

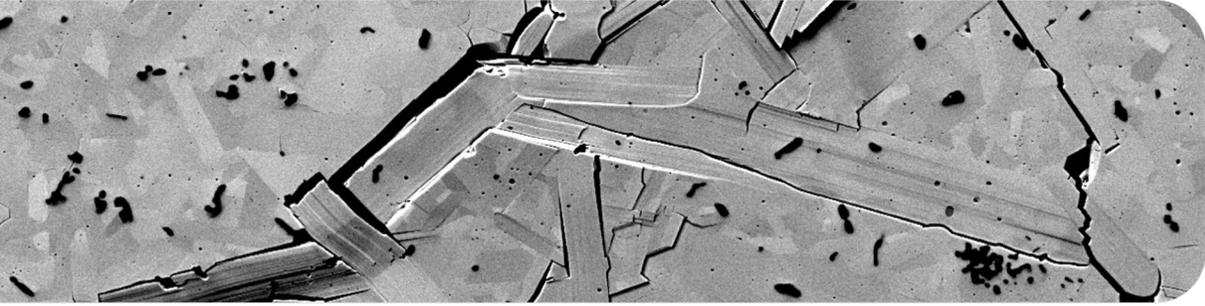


# COE–3001: Mechanics of deformable bodies

Chapter 8: stress concentration

**Prof. Antoine GUITTON**

Université de Lorraine, CNRS, Arts et Métiers Institute of Technology, LEM3, F-57000 Metz,  
antoine.guitton@univ-Lorraine.fr



# Introduction

# Definitions

***Local increase in stresses in an area featuring a geometric modification.  
⇒ Crack initiation site***

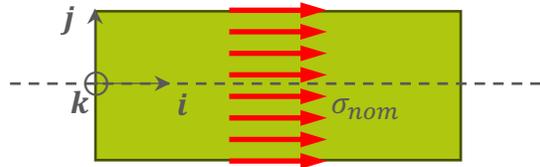
***Traction***



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**Traction**



$$\sigma_{nom} = \frac{N}{A}$$

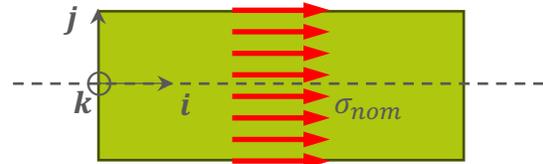
**Bending**



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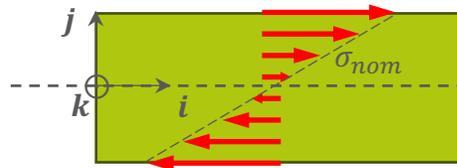
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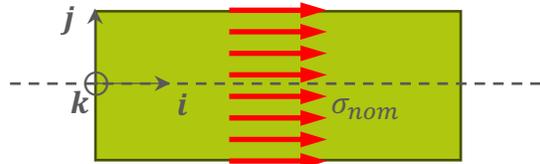
**Torsion**



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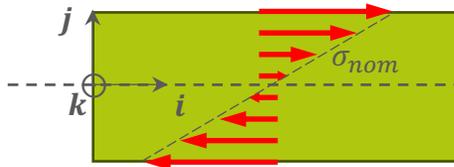
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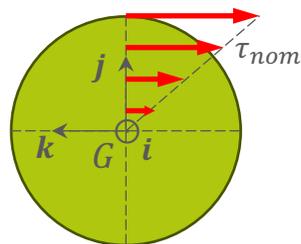
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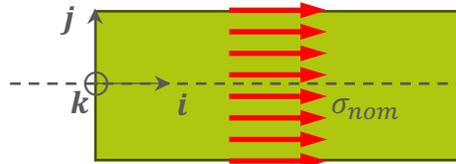
$$\tau_{nom} = \frac{M_{ext}}{I_G} \rho$$



