AIRCRAFT ACCIDENT INVESTIGATION BUREAU

FINAL INVESTIGATION REPORT ON ACCIDENT TO BEECH-CRAFT KING AIR B200 AIRCRAFT VT-HRA AT CHANDIGARH AIRPORT ON 27th MARCH 2014

MINISTRY OF CIVIL AVIATION
GOVERNMENT OF INDIA
NEW DELHI (INDIA)

AAIB (India) Report No. : 2014-ACC-0

File No. AV.15013/0 /2014-AAIB

Published on:

In accordance with Annex 13 to the International Civil Aviation Organisation Convention and the Aircraft (Investigation of Accidents & incidents) Rules 2012, the sole purpose of this investigation is to prevent aviation accidents. It is not the purpose of the investigation and the associated investigation report to apportion blame or liability.

Safety recommendation shall in no case create a presumption of blame or liability for an occurrence.

FINAL REPORT ON
ACCIDENT TO BEECH-CRAFT KING AIR B200 AIRCRAFT VT-HRA
AT CHANDIGARH AIRPORT ON 27th MARCH 2014

1.	**Aircraft**		
	Type	:	BEECH-CRAFT KING AIR
	Model	:	B 200
	Nationality	:	INDIAN
	Registration	:	VT-HRA
2.	**Owner and Operator**	:	GOVT. OF HARYANA
3.	**Date of Accident**	:	27.03.2014
4.	**Time (IST)**	:	11: 39 hrs.
5.	**Last point of Departure**	:	Chandigarh
6.	**Point of intended landing**	:	Safdarjung (Delhi)
7.	**Geographical location of**	**:**	30^0 40' 28"N / 76^0 47' 21"E
	Accident site (Lat. Long)	:	
8.	**Type of operation**	:	Passenger
9.	**Phase of operation**	:	Take off
10.	**Commander's License**	**:**	ATPL
11.	**Extent of Injury**	**:**	Nil
12.	**First Officer License**	**:**	CPL
13.	**Extent of Injury**	**:**	Nil
14.	**Damage to aircraft**	:	Substantial

I N D E X		
	SYNOPSIS	**6**
1.0	**FACTUAL INFORMATION**	**7**
1.1	**History of the flight**	**7**
1.2	**Injuries to persons**	**8**
1.3	**Damage to aircraft**	**9**
1.4	**Other damage**	**10**
1.5	**Personnel information**	**10**
1.5.1	**Pilot – in – Command**	**10**
1.5.2	**Co-Pilot**	**10**
1.6	**Aircraft information**	**11**
1.7	**Meteorological information**	**16**
1.8	**Aids to navigation**	**16**
1.9	**Communications**	**17**
1.10	**Aerodrome information**	**17**
1.11	**Flight recorders**	**17**
1.12	**Wreckage and impact information**	**17**
1.13	**Medical and pathological Information**	**20**
1.14	**Fire**	**20**
1.15	**Survival aspects**	**20**
1.16	**Tests and research**	**20**
1.17	**Organizational and management information**	**20**

SYNOPSIS :

Beech Craft King Air B200 aircraft VT-HRA was involved in an accident at Chandigarh airport on 27th March 2014. Within 3-4 seconds of getting airborne the aircraft impacted the ground in left bank attitude. The initial impact was on pucca (tar road) and the left wing took the impact loads with lower metallic surface rubbing and screeching on ground.

The aircraft was substantially damaged. There was no fire barring burning of small patch of grass due coming in contact with the hot surfaces and oil. There was no injury to any of the occupants. The accident occurred in day light conditions.

Government of India vide notification no. AV.15018/12/2014-VE ordered the investigation of the accident by a Committee of Inquiry. The intimation of the accident was provided to ICAO, TSB Canada and NTSB USA as per the requirements of ICAO Annexure 13.

The investigation of the accident was carried out by taking into account all the evidences on record. The accident occurred due to stalling of left wing of the aircraft at a very low height. The contributory factors were:

- Crew was not able to effectively put off the yaw damp so as to release the rudder stiffness as per the emergency checklist.
- Checklist not being carried out by the crew members.
- Not putting off the Rudder Boost.
- Speeds call outs not made by co-pilot.
- Not abandoning the take-off at lower speed (before V1).
- Failure of CRM in the cockpit in case of emergency.
- Early rotation and haste to take-off.

1. Factual Information

1.1 History of flight

On 25.03.2014, the operator received the travel programme for 27.3.2014, of Hon'ble Governor of Haryana from Chandigarh to Delhi. On 26.3.2014, the operations department took the flight clearances and filed the passenger manifest with the ATC and other concerned agencies.

The flight plan was filed by a CPL holder, who is working as flight dispatcher with the Government of Haryana. The departure on 27.3.2014 was fixed at 1130 hrs. The cockpit crew reported at 1045 hrs for the flight. Pre flight medical examination including the breath analyzer test was carried out at 1100 hrs. The breath analyzer test for both the cockpit crew members was negative. Pre flight briefing among the crew members was carried out by using the documents prepared by the flight dispatcher. The aircraft was taxied under its own power from Haryana Government Hangar to bay no. D-2 in front of ATC building. No abnormality was observed or reported on the aircraft during this taxiing. The engines were shut down for passenger embarkation.

