Anchor Practice

A Guide for Industry

First Edition

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CHAPTER 3
Working with Anchors

Introduction

Every experienced seafarer will have been engaged with anchors and routine anchor handling at some time in the past. However, it would be unusual to find a person who has carried out every type of mooring and every form of anchor work operation.

This chapter is introduced to illustrate the many varied operations that could and may be experienced by individuals in the field. It is not meant to provide every method available, but to show an example, method, which will not only be practical, but also acceptably safe.

The routine usage of anchors within the marine environment is readily accepted by all . From the principles of coming to a 'single anchor', to the more demanding task of 'hanging off' an anchor to enable the chain to be moored to a buoy.

Whatever the usage, most operations are considered part of day-to-day activity onboard a working vessel. However, routine can and does, often overrun into emergency use of anchors, as when weighing anchor it is realised that the chain or anchor is 'fouled', then the clearance of the foul can become anything but routine.

Prudent planning, in advance of the use of anchors, can often avoid the time consuming mishap that may occur at a later date. Such preparation must be considered normal practice. The amount of detail that is introduced into an anchor plan, will vary on each occasion and with the experienced gained by the ships Master. Many vessels may go to an anchorage having conducted an informal plan of operation. This is not to be recommended as it is all too easy to omit critical aspects. It is worth noting that 'Pilot' navigation officers in the Royal Navy carry out extensive training procedures to ensure smooth operations when laying anchors.

Lessons can also be learned from offshore operations when laying anchor patterns. These need meticulous planning in all aspects of co-ordination as well as extensive support services by way of communications, adequate manpower, and readily available resources to ensure trouble free, successful outcomes.

The Function of an Anchor

The purpose of a ships anchor has been to provide a holding point for the lay of cable between the vessel and the anchor. It is widely accepted that it is the weight and length of cable that is payed out, not the singular weight of the anchor that retains

the vessel in the anchored position. It is also an incorrect belief that in the event that the anchor is dragging, paying out more cable will hold the vessel in position. The assumption is incorrect because adding additional cable produces a more horizontal pull on the anchor causing it to dig in better and hold under this horizontal force, so preventing dragging.

If insufficient cable is employed when laying the anchor in the first place, the pull on the anchor will be upwards towards the surface, not horizontal, causing the anchor to break away from the seabed.

It is estimated that the holding power of the anchor would be reduced by the following percentages at respective angles of inclination from the seabed, when considering a conventional stockless anchor:

Angle of Inclination to Seabed	*% loss of holding power of Anchor*
5°	20% holding power lost
10°	40% holding power lost
15°	60% holding power lost

The holding power of each type of anchor is different and the effect of the holding ground, being a variable, will greatly affect its overall efficiency. The best holding ground for the anchor is generally considered as 'Clay' although 'Mud' is usually quite acceptable. Hard sand, could also be considered as a viable third option.

A high holding power anchor by its design can also be expected to benefit the ship more than a vessel equipped with say an ordinary stockless type designed anchor.

Additional factors which would directly effect the anchors holding ability will include what grade of cable is employed:

Mild Steel Cable = Grade 1
Special Quality = Grade 2
Extra Special Quality = Grade 3

NB. Grade 3, cable is the lightest type of chain and more scope would be required to achieve a horizontal pull at the anchor position.

Most shiphandlers would also be influenced on the amount of cable to use, taking into account the size of the ship and the state of loading or ballast that the vessel was in at the time of anchoring. Although the determined scope is directly related to the water depth, a ship in ballast would generally be expected to lay more cable than a ship which is in a deep laden condition. Full account should also be taken of the very worst scenario when rise and fall of a tide is involved. A large rise of tide could effectively remove the desirable, horizontal pull on the anchor if an inadequate amount of cable is veered.

The theoretical factors surrounding the ability of the anchor to hold can be documented to excess, but the individual will find that experience of use, local knowledge of the anchorage and the prevailing weather in the form of wind and current will determine the success or failure in anchoring operations.

It should be remembered that a vessel is expected to employ her anchors and remain at anchor in good holding ground and sheltered conditions in weather up to force '8' on the Beaufort Scale. They are not expected to be used to hold a vessel off a lee shore or bring a moving vessel to a stationary position. The fact that emergency situations generate the need for extreme measures and shiphandlers may have to resort to the occasional extraneous use, is a fact of life within the marine environment.

(see: Emergency use of anchors, Chapter 6)

Stresses Incurred on the Anchor and Cable by the Anchored Vessel

Movement on the anchored vessel will occur because of various external forces such as:

Wind effect, wave action, swell, tidal stream/current flow, etc., all of which are beyond the control of operational personnel. The effects of these external forces will be dependant on the draught, displacement, trim, and the light, ballast or loaded condition overall.

Limited actions by ships personnel can reduce certain effects, such as turning the rudder to provide a 'sheer' to the ships head may reduce the 'Yaw' effects or lengthening the scope to reduce 'Pitch' and 'Surge' effects. Whatever actions are permitted they will only reduce, not eliminate and caution must be used not to reduce the length of scope and the effective catenary so as to break the anchor free.

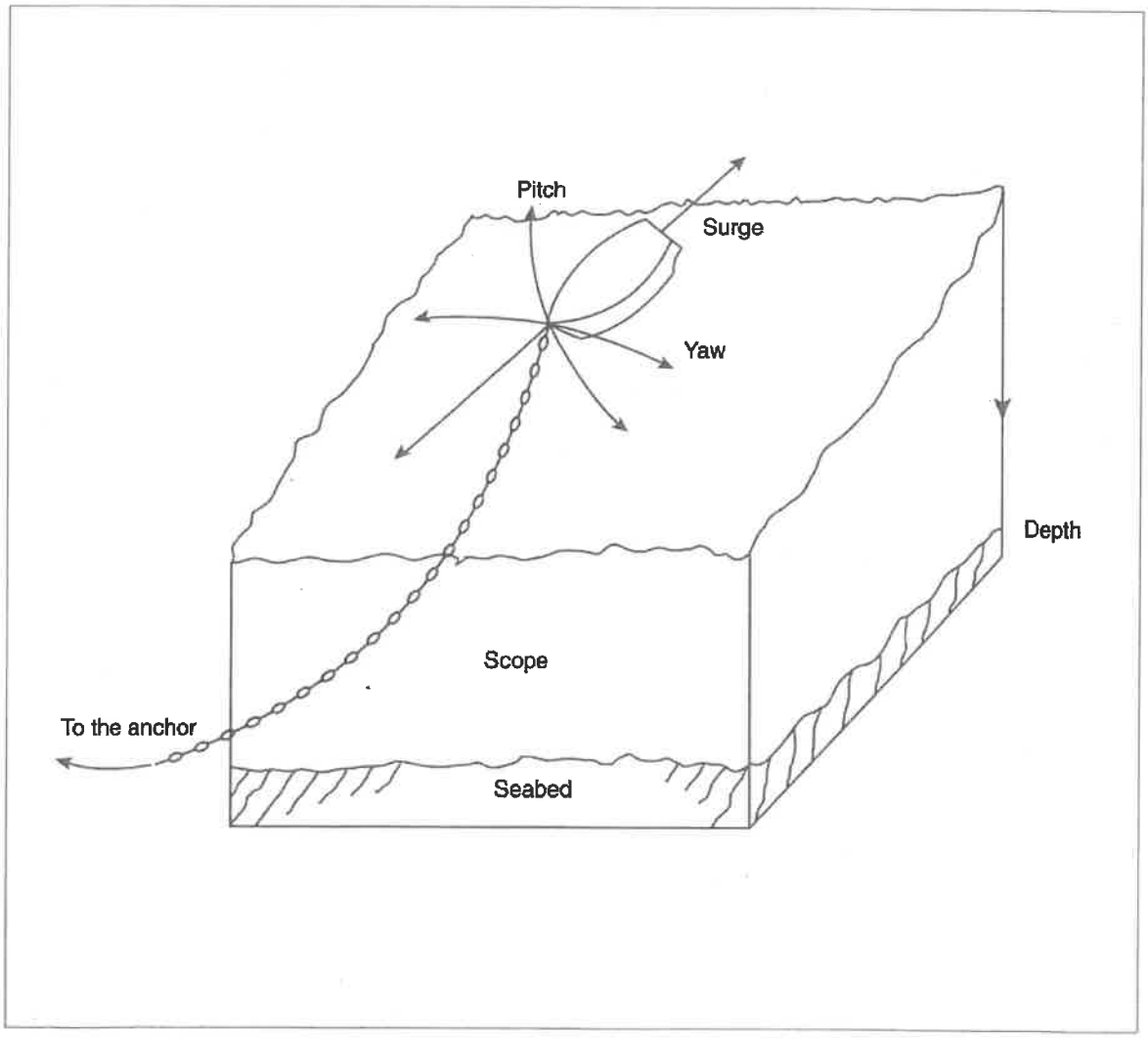


Fig. 3.1 Three degrees of movement by the vessel at anchor.

The Anchor Plan

An anchor plan should be established between the interested parties, namely, :

The Ships Master/ Captain or Offshore Installation Manager(OIM), the Officer in Charge (OiC) of the anchor party, or the Master of Anchor Handling Vessel (AHV).

It would be expected that these key personnel would inform relevant crew members through an established chain of command, regarding relevant criteria.

In the construction of any anchor plan the following items must be worthy of consideration:

1. The intended position of anchoring of the vessel.
2. The available swinging room at the intended position.
3. The depth of water at the position, at both High and Low water times.
4. That the defined position is clear of through traffic.
5. That a reasonable degree of shelter is provided at the intended position.
6. The holding ground for the anchor is good and will not lend to 'dragging'.
7. The position as charted is free of any underwater obstructions.
8. The greatest rate of current in the intended area of the anchorage.
9. The arrival draught of the vessel in comparison with the lowest depth to ensure adequate under keel clearance.
10. The choice of anchor(s) to be used.
11. Whether to go to 'single anchor' or an alternative mooring.
12. The position of the anchor at point of release.
13. The amount of cable to pay out. (Scope based on several variables)
14. The ships course of approach towards the anchorage position.
15. The ships speed of approach towards the anchorage position.
16. Defined positions of stopping engines, and operating astern propulsion (Single Anchor Operation)
17. Position monitoring systems confirmed.
18. State of tide ebb/flood determined for the time of anchoring.
19. Weather forecast obtained prior to closing the anchorage.
20. Time to engage manual steering established.

