

AA2019-1

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**PRIVATELY OWNED
JA7980**

January 31, 2019



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

ROLLOVER DURING AIR-TAXING
NEAR FUSESHITA, KASHIWA CITY,
CHIBA PREFECTURE, JAPAN
AT AROUND 13:35 JST, JULY 8, 2018

PRIVATELY OWNED
ROBINSON R22 BETA (ROTOR-CRAFT), JA7980

January 11, 2019

Adopted by the Japan Transport Safety Board

Chairman	Kazuhiro Nakanishi
Member	Toru Miyashita
Member	Toshiyuki Ishikawa
Member	Yuichi Marui
Member	Keiji Tanaka
Member	Miwa Nakanishi

1. PROCESS AND PROGRESS OF INVESTIGATION

1.1 Summary of the Accident	On Sunday, July 8, 2018, a privately owned Robinson R22 Beta, registered JA7980, with two persons, a captain and passenger, on board, at a temporary helipad in Kashiwa-City, Chiba Prefecture rolled over during air-taxing and damaged the airframe.
1.2 Outline of the Accident Investigation	On July 8, 2018, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator to investigate this accident. An accredited representative of United States of America as the State of Design and Manufacture, participated in the investigation. Comments were invited from the parties relevant to the cause of the accident and the Relevant State.

2. FACTUAL INFORMATION

2.1 History of the Flight	<p>According to the statements of the captain and a passenger, the history of the flight is summarized as follows:</p> <p>On July 8, 2018, the helicopter with the captain in the right seat and the passenger in the left seat took off from the Fuse In Chiba temporary helipad (hereinafter referred to as "Fuse helipad"), the home base of the helicopter at around 13:30 Japan Standard time (JST: UTC+9hrs). It headed to Fuse number three temporary helipad (hereinafter referred to</p>
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as “the Temporary helipad”) about one nm east of Fuse helipad, which has been used for training (for touch and go training, and operation training in the vicinity of the ground).

The captain acquired a license of a private pilot for the same type of the helicopter about 30 years ago and since then had not been flying for a long time. But he joined the flight club to which the passenger belonged about one year ago and had been flying at a pace of about an hour a month.

The flight club didn’t allow a pilot whose skill had not been fully established to make a solo flight, therefore, the captain had flown with the assistance of the passenger (qualified as a commercial pilot).

The captain looked at wind sock situation and judged as about 10 kt southeast wind and took off from Fuse helipad toward southeast. He reversed the helicopter and set at an altitude of 800 ft and a speed of 70 kt on the traffic pattern at the Temporary helipad. He made 130 degrees (Magnetic bearing; the same below) approach and approached the Temporary helipad at a speed of 60 kt. At this time, the helicopter took a right wind correction angle (correcting angle for flying the desired course) of about 10 ° right to the approach course, then flew at an altitude

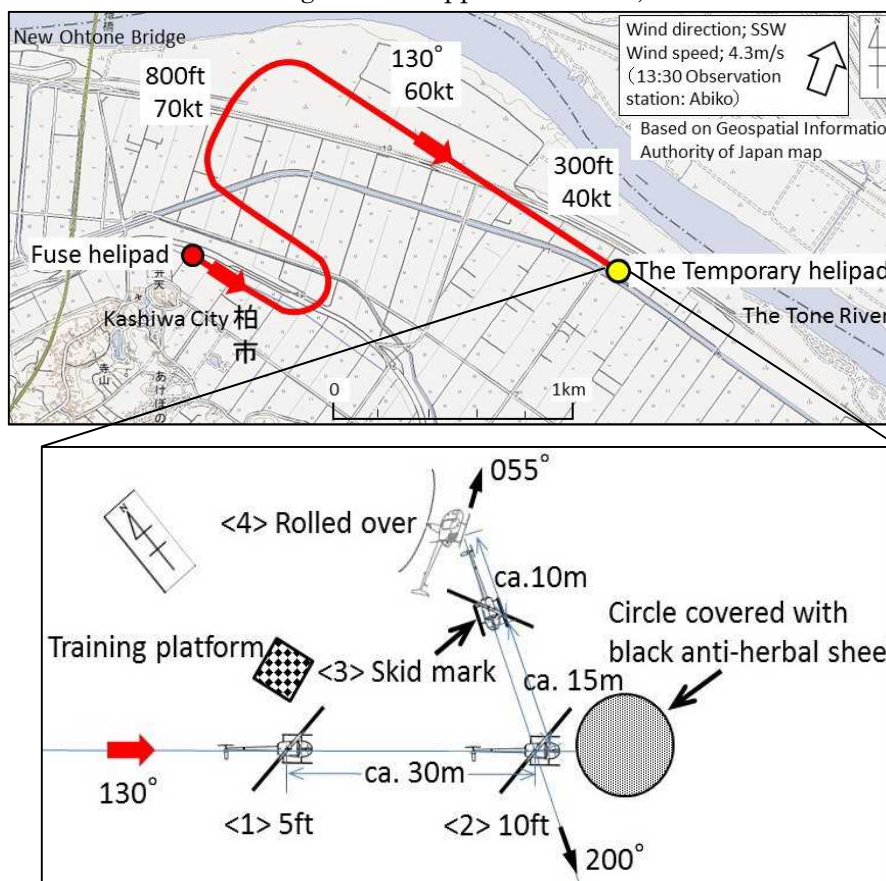
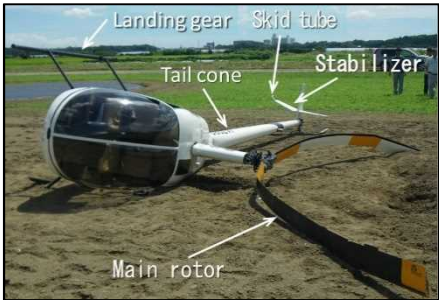
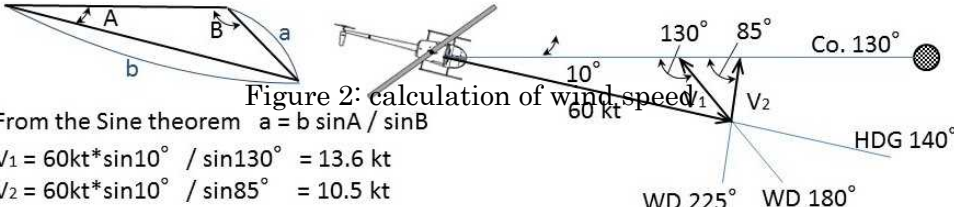


Figure 1: estimated flight route and the site sketch

of 300 ft at a speed of 40 kt. As regard about the Temporary helipad, the captain also judged as about 10 kt southeast wind by checking the wind sock.

There is a training platform near a circle place covered with the

	<p>black anti-herbal sheet which is the target of landing at the Temporary helipad. The helicopter landed over to the grassland on the south side of the training platform as hovering at about 5 ft AGL (Above Ground Level) as usual (<1>, the number in Figure 1, same below).</p> <p>After that, the helicopter climbed to about 10 ft AGL and was air-taxing at a speed slower than walking towards the circle where the captain was going to ground. Near the edge of the circle place <2>, the captain tried to correct the helicopter's attitude because the nose was suddenly taken to the right, but he could not control as he expected. On the other hand, because the helicopter suddenly tilted to the left and the nose turned about 30 degrees to the right, and the altitude also dropped, the passenger tried to support the captain. But as a result, the helicopter became the situation where two pilots were maneuvering at the same time due to the captain tried to continue maneuvering as it was. The helicopter once grounded <3>, then floated up, and rolled over with the left side down when they noticed <4>.</p> <p>The passenger said, when the helicopter suddenly tilted to the left, he felt danger because the control stick also tilted to the left, and tried to tilt the control stick to the right, but he could not move as he expected because the captain still held the control stick strongly. At this time, the passenger raised the collective pitch control lever (hereinafter referred to as "CP lever"), but he did not remember whether or not he operated the rudder pedals. The helicopter eventually rolled over with the left side down while changing its attitude greatly. The passenger remembered that the low rpm warning sound started ringing in the middle, and the engine has been running until it rolled over. After the helicopter rolled over, the passenger turned off all switches and immediately escaped from the helicopter together with the captain.</p> <p>There was no abnormality in the helicopter during pre-flight inspection and flight.</p> <p>This accident occurred at around 13:35 on July 8, 2018, at Fuse number three temporary helipad near Fuseshita, Kashiwa City, Chiba Prefecture (35 ° 54' 01" N, 140 ° 01' 36" E).</p>														
<p>2.2 Injuries to persons</p>	<p>None</p>														
<p>2.3 Damage to Aircraft</p>	<p>Extent of damage:</p> <p style="text-align: center;">Substantially damaged</p> <table border="0"> <tr> <td>Fuselage frame:</td> <td>Damaged</td> </tr> <tr> <td>Main rotor blades:</td> <td>Damaged</td> </tr> <tr> <td>Tail rotor blades:</td> <td>Broken</td> </tr> <tr> <td>Tail rotor drive shaft:</td> <td>Broken</td> </tr> <tr> <td>Landing gear:</td> <td>Broken</td> </tr> <tr> <td>Stabilizer:</td> <td>Deformed</td> </tr> <tr> <td>Tail cone:</td> <td>Deformed</td> </tr> </table> <div style="text-align: right;">  <p>Photo 1: over turned helicopter</p> </div>	Fuselage frame:	Damaged	Main rotor blades:	Damaged	Tail rotor blades:	Broken	Tail rotor drive shaft:	Broken	Landing gear:	Broken	Stabilizer:	Deformed	Tail cone:	Deformed
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2.4 Personnel information	<table border="0"> <tr> <td>Captain</td> <td style="text-align: right;">Age 54</td> </tr> <tr> <td>Private pilot certificate (Rotorcraft)</td> <td style="text-align: right;">January 31, 1990</td> </tr> <tr> <td>Specific pilot competence review</td> <td style="text-align: right;">Expiry of practicable period for flight March 11, 2020</td> </tr> <tr> <td>Type of rating for single-piston engine (land)</td> <td style="text-align: right;">January 31, 1990</td> </tr> <tr> <td>Class 2 aviation medical certificate</td> <td></td> </tr> <tr> <td>Validity</td> <td style="text-align: right;">February 14, 2019</td> </tr> <tr> <td>Total flight time</td> <td style="text-align: right;">93 hours 42 minutes</td> </tr> <tr> <td>Flight time in the last 30 days</td> <td style="text-align: right;">2 hours 2 minutes</td> </tr> <tr> <td>Total flight time on the same type of the aircraft</td> <td style="text-align: right;">93 hours 42 minutes</td> </tr> </table>	Captain	Age 54	Private pilot certificate (Rotorcraft)	January 31, 1990	Specific pilot competence review	Expiry of practicable period for flight March 11, 2020	Type of rating for single-piston engine (land)	January 31, 1990	Class 2 aviation medical certificate		Validity	February 14, 2019	Total flight time	93 hours 42 minutes	Flight time in the last 30 days	2 hours 2 minutes	Total flight time on the same type of the aircraft	93 hours 42 minutes				
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2.5 Aircraft information	<p>(1) Aircraft</p> <table border="0"> <tr> <td>Type:</td> <td style="text-align: right;">Robinson R22 Beta</td> </tr> <tr> <td>Serial Number:</td> <td style="text-align: right;">3874</td> </tr> <tr> <td>Date of Manufacture:</td> <td style="text-align: right;">June 8, 2005</td> </tr> <tr> <td>Certificate of Airworthiness:</td> <td style="text-align: right;">No. To-29-456</td> </tr> <tr> <td>Validity:</td> <td style="text-align: right;">January 14, 2019</td> </tr> </table> <p>(2) Weight and balance</p> <p>When the accident occurred, the weight and balance of the helicopter were estimated to have been within the allowable range.</p>	Type:	Robinson R22 Beta	Serial Number:	3874	Date of Manufacture:	June 8, 2005	Certificate of Airworthiness:	No. To-29-456	Validity:	January 14, 2019												
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2.6 Meteorological information	<p>According to the Captain, the weather was clear in Fuse helipad and the Temporary helipad at the time of the accident, the visibility was good, the wind was about 10 kt from the south east that was indicated by the wind sock, and there was no hindrance to flying.</p> <p>Meteorological observation values around the accident occurrence time observed at the local meteorological observatory near the accident site, "Abiko" (elevation 20 m, about 9 km east southeast of the accident site) were as follows. The maximum instantaneous wind speed was about 1.9 times the average wind speed at any time.</p> <table border="1" data-bbox="459 1370 1426 1543"> <thead> <tr> <th rowspan="2">Time</th> <th colspan="3">Wind direction (°) / Wind speed (m/s) / Wind speed (kt)</th> <th rowspan="2">Temp. (°C)</th> <th rowspan="2">Precipitation (mm)</th> <th rowspan="2">Sunshine hours (minutes)</th> </tr> <tr> <th>Average</th> <th colspan="2">Maximum instantaneous</th> </tr> </thead> <tbody> <tr> <td>13:30</td> <td>202.5 / 4.3 / 8.4</td> <td>225 / 8.2 / 15.9</td> <td>32.1</td> <td>0</td> <td>10</td> </tr> <tr> <td>13:40</td> <td>202.5 / 3.8 / 7.4</td> <td>180 / 7.1 / 13.8</td> <td>32.4</td> <td>0</td> <td>10</td> </tr> </tbody> </table> <div data-bbox="459 1559 1426 1778" style="border: 1px solid black; padding: 5px;">  <p style="text-align: center;">Figure 2: calculation of wind speed</p> <p>From the Sine theorem $a = b \sin A / \sin B$</p> <p>$V_1 = 60 \text{kt} * \sin 10^\circ / \sin 130^\circ = 13.6 \text{ kt}$</p> <p>$V_2 = 60 \text{kt} * \sin 10^\circ / \sin 85^\circ = 10.5 \text{ kt}$</p> </div> <p>The following wind speed at which the wind correction angle becomes 10 ° to the right at an approach course of 130 ° and an airspeed of 60 kt is 13.6 kt when the wind direction is 180 ° (south) and 10.5 kt when the wind direction is 225 ° (southwest) as shown below.</p>	Time	Wind direction (°) / Wind speed (m/s) / Wind speed (kt)			Temp. (°C)	Precipitation (mm)	Sunshine hours (minutes)	Average	Maximum instantaneous		13:30	202.5 / 4.3 / 8.4	225 / 8.2 / 15.9	32.1	0	10	13:40	202.5 / 3.8 / 7.4	180 / 7.1 / 13.8	32.4	0	10
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2.7 Permission under Civil Aeronautics	<p>Permission under the proviso of Article 79 (Places for landing and takeoff)</p> <p style="text-align: center;">Present</p> <p>(Regarding to the flight, permissions under the proviso of Article 79 of the</p>																						

<p>Act</p>	<p>Civil Aeronautics Act (Act No.231 of 1952) for Fuse helipad and the Temporary helipad were acquired, but the name and the license of the captain were not stated in the application.)</p>
<p>2.8 Additional information</p>	<p>(1) Situation of accident Site</p> <p>The accident site was a flat upland field, and the helicopter remained rolling over with its nose heading to northeast (about 055 °) with its left side down. There were two marks left by the landing gear at a position about 10 m south from the over turned helicopter, and these marks faced to the southwest (about 200 °) direction. There was no turnover and others found on the anti-herbal sheet.</p> <p>The helicopter's tail cone was deformed to the left and the lower stabilizer was deformed to the right. The skid tube attached below the lower stabilizer got mud.</p> <p>(2) Helicopter Damage</p> <p>Both of the main rotor blades were bent upwards. One of them, the tip was buried into the ground (about 25 cm deep) and cracks were found on the other.</p> <p>Both of the tail rotor blades were broken.</p> <p>The tail rotor drive shaft was twisted off at the joint with the tail rotor gearbox.</p> <div style="display: flex; justify-content: space-around;"> <div data-bbox="485 1234 916 1509"> <p>Tail rotor drive shaft</p> </div> <div data-bbox="983 1211 1407 1525"> <p>Fuselage V belt Tail cone Flux plate (Enlarged photo when removing the tail cone and looking from the back)</p> </div> </div> <p>Photo 2: fracture part of the tail rotor drive shaft</p> <p>Photo 3: connection between the fuselage and the tail cone</p> <p>The V-belts of the clutch to transmit the power from the engine was disengaged and the flux plate connecting the clutch and the tail rotor drive shaft was broken.</p> <p>As for the landing gear, the left side skid was buried in the ground, and it was found to be broken at one connection with the forward strut and at the other with the rear strut.</p> <p>Inside the cockpit, both left and right cyclic sticks were broken from the grip, and part of the right hand windshield was damaged.</p> <p>(3) Descriptions in the Flight Manual of the Helicopter in regard to Wind</p> <p><i>2-15 Limits on ground wind, wind shear and turbulence (excerpt)</i></p> <ol style="list-style-type: none"> <i>1. Flight when surface winds exceed 25 knots, including gusts, is</i>

	<p><i>prohibited.</i></p> <p>2. <i>Flight when surface wind gust spreads exceed 15 knots is prohibited.</i></p>
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3. ANALYSIS

3.1 Involvement of weather	Yes
3.2 Involvement of pilot	Yes
3.3 Involvement of equipment	None
3.4 Analysis of known items	<p>(1) Situation of Rollover</p> <p>It is highly probable that the helicopter was suddenly tilted to the left, its nose veered about 30 ° to the right and its altitude was lowered as moving backwards while air-taxing on the approach course 130 ° at a speed slower than walking at about 10 ft AGL, and the landing gear contacted the ground once on about 200 ° heading. It is probable that the helicopter floated up quickly and rolled over with the left side down while changing the attitude greatly.</p> <p>Before the landing gear contacted the ground once, it is somewhat likely that the low rpm warning sound was ringing because load was applied when the tail rotor blade contacted the ground, or the main rotor was not able to rotate appropriately due to the raised CP lever.</p> <p>Once the landing gear grounded, it is probable that the tail rotor blade and skid tube contacted the ground, which caused the tail rotor blade to break, the lower stabilizer to deform to the right and the tail rotor drive shaft to be twisted off.</p> <p>Once the helicopter grounded, it is probable that the direction control became impossible because the tail rotor drive shaft was twisted off.</p> <p>At the time of rollover, it is highly probable that the helicopter rolled over while violently making right turn because the main rotor blade was bent and buried in the ground and the left skid of the landing gear was found to be buried in the ground and broken. From this fact, it is probable that the engine output power was strongly applied until the helicopter rolled over. It is probable that the shock at the time of violent rollover caused the V-belts to fall off, the tail cone to deform, the flux plate to break, and each part to be damaged. It is probable that the engine stopped after the rollover.</p> <p>(2) Judgment of Wind</p> <p>It is probable that the captain judged wind direction and speed based on the indication of the wind sock as the wind from southeast about 10 kt. However, from the fact that the helicopter took the wind correction angle of about 10 ° to the right when approaching, it is somewhat likely</p>

that the actual average wind speed and direction at the Temporary helipad was approximately 13.6 kt from the south or 10.5 kt from the southwest. On the other hand, regarding the maximum instantaneous wind speed, from the fact that the instantaneous wind was blowing 1.9 times the average wind speed in Abiko about nine km away, it is somewhat likely that the instantaneous wind speed was also blowing at approximately 26 kt from the south or 20 kt from the south west in the Temporary helipad too. In that case, it is somewhat likely that the wind direction was more to the right and its speed stronger than 10 kt than the wind the captain expected. Moreover, it is somewhat likely that the wind at that time exceeded the limitation of the wind speed stated in the flight manual.

(3) Effect of Wind

The helicopter during air-taxing suddenly tilted to the left, the nose veered about 30 degrees to the right, and the altitude was also lowered. Regarding the fact that the nose veered to the right, it is somewhat likely that because the captain was unable to perform an appropriate corrective operation for stopping the movement of the helicopter that was veering to the right by a strong weathercock stability effect¹ caused by the gust of the wind from the right that was stronger than the captain predicted.

In order to grasp the wind direction and speed accurately, the captain should have strived to gather information as much as possible and taken avoidance action such as going around immediately if the helicopter take on the behaviors different from his assumption at takeoff and landing.

(4) Maneuvering during Rollover

Though the captain should have stepped the left pedal to stop the helicopter movement turning to the right due to a weathercock stability effect, it is somewhat likely that he tilted the cyclic stick to the left. It is highly probable that the passenger tried to prevent such inappropriate operation, but the passenger's maneuvering was hindered, because the captain held the cyclic stick firmly, and the helicopter rolled over without help of appropriate maneuvering. It is somewhat likely that the passenger raised the CP lever to stop the descent of the helicopter at that time, but the descent could not be stopped due to the great influence by the inclination of the helicopter.

(5) Confusion in Cyclic Stick and Rudder Pedals Operation

In maneuvering a helicopter, the direction of travel of the helicopter is controlled by manipulating the cyclic stick, operated with the right hand to forward, backward, left and right to tilt the main rotor disc and change the helicopter's attitude are tilted forward, backward, left and right, engine output and the altitude of the helicopter by raising and

¹ "Weathercock stability effect" is the same phenomenon as a weathercock faces to windward, and refers to the characteristic of aircraft to weathervane into the wind.

lowering the CP lever operated with the left hand, and the nose direction by changing the pitch angle of the tail rotor by applying a right or left pedal at the foot of the pilot's seat, respectively. Because these three controls interact one another, it is actually necessary for the pilot to use the three control simultaneously.

In the sky, a helicopter is operated by pushing the cyclic stick to left or right in order to turn left or right while applying the rudder pedals to keep the ball of the slip indicator in center. On the other hand, in the vicinity of the ground, a turning left or right is performed by applying the rudder pedals in the direction you want while the cyclic stick is operated to keep the position of the helicopter. In addition in the vicinity of the ground, the travel of the helicopter is controlled by pushing the cyclic stick to the direction you want while applying the rudder pedals for the nose direction not to fluctuate.

When maintaining the position and direction of the helicopter in disturbances such as gusts and wind fluctuations, the position is controlled by the cyclic stick, and the direction is controlled by the rudder pedals like traveling in the vicinity of the ground, but especially in this case, to perform instantaneously appropriate operation is required, and if the pilot is not skilled, it is necessary to restrict strictly the wind speed limitation until the pilot is able to properly maneuver and to provide hovering training and others for the pilot with basic operations.

Regarding the fact that the captain tilted the cyclic stick to the left during air-taxing, it is somewhat likely that the captain was not operating rudder pedals but cyclic stick when the helicopter was veered to the right at the time of the occurrence of the weathercock stability effect stronger than he predicted caused by the gust from the right.

(6) Acquisition of proper permission

The flight club to which the helicopter belongs had obtained permission in regard to the flight under proviso of Article 79 (Places for landing and takeoff) of Civil Aeronautics Act pertaining to the Fuse helipad and the Temporary helipad, but the name and the license of the captain were not stated in the application

It is necessary for the captain to confirm in advance whether the necessary permission is obtained for the flight. In addition, it is necessary for the flight club to apply for the change to Civil Aviation Bureau if there is a change in the contents of the application for permission, for example when a club member newly has joined.

4. PROBABLE CAUSES

In this accident, it is somewhat likely that the helicopter rolled over while greatly changing the attitude because the captain was unable to perform an appropriate corrective action when the helicopter veered to the right during air-taxing due to a strong weathercock stability effect caused by a gust of wind from the right.