KOMITE NASIONAL KESELAMATAN TRANSPORTASI
REPUBLIC OF INDONESIA

FINAL

KNKT.16.12.43.04

Aircraft Accident Investigation Report

PT. Wings Abadi Airlines

ATR 72-212A; PK-WGW

Ahmad Yani International Airport, Semarang

Republic of Indonesia

25 December 2016

2019

This Final Report is published by the Komite Nasional Keselamatan Transportasi (KNKT), Transportation Building, 3rd Floor, Jalan Medan Merdeka Timur No. 5 Jakarta 10110, Indonesia.

The report was based upon the investigation carried out by the KNKT in accordance with Annex 13 to the Convention on International Civil Aviation, the Indonesian Aviation Act (UU No. 1/2009) and Government Regulation (PP No. 62/2013).

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Jakarta, January 2019

KOMITE NASIONAL
KESELAMATAN TRANSPORTASI
CHAIRMAN

SOERJANTO TJAHJONO

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ABBREVIATIONS AND DEFINITIONS

AIP	:	Aeronautical Information Publication
ALAR	:	Approach-and-landing Accident Reduction
AOC	:	Aircraft Operator Certificate
ARFF	:	Airport Rescue and Fire Fighting
ATC	:	Air Traffic Control
ATIS	:	Automatic Terminal Information Service
ATPL	:	Airline Transport Pilot License
AWOS	:	Automated Weather Observing System
BMKG	:	*Badan Meteorologi Klimatologi dan Geofisika* (Bureau of Meteorology, Climatology and Geophysics)
°C	:	Celcius
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of Registration
CB	:	Cumulonimbus
CCTV	:	Close Circuit Television
cm	:	Centimeter
CPL	:	Commercial Pilot License
CVR	:	Cockpit Voice Recorder
EGPWS	:	Enhanced Ground Proximity Warning System
FCOM	:	Flight Crew Operating Manual
FDR	:	Flight Data Recorder
FSF	:	Flight Safety Foundation
GA	:	Go Around
GNSS	:	Global Navigation Satellite System
IAF	:	Instrument Approach Fix
ICAO	:	International Civil Aviation Organization
in Hg	:	Inch of mercury
km	:	Kilometer
KNKT	:	*Komite Nasional Keselamatan Transportasi* (National Transportation Safety Committee)
mbs	:	Millibars
MHz	:	Megahertz
min	:	Minute
OM	:	Operations Manual
PA	:	Public Address
PAS	:	Public Address System

PBN	:	Performance Based Navigation
PF	:	Pilot Flying
PIC	:	Pilot in Command
PM	:	Pilot Monitoring
QRH	:	Quick Reference Handbook
RNAV	:	Area Navigation approach is an approach procedure utilized both ground-based and satellite-based systems.
RVR	:	Runway Visual Range
SEP	:	Safety Equipment and Procedures Manual
SIC	:	Second in Command
SOP	:	Standard Operation Procedure
TAS	:	True airspeed
UTC	:	Universal Time Coordinated
VHF	:	Very High Frequency

SYNOPSIS

On 25 December 2016, an ATR 72-600 aircraft registered PK-WGW was being operated by PT. Wings Abadi Airlines (Wings Air) as a scheduled passenger flight from Husein Sastranegara International Airport (WICC), Bandung to Ahmad Yani International Airport (WAHS), Semarang with flight number WON 1896. On board the aircraft were two pilots, two flight attendants and 68 passengers. There was no report or record of aircraft system malfunction prior to the departure.

At 1734 LT (1034 UTC), the aircraft departed from Bandung. The Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). The flight from departure until commencing for landing approach was uneventful.

At 1121 UTC, the tower controller had visual contact to the aircraft and issued landing clearance, the pilot acknowledged the clearance and requested to reduce the approach light intensity. The tower controller reduced the light intensity and confirmed whether the intensity was appropriate then the pilot affirmed.

At 1124 UTC, the aircraft touched down and bounced. After the third bounce, the pilot attempted to go around and the aircraft touched the runway.

The tower controller realized that the aircraft was not in normal condition and pressed the crass bell then informed the Airport Rescue and Fire Fighting (ARFF) personnel by phone that there was aircraft accident near the taxiway D. While waiting the assistance, the pilot kept the engines run to provide lighting in the cabin.

At 1129 UTC, the tower controller advised the pilot to shut down the engines since the ARFF personnel had arrived near the aircraft to assist the evacuation. Passenger evacuation completed at approximately 10 minutes after the aircraft stopped.

No one injured in this accident and the aircraft was substantially damaged. The right main landing gear folded inward and the propellers tip of the engine number 2 broken at about 26 cm from the tip. On the right fuselage of the aircraft, found several dents and punctures.

The investigation determined that the aircraft serviceability was not issue in this occurrence. Therefore, the analysis discussed the bounce landing, visual illusion and emergency procedure. The investigation concluded the contributing factor of the accident was:

- The visual illusion of aircraft higher than the real altitude resulted in late flare out which made the aircraft bounced.
- The unrecovered bounce resulted in abnormal landing attitude with vertical acceleration up to 6 g and collapsed the right main landing gear.

Following the investigation, the Komite Nasional Keselamatan Transportasi (KNKT) has informed several safety actions and corrective action responding to the KNKT safety investigation on the preliminary report taken by PT. Wings Abadi Airlines. The KNKT acknowledges the safety actions and did not issue safety recommendation in this report.

Investigation involved Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation (BEA), France that assigned accredited representative according to the ICAO Annex 13.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 25 December 2016, an ATR 72-600 aircraft registered PK-WGW was being operated by PT. Wings Abadi Airlines (Wings Air) as a scheduled passenger flight from Husein Sastranegara International Airport (WICC), Bandung[1] to Ahmad Yani International Airport (WAHS), Semarang[2] with flight number WON 1896. On board the aircraft were two pilots, two flight attendants and 68 passengers. There was no report or record of aircraft system malfunction prior to the departure.

The aircraft departed from Bandung at 1734 LT (1034 UTC[3]). The Pilot in Command (PIC) acted as Pilot Flying (PF) and the Second in Command (SIC) acted as Pilot Monitoring (PM). The flight from departure until commenced for landing approach was uneventful. At 1112 UTC, at night condition, the air traffic controller of Semarang Approach unit (approach controller) informed to all traffic that the rain was falling over the airport and the pilot confirmed whether the rain was heavy and was replied that it was slight rain.

At 1115 UTC, the flight held over waypoint KENDA[4] for separation with another aircraft and maintained altitude of 4,000 feet. Two minutes later, the flight was approved to descend to altitude of 3,000 feet.

At 1118 UTC, the approach controller issued clearance for RNAV[5] approach to runway 13 and advised the pilot to report when leaving waypoint KENDA. One minute later, the pilot reported leaving waypoint KENDA and the approach controller instructed to continue approach and to contact to the air traffic controller of Semarang Tower unit (tower controller).

At 1120 UTC, the pilot advised to the tower controller that the aircraft was on final and the runway was in sight. The tower controller instructed to continue the landing approach and advised that the surface wind direction was 190° with velocity of 15 knots, altimeter setting 1,008 mbs and the runway was wet.

At 1121 UTC, the tower controller had visual contact to the aircraft and issued landing clearance, the pilot read back the clearance and requested to reduce the approach light intensity. The tower controller reduced the light intensity and confirmed whether the intensity was appropriate then the pilot affirmed.

At 1124 UTC, the aircraft touched down and bounced. After the third bounce, the pilot attempted to go around and the aircraft touched the runway. The tower controller noticed that the red light on the right wing was lower than the green light on the left wing. The aircraft moved to the right from the runway centerline and stopped near taxiway D.

1 The 24-hours clock in Universal Time Coordinated (UTC) is used in this report to describe the local time as specific events occured. Local time is UTC+7 hours.

2 Husein Sastranegara International Airport (WICC), Bandung will be named as Bandung for the purpose of this report.

3 Ahmad Yani International Aiport (WAHS), Semarang will be named as Semarang for the purpose of this report.

4 KENDA is a waypoint located 13 Nm from Semarang on bearing 309°.

5 RNAV (Area Navigation) approach is an approach procedure utilized both ground-based and satellite-based systems.

The tower controller realized that the aircraft was not in normal condition and pressed the crass bell then informed the Airport Rescue and Fire Fighting (ARFF) personnel by phone that there was aircraft accident near the taxiway D.

At 1126 UTC, the pilot advised the tower controller that the aircraft stopped on the runway and requested assistance. The tower controller acknowledged the message and advised the pilot to wait for the assistance. While waiting the assistance, the pilot kept the engines run to provide lighting in the cabin.

At 1129 UTC, the tower controller advised the pilot to shut down the engines since the ARFF personnel had arrived near the aircraft to assist the evacuation.

Passenger evacuation completed at approximately 10 minutes after the aircraft stopped.

Figure 1: The aircraft condition after stopped

1.2 Injuries to Persons

Injuries	Flight Crew	Passengers	Total in Aircraft	Others
Fatal	-	-	-	-
Serious	-	-	-	-
Minor/None	4	68	72	-
TOTAL	4	68	72	-

1.3 Damage to Aircraft

The aircraft was substantially damaged. The right main landing gear folded inward and the propeller tips of the engine number 2 broken at about 26 cm from the tip.

Figure 2: The damaged main landing gear and propeller

On the right fuselage of the aircraft, found several dents and punctures.

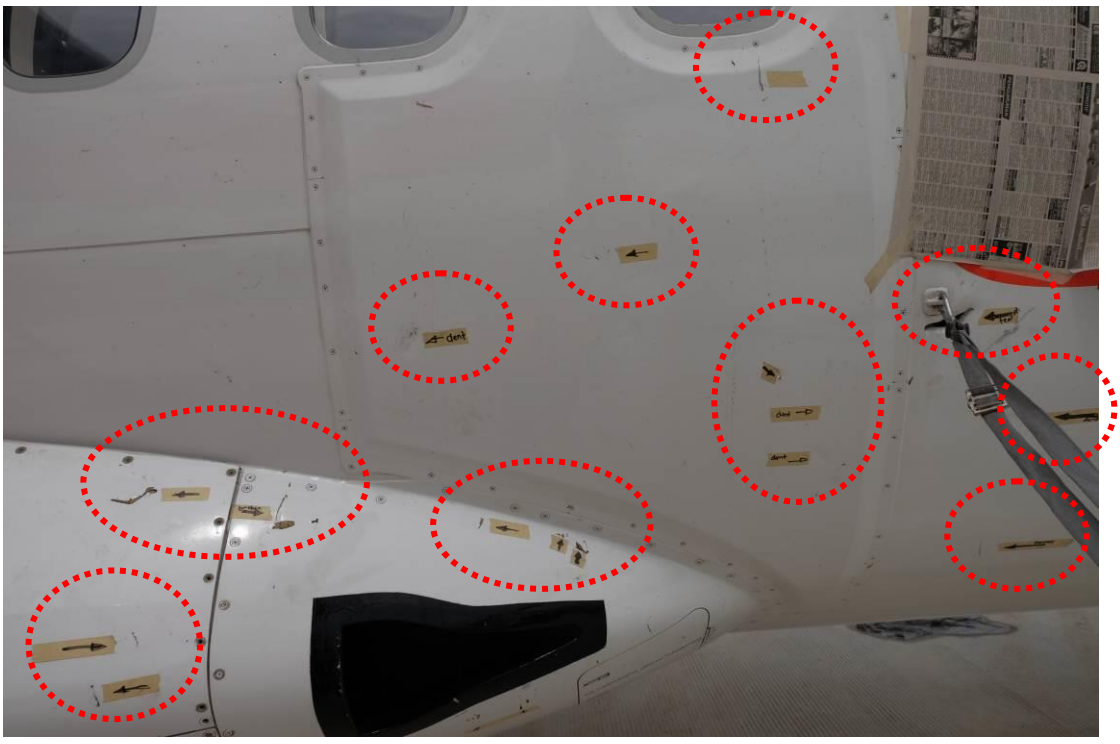


Figure 3: Several dents and damages on the right fuselage

1.4 Other Damage

There was no other damage to property and/or to environment.

1.5 Personnel Information

1.5.1 Pilot in Command

Gender	:	Male
Age	:	28 years
Nationality	:	British
Marital status	:	Single
Date of joining company	:	1 March 2012
License	:	ATPL
Date of issue	:	26 July 2014
Aircraft type rating	:	ATR 42/72
Instrument rating validity	:	4 June 2017
Medical certificate	:	First Class
Last of medical	:	30 August 2016
Validity	:	30 August 2017
Medical limitation	:	Holder shall wear corrective lenses
Last line check	:	28 July 2016
Last proficiency check	:	4 December 2016

Flying experience

Total hours	:	4,065 hours
Total on type	:	3,805 hours
Last 90 days	:	206 hours
Last 60 days	:	151 hours
Last 24 hours	:	7 hours 25 minutes
This flight	:	54 minutes

1.5.2 Second in Command

Gender	:	Male
Age	:	24 years
Nationality	:	Indonesian
Marital status	:	Married
Date of joining company	:	12 October 2012
License	:	CPL
Date of issue	:	27 November 2012

Aircraft type rating	:	ATR 72
Instrument rating validity	:	30 April 2017
Medical certificate	:	First Class
Last of medical	:	13 December 2016
Validity	:	30 June 2017
Medical limitation	:	Holder shall wear corrective lenses
Last line check	:	6 October 2016
Last proficiency check	:	28 April 2016

Flying experience

Total hours	:	3,300 hours
Total on type	:	3,200 hours
Last 90 days	:	189 hours
Last 60 days	:	105 hours
Last 24 hours	:	2 hours 40 minutes
This flight	:	54 minutes

1.6 Aircraft Information

1.6.1 General

Registration Mark	:	PK-WGW
Manufacturer	:	Avions de Transport Regional (ATR)
Country of Manufacturer	:	France
Type/Model	:	72-212A
Serial Number	:	1234
Year of Manufacture	:	2015
Certificate of Airworthiness		
Issued	:	4 March 2016
Validity	:	3 March 2017
Category	:	Transport
Limitations	:	None
Certificate of Registration		
Number	:	3620
Issued	:	4 March 2016
Validity	:	3 March 2017
Time Since New	:	3,485 hours 11 minutes

Cycles Since New	:	4,104 Cycles
Last Major Check	:	Manufacturing on 24 February 2015, next C 01 Check was scheduled on 31 Oct 2017
Last Minor Check	:	A 07 Check was performed on 24 November 2016.

1.6.2 Engines

Manufacturer	:	Pratt & Whitney Canada
Part Number	:	PW127M
Engine Number 1		
▪ Serial Number	:	PCE-ED0988
▪ Time Since New	:	3,485 hours 11 minutes
▪ Cycles Since New	:	4,104 cycles
Engine Number 2		
▪ Serial Number	:	PCE-ED0987
▪ Time Since New	:	3,485 hours 11 minutes
▪ Cycles Since New	:	4,104 cycles

1.6.3 Propellers

Manufacturer	:	Hamilton Sundstrand
Part Number	:	815500-3
Propeller Number 1		
▪ Serial Number	:	FR20141024
▪ Time Since New	:	3,485 hours 11 minutes
▪ Cycles Since New	:	4,104 cycles
Propeller Number 2		
▪ Serial Number	:	FR20141029
▪ Time Since New	:	3,485 hours 11 minutes
▪ Cycles Since New	:	4,104 cycles

1.6.4 Main Landing gear

Manufacturer : Messier Dowty

Main Landing Gear Number 1

- Part number : D23189000-24/C
- Serial number : MN 815
- Date installed : 21 October 2014
- Cycles Since New : 4,104 cycles
- Overhaul limit calendar : 3,285 days
- Overhaul limit cycles : 20,000 cycles

Main Landing Gear Number 2

- Part number : D23190000-24/C
- Serial number : MN 815
- Date installed : 21 October 2014
- Cycles Since New : 4,104 cycles
- Overhaul limit calendar : 3,285 days
- Overhaul limit cycles : 20,000 cycles

1.7 Meteorological Information

1.7.1 Automatic Terminal Information Service

The Ahmad Yani Meteorology Station issued meteorological report at 30-minute intervals or any significant changes through the Automatic Terminal Information Service (ATIS) on frequency 126.0 MHz.

The meteorological reports issued on 25 December 2016 were as follows:

Time (UTC)	1030	1100	1130
Wind (°/knots)	090 / 08	120 / 06	170 / 07
Visibility (km)	6	6	5
Weather	Nil	Nil	Slight Rain
Cloud[6]	FEW Cumulonimbus 1,500 feet, SCT 1600 feet	FEW Cumulonimbus 1,500 feet, SCT 1,600 feet	FEW Cumulonimbus 1,500 feet, SCT 1,600 feet

6 Cloud amount is assessed in total which is the estimated total apparent area of the sky covered with cloud. The international unit for reporting cloud amount for Few (FEW) is when the clouds cover 1/8 up to 2/8 area of the sky and Scatter (SCT) is when the clouds cover 3/8 up to 4/8 area of the sky.

Time (UTC)	1030	1100	1130
Temperature / Dew point (°C)	27 / 23	27 / 23	25 / 24
QNH[7] (mb/in Hg)	1,007 / 29.75	1,008 / 29.78	1,009 / 29.8
QFE[8] (mb/in Hg)	1,007 / 29.74	1,008 / 29.77	1,008 / 29.78
Remarks	Cumulonimbus to South and South East	Cumulonimbus to South and South East	Cumulonimbus to South and South West

1.7.2 Automated Weather Observing System

Ahmad Yani Meteorological Station utilized Automated Weather Observation System (AWOS) with three separated displays from three different sensor locations. The sensors were located at touchdown area of runway 13, touchdown area of runway 31 and located near the tower building on the meteorological instrument park. The following data was taken from the sensor located at the touchdown area of runway 13.

Time (UTC)	Wind Direction Magnetic heading (°)	Wind Direction True heading (°) 2 min	Variable Wind (°) 2 min	Wind speed (knots)	Precipitation 1 hour	Runway Visual Range (meter) 1 min	Visibility (meter)
11:14	179	165	-	9	0.001	2,200	16,093
11:15	167	165	-	8	0.001	2,200	16,093
11:16	164	166	-	14	0.001	2,200	16,093
11:17	188	175	-	12	0.002	2,200	16,093
11:18	177	186	-	6	0.002	2,200	16,093
11:19	180	185	-	13	0.002	2,200	16,093
11:20	184	183	-	13	0.003	2,200	16,093
11:21	202	194	-	12	0.014	2,200	16,093
11:22	189	196	-	11	0.201	2,200	10,274
11:23	176	188	150V210	7	0.769	2,200	3,857
11:24	167	188	150V210	9	1,664	2,200	1,692
11:25	164	181	-	8	2,098	2,200	1,225
11:26	162	169	-	12	2,439	2,200	1,240

7 QNH is atmospheric pressure adjusted to mean sea level. It is a pressure setting used by pilots, air traffic control (ATC), and low frequency weather beacons to refer to the barometric setting which, when set on an aircraft's altimeter, will cause the altimeter to read altitude above mean sea level within a certain defined region.

8 QFE is Atmospheric pressure, sometimes also called barometric pressure, is the pressure within the atmosphere of Earth.

Time (UTC)	Wind Direction Magnetic heading (°)	Wind Direction True heading (°) 2 min	Variable Wind (°) 2 min	Wind speed (knots)	Precipitation 1 hour	Runway Visual Range (meter) 1 min	Visibility (meter)
11:27	148	162	-	12	2,800	2,200	1,427
11:28	155	155	-	10	2,955	2,200	1,614
11:29	154	155	-	6	3,077	2,200	2,424
11:30	151	160	-	5	3,189	2,200	3,331
11:31	180	165	-	5	3,190	2,200	4,791
11:32	215	178	150 to 220	4	3,208	2,200	7,481
11:33	207	192	160 to 220	5	3,212	2,200	11,021

Note:

- Precipitation 1 hour is average precipitation in one hour;
- Runway Visual Range 1 min: the average of Runway Visual Range in the period of 1 minute;
- Wind Direction True Heading 2 min: average of true wind direction in the period of 2 minutes;
- Variable 2 min is average of variable wind direction in the period of 2 minutes.

1.7.3 Satellite Image

The satellite images provided by *Badan Meteorologi Klimatologi dan Geofisika* (BMKG – Bureau of Meteorology, Climatology and Geophysics of Indonesia) at 1000 UTC, 1100 UTC and 1200 UTC. The images indicated development of Cumulus Congestus clouds (towering cumulus) around Semarang during the accident flight (red circle). The cloud was classified as low clouds, which may produce precipitation and often release abundant rain in the form of showers[9].

9 International Cloud Atlas Volume I: Manual on The Observation of Clouds and Other Meteors, that can be found in http://wmo-cloudatlas.org/index.php/en/

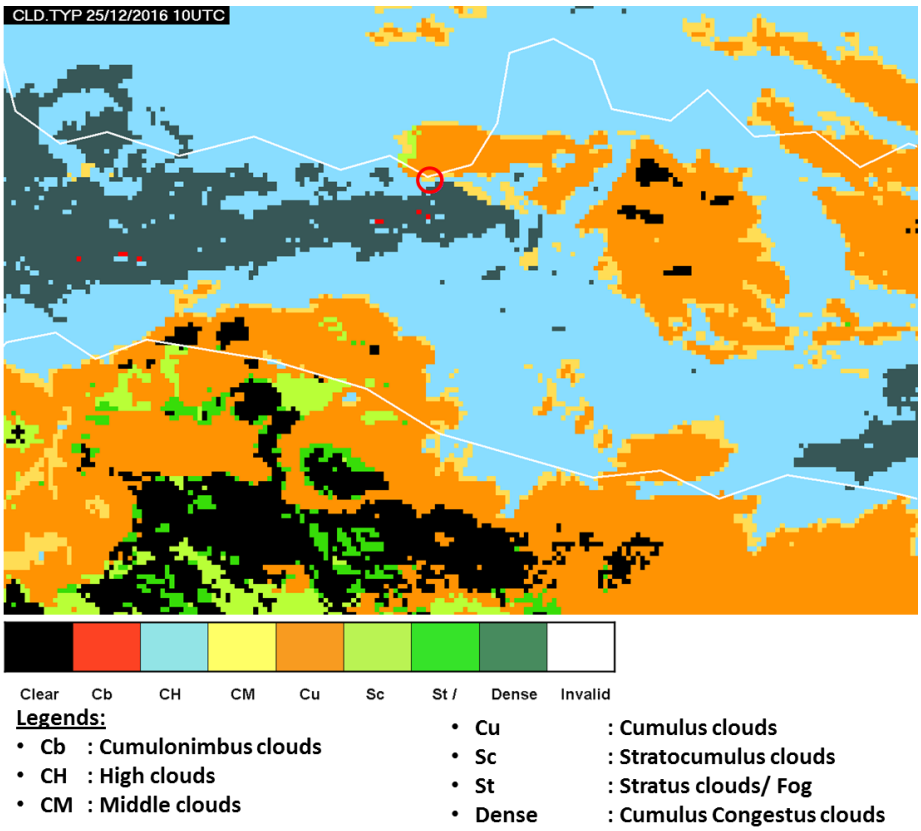


Figure 4: Satellite image at 1000 UTC (Copyright of BMKG)

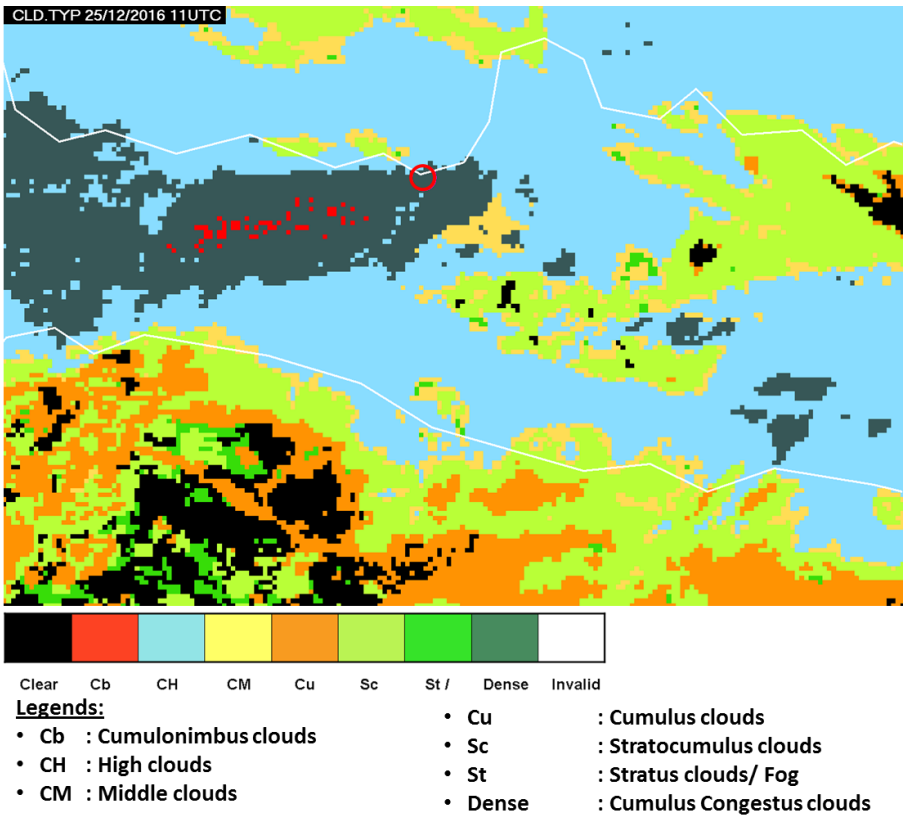


Figure 5: Satellite image at 1100 UTC (Copyright of BMKG)

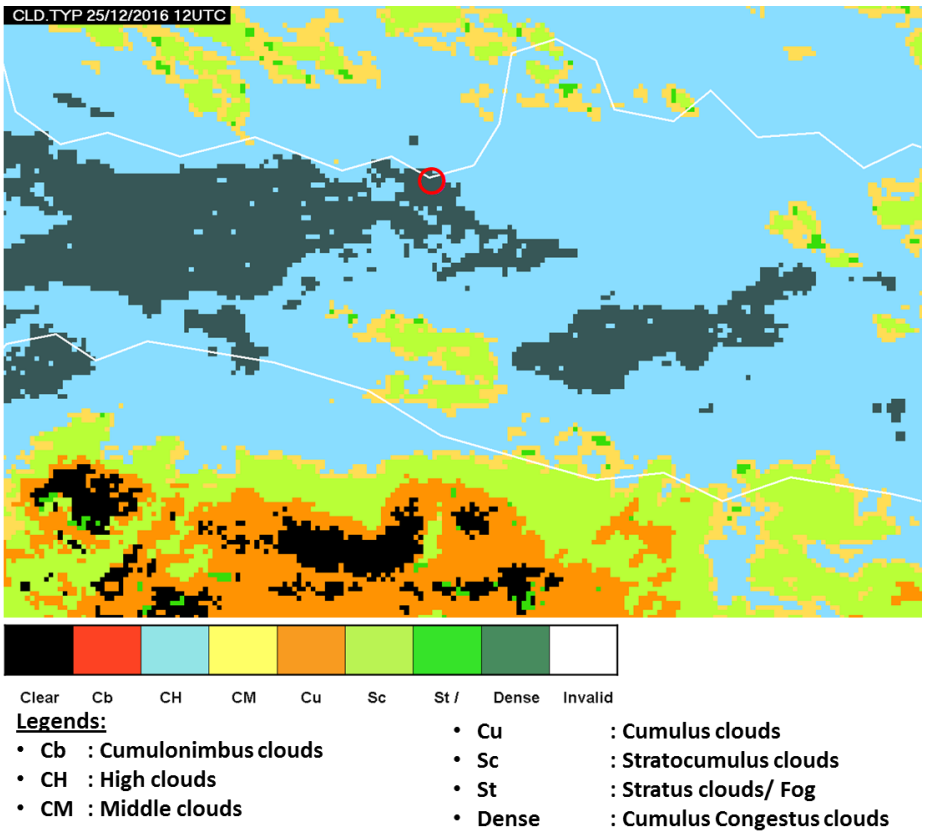
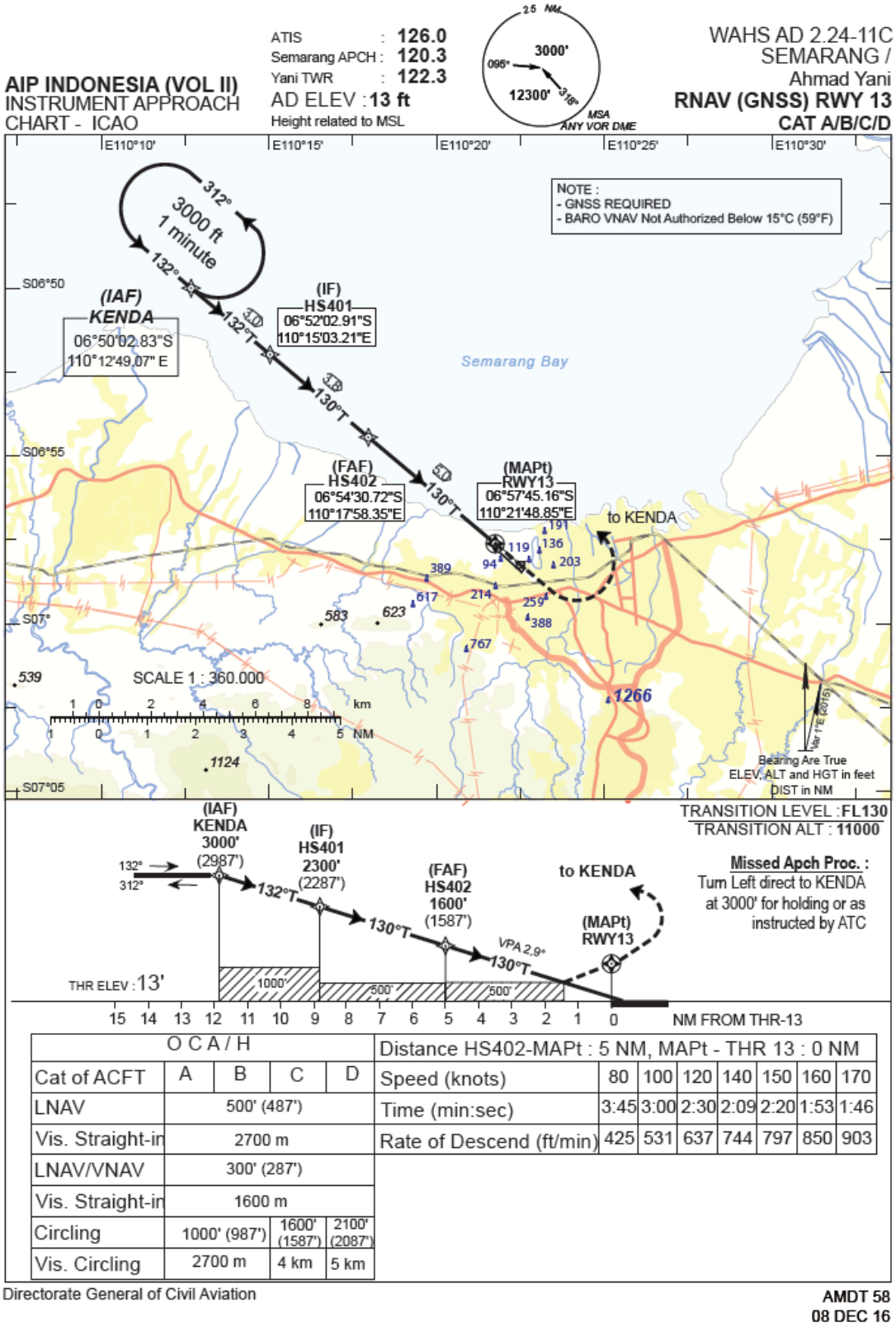


Figure 6: Satellite image at 1200 UTC (Copyright of BMKG)

1.8 Aids to Navigation

Runway 13 of Semarang has Performance Based Navigation (PBN) approach guidance facilities, which utilized RNAV (GNSS) approach. The instrument approach chart provided by Directorate General of Civil Aviation on Aeronautical Information Publication (AIP) Volume II showed on the following figure.



O C A / H				
Cat of ACFT	A	B	C	D
LNAV	500' (487')			
Vis. Straight-in	2700 m			
LNAV/VNAV	300' (287')			
Vis. Straight-in	1600 m			
Circling	1000' (987')		1600' (1587')	2100' (2087')
Vis. Circling	2700 m		4 km	5 km

Distance HS402-MAPt : 5 NM, MAPt - THR 13 : 0 NM							
Speed (knots)	80	100	120	140	150	160	170
Time (min:sec)	3:45	3:00	2:30	2:09	2:20	1:53	1:46
Rate of Descend (ft/min)	425	531	637	744	797	850	903

Figure 7: The RNAV (GNSS) approach chart published in AIP Volume II

1.9 Communications

All communications between air traffic controller and the pilot were normal as recorded on ground based automatic voice recording equipment and Cockpit Voice Recorder (CVR) for the duration of the flight. The quality of the recorded transmissions was good.

The excerpt of the communication will be described in the chapter 1.11.2 Cockpit Voice Recorder.

1.10 Aerodrome Information

Airport Name	:	Ahmad Yani International Airport
Airport Identification	:	WAHS
Airport Operator	:	PT. Angkasa Pura I (Persero)
Airport Certificate	:	030/SBU-DBU/XI/2015
Validity	:	2 September 2020
Coordinate	:	06°58’35” S; 110°22’38” E
Elevation	:	13 feet
Runway Direction	:	13 – 31 (130.2° – 310.2°)
Runway Length	:	2,560 meters
Runway Width	:	45 meters
Surface	:	Asphalt

The aerodrome had Close Circuit Television (CCTV) cameras located along and both sides of the runway. These CCTV cameras were used for the purpose of monitoring foreign object on the runway.

Investigation utilized the recorded data on several CCTV cameras which record the aircraft position prior to touch down up to the aircraft stop.

1.11 Flight Recorders

1.11.1 Flight Data Recorder

The aircraft was fitted with L3-Comm Flight Data Recorder (FDR) FA-2100 model with part number 2100-4043-00 and serial number 954765. The recorder was transported to KNKT recorder facility for data downloading process. The FDR recorded 751 parameters and approximately 66 hours of aircraft operation, which was containing 70 flights including the accident flight.

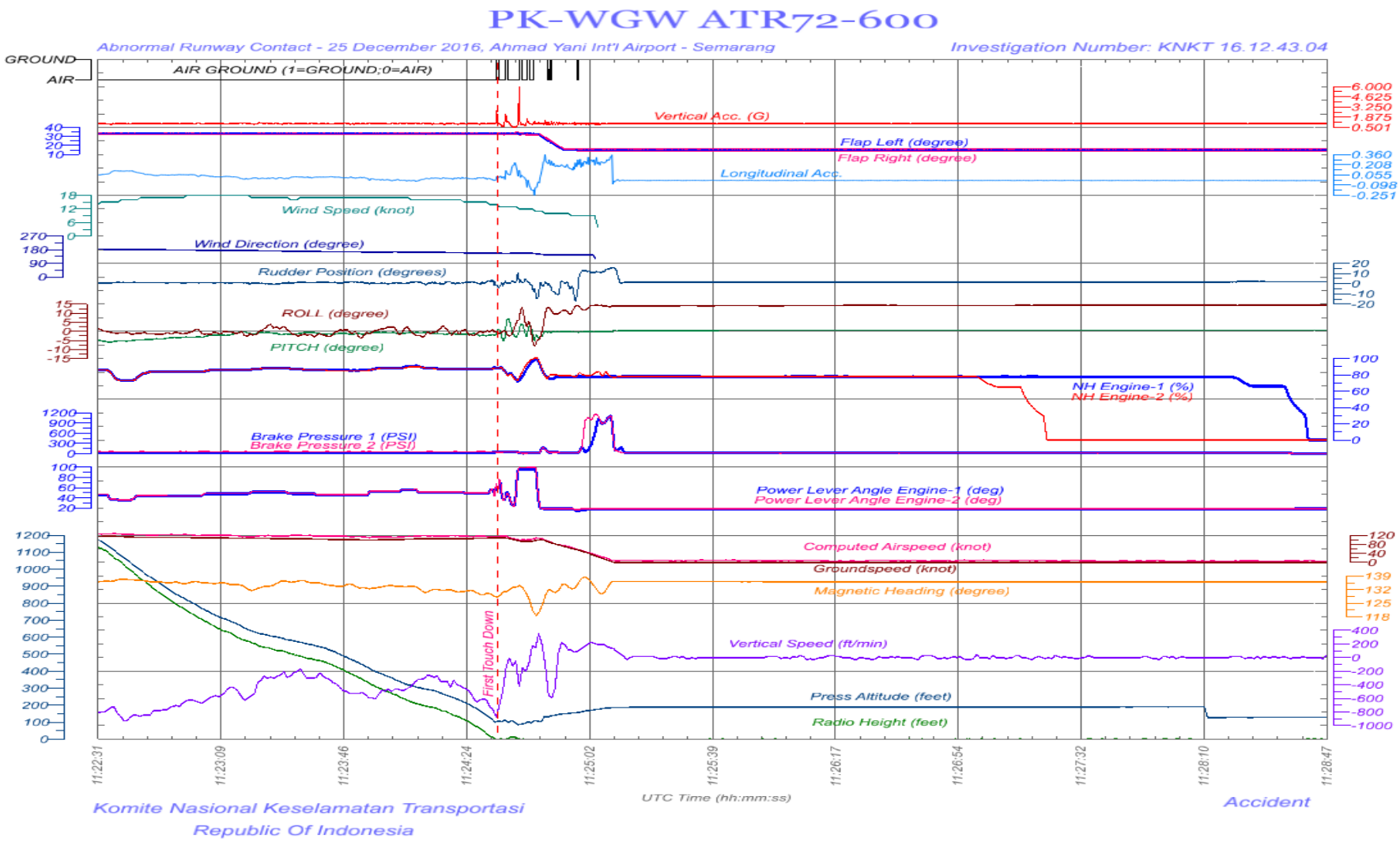


Figure 8: The FDR parameters from approach until engines shutdown

The significant FDR parameters were as follows:

- 11:22:42 UTC, the aircraft passed altitude of 1,000 feet with speed of 123 knots, pitch angle of -5.1° (nose down), thereafter the pitch angle gradually decreased toward up.
- 11:23:21 UTC, the autopilot disengaged at altitude 548 feet.
- 11:23:55 UTC, the altitude was 410 feet, the pitch angle was -0.7°, the speed was 108 knots and the NH value gradually increased from 23% and reached the highest value of 49% at 11:24:10 UTC.
- 11:24:30 UTC, the aircraft passed altitude of 50 feet with speed of 117 knots and the pitch angle was -2.3°. The wind direction was 158° and velocity recorded 15 knots.
- 11:24:32 UTC, the radio height was 15 feet, the pitch angle was -2° and the vertical speed was 780 feet/minute. The aircraft speed of 114 knots.
- 11:24:33 UTC, the pitch angle was -2° and the vertical speed was 880 feet/minute. The aircraft touched down with speed of 113 knots and vertical acceleration of 2.8 g.
- 11:24:34 UTC, the pitch angle was 0.48°, the radio altitude recorded 1 ft.
- 11:24:36 UTC, the pitch angle was -5.4° and the rate of descend was 144 feet/minute. The aircraft touched down with speed of 117 knots and the vertical acceleration was 2.2 g.
- 11:24:37 UTC, the pitch angle was 6.6°. The NH value was decreased from 31% to 8%.
- 11:24:39 UTC, the radio altitude recorded 14 feet.
- 11:24:40 UTC, the pitch angle was -2.4°, and the rate of descend was 432 feet/minute. The aircraft touched down with speed of 102 knots, roll angle was 13° and the vertical acceleration was 6 g.
- 11:24:41 UTC, the pitch angle was 3.49°. The value of NH increased gradually. The radio altitude recorded 1 ft.
- 11:24:43 UTC, the pitch angle was -2.6°, and the vertical speed was -80 feet/minutes. The aircraft touched down with speed of 99 knots, roll angle was 5° and the vertical acceleration was 1.7 g.
- 11:24:44 UTC, the pitch angle was 3°.
- 11:24:45 UTC, the pitch angle was -3.5°. The aircraft touched down with speed of 102 knots, roll angle was -7.8° and the vertical acceleration was 1.3 g.
- 11:24:46 UTC, the NH value was 94%.
- 11:25:13 UTC, the ground speed recorded 0.
- 11:27:22 UTC, the NH right engine recorded 0 and 11:28:42 UTC, the NH left engine recorded 0.
- Th FDR recorded the aircraft bounces for 5 times.

The following figure was the descent profile when the aircraft passed KENDA (Instrument Approach Fix/IAF), which was 12 nm from runway threshold compared with descent profile on RNAV approach chart published in AIP.

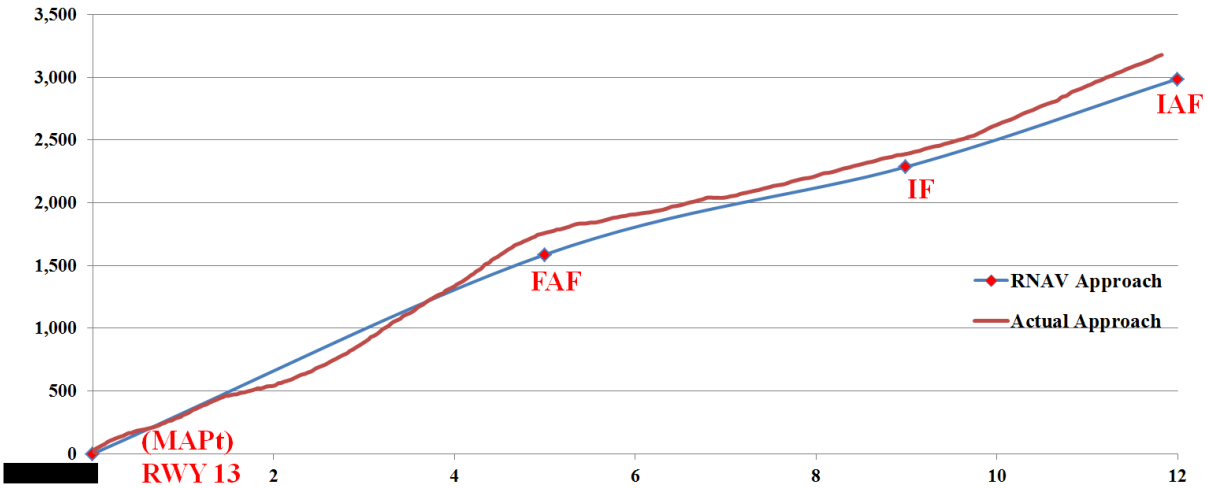


Figure 9: Descent profile from point KENDA (IAF)

1.11.2 Cockpit Voice Recorder

The aircraft was fitted with FA2100 model with part number 2100-1020-02 and serial number 929260. The recorder was transported to KNKT recorder facility for data downloading process. The CVR recorded 2 hours and 4 minute of good quality recording data. The significant excerpt from the CVR was as follows:

Note:
P1 is PIC
P2 is SIC
APP is Semarang Approach controller
TWR is Semarang Tower controller
EGPWS is Enhanced Ground Proximity Warning System

Time (UTC)	From	Communication
11:11:21	P2	Advised the approach controller that the aircraft was passing altitude of 9,000 feet and position was crossing radial 275 on distance 24 Nm from ANY VOR/DME.
11:12:19	APP	Advised to all aircraft pilots that the weather changed to slight rain over the airport.
11:12:28	P2	Confirmed to the approach controller whether the rain was heavy and advised that it was slight rain.
11:15:24	P1	Advised the P2 that the runway was in sight and acknowledged.

Time (UTC)	From	Communication
11:15:26	APP	Instructed the pilot to hold over KENDA and was acknowledged.
11:18:10	APP	Issued clearance for RNAV approach to runway 13 to the pilot and was acknowledged.
11:19:56	P2	Advised the approach controller that the flight was leaving KENDA.
11:19:58	APP	Advised the pilot to continue the approach and to contact tower controller for further instruction.
11:20:11	P2	Advised tower controller that the flight was on final runway 13 at about 10 nm from ANY VOR/DME and the runway was in sight.
11:20:28	TWR	Acknowledged the message and advised to continue the landing approach to runway 13 with additional information of the surface wind direction was 190° with velocity of 15 knots, altimeter was 1,008 mbs, and the runway was wet.
11:21:34	TWR	Advised the pilot that the aircraft was in sight and issued landing clearance to runway 13.
11:21:40	P2	Read back the landing clearance and requested the tower controller to reduce the intensity of the approach light.
11:21:50	TWR	Confirmed whether the intensity was appropriate then the pilot affirmed.
11:22:32	P1	Advised the P2, if the flight was uncomfortable a go around shall be initiated and was acknowledged.
11:23:10	EGPWS	*APPROACHING MINIMUM*
11:23:11	P1	Confirmed the P2 whether continue landing or not and the P2 answered to continue.
11:23:20	EGPWS	*MINIMUM - MINIMUM*
11:23:23		Sound autopilot disconnected
11:24:12	EGPWS	*TWO HUNDRED*
11:24:18	P2	Stated that the aircraft altitude was inappropriate and was replied by the PIC that it was fine.
11:24:27	EGPWS	*ONE HUNDRED*
11:24:31	EGPWS	*FIFTY*
11:24:32.037	EGPWS	*FORTY*
11:24:32.633	EGPWS	*THIRTY*

Time (UTC)	From	Communication
11:24:33	EGPWS	*TWENTY*
11:24:34.309	EGPWS	*TEN*
11:24:34.964		*Similar sound of touch down.*
11:24:41	P1	Advised to go around.
11:24:42	P1	*Go go go go*
11:25:18	P1	Advised the flight attendant to remain seated.
11:25:21	P2	Advised the tower controller that the aircraft experienced hard landing and requested assistance.
11:25:26	TWR	Acknowledged the message and advised the pilot to wait for the assistance.
11:26:06	P1	Asked the flight attendant regarding to the condition of the crew and passenger. The flight attendant informed that everything is fine.
11:26:57	P2	Advised the P1 whether the engine number 2 would be shut down.
11:26:59	P1	Discussed the go around decision with the P2.
11:27:29	P2	Advised the P1 to shut down the engine number 2 and agreed by the P1
11:27:39	P2	Asked the P1 whether the engine number 1 was restarted
11:27:40	P1	Advised that if the engine was shutdown, there was no light on the cabin.
11:27:53	P2	Advised the P1 that there was no fire.
11:27:56	TWR	Advised the pilot to shut down the engine and acknowledged by the P2
11:28:10	P1	Advised P2 to inform the tower controller if the engine was shut down there was no electricity for the passenger. The P2 insisted to shut down the engine and agreed by P1
11:28:38	P1	Advised the flight attendant that the engine would be shut down and no electricity.
11:29:50	TWR	Asked the pilot whether the evacuation could be started and the P2 advised to evacuate the passenger to the terminal building.
11:30:47	P1	Commanded the flight attendant to evacuate the passenger.

Time (UTC)	From	Communication
11:34:32		*End of recording*

1.12 Wreckage and Impact Information

Several scratch marks were found on the runway, the first scratch mark was found at about 500 meters from the beginning runway 13 on the left of runway centerline, the dimension was 150 cm long and 20 cm width (figure 9).

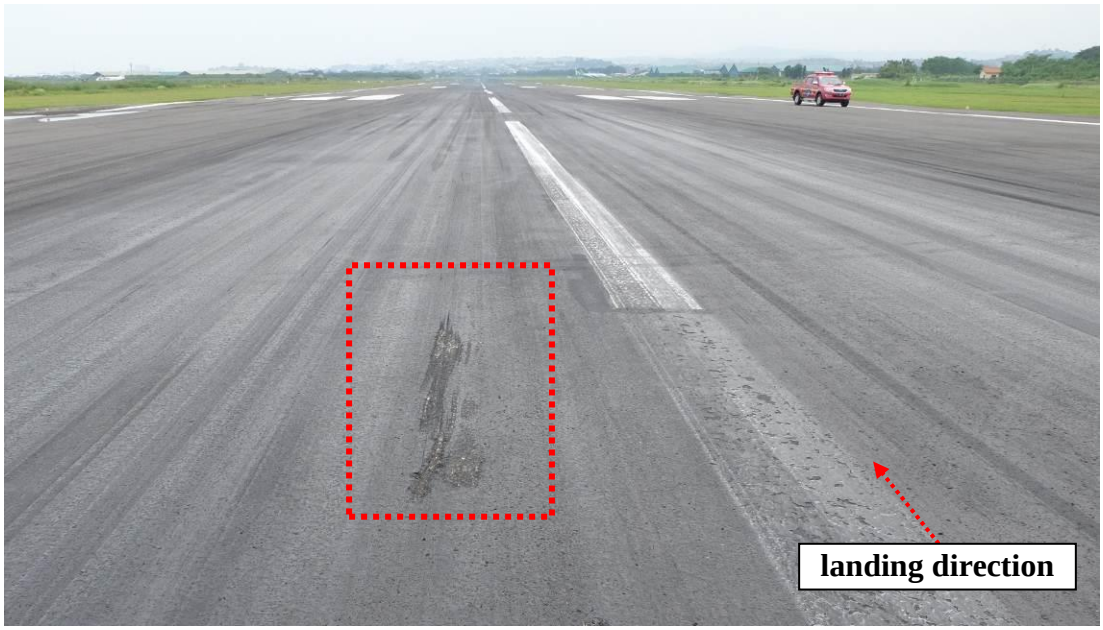


Figure 10: The first scratch

At about 390 meters from the first scratch mark, it was found white paint mark which crossed from right to the left of runway centerline (figure 10) and then at about 190 meters the white paint mark continued to cross from right to left runway centerline until the location of the aircraft stopped (figure 11).

On the right shoulder near the aircraft stopped there was propeller mark on the ground (figure 12).

Figure 11: The white marking crossed from left to right runway centreline

Figure 12: The white marking crossed from right to left runway centreline

Figure 13: The propellers condition and scratch mark on the ground

The aircraft movement based on the FDR data and the first scratch mark was found near the area of the third touchdown. The figure is as follow:

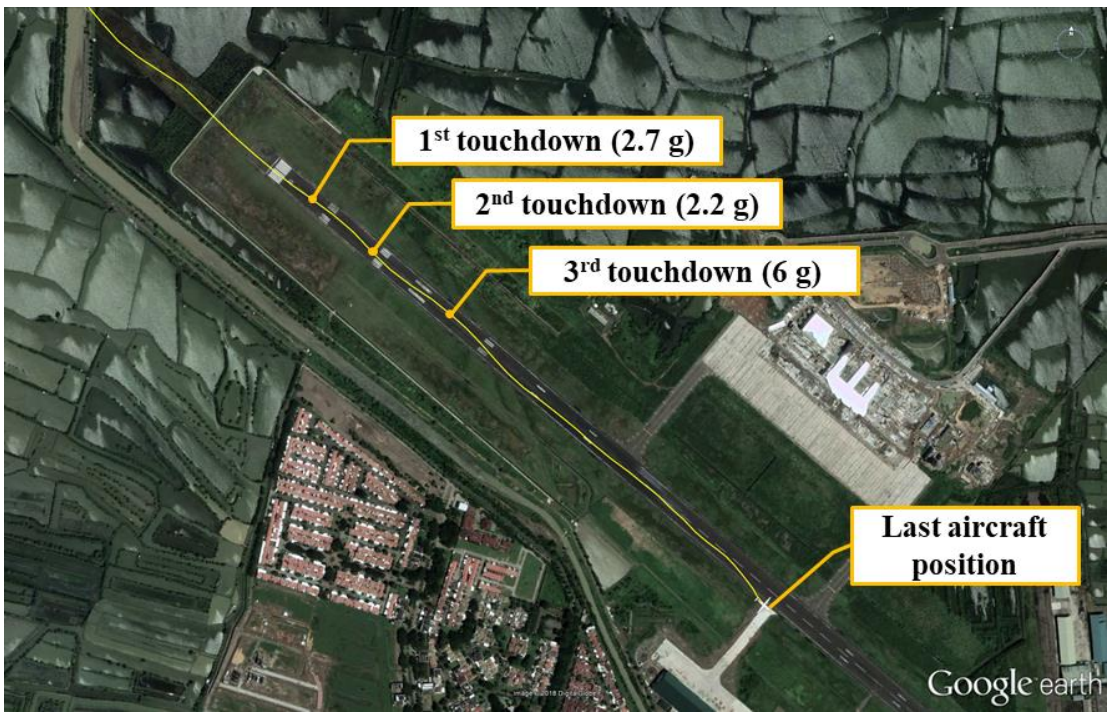


Figure 14: The aircraft trajectory based on FDR

1.13 Medical and Pathological Information

No medical or pathological investigations were conducted as a result of this occurrence, nor were they required.

1.14 Fire

There was no evidence of fire in-flight or after the aircraft stopped.

1.15 Survival Aspects

While the aircraft on landing roll, the tower controller noticed abnormal attitude of the aircraft. The aircraft was tilted to the right by the indication of navigation lights position. The aircraft then deviated to the right from the runway centerline. The tower controller pressed the crash bell then informed to the Airport Rescue and Fire Fighting (ARFF) by phone of an aircraft accident near the taxiway D.

At 1126 UTC, the pilot advised the tower controller that the aircraft stopped on the runway and requested for assistance. The tower controller acknowledged the message and advised the pilot to wait for the assistance.

At 1128 UTC, the ARFF fire tenders and command car arrived to the site and prepared for spray the fire extinguishing agent.

At 1129 UTC, the tower controller advised the pilot to shut down the engines since the ARFF personnel had arrived near the aircraft to assist the evacuation. The right engine then was shut down followed by the left engine.

Passenger evacuation completed at approximately 10 minutes after the aircraft stopped.

1.16 Tests and Research

The right main landing gear was examined in the metallurgical engineering laboratory of Institute Technology of Bandung (*Institut Teknonogi Bandung*). The examination found no previous defect on the landing gear. The examination concluded that the failure of the right main landing gear was due to excessive impact forces.

1.17 Organizational and Management Information

1.17.1 The Aircraft Operator

Aircraft Owner	:	Phoenix Aviation Limited
Address	:	PO BOX 1093, Queensgate House, Grand Cayman, KY1-1102, Cayman Islands
Aircraft Operator	:	PT. Wings Abadi Airlines
Address	:	Jl. A.M. Sangaji No. 17 Jakarta Pusat, Indonesia

The Wings Abadi Airlines had a valid Aircraft Operator Certificate (AOC) number 121-012 which approved to conduct scheduled passenger flight operation within Indonesian territorial airspace. The Wings Air was operating 20 ATR 72-500 aircraft and 32 ATR 72-600 aircraft.

1.17.1.1 Operations Manual Part A

8.3.2.9.4 BOUNCED LANDING / LONG FLARE

If a hard and/or high bounce occurs, a go-around must be initiated.

If landing within the touchdown zone is not ensured and the remaining runway is insufficient to stop safety, a go-around must be initiated.

8.3.20.11 EMERGENCY LANDING - GENERAL

8.3.20.11.1 GENERAL

Emergency landing can be divided into:

- *Anticipated landings; and,*
- *Landing that take place without prior-warning (usually crashes), or normal landings that develop into an emergency e.g. due to failing landing gear.*

The procedures to be followed have been standardized as much as possible for all types of aircraft. It is of prime importance that each crewmember has a thorough knowledge of his duties as well as of the duties of other crewmembers to be able to take over other incapacitated crewmembers tasks.

Moreover, because of a well-instructed team working in close cooperation will be able to obtain far better results.

Furthermore, a smooth operating team like a well-oiled gear in the face of emergency instills confidence and consequently will not evoke panic easily on the part of the passengers. For psychological reasons, the PIC or SIC should give the first information about an impending emergency landing to the passengers. If this is not possible due to lack of time, the Senior Cabin Crew, where applicable, must inform the passengers of the emergency.

This should be done in a concise and discrete manner in order to avoid confusion and panic. Control of voice level and modulation play an important role in situations of this nature. The information must contain the real facts.

8.3.20.14 EVACUATION DIRECTIVES

8.3.20.14.1 GENERAL

Most emergency situations develop during the initial or final stage of the flight. It must be realized that the preparation phase may be varying brief or even non-existent. Flight crew and Cabin Crews should be prepared for expected and specially unexpected emergencies.

When during cruise an emergency develops that may require an evacuation after landing, the crewmembers must be prepared for an emergency landing and evacuation. Standard procedures cannot provide for every possibility that may arise. The information of this chapter must therefore be applied with common sense, taking into account the circumstances of the particular case. Detailed of emergency evacuation procedures are laid down in respective FCOMQRH and in SEP manual.

8.3.20.14.4 INITIATION OF THE EVACUATION

When the aircraft comes to a full stop under abnormal conditions the PIC after give a command "ATTENTION CREW ON STATION" twice and evaluate situation will decide whether evacuation is required or not, and contact the CABIN CREW -1. In this case, CABIN CREW -1 will check the outside conditions and coordinated with other CABIN CREW. If there is no command from the PIC, CABIN CREW -1 will immediately check the PIC to ensure if evacuation is required.

Criteria for initiating evacuation:

- *The PIC has the prime responsibility for initiating a passenger evacuation;*
- *If a Cabin Crew consider an evacuation is necessary he must advise the PIC of the situation and await the PIC decision;*
- *The Cabin Crews may take full responsibility for initiating the evacuation, in the following cases:*
  - *It is obvious an evacuation is imperative;*
  - *No contact with the flight crew/PIC has been possible;*
  - *The safety of people is in jeopardy such as:*
    - *Heavy smoke inside or outside the aircraft;*
    - *Fire;*
    - *Severe structural damage.*
  - *Another cabin crew has started evacuating passengers. If an evacuation is initiated by a cabin crews, inform the Flight Crew that an evacuation is in progress.*

In case of evacuation required the PIC command: "EVACUATE" (repeated command). If evacuation is not required, the PIC should immediately make the following PA announcement: "CABIN CREW AND PASSENGER KEEP YOUR SEAT".

After check out side conditions and coordinate with other Cabin Crews and the condition are judged safe, CABIN CREW-1 will make the following Public Address announcement:

Para penumpang yang terhormat *Captain sedang mengevaluasi keadaan.* *Tetaplah duduk dengan tenang di kursi masing.* *Pengumuman selengkapnya akan kami berikan secepatnya*	*Ladies and Gentlemen* *Captain is evaluating the situation.* *Please keep calm and remain seated.* *Further information will be given to you as soon as possible.*

If conditions are judge unsafe, CABIN CREW-1 will report to the cockpit immediately. The PIC will command via PA: "EVACUATE". In this case, the PIC and the Cabin Crews will immediately execute their own procedures. If conditions are judge safe and the evacuation is not required, the PIC will immediately make PA announcement: "CABIN CREW AND PASSENGERS KEEP YOUR SEAT"

In this case, CABIN CREW-1 will make announcement via PA

Para penumpang yang terhomat *Keadaan pesawat sudah dapat dikendalikan.* *Anda kami minta agar tetap duduk dengan tenang.*	*Ladies and Gentlemen* *Everything is under controlled.* *Please keep calm and remain seated.*

When the aircraft comes to full stop under abnormal condition and the aircraft conditions are judge unsafe, the PIC will immediately command: "EVACUATE". In this case, the Crewmembers will immediately execute their own procedures.

***NOTE**: If no PAS available, use megaphone.*

1.17.1.2 Flight Crew Operating Manual Volume 1 & 2

2.02.00 PROCEDURES AND TECHNIQUE

2.02.12 FLIGHT CHARACTERISTIC

LANDING (page P5-001)

In order to minimize landing distance variation the following procedure is recommended:

- *Maintain standard final approach slope (3°) and final VAPP until 20 ft is called on radio altimeter.*
- *At« 20ft » call by PM, reduce to FI and flare visually as required.*

  ***Note:** 20 ft leaves ample time for flare control from a standard 3° final slope.*

  - *During this flare the airspeed will necessary decrease, leading to a touch down speed of 5 to 10 kt lower than the stabilized approach speed.*

2.04.05 EMERGENCY PROCEDURES

MISCELLANEOUS (page P7-001)

EMERGENCY EVACUATION ON GROUND

PROCEDURE

EMER EVACUATION ON GROUND

AIRCRAFT / PARKING BRAKE	STOP / ENGAGE
AUTO PRESS	DUMP
ATC (VHF1)	NOTIFY
CL 1 + 2	FTR THEN FUEL SO
MIN CAB LIGHT	ON
CABIN CREW (PA)	NOTIFY
FIRE HANDLES 1 + 2	PULL
AGENTS	DISCH AS RQD
ENG START ROTARY SELECTOR	OFF / START ABORT
FUEL PUMPS 1 + 2	OFF
EVACUATION (PA)	INITIATE
● **Before leaving aircraft**	
BAT	OFF

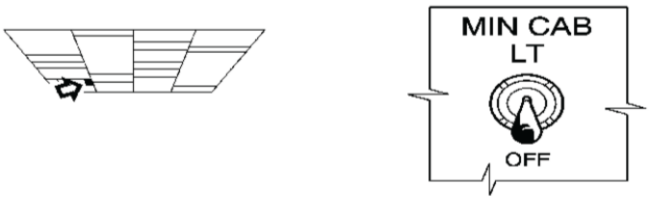
COMMENTS

Careful analysis is required to decide passenger evacuation, however useful time should not be wasted.

Notify ATC on the nature of the emergency and state intentions. Only VHF 1 is available on battery.

On battery, only PA is available to communicate with cabin crew.

MIN CAB LT SWITCH



Enables to control the minimum cabin lights powered by the main battery.

1.17.1.3 Standard Operation Procedures for ATR 72-600

EMERGENCY & ABNORMAL PROCEDURE

ABNORMAL SITUATIONS

3 Unusual attitude recovery (Section number 04.03, Page 1)

3.2 Bounced landing

Bounced landing may result from either a too high speed or too high slope on final. Decided GO AROUND if the plane is not stabilized (flight path, aircraft configuration, speed) at 500 ft, in case of bounce. NEVER push forward control column, DO NOT try to land, PERFORM a go-around immediately:

- *GA Pitch*
- *Set Power*
- *Flaps ONE NOTCH, when speed > Vga*[10]

10 Vga is go around speed

1.17.2 Civil Aviation Safety Regulation Part 25

25.473 Landing Load Conditions and Assumptions

(a) For the landing conditions specified in sec. 25.479 to sec. 25.485 the airplane is assumed to contact the ground−

(1) In the attitudes defined in sec. 25.479 and sec. 25.481;

(2) With a limit descent velocity of 10 fps at the design landing weight (the maximum weight for landing conditions at maximum descent velocity); and

(3) With a limit descent velocity of 6 fps at the design take-off weight (the maximum weight for landing conditions at a reduced descent velocity).

(4) The prescribed descent velocities may be modified if it is shown that the airplane has design features that make it impossible to develop these velocities.

25.479 Level Landing Conditions

(a) In the level attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to 1.25 V_{L2} parallel to the ground under the conditions prescribed in sec. 25.473 with –

(1) V_{L1} equal to V_{S0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L2} equal to V_{S0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.

(5) The effects of increased contact speed must be investigated if approval of downwind landings exceeding 10 knots is requested.

(b) For the level landing attitude for airplanes with tail wheels, the conditions specified in this section must be investigated with the airplane horizontal reference line horizontal in accordance with Figure 2 of Appendix A of this part.

(c) For the level landing attitude for airplanes with nose wheels, shown in Figure 2 of Appendix A of this part, the conditions specified in this section must be investigated assuming the following attitudes:

(1) An attitude in which the main wheels are assumed to contact the ground with the nose wheel just clear of the ground; and

(2) If reasonably attainable at the specified descent and forward velocities, an attitude in which the nose and main wheels are assumed to contact the ground simultaneously.

(d) In addition to the loading conditions prescribed in paragraph (a) of this section, but with maximum vertical ground reactions calculated from paragraph (a), the following apply:

(1) The landing gear and directly affected attaching structure must be designed for the maximum vertical ground reaction combined with an aft acting drag component of not less than 25% of this maximum vertical ground reaction.

(2) The most severe combination of loads that are likely to arise during a lateral drift landing must be taken into account. In absence of a more rational analysis of this condition, the following must be investigated:

(i) A vertical load equal to 75% of the maximum ground reaction of sec. 25.473 must be considered in combination with a drag and side load of 40% and 25% respectively of that vertical load.

(ii) The shock absorber and tire deflections must be assumed to be 75% of the deflection corresponding to the maximum ground reaction of sec. 25.473(a)(2). This load case need not be considered in combination with flat tires.

(3) The combination of vertical and drag components is considered to be acting at the wheel axle centerline.

25.481 Tail Down Landing Conditions

(a) In the tail-down attitude, the airplane is assumed to contact the ground at forward velocity components, ranging from V_{L1} to V_{L2} parallel to the ground under the conditions prescribed in sec. 25.473 with—

(1) V_{L1} equal to V_{S0} (TAS) at the appropriate landing weight and in standard sea level conditions; and

(2) V_{L2} equal to V_{S0} (TAS) at the appropriate landing weight and altitudes in a hot day temperature of 41 degrees F. above standard.

(3) The combination of vertical and drag components considered to be acting at the main wheel axle centerline.

(b) For the tail-down landing condition for airplanes with tail wheels, the main and tail wheels are assumed to contact the ground simultaneously, in accordance with figure 3 of appendix A. Ground reaction conditions on the tail wheel are assumed to act—

(1) Vertically; and

(2) Up and aft through the axle at 45 degrees to the ground line.

(c) For the tail-down landing condition for airplanes with nose wheels, the airplane is assumed to be at an attitude corresponding to either the stalling angle or the maximum angle allowing clearance with the ground by each part of the airplane other than the main wheels, in accordance with figure 3 of appendix A, whichever is less.

25.723 Shock Absorption Tests

(a) It must be shown that the limit load factors selected for design in accordance with Sec. 25.473 for takeoff and landing weights, respectively, will not be exceeded. This must be shown by energy absorption tests except that analyses based on earlier tests conducted on the same basic landing gear system which has similar energy absorption characteristics may be used for increases in previously approved takeoff and landing weights.

(b) The landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 fps at design landing weight, assuming airplane lift not greater than the airplane weight acting during the landing impact.

1.18 Additional Information

Spatial Disorientation

Spatial disorientation is defined as the inability of a pilot to correctly interpret aircraft attitude, altitude or airspeed in relation to the Earth or other points of reference[11].

According to the Flight Safety Foundation (FSF) Approach Approach-and-landing Accident Reduction (ALAR) Briefing Notes[12], visual illusions occur when conditions modify pilot perception of the environment relative to the pilot expectations, possibly resulting in spatial disorientation or landing errors.

There are several aspects that need to be considered including runway environment. The runway lighting conditions with low-intensity lights create the impression of being farther away. In addition, a wet runway reflects very little light that can affect depth perception and cause the flight crew to perceive incorrectly that the aircraft is farther away from the runway. This effect usually results in a late flare and hard landing.

1.19 Useful or Effective Investigation Techniques

The investigation was conducted in accordance with the KNKT approved policies and procedures, and in accordance with the standards and recommended practices of Annex 13 to the Chicago Convention.

11 Article of spatial disorientation can be found on SKYbrary website on the following link http://www.skybrary.aero/index.php/Spatial_Disorientation

12 The FSF ALAR Briefing Note 5.3 – Visual Illusions can be found on the following link https://flightsafety.org/toolkits-resources/past-safety-initiatives/approach-and-landing-accident-reduction-alar/alar-briefing-notes-in-english/

2 ANALYSIS

The aircraft touched down and bounced five times as recorded on the FDR with the highest recorded vertical acceleration was 6 g. Thereafter, during the landing roll, the aircraft was tilted to the right then deviated to the right from the runway centerline and stopped near the taxiway D with the right main landing gear folded inward and the propellers tip of the right engine broken at about 26 cm from the tip. Prior to the occurrence, there was no record or report of aircraft system malfunction and investigation considered that aircraft serviceability was not issue on this accident therefore, the analysis will focus on the following issue:

- Bounce landing;
- Visual illusion; and
- Emergency procedure.

2.1 Bounce landing

The aircraft flight profile after passed altitude of 1,000 feet prior to touchdown was relatively steady. The FDR recorded altitude deviation compared to the RNAV approach profile, however at 500 feet, the aircraft was on correct profile. Minor deviation was recorded however, it can be considered as normal.

The FCOM for landing procedure stated that at 20 feet, the flare[13] out shall be initiated by visual reference. The FDR recorded that while the aircraft passed 20 feet, the pitch angle was constant on -2° (nose down), the rate of descend was about 780 feet/minute and aircraft speed 114 knots. One second after, the aircraft touched down with pitch angle -2°, rate of descend 880 feet/minute, speed 113 knots and vertical acceleration of 2.8 g. These recorded data showed that there was no significant change on attitude (pitch), rate of descend and aircraft speed which indicated that the flare did not perform in timely manner.

The nose down attitude during touch down resulted in the nose wheel touched first as recorded on the airport CCTV. Following the nose wheel touch down, the aircraft bounced and the FDR recorded the pitch attitude nose up for about 0.5°. Two seconds later the aircraft touched down with pitch attitude nose down 5.4°, aircraft speed 117 knots and vertical acceleration was 2.2 g. The FDR did not record increasing of engine parameters.

After the second touchdown, the aircraft bounced and the recorded pitch angle was 6.6° and the aircraft reached altitude of 14 feet. Afterward, the aircraft touched down with pitch attitude nose down of 2.4°, rate of descend 432 feet/minute, aircraft speed 102 knots, roll angle 13° to the right and vertical acceleration was 6 g. The third touchdown with right roll, made the impact force was mainly occurred on the left main landing gear. The recorded vertical acceleration of 6 g means that the impact forces were approximately 6 times of the aircraft landing weight.

13 The landing flare is the transition phase between the final approach and the touchdown on the landing surface. This sub-phase of flight normally involves a simultaneous increase in aircraft pitch attitude and a reduction in engine power/thrust, the combination of which results in a decrease in both rate of descent and airspeed. The detail explanation could be found in https://www.skybrary.aero/index.php/Landing_Flare

Refer to the CASR part 25, the landing gear must have been designed capable to support the aircraft without failure on landing with 10 feet per second sink rate at or below the maximum design landing weight and or 6 feet per second sink rate at more than the maximum design landing weight. The test requirement stated that the landing gear may not fail in a test, demonstrating its reserve energy absorption capacity, simulating a descent velocity of 12 feet per second at design landing weight. This structure design based on assumption of the aircraft landed in the normal level landing attitude for airplanes with nose wheels.

The first touchdown conditions were pitch angle -2°, speed of 113 knots, vertical acceleration of 2.8 g and the rate of descend was 880 feet/minute (14.6 feet/second) which was greater than the design requirement. This landing might have degraded the landing gear strength.

The second touchdown condition were pitch angle was -5.4°, speed of 117 knots, the vertical acceleration 2.2 g and the rate of descend was 144 feet/minute (2.4 feet/second).

The third touchdown conditions were pitch angle was -2.4°, speed of 102 knots, roll angle was 13° to the right, the vertical acceleration was 6 g and the rate of descend was 432 feet/minute (7.2 feet/second)

The rate of descend on the third touch-down was below the design requirement, however the aircraft touched down with right main wheel only as the aircraft was roll 13° to the right. Therefore, the impact force with vertical acceleration of 6 g, sustained only on the right main landing gear.

The excessive rate of descend on the first touchdown might have degraded the landing gear strength, followed by landing with vertical acceleration of 6 g which sustained solely by the right main landing gear resulted in the failure of the right main landing gear.

After this third touchdown the aircraft bounced and touched down with nose down at 2.6°, rate of descend 80 feet/minute, aircraft speed 99 knots, roll 5° to the right and vertical acceleration of 1.7 g.

Afterward, the aircraft bounced with 3° nose up, reached 1 feet height, then touched down with nose down 3.5°, speed 102 knots, roll 8° to the left and vertical acceleration 1.3 g. Thereafter, the aircraft rolled until stopped near taxiway Delta.

The aircraft touched down the runway with nose wheel first due to the late of flare out resulted in bounced. The second bounce was the highest bounce which reached 14 feet altitude. According to the Operations Manual Part A, go-around must be initiated if high bounce occurs. The FCOM stated that in case of bounce, go around shall be performed immediately by set the go around pitch, set power and when speed above Vga, to set the flap one notch. The FDR did not record any pilot attempt to go around, during this high bounce.

This unrecovered high bounce resulted in abnormal landing attitude with vertical acceleration up to 6 g and collapsed the right main landing gear.

After the third touchdown, the CVR recorded the pilot call for go around and the FDR record increasing engine power, thereafter the aircraft touched down. The FDR recorded increasing of engine power (NH) up to 94% after the fifth touchdown and 27 seconds later, the aircraft stopped.

2.2 Visual illusion

The FCOM stated that the approach slope shall be maintain at 3° until 20 feet, as called by PM or radio altitude callout and at 20 feet, the flare shall be initiated. During this flare the airspeed will necessary decrease, leading to a touch down speed of 5 to 10 knots lower than the stabilized approach speed.

After passed 20 feet, the FDR data showed that the pitch maintained at 2° down, no significant change on rate of descend and aircraft speed until touchdown, this indicated that the flare did not perform in timely manner.

According to the Flight Safety Foundation (FSF) on Approach and Landing Accident Reduction (ALAR) Briefing Notes, visual illusions may occur when conditions modify pilot perception of the environment relative to the pilot expectations, possibly resulting in spatial disorientation or landing errors.

The runway lighting condition with low-intensity lights created the impression of being farther away and wet runway reflected very little light that can affect depth perception and caused the flight crew to perceive incorrectly that the aircraft was farther away from the runway.

The CVR recorded the EGPWS altitude callouts including the altitude callout from 50 to 10 feet with interval every 10 feet. These altitude callouts could be used as reference for flare out landing at 20 feet, however, the flare was not initiated at this altitude. This might indicate that the pilot relied more to the personal perception of altitude.

The pilot personal perception of altitude depends on the pilot visual references based on the experience.

The landing approach of the aircraft was at night condition with slight rain and the CVR did not record activation of windshield wiper by the pilot. In addition, while on final, the pilot requested to the controller to reduce the intensity of the runway light.

The low-intensity of the runway light and the wet runway which reflected very little light might affected the pilot depth perception and caused the pilot to perceive incorrectly that the aircraft was higher than the real condition. In addition, the absence of the windshield wiper activation might reduce the pilot visibility to the runway.

The late flare out was caused by the pilot perceived the aircraft was higher than the real altitude as the pilot relied more on the personal perception of altitude.

2.3 Emergency Procedure

At 11:25:13 UTC, the FDR recorded the ground speed 0, which indicated the aircraft stopped. The aircraft stopped near the taxiway D, tilted to the right and the right propeller scratched the runway shoulder as the right main landing gear collapsed. This condition considered as abnormal condition.

At 11:25:18 UTC, the pilot advised the flight attendant to remain seated.

At 11:25:18 UTC, the pilot advised the tower controller that the aircraft experienced hard landing and requested assistance. The tower controller acknowledged and advised the pilot to wait for the assistance.

At 11:26:06 UTC, the pilot asked to the flight attendant regarding to the condition of the crew and passengers and the flight attendant informed that everyone was fine.

At 11:30:47 UTC, the PIC commanded for evacuation.

According to the Evacuation Directive on the Wings Air Operation Manual Part A (OM-A) described that when the aircraft stopped under abnormal condition, PIC should command "ATTENTION CREW ON STATION" twice and evaluate situation then decide whether evacuation is required. This command will trigger the flight attendants to check the outside conditions. When evacuation is not required, the PIC shall announce *"*CABIN CREW AND PASSENGER KEEP YOUR SEAT".

After the aircraft stopped, the PIC commanded the flight attendant to remain seated. Thereafter the pilot asked to the flight attendant related to the condition of the crew and passengers and was informed that everything was fine. The CVR did not record PIC command "ATTENTION CREW ON STATION" after the aircraft stopped. Thereafter, the PIC commanded the flight attendant for evacuation.

The Emergency Evacuation on Ground checklist on the FCOM described that after the aircraft stopped and the air traffic controller had been notified of the emergency situation, the engine must be shut down.

The engine shut down was conducted after the tower controller advised the pilot to shut down the engine as the ARFF personnel had arrived near the aircraft to assist the evacuation. At 11:27:22 UTC or more than 2 minutes after the aircraft stopped, the right engine was shut down followed by the left engine at about 1 minute later.

The delay of engine shutdown was due to pilot consideration that the electricity for lighting on cabin passenger was needed for the passenger evacuation. One of the items on the Emergency Evacuation on Ground checklist mention MIN CAB LIGHT switch shall be ON which allows the cabin light powered by main battery. This means that lighting to the cabin would be available after the engine shut down after the activation of the switch.

The OM-A described that the passenger evacuation may be initiated by the flight attendant under certain circumstances. The passenger may also initiate evacuation without command of the crewmember if they consider necessary. The risk of engine still running when the aircraft stopped on abnormal condition and the possibility of passenger evacuation without pilot command indicated that propeller hazard during evacuation was not considered. According to the conditions above, the emergency evacuation procedures was not performed appropriately.

3 CONCLUSIONS

3.1 Findings[14]

1. The pilots held valid licenses and medical certificates.
2. The aircraft had valid Certificate of Airworthiness (C of A) and Certificate of Registration (C of R). There was no report or record of aircraft system malfunction prior to the accident.
3. The landing approach of the aircraft was at night condition with slight rain and the CVR did not record activation of windshield wiper by the pilot. In addition, while on final, the pilot requested to the controller to reduce the intensity of the runway light.
4. The low-intensity of the runway light and the wet runway which reflected very little light might affected the pilot depth perception and caused the pilot to perceive incorrectly that the aircraft was higher than the real condition. In addition, the absence of the windshield wiper activation might reduce the pilot visibility to the runway.
5. The aircraft touched down the runway with nose wheel first due to the late of flare out resulted in bounced. The second bounce was the highest bounce which reached 14 feet altitude.
6. The late flare out was caused by the pilot perceived the aircraft was higher than the real altitude as the pilot relied more on the personal perception of altitude.
7. The aircraft touched down and bounced. After the third bounce, the pilot attempted to go around and the aircraft touched the runway.
8. The excessive rate of descend on the first touchdown might have degraded the landing gear strength, followed by landing with vertical acceleration of 6 g which sustained solely by the right main landing gear resulted in the failure of the right main landing gear.
9. The tower controller realized that the aircraft was in abnormal condition and pressed the crash bell then informed the Airport Rescue and Fire Fighting (ARFF) personnel by phone.
10. The engine shut down was conducted after the tower controller advised the pilot to shut down the engine as the ARFF personnel had arrived near the aircraft to assist the evacuation. The right engine was shut down more than 2 minutes after the aircraft stopped and followed by the left engine at about 1 minute later.
11. Passenger evacuation completed at approximately 10 minutes after the aircraft stopped.

14 Findings are statements of all significant conditions, events or circumstances in the accident sequence. The findings are significant steps in the accident sequence, but they are not always causal, or indicate deficiencies. Some findings point out the conditions that pre-existed the accident sequence, but they are usually essential to the understanding of the occurrence, usually in chronological order.

12. The delay of engine shutdown was due to pilot consideration that the electricity for lighting on cabin passenger was needed for the passenger evacuation. The lighting to the cabin would be available after the engine shut down and the activation of the MIN CAB LIGHT switch as described on the Emergency Evacuation on Ground checklist.
13. The Emergency Evacuation on Ground checklist on the FCOM described that after the aircraft stopped and the air traffic controller had been notified of the emergency situation, the engine must be shut down.
14. The risk of engine still running when the aircraft stopped on abnormal condition and the possibility of passenger evacuation without pilot command indicated that propeller hazard during evacuation was not considered.
15. The delay of engine shutdown indicated that the emergency evacuation procedures was not performed appropriately.
16. The examination on right main landing gear concluded that the failure of the right main landing gear was due to excessive impact forces and no previous defect on the landing gear.
17. According to the Operations Manual Part A, go-around must be initiated if high bounce occurs. The FCOM stated that in case of bounce, go around shall be performed immediately by set the go around pitch, set power and when speed above Vga, to set the flap one notch.
18. The FDR did not record any pilot attempt to go around, during the highest bounce after the second touchdown.
19. After the third touchdown, the CVR recorded the pilot call for go around and the FDR record increasing engine power, thereafter the aircraft touched down. The FDR recorded increasing of engine power (NH) up to 94% after the fifth touchdown and 27 seconds later, the aircraft stopped.
20. The unrecovered high bounce resulted in abnormal landing attitude with vertical acceleration up to 6 g and collapsed the right main landing gear.

3.2 Contributing Factors[15]

- The visual illusion of aircraft higher than the real altitude resulted in late flare out which made the aircraft bounced.
- The unrecovered bounce resulted in abnormal landing attitude with vertical acceleration up to 6 g and collapsed the right main landing gear.

15 Contributing factors is defined as events that might cause the occurrence. In the case that the event did not occur then the accident might not happen or result in a less severe occurrence.

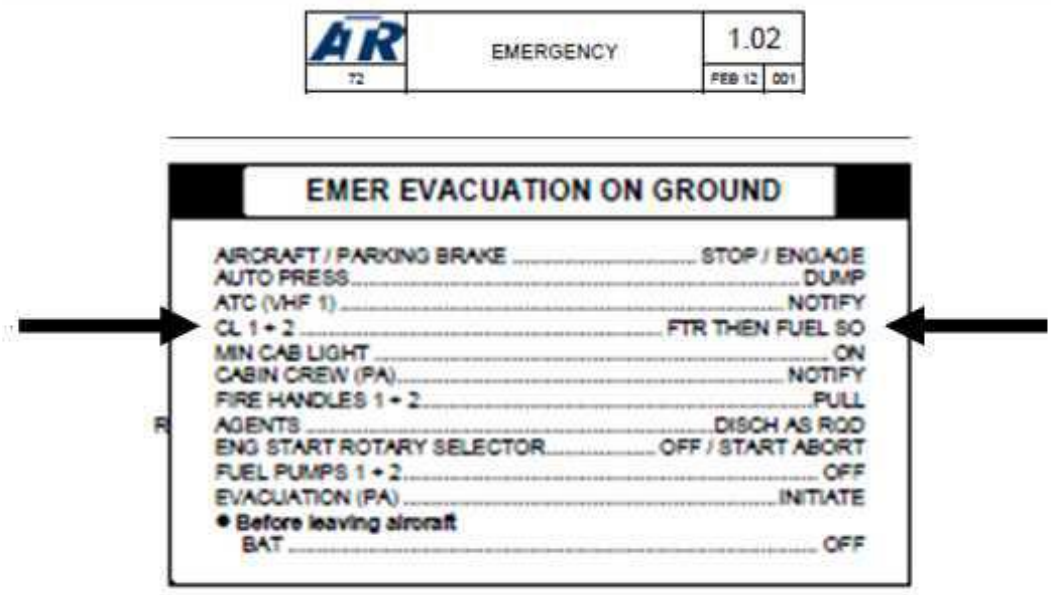
4 SAFETY ACTION

At the time of issuing this report, the Komite Nasional Keselamatan Transportasi had been informed safety actions taken by PT. Wings Abadi Airlines resulting from this occurrence.

On 6 January 2017, Notice to Pilot number 02/NTP/OMIW/I/2017 was issued (see appendices 5.1) which contained instruction to review and adhere procedures as described in the Operations Manual Part A (OM-A) and Quick Reference Handbook (QRH) regarding the following issue:

- *OM-A 8.3.12 ADVERSE AND POTENTIALLY HAZARDOUS ATMOSPHERIC CONDITIONS*
- *OM-A 8.1.1.2 PRE-FLIGHT INFORMATION Collection and analysis of all pertinent meteorological information (report and forecast), including known or forecast adverse weather phenomena, such as clear air turbulence, thunderstorms, and low altitude wind shear, for the route to be flown and each airport to be used;*
- *OM-A 8.3.2.5.5 REQUIREMENT FOR STABILIZED FINAL APPROACH:*
  - *A stabilized approach is one of the key features of a safe approach and landing.*
  - *A stabilized approach is characterized by a constant-angle, constant-rate descent approach profile.*
  - *A go-around MUST be initiated immediately if an approach is NOT STABLE AT or BELOW 1000 FEET AAL (IMC) or (VMC) or after leaving circling altitude, as applicable.*
- *OM-A 8.3.2.9.4 BOUNCED LANDING / LONG FLARE :*
  - *If a hard and/or high bounce occurs, a go-around must be initiated.*
- *OM-A 8.3.2.10 GO-AROUND AND MISSED APPROACH*
  - *Flight crews are encouraged to go-around whenever any doubt exists as to the safe continuation of an approach and/or landing;*
- *OM-A 8.3.20.14 EVACUATION DIRECTIVES*

  Most emergency situations develop during the initial or final stage of the flight. It must be realized that the preparation phase may be varying brief or even non-existent. Flight crew and Cabin Crews should be prepared for expected and specially unexpected emergencies.
- *In case of Emergency On Ground refer to QRH 1.02 EMER EVACUATION ON GROUND. Pilot are to follow strictly the QRH*



ATR 72 | EMERGENCY | 1.02 | FEB 12 | 001

EMER EVACUATION ON GROUND

AIRCRAFT / PARKING BRAKE	STOP / ENGAGE
AUTO PRESS	DUMP
ATC (VHF 1)	NOTIFY
CL 1 + 2	FTR THEN FUEL SO
MIN CAB LIGHT	ON
CABIN CREW (PA)	NOTIFY
FIRE HANDLES 1 + 2	PULL
AGENTS	DISCH AS REQD
ENG START ROTARY SELECTOR	OFF / START ABORT
FUEL PUMPS 1 + 2	OFF
EVACUATION (PA)	INITIATE
• Before leaving aircraft	
BAT	OFF

Responding to the following KNKT safety recommendation on the preliminary report:

- ***04-2016-43.01***

  The aircraft touched down and bounced twice. After the second bounce, the pilot attempted to go around and the aircraft touched the runway. According to the OM Part A and SOP for ATR 72-600 a go around shall be performed if a hard and/or high bounce occurs. Therefore, KNKT recommends reviewing the bounce recovery training for all pilots.

On 10 January 2017, the Notice to Pilot Instructor number 03/NTPI/OTIW/1/2017 was issued to encourage all simulator instructors to conduct additional training of Bounce Landing Technique during pilot recurrent session and review the Bounce Landing Technique during pilot Line Training.

- ***04-2016-43.02***

  After the RFFS personnel arrived near the aircraft to assist the evacuation, the tower controller advised the pilot to shut down the engines, thereafter the engines were shutdown. This condition might harm the RFFS personnel and/or passenger which evacuated before command by the flight crew members. It also could prolong the evacuation process. Therefore, KNKT recommends reviewing the emergency evacuation training including join training of flight crew and flight attendant.

On 7 February 2017, the PT. Wings Abadi Airlines reviewed the Emergency Evacuation Training and conducted joint emergency evacuation training between pilot and flight attendant.

5 SAFETY RECOMMENDATIONS

The KNKT acknowledges the safety actions and corrective action responding to the KNKT safety investigation on the preliminary report taken by the PT. Wings Abadi Airlines. Therefore, the KNKT did not issue the safety recommendations in this report.

6 APPENDICES

6.1 Notice to Pilot number 02/NTP/OMIW/I/2017

Wings Air	NOTICE TO PILOT			
	NOTICE NUMBER	02 /NTP/OMIW/I/2017		
	DATE OF ISSUED	06 JANUARY 2017		
RECOMENDATION FROM CASE SRG ACCIDENT	APPLICABILITY	ALL PILOT		
	DATE OF EFFECTIVENESS	06 JANUARY 2017		
	DISTRIBUTION LIST	DO	SSQ	OMP
		OR	OT	

Dear Pilot

Base on Accident on 25 December 2016 in Ahmad Yani Airport of Semarang (WAHS/SRG) :

1. Approach in marginal weather condition (reduce visibility and rain) at night.
2. Bounce landing
3. Hard landing

The fully investigation is still in progress.

Base on that accident then we recommend a few important things to be reviewed and to adhere :

- OMA 8.3.12 ADVERSE AND POTENTIALLY HAZARDOUS ATMOSPHERIC CONDITIONS
- OMA 8.1.1.2 PRE-FLIGHT INFORMATION Collection and analysis of all pertinent meteorological information (report and forecast), including known or forecast adverse weather phenomena, such as clear air turbulence, thunderstorms, and low altitude wind shear, for the route to be flown and each airport to be used;
- OMA 8.3.2.5.5 REQUIREMENT FOR STABILIZED FINAL APPROACH :
  - A stabilized approach is one of the key features of a safe approach and landing. A stabilized approach is characterized by a constant-angle, constant-rate descent approach profile.
  - A go-around MUST be initiated immediately if an approach is NOT STABLE AT or BELOW 1000 FEET AAL (IMC) or (VMC) or after leaving circling altitude, as applicable.
- OMA 8.3.2.9.4 BOUNCED LANDING / LONG FLARE :
  - If a hard and/or high bounce occurs, a go-around must be initiated.
- OMA 8.3.2.10 GO-AROUND AND MISSED APPROACH
  - Flight crews are encouraged to go-around whenever any doubt exists as to the safe continuation of an approach and/or landing;
- OMA 8.3.20.14 EVACUATION DIRECTIVES
  - Most emergency situations develop during the initial or final stage of the flight. It must be realized that the preparation phase may be varying brief or even non-existent. Flight crew and Cabin Crews should be prepared for expected and specially unexpected emergencies.

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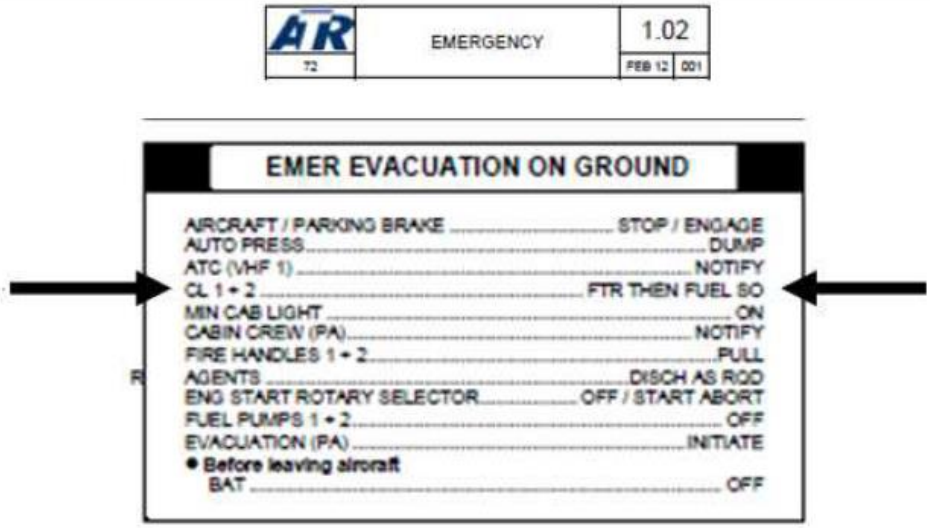
Wings Air	NOTICE TO PILOT			
	NOTICE NUMBER	02/NTP/OMIW/I/2017		
	DATE OF ISSUED	06 JANUARY 2017		
RECOMENDATION FROM CASE SRG ACCIDENT	APPLICABILITY	ALL PILOT		
	DATE OF EFFECTIVENESS	06 JANUARY 2017		
	DISTRIBUTION LIST	DO	SSQ	OMP
		OR	OT	

- In case of Emergency On Ground refer to QRH 1.02 EMER EVACUATION ON GROUND. Pilot are to follow strictly the QRH



Regards,

Flight Operation Manager

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6.2 Notice to Pilot Instructor Number 03/NTPI/OTIW/1/2017

Wings Air	NOTICE TO PILOT INSTRUCTOR			
	NOTICE NUMBER	03/NTPI/OTIW/1/2017		
	DATE OF ISSUED	10 JANUARY 2017		
BAOUNCE LANDING TRAINING	APPLICABILITY	GI; FIS; FIA		
	DATE OF EFFECTIVENESS	11 JANUARY 2017		
	DISTRIBUTION LIST	DO	SSQ	OMP
		OR	OT	

Dear Pilots Instructors

Des 25th 2016 our ATR 72-600, registration PK-WGW performing flight IW-1896 from Bandung to Semarang with 64 passengers and 4 crew, bouncy landing (bounced thrice) on Semarang's runway 13 in rain, but veered right off the runway and came to a stop with the right main gear collapsed. There were no injuries after emergency evacuation, the aircraft sustained substantial damage.

The investigation still in progress. As a lesson to learn, Operation Training Department remind and encourage to all simulator instructor to do additional training Bounce Landing Technique during reccurent session on simulator. And also review in briefing in Line Training

Bounch landing result from either too much speed or too high slope, or combination of both, on final approach.

Defence and procedure:

- To avoid bounce landing, decide to go around if the plane is not stabilized
- Apply a immediate go around
- Never try to land
- Never push the control column forward

Note:
To avoid negative training during perform Bounce Landing, Instructor must on seat to make Aircraft bouncing and the trainees will take over to recovery.

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