



**GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU**

**FINAL INVESTIGATION REPORT OF
ACCIDENT TO M/S PINNACLE AIR R-44
HELICOPTER VT-HPC
AT AHMEDABAD ON 14/08/2013**

FOREWORD

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of Aircraft (Investigation of Accidents and Incidents), Rules 2012 of India. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this accident which may help to prevent such future accidents.

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FINAL INVESTIGATION REPORT ON ACCIDENT TO M/s PINNACLE AIR R44
ROBINSON HELICOPTER VT-HPC AT AHMEDABAD, ON 14/08/2013

1. Helicopter
Type : Robinson R 44
- Nationality : INDIAN
- Registration : VT - HPC
2. Owner/ Operator : Pinnacle Air Pvt. Ltd.
3. Pilot – in –Command : CHPL holder
4. Extent of injuries : Nil
- First Officer : N/A
6. Extent of injuries : Nil
6. Place of Accident : 03 miles short of Ahmedabad helipad
7. Date & Time of Accident : 14th Aug 2013, 1253UTC(Approx.)
8. Last point of Departure : Godhara
9. Point of intended landing : Ahmedabad
10. Type of operation : Revenue Flight
11. Passengers on Board : 03
Extent of injuries : Nil
12. Phase of operation : Cruise
13. Type of Accident : Emergency landing

(ALL TIMINGS IN THE REPORT ARE IN UTC)

SUMMARY:

On 14/08/2013 M/s Pinnacle Air Pvt. Ltd., Robinson R 44, helicopter VT-HPC was on a flight from Godhra to Ahmedabad helipad under the command of Pilot holding CHPL license on type. There were 03 passengers in addition to the pilot on board the helicopter. The helicopter took off from Godhra at around 1210 UTC and when it was 03 miles short of Ahmedabad helipad, severe vibrations were felt. The helicopter crash landed while making emergency force landing in a Cemetery. There was no fire to helicopter or injury to any person. The accident occurred in day light condition.

1.0 FACTUAL INFORMATION.

1.1 History of the flight

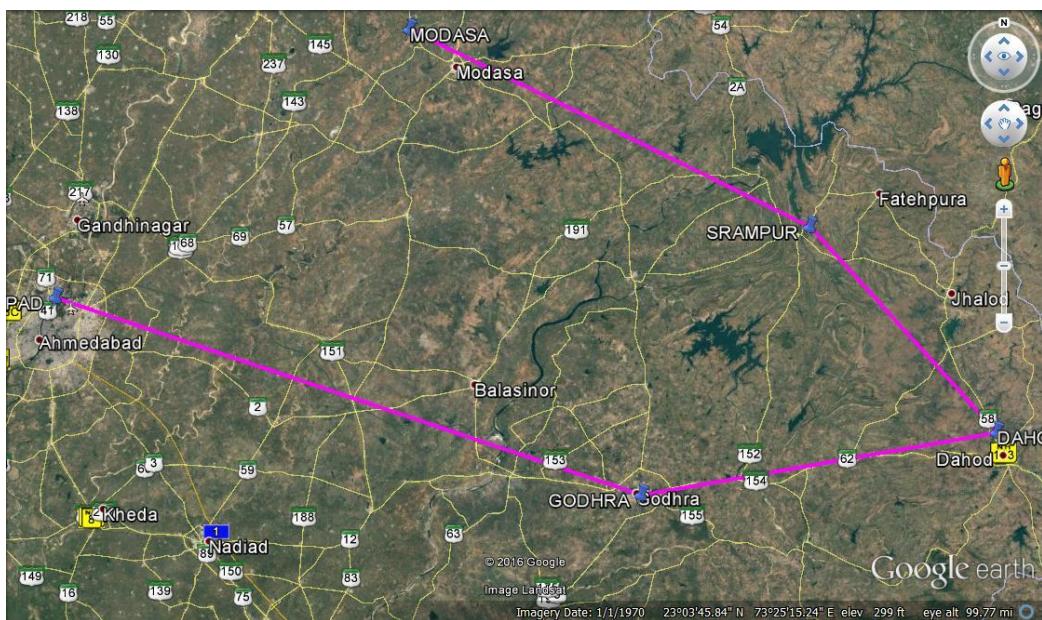
On 14/08/2013 M/s Pinnacle Air Pvt. Ltd., Robinson R 44, helicopter VT-HPC was on a flight from Godhra to Ahmedabad helipad under the command of Pilot holding CHPL license on type. There were 03 passengers in addition to the pilot on board the helicopter. On the day of accident the helicopter was planned for operating flights from Modasa-Santrampur-Dahod-Godhra and onwards to Ahmedabad helipad. All the places enroute were halts.

