

ENGINEER'S REPORT

of the

BUS V. CAR CRASH

January 19, 2011

1. INTRODUCTION

This two-vehicle crash occurred at ~11:00 a.m. on Friday, September 15th, 2006, at the Stop sign controlled intersection of West 261st Street and Tyndall Avenue, Bronx County, New York. The crash involved a 2006 Toyota Camry Solara two-door coupe, driven by Car Driver and a 2005 Bluebird school bus, owned and operated by Bus Company, and driven by Bus Driver. A passenger in the car and was seriously injured by the crash.

This investigation was conducted to determine if Bus Driver's driving was improper in a manner that was a cause of the collision.

2. MATERIALS AVAILABLE FOR REVIEW

1. Police Accident Report.
2. Photos:
 - a. Three 8-1/2 x 11" color copies of photos of the crash scene and vehicles.
 - b. Two 8-1/2 x 11" black and white copies of photos of the crash scene and vehicles.
 - c. Five 8-1/2 x 11" color copies of photos of the damaged bus.
 - d. Eight 4 x 6" black and white copies of the damaged bus.
 - e. Six 8-1/2 x 11" color copies of photos of the damaged car.
 - f. Eight 4 x 6" black and white copies of the damaged car.
3. Examinations before trial:
 - a. Bus Driver Oct. 20, 2008
 - b. President of Bus Company May 28, 2009
4. Correspondence between a neighbor and the DOT:
5. My December 4, 2007, and January 28, 2008, site inspections, measurements and photos.

3. DESCRIPTION OF THE CRASH

The police report states:

At T/P/O Veh. #1 [Car Driver] states he came out from the stop sign. States he did not see any vehicles close by but did see the bus from a distance. Veh. #1 also states he pull out fast from the stop sign, after pulling out he collided with Veh. #2. Veh. #2 [Bus Driver] states Veh. #1 was going fast and it was too late for her to stop when she collided with Veh. #1. Air bags deployed in Veh. #1.

The police report shows environmental conditions as daylight visibility, wet pavement and rain. However, Bus Driver testified that there was no rain and that the road was dry, during her approach and at the collision¹.

¹ Bus Driver EBT page 36.

The crash scene and vehicle photos show that impact was the front of bus to the right side of the Toyota. Both vehicles rotated from impact, in opposite directions: the bus rotated clockwise and the car rotated counter-clockwise. The bus and car aligned and traveled diagonally across W 261st Street. The bus mounted the sidewalk and the front of the bus hit into the corner of a private property retaining wall. This made a U-shaped impression on the front of the bus. The bus rotated clockwise from this impact, pushing the Toyota into a tree and making a vertical indent on the left side of the Toyota. The Toyota also mounted the sidewalk, but did not reach the property wall.

4. DESCRIPTION OF THE CRASH SITE

The crash occurred at the cross intersection of West 261st Street and Tyndall Avenue, Bronx County, New York. Surrounding land use is medium density residential. Terrain is generally level through the intersection, with eastbound West 261st Street on a 2% downgrade.

Tyndall Avenue is oriented south-north and W 261st Street east-west. Both roads are two-way, urban streets. There are curbs and sidewalks on all legs of the intersection.

Stop signs are present on Tyndall Avenue. W 261st Street is uncontrolled at the intersection. The speed limit is the City-wide 30 mph.

Both streets are 30 feet wide, with parking permitted both sides. Neither street has a marked centerline.

Based on the correspondence to and from the Bronx Borough Commissioner for the NYCDOT, there have been a number of collisions at the crash intersection.

5. DEPOSITION TESTIMONY.

5.1 *Bus Driver.*

- She has been driving bus for Bus Company since 1987 and this route since Bus Company started working for a local college.
- The route has been the same. She traverses it 16 to 18 times a day. It takes 8, 9 minutes.
- The bus was a Bluebird.
- The day of the crash was the first time she had driven this particular bus.
- She is familiar with the crash intersection. She approaches it slowly, carefully.
- She is not aware of prior accidents at the intersection.
- She thinks the speed limit is 25 mph.
- There is no marked centerline on 261st Street.
- Her vision of the intersection is never obstructed by parked cars.
- Her bus always fits in her lane of travel as she approaches the intersection.
- As she approached the crash intersection, and at the time of the crash, the weather was cloudy, there wasn't any rain, and the road was dry.

