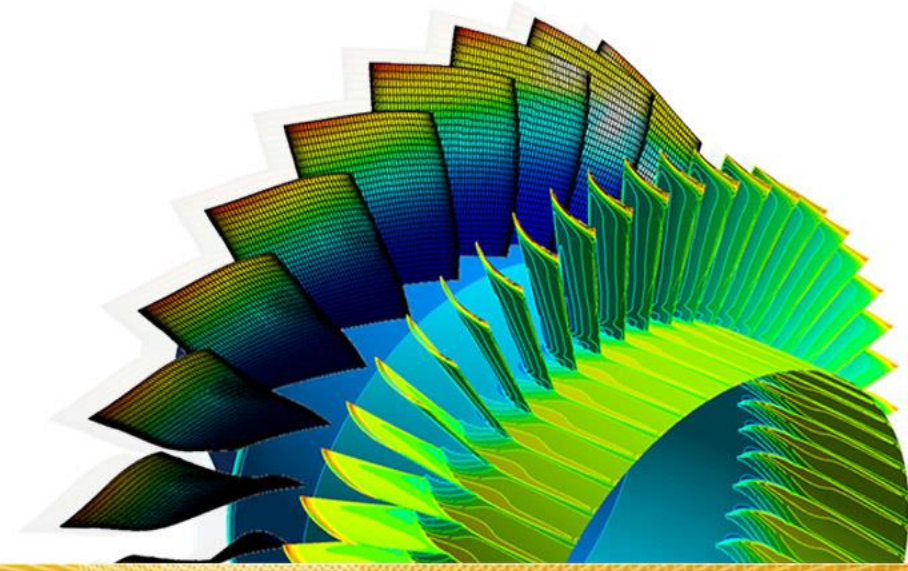
ANSYS Composite PrepPost 19.0

Workshop 10.1 – Delamination



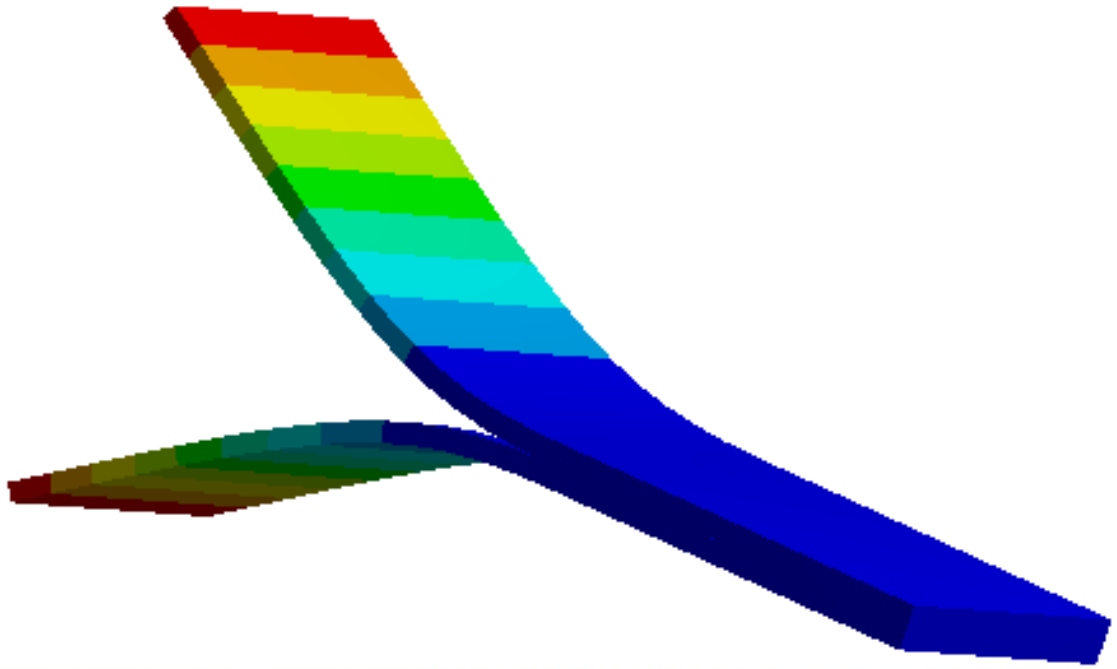
10. Workshop Delamination

Agenda

- Set up properties for delaminating interfaces inside engineering data
- define delaminating interfaces inside ACP
- Use predefined interfaces from ACP inside Mechanical
- Alternatively use contact definitions with cohesive zone material inside Mechanical
- Boundary conditions and analysis settings
- Postprocessing

10. Workshop Delamination

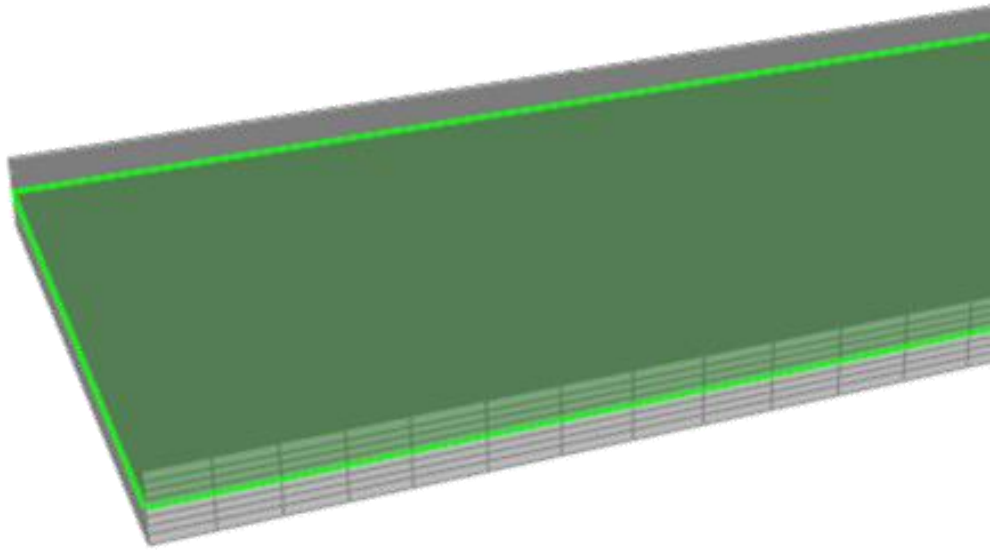
- This workshop will explain how to set up delamination interfaces using
  - interface Elements defined in ACP (Delamination)
  - contact definitions with cohesive zone material (Debonding)

