

# MEC-E1004 Principles of Naval Architecture

## Defining Hull Lines and Sectional Area Curve



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# Defining the hull form in 2D

## Tips before modelling



This tutorial explain how to use the excel sheet in defining the hull lines and sectional area curves.



By this stage the main dimensions of your ship should be defined.



Frame spacing must be defined along  $L_{pp}$  (x-direction) into 10 frames.

# Input Main Data

- The Vessel type, Lpp, B, T, D and Speed (V) need to be input first in the Main Data Sheet. These are coloured in red.

Ship type:	Passenger Ferry, 2 propellers		
Loa	144,5	[m]	From lines
Lpp	135,0	[m]	Given data
Lwl	140,4	[m]	From lines
B	25,0	[m]	Given data
T	5,5	[m]	Given data
D	14,0	[m]	Given data
Displacement Volume (Vol):	11 965	[m <sup>3</sup> ]	Hull + Skeg
Displacement Weight ( Displ)	12 265	[ton]	1,025*Vol
Hull Volume to Upper Deck	39442	[m <sup>3</sup> ]	
Speed (V):	19,0	[kn]	Given data
Froude Nr. (Fn):	0,26		

# Defining Stern and Bow profile

- Define the stern and bow profile in the Non-dimensional water line data table in the Offset Tables sheet.(marked in red)
- The CL-buttock is needed if the hull lines are defined without a CL-skeg. This simplifies the aft hull lines for slender hull forms.
- The x coordinates are  $x/L_{pp}$ , y coordinates are  $y/(B/2)$  and z coordinates are  $z/T$

Water Line Data (Non-Dimensional)																	
	z	Stern-profile		CL-buttock	Fr 0	Fr 1	Fr 2	Fr 3	Fr 4	Fr 5	Fr 6	Fr 7	Fr 8	Fr 9	Fr 10	Bow-profile	
		x	y		0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	x	y
Upper Dk	2,55	-0,040	0,950		0,99	1	1	1	1	1	1	1	1	0,89	0,5	1,030	0,2
WL 8	2,16	-0,038	0,940		0,987	1	1	1	1	1	1	1	0,99	0,82	0,35	1,022	0,12
WL 7	1,77	-0,035	0,910		0,96	1	1	1	1	1	1	1	0,96	0,74	0,2	1,013	0,06
WL 6	1,39	-0,030	0,750		0,84	0,97	1	1	1	1	1	1	0,9	0,63	0,08	1,006	0,02
CWL	1,00	-0,025	0,000	-0,025	0,4	0,87	0,985	1	1	1	1	0,98	0,82	0,49	0	1,000	0
WL 4	0,80	0,032	0,000	0,040	-0,4	0,65	0,93	0,997	1	1	1	0,95	0,76	0,41	0,01	1,000	0
WL 3	0,60	0,038	0,000	0,090	-1	0,2	0,8	0,98	1	1	0,99	0,9	0,67	0,33	0,06	1,008	0,04
WL 2	0,40	0,040	0,000	0,120	-2	-0,2	0,58	0,93	0,995	0,995	0,96	0,82	0,56	0,24	0,07	1,015	0,05
WL 1	0,20	0,040	0,000	0,150	-2	-0,5	0,33	0,8	0,97	0,97	0,88	0,69	0,4	0,14	0,06	1,015	0,04
WL 1/2	0,10	0,040	0,000	0,170	-2	-0,7	0,13	0,67	0,93	0,93	0,8	0,55	0,28	0,08	0,04	1,013	0,03
WL 1/10	0,01	0,040	0,000	0,200	-2	-1	-0,15	0,47	0,84	0,84	0,65	0,36	0,14	0,015	0,01	1,000	0,001
Flat Botto	0,00	0,040	0,000	0,220	-2	-1	-0,2	0,45	0,8	0,8	0,63	0,35	0,13	0,01	0	0,980	0
CL	0,00									0							0

# Defining Stern and Bow profile

- You can see the forms for both in the Profile graph on the Form sheet.
- The horizontal lines are the waterlines in the profile view which are drawn from the table in Form Sheet

