MINISTRY FOR
INNOVATION AND TECHNOLOGY
TRANSPORTATION SAFETY BUREAU

FINAL REPORT

2015-157-4P

Accident

Ernő Rubik sr. Aerodrome, Esztergom

7 June 2015

R-26 SU Góbé HA-5514

R-26 SU Góbé HA-5501

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.),
- GKM Regulation 123/2005. (XII. 29.) of the Ministry of Economy and Transport on the rules of safety investigation of aviation accidents and incidents and other occurrences,
- 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.

Incompatibility did not stand against the members of the IC. 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 safekeep 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 affected parties did not comment on the draft 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.

Table of Contents

Definitions and abbreviations

AME	*Aero-medical examiners*
AT	*Air Tow*
ATO	*Approved Training Organization*
DTO	*Declared Training Organization*
EASA	*European Aviation Safety Agency*
FCL	*Flight Crew Licence*
FI (S)	*Flight Instructor (Sailplane)*
FTO	*Flight Training Organization*
HM	*Ministry of Defence*
IC	*Investigating Committee*
ICAO	*International Civil Aviation Organization*
ITM	*Ministry for Innovation and Technology*
Kbvt.	*Act CLXXXIV of 2005 on the technical investigation of aviation, railway and marine accidents and incidents*
Landing on a designated point	*Landing at the line of a designated point on the runway*
LAPL	*Light Aircraft Pilot Licence*
LT	*Local Time*
METGKM	*Ministry of Economy and Transport*
MEW	*Ministry of Environment and Water*
MTTE	*Ministry of Transport, Telecommunications and Energy*
NFM	*Ministry of National Development*
NTA AA	*National Transport Authority Aviation Authority (till 31 12 2016) (Hungary)*
SGPL	*Student Glider Pilot Licence*
SPL	*Sailplane Pilot Licence*
Target angle	*The angle between the longitudinal axis of the aircraft and the line which connects the aircraft with the target.*
TSBKBSZ	*Transportation Safety Bureau*
UTC	*Coordinated Universal Time*
WL	*Winch Launch*

Introduction

Occurrence category		Accident	
Aircraft 1	Manufacturer	XII. Autójavító Vállalat, Szombathely	
	Type	R-26 SU Góbé	
	Registration mark	HA-5514	
	Operator	Aero Club Esztergom	
Aircraft 2	Manufacturer	XII. Autójavító Vállalat, Szombathely	
	Type	R-26 SU Góbé	
	Registration mark	HA-5501	
	Operator	Aero Club Esztergom	
Occurrence	Date and time	7 June 2015, 12:00 LT	
	Location	Ernő Rubik sr. Aerodrome, Esztergom (Figure 1)	
Number of people who died in the accident:		2	
Extent of damage of the aircraft involved in the occurrence:		Aircraft 1	destroyed
		Aircraft 2	seriously damaged

Any clock-time indicated in this report is given in Local Time (LT).

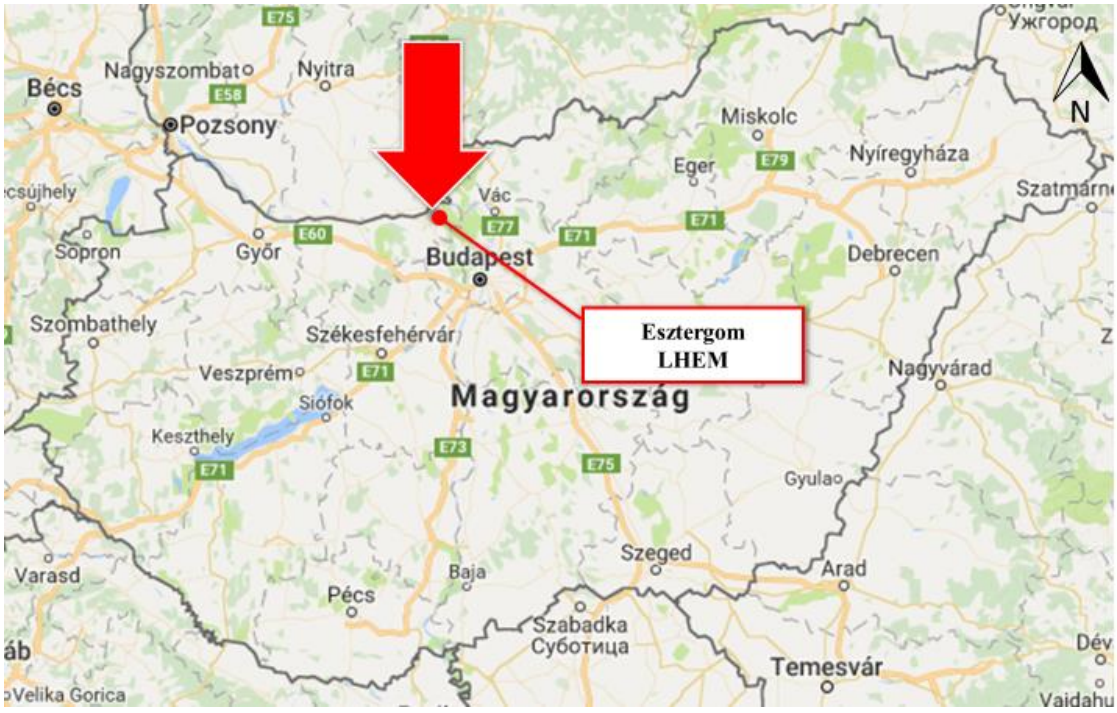

Figure 1: Location of the occurrence in Hungary

Reports and notifications

The occurrence was reported to the dispatcher of TSB by the dispatcher of Hungarocontrol Zrt. on 7 June 2015, at 12:14.

The dispatcher of TSB:

- reported the occurrence to the manager on duty on 7 June 2015, at 12:15 pm,
- informed the person on duty of NTA AA on 7 June 2015, at 12:39 pm.

Investigating Committee

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

Investigator-in-charge	**Gábor Erdősi**	Investigator
Member	**Miklós Ferenci**	Investigator
Member	**Gergely Maróti**	Investigator

Gergely Maróti government official's employment by TSB was terminated during the investigation and no one was assigned by the head of TSB as Member instead of him.

Overview of the investigation process

The IC visited the scene on the day of the occurrence. The aircraft involved in the accident were viewed. Photos were taken, measurements were performed, and the pilot involved in the accident was interviewed, as well as the head of the airport operations and a witness.

On 08 June 2015, the day after the date of the occurrence, the IC revisited the scene in order to clarify the course of events of the accident and to find out how the damages took place; more photos were also taken. On the basis of the findings of such additional visit, the IC reconstructed the movements of the sailplanes relative to each other during their collision.

On 28 July 2015, the IC requested the current list of registration relating to sailplanes, both for private persons and operating organisations, from NTA AA, and received it on 04 August 2015.

TSB issued a safety recommendation under № BA2015-157-4P-1A on 28 July 2015 during the investigation.

The IC asked for and received copies of documents available to other authorities involved.

The IC asked for and received the Training Manual of Registrated Training Organisations affected by the occurrence, both from the training organisation and from the NTA AA.

The IC reviewed the Airport Rules of Ernő Rubik sr. Aerodrome.

The IC received and reviewed the training record of the student pilots and the syllabuses of theoretical and practical training.

On the basis of calculations, the IC modelled the possible spatial movements leading to collision of the two aircraft.

On 21 February 2018, in Esztergom, the IC established, after performing experiments and measurements, to what lateral limits one can look out in various seat positions of the type Góbé R-26 SU aircraft.

On 21 September 2018 and 10 October 2018, the IC performed experiments related to the visibility of sailplanes.

In December 2018, the IC contacted a representative of EASA in connection with the issue of possible regulation of maximum age of flight instructors.

Short summary of the occurrence

On 07 June 2015, while preparing for landing in the course of performing their training tasks, two sailplanes collided on the final approach at Esztergom Airport. One of the aircraft became uncontrollable and crashed as a result of the collision, while the other was able to land safely, despite its damages. The crew of the crashed aircraft died on the spot.

According to the findings of the investigation by the IC, the crew of the crashed aircraft either did not see the other aircraft or, if they saw it, they failed to perform an avoidance manoeuvre in time, despite the fact that it was within their visual field throughout the last 10 seconds of the flight.

According to the findings of the investigation by the IC, the pilot of the aircraft landing after the collision had not seen the other aircraft for a long time, i.e. until the collision, despite the fact that it had been within his visual field (although in a limited way only).

During the investigation, the IC identified the colours of both aircraft as a factor contributing to the occurrence in the given weather conditions and visibility conditions, because both sailplanes were painted in colour combinations dominated by the silver colour and various shades of blue. For this reason, upon proposal by the IC, TSB issued a safety recommendation during the investigation.

During the investigation, the IC assumes the physiological factors related to the age of the flight instructor as a contributing factor.

Transportation Safety Bureau issues a post-investigation safety recommendation.

1. Factual information

1.1. History of the flight

1.1.1. Introduction

The aircraft with registration mark HA-5514 (hereinafter: Aircraft 1) and HA-5501 (hereinafter: Aircraft 2) were used for the purpose of pilot training by the registered training organisation Aero Club Esztergom. The surface finish of both aircraft included the same combination of colours, dominated by the silver colour and various shades of blue (see Figure 6). The student pilots involved in the accident performed their glider flight training with the aforesaid organisation in 2015.

1.1.2. Activities preceding the flight ending up in accident

According to the airport flight operation coordinator's statement, airport operations on that day started at 9 am when the flight instructor and the flight operations coordinator planned the daily tasks ("*Mainly thermalling related tasks were planned, based on the weather forecast*"), and determined which aircraft would be necessary for the tasks. Flights started after 10 am on the given day. Aircraft 1 occupied by a flight instructor and his student pilot took off to perform a so-called thermal demonstration task which was the current item of the student's training. They had two unsuccessful attempts to perform the tasks before they took off for the flight which ended up in accident.

The pilot of Aircraft 2 was about to perform the "C Badge", his current task, which is defined in the training handbook of Aero Club Esztergom effective at the time of the occurrence as staying in the air with the sailplane continuously (after one take-off) for 10 minutes at least, in such manner that "*after winch launch, the student shall find a lifting air stream and fly in it for 5 minutes at least, and then join the aerodrome traffic circuit and land within the designated landing area.*" He also had two failed attempts on that day prior to the flight which ended up in accident.

1.1.3. Aircraft 1: the flight leading to accident

The IC reconstructed the path of Aircraft 1 on the basis of the statements of the student pilot of Aircraft 2 and the witnesses who had viewed the flight from the start place, and on the basis of the flightlog (Figure 2).

No other known aircraft was there in the area of the aerodrome at the time of the reconstructed flight. The flight instructor and his student pilot started the thermal demonstration task in good visibility conditions, at daytime, after winch launch at 11:53 am. Due to the given weather conditions (mild SE wind), Runway 20 (200°) was used for the take-offs. They found a slight lifting stream on the long wall of the right traffic circuit (see Annex 1) at the line of the start place and started thermalling. It was then that the student pilot in Aircraft 2 started take-off. In the meantime, Aircraft 1 started to fly along the long wall in N-NE direction. The IC was not able to reconstruct the flight path of the aircraft between that point and the start of the fourth turn. When finishing the fourth turn, the aircraft slipped over the extension of the centerline of the runway, so it had to correct its direction to return to the Runway 20 direction. While trying to return to the line of the centerline of the runway, the pilot deployed the spoilers and Aircraft 1 flew in that setting (at a speed of ca. 100~110 km/h) until the collision which occurred at the altitude of ca. 100 metres above ground level. After the collision, the aircraft fell to the ground almost vertically, and came to rest at the point with geographic coordinates N47.763889°, E018.733611°.

The IC has no information of what the flight instructor and his student pilot sitting in Aircraft 1 saw throughout the flight.

1.1.4. Aircraft 2: the flight leading to accident

The IC reconstructed the path of Aircraft 2 on the basis of the statements of the student pilot of Aircraft 2 and the witnesses who had viewed the flight from the start place, and on the basis of the flightlog (Figure 2).

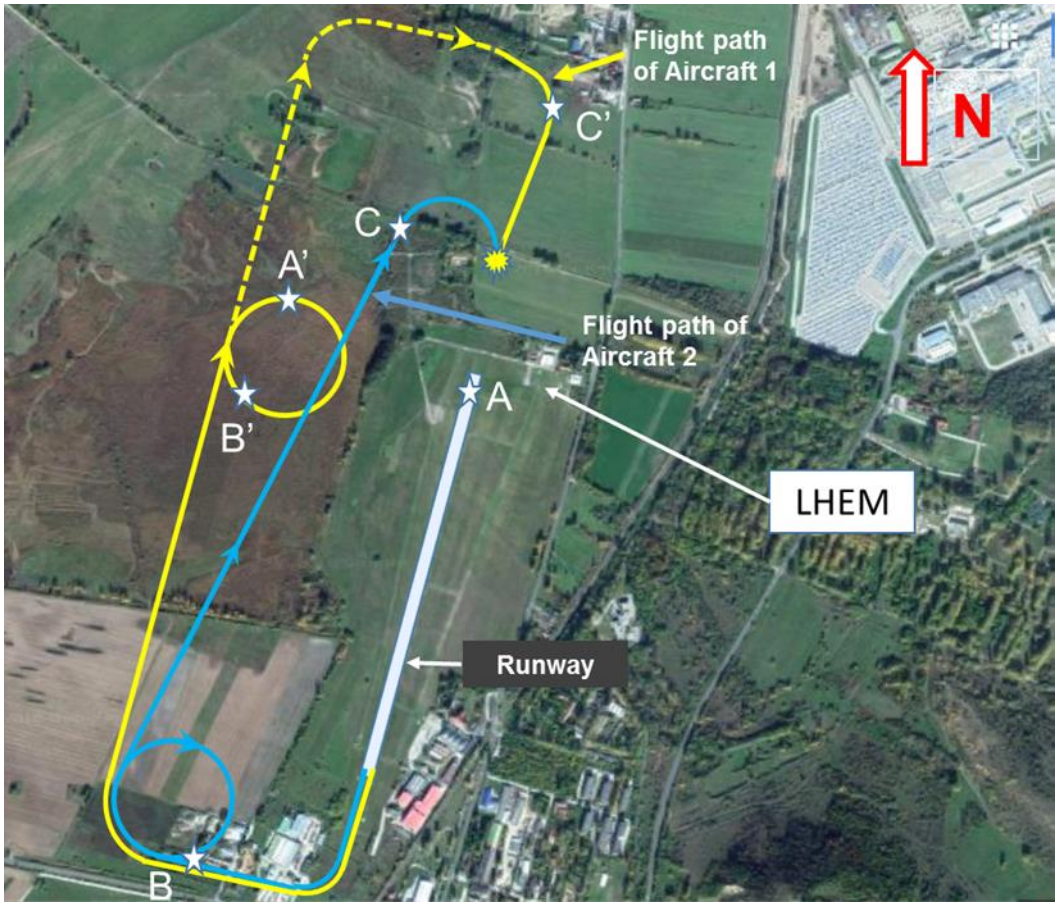

Figure 2: The flight paths of the two aircraft until the collision, on the basis of witness statements

The student pilot flying Aircraft 2 started his C Badge task by winch launch at 11:58 am. Prior to the start of his winch launch, he saw Aircraft 1 circling on the long wall, at the extended line of the start place (Figure 2, points A-A'). His glider was lifted to an altitude of ca. 400 metres with the help of the winch. After the first turn in the right-hand side traffic circuit, he looked back toward the start place in order to check for possible signals given to him. He received no signals, so he continued flying toward the second turning point where he made a couple of full circles hoping to find a thermal, but he perceived no lift. He last saw Aircraft 1 prior to starting circling, on the long wall, in the same place where he had seen it before his winch launch started (Figure 2, points B-B'). He experienced continuous descent of 2-3 m/s on the long wall. Then he decided to reduce the radius of the traffic circuit, so he flew (at a speed of 70 km/h) closer than usual to the centerline of the runway. At the line of the landing area, where his flight altitude was below 200 metres already, he viewed the runway in order to check for ground-based obstacles, as he had learnt during his training, and he saw no obstacle there. At the third turn point of his narrowed traffic circuit his flight altitude was ca. 150 metres, when he decided to enter the final approach (in order to land) a little bit faster (at a speed of 85-90 km/h) by taking a right turn (turn radius = 100~110 m,, bank angle = 27~28°). According to calculations by the IC, Aircraft 1 completed its fourth turn when Aircraft 2 started its third turn (Figure 2, points C-C'). The point of its entry to the final approach was the point of collision, at an altitude of ca. 100 metres above ground level. The aircraft was

damaged by the collision, but remained controllable. Aircraft 2 landed after the collision, and came to rest at the point with geographic coordinates N47.760380°, E18.731780°.

According to the pilot of Aircraft 2, he did not see the other aircraft between Point B and the point of collision although he had been looking for it while flying along the long wall (Figure 2).

1.1.5. The collision

At the point of the collision (Figure 3), the two aircraft were in a side-by-side position because Aircraft 1 had caught up with Aircraft 2 which was turning onto the final approach path. The right wing tip of Aircraft 1 penetrated the fuselage of Aircraft 2 behind the flight cabin, tearing the canvas cover and badly damaging the metal structure of the fuselage. The student pilot in Aircraft 2 perceived that something irregular had happened, but he did not become aware that his aircraft had collided with another aircraft.

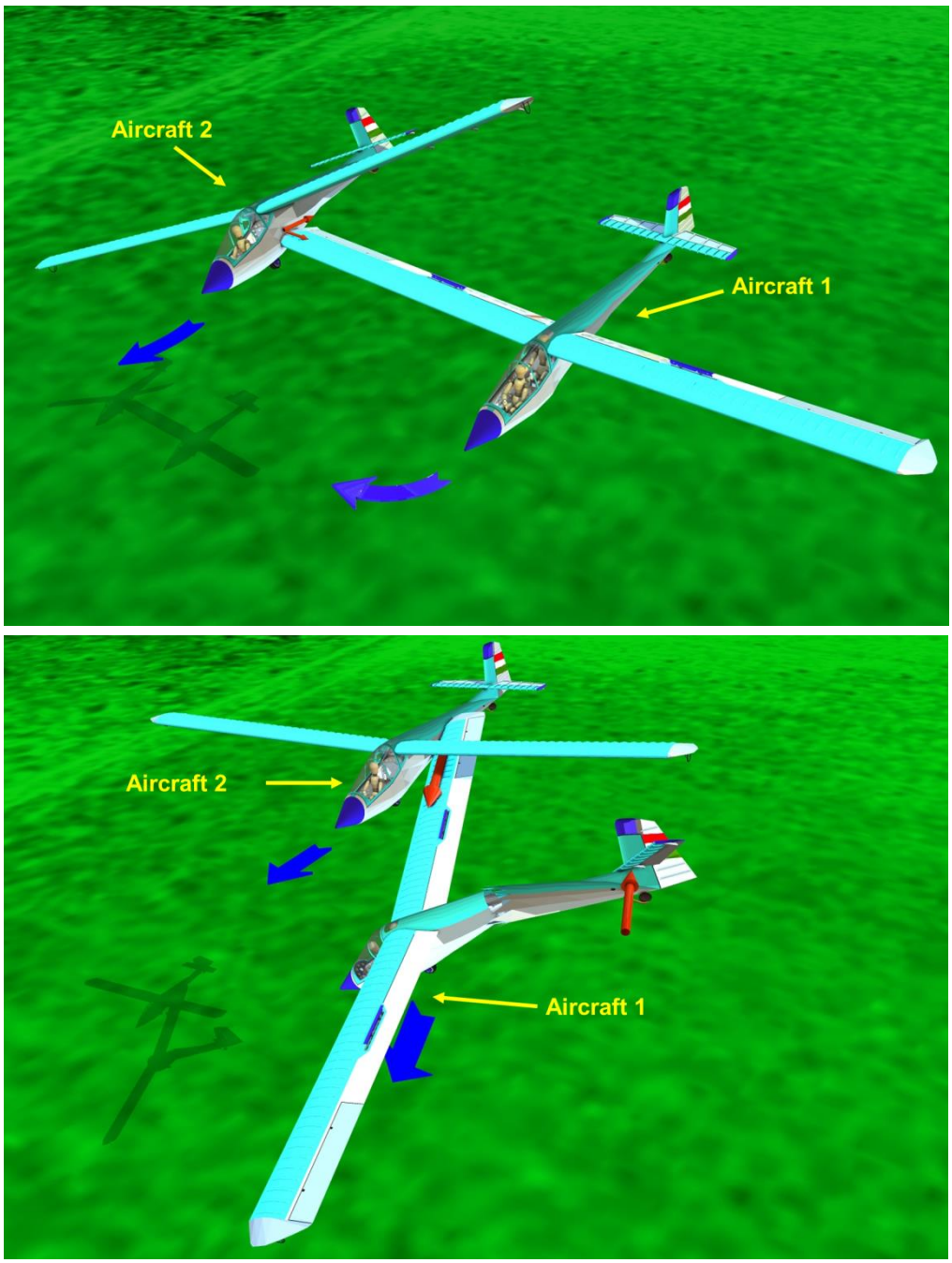

Figure 3: Start of the collision (above) end of the collision (below)

The impact made Aircraft 1 turn in front of and below the other sailplane, as a result of which its right wing tip went on slitting the fuselage structure of Aircraft 2 in the direction of the horizontal stabilizer. Now the pilot in Aircraft 2 saw the nose and the canopy of Aircraft 1 for a short time, but he could not find out about its spatial position and motion. The fuselage structure of Aircraft 1 cracked about 1 metre from the line of the wing trailing edge towards the horizontal stabilizers, as a result of which the aircraft became uncontrollable.

1.1.6. After the collision

The pilot of Aircraft 2 landed safely at Ernő Rubik sr. Aerodrome, Esztergom.

The uncontrollable Aircraft 1 began to fall almost vertically after the collision, and its tail turned 180° around its longitudinal axis in the meantime. The sailplane crashed to ground in upside down position and came to rest in that position as well.

Figure 4: Aircraft 1 (above) and Aircraft 2 (below)

1.2. Injuries to persons

Injuries	Crew		Passenger	Other
	Pilot	Flight attendant		
Fatal	2	-	-	-
Serious	-	-	-	-
Minor	-	-	-	
None	1	-	-	

1.3. Damage to aircraft

Aircraft 1 was destroyed in the accident.

Aircraft 2 was significantly damaged in the accident.

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. The Flight Instructor's data, Aircraft 1

Age, nationality, gender		81 years old, Hungarian, male
Licence data	type	FI(S)
	professional valid until	31 12 2017
	ratings	AT, WL
Certificates		Flight Instructor (sailplane)
Medical class and valid until		Class 2 and LAPL, 27/05/2016
Flying hours/take-offs	in the previous 24 hours	12 minutes / 3 take-offs
	in the previous 7 days	12 minutes / 3 take-offs
	in the previous 90 days	4 hours 40 minutes / 44 take-offs
	total:	1216 hours 50 minutes / 3282 take-offs
	on the affected type, total:	Not known

1.5.2. Student Pilots data, Aircraft 1

Age, nationality, gender		33 years old, Hungarian, male
Licence data	type	SGPL
	professional valid until	24 09 2016
	ratings	-
Certificates		Student Pilot (sailplane)
Medical class and valid until		Class 2 and LAPL, 05/10/2017
Flying hours/take-offs	in the previous 24 hours	-
	in the previous 7 days	-
	in the previous 90 days	1 hours 36 minutes / 24 take-offs
	total:	9 hours 12 minutes /139 take-offs
	on the affected type, total:	9 hours 12 minutes /139 take-offs
Aircraft types flown:		R-26 SU „Góbé"

1.5.3. Student Pilots data, Aircraft 2

Age, nationality, gender		45 years old, Hungarian, male
Licence data	type	SGPL
	professional valid until	12/07/2017
	ratings	-
Certificates		Student Pilot (sailplane)
Medical class and valid until		Class 2 and LAPL, 21/03/2016
Flying hours/take-offs	in the previous 24 hours	-
	in the previous 7 days	-
	in the previous 90 days	1 hours 14 minutes / 14 take-offs
	total:	10 hours 52 minutes / 146 take-offs
	on the affected type, total:	10 hours 52 minutes / 146 take-offs
Aircraft types flown:		R-26 SU „Góbé”

1.6. Aircraft information

1.6.1. General information

(a) Data of Aircraft 1 according to the Aircraft Registration Certificate

Class	fixed-wing, unpowered sailplane
Manufacturer	XII. Autójavító Vállalat, Szombathely
Model	R-26 SU „Góbé”
Year of manufacture	1984
Serial number	AA 800030
Nationality and registration marks	HA-5514
State of registry	Hungary
Date of registry	28 May 1984
Name of the owner	Aero Club Esztergom
Name of the operator	Aero Club Esztergom

	Flight hours	Number of take-offs
Total	2237 hours	18 322
Since overhaul	797 hours	8365
Since last inspection	11.3 hours	149

(b) Data of Aircraft 2 according to the Aircraft Registration Certificate

Class	fixed-wing, unpowered sailplane
Manufacturer	AFIT XII. Autójavító Vállalat
Model	R-26 SU „Góbé”
Year of manufacture	1983
Serial number	A-A 80002
Nationality and registration marks	HA-5501
State of registry	Hungary

Date of registry	04 February 1983
Name of the owner	Aero Club Esztergom
Name of the operator	Aero Club Esztergom

	Flight hours	Take-offs
Total	1872 hours	15 820
Since overhaul	382 hours	3658
Since last inspection	25 hours	270

1.6.2. Airworthiness

(a) Data of Aircraft 1

Airworthiness Certificate	Number	14/1984
	Date of issue	14 05 2015
	Valid until	14 05 2016
	Restrictions	Valid for flights in the airspace of Hungary

(b) Data of Aircraft 2

Airworthiness Certificate	Number	2/1983
	Date of issue	14 05 2015
	Valid until	14 05 2016
	Restrictions	Valid for flights in the airspace of Hungary

1.6.3. Aircraft loading data

Aircraft data did not influence the course of events, so it needs no detailed discussion.

1.6.4. 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.

1.6.5. On-board warning systems

No warning system is required for this aircraft type.

1.7. Meteorological information

At the time of the occurrence, the sun was seen at 157° and at an altitude of 63.5°, which is almost the daily highest position, and near the yearly highest midday position (Figure 5).

The weather of the Carpathian Basin was determined by a slowly moving cold front on the day of the occurrence. At the time of the occurrence, the weather was overwhelmingly clear, sunny and dry, with a small quantity of cloud forming (Figure 6) and weak winds of changing direction (S-SE). The temperature was 28°C, and air humidity was about 40-45% in the region at the time of the occurrence.

The weather conditions were not yet suitable for sailplanes to stay in the air for longer times in the given area in the given period of time.

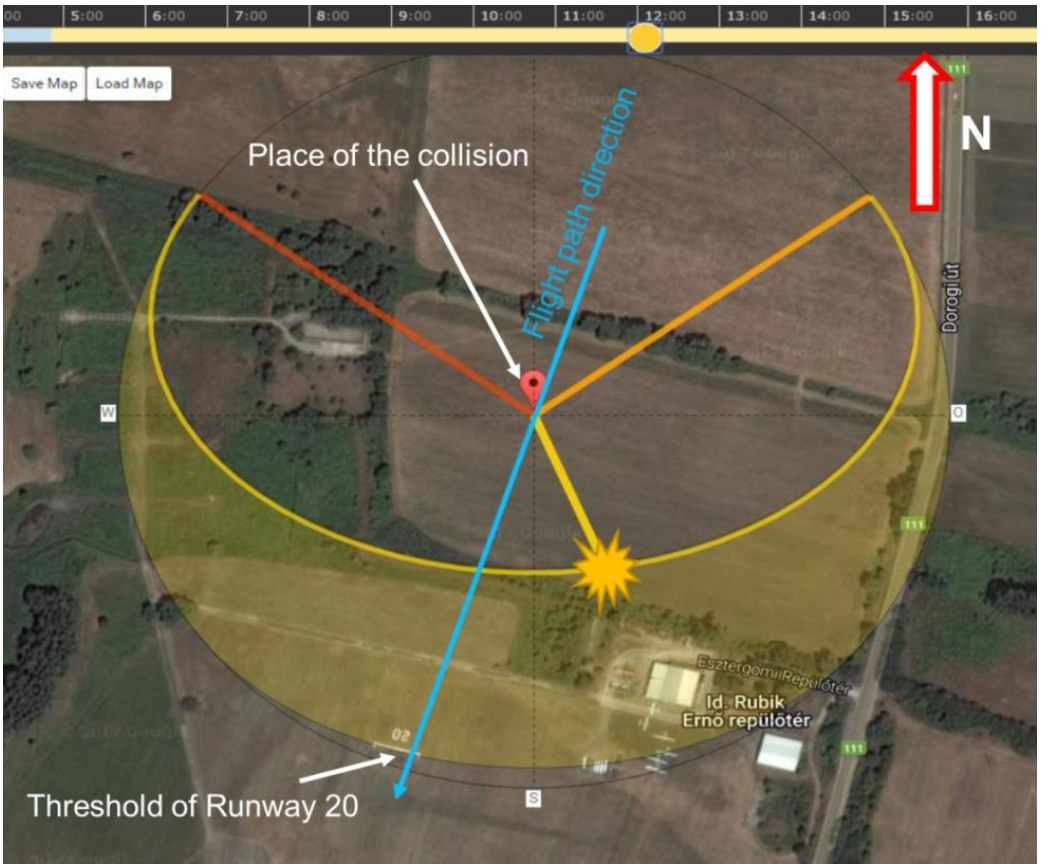

Figure 5: The position of the sun at the location of the collision on the day of the accident (source: suncalc.org)

Figure 6: The blue sky and Aircraft 2 (sailplane HA-5501) after landing

1.8. Aids to navigation

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

1.9. Communications

Neither one-way nor two-way communication devices were available on-board the two aircraft or at the start place involved in the occurrence. In this case, pursuant to GKM–HM–KvVM Joint Decree № 26/2007. (III. 1.), two-way radio communication was not required.

1.10. Aerodrome information

Ernő Rubik sr. Aerodrome, Esztergom (LHEM) is a non-public, grass-covered (Class 4) aerodrome situated at an altitude of 113 metres above sea level. Only daytime VFR flights are permitted at the aerodrome.

Coordinates of the reference point of the aerodrome: N47°45.72' E018°44.01'.

Runway direction: 02/20 (20°/200°), length: 1000 metres, width 30 metres.

The aerodrome had valid operation certificate at the time of the occurrence.

The parameters of the aerodromes did not influence the course of events therefore no detailed discussion is needed.

1.11. Flight recorders

No data recorder was installed in any of the aircraft; it is not required for the aircraft type affected.

1.12. Wreckage and impact information

1.12.1. Investigation of the scene of the impact of Aircraft 1 (HA-5514) and its wreck

Aircraft 1 crashed to ground 280 metres from the threshold of Runway 20, on the extended centerline of the runway. The spot of the impact is a flat meadow with solid soil, covered with knee-high grass. Inspection of the wreck and the impact marks in the ground showed that the aircraft had touched down almost vertically (in an angle of 70 to 80 degrees), in upside down position, with its nose touching the ground first. The tail part of the sailplane twisted 180° during the fall, and bent forward to the front section of the fuselage as an effect of the impact. The tail part then whipped back from the landing gear located at the bottom of the fuselage, and came to rest in that twisted position. At the end of the fall, the aircraft impacted the ground as one unit, i.e. no structural units had separated from it. During the investigation of the scene it was supposed that the right wing tip of Aircraft 1 might have collided with the fuselage of the other sailplane.

1.12.2. On-site inspection of Aircraft 2 (HA-5501)

Aircraft 2 remained controllable after the collision and landed safely. The starting point of the collision was found at the left-hand side of the fuselage, above the boat-shaped part, near the centre of gravity. It suggested that the right wing tip of the other aircraft had stabbed the fuselage at this point. Geometry of the damage caused by the impact suggests that the right wing of the other aircraft penetrated from the starting point rearward, in the direction of the stabilisers, tearing apart the body frames and other structural elements, together with the canvas cover.

1.12.3. Additional inspection

The purpose of the visit was to clarify (in the presence of the authorities involved in the investigation) the course of the accident as well as the moments and geometry of the collision.

After bringing the wrecks of both aircraft out of the hangar sealed by the police, the joint inspection team set up the wrecks relying on witness statements, finding the first point of

touch. Then, by determining the subsequent respective points of touch, the IC was able to reconstruct the movement of the two aircraft relative to each other.

As regards Aircraft 2, inspection of its full surface showed that only the damage located at the left hand side could be related to the collision. The damage to the fuselage began and was the deepest under the wing and became gradually slighter towards the rear part of the fuselage (Figure 7).

Figure 7: Damage to Aircraft 2

The nature of the damage hints to an object stabbed into the structure of the fuselage and leaving the fuselage by moving towards the rear end of the aircraft (Figure 8).

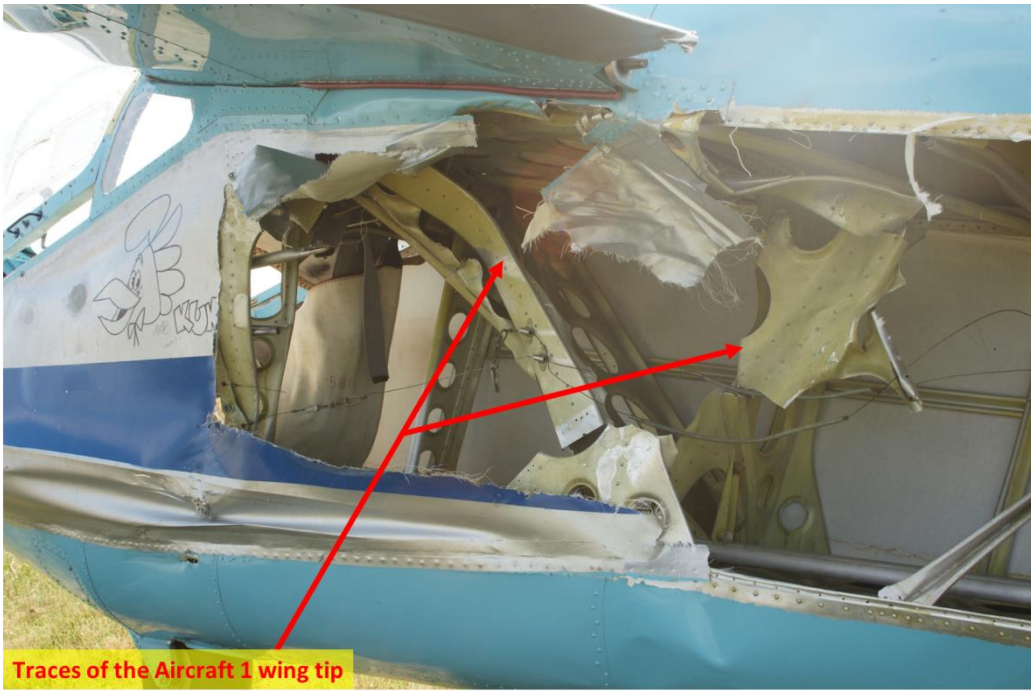

Figure 8: Damage to the fuselage of Aircraft 2

Inspection of the wreck of Aircraft 1 was made difficult by the significant damage caused to the airframe by its practically vertical fall from a height of ca. 100 metres. The wreck had damages it had suffered both during the collision and during the impact to the ground. The tail of the aircraft partly separated from the airframe and the structural elements around the surface of the fracture showed signs of multiple damage. The

damages identified by the IC along the leading edge of the right wing of Aircraft 1 (Figure 9) could not have been caused by the impact with the ground, and the IC found the matching ("mirror") marks of damage in the fuselage of Aircraft 2. One of the marks was a chipping type damage caused by a hard and sharp object (Figure 9).

Figure 9: Leading edge of the right wing of Aircraft 1

The IC found the bracket of a stringer, which had caused the chipping type damage, in the initial section of the damage near the centre of gravity of Aircraft 2 (Figure 10:). After dismounting it from the aircraft, and matching it with the damaged part of the right wing of Aircraft 1, the IC clearly identified it as the object that had caused the damage (Figure 11).

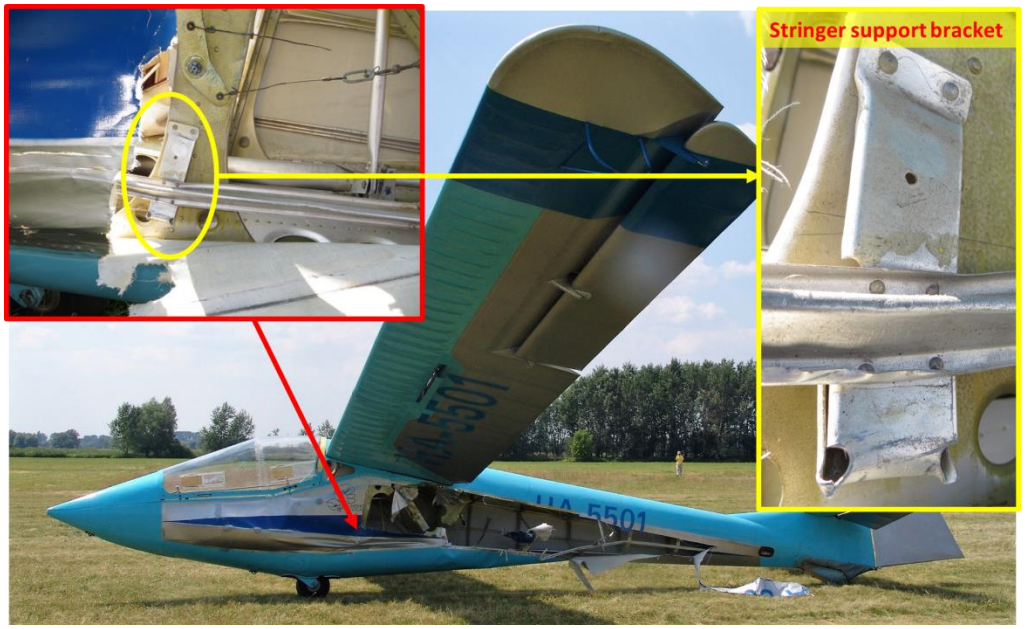

Figure 10: Bracket of the stringer, Aircraft 2

Figure 11: Identification of damage along the leading edge of Aircraft 1, using the bracket of a stringer dismounted from Aircraft 2

1.13. Medical and pathological information

It may be stated, on the basis of the forensic autopsy reports, that, at the time of the accident, neither the instructor's nor the student pilot's organism contained alcohol originating in alcohol consumption. It may be concluded from the findings that the death of the aforesaid persons was caused by the so-called polytraumatic shock due to gross injuries to several vital organs. There was direct causal link between the injuries suffered and death.

Of the deceased persons, the student pilot had no restriction in his medical certificate, while the pilot instructor's medical certificate included one restriction. Such restriction required that he should wear multifocal glasses *'during performing his tasks'*. Such glasses had to be inspected and approved by the AME for relating to correction for close, intermediate and distant visual acuity. In addition, the recorded restriction also required that spare glasses had to be available.

The IC could not find out whether the flight instructor had been wearing glasses at the time of the accident, but, according to information obtained during interviewing witnesses, he had not been using glasses during flights.

A pair of glasses was found among the items which had fallen out of the wreck upon impact to the ground at the location of the accident. The police seized the glasses. The IC has no information regarding whether the seized glasses correspond to those required by the medical certificate for the flight instructor.

1.14. Fire

There was no fire in connection with the occurrence.

1.15. Survival aspects

Both the student pilot occupying the front seat and the flight instructor sitting in the back seat of Aircraft 1 were wearing parachutes. Collision of the two aircraft took place at an

altitude of ca. 80 to 100 metres above ground level. The aircraft became uncontrollable at that height, and then it fell and crashed to the ground. There was no chance to use the parachutes safely, because the accident took place at such a low altitude that no sufficient time was left to leave the aircraft. The lives of the flight instructor and his student pilot could not have been saved by immediate medical aid either.

The extent of damage suffered by Aircraft 2 did not influence manoeuvrability and structural strength of the aircraft as far as landing was concerned. Thus, the student pilot occupying the front seat was able to land safely.

1.16. Tests and research

1.16.1. Additional inspection

In a joint effort with other authorities involved, the IC reconstructed a physically possible sequence of movements, by moving of main parts of aircraft and positioning them in their final positions, which fully explains the damage suffered by the aircraft. See more details of the additional inspection in Section 1.12.3.

1.16.2. Inspection of vision from the cockpit to the outside

The IC inspected the possibilities of vision from the two aircraft to the outside, as well as visibility of the aircraft, in the assumed positions of flight. This inspection required construction of the visual field of the occupant of the aircraft. The aircraft used by the IC for the associated measurements was the same model as those involved in the occurrence. During the assessment, the IC identified those surfaces which limited the visual field. The pilots' postures (head tilted forward/backward) and positions in the seats were also taken into account during assessment.

Measurements showed that, for the person sitting in the back seat (which is the less favourable position in terms of vision to the outside) the rear limit of the range of vision is maximum ± 59° (relative to the longitudinal axis of the aircraft) in backward head tilt position, while ca. ± 106° in forward head tilt. The range of vision of the person sitting in the front seat is significantly wider, both in forward/backward head tilt position, than that of the person sitting in the back seat.

1.16.3. In-flight assessment of visibility

When evaluating the findings of the inspections below, the IC relied on evaluation by the investigators of TSB.

On 21 September 2018, a 40 cm wide mirror foil stripe was stuck on the upper surface, on the leading edge and on part of the lower side of the left wing of a power glider, then another 40 cm wide, dark orange foil stripe 40 cm from the other stripe, and a 40 cm wide mirror foil stripe on the middle part of the vertical stabilizer.

The purpose of the visibility test performed in-flight was to collect objective data of the fully white and the other surfaces which presumably provided good visibility, and to study any difference of visibility between the mirror foil and the orange foil. The testing staff took photos of the target aircraft on a continuous basis.

The test flight included a power glider as the target aircraft and a powered aircraft which performed observation. In addition to the pilot, the latter also carried the person performing the test. The experiment took place at daytime, in good visibility conditions. Cumulus and cirrostratus clouds appeared sporadically in the sky after 12 am. There was no precipitation in the given area at the given period of time, and visibility exceeded 10 km. The wind was blowing from 170° on average, and the wind speed was 4–5 m/s. The temperature at ground level was 27ºC, and the dew point was 15ºC.

The findings of the visibility assessment were as follows:

1. The mirror foil was very rarely useful during the flights, but instead, it was utterly disadvantageous from the aspect of perception most of the time. In many cases, the mirror foil blended in with its surroundings in such manner that it reflected the features of its environment. This property of the mirror foil is demonstrated best in Figure 12 Figure 13.

2. The orange foil had no disadvantageous effect from the aspect of detectability; it even improved short range visibility (a few hundred meters) owing to its contrast against its background.

3. The limit of perception of the aircraft with the sun behind the viewer was ca. 3100 metres (with the terrain in the background of the target aircraft) or ca. 3500 metres (with the sky in the background), while these values dropped to 1000 metres and 1500 metres, respectively, when the sun was in front of the viewer.

4. Detectability of the foils and their colours on the aircraft with the sun behind the viewer was less than 1200 metres (with the terrain in the background) or ca. 1500 metres (with the sky in the background), while these values dropped to 500 metres and less than 1000 metres, respectively, when the sun was in front of the viewer.

5. The flight cabin, looking a larger dark surface, and the small black wheel tyre contrasted best with the background (sky) during the flights.

6. When the two aircraft flew towards each other, the thin profiles of the wings and fuselage were difficult to detect, even with the foils on the left wing. In that case, the relatively dark flight cabin was detected first in the given circumstances.

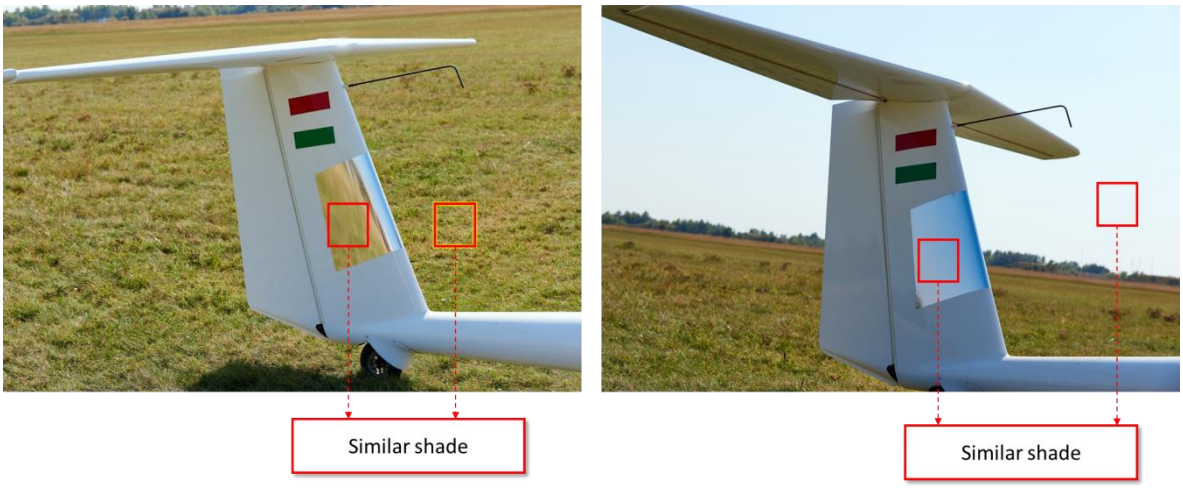

Figure 12: Highlighted properties of the mirror foil

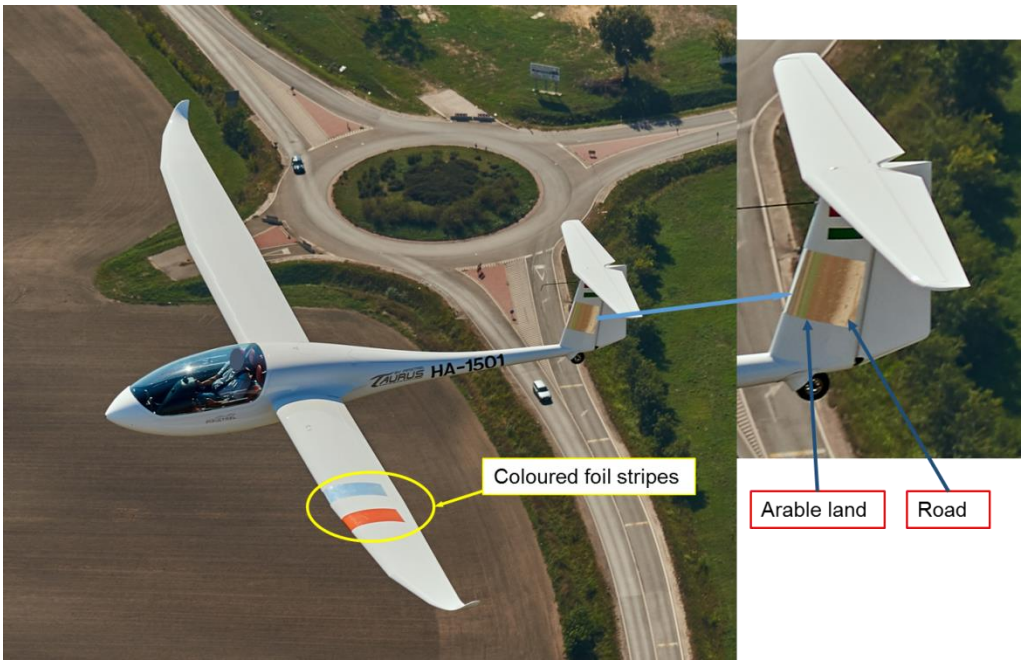

Figure 13: Foils used for visibility assessment

On 10 October 2018, the IC performed additional assessment related to visibility, during which additional 40 cm wide foil stripes were placed on the left wing of the afore mentioned aircraft in the same manner as during the test performed in September 2018. A black foil stripe was placed ca. 40 cm from the mirror foil and a yellow stripe next to the orange stripe and a red stripe next to the yellow one. The mirror foil on the vertical stabilizer was changed to orange colour foil (Figure 14).

The experiment was performed according to the same method, in good daytime visibility conditions, and similar weather conditions.

The resulting conclusions of the visibility assessment were as follows:

1. Neither of the methods tried during the experiment improved distant detection (> 3000 metres).
2. As regards shorter distances (< 1500 metres), the order of the colours in terms of better contrast against various colours of terrain was red, black and orange.
3. As regards detection and the fixation of attention: when viewing the target aircraft from below against the background of clear blue sky or some cirrostratus, the black foil provided the best effect, followed by the red and the orange colours. The shadowed mirror foil came next. The yellow foil was hard to tell from the white colour of the aircraft.
4. When assessing contrast with the target aircraft oriented vis-a-vis, the black colour was dominant, followed by orange and red, against a greyish blue background of the sky.
5. When a water surface was in the background, the order of contrast power was red, orange and black.
6. None of the persons involved in the assessment chose the mirror foil or the yellow foil as a colour facilitating detection of the target and the related fixation of attention.

Figure 14: Visibility test performed on 10 October 2018

1.17. Organizational and management information

At the time of the accident, the aviation club involved in the occurrence had a valid licence for registered flight training pursuant to KHEM Decree 32/2009. (VI.30.). Flight instructors of the training organisation are to perform practical training on the basis of the training manual.

The IC obtained the Registered Training Organisation Training Manual both from the training organisation and from NTA AA, and found that the two versions of the Manual showed great differences. The date of approval was 01 April 2004 on the version sent by the training organisation, but 06 August 2010 on the version sent by NTA AA (with 01 June 2010 as the date of preparation). For the purpose of the investigation, the IC relied on the more recent version (date of approval: 06 August 2010) sent by NTA AA.

The IC found several formal and administrative inaccuracies and incomplete chapters and sections in the approved Manual which the IC relied on for the investigation.

According to the Manual, the chapter Training of Sailplane Pilots starts with page 142 and ends with page 229. However, the headers of the given pages do not reflect this. The chapter heading shows C. TRAINING OF SAILPLANE PILOTS from page 142 to page 154, while it shows B. TRAINING OF PILOTS FOR POWERED AIRCRAFT from page 155 to page 229.

The remarks "*See in the annexes"* and *"Elaboration is underway"* appears in several sections of the inspected chapter Sailplane Pilot in the approved manual. These chapters are as follows:

- 1.9.5 Examination records and registers *"See in the annexes*". The document sent included no such annex.
- 1.9.7 Procedures for analysis and review of questions and procedures for the elaboration of alternative test papers *"Elaboration is underway"*
- 1.11.3 Requirements and procedures of standardisation. *"Elaboration is underway"*
- 1.11.4 Application of examination requirements. *"Elaboration is underway"*

The Manual of the organisation approved for registered training includes (in addition to the head of training specified in KHEM Decree 32/2009. (VI. 30)) such functions which relate to Flight training organisations (FTO) and not to registered training organisations (RF). Some examples of such functions: Senior Flight Instructor, Senior Ground-based Instructor (theory).

Annex 2 to KHEM Decree 32/2009. (VI. 30) specifies the knowledge which must be acquired by student pilots during the practical training.

"GR PRACTICAL TRAINING

2.1. Mandatory elements of the syllabus of the practical training for sailplane pilots:

a. knowledge of the procedures of pre-flight preparation, assembly and inspection of the aircraft,

b. techniques of take-off including winch launch and aero tow, or winch launch only, as well as appropriate speed limits, emergency procedures and the signals used,

c. air traffic procedures at the aerodrome, procedures for collision avoidance,

d. flying the sailplane on the basis of visual orientation,

e. knowledge of flying at critical flight speeds,

f. recognition of stalling and spiral dive, and knowledge of the technique of recovery from it,

g. take-off, approach and landing in the presence of normal and side winds,

h. emergency procedures,

i. methods of landing outside the aerodrome."

The IC found the above elements only as a list in the 1.4.1 Practical Training Syllabus chapter of the approved Training Manual. Practical implementation of the elements is indicated very marginally only. Certain elements are not even mentioned in the Training Manual (e.g. procedures for collision avoidance).

1.18. Additional information

1.18.1. Age-related regulation affecting commercial pilots over 60

Age-related restrictions for those pilots with licence for commercial air transport who are aged 60 years or more are stipulated in Annex I to Regulation (EU) № 1178/2011[1]:

Restrictions are as follows (text effective as of 08 April 2015):

"FCL.065 Curtailment of privileges of licence holders aged 60 years or more in commercial air transport

[1] COMMISSION REGULATION (EU) № 1178/2011 of 3 November 2011 laying down technical requirements and administrative procedures related to civil aviation aircrew pursuant to Regulation (EC) No 216/2008 of the European Parliament and of the Council.

a) Age 60-64. Aeroplanes and helicopters. The holder of a pilot licence who has attained the age of 60 years shall not act as a pilot of an aircraft engaged in commercial air transport except as a member of a multi-pilot crew.

b) Age 65. Except in the case of a holder of a balloon or sailplane pilot licence, the holder of a pilot licence who has attained the age of 65 years shall not act as a pilot of an aircraft engaged in commercial air transport.

c) Age 70. The holder of a balloon or sailplane pilot licence who has attained the age of 70 years shall not act as a pilot of a balloon or a sailplane engaged in commercial air transport."

No age-related restrictions similar to those above are stipulated for non-commercial aviation (e.g. practical flight training). The IC contacted EASA to inquire whether the organisation intended to introduce age-related curtailment of pilots' privileges in non-commercial aviation. A competent representative of EASA answered clearly that they did not.

1.18.2. Legislative changes

Upon expiry of the effect of KHEM Decree № 32/2009. (VI. 30), the Regulation (EU) № 1178/2011 was amended by Commission Regulation (EU) 2018/1119 with an effective date of 02 September 2018, so it was completed with Annex VIII. Such Annex VIII includes requirements relating to the training of pilots involved in non-commercial aviation (Subpart DTO). According to that, the requirements relating to approved training organisations (ATOs) were completed with requirements relating to declared training organisations (DTOs). The operation certificate (which was valid at the time of the occurrence) of the training organisation involved in the occurrence became invalid due to such legislative changes.

1.19. Useful or effective investigation techniques

1.19.1. Assessment of visibility at Cranfield University

Cranfield University had an assessment performed, with power gliders, at the beginning of the new millennium. One aircraft was marked with mirror foil glued on the leading edges and the control surfaces for the purpose of the first three visibility tests.

Then DayGlo patches were placed on the wings of the aircraft for the fourth and fifth test run, while the lower side of the wings of the target aircraft was equipped with black foil for the sixth run.

Major findings of the assessment:

1. The mirror foil does not help early detection in the overcast or nearly overcast sky.
2. The aircraft with mirror foil stripes on the leading edge and control surfaces was detected significantly earlier in the various flight situations (e.g. imitated thermalling) than the plain white aircraft.
3. The DayGlo patches did not improve detectability of the aircraft as compared to that of the plain white aircraft.
4. When trying to detect (from below) the target aircraft which was simulating thermalling,, the aircraft with black wing bottom was detected significantly earlier than the plain white aircraft.

2. Analysis

2.1. The training

On the day of the occurrence, the student pilots were given a task according to their training syllabus. The position of the IC is that the task had no effect on subsequent events.

The approved training manual lacks several elements (including knowledge relating to collision avoidance) of the requirements of practical training (mentioned in Chapter 1.17 above) where performing of practical tasks is included. It did not turn out from the training manual for the IC, for instance, which practical training item the above-mentioned knowledge should be presented or checked with. On the basis of the training manual made available to the IC, student pilots flying solo do not acquire the practical knowledge enabling them to avoid a collision prior to their first solo flight. In addition, the instructors of the training organisation have no information on when, i.e. during which flight task, they should teach their student pilots the practical training elements missing from the training manual.

According to the opinion of the IC, comprehensive scanning of the airspace can be introduced in that phase of flight training where the student pilot has already reached such a level in terms of flight techniques which allows him/her to free up resources for other tasks as well, because controlling the aircraft does not occupy all of his/her capacity. It is during their solo flights that students who fly solo acquire the skill of paying less and less attention to solving problems of flight technique and sparing more and more resource for visual checks of traffic, for detecting various meteorological changes, and for navigation and communication.

2.2. Movement of the two aircraft before and during the collision

The position of the IC is that, if viewed separately, the route choice of each sailplane pilot during the flights ending up in the accident complied with the professional practice. The opinion of the IC is that at the time of the collision, Aircraft 2, which was approaching with a right turn, was a little bit (ca. 1 metre) closer to the aerodrome when finishing the turn. It was at that moment that it was caught up by Aircraft 1 which was coming along the straight landing approach path. The difference between the speeds of the two aircraft was small (10 to 20 km/h). Aircraft 2 had not completely finished its turn yet, so it was flying with a right bank, which made it possible for the right wing of Aircraft 1 to hit the rear part of the cabin of Aircraft 2. As Aircraft 2 was hit at a point very close to its centre of gravity, it was not turned away (around any of its axes) from its original direction, while the other aircraft, which was moving faster, had its right wing tip stuck. As a consequence, the braking force acting ca. 7 metres from the centre of gravity turned Aircraft 1 right, around its vertical axis, and then the leading edge of the right wing of the aircraft now turned sideways got caught in a structural element of Aircraft 2 which was invariably flying ahead. Thus the fuselage of the aircraft turning perpendicular to its direction of travel suffered such an extent of crosswise acceleration and such a strong force awoke on its rudder which the structure could not tolerate that the fuselage fractured.

2.3. Geometrical visibility – visibility from the aircraft

For this part of the analysis, the IC relied on data measured for the person sitting in the seat offering the less advantageous position for looking to the outside (see Section 1.16.2), where the pilot occupying the instructor's seat and tilting his head back had a maximum angle of vision of 59° (relative to the longitudinal axis of the aircraft) either to

the right or to the left. When bending forward, he might have had an angle of vision up to ± 106°.

The common point of their flight paths is the point of collision. The IC was able to calculate and construct sections of the flight paths starting out from that common point and on the basis of witness statements. The IC performed its calculations using the following data: speed of Aircraft 1: 105 km/h; speed of Aircraft 2: 87.5 km/h; radius of turn: 100 metres. Aircraft 2 was moving in a turn, almost along an arc of a circle, while Aircraft 1 was moving straight ahead. The respective flight path sections covered before the collision can be seen in Figure 15 and Figure 16 where the IC indicated concurrent positions of the two aircraft by a number and a number + comma (e.g.: when Aircraft 2 was in Pos. 1, Aircraft 1 was in Pos. 1'.) The trajectory intersections show the planar positions of the two aircraft relative to each other. The diagram shows that the target angle of Aircraft 2 was always sharper than the limit of the angle of vision (to the outside) associated to the backward head tilt position of the occupant of the back seat of Aircraft 1.

The diagrams constructed during the investigation show that prior to the collision, having his head either in forward or backward tilt, the Flight Instructor sitting in the back seat of the aircraft moving along a straight line had the chance to see the other aircraft coming from the right, in each flight position.

The diagram shows that while performing the combined third and fourth turn, the target angle of Aircraft 1 was always sharper than the limit of the angle of vision (to the outside) associated to the head tilt position of the Student Pilot occupying the front seat of Aircraft 2.

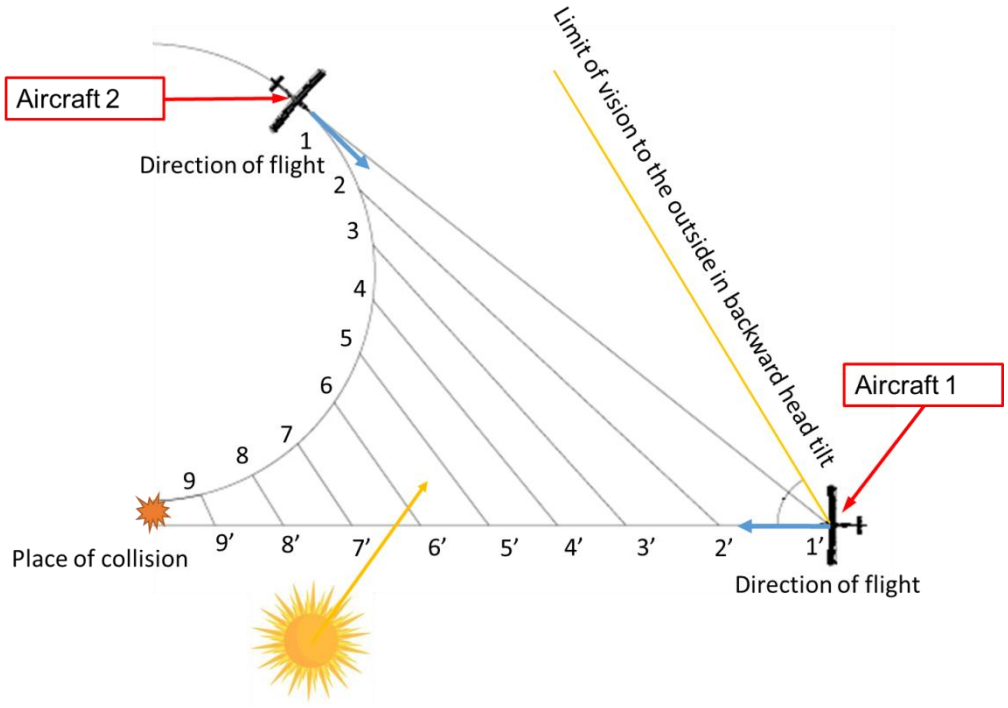

Figure 15: Visibility from the aircraft (distant)

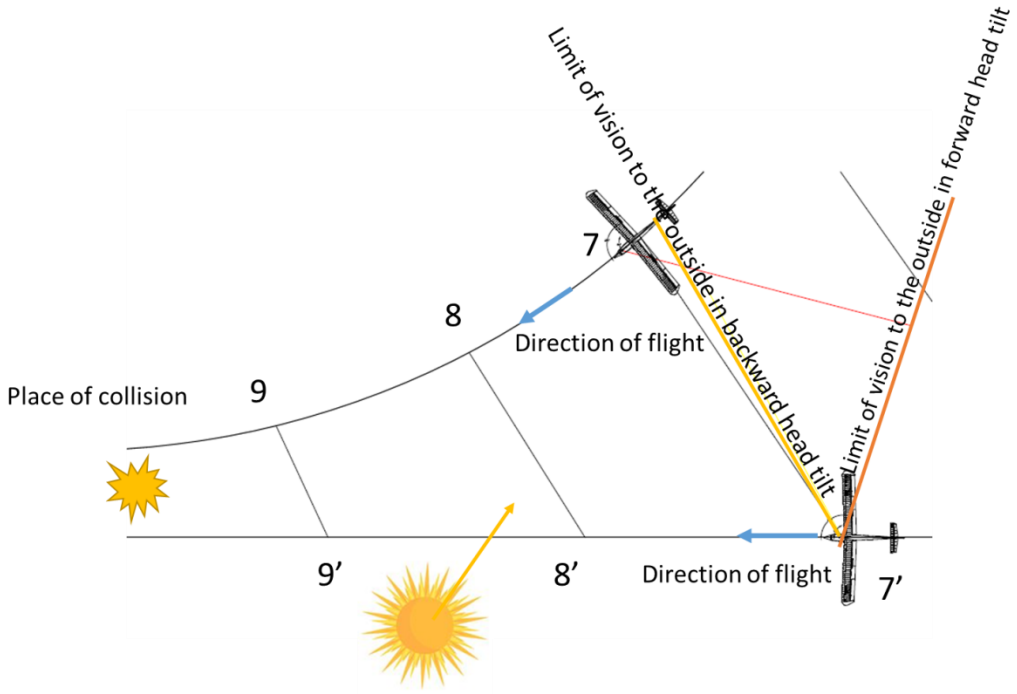

Figure 16: Visibility from the aircraft (near)

2.4. Meteorological situation from the aspects of visibility and staying in the air

According to data in the time log book and witness statements, the weather conditions were not yet suitable for longer staying of gliders in the air in the given area in the given period of time. On the given day there were several take-offs before the ones involved in the accident, but neither the Flight Instructor nor others were able to spend more than 4 minutes in the air during their flights.

There were a few cumulus clouds in the sky at the time of the accident, and the aircraft were painted the same colour combination as the colours of the sky blended into their surroundings in the given light conditions (Figure 6). The possibility of their visual detection became questionable in that situation.

Five seconds before the collision, the sun was in an unfavourable position for both aircraft as far as vision to the outside is concerned. While Aircraft 2 was moving along the middle section of its fourth turn, the line segment between the pilot's eyes and the sun formed a fairly sharp angle with the extended longitudinal axis of the aircraft.

2.5. Directions of attention of the pilots along the flight paths

The Student Pilot sitting in Aircraft 2 last saw Aircraft 1 prior to his own second turn, but he looked for it in vain before the third turn. Prior to the third turn, the Student Pilot looked to the right, at the runway, to see if there was any obstacle there. In the opinion of the IC, the Student Pilot, according to his level of practice, kept looking right while making the combined third and fourth turn in order to find a flight path along which he could land near the designated point of landing. The right bank of his aircraft helped this, but it also limited his vision to the left, in the direction of Aircraft 1. The Student Pilot, relying on his current level of practice, looked to the right, as learnt, in the direction of the landing mark while performing the combined third and fourth turn.

In the opinion of the IC, Aircraft 1 had already been on its final approach when Aircraft 2 started its fourth turn. When flying along the final approach, the pilot focuses his/her

attention on maintaining the glide path; however, the pilot will probably detect anything entering his/her peripheral visual field. On the basis of the calculations and experiments made, the opinion of the IC is that Aircraft 2 was within the respective visual fields of both the Student Pilot and the Flight Instructor occupying Aircraft 1 (which was on its final approach,) and detection of the other aircraft could only have been hindered by its grey-blue colour and the position of the sun.

2.6. The glasses

In the opinion of the IC, the fact that the function of the pair of glasses found during the inspection of the scene was not determined excludes the possibility of the IC's taking position relating to whether the Flight Instructor had been wearing glasses or not.

2.7. The Flight Instructor's age

The Flight Instructor involved in the accident was 81 years old at the time of the occurrence. The regulation cited in Section 1.18.2 applies to commercial aviation only. Pilot training is more complex activity than commercial aviation (eg. carrying a passenger in a sailplane). A pilot carrying passengers on board mainly focuses on flying the plane safely, while during pilot training, a flight instructor must be able to immediately correct the student pilot's decision making errors and erroneous management of controls at any time throughout a flight, and must share information with the student pilot, as part of the training. Humans' physical and mental capabilities inevitably impair above certain age. That is the reason why the legislature set an upper age limit for aircrews involved in commercial aviation. According to the position of the IC, it raises question why an activity (practical pilot training) which is accompanied by the same responsibility and requires at least similar capabilities to those required for commercial aviation is not regulated in a similar manner as commercial aviation activity.

2.8. Characterisation of the organisations

When inspecting the approved Manual (see in Section 1.17), the IC saw that certain parts of the Manual had not been completed (by the time of closing the investigation), and the Manual contains certain functions which apply to flight training organisations (FTO) and not to registered training organisations (RF).

It is not clear for the IC how the registered training organisation got into a situation where they had the opportunity to perform their activity using an incomplete Manual eight years after the approval.

2.9. In-flight visibility tests

As a result of the tests, the IC found that the generally mandatory white colour as well as the small surface of the cross section of the wings and fuselage (when seen from the front) of a sailplane make it difficult to detect the aircraft from larger distances, even with the foil stripes of various colours used in the experiments. Detection is made easier by the movement of the aircraft relative to its surroundings. The viewer was able to keep an eye on the detected aircraft easier if the aircraft was marked with the red, black or orange stripes.

The most striking difference between the results of the tests performed by the IC and those of the tests performed by Cranfield University (see in Section 1.19.1) appears in the findings related to the use of mirror foil. Using mirror foil was rather a disadvantage in the tests performed by the IC, while it was favourable according to the results presented by Cranfield University. The IC could not resolve this contradiction.

In the opinion of the IC, the blue and silver painting of both aircraft involved in the occurrence worked as effective camouflage in the given meteorological conditions.

3. Conclusions

3.1. Findings

Members of the flight crews had the appropriate licences and ratings, and sufficient experience for the given flight task.

Both aircraft were airworthy and had valid airworthiness certificates. According to their documents, both aircraft were equipped and maintained in compliance with effective requirements and accepted procedures.

The respective masses and mass distributions of both aircraft were within the specified limits.

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

The IC found several formal and administrative inaccuracies and incomplete parts and chapters in the training manual approved by NDA AA.

Both aircraft were painted the same (blue and silver) colour combination, and the sky was blue-greyish blue at the time of the accident, which made it more difficult to detect the aircraft against that background.

The flight ending up in accident took place at daytime, in good visibility conditions.

The meteorological conditions prevailing at the time of the accident did not allow the sailplanes to stay in the air long.

Neither the Flight Instructor nor his Student Pilot was under influence of alcohol.

The Flight Instructor's medical certificate required wearing multifocal glasses and keeping spare glasses available. The IC could not establish whether the Flight Instructor had been wearing glasses during the flight ending up in accident.

The Flight Instructor was 81 years old at the time of the accident. Legislation sets an age limit for sailplane aircrew involved in commercial aviation: the upper limit is 70 years of age. There is no legal limit relating to the maximum age of flight instructors involved in training pilots for non-commercial aviation.

After Aircraft 1 completed its fourth turn, Aircraft 2 was continuously within the visual fields of both the Flight Instructor and his Student Pilot.

The Student Pilot flying Aircraft 2 geometrically had Aircraft 1 in his visual field during the combined third and fourth turn for a few seconds preceding the collision, but the Student Pilot was necessarily looking to the opposite direction, toward the runway, in that situation.

The two aircraft collided at an altitude of ca. 100 metres, in the extension of the centreline of the runway, ca. 280 metres from the landing threshold.

The IC has no information as to when the crew of Aircraft 1 saw Aircraft 2 during their flight.

The Student Pilot flying Aircraft 2 scanned the sky for Aircraft 1, but could not catch sight of it during the period of time that elapsed after his attempting to find a thermal at the location of the second turn and before the collision.

Right before the collision, Aircraft 1 was flying at higher speed, along a steeper path, with deployed spoilers, nearly on the extended axis of the runway centerline.

The multiple damages suffered by the airframe of Aircraft 1 in the collision rendered it unsuitable to continue the flight.

Right after the collision, the Student Pilot flying Aircraft 2 saw that the nose part of Aircraft 1 was in an abnormal position unusual to him, but he could not find and explanation of what he had just seen.

The collision took place at such a low altitude that occupants of Aircraft 1 had no chance to leave the aircraft and use their parachutes.

The crash of Aircraft 1 into the ground was not survivable.

The damage suffered by the airframe of Aircraft 2 in the collision did not prevent it from continuing its flight.

3.2. Causes

The IC concluded during the investigation that the causes of the occurrence were as follows:

- The crew of Aircraft 1 either did not see Aircraft 2 or if they saw it, they failed to perform an avoidance manoeuvre in time.
- The pilot of Aircraft 2 had not seen Aircraft 1 for a long time until the collision.

In addition to the above, the IC presumes the following probable causes:

- The colour combination of the two aircraft was a contributing factor in the given meteorological and light conditions. The painting of both sailplanes included a colour combination dominated by several shades of blue and the silver colour, so both sailplanes could have blended into the blue sky as background.
- The behavioural and physiological factors originating in the age of the Flight Instructor might also have been contributing factors.

4. Safety recommendations

4.1. Actions taken by the training organisation during the investigation

During their refreshing spring training in 2016, the training organisation affected by the occurrence held a special presentation dedicated to collision avoidance.

4.2. Safety recommendation issued during the investigation

Transportation Safety Bureau issued the following safety recommendation during the investigation, on 28 July 2015:

BA2015-157-4P-1A *During its investigation, the Investigating Committee of Transportation Safety Bureau established that the colours of the aircraft might have played a role in the mid-air collision of the two aircraft. The painting of both sailplanes included a colour combination dominated by several shades of blue and the silver colour. The light conditions at the time of the occurrence might have allowed the sailplanes to blend into their surroundings, thus reducing the possibility of their visual detection. Therefore,*

> **Transportation Safety Bureau recommends the owners or operators of those sailplanes the colour of which tend to blend into the background to affix markings providing good visibility on such aircraft without influencing airworthiness. It is advisable to place high visibility marking on parts of wing surfaces, on the vertical stabiliser and/or on the nose part of the fuselage, applying markings in orange or orange and red or other contrasting colour, in sizes which facilitate detection from greater distances.**

The position of the IC is that in the case of acceptance and expected implementation of the recommendation, visual detection of aircraft with high visibility markings will become more effective, thus reducing the probability of mid-air collision or near-midair collision situations.

4.3. Safety recommendation issued on completion of the investigation

Transportation Safety Bureau issues the following post-investigation safety recommendation:

BA2015-157-4P-1: *During its investigation, the Investigating Committee of Transportation Safety Bureau established that the maximum age of aircrews involved in commercial air transport is limited (70 years of age in the case of balloon pilots and sailplane pilots), while the maximum age of flight instructors participating in the practical training of non-commercial pilots is not regulated. Practical flight instruction is a more complex activity than the aforesaid commercial aviation offering pleasure flights for passengers. Therefore,*

Transportation Safety Bureau recommends European Aviation Safety Agency (EASA) to consider initiate regulation of the maximum age of flight instructors participating in the practical training of pilots involved in non-commercial aviation, similarly to the area of commercial air transport.

The position of the IC is that in the case of acceptance and expected implementation of the recommendation, the risk arising from age-specific features of flight instructors involved in practical training can be eliminated, similar to the area commercial aviation offering pleasure flights for passengers.

Budapest, 09 Sept. 2019

Gábor Erdősi
Investigator-in-charge

Miklós Ferenci
Member of IC

APPENDIX

Appendix 1: The traffic circuit of the aerodrome of Esztergom