AA2016-4

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

PRIVATELY OWNED
J A 4 0 0 5

May 19, 2016

Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

Kazuhiro Nakahashi
Chairman,
Japan Transport Safety Board

Note:

This report is a translation of the Japanese original investigation report. The text in Japanese shall prevail in the interpretation of the report.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

CRASH DUE TO STALL DURING CLIMB AFTER TAKE-OFF

PRIVATELY OWNED

CESSNA 172P, JA4005

BETSUKAI FLIGHT PARK,

BETSUKAI-CHO, NOTSUKE-GUN, HOKKAIDO

AT ABOUT 12:42 JST, JULY 20, 2015

April 22, 2016
Adopted by the Japan Transport Safety Board
Chairman Kazuhiro Nakahashi
Member Toru Miyashita
Member Toshiyuki Ishikawa
Member Sadao Tamura
Member Keiji Tanaka
Member Miwa Nakanishi

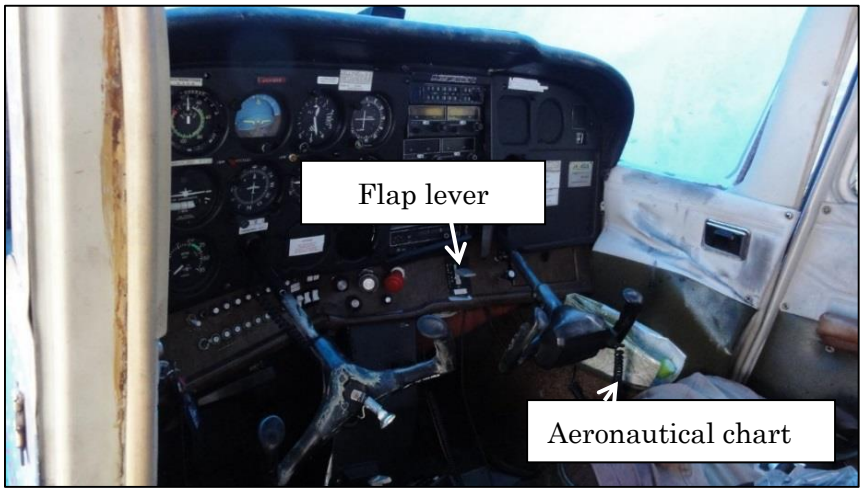
1. PROCESS AND PROGRESS OF INVESTIGATION

1.1 Summary of the Accident	At around 12:40 on Monday, July 20, 2015, privately owned Cessna 172P, registered JA4005 crashed immediately after take-off from Betsukai Flight Park Temporary Airfield planned to make a pleasure flight. The Aircraft was destroyed and a fire broke out. Three persons suffered serious injuries, while one person sustained minor injuries.
1.2 Outline of the Accident Investigation	The Japan Transport Safety Board designated an investigator-in-charge and an investigator on July 20, 2015 to investigate this accident. An accredited representative of the United States of America, as the State of Design and Manufacture of the aircraft involved in the accident, participated in the investigation. Comments were invited from parties relevant to the cause of the accident and the relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the Pilot, the passengers and the witness, as well as records from a mobile GPS device (hereinafter referred to as "GPS") the history of the flight is outlined below.

