International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Special Issue - AMET-2019

Testing and Analysis of Composite Slabs

Parimal Chilwarwar, Student, MITCOE Pune, chilwarwarparimal@gmail.com

Hanuman Gitte, Student, MITCOE Pune, hgitte7@gmail.com

Arun Goyal, Student, MITCOE Pune, arun.goyal996@gmail.com

Anand Gadsing, Student, MITCOE Pune, anandgadsing15@gmail.com

Abstract **Laminated composites are combination of layers of fibers which are combined together by means of a binder (resin). The current era finds wide applications of laminated composites, henceforth it is essential to be aware with its strengths and weakness. Total strength of a composite is combines strength of fibres and the strength of the binder used. With change in temperature there are considerable changes in the properties of composites. The current project concentrates on constructing a setup for testing of composites, the setup is equipped with an enclosure, provision for application of fatigue loading and also with provision for temperature variations (150°C to 250°C).The project also concentrates on testing of the laminated composite for its variation in strength at different temperatures. The specimen under test is a composite of glass fibres and epoxy resin which is subjected to fatigue loading. Plots of life of composite(cycles) Vs temperature at constant frequency and Plots of S-N curves .**

Keywords —Composites, Fatigue, Fibres, Life cycles, Loading frequency, Resins, Strength.

I. Introduction

Laminate composite consists of number of layers, bonded together by the resin in the thickness direction. A layer may consist of short fibers, unidirectional continuous fibers or woven fibers embedded in matrix. Properties of the laminate can be altered by controlling orientation of fibers in each lamina. Adjacent layers (plies) having the same material and the same orientation are referred to as a ply group. The characteristics of the composite is determined by strength of composite, frequency of loading, temperature and number of cycles. To test the composite the system require mechanical as well as electrical components. Mechanical components include the mechanism to provide cyclic loading. electrical components include operator machine interface and control of mechanical input.

II. COMPOSITION OF THE LAMINATED COMPOSITE SHEET

The composite sheet is made out of layers of glass fibers. The layers of fibers are held in position by a resin. The resin used here is " epoxy Resin" . This resin apart from having good mechanical strength it also shows excellent resistance to chemicals and also it requires less time for curing. It shows very less contraction during curing.

The glass fibre is popular for its wide applications, due to its light weight and providing good reinforcement. However when used in composites the glass fibre is less brittle.

The fibres used in the composite sheet are made out of E-glass , which is alumino-borosilicate glass with lass than 1% w/w a lkali oxides.

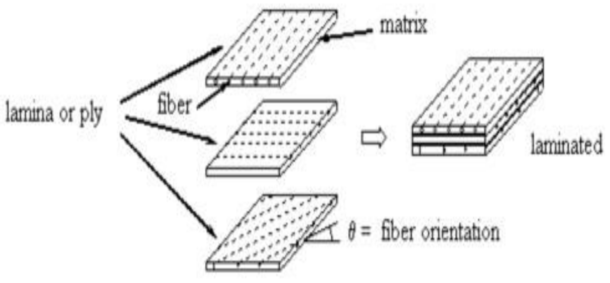


Figure 1 Laminated composite materials

III. FAILURE OF COMPOSITES

Failure of composites may occure due to breaking of fibres, micre-cracking of the matrix, de-bonding, delamination of laminated composites. Here the loading is applied in transverse direction hence compressive stresses are developed on the impact side whereas tensile stresses are developed on the other side.

IV. MATH

From the various criterions available like the Soderberg criterion, Goodman criterion and Gerber Criterion. This analysis is based on Goodman criterion.
This criterion helps to predict the fracture in composites or in other words it tells us about the decreasing life of the material. Mathematically it is given as:

$\sigma_a = \sigma_{fat} \times (1 - \sigma_m / \sigma_{ts})$

where,

σ_a = Alternating stress

σ_{fat} = Fatigue limit

σ_{ts} = ultimate tensile strength

σ_m = mean stress

V. UNITS

Unit System	Metric (m, kg, N, s, V, A) Degrees rad/s Celsius
Angle	Degrees
Rotational Velocity	rad/s
Temperature	Celsius

