NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

UAS Aerial Imagery Factual Report

12/9/2019

A. ACCIDENT CEN19MA190

Location:	Addison, Tx
Date:	June 30, 2019
Time:	0911 Local Time (CDT)
Event:	Collision with hangar, N534FF, B300

B. PERSONNEL

UAS RPIC/VO: Bill English
NTSB UAS Program Lead
Washington DC

UAS RPIC/VO: Josh Lindberg
Central Region
Dallas, Tx

C. ACCIDENT SUMMARY

On June 30, 2019, about 0911 central daylight time, a Textron Aviation B300, N534FF, was destroyed when it was involved in an accident near Addison, Texas. The airline transport pilot, the commercial co-pilot, and eight passengers sustained fatal injuries. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

D. DETAILS OF IMAGERY

1.0 Equipment and Procedures

Equipment

Flights to photo-document and map the area of the crash were conducted on July 1 and 2, 2019, using one of the NTSB DJI Phantom 4 Advanced small unmanned aircraft systems (sUAS, or drone). The drone is equipped with a dual GPS/GLONASS receiver which provides georeference information on all still photos. The drone is equipped with an FC6310 camera using the Sony Exmor 1” CMOS sensor, with a focal length of 8.8 mm. Still photo resolution is 20 megapixels in JPG or RAW format, the camera is capable of video resolution of 4K HD up to 120 frames per second.

Ground control points (GCP) were taken with a Trimble GEO7X differential GPS receiver in the hangar area.

Procedures

The accident site was in and around a large hangar on airport property. The airspace was Class D, and the accident site was adjacent to a runway and taxiway. The flight was conducted under 14 CFR 107 with airspace approval and coordination with ATC via Special Government Interest (SGI) procedures. Weather conditions were VFR.

The drone was flown in overlapping grids and oblique patterns between 85 and 140 ft above ground level (agl) over the hangar and main wreckage capturing still images to create a 3D model and orthomosaic map, as well as inspection of the debris and marks on the hangar structure. Additional still photos were taken of the interior of the hangar damage to add to the 3D model.

Video was taken along the runway and approximate path to the accident site, as well as an overview of the hangar.

On July 2, the drone was flown in support of a ground search of the airport infield area looking for potential separated parts of the airplane.

Approximately 1,945 high resolution photos and videos were gathered. Total mission time including set-up, gathering ground control points, flights, and initial processing was 13 hours over the 2 day period.

2.0 Processing and Products

Processing

The GCPs were processed using the Continuously Operating Reference Station (CORS) at Dallas, Texas, (TXDA) resulting in a positional accuracy of about 10 cm. GPS quality was somewhat degraded due to the GCP locations close to the metal hangar resulting in multipath distortions.

Still imagery was processed using Pix4D photogrammetry software in multiple projects, first an overall orthomosaic map of the hangar and accident site, a second to focus on a 3D model of the exterior of the hanger, and another to make a 3D model of the inside of the hangar. The exterior and interior models were then merged using commonly visible points in each model (manual tie points).
The photos taken in support of the ground search were processed into an orthomosaic without ground control points, for time purposes and as exact geographic locations were not necessary.

Relative accuracy within the overall orthomosaic map was calculated at 0.84 inches, (twice the average ground sample distance), relative accuracy within the merged point cloud was calculated at 0.68 inches.

Imagery products

A still frame from the video approximating the flight path of the aircraft is shown in Figure 1. The drone flight and camera orientation only follow the path as shown from ADS-B data obtained by the NTSB ATC investigator. The video flight did not attempt to recreate the attitude of the airplane. The video is included in the docket.

Figure 1 – Still shot from video approximating flight path

The overall orthomosaic map was output in both geo-tiff and Google Earth formats, and included in the docket.

Figure 2 depicts the overall accident area orthomosaic overlaid on a Google Earth base map, with select measurements.

Figure 2 – Orthomosaic overlaid on Google Earth

Figures 3 and 4 are overview photographs of the hangar with select wreckage indicated.

Figure 3 – Aerial photo over main impact site looking to the southeast

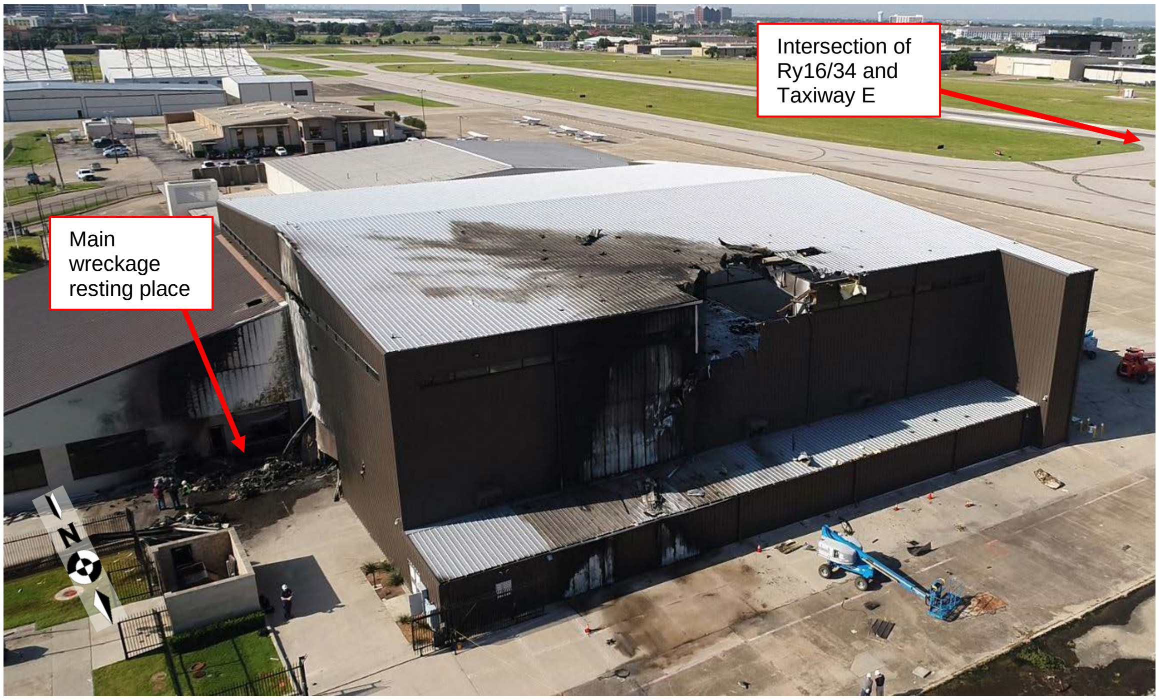

Figure 4 – Aerial photo of accident site looking southwest

The point cloud was used to take measurements of select distances and angles. Snapshots and select measurements are included below. Note all measurements are considered site and wreckage documentation and may not reflect the actual performance of the airplane.

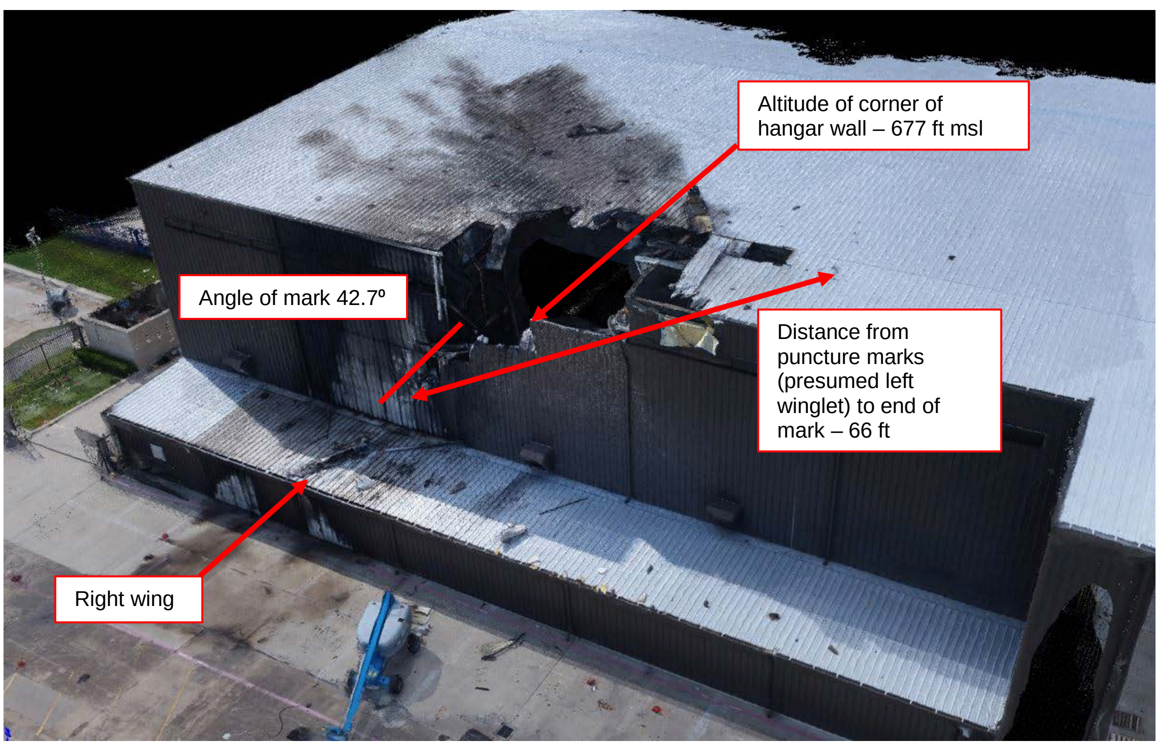

Figure 5 – Select exterior measurements

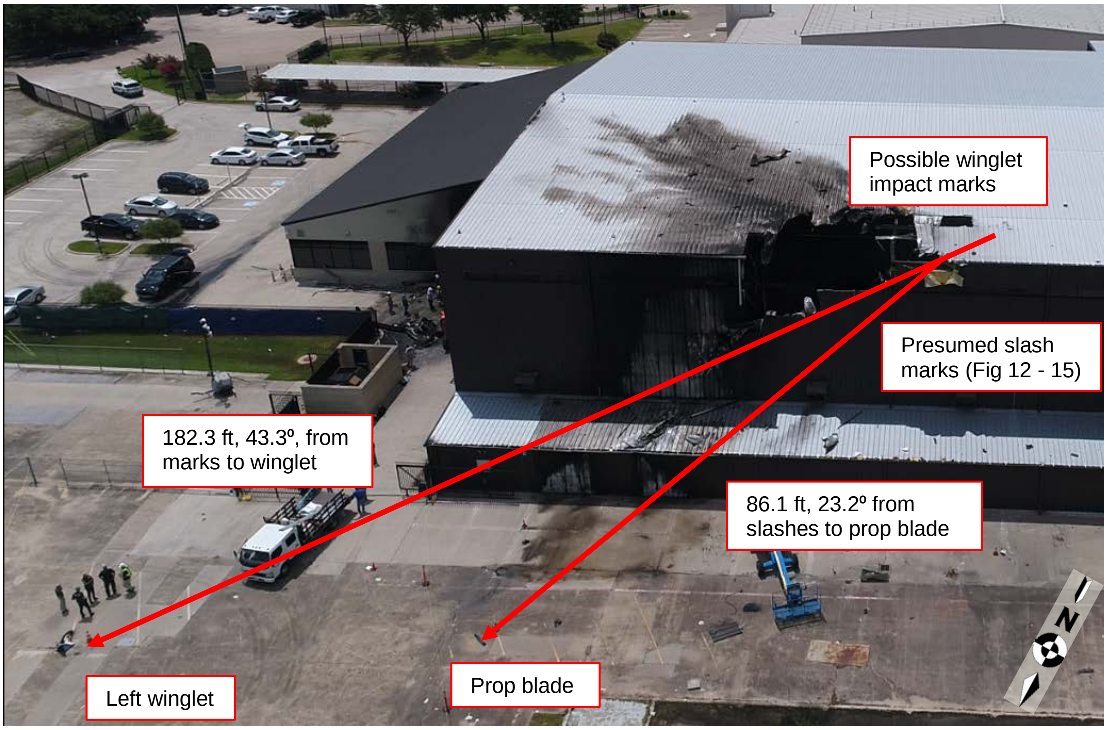

Figure 6 – Location of left winglet and prop blade

Figure 7 is a zoomed in portion of the combined exterior and interior point clouds, showing the location of the tail inside the hangar, and an indication of the 3D direction between the presumed center fuselage impact on the roof, and a large gouge in the floor.

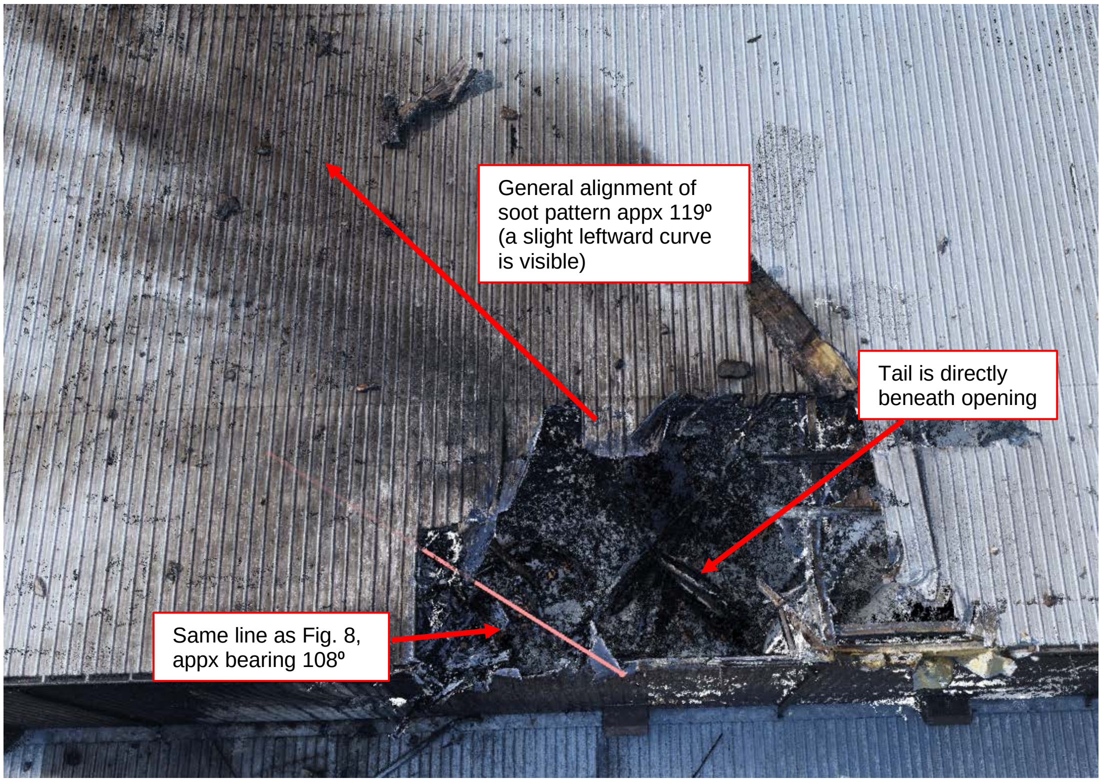

Figure 7 – Point cloud snapshot of impact area, angle to gouge, tail, and soot pattern.

Select measurements were also taken from the interior point cloud, and depicted in Figures 8 – 10. Note that the measurements were transferred to source photographs for clarity.

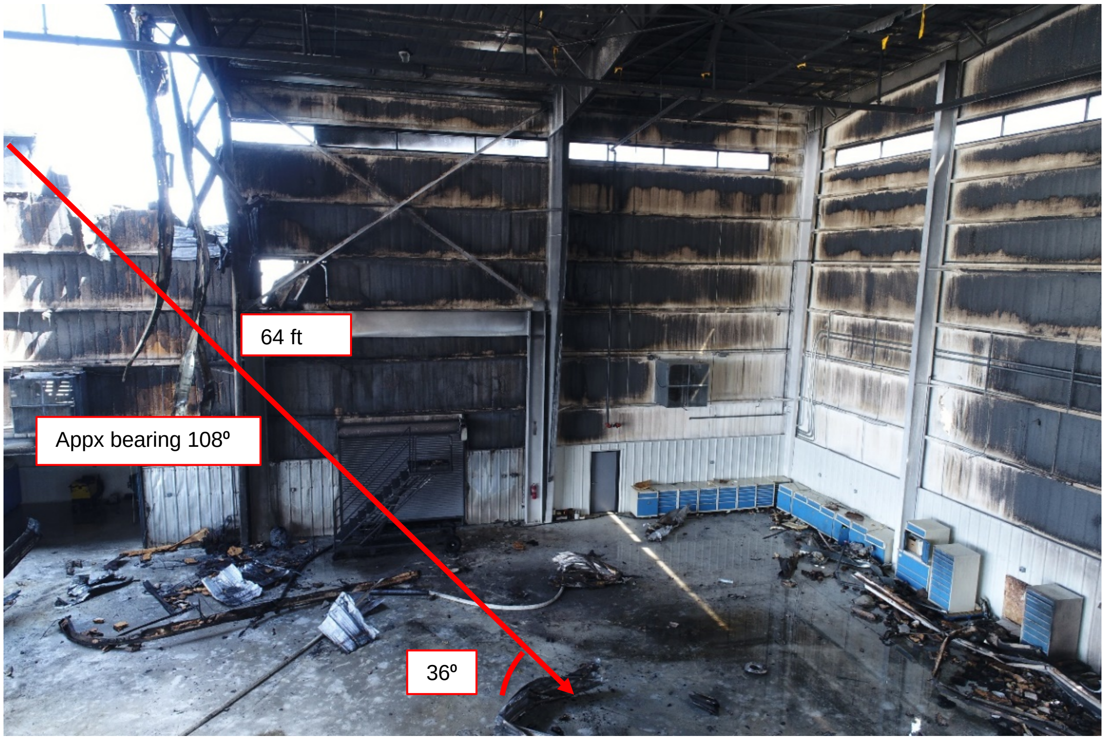

Figure 8 – Angle from approximate center of impact to first significant gouge

Figure 9 – Position of engine and tail

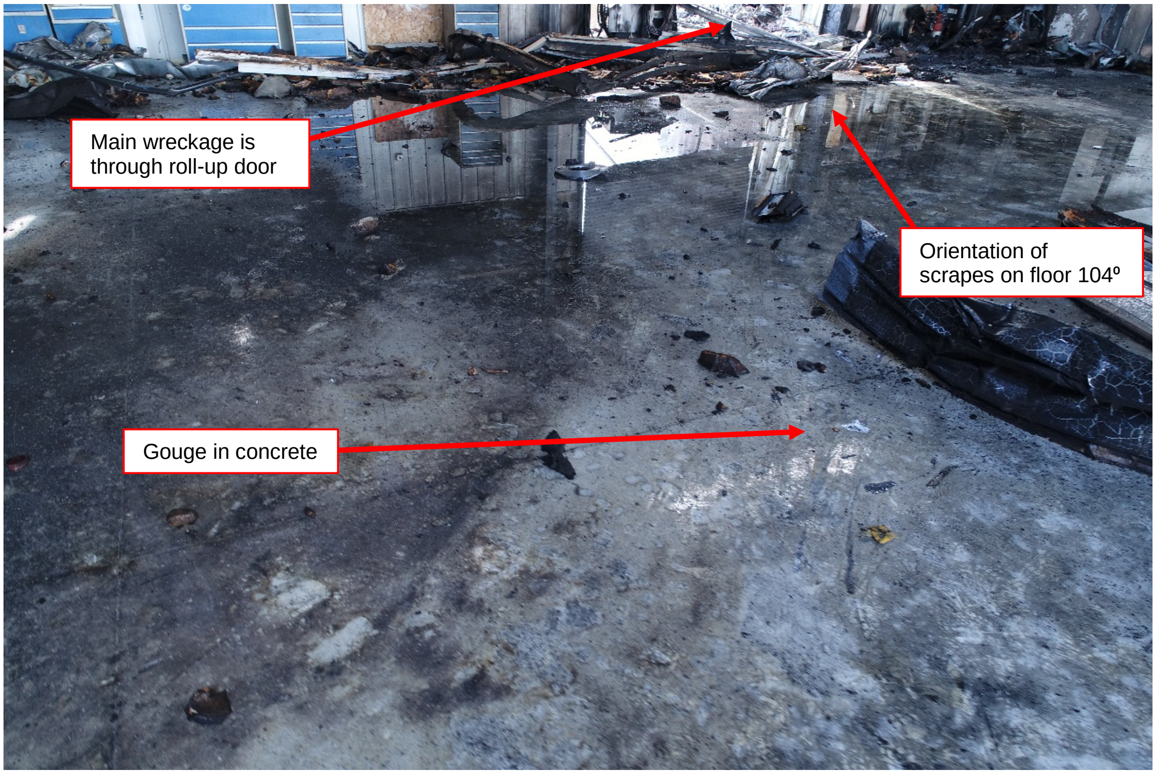

Figure 10 – Orientation of marks on hangar floor

The fuselage and right engine were located outside a roll-up door on the eastern wall of the hangar and adjacent to a cinder block wall of an office area.

Figure 11 – Orientation and location of main wreckage area

At the request of the Powerplants Group, further measurements between witness marks on the roof the hanger were obtained. The Powerplants group provided a marked up photo (figure 12) indicating the points of interest presumed to be propeller strike marks from the airplane left engine. The slash marks were located within the 3D point cloud from various angles to ensure maximum confidence in the measurement. Measurements were taken from the points as closely corresponding to the propeller tips as could be determined, however, the bending and distortion of the damaged roof material added a level of uncertainty as to where exactly to mark. Polylines within the point cloud result in a 3D distance between the witness marks, thereby accounting for the pitch attitude of the airplane, and the slope of the roof.

Figures 13 and 14 are exemplar snapshots of the point cloud and 3D measurement. The initial mark-up photo, with the resulting measurements added is Figure 15.

