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# Computational Study of Mechanical Behaviour of Fiber Matrix Interfaces of the Epoxy and Polyester Reinforced with En-8 Carbon Steel

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**ABSTRACT:** A computational study of the fiber matrix interfaces of the fiber matrix Interfaces on the stress of the Epoxy and polyester reinforced with long ferrous (En-8 carbon steel) is desired. The number of debonding stress are characterizing each interface of the different debonding length. A Modeling and analysis are carried out by catia v5 r20 and ANSYS14.5 software. The developed finite element model accessed by the available FEM computational and illustrates the dependence of the stiffness and stresses in interface of Microstructure

**KEYWORDS:** Bimetal, bounding, Matrix composites, FEA

## I. INTRODUCTION

A composite material is a material made from two or more constituent significantly different physical or chemical properties that, when combined, produce a material with characteristics different from individual components. The individual components remain separate and distinct within the finished structure. The new material may be preferred for many reasons: common examples include materials which are stronger, lighter, or less expansive when compared to traditional materials.

Typical engineered composite materials include:

- Mortars, concrete
- Reinforced plastics, such as fiber-reinforced polymer
- Metal composites
- Ceramics composites

Many composite materials are composed of just two phase; one is termed the matrix, which continuous and surrounds the other phase, often called the dispersed phase. The properties of composites are a function of the properties of the constituent phases, their relative amounts, and the geometry of the dispersed phase.

They carbon material is one of the specific component on En-8 carbon steel is used. They are most of carbon used in the material. En-8 steels is a grade of steel that is commonly used is shafts, stressed pinned and studs. En-8 is superior to mild steel in strength wear resistance and toughness.

## II. OBJECTIVE

Our objective is to:

- Pre-processing the geometric modelling of matrix material.
- Processing the designed material to analyse with various loads to generate results
- Post processing the results into get solution for overall results of metal matrix

### III. METHODOLOGY

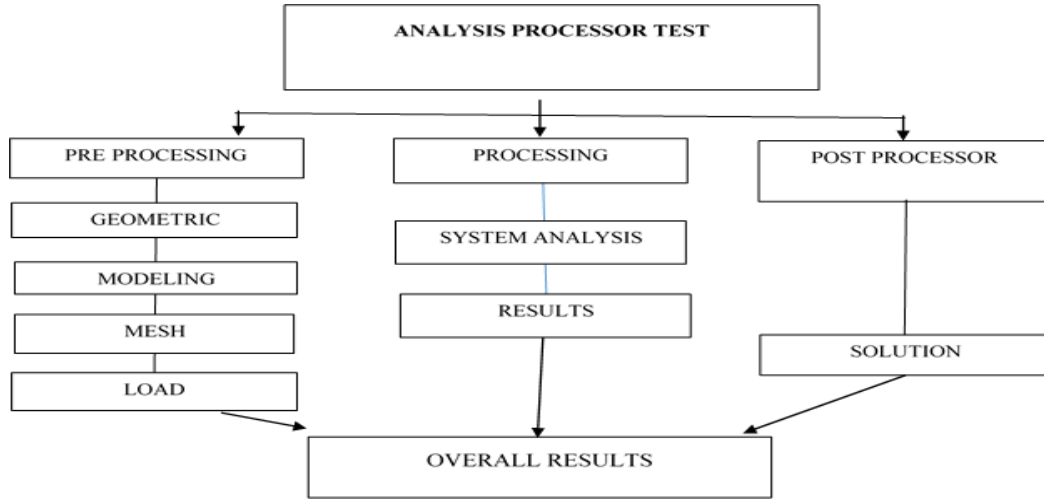


Fig 1. Flow chart for computational analysis method.

### IV. MATRIX FORMATION

We had make the composite matrix of metals combination of that is Steel vs. polyester, Steel vs. Epoxy, , and . These four composite matrix are processed to bounding of 100%, 90%, 80%, 70%, 60%, and 50%. The bounded design model is created by using Catia software and mesh creation and analysing are done byFinite Element Analysis method by using ANSYS workbench software.

