



Ministry of Land,  
Infrastructure and Transport

ARAIB/AAR2102

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# Aircraft Accident Investigation Report

Cabin Crew Injured due to In-Flight Turbulence  
Asiana Airlines  
B767-300, HL7528  
En-Route over Yesan, Chungnam During Climb  
28 May 2021

28 November 2022



Aviation and Railway  
Accident Investigation Board

This aircraft accident report has been prepared in accordance with the Article 25 of the Aviation and Railway Accident Investigation Act of the Republic of Korea.

**According to the provisions of the Article 30 of the Aviation and Railway Accident Investigation Act, it is stipulated;**

*The accident investigation shall be conducted separately from any judicial, administrative disposition or administrative lawsuit proceedings associated with civil or criminal liability.*

**And in the Annex 13 to the Convention on International Civil Aviation, Paragraphs 3.1 and 5.4.1, it is stipulated as follows:**

*The sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of the activity to apportion blame or liability. Any investigation conducted in accordance with the provision of this Annex shall be separate from any judicial or administrative proceedings to apportion blame or liability.*

Thus, this investigation report shall not be used for any other purpose than to improve aviation safety.

In case of divergent interpretation of this report between the Korean and English languages, the Korean text shall prevail.

## Aircraft Accident Investigation Report

Aviation·Railway Accident Investigation Board, Cabin Crew Injured Due to In-flight Turbulence, Asiana Airlines, HL7528, B767-300, En Route to Jeju During Climb, 28 May 2021, Aircraft Accident Investigation Report, ARAIB/AAR2102, Sejong Special Self-Governing City, Republic of Korea

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The objective of the investigation by the ARAIB is not to apportion blame or liability but to prevent accidents and incidents.

The main office is located in Sejong Special Self-governing City.

Address: A-604 Sejong Business Center, Gareum-ro 232, Sejong Special Self-governing City, 30121

Tel: 044-201-5447

Fax: 044-868-2406

E-mail: [araib@korea.kr](mailto:araib@korea.kr)

URL: <http://www.araib.go.kr>

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**Title: Cabin Crew Injured Due to In-Flight Turbulence**

- Operator: Asiana Airlines Inc.
- Manufacturer: The Boeing Company
- Type: B767-300
- Aircraft Registration: HL7528
- Location: About 16,700 ft During Climb over Yesan, Chungnam  
36° 46'35"N / 126° 24'02"E
- Date & Time: 28 May 2021, Approximately 08:08(KST)<sup>1)</sup>

**Synopsis**

On 28 May 2021, Asiana Airlines Flight No. 8913 bound for Jeju Airport which had departed from Gimpo Airport encountered turbulence about 16,700ft during climb on its air corridor. A cabin attendant who had been at the aft galley fell down and suffered a fractured left ankle.

Aboard the aircraft were a total of 241 people including 8 flight and cabin crew members. Except one injured cabin attendant, people on board had no injuries. Subsequently, the aircraft flew to Jeju airport without any damages.

The Aviation and Railway Accident Investigation Board(hereafter referred to as "ARAIB") determined that the cause of the accident was

[HL7528 encountered turbulence on its air corridor during climb.]

Contributing to the accident were [Pilot's lack of effort to avoid turbulence] and [The injured cabin crew's lack of self-protection during turbulence].

As a result of this investigation, the ARAIB issues two safety recommendations to Asiana Airlines.

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1) Unless otherwise indicated, all times stated in the report are Korean Standard Time (UTC+9)

## 1. Factual Information

### 1.1 History of Flight

On 28 May 2021 at 07:53:11, Asiana Airlines co. 8913(Registration HL7528, hereafter referred to as "HL7528") departed Gimpo International Airport. Seoul approach control transferred controller hand-off to Incheon area control center(hereafter referred to as 'Incheon ACC') as required by departure procedure while giving ATC authorization to the aircraft to climb to 16,000ft.

HL7528 captain shared information about the arrival and departure airports and en-route turbulence with all crew members prior to the flight. The captain frequently checked cockpit weather radar and cloud conditions during departure.

After takeoff, the captain identified that the aircraft would be affected by rainfall and turbulence even after it passed over 10,000ft. He conveyed a message to the senior cabin attendant(hereafter referred to as 'purser') through intercom that he would keep seatbelt sign on(hereafter referred to as 'seatbelt sign').

At 16,000ft, bad weather conditions had momentarily became fine but the captain soon realized that the cockpit radar spotted a cloudband and he decided to avoid it at right angles. He then requested a climb to Incheon ACC and the aircraft was authorized to climb to 28,000ft.

The captain expected a turbulence encounter while increasing the altitude of an aircraft. He turned passenger seatbelt sign (hereafter referred to as "chime") on twice followed by cabin announcement.

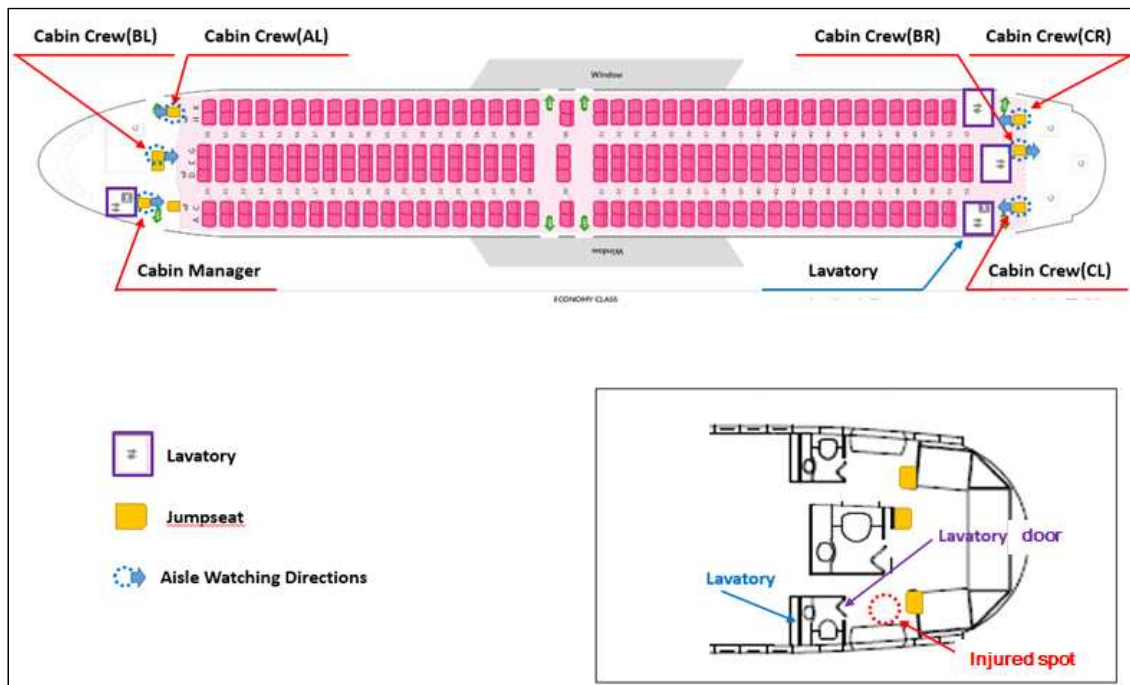
About 10,000ft, a male passenger asked if he could go to a lavatory. A cabin attendant said that he could use it but the airplane might be wobbled. However, the passenger didn't come out of the lavatory about 5 five minutes after announcement. The cabin attendant asked him to return to his seat while seated. However, he did not respond to the request.

