Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria Meccanica

Relazione per la prova finale

PROGETTAZIONE STRUTTURALE E MODELLAZIONE CAD 3D DI UN RIDUTTORE BISTADIO

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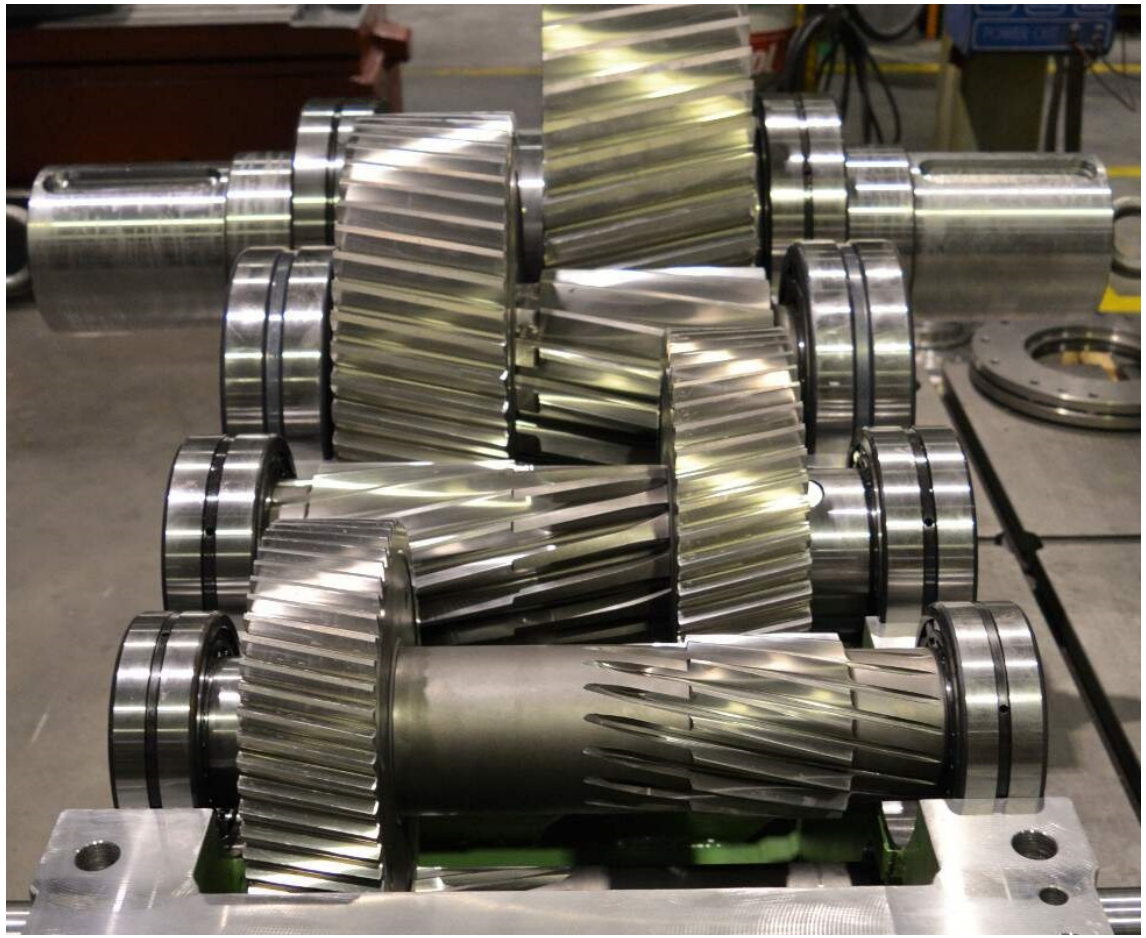
Laureando: *matricola 1190060*

