AA2013-2

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

Kyoritsu Air Co., Ltd.

J A 3 9 5 9

February 22, 2013

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.

Norihiro Goto
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

NOSE GEAR DAMAGE DURING LANDING
KYORITSU AIR CO., LTD.
CESSNA TU206G, JA3959
CHOFU AIRFIELD
AT 10:08 LOCAL TIME, OCTOBER 3, 2011

Jan 25, 2013

Adopted by the Japan Transport Safety Board

Chairman	Norihiro Goto
Member	Shinsuke Endoh
Member	Toshiyuki Ishikawa
Member	Sadao Tamura
Member	Yuki Shuto
Member	Toshiaki Shinagawa

SYNOPSIS

Summary of the Accident

On Monday, October 3, 2011, a Cessna TU206G, registered JA3959, operated by Kyoritsu air Co., Ltd., took off from Chofu Airfield for aerial photo mission at 09:20 local time*1, and sustained nose gear damage when it landed at Chofu Airfield at 10:08, swerving off the runway to a halt.

On board the airplane were a pilot and a cameraman, and neither of them suffered injuries. The airplane sustained substantial damage, but no fire broke out.

Probable Causes

In this accident, it is highly probable that the airplane bounced upon the first touchdown, and fell into a state of porpoising upon the second touchdown from the nose gear; consequently, damaging the nose gear and its attachment structure to the fuselage.

It is probable that the airplane's first bounce upon the touchdown was caused by the combined effects of: springing action of main gears due to higher sink rate; and the remaining lift as a result of insufficient deceleration.

It is highly probable that the nose gear touchdown preceded the main gears upon the second touchdown probably became a trigger for porpoising, as a result of the nose-down control input to lower the severely bounced airplane. The probable contributing factor to the damage to nose gear and its attachment structure is the absence of added power before the second touchdown, and lack of reduction of sink rate.

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*1 Japan Standard Time (JST): UTC+9 hours. Unless otherwise stated, all times are expressed in JST and on a 24-hour clock.

The following abbreviations are used in this report.

VFR:	Visual Flight Rules

Unit Conversion

1 knot (kt):	1. 852 km/h (0.5144m/s)
1 foot (ft):	0.3048 m
1 pound (lb):	0.4536 kg
1 inch (in):	2.54 cm
1 inch-Hg (inHg):	3,386 Pa (345.3 kgf/m^2)

1. PROCESS AND PROGRESS OF THE INVESTIGATION

1.1 Summary of the Accident

On Monday, October 3, 2011, a Cessna TU206G, registered JA3959, operated by Kyoritsu air Co., Ltd., took off from Chofu Airfield for aerial photo mission at 09:20, and sustained nose gear damage when it landed at Chofu Airfield at 10:08, swerving off the runway to a halt.

On board the airplane were a pilot and a cameraman, and neither of them suffered injuries. The airplane sustained substantial damage, but no fire broke out.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On October 3, 2011, the Japan Transport Safety Board designated an investigator-in-charge and an investigator to investigate this accident.

1.2.2 Representatives from the Relevant State

Although this accident was notified to the United States of America, as the State of Design and Manufacture of the aircraft involved in this accident, it did not designate its accredited representative.

1.2.3 Implementation of the Investigation

October 4, 2011: On-site investigation, interviews and airplane examination
October 12, 2011: Airplane examination and interviews

1.2.4 Comments from the Parties Relevant to the Cause of the Accident

Comments were invited from the parties relevant to the cause of the accident.

1.2.5 Comments from the Relevant State

Comments were invited from the related State.

2. FACTUAL INFORMAION

2.1 History of the Flight

On October 3, 2011, a Cessna TU206G, registered JA3959, operated by Kyoritsu air Co., Ltd. (hereinafter referred to as "the Company"), with a pilot and a cameraman, took off from Chofu Airfield for aerial photo mission at 09:20.

The outline of the flight plan was as follows.

Flight rules: Visual Flight Rules (VFR)
Departure aerodrome: Chofu Airfield
Estimated off-block time: 09:15
Cruising speed: 120 kt
Cruising altitude: VFR
Route: Otsuki – Mt. Yatsugatake – Minobu – Otsuki
Destination aerodrome: Chofu Airfield
Total estimated elapsed time: 5 hr and 00 min
Fuel load expressed in endurance: 5 hr and 30 min
Persons on board: 2

The history of the flight up to the time of the accident is summarized as follows, according to the communication records with Chofu Airfield and the statements of the persons concerned with the accident.

2.1.1 History of the Flight based on the Communication Records with Chofu Airfield

09:20: The airplane took off from Chofu Airfield for taking aerial photo mission in the area around Mt. Yatsugatake.

10:05: The pilot reported to Chofu Flight Service*2 that he was flying over Yomiuri Land*3 and would land at Chofu Airfield.
Chofu Flight Service informed the airplane that the using runway was 35, the wind direction was blowing from 010 degrees at 12 knots with its maximum velocity at 20 knots.

10:08: The airplane landed at the Chofu Airfield.

10:09: The pilot reported to the Flight Service that the airplane was unable to taxi.

2.1.2 Statements of the Persons Concerned with the Accident

a. Pilot

On the day of the accident, he flew to the area around Mt. Yatsugatake to take aerial photos. But the unfavorable weather for photo mission forced him to abort the mission and to fly back to Chofu Airfield.

As he judged from the wind information available that the fluctuation of the wind velocity would be large, he set the approach speed at 75 knots

*2 Flight Service is a ground communication station established at an airport, heliport or temporary operation site wherein any tower, radio, or remote air-to-ground facilityis not operated. It provides information on runway, weather and traffic conditions while exchanging flight information with aircraft concerned.

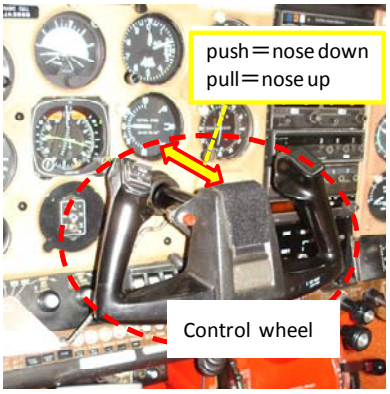
*3 Yomiuri Land is a reporting point located south-southwest of the Airfield.

with 5-knot additive to the normal approach speed, and set the flap to 40. The flight until the runway threshold was almost steady without sudden loss of altitude or speed.

After passing the threshold, he, considering the wind conditions, delayed the timing of reducing the engine power than usual. When he applied back pressure on the control wheel to flare*4, the rate of descent became unusually small and the touchdown point was put forward beyond the intended point. He relaxed the back pressure to settle on the runway. At the time of the touchdown, he further relaxed the back pressure to prevent the airplane from floating*5 as the touchdown point was already beyond the intended point. The airplane touched down with the main gears with the descent rate not reduced much.

As the airplane bounced after the touchdown, he pushed the control wheel to prevent the bounce from becoming higher. Although he judged that a second touchdown could be a safe one judging from the height of the bounce, he did not add the engine power.

He pushed the control wheel to lower the airplane during the bounce and pulled the control wheel to raise the nose before the second touchdown. The airplane touched down from the nose gear and fell into a state of porpoising*6.



He had been instructed to execute an immediate go-around in case of porpoising. He judged that it would be safer to continue the landing operation than attempting another landing after executing the go-around, because he thought that the nose gear might have been damaged by the impact at the second touchdown after hearing a loud sound coming from the nose section.

While the airplane was bouncing, he did not hear a stall warning.

The engine was operating normally until the airplane stopped on the runway.

During the landing roll, the brake functioned, but the airplane swerved off to the right from the runway center line due to failed directional control.

The pilot thought that the airplane bounced three or four times. He had no recognition of a tail strike during the bounces.

b. Cameraman

The cameraman was seated in the right seat during take-off and

*4 "Flare" is a maneuver in which the nose of the aircraft is pulled up before touchdown on the runway in order to reduce the airspeed and the rate of descent to reduce the impact of the landing.

*5 "Floating" is a flight very close to the runway surface without touchdown as a result of excessive lift during the flare. Excessive final approach speed is often responsible for it.

*6 "Porpoise" is a motion in which an airplane repeats bouncing upon the runway. (See 2.8.4)

landing.

The airplane touched down with the main gears on the first touchdown, but he did not feel the impact of the touchdown so much. The airplane bounced after the touchdown, and lowered the nose before the second touchdown.

He had experience of bouncings before. He felt that the latest bounce was bigger than those he experienced before, and he thought that he bounced three or four times until it came to a halt.

c. Witness A (a person in charge of communication in the Control Tower, Chofu Flight Service)

Witness A thought that the airplane's approach speed was a little faster.

As it bounced upon the first touchdown and fell into an unstable attitude, he mentioned it to Witness B who was next to him to watch it.

A pillar inside the control tower obstructed the view of the second touchdown.

He observed the following bouncing, although he did not know when the nose gear sustained damage.

d. Witness B (a person in charge of communication in the Control Tower, Chofu Flight Service)

Responding to the Witness A's mentioning, he looked out and recognized the airplane bouncing on the runway. The following touchdown appeared to be a three-point landing*7, in which the airplane bounced with nose-up attitude striking its tail on the runway.

He thought that the airplane bounced as high as the airplane height, or a little higher than the airplane height.

He observed the airplane bounce successively at least twice.

e. Witness C (a pilot of the Company)

He was aboard another airplane being advised by Chofu Flight Service to hold on Taxiway A1 because the accident airplane would land ahead of him. He had to hold the control wheel firmly as the control surface of his airplane flapping under the wind influence. The airplane approached in unsteady manner due to the wind, and he thought that the first touchdown point was a little beyond the intended point. After the first touchdown, the airplane bounced several times and its pitch oscillations gradually became bigger.

The accident occurred on the runway at Chofu Airfield (35°40'18" N, 139°31'41" E), at 10:08.

(See Figure 1: Accident Site Layout, Photo 1: The Accident Airplane)

2.2 Injuries to Persons

*7 "Three point landing" is a touchdown in which the simultaneous touchdown of the nose gear and both main gears take place.

Nobody suffered injuries.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

The airplane sustained substantial damage.

2.3.2 Damage to the airplane Components

a. Fuselage: damaged
b. Propeller: damaged
c. Nose landing gear: damaged

2.4 Personnel Information

Pilot: Male, Age 26

Commercial pilot certificate (Airplane)	July 5, 2006
Type rating for single engine (land)	September 1, 2005
Class 1 aviation medical certificate	
Validity	Until April 11, 2012
Total flight time	574 hr and 37 min
Flight time in the last 30 days	22 hr and 55 min
Total flight time on the type of aircraft	58 hr and 30 min
Flight time in the last 30 days	9 hr and 44 min

2.5 Aircraft Information

2.5.1 Airplane

Type	Cessna TU206G
Serial number	U20605024
Date of manufacture	April 28, 1979
Certificate of airworthiness	No. Dai – 2011 –096
Validity	May 18, 2012
Category of airworthiness	Airplane, Normal N or Special airplane X
Total flight time	6,812 hr and 40 min
Flight time since last periodical check (500 hours inspection, September 20, 2011)	22 hr and 10 min

2.5.2 Weight and Balance

When the accident occurred, the weight of the airplane was estimated to have been 3,522 pounds, and the position of the center of gravity was estimated to have been 44.8 inches aft of the reference point, both of which are estimated to have been within the allowable range (the maximum weight of 3,600 pounds, and the center of gravity range of 41.8-50.0 inches corresponding to the weight at the time of the accident).

