

Virginia Commonwealth University
Transportation Safety Training Center
Virginia Multi-disciplinary Crash Investigation Team

Report Number 209 – September, 2009

ABSTRACT

At the intersection of a major primary highway and a secondary road, a tractor and semi-trailer proceeded through a red light. A Honda Civic had just entered the intersection under a green signal, following several other vehicles. The front of the tractor struck the Honda broadside, impacting the driver's door area, killing the Honda driver. The tractor pushed the car through the intersection and traveled a significant distance before sliding to a stop. The truck was later found to have defective front brakes. The crash resulted in one fatality and extensive property damage.

This crash illustrates the importance of driving vigilantly, obeying traffic signals and the potential tragedy of running a red light. The issues of high crash locations, signal visibility and advance warning are addressed, along with the effects of defective brakes on vehicle performance.

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SYNOPSIS

Day, Time, Season: Monday, 9:53 a.m., Winter

Road/Weather: Primary highway; clear and dry

Vehicles Involved: 2000 Peterbuilt Tractor and semi-trailer
2002 Honda Civic 2 door sedan

Summary: The Peterbuilt ran a red light and struck the Honda broadside.

Severity: One fatality, extensive property damage

Probable Cause: Tractor driver failed to stop for red traffic signal.

Significant Points: Red light running, high crash locations, signal visibility

CRASH DESCRIPTION

On a sunny, dry Monday morning in winter, a 57 year old female was driving a 2002 Honda Civic west on a two lane rural road, approaching a “T” intersection with a primary highway that traverses a rural/mixed business area. The driver, who was wearing a lap/shoulder restraint, was on her way to a nearby nursing home to assist in the care of her elderly mother, a trip she made daily. The lanes on the secondary route are approximately 12 feet wide. There are no pavement markings except the double yellow lines and a stop line prior to its intersection with the primary road. Trees partially obscure a graphic “SIGNAL AHEAD” sign assembly posted in advance of the intersection, thus restricting the sight distance of the message.

The secondary road intersects a heavily traveled north-south primary route that consists of two travel lanes in each direction, separated by a grass median. In the northbound lanes, the sight distance is approximately 600 feet to the signalized intersection. Prior to that point, the view of the intersection is obstructed by a right curve and a group of evergreen trees that grow atop a small embankment on the right side of the road. The two through lanes are approximately 12 feet wide with left and right turn lanes which are approximately 12 feet wide at the intersection with the secondary route. The speed limit is 55 miles per hour (MPH). However, approximately 875 feet prior to the northbound signal, there are graphic “SIGNAL AHEAD” signs and flashers with advisory speed plaques indicating “45 MPH”. Also, “SIGNAL AHEAD” pavement markings are present on the northbound lanes prior to the intersection. The pavement is asphalt and in fair condition at the intersection. The pavement markings are in fair condition, and the signal, which uses light emitting diodes (LEDs), and signs are in good condition. In addition, snow plowable reflective pavement markers are installed on the primary route to help delineate the roadway at night and during inclement weather. There is no overhead lighting.

An unbelted 58 year old male driving a 2000 Peterbuilt tractor and pulling a semi-trailer was traveling north on the primary highway, approaching the intersection in the right lane. He had just picked up a load of sand which he had contracted to deliver to a location approximately 30 miles away. He had traveled less than 1/3 mile from his point of origin when he reached the intersection where a small car was stopped in the left through travel lane for a red light.

Four signal heads are mounted on a mast arm facing northbound traffic. The signals over the left turn lane and two through lanes were red. A green arrow point to the right was illuminated above the right turn lane. The traffic signal was green for the secondary road and

two cars had already passed through the intersection without incident. The driver of the tractor trailer entered the intersection despite having a red light above his lane of travel. The tractor collided with the Honda Civic mid-intersection, striking it broadside at the driver's door. Then, the tractor pushed the car 197 feet north and slightly to the east to final rest. Both vehicles came to rest in the roadway, blocking the right lane and shoulder. The Honda faced west, its front tires in the right lane and its rear wheels on the shoulder. The tractor and trailer faced north, resting partially on the shoulder with the rear section of the trailer blocking the right lane. When members of the Virginia Multi-disciplinary Crash Investigation Team (VMCIT) visited the scene, there were light tire marks in the middle of the intersection, indicating point of impact, but no tire marks beyond that.



