Universidade Federal de Pernambuco

DEMEC - Eng. Naval

Instruções para o projeto e análise da região de carga utilizando MEF

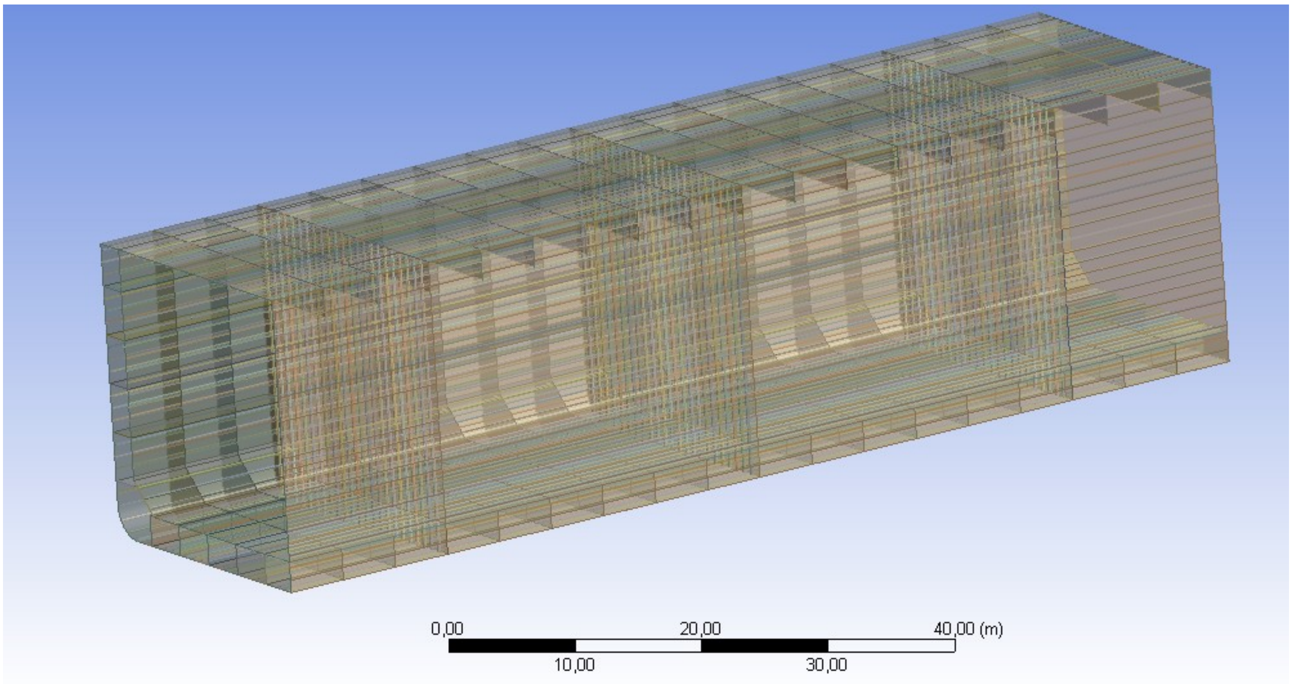
Prof. Adriano Dayvson Marques Ferreira

Recife, 2018

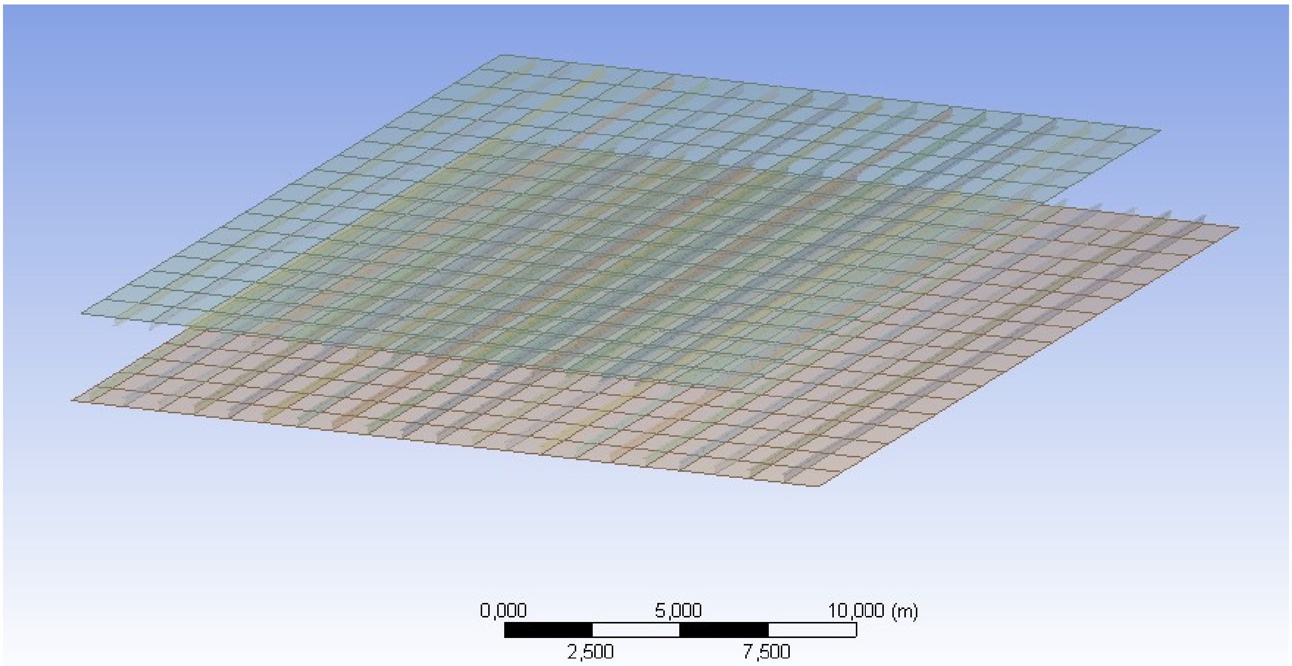
Sumário

1. Modelo Final

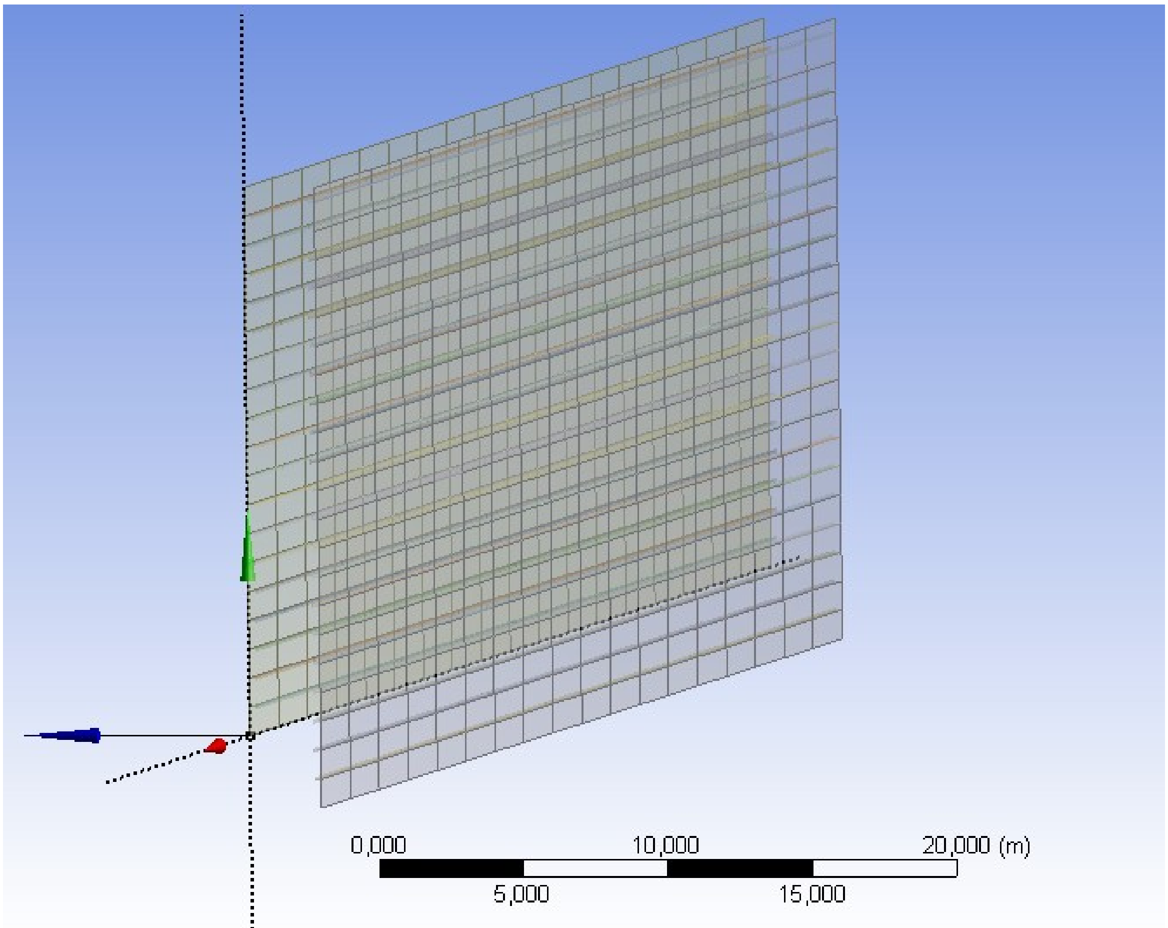