When anchoring the vessel it would be usual practice to have communications by way of anchor signals prepared for day and/or night scenarios. Port & Harbour Authorities may also have to be kept informed if the anchorage is inside harbour limits or inside national waters.

NB. Masters or Officers in Charge, should consider that taking the vessel into an anchorage must be considered a Bridge Team operation.

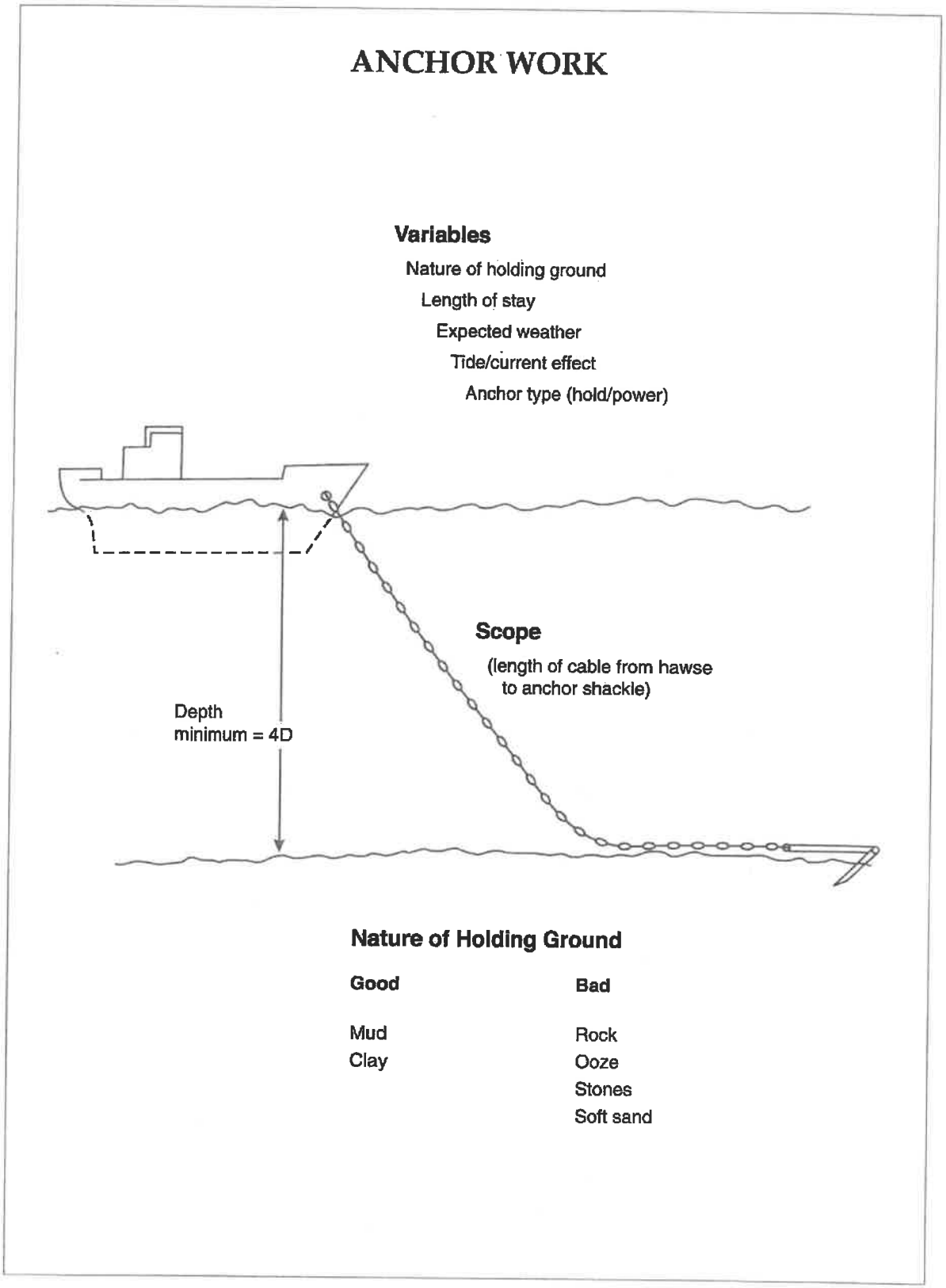


Fig. 3.3 Factors effecting the single anchor mooring.

The Anchored Vessel – Performance in Bad Weather

Once anchored and 'brought up' the main danger for the vessels security is probably from dragging her anchor(s). This detrimental situation is virtually always caused by a change in the natural weather conditions or current/tide changes, assuming that the vessel was correctly anchored in the first place. Dragging would normally be detected by the Officer of the Watch, at anchor and standing orders would invariably include instructions to call the ships Master as soon as the movement is confirmed.

Many shiphandlers have a policy to cater for a vessel dragging her anchor and the usual form would be for the scope to be increased, with the view that the additional weight in cable will cause the anchor to dig itself in again. Alternatively, a second anchor may be used, at short stay, to provide added weight at the fore end and reduce pitch on the vessel. The scope on the second anchor could also be increased if the need arose and the vessel was observed to continue to drag anchor.

Any of these options are worthy of merit, especially if the weather is known to be abating, but this fact cannot be guaranteed at the onset. The disturbing influence, causing the vessel to drag, could well be increasing and the actions taken to initially protect the safety of the ship could work against the well being of the vessel.

The disadvantage of the above actions is that they all restrict the manoeuverability of the vessel in the event that the weather conditions become so bad that the vessel is left with the only option but to heave up anchors and cables and run for open water. Adding additional scope to a single anchor, will not necessarily stop the ship from dragging and would most certainly increase recovery time when weighing anchor.

Letting go a second anchor, underfoot with or without increased scope would cause further delay and may incur constraints on the windlass, especially if the handling gear is old. Recovering one anchor in bad weather conditions may prove difficult, while attempting to recover two anchors, plus cable, may become just too demanding. Masters would invariably have to resort to using the ships engines to ease the weight on the cables and may find themselves restricted to recovering one anchor at a time.

Authors Opinion: Shiphandlers should give due consideration to the prevailing conditions and the historical weather patterns of the area in which they are anchored. Rather than encumber the vessel with more cable or even second anchors, make the decision to 'weigh anchor', and run to either a more sheltered anchorage, or seek open waters and ride out the bad weather. If the terrain and geography permit the 'lee of the land' may be sought and the vessel could steam up and down until the weather subsides.

NB. In all cases of bad weather, the ships engines should be kept available for immediate use and the weather conditions should be continually monitored.

The Master should have the 'con' of the vessel and the anchor party should be retained on 'stand-by' while conditions give cause for concern.

Letting go the Anchor

It is considered normal practice on the smaller type of vessel to let the anchor go from a position of being 'held on the brake'. Initially the anchor is placed in gear with the windlass and then all anchor securings are removed, i.e. Bow Stopper, Devils Claw, brake and any additional chain/wire strops.

Once in gear, the anchor is generally walked back clear of the hawse pipe to ensure that the cable will run freely when desired. (Anchors can be released directly from the hawse pipe in an emergency, but such practice is not considered routine).

The brake should now be applied and tested to confirm it is working correctly and holding the cable, prior to the anchor being taken out of gear. *(See: Testing Brakes.)*

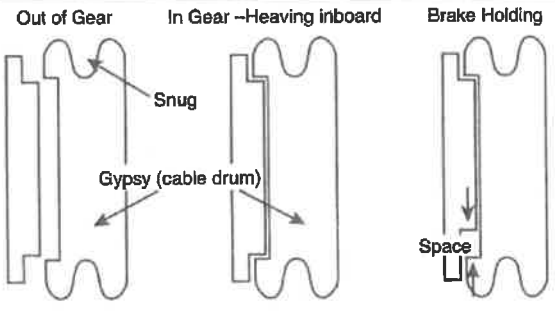
Once held on the brake alone, the ships bridge would be informed that the anchor is ready for 'letting go.'

In the case of larger vessels, anchors are prepared in a similar way and walked back clear of the hawse pipe. However, they are rarely 'let go' if at all, and it is customary to **'Walk Back' the anchor all the way,** until the desired scope of cable has been paid out. The reason for such action is that larger ships have heavier type anchors and cables and the momentum built up from releasing the brake, as with smaller ships, would be so great that the windlass braking system could fail causing loss of control.

Walking back an anchor will provide greater control to Marine Pilots and Ships Masters without incurring damage to equipment. It also reduces the risk of paying out too much or too little cable and eliminates the risk of letting the cable runaway out of control.

Testing Brakes – Windlass

It is essential that the practice of testing the windlass braking system is carried out at regular intervals under a planned maintenance system and also prior to 'letting go' the anchor. A general method employed is to clear away the anchor securings with the exception of the brake. With the anchor in gear, walk back the gear a small amount, this allows a space to appear between the gear plate and the gypsy plate. If the brake is not holding the gypsy (cable drum) correctly, then this space between the two plates will close up under its own weight. The conclusion being that the band brake is not holding the cable drum and is ineffective.



NB. If the brake is holding the cable drum, the space will not close up.

Fig. 3.4

Operational Safety When Anchoring

Certain precautions when anchoring may seem obvious to the experienced seafarer, however, when dealing with five(5) ten(10) or twenty (20) tonne plus anchors complacency can be the seamans worst enemy. Routine operations should therefore include the following items:

1. Always check that the overside surface area is clear of small craft or other obstructions under the flare of the bow, at the intended area of 'letting go' the anchor.

2. Routine operations should provide adequate time to walk the anchor back clear of the 'Hawse Pipe', prior to actually letting go.

3. Designated, experienced persons should operate the windlass and braking system. They would also be protected by suitable clothing including 'hard hat' and 'eye goggles'.

4. All parties to the operation should have inter-related communications. These should be tested prior to employing the ships anchors. In the case of "walkie-talkie" radios being used, these should operate on a clearly identified shipboard frequency and be seen not to interfere with other local shipping operations.

