SHIP SIMULATOR AND BRIDGE TEAMWORK

1. General

This manual reflects the views of the course designers on methodology and organization, and what they consider relevant and important in the light of their experience as instructors. Although the guidance given should be of value initially, the instructor should work out his own methods and ideas, refine and develop what is successful, and discard ideas which do not work.

Preparation and planning make a major contribution to effective presentation of the course. If necessary, the learning objectives should be adjusted to take account of the capabilities and limitations of the simulator and facilities in use.

1.1 Lectures

The practical exercises and demonstrations on the simulator constitute the main content of the course.

The BRM modules could be presented by means of one PC and a projector, but preferably each trainee should have a PC available.

Some maritime technical topics require theoretical explanation, and provisions are made for classroom lectures.

As far as possible, such lesson should be presented within a familiar context and make use of practical examples. They should be well illustrated with diagrams, slides and charts, where appropriate, and be related to matter included in the simulator exercises.

An effective manner of presentation is to develop a technique of giving information and then reinforcing it. For example, first tell the trainees what you are going to present; then explain the topic in detail; and, finally, summarize what you have told them. The use of an overhead projector and the distribution of copies of the transparencies to trainees contribute to the learning process.

1.2 Simulator exercises

The exercises in subject areas **3 (Standard maneuvers)**, **4 (Wind and current effects)** and **9 (Shallow-water effects)** will need to be structured to demonstrate the particular effects described in these sections.

It is important to use the briefing period to explain the purpose of the exercise and precisely what is to be done, what records are to be kept and how the results should be presented. An overhead projector is a useful training aid during these briefings; copies of the transparencies used can be given to the trainees for reference during the exercise.

In subject areas **15 (Anchoring and single-buoy mooring)** and **19 (Planning and carrying out a voyage in normal and emergency situations)** the briefing will take the form of a statement of the initial condition (time, position, course, speed, etc. or the berth where the ship is moored) and instructions regarding the maneuver or the passage to be made. The planning, preparation and how the desired result is to be achieved will form part of the exercise to be undertaken by the trainees.

Instructor should ensure that exercise are carried out with due regard to safe navigational practice and in full compliance with COLREG 1972. The use of checklist as an aid to preparation should be encouraged. A copy of the ICS Bridge Procedures Guide, which contain appropriate checklists, should be available during planning and the exercise.

During each exercise, one trainee should assume the role of master, with the responsibility of ensuring that the requirements of the exercise are properly carried out. The other members of the bridge team should be engaged in the exercise as actively as possible. In normal and critical situations the bridge team should demonstrate the principles of Bridge Resource Management.

1.3 Preparing and conducting simulator exercises

The exercise should produce the greatest impression of realism. Exceptions may be made for the demonstration of particular effects.

At the beginning of the course the exercises should be simple, so that trainees can appreciate the realism of the simulator. The exercise should become more complicated as the course progress. However, exercises should not be so complicated that trainees would have difficulty in carrying out the task required. Instructors should avoid inducing trainees to make mistakes in the early part of the course as this serves only to embarrass them or to destroy their confidence in their ship-handling ability.

The aim of the course is to provide training in ship handling under normal and emergency conditions. Trainees should be allowed to develop a satisfactory level of competence under normal conditions before the introduction of emergency situations resulting from the breakdown of engines or other equipment.

1.4 Exercise scenarios

The choice of scenario is governed by the simulator facilities available. However, the following scenarios are recommended.

1.4.1 Coastal scenario

The coastal scenario should be used for the familiarization exercise, which are designed to make the trainees familiar with the bridge layout and equipment and to allow them some initial hands-on experience in handling the ship. The maneuvering trials should also make use of the coastal scenario, which should have an area in which shallow-water maneuvers can be conducted.

1.4.2 Restricted-water scenario

This scenario should start where the coastal scenario ends and gradually become narrower. The scenario should end at the harbor scenario. The restricted-water scenario will be used for much of the time should contain a traffic separation scheme (TSS) and a vessel traffic service (VTS).

1.4.3 Harbour scenario

The harbor scenario should start at the docks and go via narrow channels to join the restricted-water scenarios.

1.5 Monitoring of exercise

During exercise the instructor will be responsible for monitoring and sailing the target ships, recording of exercise and making a summary of purpose of debriefing. Trainees will expect target ships to act in compliance with COLREG 1972, and the instructor should control the target ships accordingly.

However, even an experienced instructor may occasionally fail to comply when controlling a number of targets, and any resulting incidents should be recorded and dealt with at the debriefing. This is realistic in as much as some ships do fail to comply with the regulations.

The second instructor should monitor the trainees at work. His task will vary according to the trainees' ability and competence. At first he may find it necessary to assist and guide the trainees; later he should follow their work closely, but should avoid interrupting them and instead make a summary for the purpose of de-briefing.

1.6 Debriefing

The debriefing session is a vital phase of a simulation, since this is when consolidation of lessons learned is accomplished. An atmosphere of candour must be encourage, while participants take responsibility for assessing actions and results of decision made during the simulation.

While one group is using the simulator the other group should be debriefed on the previous exercise and briefed on the following one. In subject areas 15 **(Anchoring and single-buoy mooring)** and **19 (Planning and carrying out a voyage)** some time will be needed by trainees for passage planning and preparation for the next exercise. When a group finishes the day with an exercise, it is preferable to extend the session to include the de-briefing while the exercise is still fresh in the trainees' minds rather than to postpone it until the following day.

The time spent on debriefing will vary from exercise to exercise and should occupy between 25 and 30 percent of the total time used for simulator exercise.

Various facilities may be used to assist in debriefing, such as playback (in which the whole exercise is recorded and any sequence is available for discussion), plotters (which record the tracks made by the ships), and data-logging equipment and voice recorders.

The instructor should refer to the summary made during the exercise to raise important points and to direct the discussion among the trainees. He should encourage them to criticize the actions taken during the exercise and to suggest alternative actions which could have been taken. He should avoid imposing his own views, but should ensure that trainees follow safe and correct procedures at all times.

1.7 Bibliography (B)

B1 E.S. Maloney, Dutton's Navigation and Piloting, 14th edn. (Annapolis, Maryland, Naval Institute Press, 1985) (ISBN 0-87021-157-9

B2 W. Burger, Radar Observers Handbook, 7th edn, (Glasgow, Brown, Son and Fergusson, 1983) (ISBN 0-85174-443-5)

B3 Exxon International Company Reports, N0. EI1.4TM.79, "Maneuvering Trials of the 287,000 dwt 'Esso Osaka' in shallow and deep waters"

B4 C.B. Barrass, "Ship Squat and its Calculation" Safety at Sea, February, 1978

B5 R.A. Cahill, Collisions and their Causes. (London, Fairplay Publications, 1983) (ISBN 0-905045-46-7)

B6 R.A. Cahill, Collisions and their Causes. (London, Fairplay Publications, 1985) (ISBN 0-905045-60-2)

B7 N.H. Norrbin, "Bank effects on a ship moving through a short dredged channel" (Paper presented at the 10th Symposium on Naval Hydrodynamics in Cambridge, Mass. March 1974.) Available from H.H. Norrbin, SSPA Maritime Consulting AB, P.O. Box 24001, S-40022, Goteborg, Sweden

B8 J.H.A. Paffett, Ships and water. (London, The Nautical Institute, 1990)(ISBN 1- 870077-06-07)

B9 SAS Flight Academy, Dutch Maritime Pilots' Corporation, National Board of Navigation, Finland, National Maritime Administration, Sweden, Norwegian Shipowner's Association, Silja Line AB, Swedish Club, Swedish Shipowners' Association, Bridge Resource Management Student's Workbook.

1.8 Guidance on specific subject areas

The guidance notes which follow contain advice on the treatment of the subject areas listed in the course outline. The instructor should develop a methodology based on his own experience, but at the same time he should bear in mind the recommendations in the ILO/IMO Document for Guidance, 1985, and the requirements of regulation VIII/2 and section A-VIII/2 of STCW 95.

GUIDANCE NOTES

1. Review of basic principles

1.1 Watch keeping arrangements and principles to be observed (STCW Convention Reg. VIII/2)

1 Administration shall direct the attention of companies, master, chief engineer officers and all wathckeeping personnel to the requirements, principles and guidance set out in the STCW Code which shall be observed to ensure that a safe continuous watch or watches appropriate to the prevailing circumstances and conditions are maintained on all seagoing ships at all times.

2 Administrations shall require the master of every ship to ensure that watch keeping arrangements are adequate for maintaining a safe watch or watches, taking into account the prevailing circumstances and conditions and that, under the master's general direction:

.1 officers in charge of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they shall be physically present on the navigating bridge or in a directly associated location such as the chartroom or bridge control at all times;

.2 radio operators are responsible for maintaining a continuous radio watch on appropriate frequencies during their periods of duty;

.3 officers in charge of an engineering watch, as defined in the STCW Code, under the direction of the chief engineer officer, shall be immediately available and on call to attend the machinery spaces and, when required, shall be physically present in the machinery space during their periods of responsibility;

.4 an appropriate and effective watch or watches are maintained for the purpose of safety at all times, while the ship is at anchor or moored and if the ship is carrying hazardous cargo, the organization of such watch or watches takes full account of the nature, quantity, packing and stowage of the hazardous cargo and of any special conditions prevailing on board, afloat or ashore; and

.5 as applicable, an appropriate and effective watch or watches are maintained for the purposes of security.

Watch keeping arrangements and principles to be observed (STCW Code A-VIII/2)

Part 1 Certification

1. The officer in charge of the navigational of deck watch shall duly qualified in accordance with the provisions of chapter II or chapter VII appropriate to the duties related to navigational or deck watchkeeping.

Part 2 Voyage planning

General requirements

3. The intended voyage shall be planned in advance, taking into consideration all pertinent information, and any course laid down shall be checked before the voyage commences.

4. The chief engineer officer shall, in consultation with the master, determine in advance the needs of the intended voyage, taking into consideration the requirements for fuel, water, lubricants, chemicals, expendable and other spare parts, tools supplies and any other requirements.

Planning prior to each voyage

5. Prior to each voyage, the master of every ship shall ensure that the intended route from the port of departure to the first port of call is planned using adequate and appropriate charts and

other nautical publications necessary for the intended voyage, containing accurate, complete and up-to date information regarding those navigational limitations and hazards which are of a permanent or predictable nature and which are relevant to the safe navigation of the ship.

Passage Planning Techniques

a) Appraisal and formulating a plan
- Tracks to be made
- Natural transits
- Parallel indexing
- Course altering targets
- Aborts and contingencies
- Radar conspics

b) Execution

c) Monitoring of progress
- Position fixing methods
- Frequency and regularity of position fixing methods
- Comparison with estimated position
- Reference to sounding / under keel clearance
- Cross track error monitoring
- Management of non-navigational emergencies
- Keeping a proper lookout
- Reference to leading lines, light sectors, clearing marks and bearings

Verification and display of planned route

6. When the route planning is verified, taking into consideration all pertinent information, the planned route shall be clearly displayed on appropriate charts and shall be continuously available to the officer in charge of the watch, who shall verify each course to be followed prior to using it during the voyage.

Deviation form planned route

7. If a decision is made, during a voyage, to change the next port of call of the planned route, or if it is necessary for the ship to deviate substantially from the planned route for other reasons, then an amended route shall be planned prior to deviating substantially from the route originally planned.

Lookout

14. A proper lookout shall be maintained at all times in compliance with **rule 5** of the International Regulations for Preventing Collisions at Sea, 1972, as amended, and shall serve the purpose of:

.1 maintaining a continuous state of vigilance by sight and hearing, as well as by all other available means, with regard to any significant change in the operating environment;
.2 fully appraising the situation and the risk of collision, stranding and other dangers to navigation; and
.3 detecting ships or aircraft in distress, shipwrecked persons, wreck, debris and other hazards to safe navigation.

15. The lookout must be able to give full attention to the keeping of a proper lookout and no other duties shall be taken undertaken or assigned which could interfere with that task.

16. The duties of the lookout and helmsperson are separate, and the helm person shall not be considered to be the lookout while steering, except in small ships where an unobstructed all-round view is provided at the steering position and there is no impairment of night vision or other impediment to the keeping of a proper lookout. The officer in charge of the navigational watch may be the sole lookout in daylight provided that of each such occasion:

.1 the situation has been carefully assessed and it has been established without doubt that it is safe to do so;
.2 full account has been taken of all relevant factors, including, but not limited to:
- state of weather ;
- visibility
- traffic density
- proximity of dangers to navigation; and
- the attention necessary when navigating in or near traffic separation schemes; and

.3 assistance is immediately available to be summoned to the bridge when any change in the situation so requires.

17. **In determining that the composition of the navigational watch** is adequate to ensure that a proper lookout can continuously be maintained, **the master** shall take into account all relevant factors, including those described in this section of the Code, as well as the following:

.1 visibility, state of weather and sea;
.2 traffic density, and other activities occurring in the area in which the vessel is navigating.
.3 the attention necessary when navigating in or near traffic separation schemes or other routeing measures;
.4 the additional workload caused by the nature of the ship's function, immediate operating requirements and anticipated maneuvers;
.5 the fitness for duty of any crew members on call who are assigned as members of the watch;
.6 knowledge of, and confidence in, the professional competence of the ships officer and crew;
.7 the experience of each officer of the navigational watch, and the familiarity of that officer within the ship's equipment, procedures, and maneuvering capability;
.8 activities taking place on board the ship at any particular time, including radio communication activities and the availability of assistance to be summoned immediately to the bridge when necessary;
.9 the operational status of bridge instrumentation and controls, including alarm system;
.10 rudder and propeller control and ship maneuvering characteristics;
.11 the size of the ship and the field of vision available from the conning position;
.12 configuration of the bridge, to the extent such configuration might inhibit a member of the watch from detecting by sight or hearing any external development and;
.13 any other relevant standards, procedure or guidance relating to watchkeeping arrangements and fitness for duty which has been adopted by the Organization.

Watch arrangement

18. When deciding the composition of the watch on the bridge, which may include appropriately qualified ratings, the following factors, inter alia, shall be taken into account:

.1 at no time shall the bridge be left unattended;
.2 weather conditions, visibility and whether there is daylight or darkness;
.3 proximity of navigational hazards which may make it necessary for the officer in charge of the watch to carry out additional navigational duties;
.4 use and operational conditions of navigational aids such as ECDIS, radar or electronic position indicating devices and any other equipment affecting the safe navigation of the ship;
.5 whether the ship is fitted with automatic steering;
.6 whether there are radio duties to be performed;
.7 unmanned machinery space (UMS) controls, alarms and indicators provided on the bridge, procedures for their use and their limitations; and
.8 any unusual demands on the navigational watch that may arise as a result of special operational circumstances.

Taking over the watch

19. The officer in charge of the navigational watch shall not handover the watch to the relieving officer if there is a reason to believe that the latter is not capable of carrying out the watch keeping duties effectively, in which case the master shall be notified.

20. The relieving officer shall ensure that the members of the relieving watch are fully capable of performing their duties, particularly as regards their adjustment to night vision. Relieving officers shall not take over the watch until their vision is fully adjusted to the light conditions.

21. Prior to taking over the watch, relieving officers shall satisfy themselves as to the ship's estimated or true position and confirm its intended track, course and speed, UMS controls as appropriate and shall note any dangers to navigation expected to be encountered during their watch.

22. Relieving officers shall personally satisfy themselves regarding the:

.1 standing orders and other special instructions of the master relating to navigation of the ship;
.2 position, course, speed and draught of the ship;
.3 prevailing and predicted tides, currents, weather, visibility and the effect of these factors upon course and speed;
.4 procedures for the use of main engine to maneuver when the main engines are on bridge control;
.5 navigational situation, including, but not limited to:
.5.1 the operational condition of all navigational and safety equipment being used or likely to be used during the watch;
.5.2 the errors of gyro-and magnetic compasses;
.5.3 the presence and movements of ship in sight or known to be in the vicinity;
.5.4 the conditions and hazards likely to be encountered during the watch;
.5.5 the possible effects of heel, trim, water and squat on under-keel clearance.

23. If, at any time, the officer of charge of the navigational watch is to be relieved when a maneuver or other action to avoid any hazard is taking place, the relief of the officer shall be deferred until such action has been completed.

Performing the navigational watch

24. The officer in charge of the navigational watch shall:

.1 keep the watch on the bridge;
.2 in no circumstances leave the bridge until properly relived; and
.3 continue to be responsible for the safe navigation of the ship, despite the presence of the master on the bridge, until informed specifically that the master has assumed that responsibility and this is mutually understood.

25. During the watch, the course steered, position and speed shall be checked at sufficiently frequent intervals, using any available navigational aids necessary, to ensure that the ship follows the planned course.

26. The officer in charge of the navigational watch shall have full knowledge of the location and operation of all safety and navigational equipment on board the ship and shall be aware and take account of the operating limitations of such equipment.

27. The officer in charge of the navigational watch shall not be assigned or undertake any duties which would interfere with safe navigation of the ship.

28. When using radar, the officer In charge of the navigational watch shall bear in mind the necessity to comply all times with the provisions on the use of radar contained in the International Regulations for Preventing Collisions at Sea, 1972, as amended, in force.

29. In cases of need, the officer in charge of the navigational watch shall not hesitate to use the helm, engines and sound signaling apparatus. However, timely notice of intended variations of engine speed shall be given, where possible, or effective use shall be made of UMS engine controls provided on the bridge in accordance with the applicable procedures.

30. Officers of the navigational watch shall know the handling characteristics of their ship, including its stopping distances, and should appreciate that other ships may have different handling characteristics.

31. A proper record shall be kept during the watch of the movements and activities relating to the navigation of the ship.

32. It is of special importance that at all times the officer in charge of the navigational watch ensures that a proper lookout is maintained. In a ship with a separate chartroom, the officer in charge of the navigational watch may visit the chartroom, when essential, for a short period for the necessary performance of navigational duties, but shall first ensure that it is safe to do so and that proper lookout is maintained.

33. Operational test of shipboard navigational equipment shall be carried out at sea as frequently as practicable and as circumstances permit, in particular before hazardous conditions affecting navigation are expected. Whenever appropriate, these test shall be recorded. Such test shall also be carried out prior to port arrival and departure.

34. The officer in charge of the navigational watch shall make regular checks to ensure that:
.1 the person steering the ship or the automatic pilot is steering the correct course;
.2 the standard compass error is determined at least once a watch and, when possible, after any major alteration of courser; the standard and gyro-compasses are frequently compared and repeaters are synchronized with their master compass;
.3 the automatic pilot is tested manually at least once a watch;
.4 the navigation and signal lights and other navigational equipment are functioning;
.5 the radio equipment is functioning properly in accordance with paragraph 86 of this section; and
.6 the UMS controls, alarms and indicators are functioning properly.

35. The officer in charge of the navigational watch shall bear in mind the necessity to comply at all times with the requirements in force of the International Conventions for the Safety of Life at Sea(SOLAS), 1974. The officer of the navigational watch shall take into account:
.1 the need to station a person to steer the ship and to put the steering into manual control in good time to allow any potential hazardous situation to be dealt with in a safe manner; and
.2 that, with a ship under automatic steering, it is highly dangerous to allow a situation to develop to the point where the officer in charge of the navigational watch is without assistance and has to break the continuity of the lookout in order to take emergency action.

36. Officers of the navigational watch shall be thoroughly familiar with the use of all electronic navigational aids carried, including their capabilities and limitations, and shall use each of these aids when appropriate and shall bear in mind that the echo-sounder is a valuable navigational aid.

37. The officer in charge of the navigational watch shall use the radar wherever restricted visibility is encountered or expected, and at all times in congested waters, having due regard to its limitations.

38. The officer in charge of the navigational watch shall ensure that the range scales employed are changed at sufficiently frequent intervals so that echoes are detected as early as possible. It shall be borne in mind that small or poor echoes may escape detection.

39. Whenever radar is in use, the officer in charge of the navigational watch shall select an appropriate range scale and observe the display carefully, and shall ensure that plotting or systematic analysis is commenced in ample time.

40. The officer in charge of the navigational watch shall notify the master immediately:
.1 if restricted visibility is encountered or expected;
.2 if the traffic conditions or the movements of other ships are causing concern;
.3 if difficulty is experienced in maintaining a course;
.4 on failure to sight land, or a navigational mark or to obtain soundings by the expected time;

.5 if, unexpectedly, land or a navigation mark is sighted or a changed in sounding occurs;
.6 on breakdown of the engines, propulsion machinery remote control, steering gear or any essential navigational equipment, alarm or indicator;
.7 if the radio equipment malfunctions;
.8 in heavy weather, if in any doubt about the possibility of weather damage;
.9 if the ship meets any hazard to navigation, such as ice or a derelict; and
.10 in any other emergency of if in any doubt.

41. Despite the requirement to notify the master immediately in the foregoing circumstances, the officer in charge of the navigational watch shall, in addition, not hesitate to take immediate action for the safety of the ship, where circumstances so require.

42. The officer in charge of the navigational watch shall give watch keeping personnel all appropriate instructions and information which will ensure the keeping of a safe watch, including a proper lookout.

Watch keeping under different conditions and in different areas

Clear weather

43. The officer in charge of the navigational watch shall take frequent and accurate compass bearing of approaching ships as a means of early detection of risk of collision and shall bear in mind that such risk may sometimes exist even when an appreciable bearing change is evident, particularly when approaching a very large ship or a tow or when approaching a ship at close range. The officer in charge of the navigational watch shall also take early and positive action in compliance with the applicable International Regulations for Preventing Collisions at Sea, 1972, as amended, and subsequently check that such action is having the desired effect.

44. In clear weather, whenever possible, the officer in charge of the navigational watch shall carry out radar practice.

Restricted visibility

45. When restricted visibility is encountered or expected, the first responsibility of the officer in charge of the navigational watch is to comply with the relevant rules of the International Regulations for Preventing Collisions at Sea, 1972, as amended, with particular regard to the sounding of fog signals, proceeding at a safe speed and having the engines ready for immediate maneuver. In addition, the officer in charge of the navigational watch shall:

.1 inform the master;
.2 post a proper lookout
.3 exhibit navigation lights; and
.4 operate and use the

In hours of darkness

46. The master and the officer in charge of the navigational watch, when arranging lookout duty, shall have due regard to the bridge equipment and navigational aids for use, their limitations, procedures and safeguards implemented.

Coastal and congested waters

47. The largest scale chart onboard, suitable for the area and corrected with the latest available information, shall be used. Fixes shall be taken at frequent intervals, and shall be carried out by more than one method whenever circumstances allow. When using ECDIS, appropriate usage code (scale) electronic navigational charts shall be used and the ship's position shall be checked by an independent means of position fixing at appropriate intervals.

48. The officer in charge of the navigational watch shall positively identify all relevant navigation marks.

Navigation with pilot on board

49. Despite the duties and obligations of pilots, their presence on board does not relieve the master or the officer in charge of the navigational watch from their duties and obligations for the safety of the ship. The Master and the pilot shall exchange information regarding navigation procedures, local conditions and the ship's characteristics. The master and /or the officer in charge of the navigational watch shall co-operate closely with the pilot and maintain an accurate check on the ship's position and movement.

50. If in any doubt as to pilot's action or intentions, the officer in charge of the navigational watch shall seek clarification from the pilot and , if doubt still exists, shall notify the master immediately and take whatever action is necessary before the master arrives.

Ship at anchor

51. If the Master considers it necessary, a continuous navigational watch shall be maintained at anchor. While at anchor, the officer in charge of the navigational watch shall:

.1 determine and plot the ship's position on the appropriate chart as soon as practicable;

.2 when circumstances permit, check at sufficiently frequent intervals whether the ship is remaining securely at anchor by taking bearings of fixed navigation marks or readily identifiable shore objects;

.3 ensure that proper lookout is maintained;

.4 ensure that inspection rounds of the ship are made periodically;

.5 observe meteorological and tidal conditions and the state of the sea;

.6 notify the master and undertake all necessary measures if the ship drags anchor;

.7 ensure that the state of readiness of the main engines and other machinery is in accordance with the master's instructions;

.8 if visibility deteriorates, notify the master;

.9 ensure that the ship exhibits the appropriate lights and shapes and that appropriate sound signals are made in accordance with all applicable regulations; and

.10 take measures to protect the environment from pollution by the ship and comply with applicable pollution regulations.

BRIDGE TEAM ORGANIZATION

The bridge team plays a very important role in the safe conduct of a ship at sea and in port. It is therefore necessary to have a well organized bridge team that is able to carry out its tasks efficiently and effectively.

- All members must observe navigational standards of operation and practice good management.
- A well defined bridge organization details specific duties and responsibilities of individual members.
- There maybe differences in styles but common or standard procedures must be established and followed.
- The team must share a common goal, i.e. a safe and successful voyage based on the principle, "Safety of life, property and environment."
- Team members must fully understand and should be capable of performing their roles and tasks professionally and diligently.

Team Composition

a. Master
- Ship owner's representative.
- Over all in command and responsible of the ship.
- Responsible for the performance of watch keeping officers and also the pilot.

b. Officer on Watch (OOW)
- Officer-in-charge of a bridge navigational watch.
- Master's representative at the bridge.
- Responsible for conning the ship during his watch.

c. Extra Officer on the Bridge
- Officer assisting the master and the OOW on the bridge as required.

d. Helmsman
- Deck rating assigned to keep a navigational watch and/or to carry out helm orders from the conn.

e. Lookout
- Deck rating appointed by the Master to observe and report all relevant observations for safety of navigation.

f. **Pilot**
- Usually a local shipmaster hired to assist in the safe navigation of a vessel in port

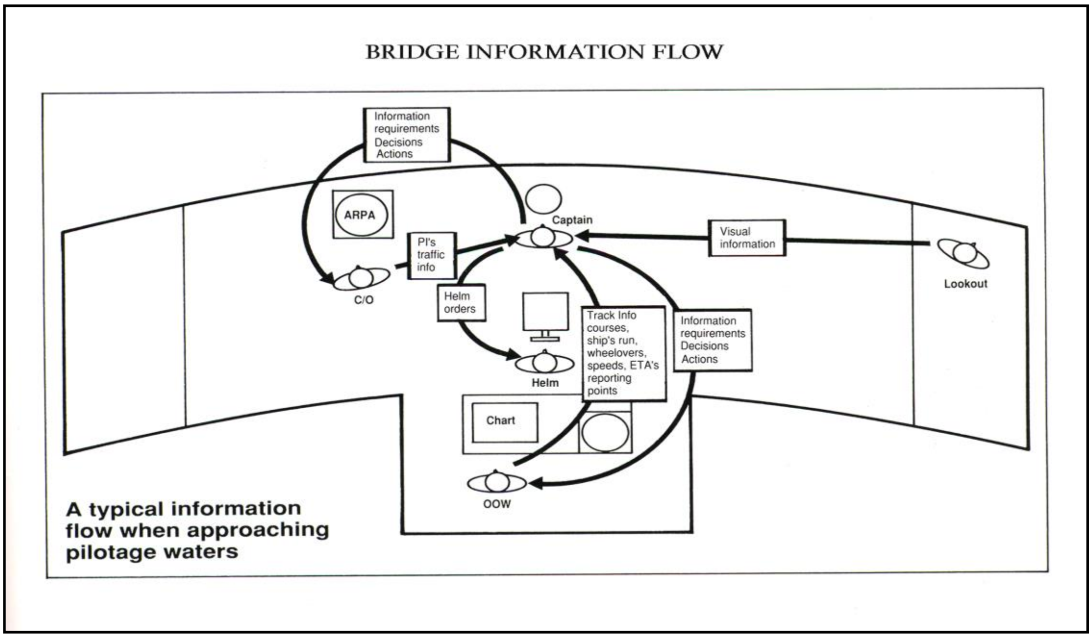


Figure 1

Chain of Command

The Master holds the highest authority and exercises control over all departments on board the ship. Every OOW is independently under the authority of the master in the performance of his duties and responsibilities. Likewise, a deck rating assigned as helmsman or lookout is under the direct command of the OOW or the Master (see diagram below):

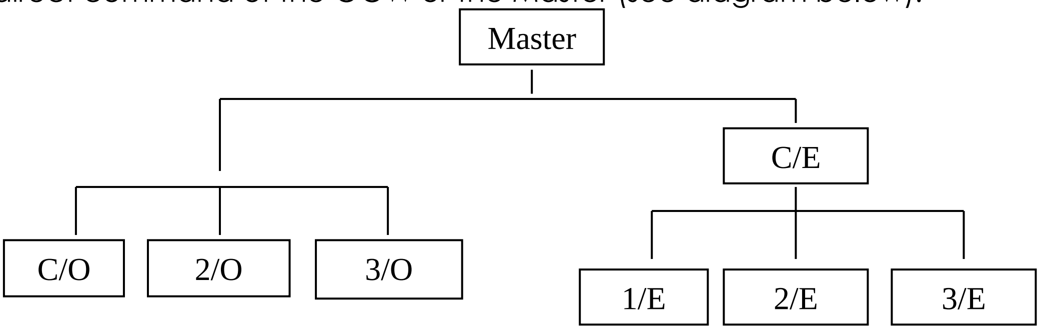


Figure 2

Bridge Watch keeping Arrangements and Conditions

Navigation varies when in open seas, coastal waters or restricted waters under different levels of weather and visibility conditions. For this reason, there is a need to identify the different watch conditions and set the proper watchkeeping arrangement capable of handling the prevailing amount of workload.

Bridge Watch keeping Arrangements

- BI-Watch (OOW and AB)
- BII-Watch (Master, OOW, AB and Lookout)
- BIII-Watch (Master, OOW, Extra, AB and Lookout)
- BIV-Watch (As per master's discretion)

(See table on bridge watchkeeping arrangement)

<table>
<tr><th></th><th>Conn</th><th>Traffic</th><th>Comm</th><th>Navigation</th><th>Others</th><th>Steering</th><th>Lookout</th></tr>
<tr><td>Job/Task</td><td>Taking the Conn</td><td>Radar
ARPA</td><td>VHF</td><td>Fixing
Position</td><td>Engine Telegraph, Steering, Engine Monitoring, Record</td><td>Steering</td><td>Lookout</td></tr>
<tr><td>B1-Watch</td><td colspan="6">OOW</td><td>AB</td></tr>
<tr><td>BII-Watch</td><td>Captain</td><td colspan="4">OOW</td><td>AB</td><td>Lookout</td></tr>
<tr><td>BIII-Watch</td><td>Captain</td><td colspan="2">Extra Officer</td><td colspan="2">OOW</td><td>AB</td><td>Lookout</td></tr>
<tr><td>BIV-Watch</td><td colspan="7">As per master's discretion (when the above watchkeeping arrangements do not apply and when special situations or circumstances require)</td></tr>
<tr><td colspan="8">Note: Job assignment may be changed at the master's discretion. Any deviation in job assignments shall clearly be informed to the concerned officers/crew.</td></tr>
</table>

Figure 3 Table on Bridge Watchkeeping Arrangement

CHARTS –Notes

(Attention should be drawn to the various measures used on charts, in what units they are given and what the datum's for the measures are. Trainees should also be taught the habit of always checking when the chart was last corrected and when the original was made.
Special attention should be drawn to datum's. The instructor should make it sure that all trainees have a thorough understanding of datum shift. This is especially important when using instruments giving positions in latitude and longitude. [The difference in position from one datum to another may be several hundred meters]).

1.2 DATUM – is a point, line or surface from which all measurements either on the map or on the Earth may be referenced.

❖ **Datum (geodetic)**
A set of parameters specifying the reference surface or the reference coordinate system used for geodetic control in the calculation of coordinates of points on the earth.

❖ L**ocal geodetic datum**
The reference surface is defined by five parameters: the latitude and longitude of an initial point, the azimuth of a line from this point, and the parameters of the reference spheroid.

❖ **Datum (vertical)**
Any level surface (e.g. sea mean sea level) taken as a surface of reference from which to reckon elevations.

➢ **The Local Datum**
The geodesists must be able to relate their measurements (distance, heights) to some system of coordinates, so the location could be entered on a map or chart at the correct position. In the past, when a universal Earth ellipsoid had not been yet known, geodesists developed various ellipsoids that best represented the local surface of the gravitational potential. The dimensions of such ellipsoid were determined so that the plumb line (dependent on gravity) coincided with the ellipsoid normal line (perpendicular to the tangential of the ellipsoid) at a fixed location.

Longitude and latitude were then given in relation to the ellipsoid, and the heights were determined in relation to the ellipsoid surface.

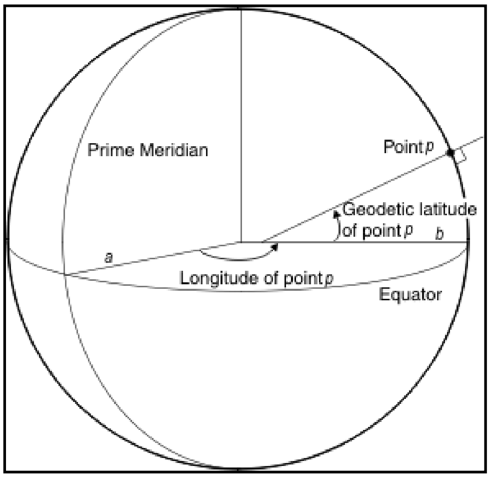


Fig. 4: Geodetic Latitude and Longitude of an

A reference system (often called a geodetic datum) is nowadays defined using two fixed terms

- The choice of a suitable ellipsoid which is determined by specifying the large half-axis and the flattening;
- Connecting the center point of an ellipsoid in relation to the fixed center point of the Earth.