The cabin attendant managed to release her seat belt to stand up as she was concerned about the passenger's safety. As chime rang twice, she lost own

balance due to turbulence. She tried to kneel down in accordance with Asiana Airline’s turbulence procedure but had a strain in her left ankle.

The cabin attendant was slightly thrown up by one more severe turbulence. Her ankle bore weight and she fell down on the floor. Her injury was too serious that she couldn’t even move at all and complained of severe pain when the purser checked her condition.

The following [Figure 1] shows HL7528 cabin seat arrangement and place where the cabin attendant injured.



[Figure 1] HL7528 Cabin Seats and Crew Injured

The captain was immediately notified by the purser of the cabin attendant’s injury and the purser rearranged cabin crew’s duties. The captain contacted Asiana Airlines’ Jeju sub-center to ask for an emergency medical service and replacement of crew members.

The injured crew stated that she had hard time enduring pain for about 30 minutes due to the shaking of the aircraft till landing. According to flight data recorder(FDR) for three minute before and after the accident, the captain began to climb from 16,000ft to 28,000ft and turned chime on twice.



When passing over 16,736ft, the center of gravity reached 1.86G at maximum and maintained 1.0G after it decreased to the lowest of 0.5G. When the center of gravity reached the highest level, the climb speed recorded at 5,100 fpm at that moment. Afterwards, the aircraft maintained 3,000 fpm. The auto-pilot continued to operate during cruise and there was no notable change in outdoor temperature, wind and angle of attack.

After the aircraft went through severe turbulence and was clear of cloud layer, it soon became stabilized. The captain ascertained no other damages to the aircraft were found. The flight route of HL7528 from Gimpo to Jeju is as shown in [Figure 2].



[Figure 2] HL7528 Flight Route on the Day of Accident

After the aircraft arrived in Jeju airport and parked on Gate 6, the emergency service team on standby transported the injured cabin attendant to the Central Hospital ER in Jeju. A doctor diagnosed a “Multiple Fractures of Ankle” that she needed a surgery.

The injured cabin attendant was given first aid and flew back to Gimpo airport (on Asiana Airlines No. 8922) as she wanted to have a treatment from one of the hospitals near her house. Subsequently, she had the \*primary surgery<sup>2)</sup>

2) Secondary surgery is scheduled as soft-tissue damage is recovered. The Catholic University of Korea Incheon St. Mary’s Hospital

(non-invasive reduction and external fixation) at a hospital in Incheon and was diagnosed with injuries requiring eight weeks of medical treatment.

## 1.2 Injuries to Persons

A total of 241 people (233 passengers, two flight crew, six cabin crew) were on board. One cabin attendant suffered from fracture<sup>3)</sup> due to turbulence and no injuries were found.

## 1.3 Damage to Aircraft

There was no damage to the aircraft due to this accident.

## 1.4 Personnel Information

### 1.4.1 The Captain

As a Korean national, the captain(age 47, male) has worked for about 11 years since he was hired by Asiana Airlines on 13 December 2010. He passed captain assessment on 25 Jan. 2019. He held a valid air transport pilot license<sup>4)</sup>, B767 type rating<sup>5)</sup>, first-class airman medical certificate, aeronautical radio operator license<sup>6)</sup> and level 6 ICAO English proficiency certificate<sup>7)</sup>.

Further, after passing simulator flight test on 12 Sept. 2020, he received the recurrent training on 9 Jan. 2021 and simulator training and its assessment on 8 Feb. He had flown on B767 and B777 and accumulated 7,810 total flight hours including 3,535 hours on B767 and 1,034 on B767 as a captain. In the 90 days before the accident, the captain had accumulated about 89 flight hours (including 38 flight hours for a month).

According to his three-day footage, he got up at 7 o'clock and visited a library from 25 to 26 May. After reading books and taking a rest, he went to bed around 22:00. On 27 May, he got up at 04:30 and flew from 06:00 to 14:00 including preparations for domestic flight. He went home at 16:00 and went to sleep at 22:00.

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3) After she had the primary external fixation surgery due to a trimalleolar fracture of her left ankle, she was given a diagnosis requiring the secondary surgery.

4) License No.: 11-004982(Acquired on 6 Jan. 2014)

5) Issue No.: 062-24565(Valid until 28 Feb. 2022)

6) License No.: 013-420011(Acquired on 12 Jan. 2021)

7) EPTA Test Exempted as he speaks English like a native speaker (Issued on 28 May 2018)

On 28 May, he woke up at 04:30 and flew from 06:00 to 11:00 including preparations for domestic flight. Afterwards, he went home and took a rest. He stated that he did not drink any alcohol or take any illegal medication in the 24 hours before the accident.

#### 1.4.2 The First Officer

As a Korean national, the first officer(age 30, male) has worked for Asiana Airlines since he was hired on 29 May 2017. He held a valid air transport pilot license<sup>8)</sup>, B767 type rating, first-class airman medical certificate<sup>9)</sup>, aeronautical radio operator license<sup>10)</sup> and level 4 ICAO English proficiency certificate<sup>11)</sup>.

He had accumulated 1,707 total flight hours including 1,406 hours on B767. He had flown 65 hours and 30 hours in the 90 days and 30 days, respectively. According to 72-hour diary, he woke up at 09:00, worked out at gym, took a rest and went to bed at 23:00 from 25 May to 27 May.

On 28 May, he woke up at 05:00 and prepared for a flight briefing at 07:00. He had a turnaround flight from Gimpo to Jeju Airport and came home at 14:00. He stated that he did not drink any alcohol or take any illegal medication in the 24 hours before the accident flight.

