

JABATAN PENERBANGAN AWAM MALAYSIA
CESSNA 206 ACCIDENT AT BAKALALAN, SARAWAK

Aircraft type and Registration: Cessna 206 9M - AUH
Engine : Piston 300 BHP Teledyne Continental 10-524
Registered Owner : Borneo Skyways, Miri, Sarawak
Crew : One - slight injury
Passengers : Nil
Cargo : 780 lb of rice
Place of Accident : 3500 ft ridge 3.2 NM NW of Bakalalan Airstrip
Date and Time : 20th September, 1980 at about 1043 hrs
local time (LT)

Synopsis

The aircraft, loaded with rice, and the pilot being the sole occupant, took off from Bakalalan airstrip at 1039 hours (LT) for Miri. Bakalalan is a typical rural airstrip constructed at 2900 feet above sea level to service a cluster of 10 plus villages around it. Being in the mountainous region the airstrip is located in a river valley aligned to allow a single entry and exit lane. On the day of the accident, the observed weather around the airstrip was fine. Wind along the strip was light and variable. The first sign of anything being amiss was the extraordinary long take-off run required before the aircraft got airborne. And at about 200 ft above the airstrip the aircraft encountered turbulence accompanied by a right wing drop. The pilot however, managed to weather it and continued with the climb aiming to fly up a valley and to cut across the lowest point of a ridge. As he neared the ridge he again encountered turbulence except being much more severe than the one earlier. Almost immediately he felt a strong sink followed by another. The next moment the aircraft left wing strut struck a tree branch on the ridge top followed by other multiple strikes. By then the aircraft was rapidly settling into the trees on the other side of the ridge. At one stage it approached the almost vertical attitude, hit a large tree with the undersurface of its left wing, ripped off its tail, rolled to right and finally rested inverted on a 50° slope about 200 feet down.

INVESTIGATION

1. History of the flight

The captain of the aircraft was employed by the Borneo Skyways to fly one of the two Cessna 206s operated by the company. On the day of the accident, he was tasked to fly a freight charter into Bakalalan. Together with the freight he was also to carry the charter along. The gross take-off weight at Miri was calculated to be 3581 lb, which was lower than the aircraft maximum allowable take off weight. The pilot as his usual practice, supervised the loading and carried out the preflight checks on the aircraft. He did not report of any discrepancy in the function of the engine, flight controls or other systems prior to his departure from Miri. Miri, being a coastal runway had a typical light patches of low clouds at 3000 ft. The captain had flight planned to route out to Bakalalan at 7500 ft. The aircraft departed Miri for Bakalalan at 0920 hrs (LT) and as planned climbed to 7500 ft. The weather enroute was fine by the pilot noticed that he was drifted to the right of track half way along route. The area QNH was 1007 mb whereas the Miri airfield QNH was 1012 mb. Giving an extraordinarily large difference of 5 mb between the coastal and interior pressure. By the time the aircraft approached Bakalalan the pilot reported that there was a cloud (Cu) build up at the 5000 ft to 7000 ft level. He landed at Bakalalan without any incident except that he noticed the altimeter read 2900 ft when he was still about 300 ft above the airstrip. After he have off loaded the charterer and freight he supervised the loading of 780 lb of rice. This rice was supposed to be sent to Miri for sale there. The eventual start up and power check before take-off did not reveal anything being wrong with the engine. However the pilot noticed that by then the altimeter was indicating 2600 ft on 1007 mb QNH instead of the airstrip altitude of 2900 ft. The take-off roll was report by the local controller to be longer than normal. This was inspite of no noticeable tail wind. The first sign of wind was at about 150 - 200 ft when the pilot reported having some control problem, associated to a sharp right wing drop. However he finally managed to control the aircraft and continued the climb. He opted to fly up the nearest valley from the strip before setting course instead of proceeding

straight on and turn left through a second valley. The valley that he selected had an initial gentle slope which gradually got steeper further in. It finally terminated on a steep ridge at about 3500 ft at its lowest point. The initial phase of the climb was uneventful. But as he was nearing the ridge he reported encountering severe turbulence. He also reported a distinct sinking feeling which happened in two stages. Followed immediately with the aircraft striking the top of the trees just short of the peak of the ridge. Being unable to do anything the pilot just braced himself and waited for the worse. The aircraft struck a number of tree tops before it finally settled through the tree canopy, ripping its tail off and finally stopping inverted in a nose down position. When he realised that he was still unhurt, the pilot managed to free himself from his harness and crawled out of the wreckage. He then instinctly climbed upslope to the ridge top and followed the ridge in a direction he thought civilisation existed. That instinct proved to be correct and he walked out of the jungle into the safe hands of the locals.

1.2 Injuries to persons: - Scratches around left wrist

1.3 Damage to aircraft: -

The aircraft was lying inverted with its nose dug into the ground. The complete tail section was detached. The right wing and strut was totally accordioned in. The rear cabin roof was punctured by 2 tree stumps. The left wing leading edge suffered multiple dents and puncture indicative of light strikes from tree branches. The propellers were severely bent. Two blades were bent against the direction of rotation and one blade was bent forward. The upper engine cowling suffered multiple dents and crumplings. The aircraft's Emergency Locator Transmitter was thrown out of the aircraft during detachment of the tail but was not activated. The cargo pack below the cabin was ripped open. But the undercarriages were intact.

1.4 Other Damage

The aircraft swath damaged 7 naturally grown primary jungle trees. 4 trees suffered impact damage due to the aircraft's airframe striking them and 3 trees had prop outs through their branches. One tree of about 10 inches diameter and three young saplings of about 5 inches diameter were cleanly severed at 10 ft and 4ft above the ground respectively.

1.5 Personnel Information

Pilot : Age 32 years
 Licence : CPL No: 543 Expires 28 Feb 81
 RT Rating : Expires 28 Feb 1981
 Aircraft Rating : Cessna 172 and Cessna 206 (Group One)
 Medical Certificate : Expires 28 Feb 1981
 Last DCA check : 21st May, 1980
 Total Flying Hours : 1155:10
 Total Hours on type : 70:15
 Total hours for the months : 15:25

1.6 Aircraft Informations:

The Cessna 206 is a high wing, 6 seater aircraft. It is powered by a 300 BHP Teledyne Continental engine through a 3 bladed constant speed propeller. It has a fixed tri-cycle undercarriage and is fitted with a Robertson STOL flaps to enhance short strips operations. On (9M-AUH), it was fitted with a cargo pack below the cabin area.

Manufacturer : Cessna Aircraft Corporation, Wichita Texas U.S.A.
 Certificate of Registration : 1975
 Airworthiness : Borneo Skyways (Miri) Sdn. Bhd (9M-AUH)
 Aircraft total hours : 2733:03 hrs
 Engine hours : 1245:07 hrs
 Propeller hours : 1009:07 hrs
 Radio Station Cert. : No: M/369 expires 12 July, 1981

9M-AUH have been the company's sole C206 that was serviceable for the last 10 months. This aircraft have been the workhorse of the company and was shared by 3 pilots to fly the ad-hoc charters into short interior airstrips. About 4 months before the accident, there have been numerous verbal complaints by pilots of back-firing/after-firing heard and felt from the engine whenever it was throttled back from cruise power to idle. The condition of the interior furnishing was also shabby and tattered. Though the propeller was reasonably new, the engine was due for a major overhaul in about 265 hours. The engine was suspected to be low on power and this was supported by the take of roll at Bakalalan which was about

1500 ft instead of about 1030 ft. The climb rate at full power at Bakalalan was reported to be about 500 FPM instead of being closer to 850 FPM. The peculiar thing was that there was no defect report in the technical log for the last 32 days of flying.

1.7 Meteorological Information

About one hour before the accident there was a forecasted pressure gradient of 5mb between the coast and the interior. However, as was observed by the pilot, his altimeter indicated 2600 ft on 1007 mb when it should have been 2900 ft. Considering Bakalalan is in a bowl, this condition would exist if there was a stable atmospheric condition on the windward side of the mountains surrounding Bakalalan.

The 5 mb pressure gradient was significant enough to create a horizontal movement of air from the Western coast towards the Eastern interior. As reported by the pilot, he experienced a significant drift to starboard when enroute to Bakalalan at 7500 ft. In fact he was drifted by about 3 nm after only 80 nm of travel. Therefore at 7500 ft he had a cross wind component of about 5.6 kt.

The forecasted wind at 5000 ft as prepared by Shell weather at Miri was from North-Westerly with the maximum strength of 24 kt.

The pilot reported the existence of a strong crosswind (Westerly) and turbulence at 150 - 200 ft in the Bakalalan valley. Likewise the light material scatter pattern along the aircraft crash swath confirmed the presence of a Westerly wind at that time. This wind (Possibly a component) was calculated to be 8.2 kt. when about 15 ft below the tree tops.

1.8 Aids to Navigation

Not available

1.9 Communication

Only on HF with Bakalalan

1.10 Aerodrome Information

Bakalalan airstrip is situated in a river valley at 2900 ft above the mean sea level. It is a gravel strip maintained by the Department of Civil Aviation to the approved standard. The strip is aligned along 050°/

230° and is 1800 ft in length. It is essentially a one way in and one way out strip. All approaches must be on runway 23 and take-offs on runway 05. It has a single wind sock located at the 23 end of the strip and controllings are done by one controller from a simple control tower, using a HF set. On the day of the accident the airstrip was dry and its surface was well rolled.

1.11 Flight Recorders: Nil

1.12 Wreckage and Impact Information

The aircraft cut a swath through the trees of about 195 ft long. Please see attached diagram for wreckage and scatter pattern.

Impact Information: - Using the formula for half sine pulse energy dissipation, the main wreckage was calculated to have decelerated with a force of 1.509 G.

1.13 Medical and Pathological Information

Pre accident - Normal

Post accident - Pilot suffered minor scratches on left wrist

1.14 Fire: Nil

1.15 Survival Aspect

The crash was surviveable because the aircraft's dynamic energy was absorbed by the branches of the trees over a distance of 175 ft, and the aircraft further slid down slope for about 20 ft. The final impact force was very much cushioned by a 10 inches diameter tree that gave way, and the accordioning of the right wing. However, had there been a post crash fire the story might have been different. The pilot was fortunate in not experiencing a secondary head collision inspite of not wearing a shoulder harness. After evacuating the aircraft, the pilot was fortunate in deciding to climb upslope and followed a ridge, instead of going for a stream downslope. He also followed the correct track that led him into civilisation instead of the multitude of others that lead to the unknowns.

Crash dynamic

Other than the tail section, the airframe held together very well. The doors and panels were still secured inspite of its frames and mountings being severely distorted in many places. The ELT however, broke loose when its mounting area was torn apart during the ripping off of the tail.

1.16 Tests and Research

Two flight trials were conducted using a BN2 aircraft, simulating the 500 FPM rate of climb of the crash aircraft while flying at 90 kts. As there was no strong prevailing wind to create severe turbulence and downdraft, the trial aircraft was able to clear the accident ridge by about 600 ft in both cases. (However it should be noted that there was still some light turbulence just as the trial aircraft approached the ridge).

1.17 Additional Information - Nil

1.18 Useful of Effective Investigation Techniques

The pilot was brought to the scene of accident and was persuaded to relive the sequence that led to the accident. Many new details were remembered and it assisted in determining the possible cause of the accident early.

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ANALYSIS

2.1 The Pilot: He had relatively little experience flying the C206 in the short strips charter role. Most of his flying hours were accumulated during his days in the RMAF, flying multi engine aircrafts as a co-pilot. Evidence strongly suggested that his conversion on the C206 was not carried out in a satisfactory manner. The airstrip check outs conducted by the Company Fleet Capt was also unsatisfactory. It is therefore safe to assume to that it was partly due to his lack of knowledge of the weather peculiarity around the mountains at Bakalalan that he choosed to route to Miri through the valley where the accident occured.

2.2 The Weather: On that particular day, winds around the mountains were rather strong. The 24 kt maximum strength forecasted by Shell in Miri was indicative of its existance. Even assuming a lower 20 kts prevailing wind, it would have easily accelerated to 25 kts at the peaks and creasts of the mountains. With the reasonably stable atmospheric condition that proved to have existed, there was bound to be strong eddies and turbulence on the leeward side of the mountains. In this particular case, the prevailing wind was from the Northwest/West direction. It would

have accelerated. Over the peak of the 5500 ft plus "Apo Balingrid" mountain, easily reaching 25 kts. With a 45° slope on the leeward side, a 25 kts crest wind can create a downdraft of more than 1700 FPM in certain areas.

2.3 Aircraft Engine Performance

Though there have been no written reports of malfunctions in the aircraft technical log, evidence pointed to a number of verbal complaints were made on the aircraft's engine. There have been grouses of back-firing/after firing when the throttle was closed from a cruise setting. Deterioration of performance are normally so gradual that pilots would not normally be able to detect it, especially when he operates the same aircraft continuously. However, the long take-off run at Bakalalan, inspite of no tail wind, was indicative of less than optimum performance. (Engine was also reaching the end of its useful life before a major overhaul). The 500 FPM climb rate achieved at Bakalalan further supported the arguement of the rather low power output. Inspection of the spark plugs provided evidence of a rich mixture prior to the engine stopping.

2.4 Climb Performance The climb performance of an aircraft directly relates to the difference of its available power and power required to sustain climb. Assuming a standard healthy aircraft, its climb rate may reduce if it is climbed at a higher than the recommended climb speed for a given weight. In this case, the pilot climbed at 90 kts instead of the recommended 82 kts for maximum climb performance. Further, the pilot have selected instead of 22 GPH, thus possible resulting in aslight loss in engine performance.

2.5 Weight: As noted in the load and trim sheet, the aircraft departed Bakalalan with less then 3,386 lb gross weight. The centre of gravity was well within its specified limits. Therefore this factor was eliminated.

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CONCLUSION AND FINDING

From the analysis of the evidence gathered it pointed to the fact that this accident occured due to the aircraft having lost its climb performance just before it crossed the ridge top. This sudden loss of performance was due to the aircraft having flown into a region of strong downdraft. The wisdom of routing though that particular valley is questionable. The selection of climbing speed and management of fuel

mixture also leaves questions on the performance of the pilot and the quality of training he received during his conversion training.

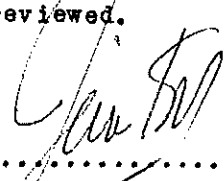
Therefore it is concluded that the probable cause of the accident as: "The aircraft entered into a region of severe downdraft at an altitude that left no margin for recovery".

Following are the contributory factors

- a. The pilot erred in his selection of the valley as his route to Miri. This of course was due to his lack of knowledge of the terrain because of the slip-shodded way he was introduced and checked for operations out of Bakalalan.
- b. The pilot did not climb at the recommended speed for maximum climb performance. Pointing to the quality of instruction he received during his conversion.
- c. The pilot did not manage the fuel mixture correctly. Again pointing to the quality of conversion on the C206 as carried out by the Company's Fleet Captain.
- d. The engine state was such that it was not delivering its full power any longer.

SAFETY RECOMMENDATION

- 1. The pilot be retrained on the C206 for a minimum of 4 hours followed by a check out by a DCA examiner.
- 2. All pilots in Borneo Skyways to wear the aircraft shoulder harness at all times during flyings around the interior.
- 3. The Borneo Skyways Fleet Captain may no longer be empowered to conduct any flying training, instructing or checking out of other pilots in the company until such time he has done an acceptable course and be checked out by a DCA Examiner.
- 4. The whole flight operations of Borneo Skyways be inspected and examined by the Department and the approval for onward operation be reviewed.



 (Capt Jamil Shariff)

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Crew : One - slight injury
Passengers : Nil
Cargo : 780 lb of rice
Place of Accident : 3500 ft ridge 3.2 NM NW of Bakalalan Airstrip
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Synopsis

The aircraft, loaded with rice, and the pilot being the sole occupant, took off from Bakalalan airstrip at 1039 hours (LT) for Miri. Bakalalan is a typical rural airstrip constructed at 2900 feet above sea level to service a cluster of 10 plus villages around it. Being in the mountainous region the airstrip is located in a river valley aligned to allow a single entry and exit lane. On the day of the accident, the observed weather around the airstrip was fine. Wind along the strip was light and variable. The first sign of anything being amiss was the extraordinary long take-off run required before the aircraft got airborne. And at about 200 ft above the airstrip the aircraft encountered turbulence accompanied by a right wing drop. The pilot however, managed to weather it and continued with the climb aiming to fly up a valley and to cut across the lowest point of a ridge. As he neared the ridge he again encountered turbulence except being much more severe than the one earlier. Almost immediately he felt a strong sink followed by another. The next moment the aircraft left wing strut struck a tree branch on the ridge top followed by other multiple strikes. By then the aircraft was rapidly settling into the trees on the other side of the ridge. At one stage it approached the almost vertical attitude, hit a large tree with the undersurface of its left wing, ripped off its tail, rolled to right and finally rested inverted on a 50° slope about 200 feet down.

INVESTIGATION1. History of the flight

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2.1 The Pilot: He had relatively little experience flying the C206 in the short strips charter role. Most of his flying hours were accumulated during his days in the RMAF, flying multi engine aircrafts as a co-pilot. Evidence strongly suggested that his conversion on the C206 was not carried out in a satisfactory manner. The airstrip check outs conducted by the Company Fleet Capt was also unsatisfactory. It is therefore safe to assume to that it was partly due to his lack of knowledge of the weather peculiarity around the mountains at Bakalalan that he choosed to route to Miri through the valley where the accident ocured.

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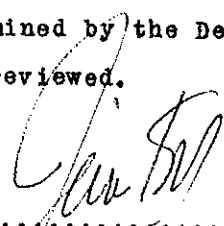
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- a. The pilot erred in his selection of the valley as his route to Miri. This of course was due to his lack of knowledge of the terrain because of the slip-shodded way he was introduced and checked for operations out of Bakalalan.
- b. The pilot did not climb at the recommended speed for maximum climb performance. Pointing to the quality of instruction he received during his conversion.
- c. The pilot did not manage the fuel mixture correctly. Again pointing to the quality of conversion on the C206 as carried out by the Company's Fleet Captain.
- d. The engine state was such that it was not delivering its full power any longer.

4. SAFETY RECOMMENDATION

1. The pilot be retrained on the C206 for a minimum of 4 hours followed by a check out by a DCA examiner.
2. All pilots in Borneo Skyways to wear the aircraft shoulder harness at all times during flyings around the interior.
3. The Borneo Skyways Fleet Captain may no longer be empowered to conduct any flying training, instructing or checking out of other pilots in the company until such time he has done an acceptable course and be checked out by a DCA Examiner.
4. The whole flight operations of Borneo Skyways be inspected and examined by the Department and the approval for onward operation be reviewed.

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 (Capt Jamil Shariff)