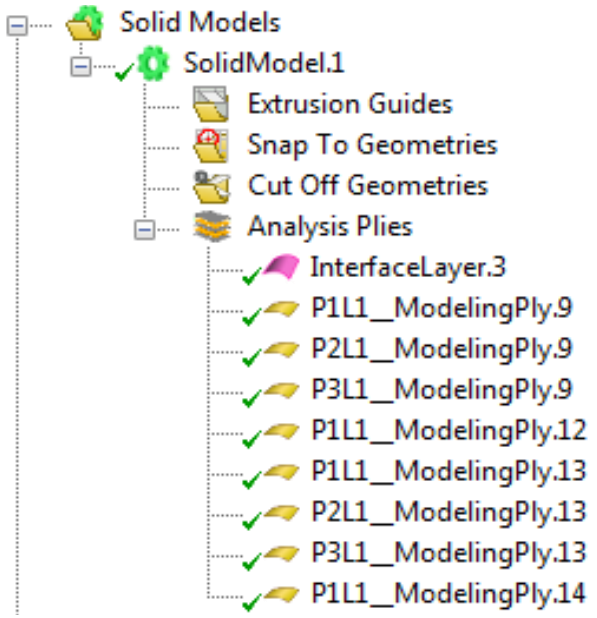


10. Workshop Delamination

Interface elements

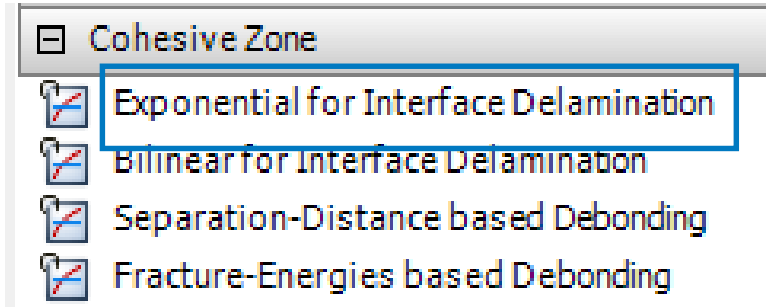
- Open the Archive *Delamination_FROM_START_19.0.wbpz*. It contains an ACP model of a simple tension test.
- As Interface elements in ACP can be generated for solid elements, we will extrude an solid model with an interface layer.





10. Workshop Delamination

Edit engineering data by adding a Cohesive Zone Material Model which will be used to simulate delamination (first click to add a new material). Choose *Exponential for Interface Delamination* from *Cohesive Zone* in Tool Box



Set properties as shown:

Outline of Schematic A2: Engineering Data

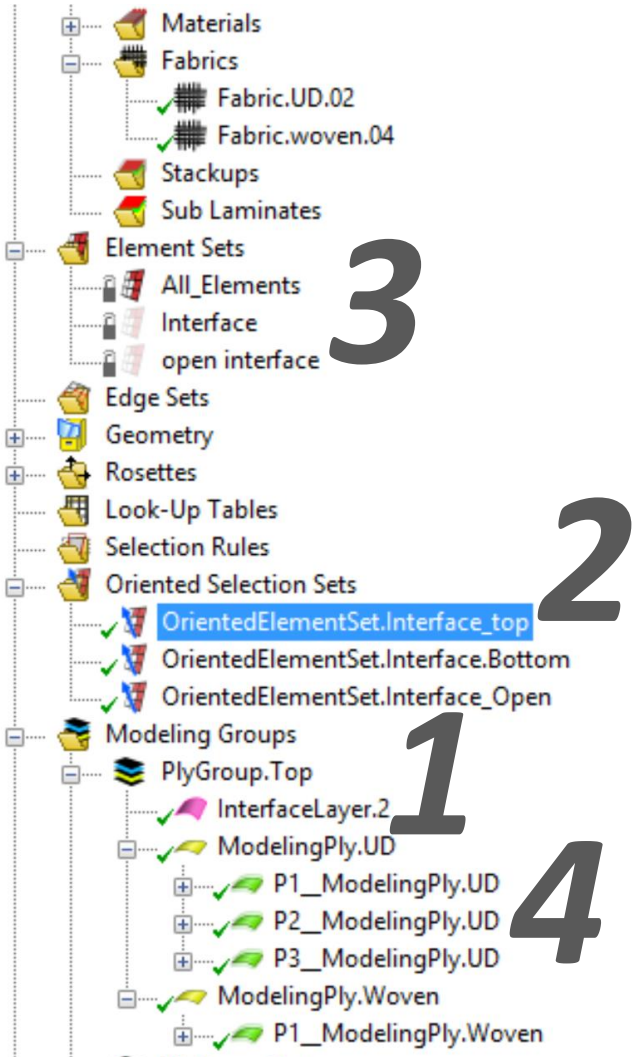
	A	B	C	D
1	Contents of Engineering Data		Source	Description
2	Material			
3	cohesive zone			
4	Epoxy_Carbon_UD_230GPa_Wet			
5	Epoxy_Carbon_Woven_230GPa_Prepreg			
6	Resin_Epoxy			
*	Click here to add a new material			

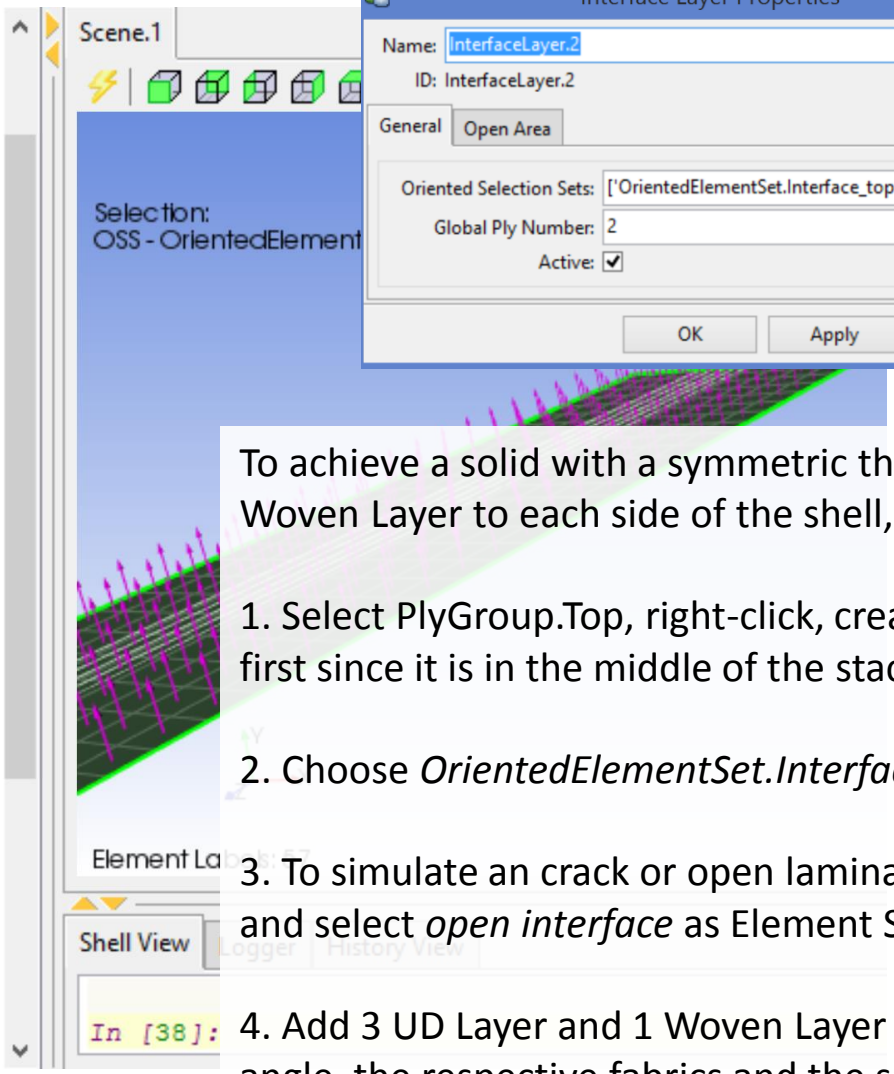
Properties of Outline Row 3: cohesive zone

