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Anchor Use in Maneuvering

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Abstract

This thesis is a guideline to deck officers and masters on how to use different types of anchor methods in maneuvering. It has shown that there is a lack of knowledge about this important topic. When there is no tug boat assistance or bow thrusters it has proven to be vital knowledge to berth the vessel safely.
It starts with the theoretical background of how the anchor and its machinery work. Different types of anchors, maneuvers, approaches, planning, and procedures to follow before anchoring. Many types of anchoring methods are explained with drawings to use according to the situation.
Three interviews were made with current masters and pilots. They share their experience of how they used anchors during the mooring. Theoretical and practical knowledge should give extra options next time when using an anchor is the only choice.

Language: English Key words: anchor, mooring, maneuvering, interviews

Contents

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Abbreviations

Anchor- Is a device, used to secure a vessel to the seabed to prevent from drifting due to wind or current

Shackle- Anchor cable is used in shackle lengths of 15 fathoms (90 feet) or 27.5 meters

Scope- A ratio of the length of an anchor rode from the bit to the anchor shackle and the depth of the water under the bow of the boat measured from deck height

Anchor Dragging- The anchor is not held in the seabed

Windlass- A winch used to raise and lower a ship's anchor

Worm gear- A device consisting of a threaded shaft (worm) that mates with a gearwheel (worm wheel) so that rotary motion can be transferred between two shafts at right angles to each other

Gipsy- The vertical wheel on the windlass which the cable passes over

Hawse Pipe- The stowage space for the anchors of a vessel

Bitter end- The last part of the chain which is connected to the vessel bulkhead

Chain locker- A compartment where the chain of an anchor is stowed when the anchor is raised

Thruster- Propulsion devices built into either the bow or stern, of a vessel to make it more manoeuvrable

Bulkhead- Is an upright wall within the hull of a vessel

Tactical diameter- The distance of a ship when the heading has changed by 180°

OOW- Officer of the watch

AB- Able seaman

Feeder vessel- A short sea vessel which transfers cargo between a central port and smaller ports. Average capacity of 300 to 1000 twenty-foot equivalent units

Squat effect- Causes the ship to increase its draft and be closer to the seabed than would otherwise be expected

Draft- Vertical distance between the waterline and the bottom of the hull

1 Introduction

The thesis is constructed with different topic parts. It starts with a simple introduction to how anchoring works, different anchor type characteristics, and the use of machinery to operate it. Preparation and procedures are explained to follow when using an anchor. Three interviews with the current master were made to share their experiences when berthing with anchor assistance was required. Many other methods of anchor use are included with drawings and explanation.

1.1 Thesis background

When boats were made of wood, it was vital knowledge among masters, how to use anchors during berthing. There weren't engines, thrusters, or tug boats to assist during maneuvering in the harbor basin. Nowadays the vessel's maneuverability is better than before. There are rare cases when anchor assistance is required by common merchant vessels in mooring.

Because of that, the skill has vaguely disappeared in the maritime industry. But there could be once in a careers lifetime situation where this kind of skill is required that separates an accident from a successful mooring. This scenario can happen when normal docking practice cannot be used due to vessel characteristics, no tug boat use, port location, rough weather, or an emergency. This is the knowledge that separates from ordinary to exceptional master.

Using an anchor during mooring is surprisingly common in coastal feeder vessels. The ports are small and free maneuverability space is restricted. The vessel lack of powerful thruster and by regulations they are not obligated to use tug assistance to berth in port. Usually, shipping companies are trying to cut costs and only in extreme cases, tugs are hired.

The topic idea to write about thesis comes from personal interest to study this valuable information, which can be in an unordinary situation very useful.

1.2 Aim of study

The aim of this thesis is to find out how to use different maneuvering techniques using anchor according to the situation. How useful is it to have knowledge of using anchors in maneuvering?

The criteria for finding a thesis subject is that it must involve maritime seamanship skills that can be used by all maritime officers and masters. During my studies, there was not enough focus implemented on the theoretical or practical use of anchors assistance in maneuvering. Because of that, it's my curiosity to find out more knowledge about that which would improve my theoretical understanding of using anchors in maneuvering. In conducted research, I didn't find any thesis made on this topic. This was also one of the reasons to choose this thesis subject because it has before not been studied. The new information that was found in the thesis gives extra choices on how to berth vessels in difficult situations when other usual berthing methods cant be used.

The thesis background was made by a literature review. Academic books were used for that which were found in the library and issued by trusted maritime publishers. The interviews were made with current masters and pilots where they share their professional experiences using anchor during maneuvering. The masters have been my previous colleagues in my career who gladly were to the interviews. My criteria for choosing interviewees is that all of them must have real-life competency on this topic.

The purpose of the interviews was to compare how the information from the literature matches with real-life experiences which result can be found in the conclusion. The interviewees's with Arno Pilt's experiences also added new information to the thesis which was not found in the literature. They are to be found at the end of paragraphs all over the thesis where he shares the career learned useful skills. All the interviews were recorded on-site and open-ended questions were formed.

In the future, I would be interested to continue master's thesis on a topic about the effects of anchor placement or developing new anchor technologies.

2 Anchors equipment

There are many anchor equipment parts involved to operate the anchors. The main parts are the windlass and the chain. Every vessel can have also different anchor types. They come with their advantages and disadvantages. In this section, the parts that involve using an anchor are explained.

2.1 How the anchor works

The anchors are mainly used in anchorage to secure the vessel in position and wait to enter the harbor. The second use comes to improve maneuverability or use as an emergency stop function.

The anchor is designed to lie flat and dig into the seabed (Figure 1). The good holding comes from how well can flukes penetrate the seabed. The anchor cable plays also a major role in holding capacity. The more cable is in contact with the bottom, the better it will hold an anchor. In rough weather more chain is let out to improve holding. Anchor may start to drag if cable tensions increase. The scope of how much cable to pay out is 5-6 times the water depth. It can vary due to weather conditions and seabed. (Baudu, 2014, p. 191).

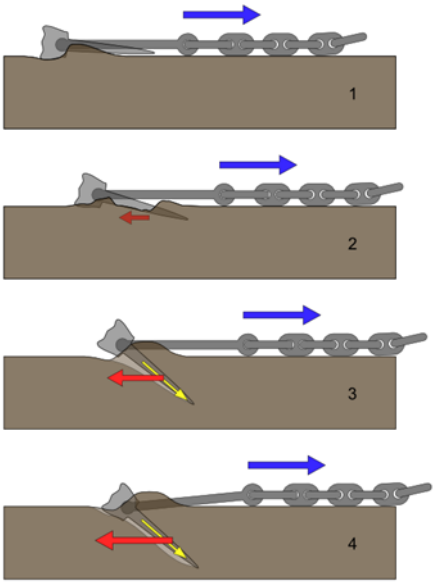

Figure 1: Anchor is designed to lie flat and dig into the seabed (Tosaka, 2008).

