

Radioss honeycomb scaled cell size modeling method: Application to deformable barrier models

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Honeycomb shell modeling in deformable barriers

➤ Goal

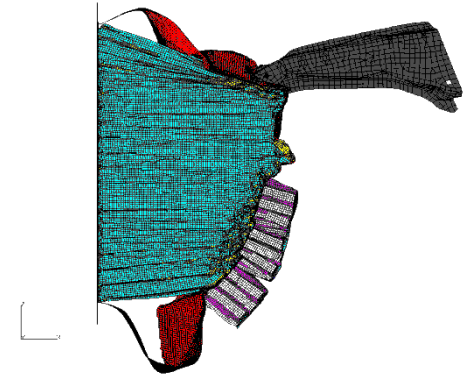
❑ Accurate local behavior

- Cell progressive buckling and global collapse under off-axis loading.
- Honeycomb punching and rupture behavior.

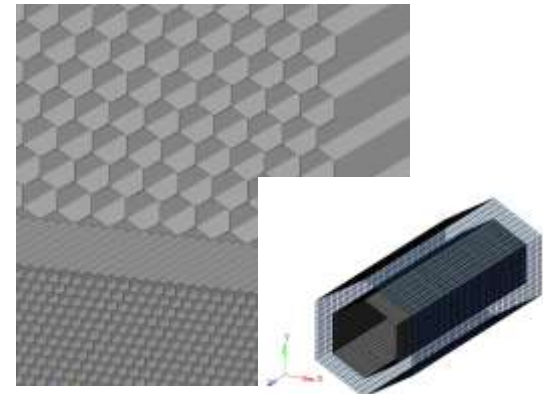
❑ Barrier realistic deformation shape

❑ Realistic loading distribution in different vehicle compartments.

❑ CPU constraint

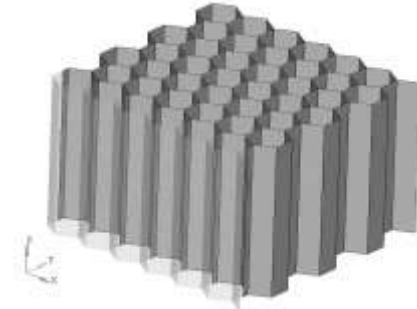
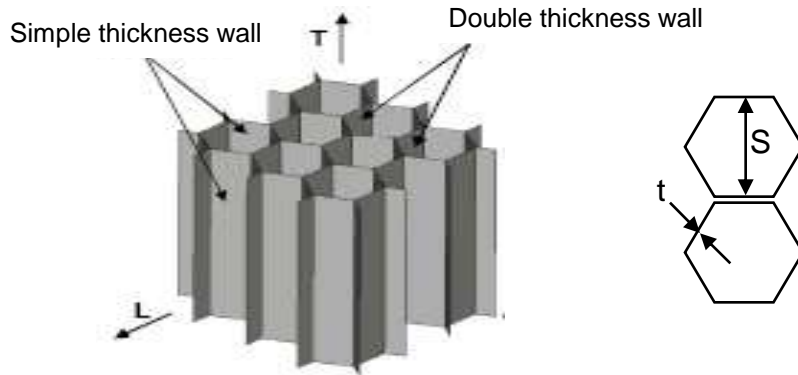


➤ Achievement : Honeycomb scaled cell size modeling



Honeycomb scaled cell size modeling method

Honeycomb structure



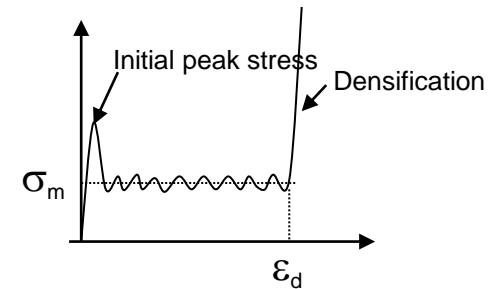
Typical response of honeycomb structure under compression

Mean crushing strength in T direction (T. Wierzbicki 1983)

$$\sigma_m = 1.56 \sigma \left(\frac{t}{S} \right)^{1/2}$$

Mean crushing strength in L and W direction (Gibson & Ashby 1981)

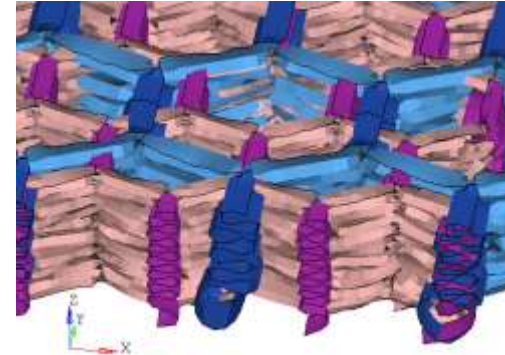
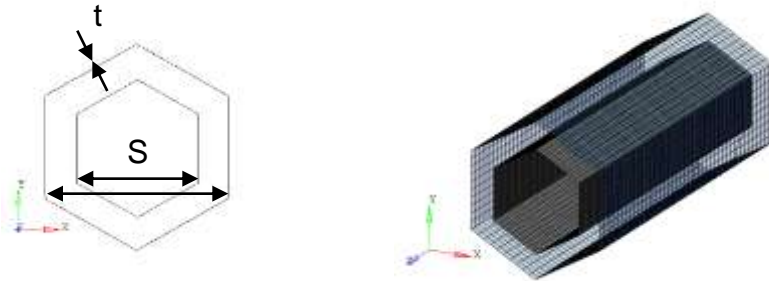
$$\sigma_m \sim 2 \sigma \left(\frac{t}{S} \right)^2$$



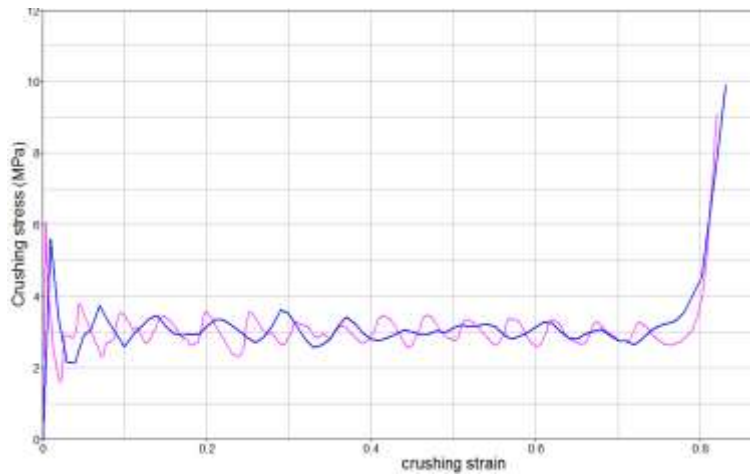
=> Crushing strength is unchanged by adjusting the ratio t/S

Verification of scaled cell size modeling method

Scaled honeycomb cell size



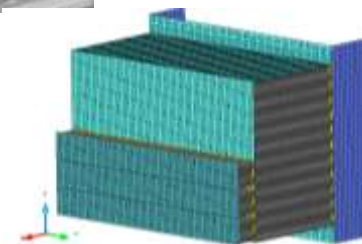
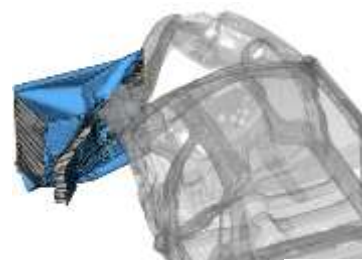
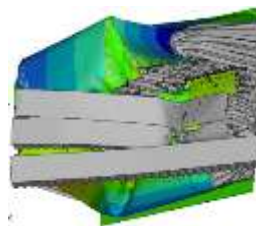
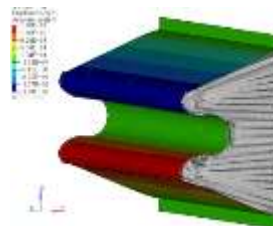
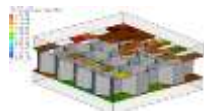
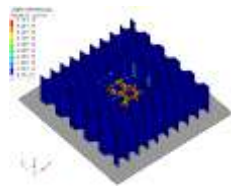
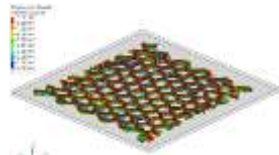
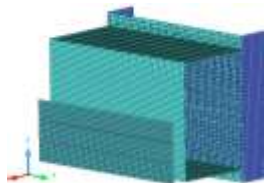
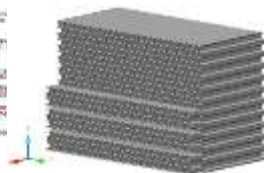
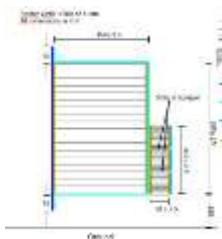
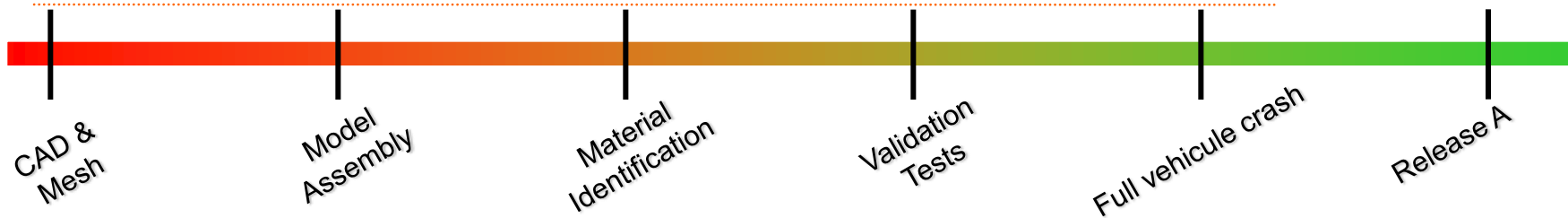
Honeycomb cell walls progressive buckling process



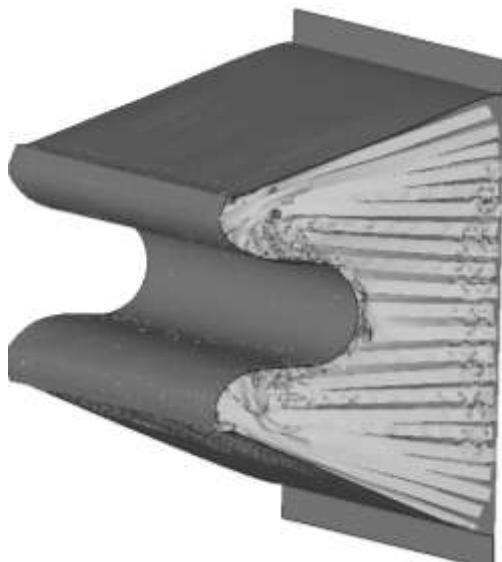
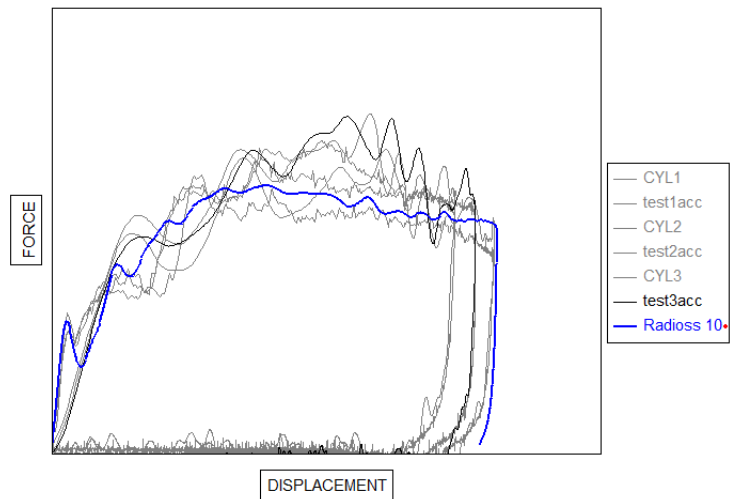
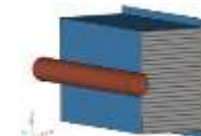
— Real honeycomb cell size
— Scaled honeycomb cell size

=> Crushing strength is unchanged by adjusting the ratio t/S

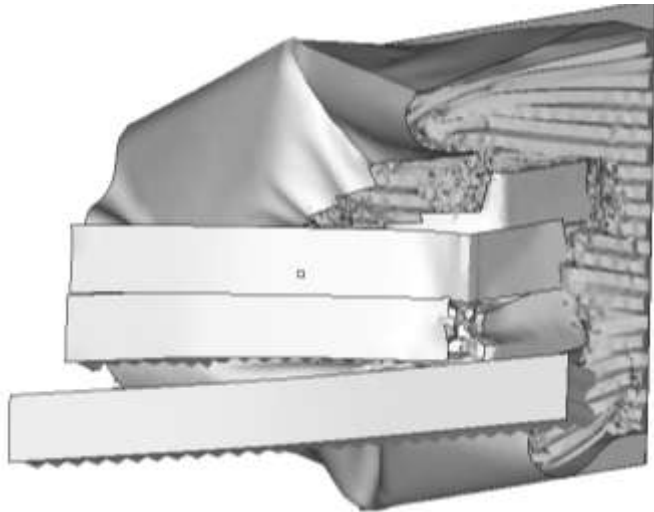
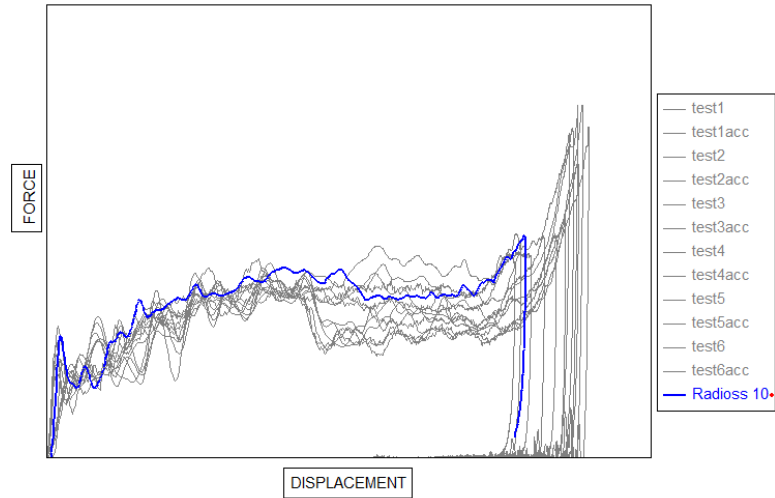
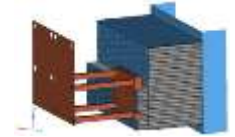
Safety tools : development method



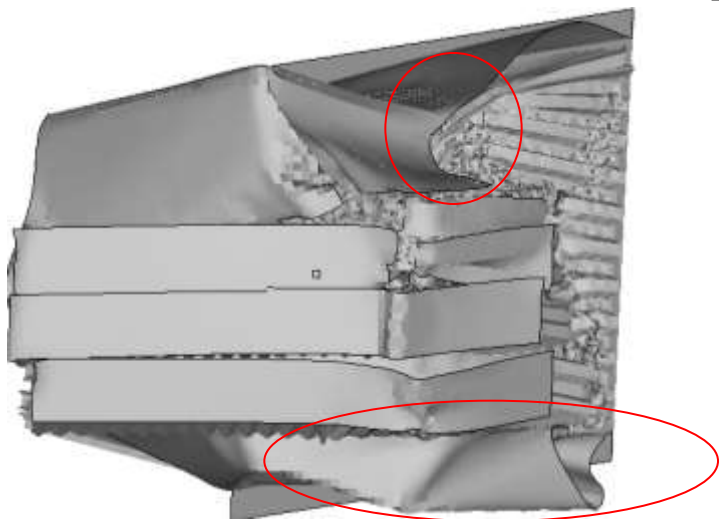
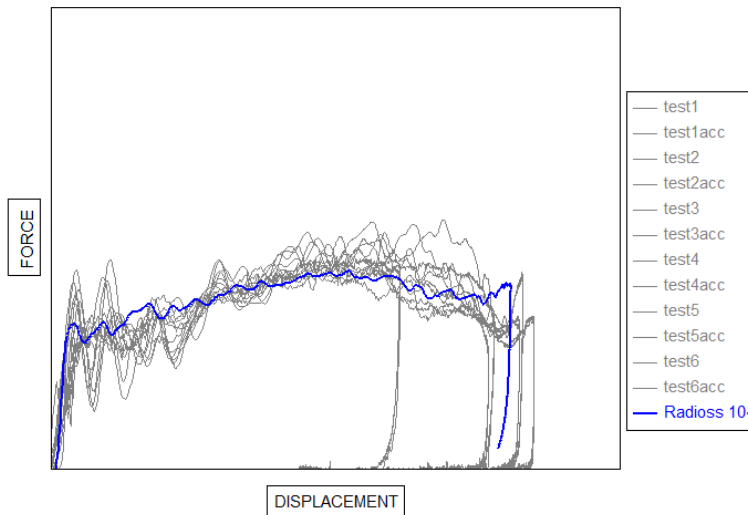
Offset Deformable Barrier : Cylindrical beam test



Offset Deformable Barrier : validation test

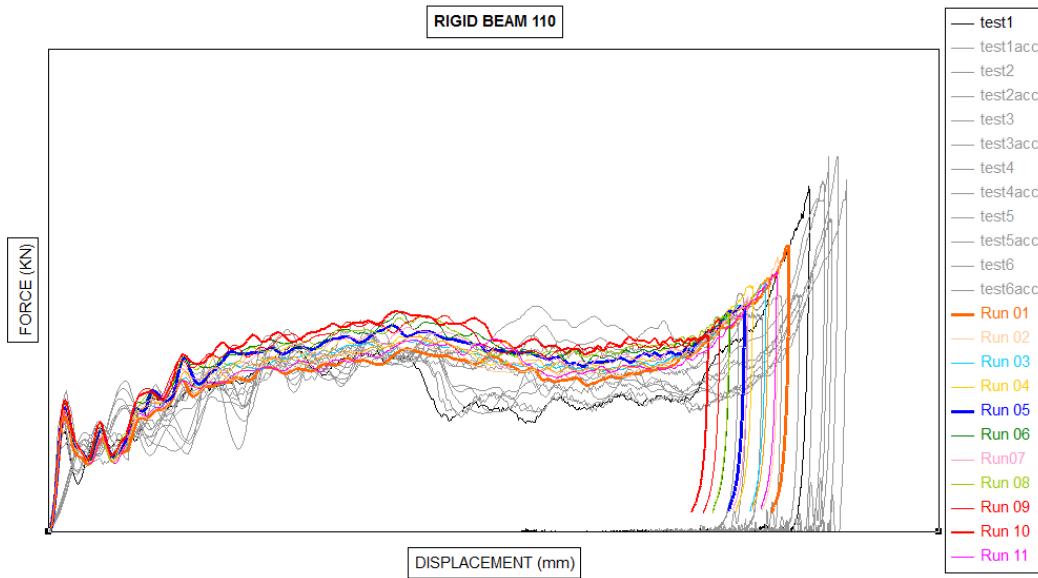
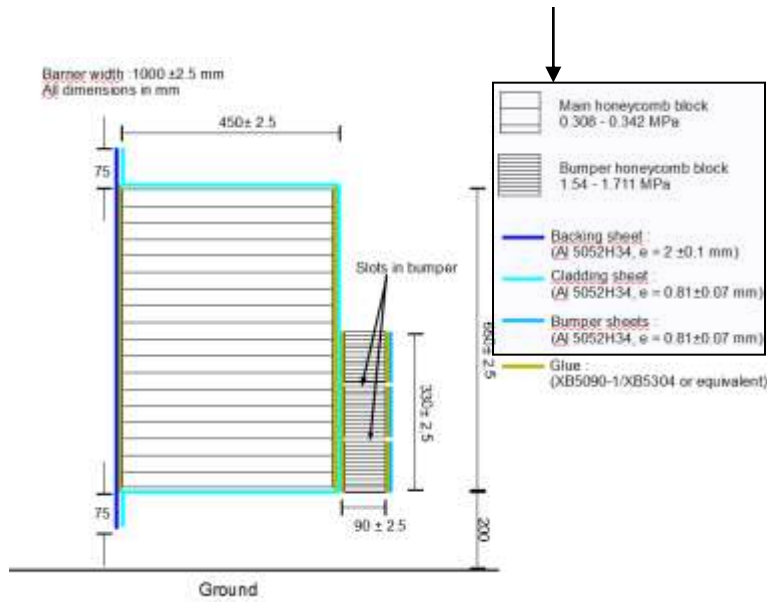


Offset Deformable Barrier : Rigid beam 60 test

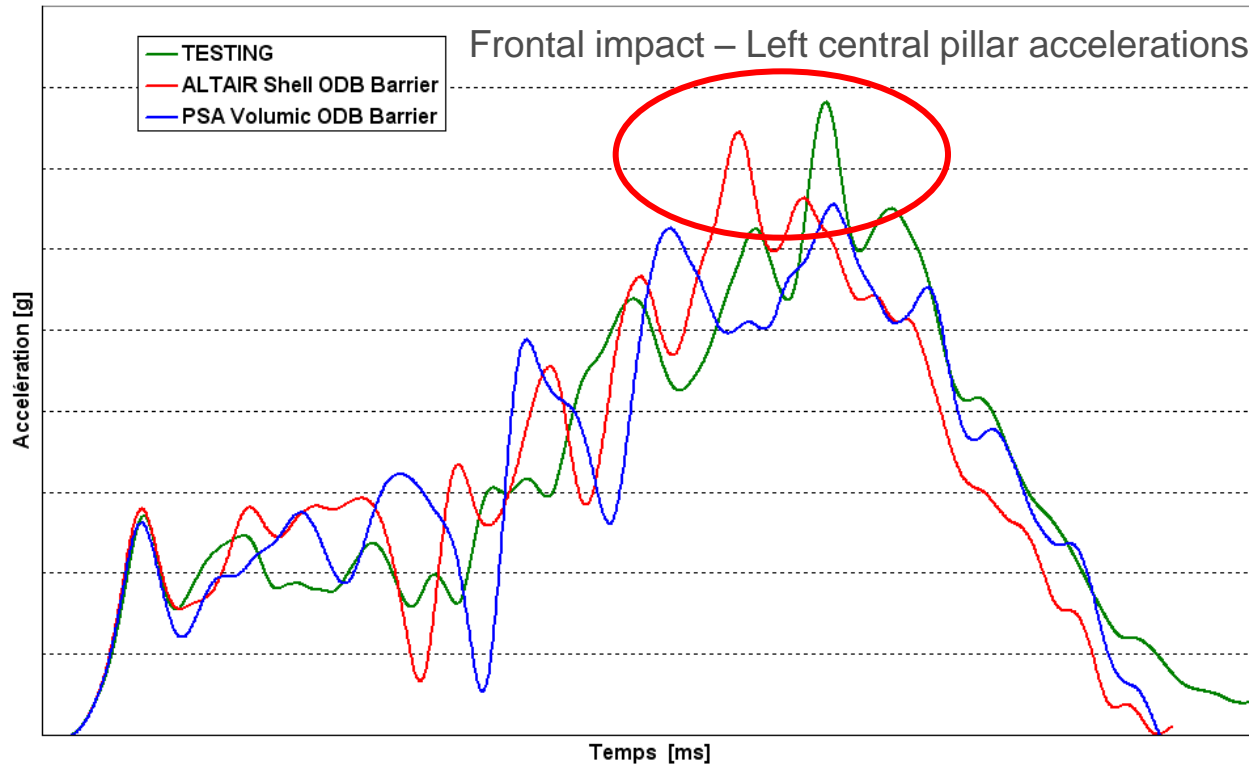


Model sensitivity

Variables used in the DOE



PSA FEEDBACK



Better prediction of the deceleration peak
→ Very important for biomechanical criterion

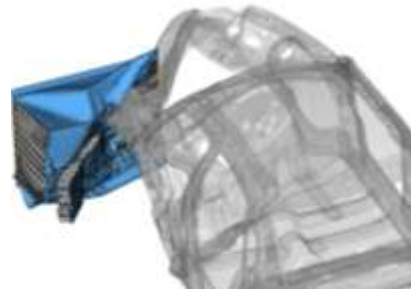
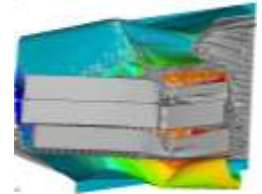
+ Improvement in prediction of Bulkhead intrusions
→ important for biomechanical criterion too

Conclusion & perspective

➤ Conclusion

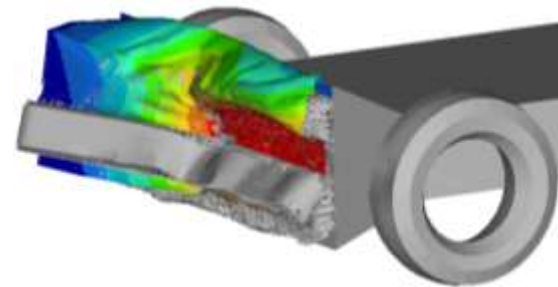
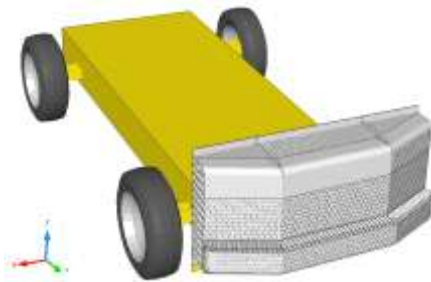
Achievements :

- Realistic barrier behavior under complex loading conditions.
- Better prediction of loading events in full vehicle crash test simulation.
- CPU time acceptable with regard to improvement in loading events prediction.



➤ Perspective

- Spread the technique to other barrier models.



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Thank you!