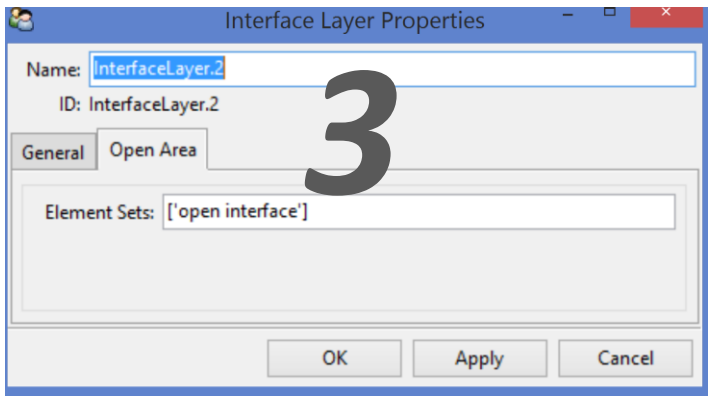
	A	B	C	D	E
1	Property	Value	Unit		
2	Exponential for Interface Delamination				
3	Maximum Normal Traction	50	MPa		
4	Normal Separation Across the Interface	0.5	mm		
5	Shear Separation at Maximum Shear Traction	0.5	mm		

Update and refresh ACP System:

10. Workshop Delamination







To achieve a solid with a symmetric thickness, we add 3 UD Layer and a Woven Layer to each side of the shell, the interface layer in the middle

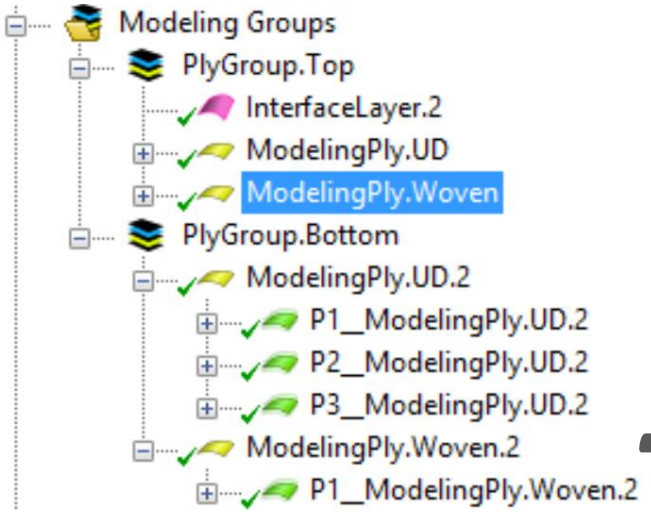
1. Select PlyGroup.Top, right-click, create interface layer; the interface is first since it is in the middle of the stackup:

2. Choose *OrientedElementSet.Interface_top* as Oriented Selection Set

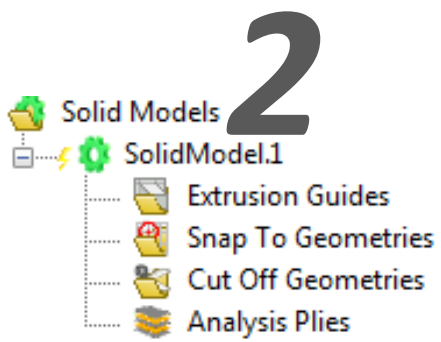
3. To simulate an crack or open laminate, we switch to Tab *Open Areas* and select *open interface* as Element Set

4. Add 3 UD Layer and 1 Woven Layer to the same PlyGroup, choose 0° angle, the respective fabrics and the same *top* orientation set as before

10. Workshop Delamination

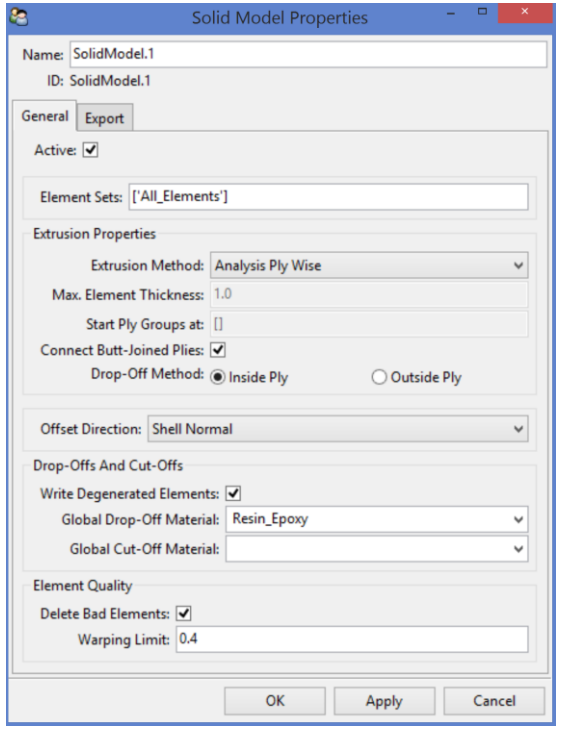


As before add a new Ply Group for the bottom and define the same stackup but using *OrientedElementSet.Interface.Bottom*, the resulting interface will be in the middle between top and bottom