As per the passenger manifest, in addition to the pilot and co-pilot there were 8 passengers. The baggage on board was approx. 50 lbs. There was 2100 lbs. of fuel on board. After boarding of the passengers, the aircraft engines were started at 1130 hrs. The aircraft was cleared for departure abeam 'D' link. The aircraft was taxied out via taxiway 'D'. After ATC departure clearance the aircraft was lined up for take-off. On clearance from ATC the take off roll was initiated and all the parameters were found normal. As per the pilot just before getting airborne some stiffness was found in rudder control as is felt in yaw damper engagement. The aircraft then pulled slightly to the left which as per the Commander was controllable. As per the pilot, the rotation was initiated at 98 knots.

As per the DATCO the aircraft had lifted upto 10-15 feet AGL. The Commander has stated that after lift-off, immediately the left rudder got locked in forward position resulting in the aircraft yawing and rolling to left. The pilots tried to control it with right bank but the aircraft could not be controlled. Within 3-4 seconds of getting airborne the aircraft impacted the ground in left bank attitude. The initial impact was on pucca (tar road) and the wing has taken the first impact loads with lower surface metallic surface rubbing and screeching on ground.

After the aircraft came to final halt, the co-pilot opened the door and evacuation was carried out. There was no injury to any of the occupants. The engine conditions lever could not be brought back as these were stuck. The throttle and pitch levers were retarded. The fuel shut off valves were closed. Battery and avionics were put off. Friction lock nuts were found loose.

As per the Commander, after ensuring safety of passengers he had gone to cockpit to confirm that all switches were ‘off’. At that time he has loosened the friction lock nuts to bring back the condition lever and throttle lever. However even after loosening the nut it was not possible to bring back these levers.

Fire fighting vehicles were activated by pressing crash bell and primary alarm. Hand held RT set was used to announce the crash. RCFF vehicles proceeded to the site via runway and reported all the 10 personnel are safe and out of the disabled aircraft. Water and complementary agents (foam and dry chemical powder) were used. After fire was extinguished, the Fire Fighting vehicles reported back at crash bay except one CFT which was held at crash site under instruction of COO.

The aircraft was substantially damaged. There was no fire barring burning of small patch of grass due coming in contact with the hot surfaces and oil. There was no injury to any of the occupants. The accident occurred in day light conditions.

1.2 Injuries to persons

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
NONE	2	8	

1.3 Damage to aircraft

The aircraft was substantially damaged particularly the wings, landing gear, both the engines bottom surfaces. The major damages to the aircraft are as follows:

On left hand side the out board wing section was damaged and ripped off at 6' outboard from the wing attachment point and again bent at around 13' from the wing attachment point). Wing tip suffered substantial damage. Aileron was found damaged and broken due to impact. LH Engine ripped off from the four engine mounts with all pipelines broken from firewall. Friction lock nut was found loose. Condition lever position was found toward low idle with control cable intact. Power lever cable found broken from the eye end. LH Landing gear found extended (11") and locked. No visible damage on Landing gear. Dorsal fin ripped off from the mounting and found with the Vertical stabilizer.

On right hand side dents were observed around the aft pressure bulkhead. Outboard tip of Inboard flap and inboard tip of outboard flap were found damaged. Wing leading edge section ripped off from the forward piano hinge. Wing tip suffered extensive damage. RH MLG broke from structural mounting. Lower drag brace found broken. RH Landing gear doors were found completely damaged. RH Engine found ripped off from all the four mounting points. Condition lever found at high idle and cable found bent and intact. Power lever found at low power and cable found intact.

In the nose section, Nose landing gear broke from mounting. Nose section completely dislodged from the fuselage. Radome found dislodged and completely damaged. Inner cylinder of nose landing gear shock absorber found dislodged of the landing gear along with nose wheel assembly. Shimmy damper found broken from the piston. Nose landing gear Steering linkage found completely damaged. Nose landing gear torque link separated from the scissor linkage point.

LH engine Propeller assembly was found near the wingtip of RH Wing. One blade of LH Propeller ripped off at around 17" from the root. Extensive rubbing marks of all LH Propeller blade tips. All blades of LH Propeller found bent and completely damaged. LH and RH Propeller Spinner assembly found completely damaged. All blades of RH Propeller found rubbed at the tip and completely damaged.