#### 1.4.3 The Cabin Attendant

The injured cabin attendant had worked for Asiana Airlines since Jan. 2001. She completed initial training course and recurrent training on 17 Apr. 2001. The last training she had received was on 26 Oct. 2020 about seven months before the accident occurred.

She took a leave of absence in the first half of 2021 and had an international flight schedule from Incheon to Frankfurt on 21 May. She had a turnaround flight on 28 May from Gimpo to Jeju(HL7528).

### 1.5 Aircraft Information

#### 1.5.1 General

HL7528 was manufactured by the Boeing Company on 12 March 1998 and

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8) License No.: 12-010868(Acquired on 9 Feb. 2017)

9) Issue No.: 062-24489(Valid until 28 Feb. 2022)

10) License No.: 14-34-4-0295(30 Mar. 2015)

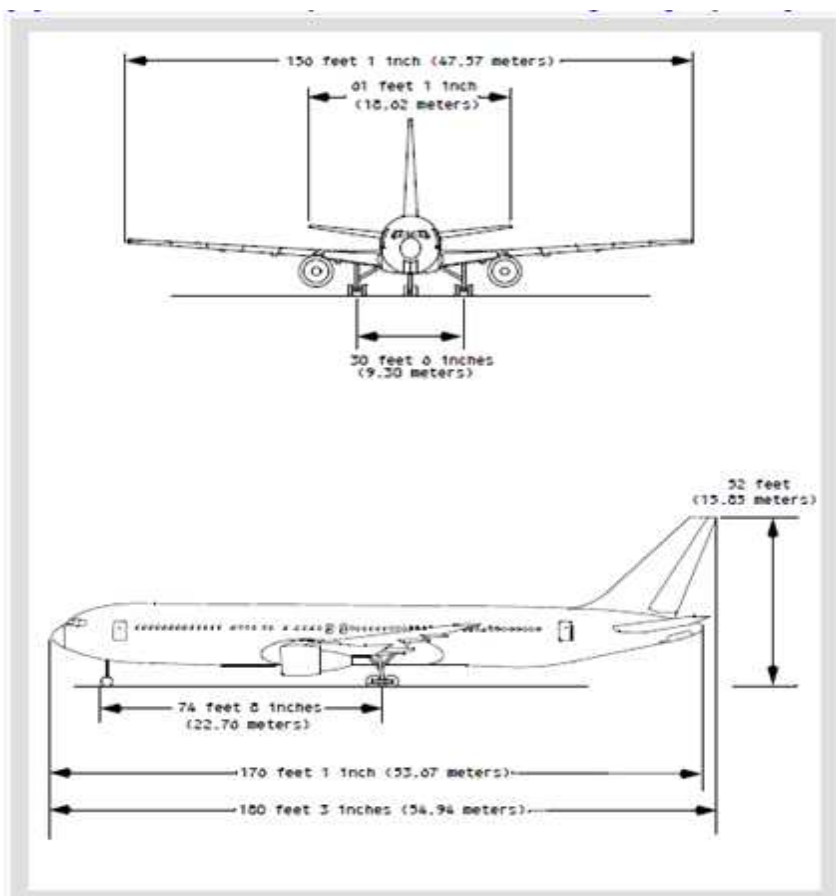
11) Level 4 is valid for four years(Valid until 23 Oct. 2022)

introduced on 30 Sept. 1999. It was registered in the Republic of Korea and held a valid airworthiness certificate<sup>12)</sup>.

The total hours of the aircraft operation is 64,478 and HL7528 was equipped with weather radar<sup>13)</sup> manufactured by Honeywell Inc. The total number of takeoffs and landings had been 34,738 until the day of the accident.

### 1.5.2 Aircraft Dimensions

The aircraft dimensions is as shown in [Figure 3].



[Figure 3] Aircraft Dimensions

### 1.5.3 Weight and Balance

There was no issue found related to the cause of this accident.

12) Airworthiness No.: AS05119, Issue Date: 21 September 2012

13) Honeywell Weather Radar RDR-4A

### 1.6 Meteorological Information

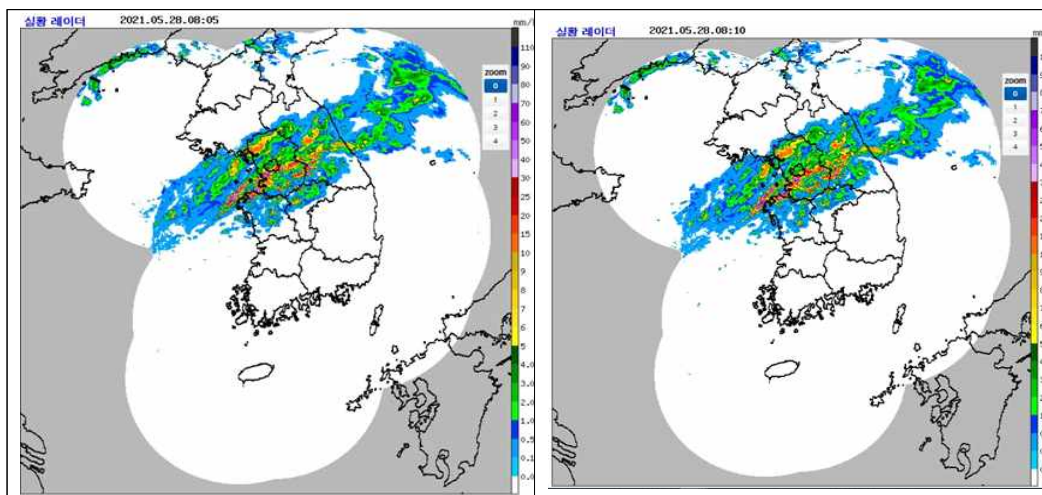
According to the weather forecast of the Aviation Meteorological Office(AMO), temperature on 28 May was 21°C and rainfall was expected to be about 20 to 30mm. Gimpo airport was affected by low pressure from the east in the Gulf of Pohai and it began raining at 03:00. The region seemed to be out of influence of a low-pressure though.

As a cold front passes in tomorrow morning(28th), a stronger pressure gradient will cause stronger winds blowing from southwest. The average wind speed is expected to be 10 to 15kts(19~28km/h) and the maximum instantaneous speed in knots is 25~35kt (46~65km/h). A gale warning is to be issued from 11:00 to 19:00.

As a cold front passes from 07:00 to 10:00, thunderstorm and lightning caused by atmospheric instability are anticipated and a hailstone of 1cm might fall. It is expected that heavy precipitation would cause poor visibility of 2,500m.