Estrutura englobando cavernas, costado duplo, fundo duplo, cavernas, atenparas, longarinas e escoas. As estruturas são compostas apenas por superfícies e linhas, nenhuma estrutura volumétrica deve ser modelada.
Obs – As anteparas nos extremos de vante e ré não necessitam de reforços, vão servir para aplicar o momento fletor.



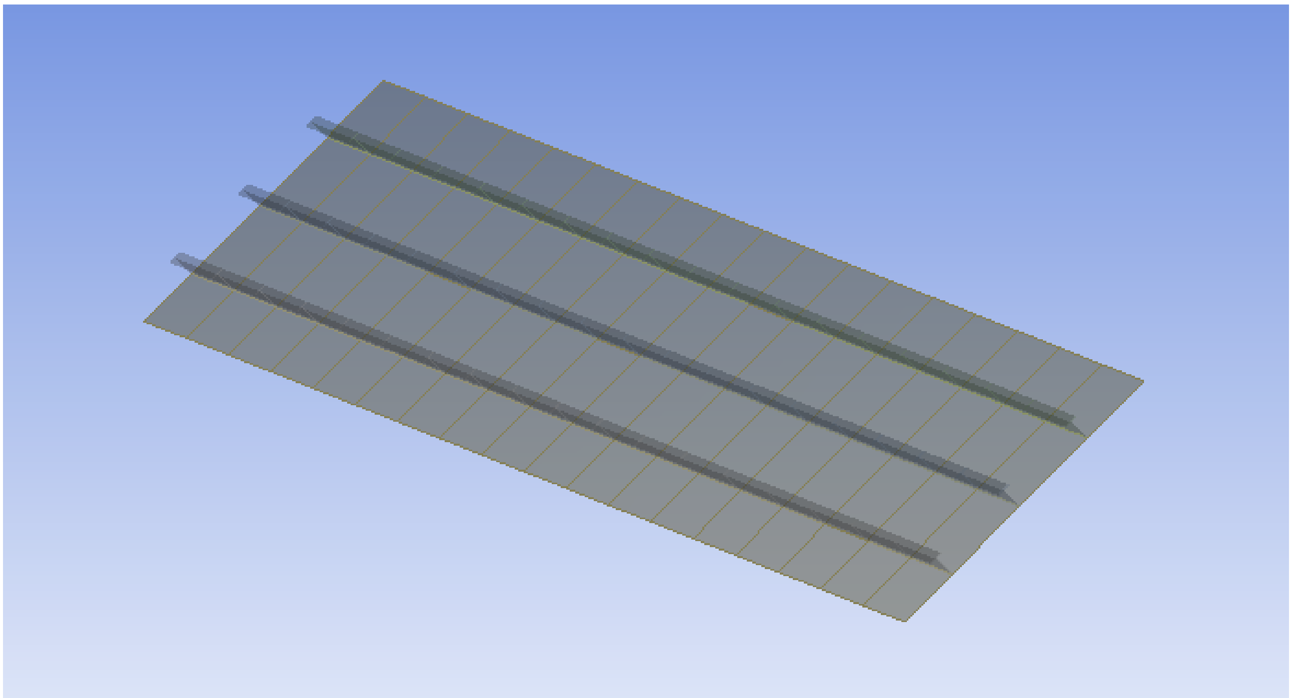
2. Painel de fundo e teto do fundo duplo



