DIPARTIMENTO DI INGEGNERIA INDUSTRIALE

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria Meccanica

Relazione per la prova finale

Analisi FEM strutturali di un albero per riduttore bistadio

Tutor universitario: Prof. Alberto Campagnolo

Padova, 09/07/2024

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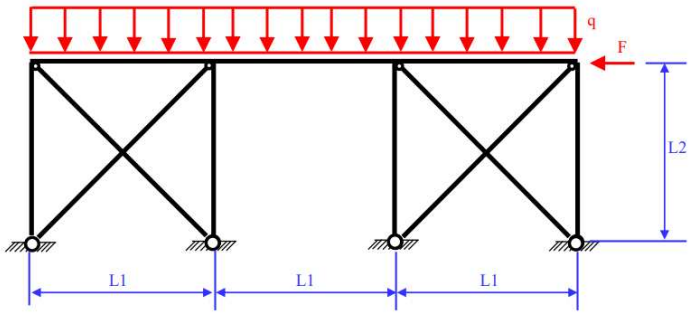
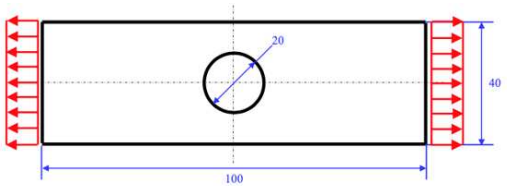
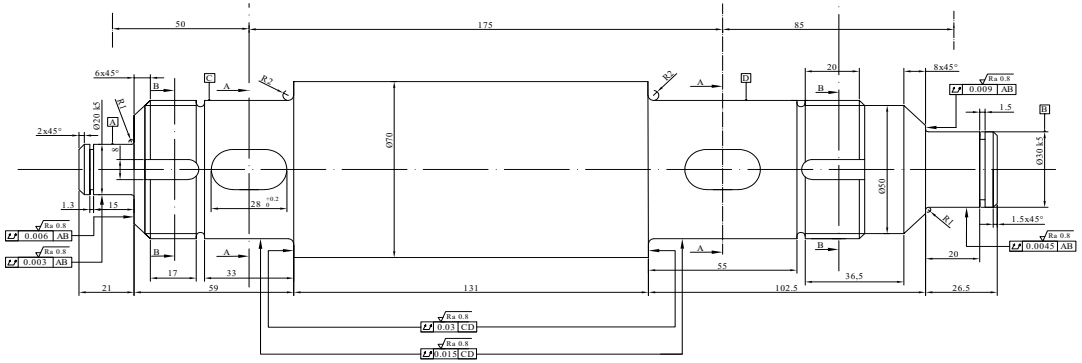
OBIETTIVI

La relazione finale svolta ha i seguenti obiettivi:

- Spiegare i concetti base dell'analisi agli elementi finiti FEM;
- Vedere delle semplici applicazioni: telaio piano monodimensionale e piastra forata bidimensionale;
- Analizzare varie sezioni caratteristiche dell'albero intermedio del riduttore bistadio progettato durante il corso di CM1;
- Ricavare frecce e rotazioni sull'asse dell'albero intermedio completo.

