3D PRINTING OF LOCALLY BENDABLE RIGID CFRTP

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Introduction

Carbon fiber reinforced thermoplastics (CFRTP) is a key material in developing lightweight aerial vehicles such as drones or air taxis because of superior specific stiffness and strength. Shape modification or shape morphing technology further enhances the weight reduction of the structure because of the elimination of mechanical hinges. In this study, the local flexibility concept was presented and locally bendable rigid CFRTP plate was fabricated by means of 3D printing technique.

Materials and Methods

A locally bendable rigid CFRTP plate was 3D-printed by changing the internal design. A parallel cross shape structure was adopted as the internal structure for the bendable part and a 100% infill structure for the solid part. Short carbon fiber reinforced Nylon filament (Onyx, Markforged) was supplid for a fused filament fabirication 3D printer (MarkTwo, Markforged).

Results

Fig. 1 shows repeatable bending deformation of the locally bendable rigid CFRTP plate. The plate was manufactured by a single 3D-printing operation using a single material. The locally bendable CFRTP plates included solid and bendable parts, which were connected seamlessly using a double-stepped lap configuration to prevent separation during cyclic loading. The bendability could be controlled by changing the girder angle of the parallel cross shape structure. The bending stiffness was reduced to up to 98% compared to that of the solid plate.

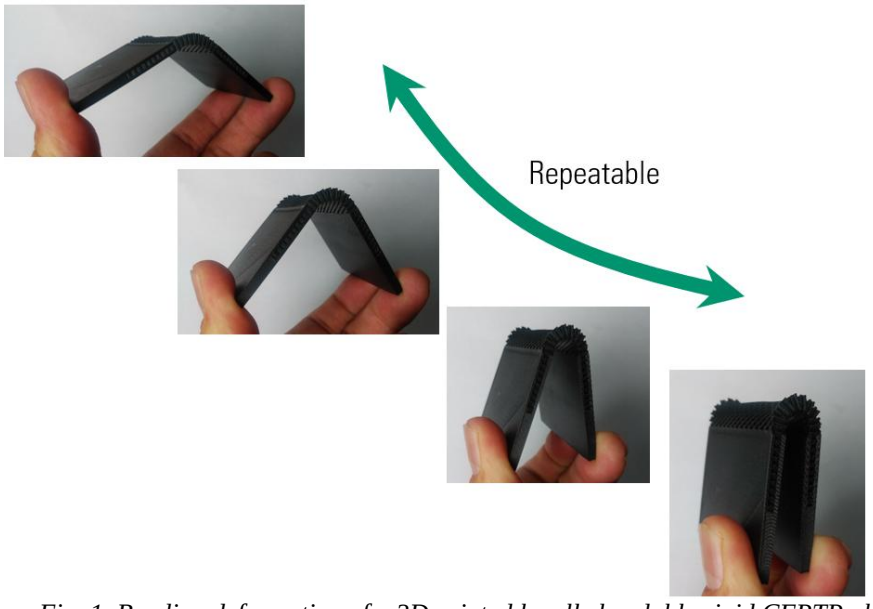

Fig. 1 Bending deformation of a 3D printed locally bendable rigid CFRTP plate