Motor Vehicle vs Motorcycle
Colonial Dr / Amber Rd
Orlando, Florida
September 22, 2019


# Final Findings Report

Delta-V Consulting

22-01/Reconstruction
Effective April 24, 2022

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<table>
<tr><td>INTERNAL USE ONLY (Leave blank)</td><td>EFFECTIVE DATE</td><td>COMPLETION DATE</td></tr>
<tr><td></td><td>April 24, 2022</td><td>07/03/2022</td></tr>
<tr><td colspan="3">AUTHORS<br>Anthony Fairbanks</td></tr>
<tr><td colspan="3">ABSTRACT<br>The Final Findings Report is comprehensive collision reconstruction report based upon fundamentals of advanced traffic collision reconstruction practices and formulae, the experience and knowledge of the collision reconstructionist, information discovered during the performance of the collision reconstruction, and the information documented in the Florida Highway Patrol’s collision investigation FHPD19OFF085910 and Traffic Homicide Investigation FHP 719-07-088 and associated discovery. The purpose of the Final Findings Report is to provide a conclusive opinion(s) regarding factors contributing to the collision and primary collision causation.</td></tr>
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# Table 1

# Introduction

On April 24th, 2022, Delta V Consulting was retained by Edgardo Antonio Montes Negron to provide expert forensic consultation services and to reconstruct the collision occurring on September 22, 2019, at approximately 2:35am at the intersection of E Colonial Dr and Amber Way within the jurisdiction boundaries of the City of Orlando, County of Orange, Florida. The collision was investigated by the Florida Highway Patrol (crash Report # FHPD18OFF085910). This Preliminary Investigative Findings report was prepared for the exclusive use of Edgardo Antonio Montes Negron and his assigned legal counsel, Chavelys Y Alers, Esq, Attorney at Law, and her associates, and is not intended for any other purpose.

Please consider the following Final Findings report drawn from the investigation into the matter. The report does not intend to be final until confirmation can be made that no additional evidence, testimony (written or otherwise), or other significant items have all been received and reviewed. As such, I would request, should any be discovered after the submission of this report, the right to amend or expand the opinions expressed in this report.

# Purpose

The Final Findings report is comprehensive collision reconstruction report based upon fundamentals of advanced traffic collision reconstruction practices and formulae, the experience and knowledge of the collision reconstructionist, information discovered during the performance of the collision reconstruction, and the information documented in the Florida Highway Patrol's collision investigation FHPD19OFF085910 and Traffic Homicide Investigation FHP 719-07-088 and associated discovery. The purpose of the Final Findings Report is to provide a conclusive opinion(s) regarding factors contributing to the collision and primary collision causation.

# 1.0 Collision Investigation

## 1.1 Collision Summary

Based upon the FHP THI and DHSMV collision reports, FHP Incident Reports, search warrants, witness statement and physical evidence, the circumstances of the collision are as follows:

1) The sedan (V1) was traveling westbound on Colonial Dr while preparing to turn left onto Amber Way after crossing over four lanes of traffic prior to the collision.
2) The motorcycle was traveling eastbound on Colonial Dr toward Amber Way at approximately 32 mph within the middle lanes of the roadway toward the sedan.
3) Prior to the motorcycles arrival at the intersection the driver of the sedan proceeded to turn left and began crossing the eastbound travel lanes.
4) As the motorcyclist neared the intersection the rider of the motorcycle perceived a potential collision and applied the front and rear brake(s), causing the motorcycle to skid approximately 43 feet until the moment of impact with the sedan.
5) The motorcyclist was ejected from the motorcycle and landed approximately 25 feet from the area of the collision.
6) The motorcycle remained at the area of the collision.
7) The sedan rotated clockwise due to the collision forces and came to final rest approximately 94 feet from the area of the collision.
8) The motorcyclist suffered massive traumatic blunt force injuries resulting in his death.
9) The driver of the sedan was allegedly observed to exhibit symptoms of alcohol intoxication, limited to the odor of an alcoholic beverage on his breath, slurred speech, bloodshot/watery/glazed eyes, and flushed face.
10) Based upon the observation of suspected impairment investigators applied for and were granted a search warrant to determine the alcohol content for the drivers' blood.
11) The toxicological analysis of the driver's blood revealed a BAC of 0.16 g/100dL.
12) Based upon the above the driver was charged with DUI manslaughter.

# 1.2 Area of the Collision

The collision investigator made following observations regarding the weather (ambiance and lighting), roadway design and relevant traffic control devices:

## 1.2.1 Ambiance

The investigator failed to make mention of the ambiance that existed at the time of the collision anywhere in the THI report, FHP Incident reports, and search warrant. The only record provided in the discovery that references the ambiance is a basic description provided in the FHP collision report.

According to the FHP collision report the ambiance was as follows:

1) Light Condition - Dark-Lighted
2) Weather Condition - Clear
3) Roadway Surface Condition - Dry
4) Contributing Circumstances: Environment – None

The investigator made no further reference and gave no consideration to lighting and it effect on a driver's ability to perceive potential hazards caused by the weather conditions or lighting in the area of the collision.

A check of the Weather Underground historical database revealed the following weather conditions at the time of the collision:

1) Temp: 73 degrees F
2) Precipitation: 0.00"
3) Dew Point: 65.25
4) Wind: 20 mph max
5) Pressure: 30.02
6) Civil Twilight: 6:61 am – 7:47 pm
7) Moon Phase: Third Quarter - 46%

| Time | Temperature | Dew Point | Humidity | Wind | Wind Speed | Wind Gust | Pressure | Precip. | Condition |
|---|---|---|---|---|---|---|---|---|---|
| 12:53 AM | 74 °F | 66 °F | 76 % | ENE | 8 mph | 0 mph | 30.02 in | 0.0 in | Fair |
| 1:53 AM | 73 °F | 66 °F | 79 % | ENE | 8 mph | 0 mph | 30.01 in | 0.0 in | Fair |
| 2:53 AM | 73 °F | 66 °F | 79 % | NE | 8 mph | 0 mph | 30.00 in | 0.0 in | Fair |

*Figure 1*

## 1.2.2 Roadway

The investigator used conventional methods to to measure the layout of the roadway in the area of the collision. The roadway was measured as follows:

1) West Colonial Dr (SR-50) has four lanes traveling in east direction and four lanes traveling in the west direction, separated by a raised grassy median.
2) The westbound lane has a left turn lane in the section of the roadway approaching the area of the collision, dedicated for turning onto southbound Amber Rd.

3) The West Colonial Dr pavement consists of bituminous asphalt that is polished from high volume of traffic.
4) Both eastbound and westbound lanes of West Colonial Dr crowned from the center outward for drainage and has no discernable grade or superelevation <10%.
5) The four eastbound lanes widths vary between 11'-7" and 12'-6".
6) Amber Rd is a two-way roadway laned for two-way traffic in the north and south directions.
7) The north and southbound lanes are divided by solid double yellow lines.
8) Amber Rd intersection with West Colonial Dr at 50-degree angle.
9) Amber Rd is crowed at the center for drainage and has no discernable grade or superelevation <10%

### 1.2.3 Traffic Control

The investigator determined the following regarding the traffic control devices that were present and affected the actions of the involved drivers.

1) Located along the south curb of West Colonial Dr there is a posted 50 mph sign .7 miles from the area of the collision.
2) Northbound traffic on Amber Rd is posted for right turn traffic only where it intersects with West Colonial Dr.
3) There is a posted Stop Sign for northbound traffic on Amber Rd where it intersects with West Colonial Dr.

# 1.3 Involved Person(s)

## Driver 1: (D1)

D1 was identified as Edgardo Antonio Montes-Negron (D1) by his valid, class "E" Florida issued driver license. D1 resides at 9863 Tivoli Villa Drive, Orlando Florida. D1 is a 52-year-old male with a date of birth of October 8, 2969. D1 does not have any endorsements or restrictions on his driver license. D1 was shown to be familiar with the area where the collision occurred.

## Passenger 1: (P1)

P-1 was identified as Steven Bula Barriera (P1), a 58-year-old male. P1 resides at 751 Golden Sunshine Circle, Orlando Florida. P1 was seated in the front right seat of V1 at the time of the collision.

## Driver 2: (D2)

D2 was identified as Auston Jauger McCurry (D2) by his valid class "E" Florida issued driver license.P1 resides at 14017 Chicora Crossing Boulevard, Orlando Florida. D2 is a 24-year-old male with a date of birth of March 6, 1995. D2 does not have any restrictions or endorsements on his driver license. According to the investigator D2 was familiar with the area where the collision occurred, however how this was established is not indicated.

## Witness 1: (W1)

W1 was identified as Derek Alan Journey (unknown DOB). W1 resides at 4946 North Palm Avenue, Winter Park, Florida. W1 was identified as a post-collision witness in the THI report.

# 1.4 Involved Vehicle(s)

**Vehicle 1: (V1)**

V1 is a black 2019 Lexus GS350. The VIN number affixed to the vehicle is JTHBZ1BL7KA017627. V1 is registered assigned Florida tag is ID56WD. V1 is equipped with a 3.5-liter engine with an 8-speed automatic transmission. V1 has 4-wheel disc brakes and power steering. The vehicle is equipped with an assortment of frontal and side impact airbags. The registered owner is Edgardo Antonio Montes-Negron.

**Vehicle 2: (V2)**

V2 is a black 2005 Suzuki GSX R600 motorcycle. The Vin number affixed to the vehicle is JS1GN7CA052106368. V2 is registered in Texas with tag 520A4D. V2 is equipped with a 600-cc engine with manual 5-speed transmission. V1 is equipped with front and rear disc brakes. D2 is not the registered owner of V2. The registered owner of V2 was not contacted by the investigators. How D2 came to be in possession of V2 was not investigated by the crash investigators.