2.6 Meteorological Information

On the day of the accident, the aeronautical weather observations at Chofu Airfield around the time of the accident were as follows:

10:00 Wind direction 020°, Wind velocity 12 kts
Wind direction fluctuation 340°- 050°
Prevailing visibility 20 km
Cloud: Amount 1/8, Type Cumulus, Cloud base 3,000 ft
Amount 4/8, Type Stratocumulus, Cloud base 8,000 ft
Temperature 19°C, Dew point 4°C
Altimeter setting (QNH*8) 30.08 inHg

According to the graphic chart showing weather observation values recorded at Chofu Airfield, the observation values of the instantaneous wind direction and wind velocity at around the time of the landing of the airplane indicated a fluctuation range of 340°-040° for the wind direction and 7-13 knots for the wind velocity.

(See Figure 3: Instantaneous Wind Direction and Wind Velocity)

2.7 Accident Site Information

2.7.1 Accident Site

Chofu Airfield has a runway that measures 800-meter long and 30-meter wide, with runway directions of 17 and 35.

The airplane approached runway 35, and came to a halt at a point about 574 meters from the runway threshold and about 18 meters to the right of the runway centerline :about 3 meters from the right edge of the runway with its fuselage almost parallel to the runway. Its nose gear was bent to the left.

There was a 1.9-meter linear scratch mark at a point 280 meters from the runway approach end. Four sets of intermittent propeller hit marks were observed in the area 314 meters from the runway threshold to the runway halfway marker :400 meters from the runway threshold . The last stretch of propeller hit marks started from the runway halfway marker to the vicinity of the airplane.

Fragments of the broken nose gear and propeller blades were found in the area between the initial propeller hit mark and the airplane.

It was unable to identify the airplane's first touchdown point due to innumerable tire marks on the runway,.

(See Figure 1: Accident Site Layout)

2.7.2 Details of Airplane Damage

a. Fuselage

The nose gear attachment structure and engine firewall were deformed.

The tail ring :aircraft mooring fitting at the rear of the fuselage was scratched and bent rearward at the root.

The tail of the airplane had a slight upward bent.

b. Propeller

Each of the three blades was bent backward with chipped end.

c. Landing gear

*8 "QNH" is a pressure value to be set on the pressure altimeter to get the airfield's elevation above mean sea level when an airplane is grounded in an airport.

The nose gear shock strut was damaged and its support fittings were partly broken.

(See Photo 2: Propeller Blades, Photo 3: Nose Gear Shock Strut)

2.7.3 Condition of Engine and Control System

The pilot did not experience engine malfunction in flight. There was nothing abnormal about the engine, either even after the airplane deviated from the runway and came to a stop.

The Company confirmed the proper control connectivity to the ailerons, elevators and rudder.

2.8 Other Necessary Information

2.8.1 Instruction and Training by the Company

The Company had not established approach speed determined by landing weight. Flight training had been conducted with approach speed of 70 knots as standard airspeed, which was the medium value of normal approach speed prescribed in the airplane flight manual. Approach speed correction under very windy conditions was to add one half of the value gained by subtracting average wind velocity from the maximum wind velocity.

As it was unable to reproduce a state of bouncing and porpoising using a real airplane, the Company had not done these trainings. The Company gave verbal instructions as a general precaution to prepare for follow-on touchdown with the landing attitude maintained upon bouncing, and to initiate a go-around in case of higher bounce or porpoising.

2.8.2 Landing Operation

The airplane flight manual states the landing operation as follows:

SECTION 4 NORMAL PROCEDURES IN NORMAL CONDITIONS

(omitted)

4-2 Airspeed during normal operation

Unless otherwise noted, each of the airspeeds as indicated below is calculated based on the maximum weight of 3,600 pounds, and this applies to the lesser weight.

(omitted)

APPROACH:

NORMAL APPROACH (flaps UP)	*75–85 kt*
NORMAL APPROACH (flaps 40°)	*65–75 kt*
SHORT FIELD APPROACH (flaps 40°)	*64 kt*

(omitted)

4-4-9 Landing

Touch down on the ground with the main gears first and reduce the speed applying brake during the landing roll. Lower the nose gear on the runway after the speed has diminished to avoid unnecessary nose gear load. This applies to the landing on the unpaved

airstrip.

2.8.3 Flare and Bouncing

The Airplane Operation Textbook published by the Japan Civil Aviation Promotion Foundation states the flare and bouncing as follows:

4.2 Landing

(omitted)

4.2.1 Normal Landing

(omitted)

(2) Flare

(omitted)

How fast the pitch attitude changes during a flare differs depending on flight conditions, i.e. the altitude, attitude, sink rate (an apparent flow velocity of off-runway terrain seen on either end of vision), wind and airspeed.

Under relatively windy conditions, the touchdown point may become nearer than wind calm conditions, and it is necessary to flare depending on the sink. (omitted)

4.4 Go-around

(omitted)

4.4.2 Unsafe Landing

(omitted)

(7) Bounce

(omitted)

In case of a low bounce with no rapid change of pitch attitude, maintain the direction, use power to soften the touchdown and operate smoothly to establish the landing attitude before follow-on touchdown.

(omitted)

In case of high bounce, initiate a go-around immediately due to a risk of stall before the follow-on landing takes place.

(omitted)

Particular attention should be paid to the bounce under cross wind conditions. When the aircraft bounces crosswind correction is lost without exception, and there is a risk of leeward roll-over under the influence of crosswind. The airspeed will be much lower than during a normal landing, and the wing-low attitude should be established for drift correction.

2.8.4 Porpoise

Airplane Flying Handbook published by the FAA (Federal Aviation Administration) states the porpoise as follows:

Chapter 8 Approaches and Landings

Faulty Approaches and Landings

Porpoising

In a bounced landing that is improperly recovered, the airplane

comes in nose first setting off a series of motions that imitate the jumps and dives of a porpoise—hence the name.

(omitted)

When a porpoise is severe, the safest procedure is to EXECUTE A GO- AROUND IMMEDIATELY. In a severe porpoise, the airplane's pitch oscillations can become progressively worse, until the airplane strikes the run-way nose first with sufficient force to collapse the nose gear.