2.1.1 Admiralty Pattern Anchor

This anchor type (Figure 2) was standard use on vessels that dates back to 10 000 years. Start of the 20th century the use rapidly decreased, because the stockless anchor was introduced. But still, some of the smaller crafts and fishing vessels are using it nowadays. (Clark, 2009, p 187).

The main design fault is the stock (Figure 4) Because of that it cant be stowed flat and only one fluke digs into the sea bed. The other fluke cant be used as holding and during the swing the cable can get stuck. The stock was added so that gravity pulls its weight to one side so that the fluke can fully into the sea bed. It also adds pressure that it doesn't turn itself on the

flat side. Stock can be removed during a stowing anchor at home so that shank is fully secured in the hawse pipe. (Danton, 1996, p. 1).

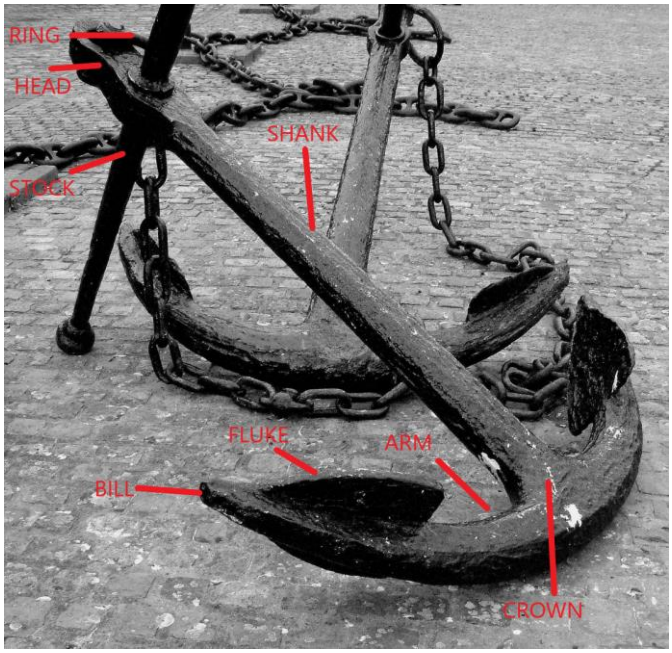

Figure 2: Admiralty pattern anchor details (Plbmak, 2008).

2.1.2 Stockless Anchor

The stockless anchor (Figure 3) is most universally used on merchant's vessels. It is easier to stow and handle onboard compared to stock anchor. There are many different design types, but the principles stay the same. It has two moving components. The shank is connected to the crown plate, which has flukes that are able to rotate angel up to 45 degrees. The ability to rotate flukes helps it to dig better into the seabed and increase anchor holding power. By that ideally, both flukes are in use compared to stock anchor. The higher the angle between flukes that can tilt away from the shank determines the anchor's ability to penetrate the seabed.

The stockless anchor has also two major problems. The mud can clog into the moving parts of the anchor. Witch causes the flukes cant tilt to the maximum desired angle. This can be avoided by regular maintenance of the washing anchor every time it's used. It is also recommended to use anchors in turn. Another problem occurs that sometimes one fluke starts to enter into the seabed earlier than other. This causes unbalance and reduced holding ability. (Clark, 2009, p 188).

2.1.3 Admiralty Cast Anchor

This anchor type (Figure 4) has mainly been used by warships, because of their good holding ability. It has twice as much holding power compared to a stockless anchor. Nowadays some merchant's vessels are starting to gain interest to them. Compared to a stockless anchor it has 2-3 times better holding power in poor holding grounds such as blue clay, soft mud, and hard rock covered with a thin layer of silt.

The similarities between stockless anchors are that they use the same moving compartment parts and the design is similar. The admiralty cast anchor is much heavier and larger. That's why it's used mainly by large vessels. The maneuverability is complicated because of the size. They are more costly and many shipping companies prefer to choose simpler and smaller size stockless anchors. (Danton, 1996, p. 4).

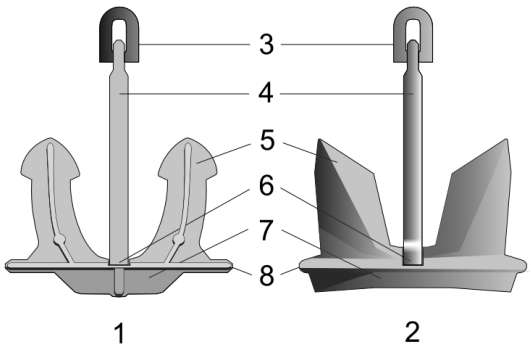

Figure 3: 1. Stockless anchor 2. Admiralty cast anchor 3. Ring 4. Shank 5. Hinged palm 6. 7. Crown (Tosaka, 2008).

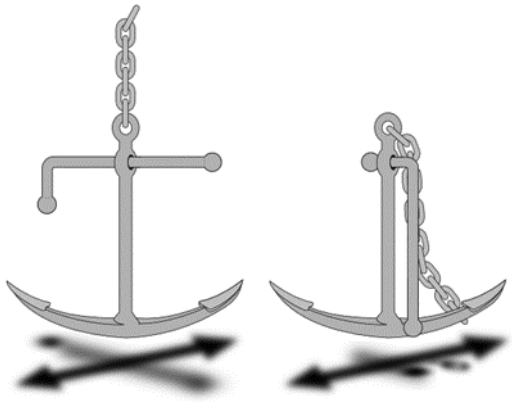

Figure 4: Admiralty pattern anchor with and without stock (Tosaka, 2008).

2.2 Anchor cable

The anchor cable is stored in the chain locker. Between bulkhead and chain, there is the bitter end. It is made of weaker material, so in an emergency situation, it breaks apart. It is designed for that if the cable runs away uncontrollably it prevents damage to the vessel.

The cable is made of a studded link chain and is usually 15 (27.5 meters) shackles in length. The studs in the middle (Figure 5) strengthen and prevents the chain to break in under heavy tension. The measuring shackle is painted red and four anchor chain links on either side are white, with the last link covered with wire. It is easy to keep in mind that the weight of one shackle is approximately equivalent to around half the weight of the anchor. (Baudu, 2014, p. 23).

Figure 5: Common (17 kg) and enlarged stud links (30 kg) (Wolfmann, 2021).

The Kenter lugess are larger than normal chains. It is used to connect shackles together. It consists of interlocking halves and a locking pin. They are removed if splitting of the shackle is needed. Another option is the Dee shackle which is used in newer vessels. It is U-shaped and connected to two cables. The shackle can split by removing the pile pin of steel and bolt from D- luggage. (Clark, 2009, p 192).

