WHEEL OVER

add-on

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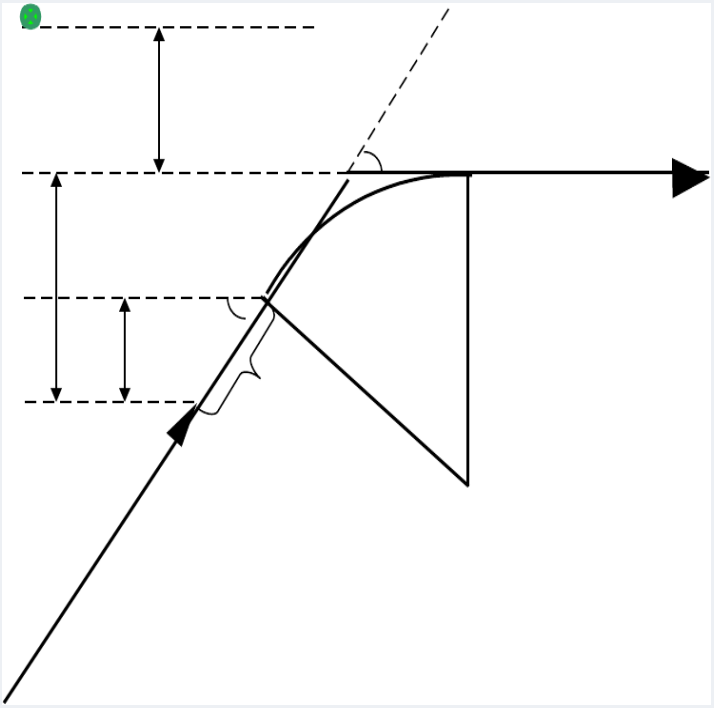
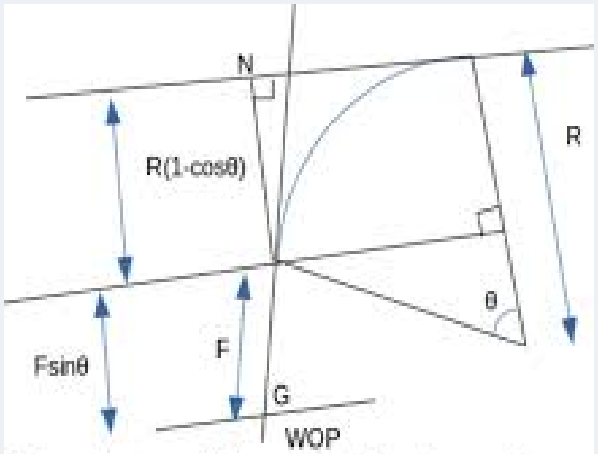
DEFINITION OF THE SITUATION

As per latest monthly alert bulletin the present voyage plans noted that the wheel over position was not marked on the charts so that the Officer on watch will be aware of its imminence and importance. In addition, wheel over calculation has been regularly overlooked or the knowledge of its calculation is vague and sometimes non-existent.

Wheel over position calculation: Wheel over positions should be determined from the ships maneuvering data and marked on the chart. Suitable visual & radar cues should then be chosen to determine when the ship is at the wheel over position. The best cues for large alterations of course consist of Parallel Indexes or visual bearings parallel to the new track, whereas for small alterations a near beam bearing is often better. Even when the pilot has the con the wheel over position should be shown on the chart so that the OOW will be aware of its imminence & importance. It is also part of the ships officers monitoring of the pilot.



