Crash ID: 150221-01

Accident Narration

At 14:20 PM, on 21 February 2015, a pickup (V1) travelling southbound on Mittrapap road, Highway no.2, KM 247-248, Bua lai, Nakhon Ratchasima, hit the rear end of bicycles (V2 & V3), resulting 1 fatality and two injuries. The location of the crash scene is shown in **Figure 1**.

Based on the evidences from investigation, prior to the crash, both bicycles were travelling on the left shoulder and pickup was following a truck in the left lane. According to the pickup driver, the truck was changing lane to right and he was unaware of the bicycles (**Figure 2**). Pickup driver did not wait by the time truck fully changing the lane, but he tried to overtake the truck to the left by using shoulder space on the left side. While overtaking, the pickup collided to the bicycle (V2) with the heading angle of 11 deg. During the crash, at first, the right side of the pickup hit the left side of bicycle carriage (V2) as shown in **Figure 3**. The rod connecting the carriage and bicycle was broken, the male rider was ejected out of the bicycle and hit the windshield bar at left front of the pickup.

The pickup lost control and run off the road with its left wheel on the side slope and right wheel on the edge of shoulder, inclined at 20 deg. After running off the road for 20 m, the Pickup swerved right to roadway in order to recover. At that instance, the male rider (V2 rider) fell off from the pickup hood and rested on the side slope .Also, while recovering, the front right side of the pickup hit the another bicycle (V3). Then, V3 rider vaulted for about 17 m and rested in the middle of road. Due to hard braking and swerving, the pickup rotated and overturned with its left side down first. The pickup slid to the median edge, and rested with its upside down. **Figure 4** shows the post-crash sequence of the crash. Moreover, the summary of the schematic sequences of the crash is shown in **Figure 5**.