Photo #1: View of primary highway looking north, direction tractor was traveling. The right turn lane has a green arrow; all other lights are red.

Several witnesses to the crash stopped to render aid and called for emergency help. The witnesses in the stopped northbound car ran to assist the Honda driver. Fire personnel were on scene within 5 minutes, followed by emergency medical workers and officers with the county

sheriff's department. As other deputies arrived, they began to manage traffic, shutting down all northbound lanes. A "Life Evac" helicopter was summoned, but the Honda driver was declared dead in an ambulance at the scene, a result of blunt force head injuries. Her body was transported to a local hospital for review by a Medical Examiner. The driver of the tractor trailer did not appear to be injured, but he was upset and breathing heavily, so he was transported by ambulance to the same hospital. After observation and evaluation, he was released the same day.

The deputy investigating this crash, a motor carrier specialist, gathered evidence and photographed the scene and the vehicles. The vehicles were towed to a secure storage lot, where further inspections were conducted by the deputy and by a State Police Motor Carrier Trooper. One northbound lane was reopened within two hours after the crash and normal traffic flow was resumed about thirty minutes later. The investigating officer cleared the scene completely three hours after the crash occurred.

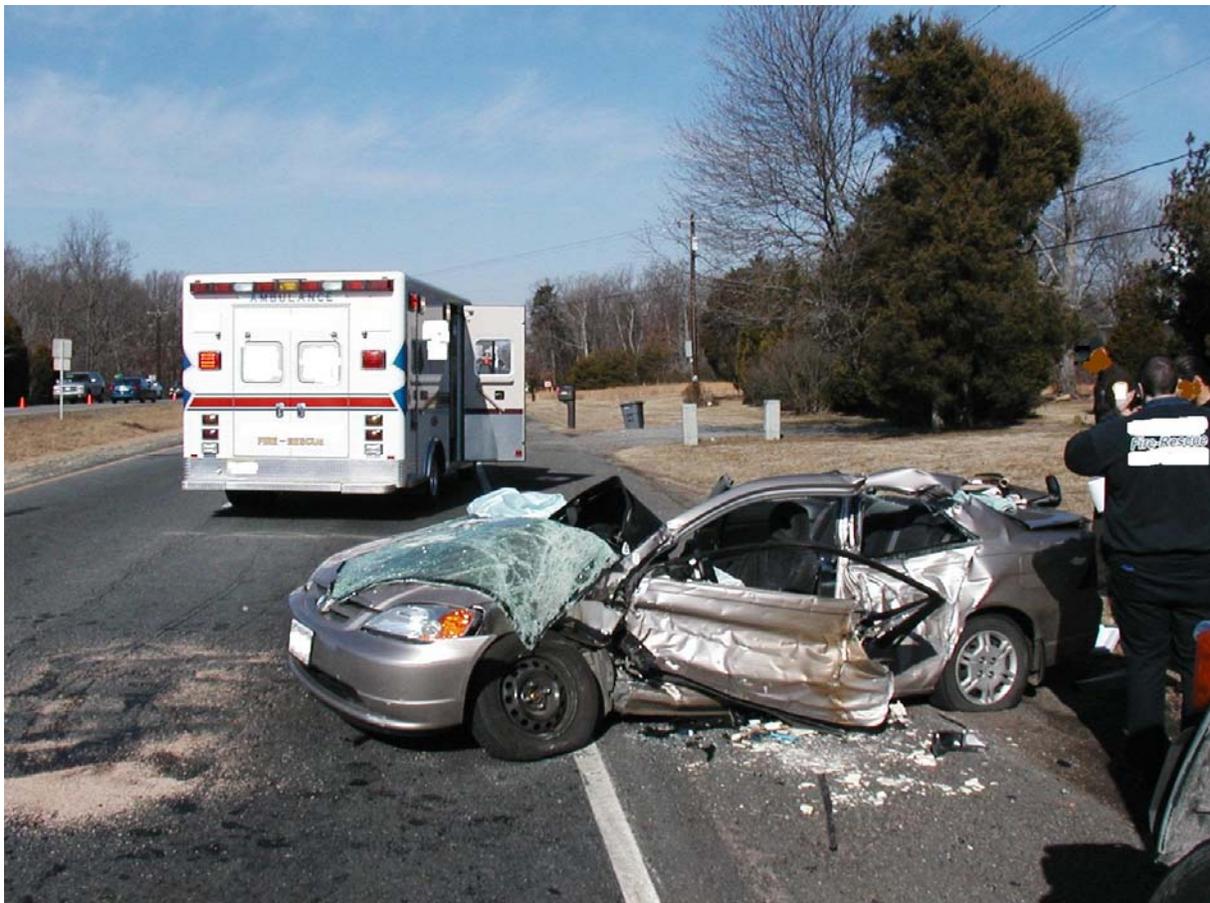


Photo #2: Honda at final rest.

REMARKS

Members of the Virginia Multi-disciplinary Crash Investigation Team (VMCIT) were first alerted to the crash when contacted by officers of the investigating agency. They had questions about the LED traffic lights because the tractor driver had stated that he thought the light was green. The initial issue was whether or not sunlight may have reflected on the traffic signal and somehow confused the driver. The VMCIT decided to visit the site and also learned that the intersection may have a high incidence of crashes. Following up, the Team decided to conduct a full investigation.

The Honda driver was familiar with the area and drove through this intersection on a daily basis, on her way to care for her mother. There is no evidence to indicate that she was impaired prior to the crash. The toxicology report for this 57 year old woman indicated that she did not have any alcohol in her system; no other drug tests were conducted. Her driving history did not reveal any infractions or prior crashes, and she maintained the maximum driver point balance of +5. This woman suffered blunt force head trauma as a result of the crash: she did not have skull fractures, but she was bleeding from both ears, an indication of a closed head injury.

