

Accident Narrative

At about 4:00 PM, on 3 July 2013, 7 peoples were returning back from Wat Nangnaithamigaram, Angthong to Doilan, Ayutthaya, in a pick up after attending their one of the relative's funeral. At about 4:17 PM, while travelling on a 4 lane Highway no. 329, between km 14+000 and km 15+000, the pickup (V1) hit a 24 wheeled trailer truck (V2) with its front at U-turn when the truck was trying to make a right turn towards its company gate. Based on the evidences found in the crash scene, the pickup was running over a painted median and when the driver saw a truck in front of it making a right turn, the pickup tried to maneuver left avoiding a truck but couldn't success and finally got collided with a truck. After the collision, the pickup moved few meters and stop on the roadway as shown in figure 2.

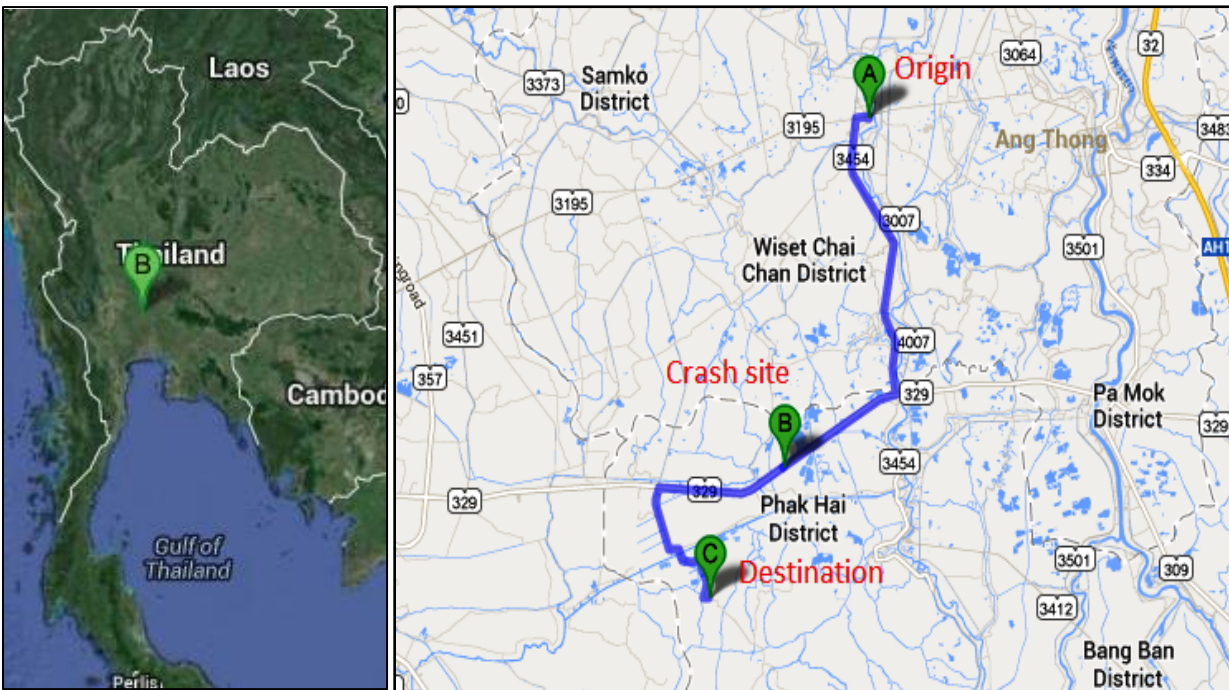


Figure 1 Map showing the location of crash site, where point A represents Wat Nangnaithamigaram, Angthong, point B represents Chakkarat, Ayutthaya and point C represents Doilan, Ayutthaya

