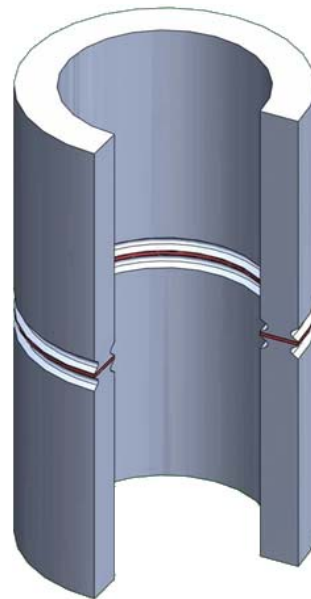


CARATTERIZZAZIONE A TRAZIONE UNIFORME DI ADESIVI STRUTTURALI SU PROVINI TUBOLARI CON GOLE SCHERMO

D. Castagnetti, E. Dragoni, A. Spaggiari

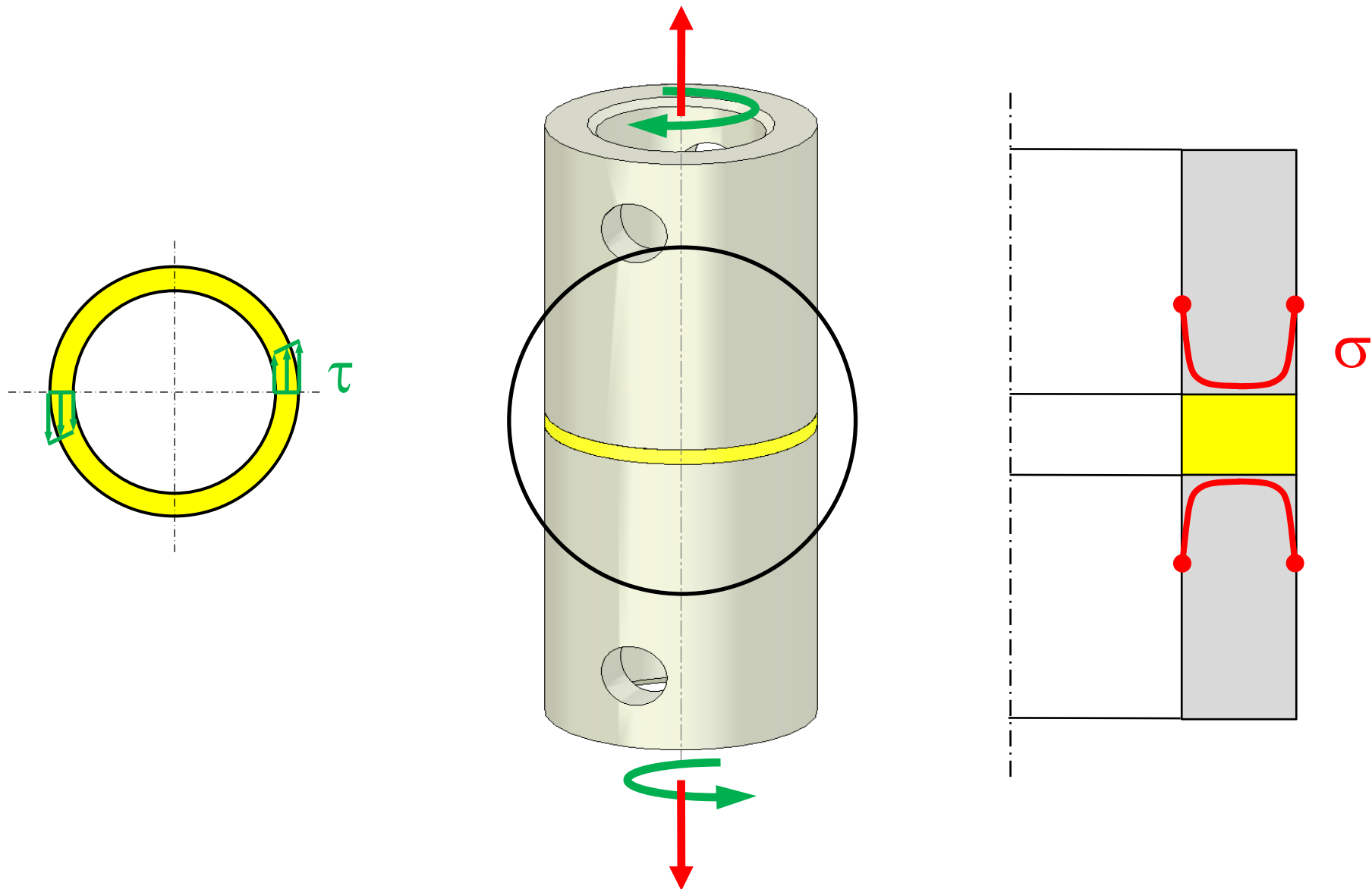


DISMI – Università di Modena e Reggio Emilia



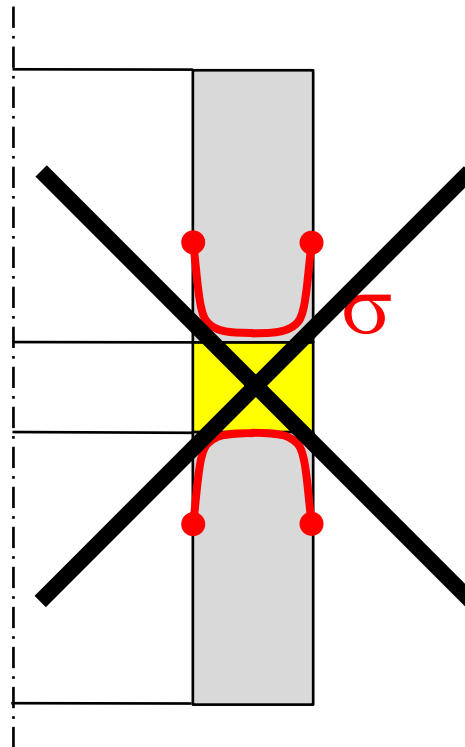
Gruppo di lavoro Tecniche di Giunzione, 8-9 Aprile 2010, Torino

MOTIVAZIONI



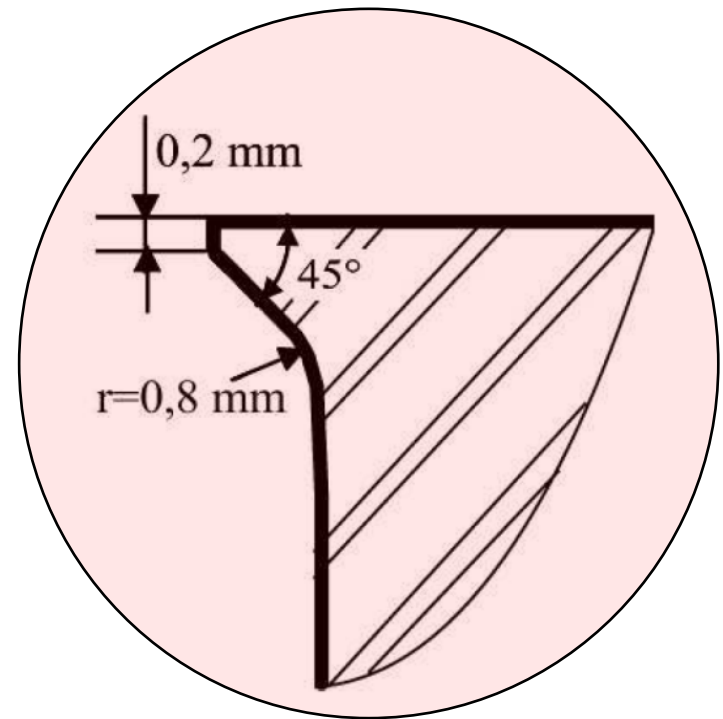
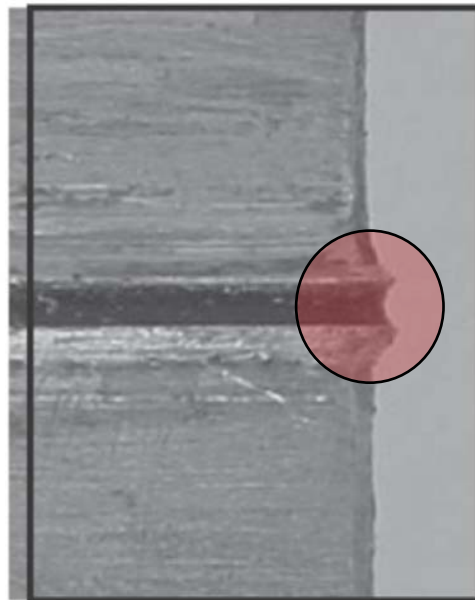
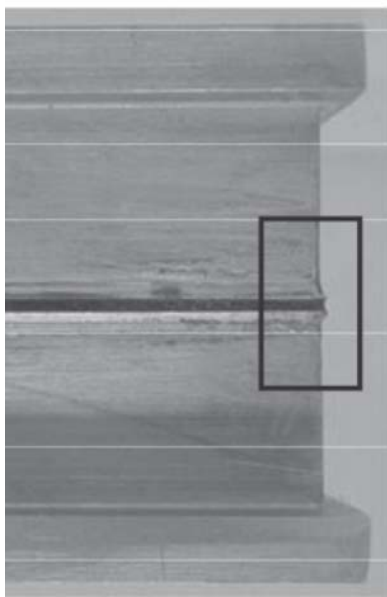
OBIETTIVO

