

## **Embedded defect identification of a multi-layered carbon fibre composite by combining different numerical model and DIC technique**

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# Content



- Introduction



- Problem Statement



- Proposed Model 1



- Proposed Model 2



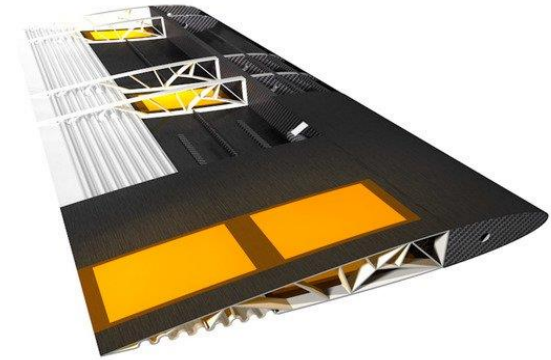
- Comparison of Healthy and Damaged Case



- Conclusion

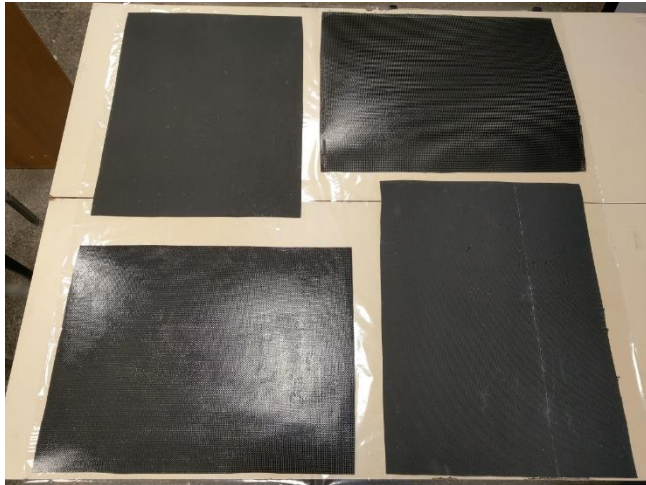
# Introduction

- Composite material is key element in smart technology and infrastructure
- Efficient in many ways compare to conventional materials
- Composites are mostly ductile in nature thus makes very important to identify early defects to avoid catastrophic failure