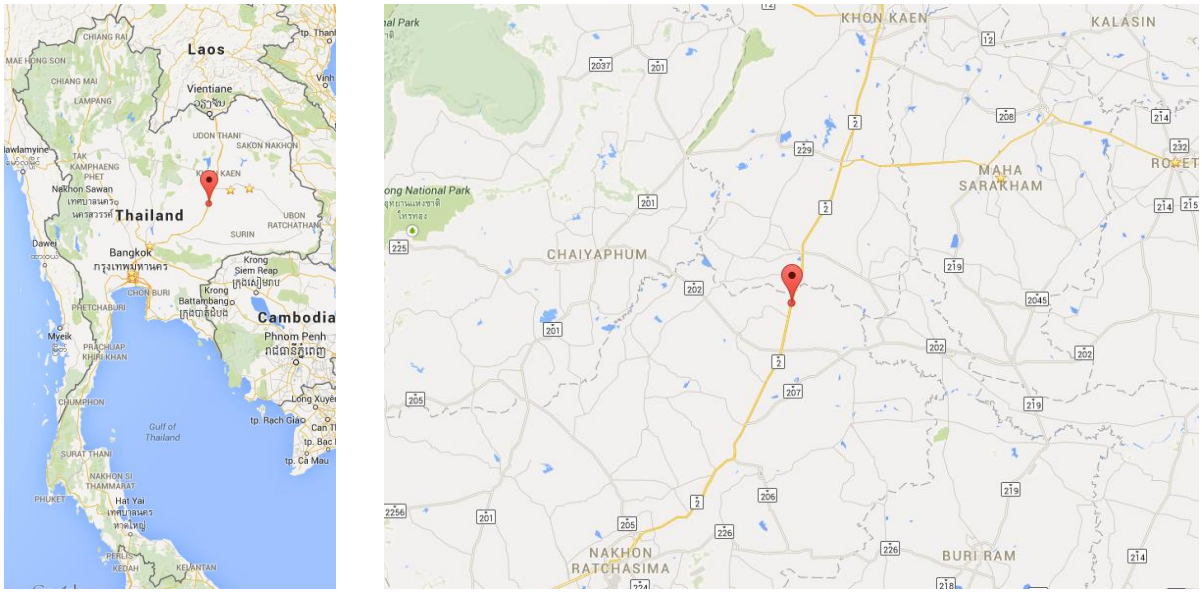


Figure 1 Location of Crash Site at Highway no. 2

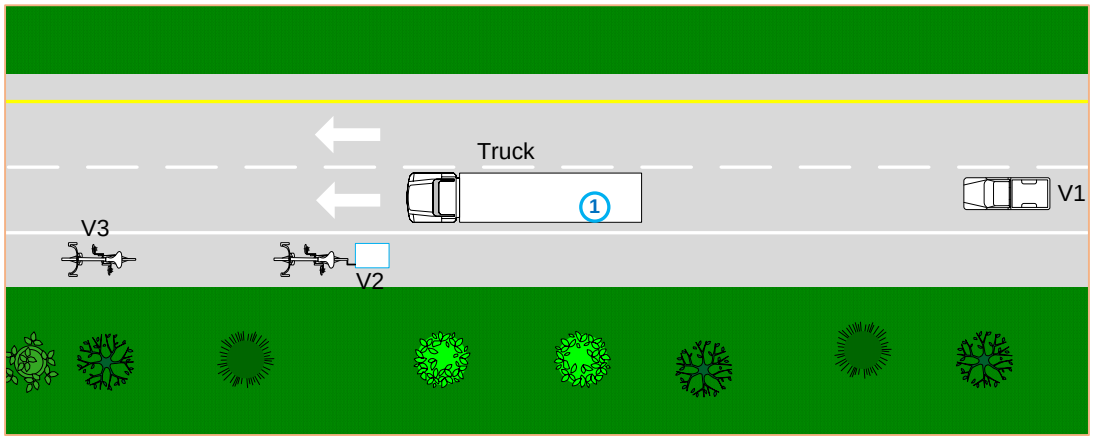


Figure 2 Pre-crash motion of the vehicles

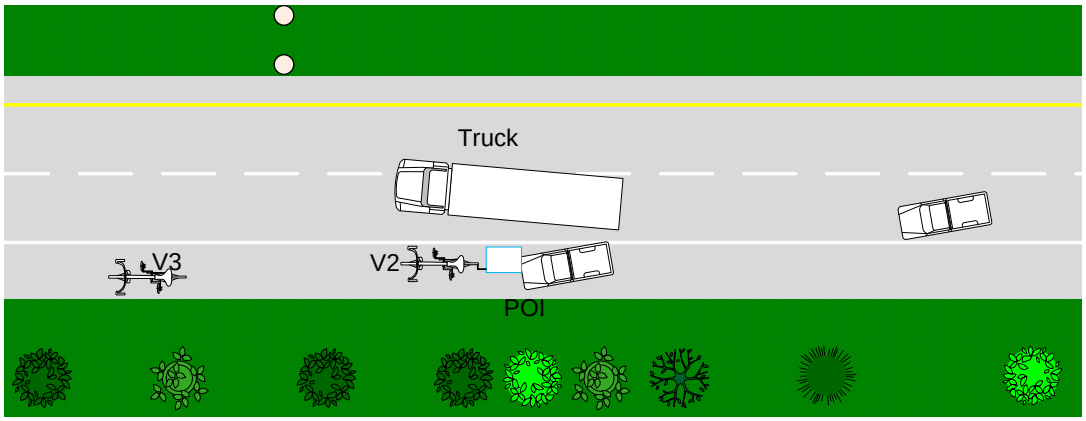


Figure 3 Motion of the vehicles during crash

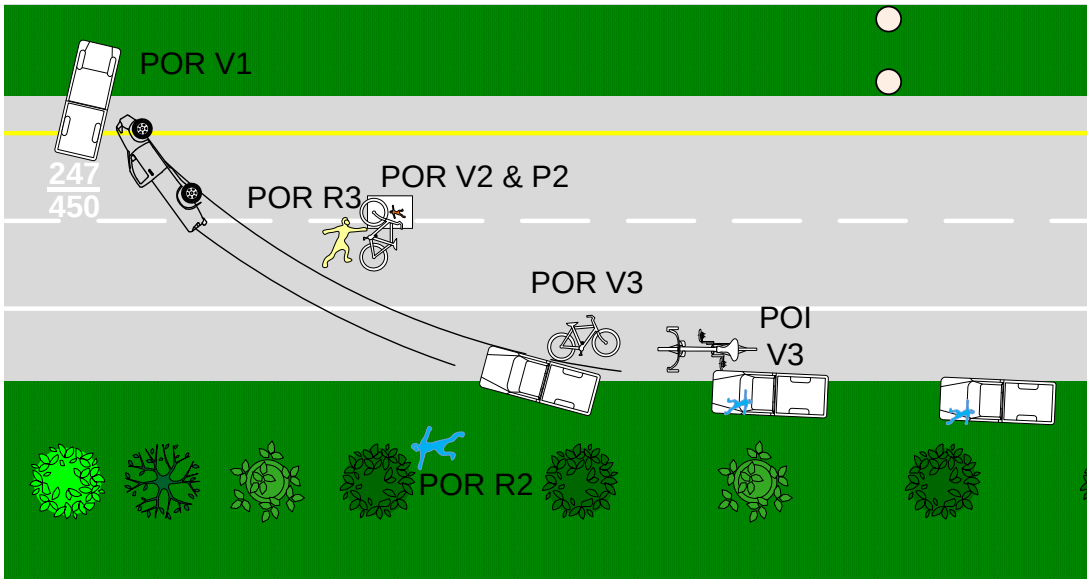
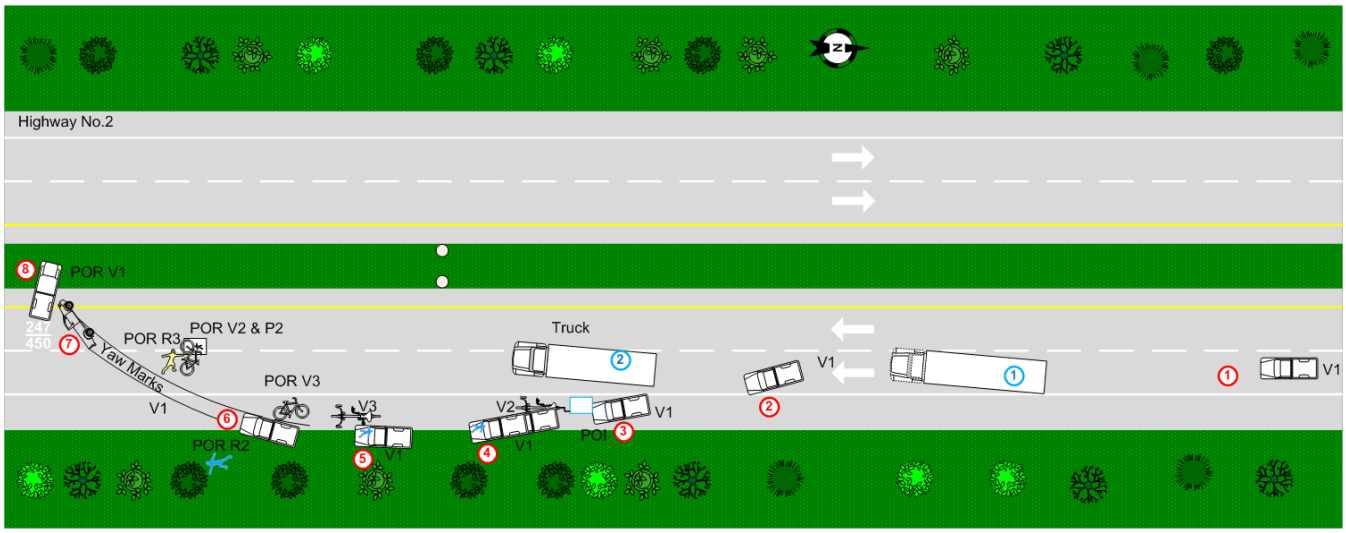


Figure 4 Post crash motion of the vehicles



1. Pre-crash position of pickup
2. Pickup overtaking using space of shoulder
3. Point of Impact with carriage and male rider
4. Pickup-run off road, male rider in windshield/hood
5. Pickup braking, swerving to right, and collision with female rider
6. Falling off male rider
7. Overturning of Pickup, left side down
8. Pickup resting at median, upside down

1. Pre-crash position of Truck, lane changing
2. Position of truck during crash, lane changing

Figure 5 Summary of the schematic sequences of the crash

The heading angle was calculated by looking at the evidences like contact point between pickup and carriage during the crash as shown in **Figure 6**. It was observed that the right front part of pickup hit the left rear part of bicycle with the heading angle of 10.9 degree. This indicates that the pickup took 15.8 m distance at the onset of overtaking to collision.

