AIR ACCIDENTS
INVESTIGATION INSTITUTE
Beranových 130
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CZ-18-0869

FINAL REPORT

Investigation of causes of an air accident of the Robinson R 44 RAVEN I helicopter identification mark OK-PLP, in the Pilsen industrial zone on 5 September 2018

Prague
August 2019

present Final Report states explicitly that the said Final Report cannot be used as grounds for holding anybody liable or responsible as regards the causes of the air accident or incident or for filing insurance claims.

Contents

Abbreviations Used

AC	Altocumulus
ACC	Air Control Centre
AGL	Above ground level
AMSL	Above mean sea level
ATS	Air traffic control service
BASE	Cloud base
Ci	Cirrus
Cu	Cumulus
CHMI	Czech Hydrometeorological Institute
E	East
FAA	Federal Aviation Administration
FEW	Few (amount of clouds)
FIR	Flight information region
FL	Flight level
GPS	Global positioning system
FRS	Fire rescue service
ICAO	International Civil Aviation Organisation
IRS	Integrated rescue system
LAND	Ground-level
LKMB	Public domestic airport Mladá Boleslav
LKPL	Public domestic airport Pilsen-Letkov
ARS	Air Rescue Service
MAG	Magnetic
N	North
NIL	None
PIC	Pilot in command
PC	Proficiency check
PPL (A)	Private Airplane Pilot Licence
PPL (H)	Private Helicopter Pilot Licence
QNH	Atmospheric pressure in the area (reduced to mean sea level according to standard atmospheric conditions used for altimeter subscale setting to obtain elevation reading when on the ground)
CEST	Central European Summer Time
SE	Single Engine
SC	Stratocumulus
SCT	Scattered
ARV	Air recreational vehicle
SYNOP	Report on surface synoptic observations made by weather stations

UTC	Coordinated Universal Time
CAA	Civil Aviation Authority
AAII	Air Accidents Investigation Institute
VFR	Visual Flight Rules
VRB	Variable
VTÚ	Military Technical Institute
VTÚL a PVO	Air Force and Air Defence Military Technical Institute
MIFM	Military Institute of Forensic Medicine

Used Units

°C	Degree centigrade
ft	Foot (unit of length – 0.3048 m)
g	Gravity load factor
g	Gram
h	Hour
hPa	Hectopascal
kg	Kilogram
km	Kilometre
kt	Knot (unit of speed – 1.852 $km.h^{-1}$)
m	Metre

A) Introduction

Operator:	legal entity
Aircraft manufacturer:	Robinson Helicopter Company, USA
Type of aircraft:	Robinson R 44 RAVEN I
Identification mark:	OK-PLP (at the time of accident still the original I−CCNI)
Location of incident:	Western part of the Pilsen industrial zone, Domažlická 194
Event date and time:	5 September 2018, 15:20 UTC

B) Synopsis

The pilot conducted a series of three short flights with passengers on board in the immediate vicinity of the registered office of his company. He finished the second flight by landing on the roof of his company's building and then, after three business partners (foreign nationals) boarded, took off. Having taken off, he continued flying low above the ground, and having flown some 2.5 km in the western direction, he made a sharp right turn with an extreme roll and pitch of the helicopter. When recovering this manoeuvre, the helicopter crashed into the roof of the factory building. Due to the crash onto the roof and subsequent break through the roof construction, the helicopter was totally destroyed. The pilot and the passengers succumbed to their injuries on the spot. A third person's property was damaged, and nobody was injured on the ground.

The Police of the Czech Republic, the FRS, and the AAII inspectors arrived at the location of the air accident and the inspectors performed professional investigation of the location and of the helicopter wreckage. On the next day, the wreckage was transported to a specialised centre for qualified expert investigation.

The cause of the incident was investigated by the AAII Commission. The investigation team comprised of:

Investigator-in-charge:	Ing. Josef BEJDÁK
Commission members:	Karel BURGER
	Doc. MUDr. Miloš SOKOL, Ph.D., VÚSL Prague

The Final Report was issued by:
AIR ACCIDENTS INVESTIGATION INSTITUTE
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On 26 August 2019

C) This Final Report consists of the following sections:

1. **Factual Information**
2. **Analyses**
3. **Conclusions**
4. **Safety Recommendations**

1. Factual Information

1.1. History of the Flight

The persons who participated in the corporate event described in detail pilot's activities during the event, his first take-off from the corporate car park, the course of the second flight, and the take-off from the company's building roof where the helicopter was seen for the last time. The course of the event flight was documented on the basis of witnesses' testimonies and several industrial cameras footage.

1.1.1. Circumstances Preceding the Incident

The pilot together with his foreign business partners had business lunch in a restaurant. After approx. 2 hours, the whole group was transported by passenger car and bus from the restaurant to the pilot's firm, where the business meeting and presentations continued. One of the business meeting's female participants literally said: *"We arrived to Pilsen sometimes before two o'clock in the afternoon, when we went for lunch to the restaurant in the Pilsner Urquell Brewery. I have known Mr (name of the pilot) from the previous meetings, but I saw him yesterday no sooner than at lunch in the brewery. Mr (name of the pilot) seemed to be acting normally. At lunch, he brought a big jug filled with beer, which he was then pouring out, but we did not have much because we are not really used to alcohol and we were hungry because it was already two p.m. After lunch, Mr (name of the pilot) started pouring out some hard alcohol from a green bottle. Mr (name of the pilot) was pouring the alcohol out for those who had just emptied their glasses. He was saying that this was some medicine and it's healthy. I don't know how many shots he could have drunk, but it seemed that he was used to it. He did not look drunk, I was normally communicating and addressing business issues with him. After lunch, we went to his firm. I went with Mr (name of the pilot) in his car from the restaurant. He was not driving, he had a chauffeur. The rest of our delegation went by bus behind us. We arrived approx. at half past three to the firm, where we had a business meeting, including presentations. In that firm, our delegation was split into small groups, each group had around five people, according to their specialisation."*

Another business meeting's female participant literally said in her testimony: *"I came to Pilsen with the whole Thai delegation from Prague. At lunch, we were drinking sparkling wine as a welcome drink and some people had beer and a few shots of whisky. After lunch, we went to the headquarters of the company in Pilsen. We had a business meeting and presentations there. At about 5 p.m. we were supposed to be returning to Prague." When asked if she had seen anyone from the helicopter crew drinking alcohol, she answered: "I am sure that I saw Mr (name of the pilot) and the senior manager of the Thai delegation drinking alcohol. They had that sparkling wine, beer and shots of whisky, they were drinking in the brewery and at the headquarters. At the headquarters, they were drinking something from a green bottle, it was supposedly herbal whisky."* She was not sure about the other two crew members, she had not seen them drinking any alcohol.

The restaurant employee, who was serving the guests during business lunch in the restaurant lounge, said exactly in his testimony: *"There were 17 Thais and 6 Czechs among those guests. The guests came at about 1:30 p.m. and were leaving at about 4 p.m. Mr (name of the pilot) was trying to entertain the guests and was constantly pouring out Becherovka liqueur, he also always ordered it after every course. Mr (name of the pilot) was supposedly drinking Becherovka liqueur, beer and sparkling wine. During the meeting, he was in a cheerful mood and was trying to entertain his guests. When we were leaving, there was nobody who would be actually tipsy and all were acting quite normally."*

During the subsequent business meeting at the corporate headquarters, the pilot made three short flights with the helicopter, including the event one. The female participant in the second flight was talking about the first flight, and when answering the question: *“Did you know that there was anyone else flying that day with Mr (name of the pilot)?”,* she literally said: *“I don’t know, but I heard that the helicopter was on the ground when we arrived at the car park and then, when I was with Mr (name of the pilot) on the roof, it was also there. From what I have heard, one of our colleagues with some woman were supposed to fly with Mr (name of the pilot) from the car park onto the roof of that building.”*

The take-off of the first flight was recorded on industrial camera, which was monitoring the area of the car park located east of the company’s building. The pilot together with another person left the building at 16:22:06 CEST and then started running to the helicopter, which was standing in the middle of the car park. Both of them boarded the helicopter (the pilot was in the right front seat and the other person in the left front seat) and the pilot started up the helicopter engine. When he was starting up the engine, a third person came to the helicopter and under the pilot’s instruction boarded the helicopter through the right back door at 16:23:19 CEST. After the doors were shut, the helicopter took off vertically upwards and got out of the camera footage. After a short flight, he landed on the roof of the headquarters at 16:24:16 CEST.

