Australian Government

Department of Infrastructure and Transport

PSI-02-13

Analysis of Vehicle Structural Deformation in Oblique, Perpendicular, and Offset Perpendicular Pole Side Impact

Thomas Belcher

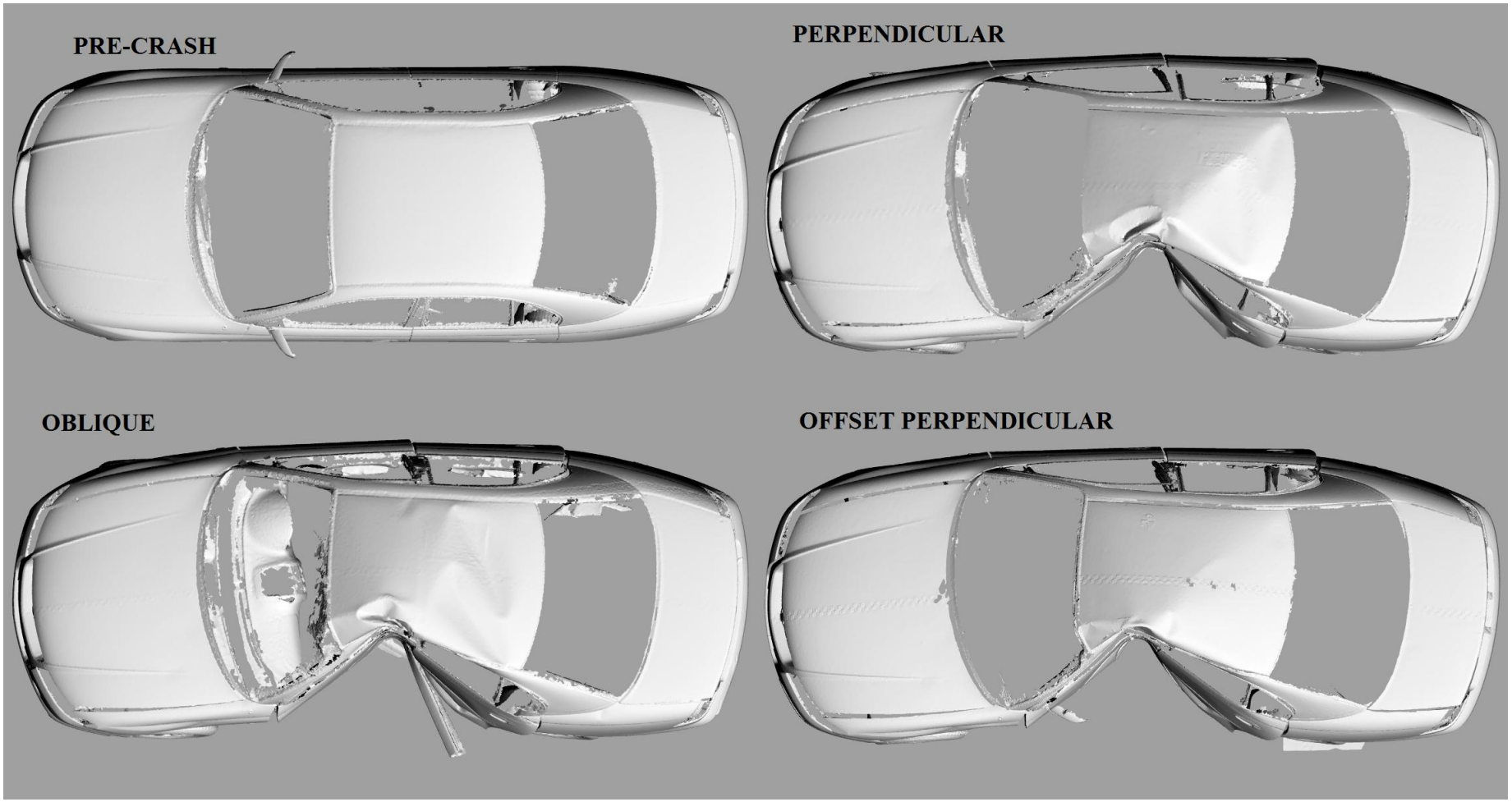
2nd Meeting - GRSP Informal Group on Pole Side Impact