2.8.5 Stall Warning Device

The airplane was equipped with a stall warning device which alerts the pilot to the stall margin of 5-10 knots with a warning sound.

3. ANALYSIS

3.1 Airman Competence Certificate and Others

The pilot held a valid airman competence certificate and a valid aviation medical certificate.

3.2 Airworthiness Certificate and Others

The airplane had a valid airworthiness certificate and had been maintained and inspected as prescribed.

3.3 Effects of Meteorological Conditions

As described in 2.6, the observed wind values around the time of the landing of the airplane were 340°-040° at 7-13 knots.

Also, as described in 2.1.1, information on the wind which Chofu Flight Service provided the airplane at 10:05 was 010 degrees at 12 knot with its maximum velocity of 20 knots.

Furthermore, as stated in 2.1.2 e., Witness C stated that the airplane approach was unsteady in the wind.

These facts indicate that the fluctuating wind in terms of direction and velocity affected the landing of the airplane.

3.4 Development of the Accident

3.4.1 Approach Speed

As described in 2.8.1, the Company's standard approach speed was 70 knots, it is probable that correction was made to add one half of the value gained by subtracting average wind velocity from the maximum wind velocity under very windy conditions.

As Chofu Flight Service informed the pilot of the wind velocity of 12 knots with maximum value of 20 knots, the pilot should have added 4 knots to the standard approach speed to get the corrected approach speed. In fact, the pilot added 5 knots as described in 2.1.2 a. The pilot probably added this value to cope with bigger wind fluctuation as the actual wind differed from the informed one.

3.4.2 The First Touchdown and the Bounce

a. Touchdown beyond the intended point

According to the statement in 2.1.2 a., considering the wind conditions the pilot delayed the timing of reducing the engine power than usual and initiated a flare. The rate of descent became unusually small and the touchdown point was put forward beyond the intended point.

Possible situations for delayed reduction of engine power are: rapid wind velocity decrease is expected during the flare; and the wind possibly remains strong until touchdown. As stated in 3.3, the wind velocity and the maximum wind velocity from Chofu Flight Service were 12 knots and 20 knots, respectively. It is probable that many pilots delay the power reduction or reduce it slowly in an expected situation where the possible wind fluctuation is minus 8 knots, or maximum wind is 20 knots.

However, judging from the observation values of the instantaneous wind velocity at the time of the landing were 7-13 knots, It is probable that wind velocity fluctuation was smaller or the wind velocity itself was smaller than expected by the pilot. It is probable that during the flare accompanied by delayed power reduction airspeed was not reduced adequately due some part to 5knots additive.

This resulted in the extended point of touchdown as the lift by the flare became more than pilot's expectation, in other words, unusually small descent rate.

It is probable that flare should have been executed as stated in the Airplane Operation Textbook: adjust the rate of flare depending on the altitude, attitude, sink rate (an apparent flow velocity of off-runway terrain seen on either end of vision), the wind and the airspeed.

b. The first bounce

The pilot stated in 2.1.2 a. that at the time of the touchdown, he further relaxed the back pressure to prevent the airplane from floating as the touchdown point was already beyond the intended point. The airplane touched down with the main gears with the descent rate not reduced much.

It is probable that the airplane started to descend with nose lower than the landing attitude as the control wheel back pressure was relaxed, followed by another flare for the touchdown. Reduced amount of flare to avoid floating lead to insufficient reduction of descent rate and the airplane landed with the main gears. Also, as described in 3.4.2 a, the airplane had not adequately reduced the airspeed, the airplane probably touched down with some remaining lift.

The airplane probably rebounded into the air because of the combined effects of the springing action provided by the main gears due to higher sink rate, and the remaining lift with still-larger airspeed.

When the airplane floats during flare with excessive airspeed, in order to avoid follow-on bounce the pilot should adjust the pitch attitude for landing and establish landing attitude as the airspeed diminishes and the airplane starts to settle.

c. From the first bounce to the second touchdown

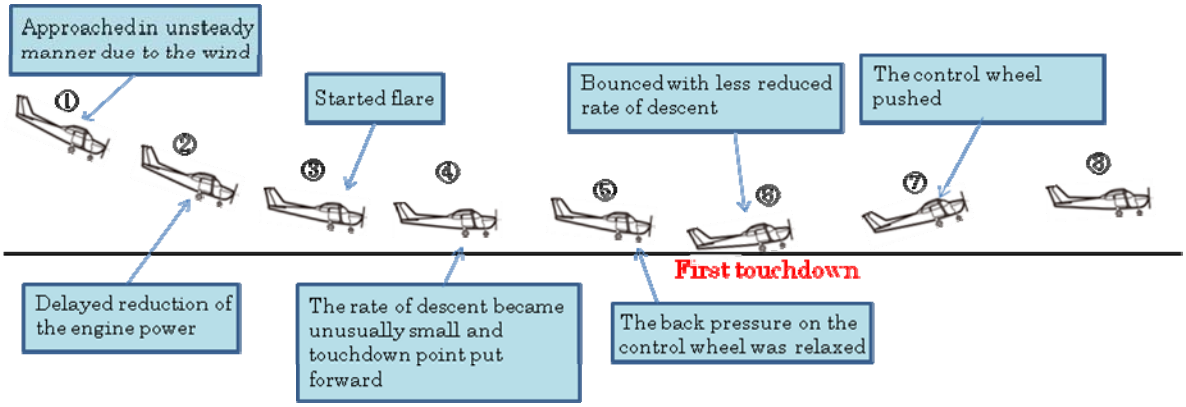
According to the pilot's statement in 2.1.2 a, because the airplane bounced after the touchdown, he adjusted the pitch attitude to prevent the bounce from becoming higher.

It is probable that he reflexively pushed the control wheel a little to prevent the bounce from becoming higher as it was a quick bounce. In spite of his preventive control input, the first bounce appeared high to Witness B at the control tower and the cameraman on board.

According to the statement 2.1.2 a., it is highly probable that he did not operate to increase the engine power, the airspeed of the airplane decreased.

Although Airplane Operation Textbook described in 2.8.3, mentions the risk of stall during bouncing, it is highly probable that the airplane was

not in a stall condition, judging from the pilot statement that he did not hear stall warning.



3.4.3 The Second Touchdown

According to the statement 2.1.2 a., the pilot pushed the control wheel to lower the airplane during the bounce and pulled the control wheel to raise the nose before the second touchdown, although the airplane touched down from the nose gear.

As the attitude was nose-low (lower than the proper landing attitude with nose gear lower than the main gears) during its descent, nose-up control input before the second touchdown was insufficient and resulted in a landing from the nose gear.

It is probable that the insufficient nose-up input was caused by the following reasons:

a. Nose-down control input and absence of added power to reduce the rate of descent while maintaining landing attitude during the bounce lead to increased sink rate, then to faster proximity to the runway, delaying the pilot action to raise the nose.

b. As described in 3.4.2 c, it is highly probable that the airspeed was decreasing and corresponding elevator effect was diminishing.

As described above, it is highly probable that the airplane with nose-down attitude touched down from the nose gear with excessive rate of descent resulting in damage to the nose gear and its attachment structure to the fuselage.

During the second touchdown, it is highly probable that the airplane became nose-up attitude as the combined result of: nose-up elevator input immediately before the touchdown to counter the nose-low attitude; and the springing action generated by nose gear strut, the tail ring at the rearmost fuselage against the runway.

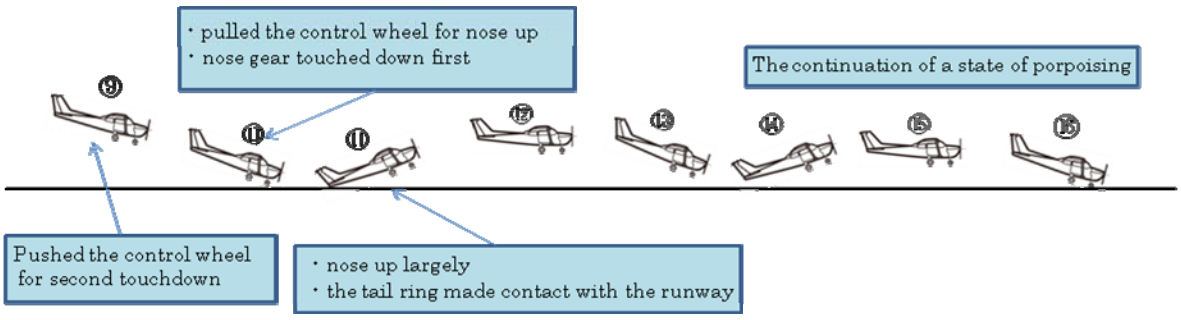
As described in 2.8.4, it is highly probable that improper bounce recovery leads to porpoise, the airplane fell into a state of porpoising after it made the second touchdown from the nose gear.

3.4.4 On and After the Second Touchdown

According the statement in 2.1.2 e, it is probable that the airplane bounced several times and pitch oscillations became gradually bigger because of the fully developed porpoising.

As described in 2.7.1, several sets of propeller hit marks were left on the runway.

It is highly probable that the porpoising airplane's propeller blades left hit marks when it contacted the ground with nose-low attitude, gradually damaging its nose gear, consequently lost directional control of nose gear and swerved off the runway to the right.



3.5 Go-around

As described in 2.8.3, the Airplane Operation Textbook stresses execution of an immediate go-around in case of a high bounce.

It is difficult to specify the height of a bounce which requires an immediate go-around; however, a go-around should be executed immediately in a case like this accident where nose-down elevator input is necessary to change the pitch attitude to land the aircraft on the runway during the first bounce.

3.6 Pros and Cons of Continued Landing Operation

The Airplane Flying Handbook referred to in 2.8.4 stresses execution of an immediate go-around in case of severe porpoise. According to the pilot's statement in 2.1.2 a., it is probable that the he was instructed to execute a go-around in case of a porpoising. it is probable that as he heard a loud sound coming from the nose section upon the second touchdown, he thought that the nose gear might have sustained damage upon the touchdown, and he judged that it would be safer to continue the landing operation than attempting another landing after executing a go-around.

As described in 2.8.4, in a severe porpoise, the airplane's pitch oscillations can become progressively worse, until the airplane strikes the runway nose first with sufficient force to collapse the nose gear. In addition, the statement in 2.1.2 e supports the progressive pitch oscillations.

In view of these facts, it is possible that the pitch oscillations became progressively larger after falling into a state of porpoising upon the second touchdown, and the repeated ground contacts with the nose gear lead to the damage of the nose gear. The accident could have been avoided if the airplane had attempted to land again by executing a go-around immediately after the second touchdown.

3.7 Instruction and Training Provided by the Company

As described in 3.4.2 c, it is probable that in order to descend the airplane during the first bounce, the pilot pushed the control wheel to lower the nose of the airplane.

According to the descriptions in 2.8.1, the Company instructed its pilots to be prepared for follow-on touchdown with the landing attitude maintained upon

bouncing. The pilot's nose-low control input exceeding the proper landing attitude indicates that the Company's instructions were not fully understood.

The Company should make sure that its pilots observe the immediate go-around without exception in case of bouncing with a situation where maintaining the proper landing attitude is impossible.

4. Probable Causes

In this accident, it is highly probable that the airplane bounced upon the first touchdown, and fell into a state of porpoising upon the second touchdown from the nose gear; consequently, damaging the nose gear and its attachment structure to the fuselage.

It is probable that the airplane's first bounce upon the touchdown was caused by the combined effects of: springing action of main gears due to higher sink rate; and the remaining lift as a result of insufficient deceleration.

It is highly probable that the nose gear touchdown preceded the main gears upon the second touchdown probably became a trigger for porpoising, as a result of the nose-down control input to lower the severely bounced airplane. The probable contributing factor to the damage to nose gear and its attachment structure is the absence of added power before the second touchdown, and lack of reduction of sink rate.

5. Safety Actions

5.1 Safety Actions Taken by the Company

a. Safety awareness and pilot training

(1) The Company issued a safety management document to inform all pilots of the accident and reminded them to reconfirm landing procedures and to stick to safety measures such as executing an immediate go-around in case of unsure situation for safety landing.

(2) The Company provided ground school training to all pilots, in which they were reminded of the normal procedures and they refreshed their knowledge about how to deal with faulty landings such as "bouncing, ballooning, high flare, and porpoising." They were also reminded of the matters to be noted until establishing the standard for faulty landing (go-around policy).

(3) The Company provided flight training to all pilots to reconfirm technical skills about landings and how to deal with faulty landing (go-around). As a result, the training confirmed the pilots' satisfactory capabilities.

(4) The Company provided special training package (ground school training and flight training) to instructor and checkers in order to improve pilot capabilities to meet the new training procedures and go-around policy.

b. Review, revision and establishment of standards and manuals

(1) The Company reviewed and revised its operation standards and their appendixes such as promotion training, transition training to a new type aircraft, regular training and its inspection items, and standard training hours, in order to: improve training for inexperienced pilots; deepen all pilots' safety knowledge; and better manage their proficiencies.

(2) The Company established the go-around policy to be included in the company regulation and made it known to all pilots.

(3) The Company designated the ongoing training procedures (originally established to train inexperienced pilots) as company training manual by upgrading it to one of the corporate regulations.

(4) The Company established a training regulation to train the instructors and checkers, who can train pilots in accordance with newly established training procedures and go-around policy.

Figure 1: Accident Site Layout

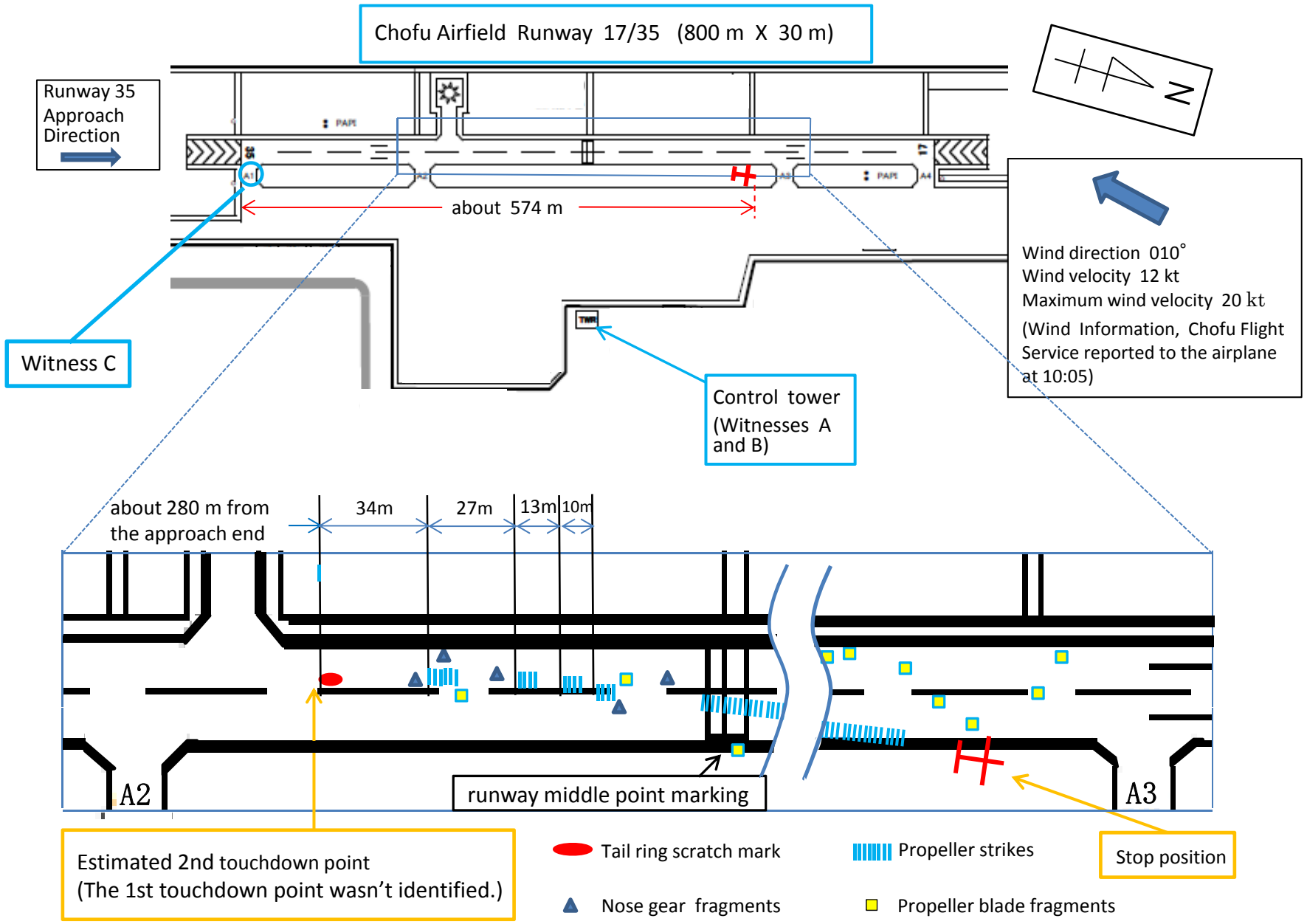


Figure 2: Three Angle View of Cessna TU206G

Unit: m

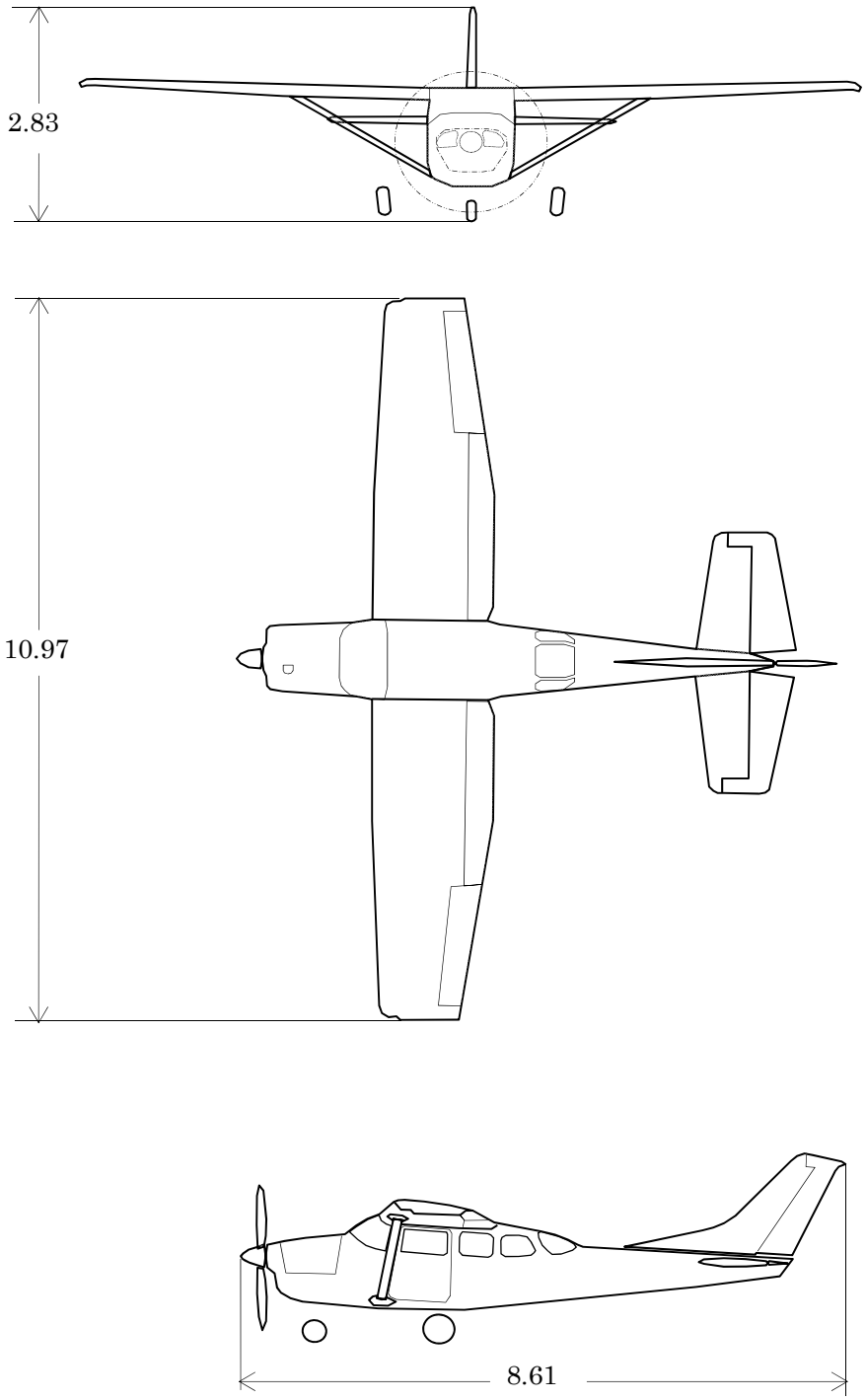


Figure 3: Instantaneous Wind Direction and Wind Velocity

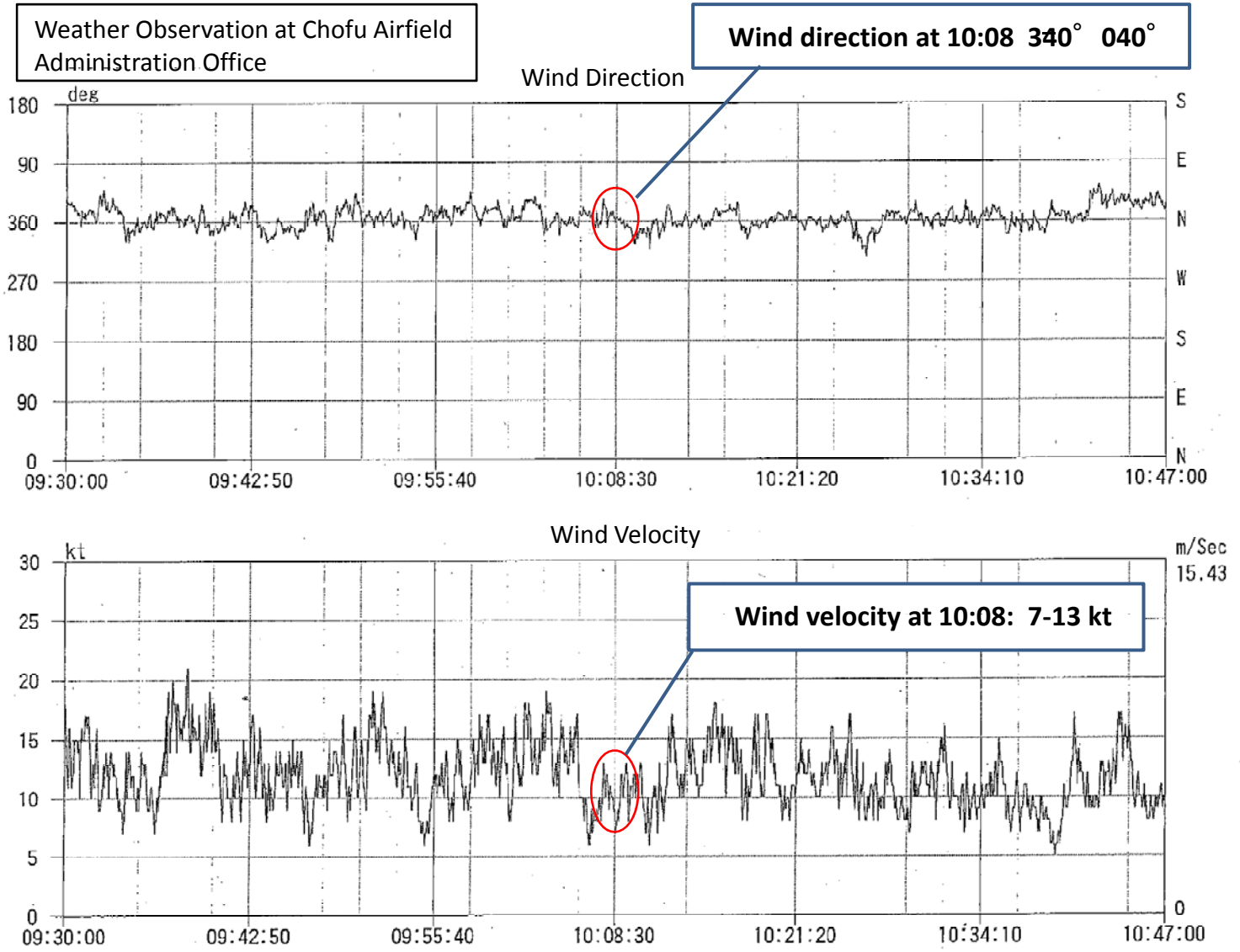


Figure 4: Development of the Accident

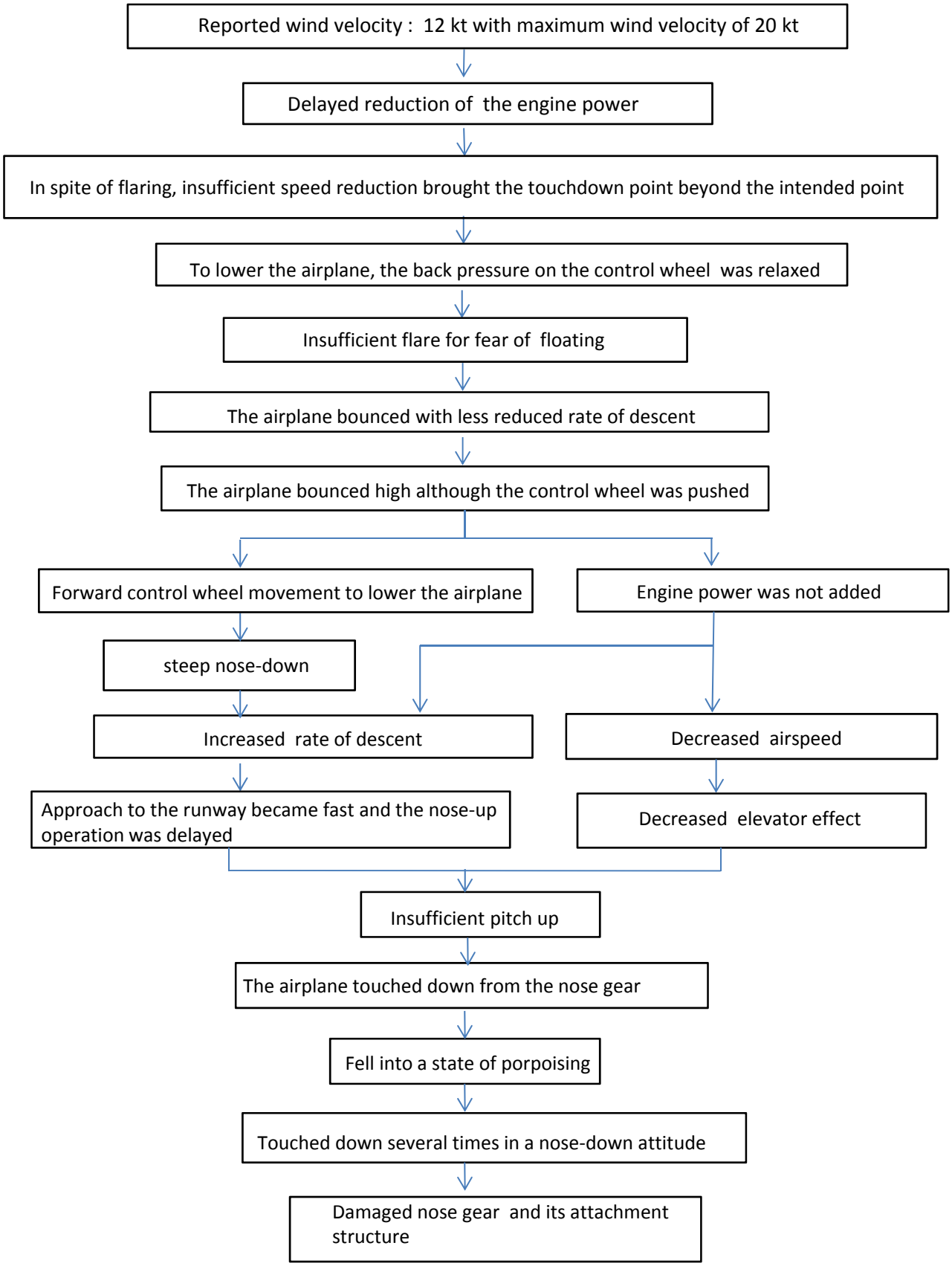


Photo 1: The Accident Airplane (Before the Accident)

Photo 2: Propeller Blades

Photo 3: Nose Gear Shock Strut