When using an anchor during maneuvering its needs to be taken into consideration how many shackles have in your vessel. It happened once in his career when their vessel run out of the chain. The anchor was dropped too early 400 m before the quay. Due to a miscalculation, the vessel was not able to berth and needed to go back to pick up the anchor. (Pilt, 2023).

2.3 The windlass

An electrical windlass (Figure 6) is used to operate two bower anchors. The motor turns the worm gear and worm wheel which makes lay shaft operation possible. When the reduction gears are engaged with the lay shaft by a sliding claw clutch, it makes it possible to heave in or pay out the anchor cable. (Clark, 2009, p 198).

The cable is connected to the windlass. The cable comes out from the chain locker through the spurling pipe to the windlass gypsy above. Then it comes to the deck and goes through a chain stopper and hawse pipe. Finally, the cable is connected swivel, which ables it to anchor turn itself and to the anchor shank. The average speed for releasing an anchor is about one shackle every three minutes. It is usually done by motor windlass controlled release. On bigger vessels and depths, the free release is used where a stopper is used to control the speed. It is riskier because it can in a short of time become uncontrollable if the stopper lacks functioning. (Baudu, 2014, p. 23).

There are two types of methods for how shackles are counted. The first one is how many shackles are on the windlass and the second is how much is in the water. When counted on the windlass, the chain length from deck to hawsepipe and freeboard needs to be taken into consideration, when determining how many shackles to put in water.

How the chain is leading plays also an important role. When letting go or dropping anchor it is recommended that the bow is positioned towards the chain to ensure even output. The vibration of the chain indicates that the anchor is clear from the sea bed when heaving up. (Pilt, 2023).

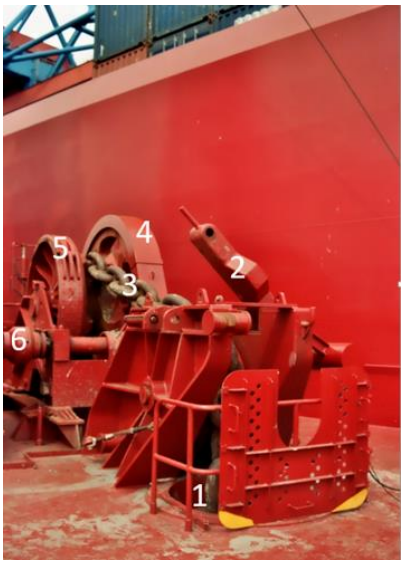

Figure 6: Windlass; 1. Hawsepipe; 2. Chain stopper; 3. Chain; 4. Gypsy wheel; 5. Break; 6. Clutch (Buonasera, 2014).

3 Procedures for anchor use

There are many procedures and checklists for every specific situation which are required to follow. They ensure that all safety measures and preparations are done, before starting to operate. This goes also with anchor use.

3.1 Planning for anchor use

Putting the vessel to anchor is the most common ship handling task to the masters. Good knowledge of your vessel and preplanning must be made to be successful anchoring. The main characteristic that determines the vessel's maneuverability is the bow thruster. Some of the vessels lack it or don't have enough power. (MacElrevey, D.H. & MacElrevey D.E., 2004, p. 165).

Planning calculations need to be done to take into consideration your and other vessels anchored swinging radius. When the wind direction changes, vessels start to swing. The vessel must be anchored that way so there is no other vessel in your safe swing circle. (Pilt, 2023).

The core planning comes from information gained on next points:

- ✓ Type of seabed
- ✓ Depth of water
- ✓ Direction and strength of wind and current
- ✓ Location of navigational hazards
- ✓ Maneuvering room
- ✓ Weather forecastle and visibility

(MacElrevey, D.H. & MacElrevey D.E., 2004, p. 167).

3.1.1 Wind and current

Wind and current determine which should be the vessel's final heading to the anchorage. Always position the vessel bow against the forces, so it is easier to drop anchor and move backward with engines. It is easily determined how all other vessels' bows are facing. It is

always better to not fight the forces but to use them to assist in maneuvering. It is recommended to plan ahead to position and maneuver a vessel so that set and leeway drifts actually help you to turn. (MacElrevey, D.H. & MacElrevey D.E., 2004, p. 168).

3.1.2 Depth of water

The shallow water increases the vessel's tactical diameter. Ship squat effect occurs also which causes an increase in the draft. The vessel can twist during a maneuver in shallow water. All those points should be taken before consideration.

Anchors should be never free-fall released over 30 m in depth. There is the possibility to create momentum where the anchor chain becomes uncontrollable. Therefore windlass should be used in high depths to lower the anchor to the bottom. (MacElrevey, D.H. & MacElrevey D.E., 2004, p. 170).

Anchor should be never dropped if there is not sufficient depth under the keel. Trim and heel should be taken also into consideration because they cause extra draft during maneuvering. Anchor and the chain can damage the hull if it gets under the keel, especially when heaving up the chain. (Pilt, 2023).

3.2 Preparing anchor for let go

The following steps are carried out, when electrical power is gained to windlass:

- ✓ The OOW is in charge on deck during anchor operation and with VHF contact to the bridge.
- ✓ Check if the chain locker is clear of people.
- ✓ Ensure that the windlass brake is on and holding and that the windlass is in gear.
- ✓ Bousin or AB is in charge of the windlass and follows orders from OOW.
- ✓ Hawse pipe covers are removed.
- ✓ Before removing the devil's claw tighten the brake band.
- ✓ Remove any additional lashings.
- ✓ Take off the break and walk back on the cable until the anchor is out.

- ✓ Apply the brake again and take the windlass out of gear.
- ✓ Report to the bridge that the anchor is ready for letting go. (House, D.J. 2014, p. 42).

3.2.1 Preparation to officers

The following steps should be briefed to officers, before anchoring operation:

- ✓ Witch anchors are used
- ✓ Vessel final heading and speed before letting go anchors
- ✓ How much chain will be put out initially
- ✓ Final amount of chain to be used

(MacElrevey, D.H. & MacElrevey D.E., 2004, p. 172).

3.3 The Anchor watch

During the change of watch each OOW should have knowledge witch anchors are let go, their estimated position and how many shackles are put in the water. The main danger comes when the anchor starts to drag. It is recognizable when the chain tightens and relaxes which causes vibration and the vessel starts to swing. (Baudu, 2014, p. 201).

During watch following duties must be carried out:

- ✓ Regular position fixes on the chart
- ✓ Bow pointing to the heading where the anchor was dropped
- ✓ The position of the vessel is in the swinging circle parameters
- ✓ Detecting dangerous vessels in navigation
- ✓ Observing and fixing the weather in the logbook
- ✓ The day and night regulation signals are displayed
- ✓ Watch rounds in the foredeck to check cable lead and windlass breaks

- ✓ If the weather worsens and there is a danger for anchor dragging, the master should be notified immediately. (Clark, 2009, p 216).

