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

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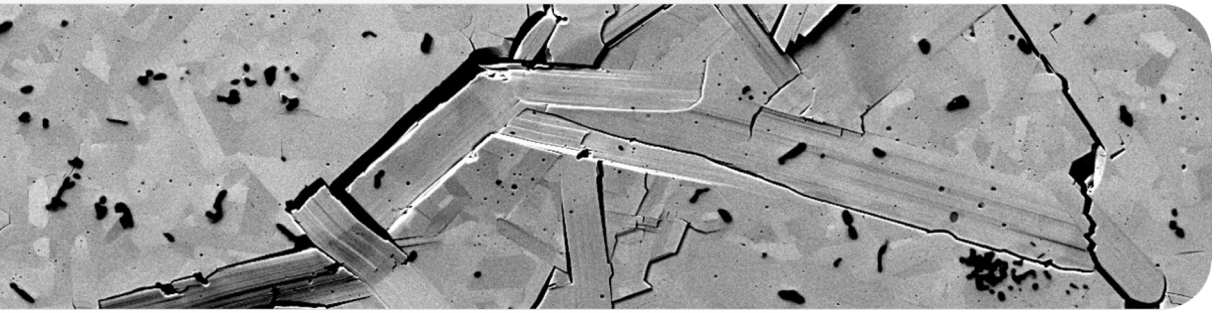

Introduction

Definitions

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

Traction

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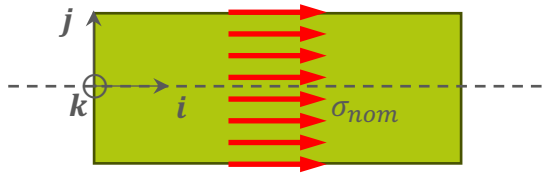

$$\sigma_{nom} = \frac{N}{A}$$

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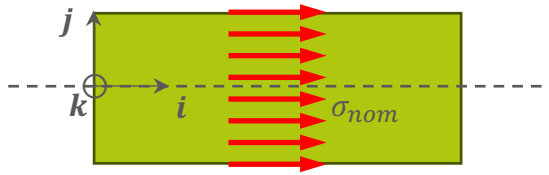

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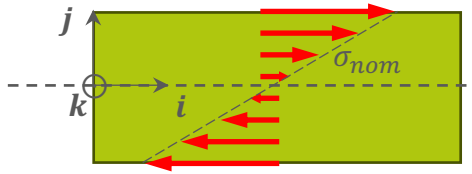

$$\sigma_{nom} = -\frac{B_{X,z}(x)}{I_x} y$$

Torsion

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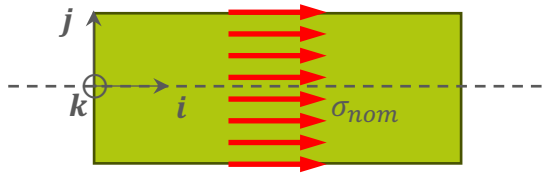

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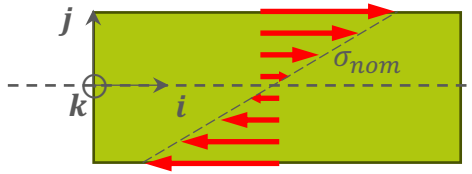

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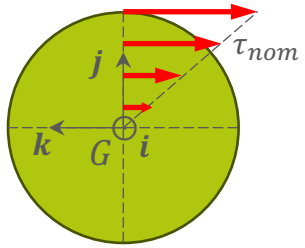

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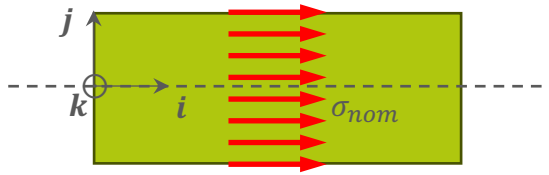

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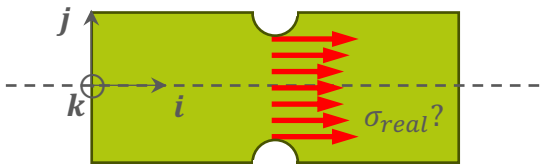