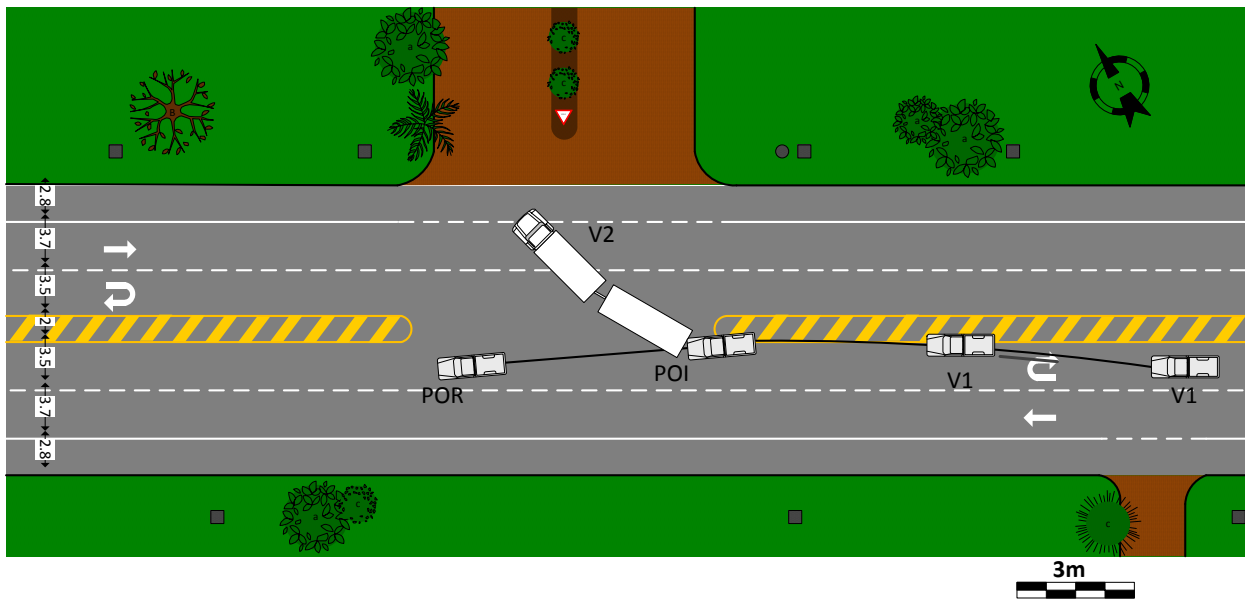


Figure 2 Schematic of Accident Scene

Vehicle Information

Pickup (V1)

The pickup was an ISUZU D-Max HI-lander, 2999 cc diesel engine, rear wheel drive, Automatic transmission with ABS equipped. The pickup was bought 2 month ago and registered in Suphanburi with the registration number 5083. It was bronze in color and the loading bed was not covered. The seat for the driver and front passenger were equipped with lap shoulder seat belts, while on the extended cab, no seat belts were installed. The dimensions of the pickup are presented in Table 1.

Table 1 Pickup Dimensions and Weight

Items	Dimension or weight
Length	5.190 m
Width	1.860 m
Height	1.780 m
Wheelbase	3.095 m
Weight	1,580 kg

All the tires of the pickup were Bridgestone Dueler H/T 255/65 R 17, manufactured in 5th week of 2013. While inspecting the pickup, the front-left tire was found to be damaged due to the crash. Table 2 shows the details of the tires taken after the crash.

Table 2 Tires Detail of V1

Location	Damage	Manufacture	Tire Name	Year	Size	Load Index & Speed Symbol	Pressure (psi)
1L	No	Bridgestone	Dueller H/T	5-2013	255/65 R 17	Max 1060 kg	52
1R	Yes	Bridgestone	Dueller H/T	5-2013	255/65 R 17	Max 1060 kg	N/A
2L	No	Bridgestone	Dueller H/T	5-2013	255/65 R 17	Max 1060 kg	50
2R	No	Bridgestone	Dueller H/T	5-2013	255/65 R 17	Max 1060 kg	50

Trailer-Truck (V2)

The trailer- truck involved in this crash was HINO 500 FM2P-NGV, 24 wheeled, 10520 cc, 6-cylinder diesel engine, white in color. A trailer had 3 axles, 12 wheels with the dimensions 7.05x2.4x3.0 m and had a registration number 70-6519 Ayutthaya. Similarly, truck had 4 axles, 12 wheels with the dimensions 8.37x2.4x3.0 m and had a separate registration number 70-6517. The vehicles tires brand and size were quit varied. Table 3 shows the details of the tires of trailer and trucks separately.



