmembers were thrown into the water. One crewmember noted that the fv Z582 ASSANAT had quickly drifted away from reportedly some hundred metres in a very short time, and a slow running diesel engine noise was heard, not resembling the noise of the engine of the fv Z582 ASSANAT. Being a good swimmer he reportedly swam to the overturned vessel that he was able to locate because reportedly the lights remained on for a while and subsequently he was able to clamber onto the overturned vessel. Another crewmember was rescued from the water but passed away in the aftermath, one crewmember remained unaccounted for at that time but was found deceased days later on the British shore.

The crewmember that had clambered onto the overturned fishing vessel was rescued hours later by a British Coast Guard helicopter.

Figure 4 - Rescue of surviving crewmember by Coast Guard helicopter

Picture by Maritime and Coast Guard Agency

A salvage company sent a rescue vessel on scene and after having arrived a rescue worker placed hot taps onto the overturned hull of the fv Z582 ASSANAT to prevent the derelict from sinking.

Figure 5 - Hot taps placed onto hull of Z582 ASSANAT

The FV Z582 ASSANAT was subsequently towed to a rendezvous point where it was turned right side up by a crane barge CORMORANT.

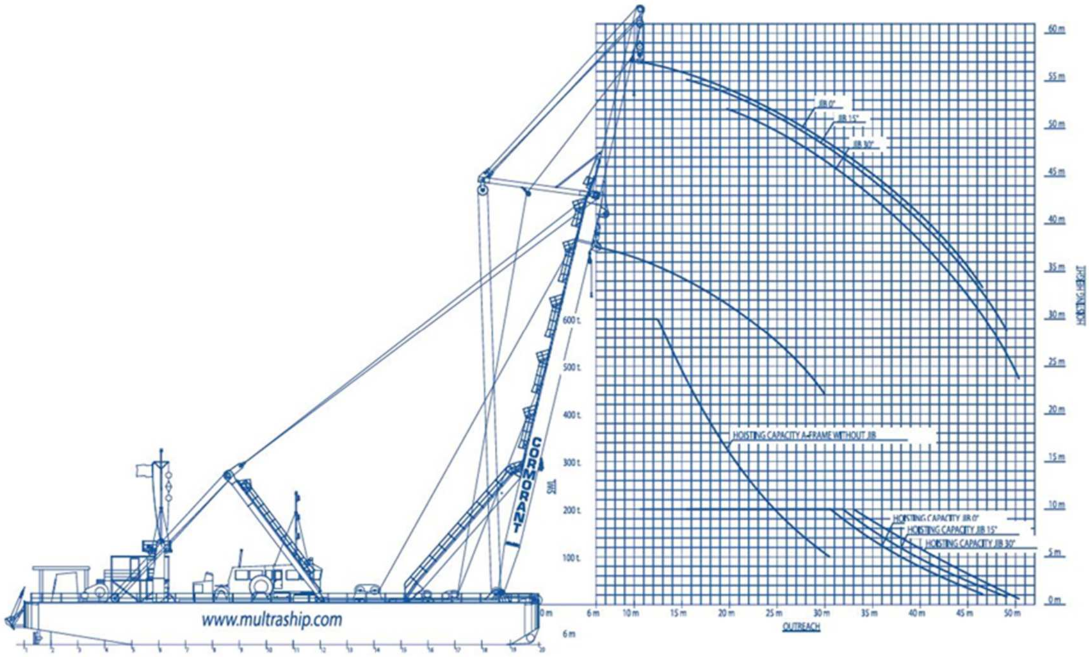


Figure 6 – crane barge CORMORANT and lifting capabilities

During the turning right side up of the fv Z582 ASSANAT, the bulwark of the vessel got damaged by the hoisting cables of the crane barge.

Figure 7 – Z582 ASSANAT Being turned right side up

The fv Z582 ASSANAT was subsequently brought back to the Port of Ostend, whilst hanging alongside by the hoisting cables of the crane barge COMORANT, where it stayed tied up for further investigation.

6 Factual Information

6.1 Historical background

Beam trawling had been developed in the England in the 19th century. Until around 1890 otter boards were first introduced. Otter boards were easier in use than the beam rigged nets and allowed for the catching of other pelagic[2] species such as cod, besides demersal[3] shrimp and flatfish. Beam trawling almost completely disappeared in the North Sea besides in Germany where shrimpers continued applying beam trawling.

It was again seen in the Netherlands were at first shrimpers, operating in sheltered and or shallow waters, such as the Wadden Sea and the Frisian and German mudflats, were rigged for beam trawling.

In 1950, first attempts were made to have beam trawling used in open water. Because of the successes, by 1957, most Dutch shrimpers were rigged for beam trawling. In 1959, the first two Belgian shrimpers with home port Zeebrugge were rigged for beam trawling. Today, the majority of the Belgian commercial fishing fleet is rigged for beam trawling.

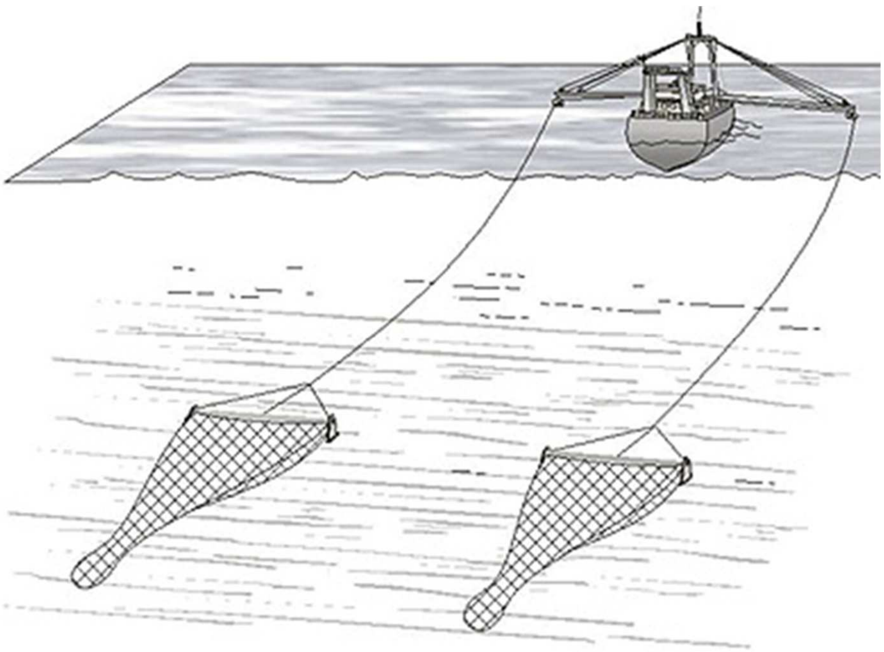


Figure 8 - Artist's impression of a typical beam trawling rig

© Hans Polet

Beam trawlers are prone to capsizing due to the nature of the activities. Although the stability conditions imposed upon fishing trawlers by the competent authorities are in most cases met, slight alterations in symmetrical load between the two fishing nets, starboard and portside, during fishing and especially during recovery can have detrimental effects on the initial stability of beam trawlers.

Since 2008, 8 Belgian beam trawlers were lost due to stability issues after the nets had been entangled on the sea bottom or after the recovery of the nets had not been done in a perfect symmetrical manner.

[2] Pelagic fish live in the pelagic zone of ocean or lake waters, being neither close to the bottom nor near the shore in the water column.

[3] Demersal fish are bottom feeders in contrast with pelagic species

6.2 The Belgian commercial fishing fleet

In December 2016 the Belgian commercial fishing fleet consisted of 70 units with an accumulated tonnage of around 13.700 register tons.

Of the 70 units 62 were beam trawlers. Occasional beam trawlers were also rigged for fly shooting and or twin rig trawling. Some trawler units were stern trawlers.

The remaining units, not equipped for trawling, fished using lines or other equipment.

Most of the Belgian registered fishing vessels operate in the southern and northern parts of the North sea. Some units operate in the Bristol Channel and or the Gulf of Biscay.

Figure 9 - Fishing areas served by Belgian beam trawlers

6.3 Particulars of the fv Z582 ASSANAT

Figure 10 – fv Z582 ASSANAT

archive picture

Name	**Z 582 ASANNAT**
Type	Fish cutter – shrimper
Gear/rig	Beam trawler
Registration number	01 00206 1996
EU-number	BEL0340316-961
Call sign	OPWZ
Flag	Belgian
Homeport	Zeebrugge
Gross tonnage	62
Net tonnage	18
Length over all	21,00 m
Length between perpendiculars	18,43 m
Width	5,43 m
Maximum summer draught	2,03 m

Depth	2,70 m
Length booms	9,00 m
Length beams	4,50 m
Mesh	0,05 m
Length nets under beam	21,00 m
Engine	Since 2000 1x Cummins - 221 kW / 300 Bhp Year built: 1999
Owner	B.V.B.A. Versluys-Vantroye H. Baelskaai 2 B-8400 Oostende Belgium
Name History	1963 Z 403 STERN 1998 Z 582 ASSANAT

The fv Z582 ASSANAT was originally built in 1963 as Z403 STERN, with A frames instead of booms as seen in Figure 11 on page 1919.

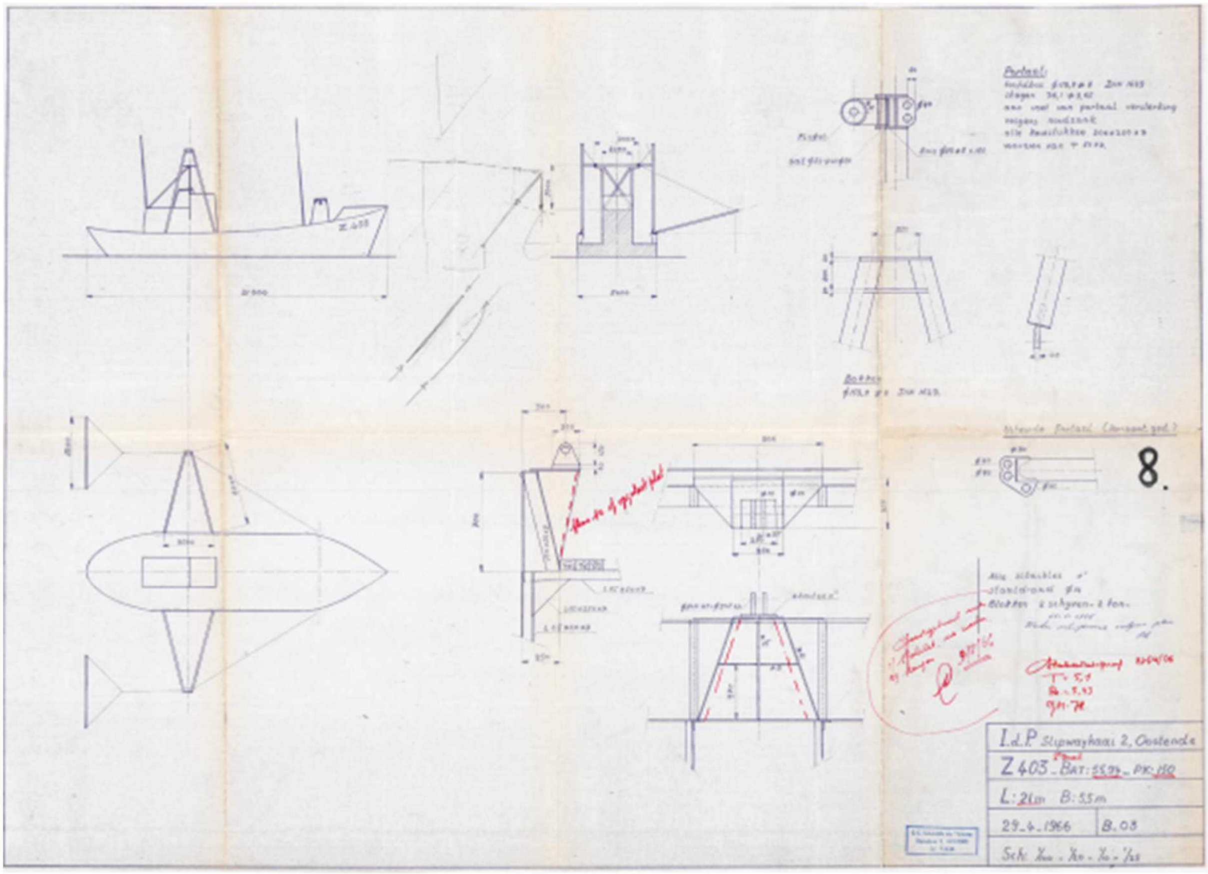


Figure 11- Original building plan with A - Frames

The A frames were hinged to allow for in up and down movement. Later , in 1968, the A frames were replaced with typical booms, with a length of 6,70 m, as seen in Figure 12 on page 20.

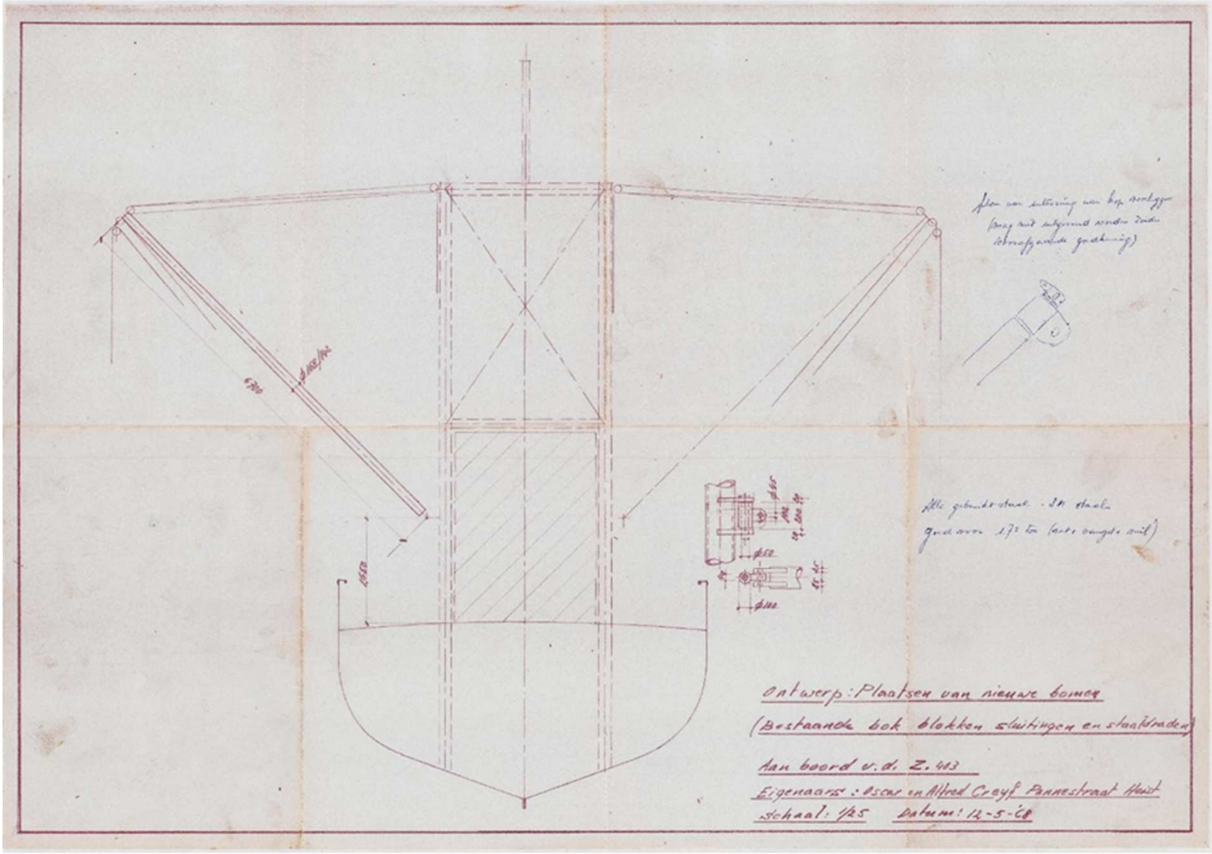


Figure 12 - Plans of booms to replace the existing A - Frames

Later the booms were again replaced with different ones with a length of 9,00 m.

