

Dynamic Evaluation of Vehicle Roof Systems under Crash Scenarios: An approach to early detection of potential concerns.

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Bengaluru, 2022.

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Introduction

SIDE POLE IMPACT : One of the challenging load case to design Roof systems

PROBLEM

- Loss of structural integrity – Separation of structural parts of the panoramic roof system in an event of side pole crash.

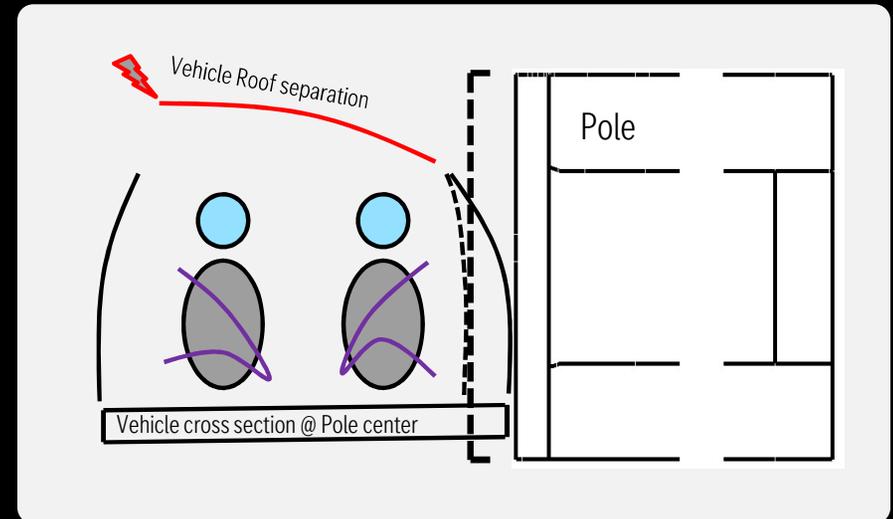
CHALLENGES

- Time : Limited time availability to develop solutions during later phases of vehicle development that might lead to delays.
- Cost : Last minute design changes leading to retooling and incur additional increased cost.

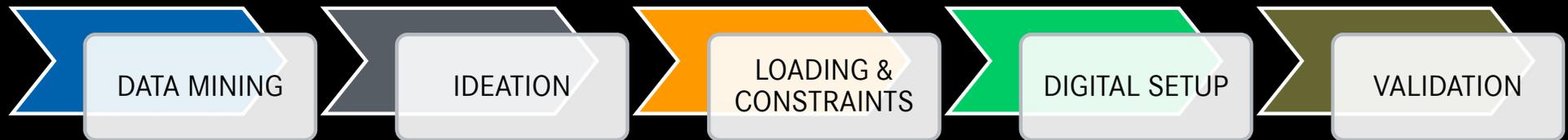
How can we minimize such scenarios in future?



With proposed dynamic sub-system setup focusing on “First time right Hardware”



Methodology



Sampling of existing CAE Roof specific results (forces/energies/deformations)

Concept Setup resembling BiW behavior similar to that in full vehicle

Impactor Energy & mass calibrated equivalent to that experienced by respective full vehicle

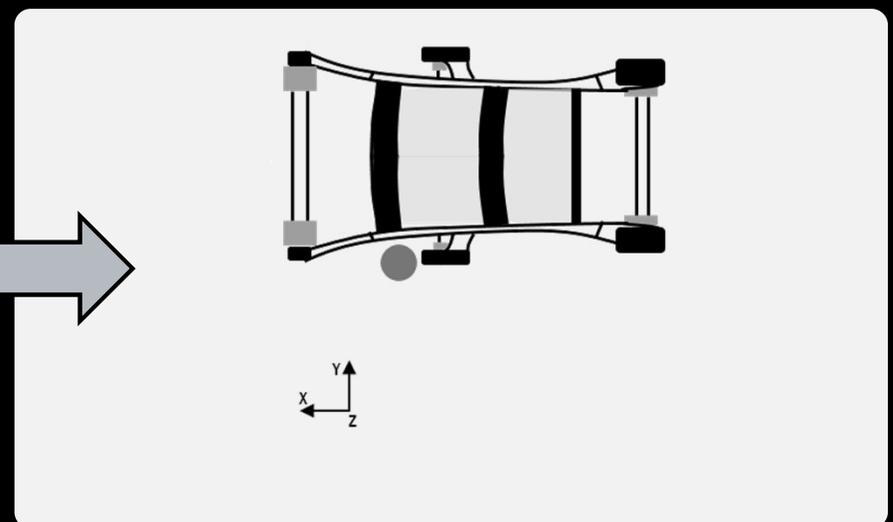
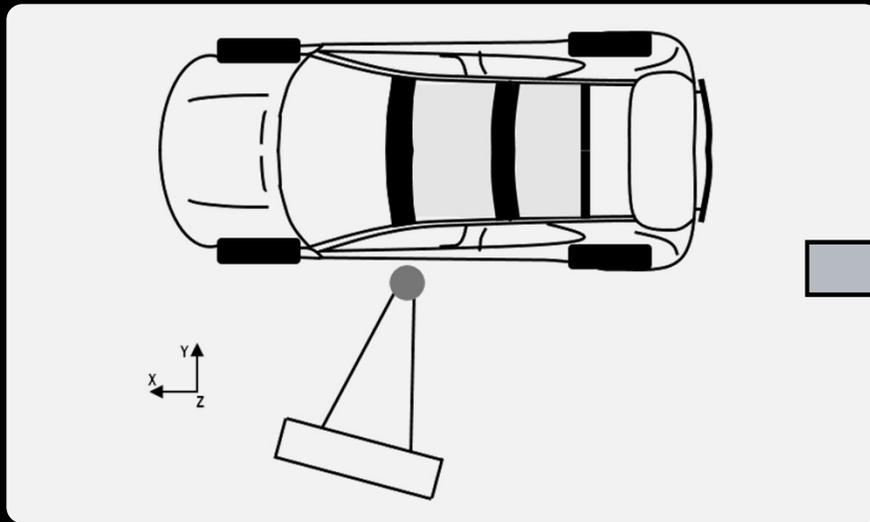
Setup replicating BiW behavior similar to full vehicle

Comparing the measuring parameter's across different carlines for robustness of method

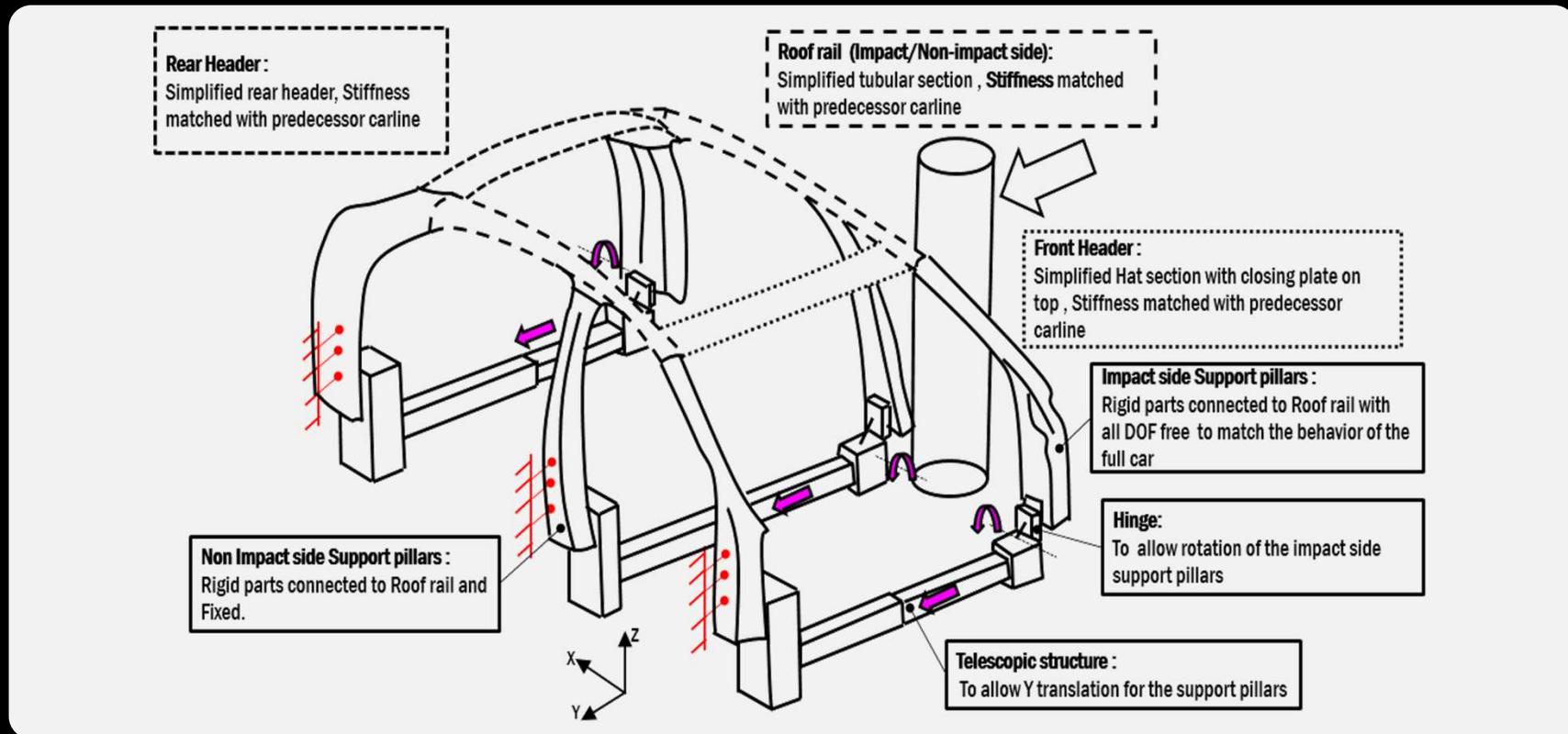
Comparison : Sub-system v/s Full Vehicle

Full vehicle setup

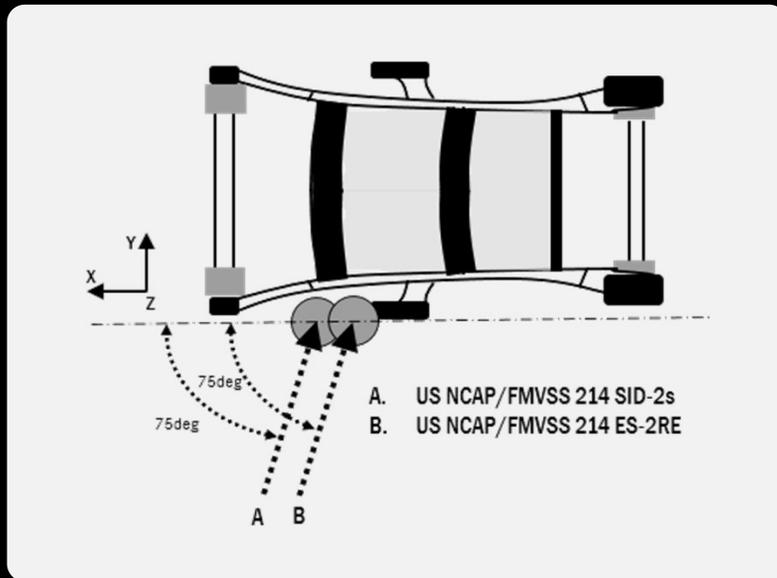
Sub-system setup



Description of Proposed sub-system setup (Digital)



Loading and Constraints

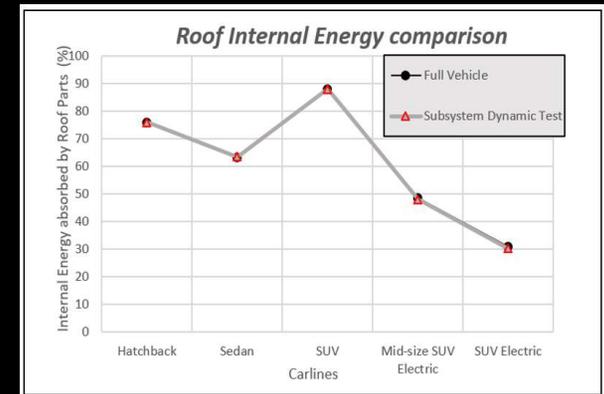
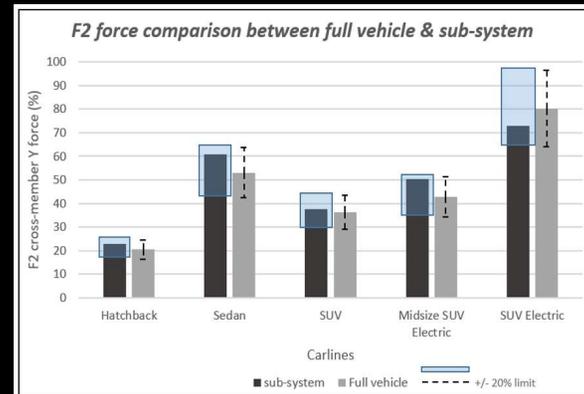
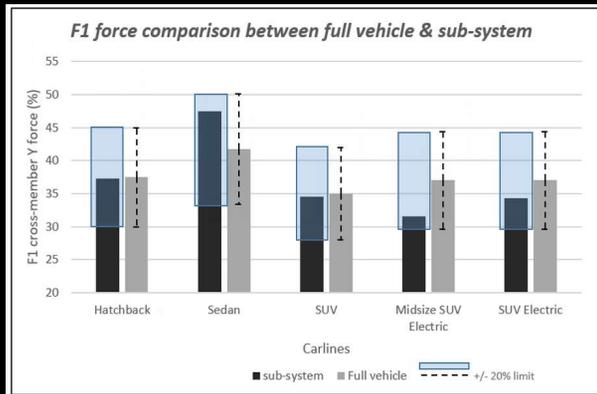
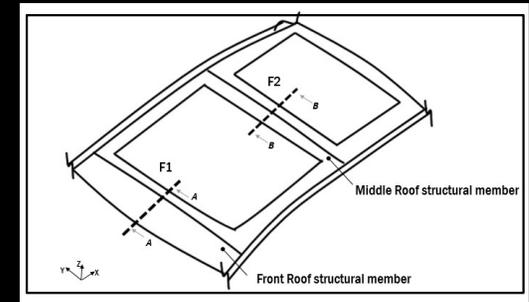


Test	Impact Angle (deg.)	Reference regulation/Rating	X Co-ordinate of the pole center before impact	Mass Moving Pole (kg)	Velocity of the pole (Kmph)
1	75	US NCAP/FMVSS 214 SID-2s	Same as Head Center of positioned 5 th percentile dummy	M	V
2	75	US NCAP/FMVSS 214 ES-2RE	Same as Head Center of positioned 50 th percentile dummy	M	V

Method Robustness

PARAMETERS COMPARED

- Objective:
 - Forces on principal Roof cross members
 - Internal energies absorbed by Roof structure
- Subjective:
 - Overall deformation of the Roof structure



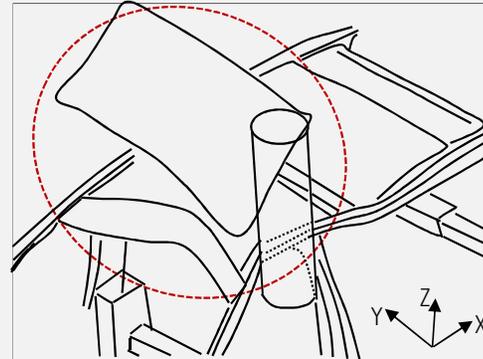
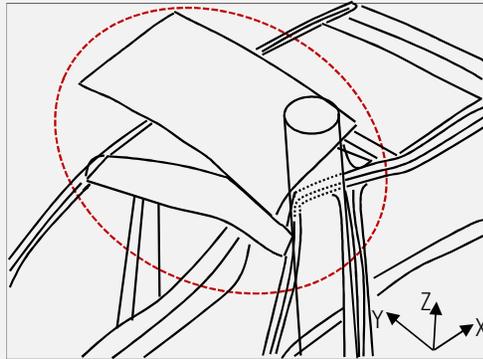
Force and energy show close correlation measured along different carlines which makes it a robust method

Method Robustness

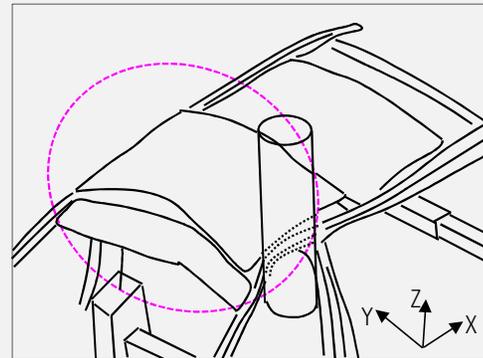
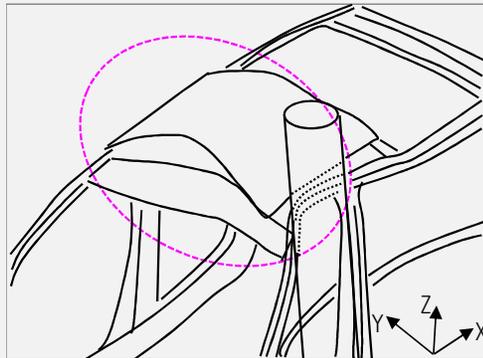
Full vehicle setup

Sub-system setup

SAMPLE (A)



SAMPLE (B)



Proposed dynamic sub-system simulation shows comparable roof deformation to that of full vehicle simulation

Conclusion and Future Scope

- Sub-system evaluation shows comparable energy, forces and deformation mode of the Roof system to that of full vehicle evaluation.
- Proposed Sub-system can be used to evaluate functional performance of the roof system in the early development stages.
- Method needs to be experimentally validated to improve the reliability of this methodology, this is seen as the future scope of the present work.

THANK YOU