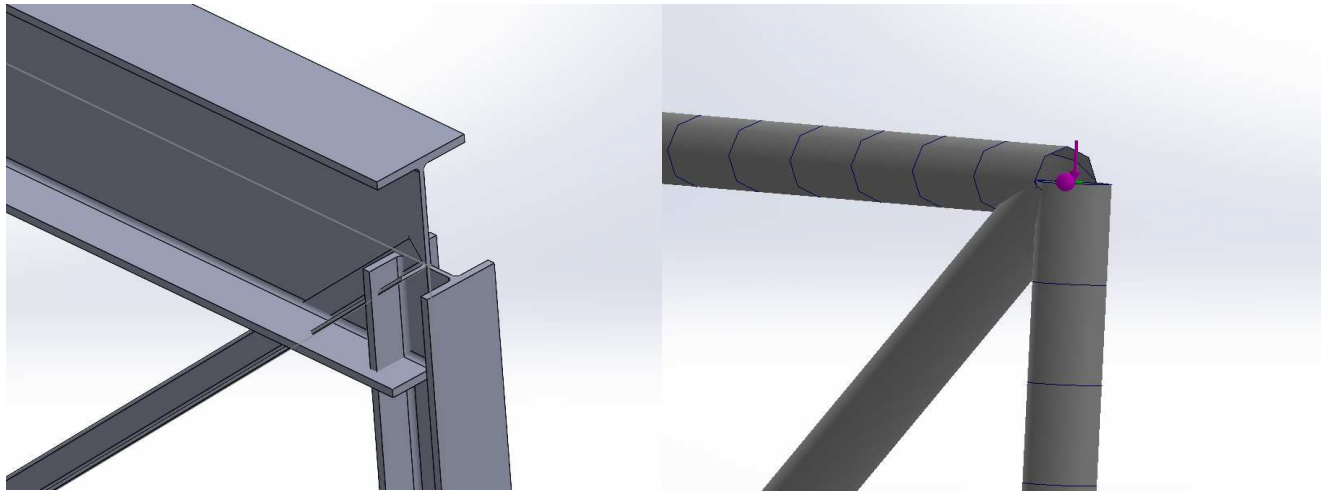


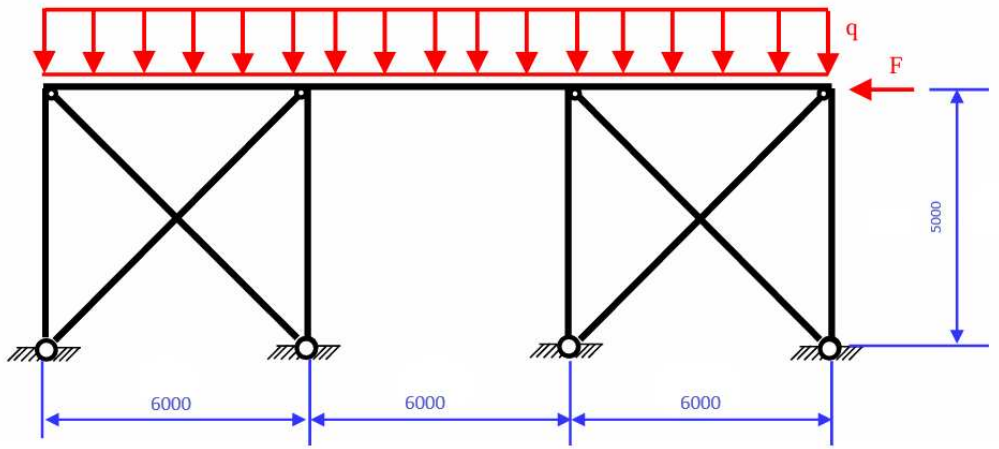




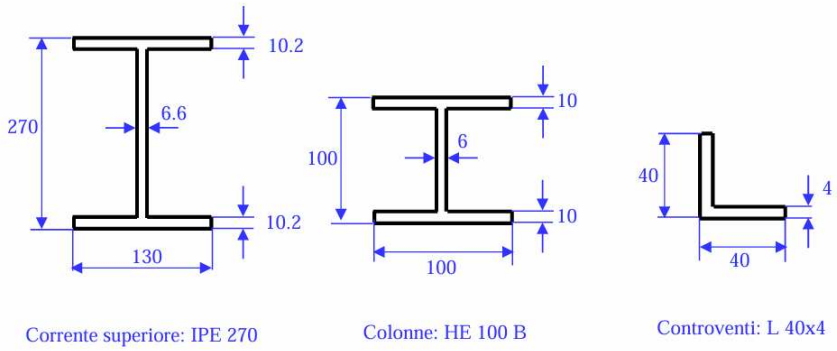
TELAIO PIANO

- Mesh di tipo trave monodimensionale;
- Giunzioni su cui applichiamo vincoli e carichi;
- Assegnazione del materiale;
- Grafici deformazione e sollecitazioni.