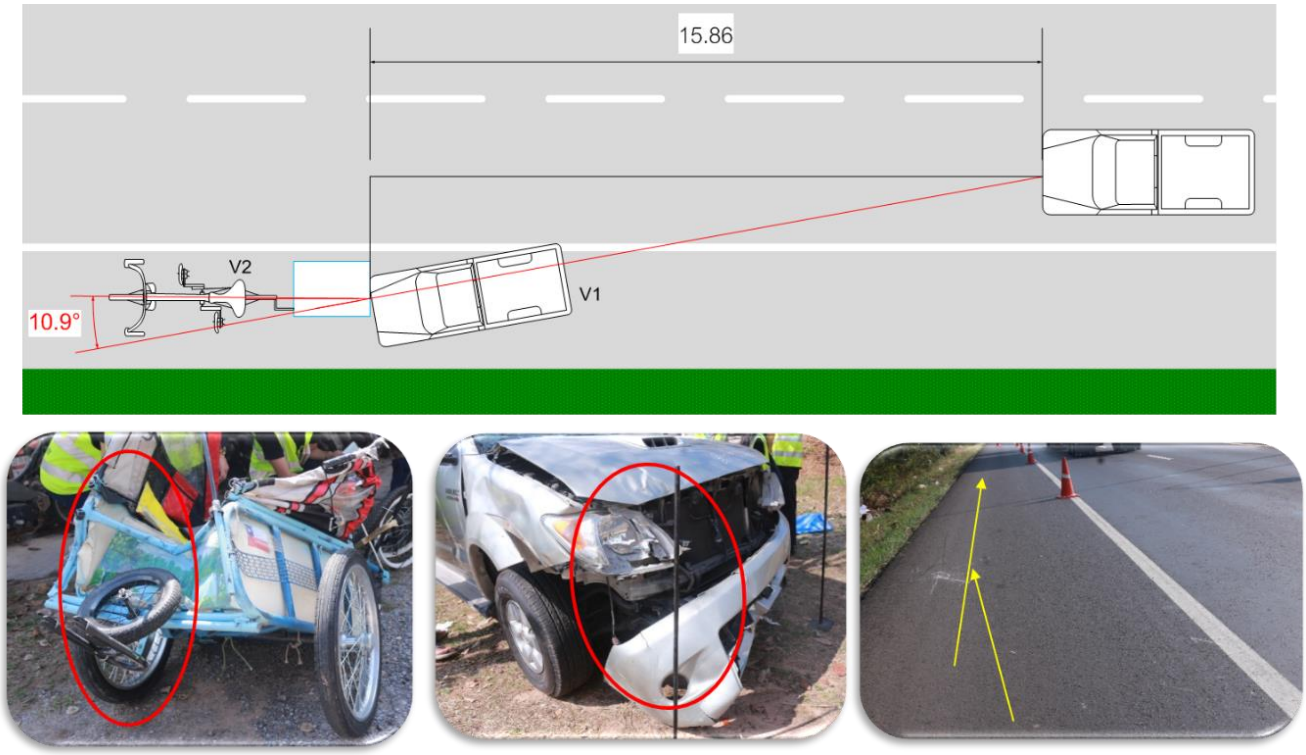


Figure 6 Heading angle of the crash

Vehicle Information

Pickup (V1)

The pickup was a TOYOTA Hilux 3.0 D- 4D (Vigo), space cab, Automatic transmission, Silver Metallic in color. The loading bed of the pickup was not covered. The seat for the driver and front passenger were equipped with lap shoulder seat belts. The dimension of the pickup is presented in
Table 1**.**

Table 1 Pickup Dimensions and Weight

Items	Dimension or weight
Length (mm)	5,185
Width (mm)	1,760
Height (mm)	1,720
Wheelbase (mm)	3,085
Weight (kg)	1,550

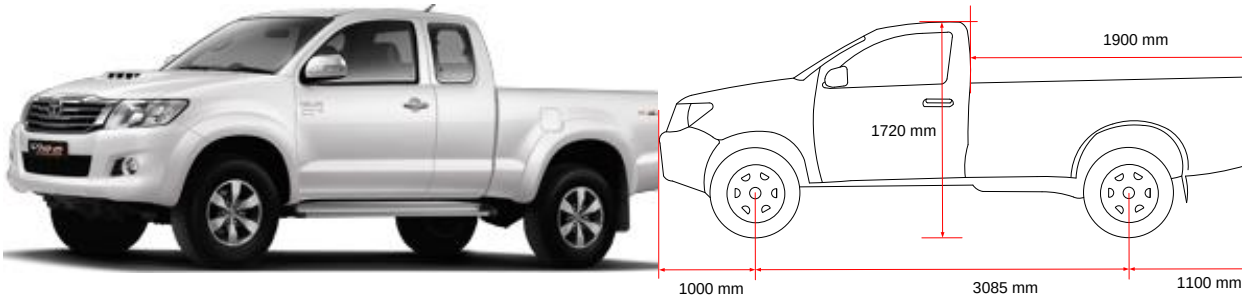


Figure 7 Original structure of the pickup, dimension of the pickup

All the tires of the pickup were Bridgestone Ecopia, Ep850, 255/70 R 15 108H, manufactured in Thailand. While inspecting the pickup, no damage was found at the tire.

Bicycles (V2 & V3)

There were two bicycles involved in the crash. (V2) was a bicycle connected to a carriage by metal rod for the purpose to carry the child and other stuffs as shown in **Figure 8 & Figure 10**. The color of the bicycle was black, and the color of the carriage was blue. The length and height of V2 was 2,000 mm and 1,300 mm respectively and the length x width x height of carriage was 1,700 mm X 750 mm X 780 mm. There was a baby seat inside the carriage and seatbelt was installed in the baby seat. Likewise, V3 was a bicycle ridden by female rider. The color of the bicycle was black and the wheel rims were pink (**Figure 9**). The length and height of V3 were 1,700 mm and 850 mm respectively.

Figure 8 Structure of bicycle (V2) with carriage

Figure 9 Structure of V3

Figure 10 Structure of bicycle (V2) with male rider

Vehicle Damages

Pickup (V1)

The pickup had a massive damage on its front part as shown in **Figure 11** & **Figure 12**. Front bumper was damaged due to impact. Bumper on right side was hanging, while on the left side was intact. The roof was deformed due to overturning and the supporting pillar were deformed from original position. In addition, the front windshield was broken and hood was penned up. There were several scratches on the left side of the pickup (**Figure 14**), which was due to sliding of pickup before overturning. **Figure 13** shows the damage condition of the pickup in all directions.

