COMMITTEE FOR THE RE-INVESTIGATION OF

THE SMOLENSK AIR CRASH

TECHNICAL REPORT

This report contains facts regarding the crash of the TU-154M No. 101 (Fight PLF101) that took place near SMOLENSK NORTH airport, Russia on April 10th , 2010.

This crash is being investigated by the Committee for the Re-Investigation of Air Crashes (hereby referred to as the "Committee") which is a part of the Committee for the Investigation of National Aviation Accidents. The Committee has been tasked with the responsibility of determining the circumstances and causes of this air crash, and with the issuance of appropriate preventive recommendations. This Technical Report includes findings concerning the most important technical aspects of this crash.

WARSAW 2018

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PREFACE

The Committee for the Re-Investigation of Aircraft Accidents (Committee) at the Ministry of National Defense of the Republic of Poland, hereby presents the findings of its investigation into the causes of the air crash of the Polish Air Force aircraft TU-154M (Flight PLF101) in Smolensk, Russia, on April 10, 2010. The crash claimed the lives of all occupants onboard, among them, the President of the Republic of Poland, Lech Kaczyński (Smolensk Crash).

According to international standards of aircraft accident investigation, all important facts (circumstances and crash evidence), which are later analyzed before stating the final conclusions and recommendation, are included in the first part of this report. In this document, the Committee focuses on the most important pieces of information, including facts and evidence not taken into consideration in the Final Report of the Committee on State Aircraft Accident Investigations (Pol. Komisja Badania Wypadków Lotniczych Lotnictwa Państwowego) - KBWLLP), headed by Jerzy Miller. Key analyses, which lead to the main conclusion of the Committee, are hereby cited as examples.

Important facts, information, and circumstances presented in this document were not taken into consideration in the reports of the Russian Interstate Aviation Committee (Rus. Межгосударственный Авиационный Комитет – "MAK Report") as well as those reports produced by Miller's committee. As a result of this Committee's investigation and analysis, the findings of Miller's Committee and the findings of the MAK Committee, which the Miller Committee concurred with, are proven to be untrue. Accordingly, the July 29, 2011 report completed by Jerzy Miller's Committee on State Aircraft Accident Investigations in the case of the Smolensk crash is not valid and is hereby nullified.

The KBWLLP Committee of the Ministry of Defense of the Republic of Poland hereby nullifies the classification of the cause of the crash of the TU-154M aircraft in Smolensk on April 10, 2010 as a "Controlled Flight into Terrain being a result of a pilot's mistake (CFIT)" due to the following reasons:

1. The Russian air traffic controllers at the Severny North airport in Smolensk (Severny), in agreement with the commander of the Russian Military Transport Aviation, Gen. Benediktov in Moscow, gave false information to the crew of the TU-154M during the landing approach on April 10, 2010. The approach of TU-154 was preceded by a controlled landing approach of a Russian military IL-76 aircraft, which was supposed to verify the functioning of the navigation instruments of the Severny aerodrome. The IL-76 aircraft performed a landing approach twice with weather conditions being sub-optimal and each time was able to approach at an altitude only a couple of meters above the runway, albeit significantly to the left.

2. In direct contradiction of the statement of Miller's committee, General Andrzej Błasik, Commander of the Polish Air Force, was not present in the cockpit of TU-154M during the crash and had no influence on the crash. Miller's Committee accused General Błasik without any evidence.

3. During the entire flight, the TU-154M air crew and the Pilot in Command (PIC) made correct decisions, which were agreed upon by the entire crew and were carried out according to the prescribed flight regulations. Sixteen (16) minutes before the crash, the captain (PIC) made the decision to go around, and, in the case of bad weather, to perform only a 'look-and-see' approach. He (the PIC) gave the order "go around" at a safe altitude, which was confirmed by the co-pilot (??). During the entire landing approach, the crew responded properly to the commands issued by the air traffic controllers, who informed the crew about their distance from the runway.

4. The TU-154M aircraft was destroyed in the air as a result of several explosions.

5. The initial explosions in the left wing lead to the destruction of the structural components in the end of the detachable wing approximately 900m before the threshold of runway No. 26 of the Smolensk Severny aerodrome. These explosions destroyed the slats, ribs and spars, as well as the skin of the aircraft; the pieces of this explosion were distributed along the flight path in an area measuring 30m in width and 400m in length. Subsequently, the flaps were torn off; pieces of which were also found at a distance of over 400m from the plane.

6. When the plane passed the point defined as TAWS38 (710m before the runway threshold) a series of malfunctions occurred to various systems, including to: the left engine, the generator, the flaps, the undercarriage, both radio altimeters, the primary hydraulics, and the magnetic course compass).

7. Another explosion in the fuselage of TU-154M occurred above the ground. At that time, before the plane impacted the ground, a failure of the electrical power supply occurred. The explosion took place in the left part of the fuselage in the area of Lounge 3 where, due to a pressure wave, the left passenger door was blown away as well as the first and third spar of the left center wing. The bodies of more than ten passengers were impacted by this explosion and body parts were ejected in the area up to 100m away.

The evidence enumerated in this document is not final. A complete list of facts, information, research and analysis will be presented in the final report.

Previous investigations

The proceedings related to the crash of military aircraft TU-154M PLF101 in Smolensk on April 10, 2010 should have been subject to the bilateral agreement between the Russian Federation and the Republic of Poland of August 1993. This agreement stated that both countries are to be equally represented in one investigative body consisting of members of institutions authorized to examine military aircraft crashes (in Poland: KBWLLP). With respect to Article 11 of the agreement, both parties have equal rights and equal access to all evidence and information.
(Source: Agreement from December 14, 1993 between the Ministry of National Defense of the Republic of Poland and the Ministry of Defense of the Russian Federation concerning the air traffic of military aircrafts of the Republic of Poland and the Russian Federation in the air-space of both countries.)

In accordance with Polish law, the former Minister of National Defense in 2010, Bogdan Klich, was obliged to send the "Committee for Investigation of National Aviation Accidents", the KBWLLP. This did not take place and Polish specialists were sent to Smolensk without proper authorization. The Chairman of the State Commission on Aircraft Accident Investigations was included in the group. The Chairman dealt exclusively with civil aviation accidents and did not have formal authorization to investigate the crash of a military aircraft.

At noon, on April 10, 2010, the then Deputy Ambassador of Poland, Piotr Marciniak, sent a diplomatic note to the Russian Ministry of Foreign Affairs demanding the crash scene be secured and that Polish representatives have full and unobstructed access to carry out their investigation. This was not signed off by the then Polish Minister of Foreign Affairs, Radosław Sikorski, and Polish experts were never afforded such an opportunity. Instead, the Russian side began to interfere at the crash site from the outset.

On April 11, 2010, the Council of Ministers created the Inter-Ministerial Team, headed by Prime Minister Donald Tusk, which was supposed to deal with all issues concerning the Smolensk crash. This team consisted of: the Minister of Foreign Affairs, the Minister of Defense, the Minister of Infrastructure, the Minister of Justice, as well as the heads of the civilian and military special services. The decisions, on behalf of the Inter-Ministerial Team, were made by Donald Tusk, who said many times, that he is personally responsible for all decisions made with respect to the investigation of the Smolensk crash.

Donald Tusk acquiesced to Russian pressure demanding that the investigation not be conducted according to the Agreement from 1993 but according to Appendix 13 of the Chicago Convention from 1944, which is applicable only to civilian aviation.

On April 13, 2010, Minister Ewa Kopacz and Tomasz Arabski, who were present in Moscow during a meeting with the then Prime Minister of Russia, Vladimir Putin, and representatives of the Russian government, confirmed it was Tusk’s decision.

The chairman of the Russian military commission, General S. Baynetov, did not recognize the demand of Polish specialists to create a joint Russian-Polish committee and referred the resolution of this issue to state authorities in Moscow. Until the issue was resolved, the Polish investigators were not allowed to conduct any independent research and were only allowed access to information made available by the Russian side.

The CVR (Cockpit Voice Recorder) and other recorders, constituting key research and/or investigative material, were extracted without the presence of the Polish representatives. On April 10 at approximately 17:00 Moscow time, according to the statement presented by the Minister for Emergency Situations Sergei Shoigu, who was responsible for the activities on the Severny aerodrome, the Russians began to examine the CVR without the participation of Poles.

On April 13, by virtue of a joint decision of the government of the Russian Federation and the government of Donald Tusk, it was decided that the investigation of the crash be based on ICAO principles from Annex No. 13 of the 1947 Chicago Convention regarding civil aircraft crashes.

In practice, this meant that the Polish experts did not have independent access to evidence material, witnesses, and other information.
(Source: Information by PAP - 16:23, 10 04, 2010, 19:10, 10.04.2010, RG.RU, 18.26, 10.04.2010, Vesti.RU)

On April 15, 2010, the then Polish Minister of Defense, Bogdan Klich, appointed the members of the KBWLLP. Its first chairman was Edmund Klich. On April 28, 2010, he was replaced by the then Minister of Interior, Jerzy Miller.

The recording from the kick-off meeting of the KBWLLP from April 28, 2010 shows that Jerzy Miller and his team worked in a "non-standard" fashion. That is, they adopted the rules of investigation applicable to a crash of a civilian aircraft - just as the Russians did. Subsequently, he also adjusted his team's findings to match the results later acquired by the Russians. This was accompanied by warnings about "unpleasant consequences" if both reports are not the same. Jerzy Miller is quoted: "We'll either have a unified [identical] message, or we can whip our backs."

At that time, the KBWLLP did not have full and independent access to the original flight data recorders or the cockpit voice recorder (CVR). The original recorders along with the wreckage still remain in Russia's possession.

Therefore, the then KBWLLP did not conduct an impartial independent investigation and, in the same manner, did not analyze the debris at the crash site. Neither lab tests of the wreckage, navigation instruments, nor engines were analyzed. The subsequently released data is based solely on the data provided by the Russian side. An exception was the examination of the engines during April 11-13, 2010, and later at the location where the debris was kept, on April 16, 2010. The KBWLLP's chief engine expert showed a lack of specialized knowledge concerning the necessity and importance of conducting tests on the starting engine TA 6A.

After analyzing the findings of the experts who were in Smolensk during the first days after the crash, the KBWLLP formulated, in writing, a plan of research to be done to clarify the nature of the crash. The investigation aimed to verify whether the "fuselage showed damage typical of an explosion", an important point in that plan. This investigation, however, was never performed. Despite that, the KBWLLP published a report concluding that there was no explosion on board the plane. The report of the archaeologists* was also not taken into consideration. contradicting itself, the report, clearly and unequivocally, showed that the plane disintegrated into tens of thousands of pieces.
(Source: Memo of Stanisław Żurkowski, Head of the Technical Committee KBWLLP from September 2010.)

According to ICAO regulations and Annex 13 to the Chicago Convention, the Russian Federation gave the draft report of MAK to the Polish side on October 20, 2010. On December 19, 2010, Poland responded and handed over its remarks to MAK and within the 148 pages it was proven that the Russians did not give the Polish authorities over 100 key documents. It also clearly stated that research performed by the Russian authorities was contradictory

and contained numerous mistakes. The Polish authorities rejected the MAK report and demanded that changes in the analysis and conclusions be introduced. In contradiction to the requirements of Annex 13, comments of the Polish authorities were not taken into consideration. On January 12, 2011, MAK published its report without the "Remarks of the Republic of Poland".

On July 29, 2011 KBWLLP published its report, in which it accepted all key theories from the MAK Report and, at the same time ignored entirely the previously stated doubts and objections included in the document entitled the "Remarks of the Republic of Poland to the draft version of the final report".

The Miller Committee did not include facts about the overhaul of TU-154M and the incomplete pyrotechnical procedure before the departure to Smolensk.

During several months following the crash, the remains of the TU-154M were treated in a way completely incompatible with proper crash investigation procedures.
(Source: Point 3.3 and Recommendation 5.4.3 Appendix 13 to the Chicago Convention)

The crash site was not secured according to standards and guidelines of proper crash investigation.
(Source: Point 3.3, Appendix 13 to the Chicago Convention)

Parts of the remains were moved to new places, which were described in the protocols of conduct as the place where they were found (e.g. a fragment of the left part of the horizontal stabilizer was moved between the 11th and 12th of April 30 meters closer to the main field of debris).
(Source: Satellite photos taken on April 10, 2010 and April 11, 2010.)

The KBWLLP Committee has more than 10 (ten) digital copies (none of which are accurate nor identical) of the CVR, which is a Russian-made MARS-BM manufactured in Moscow between the years 2010-2011 and 2014.
(Source: Copies dated 12.04.2010, 31.05.2010, 09.06.2010 and February 2014 and other copies.)

The KBWLLP possesses five (5) ATM QAR copies, each differing from each other (from April 2010, July 2010, February 2011, August 2016 and January 2018) and two (2) copies of the Russian recorders KBN 1.1 and MLP-14-5.

Even though it was obligatory under Polish law, no post-mortem examinations of the victims' bodies were conducted after they were transported to Poland. Russian medical documents, which were handed over to Poland, contained major mistakes. In the KBWLLP report, in Appendix 7, the autopsy results of only three (3) bodies of crew members and the captain were taken into consideration.
(Source: Art.209 Penal Code. Numerous mistakes in the description of body injuries, included in the documentation made and handed over by the Russian side, were described and noted in detail during exhumations and medical-forensic examinations of the body parts.)

Polish authorities had knowledge about the swapping of bodies in coffins as early as September 2010, yet they failed to take necessary and prudent steps to correct this unacceptable situation. They informed the victims' families about these mistakes almost two years after they took place. The subsequent exhumations confirmed the swapping of bodies.
(Source: Protocols from exhumations and medical-forensic examination of body parts (materials in the possession of the Committee).)

In 2016, the State Prosecutor's office decided to perform exhumation of all victims, which confirmed the swapping of bodies in coffins. This process revealed additional and numerous mix-ups where fragments of bodies belonging to victims were discovered in the wrong coffins.
(Source: Exhumation protocols and medical-forensic examinations)

Overhaul of TU-154M, PLF101

In February 2009, the Polish Minister of National Defense announced a request for proposals to overhaul two Polish Government TU-154M aircraft. Two Polish companies "Metalexport" and "Bumar" took part in the bidding process (all previous overhauls were performed at the aviation yardsin the city of Vnukovo) but, by a decree of the Russian president, were eliminated in January 2009 from participating in signing contracts with any Russian parties; apparently, due to their earlier supply of armaments to Georgia. At the same time, the Polish Minister of National Defense, Bogdan Klich, was informed that the only Russian company authorized to perform the overhaul of the Polish Government Tupolev aircraft would be OAO Aviacor based in Samara; furthermore, the only company allowed to execute the contract would be the MAW Telecom and Polit Elektronik consortium. The committee convened by the Ministry of National Defense assigned the overhaul to the consortium consisting of those companies.

The MAW-Telecom/Polit Elektronik consortium represented the interests of the Russian company Aviacor in Samara. The board of Aviacor testified before the Russian prosecutor that the overhaul of both TU-154M aircraft was already agreed on with Polit Elektronik at the end of 2008 (before the request for proposals). None of the Polish secret services organizations questioned the credibility of the MAW-Telecom and Polit Elektronik despite the warning signs and prior-knowledge that people connected to the communist intelligence services are active in both companies.

The overhaul of the engines was not done at Samara, which lacked the properly certified facility for this type of operation, but, rather, was carried out on Aviacor's behalf in Rybinsk and Mineralne Vody.
(Source: Correspondence from MAW Telecom to Director of the Department of Armed Forces Supply dated November 30, 2009 in regards to the aircraft overhaul. Warsaw prosecutor Doc. Po.Śl. 54/10, t. 66-67, 73-76, 80-81, 84 and 85.)

A Polish government official, who provided an evaluation of Polit Elektronik and MAW-Telecom, and participated in meetings of the government body that awarded the contract, later obtained a high management position on the board of Polit Elektronik.

During the repair and maintenance work performed in Samara as well as the engine overhaul in Rybinsk and Mineralne Vody, there was no proper supervision from the Polish side. Afterwards, the TU-154 M exhibited a greater failure rate than before the repairs and maintenance took place. This concerned key parts of the avionics systems, including the autopilot and slats, as well as satellite communication system(s). Some of these defects were repaired by reassembling parts from the TU-154M No. PLF 102 (the parts were transported from Russia to Poland and were installed in Poland). Other parts were not repaired at all (e.g. the satellite Communication system).
(Source: Correspondence from MAW Telecom to "Director of the Department of Armed Forces Supply" dated 30th. November 2009 in regards to the aircraft refurbishment. Warsaw prosecutor doc. Po.Śl. 54/10, t. 66-67, 73-76, 80-81, 84 and 85.)

Access to evidence

Due to the decision of Donald Tusk's government to hand over the investigation to the Russian Federation and the decision of the majority of the Polish parliament in May 2010 not to take over the investigation from the Russians, Poland was deprived access to key evidence materials and to its analysis. As a result, the Committee appointed six (6) years after the crash, had limited access to evidence materials. The KBWLLP Committee had to come up with innovative and break-through research methods. The newest scientific-technological developments were helpful in this matter. With respect to the three essential groups of evidence the Committee used: 1) analysis of photographs, video recordings, satellite pictures; 2) available maintenance documentation; and, 3) numerous experiments and simulations. With respect to the bodies of the victims, the Committee performed a reconstruction of the original distribution of body parts at the crash site, based on photographic analysis and the investigator's

documents. An important source of information was subsequent interviews and questioning of witnesses, whom the investigator's office was often not able to reach. Key evidence, in possession of the Committee which has not been used by other institutions thus far, is the PLF101's sister plane, the TU-154M, PLF102.