Figure 3 Dimension of Trailer-Truck

Table 3 Tires Detail of V2

	Location	Manufacture	Tire Name	Year	Size	Load Index & Speed Symbol	Pressure (psi)
Truck	1L	Maxxis	UM 288	4912	11R22.5	Max :3150kg Min :2900kg	N/A
	1R						
	2L	Siamtyre	Highway Special	N/A	10.0-20	Max :3000kg Min :2650kg	N/A
	2R						
	3L	Maxxis	UM 968	0313	11R22.5	Max :3150kg Min :2900kg	N/A
	3R						
	4L						
4R							
Trailer	1L	Siamtyre	Highway Special	0413	10.0-20	Max :3000kg Min :2650kg	N/A
	1R						
	2L	Maxxis	UM 968	2213	11R22.5	Max :3150kg Min :2900kg	N/A
	2R						
	3L						
	3R						

Vehicle Damages

The pickup had a massive damage on its front part as shown in figure 4. The hood was panned up and the pillars that support the roof was deflected from its original position. Similarly, the roof was also protruded at the middle and the front bumper was damaged entirely. As we can see from the figure 4, front-right tire swayed outside while the left tire swayed inside and the pickup body was found to be deflected downward it the middle. The rear window was broken totally and was intruded inside the compartment (Figure 7). Overall, we can say that the front-right part of the pickup was damaged heavily than left part (Figure 5) and the supporting pillars were intruded inside the passenger compartment especially on the driver's side (Figure 6). Figure 8 shows the deformed structure of the pickup from its original structure with high deformation at front right side (0.79 and 0.50 m). TRAC evaluated the Collision Deformation Code (CDC) for V1 as 12FDOAW6.

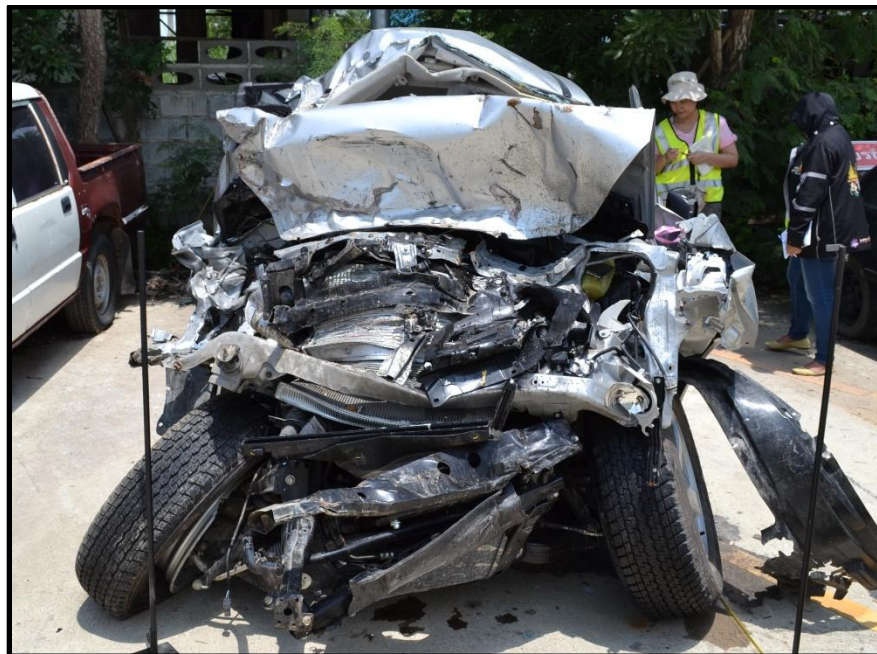


Figure 4 Damage of Pickup (Front Side)



Figure 5 Damage of Pickup (Left Side)

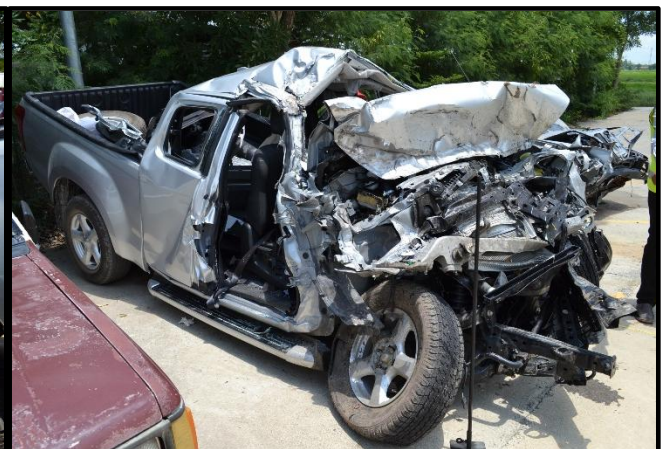


Figure 6 Damages of Pickup (Right Side)



