



# National Transportation Safety Board

Washington, D.C. 20594

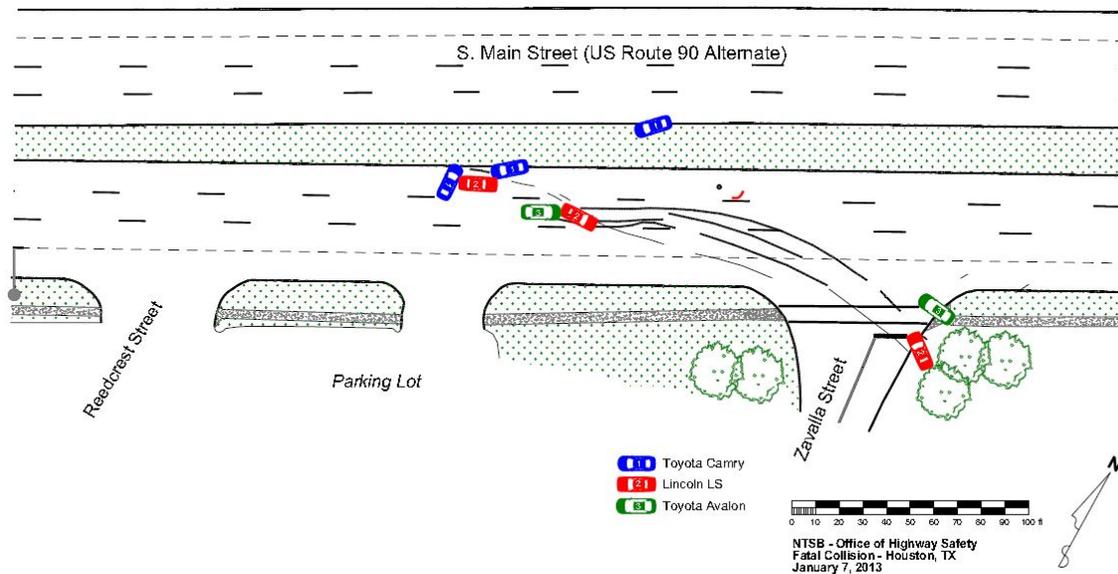
## Highway Accident Brief

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**Accident Number:** HWY-13-FH-006  
**Accident Type:** Median crossover multivehicle accident  
**Location:** 14400 block of South Main Street, Houston, Texas  
**Date and Time:** January 7, 2013; 8:40 a.m. central standard time  
**Vehicles:** 2004 Toyota Camry, passenger vehicle  
2005 Lincoln LS, passenger vehicle  
2000 Toyota Avalon, passenger vehicle  
**Fatalities:** 1  
**Injuries:** 1 serious

### Crash Description

About 8:40 a.m. central standard time, on January 7, 2013, a 2004 Toyota Camry passenger vehicle operated by a 37-year-old female driver was traveling southbound in the 14400 block of South Main Street in Houston, Texas. The Camry driver was returning home after completing a 13-hour shift as a nurse at a local hospital. The Camry was in the left lane of a three-lane divided roadway when the vehicle drifted to the left and departed the lane, mounted the curb, crossed over a 17-foot-wide earthen median, and entered the northbound lanes. The Camry struck the front left corner of a 2005 Lincoln LS passenger vehicle that was traveling northbound in the left lane on South Main Street. The initial collision redirected the Lincoln into the center lane of the northbound roadway, where it was subsequently struck in the rear by a 2000 Toyota Avalon passenger vehicle. Both the Lincoln and the Avalon traveled an additional 160 feet prior to coming to rest in the intersection of a side street. The Camry came to rest in the left lane of the northbound roadway (see figure 1).



**Figure 1.** Scene drawing showing the crash sequence, from the Camry's initial impact to final rest positions of all vehicles.

As a result of the crash, the driver of the Lincoln was fatally injured. The driver of the Camry was transported to an area hospital where she was treated for her injuries, and the driver of the Avalon was reportedly uninjured. All three drivers were restrained by three-point lap and shoulder belts.

### Roadway Information

At the crash location, South Main Street is a six-lane, divided roadway with three lanes of traffic in both the northbound and southbound directions.<sup>1</sup> The traffic lanes are divided by a 17-foot-wide curbed median, and the posted speed limit for traffic in both directions is 55 mph. The pavement surface is concrete; at the time of the crash, the pavement was dry.