1.4 Other damage

Nil

1.5 Personnel information

1.5.1 Pilot – in – Command

Age	: 58 years
License	: ATPL
Date of Issue	: 24.09.1992
Validity	: Valid
Category	: Multi Engine land
Endorsement as PIC	: B 737, B-200, Open rating
Date of Medical Examination	: 11/03/2014
Med. Exam valid upto	: 10/09/2014
FRTO License	: Valid
Total flying experience	: 9888:50 hrs.
Experience on type	: 2165:40 hrs.
Experience as PIC on type	: 1736:10 hrs.
Total flying experience during 90 days	: 61:40 hrs.
Total flying experience during 30 days	: 02:50 hrs.
Total flying experience during 07 Days	: nil
Total flying experience during 24 Hours	: nil

1.5.2 Co-Pilot

Age	: 42 years
License	: CPL
Validity	: Valid
Date of Medical Examination	: 05/03/2014

Med. Exam valid upto	: 04/03/2015
FRTO License	: Valid
Total flying experience	: 2147:25 hrs.
Experience on type	: 1383:05 hrs.
Experience as PIC on type	: 398:15 hrs.
Total flying experience during 90 days	: 55:30 hrs.
Total flying experience during 30 days	: 2:50 hrs.
Total flying experience during 07 Days	: 00 hrs
Total flying experience during 24 Hours	: 00 hrs

1.6 Aircraft information

The aircraft was manufactured by M/s Raytheon Aircraft Company in 2005. The aircraft is powered by 02 (two) PW PT6A-42 turboprop engines. These engines have a Horsepower rating of 850 SHP with engine speed of 101.5% N1 (38,100 RPM). The engines are fitted with Hartzell Inc Propellers model No.HC-D4N-3A having 04 blades. The aircraft has a seating capacity of 10 persons including cockpit crew. The aircraft is certified for a single pilot operation. There is only one door for normal entry/exit of the crew, passengers and cargo. The aircraft has a total fuelling capacity of around 3636 lbs.

The aircraft was issued with Indian Certificate of Registration (C of R) no. 3295/2 in the name of the operator. Scrutiny of the Airframe and Engine log books of the aircraft revealed that till the day of accident, the aircraft had done 2010.26 airframe hrs since new and 102.40 since the renewal of last C of A. The engine had also logged 2010.26 hrs. since new. The last C of A was done on 24.09.2013 and was valid till 28.07.2015. The aircraft was registered under Normal category with subdivision as Passenger. The highest inspection schedule on this aircraft is Phase IV (800 hrs) which was carried out on the aircraft on 23.09.2013 at 1907.46 airframe hrs. The last inspection schedule carried out was Phase I (200 hrs) and was carried out on the aircraft on 04.03.2014 at 2007.51 airframe hrs. The last flight operated by the aircraft was on 14.03.2014 and the periodic ground run was carried out on 21.03.2014.

The aircraft was issued with Certificate of Release to Service on 27.03.2014 after daily inspection. There was no snag on the aircraft after renewal of C of A and the last snag reported was related to LH engine bleed air annunciator on 22.08.2013. There was no snag reported on primary flight controls or engine system.

All the mandatory modifications/SBs were found to be complied with. On the day of the accident the Daily Inspection was carried on the aircraft by an approved AME. As per the defect register maintained by the operator no snag or defect was reported on the aircraft after 22.08.2013. Prior to that also there was no snag relating to the aircraft controls.

FLIGHT CONTROLS - CONTROL SURFACES

The airplane is equipped with conventional ailerons and rudder. It utilizes a T-tail horizontal stabilizer and elevators, mounted at the extreme top of the vertical stabilizer.

OPERATING MECHANISMS

The airplane is equipped with conventional dual controls for the pilot and copilot. The ailerons and elevators are operated by conventional control wheels interconnected by a bar. The rudder pedals are interconnected by linkage below the floor. These systems are connected to the control surfaces through push-rod and cable-and-bellcrank systems. Rudder, elevator, and aileron trim are adjustable with controls mounted on the center pedestal. A position indicator for each of the trim tabs is integrated with its respective control.

MANUAL ELEVATOR TRIM

Manual control of the elevator trim is accomplished with a trim control wheel located on the left side of the pedestal. It is a conventional trim wheel which is rolled forward for nose-down trim, and aft for nose-up trim.

ELECTRIC ELEVATOR TRIM

The electric elevator-trim system (installed in conjunction with the autopilot system) is controlled by a dual-element thumb switch on each control wheel, a trim-disconnect switch on each control wheel, and a PITCH TRIM circuit breaker in the FLIGHT group on the right side circuit breaker panel. Both elements of either dual- element thumb switch must be simultaneously moved forward to achieve nose-down trim, aft for nose-up trim; when released, they return to the center (OFF) position. Any activation of the trim system by the

copilot's thumb switch can be overridden by the pilot's thumb switch. No one switch element activates the system; only the simultaneous movement of a pair of switch elements in the same direction activates the system.

A bi-level, push-button, momentary-on, trim-disconnect switch is located inboard of the dual-element thumb switch on the outboard grip of each control wheel. The electric elevator-trim system can be disconnected by depressing either of these switches. Depressing either trim-disconnect switch to the first of the two levels disconnects the autopilot and yaw damp systems; depressing the switch to the second level disconnects the electric elevator-trim system. The manual-trim control wheel can be used to change the trim anytime the autopilot is off, whether or not the electric trim system is in the operative mode.