➢ **Over 100 Datum World-Wide**

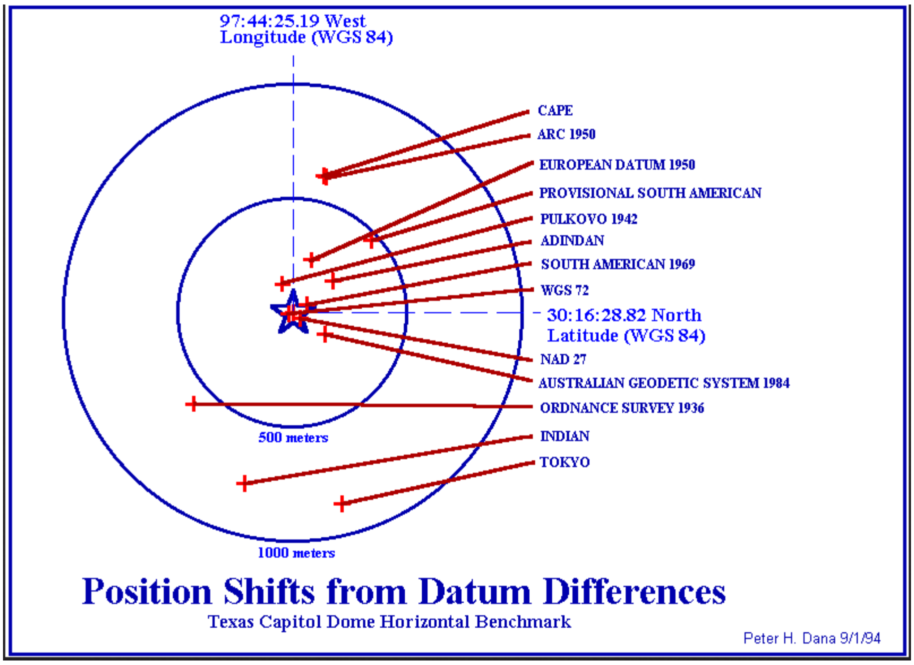
There are almost as many horizontal datum's as there are countries, well over 100 [NIMA 1997]. Navigational charts alone use over 60 various datum world-wide, and in many cases the reference systems cannot be reconstructed.

1.3 WGS-84 and the Difference with Local Datum

With development of the satellite based position-finding systems like today's Global Positioning System (GPS) it became vital that an appropriate global reference system be defined. This is the World Geodetic System 84 (WGS-84), to which all the positions established with the GPS are related. Another global reference system has been defined for the Russian equivalent of GPS, the Global Navigation Satellite System GLONASS: the PE90 (identical to PZ90) which deviates however only by a few meters from the WGS-84.

It is not customary to use a local datum outside the area for which it was defined. The reverse comparison allows us to see how big the difference can be within the area of local definition between the results from GPS using WGS-84 and those based on a local datum. It is no wonder then, that with the increasing use of GPS, there were more and more complaints about allegedly 'completely incorrect charts'. In reality, the users are often uninformed of the concept of geodetic datum; hence they may be not aware of the datum of their current charts, and that it may be not WGS-84. **These problems gradually disappear with more and more paper charts having been transformed to WGS84.** However, there are still areas in the world where charts are based on very old surveys for which no relationship to WGS84 exists. In general, it is usually possible to convert one reference system to another. In this regard a manual on transformation parameters has been published by National Geospatial Intelligence Agency (NGA) for this purpose. It is possible to select a preferred reference system in most of the GPS receivers, the conversion follows then automatically.

When using charts and GPS together, it is always necessary to ascertain the datum of the chart and then to set the GPS receiver accordingly; this is also valid for the electronic charts, when they are not uniformly related to WGS84. However, the ECDIS PS requires the chart data to be in WGS84. When using ECS it is important to examine the chart to ensure that the data is in WGS84 and not digitized from a paper chart based on a local datum.



Position Shifts from Datum Differences systems in comparison with WGS-84 based from the location of Austin, Texas, USA.

Figure 5

- **The Datum is Not Defined in Many Areas**

In such areas (e.g. in the Caribbean Sea), it is often impossible to convert the datum to WGS-84 precisely, because the local datum is not perfectly defined or is impossible to reconstruct. One must reckon here with a chart dependent positional error that can be of several hundreds of meters. In this situation, the GPS position is correct, but the chart contents are shifted from WGS-84 by an unknown and spatially variable amount.

Chart Datum, the Vertical Reference Level

As if it were not enough to be confused by all the different horizontal datum's, one must unfortunately also come to terms with the vertical datum's. In this case, we are dealing with the vertical reference system to which all depths shown on the charts are related – the chart datum which is normally a low water level. This is an important issue in areas with a perceptible tidal range (i.e. in the great majority of navigable waters). In non-tidal such as the Great Lakes of North America or the Baltic Sea, Mean Sea Level (MSL) is used as a vertical datum.

- **Depth Related to the Chart Datum are Minimum Depths (almost always)**

The purpose of providing the vertical reference of depth to chart datum is to show the minimum depths to be expected. It is the depth below which the water level is rarely likely to fall, thus providing a safety margin for the Navigator. Tidal range is usually the main determinant of the chart datum. However, spatially it is highly variable and can vary from near zero in the vicinity of so-called amphidromic points up to 14 meters in Nova Scotia and the British and French coast of the English Channel. In addition, the tidal range varies from springs (the period of highest range) to neaps in a roughly two-weekly cycle. It would be not enough to subtract a spatially constant value from the measured depth. Chart datum therefore is defined as a surface which roughly corresponds with the lowest low water at every location and which lies at a spatially variable distance below the MSL depending on the tidal range

All depths shown on charts are reduced to the chart datum. An area with little water or even with negative depths (as happens in the intertidal zones which dry out at low water) can be navigable at high water, depending on the ship's draught.

- **Wind Effects Can Lower the Water Depth Below the Chart Datum**

The water level in shelf seas like the North Sea can depend not only on tides but also on wind strength and direction as well as barometric pressure distribution. The purpose of the chart datum is fulfilled here only conditionally. In areas of high water level variability caused by the strong meteorological influences the Mariner must reckon with depths occasionally shallower than shown on the chart. For instance, during a strong and prolonged southeast wind in the German Bight, the water level can fall two meters below the depth indicated on the chart. In this situation, the water is actually below the vertical chart datum because the wind simply pushes the water out of this large shallow area.

- **Vertical Datum also has Many Definition**

Unfortunately, no definition of uniform vertical chart datum is applied throughout the world although recently the IHO has recommended the use of Lowest Astronomical Tide (LAT). For just the North Sea, there are four different vertical datum's in use. The differences can be significant and can reach 1 meter. For instance, Germany uses the Mean Low Water Springs (MLWS) which in German Bight is approximately half a meter above the datum used in English and French waters which is the Lowest Astronomical Tide (LAT), the lowest possible astronomical low water.

The effect of using various chart datum's is that the depth contour lines for different national HO charts (e.g. German-Dutch border) do not meet directly, and show a so-called 'datum jump'. Accordingly, this can happen also with the electronic charts that are based on different chart datum's that may be apparent in a lack of precise continuity of the depth colors. As noted above, it has now been internationally agreed that Lowest Astronomical Tide (LAT) should be the uniform chart datum and these troublesome discrepancies will eventually belong to the past.

- **Vertical Reference for Inland Waterways**

Inland waterways are usually located along rivers and therefore follow the gently sloping land surface from their mountainous origins down to the sea. Referencing the water level of a river to some sea surface would not make any sense. On the other hand, water depths are highly time-dependent, varying with the uptake of rain (or melting snow) corresponding to the weather situation. Additionally, water depths are critical parameters for navigation on these mostly very confines, narrow waterways, and they are decisive factors for allowed draught and the cargo the inland vessels are allowed to carry. Therefore, getting depth information is of high interest for inland waterway navigation, and facilitating this constitutes one of the most useful features of an inland ECDIS.

The issue of the reference level for depth information along inland waterways can best be illustrated by considering the source of all water level measurements: water level gauges situated along the river, measuring the water depth referred to a local reference height defined individually for each gauge. A normal water depth can be determined for each gauge position, and the time-varying deviation of the water level from this normal depth can be continuously recorded. A depth model of the river bottom can be determined by hydrographic soundings, corrected by the deviation of water level from its normal level. This is the normal depth which is contained in the inland ECDIS' database.
The actual water depth along the river can be calculated from the depth at a position contained in the database by adding the actually measured difference between the water level and the normal value at the gauge, which can be, e.g., broadcast to the Navigator. It is important, though, that only information from the nearest gauge station is used.

1.4 Methods commonly available for position fixing.

Types of Fixes

While the intersection of two LOP's constitutes a **fix** under one definition, and only an estimated position by another, the prudent navigator will always use at least three
LOP's if they are available, so that an error is apparent if they don't meet in a point. Some of the most commonly used methods of obtaining LOP's are discussed below:

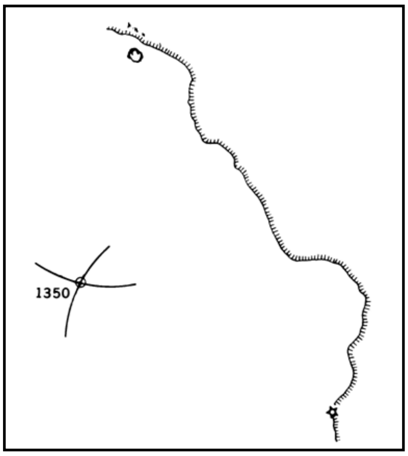


Figure 6

a.) Fix by Ranges: The navigator can plot a fix consisting of the intersection of two or more range arcs from charted objects. The navigator may take ranges to two fixed objects. The intersection of the range arcs constitutes a fix. He can plot ranges from any point on the radar scope which he can correlate on his chart

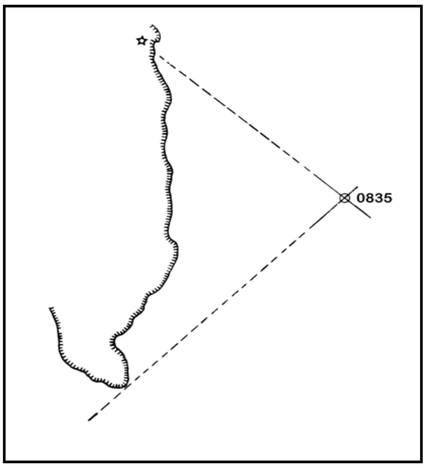


Figure 7

b.) Fix by Bearings: The navigator can take and plot bearings from two or more charted objects. This is the most common and often the most accurate way to fix a vessel's position. Bearings may be taken directly to charted objects, or tangents of points of land.
The intersection of these lines constitutes a fix. A position taken by bearings to buoys should not be considered a fix, but an estimated position (EP), because buoys swing about their watch circle and may be out of position.

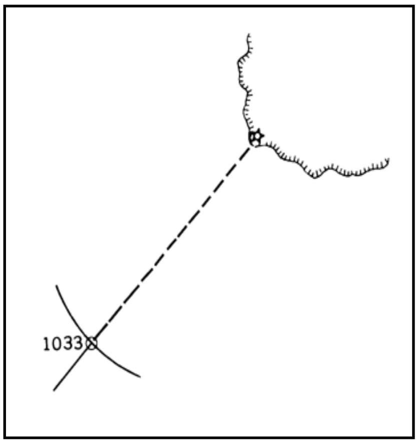


Figure 8

c.) Fix by Bearing and Range: This is a hybrid fix of LOP's from a bearing and range to a single object. The radar is the only instrument that can give simultaneous range and bearing information to the same object. With the radar, the navigator can obtain an instantaneous fix from only one NAVAID. This makes the radar an extremely useful tool for the piloting team. The radar's characteristics make it much more accurate determining range than determining bearing; therefore, two radar ranges are preferable to a radar range and bearing.

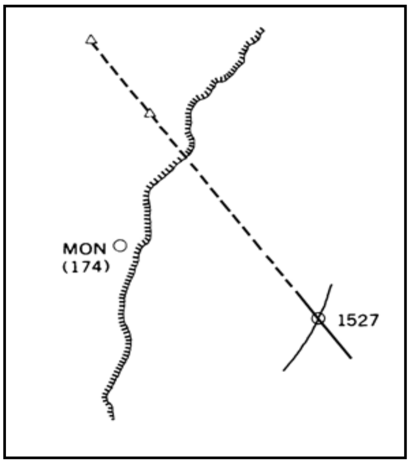


Figure 9

The Running Fix

When only one NAVAID is available from which to obtain bearings, use a technique known as the **running fix**. Use the following method:

1. Plot a bearing to a NAVAID (LOP 1).
2. Plot a second bearing to a NAVAID (either the same NAVAID or a different one) at a later time (LOP 2).
3. Advance LOP 1 to the time when LOP 2 was taken.
4. The intersection of LOP 2 and the advanced LOP 1 constitute the running fix.

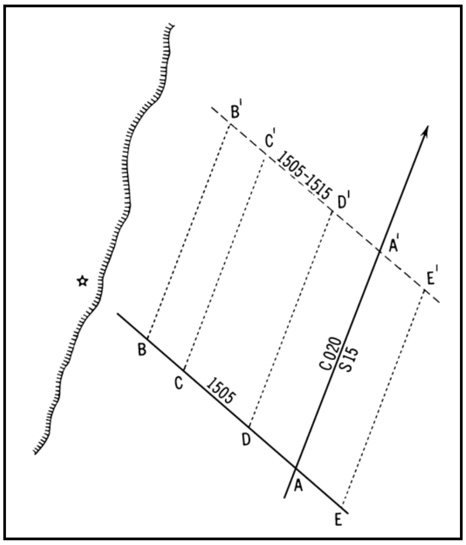


Figure 10 *Advancing a line of position.*

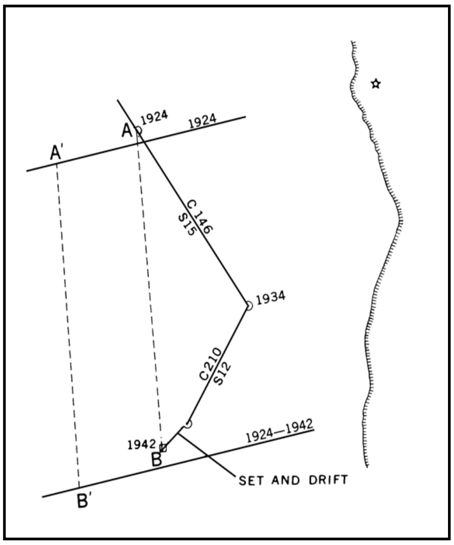


Figure 11 *Advancing a line of position with a change in course and speed, allowing for set and drift*

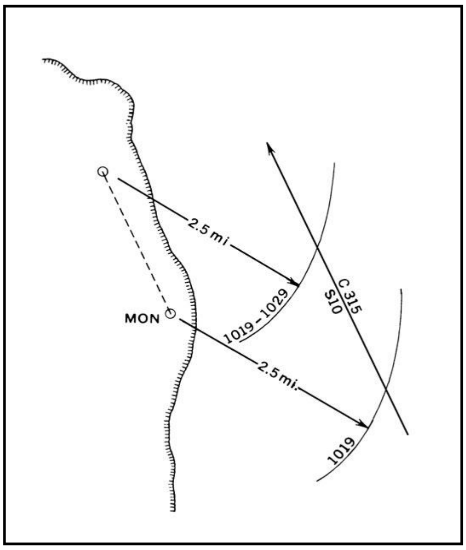


Figure 12 *Advancing a circle of position.*

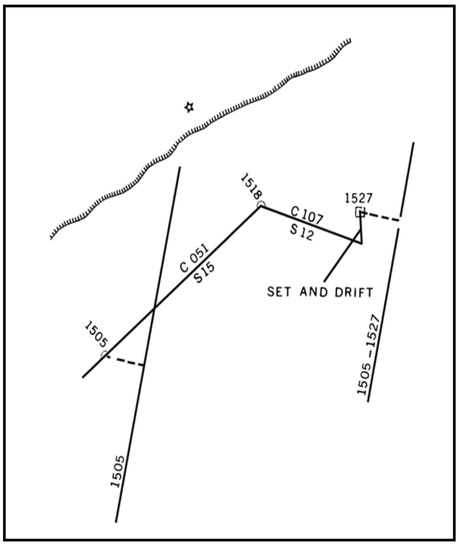


Figure 13 *Advancing a line of position by its relation to the dead reckoning.*

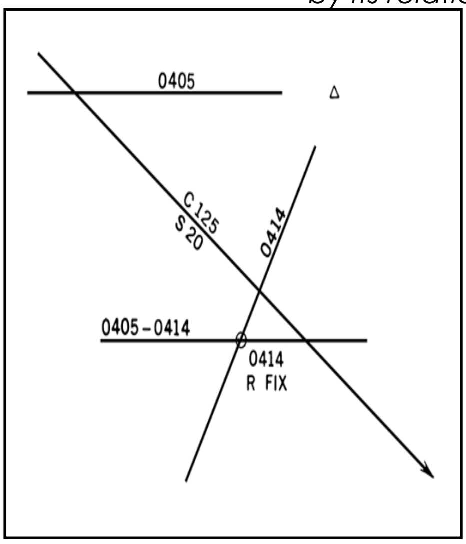


Figure 14 *A running fix by two bearings on the same object.*

Fix Type and Fix Interval

The preferred piloting fix is taken from visual bearings from charted fixed NAVAIDS. Plot visual bearings on the primary plot and plot all other fixes on the secondary plot. If poor visibility obscures visual NAVAIDS, shift to radar piloting on the primary plot. If neither visual nor radar piloting is available, consider standing off until the visibility improves.

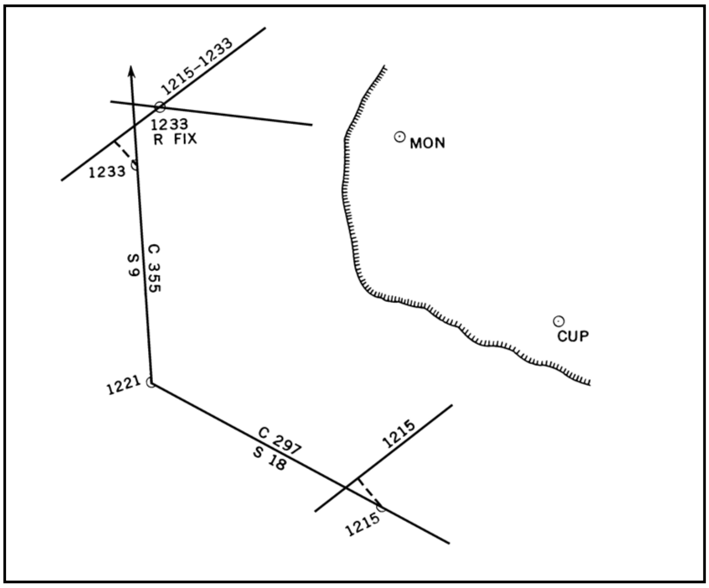


Figure 15 *A running fix with a change of course and speed between observations on separate landmarks.*

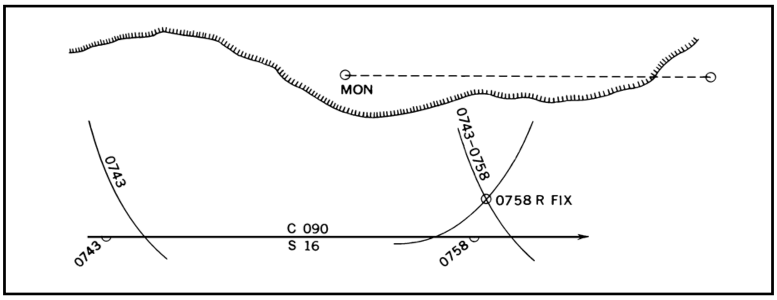


Figure 16 *A running fix by two circles of position.*

Using the Fathometer

Use the fathometer to determine whether the depth of water under the keel is sufficient to prevent the ship from grounding and to check the actual water depth with the charted water depth at the fix position. The navigator must compare the charted sounding at every fix position with the fathometer reading and report to the captain any discrepancies. Taking continuous soundings in restricted waters is mandatory.

1.5 Accuracy of range and bearing measurements required by the performance standards for radar equipment

(Notes: Trainees should be reminded about the normal accuracy of a navigational radar. Attention should be drawn to the possibility of mistaken identity of buoys or coastal areas when using the radar as a navigational aid.

The different methods of position fixing should be reviewed. The importance of periodically checking the position by different methods should be stressed. For example, if position fixing by radar bearing and range is method in use, every now and then the position should be checked by another means (e.g. GPS, LORAN-C, visual.

This is mainly a classroom session, but a brief demonstration on the simulator would reinforce the lesson. The danger of over-reliance on radar when measuring the distance to a slopping coastline is a useful demonstration. If possible, a demonstration of datum shift should be done by fixing with two different methods using different datum's. [Satellite fix in WGS84 and a radar fix in the local datum of the chart for instance.])

MSC 79/23/Add.2
ANNEX 34

RESOLUTION MSC.192 (79)
(adopted on 6 December 2004)
ADOPTION OF THE REVISED PERFORMANCE STANDARDS FOR RADAR EQUIPMENT

SCOPE OF EQUIPMENT

The radar equipment should assist in safe navigation and in avoiding collision by providing an indication, in relation to own ship, of the position of other surface craft, obstructions and hazards, navigation objects and shorelines.

For this purpose, radar should provide the integration and display of radar video, target tracking information, positional data derived from own ship's position (EPFS) and geo referenced data.

The integration and display of AIS information should be provided to complement radar. The capability of displaying selected parts of Electronic Navigation Charts and other vector chart information may be provided to aid navigation and for position monitoring.
The radar, combined with other sensor or reported information (e.g. AIS), should improve the safety of navigation by assisting in the efficient navigation of ships and protection of the environment by satisfying the following functional requirements:

- in coastal navigation and harbor approaches, by giving a clear indication of land and other fixed hazards;

- as a means to provide an enhanced traffic image and improved situation awareness;

- in a ship-to-ship mode for aiding collision avoidance of both detected and reported hazards;

- in the detection of small floating and fixed hazards, for collision avoidance and the safety of own ship; and

- in the detection of floating and fixed aids to navigation (see Table 2, note 3).

APPLICATION OF THESE STANDARDS

These Performance Standards should apply to all ship borne radar installations, used in any configuration, mandated by the 1974 SOLAS Convention, as amended, independent of the:

- type of ship;

- frequency band in use; and

- type of display,

providing that no special requirements are specified in Table 1 and that additional requirements for specific classes of ships (in accordance with SOLAS chapters V and X) are met.

The radar installation, in addition to meeting the general requirements as set out in resolution A.694 (17) *, should comply with the following performance standards.

Close interaction between different navigational equipment and systems, makes it essential to consider these standards in association with other relevant IMO standards.

TABLE 1

Differences in the performance requirements for various sizes/categories of ship/craft to which SOLAS applies

Size of ship/craft	<500 gt	500 gt to <10,000 gt and HSC<10,000 gt	All ships/craft ≥10,000 gt
Minimum operational display area diameter	180 mm	250 mm	320 mm
Minimum display area	195 x 195 mm	270 x 270 mm	340 x 340 mm
Auto acquisition of targets	-	-	Yes
Minimum ***acquired*** radar target capacity	20	30	40
Minimum ***activated*** AIS target capacity	20	30	40
Minimum ***sleeping*** AIS target capacity	100	150	200
Trial Manoeuvre	-	-	Yes

5.2 Radar Range and Bearing Accuracy

The radar system range and bearing accuracy requirements should be:

Range - within 30 m or 1% of the range scale in use, whichever is greater;
Bearing - within 1°.

1.6 Factors affecting radar detection, including blind shadow sectors

FACTORS AFFECTING MAXIMUM RANGE

Frequency
The higher the frequency of a radar (radio) wave, the greater is the attenuation (loss in power), regardless of weather. Lower radar frequencies (longer wavelengths) have, therefore, been generally superior for longer detection ranges.

Peak Power
The peak power of a radar is its useful power. Range capabilities of the radar increase with peak power. Doubling the peak power increases the range capabilities by about 25 percent.

Pulse Length
The longer the pulse length, the greater is the range capability of the radar because of the greater amount of energy transmitted.

Pulse Repetition Rate
The pulse repetition rate (PRR) determines the maximum measurable range of the radar. Ample time must be allowed between pulses for an echo to return from any target located within the maximum workable range of the system. Otherwise, echoes returning from the more distant targets are blocked by succeeding transmitted pulses. This necessary time interval determines the

highest PRR that can be used. The PRR must be high enough, however, that sufficient pulses hit the target and enough echoes are returned to the radar. The maximum measurable range can be determined approximately by dividing 81,000 by the PRR.

Beam Width
The more concentrated the beam, the greater is the detection range of the radar.

Target Characteristics
Targets that are large can be seen on the scope at greater ranges, provided line-of-sight exists between the radar antenna and the target. Conducting materials (a ship's steel hull, for example) return relatively strong echoes while no conducting materials (a wood hull of a fishing boat, for example) return much weaker echoes.

Receiver Sensitivity
The more sensitive receivers provide greater detection ranges but are more subject to jamming.

Antenna Rotation Rate
The more slowly the antenna rotates, the greater is the detection range of the radar.
For a radar set having a PRR of 1,000 pulses per second, a horizontal beam width of 2.0°, and an antenna rotation rate of 6 RPM (1 revolution in 10 seconds or 36 scanning degrees per second), there is 1 pulse transmitted each 0.036° of rotation. There are 56 pulses transmitted during the time required for the antenna to rotate through its beam width.

$$\frac{\text{Beam width}}{\text{Degrees per pulse}} = \frac{2.0°}{0.036°} = 56 \text{ pulses}$$

With an antenna rotation rate of 15 RPM (1 revolution in 4 seconds or 90 scanning degrees per second), there is only 1 pulse transmitted each 0.090° of rotation. There are only 22 pulses transmitted during the time required for the antenna to rotate through its beam width.

$$\frac{\text{Beam width}}{\text{Degrees per pulse}} = \frac{2.0°}{0.090°} = 22 \text{ pulses}$$

From the foregoing it is apparent that at the higher antenna rotation rates, the maximum ranges at which targets, particularly small targets, may be detected are reduced.

FACTORS AFFECTING MINIMUM RANGE

Pulse Length
The minimum range capability of a radar is determined primarily by the pulse length. It is equal to half the pulse length of the radar (164 yards per microsecond of pulse length). Electronic considerations such as the recovery time of the receiver and the duplexer (TR and anti-TR tubes assembly) extend the minimum range at which a target can be detected beyond the range determined by the pulse length.

Sea Return
Sea return or echoes received from waves may clutter the indicator within and beyond the minimum range established by the pulse length and recovery time.

Side-Lobe Echoes
Targets detected by the side-lobes of the antenna beam pattern are called side-lobe echoes. When operating near land or large targets, side-lobe echoes may clutter the indicator and prevent detection of close targets, without regard to the direction in which the antenna is trained.

Vertical Beam Width

Small surface targets may escape the lower edge of the vertical beam when close.

FACTORS AFFECTING RANGE ACCURACY

The range accuracy of radar depends upon the exactness with which the time interval between the instants of transmitting a pulse and receiving the echo can be measured.

Fixed Error

A fixed range error is caused by the starting of the sweep on the indicator before the r-f energy leaves the antenna. The zero reference for all range measurements must be the leading edge of the transmitted pulse as it appears on the indicator. Inasmuch as part of the transmitted pulse leaks directly into the receiver without going to the antenna, a fixed error results from the time required or r-f energy to go up to the antenna and return to the receiver. This error causes the indicated ranges to be greater than their true values. A device called a trigger delay circuit is used to eliminate the fixed error. By this means the trigger pulse to the indicator can be delayed a small amount. Such a delay results in the sweep starting at the instant an echo would return to the indicator from a flat plate right at the antenna not at the instant that the pulse is generated in the transmitter.

Line Voltage

Accuracy of range measurement depends on the constancy of the line voltage supplied to the radar equipment. If supply voltage varies from its nominal value, ranges indicated on the radar may be unreliable. This fluctuation usually happens only momentarily, however, and after a short wait ranges normally are accurate.

Frequency Drift

Errors in ranging also can be caused by slight variations in the frequency of the oscillator used to divide the sweep (time base) into equal range intervals.
If such a frequency error exists, the ranges read from the radar generally are in error by some small percentage of the range. To reduce range errors caused by frequency drift, precision oscillators in radars usually are placed in a constant temperature oven. The oven is always heated, so there is no drift of range accuracy while the rest of the set is warming up

Calibration

The range to a target can be measured most accurately on the PPI when the leading edge of its pip just touches a fixed range ring. The accuracy of this measurement is dependent upon the maximum range of the scale in use.
Representative maximum error in the calibration of the fixed range rings is 75 yards or 1½ percent of the maximum range of the range scale in use, whichever is greater. With the indicator set on the 6-mile range scale, the error in the range of a pip just touching a range ring may be about 180 yards or about 0.1 nautical mile because of calibration error alone when the range calibration is within acceptable limits.
On some PPI's, range can only be estimated by reference to the fixed range rings. When the pip lies between the range rings, the estimate is usually in error by 2 to 3 percent of the maximum range of the range scale setting plus any error in the calibration of the range rings.
Radar indicators usually have a variable range marker (VRM) or adjustable range ring which is the normal means for range measurements. With the VRM calibrated with respect to the fixed range rings within a tolerance of 1 percent of the maximum range of the scale in use, ranges as measured by the VRM may be in error by as much as 2 ½ percent of the maximum range of the scale in use. With the indicator set on the 8-mile range scale, the error in a range as measured by the VRM may be in error by as much as 0.2 nautical mile.

Pip and VRM Alignment

The accuracy of measuring ranges with the VRM is dependent upon the ability of the radar observer to align the VRM with the leading edge of the pip on the PPI. On the longer range scales it is more difficult to align the VRM with the pip because small changes in the reading of the VRM range counter do not result in appreciable changes in the position of the VRM on the PPI.

Range Scale

The higher range scale settings result in reduced accuracy of fixed range ring and VRM measurements because of greater calibration errors and the greater difficulty of pip and VRM alignment associated with the higher settings.

PPI Curvature

Because of the curvature of the PPI, particularly in the area near its periphery, range measurements of pips near the edge are of lesser accuracy than the measurements nearer the center of the PPI.

Radarscope Interpretation

Relatively large range errors can result from incorrect interpretation of a landmass image on the PPI. The difficulty of radarscope interpretation can be reduced through more extensive use of height contours on charts.

For reliable interpretation it is essential that the radar operating controls be adjusted properly. If the receiver gain is too low, features at or near the shoreline, which would reflect echoes at a higher gain setting, will not appear as part of the landmass image. If the receiver gain is too high, the landmass image on the PPI will "bloom". With blooming the shoreline will appear closer than it actually is.

A fine focus adjustment is necessary to obtain a sharp landmass image on the PPI.

Because of the various factors introducing errors in radar range measurements, one should not expect the accuracy of navigational radar to be better than + or - 50 yards under the best conditions.

FACTORS AFFECTING RANGE RESOLUTION

Range resolution is a measure of the capability of a radar to display as separate pips the echoes received from two targets which are on the same bearing and are close together.

The principal factors that affect the range resolution of a radar are the length of the transmitted pulse, receiver gain, CRT spot size, and the range scale. A high degree of range resolution requires a short pulse, low receiver gain, and a short range scale.

Pulse Length

Two targets on the same bearing, close together, cannot be seen as two distinct pips on the PPI unless they are separated by a distance greater than one-half the pulse length (164 yards per microsecond of pulse length). If a radar has a pulse length of 1-microsecond duration, the targets would have to be separated by more than 164 yards before they would appear as two pips on the PPI.

Radio-frequency energy travels through space at the rate of approximately 328 yards per microsecond. Thus, the end of a 1-microsecond pulse traveling through the air is 328 yards behind the leading edge, or start, of the pulse. If a 1-microsecond pulse is sent toward two objects on the same bearing, separated by 164 yards, the leading edge of the echo from the distant target coincides in space with the trailing edge of the echo from the near target. As a result the echoes from the two objects blend into a single pip, and range can be measured only to the nearest object. The reason for this blending is illustrated in figure 16. In part A of figure 1.19, the transmitted pulse is just striking the near target. Part B shows energy being reflected from the near target, while the leading edge of the transmitted pulse continues toward the far target. In part C, microsecond later, the transmitted pulse is just striking the far target; the echo from the near target has traveled 164 yards back toward the antenna.

The reflection process at the near target is only half completed. In part D echoes are traveling back toward the antenna from both targets. In part E reflection is completed at the near target. At this time the leading edge of the echo from the far target coincides with the trailing edge of the first echo. When the echoes reach the antenna, energy is delivered to the set during a period of 2 microseconds so that a single pip appears on the PPI.

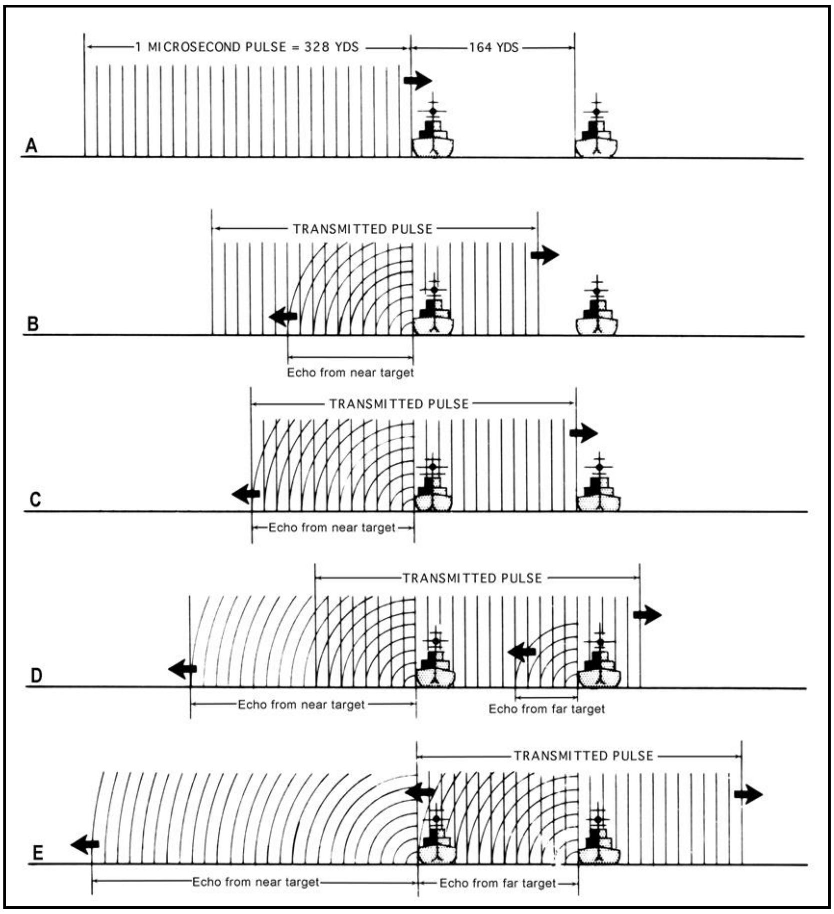


FIGURE 17 *pulse length and range resolution*

Receiver Gain

Range resolution can be improved by proper adjustment of the receiver gain control. As illustrated **in figure 18**, the echoes from two targets on the same bearing may appear as a single pip on the PPI if the receiver gain setting is too high. With reduction in the receiver gain setting, the echoes may appear as separate pips on the PPI.