# 1.5 Pre-Collision Investigation

## Pre-Trip Investigation

The following is a discussion of each driver's physical condition (health, vision, hearing, fatigue, attitude), acquired impairment, driver training, driver experience, vehicle familiarity, area of collision familiarity, and what events or conditions, if any, relative to the driver that occurred or existed before the involved parties started their trip which may have contributed to the collision.

## Driver 1: (D1)

The collision investigator made no attempt to ascertain D1's physical condition prior to the collision. The investigator also made no attempt to determine an of the other elements of a pre-trip investigation.

## Driver 2: (D2)

The collision investigator made no attempt to ascertain D2's physical condition prior to the collision. Additionally, in spite of D2's not having a motorcycle endorsement, the investigator made no effort to determine D2's level of rider experience and familiarity with V2 at the time of the collision.

## 1.6 Post-Collision Investigation

The following area conclusions made by the collision investigator regarding the area of collision, final rests, roadway evidence and the post-collision condition conditions of V1 and V2:

**Area of Collision**

The investigator concluded that the area of collision occurred within the outside middle lane (3rd from the inside lane).

Presumably the investigator based this conclusion on the size and distribution of the debris field, V2's skid mark path and termination and V2's final rest.

**Final Rests**

The investigator concluded that after the collision V1 came to a controlled stop 94'-11" south of the area of collision on Amber Rd facing southeast over the double yellow lines.

V2 came to final rest at the area of collision.

D-2 was ejected from V2 and came to final rest 25 southeast of the area of collision on the southeast corner of the intersection.

**Roadway Evidence**

The investigator observed "a single dark skid mark, in a straight line from the rear of the motorcycle stretching back west" 43 feet.

**Post-Collision Vehicle Conditions**

**V1: Lexus**

The investigator observed "heavy damage to the right side of V1. Damage observed initiating from the front passenger side door leading rearwards to the rear right door. Heavy damage was seen to the rear right door leading in the front with a 6 inches instruction." Th investigator also observed " induced damage to the right rear side of V1 roof concentrated on the top rear edge of the rear right door frame."

Additionally, the investigator observed blood to the outside of the rear passengers' side door.

**V2: Suzuki**

The investigator observed "heavy crush damage to the front of V-2. The front rim was broken, and the front forks were pushed inwards touching the body of the V-2. Damage was seen leading into side curtain airbag. the engine and gas tank. Both front and rea tire showed signs of heady skid patch indicating V-2 had engaged front and rear brakes and skidded."

The investigator measured the amount the wheelbase had been reduced by the collision. The investigator found that it had been reduced from 55.1 inches to 45 inches.

## 1.7 Medical Examiners Report

The medical examiners report revealed the motorcycle rider sustained the following traumatic injuries:

1) Blunt impact to head and neck:
    a. Cutaneous abrasions
    b. Cutaneous lacerations
    c. Multiple facial fractures
    d. Fracture of base of skull
    e. Subarachnoid hemorrhage
    f. Atlanto-occipital dislocation [2]
    g. Laceration of pons
2) Blunt impact to torso:
    a. Cutaneous abrasions
    b. Cutaneous lacerations
    c. Fracture of sternum
    d. Fractures of ribs, bilateral
    e. Lacerations of aorta
    f. Lacerations of spleen
    g. Multiple pelvic fractures
    h. Fracture of T10 vertebral body
3) Blunt impact to extremities:
    a. Cutaneous abrasions
    b. Cutaneous lacerations
    c. Open fracture of right humerus
    d. Open fracture of right radius and ulna
    e. Closed fracture of right femur
    f. Open fractures of right tibia and fibula
    g. Fracture of left humerus
    h. Open fractures of left radius and ulna
    i. Fractures of left metacarpals

The medical examiner concluded based upon the circumstances surrounding his death, and after an examination of the body and review of the toxicology report that the death was a result of multiple blunt force injuries.

While it is common for motorcyclists to become injured when colliding with a vehicle (Lower Extremity Injuries in Motorcycle Crashes, 2008) even at relatively low speeds (ex: 25-35 mph) it is uncommon for riders to be injured to the extent shown above. It should be noted that research into the "*atlanto-occipital dislocation*" injury type indicates that the injury results from a high energy trauma and is an uncommon and usually fatal. [3] (World Journal of Orthopedics, 2015)

Based upon my training and experience investigating collisions, including those involving motorcyclists, and multiple studies on the subject, I recognized that the stated injuries were caused by a vehicle collision involving significant forces. Having investigated numerous motorcycle collision of varying severity and after a thorough review of the provided discovery I established that the injuries were inconsistent with those that would have resulted from a 32-mph collision.

## 1.8 Damage Analysis

After repeated requests I was not allowed to examine the crash vehicles. However, despite this I was able to make a sufficient examination of the post-collision condition of the crash vehicles using the provided photographs taken during the at-scene investigation and post-collision vehicle examinations.

**V1: Lexus**

Based upon the direction of the abrasions extending from the front door rearward, the front passenger side door being pulled rearward, V1's oblique angle relative to V2 at the time of the collision it was apparent that the point of first contact occurred several inches ahead of the passenger side "A" pillar.

*Figure 2*

It should be noted that due to the design of modern vehicles, the "A" pillar is a structurally rigid section of the vehicle.

Due to V1's angle relative to V-2, V-2's considerable speed and the rigidity of the "A" pillar, V-2 continued forward while sliding rearward along the passenger side of V1. Upon reaching the rear passenger side door of V2, V-1 intruded into the passenger compartment of V2, causing an unknown amount of crush.

*Figure 3*

The magnitude of the collision traveled through the vehicle from the passenger side toward the driver side, crumpling and raising the roof in the area of the damage.

Additionally, fresh red blood was scattered across the exterior rear passenger side door panel, side curtain airbag and roofline.

The passenger side curtain, drivers and front passenger side airbags were deployed.

**V2: Suzuki**

V2 sustained catastrophic damage as a result of the collision. The front wheel of V2 was pushed rearward, shattering the rim, and causing the front forks to be pressed into the radiator and engine case. The fuel tank, airbox, exhaust pipe and riders saddle were dislodged from the motorcycle and sustained significant damage. The front fender, rear fender, side fairings were all dislodged and shattered into pieces.

Additionally, the force of the collision cracked the engine case, causing oil to leak on the roadway.

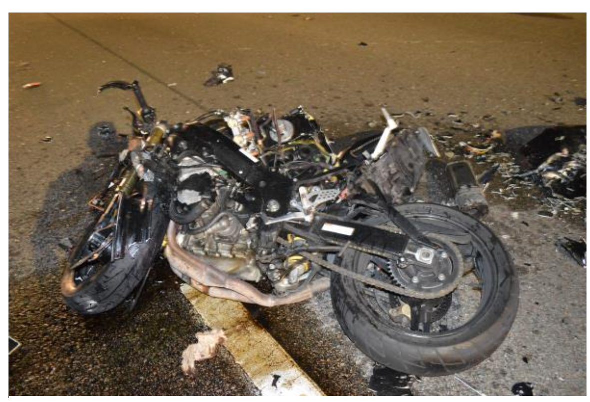


*Figure 2*

# 1.9 Event Data Recorder Analysis

The discovery provided included a copy of a Bosch CDR report. The CDR was imaged by FHP Cpl Sutton on 09/28/2019. The report indicates that the CDR imaged originated from V2. The version of the CDR tool used is 18.0.1 .

## V2 EDR Analysis

V2 is equipped with an event data recorder, device which stores certain parameters and crash information when a crash event is detected. The EDR stores data for the five second period of time prior to the trigger of the event. The pre-crash data is stored in half-second increments, with the first data point being .35 seconds after the trigger of the event.

The EDR is capable of recording collision type including, frontal crash, rear crash, side crash, and rollover events.

The data includes indicated vehicle speed in mph, accelerator pedal percentage depressed, percentage of engine throttle, engine RPM, motor RPM, service brake status (on/off), brake oil pressure (Mpa), Longitudinal acceleration VSC Sensor 2 (m/msec2), yaw rate, steering input (degrees), lateral crash pule (delta V m/sec^2), as well as seat belt status.

Lateral crash pulse sensors are based on data from accelerometers located within at 5 satellite positions within the vehicle. The crash pulse sensors record the amount of change in velocity every 4 msec of a second up to -22 m/sec prior to and 70 m/sec after an event is detected.

Lexus indicates in the Data Limitations section of the CDR report that if multiple events occur in successive order, the establishment of the recording trigger for the first event is defined as the "pre-crash recording trigger".

Due to the manner in which data is stored by the EDR, the data may have up to a 500ms (.5 second) delay in recording. Thus, the indicated data may not be true exactly at the indicated time of the data point being stored by the EDR but are true at some point within the half-second period of time that preceded its collection. The CDR report indicated that 3 crash types (triggers) occurred in succession during the crash sequence.

The following is a discussion of the data collected during each trigger beginning with the first trigger.

## 1st Crash Type: Side Impact

The first crash type detected in the crash sequence was a side impact.

***Table 1.2***

***System Status at Event TRG 1***

**System Status at Event (2nd Prior Event, TRG 1)**

| | |
|---|---|
| Recording Status, Side Crash Info. | Complete |
| Crash Type | Side Crash |
| TRG Count (times) | 1 |
| Previous Crash Type | No Event |

The lateral crash impulse sensors show that the collision occurred laterally from the passenger side toward the driver side. The lateral crash pulse indicated that Sensor 1 detected a delta V of -498 m/sec at 2 msec after the collision was detected, indicting a lateral crash pulse from the passenger side through the vehicle toward the driver side.

