Bird strike on a Flat Plate

For questions, please fill out contact form

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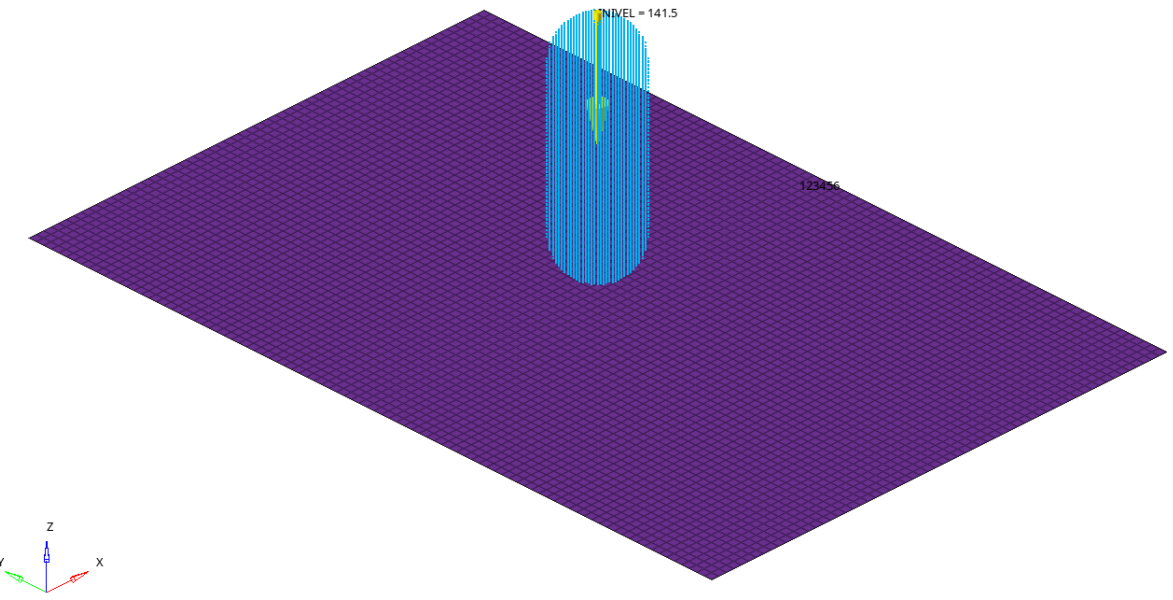
Model Description

- Simulation of bird strike on a flat plate is based on the experimental study documented in the following paper.
  - Walvekar, Vinayak & Thorbole, Chandrashekhar & Bhonge, Prasanna & Lankarani, Hamid. (2010). Birdstrike Analysis on Leading Edge of an Aircraft Wing Using a Smooth Particle Hydrodynamics Bird Model. 10.1115/IMECE2010-37667.

- Striking of SPH bird on a monolithic 7075-T6 aluminum sheet
  - Plates of different thickness evaluated