3.4 Picking up the anchor

Firstly anchor washing system is prepared. The windlass is put in gear and breaks are released. The vessel starts to move slowly ahead to the anchor. Cable is now taken at moderate speed, about 3 minutes per shackle length. Communication between the forecastle and bridge should be established to monitor the cable pick-up speed. If the chain starts to resist, heaving in the cable must be paused, so the vessel can move closer. Ideally, when the vessel is in anchor position it should be able easily to lift straight up from the seabed of the anchor (Figure 7). (Clark, 2009, p 216).

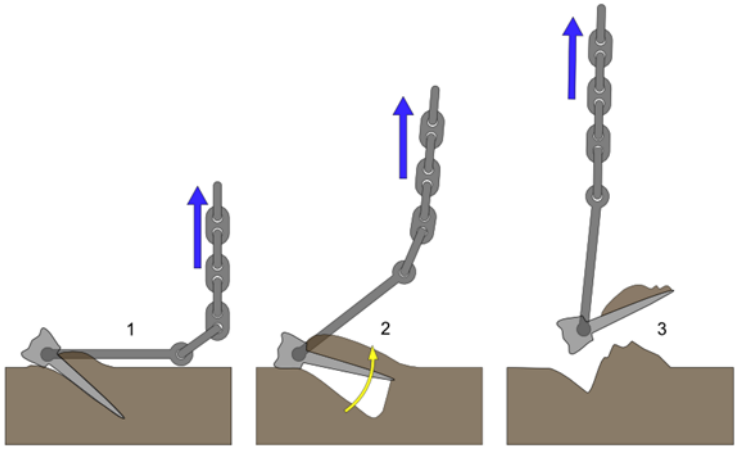

Figure 7: Picking up the anchor (Tosaka, 2008).

4 Different types of maneuvers using anchor

There are many types of methods how to use anchor assistance during berthing or anchoring. To choose to correct way, one needs to be taken first into consideration, maneuverability free space, weather conditions and also for berthing pier construction.

4.1 Mediterranean moor

This type of method (Figure 8) is commonly used when berthing in Mediterranean islands due to undeveloped ports. Mainly it is used by ro-ro vessels to position their astern ramp towards the quay. The vessel is moored by two bow anchors and astern ropes.

Wind and current play an important role in how approaching should be done. Both anchors need to be put ready by lowering the anchor from hawse pipes and putting a hold on the windlass break.

When the wind and current are from ahead, approach the berth close as possible parallel with the quay. Speed should be dead slow ahead and drop the starboard anchor (1). Put the rudder hard to starboard and pay out cable evenly when vessels making ahead (2). When the astern has turned towards the quay stop the engine and let go of the portside anchor (3). Move closer to the quay by astern thrust. The approaching speed is controlled by slacking or heaving up the chain. Send astern mooring ropes by the first available moment. The anchor chain is heaved up to tighten the ropes which are on the bitts (4).When the vessel is cast off the berth, firstly the stern lines are let go. The vessel approached with dead slow speed towards the anchors and simultaneously heaves up the chain. (House, D.J. 2014, p. 647).

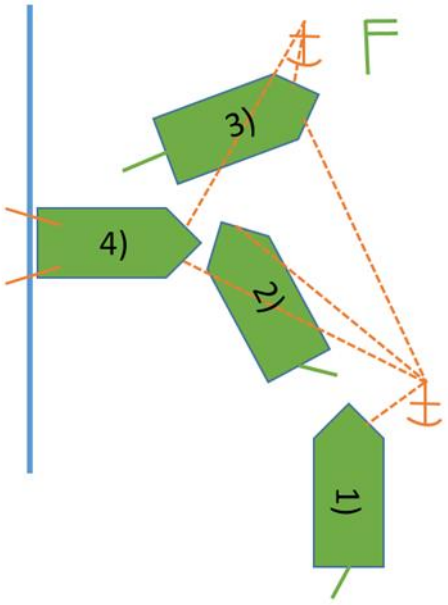

Figure 8: Mediterranean moor (Daniel Bittman, 2023).

A similar type of maneuver (Figure 9) can also be made when the vessel needs to berth where to bow is facing toward the quay. For example, the ro-ro vessel has a ramp on the bow and stern anchor. When possible the approach should be 90 degrees towards the quay with dead slow speed ahead. Before 50 m to the quay astern anchor need to be dropped and chain fixed. The vessel uses forward mooring ropes and anchor for berthing. (Kellamov, 2023).

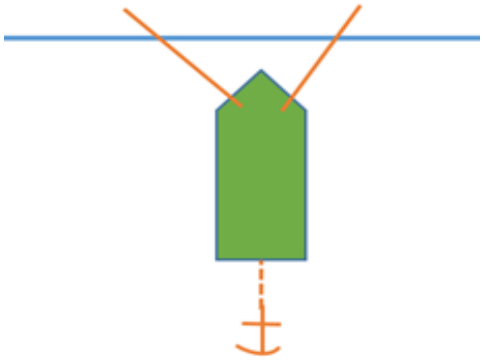

Figure 9: Opposite Mediterranean moor (Daniel Bittman, 2023).

4.2 Baltic moor

This type of maneuver (Figure 10) is useful when the wind is pushing toward the quay. The wind assists the vessel to push evenly toward the quay. Before dropping the anchor preparation needs to be made. The stern mooring wire which runs behind the board must be connected to the opposite anchor chain of the quay. Usually for that boatswain's chair is used.

The vessel must position the bow opposite of the berth. Approach with dead slow speed and a distance of about 75 meters. Drop the anchor, and pay out evenly the chain and wire (1). The force of the wind pushes the vessel towards the berth (2). When possible firstly secure the vessel in berth with forward and stern lines (3).

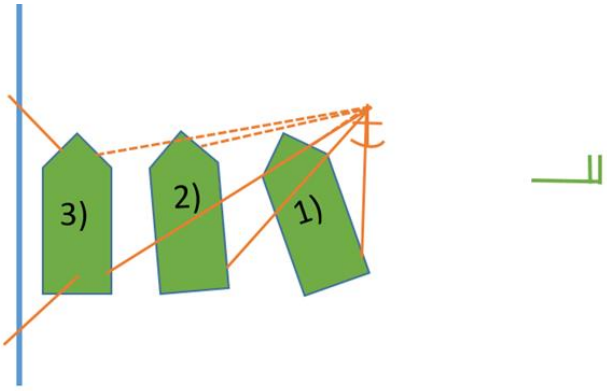

Figure 10: Baltic moor (Daniel Bittman, 2023).