Efforts to get access to substantial evidence kept by the Russian Federation

Members of the Committee, working formerly as a Parliamentary Group, contributed to putting through a resolution by the Council of Europe to secure return of the debris back to Poland. From the very beginning of its work, the Committee made efforts to gain access to the debris. At the same time, along with the State Prosecutor's Office, the Committee wanted to analyze the area of the crash site. The necessity to regain Polish property, the debris, black boxes and navigation devices, was mentioned as an important point in order to analyze it in Poland. Similarly, the necessity to analyze the area of the crash site was voiced and communicated to Russia on numerous occasions. On two separate occasions, the Polish side submitted a formal request to the MAK Committee requesting access to key information concerning the Smolensk Crash. These requests remain ignored and refused to this day and key evidence still remains in Russia.

During the meeting of the Committee with a team of archeologists on June 7, 2016, a scope of work for further analysis of the crash site was defined. The Committee determined that further research was needed and that the team would depart immediately to the crash site upon receiving approval from the Russian side to continue its research.

In October 2017, the Committee received official information from the spokesperson of the Polish Ministry of Foreign Affairs that further diplomatic notes from the government of the Republic of Poland, regarding the return of the debris, were rejected by the Russian Federation. As a result, the Committee officially filed a document with the Polish Minister of Foreign Affairs asking him to undertake necessary steps to secure permission from the Russian Federation to analyze and investigate the debris in Smolensk and to carry out a reconstruction according to ICAO recommendation**(s)**.

The KBWLLP Committee is in constant contact with the Investigator's Office and its representative(s) participating in the ongoing exhumations and actively observes these activities. The Committee expects the final results of the post-mortem examinations to be delivered shortly, which will be a key element of the final report.
(Source: Report of a member of the Committee and external expert)

RESEARCH AND CONCLUSIONS OF THE COMMITTEE

Due to a wide scope of research, it was necessary to assign particular tasks to different scientific and research centers. Each task was assigned to an accredited scientific center. The following, domestic centers specifically contributed to the research: Wojskowa Akademia Techniczna (WAT – Military Technical Institute) and Instytut Lotnictwa (Military University of Technology in Warsaw and Institute of Aviation). Additional support was obtained from the following foreign centers: the University of Akron and the National Institute for Aviation Research at Wichita State University, USA.

The same analysis was conducted at all of the research centers, and, when possible, was performed utilizing different methods, i.e. simulations and experiments, in order to verify the accuracy of the research.

Flight preparation

The electronic personnel access control system, for people entering the restricted area in the vicinity of the TU-154M 101 aircraft, was not functioning the night of April 9-10.
(Source: Report on the BOR procedures).
(Volume: Testimony of a Soldier from the 36th Regiment, 4th May 2011, Prosecutor Vol. 172, Page 95.)

During the explosives check of the aircraft, a technical kit containing more than 1066 kg of spare parts was not checked. It was loaded before the arrival of the security inspectors, on the night of April 9th through April 10th 2010. Neither BOR (Biuro Ochrony Rządu - Government Protection Bureau) nor SKW (Służba Kontrwywiadu Wojskowego - Military Counterintelligence Services) claimed to have any information concerning the means of loading of nor the content of the technical kit.
Source: Report on the implementation of BOR procedures. Response of the Minister of National Defense and Interior to the interpellation of MP Opioła.

Russian ATC activities prior to the crash

Fig. 1. Comparison of guidance of IL-76 and TU-154M on April 10th, 2010. In blue correct guidance of IL-67's two approaches, in red incorrect guidance of TU-154M.

A Yak-40, IL-76, and the TU-154M were guided with the use of a well-functioning, precision approach radiolocation station and properly functioning radio technical devices.
(Source: Committee report, 10.04.2017.)

The IL-76 pilot testified that the he was told to check the navigation system of the aerodrome.
(Source: Testimony of the IL-76 pilot to the Russian prosecutor.)

The landing approach of the IL-76 ended twice with the plane flying approximately 170 meters to the left of the runway axis.
(Source: Recording of the radio correspondence between the air traffic controller and the IL-76 pilot.)

The guidance of the TU-154M was performed with a systematic misleading of the Polish pilots by Russian General V. Benediktov, who supervised the guidance of the crew of TU-154M from the "Logika"("Logic") headquarters in Moscow. The crew of the TU-154M performed all approach procedures correctly.

The air traffic controller did not inform the TU-154M about weather conditions, which, according to the witnesses were as follows: 40m of cloud base and 200m of horizontal visibility.

At 10:23:05 (Local Time) the Flight Management Group, being in contact with the crew, took full responsibility for the guidance of the TU-154M.

The permission for a test approach was given by an unauthorized person, namely, Colonel Krasnokucki, the then Deputy Commander of the air base.

The flight controller did not tell the crew of the TU-154M about the method of landing approach, which he previously did in the case of the IL-76 aircraft crew.

At 10:29:43 (Local Time) the position of the TU-154M was determined at an altitude of 1500m before entering the second turn.

Despite a major course deviation by the TU-154M, the flight controller did not introduce any course corrections to the crew.

Before entering the third turn, the crew of the TU-154M received an order from the traffic controller: "101 perform third, radial 19". These orders were given too early and misled the pilots.

At 10:34:56 (Local Time) the crew of the TU-154M received a communiqué: "A, Polish 101 and from 100m be ready to go-around". The first pilot confirmed and made the fourth turn to the landing course and he then received the order "101 increase the fourth", which resulted in moving to the left axis of the runway.

Despite the worsening weather conditions, the air traffic controller did not inform the crew of the TU-154M about it. He did not react to any deviations from the landing course and behaved passively.

At 10:38:43 (Local Time) the air traffic controller conveyed that the TU-154M is on path 9 km before the runway threshold, but, in reality, the plane was 10.5 km before the runway threshold.

Due to the understated distance to the runway, the crew assumed a higher descent velocity, which changed the angle of the descent path, which ended a kilometer before the runway.

At 10:39:05 (Local Time) the air traffic controller gave information about the location of the plane: "101 distance 8 on glide on path". The location of the plane, however, was different - that is, 80 meters to the left of the runway and at a lower altitude.

At 10:39:12 (Local Time) the air traffic controller gave the crew confirmation of their landing approach by giving the order "Free runway" "Conditional landing (…)"

At 10:39:24 (Local Time), in accordance with military procedure USL RSL, the air traffic controller gave an order "on glide on path 6", which was false. The distance was understated by approximately 400 meters, the plane was still to the left of the runway, and the ATC did not introduce corrections to the plane's course and altitude.

The ATC gave another order "Four on glide on path", which was also false. The TU-154M was still to the left of the runway and 100 meters too high.

At 10:40:01 (Local Time), the landing zone controller said "Three on glide on path" despite the fact that the TU-154M was still to the left of the runway and approximately 60 meters too high compared to the descent path in the approach card. There was still no reaction of the landing zone controller in the form of a correction of the course and altitude. This order assured the pilot that the plane is in the right position compared to the runway.

At 10:40:13 (Local Time), the landing zone controller gave false information about the distance: "Two on glide on path". The plane was actually nearer radio-beacon (1065m) and was approaching the minimum height of the aerodrome.

After the navigator said "hundred" the commander of the TU-154M decided to go-around, which was repeated by the second pilot.

At 10:40:27 (Local Time), the landing zone controller gave late and incorrect information: "Horizon 101".

After ten seconds, the flight controller gave the order "Go-around" and, at the moment, the plane lost its left wingtip and a series of malfunctions began.

Explosion in the detachable part of the left wing

The wing tip shows a number of curls up to 450° seen as significant signs of explosion. In addition, a significant number of characteristic signs of explosion can be seen (Fig.2).

(Source: Note from the meeting with the leading investigator of the crash committee for MH17. Expertise of Frank Taylor - Fellow Member of the International Society of Air Safety Investigators (ISASI) „Forensic Investigation of Explosions" Second Edition, Alexander Beveridge, ISPN 9781420087253, 2011. ICAO Manual of Aircraft Accident and Incident Investigation Part III - Investigation. Doc 9756-AN/965.)

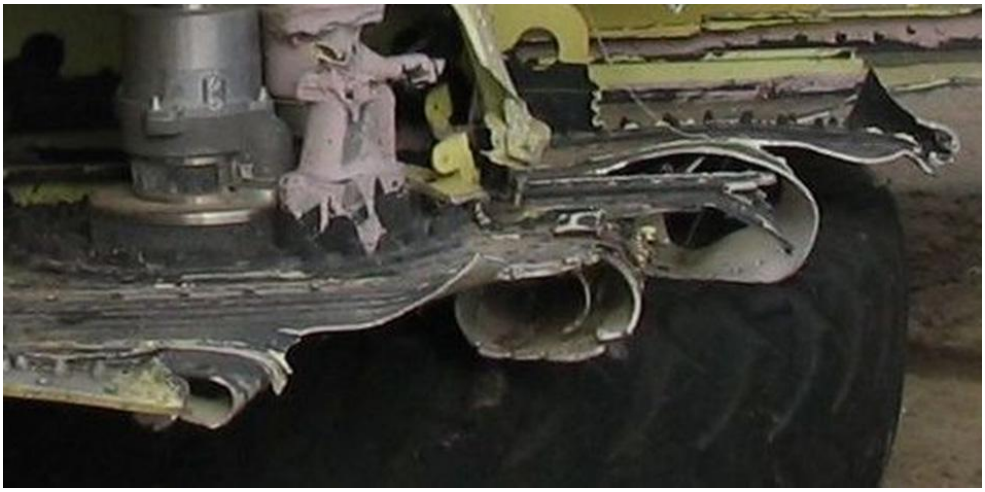

Fig. 2. Side view of the broken section of the left wing tip of the TU-154M no.101 showing significant explosive signatures (curled edges of up to 450°).

Many pieces of the left wing, in the vicinity of the Bodin birch (bb), were found before the tree in an area of 41 meters north and 17 meters south of the direction perpendicular to the flight direction and 43 meters to the east of the tree (Fig. nr.3)

(Source: WPO Expert opinion)

Fig. 3. Debris of the detachable part of the left wing identified by the Committee and experts of the Prosecutor's Office.

Three pieces of the detachable part of the left wing were hanging on the branches of the so called Bodin birch (Fig.4)

Fig. 4. Identified pieces of the detachable left wing part hanging on April 10, 2010 on the branches of the (Bodin) birch tree claimed to have cut the wing (noted "bb").

Experiments conducted by the Committee in 2016 on an element in 1:1 scale with a similar shape and weight to one of the hanging elements showed that the distance needed to lose velocity and to land on the branch is at least 100m and a height not less than 26m.

One of the elements rammed into the trunk of the Bodin birch does not come from the hypothetical place of contact between the wing and the birch; it was identified as an element in the construction of the plane being 70cm closer to the fuselage than the place of contact described by the MAK and Miller reports. (Fig. 5).

Fig. 5. The place in the wing construction of the piece rammed into the so called Bodin birch tree.

A piece of the skin of the nose, to which the piece rammed into the birch tree trunk was attached, was identified over 200m further in the direction of the flight path - next to the Kutuzov street. A fragment of the spar, to which this piece was attached, was identified 400m further in the direction of the flight path in sector 10. (Fig. 6).

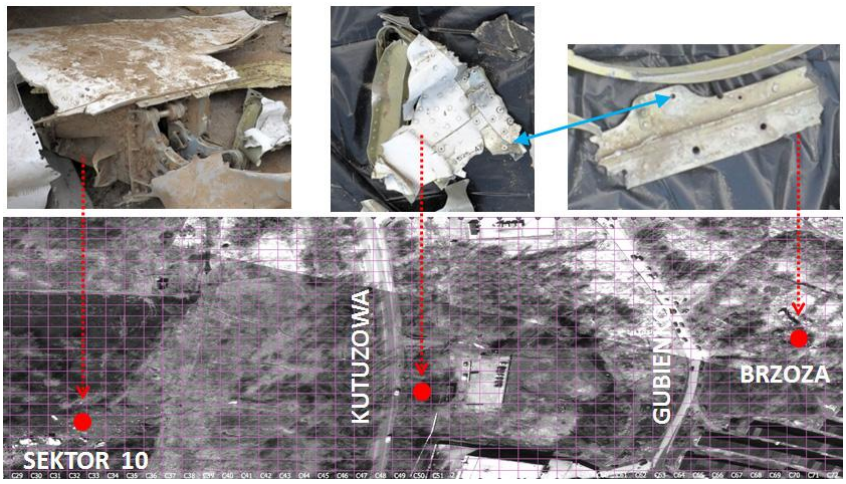

Fig. 6. Position on the ground of neighboring elements in the wing construction to the debris rammed into the trunk of 'bb'.

In the area of damaged wing pieces bent in the opposite direction than the flight direction, the presence of buckling and bandings due to an impact against the terrain obstacle was stated.

Elements of the skin of the left wing, which according to the MAK and Miller reports were supposed to have made contact with the bb tree are torn off and bent outwards; the upper side bent upwards, and the bottom side bent downwards. (Fig. 7).

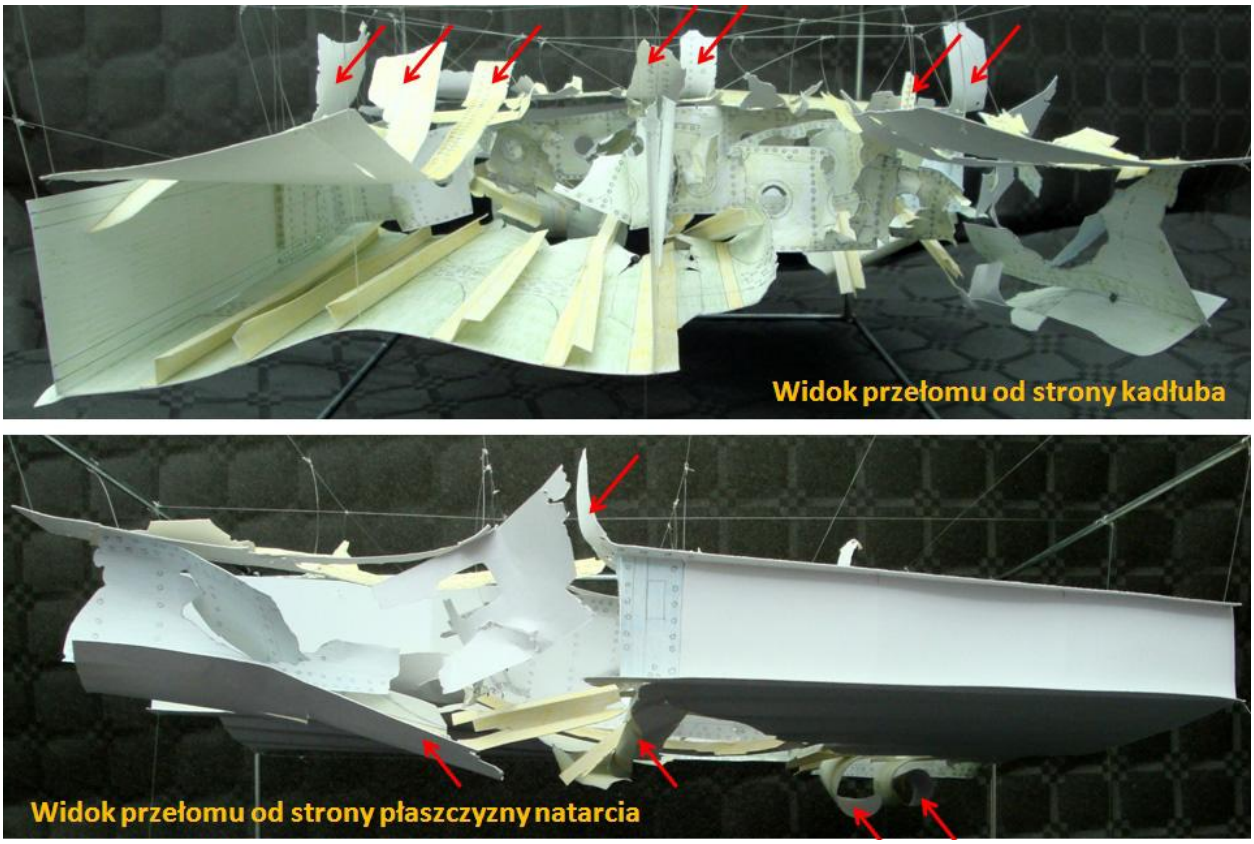

Fig. 7. Place of separation of the left wing tip. Places in the outer and bottom skin have been marked with red arrows, which have been bent outwards.

Some stringers of the left wing, which according to the MAK and Miller reports were supposed to have made contact with the Bodin birch tree (‘bb tree’), are torn away and bent outwards which indicates the activity of high pressure (Fig. 8).

(Source: Reconstruction of left wing by the KBWLLP Committee based on video and photographic material.)

Fig.8. Pieces of stringers of the left wing curled outwards

Elements of the plating of the removable part of the left wing, which according to the MAK and Miller reports were supposed to have made contact with the 'bb tree', are ripped out and bent outside the structure; on the top surface upwards (Fig. 9), and on the bottom surface downwards (Fig. 10).

Fig. 9. Pieces from the top skin curled outwards.

Fig. 10. Fragments of the bottom skin curled outside the structure.

