

AA2021-3

**AIRCRAFT ACCIDENT
INVESTIGATION REPORT**

**JIN AIR CO., LTD.
HL 8243**

April 22, 2021

The objective of the investigation conducted by the Japan Transport Safety Board in accordance with the Act for Establishment of the Japan Transport Safety Board and with Annex 13 to the Convention on International Civil Aviation is to determine the causes of an accident and damage incidental to such an accident, thereby preventing future accidents and reducing damage. It is not the purpose of the investigation to apportion blame or liability.

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.

AIRCRAFT ACCIDENT INVESTIGATION REPORT

**CABIN CREW MEMBER INJURY
BY THE SHAKING OF THE AIRCRAFT
JIN AIR CO., LTD.
BOEING 737-800, HL8243
AT FL 250 ABOUT 30 KM NORTHWEST OF
FUKUOKA AIRPORT, JAPAN
AROUND 13:17 JST, JANUARY 12, 2020**

April 1, 2021

Adopted by the Japan Transport Safety Board

Chairperson TAKEDA Nobuo
Member MIYASHITA Toru
Member KAKISHIMA Yoshiko
Member MARUI Yuichi
Member NAKANISHI Miwa
Member TSUDA Hiroka

1. PROCESS AND PROGRESS OF THE AIRCRAFT ACCIDENT INVESTIGATION

1.1 Summary of the Accident	<p>On Sunday, January 12, 2020, a Boeing 737-800, registered HL8243, operated by Jin Air Co., Ltd., took off from Kitakyushu Airport, and during the climb to the cruising altitude bound for Incheon International Airport in the Republic of Korea, the aircraft experienced shaking, which caused a cabin crew member to fall down resulting in her injury.</p>
1.2 Outline of the Accident Investigation	<p>The Japan Transport Safety Board (JTSB) designated an investigator-in-charge and an investigator on January 14, 2020 to investigate this accident.</p> <p>An accredited representative of the Republic of Korea, as the State of Operator of the aircraft involved in this accident, participated in the investigation. Although the occurrence of the accident was notified to the United States of America, as the State of Design and Manufacture of the aircraft, the State did not designate its accredited representative.</p> <p>Comments were invited from parties relevant to the cause of this accident and the Relevant States.</p>

2. FACTUAL INFORMATION

2.1 History of the Flight	<p>According to the statements of the pilot in command (PIC), the first officer (FO), the trainee in the FO promotion training and the injured cabin crew member, and the records of flight data recorder (hereinafter referred to as "FDR"), ATC communication records and radar track records, the history of the flight is summarized as follows.</p> <p>On January 12, 2020 at 13:06 JST (JST: UTC+9 hours; unless otherwise noted, all times are indicated in JST in this report on a 24-hour clock,) a Boeing</p>
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737-800, registered HL8243, operated by Jin Air Co., Ltd. as a scheduled flight 262, with 174 persons in total on board, consisting of the PIC, six crew members and 167 passengers, took off from Kitakyushu Airport bound for Incheon International Airport. In the cockpit, the PIC was in the left pilot's seat as PM*1, the trainee in the FO promotion training in the right pilot's seat as PF*1, and the FO in the observer seat.

When reaching an altitude of 10,000 ft during the climb, the flight crew members confirmed that there was no shaking in the Aircraft and visually checked that there were no clouds on the climb route, and turned off the seat belt sign in the cabin around 13:12. After that, the Aircraft continued to climb to the cruising altitude of FL*2 320.

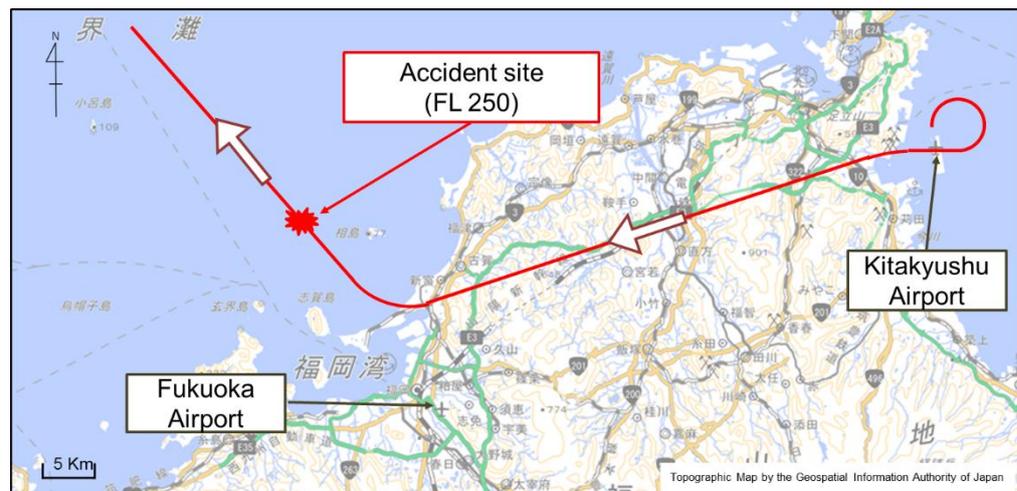


Figure 1: Estimated flight route

After the seat belt sign was turned off, based on the weather information confirmed prior to their departure, the PIC anticipated the possibility that they might encounter shaking during the climb, thus he was thinking of how to respond, such as promptly turning on the seat belt sign to have the cabin crew members seated, when detecting a sign of shaking or in the case of a sudden shaking.

On the other hand, in the cabin, after the seat belt sign was turned off, cabin crew members started selling duty-free goods and distributing immigration cards. The senior cabin crew member (hereinafter referred to as “the Purser”) moved to the aft galley to take care of passengers. The layout of cabin crew members’ positions is as shown in Figure 2.

*1 “PF” and “PM” are the terms used to identify pilots by their different roles in aircraft operated by two persons. PF is an abbreviation of Pilot Flying and is mainly responsible for maneuvering the aircraft. PM is an abbreviation of Pilot Monitoring mainly responsible for monitoring flight status of the aircraft and cross-checking of PF’s maneuvering and undertakes other non-operational tasks.

*2 “FL” (Flight Level) is the pressure altitude in the standard atmosphere. The FL is expressed in the value given by dividing the reading on the altimeter (the unit is ft) by 100 when the altimeter is set to 29.92 inHg. In Japan, flying altitudes of 14,000 ft or higher are usually indicated in the flight level. For example, FL 200 means an altitude of 20,000 ft.

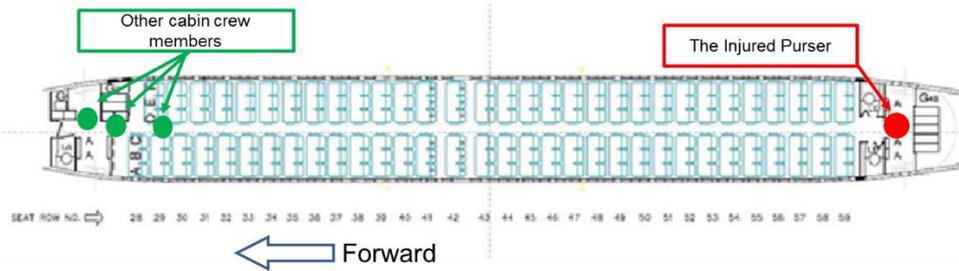


Figure 2: Layout of cabin crew members' positions immediately before the accident
(Added to the figure provided by Aviation and Railway Accident Investigation Board, Republic of Korea)

Until reaching an altitude of about FL 250 after the seat belt sign was turned off, the Aircraft had neither entered clouds nor encountered shaking, and any sign of shaking were not confirmed on the airborne weather radar and other instrument indications. However, around 13:17 immediately after reaching FL 250, the Aircraft was strongly shaken all of sudden, therefore the PIC turned on the seat belt sign at once. At this time, the PIC instructed the cabin crew members to be seated promptly.

When this shaking occurred, the Purser in the center of the aft galley was standing facing forward of the cabin, but fell down to the right not being able to support herself. Afterward, being seated in her seat located near the aft galley, the Purser confirmed that she had pain in her right ankle and suffered abrasions. Following the initial shaking, smaller shakings continued. The Aircraft ceased to be shaken after reaching FL 270, and it reported to Fukuoka Air Traffic Control that they encountered turbulence. Besides, the Aircraft was using the autopilot system from the initial climb after taking off from Kitakyushu Airport until it encountered a shaking and it subsided. Furthermore, when the Aircraft encountered turbulence, the auto pilot system remained engaged.

After the shaking in the Aircraft ceased, having received reports that passengers and the cabin crew members other than the Purser were not injured, the PIC judged that it would be possible to fly to Incheon International Airport, their destination, and the Aircraft continued to fly. The injured Purser performed her duties possible to do remaining seated in her seat.

The PIC interviewed the injured Purser on the detailed situation after the Aircraft arrived at Incheon International Airport. After that, the Purser was diagnosed with a lateral malleolus fracture in her right ankle in a hospital in Seoul City.

This accident occurred on January 12, 2020 around 13:17, at FL 250 about 30 km northwest of Fukuoka Airport (33° 48' 08" N, 130° 16' 21" E).

2.2 Injuries to Persons

A cabin crew member was seriously injured (right ankle fracture).

2.3 Damage to Aircraft	None
2.4 Personnel Information	<p>PIC Age 47</p> <p>Airline transport pilot certificate (Airplane) December 21, 2015</p> <p>Type rating for Boeing 737 November 3, 2008</p> <p>Class 1 aviation medical certificate</p> <p>Validity January 31, 2020</p> <p>Total flight time 8,593 hours 11 minutes</p> <p>Flight time in the last 30 days 62 hours 44 minutes</p> <p>Total flight time on the same type of aircraft 3,519 hours 50 minutes</p> <p>Flight time in the last 30 days 62 hours 44 minutes</p> <p>FO Age 36</p> <p>Commercial pilot certificate (Airplane) January 8, 2019</p> <p>Type rating for Boeing 737 January 30, 2018</p> <p>Class 1 aviation medical certificate</p> <p>Validity April 30, 2020</p> <p>Total flight time 2,110 hours 32 minutes</p> <p>Flight time in the last 30 days 45 hours 01 minutes</p> <p>Total flight time on the same type of aircraft 1,106 hours 56 minutes</p> <p>Flight time in the last 30 days 45 hours 01 minutes</p> <p>Trainee Age 34</p> <p>Commercial pilot certificate (Airplane) October 2, 2019</p> <p>Type rating for Boeing 737 October 8, 2019</p> <p>Class 1 aviation medical certificate</p> <p>Validity November 30, 2020</p> <p>Total flight time 1,150 hours 20 minutes</p> <p>Flight time in the last 30 days 46 hours 10 minutes</p> <p>Total flight time on the same type of aircraft 112 hours 38 minutes</p> <p>Flight time in the last 30 days 46 hours 10 minutes</p>
2.5 Aircraft Information	<p>Aircraft</p> <p>Type Boeing 737-800</p> <p>Serial number 38825</p> <p>Date of manufacture January 31, 2012</p> <p>Certificate of airworthiness AB12005</p> <p>Category of airworthiness Airplane Transport T</p> <p>Total flight time 25,121 hours 33 minutes</p> <p>At the time of the accident, the Aircraft's weight was estimated to have been 137,760 lb and its center of gravity at 26.0 %MAC*³, both of which were estimated to have been within the allowable range.</p>
2.6 Meteorological	(1) Upper layer wind forecast checked prior to the departure from Kitakyushu Airport

*³ "MAC" stands for Mean Aerodynamic Chord. This term means an average aerodynamic chord that represents the aerodynamic characteristics of wings (a straight line from the leading edge to the trailing edge of the wing). This chord indicates the typical chord in the case such as the swept-back wing. ○○%MAC shows a position ○○% from the leading edge of the mean aerodynamic chord.

Information

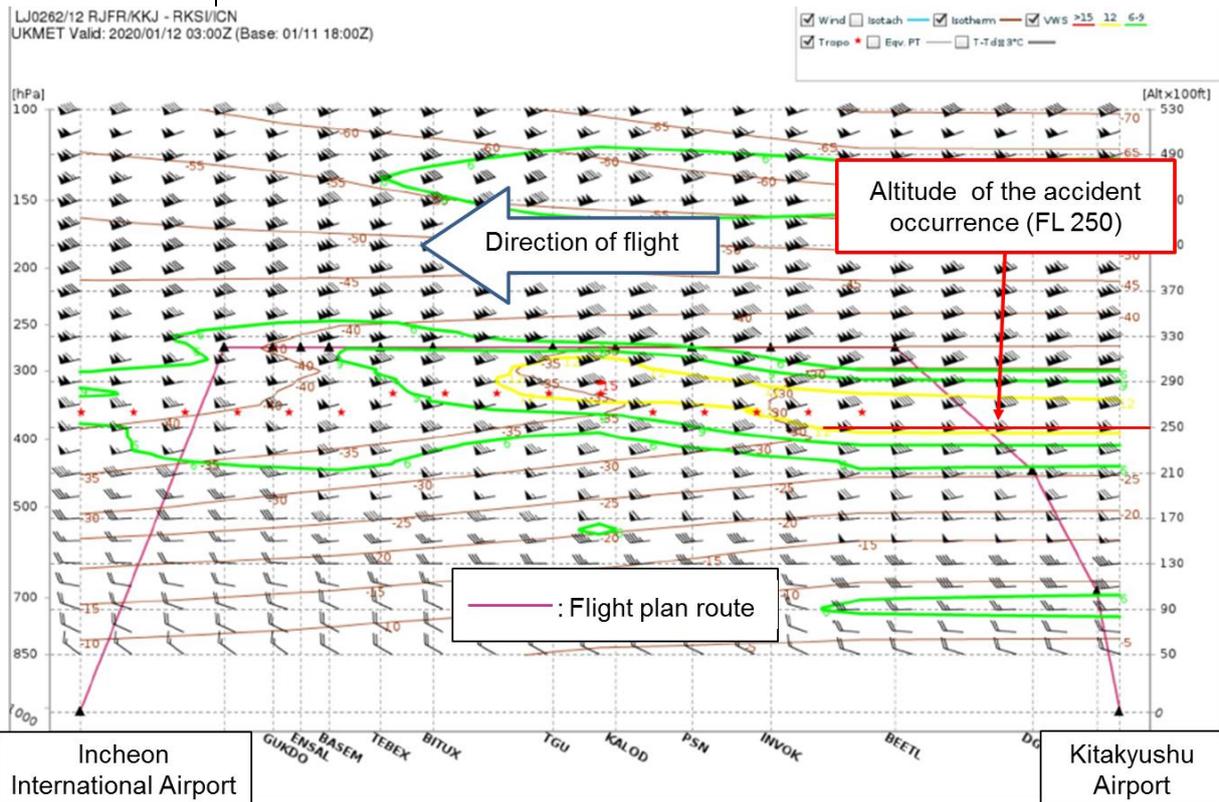


Figure 3: Upper layer wind forecast chart checked prior to the departure from Kitakyushu Airport
(Added to the chart provided by Jin Air)

In the upper layer wind forecast chart (the forecast at 12:00 on the accident day based on the data at 03:00 on January 12, 2020) which the flight crew members checked prior to the departure from Kitakyushu Airport (See Figure 3), the area enclosed with the green solid line indicate the airspace of Vertical Wind Shear*⁴ (VWS) of 6 to 12 kt/1,000 ft, and the other area enclosed with the yellow solid line indicate the airspace of VWS of 12 to 15 kt/1,000 ft. Generally, VWS in excess of 10 kt/1,000 ft can cause moderate turbulence and VWS in excess of 15 kt/1,000 ft can cause severe turbulence in the aircraft.

Upper layer wind forecast chart indicated that VWS was 12 to 15 kt/1,000 ft at between FL 240 and FL 270 during the climb on the flight plan route of the accident day.

(2) Meteorological data analysis

According to cross section chart (AXJP130) (Figure 4) at 09:00 on January 12, 2020, it was analyzed that there was the center of jet stream near FL 320 north of Fukuoka, and that at an altitude higher than FL 240 over Fukuoka, there was fluctuation such that the wind velocity increased 20 kt for every 1,000 ft rise in altitude.

*⁴ "Shear" means the condition that there are the differences which are seen in the wind direction, velocity or both at close range in the atmosphere.

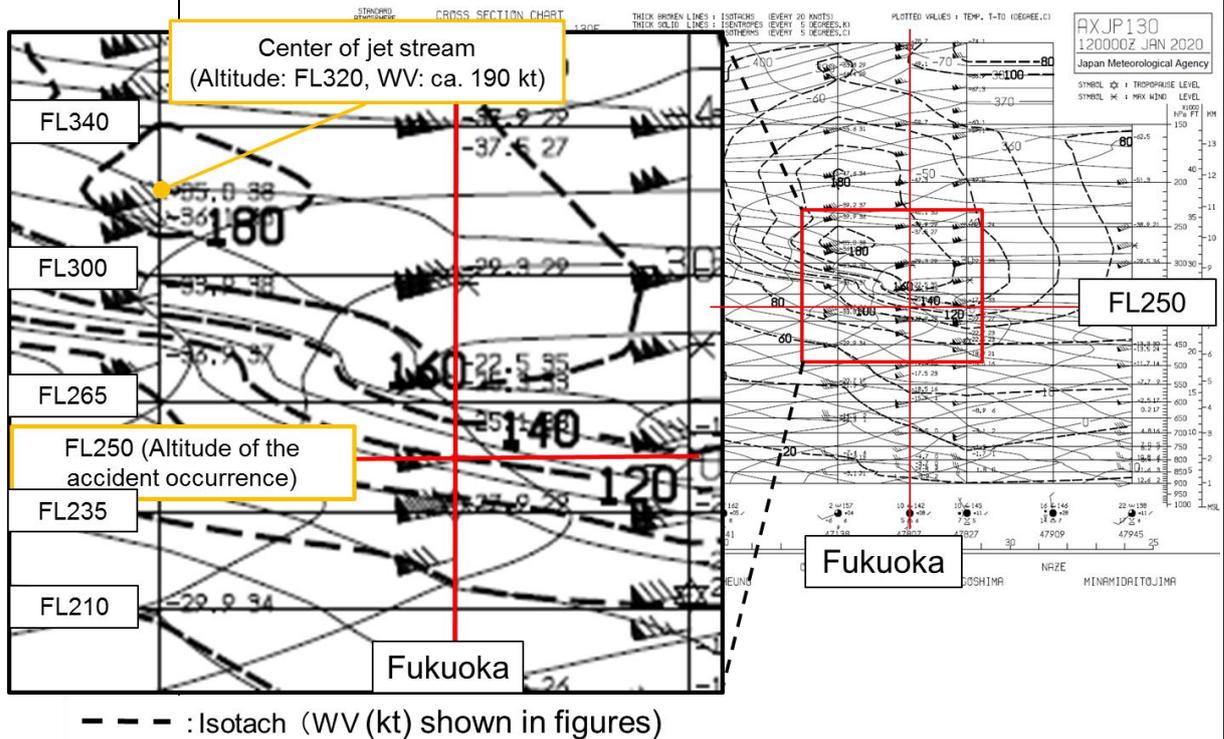


Figure 4: Cross section chart (AXJP130)
 (at 09:00 on January 12, 2020)

(Added to the chart provided by Japan Meteorological Agency)

(3) Others

Near the flight route of the Aircraft, there were no such clouds observed that could produce turbulence. In addition, before the occurrence of the accident, there were no PIREP (weather reports from pilots in flight) about encountering turbulence near the airspace of the accident site.

2.7 Additional Information

(1) FDR records

The FDR recorded fluctuations in acceleration, flight attitude and wind data between 13:17:14 and 13:17:26. The detailed data fluctuations are shown as follows.

① Acceleration (Figure 5)

After the vertical acceleration (calm wind conditions in level flight: 1 G) decreased from 1.19 G (a in Figure) to 0.8 G (b in Figure) between 13:17:14 and 13:17:15, it increased up to 1.49 G (c in Figure) between 13:17:15 and 13:17:16. After that, until 13:17:26, it repeated fluctuating little by little.

In addition, after the lateral acceleration (calm wind conditions in level flight: 0 G) fluctuated from right 0.02 G (d in Figure) to right 0.2 G (e in Figure) between 13:17:14 and 13:17:15, it fluctuated to left 0.18 G (f in Figure) between 13:17:15 and 13:17:16, and it gradually stopped to

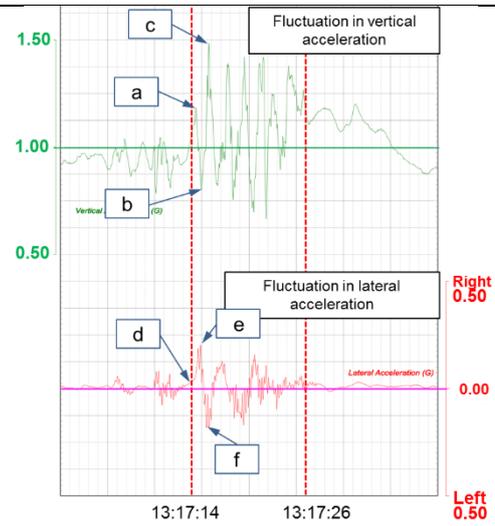


Figure 5: Fluctuation in acceleration

fluctuate.

② Flight attitude (Figure 6)

After the bank angle fluctuated from around 0 degree (level) (g in Figure) to right 4.7° (h in Figure) between 13:17:14 and 13:17:15, it fluctuated to left 5.5 ° (i in Figure) between 13:17:15 and 13:17:17.

The heading of the Aircraft (magnetic bearing) fluctuated from 317 ° (j in Figure) to 314° (k in Figure) between 13:17:15 and 13:17:16.

③ Wind (Figure 7)

The headwind component decreased from 68 kt (l in Figure) to 44 kt (m in Figure), and the crosswind component from the left direction increased from 82 kt (n in Figure) to 114 kt (o in Figure) between 13:17:14 and 13:17:18.

During the above period, the wind velocity increased from 120 kt to 140 kt.

In addition, the FDR did not record any significant changes, such as sign of turbulence and others, before the Aircraft was shaken.

(2) The Company's manual regarding the operation of seat belt sign

In the POM (Pilot Operating Manual) of the Company, it is specified that the switch on the seat belt sign shall be placed in the "AUTO"*5 position after confirming calm atmosphere and normal cabin pressurization at the time of reaching an altitude of 10,000 ft during the climb. Besides, in the FOM (Flight Operating Manual), it is specified that when there is "light" turbulence or more at the time of reaching an altitude of 10,000 ft, placing the switch in the "AUTO" position shall be delayed.

(3) Effect of wake turbulence

According to the radar track records, no aircraft whose wake turbulence*6 might have affected the Aircraft was not flying around her.

(4) The situation of the Aircraft's shaking during the previous flight from

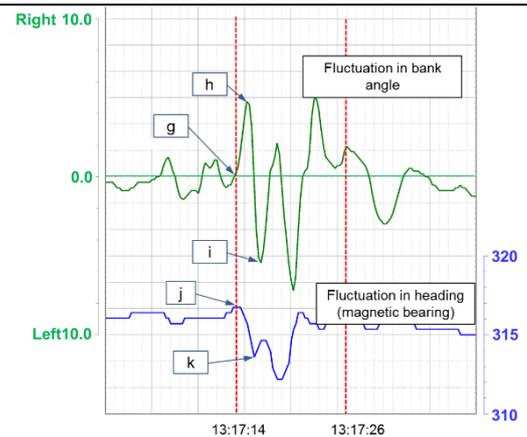


Figure 6: Fluctuation in flight attitude

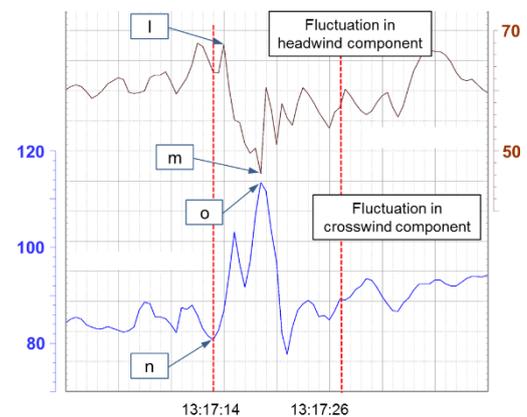


Figure 7: Wind fluctuation

*5 "AUTO" refers to the function to turn off the seat belt sign in the cabin when the flaps and landing gear are completely retracted, and to turn on the seat belt sign in the cabin when the flaps are extended or the landing gear is extended. At the time of the accident, as the flaps and landing gear of the Aircraft were completely retracted, the seat belt sign was turned off by switching to the "AUTO" position.

*6 "Wake turbulence" is a vortex generated behind an aircraft during flight, due to the effects of engine exhaust and vortices generated at the tip of the wing during flight.

	<p>Incheon International Airport to Kitakyushu Airport.</p> <p>On the accident day, the crew members of the Aircraft were engaged in their duties in the flight (as a scheduled flight 261) from Incheon International Airport to Kitakyushu Airport, which was previous flight before the accident. According to the data (the forecast announced at 12:00 on the accident day based on the data at 21:00 on January 11, 2020) checked in the pre-flight briefing, VWS in excess of 15 kt/1,000 ft was forecast in the airspace where the Aircraft would pass during the descent to Kitakyushu Airport.</p> <p>As described earlier, generally, it is noted that VMS in excess of 15 kt/1,000 ft can cause severe turbulence in the aircraft. However, in the actual flight, the turbulence which the Aircraft encountered during the descent from FL 330 was to such an extent that light one occurred intermittently.</p> <p>(5) Information sharing about turbulence among crew members</p> <p>After obtaining new weather information prior to the departure from Kitakyushu Airport, at the pre-flight briefing, the PIC notified crew members that turbulence was expected during the climb to the cruising altitude and instructed them to beware of it.</p> <p>On the other hand, during the period from when the Aircraft took off from the Kitakyushu Airport and the seat belt sign was turned off until when the Aircraft experienced a severe shaking, the flight crew members had not provided the cabin crew members with any information such that they were approaching the airspace where turbulence was expected.</p>
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3. ANALYSIS

3.1 Involvement of Weather	Yes
3.2 Involvement of Pilot	None
3.3 Involvement of Aircraft	None
3.4 Analysis of Findings	<p>(1) Sudden shaking in the Aircraft</p> <p>No clouds were observed near the airspace of the accident site, however, it is highly probable that as described in 2.6 (2), around the airspace there was jet stream, below which VWS of about 20 kt/1,000 ft was also there. In addition, no aircraft whose wake turbulence might have affected the Aircraft was flying around her, therefore, it is highly probable that in the airspace, there might have occurred clear air turbulence caused by the jet stream. It is also highly probable that this clear air turbulence caused the Aircraft to shake.</p> <p>Besides, in addition to the fact that along the flight route of the Aircraft, there were no such clouds that turbulence could be expected, according to the FDR records, any significant changes to be a sign of turbulence were not confirmed on the instruments in the cockpit. Therefore, it is probable that there was no sign of turbulence which the flight crew members could have detected.</p> <p>(2) Judgment about the weather conditions along the flight route and the</p>

operation of seat belt sign

Based on the weather data obtained prior to the departure of the flight, the flight crew members were able to expect that they would encounter shear at between FL 240 and FL 270 during the climb after taking off from Kitakyushu Airport and the Aircraft would be shaken. However, the possibility of severe turbulence was indicated in the weather data checked in the previous flight before the departure from Incheon International Airport, but it was light turbulence in the actual flight. And in the weather forecast checked before the departure from Kitakyushu Airport, the turbulence in the accident flight was expected to be moderate, which was better than that that of the previous flight, therefore, it is somewhat likely that the flight crew members did not expect that the turbulence, which they would encounter after taking off from Kitakyushu Airport, could be so severe. As a result, it is somewhat likely that the flight crew member did not turn on the seat belt sign when the Aircraft was approaching the airspace where turbulence was expected.

It is desirable for flight crew members to make decisions on the operation of seat belt sign from a safer side, by the information obtained from pre-flight meteorological data.

(3) The Purser's falling

Although the Purser was instructed by the PIC at the pre-flight briefing, to beware of turbulence that was expected during the climb, the seat belt sign was turned off when severe turbulence occurred, and then the Purser was not informed by flight crew members that the Aircraft was approaching the airspace where turbulence was expected. Therefore, it is highly probable that the Purser, who was standing, got off balance to fall down because the Aircraft repeatedly fluctuated with vertical and horizontal accelerations, irregular left and right movements, and irregular rotational movements at the same time in a short period of time.

4. PROBABLE CAUSES

In this accident, it is highly probable that the Aircraft was strongly shaken by encountering clear air turbulence during the climb, which caused the cabin crew member who was standing in the center of the aft galley to fall down and fracture her right ankle.

5. SAFETY ACTIONS

Upon the occurrence of the accident, the Company took following safety actions for the flight crew members to prevent recurrence.

- (1) notified of the summary of the Accident,
- (2) to thoroughly confirm the turbulence procedures against expected turbulence at a pre-flight briefing, and to manage turbulence hazards through thoroughly analyzing weather charts,
- (3) to conduct detailed briefings on weather information and to reconfirm the seat belt operation procedures specified in the FOM, at the pre-flight briefing with the flight crew members and the cabin crew members,
- (4) to carefully operate seat belt sign against expected turbulence.