From	To (HELIPAD)	Sector Length	Course	Bearing of departing helipad
MODASA	SANTRAMPUR	43.0 nm	116° true	N23 31 22.8 E73 13 08.4
SANTRAMPUR	DAHOD	26.7 nm	138° true	N23 12 19.8 E73 55 06.0
DAHOD	GODHRA	34.9 nm	260° true	N22 52 28.8 E74 14 34.8
GODHRA	AHMEDABAD	59.7 nm	289° true	N22 46 33.6 E73 37 24.0
BEARING OF AHMEDABAD HELIPAD				N23 05 24.0 E72 36 03.0

The above table indicates the four sectors along with the length of the sector, course to be followed and their bearing. On the previous day i.e.

13.08.2013, the helicopter was issued with a certificate of release to service by an approved AME. There was no evidence that the enroute or destination weather was taken either by the PIC or by the operator prior to takeoff from Modasa.

The helicopter took off from Modasa at around 0520UTC and after flying for 35 minutes it landed safely at Santrampur. As per the PIC, 40 liters of fuel was uplifted at Santrampur. The next sector from Santrampur to Dahod and from Dahod to Godhra comprising of 30 minutes each were also uneventful with landing at Godhra at 1115 UTC. The flight clearance was obtained from Ahmedabad Area control on phone before takeoff from Godhra. The navigation route (planned) was as follows:



The helicopter took off from Godhra at around 1210 UTC. The cloud ceiling enroute was 8000 ft with lowest at 3000 ft. After takeoff the helicopter climbed to 2000 ft and established contact with Ahmedabad area control. The helicopter was about 48 miles inbound and was subsequently handed over to Ahmedabad approach by Ahmedabad area control. Ahmedabad approach instructed the helicopter to climb to 3000 ft which the PIC did climb but after some time in order to avoid clouds he descended back to 2000 ft in contact with Ahmedabad approach. When the helicopter had flown for about 35 minutes in this sector and was about 06 miles from the destination,

severe vertical vibrations were felt by the PIC all of a sudden. The PIC tried to control these vibrations by reducing the speed in turn by getting the cyclic back in a smooth manner. In this process there was reduction in rate of descent. The vibrations however continued and kept increasing in magnitude. The engine parameters were within limits and there was no RPM hunting. As the vibrations were becoming uncontrollable, the PIC continued to descend the helicopter and finally decided to land in a field in the right hand side. When the helicopter was approximately 3 miles south of Ahmadabad, the helicopter gave "MAY DAY" calls and informed ATC that he will be carrying out straight landing as he is experiencing severe vibrations. During the whole process, no feedback was felt on the cyclic and the whole helicopter was shaking. A controlled approach was made and the helicopter landed straight and level. Simultaneous with the touch-down (collective down, cyclic neutral and mixture out) a sudden jerk was felt to the left along with the creaking noise. The helicopter main body got tilted towards the forward and left direction.

The PIC along with the passengers came out of the helicopter of their own. There was no fire. The helicopter was extensively damaged with one main rotor blade tip trailing edge sheared off.

After the helicopter gave MAY DAY call, the RT contact was lost with ASR controller. ATC controller used all available means including the help of a scheduled airline aircraft which was operating to Ahmedabad at that time to contact the distress helicopter with an advice to land at Ahmedabad. Tower controller also gave calls on 119.6 MHz in efforts to contact the helicopter. Airport runway and safety facilities were kept in complete readiness for the distress helicopter. Police control room was also informed as per standard list by tower controller when the helicopter could not be contacted. Information was received by Aerodrome control tower at 1301 UTC that the helicopter had made forced emergency landing at Gomtipur cemetery, Ahmedabad.

1.2 Injuries to persons.

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR/NONE	01	03	----

1.3 Damage to helicopter.

The wreckage was self contained and the helicopter had contacted the ground with little nose down attitude. The Committee inspected the wreckage at Delhi, after shifting from accident site.