	At around 12:40 Japan Standard Time (JST: UTC+9hrs), July 20, 2015, privately owned Cessna 172P, registered JA4005 was planned to make a pleasure flight to Obihiro Airport from the Betsukai Flight Park Temporary Airfield in Betsukai-cho, Notsuke-gun, Hokkaido (hereinafter referred to as "the Airfield"), with the Pilot sitting in the right pilot seat, passenger A in the left pilot seat, and passengers B and C in the rear seats. The Pilot had not taken off from a grass runway recently, but he intended to make a short field take-off from a grass runway using both the 560 m-long take-off and landing strip (hereinafter referred to as "the Runway") 14 and the 140 m-long grass area, the surface of which was developed to a condition equivalent to the Runway (hereinafter referred to as "the Runway Equivalent Surface"), located in front of the threshold of the Runway. Although it was slightly difficult to watch the speed indicator while controlling in the right seat, the Pilot commenced take-off with the flaps at 10° and at maximum power, raised the nose-wheel at an airspeed of about 20-30 kt, and rolled along the Runway using the main gear only, then performed a rotation at an airspeed of about 55 kt and lifted off about 300 m before the Runway end. Although he noticed that the stall warning commenced to sound immediately after lift-off, he thought the warning sound had stopped during the climb, and then continued a climb suitable for clearing an obstacle. Thereafter, thinking that the Aircraft altitude was higher than the windbreak forest ahead of the Airfield, the Pilot fixed the engine power knob (which he had been holding with his left hand) to the maximum power position and held the control column with his left hand, then used his right hand to take out an aeronautical chart that had been placed in the right door pocket and intended to confirm the flight planned route. At that time, the edge of the chart hit the flap lever, and then the flaps went into full-up position. At the same time, the Pilot felt as if the Aircraft had suddenly stopped the climb and was in stall condition. Immediately after this, the attitude of the Aircraft became unstable, and then it crashed.



Situation of the right pilot seat

The witness who was the manager of the Airfield, was watching the take-off of the Aircraft from around 50 m of the left the Runway 14 end. After lifting off, the Aircraft's altitude began to fall slightly, but immediately thereafter, it became a large nose-up and changed to ascend. The Aircraft eventually approached the witness while veering to the left in an unstable condition as if it had stalled, and crashed in a meadow in a condition rolled to the left about 65 m ahead of him.

According to the GPS records, the Aircraft commenced its take-off roll at around 12:41:30, then, after climbing to about 10 m above ground level (AGL) at an estimated average ground speed of about 40 kt at around 12:42:02, it changed to a descent, and reached 0 m AGL at around 12:42:09.

Passenger A had hardly any experience of flying an aircraft of this type, was not monitoring the flight instruments in the left pilot seat clearly during take-off. But he was mainly looking straight ahead; therefore, he knew little about the situation when the Aircraft stalled during the climb.

Passenger B had about 70 hours experience of flying an aircraft of this type, and was watching the take-off in the left-side rear seat. The Aircraft raised its nose-wheel at maximum power and accelerated, then, immediately after lift-off, there had been the continuous stall warning beeped, and about 5-6 seconds later, it crashed. At this time, the pitch angle was quite large, but a climb ratio commensurate with this angle did not seem to have been obtained.

Passenger C had about 30 hours experience of flying an aircraft of this type, and was watching the take-off in the right-side rear seat. The stall warning continued to sound after the Aircraft had lifted, shortly after it crashed from an altitude of about 10 m (by visual estimation) while rolling to the left.

	The witness came to the crash site together with several airfield people concerned, used the fire extinguisher that was equipped in the Airfield facility to extinguish a fire that had broken out in the engine, and engaged in rescue activities for the persons on board the Aircraft. Passenger C had evacuated and was at a distance from the aircraft, but on seeing that the witness and others who had come to the scene were extinguishing the fire in the engine, returned to the Aircraft and helped to rescue the two persons who were in the pilot seats. The Pilot who evacuated from the Aircraft was transported to hospital by an air ambulance and the three passengers by ambulances. (See Figure: Estimated Flight Path)
2.2 Injuries to Persons	The Pilot, Passenger A and Passenger B suffered serious injuries such as bone fractures, while passenger C sustained minor injuries such as bruises.
2.3 Damage to Aircraft	Extent of damage: Destroyed (1) Both wings were deformed upwards near the wing tips. (2) The nose-gear and right main gear were broken. (3) The flight control system was broken and stuck. (4) The primer line of the engine fuel pipe*1 was severed (above the exhaust pipe). (5) The engine cowling was partly burnt.  Situation of the Aircraft
2.4 Personnel Information	Pilot: male, age 74 Private Pilot Certificate (airplane) January 21, 1998 Restrictions: Single-engine land, multi-engine land Specific pilot competence review Validity: November 13, 2015 Class 2 aviation medical certificate: Validity: March 13, 2016 Total flight time: 1,281 hours 0 minutes Total flight time on the type of aircraft: 800 hours 0 minutes Flight time in the last 30 days: 6 hours 30 minutes

*1: The “primer line” is a pipe used to inject fuel into the cylinders when starting cold engine.

2.5 Aircraft Information	(1) Aircraft type: Cessna 172P Serial number: 17276205 Date of manufacture: August 24, 1984 Certificate of airworthiness No. To–2015–036 Validity: May 9, 2016 (2) It is estimated that the Aircraft's weight was 2,353 lbs and its center of gravity was 45.3 in aft of the reference datum when the accident occurred. Both of these are within the allowable ranges (maximum take-off weight 2,400 lbs, position of center of gravity 39.0-47.3 in).
2.6 Meteorological Information	(Pilot's statement and observation records on the Airfield) 12:30 Weather: Clear; Wind: SW 6-11kt; Visibility: good External temperature 29°C
2.7 Accident Site	The accident site was a temporary airfield with a 560 m-long, 24 m-wide grass runway and an elevation of 407 ft. The Aircraft came to rest on a meadow about 10 m to the left from the left edge of Runway14 of the Airfield about 50 m before the Runway end, in a situation opposite to the take-off direction with pointing nose to the west and its flaps were almost raised. (See Figure: Estimated Flight Path and Photo: The Accident Site)  Situation of flaps and others There was a windbreak forest with a ground height of about 15 m at a point about 400 m from the Runway 14 end in the take-off direction.
2.8 Additional Information	(1) Take-off The flight manual included the following descriptions on setting flaps for short field take-offs and soft or rough field take-offs. (Excerpt) *Normal takeoffs are accomplished with wing flaps 0°- 10°. Using 10° wings flaps reduces the ground roll and total distance over an obstacle by approximately 10%. Flap deflections greater than 10° are not approved for takeoff. If 10°*

wing flaps are used for takeoff, they should be left down until all obstacles are cleared and a safe flap retraction speed of 60 KIAS is reached.

On a short field, 10° wing flaps and an obstacle clearance speed of 56 KIAS should be used.

Soft or rough field takeoffs are performed with 10° wing flaps by lifting the aircraft off the ground as soon as practical in a slightly tail-low attitude. If no obstacles are ahead, the aircraft should be leveled off immediately to accelerate to a higher climb speed.

When departing a soft field with an aft C.G. loading, the elevator trim should be adjusted towards the nose down direction to give comfortable control wheel forces during the initial climb.

(2) Take-off distance

The flight manual included the following descriptions on short field take-off performance. (Excerpt)

Conditions:

Flaps 10° wing, Full Throttle Prior to Brake Release, Paved, Level, Dry Runway, Zero Wind

Note: 4. For operation on a dry, grass runway, increase distances by 15 % of the "ground roll" figure.

WEIGHT LBS	TAKEOFF SPEED KIAS		PRESS ALT FT	30° C	
	LIFT OFF	AT 50 FT		GROUND ROLL FT	TOTAL FT TO CLEAR 50FT OBS
2400	51	56	S. L	995	1810
			1000	1090	2000

In calculations taken from a short field take-off performance chart used to calculate the aircraft's performance during take-off, based on conditions close to the situation during take-off (i.e. take-off weight: 2,400 lbs, pressure altitude: 500 ft, no headwind component, outside air temperature 30°C, and use of a dry grass runway), the ground roll distance was about 1,200 ft (about 366 m) and the total distance until lifting above 50 ft was about 2,190 ft (about 668 m).

(Calculation based on 1 ft : 0.3048 m)

(3) Stall speeds

The flight manual included the following descriptions on stalls. (Excerpt)

4-3-8. Stalls

The stall characteristics are conventional for the flaps up and flaps down condition. The stall warning horn produces

a steady signal 5 to 10 knots before the actual stall is reached.