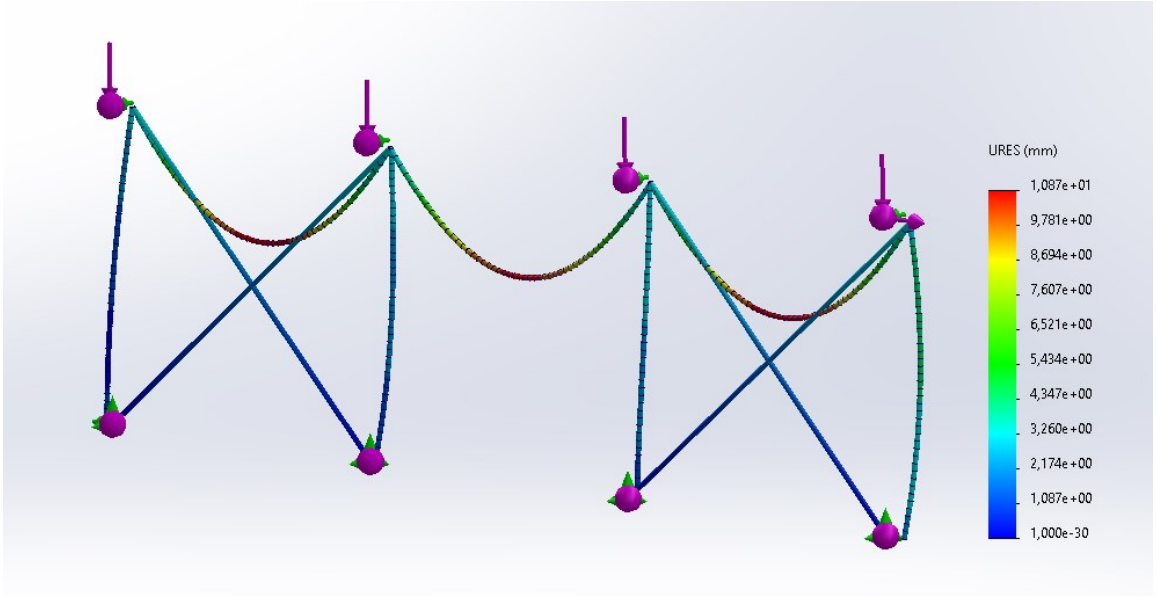


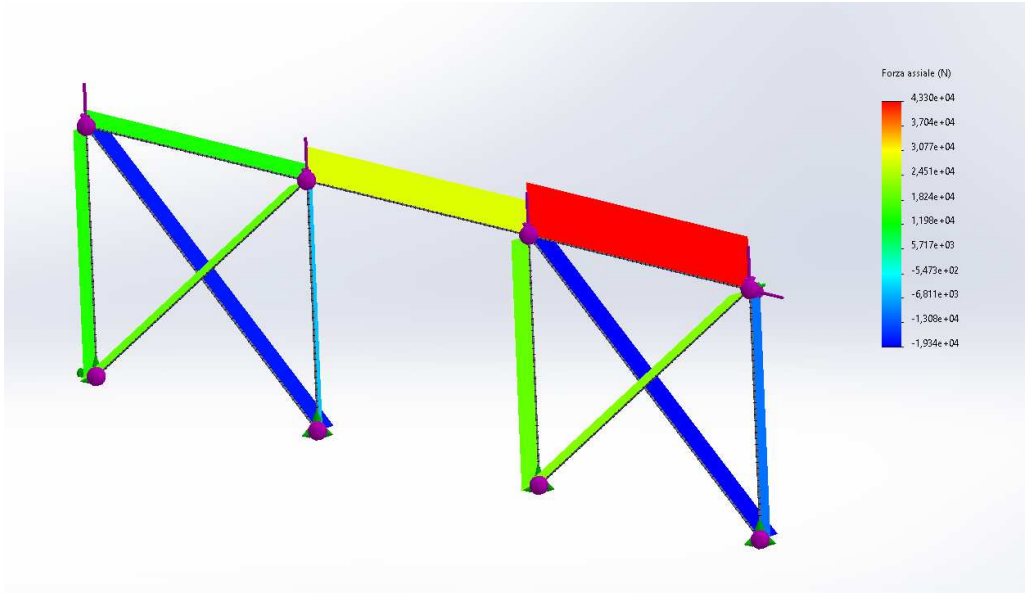
F=60000 N q=20000 N/m



Corrente superiore: IPE 270 | Colonne: HE 100 B | Controventi: L 40x4

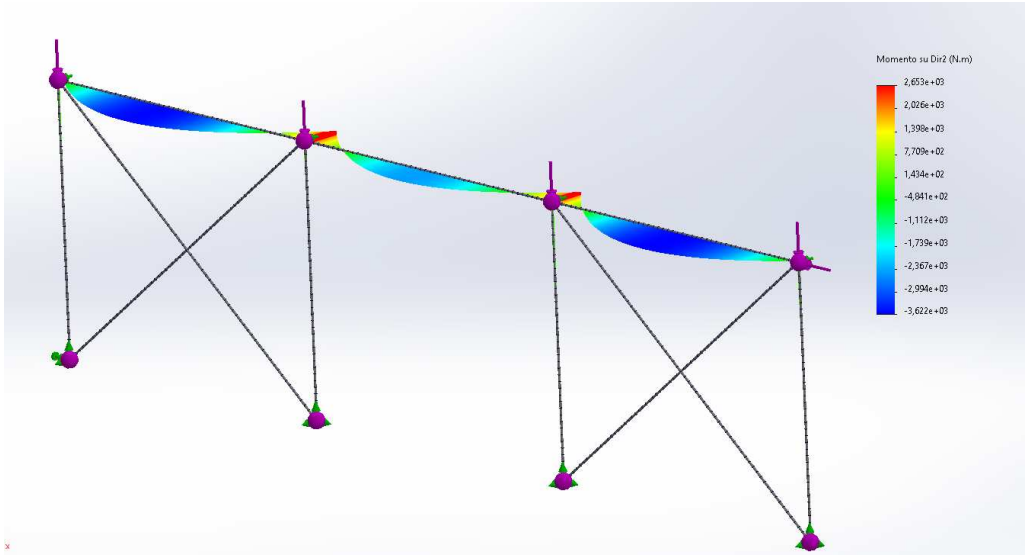
ANALISI RISULTATI TELAIO PIANO





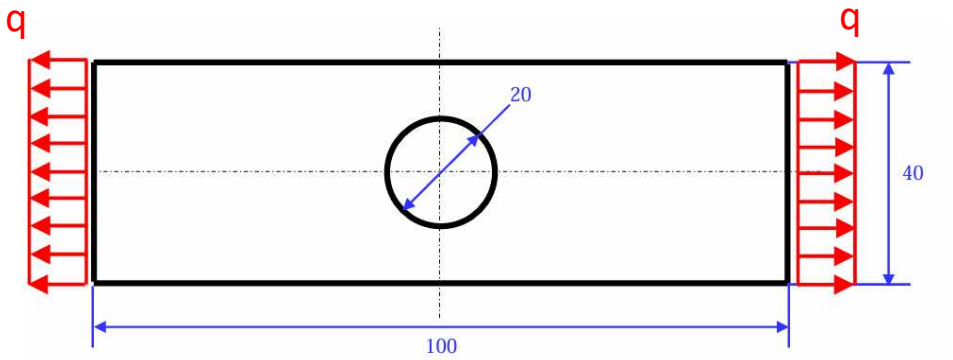
Grafici telaio piano:

- Spostamento;
- Sforzo assiale;
- Momento flettente trave superiore.