On Figure 11 on page 19 a handwritten note from 1966 was found indicating that the initial GM was 72 after an inclining test. No unit was indicated, however, it was assumed to be in centimetres. The origin of said values could not be determined.

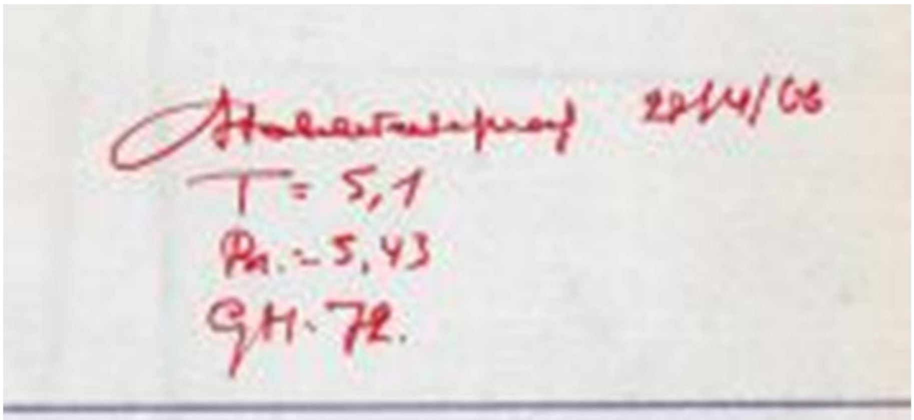


Figure 13 – Close up of note indicating GM

No records of stability calculations with A – Frames and or the initial booms or the longer booms were found after booms had replaced the A-Frames, however, the most current stability calculations were from 2009, and corresponded with the configuration at the time of the capsizing.

6.4 Typical fishing gear used on beam trawlers

The fv Z582 ASSANAT was rigged for chain mat beam trawling whereby a fishing net equipped with a beam and chain mat is trawled over the sea bottom, sliding on the beam heads as in Figure 14 - Chain mat beam trawling fishing net.

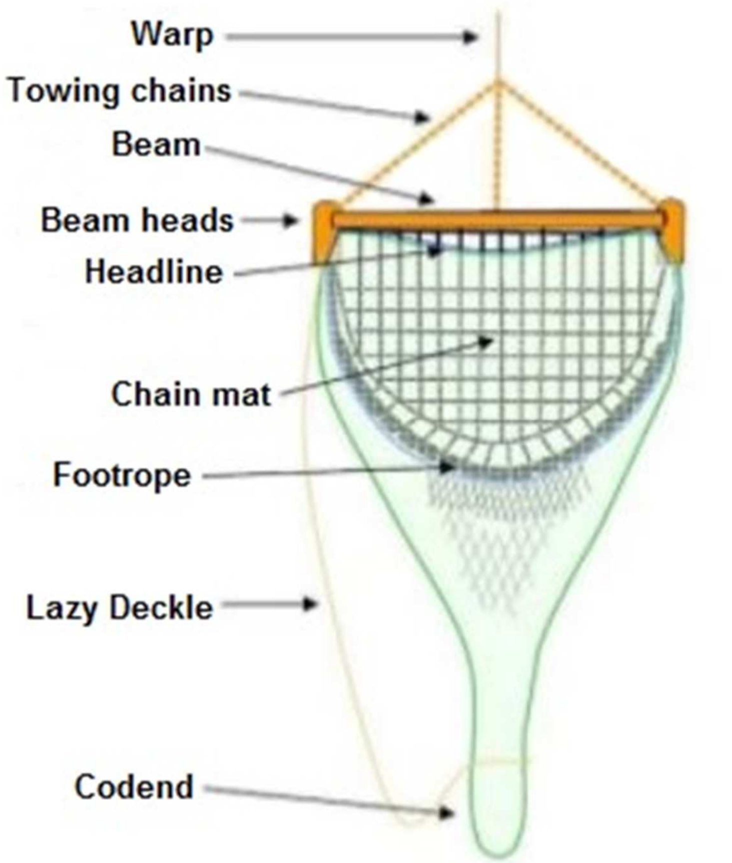


Figure 14 - Chain mat beam trawling fishing net

6.4.1 Typical winch arrangement on beam trawlers

Belgian beam trawlers have typical winch arrangements as in Figure 15, usually placed in front of the superstructure or, in rare cases, behind the superstructure.

To prevent accidents, if and when nets would be entangled to objects on the bottom of the sea such as rocks and or shipwrecks, winches can be equipped with safety devices that would reduce the rpm of the engine or even let go the fishing nets.

The winches serve several purposes during sailing amongst lowering/hoisting of the booms, lowering the nets into or hoisting the nets out of the water and pulling the fishing nets inboard.

Winches on board beam trawlers are also often used for unloading of the catch in port, where the boom serves as cargo derrick at that moment.

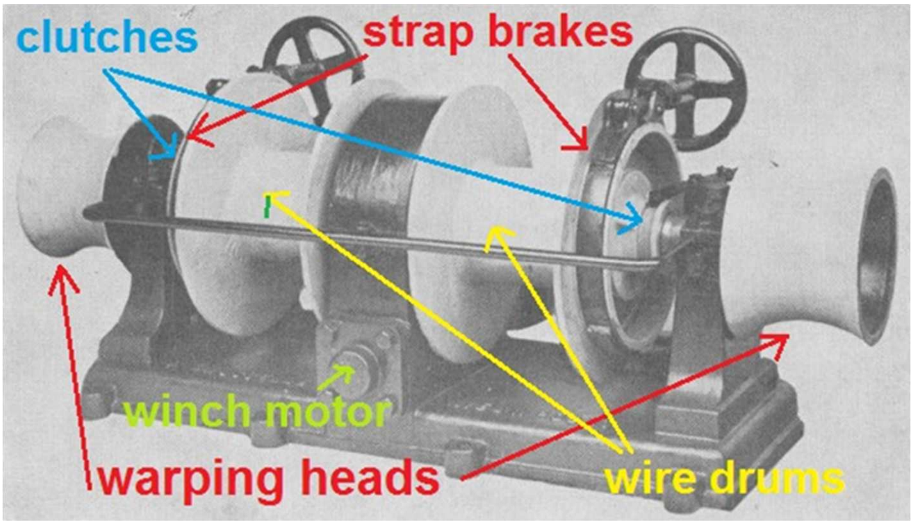


Figure 15 - Typical winch arrangement on beam trawler

6.5 Winch arrangement on board fv Z582 ASSANAT

The fv Z582 ASSANAT was a typical beam trawler with a winch, as in Figure 16 consisting of the following components:

- A winch motor, in case of fv Z582 ASSANAT a hydraulic motor, that can run in two directions

- Two warping heads at the portside and starboard end of the winch arrangement, that are permanently attached to the axle of the winch, i.e. when the winch motor is running, the warping heads are turning.

- Wire drums, fitted with hand operated strap brakes. The wire drums can be clutched in or out, but only when the running of the winch motor is stopped. In case of fv Z582 ASSANAT, there were two wire drums fitted on each side of the winch.

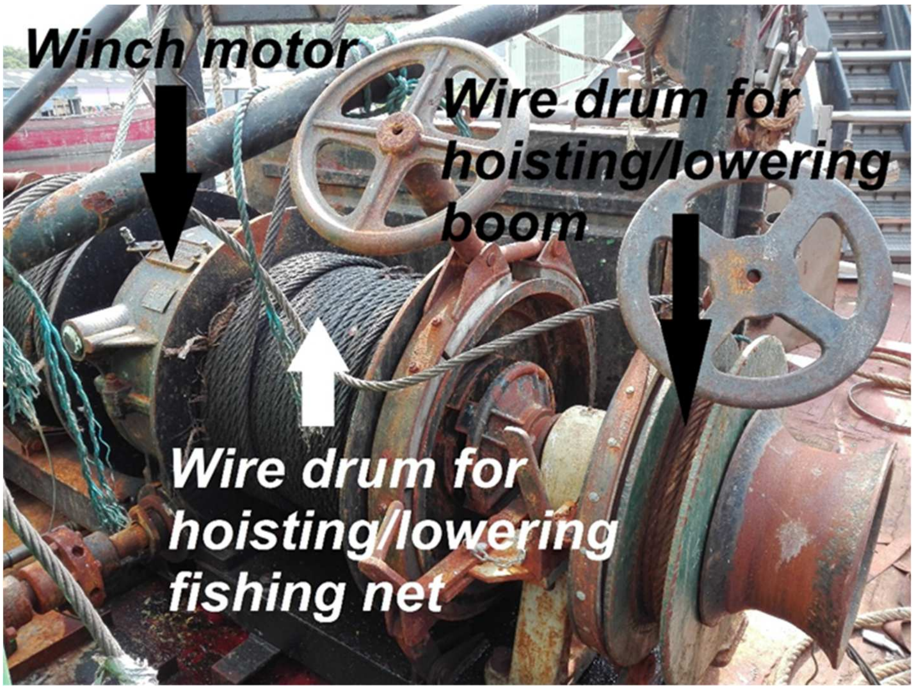


Figure 16 - Wire drum arrangement on board the fv Z582 ASSANAT

(damaged during salvage)

The winch motor on board the fv Z582 ASSANAT was of the hydraulic type. The speed of the motor was regulated by adjusting the flow of hydraulic oil under pressure to the winch motor.

On board the fv Z582 ASSANAT, the flow was regulated by means of hand operated valves. One was placed in close vicinity to the winch on the facing of the superstructure, one was placed inside the wheelhouse as seen in Figure 17 on page 25.

The valves operated in parallel, meaning that the speed of the winch motor could be regulated from either valve.

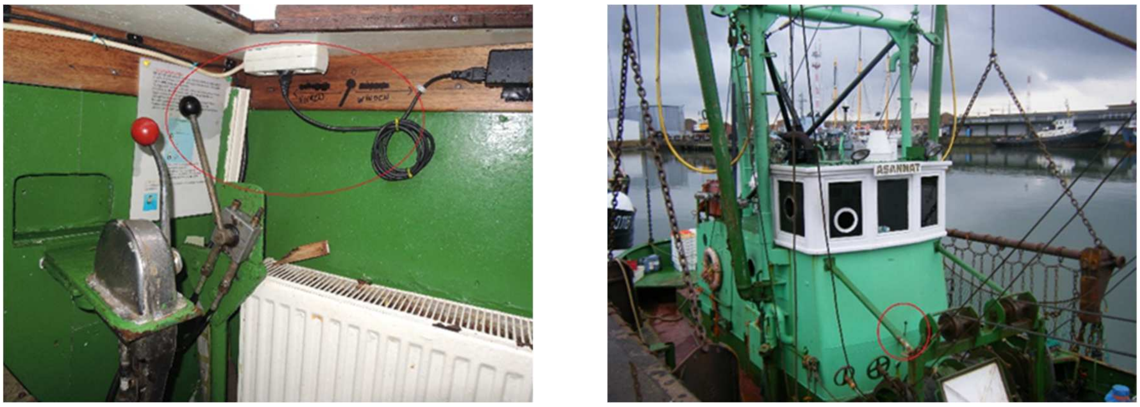


Figure 17 - winch control valves inside the wheel house and on facing of superstructure of fv Z582 ASSANAT (archive pictures)

Inside the wheel house, by means of permanent marker, it was indicated how to operate the lever of the hydraulic valve to increase or decrease the speed and how to heave or slack.

The valve lever on the facing of the superstructure had to be moved to starboard for heaving and to portside for slacking.

Fairleads on deck, through which the warps of the fishing nets were rigged were equipped with a patented length of line and force meter as an indicator for when the nets would be entangled with objects on the seabed as seen in Figure 18 on page 26.

The system did not foresee in letting go of the nets or automatically reducing the revolutions of the main engine in case of entanglement of the fishing nets.

Figure 18 - fairlead through which the net warp was rigged

equipped with hydraulics to measure line length of the warp and forces on the warp

6.5.1 Shooting and recovery of the fishing nets on board the fv Z582 ASSANAT

The construction and placement of the winch on board the fv Z582 ASSANAT was such that during operations of the fishing gear three man on deck were required to safely operate the fishing gear of the fv Z582 ASSANAT.

During the shooting of the net, one man had to present near the winch to clutch in/out the drums with the boom topping lift tackle and the warp of the net. One man had to assist the starboard net and another one has to assist the portside net.

During the deploying of the nets, i.e. when nets were empty, there was no absolute need to work symmetrically, meaning, that same proceedings, did not have to take place on starboard side as well as on port side at exactly the same moment, since the effect of shooting a single empty net would not have large impact on the vessel's stability.

During the recovery of the nets, three people were needed on deck. One operating the speed of the winch and the clutching in/out of the drums, and the two others, each on one side, hauling in the nets. It was paramount to work symmetrically in order not to have a detrimental impact on the vessel's stability, as explained in paragraph 8.3.3 on page 49.

7 Analyses

To allow for analyses of the incident, the configuration of the fishing gear on board the fv Z582 ASSANAT was represented as follows:

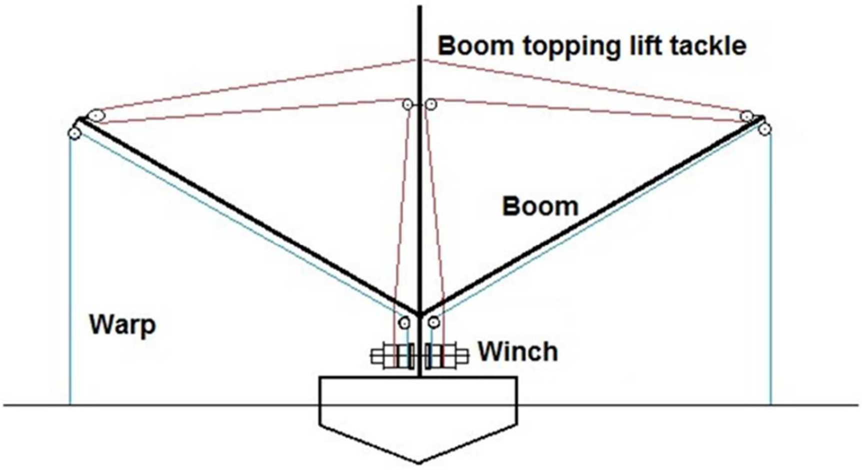


Figure 19 - Typical boom topping lift tackle and warp arrangement on beam trawler

7.1 Forces encountered with beam trawling and their effect on stability of the vessel

7.1.1 Forces acting when nets are parallel to keel

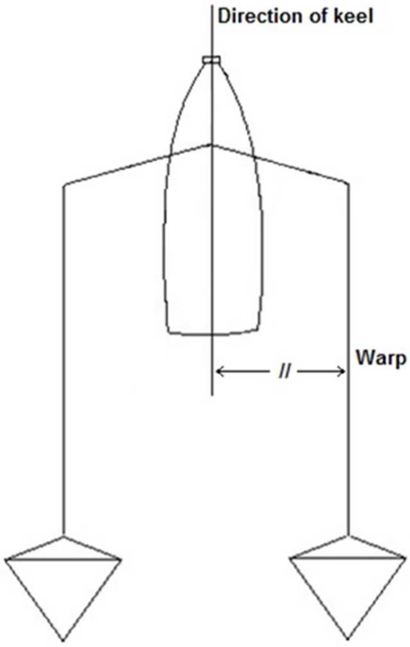


Figure 20 - Pictorial representation of beam trawling with nets parallel to keel

A force equal to the resistance of the submerged net is felt at the top of the each boom $\mathbf{W1}$ and $\mathbf{W2}$ when beam trawling with 2 nets, one off starboard and one off portside.

