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"An Experimental Research on Aramid Fiber added to Carbon Reinforced Fiber Laminate Plate"

P. Chinna Srinivas Rao, T.Prasad, S. Jush Kumar

Abstract*: Metal materials like Aluminum, Steel, and Magnesium etc have been progressively substitute by High – performance composites with Carbon fiber and Hybrid fiber composite. In recent days, Fiber-reinforced polymer (FRP) erstwhile extensively used in various fields such as aerospace, marine, transportation, and defense, because of their high strength to weight ratio and stiffness, good resistance to fatigue and corrosion, desirable thermal characteristics. In this work two composites laminates are fabricated one is Carbon – Carbon fiber reinforce composite and second is Carbon – Aramid Hybrid reinforce composite. Two laminates were prepared by varying fiber orientation such as 0^0, 45^0,90^0 and 30^0, 60^0,90^0. Hand lay – up technique has been adopted to prepare the specimens as per the ASTM standards are D3039, D3410and D790. In this project, we are going to find mechanical properties like Tensile test, Compression test and Bending test on Carbon - Carbon reinforce composite and Carbon - Aramid hybrid composite.

Keywords*: Fiber-reinforced polymers, Stiffness, Aramid composites, Carbon fiber, Hand lay-up technique.

I. INTRODUCTION

A composite be both of two materials in which one of the materials, names as a reinforcing phase, is in the appearance of fibers, sheets, or particles, and is rooted in the supplementary materials called the matrix phase. The reinforcing material and the matrix material can be metal, ceramic, or polymer. Composites habitually contain a fiber or element phase that is stiffer and stronger than the continuous matrix phase and act as the most load-moving member. The matrix, act like a weight shift intermediate among fibers, and in fewer cases wherever the masses are difficult, the matrix might so far include to stand load crossways to the fiber alignment. The matrix is additional ductile than the fibers and thus act as a basis of composite hardiness.

Fibers or particles embedded in a matrix of an additional matter are the finest examples of modern composite materials, which are usually structural. Laminates are composite material where diverse layers of material provide them the precise nature of a composite material has a precise task to execute. Fabrics comprise no matrix to fall back on, but in them, fibers of diverse compositions unite to offer them a precise nature. Reinforcing materials usually survive greatest load and serve the attractive properties.

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* Correspondence Author
P. Chinna Srinivas Rao*, Department of Mechanical Engineering, Anurag Group of Institutions, Hyderabad, India.
T. Prasad, Department of Mechanical Engineering, Anurag Group of Institutions, Hyderabad, India. Email: tatapudi.prasad@gmail.com
Jush Kumar. Siddani Department of Mechanical Engineering, Anurag Group of Institutions, Hyderabad, India.

II. METHODOLOGY

A. Hand Layup Process:

It is an easiest process and simple for making the composite laminates. Initially, we apply a release gel on the die face to keep away from the sticking of polymer to the die face. Lean plastic sheets are used at the apex and base of the die to acquire superior surface finish of the laminate. Reinforcement in the appearance of woven mats or chopped strand mats is a slice as per the die dimension and positioned at the face of a die before Perspex sheet. Next, the resin is mixed systematically in an appropriate ratio with an approved hardener and pours on the face of on the top of a mat already placed in the die. The polymer is consistently stretched with aid of a brush. Next, succeeding layer of the mat is then positioned on the polymers face and a roller is moved with a gentle force on the mat resin sheet to get rid of some air trapped and the surplus resin present. The procedure is repetitive for every sheet of a resin and mat, until the requisite layer are stack. Subsequent to insertion the plastic sheet, release gel is applied on the internal face of the top die laminate which is then set aside on the stack layer and the force is apply. After curing either at room temperature or some specific temperature, die is open and the composite component is removed and further processed. The schematic of hand lay-up is shown in figure 1. Moment of curing depends on the kind of resin applied to make composite. On behalf of, for the epoxy-based arrangement, standard curing time at room temperature is 24-48 hours. This technique is essentially apt for thermosetting polymer-based composites. Assets and infrastructural necessity is a smaller amount than compare to other methods. Fabrication rate is fewer and the high volume portion of reinforcement is complex to attain the processed composites. It claims in many areas like aircraft mechanism, automobile part, dais panel, etc.

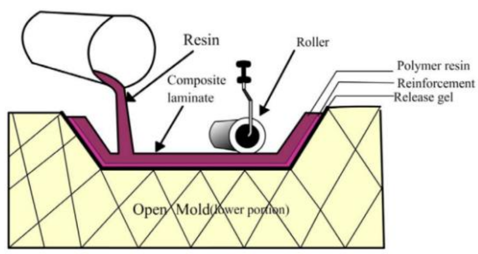

Fig: 1 Hand Lay – Up Method

B. Material Selection:

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Table: 1 Material Selection

Element	Carbon Composite	Hybrid Composite
Reinforcement	Carbon Fiber	Carbon Fiber
		Aramid Fiber
Matrix	Epoxy LY556	

III. RESULT ANALYSIS

A. Tensile Test:

Tensile Test- ASTM D3039-Sample was cut into dumbbell shape (160x20x3) mm.

Table: 2 Tensile Test

No	Specimen	Ultimate Load kN	Ultimate Tensile Strength MPa	Elongation %
1	Carbon –Carbon $0^0 – 45^0 - 90^0$	19.320	271.044	12.6
2	Carbon – Carbon $30^0 – 60^0 – 90^0$	7.520	111.871	13.2
3	Carbon – Aramid Hybrid Composite $0^0 – 45^0 - 90^0$	10.040	207.096	4.200
4	Carbon – Aramid Hybrid Composite $30^0 – 60^0 – 90^0$	8.480	157.037	5.400

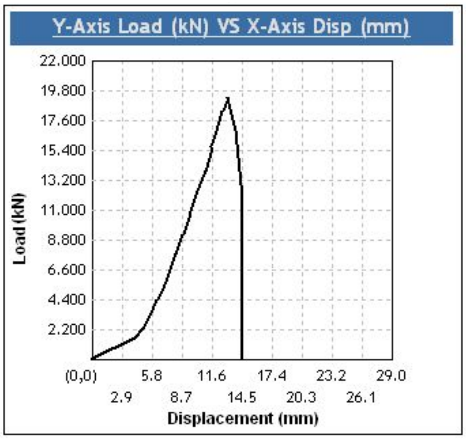

Fig: 2 Carbon-carbon composite with Orientation 0^0-45^0-90^0

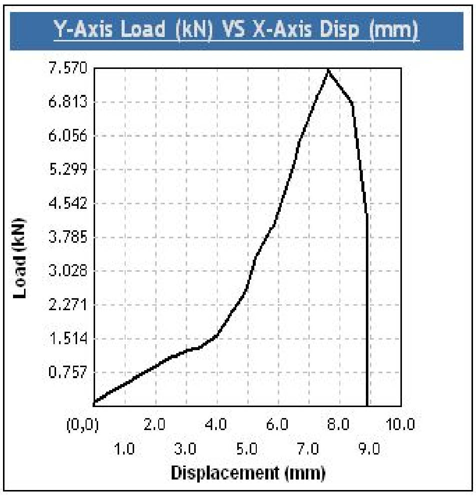

Fig: 3 Carbon-Carbon Composite with Orientation 30^0-60^0-90^0

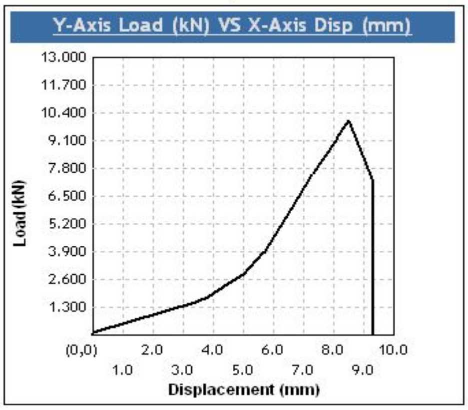

Fig: 4 Carbon-Aramid (Hybrid) with Orientation 0^0-45^0-90^0

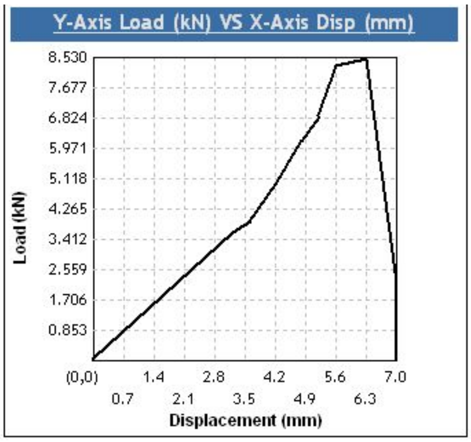

Fig: 5 Carbon-Aramid (Hybrid) with Orientation 30^0-60^0-90^0

Table: 3 Compression Test

No	Specimen	Ultimate Load kN
1	Carbon –Carbon $0^0 – 45^0 - 90^0$	1.620
2	Carbon – Carbon $30^0 – 60^0 – 90^0$	1.700
3	Carbon – Aramid Hybrid Composite $0^0 – 45^0 - 90^0$	2.460
4	Carbon – Aramid Hybrid Composite $30^0 – 60^0 – 90^0$	4.020

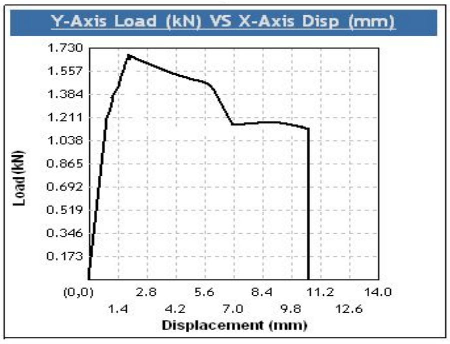

Fig: 6 Carbon-carbon composite with Orientation 0^0-45^0-90^0

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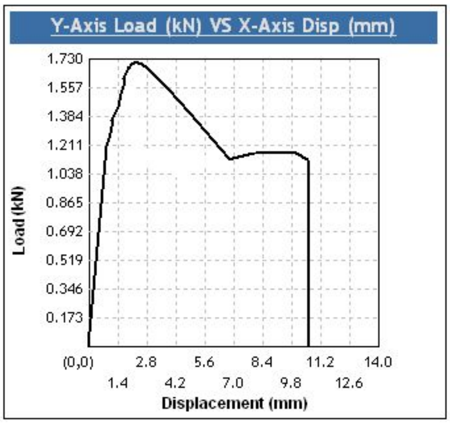

Fig: 7 Carbon-Carbon Composite with Orientation 30^0-60^0-90^0

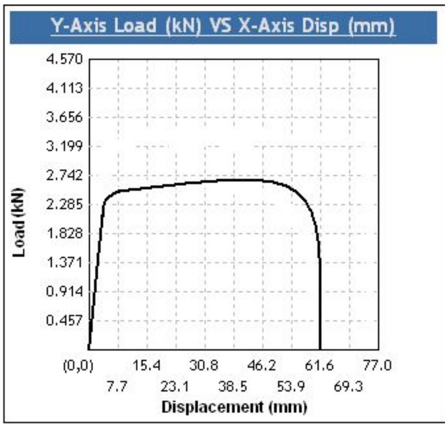

Fig: 8 Carbon-Aramid (Hybrid) with Orientation 0^0-45^0-90^0

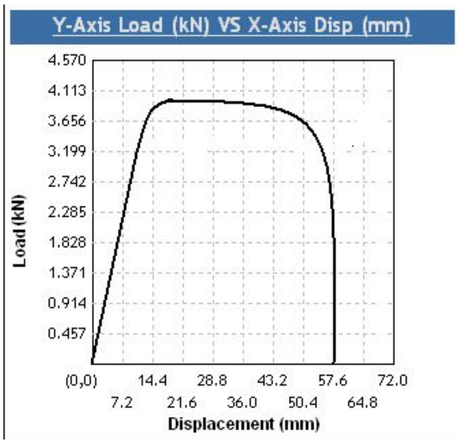

Fig: 9 Carbon-Aramid (Hybrid) with Orientation 30^0-60^0-90^0

Table: 4 Bending Test

No	Specimen	Ultimate Load
1	Carbon –Carbon $0^0 – 45^0$ - 90^0	1.200
2	Carbon – Carbon $30^0 – 60^0 – 90^0$	1.680
3	Carbon – Aramid Hybrid Composite $0^0 – 45^0$ - 90^0	2.560
4	Carbon – Aramid Hybrid Composite $30^0 – 60^0 – 90^0$	4.520

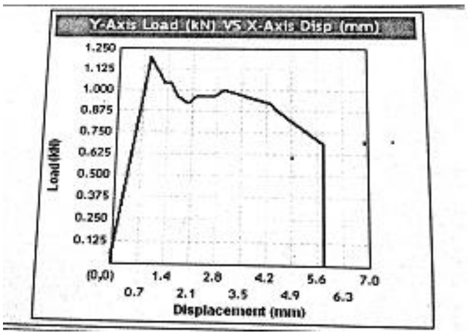

Fig: 10 Carbon-Carbon Composite with Orientation 0^0-45^0-90^0

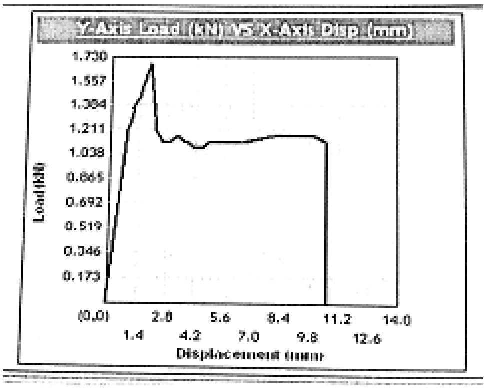

Fig: 11 Carbon-Carbon Composite with Orientation 30^0-60^0-90^0

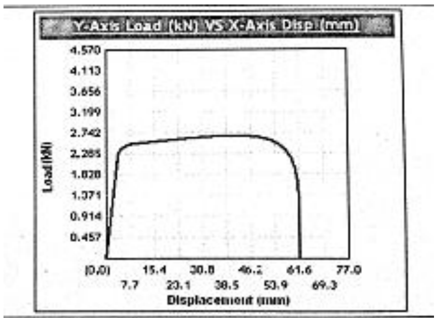

Fig: 12 Carbon-Aramid (Hybrid) with Orientation 0^0-45^0-90^0

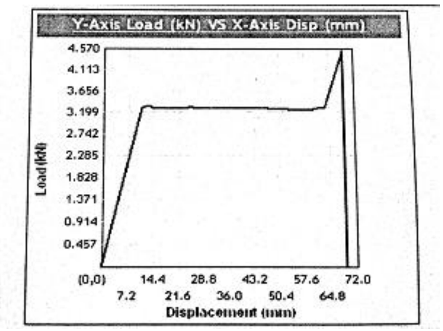

Fig: 13 Carbon-Aramid (Hybrid) with Orientation 30^0-60^0-90^0

IV. CONCLUSIONS

1. Tensile strength is **271.044** MPa in Carbon-Carbon composite at 0^0-45^0-90^0 is maximum when compare with Carbon - Aramid hybrid Composite at 0^0-45^0-90^0 is **207.096**

because tension applied in linear motion so plain carbon – carbon composites so strong in that position. .

2. Compression strength **4.020 kN** is maximum in Carbon – Aramid Hybrid Composite at 30^0-60^0-90^0 when compared with Carbon – Carbon Composite at 30^0-60^0-90^0 is **1.700** kN because compression load applied in perpendicular direction Aramid fiber is strong in Compression load in application.

3. Maximum Bending load is **4.520** kN in Carbon – Aramid Hybrid Composite at 30^0-60^0-90^0 when compared with Carbon – Carbon Composite 30^0-60^0-90^0 is **2.560** kN due to Aramid Fibers very strong in bending moment direction.

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AUTHORS PROFILE

P. Chinna Srinivas Rao is Assistant Professor in the Department of Mechanical Engineering at Anurag Group of Institution, Graduated from Jatipita College of Engineering, Adilabad and Post Graduation from J.B.I.E.T, Hyderabad, Telangana and India. He published many research papers in reputed journals and presented his papers in many International Conferences. His areas of interest are Metal Matrix Composites, and Polymer Composites.

T. Prasad is Associate professor in Department of Mechanical Engineering at Anurag Group of Institution, Graduated from SRKREC and Post Graduation from UCE – JNTUK, Kakinada, Andhra Pradesh and India. He has published many research papers in reputed journals and presented his papers in the many International Conferences. His areas of interest include Composite Materials, Experimental stresses and Design of Experiments.

Jush Kumar Siddani is Assistant professor in Department of Mechanical Engineering at Anurag Group of Institution, Graduated from SRKREC and Post Graduation from UCE – JNTUK, Kakinada, Andhra Pradesh and India. He has published many research papers in reputed journals and presented his papers in the many International Conferences. His areas of interest include Composite Materials, Electric discharge machining and Design of Experiments.