I'm not a robot



Manoeuvring is one of the critical aspects of any vessel. It is defined as the capability of a ship to change its direction of voyage or heading from its previous trajectory. Any ship must be able to turn or change its direction of voyage or route due to weather, uncongenial sea conditions, or internal reasons about the ship itselfMaintaining a desired course or trajectory. Sailing in meandering courses like rivers, channels, canals, etc. Avoiding obstacles like landmasses, bergs, reefs, offshore structures, and other vesselsCircling some point like a port or terminal or an island due to unavailability of berths, tidal conditions, rough sea or weather conditions, or marine traffic. 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As we had already mentioned in one of our previous articles, the following conditions are required during performing sea trials: Deep and unrestricted watersCalm weather conditions free from any disturbance and a normal sea state. Also, no form of random tidal fluctuations. Full load and even keel conditions are required during performing sea trials: Deep and unrestricted watersCalm weather conditions free from any disturbance and a normal sea state. Annex 6 internal quidelines, the vessels speed under consideration should be kept around 90% of the maximum rated output for all practical purposes. Preferably open waters and free from any kind of marine traffic and other forms of obstructions. Unlike resistance and propulsion, where most of the tests to obtain the vessels hydrodynamic characteristics are done on scaled-down small models in tanks or tunnels, and full-scale trials are not mandated, this is not the case for manoeuvring trials. Per IMO guidelines, even if a vessel under the aforementioned categories has trials conducted in model scale, it must undergo full-scale trials after the ship is fully ready. Moreover, the results from the model and full-scale trials should be congruent with some minor differences within acceptable limits. In other words, for most ships, model tests for manoeuvring are redundant. However, there are certain guidelines specified by ITTC for these tests on the model scale. What is a Turning Circle? Imagine driving your car on empty, flat ground. Slowly start turning the steering wheel and keep it fixated at a certain position. The car turns in the direction where the wheel is turned and starts making a circle of radius. Or even simpler, start running on a football field or an open ground. Start turning towards a side. If you do not turn forward again, you tend to keep going in circles about the same point, isnt it? Thats the simpleton laws of nature again, the smallest circle traced by any object or body is directly related to the size of the body. In other words, the minimum radius or diameter of the circle traced by a turning body increases with size because this depends on the locus of the moving body. From common sense, the smallest circle traced by you running on a field will be far smaller than a constantly turning SUV! For a vessel, the turning circle measures its turning ability as the extent of the smallest circle made by applying a constant turning moment. In simpler words, it determines the ease or rapidness with which a floating vessel can swerve or veer past any obstacle. As obvious, a small boat encountering an obstruction shall be able to evade the same much more quickly than a bulk carrier. In a technical sense, the turning moment, as we know, is caused by the vessels pivot point while applying a definite turning moment towards a particular side. This turning moment towards a particular side applying a definite turning moment towards a particular side. it exerts a moment that manifests itself in causing the vessel to turn in that same direction. Stages Of TurningWhat are the stages of turning? When the rudder is applied at a particular, it creates a rudder moment which causes the vessel to turn in the direction in which the rudder is applied. The interplay of various hydrodynamic phenomena defines the physics of turning. The altered pressure patterns on the hull cause angular acceleration for turning. After a certain point, the vessel makes a 90-degree or right angle with the original heading direction. A balance of all forces, moments and pressures leading to all unbalanced accelerations becoming zero and the turning attaining a steady state. Now, at the geometric centre of the circle, it is about to trace a centrifugal force in action. The vessel starts moving in a circle of constant radius. The same steady state if no rudder moment is applied. Factors Affecting The Turning CircleNow, let us explore the factors influencing the vessels turning circle considering a fixed turning moment. Size and extent of the vessel Hull-form Draft and trim the vessel Available depth Propulsion and machinery Rudder moment applied Displacement and cargo distribution Speed External forces and wind conditions Once again, as we know, the greater the size, the larger the turning circle and vice-versa. However, the hull form also has a vital role to play. The finer the underwater hull form, the greater the turning circle. So, a container ship or frigate will subtend a larger circle while turning compared to a bulk carrier of the same length at the same moment of a ship. Due to the lesser clearance between the bottom of the vessel and the river or seabed for shallow waters, the flow patterns and the entire hydrodynamics is affected. Because of reduced underwater clearance, there is a pressure buildup leading to higher resistance values. Moreover, wave patterns are created at the fore and aft regions. Furthermore, there is a dramatic reduction in speed. The culmination of all these factors leads to a greater increase in the force parameters and a greater turning circle. Similarly, the greater draft of a vessel also creates a greater turning circle. It has also been observed that when there is a trim by the stern, the diameter of the turning circle also increases considerably for the vessel. Conversely, the turning circle diameter decreases when there is a trim by bow. This can be explained by the simple physics that, as for most vessels, the pivot point or geometric centroid is skewed aftward of the midship because of their hull form; for trim by aft, the adequate draft concerning this point is higher as compared to the trim by condition. And we already know that the turning circles for any vessel are directly proportional to the depth and draft. Displacement and speed also play a significant role in determining the turning circle of the vessel. This is from simple Newtonian principles of inertia: the higher the motion and greater the mass. The more the tendency for a body to remain in its previous state, the higher the effort is required to turn, translating to an increased turning circle or the turning tendency is also affected by external conditions, as expected. In rougher sea states and weather conditions, the effort required to turn the vessel increases manifold due to increased hydrodynamic and wind forces and pressures. For ships with larger superstructures, the turning circle diameter increases again. You might also like to read- Disclaimer: The information contained in this website is for general information purposes only. While we endeavour to keep the information up to date and correct, we make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the website or the information, products, services, or related graphics contained on the website for any purpose. Any reliance you place on such information is therefore strictly at your own risk. In no event will we be liable for any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of this website. Manoeuvring is one of the critical aspects of any vessel. It is defined as the capability of a ship to change its course or heading from its previous trajectory. Any ship must be able to turn or change its directional sense as and when required. The requirements can be: Changing its course or heading from time to time. 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Factors Affecting The Turning CircleNow, let us explore the factors influencing the vesselAvailable depthPropulsion and machineryRudder moment appliedDisplacement and cargo distributionSpeedExternal forces and wind conditionsOnce again, as we know conditions. The depth of the waters and the vessels draft also play a crucial role in the resultant turning moment of a ship. Due to the lesser clearance between the bottom of the vessel and the river or seabed for shallow waters, the flow patterns and the entire hydrodynamics is affected. Because of reduced underwater clearance, there is a pressure buildup leading to higher resistance values. Moreover, wave patterns are created at the fore and aft regions. Furthermore, there is a dramatic reduction in speed. The culmination of all these factors leads to a greater increase in the force parameters and a greater degree of effort to turn the effort. This translates to a larger turning circle. Similarly, vessels, the pivot point or geometric centroid is skewed aftward of the midship because of their hull form; for trim by aft, the adequate draft concerning this point is higher as compared to the trim by condition. And we already know that the turning circles for any vessel are directly proportional to the depth and draft. Displacement and speed also plays turning tendency is also affected by external conditions, as expected. In rougher sea states and weather conditions, the effort required to turn the vessel increases manifold due to increased hydrodynamic and wind forces and pressures. For ships with larger superstructures, the wind resistance is more due to a greater surface area, negatively affecting the momentum required for turning. Hence, the turning circle diameter increases again. You might also like to read- Disclaimer: The information up to date and correct, we make no representations or warranties of any kind. express or implied, about the completeness, accuracy, reliability, suitability or availability including without limitation, indirect or consequential loss or damage, or any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of this website. Picture this: youre at the helm of a colossal container ship, and you need to execute a 360-degree turn. The path your ship traces forms what mariners call the turning circle. Its the maritime equivalent of a cars turning radius, but on a much grander scale. This circle represents the minimum space required for a ship to complete a full rotation under specific conditions. Several factors come into play when determining a ships turning circle. The vessels length, beam, draft, and hull shape all contribute a full rotation under specific conditions. to its turning characteristics. But thats not all the rudder design, propeller arrangement, and even the loading condition significantly impact how tightly a ship can turn. Turning a ship involves a complex interplay of forces. As the rudder design, propeller arrangement, and even the loading condition significantly impact how tightly a ship can turn. Turning a ship involves a complex interplay of forces. around the ships center of gravity. Simultaneously, the forward motion of the vessel combines with this rotational force, resulting in a curved path through the water. The rudder angle directly affects the tightness of the turn. A larger rudder angle generally produces a smaller turning circle, allowing for more agile maneuvering. However, increasing the rudder angle also increases drag, potentially slowing the ship. Its a delicate balance that skilled navigators must master. Determining a ships turning circle isnt guesswork its a precise science. Standardized tests involve steering the vessel at a constant speed and then applying a predetermined rudder angle. The ships path is carefully tracked and between the original course and the ships position after a 180-degree turn). A ships hull shape significantly influences its turning ability. Vessels with fuller hulls typically have larger turning circles, while those with sleeker designs can execute tighter turns. The location of the pivot point the spot around which the ship rotates also plays a crucial role in determining turning characteristics. The type and arrangement of a ships propulsion system can dramatically affect its turning circles. Single-screw vessels often have larger turning circles compared to twin-screw ships. The direction of propeller rotation also impacts turning performance, with outward-turning screws generally providing better maneuverability. External factors such as