***Table 1.3***

***Lateral Crash Pulse TRG 1***

**Lateral Crash Pulse (2nd Prior Event, TRG 1 - table 2 of 2)**

| Time (msec) | Lateral Acceleration, Side Satellite Sensor 1 (m/sec^2) | Lateral Acceleration, Side Satellite Sensor 2 (m/sec^2) | Lateral Acceleration, Side Satellite Sensor 3 (m/sec^2) | Lateral Acceleration, Side Satellite Sensor 4 (m/sec^2) | Lateral Acceleration for Side Crash, Floor Sensor (m/sec^2) |
|---|---|---|---|---|---|
| -22 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| -18 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| -14 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| -10 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| -6 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| -2 | 0.0 | 0.0 | SNA | 0.0 | 0.0 |
| 2 | -498.0 | -28.7 | SNA | 0.0 | -15.3 |

The side impact known to have occurred during the collision matches well to the direction and magnitude of the lateral delta V is reported by the EDR.

## 2nd Crash Type: Rollover

The second crash is labeled as 1st Prior Event, TRG2. The crash type is shown as "Rollover". The report was complete. No System Status at Event is provided for this event type.

The rollover Crash Pulse reported that the Roll Angle Peak (degrees) was -6.0 degrees and that the Roll Angle at the Time of TRG was -0.3 degrees.

***Table 1.4***

***Rollover Crash Pulse TRG 2***

**Rollover Crash Pulse (1st Prior Event, TRG 2 - table 1 of 2)**

| | |
|---|---|
| Recording Status, Time Series Data | Complete |
| Time from TRG to Next Sample (msec) | 12 |
| Roll Angle Peak (degrees) | -6.0 |
| Roll Angle at the Time of TRG (degrees) | -0.3 |

It is expected that the energy exchanged during the initial collision would force the sedan laterally from right to left. During this lateral movement the friction of the driver side tires would have increased, causing the vehicle to roll (rotate) counterclockwise around it's the yaw moment of inertia. The Roll Angle at the Time of TRG (which would have been recorded after the collision), the direction and magnitude of rollover agree well with the circumstances of the collision.

## 3rd Crash Type: Front Rear

The last reported crash type detected in the crash sequence was a front/rear collision. The report was complete.

***Table 1.5***

***System Status at Event TRG 3***

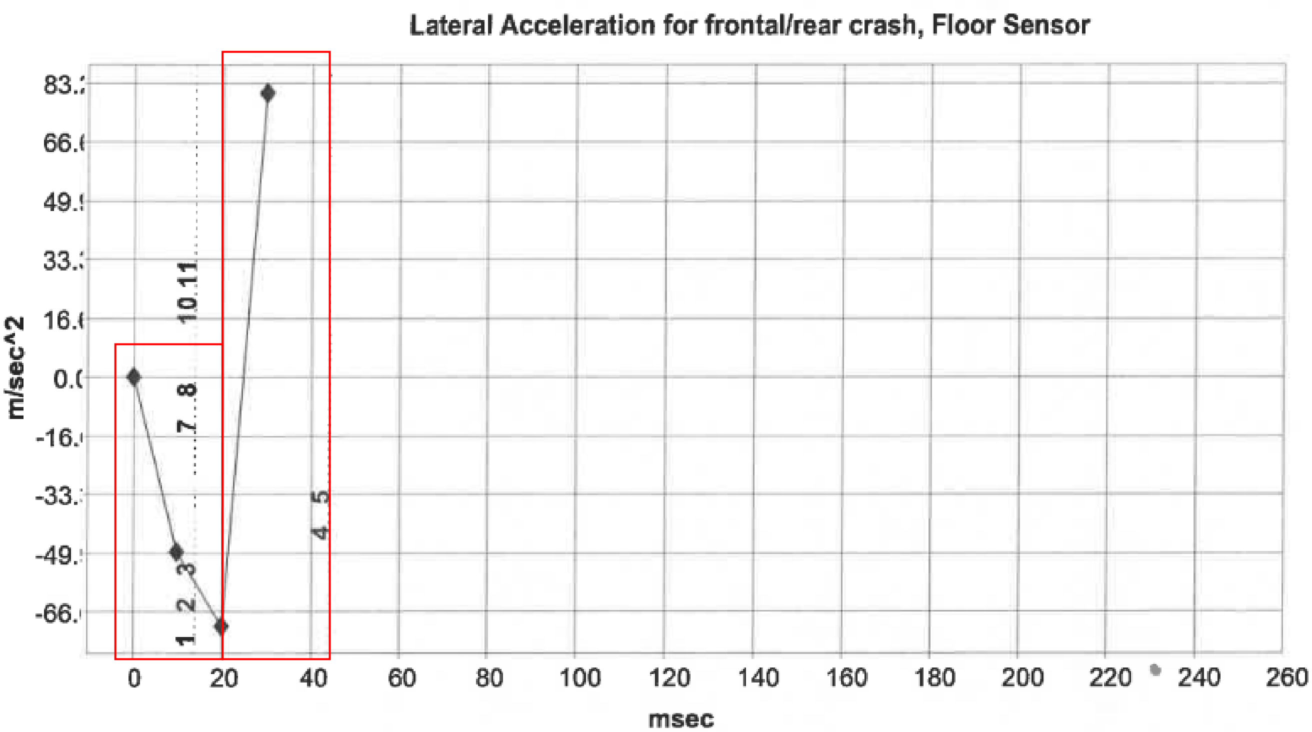
**System Status at Event (Most Recent Event, TRG 3)**

| | |
|---|---|
| Recording Status, Front/Rear Crash Info. | Complete |
| Crash Type | Front/Rear Crash |
| TRG Count (times) | 3 |
| Previous Crash Type | Rollover |

The lateral acceleration for the front/rear crash showed a delta v of -66 m/sec^2 during the first 20 msec immediately followed by a delta v of 83 m/sec^2 in the opposite direction. This can be explained by the occurrence of two factors. First, the energy imparted to the sedan caused it to rotate laterally. Once the rotation had ceased, the vehicle rolled rearward and came to a stop.

***Table 1.6***

***Lateral Acceleration for Frontal/Rear Crash***




Considering the above. The EDR data closely matches the circumstances of the collision.

## Pre-Crash Data

The following is a summary of the pre-crash data collected by the EDR.

### Vehicle Speed

The pre-crash data showed that at t-0 V1 was traveling at 26.7 mph. The preceding data points indicate that V1 had been traveling at less than 9 mph prior to beginning to accelerate -2.85 seconds prior to the event being detected.

### Service Brake

The pre-crash data showed that the service brake had been “off” for the 5 seconds preceding the event being detected. The data shows that there was no attempt by the driver to brake prior to the collision.

### Steering Input

The pre-crash data showed that the steering wheel of V2 was rotated counterclockwise, indicating a that the vehicle was turning left. Beginning at -4.85 seconds the steering wheel shows turned to 24 degrees. The steering wheel adds more left turn until -2.85 seconds when the steering wheel was turned to 81 degrees. The steering wheel remained turned to 81 degrees until -1.85 when the driver turned the steering wheel clockwise; indicating that the driver was reducing the angle of the left turn. The amount of steering wheel rotation continued to be reduced until reaching 16.7 degree at t-0 when the collision was detected. The data shows that the driver began a left turn approximately -2.85 seconds prior to the collision, which is consistent with the circumstances of the collision

**Table 1.7**

*Pre-Crash Data for TRG 1*

**Pre-Crash Data, -5 to 0 seconds (2nd Prior Event, TRG 1)**

| Time (sec) | -4.85 | -4.35 | -3.85 | -3.35 | -2.85 | -2.35 | -1.85 | -1.35 | -0.85 | -0.35 | 0 (TRG) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Vehicle Speed (MPH [km/h]) | 8.7 [14] | 8.7 [14] | 8.7 [14] | 9.3 [15] | 9.9 [16] | 13 [21] | 16.2 [26] | 19.9 [32] | 23 [37] | 25.5 [41] | 26.7 [43] |
| Accelerator Pedal, % Full (%) | 0.0 | 16.0 | 15.0 | 38.0 | 82.5 | 71.5 | 53.5 | 56.0 | 54.5 | 40.5 | 42.0 |
| Percentage of Engine Throttle (%) | 0.0 | 0.0 | 0.0 | 0.0 | 28.5 | 42.0 | 31.0 | 39.5 | 35.0 | 20.0 | 21.5 |
| Engine RPM (RPM) | 700 | 700 | 1,000 | 800 | 1,500 | 2,300 | 2,200 | 2,500 | 2,700 | 2,900 | 3,000 |
| Motor RPM (RPM) | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid | Invalid |
| Service Brake, ON/OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF | OFF |
| Brake Oil Pressure (Mpa) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Longitudinal Acceleration , VSC Sensor (m/sec^2) | -0.144 | -0.144 | 0.215 | 0.000 | 1.077 | 4.091 | 2.441 | 3.158 | 2.584 | 1.579 | 1.579 |
| Yaw Rate (deg/sec) | 1.95 | 2.93 | 4.88 | 3.90 | 9.27 | 12.20 | 13.18 | 12.69 | 8.78 | 4.88 | 4.88 |
| Steering Input (degrees) | 24.0 | 33.0 | 46.5 | 51.0 | 81.0 | 81.0 | 63.0 | 52.5 | 40.5 | 16.5 | 16.5 |

# 2.0 Collision Reconstruction

# 2.1 Investigative Narrative

On April 30, 2022, I visited the collision scene and made observations and confirmations regarding the ambiance, the roadway layout and traffic control devices in the area of the collision that may have affected the action of the drivers. Additionally, I measured the roadways dimensions, determined the roadways coefficient of friction in the area of collision and took terrestrial photos to aid in the collision reconstruction.

