CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

CESSNA 172N
ZK-JFI

AIRCRAFT DEPARTED CONTROLLED FLIGHT AFTER TAKEOFF

ARROWTOWN

17 OCTOBER 2011

Photograph by Peter Lewis

Foreword

As a signatory to the Convention on International Civil Aviation 1944 (the Chicago Convention) New Zealand has international obligations in respect of the investigation of accidents and incidents. Pursuant to Articles 26 and 37 of the Chicago Convention, the International Civil Aviation Organisation (ICAO) issued Annex 13 to the Convention setting out International Standards and Recommended Practices in respect of the investigation of aircraft accidents and incidents.

New Zealand's international obligations are reflected in the Civil Aviation Act 1990 (the Act) and the Transport Accident Investigation Commission Act 1990 (the TAIC Act).

Section 72B(2)(d) and (e) of the Civil Aviation Act 1990 Act also provides:

> **72B Functions of Authority**
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> (2) The Authority has the following functions:
>
> (d) To investigate and review civil aviation accidents and incidents in its capacity as the responsible safety and security authority, subject to the limitations set out in section 14(3) of the Transport Accident Investigation Commission Act 1990:
>
> (e) To notify the Transport Accident Investigation Commission in accordance with section 27 of this Act of accidents and incidents notified to the Authority:

Following notification to the Transport Accident Investigation Commission ("the Commission") of any accident or incident which is notified to the Authority, an investigation may be conducted by the Commission in accordance with the TAIC Act. CAA may also investigate subject to the requirements of the TAIC Act.

The purpose of an investigation by the Commission is to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future, rather than to ascribe blame to any person.

CAA however investigates aviation accidents and incidents for a range of purposes under the Act. Investigations are primarily conducted for the purpose of preventing future accidents by determining the contributing factors or causes and then implementing appropriate preventive measures - in other words to restore safety margins to provide an acceptable level of risk. The focus of CAA safety investigations is therefore to establish the causes of the accident on the balance of probability.

Accident investigations do not always identify one dominant or 'proximate' cause. Often, an aviation accident is the last event in a chain of several events or contributing factors, each of which may contribute to a greater or lesser degree to the final outcome.

CAA investigations may also inform other regulatory-safety decision making or enforcement action by the Director.

In the case of a fatal aviation accident, the final CAA investigation report will generally be highly relevant to an inquiry, and in some circumstances, an inquest, conducted by a Coroner.

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Glossary of abbreviations

ATC	Air Traffic Control
C	Celsius
CAA	Civil Aviation Authority
CAR	Civil Aviation Rule(s)
E	east
ft	foot or feet
GPS	Global Positioning System
HP	horse power
hPa	hectopascals
m	metre(s)
NM	nautical mile
NZDT	New Zealand Daylight Time
PPL(A)	Private Pilot Licence (Aeroplane)
S	south
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	very high frequency
WGS	World Geodetic System

CIVIL AVIATION AUTHORITY OF NEW ZEALAND

Data summary

Aircraft type, serial number and registration:	Cessna 172N, s/n 17273749 ZK-JFI
Number and type of engines:	One, 160 HP Lycoming O-320 H2AD
Year of manufacture:	1980
Date and time of accident:	17 October 2011, 1515 hours[1] (approximately)
Location:	Arrowtown Golf Course, One Nm south of Arrowtown Latitude[2]: S 44° 57□ 43.8□ Longitude: E 168° 50□ 50.0□
Type of flight:	Private
Persons on board:	Crew: 1 Passengers: 2
Injuries:	Crew: 1 Fatal Passengers: 2 Serious
Nature of damage:	Aircraft destroyed
Pilot-in-command's licence:	Private Pilot Licence (Aeroplane)
Pilot-in-command's age:	59 years
Pilot-in-command's total flying experience:	315 hours, 204 on type
Information sources:	Civil Aviation Authority Field Investigation
Investigator in Charge:	Mr C P Grounsell

[1] All times in this report are NZDT (UTC + 13 hours) unless otherwise specified.