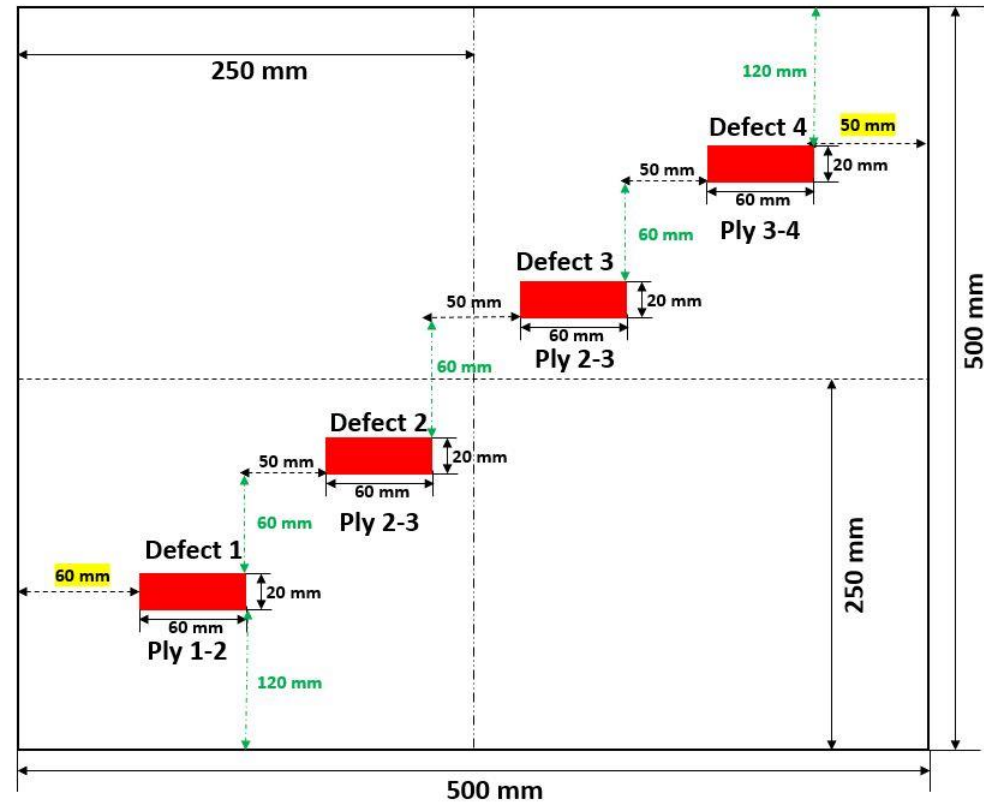


# Problem Statement

Objective: Numerical modelling to identify the defect located in different depth

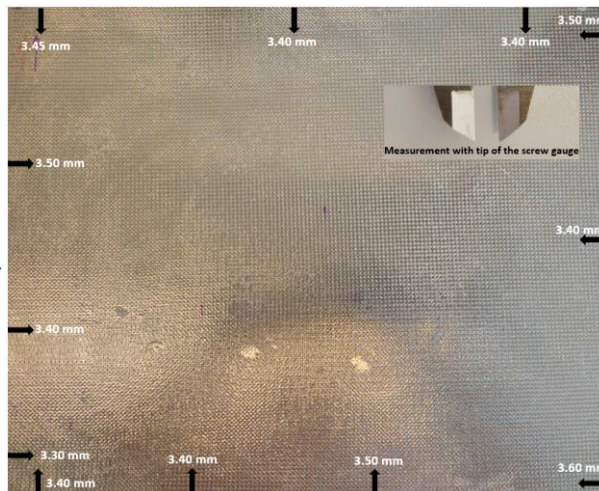


← Subjected sample

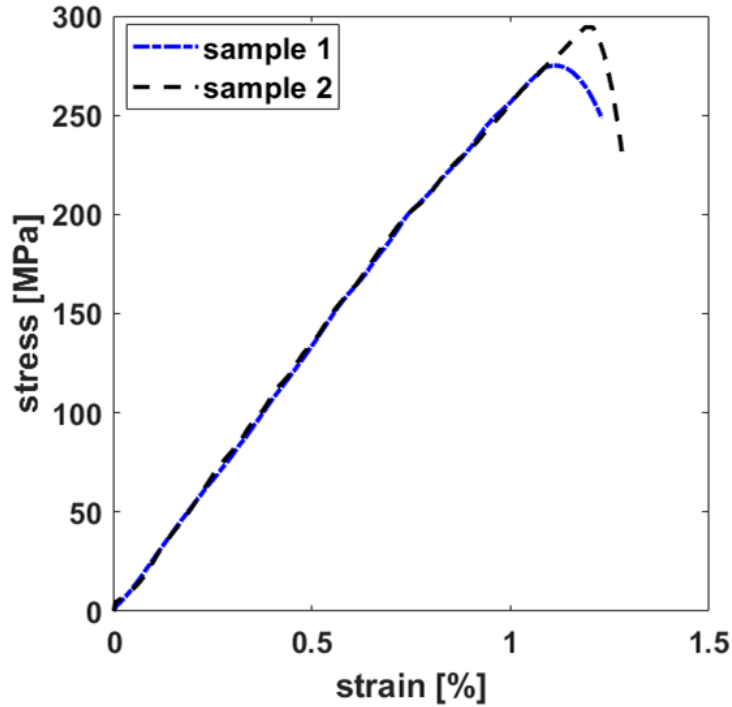


Schematic diagram of location of defect

→ Measured thickness



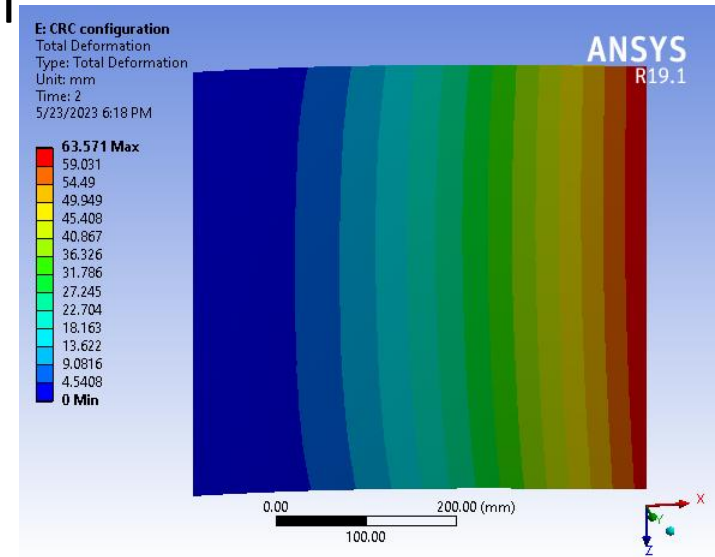
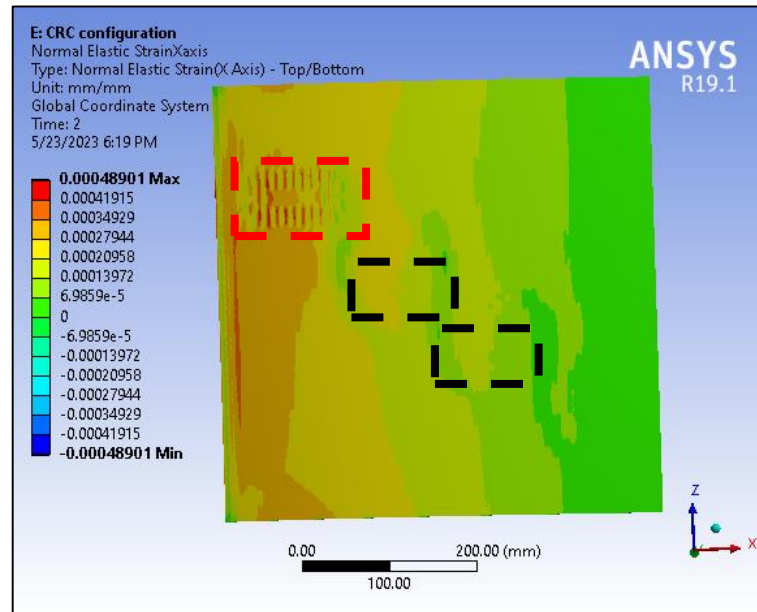
# Proposed Model 1



