



## Fatal Commuter Crash Blamed on Visual Illusion, Lack of Cockpit Coordination

*On a night visual approach to a northern Canadian airport, the crew failed to adequately monitor the aircraft's altitude. The captain's visual range was also restricted by his seating position.*

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*Editorial Staff Report*

The twin-engine turboprop Beechcraft C99 Airliner was on a night visual approach to Moosonee Airport in Ontario, Canada, when it crashed into trees and terrain about seven miles (11 kilometers) from the runway threshold. The aircraft was destroyed by the impact and a post-crash fire.

Rescue crews did not locate the survivors until the next morning. An autopsy determined that the first officer was killed on impact. The captain and two passengers were seriously injured.

The Transportation Safety Board of Canada (TSB) determined that the captain "inadvertently flew the aircraft into trees, during a condition of visual illusion, as a result of inadequate crew coordination in that neither pilot effectively monitored the altimeter."

The TSB, in a recently released accident report, added: "Contributing to the occurrence were the absence of

approach lighting, the lack of company crew-pairing policy, the captain's unfamiliarity with black-hole illusion and the seating position of the captain."

Black-hole illusion can affect pilots in night flying environments with few visual cues. The TSB report said that "lights viewed from a distance from over unlighted terrain, in the absence of ambient visual cues and reference to instruments, may give the illusion of false height."

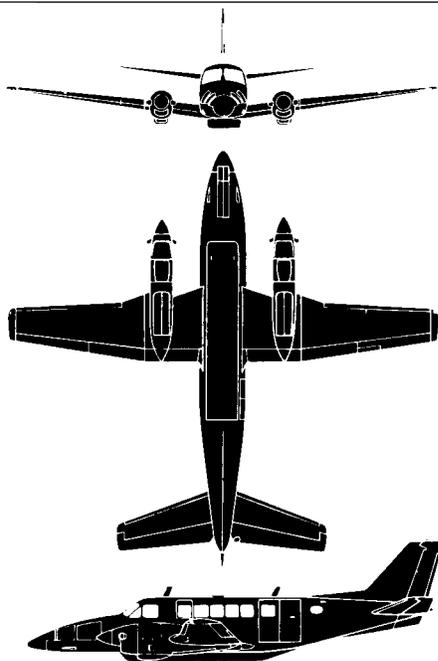
The TSB said "most pilots, including the very experienced and instructors, making a visual approach in such an area of limited visual cues could overestimate their height."

The report said that neither the captain nor the first officer was familiar with black-hole illusion, and neither pilot had received aviation human factors and medicine/psychology training beyond that required in private pilot training. The TSB said further training is not currently required.

The April 30, 1990, accident occurred at 2138 local time. It was a scheduled domestic flight operated by Frontier Air Ltd. and originated in Timmins, Ontario, at 2043 local time. Moosonee is located in northeastern Ontario near James Bay.

The aircraft struck trees while on a heading of 230 degrees. About 432 feet (132 meters) from the point of initial impact, the charred remains of the fuselage were found, along with inboard sections of both wings, cockpit and both engines and propellers, according to the TSB report.

Moosonee Airport is located on the north shore of the Moose River, just east of the town. The surrounding



**Beechcraft C99 Airliner**

The B99, the predecessor of the C99, first flew in 1966 and deliveries began in 1968. A large main cargo door allowed the aircraft to be used for either all-cargo or cargo/passenger operations. The C99, with increased power and systems refinements, was first delivered in 1981. It has a service ceiling of 28,080 feet (8,560 meters) and a range of 910 nautical miles (1,686 kilometers).

The C99 was certified for operation with one pilot, but U.S. Federal Aviation Regulations require two pilots in commuter air carrier operations. There are about 23 C99s in operation in the United States and about 52 operating in other countries.

The accident aircraft was configured to accommodate 15 passengers. It was equipped with two Pratt & Whitney PT6A-36 engines rated at 715 standard horse power. It has a cruising speed of 245 knots (454 kilometers per hour, 282 miles per hour) at 16,000 feet (4,880 meters).

*Source: Jane's All the World's Aircraft*

terrain is flat, and vegetation consists of trees about 25 feet (8 meters) high. The area was flooded from melted ice and snow packs at the time of the accident.

“Darkness, cloud cover and flooding created a ... featureless visual environment,” the TSB said.

The report added: “Because the terrain is flat and because the Moosonee town lights are oriented more laterally than longitudinally on this approach, a pilot’s ability to perceive angle is limited. There are no approach lights on runway 24, nor is there a visual approach slope indicator system (VASIS).”