Figure 7 Damages of Pickup (Rear Side)

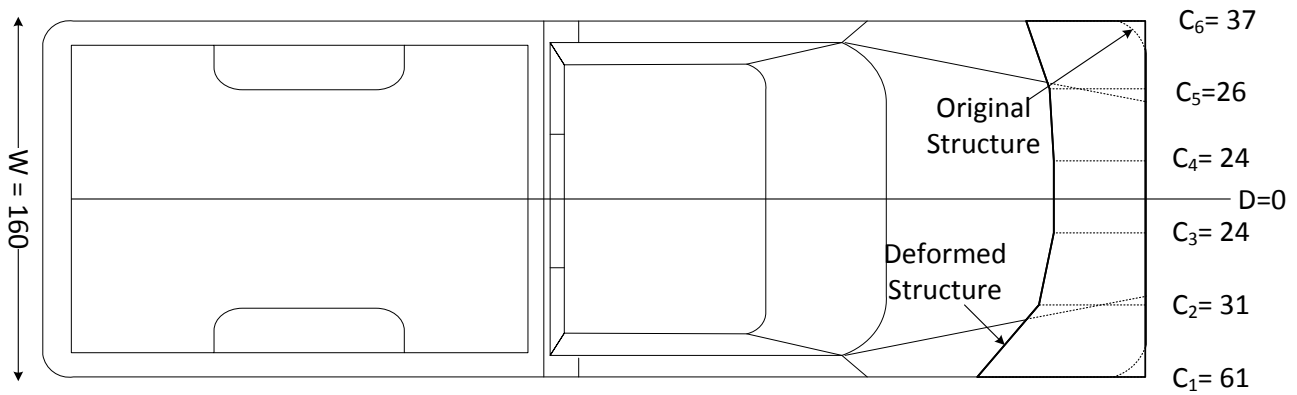


Figure 8 Crush Deformation of Pickup

Figure 9 shows that V2 has only minor damage at the rear right comparing to V1. The rear steel bumper was bent and the tail light was broken. Similarly, figure 10 shows crush deformation of the truck where the maximum deformation is on back-left side.



Figure 9 Damages of Trailer-truck

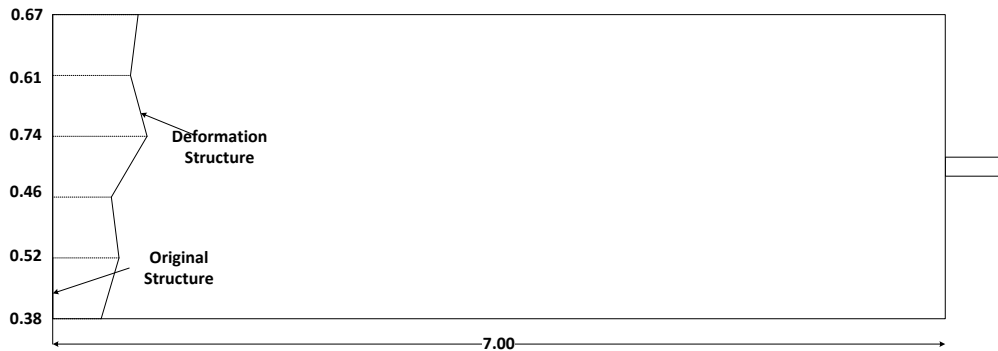


Figure 10 Crush Deformation of Trailer

Highway Information

The accident occurred on the west approach of Highway no. 329, at $14^{\circ}28'20.96''$ N, $100^{\circ}19'7.77''$ East. It is a rural highway connecting Saraburi to Suphanburi and has a total length of about 93 km. It starts at Mueang Suphan buri district and runs through Angthong province and ends in Nong Khae district of Saraburi. The highway has 4 lanes undivided, painted median strips and the pavement surface type is asphalt concrete. The width of each lane is 3.6 m, with 2 m painted median and 2.8 m shoulder width as seen in figure 2.