Figure 21 – Pictorial representation of forces felt at teach top end of boom

When fishing with equal nets, with equal lengths of warps and symmetrical rigging, meaning same lengths of booms, the two forces will be equal, $\mathbf{W1} = \mathbf{W2}$. The variations in forces due to rolling and pitching can be omitted.

The force $\mathbf{W}$ can again be decomposed into horizontal and vertical components $\mathbf{HD}$ and $\mathbf{V}$, where the horizontal component $\mathbf{HD}$ is parallel to the keel of the vessel and the vertical component $\mathbf{V}$ is perpendicular to the keel.

Figure 22 – Pictorial representation of components of the force on the end of the boom when beam trawling

With equal nets and gear ⇨ when $\mathbf{W1} = \mathbf{W2}$, then $\mathbf{V1} = \mathbf{V2}$, and $\mathbf{HD1} = \mathbf{HD2}$.

An equal increase in $V1$ and $V2$ will increase the draught of the vessel and an equal increase in $HD1$ and $HD2$ will increase the trim[4] of the vessel.

[4] Trim: the difference in a ship's draught forward and aft. Trim is said to be positive if the forward draught is less than the draught aft.

7.1.2 Acting forces during beam trawling when one of the two nets gets entangled

For analyses purposes it was assumed that the starboard net got entangled and consequentially $\boldsymbol{W2} > \boldsymbol{W1}$ resulting in $\boldsymbol{W2} - \boldsymbol{W1}$ equals $\mathbf{P}$.

If $\boldsymbol{W2} > \boldsymbol{W1}$, $\mathbf{P}$ would cause the vessel to list and to alter the heading.

$\mathbf{P}$ can again be decomposed into vertical component $\mathbf{V}$ and horizontal component $\mathbf{HD}$.

Further analyses of the decomposition of the vertical component $\mathbf{V}$ en horizontal component $\mathbf{HD}$ can found in appendix 7.

7.1.3 Forces acting on booms during beam trawling when fishing vessels run off course

When beam trawling the nets would not be parallel to the keel when:

- The vessel changes its heading
- When the vessel needs to steer a certain heading and the current runs on a crossing course with the ships heading.

In both cases an angle θ Is created between the direction of the nets and the vessels course as in Figure 23.

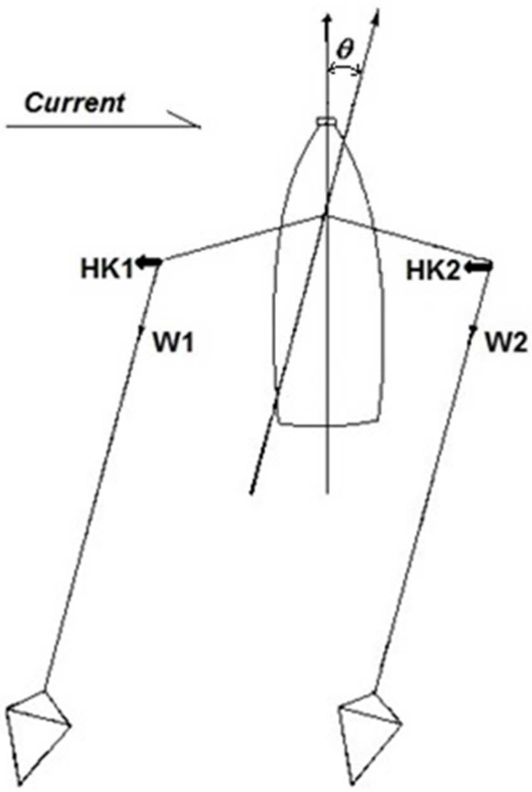


Figure 23 - Forces acting on booms when nets are not parallel to keel

At the end of the booms, two forces $\mathbf{W1}$ and $\mathbf{W2}$ are felt and are equal one to the other. The forces $\mathbf{W1}$ and $\mathbf{W2}$ can be decomposed into components $\mathbf{V}$ and $\mathbf{HD}$ as in appendix 7.

As a consequence of the slanted angle between the net warp and the keel, these forces $\mathbf{W1}$ and $\mathbf{W2}$ can be decomposed into three components as in Figure 25 page 34

$\mathbf{V}$: vertical component

$\mathbf{HD}$: horizontal component parallel to the keel

$\mathbf{HK}$: horizontal component perpendicular to the keel.

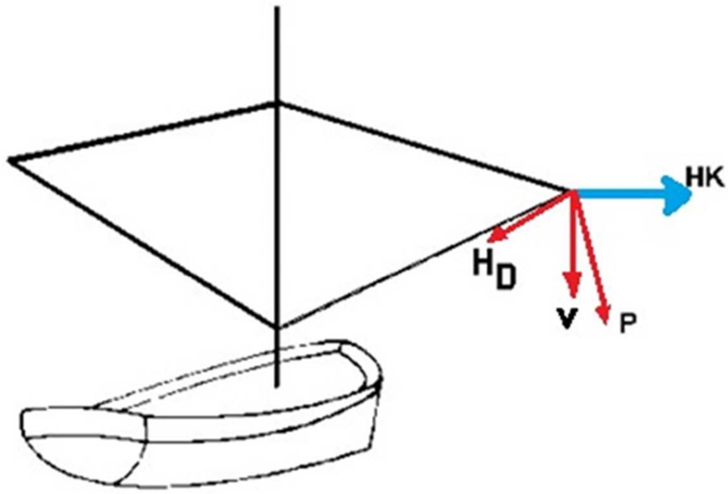


Figure 24 - Resistance W decomposed into components

Whereby, according to Figure 25 page 8, $\mathbf{P}$ was replaced by $\mathbf{W}$ and:

$$\mathbf{V = W * \cos\varphi}$$

$$\mathbf{HK = W * \sin\varphi * \sin\theta}$$

Whereby the angle θ is the horizontal projection of $\mathbf{W}$ and the keel of the vessel, and is the difference between the heading and the vessel's heading and the course made good.

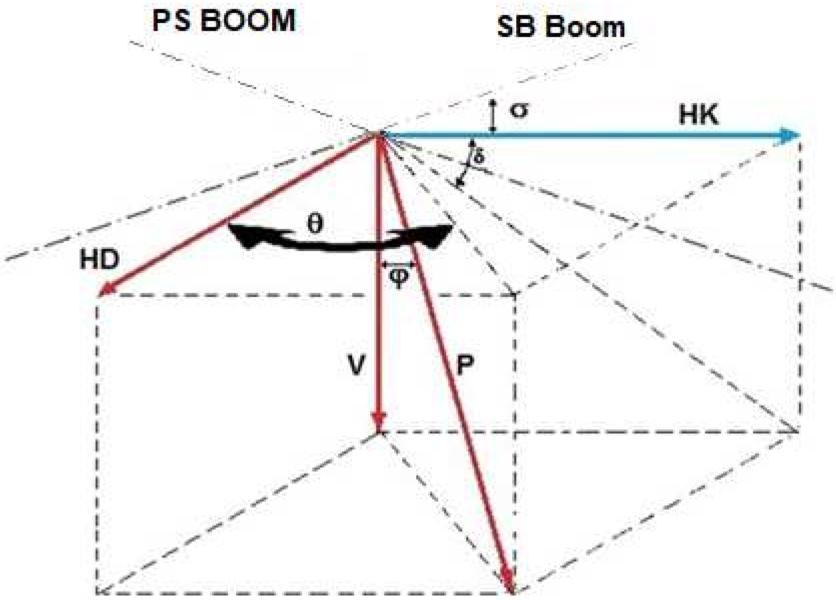


Figure 25 - Decomposition of forces at boom ends when trawling off course

Since $\mathbf{W1}$ equals $\mathbf{W2} \Rightarrow$

$$\mathbf{V1 = V2}$$

$$\mathbf{HD1 = HD2}$$

$$\mathbf{HK1 = HK2}$$

$\mathbf{V1}$ and $\mathbf{V2}$ cause the immersion of the vessel in the water. $\mathbf{HD1}$ and $\mathbf{HD2}$ cause the increase in the vessel's trim.

The heeling moment $\mathbf{MH}$ is trying to list the vessel as a consequence of the forces $\mathbf{HK1}$ and $\mathbf{HK2}$.

From Figure 23 on page 32 it is understood that the force $\mathbf{HK2}$ could swing the boom from starboard to portside, however with the boom properly secured, the heeling moment would be

$$\mathbf{MH2 = 2 * MH = \frac{2 * W * \sin\varphi * \sin\theta * (a + 1\sin\sigma)}{force * arm}}$$

whereby a is the distance between the gooseneck of the boom of the vessel and the centre of lateral resistance[5] L as in Figure 26 page 35

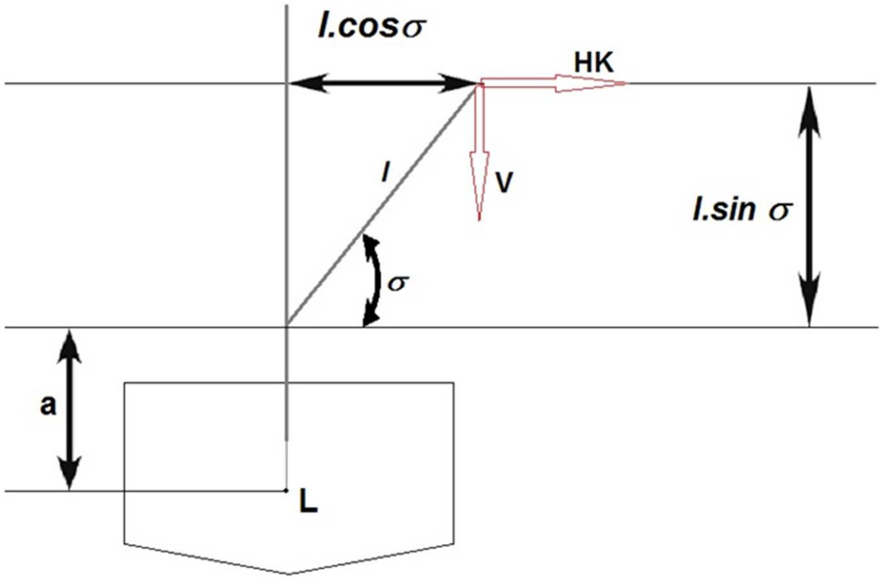


Figure 26 – pictorial cross section of beam trawler indicating forces on a boom end

From the formula can be derived that **MH** is less influenced by the length of the warp **v**, but increases with the increase of σ or the value of **MH** decreases as the boom angle decreases.

***Consequentially, when a beam trawler is engaged in trawling with the nets not parallel to the keel, the trawler will constantly list, with an angle of list which decreases as the angle of the booms decrease*.**

The trawler in the pictorial representation in Figure 23 on page 32 will list to portside.

[5] The centre of lateral resistance in a vessel is the centre of pressure of the hydrodynamic forces on the hull of the vessel. The centre of pressure is the point on a body where the total sum of a pressure field acts, causing a force and no moment about that point

7.1.4 The risk of a boom swinging from one side to the other

Theoretically a boom can swing from one side to the other when $\delta < \sigma$ as per Figure 25 on page 34, not taking the mass of the boom or possible securing devices into consideration.

From Figure 25 on page 34 we learn that δ is the angle between the projection of $\mathbf{W}$ onto the transverse plane and the horizontal.

Again can be derived that the boom will swing from one side to the other when $tg\delta < tg\sigma$ with $0° < \delta, \sigma < 90°$

$$tg\delta = \frac{cos\varphi}{\sin\varphi * \sin\theta} = \frac{1}{tg\varphi * \sin\theta}$$

$$\Leftrightarrow tg\delta = \frac{1}{tg\varphi * \sin\theta} < tg\ \sigma$$

$$\Rightarrow tg\ \sigma\ , tg\varphi\ , \sin\theta > 1$$

$tg45° = 1$ and increases as the angle increases over 45 degrees, consequentially, If the angle $\boldsymbol{\varphi}$ or the angle $\boldsymbol{\sigma}$ is greater than 45 degrees, there is a chance of the boom swinging from one side to the other.

The chance of the boom swinging over increases when the warps are longer or/and the angle of the booms increases or/and the increase of the angle between the vessel's heading and the course made good.

7.1.5 Forces acting when nets entangle

The assumption is that the portside net in Figure 23 on page 32 is entangled on the bottom which results in $\boldsymbol{W1} > \boldsymbol{W2}$, therefore it is adopted that $\boldsymbol{W1} - \boldsymbol{W2} = \boldsymbol{P}$

The force $\mathbf{P}$ acts upon the top of the portside boom, while the vessel would already have a list to portside as learned from 7.1.3 page 32.

The force $\mathbf{P}$ can be decomposed into:

$\mathbf{V}$ which causes the torque $\mathbf{Mv}$ to portside

$\mathbf{HK}$ which causes the torque $\mathbf{MH}$ to portside

$\mathbf{HD}$ which causes a rotation of the vessel to portside, thereby increasing the angle $\boldsymbol{\theta}$.

From Figure 25 on page 34 we learn that

$$\boldsymbol{MH} = \boldsymbol{P} * \boldsymbol{sin\varphi} * \boldsymbol{sin\theta} * (\boldsymbol{a} + \boldsymbol{l} * \boldsymbol{sin\sigma})$$

7.2 Structural Condition of the hull of fv Z582 ASSANAT

7.2.1 Narrative

During a survey on 21 June 2017 the recovered fv Z582 ASSANAT was found afloat, by its own means, at a ship yard in the Port of Ostend, after it had been salvaged and turned right side up by a salvage company.