5. The Marine Pilot or Ships Master who has the 'con' of the vessel should be continually informed as to the "Lead of Cable" and the number of shackles in use. It would also be expected that the Officer in Charge of the anchor party would keep the bridge informed of any untoward occurrence, e.g. Fouled anchor or windlass/ power defects.

6. All recognition and sound signals should be employed promptly and correctly to highlight the status of the vessel.

The Use of an Anchor Buoy

Anchor buoys are rarely used these days, other than in the offshore industry. The principle of its use was to identify the position of the anchor and/or aid recovery in the event that the anchor was lost. Many ships used to carry a plastic buoy specifically for this purpose, but a wood float or sealed oil drum often performed the same function.

The buoy line is meant to be attached to a convenient position on the anchor, ideally to the anchor shackle or the links of the ganger length. Unless a gravity band is fitted. The securing is of concern, as there is a risk of parting the wire with the action of the arms and flukes as they angle to dig in.

The choice of material for use as a buoy line or pendant, would depend on the intended function and the length of stay. Some buoy lines may be a combination of wire and polypropylene, especially if the vessel does not intend to remain at anchor for a lengthy period. Other buoy lines/ pendants which may be in the water for a considerable time and are used for recovery purposes, as in the offshore environment, would inevitably be of all wire construction.

Preparation of securing the anchor buoy to the anchor is usually carried out as the vessel approaches the anchorage. The buoy line being passed overside and secured onto the anchor. The anchor may or may not have already been walked back, clear of the hawse pipe. Adequate slack on the buoy line would be held in bights by sail twine, so that when the anchor is let go the line is carried away with the anchor.

The reader will appreciate that the rigging of the buoy line overside is cumbersome and its recovery, when heaving the anchor home, could also cause inopportune problems. Probably the main reason that the practice has been virtually discontinued in the shipping industry, although buoying salvage sites is still widely employed.

In the event that an anchor or cable is intended to be abandoned then the anchor buoy and line would need to be substantial to aid recovery at a later date.

Any Ships Master, given the time and the circumstances, would anticipate a recovery operation and the use of a 24 mm flexible wire rope, held by a substantial buoy, would be appreciated by salvage operators (for average weight of anchors).

Pointing Ship (to creat a 'Lee')

There may be occasions when a vessel lies to a single anchor, that a need is generated to angle the vessel away from the prevailing weather or current and 'point ship'. This action is usually generated to provide an alternative heading for the vessel, for whatever reason, when she lies at anchor. One of the main reasons for pointing a ship would be to provide a 'lee' on one side or another of the vessel to operate small launches or work cargo alongside.

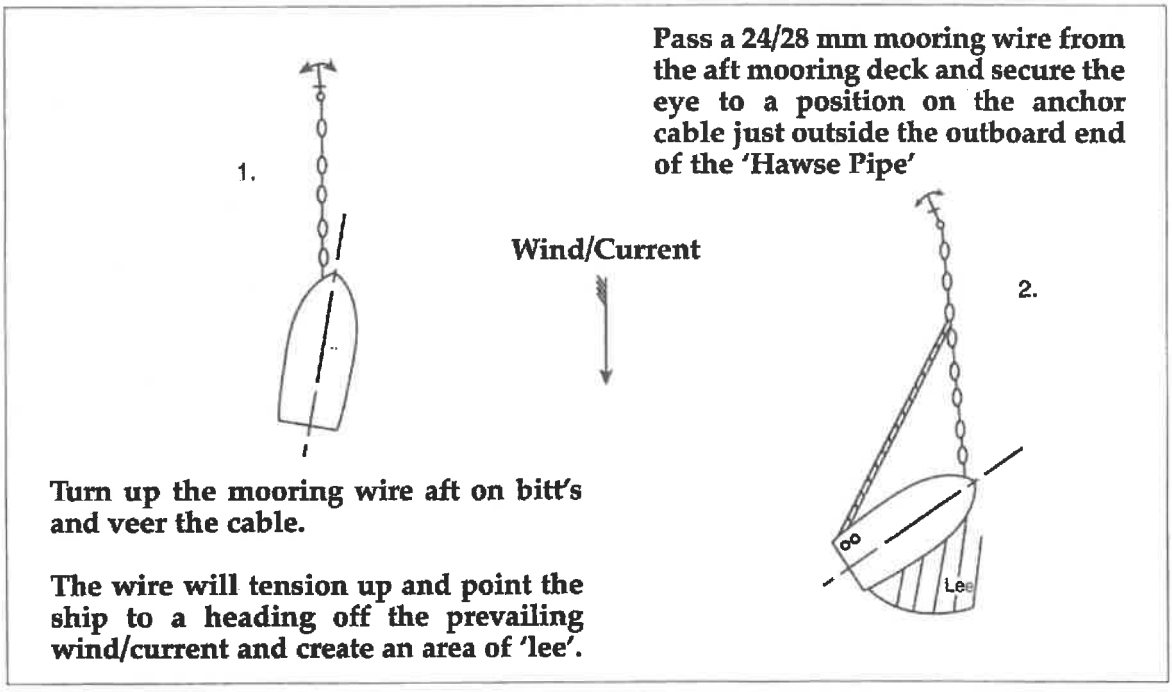


Fig. 3.5

Conducting a Safe Anchor Watch

The purpose of any watchkeeping activity, aboard a vessel at sea, is to keep the vessel safe at all times. The vessel at anchor, although its engines are generally not operational, is still considered as a vessel at sea and as such conforms to the applicable "Regulations for the Prevention of Collision at Sea". (COLREGS).

One of the prime functions of the Officer of the Watch (OOW) is therefore to ensure that the vessel complies with the COLREGS in each and every detail.

Amongst his recognised duties with good shipkeeping, the OOW would be expected to take over the watch and acquaint himself/herself with the ships position and the landmarks suitable for use in position fixing methods. The Watch Officer would also ascertain which anchor(s) is employed and how much cable is paid out.

The prudent officer would expect to carry out a chart assessment of the area and note in particular the position of the anchor(approx.) and the nature of the holding ground in which it is embedded.

The supervision of the watch would include the management of personnel and this would encompass such activities as:- deck rounds against piracy attack, fire patrols, gangway security monitoring and regular checks on the lead and tension of the cable.

The Watch Officer would generally be expected to act as the 'prime lookout' while at the same time maintaining a continuous position monitoring schedule.

Certain factors could well influence the safety of the ship while at anchor, not least the time of high water, the height and range of the tide and how it could influence the strain on the anchor cable. Knowing the times and heights of tides will allow a prior knowledge of when and if, the anchor is likely to break ground, which could cause the vessel to drag her anchor. The time of tides is not the only factor that could effect the ship dragging and moving away from the anchored position. The prevailing weather, without doubt, would be a major influence as to the vessel retaining her anchored position. The OOW would monitor any patterns of change in the weather and if detrimental to the ships security, he would immediately inform the Master of his/her concerns.

The overall safety of the ship is paramount throughout the period at anchor and external influences from either bad weather, poor visibility, local disturbance or even internal strife should not be allowed to jeopardize the effectiveness of the shipboard systems. To this end, main engines should always be left on "Stop" – not, Finished with Engines, (FWE) – and at the discretionary use of the Officer of the Watch. By comprehensive monitoring of internal and external communications, astute action by the Watch Officer should be capable of bringing the vessel to an 'alert status' to combat any emergency or changing situation.

Anchor Watch Procedures in Poor Visibility

All watchkeeping procedures at sea are now covered by either Company Standing Orders, Recommendations of Bridge Procedures, the STCW Convention, or the ISM Code. In the event of poor visibility conditions being present when the vessel lies to anchor the bridge/engine room watch arrangements should follow such recommended practices as are relevant to that vessel.

It would be the responsibility of the OOW, answerable to the Master, to ensure that the COLREG's are fully observed and that respective sound signals are made at required intervals :

"A vessel at anchor shall, at intervals of not more than one minute, ring the bell rapidly for about 5 seconds. In a vessel of 100 metres or more in length the bell shall be sounded in the forepart of the vessel and immediately after the ringing of the bell the gong shall be sounded rapidly for about 5 seconds in the after part of the vessel.

A vessel at anchor may in addition sound three blasts in succession, namely one short, one prolonged and one short blast, to give warning of her position and of the possibility of collision to an approaching vessel." (Ref. Rule 35, Sound Signals in Restricted Visibility.)

The ships position would be continually monitored as at any other time, but with the exception that visual anchor bearings, would in all probability not be possible and the position fixing would therefore have to rely on instrument fixing. Additionally extra lookouts would need to be posted to ensure all round ship security by eye and ear. The Master would have been informed of changing weather conditions and may take the 'con' or stay on the bridge in a stand-by capacity.

Summary of Watch Keeping Duties; OOW

1. Monitor closely the ships position, by both primary and secondary systems.
2. Maintain a continuous effective lookout.
3. Ensure suitable fire/piracy patrols are conducted.
4. Monitor effective communications both internal and external to the ship.
5. Monitor the prevailing weather pattern and any adverse change.
6. Check that the anchor and cable are ranged correctly.
7. Ensure that correct signals are displayed at the correct times.
8. Note tide and current flow changes.
9. Manage watch personnel in the correct administration of their duties.
10. Ensure that the vessel complies with the COLREG's and the Master is updated regarding any changing circumstance affecting the vessel.

Position Monitoring at Anchor

The ships position, when at anchor, should be checked on a regular basis by alternative methods, to ascertain that the anchor is not dragging and the vessel is not standing into danger.

Suggested fixing methods for use as primary or secondary systems are:

(a) Visual bearings. – minimum of three (3) compass bearings of suitable landmarks.

(b) Radar – bearing and distance from a fixed landmark.

(c) Intersecting radar distances from two separate landmarks spaced well apart.

(d) Global Positioning System (GPS) electronic fixing instrumentation, satellite based.

Additional equipment and methods to aid position fixing and corroboration of the vessels position are also usually available on the more modern vessels. Such items as Automatic Radar Plotting Aid (A.R.P.A.), with anchor watch facility , to monitor ship movement, can be extremely welcome. Echo sounder, is part of a ships standard navigation equipment and should also be employed to corroborate positions.