Figure 11 Damages of the pickup (V1)

Figure 12 Damages of the pickup (V1)

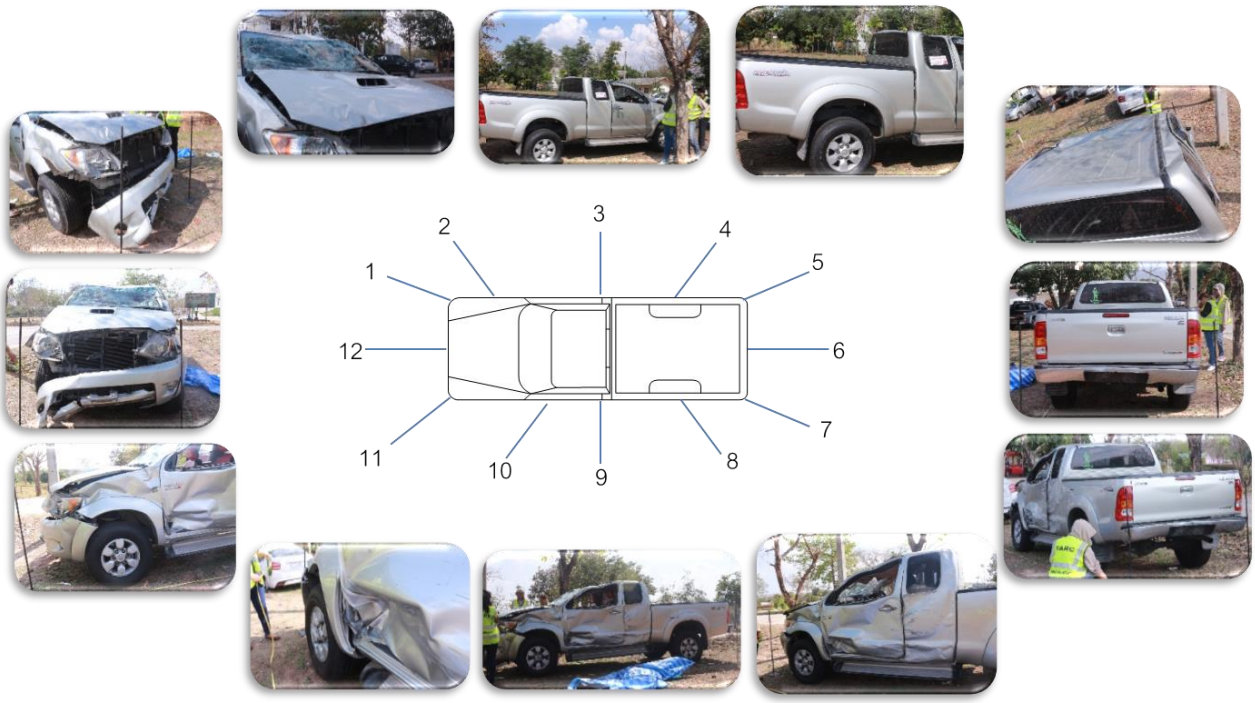


Figure 13 Damage condition of the pickup from all directions

The critical damage in the pickup was on the frontal and left side as can be seen in **Figure 14.** Deformation of 600 mm was observed on the front frame at a height of 780 mm from ground level and at a distance of 700 mm from the right front corner of the pickup. Furthermore, there was a dent on the left side, below the door at a height of 700 mm from the ground level. **Figure 14 & Figure 15** show the damages and deformation of the pickup with dimensions.

Figure 14 Critical damage and their height from ground level

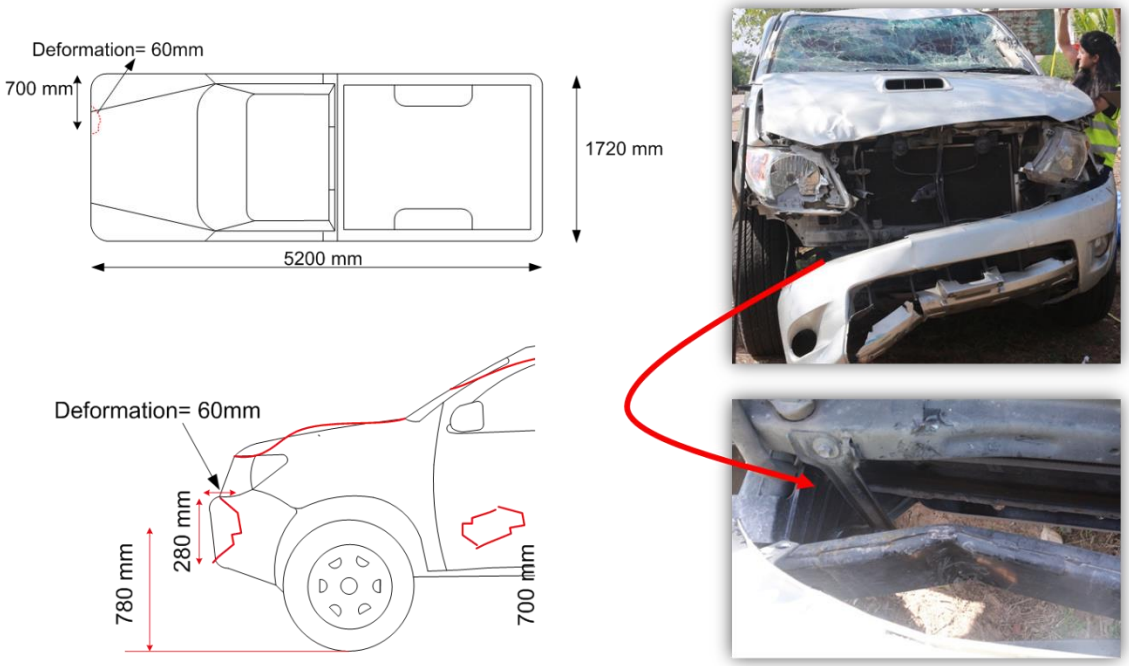


Figure 15 Deformation of the front frame of the pickup

Bicycles (V2 and V3)

The bicycle with carriage (V2) sustained heavy damages in frame and rear wheel as shown in **Figure 16** & **Figure 17**. There was a deformation of 240 mm on left rear side of the carriage. Also, the metal rod connecting the bicycle and carriage was broken by the impact. The handle of the bicycle was broken and the rear wheel was massively damaged (**Figure 18**).

Figure 16 Damage of carriage

Figure 17 Damages of V2, (broken connecting rod, frame and handle)

Figure 18 Damage in wheels of the bicycles

Another bicycle (V3), which was ridden by female had comparatively less damage than V2. The handlebar of the bicycle was broken and both tires were flat. Also, pillion seat bar was deformed by the impact as shown in **Figure 19**.

Figure 19 Damages of V3

Highway Information

The accident occurred in the southbound of Highway no. 2, KM 247-248, Bua Lai, District, Nakhon Ratchasima Province. It is a main route connecting Bangkok to Northeastern region. The highway has 4 lanes with 3.5 m. lane width, 2.5 m outer shoulder width and 1.5 m. inner shoulder width. It is a straight section with asphalt pavement and depressed median. The side slope of the highway is 1V:3H. The plan and cross section of the highway are shown in **Figure 20** & **Figure 21**. Likewise, **Figure 22** & **Figure 23** show the different approaches of the highway at crash scene.