## Ambiance

An examination of the scene revealed that West Colonial Dr is bordered along the north and south sides by traffic light poles equipped with artificial lighting. The light poles are situated approximately 5' away from the curb line. The light poles are located every 180 – 230 feet.

An examination of the photos provided in the discovery showed that the streetlights, in conjunction with the artificial lighting produced by the business signage in the area, provide what appears to be a standard Federal Highway Administration Lighting Handbook [9] approved level of illumination in the east and westbound lanes in the area of the collision. Additionally, all the streets light located along the eastbound lanes of West Colonial Dr appear to be functioning.

Additionally, the photos confirmed that there was no precipitation at the time of the collision investigation, nor any other apparent forms of roadway contamination unrelated to the collision.

## Roadway

I performed measurements in the immediate area of the collision and used a scaled satellite photo to confirm that the roadway layout measurements obtained by the investigator were within an acceptable range of accuracy. Additionally, I confirmed that there is no discernable grade or superelevation for East Colonial Dr or Amber Rd.

## Traffic Control

I confirmed that there are 50 mph speed limit signs on both the east and westbound directions of  West Colonial Dr in the sections of highway approaching the area of the collision. There was no other relevant signage that may have affected the actions of the involved drivers.

I observed that there was a single photo showing an investigator holding a drag sled, however there was no mention of its use in any of the provided discovery.

I determined that the roadway dimensions and design as described in the above section titled "Roadway".

I discovered that the roadway markings created by V2's pre-collision skid, and the roadway scrapes were no longer present.

## Coefficient of Friction

Due to the investigators failure to provide the roadway coefficient of friction at the time of the collision I performed a drag sled test.

Using a Braker Box drag sled I measured the coefficient of friction of the roadway to determine the roadways drag factor. The drag sled was pulled 10 times in the curb lane of West Colonial Dr at the intersection of West Colonial Dr and Amber Rd.

The results (Force in foot-pounds) of the pulls were as follows:

1) 23
2) 18
3) 18
4) 17
5) 18
6) 20
7) 20
8) 19
9) 20
10) 19

Total = 192

The pulls were added and divided by the number of pulls. The average Force of the pulls was found to be 19.2 foot-pounds.

$$\frac{Total\ Force}{10\#\ of\ Pulls} = Average\ Force \qquad \frac{192}{10} = \mathbf{19.2}$$

The average Force was then divided by the weight of the drag sled (25 lbs). The drag factor was found to be .76 .

$$f = \frac{F}{W} \qquad f = \frac{19.2}{25} = .76$$

## Collision Sequence

Using the THI narrative, crash report, the crash scene diagram, and the at-scene photographs I was able to determine within a reasonable degree of certainty the following existed and/or occurred during the collision sequence:

1) V1 was traveling on an 8-lane roadway and preparing to turn left across the opposing 4 lanes of traffic.
2) V2 was traveling the opposite direction of V1 and preparing to traverse the intersection at which V1 was preparing to turn left.
3) D2 was riding a black sports type motorcycle.
4) D2 was wearing black, non-reflective clothing and helmet.
5) V1 turned left and crossed into the path of V2.
6) D2 perceived the impending collision and braked, causing V2 to leave approximately 43 feet of skid up the area of collision.
7) D1 was unaware of V2's approach prior to the collision.
8) First contact between V1 and V2 occurred as indicated in the THI report within the middle portion of the outside middle lane of the roadway.

9) The front tire of V2 made first contact with V1 several inches ahead of the passenger side “A” pillar.

10) Likely due to the rigidity of the “A” pillar and the obtuse angle of V2 relative to V1, the front of V2 slide rearward.

11) Upon reaching the rear passenger side door, V2 intruded inward into the passenger compartment of V1.

12) V2 came to final rest at the approximate area of collision.

13) The rider was ejected from the saddle of V2.

14) D2’s forward momentum caused D2 to continue forward until colliding with the rear passenger side door and roofline of V1.

15) The presence of blood on the exterior of the airbag and door panel, the height of V1’s roofline, the rider height of D2 and the injury type (atlanto-occipital) make it likely that D2’s collision with the roofline of V1 was responsible for the deformation of the frame and roof panel.

16) D2’s body continued forward and vaulted over V1 until colliding with the pavement approximately 25 feet from the area of collision.

17) Due to the energy imparted to V1 by the collision and the forward momentum of V1 prior to the collision, V1 rotated laterally from right to left around the yaw moment arm.

18) V2 rotated laterally 94 feet 11 inches east/southeast until coming to final rest on Amber Rd. Although the crash diagram did not indicate an arcing pattern and there were no side slipping tire marks from the area of collision to final rest, it is reasonable to assume based upon the nature and energies exchanged during the collision that V1 traveled in a shallow arc from the area of collision until reaching final rest.

19) After reaching final rest V-1 rolled forward an unknown distance (likely only several feet) and came to stop facing southwest partially in the northbound and southbound lanes of Amber Rd.

## Discussion of Contributing Factors

Primary fault in most left turn right-of-way violation collisions can usually be assigned to the driver turning left in front of the traffic traveling on the through roadway. However, in the above-described collision sequence there were several contributing factors that suggest a closer look at V2's conspicuity and pre-collision speed should have been applied prior to assigning fault.

The following are factors that necessitated further investigation:

### a) Motorcycle Conspicuity

As discussed in the Preliminary Findings Report, determining a driver's ability to differentiate between the contrast of an on-coming motorcycle from its background is critical when determining fault in right-of-way collision. The human eye responds to an object's movements and an objects color contrast to its background. As in this instance when an object is moving toward the observer there is no lateral movement for the observers' eyes to detect. Thus, to be detectable an object must have perceivably greater contrast to its background. Generally, at night only a vehicles headlight and an objects reflectivity can provide contrast of consequence.

In this collision the rider was wearing a black helmet, tee shirt, and jeans, all of which have a very low luminance reflectivity level, which would have significantly reduced the driver's ability to see the darkly dressed rider.

As will be discussed later, the rider's having no lateral motion relative to V1, V2's low observability and V2's velocity created a situation that made it difficult for D1 to perceive and react to the potential hazard.

### b) Speed of V2 Pre-Collision

The investigator incorrectly applied two commonly used collision formulae (Crush Factor and Wheelbase Reduction) to determine the pre-collision speeds of V2, but failed to correlate his opined speeds with the following factors:

i. Amount of damage caused to both vehicles by the collision
ii. Type/extent of traumatic injuries (i.e., atlanto-occipital dislocation) caused to D2 by the series of collisions (w/ V2 and pavement)
iii. Correct formula to Find Pre-Impact and Impact Speeds of V2

Each of the above factors contradict the investigators estimated 32 mph impact speed of V2. The reason the factors are in disagreement will be discussed below:

#### 1) Amount of Damage

There has been much research by organizations such as IIHS and NHTSA into vehicle crash worthiness and the amount of force needed to deform (crush) a vehicle at varying speeds and collision types.

In each of these crash worthiness tests were limited to crashing a vehicle into a rigid barrier at right (90 degree) angle. While collisions at an oblique angle have been studied, the research has been limited to improving the vehicle structures, rather than determining the stiffness values for each vehicle.

Unfortunately, due to the limitations of the crash tests and requirements when using Crush Analysis this collision would not be a suitable candidate for using crush formula due to the extreme oblique (~55 degree) angle at which V2 collided with V1.

As is evidenced in this investigation the amount of damage to V1 and V2 was significant. While no calculation can be performed, my experience investigating collisions has taught that collisions of this severity involve speeds well above the estimated speed provided by the investigator.

**2) Injury Type/Severity**

Of note is the “atlanto-occipital dislocation” injury D2 sustained during the collision sequence. According to Wikipedia an atlanto-occipital dislocation, also known as an internal decapitation, “describes ligamentous separation of the spinal column from the skull base. It is possible for a human to survive such an injury; however, 70% of cases result in immediate death.” (Wikipedia, 2022) The data reveals that the most common mechanism on injury is a high-speed motor vehicle collision.

The medical examiner’s report revealed numerous and traumatic injuries caused to D2 as a result of the collision. While it is common for riders of motorcycles to be injured when involved in a collision with a vehicle, the injuries are typically limited to lower extremities when traveling at normal roadway speeds. [1] (Lower Extremity Injuries in Motorcycle Crashes, 2008)

While the injury itself does not precisely indicate V2’s pre-collision speed, research into the injury type clearly indicates that the root cause of the injury is due to the high energy forces generated by the change in velocity created during the rapid deceleration of a collision, such as occurred in this investigation.

Based upon this evidence it is this investigator’s opinion that the injury type strongly suggests that V2 was traveling at a speed considerably higher than the investigators estimated 32 mph.

**3) Pre-Impact and Impact Speeds of V2**

A common practice in collision investigation when attempting to ascertain the pre- and post-collision speeds of vehicles involved in angular collisions is to apply Conservation and Linear Momentum formulae.

This matter will be discussed in detail in the Application of Specialty Formulae section.

## 2.2 Application of Specialty Formulae

By gaining a better understanding of the involved pre-impact speeds of V2 a fact finder can gain a better understanding of the factors which may contributed to the collision.

To estimate the involved pre-impact, impact and post-impact speeds of V1 and V2 three equations will be used: Conservation of Linear Momentum, Searle Method and the Minimum Speed Formula.

### Conservation of Linear Momentum

The Law of Conservation of Momentum dictates that the total momentum just prior to two vehicles colliding is the same as the total momentum just after the collision. In most motorcycle collisions this basic formula must be expanded to include both motorcycle and rider post-impact trajectory, since the motorcycle and rider seldom stay together following the collision.

**Unadjusted Drag Factor**

The drag factor of .76 measured during the collision reconstruction was used.