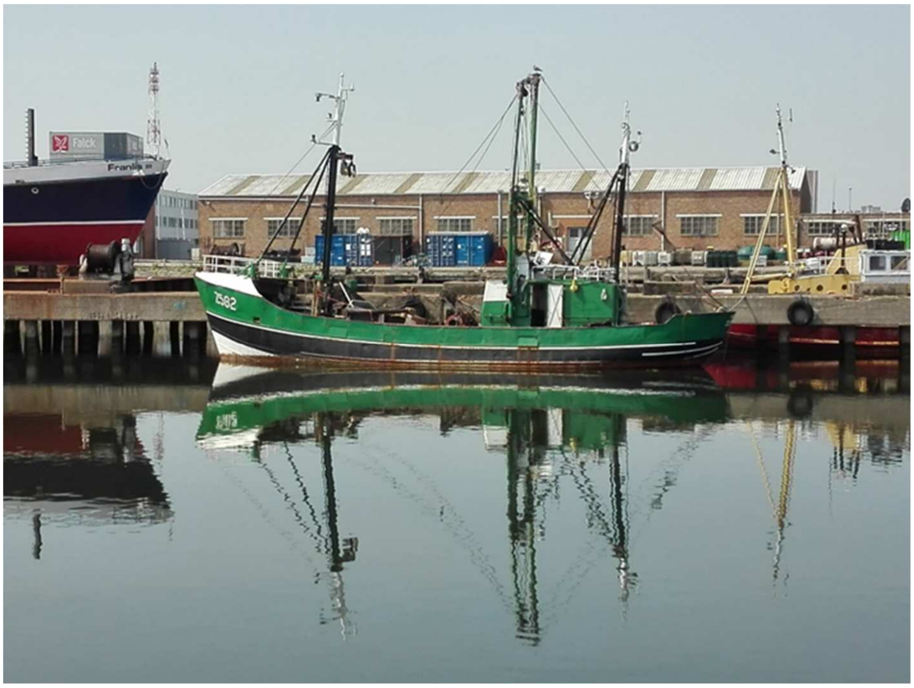


Figure 27 - fv Z582 ASSANAT afloat in the port of Ostend

after having being salvaged and turned right side up

No apparent damage to the hull was noted, however, when the vessel was found floating upside down in the North Sea, the appointed salvage company reportedly had found some weak spots in the hull. Before placing a hot tap, a salvage worker tapped the hull with a hammer in order to find the most suitable place for placing the hot tap, and reportedly the salvage worker punched holes into the hull. The holes where reportedly provisionally plugged in order to prevent the sinking of the fv Z582 ASSANAT after it would have been turned right side up.
During the survey of 21 June 2017 the actual condition of the hull could not be assessed from the outside since the vessel was afloat, and for security reasons it was decided not to assess the condition of the hull from the inside.

7.2.2 Survey and condition of the hull

The thickness of the hull of the fv Z582 ASSANAT had been measured on 12 July 2013.

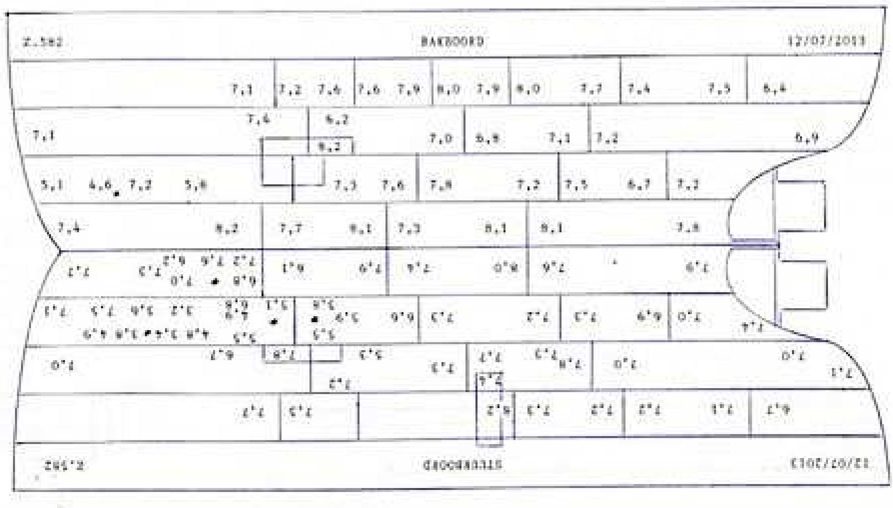


Figure 28 - Thickness measurement of 2013

Some thicknesses where causing reason for concern and the relevant authority, the Federal Public Service Mobility and Transport, DG Shipping, Belgian Maritime Inspectorate, required some additional measurements at the forepeak, sea chest and vulnerable places.

Normally, fishing vessels flying Belgian flag are required to have the hull plate thickness measured every 4 years. A decrease in thickness measurement of more than 20% requires actions to be taken.

In 2014, the hull plate thickness was measured again, with reportedly special attention to the areas that were reason for concern the year before.

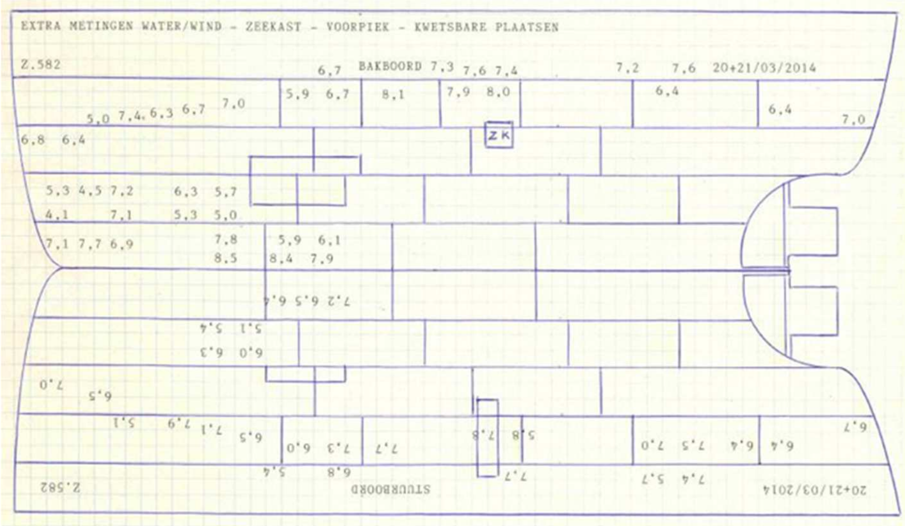


Figure 29 - Additional hull plate thickness measurement of 2014

The Federal Public Service Mobility and Transport, DG Shipping, Belgian Maritime Inspectorate performed an out of the water survey in march of 2014, same time the hull plate thickness was measured and it was noted that the frames, hull plating and stern and stem were not in sound condition as seen in Appendix 5.

The salvage company had found some weak spots in the hull while tapping the hull with a hammer in search of places where a hot tap could be inserted. The salvage worker tapping the hull hit a few holes in the hull, indicating that in the tapped area the hull was rather weak. After the hull had been temporarily fixed, hot taps had been installed and air had been blown into the hull of the fv Z582 ASSANAT the vessel remained afloat.

7.3 Minimum Safe Manning requirements for fv Z 582 ASSANAT

The fv Z 582 ASSANAT was allowed to sail, conform article 94 of the Belgian Royal Decree of 20 July 1973[6], in an area not further than 25 miles from the Belgian coast (old fishing area 1) or in an area delimited by the meridian of 2° W and the parallel of 55° N (old fishing area 2).

The minimum safe manning differed from one fishing area to the other whereby the voyages where not only delimited by geographical boundaries but voyages where also limited in time. The relevant authority, Federal Public Service Mobility and Transport, DG Shipping, did not perform any assessment with respect to the operation of the vessel for determining the minimum safe manning requirements, but based the requirements solely on the length of the vessel and the duration of the voyages.

For a voyage of maximum one natural day in old fishing area 1, the minimum crew had to consist of:

- One skipper
- One certified helmsman

One crewmember must have a valid GOC or ROC GMDSS certificate, or CEPT Long range Certificate.

One crewmember must have a valid engineer's licence for an engine rating of 221 kW.

Each crewmember must be certified in basis safety on board fishing vessels

For a voyage of maximum two natural days in old fishing area 2, the minimum crew had to consist of:

- One skipper
- One certified helmsman
- One certified deckhand

One crewmember must have a valid engineer's licence for an engine rating of 221 kW.

Two crewmembers must have a valid GOC or ROC GMDSS certificate, or CEPT Long range Certificate

Each crewmember must be certified in basis safety on board fishing vessels. If a voyage of more than 2 natural days was to be undertaken, an extra crewmember with helmsman's licence needed to be embarked.

7.3.1 The crew on board at the time of capsizing

For the fatal voyage, the crew that had embarked on board the fv Z582 ASSANAT consisted of a certified skipper also holder of the General Operator GMDSS certificate, a motorman with engineer's licence up to an engine rating of $750\ kW$ and a certified deckhand.

Compared to the minimum safe manning requirements from the Federal Public Service Mobility and Transport DG shipping, the crew was short of one licenced helmsman and a second crewmember holding a GOC or ROC GMDSS certificate, or CEPT Long range Certificate, was missing.

7.4 Survey and Certification of the fishing vessel

The Belgian Federal Public Service Mobility and Transport, DG Shipping, Belgian Maritime Inspectorate assumes the responsibility for the survey and certification of fishing vessels flying Belgian flag, provided that they are not registered with a recognized organisation, in which case the survey and certification could be delegated.

Aforementioned fishing vessels are surveyed once a year as a rule, and inspected more than once a year when circumstances demand it.

The fv Z 582 ASSANAT had been surveyed by the Belgian Maritime Inspectorate on April 20th 2016. No major anomalies had been found.

All mandatory statutory documents were valid, including the Certificaat van Deugdelijkheid [7] or freely translated the Certificate of seaworthiness. This Belgian certificate reflects the overall condition of the vessel.

It was noted that on the survey report that the placarding “closed at sea” and “wear lifejacket”, that was to be placed on the inside of the watertight accommodation doors, were not checked off.

It was further noted from same survey report that a comment had been inserted with respect to the lifejackets. According to the survey report the fv Z 582 ASSANAT was still equipped with an older type lifejackets. The older type life jackets were equipped with a Personal Locator Beacon or PLB signalling on $\mathbf{121.5\ Mhz}$ in the VHF frequency range when immerged.

This signal required a specific receiver on board vessels in order to be detected. Merchant navy men and pleasure craft are not required to carry this specific receiver.

8 Cause of the capsizing

8.1 Hull integrity

Although there were some areas of the hull that were reason for concern with respect to hull integrity, since the salvage worker tapping the hull, punctured it, damage to the hull and consequential flooding leading to loss of stability of the Z582 ASSANAT could be excluded as cause of the capsizing since *no structural damage to the hull was apparent after the capsizing*.

Figure 30 - No apparent damage to hull

© Jim Bennet

8.2 Unsafe manning

Although the Z582 ASSANAT was not manned in accordance with the vessel's minimum safe manning document, issued by the Belgian Federal Public Service Mobility and Transport, DG Shipping, Belgian Maritime Inspectorate, three men were needed on deck for the recovery of

[7] Appendix 4 – Certificate of seaworthiness of fv Z 582 Assanat page 42

the fishing nets after the third trawl and from testimonial we learned that three men were mustered on deck for the recovery operations.

By mustering the three crew members on deck, the wheelhouse was left abandoned, but the presence of a qualified crew member in the wheelhouse could most probably not have avoided the fv Z582 ASSANAT from capsizing seen the very short timespan in which the vessel turned over.

The fact that the manning was not in accordance with the prescribed minimum safe manning by the administration can be excluded as cause or contributing to the capsizing of the fv Z582 ASSANAT.

8.3 Hypothesis on what happened

8.3.1 First Hypothesis – Net(s) entangled during fishing

During a survey by a court appointed investigator, it was noted that the starboard fishing net had been damaged.

Reported close observation of the damage learned that the tear did not occur as a result of wear but the tear reportedly appeared to be a cut in the net.

Figure 31 – Damaged Starboard Fishing Net

picture by Nautical Commission to the Court of Commerce at Antwerp

From testimonial it was learned that there had not been any indication that the starboard fishing net would have been entangled during fishing, or that the entanglement of one or both of the nets would have laid at the basis of the fishing being interrupted or halted.

The skipper of the rescue craft, that had towed the overturned derelict of the fv Z582 ASSANAT to a rendezvous point with the crane barge CORMORANT, had declared that during the tow, the speed had been reduced a few times by external factors. Considering the length of the fishing net and the boom, and the water depth and the presence of several wrecks on the bottom of the sea, there was a possibility that the net had been damaged during the tow from the place where the derelict of the Z582 ASSANAT had been fastened to the rescue craft to rendezvous point with the crane barge CORMORANT as seen in Figure 32 on page 46.

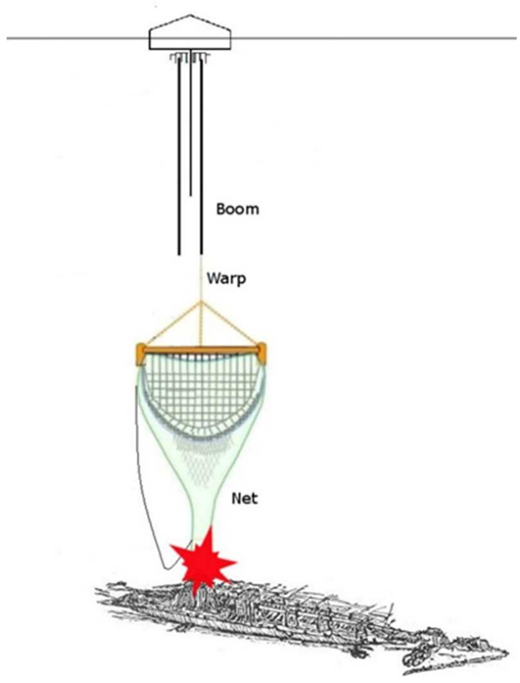


Figure 32 - Pictorial representation of net being entangled during tow

(not to scale)

If not and the hypothesis of the net being entangled needed to be followed a situation such as in paragraph 7.1.5 Forces acting when nets entangle on page 37 would have occurred.

Further, when the rescue craft encountered the derelict of the fv Z582 ASSANAT is was reportedly free floating. Thus it would have been possible that the starboard net had been entangled on the seabed and had caused the Z582 ASSANAT to capsize and that the rise and fall of the tide would have caused the freeing of the starboard fishing net, however, greater damage to the starboard fishing would have to be observed.

From the testimonial of the surviving crewmember, it can also not be derived that the starboard fishing net was entangled on the seabed.

***Therefore the hypothesis of the net(s) being entangled during fishing was no longer maintained*.**

8.3.2 Second Hypothesis – Net(s) snagged by submersible

From testimonial it was learned that, at the time of the incident, reportedly a screeching sound was heard followed by a bang and a sound that resembled the sound of a slow running diesel engine.

This could have been the sound of the engine of a submersible craft. Further, it was learned that one of the crewmembers that ended up in the water, reportedly found himself at considerable distance from the fv Z582 ASSANAT seconds after being thrown into the water. Therefrom, it was derived that the Z582 ASSANAT was somehow towed. Since no surface navigation craft was in close vicinity at the time of the incident, the hypothesis of the net or nets being snagged by a submersible craft was brought forward.

The submersible snagging the starboard net would have created a situation as in Figure 33.

