

THE LAST MAJOR AVIATION ACCIDENT IN THE UNITED STATES – COLGAN AIR FLIGHT 3407

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INTRODUCTION

On February 12, 2009, Colgan Air Flight 3407, operating as Continental Connection, departed from Newark Liberty International Airport on what was intended to be a routine 53-minute flight to Buffalo Niagara International Airport. The plane never reached its destination. Instead, it crashed into a residential home in Clarence Center, New York, killing all 49 people on board and one person on the ground. The crash stunned the aviation industry, particularly because the plane involved, a Bombardier Q400, was considered one of the most advanced turboprops of its time. This case study examines the events leading up to the crash, the complex interplay of human error and technical challenges, and the broader systemic issues that were uncovered during the investigation.

Flight Overview

Colgan Air Flight 3407 was part of a regional airline network serving Continental Airlines. The Q400 aircraft was a popular model for regional routes due to its fuel efficiency and capability to handle shorter flights. On that night, the aircraft carried 49 passengers and crew members, including Captain Marvin Renslow and First Officer Rebecca Shaw. Captain Renslow was an experienced pilot, but his experience with the Q400 was limited, and his training on stall recovery procedures was questioned during the investigation. First Officer Shaw was relatively new to the airline and had logged considerably fewer flight hours. The flight was delayed by two hours before leaving Newark due to air traffic congestion. The delay, combined with fatigue, would later become an important factor in understanding the crew's performance during the flight.

Fatigue and Crew Readiness

A deeper analysis of the crew's state of readiness revealed alarming levels of fatigue. Colgan Air, like many regional airlines, operated under conditions that required pilots to live far from their base, necessitating long commutes to their assigned airports. Captain Renslow had commuted from his home in Florida to Newark, New Jersey, the day before and spent the night sleeping in the crew lounge at the airport. Sleeping in a public space like an airport lounge did not provide the necessary rest for the demanding job of piloting a commercial aircraft.

First Officer Shaw faced an even longer commute. She had flown from Seattle, Washington, to Newark, taking a cargo flight overnight before arriving at Newark just in time for her shift. This meant that by the time Flight 3407 took off, both pilots had been awake for a significant portion of the preceding 24 hours, with little to no adequate rest. This fatigue significantly impaired their cognitive functions, reducing their ability to make critical decisions under pressure. Fatigue is known to cause slower reaction times, impaired judgment, and a higher likelihood of making errors—factors that all played a role in the unfolding events of Flight 3407. The NTSB later concluded that fatigue was a contributing factor in the pilots' failure to properly respond to the emergency. In Exhibit 1 below, conversation between the pilots about poor company treatment occurs. (National Transportation Safety Board [NTSB], 2010).

Exhibit 1: First Office Vents About Company Treatment

LEGEND:

HOT: Flight crew audio panel voice or sound source.

-1: Voice identified as the captain.

-2: Voice identified as the first officer.

21:06:31.9

HOT-1: and you know that's that's the big thing that I'd I'd recommend to any young couple that's that's out there just unsolicited advice you know just you know don't get in a big hurry.

21:06:43.5

HOT-2: yeah. no we're not. we want to give it— we want to do a lot more travelling. although gosh I'm so freaking mad. I feel like Colgan walks all over me. this company treats me like crap so much. I've been assigned my vacation in March. and I have been— I have sent four emails and I've made a dozen calls saying I do not want vacation in march I never requested that. that was assigned to me. here are ten different other weeks that I'd like vacation that are open on the vacation slot and she won't give it to me. she won't give it to me. I've called @. she's the one dealing with it. I've left her voicemails she won't call me back. I've sent her emails she won't call me back. she won't change my vacation. it still even has me in Norfolk she won't change it. and I think I've got like two more days before I'm within the forty five days and they can't change it. and I know she's going to screw me over and I'm going to be so freaking mad if they make me take my vacation in march cause I can't— I don't want to take vacation when my husband can't take vacation because we want to go somewhere.

21:07:17.2

HOT-1: sh— um...right right.

21:07:39.4

HOT-1: um now that she she looks at it on the tenth of every month and then posts it right after that so take a look.

Ice Buildup and Precipitating Factors

As the aircraft neared Buffalo, weather conditions deteriorated. The crew encountered icing conditions, which are common in winter operations in the northeastern United States. Icing can pose a serious threat to the safe operation of aircraft, particularly when it accumulates on critical surfaces like the wings and tail. Ice changes the aerodynamic profile of an aircraft, increasing drag and reducing lift, which can ultimately lead to a stall if not managed correctly.