Brussels, Belgium, 3-4 March 2011

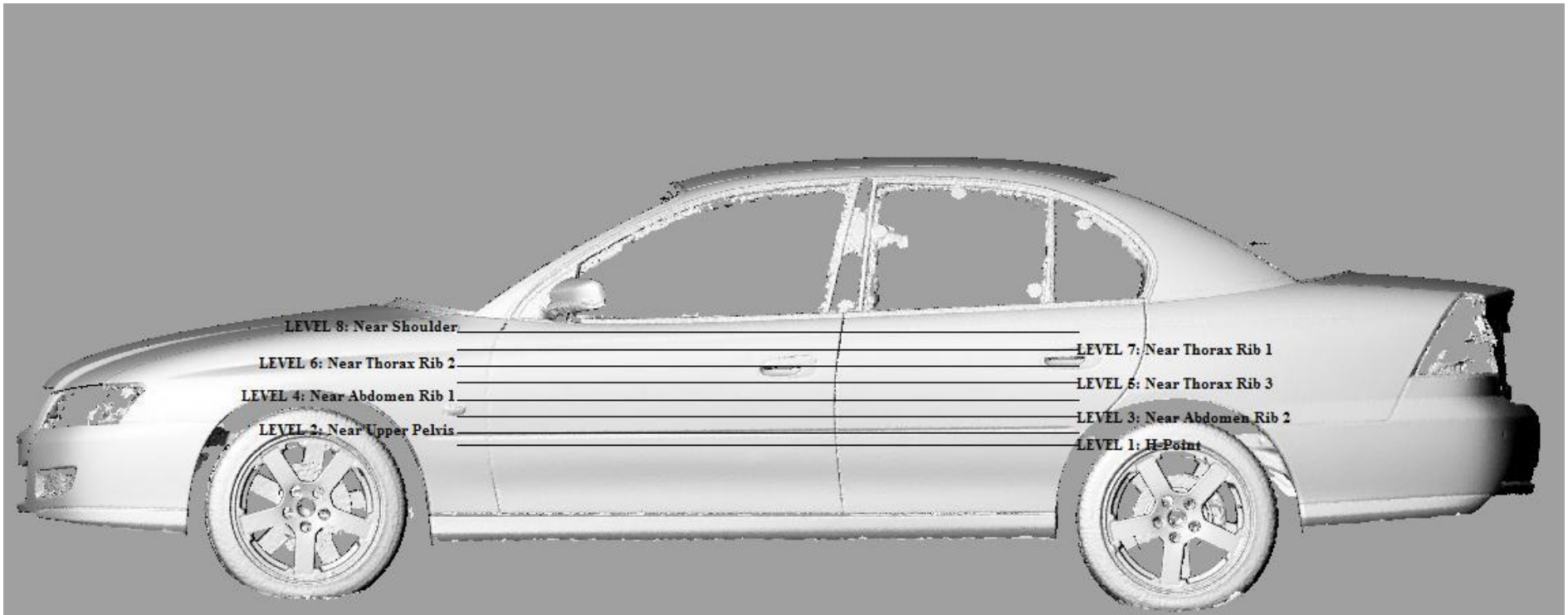
Overview

- Vehicles as tested in the Australian pole side impact research (Vehicle model A, presented at the first PSI IWG meeting in Bonn) were measured in three dimensions. A platinum faro arm with a laser attachment was used to conduct pre and post crash scans.
- The oblique, perpendicular, and offset perpendicular pole side impact test vehicles were all impacted at a target speed of 32 km/h.
- The pre-crash scan was aligned with the vehicle manufacturer's coordinate system.
- Undeformed non-struck side reference points were used to align the 3 (oblique/perpendicular/offset p.) post crash scans to the pre-crash scan.
- Each laser scan was analysed using a CAD software package to determine the pre and post crash struck side surface profile coordinates.
- The surface coordinates were then exported and plotted in Excel.