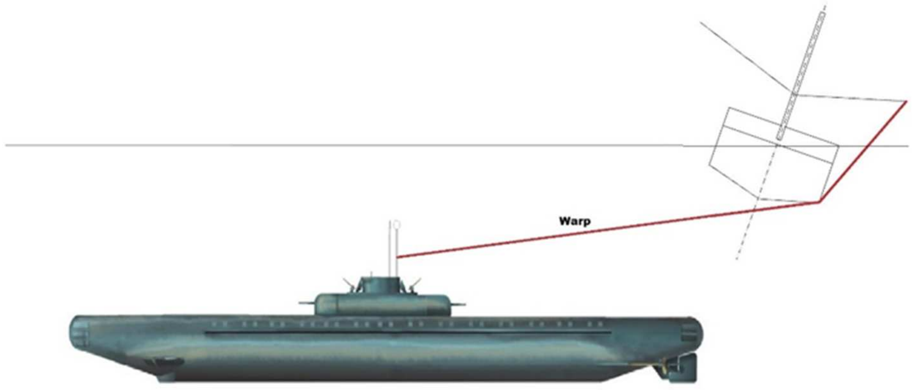


Figure 33 - Pictorial representation of submersible snagging fishing net

(not to scale)

The hypothesis whereby a submersible snagged the starboard net of the Z582 ASSANAT, and created enough torque to turn the Z582 ASSANAT upside down in the water would have been as in paragraph 7.1.3 Forces acting on booms during beam trawling when fishing vessels run off course on page 32 whereby the component **V** increased to such extent that the initial stability of the fv Z582 ASSANAT is lost. The underwater velocity of the submersible would also have had an increasing effect on the torque necessary to turn the fv Z582 ASSANAT upside down.

Further, on the portside fairlead on deck of the fv Z582 ASSANAT, several marks left by the warp of the portside fishing net, were found.

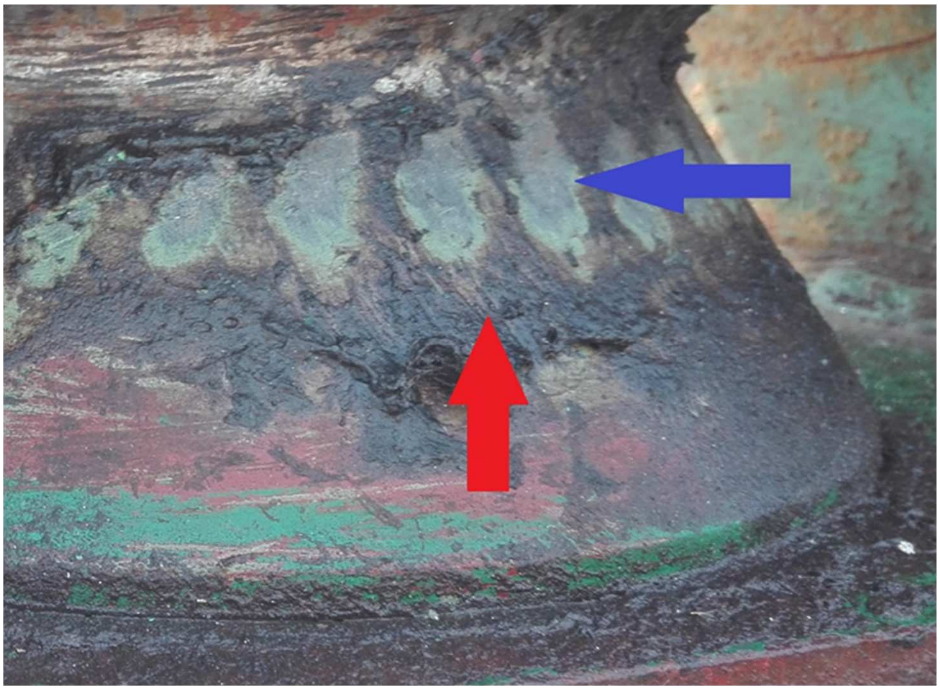


Figure 34 - Scratch marks on fairlead

Closer observation of the scratch marks indicated that two kinds of marks were left.

- Marks as a result of the pressure of the warp onto the fairlead, squeezing out grease from the warp

- Scratch marks on the lower part of the fairlead (red and blue arrows)

The origins of the second type of marks were derived from the shape of the fairlead, a diabolo, and the normal operation of the fishing gear. Because of the diabolo shape of the fairlead, and the fact that the warp is constantly under tension during shooting and recovery of the net and during fishing, the warp would always be positioned in the middle of the diabolo. Finding the warp positioned onto the bottom part of the diabolo shaped fairlead and finding vertical scratch marks indicated that at one stage, the warp was slacked and was tugged back under tension.

This could have happened when the corresponding fishing net got snagged.

However theoretically possible, the presence of a submersible would have to be confirmed. Several inquiries with the command of friendly armed forces operating submarines confirmed that no friendly submersibles were in the area at the time of the incident. Furthermore, the water depth was too low for friendly submersibles to remain under water due to restrictions in size and operational instructions.

Close observation of the damaged fishing net, soon after recovery of the vessel, also revealed that the location of the damage and the direction in which the fishing net was cut, combined with the direction in which the Z582 ASSSANAT rolled over, made it very hard to support the hypothesis of the fishing net being snagged by a submersible.

The net was cut in longitudinal direction i.e. from top to bottom, where if the net would have been snagged by a submersible it was very likely to be cut in transversal direction. The cut in the net occurred on the side closest to the ship’s side, which lead to the conclusion that if the net was snagged by a submersible, the submersible would have carefully manoeuvred itself in between both fishing nets without touching, which was very unlikely.

Therefore the hypothesis that he net(s) of the fv Z582 ASSANAT would have been snagged by a submersible could no longer be maintained.

8.3.3 Third Hypothesis – asymmetrical handling of fishing gear

The vertical component $\mathbf{V}$ causes the ship to list. To keep the vessel upright, both vertical components, the one from the SB fishing gear and the one from the PS fishing gear should be kept in equilibrium at all times.

With the vessel stopped and both fishing gears, SB and PS, at water level, and both booms topped at same angles, at the end of the booms, the two forces $\mathbf{W1}$ and $\mathbf{W2}$ are felt and are equal one to the other.

After the nets are symmetrically hoisted to water level, crewmembers fastened a spring line, a natural fibre rope, to the lazy tackle of the starboard net allowing them to hoist the cod end over the bulwark, by running the spring line on the turning warping head of the winch.

The spring line was rigged through a pulley that was attached to the mast of the fv Z582 ASSANAT at approximately 10 metres above the base of the vessel as seen in Figure 35 on page 50.

Figure 35 – spring line (coloured red) fastened to starboard fishing net

on board the Z582 ASSANAT archive picture)

When the hoist reached the desired height, the crewmember running the spring line over the warping head of the winch slacked the spring line over the turning warping head, whilst another crewmember manipulated the cod end on deck.

Figure 36 - Running a spring line over a turning warping head of a winch

The spring line of the port side net had not been fastened to the cod end of the portside net and was found still in stowed position after the Z582 ASSANAT had been turned right side up. Reportedly salvage workers had cut the port side spring line during salvage operations. The snap hook and part of the port side spring line were left in stowed position.

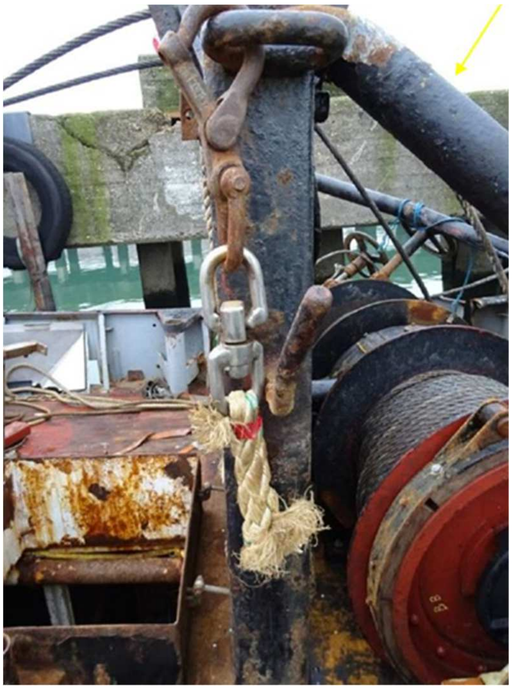


Figure 37 - Port side spring line snap hook in stowed position

picture by Nautical Commission to the Court of Commerce at Antwerp

From testimonial it was understood that at some stage the spring line attached to the starboard fishing net was squeezed under one or more turns of the spring line on the warping head. There was no time to stop the turning of the warping head before the cod end reached such height, using the warp as lift tackle bringing the boom in almost perpendicular position to the mast, that the effect of hoisting the mass of the cod end above deck height and bringing to mass closer to the centre of the vessel had such detrimental effect on the vessel's stability that, the Z582 ASSANAT capsized over port side as seen in Figure 38.

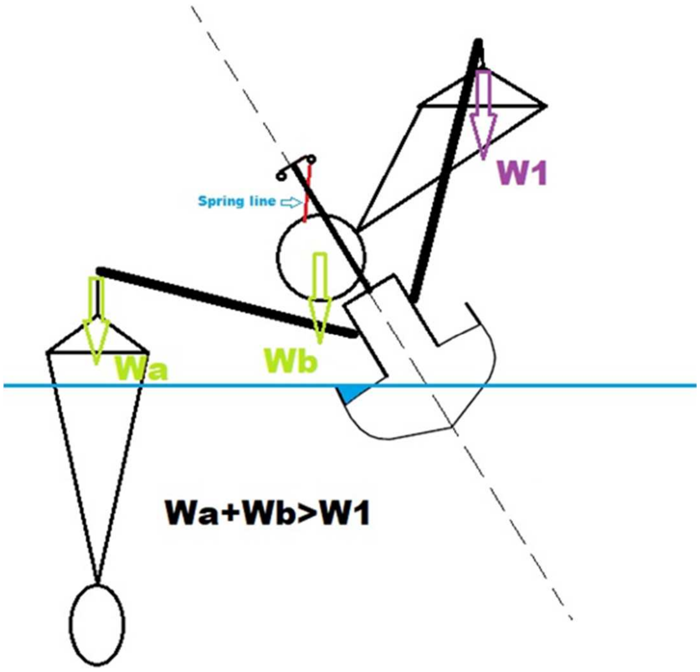


Figure 38 - Situation whereby Z582 ASSANAT capsized

From paragraph 7.1.1, we learned that W2 (in this case Wa+Wb) must be equal to W1, not to cause list to the vessel.

Figure 38 indicates that at the time of capsizing both moments caused by the mass of the fishing gear and the distance from the centre of the vessel were not equal one to the other causing a list to Portside. Simulation, using the vessel's approved stability book, indicated that at the time of the capsizing the aforementioned particular situation caused a theoretical list to portside of approximately 27° whereby water could have entered the vessel.

Once the Z582 ASSANAT was listing to port, consequential water ingress on portside caused the vessel to list even more. At a certain stage, the beam of the starboard swung to portside and smashed into the wheel house thereby again increasing the list and finally topping over the vessel.

From testimonial we learned that a screeching sound was heard just before capsizing. The beam of the starboard net, when swinging to port side, must have rubbed against the starboard boom producing the screeching sound.

9 Conclusion

9.1 Cause of the capsizing

From the aforementioned paragraph 8.3.3 "Third Hypothesis – asymmetrical handling of fishing gear " we learned that the fishing vessel Z582 ASSANAT capsized because the spring line attached to the cod end of the starboard fishing net got entangled on the warping head of the winch of the vessel, hoisting the cod end to such a height that, in combination with the portside fishing net still being at water level, the residual initial stability was insufficient leading to Z582 ASSANAT listing heavily to portside with consequential water ingress.

With the vessel listing heavily to portside, the beam of the starboard fishing gear swung over to portside thereby rubbing against the boom producing a screeching sound, smashed into the wooden upper part of the wheelhouse, destroying it and thereby increasing the list to portside even more, leading to the capsizing of the vessel.

9.2 Safety Issues

- Although the vessel was manned in excess of the minimum safe manning requirements set out by the flag state administration of the fv Z 582 ASSANAT for said voyage, the wheelhouse needed to be left abandoned and all hands were mustered and needed on deck for the recovery of the fishing nets.

- Investigation reports from the past from maritime accident investigation bodies, operating under European Directive 2009/18, on similar incidents with beam trawlers have indicated that it was vital for a beam trawler to recover the nets perfectly symmetrical in order not to create detrimental effects on the vessel's stability.

- The combined usage of a constant speed winch with warping heads and hand tailed spring lines for the hoisting and lowering of the cod end of the fishing nets onto deck was intrinsically dangerous, since the probable entanglement of the spring line on the warping heads prevents them from being slacked in timely fashion.

10 Recommendations

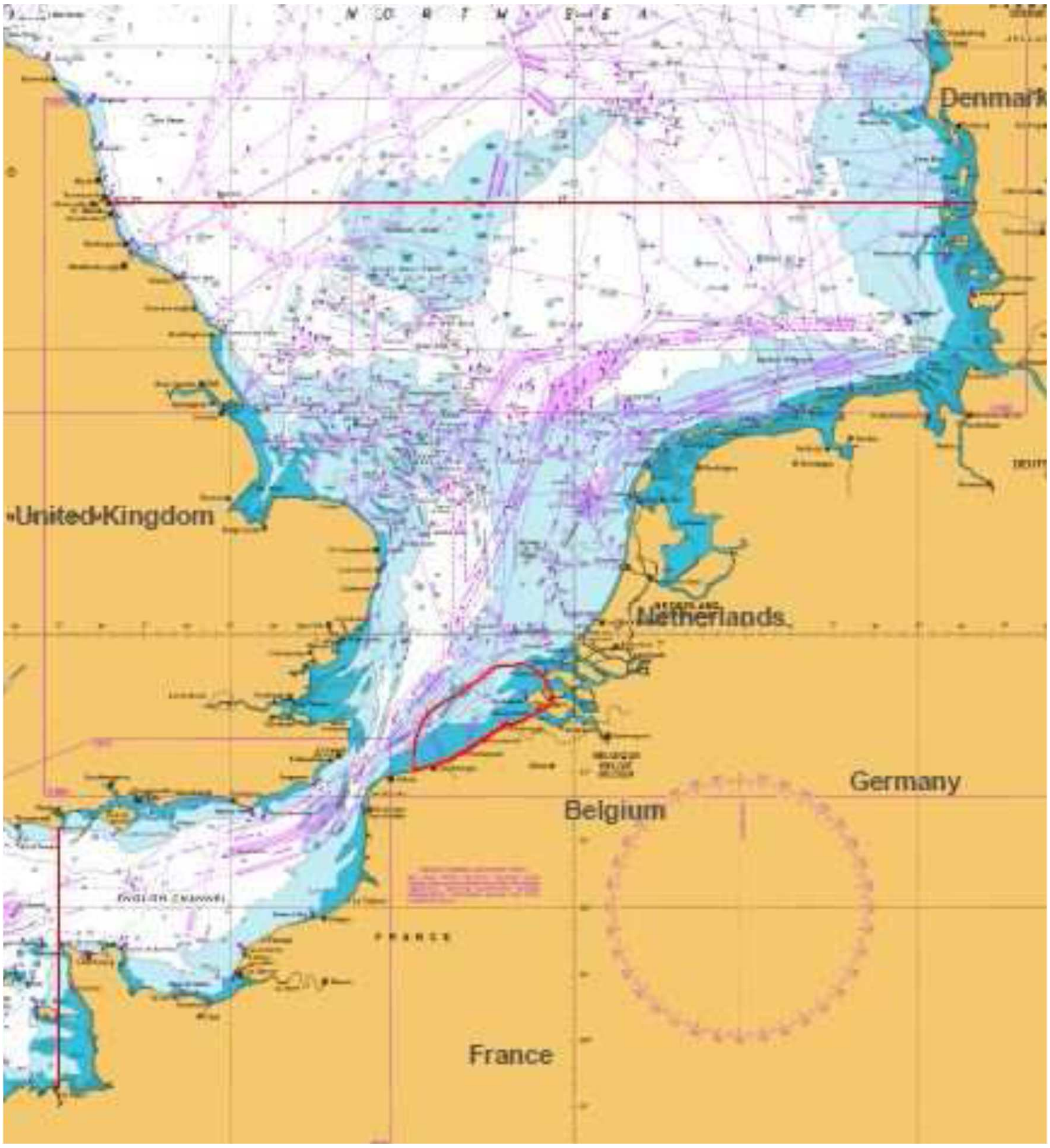
The Federal Public Service Transport and Mobility, DG Shipping are recommended to:

- When establishing the minimum safe manning requirements for fishing vessels, basing the minimum safe manning criteria not solely on the length of the vessel or the intended duration of the voyage but to also take into consideration the way the fishing gear was operated.