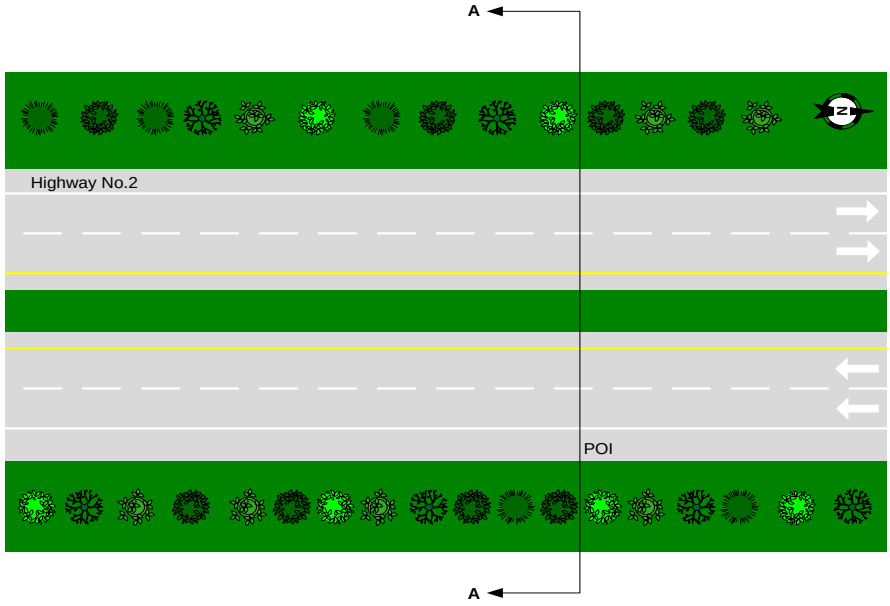


Figure 20 Plan of Hwy no.2

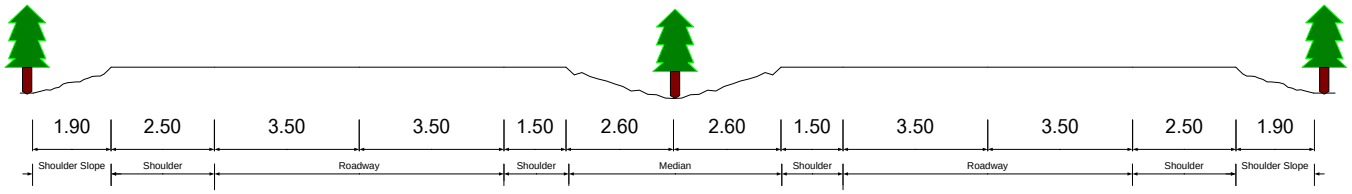


Figure 21 Typical cross section of Hwy no.2

Figure 22 Northbound of Hwy no.2

Figure 23 Southbound of Hwy no.2

Physical Evidence

One of the most important evidences guiding TARC team to the investigation was a 21 m long yaw marks on the road surface before the POR of the pickup. The physical evidences presented in the crash scene, starting from point of impact to the point of rest, showing the pre & post- crash sequence, are presented below:

i. There were several scratches, skid marks of bicycle & carriage, and markings by police present in the crash scene indicating the point of Impact (POI) as shown in **Figure 24.**

Figure 24 Evidences showing POI

ii. After the Point of Impact, there was a 22 m long tire marks on the road side slope that leads to yaw marks on the road pavement as shown in **Figure 25**.

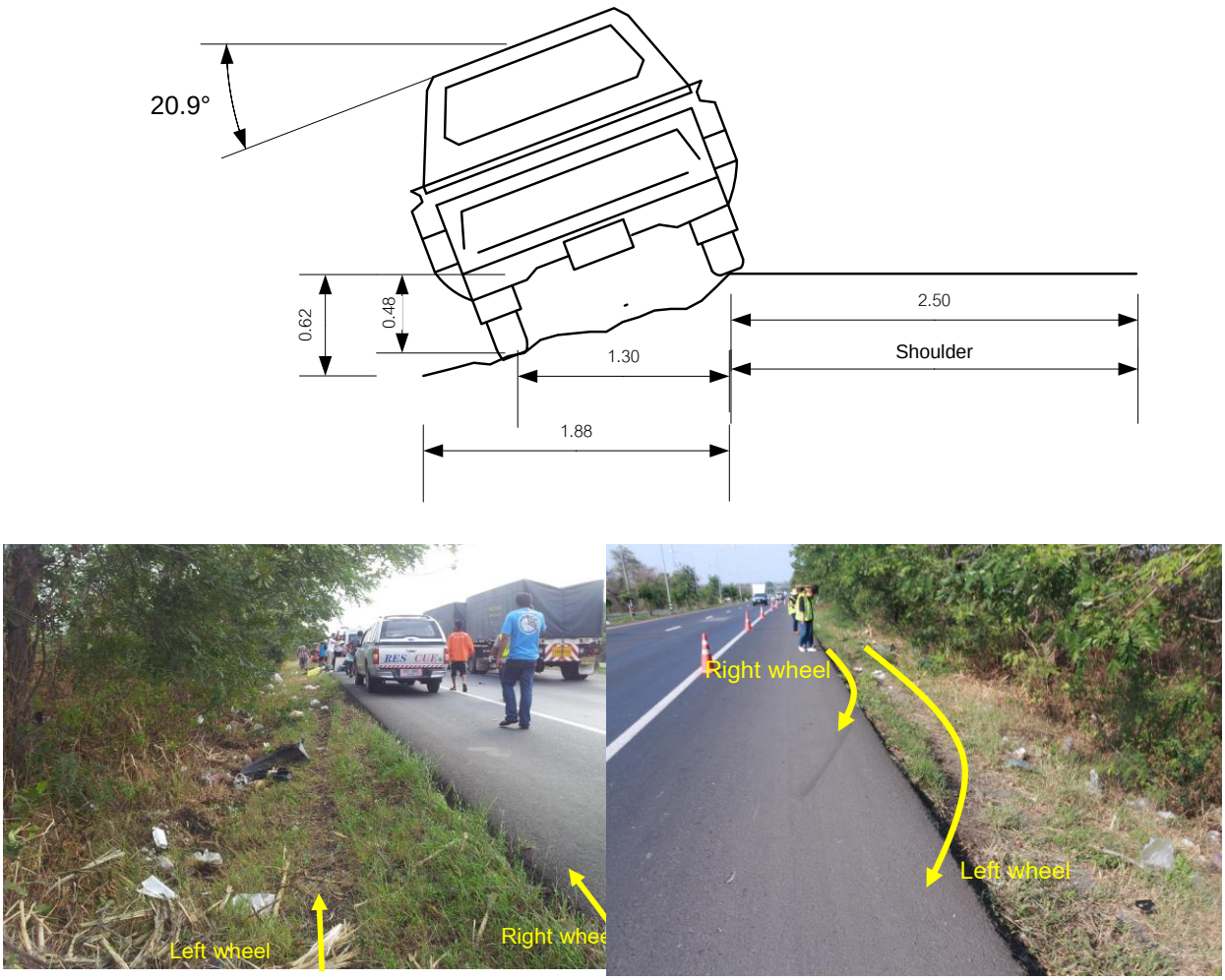


Figure 25 Tire marks (22 m) leading to skid and yaw marks

iii. Following the tire marks, there was a 7 m long skid marks on the edge of shoulder indicating that while running off road, the pickup applied brake before swerving to right as seen in **Figure 26**.

