

An Study on Compression Characteristic of Aluminum Sandwich and Carbon Fiber Reinforced Plastic Sandwich

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Abstract. The aim of this study is to analyze the mechanical properties of the aluminum sandwich and the carbon fiber reinforced plastic sandwich through the compression simulation analysis. The maximum load of the carbon fiber reinforced plastic sandwich is approximately 53kN while the maximum load of the aluminum sandwich is approximately 48.8kN. As the result of a comprehensive analysis, the maximum load of the carbon fiber-reinforced plastic sandwich appeared to be greater than the maximum load of the aluminum sandwich. The structure of the carbon fiber-reinforced plastic sandwich that has a lighter weight was considered better.

Keywords: Carbon fiber reinforced plastic sandwich, Aluminum sandwich, Compression, Simulation analysis, Maximum load

1 Introduction

It is quite important and urgent to raise the overall performance for the purpose of significantly reducing the weight of the machine. It is more efficient to reduce the weight of the machine using new light-weight materials [1]. Accordingly, the demand for the development of new materials is ever increasing and a variety of new materials have been developed to meet this need. Based on an epoxy resin among these new materials, there are fiber reinforced composite materials that use such as carbon fibers, glass fibers, and aramid fibers. These new materials are used as reinforcement materials [2]. The carbon fiber reinforced plastic (CFRP) has excellent material properties compared to normal metal such as strength ratio, elastic modulus ratio, anti-wear, fatigue property, excellent heat resistance and corrosion resistance [3]. It is hard to get these properties in normal metal [4]. In addition, it has a long fatigue life and is excellent in environmental safety [5], [6], [7]. The aim of this study is to analyze the mechanical properties of the aluminum sandwich and the carbon fiber reinforced plastic sandwich through the compression simulation analysis.

2 Simulation condition

The carbon fiber reinforced plastic sandwich that is used in this study is assembled using the carbon fiber reinforced plastic and the aluminum foam while the aluminum sandwich is assembled using the aluminum 6061-T6 and the aluminum foam. Table 1 shows the physical properties of carbon fiber reinforced plastics which were used in this study.

Table 1. Property of carbon fiber reinforced plastic

Poisson's Ratio		Tensile Modulus (GPa)		Tensile Strength (MPa)		Compressive Strength (MPa)	
v12	v23	E1	E2	Xt	Yt	Xc	Yc
0.300	0.74	132	8.98	1447	51.72	1447	206.2

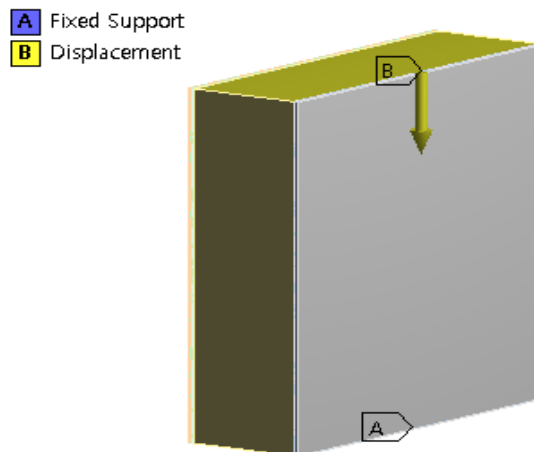


Fig. 1. Analysis condition of model

Fig. 1 shows the boundary conditions of the analysis. As shown in Fig.1, the size of two test specimens is both horizontally and vertically 100 mm. In addition, the bottom of the specimen was fixed and the forced displacement was given to the top. In order to increase the convergence, the analysis step was divided into 12. The forced displacement of the total 12 mm was given by making a step move 1mm for 1 s. It quickly notifies the debonding between carbon fiber reinforced plastic and aluminum foam.

3 Simulation results

Fig. 2 shows the equivalent stress contour according to the analysis result of each carbon fiber reinforced plastic and aluminum sandwich. At Fig. 2, the maximum equivalent stress of 2438.3MPa occurred in the carbon fiber-reinforced plastic while the maximum equivalent stress of 297.6MPa occurred in the aluminum plate. Also, the maximum compressive load of carbon fiber reinforced plastic sandwich was about 53kN when analyzed. In addition, the maximum compressive load of the aluminum sandwich was about 48.8kN when analyzed.

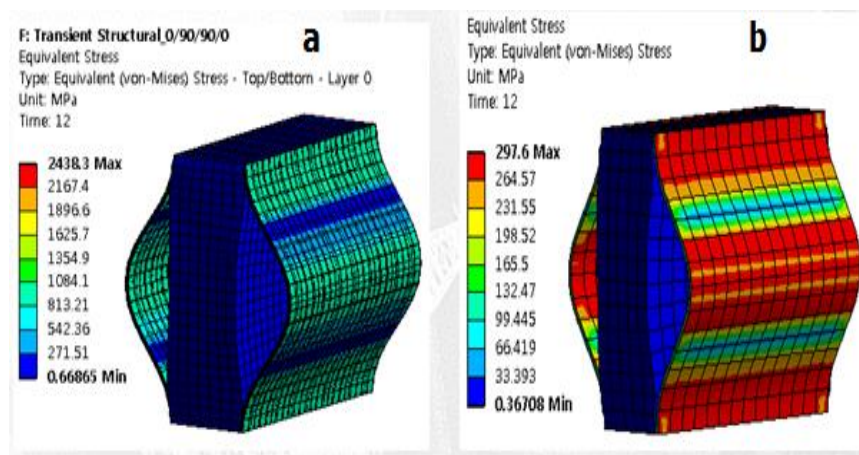


Fig. 2. Contours of equivalent stress of a(carbon fiber reinforced plastic sandwich) and b(aluminum sandwich)

4 Conclusion

As the analysis result of this study, the maximum load of the carbon fiber reinforced plastic sandwich is approximately 53kN while the maximum load of the aluminum sandwich is approximately 48.8kN. In viewed of a comprehensive analysis, the maximum load of the carbon fiber-reinforced plastic sandwich appeared to be greater than the maximum load of the aluminum sandwich. The structure of the carbon fiber-reinforced plastic sandwich that has a lighter weight was considered better. On the basis of the analysis and the experimental results that came from the present study, it is believed that the mechanical properties can be systematically analyzed by the compressive analysis on the following three materials such as the aluminum plate / the carbon fiber reinforced plastic that is being used as the face plate / the closed aluminum foam that is being used as the shock-absorbing core in many areas.

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