### Vehicle Information

The Camry sustained major front end deformation that was primarily concentrated on the driver side of the vehicle. As a result of the head-on collision with the Camry, the Lincoln sustained damage to the front left corner that continued down the left side into the driver's door. The Avalon sustained moderate front end damage from striking the Lincoln (see figure 2).

<sup>1</sup> In the area of the crash, dedicated entrance and exit lanes on both sides of the roadway allow for access to overpasses located north and south of the accident scene.



**Figure 2.** Photo at left shows the front end deformation to the Camry. Photo on right shows the front end deformation to the Avalon (left) and Lincoln (right). (Source: Houston Police Department)

The Houston Police Department (HPD) downloaded data from the Camry's air bag control module (ACM) and confirmed that the driver's seat belt was buckled. The ACM did not contain any data regarding the pre-impact speed of the Camry.

### **Camry Driver and Coworker Interviews**

The National Transportation Safety Board (NTSB) interest in this crash was to examine potential fatigue issues related to noncommercial vehicle operators. To evaluate the events leading up to the collision, NTSB investigators interviewed the driver of the Camry, as well as staff and coworkers from her workplace. Additionally, the NTSB interviewed the HPD and other first responders who spoke with the Camry driver immediately after the crash.

According to the Camry driver, she had worked at Methodist Hospital in Houston for 9 years, all on the night shift. At the time of the crash, she was working 3 days weekly, from 7 p.m. to 7 a.m., as the charge-nurse. During the week of the crash, she worked Wednesday and Thursday nights, was off on Friday, and then worked again Saturday night. The driver reported to work at about 6:38 p.m. on Sunday, and her shift ended more than 13 hours later, at 8:17 a.m., Monday.

The Camry driver told the NTSB that, on the day of the crash, she was driving home from work in the center lane of South Main Street and lost control of her car. She described the loss of control event as moving slightly into the left lane and then steering back into the center lane. She did not know if there was a problem with her car, and she tried to apply the brakes but instead went into the opposing traffic lanes, where she collided with another car. She reported that she could not remember anything after that event.

An emergency medical technician who attended to the Camry driver reported to police that, while performing his medical evaluation, the driver stated that she must have

“dozed off and fallen asleep.” The investigating officer’s narrative on the supplemental page of the *Texas Peace Officer’s Crash Report* revealed that the Camry driver stated she did not know what happened until she woke up in the vehicle with the air bags deployed. The officer described her as being dazed, and she appeared and sounded as if she were groggy from being fatigued. A short time later, while still on scene, another police officer asked the Camry driver what happened, and she stated that she was returning home from work and believes she fell asleep. In an interview with a Houston police drug recognition expert officer at the hospital, the driver stated that she was tired and dozed off.

A review of the Camry driver’s medical records did not reveal any evidence of current medical conditions or medication use that would have resulted in losing consciousness. Post-crash toxicological tests performed by the HPD were negative for alcohol and drugs. A review of cell phone records indicated that she was not using her phone at or near the time of the collision. At the time of the crash, the driver held a valid Texas class “C” noncommercial driver’s license with a restriction requiring her to wear corrective lenses. The investigation revealed that she complied with this restriction.

According to the senior vice president of operations at Methodist Hospital, the hospital does not have a specific program addressing fatigue. However, fatigue is discussed in one of its wellness programs, called “Work-Life Balance.” Additionally, the hospital was described as having an “on-call” program, allowing employees to use available patient rooms during their breaks for rest or naps.

Several coworkers who had been with the Camry driver during her shift on the night and morning of the crash stated that they were not aware of any designated rooms in which employees can rest. When asked by the NTSB if they had ever experienced fatigue during or immediately after working their night shift, one employee stated that, on one occasion, she was so tired after getting off work in the morning that she slept in her car prior to driving home. The other nurses commented that they had heard similar stories of employees sleeping in their vehicles prior to driving home.

### **Camry Driver Activity**

The Camry driver stated that, normally, on her work days, as well as on her days off, she gets at least 8 hours of sleep. She lives approximately 15 miles from work, and her drive time to and from work is 30–45 minutes, depending on traffic. The crash occurred about 5.8 miles from her residence. Information regarding the Camry driver’s 5-day history prior to the crash came from her interview with the NTSB, cell phone records, and her employee timecard (see table 1).

**Table 1.** Camry driver's 5-day history, January 2–7, 2013.

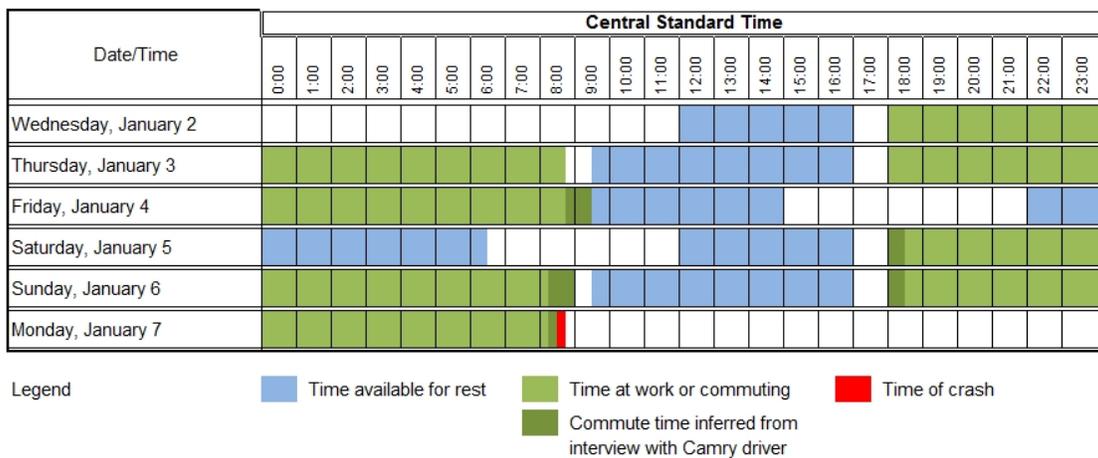
<b>Wednesday, January 2</b>		
<b>Time (CST)</b>	<b>Event</b>	<b>Source</b>
6:24 a.m.	Makes outgoing call	Cell phone record
12:00 p.m.	Goes to sleep	Interview
5:00 p.m.	Wakes up and prepares for work	Interview
6:00 p.m.	Departs home for hospital	Interview
6:38 p.m.	Clocks in for work	Time card
<b>Thursday, January 3</b>		
8:03 a.m.	Clocks out from work	Time card/interview
8:45 a.m.	Arrives at home	Interview
9:30 a.m.	Goes to sleep	Interview
5:00 p.m.	Wakes up and prepares for work	Interview
5:31 p.m.	Receives incoming call	Cell phone record
6:00 p.m.	Departs home for hospital	Interview
6:14 p.m.	Retrieves voicemail from cell phone	Cell phone record
6:22 p.m.	Makes outgoing call	Cell phone record
6:38 p.m.	Clocks in for work	Time card
<b>Friday, January 4</b>		
8:44 a.m.	Clocks out from work	Time card
8:57 a.m.	Receives incoming call from husband	Cell phone record
9:30 a.m.	Arrives at home and goes to sleep	Interview
3:00 p.m.	Wakes up	Interview
10:00 p.m.	Goes to sleep	Interview
<b>Saturday, January 5</b>		
6:30 a.m.	Wakes up	Interview
12:00 p.m.	Goes to sleep	Interview
5:00 p.m.	Wakes up and prepares for work	Interview
6:15 p.m.	Makes outgoing call to husband	Cell phone record
6:38 p.m.	Clocks in for work	Time card
<b>Sunday, January 6</b>		
6:38 a.m.	Makes outgoing call to husband	Cell phone record
8:17 a.m.	Clocks out from work	Time card
9:30 a.m.	Arrives at home and goes to sleep	Interview
5:00 p.m.	Wakes up and prepares for work	Interview
6:21 p.m.	Makes outgoing call	Cell phone record
6:38 p.m.	Clocks in for work	Time card
<b>Monday January 7</b>		
8:17 a.m.	Clocks out from work	Time card
8:17 a.m.	Makes outgoing call to husband	Cell phone record
8:40 a.m.	<b>CRASH OCCURS</b>	Police report
8:49 a.m.	Makes outgoing call to husband	Cell phone record

## Contributing Fatigue Factors

The NTSB has investigated numerous crashes involving fatigue of commercial vehicle drivers and has made recommendations addressing fatigue to the Federal Motor Carrier Safety Administration and the National Highway Traffic Safety Administration, as well as other stakeholders. Driver fatigue is not limited to commercial drivers, and this crash illustrates the critical need to examine noncommercial driver fatigue.