- She made a last stop before the collision at Delafield, one stop sign prior to the crash intersection.
- There were parked cars on 261st Street, but they did not obstruct her view of the intersection.
- She did not see the car prior to impact. The first she knew of the collision was “When I got hit on the side.”
- She felt the collision. The impact was “hard”.
- She has no idea of the speed of the car.
- She concluded that the car “...didn’t stop. It was slowly coming into the intersection”. But she doesn’t know why she reached that conclusion other than “When I went into the intersection, if they would have saw me, they would have stopped”.
- Her speed was between 10 and 15 mph at the collision. “I was going slow”.
- She did not brake or swerve prior to impact.
- She did not hear skidding prior to impact with the car; she did hear skidding after impact.
- The collision was in the middle of the intersection.
- After the collision, her bus hit the “front stoop”.
- She was wearing a seat belt. The bus does not have an air bag.
- At impact with the car, her head hit the side window and broke it, her knees jammed up against the dashboard and she took a “big hard jolt” forward.
- At impact with the steps, her neck jerked back real hard; it was a “pretty bad” impact.
- She had a passenger girl on the bus.

5.2 *President of Bus Company.*

- Since 1996 he has been the president of Bus Company.
- He started as a driver in 1980.
- The bus involved in this crash was 37’ long, 8’ wide and weighed 19,587 pounds.
- They have serviced two local colleges for 12 years.
- Bus Driver has been driving the route since the beginning.
- They took over the route used by another provider; however, he reviewed the route and is very familiar with it.
- It is a 15 minute route. The run can be done in 12, 14 minutes.
- He is familiar with the intersection. There is no issue regarding visibility.
- 261st Street is not a wide street. If trucks or cars are coming, bus has to pull over. Bus has “...got to go slow all the time...” “You got to go slow and maneuver the cars.”
- There was one passenger on the bus at the crash.

6.0 *Safe bus speed.*

261st Street is 30 feet wide, with parking permitted on both sides of the street.

Allowing 6 feet for parking, the width available for travel in one direction is 9 feet. The width of the bus is 8 feet. It is normal to leave space between a moving vehicle and a side obstruction². Therefore, it is probable that the bus will frequently be in the opposite lane.

If an urban collector street were to be built in 2005, in a residential area, the minimum travel lane would be 10 feet wide, with 12 feet desirable, and the minimum width parking lane would be 7 feet, with 8 feet desirable³. Thus, the total width of street would be 34 to 40 feet, in comparison to the 30 foot width of West 261st Street.

261st Street is a narrow street for bus operations. As stated in the New York City Transit Authority's bus operator training program⁴,

4) NARROW STREETS

Before entering a narrow street, make sure there is enough room for you to pass down the street, whenever possible.

Continually check your side clearances. Maintain at least 3 feet on each side.

If a car or other obstruction is blocking a narrow street, and it appears that the obstruction will be cleared soon, wait. If you must wait more than a few minutes, call your dispatcher for an alternate route.

If you are turning into a narrow street, you will have to move farther into the intersection. Make sure you can enter safely.

Drive at no more than 15 MPH.

If you meet a car coming from the other direction, do not back up. If necessary, ask the other driver to back up.

I conclude that the safe speed for bus operations on 261st Street is a maximum of 15 mph, and that Bus Driver's bus was likely not in proper position as it approached the intersection pursuant to safe commercial bus operation.

² New York City Transit Authority bus drivers are to maintain at least 3 feet clearance. See *New Bus Operator Road Training Program*, NYCTA/MaBSTOA, about 1992, page D-II-26.

³ Highway Design Manual, Exhibit 2-6, NYSDOT. 2005

⁴ Page D-II-26

6. RECONSTRUCTION and ANALYSIS.

6.1 Vehicle damage – Toyota. There is major contact damage to the right side, from behind the headlight area through to the top of the windshield. The car is bent at the midpoint of the passenger door. The outer skin of the passenger door is torn off. The rear window is gone, as are most windows in the car. There is a vertical rounded imprint on the left side just in front of the rear wheel. There is no frontal contact damage. The left front wheel is partially detached and lying on the ground. The right front wheel is bent in at the top. Both rear wheels are intact.

6.2 Vehicle damage – bus. Scrapes on front bumper extend from the left corner to a little past center. The left front of the bumper is pulled forward and down. There is a rounded imprint on the bumper, dead center. The left headlamps are broken and the left front corner of the sheeting is scraped, pushed back and bent under. The left sheet skirting is pulled out. Horizontal marks on the left front corner extend up to just under the window molding. The window to the left of the driver's position is cracked.