Figure 2- Units

Loading	
Type	Zero-Based
Scale Factor	1.
Definition	
Display Time	End Time
Options	
Analysis Type	Stress Life
Mean Stress Theory	Goodman
Stress Component	Equivalent (Von Mises)
Life Units	
Units Name	cycles
1 cycle is equal to	1. cycles

Figure 3

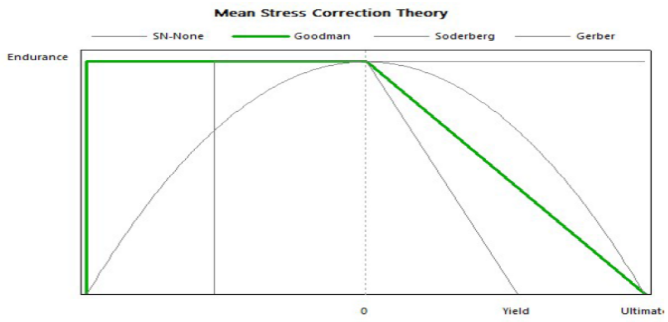


Figure 4

Object Name	*Geometry*
State	Fully Defined
Definition	
Source	C:\Users\arung\OneDrive\Documents\r_files\dp0\SYS\DM\SYS.agdb
Type	DesignModeler
Length Unit	Meters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	0.25 m
Length Y	5.e-003 m
Length Z	0.1 m
Properties	
Volume	1.25e-004 m³
Mass	0.98125 kg
Scale Factor Value	1.
Statistics	
Bodies	1
Active Bodies	1
Nodes	2422
Elements	312
Mesh Metric	None
Basic Geometry Options	
Parameters	Yes
Parameter Key	DS
Attributes	No
Named Selections	No
Material Properties	No
Advanced Geometry Options	
Use Associativity	Yes
Coordinate Systems	No
Reader Mode Saves Updated File	No
Use Instances	Yes
Smart CAD Update	No
Compare Parts On Update	No
Attach File Via Temp File	Yes
Temporary Directory	C:\Users\arung\AppData\Local\Temp
Analysis Type	3-D
Decompose Disjoint Geometry	Yes
Enclosure and Symmetry Processing	Yes

Figure 5-Geometry

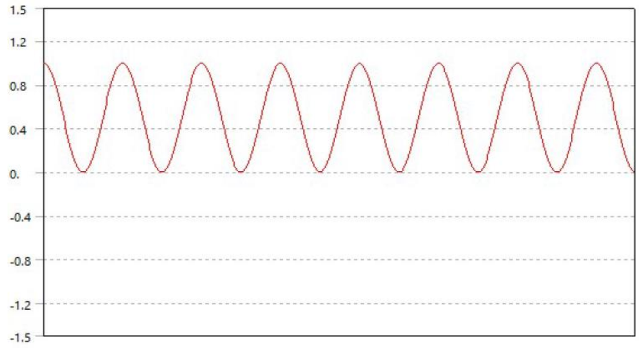


Figure 6-constant amplitude load zero based

Object Name	*Life*	*Safety Factor*	*Damage*	*Equivalent Alternating Stress*
State	Solved			
Scope				
Scoping Method	Geometry Selection			
Geometry	All Bodies			
Definition				
Type	Life	Safety Factor	Damage	Equivalent Alternating Stress
Identifier				
Suppressed	No			
Design Life		1.e+009 cycles		
Integration Point Results				
Average Across Bodies	No			
Results				
Minimum	7.4875e+005 cycles	0.95872		3.2856e+005 Pa
Maximum			1335.6	9.0643e+007 Pa