Figure 12 – Marked up photo from Powerplants Group

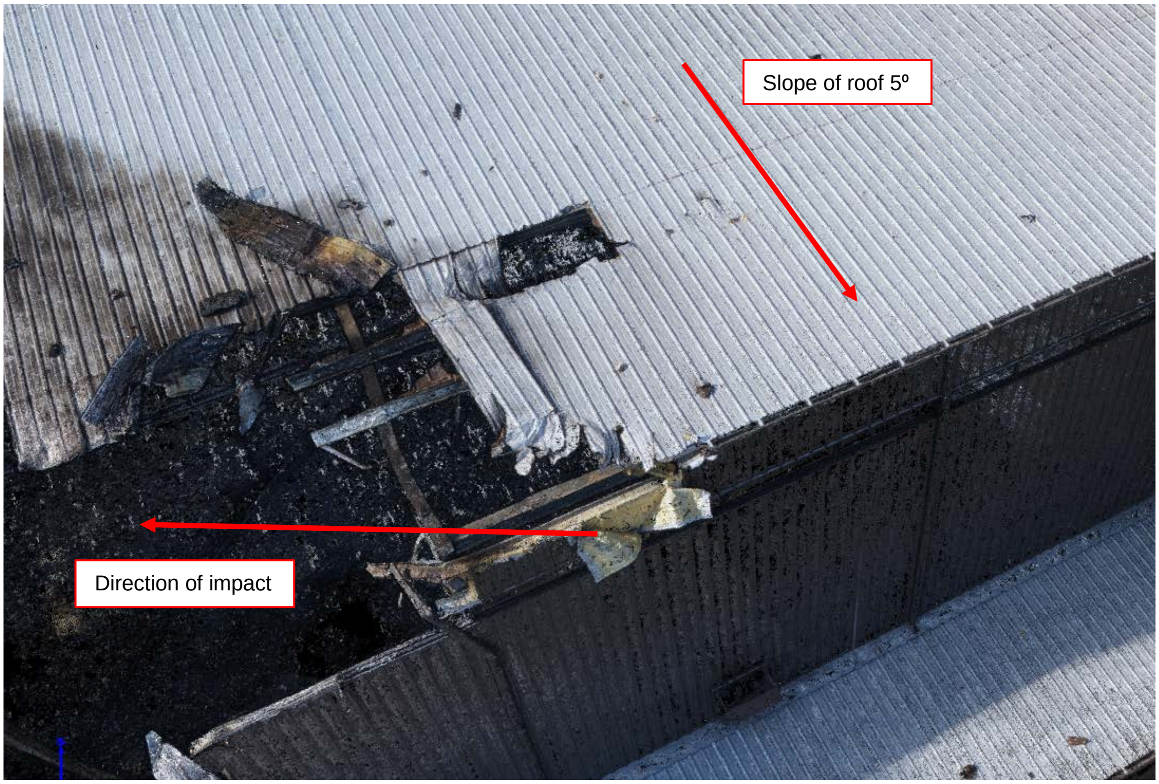

Figure 13 – View of entire point cloud looking approximately perpendicular to airplane path

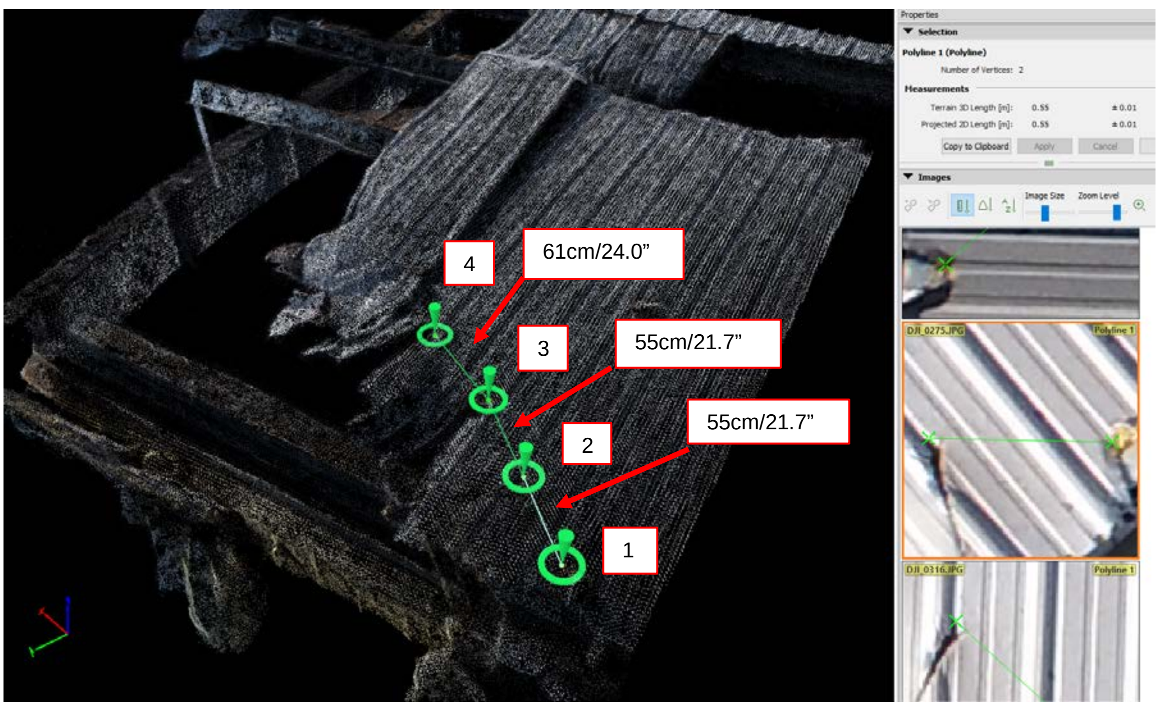

Figure 14 – Point cloud with polyline measurements.
Portions of the hangar point cloud not relevant to the measurements are masked for ease of visualization.