Figure 26 7 m long skid marks on the edge of shoulder

iv. Preceding to skid marks, there was a 21 m long yaw marks on the pavement surface (**Figure 27**), which indicates that, after the pickup lost control and run off into the shoulder, the pickup applied brake and swerved to the right in order to recover, and then overturned to the other edge.

Figure 27 Yaw marks starting from edge of shoulder

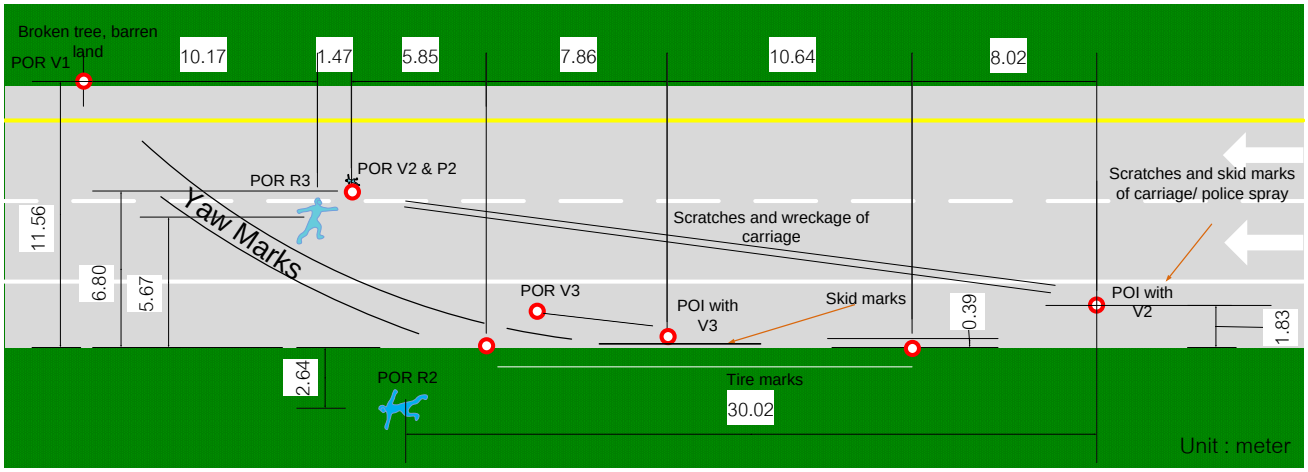
Figure 28 & Figure 29 show the point of impact and point of rest of rider, bicycles and pickup. POR of V2's rider is about 30.02 meters far from POI. The distances between the POR of pickup, bicycles, and rider are shown in **Figure 31**.

Figure 28 POR of bicycles (V2 & V3) and pickup (V1)

Figure 29 POI and POR of pickup and rider

Figure 30 Broken metal rod (left) and scratches on road surface (right)

Similarly, **Figure 30** shows the broken metal rod after the impact, POR of V3's rider and the scratches leading to the POR of V2. These evidences indicate that after the impact, the carriage disconnected from the bicycle and slide towards the middle of the road. **Figure 31** demonstrates the summary of physical evidences that were collected in the crash scene after the accident.



- V1 – Pick- Up
- V2 – Bicycle of husband
- R2 – Rider of V2 (husband)
- P2 – Baby passenger in V1's carriage
- V3 – Bicycle of wife
- R3 – Rider of V3 (wife)

Figure 31 Summary of the physical evidences present in the crash scene

Driver Information

The pickup driver, 64 years old male, Thai nationality, was travelling from Chiang Yuen, Khon Khaen Province to Pathumtahni province. According to the pickup driver, he departed from Chiang Yuen at 11:30 and reached crash scene at about 14:20. The origin and destination of the pickup is shown in **Figure 32**. Pickup was travelling in the first outer lane before the crash as can be seen in CCTV footage from gas station before the crash scene at 14:16:15 pm. There were two occupants in the pickup, driver and his wife.

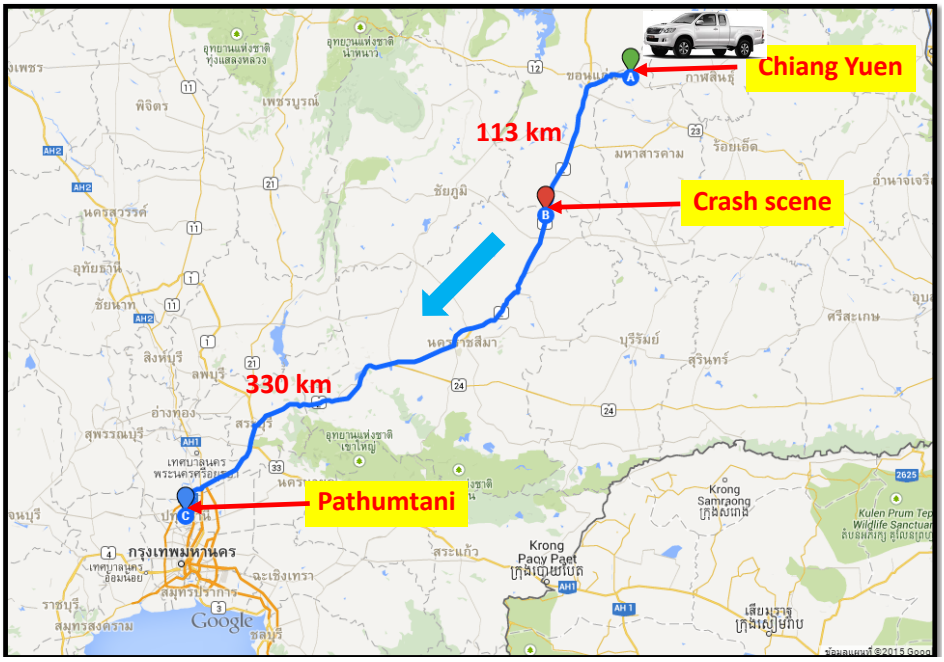


Figure 32 Origin and destination of Pickup

There were two bicyclists involved in this accident. V2's rider was 48 year's old, male, Chile nationality. His son, who was in the carriage, was 15 months old child. His wife was a V3 rider, 40 years old, female, Singaporean nationality. They were travelling around Thailand in order to set the Guinness World Record on world tour by bicycle. According to the police officer, one day before the accident, they arrived at Highway Police Service, near Khon Kaen check point at 7:00 pm and stayed there for one night. Next day (on the day of accident), they left the Police Service at 8:30 am in the morning, and their destination is to go to Suvarnabhumi airport, Bangkok. The bicyclists were also spotted in the CCTV camera of gas station at 11:38:34 in the morning. **Figure 33** shows the origin and destination of the bicycles.

