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Low Energy Impact on the Aeronautical Composite

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•**Introduction**: Composite behavior when undergoing to low energy impact has been investigated thorough modelling and simulation computation. We consider the dynamic impact among a small granular material piece and a large composite material body. Really, our investigation will to simulate the aeronautical debris impact similarly when aircraft perform the taxi on the runway or when in the deceleration phase after the landed. Here we consider a CFRP composite panel impacted from with granular particle at low velocity. We develop a finite element analysis initially on the macroscale and successively at microscale where in particular we find inside delamination in according to the experimental results.

Macromechanical simulation results

Composite type: CFRP manufactured by Alenia.
Configuration ply : 90/0/45/0/45/0/45/45/0/45/0/45/0/90
Lamina number: 17 more 2 tissue surface layers
Lamina thickness : 250,99 μm (13) 490,147 μm (4)
Fibers diameter 5,289 μm
Impact force: 9 N
Impact area diameter: 4 mm.
Thermal load: 50° C

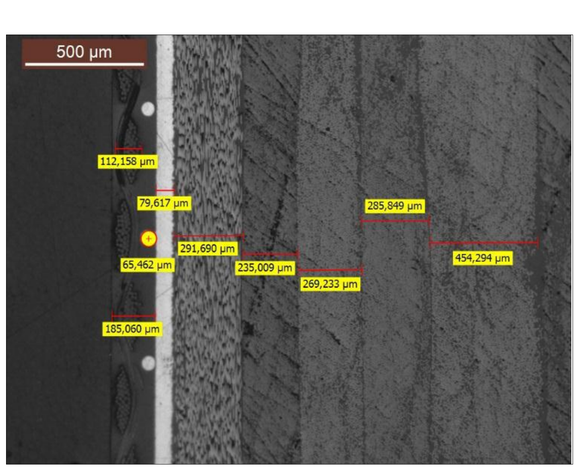

Figure 1 Specimen material property (By Alenia) and Pulse echo results (by C.S.V. Italian Air force)