The Bombardier Q400 was equipped with a de-icing system that used pneumatic boots to remove ice from the leading edges of the wings. The system inflates the boots to break off any ice that has accumulated. While the de-icing system was activated during the flight, it became clear from the cockpit voice recorder (CVR) that the crew was aware of the continued buildup of ice. First Officer Shaw commented on the severity of the icing conditions, stating, “*I’ve never seen icing like this before.*”

However, despite their awareness of the situation, the crew did not appear to take additional measures to monitor or manage the de-icing system. This failure to properly assess and adjust for the ice buildup was a critical error that would later exacerbate the challenges they faced when the “*stick shaker*”—an automatic system designed to warn of an impending stall by having the control stick shake—was activated.

The Stick Shaker and Incorrect Responses

The pivotal moment of the flight occurred when the stick shaker activated. The stick shaker is a safety mechanism that warns pilots when the aircraft is approaching an aerodynamic stall by shaking the control column. A stall occurs when the aircraft loses lift due to insufficient speed or a high angle of attack, causing it to descend rapidly. The correct response to a stick shaker activation is to push the control column forward, reducing the angle of attack, pointing the nose of the aircraft down, and increasing airspeed. In this case, however, Captain Renslow made a critical error by pulling back on the control column rather than pushing it forward. This action increased the angle of attack and further reduced the airspeed, putting the aircraft into a full aerodynamic stall. First Officer Shaw, in an attempt to assist, retracted the flaps. Flaps are essential for generating additional lift during landing. Retracting them at that moment deprived the aircraft of the lift it desperately needed to recover from the stall.

Why did Captain Renslow react this way? Investigators found that Renslow's training on stall recovery was insufficient. In fact, he had failed multiple check rides, and his understanding of how to recover from a stall was questioned by his superiors. This highlights a broader issue in regional airline operations: inadequate pilot training and evaluation, especially for challenging situations like stall recovery. His reaction to the stall warning, which was the opposite of what was required, sealed the fate of Flight 3407.

The Role of the Reference Speed Switch

The National Transportation Safety Board (NTSB) investigation also revealed another technical factor that contributed to the crash: the aircraft's reference speed switch. This switch increases the sensitivity of the stall warning system when the aircraft is flying in icing conditions. When activated, the stall warning (in this case, the stick shaker) would trigger at a higher speed, giving the crew more time to respond to the potential danger of a stall.

The problem, however, was that while the reference speed switch was set to increase sensitivity, Captain Renslow did not adjust the aircraft's airspeed accordingly. He continued flying at a lower speed, which made the stick shaker activation occur sooner than expected. This mismanagement of the reference speed switch indicated a lack of understanding of the aircraft's systems and how they interact with one another, further highlighting the gaps in pilot training and technical knowledge.

The Aftermath: Destruction and Fire

The crash itself was violent and catastrophic. Flight 3407 descended rapidly and crashed into a house at 6038 Long Street in Clarence Center, New York. The impact destroyed the house and ignited a massive fire, powered by the jet fuel onboard. The fire engulfed the home and surrounding areas, making it nearly impossible for first responders to extinguish the flames quickly or search for survivors. Tragically, all 49 people aboard the plane and one person in the house were killed instantly.

The intense heat and destruction made the crash site one of the most horrific scenes many first responders had ever encountered. The remains of the aircraft were scattered over a wide area, and the damage to both the plane and the house was nearly total. The fire burned for hours, complicating the NTSB's ability to access and recover critical components of the aircraft, such as the black boxes.

The NTSB Investigation and Systemic Failures

The NTSB launched an extensive investigation into the crash, which became one of the most important and scrutinized investigations in the agency's history. The first priority was the recovery of the flight data recorder (FDR) and the cockpit voice recorder (CVR), both of which were located in the tail section of the aircraft. Despite the intense fire, the black boxes were found intact, providing crucial insights into the final moments of the flight.

The CVR confirmed that the crew had been aware of the icing conditions but had not taken sufficient measures to address them. It also revealed a violation of the sterile cockpit rule, which prohibits non-essential conversation during critical phases of flight such as takeoff and landing. The pilots had engaged in casual conversation during the descent, a clear distraction from their operational responsibilities.

Exhibit 2: Final 6 minutes of Cockpit Voice Recorder

LEGEND:

CAM: Cockpit area microphone voice or sound source

HOT: Flight crew audio panel voice or sound source

INT: Interphone voice or sound source

RDO: Radio transmissions from N200WQ

TWR: Radio transmission from the Newark Tower controller

DEP: Radio transmission from New York Departure controller

ZNY: Radio transmission from the New York Center controller

ZOB: Radio transmission from the Cleveland Center controller

APP: Radio transmission from the Buffalo Approach controller

OPS: Radio transmission from the Colgan Buffalo Operations ground controller

-A: First controller at identified ATC facility

-B: Second controller at identified ATC facility

-C: Third controller at identified ATC facility

-1: Voice identified as the captain

-2: Voice identified as the first officer

-3: Voice identified as the flight attendant

-?: Voice unidentified

*: Unintelligible word

#: Expletive

@: Non-pertinent word

(): Questionable insertion

[]: Editorial insertion

22:09:15.9 PA-3 ladies and gentlemen in preparation for landing in Buffalo please be certain your seatback is straight up and your seatbelt is fastened. please pass any remaining service items and unwanted reading materials to us as we pass through the cabin. please turn off all portable electronic devices and stow them until we have reached the gate. after landing Continental Connection allows passengers to use cell phones. I will make an announcement when it is safe to use this device. if you plan to use your cell phone please ensure it's accessible since personal items must be stowed until we reach the gate.

22:09:17.8 HOT-1 four thousand alt sel.

22:09:18.8 HOT-2 four thousand.

22:09:26.0 HOT-1 how's the ears?

22:09:27.3 HOT-2 uh they're stuffy.

22:09:31.6 HOT-1 are they poppin?

22:09:32.7 HOT-2 yeah.
22:09:33.3 HOT-1 okay. that's a good thing.
22:09:35.7 HOT-2 yeah I wanta make em pop. [sound of laughter]
22:10:22.6 HOT-2 is that ice on our windshield?
22:10:25.6 HOT-1 got it on my side. you don't have yours?
22:10:28.7 HOT-1 * [sound of whistle]
22:10:30.5 CAM [sound of click]
22:10:32.3 HOT-2 oh yeah oh it's lots of ice.
22:10:47.5 HOT-1 oh yeah that's the most I've seen- most ice I've seen on the leading edges in a long time. in a while anyway I should say.
22:10:51.4 HOT-2 oh *.
22:10:57.7 HOT-2 yeah that's another thing. all the guys- @ came in to our when we interviewed and he said oh yeah you'll all be upgraded in six months into the Saab and blah ba blah ba blah and I'm thinking you know what. flying in the northeast I've sixteen hundred hours. all of that in Phoenix how much time do you think actual I had or any in in ice. I had more actual time on my first day of IOE than I did in the sixteen hundred hours I had when I came here.
22:11:21.0 HOT-1 [sound of laughter]
22:11:22.2 HOT-2 I'm not even kidding. the first day.
22:11:25.7 HOT-1 well that sounds- well I mean I didn't have sixteen hundred hours.
22:11:27.5 HOT [sound similar to altitude alert]
22:11:28.9 HOT-1 five for four alt sel.
22:11:29.8 HOT-2 five four alt sel.
22:11:31.5 HOT-1 but uh as a matter of fact I got hired with about six hundred and twenty five hours here.
22:11:37.6 HOT-2 oh wow.
22:11:39.4 HOT-1 uh.
22:11:39.9 HOT-2 that's not much for uh back when you got hired.
22:11:42.5 HOT-1 no but uh out of that six and a quarter two hundred fifty hours was uh part one twenty one turbine. multi engine turbine.
22:11:50.0 HOT-2 oh that's right yeah.
22:11:54.3 HOT-2 no but all these guys are complaining they're saying you know how we were supposed to upgrade by now and they're complaining I'm thinking you know what? I really wouldn't mind going through a winter in the northeast before I have to upgrade to captain.
22:12:04.0 HOT-1 no no.
22:12:05.0 HOT-2 I've never seen icing conditions. I've never deiced. I've never seen any- I've never experienced any of that. I don't want to have to experience that and make those kinds of calls. you know I'dve freaked out. I'dve have like seen this much ice and thought oh my gosh we were going to crash.
22:12:17.7 APP Colgan thirty four oh seven descend and maintain two thousand three hundred.
22:12:21.8 RDO-2 okay down to two thousand three hundred Colgan thirty four zero seven.
22:12:25.1 HOT-2 um two three alt sel.
22:12:27.4 HOT-2 I've got you in pitch pitch hold. I don't know if that's what you want.
22:12:27.6 HOT-1 two three alt sel.
22:12:29.6 HOT-1 yeah that's alright. let's uh- we'll do vertical speed back.
22:12:33.3 HOT-2 but I'm glad to have seen oh- you know now I'm so much more comfortable with it all.
22:12:37.6 HOT-1 yeah uh I I spent the first three months in uh Charleston West Virginia and

uh flew-.

22:12:43.5 APP Colgan thirty four zero seven turn left heading three three zero.

22:12:47.0 RDO-2 left heading three three zero Colgan thirty four zero seven.

22:12:49.3 HOT-1 left three three zerooo. we're in heading mode now. go to blue needles.

22:13:01.2 HOT-1 but I- first couple of times I saw the amount of ice that that Saab would
would pick up and keep on truckin'.

22:13:05.9 HOT-2 yeah.

22:13:08.0 HOT-1 saw it out on the spinner. ice comin' out about that far my eyes about that
big around. I'm going gosh. I mean Florida man- barely a little you know out of Pensacola.

22:13:09.3 HOT-2 yeah.

22:13:14.2 HOT-2 holy cow...oh my gosh...oh yeah.

22:13:18.0 HOT [sound similar to altitude alert]

22:13:21.4 HOT-1 that's uh thirty three for twenty three alt sel.

22:13:24.1 HOT-2 thirty three for twenty three alt sel.

22:13:24.8 HOT-1 let's do a descent checklist please.

22:13:25.9 HOT-2 do a descent checklist. altimeters two niner eight zero set crosschecked.

22:13:29.1 HOT-1 twenty nine eighty set crosschecked.

22:13:30.8 HOT-2 fuel balance check. pressurization set and cabin PA complete. descent
checklist complete.

22:13:35.7HOT-1 alright if you want to go ahead we can do the approach checklist along
with it.

22:13:37.4 HOT-2 yeah sure. um approach checklist approach and landing brief complete.

22:13:41.6 HOT-1 uh complete.

22:13:42.3 HOT-2 bugs set.

22:13:43.3 HOT-1 set.

22:13:44.3 HOT-2 GPWS landing flaps selected fifteen degrees. fuel transfer off hydraulic
pressure and quantity check. caution warning lights check seatbelt sign on and external lights
on. approach checklist complete.

22:13:54.7 HOT-1 rock and roll.

22:13:58.4 HOT-1 oh yeah- I'm so glad. I would've- I w- I mean-. I would've been been
fine. I would have survived it. there wasn't- we n- never had to make decisions that I wouldn't
have been able to make but...now I'm more comfortable.

22:14:08.5 APP Colgan thirty four zero seven turn left heading three one zero.

22:14:12.1 RDO-2 left heading three one zero for Colgan thirty four zero seven.

22:14:12.7 CAM [sound similar to engine power increase]

22:14:14.6 HOT-1 three one zero.

22:14:16.6 HOT-2 yeah.

22:14:22.6 HOT-1 alright let's see if I can get this seat...sited...that's alright there.

22:14:24.7 CAM [sound similar to seat track movement]

22:14:32.7 HOT-1 still trying to find that sweet spot I guess there *.

22:14:39.8 CAM [sound similar to engine power increase]

22:15:06.3 HOT-1 flaps five.

22:15:08.1 HOT-2 what?

22:15:08.8 HOT-1 flaps five please.

22:15:10.0 HOT-2 oh *.

22:15:11.2 CAM [sound similar to flap handle movement]

22:15:13.5 APP Colgan thirty four zero seven three miles from KLUMP turn left heading two
six zero maintain two thousand three hundred until established localizer. cleared ILS
approach runway two three.

22:15:22.2 RDO-2 left two sixty two thousand three hundred 'til established and cleared ILS

