MINISTRY FOR
INNOVATION AND TECHNOLOGY

TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2017-307-4

Accident

Pirtó 245° 2800 m

13 July 2017

ASW 27-18E

D-KRIB

The sole objective of the safety investigation is to reveal the causes and circumstances of aviation accidents or incidents and to initiate the necessary technical measures and make recommendations in order to prevent similar cases in the future. It is not the purpose of this activity to investigate or apportion blame or liability.

General information

This investigation is being carried out by Transportation Safety Bureau on the basis of

- Regulation (EU) No 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC,
- Act XCVII of 1995 on aviation,
- Annex 13 identified in the Appendix of Act XLVI. of 2007 on the declaration of the annexes to the Convention on International Civil Aviation signed in Chicago on 7th December 1944,
- Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents (hereinafter referred to as Kbvt.),
- NFM Regulation 70/2015 (XII.1) on safety investigation of aviation accidents and incidents, as well as on detailed investigation for operators,
- In absence of other relevant regulation in the Kbvt., in accordance with Act CXL of 2004 on the general rules of administrative authority procedure and service, and, as of 1 January 2018, in accordance with Act CL on General Public Administration Procedures.

The competence of the Transportation Safety Bureau of Hungary is based on Government Regulation 278/2006 (XII. 23.), and, as from 01 September 2016, on Government Regulation № 230/2016. (VII.29.) on the assignment of a transportation safety body and on the dissolution of Transportation Safety Bureau with legal succession.

Pursuant to the aforesaid laws,

- Transportation Safety Bureau Hungary shall investigate aviation accidents and serious incidents.
- Transportation Safety Bureau Hungary may investigate aviation and incidents which – in its judgement – could have led to more accidents with more serious consequences in other circumstances.
- Transportation Safety Bureau Hungary is independent of any person or entity which may have interests conflicting with the tasks of the investigating body.
- In addition to the aforementioned laws, the ICAO Doc 9756 and the ICAO DOC 6920 Manual of Aircraft Accident Investigation are also applicable.
- This Report shall not be binding, nor shall an appeal be lodged against it.
- The original of this report was written in the Hungarian language.

The persons participating in the safety investigation did not act as experts in other procedures concerning the same case and shall not do so in the future.

The IC shall safe keep the data having come to their knowledge in the course of the safety investigation. Furthermore, the IC shall not be obliged to make the data – regarding which the owner of the data could have refused its disclosure pursuant to the relevant act – available for other authorities.

This Final Report

was based on the draft report prepared by the IC and sent to all affected parties (as specified by the relevant regulation) for comments. All relevant parties accepted the draft report; the comments relating to the draft report have been integrated by TSB in this Final Report.

Copyright Notice

Translation

This document is the translation of the Hungarian version of the Final Report. Although efforts have been made to translate it as accurately as possible, discrepancies may occur. In this case, the Hungarian is the authentic, official version.

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Definitions and abbreviations

aerodrome	*means a defined area (including any buildings, installations and equipment) on land or water or on a fixed, fixed off-shore or floating structure intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft*
ARP	*Airport Reference Point*
AT	*Aero Tow Rating*
BFU	*Bundesstelle für Flugunfalluntersuchung (German Federal Bureau of Aircraft Accident Investigation)*
BPL	*Balloon Pilot Licence*
EASA	*European Aviation Safety Agency*
FAA	*Federal Aviation Administration (USA)*
FLARM	*a flight safety device used in small aircraft to avoid mid-air collision*
Hungarocontrol	*Hungarian Air Navigation Services Pte. Ltd. Co.*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
Kbvt.	*Act CLXXXIV of 2005 on the safety investigation of aviation, railway and marine accidents and incidents and other transportation occurrences*
LAPL	*Light Aircraft Pilot Licence*
LT	*Local Time*
MET	*Ministry of Economics and Transport*
MIT	*Ministry for Innovation and Technology*
MND	*Ministry of National Development*
NTA AA	*National Transport Authority Aviation Authority, Hungary (till 31 December 2016)*
octa/okta	*one-eighth of the sky area: to express the quantity of clouds covering the sky*
S	*Sailplane*
SPL	*Sailplane Pilot Licence*
TSB	*Transportation Safety Bureau (Hungary)*
UTC	*Coordinated Universal Time*
VFR	*Visual Flight Rules*
WL	*Winch Launch Rating*

Introduction

Occurrence class		accident
Aircraft	manufacturer	Alexander Schleicher GmbH & Co.
	type	ASW 27-18 E
	registration	D-KRIB
	operator	Flight System Kft.
Occurrence	Date and time	13 July 2017, 14:47
Location		Pirtó 245° 2.8 km (Figure 1)
Fatalities / severe injuries related to the occurrence:		1 / 0
Extent of damage to the aircraft involved:		Destroyed

Any clock-time indicated in this report is given in local time (LT). Time of the occurrence: LT= UTC+ 2 hours.

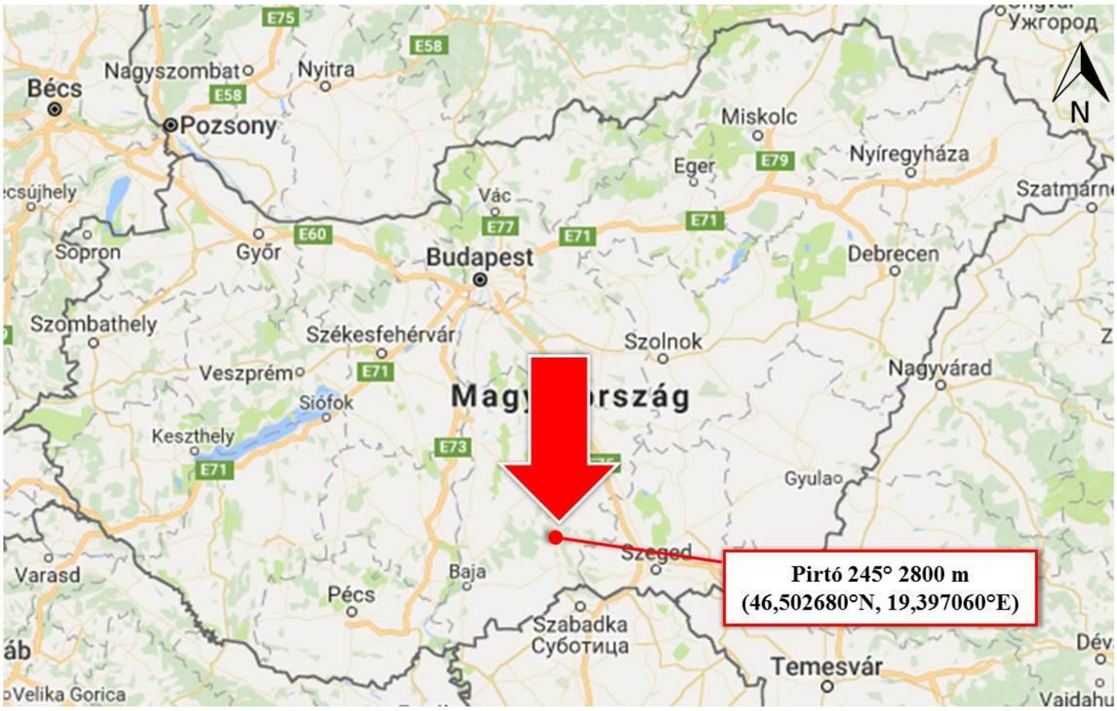

Figure 1: Location of the occurrence in Hungary

Reports and notifications

The occurrence was reported to the duty service of TSB by the duty service of Hungarocontrol on 13 July 2017, at 19: 30.

TSB Hungary notified:

– notified the investigation body (Bundesstelle für Flugunfalluntersuchung, BFU) of the state of registration which is also the state of the designer and manufacturer, on 14 July 2017, at 17:11 o’clock, and then BFU assigned a representative for the investigation.

Investigation Committee

The Head of TSB assigned the following investigating committee (hereinafter referred to as IC) to the investigation of the case:

Investigator-in-charge	**Dr Zsuzsanna Nacsa**	Investigator
Member	**György Háy**	Investigator
Member	**Gábor Torvaji**	Investigator

Overview of the investigation process

On 14/07/2017, the IC visited the scene of the occurrence, and during it, the IC:

- viewed the scene of the accident and the wreck of the aircraft involved;
- interviewed witnesses;
- took photos of the scene of the occurrence, the wreck of the aircraft, and the documents available;
- collected data, information and documents available at the departure airport, relating to preparation for the flight, the aircraft, and the pilot.

During the investigation, the IC:

- obtained information and documents related to the occurrence and the weather conditions;
- obtained copies of documents related to the accident, (e.g.: autopsy report) from other investigation authorities;
- obtained From HungaroControl Zrt. the radar and audio records of the affected flight and the search and rescue action;
- obtained a photocopy of the flight logbook of the pilot involved;
- interviewed witnesses;
- attempted to recover evaluable data from the memory of other recording devices on board; to that end, the IC contacted the manufacturer of the device and a company specialised in data recovery;
- paid an additional visit to view the scene and the wreck again;
- collected data in order to explore and understand possible similar data, using the EASA relevant database, among others;
- requested information from EASA on any regulating activity which may relate to the occurrence;
- prepared diagrams, where necessary, to visualise information;
- analysed available information and prepared this Draft Report.

Short summary of the occurrence

The pilot involved in the accident set off for a cross-country flight task in a new type of power glider after two training take-offs altogether. She interrupted the task, presumably due to weather conditions unfavourable for gliding, and turned back. Then, flying circles in order to catch a thermal lift, she temporarily lost control of the aircraft which began a steep fall. Presumably, the pilot tried to manoeuvre the aircraft from the fall so intensively that its frame was subject to overload, the left wing fractured and then separated from the frame completely. Then the aircraft falling practically in fully vertical direction, crashed to the ground at high velocity in a wooded terrain; the aircraft was fully destroyed, and the pilot died on the spot immediately. The pilot was wearing a serviceable parachute, but the investigation found no sign of her trying to leave aircraft.

The position of the IC is that the pilot's knowledge of and experience with the affected aircraft type were not in line with the requirements set by the tasks, which was worsened by unfavourable weather and the use of water ballast. For this reason the IC

- proposes that a safety recommendation be issued for the sake of maintaining the capabilities necessary for the identification and management of extreme flight situations by sailplane pilots, and
- drew and communicates lessons for the sake of pilots' acquiring skills of avoiding collisions, using the FLARM system (which facilitates search and rescue) and the knowledge relating to new sailplane types they intend to fly.

1. Factual information

1.1. History of the flight

Szatymaz Airport hosted a sailplane contest on the day of the occurrence. The pilot involved in the accident had participated in the flight program, but then set off for a cross-country flight task which was different from that of the contestants. Her scheduled goal was, with some simplification, to fly the Szatymaz – Zsana – Szabadszállás – Zsana – Szabadszállás – Szatymaz route (Figure 2). Prior to take-off, the pilot filled the water ballast tanks of the aircraft. Except for the take-off phase, the flight ending up in accident had no witness (as far as known by the IC), so it was reconstructed exclusively on the basis of data from the Colibri II recorder, information displayed via the Internet by the FLARM system, and investigation of the wreck.

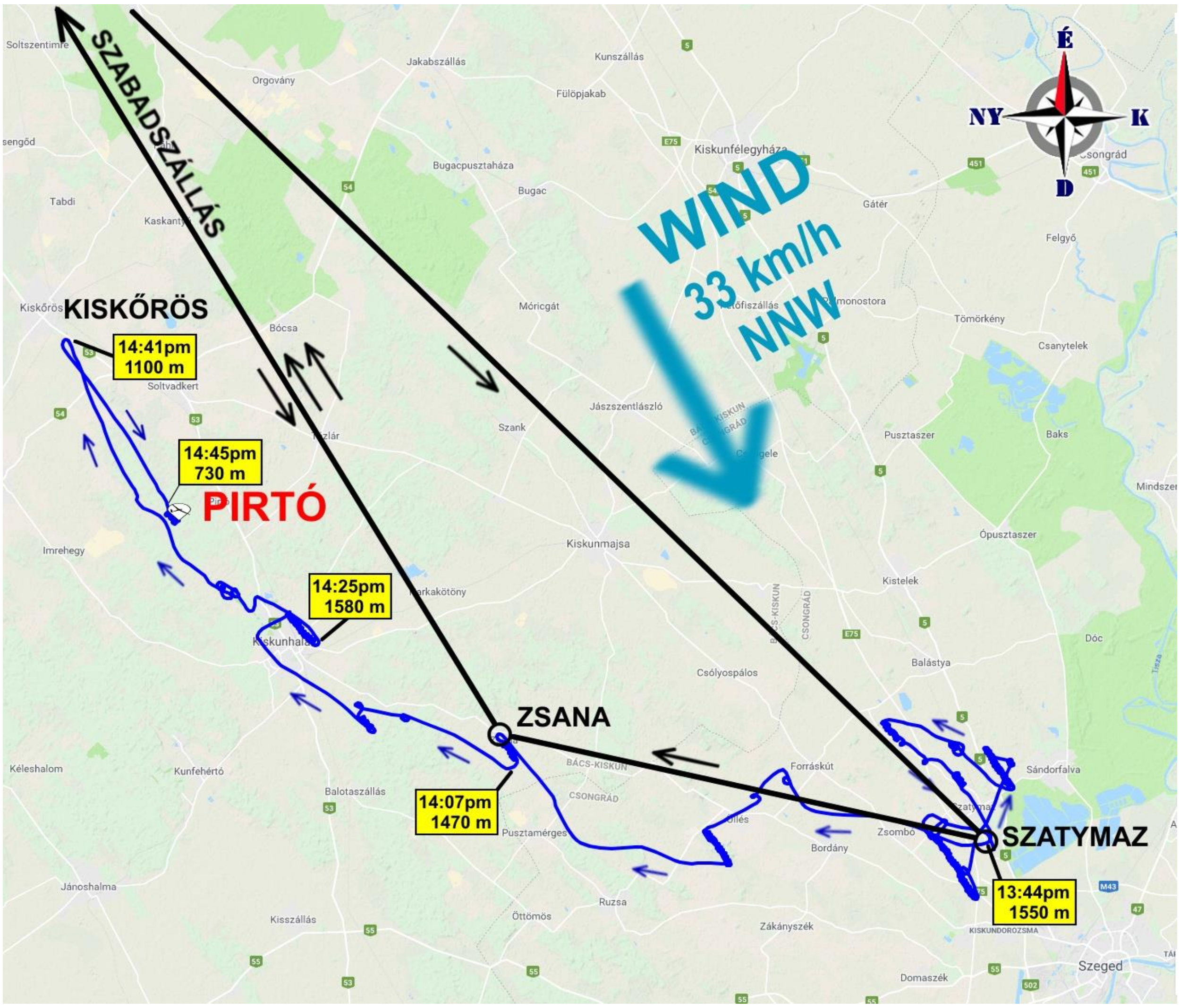

Figure 2: The planned cross-country flight task (black line) and the route actually flown (blue line)

The sailplane started take-off by aerotow at 13:03pm. The sailplane released the areotow rope at an altitude of 650 metres relative to the airport, near a thermal, at 03:07. Circulating in five various thermals, the aircraft climbed to a maximum altitude of 1690 metres, and set off to perform the pilot's scheduled cross-country flight task at 13:44. As far as the area of Kiskunhalas, she alternated between cruising-gliding flight and soaring in rising air currents, the two usual techniques used by sailplanes on cross-country flight, during which her flight altitude varied between 850 metres (minimum) and 1580 metres (maximum). During her entire flight, she had to cope with a NNW wind of 33 km/h which almost exactly blew from the direction opposite her aircraft in the first two sections of her route (Figure 2).

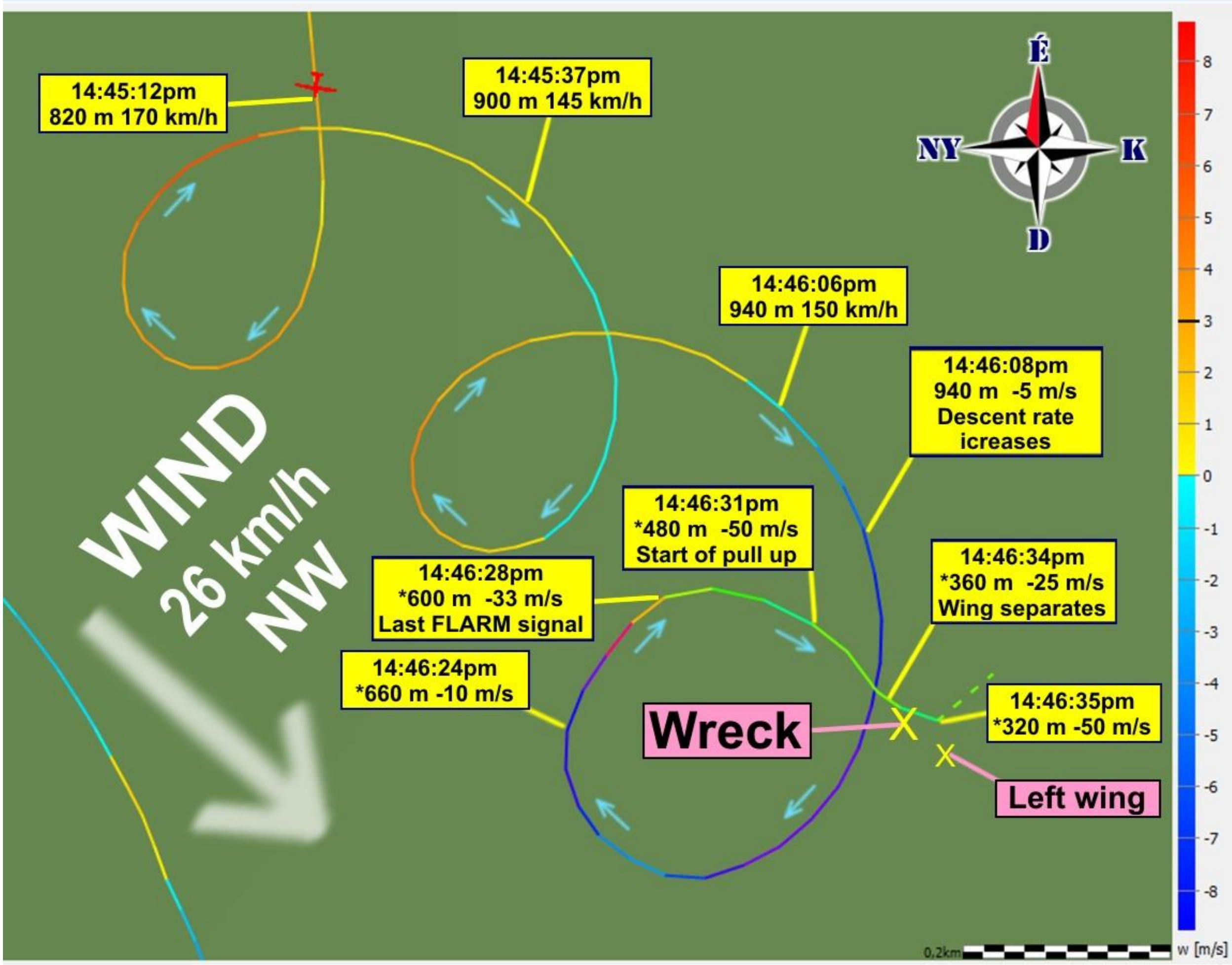

Figure 3: Last minutes of the flight. The colour of the flight path changes according to the vertical speed scale. (The values of the last 10 seconds are out of scale.) (*altitude above ground level)

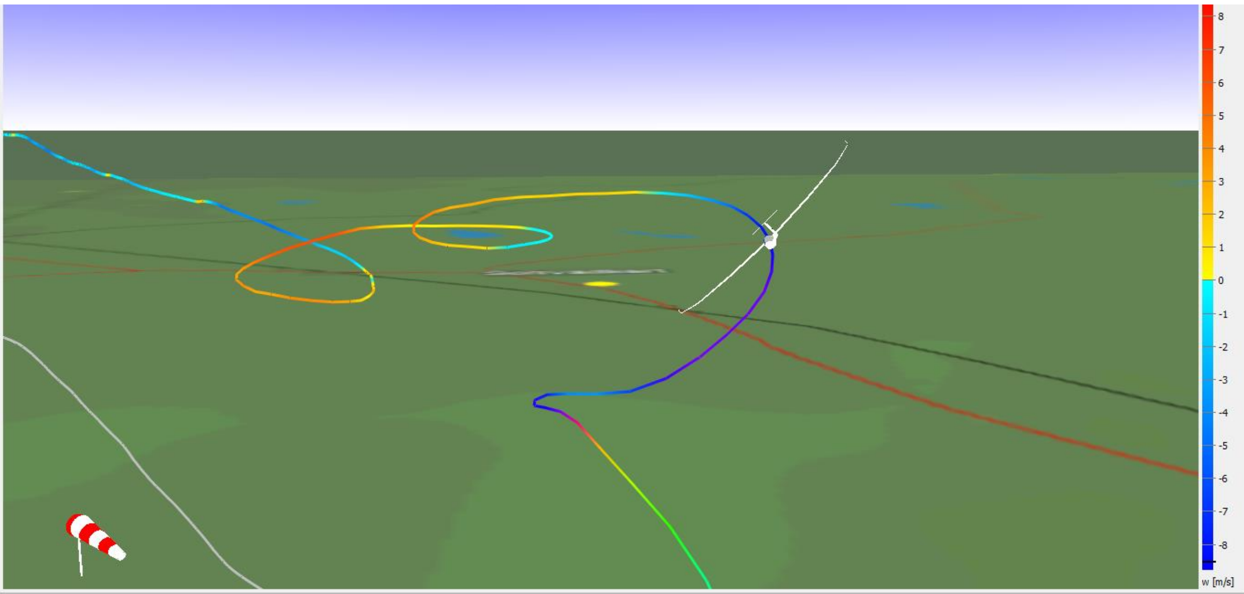

Figure 4: The last minutes of the flight path depicted in space using the See You software

After leaving Kiskunhalas, she did not circle in any rising air current, as presumably she found none. When getting close to Kiskőrös, at 14:41, she might have found that she had no real chance to successfully complete the task, so she gave up her cross-country flight and turned back. Progressing toward Kiskunhalas, the pilot might have detected signs of rising air currents, because she started circling to the right (Figure 3). During the first two circles, the aircraft climbed to an altitude of 940 metres, with decreasing vertical flight, although part of such climb could have come from the kinetic energy generated by a loss of speed of the flight. Climb completely stopped during the third round, and turned into a more and more intensive descent, the value of which was almost -50 m/s at the altitude of 600 metres, at 14:46:31 o'clock. According to recorded data, rotation of the aircraft stopped in the next 3 seconds, and its descant rate decreased to near -25 m/s. Then, the direction of rotation of the aircraft altered, to the left, and the descent rate increased dramatically again and remained high until the impact.

1.2. Injuries to persons

Injuries	Crew		Passengers	Other
	Pilot	Cabin		
Fatal	1	-	-	-
Serious	-	-	-	-
Minor	-	-	-	
None	-	-	-	

1.3. Damage to aircraft

The aircraft was totally destroyed in the occurrence.

1.4. Other damage

The IC had got no information on other damage by the completion of the investigation.

1.5. Personnel information

1.5.1. Data of the pilot in command

Age, nationality, gender		40 years, Hungarian, female
Licence data	type	SPL
	professional valid until	Continuous as of 30/03/2012
	ratings	Sailplane (S), AT, WL
Certificates		Sailplane Pilot
Medical class and valid until		Class 2 / LAPL, 22/05/2019 / 22/05/2019
Flying hours/take-offs	in the previous 24 hours	4 hours 15 minutes / 1 take-off
	in the previous 7 days	6 hours 09 minutes / 2 take-offs
	in the previous 90 days	94 hours 38 minutes / 30 take-offs
	total:	834 hours / 810 take-offs
	on the affected type, total:	7 hours 52 minutes / 3 take-offs
Aircraft types flown:		Discus, Ventus, Jantar 2B,

1.6. Aircraft information

1.6.1. General information

Class	Fixed wing power glider
Manufacturer	Alexander Schleicher GmbH & Co.
Model	ASW 27-18 E (Figure 5)
Year of manufacture	2010
Serial number	29613
Nationality and registration marks	D-KRIB
State of registry	Germany
Date of registry	14 April 2015
Name of the owner	FlightSystem Kft.
Name of the operator	FlightSystem Kft.

The aircraft model is used in two versions, one with a wing span of 18 metres, and another with 15 metres. The IC found that the aircraft involved in the occurrence was the version with 18 m wingspan.

	Flight hours	Take-offs
Since manufacture	1198 hours 29 minutes	301

Figure 5: The aircraft involved in the occurrence, photographed during an earlier aerotow take-off (source: Internet)

1.6.2. Airworthiness Certificate

<table>
<tr><td rowspan="4">Airworthiness Certificate</td><td>Number</td><td>36451</td></tr>
<tr><td>Date of issue</td><td>29/04/2010</td></tr>
<tr><td>Valid until</td><td>Until withdrawal</td></tr>
<tr><td>Restrictions</td><td>None</td></tr>
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Airworthiness Review Certificate	Number	MSE-D37-2017
	Date of issue	07/04/2017
	Valid until	07/04/2018
	Date of latest review	07/04/2017

1.6.3. Engines

Category	Retractable sustainer engine
Engine manufacturer	SOLO Kleinmotoren GmbH
Type	SOLO, 2350
Serial number	1033

1.6.4. Data of propellers installed on the engine

Manufacturer	Alexander Schleicher GmbH & Co. Segelflugzeugebau
Type	Schleicher AS2F1-3/L100-56-N2
Serial number	2584

1.6.5. Aircraft loading data

Empty mass	332.8 kg
Maximum load on pilot’s seat	80 – 105.5 kg
Mass at the time of the accident	~550 kg
Maximum take-off weight (with water ballast)	600 kg

Water ballast system
The aircraft type involved is equipped with a water ballast system.

According to the Fight Manual, during a spin: *“with water ballast present, the aircraft will accelerate quickly after the end of autorotation, therefore it is important to pull out the aircraft from the fall on time.”*

A remark in Section 4.5.6 of the Flight Manual mentions that the water ballast will increase stall speeds during flight.

1.6.6. Description and data of malfunctioned system or equipment

No information emerged during the investigation on malfunction of the structure or any system of the aircraft prior to the occurrence, thus contributing to the occurrence or influencing the course of events.

1.6.7. On-board warning systems

The aircraft was equipped with FLARM collision alert system which was in operation as required and data from it was available on the internet.

1.7. Meteorological information

The occurrence took place at daytime, in good visibility conditions.

According to information obtained from the meteorological service provider working at the contest in Szatymaz, the weather situation in the southern part of the area between the rivers Danube and Tisza on 13 July 2017 was as follows: Behind the cold front (in a field with increasing pressure) there was brisk NW wind and an unstable air mass, with gusts of winds (maximum 14 to 16 m/s) near the ground surface (at 10 m altitude). The quantity of cumulus clouds, which was typically high (4-6 octas) during the midday hours, fell dramatically (dried up) during the hour preceding the occurrence: there were no cumulus clouds west of the Main Channel of the Danube Valley, and the quantity of clouds decreased to 1-2 octas at the Bácska Sand Ridge. The cloud ceiling (level of convection) was 1800-0900 m in the area in that period.

Due to the upper wind (320°, 10-12 m/s) and turbulence, the weather was not easy to utilise and required particular attention. In addition to pilots' reports, the evaluation of flight data recorders also support objectively that thermal soaring circles were difficult to perform, and the winds speed and wind direction values were also unfavourable.

1.8. Aids to navigation

The navigation equipment did not influence the course of events, but its data recording function helped the investigation (Section 1.11).

1.9. Communications

The communication equipment did not influence the course of events, so it needs no detailed discussion.

1.10. Aerodrome information

The aircraft took off at the private airport of Szatymaz (LHST) on 13 July 2017 at 13:03 pm. Szatymaz (LHST) airport was also the scheduled destination aerodrome. The flight actually ended 2.8 kilometres west (245°) of Pirtó village on the same day, at 14:47 pm. The parameters of the aerodromes did not influence the course of events, so they need no detailed discussion.

1.11. Flight recorders

The data recording systems required for the air traffic management equipment and for the aircraft were serviceable and the data recorded by them was evaluable (Figure 6).

On-board data recorder	Manufacturer	LXNAV d.o.o.
	Model	LX8000 Vertical speed indicator and GPS navigation system
	Place of readout	Budapest – KÜRT Zrt.
	Location when found; state of repair	Among wrecks of aircraft, damaged
	Could recorded data be used?	Partial readout was possible

Other on-board data recorder	Manufacturer	LXNAV d.o.o.
	Model	Colibri II.
	Place of readout	TSB, Budapest
	Location when found; state of repair	Among wrecks of aircraft, damaged
	Could recorded data be used?	Readout was possible

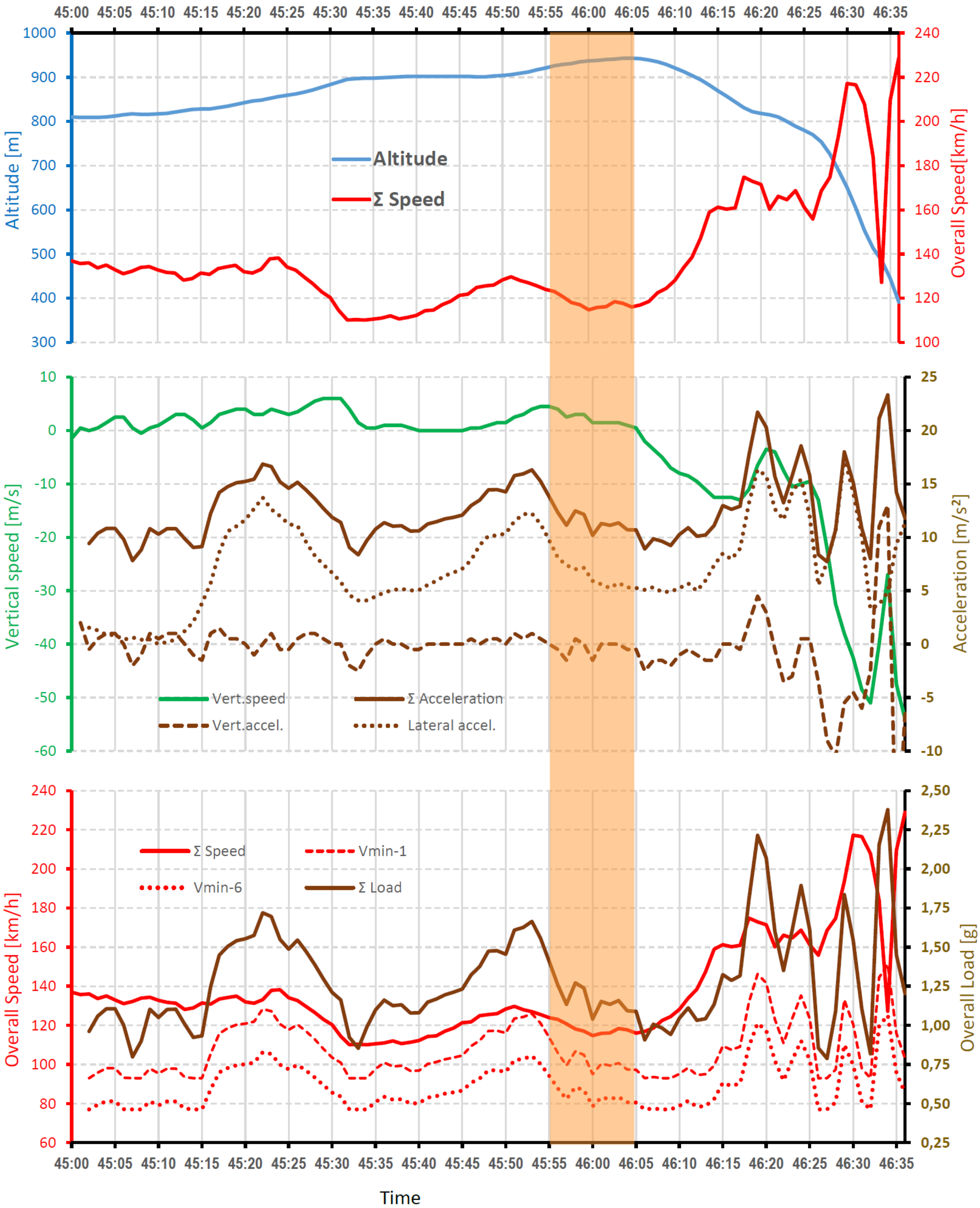

Figure 6: Data of the last 1.5 minutes of the flight, calculated from data measured by the LX8000 device

Legend: ∑= vectorial sum; Vmin-6 = stall speed with flaps in Setting 6;

1.12. Wreckage and impact information

The wrecks of the aircraft with registration sign D-KRIB and the corpse of the pilot were found by the search & rescue unit of Szolnok Helicopter Base, Hungarian Defence Forces, in an area covered with pine and birch trees of 20-25 metres of height, 2.8 km west of Pirtó village, in the morning of the day following the date of the accident. The remains were found in two areas.

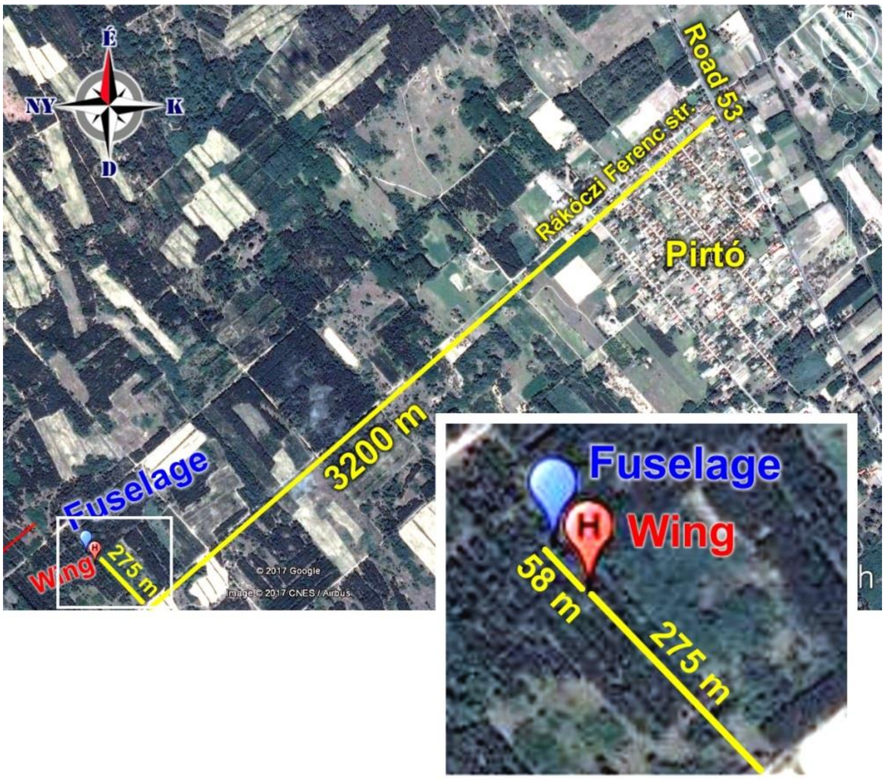

Figure 7: Location of the wrecks in a wooded area near Pirtó village

The fuselage of the aircraft and the unseparated right wing were found within a relatively small area but in extremely damaged state. It is a sign of vertical impact that most of the fuselage as well as the stabilizers and the ripped-off engine were found within a circle with a diameter of 3 metres (Figure 8). The nose part of the fuselage (with the body of the pilot) stuck in the sandy forest soil, in a depth of ca. 70 cm. No significant damage to nearby trees was found. Minor pieces of wreckage and other items from the aircraft were scattered around the wreck within a circle with a diameter of ca. 10 metres.

Figures 8: The fuselage with the stabilizers after the vertical impact

A 8,4-metre-long outer piece of the left wing was found lying, in relatively intact state, 58 metres southeast of the fuselage (Figure 9). Its aerodynamic elements (spoiler and flap) moved freely, but their actuator rod connections were torn, and their position at the moment of the accident could not be determined. Despite its fracture, the ballast water tank in the wing still contained a significant quantity of water.

Figure 9: The left wing which was ripped off in-flight

During recovery of the fuselage, it was confirmed that the pilot was wearing a parachute, the container of which opened when the unit was lifted out. The safety harnesses were in fastened position but ripped out of their connections. Due to intensive damage, the possibility to determine the respective positions of the controls in the cockpit was limited. The control of ballast water discharge valves was in “closed” position. The emergency jettison knob of the canopy was in default (i.e. closed) position.

No sign or debris originating from another flying object was detected on the wrecks or in the environment of the wrecks, which makes the possibility of in-flight collision as the cause of the accident unlikely.

1.13. Medical and pathological information

Examination by the forensic expert.

The autopsy of the pilot involved in the accident was performed at Kiskunhalas Hospital on 19 July 2017. According to the forensic medical examiner’s opinion: “*The death of the above-named person was violent death; she suffered so severe injuries, as a consequence of fall from a height, that her life could not have been saved even by professional immediate medical care.”*

There was no evidence that physiological factors or other impediments had affected the legal capacity of the personnel concerned prior to the crash.

1.14. Fire

There was no fire in connection with the occurrence.

1.15. Survival aspects

The accident was not survivable. The pilot of the aircraft suffered multiple fatal injuries upon impact. She could not have been saved even by immediate medical intervention.

Information provided by the FLARM system and available on the website live.glidernet.org (Figure 10) showed that, on 13 07 2017 at 14:46:28 pm, the aircraft involved in the accident was staying a few kilometres west of Pirtó village (46°30.226′N 19°23.659′E), at an altitude of 713 metre, and was descending extremely fast (-22,5 m/s).

The national air traffic management service company HungaroControl was notified by Szatymaz Airport on 13/07/2017 at 18:30 pm that the aircraft with reg. sign D-KRIB had not returned from its cross-country flight task. Two units of Szolnok Helicopter Base, Hungarian Defence Forces launched search & rescue activity at 19:15 pm along the known flight path, but they suspended their action at twilight. During the action continued early next morning, at 05:25 am, National Police Headquarters notified Bács-Kiskun County Police Headquarters that the wrecks of the aircraft and the body of its pilot had been found.

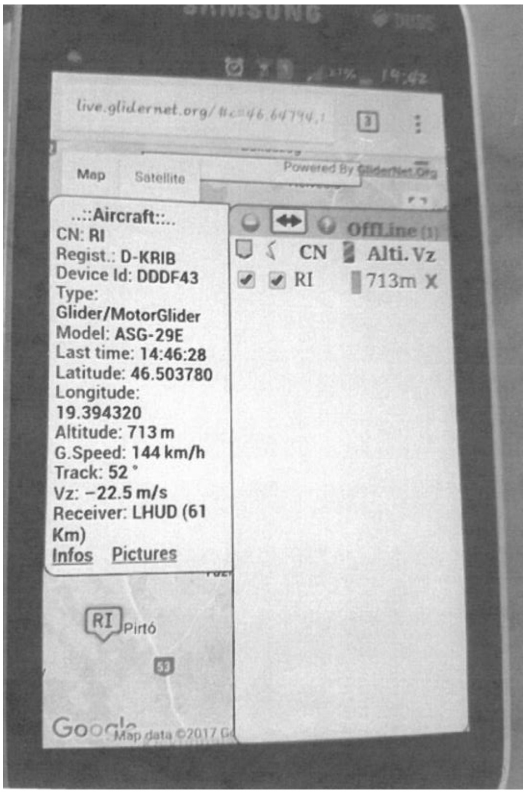

Figure 10: FLARM data displayed

Airborne search was made difficult by the fact that, as a result of vertical impact of extremely high velocity, the aircraft had lost its shape almost completely (Figure 8) – only the left wing remained identifiable from a larger distance.

1.16. Tests and research

1.16.1. Inspection of the damaged navigation equipment (LX8000) – Celje, Slovenia, 31/07/2017

TSB sent the navigation equipment found in seriously damaged and deformed state at the scene of the accident to the manufacturer LXNav in Celje, Slovenia, for inspection and possible data recovery. Subsequently, the IC sent the removed memory cards (Figure 11) to a company specialised in data recovery. The inspection and data recovery effort brought partial success only, due to seriously damaged state of the memory cards.

Figure 11: LX8000 navigation equipment and the damaged memory cards found in it

1.16.2. Additional visit to the scene – 05/09/2017 – Kiskunhalas / Pirtó outskirts

During the visit, representatives of TSB and other authorities inspected the scene of the accident and the wrecks of the aircraft involved. It was found that the landing gear, the canopy, the harnesses of the pilot's seat, as well as the discharge valves of the ballast water were in closed position. It was not possible to determine the positions of the controls (situated at the left hand side of the flight cabin) of the brake paddles and flaps at the time of the accident. During inspection of the site, an electronic device was found (Figure **12**), which contained a type Kingston memory card which was taken to TSB for further inspection (1.16.3).

Figure 12: The damaged Colibri II device with its serviceable memory card as found during the additional visit

1.16.3. Inspection of a component of an electronic device (Colibri II) – 11/09/2017 – TSB, Budapest

During disassembly and inspection of the component, it turned out that it was part of the Colibri II device installed on-board the aircraft. The micro SD card of 8 GB capacity (Figure **13**) removed from the component proved to be fully serviceable, it was possible to recover the file with igc extension from it; the file contained data of the flight which ended up in accident. As the device was connected to the navigation equipment type LX8000 during the flight, it contained data measured by such navigation equipment.

Figure 13: The face of the SD card found

1.17. Organizational and management information

1.17.1. Requirement(s) related for the learning of flight operations (obtaining type certificate) with a new sailplane type by pilots with SPL certificate

According to para. a) Section FCL.205.S of Regulation (EC) № 1178/2011 specifying the requirements and administrative procedures related to civil aviation pursuant to Regulation (EU) № 216/2008:

> *"The privileges of the holder of an SPL are to act as PIC on sailplanes and powered sailplanes…."*

According to para. a) Section FCL.700:

„a) Except in the case of the LAPL, SPL and BPL, holders of a pilot licence shall not act in any capacity as pilots of an aircraft unless they have a valid and appropriate class or type rating.)

During the investigation, the IC did not find any requirements related to the learning of flight operations of a new sailplane type or to any conditions of starting to fly a new sailplane type by sailplane pilots who hold a pilot certificate.

1.18. Additional information

1.18.1. The flight manual of the aircraft

The Flight Manual published for pilots of the Type ASG 29E powered sailplane contains a lot of information which may be related to the accident involved.

Water ballast system
The aircraft type involved is equipped with a water ballast system. The system includes water tanks integrated in the wings, with an aggregate capacity of 170 litres. The air vent is situated under the winglet on the wing tip. The tanks can be refilled through the inlets on the top of the wings. The water can be discharged through the valves installed (for each tank) at the bottom of the wings; the valves can be opened and closed, in a synchronised manner, by a control lever situated on the right in the cockpit.

The system also contains a 5-litre tank installed in the tail fin in order to compensate for the weight of the nose. Its filling and discharge openings can be found in front of the tail wheel at the bottom contour of the fuselage. Its air vent is situated at the top left area of the tail fin. Its valve is also connected to the same control lever which operates the valves situated in the wings. Controlling all valves through one control lever prevents incidental opening of a single valve which would cause asymmetric distribution of weight.

According to the Fight Manual, during a spin: *“with water ballast present, the aircraft will accelerate quickly after the end of autorotation, therefore it is important to pull out the aircraft from the dive on time.”*

A remark in Section 4.5.6 of the Flight Manual mentions that the water ballast will increase stall speeds during flight.

Flaps
Type ASW 27-18E are equipped with flaps which run along the trailing edge of the wings. The flaps also act as ailerons. The flap can be set to settings numbered from 1 to 6, plus a ‘Landing’ setting, using a lever mounted on the left side wall of the cockpit; when left alone, the lever is fixed mechanically. Flap settings 1 to 4 are used for gliding, and settings 5 and 6 are used for circling. Flap setting 6 is recommended in the case of turns with short radiuses and when landing. The landing setting should only be used during landing.

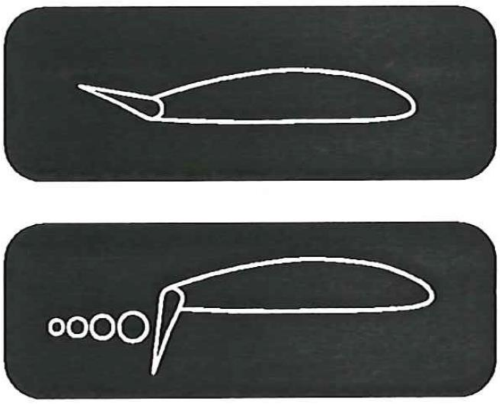

Figure 14: Indication of flap settings

Maximum flight speeds and stall speeds in function of flap and spoiler positions and aircraft total weight:

Flap setting	Maximum speed	Stalling speed (400 kg)	Stalling speed (500 kg)	Stalling speed (600 kg)
1	270 km/h in turbulence: 210 km/h	78 km/h	87 km/h	96 km/h
2		77 km/h	86 km/h	94 km/h
3		73 km/h	82 km/h	89 km/h
4	200 km/h	70 km/h	78 km/h	86 km/h
5		67 km/h	75 km/h	82 km/h
6		66 km/h	74 km/h	81 km/h
Landing	160 km/h	64 km/h	71 km/h	78 km/h
Land.+ Spoiler		71 km/h	79 km/h	87 km/h

According to Section 5.2.2 of the Flight Manual, during turns or circling, the stalling speed increases as follows, depending on the bank angle:

Bank angle	0°	30°	45°	60°	75°
Increase of stalling speed	0%	7%	19%	41%	100%

Stall characteristics and procedures
Chapter 4.5.3 Flight mentions the stall characteristics of the aircraft. According to that, the aircraft tends to drop a wing when stalling, which is especially significant when circling, with extended flap, and in rearmost centre-of-gravity position. When circling, the stalling speed will increase compared to that in straight flight. In the case of circling with 45° bank, such increase will be 19%. In the case of wing-drop, with the aircraft in rearmost centre-of-gravity position, the aircraft may get into a spin. During spin recovery, first stop rotation, and then start to recover the aircraft from dive as soon as possible, because it tends to speed up very quickly, especially when water ballast is used.

Chapter 3 Emergency procedures describes the method of spin recovery:

- Apply opposite rudder (i.e.: in the direction opposite to the rotation of the spin) and *at the same time,*
- relax back pressure on the stick until rotation stops
- center rudder and gently pull out of the dive.

This section contains two warnings as well:

“CAUTION:
Furthermore, spin recovery will be accomplished more quickly if flap deflection is reduced. It is advisable to reduce the circling flap setting to neutral (flap setting 4).
Spinning is not noticeably affected by extending the airbrakes, but this increases the height loss and reduces the load factor during recovery. It is therefore advisable to keep the airbrakes retracted.
WARNING:
Spinning in the landing-flap setting is strictly prohibited. If a spin should inadvertently develop while in this flap setting, the flaps should immediately be set to neutral (flap setting 4) before the limits of flap setting L are reached (maximum speed of 160 km/h and maximum load factor of 4g).”

Section 3.6. of this chapter describes the method of spiral dive recovery:

1. Release stick!
2. Reduce bank angle with rudder and aileron against direction of turn!
3. Gently pull out of the dive!

Bailing out in-flight

Sections 3.2 and 3.3., Chapter 3 present the emergency process of bailing out in-flight:

– Pull canopy jettison (red levers mounted left and right at canopy frame) and pull canopy rearwards and up!
– Only then release the safety harness!
– Push instrument panel UP (if this was not done in the course of jettisoning the canopy).
– Get up or simply roll over the cockpit side!
– Push yourself away from the aircraft as strongly as possible, trying to avoid contact with wing leading edges or tail surfaces!

Flight during wind gusts

Section 4.5.3 Flight of the Flight Manual includes the following caution:

"CAUTION:
And generally it applies: Do not utilise the otherwise permissible range of control deflections during strong gust loads. Simultaneous, full gust loads and manoeuvring loads can excess the structural strength."

The IC finds no circumstance relevant from the aspect of drawing conclusions and proposing safety recommendations other than the above facts, so the IC does not wish to present further data.

1.18.2. EASA „Annual Safety Review 2018"

The sailplane section of the annual safety report of 2018 issued by EASA contains the following two diagrams:

Figure 15: Percentage of sailplane fatal accidents per safety issue. (Source: EASA website[1])

[1] https://www.easa.europa.eu/sites/default/files/dfu/218639_EASA_ASR_MAIN_REPORT_2018.pdf

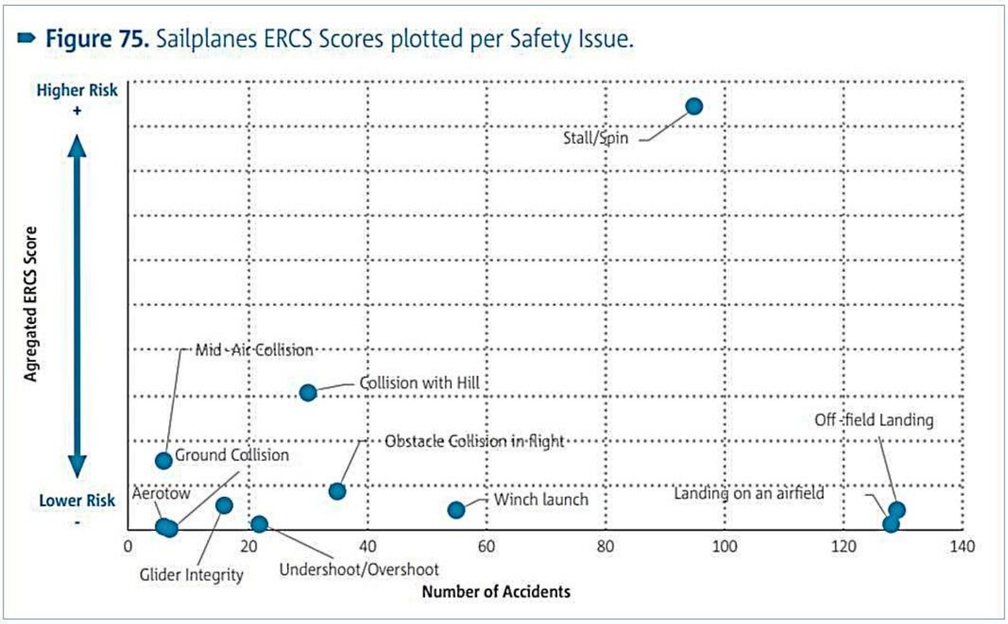

Figure 16: Risk levels of aviation safety risk factors. (Source: EASA website)

The two diagrams above show well that one of the leading causes of fatal accidents in the area of sailplanes in the member states was stall/spin. The diagram in Figure 16 depicts well the high number of serious accidents caused by stall/spin in gliding.

1.19. Useful or effective investigation techniques

The investigation did not require techniques differing from the conventional approach.

2. Analysis

2.1. Specific characteristics of cross-country flights in gliding

A common feature of longer flights using sailplanes, hang gliders, paragliders and other structures lacking own energy source is that the aircrafts needs to obtain the necessary energy from the environment. The most frequent form of that is to gain height in a rising air current. Various kinds of rising currents can be used for this purpose. In our case, the pilot relied on the upward thermal currents produced by unevenly heated ground surfaces to keep her aircraft in the air for a longer time. Thermal soaring typically consists of two main phases: climb by circling in a thermal and subsequent glide (“cruise”) as far as the next thermal (Figure 17). In the phase of climb, the pilot’s main task is to find the “core” of the thermal which provides the best lift, and to stay there as long as possible. When gliding between two climbs, it is not easy to find the next thermal because it cannot be perceived directly. The characteristics of the terrain, the cumulus appearing occasionally above it, or the movement of other gliding aircraft or birds may indicate its presence.

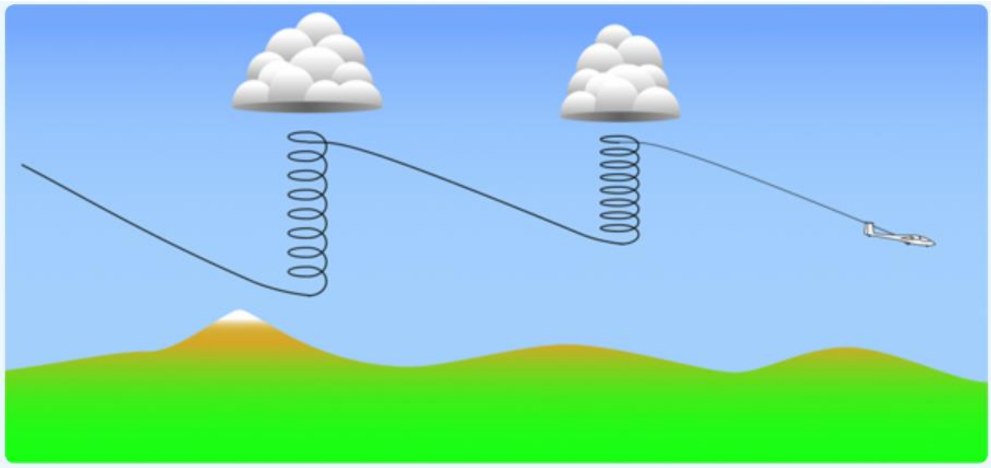

Figure 17: Alternating between climbing and gliding modes (soaringnv.com)

The pilot’s task is relatively easier during “local” flight nearby an airfield. They can decide freely where to look for the next thermal, and often other gliders are present to provide a clue for that. In addition to controlling the aircraft, the pilot may almost fully concentrate their attention to finding and catching suitable thermals, with the airfield being in comforting vicinity. During cross-country flight, the pilot has more tasks which are more complicated as well. They need to select the thermals along their route in such manner that they can also approach their destination as fast as possible. In the meantime, they need to take a number of decisions on optimal gliding speed, deviation from the route, possible turning back or selecting a place for emergency landing. While flying cross-country on your own, as the pilot involved in the accident did, you will also lack active as well as passive help from other gliders.

2.2. Weather conditions

As discussed in Section 1.7, the weather at the time of the accident was difficult to rely on, and required increased attention from the aspect of gliding. These circumstances and the resulting difficult rising air currents required close attention from the pilot on a continuous basis, and it was physically more demanding to control the aircraft.

2.3. Use of water ballast

One of the evaluation criteria of the glider pilot's performance is the average speed achieved during the flights. During high-speed flights, heavier aircraft provide better performance at the cost of slower climb in rising air currents, higher stalling speeds, and more demanding control in terms of attention and practice, due to higher inertia. For the sake of adjustment of the mass of the aircraft to the current weather conditions, additional mass is applied in the form of water ballast; the pilot can decide filling up water ballast prior to take-off, and the mass of the ballast can be reduced even in-flight as necessary.

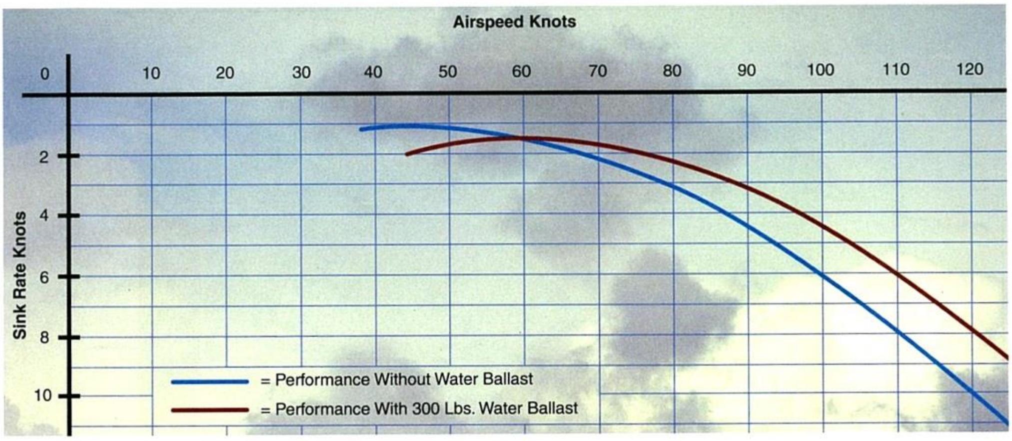

Figure 18: The effect of the water ballast on the gliding performance of the sailplane (FAA training material)

2.4. Use of the flaps

During gliding, the pilot typically alternates between two main modes of flight: climb in rising air currents and glide ("cruise") in order to cover distances (see Section 2.1). These two modes set different requirements for the aerodynamic properties of the glider. When climbing, a primary factor, in addition to low descent rate relative to the air mass, is good manoeuvring ability for the sake of finding and utilising the best lift which can be achieved at relatively low gliding speeds. When gliding, however, the purpose is to cover the longest distance within the shortest possible time, at the cost of the lowest possible loss of altitude. During low-speed flight, the ideal airfoil would be strongly curved and relatively thick, in order to generate the necessary lift. To the contrary, when the aircraft flies at higher speeds, lift is not a problem, while reduction of the disadvantageous drag is best served by airfoils that are as thin and straight as possible. A useful trade-off between the two aspects is the use of the flaps by which the pilot can change the airfoil as required by the current flight situation. A setback of this solution is that use of the flaps imposes extra task on the pilot, and requires accurate and very quick intervention from the pilot in unexpected extreme flight situations.

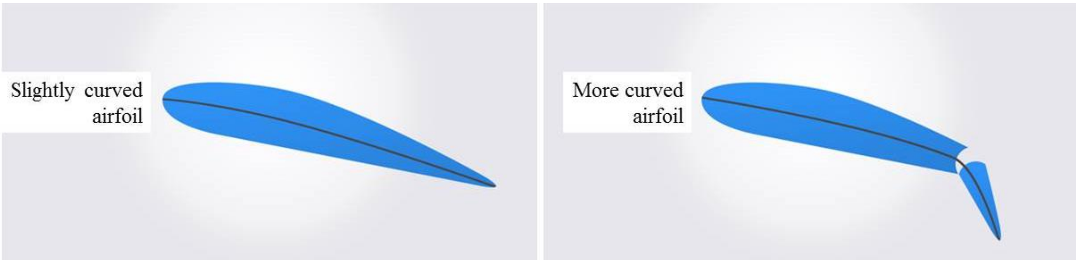

Figure 19: The effect of flap setting on the curve of the wing

A complete and objective reconstruction of the course of events leading to the accident would have required knowledge of the actual setting and possible movement of the flaps, but, due to lack of any device recording such information and to the extent of damage to the aircraft, it was not possible. Accordingly, it cannot be excluded with certainty that inappropriate setting of the flaps could also have played a role in the development and worsening of the extreme flight situation which led to the accident.

2.5. The risk levels of stall/spin in terms of flight safety

According to data from EASA (Figure 15) the third most decisive cause of fatal sailplane accidents was stall or spin in the period ranging from 2015 to 2017. The other chart prepared by EASA (Figure 16) shows quite clearly how high the risk of stall and spin is in gliding. But in spite of all that, maintaining of the Sailplane Pilot Licence is not subject to a mandatory training which would ensure pilots' acquiring and maintaining practice and knowledge related to the identification, avoiding and elimination of uncontrolled flight situations.

In addition, due to lack of a type certificate or other requirement related to acquisition of necessary knowledge and skills, the pilot can only learn the stall/spin characteristics of a new sailplane model on their own, relying on the flight manual of the given aircraft.

2.6. The pilot's flight experience and reaction time

According to information available to the IC, the pilot involved in the accident had significant flight experience of 834 hours, most of which she acquired in the circumstances of contests. Continuity of her practice is supported by the fact that she had gained 95 flight hours during the 90 days preceding the occurrence. However, the fatal flight was only her third flight with the given aircraft type, which can be regarded a low number in the opinion of the IC, taking into account that this sailplane type is optimised for performance flight and demands a lot from the pilot.

The IC did not find any document which would prove any report of the pilot on her knowledge of the given aircraft type or that she had learnt or practised the special procedure to be followed in case of an extreme flight situation. No regulation in effect requires the availability of such documents.

The practice and experience gained by the pilot related to other aircraft types, but this new type was different from the older one in various aspects. It takes some time to get familiar with a new type, in particular to find out about the "behaviour" of the aircraft in different configurations and situations, and additional time is needed to fix this knowledge. In unexpected situations, one makes a decision primarily on the basis of regularly practised[2], fixed knowledge, instinct, automatisms.

In the course of the accident, the pilot got into a situation requiring immediate decision with an aircraft which she could not yet have got familiar with closely as regards its behaviour and stall characteristics.

As the effective regulation includes no requirements for the learning and practising of procedures to follow in the case of spin or extreme flight situations, the pilot presumably was able to rely only on her experience gained during the basic training performed in a training aircraft in this respect.

Relying on such experience, the pilot should have resolved the unexpected situation (according to the flight manual) with careful operations but within fairly short time before it became irreversible.

"Reaction time is a period of time which elapses between the occurrence of the stimulus and the response given to it. This period of time includes perception, identification, information

[2] I.Cakan, S.Ozkaynakci: Aeronautical Decision Making: The Effects on Pilots' Decision

processing, decision, and an internal command given to start action; it is followed by the that phase of the reaction in a broader sense where actual movement(s) take(s) place as an effect of the internal command."[3]

The period of time that elapses between perceiving danger and starting the physical reaction is often called time lag. This term refers to the internal process which takes place in the pilot (as described above), i.e. to a delay of the performance of the necessary movements (operation of controls of the aircraft) decided on as an effect of perception, and not to any unjustifiably prolonged time.

This period of time, which is inevitably required for a reaction, is increased by the lack of experience, and possibly also by fatigue originating in the physical and mental loads described in section 2.2. However, in the case of stall or spin of modern performance sailplanes, this seemingly minimal increase of time may be sufficient to allow the development of such great forces acting on the aircraft (especially in weather with wind gusts) which exceed the structural strength of the aircraft.

2.7. Probable course of events

As the accident had no eyewitness and the data available to the IC is not detailed enough to determine the course of events unambiguously, the IC can only propose a probable version of the course of events leading to the accident (Figure 20). According to that:

In the third circle of an attempt to climb in the thermal near Pirtó village, at 14:45:50-55, the speed of the sailplane exceeded the stalling speed value only by 10-17 km/h (depending on the flap setting), according to data recorded by and read out of the data recorder. In a situation like that, a more violent wind gust (which occurred quite often on that day) could have caused stalling of one or both wings. Possible closure of the flap (setting 1) may lead to stalling even without a wind gust. This is suggested by the unusually intensive and continuously accelerating loss of altitude which started a few seconds later (Figure 6).

After the wing drop following the stall, the aircraft was rotating around its longitudinal axis, and lost altitude fast. After a few seconds, the pilot managed to stop rotation of the aircraft, and then she pulled the elevator lever firmly back in order to stop dive. The descent rate began to decrease. However, by that time, the speed of the aircraft loaded with water ballast had exceeded that value over which gross control manoeuvres may hazardously overload the structure of the aircraft. That did actually happen, and, as a result of overload, the wing spar fractured, and the left wing separated from the aircraft. The Flight Manual mentions (Section 1.18.1) that the airframe may be overloaded as a result of a stronger wind gust arriving at an unfavourable moment while the pilot is performing a permitted manoeuvre.

The process of pulling out of dive was disrupted, and the descent rate began to increase quickly again. As an effect of the unbalanced lift still acting on the right wing, the aircraft began to rotate to the left, which went on, together with the dive, until the aircraft crashed into the ground. The separated left wing fell at a significantly lower speed, owing to its higher drag relative to its mass, so it was damaged less than other parts of the aircraft, and it was drifted further away in the wind.

As the IC has no information on the setting of the flaps at the time of the accident (or on the changes of the setting during the accident), it cannot be excluded that it may also have contributed to the occurring or worsening of the accident. If, following an unexpected wing drop, the pilot moved flap control to fully opened setting, then the maximum speed dropped to 160 km/h, which had been exceeded temporarily by the peak of the actual speed (over 210 km/h) by more than 35%. Section 3.5 of the Flight Manual clearly prohibits the spin manoeuvre with the flap set to landing. In the case of inadvertent wing drop, the flap should be set immediately to neutral (setting 4), according to the Flight Manual. In order to perform

[3] Dr. Melegh Gábor: Gépjárműszakértés, Budapest 2004, 83.o.

that, the pilot involved (who had little experience with this aircraft type) should have clearly identified the situation and she should have changed the setting within only a few seconds available, before the falling aircraft speeded up.

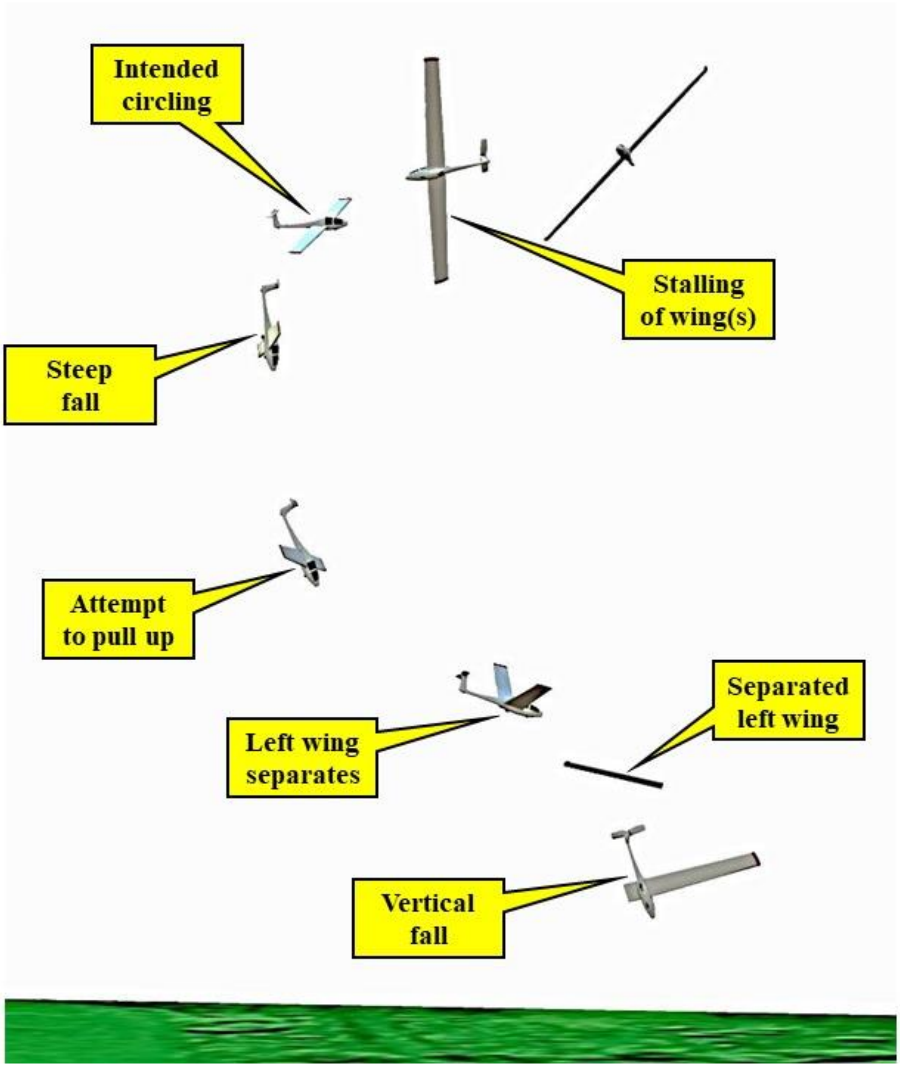

Figure 20: Assumed process of the accident

2.8. Failure to leave the aircraft

The information (closed position of the canopy and safety harness) collected at the scene of the accident and during additional visits clearly suggests that the pilot did not attempt to bail out of the falling aircraft. When the left wing separated from the aircraft during the accident, the possibility to end the flight safely was completely gone. From that moment, the only way of escape for the pilot was to jump out of the aircraft and rely on the parachute. When the wing separated, the altitude of the aircraft above the ground was ca. 360 metres. Supposing that the average descent rate was 50 to 70 m/s, the time left before crash was 5 to 7 seconds, and in the unexpected emergency situation it was not sufficient for identifying the situation, making a decision and starting to escape. During the inspection of the wreck of the aircraft, no information emerged which would suggest that the pilot had suffered any incapacitating injury prior to the crash.

3. Conclusions

3.1. Findings

At the time of the occurrence, the pilot had the appropriate licences and ratings but insufficient experience with the given aircraft type for safe performance of the given flight task. Prior to the fatal flight, she performed two take-offs with the aircraft type involved. There is no objective evidence of the pilot's demonstration of her knowledge of the aircraft type which was new to her (although it is not required).

The aircraft was airworthy when the take-off started. It had a valid airworthiness certificate.

According to its documents, it was equipped and maintained in compliance with the requirement in effect and with the accepted procedures.

No information emerged during the investigation on malfunction of the structure or any system of the aircraft prior to the occurrence, thus contributing to the occurrence or influencing the course of events.

The flight took place in good visibility conditions at daytime, but the fairly turbulent nature of the rising currents made it harder to fly the aircraft.

No information emerged on the activity of the air traffic management service(s), the support staff or the characteristics of the aerodrome which could be associated with the occurrence.

Flying the aircraft involved requires relatively extended experience and focused attention, due to the integrated flaps and the water ballast applied.

The pilot took off from Szatymaz Airport in order to perform a cross-country flight task.

After 1 hour and 43 minutes of flight, the aircraft was circling at an altitude of 660 metres, when one or both wings might have stalled, and the aircraft began to descend at an increasing descent rate.

The pilot attempted to pull out from the fall, but in the meantime she overloaded the aircraft to such extent that its left wing fractured and separated from the fuselage.

Although the pilot had a serviceable parachute, she made no attempt to leave the falling aircraft.

The pilot of the aircraft suffered fatal injuries upon impact. Her life could not have been saved even by immediate medical intervention.

Despite availability of accurate data of geographical location, the wreck was only found on the day after the accident, but that had no influence on the pilot's chance of survival.

3.2. Causes

The IC concluded during the investigation that the cause(s) of the occurrence was that the pilot's experience with the given aircraft type was not in line with the requirements set forth by the situation that occurred in the course of the given flight task (2.6).

In addition to the above, there were contributing factors too, as follows:

- The use of the water ballast increased the stall speed and inertia of the aircraft (2.3).
- The adverse weather conditions increased the pilot's psychic and physical loads and the demand for her capabilities (2.6; 2.6).
- The cross-country flight task imposed extra loads on the pilot compared to those of local flight (2.1).
- The use of the flaps of the aircraft increased the pilots work load and the risk of making mistakes (2.4).

4. Safety recommendations

4.1. Actions taken during the investigation

The IC is not aware of any action taken relating to the accident involved in this investigation.

4.2. Safety recommendation(s) issued during the investigation

The Investigating Committee of TSB identified no circumstance which would warrant issuance of a safety recommendation.

4.3. Safety recommendation(s) issued on completion of the investigation

The Investigating Committee of TSB proposes that the following safety recommendations as the closing of the investigation:

BA2017-307-4-01: *During its investigation, the Investigating Committee of Transportation Safety Bureau established that pilots have no such training obligation related to the maintaining of the Sailplane Pilot Licence which would maintain their practice and knowledge related to identification, avoiding and elimination of uncontrolled flight situations. Therefore:*

> **Transportation Safety Bureau recommends European Aviation Safety Agency (EASA) to consider determining theoretical and practical requirements, relating to identification, avoiding and elimination of uncontrolled flight situations, for the maintaining of the Sailplane Pilot Licence.**

In the case of acceptance and expected implementation of the recommendation, the safety risks originating in erroneous management of wing drop, spin or uncontrolled flight situations during sailplaning could be reduced.

5. Lessons learnt

Respecting the deregulation efforts and with regard to European efforts made to propagate the culture of aviation safety, the IC wishes, without issuing a safety recommendation, to direct the attention of all stakeholders in this field to the following significant lessons learnt from the facts and experience gained during the investigation, for the sake of reducing the flight safety risks revealed:

Relating to search & rescue activity performed in connection with the occurrence, the IC found that the location data provided by the FLARM system gave help of key importance to finding the wreck of the aircraft which was far from populated areas, hardly recognizable and obscured by trees. It may be worth exploring the possibility that every sailplane involved in cross-country flight should use a device based on FLARM technology (or compatible with it) which would reduce the risk of collision on the one hand, and could effectively support search & rescue activity as necessary, on the other. Quicker launching of search & rescue activity could be facilitated by involving an application, within the FLARM system, which would give an alert when a flight ends outside airports.

During the investigation, the IC found that, after the pilot has obtained a Sailplane Pilot Licence, there is no formal system of requirements (type certificate, etc.) relating to the knowledge (theoretical and practical) of new aircraft types which the pilot wishes to fly. Consequently, as regards getting familiar with a given sailplane type and acquiring of the practice necessary to flying it, there is no formal requirement which would determine a minimum level of flight safety other than the individual's own judgement. In view of all this, it may be worth considering the possibility of designing and introducing a system of type certificate examination which presumably would reduce effectively the risk of incidents and accidents occurring in the course of initial flights with new aircraft types.

Budapest, 21. 04. 2019

Dr Zsuzsanna Nacsa
Investigator-in-charge

György Háy
Member

Gábor Torvaji
Member

ANNEXES

Annex 1: The last 108 seconds of the flight (See You program)

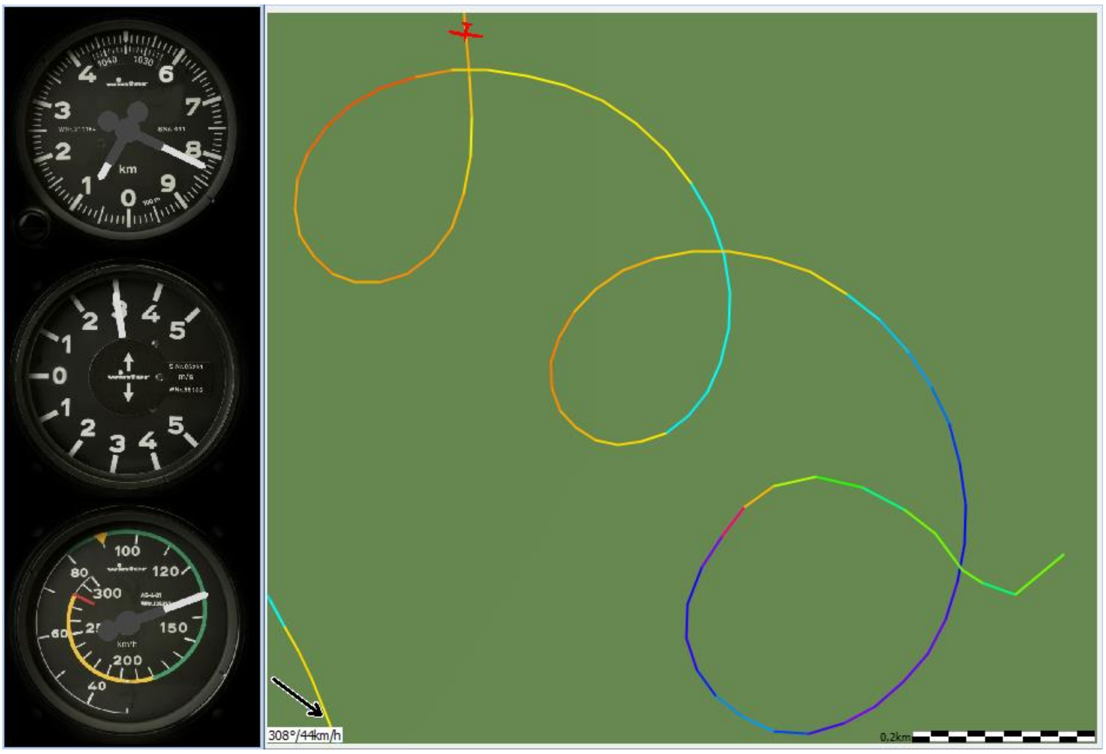

Figure 1/a: (Second -108) Start of circling in the thermal lift.

Figure 1/b: (Second -63) Completion of the first circle, after 80 metres of climb.

Figure 1/c: (Second -34) Completion of two circles, after an aggregate climb of 120 metres.

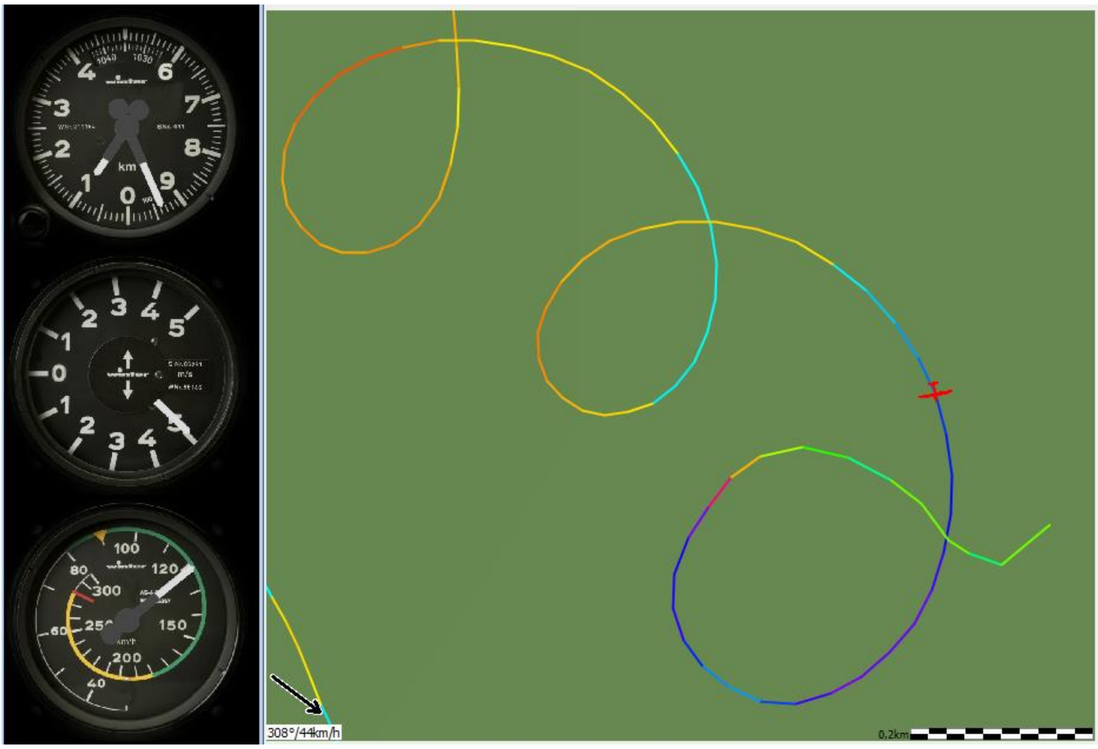

Figure 1/d: (Second -32) Start of dramatic loss of altitude.

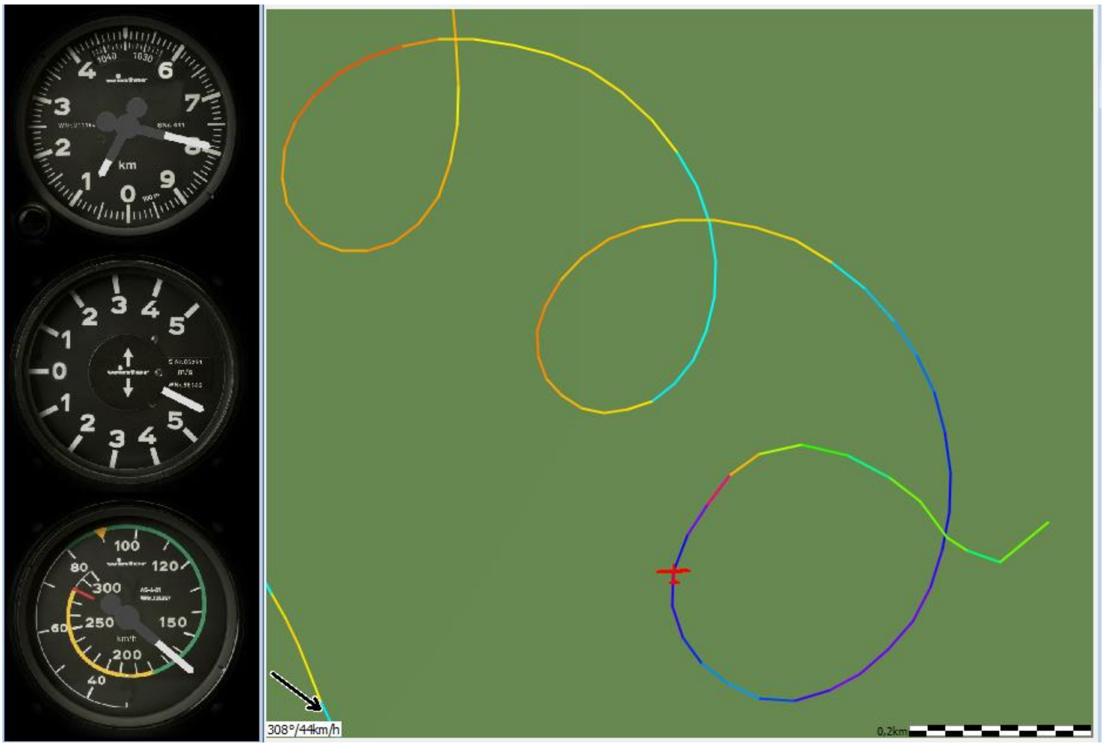

Figure 1/e: (Second -16) The rate of descent exceeds the 10 m/s value.

Figure 1/f: (Second -9) The rate of descent is 50 m/s, circling stops.

Figure 1/g: (Second -5) The rate of descent is 50 m/s, circling starts in the opposite direction, after supposed separation of the left wing; altitude above ground level is 320 metres.