Numerical Analysis of E-glass Fiber Reinforced Epoxy Composite Air Bottle used in Missile System

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ABSTRACT

Pressure vessels are being used for storage of high pressure gases for industrial purpose and aerospace applications. In missiles, pressure vessel or air bottles are used as power source to actuate various mechanisms for control and stability of the vehicle. As weight is main concern in aerospace vehicles, weight is optimized at each and every step. The air bottles used in missiles are pressurized at high pressure (nearly 400 bars) which itself is a live bomb to explode in minor defects. To reduce its weight and to avoid catastrophic failures, these days, pressure vessels are designed with fiber reinforced plastic (FRP) compo-sites.

Glass fibers currently comprise more than 90% of the fibers used to make glass fibers. These are A-glass (high alkali), C-glass (chemical), D-glass (low dielectric constant), E-glass (electrical) and S-glass (high strength), out of which the last two types, due to their superior mechanical properties, are most widely used in composite roofings, pressure vessels, containers, tanks, pipes, etc. E- glass is a low alkali, aluminum boro solicate glass and is based on a mixture of alumina, boric acid, calcium carbonate and magnesia. Epoxies are thermosetting polymer resins where the resin molecule contains one or more epoxide groups. Epoxy res-ins are cured with the addition of a curing agent, which is commonly called a hardener. Perhaps the most common type of cur-ing agent is amine based. Attributes of epoxy resins include extremely low shrinkage, good dimensional stability, high temperature resistance, good fatigue and adherence to reinforcements.

This paper dealt with design and finite element analysis of fiber reinforced plastic composite air bottle. Here, a pressure vessel made up of steel used in a missile system, was designed using composites of glass fiber/epoxy. This pressure vessel was used as a power source to actuate the different mechanisms during the flight.

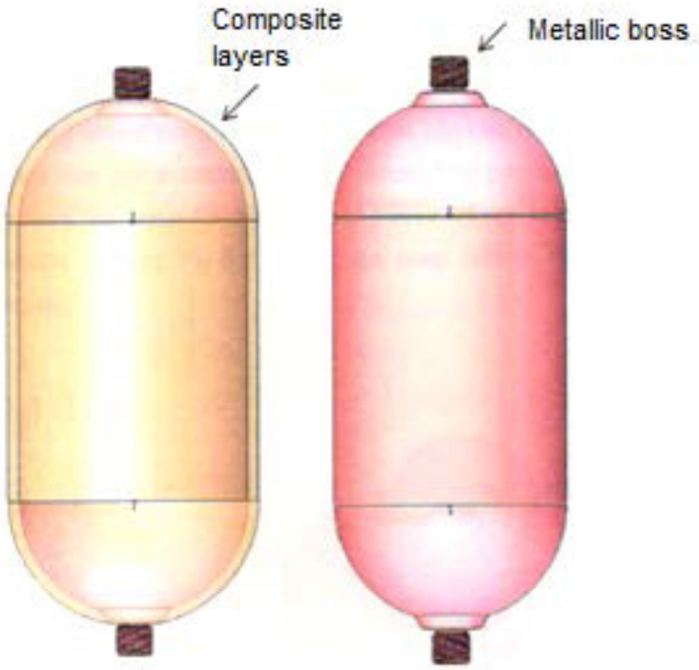

Figure 1: The composite pressure vessel.