Looking at the Camry driver’s activity in the week preceding the crash, she had an inverted sleep schedule—that is, she was awake at night and asleep for a good portion of the day (see table 2).

**Table 2.** Graphic representation of driver’s time available for rest, January 2–7, 2013.



Although the Camry driver had been working the night shift for 9 years, inverted sleep schedules have been shown to affect sleep quality and quantity. Science and medicine have long accepted that humans are diurnal, biologically hardwired to be active during the day and sleepy at night. Those engaged in “shift work,” or work outside the normal “day work” hours, are, therefore, operating in an unnatural temporal environment. Social interactions with friends and family members or at sporting and cultural events—and even common activities, such as shopping or watching television—are difficult when on a non-diurnal schedule. Changing to a normal schedule to accommodate these life activities, even for as little as a day, can completely erase any adaptation to the shift work. However, many people do so because of their desire to participate in the more regular activities of life.

Surveys show that 60–70 percent of shift workers report difficulty sleeping, sleepiness on the job, or actually falling asleep unintentionally while at work.<sup>2</sup> Shift

<sup>2</sup> Akerstedt, T. and Torsvall, L. 1981. “Shift Work: Shift-Dependent Well-Being and Individual Differences,” *Ergonomics* 24: 265.

workers have also been shown to have pathologic<sup>3</sup> sleepiness levels at work.<sup>4</sup> The effects of such schedules on sleep are so significant that the International Classification of Sleep Disorders has recognized excessive sleepiness associated with shift work as a sleep disorder.<sup>5</sup> Research has shown that inverted work schedules are specifically associated with shortened sleep lengths, higher subjective<sup>6</sup> wake-time sleepiness, and degraded performance.<sup>7</sup>

Sleeping during the day can be problematic for shift workers.<sup>8</sup> Day sleep offers more opportunities for disturbances—such as those that come with daylight, outside noises, and children—and ultimately results in less overall sleep and a reduced quality of sleep.<sup>9,10</sup>

The driver's internal rhythms (circadian cycle) were in conflict with her inverted work schedule. Although it is possible to adjust circadian rhythms so that they are more aligned with an alternate schedule, such adjustments can take a week or more to take effect. Further, the altered circadian rhythms are capable of easily changing back and can do so in as little as a single day. As shown in the Camry driver's 5-day work/sleep schedule, she worked Wednesday, Thursday, Saturday, and Sunday. On Friday, she was off work but still got about 8 hours of sleep, plus another 6 hours Saturday morning. Monday and Tuesday were her days off, on which she would have had the opportunity to "reset" her circadian rhythms back to a normal daytime schedule.

The Camry driver's inverted work schedule and her extended hours during shift work indicate that she was fatigued at the time of the crash.

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<sup>3</sup> See the Epworth Sleepiness Scale by Murray Johns, <http://epworthsleepinessscale.com>.

<sup>4</sup> Akerstedt, T., Torsvall, L., and Gillberg, M. 1982. "Sleepiness and Shift Work: Field Studies," *Sleep* 5: 95.

<sup>5</sup> The International Classification of Sleep Disorders: Diagnostic and Coding Manual, revised. 1997. Rochester, Minnesota: American Academy of Sleep Medicine.

<sup>6</sup> "Higher subjective" refers to the driver's own perception of sleepiness levels during the day.

<sup>7</sup> Ohayon, M., Smolensky, M., and Roth, T. 2010. "Consequences of Shiftworking on Sleep Duration, Sleepiness, and Sleep Attacks." *Chronobiology International* 27 (3): 575.

<sup>8</sup> Geiger-Brown and others. 2012. "Sleep, Sleepiness, Fatigue, and Performance," *Chronobiology International* 29 (2): 575.

<sup>9</sup> Akerstedt, T. 2003. "Shift Work and Disturbed Sleep/Wakefulness." *Occupational Medicine* 53: 89.

<sup>10</sup> Kroemer, K.H.E., Kroemer, H.J., and Kroemer-Elbert, K.E. 1990. *Engineering Physiology: Bases of Human Factors/Ergonomics*. New York: Van Nostrand Reinhold: 194.

## **Probable Cause**

The National Transportation Safety Board determines that the probable cause of this crash was the Toyota Camry driver's failure to maintain directional control of her vehicle because of falling asleep. Contributing to the driver's fatigue was her inverted work schedule and her extended time since waking.

**Adopted:** April 10, 2014