RUDDER BOOST

A rudder boost system is provided to aid the pilot in maintaining directional control in the event of an engine failure or a large variation of power between the engines. Incorporated into the rudder cable system are two pneumatic rudder-boosting servos that actuate the cables to provide rudder pressure to help compensate for asymmetrical thrust.

During operation, a differential pressure valve accepts bleed air pressure from each engine. When the pressure varies between the bleed air systems, the shuttle in the differential pressure valve moves toward the low pressure side. As the pressure difference reaches a preset tolerance, a switch on the low pressure side closes, activating the rudder boost system. The system is designed only to help compensate for asymmetrical thrust. Appropriate trimming is to be accomplished by the pilot. Moving either or both of the bleed air valve switches on the copilot's subpanel to the “INSTR & ENVIR OFF” position will disengage the rudder boost system.

The system is controlled by a toggle switch, placarded RUDDER BOOST - OFF, located on the pedestal below the rudder trim wheel. The switch is to be turned ON before flight.

A preflight check of the system can be performed during the runup by retarding the power on one engine to idle and advancing power on the opposite engine until the power difference between the engines is great enough to close the switch that activates the rudder boost system. Movement of the appropriate rudder pedal (left engine idling, right rudder pedal moves forward) will be noted when the switch closes, indicating the system is functioning

properly for low engine power on that side. Repeat the check with opposite power settings to check for movement of the opposite rudder pedal.

YAW DAMP

A yaw damp system is part of the autopilot and is provided to aid the pilot in maintaining directional control, and to increase ride comfort. The system may be used at any altitude, and is required for flight above 17,000 feet. It should be deactivated for takeoff and landing.

The yaw damper is automatically engaged anytime the autopilot is engaged, except when rudder boost is activated. To disengage the yaw damper, slide the YD/ AP DISC switch down on the FGP panel, press the YD push-button, or press the DISC TRIM/AP YD switch on the pilot's or copilot's control wheel to the first detent.

ANNUNCIATOR SYSTEM

The annunciator system consists of a warning annunciator panel (red) centrally located in the glare shield, and a caution/advisory annunciator panel (caution - amber; advisory - green) located on the center subpanel. Two red MASTER WARNING flashers located in the glare shield (one in front of the pilot and one in front of the copilot) are a part of the system, as are two amber MASTER CAUTION flashers (located just inboard of the MASTER WARNING flashers), and a PRESS TO TEST button located immediately to the right of the warning annunciator panel.

The annunciators are of the word-readout type. Whenever a condition monitored by the annunciator system occurs, a signal is generated and the appropriate annunciator is illuminated.

If the fault requires the immediate attention and reaction of the pilot, the appropriate red warning annunciator in the warning annunciator panel illuminates and both MASTER WARNING flashers begin flashing. Any illuminated lens in the warning annunciator panel will remain illuminated until the fault is corrected. However, the MASTER WARNING flashers can be extinguished by depressing the face of either MASTER WARNING flasher, even if the fault is not corrected. In such a case, the MASTER WARNING flashers will again be activated if an additional warning annunciator illuminates. When a warning fault is corrected, the affected warning annunciator will extinguish, but the MASTER WARNING flashers will continue flashing until one of them is pressed.

FLIGHT CONTROL ASSIST SYSTEMS - RUDDER BOOST SYSTEM

When the airplane is not equipped with an autopilot, the standard rudder installation provides for rudder boosting and yaw damping functions. Otherwise, these functions are provided by the autopilot. The systems components are two pneumatic rudder servos, one pressure regulator and two vented solenoid valves, all located aft of Fuselage Station (FS) 368.00, an inline air filter mounted on the aft side of the aft pressure bulkhead and a differential pressure switch located near the bleed air de-ice manifold. Each servo is attached to the primary rudder cable by a cable and clamp. The servo can be disconnected by removing one nut and on removing the servo cable and clamp.

Each system is energized by a two position toggle switch on the pedestal placarded “RUDDER BOOST ON OFF”. The systems are protected by a 5 amp circuit breaker on the right hand circuit breaker panel. The pressure regulator is adjusted to 15 + 0.5 psi to boost the rudder against a failed engine. When the air flow from either engine is reduced to the point that it places a differential pressure across the pressure differential switch, it actuates the appropriate solenoid valve allowing pressure from the de-ice manifold to actuate the rudder servo.

FRICTION LOCK OF ENGINE CONTROLS

The Engine controls of SKA B200 are governed by two power and condition levers of each engine, two prop lever for each propellers. All the controls are equipped with friction pads controlled by a knob on the power quadrant of pedestal below the knobs to control the friction on each control and its movability. The friction locks are provided to prevent control creep back due to cockpit vibration, springiness of control cables etc during all the phases of flight.

Four friction locks are located, one for each power lever is equipped with a friction brake, and one friction brake is available for both prop levers and condition levers.

