

Drop Simulation of Medical Disposable Elastomeric Pump

Rajesh Kapuganti, Siva Kumar Anbazhagan

1. HCL Technologies, Medical-CAE, Chennai,
2. HCL Technologies, Medical-CAE, Chennai.

Introduction:

Elastomeric pumps are used in the medical field to administer liquid drugs such as local anesthetics, analgesics or antibiotics depending on the therapy. Though it is ideal for outpatients or patients that require a high level of mobility, if pump fails during accidental drop, it could lead to spillover of drug and interruption in medication. Comsol Multiphysics was chosen as it has the best capability for coupling multiple simulations with ease.

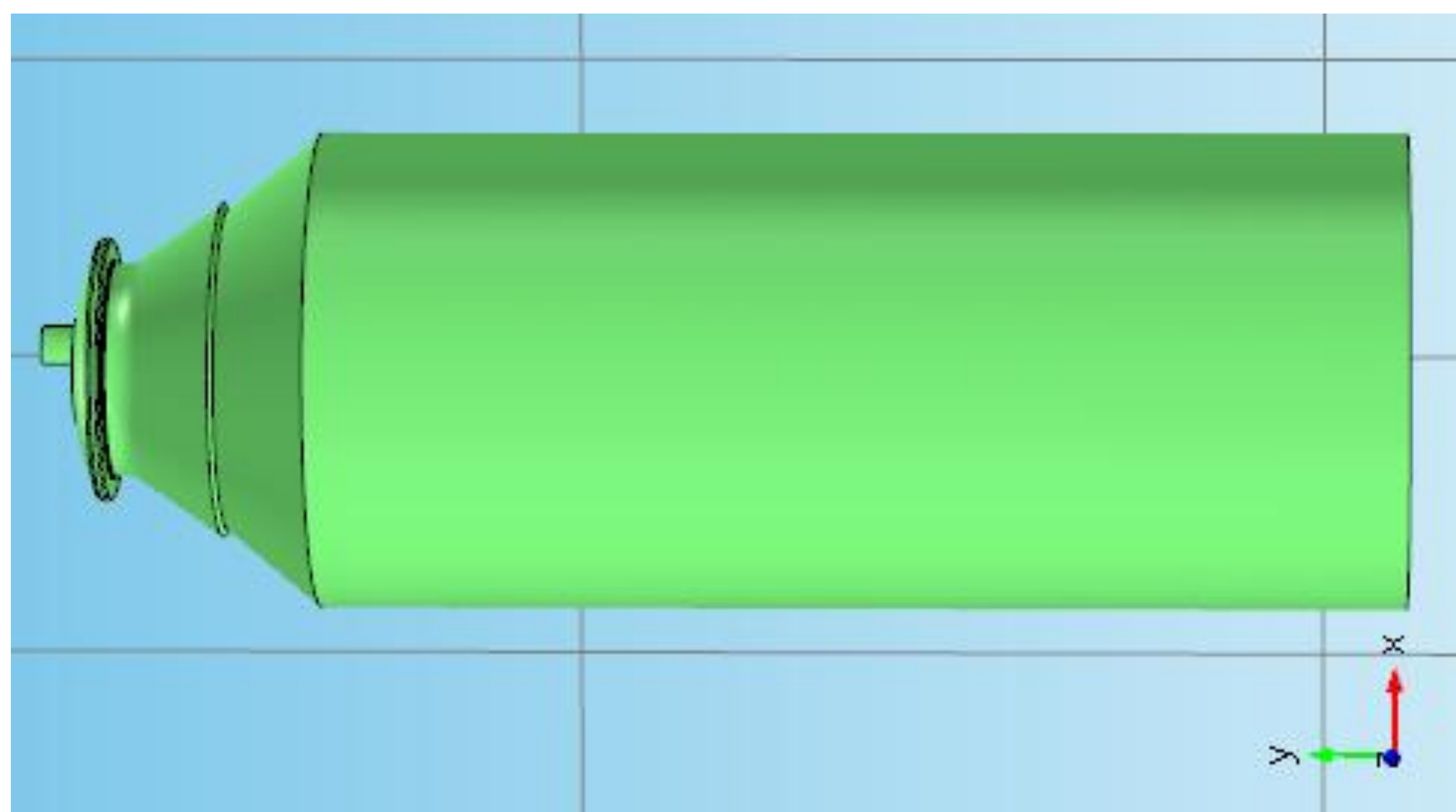


Figure 1. Elastomeric pump

Computational Methods: Consists of two parts.

1. Interference analysis was performed between the cap and the bottle. The stresses and strains of the device during the assembly procedure were captured.
2. The bottle drop simulation was performed based on IEC 60601 regulatory standard by dropping the pre-stressed device from a height of 1 metre.

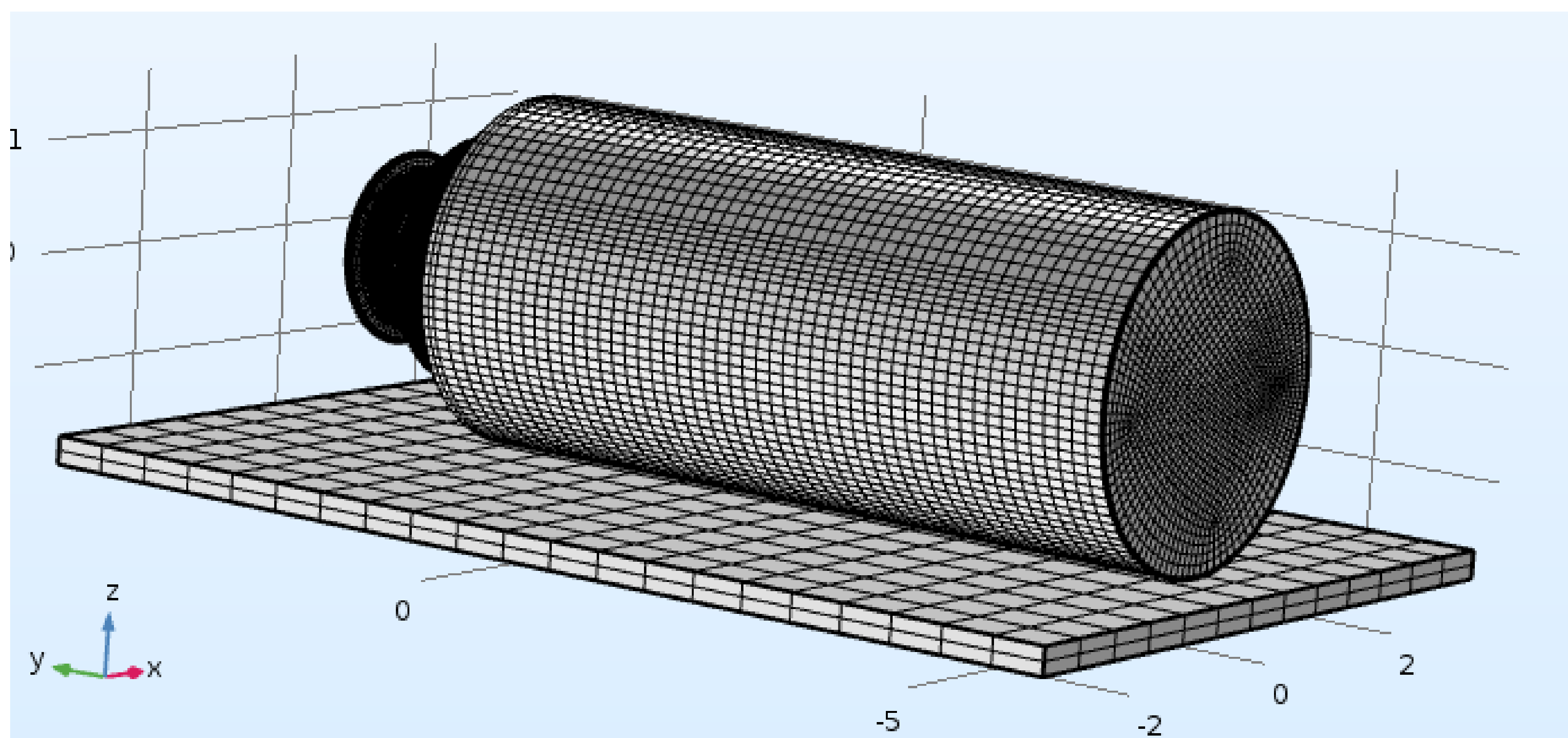


Figure 2. Finite element model

Results:

During the drop simulations of initial design configurations, the failure was observed at the snap region in the bottle. Failure of snap region has resulted in leakage of the drug. The snap regions geometry profile were optimized to avoid disengagement and hence leakage.

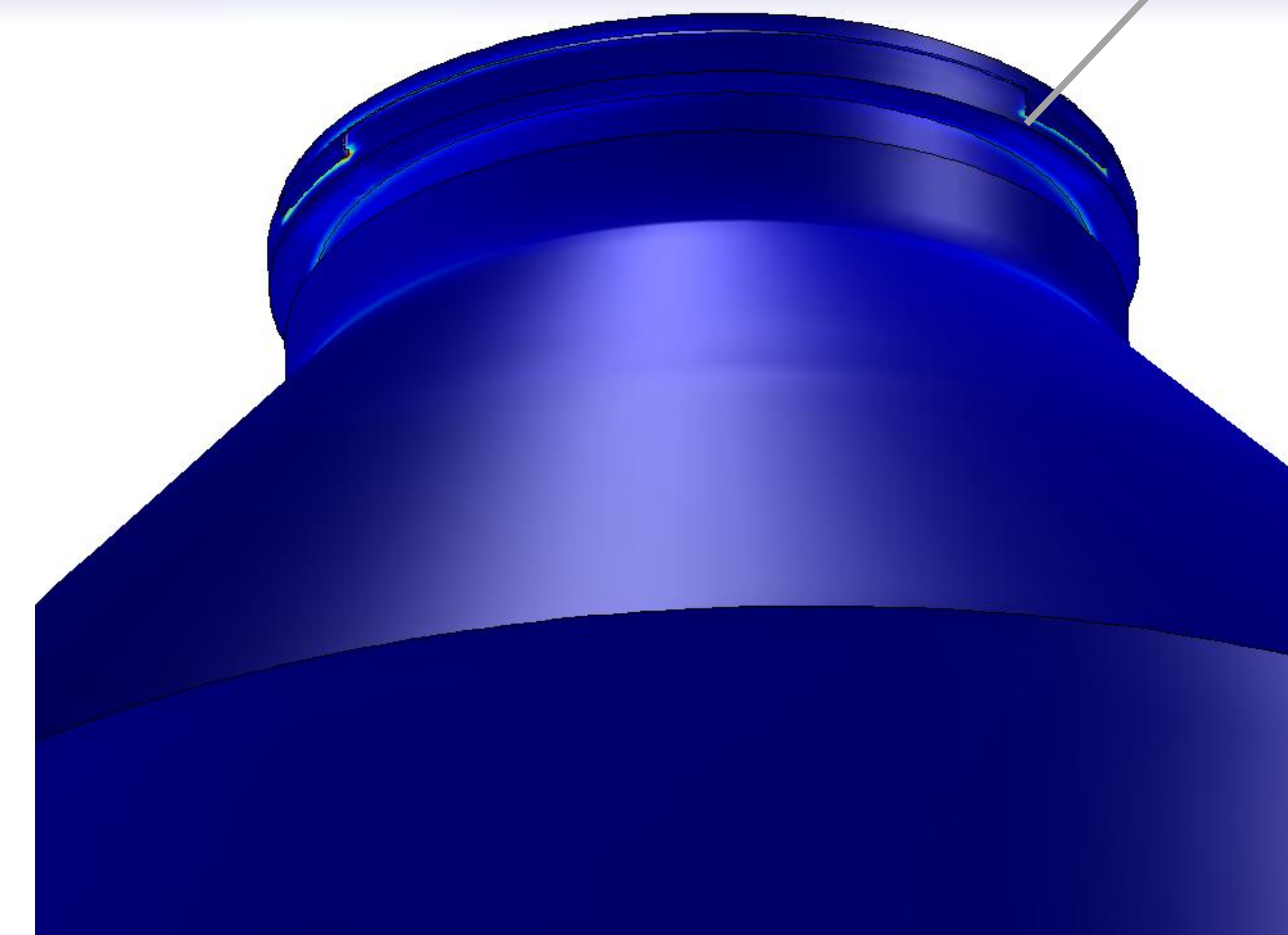
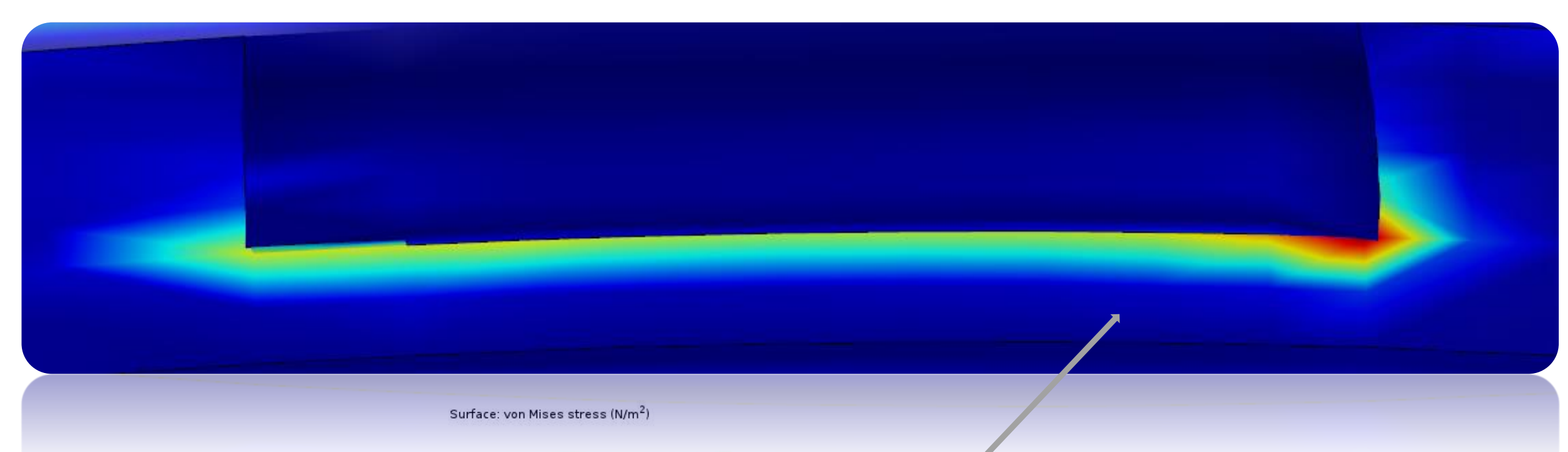


Figure 3. Failure observed at snap region in Bottle under drop

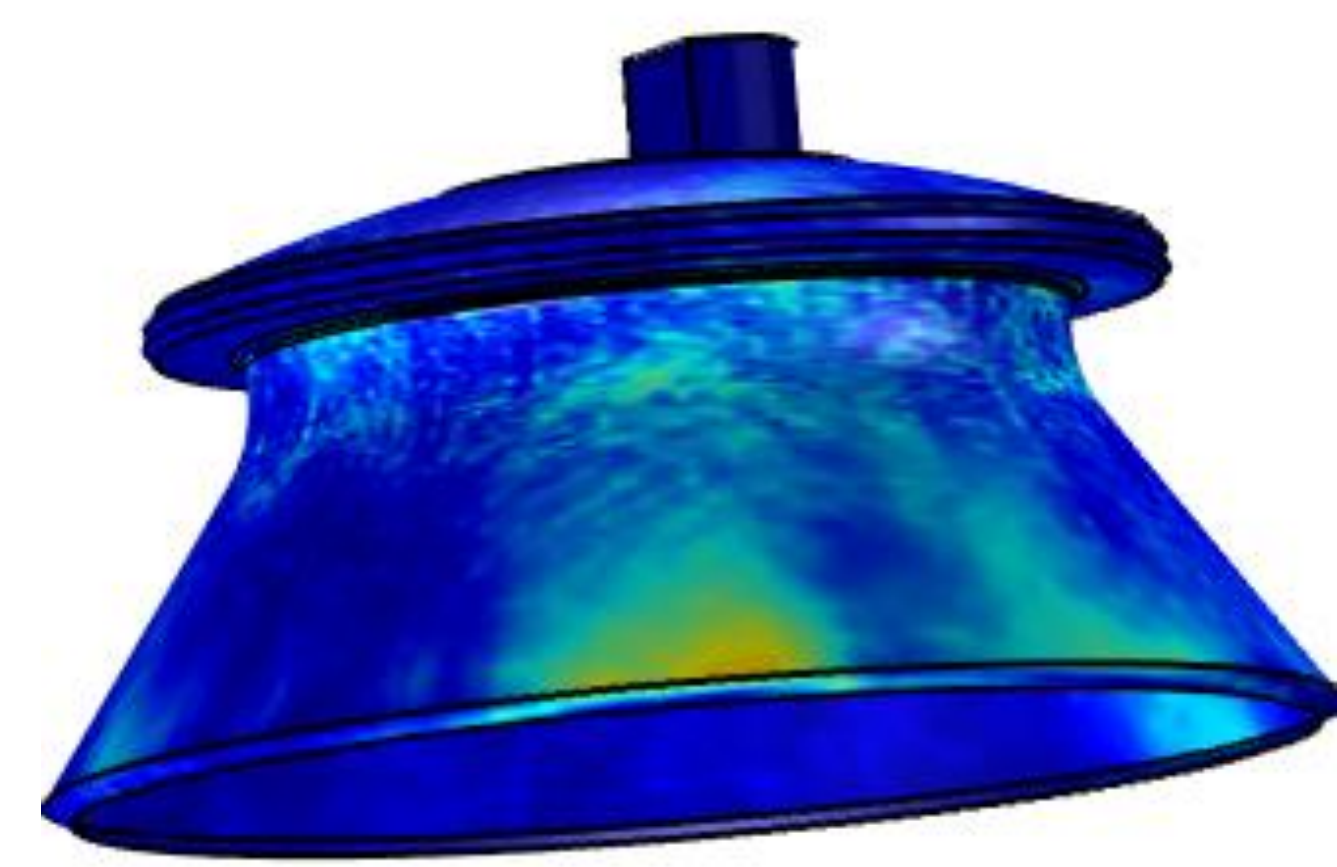


Figure 4. Stress observed in cap

Conclusions: Comsol Multiphysics simulations were performed for assembly condition and drop simulation. The output results from drop simulation were identical compared with results from physical drop test.

References:

1. Leonhardt, P.M., 2001, "Acceleration Levels of Dropped Objects", Endevco Corporation.
2. Kelly, G.A., Punch, J.M., Goyal. S., J.M., 2006. "The Dynamics Of A Small-Scale Portable Electronics Device Under Impact Stimuli".