ADA ADVANCED DESIGN ALLIANCE
ENGINEERING CENTER

Document No.: **ER00.00.00.001**
Engineering Report: **FOPS Test Simulation**

Applicable paragraphs of airworthiness requirements: N/A

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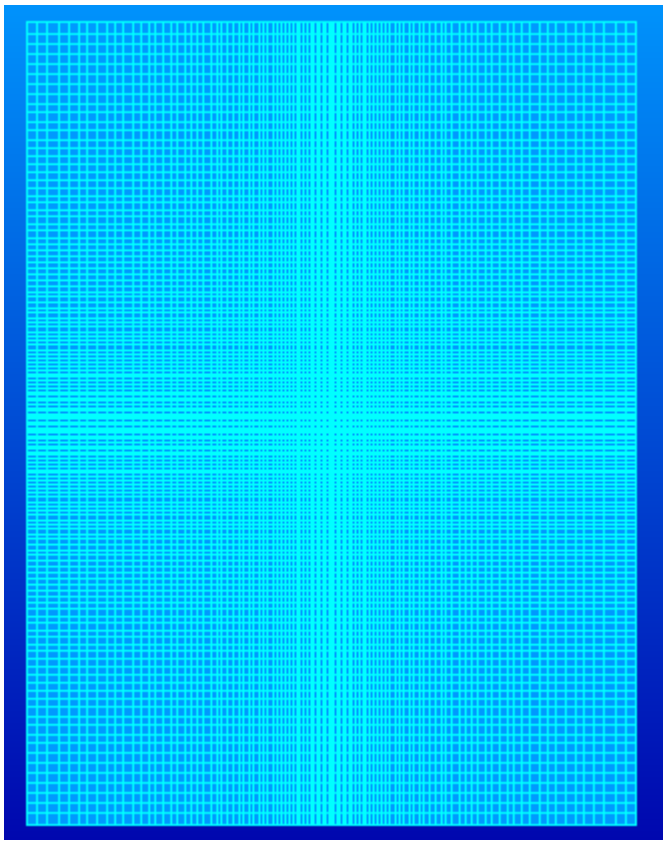
SCOPE

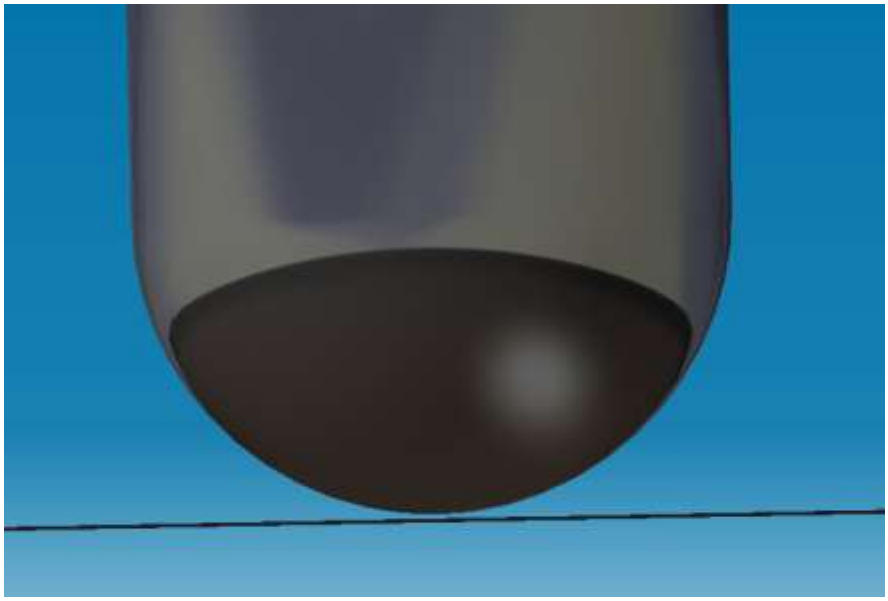
ISO 3449:2005 specifies laboratory tests of falling objects protective structures (FOPS). This report describes a simulation of FOPS test of a flat polymer plate.

