Simulation of impact damage in thin CFRP laminates

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Abstract

Study on simulation method for progressive failure in composite materials

Reasons and benefits of using JAXA Supercomputer System

Parallel calculation of JAXA supercomputer system enables to reduce the total computation time because the progressive failure analysis of composite materials require a lot of iterative simulation.

Achievements of the Year

A progressive failure model that can simulate the impact damage failure for 8ply CFRP laminates is established (Fig. 1). Delamination initiation and growth in the laminates during impact are considered, and the following findings are obtained.

The damage propagation shows the different behavior at the impact energy level larger than 5.34J. With the 6.67J impact energy, damage continues to propagate even after unloading. The propagation rate increases in proportion to the energy.(Fig. 2)

Especially, it was found that the delamination propagates significantly between the layers immediately below the middle layer of the laminate. This is because the magnitude of stress near the middle layer is more prominent than others due to the combination of internal shear stress and in-plane tensile stress caused by bending deformation during impact.(Fig. 3)

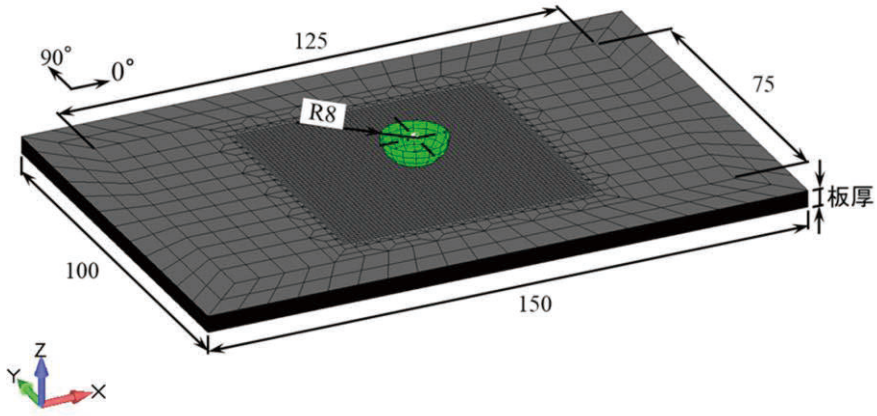

Fig. 1: Finite element model

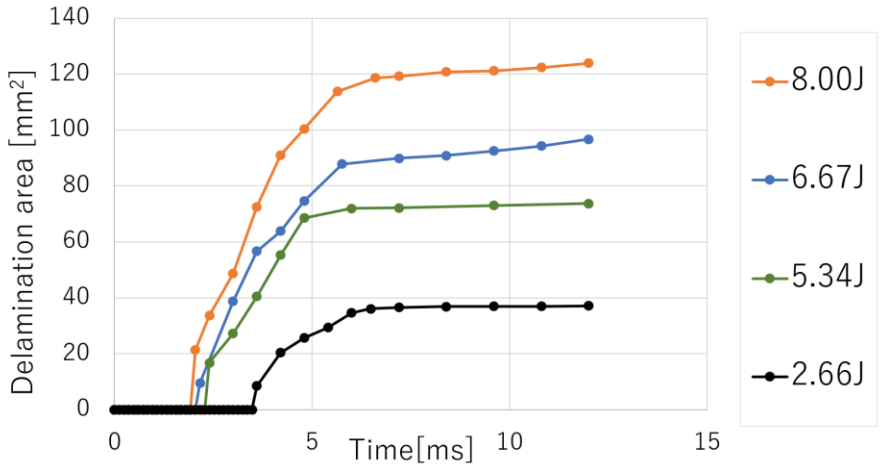

Fig. 2: Comparison of delamination propagtion history with different impact enegies

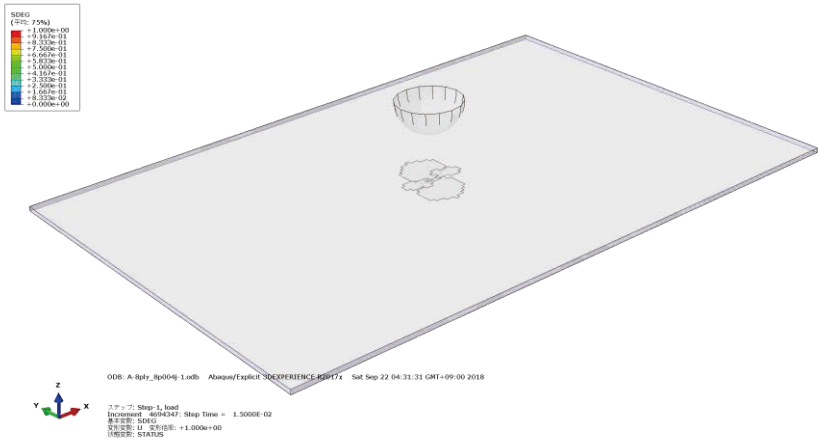

Fig. 3: Typical impact damage prediction result at 8.00J impact energy

Publications

N/A

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	2 - 228
Elapsed Time per Case	10 Hour(s)

Resources Used

Fraction of Usage in Total Resources[*1](%): 0.02

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	0.00	0.00
SORA-PP	76.53	0.00
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	36.56	0.03
/data	49,193.72	0.84
/ltmp	7,486.98	0.64

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	0.00	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.