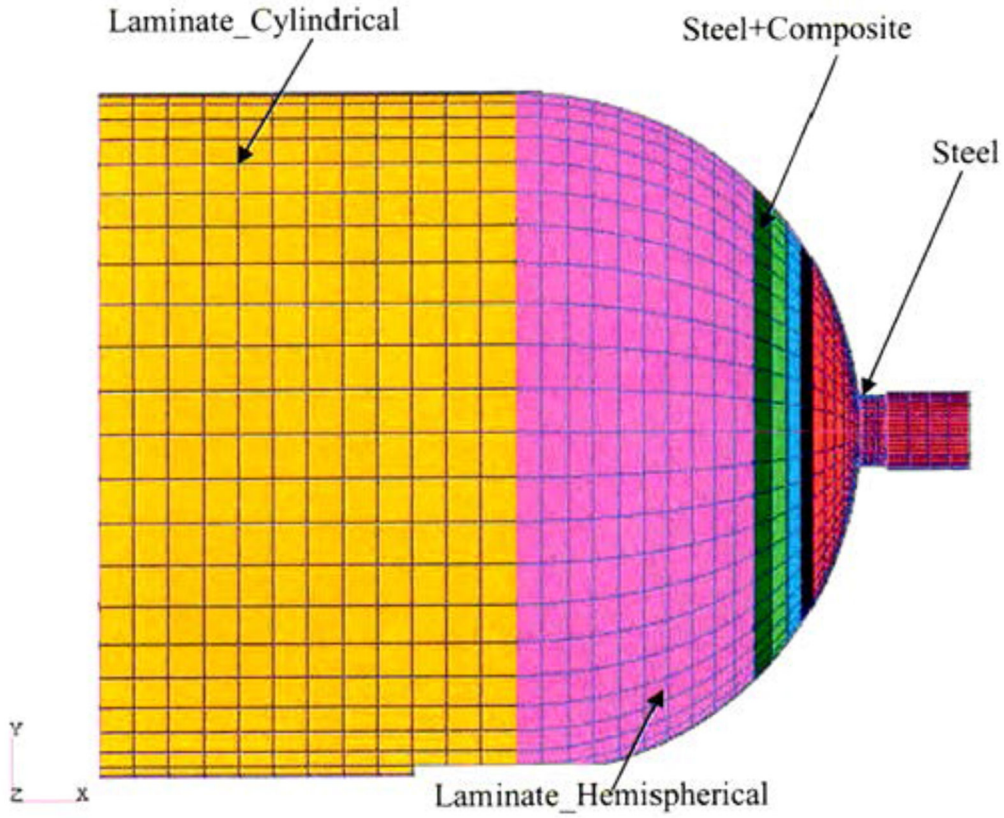

Figure 2: Discretization of air bottle.

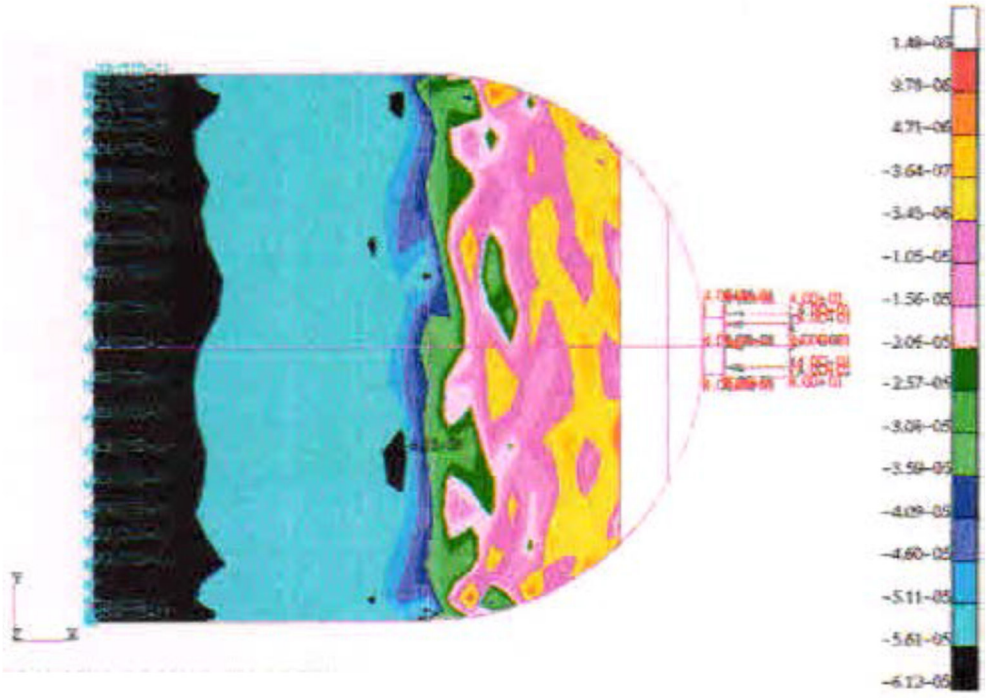

Figure 3: Stress in hoop layer-1 along z-direction.

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