General

A flat polymer plate 1.1x1.5m with thickness ranged within 4…30mm has been simulated. “Shell” elements have been used with denser mesh along the principal axes of the plate. The plate has been fixed along all four edges.

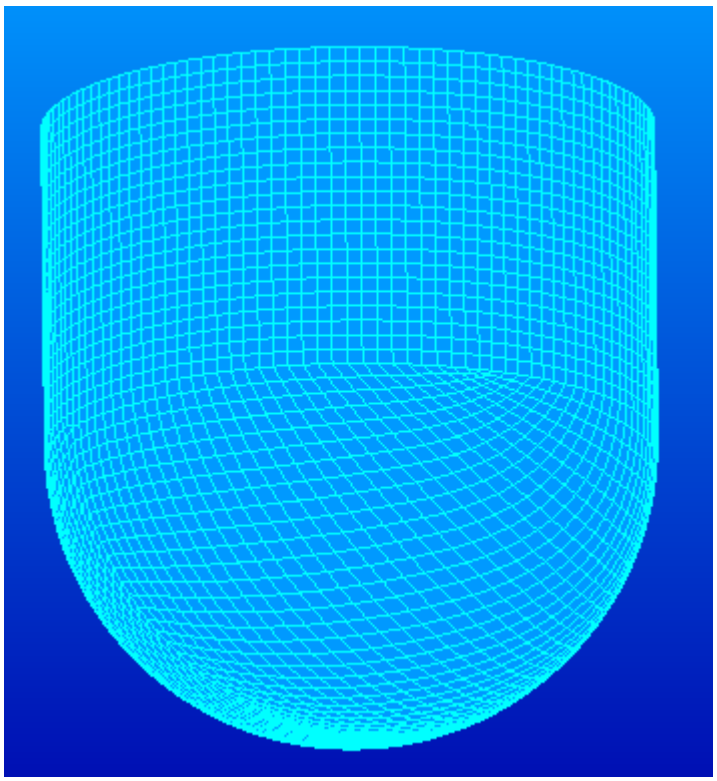


A test object of 45kg has been simulated per ISO 3449:2005 and placed 2mm above the plate

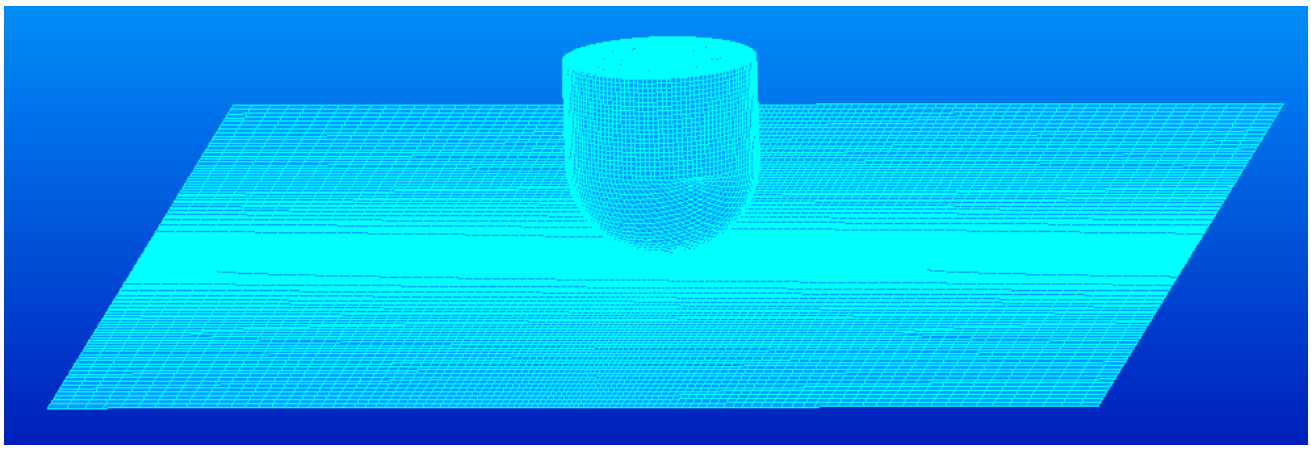


with initial velocity 7.8m/s (resulting from free fall from 3.1m height) to meet the standard's requirements on Level I performance criteria.