Rimuovere le concentrazioni di tensione normale prodotte dal carico assiale



STATO DELL'ARTE

J. Y. Cognard et al, *IJAA* 2008



OTTIMIZZAZIONE ROBUSTA TAGUCHI

Risposta del sistema

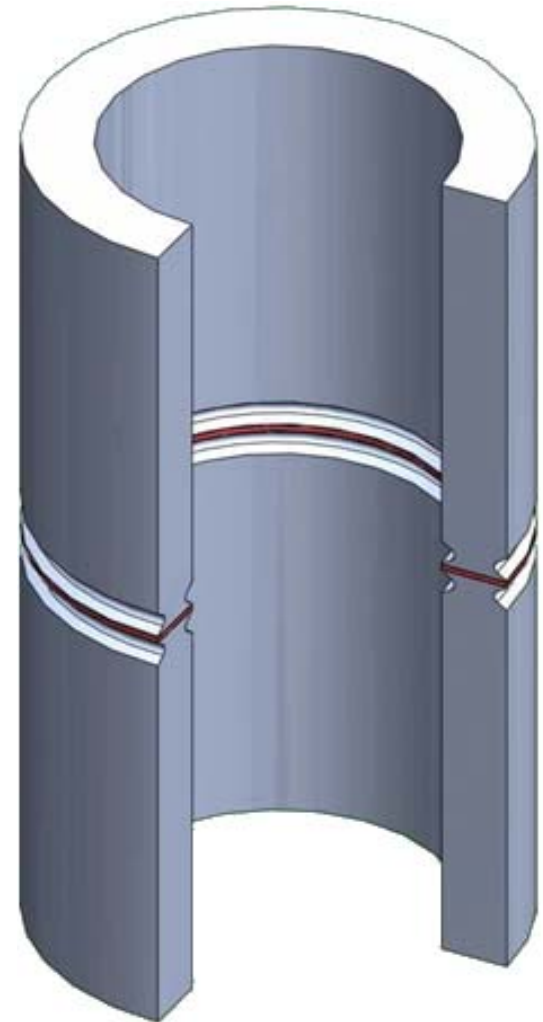
Fattori di controllo

Fattori di rumore

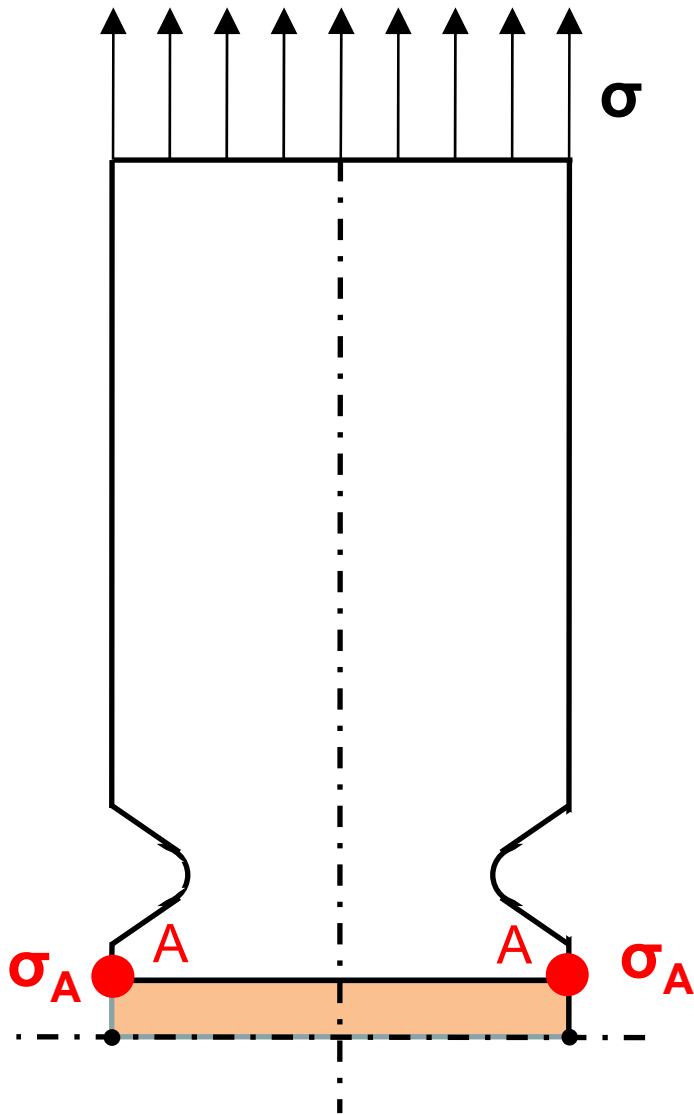
Esperimento principale

Analisi dei risultati

Esperimento di verifica

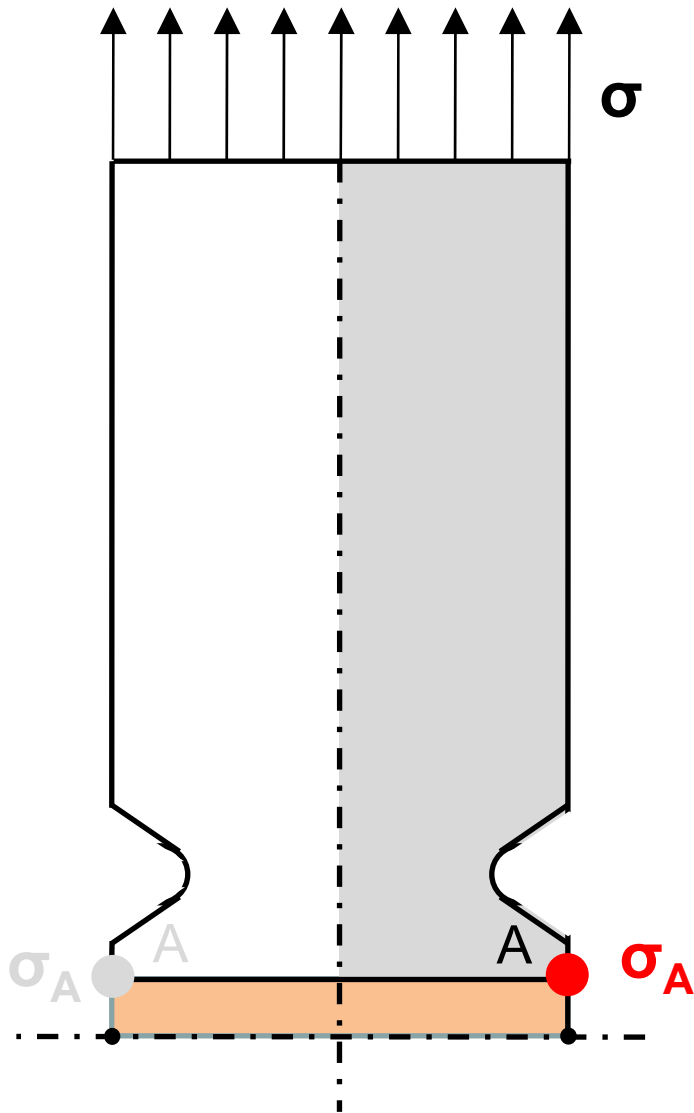


RISPOSTA DEL SISTEMA



Tensione di bordo normalizzata $\frac{\sigma_A}{\sigma}$

RISPOSTA DEL SISTEMA



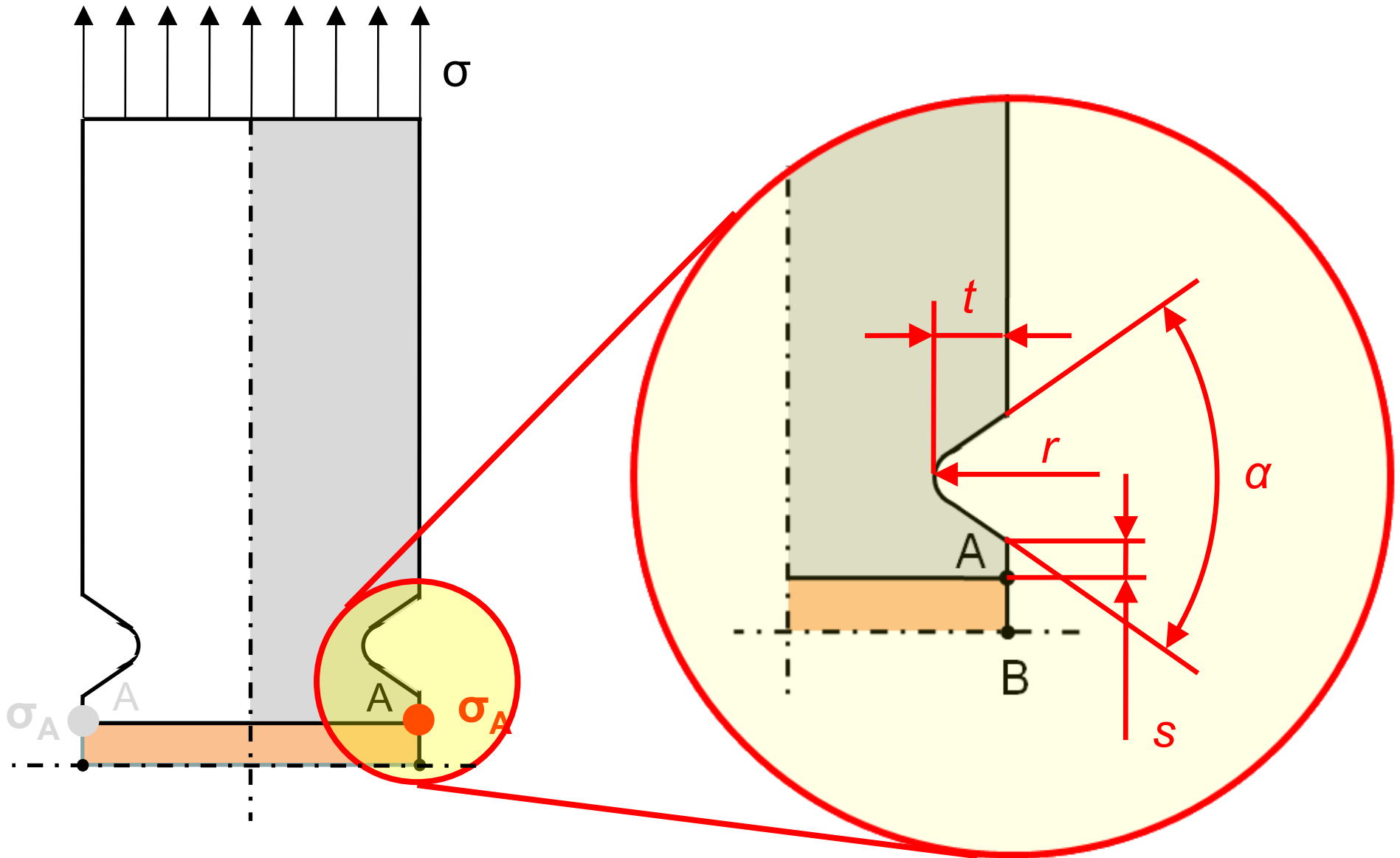
Tensione di bordo normalizzata $\frac{\sigma_A}{\sigma}$