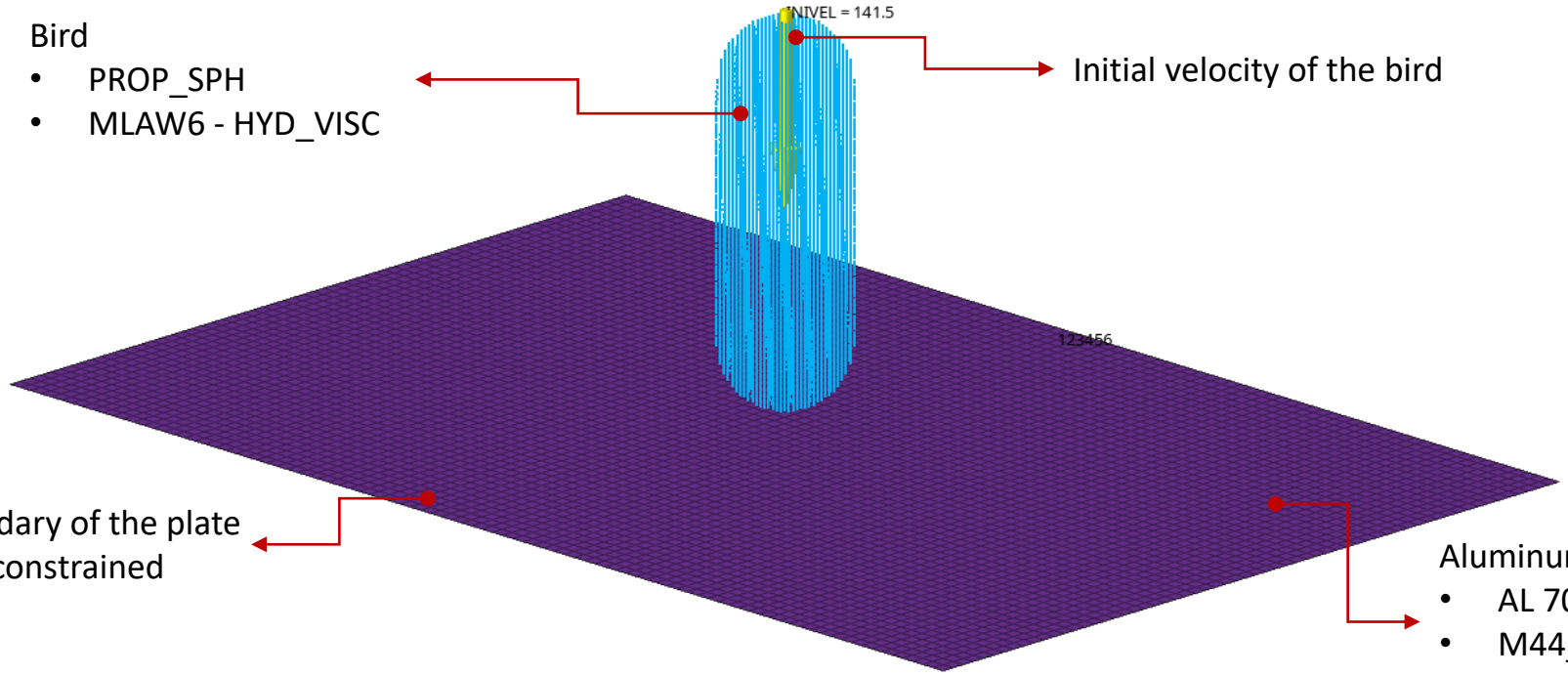
Model Parameters

Entity	Type
Solver	Altair Radioss
Version	2022.1
Processors	2
Threads	2
CPU	Intel(R) Core(TM) i7-9750H CPU @ 2.60GHz
Total run time	404.02 sec

FEA Entities	Type
Analysis Type	Dynamic Explicit
Unit System	kg, mm, ms
Element Type	P1_SHELL, PROP_SPH
Element Formulation	Q24
Material Type	M44_COWPER, MLAW6 - HYD_VISC