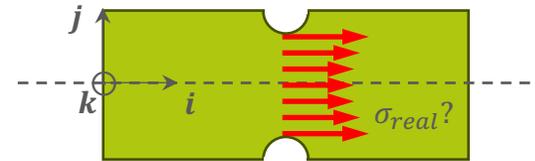
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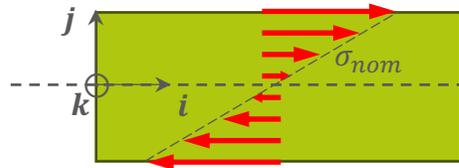
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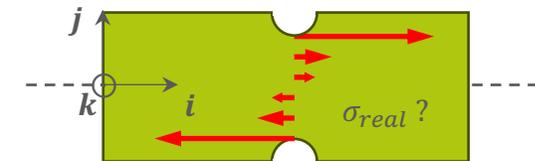
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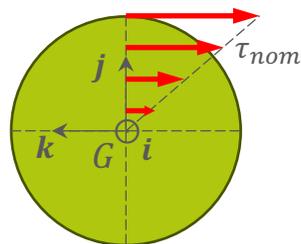
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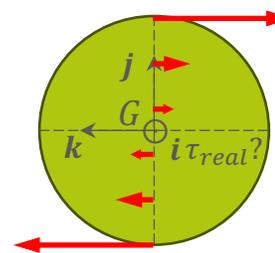
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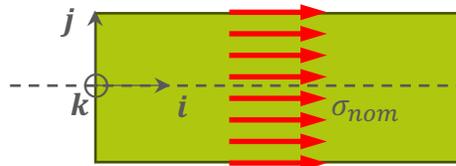
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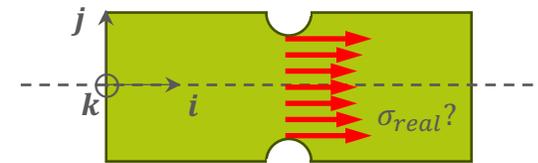
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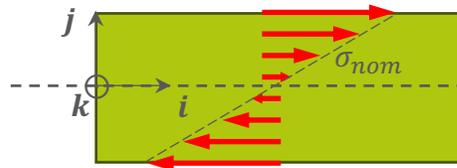
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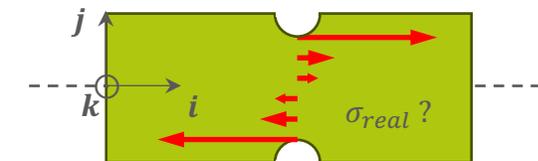
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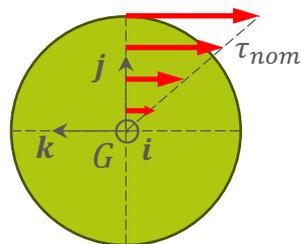


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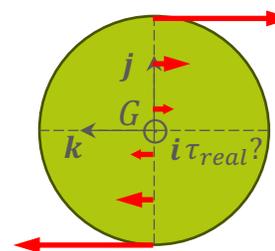


?

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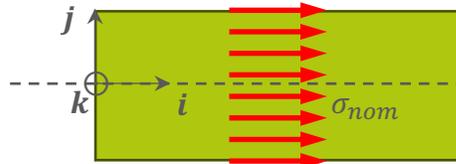


↪ Incorrect calculations in stress concentration regions!

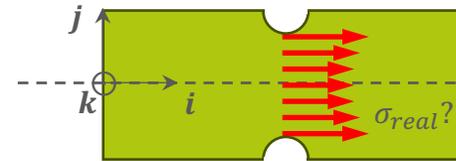
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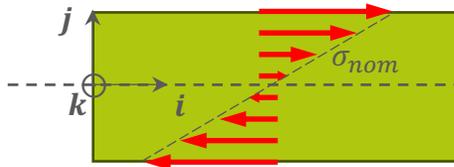
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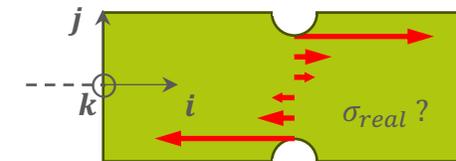
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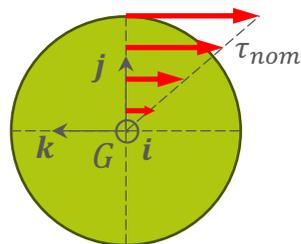
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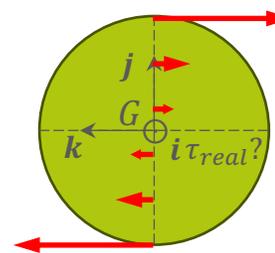
$$\phi_{real} = K_t \phi_{nom}$$