Clockwise movement of the knob increase the friction on the controls and levers progressively become more resistant to movement.

As per the checklist for Before takeoff (run up) of POH Pg 4-20, engine controls friction locks are required to be SET.

1.7 Meteorological information

The following are the extracts from relevant METARs of the date of accident:

Time (UTC)	Wind Dir	Speed (kts)	Visibility (Km)	Clouds	QNH	Trend
0530	290	04	5	FEW030 BKN090	1015	NOSIG
0600	270	06	5	FEW030 BKN100	1014	NOSIG
0618	270	08	5	FEW030 BKN100	1014	NOSIG
0630	300	06	6	FEW030 BKN090	1014	NOSIG

1.8 Aids to navigation

In addition to VHF, HF, the aircraft is equipped with VOR / ILS Navigation system. The navigation receiver is a fully integrated VOR / LOC, glide-slope, Marker Beacon and ADF receiver. The ATC system available on the aircraft is activated as soon as power is applied and Flight Management System is operational.

The NAVAIDS available at Chandigarh Airport are as follows:

NDB	CG	228	304039.400N	272^0/ 1.51 NM to Dmbl 11	196^0/ 0.57 NM to Dmbl 29	400 W
DVOR/DME	CHG	116.5	0764817.860E	291^0 / 1.66 NM to Dmbl 11	279^0 / 0.19 NM to Dmbl 29	0200-1400 UTC
ILS	Rwy 11		CHD 110.3	GP : 3^0		
PAPI	Rwy 11/29		GP : 3^0	Left Side		
CADF	123^0 /0.91 NM from Dmbl 11					

1.9 Communications

There was two way communications between the aircraft and ATC.

1.10 Aerodrome information

Chandigarh Aerodrome is a Defence airfield with civil enclave owned by Airports Authority of India. There is only one runway (11/29) of length 9000 ft and width 150 ft. First 900 ft on either side of the runway is of concrete and the rest of portion is bitumen. ILS/DME, VOR/DME is available for runway 11. The communication frequency for tower and approach is 118.3 & 118.6 respectively.

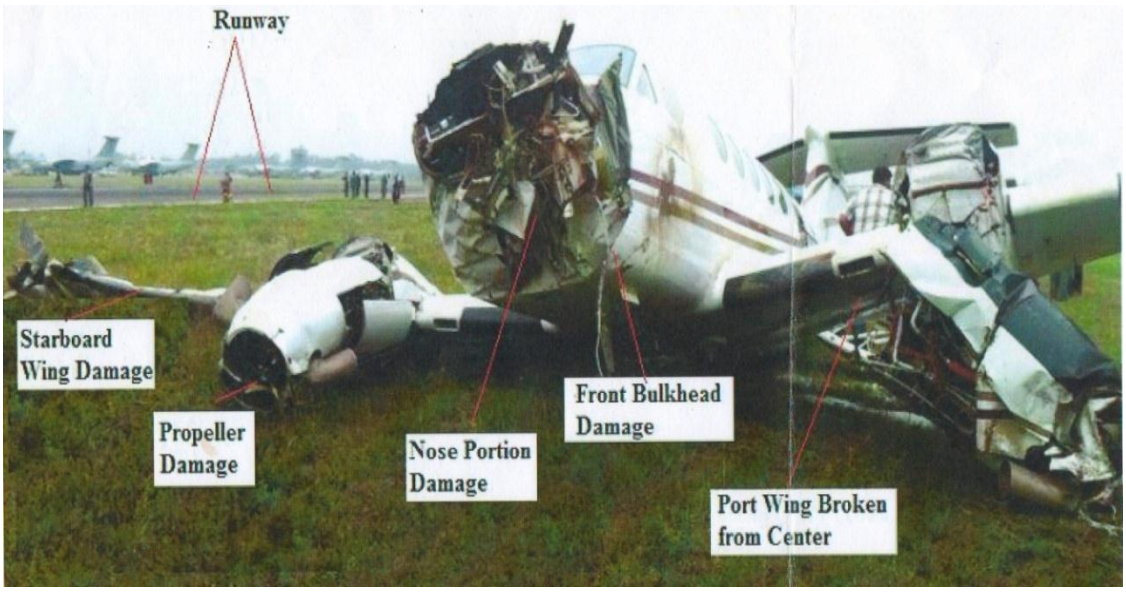
1.11 Flight recorders

The aircraft was equipped with Fairchild CVR FA 2100 with Part No. 2100 – 1020-00 and Sl. No. 000333366. The CVR was replayed at the facilities of Aircraft Engineering Directorate (AED) of DGCA. Neither there was any requirement for fitment of FDR nor was any fitted on the aircraft.