The TSB said that by using a helicopter at night at the same altitudes, it was determined that the runway lights could be seen down to the tree level at the accident site.

Weather at the time of the accident was reported as estimated ceiling 400 feet (122 meters) above ground level (AGL) broken, 1,000 feet (305 meters) AGL overcast, visibility four miles (6 kilometers) in intermittent light rain and winds from 270 degrees at four miles per hour. The captain of the accident flight reported layers of cloud throughout his en route descent from 7,000 feet (2,135 meters) to an initial approach altitude of 1,500 feet (457 meters). The captain reported no turbulence, precipitation or icing during the descent.

The TSB report said the captain reported that a lower layer of cloud was based at about 900 feet (274 meters) AGL and that “when he broke out of the cloud on final approach at about nine nautical miles [17 kilometers] on the distance measuring equipment (DME), he could see clearly the airport lights.”

Passengers also reported that the aircraft was clear of the clouds at that time and that the airport was in sight before the accident.

The captain, 25, had logged a total of 2,423 flight hours, of which 298 hours were in the Beechcraft C99. The first officer, 35, had logged a total of 1,038 flight hours, of which 102 were in the C99. The captain held an airline transport pilot certificate. The first officer held a commercial certificate.

The TSB said the captain’s last night of flight training was logged on Aug. 24, 1987, in a twin-engine Piper Seminole.

But the TSB noted that the captain had flown a twin-engine Piper Navajo PA-31 and the C99 at night without receiving any on-type night training, which is required by Canadian air navigation regulations. The TSB said the captain’s last night flight logged before the accident was April 10, 1990.

The TSB report said that regulations “require air carriers to provide their pilots with certain training before they can serve as flight crew members. This training includes takeoffs and landings at night in each type of multi-engine aircraft that the pilot is to fly at night.”

The TSB report said Frontier’s flight training manual also required night flight instruction on each aircraft pilots were assigned to fly.

The report added: “Neither of the occurrence [accident flight] pilots had received the required night training on the Beechcraft C99 nor had they received night training for any of the aircraft types that they had flown in the past for the company. For these pilots, five different companies had not conducted night training on four different aircraft.”

The TSB said that the accident flight was the first time the first officer had flown at night in the C99, his first flight to Moosonee and his first flight paired with the captain. The TSB noted that the “company did not have a system to track night training and night flying requirements, nor is one required by regulation.”

The captain had flown day and night visual approaches to runway 24 at Moosonee often, the TSB said, adding that this experience may have led the captain to feel “confident with his visual estimates of height ... and trust the visual cues present.”

The accident aircraft was manufactured in 1982 and was powered with two Pratt & Whitney PT6A-36 turbo-prop engines. The aircraft was not equipped with an altitude alerter, ground proximity warning system (GPWS) or radio altimeter, nor were these devices required by Canadian regulation. In addition, the aircraft was not equipped with a flight data recorder (FDR) or cockpit voice recorder (CVR), which were also not required.

The TSB accident investigation devoted considerable attention to cockpit design and visibility factors and crew coordination and pairing issues.

The TSB said that the design of the C99 cockpit could create visibility problems for certain pilots because of their

height and in certain seat adjustment positions. The report said that each aircraft cockpit has a design eye reference point (DERP) position that allows maximum cockpit visibility (Figure 1).

“The cockpit visibility in this type of aircraft can be limited because of the interface between height and fore/aft position of the pilot’s eyes, height of the glareshield and control column location and movement,” the TSB report said. “Without clear reference or guidance regarding where to position oneself in order to optimize external visibility, it is possible to position oneself where one cannot see anything outside the aircraft that is below the horizon.”

According to the report, the captain was seated in a position to “facilitate instrument flying, which was clearly at the expense of external visibility.”

