NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, DC 20594

July 18, 2019

Security Video Factual Report

Specialist's Factual Report
By Sean Payne

1. EVENT

Location:	Miami, Florida
Date:	March 15, 2018
NTSB Number:	HWY18MH009

2. GROUP

A group was convened on June 12, 2019, at the National Transportation Safety Board's (NTSB) Vehicle Recorder Laboratory. The group consisted of the following members:

Chairman:	Sean Payne Mechanical Engineer NTSB
Member:	Nick Swann Aerospace Engineer NTSB
Member:	Robert Accetta Investigator-In-Charge (IIC) NTSB
Member:	Mark Bagnard Chief, HS-20 NTSB
Member:	Daniel Walsh, P.E. Senior Bridge Factors Investigator NTSB

Member:	Michele Beckjord Project Manager NTSB
Member:	Reggie Holt, P.E. Senior Bridge Engineer FHWA Office of Bridges and Structure
Member:	Benjamin Graybeal, Ph.D., P.E. Team Leader - Bridge Engineering Research FHWA Office of Infrastructure Research & Development - TFHRC

3. SUMMARY

On Thursday, March 15, 2018, about 1:47 p.m. eastern daylight time, a partially constructed pedestrian bridge crossing SW 8th Street—an eight-lane roadway—in Miami, Florida, experienced a structural failure. As a result, the 174-foot-long bridge fell about 18.5 feet onto SW 8th Street. Eight vehicles that were stopped below the bridge at the time of the collapse were fully or partially crushed; seven of those vehicles were occupied. As a result of the bridge collapse, one bridge worker and five vehicle occupants died. Four bridge workers and four other people were injured.

4. DETAILS OF INVESTIGATION

Post-accident, the (NTSB) Vehicle Recorder Division received video data files associated with the following camera systems:

Recorder Manufacturer/Model:	GoPro
Owner:	HERC Rental
Location:	Truck - Eastbound - SW 8th Street
Field of View:	Facing East
Recorder Manufacturer/Model:	Unknown
Owner:	Florida D.O.T./Miami Dade County
Location:	SW Corner of E. Campus Cir. & SW 8th Street
Field of View:	Facing Northwest
Recorder Manufacturer/Model:	Unknown
Owner:	109 Tower
Location:	737 SW 109th Ave.
Field of View:	Facing Southwest

Figure 1 shows the location and approximate field of view of each camera.