Analysis Setup

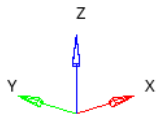
Bird
- PROP_SPH
- MLAW6 - HYD_VISC



Initial velocity of the bird

Boundary of the plate fully constrained

Aluminum Plate
- AL 7075-T6
- M44_COWPER
- ELFORM Q24 HEPH



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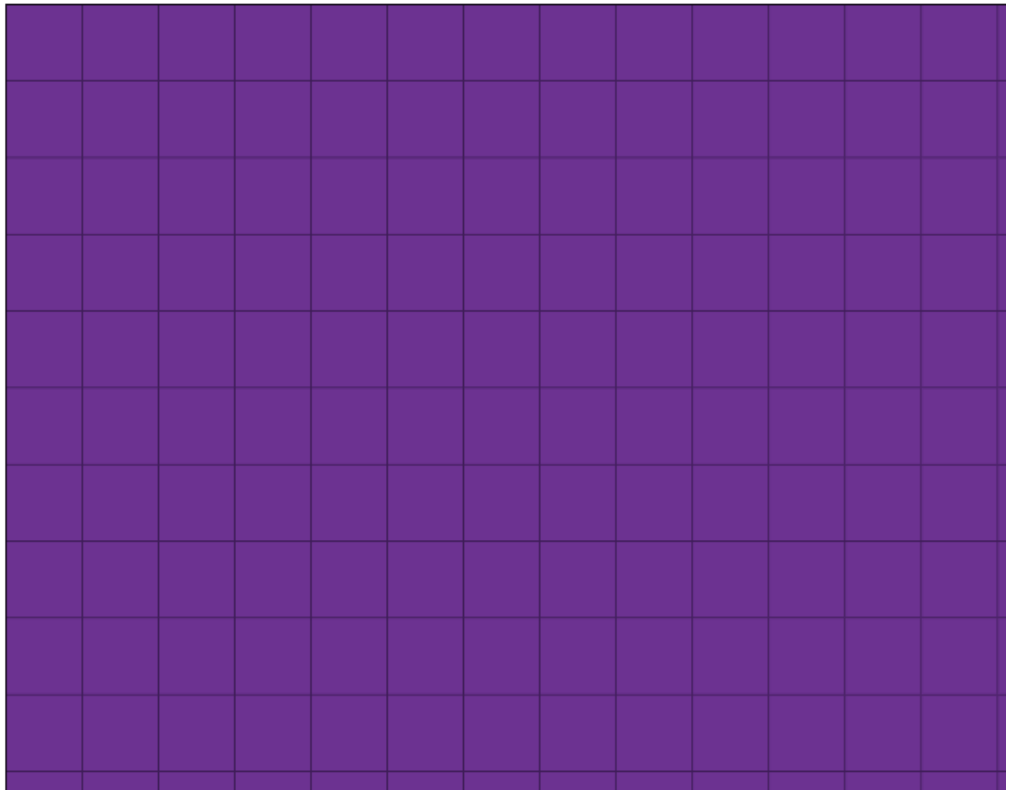
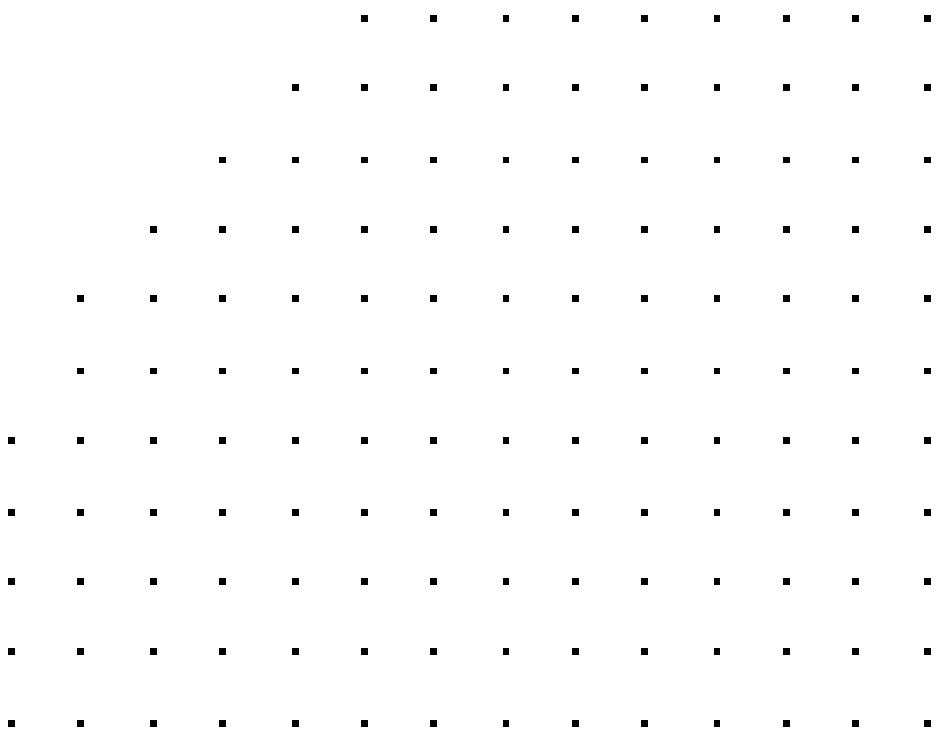
Mesh Quality

- 9.992 mm – min element length
- 1 – Jacobian
- 1.006 – max aspect ratio
- 5551 shell elements



Mesh Quality

- 4 mm – distance between particles
- 60.773 mg – mass of a particle
- 29784 SPH particles



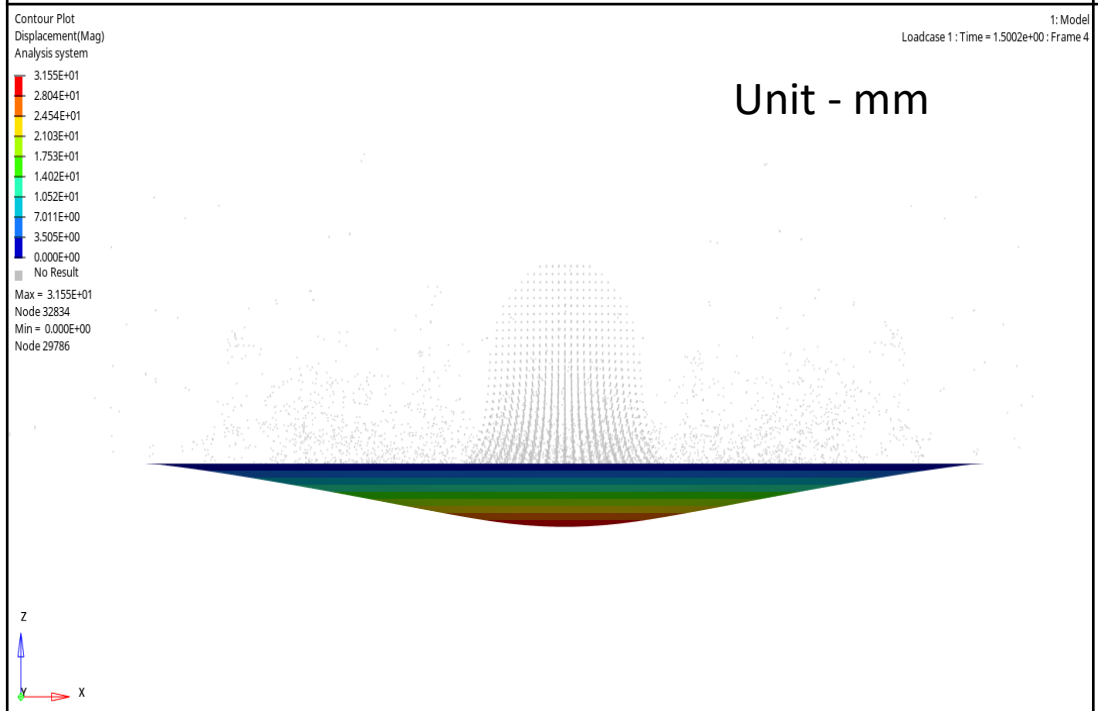
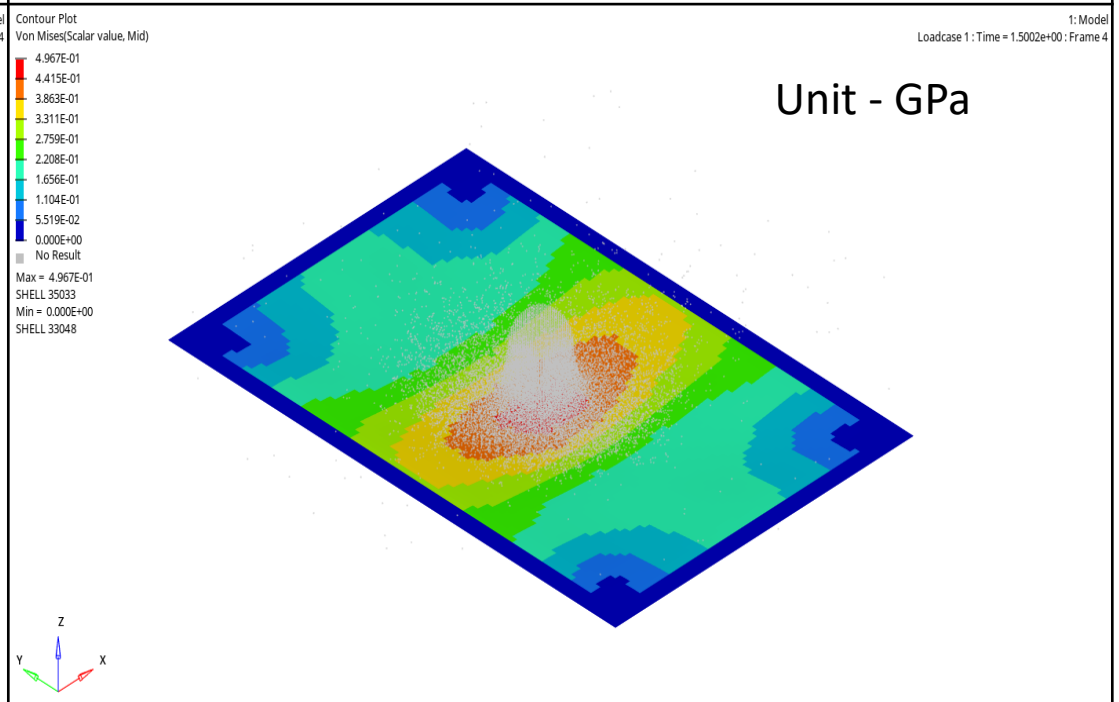
Assumptions