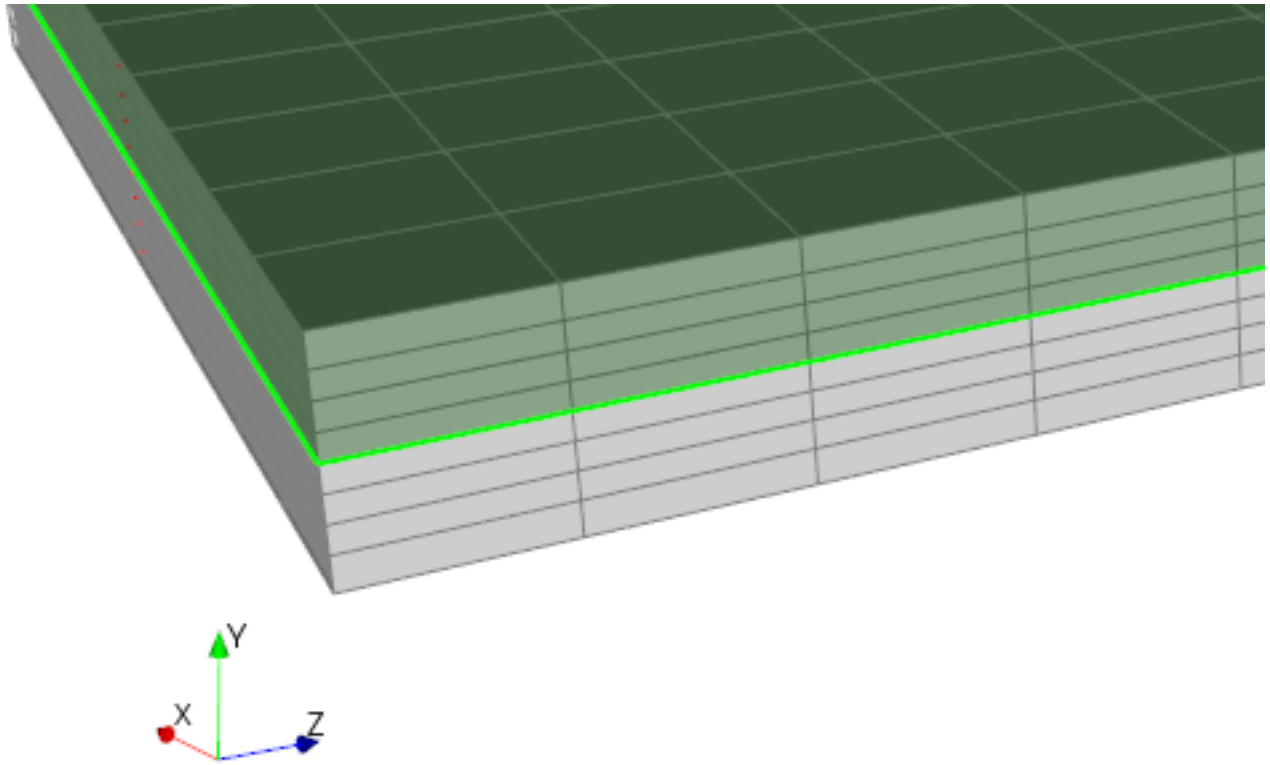
Add a Solid Model and choose

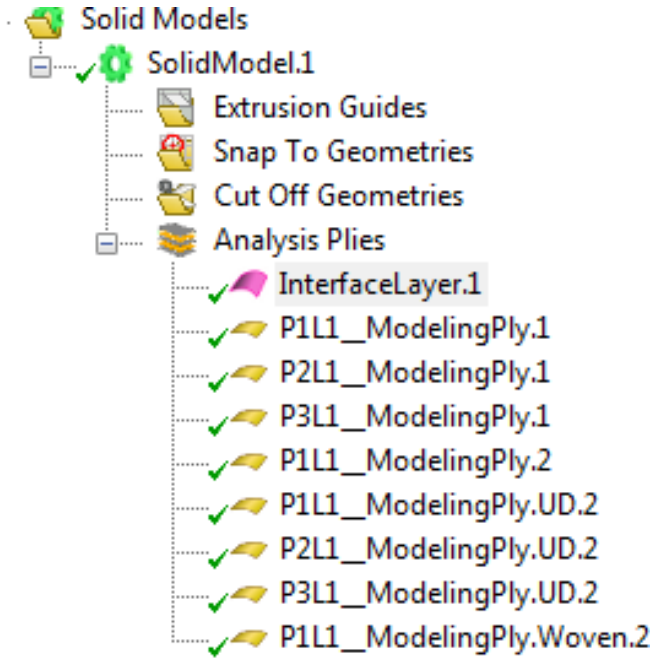
- *All Elements* as Element Set
- *Analysis Ply Wise as Extrusion Method*
- *Resin_Epoxy as Global Drop Off Material*