Scans in Overhead / Plan View

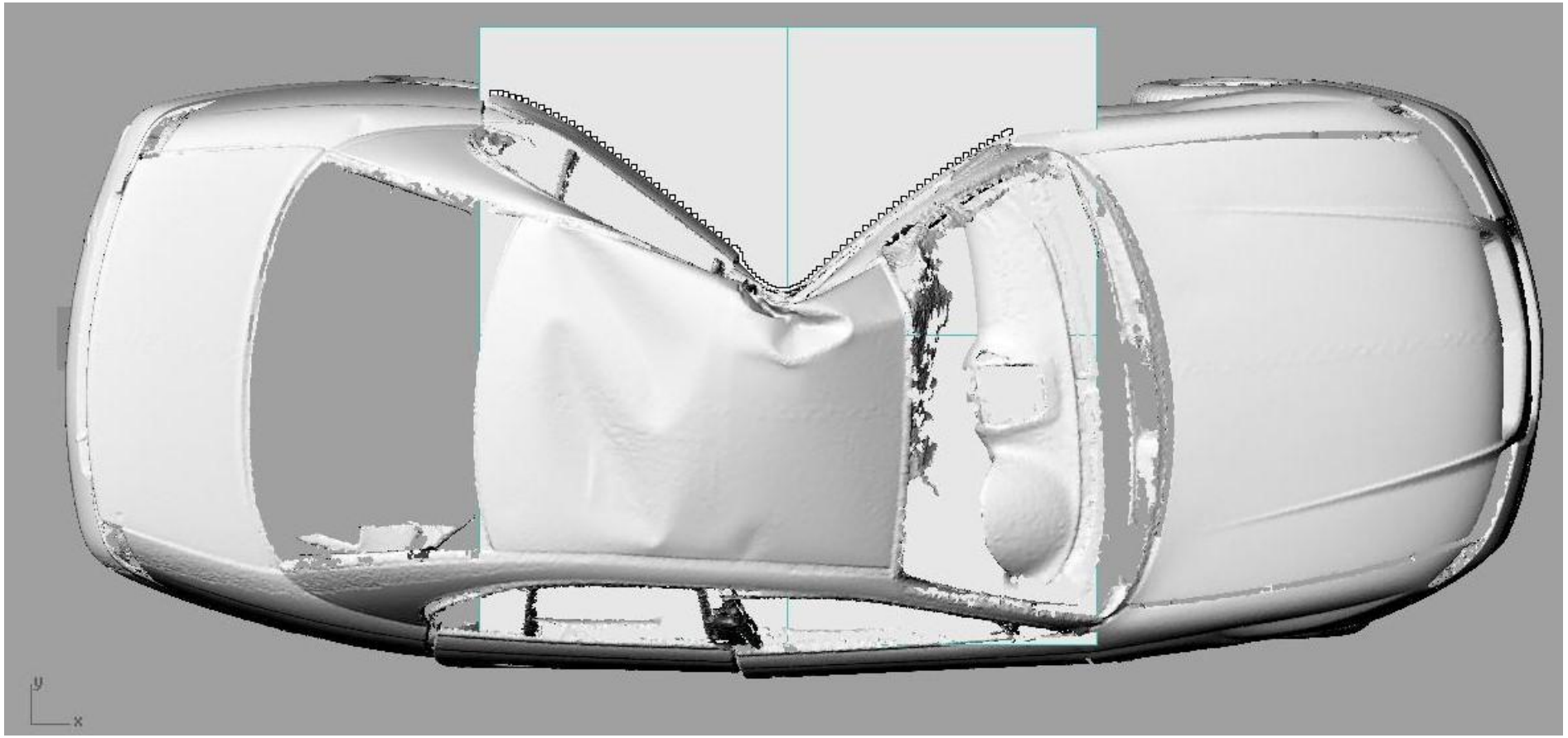


Struck Side Deformation Analysis



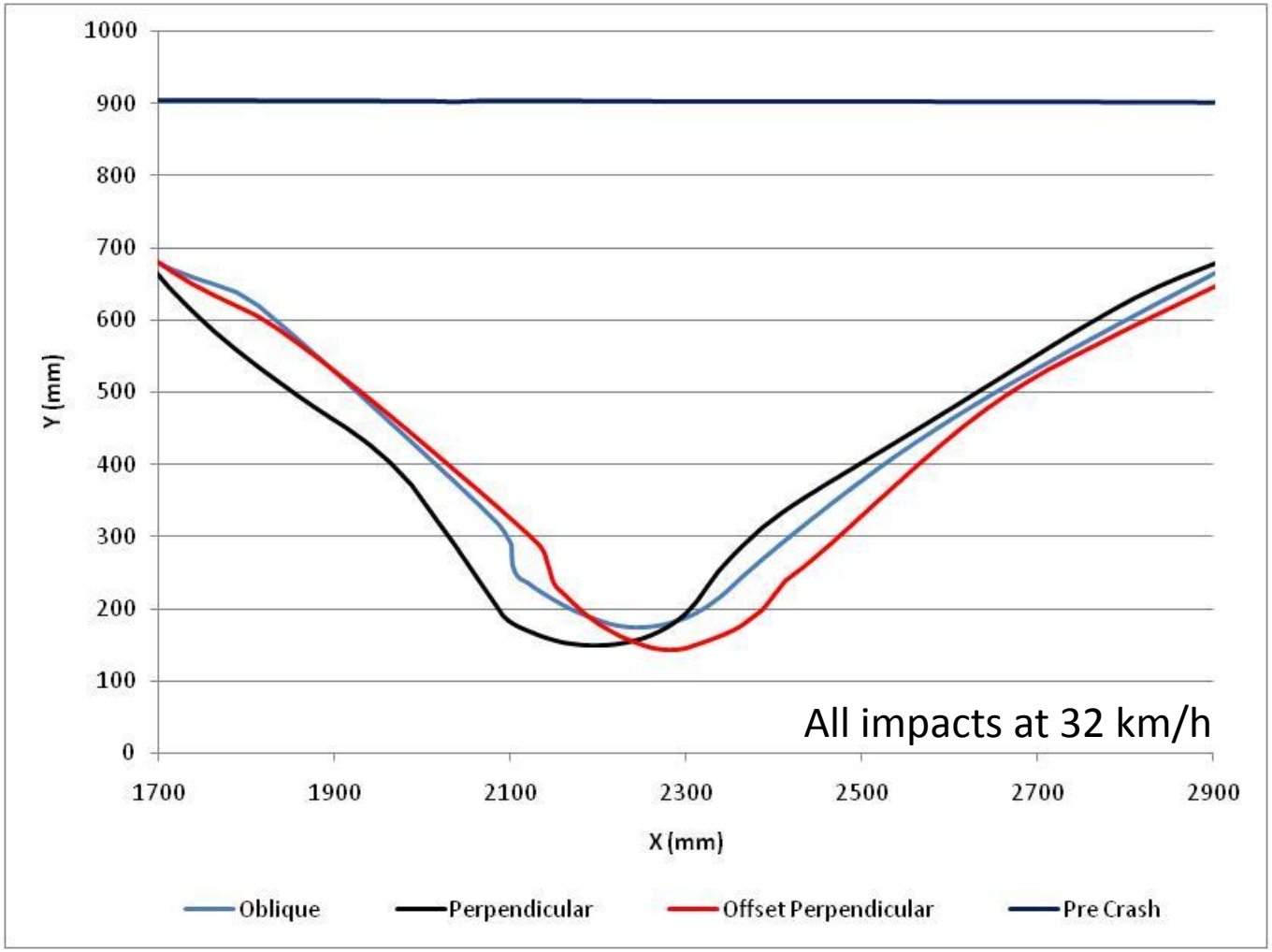
Deformation profile analysed at 8 levels chosen to correspond to the approximate location of the WorldSID 50th dummy shoulder, thorax, abdomen, pelvis and H-point.