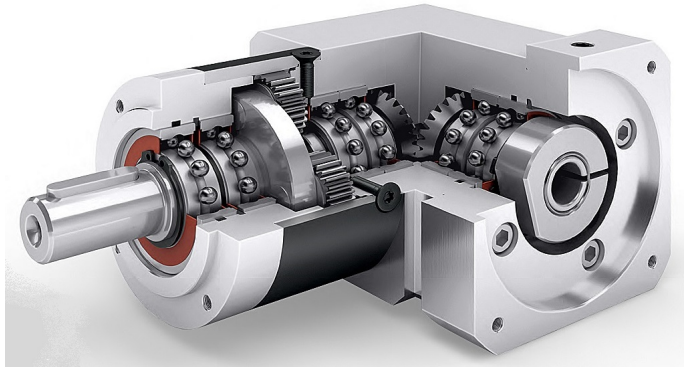
Quargentan Giovanni

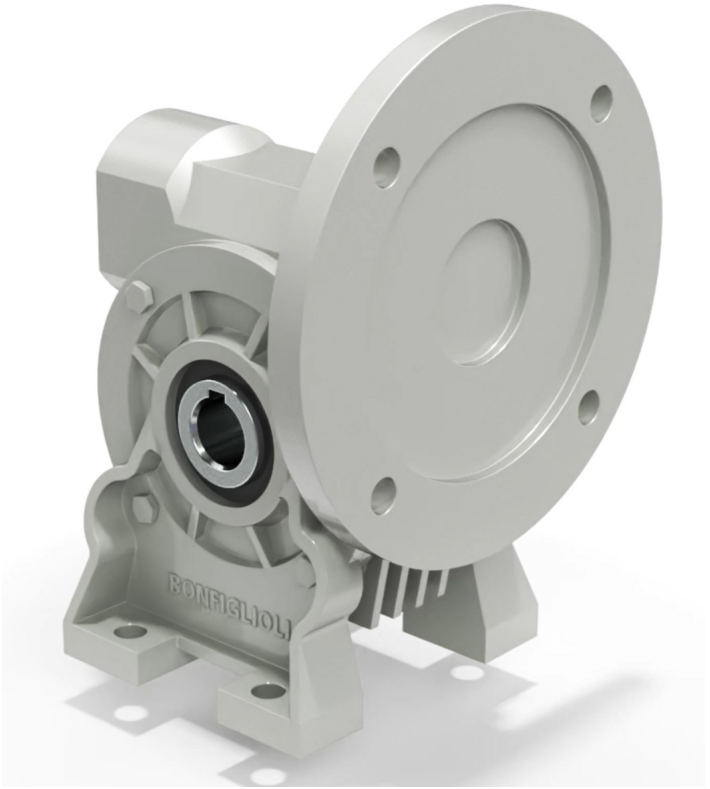
Padova, 16/09/2022

INTRODUZIONE

- Che cos'è un riduttore?

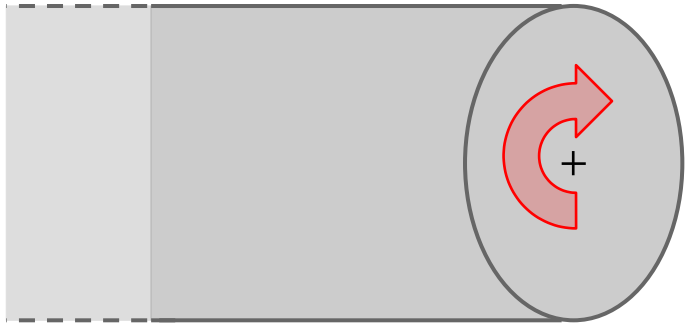






OBIETTIVI E METODO DEL LAVORO

DATI DI PARTENZA:



- COPPIA T2
- VELOCITA' ω2
- RAPPORTO u

GRANDEZZE MACROSCOPICHE DELLA TRASMISSIONE

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DIMENSIONAMENTO MODULO E RUOTE → DIMENSIONAMENTO ALBERI → SCELTA DI CUSCINETTI E LINGUETTE

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VERIFICHE STATICHE, A FATICA, A DEFORMABILITA'

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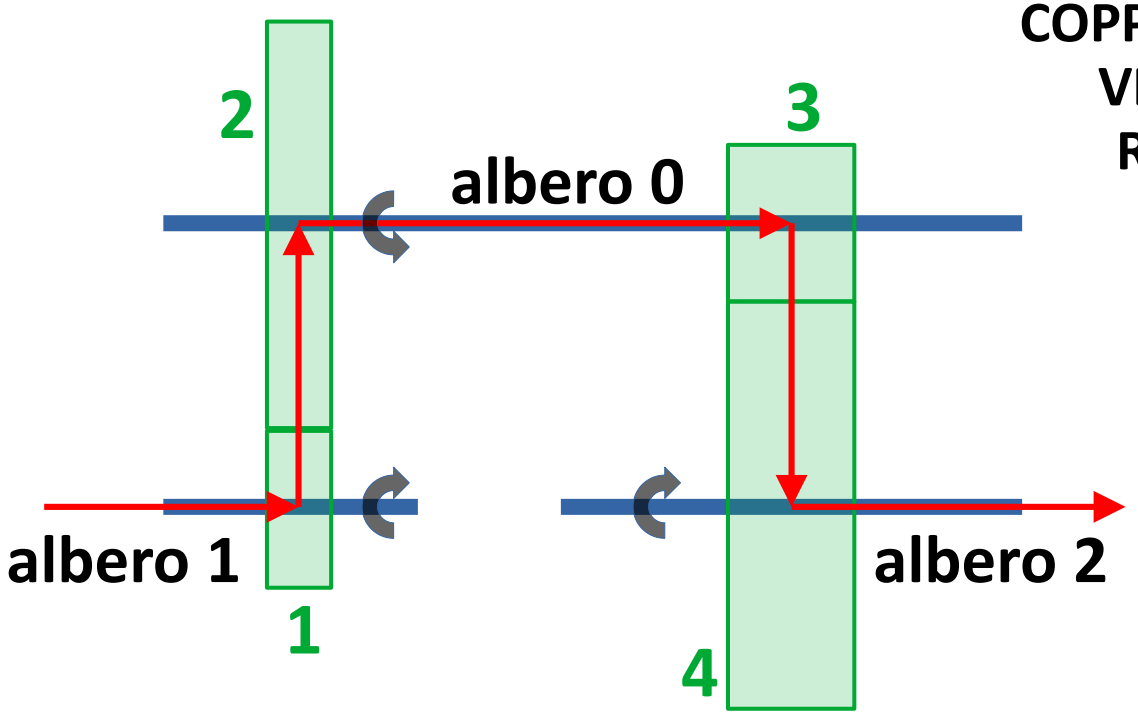
MODELLAZIONE CAD