NB. Transit bearings of fixed objects can be reassuring for a Watch Officer on an anchored vessel. However, these are not in themselves totally reliable and should never be used as a stand alone position fixing method.

Detection of a vessel – 'Dragging her Anchor'

When a vessel is dragging her anchor this fact should become noticeable because of the changing position of the ship, (detected by regular fixing). However, good watchkeeping and attention to the weather, sea conditions and the times of tide change, could provide early indication of the possibility of the anchor breaking out. Although close position monitoring is a very definite indication of a dragging anchor, other methods would also be employed, such as:

(a) Checking the anchor bearings for position.

(b) Use of a radar range circle, 'cutting' a prominent point of land, is a very quick indicator that the vessel is dragging and moving towards or away from the displayed landmark.

(c) Depending on the nature of the sea bottom, if the anchor has broken out and is dragging, vibration from the anchor movement would travel through the length of the cable, (especially so on hard or rocky bottom surface). It is not advocated that the OOW leaves the bridge unattended, but a visit to the mooring deck, to feel for cable vibration, may confirm the anchor is dragging.

(d) Alternatively a weighted line (Lead Line) could be lowered over the bridge wing and observed. If the vessel is dragging the lead line would start to lead forward towards the direction of the anchor.

NB. Watch Officers are advised that even if it is only suspected that the vessel might be dragging her anchor the ships Master would need to be informed immediately.

Dragging Anchor – Masters Options

In the event that a vessel is "dragging her anchor" the ships Master would expect to be informed as soon as the situation was detected. Normal practice would be that he/she would take the 'con' of the vessel and order the engines to be placed on 'Stand By'. An anchor party would be dispatched to the fo'c'stle head in readiness to work anchors and cables.

First option – available to the Master would be to order additional cable to be paid out. By increasing the scope of the anchor cable the hope is that the anchor will re-settle and bed into the ground again and the increased amount of chain will reduce the cable angle at the seabed. The expectation being that the increased weight and reduced pull out angle will prevent the anchor from breaking out and dragging a second time.

Second option – If the first option of additional cable is non-effective the Master may consider the use of laying a second anchor, probably at 'short stay'. This option looks at why the anchor has broken out in the first place.

The vessel may have experienced excessive 'YAWING' about the anchor causing a sideways movement on the shank resulting in the anchor working itself free.

The use of a second anchor 'under foot' could well reduce the 'Yaw' motion and allow the anchor to set in a more stabilized manner.

Third Option – If the first two options do not resolve the dragging situation, the prudent Master would have to consider heaving up on anchors and either moving to a better anchorage or steam up and down, until weather and sea conditions improve to allow a further attempt at using anchors.

Dredging Down

The use of anchors when berthing is not unusual and a common use is employed when a vessel is said to be 'dredging down' from a position ahead of the berth, when stemming the tide/current. Once past the berthing position the offshore anchor is let go at 'Short Stay', paying out just enough scope on the cable to allow the anchor to reach the seabed. It should be noted that the speed of the vessel over the ground is not moving as fast as the current. Therefore with a flow of water past the rudder, the control of the rudder and the steering is still effective.

The objective is to achieve a 'crab wise', side movement of the vessel towards the berth. This movement is made by a combination of bold helm action and main engine power ahead, combined with the direction and rate of the current flow, ahead of the vessel. Shiphandlers endeavouring to keep the vessels fore and aft line parallel to the quayside as the ship closes to the alongside position, while at the same time dragging (dredging) the anchor along the bottom to steady and check the bow movement.

Dredging an Anchor – Operational Aspects

If dredging an anchor is to be considered a successful manoeuvre the shiphandler should be aware of the following points :-

1. Walk back the anchor(s) as early as possible in order to acquire the feel of the vessel before she approaches the berth.

2. Approach the position of 'letting go' anchors at a slow speed to retain steerage way. Do not let the vessel stop, as the anchor will have a tendency to dig in, and this would allow the vessel to drift from the line of approach as well as make it difficult to get back underway again.

3. Too much speed on the vessel after the anchor has been let go would cause the pivot point of the ship to be pushed aft and this effectively reduces the benefits of the anchor in the fore end position.

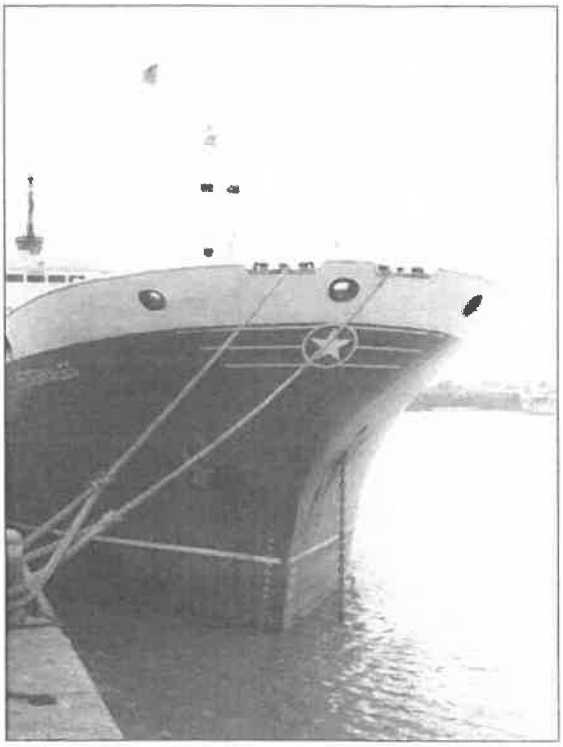
4. Endeavour to keep the weight on the anchor cable. If the cable is allowed to slack, the anchor becomes ineffective.

5. The anchor should be let go at 'short stay' with no more than 1½ times the depth of water. This amount of scope can be varied during the execution of the manoeuvre and can be adjusted accordingly as the weight is seen to bite.

6. Large ships should try to avoid any swinging movement of the vessel. To this end, movement should be positive and deliberate, to provide a steady strain on the cable.

7. Slow continuous movement is more effective than sharp erratic corrections to the ships head.

8. Once moorings have been landed ashore, slack back on the cable as there may be sufficient tension towards the anchor to pull the vessel back off the quayside.



23. General cargo vessel berthed alongside after using her offshore , Port Bow Anchor to check the speed of approach to the berth when docking. The anchor cable is walked back to the 'up and down' position once the vessel is secured alongside.

It would be unusual to 'draw the anchor home' from this position and it is more common to leave the anchor down. This way it can be used to draw the vessel off the quayside when letting go the moorings to clear the berth.

In some cases where the anchor may be seen to cause an obstruction to other vessels using the docking area, the harbour authority may ask the vessel to recover the anchor, or buoy it. Clearly if the anchor position is to be identified the need to buoy it must be known prior to letting it go. In any event the cable would never be left under tension at 'long stay' as this would only cause an extended area of obstruction to other traffic.

Mooring Examples – Preamble

For the purpose of this and other examples, a general cargo ship, single right hand fixed propeller, is being considered. No bow or stern thrust is fitted and tugs are not involved. Main engine power has a delivery of 16 knots maximum speed.

Standard navigation equipment inclusive of single semi-balanced rudder and twin steering motors apply. Transverse thrust effects are anticipated on relevant astern movements. A 'Mooring Boat' may be used as and when appropriate.

The Mediterranean Moor

As the name suggests the historical origins of this type of mooring stems from the Mediterranean Ports, where places like Alexandria (Egypt) , Piraeus (Greece) and Malta, continue to use this method of mooring. However, it is now far more widely employed worldwide, with certain different classes of ship requiring a stern to quay aspect. e.g. Roll On – Roll Off vessels, Tankers with stern discharge manifolds, and general cargo vessels working both port and starboard sides to barges.

Disadvantages of this type of mooring are:

- the vessel is exposed to the prevailing weather in the fore part.
- going ashore requires a small boat.
- the benefit of shoreside cranes are denied to the vessel.
- additional wear and tear on ships cargo handling gear.

Operation

As with any mooring operation, good planning beforehand, can generate high success. If the conventional vessel is considered, its speed should be reduced well in advance of nearing the berth and the anchor party should be on early stand-by to clear away and walk back both anchors.

With a right hand fixed propeller the approach must be made with the berth on the ships Port Side at about a distance of two ships lengths away at Dead Slow speed 3 to 4 knots.

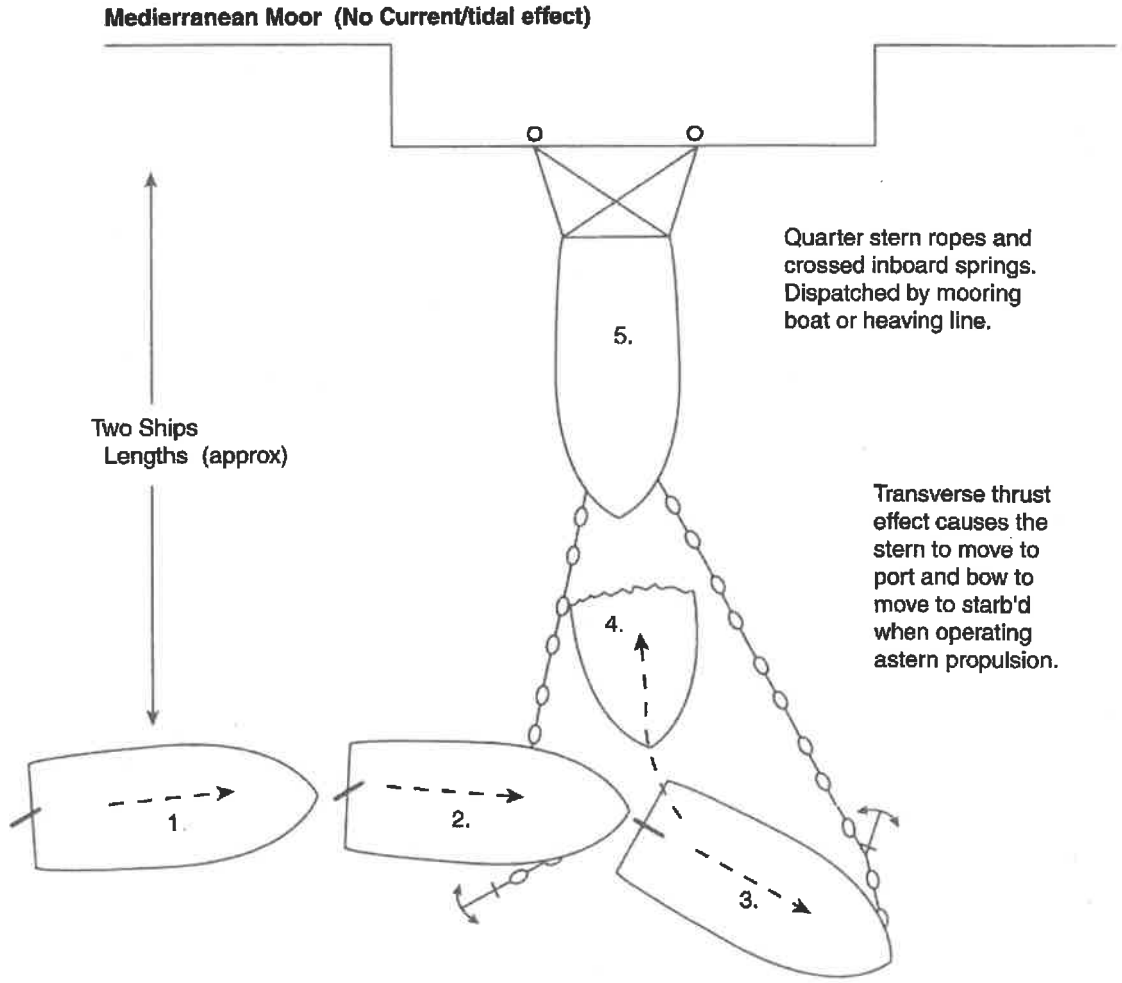
As the bow draws to a position level with the intended docking position, the sequence of action is suggested as follows:

1. Let go the offshore (starboard) anchor.
2. Helm hard to starboard, 'Stop engines' and let the cable run on the starboard anchor.
3. 'Half astern engines', rudder midships, then let go the port anchor.
4. As the vessel gathers sternway, pay out on both cables. The ships stern will move to port due to the effect of transverse thrust.
5. Stop engines and check astern movement by applying brakes on cables.
6. Run stern lines to quayside by use of mooring boat, or heaving lines.
7. Secure stern by quarter ropes and crossed inboard springs.
8. Once all fast aft, tension stern moorings by heaving easy on both anchors.

NB. This type of mooring may justify the use of anchor marker buoys.

Mediterranean Moor

(No current/tidal effect)



Position 1

Dead slow starb'd helm

Position 2

Stop, starb'd helm let go, offshore, starb'd anchor

Position 3

Let go port anchor rudder midships, full astern.

Position 4

Reduce astern speed to dead slow and pay out on both port and starb'd cables. Stop engines check cables.

Fig. 3.7

The Open Moor

There may be occasions when a vessel would wish to gain the additional holding weight of a second anchor either when at an exposed anchorage or in a fast flowing river.

In such circumstances the setting of two bow anchors each approximately 15° off the projected fore and aft line, to give a 30° spread between the anchors would provide improved holding for the vessel. This type of moor should not be carried out in tidal regions, unless the anchor period is short otherwise the turn of the tide would generate a fouled hawse.

To this end where a fresh water (non-tidal) river is fast flowing such a mooring could be beneficial to holding the ships position.

A more common use, in exposed sea conditions, is when the weather or surface conditions are causing additional weight coming to bear on the cable. The possibility of breaking the anchor out and experiencing the vessel dragging becomes a real one and a prudent Master would probably pay out more chain on the riding cable as a first option. However, if the risk of dragging persists, the use of a second anchor, underfoot would not be seen as an unreasonable action. In general the vessel would then ride to the basic principle of an open moor, albeit with more scope on one anchor than another, one anchor at 'long stay', the other at 'short stay'.

The scope of cable on the second anchor could always be increased as conditions dictate, but it should be remembered that two anchors down with 8/9 shackles of cable paid out to each anchor reduces the manoeuvreability of the ship considerably. In the event that both anchors start to drag under extreme conditions the Master would probably need to employ engines to ease the weight on the cable and the load on the windlass.

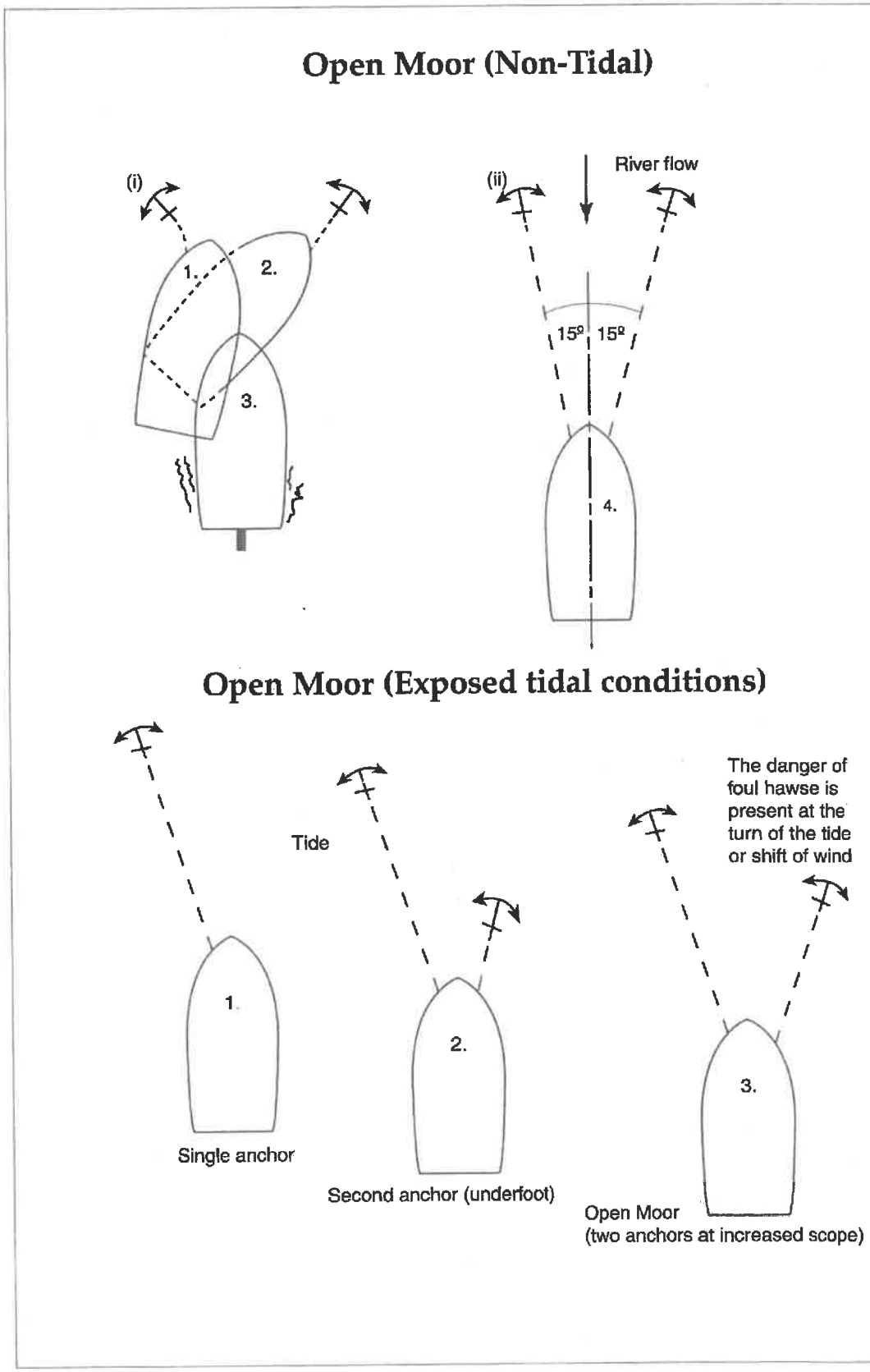

Open Moor (Non-Tidal)
(i)
1.
2.
3.
(ii)
River flow
15º
15º
4.
Open Moor (Exposed tidal conditions)
1.
Single anchor
Tide
2.
Second anchor (underfoot)
The danger of foul hawse is present at the turn of the tide or shift of wind
3.
Open Moor
(two anchors at increased scope)

Fig. 3.13

CHAPTER 5
Anchor Practice for Large Vessels

Introduction

The commercial shipping operations of the world continue to see many changes on a virtual day-to-day basis and the increase in vessel size/tonnage is a highly visible factor. The growing cruise market with developments to carry in excess of 3000 passengers per vessel is already established, as is the million ton oil tanker. The large ore carriers, and the everyday Very Large Crude Carrier (VLCC) or the Ultra Large Crude Carrier (ULCC) are now a way of life in the shipping lanes.

With such developments in the shipping field, associated marine equipment was forced to keep pace and match size and weight to ensure manageable operations.

Mooring decks had to accommodate the +20 tonne anchors. The cable dimension, windlass power and accessories were forced to increase in size to be capable of safe activity. Alternative braking systems had to be seen to be effective on the heavy anchors while the amount of chain carried had to be commensurate with the deep draughted vessels needed to anchor in deeper water.

The design of wide beamed vessels generated separate windlass arrangements to port and starboard and designated the centre line windlass to the much smaller type of vessel. Tension winches became incorporated with standard mooring equipment to support fast loading/discharge operations. As such, combined powered warping drums and gypsy control moved side by side on the mooring deck.

The operators of machinery required, a wider variety of skills and experiences in order to achieve greater coverage to encompass many different mooring configuration patterns. Many such patterns of which employed the combined use of quayside moorings, floating mooring buoys and at the same time coupled anchor use, with tension winches or conventional heavy duty warps.

Routine Procedure for the Large Vessel Underway

It is normal practice for the large VLCC/ULCC when underway at sea, to operate with the windlass in gear with the brake hard on, the bow stopper in position and the additional securing chains/lashings in position. If the vessel is approaching an anchorage the windlass would be in gear, with the brake on and the bow stopper in position, but any other anchor lashings would be removed.