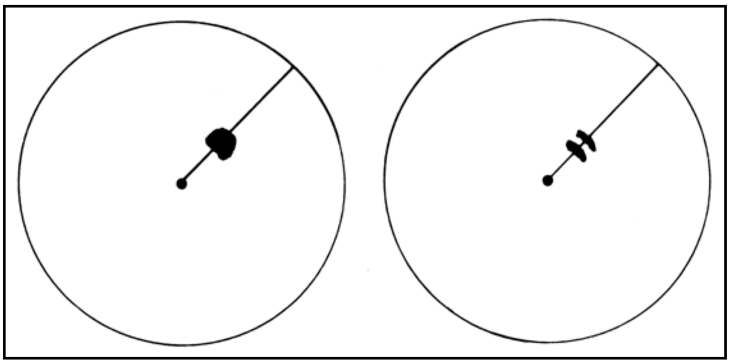


Figure 18 - *Receiver gain and range resolution.*

Range Scale
The pips of two targets separated by a few hundred yards may merge on the PPI when one of the longer range scales is used. The use of the shortest range scale possible and proper adjustment of the receiver gain may enable their detection as separate targets. If the display can be off-centered, this may permit display of the targets on a shorter range scale than would be possible otherwise.

FACTORS AFFECTING BEARING ACCURACY

Horizontal Beam Width
Bearing measurements can be made more accurately with the narrower horizontal beam widths. The narrower beam widths afford better definition of the target and, thus, more accurate identification of the center of the target.
Several targets close together may return echoes which produce pips on the PPI which merge, thus preventing accurate determination of the bearing of a single target within the group.
The effective beam width can be reduced through lowering the receiver gain setting. In reducing the sensitivity of the receiver, the maximum detection range is reduced, but the narrower effective beam width provides better bearing accuracy.

Target Size
For a specific beam width, bearing measurements of small targets are more accurate than large targets because the centers of the smaller pips of the small targets can be identified more accurately.

Target Rate of Movement
The bearings of stationary or slowly moving targets can be measured more accurately than the bearings of faster moving targets.

Stabilization of Display
Stabilized PPI displays provide higher bearing accuracies than unstabilized displays because they are not affected by yawing of the ship.

Sweep Centering Error
If the origin of the sweep is not accurately centered on the PPI, bearing measurements will be in error. Greater bearing errors are incurred when the pip is near the center of the PPI than when the pip is near the edge of the PPI.
Since there is normally some centering error, more accurate bearing measurements can be made by changing the range scale to shift the pip position away from the center of the PPI.

Parallax Error
Improper use of the mechanical bearing cursor will introduce bearing errors. On setting the cursor to bisect the pip, the cursor should be viewed from a position directly in front of it. Electronic bearing cursors used with some stabilized displays provide more accurate bearing measurements than mechanical bearing cursors because measurements made with the electronic cursor are not affected by parallax or centering errors.

Heading Flash Alignment
For accurate bearing measurements, the alignment of the heading flash with the PPI display must be such that radar bearings are in close agreement with relatively accurate visual bearings observed from near the radar antenna.

FACTORS AFFECTING BEARING RESOLUTION
Bearing resolution is a measure of the capability of a radar to display as separate pips the echoes received from two targets which are at the same range and are close together. The principal

factors that affect the bearing resolution of a radar are horizontal beam width, the range to the targets, and CRT spot size.

Horizontal Beam Width

As the radar beam is rotated, the painting of a pip on the PPI begins as soon as the leading edge of the radar beam strikes the target. The painting of the pip is continued until the trailing edge of the beam is rotated beyond the target. Therefore, the pip is distorted angularly by an amount equal to the effective horizontal beam width.

As illustrated in figure 21, in which a horizontal beam width of 10° is used for graphical clarity only, the actual bearing of a small target having good reflecting properties is 090°, but the pip as painted on the PPI extends from 095° to 085°. The left 5° and the right 5° are painted while the antenna is not pointed directly towards the target. The bearing must be read at the center of the pip.

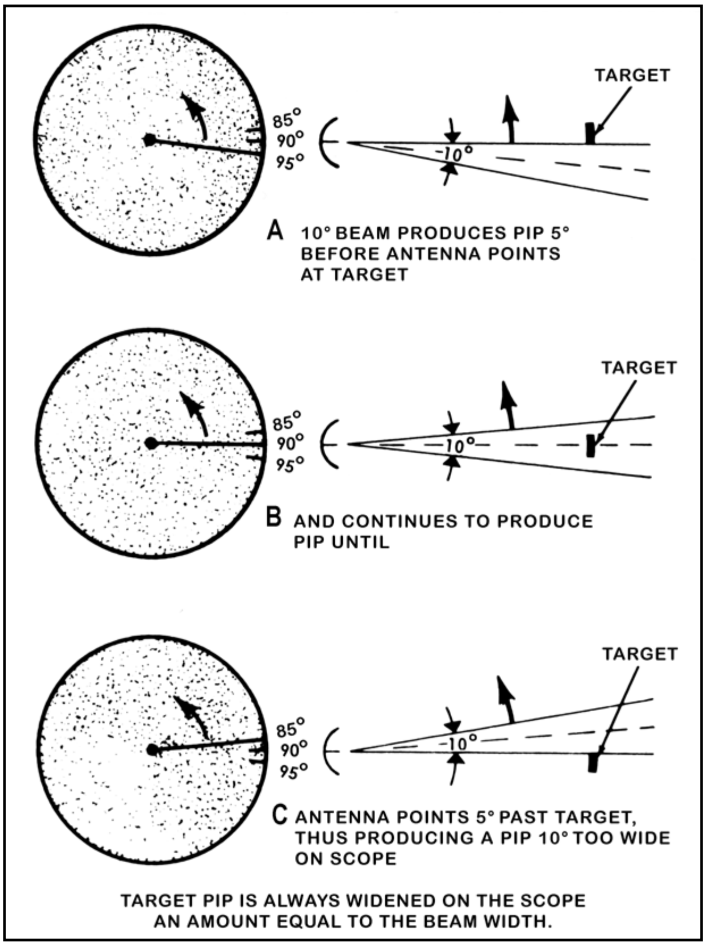


Figure 19. *Angular distortion*

Range of Targets

Assuming a more representative horizontal beam width of 2°, the pip of a ship 400 feet long observed beam on at a distance of 10 nautical miles on a bearing of 090° would be painted on the PPI between 091.2° and 088.8°, the actual angular width of the target being 0.4°. The pip of a ship 900 feet long observed beam on at the same distance and bearing would be painted on the PPI between 091.4° and 088.6°, the angular width of the target being 0.8°.

Since the angular widths of the pips painted for the 400 and 900-foot targets are 1.4° and 1.8°, respectively, any attempt to estimate target size by the angular width of the pip is not practical, generally.

Since the pip of a single target as painted on the PPI is elongated angularly an amount equal to beam width, two targets at the same range must be separated by more than one beam width to appear as separate pips. The required distance separation depends upon range. Assuming a 2° beam width, targets at 10 miles must be separated by over 0.35 nautical miles or 700 yards to appear as separate pips on the PPI. At 5 miles the targets must be separated by over 350 yards to appear as separate pips if the beam width is 2°

WAVELENGTH

Generally, radars transmitting at the shorter wavelengths are more subject to the effects of weather than radars transmitting at the longer wavelengths. Without use of anti-rain and anti-sea clutter controls, the clutter is more massive on the PPI of the radar having the shorter wavelength. Targets, which can be detected on the PPI of the radar having the longer wavelength, cannot be detected on the PPI of the radar having the shorter wavelength. Following use of the anti-rain and anti-sea clutter controls, the targets still cannot be detected on the PPI of the radar having the shorter wavelength because too much of the energy has been absorbed or attenuated by the rain. Similar detection of close targets by a radar having a relatively long wavelength and no detection of these targets by a radar having a relatively short wavelength.

1.6 Factors affecting radar detection, including blind shadow sectors

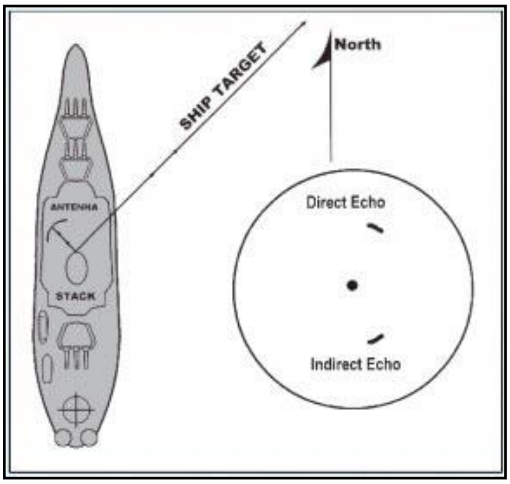


Figure 20 *Indirect echoes*

Recognition of Unwanted Echoes

Indirect or false echoes are caused by reflection of the main lobe of the radar beam off ship's structures such as stacks and kingposts. When such reflection does occur, the echo will return from a legitimate radar contact to the antenna by the same indirect path. Consequently, the echo will appear on the PPI at the bearing of the reflecting surface.

Characteristics by which indirect echoes may be recognized are summarized as follows:

1. Indirect echoes will often occur in shadow sectors.
2. They are received on substantially constant bearings, although the true bearing of the radar contact may change appreciably.
3. They appear at the same ranges as the corresponding direct echoes.
4. When plotted, their movements are usually abnormal.
5. Their shapes may indicate that they are not direct echoes

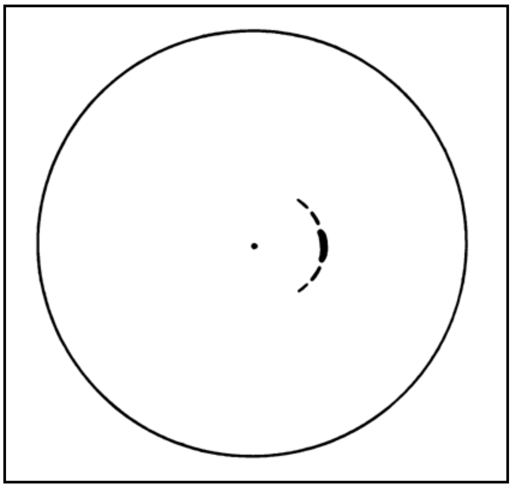


Figure 21 *Side lobe effects*

Side-lobe effects are readily recognized in that they produce a series of echoes **(Figure 21)** on each side of the main lobe echo at the same range as the latter. Semicircles, or even complete circles, may be produced. Because of the low energy of the side-lobes, these effects will normally occur only at the shorter ranges. The effects may be minimized or eliminated, through use of the gain and anti-clutter controls. Slotted wave guide antennas have largely eliminated the side-lobe problem.

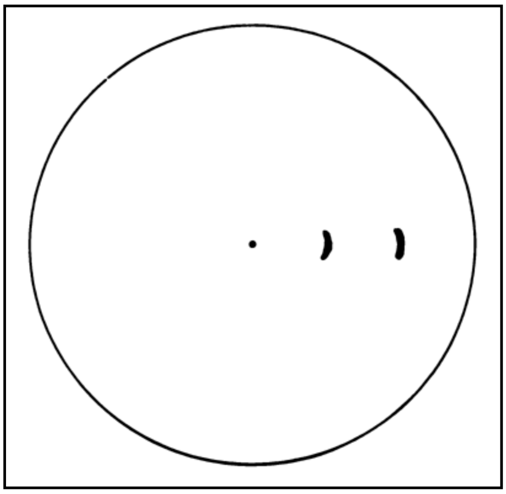


Figure 22 *Multiple echoes*

Multiple echoes may occur when a strong echo is received from another ship at close range. A second or third or more echoes may be observed on the radarscope at double, triple, or other multiples of the actual range of the radar contact

1.7 Characteristics of targets that influence their detection range

TARGET CHARACTERISTICS

There are several target characteristics which will enable one target to be detected at a greater range than another, or for one target to produce a stronger echo than another target of similar size.

Height

Since radar wave propagation is almost line of sight, the height of the target is of prime importance. If the target does not rise above the radar horizon, the radar beam cannot be reflected from the target. Because of the interference pattern, the target must rise somewhat above the radar horizon.

Size
Up to certain limits, targets having larger reflecting areas will return stronger echoes than targets having smaller reflecting areas. Should a target be wider than the horizontal beam width, the strength of the echoes will not be increased on account of the greater width of the target because the area not exposed to the radar beam at any instant cannot, of course, reflect an echo. Since the vertical dimensions of most targets are small compared to the vertical beam width of marine navigational radars, the beam width limitation is not normally applicable to the vertical dimensions. However, there is a vertical dimension limitation in the case of sloping surfaces or stepped surfaces. In this case, only the projected vertical area lying within the distance equivalent of the pulse length can return echoes at any instant.

Aspect
The aspect of a target is its orientation to the axis of the radar beam. With change in aspect, the effective reflecting area may change, depending upon the shape of the target. The nearer the angle between the reflecting area and the beam axis is to 90°, the greater is the strength of the echo returned to the antenna.

Shape
Targets of identical shape may give echoes of varying strength, depending on aspect. Thus a flat surface at right angles to the radar beam, such as the side of a steel ship or a steep cliff along the shore, will reflect very strong echoes. As the aspect changes, this flat surface will tend to reflect more of the energy of the beam away from the antenna, and may give rather weak echoes. A concave surface will tend to focus the radar beam back to the antenna while a convex surface will tend to scatter the energy. A smooth conical surface will not reflect energy back to the antenna. However, echoes may be reflected to the antenna if the conical surface is rough.

Texture
The texture of the target may modify the effects of shape and aspect. A smooth texture tends to increase the reflection qualities, and will increase the strength of the reflection, but unless the aspect and shape of the target are such that the reflection is focused directly back to the antenna, the smooth surface will give a poor radar echo because most of the energy is reflected in another direction. On the other hand, a rough surface will tend to break up the reflection, and will improve the strength of echoes returned from those targets whose shape and aspect normally give weak echoes.

Composition
The ability of various substances to reflect radar pulses depends on the intrinsic electrical properties of those substances. Thus metal and water are good reflectors. Ice is a fair reflector, depending on aspect. Land areas vary in their reflection qualities depending on the amount and type of vegetation and the rock and mineral content. Wood and fiber glass boats are poor reflectors. It must be remembered that all of the characteristics interact with each other to determine the strength of the radar echo, and no factor can be singled out without considering the effects of the others.

1.9 Parallel Indexing Navigation

Parallel indexing is an advance navigation technique mainly used to keep a safe distance from a navigational hazard (shoreline, rocks, etc.) The Radar - Parallel Indexing feature is a visual aid to indicate when the vessel has drifted too close to a navigational hazard. When the navigational hazard is drawn between the parallel indexing line and the Electronic Bearing Line (EBL) the mariner knows that he has come to close to the hazard and must correct for this error.

Radar - Parallel Indexing consists of a radar ring, electronic bearing line, Variable Range Marker (VRM) and an Indexing Line.

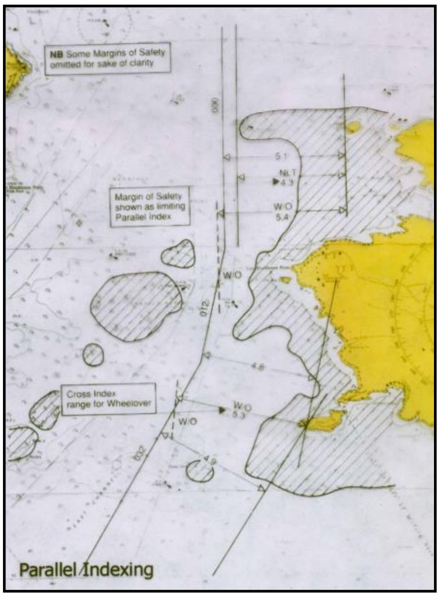


Figure 23. Parallel indexing techniques

1.10 Use of Nautical Publications

Notes: Regarding publications, different volumes and issues of pilot books, tide tables and current charts must be available. The instructor should avoid ranking then and rather point out the advantages and disadvantages of the various volumes. The instructor should use the opportunity to lead a discussion between the trainees based on their own experience.

There are a number of published navigational information intended for the use of professional ship navigators.

- Chart catalogue and folios.
- Sailing directions and ocean passages of the world.
- Notices to mariners.
- Admiralty lists of lights and fog signals.
- Admiralty lists of radio signals.
- The mariner's handbook.
- Passage planning charts, routeing charts, etc.
- Tide tables.
- Tidal stream atlases.
- Navigational warnings.
- Weather reports.
- Merchant shipping (M) notices.
- Navigational systems manual.
- Mersar manual.
- Bridge procedure guides.
- Etc.

2. FAMILIARIZATION WITH THE BRIDGE

Notes: The main objective of this session is to make the trainees familiar with the layout of the bridge, where the different instruments are located and how to operate them. The instructor *should introduce the trainees to the bridge and then let them operate the engine and rudder as well as the other instruments.*

It is vital for all watchkeeping officers to be familiar with all navigational equipment on board, particularly their operation

Bridge Operation and Instrumentation

The following bridge equipment / instrumentation are those included in the bridge simulator system

- Radar / ARPA system
- Steering system
- Steering stand
- Dual throttle control
- Thruster control (dual lever version)
- Anchor control
- RPM and start air indicator
- Navigation lights control
- Sound signals
- View control
- Radio direction finder
- GPS receiver
- Echo sounder
- Gyro repeater / pelorus gyro repeater
- Magnetic compass
- Doppler log
- VHF transceiver
- Intercom
- Engine alarms
- Overhead console

2.3 Parallax

Parallax is a displacement or difference in the apparent position of an object viewed along two different lines of sight, and is measured by the angle or semi-angle of inclination between those two lines. The term is derived from the Greek word (*parallaxis*), meaning "alteration". Nearby objects have a larger parallax than more distant objects when observed from different positions, so parallax can be used to determine distances.

Parallax also affects optical instruments such as rifle scopes, binoculars, microscopes, and twin-lens reflex cameras that view objects from slightly different angles.

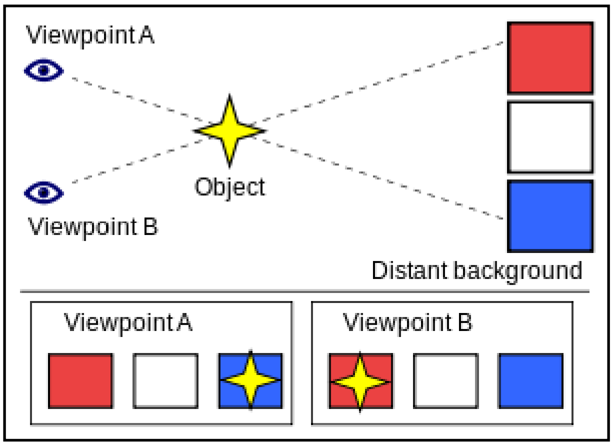


Figure 24 Parallax

A simplified illustration of the parallax of an object against a distant background due to a perspective shift. When viewed from "Viewpoint A", the object appears to be in front of the blue square. When the viewpoint is changed to "Viewpoint B", the object *appears* to have moved in front of the red square

3. Planning and carrying out a voyage

Notes: The training elements in subject areas 1 to 18 lead up to the last training element. In the last subject all that has been learned during the other lessons will be practiced in combinations in a realistic manner. The trainees will work in bridge teams in order to add to the realism and to learn the advantages of well-planned teamwork.

The teams should now be given a route which they must plan in detail, taking into account all relevant aspects such as tide, time of arrival at the pilot station, reorganizing the team when the pilot is onboard, alternative plans, special dangers, whether day or night, etc. The plans could partly be done as evening assignments. Some of the plans should be discussed among all of the trainees and instructors, but the instructors must be aware of the possibility of trainees getting embarrassed.

Each group is timetables for one-hour sessions on the simulator for putting the plan into practice. A suitable stage of the voyage should be chosen for each session.

1. *Leaving a berth, followed by a passage in a narrow channel;*
2. *Setting down a pilot and leaving the port approaches;*
3. *Entering and leaving a TSS, including crossing one lane in heavy traffic;*
4. *Making a port approach and picking up a pilot; and*
5. *A passage in a narrow channel leading to berthing.*

Exercise should run for a reasonable time to give the opportunity to get familiar with the situation. The instructor should set up a realistic traffic pattern and when the trainees are familiar with the situation he should introduce difficulties. If the plans have a weak point this could be the right spot to introduce difficulties. However, the instructor must keep in mind that the exercise should be realistic. The actual picking up and setting down of pilots may have to be omitted due to the capabilities of the simulator at hand. However, in many simulators this may be done fairly realistically by the instructor maneuvering a small target ships in the same manner as a pilot vessel would maneuver. In order to ass to the realism, the officer of the watch should leave the bridge and go to meet the pilot. Because many institutions that provide courses in nautical training are located close to harbours, the possibility of having a real pilot embarking the ship (simulator) *should be examined. He could make a valuable contribution to the course by demonstrating and explaining berthing techniques.*

As may be seen, tugs, thrusters and other special maneuvering tools have been omitted, because most ship-handling simulators do not cover these effects in their models or do it in an unrealistic manner. Should the simulator at hand cover these effects realistically, they should, by all means, be included in the course.

<u>It is important to express to all governments, ship management companies, masters, pilots and deck officers that passage planning from berth to berth is an essential navigational discipline which must be supported, encouraged and applied as part of the bridge team management.</u>

Principles of Passage Planning

The objective of developing a plan for the voyage or passage as well as the close and continuous monitoring of the vessel's progress and position during the execution of the plan. The need for a plan applies to all vessels and the size and type of vessel must be considered when formulating the plan. All information must be assembled as the requirement is a plan covering from berth to berth it therefore includes the period a pilot will be on board.

<u>There are four distinct stages in the planning and achievement of safe passage:</u>

a. Appraisal stage

The process of gathering together all information relevant to the contemplated passage such as navigational information from charts, publications, meteorological reports, etc. This will provide the Master and his bridge team an overall assessment of the voyage considering safety in priority.

- the condition and state of the vessel, stability, equipment, permissible draft, maneuvering data
- special characteristics of the cargo its stowage and securing
- provision of competent and well rest crew
- up-to-date certificate and documents concerning vessel, crew, passengers and cargo
- corrected and up-to-date charts in appropriate scale, navigational warnings and notices to mariners
- up-to-date sailing directions, light lists and radio aid lists
- mariners routing guides and passage planning charts
- tide tables and current atlases
- climatological, hydrographical, oceanographic and meteorological data
- existing ship's routing and reporting systems, vessel traffic services and marine environmental protection measures
- volume of traffic in transit areas
- compulsary pilotage information, port information including availability of shore-based emergency equipment
- procedure for the embarkation and the disembarkation of a pilot
- details of the 'exchange of information' between the Bridge Team and the Pilot
- any additional information useful to the vessel type and voyage or passage track

b. Planning stage

On the basis of the fullest possible appraisal a detailed voyage or passage plan should be prepared which should cover the entire voyage or passage from berth to berth, including those areas where the services of a pilot will be used,

- this plan should include the plotting of the intended track on appropriate charts
- the true course of the planned track should be marked
- areas of danger, ship reporting systems, vessel traffic services and marine environment protection areas indicated
- safe speed with regard to navigational hazards and draft limitations in relation to the available water depth should also be marked
- limitations due to night passage, draft increases due to squat and heel on turns must be indicated
- plot all course alterations with 'wheel over' points, speed and draft data
- nearest ports of refuge and safe anchorages should also be listed

c. Execution stage

Having finalized the voyage or passage plan as soon as time of departure and estimated time of arrival can be determined with reasonable accuracy the voyage or passage plan should be executed in accordance with the plan including update changes made.

Updates;

- times of tide heights and flow
- daytime versus nighttime passing of danger points
- traffic conditions particularly at navigational focal points
- meteorological conditions, speed reductions in poor visibility

d. Monitoring stage

The close and continuous monitoring of the ship's progress along the pre-planned track is essential for the safe conduct of the passage. Performance of all navigational equipment must be constantly checked, various position fixing methods must be applied, bridge teamwork principles must be in effect, a high level of situational awareness must be in place, etc.

- the plan must be available at all times on the Bridge for reference
- the progress of the vessel in accordance with the voyage or passage plan should be closely and continuously monitored.

Any changes made in the Plan should be made consistent with these 'Guidelines' and clearly marked and recorded

Planning the Voyage

The purpose of planning the passage is to ensure positive control over the safe navigation of the ship at all times. The passage should be planned from berth-to-berth considering IMO Resolution A.285 (VIII), Annex A (v) which states that:

"Despite the duties and obligations of a pilot, his presence on board does not relieve the officer of the watch from his duties and obligations for the safety of the vessel. He should co-operate closely with the pilot and maintain an accurate check on the vessel's position and movements. If he is in any doubt as to the pilot's actions or intentions, he should seek clarification from the pilot and if doubt still exists he should notify the master immediately and take whatever action is necessary before the master arrives."

Necessary Voyage Information

- Information from navigational publications.
- Draft, squat and depth of water.
- Tides and currents.
- Weather and climate.
- Available navigational aids.
- Means of monitoring and determining arrival at critical points.
- Expected traffic.
- Traffic separation and routeing schemes.
- Requirements for VTS.
- Ship's maneuvering data.
- Contingency plans for critical points of the passage.

Checklists for Departure, Arrival and Coastal Waters

- Anchoring.
- Pilot embarkation/disembarkation.
- Helicopter/ship operation.

Detailed Plan of Approach to and from a Pilot Station

Records and appropriate logbook entries

Records are necessary for the following reasons:

- To uncluttered the mind of the OOW, allowing concentration on watchkeeping priorities.
- To keep an accurate record of events.
- To establish trends.
- To provide evidence in the event of an accident.
- To maintain a reference for future use.

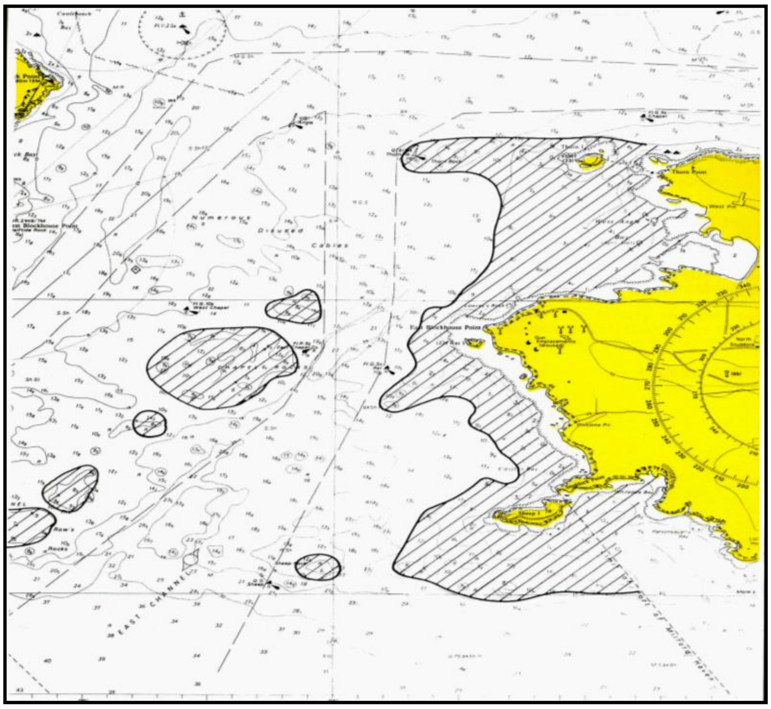


Figure 98 No Go Areas

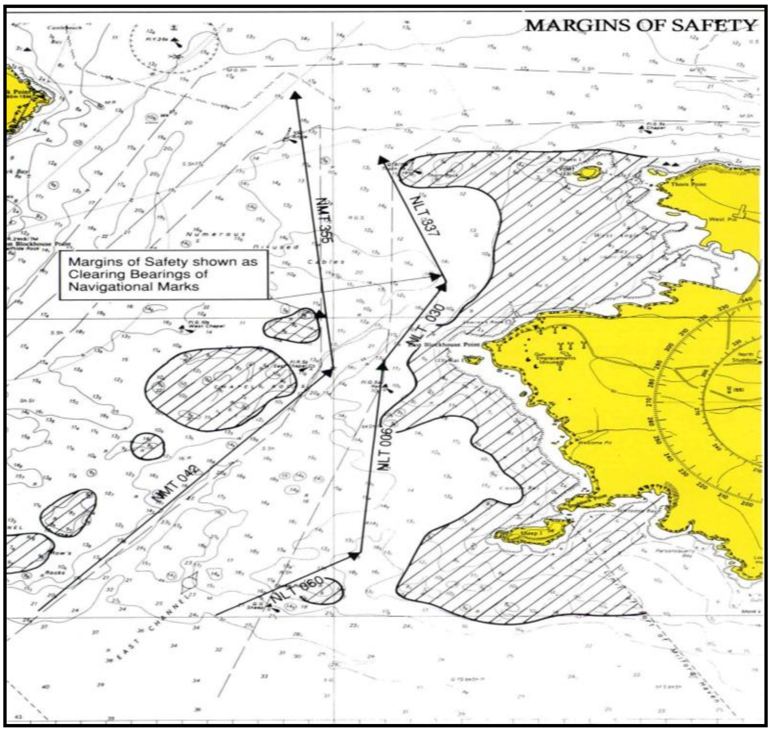


Figure 99 Safety Margins

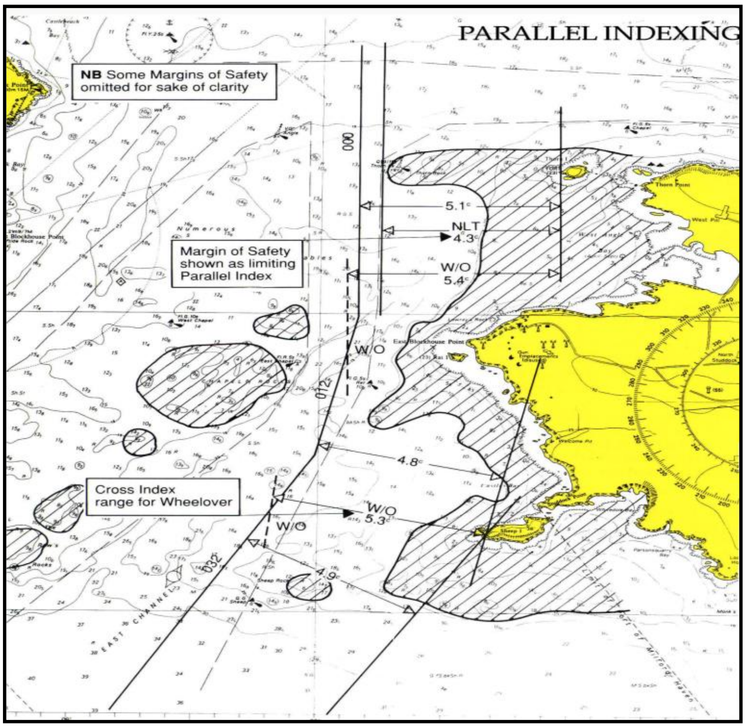


Figure 101 Parallel Index

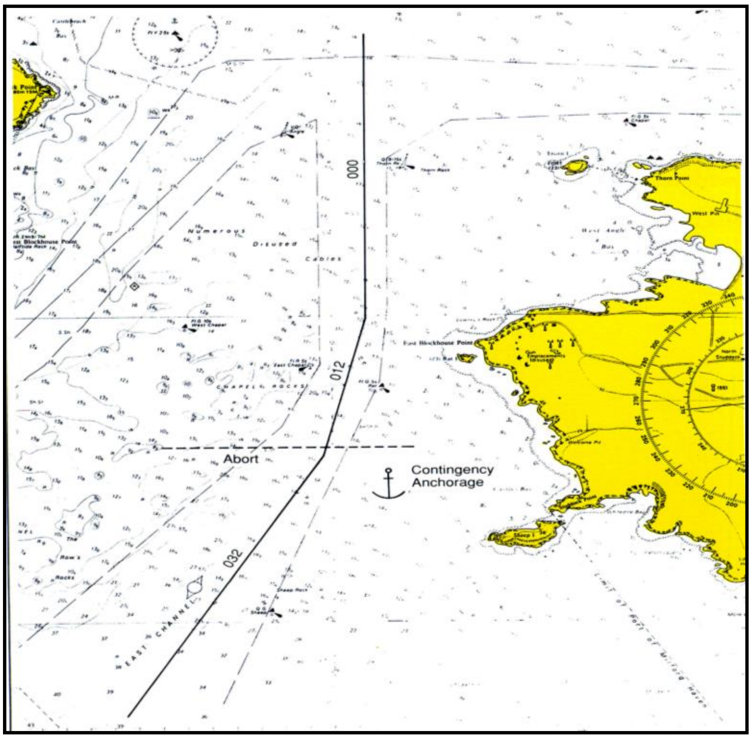


Figure 102 Abort point and Contingency Anchorage

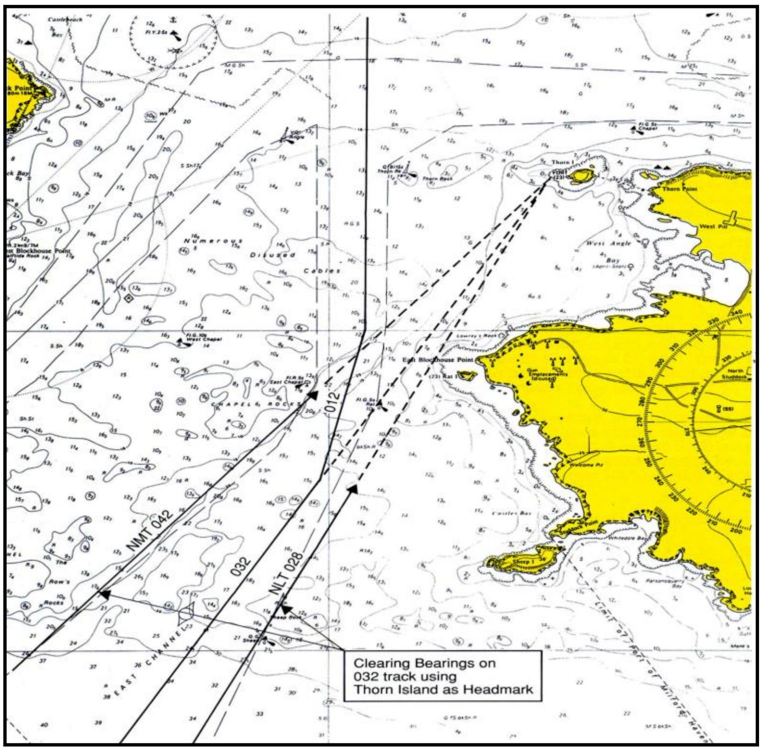


Figure 103 Clearing Bearings

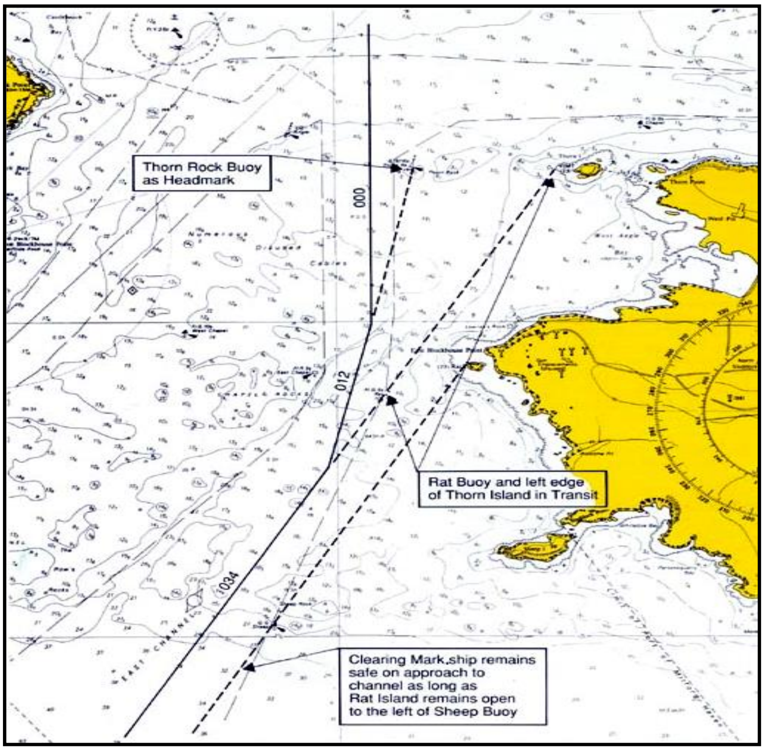


Figure 104 Transits

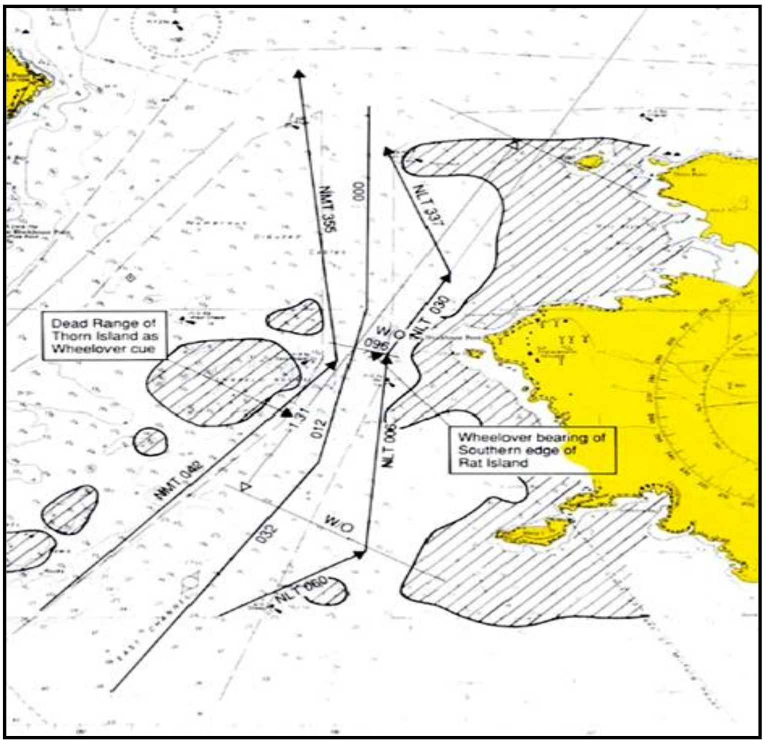


Figure 105 Wheel over point

4 ATTITUDE

Notes: The training objectives are that by the end of the lesson, the trainees will be able to to sate the three 'truths':

