

CIVIL AERONAUTICS BOARD

ACCIDENT INVESTIGATION REPORT

Adopted: April 7, 1953

Released: April 10, 1953

LAKE CENTRAL AIRLINES, INC., - INDIANAPOLIS, INDIANA,
AUGUST 21, 1952

The Accident

At 1520,^{1/} August 21, 1952, a Beech Bonanza, N 8765A, owned by Lake Central Airlines and operated as Flight 4, crashed 332 feet short of Runway 31 at Weir Cook Municipal Airport, Indianapolis, Indiana. During final approach for landing the Bonanza was thrown without prior warning into approximately a right vertical bank at an altitude of about 75 feet and sideslipped to the ground. The three occupants of the Bonanza were seriously injured and the aircraft was demolished.

History of the Flight

Flight 4 departed Connersville, Indiana, at 1451 on the last portion of a scheduled flight from Indianapolis to Cincinnati, Ohio, and return.

Upon departure of Flight 4 from Connersville the gross weight of the aircraft was approximately 2,344 pounds with two passengers, the pilot, 72 pounds of mail and baggage, and approximately 24 gallons of gasoline. The gross weight was less than the allowable certificated gross takeoff weight of 2,650 pounds, and the load was properly distributed with relation to the center of gravity of the aircraft.

The flight proceeded without incident to the vicinity of Indianapolis on a VFR flight plan. When about five miles southeast of the airport, the pilot of the Bonanza was given landing information for Runway 27 by the Indianapolis tower and was instructed to report over Stout Field, approximately 2-1/2 miles east of Weir Cook Municipal Airport.^{2/} Shortly thereafter, the pilot reported passing Stout Field on a stright-in approach to Runway 27; the Indianapolis controller acknowledged the position and gave permission to continue the approach.

An Eastern Air Lines Constellation, operating as Flight 109, had approached the field from the northwest and made its downwind leg west of the airport. At the time the pilot of the Bonanza reported over Stout Field, the Constellation

^{1/} All times referred to herein are Central Standard and based on the 24-hour clock.

^{2/} See attachment.

had been cleared to land on Runway 31 and its pilot was making a left-hand approach. Shortly thereafter, the controller changed the landing instructions to the Bonanza and advised: "LAKE CENTRAL FOUR YOU'D BETTER SWING OVER. USE RUNWAY THREE ONE, FOLLOW THE CONSTELLATION."

The Bonanza immediately turned left to a southerly heading. The pilot made several S-turns in order to increase the time interval between himself and the landing Constellation, then made a wide right turn to align his aircraft for final approach to Runway 31. The Bonanza began the turn to final approach as the Constellation landed.

The Bonanza, during final approach, was suddenly thrown into approximately a right vertical bank. This occurred at about 75 feet altitude and some 350 feet from the threshold of Runway 31. It struck first on the right wing tip, then described a partial cartwheel toward Runway 31 as the nose and then the left wing tip struck the ground. It came to rest on the nose (the engine was thrown clear upon impact), upright but tail high, on a magnetic heading of approximately 120 degrees and 140 feet beyond the point of initial contact with the ground.

The Investigation

Indianapolis weather conditions at the time of the accident were: Broken strato-cumulus clouds at 1,800 and 6,000 feet, with an overcast of alto-cumulus clouds at 10,000 feet; visibility 12 miles; surface wind from the west at 11 miles per hour. The wind was steady, with no gusts reported. Investigation revealed that there was little or no turbulence from natural causes.

Examination of the wreckage indicated no structural failure or malfunction of any component of the aircraft. This was further confirmed by the pilot of the Bonanza, who stated that no malfunctions were experienced. A review of the maintenance records for N 8765A showed that all corrective maintenance had been accomplished, all applicable airworthiness directives complied with, and progressive maintenance checks made as required.