Modello EF in deformazione piana

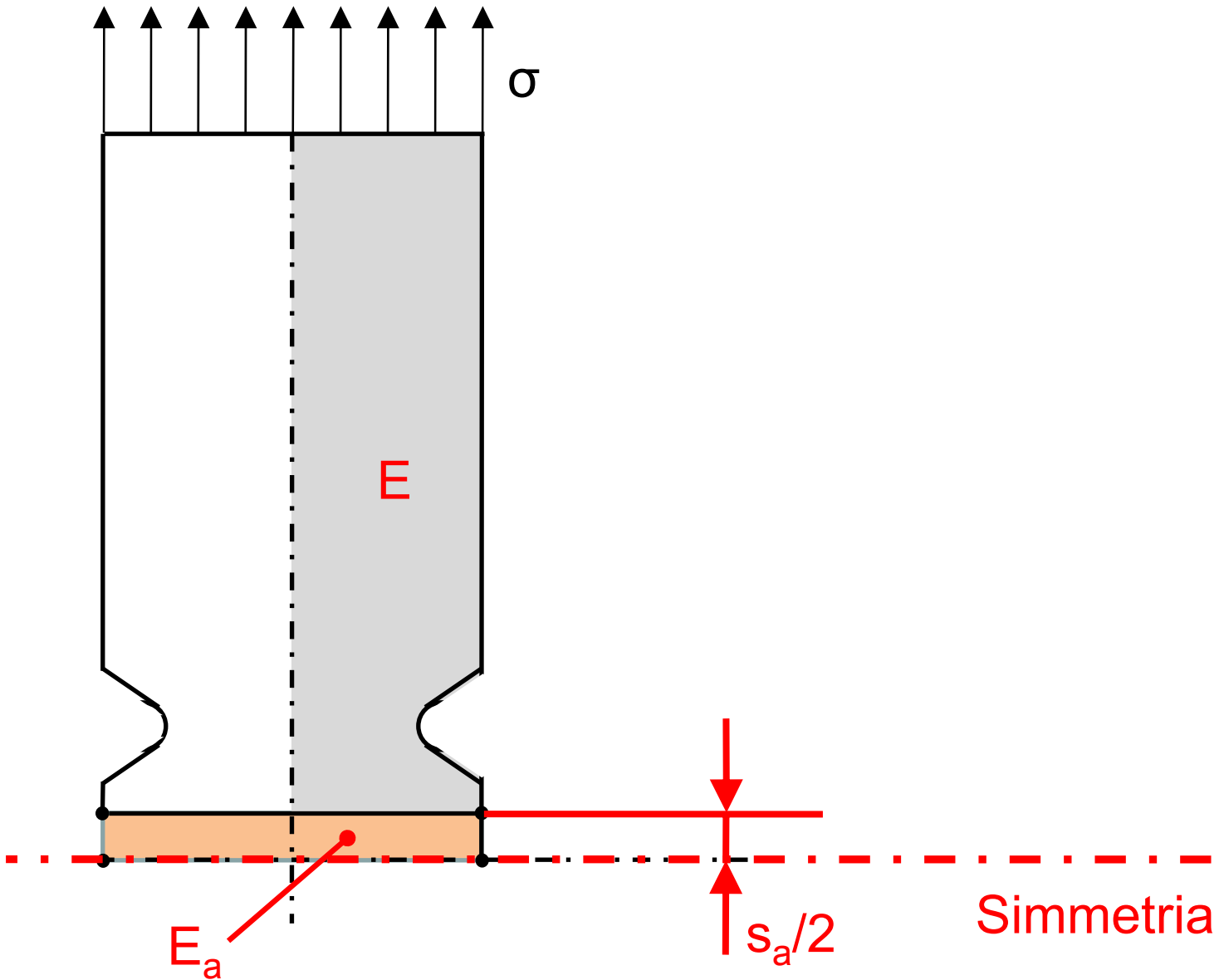
Comportamento elastico lineare

ABAQUS 6.8.1

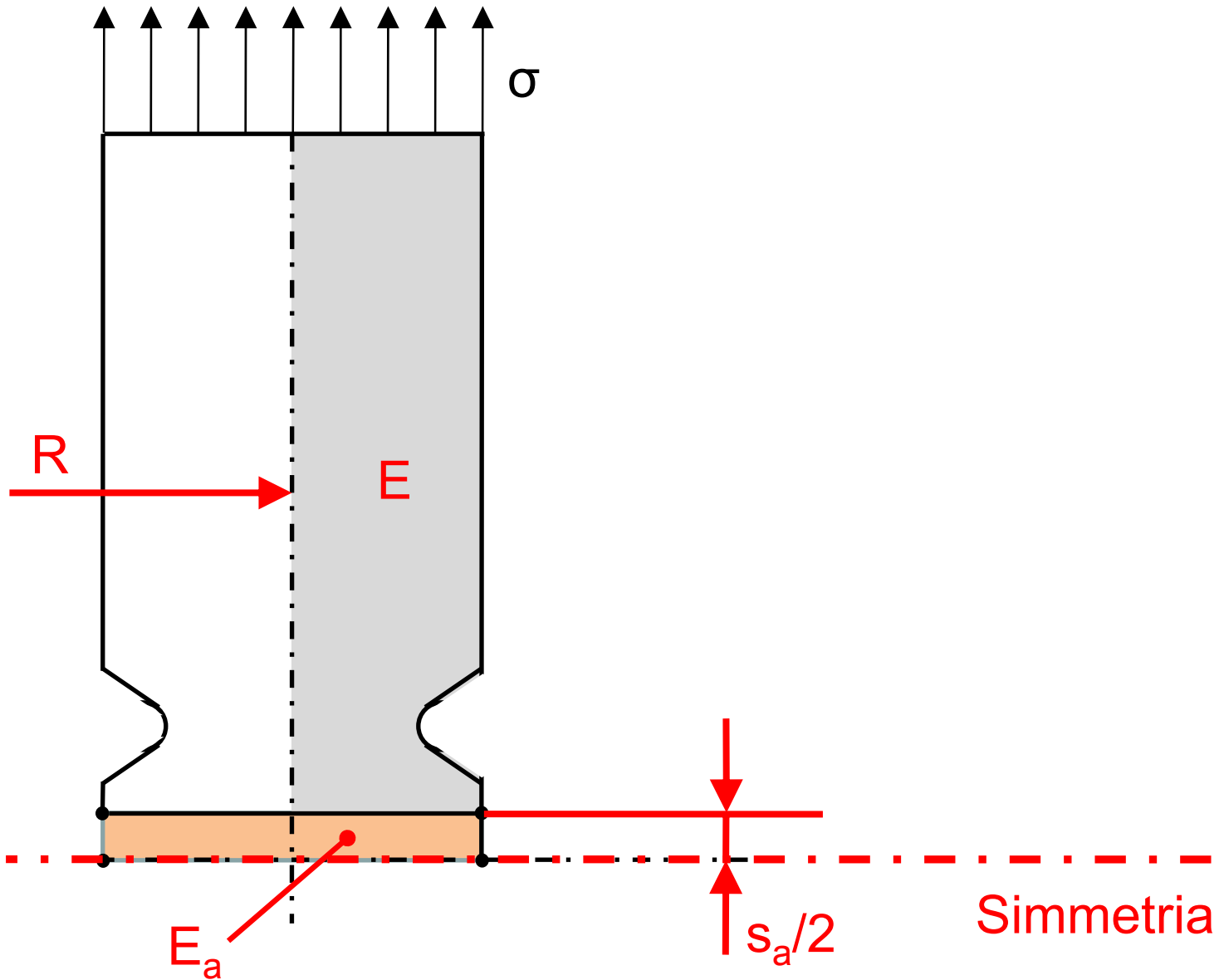
FATTORI DI CONTROLLO



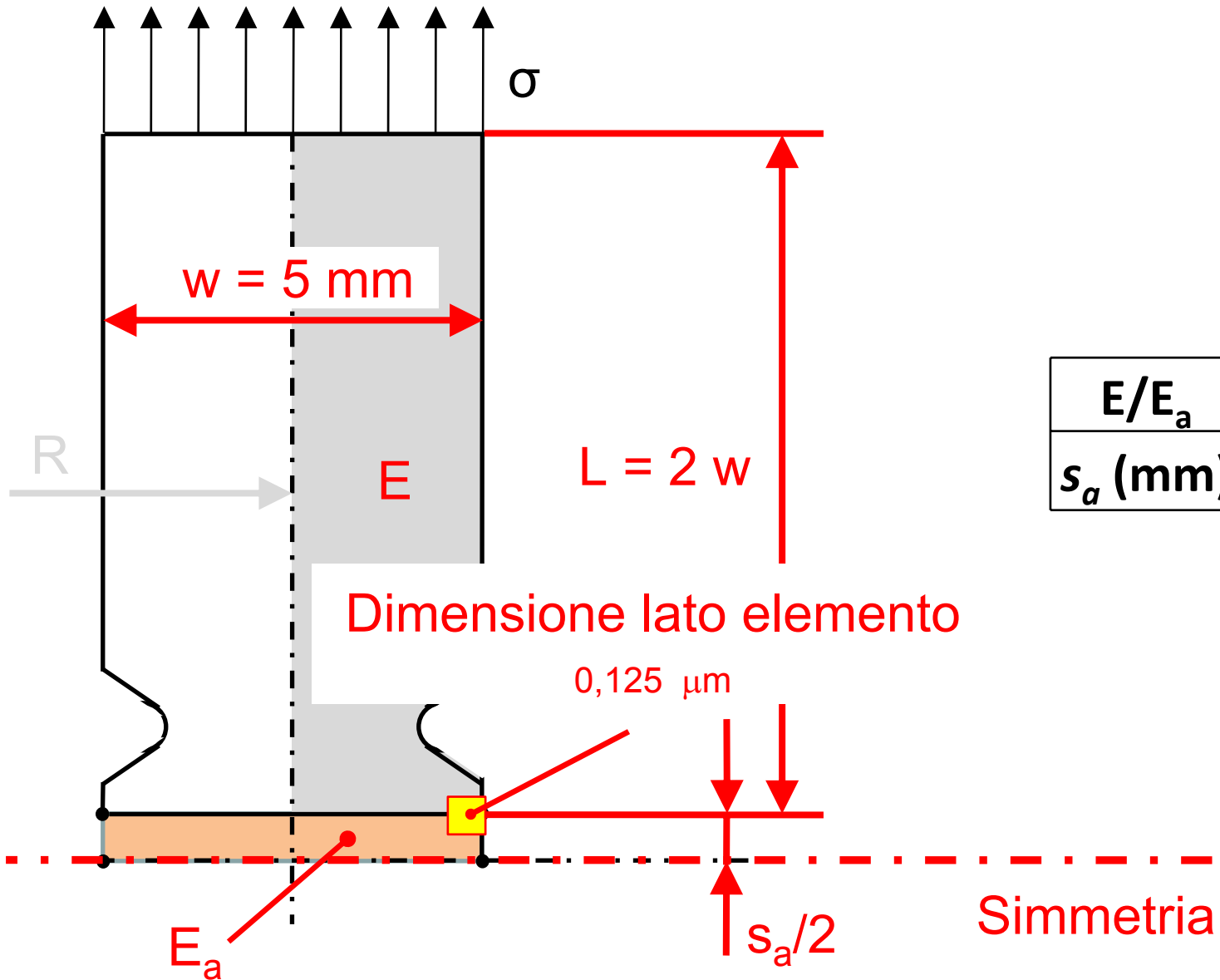
FATTORI DI RUMORE



FATTORI DI RUMORE

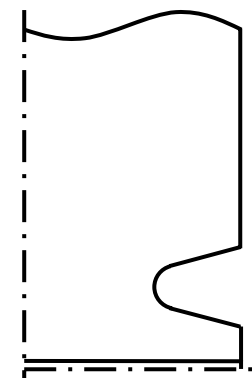
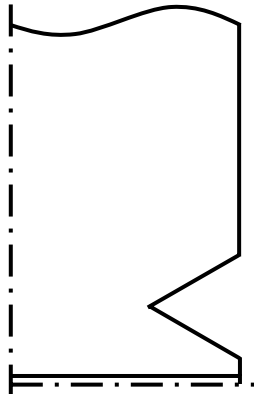
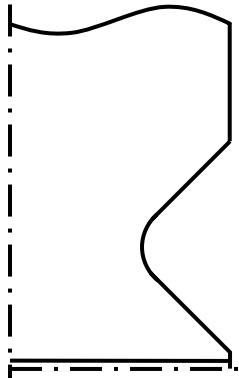
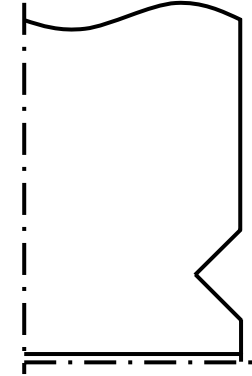
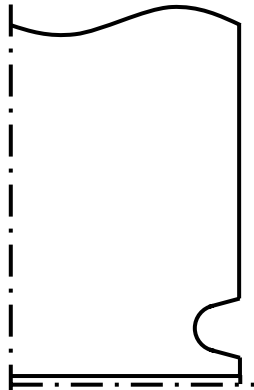
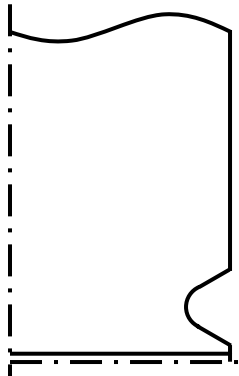
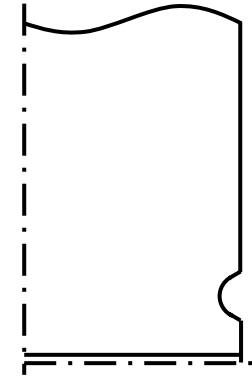
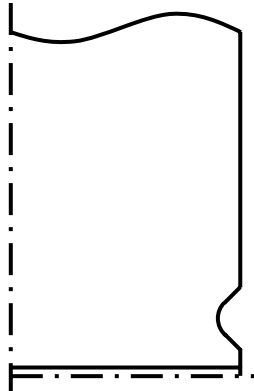
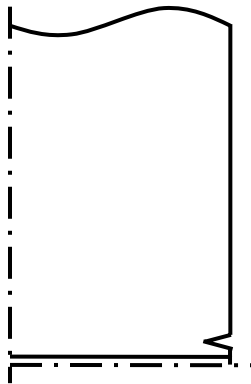


FATTORI DI RUMORE



| | | |
|------------|-----|-----|
| E/E_a | 23 | 140 |
| s_a (mm) | 0.1 | 0.4 |

ESPERIMENTO PRINCIPALE



ESPERIMENTO PRINCIPALE

Fattori di rumore

Fattori di controllo

L_g

| | | | | |
|------------|-----|-----|-----|-----|
