Failure analysis of carbon fibre laminate aircraft strut model

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Overview

- Introduction
- Testing of mechanical properties
- Fabrication of the empennage model
- Two numerical simulations
- Validations by experiments
Failure criteria for composite materials

**Goal:** verify design of the composite strut of the aircraft empennage using failure criteria for composite materials

- Max stress
- Max strain
- Tsai – Hill
- Hoffman
- Hashin

Fig. 1: Yield surface of Hoffman criterion.
Fabrication of specimens

- Carbon fibres + epoxy resin
- Vacuum infusion process

L1 [0, 0, 0, 0]
L2 [OF, OF, OF, OF]
L3 [OF, 0, 0, OF]
Testing of mechanical properties

- Tensile test - ASTM D3039/D3039M
- Compressive test - ASTM D6641/D6641M
- Flexural test - ASTM D7264/D7264M
Empennage model

Fig. 7

Fig. 8

Fig. 9
Fig. 10
Empennage test - design

Fig. 11
Simulation of empennage test
Empennage test

Fig. 14
Empennage test

Fig. 15

Fig. 16
Strut test design

![Diagram of strut test design]

Fig. 18
Strut test simulation
Strut test
Strut test - delamination

Fig. 24
Strut test - results
Conclusion

- The failure of laminate parts was not predicted by failure criteria in any of the simulation – other failure mechanisms occurred
- Simulations were compatible with experiments - predicted failure mode correctly
- Verification of the strut design