- Asses the equipment on board fishing vessels during inspections and identify intrinsically unsafe equipment and inform owners and operators of the imminent dangers and advice owner and operators to have the equipment removed and or altered.

11 Appendices

Appendix 1 - Fishing areas according to the Belgian Maritime Inspectorate



Appendix 2 - Minimum Safe Manning document for fv Z 582 ASSANAT

KONINKRIJK BELGIE

FEDERALE OVERHEIDSDIENST MOBILITEIT EN VERVOER

DG SCHEEPVAART

DOCUMENT INZAKE MINIMUMBEMANNING OP VISSERSVAARTUIGEN

Uitgereikt krachtens de bepalingen van artikel 94 van het koninklijk besluit van 20 juli 1973 houdende zeevaartinspectiereglement.

Kenmerken van het vaartuig

Naam van het vaartuig :	**Z 582 ASANNAT**
Roepnaam :	**OPWZ**
IMO nummer :	——
Thuishaven :	**ZEEBRUGGE**
Brutotonnage	
Nationale meting :	**62**
Internationaal verdrag betreffende de meting van schepen 1969:	
Voortstuwingsvermogen (kW) :	**221**
Motor bedienbaar van op de brug	**Ja**
Tijdelijk onbemande machinekamer	**Ja**

Radio zeegebied **A1**
Vaargebied **een zeegebied dat beperkt is tot 25 zeemijl uit de Belgische kust (oud VG I).**

Het vaartuig genoemd in dit document is veilig bemand indien het zee kiest men een bemanning die noch in aantal noch in hoedanigheid lager is dan de tabellen hieronder opgegeven.

Hoedanigheid	Brevetten, certificaten, getuigschriften en dienstbewijzen	Aantal
Schipper	**Vaarbevoegdheidsbewijs schipper beperkt vaargebied (I.3) (*)**	**1**
Roerganger	**Vaarbevoegdheidsbewijs roerganger (I.6)**	**1**

Bijzondere eisen of voorwaarden (indien vereist) :
Eén bemanningslid dient houder te zijn van het Beperkt Certificaat van Operator GMDSS, of van het CEPT Long range Certificate, of van het Algemeen Certificaat van GMDSS.
Eén bemanningslid moet houder zijn van het vaarbevoegdheidsbewijs motorist 221 kW (I.5.1)
Ieder bemanningslid moet houder zijn van het certificaat voor Basisopleiding in Veiligheid aan boord van vissersvaartuigen, certificaat (I.7).
Reisduur max. één etmaal.
(*) Dit mag ook houder zijn van het vaarbevoegdheidsbewijs schipper beperkt vaargebied met een beperking tot min. bovenvermeld vaargebied

Uitgereikt te , onder nr. 369/16, op 17 augustus 2016
Geldig tot **20 april 2017**

De met de scheepvaartcontrole belaste ambtenaar die daartoe aangesteld is.

Document inzake minimumbemanning op vissersvaartuigen nr. **369/16**
Z 582 ASANNAT - Page 1 of 2

KONINKRIJK BELGIE

FEDERALE OVERHEIDSDIENST
MOBILITEIT EN VERVOER

DG SCHEEPVAART

DOCUMENT INZAKE MINIMUMBEMANNING OP VISSERSVAARTUIGEN

Uitgereikt krachtens de bepalingen van artikel 94 van het koninklijk besluit van 20 juli 1973 houdende zeevaartinspectiereglement.

Kenmerken van het vaartuig

Naam van het vaartuig :	**Z.582 ASANNAT**
Roepnaam :	**OPWZ**
IMO nummer :	-----
Thuishaven :	ZEEBRUGGE
Brutotonnage	
Nationale meting :	**62**
Internationaal verdrag betreffende de meting van schepen 1969:	
Voortstuwingsvermogen (kW) :	**221**
Motor bedienbaar van op de brug	**Ja**
Tijdelijk onbemande machinekamer	**Ja**

Radio zeegebied **A2**
Vaargebied **een zeegebied begrensd in het westen door de meridiaan 2° W en in het noorden door de parallel 55° N (oud VG II).**

Het vaartuig genoemd in dit document is veilig bemand indien het zee kiest men een bemanning die noch in aantal noch in hoedanigheid lager is dan de tabellen hieronder opgegeven.

Hoedanigheid	Brevetten, certificaten, getuigschriften en dienstbewijzen	Aantal
Schipper	**Vaarbevoegdheidsbewijs schipper beperkt vaargebied (I.3) (*)**	**1**
Matroos	**Certificaat basisopleiding veiligheid I.7**	**1**
Roerganger	**Vaarbevoegdheidsbewijs roerganger (I.6)**	**1**

Bijzondere eisen of voorwaarden (indien vereist) :
Twee bemanningsleden dienen houder te zijn van het Algemeen Certificaat van Operator GMDSS, of van het CEPT Long range Certificate.
Eén bemanningslid moet houder zijn van het vaarbevoegdheidsbewijs motorist 221 kW (I.5.1)
Ieder bemanningslid moet houder zijn van het certificaat voor Basisopleiding in Veiligheid aan boord van vissersvaartuigen, certificaat (I.7).
Reisduur max. twee etmalen.
Voor een onbeperkt reisduur dient supplementair één bemanningslid, houder van het vaarbevoegdheidsbewijs roerganger te zijn aangemonsterd.
(*) Dit mag ook houder zijn van het vaarbevoegdheidsbewijs schipper beperkt vaargebied met een beperking tot min. bovenvermeld vaargebied

Uitgereikt te , onder nr. 369/16, op 17 augustus 2016
Geldig tot **20 april 2017**

De met de scheepvaartcontrole belaste ambtenaar die daartoe aangesteld is.

Document inzake minimumbemanning op Vissersvaartuigen nr. **369/16**
Z.582 ASANNAT - Page 2 of 2

Appendix 3 - Article 94 of the Belgian Royal Decree of 20 July 1973

Artikel 94. Visserij, dek en machine :

1. a) Aan boord van een vissersvaartuig met een lengte van niet meer dan 24 m dat vaart in een zeegebied dat beperkt is tot 25 zeemijl uit de Belgische kust en uitsluitend reizen onderneemt van maximum een etmaal, moeten ten minste 1 schipper en 1 roerganger aanwezig zijn. De schipper dient houder te zijn van tenminste het vaarbevoegdheidsbewijs voor schipper beperkt vaargebied en de roerganger dient houder te zijn van ten minste het vaarbevoegdheidsbewijs van roerganger.

b) Aan boord van een vissersvaartuig met een lengte van niet meer dan 24 m dat vaart in een zeegebied begrensd in het westen door de meridiaan 2°W en in het noorden door de parallel 55°N moeten ten minste 1 schipper en 3 matrozen aanwezig zijn. De schipper dient houder te zijn van ten minste het vaarbevoegdheidsbewijs voor schipper beperkt vaargebied. Benevens de schipper moeten 2 van de bemanningsleden houder zijn van ten minste een vaarbevoegdheidsbewijs voor roerganger.

c) Aan boord van een vissersvaartuig met een lengte van niet meer dan 24 m dat vaart in een zeegebied begrensd in het westen door de meridiaan 2°W en in het noorden door de parallel 55°N en uitsluitend reizen onderneemt van maximum twee etmalen moeten ten minste 1 schipper en 2 matrozen aanwezig zijn. De schipper dient houder te zijn van ten minste het vaarbevoegdheidsbewijs voor schipper beperkt vaargebied. Benevens de schipper moet 1 bemanningslid houder zijn van ten minste een vaarbevoegdheidsbewijs voor roerganger.

Free Translation into English

***Article 94**. Fishing, deck en engine:*

“ 1.a) On board a fishing vessel with a length of not more than 24 m, sailing in a sea area restricted to 25 sea miles off the Belgian coast, and undertaking voyages of maximum one natural day, should at least 1 skipper and 1 helmsman be present. The skipper must be the holder of a certificate of competence of skipper restricted sea area and the helmsman should be the holder of a certificate of competence of helmsman

b) On board a fishing vessel with a length of not more than 24 m, sailing in a sea area delimited by the meridian of 2° W and in the North by the parallel of 55°, at least 1 skipper and 3 deckhands should be present. The skipper must be holder of a certificate of competence of skipper for restricted sea area and 2 of the 3 deckhands must be holder of the certificate of helmsman.

c) On board a fishing vessel with a length of not more than 24 m, sailing in a sea area delimited by the meridian of 2° W and in the North by the parallel of 55°, undertaking voyages of maximum two natural days, at least 1 skipper and 2 deckhands should be present. The skipper must be holder of a certificate of competence of skipper for restricted sea area and 1 of other crewmembers must be holder of the certificate of helmsman

Appendix 4 - Certificate of seaworthiness for fv Z 582 ASSANAT

KONINKRIJK BELGIE

FEDERALE OVERHEIDSDIENST MOBILITEIT EN VERVOER

DG SCHEEPVAART

CERTIFICAAT VAN DEUGDELIJKHEID VOOR VISSERSVAARTUIG MET EEN LENGTE MINDER DAN VIERENTWINTIG METER

Dit certificaat dient te w orden aangevuld met de inventaris van uitrusting en het document inzake minimumbemanning op vissersvaartuigen.

Inschrijvingsletters en nummer Naam van het vaartuig	Onderscheidings nummer of -letters	Thuishaven Zeegebied	Bruto-Tonnenmaat	Vermogen in kW	Naam van de eigenaar
Z.582 ASANNAT	**OPWZ**	**ZEEBRUGGE**	**62**	**221**	**VERSLUYS - VANTROYE BVBA**

De ondergetekende verklaart dat bovenvermeld vissersvaartuig onderzocht w erd en voldoet aan de voorschriften van de w et van 5 juni 1972 op de veiligheid der schepen en aan de ter uitvoering van die w et genomen besluiten.

Het vaartuig is niet voorzien van het certificaat van deugdelijkheid voor vissersvaartuigen w aarvan de lengte vierentw intig meter of meer bedraagt bedoeld in artikel 18 van het koninklijk besluit van 20 juli 1973 houdende zeevaartinspectiereglement.

Op dit vaartuig w orden maximaal **4** personen toegelaten.

Op grond hiervan w ordt dit certificaat uitgereikt dat geldig blijft zolang aan de voorw aarden van de hogervermelde w et en besluiten w ordt voldaan en uiterlijk tot **20 april 2017**, behoudens de jaarlijkse inspectie overeenkomstig artikel 6, 1 c), van het koninklijk besluit van 20 juli 1973 houdende zeevaartinspectiereglement.

Uitgereikt te , onder nr. 368/16, op 17 augustus 2016

De met de scheepvaartcontrole belaste ambtenaar die daartoe aangesteld is.

De ondergetekende verklaart dat de jaarlijkse inspectie overeenkomstig artikel 6, 1 c), van het koninklijk besluit van 20 juli 1973 houdende zeevaratinspectiereglement heeft plaatsgevonden, w aarbij is gebleken dat het vaartuig nog voldoet aan bovenvermelde w et en besluiten.

Te .... op ....20..

NIET VAN TOEPASSING

....

De met de scheepvaartcontrole belaste ambtenaar die daartoe aangesteld is.

Certificaat van Deugdelijkheid voor Vissersvaartuigen met een lengte van minder dan vierentw intig meter nr. 368/16
Z.582 ASANNAT - Pagina 1 van 1

Appendix 5- Report on the out of water survey of 2014

FEDERALE OVERHEIDSDIENST MOBILITEIT EN VERVOER
Maritiem Vervoer
Scheepvaartcontrole - Vlaggenstaat

Scheepvaartinspectie Oostende **DROOGSCHOUWING**

Naam	Roepnaam	Thuishaven	GT	vermogen
Z.582 Assanat	**OPWZ**	**Zeebrugge**	**62**	**221**

Gedaan te: Oostende op 21/03/2014

I. ROMP:

- Voor- en Achtersteven: - NOK
- Huid: - NOK
- Kiel: - OK
- Kimkiel: - OK
- Anoden: - OK
- Spanten: - NOK
- Dekbalken: - OK
- Plaatdiktes: - Volledig laatst op juli 2013, verdachte delen opnieuw mrt 2014. Ook plaatdiktes genomen van aanvaringsschot + schot tussen nettenruim en visruim + zeekasten. Deze waren OK.

II. ZEEKRANEN:

- Zeekasten: - Toestand:
- Zeekranen BB: - 2 Soort: klep
- Zeekranen SB: - 1 Soort: schuif
- Zeeroosters: - OK
- Doorblaaskranen: -
- Ontluchtingskranen: -

III. SCHROEFAS:

- Datum laatste schroefasonderzoek: 15/07/2013
- Schroef: - OK
- Schroefasafdichting: - OK onbeschermd
- Schroefmoer: - OK
- Schroefas: - OK
- Speling schroefas: - 1 mm (juli 2013)

IV. ROER:

- Roer: - OK
- Taatspot en hiel: - OK
- Speling taatspot: - 2mm: op te volgen

Appendix 6 - Service Regulation 15 Stability of fishing vessels

(Article 13 of the Maritime Inspection Regulations).

1. Before a fishing vessel is put into service, the following data must be submitted in duplicate:

a) A calculation report of the inclining test and the calculation of the ship's mass and of the location of the centre of gravity above keel (KG), in both cases for the lightweight ready for service.

If the loading conditions that occur during operations are subject to considerable trim differences, the location of the longitudinal centre of gravity must also be calculated for the lightweight ready for service.

For fishing vessels equipped for bottom trawl fishing, the location of the centre of gravity above keel can be calculated with the booms at an angle of no less than 45° to the horizontal plane.

b) A plan of the longitudinal section of the ship, showing the various hold and tank capacities, as well as the location of the corresponding centres of gravity above keel, and, if necessary, the longitudinal centres of gravity.