1. *The sea is dangerous,*
2. *You can't change the laws of nature,*
3. *We make mistakes*

to recognize common "hazardous" thoughts and state their opposite "safe" thoughts.

Attitude is an expression of favor or disfavor toward a person, place, thing, or event (the attitude object). It can be as a positive or negative evaluation of people, objects, events, activities, and ideas. The "readiness of the psyche to act or react in a certain way"

Attitude component models

1. **Cognitive component** - The cognitive component of attitudes refer to the beliefs, thoughts, and attributes that we would associate with an object. Many times a person's attitude might be based on the negative and positive attributes they associate with an object.

2. **Affective component** - The affective component of attitudes refer to your feelings or emotions linked to an attitude object. Affective responses influence attitudes in a number of ways. For example, many people are afraid/scared of spiders. So this negative affective response is likely to cause you to have a negative attitude towards spiders.

3. **Behavioral component** - The behavioral component of attitudes refer to past behaviors or experiences regarding an attitude object. The idea that people might infer their attitudes from their previous actions.

Daniel Katz classified attitudes into four different groups based on their functions

1. *Utilitarian*: provides us with general approach or avoidance tendencies
2. *Knowledge:* help people organize and interpret new information
3. *Ego-defensive:* attitudes can help people protect their self-esteem
4. *Value-expressive:* used to express central values or beliefs

The study of attitude formation is the study of how people form evaluations of persons, places or things. Theories of classical conditioning, instrumental conditioning and social learning are mainly responsible for formation of attitude. Unlike personality, attitudes are expected to change as a function of experience.

Attitudes can be changed through persuasion and an important domain of research on attitude change focuses on responses to communication. Emotion is a common component in persuasion, social influence, and attitude change.

There is deliberative process happening, individuals must be motivated to reflect on their attitudes and subsequent behaviors. Simply put, when an attitude is automatically activated, the individual must be motivated to avoid making an invalid judgment as well as have the opportunity to reflect on their attitude and behavior.

5.1 Minimum standards of safety margins.

Three truths:

1. The sea is dangerous
2. You can't change the laws of nature
3. We make mistakes.

Most common hazardous thoughts.

a) It can do it
b) It won't happen to me
c) It won't make any difference
d) It's not my job
e) Don't tell me what to do
f) We've always done it that way
g) Do something, quickly

Be replaced by safer thought.

a) Why take chances
b) It could happen to me
c) Don't give in
d) Were all on the same ship
e) Follow the rules
f) Then it's about time we changed – is there a better way?
g) Not so fast, think

5.2 Minimum standards of safety margins.

Mariners were good in navigation and ship handling, this is technical skills. Perhaps if we do not pay attention to human element (management and people skills).

Figure 44 *Bridge equipment*

- The Master is not sing the available human resources.
- There is really only one person on the bridge.

Figure 45 *Master doing all things*

- Team members should take action to see minimum standards are established if they are not volunteered by the team leader or pilot. If conning the vessel, the bridge team member should take the initiative to put them in place.
- Volunteer assistance when it appears that he team leader or pilot does not fully use all his available human resources.
- Recognize "hazardous thought" and work towards replacing them with "safe thoughts'.

5 CULTURAL AWARENESS

Notes: The training objectives are that by the end of the lesson the trainees will be able to explain the need for cultural awareness, explain how people can vary, explain ways of classifying national culture and explain what you can do to meet these facts.

Culture — the software of the mind

Every person carries him- or herself patterns of thinking, feeling, and potential acting that were learned throughout their lifetime. Using the analogy of the way computers are programmed, this book will call such patterns of thinking, feeling, and acting ***mental programs***, or ***software of mind***. A customary term for such mental software is ***culture***. The sources of one's mental programs lie within the social environment in which one grew up and collected one's life experiences.

Culture consists of the unwritten rules of the social game. It is '***The collective programming'*** of the mind that distinguishing the members of a group or category of people from others. "That complex whole which includes knowledge, belief, art, morals, law, custom and any other capabilities and habits acquired by man as a member of society." Culture is, "the way of life, especially the general customs and beliefs, of a particular group of people at a particular time.

"When people fail to understand the factors that define cultures and those that affect perceptions about the world in general, there will always be misconceptions and judgments against certain cultures. Conflict resolution and productive inter—cultural relationship always require a great effort to understand, to know and to accept the basic cultural diversity of man." Author: Unknown

5.1 Cultural differences and similarities

Building Inter-Cultural Relationship

Inter-cultural relationship brings people of different culture together and at the same time breaks them apart. "Why can't we all get along?" It is only when people of dissimilar beliefs and characteristics interact that they recognize the ways each concerns are being managed.

When in association with people of different culture and nationalities, we need to remember the following:

a) No culture is common to everyone. There are similarities and differences, acceptable acts and taboos.

b) We are all different from one another. People have different values, standards of living, approaches to life and ways of getting things done.

c) Cultural divergence is a fact. We all have the right to be different from others and them from us.

d) We can learn from the culture of others. It is an additional and exciting knowledge to be familiar with the desirable customs and habits of people from other culture.

e) Seek for any resemblance. Similarities in behavior or in any form can bridge inter-cultural differences.

f) Let us just enjoy each other. We must not make the mistake of thinking that we know much of anything about anyone simply because we are aware of his/her racial or ethnic background.

Classifying culture

1. Collectivism (Group) and Individualism

Collectivism pertains to societies in which people from birth onward are integrated into strong and cohesive in-groups, which throughout people's lifetimes continue to protect them in exchange for unquestioning loyalty.
Individualism pertains to societies in which the ties between individuals are loose everyone is expected to look after himself or herself and his or her immediate family.

Collectivism vs. Power Distance
Negative correlated: large power distance countries are also likely to be more collectivist, and small power distance countries tends to be more individualist.

Key differences between Collectivist and Individualist Societies: Languages, Personality, and behavior

COLLECTIVIST

- Use of the word *I* is avoided.
- On personality test, people score more introvert.
- Showing sadness is encouraged, and happiness discouraged.
- Slower walking speed.
- Social network is the primary source of information.
- A smaller share of both private and public income is spent on health care.

INDIVIDUALIST

- Use of the word *I* is encouraged.
- On personality test, people score more extrovert.
- Showing happiness is encouraged, and sadness discouraged.
- Faster walking speed.
- Media is the primary source of in-formation.
- A larger share of both private and public income is spent on health care.

Key differences between Collectivist and Individualist Societies: School and the Workplace

COLLECTIVIST

- Students only speak up in class when selected by group.
- The purpose of education is learning how to do.
- Occupational mobility is lower.
- Direct appraisal of subordinates spoils harmony.

INDIVIDUALIST

- Students are expected to indivi-dually speak up in class.
- The purpose of education is lear-ning how to learn.
- Occupational mobility is higher.
- Management training teaches the honest sharing of feelings.

2. Power Distance

Power distance can be defined as the extent to which the less powerful members of Institutions and organizations within a country expect and accept that.

Power Distance: Difference between countries reflects in role pairs of *parent-child*, *teacher-student*, *boss-subordinate*, and *authority-citizen*.

Key Difference between Small– and Large-Power-distance Societies: General Norm, Family and School

SMALL POWER DISTANCE
Inequalities should be minimized.

- There should be interdependence between less and more powerful people.
- Parents treat children as equals.
- Children play no role in old-age security of parents.
- Teachers expect initiative from students in class.
- Quality of learning depends on two-way communication and excellence of students.
- Educational policy focuses on secondary schools.

LAGE POWER DISTANCE
Inequalities are expected and desired.

- Less powerful people should be dependent; they are polarized between dependence and counter dependence.
- Parents teach children obedience.
- Children are a source of old - age security to parents.
- Teachers take initiative in class.
- Quality of learning depends on excellence of teacher.
- Educational policy focuses on university.

3. Uncertainty Avoidance

Uncertainty avoidance is the extent to which the members of a culture feel threatened by ambiguous or unknown situations.

Some cultures are more anxious than others. Anxious cultures tend to be expressive cultures. In weak uncertainty avoidance countries, anxiety levels are relatively low. Aggression and emotions are not supposed to be shown.

Key differences between Week and Strong Uncertainty Avoidance Societies: General Norm and Family

WEAK Uncertainty Avoidance

- Low stress and low anxiety.
- Aggression and emotions should not be shown.
- In personality tests, higher scores on agreeableness.
- What is different is curious.
- Family life is relaxed.

STRONG Uncertainty Avoidance

- High stress and high anxiety.
- Aggression and emotions should be shown according to situations.
- In personality tests, higher scores on neuroticism.
- What is different is dangerous.
- Family life is stressful.

Key differences between Week and Strong Uncertainty Avoidance Societies: Health, Education, and Shopping

WEAK Uncertainty Avoidance

- People feel happy.
- There are more nurses but few doctors.
- Teachers may say “I don’t know”.
- In shopping the research is for convenience.
- Risky investments.

STRONG Uncertainty Avoidance

- People feel less happy.
- There are more doctors but few nurses.
- Teachers are supposed to have all the answers.
- In shopping the research is for purity and cleanliness.
- Conservative investments.

4. Masculinity vs. Femininity

A society is called *masculine* when emotional gender roles are clearly distinct: men are supposed to be assertive, tough, and focused on material success, whereas women are supposed to be more modest, tender, and concerned with the quality of life.

Gender roles
Men, in short, are supposed to be assertive, competitive, and tough. Women are more concerned to be taking care of the home, of the children, and of people in general-take the tender roles.

Key Differences between Feminine and Masculine Societies: General Norm and Family

FEMININE	MASCULINE
• Relationships and quality of life are important. • Both men and women should be modest. • In the family both fathers and mothers deal with facts and feelings. • Boys and girls play for the same reasons.	• Challenge, earnings, recognition, and advancement are important. • Men should be assertive, ambitious, and tough. • In the family fathers deal with facts, and mothers with feelings. • Boys play to compete, girls to be together.

Key Differences between Feminine and Masculine Societies: Education and Consumer Behavior

FEMININE	MASCULINE
• Average student is the norm; praise for weak students. • Falling in school is a minor incident. • Women and men teach young children. • Couples share one car. • More products for the home are sold.	• Best student is the norm; praise for excellent students. • Falling in school is a disaster. • Women teach young children. • Couples need two cars. • More status products are sold.

5. Time Perception

Short term culture: Quick results are expected
Long term culture: Results far in future are accepted

5.2 dealing with cultural differences

The cultural wheel:

1. Respect, without it good communication will not start.
2. Learn what motivates people and the reason for their behaviors. Careful attention to body language and reactions.
3. Interpreter can provide a link between two cultures.
4. Explain if appropriate (action and message) to clear understanding.
5. Procedures and checklist can be used to minimize cultural misunderstanding.
6. Consistency is very important in order not to create confusion and misunderstanding.
7. Use the name or title, be sensitive what people expect.
8. Keep an open mind for understanding. You will be surprise to learn more about them.

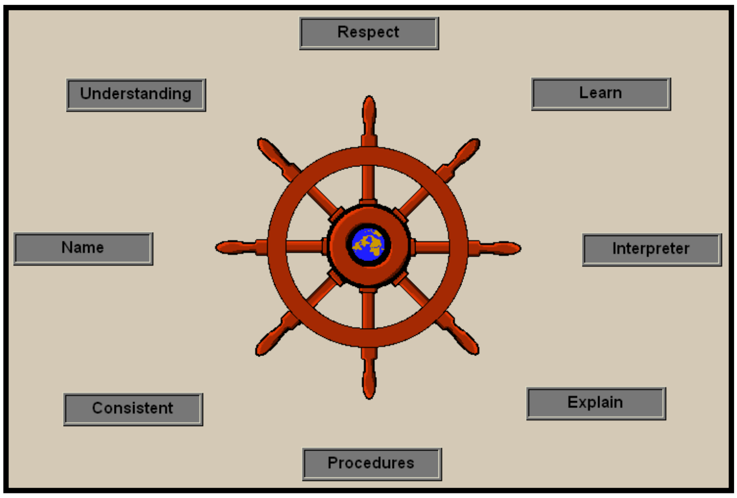


Figure 46 *The cultural wheel*

Practice Cultural Sensitivity

a) Generalizations may help us better understand the similarities and differences a certain group of people may possess but care must be taken to avoid not to stereotype or prejudice others. They may be alike but each person is still unique. Practice open-mindedness and care in judgment.

b) Treat the ideas, manners and customs of other people with respect. Be polite, courteous and open to the possibilities of learning new things.

c) Remember that religion and culture influence each other. They must be recognized and appreciated as part of a person's individuality, as much as his behavior and manners may be influenced by his religious practices and cultural beliefs.

d) There will always be differences on how people from different cultural background may see or interpret things. It is necessary for a person to be aware that differences in points of view and opinions should be expected and that consideration and respect must guide a person's conduct.

6. Briefing and Debriefing

Notes: The training objectives of this BRM module are that by the end of the lesson the trainees will be able to state the principles of good bridge communication, recognize the importance of briefing (in particular a good master – pilot information exchange and a change of watch briefing) and to recognize the importance of debriefings.

6.1 Behavioral Objectives for the Master

The master shall:

1. Lead a pre-departure BRIEFING which includes:

   - Presentation of route plan.
   - Interaction with the bridge team.
   - Setting of stipulated requirements.
   - Identification of possible weak links on the route.

- Establishing standards and guidelines to be met during passage.
- Setting the environment for an effective team oriented operation.

2. Brief the pilot on the ship's characteristics and equipment using the pilot card.
3. Ask the pilot to present his route plan and give information on local conditions.
4. Demonstrate responsibility to brief and coordinate operational factors with the bridge team.
5. Establish an open, interactive and closed loop communication.
6. During the voyage, brief the team on any significant situations encountered.
7. During the voyage or as soon as possible after the team on any significant situations encountered.

The Debriefing

The debriefing should:

- Be a whole team affair.
- Cover positive and negative points.
- Not blame individuals.
- Be a positive learning experience.
- Result in a plan for future improvements in early detection and correction of errors.

6.2 Behavioral Objectives for the Pilot

The pilot shall:

1. Present a route plan explaining his navigational intentions, enabling the bridge team to monitor the progress of the vessel along the planned track.
2. Brief the bridge team on local conditions and traffic regulations.
3. Inform the bridge team before making any change of course or speed.
4. Inform the bridge team of any changes or expected changes regarding traffic, weather, visibility, currents etc.
5. Should the principles of good briefings and communications not be used by the master/ bridge team, the pilot should point this out in a diplomatic way.

6.3 Behavioral Objectives for the Bridge Team Members

The bridge team members shall:

1. Actively support and participate in all briefings and debriefings.
2. Ensure that good briefings and communications are used when changing over the watch
3. Actively participate in a working environment that supports effective communication principles.
4. Should the principles of good briefings and communication not be used by the master or pilot, the officer on watch should point this out in a diplomatic way so as not to threaten the leadership or command.

Communication is not simple, needs to be constantly aware when sending out and receiving the message. In spoken communication, we carried out briefings.

- Master creates the communication climate and open up for interactive communication style. Communication can be misunderstood. We often want to say something but say something else.

- Anticipation can help to speed up communication but can be dangerous if they get the message wrong.

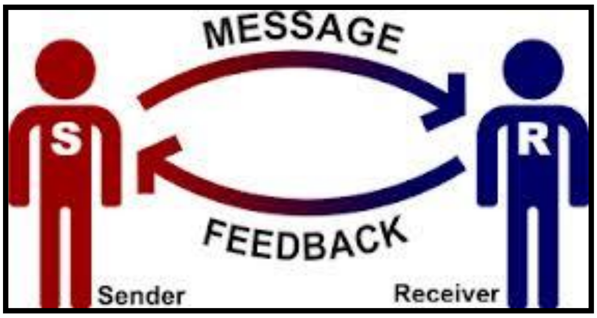


Figure 47 *Closed loop communication*

Closed loop communication is a communication technique used to avoid misunderstandings. When the sender gives a message, the receiver repeats this back. The sender then confirms the message; thereby common is using the word "*yes*". When the receiver incorrectly repeats the message back, the sender will say "negative" (or something similar) and then repeat the correct message. If the sender (person giving the message) does not get a reply back, she must repeat it until the receiver starts closing the loop. To get the attention of the receiver, the sender can use the receiver's name or functional position, touch his or her shoulder, etc.

Open Style open communicators tend to use both disclosure and feedback and are equally interested in people's needs and productivity (Hamilton, 2008). In some cases, open communicators may disclose too much information which may make people around them uncomfortable. There are generally sensitive to the needs of others and realize that conflict can be productive (LAROCHE, 2006).
Open communicators are best at negotiating and coming up with solutions that satisfy the needs of all parties. This makes them perfect for working with clients, especially in conflict resolution. These empowered employees usually develop quality relationships and increase productivity. Generally, "employees in open, supportive climates are satisfied employees" (Conrad, 2002).

Interactive communication is an exchange of ideas where both participants, whether human, machine or art form, are active and can have an effect on one another. It is a dynamic, two-way flow of information.

It is a modern term that encompasses these evolving forms of conversation. It is a primary characteristic of the present Information Age. Interactive communication forms include basic dialogue and nonverbal communication, game books, interactive fiction and storytelling, hypertext, interactive television and movies, photo and video manipulation, video sharing, video games, social media, user-generated content, interactive marketing and public relations, augmented reality, ambient intelligence, and virtual reality.

BRIEFING

One important area of communication is briefings. The team leader sets the climate for briefing. The briefing sets the climate for operation.

Briefing is a productive way of communicating the same information to the team and defining responsibilities. Without it, it can create confusion and negative feelings might set in.
How to create a briefing? There are guidelines on how to conduct.

1. Make time, ensure that everybody pay's attention.
2. Keep it open and friendly.

3. Not necessary the Master will carry out the briefing but the person who has the information. (Delegate and Master will not lose control).
4. Be interactive making communication as two way.
5. Ensure all share the same wavelength and mental model.
6. Assign task, who's doing.
7. Establish closed loop communication.
8. Stick to the subject or objectives.
9. If have opportunity, ask for question.

Briefing also include when the pilot boarded your vessel. Briefing are not just arrival at and departure from. It can take place in any situational changes and it don't have to be long.

Using checklist make the briefing:

1. Effective as it covers all areas:
2. Efficient as it saves time.
3. Interactive as who will do what.
4. Closed loop to avoid misunderstanding.

DEBRIEFING

De-briefing or progress meeting is valuable. It is a good investment in training and in the future since events are already past.
Tips for de-briefing.

1. It should be carried out as soon as possible while it is still fresh on the mind.
2. Make it as a learning experience, even the result was positive or negative.
3. Get the whole team be involved. Their comments or suggestions are valuable.
4. Be relevant and not a distraction.
5. Stick to the facts.

7 Challenge and Response

Notes: The training objectives are that by the end of the lesson the trainees will be able to define the Challenge and Response, recognize the importance to safety of establishing a Challenge and Response environment and to recognize that the whole team is involved in challenged and response.

To improve safety, everybody needs to operate as a team. Open communication style set up the challenge and response environment. It has been part of our lives and maybe not aware of it.

Onboard, the Master set up the environment that support challenges as they are expected and welcome. Other members should persuade the Master diplomatically if the environment is not set.

Challenge and response is divided into three parts.

1. Concept- This is our understanding and giving the intentions. Setting up the limits.
2. Challenge- If there is a deviation on the limits set, then challenge is needed.
3. Response- Our reaction.

First the concept.

1. Understanding (reduce visibility).

Example: The pilot mentioned that visibility is reducing.

2. Intention (clearly state)
   Example: The pilot mentioned that the vessel needs to reduced speed or next alteration after port hand buoy.

After the concept the next stage is the challenge.

- If limits not exceeded, a challenge may not be required.
- Challenge can come from anywhere and particular within ourselves.
- Concept should continuously be challenge.

Challenge can happen if the environment is open. If challenge is not requested, do it diplomatically. Assertiveness can help to make the challenge strong enough

There are four points to note on challenge.

1. Challenges should be encourage. You focus on the team and not on legal issues.
2. Always challenge a possible difference of concepts.
3. Be diplomatic, if time allows.
4. If necessary challenges again. (Show assertiveness).

Then the stage is response.

1. Welcome the challenge, take action to confirm even it is correct or incorrect.
2. If time allows cross check the challenge using a third source. Checking the difference of concept between the originator and challenger.
3. Take cautious action to protect safety. Act instinctively during emergency situation.

We must be alert to recognize the blocks which stop the working of challenge and response. It needs a whole team effort.

Challenge and response blocks

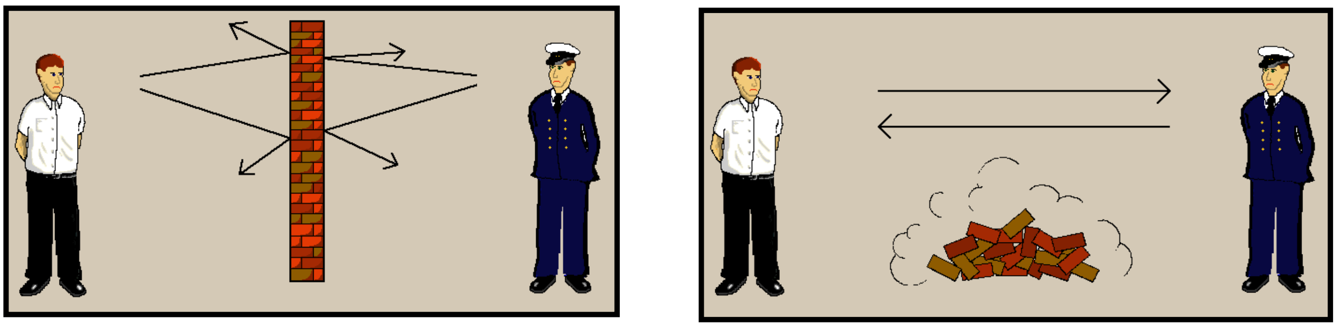


Figure 48 Challenge and Response blocks

Challenge and response blocks:

1. Quiet (silence by superior).
2. Lack of confidence.
3. Non- assertive behavior.
4. High power distance.
5. Does not accept responsibilities.
6. Interpersonal conflicts.

The cause of the blocks are:

1. Authority is threatened.
2. Lack of confidence.
3. He may respond emotionally
4. Poor communication skills
5. Poor manager.

Summary:

1. The Master responsibility to set up the right environment.
2. The team should support and make challenges as necessary.
3. We should continually challenge our old concepts.
4. The challenges and response increases the Master's authority, it encourage teamwork to support his management skills.

8. Management on the bridge

Notes: The training objectives are that by the end of the lesson the trainees will be able to state different management styles, state how to identify them and state how to respond to them.

Leadership style – depending on the situation, a person may switch between the different management styles not a personal characteristics.

The Master shall:

1. Manage his crew using a balance between performance – and - people oriented styles.
2. Vary the management style as appropriate.
3. Encourage officers to ask for challenging duties.

The bridge team member including the pilot:
1. Use a balanced leadership style.
2. Demonstrate the ability to work with managers using different styles.
3. Maintain safe working conditions without threatening the command or leadership roles.

High on performance, Low on People style characteristics.
- Authoritarian style
- One – way communication
- Limits the challenges
- One man band
- A strong leader and good in crisis.

Effects on this style:
- Quiet, defensive team members
- Poor communication and few challenges
- There is a decrease in performance
- Low morale

Figure 66 Tiger type

Response to this kind of leadership style:

- Continue your assertiveness, apply diplomacy and humour.
- Try to get delegation, set up for a challenge and response environment etc.
- Accept that this kind of leadership style is very difficult to change.

Low on Performance, High on People Style Characteristics

- Uses too much unimportant communication
- Unbalanced challenge and response
- Mistakes easily forgiven
- Accept low standards
- Trust people, gives them responsibility

Effects on this style:

- Lowering professional standards
- Morale can be high or low
- Low respect for leadership
- Team members may have the opportunity to grow and improve skills.

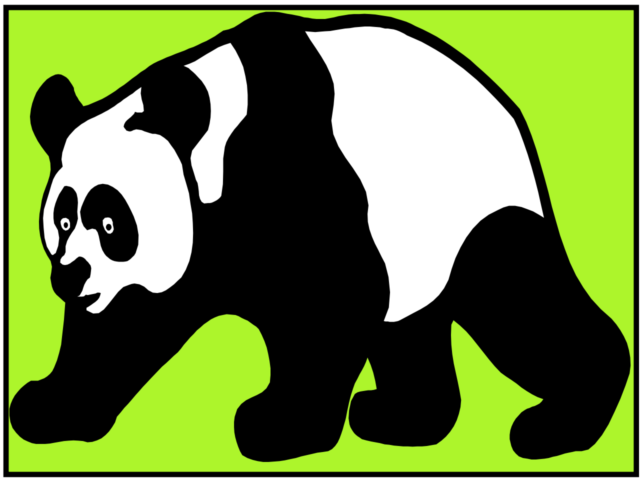


Figure 67 Panda type

Response to this kind of leadership style:

- Make communication direct to the point.
- Aim for higher standards.
- The Panda's will do his/her best to keep a good relationship.

Middle on Performance, Middle on People Style Characteristics

- Has a reasonable communication
- Challenges are accepted
- Short term strategies are used.

Figure 68 Zebra type

Response to this kind of leadership style:

- Do what you can to support him/her to make improvement.
- Good personal contact is necessary and will help.
- Every step to the better is good.

High on Performance, High on People Style Characteristics

- Good in communication
- Accepts challenges
- Uses short term strategy
- Know how to balance the situation

Figure 69 Dolphin type

The ideal manager is somebody who is very concerned with performance but at the same time makes best uses of his team. He uses Maritime Resource Management tools. Communications and briefings are carried out in the correct way. He establishes a good challenge and response environment, and always uses the short term strategy when appropriate.

- At a certain degree, our style changes in accordance with the environment, some to the better others to the contrary .
- The question is, are we really doing our best as leaders, are we getting the very best out of those under our "umbrella"?

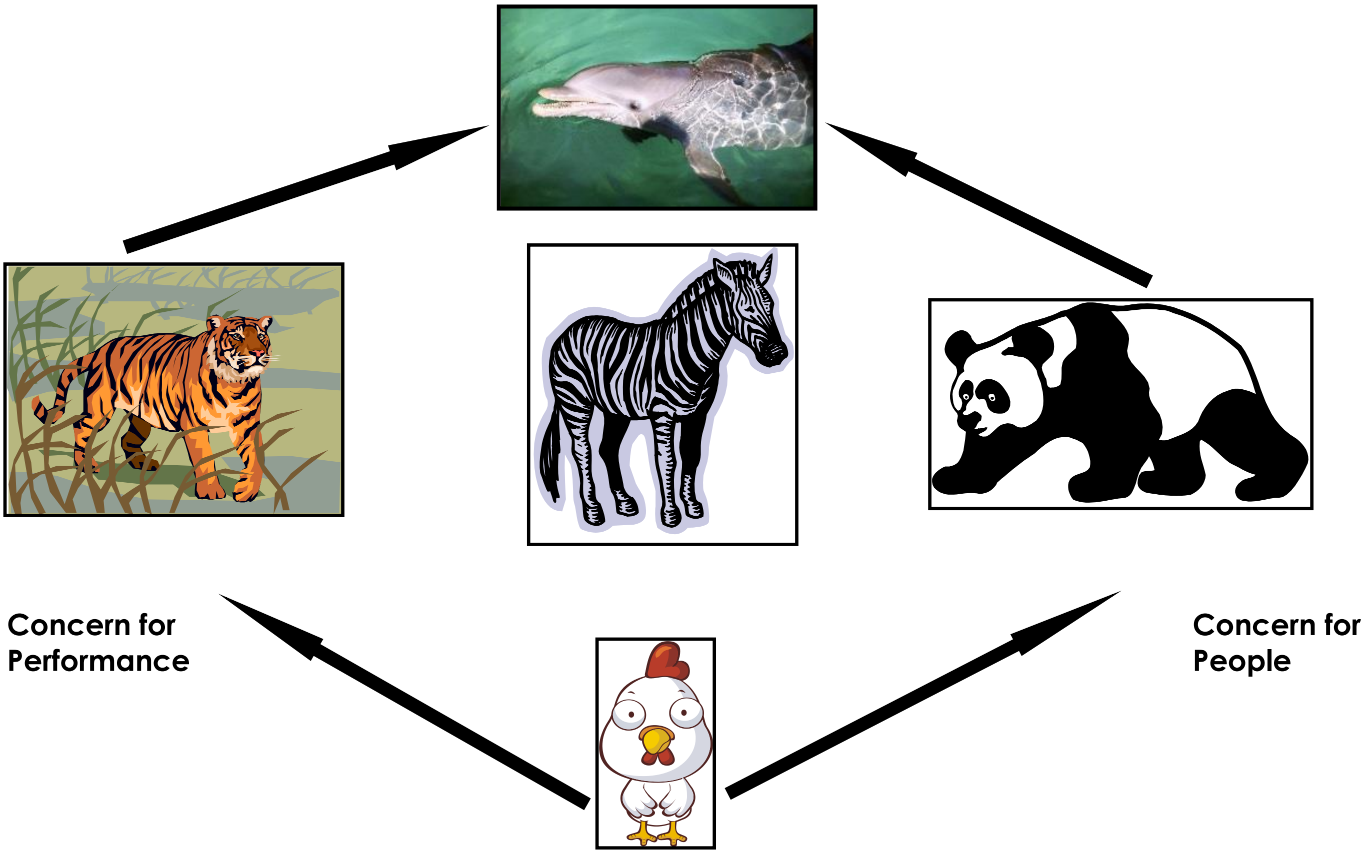


Figure 70 Type of Managers

9 Workload and Stress

Notes: The training objectives are that by the end of the lesson the trainees will be able to recognize the whole range of workload:

- *Underload*
- *Normal*
- *High*
- *Overload*

We need to recognise the whole range of workloads:

- Under load
- Normal
- High
- *especially* **Overload**

1. What is the importance of pre-planning?
2. What are the problems at the start and during delegation?
3. How to delegate the task correctly?

