

Stress concentration

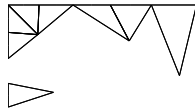
Mesh and boundary conditions

Aluminium alloy : $E = 72 \text{ GPa}$, $\nu=0.32$

$\sigma_\infty = 100\text{MPa}$, square plate: $10\text{mm} \times 10\text{mm}$, hole: $r=1\text{mm}$

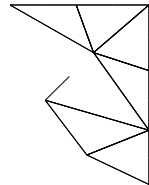
circle

1089 nodes, 488 elts



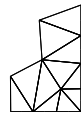
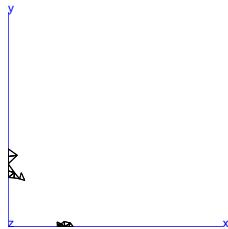
circle0

274 nodes, 121 elts



circle00

77 nodes, 121 elts



Validity of Paterson's formula

Stress concentration factor for an ellipse (Paterson) :

$$K_{tg} = 1 + 2 \frac{b}{a}$$

with b horizontal axis, a vertical axis for a vertical tension on the plate.

type of geometry	$1 + 2 \frac{b}{a}$	Finite Element
circle, $a=b=1\text{mm}$	3	3.018
ellipse, $a=0.4\text{mm}$; $b=1.\text{mm}$	6	5.995
ellipse, $a=2.5\text{mm}$; $b=1.\text{mm}$	1.8	1.821

Comparison between circle and "flat" hole

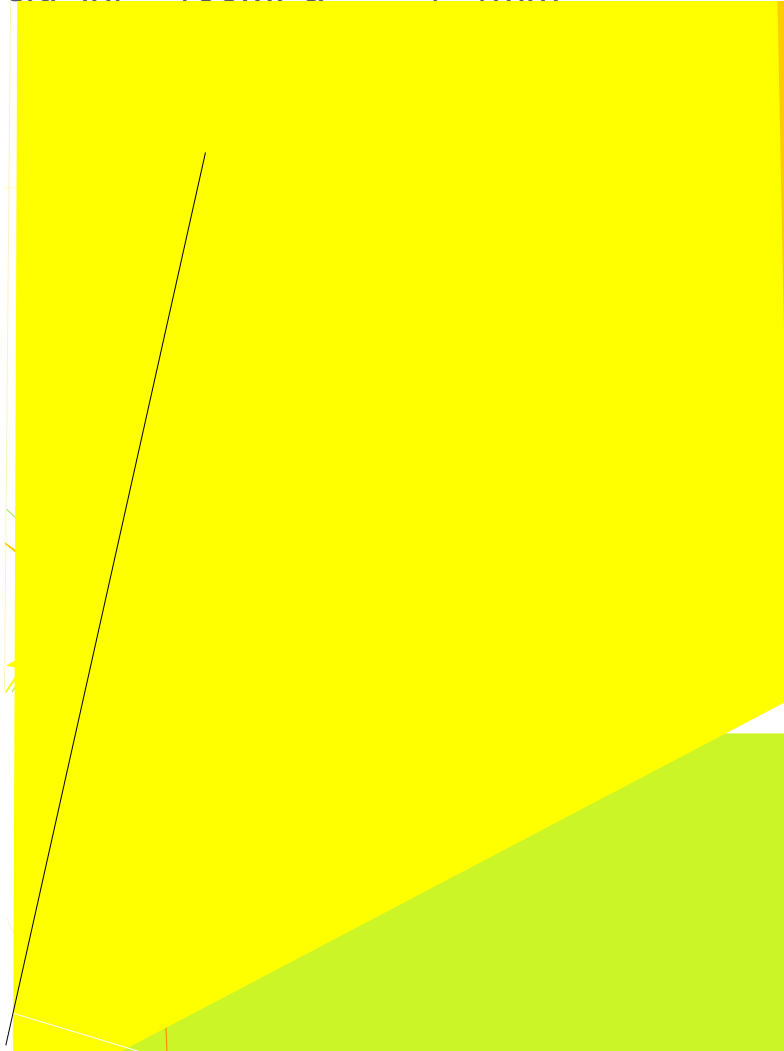
Comparison between circle and "flat" hole