When actually engaged in routine anchoring i.e. other than an emergency, the windlass would be retained in gear, with the brake and bow stopper removed and the anchor would be walked back clear of the hawse pipe. The anchoring operation in total would be completed with the anchor being walked back under power all the way by one of the steam power units. (Normal practice for tanker vessels to have steam powered windlasses. Alternatives are hydraulic or pneumatic, as opposed to electric).

Once the vessel is anchored, the bow stopper, guillotine or compressor, would be applied, the cable being adjusted to ensure that the bow stopper sets true. The brake would also be hard on and in normal circumstances the power shut down, leaving the windlass in gear. (This particular procedure would tend to relieve the load on the braking system)

If the vessel was engaged in a 'mooring operation' the cables may be let go and allowed to run under the control of the brake, but it would be expected that the speed of paying out would be at a minimum speed which is consistent with safe operation . Such speed must not allow the risk of losing control of the cable.

Once the manoeuvre is complete the cables would be secured as stated to relieve load on braking systems.

48. Class 1 Passenger Cruise Liner *'Seaward'* with both anchors deployed off Cozumel Island, Mexico. Stem anchor also visible.

the larger of larger vessels. The ideal anchorage with everything going for the Ships Master with the larger vessel does not exist and it becomes a 'trade off' to gain as many favourable aspects as possible to ensure the safety of the vessel. Experience has shown that many Masters would opt for steaming up and down at reduced speed rather than expose the vessel to the imperfect anchorage site.

Example: A VLCC with a 20 tonne anchor decides to go to a single anchor at low water time when the present depth is 30 metres with a tidal range of 10 metres. How much cable would she be expected to deploy ?

A VLCC would base the minimum amount of scope on six (6) times the depth of water as a starting figure. Conventional vessels use a factor of four (4) times depth.

This minimum factor would only be used if everything was favourable ... a highly unlikely situation.

Minimum amount of cable to use would be 6 x 40 = 240 metres
(Figure 40 accounts for rise of tide to high water time)
240 metres (787') = 8.74 shackles of cable (assuming 27.5 m or 90' per shackle length)
One shackle of 50 mm diameter stud link cable = 1568 kg

This would require the windlass to overcome approx 13.7 tonnes excluding anchor and drag effects from the sea bottom. When the anchor is up and down, allowing for two (2) shackles of vertical rise, plus a twenty tonne anchor, windlass pull must equal at least 24 tonne capability.

Practical Application

If charted anchorages around the world are investigated it will be found that water depths vary from 40 to 60 metres and effective anchoring of a large vessel would employ a scope of a probable range from between 6 to 10 times the depth.

If the maximum factor of ten (10) is used at a depth of 60 metres = 600metres, it is questionable whether ships have this capability in chain resource. Classification Societies only require the largest ships to carry 351 metres of cable, however, ship owners have sensibly increased this figure in the majority of cases and permit their ships to carry in excess of basic requirement.

Tests results revealed in "Shipbuilding & Marine International" magazine (1981) would suggest that if the anchor and chain are considered, the anchor would appear to be the weakest link in the system. The tests revealing that the anchor would drag, unless hung up on rock, rather than see the chain part. Such evidence would lend to the ideology that high holding power anchors are better suited to be fitted to the larger type vessels.

The conditions at the time would of course influence the actions of a ships Master as to whether he/she takes his vessel clear of the anchorage and runs for open water. A five knot current or a sixty knot wind, on an anchored vessel, would place enormous stress on the cable and could easily force the anchor to break out.

It would be hoped that the prudent Master would use engines to ease the weight on cables and engage the windlass in ample time to heave away and recover anchors while in a position to do so, prior to accepting the consequences of dragging.

Routine Anchoring for the Large Ship

There are several critical elements to achieving a successful large vessel anchoring operation, not least the speed over the ground and the heading that the vessel will need to adopt. This heading could well be influenced by current flow causing the vessel to set down from her approach line and when considering the 'Anchor Plan' external forces such as current and wind would need to be addressed.

Not all vessels are equipped with 'Bottom Lock, Doppler Speed Logs' and even if they are fitted, stern wash from propellers could cause distorted readings. Determining when the vessel is stopped over the ground is therefore sometimes a difficult task in itself. Bearing in mind that a VLCC making 1 knot over the ground carries an enormous amount of kinetic energy.

Clearly, these two elements of heading and speed, cannot be separated from other influencing factors such as draught, size of vessel, loaded or ballast condition and the windage that might prevail on the superstructure. The actual handling of the vessel will also vary from ship to ship subject to manoeuvring equipment, reliable steering, twin propellers/rudders, bow thrust, etc.,

Anchors should be prepared well in advance of closing the anchorage and the anchor party stood-by in ample time. Communications between the forecastle party and the 'Bridge Team' should be established as the speed of approach reduces. The heading would be adopted to oppose the resultant wind and current effects and reference to other vessels lying in the anchorage would provide an ideal indicator to a desired heading.

Once it is ascertained that the vessel is stopped over the ground she may not have attained the correct heading, even though her actual desired position has been achieved. If this is the case correction can take place by walking the anchor back in gear to a short stay. The length of cable should not exceed twice the depth of water at this stage. It would be anticipated that the anchor would drag and not dig in and as such should not overload the windlass. Once the heading is aligned to that required, the remaining amount of cable can be paid out and the vessel 'brought up'. Circumstances would dictate that the cable is walked back under gear all the way.

Excessive sternway should be avoided especially once it is appreciated that the anchor has dug in. This could cause either the anchor to break out or failure of equipment to take place. Ideally, a high holding power anchor will be employed and a minimum scope of cable of six times the depth of water would be used. Although, Ships Masters would expect all aspects to be favourable before laying to the minimum scope and would usually add an extra shackle of cable for peace of mind.

Once the vessel is 'Brought Up' the position of the anchor should be charted as well as the position of the bridge marked on a position circle of swing. Anchor bearings, together with clearing bearings should be noted.

NB. As with any anchor operation, if it is planned correctly, such items as underwater obstructions, circle of swing and surface obstructions would have been accounted for in the detailed 'Anchor Plan' prior to commencing the operation.

The Alternative to Walking Back the Anchor (all the way)

The seemingly accepted norm for bringing a large vessel to anchor is to walk back the anchor all the way to the sea bottom in gear. This procedure, however, is not that which is recommended by the windlass manufacturers. The reasoning is based on past practice that the average vessel stems the tide and operates engines astern when about to anchor. Once the vessel gathers sternway, the anchor is 'let go' and the sternway lays the cable back from the anchor. During such a procedure the lead of cable being forward, prevents the cable falling back onto the anchor and causing either a fouled anchor by the cable or even a damaged anchor. This method widely adopted by the smaller conventional vessel employs the brake as an intermittent slipping arrangement and reduces the possibility of overload on the windlass motor by walking back all the way.

If it is realized that the lifting power of the motor is only 1/12th that of the brake holding ability it becomes questionable why anybody would want to use the motor instead of the brake.

If examined further the combined effect of motor and gearing of 50 : 1 or more, with an increasing load being applied (as the cable is paid out in the vertical), is bound to suffer from overloading.

If the vessel is then operating astern to avoid fouling the anchor the momentum of the vessel would also start to effect the windlass motor. To this end it is considered essential to halt the sternway on the vessel before the anchor reaches the bottom and prevent the lead of cable coming off the vertical and incurring undesirable strains on motor and gearing.

To avoid the forward lead on the cable and effectively reduce the expected overload on the motor generated by the ships mass coming to bear, Captain C.A. McDowall, in his monograph for the Nautical Institute (Anchoring Large Vessels) suggests that excessive stresses can be avoided by the following method:

The anchor is walked back to a position just above the seabed when on approach to the anchorage . A tight turn is executed to bring the weather onto the beam and the bow is allowed to attain a position of approximately 20° off the wind. The final approach towards the anchorage is made 'down weather' in a sideways movement. The anchor is let go and allowed to run at a speed consistent with eye contact to each link. The ship movement over the ground should permit all the designated cable to run before the brake is applied.

Once the desired amount of cable is released the brake is applied tightly and the pawl (guillotine stopper) is positioned with the safety pin in situ. It is essential to place the stopper while the cable is still in the up and down position. The design of the stopper arrangement is such as to be able to hold the ships mass by holding the cable in the up and down position. The design of the brake is meant only to control cable movement and is not designed to hold the ships mass.