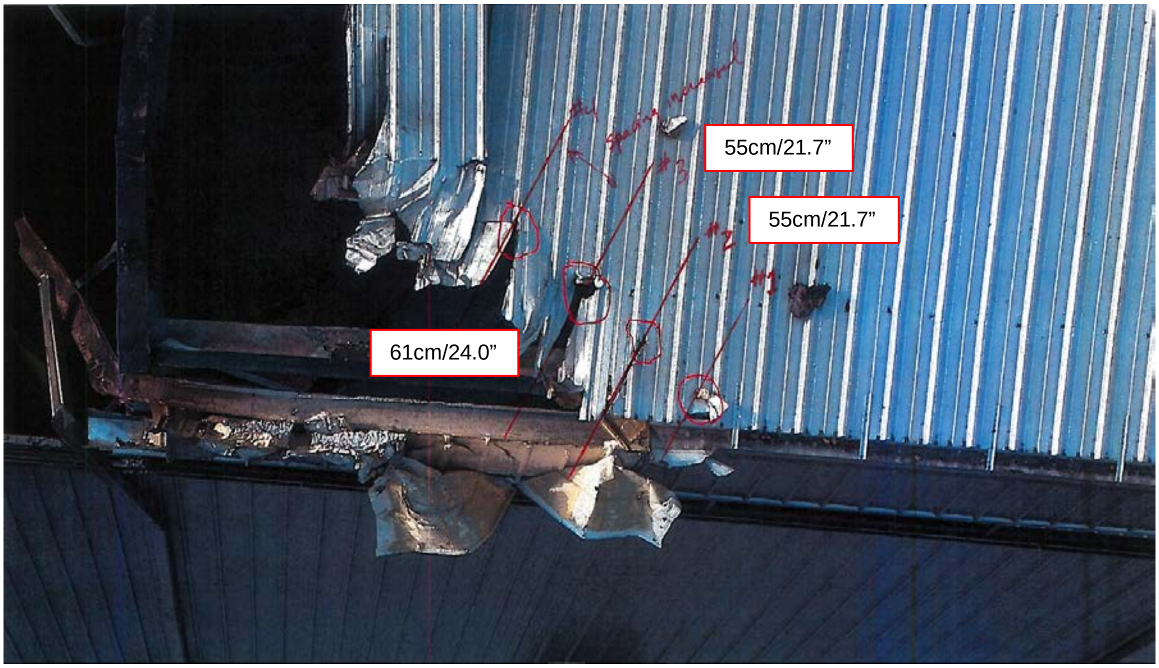

Figure 15 – Markup photo with measurements added

The combined 3D point cloud is included in the docket in xyz format. Additionally, a virtual "fly through" video of the point cloud is included. Note that the point cloud fly through does not attempt to depict the attitude of the accident airplane.

The systems group chairman organized a walk of the runway infield area to search for any potential components which may have departed the airplane during the takeoff roll. Although no parts were found, the exercise allowed for a comparison between drone photography and manual search. Drone flights took less than 20% of the time to cover the desired areas of approximately 1,850 ft by 550 ft. Figures 16 and 17 depict the orthomosaic ability to see small objects.

Figure 16 – FOD-walk Orthomosaic

Figure 17 – Sample zoom in to orthomosaic (not photograph), showing capable detail

E. ATTACHMENTS

1.0 Flight Path Video
2.0 Accident Site Orthomosaic Geo-Tiff
3.0 Accident Site Orthomosaic Google Earth
4.0 Hangar Point Cloud Exterior and Interior
5.0 Fly-Through Video of Point Cloud
6.0 Fly-Through Video of 3D Mesh
7.0 Overview Video of Hangar
8.0 FOD Walk Orthomosaic Geo-Tiff