[Figure 4] Weather Forecast in Gimpo Airport

At 08:00 on 28 May (the day of the accident), a turbulence weather map over the Korean Peninsula announced by the AMO is as shown in [Figure 5].



[Figure 5] Meteorological Radar during Turbulence

At the time of the accident(at 08:00), weather conditions in Gimpo airport are as follows: wind blown from 130 degrees at 13 kts, visibility of 4.5km, clouds scattered at 1,000ft, broken clouds from 1,500 to 8,000ft, temperature of 13°C and atmosphere pressure of 1,002mb.

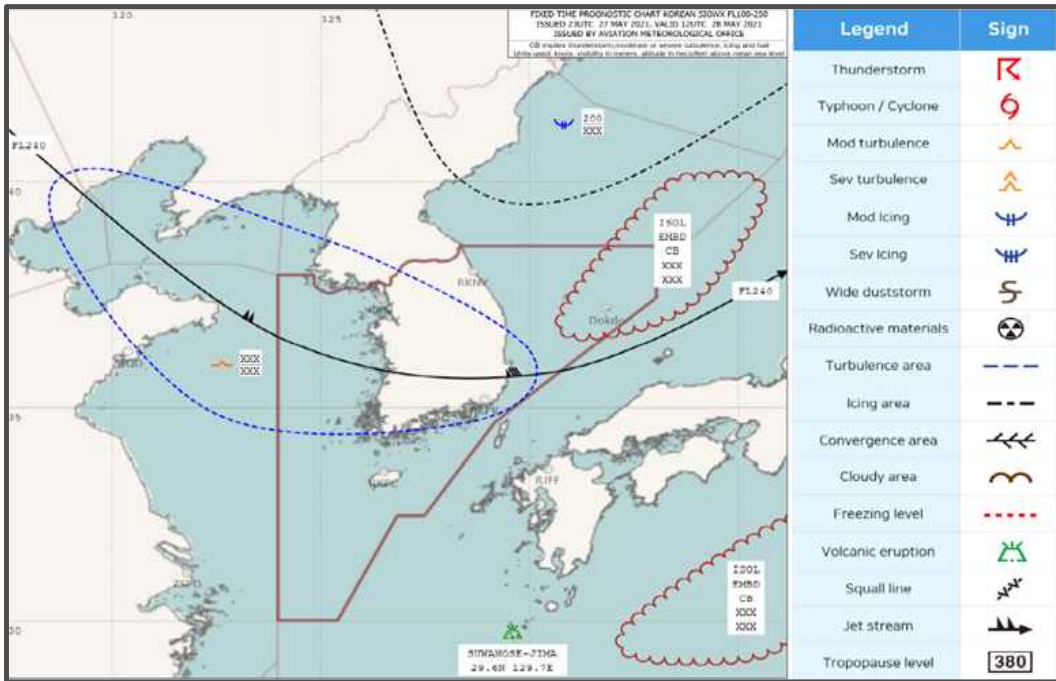
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OVC060 13/11 Q1002 NOSIG RMK TS B24 S MOV SE

RKSS 272300Z 13013KT 4500 -TSRA BR FEW010CB SCT015 BKN045 OVC080
13/11 Q1002 NOSIG
    
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[Figure 6] Meteorological Information in Gimpo Airport

According to the weather chart(SIGWX) showing dangerous weather conditions announced by the AMO on the day of the accident, a turbulence from 10,000 to 25,000ft in central district of the Korean Peninsula is expected to occur.



[Figure 7] Distribution of Weather Elements at Medium Altitude (SIGWX)

### 1.7 Aids to Navigation

There were no issues found with regards to the cause of the accident.

### 1.8 Communications

There were no issues found with regards to the cause of the accident.

### 1.9. Aerodrome Information

There were no issues found with regards to the cause of the accident.

### 1.10 Flight Recorders

#### 1.10.1 Flight Data Recorder

Data saved in the flight recorders(flight data recorder and cockpit voice recorder) are recorded based on the coordinated universal time(GMT, nine hours behind KST). Flight crew’s control of the aircraft and turbulence influence of each time zone are demonstrated as shown in [Figure 8].



[Figure 8] FDR 5 Minutes Before and After Accident

Based on the data retrieved from the flight data recorder, the impact at turbulence encounter while HL7528 was climbing. Captain turned chime twice about 14 seconds he began climbing at 16,000ft at 23:07:43.

About 24 seconds later, gravity affected to the aircraft at the time of turbulence encounter at 16,672ft recorded at a maximum of 1.86G and the minimum of 0.5G. The difference was 1.36G. The instantaneous climb speed recorded at 5,100fpm. (About 1.7 times in proportion to 3,000ft on average)

#### 1.10.2 Cockpit Voice Recorder

The cockpit voice recorder of HL7528 was not retrieved due to a delay in judgment and reporting of accidents. However, communication transcript between the captain and Asiana Airlines sub-center was acquired.

### 1.11 Wreckage and Impact Information

It is irrelevant to the accident.

### 1.12 Medical and Pathological Information

There was no medical and pathological information which could have affected the operations.

There was no medical and pathological information about the injured cabin attendant which could have affected the operations.

### 1.13 Fire

No fire broke out due to the accident.

### 1.14 Survival Aspects

There were no injuries reported except the injured cabin attendant. The injured cabin crew was transported to Joongang hospital in Jeju right after she arrived at the destination airport.

According to the Jeju Airport's ambulance report, the injured cabin crew had her ankle completely sprained that she had severe swelling and flare<sup>14</sup>). She stated that she had no symptoms of COVID-19. Emergency actions taken for each time zone are as follows.

-08:40 Event notified and respond to the site

-08:44 Ambulance arrived at the site and first aid given to the cabin attendant (She was conscious and her pulse, mobility and sense were normal. Splint her left ankle)

-09:08 Jeju Joongang Hospital began transporting the injured(at 09:15, the patient was passed on to a doctor) and returned to the hospital

On the day of the event, the injured crew tried to kneel in accordance with

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14) A diffuse redness of the skin when capillary vessel enlargement occurs. Excerpted from Seoul Asan Hospital



turbulence procedure but had her ankle sprained. Right at that moment, another strong jolt caused her to be thrown and fallen on the floor. Her sprained ankle bearing weight caused serious pain to her.

As the cabin attendant was injured due to severe turbulence, HL7528 purser reported it to the captain. The captain made a radio contact with Asiana Airlines Jeju Sub-center to request crew replacement and ambulance.

Further, the purser instructed cabin attendants to coordinate their duties following the cabin crew injured. Then, she helped the injured crew who had fallen to get up from the ground and move to her seat and secure the seatbelt. After landing, the injured cabin crew was transported by an ambulance.

After arriving at Jeju Joongang Hospital, she was given first aid. Because she wanted to have a surgery and treatment at one of the hospitals near her residence, she visited the International St. Mary's Hospital in Incheon. When she had a medical examination, she was diagnosed with a trimalleolar left ankle fracture which requires the secondary surgery after soft-tissue injury is recovered and she had an emergency surgery<sup>15)</sup>.

### 1.15 Tests and Research

There were no tests and research conducted related to this accident.

### 1.16 Organizational and Management Information

Asiana Airlines has established<sup>16)</sup> and implemented safety management system manual(SMSM) to prevent aviation accidents.

The manual is designed to reach the following safety objectives by managing safety performance indicator for the purpose of preventing damage of properties and injures to a person caused by the aircraft accident.

“Maintain Zero Aircraft Accidents and Serious Incidents”

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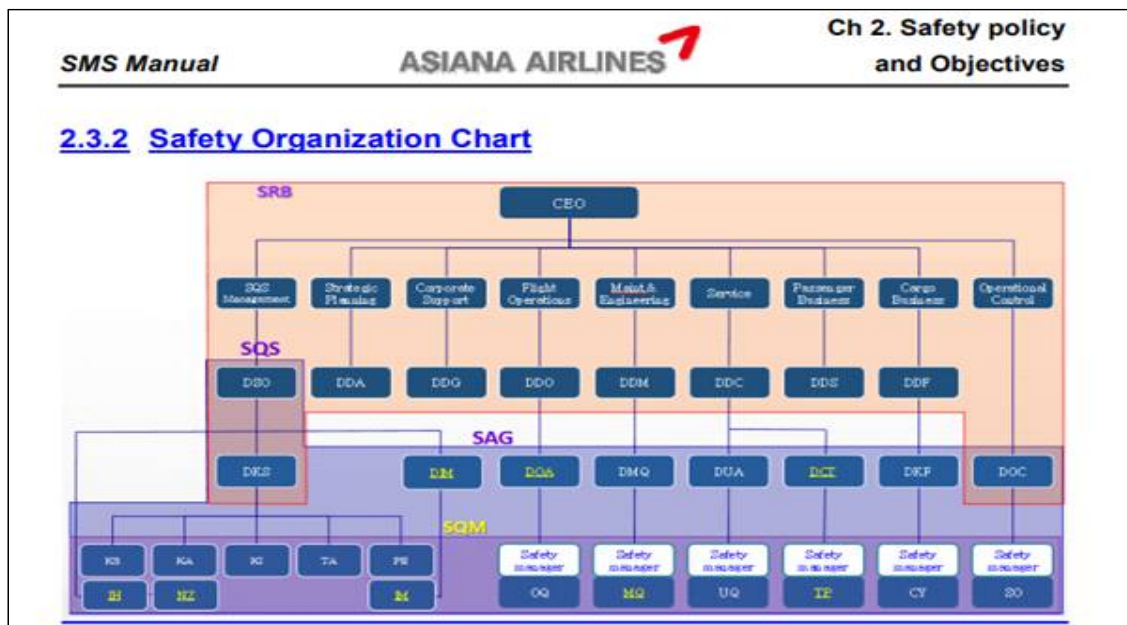
15) Non-invasive reduction and external fixation

16) Since 1 Jan. 2008, the Asiana Airlines manual has been established and implemented as the CEO has right of establishment. The company's manual was authorized by the Ministry of Land, Infrastructure and Transport and its 16<sup>th</sup> edition was published on 18 Dec. 2020

To achieve the safety objectives, the aircraft operator provided 27 safety performance indicators in areas of operation and risk management. In particular, an injury “during aircraft operation<sup>17)</sup>” just like this accident is categorized as a high-risk and low-frequency event. The safety target value has recently been set as 0.064 based on the number of occurrences for the past three years.

1.16.1 Safety Management Organization Chart

The Chief Executive Officer shall make a decision to be in accord with the safety policy and goals of the Asiana Airlines. The CEO has to establish and implement measures necessary to achieve the goals and improve vulnerable areas in order to provide properties including human and material resources.



[Figure 9] Safety Management Organization Chart of Asiana Airlines

In addition, the CEO has to fulfill corporate responsibilities in manpower management and business to achieve the safety and security objectives. The organization in charge of the safety goals is managed as shown in [Figure 9].

17) Asiana Airlines Safety Management Manual 4.2 (Safety Performance Indicator-8): It falls on passengers or crew members on board seriously injured due to meteorological factors or abrupt maneuver during operation. Except injures including disease, crime and cause attributable to the injured.

### 1.16.2 Turbulence Procedure for Flight Crew

Asiana Airlines has operated three-way communication systems including prior notification, chime signal and intercom to facilitate effective communications between pilots and cabin crew in accordance with the Flight Operations Manual (FOM) shown in [Figure 10].

**2.8.8.7 Informing Turbulence**

For clear and accurate communication between flight crew and cabin crew, terms for turbulence are categorized as Light, Moderate, and Severe.

- a. When turbulence is expected, captain(PIC) must inform cabin crew before entering the area so that cabin crew can take precautionary action.
- b. When captain(PIC) switch on/off Seat Belt Selector, prior notice to cabin manager should be made.
- c. When turbulence is expected or entering area of turbulence, captain(PIC) must give Chime(Once under Light / Twice under Medium or Severe) to cabin crews so that cabin crew can make necessary announcement refer to FOM 2.8.8.8(Level of Turbulence & Procedures). Captain(PIC) may make an announcement if necessary.
- d. If moderate/severe turbulence is encountered after captain(PIC) switch on Seat Belt Selector, 2 chimes with Seat Belt Selector shall be made by captain(PIC). In this case, cabin crew must quickly make announcement and accomplish precautionary actions.  
If seat belt sign lasts for more than 5 minutes and the turbulence determined to be moderate, cabin manager shall contact the captain(PIC) to confirm time that how long the turbulence will be continued as well as check the time and determine serviceability.
- e. The captain(PIC) will notify the senior cabin crew if it is determined that the service can be possible even during Seat Belt Sign On.

[Figure 10] Flight Crew's Turbulence Response Procedure (FOM)

### 1.16.3 Turbulence Procedure for Cabin Crew

As shown in [Figure 11], the Asiana Airlines classified turbulence situations into three categories (light, moderate and severe turbulence) in accordance with Chapter 2, Section 8 (1) of the Cabin Operations Manual, which defines specific guidelines for cabin crew.