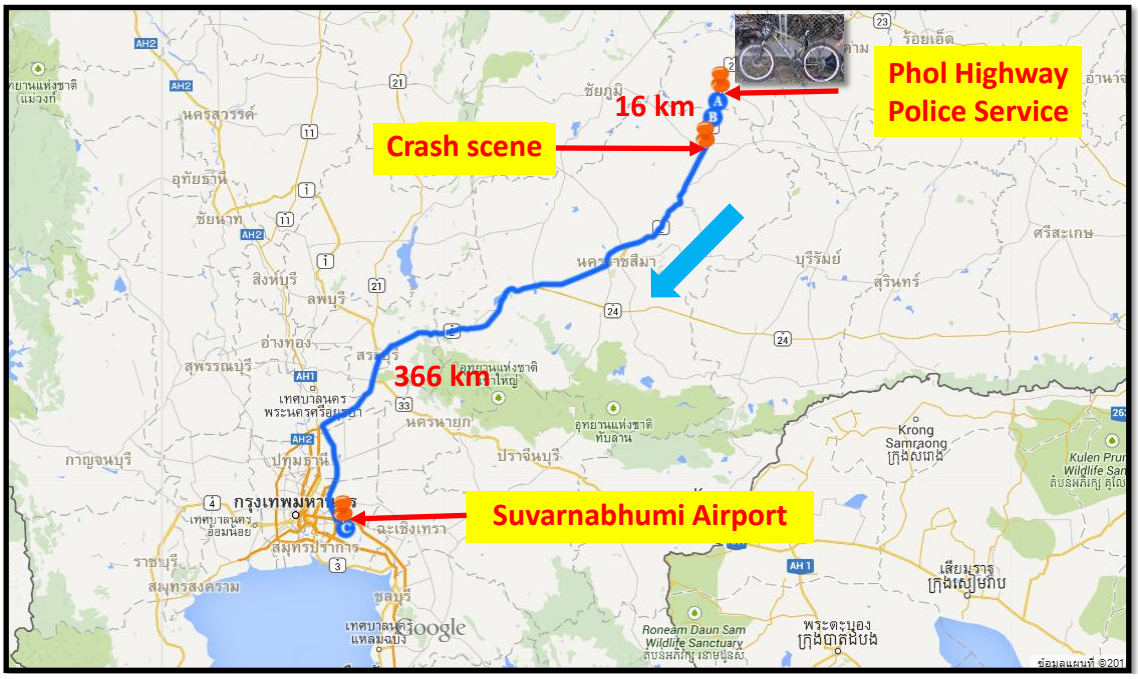


Figure 33 Origin and destination of the bicycles

The vehicles including bicycles, pickup and ambulance were spotted in the CCTV of the gas station, which is about 7 km before approaching to the crash scene. The time stamps of the vehicles leaving the gas station are shown in **Table 2**.

Table 2 Vehicle time at the gas station

Vehicles	CCTV footage of vehicles	Time at gas station
Bicycle		11:38:34
Pick-up		14:16:15
Ambulance		14:21:49

Injury Information

There were three casualties in this accident. Among them, V2 rider was dead at the scene due to severe head and neck injuries. While V3 rider and child were injured and taken to the hospital for treatment. V3 rider was seriously injured as her left leg was fractured. The child sustained minor injury in his face. The injury information of the bicycle riders and a child categorized by AIS are presented in **Table 3 to Table 5.** The diagrams in the table are anatomical representation of the injured area. The range of colors show the severity of injury. Red color represents the critical injury followed by yellow and green, which shows the serious and minor injuries.

Table 3 Injury information of V2 rider

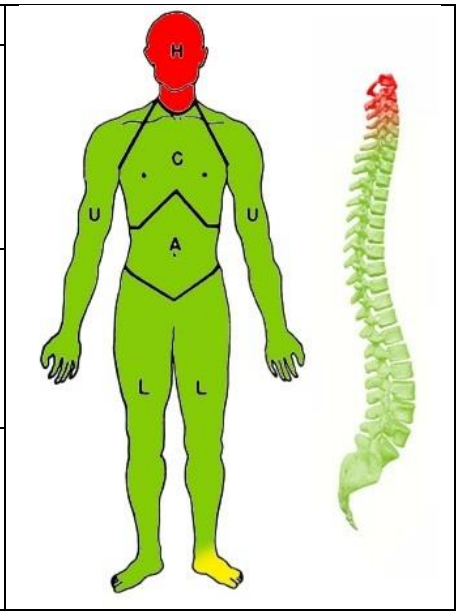
Region	Injury description	AIS	
Head	• Fracture of skull • Severe blood loss from head • Open wound on head (4 cm)	6	
Neck	• Fracture of cervical spine • Neck contusion	6	
Lower extremity	• Left foot deformity	3	

Table 4 Injury information of V3 rider

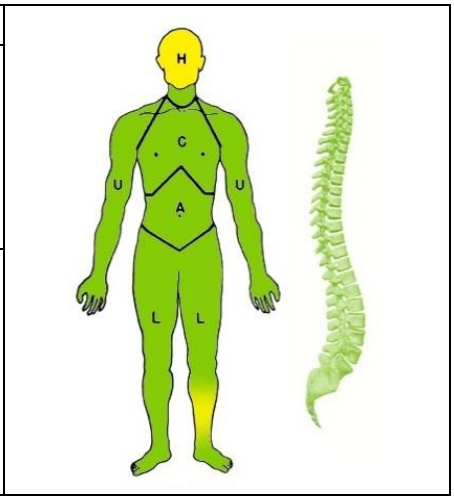
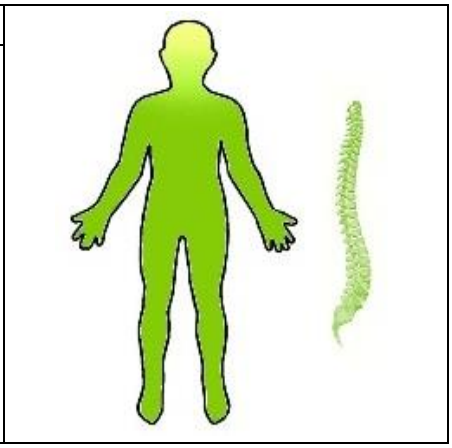
Region	Injury description	AIS	
Face	• Laceration wound on lip (3 cm) • Contusion on forehead (5 cm)	2	
Lower extremity	• Fracture of left fibula	3	