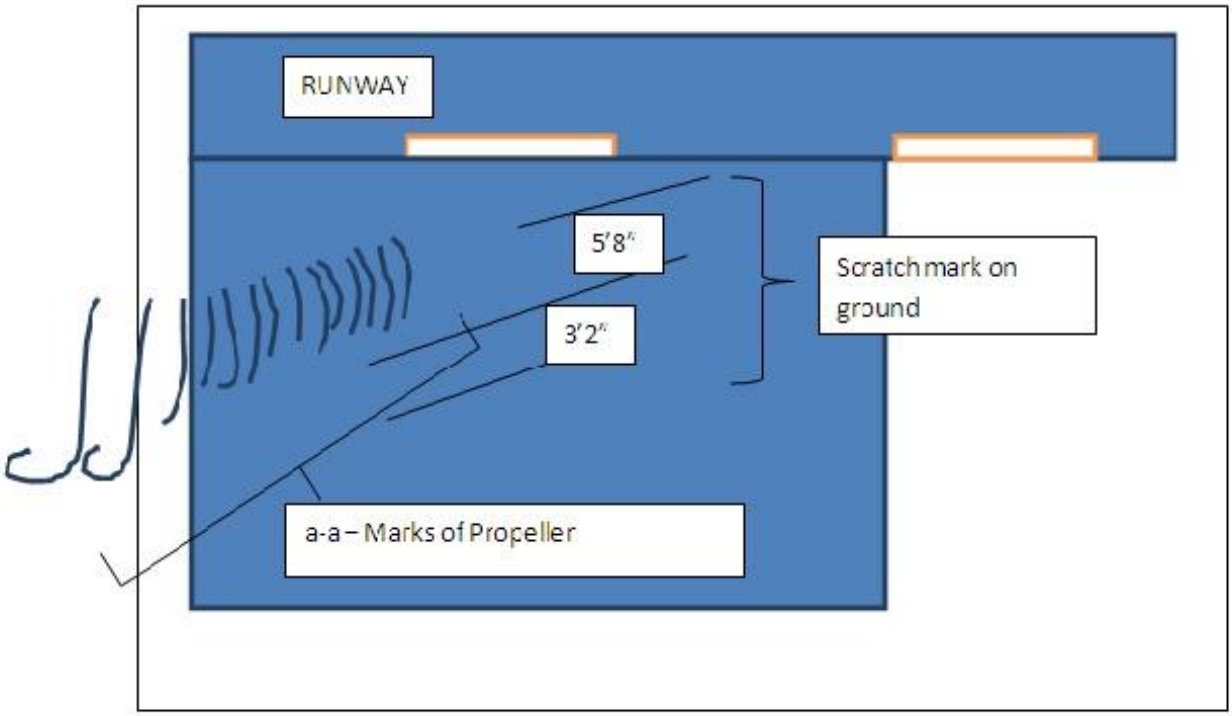
1.12 Wreckage and impact information

Within 3-4 seconds of getting airborne the aircraft impacted ground in left bank attitude. The initial impact was on pucca (tar road) and the left wing has taken the first impact loads with lower surface metallic surface rubbing on ground.

On the ground, there were marks of the propeller. The propeller blades of the left engine had made cut marks on the ground and then skidding of the aircraft. On the way both the propeller hub assemblies have got detached from the main structure. The nose section also got separated from the aircraft and was lying at a distance of 30’ from the final position of aircraft.


Runway
Starboard Wing Damage
Propeller Damage
Nose Portion Damage
Front Bulkhead Damage
Port Wing Broken from Center

Rubbing marks observed on the ground are as in the drawing below:



a-a : Mark of Propeller Striking the ground in running condition. Dimensions (starting at 1 from right)

1-2	:	10”	8-9	:	17”
2-3	:	10”	9-10	:	17”
3-4	:	12”	10-11	:	22”
4-5	:	12”	11-12	:	22”
5-6	:	14”	12-13	:	26”
6-7	:	17”	13-14	:	31”
7-8	:	16”			

1.13 Medical and pathological Information

Both the crew members had undergone pre flight medical examination and were found fit. The breath analyser test was found negative. After the accident also both the crew members were put for breath analyser test and the test was found negative for both the crew members.

1.14 Fire

There was small fire to the grass due to spillage of hot oil and engine exhaust.

1.15 Survival aspects

The accident was survivable.

1.16 Tests and research

The samples of the fuel and engine oil were taken after the accident and were tested at the fuel and oil testing lab of Directorate of Civil Aviation at Delhi. The fuel passed all the specified tests. The oil had also passed the specifications tests regarding density, viscosity and flashpoint.

1.17 Organizational and management information

The operator had Non Scheduled Operators Permit (NSOP) and is an Organisation based in Chandigarh operating with two aircraft under Private

Operations for the use of State Government VIPs. The organisation was structured under the management of the Accountable Manager.

The operating permit no. 03/2011 was valid till 22.12.2015. The Organisation had approved CAME. The continuing airworthiness of the aircraft was managed by CAMO approved organisation at New Delhi and Chandigarh. The continuing airworthiness management functions were subcontracted to third party. The maintenance was being carried out by another third party within the requirements of CAR on the subject. The operations manual available with the operator defines the duties and responsibilities of the cockpit member. In addition to other responsibilities the pilot in command is responsible for

- Use of the check list for every phase of flight.
- Ensuring that no hazardous flight maneuver is executed during any phase of the flight.
- Affording every opportunity to the Co- Pilot to prepare himself for the position of Pilot – in- command and explaining methods and procedures being adopted.

