

Università degli Studi di Padova – Dipartimento di Ingegneria Industriale

Corso di Laurea in Ingegneria Meccanica

Relazione per la prova finale
VERIFICA STRUTTURALE E RIPROGETTAZIONE STATICA E A
FATICA DI UN OCCHIELLO DI TRAINO

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Laureando: *Andrea Pavan*

Padova, 14/03/2022

COS'È UN OCCHIELLO



gancio
traino

occhiello



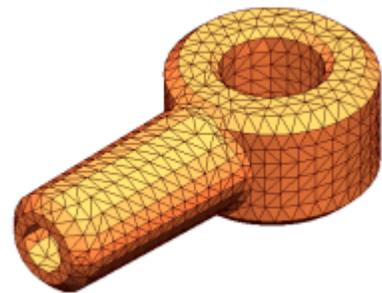
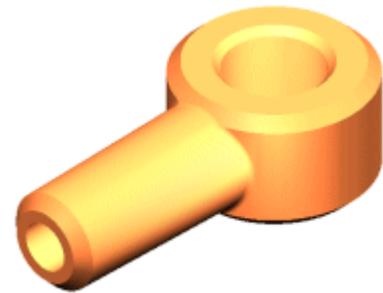
timone

trattrice



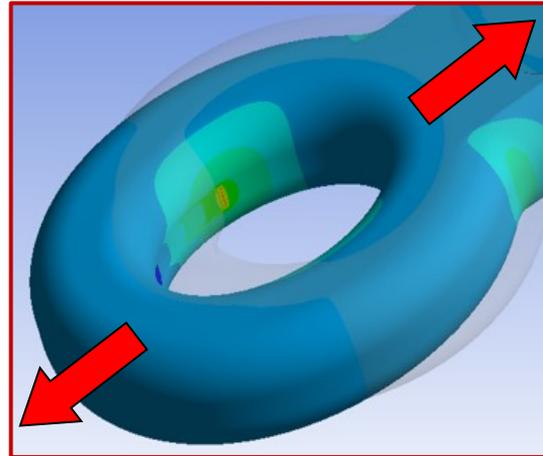
rimorchio

ELEMENTI FINITI

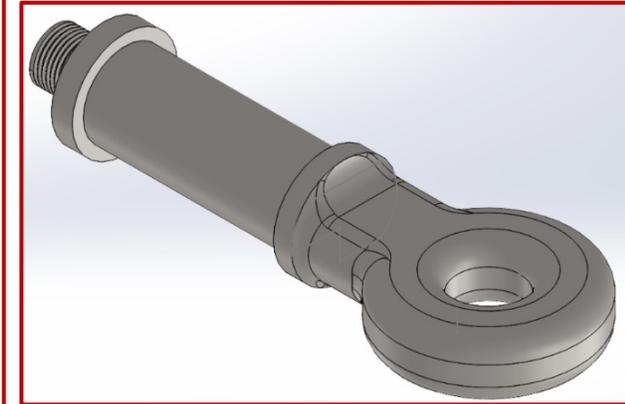




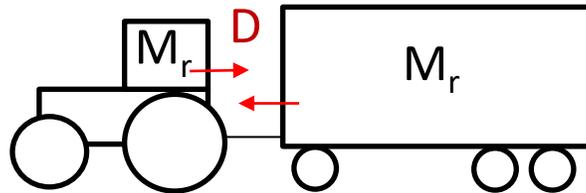
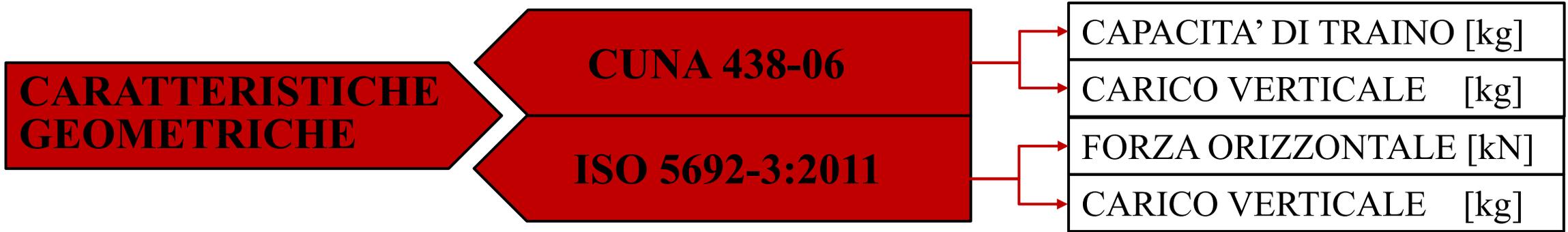
**ANALISI
STATICA-
FATICA DI UN
OCCHIELLO
ESISTENTE**