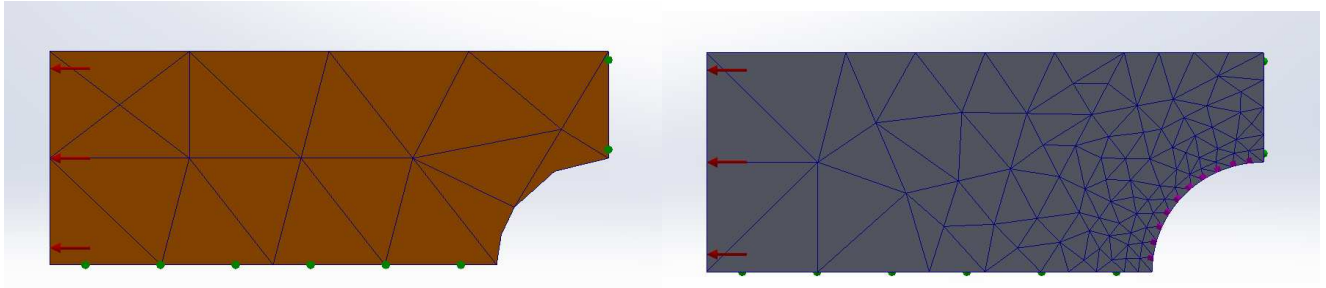


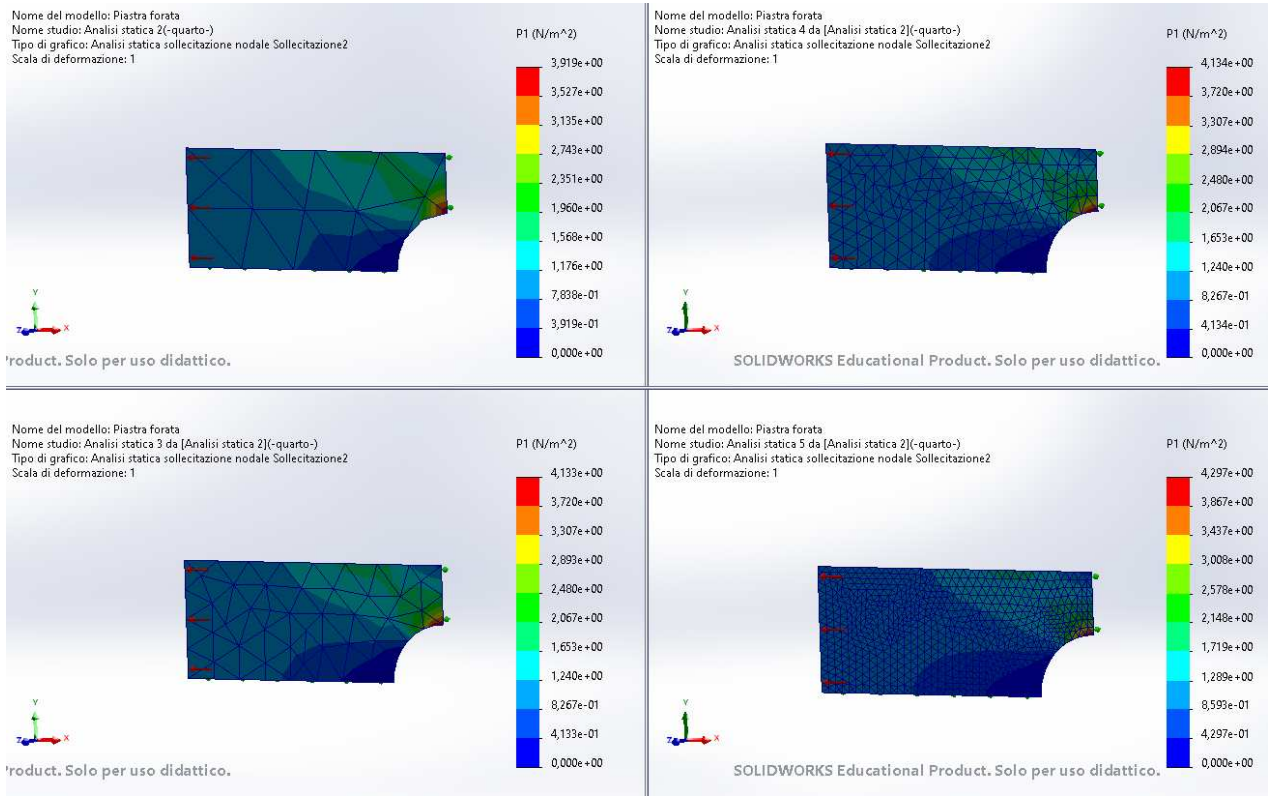
PIASTRA FORATA

- Utilizzo delle simmetrie;
- Mesh control;
- Confronto risultati al variare della mesh;
- Calcolo K_t FEM e Pettersson.