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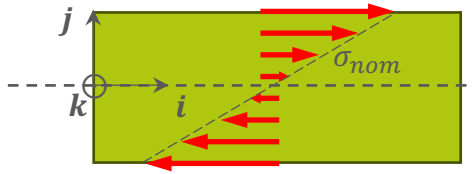

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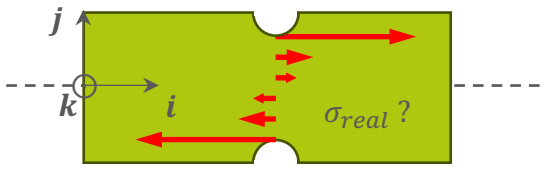

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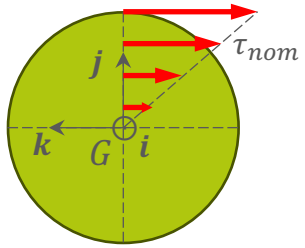

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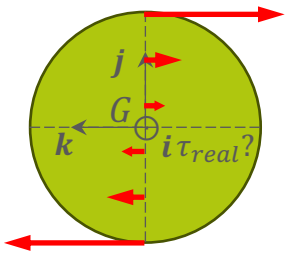

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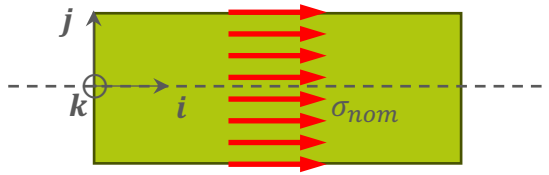

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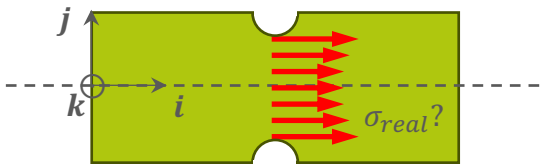

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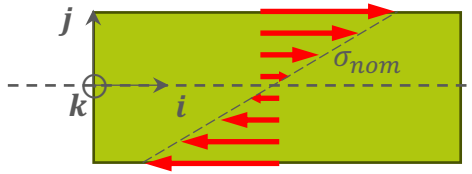

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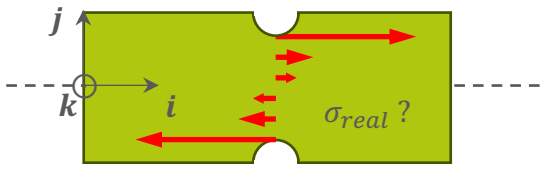

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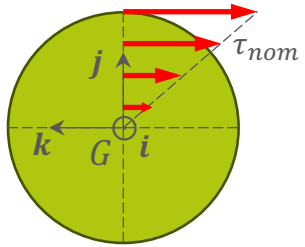
Torsion



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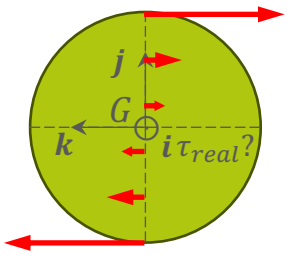

Incorrect calculations in stress concentration regions!

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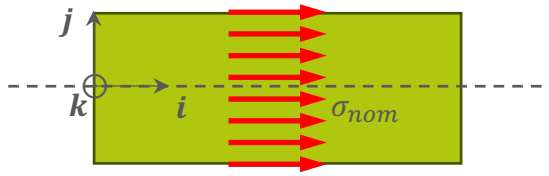

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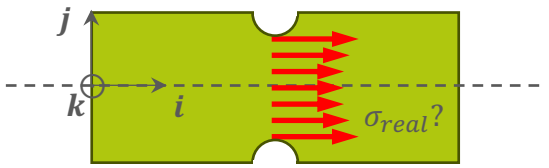

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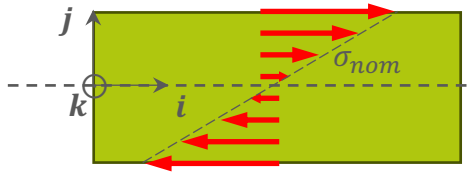

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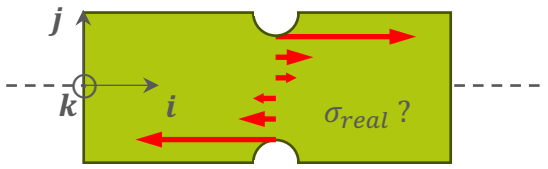
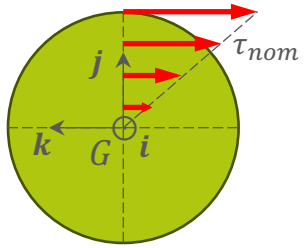


$$\phi_{real} = K_t \phi_{nom}$$

K_t: constant

Torsion



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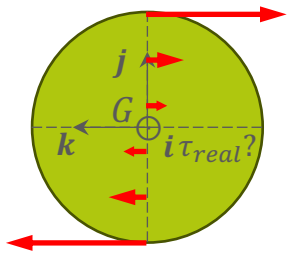

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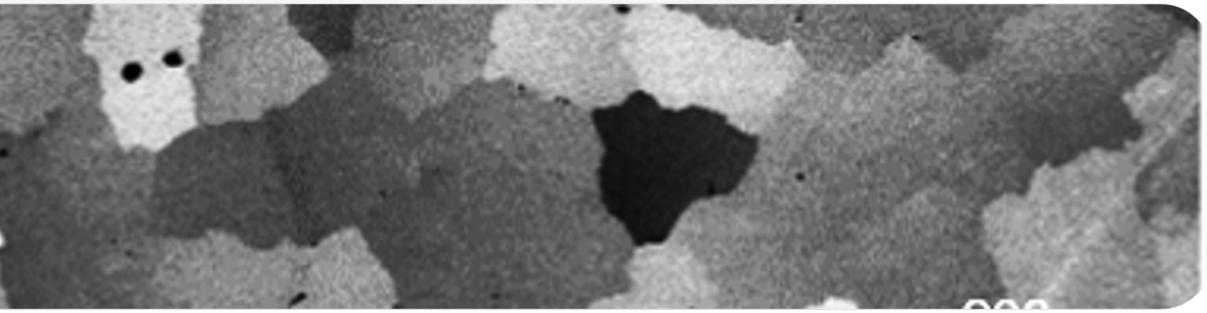

Detection

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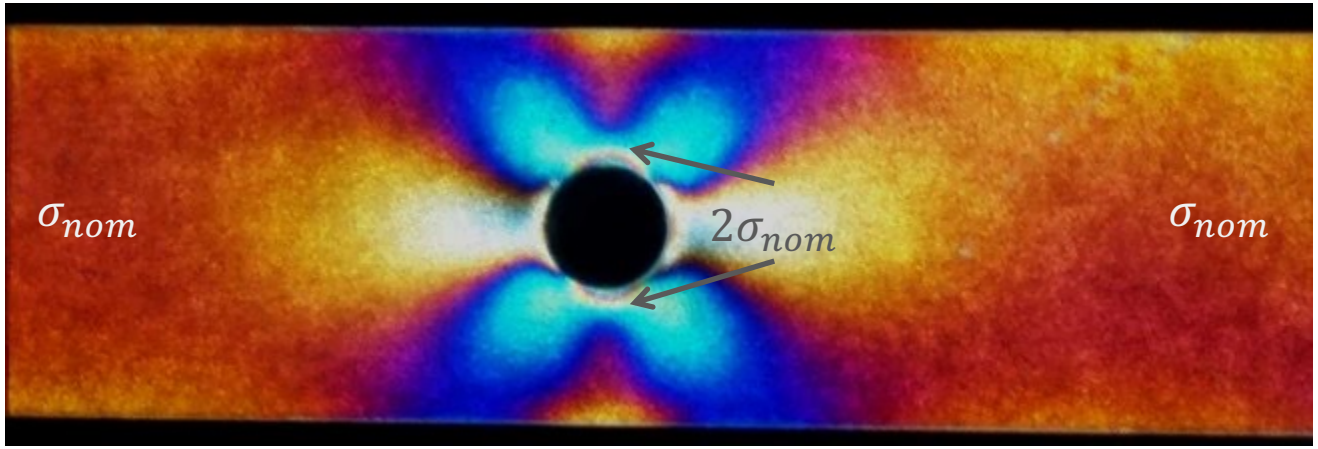
Example 1: notched plate

