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Experiment and Simulation verification on Impact of Aluminum Foam Sandwich due to Thickness of Aluminum Board

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Abstract. A composite material is produced by combining and forming two or more types of material. In this study, aluminum alloy and aluminum foam assembled into sandwich by using adhesive. The aim of this study is to analyze the mechanical properties of the aluminum through the impact experiment and simulation analysis. Since experimental results and analysis results can verify each other by affirming that similar experimental and analysis results were produced in the present study, it can be seen that experimental results and analysis results produced in the present article can be applied to practical cases.

Keywords: Composite material, Aluminum alloy, Aluminum foam, Impact, Simulation analysis

1 Introduction

Aluminum foam is a porous metal material. Currently, aluminum foams with lightweight and maximized absorption function for impact energy are widely utilized in automobile areas [1]. In this study, aluminum foam of a honeycomb structure was inserted in a sandwich form between aluminum boards of 6061 with T6 heat treatment, in order to have similar advantages as aluminum foam such as shock absorbing property [2], soundproof, thermal conductivity [3], lightweight, etc. as well as advantages of general aluminum since the surface destruction can be prevented by using 6061 aluminum boards with T6 heat treatment [4], [5]. In the present study, mechanical characteristics were analyzed through impact experiments and simulation [6], [7] for aluminum foam sandwiches.

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2 Experimental method and simulation method

In this study, impact experiments were carried with 2 types of modeling. In Fig.1 , the face sheet of Case 1 is an aluminum board with a thickness of 3mm, while the face sheet of Case 2 is an aluminum board with a thickness of 8mm. Also, the core material for both Case 1 and Case 2 is an aluminum foam with a thickness of 30mm.

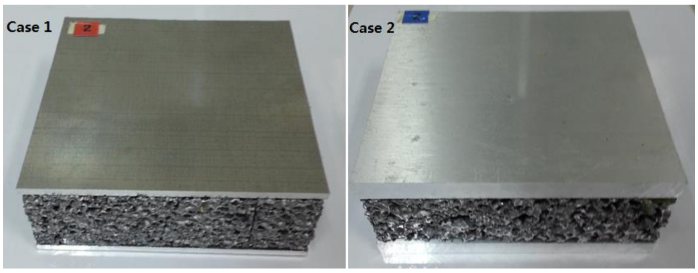

Fig. 1. Configuration of specimen case 1(Aluminum board thickness of 3mm) and case 2(Aluminum board thickness of 8mm)

At simulation analysis, the impact energies of 100J respectively to Case 1 and Case 2 were applied. Experimental apparatus used for experiments is Dynatup 9250 HV. Also, a striker with a diameter of 12.5 mm was used in experiments, where experiments were conducted with application of impact energy to the specimens by the striker after the specimen was fixed to the impact tester using this apparatus.

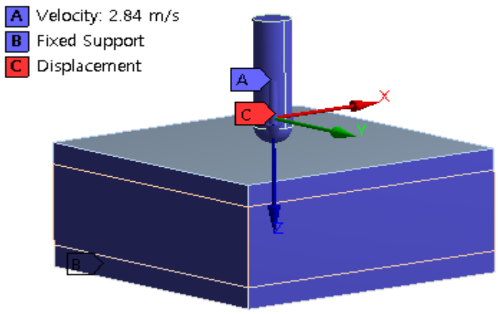

Fig. 2. Analysis condition of model

Boundary conditions for the analysis are shown in Fig. 3. Since the same boundary conditions were assigned to Case 1 and Case 2, only the boundary condition of Case 1 is shown. Depending on the values of impact energy, initial velocities moving to +Z axis were assigned to the striker with immobile displacements to X axis and Y axis, while side faces of the specimen part were stationary. Mass of the striker was assumed to be 24.78kg, and impact velocity conditions for impact energies applied to the striker are 2.84m/s.

3 Experimental results and simulation results

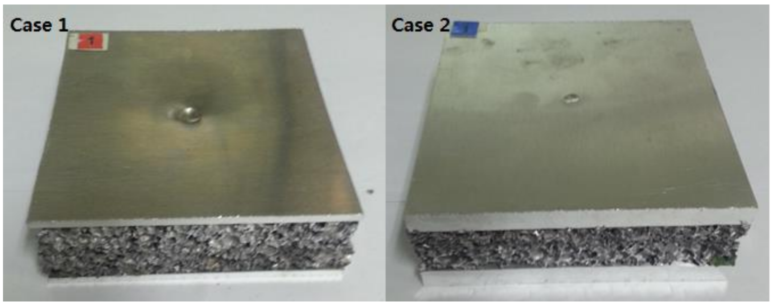

Fig. 3. Experimental pictures of case 1(Aluminum board thickness of 3mm) and case 2(Aluminum board thickness of 8mm)

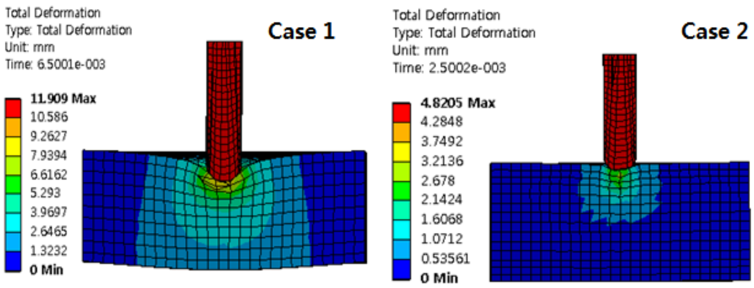

Fig. 4. Contours of total deformation of case 1(Aluminum board thickness of 3mm) and case 2(Aluminum board thickness of 8mm)

Fig. 3 and Fig. 4 show experimental and analysis results for Case 1 and Case 2, respectively. In Fig. 3, the striker is affirmed to have failed to pierce the upper face bars in the specimens of Case 1 and Case 2 when an impact energy of 100J was applied to the specimen. In Fig.4, a similar shape to that of the experiment occurred where the striker failed to pierce the upper face bars. Also, the amount of deformation in the experiment of Case 1 was 13.35mm, while that in the analysis was 11.909mm. The amount of deformation in the experiment of Case 2 was 10.17mm, while that in the analysis was 4.8205mm. In the case of Case 2, this is attributed to the fact that face bars were actually not nearly destroyed but plastic deformation occurred with many cell walls being collapsed within the aluminum foam.

4 Conclusion

Since experimental results and analysis results can verify each other by affirming that similar results were produced from experiments and analyses in the case of impact energies of 100J, it can be seen that experimental results and analysis results produced in the present article can be applied to practical cases. The amount of deformation in the experiment of Case 1 was 13.35mm, while that in the analysis was 11.909mm. The amount of deformation in the experiment of Case 2 was 10.17mm, while that in the analysis was 4.8205mm. Also, the striker is affirmed to have failed to pierce the upper face bars in the specimens of Case 1 and Case 2 when an impact energy of 100J was applied to the specimen. Consequently, in this study, an analysis has been made on mechanical characteristics through impact experiments and analyses of an enclosed-type aluminum foam used as the core material for shock absorption in many areas and an aluminum alloy used for face sheets.

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