The duties of co-pilot include

- Render all material assistance to the Pilot –in-command
- Shall carry out all duties pertaining to the operation of the flights as directed by the Pilot-in-command.
- Read out of the check list at the appropriate times and ensure that same is being complied with.

1.18 Additional information

As per the “Before Take Off” checks of the pilot checklist, the operation of the Yaw Damp has to be checked before take off (runup). Following steps are to be followed in order to check the yaw damp:

1. Yaw Damp……. ON
   (YAW) – illuminated
2. Rudder Pedals…… check for added resistance
3. AP/Trim disconnect…… depress to first level
   [YAW DIS] – illuminated, flashing then extinguished
4. Repeat steps 1 through 3 for copilot’s side.

Similarly primary governor, over-speed governor and rudder boost is to be checked as follows:

1.	Rudder Boost	ON
2.	Prop Governor Test Switch	Hold to test
3.	Power levers (individually)	Increase until prop is stabilized at 1800 to 1910 RPM
4.	Prop Lever	Retard to detent, then full forward (to check primary governor)
5.	Power Lever	Continue to increase until rudder movement is noted (Observe ITT and Torque limits)
6.	Power Lever	Idle
7.	Repeat steps 3 thru 6 on opposite engine	
8.	Prop Governor Test Switch	Release

Further, as per the Section 3 of the "Emergency Procedures" of the Pilot Operating Handbook of the aircraft, the rudder boost operation without a large variation of power between the engines indicates a failure of the system. In such a situation

1. Directional Control ……. ……..maintain using rudder pedals
2. Rudder Boost ……OFF

As per para 6.15 of CAR - Section 3, Series C, Part X

"When operating VIP flights with fixed wing aircraft, the pilot-in-command shall possess CPL or ATPL with at least 3000 hours including 2000 hours as PIC, 50 hours as PIC on type of aircraft to be flown and 50 hours of night flying experience. In addition, the pilot should have a minimum of 30 hours as PIC experience in the last 6 months including five hours on type in the last thirty days of the intended flight. In case 30 hrs. recency during the last 6 months is not met with, then in last 30 days, a satisfactory skill test (as required for licence renewal) shall be carried out followed by 5 hrs. of PIC experience."

Further as per the Note 2 to para 6.17 of the CAR, VIP flight means a flight having among its passengers any dignitaries (as per the list given there) which include Governors of State.

1.19 Useful or effective investigation techniques

Nil

2. ANALYSIS

2.1 Serviceability of the aircraft

The aircraft was having valid Certificate of Airworthiness, Certificate of Registration and Flight Release. On the day of accident the AME carried out the inspection. There was no snag and the aircraft was released for operation. No item was released under MEL. The pilot had also accepted the aircraft and the aircraft was moved under its own power from the Government Hangar for embarkation of passengers from the bay indicating that all the controls including rudder were operating in correct sense.

The engines were shut down. The crew has not reported any snag on the aircraft systems or engines. No difficulty was reported by the crew regarding operation of flight controls. The aircraft was again started and taken to runway under its own power.

The crew members have reported that engines were generating full power. The rudder boost was also serviceable before take-off. Till the beginning of take off roll, the controls were functioning satisfactorily. The Commander had reported that just before getting airborne some stiffness was found in rudder control as is felt in yaw damper engagement. As per the co-pilot soon after take-off roll the aircraft had started going to the left and continued to go to left as the speed increased. He also mentioned that the aircraft had got airborne from very close to the left edge of the runway.

As per the “Before Take Off” checks of the pilot checklist, the operation of the Yaw Damp has to be checked before takeoff (runup) for both the Captain and Co-pilot side. By putting yaw damp ‘ON’, the rudder pedals are checked to see for added resistance in operation.

As per Section 3 of the “Emergency Procedures” of the Pilot Operating Handbook of the aircraft, the rudder boost operation without a large variation of power between the engines indicates a failure of the system. In such a situation the directional control is maintained by using rudder pedals after putting the rudder Boost to ‘OFF’.

The CVR was removed and tape transcript of the relevant portion was prepared. It was observed that no check list was carried out by the flying crew. This was agreed by the co-pilot also.

The relevant extract of the CVR transcript for the accident flight is given below.

