GOVERNMENT OF NEPAL

AIRCRAFT ACCIDENT INVESTIGATION COMMISSION

FINAL REPORT

OF

9N-AMI H125 (AS350 B3e) Helicopter
Owned & Operated by Air Dynasty Heli Services Pvt. Ltd.
at near SisneVir, Pathivara, Nepal
On February 27, 2019

SUBMITTED BY:

COMMISSION FOR THE ACCIDENT INVESTIGATION

TO

THE GOVERNMENT OF NEPAL

MINISTRY OF CULTURE, TOURISM AND CIVIL AVIATION

23/02/2020 (2076/11/11 B.S.)

FOREWORD

This report on the accident of 9N-AMI, H125 (AS350 B3e) Airbus Helicopter owned and operated by Air Dynasty Heli Services Pvt. Ltd., Nepal is based on the investigation carried out by the 'Accident Investigation Commission' constituted by the Government of Nepal on February 27, 2019. The responsibility of the Commission is to find out the cause of the accident and offer recommendations to prevent the recurrence of such kind of accident in the future to ensure a safer sky for all forms of aviation activities.

The Commission has compiled all available resources including technical information on the aircraft, relevant documents, existing rules and regulations, crash site examination, meteorological reports, Vision 1000 and VEMD analysis, V2 tracker details, interviews with company flight and ground crew, eye-witnesses and CAAN officials and expert advice from BEA, Airbus helicopters and Safran Helicopters.

This report is prepared in accordance with the provisions of ICAO Annex 13 and Civil Aviation (Investigation of Accident) Rules, 2071 B.S (2014 A.D) with the purpose of preventing future aircraft accidents and incidents. It is not the function of the Commission to apportion blame or determine civil and criminal liability.

Composition of Commission:

1. Mr. Yajna Prasad Gautam	**Chairman**
2. Brig. Gen. Dipak Prasad Bastola	**Member**
3. Pilot Col. Pramod Kumar Lama (Retd.)	**Member**
4. Mr. Buddhi Sagar Lamichhane	**Member- Secretary**

_____ _____

Mr. Yajna Prasad Gautam
Former Secretary,
Government of Nepal

Aeronautical Engineer Dipak Prasad Bastola
Brigadier General
Nepali Army

_____ _____

Capt. Pramod Kumar Lama
Colonel (Retd.)
Nepali Army

Mr. Buddhi Sagar Lamichhane
Joint Secretary,
Ministry of Culture, Tourism &
Civil Aviation

Invitee Member to the Commission:

Dr. Rajeeb Kumar Deo, Colonel, Nepal Army

Ms. Bibhuti Pokharel, Senior Division Meteorologist, DHM

Technical Support to the Commission:

Yogesh Aryal, Electronics Engineer, Ministry of Culture, Tourism & Civil Aviation

Note:

1. This report contains the facts which have been determined up to the date of publication. This information is published to inform the aviation industry and the public of the general circumstances of accidents and serious accidents.

2. The extracts may be published without specific permission provided that the source is duly acknowledged, the material is reproduced accurately and it is not used in a derogatory manner or in a misleading context.

Acknowledgements:

The Commission would like to thank to the Government of Nepal, Airbus France, SAFRAN, BEA France and all those who spared out their valuable time and suggestionsin course of investigation to prepare this report.

Abbreviations and Definitions

AD	Airworthiness Directives
AFT	Rear (Antonym of Forward)
AGL	Above Ground Level
AIG	Aircraft Accident and Incident Investigation
AMSL	Above Mean Sea Level
AMT	Aircraft Maintenance Technician
ATF	Aviation Turbine Fuel
ATC	Air Traffic Controller
ATPL	Airline Transport Pilot License
ATZ	Aerodrome Traffic Zone
AUW	All up weight
BR	Mist
B. S.	Bikram Sambat
C of A	Certificate of Airworthiness
CAAN	Civil Aviation Authority of Nepal
CFIT	Controlled Flight Into Terrain
CG	Center of Gravity
CPL	Commercial Pilot License
CRS	Certificate of Release to Service
CTR	Control Zone
CVR	Cockpit Voice Recorder
DD	Deferred Defect
DI	Daily Inspection
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FDR	Flight Data Recorder
FMS	Flight Management System
FOM	Flight Operations Manual
FOR	Flight Operation Requirements
Ft/min	Feet per Minute
FWD	Forward
GPS	Global Positioning System
HF	High Frequency

HFACS	Human Factor Analysis and Classification System
IFR	Instrument Flight Rules
INMCC	Indian Mission Control Center
Kg	Kilogram
KHz	Kilo Hertz
Kts	Knots
Lbs	Pounds
LCD	Liquid Crystal Display
LH	Left Hand
LRU	Line Replaceable Unit
LST	Local Standard Time
MAU	Modular Avionics Unit
MEL	Minimum Equipment List
METAR	Meteorological Report
MHz	Mega Hertz
MoCTCA	Ministry of Culture, Tourism and Civil Aviation
MSA	Minimum Safe Altitude
Mtrs	Meters
N/A	Not Applicable
NM	Nautical Mile
OAT	Outside Air Temperature
OM	Operations Manual
Pax	Passengers
PF	Pre-Flight
PFD	Primary Flight Display
PI	Preflight Inspection
PIC	Pilot in Command
POH	Pilot's Operating Handbook
PPC	Pilot Proficiency Check
QNH	Pressure Setting to Indicate Elevation AMSL
RH	Right Hand
SB	Service Bulletin
SOP	Standard Operating Procedure
UTC	Universal Co-ordinated Time

VFR	Visual Flight Rules
VHF	Very High Frequency
WX	Weather

Definitions

Crew Decision Making: Decision making is the cognitive process of selecting a course of action from among multiple alternatives. The decision-making process produces a choice of action or an opinion that determines the decision maker's behavior and therefore has a profound influence on task performance.

Crew Resource Management: Crew resource management or cockpit resource management (CRM) is a set of training procedures for use in environments where human error can have devastating effects. Used primarily for improving air safety, CRM focuses on interpersonal communication, leadership, and decision making in the cockpit.

Human Factors : Human factors is the discipline concerned with optimizing the relationships between people and their activities through the systematic application of the human sciences, integrated within the framework of system engineering.

Over Confidence: The overconfidence effect is a well-established bias in which a person's subjective confidence in his or her judgments is reliably greater than the objective accuracy of those judgments, especially when confidence is relatively high.

Situational Awareness: Situational Awareness (S.A.) means having a mental picture of the existing inter-relationship of location, flight conditions, configuration and energy state of your aircraft as well as any other factors that could be about to affect its safety such as proximate terrain, obstructions, airspace reservations and weather systems.

Skill-Based Behaviors: Behaviors that rely on stored routines or motor programs that has been learned and can be repeated without conscious thought.

Spatial Disorientation: Spatial disorientation, spatial unawareness is the inability of a person to correctly determine his/her body position in space. When a pilot does not know in flight where his or her body is in relation to the surface of the Earth, the pilot has spatial disorientation (S.D.)

Violation:A Violationis an intentional action (or inaction) that results in noncompliance with known rules, policies, procedures or acceptable norms

SYNOPSIS

On February 27, 2019, an Airbus helicopter H125 (AS350B3e), 9N-AMI, owned and operated by Air Dynasty Heli Services Pvt. Ltd, Nepal carrying 7 Nepalese passengers along with the Captain, crashed on Sisne Khola, taplegunj District, Province No. 1 coordinate N27^{0}25'42" E087^{0}45'59" within a minute after takeoff from Pathibhara towards Tribhuvan International Airport, Kathmandu with casualty of all onboard the helicopter including the Minister of Culture, Tourism and Civil Aviation.

The VIP flight was given approval to fly on VNKT-Panchthar-VNKT sector by TIA office on February 27, 2019. Even though the approved flight plan was for Panchthar with ETD of 0230 UTC, the PIC requested the tower to change the destination to Terathum in VHF indicating VIP on board. The flight was then approved to VNKT-Terathum-VNKT sector. The helicopter departed from VNKT at 0246 UTC (08:31 LT) and arrived Terathum at 0409 UTC (9:54 LT). As per the scheduled plan, the helicopter supposed to fly back to VNKT from Terathum but the helicopter departed from Chuhandada Terathum at 0545 UTC (11:30 LT) and proceeded to Pathibhara without prior approval and landed at approximately 0604 UTC (11:49 LT). Around forty-five minutes later, at 0649 UTC (12:34 LT), the helicopter departed for VNKT and met with a fatal accident within a minute later. The aircraft crashed at an altitude of 10350 ft. coordinated at N27^{0}25'42", E087^{0}45'59".

Search and Rescue was carried out by Local Administration, RCC, Nepal Army, Simrik Air, Air Dynasty, taplejung Airport simultaneously.

The crash site was about 5.49NM NNE from Taplejung airport and the helicopter was found destroyed due to impact on rocky hill followed by post-crash fire. There was no any noticeable third- party damage.

The accident was notified to BEA and Airbus Helicopters, France by the Aircraft Accident Investigation Commission immediately after the accident.

Pursuant to Civil Aviation (Accident Investigation) rules 2071 B.S., the Government of Nepal convened four members Aircraft Accident Investigation Commission on February 27, 2019 to probe into the circumstances and probable cause of the accident with the purpose of preventing recurrence of similar accidents in the future and enhancing flight safety. The Commission commenced its investigation accordingly. The Commission conducted crash site observation and analysis, analyzed weather factor, interviewed witnesses, communicated with BEA, Airbus Helicopters and Safran Helicopters for their expert advice, reviewed documents and analyzed the data from V2 tracker. The commission could not retrieve the EDR, Vision 1000 and VEMD from the crash site.

The Accident Investigation Commission has concluded that the probable cause of the accident was the PIC, who was possibly affected with euphoria (initial phase of hypoxia) immediately after take-off from the Pathibhara helipad in unfavorable weather encountered strong gusting wind along with snowfall which led him to inadvertently enter into IMC conditions, lost his situational awareness and positive control of helicopter which ultimately led to the CFIT accident and ended with the tragic crash.

The Commission has made 13 safety recommendations to the concerned agencies for the enhancement of safety and to prevent such accidents in the future. This report is submitted to the Ministry of Culture, Tourism and Civil Aviation, GoN on 16 February 2020.

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1 FACTUAL INFORMATION

1.1 History of Flight

On February 27, 2019, an Airbus helicopter H125 (AS350 B3e), 9N-AMI, owned and operated by Air Dynasty Heli Services Pvt. Ltd, crashed at Sisne Khola Bhir, Pathibhara, Taplegunj District, Province No. 1 coordinates N27025'42" E087045'59" within a minute after take-off from Pathibhara helipad for Tribhuvan International Airport, Kathmandu with fatality of all 7 persons onboard including the Minister of Culture, Tourism and Civil Aviation, Government of Nepal.

