

A Study on the Restoration of Buckling due to the Stacking Angle of 3-Point Bending Specimen with CAE

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Abstract. This study investigates the restoration of buckling due to the laminate angle of 3-point bending specimen with CAE. 3D modeling and structural analysis are carried out for the analyses on 3-point bending specimens with different stacking angles.

Keywords: Buckling, Stacking angle, 3-point bending specimen, CAE

1 Introduction

This study is investigated on CFRP composed of carbon fibers in the matrix among FRP, and fiber stacking angles are applied by using unidirectional carbon fibers. Bending test condition was set with a jig for composing 3-point bending specimens. Fiber reinforced plastic has various material properties. Particularly, the bending phenomenon which happens by the external force is observed. For this reason, the fiber within plastic is supposed to be one independent axis. The different property is shown according to the stacking angle and the directionality of this axis. Therefore, this study investigates the restoring property after applying the external force to 3-point bending specimen. The buckling property at the structure with fracture happening by the external force is investigated. And the decrease of fracture propagation and the damping effect can be understood. The result of this study can be devoted to the safe design of structure composed of CFRP [1,2].

2 Analysis Model and Study Result

Fig. 1 shows the specimen subjected to 3D modeling for analysis, and each specimen has dimension of 180mm in length, 20mm in width, and 5mm in thickness. Here, each

specimen is characterized by having different stacking angles of, 30°, 45°, and 60° for fibers. Fig. 2 shows the analysis condition of specimen model.

