

LHC Collimators

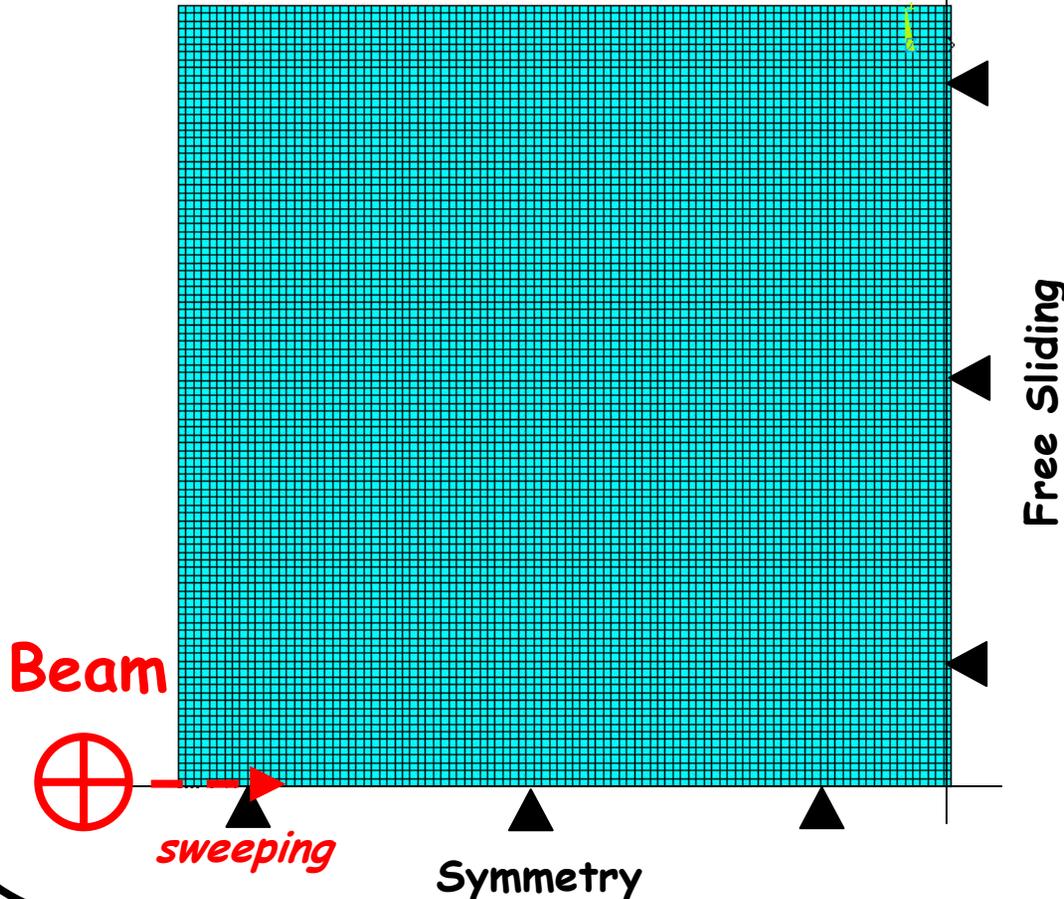
Conceptual Mechanical Design

Test Case #1 - *Preliminary results*

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Target & Dumps Section

Test Study #1 - Finite Element Model

□ 10x10 mm



2D MESH

10^4 parabolic elements

$3 \cdot 10^4$ nodes

0.1x0.1 mm mesh size

MATERIAL

Graphite "standard"

Homogeneous isotropic

Elastic linear law

Small deformations

#1 A M 8 A

Test Study #1 - Out-of-plane Boundary Conditions

1. **Plane stress**

2. Generalized Plane Strain
with bending

3. Generalized Plane Strain
without bending

4. Plane strain

Less conservative
(stress underestimate)

More conservative
(stress overestimate)

Test Study #1 - Stress field studied (Analysis type)

