MEC-E1004 Principles of Naval Architecture

Section modulus Calculations

Aalto University
School of Engineering

Determining main dimensions

Tips before going to calculations

- Make sure you have the scantlings and the dimensions of the ship section ready
- Be careful of the units used in defining scantlings and during calculations
- For simplicity, we do not consider any stiffeners

Define Scantlings

- **Define the dimensions of the plating.**
  - The breadth is the dimension parallel to the NA.
  - The depth is the dimension perpendicular to the NA.
- **Then define the number of each component.**

Item	Number of parts	Breadth	Depth	Height	Area	1. Moment	2nd Moment @ centroid	2nd moment @BL
	n	b	d	h_j	A=n*b*d	S=A*h_j	i=n*b*h3/12	I_S=A*h_j^2
[-]	[-]	[m]	[m]	[m]	[m^2]	[m^3]	[m^4]	[m^4]
Tank Bottom	1	17,955	0,012	0,006	0,215	0,001	2,59E-06	7,76E-06
Tank top	1	17,955	0,009	1,196	0,162	0,193	1,09E-06	2,31E-01
Deck	1	17,955	0,009	8,996	0,162	1,454	1,09E-06	1,31E+01
Outer shell	2	0,009	9,000	4,5	0,162	0,729	1,09E+00	3,28E+00
Inner shell	2	0,009	9,000	4,5	0,162	0,729	1,09E+00	3,28E+00
Long. bulkhead	1	0,009	9,000	4,5	0,081	0,365	5,47E-01	1,64E+00
				Σ	0,944	3,471	2,734	21,508

Height (hj)

- **Define the height of each component's centroid above the baseline.**
- **For instance, the side shell in the figure has (h) above BL equal to its half length+the thickness of the bottom plate.**

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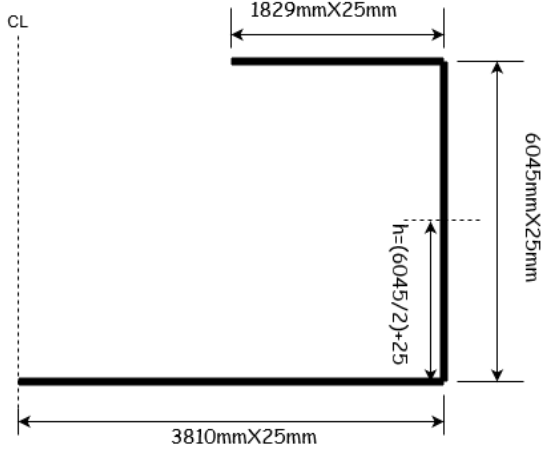

2nd moment of area @centroid (i)

- **Calculate the area moment of inertia of each component about its centroid.**
- **For rectangular cross-sections (e.g. plates) i=breadthxdepth^3/12**

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	n	b	d	h_j	A=n*b*d	S=A*h_j	i=n*b*h3/12	I_S=A*h_j^2
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Bending moment (M); ship depth

- **Insert the bending moment of the ship section considered.**
- **Insert the height of the deck above the baseline (the ship's depth).**

Σ	0,944	3,471

Total cross-section		
Ship Depth D	9,00	m
Neutral axis	3,68	m from BL
Elements, $i_{,tot}$	2,73	m^4
Elements, $I_{S,tot}$	21,51	m^4
I_{BL}	24,24	m^4
I	11,48	m^4
Z_{deck}	2,156590303	m^3
Z_{bottom}	3,12075623	m^3

Load and response		
Moment	1,50E+08	Nm
σ_{deck}	69,55	MPa
σ_{bottom}	48,07	MPa

Results

- **The results you get in the spreadsheet are:**
  - The location of the neutral axis.
  - The sectional modulus at the deck and the bottom.
  - Stresses at the deck and the bottom.
  - The area moment of inertia of the ship section considered.

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