Captain J. C. Thompson made the approach and landing of Eastern Air Lines Flight 109 at Indianapolis, a scheduled stop on the flight between Chicago, Illinois, and Miami, Florida. He stated that both the approach and landing were normal and were made in accordance with Eastern Air Lines procedures. Manifold pressure was reduced to 20 inches prior to starting a left turn to base leg and final approach. During the descent, the power settings were increased to 22-25 inches and 2400 rpm maintained. Flaps were extended to the 60 per cent position when downwind, 80 per cent at 700-800 feet altitude, and 100 per cent flaps at 300-400 feet altitude when one-fourth mile from the end of the runway. Speed was reduced from 175 miles per hour on the

downwind leg to 150 miles per hour on base leg, and 120-125 miles per hour was maintained during final approach to Runway 31. Captain Thompson sighted the Bonanza an estimated five miles to the northeast when the Constellation was turning base. He experienced no gusts or turbulence. After landing, the aircraft made a right turn at the intersection of Runways 9 and 31. Although the Constellation was equipped with propeller reversing, it was not used.

After the turn off was made and the Constellation was at a right angle to the active runway, Captain Thompson glanced across the cockpit and saw the Bonanza in a right vertical bank a short distance from the approach end of Runway 31 at an estimated 25-50 feet above the ground. The nose was about level with the horizon and the landing gear was extended. He did not see the light aircraft thrown into the vertical position but observed it only during the sideslip and crash. The first officer of the Constellation was changing radio frequencies and did not see the Bonanza fall, but observed it only at impact.

Mr. Robert W. DeWitt, stationed at the local control (A) position in the Indianapolis tower, testified that at the time the pilot of the Bonanza was advised to land on Runway 31 rather than Runway 27, the Constellation had completed its turn to final approach for Runway 31. It appeared to him that as the Eastern Air Lines aircraft approached the end of the runway, the Bonanza turned right for final approach. Immediately after the Constellation had turned off Runway 31, he observed the Bonanza in a normal approach an estimated one-half mile southeast of the airport. After glancing at the Constellation to make positive that it was clear of Runway 31, he cleared the Bonanza to land.^{3/} He then momentarily directed his attention to the approach area of Runway 27 to make positive that it was clear of other traffic and therefore did not see the accident. He said that the Lake Central pilot "made a perfectly normal flight pattern" and that he had seen similar approaches completed without incident.^{4/} Mr. DeWitt testified that he would have transmitted precautionary advice to the pilot of the Bonanza had he felt that a dangerous situation existed.

Captain Haas said that as he passed Stout Field at 500 feet altitude, he lowered the landing gear and about one-third flap. At about the time he reported passing Stout Field, he heard the pilot of the Constellation report

3/ Section 3.141 of the joint Air Force-Navy-CAA publication, "Procedures for the Control of Air Traffic," states that "Sufficient separation shall be effected between arriving aircraft to insure that the succeeding landing aircraft on the same runway will not cross the airport boundary in its final glide until the preceding aircraft has cleared the runway-in-use."

4/ Mr. DeWitt had been employed by the CAA as an Airways Operations Specialist at the Indianapolis tower since 1949, and was a certificated controller with an all-region senior rating; in addition he was a currently certificated commercial pilot.

that he was about a mile south of Weir Cook Municipal Airport. The controller then requested Captain Haas to land after the Constellation. He therefore maintained his altitude, turned left to a southerly heading when at an estimated 1,500 feet from the east side of the airport, and had the Constellation continually in sight from that time. The Constellation was proceeding downwind when first sighted, some two or three miles from the airport.

After the Constellation had turned off Runway 31, Captain Haas began descent to final approach. He stated that since he still had considerable altitude, more flap (amount not recalled) was added, and the propeller was put in low pitch. The wings of the Bonanza were level in the final approach, with an estimated power setting of 14-15 inches of manifold pressure being maintained. The air was smooth until a single "terrific jolt" of turbulence, as he termed it, was experienced. According to Captain Haas, the nose was probably slightly elevated at the time he encountered the turbulence, for he had begun to reduce air speed from 80 miles per hour in anticipation of the landing flareout. However, the air speed was nearly 80 miles per hour at that moment and far from the stalling speed of 55 miles per hour. He felt no indication of a stall. Full power and counter control -- full left aileron and rudder, wheel forward -- had no effect until the Bonanza started to recover at 5 to 10 feet above the ground.

All three occupants had their safety belts fastened; the rear belt broke in the webbing, but the other two did not fail.

Captain Haas estimated that the closest horizontal separation between the two aircraft while the Bonanza was in final approach was about 3,000-4,000 feet. He stated that separation with the Constellation was that which he would normally maintain in any approach.

He also testified that he had previously experienced turbulence in this and other aircraft during approaches for landing, but had always been able to maintain control. Captain Haas could not recall having experienced turbulence in the wake of a Constellation prior to this incident. The possibility of such turbulence occurred to him during the approach, he said, but no difficulty was anticipated since the distance and time separation seemed adequate. He felt that additional altitude would have enabled him to recover, but that "quite a lot of air speed" would have been necessary to effect recovery.

The chief pilot of Lake Central Airlines testified that pilots for the Bonanza operation were taught to make approaches for landing at 80 miles per hour indicated air speed with landing gear down, flaps extended, and a slight amount of power. The aircraft manufacturer's handbook likewise recommends that 80 miles per hour indicated air speed be maintained on final approach, with landing gear down and flaps fully extended.

Facts and circumstances surrounding the two flights were further corroborated through the observations of two other controllers on duty at the time, an aircraft line service employee of the Roscoe Turner Aeronautical Corporation, and two U. S. Air Force pilots who were in a B-26 awaiting

clearance to take off. The B-26 was on the taxiway near the approach end of Runway 31.

Following the accident, Board investigators timed with stop watches a number of approaches and landings of Constellations from a point about 300 feet from the end of the runway to the time the aircraft turned off the runway. Most of the observations were made on aircraft which had landed on Runway 31 and turned at the intersection of Runway 9. Only those landings in which propeller reversing was not used were clocked. The time spread was from 31 to 38 seconds. It was thus ascertained that the time separation between the approaches of the Bonanza and the Constellation was one-half minute or more.

Investigation disclosed that the Beech Aircraft Corporation had made a study of turbulence induced by aircraft. This study was completed shortly before the accident. Lake Central Airlines received a copy of the Beech report four days after the incident. It revealed that severe turbulence can be caused by any type of aircraft, but that the more frequent cases were reported by pilots who had experienced the phenomenon in either landing or taking off behind large aircraft.

The Beech safety bulletin advised pilots that the induced turbulence is caused, basically, by the vortex from each wing tip and the swirling propeller wash. One report commented that the turbulence created by jet aircraft is considerably higher than that produced by propeller-driven aircraft. A number of persons reported conditions almost identical to those experienced by Captain Haas. Several pilots had encountered severe turbulence while flying larger aircraft such as the Lockheed Lodestar, Douglas A-20, B-26, DC-3 and others.

Investigation by the Board showed that wing tip vortices are caused by the air at increased pressure under a wing tending to flow outboard around the tip to the area of reduced pressure above the wing. The magnitude of the vortices is dependent on several factors including the shape of the wing, the amount of lift being produced, and the angle of attack at which the wing is operating. The relationship of these factors is such that a large, heavy aircraft breaking its descent to flare out for a landing causes very powerful wing tip vortices. Extended wing flaps also can cause powerful vortices. Severe turbulence may be induced by the propellers, wing tips, and flaps, the severity depending upon the combination of circumstances and the aircraft involved.

On March 3, 1952, the CAA issued a circular to each Regional Administrator requesting reports of incidents in which small aircraft had encountered dangerously severe turbulence when following large multi-engined aircraft.^{5/}

^{5/} Circular Letter W-380-105 from the Chief, Airways Operations Division, CAA, Washington, D. C., to all CAA Regional Administrators. Subject: Effect of Large-Plane "Turbulence" on Small Aircraft.

Following receipt of these reports, another circular^{6/} was prepared and distributed to all Regional Administrators a week subsequent to the accident. This latter circular stated that the various Regions had reported numerous incidents in which small aircraft had encountered turbulence both on the ground and in flight when following or crossing the thrust streams of multi-engined or jet aircraft. Control tower personnel were cautioned to be alert to situations which, if properly recognized and acted upon, could prevent such accidents. The circular pointed out that there are so many variables concerning large aircraft turbulence that it would be almost impossible to delineate specific procedures to cope with the problem.

Investigation disclosed that Lake Central Airlines, the aircraft, and the pilot were properly certificated.

Analysis

The evidence indicates that the Bonanza crashed as a result of severe turbulence in the wake of the Constellation. Weather was not a factor in this accident.

The accident could have been prevented had the Bonanza pilot conducted his approach with greater separation, and made the turn to final approach later. A higher approach air speed might have prevented it or permitted the aircraft to be controllable in greater degree. Air speed is definitely a factor in a pilot being able to maintain control and to effect recovery, for the margin of safety lies between air speed and altitude. The final approach of the Bonanza was made in accordance with company procedures and air speed recommendations of the aircraft manufacturer, but the air speed and altitude were insufficient for the unexpected condition which was encountered.

There has long been knowledge that the turbulence induced by any aircraft in flight can, under certain conditions, be hazardous. The degree of danger present in any particular portion of such turbulence is subject to many variables and cannot be accurately predicted. Though separation, both in time and distance was equal to or greater than normal, the turbulence encountered was of such violence that the Bonanza was thrown out of control. Thus the primary factor in the cause of this accident was a lack of full appreciation by both the pilot of the Bonanza and the controller that the turbulence created by the Constellation placed the Bonanza in jeopardy. The Board believes that the approach of Lake Central's Flight 4 and air traffic control functions were properly conducted, considering that both parties were of the belief that a normal situation existed.

^{6/} Circular Letter W-380-213 from the Chief, Airways Operations Division, CAA, Washington, D. C., to all CAA Regional Administrators.
Subject: Effect of Large-Plane "Turbulence" on Other Aircraft.

Findings

On the basis of all available evidence, the Board finds that:

1. The carrier, the aircraft, and the pilot of the Bonanza were properly certificated.
2. There was no malfunction of any component of the Bonanza.
3. Weather was not a factor.
4. Airport traffic control functions were conducted correctly, with proper consideration and adherence to separation requirements between landing aircraft.
5. The approach and landing of the Eastern Air Lines Constellation were executed in accordance with tower instructions, and were normal in all respects.
6. The pilot of the Lake Central Airlines Bonanza, while making a normal approach unexpectedly encountered severe turbulence in the wake of the preceding multi-engine aircraft.
7. The Bonanza was thrown into an unusual attitude at an altitude of about 75 feet and approximately 350 feet from the approach end of Runway 31 when it entered the severely turbulent area.
8. The turbulence was so severe, and encountered at such low altitude, that recovery could not be effected.
9. Separation, while considered adequate by the pilot of the Bonanza and the controller, was in fact insufficient.

Probable Cause

The Board determines that the probable cause of this accident was the fact that the final approach of the Bonanza was made so closely behind that of the Constellation that the Bonanza encountered an area of severe turbulence created by the preceding multi-engine aircraft and became uncontrollable, side-slipping to the ground.

BY THE CIVIL AERONAUTICS BOARD:

/s/ OSWALD RYAN

/s/ JOSH LEE

/s/ JOSEPH P. ADAMS

/s/ CHAN GURNEY

S U P P L E M E N T A L D A T A

Investigation and Hearing

The Civil Aeronautics Board was notified of this accident at 1540 by telephone call from the Chief of Flight Operations, CAA Regional Office, Chicago, Illinois. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing ordered by the Board was held at Indianapolis, Indiana, on September 17, 1952.