Physical Evidence

One of the most important evidence for guiding TARC team to investigate was 25 m long straight skid mark of the left wheel on the U-turn sign (figure 11), about 1m near to the median, which clearly shows that the right wheel of the pickup was running over the median. This evidence was supported by the CCTV footage. After the close examination of the footage it was found that the pickup might have overtaken another vehicle from the median and was unaware of the turning truck ahead, making a crash (figure 11).



Figure 11 Sequence of Crash (1 to 5) according to CCTV Footage and Skid Marks on the Road Surface.

Driver Information

Pickup (V1)

The driver, 52 years old male was not a pickup's owner. According to the information from his relatives, he drove the pickup because the pickup's owner was drunk. On that day, he started his trip from Wat Nangnaithamigaram, Angthong and was returning back to Doilan, Ayutthaya after attending the funeral. According to police, the alcohol content in his blood was found to be 10 mg % which is quite that alcohol impairment was not significant enough for the accident.

Truck (V2)

Truck driver is 36 years old male from Kalasin and was working in Siam City Cement Public Co. Ltd. According to his interview, he was unaware of the pickup coming closely to the rear of the truck, while he was making the right turn towards the company gate.

Injury Information

There were 7 occupants on board at the time of the crash. 4 occupants were sitting in the loading bed while 3 were sitting inside the occupant's compartment including the driver (Figure 12, 13). 5 out of 7 occupants died at scene inside the wrecked pickup, while one occupant died on the way to hospital, and remaining one occupant was severely injured. The details of the injury information are shown in table 4.