wind, currents, and water depth can significantly alter a ships turning circle. Shallow water, for instance, can increase the turning circle becomes critical when navigating through narrow channels, crowded harbors, or when performing intricate docking maneuvers. Captains and pilots must intimately know their vessels maneuvering capabilities to ensure safe passage in these challenging environments. In high-stakes situations where quick action is necessary to avoid collisions, a thorough grasp of the ships turning characteristics can mean the difference between safety and disaster. Skilled mariners use this knowledge to execute precise evasive maneuvers when seconds count. Modern ships often employ azimuth thrusters propulsion units that can rotate 360 degrees. These innovative systems allow for much tighter turning circles and even enable a ship to move sideways, revolutionizing maneuverability in confined spaces. For vessels that need to maintain a fixed position or follow a precise path, dynamic positioning systems use a combination of thrusters and propellers to automatically control the ships movement. This technology has transformed operations in offshore industries and specialized maritime sectors. The maritime industry continues to push the boundaries of ship maneuverability. Innovations like podded propulsion systems, advanced hull coatings to reduce drag, and AI-assisted navigation promise to further enhance turning capabilities and overall vessel control. Ship turning circles remain a fundamental aspect of maritime operations. From massive container ships navigating busy ports to agile naval vessels executing tactical maneuvers, the ability to control a ships turn with precision is paramount. As technology advances and environmental concerns grow, the importance of efficient and effective ship maneuvering will only increase. For maritime professionals, a deep understanding of turning circles and the factors that influence them is not just academic knowledge its a critical skill that ensures the safety of crew, cargo, and the marine environment. By mastering the art and science of ship turning, mariners contribute to the smooth flow of global commerce and the ongoing evolution of maritime capabilities. The next time you witness a large vessel gracefully pivoting in a harbor or executing a tight turn in a narrow strait, youll appreciate the complex calculations, advanced technology, and skilled seamanship at work. Ship turning circles may seem like a simple concept, but they encapsulate the essence of maritime mastery the ability to control these magnificent machines with finesse and precision in the vast, ever-changing canvas of the worlds oceans. In order to make sure the vessel hits its planned course track after a major course alteration, it is adviseable to calculate and plan the turn in advance. This is especially valid for larger vessels. With this method a safe and controlled turn can be carried out. This method requires that the vessel is equipped with a Rate of Turn indicator. The Rate Of Turn can be found with this approximate formulae: ROT (0/min) (The ROT is measured in degrees per minute)EXAMPLE: Select the turn radius to find the Centre Of turn. A line drawn from the Centre Of Turn and 900 down to the initial course track marks the Actual Start Of Turn. The wheel Over Line is generally, for larger vessels, about 1-2 cables before the Actual Start Of Turn The Wheel Over Line is generally, for larger vessels, about 1-2 cables before the Actual Start Of Turn. 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While we endeavour to keep the information up to date and correct, we make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, suitability or availability with respect to the website or the information, products, services, or related graphics contained on the website for any purpose. Any reliance you place on such information is therefore strictly at your own risk. In no event will we be liable for any loss or damage including without limitation, indirect or consequential loss or damage including without limitation, indirect or consequential loss or damage including without limitation, indirect or consequential loss or damage whatsoever arising from loss or damage including without limitation, indirect or consequential loss or damage including without limitation. this website. In order to negotiate a plan turn, a constant radius turn concept can be used. Theory and procedures of using constant radius turn are explained below. Suppose the vessel has to take a turn in the path marked in above figure (from A to B). The total course change is The distance AB= R /57.3 mile (R in Miles) Vessels speed, V Knots Time taken to cover distance AB, T = R / 57.3 V/R, (Deg/hour) Rate of turn /T = 57.3 V/R, (Deg/hour) Rate of turn = V/R (degree per minute = 57.3V/R, (Deg/hour) Rate of turn = V/R (degree per minute = 57.3V/R, (Deg/hour) Rate of turn = V/R (degree per minute) Therefore, to have a turn of constant radius, relationship between V & ROT can be established. For example: For having a turn of radius 1 Mile, V/ROT both the line will give the centre of the circular path the vessel will be following while going from initial to final course. 4. Taking above as a center make an arc of the circular path meeting both the courses. 5. WOP is to be marked off at a distance equal to the reaction time of the vessel. 6. WOL is the dotted line shown on the above figure, which is parallel to the final course passing through WOP. 7. WOL is marked so that the vessel remains on the final course after alteration, irrespective of the vessels cross track error in the initial course. 8. Required helm to be given when vessel passes WOL. Manoeuvring is one of the critical aspects of any vessel. It is defined as the capability of a ship to change its course or heading from its previous trajectory. Any ship must be able to turn or change its directional sense as and when required. The requirements can be: Changing its course or heading from time to time. Changing its direction of voyage or route due to weather, uncongenial sea conditions, or internal reasons about the ship itselfMaintaining a desired course or trajectory. 