"Shell" elements have been used for the simulation.



The test object impact on the plate has been located at the plate's centroid.



Acceleration due to gravity of 9.81 m/s has been applied to the simulated setup.

The plate material properties used for the analysis have been selected as follows:

- density
- .

Results

Results of the simulation are summarized in the table below.

Analysis End Time – is timeframe of the analysis, with the start time at the moment when the test object had the initial velocity of 7.8m/s and was 2mm above the plate upper surface.

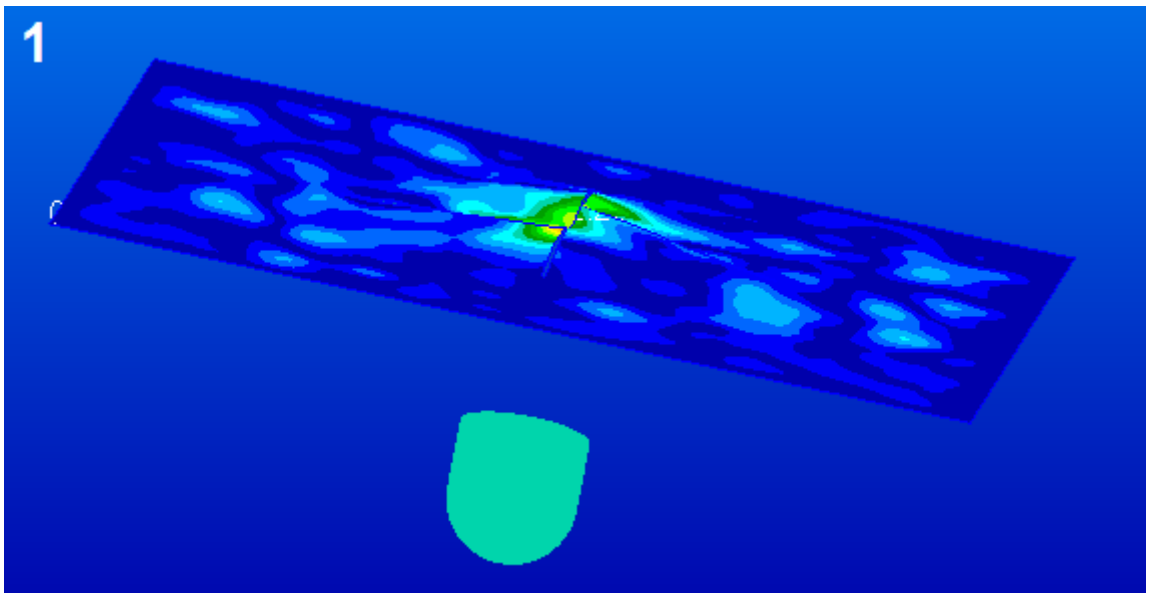
End Time Velocity – is velocity of the test object at the analysis end time.