**Post-Collision Departure Speed V1**

The post-collision departure speed of V1 was presented a challenge to calculate. While some investigators would simply follow the typical practice of using the skid to stop (minimum speed formula) to calculate V2's departure speed, I discovered this artificially inflated V1's post-impact departure speed.

To use the minimum speed formula and expect an accurate result the vehicle must be actively braking and leaving perceptible roadway skid or incipient markings. As can be seen in the scene photos no evidence exists of V1 having left any skid or incipient road marks. V1's EDR provided additional evidence that no post-crash braking occurred in the 5 seconds preceding the collision.

If braking were to have occurred after the initial collision it would have taken at least .5 seconds for the driver to move their foot from the accelerator pedal to the brake pedal. Furthermore, it would take a driver who was previously unaware of the collision at least 1.6 seconds to perceive and react to the collision by braking. With this in mind, it is unlikely that any post collision braking occurred.

Due to the absence of physical evidence suggesting that post-collision braking occurred and the EDR data it is reasonable to assume that V1 rotated rapidly over an unknown distance and then rolled backward until reaching final rest.

Due to its accuracy and verifiability the last EDR speed (26 mph) data point will be used for the post-collision speed of V1. It is acknowledged that using this speed tends to underestimate V1's pre-impact, impact and post-impact speeds. However, by using the impact speed of 26 mph the calculated speeds of both vehicles are **reduced,** giving benefit to both drivers

**Post-Collision Departure Speed V2**
Since V2 collided with V1 and came to an immediate stop at the area of collision, post-collision speed of 0 mph was used for V2.

**Searle Method**
The post-collision speed of the rider (D2), upon his separation from V2, was calculated using the Searle throw method. The equation will calculate the minimum velocity needed to throw an object a given distance. It does not predict the impact speed of the collision vehicle.

The post-collision distance D2 traveled was reported as being 25 feet. D2 was wearing a tee shirt and denim jeans, which have an approximate coefficient of friction of .66 on pavement.

$$s = \sqrt{\frac{30\ 25\ .66}{1 + .66^2}}$$

$$s = \sqrt{\frac{495}{1.43}}$$

$$s = \sqrt{346.15}$$

$$\boldsymbol{s = 18\ mph}$$

**Departure Angles**
In real world crashes vehicles rarely depart from an angular collision in a straight path. Most often a vehicles departure angle will be influenced due to damage to the under carriage creating unbalanced friction, secondary collisions, driver input, etc.

V2's collision behind V1's center of mass, the expected magnitude of force imparted to V1 by V2, and V1's final rest suggest that rather than sliding sideways in a direct path, the rotational mechanics of the collision caused V1 to rotate around its yaw moment arm for an unknown distance and then rolled backward until reaching final rest. Unfortunately, due to the absence of side slip tire marks created during V1's rotation the exact departure angle of V1 in unknown.

However, due to the absence of evidence suggesting V1 left the roadway (disturbed parkway, curb damage to driver side wheels, etc.) it is reasonable to assume that V1 remained on the roadway until final rest.

Based upon the above it is possible to assume within a reasonable degree of certainty that V1's departure angle ranged from lowest (12 degrees) to highest (15 degrees).

Rather than selecting only one departure angle, this investigator calculated the impact speeds using both departures angles in two scenarios to determine the highest and lowest possible impact speeds.

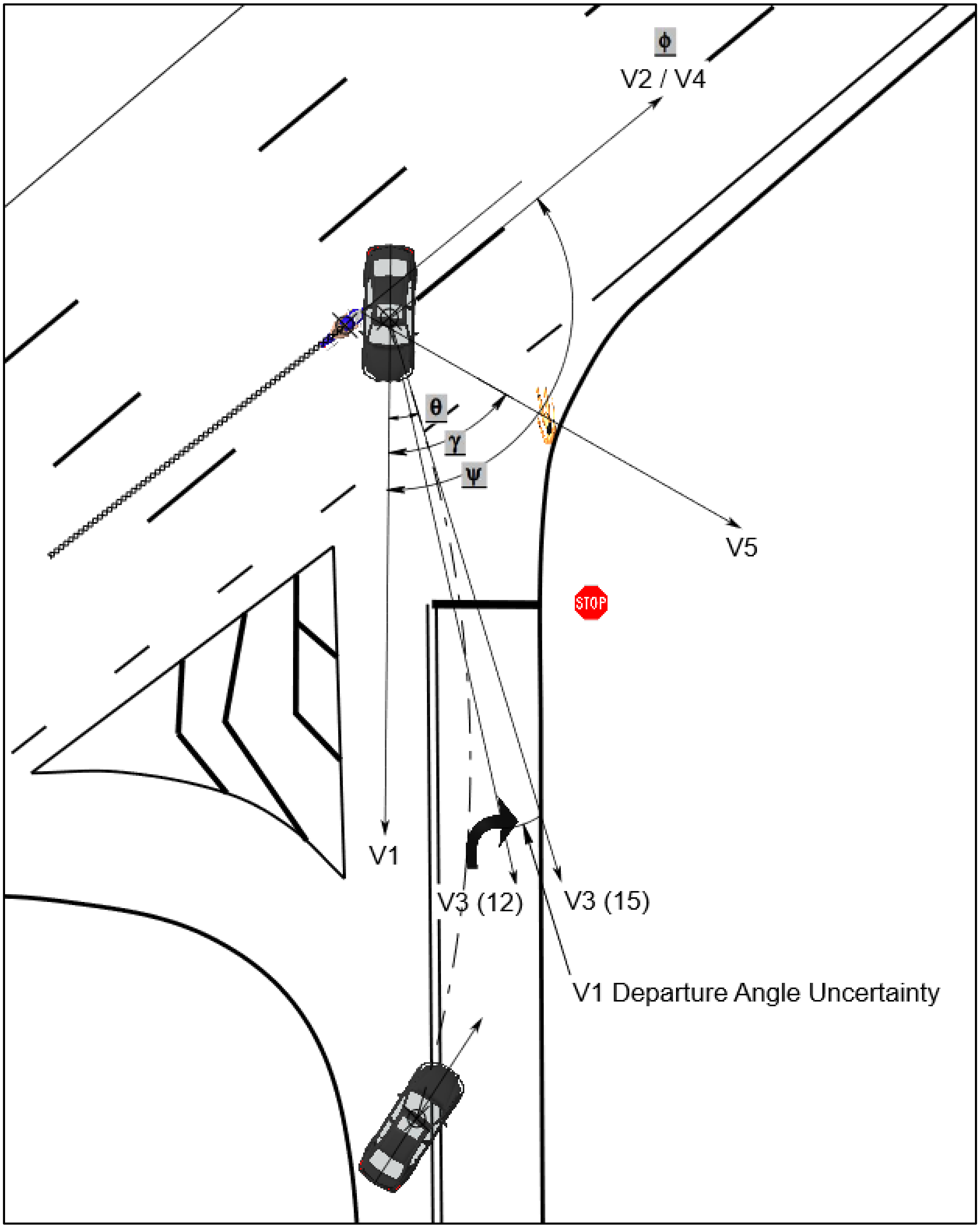

ϕ
V2 / V4
θ
γ
Ψ
V5
STOP
V1
V3 (12)
V3 (15)
V1 Departure Angle Uncertainty

*Figure 5*

# Scenario 1 – 15 degrees

**Values Used for COLM - Scenario 1 (15 degrees)**

| | **Degrees** | | **Sin** | **Cos** | **Weights and Speeds** | | |
|---|---|---|---|---|---|---|---|
| | 0 deg. | Approach angle for V1 Lexus | 0 | 1 | **W1** | **Lexus** | 3,891 lbs. |
| $\psi$ | 135 deg. | Approach angle for V2 Suzuki | .7071 | -.7071 | **W2** | **Suzuki** | 354 lbs. |
| $\theta$ | *15 deg.* | *Departure angle of V1 Lexus* | *.2588* | *.9659* | **W3** | **Rider** | 163 lbs. |
| $\phi$ | 135 deg. | Departure angle of V2 Suzuki | . 7071 | -.7071 | | | |
| $\gamma$ | 50 deg. | Departure angle of D2 Rider | .7660 | .6427 | | | |

| | |
|---|---|
| Impact Speed of V1 | S1- See Below |
| Impact Speed of V2 | S2- See Below |
| Departure Speed V1 | S3- 26 mph |
| Departure Speed V2 | S4- 0 mph |
| Departure Speed D2 | S5 - 18 mph |

**Solving for Impact Speed**

Using Equation 1 we can first solve for the impact speed of the motorcycle (V2).

**Solving for $S_2$ – Scenario 1 (15 degrees)**

| | |
|---|---|
| **Equation 1** | $S_2 = \dfrac{W_1 S_3 \sin\theta + W_2 S_4 \sin\phi + W_3 S_5 \sin\gamma}{(W_2 + W_3)\sin\psi}$ |
| **Step 1** | $S_2 = \dfrac{3891\ 26\ .2588 + 354\ 0\ .7071 + 163\ 18\ .7660}{(354 + 163).7071}$ |
| **Step 2** | $S_2 = \dfrac{26181.76 + 0 + 2247.44}{(517).7071}$ |
| **Step 3** | $S_2 = \dfrac{28429.20}{365.57}$ |
| **Solution** | $S_2 = \mathbf{77\ mph}$ |

The solution for S2 Suzuki indicates that the impact speed of V2 was **77 mph.**

Substituting the value of S2 (77 mph) from the above calculation allows us to calculate the impact speed of the Lexus (V1) with Equation 2.

| Solving for $S_1$ – Scenario 1 (15 degrees) | |
|---|---|
| **Equation 2** | $S_1 = \frac{W_2 S_4 \text{ Cos } \phi + W_3 S_5 \text{ Cos } \gamma - (W_2 + W_3)\ S_2\ Cos\ \psi}{(W_1)} + S_3 Cos\theta$ |
| **Step 1** | $S_1 = \frac{354\ 0 - .7071 + 163\ 17\ .6427 - (354 + 163)\ 77 - .7071}{3891} + 26\ .9659$ |
| **Step 2** | $S_1 = \frac{0 + 1780.92 - -28148.94}{3891} + 25.11$ |
| **Step 3** | $S_1 = \frac{29929.86}{3891} + 25.11$ |
| **Step 4** | $S_1 = 7.69 + 25.11$ |
| **Solution** | $S_1 = \mathbf{32\ mph}$ |

The solution for V1 Lexus indicates that the impact speed of V1 was **32 mph**.