| E/E_a | 23 | 140 | 23 | 140 |
| s_a (mm) | 0.1 | 0.1 | 0.4 | 0.4 |

| Ordine std. | s (mm) | t (mm) | r (mm) | α (°) | Tensione di bordo normalizzata | | | |
|----------------------------------|----------|----------|----------|--------------|--------------------------------|--|--|--|
| 1 | 0.1 | 0.25 | 0 | 30 | | | | |
| 2 | 0.1 | 0.5 | 0.5 | 60 | | | | |
| 3 | 0.1 | 1 | 1 | 90 | | | | |
| 4 | 0.2 | 0.25 | 0.5 | 90 | | | | |
| 5 | 0.2 | 0.5 | 1 | 30 | | | | |
| 6 | 0.2 | 1 | 0 | 60 | | | | |
| 7 | 0.4 | 0.25 | 1 | 60 | | | | |
| 8 | 0.4 | 0.5 | 0 | 90 | | | | |
| 9 | 0.4 | 1 | 0.5 | 30 | | | | |
| Giunto di riferimento senza gole | | | | | | | | |

ESPERIMENTO PRINCIPALE

Fattori di rumore

Fattori di controllo

L_g

| | | | | |
|------------|-----|-----|-----|-----|
| E/E_a | 23 | 140 | 23 | 140 |
| s_a (mm) | 0.1 | 0.1 | 0.4 | 0.4 |