In addition, this plan must show, in tabular form, the largest transverse moment of inertia of the liquid surface of each tank individually.

c) The carène diagram in tabular form including the frame surfaces (Bonjean curves) and the frame moments.

The data for the carène diagram must be calculated by means of a computer programme.

For the calculation of the carène diagram in tabular form, the line described under Appendix A must be taken as the base line.

d) The transverse curves of the static stability (KN sin φ) in tabular form for angles of heel of 2°, 5°, 10°, 20°, 30°, 40°, 50°, and 60° and for draught variations of 1 cm.

The transverse curves must be calculated by means of a computer programme.

For further data concerning the calculation of the transverse curves, see Appendix A.

e) The line plan used to determine the input data for the computer calculations and which must be certified by the computer centre for identification of the output data of the computer centre.

The full input data as part of the output data in such a manner as to permit a check of the input data.

f) The calculation of the location of the centre of gravity above keel and if necessary the longitudinal centre of gravity, as well as the calculation of the initial metacentric height and of the curves of the righting levers for the following loading conditions of the ship:

(i) Departure from port with destination fishing grounds, fully equipped with full bunkers and freshwater tanks and with ice and/or salt in the fish hold.

(ii) Departure fishing grounds with a quantity of fuel oil and freshwater corresponding to 50 percent of the available capacity of the tanks, fish hold fully filled with a homogeneous cargo with a stowage weight of 0.55 t/m^3, as well as deck cargo with a weight of 4 percent of the displacement belonging to the loading condition referred to under (i).

For ships used for bottom trawl fishing, a quantity of cargo in the fish hold that is to be considered normal for this method of fishing can be included instead of the abovementioned cargo in the fish hold and on deck.

For ships equipped both for bottom trawl fishing and for another fishing method, and on which the entire bottom trawl gear remains on board permanently, the including of the deck cargo can be omitted.

iii) Return to harbour with a residue of fuel oil and freshwater corresponding to 10 percent of the available capacity of the tanks concerned and otherwise loaded as described in (ii).

(iv) Return to harbour with a residue of fuel oil and freshwater corresponding to 10 percent of the available capacity of the tanks concerned, in the fish hold, a cargo equal to 20 percent of the cargo in the fish hold as referred to in (ii).

For ships equipped with a machine for the preparation of ice it may be calculated that a larger residue of the amount of freshwater required for the preparation of the ice will remain on board.

(v) Any other loading condition which occurs frequently and which produces considerably less favourable results than the loading conditions mentioned under (i) to (iv).

When calculating the loading conditions mentioned under (ii) to (v), the influence of free liquid surfaces in the tanks must be included (see Appendix B).

If the fishing is to be carried out in an area where the formation of ice is to be expected, the calculation of the loading conditions referred to under (i) to (v) must include the formation of ice (See Appendix C).

The influence of the wind on the vessel must be included for the loading condition that is least favourable from the point of view of windsail (See Appendix D)

g) For ships equipped for several fishing methods that will lead to different loading conditions, the loading conditions for each of these fishing methods must be submitted separately.

2. a) In each of the loading conditions mentioned in paragraph 1 under f) the following criteria must be met:

(i) The righting lever must be no less than 0.20 metres at an angle of heel of 30° or more.

(ii) The maximum value of the righting levers must preferably be reached at an angle of heel of at least 30°, but under no circumstances at an angle of heel of less than 25°.

(iii) At an angle of heel of 30°, the area under the GZ curve must not be less than 0.055 metre-radians, and not less than 0.09 metre-radians at an angle of heel of 40° or at an angle of flooding (φ f) (1) if that angle be less than 40°.

(iv) The increase of an area under the GZ curve between an angle of heel of 30° and an angle of heel of 40°, or an angle of flooding (φ f), if this be less than 40°, must not be less than 0.03 metre-radians.

(v) Except for ships equipped for bottom trawl fishing, the initial metacentric height must be at least 0.35 metres. For ships equipped for bottom trawl fishing, the initial metacentric height must be at least 0.50 metres.

(vi) If the ship is equipped for bottom trawl fishing, the righting levers mentioned under (i} and the areas under the GZ curve mentioned under (iii) and (iv), must be augmented by 20 percent.

(vii) the criteria mentioned under (i), (iii) and (iv) are only valid for ships used for bottom trawl fishing if the engine power established by the District Head of the Maritime Navigation Inspectorate and expressed in axial horsepower, is no larger than L^2 .

If the engine power is larger than L^2 the righting levers and the areas under the GZ curve must be augmented in proportion to the larger engine power.

"The length (L)" is equal to 96 percent of the total length on a water line at 85 percent of the least moulded depth measured from the top of the keel, or from the intersection of the top of the garboard strake with the bar keel if the ship has a bar keel, or equal to the length from the foreside of the stem to the axis of the rudder stock if this last length be greater.

If the ship was designed with a rake of keel, the load water line on which this line is measured must be parallel to the construction water line.

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(1) The angle of flooding (φ f) shall mean: the angle of heel at which the apertures in the hull, superstructure or deckhouses that cannot be closed watertight, are flooded. In applying this criterion, small apertures that, in the judgement of the District Head of the Maritime Navigation

Inspectorate, do not allow water flowing in to penetrate further into the ship, need not be regarded as open.

2. b) The loading condition that is least favourable from the point of view of windsail must, moreover, meet the following criterion: the angle of heel that occurs as a result of the wind moment (φc) may not be more than 40° or the angle of flooding (φf) if this be less than 40°.

For details concerning the calculation of the wind moment, see Appendix D.

3. Before the keel of a fishing vessel is laid, the following data must already have been submitted in duplicate:

a) the data mentioned under 1b, c and e .

b) the maximum permissible KG according to the criteria mentioned under 2 and this in the range empty ship – fully loaded ship for draught variations of 5 cm.

4. If a fishing method is used which in the judgement of the District Head of Maritime Navigation Inspections entails an increased risk with regard to stability, he is entitled to establish alternative stability criteria.

The District Head of the Maritime Navigation Inspectorate Antwerp

Ir. H. DE PAEPE

The District Head of the Maritime Navigation Inspectorate Ostend

Ir. R. BLOMME

APPENDIX A

Calculation of the transverse curves of static stability

1. The base line for the calculation must be the line parallel to the designed water line, drawn through the intersection between the moulding side frame and the centre line of the ship at the location of 1/2 Lord; all this in accordance with the NEN 3085 norm.

2. If the trim conditions that occur during operations or the shape or arrangement of the ship are such that changes of trim have a noticeable impact on the righting levers, the influence of such changes of trim must be taken into account.

3. The possible presence of wooden deck coverings may be taken into account in the calculation.

4. In relation to superstructures, deckhouses etc. the following applies:

a) Closed superstructures that comply with the provisions under b of the tenth paragraph of Article 2 of Appendix I of the Royal Decree 20.7.73 may be included.

b) Closed superstructures under the second deck above the freeboard deck that comply with the provisions under a) of the current paragraph may also be included.

c) Deckhouses on the freeboard deck may be included if they comply with the provisions under a) of the current paragraph for closed superstructures.

d) (i) If deckhouses on the freeboard deck comply with the provisions under a) of the current paragraph, with the exception of the prescribed extra exit to a higher deck, these deckhouses may not be included; however, apertures in the freeboard deck within these deckhouses may be considered to be closed, even if they are not equipped with any means of closing.

(ii) By way of derogation from the stipulations under (i) these deckhouses on small fishing vessels may be included, if the creating of the extra exit is of no practical use.

e) Deckhouses on the freeboard deck whose access routes do not have doors that comply with the provisions in Article 10 of Appendix I of the Royal Decree 20.7.73 may not be included; apertures in the freeboard deck within these deckhouses are considered to be closed if they have adequate means of closing. With the provisions of the Articles 13, 14, 15 or 16 of the Appendix mentioned.

f) Deckhouses under the second or higher decks above the freeboard deck may not be included; however, apertures in the deck within these deckhouses may be considered to be closed.

g) Upper houses and deckhouses that do not comply with the provisions under a) of the current paragraph may be included up to the angle of heel at which the underside of the access apertures and such like becomes submerged (at this angle of heel the curve of the righting levers must show one or more leaps, while at larger angles of heel the flooded spaces are no longer considered to contribute to stability.

h) Small apertures, such as those intended for running mooring lines, anchor chains etc. through them, as well as scuppers and drainage and discharge pipes are not required to be considered to be open if they are submerged at an angle of heel of 30° or more.

If these apertures are flooded at an angle of heel of less than 30°, they must be considered to be open if they permit the entry of quantities of water that are significant in the judgement of the District Head of the Maritime Navigation Inspectorate.

i) Trunkways and hatchways may be included.

When submitting the data, those parts of the ship that have been included in the calculation of the transverse curves must be mentioned.

APPENDIX B

Influence of free liquid surfaces on stability.

1. In every loading condition of the ship, the initial metacentric height (GM) must be corrected for the influence of the free liquid surface in tanks that are not entirely full.

   All tanks that can simultaneously be “slack” in a certain loading condition must be included in this.

2. The apparent decrease of GM can be determined for each tank individually with the formula:

$$\frac{\gamma i}{\Delta} \text{ metre}$$

in which: γ = the specific weight of the liquid in the tank in t/m³

i = the transverse moment of inertia of the liquid surface in the tank in m^4

Δ = the displacement of the ship in the prevailing loading condition in metric tonnes.

3. The curve of the righting levers must be determined with due consideration to the apparently changed position of the height of the centre of gravity above keel (KG) as a result of the influence of the free liquid surfaces.

   In doing so, the value of KG must be increased with the calculated decrease of GM as stipulated under paragraph 2 of this Appendix.

4. If the influence of the free liquid surfaces on the stability at various angles of heel is considerable, the decrease of the righting levers at the various angles of heel can – by way of derogation from the provisions of paragraph 3 of this Appendix - be determined for each tank individually with the formula:

$$\frac{v \; b \; \gamma \; F^{1/2}}{\Delta} \text{ metre}$$

in which: v = the total content of the tank in m³.

b = the largest breadth of the tank in m.

γ = the specific weight of the liquid in the tank in t/m³

$F = \frac{v}{\text{ïbh}}$ = the coefficient of fullness of the tank: in which l, b and h are the largest length, the largest breadth and the largest height respectively of the tank

Δ = the displacement of the ship in the prevailing loading condition in tonnes of 1,000 kg; and

k = a dimensionless factor that can be determined for various angles of heel on the basis of the table belonging to this Appendix, depending on the b/h relationship of the tank; for intermediate values of b/h the factor is obtained through linear interpolation.

5. Other, equally effective methods to calculate the influence of free liquid surfaces on the righting levers are also acceptable.

6. The influence of the residual liquid normally remaining in empty tanks does not have to be included.

7. It must be clearly indicated in the calculated loading conditions which tanks have been calculated as being “slack”.

TABLE FOR THE VALUES OF COEFFICIENT “K” FOR THE CALCULATION OF CORRECTIONS FOR FREE LIQUID SURFACES OF THE RIGHTING LEVERS.

$$k = \frac{\sin\varphi}{12}\left(1 + \frac{\tan^2\varphi}{2}\right) \times b/h$$

where cot φ ≥ b/h

$$k = \frac{\cos\varphi}{8}\left(1 + \frac{\tan\varphi}{b/h}\right) - \frac{\cos\varphi}{12(b/h)^2}\left(1 + \frac{\cot^2\varphi}{2}\right)$$

where cot φ ≤ b/h

φ / b/h	5°	10°	15°	20°	30°	40°	45°	50°	60°	70°	75°	80°	90°	φ / b/h
20	0.11	0.12	0.12	0.12	0.11	0.10	0.09	0.09	0.07	0.05	0.04	0.03	0.01	20
10	0.07	0.11	0.12	0.12	0.11	0.10	0.09	0.09	0.07	0.05	0.04	0.03	0.01	10
5	0.04	0.07	0.10	0.11	0.11	0.10	0.10	0.10	0.08	0.07	0.06	0.05	0.03	5
3	0.02	0.04	0.07	0.09	0.11	0.11	0.11	0.10	0.09	0.08	0.07	0.06	0.04	3
2	0.01	0.03	0.04	0.06	0.09	0.11	0.11	0.11	0.10	0.09	0.09	0.08	0.06	2
1.5	0.01	0.02	0.03	0.05	0.07	0.10	0.11	0.11	0.11	0.11	0.10	0.10	0.08	1.5
1	0.01	0.01	0.02	0.03	0.05	0.07	0.09	0.10	0.12	0.13	0.13	0.13	0.13	1
0.75	0.01	0.01	0.02	0.02	0.04	0.05	0.07	0.08	0.12	0.15	0.16	0.15	0.17	0.75
0.5	0.00	0.01	0.01	0.02	0.02	0.06	0.04	0.05	0.09	0.16	0.18	0.21	0.25	0.5

0.3	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.11	0.19	0.27	0.42	0.3
0.2	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.13	0.27	0.63	0.2
0.1	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.06	0.06	0.14	1.25	0.1

APPENDIX C

Ice formation

1. Areas where ice formation is to be expected:

a) The area north of the parallel 65°30 N, between the meridian of 28° and the west coast of Iceland north of the north coast of Iceland north of the loxodrome between 66°N-15°W and 73°30 N-15° E, north of the parallel 73°30 N between the meridians of 15°E and 35° and east of the meridian of 35° E , as well as north of the parallel 56° N in the Baltic Sea.

b) The area north of the parallel 43° N, bordered on the west by the coast of North America and on the east by the loxodrome between the positions of 43° N-48° W and 63° N-28° W and subsequently along the meridian of 28° W.

c) All sea areas north of the North American continent west of the areas described in (a) and (b)

d) The Bering Sea and the Sea of Okhotsk as well as the Strait of Tartary during the ice season.

e) South of the parallel 60° S.

The areas listed above have been indicated on the map included in this Appendix.