$K_t$ : constant

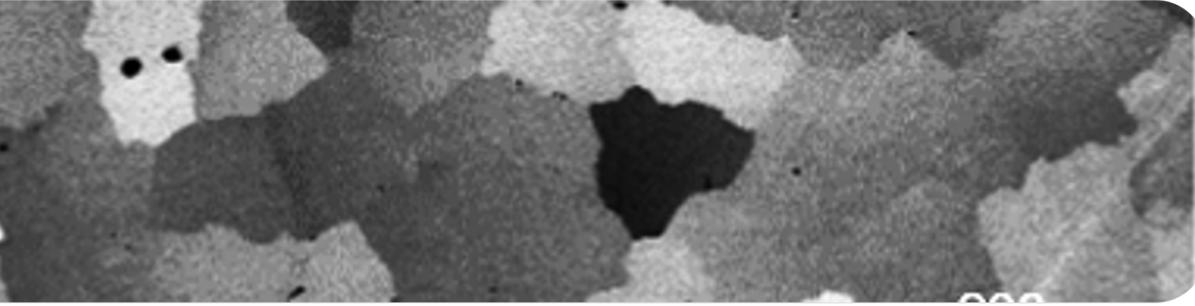
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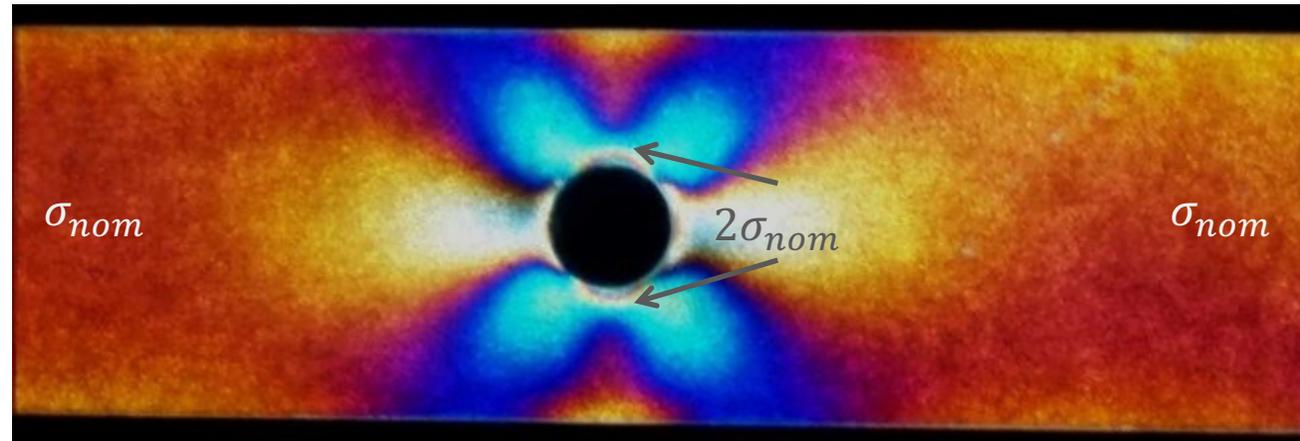
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# Detection