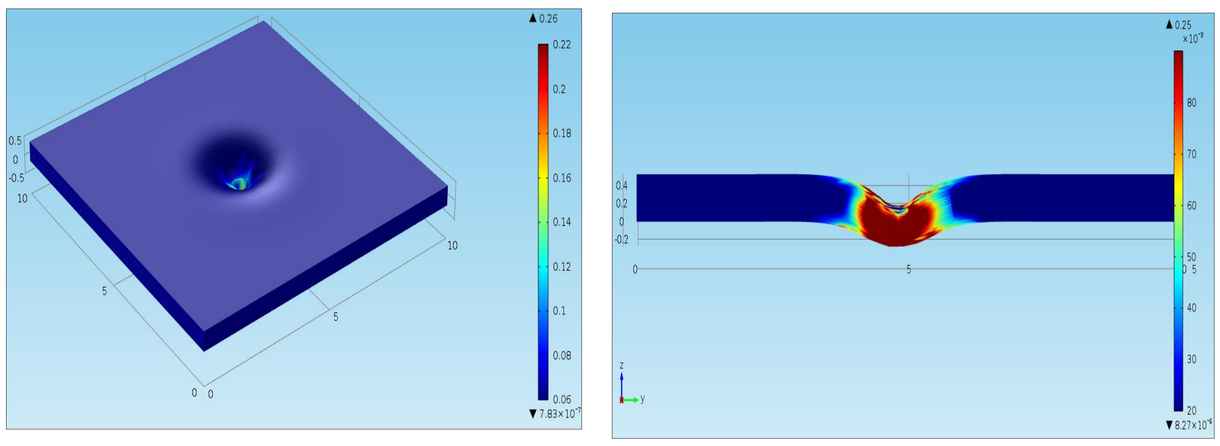

Figure 2 Von Mises stresses a time t= 0 impact

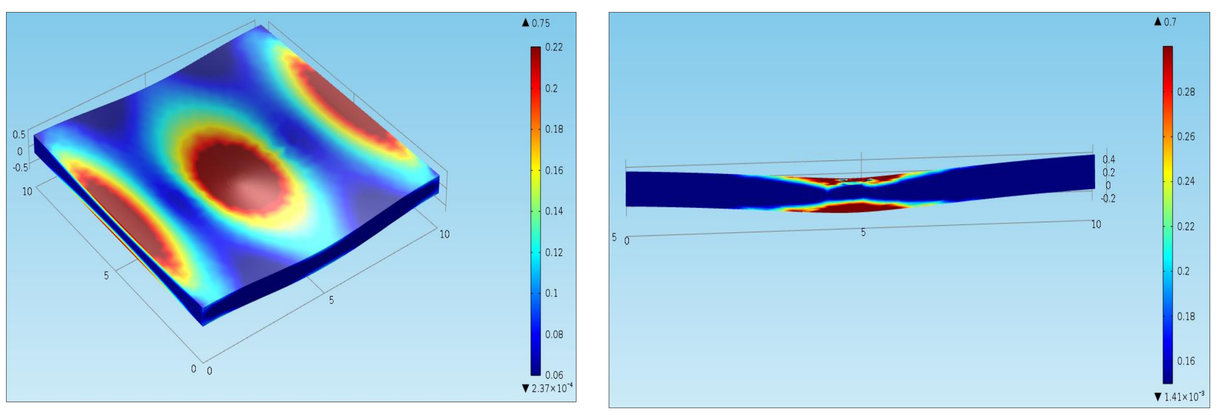

Figure 3 Von Mises stresses a time t= 1s after impact

Micromechanical Simulation Results:

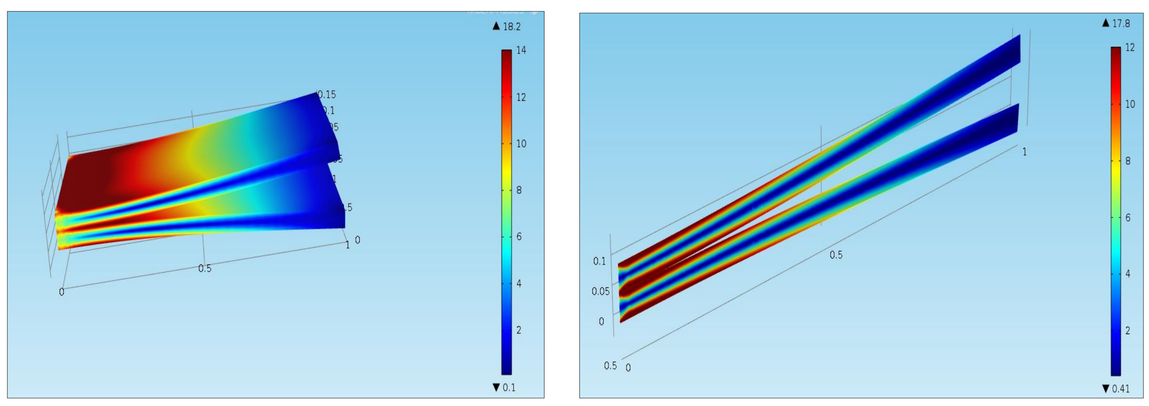

Figure 4. Von Mises stresses (L) and displacement field (R) at 3 g

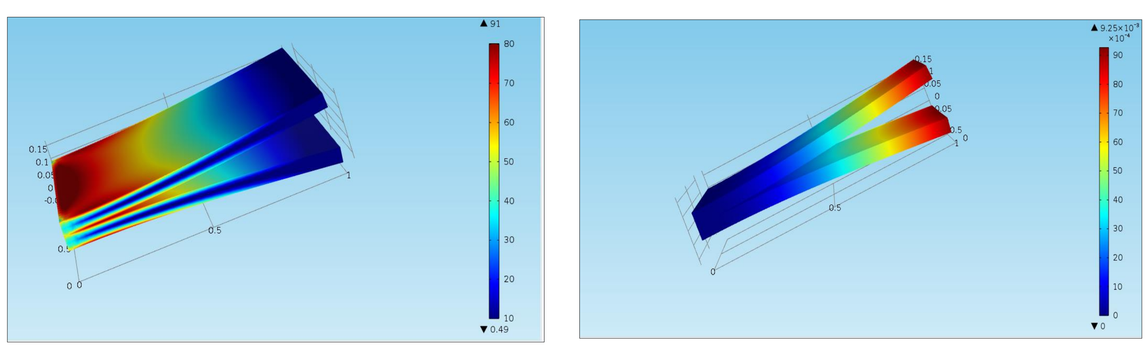

Figure 5. Von Mises stresses (L) and displacement field (R) at 9 g

Thermomechanical analysis results:

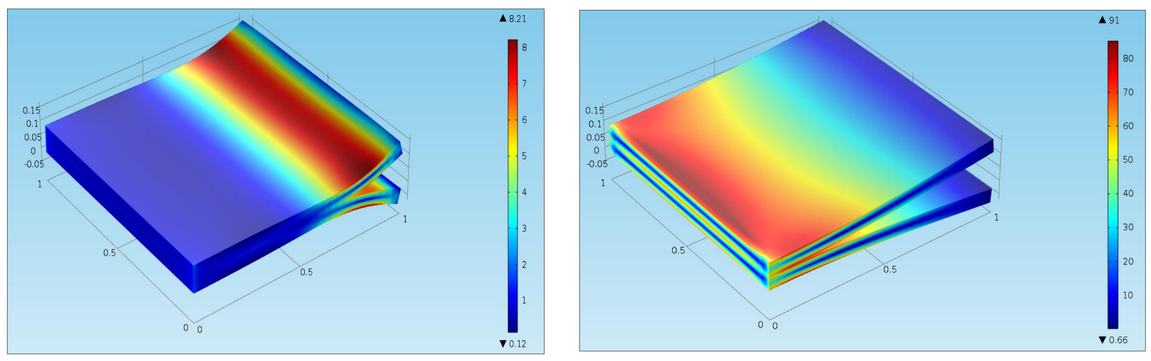

Figure 6. Von Mises stresses (L) and displacement field (R) at 9 g and 50° C

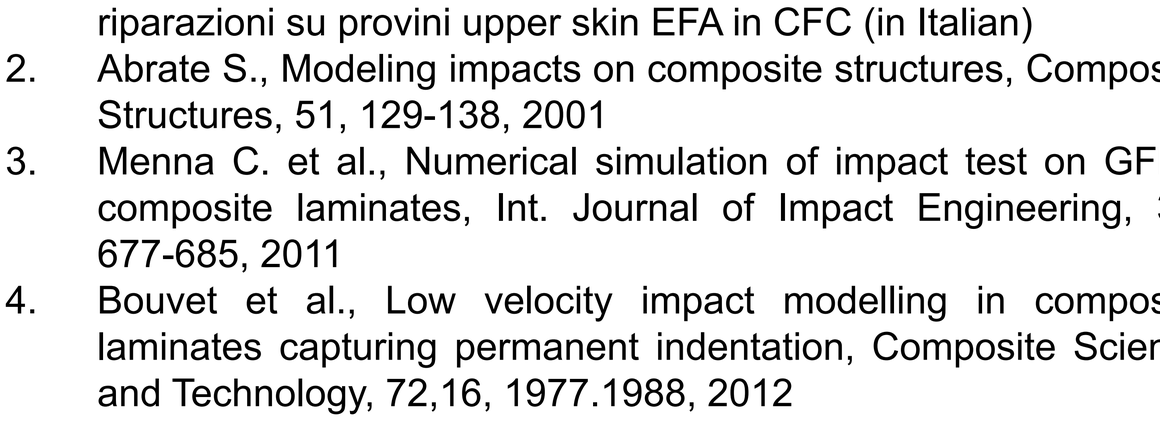

Figure 7. Von Mises stresses (L) and displacement field (R) at 9 g and 50° C

Conclusions: A low velocity impact over an aeronautical composite panel has been performed to simulate inner defects birth and growth after the impact. Comparing to the experimental results and real cases the approach appear as reliable.

References

1. Alenia Aermacchi Report, Prove di impatto e successive riparazioni su provini upper skin EFA in CFC (in Italian)
2. Abrate S., Modeling impacts on composite structures, Composite Structures, 51, 129-138, 2001
3. Menna C. et al., Numerical simulation of impact test on GFRP composite laminates, Int. Journal of Impact Engineering, 38, 677-685, 2011
4. Bouvet et al., Low velocity impact modelling in composite laminates capturing permanent indentation, Composite Science and Technology, 72,16, 1977.1988, 2012