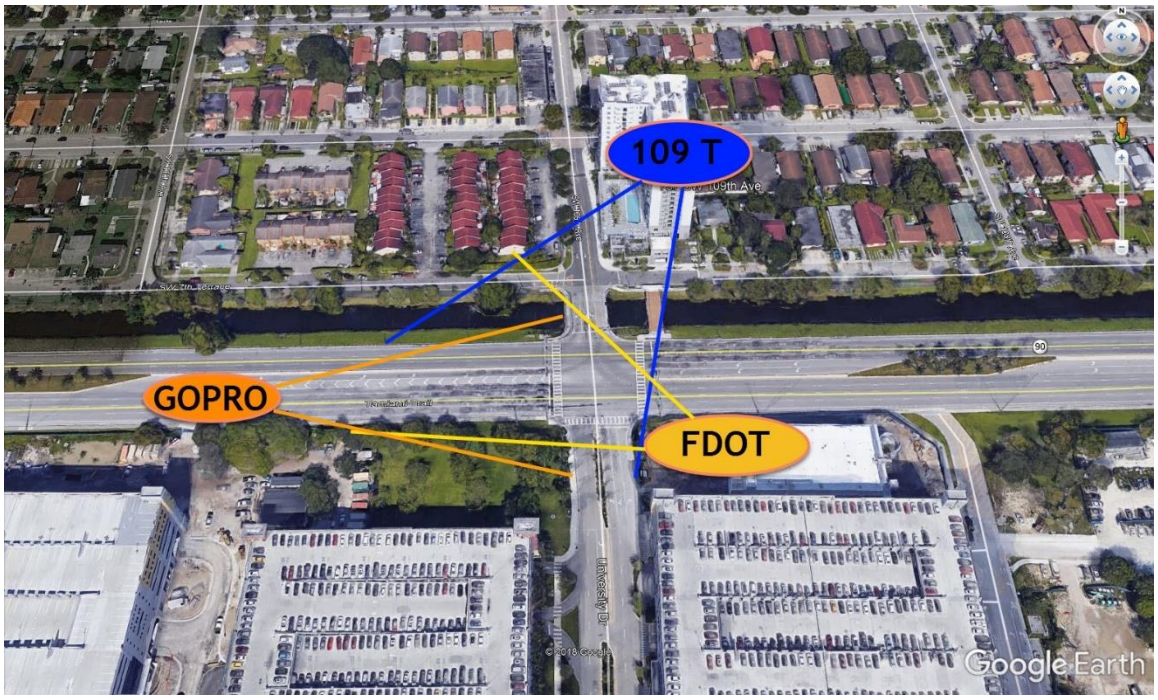

Figure 1. The approximate field of view of the three cameras that captured the bridge collapse.

4.1. Timing and Correlation

The times used in this report are expressed as Local Time of the accident eastern daylight time, (EDT.

Timing of the transcript was established by correlating the video events to the collapse of the bridge. The Florida D.O.T. camera was determined to be the authoritative timing source.

4.2. Summary of Recording Contents

GoPro

Frame 18 - Figure 2 - The main-span is shown in pre-collapse condition. No deformation or evidence of collapse or pre-collapse was visible at this time. Workers were visible on the canopy of the main-span in the vicinity of node 10/11. There is eastbound traffic stopped underneath the bridge, but from this vantage it is not clear which cars are directly beneath the mainspan.

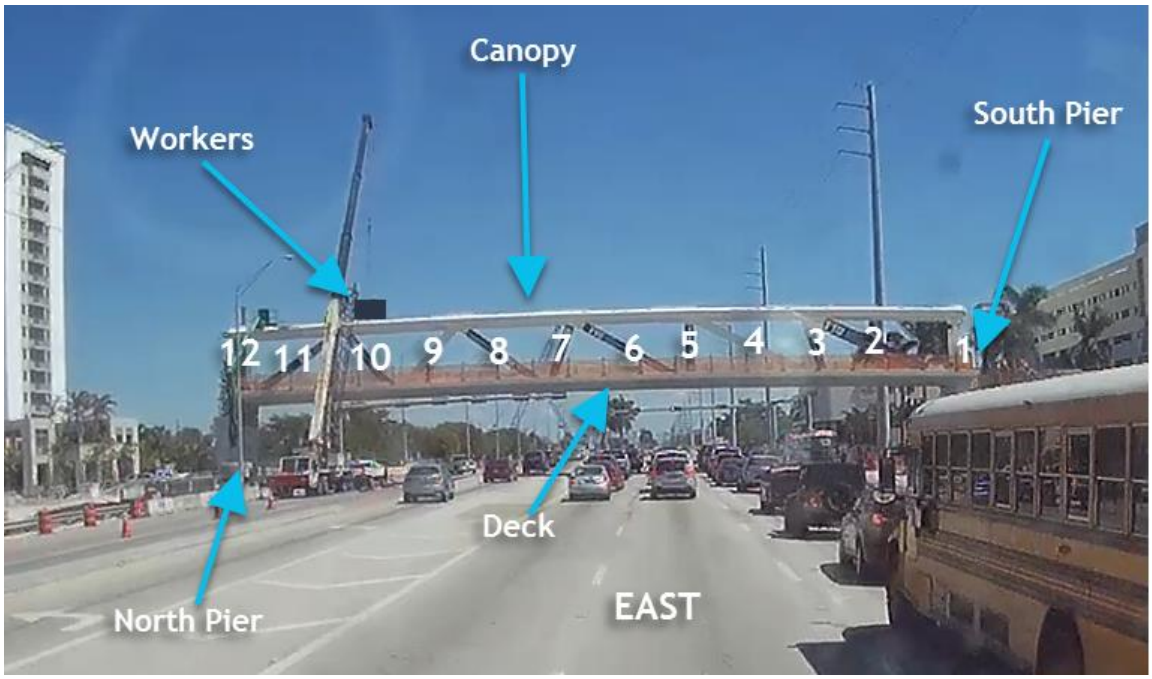

Figure 2. GoPro recording at frame 18 - 13:46:43.815

Frame 19 - Figure 3 - Debris consistent with concrete dust blowout appeared on the north side of the bridge in the region of node 11/12 at deck level. This occurred at the pylon pier (north end of the main-span). Workers were visible on the canopy of the main-span in the vicinity of node 10/11.

