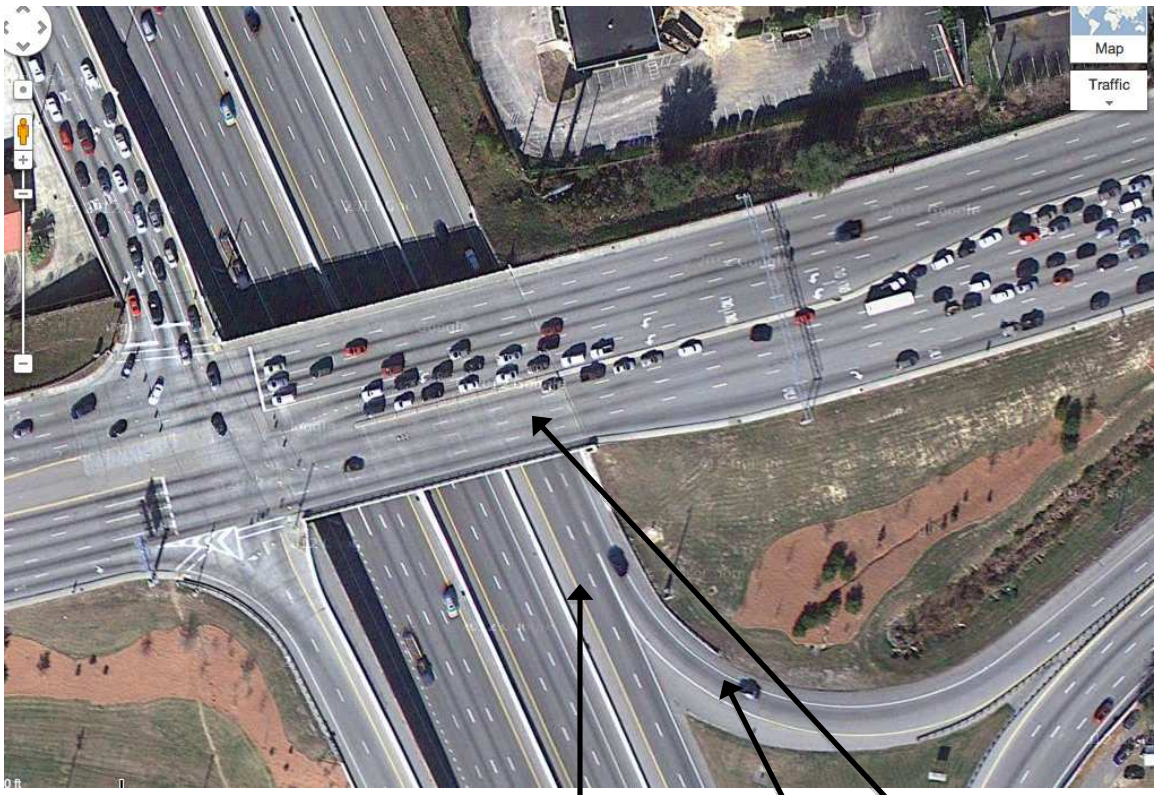
15 April 2012

ACCIDENT REPORT ANALYSIS

By Norman Ugolini, Civil Engineer, E.I.T.

The accident occurred on 14 April 2012 at approximate 7:50 PM on the bypass to Goose Creek, SC at the Ashley Phosphate on ramp to the bypass involving 3 cars.



Car 1 driven by Amanda Koster
Car 2 driven by Norman Ugolini
Car 3 driven by Tomas Jennings

Car 2 and 3 are traveling on the left most lane high speed lane

Car 1 entered the highway on the ramp

Accident site under the bridge

After leaving the curve of the entry ramp, car 1 immediately proceeds across 2 lanes of traffic (not utilizing the merge lane) to the left high speed lane into the path of car 1 and 2. Two seconds later the accident occurred the bridge.

Statement by Car 2.
Driver 2 claims driver 1 pulled in front of him after leaving the ramp, then Car 2 hit the brakes, causing car 1 to quickly slow down into car 2. Car 2 was then hit by car 3.