6.3 Collision events. Impact was left front of bus to right side front of Toyota. The marks on the bus indicate the right side of the car was lifted up on the front of the bus. The front corner of the bus bumper is pulled out and heavily marked on top. The damage to the vehicles indicates the angle of impact was not perpendicular. The car pushed across front of bus, not into the side of the bus. The right door of car caught on corner of bus. This peeled off the outer skin of the car door and pulled out the left skirt of bus. The vehicles were fully engaged at impact. Both vehicles rotated from impact, in opposite directions. The bus and the car aligned and traveled diagonally across W 261st Street. The front of the bus hit into the corner of a private property retaining wall, at the steps to the elevated entrance. This made the U-shaped impression on the front of bus. The bus rotated clockwise from this impact, pushing the Toyota into a large tree, which made the vertical indent on left side of Toyota. The Toyota did not reach the wall.

6.4 Bus speed. The bus speed is determined by combining energy dissipation during different phases of the collision to determine post-impact speeds of both vehicles, and a conservation of momentum analysis at impact. The phases were: final rotation which pushed the Toyota into a tree; impact with a property wall, which pushed in the front bumper; movement across the street after impact with the Toyota to impact with the wall.

Assumptions regarding speed determination:

- It was a 2005 Bluebird bus with the weight stated by President of Bus Company.
- There was the driver and one passenger aboard the bus at impact.
- Maximum deformation of the front bumper at wall impact was 12 inches.
- The Toyota was a 2006 Camry 2 door Coupe, SE model.
- The bus driver did not brake or steer prior to the collision.
- Energy loss due to the Toyota's impact with the tree is neglected.

- Bus Driver did not brake after impact.

Based on the analysis and assumptions, the speed of bus at impact was at least 22 mph. Bus Driver's speed was significantly higher than the 10 to 15 mph Bus Driver said her speed was at impact.

6.5 *Affect of bus speed.* According to Car Driver, he accelerated rapidly from a stop to impact. Assuming the left side of the bus was at the unmarked center line of 261st Street, and that Car Driver started with the front of his car 4 feet north of the curb, the Toyota travelled 26 feet to impact.

The Toyota can accelerate from a stop to 30 mph at 13.8 ft/sec/sec⁵; however, the typical rate for rapid acceleration to less than 20 mph is 9.7 ft/sec/sec⁶. Using the latter acceleration rate, the Toyota's speed at impact is calculated to be 15 mph, and the time to move from a stop to impact was 2.3 seconds. During the 2.3 seconds, the bus travelled 75 feet. If the bus had been travelling at 15 mph, as claimed by Bus Driver, the bus would have arrived at the impact point 1.1 seconds later than it did, the Toyota would have travelled more than 24 feet further and would have been well clear of the bus.

If the Toyota accelerated at a normal rate of 4.8 ft/sec/sec, the Toyota's speed at impact is calculated to be 11 mph, and the time to move from a stop to impact was 3.3 seconds. During the 3.3 seconds, the bus travelled 106 feet. If the bus had been travelling at 15 mph, as claimed by Bus Driver, the bus would have arrived at the impact point 1.6 seconds later than it did, the Toyota would have travelled more than 25 feet further and again the Toyota would have been well clear of the bus.

The high speed of the bus was a cause of the collision.

6.6 *Bus Driver's attentiveness.* Bus Driver testified that she did not see the car before impact.

To stop from 22 mph, Bus Driver needed 27 feet, which is equivalent to 0.8 seconds of travel time at Bus Driver's least speed. Therefore, Bus Driver had sufficient time to have seen, reacted to the crossing Toyota and braked to avoid this collision.

That Bus Driver did not see the crossing Toyota prior to impact shows that she was not attentive. There was sufficient time and distance for her to have stopped and avoided this collision, even from her speed of 22 mph. Bus Driver's inattentive driving was a cause of this collision.

⁵ Expert Autostats for a 2006 Toyota Camry Solara, 2 door coupe.

⁶ *Chapter 6—Drag Factor and Coefficient of Friction in Traffic Accident Reconstruction. Traffic Crash Reconstruction*, Lynn B. Fricke, Northwestern University Traffic Institute. (2010) Page 176.

7. FINDINGS

Within the bounds of reasonable certainty, and subject to change if additional information becomes available, it is my professional opinion that:

1. The front of the bus hit the right side of the Toyota. The Toyota did not run into the side of the bus.
2. 261st Street is a narrow street for bus operations. Bus Driver's bus was likely not in proper position as it approached the intersection pursuant to safe commercial bus operation.
3. The safe speed for bus operations on 261st Street is a maximum of 15 mph.
4. The bus' speed at impact was at least 22 mph.
5. The bus was being driven at a dangerous speed.
6. Had the bus' speed been 15 mph there would not have been a collision.
7. The high bus speed was dangerous and a cause of the collision.
8. Bus Driver had sufficient time to have seen, reacted to the crossing Toyota and braked to avoid this collision.
9. That Bus Driver did not see the crossing Toyota until impact shows that she was not attentive.
10. Bus Driver's inattentive driving was a cause of this collision.