AI2023-2

AIRCRAFT SERIOUS INCIDENT
INVESTIGATION REPORT

Privately owned
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February 16, 2023

JTSB Japan Transport Safety Board

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board (and with Annex 13 to the Convention on International Civil Aviation) is to prevent future accidents and incidents. It is not the purpose of the investigation to apportion blame or liability.

TAKEDA Nobuo
Chairperson
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.

《Reference》

The terms used to describe the results of the analysis in "3. ANALYSIS" of this report are as follows.

i) In case of being able to determine, the term "certain" or "certainly" is used.
ii) In case of being unable to determine but being almost certain, the term "highly probable" or "most likely" is used.
iii) In case of higher possibility, the term "probable" or "more likely" is used.
iv) In a case that there is a possibility, the term "likely" or "possible" is used.

AIRCRAFT SERIOUS INCIDENT INVESTIGATION REPORT

DRAGGING DURING LANDING OF ANY OTHER PART OF THE LANDING GEARS OF THE AIRCRAFT

PRIVATELY OWNED

SOCATA TBM700, JA007Z

YAO AIRPORT, YAO CITY, OSAKA PREFECTURE

AT ABOUT 18:06, MARCH 6, 2022

January 27, 2023

Adopted by the Japan Transport Safety Board

Chairperson TAKEDA Nobuo

Member SHIMAMURA Atsushi

Member MARUI Yuichi

Member SODA Hisako

Member NAKANISHI Miwa

Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE SERIOUS INCIDENT INVESTIGATION

1.1 Summary of the serious incident	On March 6 (Sunday), 2022, a privately owned Socata TBM700, registered JA007Z, repeated bouncing*1 on Runway A at Yao Airport when landing, then executed a go-around, and landed on the runway at 18:11. The inspection conducted after the Aircraft's landing found the damage of the propeller blade tip and scratch marks on the runway. The only person on board the aircraft was the captain, who did not sustain any injuries.
1.2 Outline of the serious incident investigation	The occurrence covered by this report falls under the category of "Dragging during landing of any other part of the landing gears of the aircraft" as stipulated in Article 166-4, Item (iii) of the Ordinance for Enforcement of Civil Aeronautics Act (ordinance of Ministry of Transport No. 56 of 1952), and is classified as a serious incident. On March 7, 2022, the Japan Transport Safety Board (JTSB) designated an investigator-in-charge and two other investigators to investigate this serious incident. An accredited representative and an advisory of the French Republic, as the State of Design and Manufacture of the aircraft involved in this serious incident, and an accredited representative of Canada, as the State

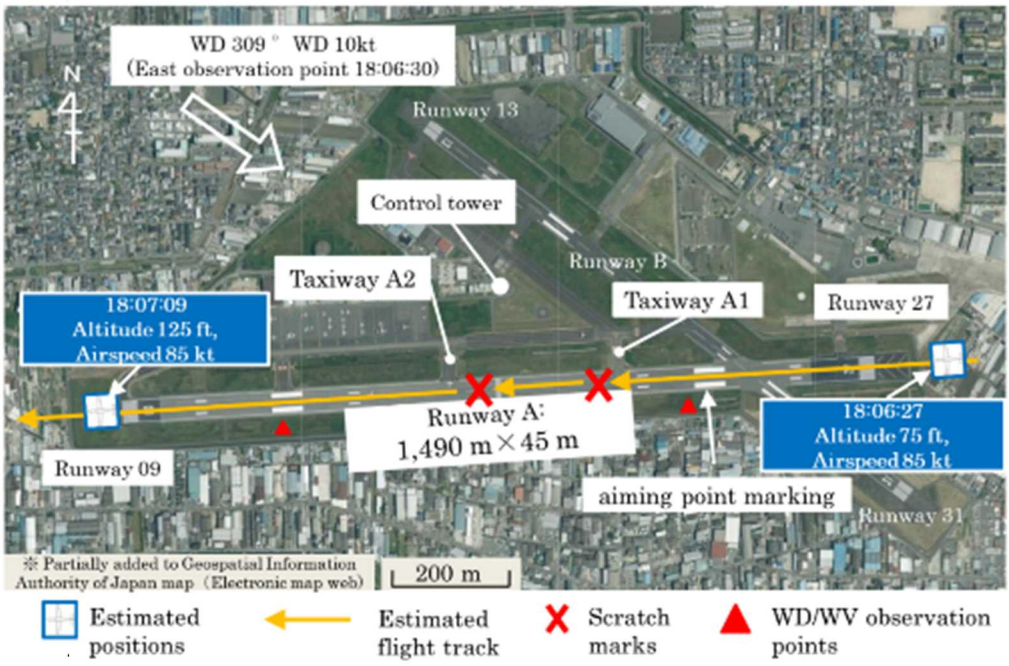
*1 A "bouncing" is a phenomenon where an aircraft bounces back into the air after the aircraft touched down during landing.

	of Design and Manufacture of the engine of the aircraft involved in this serious incident, participated in the investigation. Comments on the draft Final Report were invited from the parties relevant to the cause of the serious incident and the Relevant States.

2. FACTUAL INFORMATION

2.1 History of the Flight	According to the statements of the captain, the air traffic controller at Yao Airport Traffic Control Tower and the air traffic service flight information officer at the Yao Airport Office, as well as the air traffic control (ATC) communications records, the history of the flight is as outlined below. At about 16:37 Japan Standard Time (JST: UTC+9h, unless otherwise stated all times are indicated in JST on a 24-hour clock), March 6, 2022, a privately owned Socata TBM700, registered JA007Z (hereinafter referred to as "the Aircraft"), departed from Honda Airport in Saitama Prefecture under VFR toward Yao Airport in Osaka Prefecture for flight training, with a captain on board the Aircraft. At about 17:59, the captain established communication with the air traffic controller (hereinafter referred to as "Yao Tower") in charge of the aerodrome control station of Yao Airport Traffic Control Tower, and was instructed to land on Runway 27, then the Aircraft flew toward the traffic pattern*2 on the south side of the runway. The Aircraft was cleared by Yao Tower for landing on Runway 27, and encountered turbulence at an altitude of around 500 ft when approaching the runway. This turbulence had continued just before the touchdown. When the Aircraft was cleared for landing, it was informed by Yao Tower that the wind was blowing from the direction of 320° at 11 kt, and when the serious incident occurred (about two minutes after the landing clearance was given), the wind was from 320° at 8 kt. The captain executed an approach with the adequate descent angle (4.5°) as indicated by the Precision Approach Path Indicator (PAPI) installed on the runway while maintaining an indicated airspeed of 85 kt, and continued the final approach to land, regarding the aiming point marking*3 on the runway as the Aiming Point. At about 18:06, the captain reduced the engine thrust to idle for touchdown, and flared in order to reduce the descent rate of the Aircraft. However, the descent rate of the Aircraft was not reduced, and the Aircraft touched down with a greater than normal impact, and bounced back into the air. The captain continued landing while maintaining idle engine thrust, judging it was possible to land like that because the Aircraft's attitude was stable after bouncing. After that, the Aircraft repeated bouncing three times at intervals of two to three seconds, and its attitude became unstable when it last bounced

*2 The "traffic pattern", is the standard flight path flown by aircraft taking off from and landing under VFR.
*3 The "aiming point marking" indicates a visual aiming point on the runway and is painted on the runway surface.

	back into the air, therefore, the captain judged that it would be dangerous to continue landing, and commenced a go-around in the vicinity of the south of Taxiway A2 (see Figure 1). The captain felt that the Aircraft touched down from the nose gear one time while it was repeatedly bouncing. At 18:06:58, the Aircraft informed to Yao Tower that it executed a go-around, and after that, the Aircraft approached for the runway again. At 18:11, the Aircraft landed on the runway, moved to the apron, and stopped the engine. As the post-landing exterior check of the Aircraft found the damage to the propeller blade tip, the captain reported it to the Yao Airport Office. The air traffic service flight information officer at the Airport Office who received the report above conducted an inspection of the runway, and found there were four scratch marks (at about 40 cm intervals) on the runway surface near Taxiway A1 and five scratch marks (at about 40 cm intervals) near the center of the runway. The serious incident occurred on Runway A at Yao Airport (the location of scratch marks on the east side) (34'35"46 N, 135'35"58 E) at 18:06 on March 6, 2022.  Figure 1: Estimated flight route (The estimated position information is based on Flightrada24*4 tracks.)
2.2 Injuries to Persons	None
2.3 Damage to the Aircraft	Slightly damage (1) Four propeller blades: Damage to tips (about 3 cm) (2) Nose gear: Wheel misalignment (Tilted to left wing), cracks in landing light front cover

*4 "Flightradar24" is a website where aircraft radar position information and flight routes can be obtained.

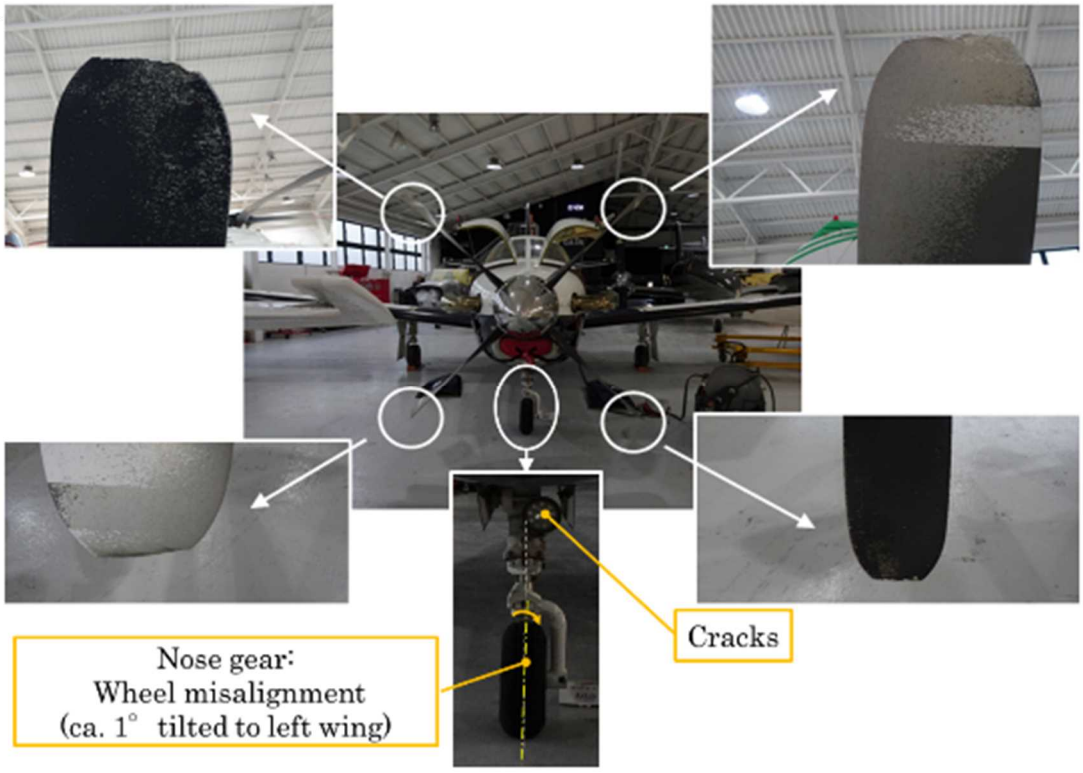


Figure 2: Conditions of propeller blades and nose gear

2.4 Personnel Information	Captain Age 51 Airline transport pilot certificate: July 3, 2018 Rating for Single: May 29, 1998 for Airbus A320: December 6, 2012 Class 1 aviation medical certificate Validity: September 26, 2022 Pilot Competency Assessment (Airbus A320) Validity: May 22, 2023 Date of the confirmation of knowledge and proficiency required for piloting the Socata TBM700: February 22,2022 Total flight time: 10,496 hours 08 minutes Flight time in the last 30 days: 61 hours 01 minutes Flight time in the last 90 days: 149 hours 27 minutes Total flight time on the type of aircraft: 11 hours 44 minutes Flight time in the last 30 days: 4 hours 20 minutes Flight time in the last 90 days: 4 hours 20 minutes
2.5 Aircraft Information	(1) Aircraft Type: Socata TBM700 Serial number: 313 Date of manufacture: November 22, 2004 Certificate of airworthiness: No. Dai-2021-020 Validity: April 11, 2022 Total flight time: 2,180 hours 06 minutes (2) Type of engine: Pratt & Whitney Canada PT6-64 Serial number: PEC-PM0195 Date of manufacture: October 2, 2004

Total time in service 2,180 hours 06 minutes

When the serious incident occurred, the Aircraft's weight is estimated to have been 5,759 lb and its center of gravity is estimated to have been 23.6% MAC*5, both of which are estimated to have been within the allowable range.

2.6 Meteorological Information

(1) The observation data in the aerodrome routine meteorological report at Yao Airport at around the time of the serious incident was as follows:

18:00 Wind direction and velocity 310° 10 kt, Visibility 10 km or more,
Clouds: Amount FEW, Type Cumulus, Cloud base 2,500 ft
Clouds: Amount SCT, Type Stratocumulus, Cloud base 6,000 ft
Temperature 7 ℃, Dew point -4 ℃,
Altimeter setting (QNH) 1,016 hPa

(2) At the Airport, meteorological observation instruments are installed at two places in order to measure wind direction and velocity (see Figure 1). The observation values of wind direction and velocity every six seconds between 18:05 and 18:07 on the day of the accident, which were measured by each instrument, were shown in Table 1.

Table 1: Observation values of wind direction and velocity on Runway A

Time	RWY09		RWY27	
	WD (magnetic bearing)	WV (kt)	WD (magnetic bearing)	WV (kt)
18:05:00	297	12	310	7
18:05:06	298	11	311	7
18:05:12	305	13	314	8
18:05:18	295	17	316	8
18:05:24	292	13	316	8
18:05:30	302	14	315	10
18:05:36	303	14	308	7
18:05:42	294	15	316	8
18:05:48	298	17	307	9
18:05:54	300	16	319	11
18:06:00	286	17	303	9
18:06:06	286	15	311	12
18:06:12	293	13	307	11
18:06:18	304	12	308	11
18:06:24	294	14	309	10
18:06:30	292	13	309	10
18:06:36	293	13	322	9
18:06:42	298	14	314	9
18:06:48	295	13	315	8
18:06:54	289	13	325	9
18:07:00	286	14	329	10

(3) According to the information on the surface winds provided to the captain by Yao Tower, the maximum instantaneous wind velocity exceeding the average wind velocity of 10 kt or more had not been reported.

*5 "MAC" refers to the abbreviation Mean Aerodynamic Chord. It is a wing chord that represents the aerodynamic characteristic of the wing, and indicates the average of when the wing chord such as the rear wing chord is variable. 23.6% MAC indicates a 23.6% position from the front of the mean aerodynamic chord.

2.7 Additional Information	(1) Scratch marks on the runway There were scratch marks in two sections on Runway 27. The four scratch marks on the east side were located on the runway centerline at equal intervals of about 40 cm, and the width of the scratches was about 3 mm to 21 mm, the length was about 50 mm to 170 mm, and the maximum depth was about 3 mm. The five scratch marks on the west side were located about 200 m west of those on the east side, and about 2 m south from the runway centerlines. The five scratch marks were located at equal intervals of about 40 cm, the width of the scratches was about 29 to 52 mm, the length was about 220 to 270 mm, and the maximum depth was about 4 mm. Comparing those scratch marks on both sides, the scratched size of the marks on the west side were larger than that of those marks on the east. (See Figure 3) In addition, the runway check before this serious incident occurred, the scratch marks located on the east and west were not confirmed on the runway.

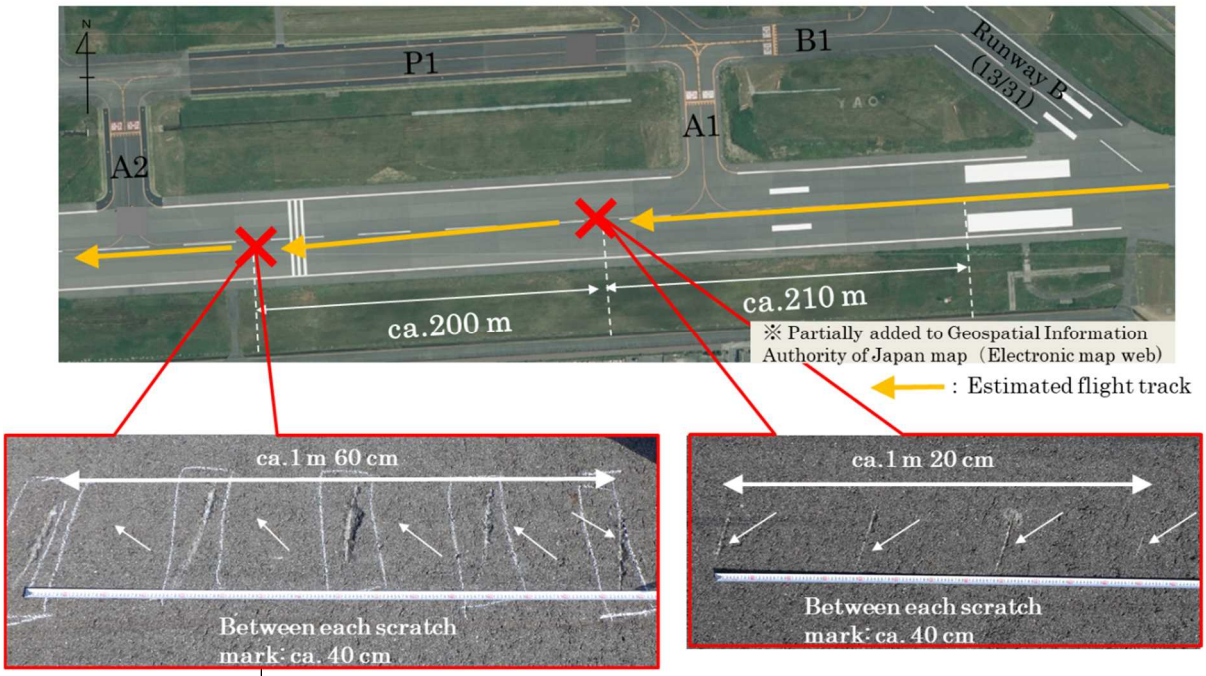


Figure 3: Scratch marks on the runway

(2) Captain's flight experience on the Socata TBM700

In order to fly the Aircraft, from November 1, 2021, to February 11, 2022, the captain took the training which was provided in the "Guideline on education and training for those who intend to fly the aircraft of the same type and class as the rating on the competence certification, but for the aircraft they have no flight experience" (Kokukuko No. 1055, June 29, 2020), issued by the Civil Aviation Bureau of the Ministry of Land, Infrastructure, Transport and Tourism. On the final day of this training, the captain completed the prescribed training and was checked by the instructor in this

training to have sufficient knowledge and skills to fly the Socata TBM700. During this training, the captain made six landings (including the two landings at night) on Runway 27 at Yao Airport.

The serious incident flight was the first solo flight on the Socata TBM 700 for the captain after completing the training. Before this flight, on the day of the serious incident, the captain observed a flight to familiarize himself with the Aircraft while on board, operated by its owner from Yao Airport to Honda Airport. In this flight, the final approach to Honda Airport was made with a descent angle of about 3°.

In addition, working for the Air Transport Services operator, the captain was engaged as a pilot of an Airbus A320 to take scheduled flights. For about one month from the next day of the training completion date to the previous day of the occurrence of the serious incident, the captain had flown an Airbus A320 and conducted 14 landings. Therefore, due to influence of landing a large airplane, the captain was conscious not to commence flare for landing too early, he stated.

(3) The time of sunset on the day of the serious incident

The time of sunset on the day of the serious incident was 17:58. When the serious incident occurred, it was twilight, and it was getting slightly darker compared to the daytime, but not completely dark.

In addition, according to the statement of the captain, at the time of the serious incident, it was more difficult to see the runway compared to the daytime.

(4) Characteristics of Yao Airport

The Airport has Runway A, 1,490 m long and 45 m wide, which has a magnetic bearing of 93°/273°. Approach angles indicated by the PAPIs installed at Yao Airport are 4.5° for Runway 27 and 4.0° for Runway 09. Runway edge lights and runway threshold lights are installed at the Airport, and both types of them were lit when the serious incident occurred.

Besides, according to the statement of pilots based at the Airport, when landing on Runway 27 in the strong wind blowing from the northwest, a phenomenon may occur where an aircraft greatly sinks from the time of passing over the runway threshold to the time of the touchdown.

(5) Bouncing

According to the "Airplane operation textbook" (4th Edition, 2013) (hereinafter referred to as "the Textbook") supervised by the Civil Aviation Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "a bouncing will occur when the aircraft touches down before it reaches the proper landing attitude" (P. 122), and as correction procedures in case of a bouncing, "it should immediately execute a go-around for 'a large bouncing', while in case of 'a light bouncing' and no radical change in pitch attitude, by maintaining the direction, increasing engine thrust in order to mitigate the impact of touchdown, and operating smoothly to establish the touchdown attitude, it is possible to continue landing" (P. 122).

	Although the captain had not experienced a bouncing during the landing of the Aircraft, he had experience of a go-around and continuing landing following the bouncing of other small aircraft. He also experienced bouncing during the landing in the flight on the air transport services, which was his latest major flight experience, when he continued landing judging it would be "a light bouncing" and made the landing without any problems. (6) Similar cases ① On Thursday, March 24, 2011, a Cessna 172S, registration JA33UK, attempted to land on Runway 07 at Kumamoto Airport, bounced at the touchdown, and at the second touchdown, the propeller blades contacted the runway surface resulting in damage to the aircraft. As one of the measures of recurrence prevention for the relevant serious incident, it was recommended that appropriate flight training including the use of actual aircraft should be provided so that pilots can exeute a go-around without hesitation when encountering the abnormal sink after passing over the runway threshold, or bouncing at the touchdown. ② On February 18, 2011, a Fairchild Swearingen SA226-AT, registered JA8828, had its airframe damaged, when it had a rapid descent due to sudden changes in the wind direction and velocity after passing over the runway threshold and violently touched down during the landing on Runway 27 at Yao Airport. As a cause of the accident, it was pointed out that changes in the wind direction and velocity contributed to the rapid reduction in the lift, and a go-around should have been executed as quickly as possible when the Aircraft started to descend rapidly after passing the runway threshold.

3. ANALYSIS

(1) The course from first touchdown up to go-around

The JTSB concludes that the situation from the Aircraft's first touchdown up to its go-around was more likely as shown in Figure 4.

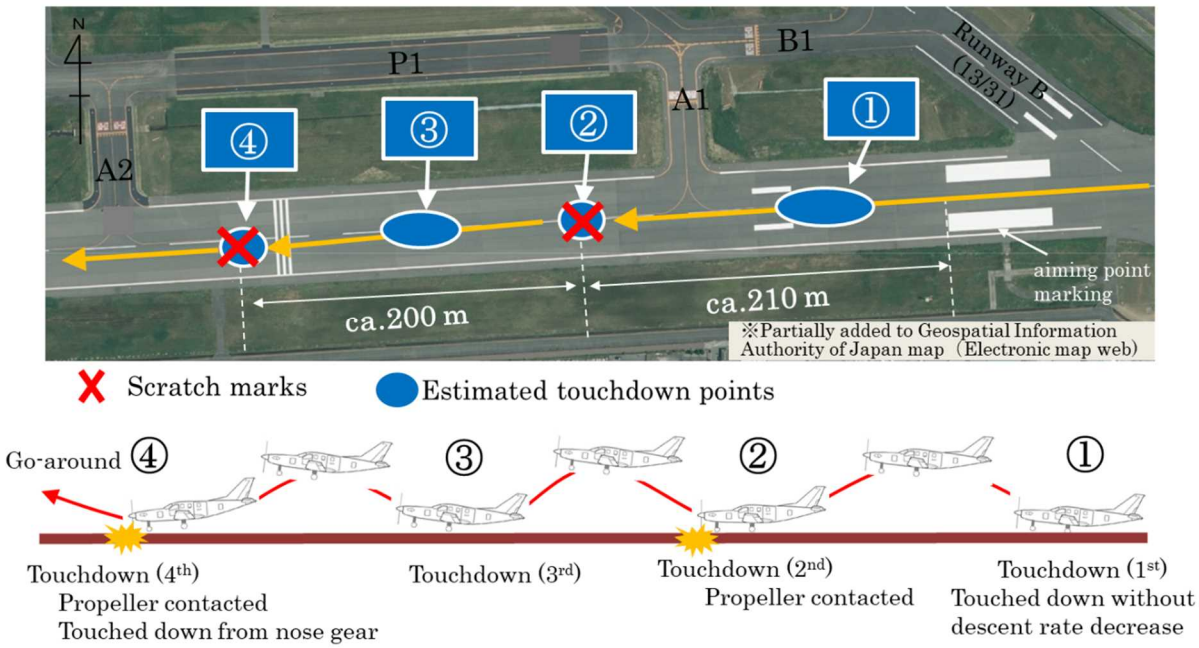


Figure 4: Touch down status (Estimation)

The ground speed, which was calculated from the scratch marks generated by contact between the propeller blades and the runway surface, which were found in two locations in the east and the west (② and ④ in Figure 4), was about 78 kt for both of them. The distance between the scratch marks on the east side (② in Figure 4) and those on the west side (④ in Figure 4) was about 200 m, when the Aircraft flies at the ground speed as above, it would take about five seconds from the first contact with the propeller blades to the second contact with them. As the captain stated the Aircraft repeatedly touched down and lifted off at equal intervals of two to three seconds, it is probable that the Aircraft touched down once (③ in Figure 4) between the scratch marks on the east side and those on the west side, and lifted off.

On the other hand, the distance between the scratch marks on the east side (② in Figure 4) and the aiming point marking on the runway was about 210 m, therefore from the number of repeated touchdowns and lift-offs and intervals between them, the first touchdown position was more likely located about 100 m east (① in Figure 4) of the scratch marks on the east side (② in Figure 4). From this, the propeller blades more likely contacted with the runway surface for the first time at the second touchdown.

It is probable that the bouncing followed by the touchdown with a nose low attitude caused the propeller blades to contact with the runway, and as the size of scratch marks on the west side was deeper and larger than those on the east side, suggesting that the second propeller blade contact was more intense than the first, and the touchdown from the nose gear, which the captain recognized, was the fourth touchdown immediately before the go-around.

(2) Occurrence of bouncing

The JTSB concludes that according to the Textbook, "a bouncing will occur when the aircraft touches down before it reaches the proper landing attitude", which indicates that the aircraft touches down when the descent rate cannot be reduced to an appropriate value by making flare, therefore the touchdown at a descent rate higher than the appropriate value more likely

contributed to the Aircraft's bouncing. It is probable that the wind effects and the captain's operations contributed to a bouncing that occurred in this serious incident as follows:

① Effects of winds

A northwesterly wind was blowing throughout the Airport.

From observation results for the wind direction and velocity in the two locations on Runway A, the wind velocity in the vicinity of the touchdown point on Runway 27, when the Aircraft made the first approach, was 1 to 9 kt less than that measured by the anemometer on the west side. In addition, the wind direction measured by the anemometer on the east side was 4° to 43° norther (change in the direction of decreasing wind velocity from the front of the fuselage) than the value measured by the anemometer on the west side (see Table 1).

This was likely the local change that occurred when the northwesterly wind was affected by buildings such as the hangars, etc., (see Figure 5), and it is possible that during the final approach to runway 27, at a location which was not leeward of the building, the wind was not affected by the hangars, etc., and was equivalent to the value measured by the anemometer on the west side. Due to the reduction of the wind velocity and changes in the wind direction, the lift decreased after the Aircraft passed the runway threshold, which likely resulted in the touchdown with a greater than normal impact while the descent rate could not be reduced even with flare. (See Figure 5)

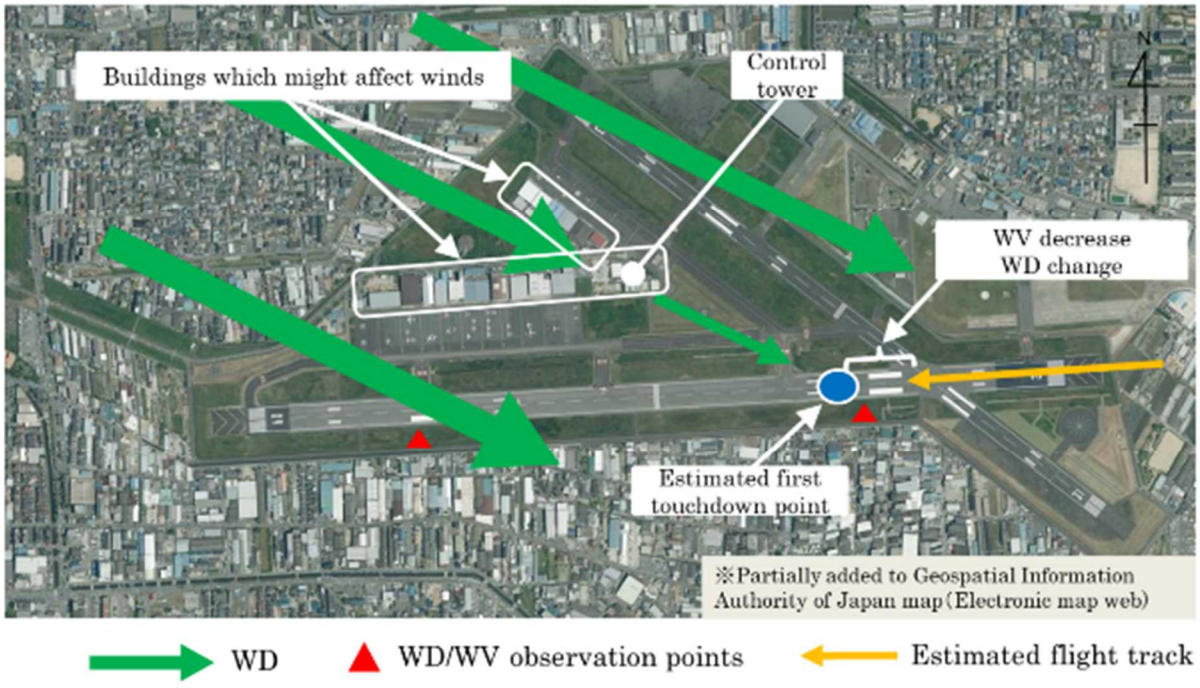


Figure 5: Wind conditions at the Airport

When landing on Runway 27 if a strong northwesterly wind is blowing in this way, in case there are differences in the wind direction and velocity values between the two locations, east and west, an aircraft may have a rapid descent in the vicinity of the touchdown point on Runway 27. At the time of landing on the runway, by confirming the wind conditions on both sides, east and west in advance, it is possible to expect the possibility of a rapid descent at the touchdown and avoid landing while the descent rate cannot be reduced. For this reason, when the wind blows strongly from the direction of the northwest to the north, it is recommended to confirm with air traffic controllers about both wind conditions before landing.

② Pilot's operations

The main factors for pilot's operations relating to the magnitude of the impact at the touchdown during landing are touchdown attitude and airspeed. It is probable that from the airspeed calculated from the scratch marks, and the wind conditions when this serious incident occurred, the flight speed of the Aircraft had been maintained appropriately up until the touchdown, and the flight speed during the final approach would less affect the Aircraft's touchdown in this serious incident.

On the other hand, regarding the touchdown attitude that affects landing operations, the following possibilities are considered.

When performing landing, a pilot visually judges the timing to start reducing the descent rate, the subsequent adjustment of the descent rate shall be performed depending on how the runway and its surrounding ground references look. It is certain that the landings that the captain had experienced in the most recent one month were made mainly with an approach angle of about 3°, which is a standard for large aircraft. For this reason, the captain's visual perception had likely gotten used to landing with a descent angle of 3°. For Runway 27 at Yao Airport, the final approach descent angle was 4.5°, which is steeper than the standard one. When an aircraft approaches with a descent angle steeper than the standard one for landing, the nose will be downward more than in a standard landing approach. Establishing a proper touchdown attitude requires a major attitude change greater than in a standard approach, however, in this serious incident, the Aircraft likely touched down before the required attitude change was made.

Besides, the timing to start flare is different between a large aircraft and a small one, and the aircraft attitude at touchdown is different depending on the aircraft type.

Furthermore, cockpit location and window size are different between a large aircraft and a small one, therefore, there is a difference between them about how the runway looks. The captain was aware that the descent angle at Yao Airport was as large as 4.5°, and the timing to start flare was different between a large aircraft and a small one, however, his flare was likely delayed under the circumstances after-dark when it was difficult to see the runway compared to the day time and to judge the height from the runway.

From above, it is possible that the Aircraft could not established a proper touchdown attitude and touched down with a greater than normal impact while the descent rate could not be reduced.

(3) The fact that the landing was continued without recognizing the change in touchdown attitude after the bouncing

The JTSB concludes that as described in 2.7 (5), as correction procedures in case of a bouncing, it should immediately execute a go-around, or establish a proper touchdown attitude by increasing engine thrust in order to mitigate the impact of touchdown. The captain stated that he continued landing because the Aircraft's attitude was stable after the bouncing, however the propeller blades contacted with the runway at the time of the first touchdown after the bouncing, therefore, it suggests that the Aircraft was more likely in a nose-low attitude.

Regarding the fact that the captain was not able to recognize this change in attitude, it is possible that the circumstances of the twilight after sunset likely resulted in the captain's failure to recognize the nose-low attitude because it was difficult for him to see the runway and its surrounding ground references on the ground and to judge the height and its attitude.

Besides, the reason why the captain continued landing after the first bouncing is that the captain recognized the Aircraft's attitude was stable, and, in addition, that it was possibly

influenced by the captain's experience having continued landing after the bouncing to make the landing without any problems in a flight on other aircraft.

(4) Countermeasures against abnormal aircraft behavior during landing approach and touchdown

The JTSB concludes that it is necessary to execute a go-around without hesitation to counter a large bouncing after the touchdown as indicated in the Textbook and described in the recommendations from the JTSB for similar past serious incident ① introduced in this report, or the abnormal sink after passing over the runway threshold as in the similar past serious incident ②. Especially as in this serious incident, when an aircraft bounces after touching down with an impact greater than usual while the descent rate cannot be reduced, the pilot is probably more likely able to prevent the propeller blades, etc. from contacting with the runway by executing a go-around immediately. It is important for pilots to undergo training on a regular basis for a go-around using actual aircraft and double-check countermeasures for how to deal with bouncing and others after touchdown so that they can make decisions and always conduct the response operations in such cases.

4. PROBABLE CAUSES

The JTSB concludes that the probable cause of this serious incident was that after the aircraft touched down and bounced with a greater than normal impact while the descent rate could not be reduced in the strong wind blowing from the northwest, it was unable to establish a proper attitude and touched down again with a nose-low attitude.

It is probable that the Aircraft touched down again with a nose-low attitude because the change in the Aircraft's attitude after the touchdown was not properly recognized.

5. SAFETY ACTIONS

It is important for pilots to execute a go-around without hesitation, if a bounce occurs after the touchdown with a greater than normal impact while the descent rate cannot be reduced.