sig22 contour plot

circle

sig inf = 100MPa

r=1mm



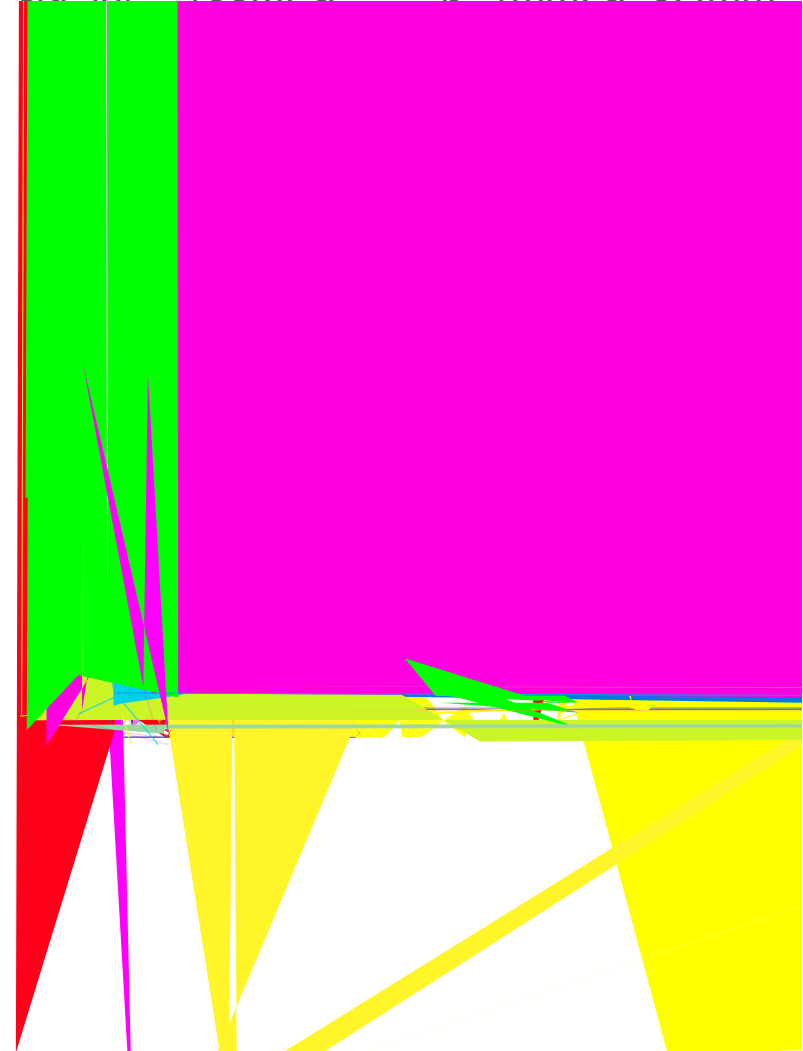
circle (max=301 MPa)