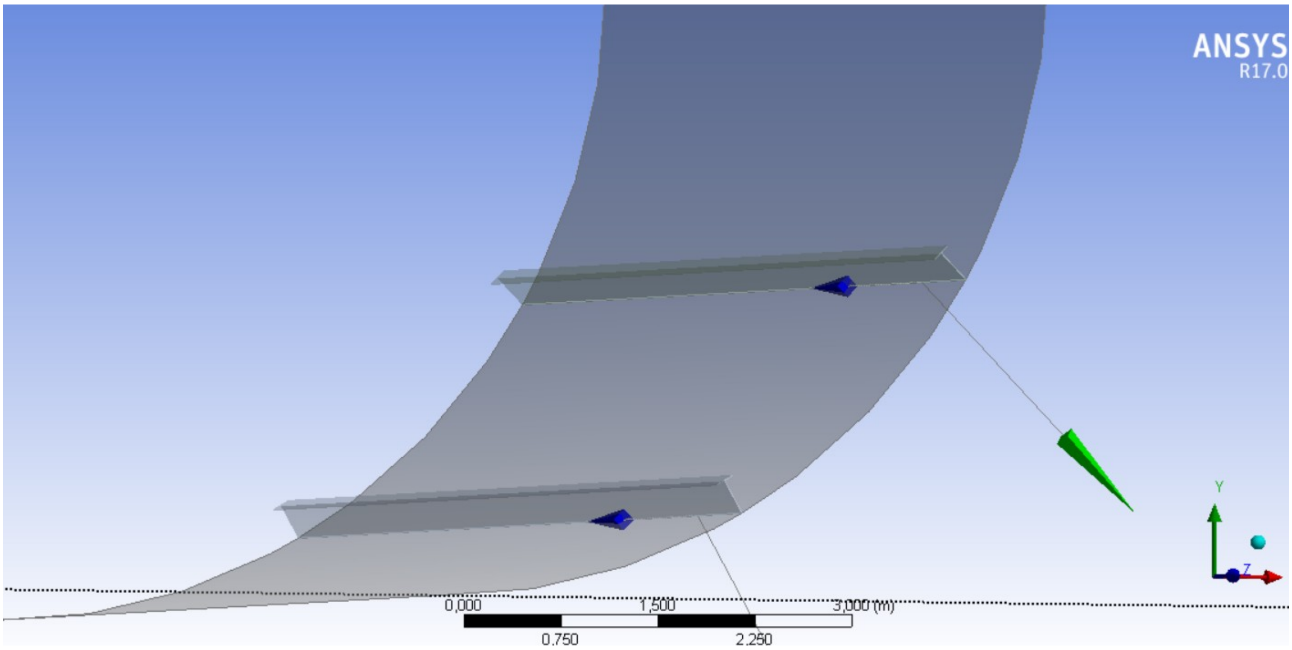
3. Costado interno e externo



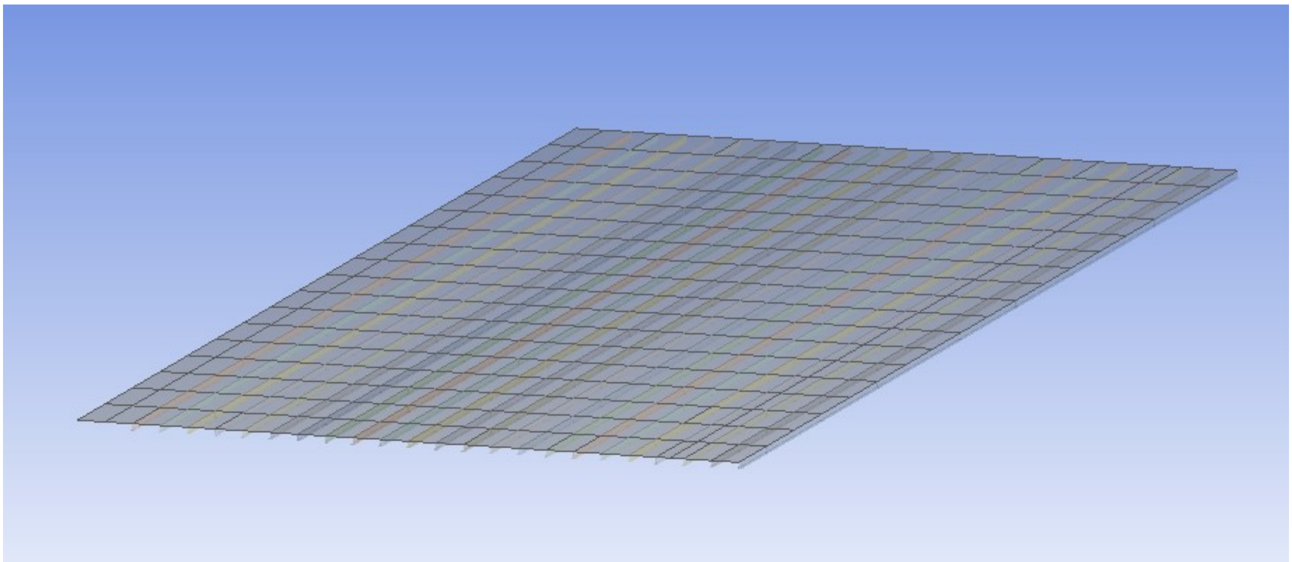
4. Hopper



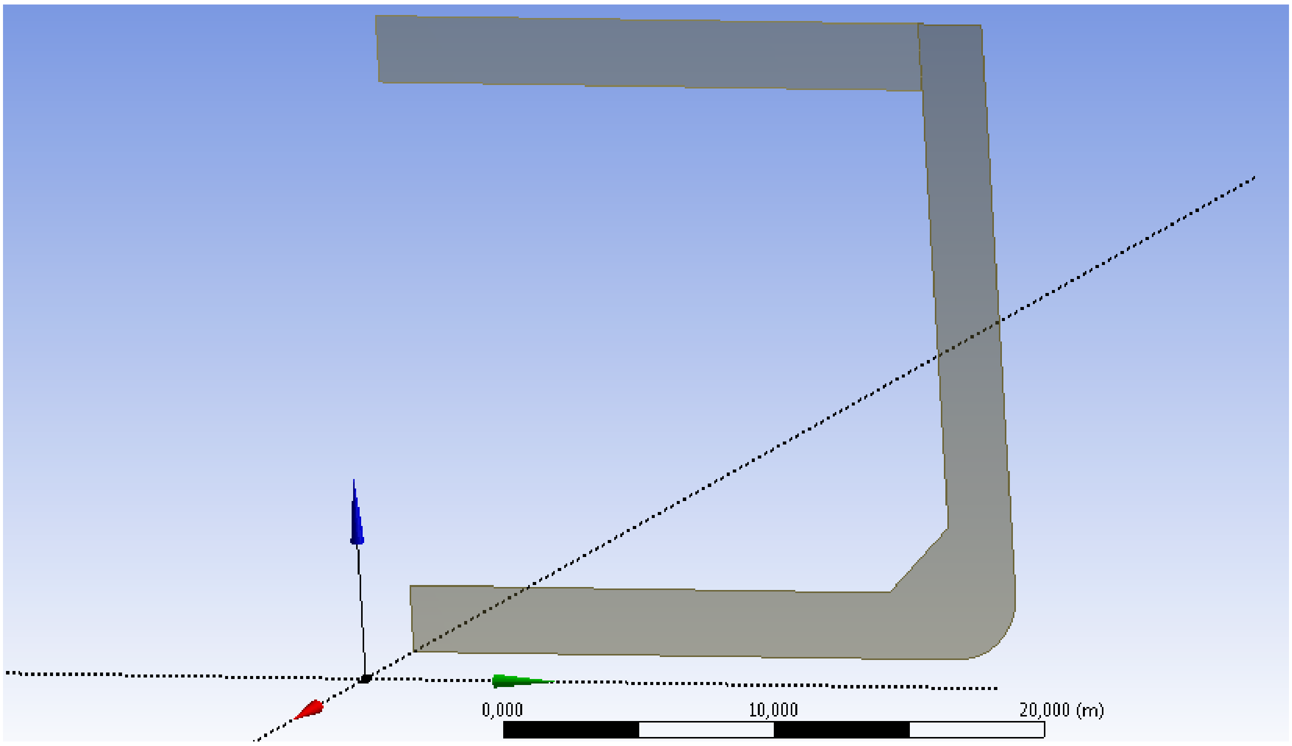