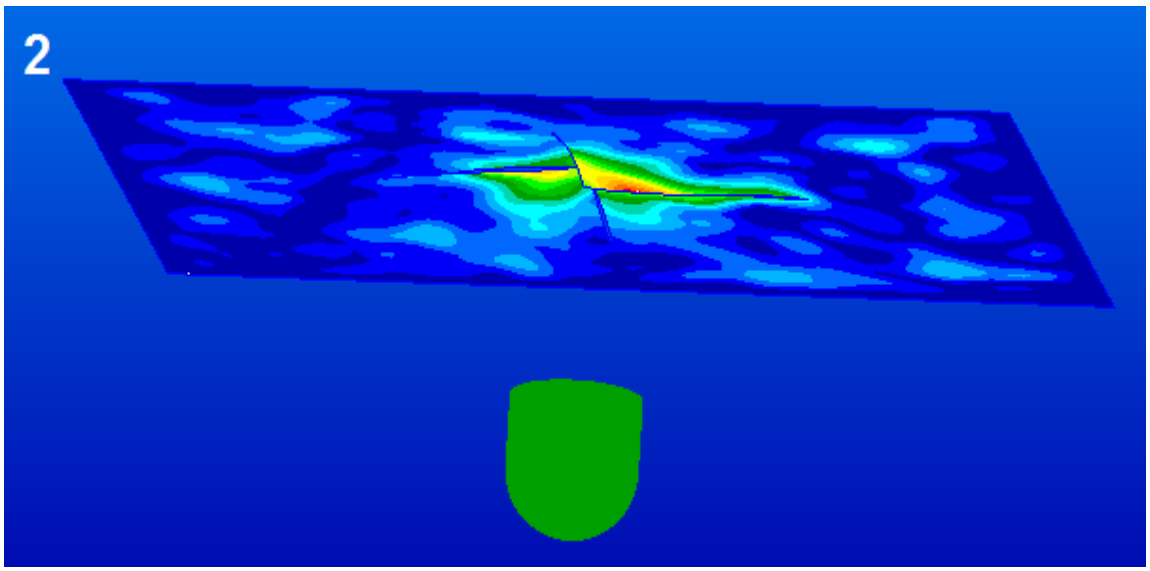
Minimum velocity – is the minimum velocity of the test object within the analysis time frame.

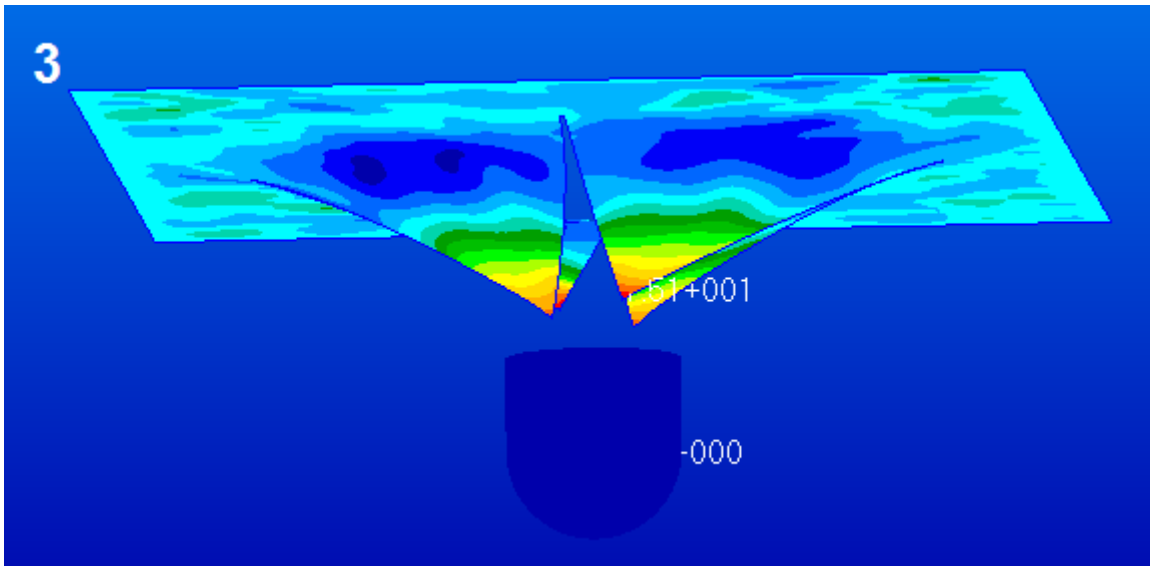
Failure Mode – characterizes whether the plate has been penetrated by the test object, or just cracked during the impact, or remained intact, etc.