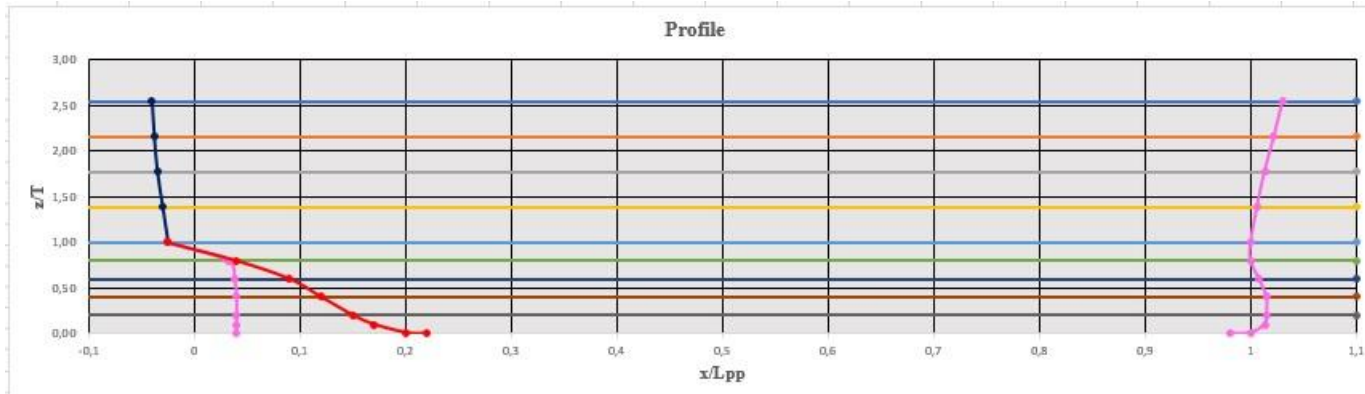


Table for marking waterlines		
	$x/L_{pp}$	$z/T$
Upper Dk	-1,1	2,55
	1,1	2,55
WL 8	-1,1	2,16
	1,1	2,16
WL 7	-1,1	1,77
	1,1	1,77
WL 6	-1,1	1,39
	1,1	1,39
CWL	-1,1	1,00
	1,1	1,00
WL 4	-1,1	0,80
	1,1	0,80
WL 3	-1,1	0,60
	1,1	0,60
WL 2	-1,1	0,40
	1,1	0,40
WL 1	-1,1	0,20
	1,1	0,20

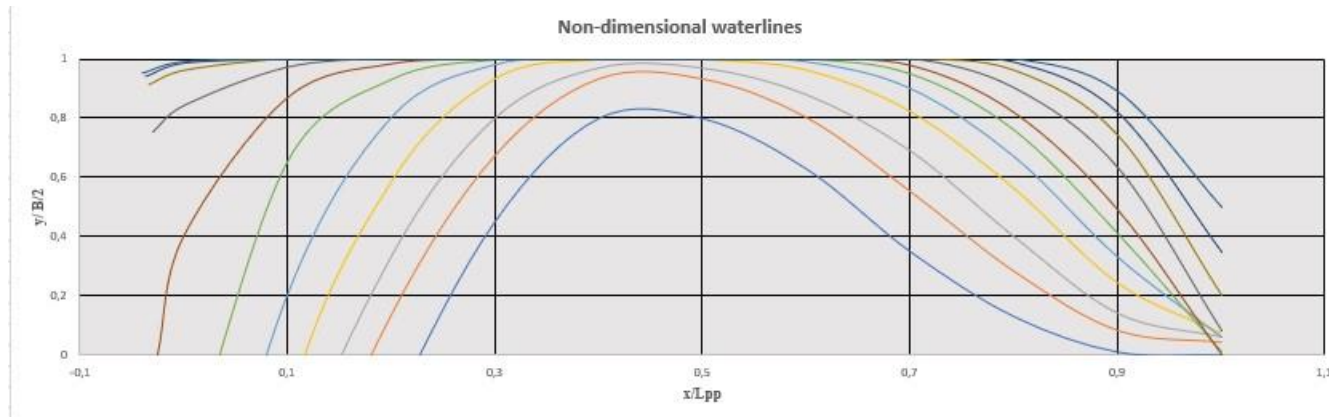
# Defining the half breadths

- Define the non-dimensional half breadths for each of the frames co-inciding with the correct waterlines ( $y/(B/2)$ ) where  $y$  are the half-breadths.(marked in red)
- These half breadths are used to plot the Non-dimensional waterline and Frame Section on the Form sheet.

Water Line Data (Non-Dimensional)																	
	z	Stern-profile		CL- buttock	Fr 0	Fr 1	Fr 2	Fr 3	Fr 4	Fr 5	Fr 6	Fr 7	Fr 8	Fr 9	Fr 10	Bow-profile	
		$\kappa$	y													$\kappa$	y
Upper Dk	2,55	-0,040	0,950		0,99	1	1	1	1	1	1	1	1	0,89	0,5	1,030	0,2
WL 8	2,16	-0,038	0,940		0,987	1	1	1	1	1	1	1	0,99	0,82	0,35	1,022	0,12
WL 7	1,77	-0,035	0,910		0,96	1	1	1	1	1	1	1	0,96	0,74	0,2	1,013	0,06
WL 6	1,39	-0,030	0,750		0,84	0,97	1	1	1	1	1	1	0,9	0,63	0,08	1,006	0,02
CWL	1,00	-0,025	0,000	-0,025	0,4	0,87	0,985	1	1	1	1	0,98	0,82	0,49	0	1,000	0
WL 4	0,80	0,032	0,000	0,040	-0,4	0,65	0,93	0,997	1	1	1	0,95	0,76	0,41	0,01	1,000	0
WL 3	0,60	0,038	0,000	0,090	-1	0,2	0,8	0,98	1	1	0,99	0,9	0,67	0,33	0,06	1,008	0,04
WL 2	0,40	0,040	0,000	0,120	-2	-0,2	0,58	0,93	0,995	0,995	0,96	0,82	0,56	0,24	0,07	1,015	0,05
WL 1	0,20	0,040	0,000	0,150	-2	-0,5	0,33	0,8	0,97	0,97	0,88	0,69	0,4	0,14	0,06	1,015	0,04
WL 1/2	0,10	0,040	0,000	0,170	-2	-0,7	0,13	0,67	0,93	0,93	0,8	0,55	0,28	0,08	0,04	1,013	0,03
WL 1/10	0,01	0,040	0,000	0,200	-2	-1	-0,15	0,47	0,84	0,84	0,65	0,36	0,14	0,015	0,01	1,000	0,001
Flat Botto	0,00	0,040	0,000	0,220	-2	-1	-0,2	0,45	0,8	0,8	0,63	0,35	0,13	0,01	0	0,980	0
CL	0,00									0							0

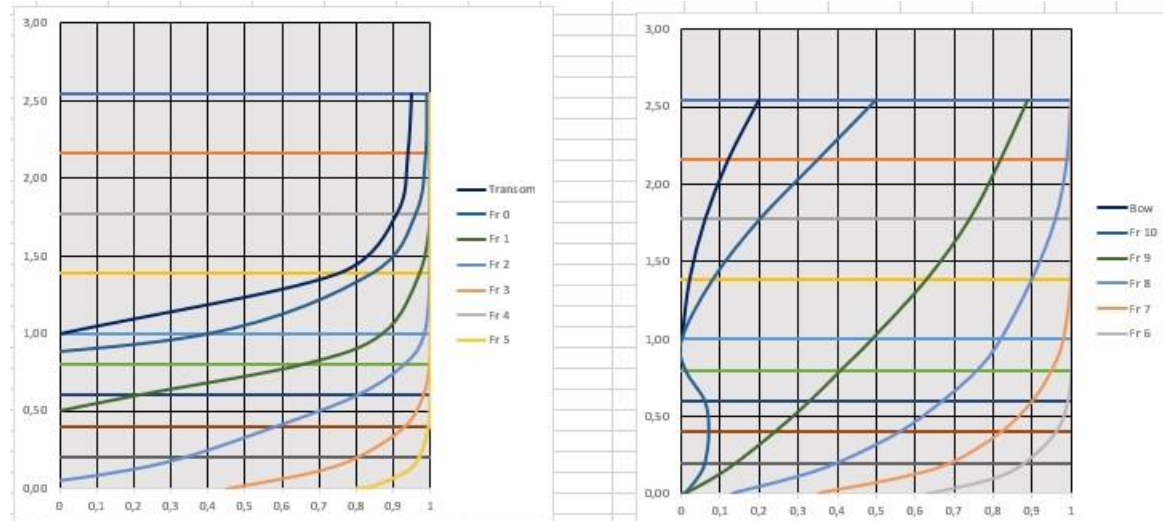
# Defining the half breadths

- The waterline curves are defined by taking each frame into consideration.
- The fairness of the waterlines must be checked



# Defining the half breadths

- The frame sections are defined by taking each frame into consideration.
- The fairness of the frame section must be checked.





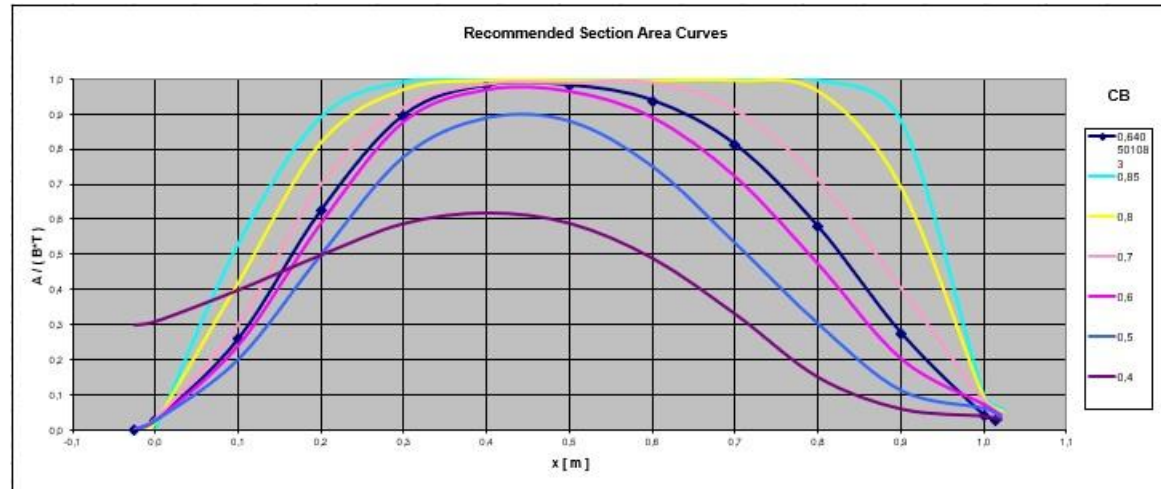
# Sectional Area Curves

- Next step is to check the CB and LCB in the SAC sheet. These values must be in the required range for the type of ship being designed.
- The SAC curve plotted must be checked with the recommended curves.

		Section Areas [SB•BB] [ m <sup>2</sup> ]												Bulb	Hull Vol	CB	LCB	Am
	Transom	Fr 0	Fr 1	Fr 2	Fr 3	Fr 4	Fr 5	Fr 6	Fr 7	Fr 8	Fr 9	Fr 10	Bow	[m <sup>3</sup> ]		[%]	[m <sup>2</sup> ]	
CwL	0	4	35	86	123	135	135	129	112	79	38	6	4	11889	0,641	-0,32%	135	
Upper Dk	169	192	244	298	336	347	347	341	324	280	191	52	16	39370			347	

# Sectional Area Curves

- If the SAC is not appropriate changes must be made to the Offset Tables sheet to have the fair form.



# Hull Lines

- After the SAC is correct the dimensional hull lines in the Lines Sheet need to be checked. They are plotted by the dimensional table which depends on the Non-dimensional table. The axes should be adjusted accordingly.

Water Line half breadth (m)																		
	Stern-profile			CL-	Fr0	Fr1	Fr2	Fr3	Fr4	Fr5	Fr6	Fr7	Fr8	Fr9	Fr10	Bow-profile		
	z	x	y	buttack	0	13,5	27	40,5	54	67,5	81	94,5	108	121,5	135	x	y	
Upper Dk	14,00	-5,4	11,875	0	12,375	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	11,125	6,25	139,05	2,5	
WL 8	11,875	-5,13	11,75	0	12,3375	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,375	10,25	4,375	137,97	1,5
WL 7	9,75	-4,725	11,375	0	12	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12,5	12	9,25	2,5	136,755	0,75
WL 6	7,625	-4,05	9,375	0	10,5	12,125	12,5	12,5	12,5	12,5	12,5	12,5	11,25	7,875	0	135,81	0,25	
CWL	5,5	-3,375	0	-3,375	5	10,875	12,3125	12,5	12,5	12,5	12,5	12,25	10,25	6,125	0	135	0	
WL 4	4,4	4,32	0	5,4	-5	8,125	11,625	12,4625	12,5	12,5	12,5	11,875	9,5	5,125	0,125	135	0	
WL 3	3,3	5,13	0	12,15	-12,5	2,5	10	12,25	12,5	12,5	12,375	11,25	8,375	4,125	0,75	136,08	0,5	
WL 2	2,2	5,4	0	16,2	-2,5	-2,5	7,25	11,625	12,4375	12,4375	12	10,25	7	3	0,875	137,025	0,625	
WL 1	1,1	5,4	0	20,25	-2,5	-6,25	4,125	10	12,125	12,125	11	8,625	5	1,75	0,75	137,025	0,5	
WL 1/2	0,55	5,4	0	22,95	-2,5	-8,75	1,625	8,375	11,625	11,625	10	6,875	3,5	1	0,5	136,755	0,375	
WL 1/10	0	5,4	0	27	-2,5	-12,5	-1,875	5,875	10,5	10,5	8,125	4,5	1,75	0,1875	0,125	135	0,0125	
Flat Buttack	0	5,4	0	29,7	-2,5	-12,5	-2,5	5,625	10	10	7,875	4,375	1,625	0,125	0	132,3	0	
CL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

# Hull Lines

- **To make these lines final the Non-dimensional table needs to be adjusted accordingly and the Form Frames should be adjusted so that both the sections and the waterlines are correct.**