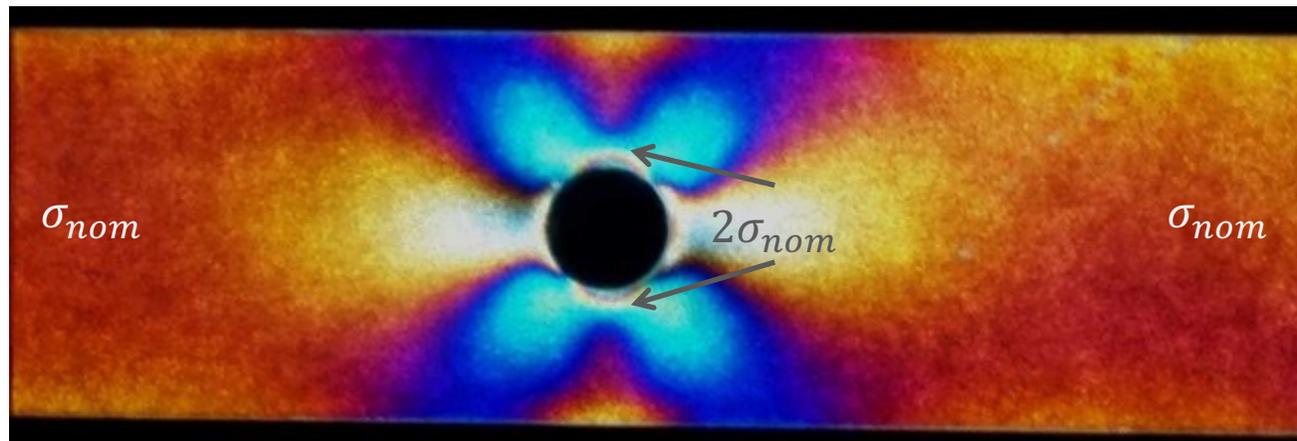
# Example 1: notched plate

*Experiment: photoelasticity*

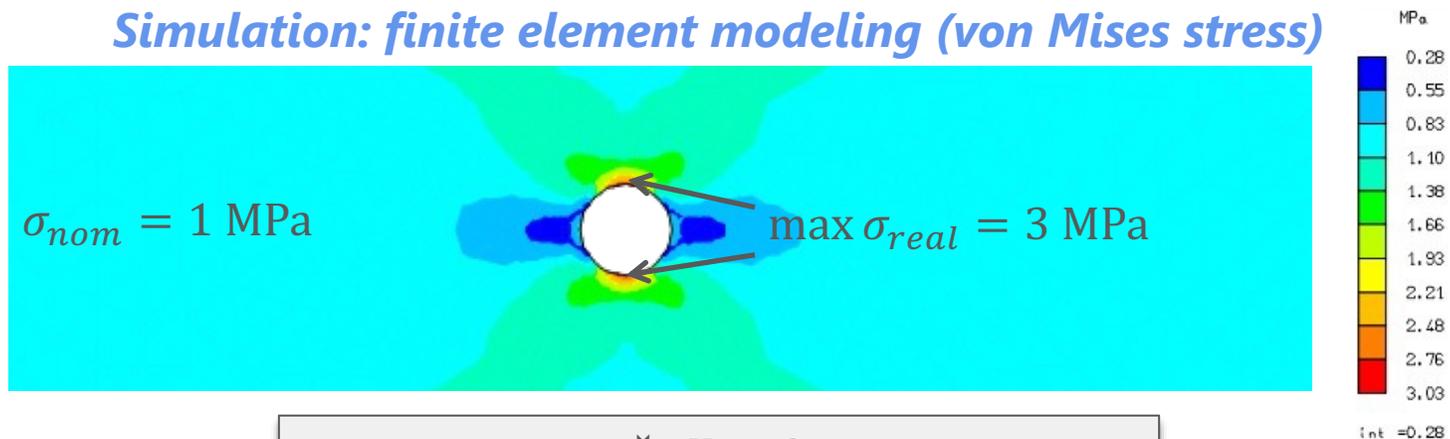


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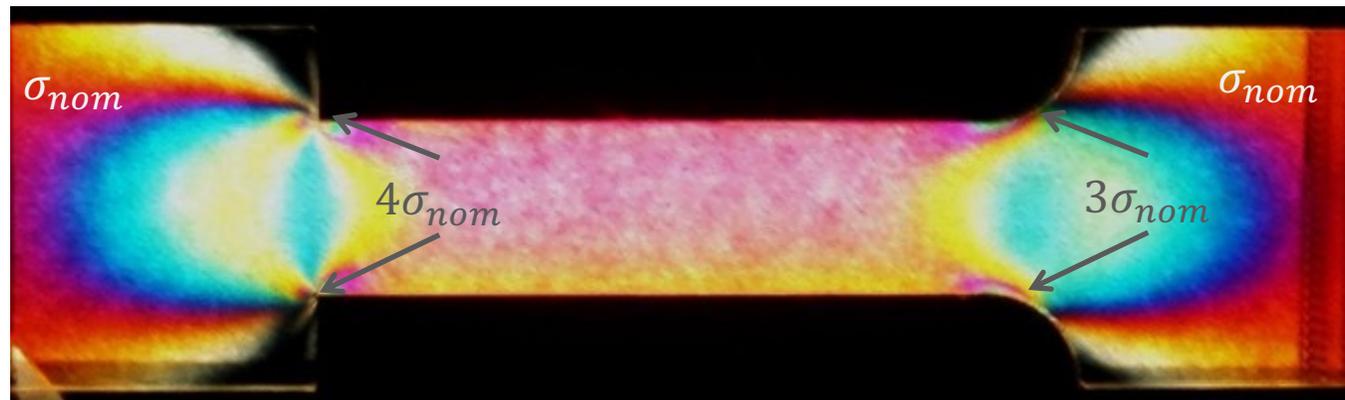
*Simulation: finite element modeling (von Mises stress)*