sig22 contour plot

ellipse

sig inf = 100MPa

b=1mm, a=0.4mm

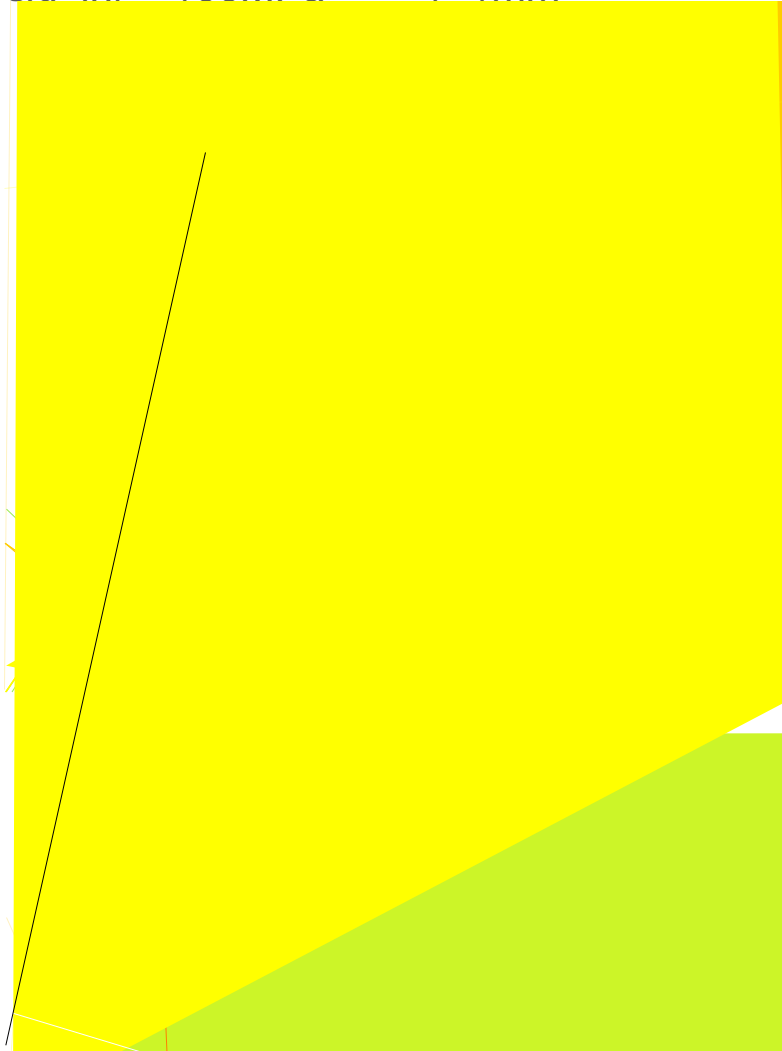


flat (max= 599 MPa)

Comparison between circle and "elongated" hole

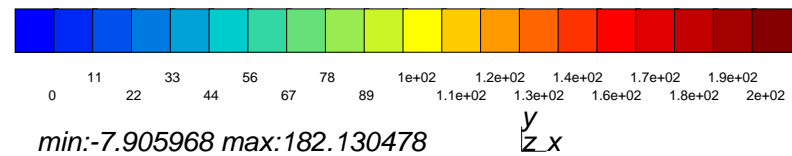
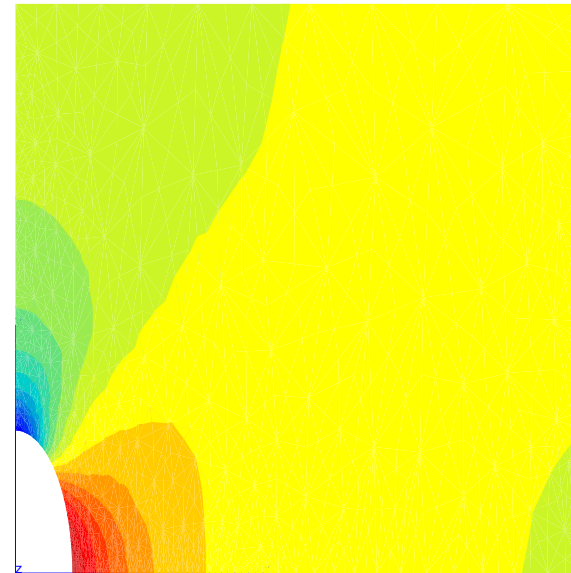
Comparison between circle and "elongated" hole