GRANDEZZE MACROSCOPICHE DELLA TRASMISSIONE



COPPIA T2 = Tout*fs, VELOCITA' n2, RAPPORTO u → **COPPIA T0, T1 VELOCITA' n0, n1 POTENZA P0, P1**

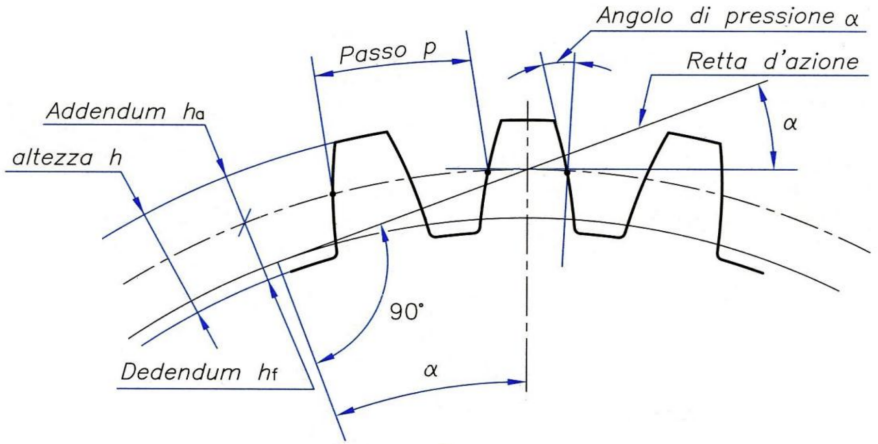
↓

FORZE TANGENZIALI Ft E RADIALI Fr

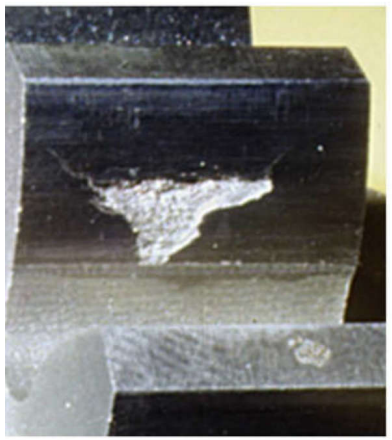
DATI INIZIALI: **Tout = 1180 Nm**
n2 = 70 rpm
u TOT = 20,5

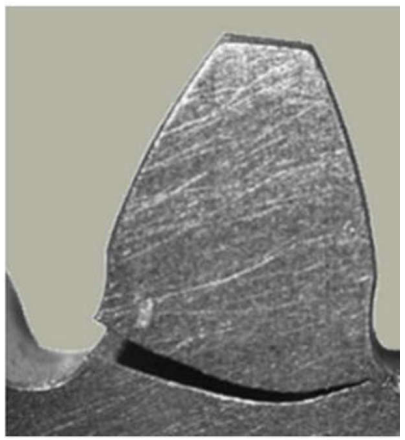
T2 [Nm]	n2 [rpm]	P2 [W]
1770	70	12975
T0 [Nm]	**n0 [rpm]**	**P0 [W]**
405,0	318	13515
T1 [Nm]	**n1 [rpm]**	**P1 [W]**
93,0	1449	14079

DIMENSIONAMENTO MODULO E RUOTE



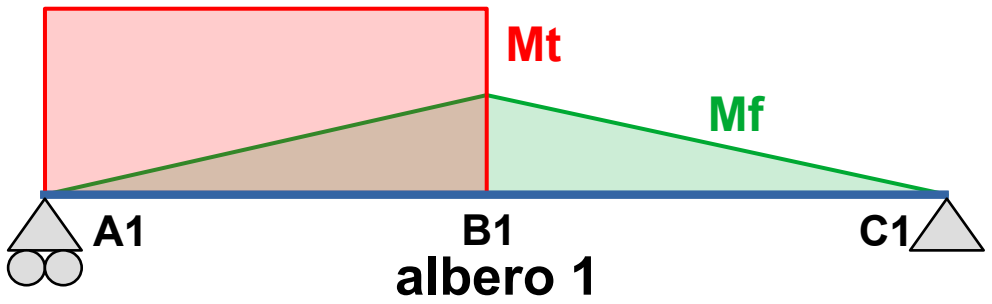
materiale	σ R [MPa]	p ammissibile [MPa]	durezza HB
ghisa grigia G 20	195	400	205
acc. da bonifica C40	755	490	215
acc. da cementazione 15CrNi4	**1270**	**1300**	**700**
acc. da nitrurazione 42CrAlMo7	980	1170	820