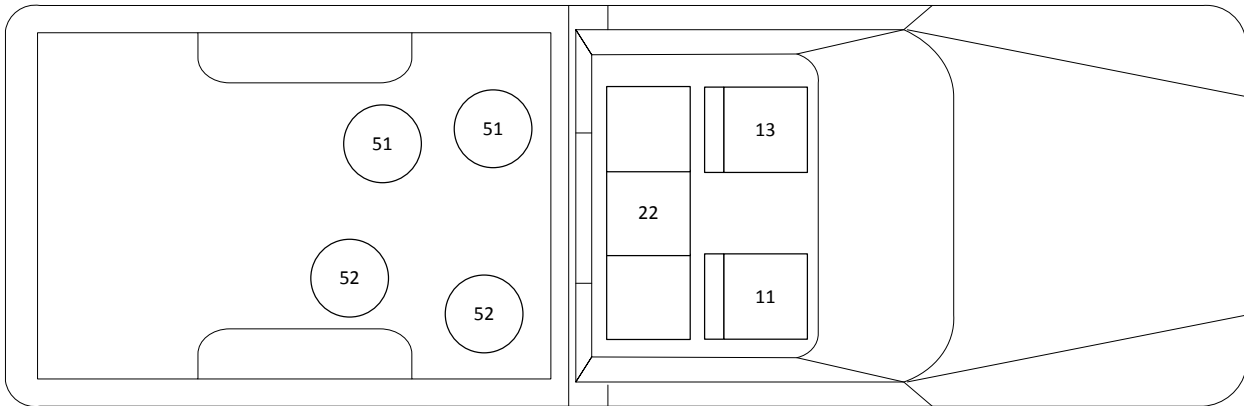


Figure 12 Occupant's Seating Position

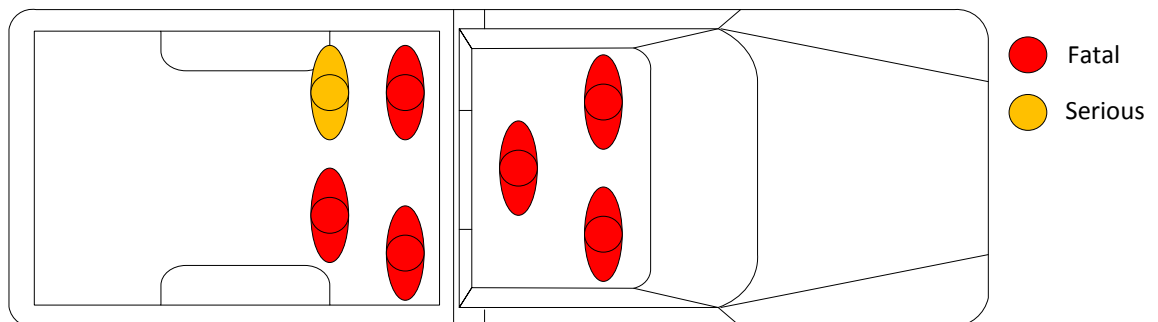


Figure 13 Level of Injuries

The evidences inside the crashed vehicle shows that the driver was using seat belt (figure 15) while the front passenger did not use the seat belt and rest of the passenger were sitting in the position where the seat belts were not installed. The interior damage at the front showed blood stains on the driver hand-hold fitted on the roof near the door (figure 14). Both the airbags were activated and were exploded as well (figure 15).

Table 4 Summary of Occupant's Injuries in V1

Person	Gender	Age	Level of Injury	Seating Position	Seat belt	Injury
1(Driver)	Male	52	Fatal	11	Used	Severe brain concussion, broken neck, right limb and left arm twisted, Fracture of patella.
2	Male	42	Fatal	13	Not installed	Severe brain concussion Bleeding from right ear and nose
2	Female	52	Fatal	22	Not Used	Lacerated wound at right side of head Traumatic tear (deep down to brain) Right fore-arm, right upper limb twisted Lower limb twisted both sides
4	Female	56	Fatal	52	Not installed	Severe Brain concussion but no bleeding
5	Female	48	Fatal	51	Not installed	Fracture of skull Lacerated wound at fore head deep down to skull Abrasion at back Left arm twisted
6	Female	52	Fatal	51	Not installed	Broken ribs and groin, severed bleeding
7	female	48	Serious	52	Not installed	Traumatic tear Injuries to liver



