AA2010-4

AIRCRAFT ACCIDENT
INVESTIGATION REPORT

PRIVATELY OWNED

J A 3 3 T H

April 23, 2010

Japan Transport Safety Board

The investigation for this report was conducted by Japan Transport Safety Board, JTSB, about the aircraft accident of Privately Owned, ROBINSON R44 (ROTORCRAFT), registration JA33TH in accordance with the Act for the Establishment of the Japan Transport Safety Board and Annex 13 to the Convention on International Civil Aviation for the purpose of determining causes of the aircraft accident and contributing to the prevention of accidents/incidents and not for the purpose of blaming responsibility of the accident.

This English version of this report has been published and translated by JTSB to make its reading easier for English speaking people who are not familiar with Japanese. Although efforts are made to translate as accurately as possible, only the Japanese version is authentic. If there is any difference in the meaning of the texts between the Japanese and English versions, the text in the Japanese version prevails.

Norihiro Goto
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

PRIVATELY OWNED
ROBINSON R44 (ROTORCRAFT), JA33TH
MIHO TEMPORARY OPERATION SITE
SHIMIZU-KU, SHIZUOKA CITY, SHIZUOKA PREFECTURE
AT ABOUT 11:30 JST, SEPTEMBER 5, 2009

March 19, 2010

Adopted by the Japan Transport Safety Board (Aircraft Sub-committee)

Chairman	Norihiro Goto
Member	Shinsuke Endo
Member	Toshiyuki Ishikawa
Member	Noboru Toyooka
Member	Yuki Shuto
Member	Toshiaki Shinagawa

1. PROCESS AND PROGRESS OF AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On September 5 (Saturday), 2009, at about 11:30 Japan Standard Time (JST: unless otherwise stated, all times are indicated in JST (UTC+9h)), a Robinson R44, registered JA33TH, operated by a private pilot, sustained damage to a part of its airframe due to a hard landing on a rough surface at the Miho Temporary Operation Site, when the helicopter lost balance during an attempted touchdown subsequent to an air-taxiing to an intended parking spot after finishing a familiarization flight.

The Captain, who was the only person onboard the aircraft, was not injured.

The aircraft sustained substantial damage, but there was no outbreak of fire.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On September 9, 2009, upon receipt of the accident notification, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and one other investigator to investigate this accident.

1.2.2 Representative from Foreign Authorities

An accredited representative of the United States of America, as the State of Design and Manufacture of the helicopter involved in this accident, participated in the investigation.

1.2.3 Implementation of the Investigation

September 10, 2009	On-site investigation, airframe examination, and interviews
September 14, 2009	Interviews
September 19, 2009	On-site investigation and interviews

1.2.4 Comments from Parties Relevant to the Cause of the Accident

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

1.2.5 Comments from the Participating State

Comments were invited from the participating State.

2. FACTUAL INFORMATION

2.1 History of the Flight

On September 5, 2009, a Robinson R44, registered JA33TH (hereinafter referred to as "the Aircraft"), operated by a private pilot, took off from the Runway 15 at the Miho Temporary Operation Site (hereinafter referred to as "the Miho Site") at about 11:22 for a familiarization flight. The Aircraft flew following the traffic pattern and then made an approach to the Runway 33. After the transition to hovering in the air above the landing point, the Aircraft moved to an intended parking spot by air-taxiing*[1].

No flight plan was submitted because the flight was limited to within 9 km of the Miho Site.

The history of the flight up to the time of the accident is summarized below, based on the statements of the Captain.

On the day of the accident, I conducted the pre-flight inspection from around 7:45 at the temporary operation site in Yaizu City, Shizuoka Prefecture, where the Aircraft was kept, and completed the inspection by confirming that there was nothing abnormal with the Aircraft. The Aircraft took off from the temporary operation site at about 9:54 with three friends of mine aboard in addition to me, and at about 10:21, it landed on the Runway 15 of the Miho Site.

After my friends disembarked, I took a break and then decided to fly a solo for familiarization. The Aircraft took off at about 11:22 from the Runway 15. The weather was fine with good visibility. There was a crosswind from the left (northeast) that I checked during the takeoff with the windsock beside the runway; it appeared to me that the direction of wind had shifted slightly northward compared with that at the time of the previous landing. This made me decide that the Runway 33 would be appropriate for landing. The windsock indication suggested a wind velocity of about 10 kt and it appeared to be blowing in fitful gusts accompanied by a variation in wind velocity.

A short time later, I commenced an approach to the Runway 33 from the traffic pattern and then started hovering at about 3 ft above the landing point. To park the Aircraft temporarily on the runway, then I was air-taxiing along the runway at the same altitude. At a point about 100 m short of the end of the Runway 33, I turned the Aircraft so that it would be able to touch down on the left edge of the runway with the heading aligned with that of the Runway 33, and I started hovering there.

While hovering, crosswind with fitful gusts was drifting the Aircraft repeatedly but I managed to stabilize the Aircraft a little while later, so I gradually lowered the Aircraft to about 1 ft above the ground. Just when I was about to make touchdown I felt a sudden pitch-up movement. The angle of this instantaneous pitch-up was about one-half to one-third of the angle of 15–20°, which is usually used during the "quick stop" control I had

*[1] : According to the definition in Annex 2 to the Convention on International Civil Aviation, "air-taxiing" refers to the movement of a helicopter above the surface of an aerodrome, normally in ground effect and at a ground speed normally less than 20 kt.

experienced several times during training in the air. I felt nothing that indicated contact with something, but I was afraid of possible tail rotor contact, so I quickly responded by pulling the collective control lever up to raise the Aircraft's height.

After recovering an adequate hovering height, I made every effort to control the Aircraft, which had become unstable, and I finally managed to level its attitude over the grass beside the left side of the runway. The next moment, hoping to make a touchdown before the Aircraft lost balance again, even at the risk of a hard landing, I pushed the collective control lever down while keeping the cyclic control stick tilted forward to prevent another pitch-up. The Aircraft touched down on the grass beside the runway with a loud hitting sound. I suppose the hovering height before the touchdown was about 5 ft.

After the touchdown, I confirmed that I was not injured and the engine and the main rotor appeared to have no abnormalities, so I shut down the engine according to the normal procedure. The time of the touchdown was about 11:30. After the rotor stopped rotating, I got off the Aircraft and found that the vertical stabilizer was deformed.

A short time later, I reported the Aircraft's hard landing on grass to my friends and the flying club members who were at the Miho Site.

I had never before experienced sudden buffeting by wind at a low altitude, so after the recovery of an adequate hovering height, at the moment the Aircraft became level, I was overcome with a sense of urgency to land as soon as possible. I have almost no experience flying solo on the Aircraft with four seats, which, I suppose, might have affected the control moves that I made during this accident.

The accident occurred at about 11:30 on the grass to the west and near the end of the Runway 33 of the Miho Site (Latitude 35°01'N, Longitude 138°32'E).

(See Figure 1 – Estimated Flight Route, Figure 2 – Accident Site, Photo 1 – Accident Site)

2.2 Injuries to Persons

No one was injured.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

The Aircraft sustained substantial damage.

2.3.2 Damage to the Aircraft Components

Fuselage	Left-hand lower frame was deformed.
Tail assembly	Lower half of the vertical stabilizer was deformed.

As a result of the examinations of the engine and the control system, the engine was normally operational and there was no binding found in the control system.

(See Photo 2 – Accident Aircraft)

2.4 Personnel Information

Captain: Male, Age 44

Private Pilot Certificate (Rotorcraft):	July 23, 2009
Type rating for single-piston engine (land):	July 23, 2009
Class 2 Aviation Medical Certificate	
Validity:	Until August 3, 2010
Total flight time:	59 h 17 min
Flight time in the last 30 days:	13 h 58 min
Total flight time on this type of aircraft:	13 h 58 min
Flight time in the last 30 days:	13 h 58 min

2.5 Aircraft Information

2.5.1 Aircraft

Type:	Robinson R44
Serial number:	1130
Date of manufacture:	November 14, 2001
Certificate of airworthiness:	DAI 20-617
Validity:	Until January 27, 2010
Category of airworthiness:	Rotorcraft Normal (N)
Total flight time:	743 h 48 min
Flight time since last periodical check (50-hour check on August 27, 2009):	4 h 12 min

(See Figure 3 – Three Angle Views of Robinson R44)

2.5.2 Weight and Balance

At the time of the accident, the weight of the Aircraft is estimated to have been 1,866.9 lbs and the position of the center of gravity is estimated to have been longitudinally at 100.8 in aft of the datum and laterally 1.1 in to the right of the airframe symmetry plane, both of which are estimated to have been within the allowable limits (i.e., maximum gross weight of 2,400 lbs, minimum gross weight of 1,550 lbs, center-of-gravity range for the weight at the time of the accident: longitudinally 92 – 102.5 in aft of the datum and laterally within 3 in to the left and 3 in to the right of the airframe symmetry plane).

2.5.3 Investigation of the Aircraft

(1) The height of the tailskid from the ground (hereinafter referred to as “the tailskid height”) was 92.5 cm as measured during the airworthiness inspection of the Aircraft (January 21, 2009).

(2) With the cooperation of the National Transportation Safety Board (NTSB) of the U.S.A., using a helicopter of the same type as the Aircraft, the angle between the helicopter axis and the ground (tail strike angle) was measured at Robinson Helicopter Company, the Designer and Manufacturer of the Aircraft, using the following method:

The helicopter (the tailskid height 97.8 cm) was mechanically suspended in air at a height of 1 ft (the same height that the Aircraft reached when it had pitched up as stated by the Captain in 2.1) and the tailskid was brought into contact with the ground.
The measurement was 12°.

2.6 Meteorological Information

Wind direction and velocity between 10:30 and 11:30 on the day of the accident were as indicated below according to the records of the Shimizu Automated Meteorological Data Acquisition System of the Japan Meteorological Agency, which is located about 4 km north of the Miho Site.

Time	10:30	11:00	11:30
Wind direction	East North-east	East North-east	North-east
Average wind velocity *	6 kt	6 kt	6 kt
Maximum instantaneous wind velocity	10 kt	11 kt	11 kt

(*Average wind velocity: Average of the wind velocities in the 10 minutes before each of the indicated times)

2.7 Accident Site Information

2.7.1 Overview of the Miho Site

The Miho Site is a temporary operation site located at Cape Fukiai-no-Misaki of Shizuoka City and facing Suruga Bay. The Runway 15/33 is 600 m in length and 20 m in width; it is asphalt-paved but both sides of the end of the Runway 15 have grass-covered areas.
(See Figure 1 – Estimated Flight Route)

2.7.2 Accident Site Conditions

The grassy area on the west of the runway where the Aircraft touched down had a rough surface which includes slopes and stepped terrain. This rough surface extended about 14 m westward from the left edge of Runway 33 and was bordered by a bank.

In the grass, there were marks made by the skids at the time of the touchdown, indicating that the Aircraft came to a stop at a heading of about 310°. The area ahead of the skid marks was an upward slope extending towards an old taxiway, whereas there was a nearly flat surface in the area aft of the marks, which extended over a distance of about 4 m. Beyond the flat surface, there was a rise about 40 – 50 cm high when measured from the touchdown surface.
(See Figure 2 – Accident Site and Photo 1 – Accident Site)

2.8 Shift in Position of the Aircraft's Center of Gravity

The position of the longitudinal center of gravity when the Aircraft had landed with four persons onboard on the day of the accident is estimated to have been 95.8 in aft of the datum, which

corresponds approximately to the center value in the allowable range (48.6% when the forward limit is assumed to be 0% and the aft limit, 100%). On the other hand, the position of the longitudinal center of gravity at the time of the accident was shifted toward the aft limit in the allowable range (83.8% on the same assumption as above).

3. ANALYSIS

3.1 The Captain held a valid airman competence certificate and a valid aviation medical certificate.

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

3.3 Meteorological Conditions at the Miho Site

According to the statement in 2.1 and the records of the Shimizu Automated Meteorological Data Acquisition System of the Japan Meteorological Agency as described in 2.6, it is considered highly probable that the weather at the Miho Site was fine, visibility was good, and the wind was blowing northeasterly in the order of 6 kt in velocity and occasional gusts having maximum instantaneous wind velocity of about twice that of the prevailing winds, i.e., 11 kt, at the time of occurrence of the accident.

3.4 Damage to the Aircraft

The analysis of the damage to the Aircraft listed in 2.3 are as detailed below. It is considered highly probable that external forces applied during the accident caused all of the damage and that the airframe did not have any abnormalities before the occurrence of the accident.

(1) Deformation of the left-hand lower frame of the fuselage

Because the left-hand lower frame of the fuselage are attached to the skids, it is considered highly probable that the upward force applied to the skid during the touchdown caused compressive deformation in the frame.

(2) Deformation of the lower half of the vertical stabilizer of the tail assembly

According to the statement in 2.1, the instantaneous pitch-up angle at a height of 1 ft before touchdown was about one-half to one-third of the angle of 15–20°, which is usually used during the “quick stop” control. When deduced from these angles, the pitch-up angle at that time should have been less than or comparable to the angle of 10°. On the other hand, the measurement conducted at Robinson Helicopter Company, U.S.A. gave an angle of 12° when the tailskid touched the ground as described in 2.5.3. And, the Captain also said in his statement that he felt nothing that indicated contact with anything. Judging from all of the above, it is considered probable that, at the time of occurrence of the instantaneous pitch-up, the Aircraft did not experience any contact at its tailskid that would have been hard enough to deform the lower half of the vertical stabilizer of the tail

assembly which has an integral structure.

Since the site, as described in 2.7.2, where the Aircraft touched down had a rough surface which includes stepped terrain that has a rise in surface height of about 50 cm, it is considered probable that the ground clearance of the tailskid at that step was less than half of the tail skid height as described in 2.5.3. In addition, as the Aircraft's touchdown involved a landing so hard that the resulting loads caused deformation even to the frame structural member as described in (1) above. Therefore, it is considered probable that the tailskid came in contact with the ground at the time of the touchdown and the lower half of the vertical stabilizer in the tail assembly was then damaged.

(See Figure 2 – Accident Site, Photo 1 – Accident Site, and Photo 2 – Accident Aircraft)

3.5 Situation in Which the Hard Landing Occurred

(1) It is considered highly probable that the Captain, under the meteorological conditions as described in 3.3, had to depress the left rudder to keep the Aircraft from turning to the right under the weathercock effect that should have then been acting because the Aircraft was hovering in a constant crosswind from the right.

The following is also considered possible:

The Captain had to adjust its controls to respond fitful gusts as they blew, but he was not always successful at it, which caused the Aircraft to yaw right and left. This resulted in an instantaneous increase and decrease in relative velocity to the head wind and eventual pitch-up and pitch-down motions, and then the Aircraft's attitude became unstable.