Figure 3. GoPro recording at frame 19 - 13:46:43.815

Figure 20 - Figure 4 - Debris consistent with concrete dust blowout on the north side of the bridge appears larger. Workers were visible on the canopy of the main-span in the vicinity of node 10/11.

Figure 4. GoPro recording at frame 20 - 13:46:43.848

Frame 21 - Figure 5 - Debris consistent with concrete dust blowout appears larger. It was not conclusive if any deformation of the main-span was visible at this time. Workers were visible on the canopy of the main-span in the vicinity of node 10/11.

Figure 5. GoPro recording at frame 21 - 13:46:43.881

Frame 22 - Figure 6 - Deformation in the downward direction was conclusively noted as the structure began to hinge at member 10 for the canopy and the deck. Workers were visible on the canopy of the mainspan in the vicinity of node 10/11.

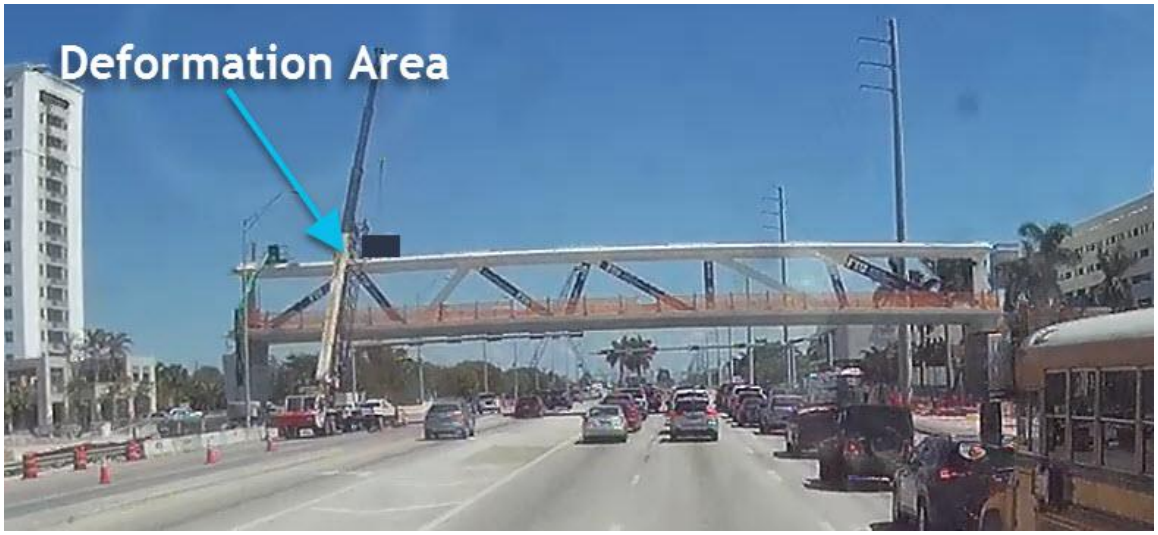

Figure 6. GoPro recording at frame 22 - 13:46:43.914

Frame 23 - Figure 7 - As the structure continues to hinge the deck and canopy south of member 10 can be seen to begin rotating downward as a rigid structure. Workers were visible above the canopy of the main-span in the vicinity of node 10/11.

Figure 7. GoPro recording at frame 23 - 13:46:43.947

Frame 24 - Figure 8 - Fracturing in the structure of the canopy was visible north of node 10/11 and in the structure of the deck north of node 9/10. The workers were

still visible in the vicinity of node 10/11 and were moving downward with the structure.