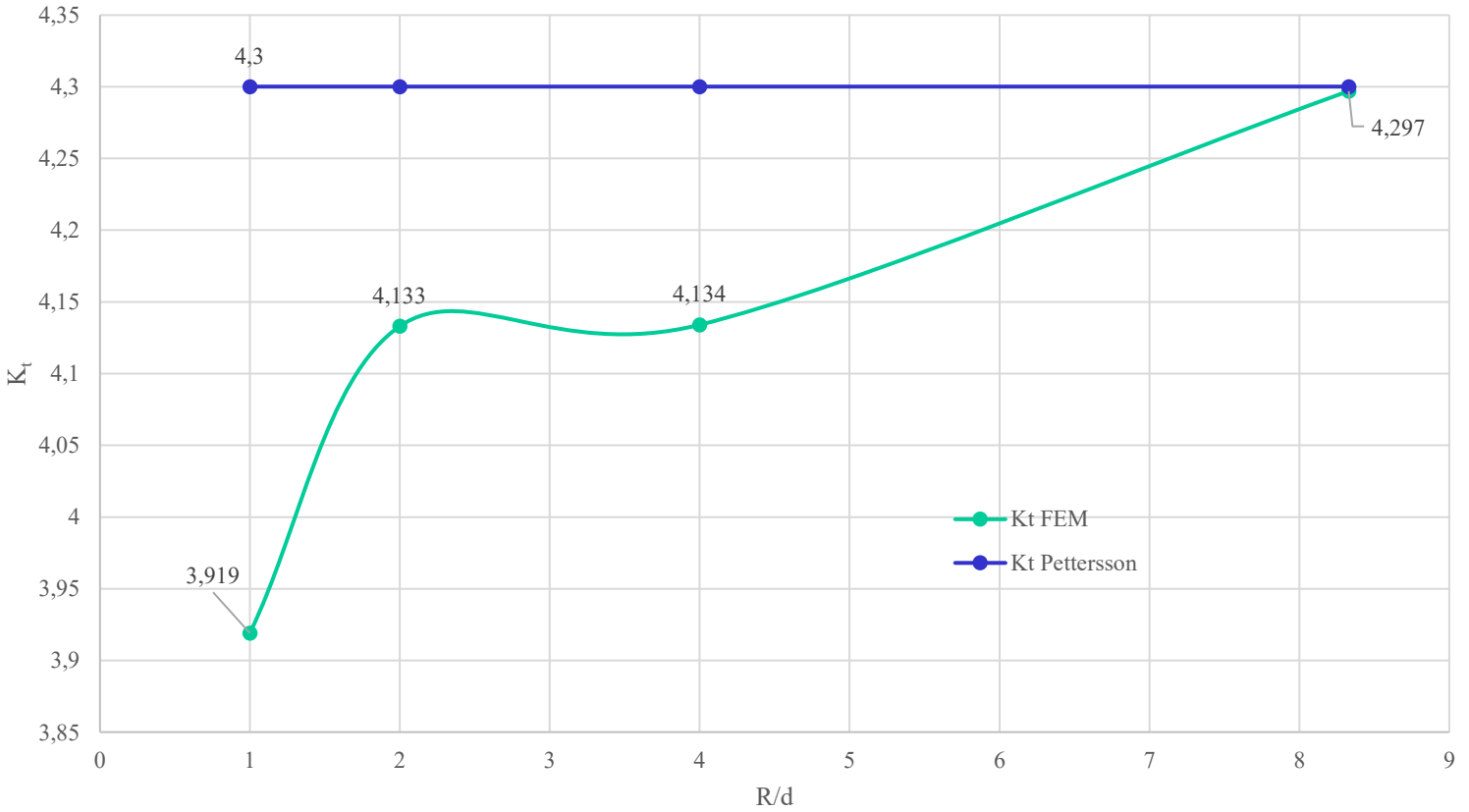


q=1 MPa





ANALISI RISULTATI PIASTRA FORATA



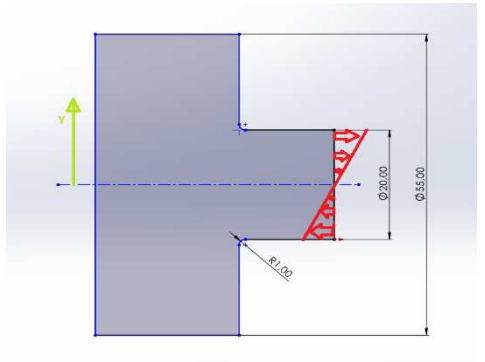
R/d	KT FEM	Δ% (KT Pett. e KT FEM)
1	3,919	9,72%
2	4,133	4,04%
4	4,134	4,01%
8,33	4,297	0,06%

Andamento coefficiente d'intaglio Kt in funzione del rapporto R/d
(R=raggio foro; d=definizione mesh in mm)

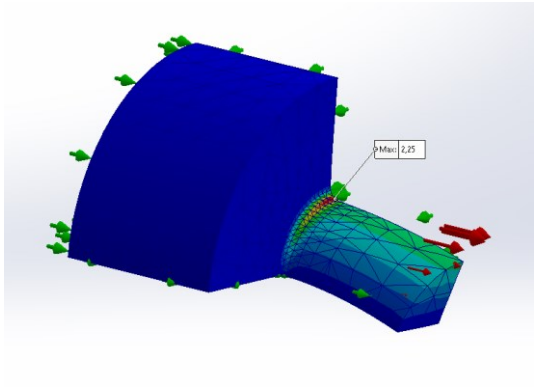
ALBERO INTERMEDIO RIDUTTORE

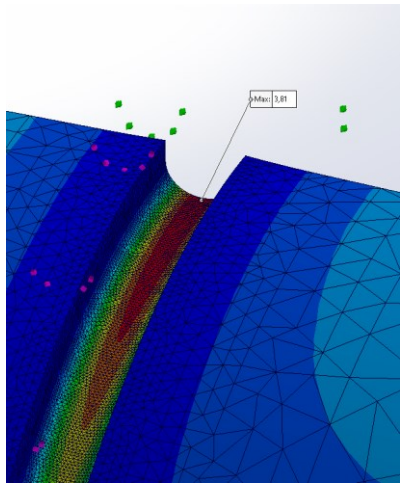
SEZIONI CARATTERISTICHE:

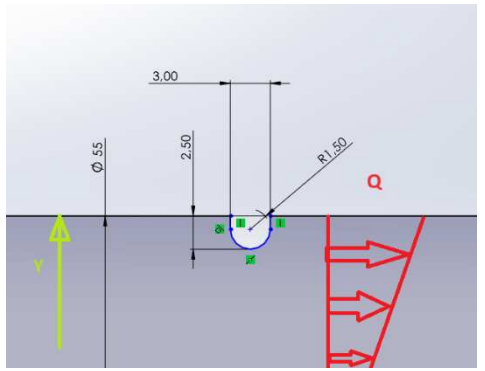
- Spallamento del cuscinetto sinistro
- Gola di scarico della filettatura
- Spallamento della ruota dentata sinistra