- Same mesh used as in the thesis
- Width of the fixed boundary line of the plate was not mentioned in the paper and is thus assumed.

Results

Plate Thickness		Test Results	Simulation Results (Paper)	Simulation Results (Algo Model)
0.25 in.	Deformation	1.0 in.	1.2 in.	1.24 in.
	Max Von Mises	n/a	73.24 Ksi	72.04 Ksi
0.16 in.	Deformation	1.5 in.	1.8 in.	1.54 in.
	Max Von Mises	n/a	73.1 Ksi	76.16 Ksi
0.10 in.	Deformation	Material Failure	Material Failure	Material Failure

Analysis Results

Plate Thickness - 0.25 inches	
Displacement	Von mises
	
Maximum value – 1.24 in	Maximum value – 72.04 Kpsi

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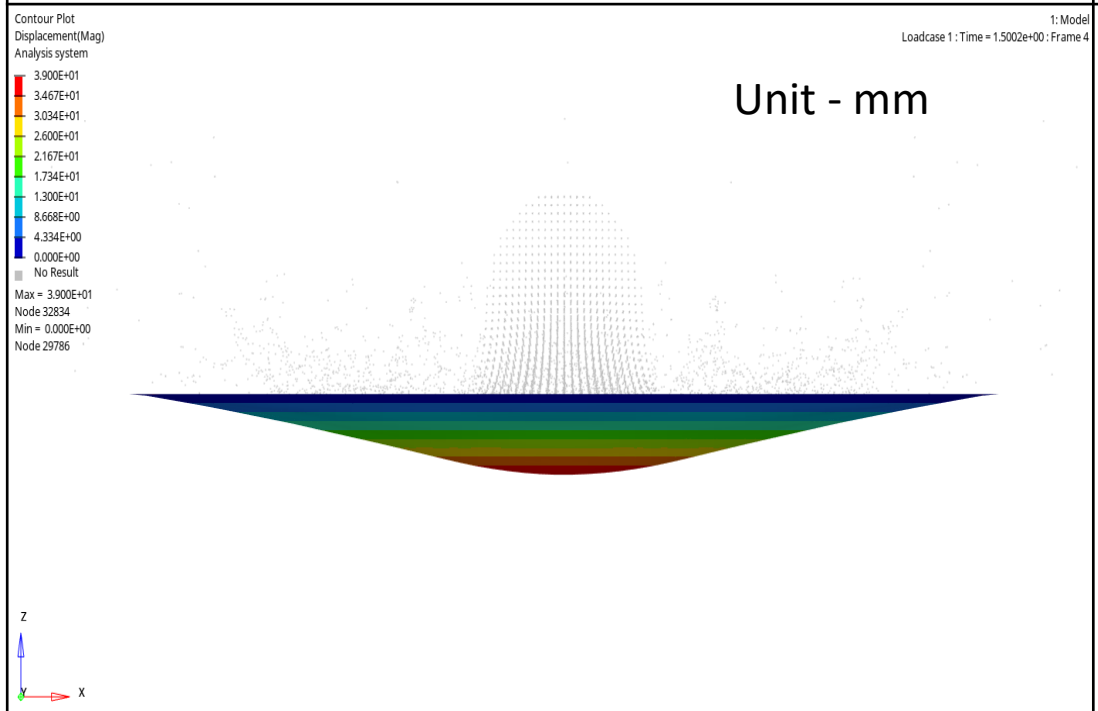
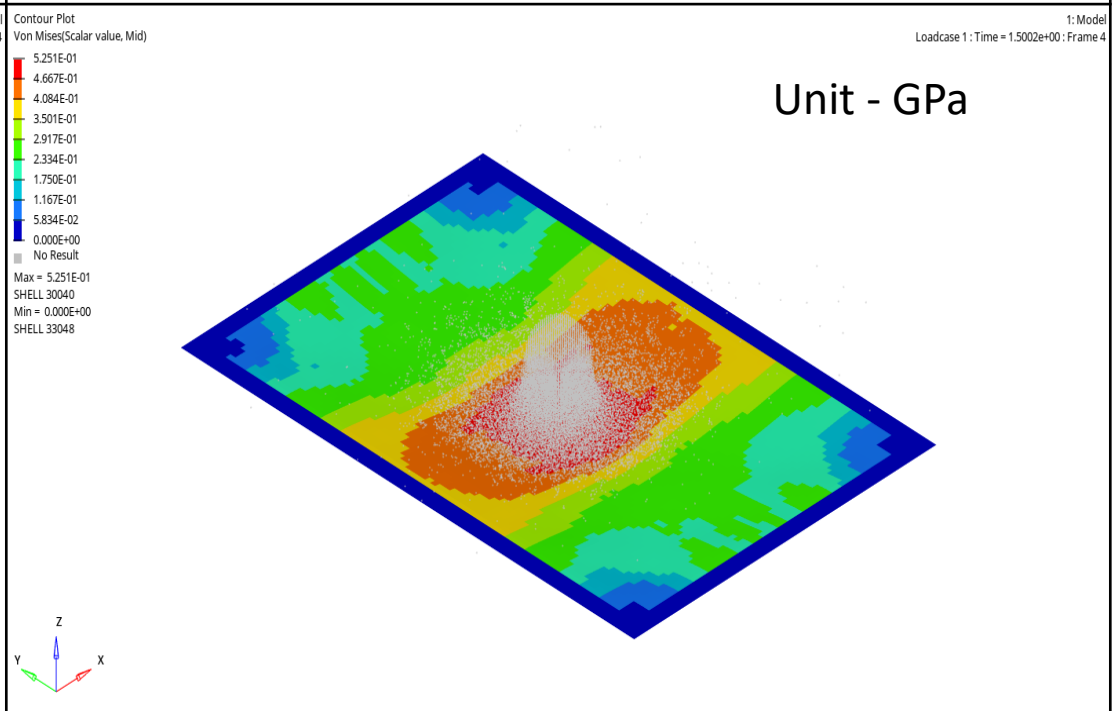
Analysis Results