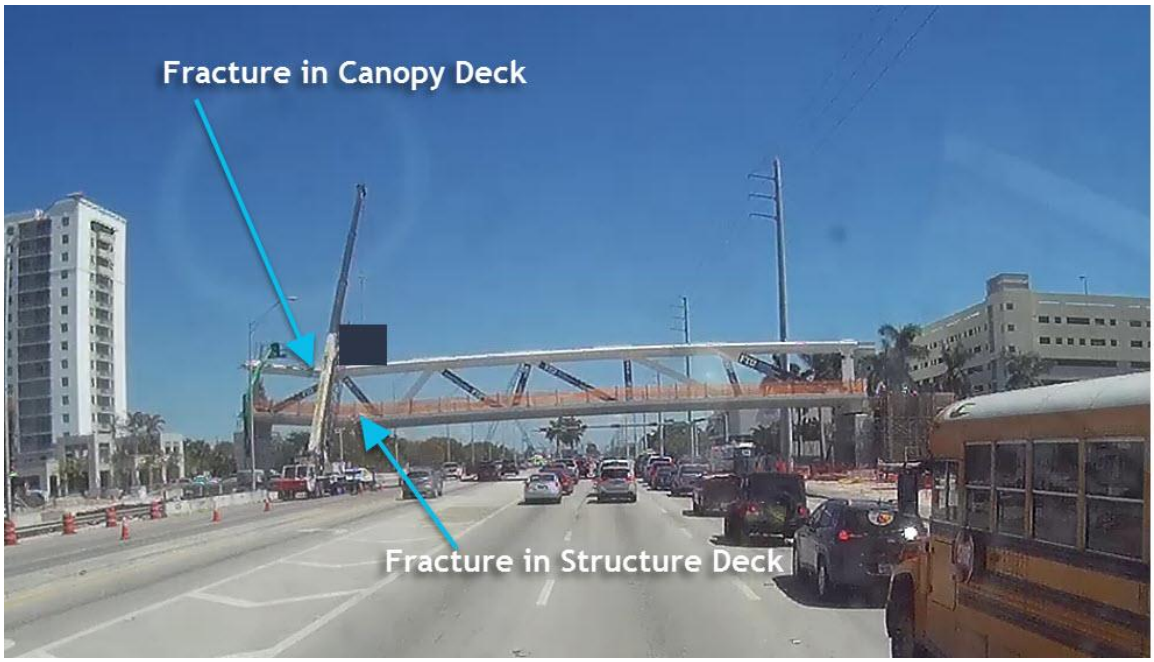

Figure 8. GoPro recording at frame 24 - 13:46:43:980

Frame 25 - Figure 9 - The hinging motion was increasing, the structure south of member 10 appeared to remain rigid and rotated downward about the South Pier. The concrete dust blowout was moving downward with the collapsing main-span. The signal light was green but eastbound traffic remained underneath the main-span. The workers were still visible in the vicinity of node 10/11 and were moving downward with the structure.

Figure 9. GoPro recording at frame 25 - 13:46:44.013

Frame 26 - Figure 10 - The hinging motion continued north of member 10. The main-span south of member 10 continued to rotate downward rigidly about the South Pier. The canopy was now below the workers in the vicinity of node 10/11 as the workers continued to move downward.

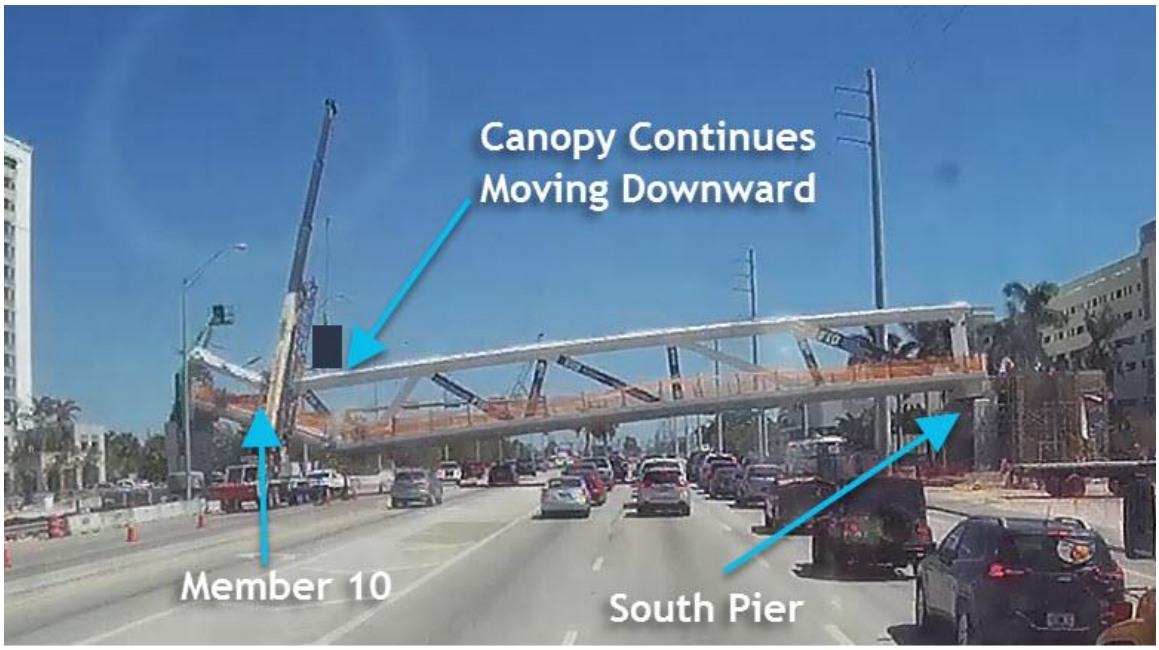

Figure 10. GoPro recording at frame 26 - 13:46:44.046

Frame 27 - Figure 11 - The hinging motion continued north of member 10 as in the previous frame. The hinged area of the deck north of member 10 was making contact with an eastbound facing parked white work truck on the westbound shoulder under the main-span. The workers continued to move downward and were slightly above the canopy. The main-span south of member 10 rotated downward rigidly about the South Pier as in the previous frame.

Figure 11. GoPro recording at frame 27 - 13:46:44.079

Frame 28 - Figure 12 - At the fracture area, the deck and canopy made contact. The north end of the deck has slid off the south side of the north pylon pier. The deck region north of node 8/9 made contact with the road. Member 10 and the lower side of member 9 have pulverized in this frame. The deck appeared to make contact with a vehicle in the left-most eastbound through-lane. The southern side of the main-span continued to rotate around the South Pier. The workers continued to move downward and were slightly above the canopy. Workers can be seen on the south side grand staircase.

Figure 12. GoPro recording at frame 28 - 13:46:44.112

Frame 29 - Figure 13 - The diagonal members between the deck and canopy begin to pulverize as the deck continued to make contact with the road. The deck remained outside the leftmost through-lane, however, the clearance between the deck and the roadway is small enough to continue contact with the vehicle in the

leftmost through-lane. In the vicinity of the north pylon pier, the deck continued to fall toward the roadway. Member 12 was rotating downward and inward toward the roadway into a horizontal position. The workers continued to move downward and were slightly above the canopy. An expulsion of concrete can be seen above the canopy near node 8/9.

Figure 13. GoPro recording at frame 29 - 13:46:44.145

Frame 30 - Figure 14 - The deck of the main-span has made contact with the leftmost and left center eastbound through-lanes as well as the vehicles occupying those lanes. It was unclear if the deck has made contact with vehicles in the rightmost and right center lane. A piece of equipment was falling from where the workers were originally standing. The north end deck continued to fall inward towards the roadway as member 12 continued to pivot downward and inward. The concrete expulsion in the canopy near node 8/9 was still visible as the canopy continued to fall towards the deck and the roadway. On the north end of the main-span the canopy has made contact with the deck and roadway. One worker was still visible above the canopy.

Figure 14. GoPro recording at frame 30 - 13:46:44.178

Frame 31 - Figure 15 - Member 12 was in a near horizontal position as the main-span north of member 10 was beginning to come to a rest. The workers were no longer visible, the piece of equipment continued to fall. The canopy of the main-span had made full contact with the westbound lanes. No vehicles other than the white work truck were visible under the deck of the main-span in the westbound lanes. The concrete expulsion near node 8/9 had begun to settle.

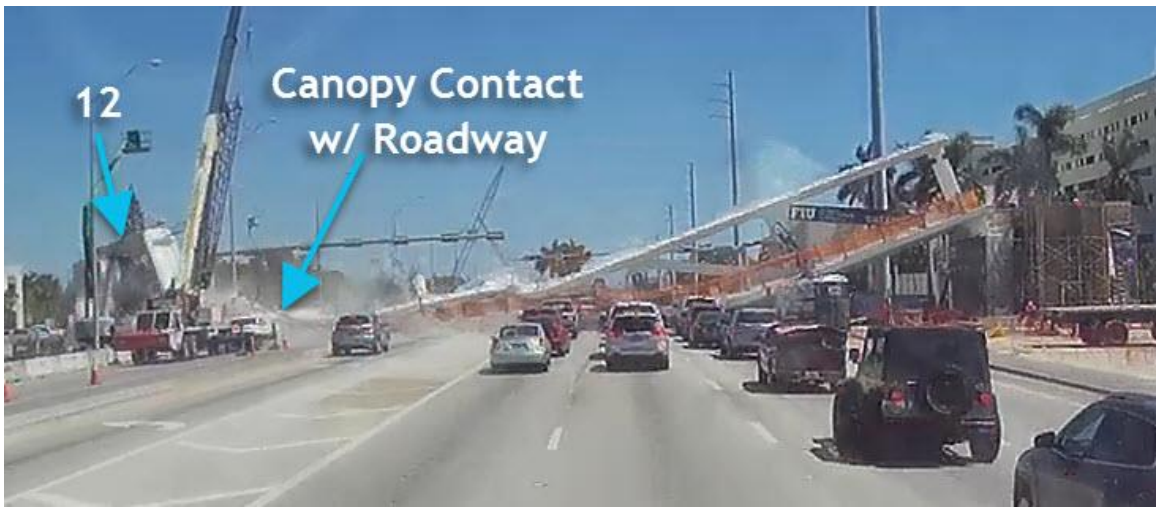

Figure 15. GoPro recording at frame 31 - 13:46:44.211

Frame 32 - Figure 16 - The north side of the main-span occupying the westbound lanes of the roadway had come to rest in this frame. The piece of equipment was still falling. The south side of the main-span continued to pivot about the South Pier as the deck continued to make contact with the eastbound lanes. The rate of deflection of the south side of the main-span was slowing down as more of the deck impacted the roadway.

Figure 16. GoPro recording at frame 32 - 13:46:44.244

Frame 33 - Figure 17 - Slight deflection of the south side of the main-span was visible. The deck had made contact with the leftmost, left center, and right center lanes and was very close to the rightmost lane. The falling piece of equipment was no longer visible.

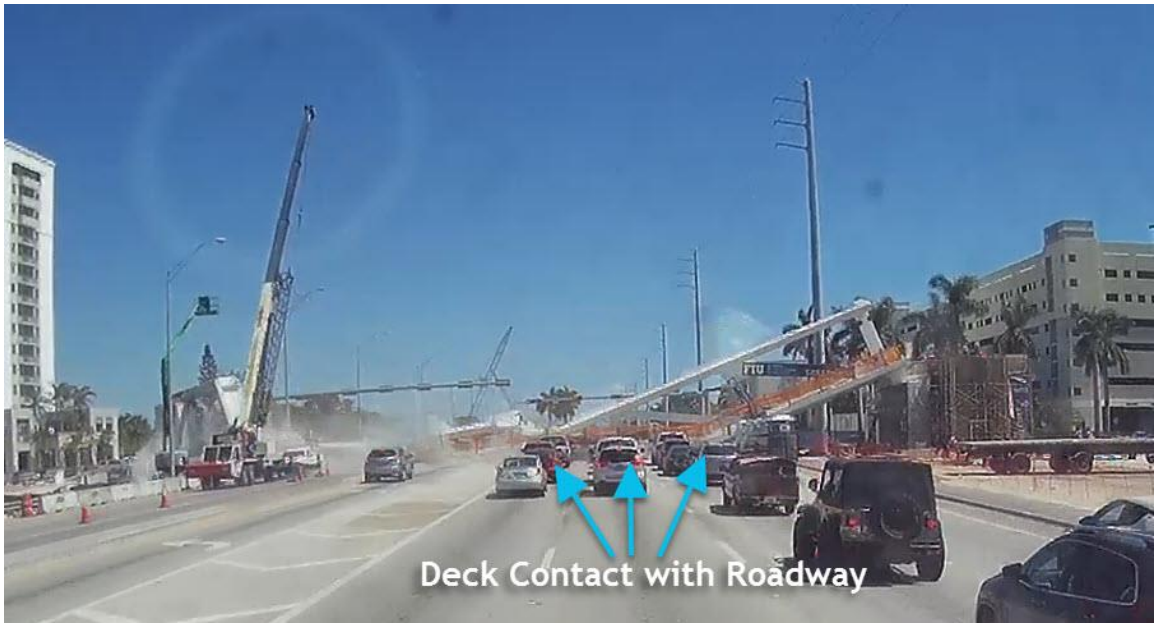

Figure 17. GoPro recording at frame 33 - 13:46:44.277

Frame 34 - Figure 18 - No deflection was visible between frames 33 and 34. The main-span had come to rest on the roadway and made contact with all of the

westbound lanes and the leftmost, left center, and right center lanes of the eastbound side of the roadway. Members 1, 2, 3 and 4 remained intact.

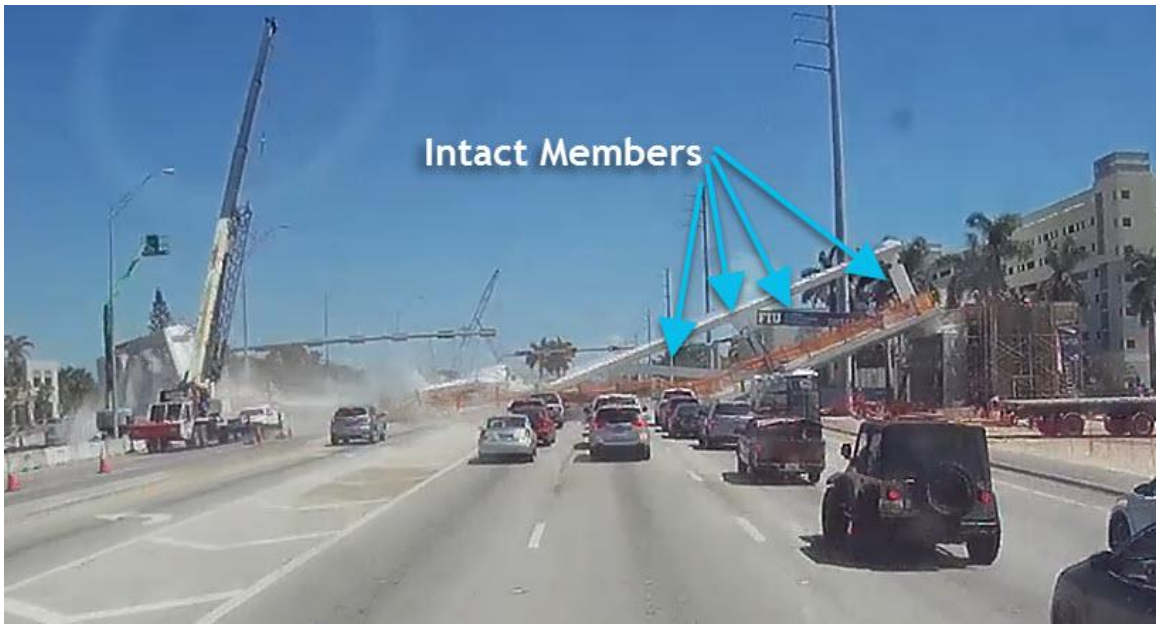

Figure 18. GoPro recording at frame 34 - 13:46:44.310

Frames 34-62 - Figure 19 - In the next 28 frames, unidentified material was visible sliding down the sound end of the now sloped deck. Frame 43 is shown.