The Honda had a valid inspection sticker, although it was about to expire at the end of the month. It appeared to have been in good shape prior to the crash. All four tires were deflated as a result of the collision, but they were a matched set and all showed good tread depth. The deceased driver, the registered owner, had purchased the vehicle new in January, 2003. A CARFAX report did not reveal any past crashes or problems. The only mileage reported was at initial purchase and the odometer was not readable when VMCIT members examined the car.

Both vehicles showed damage consistent with a side impact crash. The Honda had significant damage to the driver's side. Several points along the door had as much 30 inches of crush into the occupant area. Paint transfers on the driver door matched the tractor license plate letters. Both front airbags deployed during the collision, even though the forces exerted in the car were all from the side. Due to its age, this vehicle did not have side airbags.

The tractor and semi-trailer, which was loaded with sand at the time of the crash, weighed approximately 83,000 pounds. Damage to the front of the tractor was obvious where it struck the Honda. Inspection of the power unit by local officers revealed problems with the brakes on the steering axle. A large section of the front brake drum on the driver's side of the vehicle had been broken and removed prior to this crash. The remainder of the brake components

on this side had been removed as well. The brakes on the passenger side had significant defects also. The brake shoe linings, both upper and lower, showed extreme wear and were no longer in compliance with U.S. Department of Transportation (DOT) regulations. The brakes on the remainder of the vehicle were in compliance. Despite the deficient braking system on the front of the tractor, however, the problem should have contributed very little to the crash. Based upon data which was compiled from skid tests conducted by the Institute of Police Traffic Management, the general “rule of thumb” for braking percentages on a tractor and semi-trailer front or “steer” axle is 10% (Transportation Safety Training Center, 1999). If all other aspects of the system were functional, as reported in the motor carrier inspections conducted by local and state officials, approximately 90% of the braking potential should have been available.