Experiment: photoelasticity



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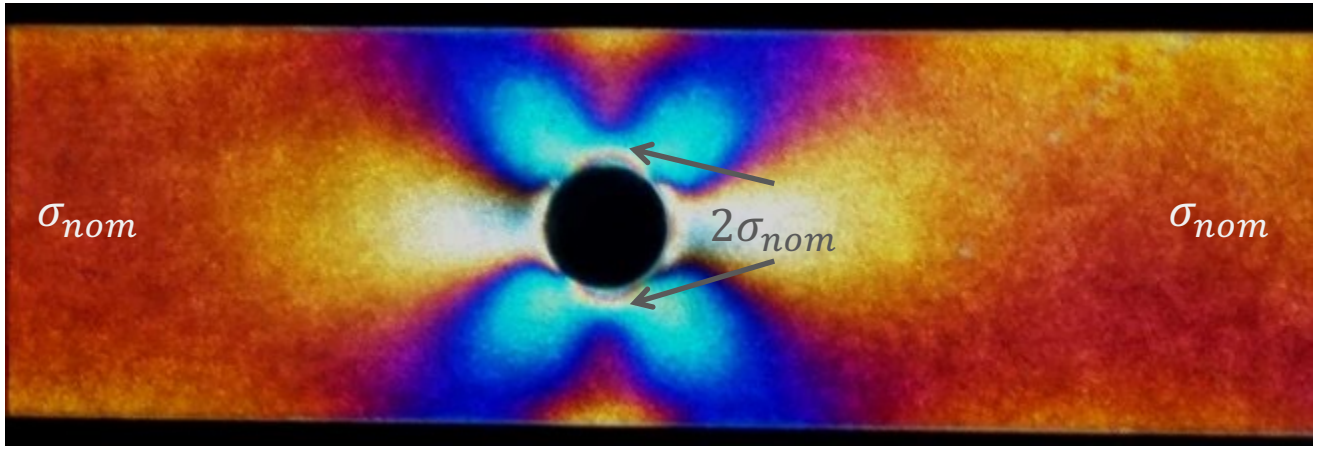
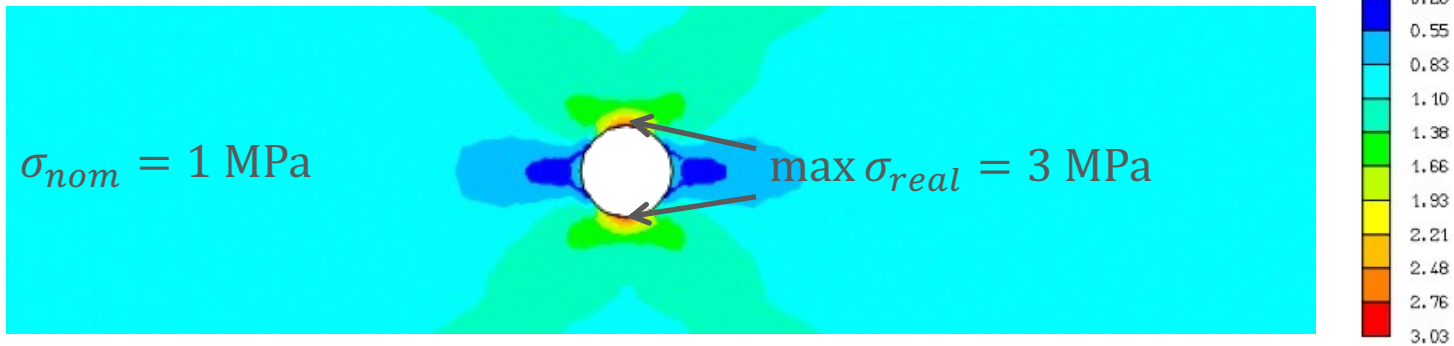


