AA2009-1

AIRCRAFT ACCIDENT INVESTIGATION REPORT

OSAKA AVIATION INC.

J A 1 0 2 D

January 30, 2009

Japan Transport Safety Board

The investigation for this report was conducted by Japan Transport Safety Board, JTSB, about the aircraft accident of OSAKA AVIATION, ROBINSON R22 Beta registration JA102D in accordance with Japan Transport Safety Board Establishment Law 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.

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Norihiro Goto,
Chairman,
Japan Transport Safety Board

AIRCRAFT ACCIDENT INVESTIGATION REPORT

OSAKA AVIATION INC.

ROBINSON R22 BETA (ROTORCRAFT)

JA102D

AT ABOUT 15:05 JST, OCTOBER 27, 2007

SAKAI CITY , OSAKA PREFECTURE

December 24, 2008

Adopted by the Japan Transport Safety Board

(Aircraft Sub-committee)

Chairman Norihiro Goto

Member Yukio Kusuki

Member Shinsuke Endo

Member Noboru Toyooka

Member Yuki Shuto

Member Akiko Matsuo

1. PROCESS AND PROGRESS OF AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident

On October 27 (Saturday), 2007 at about 14:50 JST, a Robinson R22 Beta (rotorcraft), registered JA102D, operated by Osaka Aviation Inc. took off from Yao Airport for the purpose of experience flight. During the flight, at about 15:05, the aircraft crashed onto the railway tracks at a point in Sakai Ward, Sakai City, Osaka Prefecture, which was located between Asakayama Station and Abikomae Station of Nankai Electric Railway Co., Ltd. Koya Line.

A captain and a passenger were on board the aircraft and both of them died in the crash.

The aircraft was destroyed and a fire broke out.

1.2 Outline of the Accident Investigation

1.2.1 Investigation Organization

On October 27, 2007, the Aircraft and Railway Accidents Investigation Commission (ARAIC) assigned an investigator-in-charge and two other investigators for investigation of this accident.

1.2.2 Representative from Foreign State

An accredited representative of the United States of America, as the state of design and manufacture of the aircraft involved in this accident, participated in the investigation.

1.2.3 Implementation of the Investigation

October 27 - November 1, 2007	Interviews, on-site investigation and aircraft examination
December 6 and 7, 2007	Interviews
December 11 and 12, 2007	Interviews and analysis of radar records
February 29, 2008	Examination of VHF radio equipment

1.2.4 Comments from Parties Relevant to the Cause of the Accident

Comments were gathered 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 October 27, 2007, the Robinson R22 Beta, registered JA102D (hereafter referred to as "the Aircraft"), operated by Osaka Aviation Inc. (hereafter referred to as "the Company"), was scheduled to make a total of five experience flights, each lasting about 15 minutes, from/to Yao Airport (hereafter referred to as "the Airport"), all to be piloted by the same captain (hereafter referred to as "the Captain"). For the fourth experience flight, the Aircraft took off from the Airport at about 14:50. According to a staff of the Company, the Captain was in the left seat and the passenger was in the right seat.

The flight plan submitted to the Yao Airport Office of the Osaka Regional Civil Aviation Bureau is outlined below:

Flight rules:	Visual flight rules (VFR)
Departure aerodrome:	Yao Airport
Estimated off-block time:	13:30
Cruising speed:	80 kt
Cruising altitude:	VFR
Route:	Osaka
Destination aerodrome:	Yao Airport
Estimated time of arrival:	15:30
Purpose of flight:	Company flight, with four landings at Yao Airport
Fuel load expressed in endurance:	2 h and 30 min
Persons on board:	2

The history of the flight up to the time of the accident is summarized below, based on the ATC radar records of Kansai International Airport and the statements of witnesses.

2.1.1 History of the Flight based on ATC Radar Records

The Aircraft was initially detected by the ATC radar of the Kansai International Airport Office and the Osaka International Airport Office of the Osaka Regional Civil Aviation Bureau at 14:53:01*1 The Aircraft was 14.1 nm south-southeast of the Osaka International Airport radar site*2, flying west at a ground speed of 70 kt and an altitude of 640 ft.

During the period that followed until 15:04:21 at which time the Aircraft disappeared from the ATC radar, the Aircraft ground speed fluctuated between 90 and 30 kt and the altitude between 1,050 and 650 ft. During the same period, the course of the Aircraft was varied irregularly.

The flight status records for some significant points are indicated in the following

*1 The indicated time represents the time at which radar returns were recorded and synchronized with the time signal of NTT(Nippon Telegraph and Telephone Corporation).

*2 The radar facility installed at the Osaka International Airport and is located about 15 nm north-northwest of Yao Airport.

table.

(NOTE: The altitude records at 15:04:17 and 15:04:21 indicate altitudes definitely not achievable by the performance of the Aircraft. It was not possible to clearly establish the airspeed, the speed relative to the air, of the Aircraft.)

Time (hour:minute:second)	Position		Altitude (ft)	Ground speed (kt)	Course: Magnetic heading (°)	Turn determination identifier *3
	Magnetic heading (°)	Distance (nm)				
14:59:08	176	12.5	940	40	311.8	Left
14:59:35	174	12.4	940	60	88.9	Right
15:00:26	172	13.2	940	70	110.5	Left
15:01:29	168	12.9	1,050	30	6.9	—
15:01:40	169	12.8	950	30	340.8	Left
15:02:20	170	12.5	950	50	297.2	Right
15:02:43	172	12.2	950	40	301.8	Right
15:03:30	174	12.1	850	60	231.5	Left
15:03:53	174	12.5	750	70	123.2	Left
15:04:05	173	12.6	750	70	113.4	Left
15:04:13	173	12.6	750	60	136.1	Right
15:04:17	173	12.7	3,850 (Note)	60	126.0	Left
15:04:21	173	12.7	11,450 (Note)	20	-	Right

At 15:04:21, the Aircraft disappeared from the radar screen at about 13 nm south-southeast of the Osaka International Airport radar site.

(See Figure 1.)

2.1.2 Statements of Eyewitnesses

(1) Eyewitnesses A and B (from a point about 800 m southeast of the crash site)

While we were playing tennis, we heard a noise coming from the west (where the Yamato River runs) as seen from the tennis court. It sounded like a large steel plate fell on a concrete floor in an ironworks factory or somewhere. When we looked toward the west, in the direction of the noise, we saw an orange helicopter at a rather low height with its nose pointing south. The main rotor blades looked stationary. While

*3 Each of these identifiers shows the search area (right or left side relative to the flying direction of the Aircraft) to which the Aircraft made its way as determined by the turn determination processing in the data scanning concerned.

the helicopter was in a horizontal position, the main rotor blades were not horizontal; they appeared to be high on their nose end and low on the tail end.

The helicopter then pitched nose up once, after which it fell to the ground near a blue tank with the nose down. The helicopter appeared to spin around two or three times before crashing. We heard a bang shortly after the crash.

There appeared to be an interval of about ten seconds between the first large noise and the second bang. There was a strong northeasterly wind at that time.

(2) Eyewitness C (from a point about 200 m south of the crash site)

The helicopter was in a northwesterly direction with the nose toward the east when I first saw it. I often see helicopters in this area, but I felt that this one was flying at a rather low height. After a while, the helicopter went into a nose up, tail down attitude. The helicopter appeared to slow down rapidly and it was shaking. At that time, the main rotor blades did not seem to be rotating. A short time later, the helicopter's position reversed; it pitched nose down with the tail up while slowly spinning around and falling to the ground.

At the moment of impact, I heard a crashing noise and saw a little smoke, but no flames.

Some students were playing tennis in the schoolyard and there was a strong wind throughout the day.

(3) Eyewitness D (from a point about 650 m northeast of the crash site)

I was on the road that runs along the west side of the railway tracks. I saw a small helicopter flying at about the same height as high-voltage power pylon. It appeared to me that the helicopter was flying much lower than usual.

Shortly afterward, the helicopter began wobbling as if losing its balance and, after a moment of standstill, it fell like a shooting star toward a blue tank while spinning around. Just in front of me, the overhead wires of the Nankai Koya Line (which refers to the Koya Line of Nankai Electric Railway Co., Ltd. The same applies hereafter.) swung wildly. About 30 seconds after this, I called the police on my mobile phone. The time of the call was 15:05 as recorded in my phone's call history. I saw smoke rising from the far side of the blue tank.

It was gusty on that day; there was an especially strong wind at around the time of the accident.

(4) Eyewitness E (from a condominium apartment on the 10th floor, about 500 m northeast of the crash site)

I first saw the helicopter flying from the southeast to the west, at a low height that seemed unusual to me. After a while, I saw the helicopter flying from the west to the east and then it suddenly turned its nose towards the south. Before long, the main rotor blades stopped rotating and the helicopter looked as if it were hovering, and

then the helicopter wobbled once or twice before it fell sharply to the ground. Shortly afterward, I saw thin smoke and then flames rising.

We often have westerly winds here, much stronger than winds from other directions. When I was looking at the helicopter, there was a fairly hard wind for a short time, which was strong enough to loudly flap the leaves of potted plants on the balcony.

(5) Eyewitness F (from a point about 400 m south of the crash site)

I was riding my bicycle. As I passed near the railway crossing of Asakayama Station from the south, I heard a large noise in the sky. I looked up and saw a small helicopter flying low seemingly from the west to the east. The helicopter then spun around and suddenly crashed. I dialed the fire department (at 119) while pedaling. Since the airframe was visible on the railway tracks, I said, "It's on the tracks of the Koya Line. Please call an ambulance." I watched the airframe from the railway side and saw small flames and smoke. Two persons climbing up onto the tracks from the other side of the railway had brought fire extinguishers with them and started fire control; they put out the fire soon.

A typhoon was approaching on that day and rain was falling intermittently accompanied by strong winds. At around 3:00 PM, we had strong gusts blowing from west to east.

(6) Eyewitness G (from a point about 10 m east of the crash site)

I was watching the passing trains from a spot on the roadside east of the crash site. Just as an outbound train was about to pass in front of me, I heard a bang like a fireworks explosion in the sky.

About three seconds after the train passed, a helicopter crashed with a great bang just in front of me. When I first became aware of the helicopter, it had already reached the overhead wires for the trains. I heard no engine sounds, so I suppose that the engine was not running. The falling airframe was spinning with the nose down and the tail up. Some of the overhead high-voltage wires had snapped and broken, sparks were flying around, and a lot of broken helicopter parts were scattered. After a while, flames started rising from the bottom portion of the helicopter and grew to about 2 m high, but the persons who came from the other side of the tracks put out the fire using extinguishers.

(7) Eyewitness H (from a point about 50 m west of the crash site)

I was sitting on a bench in the plant premises and just when I happened to look up I saw a helicopter falling from the sky at a slight distance northward from the sky just above the plant. It was falling with its nose slanted down while spinning clockwise as seen from below. My first fear was that the helicopter would fall onto the plant. While the helicopter was falling, engine sounds were barely heard and the

main rotor blades were practically not rotating. It fell towards the Nankai Koya Line right beside the plant and I heard a large snapping sound when the overhead wires broke.

I rushed to the crash site and, thinking that the first thing to do was to rescue the persons on board, I climbed over the trackside fence and entered the railway premises. In the wreckage of the crashed airframe, I found one person obviously dead, lying on his belly over the tracks and thrown forward from the cockpit. I found another person, not moving, with his head resting face down on the seat and the rest of his body lying outside the cockpit. Next to the second person, I saw small flames flickering.

Thinking that I must quench the flames by all means, I went on to put out the fire using the fire extinguishers brought by nearby residents, in spite of warnings from the rescue people, saying, “It’s dangerous. There’s a risk of an explosion.”

The accident occurred at about 15:05 on the tracks for inbound trains of the Nankai Koya Line, about 300 m north of Asakayama Station in Sakai Ward, City of Sakai, Osaka Prefecture. (Latitude 34°35'32"N, Longitude 135°29'34"E)

(See Figures 1, 2, 3 and Photos 1.)

2.2 Deaths, Injuries and Missing Persons

The Captain and the passenger were killed.

2.3 Damage to the Aircraft

2.3.1 Extent of Damage

Destroyed

2.3.2 Damage to the Aircraft Components

Fuselage	Entirely broken and damaged; bottom portion burned
Main rotor blades	Both blades broken
Tail cone	Broken and detached
Tail rotor blades and stabilizer	Broken and detached
Landing gear	Broken
Aircraft control system	Broken

(See Figure 3 and Photos 1, 2, 3, 5.)

2.4 Damage to Objects Other Than the Aircraft

Six overhead wires were broken and a power pole partially damaged on the Nankai

Koya Line.

(See Photo 4.)

2.5 Crew Information

Captain Male, aged 40

Commercial Pilot Certificate (Rotorcraft)	February 26, 2001
Type rating for single-piston engine (land)	February 26, 2001
Class 1 Aviation Medical Certificate	
Validity	Until February 24, 2008
Total flight time	807 h 04 min
Flight time in the last 30 days	13 h 44 min
Total flight time on the type of aircraft	218 h 15 min
Flight time in the last 30 days	6 h 15 min

2.6 Aircraft Information

2.6.1 Aircraft

Type	Robinson R22 Beta
Serial number	2995
Date of manufacture	September 23, 1999
Certificate of airworthiness	DAI 19-400
Validity	Until October 11, 2008
Category of airworthiness	Rotorcraft Normal (N)
Total flight time	1,801 h 00 min
Time in service since last periodical check	8 h 40 min

(100-hour check on September 30, 2007)

(See Figure 4.)

2.6.2 Weight and Balance

When the accident occurred, the aircraft's weight is estimated to have been 1,266 lbs and the position of the center of gravity is estimated to have been 96.5 in. aft of the reference point and 0.69 in. left of the centerline, all of which are estimated to have been within the allowable limits (i.e., maximum takeoff weight of 1,370 lbs and allowable center-of-gravity ranges of 95.5–101.0 in. and 1.6 in. leftward – 1.5 in. rightward based on the estimated aircraft weight at the time of the accident).

2.7 Meteorological Information

2.7.1 Synoptic Weather Report

Among the weather warnings and advisories issued by the Osaka District

Meteorological Observatory for Osaka Prefecture at 8:54 on October 27, those applicable to the Senshu area that includes the crash site are as follows:

Storm and high-waves advisories were issued for the Senshu area.

There was a northerly wind with maximum velocity of 12 m/s on land and 15 m/s on the sea, from early afternoon to early night on October 27.

Typhoon No. 20 was on the sea off the Kii Peninsula at 15:00 on October 27 and was moving northeastward at 95 km/h.

2.7.2 Aeronautical Weather Observations for the Airport

(1) Aeronautical weather observations for Yao Airport, located about 5 nm east of the crash site, around the time of the accident were as follows:

15:00 Wind direction 350°; Wind velocity 8 kt; Wind direction variable 330°–040°; Visibility 30 km
Cloud: Amount 1/8, Type Stratus, Cloud base 1,000 ft
Amount 3/8, Type Cumulus, Cloud base 2,500 ft
Amount 5/8, Type Cumulus, Cloud base 4,500 ft
Temperature 20°C; Dew point 16°C
Altimeter setting (QNH) 29.63 inHg

(2) Aeronautical weather observations for Kansai International Airport, located about 15 nm southwest of the crash site, around the time of the accident were as follows:

15:00 Wind direction 340°; Wind velocity 17 kt; Visibility 35 km
Cloud: Amount 1/8, Type Cumulus, Cloud base 1,500 ft
Amount 3/8, Type Cumulus, Cloud base 4,000 ft
Amount 5/8, Type Altocumulus, Cloud base 7,000 ft
Temperature 21°C; Dew point 14°C
Altimeter setting (QNH) 29.65 inHg

15:08 Wind direction 340°; Wind velocity 17 kt; Maximum instantaneous wind velocity 27 kt; Visibility 35 km
Cloud: Amount 1/8, Type Cumulus, Cloud base 1,500 ft
Amount 3/8, Type Cumulus, Cloud base 4,000 ft
Amount 5/8, Type Altocumulus, Cloud base 7,000 ft
Temperature 21°C; Dew point 13°C
Altimeter setting (QNH) 29.65 inHg

2.7.3 Meteorological Information Provided by Eyewitnesses

(1) In the period of time concerned on the day of the accident, it suddenly went dark and pretty strong westerly gusts blew for about 60 to 90 seconds at the entrance to the Suminoe Ward Municipal Office (about 2 km north-northwest of the crash site).

(2) As described in 2.1.2, the eyewitness statements suggest that strong winds were blowing on the day of the accident, strong westerly gusts especially during the time of the accident.

2.8 Accident Site and Wreckage Information

2.8.1 Accident Site Conditions

The accident site was on the inbound train tracks of the Nankai Koya Line, about 300 m north of Asakayama Station.

The Aircraft crashed onto the site, snapping an overhead wire, three high-voltage signal wires and two high-voltage distribution lines. A fire broke out afterwards.

The burned Aircraft lay on the railway tracks in almost parallel alignment, with the nose in the direction of about 180° and the airframe tilted about 40° to the right. Fragments of the airframe were found scattered within an about 20m radius surrounding the crash site.

The nose of the Aircraft was severely broken and the instrument panel had also broken off.

Both of the main rotor blades had broken off from the airframe. The black blade*4 lay on the ground about 5 m rearward and to the left of the Aircraft. The red blade had broken into two pieces, both of which were found 10–14 m forward and to the right of the fuselage.

The tail cone had broken off from the fuselage at the joint and had further broken into three pieces that lay apart from the fuselage, the first one about 2 m to the right, the second one about 10 m to the right, and the third one about 10 m rearward and to the right of the fuselage.

The stabilizer and the tail rotor blades had broken off from the tail cone, and were found lying on the road at a point about 15 m rearward and to the right of the fuselage.

Both skids had broken off and scattered. Part of the right skid was found on the road at a point about 15 m rearward and to the right of the fuselage, and part of the left skid was found lying on the road at a point about 20 m forward and to the left of the fuselage.

The overhead wires above the inbound train tracks had been snapped by the falling Aircraft and were hanging down. The arm for supporting the high-voltage distribution lines on the power pole about 5 m rearward and to the right of the airframe was found detached from the pole.

(See Figure 3 and Photos 1, 2, 3, 4, 5.)

2.8.2 Details of Damage to the Aircraft

Details of the damage to principal structural parts of the Aircraft are described below.

(1) Fuselage

- The front face was destroyed, with extensive cracks and deformation over the

*4 The two main rotor blades were color-coded for identification: one was marked red and hence called “the red blade” and the other was marked black, “the black blade.”

entire skin. Part of the skin at the lower portion of the left door was found detached, after having crushed the skin below it into pleats and reaching the right-side skin.

- The bottom portion of the mast front fairing was lost in the fire while the portion above it was in position but burnt.
- The push-pull tube inside the mast had buckled and showed damage.
- The lower portion including the engine frame was burnt.
- The pitch linkages were bent and broken.

(2) Main rotor blades

- The red blade had broken off at about 60 cm from the root and the black blade at about 70 cm from the root.
- The red blade further broke into the leading edge portion and the honeycomb-structured trailing edge portion. The leading edge portion had been bowed downward while the trailing edge portion was bowed upward.
- The black blade had been bowed upward.
- The spindle end (tongue-shaped portion) on the red blade side had broken off. The top end of the droop stop had broken off and adhered to the main rotor hub by fusion.
- The teeter stop and its bracket for the red blade were lost. The mast had a mark indicative of contact with the hub.
- The bolt of the teeter stop on the red blade side had broken off.
- The teeter stop for the black blade had been crushed and broken into top and bottom halves; they remained adhered by fusion. The teeter stop location on the mast had been heavily damaged. The droop stop had broken off.

(3) Tail cone

- The tail cone had broken off at its joint to the fuselage and had split into three portions ending at about 2.3 m, about 2.7 m and about 3.7 m, respectively, as measured aft from the joint. On the left surface of the piece ending at about 2.7 m from the joint, there were paint marks from the main rotor blade (black) and a large dent as wide as the blade, both running from the top front section to the bottom rear section of that portion.

(4) Tail rotor and stabilizer

- The tail rotor drive shaft had been hit by the main rotor blade (black) and broken off in the tail cone piece ending at about 2.7 m from the joint.
- The intermediate flex plate was found twisted and broken off.
- One of the two power transmission clutch belts was burnt and the other was detached from the upper and lower sheaves.

(5) Landing gear

- Both the left and right skids had broken off and were scattered around.

(6) Aircraft control system

- The bell crank and the push-pull tube of the tail rotor control system had broken off.

(See Photos 1, 2, 3, 5, 6, 7, 8.)

2.9 Communication Information

2.9.1 At about 15:05 (according to the clock at the company's operation control desk), the time immediately before the crash, communication from the Aircraft was received by the company's operation control staff on the company radio frequency (129.00 MHz), saying, "We are now over the Asaka point. We will be landing soon." Communication conditions were good.

ATC communication records at Yao Airport did not include any communication with the Aircraft immediately before the crash.

2.9.2 Transmission of the transponder code (1200) from the Aircraft's transponder was confirmed up until 15:04:21.

2.10 Medical Information

(1) In the autopsy conducted by the Osaka Prefectural Police Department on October 28, the Captain and the passenger tested negative for both alcohol and drugs.

It was determined that the Captain died from a crushing head injury and the passenger from contusions to both lungs.

(2) According to the Osaka Prefectural Police Department, the Captain had been suspected of suffering from sarcoidosis, a disease not accepted by the aviation medical certification criteria, and was regularly visiting a hospital that specialized in this illness since October 2003. An ophthalmologist at the hospital diagnosed the Captain as not requiring eye treatment.

The Captain did not undergo a thorough respiratory examination at the hospital.

When the Captain underwent an aviation medical checkup in February 2004, he mentioned to the doctor who examined him that he was suspected of suffering from sarcoidosis, a condition not accepted by the "Aviation Medical Certification Manual" issued by the Director-General of the Civil Aviation Bureau. However, the Captain was granted an aviation medical certificate since no abnormal indications were found in any examination items. After the aviation medical checkup in February 2004, the Captain underwent a checkup every year by the same doctor authorized for aviation medical checkups.

(3) According to a flight instructor of the Company, the Captain did not show any symptoms typical of sarcoidosis such as decreased vision, respiratory discomfort and

abnormal cardiac rhythm. The Captain did not ask for consultation on any illness and did not submit any related reports.

(4) The post-accident biopsy conducted on the body of the Captain by the Osaka Prefectural Police Department confirmed that the Captain had been suffering from sarcoidosis.

Sarcoidosis is explained by the Japan Intractable Diseases Research Foundation/Japan Intractable Diseases Information Center as follows:

Sarcoidosis is a disease characterized by the appearance of nidi in various organs that are fairly similar to those of tuberculosis and other infectious diseases. These nidi are generally called epithelioid cell granuloma. The cause of the disease has not yet been identified. Typical symptoms include blurred vision, decreased vision, cough, respiratory discomfort, a range of rashes and abnormal cardiac rhythm. Any of these disorders manifest themselves related to the organ that suffers from granuloma.

2.11 Information on Search and Rescue Related to Survival, Death and Injury

At 15:08 on the day of the accident, an emergency 119 call was received by the Command and Control Center of the Sakai Municipal Fire Department from a witness near the crash site, saying, "A railway work vehicle or something hit the high-voltage wires and caught fire on the tracks north of Asakayama Station on the Nankai Koya Line. There are people injured."

At 15:09, the Center received a second call reporting that a helicopter had crashed.

Upon receiving these reports, 16 vehicles including ambulances and special work vehicles were dispatched in addition to 60 rescue and other fire brigade members.

At 15:18, the ambulances and other vehicles with the dispatched members arrived at the crash site, and then, at 15:20, the Captain was confirmed dead. At 15:35, the passenger was transported from the site in an ambulance, which arrived at the Emergency Medical Care Center of Kinki University at 15:58, and then, at 16:45, the passenger was confirmed dead.

The Captain had been wearing a three-point seat belt but was thrown forward from the Aircraft since the seat belt no longer worked due to damage to the airframe at one of the seat belt anchors. Because of the severe damage to the aircraft, it was not possible to establish whether or not the passenger had been wearing a seat belt. Nonetheless, a staff member of the Company saw both the Captain and the passenger had worn their seat belts when the Aircraft took off.

2.12 Tests and Research for Fact Finding

2.12.1 Examination of the Engine and Equipment

The results of the examination carried out at the Company's hangar at Yao Airport are as described below. No manufacturing defects or component failure were identified other

than the damage caused by the crash.

(1) Teardown inspection of the engine

① No defective conditions were found in the internal components of the engine, with no noticeable abnormalities such as binding or interference of moving parts.

② All cylinders were in good condition, without any traces of abnormal combustion.

③ No abnormalities were found in the ignition system.

(2) The teardown examination performed on the main gearbox found no major damage, and revealed no abnormalities.

(3) The governor*5 operated normally in the functional test conducted.

(4) The teardown examination conducted on the clutch assembly revealed no abnormalities.

2.12.2 Examination of the Main Rotor Hub

A detailed examination of the main rotor hub found that it was partly stripped of paint and discolored and partly melted. A broken piece of a droop stop was found wedged between the spindle and hub and adhered by fusion onto the main rotor hub.

(See Photo 8.)

2.12.3 Examination of the Push-Pull Tube and the Fractured Surfaces of the Pitch Linkages

The push-pull tube was buckled and damaged. The two pitch linkages were bent and broken off. Examination of the fractured surfaces revealed that the linkages had broken off after being subjected to several large bending and twisting forces.

2.12.4 Examination of the Radio Equipment Frequencies

An examination was conducted to establish the frequencies selected by the radio equipment. The results are as follows.

(1) VHF NAV/COM equipment

① COM equipment

Selected frequency: 129.00 MHz (Osaka Aviation)

② NAV equipment

Selected frequency: 112.30 MHz (Shinoda VOR)

(2) ATC transponder

Set code: 1200

*5 The governor is a device that maintains the rotor blade speed at a preset value by automatically adjusting the throttle opening.

2.13 Other Relevant Information

2.13.1 Statements of Persons Related to the Accident

(1) Organizer for the experience flight program

I organize and run a membership Outdoor Circle over the Internet as a hobby. I made the experience flight plan because I actually tried an experience flight offered by the Company and enjoyed it very much. As part of the promotion, I posted my experience online and invited would-be members by saying, "Join us if you intend, like me, to obtain a pilot's license."

The passenger who died in the crash applied for membership saying, "I am very interested in joining." He joined our circle in June 2006. He said, "I hang-glide. I want to obtain an aircraft pilot's license." I believe he truly loved aircraft.

I developed the plan in consultation with the Captain to provide flight experience to seven members on an airplane and seven members on a helicopter, with 15-minute flights for each member. The passenger who died in the crash applied for both airplane and helicopter flights. He was scheduled to be the first passenger for flying on airplane and the fourth for flying on helicopter.

I believe that this was his very first experience flight on an airplane. After the flight, he was quite excited about the experience and said, "It was fascinating. I am kind of getting addicted to it."

The Captain had changed his method of presentation to suit each passenger. He was keen on explaining how to operate the flight controls to those who wished to obtain a pilot's license.

(2) The passenger on the first helicopter experience flight

I was on the first helicopter experience flight. There was no pre-flight precautionary briefing; I was only told about the "rough area in which the helicopter was going to fly." I hold a private pilot's license of airplane, but as I had not flown for the past 12 years, I had completely forgotten how to control an aircraft. The flight made me feel like resuming flying an aircraft myself again.

I sat in the right seat wearing a seat belt while the Captain sat in the left seat wearing a seat belt.

When making turns on the flight route at 900–1,000 ft, the Captain explained the method for turning, saying something like, "To make a left turn, you tilt the control stick to the left like this," and sometimes the Captain let me hold the cyclic stick (hereafter referred to as "the control stick"). I think that even at that time, the Captain kept holding his control stick, but I am not sure of this because I was not composed enough to remember.

(3) The passenger on the second helicopter experience flight

I was the one on the second helicopter experience flight. I sat in the right seat

while the Captain sat in the left seat. Before the flight, there was no precautionary briefing.

Throughout my time on board, I kept my hands on the control stick as I was instructed to do so by the Captain. While up in the air, the Captain explained the instruments that indicated altitude and heading. I was also instructed to make turns. While hovering at an altitude of 1,000 ft, the Captain demonstrated that the helicopter moved right when the control stick was tilted to the right and similar maneuvers and I did them together with the pilot.

(4) The passenger on the third helicopter experience flight

There was no prefixed route or other conditions for my experience flight. To me, this experience flight of about 15 minutes was also for sightseeing, so we flew over the city of Osaka including the “Osaka Dome.”

When the helicopter was high in the air, the Captain let me hold the control stick and make right and left turns.

(5) Flight instructor A of the company

There are two flight instructors in the Company and I took care of training the Captain in both commercial pilot certification and captain qualification. Flight instructors are the only personnel authorized to conduct flight training. Flight instructors are also usually responsible for experience flights.

In the routine procedure for landing at the Airport from the Asaka point, a pilot communicates his intention to land on the company radio frequency, and then changes to the Yao Tower frequency to make a position report.

Reporting to the company and Yao Tower is performed in a single sequence, usually at an altitude of 1,000 ft.

A passenger must normally take the left seat, I believe. The flight manual specifies that the left control stick must be removed when a passenger takes the left seat, but it is a usual practice to fly without removing the stick. I always wear a seat belt and I instruct passengers to do the same.

In the case of an experience flight, I allow a significant amount of time for pre-flight briefing to give passengers necessary precautions, such as “You must not hold the control stick. Please do not touch any switches.”

Although the frequency selection switch is provided on the radio equipment in the instrument panel, a pilot, when sitting in the right seat, uses another frequency selection switch on the right control stick because it can be operated without letting go of the hold on the control stick. When sitting in the left seat, a pilot must do the following to change the radio frequency because there is no frequency selection switch on the left control stick: A pilot lets go of his left-hand hold on the collective pitch lever in order to hold the control stick and then operates the frequency selection

switch on the radio equipment in the instrument panel with his right hand. Changing the frequency from the left seat is more difficult for the pilot.

(6) Flight instructor B of the company

At around the time of the accident, I was in the Yao Airport office of the Company. It was extremely windy all day. My impression from the analysis data of the radar records provided by the ATC of the Aircraft is that the flight was unlike a normal flight; the Aircraft repeatedly made small heading changes to the left and right and also flew at wildly different high and low speeds. Even though the wind direction could have affected the speed somewhat and rough air currents might have contributed to this, the behavior of the Aircraft seems too unstable even including the repeated climbs and descents. We never fly like this, especially with a passenger on board.

Experience flights are conducted on the assumption that "the passenger does not have any knowledge about aircraft control." High-skill maneuvers are not comprehensible to passengers; they may feel rather scared by them. So flying like the way suggested by the recorded data is meaningless. In my case of normal experience flights, I just perform ordinary level flights and turns to show passengers how the aircraft moves in response to the movement of the control stick.

In a training flight, however, an instructor may leave a certain extent of aircraft control up to trainee's discretion so as to let the trainee learn how the aircraft behaves in response to control. So, it is not strange for an aircraft to behave like the Aircraft if a trainee is handling the controls for the first time. The route and speed records of the accident flight suggest this: The passenger, naturally an amateur in piloting, would have been controlling the Aircraft, while the Captain would have been making recovery maneuvers repeatedly.

The auto rotation speed of the Aircraft is 65 kt. Even with the tail rotor inoperative, the Aircraft can still achieve level flight by maintaining 70 kt.

At about 15:05, immediately before the accident, there was communication from the Aircraft to the office over the company radio saying, "We are now over the Asaka point and will be landing soon." I detected nothing strange from this message.

(7) Pilot A of the Company

The experience flight program at this time included flights on a helicopter and on an airplane, so I was assigned to piloting the airplane and the Captain to piloting the helicopter. The passenger who died in the accident was the first experience flight passenger on my airplane. I went through a general explanation on the method of controlling an airplane and other related matters until the experience flight ended. The passenger was not overexcited, nor did he act abnormal in any other respect either.

At the time of the accident, I was flying in almost the same area as the helicopter at an altitude of about 1,500 ft. Cloud conditions were almost perfect, but there was a strong northwesterly wind and turbulence as well.

2.13.2 Information on the Experience Flight

Under the title of "experience flight," the company used to offer opportunities to experience a flight in a cockpit for applicants who hold neither a pilot's license nor a student pilot permission in the hopes that some of them might develop an interest in piloting and aspire to obtain a pilot's license. In an actual experience flight, the Company allowed passengers, wherever judged appropriate from their attitude, to touch the control stick and even pilot the aircraft during phases other than takeoff and landing in order to help relieve their fear of flying and further develop their interest in piloting.

The Company, however, did not require applicants to have a student pilot permission, and assigned not only flight instructors but also other pilots to the duty of experience flight captain on the assumption that the experience flight was not a training flight. In the case of this accident, the Captain was not qualified as a flight instructor and the passenger did not hold a student pilot permission.

The Captain sat in the left seat and the passengers sat in the right Main pilot seat at the direction of the Company, and the Company also left the preflight briefing of passengers to the Captain.

The Aircraft had been approved for aerial work but not for air transport service.

The Company's operations manual, operating procedures manual and other documents do not include any mention of an experience flight.

2.13.3 Design of the Aircraft's Control Stick

The Aircraft's control stick consists of a rod that is located near the midpoint between the seats and branches out to the left and right rods, each end of which is provided with a grip. A pilot holds either of these grips with his right hand to control the Aircraft. The Aircraft can be controlled from either of the seats. When a person sitting in one of the seats moves the grip to a point above his knees from a point just in front, the other grip moves upward by approximately 30 cm.

Therefore, if the person in the left seat attempts to hold the control stick with his/her right hand when the person in the right seat is operating the control stick that has been brought to a point in front of him/her, the person in the left seat must raise his/her right hand to a considerably high level.

The left control stick is detachable by means of a quick release pin.

A press-to-talk switch is provided on both control stick grips. A radio frequency selection switch is provided on the right control stick, but not on the left control stick.

(See Figure 5.)

2.13.4 Influence of the Accident on Train Service

On the day of the accident, train service on the Nankai Koya Line was suspended for the period between 15:05 and 21:38 because of the accident.

2.13.5 Flight Manual of the Aircraft

The flight manual of the aircraft states the following (excerpts):

SECTION 2 LIMITATIONS

FLIGHT AND MANEUVER LIMITATIONS

Low-G cyclic pushovers prohibited.

CAUTION

A pushover (forward cyclic maneuver) performed from level flight or following a pull-up causes a low-G (near weightless) condition which can result in catastrophic loss of lateral control.

To eliminate a low-G condition, immediately apply gentle aft cyclic. Should a right roll commence during a low-G condition, apply gentle aft cyclic to reload rotor before applying lateral cyclic to stop the roll.

CAUTION

Avoid abrupt control inputs. They produce high fatigue stresses and could lead to a premature and catastrophic failure of a critical component.

WIND LIMITATIONS

(1) Flight when surface winds exceed 25 knots, including gusts, is prohibited.

(2) Flight when surface wind gust spreads exceed 15 knots is prohibited.

(3) Flight in wind shear is prohibited.

(4) Flight in moderate, severe, or extreme turbulence is prohibited.

(5) Adjust forward airspeed to between 60 knots and 0.7 Vne but no lower than 60 knots upon inadvertently encountering moderate, severe, or extreme turbulence.

Note: Moderate turbulence is turbulence that causes:

(1) changes in altitude or attitude;

(2) variations in indicated airspeed; and

(3) aircraft occupants to feel definite strains against seat belts.

SECTION 3 EMERGENCY PROCEDURES

LOSS OF TAIL ROTOR THRUST DURING FORWARD FLIGHT

1. Failure is usually indicated by nose right yaw which cannot be corrected by applying

left pedal.

2. Immediately enter autorotation.

3. Maintain at least 70 KIAS airspeed if practical.

4. Select landing site, roll throttle off into overtravel spring and perform autorotation landing.

SECTION 4 NORMAL PROCEDURES

DAILY OR PREFLIGHT CHECKS

13 Cabin Interior

CAUTION

For helicopters with removal controls, remove left seat controls if person in that seat is not a rated helicopter pilot.

M/R blades contacting the fuselage

NOTE

Main Rotor Stall: *Many factors may contribute to main rotor stall and pilots should be familiar with them. Any flight condition that creates excessive angle of attack on the main rotor blades can produce a stall. Low main rotor RPM, aggressive maneuvering, high collective angle (often the result of high-density altitude, over-pitching [exceeding power available1 during climb, or high forward airspeed) and slow response to the low main rotor RPM warning horn and light may result in main rotor stall. The effect of these conditions can be amplified in turbulence. Main rotor stall can ultimately result in contact between the main rotor and airframe. Additional information on main rotor stall is provided in the Robinson Helicopter Company Safety Notices SN-10, SN-15, SN-20, SN-24, SN-27, and SN-29.*

Mast Bumping: *Mast bumping may occur with a teetering rotor system when excessive main rotor flapping results from low "G" (load factor below 1.0) or abrupt control input. A low "G" flight condition can result from an abrupt cyclic pushover in forward flight. High forward airspeed, turbulence, and excessive sideslip can accentuate the adverse effects of these control movements. The excessive flapping results in the main rotor hub assembly striking the main rotor mast with subsequent main rotor system separation from the helicopter.*

To avoid these conditions, pilots are strongly urged to follow these recommendations:

1) Maintain cruise airspeeds greater than 60 KIAS and less than 0.9 Vne, but no lower than 60 KIAS.

2) The possibility of rotor stall is increased at high density altitudes; therefore, avoid flight at high density altitudes.

3) Use maximum "power-on" RPM at all times during powered flight.

4) Avoid sideslip during flight. Maintain in-trim flight at all times.

5) Avoid large, rapid forward cyclic inputs in forward flight, and abrupt control inputs in turbulence.

This flight manual reflects the airworthiness directives TCD-4159-1-95 and TCD-4239-95 that were issued in order to prevent those problems which are caused by separation of the main rotor and contact of the main rotor with the fuselage during flight and may lead to a loss of control.

3. ANALYSIS

3.1 Crew Qualifications

The Captain possessed a proper airman competence certificate and a valid aviation medical certificate. (See 3.9 for further details regarding the aviation medical certificate possessed by the Captain.)

3.2 Airworthiness Certificate of the Aircraft

The Aircraft had a valid airworthiness certificate and had been maintained and inspected as prescribed. As described in 2.12.1, the engine teardown examination revealed no obvious abnormalities and no defects were detected in any major equipment of the aircraft. Therefore, it is estimated that the Aircraft operated normally until some abnormal conditions occurred during the flight.

3.3 Meteorological Conditions

As described in 2.7, wind conditions observed at Kansai International Airport at the time of the accident were as follows: wind direction: 340°, wind velocity: 17 kt, maximum instantaneous wind velocity: 27 kt.

As described in 2.1.2 and 2.7.3, eyewitnesses stated that there were fairly strong westerly gusts in the area at the time when the accident occurred. And as described in 2.13.1 (7), another pilot of the Company who was flying at the time of the accident and in almost the same area as the Aircraft, stated, “There was a strong northwesterly wind and turbulence as well.” Therefore, it is considered that there were strong westerly gusts in the area at the time that the aircraft experienced abnormal conditions. From these, it is considered that the Aircraft was subjected to strong tail gusts immediately before the accident.

3.4 Aircraft Control Performed by the Passenger

Judging from the following, it is considered likely that, immediately before the accident, the aircraft would have been flying under the control of the passenger while the

Captain kept his hand on the control stick:

(1) As described in 2.1, the passenger was in the right seat and the Captain was in the left seat when the Aircraft took off from the Airport.

(2) As described in 2.1.1, the Aircraft was flying unstably while varying its course irregularly as indicated by the ATC radar records for the time immediately before the accident.

(3) As described in 2.13.2, the Company used to allow passengers, while monitoring their attitude, to touch the control stick and even to pilot the aircraft in phases other than takeoff and landing during the experience flight to help relieve the fear of flying and further develop their interest in piloting through actual experience.

(4) As described in 2.13.1 (2), (3) and (4), the three passengers on the experience flights immediately before the accident flight were allowed to hold the control stick to control the aircraft.

(5) As described in 2.13.1 (1), the Captain changed his method of teaching according to the type of passenger, being keen on explaining how to control the aircraft to those who wished to obtain a pilot's license.

The Captain did not hold a flight instructor certificate and the passenger did not hold a student pilot permission.

3.5 Occurrence of Abnormal Conditions in Flight

Judging from the following, it is considered likely that mast bumping in which the main rotor blades hit the tail cone would have occurred while the Aircraft was in flight, causing the main rotor to slow down and making the Aircraft uncontrollable.:

(1) As described in 2.1.2 (1), an unusual noise similar to what it would sound like if a large steel plate fell on a concrete floor was heard coming from the helicopter that was flying at a rather low altitude on the west as seen from the tennis court.

(2) As described in 2.8.2 (3), a large dent made by the black main rotor blade was found on the tail cone at about 2.7 m from its joint to the fuselage.

(3) As described in 2.8.2 (2), the teeter stop for the black blade had been crushed and broken into top and bottom halves, which remained adhered by fusion, and the teeter stop location on the mast had been heavily damaged. Considering this, it is recognized that, when the black blade hit the tail cone, the main rotor hub hit the mast with a large force.

(4) As described in 2.8.2 (2), the teeter stop and its bracket for the red blade were lost and the mast had a mark indicative of contact with the hub.

(5) As described in 2.8.2 (2), the spindle end on the red blade side had broken off.

It is considered possible that the following had contributed to the occurrence of the mast bumping discussed here: As described in 3.4, it appears possible that the passenger was controlling the aircraft immediately before the accident. As described in 2.13.1 (1), the passenger had never before experienced a helicopter flight and was controlling the aircraft without any knowledge about the aircraft. It appears possible that the passenger made some maneuver so abrupt that it was difficult for the Captain to recover control of the Aircraft after it was subjected to strong tail gusts.

3.6 Time and Place that Abnormal Conditions Occurred to the Aircraft

As described in 2.13.1 (6), the Captain made communication immediately before the accident to inform the Company of his intention to return to the Airport, and, since the communication at that time did not indicate any abnormal conditions, it is considered likely that the Aircraft was then flying normally.

Although it is the normal routine to change the radio frequency to make a position report to Yao Tower immediately after making communication over the company radio as described in 2.13.1 (5), frequency change had not yet taken place with the VHF radio equipment as described in 2.12.4.

Judging from this, the abnormal conditions would have occurred to the Aircraft immediately after the Captain finished the communication with the Company. As described in 2.1.2 (3), witness D called police over a mobile phone about 30 seconds after the crash at 15:05, according to the call history of the phone. This suggests that the abnormal conditions occurred at a time immediately before 15:05.

On the other hand, the ATC radar records for the Aircraft show an abnormal altitude at 15:04:17 as described in 2.1.1, which suggests that it would have been recorded due to an abnormality in the altitude code pulses transmitted from the Aircraft.

Judging from these, it is considered likely that the abnormal conditions occurred on the aircraft at around 15:04:17, the time immediately after the Captain finished radio communication with theCompany.

Based on the ATC radar records described in 2.1.1 and the statements of eyewitness described in 2.1.2, it is estimated that the abnormal conditions would have occurred somewhere in the air space above the blue tank on the Yamato River.

3.7 Occurrence of the Accident and Preventing the Recurrence of Similar Accidents

As described in 3.6, it is considered likely that the abnormal conditions occurred immediately after the Captain's communication on the company radio frequency and immediately before switching to the Yao Tower frequency. Therefore, it is considered possible that the captain was not able to swiftly take over control of the Aircraft because he had to

remove his right hand from the control stick in order to operate the frequency selection switch of the radio equipment on the instrument panel, with his eyes and attention focused on the inside of the cockpit. As described in 3.5, it is considered possible that the Captain delayed in performing appropriate recovery control of the Aircraft because he was operating the radio equipment with his right hand when the aircraft, which was being controlled by the passenger who was not qualified to pilot an aircraft nor had the necessary experience and knowledge, was subjected to strong tail gusts.

When a passenger unqualified to pilot a helicopter is aboard for an experience flight, the following must be ensured: The passenger is seated in the left seat, the left control stick is removed to eliminate the possibility of the passenger touching the stick, the passenger is instructed before boarding not to touch any of the switches and other controls, and the passenger is also restricted from doing this when the helicopter is flying in the air.

3.8 Ensuring Safety on the Company Experience Flights

With the Robinson R22 series helicopters, there have been numerous reported cases of accident similar to the one covered in this report, which led to the issuance of airworthiness directives concerning controllability of the aircraft type series. Despite this, the Company had allowed passengers who were not qualified to pilot a helicopter to control aircraft in experience flights in order to help relieve the fear of flying and further develop their interest in piloting during phases other than takeoff and landing as described in 2.13.2. It is considered likely that the accident occurred because the passenger who was not qualified to pilot was allowed to control the Aircraft in the accident flight, too.

When considering that the Company did not comply with the Civil Aeronautics Law, the flight manual and the operations manual exactly as stipulated, the personnel in charge of flight operations and other related tasks of the Company should have made appropriate and timely decisions at the flight preparation stage and other relevant stages and, accordingly, give appropriate instructions to the Captain in order to ensure proper operation in exact compliance with the Civil Aeronautics Law, the flight manual and the operations manual.

It is important for the Company to thoroughly instill safety consciousness in all staff members, whereby they will be encouraged to respect the relevant stipulations in laws, regulations and manuals through reeducation programs established for this purpose.

Although an experience flight of this type is legally categorized as air transport service, the Company had been conducting the experience flights believing it to be categorized as aerial works. It is therefore estimated that the Company had been conducting this part of its business vaguely and arbitrarily defining its category between air transport services and aerial works.

3.9 Influence of Chronic Illness on Flight Operations

As described in 2.10, the Captain was suffering from sarcoidosis, a health condition not accepted by the aviation medical certification criteria.

Since October 2003, the Captain had been visiting a hospital that specialized in sarcoidosis as he was suspected of suffering from the illness. It is estimated that the Captain continued his aircraft duties believing that the illness would not have any impact on flight operations.

An aviation medical certificate was issued for the Captain even though he had informed the qualified aviation medical certification doctor that he was suspected of suffering from sarcoidosis at the time of the aviation medical checkup.

It is estimated that the aviation medical certificate was issued for the Captain because there were no indications of abnormalities for any of the examination items of the aviation medical checkup conducted at that time.

Although some ailments and dysfunctions do not necessarily bring about loss or reduction of faculties required to properly perform flight operations, it is considered that the authorized aviation medical certification doctor should have conducted the necessary tests to make an appropriate diagnosis from the viewpoint of ensuring aviation safety.

As described in 2.10 (3), when asked whether the chronic illness of the Captain affected his flight operations performance, the flight instructor confirmed that the captain did not show any symptoms that worried the instructor nor did he ask for consultation from or submit reports on the illness to the instructor. Therefore, it could not be ascertained whether or not the chronic illness of the Captain made any direct contribution to the accident.

4. PROBABLE CAUSE

In this accident, it is considered likely that mast bumping occurred while the Aircraft was in flight, and that a main rotor blade hit the tail cone, causing the speed of the main rotor to drop, which rendered the Aircraft uncontrollable and led to the crash landing.

With regard to the occurrence of the mast bumping, it is considered possible that the contributing factor was that, when the Aircraft was subjected to strong tail gusts during the experience flight, the passenger in the right seat, who was not qualified to pilot, made maneuvers so abrupt that it was difficult for the Captain to recover control of the Aircraft.

5. REFERENTIAL MATTERS

Following an inspection conducted by Osaka Regional Civil Aviation Bureau, the Company decided to make the following improvements (excerpts).

(1) Ensuring the safety of experience flights and other operations

The Company will review and modify the experience flight so that it will be conducted as part of flight training, which requires that every applicant who wants to be an onboard passenger, as in the experience flight covered in this report, must have

a student pilot permission. In addition, the following stipulation was included in the company regulations: Except in ordinary flight training, when a person not qualified as a pilot (person without a pilot's license) flies on a Robinson helicopter as a passenger, the person must be seated in the left seat and the left control stick must be removed. Also, the captain must conduct preflight safety briefing for the passenger.

(2) Establishment of an In-house System to Respect Legal Requirements and Ensure Safety

The entire company staff will be reeducated about the safety declaration, advisories, laws and relevant regulations in order to ensure that each staff member thoroughly realizes the importance of respecting laws and regulations. In addition, the current safety promotion system will be reorganized as a new system headed by the president (as the safety manager), to which full-time staff members will be assigned .

On November 7, 2007, the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism asked the All Japan Air Transport and Service Association Co., Ltd. to instruct its member organizations to provide appropriate training to pilots of the Robinson R22 and R44 type helicopters, ensure full awareness of safety by all concerned in such operations as experience flights, and take all necessary measures for ensuring safe operation of these helicopters.

Figure1　Estimated Flight Path

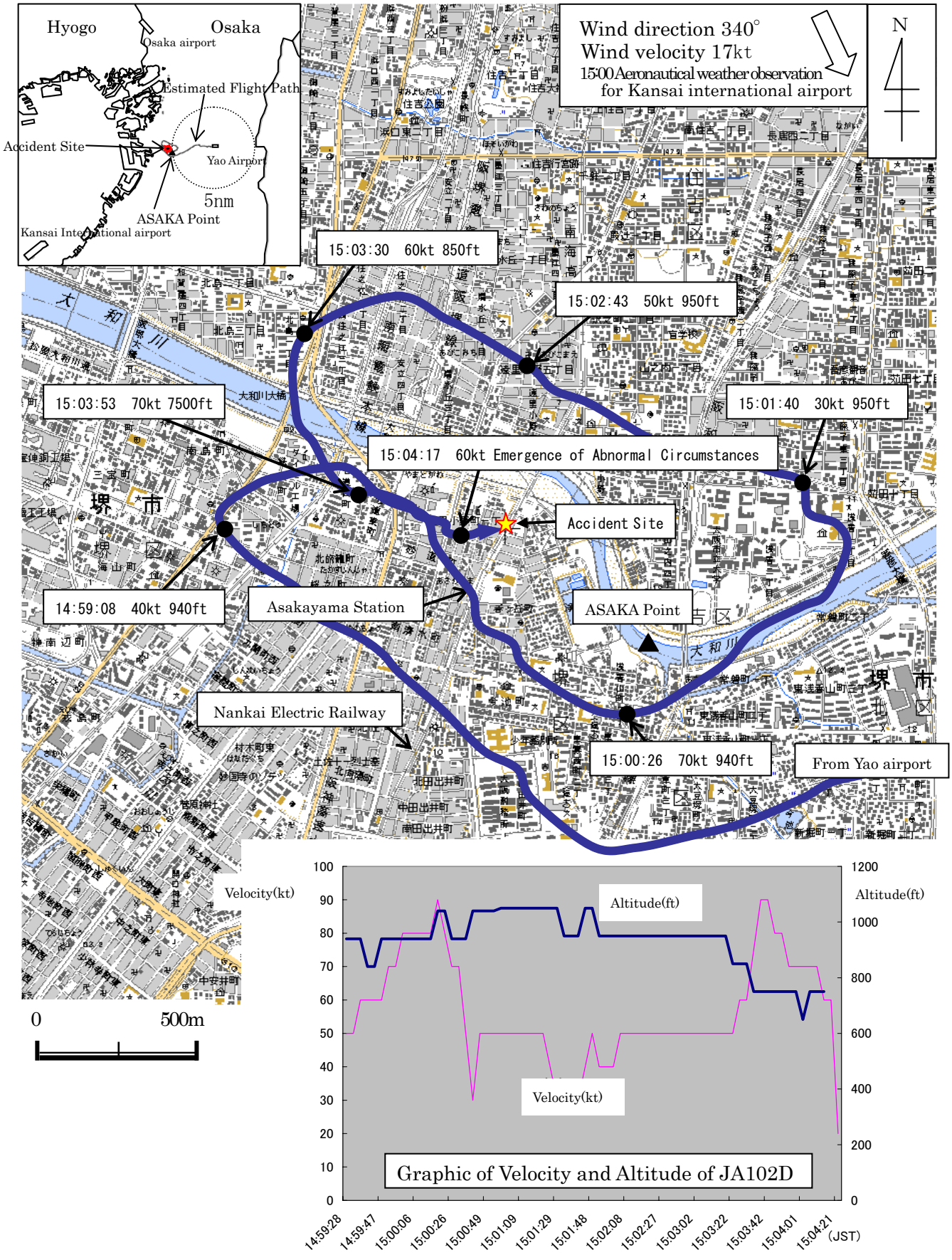


Figure 2　Locations of Eyewitnesses

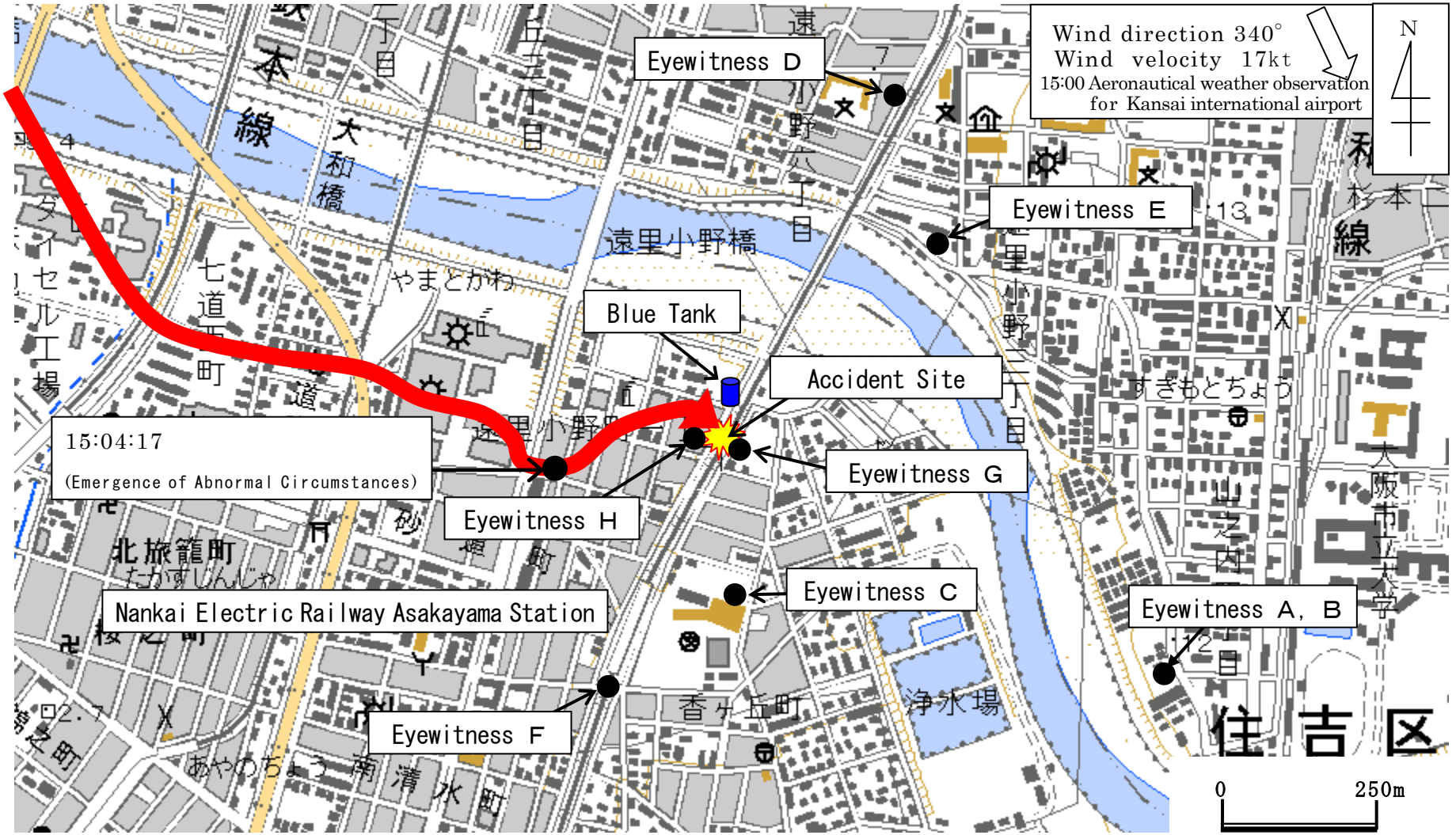


Figure 3　Around the accident site

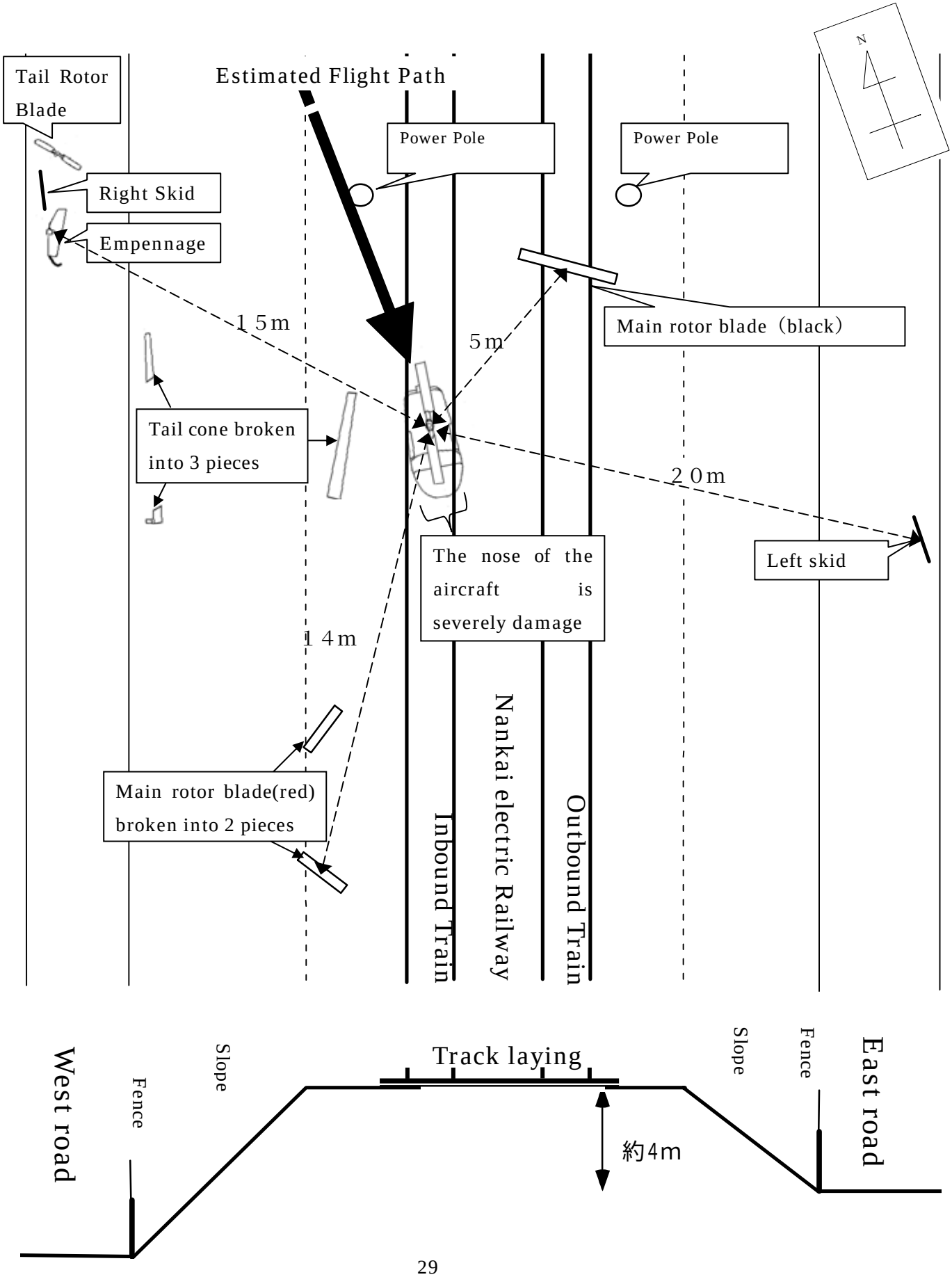


Figure 4　Three angle view of Robinson model R22 Beta

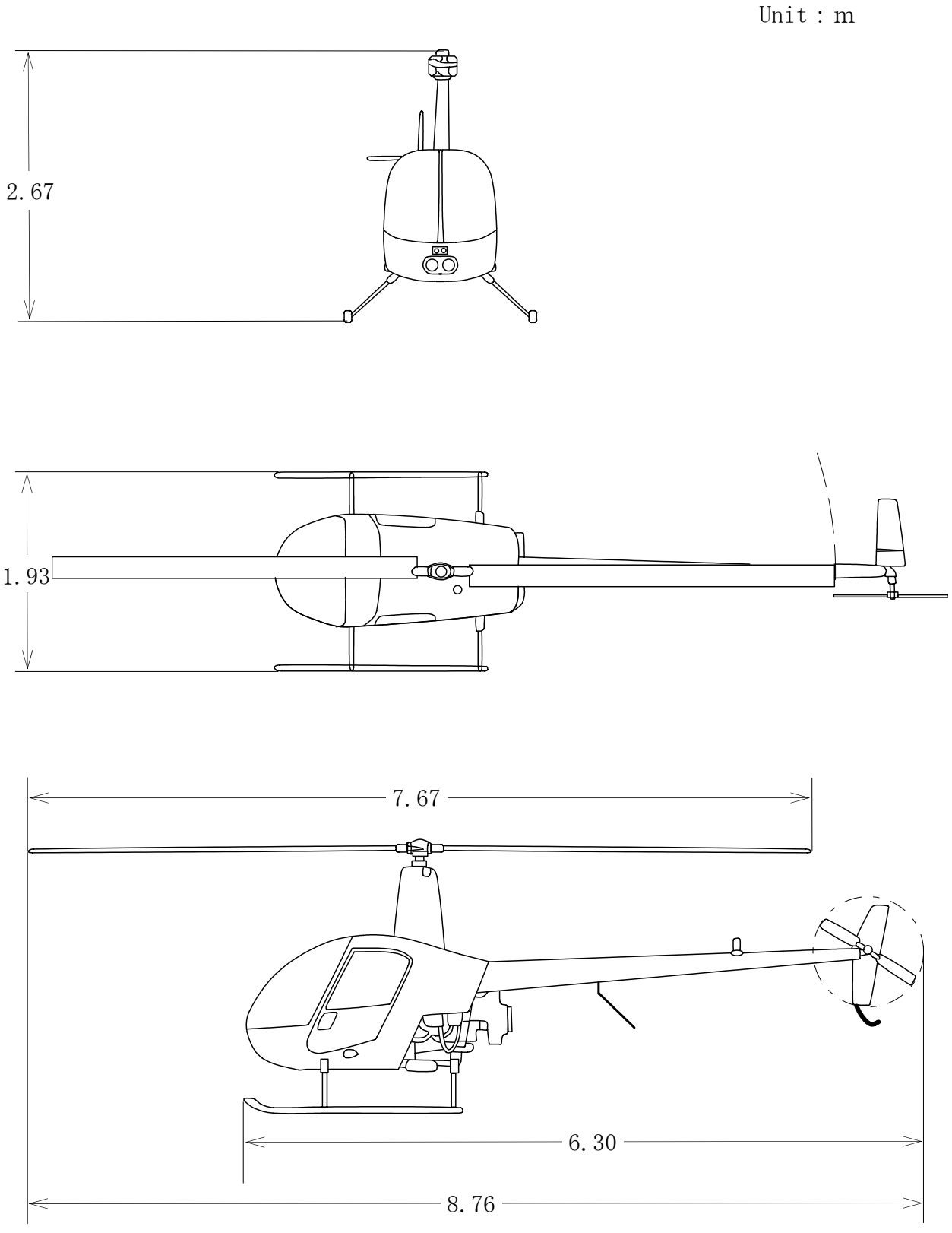
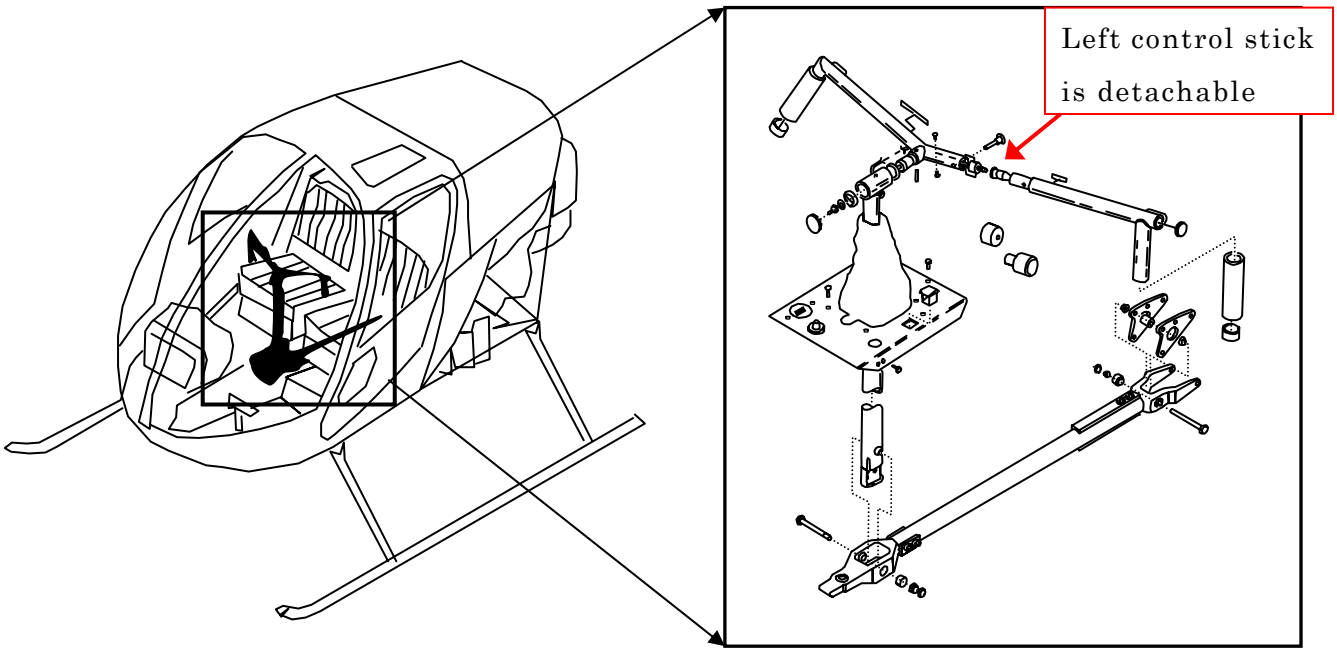
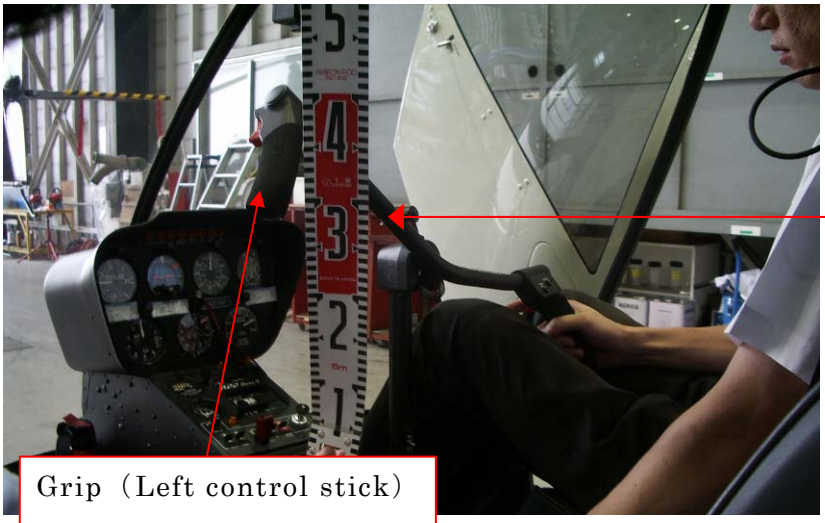


Figure 5　Control Stick





Grip（Left control stick）

Press-to-talk switch is provided.
Radio frequency selection switch is not provided.

If the person in the left seat attempts to hold the control stick with his/her right hand when the person in the right seat is operating the control stick that has been brought to a point in front of him/her, the person in the left seat must raise his/her right hand to a considerably high level. (grip moves upward by approximately 30 cm)

Figure 6　Image of mast bumping

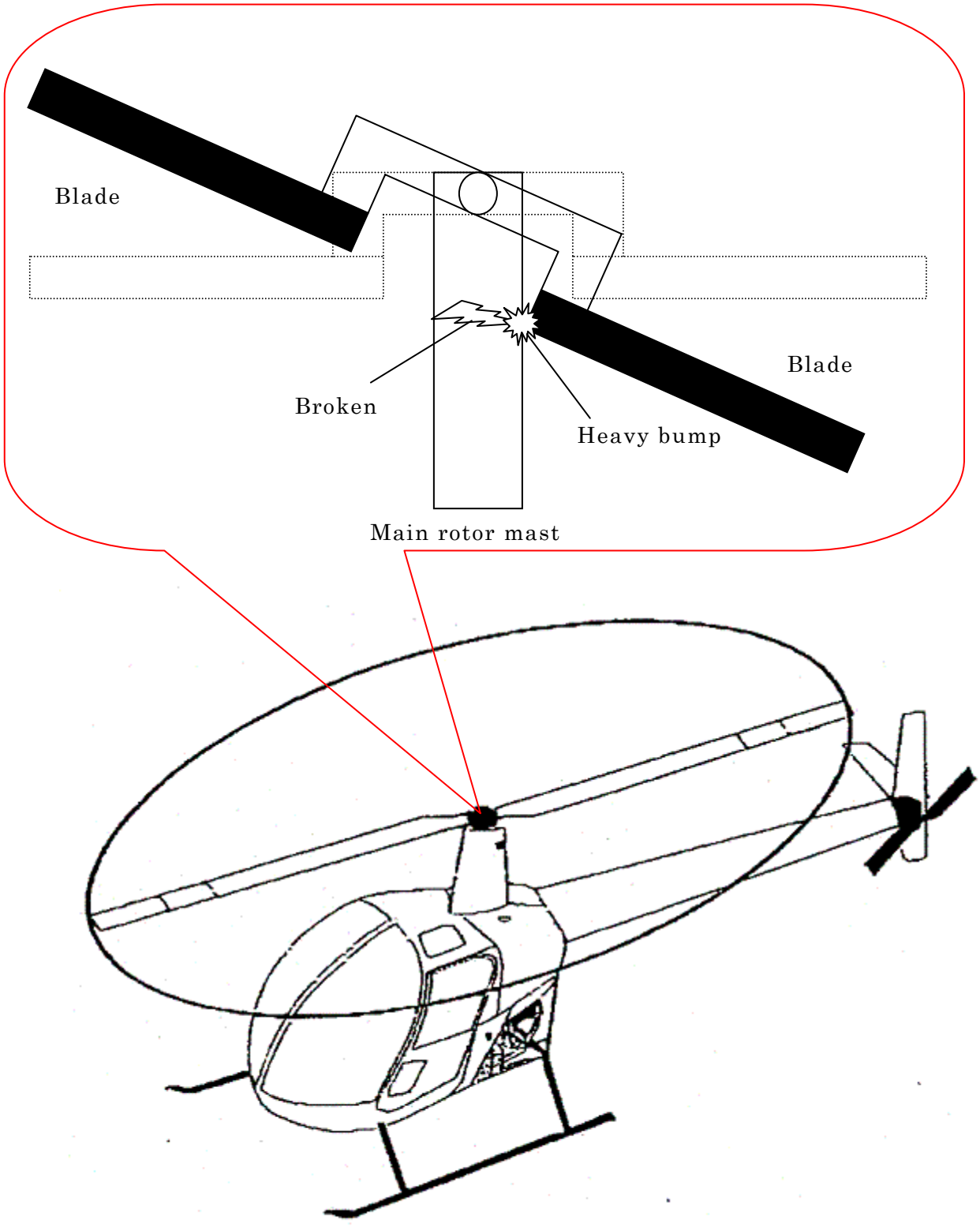


Photo 1　Accident aircraft 1

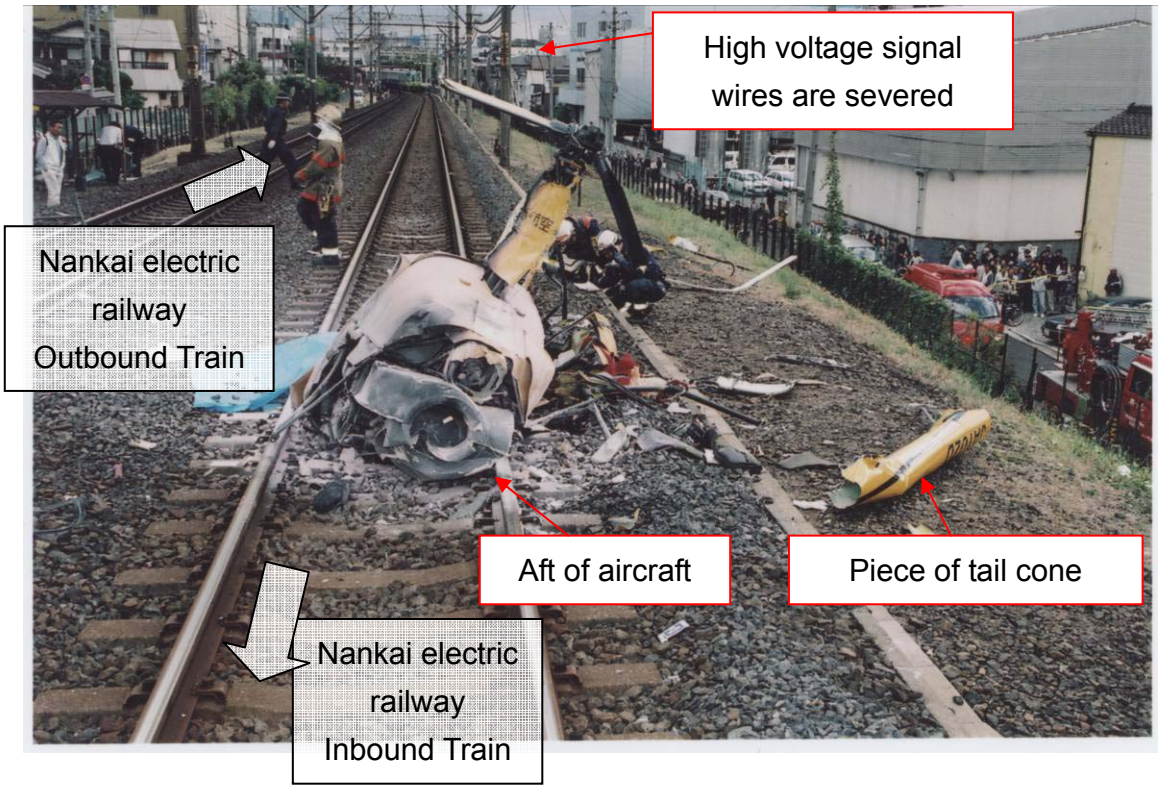


Photo 2　Accident aircraft 2

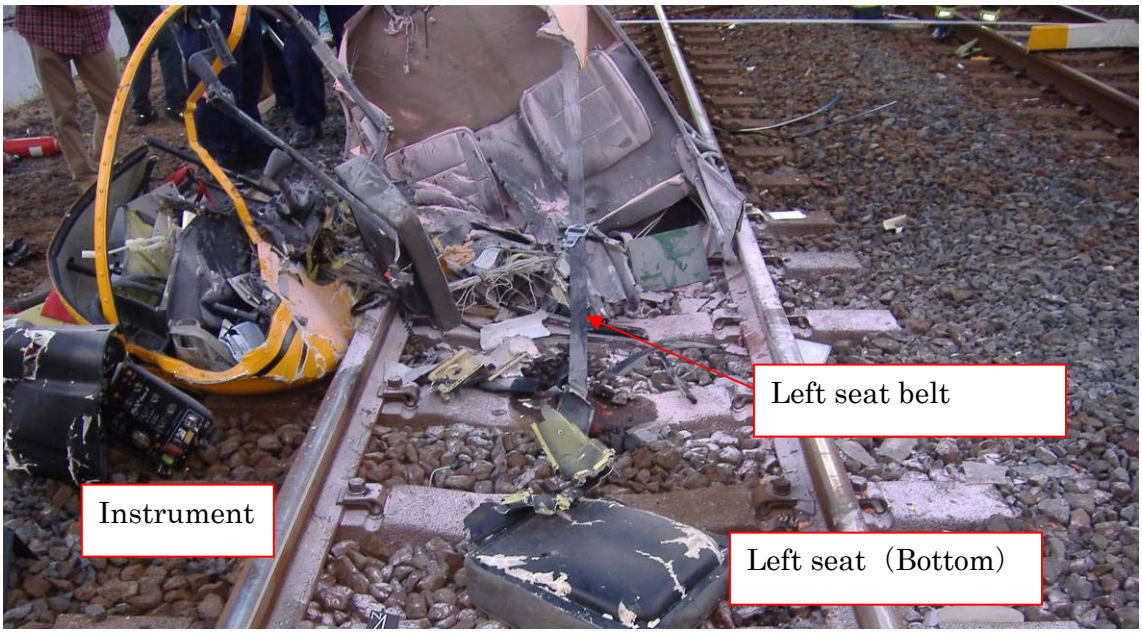
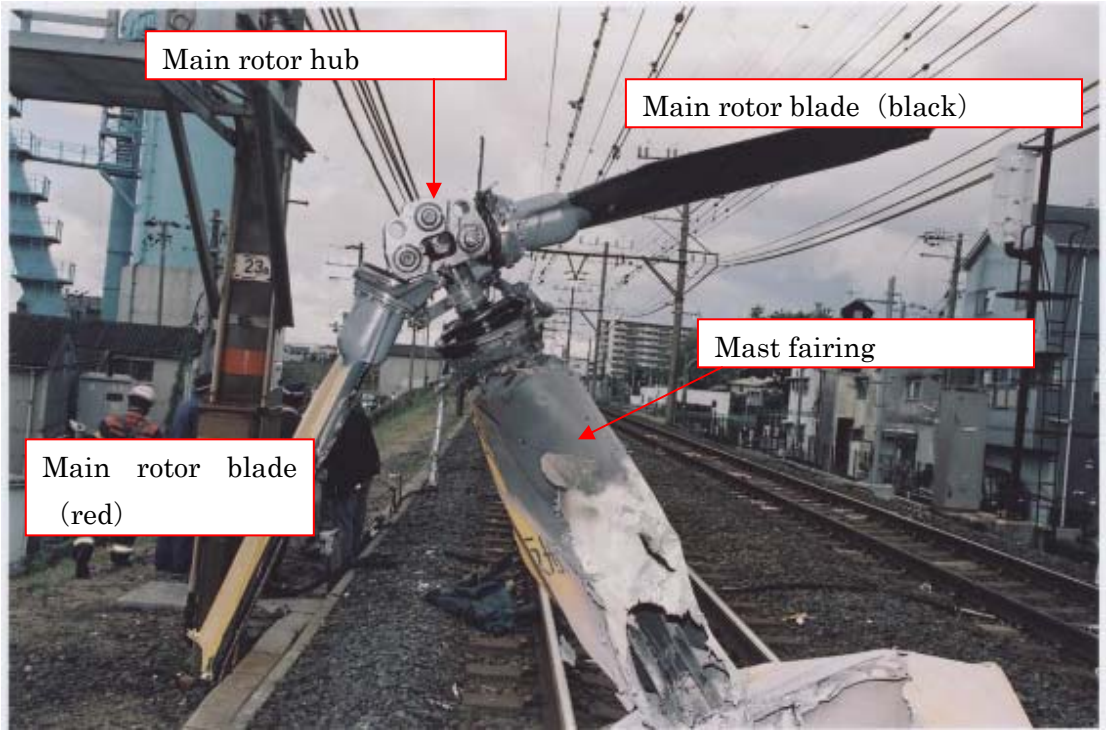


Photo 3　Main rotor blade



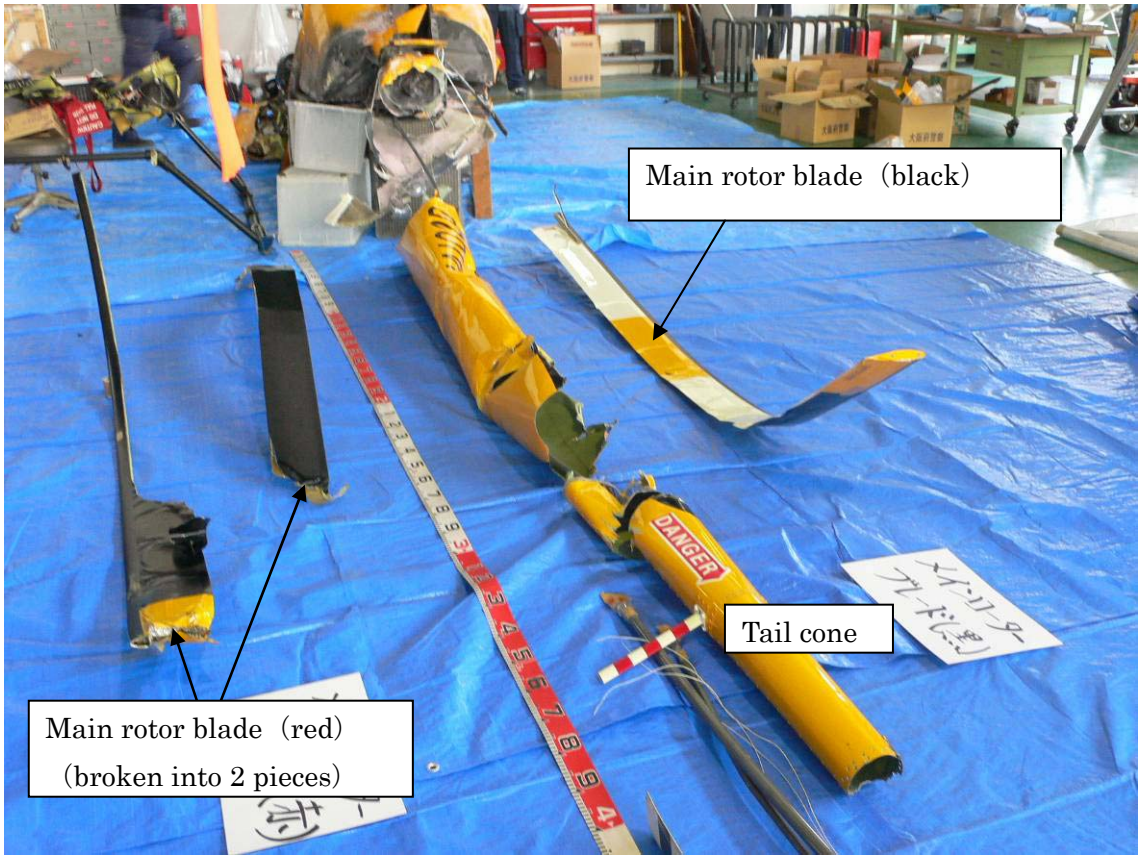
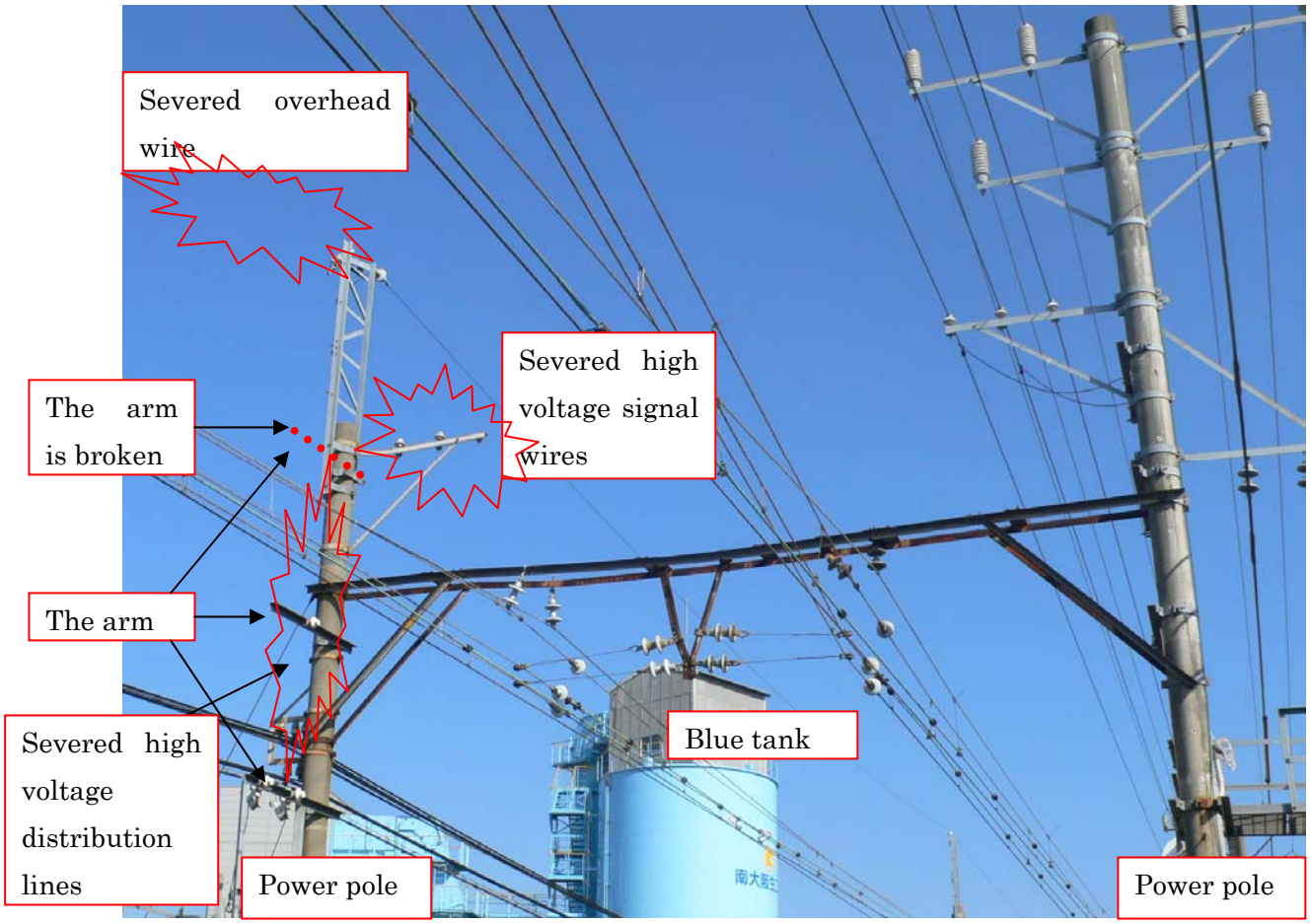


Photo 4　High tension signal wires are severed



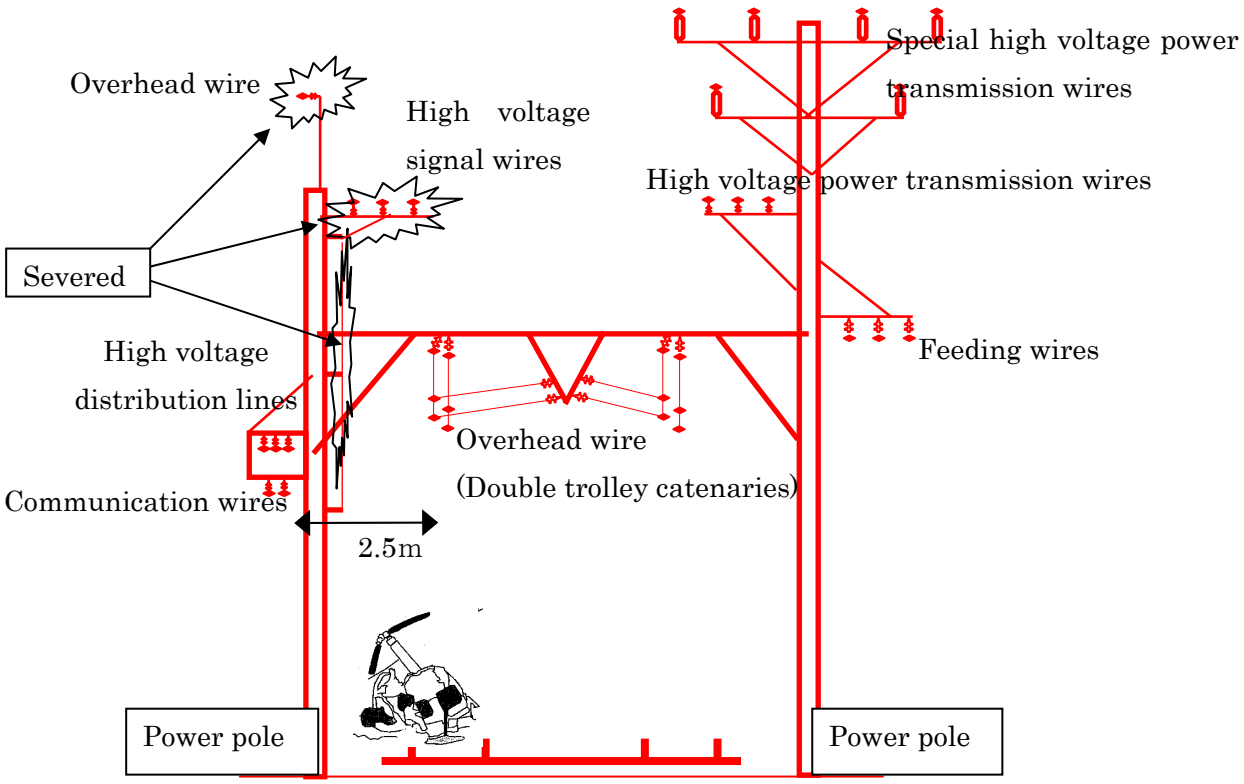
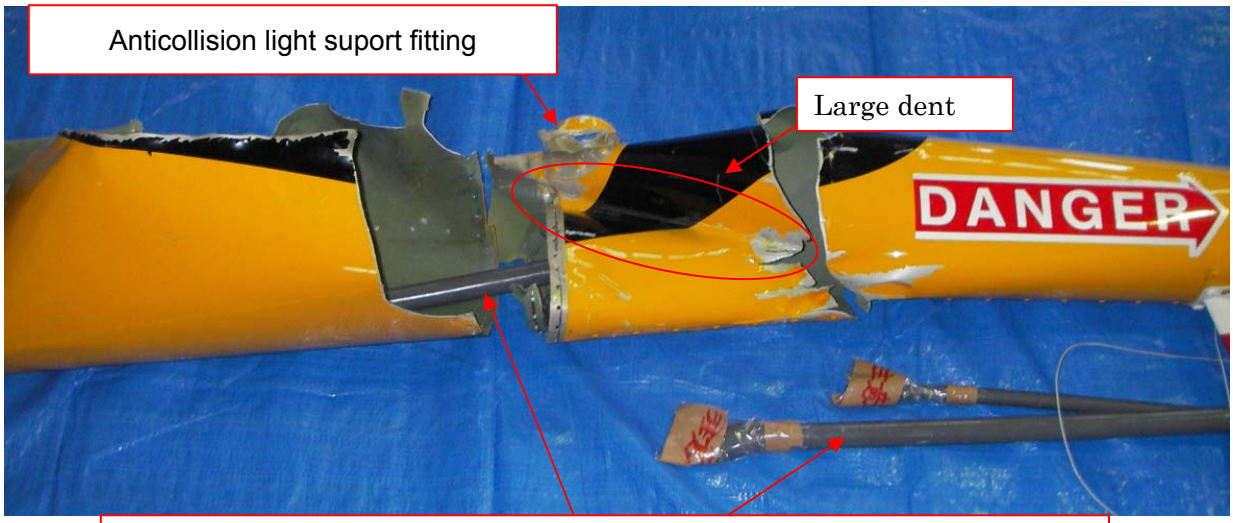


Photo 5　Large dent of main rotor blade in tail cone



Positional relationship between main rotor blade(black) and tail cone

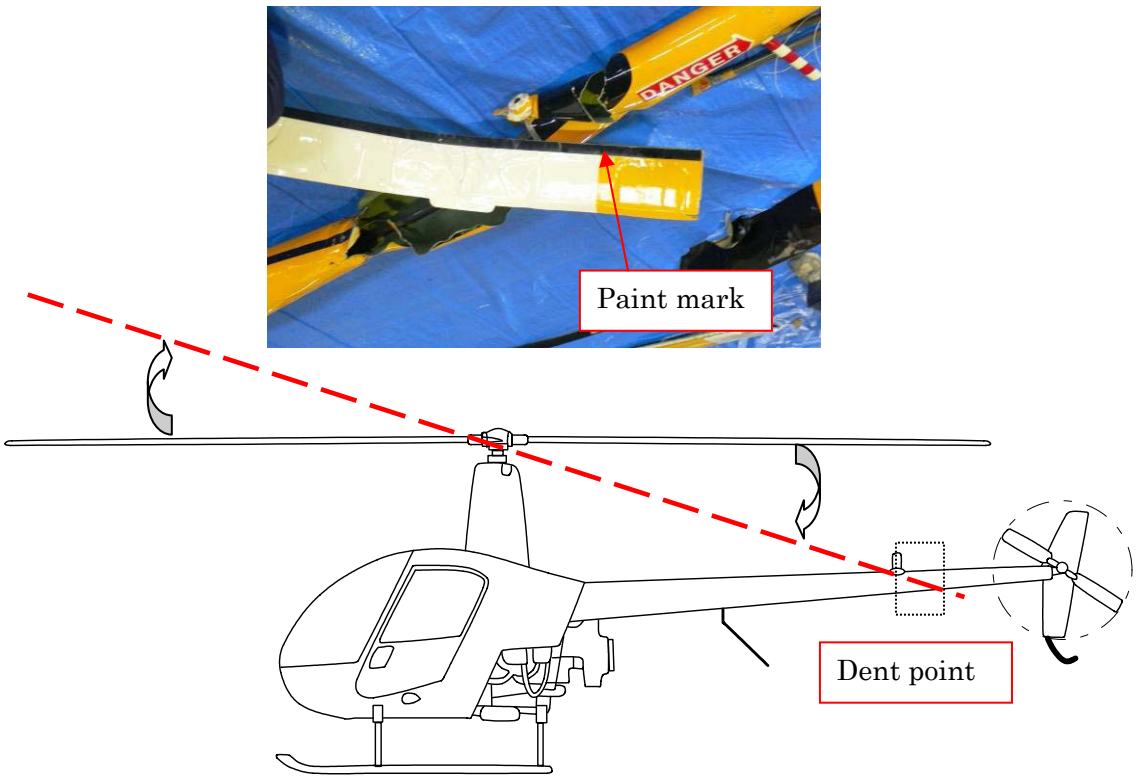
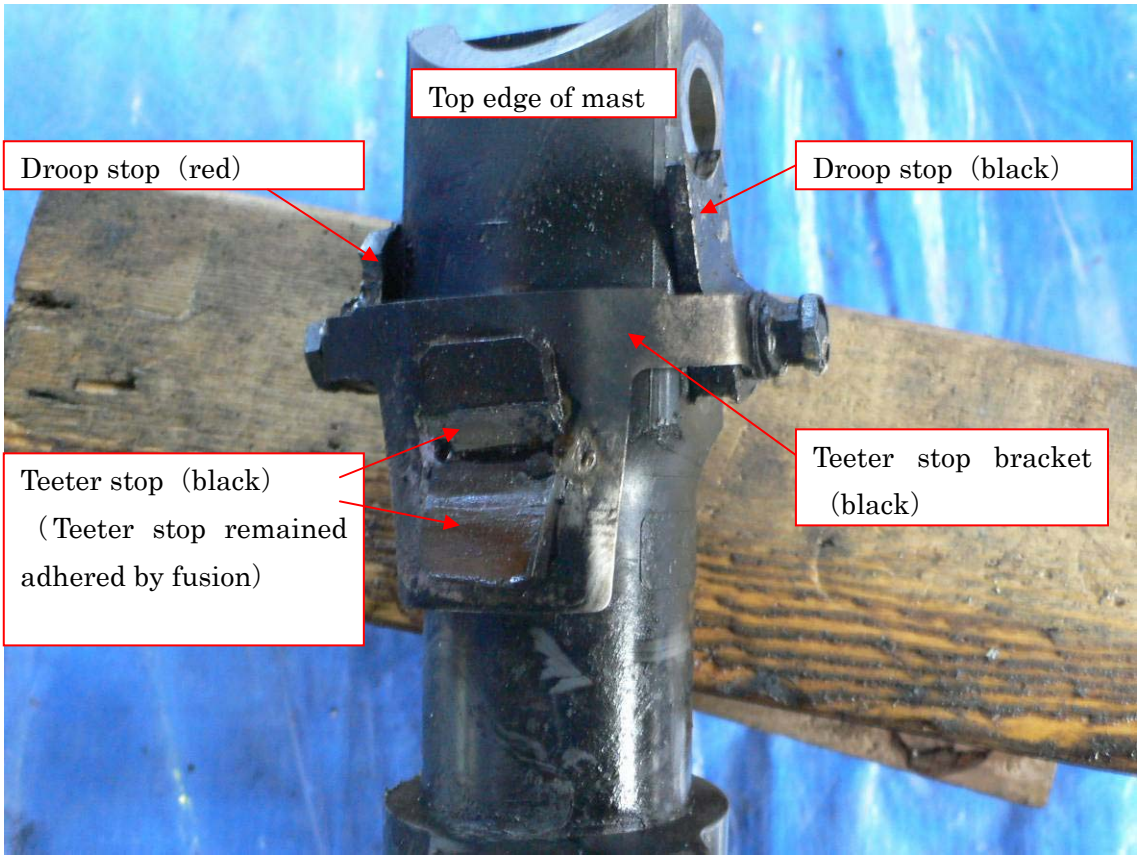
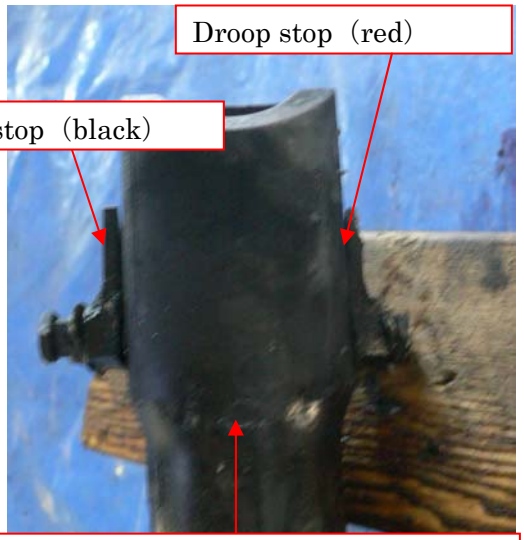


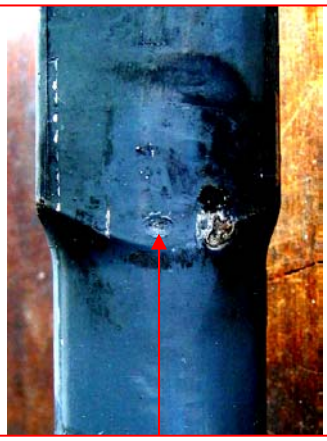
Photo 6　Top edge of mast





Teeter stop(red) and its bracket(red) were lost.
Teeter stop(red) location on the mast had been damaged

Mast removed from teeter stop bracket（black）



Teeter stop(black) location on the mast had been damaged

Photo 7　Spindle end on the red blade side

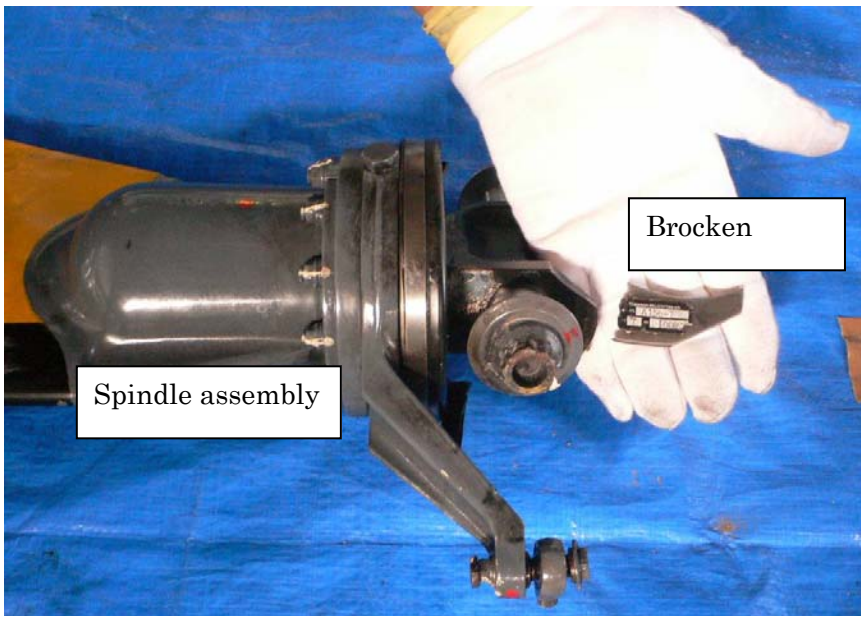


Photo 8　Main rotor hub