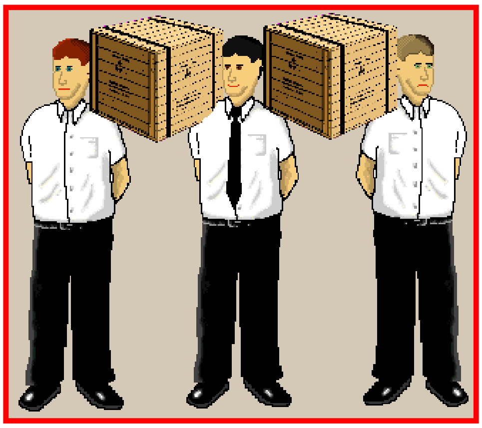


Figure 71 Workload sharing

One of the important functions are:

- Control workload by pre-planning
- Delegate other task.
- It is not just a Master's job.
- Everyone is responsible for his/her workload.
- Should help to share to total workload.
- There is no real measure about workload.
- Basis is how we feel, the attitude and feelings influence on how we react in particular moment.

Ranges of workload

Figure 72 Underload

Figure 73 Overload

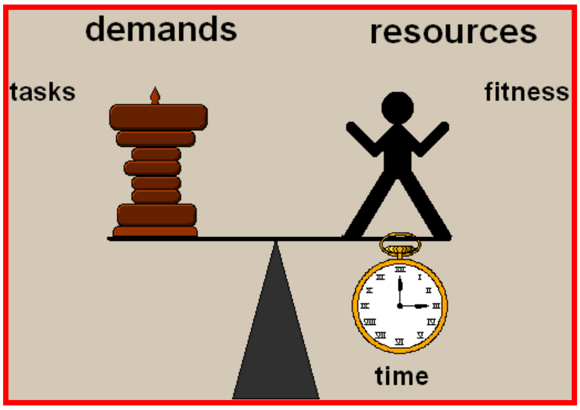


Figure 74 Workload formula

We need to balance the demand and resources (workload).

- Demands – task to be done with different weights.
    - Easy, difficult, very difficult
    - Important, not important, very important
- Resources – the fitness for the task.
    - Skills, experience, health
    - Training, attitude and time table.

What will happen if we are working in overload condition?

- Increased in:
    - Duplication of effort, errors, over control
    - Focus on urgent task and bad temper
- Decreased in :
    - Attention to important task
    - Briefings, delegation, planning
    - Chatting

What will happen if we are working in under load condition?

- Increase in:
    - Errors
    - Time to perform task (mind and body is sluggish)
- Decrease in:
    - Alertness (boredom)
    - Concentration (lack of attention)

How to control the workload?

- Decrease the number of task.
    - Postponing or not doing the task
- Increase the time available (be in control)

- Example delay the time of departure
- Reduce speed to have time to assess the situation

\

- Increase the resources to spread the load.
    - Delegate as appropriate

Method no. 1 - Pre-planning.

- a long term strategy in balancing workload.
- It defines procedures, job functions and introduce new technology.
- It involves task for a voyage what are the expected and not expected.
- It looks for time available
- Skills of people to make it as always as possible.
- A team effort cannot be done behind close door without consultation.

Example: The intended to change the bridge watch.

- To break up the routine

- Update the procedure manual

Preplanning gives opportunity for team problem solving:

- Master presents the problems and objectives.
- Officers suggest and decide on the plan.
- It becomes independent and confident.
- The preplanning is a time well spent.

Figure 75 Master with bridge team

Method no. 2 – Delegation

Some people do it well, while others don't, why?

- Personality? (some does it other doesn't)
- Workload? (who is getting overloaded or not)
- Experience? (good or bad)
- Someone may have hazardous thoughts when it comes to delegation.

Hazardous thoughts: then replaced by safer thoughts

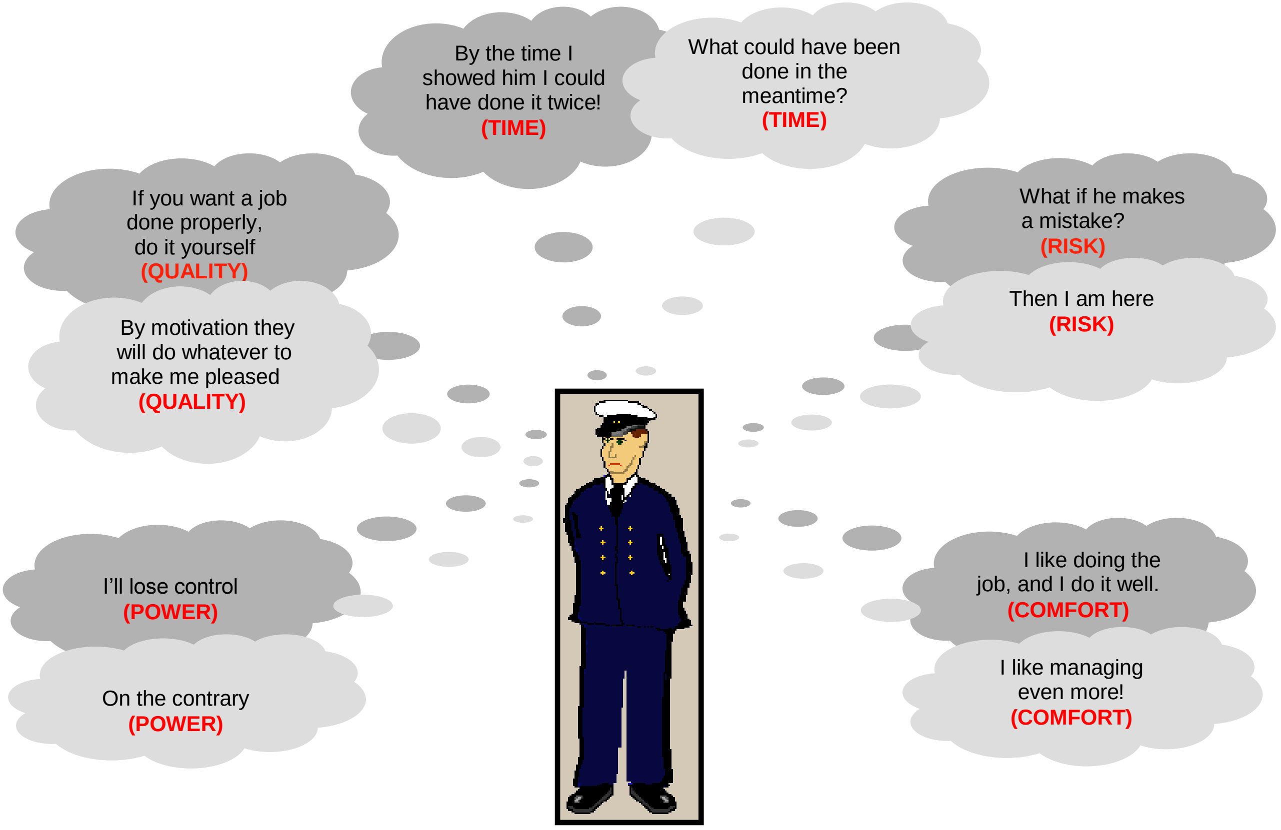


Figure 76 Hazardous thought

Having overcome fear, we need to decide which task to delegate, to whom, how and when.

1. Task – depending on the level of difficulty, its importance, time available and which task not fit to delegate.
2. Whom – Fitness for the task, skills, experience, personality, any existing workload.

   "Delegate the task with a high chance of success."

3. Brief - Tell the person what is expected of him.
   - Discuss what are the available resources and time.
   - Inform others about the process so as not to bypass and disrupt the delegation process.

For example, the Master ask the Third Officer to make a voyage plan.

- What are the challenges lies ahead?
- During the process you should:
  1. Let go, stop interfering.
  2. Keep a balance on
  3. Monitoring progress
  4. Trust the person
  5. Coach and to not criticize

6. Withdraw support, more at the start of the process and less as it progress
7. Give time for them to discover
8. Refuse help by asking "Question what do you think?"
9. Finally reward progress by giving more responsibility.

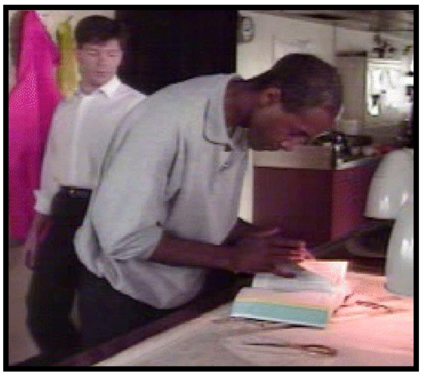


Figure 77 Delegating

Figure 78 Coaching, offer

Figure 79 Reward by giving the task less help additional responsibility

10 Human Factor in error

Notes: The training objectives are that by the end of the lesson the trainees will be able to state some underlying cause of accidents, describe some cause of external errors, state some causes of internal errors and state a policy for responding to and learning from errors."

"Human Factors" describe the interaction of individuals, with facilities and with equipment including the management and any other systems. Refers to environmental, organizational and job factors, and its cognitive abilities.

Figure 85 Human Factor

Human Error is a concept for explaining malfunctions, accidents or other bad consequences from operating a system.

Definition: an inappropriate human decision or behavior that reduces (or has the potential for reducing) effectiveness, safety, or system performance.
(Note: an error that is corrected before it can cause damage is an error)

Figure 86 Human error

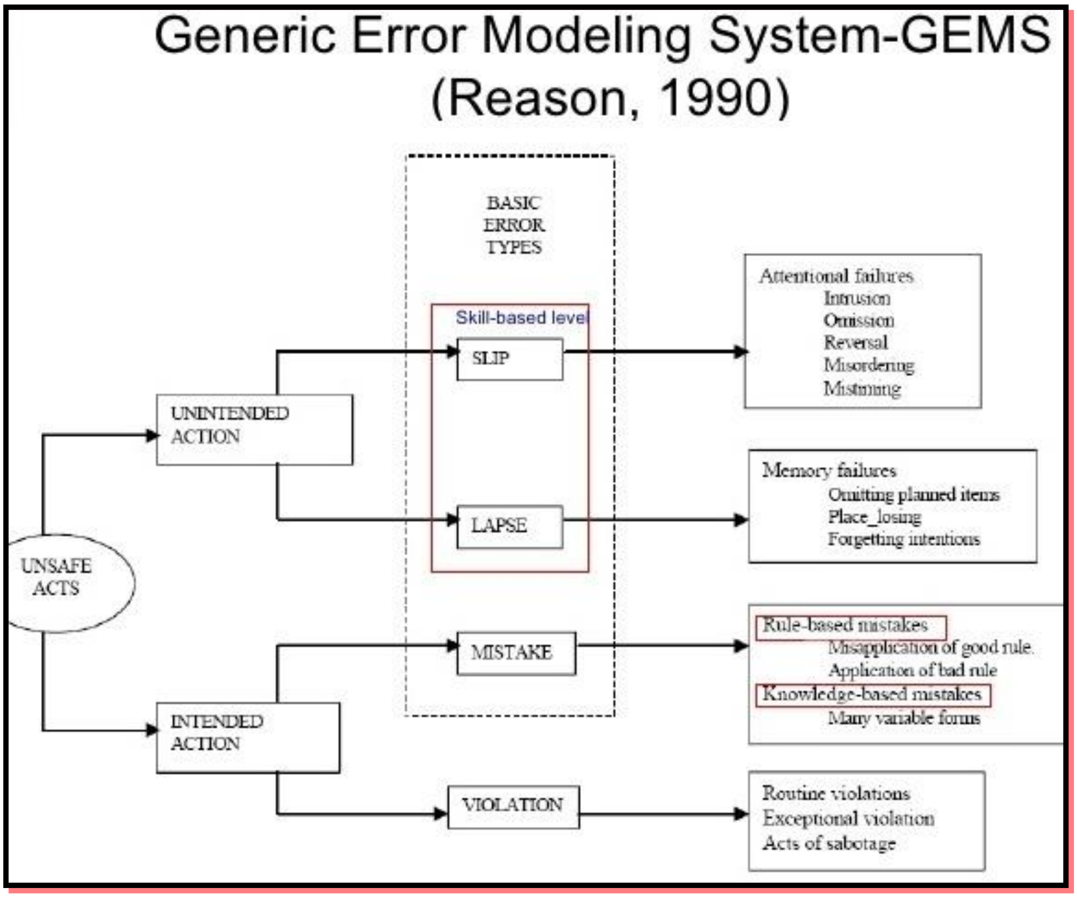


Figure 87 Generic error modeling system

<u>Slips / Lapses</u>

- Un-intended actions, due to various reasons:
  - miss-communication,
  - misprioritizing of tasks,
  - inattention,
  - loss of memory, etc.
  - Slips may be humorous, insignificant
  - they are a visual or an auditory form of human error,
  - It may not recognized.

- Slips and lapses usually occur:
  - very familiar tasks

– Or acquired habits

Examples:

- The wrong call-sign is used to call another vessel
- Helmsman applying wrong rudder angle, not in accordance with the order received.

(generally doing the right action on the wrong object, or the wrong check on the right item, etc.)

Corrective Action:

- Inform the individual of the slip, regardless of difference in rank; (generally include proper settings).

Mistakes

- An incorrect, unwise, or unfortunate act or decision, caused by bad judgment, or lack of information, or poor projection, or lack of care.

The two main types of mistake:

- rule-based and
- knowledge-based mistakes,

"Arise *when we do the wrong thing, believing it to be the right*."

Examples:

- *making a inadequate assessment when overtaking, leaving insufficient room to execute the maneuver without compromising safety (ignore traffic, passing effect, etc.).*
- *an operator misjudging the sound of an alarm / breakdown.*

Corrective Actions:

- Effective planning, Thorough briefings, cross checks the procedures and monitor high risk task
- Risk assessments, Training, job aids, diagrams, improve working environment,
- workload management, drills (to have an effective habit), scenarios, etc.

Violations

- Intentional failures, deliberately doing the wrong thing, due to various reasons:
  - time pressure,
  - not considering consequences,
  - over-estimating and
  - over-compliance,
  - complacency

Examples:

- Ignoring the regulations and the safety rules:
  "it will not happen to me" or "I am above the rules and regulations" type.

- Allowing untrained crew to carry out steering / watch-keeping.
- Master increasing the speed in restricted visibility – time pressure.

Corrective Actions

- Proper supervision and monitoring of the personnel
- Explain the reasons and relevance behind the rules and procedures

Figure 88 Sample of violation

Error Trapping: is a key mechanism in avoiding mistakes, and includes procedures that detect and correct errors before accidents are occurring.

"WHEN To Do It And WHO Should Do It"

- Regulations are implemented to control some of the known errors, but regulations and standard operating procedures are not fail-safe mechanisms.
- Team members must be able to identify all levels of human error.

Team members should be empowered to take corrective action!
ISM…SOLAS…MARPOL…STCW…MLC

The problem of human error can be viewed in 2 ways:

– the Person approach
– the System approach

PERSON APPROACH

- It focuses on the unsafe acts—errors and procedural violations—of people on the front line: doctors, anesthetists, pharmacists, pilots, masters, etc.
- Unsafe acts as arising primarily from mental processes:
  – such as forgetfulness, inattention,
  – poor motivation, carelessness,
  – negligence, and recklessness.
- Blaming is more satisfying and convenient than targeting institutions.

- People are viewed as free agents capable of choosing between safe and unsafe behavior.
- If something goes wrong, a person (or group) is responsible.
- Separating a person's unsafe acts from any institutional responsibility is clearly in the interests of managers. It is also legally more convenient.

Countermeasures:

- poster campaigns that appeal to people's fear,
- disciplinary measures, threat of litigation,
- retraining, naming, blaming, and shaming.
- Errors are considered a moral issues, assuming that bad things happen only to bad people.

SYSTEM APPROACH

- Humans are fallible and errors are to be expected, even in the best organizations.
- We cannot change the human condition, but we can change the system and conditions under which humans work.
- Errors are seen as consequences rather than causes.

Countermeasures - barriers and safeguards:

- engineered (alarms, physical barriers, automatic shutdowns), etc.
- procedures and administrative controls.
- Ask not who blundered, but how and why the defenses failed.

THE "SWISS CHEESE" MODEL OF SYSTEM ACCIDENTS"

- In an ideal world, each defensive layer would be intact. In reality, they are more like slices of Swiss cheese, having many holes—continually opening, shutting, and shifting their location.
- The presence of holes in any one "slice" does not normally cause a bad outcome.
- Usually this can happen only when the holes in many layers momentarily line up to permit a trajectory of accident opportunity, bringing hazards into damaging contact with victims.

The holes in the defenses arise for 2 reasons:

- active failures
- latent conditions.

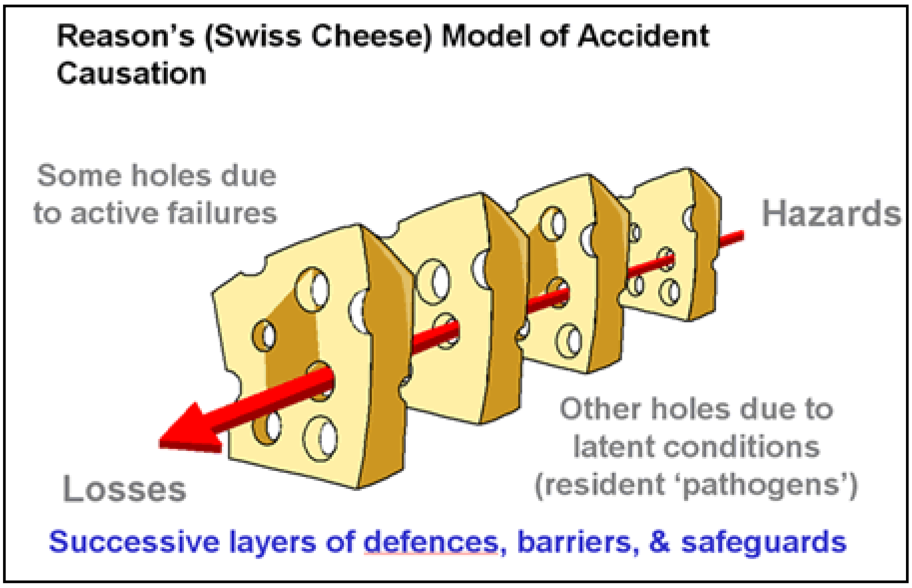


Figure 89 Swiss cheese accident causation

Active failures are the unsafe acts committed by people who are in direct contact with the system:

- slips, lapses, fumbles,
- mistakes, and procedural violations.
- *They are like mosquitoes.*
  - *They can be swatted one by one, but they still keep coming.*
  - *The best remedies are to create more effective defenses and to drain the swamps in which they breed.*
  - *The swamps, in this case, are the ever-present latent conditions.*

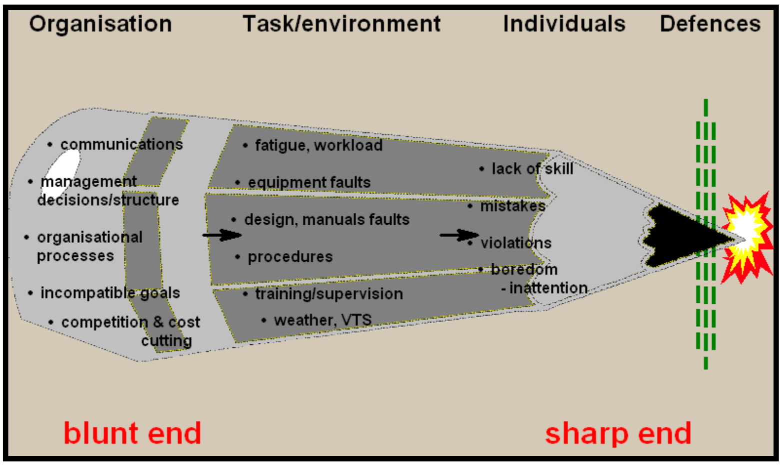
Latent conditions are the inevitable "resident pathogens" within a system.

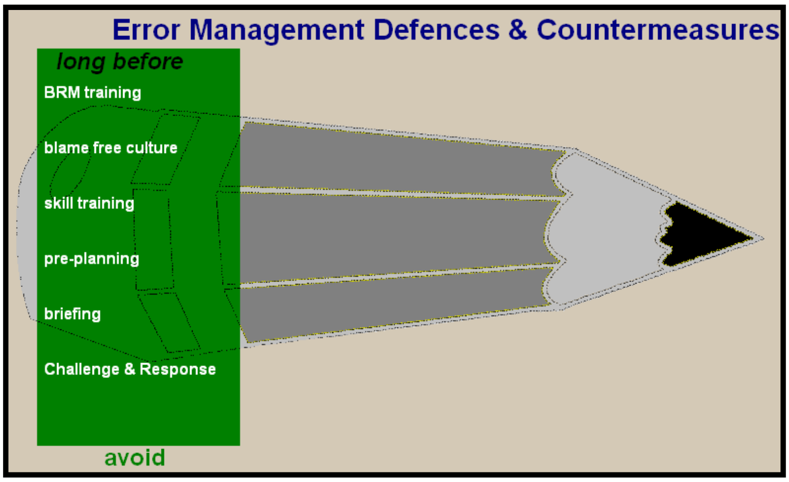
- They arise from wrong decisions made by designers, builders, procedure writers, and top-level management.

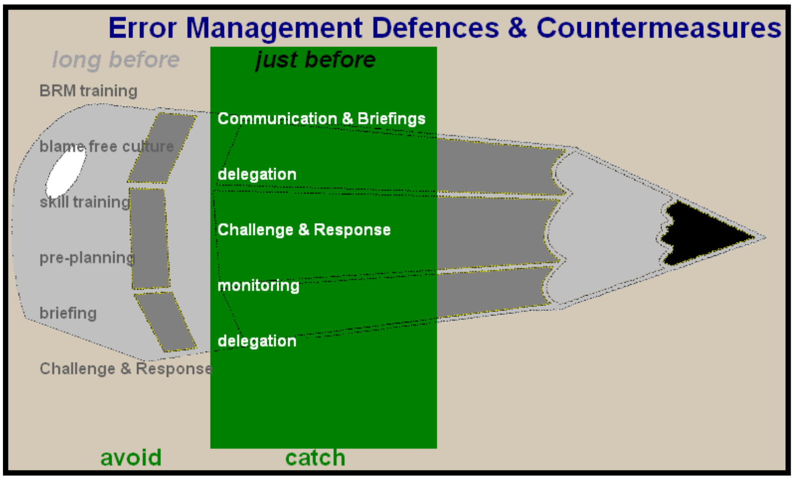
- can translate into error-provoking conditions within the workplace, creating long-lasting holes or weaknesses in the defenses:

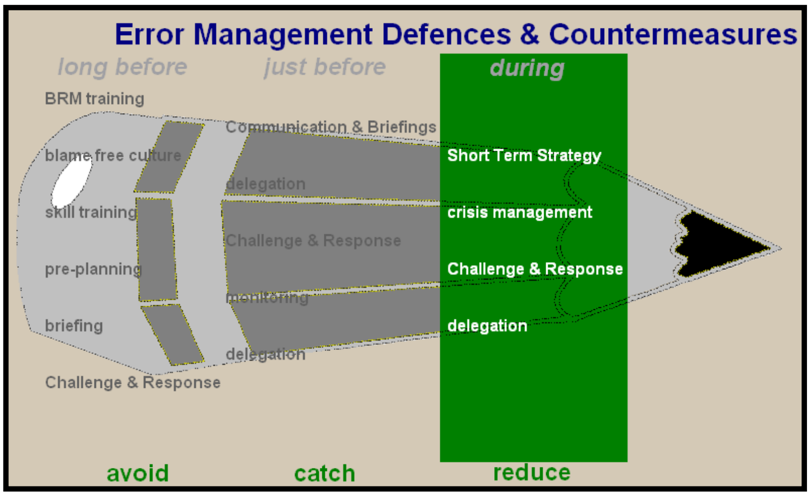
  - time pressure
  - understaffing → fatigue and stress
  - inadequate equipment
  - untrustworthy alarms and indicators
  - unworkable procedures design and construction deficiencies.

Some incidents and accidents are caused by Acts of God. The sea is an error rich environment and human error play a major part. We need to understand the nature of the error. Apply counter measures as possible.


Organisation
Task/environment
Individuals
Defences
• communications
• management decisions/structure
• organisational processes
• incompatible goals
• competition & cost cutting
• fatigue, workload
• equipment faults
• design, manuals faults
• procedures
• training/supervision
• weather, VTS
• lack of skill
• mistakes
• violations
• boredom
- inattention
blunt end
sharp end


Error Management Defences & Countermeasures
long before
BRM training
blame free culture
skill training
pre-planning
briefing
Challenge & Response
avoid


Error Management Defences & Countermeasures
long before
BRM training
blame free culture
skill training
pre-planning
briefing
Challenge & Response
just before
Communication & Briefings
delegation
Challenge & Response
monitoring
delegation
avoid
catch



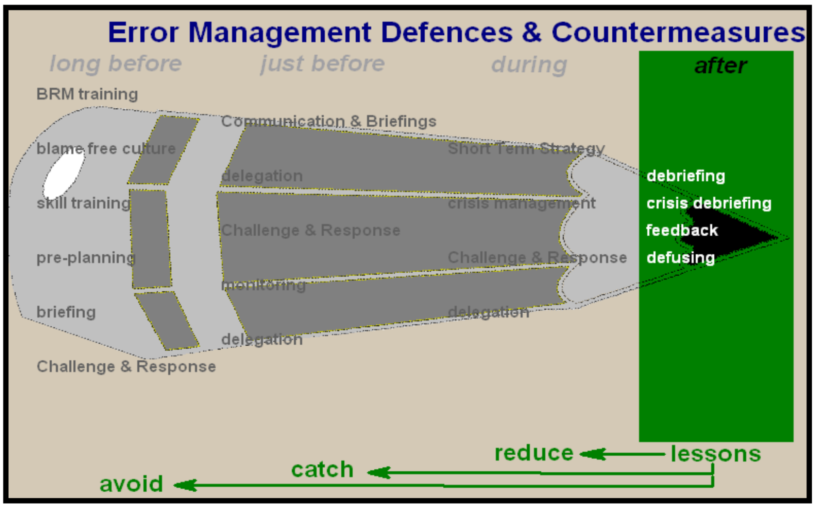


Figure 90 Error Management and Counter measures

There are many sources of error no error is absolute to safety. Many factors are under your control like:

- Follow the safety policy
- Follow rules
- Discuss safety
- Use BRM
- Learn from experience

11 Decision Making

Notes: The training objectives are that by the end of the lesson the trainees will be able to state the factors affecting judgement and decision making, state the process of decision making and state how hidden pressure can negatively influence judgement and decision making.

Judgements are usually a result of concept covering the situation, management method, use of human resources available including C&R and many more.

There a 3 categories of decision. These are

1. Skill based.
2. Rule based.
3. Knowledge based.

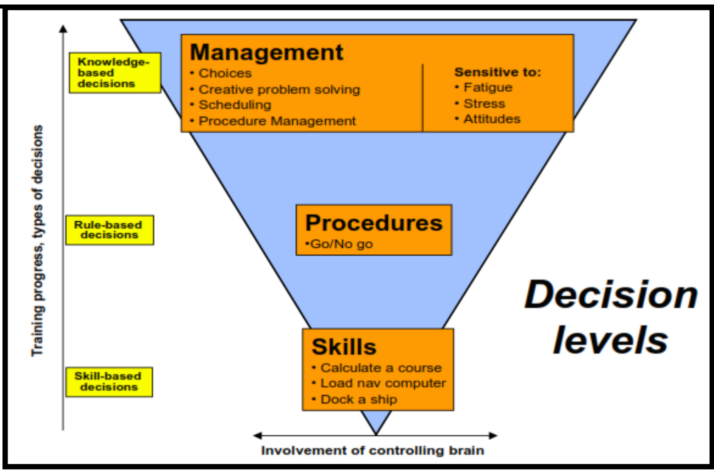


Figure 91 Categories of decision

How do you recognise the point of no return in your decision-making? Be aware of its existence and the point where decisions cannot be changed.

Our decisions are based on:

1. Personality
2. Attitudes
3. Source of information
4. Training and experience

Hidden Pressure: Fitness, Emotions, Fatigue Blocks

Application of BRM to prevents the Blocks.

Classification of our decision:

1. Have we seen it before?
2. How much time we got?
3. What are the risk?
4. Are there any rules that we can use?

Hidden pressure can lead us into making errors. What is our best defence?

Dealing with hidden pressures:

1. Be alert and try to separate facts from emotions.
2. Go through the decision-making process with someone else.
3. Recognise pressure you are sensitive to.
4. Be aware and control the pressure, not letting hidden pressure control you!

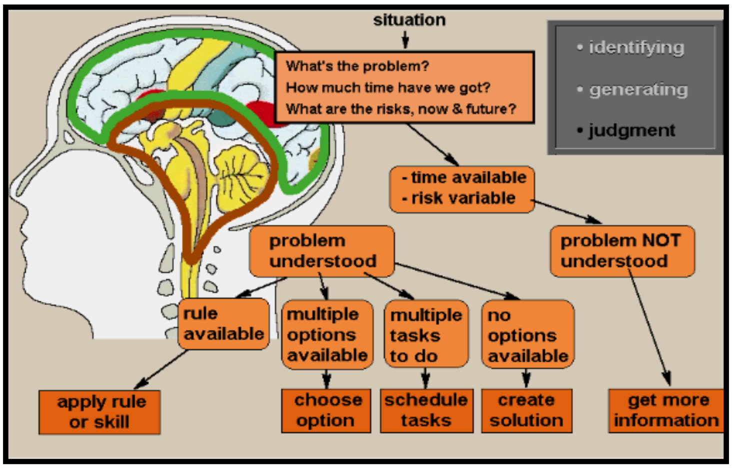


Figure 92 Decision making flow chart

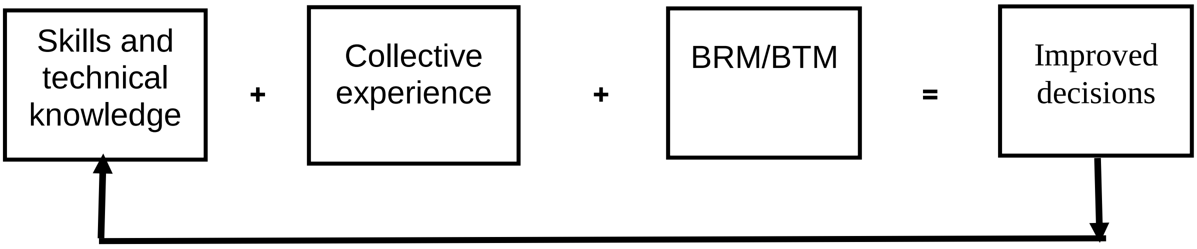


Figure 93 Improving decisions

12 Authority

Notes: The training objectives are that by the end of the lesson the trainees will be able to define Authority and Assertiveness, recognize the need for a balance between authority and assertiveness, state possible reasons for extreme personalities and state the dangers of extreme combinations.

"Authority and Assertiveness is a major shipping hazard. Understanding it can limit the negative effect."

Authority – Is a person refers to his capacity to issue (legal) orders based on his commanding power (company's responsibilities) whether he shows it or not.

Assertiveness – A person's act of asserting or expressing his opinion or viewpoint.

"Too low assertiveness is more common"

A. High in Authority (Obey without questioning policy) vs. Low in Assertiveness

1. The whole team does not participate in the decision making. (Silenced by superior's authority)
2. Ideas and challenges are put down with little thought. (No challenge and response)

B. Low in Authority (Weak commanding power) vs High in Assertiveness.

1. It is the least dangerous.

2. High assertiveness compensate for low authority.

   (Subordinate – strong reliance, opinions and decision prevails).
3. Far from ideal. Stress is high.

C. <u>High in Authority</u> vs <u>High in Assertiveness</u> (Too much challenge and response)

1. There is a clash in personality and very dangerous.
2. It takes time to repair any bad feeling.
3. Stress is increase higher than workload.
4. Dangerous situation might be left unnoticed.

D. Low in Assertiveness and Low in Authority (Nobody is in charge)
1. The most dangerous combination.
2. Nobody recognize if problem arise
3. Slack in making decision due to lack in challenge and response.
4. Incorrect and improper action.

"Be aware on the level of authority and assertiveness and how you effect others."
1. Are we setting up the right environment?
2. Do we give enough opportunity for them to participate?
3. Do we respond positively or shutting them up badly?

How to deal with the extremes?

- High Authority: Use humor and diplomacy, but not as the safety is threatened

- Low Authority: Stimulate or even provoke, but within reasonable limits.

- High Assertiveness: Use humor and diplomacy, but make the position clear!

- Low assertiveness: Stimulate - coach – build confidence

Balance on Authority and Assertiveness

A balance is an indication of good leadership and management style.

- Master must conduct proper team briefing.
- He sees opinions from other members before making a decision if time and situation allows.
- Members should not hesitate to challenge others especially when safety is threatened.
- The Master and Pilot should consider and acknowledge the challenge and encourage others to participate.
- When Master authority is too high, members should lower the assertiveness to avoid conflict without compromising on safety.

- When Master authority is low, members should increase their assertiveness so as not to threaten safety.
- The pilot should be properly briefed, coordination with the master and team members is encourage – a balance condition.
- Team members should develop a safety culture engaged in the practice of challenge and response and in open communication.