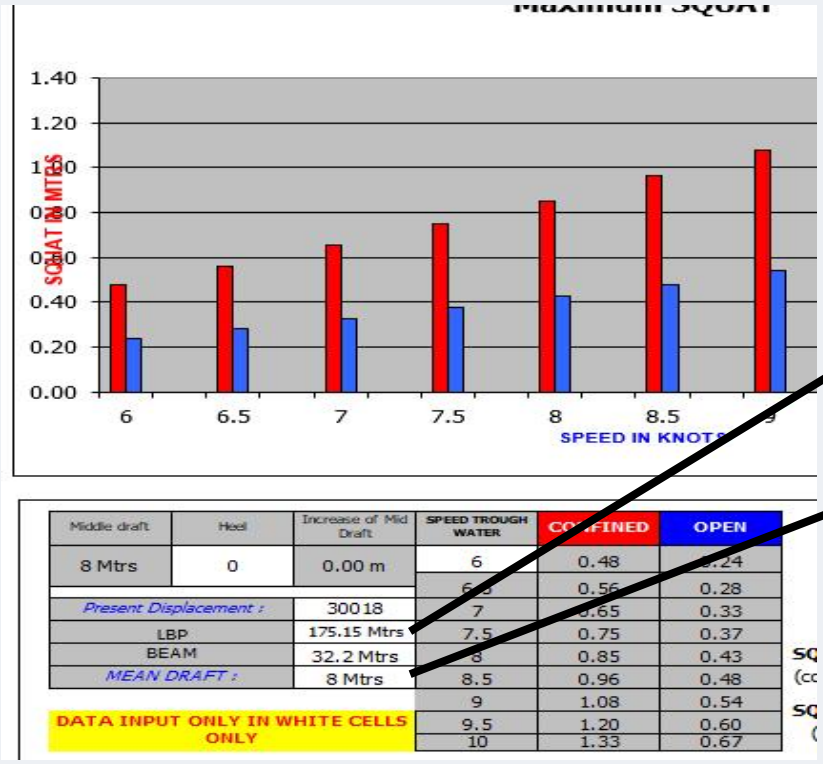


Distance between final course and wheel over point,
T = R(1-cosθ) + F sinθ
R = Radius of turn
Θ = Angle of alteration of course
F = depends on the type and size of the ship
0.1Nm for small ship
0.15Nm for large ship
0.2Nm for very large ship

The scope of this report is not to emphasize into the wheel over calculation itself but rather make it simpler to understand and automatically applied in to the ECDIS easy and effectively.

FACTORS THAT AFFECT A TURN: - Structural design & length of the vessel. - Draught & trim of the vessel. - Size & motive power of the main machinery. - Amount of helm used. - Available depth of water. A vessel trimmed by stern will steer more easily, but the tactical diameter of the turn is increased. Trim by head will decrease the diameter of the turning circle but it will be difficult to steer the vessel. Listed vessel will be subject to delay in turn. A larger turn will be experienced when turning into the list. External forces, wind & current will affect the turn. 1. 2. 3. 4.