When clearing the berth anchor chain and stern mooring line are heaved up. Slack is given to the wire and the bow turns away from the quay. After that engines and helm are used to fully berth away. This type of operation consumes a lot of time and mooring wire length. (House, D.J. 2014, p. 646).

4.3 Mooring between two ships

The wind is pushing towards the quay and current from ahead (1). Position the vessel to parallel the moored vessel (2). Use a line thrower or mooring boat to send out a stern starboard quarter mooring line (Figure 11).

With heaving up the line and giving astern trust, the vessel starts to turn. The current directions assist also in maneuvering (3). The wind starts to push rapidly towards the quay. The Port anchor is dropped to control the bow movement. Pay out the chain and heave up the stern line to close the gap with the quay (4). When possible firstly send out forward head lines. When getting underway heave up the anchor chain to move the bow away from the quay. (House, D.J. 2014, p. 627).

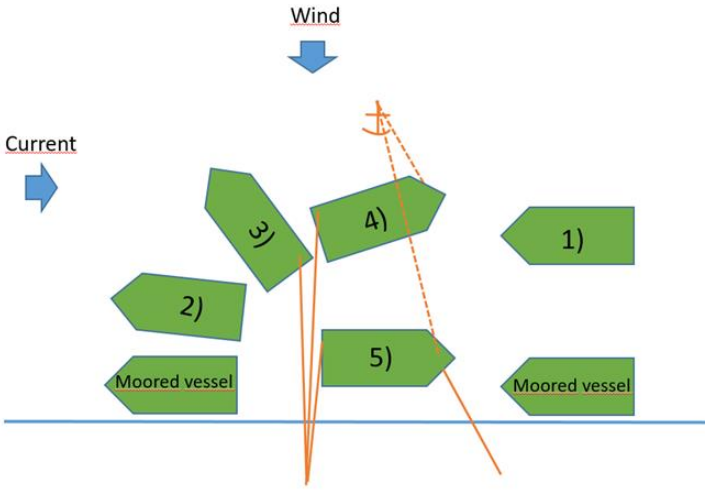

Figure 11: Mooring between two ships (Daniel Bittman, 2023).

4.4 Dragging anchor

A dragging anchor is a method when a full stop of a bow movement is not needed when dropping an anchor. When the vessel is steamed at low speed it is exposed to wind and

current which can cause drift. It provides accurate helm control for maneuvering. It can be used as a spring effect by turning aft towards the berth with rudder use.

An alternative option is to dredge the anchor when the vessel is positioned up tide. Let the tide forces push the vessel backward. Use the rudder to move towards the berth The length of the cable out should not be more than twice the depth of the water. (House, D.J. 2007, p. 96).

4.5 Running moor

This method (Figure 12) is used to moor a vessel between two anchors. It is used for limited sea room and to reduce swinging. The vessel needs to approach slow speed towards the tide. Let go of the windward anchor at the length of the final cable from the desired position (1). Continue moving forward and pay out about 9 shackles. Stop the engines when 8 shackles have paid out. Let go of another anchor. At this time 9 shackles have paid out and the vessel starts moving astern (2). Simultaneously heave up windward and pay out port side anchor chain. Once both anchors are at 5 shackles fix them and stop the vessel (3). (House, D.J. 2014, p. 643).

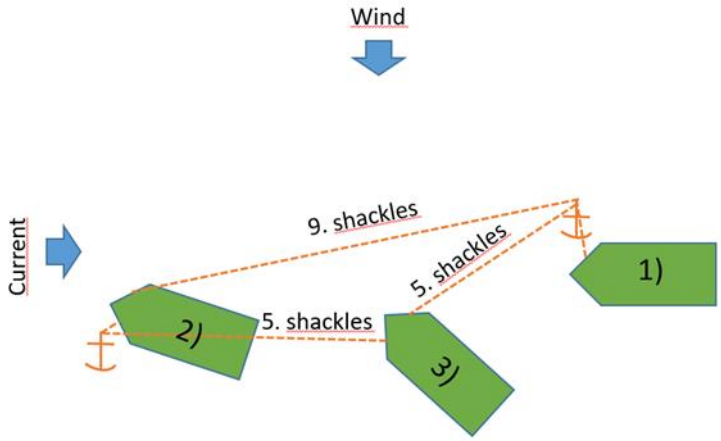

Figure 12: Running moor (Daniel Bittman, 2023).

4.6 Standing moor

The method (Figure 13) is similar to running moor, but the procedures are opposite. It can be extremely useful when engines stopped working and anchoring of the vessel is needed. The vessel bow needs to be positioned towards the tide. Let go leeside anchor and let the

tide forces move the vessel backward (1). When 8 shackles have paid out drop the starboard anchor. Simultaneously heave up the leeside and pay out the starboard anchor chain (2). Vessel stars move ahead and when both anchors are 5 shackles of length fix them (3).

The main idea in both running and standing moor is there is the main and sleeping anchor. Once the tide direction changes one of the anchors becomes main. This will reduce the swinging area. (House, D.J. 2014, p. 645).

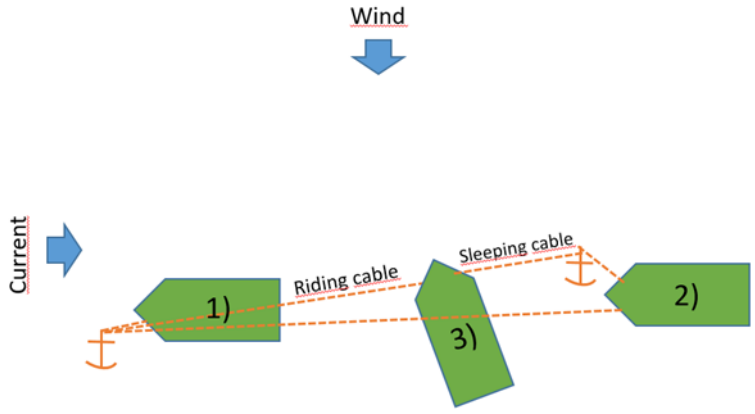

Figure 13: Standing moor (Daniel Bittman, 2023).

4.7 Open moor

When the vessel has arrived at the determined position (Figure 14) with dead slow speed, the windward port anchor is let go. Switch to dead slow astern. When the vessel has reached to desired chain length, the direction to dropped anchor is fixed (1). Then approaching ahead about 20-30 degrees from the previously dropped anchor. When reaching transverse from the first dropped anchor, the second starboard anchor is dropped (2). The same amount of cable is paid out and both chains remain at equal lengths in the end (3).

The length of the chain paid out depends on the water depth. The following average values are used: depth over 20 meters, pay out a length of chain that is 3-5 times the depth. When below 20 meters, pay out 5 times the depth. (House, D.J. 2007, p. 95).