13 Crisis Management

Notes: The training objectives are that by the end of the lesson the trainees will be able to explain Reptile and Controlling Brain functions, identify signs of stress and how it degrades performance, explain a strategy for managing a crew through crisis phases, explain important factors in managing a crown in a crisis and understand how to conduct a personal crisis debriefing.

What is stress?

Stress is your body's way of responding to any kind of demand or threat. When you feel threatened, your nervous system responds by releasing a flood of stress hormones, including adrenaline and cortisol, which rouse the body for emergency action. Your heart pounds faster, muscles tighten, blood pressure rises, breath quickens, and your senses become sharper. These physical changes increase your strength and stamina, speed your reaction time, and enhance your focus.

This is known as the "fight or flight" stress response and is your body's way of protecting you. When working properly, stress helps you stay focused, energetic, and alert. In emergency situations, stress can save your life—giving you extra strength to defend yourself, for example, or spurring you to slam on the brakes to avoid an accident.

Stress can also help you rise to meet challenges. Stress is what keeps you on your toes during a presentation at work, sharpens your concentration when you're attempting the game-winning free throw, or drives you to study for an exam when you'd rather be watching TV.

But beyond your comfort zone, stress stops being helpful and can start causing major damage to your mind and body.

Causes of stress

The situations and pressures that cause stress are known as stressors. We usually think of stressors as being negative, such as an exhausting work schedule or a rocky relationship. However, anything that puts high demands on you or forces you to adjust can be stressful. This includes positive events such as receiving a promotion or recommendation.

Isolation and stress

Since social engagement appears to be our best defense against stress, isolation or a lack of positive, consistent human interaction can be both a stressor in itself and exacerbate other causes of stress

Common external causes of stress

Major life changes
Work or school
Relationship difficulties
Financial problems
Being too busy
Children and family

Common internal causes of stress

Chronic worry
Pessimism
Negative self-talk
Unrealistic expectations/Perfectionism
Rigid thinking, lack of flexibility
All-or-nothing attitude

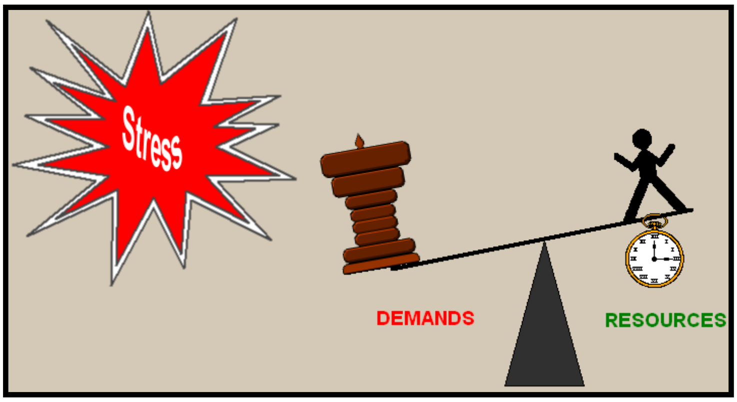


Figure 94 Balance on demand and resources

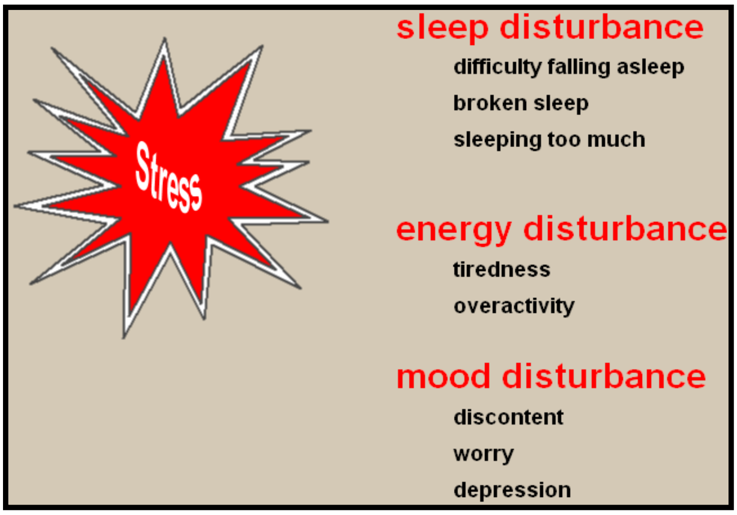


Figure 95 Causes of stress

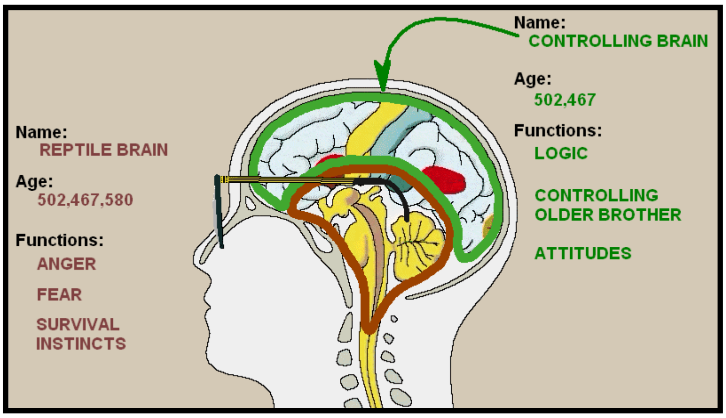


Figure 96 Human brain

How do we recognize stress:

1. Strange behavior like nervous, voice pattern
2. Acceleration – over activity
3. Jump to different solutions and ideas
4. Expectation becomes certainty
5. Tunnel vision
6. Concentration on irrelevant details
7. Denying facts and reality
8. Perception of Time.

How do we handle stress?

1. Anticipation – mental rehearsal
2. Regular breathing
3. Slow down – make haste slowly
4. Structured approach to crisis (Using the checklist)

Stress is also needed.

- Hypo stress or little,
- Optimum stress – recommended,
- Panic or Hyper stress)

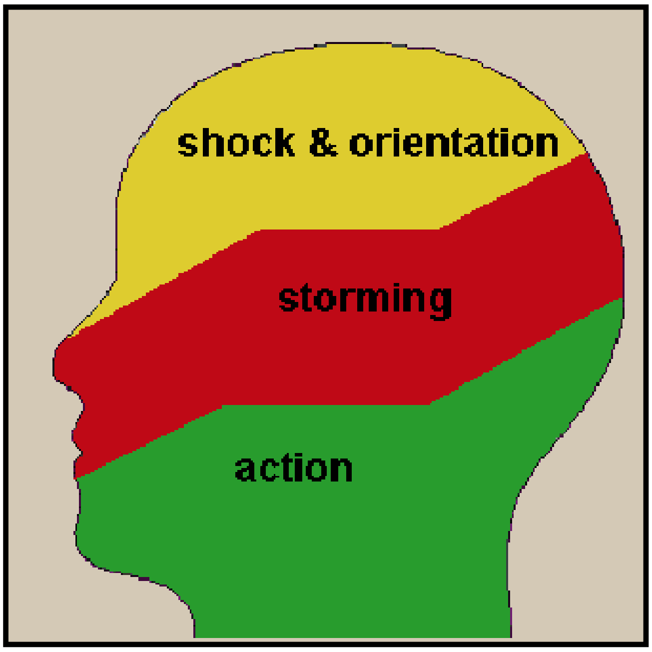


Figure 97 Psychological phase

Psychological Crisis Phases

1. Shock & Orientation

- Uncertain & show stress

- Depend up a leader for direction
- Need to be told what to do
- Coded pre-announcement (Mr. Skylight)

2. Storming

- Emotional resistance – mild unease or open conflict
- Should end in agreement
- Anxiety level should go down

3. Action

- Co-operation develops
- Team starts to work as a team
- Members become more flexible

The Crisis Commander should during…

… shock & orientation

- Give direction and leadership
- Make an initial assessment
- Be authoritative

… storming

- Give them time to argue
- Be supportive
- Do not join in

… action

- Give support and direction

What would be the Commander's Role?

1. Delegate – do no get overload.
2. Monitor your stress level (Hypo, Optimum, Hyper).
3. Give support and encouragement (Self- efficiency and self-esteem).
4. Perform briefings / debriefings – close loop.
5. Monitor time – set intermediate progress and decision times.

Managing the crowd

Obviously these figures vary a great deal depending on the emergency, but are useful as a guideline.

After initial announcement of an emergency…

- 10% accept the situation immediately
- 30% investigate

- 60% ignore the situation

After people accept the danger…

- 10% flee and save themselves
- 5% stand and fight the danger
- 10% help others
- 60% await initiatives from others
- 12 to 14 % freeze and do nothing
- 1 to 3 % panic

Evacuation strategy

- The "fleeing" group will take care of themselves
- Direct the "helper" group to help the "frozen group"
- The "hero" group can be helpful but will need guidance

What will happen?

- Family member will try to regroup
- People will go back for belongings
- The crew will spend time dealing with passenger (crew) questions

Announcements

- Use "I" instead of "we" – like "I have decided", "I expect", "I am sure"
- Avoid "trigger" words – emergency, danger, fine
- Avoid negatives – like "no danger"

Minimising post traumatic stress

- Company support
- Defusing
- Critical Incident Stress Debriefing

Critical incident stress debriefing

1. Introduction

- Settle down
- Confidentiality
- No notes
- No actions
- No blames

2. Facts

- Role then and now

- What happened

3. Emotional

- Feelings – then, later, now
- Physical reactions
- Sleeping
- Triggers

4. Conclusion

- Normal reactions in an abnormal situation
- More support and more meetings

Critical Incident Stress Debriefing Tips

Do not…

- Interpret
- Discuss organizational and technical issues
- Blame individuals
- Provoke reactions
- Give meaningless remarks

Do…

- Listen actively
- Let the group give mutual support
- Give individual a chance

14 Planning

Notes: The training objectives are that by the end of the lesson the trainees will be able to remember the five steps of the Short term strategy:

- *Identify the problem,*
- *Build the plans,*
- *Check the plans,*
- *Summary briefing and*
- *Monitor*

Short term strategy

The standard way to approach problem.

a. It is a formula that we can follow consciously.
b. It is used to maintain the situational awareness.
c. Making sure that everyone make contribution.

As an individual – good in solving immediate problems.

But under time pressure:

- *We don't assess risk,*
- *Prioritize correctly,*

- *unable to use all available resources*
- *Do not cooperate and work as a team*

There is a structure to be used involving the whole team.

"Common structure" (that all share).
- It saves time
- It increase the situational awareness by sharing a mental model
- Minimize the misunderstanding and risk.

When we will use the "short term strategy"?

1. When there are no rules or standard operating procedure for routine decision.
2. When not force make an instant decision.
3. If there is considerable time to consider alternatives.
4. When it is possible to consult the whole team.

"There are occasions that it don't have to involved problems."

Related problems:

1. Navigation
2. Cargo
3. Machinery related.

Could involved higher stress and risk over a high period.

1. Grounding / Collision
2. Fire / Piracy

What is the importance of team contribution?

Ans: The team relevant knowledge such as:

1. Experience
2. Information
3. Skills
4. Attention
5. Ability

Acting on our own = operating on high risk area.

Figure 64 (relevant knowledge)

But if the two combined knowledge work and acting as a team, combined knowledge increase. Reduce in the risk area = increase in the safety margin.

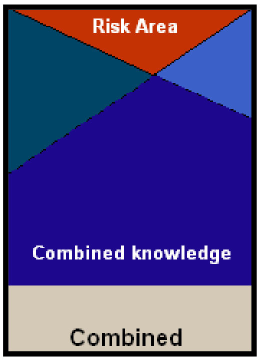


Figure 65 (relevant knowledge combined)

Six steps for Short Term Strategy:

1. Identify the problem (Assess the situation, risk, time available and gather information).
2. Build the plan (Each member to make their own plan and judge the situation. Interacting with other through the process).
3. Check the plan (Combining the individual plans takes care of other possibilities, that they are true and correct. Nothing is miss look). _(These three steps builds the situational awareness._
4. Summary briefing (Everyone is brief with the summary of the combined plan. It should be interactive).
5. Monitor as they are executed. [If necessary to adjust the plan (flexible). [Ensure that everybody knows their task].
6. Debrief – ask the team what are the lessons that can be learn.

15 STANDARD MANEUVERS

Notes: The main objective of these exercises is to give the trainees a thorough understanding of how the maneuvering data are obtained, thus making them better able to use this information. The trainees should be able to improve or augment these data onboard ships after completion of the course. A brief description of the maneuvering information recommended in Assembly resolution A.601 915) should be included.

When executing these exercises it is of the utmost importance that the initial course and speed are exact and well established before the maneuver starts. Otherwise the results cannot be compared with other data for the same maneuver. If possible, some of these maneuvers should be done with two ship, one with a fixed propeller and one with a controllable-pitch propeller. At least one maneuver should be repeated with the ship in loaded and ballast conditions, to demonstrate the difference in behavior.

Plotting the data obtained during the exercise onto a wheelhouse poster could be completed by the trainee on his/her own evening assignment. Instructions on how to do this could be a subject during the debriefing.

Because of the limited time available, the zig - zag maneuver may have to be omitted as an exercise. However, this maneuver demonstrates the time it takes to stop a turn and the time it takes to get back on course, and it is recommended that the coasting stop is only demonstrated or that only one group carries out the maneuver. The results of these exercise can be exchanged between the groups, provided that both groups are using the same ship model.

It is recommended that these exercises are performed in the vicinity of a coastline.

The basic understanding of a ship's behavior in any maneuver can be based on results taken from trials conducted to determine the ship's maneuvering characteristics.

MSC 76/23/Add.1

ANNEX 6

RESOLUTION MSC.137 (76)
(adopted on 4 December 2002)

STANDARDS FOR SHIP MANOEUVRABILITY

1 PRINCIPLES

1.1 The Standards for ship maneuverability (the Standards) should be used to evaluate the maneuvering performance of ships and to assist those responsible for the design, construction, repair and operation of ships.

1.2 It should be noted that the Standards were developed for ships with traditional propulsion and steering systems (e.g. shaft driven ships with conventional rudders). Therefore, the Standards and methods for establishing compliance may be periodically reviewed and updated by the Organization, as appropriate, taking into account new technologies, research and development, and the results of experience with the present Standards.

2 APPLICATION

2.1 Notwithstanding the points raised in paragraph 1.2 above, the Standards should be applied to ships of all rudder and propulsion types, of 100 m in length and over, and chemical tankers and gas carriers regardless of the length.

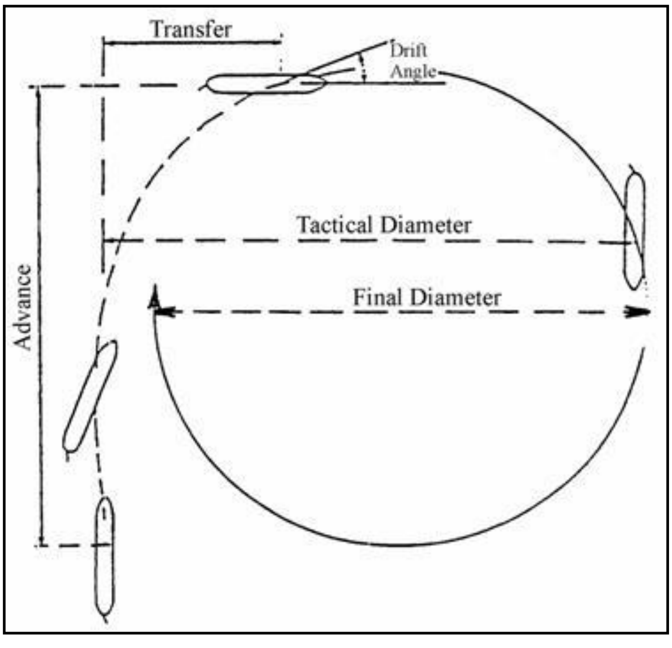


Figure 25. *Advance and Transfer*

3 Standard maneuvers and associated terminology

Standard maneuvers and associated terminology are as defined below:

.1 The test speed (V) used in the Standards is a speed of at least 90% of the ship's speed corresponding to 85% of the maximum engine output.

.2 Turning circle maneuver is the maneuver to be performed to *both starboard and port with 35° rudder angle or the maximum rudder angle permissible* at the test speed, following a steady approach with zero yaw rate.

.3 Advance is the distance travelled in the direction of the original course by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 90° from the original course.

.4 Tactical diameter is the distance travelled by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 180° from the original course. It is measured in a direction perpendicular to the original heading of the ship.

.5 Zigzag test is the maneuver where a known amount of helm is applied alternately to either side when a known heading deviation from the original heading is reached.

.6 The 10°/10° zigzag test is performed by turning the rudder alternately by 10° to either side following a heading deviation of 10° from the original heading in accordance with the following procedure:

- after a steady approach with zero yaw rate, the rudder is put over to 10° to starboard or port (first execute);
- when the heading has changed to 10° off the original heading, the rudder is reversed to 10° to port or starboard (second execute); and
- after the rudder has been turned to port/starboard, the ship will continue turning in the original direction with decreasing turning rate. In response to the rudder, the ship should then turn to port/starboard. When the ship has reached a heading of 10° to port/starboard of the original course the rudder is again reversed to 10° to starboard/port (third execute).

.7 The first overshoot angle is the additional heading deviation experienced in the zigzag test following the second execute.

.8 The second overshoot angle is the additional heading deviation experienced in the zigzag test following the third execute.

.9 The 20°/20° zigzag test is performed using the procedure given in paragraph 4.2.6 above using 20° rudder angles and 20° change of heading, instead of 10° rudder angles and 10° change of heading, respectively.

.10 Full astern stopping test determines the track reach of a ship from the time an order for full astern is given until the ship stops in the water.

.11 Track reach is the distance along the path described by the midship point of a ship measured from the position at which an order for full astern is given to the position at which the ship stops in the water.

<u>Final diameter</u>

The distance perpendicular to the original course between tangents drawn at the points where 180 and 360 degrees of turn has been completed.

<u>Kick</u>

The distance the ship moves sidewise from the original course away from the direction of the turn after the rudder is first put over.

<u>Drift angle</u>

Is the angle between the tangent to the turning circle at any point and the fore and aft line of the ship?

4 Conditions at which the standards apply

In order to evaluate the performance of a ship, maneuvering trials should be conducted to both port and starboard and at conditions specified below:

.1 deep, unrestricted water;

.2 calm environment;

.3 full load (summer load line draught), even keel condition; and

.4 steady approach at the test speed.

5 Criteria
The maneuverability of the ship is considered satisfactory if the following criteria are complied with:

.1 Turning ability

The advance should not exceed *4.5 ship lengths (L)* and the tactical diameter should not exceed *5 ship lengths* in the turning circle maneuver.

.2 Initial turning ability

With the application of *10° rudder angle to port/starboard*, the ship should *not have travelled more than 2.5 ship lengths* by the time the heading has changed by 10° from the original heading.

.3 Yaw-checking and course-keeping abilities

.1 The value of the first overshoot angle in the 10°/10° zigzag test should not exceed:

.1 10° if L/V is less than 10 s;

.2 20° if L/V is 30 s or more; and

.3 (5 + 1/2(L/V)) degrees if L/V is 10 s or more, but less than 30 s,

where L and V are expressed in m and m/s, respectively.

.2 The value of the second overshoot angle in the 10°/10° zigzag test should not exceed:

.1 25°, if L/V is less than 10 s;

.2 40°, if L/V is 30 s or more; and

.3 (17.5 + 0.75(L/V)) °, if L/V is 10 s or more, but less than 30 s.

.3 The value of the first overshoot angle in the 20°/20° zigzag test should not exceed 25°.

.4 Stopping ability

The track reach in the full astern stopping test *should not exceed 15 ship lengths*. However, this value may be modified by the Administration where ships of *large displacement* make this criterion impracticable, but should in *no case exceed 20 ship lengths*

Pivot Point

The point about which the vessel pivots with the bow swinging inwards and the stern swinging outwards

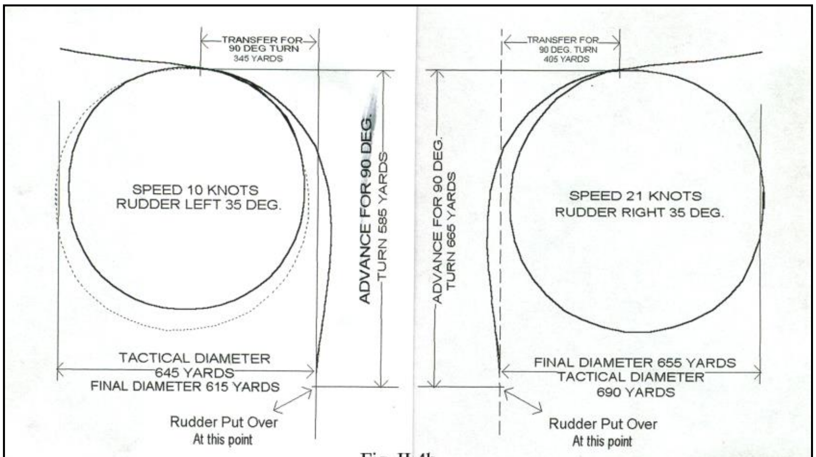


Fig. II-4b

Figure 26 shows the actual turning circles of a model ship made at 21 knots with 35 degrees right rudder; the other, the circle made at 10 knots with 10 degrees left rudder.

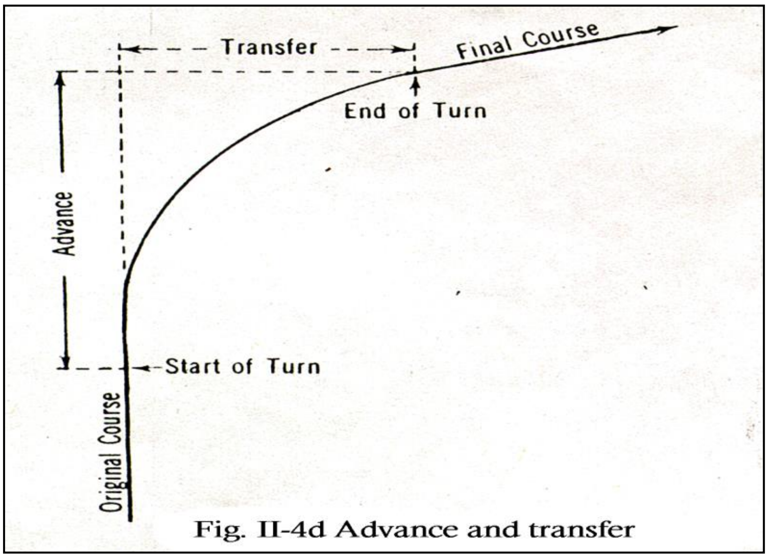


Figure 27 *Advance and transfer*

Factors Affecting Advance and Transfer

The amount of advance and transfer for a given vessel depends primarily upon the amount of rudder used and the angle through which the ship is to be turned. The speed of the vessel has little effect **(see fig. 27 and 28)**

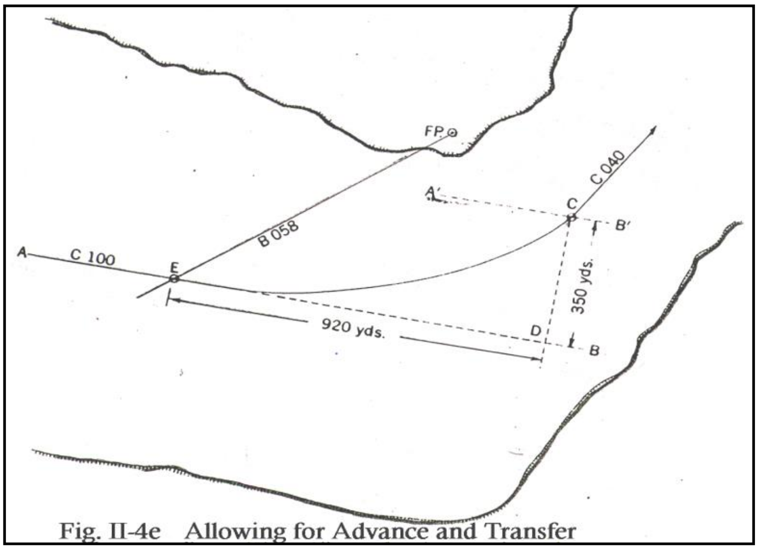


Figure 28. *Using the advance and transfer for new course*

Distance to New Course

A method wherein a table based from the vessel's characteristics is constructed to indicate the following for various course alterations not greater than 120 degrees (see figure 32).

- Speed
- Rudder angle
- Distance of intersection point from rudder application point

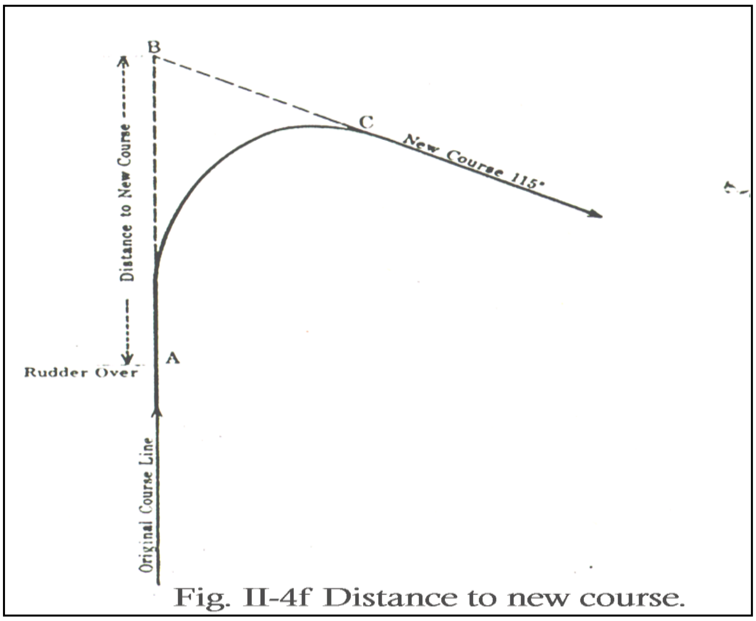


Figure 29 *Distance to new course*

Turning Bearing

This is the predetermined bearing to a charted object from that point on the original track at which the rudder must be put over in order to effect the desired turn. (See figure 33 and 34)

Stopping Distances

- Inertia or coasting stop (fig. 34)
- Crash stop (fig. 35)
- Rudder cycling or zigzag maneuver (fig. 36)
- Hard turn (fig. 35)

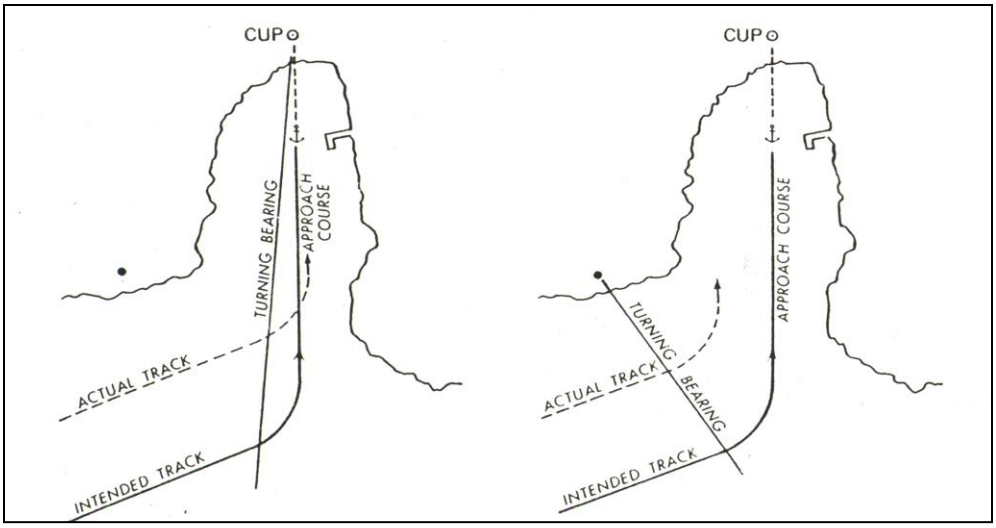


Figure 30 *Turning Bearing*

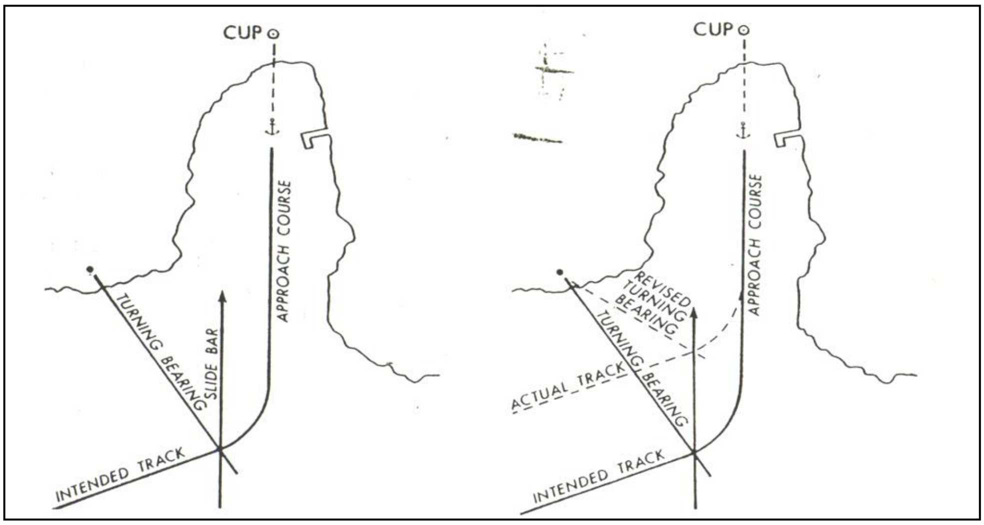


Figure 31 Side bar technique

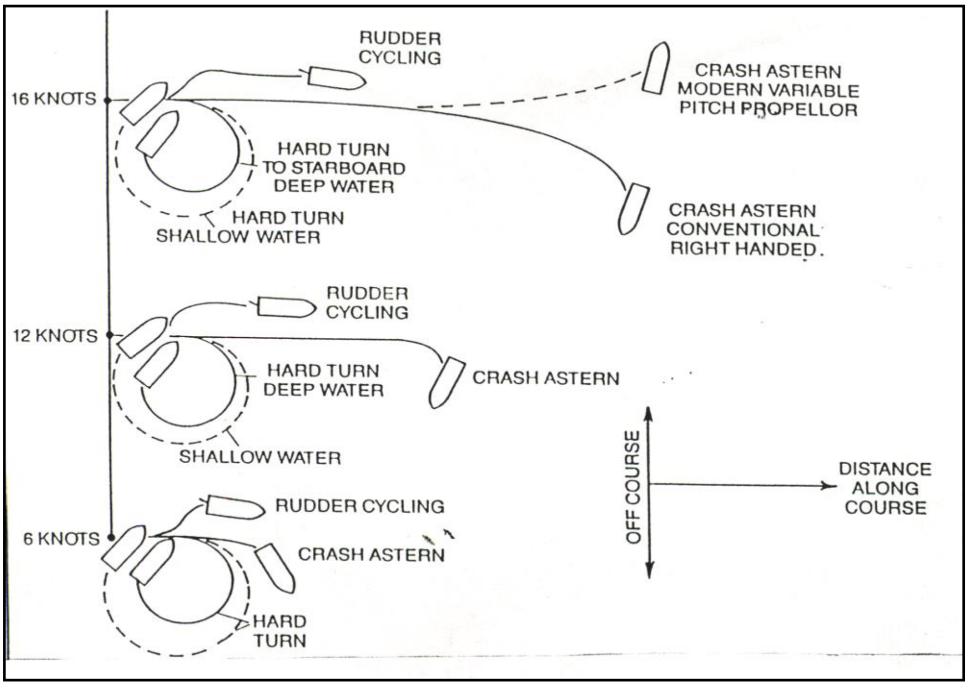


Figure 32 *Crash stop and Hard turn*

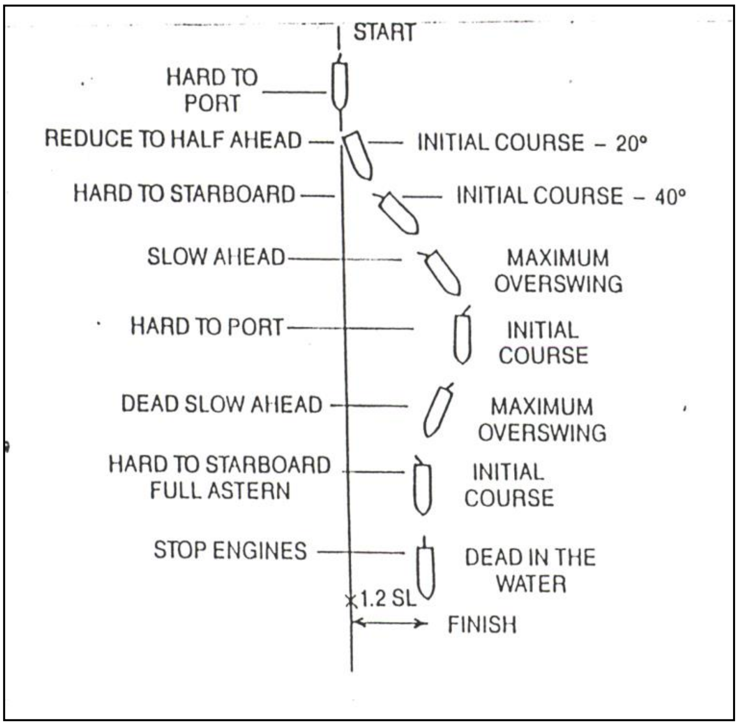


Figure 33 *Rudder cycling*

- **Pilot Card and Wheelhouse poster**

IMO Resolution A. 601 (15)
Adopted on 19 November 1987
Provision and Display of Maneuvering Information On Board Ships

Recommendation on the provision and the display of maneuvering information on board ships

Introduction
1.1 In pursuance of the Recommendation on Data Concerning Maneuvering Capabilities and Stopping Distances of Ships, adopted by resolution A.160 (ES.IV), and paragraph 10 of regulation II/1 of the International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978, Administrations are recommended to require that the maneuvering information given herewith is on board and available to navigators.