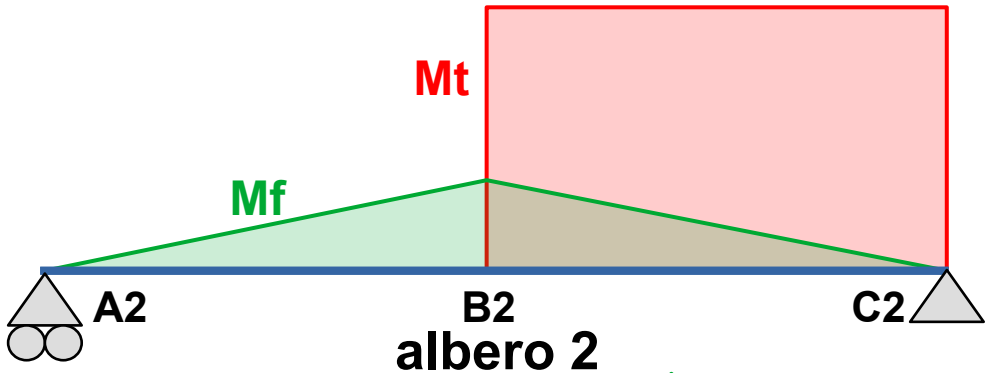


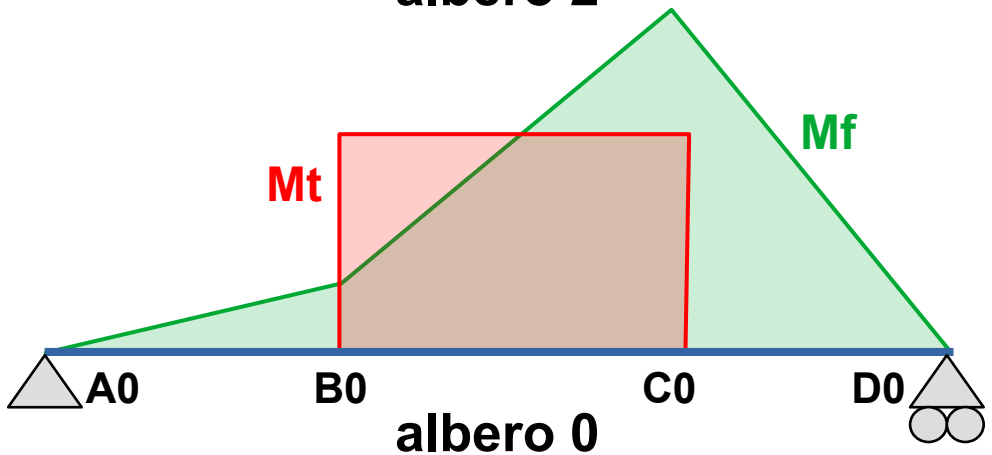


	λ	m_{Lewis} [mm]	$m_{min,fles}$ [mm]	$m_{min,pit}$ [mm]	larghezza [mm]	D_p [mm]
Ruota 1	8	3,21	2,09	2,53	32	80
Ruota 2		2,85	2,01	1,39		364
Ruota 3	14	3,9	3,54	3,40	56	80
Ruota 4		3,46	2,71	1,86		364

DIMENSIONAMENTO ALBERI





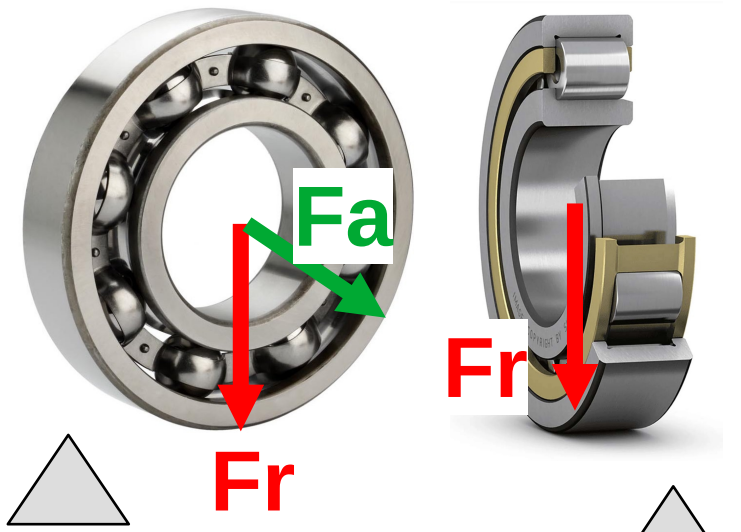


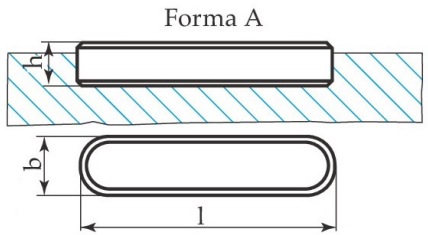
- Lunghezza L ~3 volte la larghezza della ruota
- Materiale isotropo
- L/D: snello v_{ST} ~ 10 oppure tozzo v_{ST} ~ 5
- Taglio trascurato
- D calcolato nella sezione più gravosa

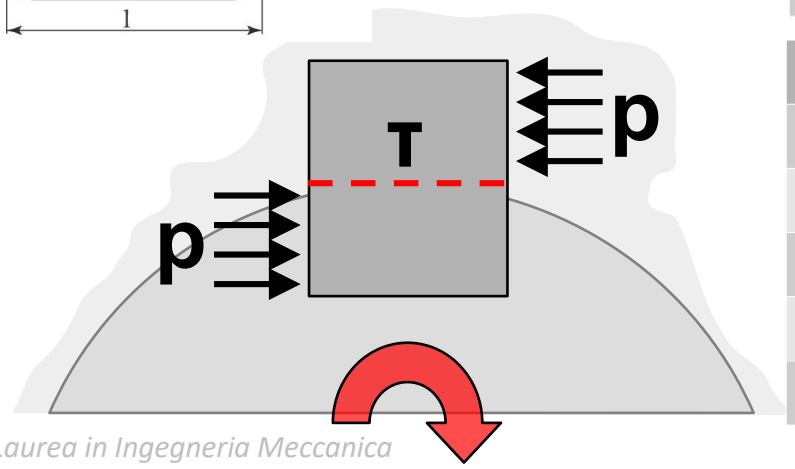
	materiale	σS [MPa]	vST obb.	sezione
albero 1	acc. C35 bon.	390	7	B1
albero 2	acc. C35 bon.	355	7	B2
albero 0	acc. C60 bon.	510	10	C0