Nowadays there are a lot of electronics that show vessel moment, but there can be errors. That's why the eye is the king when determining if the vessel has fully stopped. When the vessel is moving astern water jets from both sides are visually seen. They move towards the

vessel's bow. The vessel is stopped when water jets don't continue to flow over the vessel's middle point. That is a handy hint of what he has learned over the years. (Pilt, 2023).

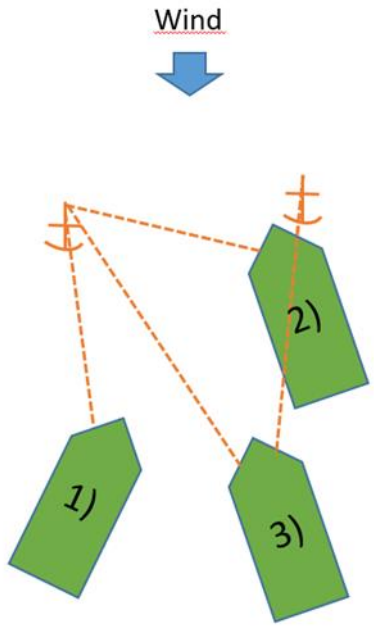

Figure 14: Open moor (Daniel Bittman, 2023).

5 Master's experiences using anchor assistance

Three interviews were made with current masters and pilots where they share their professional experiences using anchors during maneuvering. Vitali Minin is currently a master on a coastal feeder-type vessel where using an anchor during berthing occurs at least once per year. He explained the basic theory of how he approaches when using anchor assistance during berthing and its dangers. Pilot Gunnar Kellamov shared how he managed to use anchor assistance in unplanned, planned, and emergencies where both anchors were used to stop the vessel. Arno Pilt's interview experiences are to be found at the end of paragraphs all over the thesis where he shares the career learned skills.

5.1 Master Vitali Minin's experiences

He has been working as a captain for over 15 years. At least once per year, anchor assistance has been needed for maneuvering. The knowledge of how to operate with it has been crucial because otherwise, the vessel would have not been possible to berth. He has learned and practiced the technique over the years by himself.

When a vessel lacks bow thruster and tug boats, anchor use is very common in small types of coastal type vessels. It is not prohibited to berth if you don't have those to assist during maneuvering.

The wind and current direction and force play a crucial role in planning for berthing while using anchor assistance. In good weather conditions approaching to berth should be 20-25 degrees angle. If the wind direction is towards the quay, the approach angle should be higher up to 90 degrees. The current direction should also be taken into consideration. Especially in British and Danish ports, where it can occur to 2.5- 3 knots. The approaching speed is dead slow ahead about 2-2.5 knots (Figure 15).

The seabed should be checked if you are even allowed to drop anchor. There can be underwater cables, stones, or obstructions which should be avoided. Anchor should be dropped about 1 - 1.5 of your vessel length distance to the quay. One shackle of cable to pay out and fix. Ports with a water depth of 25 m, two shackles. Always use an opposite anchor to which side vessel berth.

The main purpose of the anchor is to improve maneuverability and control the bow. Many accidents happen in the forward part. It stops the bow movement and works like a spring. The vessel by that has very good turning ability, while the astern moves and the bow is fixed in position. It is possible by engine and rudder use. When a bow moment is needed, more chain should be paid out. (Minin, 2023).

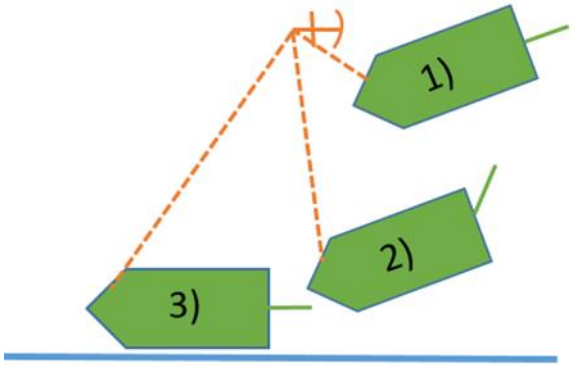

Figure 15: Using starboard anchor (Daniel Bittman, 2023).

5.2 Master Gunnar Kellamov's experiences

He is an Estonian pilot and Bekker harbor captain who has been berthing vessels in port for over 21 years. During his career, he has used three times anchor assistance during mooring and one time in an emergency to stop the vessel. He has seen few masters who have the knowledge of using anchors during maneuvering. Many are afraid to use it due to a lack of experience. Only by personal practice in a career is this learnable. One bigger vessel, tug boat assistance is always available, and because of that anchors are very rarely used.

Each harbor has different criteria when tug boat use is mandatory. For example in Bekker port when the vessel is over 130 meters and the wind force is above 15 m/s it is a requirement. He made the corrections after the previous experiences in scenarios 1 and 2. (Kellamov, 2023).

5.2.1 Unexpected anchor use nr.1

The first time where anchor assistance was required happened with a coastal vessel in 106 meters in length (1). The plan was to berth port side alongside (Figure 16). Approaching

quay about 90 degrees with a speed of 1.5 knots and turning vessel to starboard using engine momentum when astern trust is given (2). When the vessel is parallel use the bow thruster and rudder with engine trust to close the cap with the quay. Finally, send ropes to berth. Weather was rough on that day and wind force was about 15 m/s SE. Tug boat assistance was not mandatory due to regulations.

When it was time to turn the vessel to starboard the engine astern trust momentum didn't work but bow kept heading straight to the quay. The bow thruster lacked the power to turn. To stop the vessel bow from moving ahead and at the same time turn, the starboard anchor was dropped. About one shackle of cable was paid out and fixed. Engine trust was put in full ahead and the rudder was hard to starboard (3). The vessel turned to parallel 25 meters away from the quay. At that time engine trust was put astern and helm amidship (4). The first danger was avoided and the situation stabilized. To avoid the stern drifting to the quay, the rudder and the engine were used to keep distance. The anchor was used like a spring. More anchor cable was paid out to let the wind push bow slowly alongside to quay. At the end with the engine and rudder astern was pushed to berth port side alongside (5). (Kellamov, 2023).