1.2 The maneuvering information should be presented as follows:
.1 Pilot card
.2 Wheelhouse poster
.3 Maneuvering booklet

2. Maneuvering Information

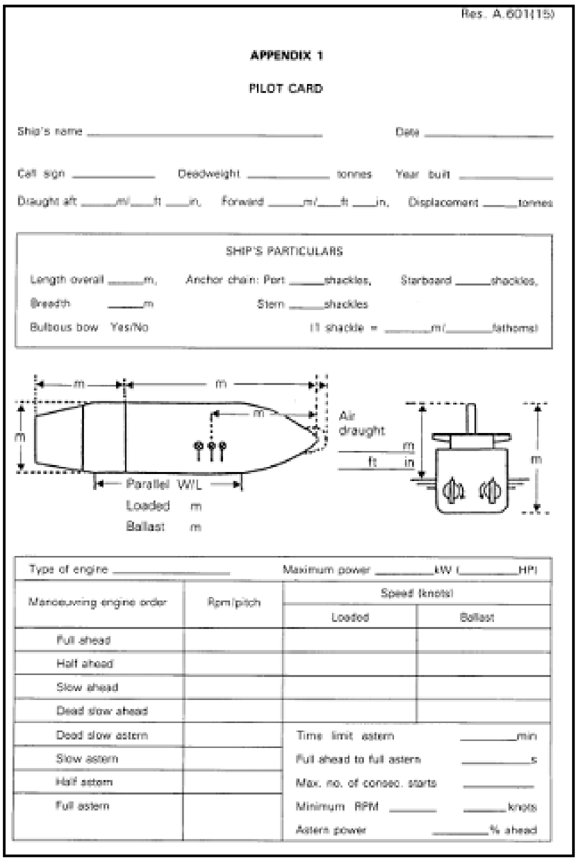
2.1 Pilot Card (appendix 1)
The pilot card, to be filled in by the master, is intended to provide information to the pilot on boarding the ship. This information should describe the current condition of the ship, with regard to its loading, propulsion and maneuvering equipment, and other relevant equipment. The contents of the pilot card are available for use without the necessity of conducting special maneuvering trials.

2.2 Wheel House poster (appendix 2)

The wheelhouse poster should be permanently displayed in the wheelhouse. It should contain general particulars and detailed information describing the maneuvering characteristics of the ship, and be of such a size to ensure ease of use. The maneuvering performance of the ship may differ from that shown on the poster due to environmental, hull and loading conditions

2.3 Maneuvering booklet (appendix 3)

The maneuvering booklet should be available on board and should contain comprehensive details of the ship's maneuvering characteristics and other relevant data. The maneuvering booklet should include the information shown on the wheelhouse poster together with other available maneuvering information. Most of the maneuvering information in the booklet can be estimated but some should be obtained from trials. The information in the booklet may be supplemented in the course of the ship's life.



Res. A.601(15)

APPENDIX 1

PILOT CARD

Ship's name ____________ Date ________

Call sign ________ Deadweight ________ tonnes Year built ________

Draught aft ____m/____ft ____in. Forward ____m/____ft ____in. Displacement ____tonnes

SHIP'S PARTICULARS

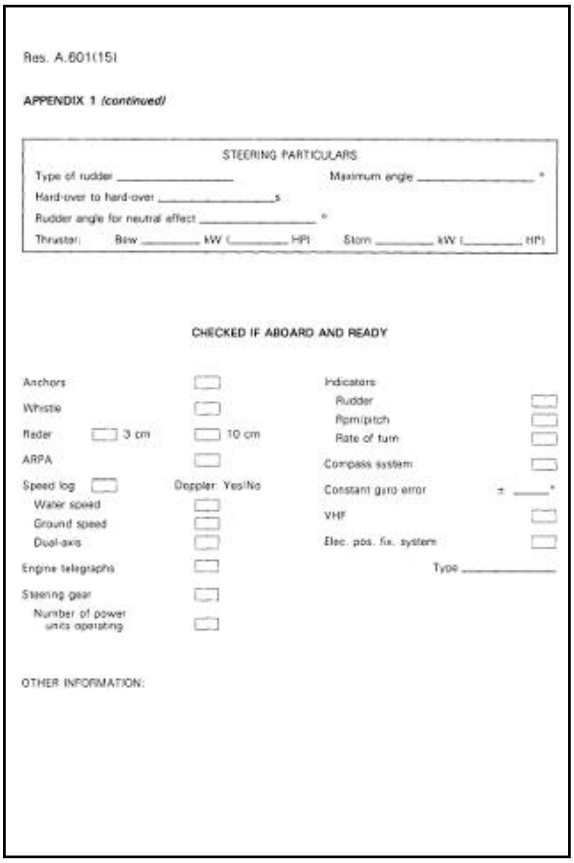
Length overall ____m. Anchor chain: Port ____shackles, Starboard ____shackles,

Breadth ____m Stern ____shackles

Bulbous bow Yes/No (1 shackle = ____m/____fathoms)

Type of engine ________ Maximum power ________kW (________HP)

Manoeuvring engine order	Rpm/pitch	Speed (knots) Loaded	Ballast
Full ahead			
Half ahead			
Slow ahead			
Dead slow ahead			
Dead slow astern		Time limit astern	________min
Slow astern		Full ahead to full astern	________s
Half astern		Max. no. of consec. starts	________
Full astern		Minimum RPM ________	________knots
		Astern power	________% ahead



Res. A.601(15)

APPENDIX 1 *(continued)*

STEERING PARTICULARS

Type of rudder ____________ Maximum angle ________°

Hard-over to hard-over ________s

Rudder angle for neutral effect ________°

Thruster: Bow ________kW (________HP) Stern ________kW (________HP)

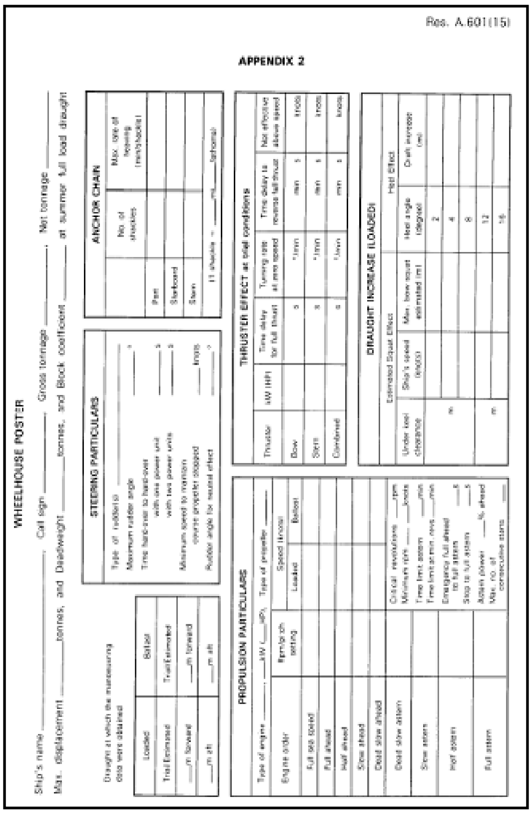
CHECKED IF ABOARD AND READY

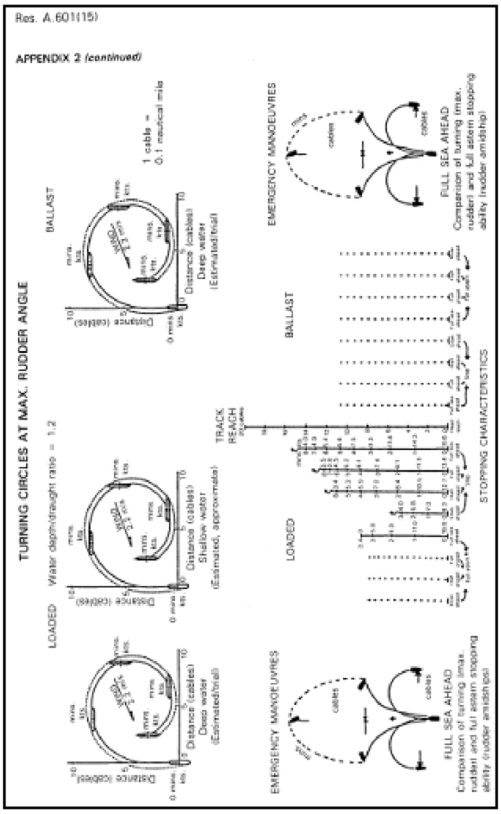
Anchors ☐
Whistle ☐
Radar ☐ 3 cm ☐ 10 cm
ARPA ☐
Speed log ☐ Doppler: Yes/No
Water speed ☐
Ground speed ☐
Dual-axis ☐
Engine telegraphs ☐
Steering gear ☐
Number of power units operating ☐

Indicators:
Rudder ☐
Rpm/pitch ☐
Rate of turn ☐
Compass system ☐
Constant gyro error ± ____°
VHF ☐
Elec. pos. fix. system ☐
Type ________

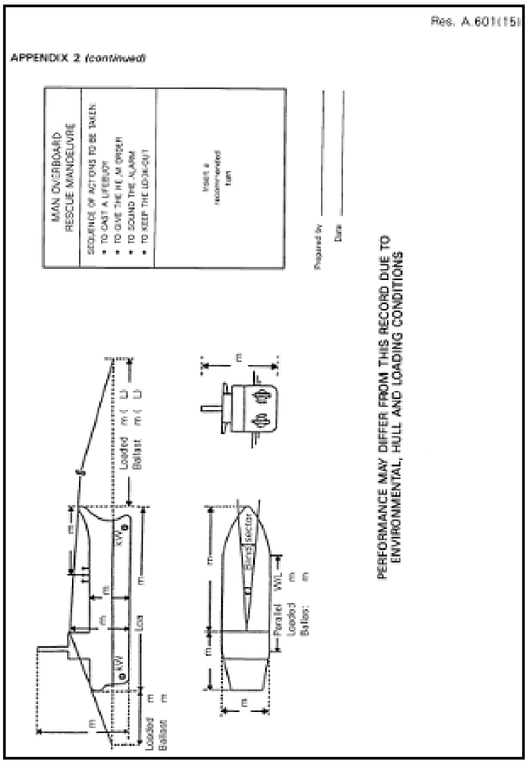
OTHER INFORMATION:

Appendix 1 Pilot Card





Appendix 2 Wheelhouse poster



Appendix 2 Wheel house poster

Res. A.601(15)

APPENDIX 3

RECOMMENDED INFORMATION TO BE INCLUDED IN THE MANOEUVRING BOOKLET

CONTENTS

Appendix 3 Manuevering booklet

16 WIND AND CURRENT EFFECTS

Notes: The instructor should show the trainees how the wind and current affect the maneuverability of the ship. It is recommended that some of these exercise are exactly the same as those executed under "Standard maneuvers" above. By plotting the results of the same maneuver executed under different circumstances the trainees will get a visual impression of the effect.

When it comes to the slow speed situations the trainees should be given a short exercise demonstrating how difficult it may be to handle a ship under conditions of slow speed, wind and current. Preferably, an exercise demonstrating this should be performed in a narrow channel.

During the classroom session, in addition to the general topic, attention should be drawn to how the turning point of the ship is affected by the wind.

Wind

One of the most frequently experienced and less understood natural phenomenon affecting a ship's behavior is the effect of wind. Its effect on ships varies depending on different situations:

- Vessel stopped

  In figure 34, a ship is on even keel, stopped dead in the water. It has the familiar all aft accommodation and we will assume, at this stage that the wind is roughly on the beam. Whilst the large area of superstructure and funnel offer a considerable cross section to the wind, it is also necessary to take into account the area of freeboard from forward of the bridge to the bow. On a VLCC this could be an area as long as 250 x 10 meters. The center of effort of the wind (W) is thus acting upon the combination of these two areas and is much further forward than is sometimes expected.
  This now needs to be compared with the underwater profile of the ship and the position of the pivot point (P) as discussed previously. With the ship initially stopped in the water as this was seen to be close to amidships. The center of effort of the wind (W) and the pivot point (P) are thus quite close together and therefore do not create a turning influence upon the ship. Although it will vary slightly from ship to ship, generally speaking most will lay stopped with the wind just forward or just abaft the beam.

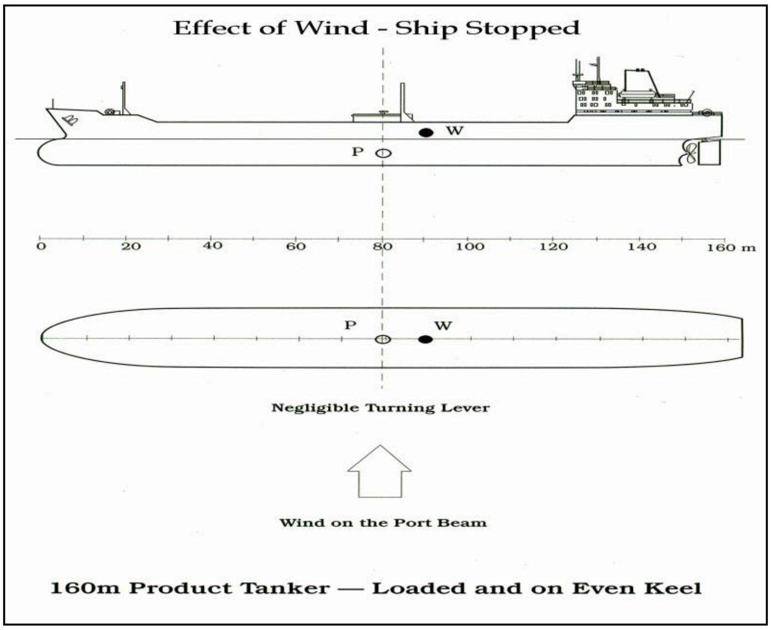


Figure 34 *Vessel stopped*

- **Vessel making headway**

  When the ship is making headway, the shift of the pivot point upsets the previous balance attained whilst stopped, as in **figure 35**. With the wind on the beam, the center of effort of the wind remains where it is but the pivot points moves forward. This creates a substantial turning lever between P and W and, depending on wind strength, the ship will develop a swing of the bow into the wind.

  This trend is compounded by the fact that at lower speeds the pivot point shifts even further forward, thereby improving the wind's turning lever and effect. It is a regrettable fact of life, when approaching a berth with the wind upon or abaft the beam, that as speed is reduced the effect of the wind gets progressively greater and requires considerable corrective action.

  When, however, approaching a berth or a buoy with the wind dead ahead with the ship on an even keel, the approach should be much easier to control. Even at very low speeds the ship is stable and will naturally wish to stay with the wind ahead until stopped.

- **Vessel making sternway**

  The effect of the wind on a ship making sternway is generally more complex and less predictable. In part this is due to the additional complication of transverse thrust when associated with single screw ships. Remaining with the same ship **(see figure 36)** we have already seen that with the sternway the pivot point moves aft to a position approximately ¼ L from the stern. Assuming that the center of effort (W) remains in the same position, with the wind still on the beam, the shift of pivot point (P) has now created a totally different turning lever (WP). This will now encourage the bow to fall off the wind when the ship is backing, or put another way, the stern seeks the wind.

  Some caution is necessary, however as the turning lever can be quite small and the effect disappointing, particularly on even keel. In such cases the stern may only partially seek the wind, the ship making sternway 'flopped' across the wind. This situation is not helped by the center of effort (W) moving aft as the wind comes round onto the quarter. This in turn tending to reduce the magnitude of the turning lever WP.

  The other complicating factor is transverse thrust. If the wind is on the port beam, there is every likelihood that transverse thrust and effect of wind will combine and indeed take the stern smartly into the wind. If, however, the wind is on the starboard beam, it can be seen that transverse thrust and effect of wind oppose each other. Which force wins the day is therefore very much dependent upon wind strengths versus stern power, unless you know the ship exceptionally well, there may be no guarantee as to which way the stern will swing when backing.

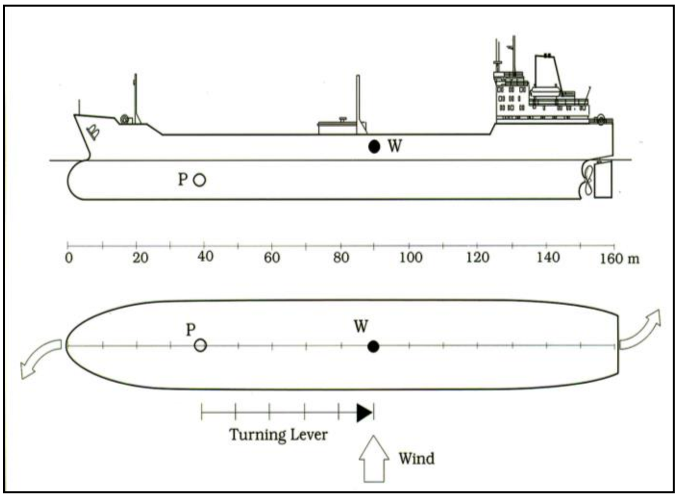


Figure 35 *Effect of wind headway*

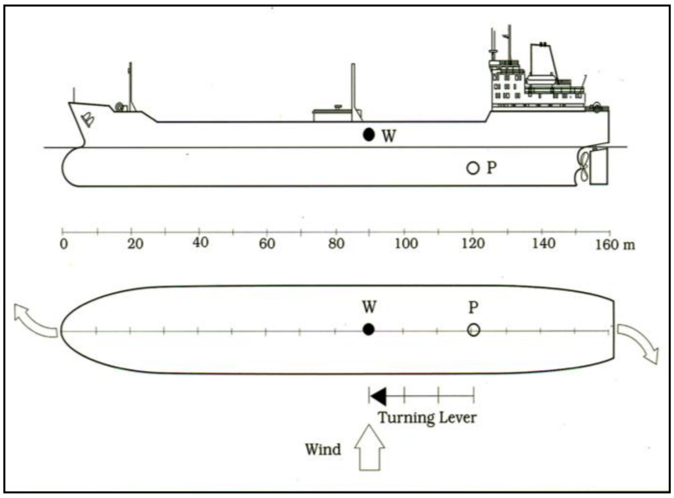


Figure 36 Effect on wind sternway

- **Trim and headway**

  So far we have only considered a ship on even keel. A large trim by the stern may change the ship's wind handling characteristics quite substantially. **Figure 37** shows the same ship, but this time in ballast and trimmed by the stern. The increase in freeboard forward has moved **W** forward and very close to **P**. With the turning lever thus reduced the ship is not so inclined to run up into the wind with headway, preferring instead to fall off, or lay across the wind. Because the ship is difficult to keep head to wind, some pilotage districts will not accept a ship that has an excessive trim by the stern, particularly with regards SNM operations.

- **Trim and sternway**

  The performance when backing is also seriously altered. With the wind on the beam and **W** well forward, the turning lever **WP** is consequently increased **(see figure 41)**. Once the ship is stopped and particularly when backing, the bow will immediately want to fall off the wind, often with great rapidity, while the stern quickly seeks the wind.
  When berthing with strong winds, or attempting to stop and hold in a narrow channel, it is best to plan well ahead as such a ship can prove very difficult to hold in position. However

as long as we have some prior knowledge as to how the ship will react, under the influence of the wind, it can be turned to advantage and readily employed to aid rather than hinder ship handling. Not for nothing is it often referred to as a "poor man's tug'.

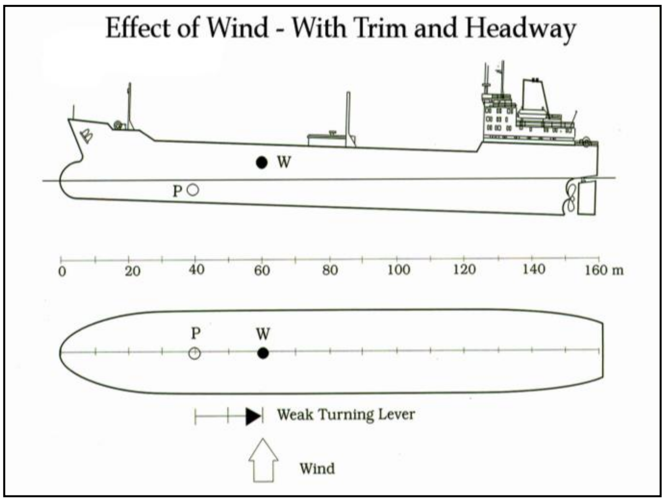


Figure 37 *Trim and Headway*

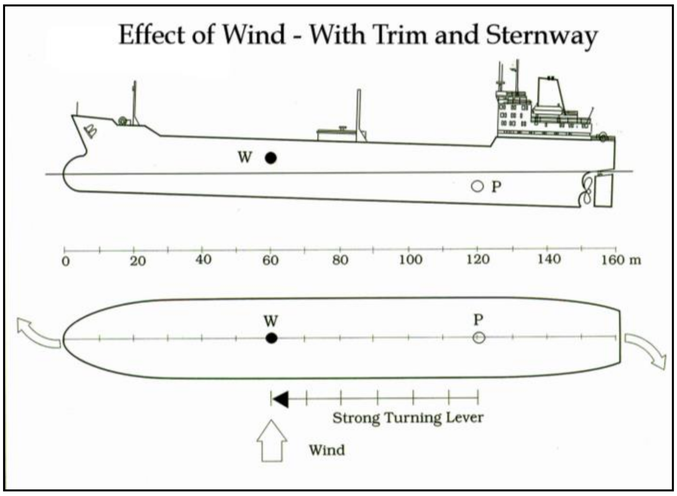


Figure 38 *Trim and Sternway*

Calculations

A quantitative understanding of the actual force that a ship experiences whilst influenced by the wind. It is beneficial to estimate the wind limitations of a particular class of ship, establishing the size of tugs for a district and so forth. In the interest of professionalism, better to be armed with concrete facts rather than simply say "we don't think it can be done" Worse, is to be forced to attempt a movement with unacceptable risk.

It is best to obtain available estimation of the area of the ship presented to the wind in square meters, if it were on the beam.

Length overall (m) x max. freeboard (m) will give an approximation of the total windage area (m^2)

An approximate wind force in tonnes per 1,000 m^2 can then be calculated as follows:

$$\text{If } V = \text{wind speed (meters/second)} = \frac{\text{wind speed (knots)}}{2}$$

Then

$$\text{Force in [tonnes] per 1000 m2} = \frac{V^2}{18}$$

Example: Container vessel LOA 300 meters, Freeboard 15 meters, Wind speed is 25 knots.

LOA (300) x freeboard (15 meters) = windage area (4500 m^2)

$$\text{Then force in tonnes per 1000 } m^2 = \frac{V2\ (12.5^2)}{18} = 8.7 \text{ tonnes per 1000 } m^2$$

4500 m^2 x 8.7 tonnes per 1000m^2 / 1000 = 39.15 tonnes of force.

Important Considerations Regarding Strong Wind Effect

- Kicks ahead with full power are very effective against a wide range of wind strengths.
- Kicks ahead of dead slow and slow will be ineffective at certain wind strengths and more power must be used.
- The weakness of transverse thrust as a force.
- The likely wind strength at which the transverse thrust will be overcome by wind.
- The limits of the thruster in beam winds.
- The size of tugs required for the class of ship, or its wind limits with the operational tugs in a port

Current

The effect of tides and currents may sometimes be easy to explain but their actual effect can sometimes be complex especially for less experienced officers.
It should be borne in mind that a mass of water on the move is several hundred times denser than air and thus by comparison is capable of generating forces of enormous magnitude.

Effect of Tide upon the Ship's Handling Characteristics

Handling a ship in a tide is a special circumstance where it is important to understand that the area of water encompasses a vessel's maneuver. The water is moving en masse together with the ship throughout the whole maneuver, whereby, the maneuvering is not affected but the ship is, relative to a fixed object or landmark.
It is important, therefore, that the shiphandler assesses the tidal strength and direction with some care, prior to the commencement of any maneuver, in order to ascertain if there is sufficient time and space to complete it. **(see figure 39)**

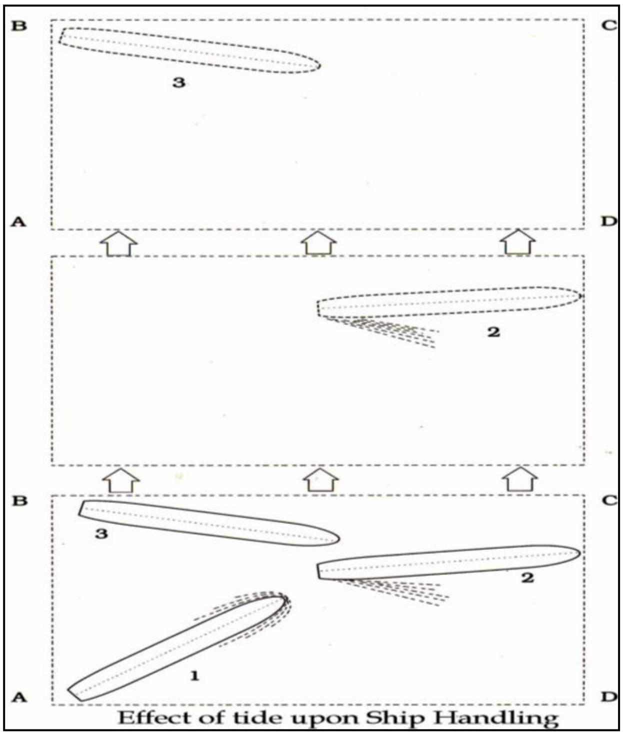


Figure 39 *Effect of tide on ship handling*

Working with a Tide

With the obvious exception of difficult and complex tidal situations, when the tide flows across a berth for example, it may often be found that the tide can be used to:

- Improve slow speed control
- Create lateral motion

<u>With the tide from ahead</u> **(Figure 40)**

By using low revolutions or short kicks ahead in order to maintain a small amount of headway 'through the water' and into the tide, it is possible to balance the ship's headway against the tide and keep the pivot point forward, even though the ship is making very little speed 'over the ground'. This retains a good steering lever and positive control over the ship, but at a considerably lower speed over the ground than would otherwise be normal. In general terms this is known as 'stemming the tide'.

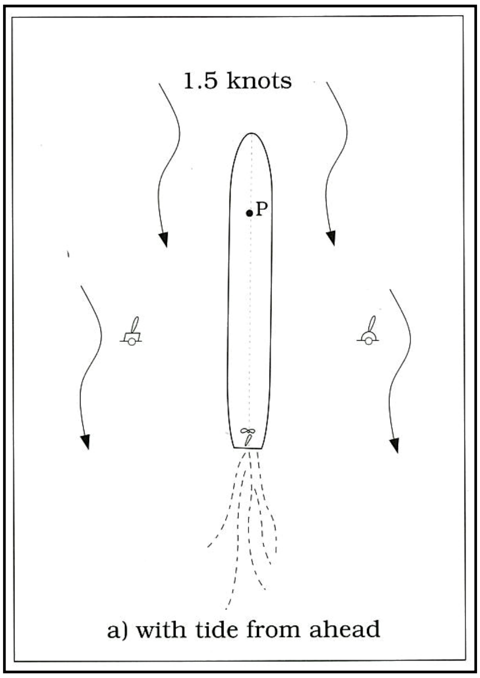


Figure 40 *Stemming the tide*

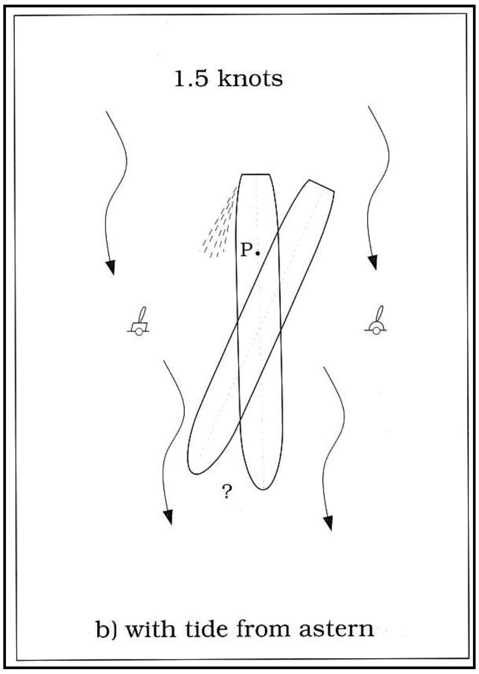


Figure 41 *Tide coming from astern*

<u>With the tide from astern **(Figure 41**</u>

This is the most unsatisfactory situation and one where it is extremely difficult to maintain positive control of the ship. In order to maintain headway over the tide or through the water and so keep the pivot point forward, the ship would have to be running at a speed over the ground which is considerably higher than the speed of the tide. This will often to be far too fast.

It can be very difficult to keep control of a ship with a following tide. If practicable it is always preferable to stem the tide.

<u>Working across the tide **(Figure 42 and 43)**</u>

If a reasonable balance has been achieved between the tidal stream and the ship's speed through the water, so that the ship's speed over the ground is minimal, it becomes possible to work the tide and create sideways or 'lateral motion'. This can often be achieved by using rudder angle alone, but if that is not enough, a short kick ahead can be used to ease the tide around onto the appropriate bow. The resultant of the two vectors, tidal stream and ship's headway will then be noticeable, as the ship starts to work or 'crab' across the tide. To stop or correct this sideways drift, it will necessary to bring the ship's head back around into the tide, so that it is once again dead ahead.

When using the tide in this way it is very important not to be impatient and put the tide too far around on the bow. This will create good lateral motion but if the angle of the tide upon the bow is too large, it may require too much time, power and clear distance ahead, to bring the ship's head back up into the tide. There may, for example, be insufficient water with which to do this in, particularly in the close proximity of a berth. It is therefore better to put the tide fine on the bow and then wait to see if it is having the desired effect, rather than rush the maneuever.

By working the ship across a tidal stream in this manner, the tide is really being used as a sort of 'poor man's tug' and in tidal work, more than anywhere else, the ship handler needs to develop a keen, sensitive 'feel' for the movement of the ship, virtually drifting it into the desired position.

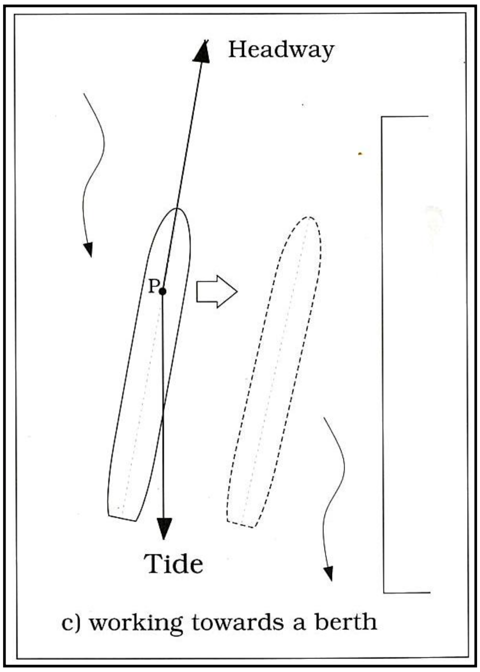


Figure 42 *Towards berth*

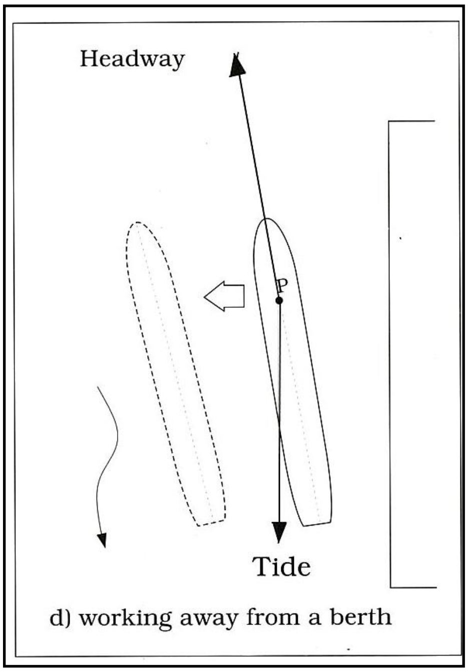


Figure 43 *Away from berth*

17 Shallow water effects

Notes: It is recommended that some theory concerning shallow-water effects is dealt with. Useful examples may be found in reference B3

It is recommended that some of these exercise are exactly the same as those executed under "Standard maneuvers" above. By plotting the results of the same maneuver executed under circumstances the trainees will get a visual impression of the effect.

Shallow water

When the depth of water is less comparing to the draft of the ship. The hydrodynamic forces affect the ship handlings in different ways. The effects become evident when the depth of water is less than 1.5 times of the draft of the ship.
When the ratio of water depth to ship draft is three or less. At greater ratios, shallow water effects on maneuvering performance become rapidly less significant as the water deepens. Restricted water may be defined as narrow channels or canals, waterways with vertical or overhanging banks or areas that include piers and breakwaters which introduce a substantial change in maneuvering characteristics or requirements. Most restricted waters include shallow water and many include significant currents and tides. In restricted waters, areas available for navigation are limited, further complicating the problems of maneuvering and control of the ship.

In shallow waters, the vessel may encounter the following effects:

Sluggish movement:

- As the hull moves along the water, the water which is displaced is not instantly replaced by surrounding water
- A partial vacuum is created.
- The vessel takes longer to answer helm.

- Response to engine movement becomes sluggish and speed reduces due to increased wave making resistance and the deterioration of propulsive efficiency.

Vibration:

- In shallow water vibrations set up.
- It becomes very difficult to correct a yaw or sheer with any degree of rapidity.

Steering:

- Steering becomes erratic.
- Rate of turning is reduced.
- Loss of speed due to turning is less in shallow water.
- Turning circle becomes larger due to the blunt ness of hull response at the initial stage of the turn and the increase of the turning moment of resistance.
- The maximum advance increases up to approximately 1.4 times as the tactical diameter increases up to about 1.3 times as compared to turning in deep water. respectively

Smelling the ground:

- Occurs when a ship is nearing an extremely shallow depth of water, such as a shoal.
- The ship likely to take a sudden sheer.
- The sheer is first towards the shallow, then violently away from it.
- The movements of a sluggish ship may suddenly become astonishingly lively.
- These effects are called smelling the ground.