	D fles. [mm]	D tors. [mm]	D [mm]	vST	L/D
albero 1	22,0	24,5	30	10,4	3,1
albero 2	41,8	67,5	76	9,7	1,8
albero 0	47,5	41,2	50	9,7	5,5

SCELTA DI CUSCINETTI E LINGUETTE





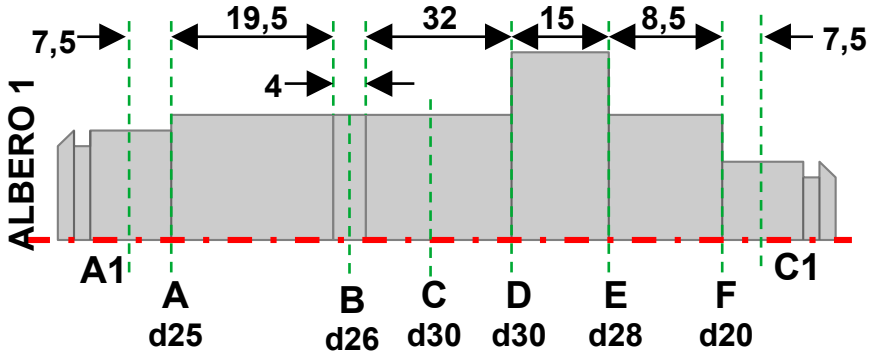


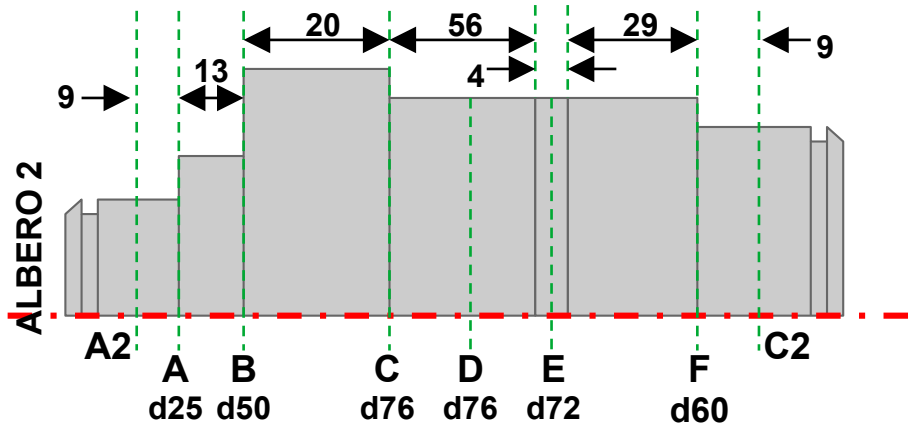
Albero 1				
	materiale	**b [mm]**	**h [mm]**	**l [mm]**
Linguetta	acc. C40 bon.	8	7	18
		modello	**D_{int} [mm]**	**D_{est} [mm]**
Cuscinetti	**sx**	NU205	25	52
	dx	6304	20	52

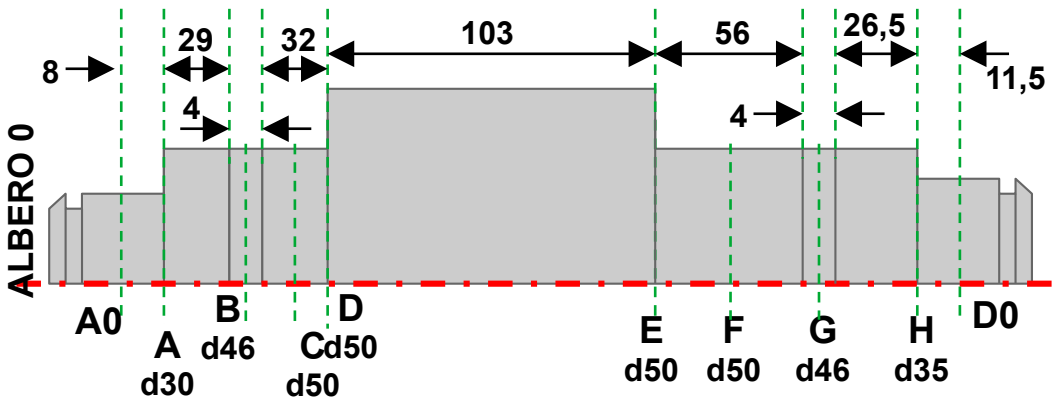
Albero 2				
	materiale	**b [mm]**	**h [mm]**	**l [mm]**
Linguetta	acc. C40 bon.	22	14	50
		modello	**D_{int} [mm]**	**D_{est} [mm]**
Cuscinetti	**sx**	NU2205ECP	25	52
	dx	6012	60	95