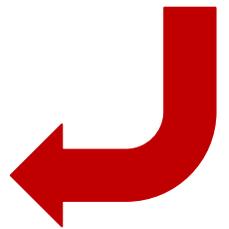
**INDIVIDUAZIONE
DELLE CRITICITA'
QUANDO
SOLLECITATO**

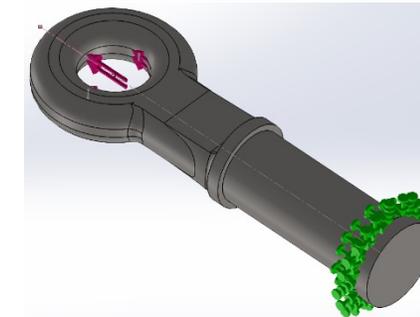
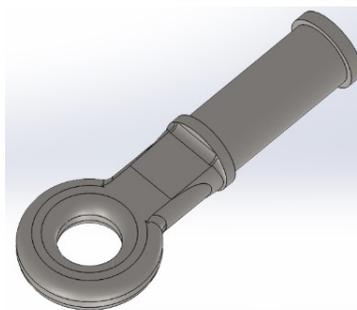


**RIPROGETTAZIONE
STATICA- FATICA DI
UN NUOVO
OCCHIELLO**



$$D = g \frac{M_t M_r}{M_t + M_r}$$





Occhiello girevole, flangiato, F3.
Materiale: 39NiCrMo3 bonificato.

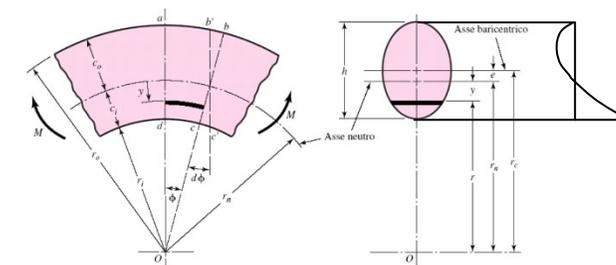
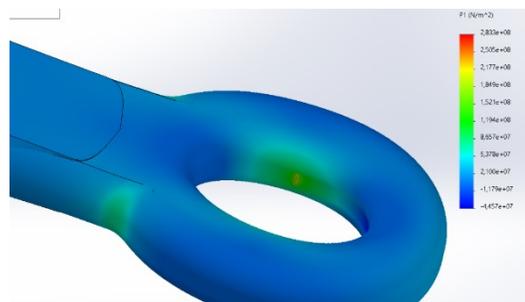
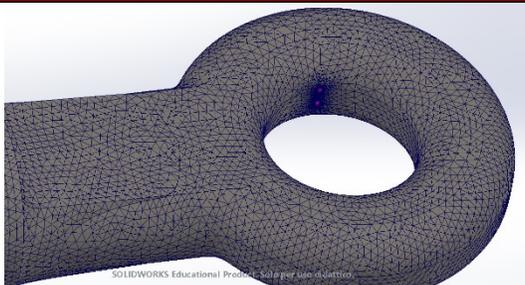
Geometria rilevata e ridefinita su
Solidworks.

