

# Question 7

**Q:** How to calculate the stress that affects peeling on the bonding face between bodies?

**A:** Refer to the next few slides.

# Stress for Peeling

Stress Tensor

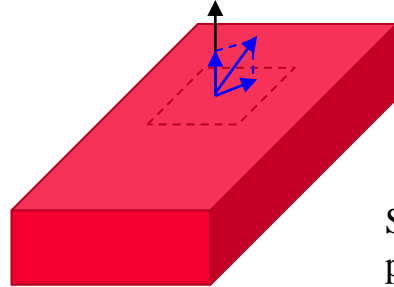
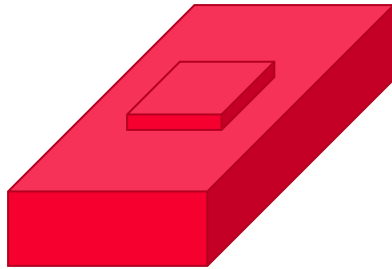
$$\sigma = \begin{pmatrix} \sigma_{xx} & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & \sigma_{yy} & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & \sigma_{zz} \end{pmatrix}$$

Normal Direction

$$n = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$$

Force applied from the upper plate to the top surface of the lower plate

$$f = \sigma n = \begin{pmatrix} \sigma_{xz} \\ \sigma_{yz} \\ \sigma_{zz} \end{pmatrix}$$



Separate into normal and in-plane directions

Normal Stress

$$f_v = f \cdot n = \sigma_{zz}$$

Magnitude of Shear Stress

$$f_h = |f - (f \cdot n)n| = \sqrt{\sigma_{xz}^2 + \sigma_{yz}^2}$$

- Force applied from the lower plate to the bottom surface of the upper plate is the same as above in accordance with the law of action and reaction.  
(They may not match because of numerical errors)

# User-Defined Field

✕

**User-Defined Field**

Equation

```
sqr(TEN_YZ(GALILEO_STRESS)*TEN_YZ(GALILEO_STRESS)*TEN_ZX(GALILEO_STRESS)*TEN_ZX(GALILEO_STRESS))
```

Insert Fields in the Equation

Field Selection

File Name: Result currently open Add Other Results

Solver: Stress Analysis

Modes: 0: Static Analysis

Field: Displacement [m]

Component: X Component

Phase:

Display

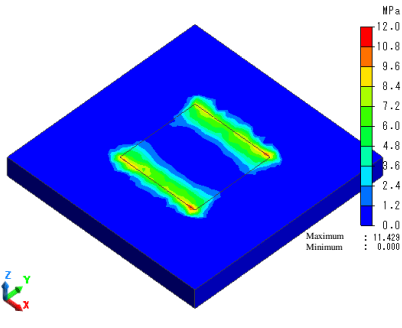
Field Name (Mandatory): Operation\_001 Delete

Unit (Not mandatory):

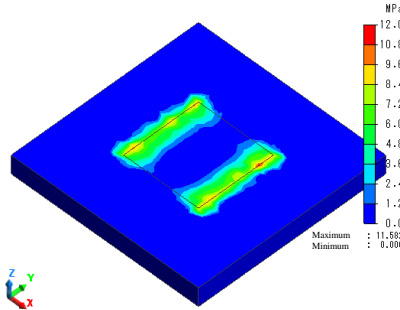
OK
Cancel
Help

$$f_h = \sqrt{\sigma_{xz}^2 + \sigma_{yz}^2}$$

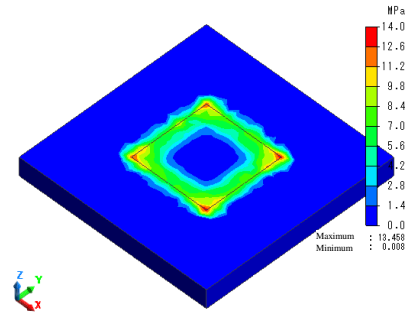
# Example of User-Defined Field



YZ Shear Stress



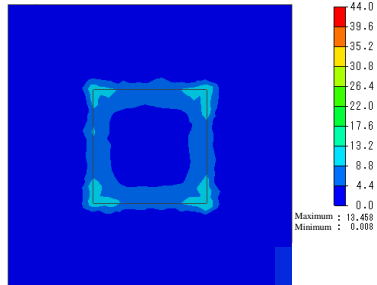
ZX Shear Stress



User Defined  
Shear Stress

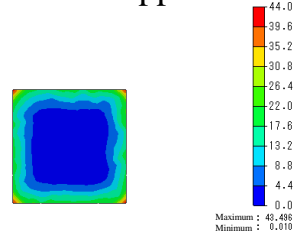
$$f_h = \sqrt{\sigma_{xz}^2 + \sigma_{yz}^2}$$

Top Surface of Lower Plate



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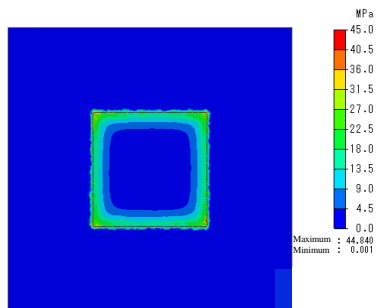
Bottom Surface of Upper Plate



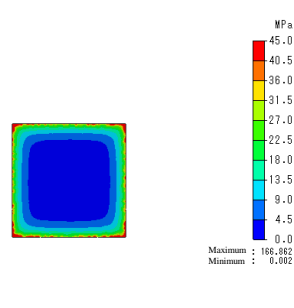
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Large-size  
Meshes

Small-size  
Meshes



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\* The stresses on the top surface of the lower plate and the bottom surface of the top plate do not match because of numerical errors.  
 (Smaller-size meshes will improve the matching.)