10. Workshop Delamination

Extrude Solid and check stack up and position of interface layer

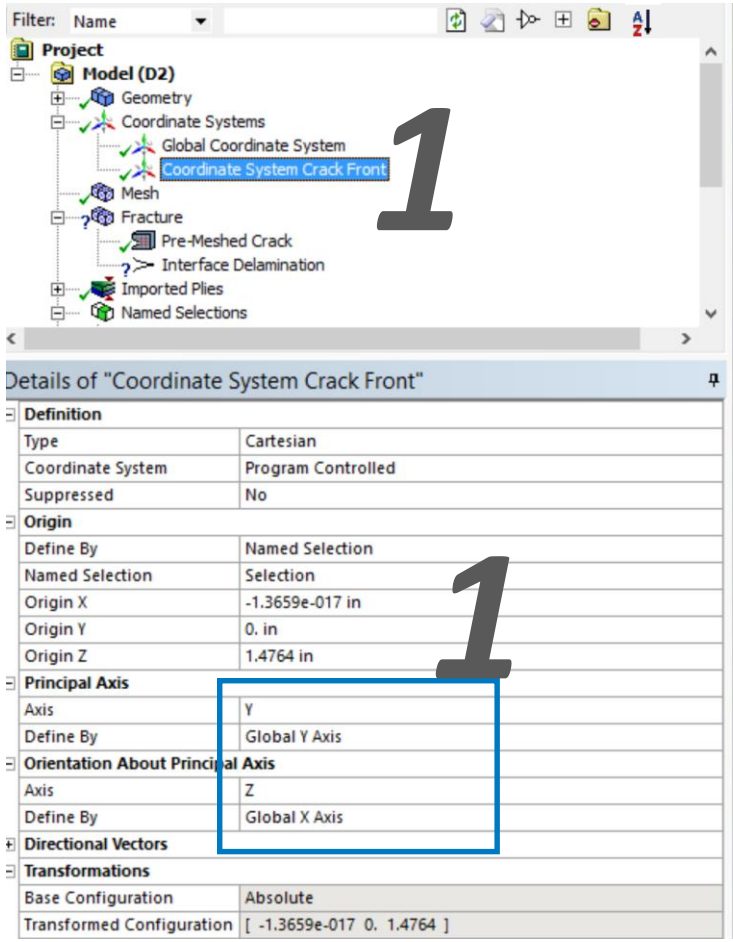


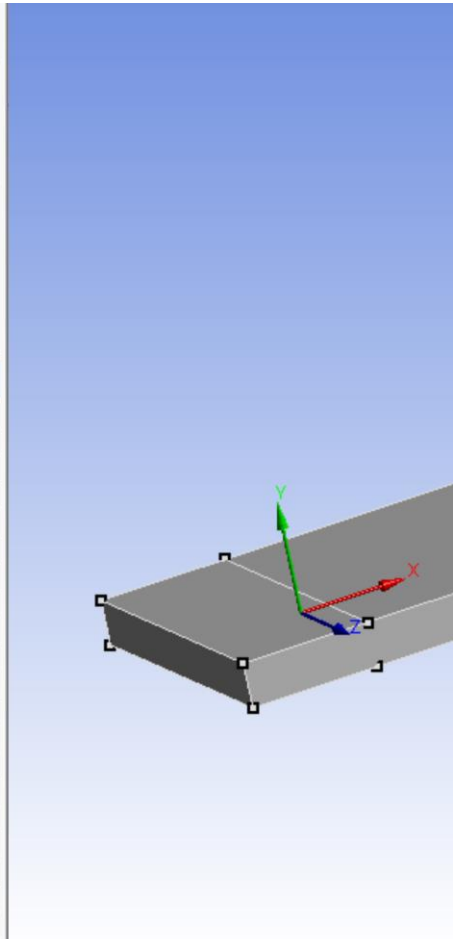


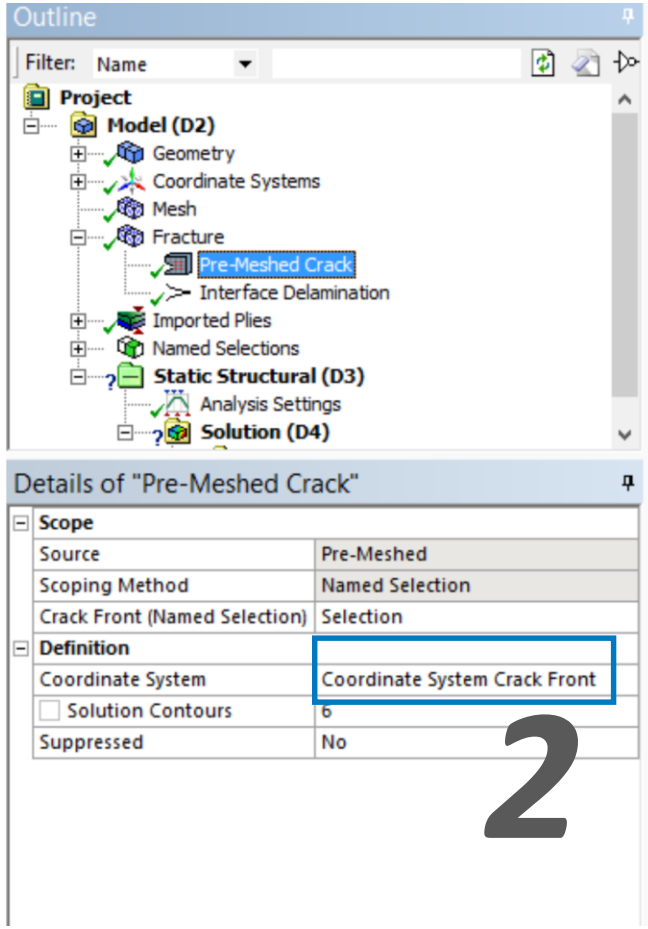
10. Workshop Delamination

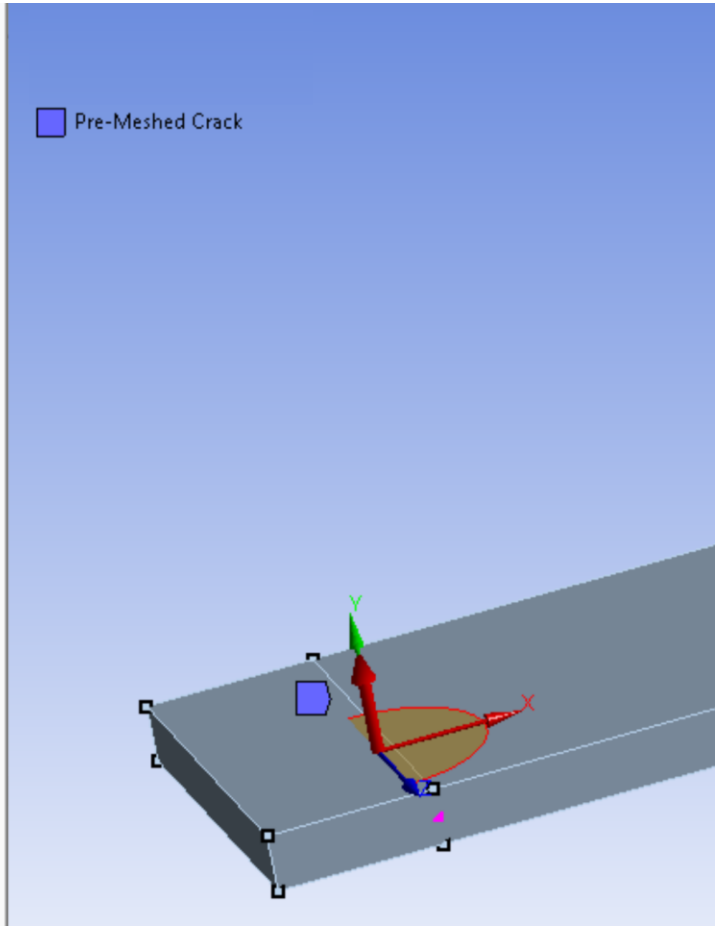
1. Add this COS for Crack Front, choose ACP created *Selection* for origin