Photo #3: Driver's side front brake drum.



Photo #4: Driver's side front brake drum removed.

One question to consider in this crash is the amount of time and distance the tractor driver had to perceive and react to the red signal and vehicles crossing his path of travel. Witness reports indicate that two vehicles had already negotiated the intersection successfully before the third in the line was struck. Using a scenario that assumes that these two vehicles utilized average acceleration rates, the northbound lanes should have had a red light for at least 9 seconds prior to the crash. If the tractor was traveling at a constant 55 mph (speed limit), it would have been approximately 725 feet from the point of impact when the light turned red. Based on sight distance, first visibility (point of possible perception) of the traffic light gave the tractor driver more than 600 feet to stop his vehicle before the intersection. Also, warning signs displaying flashing lights and a recommended 45 MPH speed limit are on both sides of the northbound lanes to indicate an intersection ahead. These signs, which are about 875 feet from the

intersection, were working properly when examined by members of the VMCIT. Even fully loaded, the tractor would have had enough time to stop his vehicle safely if the driver was alert to the changing conditions.



Photo #5: Damage to tractor. Honda is parked to left.

The road conditions at the time of the crash were good for this time of year. The roadway was dry and the weather was clear and sunny when the crash occurred just before 10 a.m. At that time, the sun would have been to the left and slightly behind the tractor driver as he approached the intersection. The traffic signals were equipped with light-emitting diodes (LEDs). The tractor driver initially stated that he thought his light was green, raising concerns on the part of investigators about the perceptibility of the LED light colors. Research on transportation lighting revealed that there is essentially no difference between red LED and incandescent signal lights of the same luminance (a physical measurement of projected light) when human subjects were tested on measures such as in detection, reaction times, conspicuity

and color identification during daylight conditions (Bullough, Boyce, Bierman, Conway, Huang, O'Rourke, Hunter & Nakata, 2000). When members of the VMCIT evaluated the site at the same time of day and under conditions similar to when the crash occurred, the red signals over the left turn lane and two through lanes were clearly visible from the maximum sight distance. The red and green colors were easily distinguishable and the lights were positioned correctly on the signal head, with the red light at the top and green at the bottom.

According to the Virginia Department of Transportation (VDOT), staff members reviewed signal clearance times on February 19, 2009 and found the timing to be in accordance with guidelines outlined in Traffic Engineering Memorandum # 306 dated August 16, 2001. This memorandum establishes the method of the timing of the yellow change intervals and all red intervals of traffic signals.

While examining the scene, members of the VMCIT observed several cycles of the signal system and noted that when the secondary road has a green light, the right turn lane on the northbound primary road has a green arrow. When the signal heads on the mast arm over the left turn lane and the two through travel lanes are red, the right turn arrow is green. As a driver approaches the signal from the south, the right turn arrow is the last to become visible because of the curvature of the roadway and several trees slightly blocking visibility. Consequently, the last light the Peterbuilt driver would have seen as he approached the intersection would have been the green turn arrow. All other lights, which would have appeared in his field of view earlier, were red. This information should have been sufficient to alert him that he needed to stop his vehicle.

In addition to signal information, the driver failed to perceive or react to the actions of other vehicles in the intersection. Two vehicles ahead of the Honda passed through the intersection and turned left while the tractor's signal was red. Furthermore, a witness reported that her northbound vehicle was stopped in the left travel lane, adjacent to the tractor's lane, and it been fully stopped for some time. These reports and actions are consistent with the conclusion that the red light was not "fresh"—it had not just turned red as the tractor approached. It also raises the question as to why the driver failed to respond to a multitude of visual cues signifying a need to stop. He did not indicate to the investigating officers that he was distracted by any other task, and emphasized instead his belief the light was green. He reported that he had waited for a logging truck to pass him before entering the primary highway less than 1/3 mile from the crash site. The logging truck was "several hundred yards ahead" and had already passed through

the intersection when the tractor driver reported observing the green right turn arrow. He appears to have focused on those two pieces of information, disregarding all other cues, incorrectly concluding that he had the right-of-way.

