

# National Transportation Safety Board

Office of Research and Engineering

Washington, D.C. 20594

## Performance Study

### Specialist Report

Marie Moler

#### A. ACCIDENT

Location: Rockford, Illinois  
Date: August 20, 2020  
Time: 1543 central daylight time (CDT)  
Airplane: Beech 200, N198DM  
NTSB Number: CEN20LA352

#### B. SUMMARY

On August 20, 2020, about 1543 central daylight time, a Beech 200 airplane, N198DM, was destroyed when it was involved in an accident near Rockford, Illinois. The private pilot was fatally injured. The airplane was operated as a Title 14 *Code of Federal Regulations* (CFR) Part 91 positioning flight.

#### C. PERFORMANCE STUDY

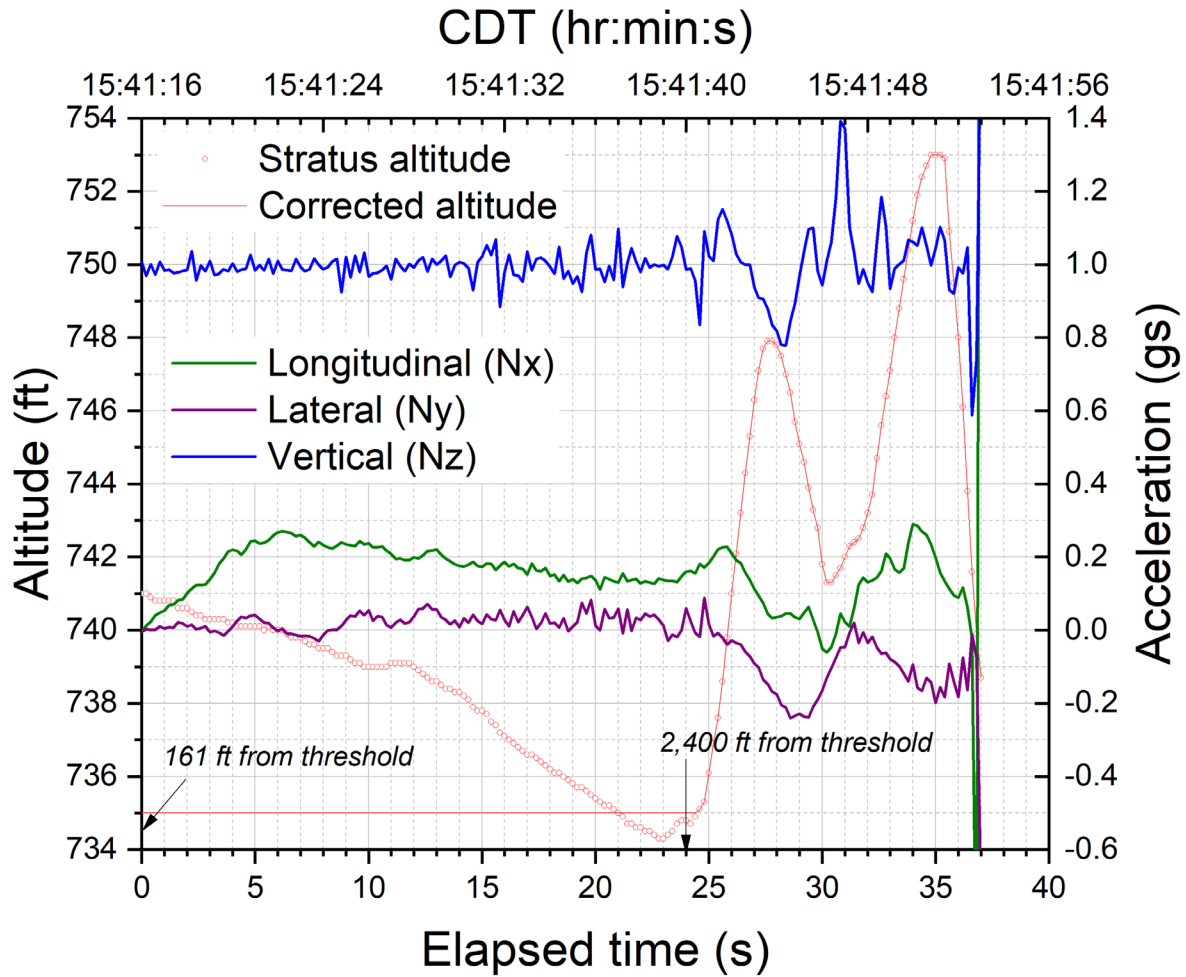
This performance study is based on data from the onboard Appareo Stratus which recorded altitude, latitude and longitude, acceleration in the x, y, and z directions, groundspeed, ground track, heading, pitch, roll, slip, turn rate, and vertical speed. Data comes from a combination of a GPS (global positioning system) and an AHRS (attitude heading reference system). Data was recorded at 5 Hz.

Weather was recorded at Chicago Rockford International Airport (KRFD), where the accident occurred, at 1554. The temperature was reported as 84°F (29°C), the dew point was 57°F (14°C), and the barometric setting was 29.95 inHg. Winds were 10 kts gusting to 18 kts from 200°. Visibility was 10 statute miles and clouds were reported as few (1-2 oktas) at 200 ft above ground level (agl).

Altitude recorded on the Stratus was not accurate until after take-off. Field elevation at the threshold of runway 19 is 735 ft. Figure 1 shows the recorded altitude relative to mean sea level (msl), corrected altitude, which pins altitude to the ground until after take-off, and accelerations from the AHRS. Elapsed time from the beginning of the take-off run is shown along the bottom axis and correlated to CDT along the top axis (beginning of take-off roll is coincident with 15:41:16). Distance along runway 19 based on recorded GPS position is called out for time zero

**Performance Study**  
**CEN20LA352, Beech 200, N198DM**

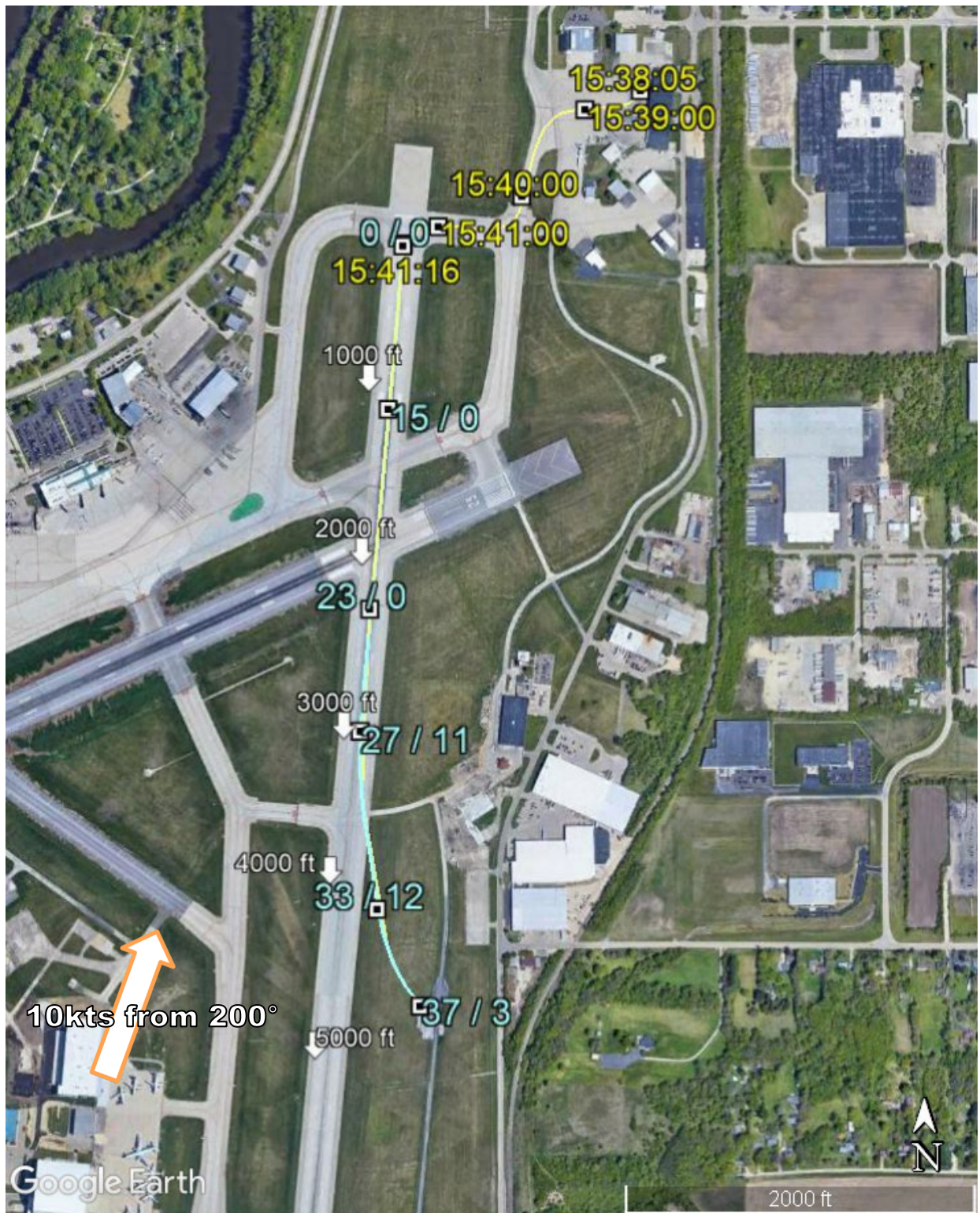
and 24 s. Data after time 37 s (15:41:53) became unreliable as can be seen in the acceleration data and was consistent with impact.



**Figure 1.** Recorded and corrected altitude (msl) with Nx, Ny, and Nz accelerations. Time shown in CDT and in elapsed time since the beginning of the take-off roll.

Vertical acceleration shows take-off to be between 24 and 25 s after the beginning of the take-off roll. About 2 s later, Ny recorded a significant left side force on the airplane. The side force was relieved at time 32 s, but then returns.

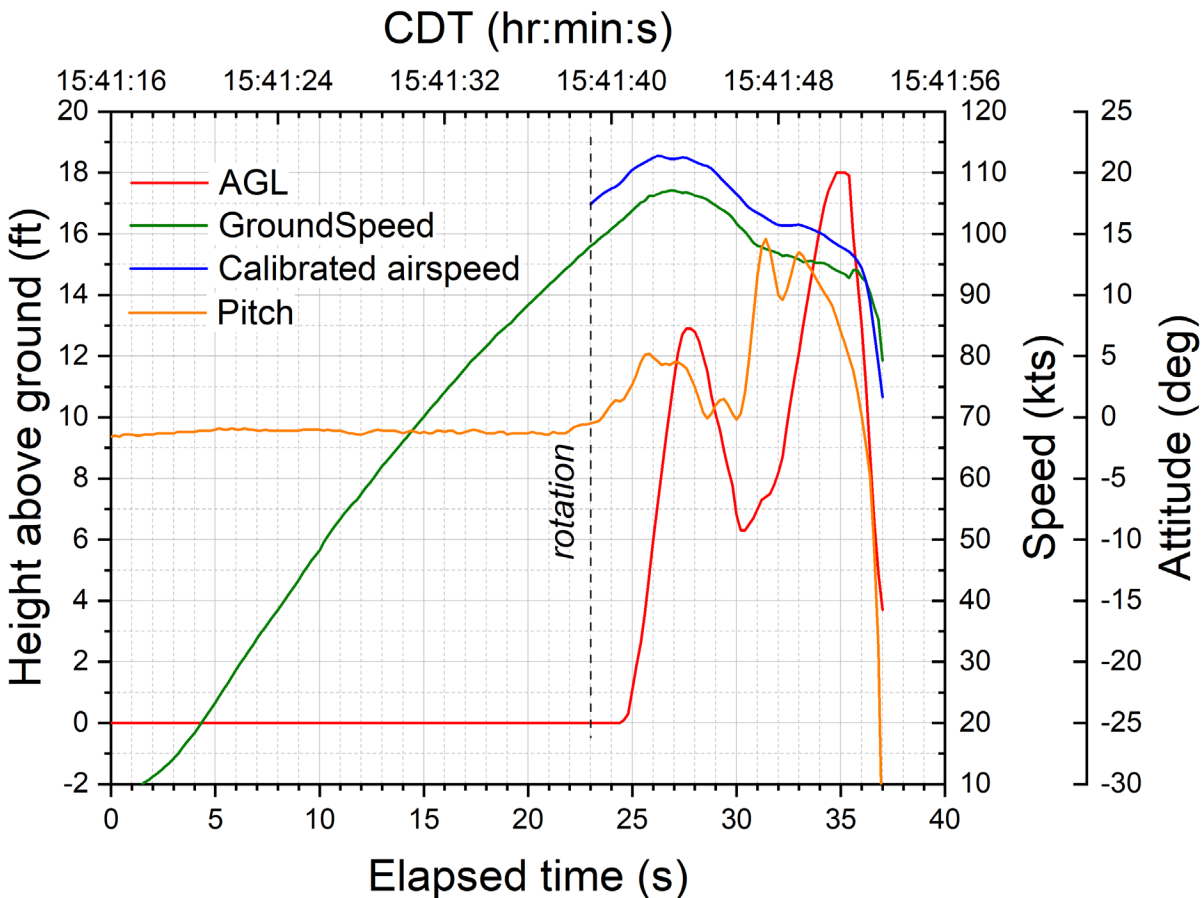
Runway 19 is 8,200 ft long. Figure 2 shows the airplane's taxi with local time in yellow and path along the runway with elapsed time in seconds and height above ground in feet noted. Take-off occurred at about 24 s. Just after 27 s and 3,000 ft down the runway, the airplane's flight path began deviating to the left. Ten seconds later it impacted the ground.



**Figure 2.** Taxi shown with local time in yellow. Accident flight in blue with elapsed time since beginning of take-off roll and altitudes (agl) annotated in blue. Distance along runway shown in white with arrows. Wind is shown with an orange and white arrow.

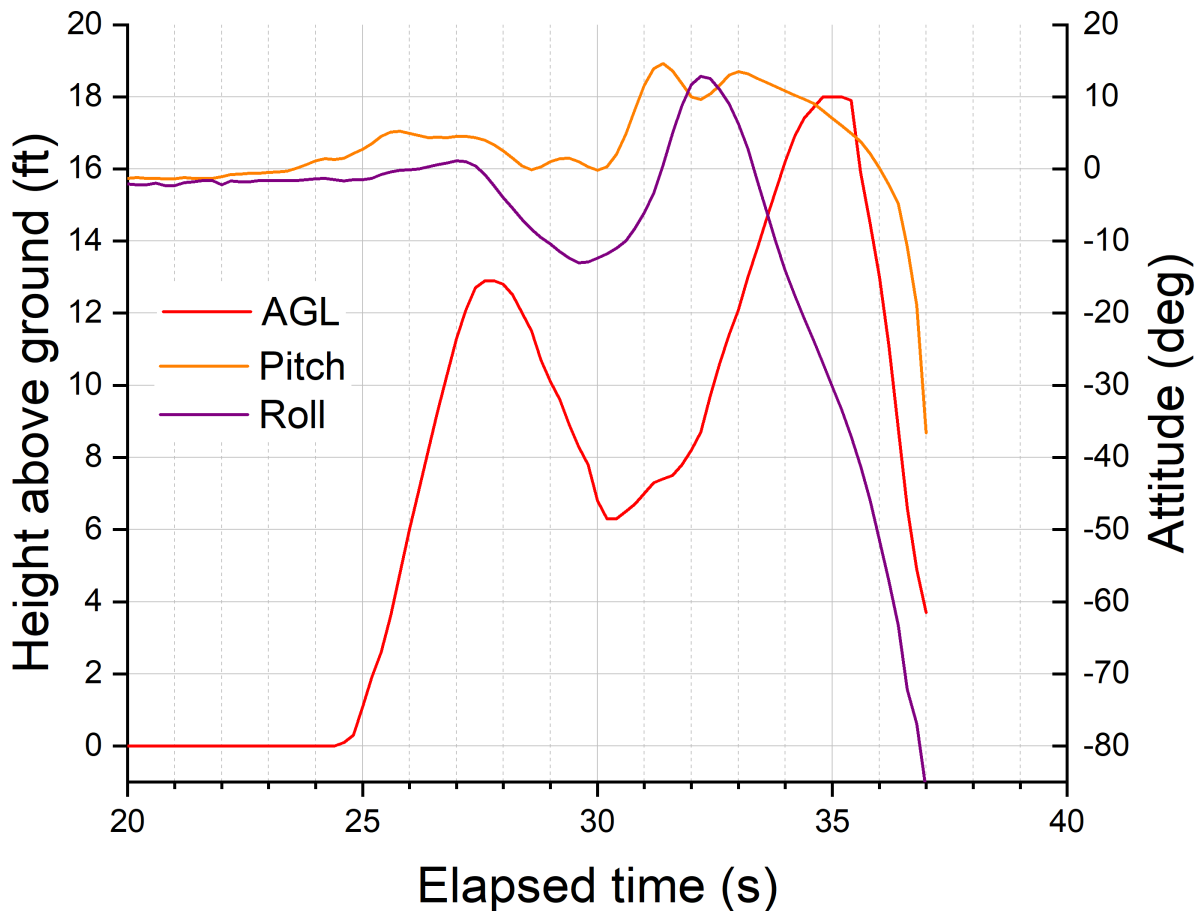
**Performance Study**  
**CEN20LA352, Beech 200, N198DM**

Figure 3 shows height above ground, the recorded groundspeed, calculated airspeed, and recorded airplane pitch. Rotation occurred about 23 s when the airplane's groundspeed was 98 kts and its airspeed was 105 kts. Rotation speed was consistent with guidance. The airplane was less than 20 feet above the ground for the duration of the flight.



**Figure 3.** Height above ground (altitude agl), recorded groundspeed, calculated airspeed, and pitch.

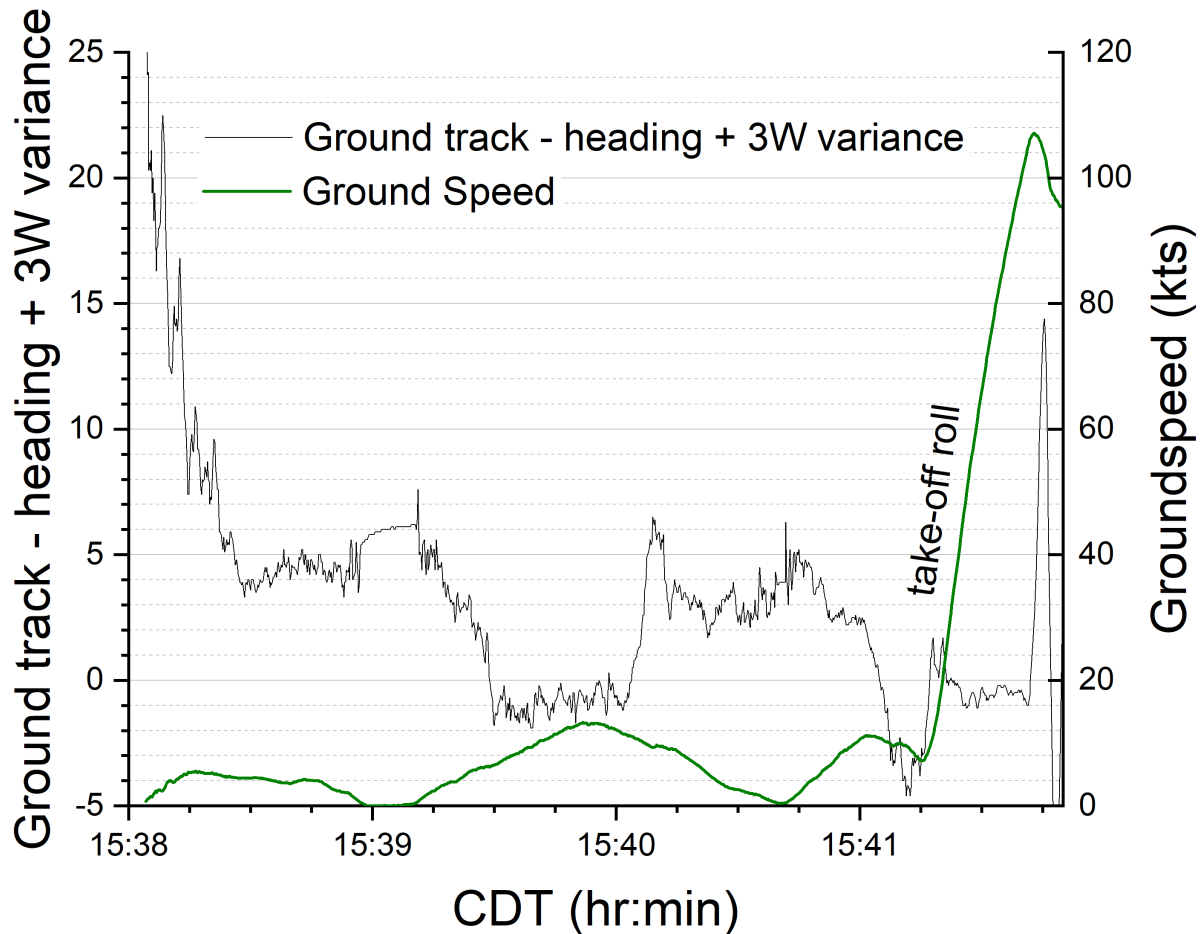
About four seconds after rotation (27 s), the airplane began to descend and lose airspeed while rolling to the left. The airplane began rolling back to the right and climbing again but continued to slow. By elapsed time 33 s (10 s after rotation) the airplane was again rolling left rapidly and after 35 s it was descending.



**Figure 4.** Height above ground (altitude agl), recorded pitch and roll.

The Stratus also recorded airplane heading and ground track angle. Ground track is calculated from the airplane's GPS location. Heading is calculated using ground track and gyroscopic measurements from the AHRS. Appareo was consulted about the accuracy of heading while on the ground and they responded that if the heading and ground track have aligned during recent taxi or if the takeoff roll is long enough to allow alignment, heading can be accurate. However, if heading and ground track have not aligned, short term yawing of heading may not be accurate.

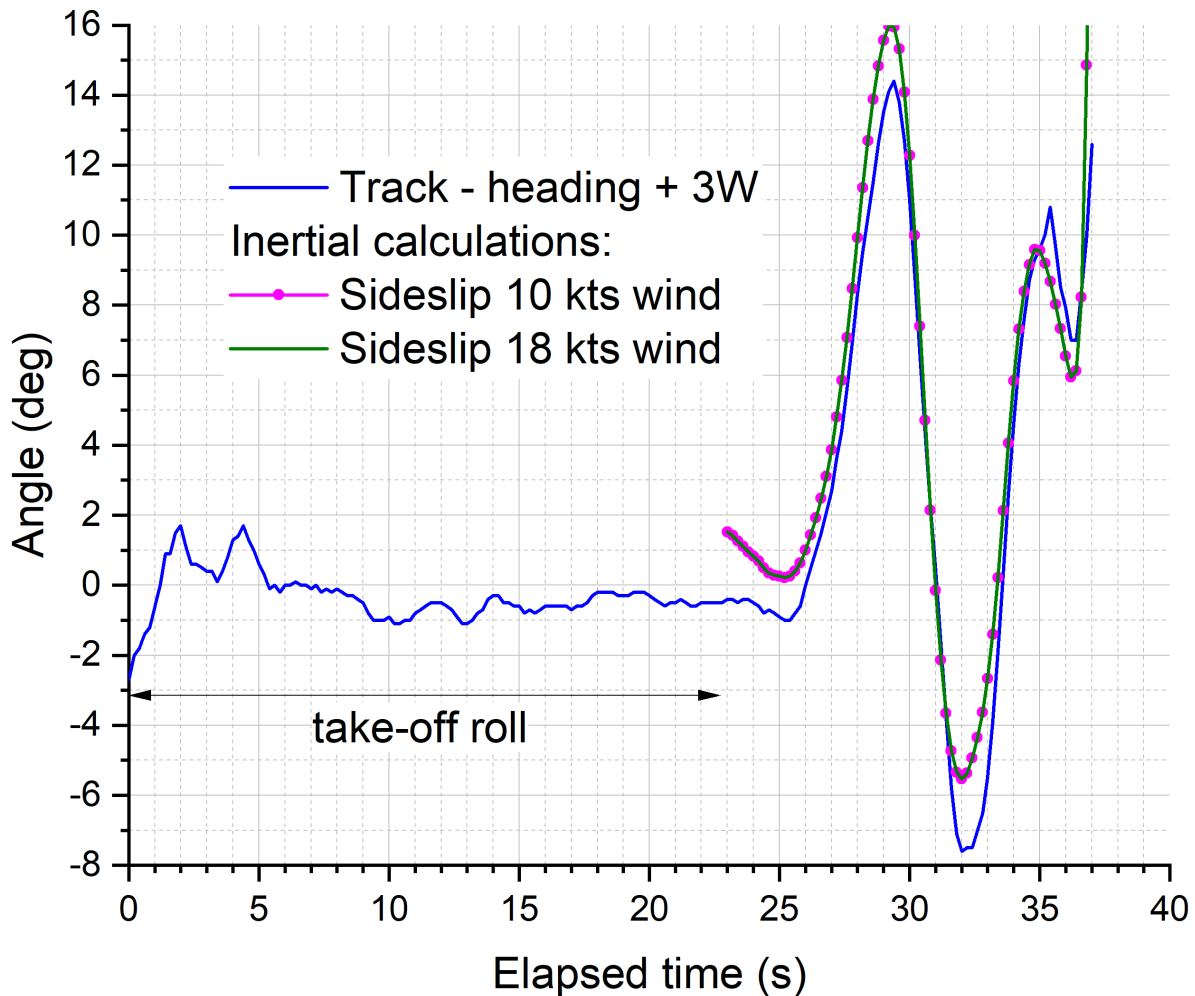
Figure 5 shows the alignment of ground track and heading with the local magnetic variance of  $3^{\circ}$  west taken into account. At the beginning of the data, heading was very different from ground track, but it began to resolve during taxi. During the takeoff roll, the ground track and heading were within a degree of one another.



**Figure 5.** Ground track minus heading plus magnetic variance and groundspeed.

Wind was from  $200^{\circ}$  and the runway's true heading was  $185^{\circ}$ , so the wind was a slight right cross wind. Upon takeoff, it would be expected that the airplane would be slightly nose right of the ground track. However, the difference between ground track and heading show a large increase in yaw to the left. Additionally, as discussed in Figure 1, the lateral ( $N_y$ ) acceleration recorded a significant increase in the side force in that direction on the airplane after 26 s.

To further investigate the possible increase in sideslip, the x, y, and z directional accelerations from the AHRS on the Stratus were integrated and compared to the flight path recorded by the GPS unit and then corrected to the airplane's center of gravity using B200 moments of inertia and geometry. The results of those calculations were paired with the wind data to calculate the resultant sideslip and are shown in Figure 6. The magnitude of the wind (reported as 10 kts gusting to 18 kts) made little difference in the results, and neither did some possible variations in the location of the Stratus in the cockpit. The calculated sideslip was about  $1^{\circ}$  more than the difference between track and heading.



**Figure 6.** Ground track minus heading plus magnetic variance and groundspeed and calculated sideslip.

One to two seconds after take-off, the airplane encountered a substantial sideslip and corresponding side force to the left which was followed by a left roll and a loss of altitude. The airplane then rolled back to wings level and the sideslip was in the opposite direction at time 32 s and the airplane again climbed. Figure 1 showed that  $N_y$  returned to near zero at this time. However, roll and side force both then increased in the left direction again and the airplane lost altitude and impacted the ground.

Of interest was the possibility that the airplane lost thrust in the left engine. After time 27 s, the airplane lost both altitude and airspeed, consistent with a reduction in power. If left engine thrust was reduced or lost, the right engine would exert a yawing moment on the airplane, driving the nose to the left and inducing a left roll. The airplane's directional control can be maintained by putting in opposite rudder to counteract the sideslip. Starting at time 29 s, the airplane's nose-left sideslip and left side force (Figure 6 and Figure 1) reduced, possibly due to rudder input. Sideslip then went the other direction, possibly due to an overcorrection. After 34 s, the nose left sideslip again increased and the airplane rapidly rolled left.

#### **D. CONCLUSIONS**

The airplane took off from runway 19. The airplane accelerated to a groundspeed of 98 kts and an airspeed of 105 kts before rotating and lifting off. The airplane pitched up, climbed, and gained height above the ground. Then, four seconds after rotation, the airplane began descending and slowing, consistent with a loss of power. A nose-left sideslip, a left side force and a left roll were recorded, consistent with the loss or reduction in thrust of the left engine. The sideslip was reduced, likely by opposite rudder input, and the airplane briefly rolled right. The airplane pitched up and was able to begin climbing again, however it continued to lose speed. The sideslip then reversed and the airplane rolled left again and impacted the ground.

---

Marie Moler  
Specialist – Airplane Performance  
National Transportation Safety Board