**Solving for Pre-Skid Speed of V2**

Using the standard Minimum Speed (Workhorse) Formula, we will determine V2's velocity when it began to skid. To do this we will combine the kinetic energy speed loss (KES) of V2 to its speed at impact. We will use the skid distance of 43 feet and the drag factor of .76.

$$s = \sqrt{S_0^2\ \pm 30\ \cdot\ d\ \cdot f}$$

$$s = \sqrt{77^2 +\ 30\ \cdot\ 43\ \cdot .76}$$

$$s = \sqrt{5929 + 980.40}$$

$$s = \sqrt{6906.40}$$

$$s = \mathbf{83\ mph}$$

Based upon the above calculations V2 was traveling at **83 mph/121 fps** when it began to skid to impact with V1.

**Note**: It should be noted that due to use of the EDR speed (26 mph) as the impact speed of V1, the above stated speeds are very conservative.

# Scenario 2 – 12 degrees

| Values Used for COLM - Scenario 2 (12 degrees) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Degrees** | | **Sin** | **Cos** | **Weights and Speeds** | | |
| | 0 deg. | Approach angle for V1 Lexus | 0 | 1 | **W1** | **Lexus** | 3,891 lbs. |
| $\psi$ | 135 deg. | Approach angle for V2 Suzuki | .7071 | -.7071 | **W2** | **Suzuki** | 354 lbs. |
| $\theta$ | *12 deg.* | *Departure angle of V1 Lexus* | *.2079* | *.9781* | **W3** | **Rider** | 163 lbs. |
| $\phi$ | 135 deg. | Departure angle of V2 Suzuki | .7071 | -.7071 | | | |
| $\gamma$ | 50 deg. | Departure angle of D2 Rider | .7660 | .6427 | | | |

| | |
|---|---|
| Impact Speed of V1 | S1- See Below |
| Impact Speed of V2 | S2- See Below |
| Departure Speed V1 | S3- 26 mph |
| Departure Speed V2 | S4- 0 mph |
| Departure Speed D2 | S5 - 18 mph |

**Solving for Speeds at Impact**

Using Equation 1 we can first solve for the motorcycle speed.

| Solving for $S_2$ – Scenario 2 (12 degrees) | |
|---|---|
| **Equation 1** | $S_2 = \frac{W_1 S_3 \sin\theta + W_2 S_4 \sin\phi + W_3 S_5 \sin\gamma}{(W_2 + W_3)\sin\psi}$ |
| **Step 1** | $S_2 = \frac{3891\ 26\ .2079 + 354\ 0\ .7071 + 163\ 18\ .6427}{(354 + 163).7660}$ |
| **Step 2** | $S_2 = \frac{21032.41 + 0 + 1885.68}{(490).6427}$ |
| **Step 3** | $S_2 = \frac{22918.09}{314.92}$ |
| **Solution** | $S_2 = \mathbf{72\ mph}$ |

The solution for S2 Suzuki indicates that the pre-impact speed of V2 was **72 mph.**

Substituting the value of S2 (101 mph) from the above calculation allows us to calculate the impact speed of the Lexus with Equation 2.

| **Solving for $S_1$ – Scenario 2 (12 degrees)** | |
|---|---|
| **Equation 2** | $S_1 = \frac{W_2 S_4 \operatorname{Cos} \phi + W_3 S_5 \operatorname{Cos} \gamma - (W_2 + W_3)\, S_2 \,Cos\, \psi}{(W_1)} + S_3 Cos\theta$ |
| **Step 1** | $S_1 = \frac{354\ 0 - .7071 + 163\ 18\ .6427 - (354 + 163)\ 72 - .7071}{3891} + 26\ .9781$ |
| **Step 2** | $S_1 = \frac{0 + 1885.68 - -22299.81}{3891} + 25.43$ |
| **Step 3** | $S_1 = \frac{24185.49}{3891} + 25.43$ |
| **Step 4** | $S_1 = 6.21 + 25.43$ |
| **Solution** | $S_1 = \mathbf{31\ mph}$ |

The solution for V1 Lexus indicates that the pre-impact speed of V1 if V1 departed at 12 degrees was approximately **52 mph.**

**Solving for Pre-Skid Speed of V2**

Using the standard Minimum Speed (Workhorse) Formula, we will determine V2's velocity when it began to skid. To do this we will combine the kinetic energy speed loss (KES) of V2 to its speed at impact. We will use the skid distance of 43 feet and the drag factor of .76.

$$s = \sqrt{S_0^2\ \pm 30\ \cdot\ d\ \cdot f}$$

$$s = \sqrt{72^2 +\ 30\ \cdot\ 43\ \cdot .76}$$

$$s = \sqrt{5184 + 980.40}$$

$$s = \sqrt{6164.40}$$

$$s = \mathbf{78\ mph}$$

**Pre-Skid Speed V2**

Based upon the above calculations V2 was traveling at **78 mph/114 fps** when it began to skid to impact with V1.

**Note**: It should be noted that due to use of the EDR speed (26 mph) as the impact speed of V1, the above stated speeds are very conservative.

## 2.3 Human Factors

To understand what caused a collision and assign fault to a driver an investigator must understand what circumstances contributed to the drivers' decision to take the action and if those actions were reasonable and prudent under the circumstances that existed at the time of the collision.

In any situation where a potential hazard may be encountered a driver must become aware of the possible problem, diagnose it, determine whether a response is called for and, if it is, decide what response is appropriate and then carry it out. [7] (Kraus, 2015) These factors have been referred to by researchers as the four stages of perception-reaction.

The time between the appearance of some hazard and a response is filled with certain activities on the part of the driver. It helpful to divide the stages of perception-response into stages as a means of understanding both the nature of the activities and how altered circumstances can change total response time and decision making.

**Detection**

The first stage of the perception reaction sequence involves the driver's detection of a potential hazard. In this collision a driver was preparing to turn left at an intersection. To do this safely a prudent driver must scan the opposing lanes for oncoming vehicles. Using their knowledge of the roadways speed limit, and ability to estimate distance and the time, a driver should scan far enough down the roadway to permit detection of a vehicle (traveling at or around the legal speed limit) which may arrive at the intersection while they are turning.

It is unreasonable to expect a driver to scan further than the distance it would take for an oncoming vehicle to arrive at the intersection. Because of this, drivers tend to limit the distance at which they scan based upon the speed of the roadway and the distance of the approaching vehicle

In this investigation there exists EDR data which shows, when combined with time-distance calculations, the pre-collision actions and locations of the vehicles in 1 second intervals. The data reveals that V1 had slowed to less than 9mph as it approached the intersection, clearly demonstrating that the driver was aware of the need to slow and scan for potential hazards prior to turning.

**Identification**

If a driver becomes aware of a hazard, the driver must next acquire sufficient information to be able to decide what action, if any, is appropriate.

Likely due to the speed at which V2 was traveling, V2's the distance V1 when D1 decided to turn, and D2's lack of conspicuity due to his attire and lack of lateral motion, the driver of V1 did not detect V2 approaching, therefore he did not progress to the identification stage of PRT.

**Decision**

Once identification has been made the driver must decide what action, if any is needed, such as slowing, stopping, swerving, etc.

Due to the circumstances of the collision D1 did not have the opportunity to proceed to this stage.

**Response**

In this stage the brain sends instructions to the necessary muscle groups to carry out the intended action.

To illustrate the issue, we will consider the locations of each vehicle in (1) one second increments based upon their known pre-collision speeds.

To do this we must determine the time it took for V2 to decelerate from 83 mph (121 fps) to 77 mph (121 fps):

| Solving for Time to Decelerate | |
|---|---|
| **Explanation** | The equation will determine the time it takes to decelerate from one velocity to another velocity. |
| **Equation 2** | $t = \frac{v_0 - v_f}{32.2 \cdot f}$ |
| **Step 1** | $t = \frac{121 - 112}{32.2 \cdot .76}$ |
| **Step 2** | $t = \frac{9}{24.47}$ |
| **Solution** | $t = \mathbf{.35\ secs}$ |

We now know it took V2 .35 seconds to slow from 121 fps to 112 fps over the 43-foot skid distance.

Next, we use the first speed data point from V1's EDR to determine the distance V1 traveled while decelerating (working away from the crash) from 0 TRG (26.7mph/39fps) to -0.35 (25.5mph/37fps).

| **Solving for Distance to Decelerate (TRG 0 to -0.35 secs)** | |
|---|---|
| **Explanation** | The equation will determine the distance it takes to decelerate from one velocity to another velocity. |
| **Equation 2** | $d = v_0(t) \pm .5(32.2 \cdot f)(t^2)$ |
| **Step 1** | $d = 39(.35) - .5(32.2 \cdot .76)(.35^2)$ |
| **Step 2** | $d = 13.65 - .5(24.47)(.12)$ |
| | $d = 13.6 - 1.46$ |
| **Solution** | $d = \mathbf{15\ feet}$ |

Now we know how far V1 and V2 were from colliding t-0.35 seconds before the collision (Reference Point 1). Next, we back up each vehicle at 1 second intervals based upon their known speeds.