Struck Side Deformation Analysis cont'd

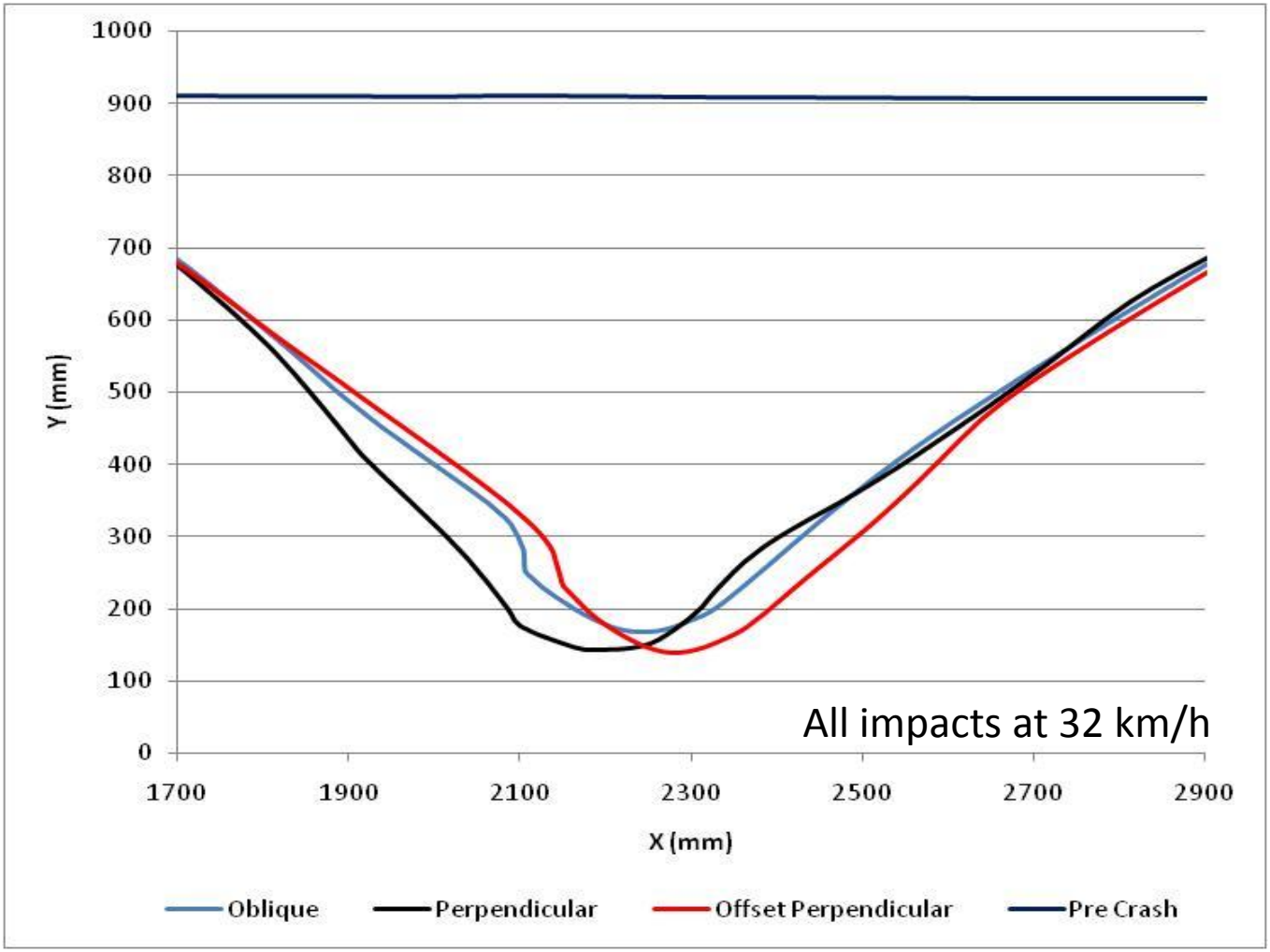


Intersecting points on each plane and surface of vehicle (see above example) used to determine pre and post crash vehicle surface profile coordinates.