5-4. Stall speeds

Conditions: Power off

Notes:1. Altitude loss during a stall recovery may be as much as 230 feet.

2. KIAS values are approximate.

(1) Most Rearward Center of Gravity

WEIGHT LBS	*FLAP DEFLECTION*	*ANGLE OF BANK O° KIAS*
2400	*UP*	*44*
	10°	*37*
	30°	*33*

(4) Climb speed

According to the flight manual, the best-angle-of-climb speed (V_X) with a weight of 2,400 lbs, sea-level altitude and full power was 56 KIAS with flaps 10°, and the best-rate-of-climb speed (V_Y) in the same condition was 76 KIAS with flaps 0°.

(5) Technique for take-off from soft fields

On the technique for take-off from soft fields, descriptions to the following effect are included in the U.S. Department of Federal Aviation Administration, Flight Standards Service, "FAA Airplane Flying Handbook" 2004, pp.5-10 through 5-11.

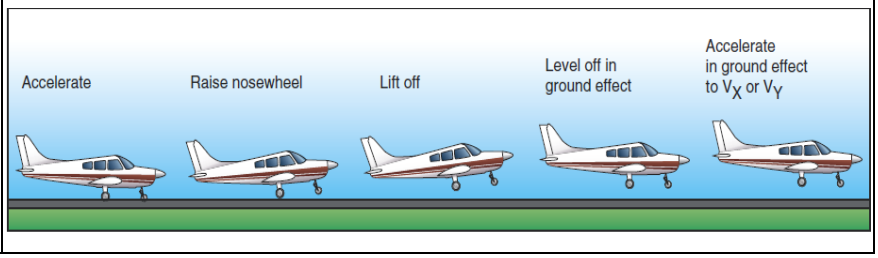
(Excerpt, abridged)

Takeoffs and climbs from soft fields require the use of operational techniques for getting the airplane airborne as quickly as possible to eliminate the drag caused by tall grass, soft sand, mud, etc. As the airplane accelerates, enough back-elevator pressure should be applied to establish a positive angle of attack and to reduce the weight supported by the nosewheel.

When the airplane is held at a nose-high attitude throughout the takeoff run, the wings will relieve the wheels of the airplane's weight, thereby minimizing the drag caused by the surface irregularities or adhesion. If this attitude is maintained, the airplane will virtually fly itself off the ground, becoming airborne at airspeed slower than a safe climb speed because of ground effect.

After becoming airborne, the nose should be lowered very gently with the wheels clear of the surface to allow the airplane to accelerate to V_Y, or V_X if obstacles must be cleared.

An attempt to climb out of ground effect before sufficient climb airspeed is attained may result in the airplane being unable to climb further as the ground effect area is transited,

	even with full power. Therefore, it is essential that the airplane remain in ground effect until at least V_X is reached. 

3. ANALYSIS

3.1 Involvement of Weather	None
3.2 Involvement of Pilots	Yes
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	(1) Situation at the time of commencement of take-off It is highly probable that the Aircraft commenced a short field take-off from a grass runway consisting of the 560 m-long Runway 14 together with an additional 140 m-long grass area with the Runway Equivalent Surface, with two persons sitting in the rear seats, thus causing the center of gravity to be aft while also increasing its weight. According to the Pilot's statement, it is probable that the Aircraft's ground roll distance was about 400 m, and it is probable that this was more or less in accordance with its performance chart. (2) Situation after lift-off It is probable that the Aircraft's center of gravity at this time was within the allowable range; however, it was relatively aft, making the Aircraft susceptible to nose-up after lift-off. The Pilot stated that, although it was slightly difficult to watch the speed indicator while controlling in the right seat, he performed the take-off roll with the nose-wheel raised, then performed the rotation at about 55 kt. At this time, he heared the stall warning sound which operates with the speed larger 5-10 kt than 37 kt of the stall speed; therefore, it is probable that he performed the rotation at a speed lower than 55 kt and close to the stall speed, making the control surfaces less effective and the Aircraft more difficult to control. Based on the above, it is probable that the Pilot did not accelerate the Aircraft sufficienly before starting the climb, and performed the climb at a low speed that made it difficult to control the Aircraft. (3) Situation from stall to crash According to the statements of passengers B and C, it is

	probable that the stall warning was sounding continuously until the altitude at which the descent began (about 10 m by visual estimation); based on this, it is probable that the pitch angle of the Aircraft was too large. Moreover, based on the above, it is probable that pitch control*2 was not performed adequately by the Pilot during the climb, and that the Aircraft continued to climb at a low speed close to stall speed. It is probable that this was because the low speed of the Aircraft made it difficult to control since the Pilot had not accelerate it sufficienly before starting the climb in a condition susceptible to nose-up, in addition to the fact that he did not adequately monitor the speed indicator during the climb. Furthermore, it is also probable that the stall speed had increased to about 44 kt, because the aeronautical chart inattentively taken out by the Pilot at low altitude while climbing at low speed hit the flap lever, causing the flap position to change from 10° to full up. According to the GPS records, the estimated average ground speed of the Aircraft at around 12:42:02 when it reached a ground altitude of about 10 m was about 40 kt. There was no great change in airspeed with a large nose-up condition and there was a weak southwesterly wind; therefore, it is probable that average airspeed at this time was also about 40 kt. From these, it is probable that the Aircraft stalled because the flaps moved to full up at low altitude while it was continuing to fly at low speed. Since it is probable that the Aircraft was flying at a low altitude of about 10 m when it stalled, it is highly probable that the Pilot was unable to recover from the stall and got into the difficult condition for controlling it, thus causing it to crash, whereupon the Pilot and passengers sustained injuries and the Aircraft was destroyed. Moreover, it is also probable that the primer line of the engine was severed by the impact of the crash; accordingly, leaking fuel came into contact with the heated exhaust pipe, resulted in brake out of fire. (4) Situation of rescue activities According to the statements of the witness and passenger C, it is highly probable that several airfield people concerned immediately came to the accident site after the accident had occurred, and used the fire extinguisher that was equipped in the Airfield facility to appropriately extinguish the fire that

*2: "Pitch control" means control of the aircraft's vertical attitude.

	had broken out, as well as quickly engaging in rescue activities for the Pilot and passengers. It is highly probable that these prompt and appropriate rescue activities prevented fatalities or more severe injuries from occurring. (5) Preventing stall when taking off from soft fields When taking off from a grass runway, a judgment must be made on whether to use the normal take-off technique or the technique for take-off from soft fields, based on careful consideration of the runway condition, aircraft characteristics, take-off performance and others. The following measures may be generally considered as means of preventing stall when using the technique for take-off from soft fields. When taking off from a temporary airfield, appropriate plans must be made, such as adjusting the take-off weight in consideration of the outside air temperature and others; consequently, the take-off roll can be started within the permitted landing strip and completed safely. After the take-off roll has been performed in nose-up condition and the main gear has left from the ground, the aircraft must be leveled off at an altitude at which the main gear does not touch down, by making use of the ground effect whereby lift-drag ratio increases near the ground. The attitude must then be changed to climb after accelerating to the best-angle-of-climb speed or best-rate-of-climb speed. Flaps may only be raised after confirming that the safe speed prescribed in the flight manual has been reached. If a stall warning sounds during the climb, the nose-up must be reduced immediately and speed be increased to a safe speed.

4. PROBABLE CAUSES

It is highly probable that this accident occurred because the Aircraft stalled at low altitude during the take-off climb, a recovery from the stall could not be achieved, which made it become difficult to fly and crashed.

It is probable that the Aircraft stalled at low altitude during the take-off climb because the flaps moved to full up at low altitude under conditions in which pitch control was not properly achieved during the climb and flight was continued at a low speed close to stall speed.