2. Choose the COS defined before for the Pre-Meshed Crack COS



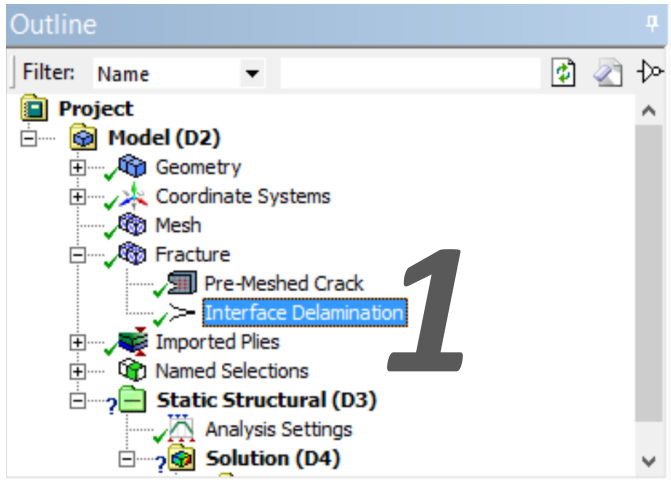


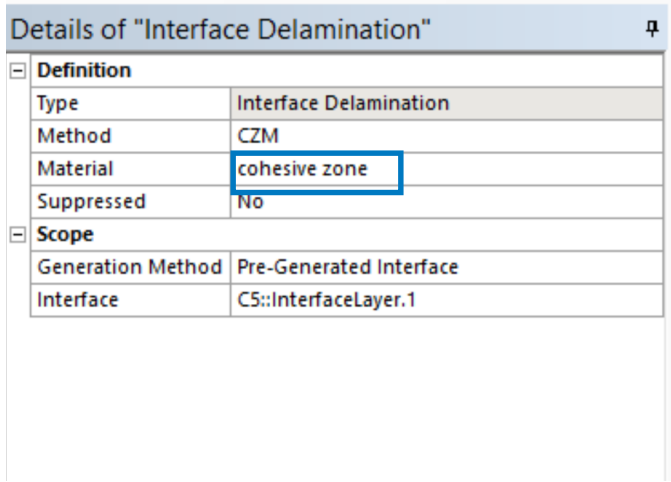


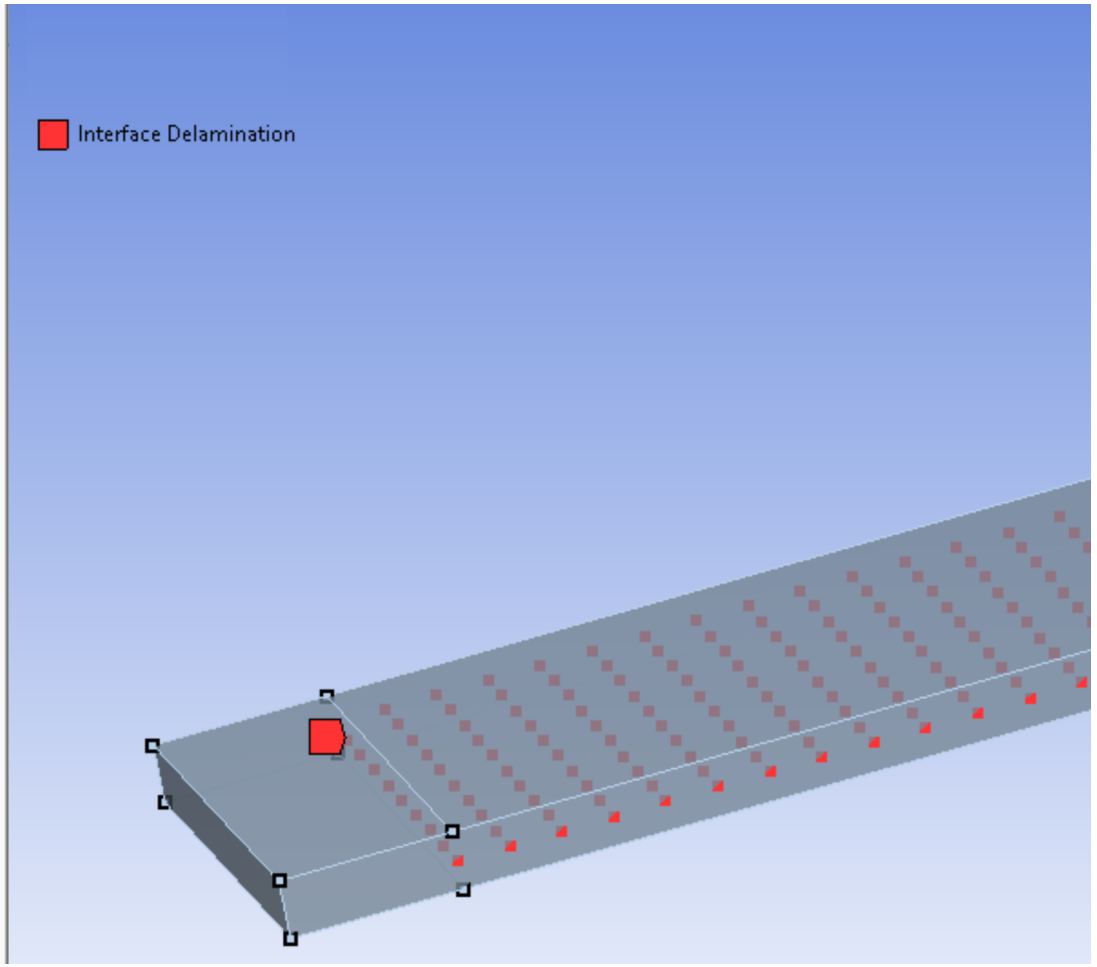


10. Workshop Delamination

In Definitions of Interface Delamination Object Select *CZM* for Method and *cohesive zone* as Material:

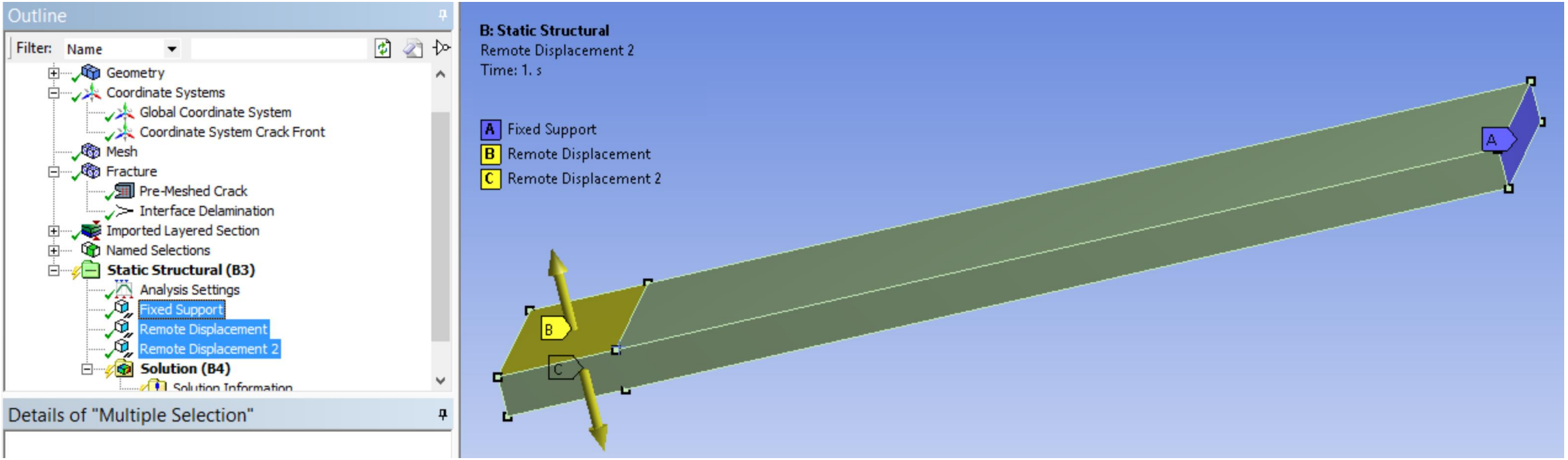






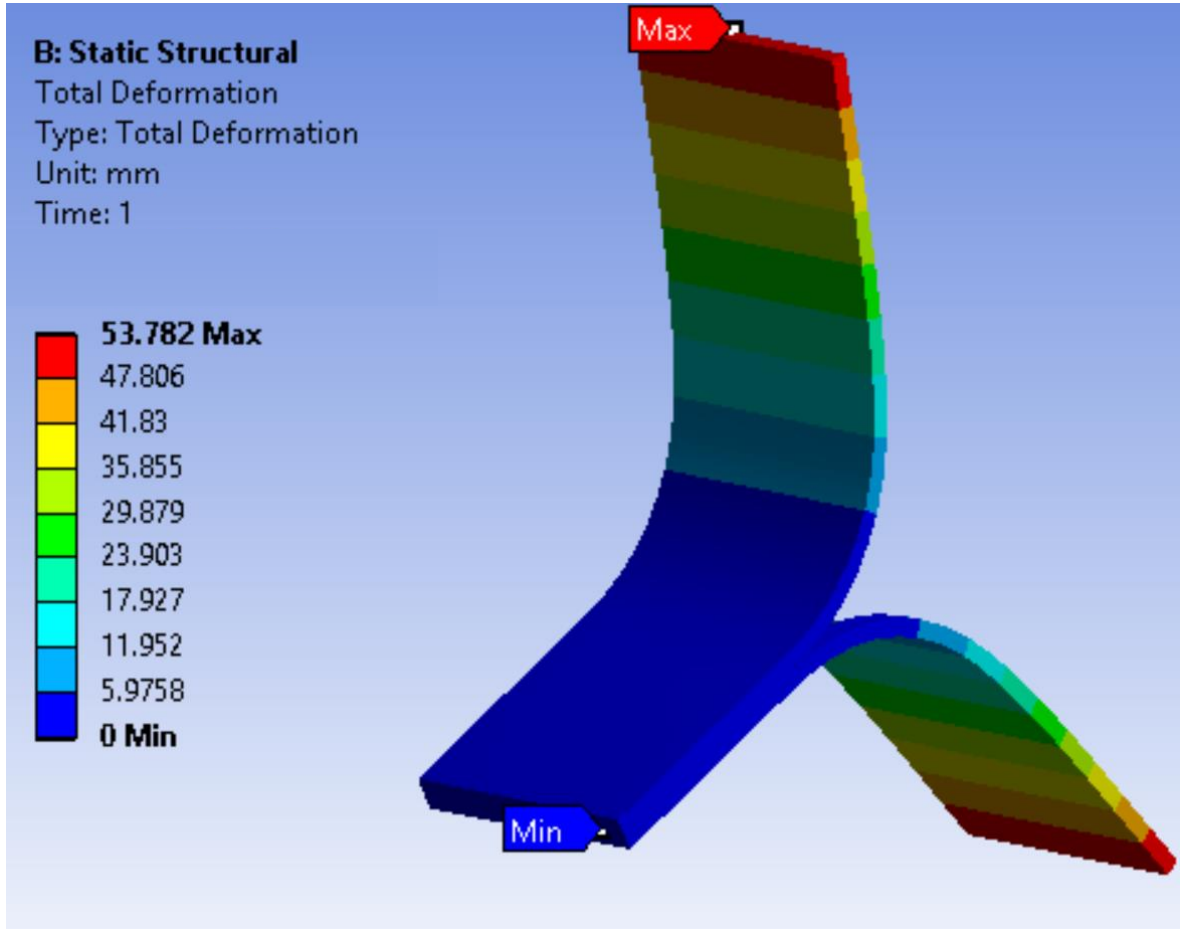
10. Workshop Delamination

Reattach boundary conditions and solve:

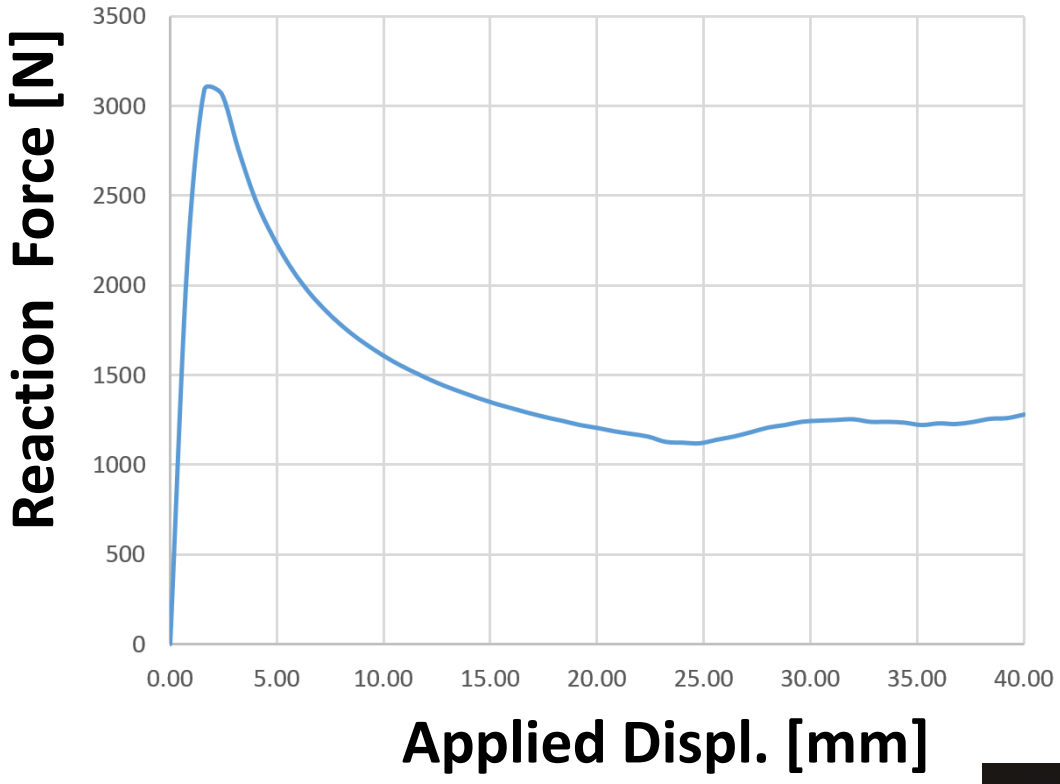


10. Workshop Delamination

Postprocess Results:



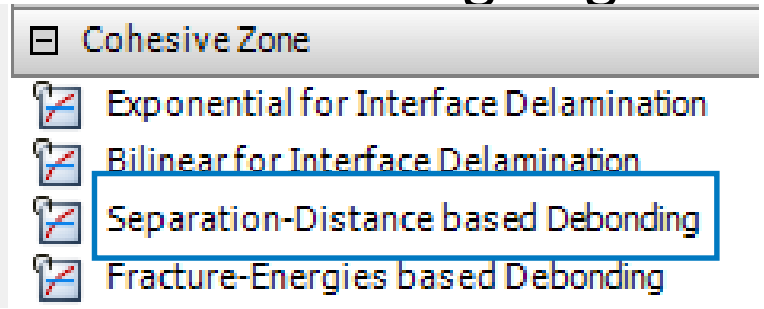
Extract from Tabular Data:



10. Workshop Delamination

Contact Elements

- The ANSYS Workbench Archive *Debonding_FROM_START_19.0.wbpz* contains an ACP model of a simple tension test.
- The ACP Model is already prepared for you (if you want to create it yourself proceed as before, without creating an interface layer, and extrude all elements in 2 different solid bodies for top and bottom according to the orientation selection sets).
- Start editing engineering data to add Cohesive Zone Material



In Engineering Data add new Material *Cohesive* and choose *Separation-Distance based Debonding* Model from Tool Box

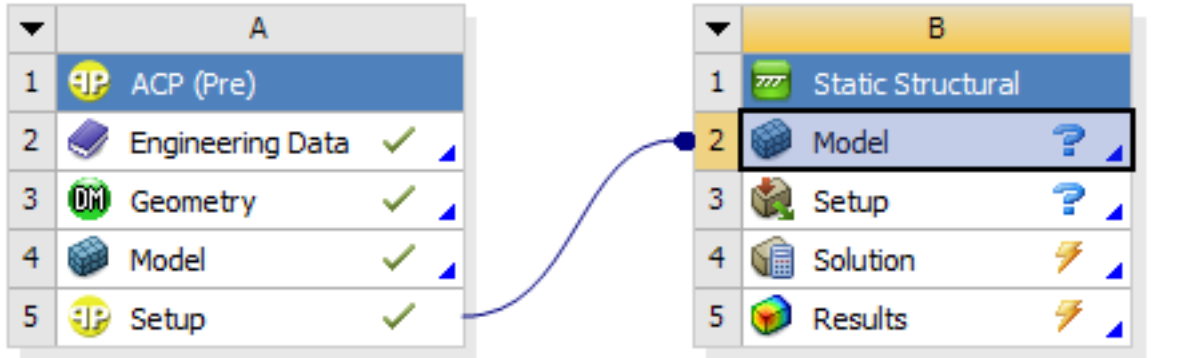
10. Workshop Delamination

Set properties as shown:

Properties of Outline Row 3: cohesive zone

	A	B	C
1	Property	Value	Unit
2	Separation-Distance based Debonding		
3	Tangential Slip Under Normal Compression	No	
4	Debonding Interface Mode	Mode I	
5	Maximum Normal Contact Stress	50	MPa
6	Contact Gap at the Completion of Debonding	0.5	mm
7	Maximum Equivalent Tangential Contact Stress	50	MPa
8	Tangential Slip at the Completion of Debonding	0.5	mm
9	Artificial Damping Coefficient	0.001	s

Update and refresh ACP System:



ACP (Pre) Contact Elements

Static Structural Contact with cohesive zone

10. Workshop Delamination

Open Mechanical and add a single contact, if not automatically inserted.

Edit Properties of Contact to:

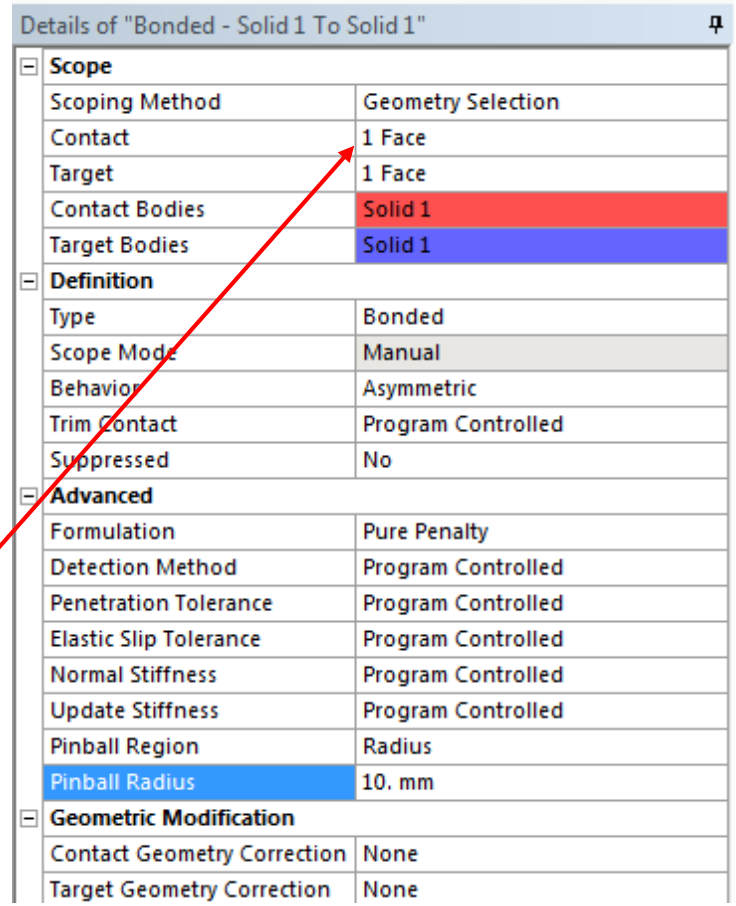
Type - Bonded

Behavior - Asymmetric

Formulation – Pure Penalty

Pinball Radius – Radius = 10mm

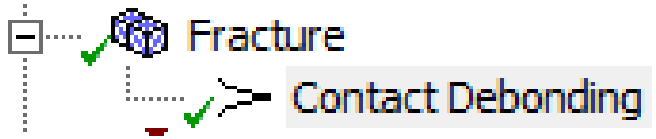
Note that you should select only one portion of the two faces in contact, Contact and Target requires two surfaces in the selection, let free an initial gap between the two bodies



Details of "Bonded - Solid 1 To Solid 1"	
Scope	
Scoping Method	Geometry Selection
Contact	1 Face
Target	1 Face
Contact Bodies	Solid 1
Target Bodies	Solid 1
Definition	
Type	Bonded
Scope Mode	Manual
Behavior	Asymmetric
Trim Contact	Program Controlled
Suppressed	No
Advanced	
Formulation	Pure Penalty
Detection Method	Program Controlled
Penetration Tolerance	Program Controlled
Elastic Slip Tolerance	Program Controlled
Normal Stiffness	Program Controlled
Update Stiffness	Program Controlled
Pinball Region	Radius
Pinball Radius	10. mm
Geometric Modification	
Contact Geometry Correction	None
Target Geometry Correction	None

10. Workshop Delamination

Add a Contact Debonding Object under Fracture in tree

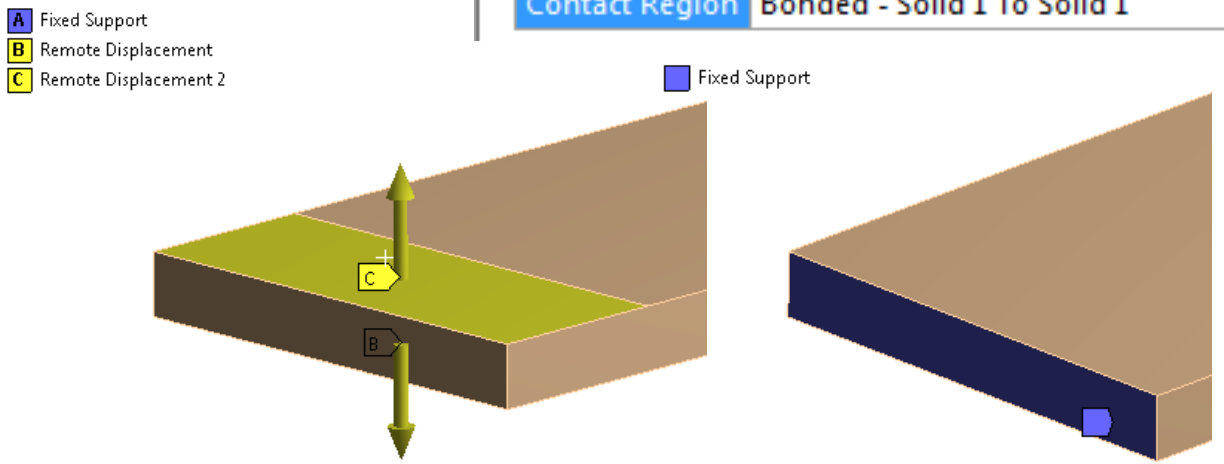


Select defined cohesive zone Material and

Prior defined Contact

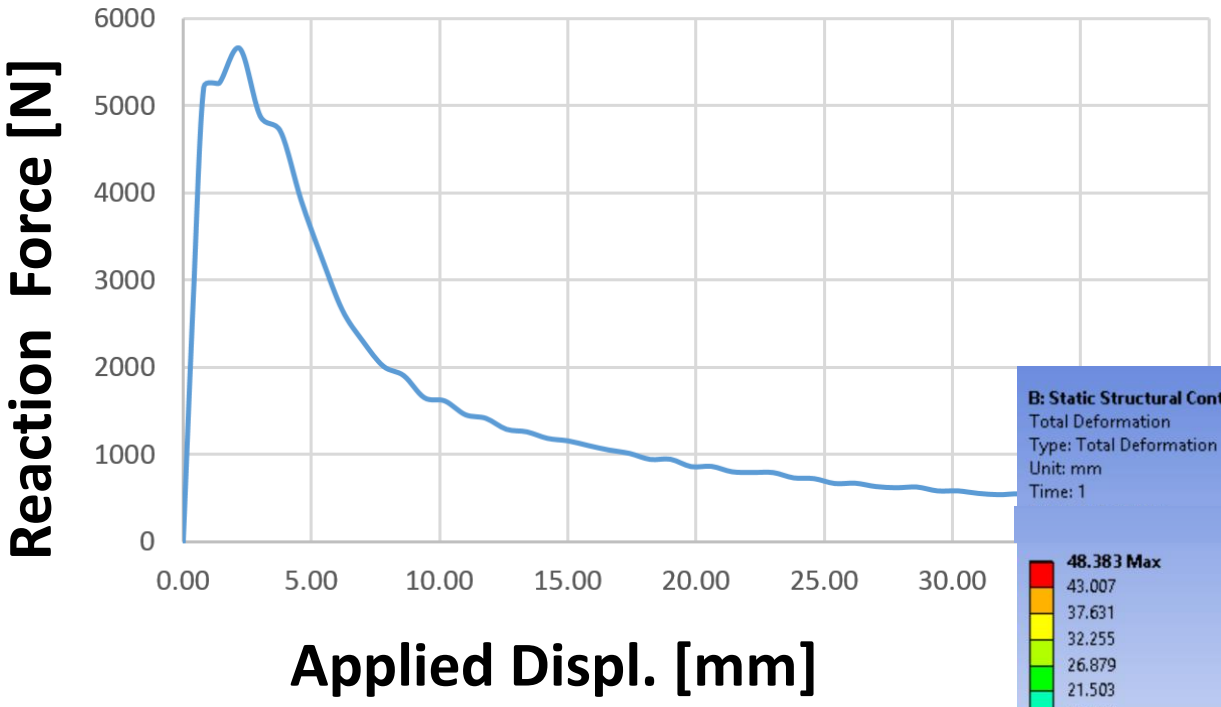
Details of "Contact Debonding"

Definition	
Type	Contact Debonding
Method	CZM
Material	cohesive zone
Suppressed	No
Scope	
Contact Region	Bonded - Solid 1 To Solid 1



Reattach boundary conditions and solve

10. Workshop Delamination



Postprocess Results: