National Transportation Safety Board

Office of Aviation Safety

Washington, D.C. 20594-2000

December 19, 2015

SIDESLIP THRUST and RUDDER STUDY

CEN15FA034

A. Accident

Location: Wichita, KS Mid-Continent Airport
Date: October 30, 2014
Time: 0948 CST
Vehicle: Raytheon Super King Air 200, BB-1686, N52SZ,
Engine: Pratt Whitney PT-6A-42, 850 SHP
Propeller: Hartzell Propeller, Inc.

B. Investigators

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C. Summary

On October 30, 2014, about 0948 central daylight time, a Raytheon Aircraft Company King Air B200, N52SZ, operated by a private individual, was destroyed shortly after takeoff when it impacted a building at the Wichita Mid-Continent Airport (KICT), Wichita, KS. The private pilot sustained fatal injuries. Visual meteorological conditions prevailed for the personal flight conducted under Title 14 Code of Federal Regulations Part 91. The flight originated from KICT and was destined for Mena Intermountain Municipal Airport (KMEZ), Mena, AR.

The airplane was taking off from Runway 1R. Shortly after takeoff, the pilot reported that power was lost in the left engine. Witnesses reported that the airplane started turning left, leveled wings briefly, and then began a descending left bank. The airplane descended rapidly and hit the east wall and roof of the Cessna Citation Learning Center, operated by Flight Safety International, Inc. The impact and post-crash fire resulted in three additional fatalities inside a flight simulator in the building. Four flight simulators in the north end of the building were substantially damaged.

The airplane was powered by two Pratt Whitney PT-6 turboprop engines.

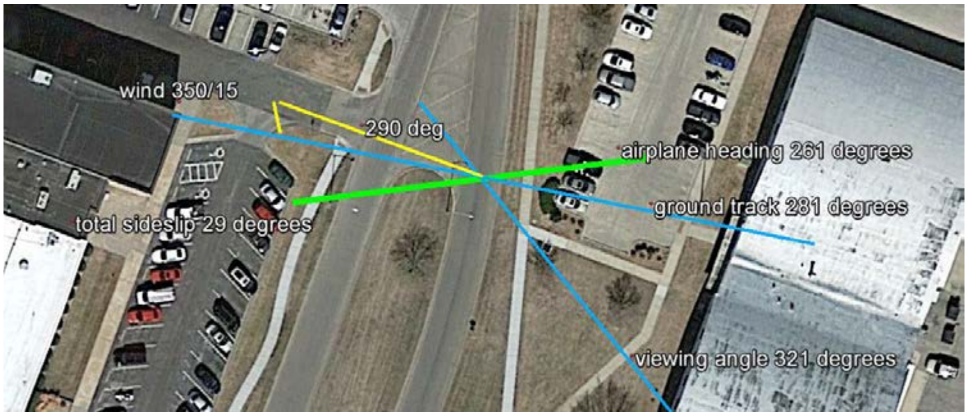
1.0 Summary

The Sideslip Study used local surveillance video recordings that captured the final moments of the flight. In that study, the airplane was found to be in a 29^{o} airplane nose left sideslip (ANL). The sideslip angle develops when there is a rudder deflection and/or difference in thrust between the left and right engine.

This study evaluates the relationships between the sideslip angle, thrust differential, and rudder deflection. The relationships are derived from proprietary aerodynamic coefficients provided by Textron Aviation. Therefore, only the results are presented in this study.

The photo below was extracted from a video camera. The airplane was about one second from impact one second before impact. Data extracted from the surveillance videos show that the ground speed ranged between 80 and 89 knots (KGS), resulting in a calibrated airspeed ranging between 85 and 94 knots (KCAS). The higher speeds were presented in the Wichita Video Study.

A 29-degree airplane nose left (ANL) sideslip was reconstructed from an image recorded moments before the airplane hit the Flight Safety building (see the Sideslip Study).



Various sideslip angles were calculated by balancing the yawing moments created by the sideslip angle of the airplane, rudder deflection, thrust from the right engine and either the thrust or drag from the left engine.

Textron provided yawing moment coefficients related to sideslip and rudder deflection. The yawing moment coefficients are considered accurate; the yawing moment coefficients at large sideslip angles are considered approximate. Textron and Hartzell also provided estimates of drag if the left propeller were windmilling (400 lbs drag) or thrust if the engine was operating at min-power (250 lbs thrust). The rudder can deflect 25 degrees left or right.

This study assumes that the right engine was at full power. However, the powerplant report shows evidence consistent with the right engine operating at moderate power. The right engine did not hit the building. It is possible that the right engine was at full power and was slowing down, either by the pilot pulling the power in the right engine or the right engine was winding down during the impact sequence.

The left engine was found to be at partial power rather than windmilling. The result using 250 lbs thrust from the left engine is considered more accurate than the results using 400 lbs drag from the left engine. If the left propeller was feathered, drag or thrust would be zero.

If the rudder were deflected full right, the resultant sideslip angle ranged from 2 degrees airplane nose right (ANR) to 3 degrees airplane nose left (ANL). See Table 1. If the rudder were neutral, the resultant sideslip ranged from 14 to 19 degrees ANL. If the rudder were deflected full left, the resultant sideslip ranged from 28 to 35 degrees ANL[1]. The calculations resulting in sideslip angles less than 15 degrees are considered reliable. The calculations resulting in sideslip angles in the 25-38 degree range are considered representative.

The results show that with full right rudder deflection, the airplane sideslip angle should have been near zero. A zero rudder deflection would result in an airplane sideslip angle between 14-19 degrees. A full left rudder deflection would result in an approximate airplane sideslip angle between 28 and 35 degrees ANL.

To achieve greater nose-left sideslip angles as noted in the photograph, a substantial left rudder input is necessary.

[1] The sideslip coefficients are considered approximate. The values are consistent with aerodynamic data provided by Textron. However, a precise buildup using all factors to determine the coefficients at high sideslip angles was beyond the scope of this report.

Table 1 – Sideslip angles (beta) with various rudder deflections and thrust/drag combinations. The 89 KIAS was developed from the Video Study. The lower speed (80 KIAS) is presented to explore the sensitivity of the sideslip angle to airspeed.

Constants:	Speed:	89 KIAS	94 KCAS
	R thrust:	2354 LBS	
	R Wheel:	20 rwd	

Rudder	L thrust	Beta
25 TER	250 lbs	2 ANR
25 TER	-400 lbs	2 ANL
zero	250 lbs	14 ANL
zero	-400 lbs	18 ANL
25 TEL	250 lbs	28 ANL
25 TEL	-400 lbs	32 ANL

Constants:	Speed:	80 KIAS	85 KCAS
	R thrust:	2603 LBS	
	R Wheel:	20 rwd	

Rudder	L thrust	Beta
25 TER	250 lbs	3 ANL
25 TER	-400 lbs	8 ANL
zero	250 lbs	19 ANL
zero	-400 lbs	24 ANL
25 TEL	250 lbs	35 ANL
25 TEL	-400 lbs	40 ANL

note: rolling moments are not resolved, only Cnda is used

2.0 Air minimum control speed V_{MCA}

For reference, V_{MCA} = 86 KIAS or 92 KCAS. The King Air 200 POH states:

> AIR MINIMUM CONTROL SPEED (V_{MCA})
>
> V_{MCA} is designated by the red radialon the airspeedindicator and indicates the minimum control speed, airborne at sea level. V_{MCA} is determined by FAA regulations as the minimum airspeed at which it is possible to recover directional control of the airplane within 20 degrees heading change, and therefore maintain straight flight, with not more than 5 degrees or bank if one engine fans suddenly with:
> • Takeoff power on the operative engine
> • Rearmost allowable center of gravity
> • Flaps in takeoff position
> • Propeller on failed engine windmllling (feathered if Auto-Feather system is required)
>
> However, sudden engine failures rarely occur with all factors listed above, and therefore, the actualVMCA under any particular situation may be a little slower than the red radialon the airspeed indicator. Most airplanes will not maintain levelRight at speeds at or near VMCA·Consequently,it is not advisable to fly at speeds approaching VMCA· except in training situations or during flight tests. Adhering to the practice of never fly- ing at or below the published VMCA speed for your airplane will virtually liminate·loss of directional control as a problem in the event of an engine failure.

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