Table 1. Selected Matrix Properties

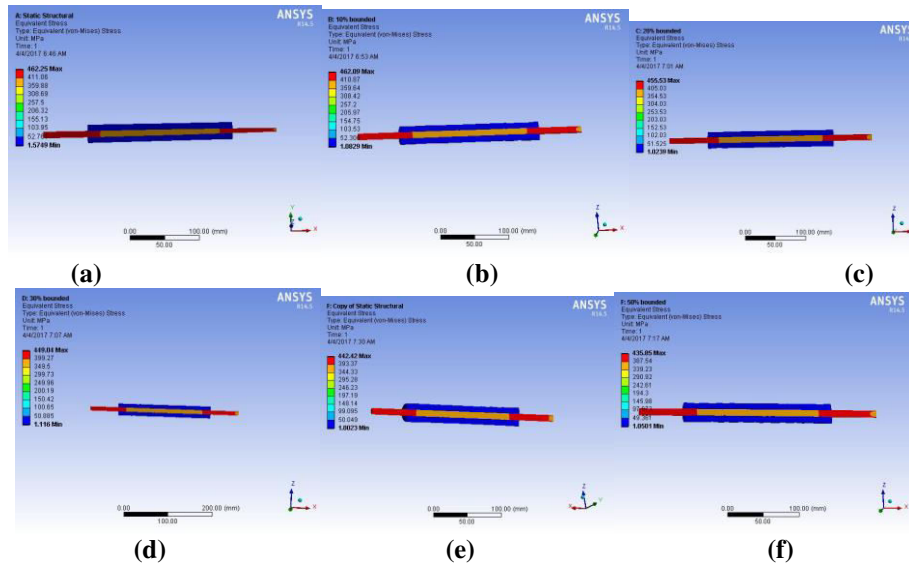
Properties of Selected Matrices								
	Density (gcm <sup>-3</sup> )	Tensile Modulus E (GPa)	Poisson's ratio ν	Shear Modulus G (GPa)	Longitudinal Tensile Strength σ <sub>s</sub> (MPa)	Longitudinal Thermal Expansion α (10 <sup>-6</sup> K <sup>-1</sup> )	Glass transition melting Point (°C)	Cost (\$/kg)
Epoxy	1.54	3.5	0.33	1.25	60	57.5		8.00
PolyEster	1.38	2.5	0.33	1.2	35		260	2.00
polyVinylEster	1.5	3.0			60		260 (T <sub>max</sub> )	3.00
PolySulfone (PS)	1.25	2.7			106	56	190 (T <sub>g</sub> )	14.00
PolyPhenyleneSulfone (PPS)	1.25	4.8			135	56	93 (T <sub>g</sub> ) 285 (T <sub>m</sub> )	14.00
PolyEtherSulfone (PES)	1.37	2.6			129	55	230 (T <sub>g</sub> )	14.00
PolyEtherImide (PEI)	1.27	3.3			145	62	217 (T <sub>g</sub> )	17.00
PolyAmideImide (PAI)	1.4	4.8			197	63		16.00
polyAmide (nylon)	1.36	2.5			100			6.00
PEEK	1.3	3.6	0.37	1.4	70	45	143 (T <sub>g</sub> ) 334 (T <sub>m</sub> )	18.00
Aluminium	2.71	69	0.32	26	74*	23.6	660	2.00
Titanium	4.51	113.8	0.33		238**	8.4	1670	18.00
Magnesium	1.74	45.5	0.33	7.5	189	26	650	4.00
Borosilicate glass	2.23	63.7	0.21	28	90	3.25		0.50

### V. RESULTS AND DISCUSSIONS

Created matrix are analysed by using ANSYS Software. The various matrix and their bounding stress and forcs results are shown below as follows:

**STEEL VS EPOXY**

**Stress distribution results for Steel vs. epoxy:**



**Fig2.** Analysis of stress distribution of bounded Steel vs. epoxy. (a) 100% bounding, (b) 90% bounding, (c) 80% bounding, (d) 70% bounding, (e)60% bounding, (f) 50% bounding

**Loads applied:**

Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	35000 N (ramped)	
Direction	Defined	

(a)

Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	35000 N (ramped)	
Direction	Defined	

(b)

Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	34500 N (ramped)	
Direction	Defined	

(c)

Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	34000 N (ramped)	
Direction	Defined	

(d)

Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	33500 N (ramped)	
Direction	Defined	

(e)

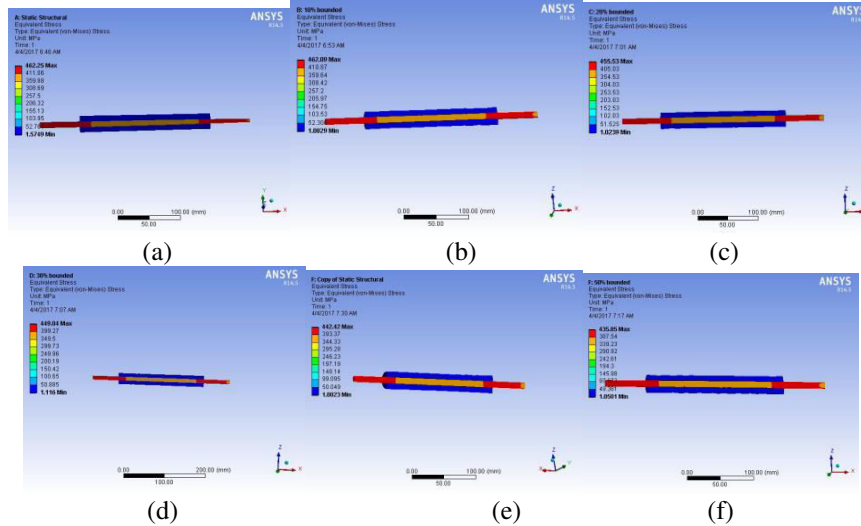
Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By	Vector	
Magnitude	33000 N (ramped)	
Direction	Defined	

(f)

**Fig 3.** Tabulated results of boundings of steel vs. epoxy and their loads magnitude and directions at (a) 100% ,(b) 90%, (c) 80% , (d)70% ,(e)60% ,(f) 50% boundings respectively.

**STEEL VS POLYESTER**

**Stress distribution results for steel vs. Polyester**



**Fig4.** Analysis of stress distribution of bounded Steel vs. Polyester. (a) 100% bounding, (b) 90% bounding, (c) 80% bounding, (d) 70% bounding, (e)60% bounding, (f) 50% bounding.

**Loads applied:**

Object Name	Fixed Support	Force	Object Name	Fixed Support	Force	Object Name	Fixed Support	Force
State	Fully Defined		State	Fully Defined		State	Fully Defined	
Scope			Scope			Scope		
Scoping Method	Geometry Selection		Scoping Method	Geometry Selection		Scoping Method	Geometry Selection	
Geometry	1 Face		Geometry	1 Face		Geometry	1 Face	
Definition			Definition			Definition		
Type	Fixed Support	Force	Type	Fixed Support	Force	Type	Fixed Support	Force
Suppressed	No		Suppressed	No		Suppressed	No	
Define By	Vector		Define By	Vector		Define By	Vector	
Magnitude	32500 N (ramped)		Magnitude	32700 N (ramped)		Magnitude	32750 N (ramped)	
Direction	Defined		Direction	Defined		Direction	Defined	

(a) (b) (c)