The second flight was described by one of female participants of the business meeting, who in her testimony literally said, among other things: *“I don't know exactly when, but it was sometimes after those presentations when I was with Mr (name of the pilot) who wanted to show me where he usually relaxes. I went with him onto the roof where he showed me his place where he practices golf, then he showed mi the nearby standing helicopter. He was in fact dragging me to it and wanted me to fly with him. I did not mind because I trusted him. I thought that he was a good pilot. At the time when I was flying with him, he didn’t seem drunk in any way. I knew that he had drunk, but he seemed okay to me. I don't know exactly when it was, but it could have been sometimes after 4 p.m. I was sitting on the left and Mr (name of the pilot) on the right side. Nobody else flew with us. That flight was short, he just showed me the surroundings of the factory, some production halls and I want to say that he definitely did not take me to the town centre. The entire flight took less than 10 minutes. We had got out of the helicopter, and that was the last time I saw Mr (name of the pilot).”*

1.1.2. Description of the Event Flight

The course of the event flight was documented on the basis of analyses of eyewitnesses’ testimonies and industrial cameras footage.

At 17:15:19 SECT, one of the industrial cameras which was placed on the company’s building recorded the helicopter flying in the western direction. The flight at low altitude over Folmavská street was then described in witnesses’ testimonies. They are describing that the helicopter rolled to the left and then made a sharp turn to the right with an extreme roll and pitch. The recovering of this manoeuvre and the crash onto the roof of the building were recorded on the industrial camera at 17:20:39 SECT.

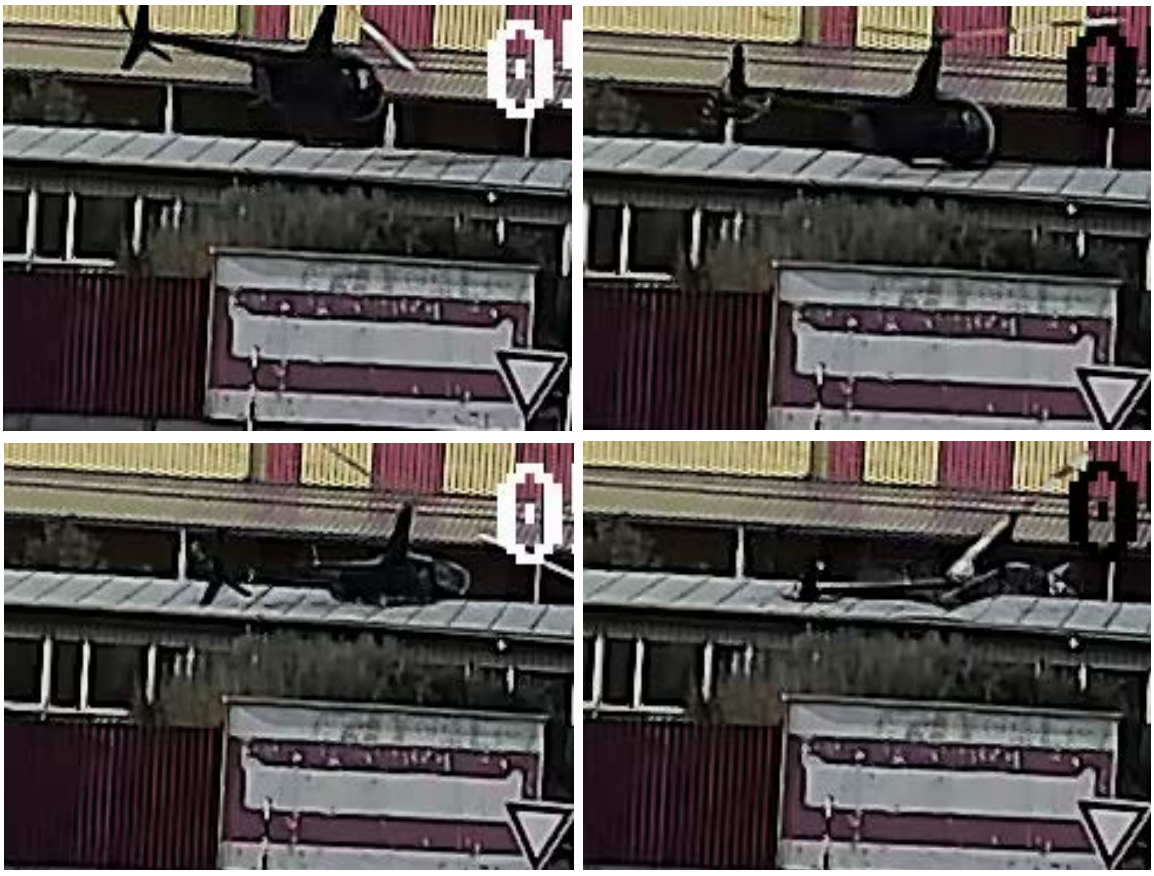

Fig. 1 – Videorecording sequences capturing the crash of the R 44 helicopter onto the roof of the hall

1.1.3. Witnesses' Observations

The witnesses stated that shortly before the air accident, they had heard or seen the helicopter flying low above the ground and they described the critical situation which ended in a crash of the helicopter onto the building. The witnesses were located at various places in the close vicinity of the roundabout near the MAKRO Cash & Carry ČR shop (Obchodní 1129/2, Pilsen 3) and at various distances from the place of the air accident.

Witness No. 1 was on a walk with a baby, who was in the pushchair. He was walking on the pavement which is on the left side of the street in between the Borská pole shopping centre and the Folmavská/Domažlická roundabout. The witness stated specifically: *"When I was approx. 300 to 400 m from the roundabout, I think that I was nearby the Folmavská/U Nové Hospody crossing, I first saw a yellow and black Lamborghini convertible with a roof down going really fast. That car could have been going almost 150 km·h^{-1}. It was going extremely fast and was weaving in and out through the traffic. Approximately 10 minutes later, I saw a black helicopter flying in the same direction, i.e. from the Tesco store to the Folmavská/Domažlická roundabout. The helicopter was flying approx. 20 to 25 meters above the ground. I know that it was a few meters above the street lights. Then I saw the helicopter as it first turned slightly left over the roundabout near Makro as if wanting to continue towards Domažlice, that is as if wanting to fly over the urban clearway in the direction of Domažlice. However, it then turned sharply to the right, it rolled by 90 degrees, the propeller was transverse to the ground, which was somewhere above the Pyramida Swimming Pools and Sappeli Doors shops, and then I saw it falling down. I didn't see the fall as such as it was behind the roundabout and the horizon. I know the position of the*

helicopter above the shops pretty well because I live nearby. When the helicopter was passing by me, I didn't notice any strange sound. When the helicopter was passing by us, I didn't notice whether it was vibrating or rocking. It was flying relatively straight. From the moment when I noticed the helicopter passing by until its fall, not more than 30 seconds elapsed."

Witness No. 2 was driving his private car with an open window in Domažlická street from the town centre to the roundabout by MAKRO at about 17:15 CEST. Together with him, there were other passengers in the car, his wife in the right front seat, and their small son, sitting in the back. In his testimony, the witness said exactly: "*I noticed a small black helicopter over the roundabout at approximately 50 meters above the ground. The helicopter was flying in the direction from the Tesco store at Borská pole to Líně. The helicopter was behaving normally and was producing a standard sound. It rolled first to the left and then to the right. It was flying at the speed of some 50 km·h^{-1}. No smoke was coming from the helicopter and no objects were falling down from it. When I reached the roundabout, I noticed with my peripheral vision that the helicopter crashed onto the hall roof by the roundabout next to MEA. I saw a few fragments or some items flying off the place of helicopter fall. I saw neither smoke nor fire.*" The witness went round the roundabout, stopped at the MEA gatehouse and used his wife's phone to report the accident on emergency line 112.

Witness No. 3 was travelling as a passenger in a passenger car with her family. When they were on the roundabout near MAKRO in Pilsen, the driver, her husband, drew her attention to the low-flying helicopter of black colour. The witness commented on the course of event as follows: *"The helicopter was flying some 50 metres above the ground and was flying somewhat strangely. It was rolling from one side to another and it was obvious that the pilot was trying to keep it straight, to fly calmly, but was unable to do so. At that point, the helicopter was flying from Domažlická street in the direction of Líně, then started descending onto the ground as if the pilot wanted to land on one of the roofs of some of the companies there. The helicopter was descending on one of the roofs and kept rolling from one side to another. When it was close to that roof, it rolled and fell on the roof. I then saw a cloud of dust but no smoke or flames."*

Witness No. 4 was unloading goods from a lorry on the premises of DAIKKIN at Borská pole shortly after 17:00 CEST. At one point, he noticed a black helicopter flying very low above the ground from Nová Hospoda to the speedway. It started turning left over DAIKKIN. The witness stated specifically: *"The helicopter was behaving strangely, it seemed to me that it was shaking a bit. It was also making strange sounds as when a car is running without an exhaust pipe, and even the rotor blade was moving strangely. The helicopter made a turn and flew towards Nová Hospoda. I didn't see it fall."*

Witness No. 5 was going by a motor vehicle down Folmavská street and saw a small helicopter starting from a building on the right side in the direction from the centre. At the same time, a luxury Lamborghini of yellow colour with a Prague registration plate came rushing up. The witness stated specifically: *"The car was going really fast, weaving in and out through the traffic in the direction to the centre. As I was approaching the roundabout from Domažlická street, some 150 metres before the roundabout, a helicopter, which I saw starting, overflew me while flying very low. The helicopter was performing strange manoeuvres, turned sharply left and then rather sharply right. It ended up over the roundabout, started rocking from one side to another and after a while rolled over and fell on some hall on the premises of some company behind the roundabout."*

At approx. 16:55 CEST, witness No. 6 as a Police CR patrol was going by police car round the roundabout and continued down Folmavská street towards TESCO hypermarket. At that moment, the policemen noticed the black helicopter parked on the roof of a building in Folmavská street 2.

1.2. Injuries to Persons

Injury	Crew	Passengers	Other persons (inhabitants, etc.)
Fatal	1	3	0
Serious	0	0	0
Light/No injury	0/0	0/0	0/0

1.3. Damage to Aircraft

The helicopter was totally destroyed by the crash into the roof of a storage hall.

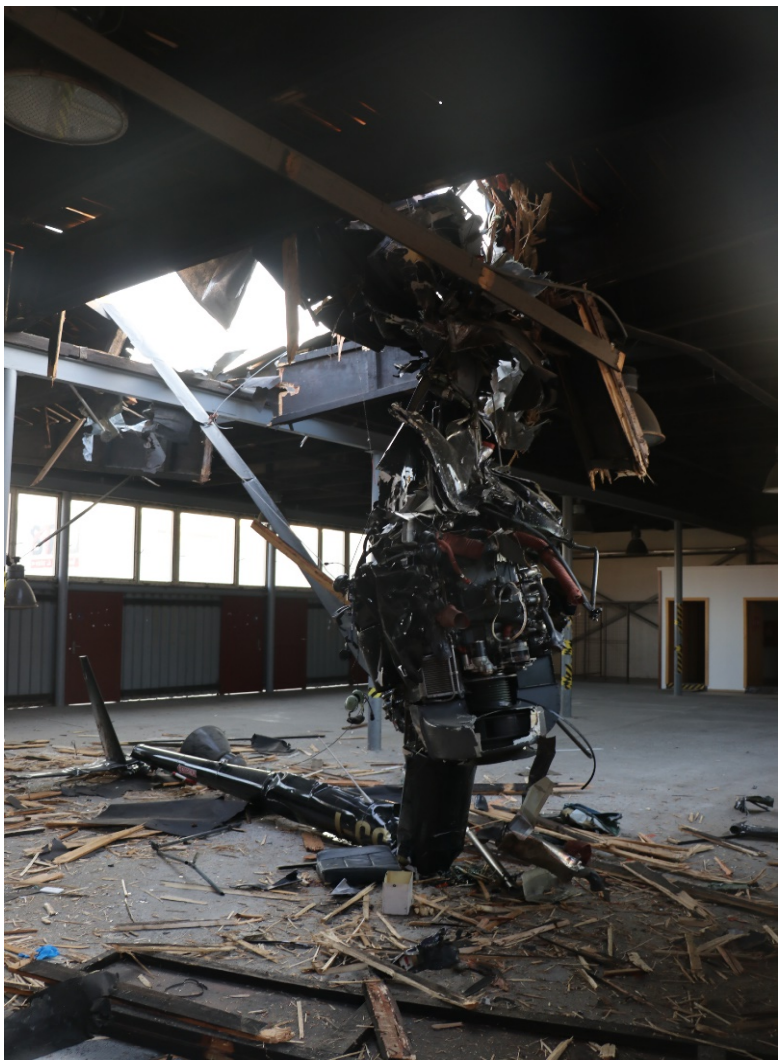

Fig. 2 – Helicopter R 44 after crash into the hall roof

1.4. Other Damage

The helicopter crashed into the building, damaged a substantial part of the plate roofing, and seriously damaged the roof supporting structure.

1.5. Personnel Information

1.5.1. Pilot

Personal data:

- Male, aged 32 years,
- valid Private Pilot Licence – Helicopters (PPL –H),
- valid rating for the type R 44 until 30 September 2018,
- invalid class 2 medical certificate (valid until 19 August 2018),
- valid limited licence of the aeronautical mobile service radio operator.

1.5.2. Flying experience

The pilot started practice flight training on the type R 44 on 13 May 2015. Having flown 20 hours, he performed his first solo flight on the R 44 type on 25 May 2015 and continued the training in order to acquire the PPL (H). On 4 August 2015, he passed a skill test and a type test for the Robinson R 44 helicopter with the following assessment: "qualified for PPL (H) under Day VFR". Prior to the test day, he had already flown 47 h 52 min and had conducted 200 landings. The last proficiency check on the given type took place on 20 September 2017 with assessment "passed" and the validity of R 44 type qualification was extended until 20 September 2018. In 2017, he reached the total of 76 h 01 min flown on the given type. In 2018, he reached the total of 37 h 12 min flown and conducted 67 flights on the given type.

Tab. 2 – Helicopter pilot's total hours flown recorded in the Pilot Logbook

Hours flown over:	24 h	90 days	Total
This type of helicopter:	00:15	09:06	308:54
All helicopter types:	00:15	09:06	308:54

1.5.3. Other Flying Experience

Since 2014, the pilot had been a holder of the Private Pilot Licence PPL (A) with the qualifications SEP LAND.

1.5.4. Administrative Proceedings Conducted with the Pilot

The Civil Aviation Administration carried out two administrative proceedings regarding the below flights with the pilot and subsequently issued CAA Decision with Ref. No. 1701-16-301/12 dated 23 August 2016, and CAA Decision with Ref. No. 3781-16-301/5 dated 12 January 2017.

On 15 April 2016 in the morning, the pilot performed landing and take-off with his own helicopter R 44 with identification mark OK-BAJ at a lot with parcel index 265/61 in the cadastral area of Plasy located in the municipal housing area, less than 100 m from residential buildings, and less than 50 m from bystanders.

On 10 September 2016 in the afternoon, the pilot performed landing and take-off with his own helicopter R 44 with identification mark OK-BAJ at a lot with parcel index 2337/1 in the cadastral area of Pilsen-Valcha close to the crossing of Osiková and Dobřanská streets,

less than 100 m from residential buildings, without having a written consent to landing issued by the lot owner.

1.5.5. Pilot Logbook

The pilot had been making records in the Pilot Logbook in accordance with the instructions for pilot logbook use until he acquired his Private Pilot Licence in 2015. In following years, he was keeping records of his flights only formally with a number of deficiencies or not at all. For example, the pilot failed to make records of the flights which were subject to the above stated administrative proceedings. In neither case, the departure and arrival columns stated the lot on the premises of the pilot's company but mostly LKPL. The hours flown (79 h 01 min), including 141 flights in 2017, were mostly broken down to 9 lines, specifying the total flight duration of 5:30–7:30 hours with the number of flights from 10 to 13. On 19 September 2017, he first recorded two separate flights although he underwent last proficiency check on 22 August 2016. Afterwards, he corrected the record unsuccessfully, stating deceitfully the name of a pilot with instructor rating certificate in the PIC column. The last flight record was dated 18 June 2018. The Pilot Logbook does not contain any records of winter training in regulations and materials of the Robinson R 44 helicopter in 2018, including an analysis of accidents in 2017.

1.5.6. Other Persons on Board

The left front and both back seats were occupied by passengers, foreign nationals, with no flying experience. They were two men, and one woman who was sitting in the back left seat.

1.6. Aircraft Information

1.6.1. General Specifications of the Aircraft

The Robinson R 44 RAVEN I helicopter, identification mark OK-PLP, was a light single-engine, four-seat, all-metal helicopter with a traditional structure with a two-bladed left-hand main lift rotor, two-bladed tail propeller, and a fixed skid landing gear.

The R 44 helicopter has an enclosed glass fibre cabin with maximum seating capacity of two side-by-side rows; it can be accessed through 2 left and 2 right doors. The doors are front-opening. The helicopter is piloted by one pilot sitting in the right seat as the controls are conventionally installed on the right side. For training flights, it is possible to add controls also on the left side provided the left seat is occupied by the pilot – instructor.

The helicopter concerned was powered by the Lycoming O-540-F1B5 piston engine. Prior to the departure from the LKMB, fuel tanks with the volume of 176 l were filled with the AVGAS 100 LL fuel up to the amount of approx. 110 l, representing 62 per cent of the full tank volume.

After landing on the pilot's company's headquarters in Pilsen in the morning on 5 September 2018, the fuel-consumption gauge showed the amount of fuel slightly below the midpoint of the full tank volume – as testified by the professional pilot who flew the helicopter from the LKMB to Pilsen. When investigating the helicopter wreckage in the AAII hangar, the Commission pumped out 33 l of aviation petrol from the considerably damaged fuel tanks.

Type:	R 44 RAVEN I
Identification mark:	OK-PLP
Manufacturer:	Robinson Helicopter Company, USA
Year of manufacture:	2000

Serial number:	0792
Certificate of airworthiness inspection:	valid
Total hours flown:	3,346 h
Liability Insurance:	valid

1.6.2. Power unit

Type:	Lycoming O-540-F1B5
Manufacturer:	Lycoming Engines, USA
Serial number:	L-263850-40A
Year of manufacture:	2000
Year of overhaul:	2012
Total hours flown:	3,346 h

1.6.3. Helicopter Operation

The helicopter was operated with identification mark SE-JHS in Sweden from July 2000 to October 2017. In the second half of 2017, it was sold to Italy where it was operated with identification mark I-CCNI until 3 August 2018. In July 2018, the helicopter was purchased by Future WOOD s.r.o. On 13 August 2018, the Czech owner/operator filed an application for an entry into the CR aircraft register. On 5 September 2018, the Civil Aviation Administration issued Aircraft Registration Certificate No. 5384.

1.6.4. Operating Documentation

The Pilot Logbook was newly started by the Italian owner on 21 July 2018, and the Aircraft Logbook and Engine Logbook were started on 3 August 2018 with no records of any defects in helicopter operation.

The documentation necessary for sale to Future WOOD s.r.o. in July 2018 was complete and free of any deficiencies. The total hours flown by the helicopter as at the day of sale were 3,346 flight hours (1,146 hours flown since the general overhaul in 2012).

Since the day of helicopter sale to Future WOOD s.r.o. in the Czech Republic, NISA AIR has carried out the following works on the helicopter:

- servicing on 14–17 August 2018 (see Report 2018-SRV-035);
- replacement of speed governor D 278-1 (serial No. 2301), and engine and flight tests – with no defects identified – on 4–5 September 2018 (see Report 2018-SRV-041).

On the day of the air accident, the helicopter had flown 1 hour and conducted 4 flights, including the event one.

1.6.5. Calculation of the Total Weight of the Helicopter

The maximum total weight of the helicopter is 1,089 kg. The minimum total weight of the helicopter is 703 kg.

Tab. 3 – Calculation of the total weight of the helicopter

Weight of an empty helicopter:	675.95 kg
Weight of fuel:	37.50 kg
Weight of the crew:	298.00 kg
Weight of cargo:	5.00 kg
Total weight of the helicopter:	1016.45 kg

1.7. Meteorological Information

The analysis of the meteorological situation at 15:20 is based on the expert estimate of probable weather at the place of air accident made by the CHMI for the day of 5 September 2018.

1.7.1. General Weather Information

The situation:	The weather over the territory of the Czech Republic was under the influence of an insignificant high-pressure area moving from the west.
Ground wind:	VRB 4 kt or 090−360°/4−12 kt
Upper wind:	2 000 ft AMSL 040°/06 kt, 5 000 ft AMSL 030°/06 kt
Visibility:	over 10 km
Weather:	Few of cloud amount, scattered clouds
Cloudiness:	FEW/SCT Ac, Ci, Cu, Sc the lowest layer FEW/SCT Cu/Sc, BASE 5 000-6 000 ft AGL
Turbulence:	NIL
Ice:	NIL
Zero isotherm level:	FL 115−125
Regional QNH:	1 012 hPa, slight decline

1.7.2. Abstracts from SYNOP reports, radar and satellite images

Tab. 3 – Abstract from SYNOP reports from the Pilsen-Mikulka weather station (PMI) dated 5 September 2018

Time	Visibility [km]	Wind direction [°MAG]	Wind velocity [m·s^{-1}]	Wind gusts [m·s^{-1}]	Cloudiness [type/altitude] [m AGL]	Temperature [°C]
15:00	40	VAR	2	NIL	1/8 Sc/1,500	24.9
16:00	35	VAR	1	NIL	1/8 // 2,400	23.6

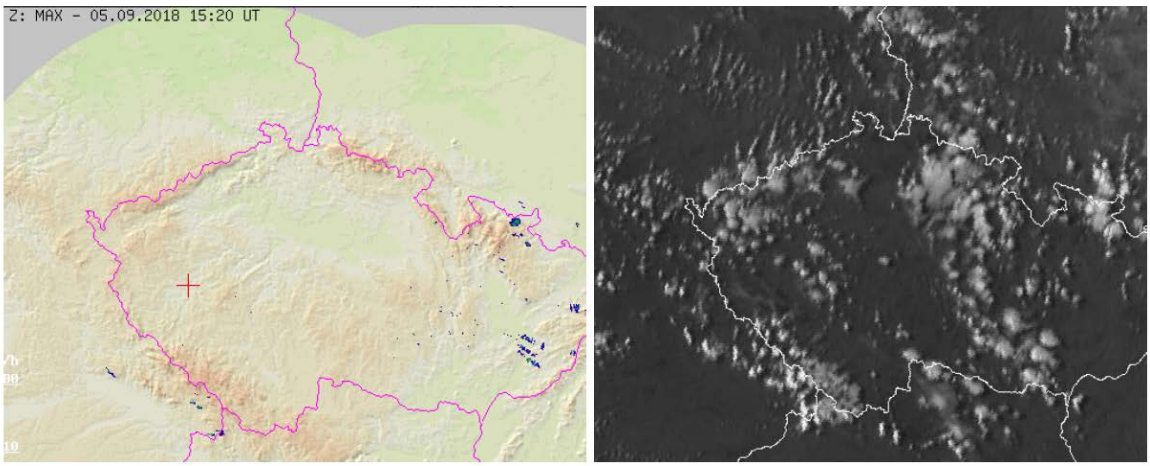

Fig. 4 Radar and satellite images (the cross marks the location of Pilsen)

At the time of the air accident, approx. at 15:20 on 5 September 2018, the sky was clear with a few clouds up to scattered clouds with gradual breaking up of flat cumuliform clouds of Cu type. The lowest level of clouds amounting to 2–3/8, Cu type, breaking up to Sc, was located at approx. 5,000 ft AGL. Visibility was well over 10 km, partially deteriorated when

facing the sun. Air temperature equalled 24–25 °C and relative humidity was approx. 35%. Wind was blowing from the direction of 360–090° or varied at a speed of 3–5 kt. There were no dangerous weather phenomena at the location of the air accident site and its surroundings.

1.8. Radio Navigational and Visual Aids

The area used by the pilot for helicopter take-off and landing was not equipped with any radio navigational and visual aids.

1.9. Communications

During the flight in the surroundings of his company, the pilot was not in contact with any ATS site.

1.10. Aerodrome Information

According to the owner's/operator's information, the helicopter was supposed to be parked in the fenced area behind the northern wall of the pilot's company building. (In Fig. 5, this place is marked as the usual parking place. It is highly probable that the pilot's helicopter RR 44, identification mark OK−BAJ, flown by the pilot from 13 May 2015 to 18 June 2018 according to the data recorded in the Pilot Logbook, was captured there by terrestrial photography. On the day of air accident, that helicopter was not there as it was in repair by repair service at LKMB.) On the day of the event flight, the helicopter was first parked at the corporate car park behind the eastern wall of the building and then the pilot flew it up onto the building roof. The corporate premises are located outside the municipal housing area. There is a multi-lane road, a pavement, and a cycle path along the southern edge of the building lot where the company building and the car park are located.

Fig. 5 – Places of take-off and landing on corporate premises

1.11. Flight Recorders and Other Means of Recording

No logger, the record of which might be used in the flight analysis, was installed on the helicopter board.

The ACC summary display records did not show any indication of the position of the helicopter at the given place at that time.

1.12. Wreckage and Impact Information

1.12.1. Inspection of the accident scene

The helicopter broke through the roof of MEA hall in air accident. As the helicopter crashed into the roof of a single-storey building, its integrity was impaired and even before the helicopter partially fell into the interior of the hall, some of its parts, equipment and also the bodies of two persons sitting in the front seats were destroyed and ejected into the near vicinity of the hall.

Tab. 5 – Place of the air accident

Geographical coordinates:	N 49°43´55.945´´
	E 013°19´06.642´´
Altitude:	350 m

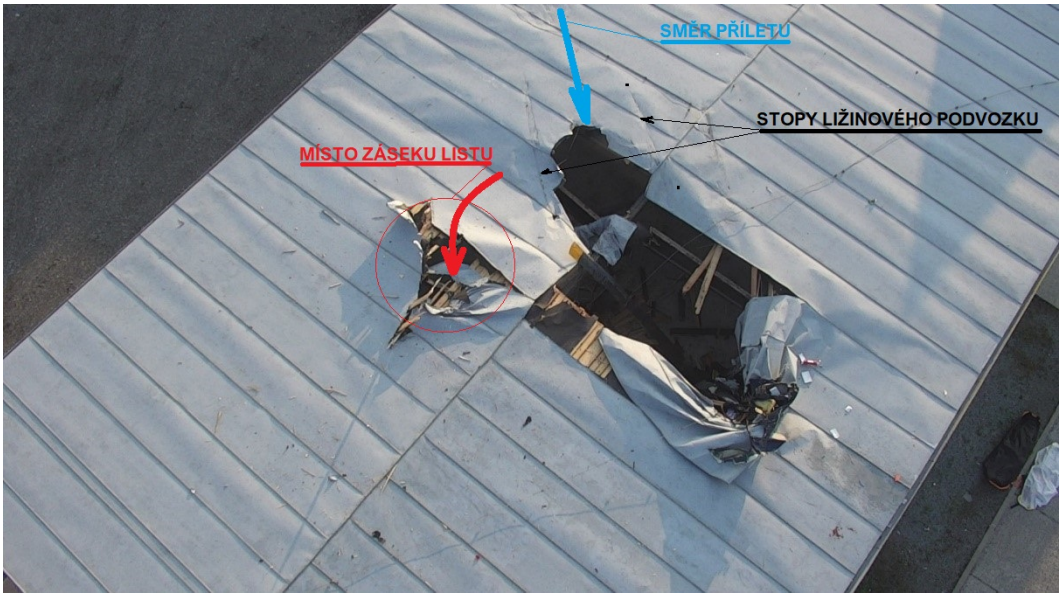

Fig. 6 – View of the broken roof of the MEA hall.

1.12.2. Wreckage inspection at air accident location

Due to the crash and subsequent effect of inertial forces, the helicopter cabin was totally destroyed. The entire upper part was separated from the fuselage during the crash. The helicopter nose was separated from the cabin during the crash approximately at the level of pedal controls. The cabin floor and the lower part of fuselage were deformed by the crash into the hall roof and carrying structure elements. The cabin was torn apart approximately at the level of middle pillars and both parts remained connected with a deformed part of the floor and the central channel with the control cables.

The skid landing gear of the helicopter was totally destroyed by the crash onto the hall roofing. The helicopter crashed onto the roof with the front part of its skids and then fell on nearly entire area of skids. The front part of the right skid was broken off. The broken part of the skid was found in front of the hall. Both couplings of the landing gear in the U-shape, connecting the left and right skids, and forming the elemental bearing part of the skid landing gear, were broken off the helicopter fuselage, deformed and damaged.

The protective guard of the tail rotor was broken into several pieces which were scattered in the near vicinity of the hall. Only one piece was found in the hall. It means that the destruction took place due to the crash onto the roof prior to the helicopter's fall into the hall.

Cabin deformation and breaking off of the upper part during the crash resulted in failure of the safety seatbelt system as the seatbelts failed to fulfil their restraint functions; that is why the persons in the front seats were ejected from the cabin as a result of the crash. The persons in the back seats remained in the deformed cabin until the helicopter fell through the roof down to the hall.

All the 4 doors were found in the vicinity of the hall after the accident. All the safety pins in all the doors were closed and the control levers were in the closed position.

The right controls were in the helicopter wreckage, while the dismantled left controls were ejected during the crash from their place and were found in the immediate vicinity of the hall.

With regards to both the unstable and dangerous position of helicopter wreckage and to the extent of damage of carrying structure elements of the roof, it was impossible to carry out detailed investigation and technical inspection of the helicopter. For that reason, a decision was made to first support and secure the hall roof, and then pull the helicopter wreckage down, load it and transport for further technical investigation to the AAII hangar.

Due to the position of the wreckage and its inaccessibility, it was not possible to verify if the automated emergency locator transmitter (ELT) was activated during air accident and whether it was broadcasting the distress signal. On the following day, 6 September 2018, after the wreckage was removed from the sheet metal hall and was being transported to the AAII hangar, the COSPAS-SARSAT international safety system captured the ELT distress signal. The ELT was deactivated by the AAII inspector.

1.12.3. The results of the controls technical inspection

On 19 September 2018, a detailed technical inspection of all the helicopter controls was carried out in the AAII hangar (see the Helicopter controls inspection report). The aim of the inspection was to verify whether the controls of the helicopter were functional and operational and whether at the time of the accident the auxiliary controls had been installed or not. Assessment of the photographs taken on the day of the accident and on the following day (i.e. on 5 and 6 September 2018) was a part of the inspection. During the examination of individual parts of the controls in the AAII hangar, it was assessed that at the time prior to the accident the controls had been fully functional and operational.

Upon examination of the accident site, the elements of the auxiliary control (left) were found in the close vicinity of the hall with the roof of which the helicopter collided. Those were separated from the main body of the helicopter due to the forces acting upon the impact of the helicopter onto the roof of the hall. The condition of the coupling parts of auxiliary controls and of the joining elements to the helicopter controls shows that the auxiliary controls had not been connected with the helicopter controls at the time of the accident, therefore it had been rendered impossible to pilot the helicopter from the left seat.

The auxiliary control elements had been only placed in the helicopter, most likely at their usual place (i.e. under the seats). Upon the impact and helicopter destruction, the auxiliary control elements were ejected and catapulted from the helicopter cabin in the like manner as the seats under which they had been stored. All the minor damage was caused by the contact (impact) with the surface on which they had fallen.

1.12.4. The results of the controls and hydraulic booster technical inspection

On 9 November 2018, inspection of all three hydraulic boosters from the helicopter controls system was carried out in the AAII hangar (see the Helicopter hydraulic booster technical inspection report). Prior to their disassembly, an examination of their connection to the hydraulic system, leak tightness, and attachment to the helicopter frame had been performed. Furthermore, the integrity and intactness of the push-pull rods connection to the boosters, and unobstructed operation were examined. Upon disassembly a detailed examination of the boosters' condition was performed. The aim of the examination was to verify whether they had been defect-free and whether they had been fully operational and functional prior to the helicopter accident.

The system of hydraulic boosters, except for the broken "T" screw joint in the collective control, showed no signs of any mechanical damage, leakage, or any other defects.

The push-pull control rods were connected to the relevant controls at their terminal points. The push-pull rods themselves were neither disconnected, nor broken. The tail rotor control system was damaged due to the crash onto the roof with the subsequent impact onto the concrete floor in the hall.

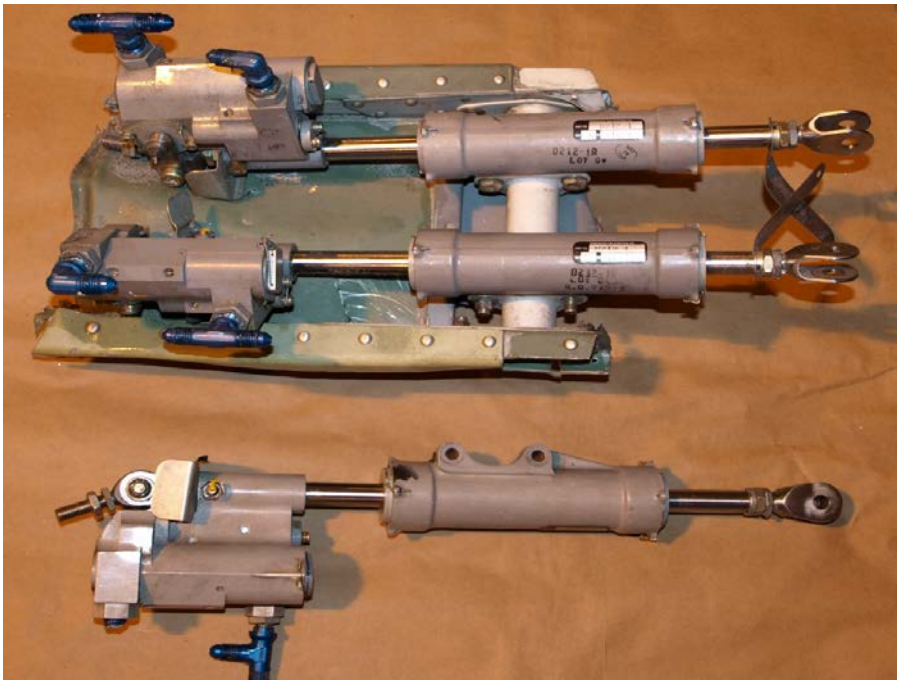

Fig. 4 – All the three hydraulic boosters after disassembly from the helicopter wreckage.

The condition of all the three hydraulic control boosters shows that up to the moment of the helicopter crash onto the roof, they had been fully functional and operational and operating defect-free. They retained their full functionality also after the helicopter accident. Only the collective control hydraulic booster screw joint of the hydraulic pressure hose was broken

off due to the accident impact. It follows from the stated information that the hydraulic boosters' condition and functionality had no bearing on the air accident origin and cause.

1.12.5. The results of the cabin door technical inspection

On 9 November 2018, the technical inspection of all the doors and their components was carried out in the AAII hangar. All the 4 doors were found in the vicinity of the hall after the accident. All the safety pins in all the doors were closed and the control levers were in the closed position. The hinges on all the doors were slightly bent and the gas absorbing cylinders were torn off due to the forces acting upon the crash onto the roof. The structure of all the doors was damaged in the place above the safety pins. This damage shows that all the doors were closed and secured at the time of the accident.

1.12.6. The results of the safety belt restraint system technical inspection

During the safety belts examination, it was ascertained that in all likelihood until the moment of the destruction of the upper cabin part, the bodies had been exerting such force on the belts that the surface damage and creasing of the belts in the upper buckle attachment point took place.

The safety belts system failed most likely in the moment of cabin deformation and its upper part separation from the helicopter fuselage upon the impact. The belts, at that moment, were not providing their restraint function and the people in the front seats were catapulted out of the cockpit due to the impact. The persons in the back seats remained in the deformed cabin until the helicopter fell through the roof down to the hall. Their safety belts were cut during the FRS response.

The condition of safety belts showed that the persons onboard had been wearing their safety belts in the moment of helicopter impact, and that those safety belts had been fastened.

1.12.7. The results of the power unit system technical inspection

Upon the disassembly from the wreckage, the engine was submitted to the technical inspection and expert examination at EEA TECH spol. s.r.o. During the engine disassembly on 4 October 2018, experts carried out the check of the power transmission from engine to the gearbox, to the main rotor shaft, and to the tail rotor shaft.

The pulleys, transmitting the power to the gearbox, were undamaged as well as all of the aggregates connected with the drive gearbox. All four powering belts were found on the pulley. Three of those were undamaged and in good technical condition. The fourth was mechanically damaged by the pulley in two thirds of its length due to the helicopter crash onto an obstacle.

The cooling vent blower and the oil cooler remained undamaged. The vent blower and air distribution piping were damaged due to the crash onto the roof. Because of the destruction of the lower fuselage part due to the crash onto the roof, the carburettor suction inlet found on the bottom side of the engine casing was also damaged.

The main rotor head was not damaged and no traces showing the main rotor working in the "low g" mode have been found. Both the main rotor blades were destroyed during the accident. The first blade was driven into the hall roof resulting in bending of the blade across its full length and in breaking off of the honeycomb from the beam in the length of 70cm from the end arch. The second blade was deformed in its full length during the fall through the roof. There were traces found on the bottom side of both the blades left from the dragging movement over the sheet metal roofing.

All the above stated damage was caused by forces generated by the helicopter impact onto the hall roof.

1.12.8. The results of the tail beam and tail rotor technical inspection

The tail beam was deformed considerably after the crash onto the hall roof. The tail rotor drive axis was broken at the place of the tail beam break off point. The horizontal and vertical stabilisers were damaged in several places. They were detached from the tail beam after the contact with the roof when the connecting hinge was broken. The tail rotor gearbox, together with the rotor, was separated from the tail beam. The tail rotor blades were deformed and remained on the gearbox shaft together with the hub.

1.13. Medical and Pathological Information

The immediate cause of death of the pilot was the internal haemorrhage during traumatic rupture of aorta.

The death of the pilot and of all the three passengers was caused in casual link with the injuries suffered during the concerned air accident. All of them died at the accident site. A great intensity blunt force was affecting the bodies of all the four persons onboard, mostly from the front, moderately from the bottom. The injuries originated primarily at the moment of helicopter crash onto the building roof with subsequent destruction of the helicopter cabin.

The given type of helicopter is fitted with three-point seat belts, such as are found in passenger cars. Considering the substantial destruction of the cabin, especially in its front part, no statement can be made with certainty in regards of the use of the seat belts by individual persons onboard. The type of chest injuries of the persons sitting in the back seats would allow for the notion of the seat belts being used. However, even if none of the persons onboard had properly fastened seat belts, the high-energy effect of forces on their bodies, combined with opening and exposure of the cabin area by destruction, lethal injuries would have been caused nonetheless even with the proper use of the safety belts.

An injury on the right upper limb was discovered on the pilot's body who was supposed to be sitting in the front right seat while piloting, which injury was sustained when the said limb was placed in front of the body, bent in the elbow joint, in the moment of the impact. The right hand injury suggests the hand being placed on the handle of the cyclic stick. The injuries on the lower limbs cannot be evaluated as in relation to the pedal controls.

The right upper limb of the passenger sitting in the front, left, was in the moment of crash alongside his body. The right hand was very likely placed on the side area of the seat cushion, most probably in the general defence reflex. The limb was not rested against a firm part of the cabin (e.g. control board) and did not hold any cylindrical object (e.g. the cyclic stick, or the collective lever). Therefore, it can be concluded that this person did not interfere with helicopter piloting.

The autopsy has detected no traumatic alterations which could not have been explained by the mechanism of the said air accident, such as a projectile wound, an explosion, etc.

The pilot's autopsy results have not disclosed any pathological changes that might have been involved in the causes of the accident, or that could have been considered as a causal link with the pilot's death.

It followed from the autopsy procedures that the weight of the pilot dressed was 75 kg. The weight of the other persons onboard was 91 kg, 75 kg, and 57 kg. The total weight of all the persons onboard was thus 298 kg.

The pilot did not have a valid class 2 medical fitness certificate. He underwent the last medical check on 19 August 2013 at aeromedical examining centre Centrum Letecké medicíny s.r.o. with the conclusion “fit for class 2”. The medical fitness certificate was valid until 19 August 2018.

Toxicological analysis showed the alcohol levels in the deceased pilot’s blood equalled 1,97 g.kg-1 that is 1.97‰ (per mille), and 2.47 g.kg-1 in urine. Presence of other toxicologically significant substances (hazardous drugs, substances prohibited for aviation duty) was not detected. During the event flight, the pilot was in the state of medium to heavy inebriation. Such levels of alcohol impact the sensory-motor as well as cognitive functions in a degree that is very significant and a pilot in such condition is not capable of safe piloting of any aircraft, or ARV. In the assessed case, it decidedly presented a significant influence on the flight safety.

The biochemical tests of the psychosomatic condition of the pilot were not performed due to significant inebriation and metabolic processes linked with such intoxication.

It follows from the complex forensic medical analysis that the pilot was incapable of safe piloting of the helicopter in question due to his state of inebriation. The conceivable erroneous conduct on the part of the pilot could have been in causality with him being under the influence of alcohol.

1.14. Fire

No fire was ignited after the helicopter crash onto the building roof and the subsequent wreckage breakthrough inside the structure. At the moment of the air accident, there were 40 l of fuel in the helicopter tanks.

1.15. Search and Rescue

No search and rescue procedures were organised. A random observer of the event reported the air accident on emergency line 112 and the IRS units came directly to the air accident site. FRS and the Police of the Czech Republic units as well as IRS helicopter came to the site.

The bodies of the pilot and the passenger sitting in the left front seat were found in the immediate vicinity of the hall. The body of the passenger sitting in one of the back seats of the helicopter was found on the floor inside the hall. The body of the passenger from the other back seat remained hanging in the helicopter wreckage.

All four persons from the crashed helicopter were resuscitated with a negative outcome.

1.15.1. Emergency Locator Beacon ELT

The ARTEX ME 406 P/N 453-6603 ELT with serial number 197-16026, installed in the helicopter, was activated upon the impact of the helicopter into the roof, but the emergency signal transmission was shielded by the metal surface of the hall. The international search and rescue system COSPAS-SARSAT intercepted the emergency signal of the ELT concerned from the air accident site after being retrieved from the wreckage and the building, and the subsequent transportation on the lorry loading platform.

1.16. Tests and Research

1.16.1. Engine disassembly and expert examination

On 4 October 2018, a disassembly and expert examination of Lycoming O-540-F1B5 engine, serial number L-263850-40A, at certified maintenance organisation EEA Tech spol. s.r.o. took place with the AAII inspectors present. On 10 October 2018, a findings report from the said expert examination was drafted stating:

- No obvious damage was found on the engine;
- Both starting magnetos were fully functional;
- The carburettor was defect-free and it was subject to any and all valid service bulletins (SB/AD);
- Disassembled aggregates did not show any signs of damage;
- Inner engine parts, distribution gears, crankshaft, connecting rod, and cylinders were defect-free, undeformed, and free of any corrosion.

In some of the cylinders, there were wooden splinters from the roofing structure, which is an evidence of the engine being working also at the moment of impact into the hall roof at higher revolutions. The conclusion of the engine expert examination report is that the engine was working defect-free until the moment of impact into the hall roof and had no effect on the cause of the air accident.

1.16.2. Test of fuel used

On 6 September 2019, samples of fuel (1 litre) and of hydraulic fluid (0.15 litre) were taken from the helicopter wreckage at the air accident site. The samples were collected into clean standard sampling bottles.

On 21 September 2018, a sample of fuel taken from the helicopter fuel tanks was submitted to Testing Laboratory No. 1152.1 of SGS, the company that drafted Test Report No. 25426 as at 26 September 2018. The expert examination conclusion – the submitted aviation petrol sample complies with the requirements specified under DEF STAN 91-90 ISSUE 3 for AVGAS aviation petrols.

1.16.3. Test of engine oil used

The engine oil sample was collected from the engine oil pan on 4 October 2018 during the engine disassembly in the amount of 0.3l, and on 8 October 2018, it was handed over for an expert examination to the Tribology Laboratory of the Military Technical Institute (VTÚ s.p.), testing laboratory of the Air Force and Air Defence Military Technical Institute.

The above stated testing facility drafted Report No. 18/10/19 describing the results of tests aimed at the spectral analysis of the AES-RDE oil, determination of the chemical and physical properties of the said oil, and the analysis of mechanical impurities present in the oil. The applied set of tests has revealed no signs of defect or malfunction of any engine parts lubricated – washed with engine oil.

1.16.4. Test of hydraulic fluid used

The hydraulic fluid sample (0.15 l) was taken from the helicopter wreckage on 6 September 2018 Due to the small amount of the provided hydraulic fluid it was not feasible to perform an expert examination of the sample. Only visual inspection focused on the presence of mechanical impurities was carried out, and water presence was tested with an indication tablet.

The sample in question and the residues of the hydraulic fluid from the hydraulic booster system were clear, with no mechanical impurities and no water present.

The conclusion of the above listed tests of the working fluids is that their type, amount, and quality had no effect on the emergence of the air accident.

1.16.5. Test of the emergency locator beacon ELT

The helicopter was fitted with an automatic emergency locator radiobeacon ELT ARTEX ME 406 P/N 453-6603, serial number 197-16026. There was an identification code and the code of the country of registration on the ELT body. According to the said data, the beacon in question was registered in Italy for the Robinson R 44 RAVEN I helicopter, identification mark I-CCNI.

The automatic activation is started by the G-force switch at sudden and rapid deceleration corresponding with G-force overload equal to 2.3, or at 12 g reading on one of the five auxiliary G-force overload sensors.

The beacon was activated automatically due to the G-force overload at the moment of helicopter crash. The beacon transmission was shielded by the steel structure of the hall. The first emergency signal was intercepted by the international search and rescue system COSPAS-SARSAT no sooner than on 6 September 2018 after the helicopter wreckage had been retrieved from the building at 08:57, and the last signal was intercepted at 16:40 when the beacon had been transported with the wreckage to the AAII hangar and switched off. Subsequently, in October 2018, the beacon was disassembled and submitted to Tomi Air s.r.o. examining facility for technical inspection with the following results:

- The installed emergency locator beacon ELT, serial number 197-16026 was functional;
- The battery life-span was OCT/2020;
- The device had valid identification codes and registration;
- Onboard GPS receiver was not connected to the ELT beacon;
- The controls were in the correct positions;
- The device was working in compliance with the relevant technical conditions.

1.17. Organisational and Management Information

The helicopter was owned and operated by Future WOOD s.r.o. The company owner purchased the helicopter on 21 July 2018 in Italy for the purpose of his own training in order to obtain a pilot licence and to pursue the sport and recreational flying. The owner and operator in one person literally stated as follows regarding the operation of a helicopter: *"As far as the helicopter fall itself is concerned, I learned about it only from the media while out of office on a sick leave. As I said, I learned about the accident from the media, my immediate thought was it could have been that helicopter of ours as I could discern blue colour of the seats in the news camera shots. I had not authorised Mr (name of the pilot) to perform any flights with our helicopter other than the overflight from Italy to the Czech Republic, and I also understood the servicing would have been carried out by a mechanic, or a technician summoned to the heliport on the pilot's company premises. I repeat that I had absolutely not authorised Mr (name of the pilot) to take the liberty in flying the concerned helicopter at will. At the time of the accident, as I stated at the beginning, I was in hospital."*

1.18. Supplementary Information

1.18.1. Regulation (EU) 2018/1139 of the European Parliament and of the Council

Regulation (EC) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency. Annex V, Essential requirements for air operations:

1.3 Before every flight, the roles and duties of each crew member must be defined. The pilot in command must be responsible for the operation and safety of the aircraft and for the safety of all crew members, passengers and cargo on board.

1.18.2. Commission Implementing Regulation No. (EU) 923/2012

Commission Implementing Regulation (EU) No. 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation. Article 2. Definitions:

100. 'Pilot-in-command' means the pilot designated by the operator, or in the case of general aviation, the owner, as being in command and charged with the safe conduct of a flight,

102. 'Problematic use of substances' means the use of one or more psychoactive substances by aviation personnel in a way that:

a) constitutes a direct hazard to the user or endangers the lives, health or welfare of others; and/or

b) causes or worsens an occupational, social, mental or physical problem or disorder.

104. 'Psychoactive substances' mean alcohol, opioids, cannabinoids, sedatives and hypnotics, cocaine, other psychostimulants, hallucinogens, and volatile solvents, whereas coffee and tobacco are excluded.

1.18.3. Commission Implementing Regulation No. (EU) 923/2012, Annex

Commission Implementing Regulation (EU) No. 923/2012 of 26 September 2012 laying down the common rules of the air and operational provisions regarding services and procedures in air navigation. Annex, Rules of the Air, Section 2, Applicability and compliance, Section 3, General rules and collision avoidance.

SERA. 2005 Compliance with the rules of the air

The operation of an aircraft either in flight, on the movement area of an aerodrome or at an operating site shall be in compliance with the general rules, the applicable local provisions and, in addition, when in flight, either with:

a) the visual flight rules

SERA. 2010 Responsibilities for compliance with the rules of the air

a) Responsibility of the pilot-in-command

The pilot-in-command of an aircraft shall, whether manipulating the controls or not, be responsible for the operation of the aircraft in accordance with this Regulation, except that the pilot-in-command may depart from these rules in circumstances that render such departure absolutely necessary in the interests of safety.

SERA. 2015 Authority of pilot-in-command of an aircraft

The pilot-in-command of an aircraft shall have final authority as to the disposition of the aircraft while in command.

SERA. 2020 Problematic use of psychoactive substances

No person whose function is critical to the safety of aviation (safety-sensitive personnel) shall undertake that function while under the influence of any psychoactive substance, by reason of which human performance is impaired. No such person shall engage in any kind of problematic use of substances.

SERA. 3101 Negligent or reckless operation of aircraft

An aircraft shall not be operated in a negligent or reckless manner so as to endanger life or property of others.

SERA. 3105 Minimum heights

Except when necessary for take-off or landing, or except by permission from the competent authority, aircraft shall not be flown over the congested areas of cities, towns or settlements or over an open-air assembly of persons, unless at such a height as will permit, in the event of an emergency arising, a landing to be made without undue hazard to persons or property on the surface. The minimum heights for VFR flights shall be those specified in SERA 5005(f).

a) over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300 m (1,000 ft) above the highest obstacle within a radius of 600 m from the aircraft;

b) elsewhere than as specified in (a), at a height less than 150 m (500 ft) above the ground or water, or 150 m (500 ft) above the highest obstacle within a radius of 150 m (500 ft) from the aircraft.

1.18.4. Decree No. 108/1997 Coll.

Decree No. 108/1997 Coll. of the Ministry of Transport of 23 April 1997, Sections 14(5)(d) and (6)(c):

(5) Only the following types of areas are allowed to be used for take-offs and landings:

d) whose dimensions and surfaces comply with the requirements determined in the relevant aircraft flight manual and in the relevant aircraft operating manual of the operator for whose take-off and landing the given area is to be used;

(6) Landings, take-offs and related activities are allowed to be carried only:

c) when the aircraft is not performing the said manoeuvres within a distance shorter than 50 m from persons not taking part in the aircraft operation.

1.18.5. Textbook of Forensic Medicine

Textbook by Vorel, F. et al. Forensic Medicine, Grada,1999. Hirt, M., Vorel, F. et al. Forensic Medicine, Volume II., Grada. 2016. Effect on Flight Safety

Tab. 6 – Effects of alcohol on human body

Blood alcohol content [g.kg^{-1}]	Effects on human body
Up to 0.20	Inconclusive levels
0.21–0.30	Levels are not significant for the road traffic operation
0.31–0.49	Individual has consumed alcoholic beverage but is practically uninfluenced
0.5–0.99	Inebriation – the mildest degree of alcohol influence
0.80 and more	A driver is impaired to drive a motor vehicle safely
1.00–1.49	Moderate intoxication – mild lowering of judgement, attention, heightened confidence, excessive talking, prolonged response times and possibility of incorrect solutions in as well as outside of traffic
1.50–1.99	Medium intoxication – lacking in bodily coordination, lowered attention abilities, slowing down of body movements
2.00–2.99	Heavy intoxication – nonsensical incomprehensible speech, psychological disorders, inability to walk
3.0–3.99	Alcohol poisoning
4.00 and more	Deadly poisoning by alcohol

Tab. 6 – Evaluation of alcohol influence on the driver's abilities and functions by Nešpor

Blood ethanol level [g.kg^{-1}]	Observed symptoms
0.20–0.5	Demonstrably impaired ability to drive, tendencies to hazardous behaviour, excessive self-confidence, impaired ability to discern moving lights, impaired ability to estimate distances
0.5–0.8	Besides the above listed symptoms, we can also observe distinctly prolonged response time (deteriorated reflexes and responses), overestimating of own abilities, eyes adapting to transition from light to darkness (and vice versa) with great difficulty, impaired ability of perception of colours, impaired concentration ability, impaired balancing ability, deterioration in estimating of distances
0.8–1.2	Besides the above listed, also the ability to perceive the edges of the vision field (tunnel vision), deterioration of concentration ability, the reflex and response time is prolonged even more, the recklessness and inconsiderateness levels when driving rise
1.2 – and more	The driver presents a great hazard to himself and his surroundings, the concentration disorders deteriorate even more, reflex and response times grow longer, the disability to keep balance and uncritical judgement increase, impaired and deteriorated time-space orientation is frequent, even a very experienced driver in such condition may commit gross errors.

Compared to the road traffic, the pilot operates in a three-dimensional space, which brings higher demands on the immediate health capacity and capabilities. There are many studies issued by ICAO and FAA regarding the negative influence of alcohol on pilots, namely on the vision analyser, vestibular (sense of balance) system, fine motor skills, and cognitive functions.

1.19. Useful or Effective Investigation Techniques

Air accident investigation was carried out in compliance with L 13 (ICAO, Annex 13).

2. Analyses

Majority of facts pointing to the determining of the causes of the air accident arise from the evidence found in the helicopter wreckage, from the findings from the detailed inspection of the air accident location, conclusions of forensic medical examination, from the information provided by the witnesses in their testimonies and the industrial camera footage. No devices whose recordings could be used by the investigators in analysis of the critical stage of the event flight were installed in or on the helicopter.

2.1. Pilot

2.1.1. Pilot's Qualifications

The pilot was a holder of adequate qualifications for performing flights with the R 44 Raven I helicopter on which type he had flown in total more than 308 flight hours 54 minutes since 13 May 2015. He performed flights on regular basis with no lengthy breaks between the flights. He underwent last proficiency check on the type on 20 September 2017 with the qualification "passed". From this perspective it can be assumed that the pilot had sufficient experience in flying and was also well acquainted with the given type of helicopters.

2.1.2. Pilot’s Competency

The pilot was not medically fit to perform the flight as he had no valid class 2 medical fitness certificate, and was piloting the helicopter under the influence of alcohol, intoxicated in the band of medium to heavy intoxication, the alcohol level identified in his blood was **1.97 per mille**. The fact that the toxicological examination proved the presence of alcohol in the pilot’s blood in the concentration whose level rendered the piloting unsafe can be considered as the decisive factor in overestimating his own abilities and incorrect dealing with the error made in the process during which he performed such a manoeuvre in the immediate vicinity of the ground he was subsequently not able to recover.

2.2. Flight Performance

The pilot performed the flight from the company’s building roof, about 10 metres above the surrounding terrain. By this decision he acted against the flight manual provisions regarding the take-off procedure as shown in the chart depicting the correlation of altitude and speed in Section 5. By the same decision he endangered the safety of the flight in question as in the case of power unit malfunction at the moment of take-off he would not have been able to perform a safe emergency landing.

After the take-off, instead of ascending to the minimum altitude above the ground stipulated for VFR flights, he continued in horizontal flight at low altitude above Folmavská street all the way into the roundabout area near MAKRO cash & carry. There, after having flown approx. 2.5 km, he most probably decided to return back to the point of take-off. The helicopter then first rolled to the left but immediately made a sharp turn to the right with an extreme right roll and pitch losing altitude rapidly.

2.2.1. Emergency

The emergency situation arose evidently as a consequence of the poorly and incorrectly performed right turn with an extreme roll and pitch while flying at low altitude above ground with a fully occupied helicopter. Due to the poor coordination of movements of individual controls in the immense roll, the pilot failed to respond in a timely manner to the fast change in helicopter roll and pitch accompanied by an increased vertical descent velocity. He managed to eliminate this condition, as it is evident from the CCTV footage and from the

trace left by one of the main rotor blades driven into the roof that the helicopter was flying in a slight positive roll prior to the impact into the obstacle. The pilot's effort to level also the pitch is evident from the view of the rotor disc immediately prior to the impact into the obstacle. The helicopter in spite of a slightly pitched nose crashed onto the one storey building roof at great vertical velocity.

2.2.2. Bodily movement coordination and precision necessary when piloting a helicopter

Flight manoeuvres such as turns with the roll greater than 30° require mutually coordinated and precise movements of all the controls. When performing the turn with a great roll, it is necessary to increase the main rotor thrust in time by lifting the collective lever and thus eliminate a certain loss in altitude. It is further necessary to consider that the specifically structured linkage of the collective controls in R 44 demands precise leading of the handle of the cyclic stick in the transverse direction movement. In the case of improper handle holding combined with pilot's inattentiveness, the cyclic stick moves to the right and simultaneously slightly forward in longitudinal direction, which results in the helicopter nose pitch down towards the ground. The inverse phenomenon takes place when the cyclic stick is moved in the opposite direction, that is to the left.

2.3. The helicopter

2.3.1. Helicopter Operation

The helicopter was operated within the range of the authorised weight and centre-of-gravity position, which ensured sufficient range of control for its safe piloting. The maximum take-off weight of the helicopter was not exceeded.

The operational fluids in the helicopter were compliant with quality requirements and technical standards in type, quality and amount filled in the systems.

2.3.2. Results of technical inspection and expert examination

The technical inspection, performance of essential expert examinations and analyses, including the assessment of the technical condition of the helicopter critical parts discovered neither any trace nor any technical defect or malfunction that could be the cause or could lead to the loss of power or manoeuvrability of the helicopter. No contact of the rotating lifting surfaces with the helicopter fuselage took place during the event flight. The destruction of both, interior and exterior parts of the cabin, as well as of the landing gear, the tail beam, main and tail rotor and of the main rotor blades took place as a consequence of the helicopter impact into a solid obstacle.

All of the damage of the helicopter was generated as a consequence of the helicopter crash onto the hall roof. Neither any technical defect of the helicopter nor of its systems could be identified, implying the helicopter was fully functional, operational and airworthy until the moment of impact into the MEA building roof.

2.4. Weather Effects

Weather conditions had no influence on the origin and course of the air accident.

3. Conclusions

3.1. The AAII Commission concludes as follows:

3.1.1. Pilot

- had valid qualifications for the said flight,
- held a valid limited licence of the aeronautical mobile service radio operator,
- had, from the skills point of view, sufficient piloting experience with flying this specific type of helicopters,
- was unauthorised to use the helicopter by its owner, or as the case may be its operator,
- had not a valid class 2 medical certificate,
- the comprehensive medical examination discovered no facts that would indicate a health-related cause of the air accident,
- wilfully, in the course of approx. 2 hours prior to the event flight, consumed alcoholic beverages, as was proven by toxicological testing showing **blood alcohol content in the amount of 1.97 g.kg^{-1}**,
- although he had managed to perform two flights immediately prior to the event flight, the blood alcohol concentration rendered safe piloting impossible,
- performed the event flight as well as the two previous flights contravening the rules for performing VFR flights,
- carried out a take-off from the company building roof which was outside the residential area of the given municipality, but the manoeuvre was performed at a distance shorter than 50 m from persons not participating in aerospace activities,
- the Commission was unable to clarify the reason why he had landed from the flight preceding the event flight on the building roof and took off for the event flight from the same roof, when there was a suitable area for performing landing and take-off on the ground, as he had been using that area for take-offs and landings with his own helicopter,
- the decision to take off from the building roof and to perform the subsequent flight cannot be accounted for by operational or weather conditions, but only by irresponsible and almost arrogant approach negatively influencing flight safety,
- by his approach towards keeping the aeronautical regulations he caused an air accident in which he himself died and three other people onboard together with him, and endangered safety of more people in the area of his flight,
- by his deliberate and wilful behaviour caused a situation leading to an air accident.

3.1.2. The helicopter

- had a valid certificate of airworthiness inspection and was airworthy,
- had a valid liability insurance;
- at take-off, the maximum take-off weight of the helicopter was not exceeded,
- at the time of air accident, there was sufficient amount of fuel in tanks,
- the engine worked perfectly normally during the whole flight and all control elements were fully functional,

- no evidence exists to substantiate any and all defects of the helicopter prior to its impact into the building roof,
- the described damage to the structure of the helicopter was caused only after the crash into an obstacle,
- was completely destroyed due to the forces affecting it after the contact of the rotating surfaces and the fuselage with the building roof and by the consequent crash into the roofing structure.
- the damage to the main rotor, fuselage, and to the tailplanes corresponds to the impact into the roof in flight attitude,
- after the break through the roof structure into the hall, the helicopter fell with the tail beam onto the hall floor and the helicopter fuselage remained hanging under the roof,
- was piloted by the pilot seated in the front right seat during the event flight.

3.1.3. Causes

The cause of the air accident was a combination of overestimating of pilot's own abilities with the effect of blood alcohol concentration rendering safe piloting impossible namely during an extreme manoeuvre in flight at a very low altitude above ground.

4. Safety Recommendations

Given the causes of the air accident, the AAII issues no safety recommendations.