(2) In general, when a single rotor helicopter hovers being its center of gravity positioned rather aft, its tail rotor drops much lower than that of when the center of gravity is positioned near the longitudinal center. If the pilot forcefully steps on a rudder pedal when the tail rotor is at a low position, a roll moment may be caused in addition to a yaw moment. This tendency increases as the drops of the tail rotor from the level of the main rotor. If the pilot tilts the cyclic control stick excessively in the direction opposite to that of the roll, the main rotor tilts to the opposite side, which is followed by the helicopter swinging wildly in the opposite direction, then could result in over-control. Helicopters with a seesaw type rotor are generally less responsive to the pilot's control, and this makes these helicopters more likely to display above characteristics. As described in 2.8, after the passengers had disembarked, the Captain flew the Aircraft with the center of gravity shifted toward the aft limit. It is, therefore, considered possible that the Captain failed to react appropriately to the shift in position of the center of gravity toward the aft limit while hovering in a crosswind with fitful gusts, and this led to over-control by the Captain and the Aircraft's attitude thus became unstable.

(3) It is considered highly probable that the hard landing and the consequent damage to the airframe occurred as follows:

With the Aircraft in an unstable condition as mentioned above, the Captain became uneasy about its control. As described in his statement in 2.1, the Captain then rushed

into pushing the collective control lever down, in a hurry to touch down before the Aircraft became unstable again, even though he knew the touchdown spot was on a rough surface unlike the originally intended spot.

3.6 Prevention of Recurrence of Similar Accidents

To prevent damage to the airframe due to a hard landing during normal touchdown, it is necessary for a helicopter pilot to operate following controls. First, select an appropriate touchdown spot and bring the helicopter in a stable hovering attitude over the spot. And then make such control moves as lowering the collective control lever gradually until the helicopter comes in contact with the ground surface. Whenever the pilot feels it is inappropriate to keep attempting touchdown, he should immediately abort the operation and start the descent procedure over again and, make another touchdown attempt after calmly stabilizing the helicopter attitude.

When a helicopter is hovering with the position of the center of gravity shifted rather aft and the tail rotor in a lowered position, the pilot can stabilize the helicopter's attitude by operating a rudder pedal smoothly enough to suppress the possible generation of a roll moment.

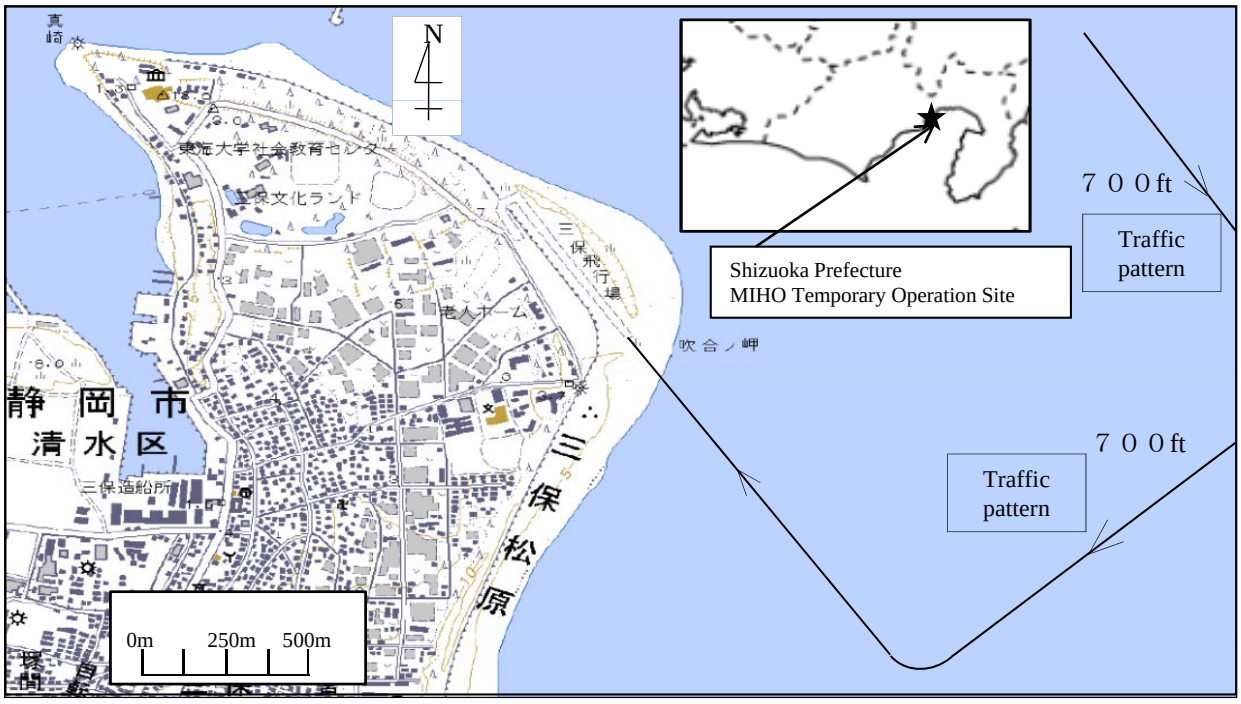
If the helicopter is to hover under weather conditions involving gust of wind, turning the nose against the wind can stabilize the helicopter's attitude, as this eliminates the weathercock effect and thus minimizes and facilitates necessary rudder pedal operations.