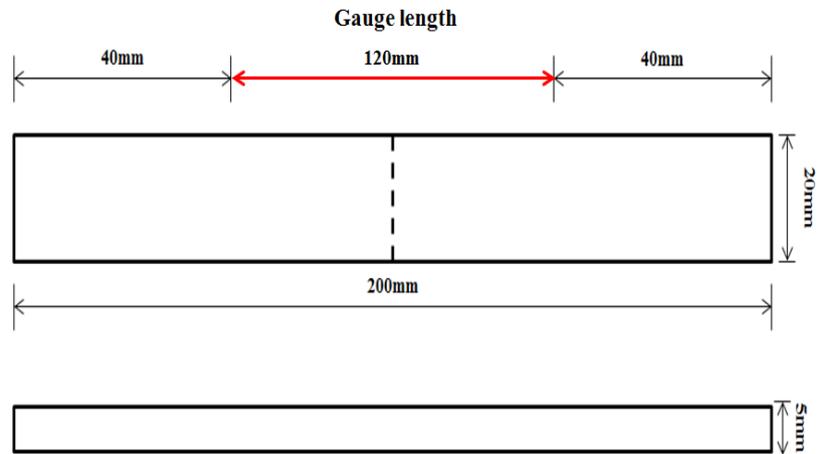


Fig. 1 Analysis model

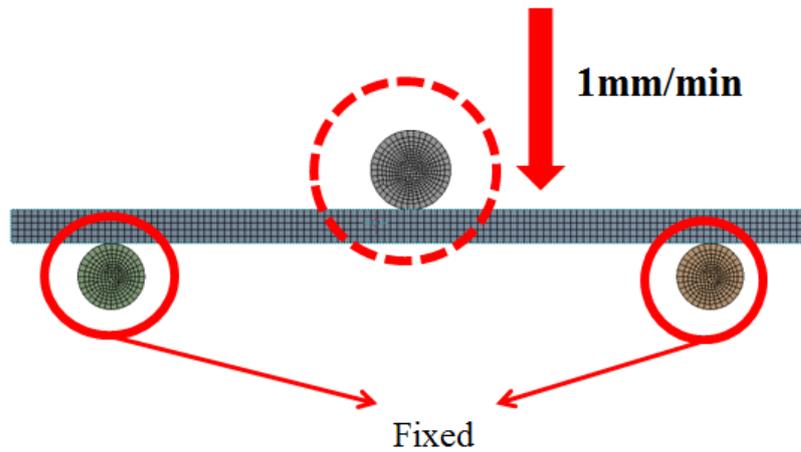
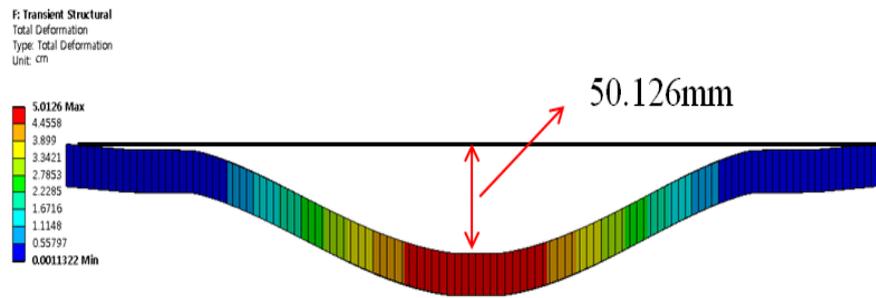
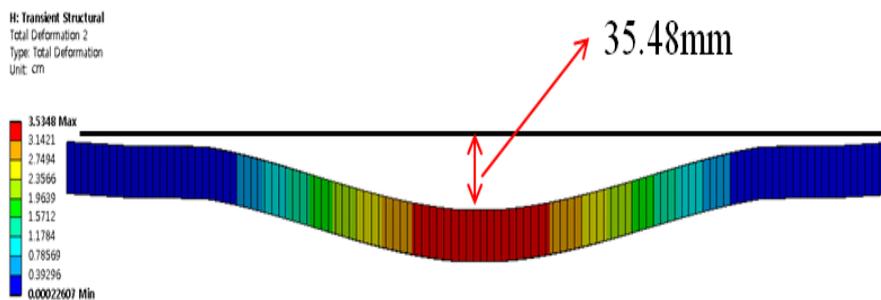


Fig. 2 Analysis condition

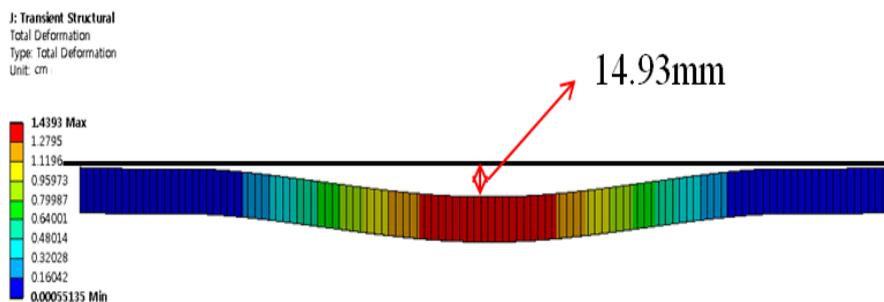
Fig. 3 shows the contour of total deformation and the buckling restoration amount at the specimen with the stacking angle.



(A) Stacking angle 30



(B) Stacking angle 45



(C) Stacking angle 60

Fig. 3 Contour of total deformation and the buckling restoration amount at the specimen with the stacking angle.

3 Conclusion

In this study, the following conclusions could be derived through 3D modelling and structural analysis for the 3-point bending specimens with different stacking angles. The different physical property is shown according to the variability of fiber design for the laminate. So, the restoring property of buckling is shown to increase as the stacking angle increases. In case of the stacking angle of 30°, the specimen is not restored at the lowest point of 3-point bending specimen with the buckling restoration amount of 50.126 mm. The breakage of inner fiber and the matrix cracking of constituted resin are shown to happen at this time. In case of the stacking angle of 45°, the buckling restoration amount becomes 50.126 mm. In case of the stacking angle of 60°, the buckling restoration amount is shown to become least. In case of the stacking angle of 60°, the breakage by the external force applying to fiber becomes low and the specimen is shown to be restored to the original configuration after the external force disappears. It is thought that the foundation data for the assessment of restoring property at the specimen broken by the external force and the safe design can be supplied through the result of this study.

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