Cabin Crew Manual		ASIANA AIRLINES <b>7</b> Chapter 2 Flight Procedures & Safety Standards	
<b>2.8 Duty Procedures by Turbulence Level</b>			
	Light	Moderate	Severe
Situation in the cabin	Liquids are shaking but not splashing out of cups. Cabin shake slightly.	Beverage splashes Walking and standing without support is difficult.	Items are falling over, unsecured objects are tossed about. Walking is impossible
Cabin Crew Response			
Seat Belt Sign	1 Chime	2 Chimes	
Announcement	Make cabin announcement immediately and <u>periodically</u> .		
Safety checks	<u>Sit the jumpseat immediately and fasten seat belt and shoulder harness.</u>  <u>If feasible, check that passengers are seated with seat belt fastened, while move to a jumpseat.</u>	Sit the jumpseat or the nearest available seat immediately and fasten seat belt and shoulder harness.  If it is impossible to sit or move, hold the armrest to be secured.  Instruct passengers to be seated with seatbelt fastened by PA or verbally while seated	
Use of LAV	Using lavatory is restricted.	Using lavatory is prohibited.	
In	<u>Stop all service immediately.</u> (If food and beverage service is in progress, <u>stop immediately and take necessary measures such as cart lock, passenger guidance, and seating</u> )  <u>After check the turbulence level 1 to 2 minutes later</u>	<u>Stop all service immediately.</u>  Place service items on cart top (hot liquids, water pots..etc) inside the cart. If not possible, place them on the floor.  Cabin crew takes the nearest available seat or kneel down on the floor while holding the cart. When the seatbelt sign is continuously on for more than 5 minutes and the quake of an aircraft has weakened, the senior cabin crew contacts the captain to check the time of continuation of the	
Est : 1SEP 1994		REV. 60: 14JUN 2022	

[Figure 14] Cabin Crew’s Turbulence Response Procedure

1.17 Additional Information

1.17.1 Captain’s Statement

Prior to the departure, the captain explained bad weather conditions and

possible turbulence encounter on air route during pre-flight briefing. Subsequently, HL7528 took off at Gimpo Airport.

The captain increased the altitude of each flight phase as provided in departure procedure and the aircraft was continuously affected by turbulence even after passing over 10,000ft. As he kept seatbelt sign on, he contacted the purser by intercom.

At 16,000ft, the weather became momentarily fine but clouds in the forward, rightward and leftward direction were captured by cockpit radar as shown in [Figure 15]. The captain decided to avoid the clouds at right angles and was authorized by ATC to climb to a higher altitude, thereby climbing to 28,000ft.

While climbing to a higher altitude with a speed of 290 kts, the captain operated chime twice about 30 seconds before the aircraft entered clouds and then he checked cabin announcement was made. After passing through clouds, turbulence became weaker and the aircraft stabilized. Then, the captain was able to focus on the flight.

After a while, the captain was notified of a cabin attendant injured due to the turbulence and checked if someone could give first aid. Then, he made an emergency call to Jeju Sub-center of Asiana Airlines and the injured cabin crew was transported upon arrival in Jeju Airport.

#### **1.17.2 First Officer's Statement**

After departing from Gimpo Airport, the first officer increased the rate of climb to avoid the possible impact of turbulence at right angles. The captain contacted the purser by intercom that he kept turning seatbelt sign on.

When the aircraft reached 16,000ft, the first officer requested ATC to climb to a higher altitude to vertically avoid clouds in the forward, rightward and leftward direction. While climbing to 28,000ft, the captain turned chime twice as he was concerned about possible turbulence and the he heard cabin announcement.

About 27,000ft, the first officer was also notified from the purser that one of the cabin attendants was injured as she attempted to take precautions on a passenger using laboratory. The captain reported the situation to Jeju Sub-center

and requested medical support.

Upon arrival at Jeju Airport, the injured cabin attendant was taken by ambulance to a nearby hospital. Meanwhile, there was a 40-minute delay in departing for Gimpo Airport as another cabin attendant was brought on as a substitute. All flight and cabin crew members conceived the importance of compliance with turbulence procedure.

### **1.17.3 Purser's Statement**

By the time the aircraft entered the cruise phase after takeoff, there was an intercom contact from the captain that he would maintain seatbelt sign on. The purser shared the information to all cabin attendants and instructed them to have their seats.

The aircraft experienced a bumpy ride during climb but all cabin attendants secured themselves to their seats. At that moment, a male passenger moved to the aft lavatory and a cabin attendant informed him to be cautious. About five minutes later, chimes rang twice in cabin.

Even after cabin announcement was made and all passengers were seated, the male passenger did not come out of the lavatory. The purser knew from the injured cabin crew's statement that the injured cabin attendant had flopped down the moment she had been just about to stand up. She had lost her balance due to severe turbulence and had her ankle sprained.

When the purser checked the injured cabin attendant, she found the cabin attendant was unable to move. After reporting to the captain and giving first aid, she re-coordinated cabin crew duties. After arriving at Jeju Airport, there was a 40-minute delay in departing for Gimpo Airport as the injured cabin attendant was taken to a hospital and another cabin attendant was brought on as a substitute.

### **1.17.4 The Injured Cabin Attendant's Statement**

During pre-flight briefing, the injured cabin attendant was instructed to pay attention to all passengers'safety and keep seatbelt sign on after takeoff because of a possible turbulence. Three cabin attendants including the injured monitored the cabin while they were seated.

By the time the aircraft passed through 10,000ft, a male passenger asked if

he could use a lavatory. The injured cabin attendant escorted him to the lavatory and told him to be cautious when using it due to possible turbulence. The aircraft was in a normal cruise phase without any bumpy rides.

About five minutes later, the passenger was still in a lavatory and the cabin attendant said, "Sir, would you please hurry?" Then, the chime rang twice. The moment the cabin attendant stepped forward to guide him to his seat, the aircraft encountered turbulence and had an abrupt jolt.

She tried to kneel down and sit on the floor in accordance with turbulence procedure but she had her ankle sprained and dropped to the floor. At that moment, she was thrown up by another strong jolt and had a serious injury to her left ankle. She had suffered from terrible pain until the aircraft landed at Jeju Airport.

#### **1.17.5 The Air Traffic Controller's Statement**

On the day of the accident, the airspace assigned to the controller was not crowded with airplanes as there were about four to five airplanes. The radio contact with ATC radar, radio communication, aids to navigation were operable.