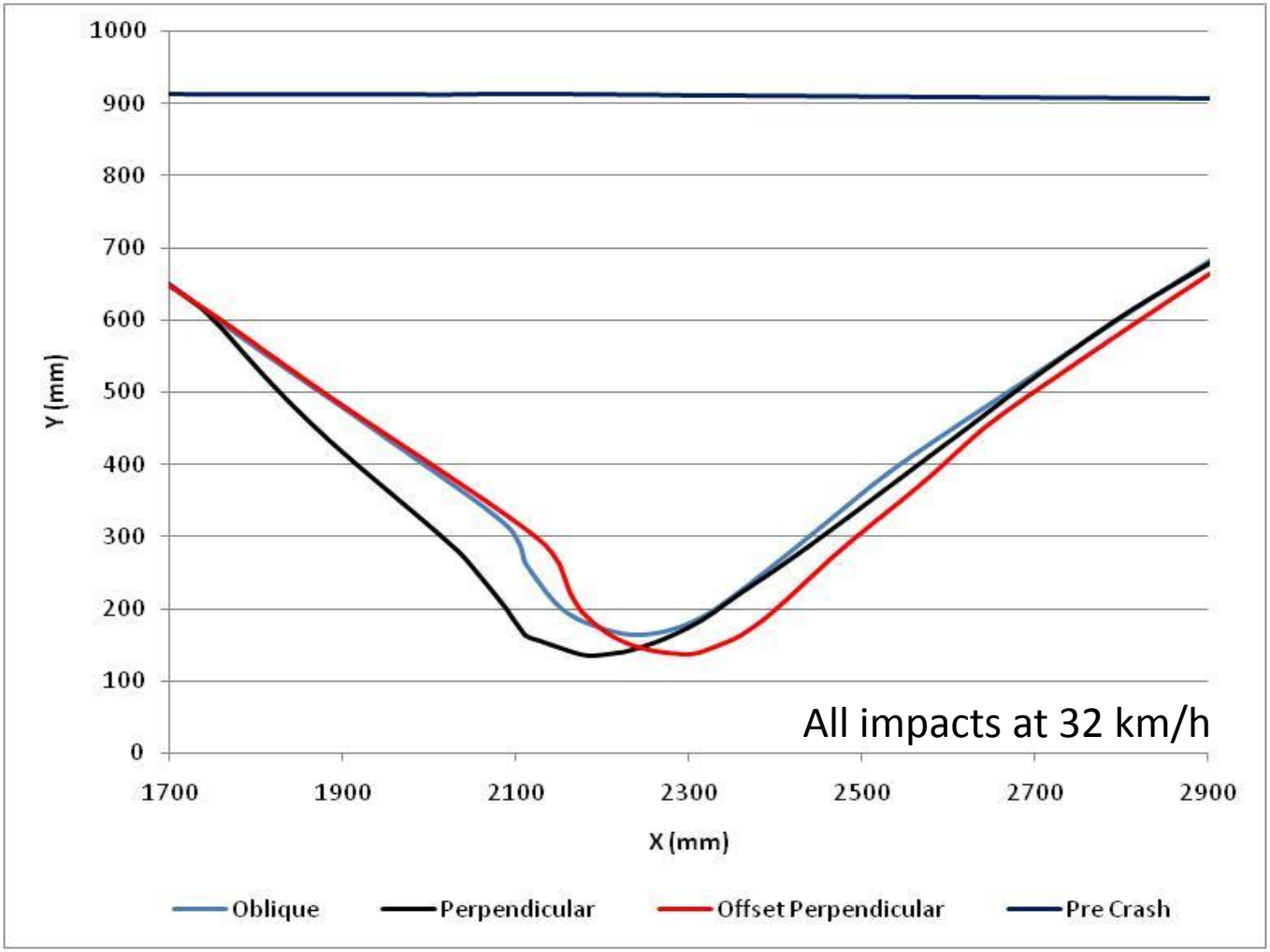
Level 1: At H-Point Height



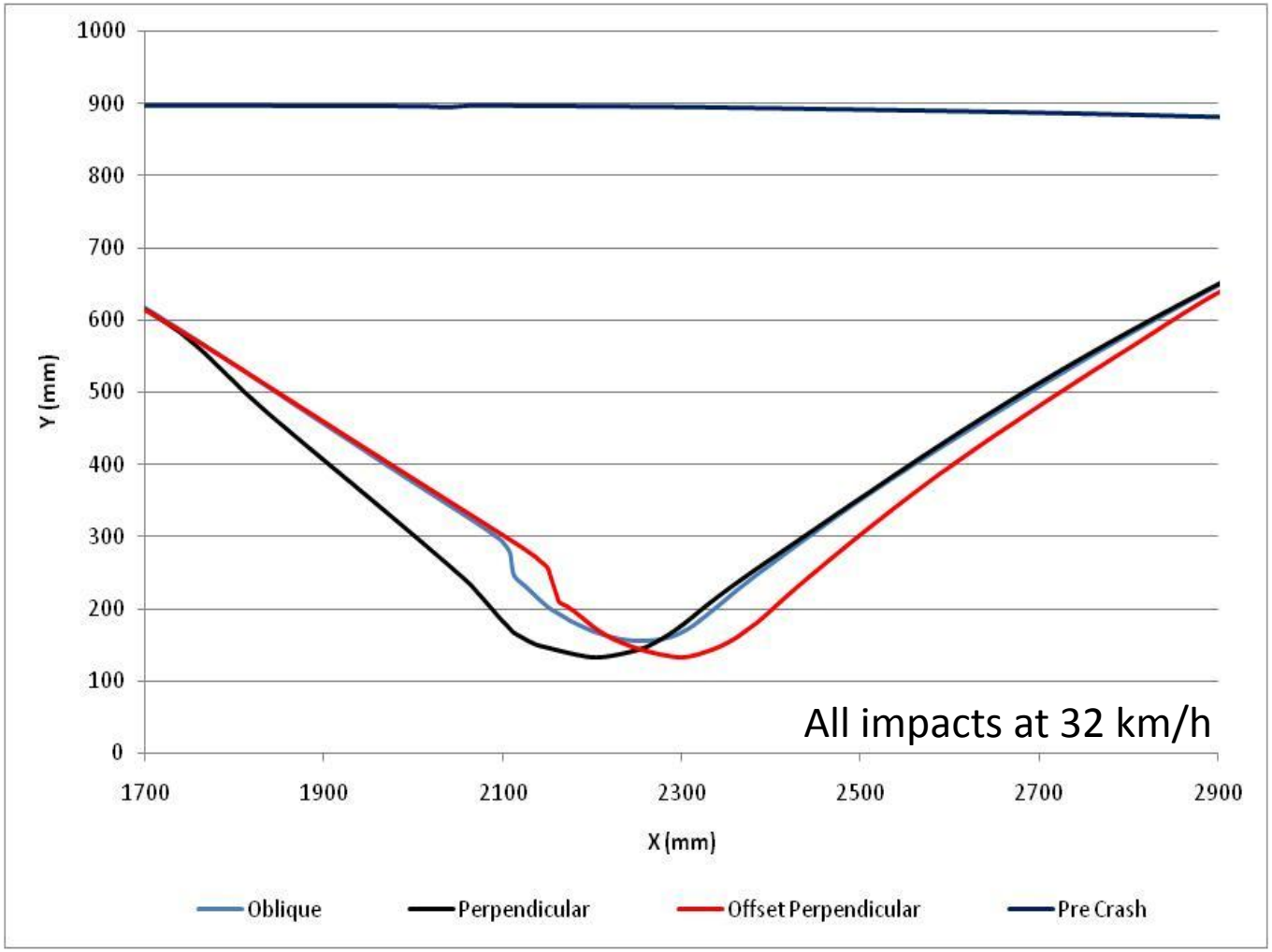
Level 3: Near Lower Abdomen Height



Level 5: Near Lower Thorax Height



Level 7: Near Upper Thorax Height

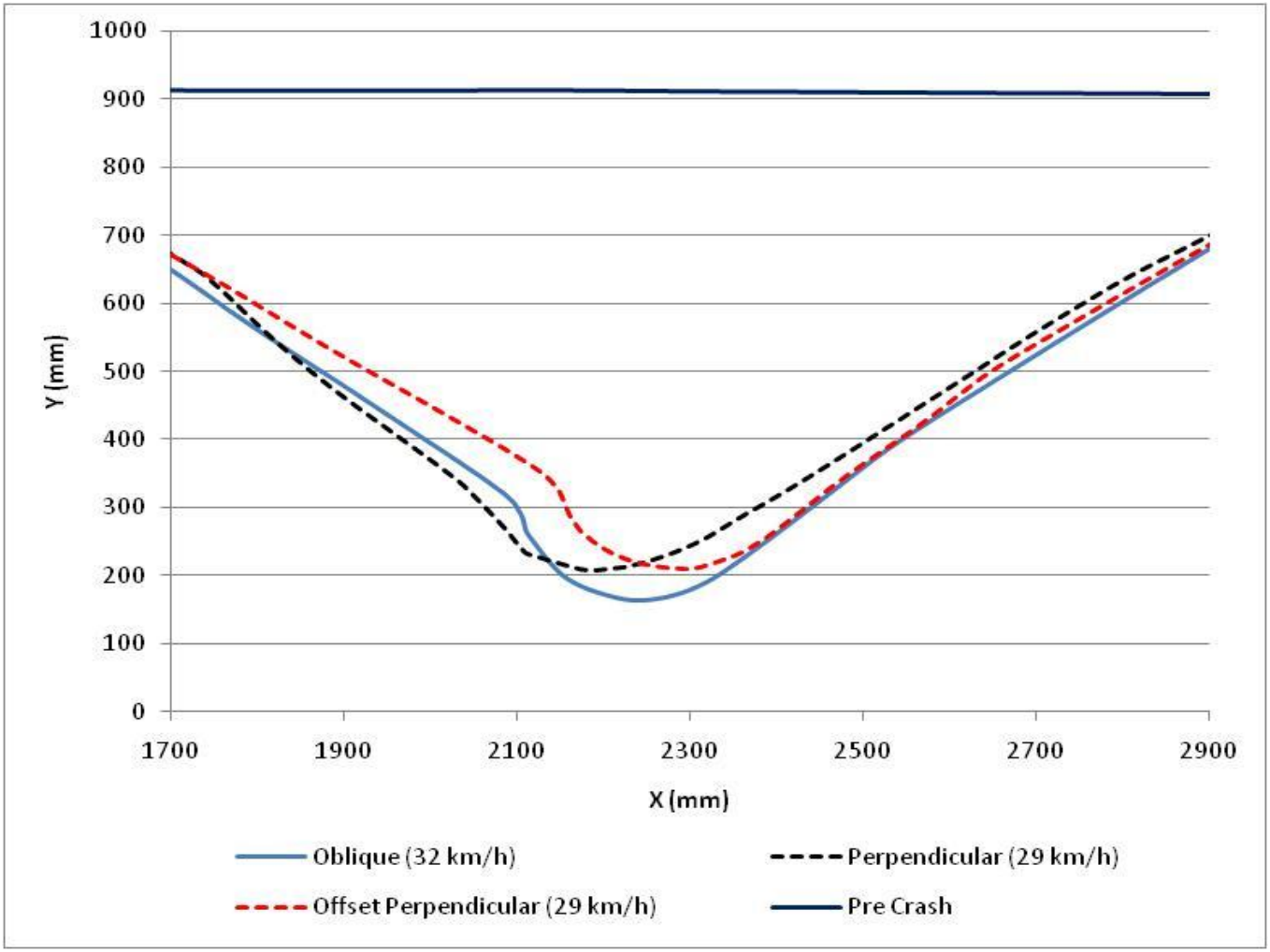


Summary

- Deformation is represented by the difference between each post crash deformation profile and the pre crash surface profile.
- Peak deformations were similar in the perpendicular and offset perpendicular pole tests.
- The peak deformations in the offset perpendicular test were located approximately 100 mm forward of the corresponding peak deformations in the perpendicular test (as expected).