5. Bojo



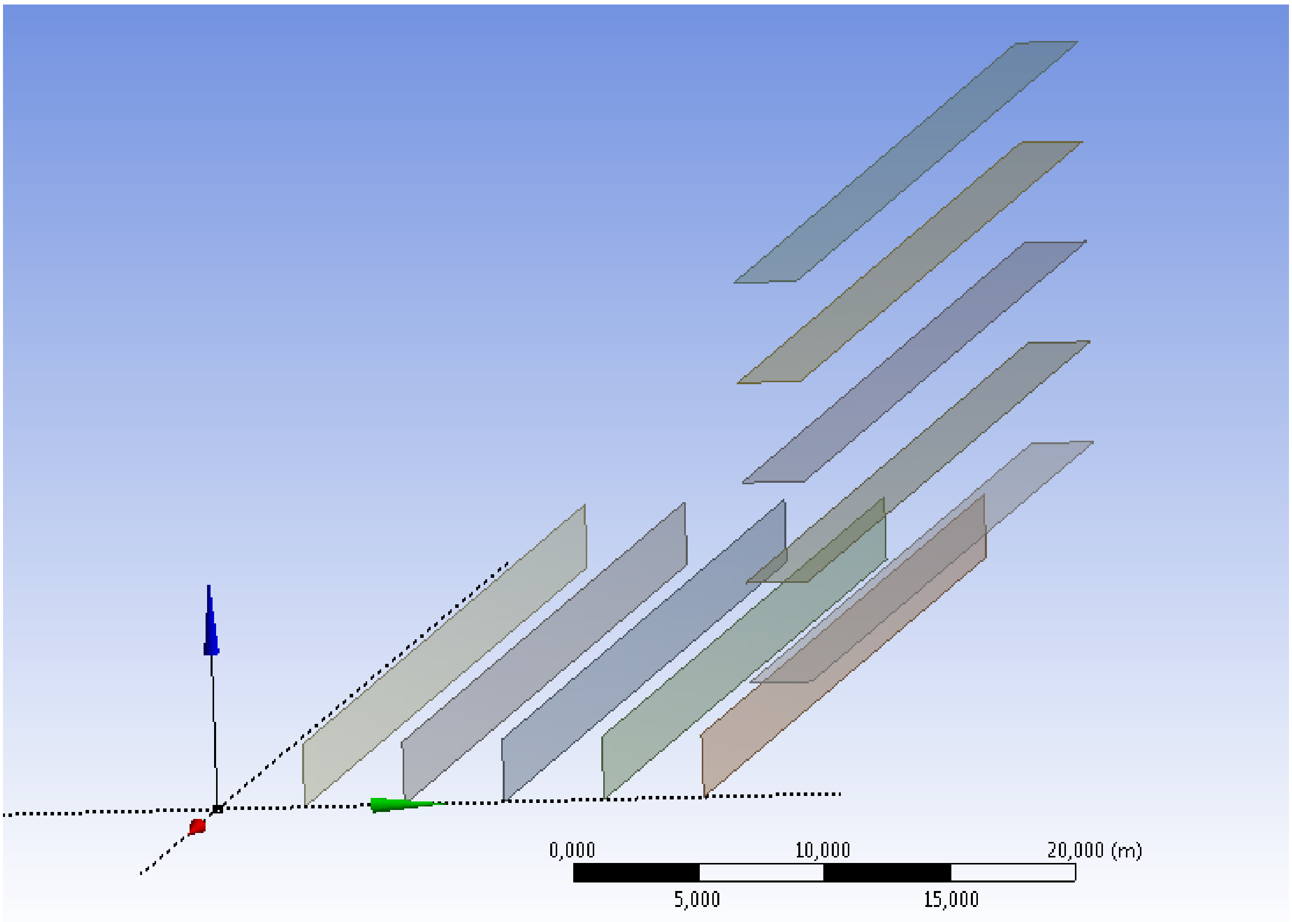
6. Convés



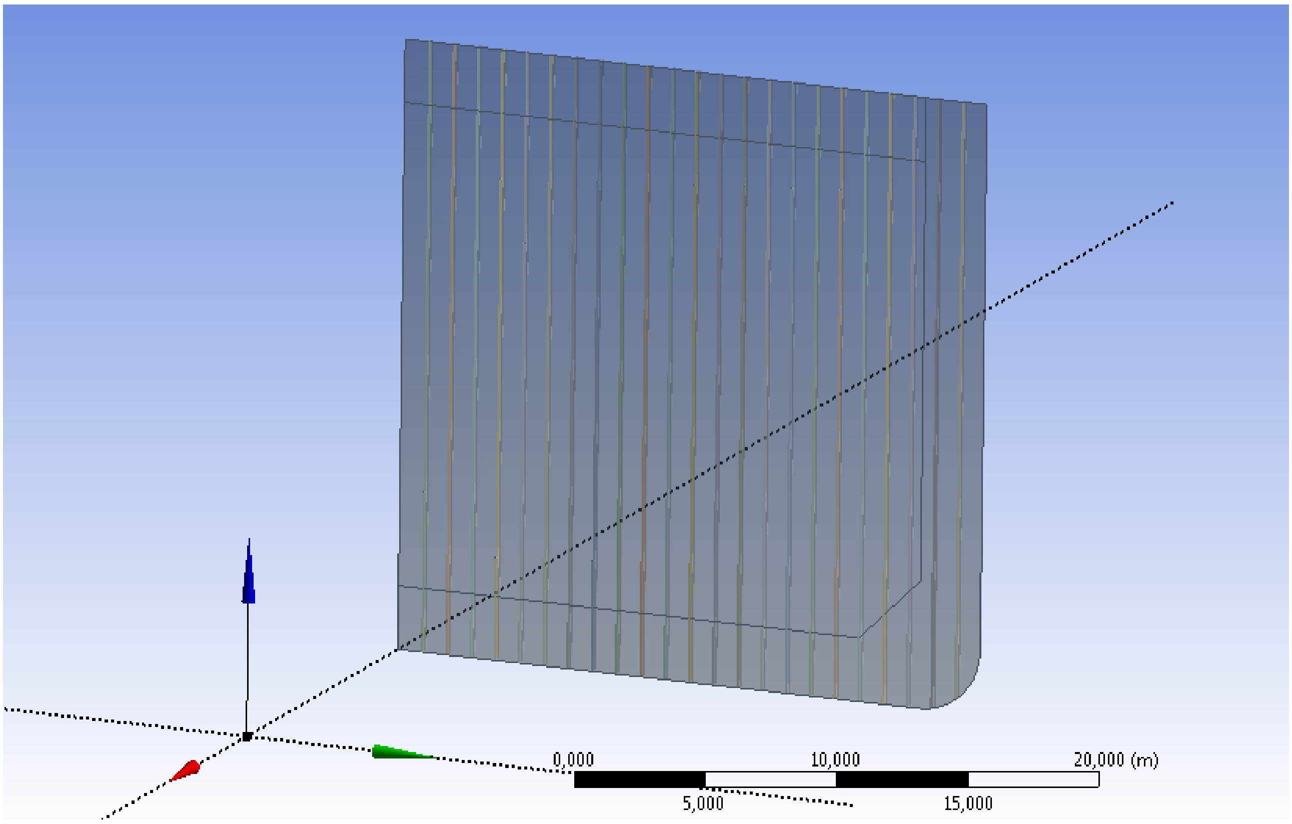
7. Caverna



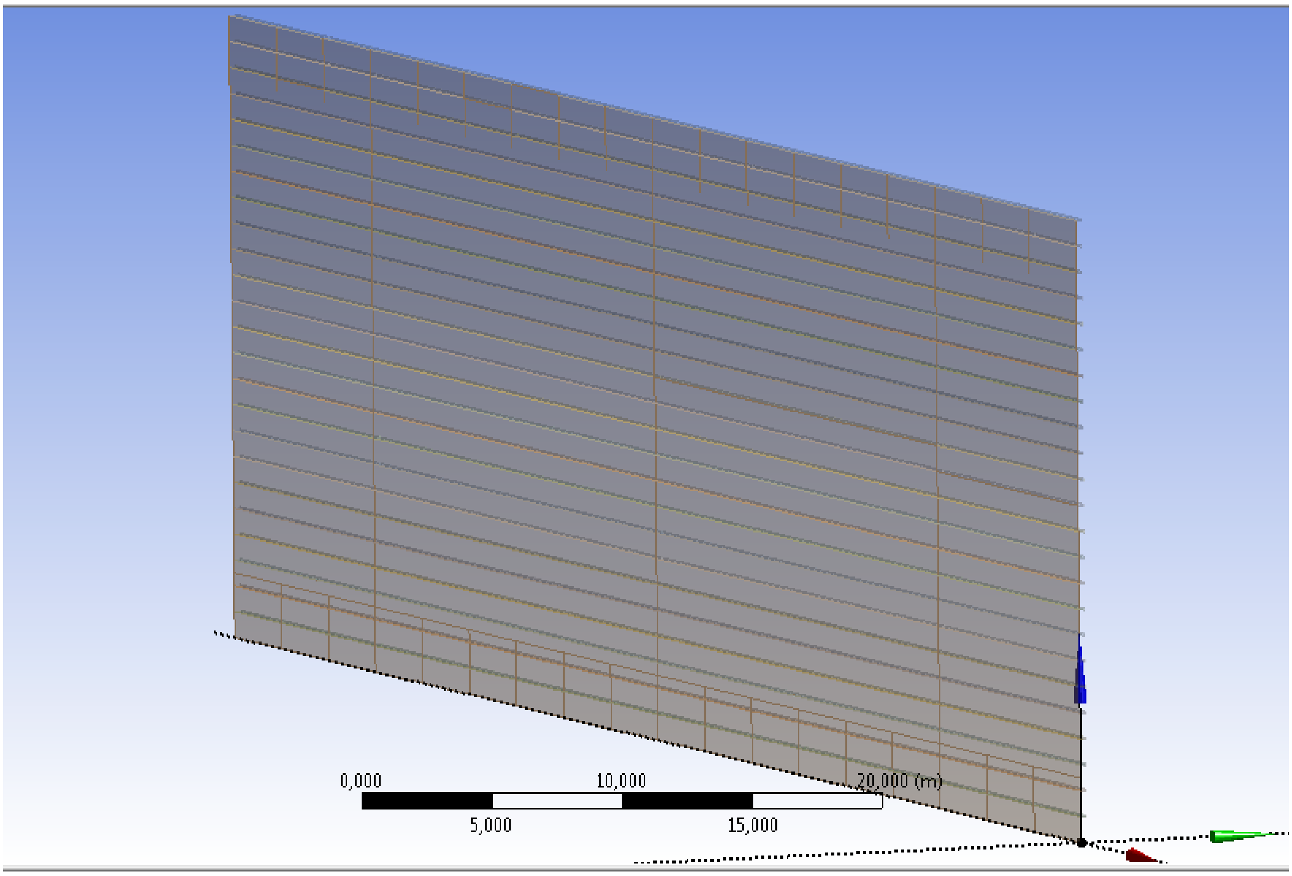
8. Longarinas e escoas



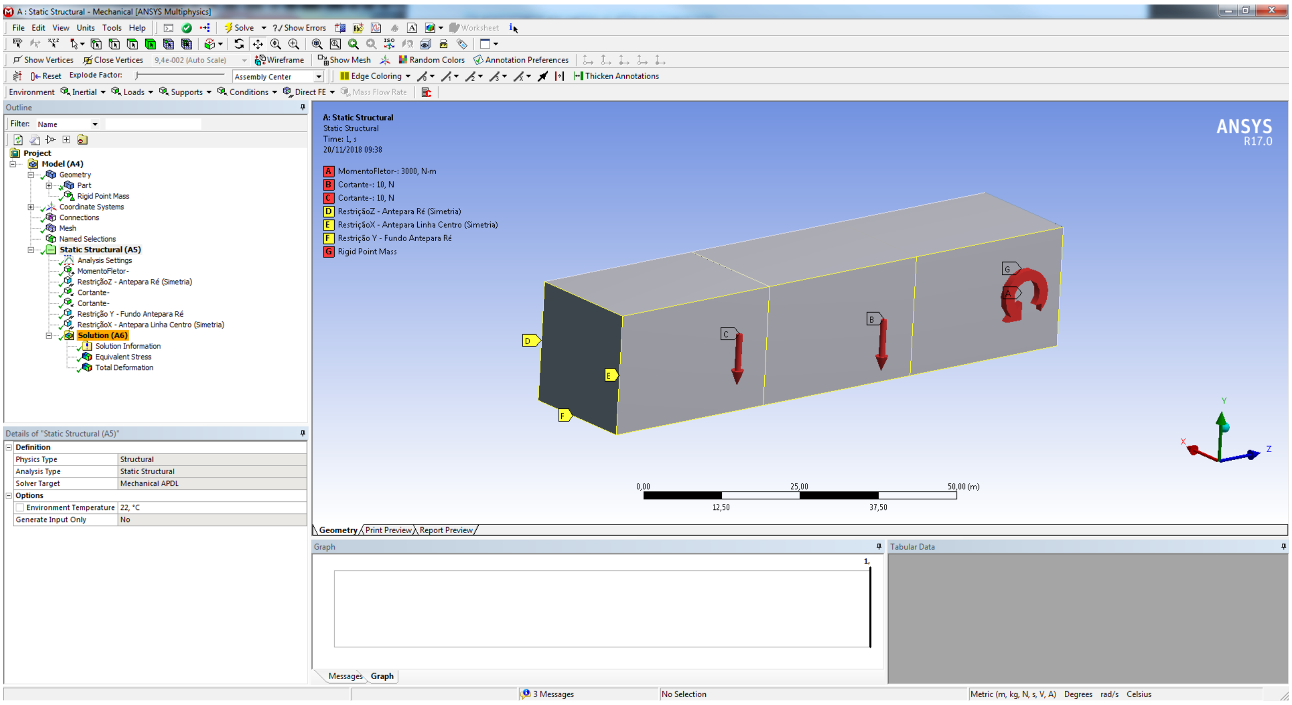
9. *Antepara transversal*



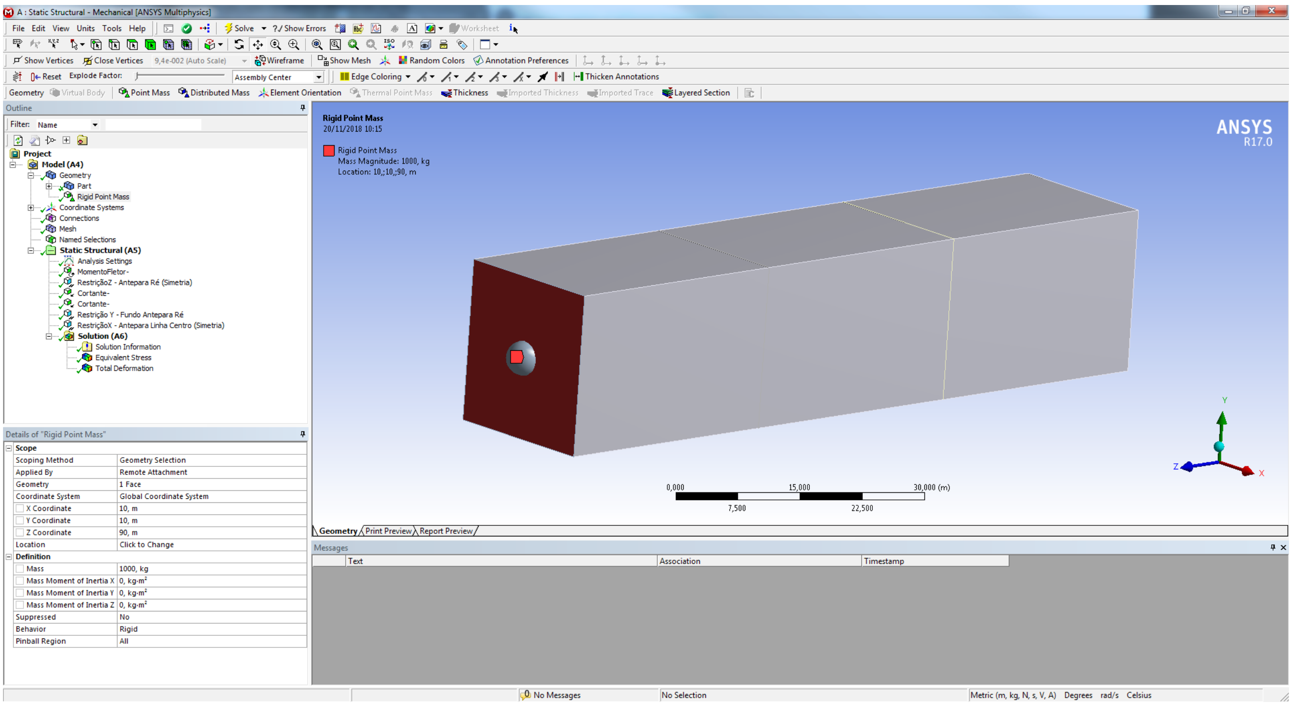
10. *Antepara longitudinal*



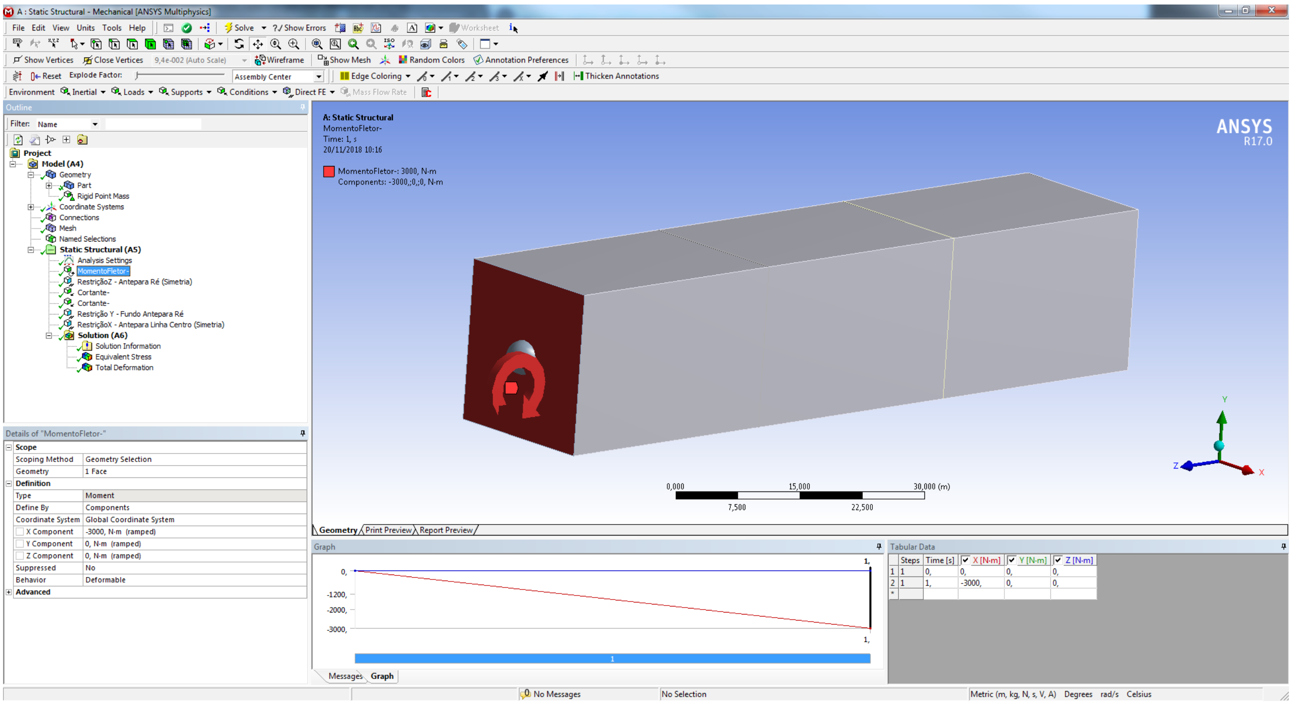
11. Condições de Contorno e Carregamento



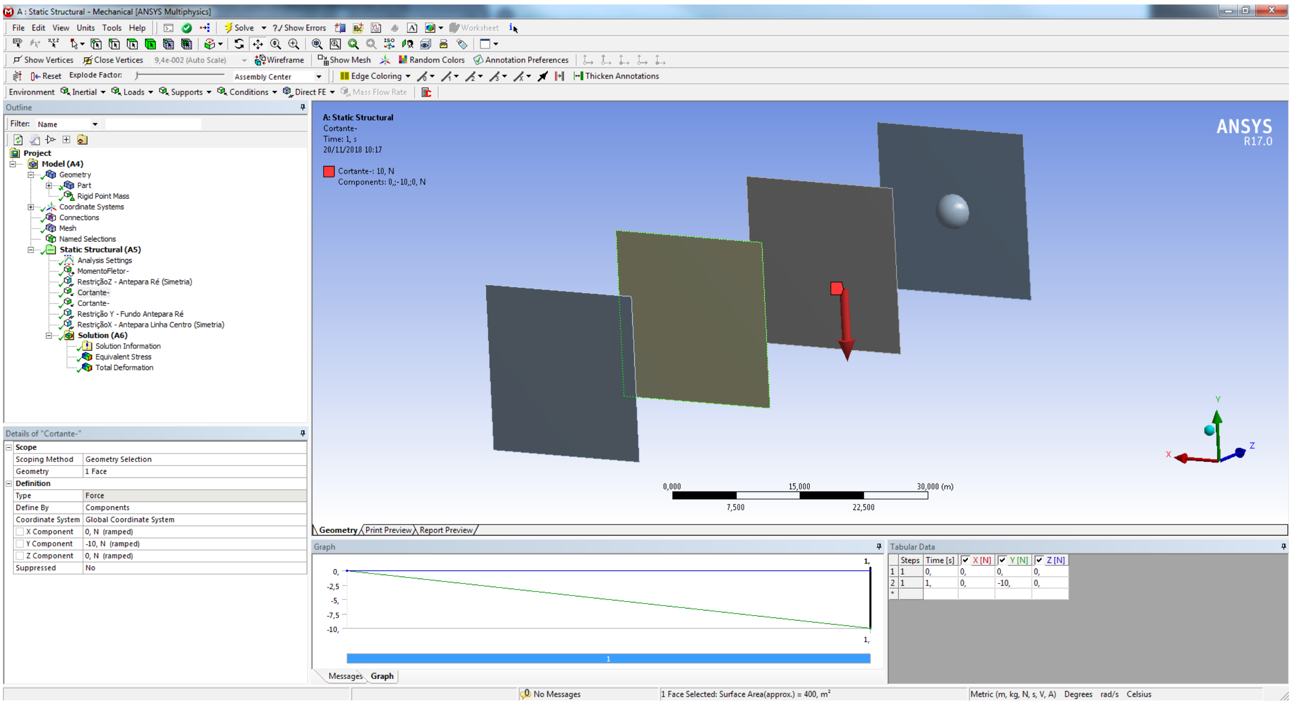
Aplicar ponto de massa rígido em uma das anteparas