Squat

A reaction causing a bodily sinkage and a change of trim due to changes of pressure which occur as the ship moves through the water **(see fig. 49).**

a. At moderate speeds most vessels will tend to trim by the head.
b. An increase to a high speed may cause a rapid change to a trim by the stern.
c. Squat is the decrease in under keel clearance caused by forward motion and not the difference in fore and aft draft readings.
d. Water forced under the bow at a higher speed than normal creates a low pressure and loss of buoyancy.
e. Build-up of water ahead of the ship increases longitudinal resistance.

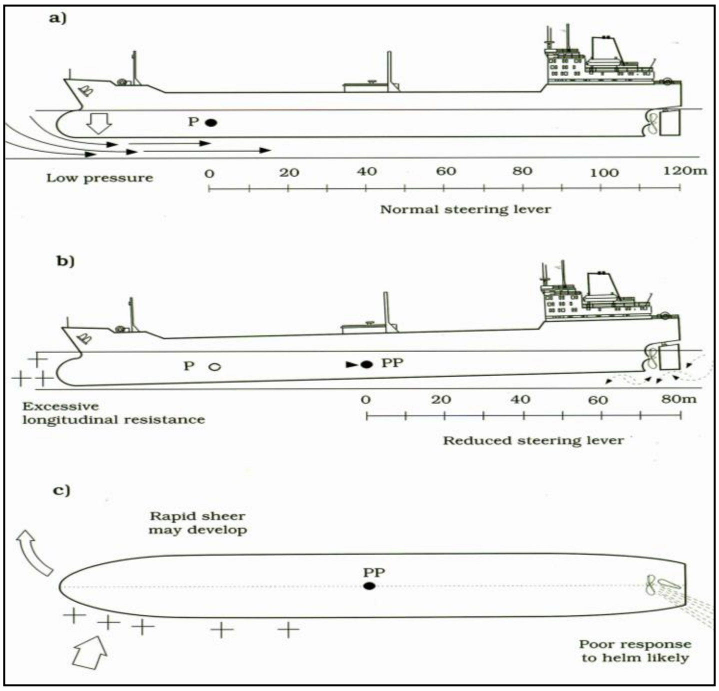


Figure 49 *Effect of trim and squat*

Squat

- Water displaced by the hull is not easily replaced.
- Bow wave and stern wave increase in height.
- Trough becomes deeper and after part is drawn downwards.
- Under keel clearance decreases.
- This effect is called squat.

Factors governing squat. Squat varies on the following factors:

Ship's speed: Squat is directly proportional to the square of speed

Squat μ V^2 (V=speed in knots)

Block co-efficient: Squat directly varies with C_B.

Squat μ C_B

Blockage factor (S): It is the ratio between cross section of the vessel and cross section of the canal or river. Squat varies with blockage factor as.

Squat μ $S^{0.81}$

So, in confined water, squat is more than in open water.

Squat may be calculated by the following simplified formulae:

Squat = $(C_B \times V^2) / 100$ (In open waters)

Squat = $2 \times (C_B \times V^2) / 100$ (In confined waters)

Precaution

- Squat may cause grounding in spite of enough UKC.
- Squat to be calculated beforehand.

- Speed to be reduced to reduce squat.
- While determining UKC, squat for the speed to be taken into consideration.

18 Bank, channel and interaction effects

Notes: In the classroom session the forces involved should be explained. The three effects, bank channel and interaction, are primarily the same. The channel has a bank on each side and interaction can be regarded as the effect of a moving bank. While describing these forces it should be pointed out how a skilled master can use the forces to his advantage in some cases.

<u>Bank effect</u>

When a ship is making headway, a positive pressure area builds up forward of the pivot point , whilst aft of the pivot point the flow of water down the ships side creates a low pressure area (**see figure 50**). This area extends out from the ship and in deep, open water, clear of other traffic, is not a problem.

If however the ship commences to close a vertical obstruction, such as shoal or canal bank, the area experiences some degree of restriction and the ship will be influenced by the resultant forces which build up. Looking at **figure 51,** it can be seen that whilst the pressure at the bow is important, it is only working on a short turning lever forward of the pivot point. The low pressure or suction area is, on the other hand, working well aft of the pivot point and consequently is a very strong force.

As a result of these two forces which have developed, the stern of the ship is likely to be sucked into the bank. It can be very difficult to break out of its hold, the ship requiring constant

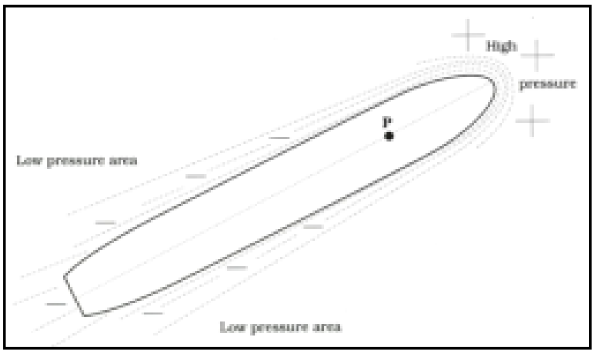


Figure 50 *Pressure fields*

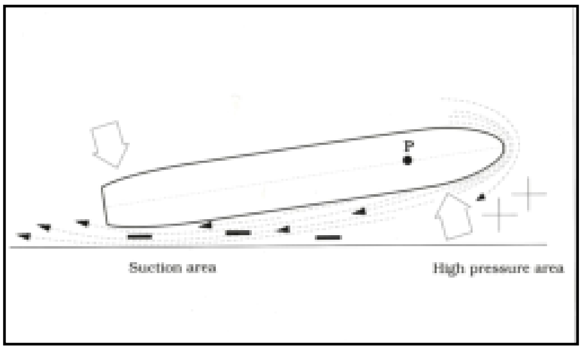


Figure 51 *Bank effect*

Bow cushion and bank suction effect:

- Occurs in narrow channels near proximities of banks.
- There is a tendency for the bow of a ship to be pushed away from the bank, called bow cushion.
- The ship moves bodily towards the bank, which appears at the stern, called bank suction.
- Caused by the restricted flow of water on the bank's side.
- Velocity of water to the bank increases and pressure reduces.
- Results in drop of water level towards the bank.
- As a result, a thrust is set up towards bank.
- A vessel approaching to the bank will have to apply helm to the bank and reduce speed to prevent the sheer from developing.

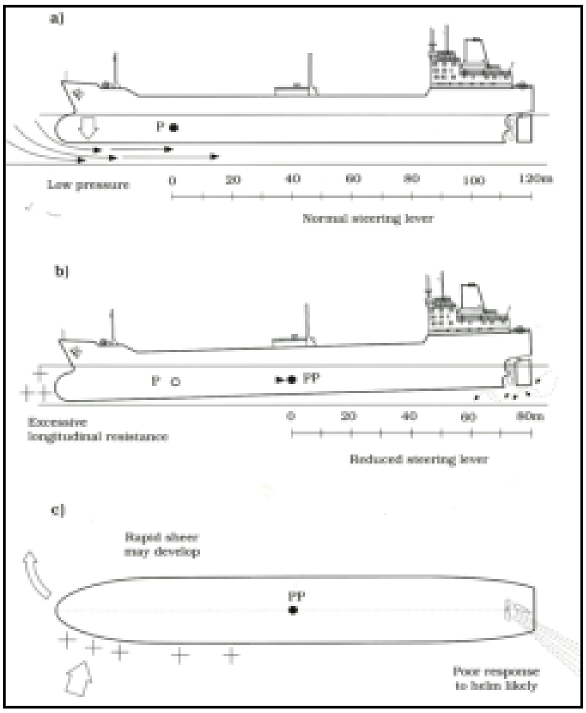


Figure 52 *Effect of trim and squat*

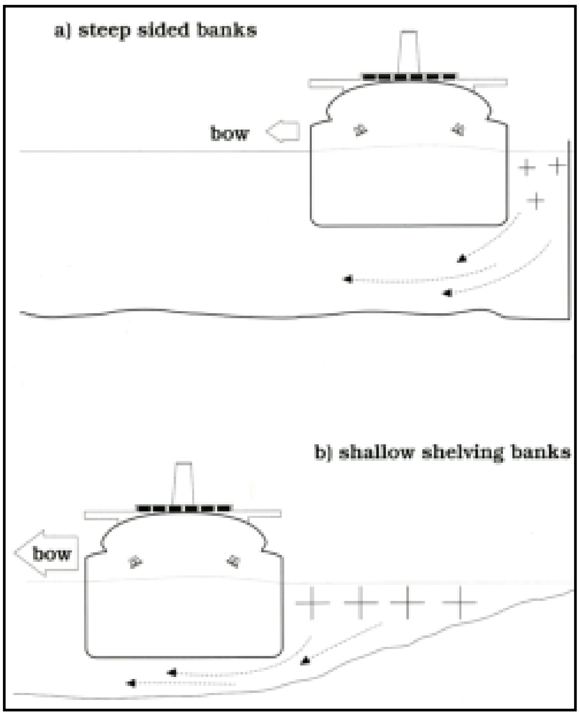


Figure 53 *Bank configuration*

Canal effect:

- Water level drops towards a bank.
- Vessel heels towards bank to displace constant volume.
- Varies as the square of speed.
- Corrective helm to be applied.

Bends in a tidal River

In these areas where the tide may be of differing strengths, perhaps running very rapidly on the outside of the bend but relatively weaker on the inside of the bend.

Following tide **(figure 54)**

If a large ship is rounding a bend in a channel, it is possible for the ship to be positioned so that the strong tide is working on the after bod of the ship, whilst only the weaker tide is influencing the fore body. With the pivot point forward the strongest tide is thus working on a good turning lever and a turning force of considerable magnitude is created.

- A ship can react both violently and rapidly to this force and it should never be underestimated.
- It may be prudent to keep to the outside of the bend, so that the ship is always in the area of stronger flowing tide. Area of the stern put into a strong following tide should be done with extreme caution.

Tide from ahead

When a relatively large ship, is negotiating a bend in a channel, with the tide from ahead, it is possible to get into a position where the ship is influenced by tides of differing strength **(see figure 55)**.

- Basis above figure, if the ship's bow that is now influenced by the very strong tide while the after body of the ship is in the area of relatively weaker side.
- This creates a turning moment which is opposing the intended turn and if it is not anticipated with appropriate helm and power, it can surprise the unwary and the vessel may not come around in sufficient time to clear the bend, without the risk of grounding.

If it is practicable it is better to keep to the inside of a bend, so that the bow does not enter the area of stronger tide at any time during the turn. Unfortunately this is often the shallow side of the bend as well and this may be prohibitive to a larger vessel with a draft restraint.

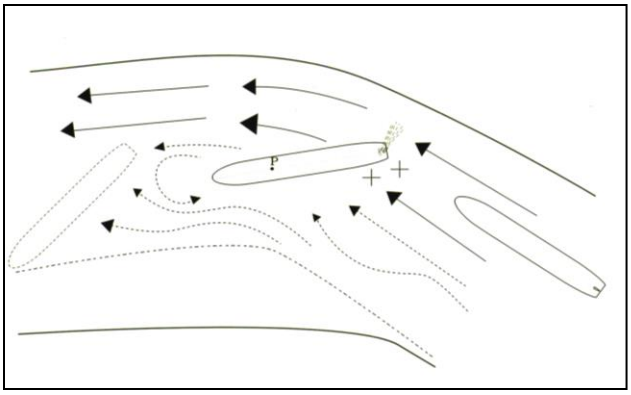


Figure 54 Following tide

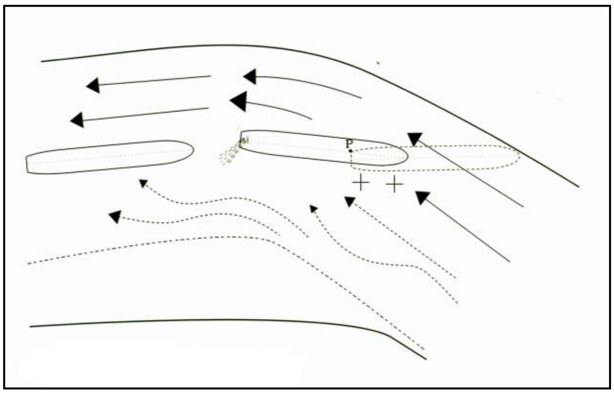


Figure 55 Tide from ahead

Rapid changes in tidal direction

There are occasions when a ship is required to pass close to shallow areas or manmade structures, where the tide may change rapidly in direction over a very short distance. If a ship is proceeding at slow speed this can have a very serious consequences for the handling of the vessel.

In **figure 56** as the ship passing close to the end of a jetty and an area of shallow water, with the ship's ahead already canted to starboard to allow for the set and drift of the tide. As the shoal comes abeam the ship suddenly loses the influence of the tide forward, but it is still working strongly on the starboard quarter. With the combination of slow speed and the pivot point, the tide aft is working on good turning lever. This creates a strong turning moment and the bow, which was already canted that way, will swing rapidly to starboard. It is therefore important to anticipate this and check it immediately, with a substantial kick ahead.
Equally important as the ship comes out of the tide, the fact is that the ship may swing just as quickly to port, unless corrective helm and power is promptly taken off. It is not unknown for this chain of events, particularly with strong cross tides, to generate into a situation where a large ship can swing rapidly out of control, from one side of the channel to the other and eventually aground.

Restricting the tidal flow

This is unusual tidal problem but one that can, nevertheless, cause a considerable amount of damage to a jetty, if the ship in question is very large. It occurs when a ship is angled in towards a jetty and diagonally across a tide (**see figure 57**).

With the ship blocking the tide, even though it may be quite weak, the tide is forced to flow with increased velocity between the ship and the jetty, thus creating a low pressure area between the two. The ship, surprisingly perhaps, can be sucked into and accelerated towards this area, with the risk of damage to both the ship and the quay. It is advisable therefore, to avoid acute angles with a jetty, even in fairly weak tides

Tidal forces

The force of the tide can be immense. Water is several hundred times denser than air and if any attempt is made to restrict its flow by holding the ship with moorings, anchor or tugs it can generate an enormous force. The magnitude of this force is influenced by…..

- Draft and depth of water'
- The ship's bow configuration
- The velocity of the tide
- Under keel clearance

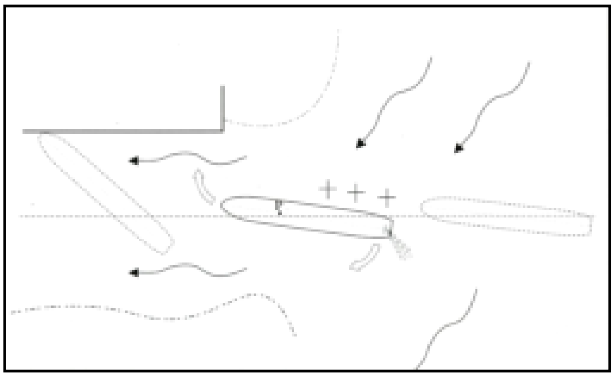


Figure 56 *Rapid changes in tide*

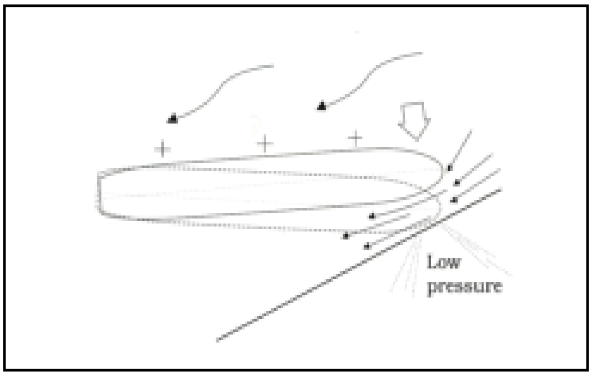
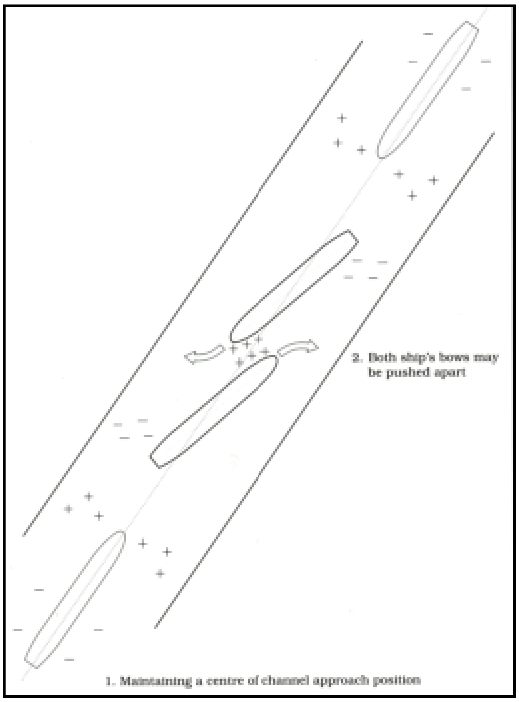


Figure 57 *Restricting tidal flow*

Ship to ship Interaction

It is clear thus far that a great deal of caution needs to be shown when operating in narrow and shallow waters. It almost goes without saying that extreme care is needed. If intentionally or otherwise, another ship is brought into this dangerous scenario, with involvement in an overtaking or passing situation, it is essential to be aware of the forces at work.

Passing – in the interest of both simplicity and clarity the sequence of events during a meeting end on maneuver are illustrated with the diagrams.



Passing (Phase 1)

It is important at this stage, when meeting another ship, not to work to the starboard side of the channel too early or too far. If the ship gets too close to a shoal or bank it can experience bank effect and unexpectedly sheer across the path of the approaching ship with appalling consequences

As the two bows approach each other, the combined bow pressure zones between them will build up and encourage the respective bows to turn away from each other. Helm may be required to check the swing. Ship B may experience an increase in speed, as it is virtually pushed along by the pressure zone of the overtaking ship

Figure 58 (phase 1)

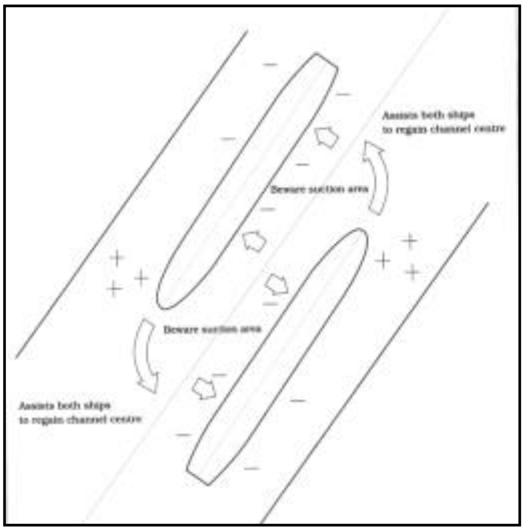


Figure 59 (phase 2)

Passing (Phase 2)

With the two ships nearly abeam of each other, a combined low pressure, or suction area exist between them and, if the vessel are too close together, there is every likelihood of them being sucked together in a collision. Literally!

At this stage, the bow of each ship will also begin to smell the low pressure area astern of the other. It is usual to feel this 'turning in' towards the other ship as you pass and it is helpful because it is also back towards the center of the channel.

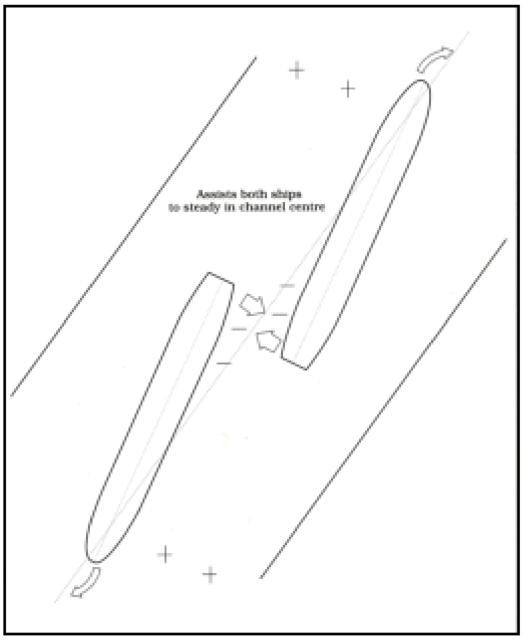
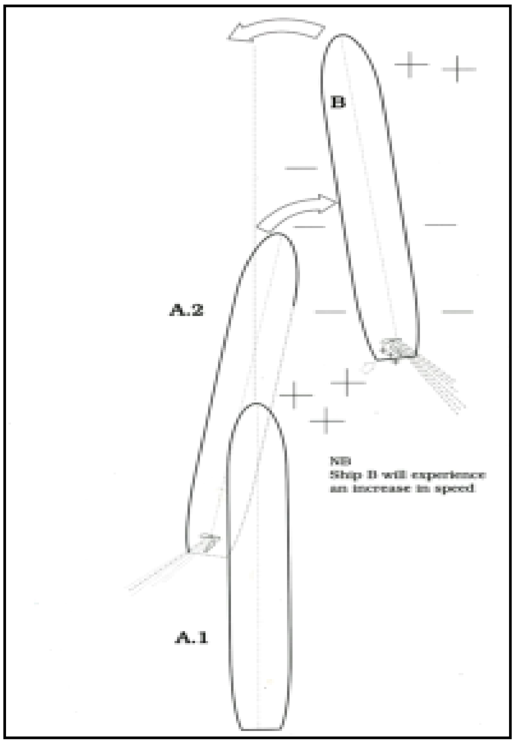


Figure 60 (phase 3)

Passing (Phase 3)

Having previously turned in towards the center of the channel, the opposite now occurs. As the two sterns pass each other, they are drawn together by the low pressure area between them and this has a tendency to realign the ships with the channel. These effects are not always very noticeable, because the ships often pass through the pressure zones fairly quickly, even at relatively slow speeds. The effects however should always be anticipated and used correctly to advantage, corrective helm being applied when necessary.

Overtaking – For the sake of clarity, the "overtaking" operation is also discussed with three illustration



Overtaking (Phase 1)

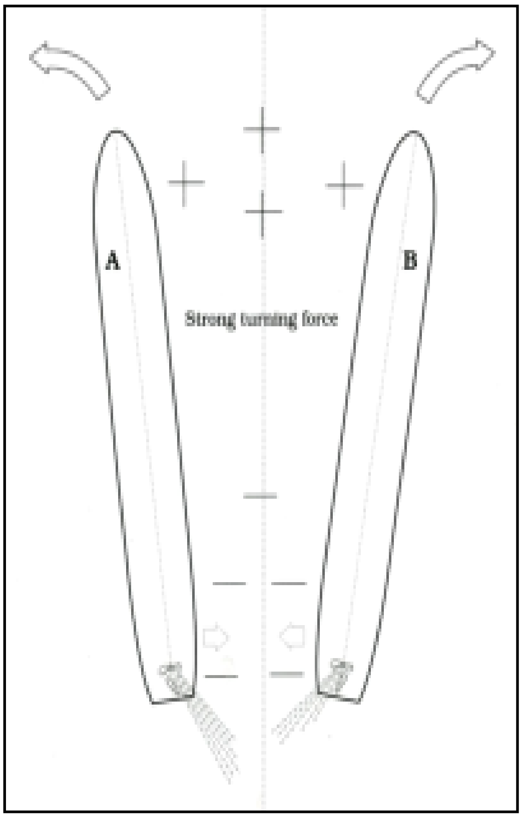
The ship to be overtaken should not move over to the starboard side of the channel without first considering the consequences of bank effect and the danger of shearing across the path of the overtaking vessel, which will easily be influenced by a larger ship.

As ship A approaches the stern of the ship B its bow pressure zone will put pressure on the rudder of ship B causing it to shear across the path of the overtaking vessel.

The overtaking ship A will also fell the low pressure area astern of B and exhibit a tendency to turn in towards the stern of the other ship.

These can be very powerful forces, and it may require full rudder and power to counteract them.

Figure 61 (phase 1)



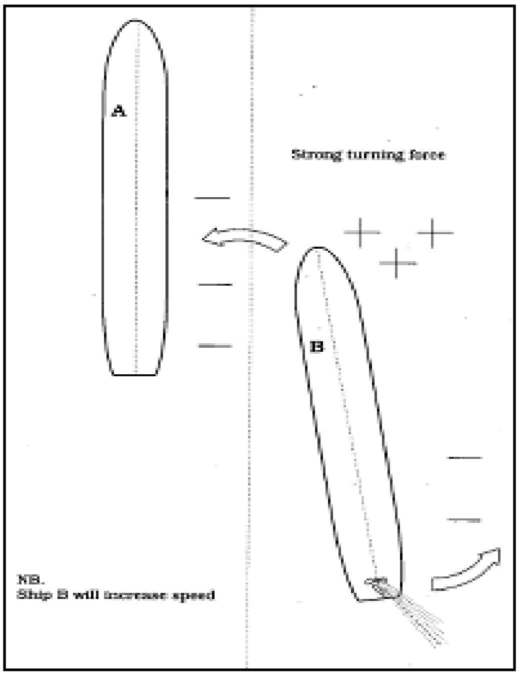
Overtaking (Phase 2)

With two ships abeam of each other, a powerful pressure zone exists between their bows and a low pressure area between their sterns. These combine to produce a strong turning lever which is trying to swing the bows away from each other. This is powerful force and vigorous corrective measures may again be needed.

In addition to the turning forces, there is also an underlying suction area between the two ships which will, if they are allowed to get too close, draw then inexorably alongside of each other. If this does happen, ship B is normally dragged along with ship A and unless they both slow down together, to relax the suction area between them, it is especially difficult to get the two ships apart again.

At this stage ship B may revert to its original propeller speed and appear to slow down in relation to the other vessel.

Figure 62 (phase 2)



Overtaking (Phase 3)

As the overtaking ship passes the other vessel, ship B. may be influenced by the effects of two powerful forces. Firstly on one side, bank effect and secondly, on the other side, the low pressure area of the passing vessel. This can combine as a very strong turning force and require bold corrective action.

The rudder of ship A may be adversely effected with positive pressure, as it passes through the pressure zone around the bow of the overtaken ship B, particularly if that ship is large. This can cause ship A to turn unexpectedly.

As ship B is drawn towards the suction area of the passing ship, it may experience a noticeable increase in speed.

Figure 63 (phase 3)

19. Anchoring and Single Buoy Mooring

Notes: The instructor should stress the importance of making plans for anchoring and single-buoy mooring. Trainees will be required to use the maneuvering data in planning the approach. The plan should contain details of approach tracks and course, wheel-over positions and the points at which to reduce and to reverse engines. It should also indicate the method of monitoring progress and determining when those positions have been reached.

A contingency plan, outlining the actions to take in the event of something going wrong should be included.

The designated master will organize the bridge teams and assign various task for performing the exercise. The same navigational procedures and record keeping should be followed as would be done aboard ship.

When the exercise is carried out, realistic difficulties can be introduced by the instructor. Examples would include a ship heaving up anchor and maneuvering in the vicinity of the planned approach to the anchoring position and a ship anchoring in or very near to the position chosen by the trainees. Either of these examples would force the trainees to use their alternative plans and would emphasize the need for such pans. Failure of the engine or of the steering gear could exceptionally be introduced to highlight the potential dangers of a risky maneuver undertaken by a trainee.

Anchoring

The method of securing a ship to the bottom of which letting go a single anchor is the simplest method.

Anchoring Plan

The Master shall prepare a plan for anchoring in accordance with but not limited to the following:

- Approach tracks and courses to steer.
- "Wheel-over positions."
- Points at which to reduce speed.
- Position at which to reverse the engine.
- Position to drop the anchor.
- Means of monitoring the progress and arrival at critical points.
- Clear and specific instructions from the Master.

The following matters shall also be taken into consideration:

- Selection of anchorage.
- Determining of anchoring method.
- Deciding which anchor to use.
- Deciding the length of anchor chain.
- Anchoring approach plan.

An anchor is a device normally made of metal that is used to connect a vessel to the bed of a body of water to prevent the craft from drifting due to wind or current.

Preparation for Anchoring:

1. Direction and strength of wind and current.
2. Depth of water.
3. Type of seabed. (Select a type of seabed with good anchor characteristics).
4. Location of lee – shore, shoals or hazards such as submarine cables or other obstacles.
5. Maneuvering room for approach.
6. Swinging room for anchoring.
7. Conditions affecting visibility, weather and currents.

Japanese standard: Formula for scope of chain

Normal.

$Lc = 3 \times D + 90$ m.

Heavy weather anchoring.

$Lc = 4 \times D + 145$ m.

U.K Standard (Admiralty Manual of Seamanship)

$Lc = 27.5 \times 1.5 \sqrt{D}$ or $NS = 1.5 \sqrt{D}$

Legend: Lc: length of cable to be paid out , D = water depth,

NS = shackles of cable to be paid out.

Anchor and cable. Each classification society lays down its own requirements in compliance with the standard.

Anchor capability

1. The anchor flukes bite into the seabed without fail after the anchor is let go.

2. The anchor possesses sufficient holding power (resistance) to cope with the force dragging the anchor.
3. The anchor maintains postural stability without turning over when it is pulled through the seabed.

JIS type **AC-14 type**

Figure 80 Types of anchor

Types of anchor

The major anchors commonly used in merchant ships and naval vessel are shown in **figure 80**. In merchant ships, the AC14 type anchor appears to be most widely used because of its high holding power and postural stability.

The AC14 anchor holds more than 10 times its own weight if the seabed is good; in poor seabed of soft, silty mud, the holding power will drop to about 3 times anchor weight. However the holding power of the JIS type anchor is, at best, half that of an AC14 anchor of equal weight under normal seabed conditions.

In figure 81 shows that the anchor bites well into the seabed for AC14 and maintains stable posture without turning over. The JIS anchor (**figure 82**) tends to turn over when dragged and subsequently breaks out with flukes up.

Figure 81 AC14 biting into the seabed

Figure 82 JIS anchor overturned

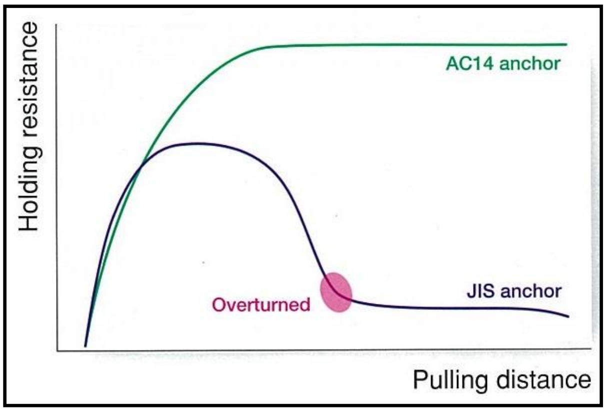


Figure 83 Holding power characteristic

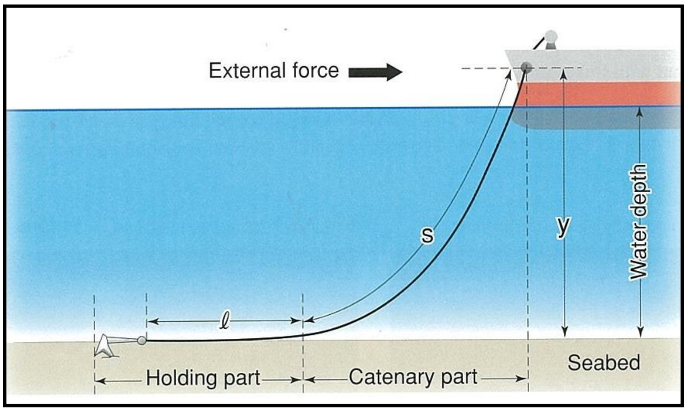


Figure 84 Anchor system on single anchor curve

Preparing to let go Anchor

Carry out preparatory work for anchoring in accordance with the following procedures.

a. The master shall advise the forecastle cable party in advance of the anchor to be used, expected amount of chain to be laid out, expected depth, etc.
b. The Officer in charge of the forecastle cable party shall prepare for and advise the Master on readiness to anchor prior to reaching anchoring position.
c. The Officer on the bridge shall report the sounding, headway, position and all other information required by the master or the pilot.

Anchor Operations

Four Main Approaches to Anchoring

- Anchoring in a designated position.
- Anchoring in a waiting area.
- Anchoring in a shelter of land.
- Anchoring in a tidal river.

Approach to an anchor berth:

- Riding to a single anchor normally used coz its simple to let go and weigh in.
- Used the engine wisely taking in consideration the inertia,
- By putting engine on astern before the intended location will stop the vessel.
- Anchor is let go and the cable is paid out under sternway (0.5 to 1.0 knot)

Anchoring in water of 20 meters or less depth:

- Let go freely by releasing brake into cockbill position.
- Amount of cable = 2 x depth of water should be first allowed to run out freely to enable the anchor to embed itself.
- When intended shackles of the cable are paid out, sufficient brake should be applied to cause the flukes of the anchor bite into the seabed.

Anchoring in water of 20 to 50 meters depth:

- Walked back the anchor by windlass control until it reaches about 5 meters above the bottom, then let go the anchor.
- Afterwards, the proper brake should be applied to control cable running out speed and sternway of the ship should be maintained within permissible range.

Anchoring in water more than 50 meters depth:

- Walked back the anchor by windlass control.
- Sternway over the ground should not exceed 0.5 knots (large ship) after the anchor has been embedded in the bottom

Permissible water depth for anchoring.

- Not determined by the total length of equipped cable but by capacity of the windlass.
- Generally windlass cap. 3 to 4 shackles with an anchor.
- Permissible water depth will be in between 82 – 110 meters.

Anchoring under wind and current effects

Approach with head to wind / stream

- Made head to wind or head to stream then let go the anchor.

Approach with wind or current on the beam

- Ship should stem the wind or current just before letting go the anchor.

Approach with wind or current on the stern

- It should be avoided because headway control is difficult.

Single Buoy Mooring

Mooring to a buoy is somewhat similar to anchoring in terms of approach. The only distinction is in making fast the anchor to the ground for anchoring and making fast the anchor chain to a mooring buoy for single buoy mooring. The following shall be prepared:

- Mooring plan
- Approaching the buoy procedure
- Mooring to the buoy procedure