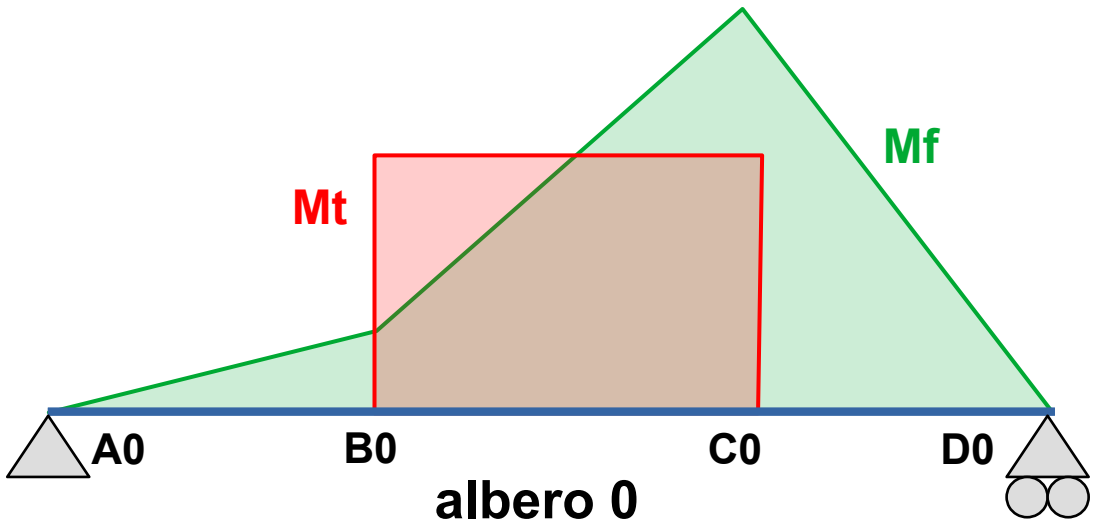
Albero 0				
	materiale	**b [mm]**	**h [mm]**	**l [mm]**
Linguetta	acc. C40 bon.	14	9	28
		modello	**D_{int} [mm]**	**D_{est} [mm]**
Cuscinetti	**sx**	6206	30	62
	dx	NU2207ECP	35	72

VERIFICHE STATICHE



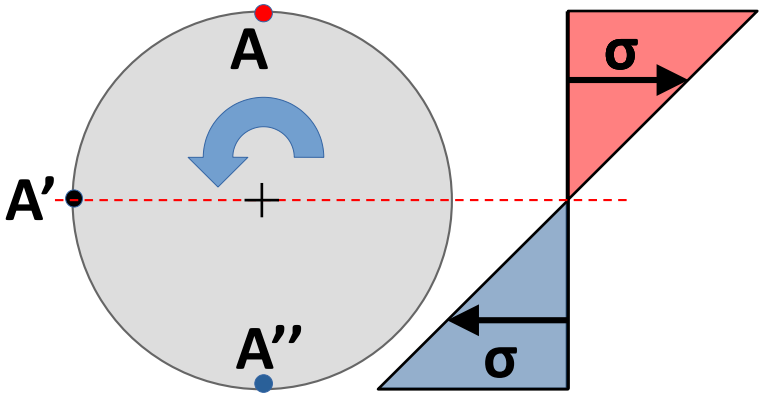






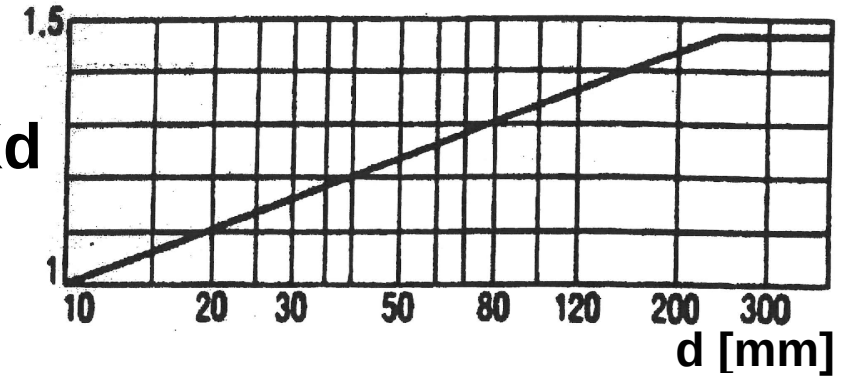
ALBERO 0					
SEZIONI:	d [mm]	Mf [Nm]	Mt [Nm]	σ ID [MPa]	vST
A	30	14	0	5,4	94,6
B	46	70	0	7,3	70,0
C	50	102	405	29,8	17,1
D	50	140	405	30,8	16,6
E	50	449	405	46,4	11,0
F	50	536	405	52,2	9,8
G	46	306	0	32,0	15,9
H	35	88	0	20,9	24,4