Some pieces of the left wing rib, which according to the MAK and Miller reports were supposed to have made contact with the 'bb tree', are torn off of the structure (Fig. 11)

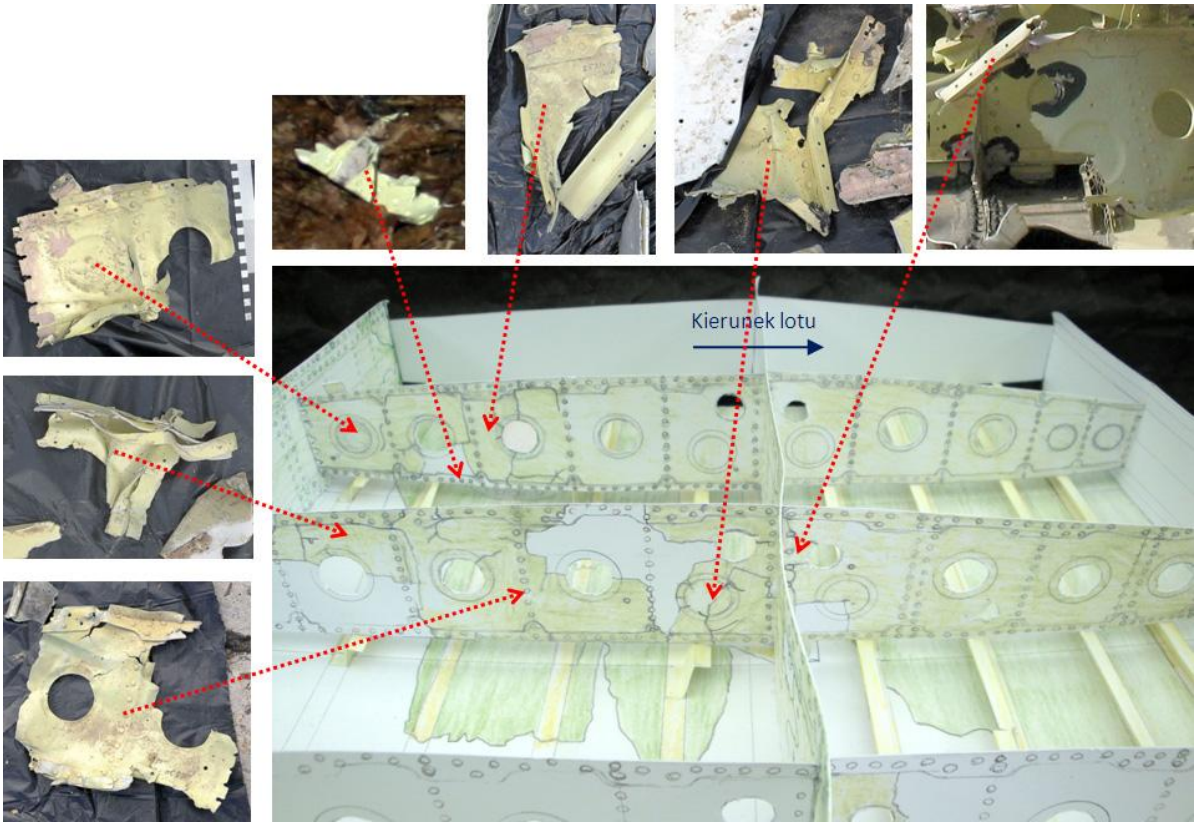

Fig. 11. Condition of the ribs of the left wing according to the reconstruction made by the Committee. The blue arrow denotes the direction of the flight.

Some pieces of the wing spars from the detachable part of the left wing, which according to the MAK and Miller reports were supposed to have made contact with the 'bb tree', are torn off or bent outwards (Fig. 12, 13 and 14)

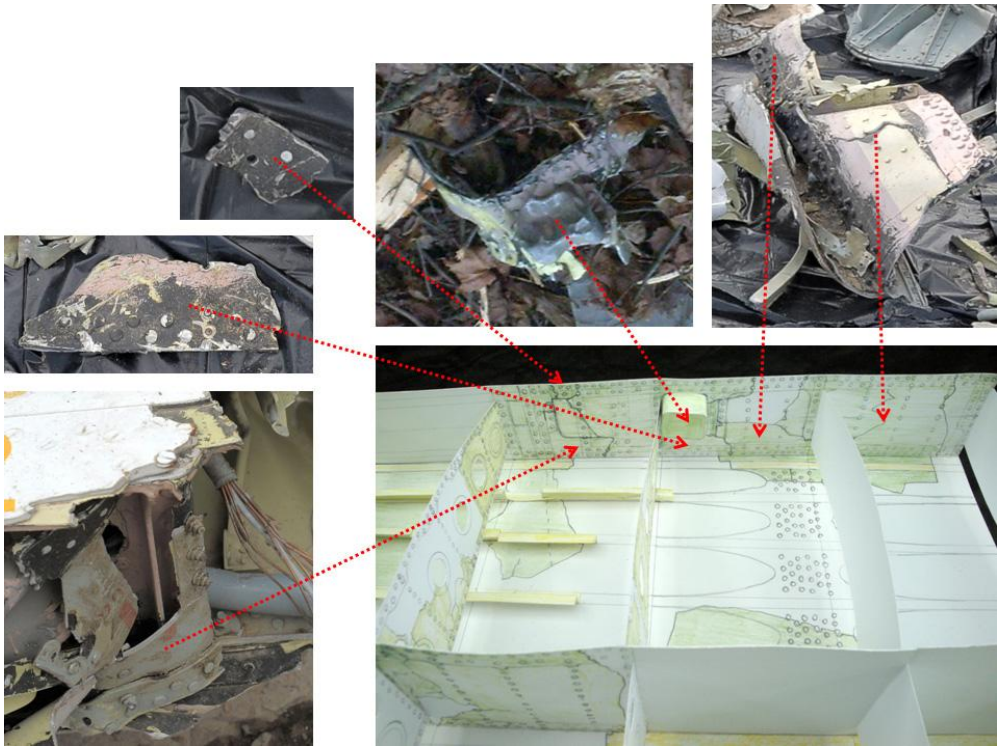

Fig. 12. Condition of spar no.1 of the left wing according to the reconstructed model made by the Committee, based on pictures and videos.

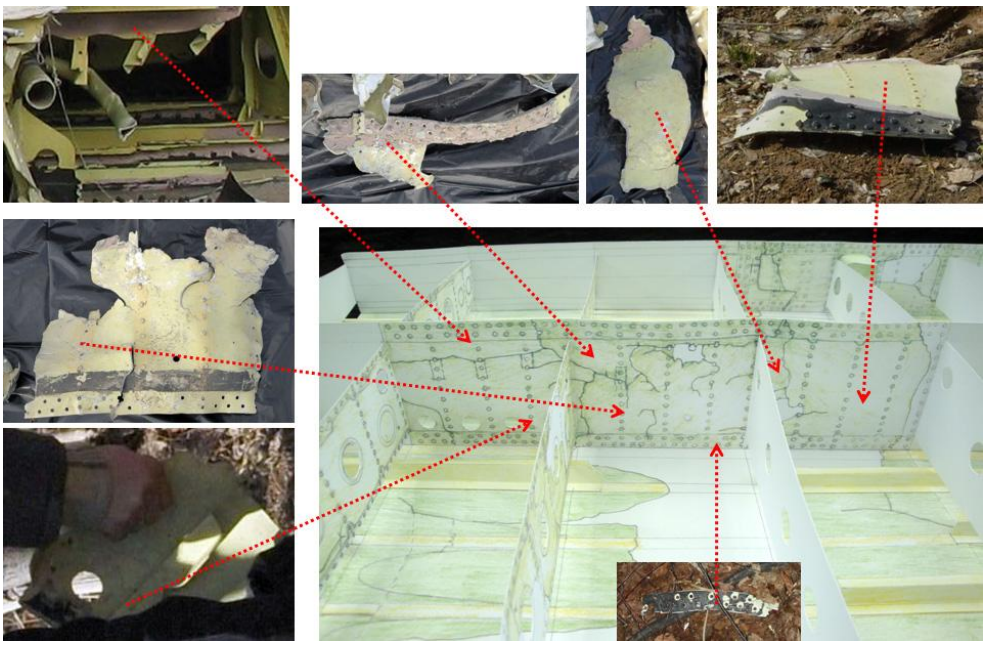

Fig. 13. Condition of spar no.2 of the left wing according to the reconstructed model made by the Committee, based on pictures and videos.

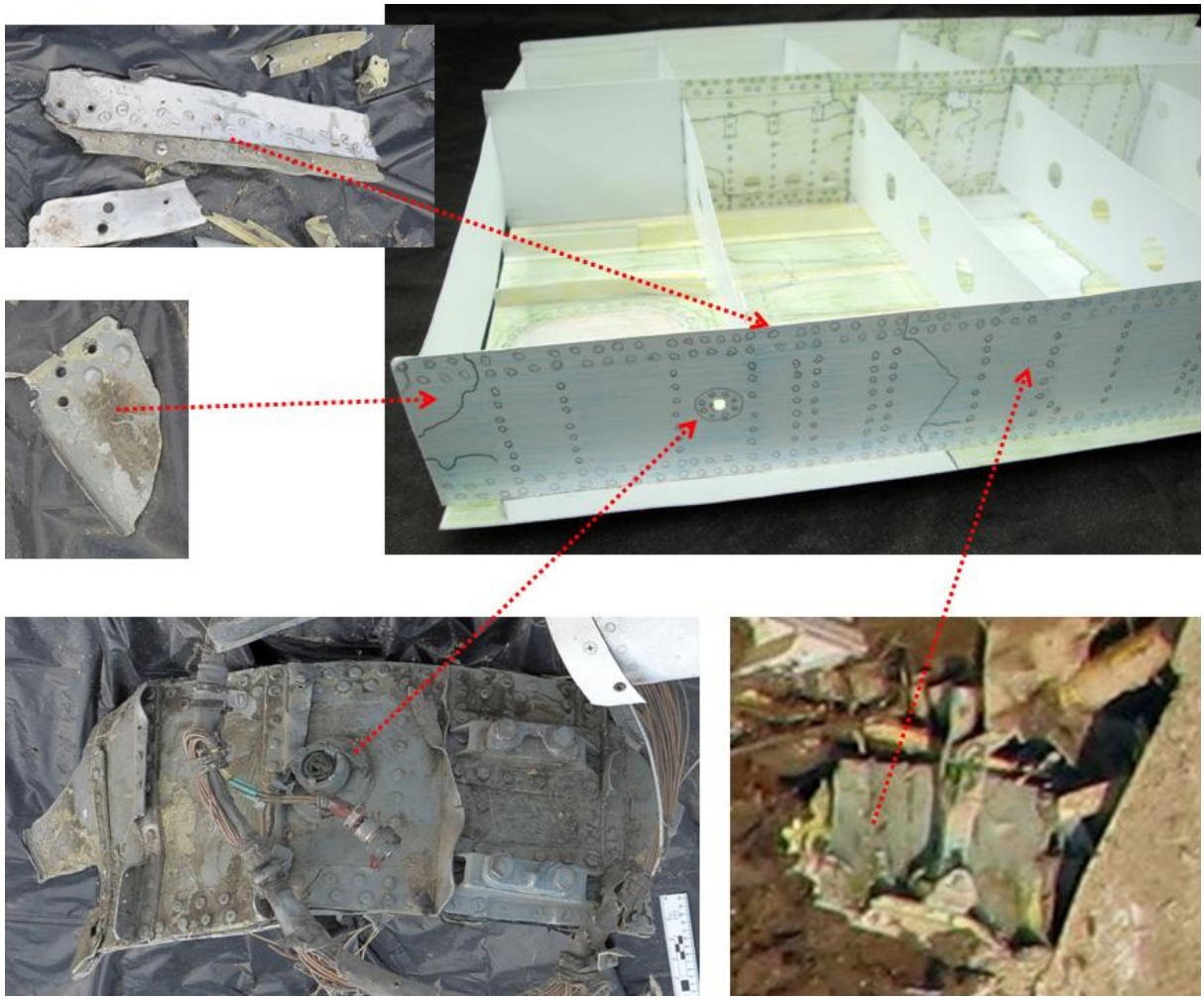

Fig. 14. Condition of the spar no.3 of the left wing according to the reconstructed model made by the Committee.

A fragment of spar no.3 of the left wing, which according to the MAK and Miller reports was supposed to be cut by the so called Bodin birch tree, was found on the main crash site 450m behind the 'bb tree' and then cut. Its separated pieces were found in various places of the debris storage place (Fig. 15).

Fig. 15. View of the same part of spar no.3 from the detachable part of the left wing on the main crash site (top two pictures) and place of storage of the debris (bottom left and right pictures). The bottom middle picture is a drawing of the left wing of TU-154M, No. 102, where the red arrows show the hypothetical trail of the 'bb tree' through the left wing, while the black arrow shows the location of the part of the third spar.

Some elements of the nose of the left wing, which according to the MAK and Miller reports were supposed to have made contact with the Bodin birch 'bb tree', are torn off or bent outwards (Fig. 16)

Fig. 16. Condition of the nose of the left wing according to the model reconstruction made by the Committee.

Some pieces of the second section of the left wing slats, which according to the MAK and Miller reports were supposed to have made contact with the so called 'bb' tree, are torn off or bent outwards; the upper side upwards, the bottom side downwards, and from the side of the angle of contact to the front (Fig. 17).

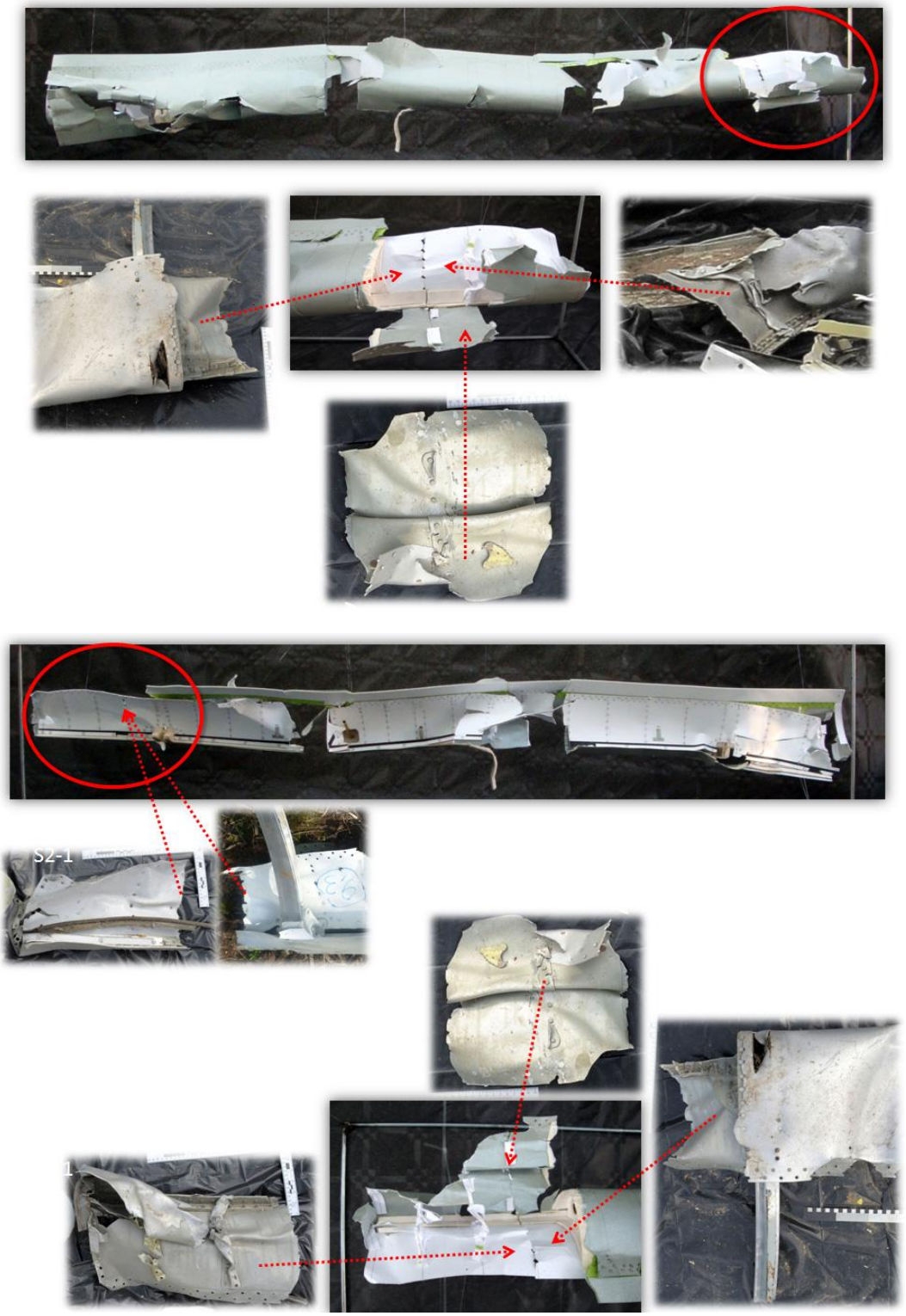

Fig. 17. Condition of the second section of the left wing slat according to the reconstructed model made by the Committee (is this also based on pictures and videos?)

The reconstruction of the console of the left wing made by the Committee/KBWLLP, in the place where according to the MAK and Miller reports was supposed to have made contact with the 'bb' tree, shows clear signs of deformation as a result of high internal pressure with the epicenter being between ribs 27-32 (Fig. 18.)
(Source: Reconstruction of the console of the detachable left wing part with elements of the external construction, which have traces of deformations due to high internal pressure and an epicenter between ribs 27-32.)

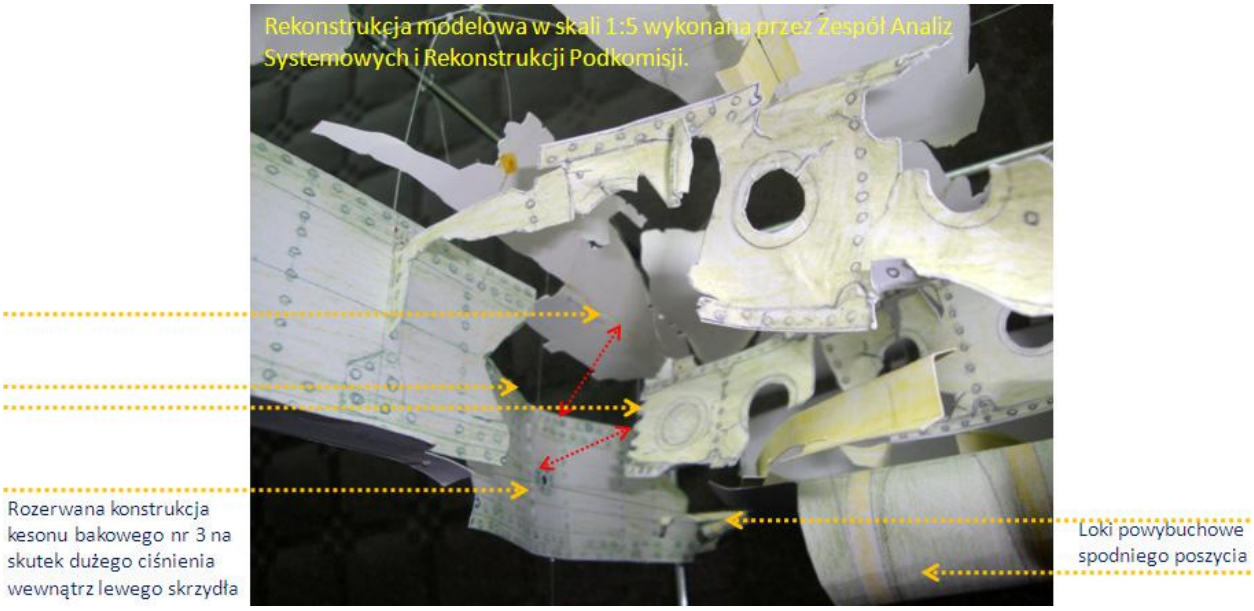

Fig. 18. Reconstruction of the console of the subtracted part of the left wing with elements of the internal structure, bearing traces of deformation through the impact of high internal pressure with an epicenter between ribs No. 27-32.

Pieces 1 and 2 of the slot section of the left wing (which are 6m20cm long in the structure) were distributed in the direction of the flight path of the TU-154M in an area of 20m to 230m from the so called Bodin birch ('bb tree'). Many elements were moved and some of them swapped on the 11th and 12th of April, which might indicate a purposeful manipulation of the evidence material.

Example: One of the pieces of the 2nd section of the slot, which fell into a ditch next to the road leading from the garages to Gubienko street (approx.20m behind the birch tree), was moved on April 11, 2010 under the 'bb' tree. On April 12, it was swapped with another piece stemming from the line of separation, which fell into the ditch next to the street leading from the garages to Gubienko Street (approx. 50m behind the birch). Picture 19.

Fig. 19. Fragments of 2 sections of the slot moved from the original location on the ground under the tree claimed to have made contact with the wing.

The majority of elements from the flaps of the detachable wing part were scattered from the 'bb tree' in the direction of the main crash site in an area that spanned 15m-225m in the flight direction of the TU-154M. (Fig. 20).

(Source: Pictures from the report and video materials of the Committee.)

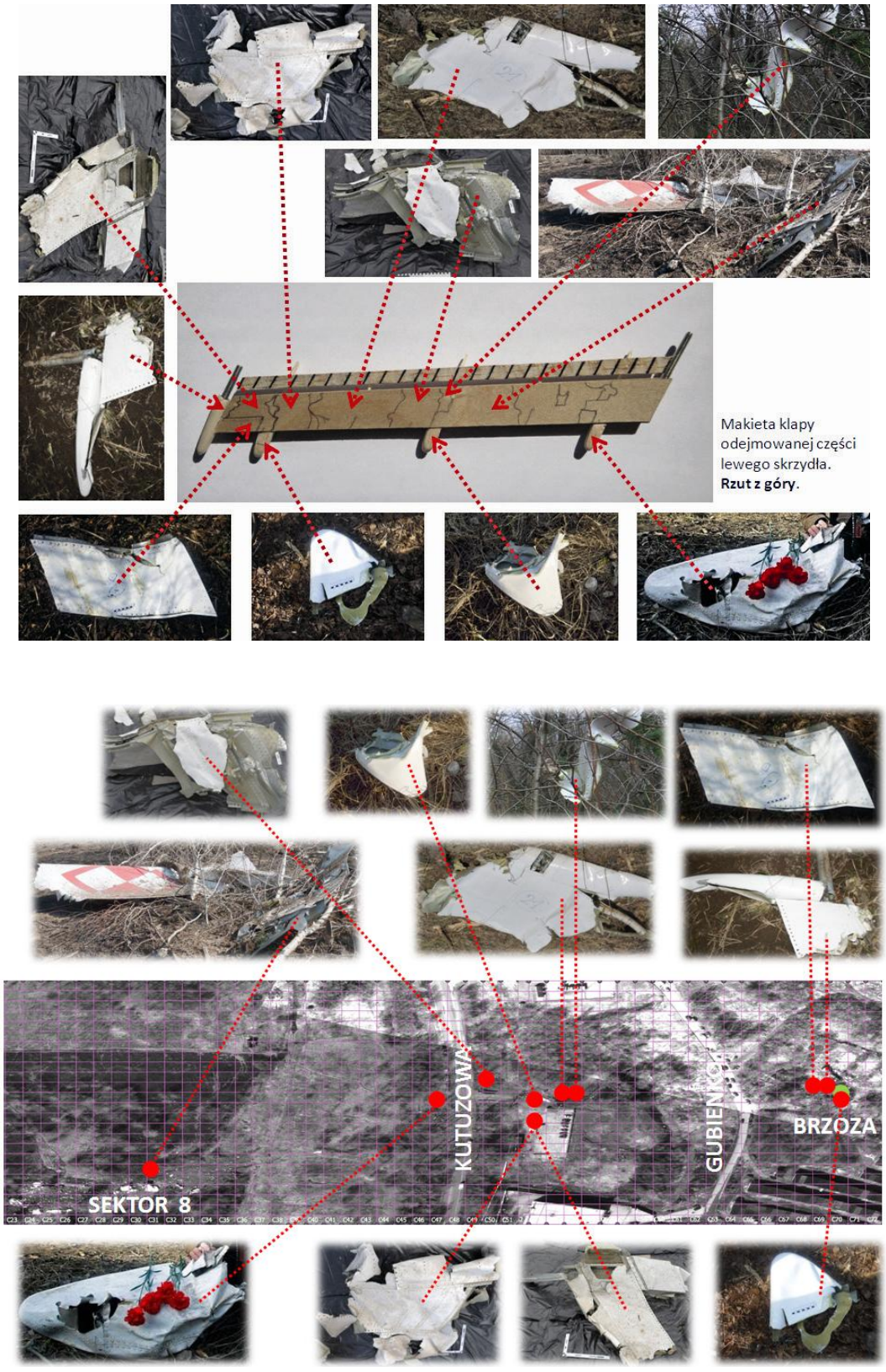

Fig. 20. The locations on the ground of various parts from the left wing.

The location of the separation of the left wing tip is not parallel to the axis of the fuselage, instead it creates a line deviating from this axis by 7.5-10 degrees.

The location of the separation the left wing tip shows classical post-explosive signatures typical of explosive materials, including irregularly curled edges with more than one turn. The broken area of the left wing tip shows a large number of the characteristic signs indicating high internal pressure, including damage to rivet lines, separation of rivets, and clean separation of skin from the remaining parts. (Fig. 21 and Fig.22).

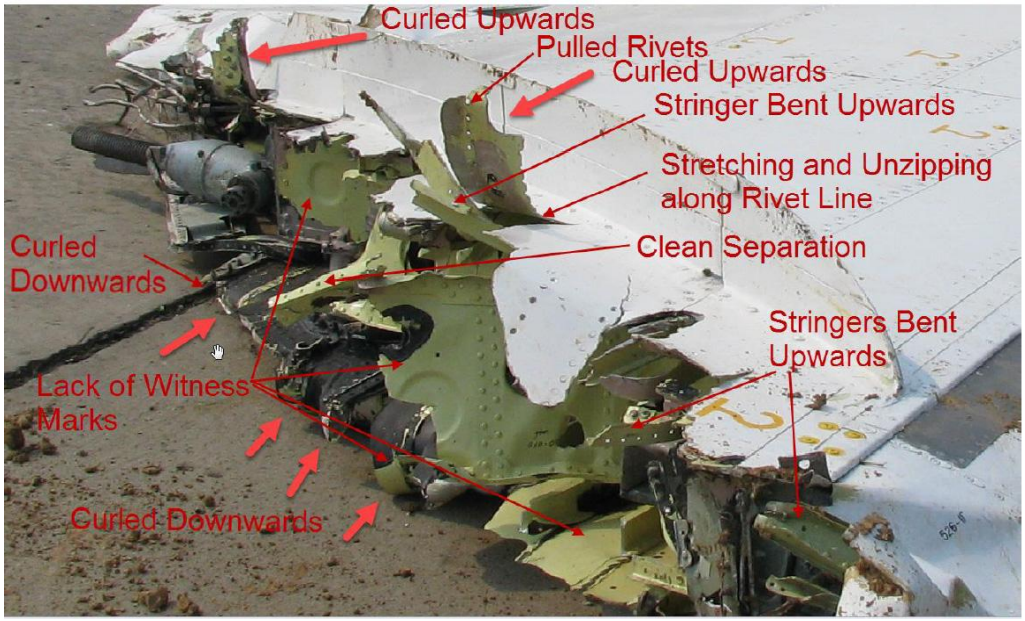

Fig. 21. The area of separation of the left wingtip of the TU-154M, PLF101 showing obvious and significant signs of explosion as well as many other characteristic signs of explosion.

Fig. 22. A close-up of the photograph from Fig. 21 with visible post-shock curls with the axis of curl in the direction of flight.

The experiments carried out by the KBWLLP Committee in March 2018 on the wing fragment model (Scale 1: 4 and 1: 1) show that a wing with fuel and fuel vapors can be destroyed by explosive charges without a major fuel explosion and with many observed features similar to the destruction of the wing tip of the TU-154M that crashed in Smolensk. (Fig. 23 and Fig. 24)

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Fig. 23. Separation by explosive material of the wing box containing fuel (Scale 1:1). The experiment demonstrated the wing could be cut (destroyed?-?) without a secondary, major fuel explosion.

Fig.24. Experiment (model on a 1:4 scale) of cutting a wing with fuel with the use of 6g/m PETN Cord Note in the direction of curls away from the area of high internal pressure. The experiment demonstrated the wing could be cut without a secondary, major fuel explosion.

(Source: Report on the research on explosiveness of fuel, Volume 1 2017. Report on experimental research concerning the destruction with the use of explosive materials of a construction imitating a part of the fuel box in the left wing of TU154M, 2018. Doc No: PW/WB/GAJ-080717-01 Experiment: cutting the wing model with the use of a linear explosive charge, 2017.)

The experiments conducted by the Committee in February 2018 (on a of scale 1:1) show that the destruction of a wing with the characteristics of a 'cut', with all the spars and stringers, can be achieved with the use of a linear explosive material with a thickness of 1mm and width of 5mm. This material can be placed inside the fuel box and sealed to prevent it from having contact with fuel and, at the same time, making it undetectable.

(Source: Report on experimental research concerning the destruction with the use of explosive materials of a construction imitating a part of the fuel box in the left wing of the TU-154M, 2018.)

Events between the explosion in the wing and TAWS 38

The main part of the lifting force of the 76-ton TU-154M comes from the lift force of the left and right wing, and from the slats and flaps. When rolling (90 degrees or more) the plane loses altitude.

Very precise experiments conducted in an aerodynamic tunnel, as well as simulations with the use of fluid dynamics conducted by 4 independent institutions (WAT, Akron University, IL, Metacomp), show that the loss of the left wingtip, which decreased the wingspan by approx. 6.5m, would result in the loss of lift, in this particular case by 4.8%-8.7% depending on the angle of impact.

(Source: Results of experiments of the Aviation Institute 6.XI.2017 and 27.III.2018.)

Experiments in an aerodynamic tunnel, conducted in IL, showed that the loss of lift between 4.8% and 8.7%, due to the loss of the left wingtip, does not necessarily result in a left roll. Those experiments show that the pilots, even with an angle of impact up to 11.5degrees, can fully balance the rolling moment by introducing a 7-degree side slip (i.e. they have to change the configuration of the plane in such a way that the left wing is moved forward). Further balancing is possible with the move of the right aileron. A side slip is an element of basic aviation training and instinctive for experienced pilots, who use this technique during situations with cross-wind. When losing 1/3 of the left wing, the decreased wind resistance on this side will result in a right-turn of the plane towards the sideslip resulting in the left wing facing towards the front. (Fig. 25).

(Source: Results of experiments of the Aviation Institute 6.XI.2017 and 27.III.2018.)

Fig. 25. Airplane model in the wind tunnel of the Institute of Aviation. This version includes a cut left wing and is without slats and the outer flap.

A number of airplanes of similar size to the TU-154M, e.g. the B707, experience similar or even a bigger loss of lift of one of the wings during flight and are still able to land safely.

(Source: PANAM flight 843, https://www.youtube.com/watch?v=_-fNahas8Ro.)

The loss of the left wingtip (1/3 of the total length) together with the loss of the left slats and flaps (which were found before Kutuzov street) would result in a major loss of lift (approx. 16%-20%), which could not be balanced by the actions of the pilots and would lead to a left roll as well as a deepening turn on the left wing and a sudden loss of altitude.

(Source: Experiment on TU-154M model on a 1:40 sale in the T-1 tunnel of the Aviation Institute, Polish Institute of Aviation (IL), Prof. Krysiak, 06.11.2017. Polish Institute of Aviation (IL), Prof. Krysiak, 27.03.2018.)

At the altitude point set by the geographical coordinates recorded in TAWS#38 approx.710m from the runway threshold, the recorded barometric altitude was 36.5m**(?)** with reference to RWY26. This altitude was confirmed by the FMS of the second pilot, who, a second after TAWS#38, noted the same barometric altitude.

(Source: Universal Avionics Report)

The distance between the Bodin tree ('bb') and TAWS38 is approx. 140m. The distance that the plane traveled between the location of supposed contact of the wing with the 'bb' tree, as assumed in the Miller and MAK reports, and TAWS 38 is 115m.

(Source: Reconstruction of the Committee showing real distances between 'bb' and TAWS38.)

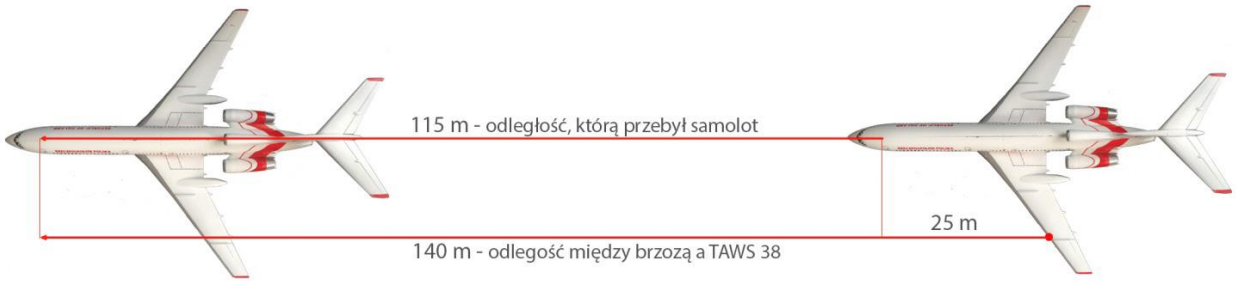


Fig. 26. The difference in distance from the tree claimed to have made wing contact to TAWS38 (140m) and the distance that the plane travelled (115m). The distances are different as the GPS antennas are located 25m in front of the hypothetic zone of contact.

According to the profile from the SRTM 1 base (made available by the US Geological Survey in 2014), the level of terrain next to the 'bb' tree, broken at a height of approx.6m, was 249m; so, 5 meters below the level of the runway, which is at 254m. According to this data and ATM WAR, the damaged plane, which was in landing configuration after contact with the birch tree, would have to climb over 35m to the barometric altitude recorded in TAWS38 within one second, which exceeds the possibilities of an intact TU-154M plane by a factor of four (4).

During the test flight of another TU-154M, PLF101 at Okęcie airport, which was lighter during this test, with 85% RPM, so 9500 kg of thrust, the plane was climbing while doing the go-around with a velocity of 7.5 m/s and 80m/s of horizontal velocity.

(Source: Committee materials.**)**

The disintegration of the plane between TAWS38 and Kutuzov Street

Data from the FDR indicates that three engines were working at 85% RPM, so 9500kg thrust per engine after moving the thrust lever from small RPM to full power after 5 seconds of acceleration. Such thrust sufficed for another go-around. This was achieved in the vicinity of TAWS38. Then, according to FDR data, the RPM's started to decrease on engines 2 and 3 to 80.7% and 81.6%, meaning 8300-8500 kg, and in engine 1 (left), they rapidly fell

to 39.5%, so the thrust of approx. 2000kg. After passing Kutuzov Street, the total thrust of the three engines, according to ATM-QAR, was 18,800 kg, which was 60% of the maximum total thrust, not enough to continue the go-around. Approximately 650m from the beginning of the runway, the KBN 1-1 recorder noted an error of the first engine.

In the last seconds of the flight TAWs and FMS recorded a series of errors:

• TAWS recorded the first fault.log at 6:40:59 UTC time, in the place of the landing event (TAWS#38 landing), and recorded no connection with the sensor on the flaps of the wing.

• The last two fault.log records happened at the same time at 6:41:02 UTC time and informed about a loss of communication between FMS of the first and second pilot as well as a frame error.

• At the same time, the readout of the FMS memory of the second pilot included information about other readouts concerning the magnetic course, and the last value read was 267.1 degrees, the same as in TAWS#38 three seconds earlier.

• At 6:41:02 UTC time, when the plane was still in the air, the FMS memory froze, which meant there was no power.

In addition to these errors, the following information about the subsequent TAWS38 errors from discreet data recordings shows:

• The radio altimeter of the first and second pilot (parameter SPRRW5NR1/2), and the first hydraulic installation (parameter PH1VZBLIZ).

• The engine/generator no.1 of the same engine.

Series of events between Kutuzov Street and the explosion in the center wing

One line of debris from the left horizontal and vertical stabilizers (stemming from the area, where it was connected to the horizontal stabilizer) behind Kutuzov Street, shows that the roll of the plane was large, and the dispersion of parts falling off of the plane and destroyed branches, points to a sudden destruction of the plane in the air (Fig. 27).

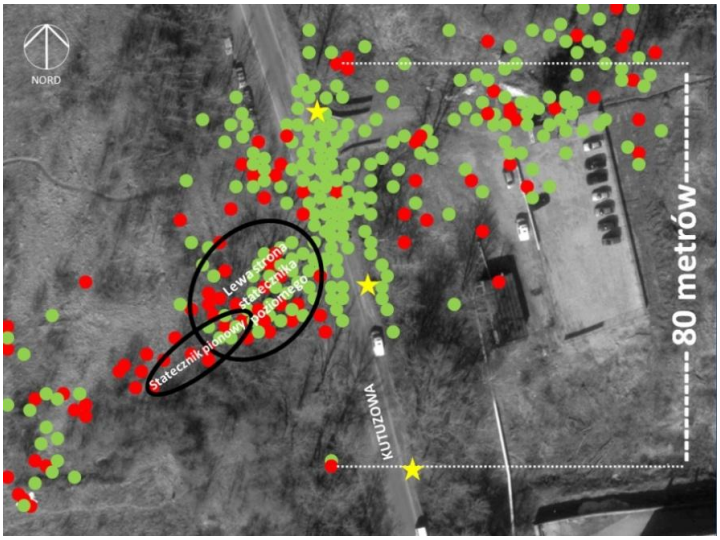


Fig. 27. Placement of the horizontal stabilizer and the vertical stabilizer on the left side of the Kutuzov highway. The flight direction is from right to left. Red dots show debris from the Tu-154M, and green dots show debris from the associated tree damage.

The treetop of one of the trees on the eastern side of the Kutuzov street, on the flight path of the TU-154M, was severed [sliced] in a straight line, at a 120 degree angle from the horizon line. (Fig. 28).

Fig. 28. A damaged tree on the East side of Kutuzov Street.

A look at the damage to the trees on both sides of the street can determine the altitude of the plane just before reaching the street to be 28m, and the path of the left wing's roll at 120 degrees.

Source: Committee Analysis.

Based on the damages on both sides of Kutuzov street, the balance point of the plane was set the moment the plane passed the trees on the western side (closest to the crash), which is 26m above the place of the actual crash.

A tree of 6-7m in height is marked with the letter "Z" on fig 29 to fig. 31b and is directly above the trajectory of the flight. It was not damaged by the plane, which means that the altitude to the balance point in that moment, when the tail passes the "Z" tree, is at least 10m.

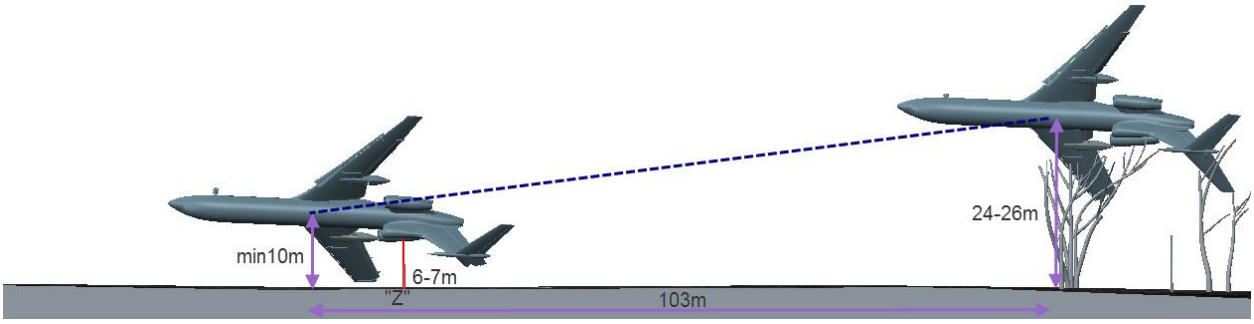


Fig. 29. A view to the north in the moment when the plane flies from Kutuzov street (right) to the crash site (left). The 6-7m tall tree is marked with the letter "Z".

Fig. 30. The tree marked "Z" growing in the direct vicinity of the flight path, where the plane was flying from Kutuzov Street (in the background) to the place of the crash. On the right side, starting at the blue marker on a tall stem, there is a visible trace in the ground, where the left stabilizer ploughed through.

Fig. 31a. The tree marked "Z" growing in the direct vicinity of the flight path, where the plane flew from Kutuzov Street (red circle) to the place of crash. The ground trace from the tail is visible and marked here as "Southern Ground Trace".

Fig. 31b. The tree marked "Z" growing in the direct vicinity of the flight path, where the plane was flying from Kutuzov Street (right side) to the place of crash (left side). The trace in the ground from the tail's collision is visible and marked with a red oval. The white part inside the oval shows the new position of the left horizontal stabilizer after the Russians moved it 35m closer to the crash site.

Burnt pieces of the Tu-154M found 100m before the crash site

Numerous pieces of the plane were found during a terrain analysis, performed by Polish archeologists in Smolensk in October 2010, in sector 13, behind Kutuzov Street and before the main crash site (fig 32). These pieces, ranging in size from a couple to tens of square centimeters, had traces of thermal and mechanical effects (fig 33).

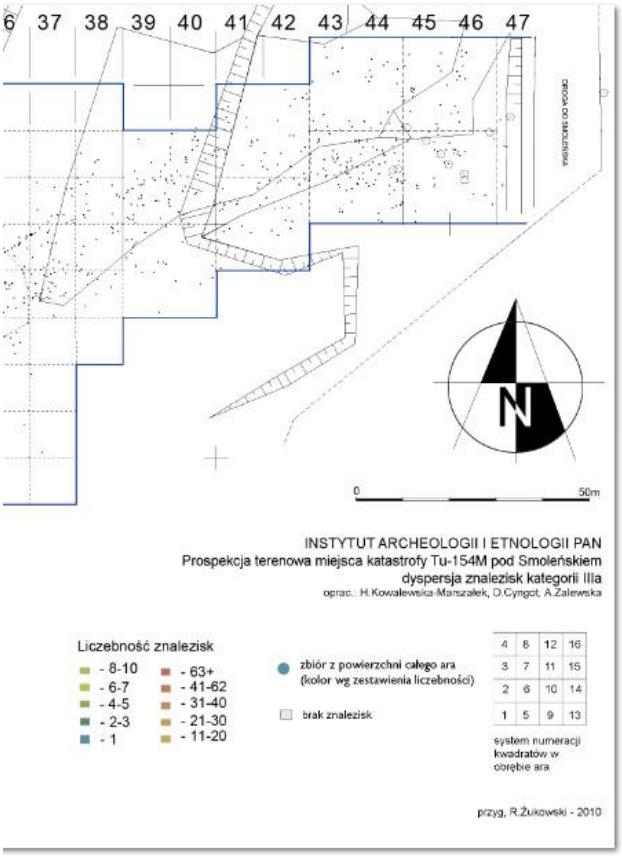


Fig. 32. A map from the archeological report showing where pieces were found behind Kutuzov street (marked "the road to Smolensk" at the right).

Fig. 33. Collected pieces of the Tu-154M taken from the ground 100m before the main crash site, having visibly undergone thermal change.

Many of the pieces of debris had distinct traces (micro craters) on their surface. Their appearance corresponds in shape and size with the traces of the debris created during the pyrotechnical experiment performed by the Committee. (Fig. 34).

This feature is typical for explosive destruction.

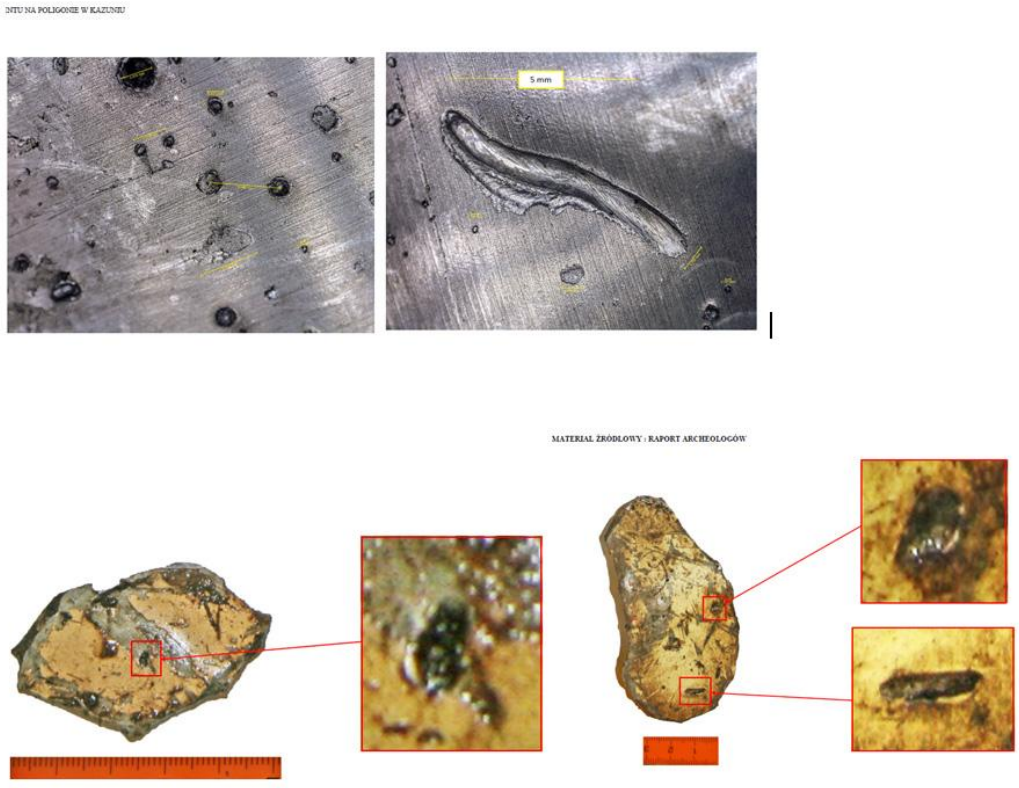


Fig. 34. Comparison of micro craters on the surface of the debris found by archeologists and debris created after the pyrotechnical experiments.

Explosion in the TU-154M fuselage

The view of the crash site, with very scattered debris, compared to the shape of TU-154M in a 1:1 proportion shows that the pieces of the plane fell as a result of an explosion in the air, and did not disintegrate during the sliding on the ground. There is no evidence of a ground collision, no visible crater or trace like the one from the stabilizer analyzed earlier. (Fig. 35).

Fig. 35. A view of the crash site compared to TU154M in reverse position in correct scale.

The top view of the main crash site shows characteristic positioning of trees in its initial part – from the northern part to the front, in accordance with the flight path, and from the south to the back. This fact directly implicates the occurrence of a blast wave.

Fig. 36. A picture of the main crash site.

An explosion in the left part of the center wing caused the destruction of the majority of the outer skin, ribs and spar no.1 of the fuel box no.4. Those elements of the plane on the main crash site (Fig. 36) have clear sear marks and visible effects of the blast wave being the result of an explosion. The pictures below reconstruct the mechanism and scale of destruction of the left center wing.

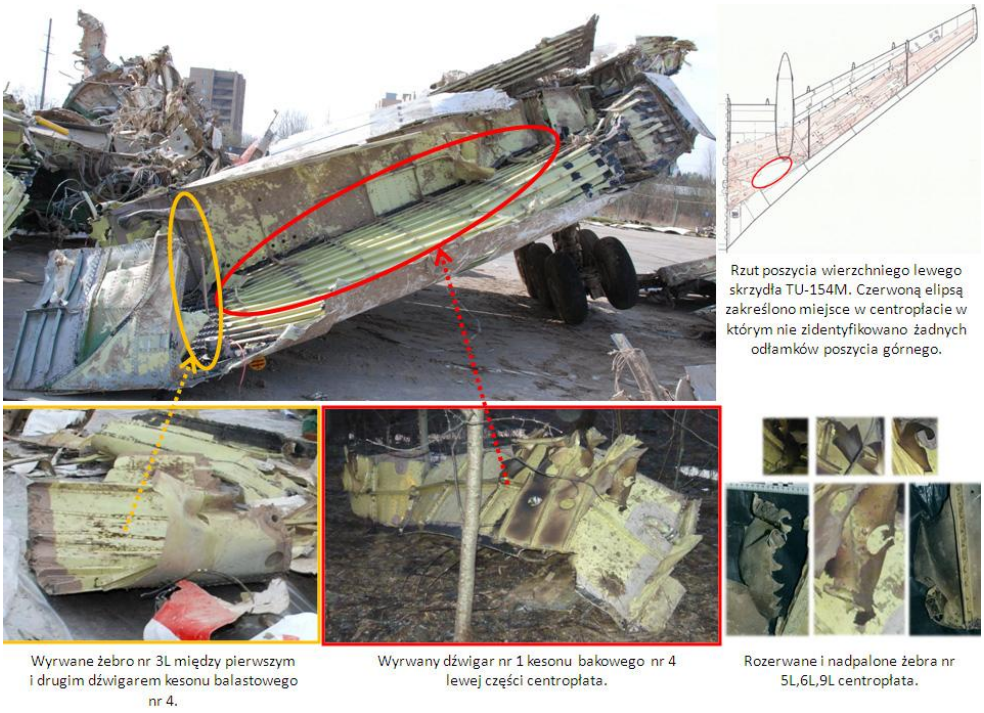


Fig. 37. Note the ripped spar no.1 of the fuel box no.4 of the left part of the center wing with clear signs of high temperature, as well as the destruction of burned ribs visible on the right side of the picture. Other parts from this area found outside the fire zones were also found with similar signs.

The epicenter of the fuselage explosion, and the dispersion of fuselage elements

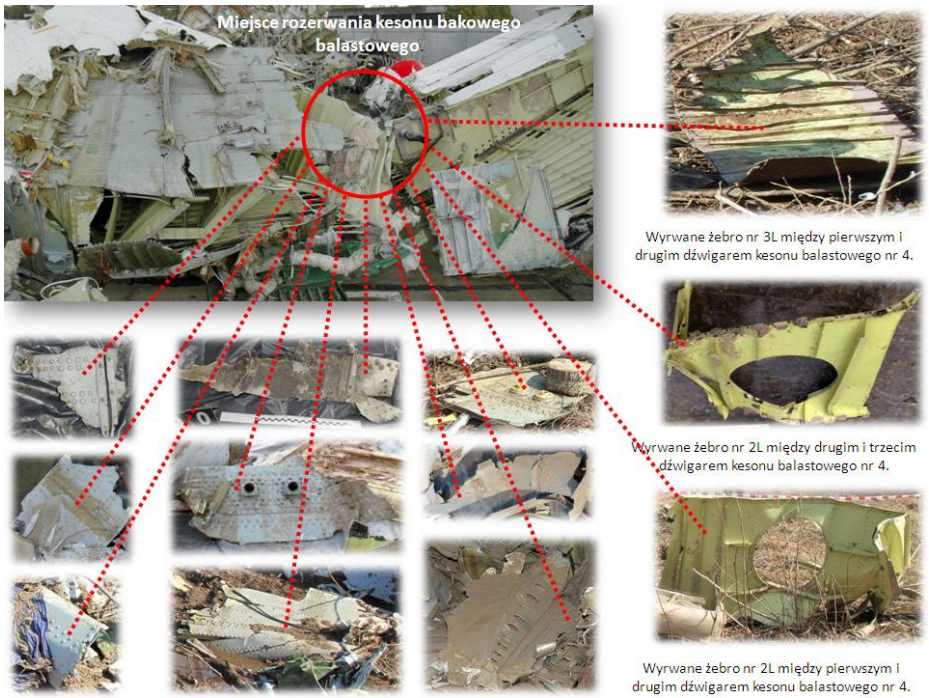


Fig. 38a. The place of the destruction of the ballast box and destructed elements.

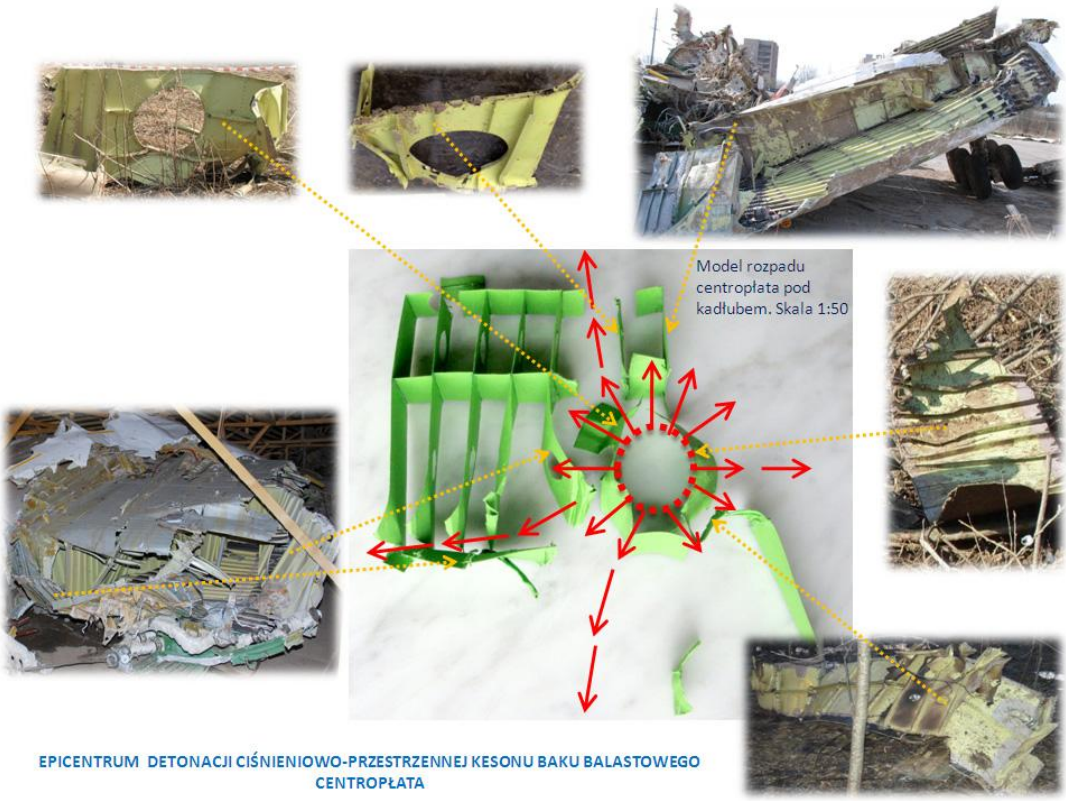


Fig. 38b. Epicenter of the wing box breakage. Study by the Committee.

The tearing and destruction of the fuel box could not have been a result of a hydraulic impact, caused by the impact with the ground, especially considering the small amount of fuel and limited space. One has to consider the elements of skin, ribs, and rear spar, which were torn off/ripped apart likely due to high internal pressure. (Fig. 38 and fig. 40).

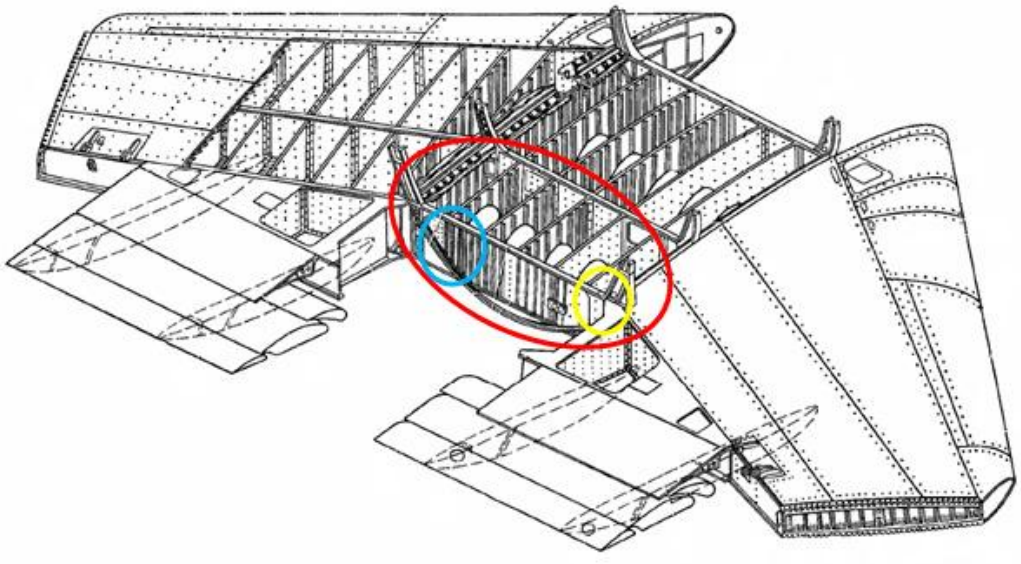


Fig. 39. The center wing box of TU-154M. Highlighted in red, the fuel box no.1.

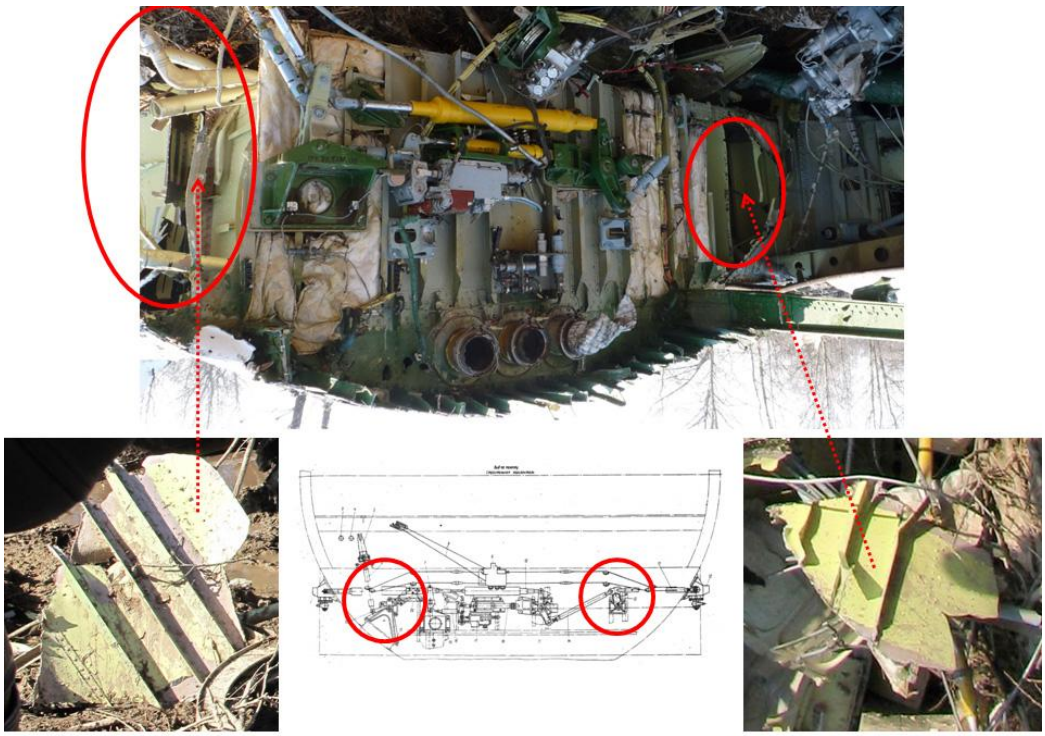


Fig. 40 Pieces of the left and right side of spar no.3 of fuel box no.1.

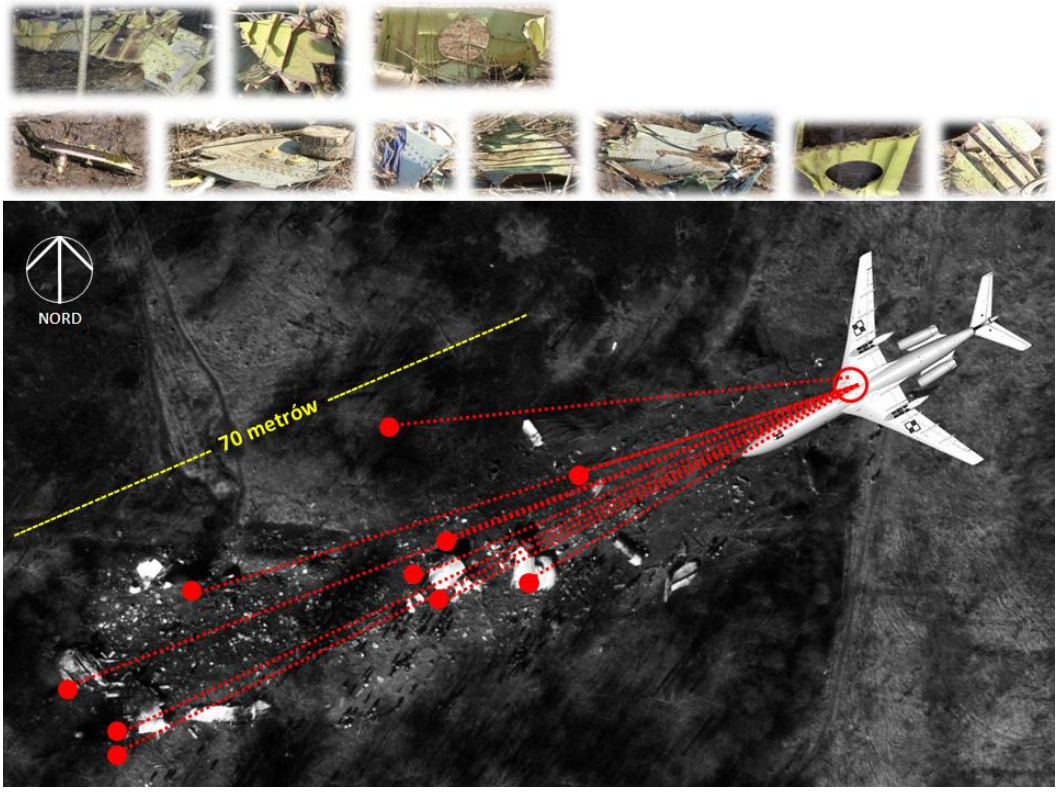


Fig. 41. The general dispersion of the pieces of the center wing on the crash site, with the distance and place where the most important pieces fell. The torn pieces of the rear spar No.3 of fuel box No.1 of the central part of the center wing.

The torn pieces of the rear spar no.3 of the fuel box no.1 of the central part of the center wing confirms the theory that its destruction was the result of an explosion and not a hydraulic impact to its front wall during the fall of TU154M to the ground.

The explosion of the ballast box (Fig. 42) was the main reason for the destruction of TU154M a moment before it hit the ground. The destruction, which took place, destroyed the box, meaning the fragment of the left part of the center wing together with the front spar, and destroyed blackened ribs. This spar flew 70m to the west. The explosion destroyed the third salon, killing all the passengers, and distributing their body parts across the entire crash site. At the same time, the detonation wave blew away the left passenger door (2L), which was rammed with huge force into the ground, one meter deep, and the galley and thousands of its pieces were dispersed on 1/3 of the crash site area. The detonation wave, heading in the direction of the tail, destroyed this part of the fuselage and curled the left and right sides of the plane together with the roof outwards. The floor panel, which is torn off along the left side of the airplane, is proof of the direction of the blast wave.

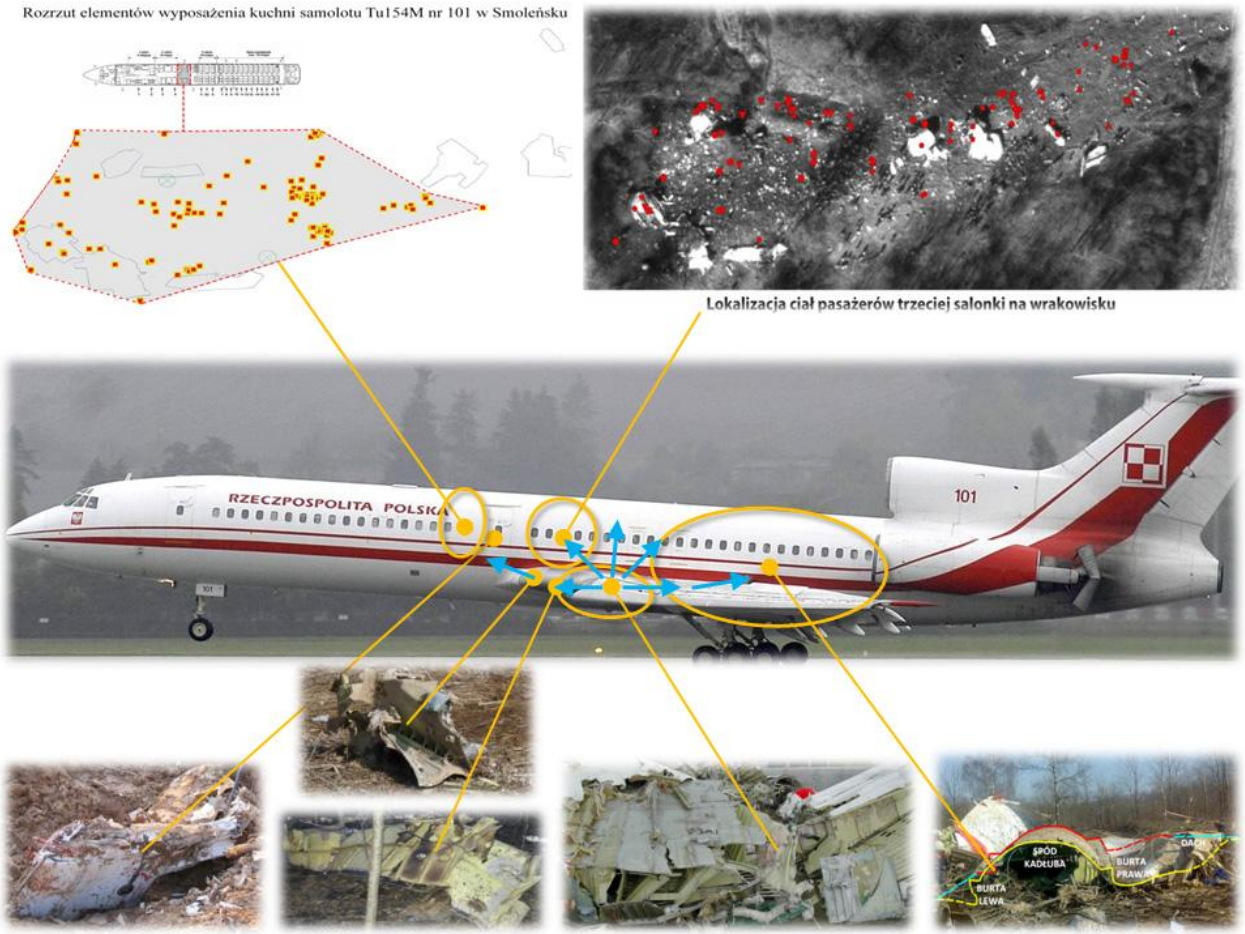


Fig. 42. The effects of the explosion of the ballast tank caisson. From the left of the top picture: galley area, left passenger door no 2. (823), third salon, fragments of the left part of the center wing, and passenger compartment. The bottom left picture shows the left door rammed into the ground. The right bottom picture shows the rear fuselage after the crash with both sides opened outwards.

Main crash site

An overview of the main crash site shown in Fig. 43.

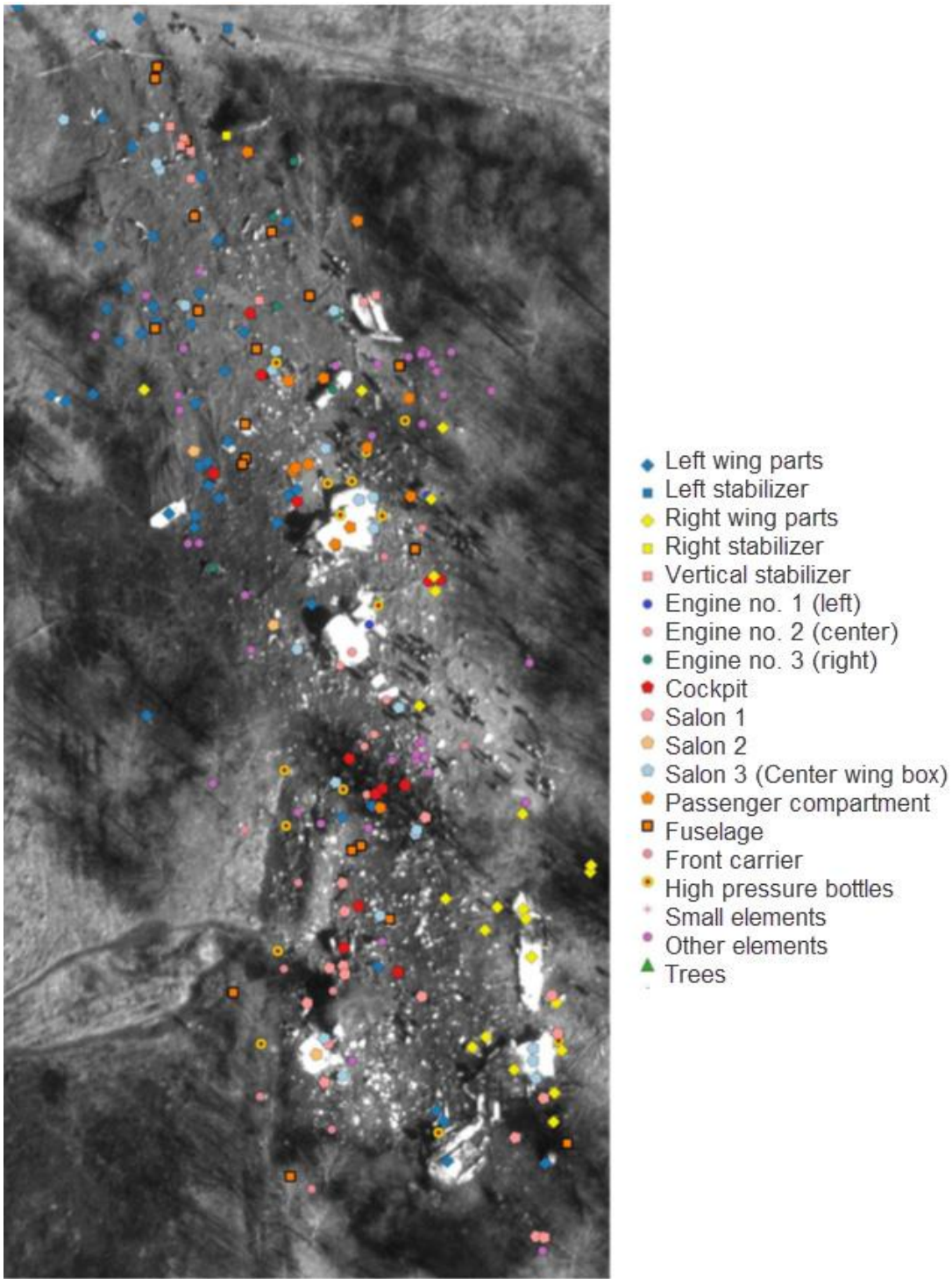


Fig. 43. Dispersion of the aircraft debris. Study of the Committee. The direction of the flight is from top left corner and down towards bottom right corner.

The TU154M aircraft disintegrated into more than 60,000 pieces. The majority of the elements were rammed into the ground, and though located, they were never extracted. 10,000 pieces were collected 6 months after the crash. To date, the number of elements of the debris that were not removed from the ground to be moved to storage has not been calculated.

(Source: report of the archeologists, materials of the Committee)

The main crash site is 45mx160m, which means that the movement of the aircraft in this area, with its total destruction, happened in a distance corresponding to 3 lengths of the plane. The ground impact of the plane happened in a reverse position of the aircraft, which is visible based on the dispersion of pieces of the left and right wing on the crash site. Indentations were observed in the ground in the place of the crash but without a deep crater. On the entire crash site, there are no traces of a strong impact of the fuselage in the ground.

All the seats were totally destroyed, meaning that the seating part, backrest, armrest, and frame were separated and scattered.

Apart from the front part of the fuselage, between the nose and the beginning of the center wing, pieces from the right side of the plane were found mainly on the left side of the crash site, and pieces from the left side of the plane were found mainly on the right side of the crash site.

(Source: Analysis of pictures and videos made by the Committee)

The part of the fuselage between the center wing and the tail was found in an upside-down position with both sides of the plane curled outwards. Studies by Sandia laboratories in the US, and simulations done at Akron University show that the fuselage is exposed to high internal pressure when in air. The sides of the plane curled outwards were cut up by the Russian services the day after the crash.

(Source: Analysis of pictures from the materials of the Committee. Materials from Sandia National Laboratories in the USA)

Some parts of the aircraft from the front of the fuselage between the front and the center wing were found at the main crash site in the normal position (as for landing). In sector 2 and 3, these were: a part under the cockpit (technical compartment no. 1), the right side of the aircraft cabin section nr. 1 and nr. 2, the first luggage compartment and the compartment of the first main chassis together with the front chassis. The part with the cabin sections nr. 1 and 2 was set up in the opposite direction to the flight path of the aircraft.

(Source: Analysis of own pictures and materials of the Committee)

Parts of the passenger fuselage

The destruction of the part of the fuselage with both sides of the plane opened and a corresponding reconstruction show the hypothetical explosion in the fuselage, while the plane was still airborne. Below: parts of floor panels with characteristic signs of destruction caused by explosion. Panels were close to the left side of the plane at a corresponding reconstruction.

Fig. 44. Image of the fuselage destruction with both sides of the fuselage opened and thrown outwards.

Disintegration of the galley

The less than 8m^2 galley area was found scattered over an area of more than 1300m2 in small fragments.

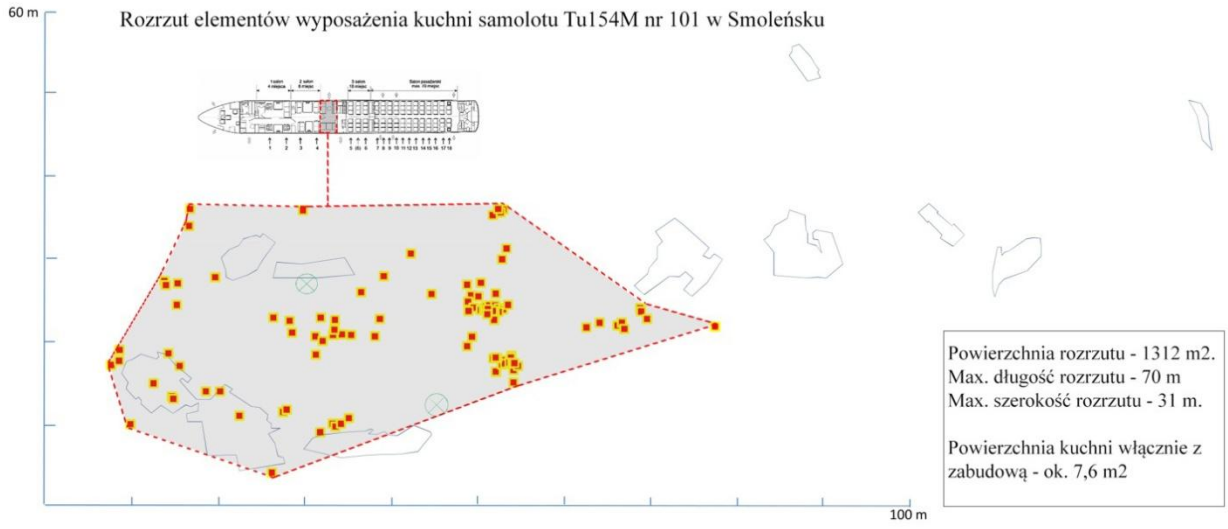
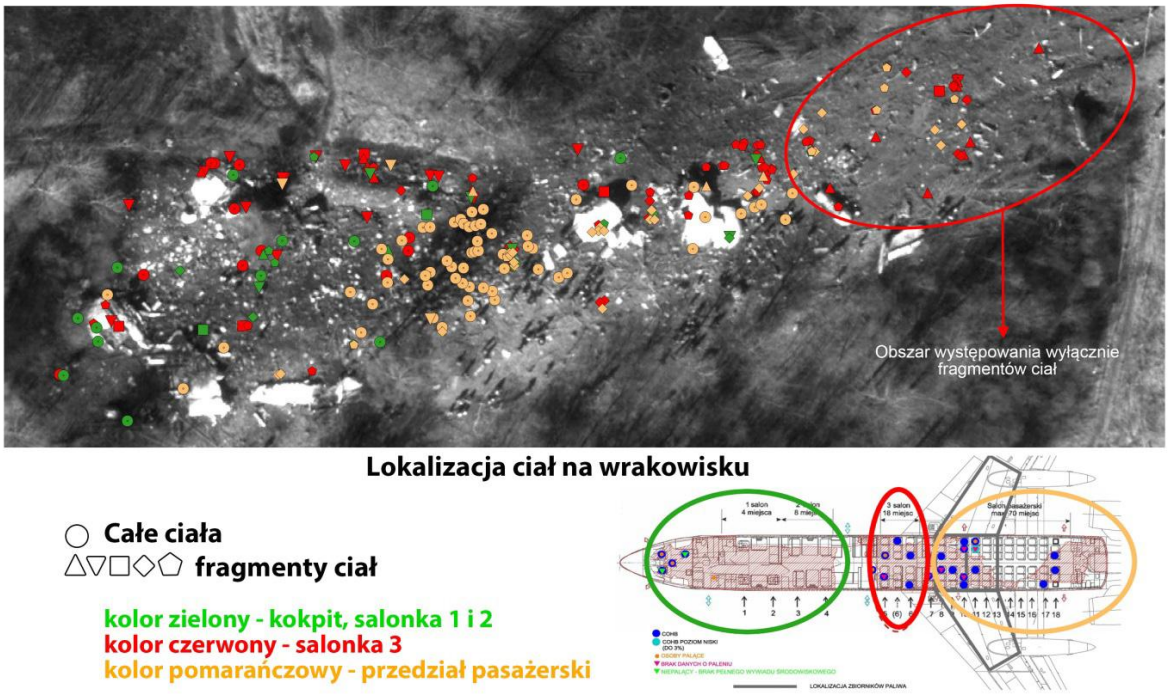


Fig.45. Parts of the galley being before the third salon were distributed in the shown region on an area of 1312m2.

Experts of the Polish Prosecutor's Office found traces of explosive materials on 175 pieces of the seats using special sniffing equipment and instruments. Source: CLKP E-CHE-0/2 p.32

The passengers and crew

All 96 passengers and crew onboard the aircraft died. The remains were scattered outside of the fuselage, just as the seats on which they were sitting, as well as the floor-covering and insulation. At the beginning of the crash site, apart from pieces of the plane debris, only small, torn body parts of victims were found, including numerous, identified internal organs, which prove that even before the plane hit the ground, the bodies of the passengers sitting in the center part of the aircraft cabin (section no.3) were impacted and torn into pieces. (Fig. 46)



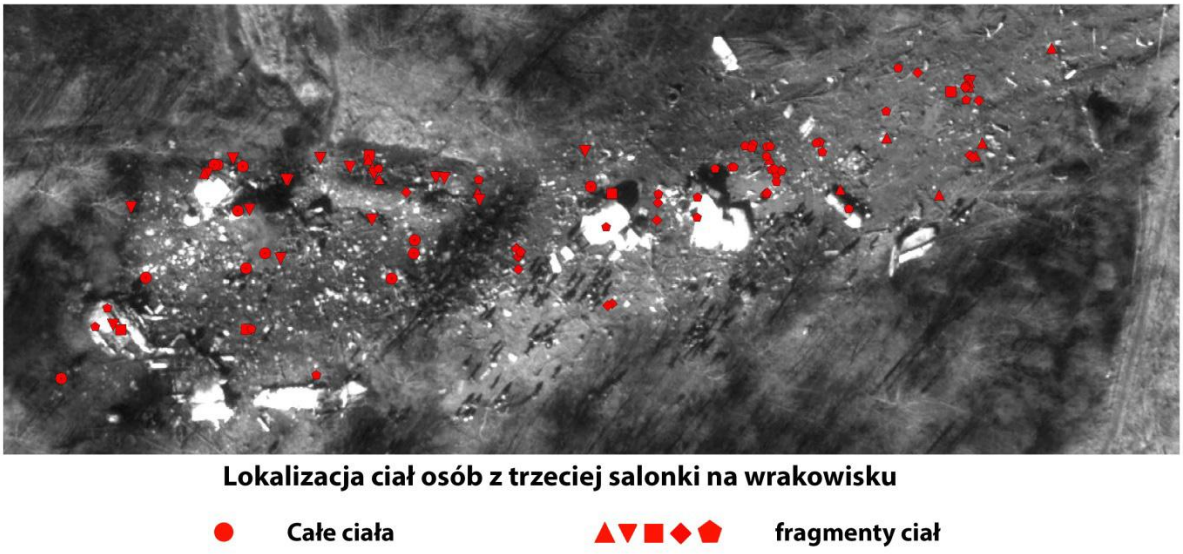


Fig.46. Location of bodies on the crash site. Only small body fragments and intestines were found in the area circled at the top picture often at a far distance from the main body. The fuselage was more than 6m above the ground when passing this area. Whole bodies are marked with a red circle.

Body parts were found at the beginning of the crash site, before the area where the fuselage hit the ground. This suggests that movement of the body parts was opposite to the movement of the plane. In all the cases identified, these were body parts of people sitting in the front part of the plane, especially in lounge (salon) 3. At the same time, it is important to state that the door rammed into the ground was found nearby, as well as the galley (distributed on 1/3 of area of the crash site) and the left center wing.

(Source: Archeologist report. Analysis of own pictures of the Committee)

Partial or total tearing off of clothing from bodies was seen in the case of more than 35 of the passengers and crew. These were mainly the bodies of occupants located in the front of the plane, starting with the 3rd section, where all the generals were sitting, and forward. Of the 20 people sitting in the 3rd lounge or in its immediate surroundings, clothing was completely or largely torn off 12 of the passengers. As research quoted in literature proves, clothing can be torn off a passenger if she/he is subject to an air speed exceeding 460 km/h.

(Source: Experiments conducted in order to determine the reasons for the MH17 crash. Memo from the meeting of the members of the Committee leading that investigation).

In the case of Smolensk, the speed of the aircraft was about 265 km/h before the crash, so 58% of the critical speed needed for clothing to be ripped off of a human body. In addition to mechanical damage to the bodies, there is a significant percentage of victims (25%) with extensive burns of up to 40% of the body surface, some of which were found even more than 55 meters from the ground fire source.

(Source: investigation files)

In at least 12 cases, the fragmentation of bodies is also connected with a large linear dislocation of fragments of bodies on the surface of the main crash site, approx. tens of meters, scattered almost throughout the total length of the main crash site. Passengers and crew members who suffered such injuries occupied space near the aircraft bursting, near cabin section nr.3. The distance of the scattered bodies of the cockpit crew stretches approx. 35 meters.

(Source: Investigation files)

The body of one of the passengers sitting in the rear part of the plane was rammed into the rear wall of the toilet (without the seat backrest) in such a way, that the wall was folded around the body of the passenger. The damage of the body and location of it show that the body was moving in the direction opposite to the moving plane. Another passenger was thrown in the air in such a way that he fell between the reverse center wing and the flap.

(Source: Analysis of pictures of the Committee)

The initial analysis resulting from the study of the previously analyzed single person sitting in the cabin section nr. 3 indicates that the cause of her death could have been the impact of a detonation wave resulting from an explosion. According to experts, the evidence for this is the unusual range of body damage. The same applied to at least 12 out of 20 people sitting in or near the section.

Firefighting, medical, and rescue services

Some of the firefighting units, which were supposed to secure the landing of the plane TU-154M with the President of Poland onboard, were not located at the airport but, coincidentally or not, in the vicinity of Kutuzov Street, in the direction of the landing approach. In the moment of crash, these units were the first to make it to the crash site (within 3 minutes). The Head of the Center for Crisis Situation Management of the Ministry of Emergency Situations of the Smolensk Oblast was waiting for the arrival of the TU154M plane together with firefighting units in the vicinity of Kutuzov Street.

Medical services

There were no military medical personnel at the airport before the landing - medical services or doctors. The medical staff from the regional hospital of the village Pokornovo, more than ten kilometers from Smolensk, had their shift at the airport instead. A couple of minutes after the crash, the second medical team from the same hospital were called to the emergency site. While going to the crash site, they were told to go back to a different emergency because none of the passengers on board survived.

Rescue services

Before the arrival of the Polish plane, an emergency team from the city of Smolensk (to prevent and manage extraordinary situations) was already waiting at the airport. They arrived first at the crash site. They were followed by the rescue team from the Special Work Unit on special vehicles. Within the next hours, other rescue teams from the Ministry for Emergency Situations followed, like: LIDER (from Ramienskoye), Military Unit 96 from the Rescue Center (from Korakovo, Tulski Oblast), Rescue Units from Reytowo, Kaluga, Mozhaysk, Ruzy, Luberec, Zvienigorod, and other cities. Functionaries of the majority of those units, during the rescue action, did not have their identification badges on their clothes. According to the testimonies of policemen, their mobile phones were confiscated by their superiors.

Security services

Directly after the crash, the following services were present: FSO, FSB, OMON, SPECNAZ, SORB, and police units. All those units created a cordon around the crash site, and police units also set up blockades on Kutuzov Street.

ANALYSIS AND EXPERIMENTS

The falsification of the hypotheses from the Miller and MAK reports concerning the destruction of the entire plane after hitting the ground

The main objective of the research was to determine the plane's disintegration when hitting the ground. Substantial data are: the velocity and aerial angles, which can be called „initial state". The main tool for analysis will be the FEM (Finite element method), which is mainly used when a physical experiment is not a practical proposition. In order to see the results, this Committee built a construction model according to FEM, and gave the plane its initial state according to the MAK and Miller reports.

After conducting a simulation, we compared the results with the actual crash and crash site. It is obvious that a statement confirming the same results of the simulations just as MAK or Miller would be beneficial to the investigation. The simulation was done up to 1000 milliseconds, so 1s, and in this time the plane travelled 46.6m.

The progressing velocity at that moment dropped to approx. 20m/s and the destruction of the model did not worsen throughout the simulation (of course a certain delay took place). The skin of the fuselage had a thickness of 1.5mm. The stringers of the fuselage with an omega cross-section, modeled as lines, had a wall thickness of 2.0mm.

Some fragments, like the ones we see on the pictures, appeared due to the destruction of the elements joining them with the rest of the model. Elements, which are destroyed (torn), disappear from the calculation and the screen. (In reality those elements create the torn edge of the remaining model). Fragments from the destroyed fuselage are mainly pressed inside, and consequently invisible in the pictures.

Properties of aluminum alloys used for the model construction (yield limit, durability and maximum elongation)

2024-T3: Fy = 334 MPa, Fu = 448 MPa , e = 16%

7075-T6: Fy = 493 MPa, Fu = 545 MPa , e = 9% (Only stringers)

They are analogical to the corresponding alloys used in TU-154M

The angle position of the plane at the beginning of the crash was given according to the Miller report.

In reference to the description of ideal levels and a straight flight, those angles were as follows: pitch 6degrees (nose down), yaw 20 degrees (nose left), and roll: 150 degrees (left wing down). The initial state of the plane, determined by those angles and velocity, dictates the order of hitting the ground for particular pieces.

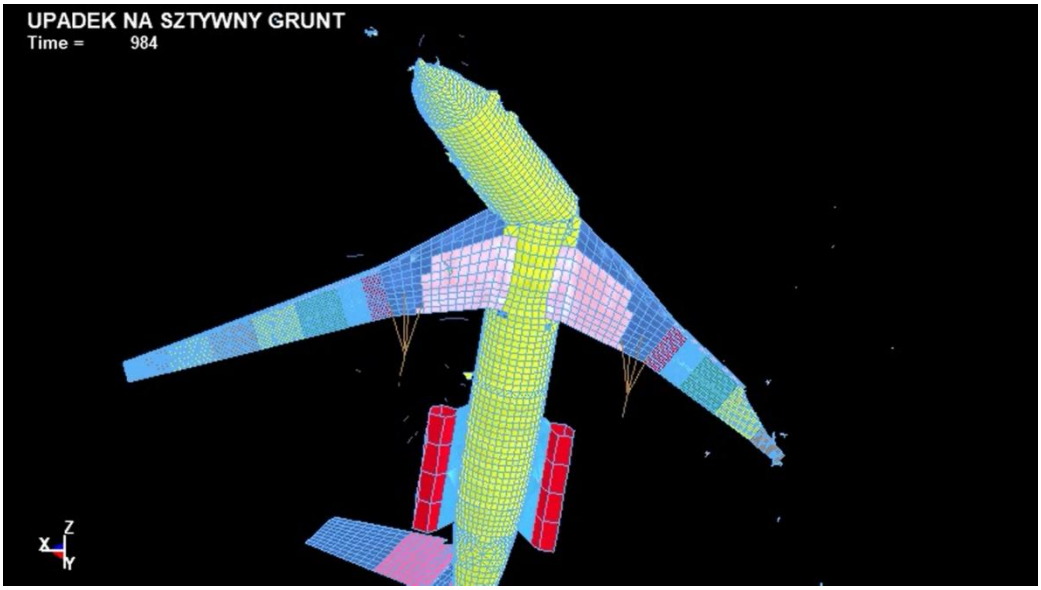


Fig. 47. Simulation of the disintegration of an airplane hitting the ground (concrete). The aircraft breaks into only a few parts.

Conclusions

1. The simulation of the plane's destruction shows a completely different destruction of the model than the plane at the crash site.

2. The initial state of the falling plane was described in the MAK and Miller report and confirmed in supportive works [3]. It seems that this statement was far from true, which is why the simulation presented different results.

3. The above-mentioned crash reports assume that the plane, while hitting the ground, should disintegrate into thousands of smaller and bigger pieces, according to what was found at the crash site. The results of the simulation show clear destruction of the model; however, the plane is still visible and not as destroyed.

4. The results of the simulation show that the assumptions of the above-mentioned reports concerning the destruction of the construction are wrong and have nothing to do with reality.

5. If the crash involved only impact with the ground, the pieces, which fell off, should be in one long line. It would not be possible for the fragments to be scattered tens of meters to the side.

6. The assumption that the plane fell on concrete, instead of the ground, can influence some features of the disintegration, but do not change its general character.

Simulation of door impact into soft ground - NIAR

The left passenger door No. 2 (No. 823) with a mass of about 77kg located in the fuselage in the front of the left wing was found completely driven into the ground (more than 1 meter deep) about 34 meters downstream (West) from the more than 6m tall tree located between the ground traces. This passenger door was found in its locked position completely detached from the massive door frame. The two bottom hinges of the left passenger door No. 2 (No 823) are each rotated 90degrees from their standard orientation in the closed door position.

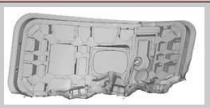
(Source: Materials of the Committee)

The vertical speed of the aircraft just before the impact to the ground was V = -12 m/s according to the FSM memory reading at the moment of power failure.

Simulations done by the independent National Institute of Aviation Research (NIAR) in the US show the required vertical speed of the left passenger door was more than Vz_door > 120m/s in order to produce the observed door damage and full penetration into the ground. (This means the vertical energy of the door when penetrating into the ground was 100 times greater than the kinetic energy it possessed by the vertical velocity of the aircraft.) The 100x increase of vertical kinetic energy of the door, with a mass of 77kg, requires large acceleration, and thereby force, behind it. There is no buildup of soil in front of the door (in the direction of the flight) or empty space behind it.

On the inside of the left passenger door nr. 2 (No. 823) there are numerous cracks in the aluminum cover. Such cracks should not be generated during flight.

Analysis Summary

Case	Vertical Velocity (m/s)	Horizontal Velocity (m/s)	Penetration at Door Center (m)	Door Damage	Notes
5	100	20	0.69		More than 50% penetration of the door. Half of the door is fully penetrated. Extensive damage on the door
7	125	20	0.68		Full penetration of door. The penetration value is low because door is crushed and has very high deformations.

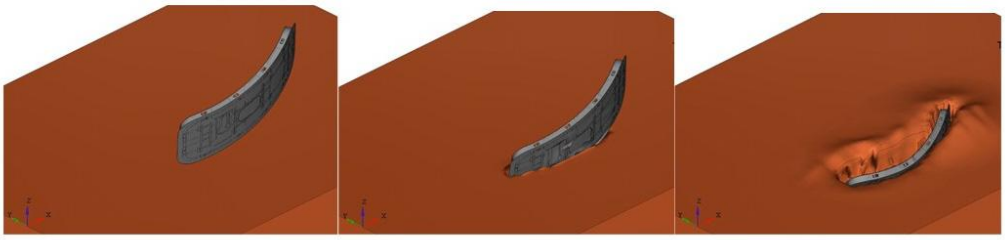


Figure 48 shows results from NIAR's simulation of the door hitting soft ground and the door 1meter in the ground as Russians were digging it out by hand.

When pulling the left passenger door 2L, driven over 1m into the ground, a human hand and forearm were found near the door handle. Source: Images of the door driven into the ground

(Source: Pictures of the door rammed into the ground)

No other body parts were found around the door (no.823), indicating that the hand was separated from the rest of the body before the door hit the ground.

Simulations and results from various crashes with the participation of similar aircrafts falling with similar vertical velocity show that the aircraft normally should break into 3-5 bigger pieces with a visible line of separation. The breaks usually occur where the stiffness makes relatively large changes: On both sides of the center wing, behind the cockpit, and in front of the tail part.

Source: Materials of the Committee

Analysis of the last seconds of the trajectory

Assumption: The severely damaged trees on both sides of Kutuzov Street are caused by the aircraft.

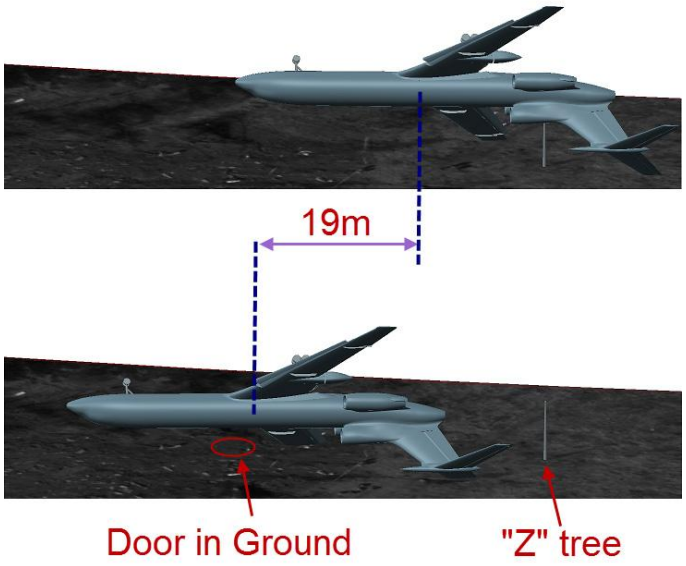


Fig. 49. The position of the plane the moment it passes the Z tree and the position of the plane above the rammed door.

The distance between the trees west of the street and the tree marked "Z" is about 103m. and the time it takes to travel this distance can be found as Δt= 103m/75m/s = 1.37s

The vertical velocity by this method is found as $\Delta H/\Delta t$ = (25m-10m)/1.37s = 15m/1.37s = 11m/s

The minimum height 19m after passing the tree marked "Z" is found as (10m - 19m/103m*15m) = 7m

This is the height of the center of gravity of the aircraft at the moment the aircraft is above the position where the door was found buried 1m into the ground.

Confirmation 1:

Assumptions:

1. Both flight management systems (FMS1 and FMS2) are working until the moment of the freeze (power outage).
2. Power is lost at the same time for FMS1 and FMS2.
3. Forward horizontal velocity of aircraft is about 75m/s.
4. Tree located 8m before the ground traces in the area passed by the aircraft is about 6-7m tall.
5. A 6-7m tall tree (marked Z) in the flight path of the TU-154M located about 8m before the first ground traces near the main crash site was not cut or damaged by the aircraft when it passed this location.

The FMS is designed to capture and store important data to non-erasable memory in the event of a complete loss of electrical power. Data on the input side of the FMS are newer than internal FMS data (captured earlier). (GPS positions are updated with a refresh rate of 1s).

The internal barometer corrected the height captured by the FMS1 at the moment of the first freeze, is +14.3m above RWY.

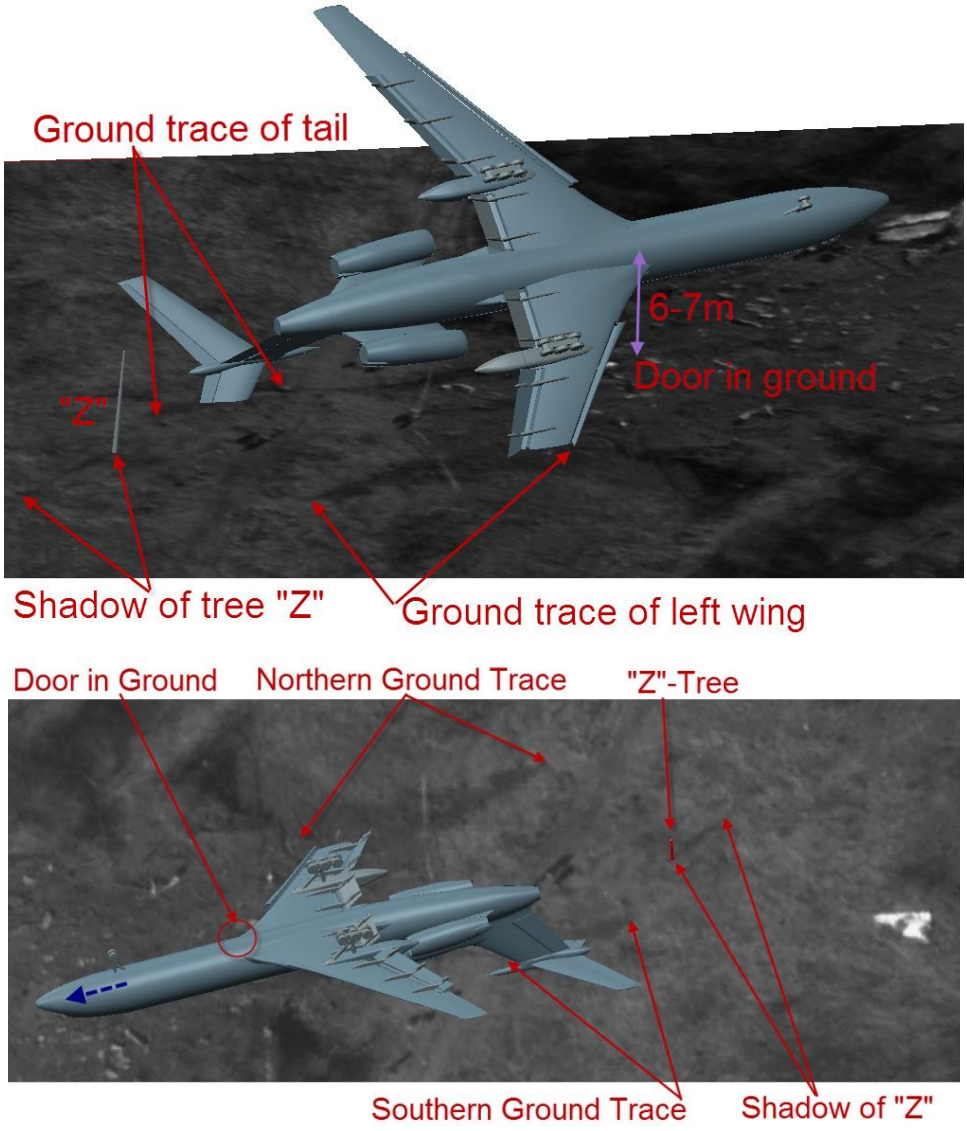
The barometer corrected the height captured on the input side of FMS2 at the moment of the freeze at +6m above RWY.

The difference between the recorded positions of the FMS1 (internal) and the newer position of the FMS2 (input) is about 40m.

Confirmation 2:

Assumption: The ground traces at the beginning of the crash site are produced by the remains of the left wing and remains of the left horizontal stabilizer.

Based on visible damage to the trees seen on both sides of Kutuzov street, the height to the center of gravity (COG) of the aircraft when it passes the trees on the West side (nearest the crash site) is about 24m -26m above the crash site. The 6-7m tall tree marked "Z" in the following figures, and under the direct line of flight was undamaged by the aircraft.



Pic.50. The moment the plane hits the ground

Analysis of the traces in the ground indicates the left roll of the aircraft to be about 130° when the remains of the left wing touched the ground at the beginning of the main crash site. They indicate the height above the ground of about 6-7m when the fuselage is positioned with the left passenger door above the location it was in the ground.

The ground traces of the wing come to a stop at the moment the fuselage is above the position of the door in the ground, and from this point the aircraft is found scattered in thousands of pieces without the creation of a crater.

CONCLUSION:

The aircraft was at a minimum of 6m above the ground (RWY) when the left passenger door nr.2 (823) was shot to the ground. The height of both FMS1 and FMS2 at the moment of power loss was 6-8m. The vertical velocity by the FMS was about 12m/s, which is confirmed by the analysis regarding the tree damage resulting in a vertical speed of 11m/s.

Analysis by NIAR shows, that the velocity of the door when shot into the ground had to be greater than 125m/s. It is reasonable to assume, that the reason for the power failure of both flight management systems is connected to the event causing the door to be shot to into the ground. This requires an acceleration from 12m/s of vertical velocity to more than 125m/s vertical velocity of the left passenger door no.2 (823). Such an increase in the vertical kinetic energy more than 100 times, and such an increase in energy can only be the result of sudden high internal pressure, i.e. explosion above the ground.

This is again confirmed by the fact that the trace on the ground of left wing (and of the tail) comes to a sudden stop at the position where the left passenger door was shot into the ground.

Pyrotechnical experiments

Experiments carried out by the Committee on a model of the passenger part of TU154M on a 1:1 scale show that the destruction of the plane in Smolensk could not be the result of a fuel explosion. (Fig. 51).

Fig.51. The outcome of an explosion of jet-fuel in the cabin of the fuselage resulting in a large opening but no destruction into small pieces.

(Source: Report on experimental results from the explosion of an object imitating the cabin area in the fuselage, Vol.2 2017)

Experiments conducted by the Committee on a 1:1 model of the passenger's part prove that such disintegration, as observed in Smolensk, can be the effect of one or many detonations of air-fuel charges, with special consideration of a thermo-baric charge with a longer tension and impulse propagated inside the fuselage before hitting the ground. (Fig. 52)

Fig. 52 The outcome of an explosion of a thermo-baric charge in the cabin of the fuselage resulting in the complete destruction of the fuselage and the formation of a large quantity of small debris.

The same experiments show that a thermo-baric explosion can leave only minor traces of explosive materials on the debris of the plane, which are visible only in minor quantities during spectrometric analysis.
(Source: Reports on explosive experiments of an object imitating the cabin of the fuselage)

Pathological expertise

A spatial explosion (thermo-baric, as well as air-fuel) has to generate a number of pieces and micro pieces from the container, where the charge is placed, or from objects being in its vicinity. Those pieces may or may not be metallic. In the latter case, they will not be visible on any X-Ray pictures or on CT scan. Those pieces cause characteristic damage of the bone structure (with beveling) but- what is especially important- practically impossible to notice during a routine postmortem examination, even with a CT scan. In order to make those damages visible (less spectacular compared to others in such circumstances), it is necessary to prepare the bone fragments (sometimes by cutting a particular fragment) and analyze them after gluing them together in an anatomical position.

Without gluing the bone, the chances of finding such changes are close to zero. The postmortem examinations, which have been conducted up till now (Russian, as well as Polish ones after the exhumations) ignored those issues and gave no chance to find traces of this type of explosion.

Fig. 53 Medical phantoms inside the model of the aircraft cabin.

SUMMARY OF THE EVIDENCE OF EXPLOSIONS

1. Post explosive destruction on the wing and pieces of debris.
    a) Post explosive [wave induced] curls of more than one turn [coil of more than 360 degrees].
    b) Deformation of debris due to high internal pressure.
    c) Dispersion of debris in all possible directions with reference to the direction of flight (also to the back and sides).
    d) Identification of the internal parts of the wing hanging on treetops.
    e) Destruction of boards and parts of the nose of the detachable part of the wing, pointing to internal pressure.
2. No traces of hitting a terrain obstacle on the leading edge of the wing.
3. Experiments conducted by the Committee confirm the possibility of the wing being cut with an explosive material and causing damages analogical to the ones observed in the case of the destruction of the TU-154M wing.

The explosion of the central wing box (Fig. 37) was the main reason for the destruction of TU-154M before hitting the ground. The explosion, which happened in that place, destroyed the box, meaning the fragment of the left center wing, together with the front spar and soothed ribs. The spar flew west. The third spar was destroyed as well. The explosion destroyed cabin section 3 killing all passengers inside and throwing body-parts over the entire crash site, before the fuselage had made ground contact. At the same time, the explosion wave blew out the left passenger door ramming it one meter into the ground, and blew out thousands of pieces of the galley, which were dispersed over 1/3 of the crash site area. The explosion wave heading to the tail destroyed this part of the center wing and curled the left and right side of the aircraft outwards with the roof to the outside.

1. Numerous pieces of debris are burned and spread over 100m before the plane hit the ground.
2. The aircraft hitting at a shallow angle disintegrated into tens of thousands of pieces

3. There is no crater resulting from the collision of a 76ton plane hitting soft soil sliding up to 150m at the crash site.
4. The total destruction of all seats. The armrests, seat frames, and seating are disintegrated.
5. The internal part of the aircraft completely lacks floor panels and insulation.
6. The left passenger door was rammed 1m to the ground with a speed 10x the speed of the aircraft (12m/s), i.e. its vertical kinetic energy was increased by 100 times.
7. The sides of the central part of the fuselage right above the place of the explosion are curled outwards.
8. The destruction of the galley, being close to the epicenter, was scattered in small fragments over an area of 1300m2.
9. Characteristic body damages:
    a) Total defragmentation of dozens of bodies sitting in the cabin sections near the center(s) of explosion and their dispersion on the entire crash site.
    b) Small body pieces at the beginning of the crash site (1/3 of entire crash site) before the fuselage made ground contact.
    c) Numerous large burn-injuries of bodies found outside of the fire zones.
    d) Clothes were completely or nearly completely torn off a large number of the bodies (35).
10. A massive presence of traces of explosive materials, especially on the seats, identified by CLKP experts in the fall of 2010.