Honeycomb Structures Manufactured by a New Method and Its Failure Analysis

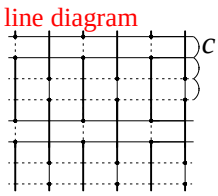
Lijun WANG[*1], and Kazuya SAITO[2] ([1]Xihua University, China; [2]Kyushu University, Japan)

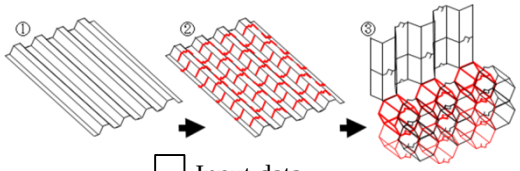
Introduction

In this work, strong and lightweight hexagonal honeycomb cores were proposed by origami technology, and the aluminum honeycomb sandwich structures were manufactured by a new manufacturing method (i.e. a press and folding process). Two type specimens were studied one with the honeycomb core bonded by common adhesive and another with the honeycomb core bonded by aluminum claws. The three-point bending test and the finite element analysis (FEM) were carried out to evaluate the structural failure. It offers a novel technology to fabricate a strong and lightweight honeycomb core without any adhesive, which was expected to apply in transport industry and aerospace field.

Concept of origami method

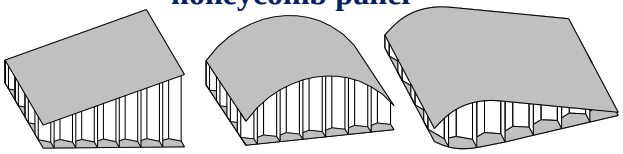
①Design of folding line diagram



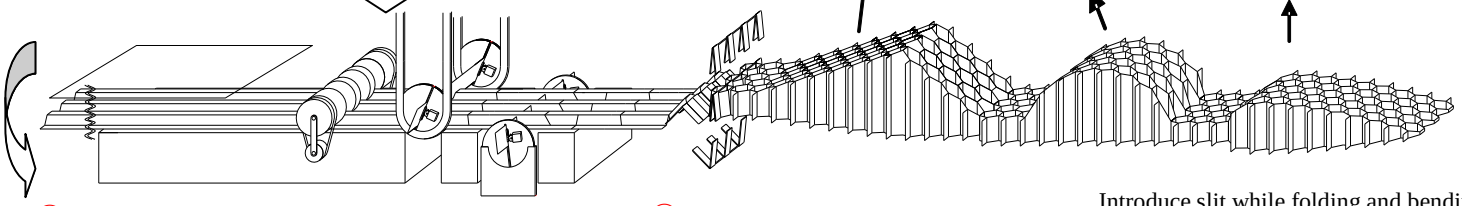


Input data

Directly fabricate the required-shape honeycomb panel



⑤Paste the facing skins



②Fold into wave plate

③Introducing slits

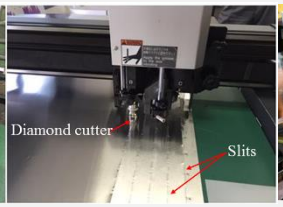
④Forming core(Folding-bending)

Introduce slit while folding and bending

Sheet was formed to corrugated

Molding honeycomb core

Schematics of the process of honeycomb core



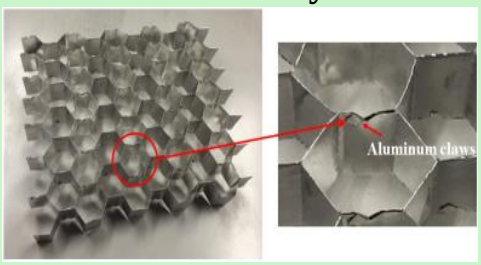
Slit introduction process by laser

Wave plate forming device (Press)

Folding-bending machine

※ Supported by JST research results of the most suitable support program in 2015 , and cooperated by Shiroyama Industrial Co., Ltd.

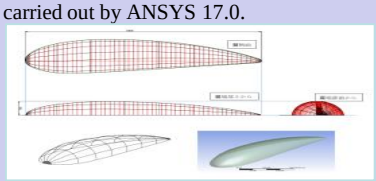
Aluminum claw honeycomb core

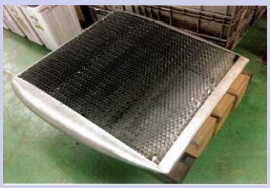


※Provide: Shiroyama Industrial Co., Ltd, Fujikake Co., Ltd.

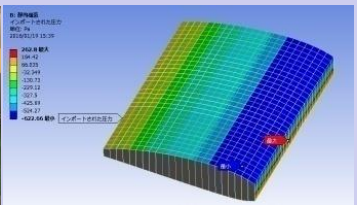
Turbine blade for tidal power generation

Supported by Mr. Lin researcher laboratory of Tokyo Univ. Institute of Industrial Science, the turbine blade for tidal power generation was designed by the Origami technology. Besides, the specimens of the designed honeycomb construction was manufactured by a press and folding process. Moreover, the simulation was carried out by ANSYS 17.0.

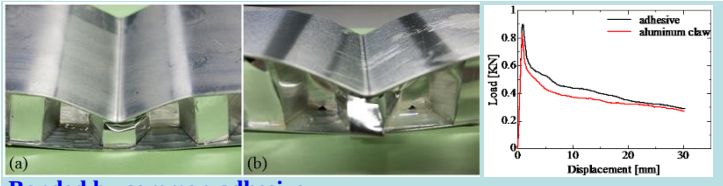




Manufactured specimens of the turbine blade

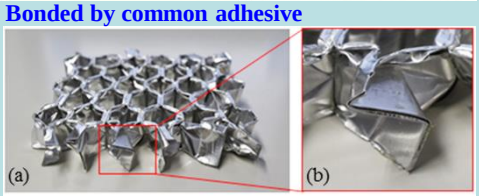


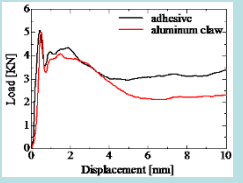
Numerical simulation results of stress analysis



Bonded by common adhesive

Strength decreased by **8%**





Bonded by aluminum claws

Maximal load: **5.1 KN**