sig22 contour plot circle
sig_inf = 100MPa r=1mm



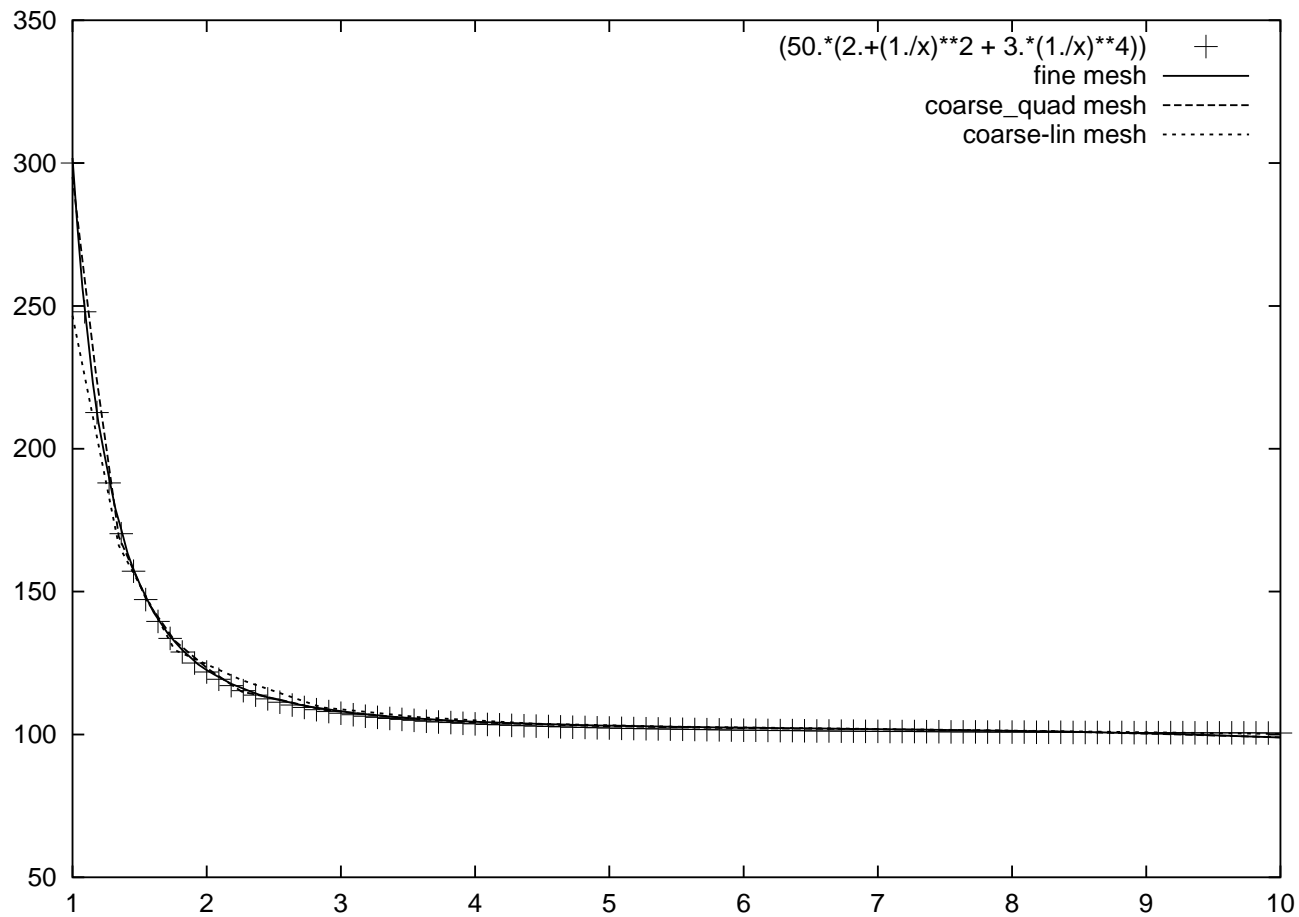
circle (max=301 MPa)