Plate Thickness - 0.16 inches	
Displacement	Von mises
	
Maximum value – 1.54 in	Maximum value – 76.16 Kpsi

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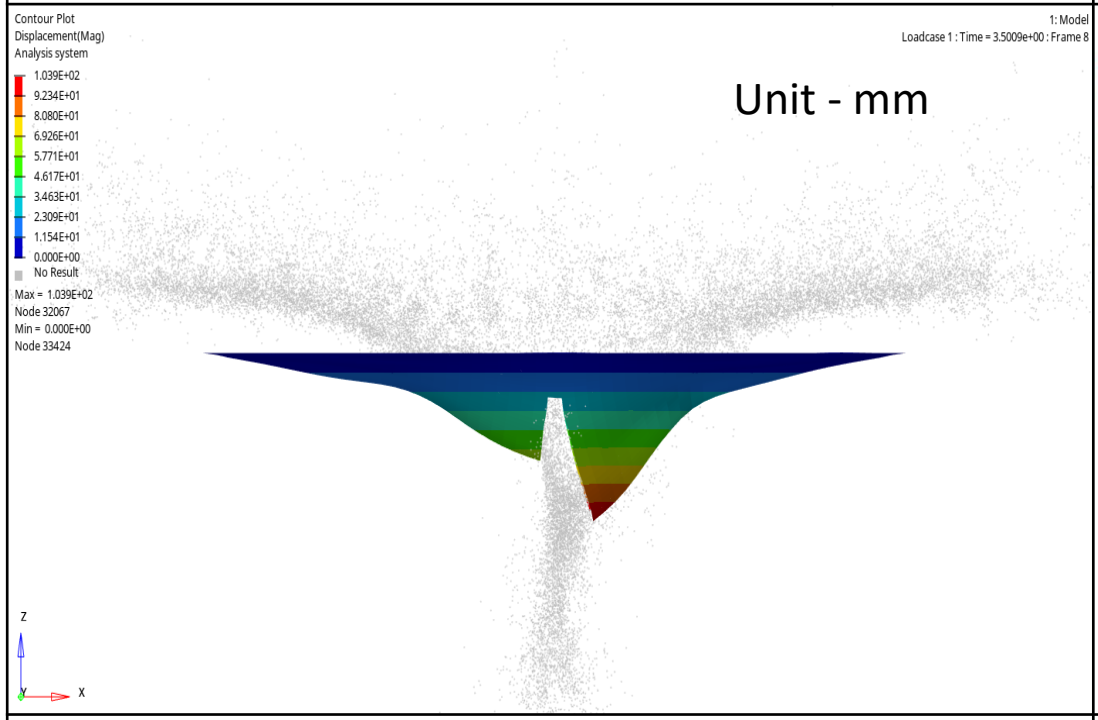
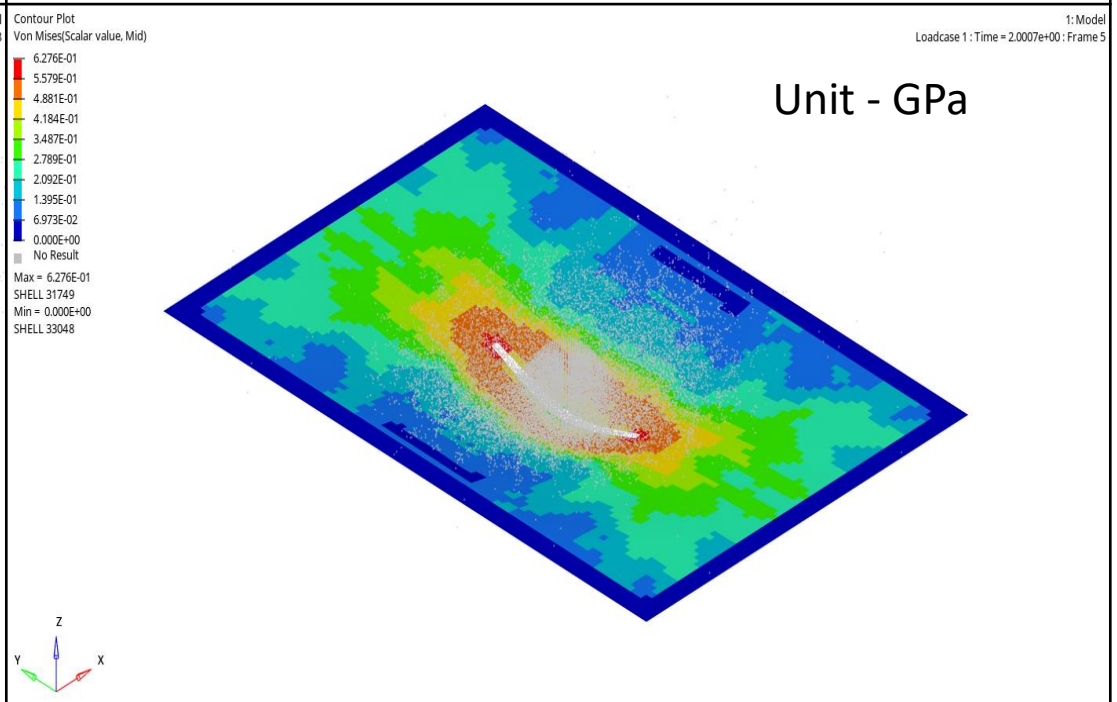
Analysis Results

Plate Thickness - 0.1 inches	
Displacement	Von mises
	
Maximum value – 4.09 in	Maximum value – 91.03 Kpsi

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Conclusions

- Simulation of bird strike was conducted to study the deformations and stress distribution of the plate.
- The simulation shows good correlation for the displacement and von Mises stress results when compared to the test data presented in the paper.
- The model runs very fast so it can be useful to perform parametric studies as needed.