When HL7528 was authorized to climb to 16,000ft in accordance with departure procedure at Gimpo Airport, the controller hand-off was transferred from Seoul Approach Control. During initial contact, HL7528 reported that it reached to the authorized altitude.

HL7528 requested to climb to a higher altitude about three minutes after the initial contact in order to avoid turbulence. Right after the request, the aircraft was authorized to climb to the assigned altitude of 28,000ft on flight plan. There were no notable traffic conditions which could have affected the operation of the aircraft.

The controller approved other requests that were mostly made by departure flights from Incheon and Gimpo Airport, which includes a change in heading and adjustment of altitude caused by bad weather conditions nationwide on the day of the accident. HL7528 was also authorized to climb to the assigned altitude and reached to the altitude for about five minutes.

## 2. Analysis

### 2.1 General

The ARAIB closely looked into details of the accident caused by in-flight turbulence encounter and studied correlation between the adequacy of the cabin attendants' action against turbulence and the Asiana Airlines guidelines.

In addition, the ARAIB worked on the intensive analysis of 'How to enhance turbulence guidelines and cabin crew actions against in-flight turbulence' to prevent similar occurrences in Asiana Airlines.

### 2.2 Flight Crew's Actions during Turbulence

After HL7528 took off at Gimpo Airport under severe weather, it kept seat belt sign on until it entered the air route. The aircraft went through a continuous bumpiness until it reached 16,000ft.

About 16,000ft, the captain requested to climb to a higher altitude as there was a cloud captured by radar in the forward, rightward and leftward direction. He avoided the clouds and used chime twice in accordance with standardized signal of flight operations manual(FOM).

The flight crew had expected a turbulence encounter under severe weather prior to the flight. The captain gave a caution about possible turbulence and paying attention on cabin safety during pre-flight briefing. It appears that the captain took an active action during turbulence by maintaining seatbelt sign "ON" after takeoff.

#### **8.1.8.1 Authority and Responsibility of the PIC**

A. The captain shall be responsible for the following duties.

- 1) The captain(PIC) of the aircraft is responsible for the safety of all crew members, passengers and cargo on board from the moment of the aircraft door closes. The captain also shall be responsible for safety, security and operation of the aircraft between the time the aircraft begins to operate with the intention of flight until such time as it comes to rest at the end of the flight and the engine is shut down.

[Figure 12] Authority and Responsibility of the PIC



The flight safety regulations<sup>18)</sup> for fixed-wing aircraft which establish minimum safety requirements for airmen define the authority and responsibility of the PIC as shown in [Figure 12].

As provided in Chapter 2 of the Asiana Airlines FOM shown in [Figure 13], flight crew may report meteorological conditions during flight in order for personnel involved in aircraft operations to be able to utilize it for safe flight.

#### **2.5.15.3 PIREP (Pilot Reports)**

1. Pilots should report any observation including meteorological conditions or operations affecting the aircraft operation to relevant parties(ATC, other aircraft, company/control team in order for them to utilize the information.
2. Pilots should report(PIREP) it though anticipated situations do not develop into actual situation.

[Figure 13] Reporting Obligations by Asiana Airlines Flight Crew

Other aircraft from Gimpo to Jeju airport on the day of the event, made further attempts to avoid turbulence such as change in heading mode by reporting to ATC as described in procedures shown in [Figure 14]. But HL7528 possibly had a lack of effort to avoid turbulence except its request to climb to a higher altitude.

#### **8.1.8.14 Reporting of Hazardous Conditions**

- A. The captain promptly reports matters affecting the safety of other aircraft, including those related to meteorological conditions and dangerous flight conditions (e.g., air current disturbance, thunderstorm, volcanic ash, etc.) encountered on the route, and noise. Report to air traffic control.

[Figure 14] Reporting Hazardous Conditions (Flight Safety Regulations)

## **2.3 Cabin Crew's Actions during Turbulence**

About 16,000ft during climb, HL7528 momentarily encountered severe turbulence and started to shake considerably. A cabin attendant had her left ankle sprained right at the moment she stood up and stepped forward for safety of a passenger who were then using aft laboratory.

The injured crew was then seated with her seatbelt fastened. With seat sign on and chime sounding once, she verbally advised the passenger to return to his

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18) An excerpt from MOLIT Notice 2022-572(5 Oct. 2022) Safety Standards according to Article 77 of the Aviation Safety Act

seat as the passengers who had gotten into a laboratory did not come out of it even after five minutes passed.

Despite the cabin attendant's advice, the passenger did not make any sounds. When the cabin attendant stood up to knock on the door, chime sounded twice. At that moment, the aircraft wobbled and the cabin attendant lost her balance. She tried to kneel down but then had her left ankle sprained. At that moment, she was thrown up by another strong turbulence and hit against the floor.

One of the cabin attendants who had worked in aft galley with the injured cabin attendant stated that she was instructed by the purser to keep seatbelt sign on and be cautious about turbulence as it rained heavily at takeoff. When she witnessed the cabin attendant was seriously injured while attempting to protect the passenger, she thought to herself that self-protection as well as passengers' safety is equally important as cabin crew.

Based on the accident where a cabin attendant got injured to protect a passenger, the ARAIB investigation team has concluded the analysis of the accident as follows. Above all, cabin crew's self-protection should be prioritized first as they are the ones who are responsible for passengers' safety.

## **2.4 Preventive Measures for Passengers Due to Turbulence**

Asiana Airlines enhanced safety guidelines for cabin crew as well as passengers during in-flight turbulence. It also added phrases in cabin announcement that the instructions became more specific to ensure that similar occurrences won't happen again.

The revised turbulence procedure defines guidelines for each turbulence level. By taking into consideration safety for both passengers and crew members, service guideline has become stricter by making detailed cabin announcement and discontinuance of service.

Cabin Crew's Operations Manual was revised as shown in [Figure 15]. Asiana Airlines strengthened response procedure during turbulence of each phase for safety of both passengers and cabin crew.

**(Taking Enhanced Action)** Cabin Attendants Operating Manual 2.8 Guidelines for each level Turbulence

- 1) Cabin Announcement: A further announcement is promptly made to passengers in a lavatory.
  - (Passenger’s safety) “Please hold on to a door knob when using lavatory.”
- 2) Light Turbulence(Seatbelt Chime Once): All crew members sit immediately in the closest available seat
  - Cabin Service: Discontinue all service immediately
  - Purser should check cabin condition for one or two minutes and then determine if cabin service can be resumed.
- 3) Guidelines integrated when encountering moderate and severe turbulence
  - Discontinue service immediately
  - (Passenger’s safety) “Dear passengers, please hold on to a door knob when using lavatory.”

[Figure 15] Cabin Crew’s Response to Turbulence of Each Level

The Federal Aviation Administration(FAA)<sup>19)</sup> establishes guidelines to prevent injuries caused by turbulence as shown in [Figure 16].

DESIGN EFFECTIVE TRAINING TO PREVENT OR MITIGATE INJURIES TO F/As (Flight Attendant) CAUSED BY TURBULENCE.

- a. Take Advantage of the Training Environment.
- b. Emphasize the Importance of F/A’s Personal Safety.
- c. Promote Communication and Coordination.

[Figure 16] FAA Guidelines to Prevent Cabin Crew’s Injuries for Turbulence

13.6.9 Cabin Crew Response

Cabin crew responses should be appropriate to the level of turbulence encountered and consider their own safety.

13.6.9.1 Overall Objective

Light Turbulence	Moderate Turbulence	Severe Turbulence
Perform safety and seatbelt compliance checks. Continue service with caution according to operator policy. Consider suspension of hot beverage service.	Suspend service. Perform safety and seatbelt compliance checks, if safe to do so. Secure in crew seats.	Suspend service. Take immediate action to protect individual safety. If possible, sit in nearest available seat and fasten seatbelt/harness. Assist passengers when safe to do so.

[Figure 17] Cabin Crew’s Turbulence Guidelines Established by IATA

Asiana Airlines has shared this accident with all crew members to prepare for possible occurrences caused by in-flight turbulence. Further, turbulence safety rules has been disseminated through safety campaign to ensure that crew’s individual safety is the first priority when encountering with turbulence.

19) Advisory Circular No 120-88A, “Preventing Insuries Caused by Turbulence”. 2007.11. FAA.

### 3. Conclusion

#### 3.1 Findings

1. The flight crew of HL7528 held valid aviation pilot license and airmen medical certificate. No special indications or factors that could have affected the flight were found.
2. The captain was hired by Asiana Airlines and he had worked for about 11 years. He had accumulated 7,810 flight hours in total. There was no special indication with regards to the captain's training and flight test performance. It was 27 May that he had recently flown on the same flight route.
3. The first officer joined Asiana Airlines on 29 May 2017 and had worked for about five years since then. He had accumulated 1,707 flight hours in total. There was no special indication with regards to recurrent training and flight test performance. The last day that he had flown on the same flight route was 19 May.
4. The injured cabin attendant joined the Asiana Airlines in January 2001 and had worked for about 22 years before the accident. She had flown on Incheon-Paris round trip flight on 24 May. After three days of rest, she had HL7528 flight schedule. She had no fatigue and underlying medical conditions that could have affected the flight on the day of the event.
5. HL7528 was manufactured by the U.S. Boeing Company on 12 March 1998 and introduced on 30 September 1999. It was registered in the Republic of Korea and had been operated with a valid airworthiness certificate. The flight hours of the aircraft was 64,478 in total. HL7528 was equipped with weather radar manufactured by Honeywell and its total number of takeoffs and landings was 34,738.
6. After takeoff, HL7528 started shaking due to irregular movement of air currents and the captain maintained seatbelt sign on by considering unstable air stream during the entire flight.
7. About five minutes before the accident, one male passenger asked if he could use a lavatory. One of the cabin attendants informed him to be cautious due to possible turbulence.
8. The captain checked clouds in the forward, leftward, rightward at 16,000ft. When he requested to climb to a higher altitude to avoid turbulence, the aircraft was authorized by Incheon ACC. Subsequently, he turned seatbelt sign on twice as severe turbulence was anticipated. Right after that, he heard cabin announcement.
9. Before reaching 16,000ft, the passenger was still in a lavatory and the cabin attendant called for him to return to his seat but there was no answer. The cabin attendant was concerned about his safety. The moment the cabin attendant stepped forward to guide him to his seat, the aircraft had an abrupt jolt. She had her left ankle sprained right at the moment and was badly injured by another severe turbulence.

10. A review of flight data records revealed that the center of gravity reached 1.86G at maximum when the aircraft passed over 16,736ft. The rate of vertical climb increased by about 1.7 times and about four seconds later, it recorded at the lowest of 0.5G.
11. The aircraft was exposed to severe turbulence for about four seconds while it was climbing from 16,000ft to 28,000ft in auto pilot mode. 24 seconds earlier, the captain used chime twice with seatbelt sign on but a cabin attendant was injured. There was a slight change in climb speed but there was no warning sign.
12. The cockpit voice recorder was not retrieved as its maximum recording time exceeded two hours. According to the transcript between the captain and Jeju sub center, the captain notified the cabin crew injury and requested ambulance. Upon arrival in Jeju Airport, the cabin attendant was transported.
13. After arriving at Jeju airport, HL7528 was scheduled to return to Gimpo airport at 09:20. However, there was a delay in departure due to the injured cabin crew and crew substitute. About two hours after the accident, the aircraft departed at 10:11. After arriving at Gimpo airport, the CVR was removed but it was overwritten and no longer available.
14. The Asiana Airlines established its safety management system manual to prevent aircraft accidents as of 1 January 2008. The manual was approved by the Ministry of Land, Infrastructure and Transport and has been implemented. Its 18<sup>th</sup> revision was published on 8 July 2022.
15. The Asiana Airlines has disseminated the HL7528 accident to all flight crew members and took appropriate measures to prevent similar occurrences by enhancing actions against in-flight turbulence encounter.
16. The Asiana Airlines revised cabin operations manual to secure safety first by supplementing guidance procedure for passengers using lavatory and reinforcing response procedure when encountering similar occurrences.

### 3.2 Cause

The ARAIB determines the cause of the accident as follows:

1. HL7528 encountered turbulence on the air corridor during climb

Contributing to the accident were as follows.

1. The pilot's lack of effort to avoid turbulence
2. The injured cabin attendant's lack of self-protection when encountering turbulence

#### 4. Safety Recommendation

As a result of the investigation of the accident occurred to HL7528 encountering turbulence after takeoff at Gimpo Airport on 28 May 2021, the ARAIB issues the following safety recommendations:

##### 4.1 To Asiana Airlines

1. Provide refresher training for all flight crew members to avoid turbulence for passengers'safety and implement enhanced actions to appropriately respond to turbulence (AAR2102-1)
2. Establish safety measures to prevent similar occurrences including cabin crew injuries when encountering in-flight turbulence (AAR2102-2)