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Per IMO guidelines, even if a vessel under the aforementioned categories has trials conducted in model scale, it must undergo full-scale trials after the ship is fully ready. Moreover, the results from the model and full-scale trials should be congruent with some minor differences within acceptable limits. In other words, for most ships, model tests for manoeuvring are redundant. However, there are certain guidelines specified by ITTC for these tests on the model scale. What is a Turning Circle? Imagine driving your car on empty, flat ground. Slowly start turning the steering wheel and keep it fixated at a certain position. The car turns in the direction where the wheel is turned and starts making a circle of radius. Or even simpler, start turning towards a side. If you do not turn forward again, you tend to keep going in circles about the same point, isnt it? Thats the simple law of nature: any finite object constantly tending to turn towards a particular side makes a circular trajectory! But from the simple to the body. In other words, the minimum radius or diameter of the circle traced by any object or body is directly related to the size of the body. In other words, the minimum radius or diameter of the circle traced by any object or body is directly related to the size of the body. In other words, the minimum radius or diameter of the circle traced by any object or body is directly related to the size of the body. In other words, the minimum radius or diameter of the circle traced by any object or body is directly related to the size of the body. In other words, the minimum radius or diameter of the circle traced by any object or body is directly related to the size of the body. by a turning body increases with size because this depends on the locus of the moving body. From common sense, the smallest circle measures its turning ability as the extent of the smallest circle made by applying a constant turning moment. In simpler words, it determines the ease or rapidness with which a floating vessel can swerve or veer past any obstacle. As obvious, a small boat encountering an obstruction shall be able to evade the same much more quickly than a bulk carrier. In a technical sense, the turning circle of a ship is the locus traced by the vessels pivot point while applying a definite turning moment towards a particular side. This turning moment, as we know, is caused by the application of a rudder force or any other turning mechanism it has. So, when a certain angle turns the rudder to a particular side, it exerts a moment that manifests itself in causing the vessel to turn in that same direction. Stages Of TurningWhat are the stages of turning? When the rudder is applied at a particular, it creates a rudder moment which causes the vessel to turn in the direction in which the rudder is applied. The interplay of various hydrodynamic phenomena defines the physics of turning. The altered pressure patterns on the hull cause angular acceleration for turning. After a certain point, the vessel makes a 90-degree or right angle with the original heading direction. A balance of all forces, moments and pressures leading to all unbalanced accelerations becoming zero and the turning attaining a steady state. Now, at the geometric centre of the circle, it is about to trace a centrifugal force in action. The vessel starts moving in a circle of constant radius. The ship will continue to turn in the same steady state if no rudder moment is applied. Factors affecting The Turning Circle Now, let us explore the factors influencing the vessels turning circle considering a fixed turning moment. Size and extent of the vessel Hull-formDraft and trim the circle. So, a container ship or frigate will subtend a larger circle while turning compared to a bulk carrier of the same length at the same speed, rudder moment, and sea conditions. The depth of the waters and the vessels draft also play a crucial role in the resultant turning moment of a ship. Due to the lesser clearance between the bottom of the vessel and the river or seabed for shallow waters, the flow patterns and the entire hydrodynamics is affected. Because of reduced underwater clearance, there is a pressure buildup leading to higher resistance values. Moreover, wave patterns are created at the fore and aft regions. Furthermore, there is a pressure buildup leading to higher resistance values. of all these factors leads to a greater increase in the force parameters and a greater degree of effort to turn the effort. This translates to a larger turning circle. Similarly, the greater degree of effort to turn the effort. This translates to a larger turning circle. considerably for the vessel. Conversely, the turning circle diameter decreases when there is a trim by bow. This can be explained by the simple physics that, as for most vessels, the pivot point or geometric centroid is skewed aftward of the midship because of their hull form; for trim by aft, the adequate draft concerning this point is higher as compared to the trim by condition. And we already know that the turning circles for any vessel are directly proportional to the depth and draft. Displacement and speed also play a significant role in determining the turning circles for any vessel are directly proportional to the depth and draft. tendency for a body to remain in its previous state, the higher the effort is required to turn, translating to an increased turning circle or the turning to increased hydrodynamic and wind forces and pressures. For ships with larger superstructures, the wind resistance is more due to a greater surface area, negatively affecting the momentum required for turning. Hence, the turning circle diameter increases again. You might also like to read- Disclaimer: The information contained in this website is for general information purposes only. While we endeavour to keep the information up to date and correct, we make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability with respect to the website or the information, products, services, or related graphics contained on the website for any purpose. Any reliance you place on such information is therefore strictly at your own risk. In no event will we be liable for any loss or damage whatsoever arising from loss of data or profits arising out of, or in connection with, the use of

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