Simulation: finite element modeling (von Mises stress)



$\hookrightarrow K_t = 3$

Example 2: shouldered plate

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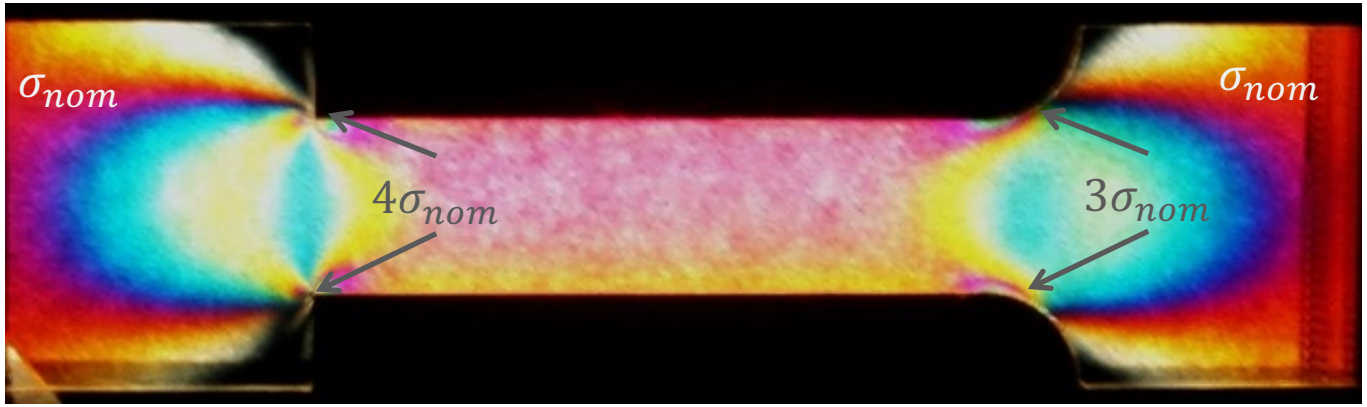

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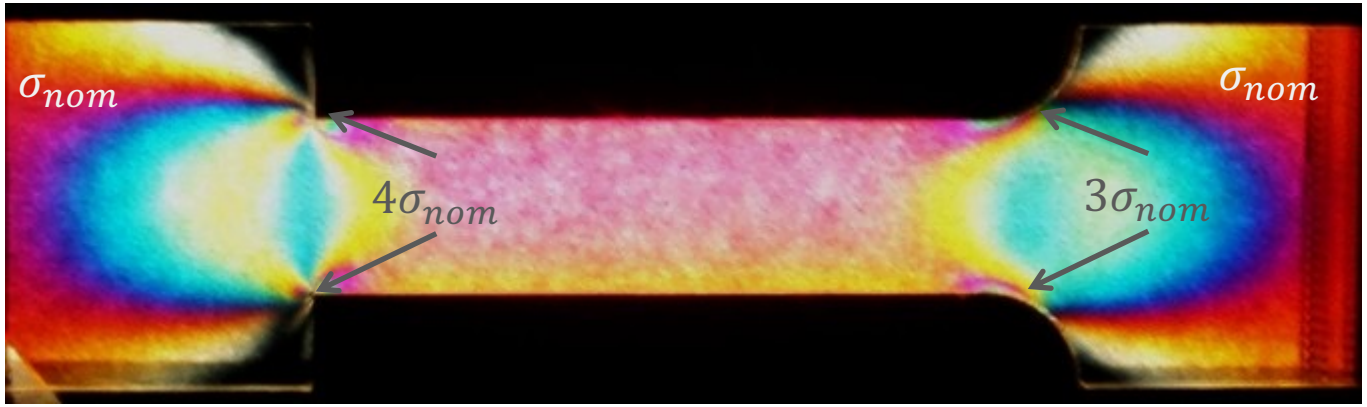