[2] WGS-84 co-ordinates.

Synopsis

At approximately 1515 hours on 17 October 2011 the aircraft was approaching to land at a private airstrip (locally known as Monk's Strip) located one nautical mile to the south of Arrowtown near Queenstown.

Following the landing and a subsequent takeoff from the airstrip, the aircraft was observed in a climb. The aircraft failed to gain any appreciable altitude and stalled. The aircraft did not recover from the stall and struck the ground. The first responders to the accident scene administered first aid to the pilot and passengers, however despite their best efforts, the pilot died shortly thereafter.

The Civil Aviation Authority (CAA) was notified of the accident at 1530 hours on 17 October 2011. The Transport Accident Investigation Commission was in turn notified but declined to investigate. A CAA Field Investigation was commenced the following day.

1. Factual Information

1.1 History of the flight

1.1.1 On the morning of the accident, the pilot and two passengers departed from Monk's Strip for the purpose of a flight to Invercargill Aerodrome with a planned return flight later that afternoon.

1.1.2 After departing Monk's Strip, the pilot landed at Queenstown Aerodrome and filled the aircraft fuel tanks to the maximum capacity of 190 litres useable fuel.

1.1.3 The aircraft then departed Queenstown Aerodrome for a direct VFR flight to Invercargill Aerodrome arriving at approximately 1100 hours. The pilot and two passengers then departed Invercargill Aerodrome at approximately 1400 hours for the return flight to Monk's Strip.

1.1.4 As the aircraft approached Monk's Strip, the passenger seated in the front right hand seat began to video record the flight using his iPhone. He continued to record the remainder of the flight including the accident sequence.

1.1.5 A number of eye witnesses, who were playing golf on the adjacent Arrowtown Golf Course, observed the aircraft operating in the vicinity of the airstrip and also the final moments of the flight.

1.1.6 On initial return to Monk's Strip at approximately 1515 hours, the pilot carried out a low pass in a westerly direction over the airstrip in an attempt to clear stock from the landing area, the stock could be seen in the video recording. From the video recording it was observed that the pilot flew the aircraft in close proximity to the ground and offset to the right of the airstrip in an attempt to move the stock which was successful.

1.1.7 It was observed on the video recording that as the pilot approached the airstrip to carry out the stock clearing pass, moderate turbulence was encountered in the vicinity of the eastern end of the airstrip. The pilot also had to contend with strong crosswind conditions from the left.

1.1.8 On completion of the stock clearing pass the pilot increased engine power and increased altitude. He flew the aircraft towards Arrowtown before turning around to commence an approach to land at the airstrip from the opposite direction.

1.1.9 It was observed from the video recording that the pilot had selected 20 degrees of wing flap while on final approach to land. It was also observed that the final stage of the approach was high and the groundspeed was also higher than would have normally been expected. The aircraft touched down approximately 250 metres into the 500 metre airstrip and bounced lightly twice before settling on to the ground.

1.1.10 The pilot then increased the engine power to full power and conducted a take-off. It was noted in the video recording that the pilot had fully retracted the flap, most likely after selecting full power for the takeoff.

1.1.11 The aircraft became airborne near the end of the airstrip. The pilot initiated a climb and a left turn to avoid power lines and trees which bordered the road at the end of the airstrip.

1.1.12 On the climb-out from the airstrip, the pilot had to again contend with the strong crosswind conditions and moderate turbulence being generated by the wind passing over high ground to the right of the airstrip.

1.1.13 The pilot continued to raise the nose of the aircraft. The stall warning was heard to sound in the video recording as the aircraft encountered the turbulent conditions. The aircraft then rolled rapidly to the left and pitched down as the aircraft entered a fully developed wing drop stall.

1.1.14 As the aircraft rolled and pitched down towards the ground, it was observed in the video recording that the pilot was holding the elevator control fully aft. The aircraft rapidly lost altitude and struck the ground.

1.1.15 The accident occurred in daylight, at approximately 1515 hours, one nautical mile south of Arrowtown, at an elevation of 1300 feet amsl, latitude S 44° 57□ 43.8□, longitude E 168° 50□ 50.0□.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	2	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The aircraft was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot was initially issued with a Private Pilot's Licence (Aeroplane) in 1976. After a period of inactivity, he was re-issued with a CAR Part 61 Private Pilot's Licence (Aeroplane) in April 2010.

1.5.2 He had approximately 315 hours of flight experience at the time of the accident of which approximately 205 hours were on type. In the past 90 days he had flown 37 hours on type.

1.5.3 The pilot held a current Class II Medical Certificate at the time of the accident which is appropriate for this type of flight.

1.6 Aircraft information

1.6.1 Cessna 172N ZK-JFI had been imported into New Zealand from the USA in early 2008. The aircraft was subsequently registered as ZK-JFI and a Standard Certificate of Airworthiness was issued by the CAA in May 2008.

1.6.2 At the time of the accident the aircraft had accrued 10199.1 hours total flight time. The last scheduled maintenance was a 50 hour inspection carried out on 6 August 2011. The aircraft had flown 26.2 hours since the last inspection.

1.6.3 The aircraft was powered by a Lycoming O-320 H2AD, 160 horsepower engine driving a McCauley 1C160/DTM7557M1 propeller. At the time of the accident the engine had accrued 1732.4 hours flight time since overhaul and the propeller 945 hours since new.

1.6.4 It was determined by calculation that at the time of the accident, the aircraft was approximately 32 kilograms below the maximum allowable all up weight of 1045 kilograms. The aircraft's centre of gravity was within the prescribed limits.

1.7 Meteorological information

1.7.1 On the day of the accident, the lower South Island was affected by a southerly airstream. A cold front was approaching from the south-west and was expected to bring showers of rain and increasingly strong south-westerly winds to the Queenstown area during the late afternoon.

1.7.2 At the time of the accident, a south-westerly wind prevailed which led to turbulence in the vicinity of the airstrip due to the local topography.

1.7.3 The witnesses who had been playing golf stated that they were packing up to go home due to the increased wind and light rain starting to fall with the approach of the cold front.

1.7.4 It was observed from the passenger's video recording that the wind strength was approximately 15 knots in strength from a south-south-westerly direction and blowing across the airstrip. Light rain was also starting to fall.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 The pilot had been in VHF communication with Queenstown Aerodrome ATC. As the airstrip was located within the Queenstown Aerodrome Control Zone the pilot was required to gain ATC approval for his intended activities.

1.9.2 The last recorded communication with Queenstown ATC involved the pilot advising that he was carrying out a stock clearing pass prior to landing at Monk's Strip.

1.10 Aerodrome information

1.10.1 Monk's Strip is located one nautical mile south of Arrowtown at an elevation of approximately 1300 feet amsl. The airstrip measures approximately 500 metres in length and is orientated in an east-west direction, there is a slight downward gradient towards the east for the last 100 metres. A windsock is located at the western end of the airstrip and this was observable in the passenger's video recording.

1.10.2 The airstrip has an area of higher ground on the southern side. Power lines and willow trees are located approximately 80 metres from the eastern end of the airstrip. The Arrowtown Golf Course is adjacent to the airstrip on the northern side. Approximately one nautical mile to the east of the airstrip, the terrain forming the start of the Crown Mountain Range rises to a height of approximately 2000 feet amsl.

1.11 Flight recorders

1.11.1 A dedicated flight recorder was not fitted to the aircraft, however the video recording taken by the front seat passenger assisted the safety investigation.

1.12 Wreckage and impact information

1.12.1 The aircraft struck the ground in a steep nose down attitude while rotating to the left with low forward airspeed.

1.12.2 At the point of ground impact, the right hand horizontal stabiliser and elevator had struck a small Cedar Tree, the right hand elevator remained lodged in the tree. After the initial ground impact the aircraft slid to the right for approximately 15 metres before coming to rest upright, down a small embankment.

1.12.3 Initial impact forces resulted in major disruption to the nose section of the aircraft. The engine was observed to have broken free from the engine mount but remained loosely attached to the airframe.

1.12.4 Damage observed to the propeller indicated that the engine was producing significant power at the time of ground impact.

1.12.5 The cabin of the aircraft remained intact, however, there was a significant amount of disruption forward of the wing strut attachment points. The fuselage aft of the cabin had failed due to impact forces when the empennage struck the tree.

1.13 Medical and pathological information

1.13.1 Post-mortem examination showed that the pilot died from blunt force head injury and severe facial fractures causing upper airways obstruction.

1.13.2 There were no pre-existing conditions found that could have resulted in incapacitation or affected the pilot's ability to fly the aircraft.

1.13.3 Toxicological testing showed no alcohol or drugs present in the blood.

1.13.4 Carbon Monoxide saturation was less than 5%. (Blood carbon monoxide saturations of less than 10% are consistent with normal levels observed in the general population).

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 All persons on board the aircraft were restrained by the use of seatbelts. The rear seats in the Cessna 172N utilises lap belts. The pilot and front seat passenger utilises a combination of a lap and a diagonal shoulder harness.

1.15.2 Due to the rotational impact forces, the pilot was thrown to the right in his seat. As a consequence, the diagonal shoulder restraint over his left shoulder became ineffective. As a result, the pilot received heads injuries from striking the instrument panel.

1.16 Tests and research

1.16.1 The engine was disassembled and inspected by an authorised maintenance provider under CAA supervision. The engine was observed to be in good condition and no defects were found which may have prevented the engine from delivering full power at the time of the accident.

1.17 Organisational and management information

1.17.1 Not applicable.

1.18 Additional information

1.18.1 Entries in the Pilot's Logbook showed that he had flown in and out of Monk's Strip on approximately 18 previous occasions since February 2011.

1.18.2 The pilot had also previously attended the CAA AvKiwi Mountain Flying Seminar held in Tauranga on 6 February 2010. The seminar focused on raising pilot's awareness when operating in and around mountainous terrain and the effects of false horizons were discussed.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 Following the stock clearing pass from the east, rather than carrying out a standard circuit to approach and land from the same direction, the pilot opted to carry out a reversal turn to approach and land from the west. By deviating from a standard rectangular circuit, and electing to complete a reversal turn, the pilot probably had insufficient time to fully assess the environmental conditions existing at the airstrip.

2.2 A well planned approach is required when using airstrips and strict adherence to landing criteria must be maintained, regarding environmental conditions, height, airspeed and the descent profile. If any of these are not correct, the aircraft will not land on the designated point on the airstrip. A prudent pilot should make the conscious decision to abort the landing and go-around as early as possible.

2.3 The airstrip windsock observed in the video recording indicated that at the time of the accident the wind strength was approximately 15 knots from a southerly direction. The wind conditions would have presented the pilot with an approximate 15 knot crosswind component which is the maximum demonstrated crosswind component for the Cessna 172[3]. However, the pilot's ability to handle a crosswind is more dependent upon pilot proficiency than aircraft limitations.

2.4 It was noted from the video recording that during the final approach, full flap was not extended. This was most likely due to the pilot limiting the amount of flap extension to assist him in coping with the crosswind conditions.

2.5 The amount of wing flap selected during crosswind operations is not only dependant on the strength of the crosswind but also the length of the runway being used. Where shorter distances are involved, the use of a wing flap setting greater than normally used for a crosswind would be appropriate.

2.6 With the aircraft touching down well into the airstrip, the pilot made the decision to abort the landing and attempt to takeoff. This decision was probably due to the fact that he had realised that he would not have been able to stop the aircraft in the distance remaining. The pilot may have also given consideration to the slight down slope and the fact that the grass surface was now damp due to the light rain which would further reduce braking effectiveness.

2.7 While the aircraft was on the ground following the landing, or immediately after becoming airborne again, the pilot made a selection to reduce the amount of wing flap extended and in doing so he fully retracted the wing flaps.

2.8 Without the benefit of some wing flap extended for the takeoff and climb-out, the stalling speed of the aircraft was now increased. Given the slow climb-out speed of the aircraft observed in the video recording during this phase of flight, there was very little airspeed margin above the stall speed.

2.9 Once airborne, the manufacturers best angle of climb speed or best rate of climb speed should be strictly adhered to, plus any additional speed increments as dictated

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[3] Maximum demonstrated crosswind component: The maximum crosswind velocity that the aircraft was tested to during initial flight testing without the use of special techniques by the pilot.

by the environmental conditions, until such a time that the aircraft is clear of all obstacles.

2.10 As the aircraft initially climbed from the airstrip, the pilot turned the aircraft to the left through approximately 40 degrees, possibly in an attempt to avoid power lines and willow trees ahead of the aircraft, or to escape the turbulence. In turning the aircraft to the left this action placed the aircraft further out of the prevailing wind and consequently reduced the aircraft's climb performance.

2.11 Due to the rising terrain of the Crown Range ahead of the aircraft, the pilot would have had difficulty in establishing a true horizon to use as a visual reference on the climb-out. The tops of the Crown Range were also covered in cloud which would have made the task more difficult. It is possible that the pilot may have been fooled by a false horizon and therefore continued to raise the aircraft's nose to establish what he perceived to be the correct climb attitude. This action would result in the aircraft's airspeed reducing to the point of a stall unless corrective action was taken.

2.12 The aircraft then entered the area of moderate turbulence at the eastern end of the airstrip. It was at this point that the aircraft stalled and departed from controlled flight.

2.13 It could be seen from the video recording that the pilot had pulled the elevator control fully aft, probably as a natural reaction to the aircraft descending close to the ground. The correct technique would have been for the pilot to move the elevator control forward to reduce the angle of attack of the wing and regain control of the aircraft[4]. However, due to the close proximity to the ground, this action although correct, may not have been successful.

3. Conclusions

3.1 The pilot was appropriately licensed and fit to carry out the flight.

3.2 The pilot was familiar with operating at Monk's Airstrip.

3.3 The moderate turbulence and crosswind conditions encountered by the pilot at the time of the accident were significant factors.

3.4 The pilot had limited the amount of wing flap selected for landing which was likely as a decision that he made based on the crosswind conditions.

3.5 Due to the approach being high and fast for landing on the airstrip, it would have been prudent for the pilot to have conducted a go-around rather than continue with the landing.

3.6 The aircraft landed approximately halfway down the airstrip. The pilot would not have been able to stop the aircraft prior to it contacting the boundary fence.

3.7 The pilot fully retracted the wing flaps either during landing or the subsequent takeoff.

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[4] Angle of attack: The angle between the chord line of the wing and the relative airflow.

3.8 After takeoff the pilot continued to raise the nose attitude of the aircraft to an excessively high angle.

3.9 After entering the turbulence at the eastern end of the airstrip during climb-out, the aircraft stalled and departed from controlled flight.

3.10 The pilot's actions for a stall recovery were incorrect, however, there was probably insufficient altitude available to ensure a safe recovery.

3.11 The aircraft struck the ground from a fully developed wing drop stall.

3.12 Due to the rotational forces at impact, the pilot was not restrained by his shoulder harness and received fatal injuries.

4. Safety Actions

4.1 A CAA Safety Recommendation (No.13A80) was raised on 24 July 2012 for the CAA Safety Promotion Unit to develop information for pilots regarding unsupervised operations at private airstrips. The prudence of obtaining additional training for airstrip operations will also be highlighted. This information will be published via an article in the CAA Vector magazine scheduled for late 2012.

4.2 Additional information is also available via the CAA Good Aviation Practice information booklets. The relevant topics regarding takeoff and landing performance, mountain flying, and spin avoidance and recovery are freely available to all pilots.

Report written by: Authorised by:

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Date: 20 August 2012

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