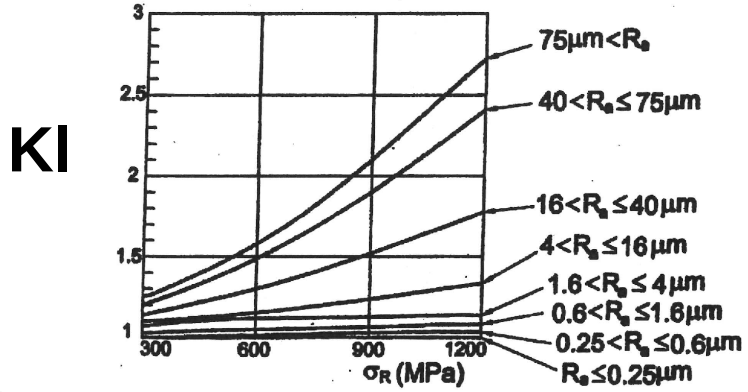
VERIFICHE A FATICA

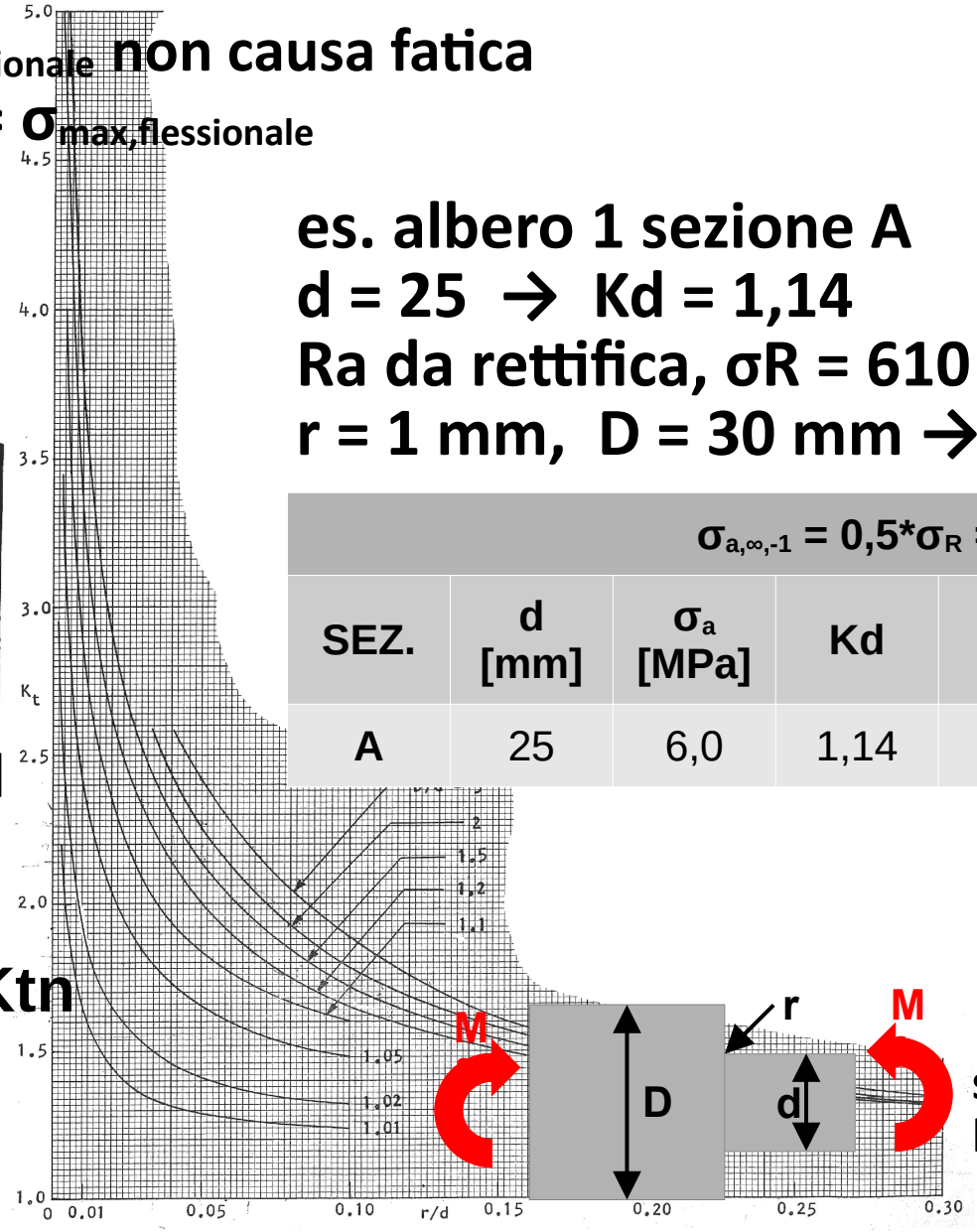


$T_{torsionale}$ non causa fatica

$\sigma_a = \sigma_{max,flessionale}$







es. albero 1 sezione A

d = 25 → Kd = 1,14

Ra da rettifica, σR = 610 MPa → Kl =1,05

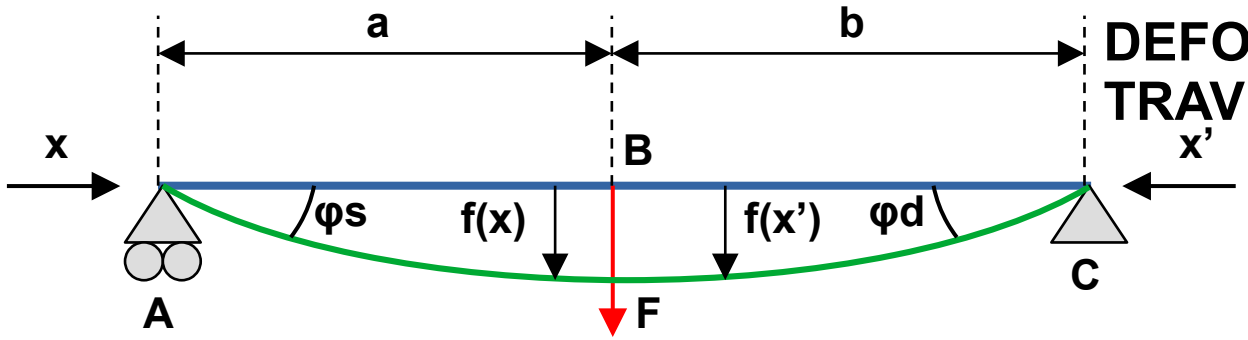
r = 1 mm, D = 30 mm → Ktn = 2,1 → Kf = 1,91