Alternative Large Vessel Anchoring Method

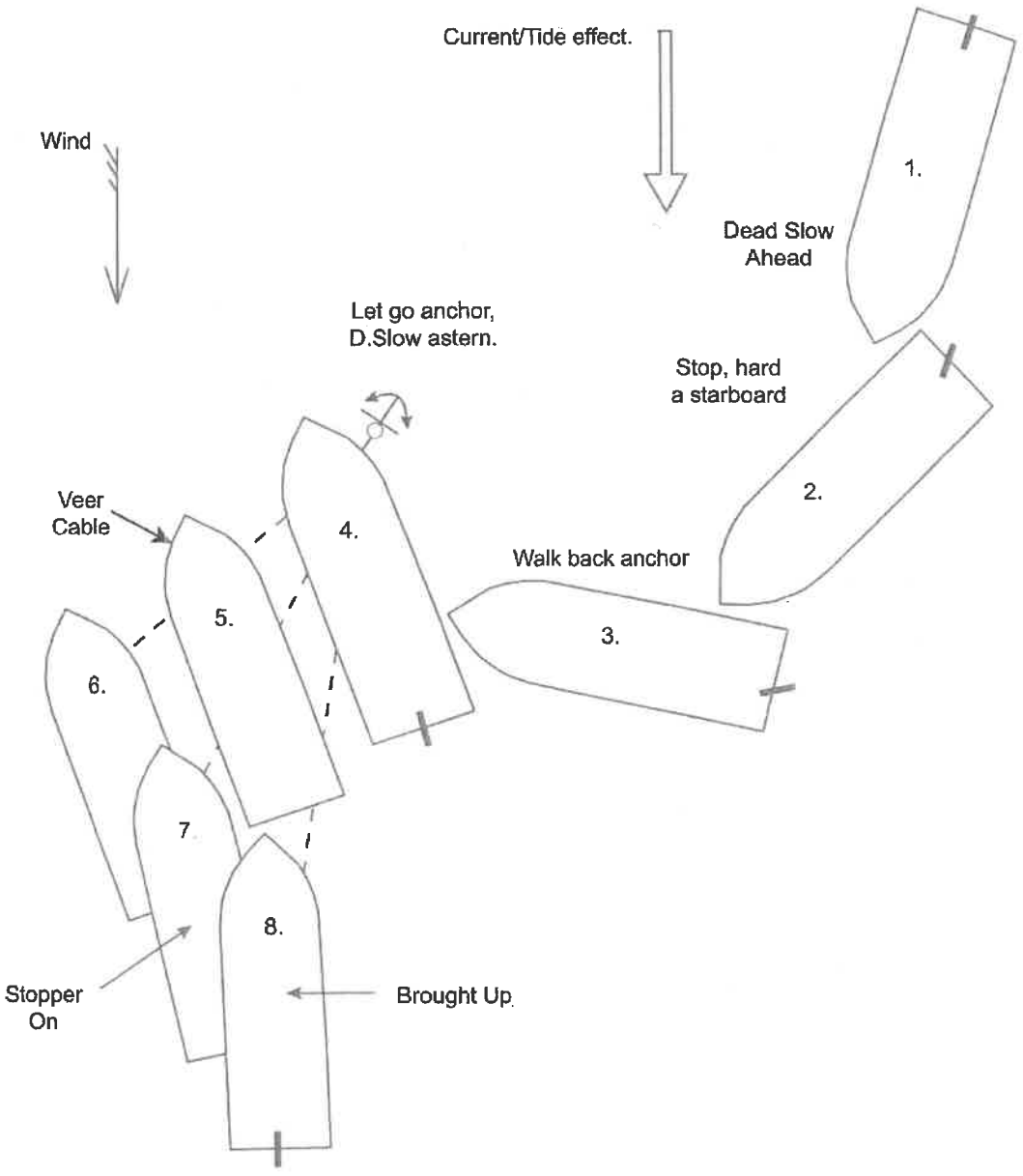
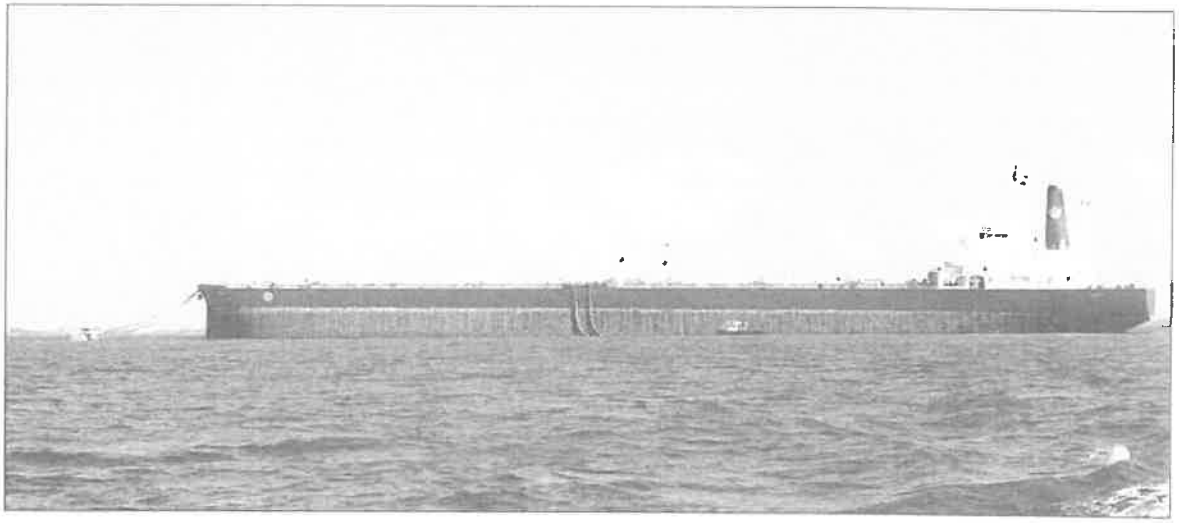


Fig. 5.1

Disadvantages of Walking Back the Anchor

The Master who continually walks back the anchor 'all the way' cannot escape the reality that the angle of the chain will not remain in the vertical. Bearing in mind that the windlass is designed to lift anchor and chain to a maximum of 82 metres in the vertical. Such inclination off the vertical would allow the weight of the vessel to be brought onto the speed of the motor. This would cause additional pressures to occur inside the casing of the hydraulic motor and generate excessive forces on the motors components. Such adverse effects would create particle damage within the hydraulic fluid. Although oil filters should prevent metal fragments passing through the system this is not guaranteed especially as some filters are quite coarse and would result in progressive damage occurring. The worst scenario being that the motor casing could crack and unless the vessel carried a spare may find the task of anchor recovery impossible.

It is also pointed out that walking back the anchor on the motor with the brake off is an extremely slow process (estimated at 7.0cm/sec) and a vessel intending to lay more than eight shackles of cable must expect to take over thirty minutes. The temptation therefore to lay to a lesser scope could cause the catenary to place excessive strain onto the anchor itself. Leaving the situation with an inadequate scope would also of course lead to subsequent dragging and/or a grounding situation developing. Practically speaking few Masters would be able to retain the direction of the ships head for an excessive period of time with a cable in the up and down position. Control would invariably be lost during the period of anchoring especially if more than the example eight shackles was intended for use.



49. Ultra Large Crude Carrier, ULCC, lying to a Single Buoy Mooring (SBM).

50. Large warship lies to mooring buoys fore and aft inside harbour limits.

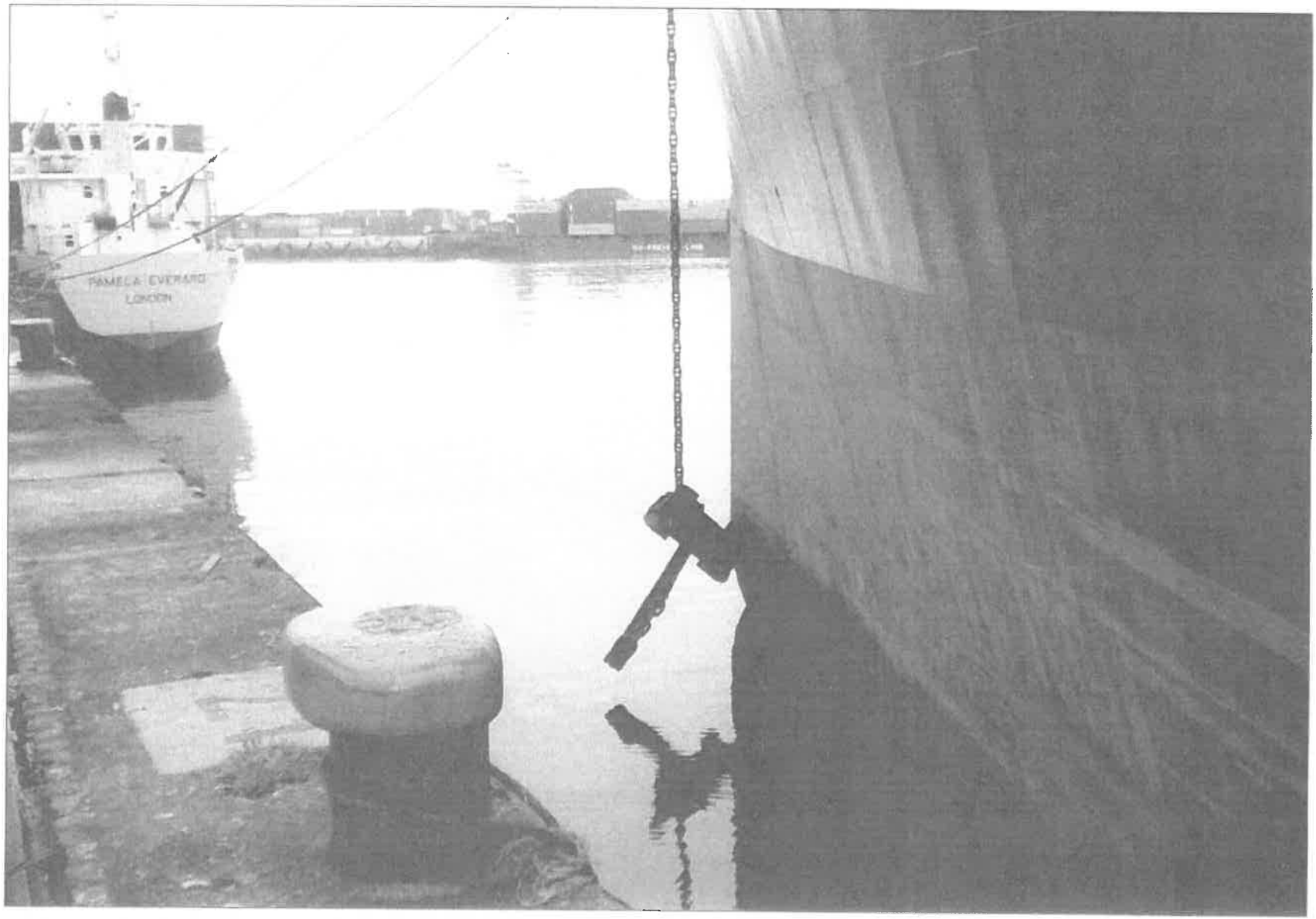
Anchoring Practice

Operational methods for bringing a vessel into a safe anchorage vary considerably and are influenced often by location, local practice, working requirements of the vessel and of course the type of equipment in use. Most commercial vessels operate with two bower anchors and a spare.

Others will have a stern or stem anchor in addition to the bow anchors. The newer 'Catamaran Ferries' for example employ a single stem anchor because of the specific hull design.

Some large warships, 'Sheffield' class destroyers (British Royal Navy) are only fitted with a single working bower anchor on the starboard side, although a spare is carried at the break of the fo'c'stle head. While the 'Amazon' class frigates (British Royal Navy) have both port and starboard bow anchors but with a single centre line combined capstan/cable holder with interchangeable anchor chain to a self stowing locker.