4. PROBABLE CAUSE

In this accident, it is considered highly probable that the hard landing and the consequent damage to the Aircraft occurred because the Captain, in a hurry to touch down, rushed into pushing the collective control lever down without adequately checking the surrounding conditions.

With regard to the reason why the Captain hurried to touch down the Aircraft without adequately checking the surrounding conditions, it is considered possible that a contributing factor was his uneasiness about controlling the Aircraft after losing its balance as a result of inappropriate response to the crosswind with fitful gusts and reaction to the shift in position of the center of gravity toward the aft limit.

Figure 1　Estimated　Flight　Route



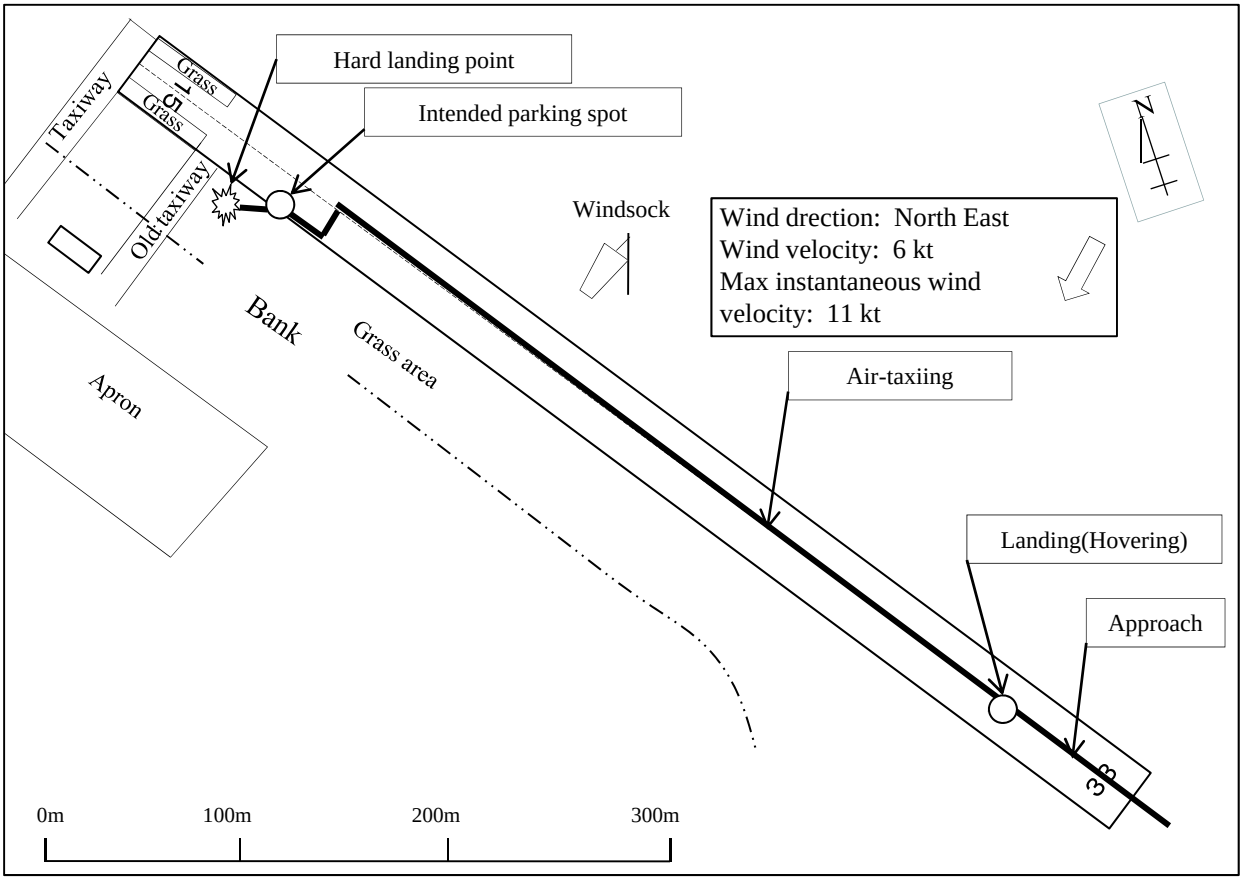
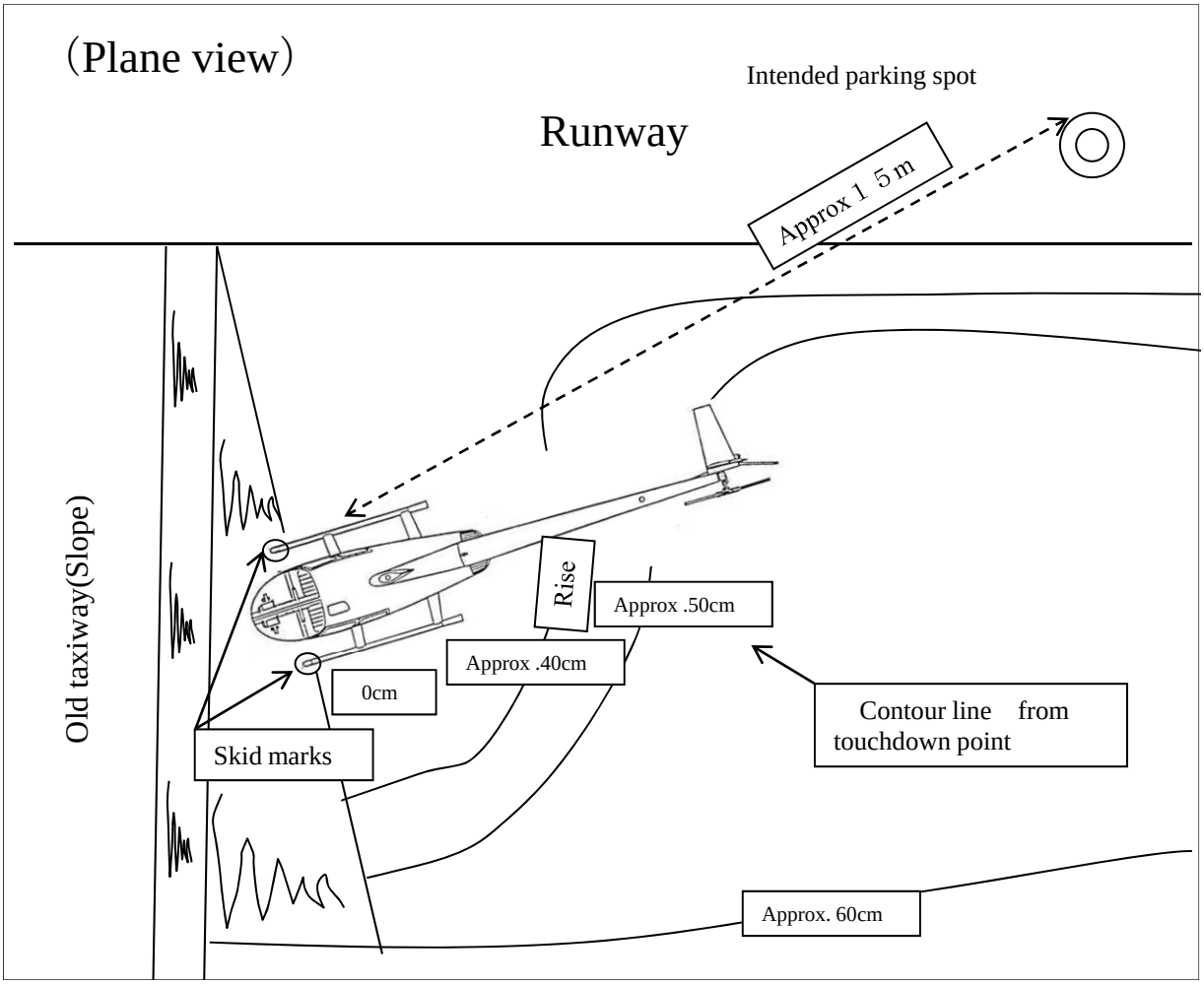