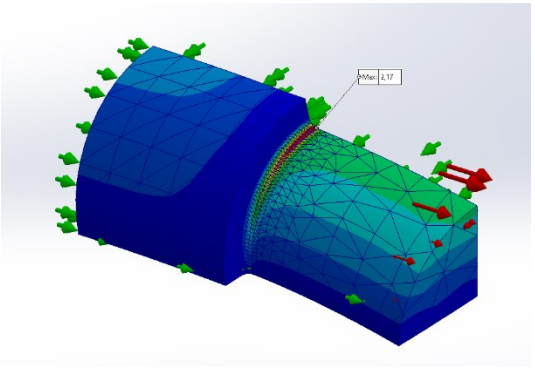
Q= 1 * y/r MPa
con r=10 mm



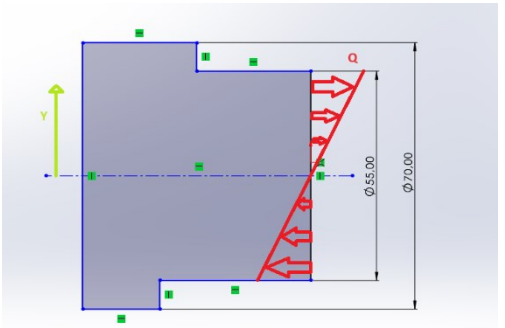




Q= 1 * y/r MPa
con r=55 mm



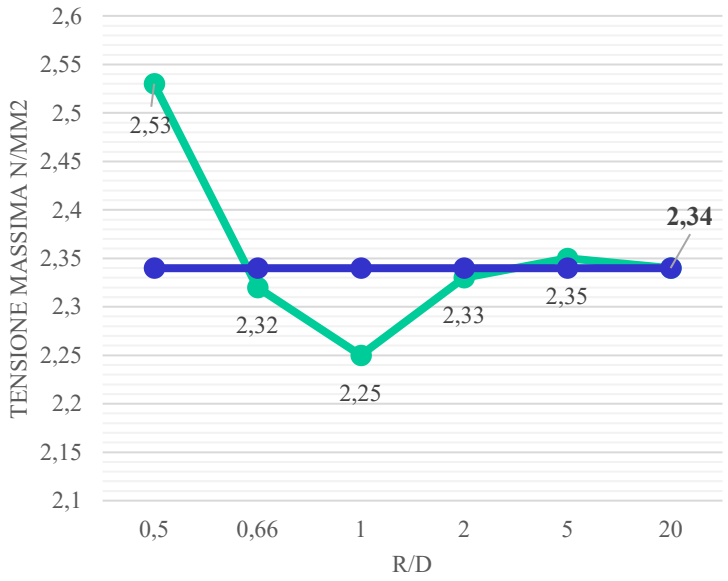
Simulazione di una classica flessione a farfalla



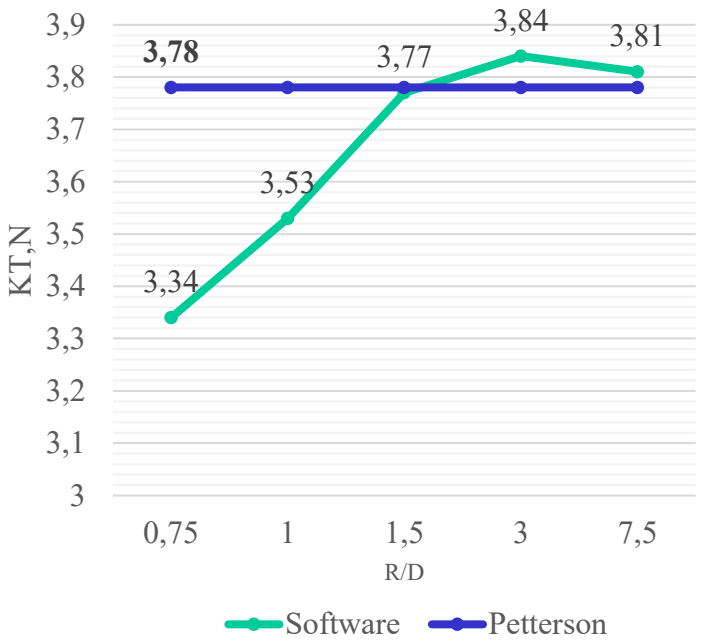
Q= 1 * y/r MPa
con r=55 mm

RISULTATI OTTENUTI

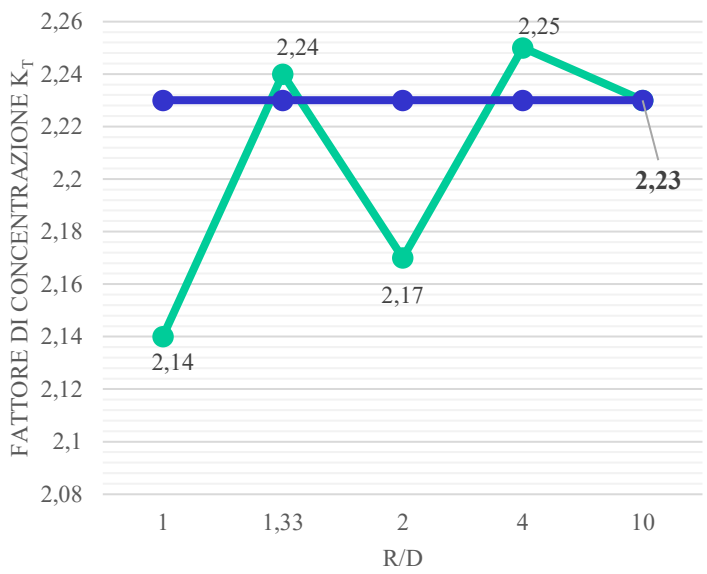
Spallamento cuscinetto



Gola di scarico filettatura



Spallamento ruota dentata



R/d	K_t Software	Δ% K_t FEM e K_t Pett.)
0.5	2.53	8.11
0.66	2.32	0.85
1	2.25	3.84
2	2.33	0.42
5	2.35	0.42
20	2.34	0

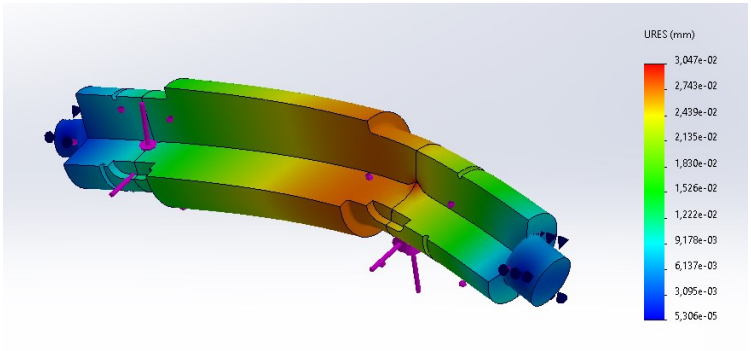
R/d	K_t Software	Δ% K_t FEM e K_t Pett.)
0.75	3.34	11.82
1	3.53	6.81
1.5	3.77	2.32
3	3.84	1.37
7.5	3.81	0.58