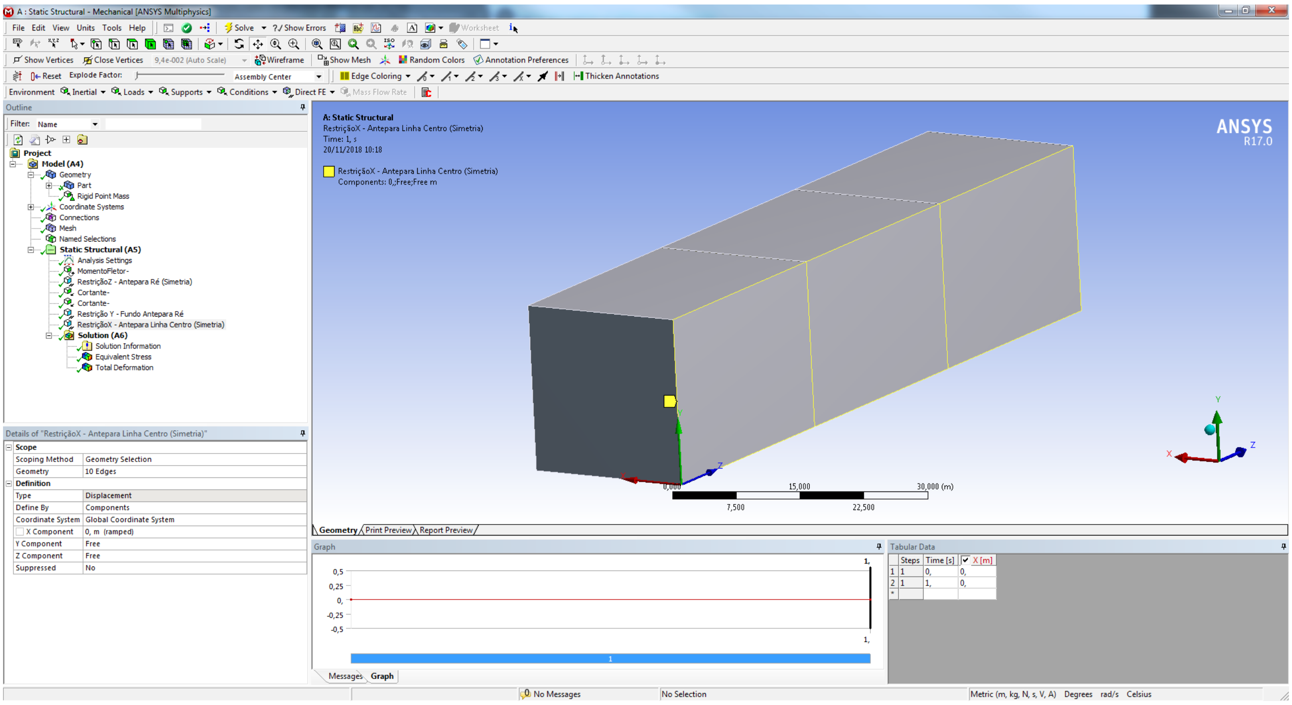
Aplicar o momento fletor calculado por norma na antepara



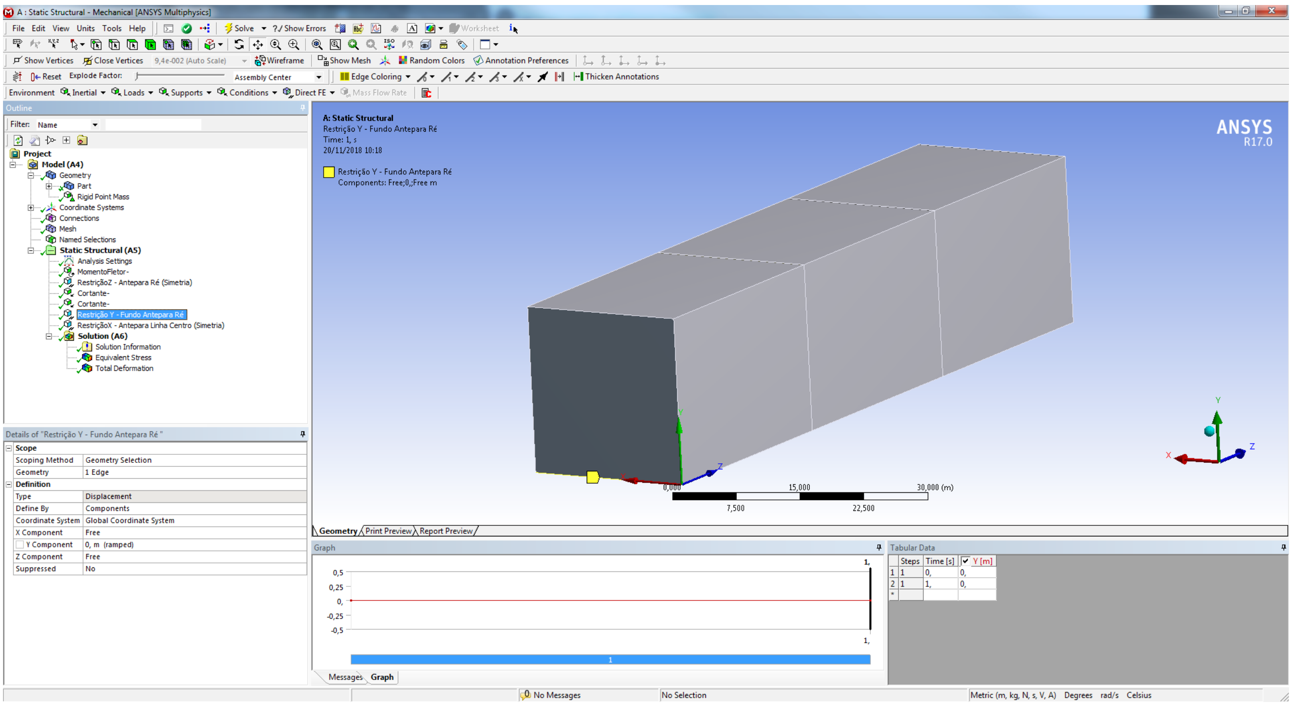
Aplicar momento fletor nas duas anteparas centrais



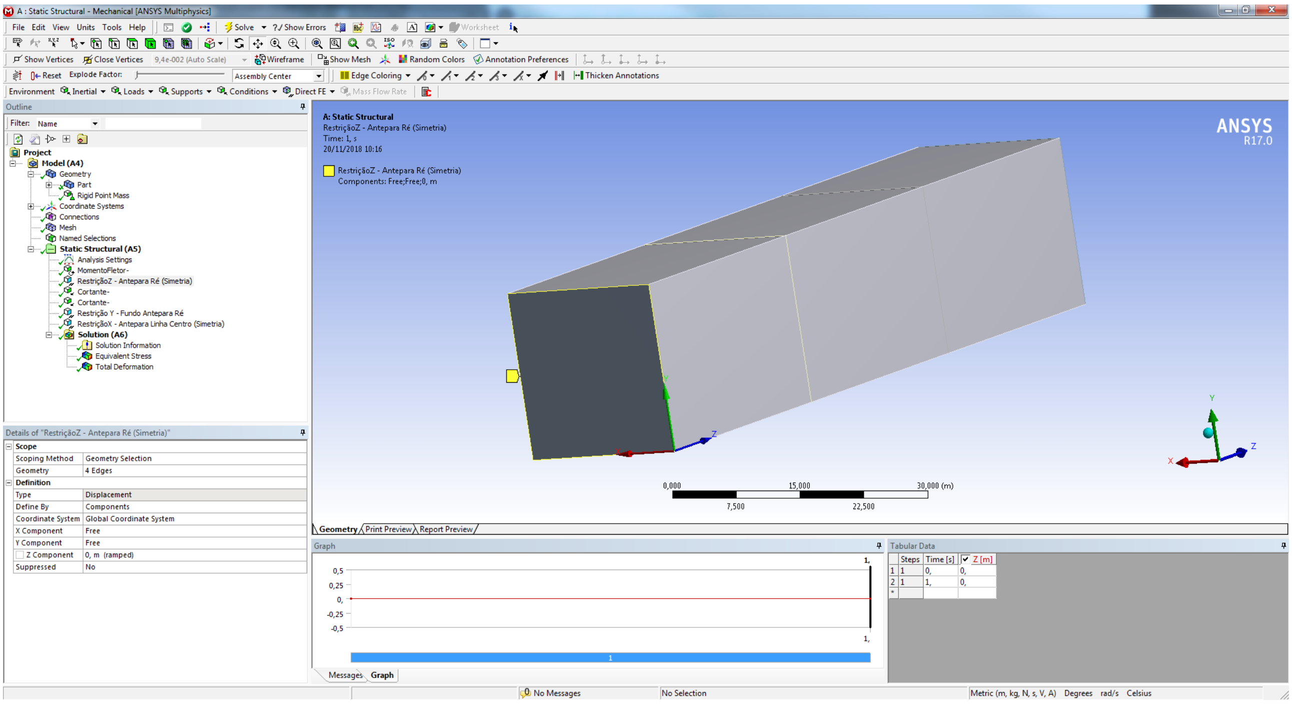
Aplicar restrição de deslocamento na direção horizontal nas linhas da antepara da linha de centro