Statement by car 3
Mr. Jennings also told the driver of car 2 that car 1's brake lights were activated prior to impact.

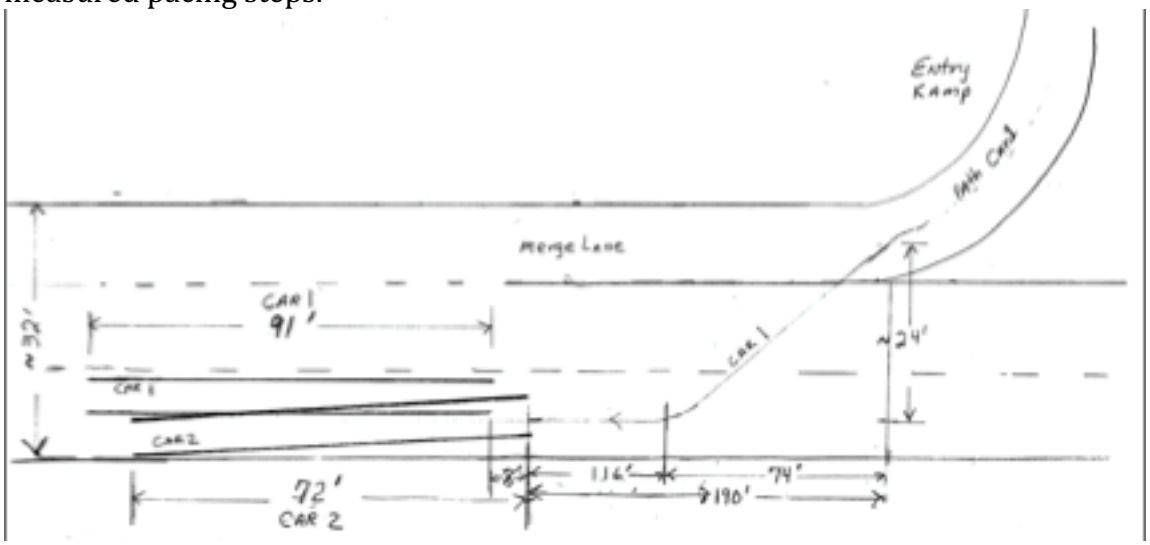
Highway Patrol Investigation at the scene
The highway patrol office L/CPL McAbee stated to Driver 2 that he found no evidence of the Car 1 braking and reported that car 2 skidded for a distance of 105 ft. These statements are incorrect and could possible be due to the investigation taking place at night on an unlighted highway with the danger of high-speed traffic impleading the data gathering.

Physical Analysis
<u>The following is an analysis of the PHYSICAL evidence at the crash site, and is not based on statements.</u>

Data Gathering
The morning following the accident when sufficient light was available N. Ugolini went to the accident site with a witness to take pictures (date/time stamped) of the skid marks and measure the actual distance of any skid marks.

The pictures clearly show two sets of skids marks (see attached).

Drawing of the physical measurements
This drawing is based on accurate physical measurements of the skid marks using a 100 ft. survey tape. Measurements with a ~ are approximate distances using measured pacing steps.



(see larger drawing in attachments)

Observed
Skid marks length and number of tracks.

Analysis
Measured distance indicates car 1 skidded for a measured distance of 91 ft and car 2 skidded for measured distance of 72 ft with 8 ft of separation between the two sets of skid marks. Adding 91 ft plus the 8 ft separation at the beginning of the skid (total of 99 ft) would account for the investigating officers estimate of approximately 105 ft of skid.

Observed:
There is 8 ft. of separation between the skids of car 1 and 2.

Analysis:
8 ft. of separation between skids, indicates both drivers had their foots on the brake at time of impact. Human reaction time is 1 to 2 sections. If a driver has the foot on the accelerator then 1 second of reaction time at 50 mph equates to 73 ft. of travel distance. At 40 mph, 1 sec reaction time equates to 56 ft. Since there is only 8 ft. of separation, the spacing of the beginning of the skid could only have occurred if both drivers were braking almost simultaneously.