V2 remained at a constant velocity of 121 fps. Refer to each RP to determine the vehicles distance from the area of collision.

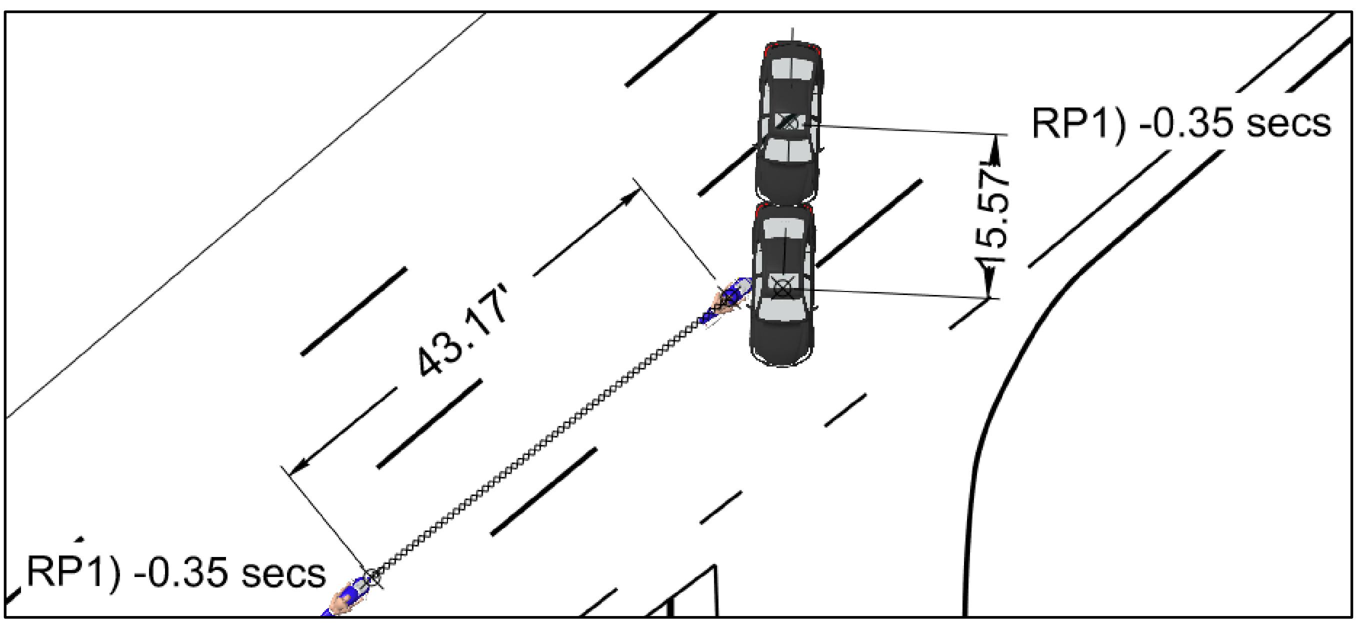



*Figure 6*

V1's speed increased gradually as it neared the area of collision. We will use one second intervals from V1's EDR report starting at -0.35, then data points -1.35, -2.35, -3.35, and -4.35.

| **Solving for Distance to Decelerate (-1.35 secs)** | |
|---|---|
| **Explanation** | The equation will determine the distance it takes to accelerate/decelerate from one velocity to another velocity. |
| **Equation 2** | $d = v_0(t) \pm .5(32.2 \cdot f)(t^2)$ |
| **Step 1** | $d = 29(1) - .5(32.2 \cdot .76)(1)$ |
| **Step 2** | $d = 29 - .5(24.47)(1)$ |
| | $d = 29 - 12.23$ |
| **Solution** | $d = \mathbf{16}\ \boldsymbol{feet}$ |

| **Solving for Distance to Decelerate (-2.35 secs)** | |
|---|---|
| **Explanation** | The equation will determine the distance it takes to accelerate/decelerate from one velocity to another velocity. |
| **Equation 2** | $d = v_0(t) \pm .5(32.2 \cdot f)(t^2)$ |
| **Step 1** | $d = 19(1) - .5(32.2 \cdot .76)(1)$ |
| **Step 2** | $d = 19 - .5(24.47)(1)$ |
| | $d = 19 - 12.23$ |
| **Solution** | $d = \mathbf{6}\ \boldsymbol{feet}$ |

| Solving for Distance to Decelerate (-3.35 secs) | |
|---|---|
| **Explanation** | The equation will determine the distance it takes to accelerate/decelerate from one velocity to another velocity. |
| **Equation 2** | $d = v_0(t) \pm .5(32.2 \cdot f)(t^2)$ |
| **Step 1** | $d = 13(1) - .5(32.2 \cdot .76)(1)$ |
| **Step 2** | $d = 13 - .5(24.47)(1)$ |
| | $d = 13 - 12.23$ |
| **Solution** | $d = \mathbf{1\ feet}$ |

| Solving for Distance to Decelerate (-4.35 secs) | |
|---|---|
| **Explanation** | The equation will determine the distance it takes to accelerate/decelerate from one velocity to another velocity. |
| **Equation 2** | $d = v_0(t) \pm .5(32.2 \cdot f)(t^2)$ |
| **Step 1** | $d = 12(1) - .5(32.2 \cdot .76)(1)$ |
| **Step 2** | $d = 12 - .5(24.47)(1)$ |
| | $d = 12 - 12.23$ |
| **Solution** | $d = \mathbf{1\ feet}$ |

Using the calculated time/distances we can obtain a better understanding of the distances that existed between each vehicle at 1 second intervals during the 4.35 seconds that preceded the collision.

***Table 2.1***

***Distances the vehicles were from one another at specific points prior t the collision.***

| Pre-Crash Time / Distance from Each Other | |
|---|---|
| **Time** | **Distance (ft)** |
| **-0.35** | 58.29 feet |
| **-1.35** | 191.09 feet |
| **-2.35** | 312.09 feet |
| **-3.35** | 436.80 feet |
| **-4.35** | 559.52 feet |

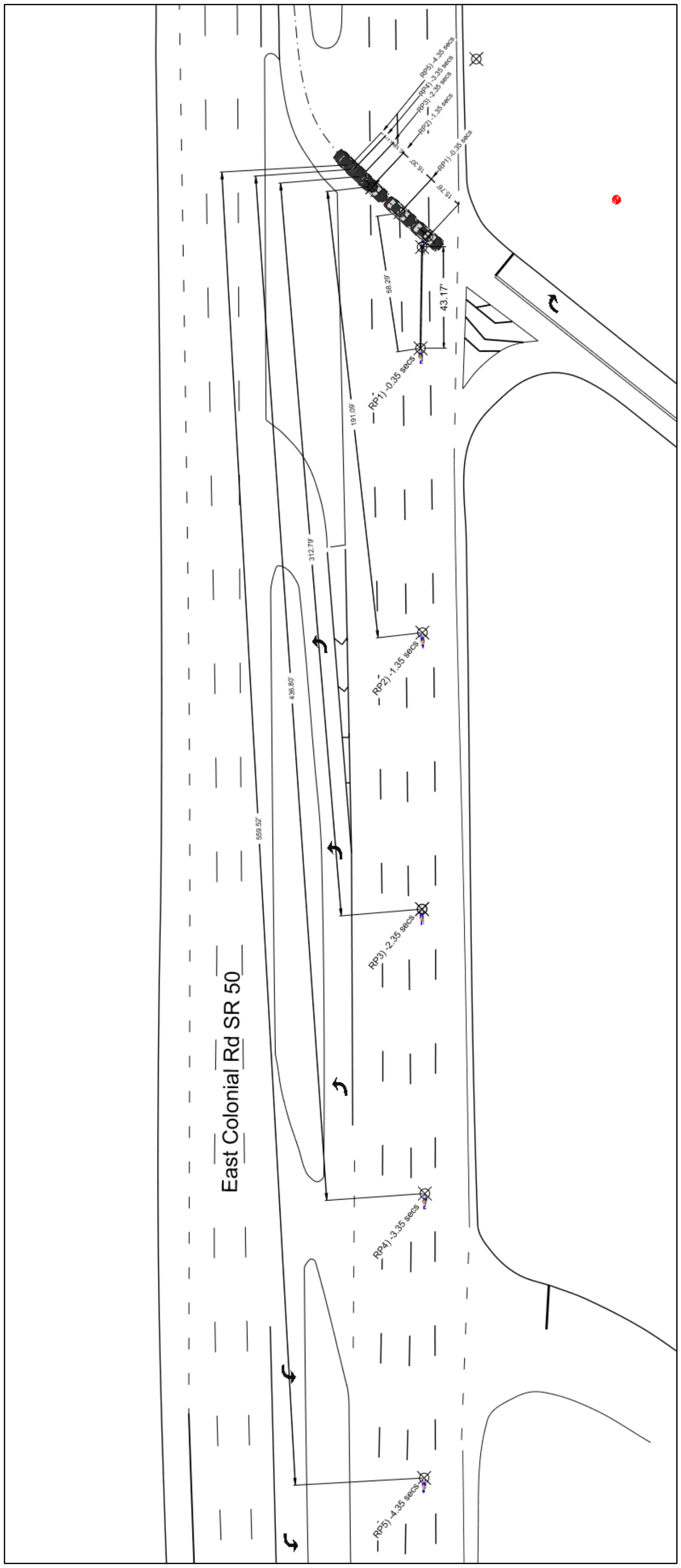

East Colonial Rd SR 50
43.17'
RP1) -0.35 secs
RP2) -1.35 secs
RP3) -2.35 secs
RP4) -3.35 secs
RP5) -4.35 secs

*Figure 7*

## 2.4 Time / Distance Comparison

As previously discussed, the driver of a vehicle preparing to turn left must scan far enough down the roadway to avoid turning in front of an approaching vehicle that might arrive at the intersection at the same time.