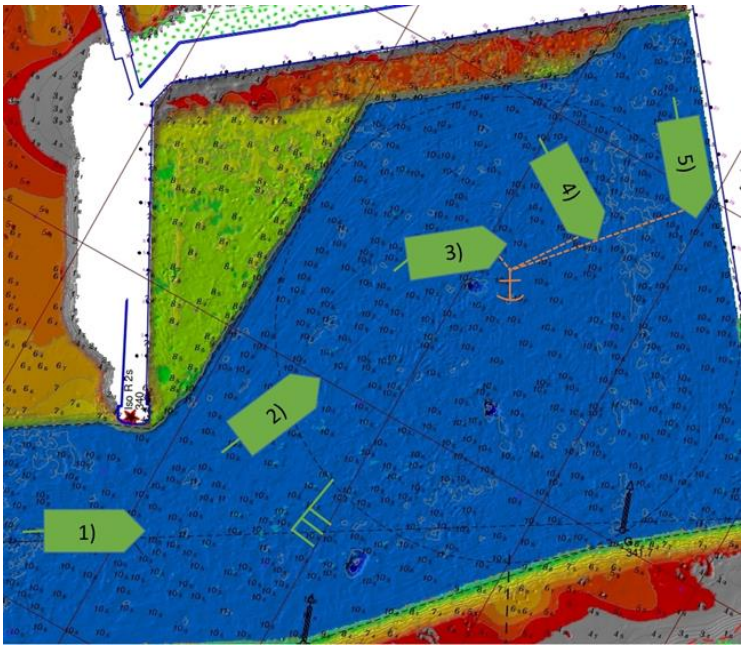

Figure 16: Starboard anchor use in Bekker port (Daniel Bittman, 2023).

5.2.2 Unexpected anchor use nr.2

A similar scenario to 1 happened with a vessel length in 125 m. The approach and berth plan was the same, but the wind was now pushing starboard astern 18 m/s from SW. When the astern trust was given, the vessel bow didn't turn. Thruster was also lacking the power to turn.

The vessel was now drifting toward danger. The starboard anchor was dropped 50 meters before the quay, the rudder was put hard to starboard and full ahead. The vessel turned around the bow pivot point due to the anchor and placed it parallel with the quay. The anchor after maneuvering was taken in. Standard docking practice was done, using an engine with a rudder and bow thruster to berth. (Kellamov, 2023).

5.2.3 Planned anchor use

He has only done one planned maneuvering with anchor assistance. The vessel was 95 m in length without a bow thruster. The weather was good and the wind was 5-7 m/s.

The vessel approached 90 degrees towards the quay while dead slow ahead speed. The starboard anchor was dropped before 100 from the quay. One shackle of the chain was paid out first and fixed. The vessel turned around while the bow stayed in a fixed position and only astern moved towards the quay.

The slight wind from the starboard side was pushing the vessel slowly towards the quay. Periodically total amount of 5 shackles chain was paid out, to let the bow also move towards the quay. Engine and rudder were used to not let astern close. Because the wind was pushing the bow more slowly compared to the astern. When the vessel was close enough mooring ropes were given to fully berth.

When heaving up the anchor unexpected problem occurred. The sea bottom which was blue clay absorbed the anchor, and it was impossible to heave up the anchor by the vessel itself. It required two tug boats to pull out the anchor. (Kellamov, 2023).

5.2.4 Emergency stop scenario using anchor

One time both anchors were used in an emergency to stop the vessel. It was a 150 m tanker. Before the final turn to the Vene-Balti harbor entrance vessel lost engine power (1). The approaching speed was 7 knots (Figure 17). The wind was from astern at 15 m/s and the vessel moving toward to breakwaters. Hard a starboard rudder was given. When the vessel

started to turn and starboard anchor was dropped (2). Bow movement was stopped, but by momentum astern started to move towards the breakwaters. Then port anchor was dropped (3). At that time two tug boats arrived at the situation to assist the vessel to turn away from danger. Finally, the vessel stopped 10 meters before the breakwaters (4). (Kellamov, 2023).

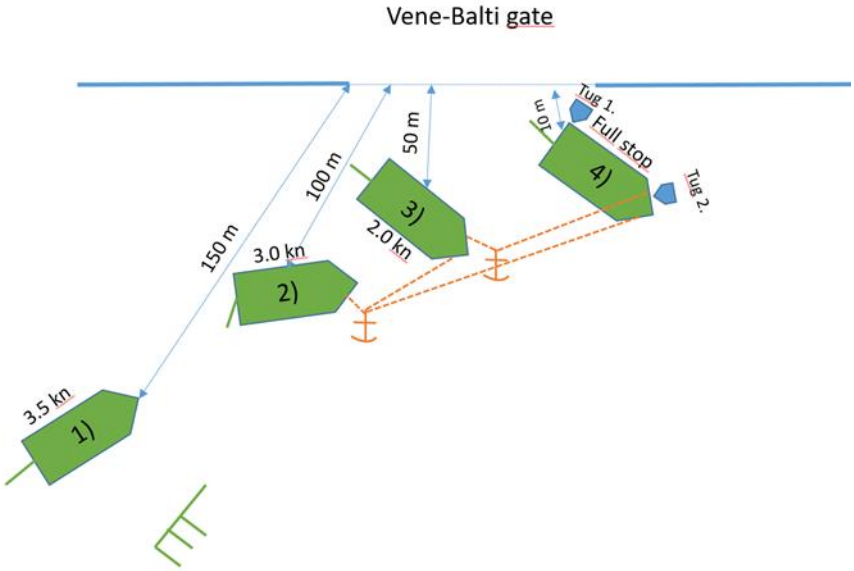

Figure 17: Emergency both anchor use in Vene-Balti port (Daniel Bittman, 2023).

6 Master Hjortur Jonasson anchor manouvering video

The video was put in the thesis to give also a visual example of how in real life anchor assistance is used to berth the vessel (Figure 18).

The vessel was 85 meters in length without a bow thruster and no tug boats were required. A 180° turn needed to be done in a narrow place and with the wind 15 - 18 m/s off the berth. Approaching speed was dead slow ahead with a slight angle towards the quay.

About 50 meters from the quay starboard anchor was dropped and 1.5 shackles were put on the windlass. The rudder was put starboard and shortly time full thrust was given to speed up turning (1). At this moment bow stopped moving ahead and the vessel turned around the anchor (2).

Firstly forward spring was sent out and heaved up. It makes it possible to pull the bow closer to the quay and control its movement (3). Anchor chain is many times heaved up or paid out according to the situation need to control the bow movement speed towards the quay. The

rudder is put to starboard to work astern closer to the quay (4). Vessel is now parallel with the quay and all mooring ropes are sent and heaved up (5).