Figure 19. GoPro recording at frame 43 - 13:46:44.610

FDOT/Miami Dade Camera (Facing NW) -

The following annotated screenshots show only additional evidence visible from the FDOT/Miami Dade camera.

The FDOT/Miami Dade camera's timestamp was considered authoritative.

The FDOT/Miami Dade camera does not record evidence for durations longer than 30 minutes. The camera could not be downloaded. A Miami Dade employee was able to capture a recording of the recording with a personal electronic device (PED) camera before the 30 minute time period expired and the video data became overwritten. The evidence discussed below is from the employee's PED camera. The PED video is a 30 frame per second (fps) recording of a 2 fps video.

This recording faced NW as shown in figure 1. Main-span members 8 through 12 were visible in the recording.

Frame 9 - Figure 20 - Main-span was in pre-collapse condition. A white work truck was visible underneath the main-span, on the westbound side, beneath the span. From this viewpoint, one silver vehicle entering the open westbound lane was visible. Workers and equipment were visible on the main-span's canopy level, however, their position was less distinguishable as compared to the GoPro recoding.

Figure 20. FDOT/Miami Dade camera at 13:46:43:814

Frame 13 - Figure 21 - Significant deformation was distinguishable on the main-span canopy north of member 10.

Figure 21. FDOT/Miami Dade camera at frame 13 - 13:46:43.947

Frame 25 - Figure 22 - Significant downward deformation and hinging of the canopy and bridge deck were visible. The silver vehicle entering the westbound lane appeared to have moved closer to the collapsing bridge.

Figure 22. FDOT/Miami Dade camera at frame 25 - 13:46:44.347

Frame 39 - Figure 23 - The canopy was in contact with the bridge-deck. The deck and diaphragm was dislodged from the pylon pier and was beginning to slide off the pylon pier. The silver vehicle was still occupying the only open westbound lane,

east of the bridge. Structure was collapsed in the immediate frontal vicinity of the vehicle.

Figure 23. FDOT/Miami Dade camera at frame 39 - 13:46:44.813.

Frame 50 - Figure 24 - Member 12 and the canopy had appeared to rotate inward and downward. A debris cloud was visible forming in front of the silver vehicle in the westbound lane.
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Figure 24. FDOT/Miami Dade camera at frame 50 - 13:46:45.179.

Frame 60 - Figure 25 - The deck and diaphragm was fully dislodged from the north pylon pier and had fallen to its final resting position on the roadway surface and surrounding earthen surface adjacent to the roadway surface. The canopy came in contact with the deck and the roadway surface and appeared flattened. A debris cloud continued to form and spread in the vicinity of the roadway surface.

Figure 25. FDOT/Miami Dade camera at frame 60 - 13:46:45.512

Frame 74 - Figure 26 - The debris cloud continued to grow larger. It appeared that all visible main-span surfaces had come to rest and no other remarkable evidence was noted in the remaining frames associated with this camera.

Figure 26. FDOT/Miami Dade camera at frame 74 - 13:46:45.978

109 Tower Camera (FIU)

The following annotated screenshots show only additional evidence visible from the 109 Tower camera, a campus building of FIU.

The camera recorded a burst of three frames for a duration of three seconds approximately every one minute.

Frame 1 - Figure 27 - 13:46:42.715 -The bridge in a pre-collapse state.

Figure 27. 109 Tower camera at 13:46:42.715

Frame 2 - Figure 28 - 13:46:47:39.715 - The bridge post collapse.

Figure 28. 109 Tower camera at 13:47:39.715

Additional Cameras

Camera PG5 and Camera PG6 recorded at 1 frame per minute. No new evidence of interest was captured.