Object Name	Fixed Support	Force	Object Name	Fixed Support	Force	Object Name	Fixed Support	Force
State	Fully Defined		State	Fully Defined		State	Fully Defined	
Scope			Scope			Scope		
Scoping Method	Geometry Selection		Scoping Method	Geometry Selection		Scoping Method	Geometry Selection	
Geometry	1 Face		Geometry	1 Face		Geometry	1 Face	
Definition			Definition			Definition		
Type	Fixed Support	Force	Type	Fixed Support	Force	Type	Fixed Support	Force
Suppressed	No		Suppressed	No		Suppressed	No	
Define By	Vector		Define By	Vector		Define By	Vector	
Magnitude	32800 N (ramped)		Magnitude	33000 N (ramped)		Magnitude	33000 N (ramped)	
Direction	Defined		Direction	Defined		Direction	Defined	

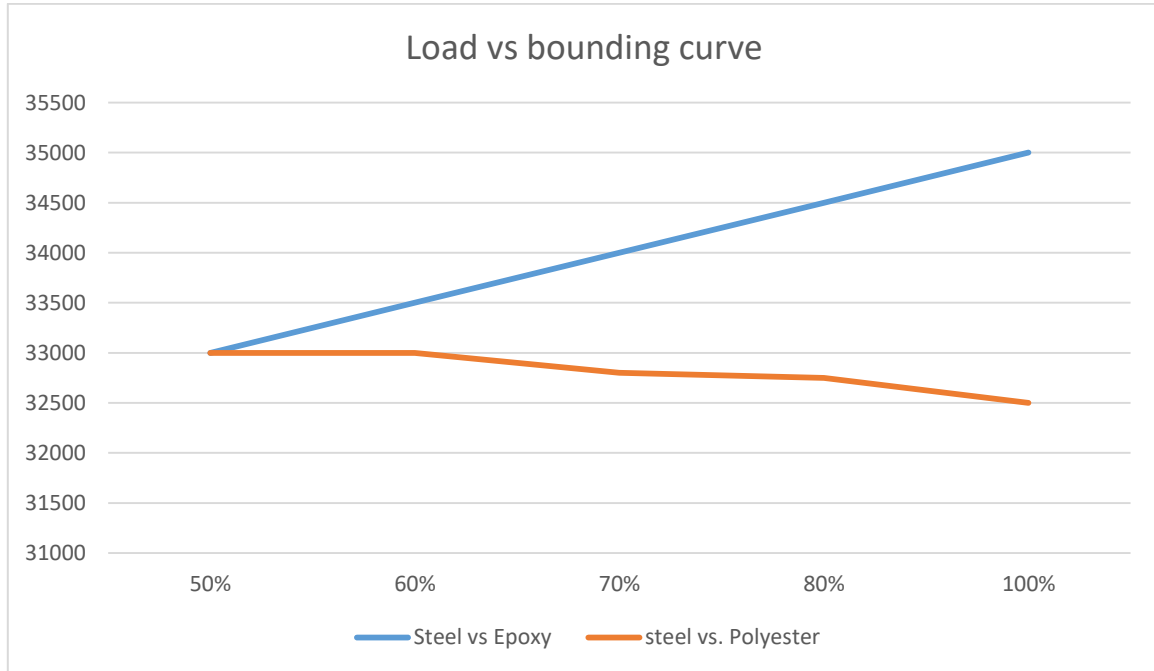
(d) (e) (f)

**Fig 5.** Tabulated results of boundings of steel vs. Polyester and their loads magnitude and directions at (a) 100% ,(b) 90%, (c) 80% , (d)70% ,(e)60% , (f) 50% boundings respectively



**DISCUSSION :**

**Forces distribution of steel vs Epoxy and Steelvs. Ployester**



**Fig 6.** Curve for magnitude f loads vs bounding of steel vs. Epoxy and Steel vs. polyester.

**VI. CONCLUSION**

The Application of composite materials in modern world is increase now, for example aircrafts windows frames, racing car, etc., If a 20% of debonding in the composite material will increase the stress inside the composite in our experimental setup we tested in composite material more than 20% debonding which resulted in immediate breakdown in the material and the stress created inside the material is high.

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