This begs the question, how far should a driver scan down the roadway to avoid a potential hazard? There is no guidance on the issue, even from the Florida Driver's handbook. Additionally, there is no statutory requirement setting the required distance a driver must scan. The answer is "*far enough to avoid a hazard based upon the circumstances that existed at the time, such as weather, roadway and vehicle condition, the speed of the approaching vehicle, et*c.".

To assist fact finders in determining how far would have been enough under the circumstances that existed at the time of the collision the following example will be discussed:

Example – Vehicle approaching at 50 mph (73.3 fps)
A driver about to turn left across a four-lane roadway must consider how long will it take to cross 66 feet over all the lanes. If a vehicle accelerates from a stop the driver can expect to travel approximately 24.47 feet every second, requiring 2.69 seconds to cross all four lanes. This time would have been less in this instance since V1 was already in motion.

A vehicle traveling at the posted speed limit of 50 mph will travel 73.3 feet every second. To be safe a considerate and cautious driver about to turn in front of the approaching vehicle should leave some separation between the vehicles when turning so as to not alarm the driver of the approaching vehicle.

According to EDR data V1 was at the intersection and about to turn at approximately -4.35 seconds prior to the collision. At the same time V2 was 570 feet from the intersection. The driver of V1 can expect a vehicle that is traveling at 50 mph (73.3 feet per second) to take (t=570 / 73.3) 7.77 seconds to arrive at the intersection.

**Conclusion**: If V2 had been traveling at 50mph and V2 had turned when V2 was 4.35 secs/552feet away, V1 would have completed a left turn 5 seconds **before** V2 arrived at the intersection.

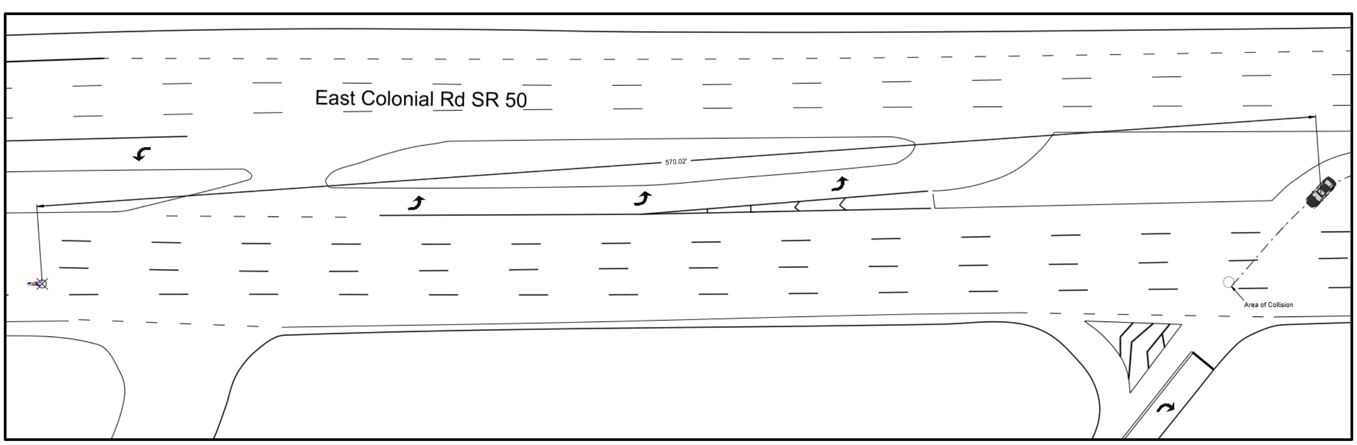



*Figure 8*

**Data Limitations**

It should be noted that EDR data is recorded at .5 second interval, meaning that the speeds recorded at each data point were true during the preceding .5, but not necessarily exactly when the data point is recorded. However, due to V1's relatively low pre-collision speeds and distances traveled during the acceleration the phase any deviation is inconsequential.

**Uncertainty and Sensitivity**

The collision reconstruction and speed estimations were based upon available evidence included in the discovery, photographs, measurements, and recorded observations of the FHP investigator. The scene evidence provided by FHP was limited to photographs, an un-scaled diagram, and basic measurements. Despite the limited information most evidence, such as area of collision, approach angles, departure angles, post collision paths, and final rest could be reasonably corroborated by photographs and logical deduction based upon the laws of physics and accepted collision investigation practices. In this reconstruction the approach and departure angles were determined using the roadway design to within a narrow range, but the exact value can never be determined therefore the speeds were ranged from the most extremes.

However, regardless of how carefully distances, angles, drag factors, grades, slopes, etc. are measured at a scene, the accuracy of the reconstruction calculations is dependent upon the quality of the information available to the reconstructionist. Every effort was taken to ensure that the provided results are within a reasonable degree of scientific certainty however due to the limited amount of data available during this reconstruction a statistical error rate of ±10% should be applied to stated speeds.

# 3.0 Conclusions

On Sunday, September 22, 2019, at approximately 2:35 am V1 Lexus was slowing to 8 mph while traveling westbound in the left turn lane of East Colonial Drive toward the intersection of East Colonial Drive and Amber Road, while preparing to turn left onto southbound Amber Road. V2 Suzuki was traveling eastbound at 88 mph in a 50-mph zone in the outside middle lane of East Colonial Drive toward Amber Road; while preparing to traverse the intersection and continue eastbound.

Upon V1 Lexus' reaching the intersection and preparing to turn left V2 was approximately 559 feet west of the intersection.

Due to the lack of conspicuity of V2 caused primarily by the distance V2 was from the intersection, but also the attire of D2 and the absence of lateral motion of V2, the driver of V1 Lexus did not perceive the approach of V2 Suzuki.

Having not seen V2, the driver of V1 proceeded to turn left and cross over the eastbound lanes of East Colonial Drive.

As the V1 Lexus crossed into the eastbound curb lane of East Colonial Drive V2 Suzuki arrived at the intersection and collided with V1 Lexus.

V1 Lexus rotated and rolled until reaching final rest. V2 came to final rest at the area of collision. D2 was ejected from V2 Suzuki, causing D2 to strike the passenger side of V1 Lexus and then vault 25 feet until reaching final rest.

# 4.0 Opinions

Based upon the totality of the circumstances discovered during the collision reconstruction it is this investigator's opinion that primary fault for the collision should be assigned to V2 for the collision for the following reason:

**1) Speed of V2 Suzuki**

a. Violation of Florida Statute 316.187(1) Establishment of Speed Zones – 88 mph in 50 mph zone

The rider of V2 chose to operate his vehicle at an unreasonably high rate of speed for the conditions and in violation of the posted speed limit, which reduced his conspicuity to other drivers by placing him outside the area a reasonable and prudent driver should be expected to scan when preparing to turn left. In doing so the rider of V1 created a situation that would have placed any reasonable and prudent driver in jeopardy of violating his right of way, thereby shifting fault for the collision to himself.

Respectfully Submitted

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# Appendixes

## Appendix A: Discovery Items Reviewed

| | Pgs. |
|---|---|
| 1) State Farm Vehicle Valuation | 9 |
| 2) Emergency Department Record D1 | 56 |
| 3) Emergency Department Record D1 1 | 56 |
| 4) Copy of 48-2020-CF-002956-O-DO NOT DISCLOSE- UNREDACTED(1) | 67 |
| 5) Bosch CDR Record V1 - incomplete | 15 |
| 6) Bosch CDR Record V1 - complete | 16 |
| 7) 48-2020-CF-002956-O-DO NOT DISCLOSE- UNREDACTED (1) | 67 |
| 8) 48-2020-CF-002956-O-Case Package Part 5 - Mix | 20 |
| 9) 48-2020-CF-002956-O-case package part 4 - THI Report | 40 |
| 10) 48-2020-CF-002956-O-Case Package Part 3 - Incident Rpt | 45 |
| 11) 48-2020-CF-002956-O-Advent Health Medical Records (1) | 89 |
| 12) Copy of 48-2020-CF-002956-O-Registration History for ID56WD | 5 |
| 13) 48-2020-CF-002956-O-Registration History for ID56WD | 6 |

# References

1) Refaat Hanna & Rory Austin, "Lower Extremity Injuries in Motorcycle Crashes", NHTSA Technical Report January 1997- December 2006, DOT HS 810 982, 2008

2) NHTSA "Motorcycle Crash Causes and Outcomes: Pilot Study – NHTSA", 2022 https://www.nhtsa.gov/sites/nhtsa.gov/files/811280.pdf

3) Hall, Graham, "Atltanto-Occipital Dislocation", World Journal of Orthopedics, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4363805/

4) Wikipedia "Atlanto-occipital dislocation" June 12, 2022, https://en.wikipedia.org/wiki/Atlanto-occipital_dislocation#:~:text=Atlanto%2Doccipital%20dislocation%2C%20orthopedic%20decapitation,cases%20result%20in%20immediate%20death.

5) "Crash Factors in Intersection-Related Crashes: An On-Scene Perspective", Mathematical Analysis Division, National Center for Statistics and Analysis, DOT HS 811 366, 2010

6) McNally, Bruce F. "Motorcycle Speed Estimates Using Conservation of Linear and Rotational Momentum" 2002

7) Krauss, D, "Forensic Aspects of Driver Perception and Response" 4th edition, Lawyers & Judges Publishing Company, 2015

8) FHSMV "Official Florida Driver Handbook", 2022 https://flhsmv.gov/pdf/handbooks/englishdriverhandbook.pdf

9) Lutkevich, "FHWA Lighting Handbook", 2012