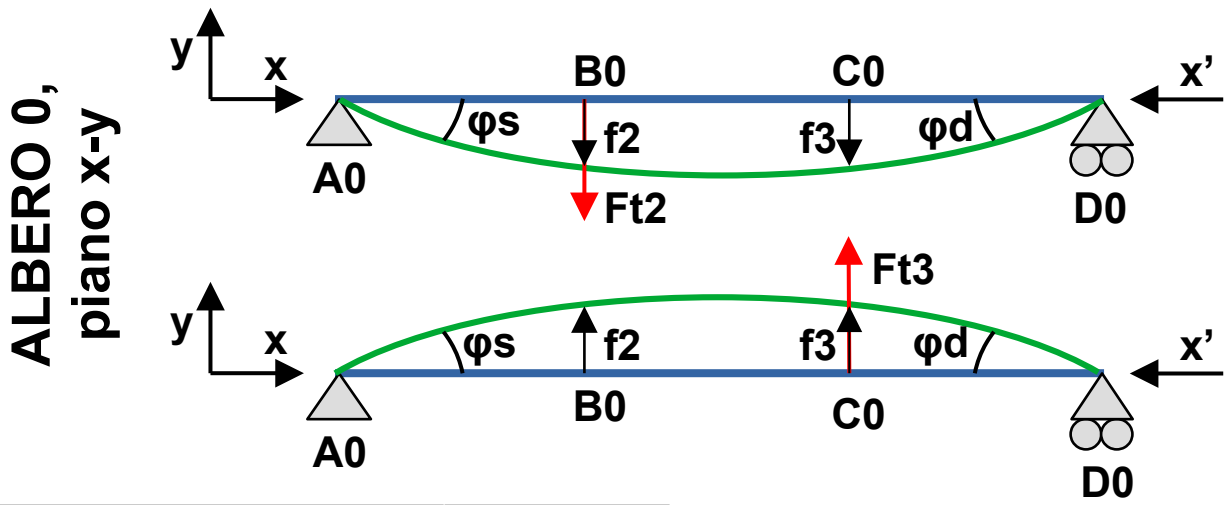
$\sigma_{a,\infty,-1} = 0{,}5*\sigma_R = 305$ MPa							
SEZ.	d [mm]	σ_a [MPa]	Kd	Kl	Kf	$\sigma_{a,\infty,-1}$ [MPa]	vσ
A	25	6,0	1,14	1,05	1,91	133,4	22,1

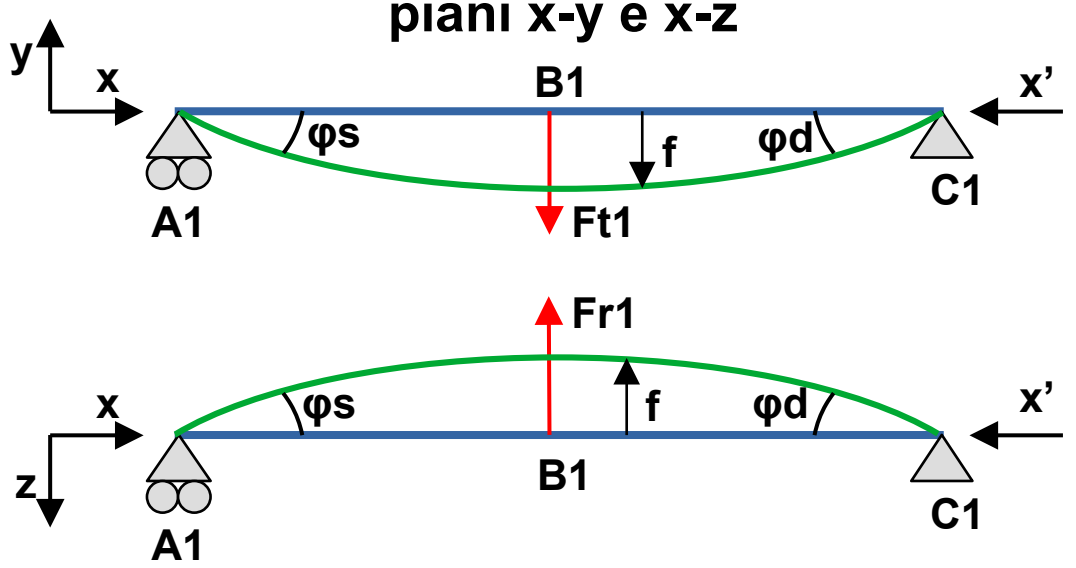
se r < 2 mm

Kf = 1+q(Ktn-1)

VERIFICHE A DEFORMABILITA'







albero 1		limiti
f1 [mm]	0,005	0,029
φ s [rad]	0,00016	0,00088
φ d [rad]	0,00016	0,00291

albero 2		limiti
f4 [mm]	0,002	0,040
φ s [rad]	0,00004	0,00056
φ d [rad]	0,00004	0,00185

albero 0		limiti
f2 [mm]	0,023	0,078
f2 [mm]	0,038	0,078
φ s [rad]	0,00041	0,00226
φ d [rad]	0,00064	0,00072

MODELLAZIONE CAD