$K_t = 3$

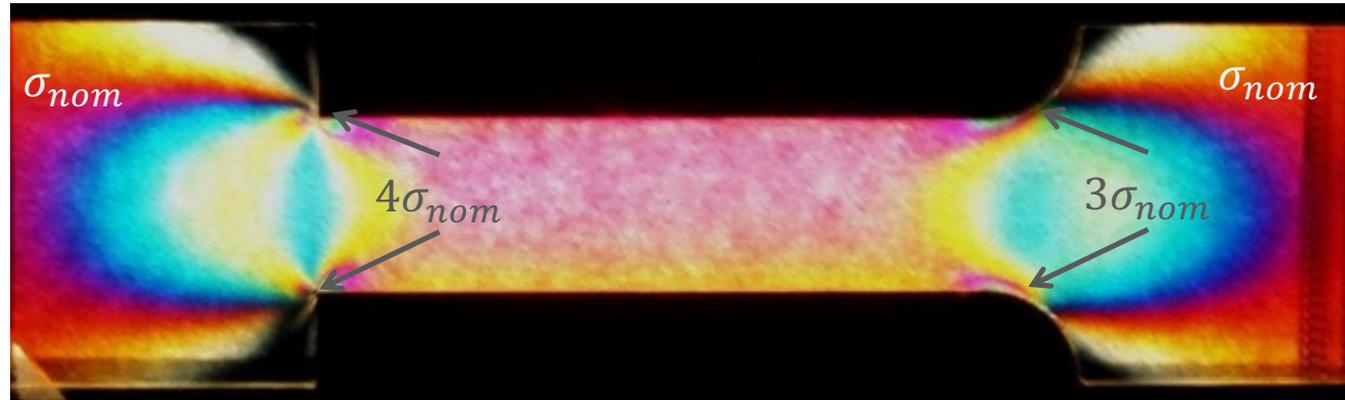
## Example 2: shouldered plate

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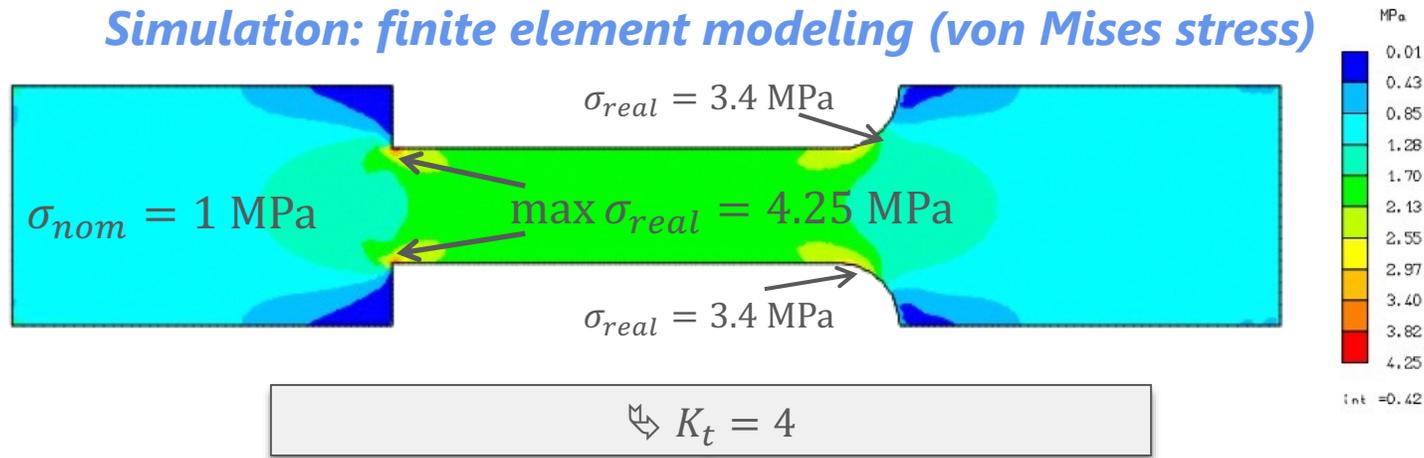


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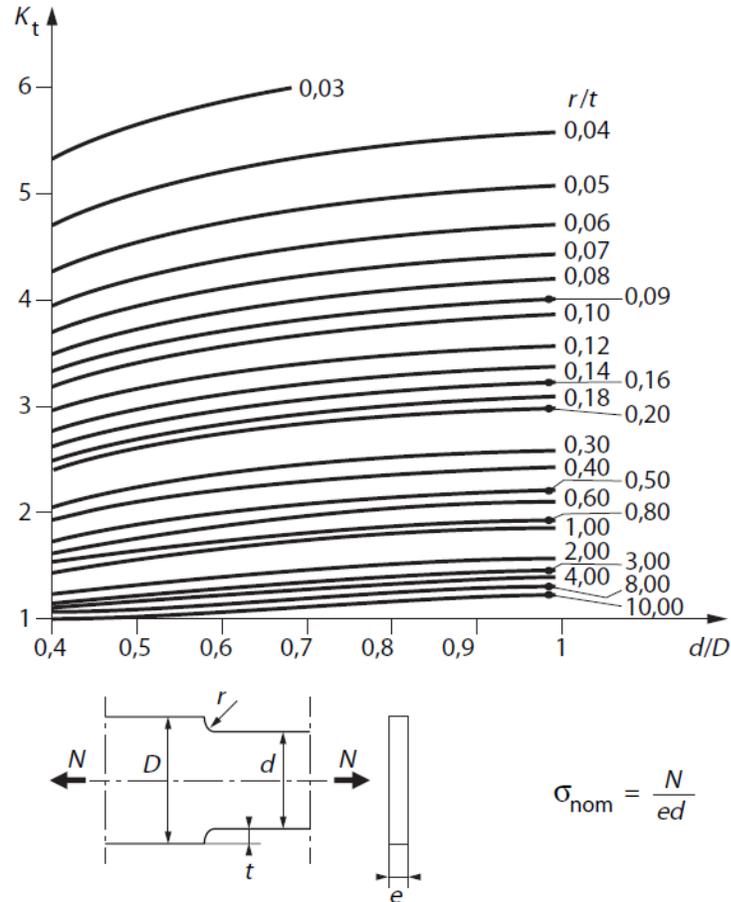


# Charts

## ❖ Definition:

- $K_t$  is a dimensionless stress concentration factor that quantifies how much the local stress exceeds the nominal stress due to a geometric discontinuity.
- A value of  $K_t = 3$  means the actual stress at the notch root is three times the stress calculated from elementary mechanics.
- $K_t$  depends solely on geometry; not on load magnitude or material.

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## ❖ Reading procedure:

- Compute  $d/D$  and  $r/t$  from the geometry.
- Locate  $d/D$  on the  $x$ -axis.
- Select the curve corresponding to  $r/t$  (interpolate if needed).
- Read  $K_t$  on the  $y$ -axis.
- Apply:  $\sigma_{real} = K_t \times \sigma_{nom}$



Thanks for your listening!

If you need further information:

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