Figure 14 Blood Stains at the Handle

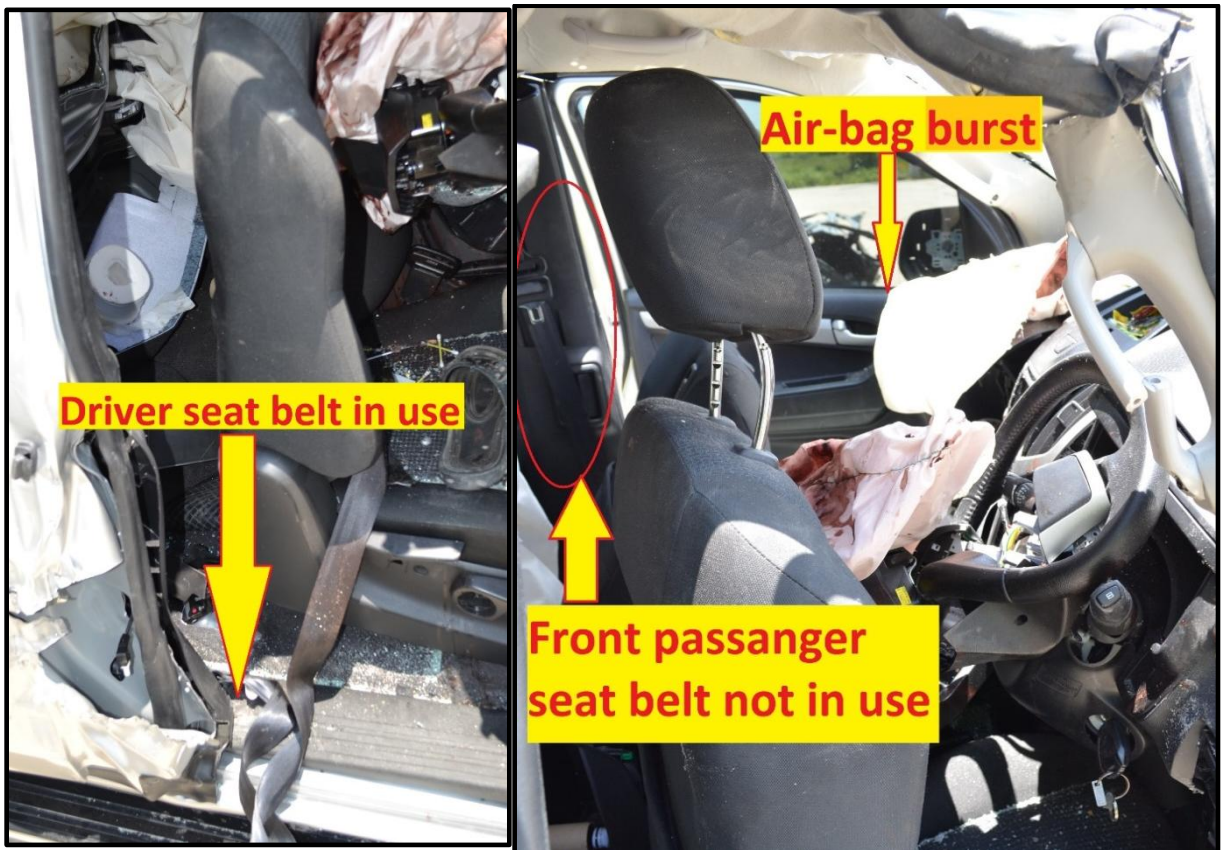


Figure 15 Seat Belts and Airbags Information

Accident Contributing Factors

Speed

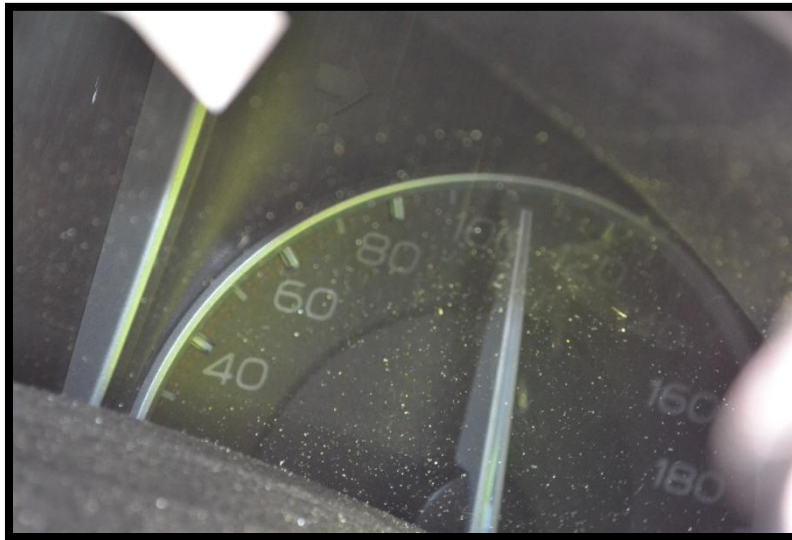


Figure 16 Reading of Speedometer Gauge during Impact

The speed limit of highway no. 329 is 90 km/h. However, from figure 16, we can see that the speedometer is showing the speed around 105 km/h during the impact and the speed is expected to be higher before braking. TARC performed the crash speed analysis to determine the pickup speed during the impact and before braking. Following steps are followed to carry out the crash speed and pre-crash speed.