two three approach Colgan thirty four zero seven.
22:15:31.7 HOT-1 alright approach is armed.
22:15:32.8 HOT-2 roger.
22:15:59.5 CAM [sound similar to decrease in engine power]
22:16:04.1 HOT-1 gear down...loc's alive.
22:16:06.2 CAM [sound similar to landing gear handle movement]
22:16:06.4 APP Colgan thirty four zero seven contact tower one two zero point five. have a good night.
22:16:07.4 CAM [sound similar to landing gear deployment]
22:16:11.5 RDO-2 over to tower you do the same thirty four zero seven.
22:16:14.9 HOT [sound of two double chimes]
22:16:21.2 HOT-2 gear's down.
22:16:23.5 HOT-1 flaps fifteen before landing checklist.
22:16:26.0 CAM [sound similar to flap handle movement]
22:16:26.6 HOT-2 uhhh.
22:16:27.4 CAM [sound similar to stick shaker lasting 6.7 seconds]
22:16:27.7 HOT [sound similar to autopilot disconnect horn repeats until end of recording]
22:16:27.9 CAM [sound of click]
22:16:31.1 CAM [sound similar to increase in engine power]
22:16:34.8 HOT-1 Jesus Christ.
22:16:35.4 CAM [sound similar to stick shaker lasting until end of recording]
22:16:37.1 HOT-2 I put the flaps up.
22:16:40.2 CAM [sound of two clicks]
22:16:42.2 HOT-1 [sound of grunt] *ther bear.
22:16:45.8 HOT-2 should the gear up?
22:16:46.8 HOT-1 gear up oh #.
22:16:50.1 CAM [increase in ambient noise]
22:16:51.9 HOT-1 we're down.
22:16:51.9 CAM [sound of thump]
22:16:52.0 HOT-2 we're [sound of scream]
22:16:53.9 END OF TRANSCRIPT

The FDR provided detailed data on the aircraft's performance, showing that it had been flying at an airspeed well above the stall threshold when the stick shaker was triggered. However, the improper use of the reference speed switch and the subsequent mismanagement of the aircraft's controls led to a full aerodynamic stall, from which the crew failed to recover.

The investigation uncovered systemic issues within the regional airline industry, particularly in areas of training, pilot fatigue, and safety protocols. Colgan Air's training program was found to be inadequate, especially in terms of preparing pilots for complex emergency situations such as stall recovery. The airline's oversight of its pilots was also called into question, as Captain Renslow's repeated training failures had not been adequately addressed.

The Role of Regional Airlines and Economic Pressures

The Colgan Air Flight 3407 disaster also highlighted the broader economic pressures facing regional airlines. Pilots at regional airlines often earn significantly less than their counterparts at major carriers, which can lead to high turnover and challenges in recruiting experienced pilots. First Officer Shaw, for example, earned just \$16,000 a year—an astonishingly low salary for someone responsible for the lives of dozens of passengers. This economic reality led many pilots, including both Renslow and Shaw, to commute long

distances to their base of operations, further exacerbating fatigue and reducing their overall effectiveness.

Regional airlines also tend to have lower operating margins than major carriers, which can result in cost-cutting measures that affect safety. Training programs, rest facilities, and overall safety culture at some regional airlines were found to be lacking in comparison to the standards maintained by larger carriers. This discrepancy between regional and major airlines became a focal point of the post-crash discussions.

Regulatory Changes and Industry Reforms

The crash of Flight 3407 sparked a nationwide conversation about aviation safety and led to significant regulatory changes in the U.S. aviation industry. The families of the victims became vocal advocates for stricter safety regulations, and their persistent lobbying efforts culminated in the passage of the Airline Safety and Federal Aviation Administration Extension Act of 2010.

Among the most significant changes were:

- a) **Increased Training Requirements:** The Act mandated that pilots undergo more comprehensive training, particularly in areas such as stall recovery and high-altitude flight. Pilots were also required to log more flight hours before being promoted to captain.
- b) **Fatigue Management:** The FAA introduced stricter rules on rest periods for pilots, ensuring that they had adequate time to recover between shifts. These rules were aimed at reducing fatigue, which was a key factor in the Flight 3407 crash. (Federal Aviation Administration [FAA], 2011).
- c) **Qualification Standards:** The Act raised the minimum qualification standards for airline pilots, requiring them to hold an Airline Transport Pilot (ATP) certificate, which includes a minimum of 1,500 flight hours. This significantly increased the experience level of new pilots entering the industry.
- d) **Safety Culture Reforms:** The FAA placed a renewed emphasis on safety culture, pushing airlines to prioritize safety over operational efficiency. Airlines were required to implement Safety Management Systems (SMS) to proactively identify and mitigate risks before they led to accidents.

CONCLUSION

The crash of Colgan Air Flight 3407 was a tragedy that could have been prevented. The investigation revealed a combination of human error, technical mismanagement, and systemic failures within the regional airline industry. Fatigue, inadequate training, and economic pressures all played a role in the events that unfolded on that fateful night. However, the legacy of Flight 3407 is one of reform and improvement. The regulatory changes that followed have made the skies safer, but the lessons learned from this disaster continue to serve as a reminder of the importance of vigilance, training, and a commitment to safety in the aviation industry. Colgan Air Flight 3407 was the last major aviation accident in the United States, as of 2024.

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