Observed:
Car 2 skidded a distance of 72 ft. as the tire tracks moved out of the lane of traffic.

Analysis
A skid distance of 72 feet indicate a speed 37 mph or less, due to the fact a car with locked brakes takes longer to stop (sliding friction) then when quickly stopping with normal braking. Therefore the skid distance indicates car 2 was traveling slower than 37 mph. See chart.

Braking/Stopping Distances

MPH	Ft./Sec.	Braking Deceleration Distance	Perception Reaction Distance	Total Stopping Distance
10	14.7	5	22	27
15	22	11	33	44
20	29.3	19	44	63
25	36	30	55	85
30	44	43	66	109
35	51.3	59	77	136
40	58.7	76	88	164
45	66	97	99	196
50	73.3	119	110	229
55	80.7	144	121	265
60	88	172	132	304
65	95.3	202	143	345
70	102.7	234	154	388
75	110	268	165	433
80	117.3	305	176	481

37 mph ~ 70'

Observed
At the time of the accident, car 2 was ONLY damaged on the right side of the hood and the right quarter panel after being hit by two cars.

Analysis
It is important to note that the skid of car 2 was due to the back tires. Vehicular weight during a hard stop transfers to the front of the vehicle unloading the back of the car causing a rear wheel skid.

When car 1 and 2 collided, the force of the collision on the right front of car 2, created a coupled moment around the center of mass of car 2. The force on the right front combined with the unloaded locked rear tires, caused a rotation the back end of car 2 toward retaining wall (skid marks). The rotation exposed the passenger side of the car. Rotation was significant enough that only right front fender of the car 2 was damaged, leaving the entire right side of the car 2 untouched.

Car 3 was only lightly damaged on the left front fender and was able to drive away from the scene of the accident after hitting car 2.

Observed
Driver 2 reported Car 1 was in the left most lane for 2 seconds prior to impact.

Analysis
The distance from the end of the on ramp to the point of impact is approx. 190 ft.

Assuming car 2 was traveling at 40 mph leaving the on ramp (highly unlikely) the accident had to occur 3.27 seconds after leaving the on ramp (190 ft. / 58 ft. @40 mph).

It took approx. 74 feet or 1.27 sec for car 2 to travel from the ramp to the high-speed lane (74 ft. 58 fps@40 mph). Car 2 was established in the high-speed lane for 2 seconds or less traveling at 40 mph or less.

Conclusion

- Car 1 moved across 2 lanes of traffic 3 seconds after leaving an on ramp with a clearly marked merge lane.
- Car 1 traveled from the on ramp into the high speed lane in 74 ft. or less and did not use the merge or center lane.
- Car 1 was established in the high-speed lane for approximately 2 seconds or less traveling at 40 mph or less.
- At the time of impact, car 2 traveling in the high speed lane had significantly slowed down from the posted 60 mph to approximately 35 mph or less.
- No conclusion can be made from the physical evidence as to which driver put the brakes on first, but with 8 ft. of skid separation it can be clearly shown both car 1 and 2 had their feet on the brake at the same time with milliseconds of difference between application.
- The minor amount of damage to all cars indicate at point of impact the closure speed of the vehicles was very low.