- The oblique test produced marginally less peak deformation than the perpendicular and offset perpendicular tests.
- For this vehicle, the peak deformations (P_D) were approximately proportional to the lateral component (V_Y) of impact velocity:
  - $P_{D\ (PERPENDICULAR)} \approx P_{D\ (OFFSET)}$
  - $P_{D\ (OBLIQUE)} \approx (V_{Y\ (OBLIQUE)} / V_{Y\ (OFFSET)}).(P_{D\ (OFFSET)}) \approx (32\sin(75)/32).\ (P_{D\ (OFFSET)})$

Level 5: Near Lower Thorax Height

Oblique Impact Profile vs. Theoretical Deformation Profiles for 29 km/h Impacts



Conclusions

- A 32 km/h oblique pole test should be expected to be structurally more severe than a 29 km/h perpendicular pole test.
- The oblique deformation profiles were very similar in general shape to the perpendicular and offset perpendicular deformation profiles.
- The differences in deformation were relatively small (less than 50 mm for deformations of the order of 750 mm).
- It would therefore be very difficult to differentiate the oblique angle impact from the perpendicular and offset perpendicular impacts (i.e. structurally they may all appear to be 90° impacts).

Conclusions cont'd

- To differentiate 75 degree oblique and perpendicular pole side impacts, other evidence from the crash scene would be needed, but in each case this would be approximate, and the oblique impact could also be captured by a 3 or 9 o'clock ± 15°definition of perpendicular impact.

Thank you