2. For fishing vessels that will be carrying out fishing in the areas listed under paragraph 1, the following ice formation must be included in the various loading conditions:

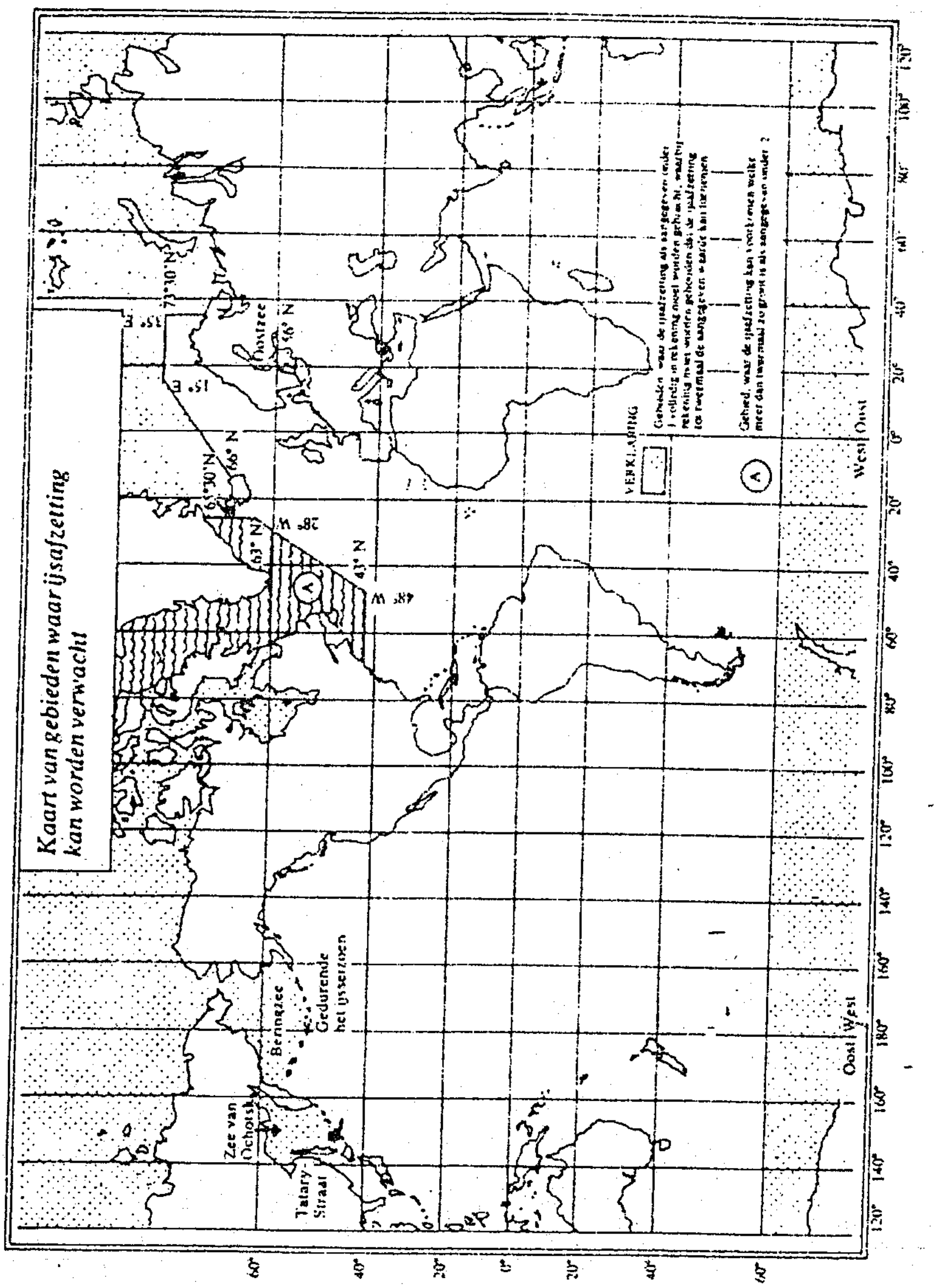
a) 30 kg per square metre for exposed decks;

b) 7.5 kg per square metre for projected lateral surface on each side of the ship above the water line;

c) the projected lateral surface of the railings, loading gear (with the exception of masts) and rigging and the projected lateral surface of other small parts must be included by increasing the total projected continuous area by 5 percent and the total static moment of this area by 10 percent.

3. Skippers of fishing vessels must nonetheless be aware that in certain parts of the areas listed in paragraph 1 larger ice formation can be expected, which can, in some parts of the

areas listed under a, c, d and e, grow to twice the values mentioned in paragraph 2, and in the area mentioned under b) even more than twice the values mentioned in paragraph 2.



APPENDIX D

Impact of the wind

In order to determine the impact of the wind on the ship, the calculation should be based on a gust of wind of long duration acting on the ship athwartships.

To this end the following must be calculated:

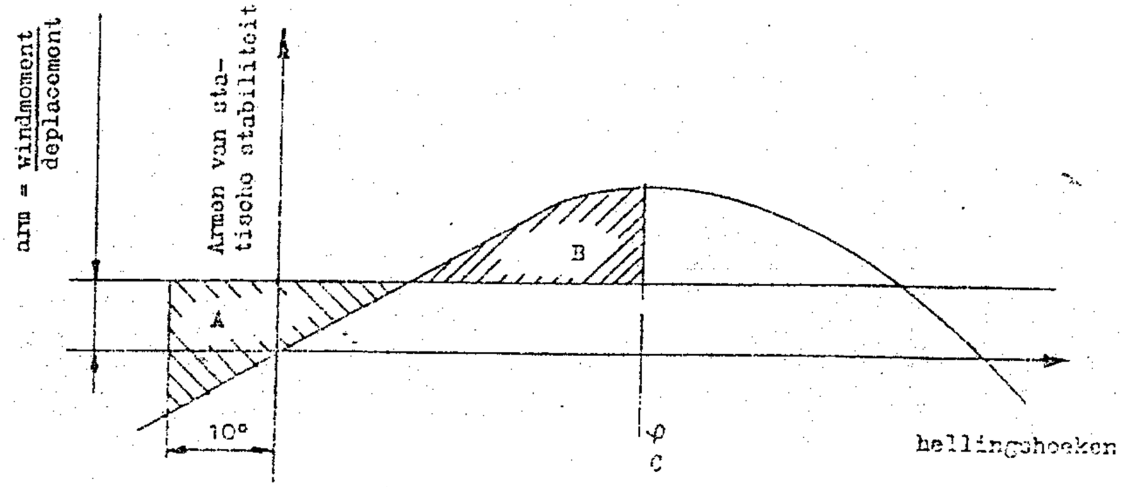
1. The lateral surface of the ship above the water line; i.e. the projected lateral surface of the hull, bulwark, superstructures, deckhouses, hatchways, masts and booms etc.;

2. The total wind pressure on the lateral surface of the ship, on the basis of a wind pressure of 75 kg/m² up to a height of 5 m above the load water line and of a wind pressure of 125 kg/m² above this height;

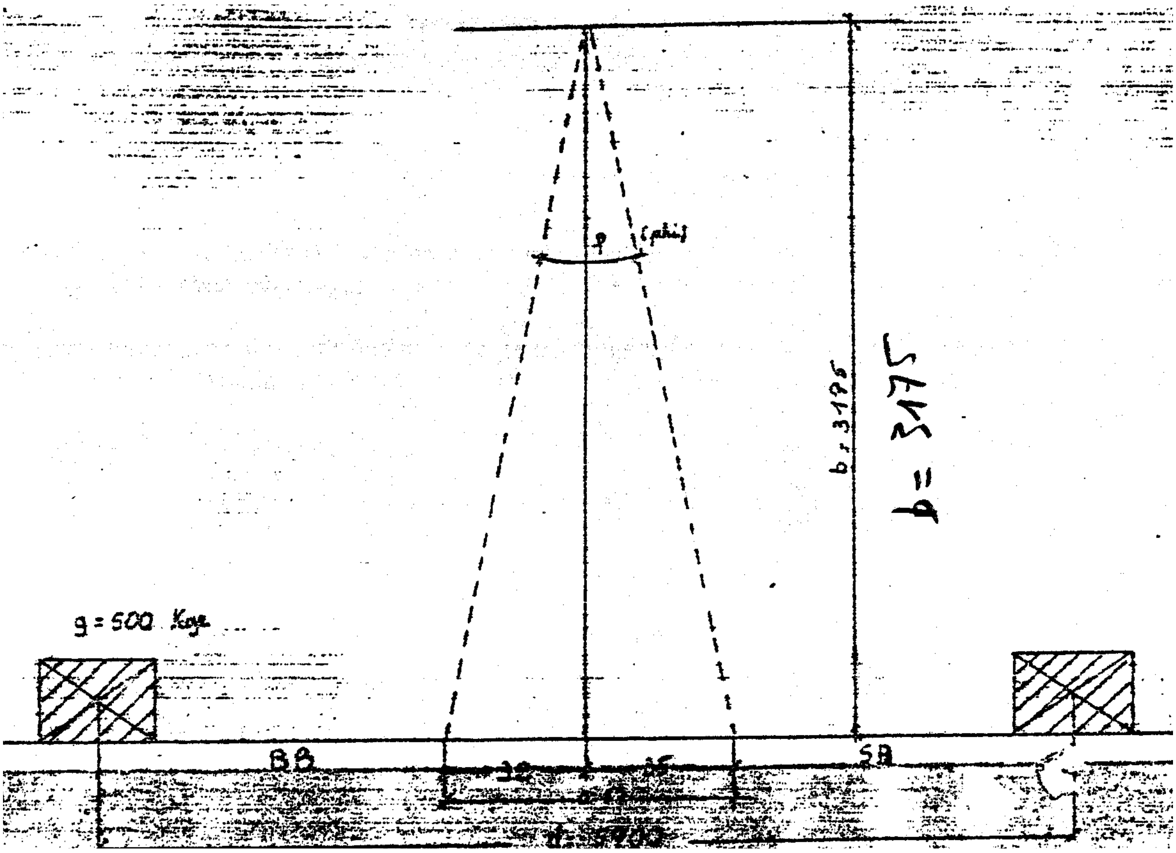
3. The wind moment, i.e. the moment of the total wind pressure calculated in relation to the centre of lateral resistance of the underwater hull;

4. The wind arm, i.e. the wind moment divided by the displacement; this wind arm must be kept equal for all angles of heel.

The calculation of the angle of heel (φ_c) caused by the wind moment should be based on a windward angle of heel of 10°; see the corresponding figure. Surface B indicated in this figure must be equal to surface A indicated.



INCLINING TEST AND PENDULUM TEST



Water displacement D = 226 m³ (obtained by calculation of the lines plan)

Heeling moment gd = 0.5 T x 5.7 m = 2.85 T/m

$$MG = \frac{gd}{D\ tg} = \frac{2.85}{226 \times 0.021} = 0.60$$

Pendulum test: example

Number of rolling periods per minute= 8.5

T = 60/8.5 = 7.05” per rolling period

$$\text{If } t = \frac{0.8\ B}{MG} \text{ then MG is} = \frac{(0..8\ B)^2}{t^2} = \frac{(0.8 \times 6.25)^2}{7.05^2} = \frac{25}{49} = 0.51$$

B = breadth of the vessel.

T = rolling period in seconds

Appendix 7 – Decomposition of residual force on fishing nets

The vertical component $\mathbf{V}$

The vertical component $\mathbf{V}$ causes the ship to list

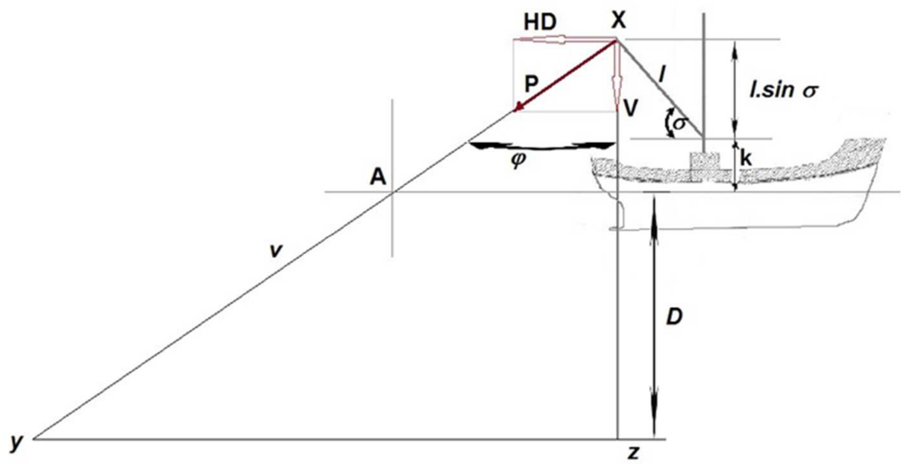


Figure 39 - forces acting upon booms when trawling

From Figure 39 we learn that:

$$\mathbf{V} = \mathbf{P} * \mathbf{cos\varphi} \text{ and } \mathbf{cos\varphi} = \frac{(\mathbf{D+k+l.sin\ \sigma})}{\mathbf{v}}$$ (in triangle xyz)

Where:

$\boldsymbol{l}$ = length of the boom

$\mathbf{P} = \boldsymbol{W2} - \boldsymbol{W1}$

D = water depth

k = distance from the gooseneck[8], a fitting which secures the hinged end of a boom or derrick to the mast, allowing the move the latter in all directions of the boom, to the surface of the water.

v = length of net warp

φ = angle between **P** and **V**

σ = angle between boom and horizontal plane

The arm of the torque equals $\mathbf{l} * \mathbf{cos\sigma}$. It is assumed in this equation that the angle in the horizontal plane between the boom and the keel is 90° as in Figure 41 on page 75.

[8]**Fout! Verwijzingsbron niet gevonden.** Goosenecks as on board the fv Z582 ASSANAT, page 22

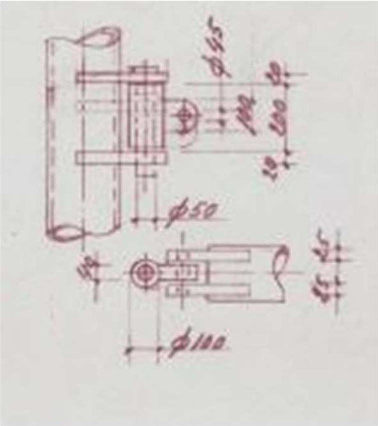


Figure 40 – Goosenecks

as on board fv Z582 ASSANAT

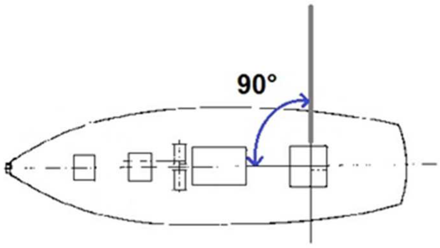


Figure 41 - Angle between boom and keel

The heeling moment **Mv**, when the vessel is upright equals

$$\mathbf{Mv = V.l.\cos\sigma = \frac{P.l.(D + k + l.\sin\sigma).\cos\sigma}{v}}$$

Mv changes when the angle of heel increases however not significantly. The above formula indicates that **Mv** is highly dependable of the length of the net warp.

In case a net is entangled on the bottom during fishing, the heeling **Mv** will be greater with a shorter net warp.

Therefrom, for a fishing vessel with the fishing net warps parallel to the keel, the heeling moment **Mv** would be smaller as the warps of the fishing nets were longer.

The angle of the boom has a lesser influence on **Mv**.

The value of **P** at the moment that one of the nets gets entangled is rather difficult to determine, and is depending upon the velocity of the vessel, the displacement of the vessel en the dampening effect of the fishing gear.

At first **P** would increase and when the vessel was stopped **P** would decrease again.

Since **P** was considered as a thrust, the dynamic stability[9] of the vessel needed to be considered.

The Horizontal component HD

The horizontal component **HD** could create a change of heading towards the side where the net was entangled on the bottom.

Depending upon the steering characteristics of the vessel, the velocity at which the entangled net is slacked, the response time before the engine's rpm is lowered, the change of heading would vary.

When one of the fishing nets of a beam trawler gets entangled on the bottom, a consequential change of heading will result in the net warp pulling on the boom at a slanted angle, thereby generating a new residual force.

[9] The characteristic of a ship, that causes it, when disturbed from an original state of steady motion in an upright position, to damp the oscillations set up by restoring moments and return to its original state.

Federal Bureau for the Investigation of Maritime Accidents

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