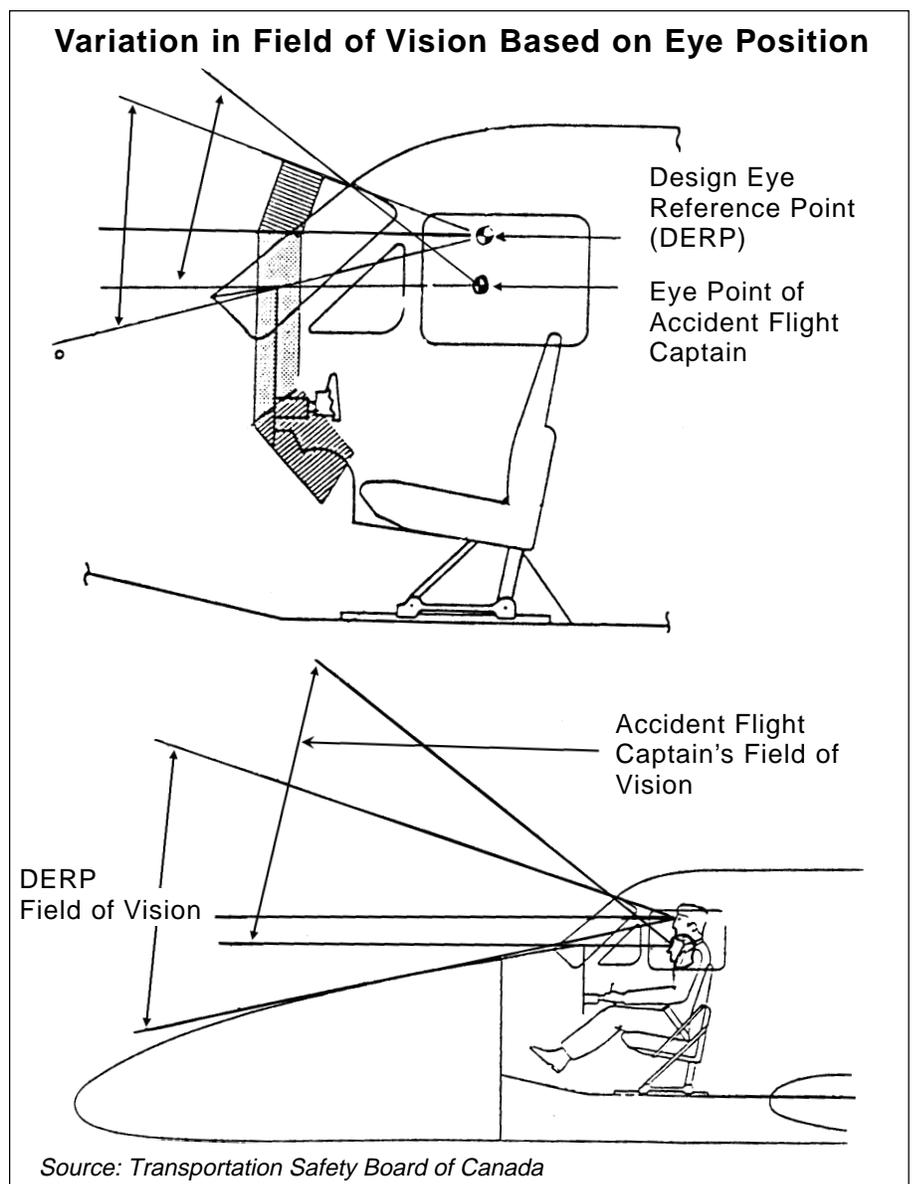


Figure 1

The TSB concluded: "The fact that there is a design eye position that guarantees certain fields of visibility, but which cannot be achieved for a pilot the size of the [accident] captain because of cockpit layout and control interference is a problem in this type of aircraft.

"The captain on this flight was unable to adjust his seat to achieve the DERP and, therefore, was unable to see anything below the nose of the aircraft without either leaning forward and/or stretching or by lowering the nose, thereby introducing a descent.

"Measuring the captain in the C99 seat position he used during the accident flight and later repositioning him to achieve the DERP resulted in two specific findings. First, in order for him to see the runway lights, from breakout below the cloud to impact, as he indicated, the aircraft would have had to be in, and continued to be in, a descent. Second, he could not achieve the DERP because the seat could not be elevated high enough."

Cockpit crew coordination was also lacking, the TSB report said.

The report said the captain was not aware of the first officer's activities in the final portion of the flight and that the first officer may have been directing his attention outside the cockpit. The TSB said that company procedures for a night visual approach required that the pilot not flying call out the airspeed and altitude every 100 feet (30 meters) below 500 feet (152 meters) AGL.

"According to the captain, this was not done," the TSB report said. "Moreover, it is clear that the captain was not referring to his altitude throughout the visual approach. If either of these two requirements had been done, it is likely that the descent would have been arrested prior to impact."

The TSB said a lack of a company crew-pairing policy also contributed to the accident. It said the captain and first officer had been in their respective crew positions for less than one month.

Based on its investigation, the TSB recommended that the Department of Transport provide guidance to air carriers in setting up crew-pairing plans, encourage the continuing implementation of crew resource management and human factors training and take steps to ensure that "pilots receive appropriate guidance for positioning their eyes at or close to the DERP."

The TSB also called on the Department of Transport to "validate its current procedures for checking that carriers provide the required multi-engine night training."

"Transport Canada's process for ensuring compliance with night training requirements is inadequate," the TSB report concluded. ♦

## ACCIDENT PREVENTION

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