Air Carrier

Lake Central Airlines, Inc., a Delaware corporation, maintains its general offices at Indianapolis, Indiana. The company is successor to Turner Airlines, Inc., and was certificated to the present management by Board order dated August 9, 1949. Lake Central Airlines is engaged in the transportation of persons, property, and mail under a certificate of convenience and necessity issued by the Civil Aeronautics Board and an air carrier operating certificate granted by the Civil Aeronautics Administration. The company operates over routes in the Midwest, utilizing DC-3 equipment and until this accident, the one Bonanza. Following the accident, Lake Central Airlines discontinued, with Board permission, the daily round trip Bonanza flight between Indianapolis and Cincinnati, Ohio, via Connersville, Indiana. It currently operates flights between Indianapolis and Cincinnati using other equipment.

Pilot

Captain Jerry H. Haas, age 36, was employed by Lake Central Airlines on September 28, 1950. He held a valid airman certificate with an air transport rating for single-engine land aircraft, and a commercial pilot rating for both multi-engine land aircraft and single-engine seaplanes. Captain Haas had a total of 6,933 flying hours, of which 4,435 were in single-engine aircraft and 158 hours in the Beech Bonanza. He had flown 78 hours in the 30 days preceding the accident, 24 of which were in the Bonanza and the remainder in DC-3's on scheduled operations. Captain Haas received his type rating for the Bonanza on May 23, 1951, and was given his last six-months check on June 5, 1952. His last CAA physical examination (first class) was completed on April 1, 1952; there was no record of any waivers. He had a rest period of 20 hours and 10 minutes prior to the flight.

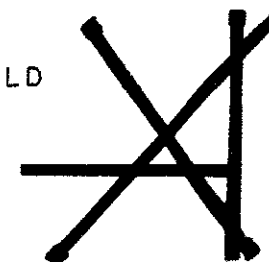
The Aircraft

N 8765A, a Beech Bonanza A-35, serial number D 2187, was owned and operated by Lake Central Airlines. It had a total of 1,719 flying hours and was currently certificated by the Civil Aeronautics Administration. The aircraft was equipped with a Continental E-185 model engine and a Beech model B-200 propeller. The engine had a total time of 1,719 hours with 526 hours since overhaul. Maintenance records showed that Nos. 1, 2, 3, and 4 progressive checks had been made as required; the last No. 1 check was completed on August 20, 1952.

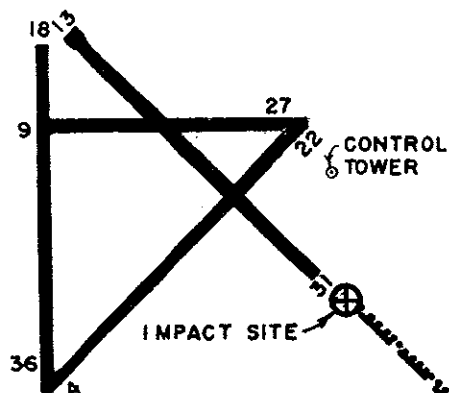
ATTACHMENT

VAR 20E

STOUT FIELD



WEIR COOK
MUNICIPAL AIRPORT



APPROXIMATE POSITION WHEN EAL 109
TURNED OFF RUNWAY 31; STARTED
DESCENT FROM 500'

ESTIMATED ALTITUDE 300';
ADDED FLAP.

LAKE CENTRAL AIRLINES, INC.,
BEECH BONANZA N8765A,
INDIANAPOLIS, INDIANA
AUGUST 21, 1952

..... FLIGHT PATH OF LAKE CENTRAL AIRLINES FLIGHT 4
- - - - FLIGHT PATH OF EASTERN AIR LINES' FLIGHT 109



NOTE: Probable flight paths and relative positions are based upon testimony and sketches by pilots, tower personnel, and ground witnesses.