The original of the Final Report was issued in the Slovak language.
In case of inconsistency original version in Slovak language is applicable.

MINISTRY
OF TRANSPORT
AND CONSTRUCTION
OF THE SLOVAK REPUBLIC

AVIATION AND MARITIME INVESTIGATION AUTHORITY
Námestie slobody 6, P.O.BOX 100
810 05 Bratislava 15

FINAL REPORT

on the safety investigation of the incident

of aircraft type **Boeing 737-500**

registration mark **SU-GBK**

Reg. No: SKI2017137

The investigation of occurrence has been conducted pursuant to Art. 18 of the Act No. 143/1998 on Civil Aviation (Civil Aviation Act) and on Amendment of Certain Acts and in accordance with the Regulation (EU) No. 996/2010 of the European Parliament and of the Council on investigation and prevention of civil aviation accidents and incidents, governing the investigation of civil aviation accidents and incidents.

The final report is issued in accordance with the Regulation L 13 that is the application of the provisions of ANNEX 13 Aircraft Accident and Incident Investigation to the Convention on International Civil Aviation.

The exclusive aim of investigation is to establish causes of accident, incident and to prevent their occurrence, but not to refer to any fault or liability of persons.

This final report, its individual parts or other documents related to the investigation of occurrence in question have an informative character and can only be used as recommendation for the implementation of measures to prevent occurrence of other accidents and incidents with similar causes.

Abbreviations and acronyms

APN	Apron
APP	Approach control service
ATPL	Airline Transport Pilot Licence
ATSUs	Air Traffic Services Units
DIST THR	Distance from a RWY threshold
ECAA	Egyptian Civil Aviation Authority
ETI	Express Travel International
FAF	Final Approach Fix
FAP	Final Approach Point
FL	Flight Level
ft	Feet (unit of length)
FRS	Firefighting and rescue service
GS	Ground Speed
HEGN	ICAO code for Hurghada Airport
IAF	Initial Approach Fix
IAS	Indicated Airspeed
IFR	Instrument Flight Rules
ILS	Instrument Landing System
kt	Knots
LZSL	ICAO code for Sliač Airport
LOCALIZER	ILS course beacon
NM	Nautical Mile
OM	Outer Marker
PC	Procedural air traffic controller
PIC	Pilot In Command
QNH	Altimeter setting used to acquire an aircraft´s altitude above sea level
RC	Radar air traffic controller
RWY	Runway used for take-offs and landings
SLC	IATA code for Sliač Airport
THR	Runway Threshold
TWR	Airport control tower
UTC	Co-ordinated Universal Time
VREF	Reference speed

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A. INTRODUCTION

Operator / Owner:	AMC airlines / CIAF LEASING COMPANY
Operation type:	Commercial operation/charter flight
Aircraft type:	B737-500

Registration mark:	SU-GBK
Take-off site:	HEGN
Flight phase:	Landing
Accident Site:	LZSL
Accident date and time:	2 August 2017 07:27

Note: All time data in this report is in UTC time.

B. INFORMATIVE SUMMARY

An Egyptian aircraft type Boeing 737-500, registration mark SU-GBK, was making a charter flight for the ETI travel agency from HEGN to LZSL and back.

Its landing on RWY36 LZSL was performed at a higher speed (touch-down point: 1,090 m from THR RWY36). After landing, the crew braked intensively, causing vibration of the aircraft and subsequent damage to the landing gear and to the tyres. Both main landing gear legs were damaged during the landing roll. In this phase, the PC TWR spotted dense smoke behind the aircraft coming from the landing gear area.

The aircraft did not leave the RWY´s concreted areas. It finished the landing roll with damaged landing gear legs, made a U-turn at the THR RWY18 sign and taxied in the direction of RWY18. The aircraft stopped at the aim point signs of RWY18.

Then, the TWR declared an emergency for rescue units and called them into action. An FRS unit of the civil operator of LZSL supported by the military fire-fighting unit took part in the action. The FRS cooled the left landing gear leg. After the cooling finished, aircraft stairs were brought and the passengers disembarked; then they were transported to the arrival lounge.

The civil operator of the airport organized the removal of the aircraft - which was unable to move - from the RWY. The activity finished at 12:50 by towing the aircraft to the APN. RWY cleaning works started subsequently. The RWY was reopened at 14:00.

Based on an agreement with the Chief Inspector of Flight Safety, Military Aviation State Administration Department at the Ministry of Defence of SR, the following Safety Investigation Committee was appointed by the Head of the Aviation and Maritime Investigation Authority of the Ministry of Transport and Construction of SR to investigate the underlying causes of the incident:

Ing. Zdeno BIELIK	Chairman of the Safety Investigation Commission
Col.Ing. Ján SALAJ	Member of the Safety Investigation Commission
LTC.Ing. Koloman BORNEMISZA	Member of the Safety Investigation Commission

The Report has been issued by:

Aviation and Maritime Investigation Authority
of the Ministry of Transport and Construction of the Slovak Republic

C. MAIN PART OF THE REPORT

1. FACTUAL INFORMATION
2. ANALYSES
3. CONCLUSIONS
4. SAFETY RECOMMENDATIONS

1. FACTUAL INFORMATION

1.1 History of the flight

The flight crew was performing a charter flight from HEGN to LZSL as Flight AMV3811. At 06:53:30, the crew switched to the frequency of RC APP Sliač at FL255 when the pilot of Flight AMV3811 asked the RC APP for current weather information at LZSL when he was still in Hungarian airspace. The pilot accepted a shortened approach to IAF SLC. Then the pilot was given information about the RWY in use, transition level, vectoring for ILS approach to RWY36, QNH and weather conditions.

Transcript of the radio communication between the RC APP and the crew of Flight AMV3811:

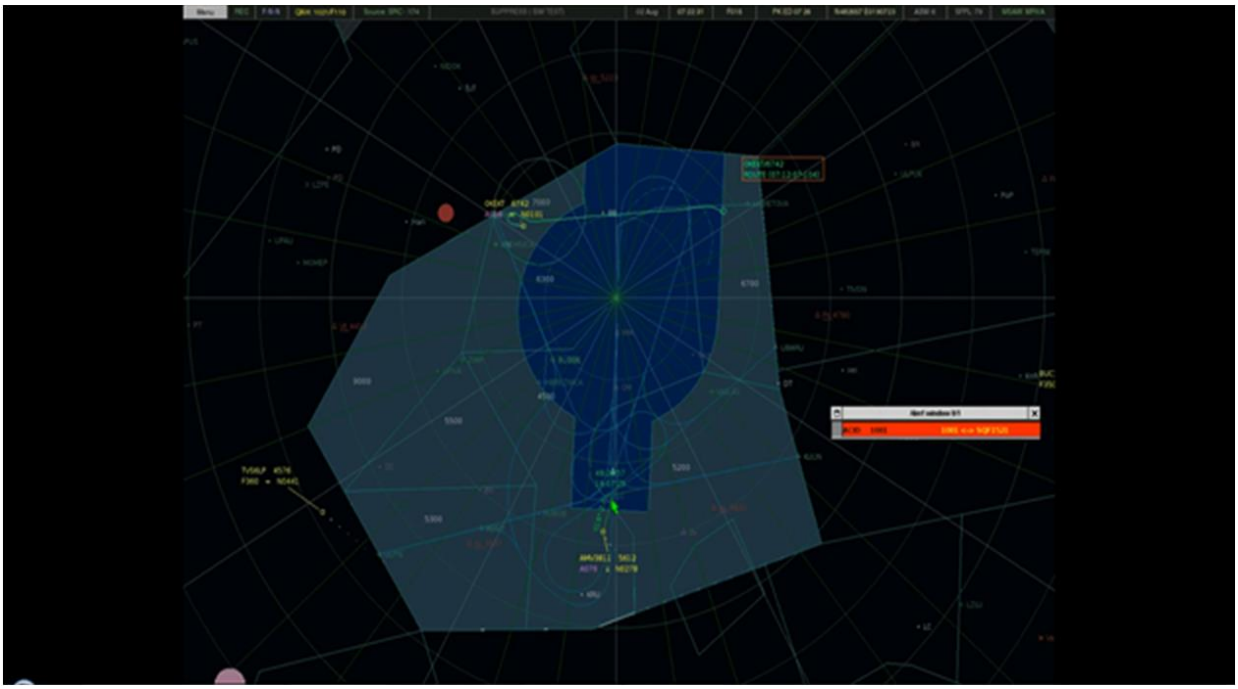
Time: 07:17:17 RC APP – AMV3811

RC APP: Alpha, Mike, Victor 3811 are you able to descend by 8 nautical miles from altitude 9000ft to 4500ft
AMV3811: Affirmative, we able.

At 07:17:17, when descending to A090 and in response to the RC APP´s question, the crew confirmed that they were able to descend from A095 to A045 at a distance of 8 NM. During the descent the RC APP was actively communicating with the crew in order to vector the aircraft to the LOCALIZER.

Time: 07:22:24 RC APP – AMV3811

RC APP: Alpha, Mike, Victor 3811 passing localizer, turn right heading 020
AMV3811: Now we are established (unreadable) Alpha, Mike, Victor 3811
RC APP: Say again please
AMV3811: Established on the localizer Alpha, Mike, Victor 3811
RC APP: Roger, continue descend to altitude 4500ft
AMV3811: 4500ft Alpha, Mike, Victor 3811
(transmission end: 07:22:47)



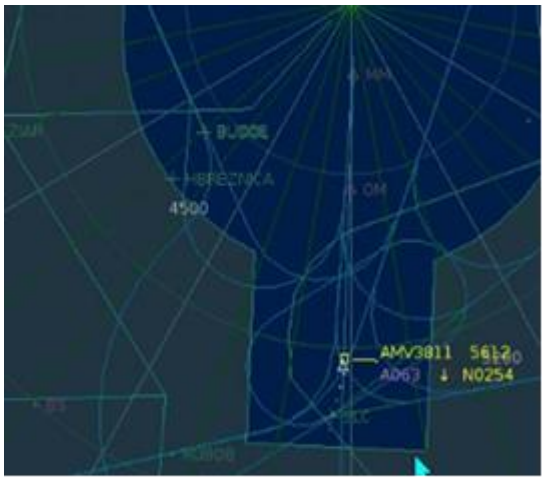
Picture 1 At 07:22:31, AMV3811 confirms being established on the LOCALIZER, altitude A076, speed IAS 278

Time: *07:23:19 RC APP – AMV3811*

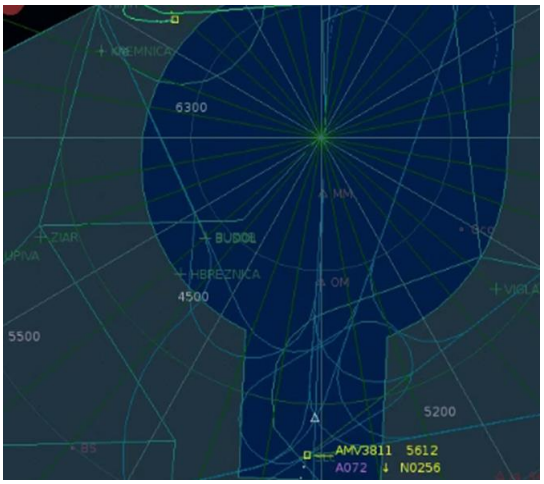
RC APP: Alpha, Mike, Victor 3811 contact Sliač tower 122,9 bye for now
AMV3811: 122,9 thank you, good bye
(transmission end: 07:23:29)

However, according to the RC APP´s statement, after the crew reported being established on the LOCALIZER, the aircraft was flying faster and at a higher altitude. According to the pilot, the aircraft was descending at 3.5° and landed at a speed of 175 kt.

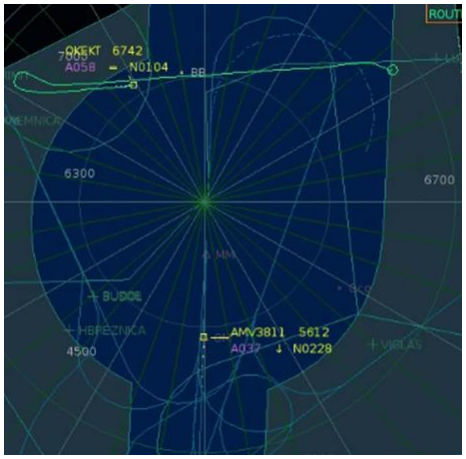
At 07:26, AMV3811 landed at a higher speed – 175 kt (according to the pilot´s statement); the aircraft first touched the RWY 1,090 m from the THR (according to the tyre tracks on the RWY). After landing, the pilot started braking intensively, using the maximum braking effect, which caused the aircraft to vibrate; several parts dropped out of the main landing gear area and smoke started spreading from the wheels which the crew was notified of. After the aircraft braked, it made a U-turn and stopped on the RWY as instructed by the PC.



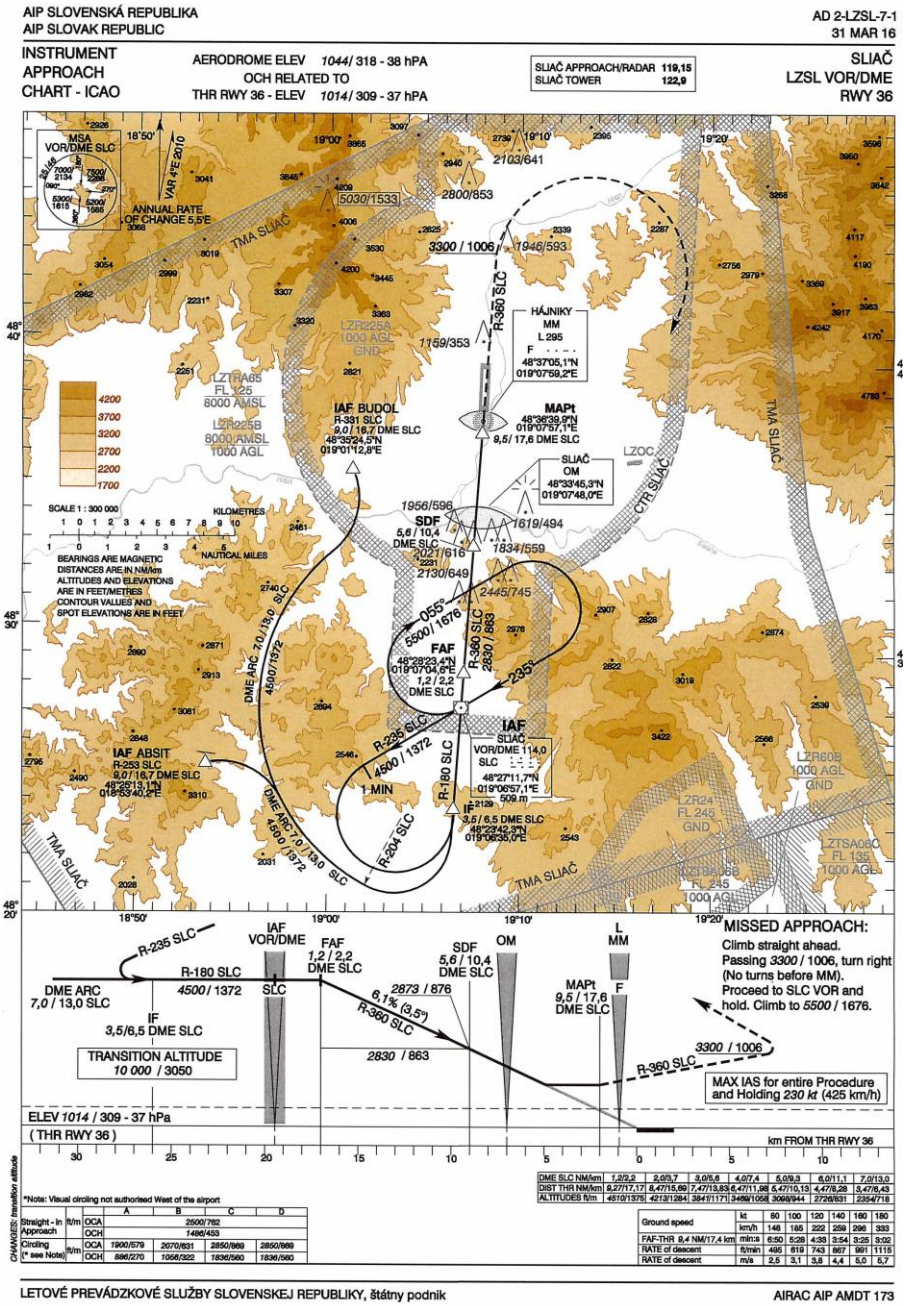
Picture 2 IAF position VOR/DME A 7,200 ft



Picture 3 FAF position, DIST 17.17 A 6,300 ft



Picture 4 OM position, DIST THR 7km A=3,700 ft



Picture 5 Map of the instrument approach to LZSL

1.2 **Injuries to persons**

No injuries.

1.3 **Damage to the aircraft**

As a result of the intensive braking, the aircraft was damaged in the area of the landing gear and the tyres.

1.4 **Other damage**

No circumstances have been reported to the Safety Commission which might lead to any other claims for compensation of damage against a third party.

1.5 **Personnel information**

PIC:

Citizen of the Arab Republic of Egypt, aged 33, holder of the ATPL license issued on 3 October 2012 by ECAA.

Medical certificate Class 1 with marked validity until 13/03/2018.

Qualifications:

SEPL	with marked validity until 31 December 2017
MEPL	with marked validity until 31 December 2017
B-737-500	with marked validity until 31 December 2017
IR	with marked validity until 31 December 2017

C-172, B-58, COM-114B, B737-800, MD-83
Total flight hours: 7,000 hours
Total flight hours on aircraft type B-737: 300 hours

Co-pilot:
Citizen of the Arab Republic of Egypt, aged 44, holder of the ATPL license issued on 22 May 2017 by ECAA.

Medical certificate Class 1 with marked validity until 15 August 2017.

Qualifications: SEPL, MEPL

C-172

Instructor B737-800	with marked validity until 27 November 2017
B-737-500-800	with marked validity until 31 August 2017
IR	with marked validity until 31 August 2017
Total flight hours:	13,000 hours

1.6 **Aircraft information**

Type:	B-737-500
Registration mark:	SU-GBK
Serial number:	26052
Manufacturer:	Boeing Commercial Airplanes
Total flight hours:	50,303 hrs. 32 min.
Engines:	1 S/N 856167
	2 S/N 725932
	APU S/N SP-E912005

Airworthiness certificate No. 769 issued by ECAA on 22 April 2015.

Registration certificate No. 905 issued by ECAA on 25 October 2016.

Insurance: ARAB MISR INSURANCE GROUP from 1 October 2016 to 30 September 2017.

1.7 Meteorological information

Clear sky, visibility over 10 km, changeable wind up to 3 m/s.
METAR from 2 August 2017 06:30 – 08:00 Z
METAR LZSL 020630Z 00000KT CAVOK 24/18 Q1020=
METAR LZSL 020700Z 00000KT CAVOK 26/19 Q1020=
METAR LZSL 020730Z 00000KT CAVOK 27/18 Q1020=
METAR LZSL 020800Z 00000KT CAVOK 28/18 Q1020=

1.8 Aids to navigation

N/A.

1.9 Communications

The aircraft was equipped with a radio communication device that allowed two-way radio connection at any time during the flight with all air stations and rescue service stations.

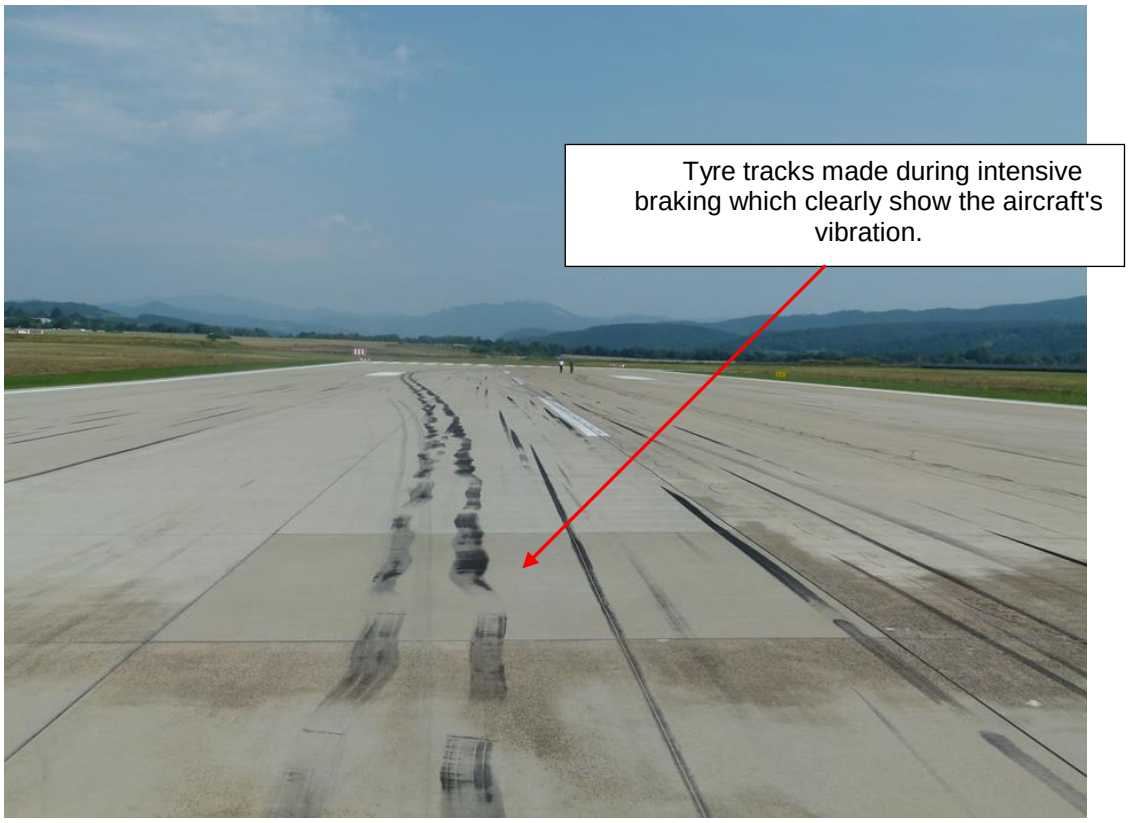
1.10 Aerodrome information

LZSL airport is an international airport with joint military and civilian operation.

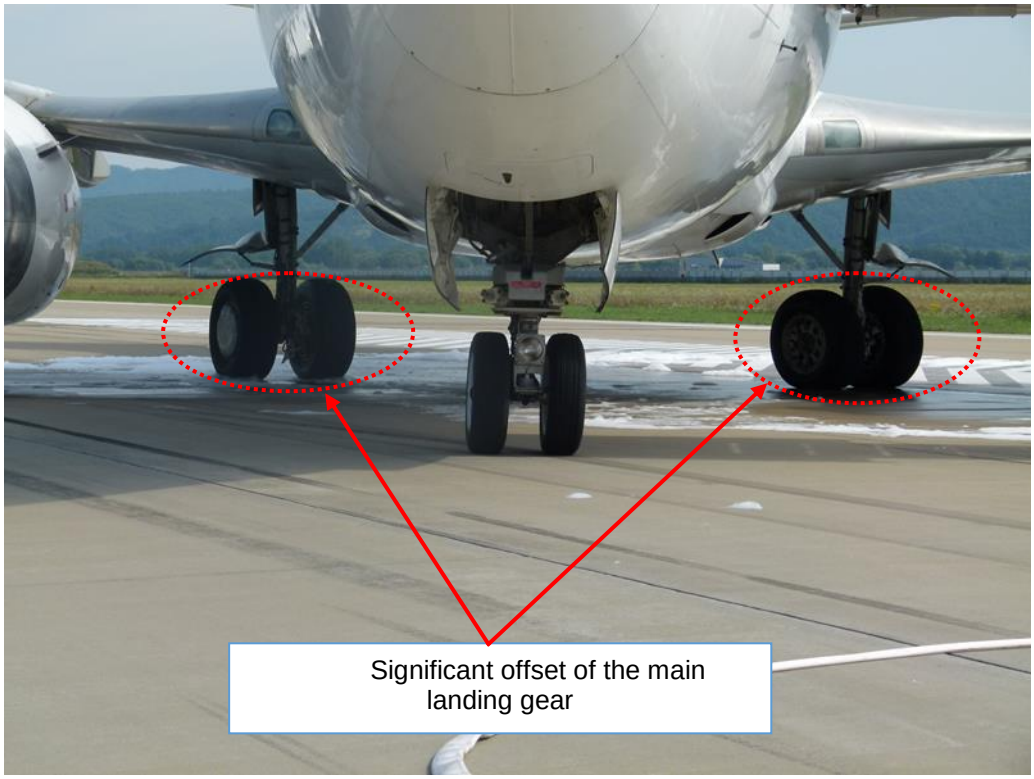
1.11 Flight recorders and other recording devices

AMIA does not have the possibility to assess the recording devices installed on board of the aircraft. Statements by witnesses to the occurrence, data from LZSL recording devices, radar records and radio communication between the crew and the control service were used for assessment.

1.12 Wreckage and impact information



Picture 6 Tracks proving intensive braking



Picture 7 Offset of the main landing gear

Picture 8 Details of the damage to the main landing gear

Picture 9 Fragments of landing gear components found on the RWY

Picture 10 Fragments of landing gear components found on the RWY

Picture 11 Fragments of landing gear components found on the RWY

Picture 12 Detail of a damaged tyre

Pictures 9, 10 and 11 show individual parts coming from the main landing gear which were found on the RWY.

1.13 **Medical and pathological information**

N/A.

1.14 **Fire**

None.

1.15 **Survival aspects**

N/A.

1.16 **Tests and research**

N/A.

1.17 **Organizational and management information**

N/A.

1.18 **Additional information**

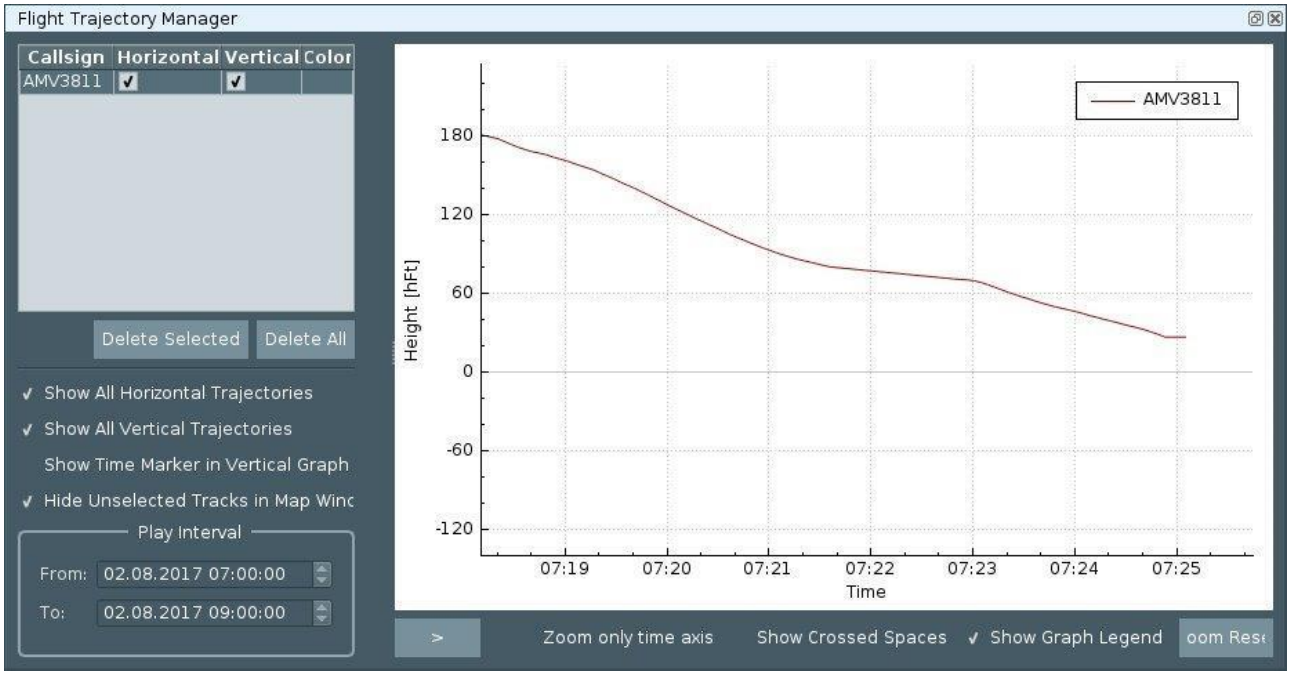
N/A.

1.19 **Useful or effective investigation techniques**

Standard investigation methods were used.

2. ANALYSIS

At 07:17:17, due to operation economy, the RC APP asked the pilot of Flight AMV3811 even before LITKU in Hungarian airspace if he was able to descend 4,500 ft in 8 NM. The pilot confirmed and received a new clearance to fly directly to VOR SLC instead of flying to KULÍN.



Picture 13 Vertical descent mode

When trying to shorten his approach, the pilot did not adhere to the determined altitudes stated on the instrument approach map and he was above the mode/above the glide slope during the entire period of his descent from FAP DME/SLC where he was supposed to be at 4,500 ft. According to radar records, at this point the aircraft was at 6,300 ft.

Then, the aircraft was supposed to descend at 3.5°; however, according to radar records, the angle of its descent with regard to the touch-down point ranged from 5.2° to 6.3° during the final phase of its descent between points FAP and OM.

At 07:24:51, AMV3811 was 5.4 km from the THR, its altitude was A031, GS-222, IAS-202 and the vertical descent rate was 2,100 ft/min.

At 07:26, AMV3811 landed at a higher speed – 175 kt (according to the pilot´s statement); the aircraft first touched the RWY 1,090 m from the THR (according to the tyre tracks on the RWY).

It results from the above-stated that throughout the entire ILS approach, from IAF to touch-down, the pilot did not have a stabilized approach.

a) The pilot did not meet the requirements for a stabilized approach upon reaching 1,000 ft above the THR, namely:
   - the aircraft was not established in terms of its direction and descent;
   - the approach speed was higher than the VREF by over 20 kt;
   - the vertical descent rate was higher than 1,000 ft/min.

Even if only one of the above-stated conditions had not been met, the pilot should have considered a missed approach procedure.

b) The pilot did not meet the requirements for a stabilized approach upon reaching 500 ft above the THR, namely:
   - the aircraft was not established in terms of its direction and descent;
   - the approach speed was higher than the VREF by over 20 kt;
   - the vertical descent rate was higher than 1,000 ft/min.

Even if only one of the above-stated conditions had not been met, the pilot should have performed a missed approach procedure.

c) The pilot did not meet the requirements for a stabilized landing during the landing phase:
- when passing the THR, the approach speed was higher than the VREF by over 10 kt;
- the landing was not performed until up to 1/3rd RWY from the THR.

Even if only one of the above-stated conditions had not been met, the pilot should have performed a missed approach procedure.

It results from the above-stated that during the descent the pilot created unfavourable conditions prior to the touch-down itself, which was made 1,090 m from the THR36 at a speed of 175 kt instead of the correct landing speed which is 135 kt. With such touch-down parameters of the aircraft it was necessary to brake intensively (the crew used emergency braking) in order to maintain the aircraft on the RWY; however, this caused the landing gear and then the entire aircraft to vibrate. Enormous forces generated during such intensive braking led to such major damage to the landing gear that the damaged components separated during the final stage of the movement and they were found on the RWY (Pictures 9, 10 and 11). The braking system and the tyres were overheated and severely damaged (Picture 12). After the aircraft braked and made a U-turn, the PC TWR noticed that thick smoke was coming from the landing gear area and that the aircraft continued swerving off the RWY axis and he reported this to the pilot. Then, the PC TWR instructed the pilot to stop the aircraft and activated FRS which cooled the landing gear after the engines had been shut down and removed the leaked liquids.

After a comprehensive analysis of the actions of the crew and of the ATSUs, the Safety Investigation Commission came to the conclusion that the actions performed by the ATSUs were correct.

Although the aircraft was moving above the mode throughout the final descent for landing, the crew did not respond appropriately to the situation and continued descending even though it still had a chance to solve the unfavourable situation by aborting the landing manoeuvre and performing a go-around or another manoeuvre, during which it could have lead the aircraft to the correct altitude and speed parameters. The crew thus did not meet the conditions and criteria of a stabilized approach, based on which it should have aborted the approach and initiated a missed approach procedure.

3. CONCLUSIONS / Cause of air accident

3.1 **Findings**

- the pilots had all valid qualifications to perform the flight in question;
- the Commission did not assess the flight recorder due to absence of an evaluation device and used statements of the crew and of the control units and records from objective control devices available at LZSL;
- the aircraft had valid documentation and did not demonstrate any malfunction prior to take-off or during the flight;
- the aircraft met airworthiness conditions before the critical flight according to the available documentation.

3.2 **Cause of the air accident**

Intensive braking - necessary as a result of landing at a high speed and 1,090 m from THR RWY36.

3.3 **Contributing causes**

Non-stabilized approach at a higher angle and higher speed.

4. SAFETY RECOMMENDATIONS

Proposed recommendations:

- **for the aircraft operator:**

  it is our proposal to adopt internal measures to ensure that, during a non-stabilized approach, crews make a timely decision to perform a missed approach procedure;

- **for the provider of air traffic control services at Sliač Airport:**

  it is our proposal that if aircraft deviate significantly from the prescribed parameters during the phase of initial and intermediate approach, the APP Sliač unit should notify the crew of such deviations.

In Bratislava, 4 April 2018