Aplicar restrição de deslocamento vertical na linha do fundo da antepara do extremo oposto a da aplicação do momento



Aplicar restrição de deslocamento longitudinal nas demais linhas da antepara do extremo oposto a da aplicação do momento.



12. *Cálculo de Momento Fletor e Cortante utilizando ABS*

Referências (2018):

ABS Rules for Building and Classing Steel Vessels

[Part 5A & 5B, Specific Vessel Types]

Part 1, Chapter 7, Section 2 - CARGO HOLD STRUCTURAL STRENGTH ANALYSIS

Part 1, Chapter 4, Section 8 – LOADING CONDITIONS

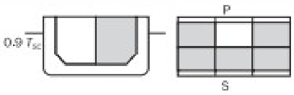
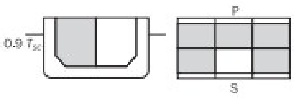
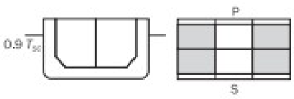
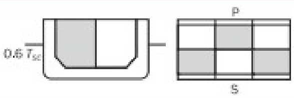
Part 1, Chapter 4, Section 4 – HULL GIRDER LOADS

Escolher uma condição de B1 e uma de B4 e calcular o momento fletor e esforço cortante estático e dinâmico na direção vertical.

Obs – Todos os cálculos podem ser encontrados com a respectiva norma. As tabelas a seguir por si só não são suficientes.

IACS

Table 3 : Load combinations for FE analysis for one centreline oil-tight bulkheads oil tankers applicable to midship cargo region

No.	Loading pattern	Still water loads			Dynamic load cases		
		Draught	C_{BM-LC} : % of perm. SWBM	C_{SF-LC} : % of perm. SWSF	Midship cargo region		
Seagoing conditions							
B1		$0.9T_{SC}$	100% (sagging)	100%	HSM-1 HSA-1	BSP-1P/S	N/A
			100% (hogging)	100%	HSM-2 FSM-2	BSR-1P BSP-1P	OST-2P
B2		$0.9T_{SC}$	100% (sagging)	100%	HSM-1 HSA-1	BSP-1P/S	N/A
			100% (hogging)	100%	HSM-2 FSM-2	BSR-1S BSP-1S	OST-2S
B3		$0.9T_{SC}$	100% (hogging)	100% (3) Max SFLC	HSM-2 FSM-2	N/A	N/A
				100% (4) Max SFLC	HSM-2 FSM-2	N/A	N/A
				100%	N/A	BSP-1P/S	N/A
			0%	100% (5) Max SFLC	HSM-1 FSM-1	N/A	N/A
B4		$0.6T_{SC}$	100% (sagging)	75%	HSM-1	BSP-1P	OSA-2P/S

Utilizar a relação a seguir para calcular o momento e o esforço cortante máximo.

4.3.2 Target hull girder vertical bending moment

The target hull girder vertical bending moment, $M_{v\text{-}targ}$, in kNm, at a longitudinal position for a given FE load combination is taken as:

$$M_{v-targ} = C_{BM-LC}\, M_{sw} + M_{wv-LC}$$

where:

$C_{BM\text{-}LC}$: Percentage of permissible still water bending moment applied for the load combination under consideration as given in Ch 4, Sec 8,

M_{sw} : Permissible still water bending moments in kNm, at the considered longitudinal position for seagoing and harbour conditions as defined in Ch 4, Sec 4, [2.2.2] and Ch 4, Sec 4, [2.2.3] respectively.

$M_{wv\text{-}LC}$: Vertical wave bending moment in kNm, for the dynamic load case under consideration, calculated in accordance with Ch 4, Sec 4, [3.5.2].

A próxima tabela auxilia o cálculo do esforço cortante e momento fletor.

2.2 Load combination factors

2.2.1

The load combinations factors, LCFs for the global loads and inertia load components for strength assessment are defined in:

Table 4 : LCFs for HSM, HSA and FSM load cases.

Table 5 : LCFs for BSR and BSP load cases.

Table 6 : LCFs for OST and OSA load cases.

Table 4 : Load combination factors, LCFs for HSM, HSA and FSM load cases - Strength assessment

Load component		LCF	HSM-1	HSM-2	HSA-1	HSA-2	FSM-1	FSM-2
Hull girder loads	M_{WV}	C_{WV}	-1	1	-0.7	0.7	$-0.4f_T - 0.6$	$0.4f_T + 0.6$
	Q_{WV}	C_{QW}	$-1.0f_{lp}$	$1.0f_{lp}$	$-0.6f_{lp}$	$0.6f_{lp}$	$-1.0f_{lp}$	$1.0f_{lp}$
	M_{WH}	C_{WH}	0	0	0	0	0	0
	M_{WT}	C_{WT}	0	0	0	0	0	0
Longitudinal accelerations	a_{surge}	C_{XS}	$0.3 - 0.2f_T$	$0.2f_T - 0.3$	0.2	-0.2	$0.2 - 0.4f_T$	$0.4f_T - 0.2$
	$a_{pitch\text{-}x}$	C_{XP}	-0.7	0.7	$-0.4f_T - 0.4$	$0.4f_T + 0.4$	0.15	-0.15
	$g\sin\varphi$	C_{XG}	0.6	-0.6	$0.4f_T + 0.4$	$-0.4f_T - 0.4$	-0.2	0.2
Transverse accelerations	a_{sway}	C_{YS}	0	0	0	0	0	0
	$a_{roll\text{-}y}$	C_{YR}	0	0	0	0	0	0
	$g\sin\theta$	C_{YG}	0	0	0	0	0	0
Vertical accelerations	a_{heave}	C_{ZH}	$0.5f_T - 0.15$	$0.15 - 0.5f_T$	$0.4f_T - 0.1$	$0.1 - 0.4f_T$	0	0
	$a_{roll\text{-}z}$	C_{ZR}	0	0	0	0	0	0
	$a_{pitch\text{-}z}$	C_{ZP}	-0.7	0.7	$-0.4f_T - 0.4$	$0.4f_T + 0.4$	0.15	-0.15