Applicazione di forze e vincoli,
Forza orizzontale $D=50$ kN.

Mesh applicata al componente,
funzione 'Controllo mesh' per
risultati più accurati.

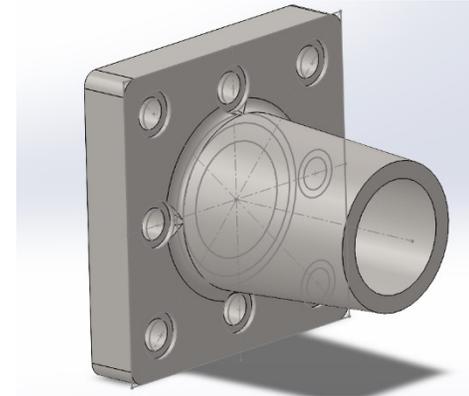
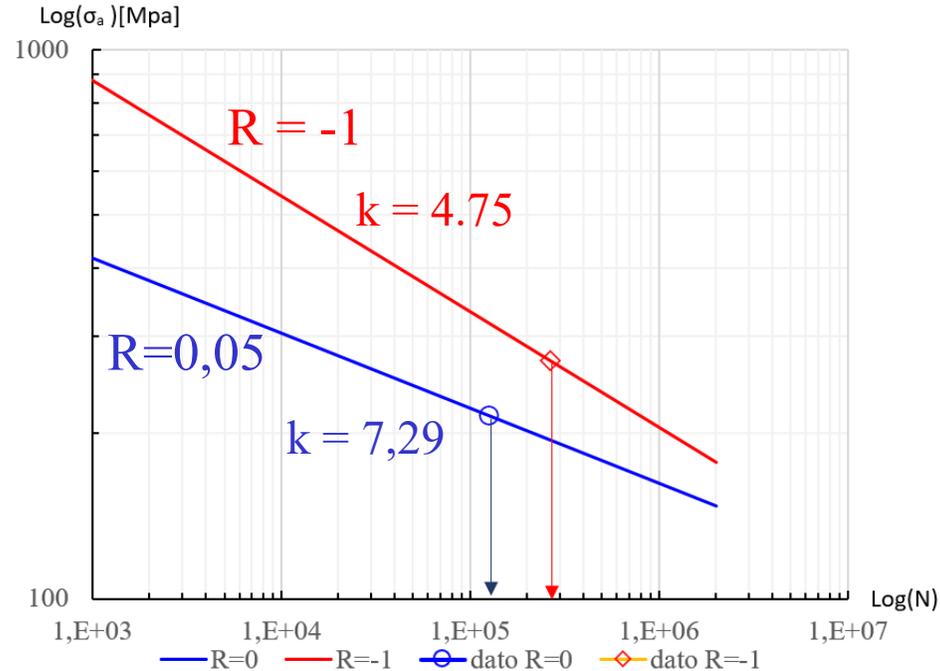
Analisi FEM con Solidworks
Simulation conferma il picco di
tensioni pari a $\sigma_i=283$ MPa.

Tensioni calcolate con la Teoria
della Trave Curva, massime
all'intradosso nelle sezioni
attorno al foro, $\sigma_i=283$ MPa.



Materiale:
39NiCrMo3

$K_d=1.21$
 $K_l=2.05$
 $K_v=1$



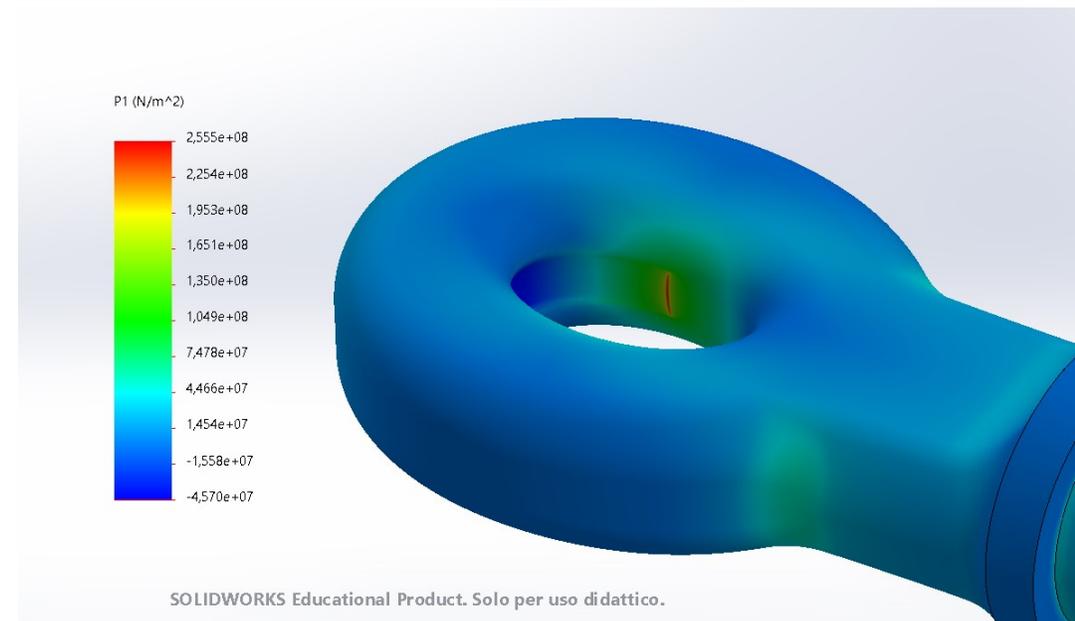
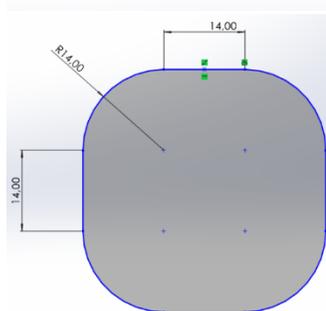
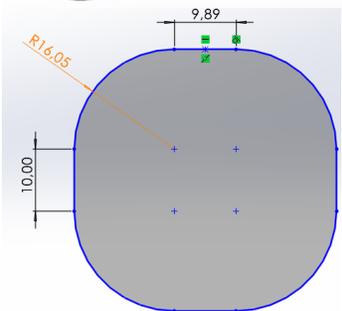
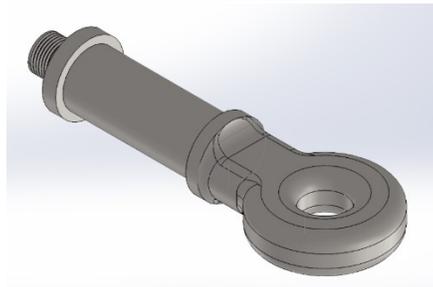
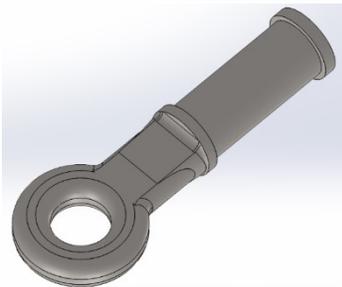
Verifica a fatica si esegue per mezzo di due prove:

- $R = -1, F = \pm 0.6 \cdot D \longrightarrow N_{obiettivo} = 267000 \text{ cicli}$
- $R = 0.05, F = \pm D \longrightarrow N_{obiettivo} = 127000 \text{ cicli}$

Entrambe i risultati sono riferiti ad una PS 97,7%

Verifica di resistenza delle giunzioni bullonate tramite la relazione ellittica di:

- 8 bulloni M20 8.8 che collegano la flangia al rimorchio
- Bullone posteriore M45x3 8.8



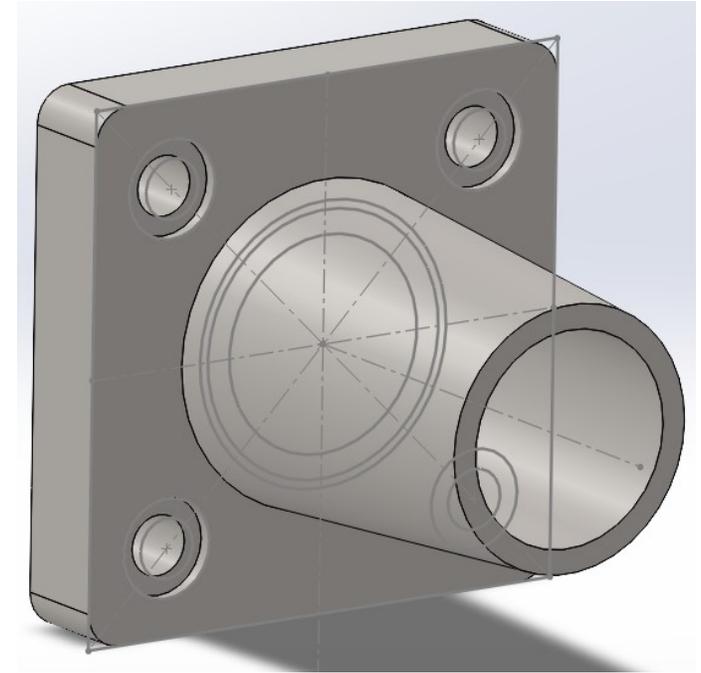
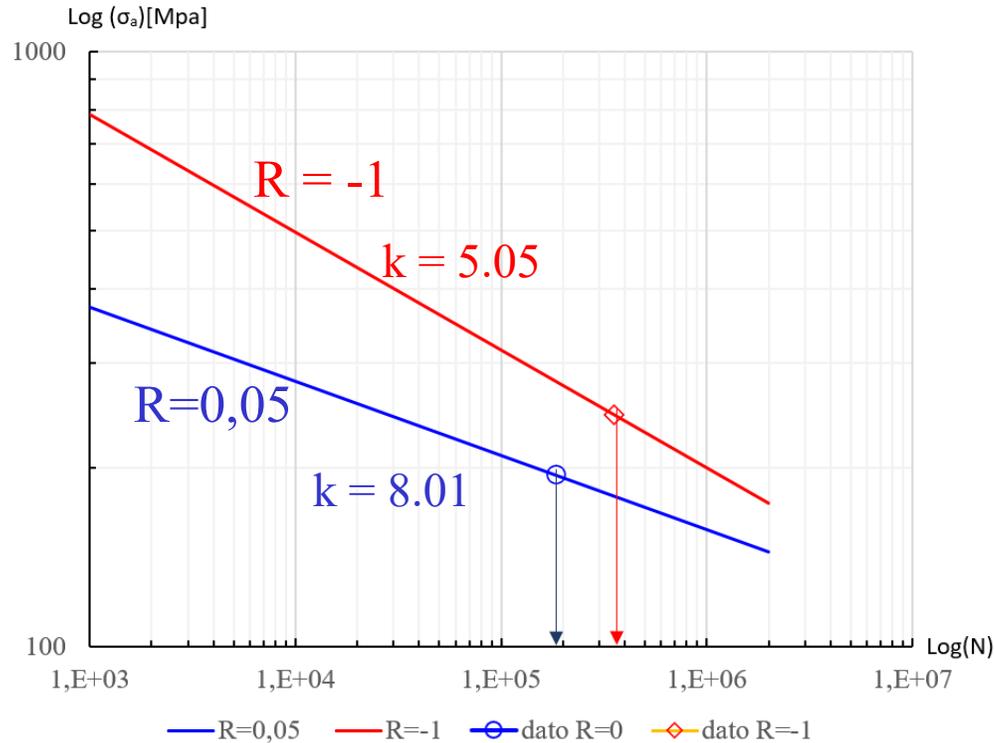
- Materiale: 35CrMo3 bonificato
- Stessi carichi applicati
- Forma mantenuta
- Dimensioni diminuite:
 1. $D = 68 \text{ mm}$ $D = 45 \text{ mm}$
 2. Sezione quadrata

Verifiche strutturali:

- Solidworks Simulation $\sigma_i = 255 \text{ MPa}$
- Metodi analitici (Teoria della Trave Curva) per:
 1. Sezione quadrata $\sigma_i = 146 \text{ MPa}$
 2. Sezione circolare $\sigma_i = 255 \text{ MPa}$

Materiale:
35CrMo3

$K_d=1.21$
 $K_l=1.85$
 $K_v=1$



Verifica a fatica si esegue per mezzo di due prove:

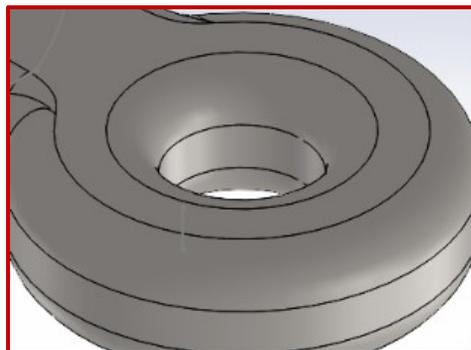
- $R = -1, F = \pm 0.6 \cdot D \longrightarrow N_{obiettivo} = 355000$ cicli
- $R = 0.05, F = \pm D \longrightarrow N_{obiettivo} = 186000$ cicli

Entrambe i risultati sono riferiti ad una PS 97,7%

- Dimensioni diminuite
- 4 x M16 8.8
- M39 5.6

39NiCrMo3 → **35CrMo3**

D=68 mm