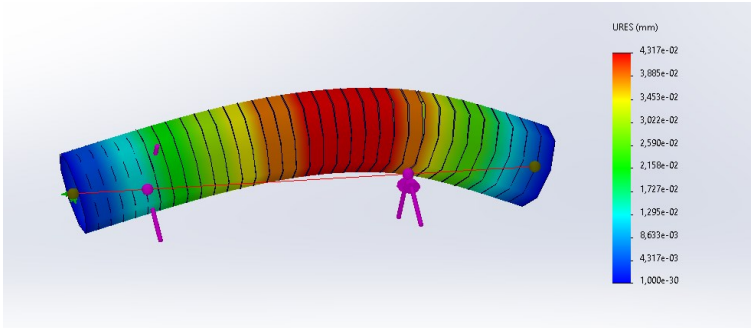
R/d	K_t Software	Δ% K_t FEM e K_t Pett.)
1	2.14	4.07
1.33	2.24	0.40
2	2.17	2.73
4	2.25	0.85
10	2.23	0.04

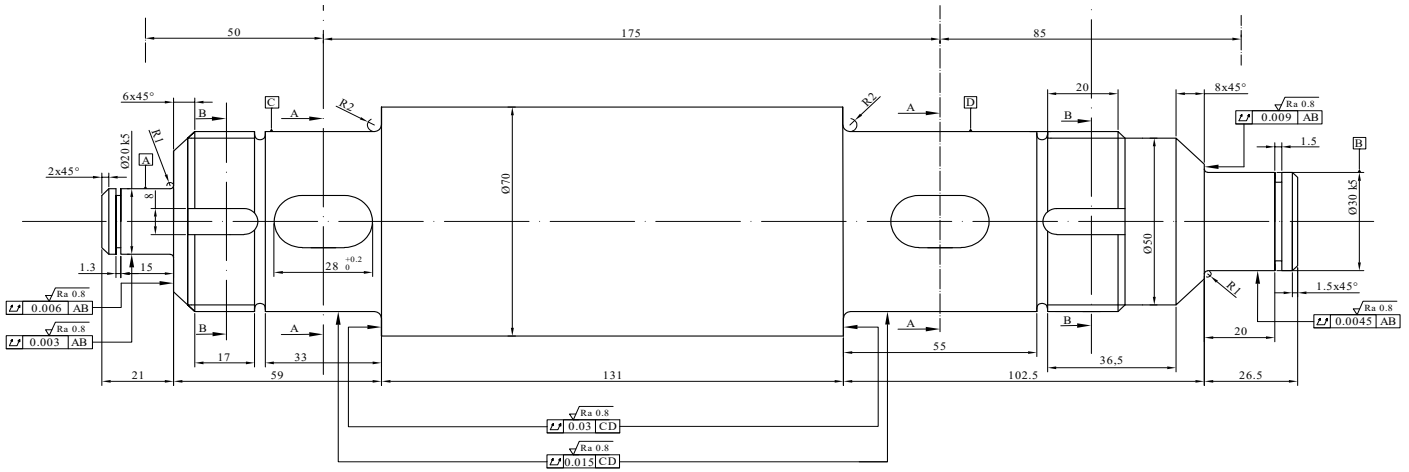
ALBERO INTERMEDIO: VERIFICHE A DEFORMABILITÀ

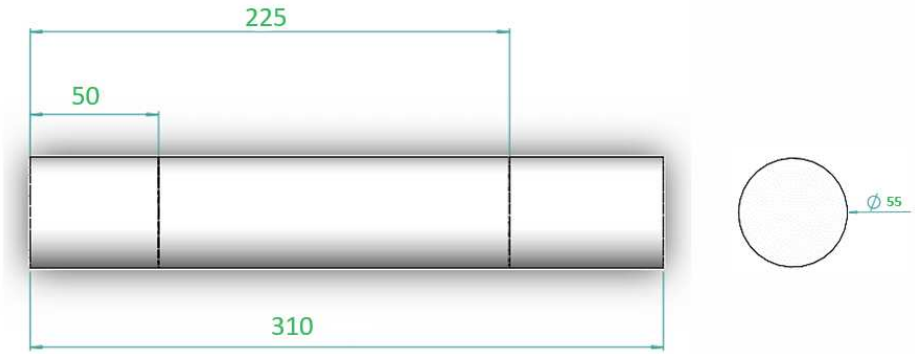
DUE CONFIGURAZIONI:

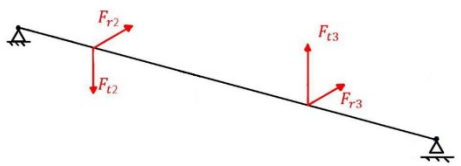
1. Albero solido completo;
2. Albero con diametro costante (55mm) trattato come elemento trave monodimensionale.