It is probable that pitch control was not properly achieved during the climb because the low speed of the Aircraft made it difficult to control because the Pilot had not accelerated sufficiently before starting the climb with the Aircraft in a condition susceptible to nose-up, in addition to the fact that he did not adequately monitor the speed indicator during the climb.

It is probable that the flaps moved to full up at low altitude because the aeronautical chart taken out by the Pilot at low altitude hit the flap lever.

Figure: Estimated Flight Path

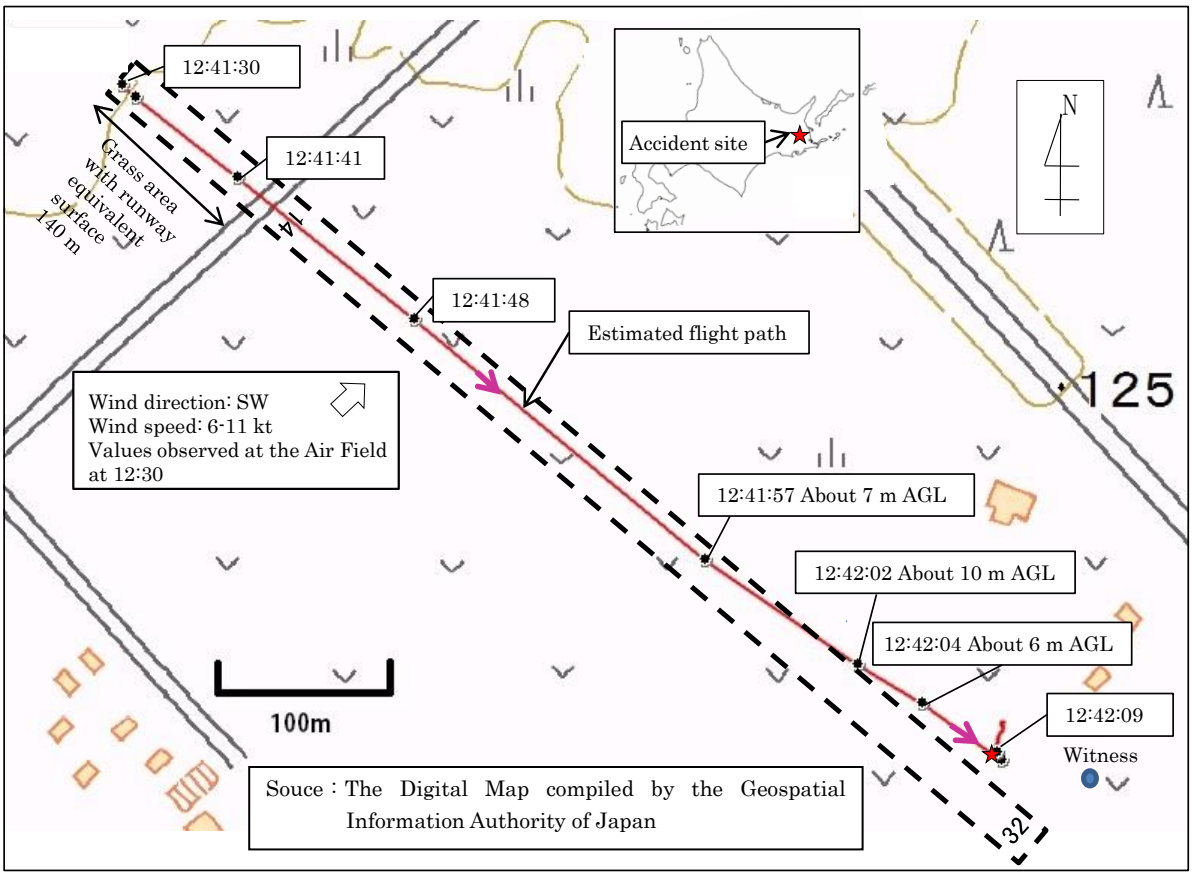


Photo: The Accident Site