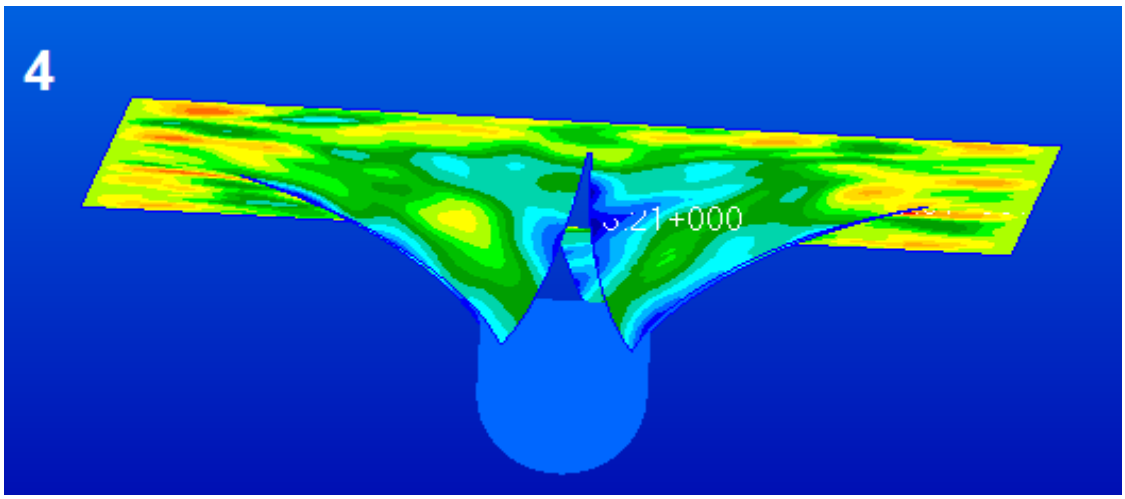
No.	Plate Thickness, mm	Analysis End Time, s	End Time Velocity, m/s	Minimum Velocity, m/s	Failure Mode
1					
2					
3					
4					
5					
6					
7					

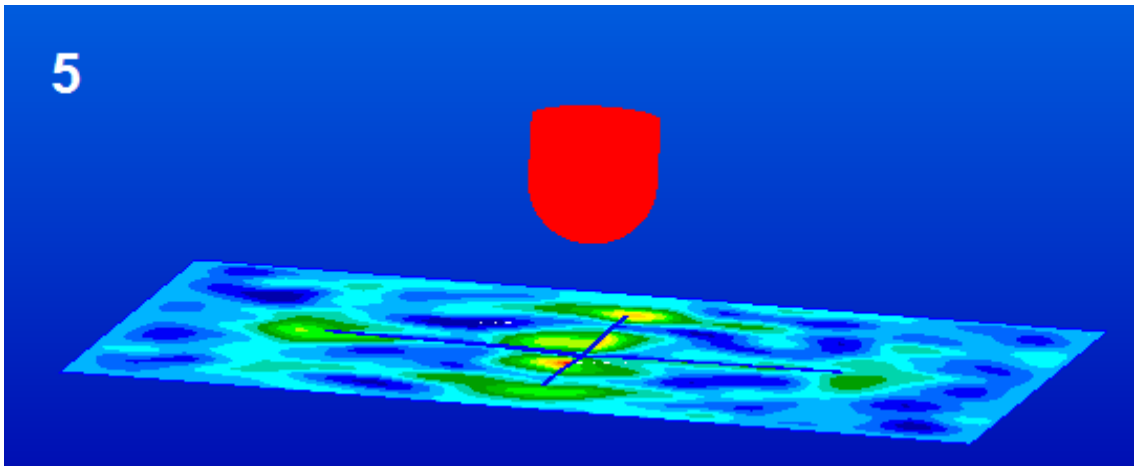
The results are illustrated below.