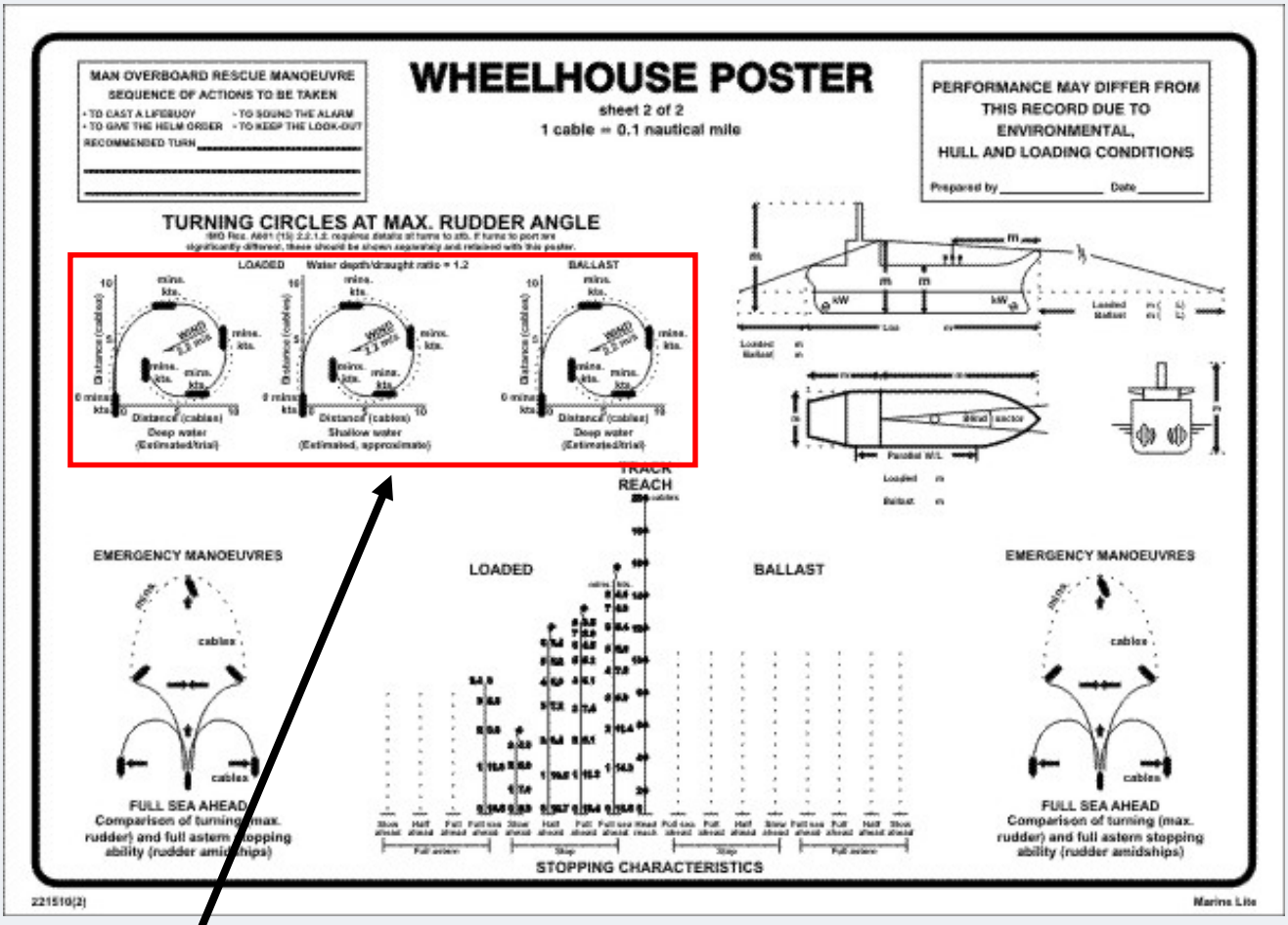
So in order to make it easier we took all these data from the excel form already in existence in the voyage plan. Squat calculation form incooprarates some of the data required. It goes without saying that the Manouvering booklet as well as the wheel house poster should be taken into consideration as well.



Middle draft	Heel	Increase of Mid Draft	SPEED TROUGH WATER	CONFINED	OPEN
8 Mtrs	0	0.00 m	6	0.48	0.24
			6.5	0.56	0.28
Present Displacement :		30018	7	0.65	0.33
LBP		175.15 Mtrs	7.5	0.75	0.37
BEAM		32.2 Mtrs	8	0.85	0.43
MEAN DRAFT :		8 Mtrs	8.5	0.96	0.48
			9	1.08	0.54
DATA INPUT ONLY IN WHITE CELLS ONLY			9.5	1.20	0.60
			10	1.33	0.67

Data regarding the general maneuverability of the vessel such as: length, beam, and draft can be obtained from the squat excel sheet in the voyage plan

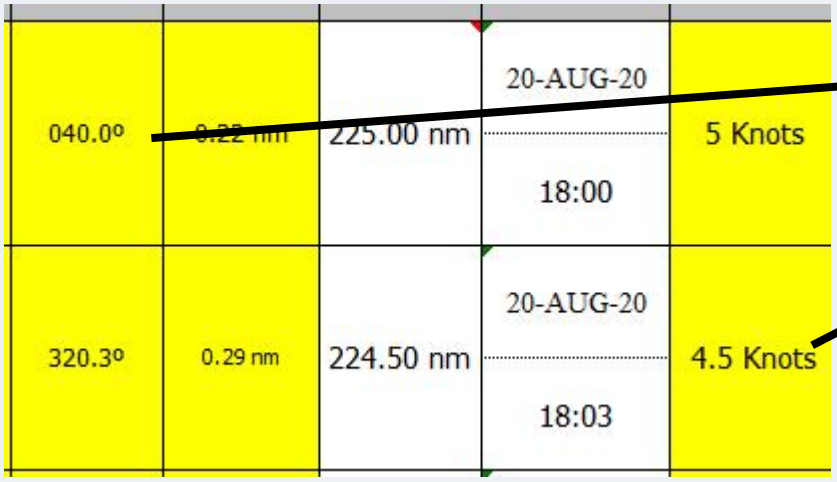
CONSTANT RUDDER ANGLE TURN Larger drift angle with a corresponding loss of speed A large rudder angle is needed to steady the vessel on new course Uncertainty of ships position during the turn Higher fuel consumption due to zigzagging with excessive use of helm.



Data regarding the general maneuverability of the vessel taken from wheel house poster turning circles

CONSTANT RADIUS TURN Lesser drift angle & hence lesser loss of speed At the end of the turn, the new course can be steadied with lesser rudder angle Proper control of ships positionn. during the turn Lesser fuel consumption, with reserve rudder and engine power available Constant radius turn technique is based on the following formula: Rate of turn (Degrees/ minute) = 57.3 x V 60 R where V= Ships speed over ground, in knots and, R= Radius of the turn in nautical miles. The distance of wheel over point from the point where the turn is to become effective is usually taken as one ships length but it is recommended to find it out by some practice turns on the type of ship one is serving. The distance of wheel over point from the point where the turn is to become effective is usually taken as one ships length but it is recommended to find it out by some practice turns on the type of ship one is serving. Following formula can be used to find the distance of wheel over line from the new course line and the same can be used to set the parallel indexing line or the line of turn for giving the wheel over order: Distance of wheel over line from the new course line = F sin + R (1 cos) where, F = one ships length (usually), R = Radius of the turn.

Consequently, the main data needed for the radius of turn is the rate of turn and the speed of the vessel in the particular leg. The speed can also be obtaining in the excel form of the voyage plan (at the voyage plan sheet).



Data regarding the vessel's movements such as: speed and course can be obtained from the voyage excel sheet in the voyage plan

WHEEL OVER POSITION: D P Course Alteration F W/O R Centre Old Course F = Head Reach Distance traveled by vessel after giving wheel over & before commencing turn, i.e. distance to overcome inertia. P = Perpendicular distance from wheel over point to new course extension. D + P = Parallel Index distance at W/O position. D = Parallel Index distance from new course, as obtained from chart. R = Radius of turn. = Change of course angle. TO FIND & MARK APPROX. W/O POSITION: F = 0.1 to 0.15 NM P = R(1-Cos) = F Sin Rate of turn = (V / R) x 0.96 where V = speed of vessel Distance to new course = Radius x Tan /2.

First the Master of the vessel has to decide the radius of turn required, depending on the maneuvering characteristics of the vessel & available sea room this can be added manually. A reference point such as an island, buoy, etc. can be also used to decide the radius of turn. Wheel over point = F + Distance to new course Distance to new course can be found by the above formula. Once the Master has decided on the radius of turn, a tabular ready reckoner may be prepared for various course change angles.

The below W/P shall cover the passage FROM BERTH TO BERTH

W/P No.	W/P Ref./Name	Lat/Long	Alter Course to	Distance to next W/P	Distance to GO (berth to berth)	Anticipated Date-Time	Planned safe speed	Manual position plot method	Manual position plot Intervals	B.W.S	ECDIS CAT ZOC	SHALLOW OR DEEP WATERS	Safety Depth(*)	Safety Frame Looking Ahead Distance	Min. Expected Depth / Echo Sounder On-Off	Max Allowable off track Margins (ECDIS XTD)	MARSEC LEVEL	ROT-W/O
1	Berth No.1 - Guaraguao Terminal	10º 14.49' N 064º 37.88' W	050.0º	0.22 nm	225.00 nm	20-AUG-20 18:00	3.5 Knots	Terrestrial	1 Hr	II	6 stars / A1	SHALLOW	10 Mtrs	Ahead 2 min P&S 0,1 nm,	17.6 Mtrs On	150 m		15 -0.128 nm

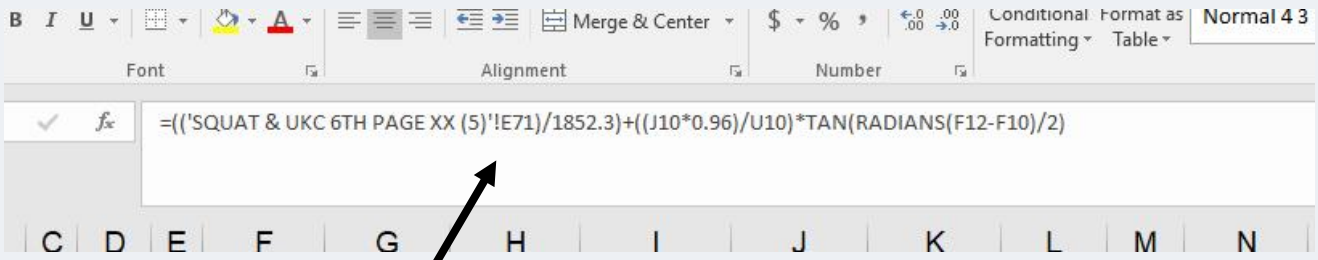
Rate of turn pre-determined by the master, depending on each leg of the voyage

Therefore, all the necessary information that required to obtain a well-calculated wheel over turn are readily available in the same form.

WHAT DO WE NEED:

Length of the vessel
Current and next course
Speed of the vessel
Radious of turn

And finally and combined accurate calculation that can only change automatically when some of the main parameters of the equation change.



Calculation formula applied on cell for wheel over calculation on each leg.

THE PROPOSAL

The final proposal is to add the calculation in the voyage plan and the function in each cell of the waypoints themselves. The outcome will be the wheel over calculation itself after manually applying the rate of turn according to master's discretion in each leg of the voyage.

Max.Draft :	8.00 M	Dist. Berth to Berth :	225 n.m.
Date :	20-AUG-20	Dist Pilot to Pilot :	221 n.m.

Manual position plot Intervals	B.W.S	ECDIS CAT ZOC	SHALLOW OR DEEP WATERS	Safety Depth(*)	Safety Frame Looking Ahead Distance	Min. Expected Depth / Echo Sounder On-Off	Max Allowable off track Margins (ECDIS XTD)	MARSEC LEVEL	ROT-W/O
1 Hr	II	6 stars / A1	SHALLOW	10 Mtrs	Ahead 2 min P&S 0,1 nm,	17.6 Mtrs On	150 m	I	10 -0.306 nm
1 Hr	II	6 stars / A1	SHALLOW	10 Mtrs	Ahead 12 min P&S 0,1 nm,	16.8 Mtrs On	80 m	I	10 m -0.134 nm

Automatic calculation of the Wheel over position

After the Rate of turn pre-determined by the master, depending on each leg of the voyage the calculation of the wheel over position is automatically shown in the form. Based upon instructions obtained from the Master prior departure from any port prepares the “voyage plan” for the entire voyage and lay-out on the appropriate charts the courses and other useful navigational information. Below is a simple example of applying the information from the voyage plan directly on ECDIS for the OOW to be aware of prior any alteration of course.