Photographs showing separation of tail rotor boom from the rivets

1. Tail boom broken from last segment along with horizontal, vertical stabilizer, tail gear box and tail rotor blades.
2. One Tail rotor blade totally damaged sheared out from root.



Damaged tail boom

3. Main Rotor Blade: One of the main rotor blade skin separated about 3 feet from tip. Next three feet (approx) only upper skin came out. Lower skin along with honey comb is intact. Spar is intact all along the length.
4. Tail Rotor Drive Shaft sheared out from last segment of tail boom.
5. Tail Rotor Pitch change control sheared out.
6. Tail Rotor Guard broken into two pieces.
7. Main Rotor Shaft Core/Fin damaged.
8. Structure just ahead of Main Rotor shaft core damaged.
9. Auxiliary Tank (LH Side) structure/Fuselage damaged.
10. Forward Portion of LH skid broken.
11. RH and LH both side windshield broken.
12. LH side door window glass broken from upper end.
13. Magnetic compass came out along with base/stand.
14. ELT antenna broken.
15. Fan Belts: Out of 4 belts 2 belts damaged and rest two broken.



**Photographs showing peeling of the blade skin with consequential
damage to honey comb structure**

The photograph of undamaged blade (below) indicates that there was very high probability of de-bonding initiation taking place.





Photographs showing exposed bond line on the blade (without de-bonding)

1.4 Other damage:

Nil

1.5 Personnel information:

1.5.1 Pilot – in – Command:

AGE	: 53 years
Licence	: CHPL holder
Date of Issue	: 01/03/2001
Valid up to	: 19/11/2013
Category	: Helicopter
Class	: Multi Engine/Land
Date of Med. Exam.	: 19/06/2013
Med. Exam valid upto	: 18/12/2013
FRTD Licence	: Valid
Total flying experience	: 5676 hours approx
Experience on type	: 388 hours approx
Experience as PIC on type	: 365 hours approx
Last flown on type	: 14/08/2013
Total flying experience during	
last 180 days	: 32:00 hours approx
last 90 days	: 23:00 hours approx.

last 30 days	: 11.00 hours
last 07 Days	: 02:10 hours
last 24 Hours	: 02:10 hours

1.6 Helicopter information:

The Helicopter was manufactured by M/s Robinson Helicopter (USA) in 2006. Helicopter is powered with Textron Lycoming Engine IO-540-AE1A5. It has got capability of producing 300 HP and is rated 260 HP at 2800 RPM for takeoff.

The Helicopter has a seating capacity of 3+1 persons including cockpit crew. The Helicopter is certified for a single Pilot operation. There are two doors. The Helicopter has a total fuelling capacity of around 47.7 U.S Gallons (Tanks with Bladders) and total endurance of about 3 Hrs.

The Helicopter had done 616:50 airframe hrs since new and 289:25 hrs since the renewal of last C of A on the day of Accident (14.08.2013). The Engine had logged 616:50 hrs since new. The Helicopter was approx. 7 years old. The Last C of A was done on 17.10.2008 and was valid till 16.10.2013. The Helicopter was registered under Normal category subdivision Passenger. The Highest Inspection Schedule on Helicopter is 100hrs/12 months which were carried out on the Helicopter on 10.09.2012 at 569:14 Hrs.

The Helicopter was issued with Indian Certificate of Registration (C of R) no. 3892/3 on 14.02.2013 under Category 'A' in the name of PINNACLE AIR PVT.LTD. It also held valid Certificate of Airworthiness no. 6001, which was initially issued on 17.02.2009. The C of A was revalidated on 5 yearly basis. On observing the wreckage especially both the main rotor blades it was observed that both the blades were having similar life as the serial nos. of the blades were of the same lot.

There was no snag on the H/C after renewal of C of A. All Mandatory Modifications/SB's were found to be complied with. The Helicopter had valid

Certificate of Release to Service, which was issued on 14.08.2013 at BAKOLA at 616:50 hrs and was valid till 14.08.2013. There was no snag reported by pilot/observed by AME in the previous flight. On the day of accident, the pre-flight inspection on the Helicopter was carried on the Helicopter by the duly Auth AME. Thereafter the helicopter was engaged in routing flying till the time of accident.