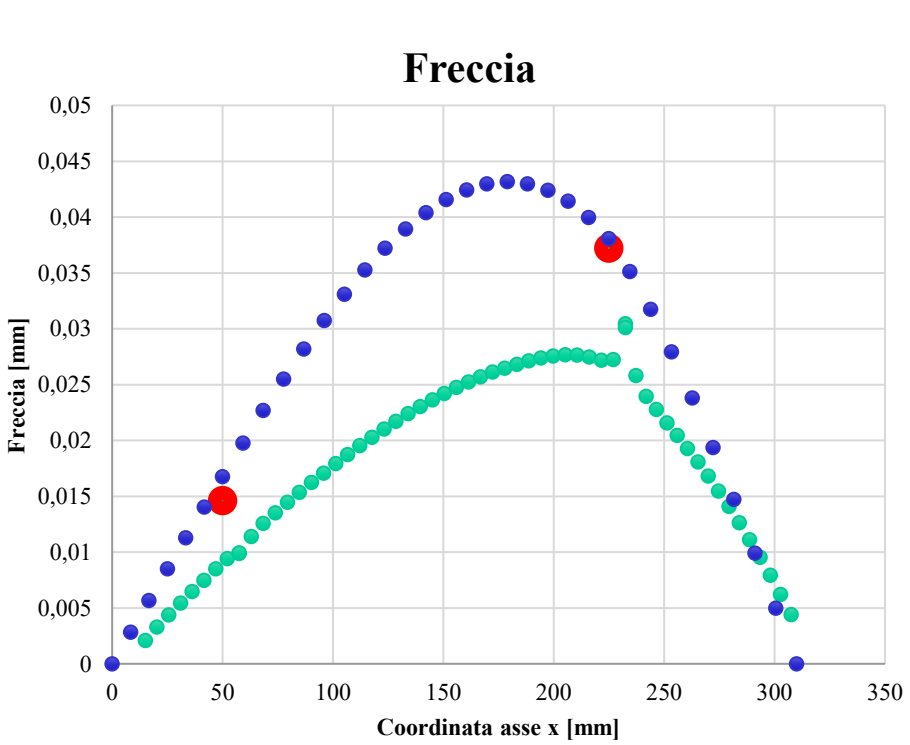


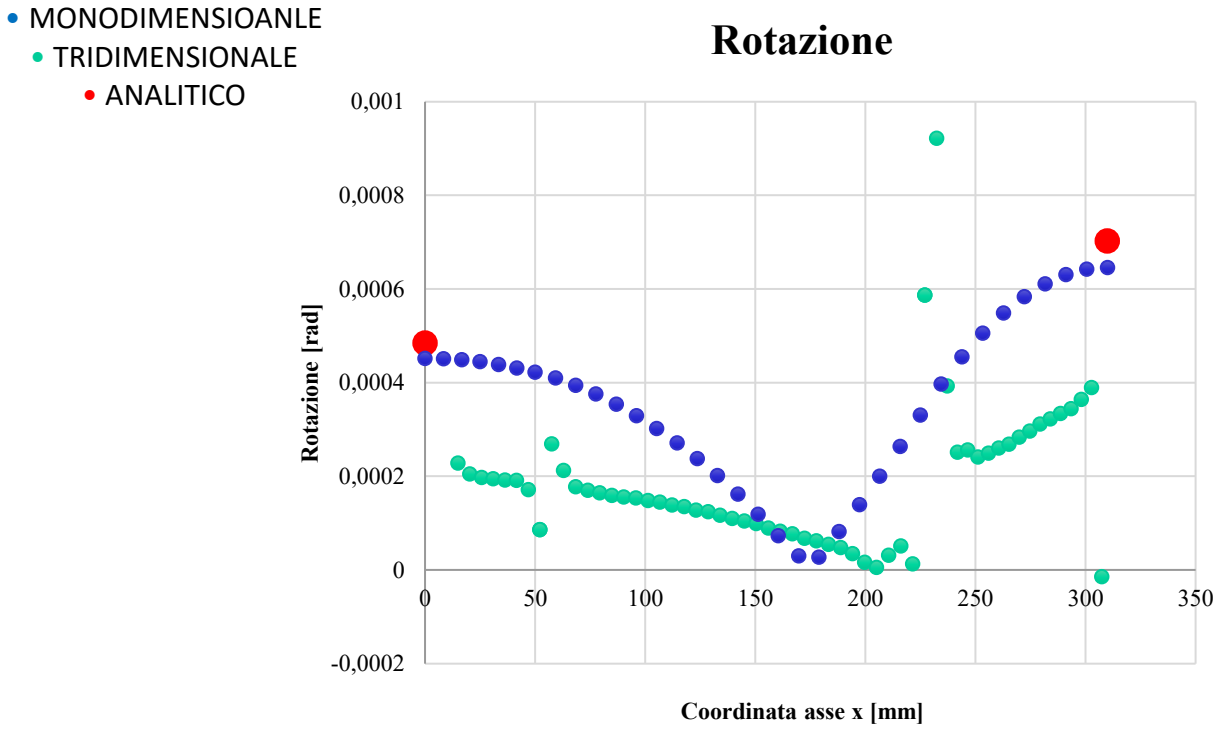




Ft2=1708.88N
Fr2=621.98N
Ft3= 8330.82N
Fr3= 3032.17N

ALBERO INTERMEDIO: VERIFICHE A DEFORMABILITÀ





FRECCIA SINISTRA:
FEM: 0,0168 mm
Analitico:0,0156 mm
Δ%: 7,14 %

FRECCIA DESTRA:
FEM: 0,0381 mm
Analitico:0,0372 mm
Δ%: 2,41%

ROTAZIONE SINISTRA:
FEM: $4{,}52 * 10^{-4}$ rad
Analitico:$4{,}9 * 10^{-4}$ rad
Δ%: 7,75%

ROTAZIONE DESTRA:
FEM: $6{,}46 * 10^{-4}$ rad
Analitico:$7{,}02 * 10^{-4}$ rad
Δ%: 7,97%

CONCLUSIONI

In questa relazione abbiamo visto i seguenti casi:

- Telaio piano
- Piastra forata
- Sezioni caratteristiche albero
- Albero intermedio completo (frecce e rotazioni)

PIASTRA FORATA
$\Delta\%_{MAX}$=9,72%
$\Delta\%_{MIN}$=0,06%

SPALLAMENTO CUSCINETTO
$\Delta\%_{MAX}$=8,11%
$\Delta\%_{MIN}$=0 %

SPALLAMENTO RUOTA DENTATA
$\Delta\%_{MAX}$=4,07%
$\Delta\%_{MIN}$=0,04 %

GOLA SCARICO FILETTATURA
$\Delta\%_{MAX}$=11,82%
$\Delta\%_{MIN}$=0,58 %