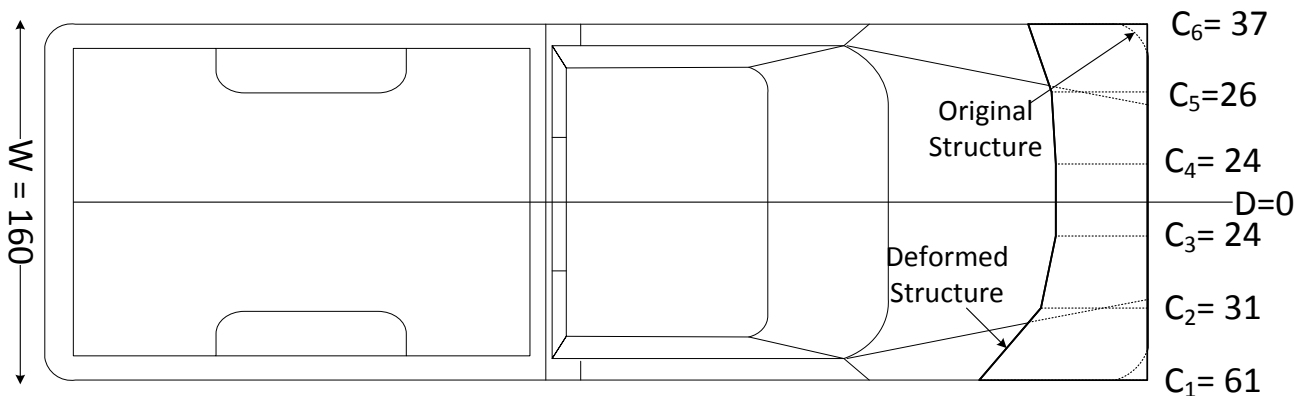


Figure 17 Dimension of Deformed Structure of the Pick up

Impact Angle, $\theta = 5.00^\circ$
 Gross vehicle weight = 1,580 kg
 Gross passenger weight = 428 kg
 Actual weight, $w = 2,008.00$ kg

Stiffness Coefficient of ISUZU (Frontal Impact)

$A = 465.64$ N/cm (266.08 lb/in)

$B = 75.05$ N/cm² (108.92 lb/in²)

$$G = \frac{A^2}{2B} = 1,444.59 \text{ N}$$

$$E = \left(\frac{W}{5}\right) \left\{ 5G + \frac{A}{2} (C_1 + 2C_2 + 2C_3 + 2C_4 + 2C_5 + C_6) + \left(\frac{B}{6}\right) (C_1^2 + 2C_2^2 + 2C_3^2 + 2C_4^2 + 2C_5^2 + C_6^2 + C_1C_2 + C_2C_3 + C_3C_4 + C_4C_5 + C_5C_6) \right\} (1 + \tan^2\theta)$$

$$E = 8,715,592.03 \text{ N-cm}$$

$$E_{\text{actual}} = E(1 + \tan^2\theta) \\ = 9,192,064.59 \text{ N-cm (91,920.65 N-m)}$$

$$V_{\text{impact}} = \sqrt{\frac{2gE_{\text{actual}}}{w}} \\ = 29.95 \text{ m/s} = \mathbf{107.83 \text{ km/h}} \approx 105.0 \text{ km/h (Speedometer reading)}$$

$$V_{\text{prebrake}} = \sqrt{v^2 - 2fgd} \quad \text{as} \quad f = -0.4; d = 24.6\text{m} \\ V_{\text{prebrake}} = 33.02 \text{ m/s} = \mathbf{118.86 \text{ km/h}}$$

From the calculation the speed during impact was found to be 107.83 km/h which is nearly equals to the speedometer speed, while the speed before braking was 118.86 km/hr. It means the speed of the pickup was more than the speed limit, which became one of the important factor for the accident.

Road Geometry and Environment

The roadways with raised or depressed medians has the lowest crash rates as they separate the traffic travelling in opposite direction and limit the left turn movements. At the crash site, the road has 4 lane, two way traffic separated by painted median strips only which increases a risk of illegal overtaking and right turning. Also, at U-turn section, the unavailability of transitional area or a bay doesn't reduces the speed differential between turning vehicles and through traffic and maximizes the chances of rear end collision.

Injury Contributing Factor

Seat belts and Seating Position

Seat belt can protect the occupants by limiting the distance in the forward movement and acts as a passive device in frontal collision. However, In this case the front right side of the pickup was heavily damaged, deforming the supporting structures and making an impacts between body regions and the crushed interior parts of compartment (Figure 15). Both seat belts and air bag couldn't do much to reduce the level of injury of the driver. Similarly, one front passenger was not using the seat belt and one passenger was sitting in the extended cab where the seat belts was not installed. Occupants not restrained by the seat belts has high chances to get killed due to frontal collision. Also, the occupants sitting in the pickup bed have high a risk of ejecting or intruding inside the compartment through the rear window. In this case, four occupations sitting in the bed of pickup were intruded inside the compartment, killing 3 of them due to the sudden impact.

Significant Factors

TARC determined that the probable cause of the 130705-01 crash occurrence was due to high speeding of the pickup followed running over the medians as supported by the mentioned evidences. The crash consequences were increased by the lack of raised median and transitional area or bay for the turning vehicles at U-turn section. Similarly, TARC also determined the probable cause of injury of the same case. Sitting in position without any safety protection also increases the level of injuries to the occupants in both extended cab and pickup bed.