sig22 contour plot ellipse
sig_inf = 100MPa b=1mm, a=2.5mm



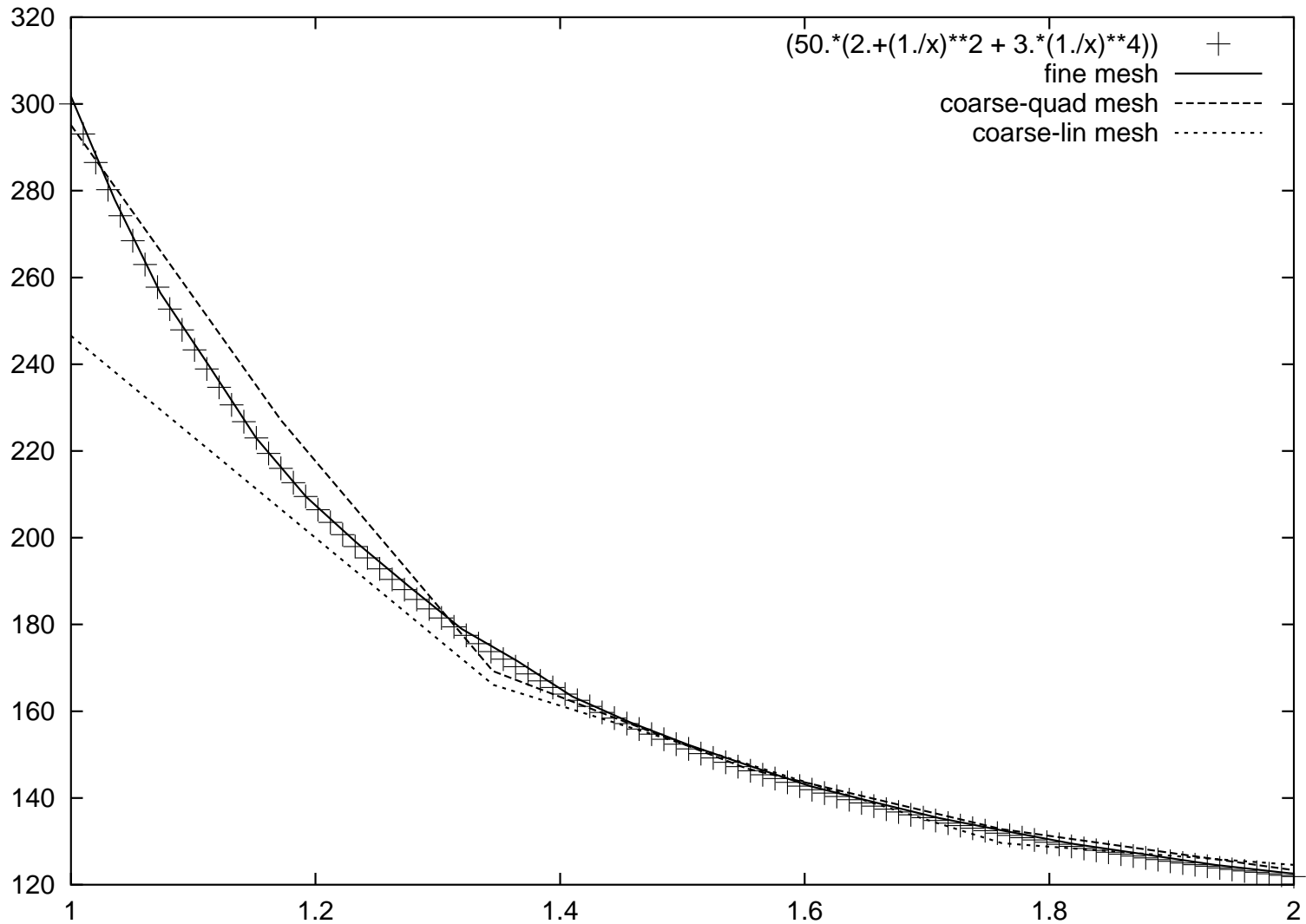
elongated (max=182 MPa)

Stress concentration for a circular hole



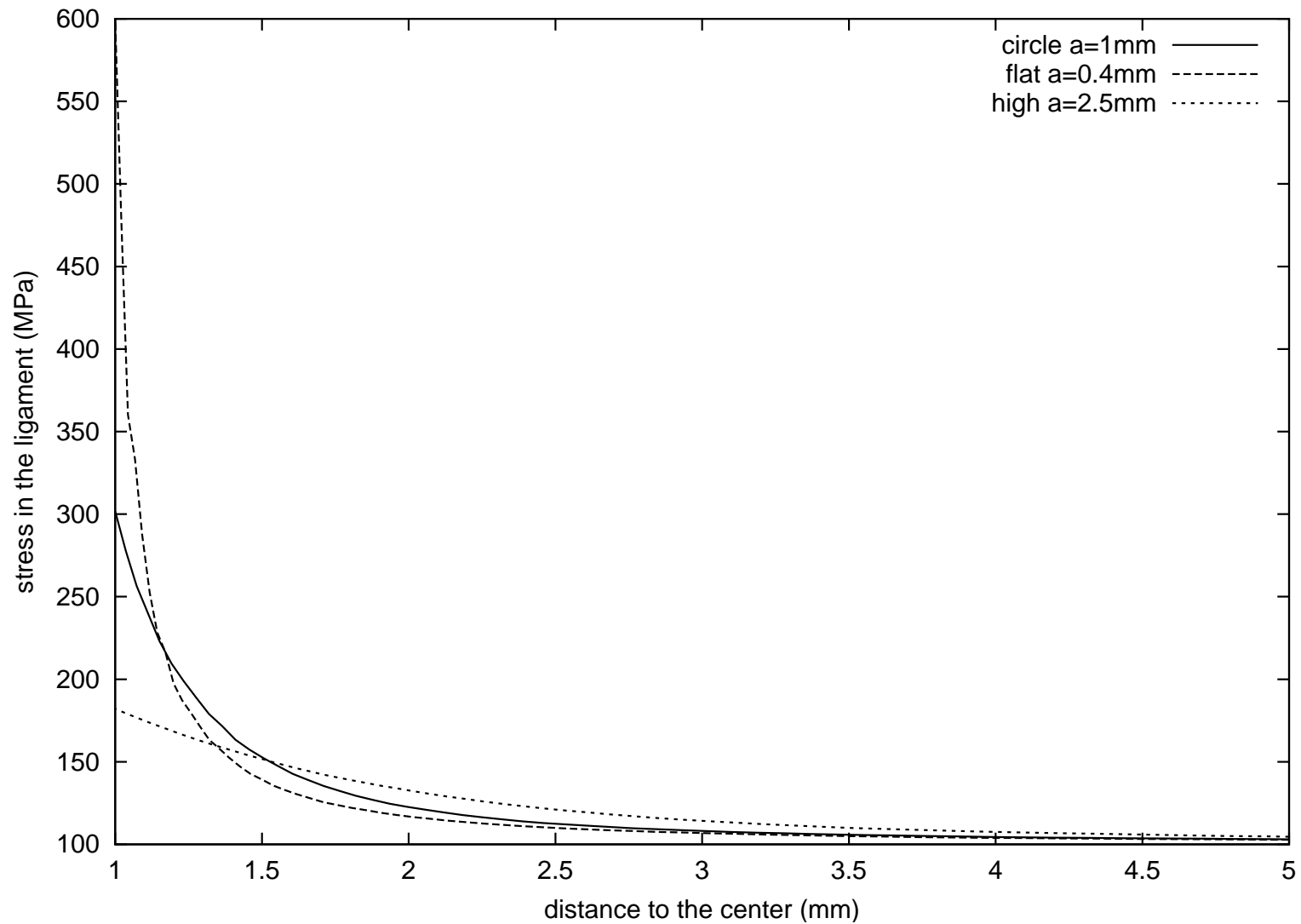
σ_{22} profile on the ligament for a 1mm circular hole in a 10mm \times 10mm plate with various meshes

Stress concentration for a circular hole (zoom)



σ_{22} profile on the ligament for a 1mm circular hole in a 10mm \times 10mm plate with various meshes
(zoom)

Stress concentration for various hole shapes



σ_{22} profile on the ligament for a 3 types of hole in a $10\text{mm} \times 10\text{mm}$ plate ($\sigma_{\infty}=100\text{MPa}$), $b=1\text{mm}$