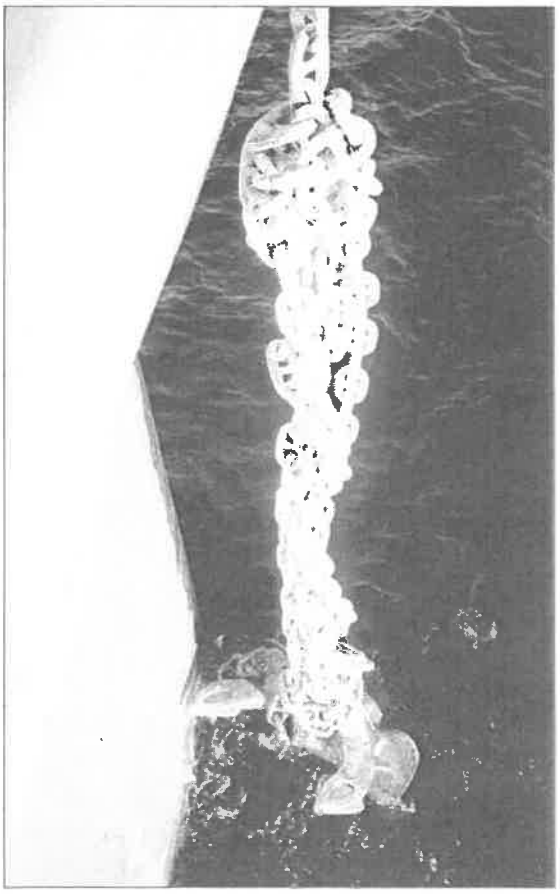
Design and practice must vary to suit the practical needs of a safe operation and the familiarity of ships crews with on board equipment will lend to improved safety and better performance when engaged in anchoring and anchor work activities, especially required with the larger vessels.



51. The Fouled Anchor – Conventional 'Stockless Anchor' seen to be fouled by a round turn of its own cable, around the head of the anchor. Docking with this situation against a high wharf would carry some risk of hull damage, but clearing the anchor on the quayside with the aid of motor transport, would be easier than attempting the task at sea. A Pilot/Master would also have concerns about berthing having only one anchor available.

The Fouled Anchor Cable

Even after all correct procedures are followed, an element of 'bad luck' can effect the well being of the ship and a fouled cable or anchor can occur. Such incidents are not only time consuming to clear but may be costly and hazardous to personnel. This is especially so where heavier cables are involved and specialized equipment is subsequently required. It is also pointed out that while an anchor is so fouled, its use is denied to the shiphandler, until it is resolved.



52. A badly fouled anchor cable, around and above the shank. This particular problem required the services of a tug and the cable had to be broken at the joining shackle in order for the anchor to be cleared and recovered. A lengthy delay for the ship was involved and the costs of employing a tug and labour became additional voyage expenses.

Use of Anchor – to avoid obstruction.

There may be occasion when a shiphandler needs to employ all his expertise and the vessels resources to avoid contact with an obstruction. An example of this could be illustrated where a vessel approaching a port at a slow speed of 4 knots with a three knot current astern, is approximately 1 mile from the harbour entrance, when the ship is informed of a 'collision' blockage which has closed the ports approaches.

Clearly the Master or OiC, needs to abort the approach but how best to reduce speed and effectively turn the vessel in such a short distance becomes questionable.

NB. A ship will make less advance in a turn than the head reach attained from a 'Crash Full Astern' (Double telegraph ring – to place the engines into a full astern motion, from an ahead movement).

By an awareness of the ships capabilities the following solution is suggested as being possibly appropriate for such an extreme emergency. Practically, where all incidents and ships equipment differ, flexibility in actions must also be expected to differ. Neither of course, at the end of the day, is any positive result guaranteed, but such an attempt would indicate that one has engaged the available resources in the best possible manner.

it sinking and becoming a total constructive loss. The intention being to instigate temporary repairs, with a view to re-floating at a later time.

Clearly, no position with all the requirements can expect to present itself, just when the need arises, and the prudent Master would be advised to settle for as much of the available criteria as is possible, at the time. With re-floating in mind and armed with the knowledge that the ships anchors could play a major role, good holding ground may not be an immediate concern for a Master about to beach his ship. However, once the vessel is in a condition to attempt re-floating, anchors set in mud or clay could be noted as being extremely beneficial to aid hauling off.

Operation of Beaching

Approach to the beach should be made at right angles . This would take any further damage on landing forward of the 'Collision Bulkhead', beaching stern first is not recommended. The vessel should be under full ballast conditions with both anchors walked back, clear of hawse pipes and ready for letting go.

If time permits stern mooring wires should be passed from the ships quarters towards the bow area, and secured to the ganger lengths of the chain cables.

Once the anchors are released on direct approach to the beach, the stern wires could act as anti-slewing moorings as and when weather/tides change, effectively reducing movement on an already delicate ship situation.

NB. Once on the beach, the danger of a rising tide could cause the vessel to float off accidentally. Adding additional ballast may resolve the situation, if this is possible. However, some thought must also be given to pushing the vessel further beyond the immediate shoreline to prevent the vessel accidentally re-floating itself off into deeper water.

Use of Anchors on Approach to Beach

The amount of cable secured to each anchor will influence at what point the Master will order the release of anchors. Clearly too soon, may prevent the vessel from attaining the shoreline. Too late could render them ineffective for refloating.

As a yard stick the average vessel has between 10 – 15 shackles of cable to each anchor (300 – 450 metres) it may prove useful to compare distance from shore by ships lengths, knowing of course the overall ships length, and being able to judge when best to 'let go' taking into account the amount of cable aboard.

It should be realized that the time factor and prevailing conditions may render the intended use of anchors impossible. If such is the case and the vessel attains the beach without deploying anchors, then it is still recommended that anchors are walked back to take the ground. Should the vessel start to drop back say with a rising tide, these anchors although positioned well forward, could act as a drogue and prevent the vessel dropping astern into deeper water.

NB. The phrase, "never go ashore with an anchor in the pipe" comes to mind.

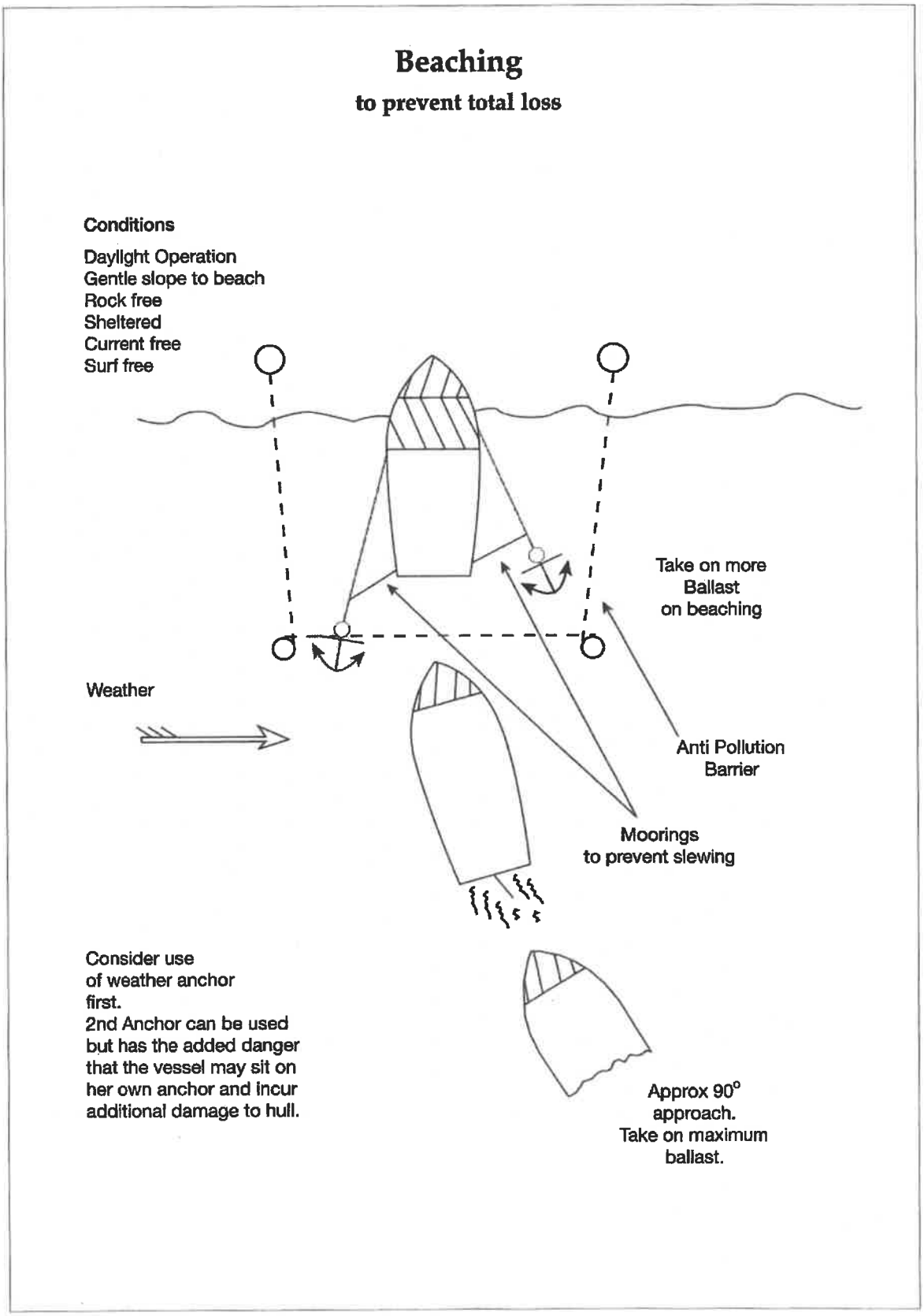

Beaching
to prevent total loss
Conditions
Daylight Operation
Gentle slope to beach
Rock free
Sheltered
Current free
Surf free
Take on more
Ballast
on beaching
Weather
Anti Pollution
Barrier
Moorings
to prevent slewing
Consider use
of weather anchor
first.
2nd Anchor can be used
but has the added danger
that the vessel may sit on
her own anchor and incur
additional damage to hull.
Approx 90°
approach.
Take on maximum
ballast.

Fig. 6.4