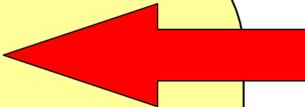
1. **Static stress**

2. **Dynamic stress**

3. **Initial stress**

4. **Eigenstress**

**Less conservative
(stress underestimate)**



Test Study #1

#1 Test study #1

A A-model

M Mechanical

8 Load case 8

A Boundary conditions

A: plane stress, Gr, 10x10 mm

B: plane strain, Gr, 10x10 mm

C: plane strain, Gr, 5x5 mm

D: plane strain, Be, 5x5 mm

1 : 2D Gaussian temp. distribution

2 - 8: 1400 - 200 mm planes

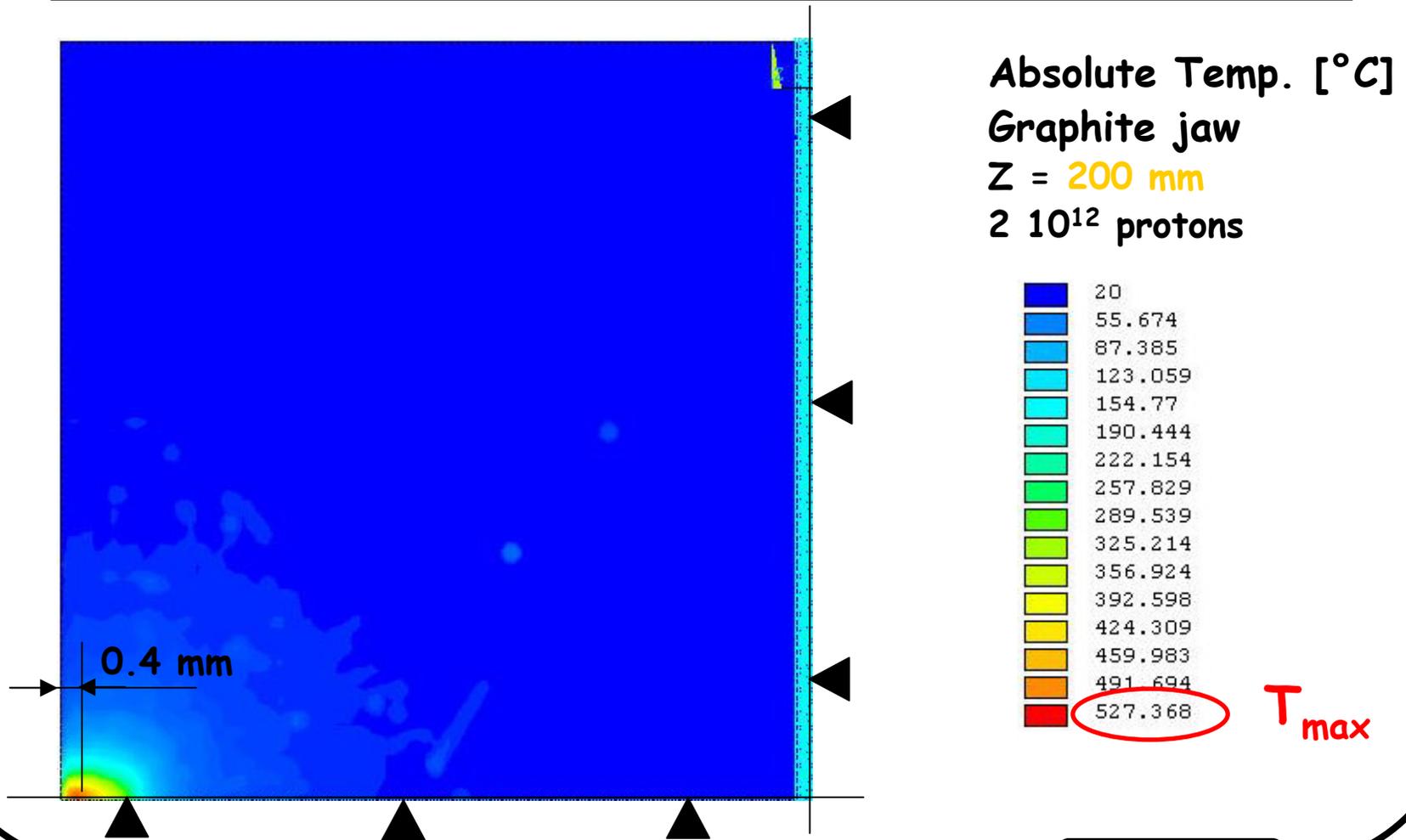
9: plane at 20 mm