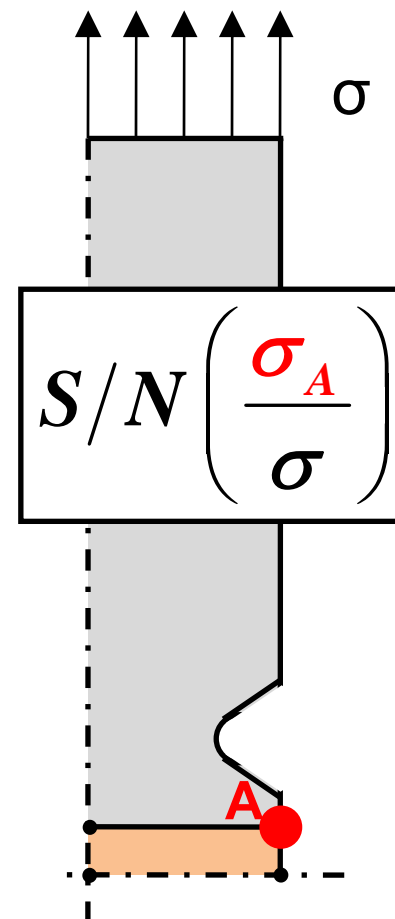
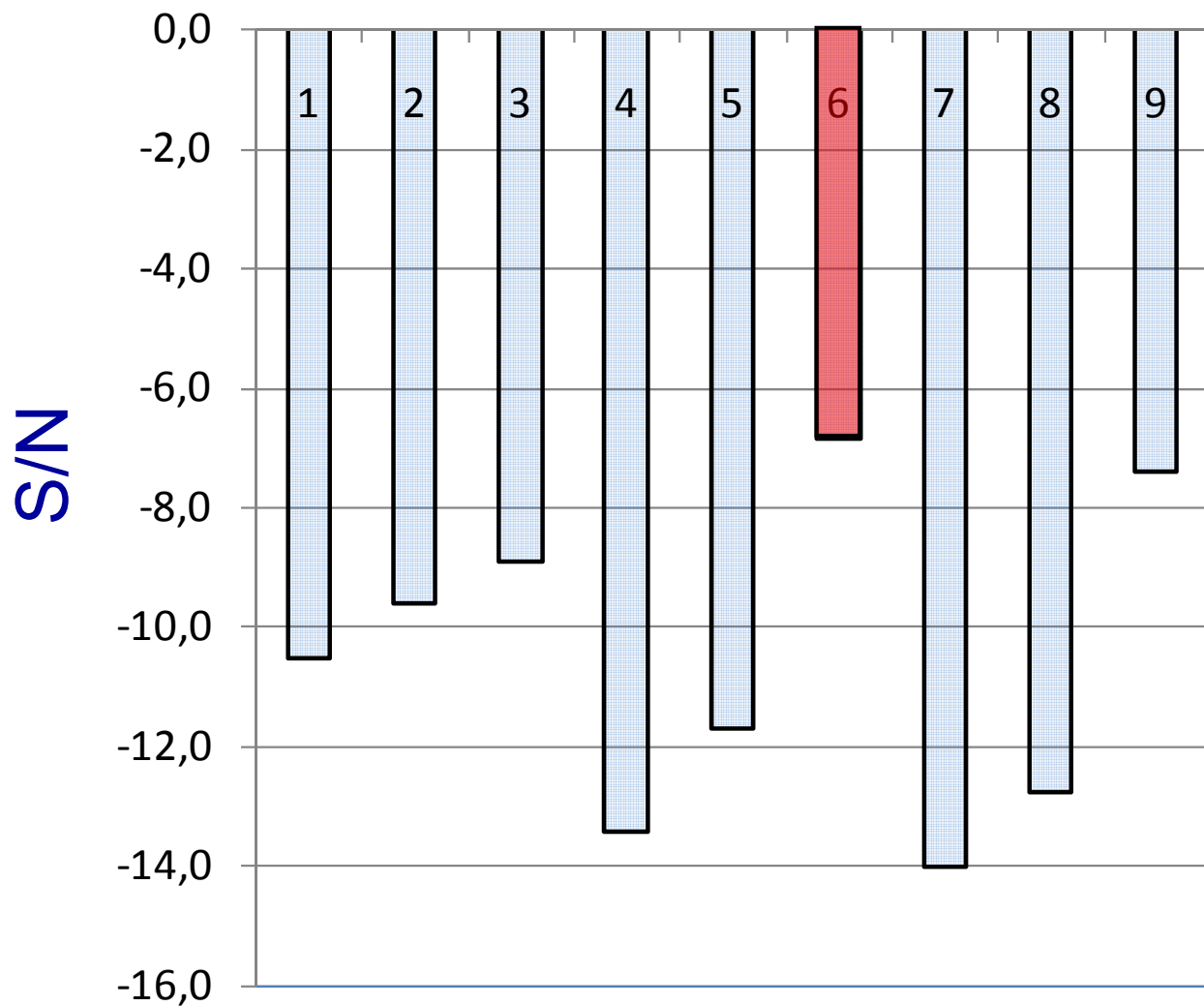
| Ordine std. | s (mm) | t (mm) | r (mm) | α (°) | Tensione di bordo normalizzata | | | |
|---|----------|----------|----------|--------------|--------------------------------|------|------|------|
| | | | | | | | | |
| 1 | 0.1 | 0.25 | 0 | 30 | 0.13 | 2.45 | 1.83 | 5.97 |
| 2 | 0.1 | 0.5 | 0.5 | 60 | 0.28 | 1.77 | 1.35 | 5.61 |
| 3 | 0.1 | 1 | 1 | 90 | 0.34 | 1.35 | 0.94 | 5.31 |
| 4 | 0.2 | 0.25 | 0.5 | 90 | 1.92 | 4.17 | 4.09 | 7.10 |
| 5 | 0.2 | 0.5 | 1 | 30 | 0.57 | 3.03 | 2.73 | 6.51 |
| 6 | 0.2 | 1 | 0 | 60 | 0.74 | 0.31 | 0.01 | 4.33 |
| 7 | 0.4 | 0.25 | 1 | 60 | 2.61 | 4.48 | 4.58 | 7.26 |
| 8 | 0.4 | 0.5 | 0 | 90 | 1.36 | 3.72 | 3.60 | 6.87 |
| 9 | 0.4 | 1 | 0.5 | 30 | 0.78 | 0.52 | 0.19 | 4.60 |
| Giunto di riferimento senza gole | | | | | 3.66 | 4.97 | 5.23 | 7.43 |

ANALISI DEI RISULTATI

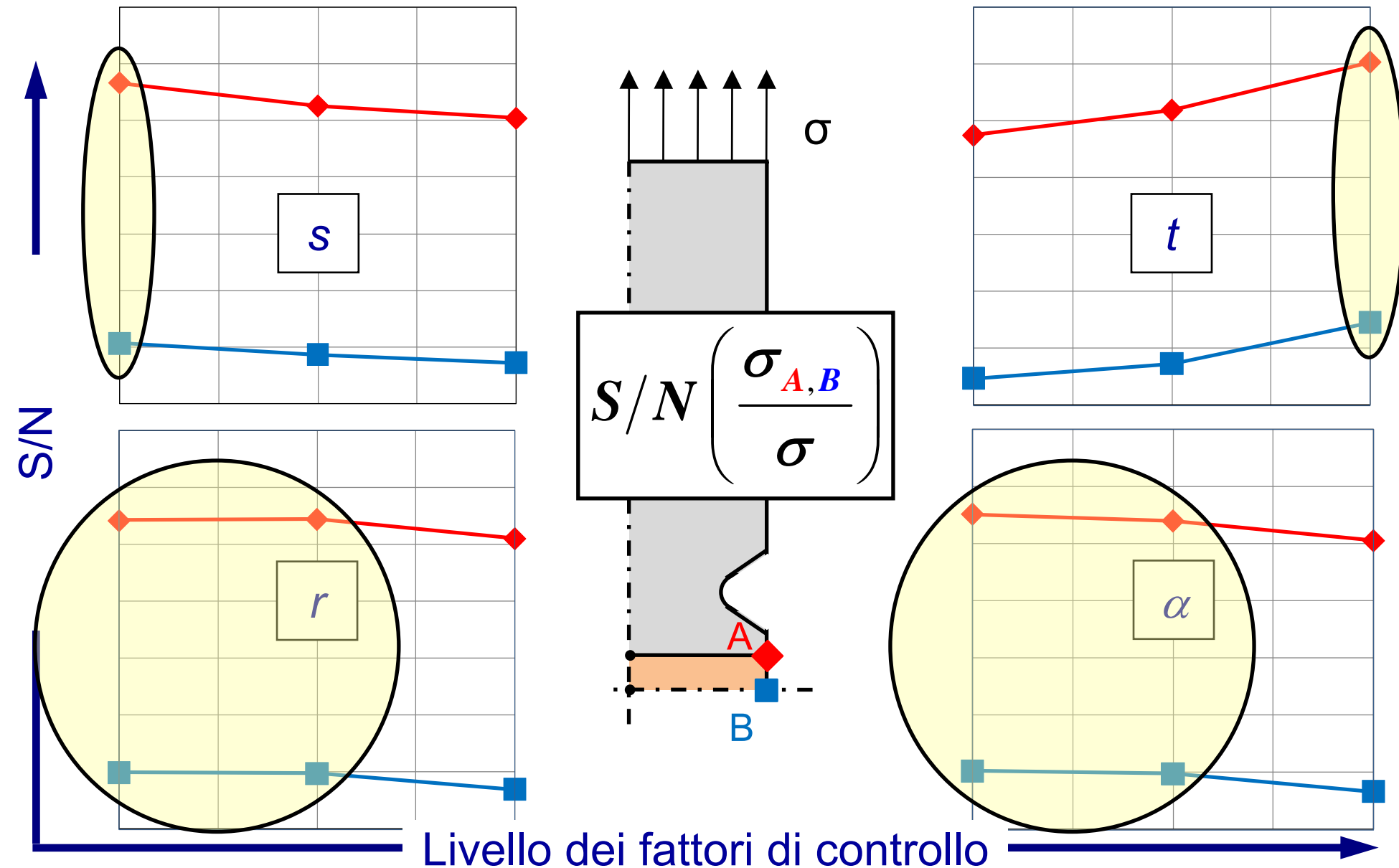
Problema “Smaller the better”

$$S/N = -10 \log \left(\frac{1}{n} \sum_{i=1}^9 \left(\frac{1}{(\sigma_A/\sigma)_i} \right)^2 \right)$$

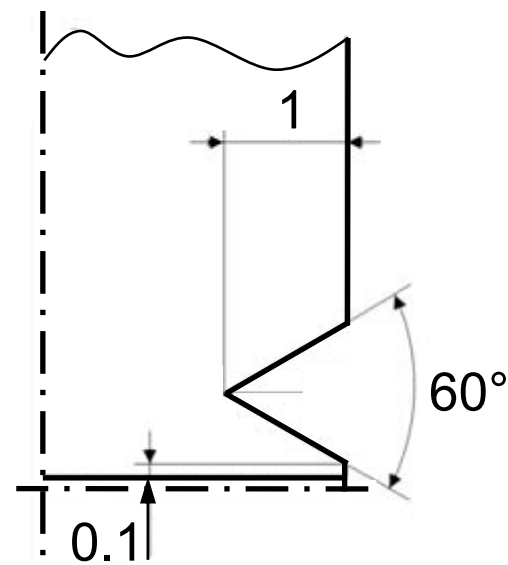
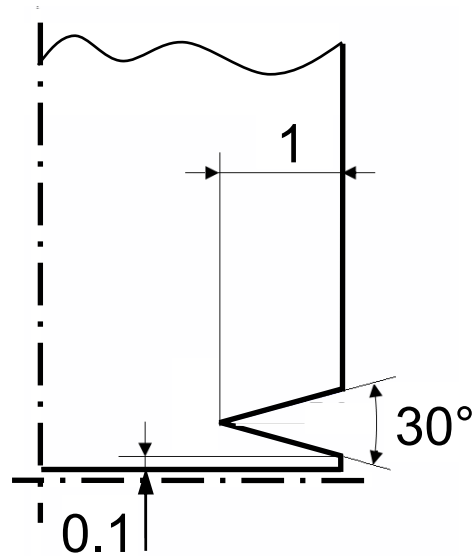
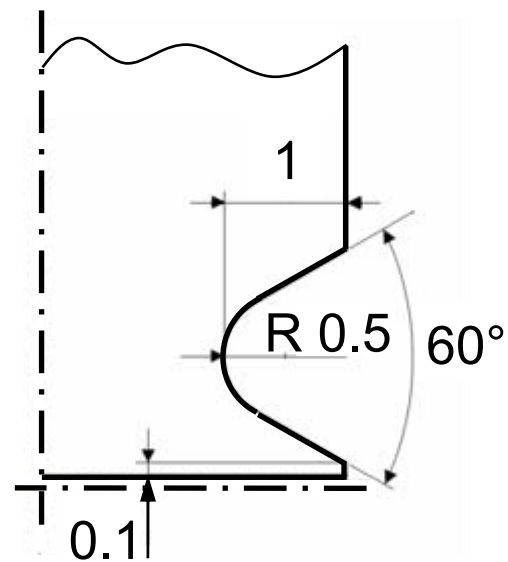
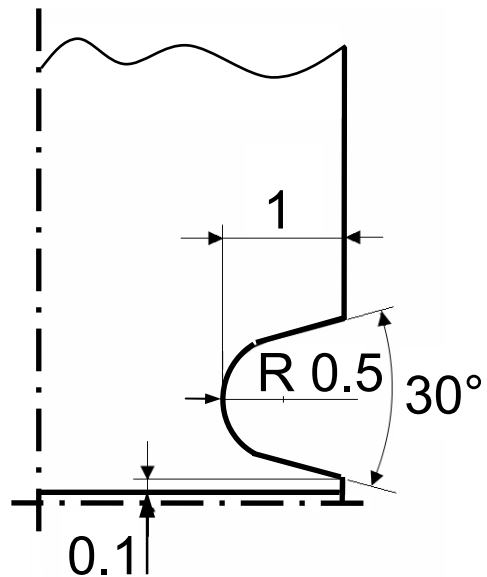
ANALISI DEI RISULTATI



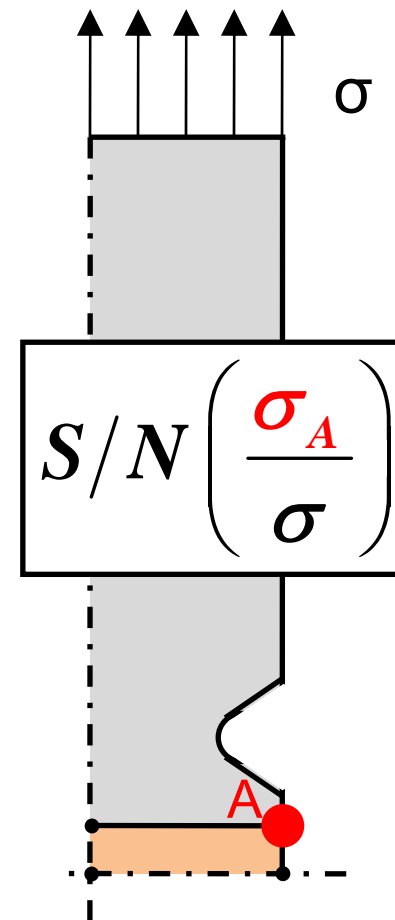
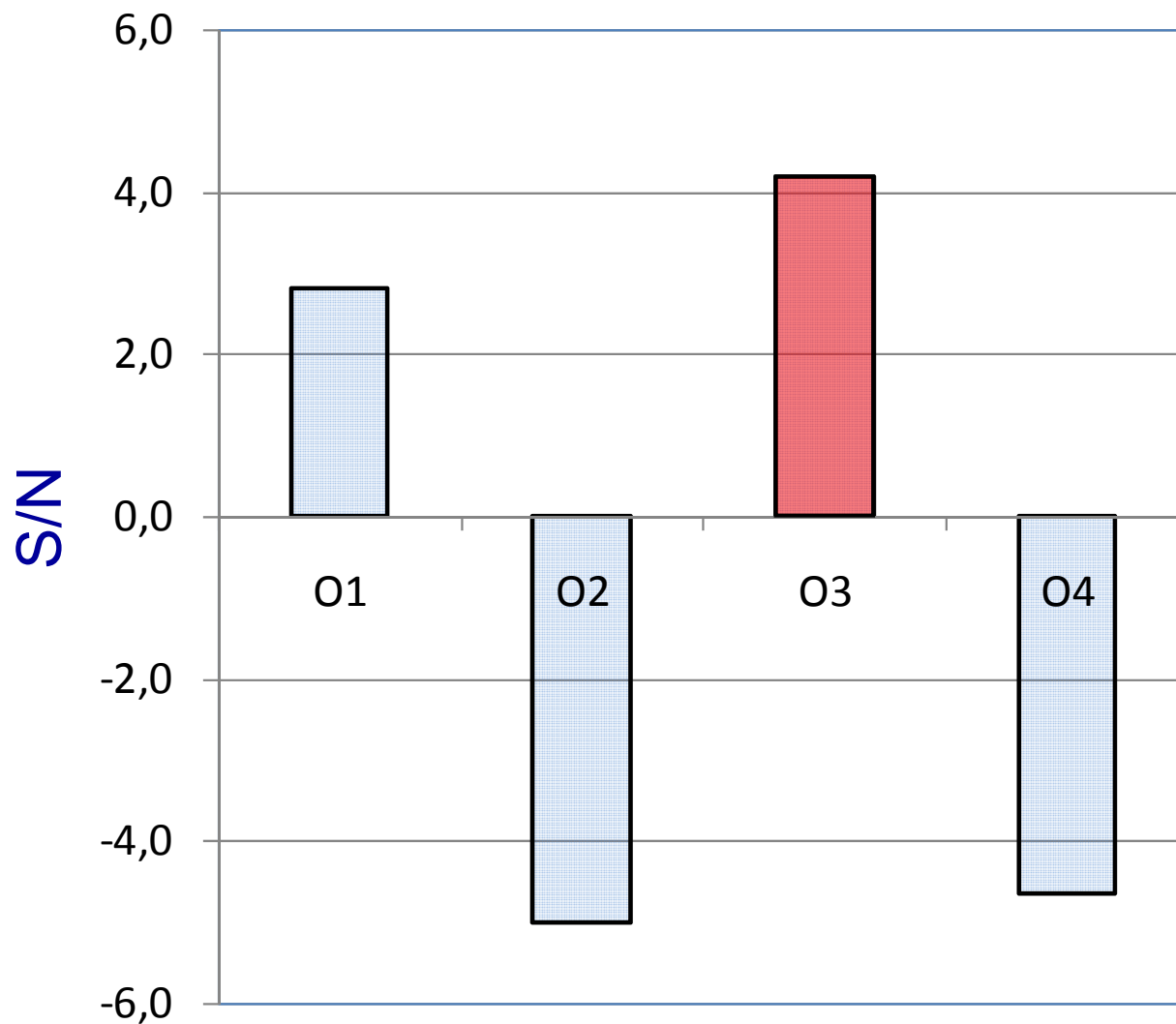
ANALISI DEI RISULTATI



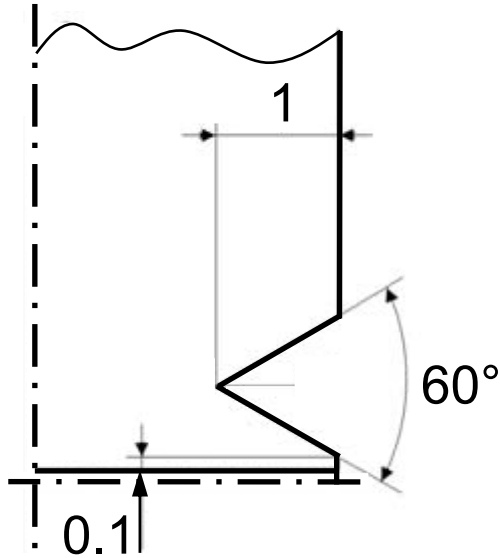
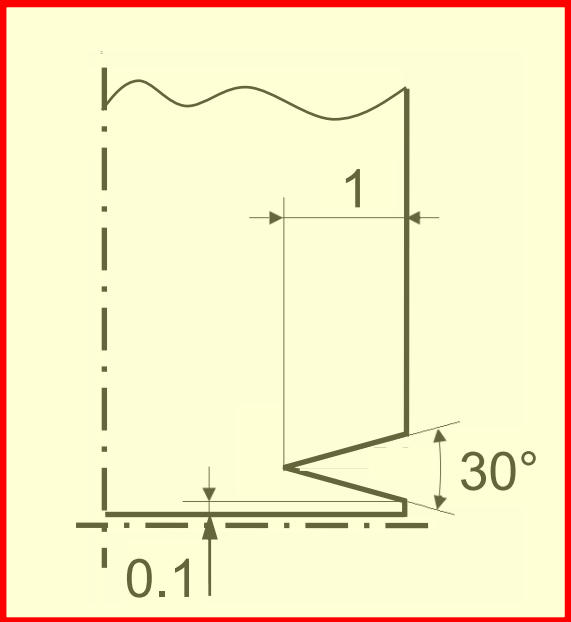
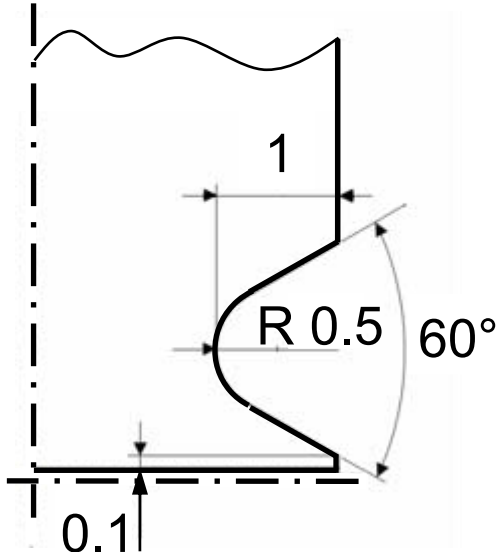
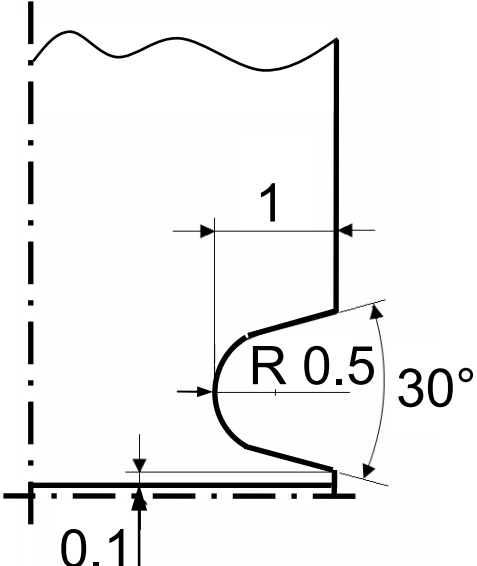
ESPERIMENTO DI VERIFICA



ESPERIMENTO DI VERIFICA

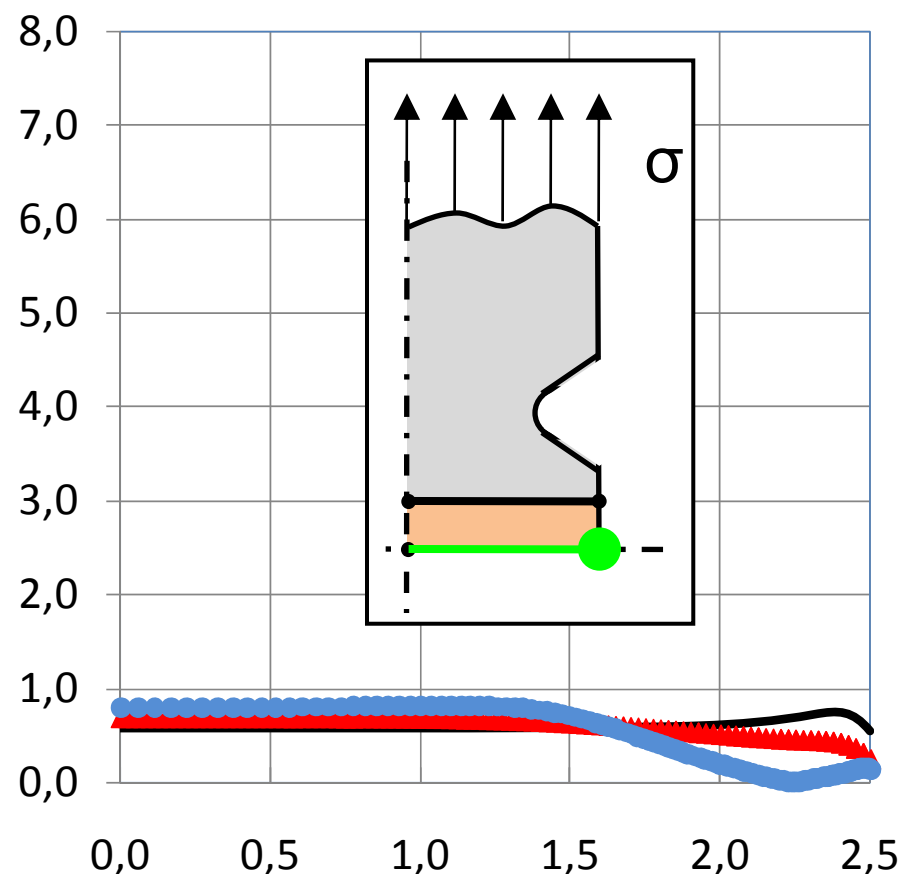
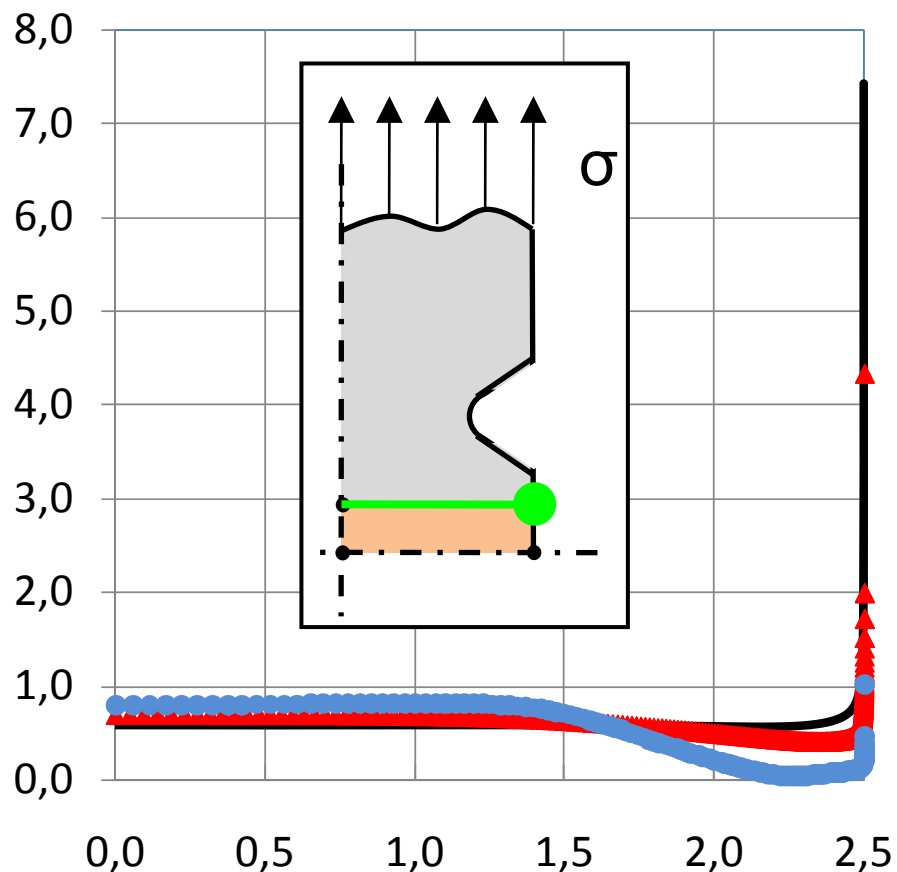


ESPERIMENTO DI VERIFICA



ESPERIMENTO DI VERIFICA

— Geometria di riferimento ▲ Configurazione standard 6 ● Configurazione O3



Spessore di parete aderendo

VERIFICA SPERIMENTALE

| | - | + |
|---------------------------|------------|----------|
| Tipo di giunzione | senza gole | con gole |
| Spessore adesivo | 0.1 | 0.4 |
| Materiale aderendi | Al 2020 | Fe 360 |

5 ripetizioni

40 giunzioni



CONCLUSIONI

Rimuovere concentrazioni di tensione sui bordi liberi

Ottimizzazione robusta della forma di gola schermo

Identificata gola ottima superficiale di forma a V

Convalida sperimentale