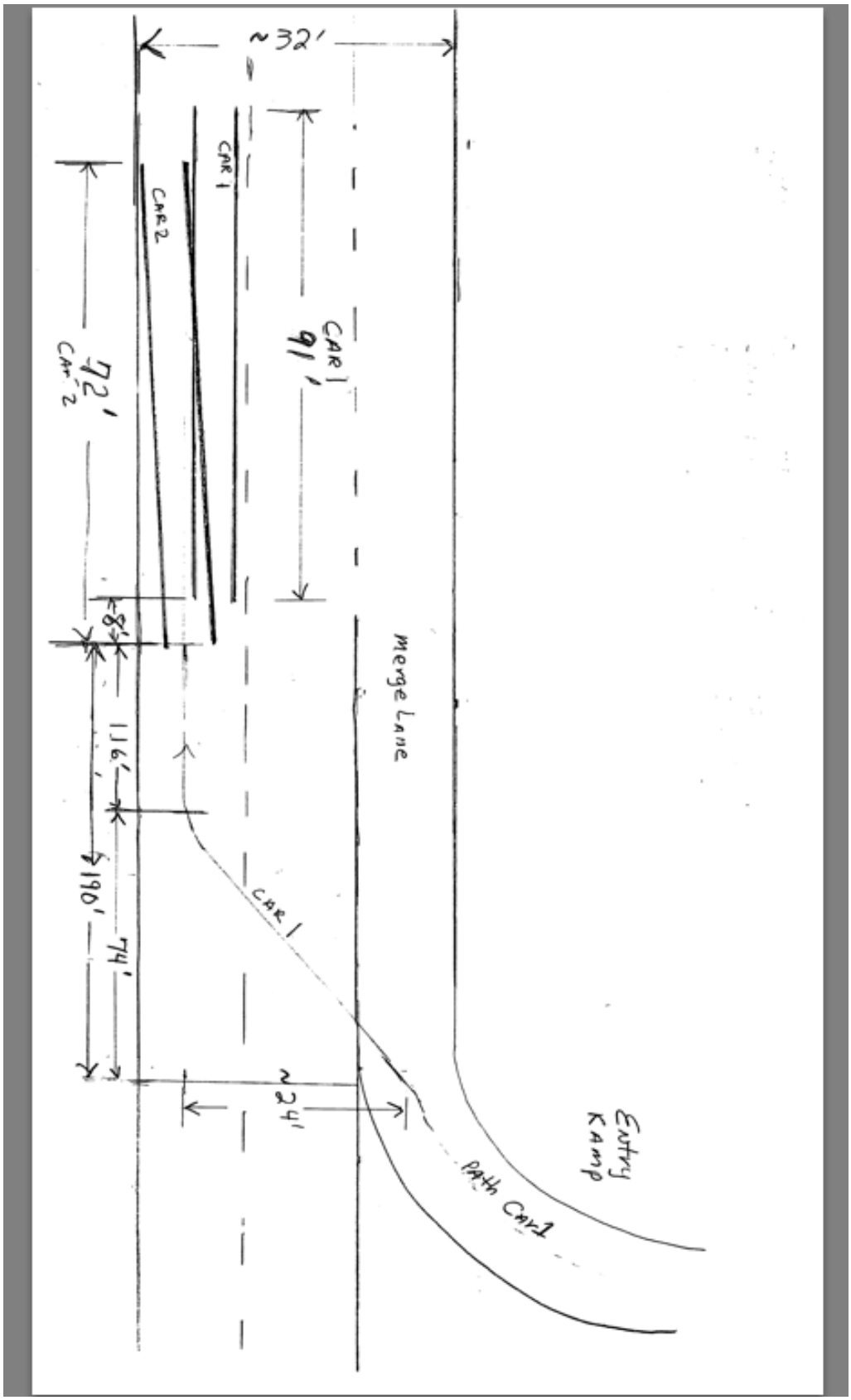


Figure 1: Diagram of accident site. **NOTE: DRAWING IS NOT TO SCALE**

Photo 1: Ramp, just prior to prior to entry onto the interstate ramp.


Photo: Just after officer left scene of accident indicating 2 sets of skit marks.

Photo: Start of accident skid marks. Note two sets of skids and position under the bridge ~190 ft from on ramp (where the truck is entering the highway).

Photo: Start of skid. Clearly shows both car 1 and 2 were skidding at time of impact.

Beginning of skid. Note the distance between the first and second set of skids measured at 8 ft.

Beginning of skid.

Midpoint of skid

Note: Two skid marks on left is from car 2, the two skid marks on right is from car 1 which extend beyond car 2's marks.