Figure 2　Accident Site



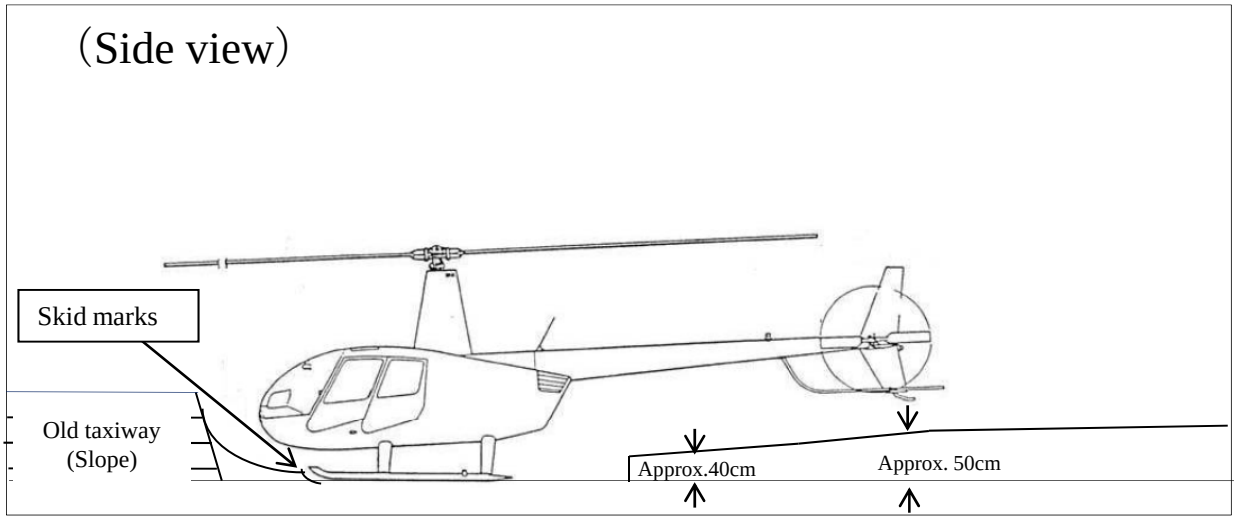


Figure 3　Three Angle Views of Robinson R44

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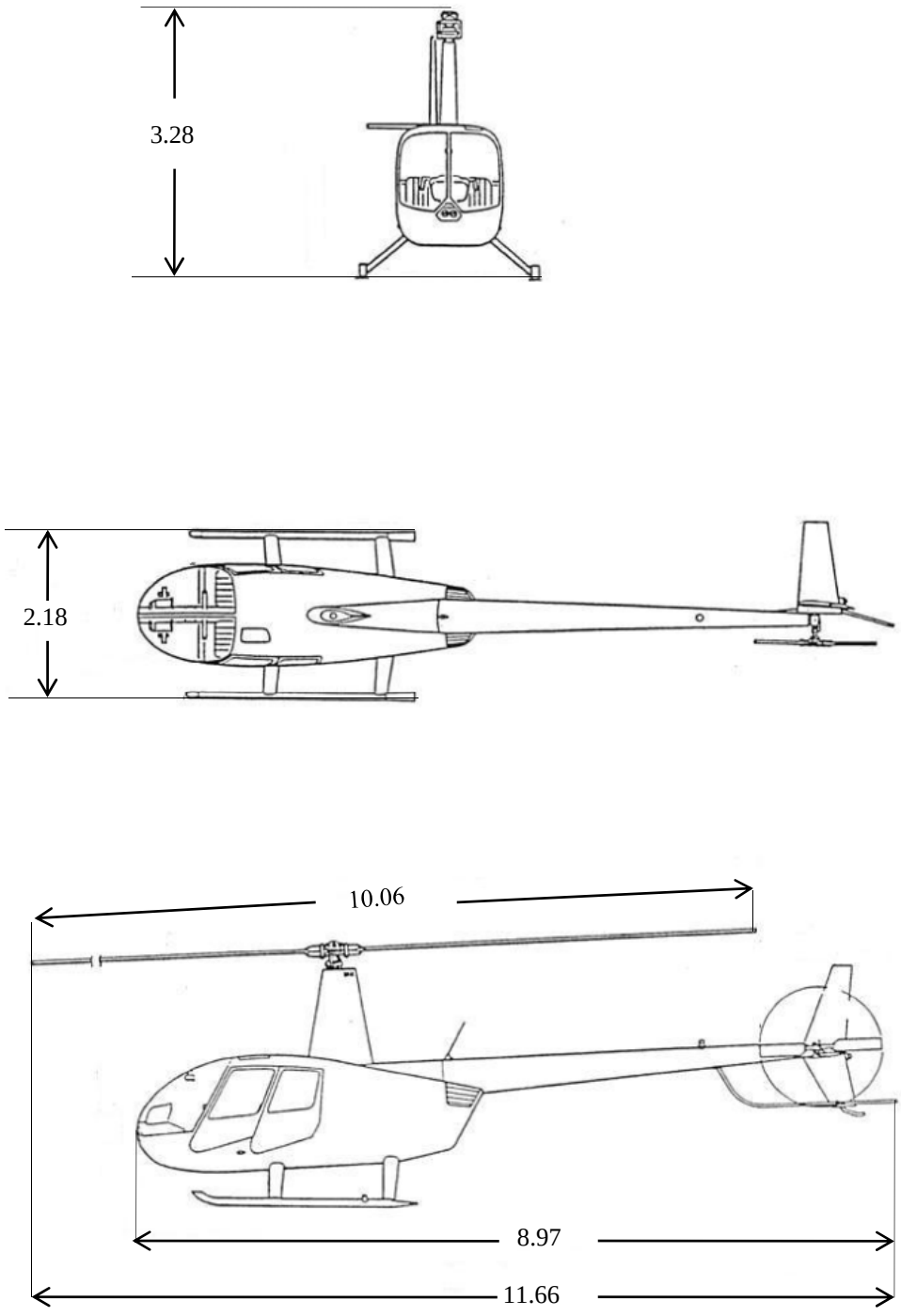
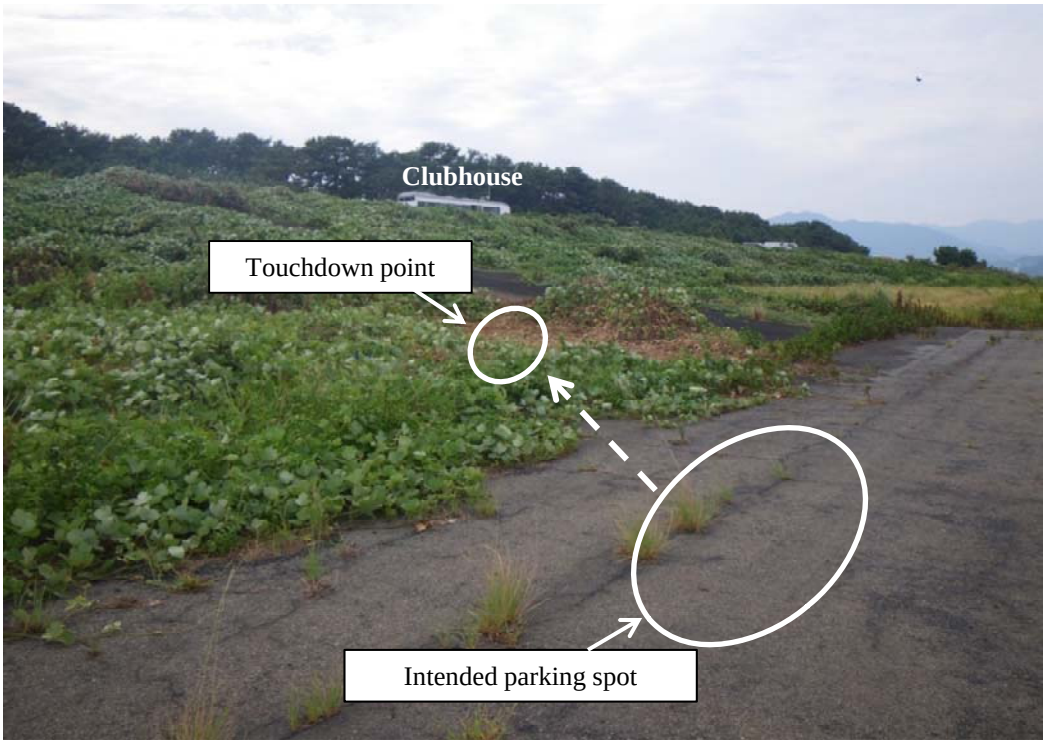


Photo 1　Accident Site



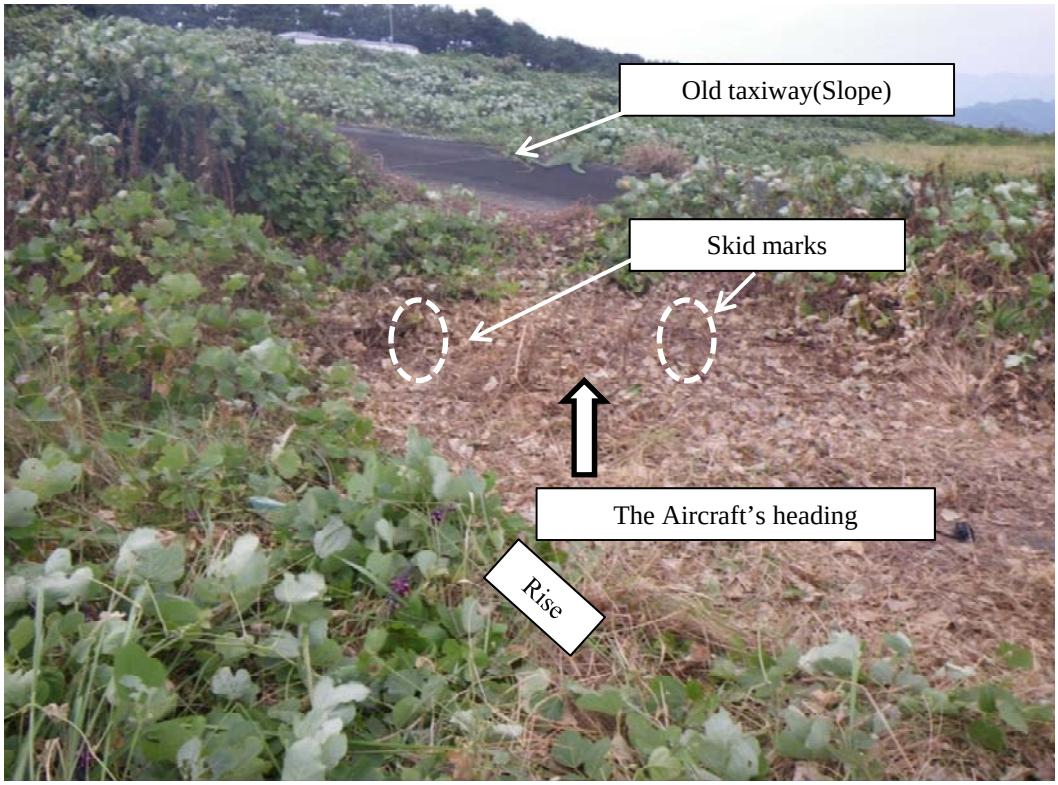


Photo 2　Accident Aircraft