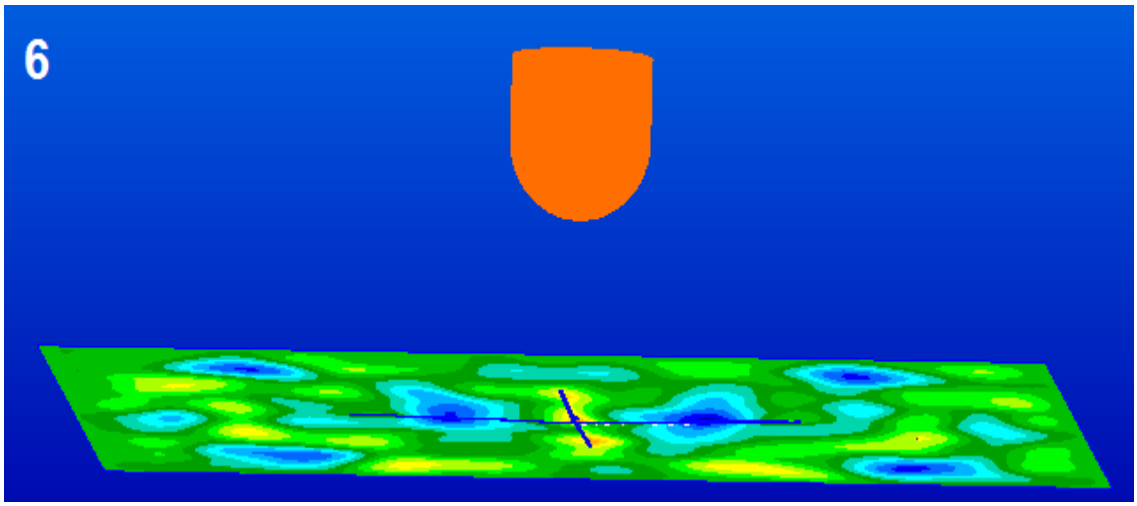

1

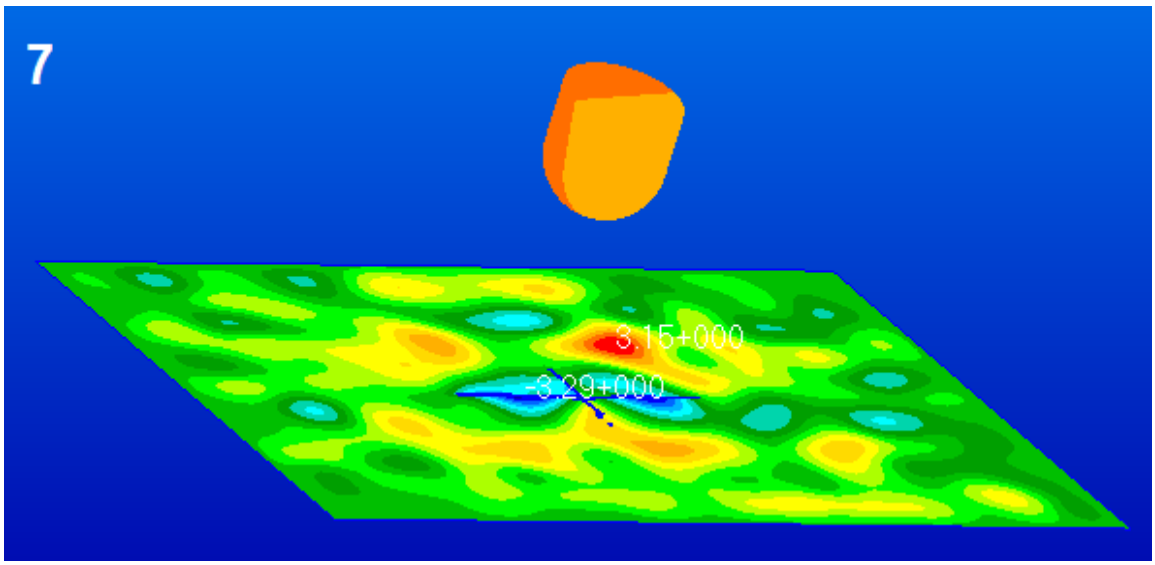

2


3
+001
-000


4
5.21+000


5


6


7
8.15+000
-8.29+000

Conclusion

1. Plate thickness of between 15 and 20mm appears to be the minimum to meet the requirements.
2. A more precise result for the thickness might be generated.
3. The results of the simulation need to be validated by results of an actual similar test.

References

1. ISO 3449:2005. Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements.