IMPACT ANALYSIS ON COMPOSITE HELMET BY USING FRC AND GLASS FIBER BY USING ANSYS

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ABSTRACT

In this work impact analysis is carried out in the Composite Helmet by Using FRC and Glass Fiber. In this recent world the fiber strengthened composite materials are synthesized using glass fiber as reinforcements together with matrix, which have attracted the attention of researchers due to their low density with high specific mechanical strengths, convenience, and renewability. The current work efforts to make a development in the current existing helmet manufacturing procedure and materials used to have better mechanical properties as well as to enhance the compatibility between fibers and the matrix. The composites are ready with the unsaturated polyester matrix and fibers such as, reinforced composite materials and glass fiber using hand lay-up method with suitable proportions to result in helmet shell construction. The fabricated helmet are planned to estimate its mechanical properties such as tensile strength, impact strength and compression strength.

Keywords: *Fibers reinforced composite materials, glass fiber, manufacturing methodology, fabricated helmet, tensile strength, impact strength and compression strength.*

1. Introduction

Fiber-reinforced polymer composites are similar to wood, as they consist of reinforcing fibers embedded in a polymer matrix as well. Within fiber-reinforced polymer composites, the distinction between short and continuous fibers is important. Short fiber composites, are mainly used for non-structural complex parts. One of the most common short fiber composites is injection moulded glass fiber - polypropylene. REIN4CED however, focuses on high performance continuous fibers. To fully exploit the potential of fibers, fibers need to be aligned to the load direction over the entire length of the object. Commonly used continuous fibers are carbon, glass and aramid. The combination of high-performance continuous fibers and a polymer matrix results in a composite material which is a lightweight alternative for steel and aluminium for structural applications. Compared to plastics, fiber-reinforced composites have outstanding mechanical properties per weight. The most interesting features of fiber-reinforced polymer composites are:

- High mechanical properties per weight for lightweight structural applications
- Excellent fatigue performance
- Good impact resistance
- Corrosion resistant
- Large design freedom and near net shape production
- Both small- and large-series production possible

2. Analysis using ANSYS

Table: 2.1 Model information

Model Information:

Analysis	Impact test
Velocity Magnitude	12.75 m/sec
Solution time	35 microsecond
Result time	25 microsecond

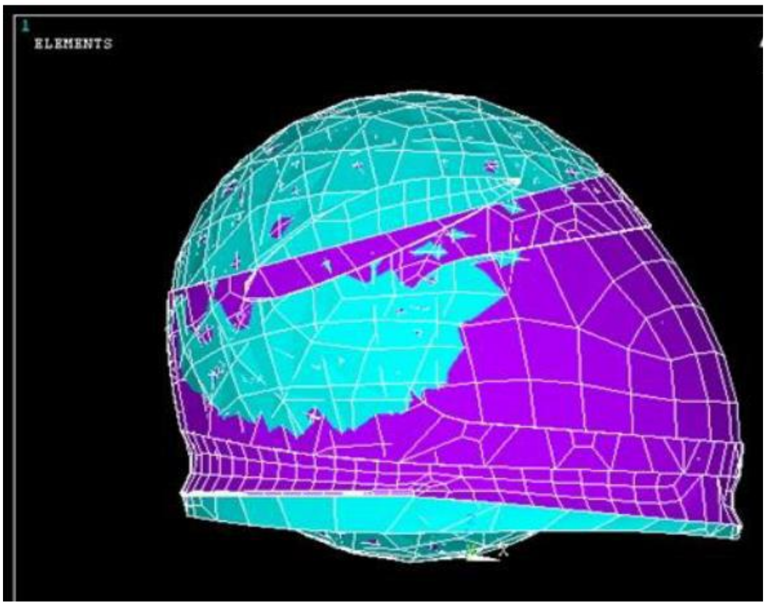


Fig.2.1Meshing operation being carried out

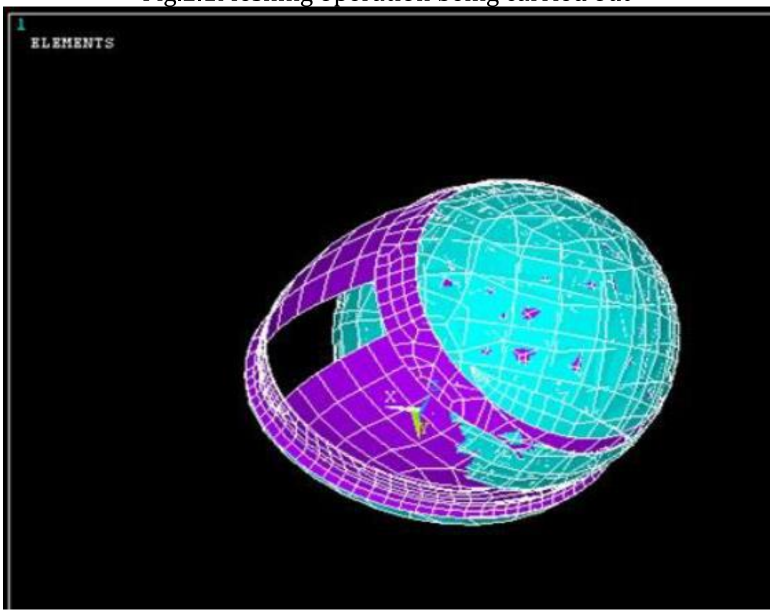


Fig.2.2 Meshing in the helmet using APDL

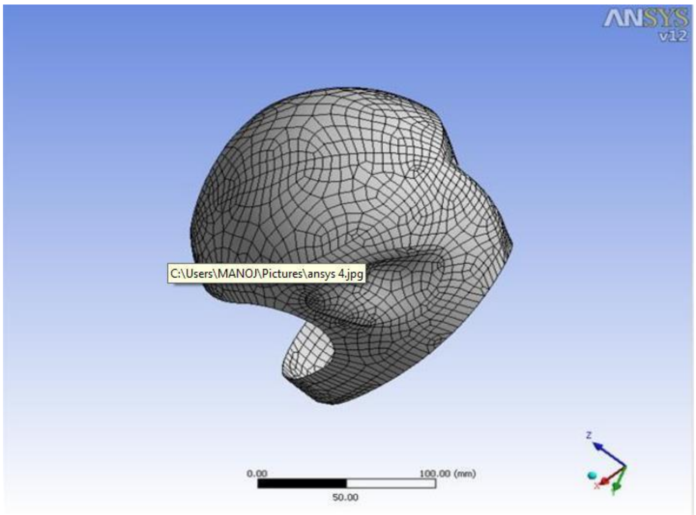


Fig.2.3.Deformation developed at sides of the helmet.

3. Results And Comparison Of Composite Helmet And Conventional (Thermoplastic)Helmet:

Table: 3.1 COMPOSITE HELMETS

Hitting at 50 km/hr

	FRONT	RIGHT	BACK
STRESS	31.2728	38.3062	43.2435
DEFORMATION	0.44952	0.48752	0.45920
STRAIN	0.008201	0.009421	0.00991

Hitting at 60 km/hr

	FRONT	RIGHT	BACK
STRESS	34.2267	42.8764	49.2147
DEFORMATION	0.549887	0.585864	0.54782
STRAIN	0.009512	0.009548	0.02144

Hitting at 70 km/hr

	FRONT	RIGHT	BACK
STRESS	39.281	44.1295	52.0684
DEFORMATION	0.647630	0.699132	0.63889
STRAIN	0.008560	0.009058	0.01210

Table: 3.2 CONVENTIONAL HELMET

Hitting at 50 km/hr

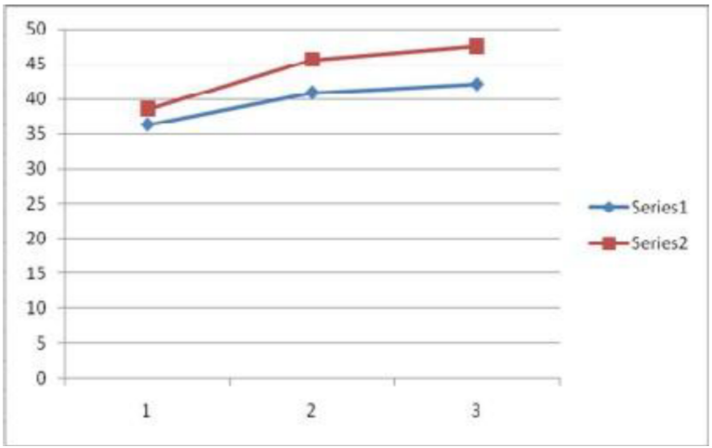
	FRONT	RIGHT	BACK
STRESS	36.0129	40.5314	46.0577
DEFORMATION	0.459251	0.494876	0.44981
STRAIN	0.008094	0.01069	0.01095

Hitting at 60 km/hr

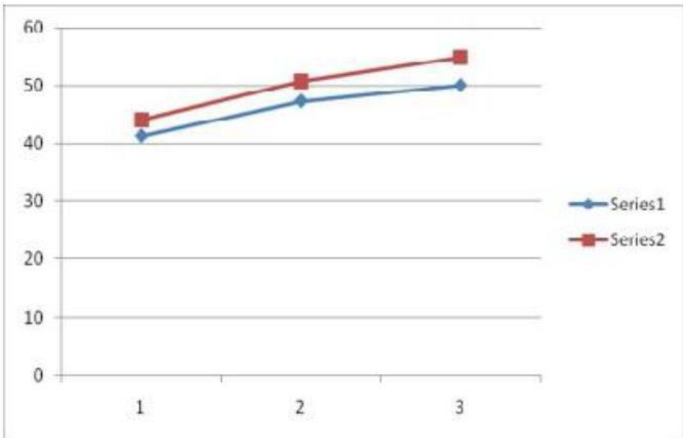
	FRONT	RIGHT	BACK
STRESS	42.2738	47.5802	52.7399
DEFORMATION	0.548546	0.583436	0.55876
STRAIN	0.007862	0.010157	0.12235

Hitting at 70 km/hr

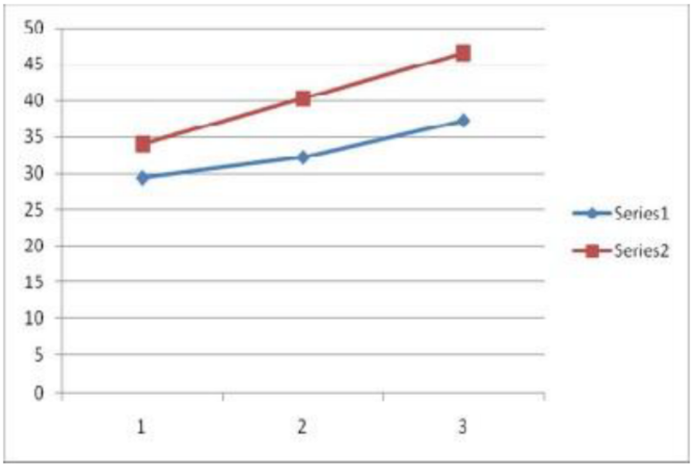
	FRONT	RIGHT	BACK
STRESS	48.591	49.4815	55.9121
DEFORMATION	0.63649	0.681212	0.640283
STRAIN	0.00912	0.009462	0.057121



Graph: 3.1 Composite and conventional material for Von Misses Stresses from right direction.



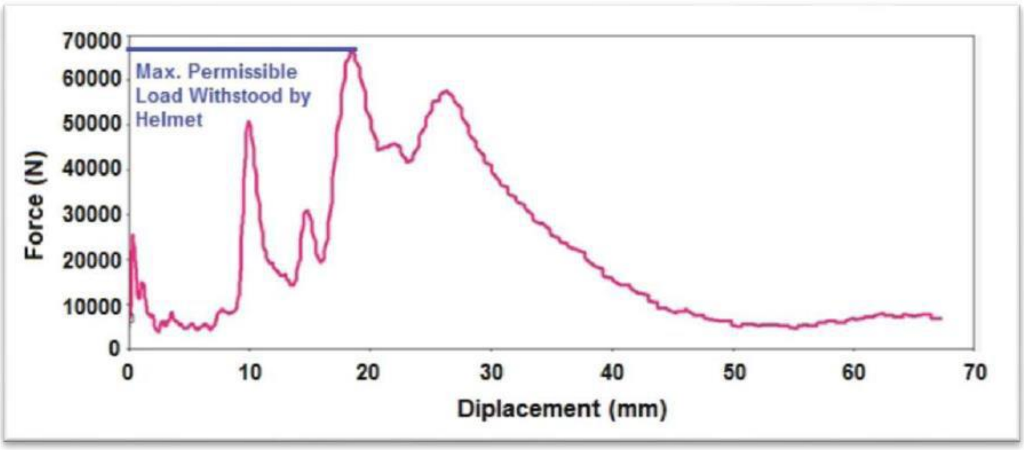
Graph: 3.2 Composite and conventional material for Von Misses Stresses from Back direction



Graph: 3.2 Composite and conventional material for Von Misses Stresses from front direction.

4. **Test Result of Composite Helmet:**

The drop weight impact tests were performed on the fabricated composite helmet. Although, the maximum permissible limit of 19.5 kN (as per BIS standard) impact load is required for drop weight impact analysis, due to limitation of test rig, we performed the test with drop mass of 430 N. shows the impact load against displacement for tested -composite helmet. It could be observed that maximum permissible load withstood by the helmet is 68.57 KN and the impact energy absorbed by the helmet was found to be 1397.913 KJ by post processing the experimentally acquired data.



Graph: 4.1 Experimental Load Displacement Curve of Tested Helmet

5. **Conclusion**

The new hybrid composite produced with natural fibers as reinforcements gives good mechanical properties as compared with pure matrix material. These hybrid bio- composite can be used in Aerospace and automobile applications. In the present work, composite fibers have been successfully reinforced with the epoxy resin by simple and inexpensive hand lay-up technique. The mechanical testing results of fabricated composite helmet indicate that, concept of using multiple fibers is viable for helmet application. However, there is a scope to optimize the volume fraction of composite fibers as reinforcements to achieve enhanced mechanical properties of helmet. So, it is clearly indicates that reinforcement of composite fibers have good and comparable mechanical properties as conventional composite materials.

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