The 58 year old tractor driver, although residing in a different geographic region of the state, was familiar with the area and the route he was traveling that day. He rose early on the day of the crash and left home at 5:00 a.m., driving approximately 90 miles to a VDOT office to get certified to carry salt and/or sand. He then drove approximately 28 miles to the facility that housed both the company that brokered his services and the company that held the load of sand he picked up. He was aware that the brakes on his tractor were defective: he had purchased replacement parts. After picking up the trailer of sand, he dropped off new brake drums and pads he had purchased to replace the worn and missing front brakes. His intention was to deliver his load of sand to a location about 30 miles away and then return to have the repairs made to his tractor.

This driver had both a regular and a class A commercial driver's license with no restrictions. His driving record showed three driving related convictions stemming from two traffic stops. These left his driver point balance at +1. Two years prior to the crash, he had been convicted in absentia of speeding 10-14 MPH above the 55 MPH limit (-4 points) and of operating an uninspected vehicle (0 points deducted). One month prior to the crash, in the same jurisdiction of the crash, he was convicted of driving with defective equipment, an offense that does not result in a driver point deduction. A review of the court data related to that offense revealed that he had initially been charged with driving 69 MPH in a 55 MPH speed limit, the same charge as his earlier conviction. This charge would normally result in a fine of \$75.00 or higher and a 4 point deduction on his driving record with DMV. This would have created a - 3 driver point balance. Instead, the judge reduced the charge to "defective equipment", which results in no point deduction. The judge fined him at a level consistent with speeding, however, since defective equipment violations typically result in fines of about \$25.00. This approach, which may not be unusual, skews individuals' driving histories. This, in turn, may alter future judicial decisions if the offender repeats. Additionally, it fails to hold drivers accountable for their specific actions, limiting the effectiveness of punitive measures on influencing driving behavior. Repeated across cases and jurisdictions, the cultural message is that driving is an area where people are not responsible for their actions, despite the potential for harm to themselves and others.

As a result of this crash, the tractor driver was charged with a felony: involuntary manslaughter, and two traffic offenses: reckless driving and operating a vehicle with defective equipment. He requested a trial by jury. However, when his lawyer was unable to get the information about the defective brakes suppressed, the driver agreed to change his plea to guilty under an Alford plea (he did not admit guilt but recognized that the prosecutor had sufficient evidence to convict him of the charge and waived his right to a trial). As part of the plea agreement, the two traffic offenses were not prosecuted. As this report went to press, the driver had his bond revoked and he was awaiting sentencing in the county jail. The maximum sentence for involuntary manslaughter is 10 years in prison.

According to a VDOT (2007) publication, *AVERAGE DAILY TRAFFIC VOLUMES with VEHICLE CLASSIFICATION DATA on INTERSTATE, ARTERIAL, and PRIMARY ROUTES*, the traffic volume on this section of the road is 24,000 vehicles per day. This geographic area has experienced significant population growth, which has changed the vehicle density (especially during morning and evening commute times), as well as the general character of the highway. What was once an uninterrupted rural road has become a highway punctuated by an increasing number of signalized intersections with one or more turn lanes. The vehicle types are mixed, including commercial tractor trailers making long business runs, as well as local commuter and residential vehicles.