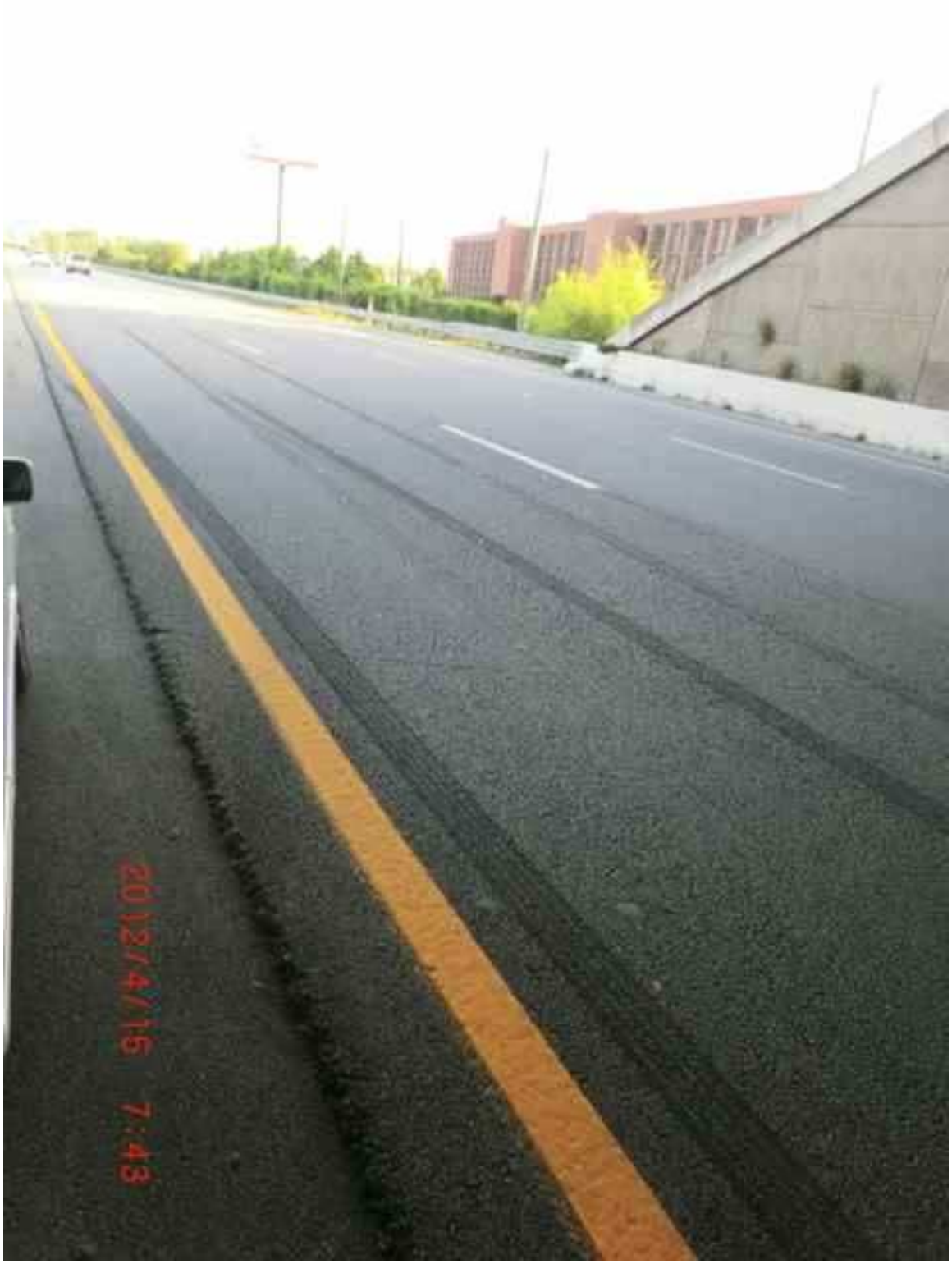


Photo: End picture of skid

Composite of entire skid.

Vehicle Damage

Damage to car 1 confined to left rear

Damage to car 2 confided to the right front of car. No other damage occurred.

At scene, at time of accident. Dusk lighting at approximately 8 pm.

Damage to car 3 confined to left front quarter panel and bumper. No other damage occurred.

Site conditions at time of investigation by highway patrol. Approximately 9 to 9:30 pm.