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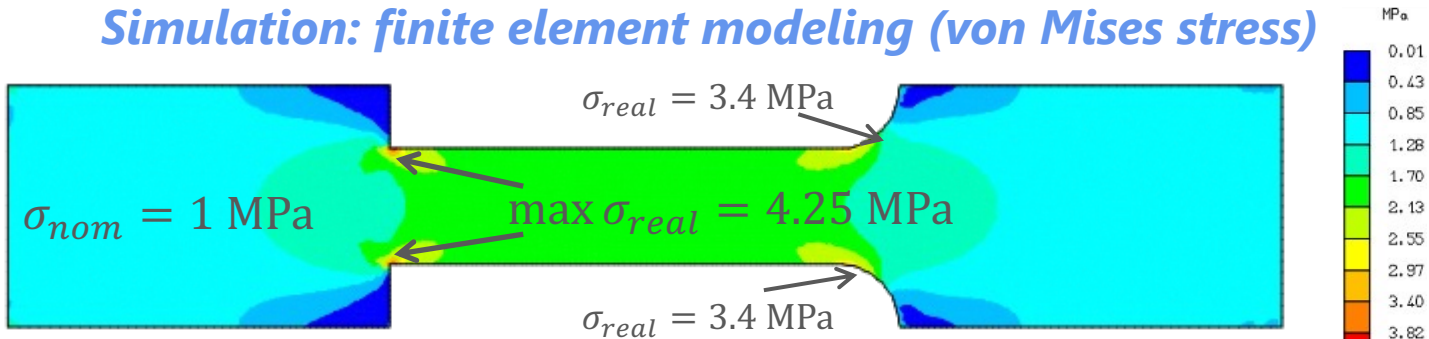

$\hookrightarrow K_t = 4$

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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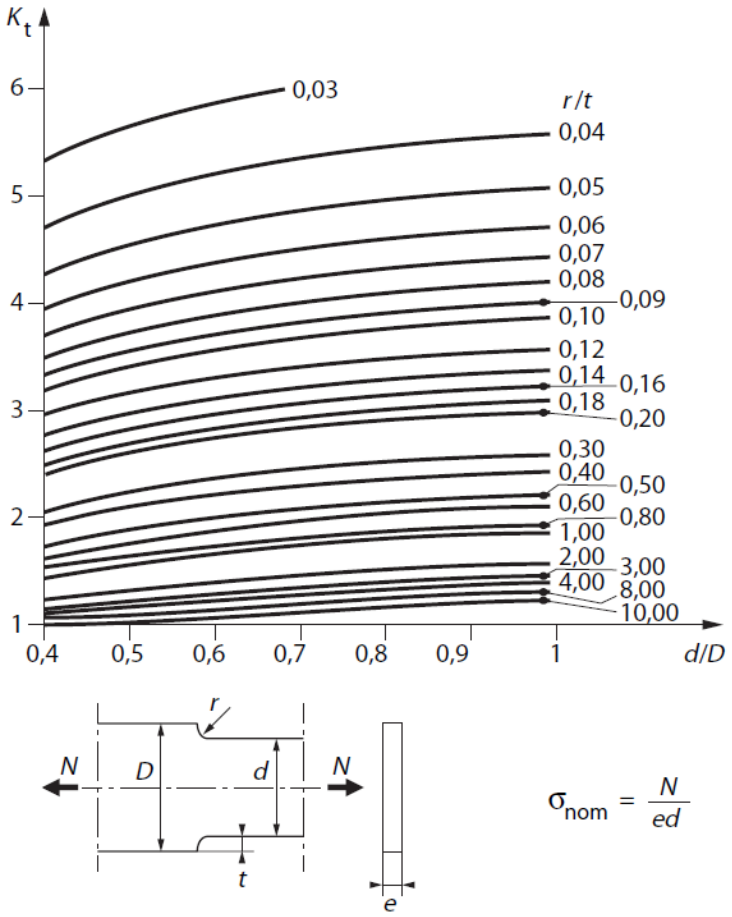

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❖ Reading procedure:

- 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:

Prof. Antoine GUITTON

Full Professor at Université de Lorraine

Phone (LEM3): +33 372 747 826

Email: antoine.guitton@univ-lorraine.fr

Website: www.antoine-guitton.fr

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