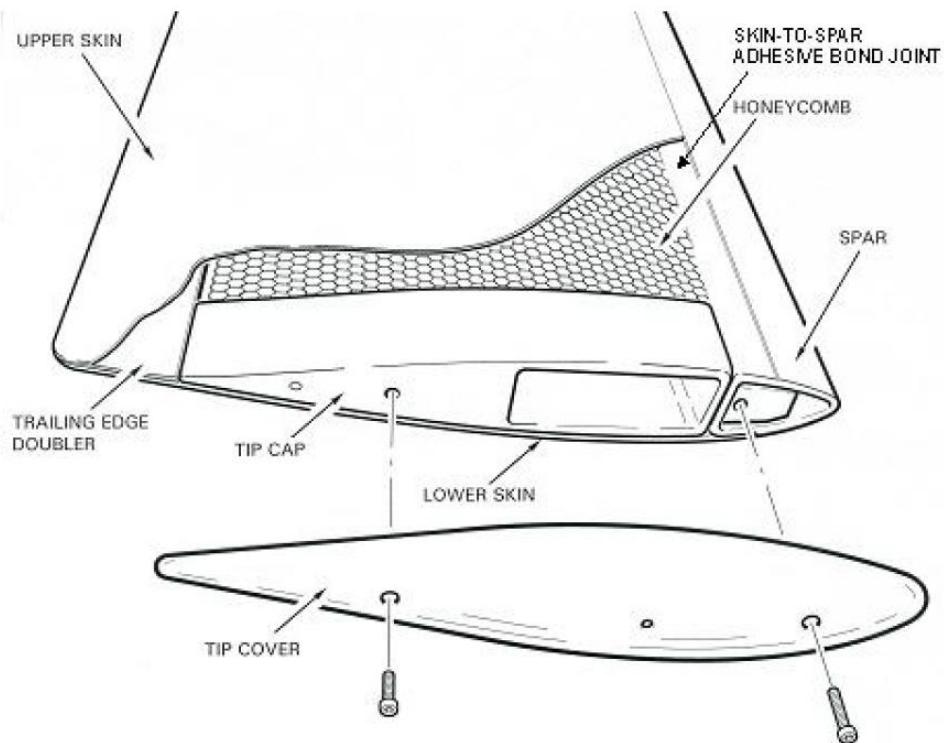
Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this helicopter and its engine has been complied with as on date of event. Prior to the accident flight there was no pending/repetitive defect entered on the Commander Defect Report/Technical Logbook of the helicopter. The certificate of Flight Release was valid prior to the accident flight.

Transit Inspections were carried out as per approved Transit Inspection schedules and all the higher inspection schedules include checks/inspection as per the manufacturer's guidelines as specified in Maintenance Program.

MAIN ROTOR BLADES:

The main rotor blade construction is a normal honey comb construction. The tip portion of the blade contains a spar at the leading edge, skin (stainless steel) overlying a honeycomb core structure (Aluminium) trailing the spar (stainless steel), and a tip cap between the spar and the trailing edge doubler. A portion of the leading edge of the upper and lower skin (approximately 0.5 inch wide) is bonded to the upper and lower surfaces of the spar on the trailing side of the spar. The pieces on the blade are mostly bonded to each other with adhesive epoxy film, which is cured at elevated temperature since the blades were first introduced. A tip cover is secured to the tip of the blade by two attachment screws. The length of the blade is about 198 inches.

The cross-section of the outboard portion of a main rotor blade is shown below. The skin to spar joint is adhesive bond joint.



1.7 Meteorological information:

The following is the Met report on the date of accident between 1240 UTC to 1310 UTC (Ahmedabad airport)

Time (UTC)	Wind Dir	Speed (kts)	Visibility	Clouds	Temp (°C)	DP (°C)	QNH	Trend
12 :40	230	10	3 Km	SCT 1500 FT SCT 1800 FT BKN 8000 FT	29	26	1001	TEMPO VIS 2000 M
13:10	230	05	3 Km	SCT 1500 FT SCT 1800 FT BKN 8000 FT	27	27	1001	No Sig

1.8 Aids to navigation:

Magnetic Compass, Maps and a Garmin GNS 530 were available as Aids to navigation on the helicopter.

1.9 Communications:

No difficulty has been reported either by the PIC or ATC regarding two way communication. When the helicopter was at 3 miles from destination, the communication was lost.

1.10 Aerodrome information:

The destination was helipad in Ahmedabad, which was a temporary helipad.

1.11 Flight recorders:

Neither fitted nor required

1.12 Wreckage and impact information.

The wreckage of the helicopter was found in a cemetery and it was confined to an area of 20 meters diameter. The helicopter had landed on the left skid and got imbedded in wet soft ground which happened to take maximum of impact load.

The tail boom was broken from the last segment along with the vertical fin and was lying next to the helicopter with the tail gear box. Both the tail rotor blades were damaged on impacting ground.

One main rotor blade had skin delaminated and sheared off till 33% of the span. There was no damage to the other main rotor blade.

The left windshield was cracked and broken. All other windshields had minor cracks.

The main rotor shaft and MGB were tilted towards front.

1.13 Medical and pathological Information:

Pre-Flight medical of the pilot was carried out prior to the first sortie of the day including BA test, which was satisfactory. Post accident, medical check was not carried out for the crew.

1.14 Fire:

There was no fire during or after the accident.

1.15 Survival aspects:

The accident was survivable.

1.16 Tests and research:

Nil

1.17 Organizational and management information:

The helicopter was owned and operated by a Non Schedule Operator having valid NSOP. Scrutiny of the documents and inspection of the helicopter reveled that though the latest C of R and C of A of the helicopter were in the name of Pinnacle Airways, the operations manual was that of Karina Airways (earlier owner of the helicopter). Further the external body of the helicopter had Tej Airways written on it.

1.18 Additional information:**1.18.1 Failure of Adhesive Bonds**

Whenever adhesive bond joints fail, the fracture face can exhibit three types of failure: cohesive failure, adhesive failure, or a mixture of both.

- Cohesive failure is a fracture within the adhesive material; that is, adhesive material remains on both bonded substrates. A test showing this type of failure demonstrates that the failure is dominated by the strength of the adhesive material and not by the ability of the adhesive to hold to the substrates.
- Adhesive failure is a fracture at the interface between the adhesive material and substrate. This type of failure indicates that the joint will fail before the maximum strength of the adhesive material is reached.
- Mixed adhesive and cohesive failure is a fracture that occurs at a bond joint and contains many separate adhesive and cohesive failure

regions. A bond joint containing randomly mixed adhesive and cohesive failures indicates that bond strength can fail well below the maximum strength of the adhesive. Mixed adhesive and cohesive failure bond strength is often quantified as the ratio of adhesive failure to cohesive failure.

At the time of manufacturing, the Robinson helicopter Company tests the strength of its adhesive bond joints using standardized lap and peel tests. For each lot of prepared adhesive, specimens are tested to failure and the level of stress that causes bond failure is recorded. The appearance of the adhesive bond fracture face is expressed as a percentage of cohesive and adhesive failures. A 100 percent cohesive failure indicates the strongest bond. Adhesive process specification indicates that the fracture face of specimens that are tested to failure must have a minimum of 80 percent cohesive failure. If a lap or peel test specimen fails to meet the 80 percent criterion or the minimum level of strength specified in the manufacturing process specification.

A weak bond in any area allows the leading edge of the skin to lift above the blade surface so that airflow during main rotor rotation peels the skin back further. If peel damage to the skin is minor, the main rotor blade will vibrate irregularly, indicating that the helicopter must be landed immediately. However, if the degraded bond on the main rotor blade is significant when the skin begins to peel, a large portion of the skin may peel back suddenly, resulting in catastrophic fracture of the blade and complete loss of control of the helicopter.





Examples of Peel damage to the skin

1.18.2 Requirements of Post Flight Medical

As per para 10 of the DGCA CAR Section 5, Series F, Part III

“In the event of an accident at an airport or in its near vicinity, the Officer Incharge of the airport shall ensure that the crew members are immediately subjected to medical check-up for consumption of alcohol. The doctor conducting such checkup shall take samples of blood, urine, etc. required for detailed chemical analysis. Such examination and collection of samples shall be done at the Airport Medical Centre, wherever available.

In case where medical centers are not available at the airports or when the condition of crew members requires immediate hospitalization, Aerodrome Officer Incharge shall ensure that the sample of the blood, urine, etc. is taken at the nearest hospital. These checks should be expeditiously carried out without any loss of time.

In case where accident is at a location far away from the airport and the police authorities are able to reach the site before the aerodrome authorities and the crew members are alive, the procedure for collection of blood/urine samples shall be performed by the police at the nearest hospital. Such samples shall be properly preserved.”

1.18.3 R44 Service Bulletin SB-72A

De-bonding of rotor blade skins can occur when the bond line is exposed due to erosion of the blade finish, or when corrosion occurs on the internal aluminum tip cap. Proper inspection and protection (refinishing) of bonded areas is required. De-bonding resulting from improper inspection and maintenance can cause a catastrophic accident. Recognizing this fact, Robinson Helicopter Company had issued a Service Bulletin SB-72A on 30th April 2010 regarding Main Rotor Blade Bond to be carried out at 100 hours/four months inspection.

1.19 Useful or effective investigation techniques:

NIL

2.0 ANALYSIS

2.1 Serviceability & maintenance of the helicopter:

The helicopter was fully serviceable before the flight. All maintenance activities were completed. The relevant SB 72-A was also complied with. As mentioned in the SB, the debonding incidents are very common in R22 and R44 rotor blades all over the world. The daily inspection schedule of the operator wanted inspection of blades for any indication for debonding to be carried out on daily basis. It required physically checking of both the blades for any debonding. Manufacturer has issued many bulletins in this regard and also changed the blade design from time to time. All bulletins applicable at the time of accident were complied with by the operator.

The helicopter was loaded as per its weight limitations and operated within the flight envelope. The two major flying aspects relevant to the present circumstances are Mast bumping (being a two bladed rotor system) and/or main rotor skin debonding.

Mast bumping can be due to harsh movement of controls, resulting into main rotor blades hitting the tailboom in flight. In such cases the tail boom can get damaged and detached in flight, making helicopter totally

uncontrollable in all planes, causing a catastrophe. In the present case the helicopter has landed safely on ground with almost horizontal attitude and without any rotational/ excessive yaw movements as is evident from the wreckage and conditions of Skids. Mast bumping or main rotor blade hitting the tail boom in flight is therefore ruled out.

2.2 Weather:

Weather was fine at the time of accident. There was no evidence that the enroute or destination weather was taken either by the PIC or by the operator prior to takeoff from Modasa however visibility was sufficient for undertaking the flight under SVFR conditions and weather is not a factor as the PIC was flying under SVFR rules.

SVFR flight requires two aspects to be looked into, firstly the Pilot should be qualified and secondly the machine should have requisite instrumentation i.e

- i) Artificial horizon
- ii) Heading Indicator (Direction Gyro)
- iii) Rate of Climb Indicator
- iv) VOR or ADF
- v) GPS (recommended)

In the present case, it is found that the helicopter did not have VOR or ADF installed though SVFR flights were undertaken on regular basis.

2.3 Crew Qualification

R44 helicopter is cleared for Single pilot operations. PIC a CHPL holder was fully qualified for the flight.

2.4 Pilot handling of the helicopter:

Skin of one of the main rotor blades of the helicopter has got debonded from the structure in flight, which caused severe vibrations and forced the pilot to carry out an emergency landing. The pilot could land the

helicopter on a safe ground available in the built-up area. There was no injury to any of the occupants of the helicopter or person on ground.

2.5 Debonding of main rotor blade skin & circumstances leading to the Accident

On 13.08.2013 i.e. a day prior to the accident flight an approved AME had issued a certificate of release to service at Modasa for the helicopter. The helicopter took off from Modasa at around 0520UTC and flew 3 sectors of 35 minutes, 30 minutes and 30 minutes respectively. During these sectors and the accident flight the pilot was supposed and as per his statement had carried out the pre-flight inspections.

The wreckage examination particularly the main rotor blades indicate the one of the main rotor blades skin had got de-bonded in-flight with consequential damage to the honeycomb structure.

Examination of the second main rotor blade revealed signs wherein there was a very high probability of the similar skin debonding as occurred on the damaged blade. Prior to the accident flight the helicopter has flown for almost 95 minutes comprising of 3 sectors. It is not possible for a pilot to check the condition of the blades (top view) by a pilot while carrying out pre flight inspection. Secondly once there is initiation of debonding of the skin, resultant failure is immediate.

The type of de-bonding failure observed on one of the main rotor blades which had occurred in-flight (from tip end) caused static and dynamic imbalance of the main rotor system which in turn resulted in severe vibrations in lateral and vertical planes, making the helicopter uncontrollable. During the whole process, no feedback was felt on the cyclic and the whole helicopter was shaking.

This aspect has been recognized by the aviation industry and it is advised that a controlled approach be made to land the helicopter in straight and level attitude as far as possible. This the pilot could achieve without any injury to any of the occupants.

During touch-down, with the creaking noise a sudden jerk was felt to the left. The helicopter main body got tilted towards the forward and left direction with substantial damages.

3 CONCLUSIONS:

3.1 Findings:

- 1) The Certificate of Airworthiness and the Certificate of Registration of the helicopter was valid on the date of accident.
- 2) The Certificate of Flight Release was valid at the time of accident.
- 3) R44 SB72-A related to debonding of the main rotor blade skin was complied with.
- 4) The PIC had accepted the helicopter for flight after the daily inspection schedule was carried out on the helicopter by the AME on 14.08.2013.
- 5) Prior to the accident flight the same PIC had carried out three sector - Modasa-Santrampur-Dahod-Godhrara and all the flights were uneventful.
- 6) The weather at the time of accident was below VFR and the flight was operating under SVFR conditions.
- 7) All maintenance activities were done as per manufacturer and DGCA directions.
- 8) The helicopter was operating from temporary helipads regularly away from base.
- 9) The helicopter did not have VOR or ADF installed but was undertaking SVFR flights on regular basis
- 10) During the last (accident) sector, the helicopter suffered severe vibrations which made the PIC to carry out forced landing.
- 11) One of the blades skin debonding had taken place in air resulting in skin shearing off till almost 1/3rd of the blade length.
- 12) This skin debonding resulted in static and dynamic imbalance of main rotor system and severe vibrations.
- 13) Second blade was though undamaged but had indications of debonding setting in.
- 14) The pilot could manage an almost straight & level landing.

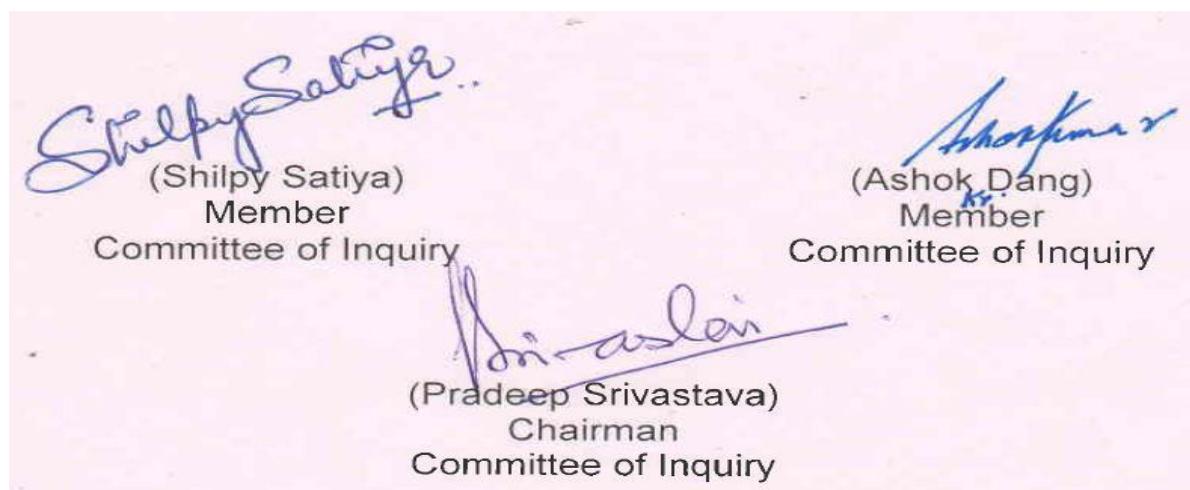
- 15) Simultaneous with the impact of helicopter on ground, the main rotor blade has hit the tail boom and detached the rear portion along with TGB and tail rotor blades from the main airframe.
- 16) In its final position, the helicopter main body had tilted towards the forward and left direction.
- 17) All the occupants came out of the helicopter of their own and without any injuries.

3.2 Probable cause of the accident:

The accident was caused by in-flight de-bonding of main rotor blade skin resulting in static and dynamic imbalance of main rotor system. The pilot had to make a forced landing due severe vibrations, which resulted into the substantial damages of the helicopter.

4 SAFETY RECOMMENDATIONS:

Stringent checks of main rotor blades of R44 helicopters particularly at outstations before issuing CRS should be carried out prior to every flight.



Date : 04.10.2016
Place: New Delhi