Table 5 Injury information of child

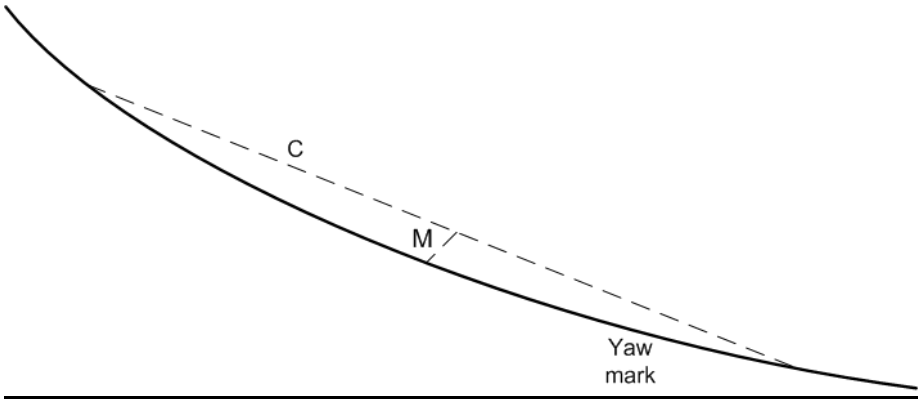
Region	Injury description	AIS	
Face	• Abrasion wound	1	

Index
1 = Minor no treatment needed
2 = Moderate requires only outpatient treatment.
3 = Serious requires non-ICU hospital admission.
4 = Severe requires ICU observation and/or basic treatment.
5 = Critical requires intubation, mechanical ventilation or vasopressors for blood pressure support.
6 = Maximum not survivable.
9 = Not further specified (NFS)

Speed Calculation

The speed of the pickup at different sequences were calculated from the evidences like yaw marks and skid marks. Also, the speed of the pickup before crash scene was calculated from the CCTV footage as shown in calculation below.

From Yaw marks



- Middle ordinate, M = 0.84 m , Chord, C = 19.1 m
- Radius of curvature (R) = C2/ (8M) + M/2 = 54.14 m
- Critical velocity, V_4 = √ (gxRxf) = 20.08 m/sec **=72 km/h**r
- Skid mark (d) = 7 m on shoulder
- Impact Speed (V_2) = √ (V_1^2 + 2gfd) = 22.41 m/s = **80.66 km/hr**

The 60 mm deformation on the frontal frame of pickup indicates that some energy might have dissipated during the collision. Hence, the pre-crash speed of the pickup can be estimated as: 81 to 85 km/hr.

Speed of the pickup at different events are shown in **Figure 34**. Impact speed with V2 was 80 km/hr. Furthermore, the speed of pickup during collision with female rider was between 73 to 80 km/hr. The operating speed of other pickups on this highway was 92 km/hr.

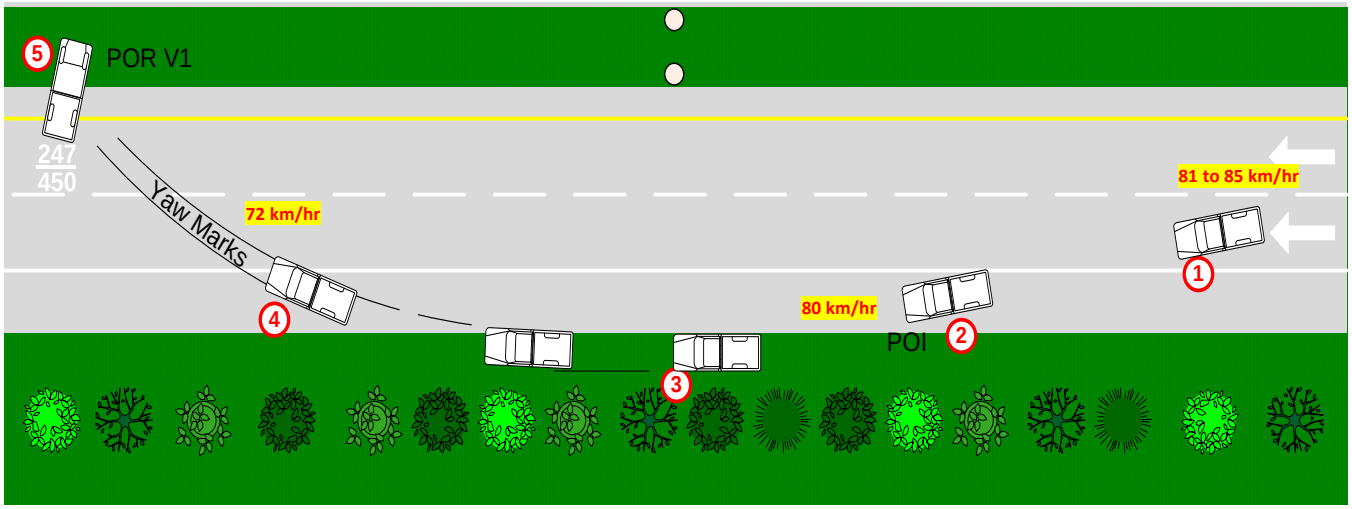


Figure 34 Speed of the pickup at different events

From CCTV footage

- Time at point A = 55.121 s
- Time at point B = 55.321 s, at distance 4.5 m from A
- Time at point C = 55.622 s, at distance 11 m from A
- Time at point D = 55.755 s, at distance 15 m from A

- Speed (V1) from point A to B = (4.5/(55.321-55.121))*3.6 = 81 km/hr
- Speed (V2) from point A to C = (11/(55.622-55.121))*3.6 = 80 km/hr
- Speed (V3) from point A to D = (15/(55.755-55.121))*3.6 = 85 km/hr

Hence, average travelling speed of pickup = ((V1) + (V2) + (V3))/3 = **82 km/hr**

Accident Contributing Factors

Human factor

The carelessness of pickup driver is the main contribution factor for this accident. He swerved to left to use some space on the shoulder for overtaking. He did not wait for the truck ahead to fully change lane.

Road Geometry and Environment

Highway no. 2 has lots of truck travelling daily, so line of sight of driver is sometimes obstructed by large trucks.

Injury Contributing Factor

Human factor

Both bicyclists did not wear safety helmet, which is the contribution factor for the head and face injury. However, in this case, the fatal rider has severe injuries at neck and cervical spine. Helmet may not be able to reduce the severity of neck and cervical spine injuries for this case.