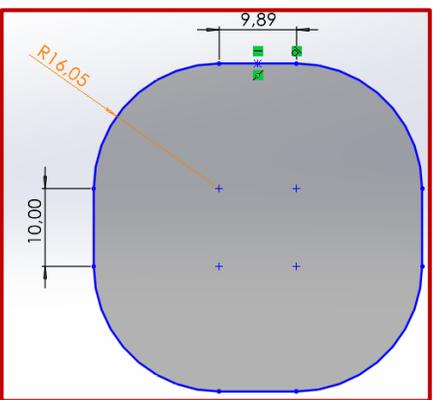
D=45 mm

Dimensioni più contenute

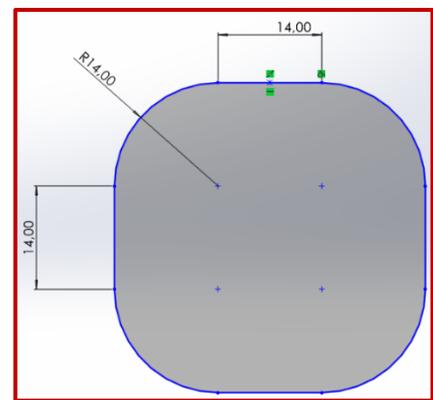
13.7 kg

8.8 kg

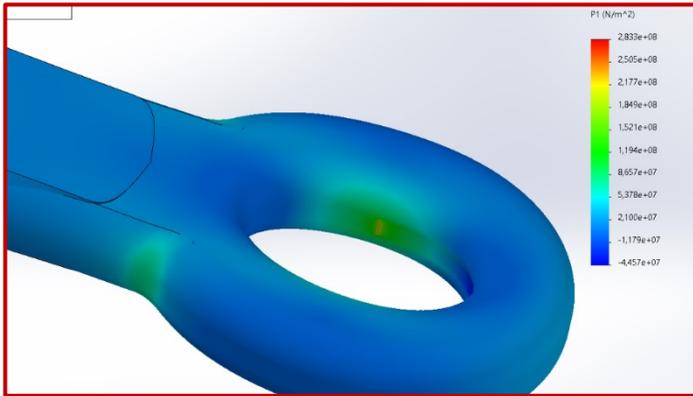
- 36 %



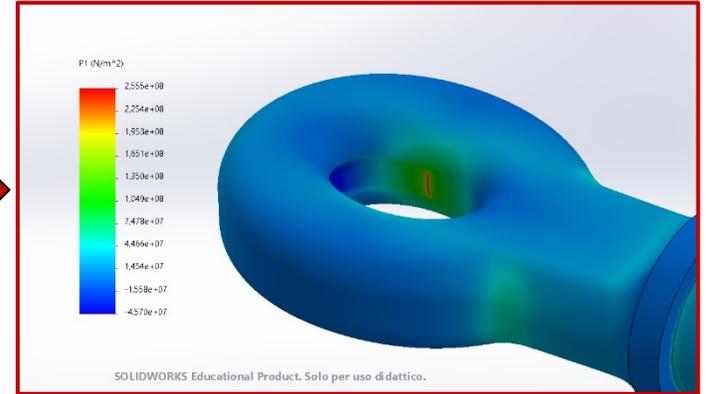
Sezione attorno al foro



$\sigma_i = 283$ MPa

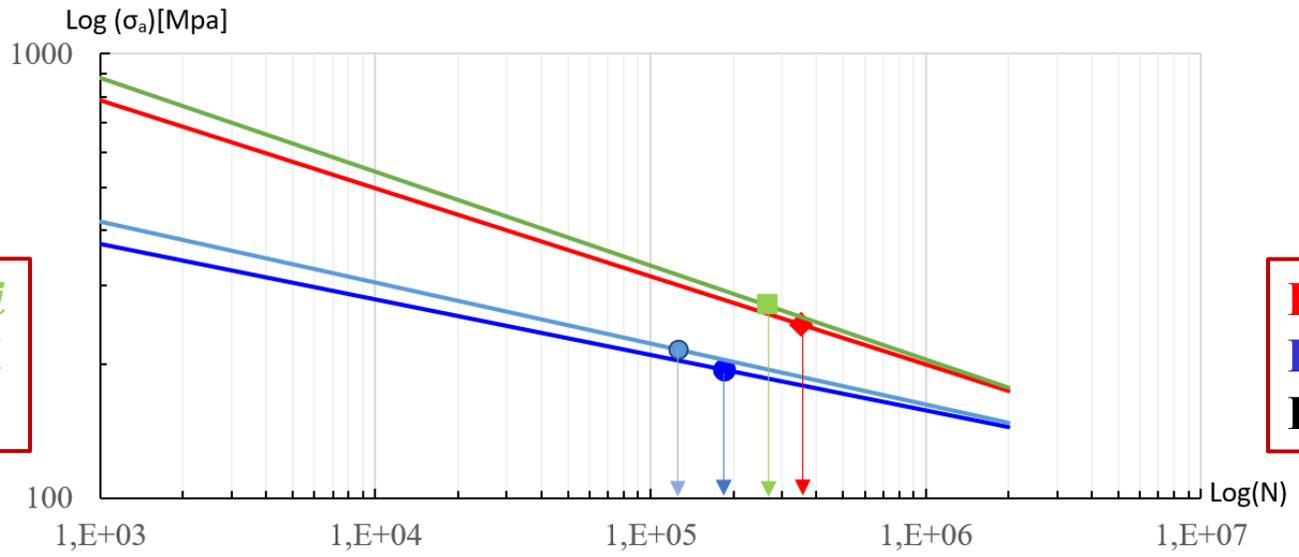


$\sigma_i = 255$ MPa



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R = -1, N = 267000 cicli
R = 0.05, N = 127000 cicli
PS 97,7%



+ 33 %

R = -1, N = 355000 cicli
R = 0.05, N = 186000 cicli
PS 97,7%

— R=0,05 — R=-1 ● dato R=0 ◇ dato R=-1
— R=0,05 caso studio — R=-1 caso studio ● dato R=0.05 caso studio ◇ dato R=-1 caso studio