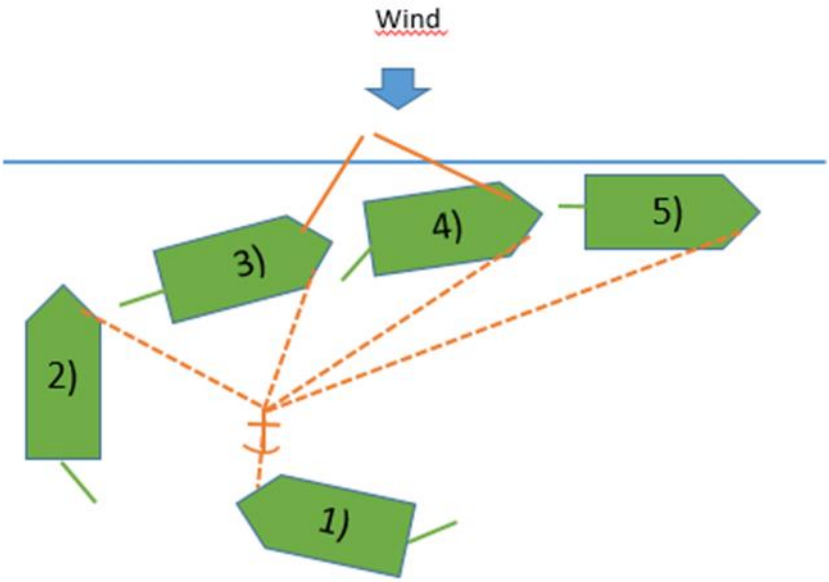

Figure 18: Berthing with the use of a starboard anchor (Daniel Bittman, 2023).

6.1 Anchor manouvering video

Drawing and explanation were constructed by Hjortur Jonasson's youtube video *Vessel Docking/berthing on anchor, old style, full length* (Figure 19). With the permission of the author original video was edited.

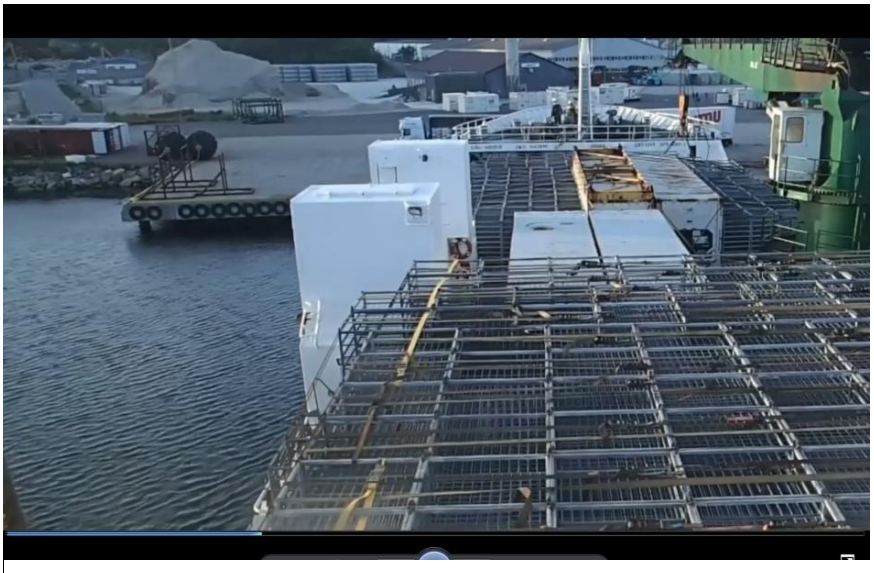

Figure 19: Screenshot of the video Anchor use in maneuvering (Daniel Bittman, 2023).

Video 1: https://www.youtube.com/watch?v=hpI8SDJfAZA

Link to the original video 1. *Vessel Docking/berthing on anchor, old style, full length.*

Video 2: https://www.youtube.com/watch?v=gEKTaskPC6U

Link to the edited video 2. *Anchor use in manouvering*

7 Discussion

The objective of the thesis was to find out how important is it to have the skill of using anchors in maneuvering. How to use anchors in different maneuvering techniques according to the situation.

In interviews conducted, it was found that it is a crucial skill for the master to use anchors during berthing. The result was that vessels without bow thrusters and tug boat assistance are commonly using anchors with heavy wind. Otherwise, it is too dangerous to the vessel berth, and delay is inevitable. It mainly concerns smaller vessels under 100 meters that are not required by port regulation to use tug boats. The shipping companies are often not willing to pay for the extra expense of hiring tug boats when it is not required.

Therefore it is important to ensure that masters who are going to operate similar types of vessels have at least a theoretical part of how to use anchor during berthing. Interview with master Vitali Minin he added that nobody has ever been asked about his experience maneuvering the use of anchors.

Master Gunnar Kellamov's experiences being a pilot for over 20 years state that there are very few masters with sufficient skill and confidence to use anchors during berthing. Skill in how to use anchors during maneuvering can decide from successful berthing to an accident.

A good example is in chapter unexpected anchor use nr.1 and nr.2. Berthing did not go by plan and fast acting was required. Theoretical knowledge that dropping the starboard anchor will stop bow movement and improve turning was a very important decision to avoid colliding with the quay. But if the port anchor would be dropped without theoretical knowledge it may be made the situation worse. Understanding the fundamental use of anchoring will add to your seamanship portfolio extra choice when a critical situation occurs.

Sometimes the only correct choice is to drop both anchors to avoid a collision. It was discussed in the chapter emergency stop scenario using an anchor. The vessel lost an engine, before entering the port. The vessel master panicked and started to pray not even trying to find a solution how to avoid disaster. Gunnar Kellamov being a pilot and realized that dropping both anchors would be the only choice to save collision. Luckily the vessel stopped 10 meters before the gate. Therefore he always lets both anchors make ready when entering to port.

It is under the shipping crewing department's responsibility that the master has sufficient knowledge according to vessel type and reduces possible accidents in the future.

In the thesis, there are many examples and situations on how to berth. Comparing master experiences and literature the fundamentals of maneuver are the same. The main purpose of the anchor is to improve maneuverability and control the bow. The positioning of the vessel and approach angle can vary due to port characteristics.

It was interesting to find that in the chapter Mediterranean moor there is also an opposite berth option to that where a stern anchor is used which was not found in literature, but in master Gunnar Kellamov's own experiences using that.

8 Conclusion

Based on the literature review and real-life interview examples it can be stated that the skill to use the anchor in maneuvering can be crucial to avoid accidents or berth successfully. Using an anchor is often used in coastal-type feeders to improve the vessel's ability to maneuver in rough weather conditions or currents during berthing. It is also important to plan the anchor use taking into consideration sea bottom type, the scope of shackle, and depths.

In conclusion, the use of anchors needs good theoretical knowledge and confidence to stick to the plan. It is only possible to improve the skill by use of the practice. If the theoretical part is well understood it will help future masters to overcome challenging situations and ensure the safety of the crew and the vessel.

9 References

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Interviewees

Estonian pilot and Bekker harbor captain Gunnar Kellamov

Master Vitali Minin

Estonian pilot Arno Pilt

List of Figures

List of videos

1. https://www.youtube.com/watch?v=hpI8SDJfAZA

Link to the original video 1. Vessel Docking/berthing on anchor, old style, full length. (Hjortur Jonasson, @1234triumph, 2017)

2. https://www.youtube.com/watch?v=gEKTaskPC6U

Link to the edited video 2. Anchor use in manouvering. (Daniel Bittman, 2023)