A: plane stress

B: plane strain

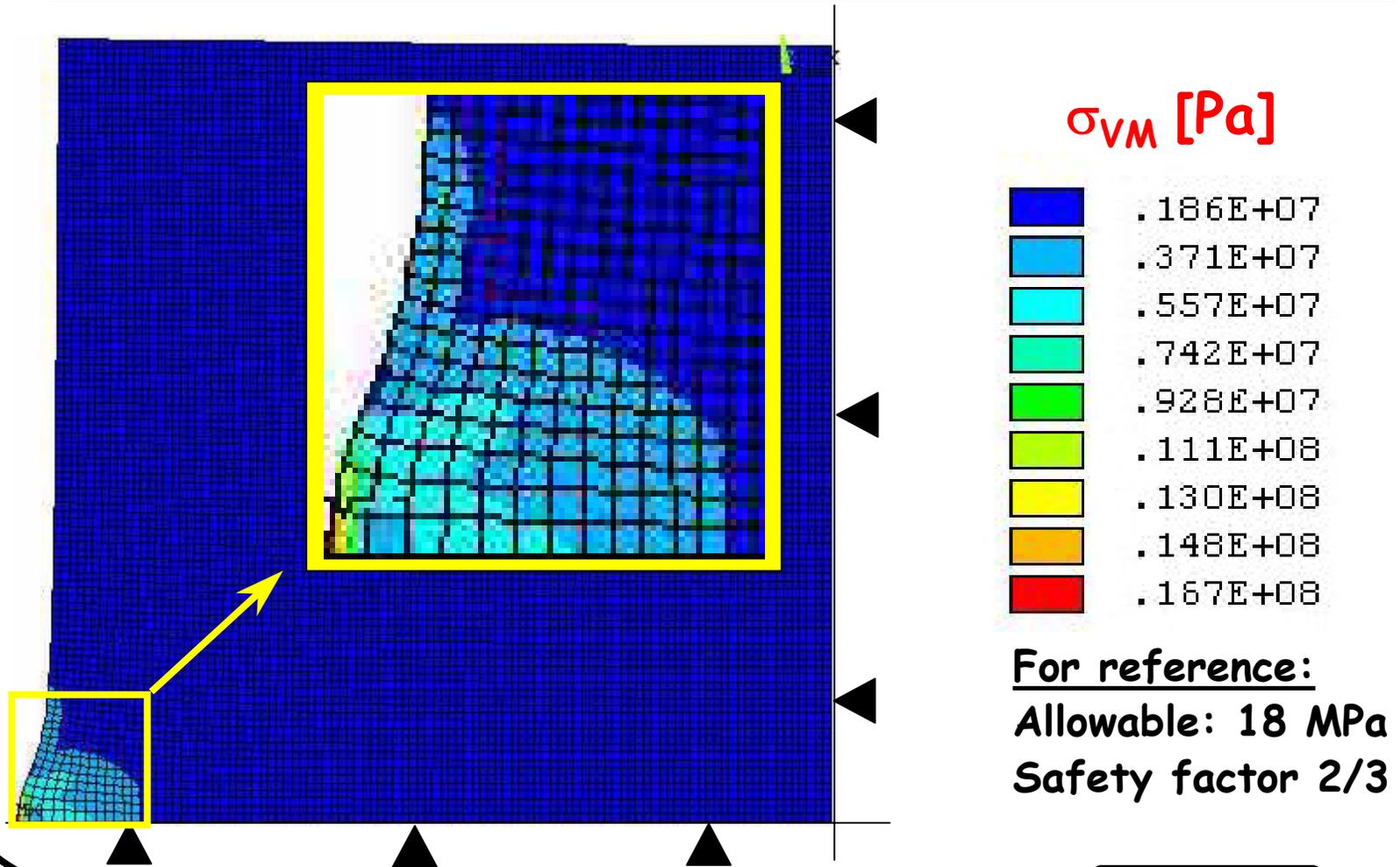
#1 A M 8 A

Test Study #1 - Beam Heat Load



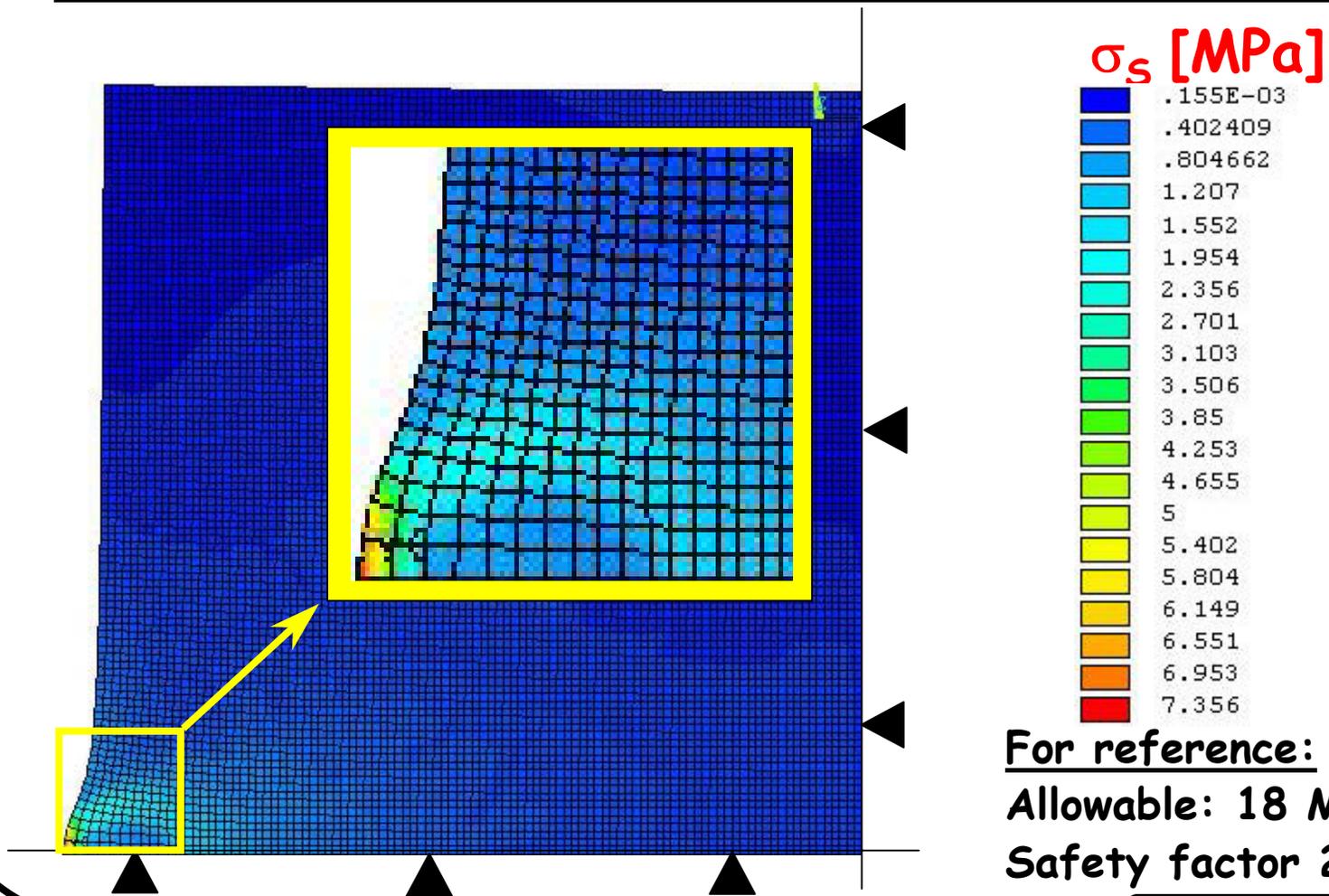
#1 A M 8 A

Test Study #1 - Von Mises Stress



#1 A M 8 A

Test Study #1 - Stassi Stress



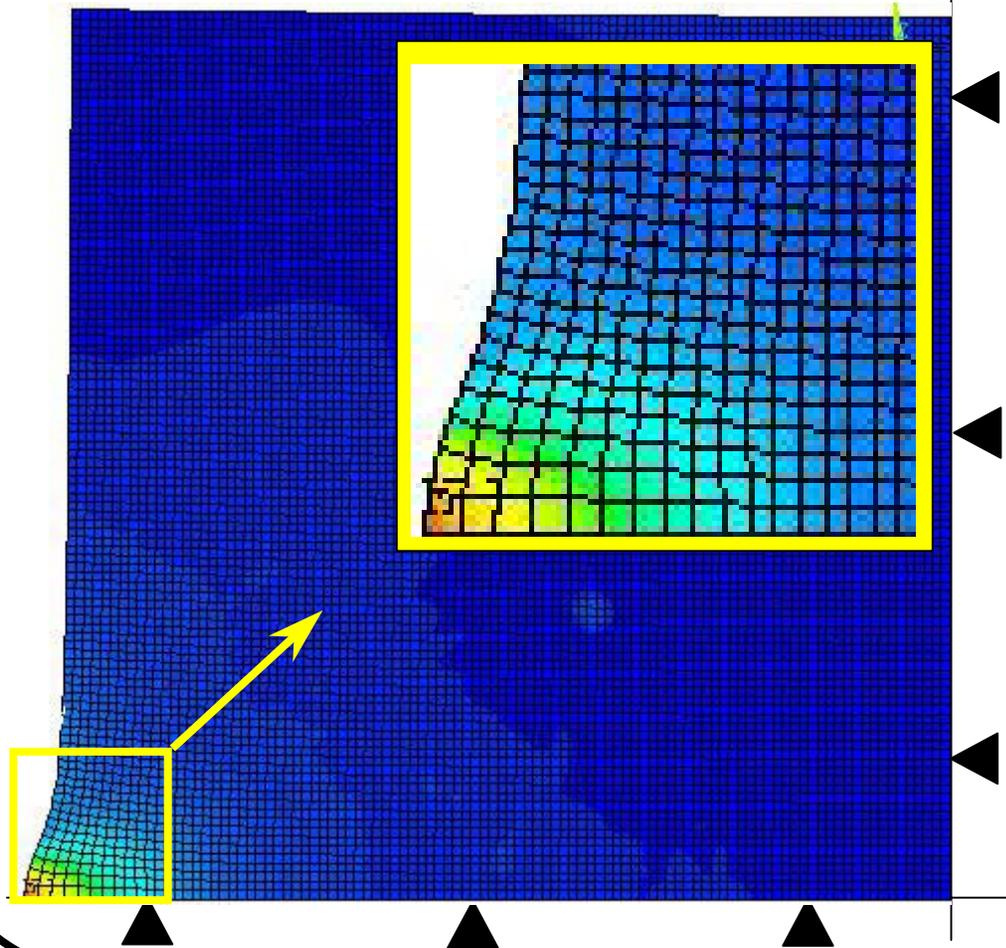
For reference:

Allowable: 18 MPa

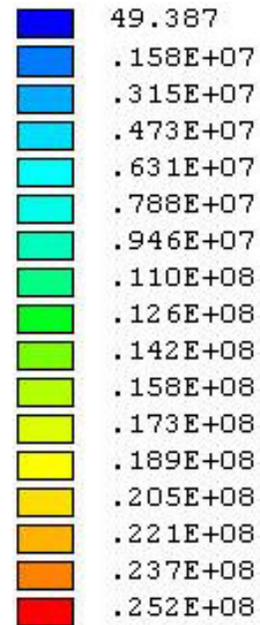
Safety factor 2/3

#1 A M 8 A

Test Study #1 - Von Mises Stress



σ_{VM} [Pa]



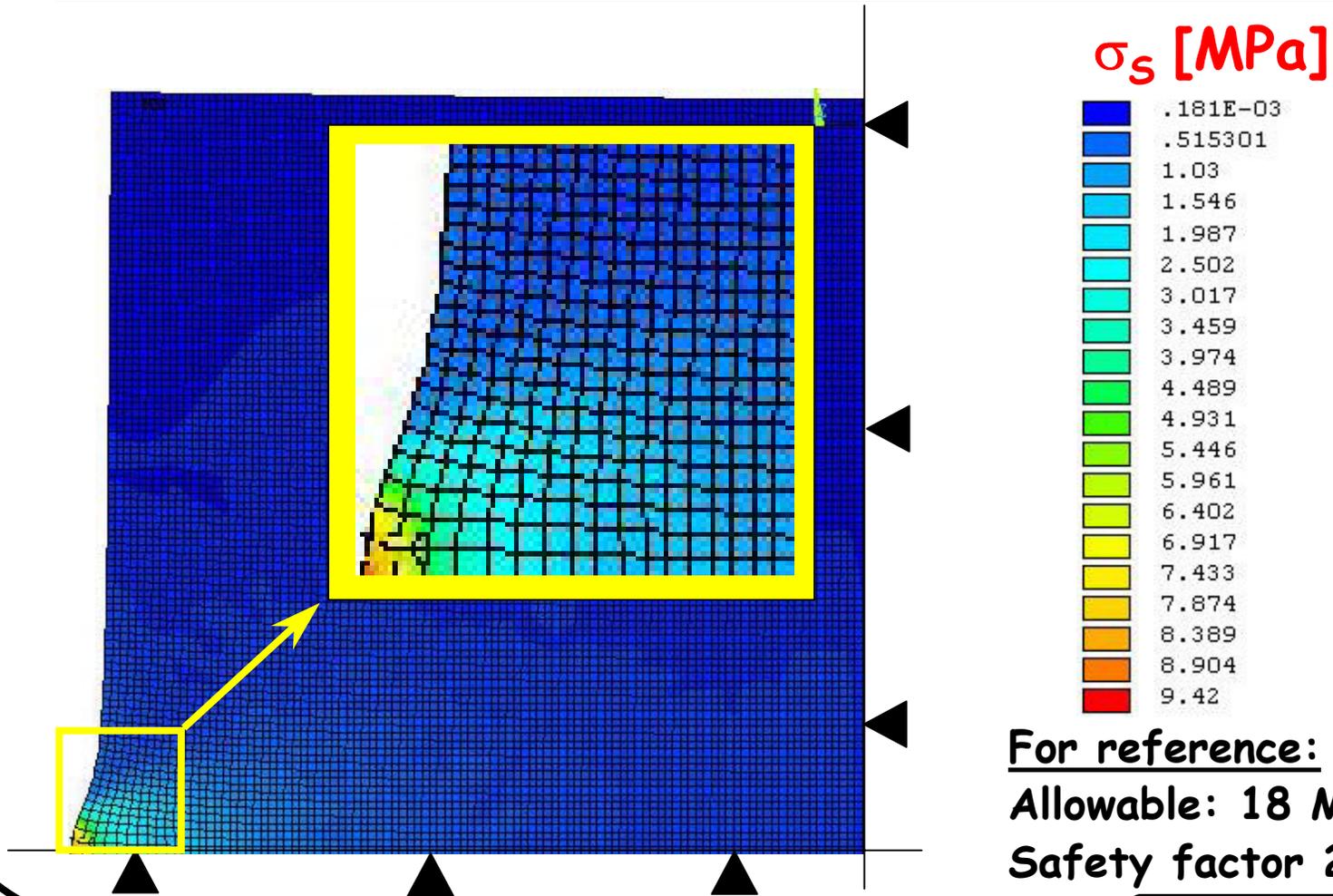
For reference:

Allowable: 18 MPa

Safety factor 2/3

#1 A M 8 B

Test Study #1 - Stassi Stress



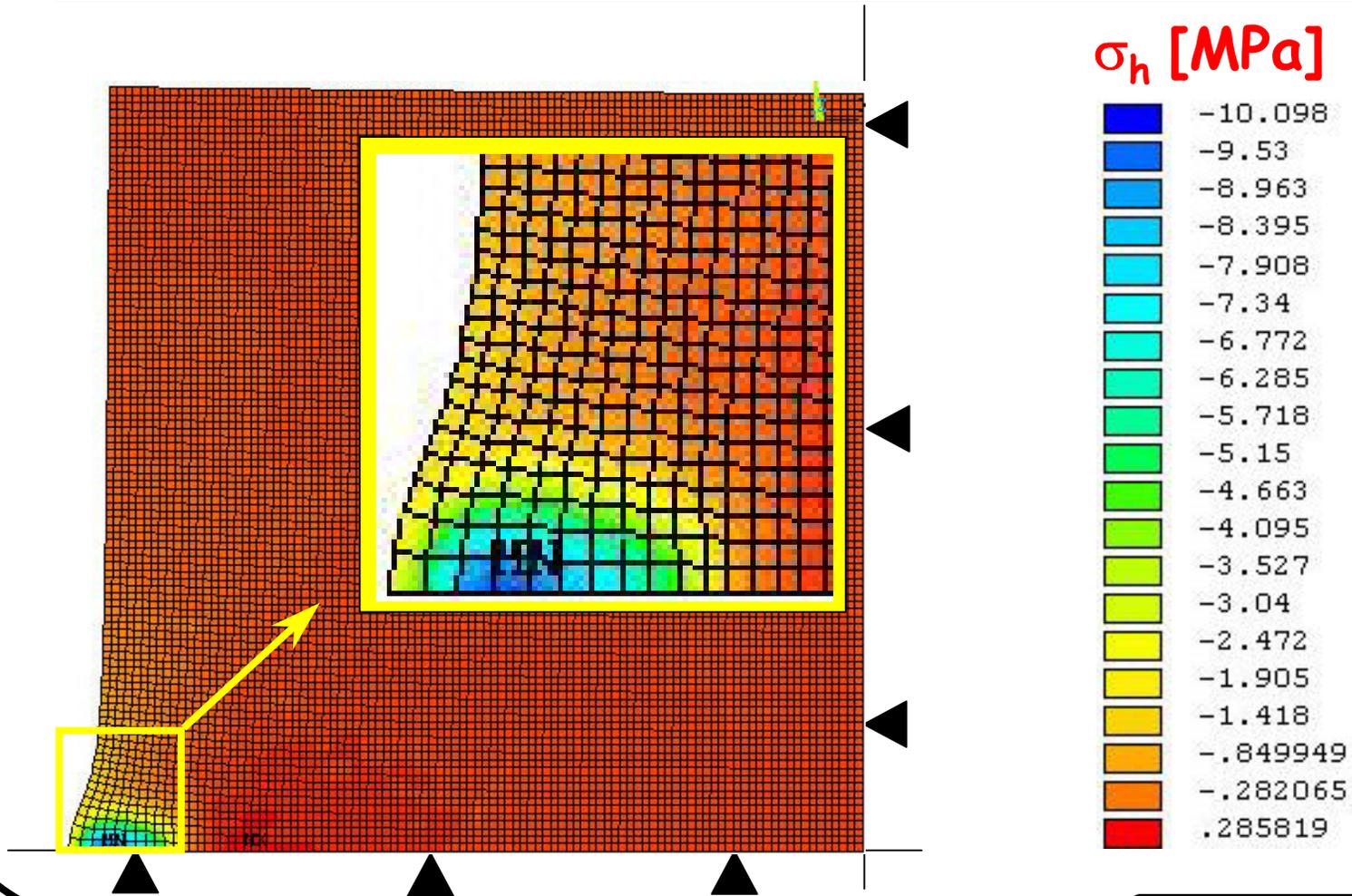
For reference:

Allowable: 18 MPa

Safety factor 2/3

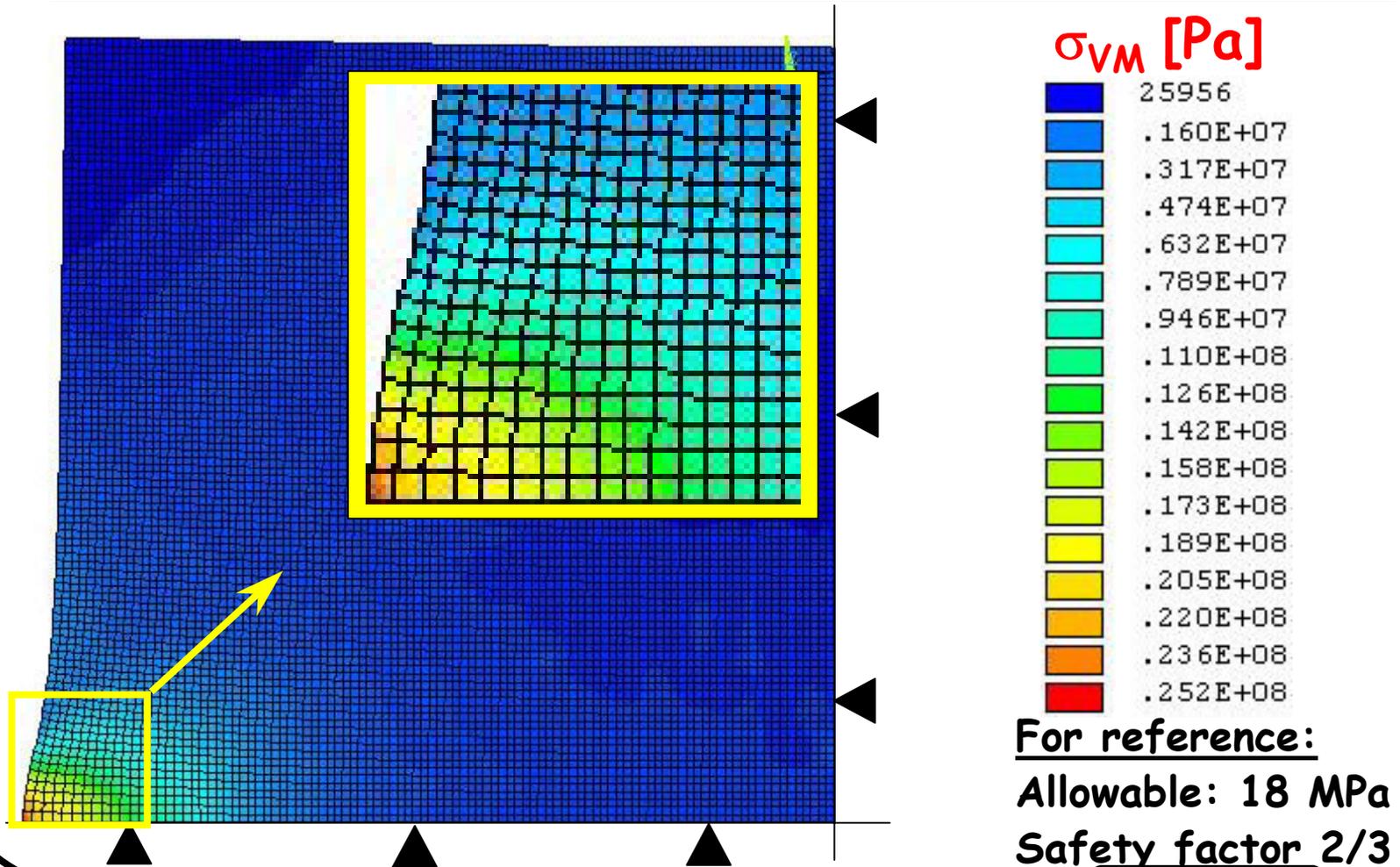
#1 A M 8 B

Test Study #1 - Hydrostatic Stress



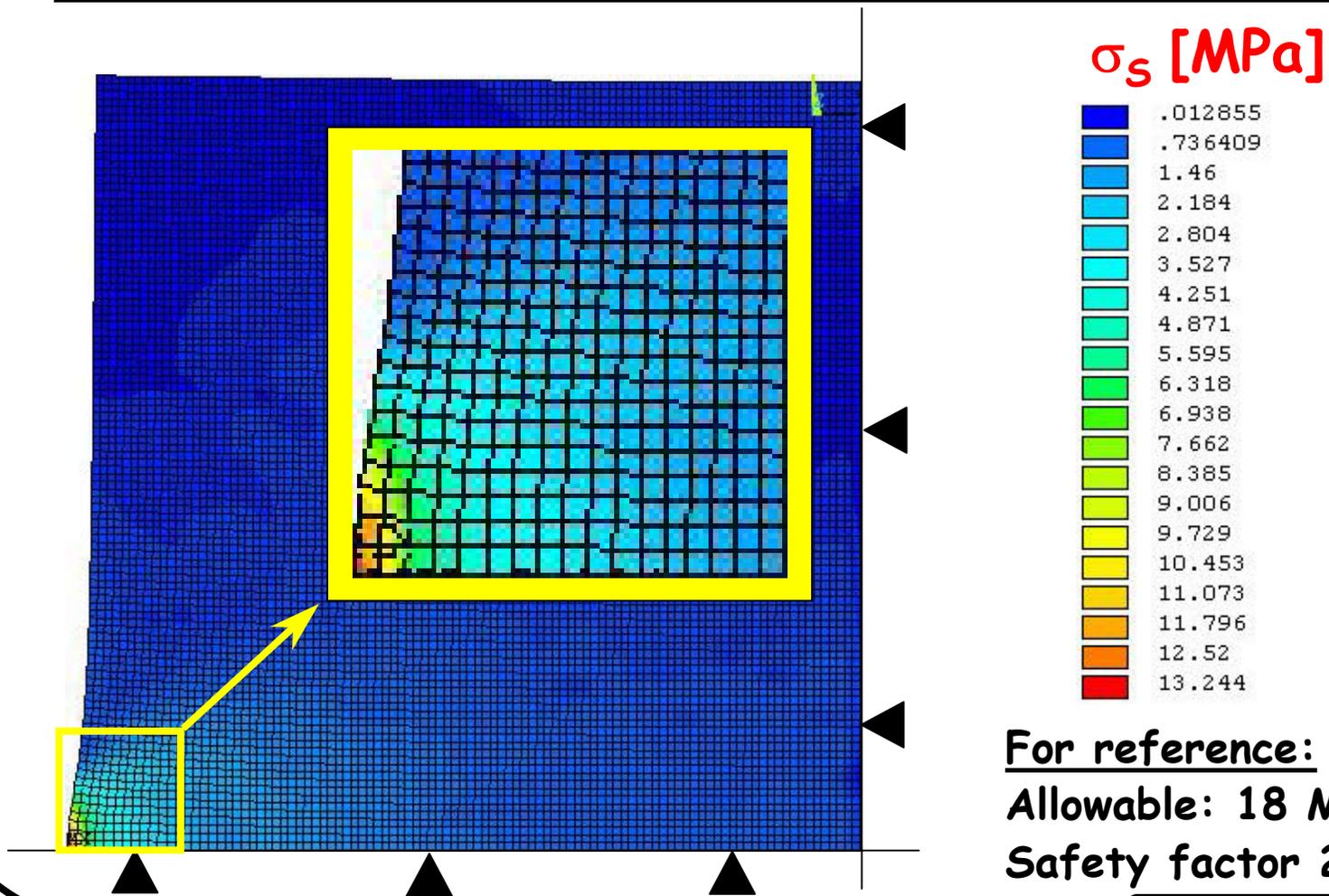
#1 A M 8 B

Test Study #1 - Von Mises Stress