Tensile Test

## Multilayered model

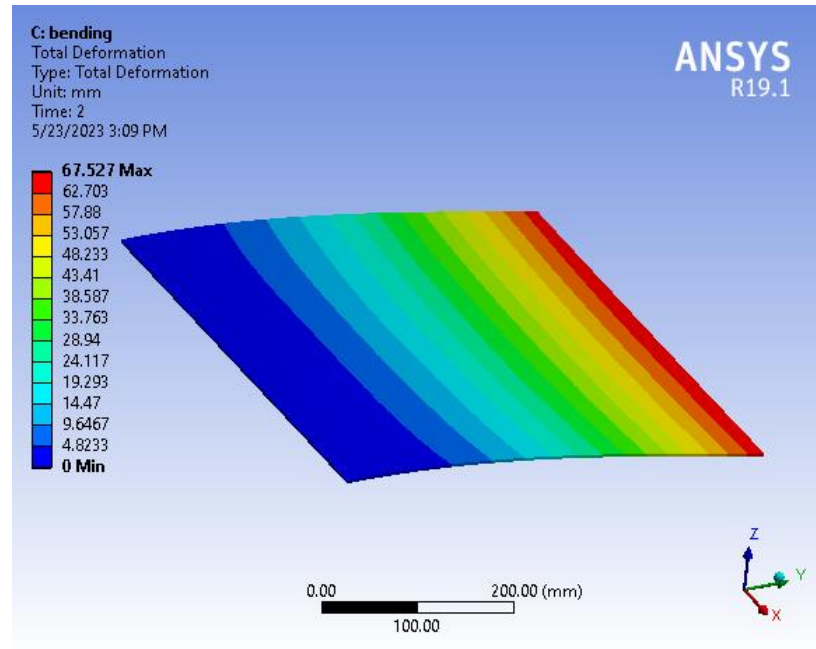
- CFC
- Epoxy Resin
- CFC
- Epoxy Resin
- CFC
- Epoxy Resin
- CFC



- First delamination is visible
- Others are not prominent

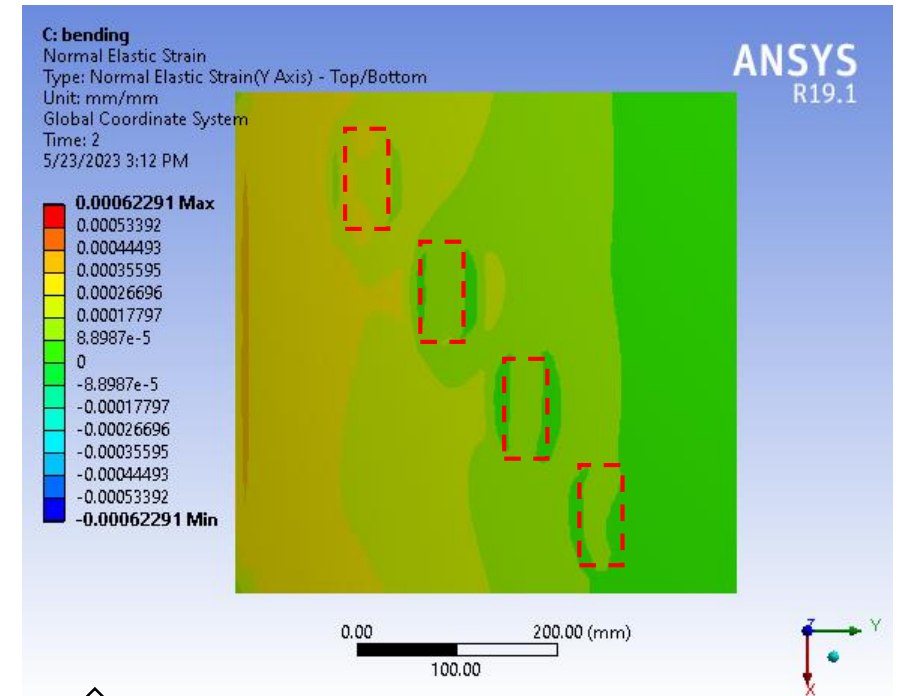
This model is competingly heavy thus unsuitable to use practical purpose

# Proposed Model 2



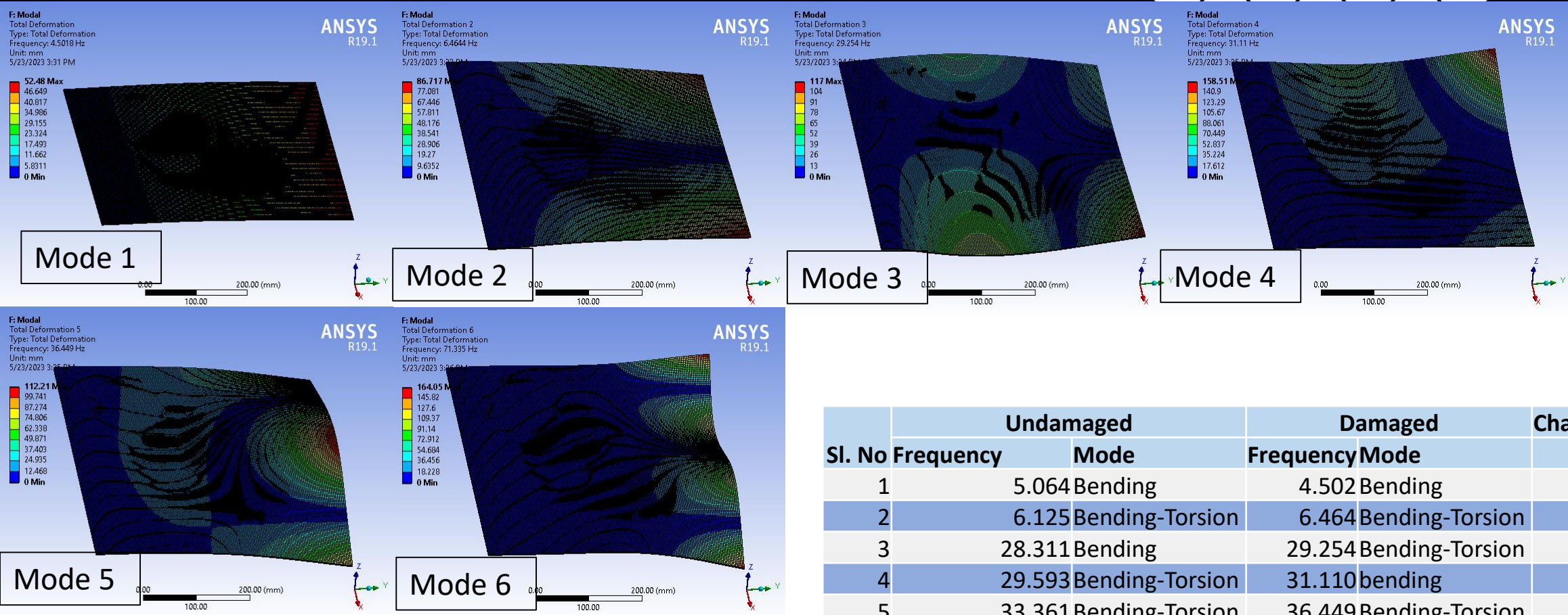
- 4 layers CFC are modelled with proper delamination

- Displacement is similar to previous model



- Strain contour gives approximate locations of delamination
- Delamination, present in depth is also visible from surface strain contour

# Modal Analysis



Sl. No	Undamaged		Damaged		Change
	Frequency	Mode	Frequency	Mode	
1	5.064	Bending	4.502	Bending	11.10%
2	6.125	Bending-Torsion	6.464	Bending-Torsion	5.53%
3	28.311	Bending	29.254	Bending-Torsion	3.33%
4	29.593	Bending-Torsion	31.110	bending	5.13%
5	33.361	Bending-Torsion	36.449	Bending-Torsion	9.26%
6	59.170	Bending-Torsion	71.335	Bending-Torsion	20.56%

# Conclusion

- The first model show only one delamination zone because of non-smooth strain transfer from one layer to other
- Second model perform better in absence of intermediate layer
- The strategic location of delamination zone largely affect the modal behavior of the plate
- Depending on the location, the modal characteristic have been changed



# Q&A