Figure 7-Life of slab

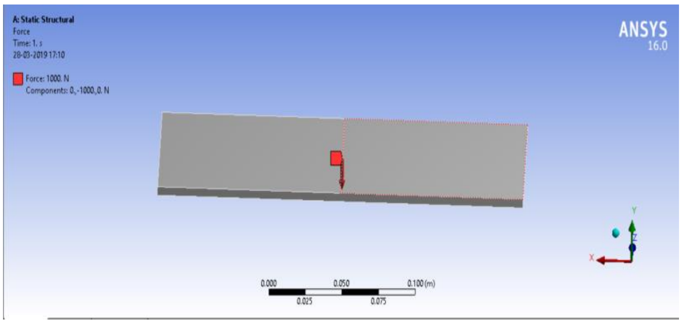


Figure 8 - Loading

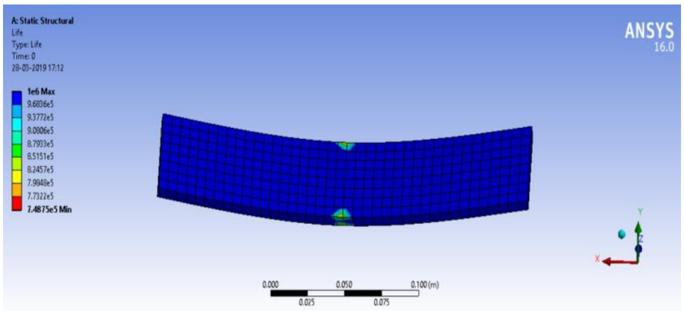
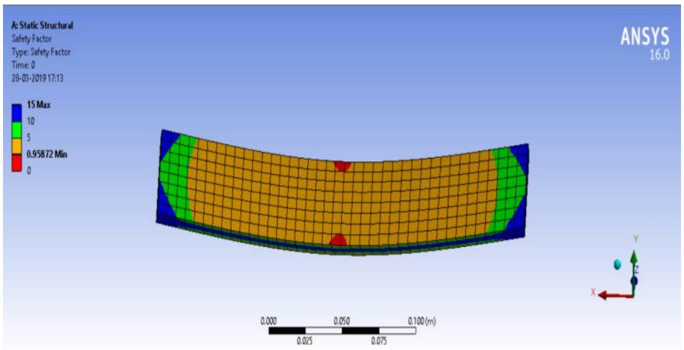


Figure 10 – Life of Slab



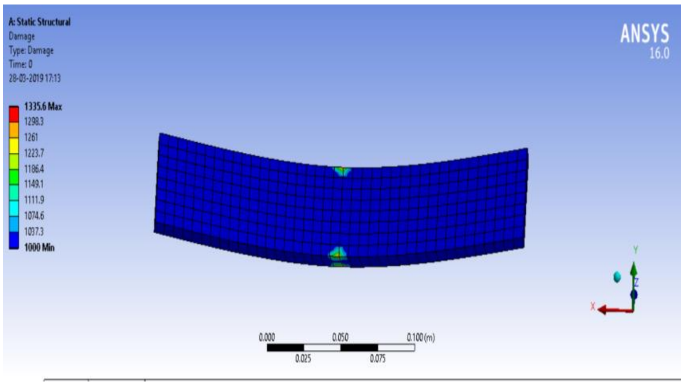


Figure 9 – Damage

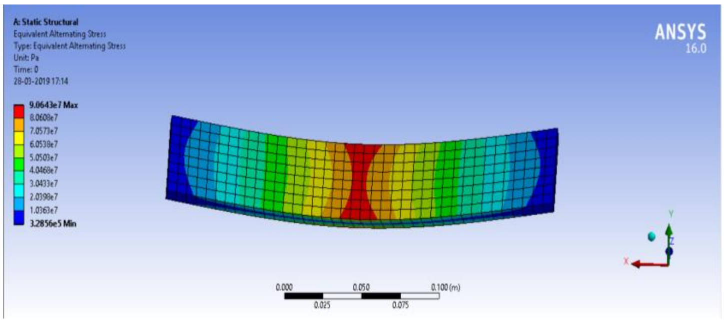


Figure 11 – Factor of safety

VI. CONCLUSION

The analysis focuses on determining the composite slab strength so as to suite its application. It helps to choose the other parameters of the application accordingly so as to avoid any kind of unwanted damage to its application.

REFERENCES

[1] A. Varvani-Farahani ,International Journal of Fatigue, Volume 113, Pages 253-263, August 2018

[2] Epaarachchi JA, Clausen PD, A New Approach to a Fatigue Damage Model for Glass-Fibre Reinforced Plastic Composites, Proceeding of the Seventh International Conference on Composite Engineering (ICCE/7), D. Hui, Ed., Denver, Colorado; 2000.

[3] Menard K. P., 2008. Dynamic Mechanical Analysis: A Practical Introduction. 2nd edition, CRC Press International Standards Organisation. ISO 13003:2003 Fibre reinforced plastics - determination of fatigue properties under cyclic loading conditions, 2003.