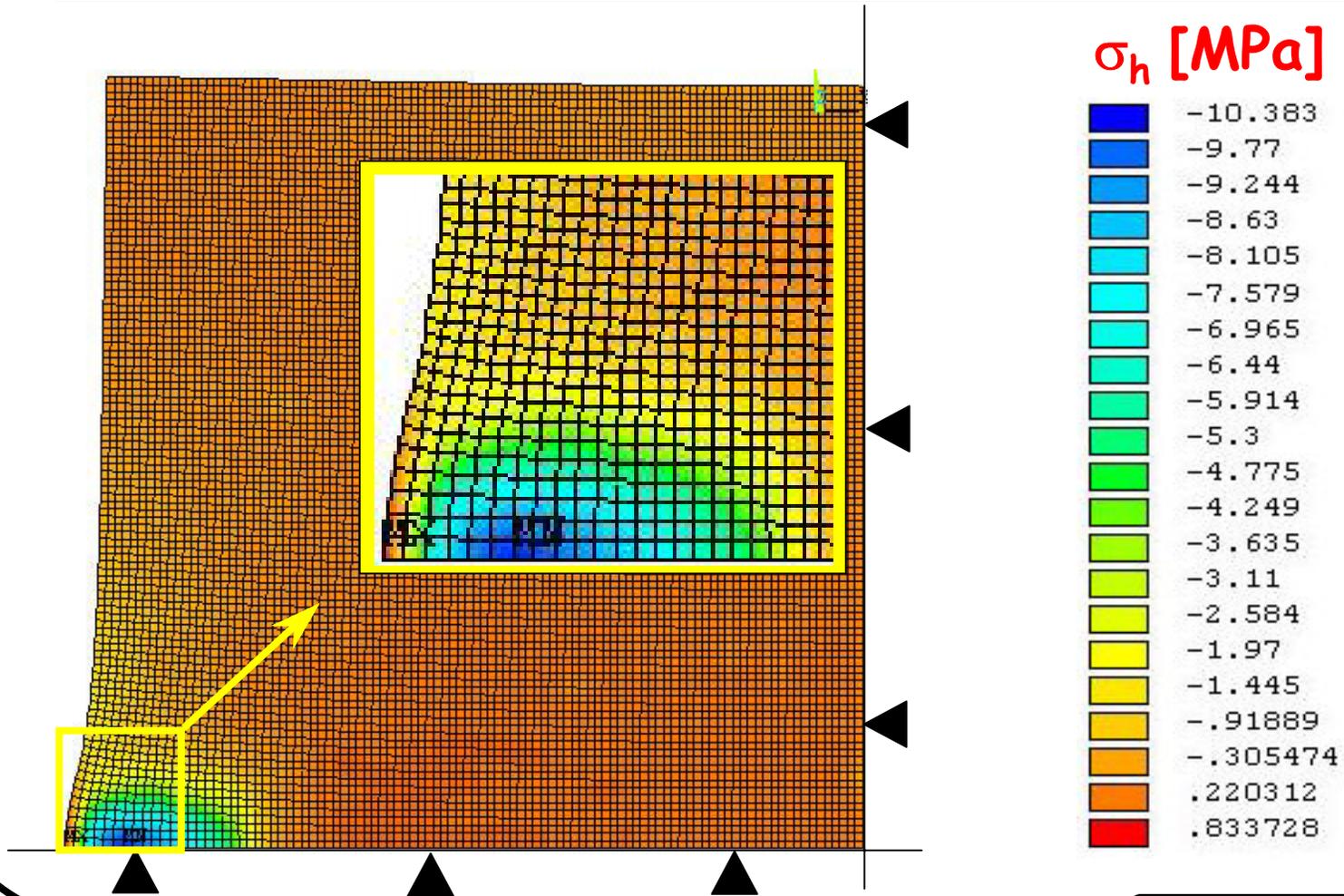
#1 CM 8 B

Test Study #1 - Stassi Stress



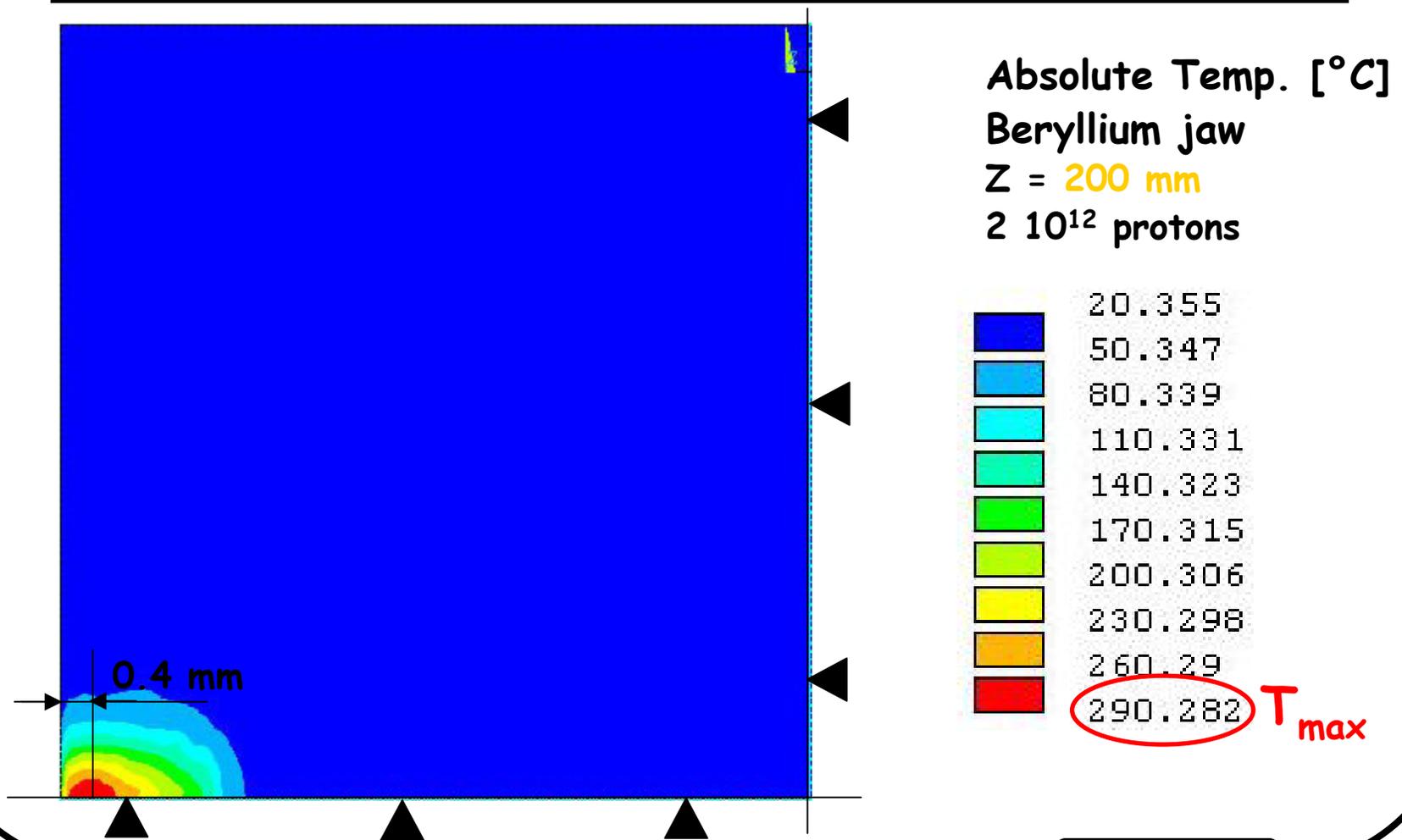
#1 CM 8 B

Test Study #1 - Hydrostatic Stress



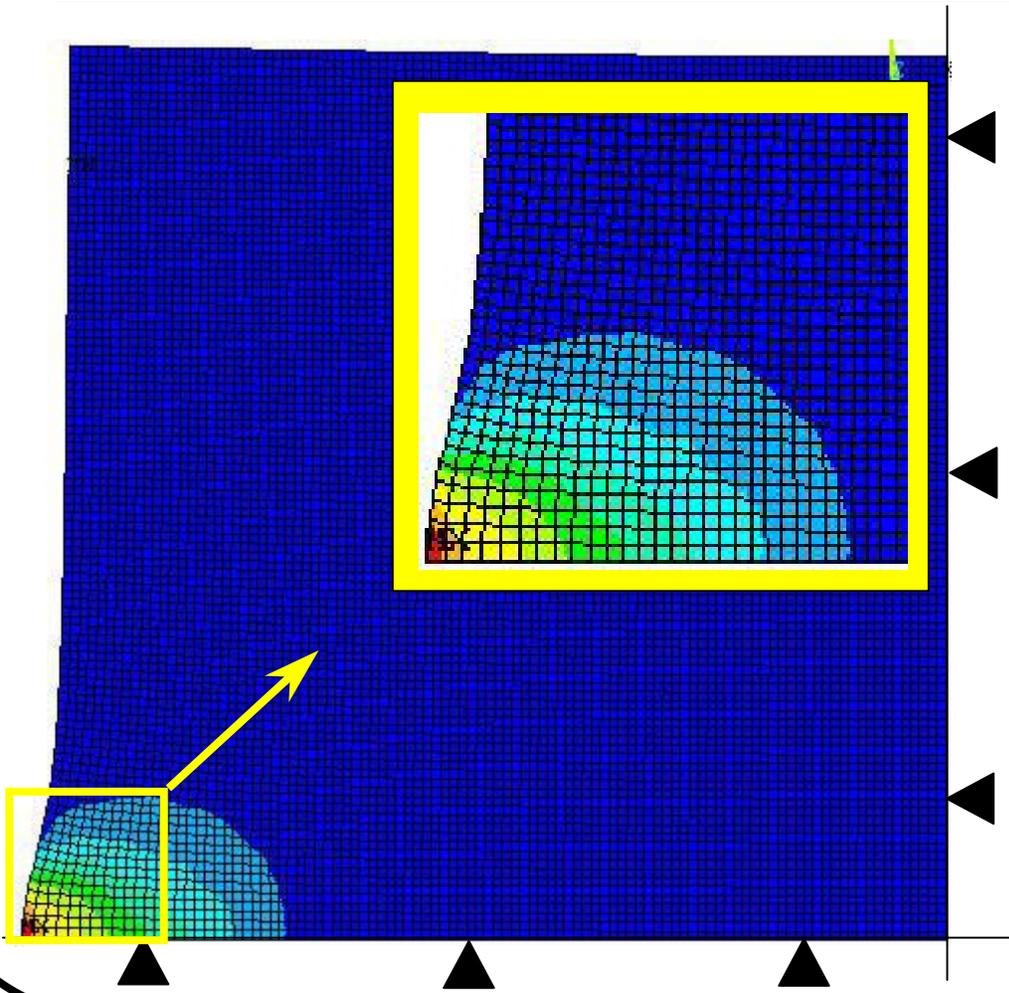
#1 CM 8 B