A crash history for this intersection was developed based on FR300 forms (Police Crash Report) for crashes reported between 5/1/05 and 5/30/08. A total of 25 crashes were reported, with the majority related in some way to the traffic signal. Fourteen angle crashes involved one vehicle running the red light. In thirteen of these, the violating vehicle was traveling on the primary route; one was on the secondary leg of the intersection. There were six rear end collisions reported, all involving at least one vehicle stopped for a red signal. Four of these occurred on the primary leg approaching the intersection from the south. Four other collision crashes occurred which were not related to the signal phase and one run off road/fixed object crash was reported, although that driver claimed that he was avoiding a collision with a red light running vehicle. It is clear from this data that the red signal phase played some role in the majority of reportable crashes occurring at this intersection. Drivers either misjudged the conditions and timing of light phases or they acted in disregard of the available information.

Because they are points of conflict and changing driving conditions, intersections are inherently locations of higher crash potential, as compared to uninterrupted segments of

highway. It is more difficult to assess whether a specific intersection's crash occurrence is higher than that for other intersections. However, the number of crashes involving error with respect to the red signal phase at this intersection is disconcerting and appears to warrant closer attention and possible remediation. Since the crash, VDOT has completed an intersection review and made the following recommendations for roadway changes:

- (a) Remove trees on the VDOT right-of-way and prune the overhanging branches, opening up line of sight approaching the signal heads northbound lanes on the primary road.
- (b) Prohibit U-turns in each direction to reduce conflict points.
- (c) Close in 200 feet of skip lines on the northbound approach to discourage lane changes.
- (d) Install an advance set of "SIGNAL AHEAD" signs with distance plaques (1300 feet) in advance of the existing "SIGNAL AHEAD" signs and flashers.
- (e) Install 2 sets of rumble strips on the northbound approach—one set prior to the existing "SIGNAL AHEAD" message and another set 200 feet north of the message.
- (f) Upgrade and relocate warning signs on the secondary route approaching the signal and add "SIGNAL AHEAD" pavement message.

The recommendations included a suggestion to increase law enforcement efforts in the area.

It should be noted that a cost benefit analysis is currently underway to consider eligibility for funding of possible intersection improvements under the Highway Safety Improvement Program. These improvements might involve intersection redesign, possibly including measures to widen the roadway and cut back the embankment to increase sight distance

Lateral collisions are more likely to result in fatal injury. Reviews such as the one cited above can help reduce some of the conflict—and consequent crashes—at intersections, if appropriate engineering changes are identified and implemented. Law enforcement and engineering measures that reduce the number of red light violations could also reduce exposure to these potentially tragic crashes. The element of human choice is an important factor as well. Drivers must take driving seriously. They must conscientiously and consistently operate vehicles only when all equipment is in good working condition. Then, every time a driver gets behind the wheel, he or she must pay full attention to the driving task, making a safe trip their

highest priority. Failure to do so may result in consequences that are devastating to many people. The victim in this crash lost her life; her family and friends are deprived of the values she brought into their lives, materially and psychologically. The tractor driver, now a convicted felon, has lost his freedom, as well as his business and ability to earn a living. His family no longer has the benefit of the material and psychological value he brought to their lives. Crashes result only in losses for those involved.

RECOMMENDATIONS

1. In addition to implementing its internal recommendations, the Virginia Department of Transportation should remark the pavement markings at this intersection.

2. The Virginia Department of State Police (VSP) and local law enforcement agencies should review safety at this intersection, considering heightened enforcement efforts to deter speeding, unsafe following distances, traffic signal violations, and commercial motor vehicle violations.

3. The Department of Motor Vehicles and VSP should provide feedback to judges on the long term effects of lessening charges and delaying consequences to violators. This feedback, which could be disseminated during the annual Judicial Transportation Safety Conference, should include information about the effects on:
 - (a) individual drivers, who may come to believe that the laws are not strictly upheld and therefore need not be obeyed,
 - (b) the safety of others traveling the highways of the Commonwealth when violators are not identified appropriately and sanctions are delayed or eliminated, and
 - (c) law enforcement officers, when their efforts to enforce the laws result in a low likelihood of conviction for the original charges.

REFERENCES

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