The helicopter company submitted a flight plan to ATS Reporting Office of TIA for Panchthar with ETD of 0230 UTC, and the same was approved. Before departure the PIC requested the Kathmandu tower to change the destination to Terhathum in VHF indicating VIP on board. The flight was then approved for VNKT-Terhathum-VNKT sector. The helicopter departed from VNKT at 0246 UTC (08:31 LT) and landed Terhathum at 0409 UTC (9:54 LT). As per the scheduled plan, the helicopter was supposed to fly back to VNKT from Terhathum but the helicopter departed from Chuhandada, Terhathum at 0545 UTC (11:30 LT) and instead of coming back to Kathmandu proceeded to Pathibhara and landed at approximately 0604 UTC (11:49 LT). About forty-five minutes later, at 0649 UTC (12:34 LT), the helicopter departed for VNKT and met with a fatal accident within a minute. The aircraft crashed at an altitude of 10350 feet coordinates at N 27025'42", E 087045'59". The crash site is about 5.49 NM NNE from Taplejung airport and the helicopter was found completely destroyed due to impact on steep/rocky hill followed by post-crash fire.

1.2 Injuries to Person

Type of Injuries	Pilot In Command	Passengers	Others	Total
Fatal	1	6	0	7
Serious	-	-	-	-
Minor/None	-	-	-	-

1.3 Damage to Helicopter

Helicopter was completely destroyed and beyond repair due to the impact and post impact fire.

1.4 Other Damages

The crash site was very remotely located and not easily accessible due to the steep and rocky terrain. No damage was caused to private property or persons on ground. There was no noticeable environmental effect caused by the accident.

1.5 Personnel Information of Pilot in Command (PIC)

Sex	Male
Date of Birth	June 9, 1992
Nationality	Nepalese
Marital Status	Single
CAAN License No.	CPL (H) 078
Validity of License	31-07-2023
Ratings	AS350 B3e / AS350 FX II / AS350 BA
Total Flying Hours Solo Hours Dual Hours	2105:55 Hrs 1272 Hrs 833 Hrs
Time flown since last 90 days	148:40 Hrs
Time flown since last 30 days	35:55 Hrs
Time flown since last 7 days	17:10 Hrs
Time flown since last 24 Hrs	1:10
Rest Period	Standard
Last date of annual review / check-ride	21-03-2018
Proficiency Expiry	1 year

The flying experience in helicopter 9N-AMI of PIC is attached in Appendix “A”

1.6 Helicopter Information

1.6.1 General

AS350 B3e (H125) with Serial No. 8324 was a single engine helicopter manufactured by Airbus Helicopters, France and designed for light utility work with good high altitude performance. The helicopter was equipped with three bladed main rotors and two bladed tail

rotor, skid type landing gear, 6+1 seating capacity and right side control. It was owned, operated and maintained by Air Dynasty Heli Services Pvt. Ltd.

The helicopter has arrived in Nepal on 16th September 2017 with 27:06 Flying Hours. The Air Dynasty Heli Services Pvt. Ltd. operated additional 1278:52 Hrs till 2019/02/26 in Nepalese territory.

1.6.2 Helicopter Airframe

Model	- AS350 B3e (H125)
Type Certificate Number	- EC 2931/21 Nov 2016
Manufacturer	- Airbus Helicopter
Classification Aircraft Category	- Transport (Passenger)
Registration	- 9N-AMI
Operator	- Air Dynasty Heli Services Pvt. Ltd.
Owner	- Air Dynasty Heli Services Pvt. Ltd.
Serial No	- 8324
Date of Manufacture	- 21st Nov 2016
Last C of A Test Flight	- 26th Sept 2017
Validity of C of A	- 03 August 2019
Maximum Take-off Weight	- 2250 kg
Total Airframe Hours (TTSN)	- 1280:32 Hrs
Total Number of Landings	- 4608
Classification Aircraft Category	- Chartered, VFR
Certificate of Release to Service (CRS)	- Last CRS on January 14, 2019 at 1199:27 Hrs
CRS Airframe Hour	- 1280:32
Total Time Since New of Airframe	- 1280:32 Hrs
Main Rotor Blades TSN	- 1280:32 Hrs
Validity	- Valid Until 1350 Hrs

This helicopter was equipped with VEMD, EDR, DECU and Vision1000.

1.6.3 Engine

This helicopter was fitted with Arriel 2D, free turbine turbo-shaft type engine. The engine was manufactured by Safran Helicopter Engines, France. There are total 5 modules of this engine as shown below:

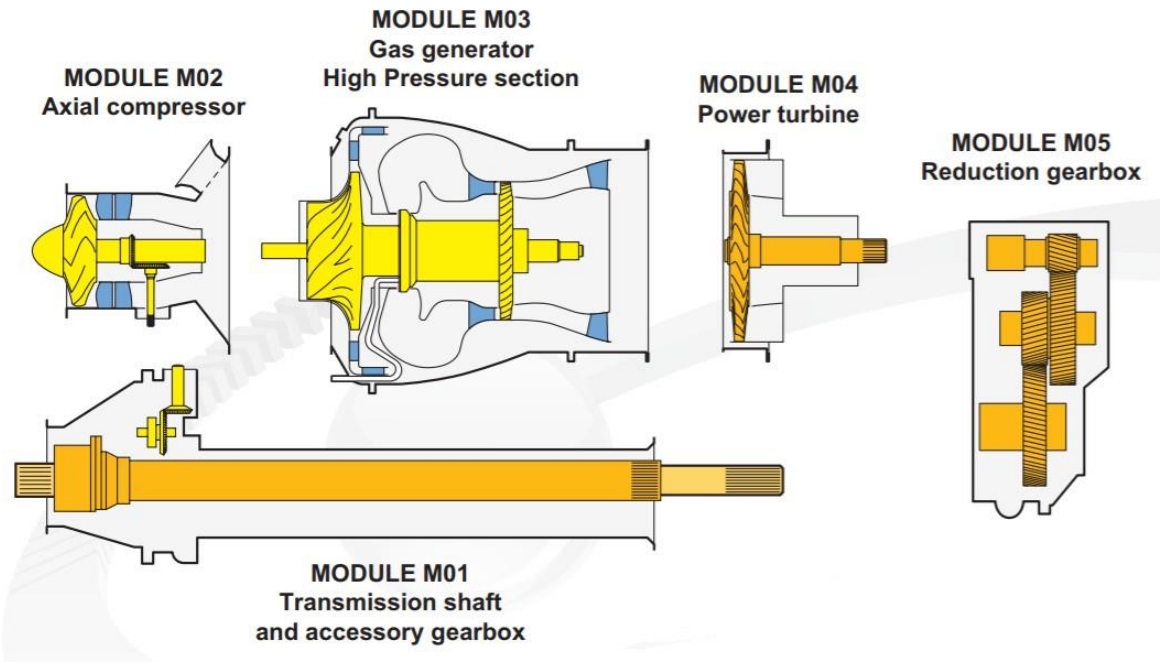


Figure 1 Arriel 2D Engine

The helicopter was fitted with Engine Electronic Control Unit (EECU) which was responsible for constant engine operation as per pilot collective input. Therefore it can be considered as a fully automatic control of engine during flight. In such engine, Pilot does not require extra effort to control the engine. Hence Pilot can focus on his flying and other flight parameters during flight. EECU is shown as below:

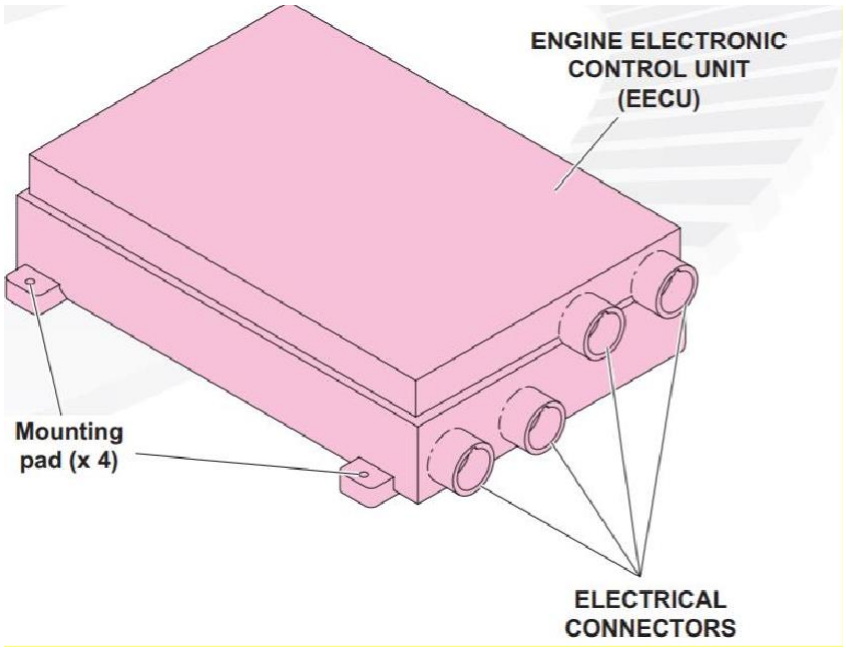


Figure 2 Engine Electronic Control Unit

This engine was also fitted with engine data recording system. One dedicated Engine Data Recorder (EDR) which is shown as below:

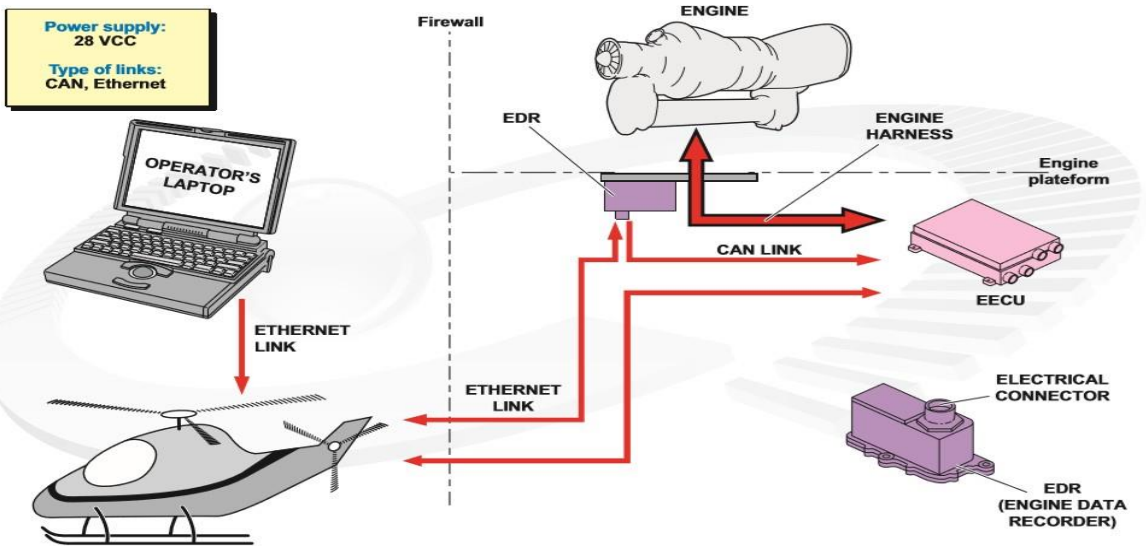


Figure 3 Engine Data Recorder

Additional information of the engine fitted with this helicopter are listed below:

Manufacturer	- Safran Helicopter Engines (Previously Turbomeca)
Type	- Arriel 2D
Engine Serial No	- 50966
Date of manufacture	- 23rd June, 2016
Total Gas Generator Cycle	- 2260
Free Turbine Cycle	- 848
Engine Fitted	- April 01, 2016
Total Time since New	- 1280:32 Hrs

1.6.4 Rotor Blade

Main Rotor Blade Make	- Airbus Helicopter
Model (Qty-3)	- 355A11-0030-04 (Part Number)
Serial number	- 44586, 44615, 44616 R 408/6-123F/17
Tail Rotor Blade Make	- Airbus Helicopter
Model (Qty-1)	- 355A12-0060-04 (Part Number)
Serial Number	- 22087

1.6.5 Inlet Barrier Filter (IBF)

The helicopter was fitted with Inlet Barrier Filtration (IBF) Kit at the inlet of the engine. It removes more than 99% of airborne dust and sand that can wreak havoc with helicopter engines, while providing an enhanced engine performance over the entire flight envelope compared to standard particle separators. IBF provides more useful load and reduced operating temperatures, while simultaneously reducing engine operating and overhaul costs.

As per the Flight Manual Supplement, flight in falling or blowing snow is permitted with no flight envelope restrictions and there is no obstruction from the IBF for the engine performance.

1.6.6 V2 Tracker

The helicopter was fitted with a V2 Tracker which transmits the data either on satellite or cellular technology. The tracker updates the position of the helicopter every 15 seconds interval by default. The tracker provides the real time tracking with the data such as Ground Speed, Track, Rate of Descend or Rate of Ascend, Altitude, Geographical position overlay, Weather overlay and Time. The Commission has analyzed the recorded data in detail to discover the track, speed, altitude, bank angle, etc. to visualize the flight but the reliability of the data couldn't be assured.

1.6.7 Appareo Vision 1000

The helicopter was equipped with Appareo Vision 1000 modern recording equipment in the cockpit which could record different data such as: X, Y, Z accelerations, Attitude data (pitch, roll, yaw, etc.), GPS (latitude, longitude, ground speed, vertical speed, GPS altitude, etc.), cockpit imaging and ambient audio. But in this accident it had been lost and could not be retrieved.

Figure 4 Appareo Vision 1000

1.6.8 VEMD

Vehicle and Engine Multifunction Display (VEMD) is the main indicating and recording system of all necessary flight parameters of the helicopter. This VEMD can displays all the necessary engine and vehicle parameters as the First Limitation Indicator (FLI) and performs the different complementary functions like engine power check, maximum take-off weight calculation and over limit recording etc. Location of VEMD and its inputs are shown as below:

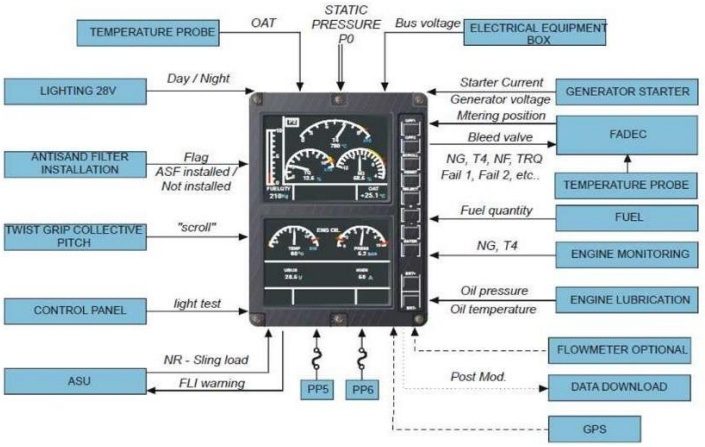


Figure 5Vehicle Engine Multifunction Display

But in this accident VEMD could not be retrieved.

1.6.9 Helicopter Attitude Indicator

This helicopter was equipped with Garmin Display unit (GDU 620) for helicopter attitude indication as below.

Figure 6 Garmin Display Unit - GDU 620

1.6.10 Flight and Navigation Instruments

The aircraft was equipped with the standard AS350 B3e base line flight and navigation instruments required for VFR operation. It features one LCD (Liquid Crystal Display), dual screen Vehicle and Engine Multifunction Display (VEMD) displaying vital information such

as First Limitation Indicator (FLI) as standard. The avionics of the AS350 B3e helicopter includes an attitude indicator, heading indicator, course deviation indicator, turn and balance indicator, transponder, emergency location transmitter, communication systems, navigation systems and global positioning system (GPS).

This helicopter is equipped with all modern equipment for flight navigation as shown as below.

Figure 7Flight Navigation System

1.6.11 Emergency Locator Transmitter (ELT)

The ELT Kannad Integra AP-H was installed on board the aircraft 9N-AMI. As per the record the Last programing date of this ELT was 14.08.2017 and certificate received on 22.08.2017. The ELT was not transmitting the distress signal after the crash.

1.6.12 Crew Oxygen Facility

The Helicopter was equipped with supplementary oxygen cylinder and mask onboard for the Pilots as per the CAAN and Company requirements.

1.6.13 Heating and Demisting System

This helicopter has provision of cabin heating and demisting of windshield. This system can be operated by the pilot as required after the engine start-up. Below is the brief description of heating and demisting system.

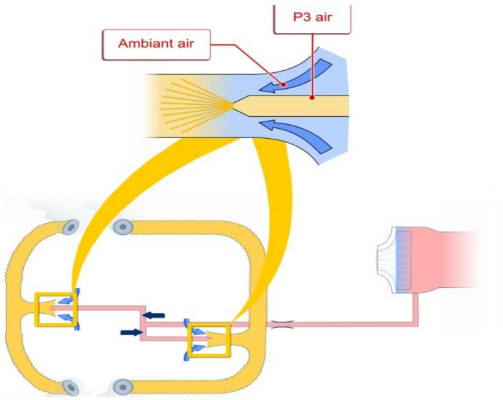


Figure 8Heating and DemistingSystem

1.6.14 Ice and Rain Protection

This helicopter was equipped with Ice protection for pitot system and rain protection for windshield only. There is no anti-icing system fitted with engine.

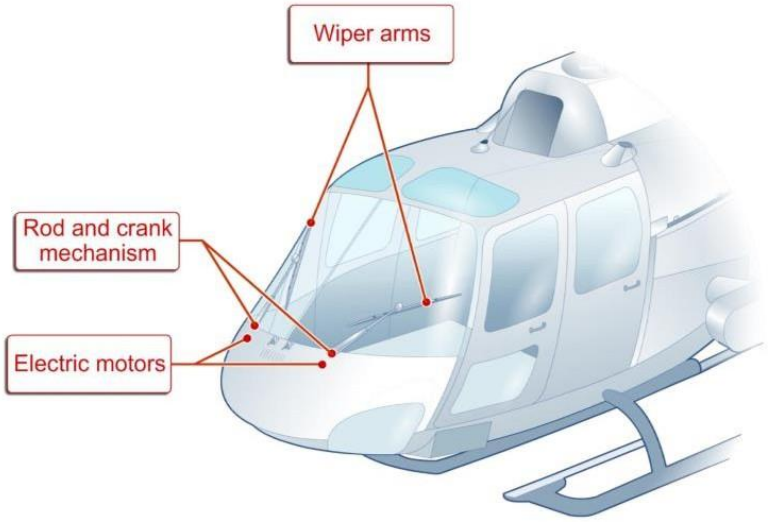


Figure 9Ice and Rain Protection System

1.6.15 Aircraft Maintenance History

Few remarkable maintenance history evidences of this aircraft are listed below:

- Last engine 25 Hrs inspection was carried out by AME (AMT/Appro.No. CA 217) on 23.02.2019 and 300 Hrs inspection also carried out by the same AME on 07.02.2019.
- At AFH 472 Elastomeric pitch rod removed and replaced due to delamination.
- At 1268 AFH dated 17.02.2019 fuel filter element removed and replaced due to pre blockage flashing light on in caution panel. That was the last maintenance work carried out on that helicopter.
- Engine power assurance check of Arriel 2D Engine S. No. 50966 fitted with 9N-AMI was performed on 23.12.2018 at 1175 engine Hrs. TRQ Margin/TOT and TRQ Margin/N1 found

during check was 20.5 and 2.7 respectively which were both in the good remarks.

- Last CRS of 9N-AMI issued on 14 Jan, 2019 and valid till 1350 AFH.
- All the service bulletins including S.B No. A 292732851 and 292722861 were compliance and found satisfactory result.
- The helicopter with Serial No. 8324 and call sign 9V-HCE was owned by LAO SKYWAY as a first customer. The test flight of this helicopter was carried out on 17th Jan 2017. It was noticed that helicopter was kept idle for almost 8 months since its manufactured date. But all preservative ground runs were performed by Airbus Helicopter as per its requirements.
- Helicopter arrived in Kathmandu on 16th Sept 2017. First test flight was carried out on 26th Sept 2017 and helicopter started its normal operation from 27th Sept 2017.
- Helicopter was equipped with IBF with part no. 1350 A2-1, S. No. 06716 which was last cleaned on 23.02.19 at AFH 1276. This IBF has completed total 645 Hrs at the time of cleaning.
- All components were found within its TBO.
- As per the engine logbook till 26.02.2019 engine operation was found normal.
- All maintenance schedules were performed as per maintenance manual.

1.6.16 Aircraft Weight and Balance

Following are the weight and balance limitation as per the Flight Manual of AS350 B3e (H125) as airwortiness approval:

Flight Manual limitation: 5+1 (Weight and Balance Limitation)

Flight Manual Supplement for two passenger front seat: 6+1(Weight and Balance

Limitation given in the flight manual remain applicable)

Last Aircraft Weighing Date	September 17, 2017
Maximum Take-Off/Landing Weight	2250 Kg
Aircraft empty weight	1305 Kg
Weight of the Crew	85 Kg
Weight of the Front Bench Seat (2 Pax)	150 Kg
Weight of Rear Cabin Pax	300 Kg
Weight of the Cargo / Baggage	Nil
Weight of the fuel (95%)	405 Kg
Total weight (at takeoff from KTM)	2245 Kg
Trip Fuel	175 Kg
Total landing weight (at Terhathum)	2070 Kg
Total landing weight (at Pathibhara)	2025 Kg
Take -off / Landing C of G	3.18/3.1

1.6.17 Fuel Status

The Helicopter was refueled at Kathmandu airport on 27 Feb 2019 with total of 95% ATF on-

board.

1.7 Meteorological Information

The weather at Kathmandu, en-route and accident site was provided by Department of Hydrology and Meteorology (DHM) to the commission. The real-time weather at Pathibhara was received by the commission members with interviewing the local people there and the analysis of the real time photographs collected.

1.7.1 Weather Conditions over Eastern Nepal

As weather report provided by Meteorological Forecasting Division, DHM, the weather conditions over Eastern Nepal was as follows:

Wind: The wind flow pattern at surface wind depicted easterly to southerly-easterly windover the Nepal at 0600 UTC. The High altitude wind at 700 and 500 hpa showed south-westerly to southerly wind over eastern side of Nepal at 0600 UTC.

Cloud: On February 27, 2019 between 0300 UTC to 0800 UTC (i.e. 08:45 NPT to 13:45 NPT), broken to overcast low/medium clouds were observed over Taplejung district. Broken to overcast medium low/medium clouds observed over Kathmandu between 0500 UTC to 0900 UTC (i.e. 10:45 NPT to 14:45 NPT)

1.7.2 Weather Report at Crash site

At the time of occurrence, the weather around the crash site was low ceiling with cloud base from ground level, gusting strong wind with light to moderate snowfall, sky and mountain ridges invisible according to nearby eyewitnesses.

The weather at Kathmandu was VFR all the day since morning. But there was low cloud scattered, no significant wind factor which could affect the flight. But because of the deteriorating weather in the eastern sector some of the mountain flights and helicopter flights were diverted to Kathmandu before noon. The Meteorological forecast also indicated the weather deterioration in the eastern mountain area.

Figure 10 Weather at Pathibhara

As per the eyewitness weather at Pathibhara was: wind- strong, gusty and variable, Visibility- marginal because all around covered up by cloud and light snowfall. This statement was supported by the photograph captured just before departure. The PIC was in contact with Taplejung Tower few minutes before take-off and the tower reported that visibility was 2 Km, all around covered up, airport closed.

1.8 Aids to Navigation

Departure point and crash site is located at remote area. No ground aids to navigation is available. Despite other navigational equipment helicopter was fitted with GTN 650 H Garmin GPS. Along with GPS, helicopter was also fitted with magnetic compass as shown below for heading indication.

Figure 11 Navigation Aid

The helicopter was equipped with a VHF transceiver and a satellite phone onboard.

Records of radio transmission between aircraft and Taplejung ATC were available as hand written logbook.

1.9 Communications

The helicopter was equipped with VHF communication having alternate set for air to ground and air to air communication. It was also equipped with satellite phone to communicate for ground station.

1.10 Helipad Information

1.10.1 Departure Helipad Information

The last departure point of the helicopter was Pathibhara Helipad at Pathibhara temple area. Pathibhara temple is one of the significant religious place located in a remote area of Taplejung, east side of Kathmandu. The Pathibhara helipad elevation is 12,447 feet and coordinates is N 27° 25' 43", E 087° 45' 59.9".

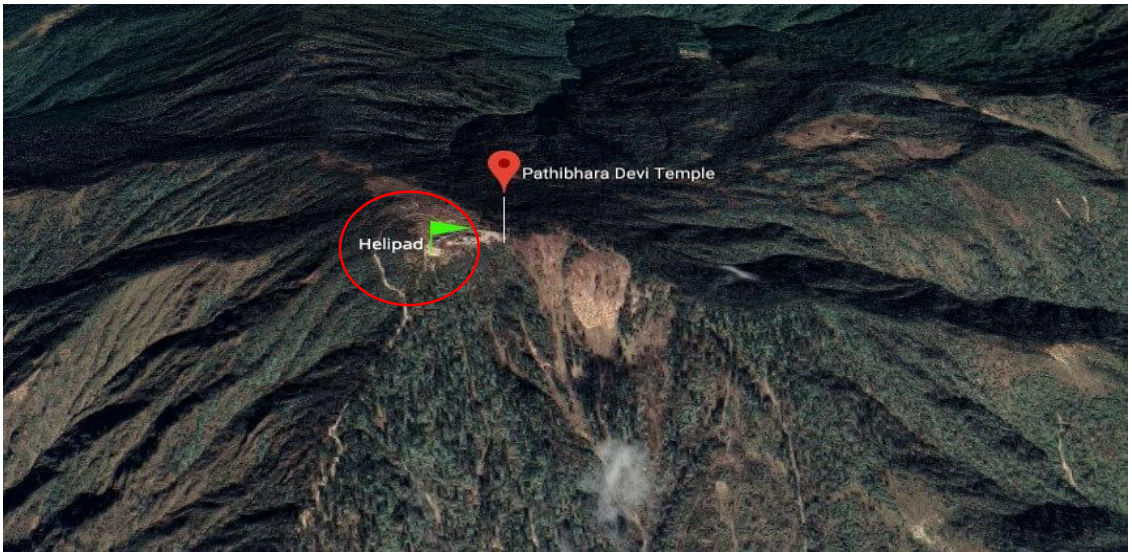


Figure 12 Departure Helipad - Pathibhara

1.10.2 Destination Aerodrome

Helicopter was supposed to come back to Kathmandu on same day and other point of intended landing was not specified.

1.10.3 Crash Site Information

The crash site is located at Sisne Khola Bhir, Pathibhara, Taplegunj District, Province No. 1 coordinates N27°25'42" E087°45'59" at an elevation of 10,350 feet, which is about 5.49 NM NNE from Taplejung airport.

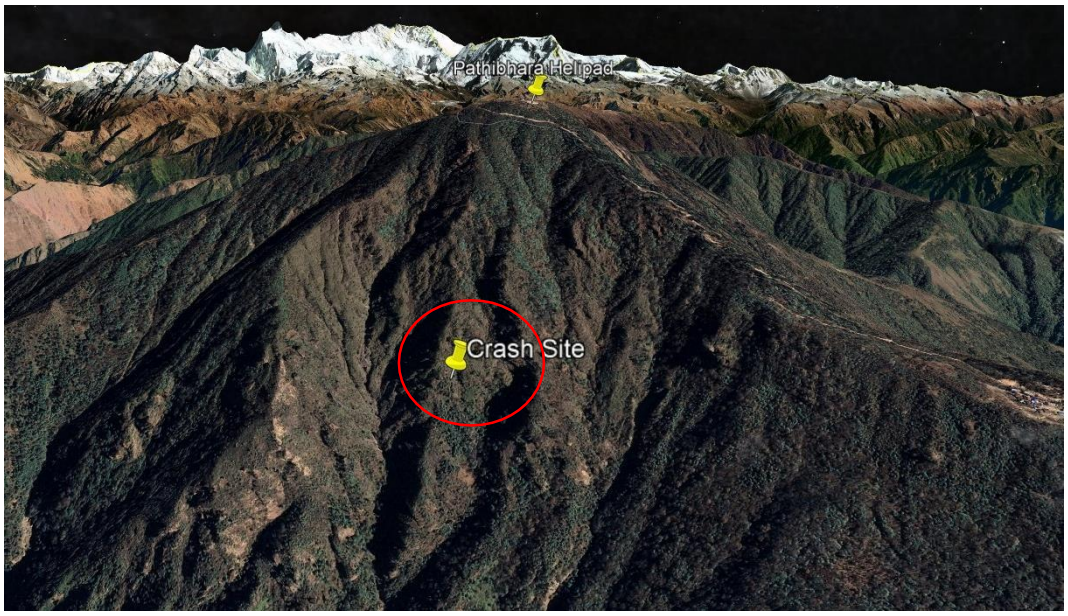


Figure 13 Crash Site Location

1.11 Flight Recorders

Helicopter was not fitted with Cockpit Voice Recorder (CVR) and Flight Data Recorder (FDR), but was equipped with APPAREO VISION 1000, Engine Data Recorder (EDR), Vehicle and Engine Multifunction Display (VEMD) etc which are capable to record some data of particular components and performance.

1.12 Wreckage and Impact Information

The helicopter was found as a wreckage with crumpled fuselage section, detached tail structure, dispersed main rotor and tail rotor blades, engine and cowlings. The fuselage, resting on its upper side, was mostly consumed by the fire. The instrument panels were damaged by the impact force and partially destroyed by fire and all the cowlings and fairings were in a damaged condition. Based on the data collected via picture taken by rescue team and aerial observation during the crash site visit by the commission members; the following observations were made:

- The helicopter initially impacted with its tail portion which was then separated from the main structure.
- The point of first impact was approximately 10 meters from the main fuselage resting position refer Appendix-C.
- Moving from the location of where the helicopter hit the ground, the fuselage, the MRB and engine touched the ground after impact.
- The wreckage were scattered within 25 square meter area at the crash site.

Figure 14 Helicopter Wreckage

1.13 Medical and Pathological Information of Pilot in Command

PIC underwent routine medical examination before enrolling as student pilot and was found to be physically and mentally fit. After joining as a pilot, he was evaluated by CAAN regularly as per the existing guidelines. His last medical was completed on 25th July, 2018. There was no declaration by PIC about any remarkable previous medical conditions during all his routine medical examination. His medical examination did not reveal any medical conditions and was deemed fit to continue his flying privilege.

Postmortem examination of PIC was conducted in Department of Forensic Medicine, Institute of Medicine, Tribhuvann University.

As per the analysis of postmortem report BURN INJURY WITH MULTIPLE INJURIES TO THE BODY as likely cause of death.

Viscera examination of PIC was also conducted which shows that the PIC was not under the influence of any narcotic substance which could affect his performance.

1.14 Fire

The investigation of the crash site, analysis of flight path and evaluation of available evidence showed that the fire was the post impact event. Most of the aircraft part and seven occupants were severely burnt as the consequence of the high speed impact of the aircraft with the terrain.

1.15 Survival Aspect

The accident was fatal and none of the onboard persons survived.

1.16 Tests and Research

The commission could not retrieve any useful component like VEMD, EDR, EECU and Appareo Vision 1000 for further test and research. So no laboratory test could be made.

1.17 Organizational and Management Information

1.17.1 Air Dynasty Pvt. Ltd.

Air Dynasty Heli Services Pvt. Ltd. Established in the year 1993 AD under the company Act of Government of Nepal. It obtained its Air Operators Certificate AOC #035/2001-02 on 15/01/2001. It is operating three types of helicopters- AS350 B3e, AS350 BA and AS350 FX 2. The company is under regular oversight of CAAN with fulfilling basic requirements and regulations providing the service continuously since its establishment.

There was one recorded accident of AS350 BA with one pilot and three pax on board during landing at Lukla Helipad on September 26, 2013 of that company, with one fatality and aircraft was substantially damaged and also three other incidents were recorded.

1.17.2 Maintenance Organization

Second Line Maintenance within the organization.

1.17.3 Air Traffic Services

Civil Aviation Authority of Nepal (CAAN) providing air traffic services at controlled aerodrome and aerodrome flight information and alerting services at AFIS Station

1.17.4 Aerodrome Administration

Civil Aviation Authority of Nepal (CAAN) is running all airports in Nepal and administering them.

1.17.5 Meteorological Services

The Department of Hydrology and Meteorology is an organization under the Ministry of Energy, water resource and Irrigation, Government of Nepal. This is the meteorological authority of Nepal that forecasts, analyses and disseminates weather report for aeronautical purpose as well.

1.17.6 Aircraft Manufacturer

9N-AMI was manufactured by Airbus Helicopter, France.

1.17.7 Regulatory Authority and safety oversight

Civil Aviation Authority of Nepal (CAAN) is the civil aviation safety regulatory authority of Nepal and the company was under regular oversight of CAAN.

1.17.8 Ministry of Culture, Tourism and Civil Aviation (MoCTCA)

MoCTCA is the line ministry for the overall development and management of civil aviation within Nepalese territory. MoCTCA is also responsible for the investigation of any kind of accident of civil aircraft.

1.17.9 Nepal Oil Corporation (NOC)

Nepal Oil Corporation Limited is a state owned trading enterprise of Nepal to deal with the import, transportation, storage and distribution of various petroleum products in the country including aviation fuel.

1.18 Human Factor

The PIC's medical history shows that he had no pre-existing medical condition and no limitation mentioned in his medical certificate. As verified from various sources the PIC was found to be from a well to do family background. He was unmarried and had no family issues to distract him from flying duties. He was the youngest among the two sons in his family.

He was interested in music and playing musical instruments, singing and dancing.

As per family sources he was a very determined person on his commitment and would make sure that he accomplished the task that he set upon.

On the date of accident there was no evidence of commitment to PIC to operate the flight on adverse weather condition too. Hence the flight was conducted on situational base. Commission assumed that the proper judgment and final decision to operate helicopter on unfavorable weather condition was fully on PIC. Based on the interview with the locals at Pathibhara it is found that none of the passengers were forcing the PIC to fly from the Pathibhara. So it is very important to find out the casual factor that causes PIC to attempt for take-off from Pathibhara.

1.19 Search and Rescue (SAR) Operations

Civil aviation Authority of Nepal is the responsible agency to coordinate all SAR activities within Kathmandu FIR. Once the missing of the helicopter suspected the RCC at TIA activated and SAR activity was coordinated properly with the joint effort of Nepali Army, Local Administration, local people and private helicopter companies. The crash site was located by the helicopter mobilized for SAR and the rescue of the deceased was completed next morning only due to the weather, steep terrain and time factor.

2 ANALYSIS

2.1 Introduction

Analysis of the events was done considering fact-based information, psychological factors, physiological factors and mechanical factors. Several discussions were made among the members and experts including BEA France, ACCREP, Airbus Helicopter and SAFRAN Helicopters Engine company experts, especially on the conditions of crash site, aerodynamics of helicopter, operation at high altitude, weight and balance and other relevant operational, technical and environmental aspects.

2.2 Methodology

The following methodology was adopted by the Commission during the investigation to reach the conclusion on the probable causes of the accident.

a) Visit to the crash site
b) Visual examination and assessment of wreckage. Photographs and videos were collected for detailed study
c) Wreckage distribution plotting
d) Collection and study of the prevailing weather report
e) Collection and study of technical documents related to the maintenance and operational history of the aircraft
f) Interview and written statement collection with the concerned people and organization
g) Study of personal files and information about the crew
h) Study of issues related with the human factors, aviation medicine etc.
i) Collection of medical history and medical report of PIC
j) Review of the CAAN regulations/requirements regarding aircraft operations
k) Collection of autopsy and viscera report of PIC
l) Collection of company profile
m) Consultation with concerned experts

2.3 Visits to the Crash Site

The Team of the Commission along with technical experts and security persons visited the crash site to study the nature of the accident and to collect necessary data and information regarding the accident.

2.4 Pre-flight observation

It has been found that the flight to Terhathum was arranged at very short notice and the VIP passenger travel was not notified to the flight operation till the time of boarding. The number

of the passengers that would be making the trip was also not confirmed till the last moment of the boarding. The passengers were seemed to be in a hurry. Since the destination was not confirmed the flight dispatcher prepared the load and trim sheet only for the Kathmandu-Panchthar-Kathmandu sector.

It was found that the passengers were not weighed individually as per the aircraft flight manual and an average weight of 75 kg per passenger was taken for C of G calculations.

It was found there is no VIP movement guide line existing in the company SOP as well as in CAAN requirements. All VIPs that use helicopters for official or personal reasons travel as a normal passengers.

2.5 ATC Flight Plan

As per the Company SOP's Section 200.17.4 the concerned person of the company should file the ATS flight plan detailing the information required prior to the departure from an airport. If there is any change in flight plan it should be coordinated with appropriate ATS unit on time when practicable.

The flight plan for the flight was submitted to ATS Reporting Office mentioning the destination as Panchthar, But the PIC through RT confirmed the destination as Terhathum just before he took-off from Kathmandu and the ATC has corrected the destination accordingly. The flight program for Pathibhara was not communicated to any ATS unit or government agencies.

This shows that initially the flight was planned only up to Terhathum but departed from terhathum to Pathibhara without appropriate communication and prior flight preparation.

2.6 Mechanical Factors

The Commission examined the maintenance history of the helicopter and found that all the airworthiness directives and service bulletins had been complied with as per the maintenance requirements within the prescribed time frame. The technical logs shows that the maintenance works, major inspection works and modifications were carried out as per the approved maintenance program.

There was no evidence of any system or primary flight controls failure during the flight. Hence, the failure of the helicopter systems e.g. hydraulic, flight control, and other major components can be ruled out.

2.7 Duplicate Inspection (Re-Inspection)

The duplicate inspection would normally be carried out by the person who is certifying the work that requires inspecting to perform the specific inspection. Commission found that the same AME has performed repetitive inspection in lieu of duplicate inspection. Due to same person carrying out the duplicate inspection the possibility of finding out mistake on the previous job is remote.

2.8 Probability of In-flight Engine Failure

According to nearby witness and local villagers near the crash site they could hear the noise of the engine till the moment of impact when there was a booming sound of an impact. The post-crash fire that followed after the helicopter impacted the rocky terrain is most probably due to hot surfaces of the engine caused the fuel that was sprayed after rupture of the fuel tank immediately caught fire and consumed the wreckage and dead bodies.

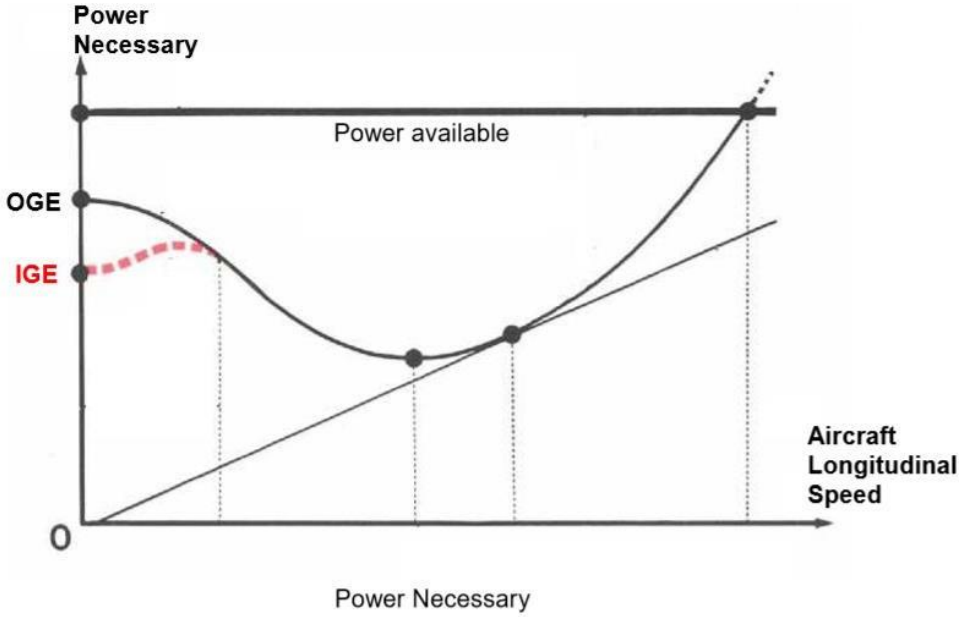
The helicopter crashed into the steep terrain at a high speed which can only be achieved if the engine is running to provide thrust to the main rotors to achieve this high speed which also contributes to the fact that the engine was running until the moment of impact. Hence, the possibility of in-flight engine failure is remote. The examination of the photographs of the wreckage of engine also supplement the engine running condition till last moment of the accident.

2.9 Vortex Ring Condition

Vortex Ring State occurs when a helicopter is in an excessive rate of descent, has low airspeed and the pilot has applied partial power. After the helicopter has entered Vortex Ring State, the situation gets worse if the pilot applies more power to stop the excessive rate of descent because the helicopter is sinking in its own downwash. From the observation of the wreckage, postmortem report of the occupants, conditions of the ground at the crash site, it seems that it was a high forward speed impact. The commission analyzed all the existing situation and observed minimum possibility of Vortex Ring State occurring leading to the accident.

2.10 Performance of Helicopter at IGE and OGE

The Maximum Take-Off Weight (MTOW) of the helicopter is 2250 Kg. But it depends on altitude and OGE or IGE flight configuration. Graphical presentation of power necessary and power available at different airspeed is as shown below:



Power Necessary

At Pathivara helipad as per the helicopter flight manual IGE take-off weight is 2250 Kg and OGE take-off weight is limit to 2120 Kg, in both cases though weight was within limit due to topography of Pathivara hilltop and layout of the helipad possibility of IGE take-off is very remote. At the time of take-off from Pathivara all up weight of the helicopter was 2025Kg as per calculation. From the power margin graph as shown in above, in OGE configurations the power available for the maneuver could be limited, which can restrict the pilot for the desired maneuver of the helicopter which has contributed to further deterioration of controls due to forward C of G being outside of prescribed limit

2.11 Helicopter Aerodynamic - Load Factor

The resultant weight and centrifugal force during turns produces an increased load factor on the helicopter. As per the data analysis and crash-site visit, commission found that it was a high speed impact. The average rate of descent of that helicopter was high and estimated at 3600 ft per min. This could be possible due to the effect of a high bank angle or nose down attitude. This rate of decent was higher than auto-rotative rate of decent. In such high rate of descent situation, handling of helicopter is extremely difficult while maneuvering in IMC conditions.

2.12 Emergency Location Transmitter (ELT)

ELT was not transmitting the distress signal after the crash and commission found that there was no in-built antenna. Analyzing the accident scenario the possibility of complete destruction and a burnt of the ELT caused by high speed impact could be the reason for the ELT not transmitting the signal post crash.

2.13 Guns On Board

There is a clear provision for guns on board given in the Company SOP. As per the sub-section (B) of section number 200.17.7.4 "Guns on Board", the company staff should ensure the weapon is not loaded, is in a safe condition and is stowed on the helicopter in a place which is inaccessible to any person on board the flight if a valid firearms license holder wishes to take firearm with himself in flight.

As per the sub-section (C) of same section provides that at rare condition, the members of police on official duties or others, such as military personnel may have need to carry a firearm in the cabin of passenger aircraft.

From analysis of the wreckage of the helicopter and post-mortem report of the deceased commission reached to the conclusion that the gun was not used in flight. Similarly the possibilities of explosives was also ruled out.

2.14 Front Bench Seat

All the past three accidents of AS350 B3e type helicopters in Nepal had the front bench Seat and were used at the time of accident. According to the Supplement 21, from the Airbus Helicopter aircraft flight manual, number of occupants as seven including crew should not have more than 154 Kg on the two-passenger front bench seat. But in actual the weight of the two pax and bench seat had exceeded the limit of 154 kg, which was a very serious matter while operating in the high altitude airfields.

The Commission analyzed this issue and reached to the conclusion that considering the operational environment of Nepal in remote and high altitude areas where the availability of weighing facility and trained manpower during boarding is rare. The use of front bench seat with two adult passengers usually leads to exceedance of prescribed weight limit of 154 Kg.

As a result the loading will be affected and over all C of G of the helicopter also moves beyond limit, which always poses threat to the safety of flight. So the safety regulator of Nepal have to review the front bench seat utilization in Nepal considering the past accidents of the helicopter and operation environment of Nepal.

2.15 Helicopter Weight and Balance Analysis

According to the Flight Manual's section no 2.1 "Occupants", the minimum flight crew is one pilot in right seat and maximum number of occupants (including flight crew) is six. The supplement 21 given in the flight manual allows for the number of occupants as seven including crew. The weight on two-passenger seat should not be more than 154 Kg (340 lb.).

The flight dispatcher submitted a load sheet to the PIC before departure from Kathmandu showing that C of G was within limit, in fact C of G was forward of the prescribed limit. The flight manual has authorized two passengers in front bench seat but the flight dispatcher has shown one passenger in front seat and five passengers in the rear seat where as it is authorized two passengers in front bench seat and only four passengers in rear seat. As per the dispatcher he did it to manage C of G of helicopter within limit. This shows that while authorizing two adult passenger in front seat is very critical and there is always a risk.

As the flight progressed and fuel was consumed and the C of G shifted more forward than when it was at take-off position because the fuel tank is behind the passenger compartment. Thus, at the Pathibhara helipad there was less fuel remaining in the tank resulting in the C of G position forward of the prescribed limit. It is a real fact that an out of C of G helicopter could be very difficult to control during gusty wind conditions. In this accident the forward C of G due to exceed weight onboard helicopter could be considered as a contributing factor in the loss of control of helicopter in IMC conditions.

2.16 Helicopter Flight Limitation

The flight manual states that the AS350 B3e helicopter can be operated up to an altitude of 23,000 feet (pressure altitude). The maximum take-off weight of the helicopter is nonetheless restricted by the altitude and outside air temperature existing at the take-off point. The flight manual has provided a graph of In Ground Effect (IGE) and Out of Ground Effect (OGE) performance at different altitudes and temperatures. At an elevation of 12,447 ft and -2 °C as the conditions existing at Pathibhara during take-off on 27th FEB 2019, it can be seen that the IGE hover performance of 9N-AMI is within limits of the prescribed graph in the flight manual

which is 2250 Kg. But for OGE performance for the same conditions the maximum take-off weight is limited to 2120 Kg.

The surface wind at Pathibhara on 27 Feb 2019 was strong, variable and gusty with snowing conditions since morning. Subsequently it would have exceeded the engine power available if the helicopter was out of wind or facing tail wind during take-off. In such conditions with limited choices available to the PIC due to the layout of the helipad at Pathibhara, he had the possibility of making an OGE take-off only. The eye witnesses could not confirm the direction of take-off and the course it took as they proceeded indoors to avoid uncomfortable wind blast during take-off.

One of the limitation of helicopter as per flight manual is cabin compartment load limitation that is 154 Kg in front two passenger seat. Supplement 21 of flight Manual shows that seven seat configuration is allowed but presence of seven seat and only pilot cause significant change in the C of G position. So, each configuration must be checked properly. The limitation on C of G was overlooked by both the dispatcher and PIC in practical. So exceeding the limitation of the helicopter during flight operation could be considered as one of the contributing factor of the accident.

2.17 High Altitude and Mountain Flight Technique

Before operating high altitude flight for helicopter it is important for the pilot to consider the following situations:

Hypoxia – a lack of oxygen, which is difficult to identify in oneself and can lead to over confidence and a lack of judgment.

Spatial Disorientation – being surrounded by high mountains and flying over deep valleys can disorientate a pilot. Visual Illusions – lack of horizon, false horizon, white out and grey out, lack of depth perception which can lead to disorientation.

Apprehension – nervousness due to lack of experience in the environment can lead to nervousness indecision and over-controlling.

Fatigue – mountain flying can be very mentally and physically tiring.

Hence, the commission found that the PIC could not make the appropriate judgment considering the factors affecting the high altitude flight on adverse weather condition before take-off.

2.18 Training and Company Procedure:

As per the evaluation of records carried out by the Commission, the PIC was provided with relevant trainings including high altitude and Mountain flight training on 21.03.2018 as per the requirements of CAAN and Air Dynasty Heli Service Pvt. Ltd.

2.19 Crew Rest

From the flying records provided to the commission the PIC had complied with all flight duty time limitations, flight hour limitation stipulated by CAAN and the company SOP. He was adequately rested prior to the flight on 27 February, 2019.

2.20 Crew Oxygen/Hypoxia

According to V2 tracker records and ATC Taplejung logs 9N-AMI was on ground for at least 45 min at Pathibhara which is at an elevation of 12447ft. There is no evidence of the PIC using supplementary oxygen while on ground. Just before starting engine at Pathibhara he exited the cockpit to remove the engine air intake cover and proceeded to start the engine for take-off. Even if he had inhaled supplementary oxygen during start of helicopter engine the effect would have been negligible because breathing supplementary oxygen is required for a few minutes to be assimilated in the human body fully. As per eye witnesses once helicopter started up it took off immediately

Regarding oxygen supply according to FOR, 5th Edition, the clause number 2.3.8.1, a flight to be operated at flight altitudes between 700 hPa (10000 ft.) and 620 hPa (13000 ft.) shall not be commenced unless sufficient stored breathing oxygen is carried to supply all crew members and 10 per cent of the passengers for any period in excess of 30 minutes.

It has been mentioned in the General Operation Manual (GOM) of Air Dynasty that "An aircraft shall not fly to an altitude higher than 10,000 feet unless the oxygen requirements are fulfilled and regardless of any rules, company pilots shall use oxygen when flying higher than 10,000 feet regardless of time.

After departing from Tehrathum and proceeding to Pathibhara and while on ground there, very little evidence is available to indicate that the PIC used oxygen before take-off. Even if he had used oxygen before flight it would have taken at least 5-10 minutes before the oxygen was assimilated in the blood system to be effective. Just before starting the engine the PIC came out of the helicopter and removed the engine intake cover. This indicates that even if PIC had

taken oxygen, it was for less than five minutes before the helicopter took off. Therefore hypoxia in PIC cannot be ruled out.

2.21 Helicopter Operation at High Altitude and Adverse Weather Condition

Nepal is a mountainous country with very difficult terrain and the location of the crash site is near Mt. Kanchanjunga which is the third highest mountain in the world. The weather in the mountains is very unreliable, the wind changes its direction often, and is gusty in nature. There are updrafts and downdrafts in the valleys. The temperature in the afternoon is high leading to hot and high conditions which decreases engine power. For high altitude flight operation physiological needs on the human body like nutritious food and appropriate clothing could be necessary but may not be easily available in that area. Therefore, it is a very challenging job to carry out helicopter flights at high altitude in a country like Nepal. Careful pre-flight planning, detailed study of the weather, knowledge of limitations of the aircraft, good experience in high altitude flying, proficiency in flying techniques, detailed pre-flight briefing are all important aspects that must be considered to successfully carry out a safe flight.

On the fateful day on 27 Feb, 2019 9N-AMI PIC departed for Tehrathum at 0246 UTC (0831 LT). The weather provided by Department of hydrology and Meteorology was broken to overcast low and medium clouds over Taplejung district. The flight took 1 Hr15 Min. to reach Tehrathum which was 126 NM from KTM which usually takes 1 Hr 10 Min. The helicopter took the river route due to the passes on the normal route being covered up with low clouds. Later in the morning numerous fixed wing and rotor wing aircraft diverted back to Kathmandu due to adverse weather with icing conditions. After landing at Tehrathum and spending 1:36 Mins there, it took off for Pathibhara located at 12,447 ft (AMSL) where helipad is located on pyramid shaped high hill top without providing flight details to any ATS station or information to any responsible agency.

A Simrik Air helicopter 9N-ALT has made multiple trips to Pathibhara on the same day and the PIC of the aircraft gave information to the commission that there was strong gusty wind, continuous snowfall and overcast conditions at Pathibhara. On the fourth flight the PIC of Simrik Air diverted to Taplejung airport and after waiting about twenty minutes for weather to improve, it proceeded to Pathibhara, picked up his passengers and returned to Bhedetar.

From the V2 tracking records provided to the Commission on the Tehrathum Pathibhara leg, it is evident that the PIC is constantly maneuvering the aircraft to avoid clouds and remain VFR

which is seen by the large Rate of Climb (ROC) and Rate of Descent (ROD) changes made during the flight. At 11:37:29 LT the helicopter was in climbing attitude and the ROC was 1496 ft/min and immediately just after 15 seconds at 11:37:44 LT the helicopter was in descending attitude with ROD 669 ft/min.

The helicopter 9N-AMI landed at Pathibhara in adverse weather conditions. The weather was unstable moving cloud with gusting wind, light snowfall and marginal visibility. The priest of Pathibhara has mentioned that if they had prior notice of the arrival of the helicopter he would have immediately suggest to cancel the flight. The Taplejung Airport tower ATC also said the same as priest. After spending around 45 minutes on ground and the weather remaining the same PIC has decided to take-off for Kathmandu. Right after take-off it is assumed that the helicopter had entered into the clouds, then PIC became disoriented, lost control of the helicopter and collided with steep/rocky terrain which totally destroyed the helicopter killing all seven occupants.

The commission could not confirm the reasons and actual situations which compelled PIC to return back to Kathmandu in such unfavorable weather conditions.

According to Company SOP's Section 200.17.3 "Weather Reports, PIREPS", the PIC should not fly without studying all available weather reports from appropriate meteorological services and PIC must ensure the weather is suitable, with adequate margin.

According to Operational manual Part A's Section 3.4.7 "Report Weather Condition in Flight", the PIC should report the meteorological condition observed on the en-route to the concerned unit.

In pictures provided to the commission by people at Pathibhara it can be seen that while on ground and prior to take-off light snow fall was continuing and light ice has accumulated on the surface of both the wind shield.

According to eye – witness shortly after take-off there was suddenly very strong wind and snow at Pathibhara which could have made the task of controlling the helicopter very difficult for the PIC.

As interviewed with ATC of Taplejung Airport, weather condition at Taplejung during the time of departure was not advisable for VFR operation. Based on the evidences and interviews it is proved that the PIC did not abide by the provision of the Company SOP and the Company Operation Manual.

Considering all the available information; the weather was one of the main contributing factors of the accident.

2.21.1 Possibility of Misting and condensation

During cold weather conditions, possibility of condensation on inside surface of the windshield and passenger windows from the breath and body heat of passengers could severely limit the outside view of the pilot and passengers. After engine has been started it will take a few minutes for windshield heating and cabin heating to clear and remove accumulated ice and condensation from the windshield and windows. But according to local people at Pathibhara, the helicopter took-off shortly after starting engine. As per V2 track records the helicopter took-off within one minute 28 seconds from start-up.

It seems that the PIC was in a hurry to start the engine and took-off from Pathibhara without waiting for the wind shield heating to fully remove the ice and condensation in the passenger windows. Without a clean windshield, the crew's visibility outside can be severely limited which could contribute to worsen the situation while helicopter operating in marginal weather conditions. Based on the analysis the possibility of condensation of vapor inside the windshield of helicopter could be one of the contributing factor to lead this accident.

2.21.2 Icing on the windshield outer surface

Since there was continuous snowfall in Pathibhara area and the helicopter was on ground for last 45 minutes it was certain that there was icing on the outer surface of windshield, which could not be removed by windshield wiper only. It was also proved from the photograph taken just before take-off from Pathibhara. As per the eyewitness the PIC has not removed the accumulated ice by any other means. So icing on the outside windshield could contribute to limit the visibility of crew and limit the flying performance.

2.21.3 Unfamiliar Terrain

Although the PIC completed high altitude training on 21/3/2018, from available records it seems that it was PIC's first landing at Pathibhara in his career. With this fact in mind, his task was more challenging when he proceeded to land and later take-off from Pathibhara in unfavorable weather conditions on that day. Eye witness account also provided details about the PIC inquiring the location of Taplejung airport which is located 6 NM south south-west of Pathibhara. Poor situational awareness regarding terrain and navigation therefore also contributed to the PIC being disoriented after take-off.

2.22 Adherence to Manuals

2.22.1 Aircraft Flight Manual

a) The ill-fated flight was not in adherence to the sub-section 1 of section 2.1"General limitation" in terms of operation of flight in VFR.
b) PIC did not check and confirm the limitation of the sub-section 2 of section 2.2 "Longitudinal C of G" and its supplement in terms of weight and balance.

2.22.2 Standard Operating Procedure

Section 200.14.1 "CFIT Briefing" states that CFIT occurs when an airworthy aircraft is flown, under qualified pilot, into the terrain with inadequate awareness on the part of the pilot of the impending collision. According to the provision pilot should fly in VFR and maintain situational awareness both vertically and horizontally.

Pilot needs to know about the aircraft and performance of the equipment's installed and be extra careful when operating in unfamiliar area. Although the commission has no doubt regarding the knowledge of the pilot in flying aircraft and its equipment, commission could not be confirmed regarding the operational plan of the pilot before flying to Pathibhara which was unfamiliar area for the PIC.

2.22.3 Operation Manual

a) Section 3.3.15 of Operation Manual of Air Dynasty" CFIT risk Reduction" states that a risk reduction of CFIT is achievable by strict adherence to SOP, but while analysing the departure flight path from Pathibhara, it seems that PIC was unable to follow the provisions of SOP and entered into clouds which led to the CFIT accident.
b) Section 3.3.16 "Factors causing CFIT accidents" states many factors for the CFIT some of which are outlined below:
    i. Lack of Lateral situational awareness
    ii. Failure to recognize responsibilities
    iii. Violation of the procedure

Analyzing the above mentioned provisions of different documents and factual information the commission reached to the conclusion that the PIC of ill-fated helicopter was not familiar with the terrain, the visibility and overall weather condition was not favorable for flight at the time of take-off.

2.23 Crash Resistant Fuel System

The last three helicopters accidents in Nepal have resulted in post-crash fire except the Air Altitude crash where the helicopter impacted with trees in a thick forest whose branches

probably cushioned the impact of the crash and prevented post-crash fire. All these three helicopters were not equipped with the Crash Resistant Fuel System and none of these type of helicopters operating in Nepal have such system.

The FAA Re-Authorization Act at 2018, P.L. 115-254 requires all newly manufactured helicopters, including that type certified before 1994 to have crash resistant fuel systems.

Part 44737 of the law gives helicopter manufacturers until April 5, 2019 to comply with the inclusion of the system on all newly built helicopters and stipulates that the FAA administrator will expedite the certification and validation of United States and foreign type designs and retrofit kits that improved fuel systems crash worthiness.

Airbus said that all newly built H130s-EC130 T2s have had CRFS (Crash Resistant Fuel System) since the H130s' entry into service in 2012 and that all newly manufactured Airbus H125s will have CRFS by next year.

2.24 Organizational Factor

The commission has carried out the analysis of organization's internal environment like organization structure, management policies and practices, resources and financial viability, internal and external communication, safety culture, operation management, safety management and regulatory framework etc. Likewise, Commission analyzed the accident event and organization relation and reached to the conclusion that there are some organizational deficiencies contributing to the accident.

2.25 Human Factors

The commission carried out in-depth examination on human factor aspect of this accident. A systematical analysis of the accident was carried out to determine the primary factor or casual factor of this accident following the guideline of HFACS framework. The framework is listed. Interactions with concerned personnel of different aviation organizations revealed some underlying problems of human factors associated with this accident are inadequate judgment of PIC regarding latest situation, PIC could not consider to use available resources (Lack of CRM), operational tempo and lack of risk management which are tabulated in Appendix-B.

Since the helicopter was initially dispatched for Kathmandu–Tehrathum-Kathmandu, it looks he easily accepted the request of additional sector flight made by the passenger on board even

in the bad weather. PIC may have additional excitement to satisfy the interest of high level passengers onboard. Without analyzing the aircraft limitation, weather factor and fuel status etc. PIC took off from Pathibhara.

As per eyewitnesses and the available photograph most of the occupants of the helicopter had not worn the warm clothing suitable for high altitude snowing and cold weather. Observing the further deterioration of the weather condition and the circumstances to return back to Kathmandu on same day commission could not rule out the intention of all occupants to take off as soon as possible and escape from the deteriorating weather.

It was found that he was in a very comfortable position from family standpoint, organization and colleagues' side. He had no undue pressure, conflicts in his day to day matters. He had life with a lot of opportunities.

So it could be understood that the decision of PIC to take additional initiative in completing the flight may be one of the contributing factor in this accident.

2.26 Sector Fuel

The normal fuel consumption rate of the aircraft was 130 kg per hours. Estimated endurance remaining at the time of accident was for 1 hours and 30 minutes; which could have been insufficient for the helicopter to fly back to Kathmandu. In the adverse weather condition the helicopter may need more fuel than normal to reroute the flights. So the sector fuel planning was not appropriate for the flight.

Type of Fuel Used JET A-1. On board fuel before Departure: 95% (405 Kg)

Sector	Time	Approx. Fuel Burnt as per calculation (Kg)	Remaining Fuel (Kg)
Kathmandu-Tehrathum	75 Minutes	165	240
Tehrathum-Pathibhara	19 Minutes	45	195

2.27 Flight Path after take-off from Pathibhara

After departure from Pathibhara at an elevation of 12427 feet AMSL helicopter took off on a north north-westerly heading and started to turn left then continued turning at a high speed descent at the rate of about 3600 feet per minute and impacted at a distance of 0.02 NM west from Pathibhara helipad at an elevation of 10,350 feet. The likely flight path of the ill-fated helicopter was reconstructed on the basis of V2 track data, Elapsed time (ET) and account of nearby local people.

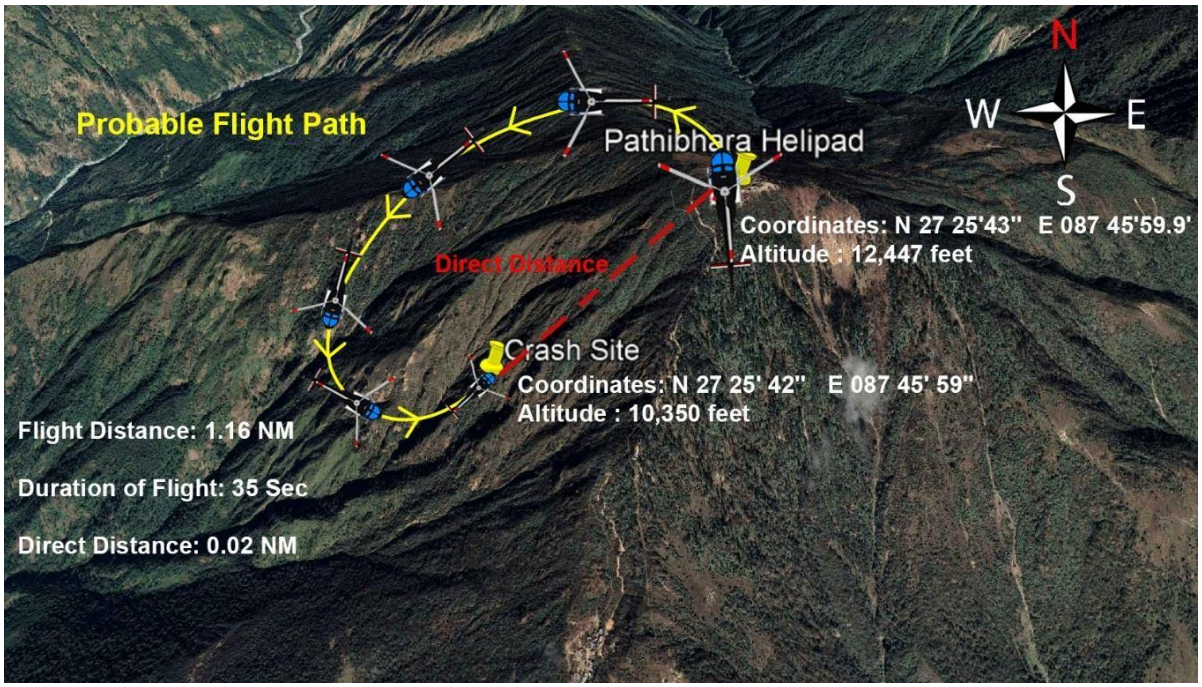


Figure 15Flight Path

Brief analysis of take-off flight path and sequence of events are listed as below:

Sequence of Event	Status of Helicopter	Significant Results	Evidences
1	Landed at Pathibhara lower-side helipad, parking facing on North North-West heading 336°	Stranded at Helipad about 45 minute waiting for passenger	Verbal statements of eye witnesses at Pathibhara Temple. According to V2 tracker
2	While all pax on board pilot came out and removed engine intake cover. Before that also	Pilot has not used oxygen till the period of take-off. Suspected	Verbal statements of eye witnesses

	PIC was came out for Photography	effects of hypoxia in the pilot	
3	Before or during start-up pilot to go through the pre-flight check list as per SOP and CAAN requirement	No evidence of use of check list	In a hurried to take-off
4	Helicopter took-off within a 1 min 28 seconds of start-up and proceeded to North side about 200-300 meter and made left turn. Just after take-off within a short period the sudden very strong gusting wind with snow fall encountered resulting the uncontrolled attitude of flight	Visibility was very poor. Helicopter made a step descend heading South, Southeast and suddenly drifted to Northeast and hit to the step rocky hill at an elevation of 10,350 feet approximately on 0.02NM direct distance from Pathibhara Helipad	As per V2 track record and eye witnesses helicopter made a round after take-off and travelled 1.16 NM to intersect the flight path. Uncontrolled decent to approx. 2000 feet within 35 seconds, steep nose down

3 CONCLUSION

3.1 Findings

1. The PIC was qualified and certified in accordance with the rules and the regulations of CAAN.
2. As per the documents the PIC had received required training and flight experience.
3. The PIC was not under influence of any narcotic drugs.
4. Rest period and duty time of the PIC was within the acceptable limit.
5. The helicopter was maintained properly as per approved maintenance schedule. No maintenance work was found overdue.
6. While the flight plan was submitted to the ATS Reporting Office, the destination was Panchthar. But while on start-up PIC changed the destination to Terhathum through RT.
7. The flight was planned in very short time and conducted in a hurry.
8. CG computation while carrying two passengers in front seat was not correctly done as per flight manual leading to forward CG being out of limits.
9. Based on the evidences collected and analyzed from past accidents of similar nature in Nepal, use of front bench seat for two adult passengers in the high altitude sectors of Nepal poses risk to the safety of flight due to the CG imbalance of aircraft in flight.
10. Carriage of two passengers in front seat entails change in CG position that needs to be carefully checked and computed which in this flight was incorrectly done.
11. The actual C of G of the helicopter was beyond the prescribed limits when taking off from Kathmandu. While taking off from Pathibhara the possibility of shifting C of G further forward was more likely.
12. The weather at Pathibhara was unstable gusting wind, poor visibility with snowing condition and all around covered up during take-off.
13. Because of the weather and full passenger on board the possibility of condensation within the cabin windshield was probable and that might have limited the PIC's outside vision to navigate the helicopter properly in adverse weather condition.
14. The outer surface of the helicopter's windshield was covered by ice and that could have minimized the external visibility of PIC.
15. The clothing of most of the occupants was not appropriate for that kind of cold weather.
16. The crash site was very steep terrain and very difficult to reach.

17. The helicopter was completely destroyed due to the impact force and post impact fire.
18. The fuel on board was only for the sector Kathmandu-Terhathum-Kathmandu, which indicates that there was no pre-plan for the Pathibhara sector.
19. No evidence was found to indicate any pre-existing medical condition that might have adversely affected the pilot's performance during the accident flight.
20. There was no evidence of failure of the helicopter's flight control systems, structure, or power-plant prior to the impact.
21. There was possibility of PIC affected by hypoxia.
22. Because of the location and nature of the crash site, it was not possible for the Commission to collect the necessary components which could be tested in the laboratory.
23. ELT was most probably destroyed during the high speed impact and burnt causing non transmission of distress signal.
24. From the study of V2 track data from Chuhandada to Pathibhara sector, it was noticed that PIC continued flight despite unfavourable en route weather.
25. As the flight was VFR and all the company manual and procedures require only VFR flight but PIC could not follow the VFR flight rule.
26. No VIP flight handling procedure found in CAAN guidelines and Airline SOP.
27. Probability of unlawful act is remote.

3.2 Contributing Factors

The contributing factors for the accident are:

1. Unfavourable weather condition at Pathibhara area for VFR flight.
2. Excess load on front bench seat which contributed for the C of G to go beyond the limit.
3. The concern of the occupants to escape from that deteriorating weather as early as possible.
4. Condensation inside the windshield and icing on the outside of the windshield which reduced outside visibility.
5. Insufficient operational oversight from the organization.
6. Inadequate pre-flight planning and lack of consideration on individual load while preparing load and trim sheet.

3.3 Probable Cause

The PIC, who was possibly affected with euphoria (initial phase of hypoxia) immediately after take-off from the Pathibhara helipad in unfavorable weather encountered strong gusting wind along with snowfall which led him to inadvertently enter into IMC conditions, lost his situational awareness and positive control of helicopter which ultimately led to the CFIT accident.

4 Safety Recommendations

4.1 Air Dynasty Pvt. Ltd. and other helicopter operators

1. An effective operational control should be maintained in each helicopter operation.
2. Adequate skill based training for the crew should be provided when new technology is introduced in the helicopter.
3. The operator should ensure compliance to the provisions of VFR flight as stipulated in Operation Manual.
4. Helicopter Operators should ensure the weather at destination and en-route is favourable for the flight operation before dispatching the flight.
5. Operators shall ensure that the helicopter pilots strictly follow the approved flight plan.
6. Provisions should be made for compulsory weighing of individual passenger and baggage before preparing load and trim sheet.
7. Air Dynasty as well as all operators should have their own VIP movement guideline.
8. Helicopter operators to ensure the continuous monitoring the V2 track record of each flight and confirm its position accordingly.

4.2 Civil Aviation Authority of Nepal (CAAN)

1. CAAN should ensure the provision of duplicate inspection on aircraft maintenance by approved second AME.
2. CAAN, in coordination with operators should initiate for reviewing the existing Appareo Vision 1000 analysis program to ensure operating procedures applicable to en route phase of flight and take off/landing phases of flight operations.
3. Considering the C of G limit, CAAN should take necessary steps for the provision of single passenger only in front seat in AS350 series.
4. CAAN should ensure the inadvertent IMC training to all helicopter pilots.

4.3 Ministry of Culture, Tourism and Civil Aviation

1. Government should develop and encourage operators to implement VIP flight handling procedure and guidelines.

Appendix A

Flying Record of PIC (Before accident date 27.02.2019) as provided by Air Dynasty Heli Services

SN	Flight Date		Take-off Count	Landing Count	Hours flown	Remarks
	From	To				
1	02.12.2018	25.02.2019	On record	On record	148:40:00	90 day record. As per Air Dynasty record not flown on 26.02.2019 flying experience on 9N-AJD, 9N-ALA and 9N-AMI as a pilot (duel and solo both, mainly solo flight)
2	02.02.2019	25.02.2019	100	100	35:55:00	30 days record. Flown on 9N-AJD, 9N-ALA and 9N-AMI, duel and solo both, mainly solo flight
3	17.02.2019	25.02.2019	59	59	17:10:00	Was flown on 9N-AJD and 9N-AMI. 7 days record before 27.02.2019. Solo flight. No flight on 18 and 19 Feb 2019
4	25.02.2019	26.02.2019	01	01	01:00:00	One day record. Solo flight. No flight on 26 Feb 2019
Total flight record before 27.02.2019 on 9N-AMI only						
1	26.09.2017	24.02.2019	On record	On record	249:19:00	Flew only on 9N-AMI (Duel and solo both, mainly solo flight)
Exception						
1	10.02.2019	10.02.2019	29	29	06:50:00	One day record, if properly calculated the sector and elapse time may exceed 7 Hrs flight a day. Solo flight
2	11.02.2019	11.02.2019	04	04	01:55:00	Duel flight
3	12.02.2019	12.02.2019	13	13	03:55:00	Solo flight
4	17.02.2019	17.02.2019	16	16	02:55:00	Solo flight

As information provided by Air Dynasty Heli Services total flying hours of PIC is 2105 Hrs. flight on AS350 B3e, AS350 FX2 and AS350 BA type helicopter as a pilot (Duel and Solo both)

Appendix B

Human Factor Analysis and Classification System (HFACS)

PARAMETER	EVIDENCE	SOURCE	EFFECT	OTHER INFORMATION
1) Unsafe Acts				
Poor Judgment of PIC regarding latest situation	Decision to depart without considering the all up weight	Flight Plan /Load and Trim sheet	No direct effect for low altitude flight	Unknowingly Risk factor included considering for high altitude flight
	Decision to takeoff on unfavorable weather condition from pathibhara	Evaluated the information gathered from Eye witness	Causal/ Contributory	Significant effect in this accident
Skill Base error of Crew	No IFR certified pilot	Log Book records	Causal/ Contributory	Flight at IMC and VMC conditions considered significantly different
	Not seemed very serious to respond Icing condition	Evaluated photography and information from Eye witness	Causal/ Contributory	Significant effect in this accident as per manufacturer requirements
Perceptual error	Unfamiliar topography to the pilot/Loss of situational awareness	Flying record of the captain/ Crash site visit of the commission	Causal/ Contributory	Rapid descend just after takeoff contributed for Significant effect in this accident
Poor review of situation	Poor analysis of bad weather condition for flight	Weather analysis of MET office / Interviews	Contributory	Flight commenced on poor judgment resulted in accident
2**) Preconditions for Unsafe Acts**				

Loss of Situational awareness	Unaware about its own position	Descent / loss off altitude around 2000 ft within 35 sec	Contributory	Significant effect in this accident
Complacency	Improper judgment of weather condition before departure from Pathibhara	Interview/ reports	Confusion to set course of flight	Due to higher authority on board, PIC excited to fly
	Continue into IMC	Eye witness	Contributory	PIC encounter further deterioration of weather
PIC Could not consider to use available resources (Lack of CRM)	PIC failed to be assertive with passengers and more interactive during departure	Eyewitness	Contributory	Lack of CRM
	GPS not managed	Asking the direction to local	Contributory	Loss of situational awareness, improper heading
Mission not in accordance with rules/ regulations	Inconsistent meteorological information and flight departed without pre identifying the alternate	ATC Recording	Circumstantial	May be due to VFR operation
	IMC encountered and flight continued	Eye witness	Contributory	Limited option to maneuver
Company poor focus on skill based training mainly in GPS/ V2 Track to the flight crew	Lack of appropriate response	Training reports/ Conversion training programs	Circumstantial	Less priority to provide training on changing context
Cockpit Gradient with Passengers	Flight hours/ age	Log books record	Circumstantial	

(VIP/Authorities/Company heads)				
Get-Home-Itis	Circumstances to come back to Kathmandu on same day	Operator Air Dynasty	Circumstantial	Occupants without suitable clothing for High Altitude, snowing and cold weather condition
3) Unsafe Supervision				
Lack of effective performance monitoring of the airlines by the CAAN	Tendency of the crew to take risk for the completion of flight even though in marginal weather condition	Interviews/ visual weather condition	Contributory	There is no SOP for individual airport
Lack of effective oversight by Operator	Failed to identify unsafe acts	Interviews	Circumstantial	Entering IMC in VFR flight
	No Vision 1000 analysis on previous flights			No Vision 1000 downloading facility available for H-125 (AS350 B3e)
	Failure in monitoring SOP compliance by the crew			
Failed to identify documentation error by CAAN	Basis of Take-off weight and CG calculation undetermined	SOP/ OM and AFM	None	Significant documentation deficiency (Duplicate inspections are carried out by the same Engineer)
4) Organizational Influences				
Lack of inadvertent	Skilled based training on IMC	Training record	Contributory	

IMC training for crew	Confusion on interpretation of digital instrumentation like GPS	Interview	Circumstantial	Theoretical base training only could not cover all the areas
Operational Tempo	Get-There-It is in VIP Flight	Interview/ Accident/incident records	Circumstantial	Maximum number for flights in Tourist sectors and religious places focused and accident/incident in such places are maximum as per the past record.
Lack of risk management	Flight information and advisory service of Taplejung airport performance seems traditional nature	Interview with ATC an review of Tower Logbook	Circumstantial	ATC personal should be assertive to provide necessary information related to safe flight operation

Appendix C

Figure 16 Rescue Operation of 9N-AMI

Figure 17 Aerial View of Crash Site