Test Study #1 - Beam Heat Load



#1 DM8B

Test Study #1 - Von Mises Stress



σ_{VM} [Pa]

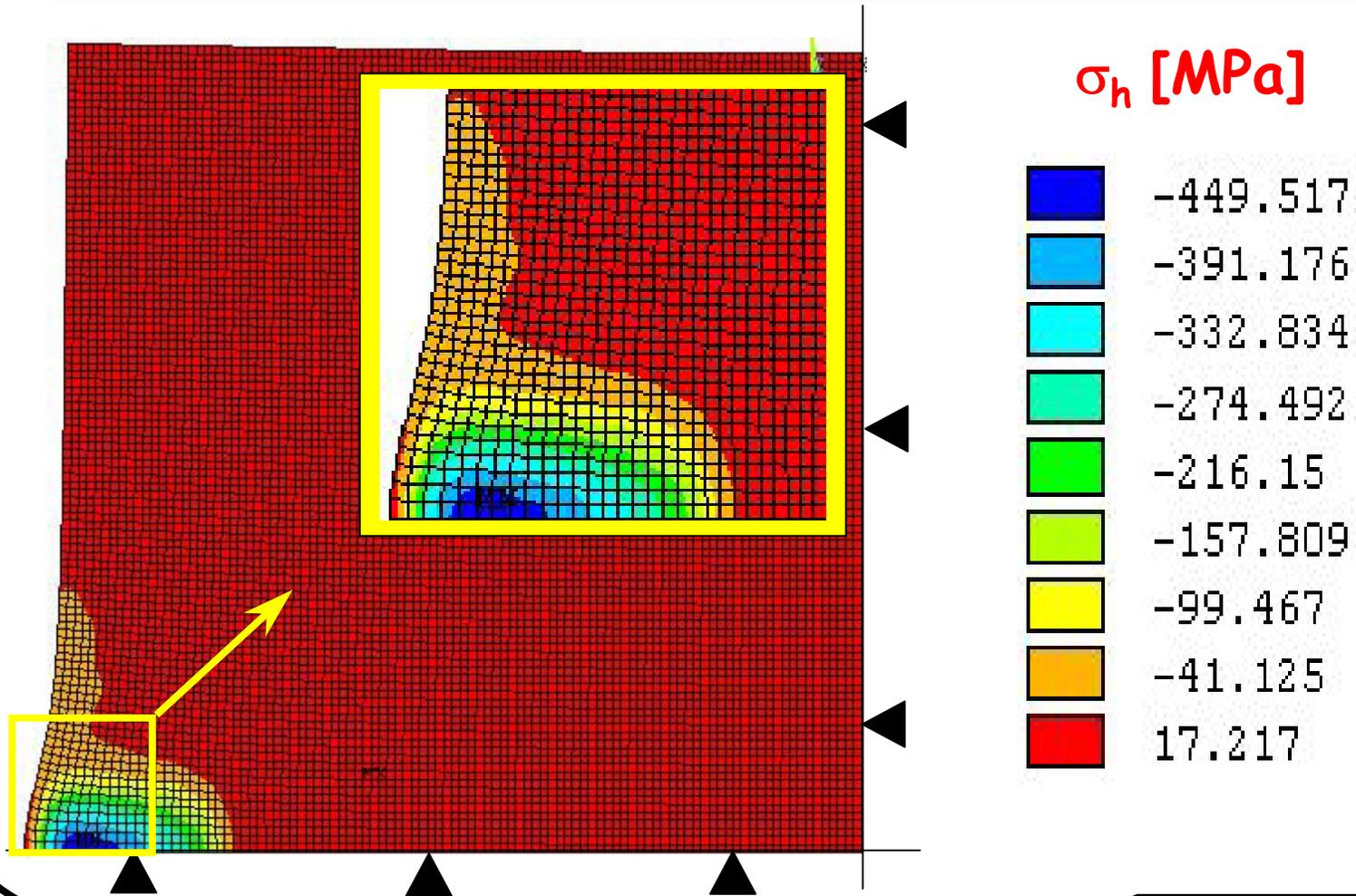
	.149E+09
	.297E+09
	.445E+09
	.593E+09
	.741E+09
	.889E+09
	.104E+10
	.119E+10
	.133E+10

For reference:

Allowable: 160 MPa

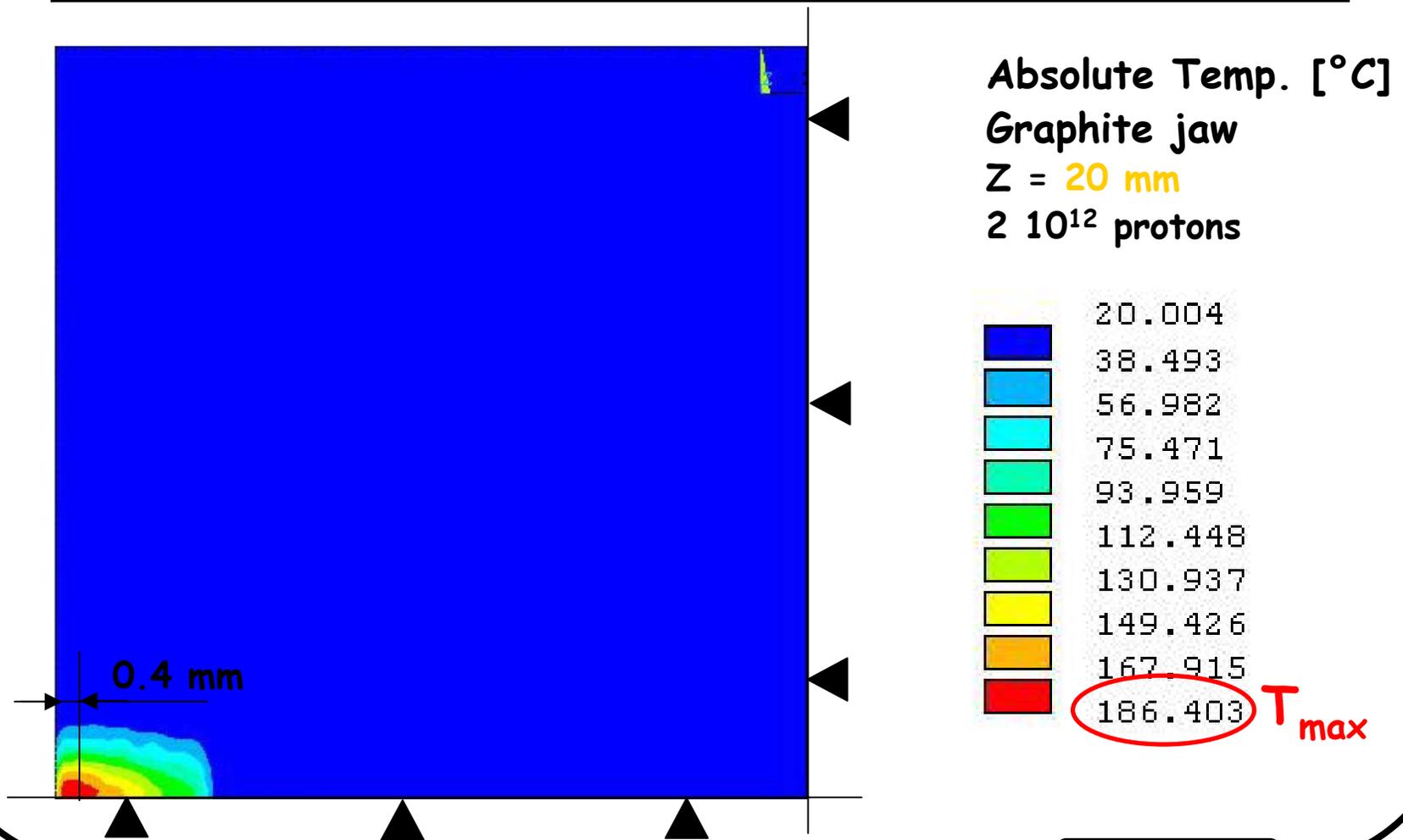
Safety factor 2/3

Test Study #1 - Hydrostatic Stress



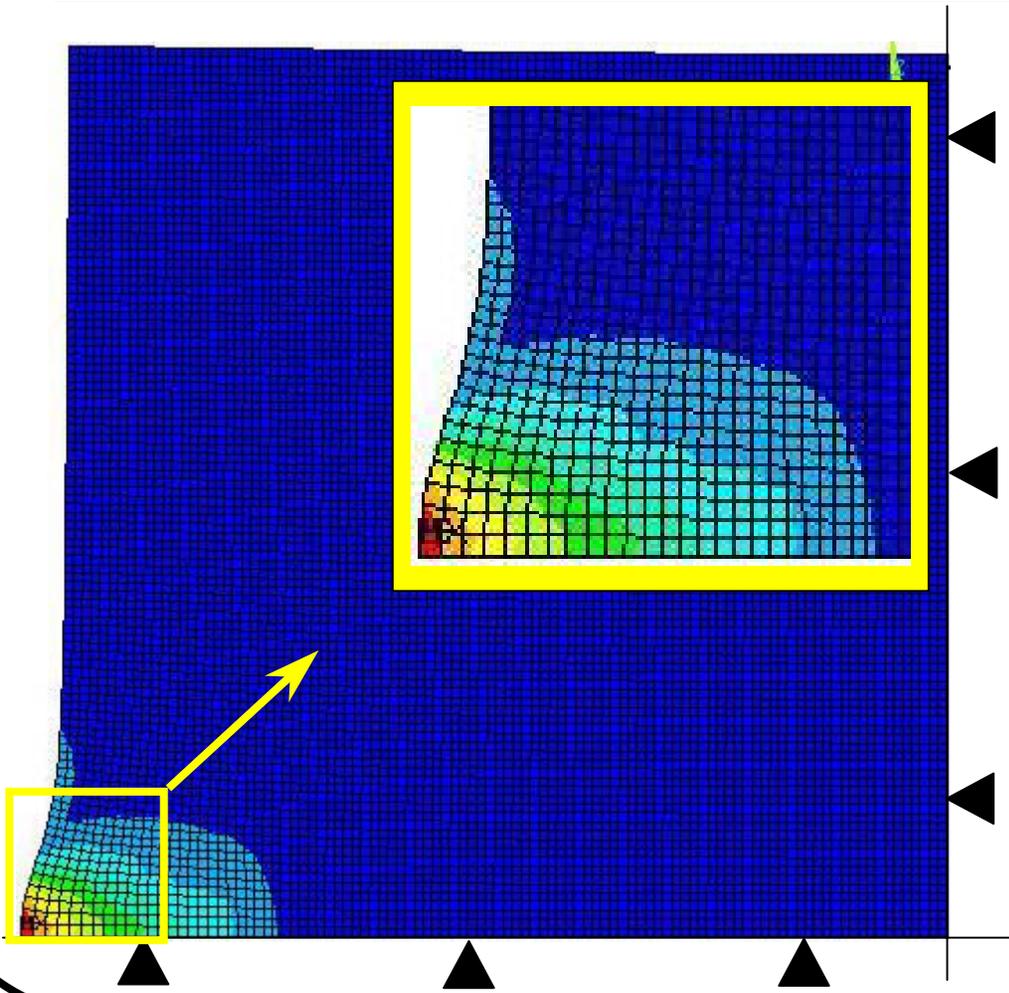
#1 DM8B

Test Study #1 - Beam Heat Load



#1 CM9B

Test Study #1 - Von Mises Stress



σ_{VM} [Pa]

DMX	=	.369E-06
SMN	=	359.385
SMX	=	.667E+07
		359.385
		741900
		.148E+07
		.222E+07
		.297E+07
		.371E+07
		.445E+07
		.519E+07
		.593E+07
		.667E+07

For reference:
Allowable: 18 MPa
Safety factor 2/3

Test Study #1 - Further work

What is still to be done ?

- Check **sensitivity** to model and mesh size;
- Study **stress** components;
- Compare **boundary conditions**;
- Investigate **load** at different cross-sections;
- Perform **dynamic** analysis ;
- Choose material models.