Relative Time (secs.)	by	TEXT
00	P1	Oh yeh kya hua
00	P2	Kya
01	P1	------
02	P1	Mera rudder lock ho gaya
03	P1	-------- Yaw damper
04	P2	Oh yaw damper
04	P1	Yaw damper off kar
05	P1	Kar off kar
09	P1	------
10	P2	Ho gaya ab ho gaya
11	P1	Nahin hua yaar
14	P2	Ho gaya vo sir aapne green kar diya na dekho
17	P2	Rehne do
19	P1	Apne aap kaise engage ho gaya
22	P1	oye oye (aircraft crashes)

The CVR tape transcript of the take-off roll reveals that the commander of the flight during take-off roll says “oh Rudder lock ho gaya”. The ATC prior to this have given clearance to the aircraft to enter the runway and hold for clearance to take-off. The aircraft has moved into the runway with the use of rudder and the rudder movement was normal. As per the system and controls of the aircraft the rudder pedal stiffness can exist only in case Yaw damper is ‘ON’. Immediate normal reaction of the commander was therefore that yaw damper be put off. He has asked his Co-pilot to check & put off the yaw damper, which was done by the Co-pilot. During take-off roll the rudder pedals are in the

neutral position and the need of using rudder pedal arises only in case the aircraft is not going straight. The emergency of Rudder pedal stiffness could have been handled by taking corrective actions as mentioned in the report or just by rejecting takeoff.

From the schematic of the control system, there was no reason that why the yaw damp lever should go to 'ON' during takeoff roll assuming that it has not been put 'ON' inadvertently by the crew. The matter was taken up with the manufacture of the control system to find out if any information can be retrieved from the Data Concentrator Unit or Flight Guidance Computer. These units as such do not have any memory. The Manufacturer advised that Maintenance Diagnostic Computer may be sent first to check if any data is there. The matter was deliberated and it was opined that no useful information can be retrieved from the units. It was advised to the Committee that as it is not sure that we can get some relevant information and the other evidences on record are capable to stand alone, the Committee may go ahead with the investigation with the existing evidences.

Rudder Control Cable was checked in the cabin, under the floor board for any defect, damage or unusual observations. Inspection was found satisfactory. Rudder was commanded by Rudder Pedal and responding as desired confirming the cable continuity. Rudder Boost Differential Pressure Switch was checked for current status and found "on ground" with "engine not running". The same was also found working satisfactorily during operational check. A118 (K4) Relay was checked for status on ground and found "on ground" and responding to Bleed Air Switches.

Autopilot Disconnect Switch on Cockpit Control Column (both Pilot and Copilot) was checked for serviceability and no abnormality was observed.

From the foregoing, it can be safely concluded that the aircraft was fully serviceable prior to take-off and the aircraft serviceability has not contributed to the cause of accident.

2.2 Crew qualification

Both the crew members were qualified to undertake the flight. They had valid licences with appropriate endorsements. They had valid Medical certificates for carrying out flying. Pre Flight Medical checks were also carried out prior to flight and after the accident on both of them. The Breath analyser test was negative for both of them.

Honorable Governor of State is VIP as per Note 2 to para 6.17 of the CAR - Section 3, Series C, Part X. The CAR requires that when operating VIP flights with fixed wing aircraft, the pilot-in-command shall possess in addition to other qualifications and experience, five hours of PIC experience in the last thirty days of the intended flight. The Commander was not having 5 hours of PIC experience in the last 30 days.

2.3 Weather

The sky was clear with few broken clouds at higher altitudes. The visibility was 5 kms. without any significant changes anticipated. The visibility trend was of improvement. The visibility and other weather conditions were satisfactory for the conduct of flight and have not contributed to the accident.

2.4 Circumstances leading to the Accident

1. The Commander of the flight has stated that the yaw damper was not engaged before the start of take-off roll and the Check-list was carried out prior to start, after-start and before take-off. He has also said that sterile cockpit environment was maintained during the flight. Whereas the co-pilot stated that for positioning the aircraft at Bay D2 from the hangar he has carried out the check-list but for the flight, it was not carried out. The CVR was replayed which indicated that contrary to the statement of both the crew members, no checklist was carried out at all. The CVR contained the recording of last phase of earlier flight from Chandigarh to Delhi and full flight from Delhi to Chandigarh. It was observed that no checklist has been carried out during these flights.

2. As per the commander only after the speed of 80-85 knots was attained, it pulled slightly to the left which was corrected by the help of rudders. After which, a slight stiffness in the rudder was observed as in case of yaw-damper engagement which when asked to the co-pilot was confirmed and observed to be ‘OFF’. This stiffness was only for 2-3 seconds and before the aircraft took-off.

   Whereas the co-pilot stated that soon after the take-off roll, the aircraft started going to the left. As the speed increased, the aircraft continued to move to the left. During lift-off, the aircraft was on the runway but towards the left of the centre line. The Co-pilot was shown the video of the flight from take-off roll onwards and the aircraft was found going to left and took off from close to the

left edge of the runway. So during initiation of take-off roll itself, the aircraft had started going to left.

3. The crew have stated that they have not heard any stall warning. CVR was played and the Co-pilot identified the stall warning.

4. As per the crew, both the engines were generating full-power. The power-lever(s) were guarded by the co-pilot and speed & power checked before rotation. The take-off weight was 12315 Lbs and unstuck speed of 99 knots with Flaps 'UP'. The stalling speed of aircraft in take-off configuration with the weight of 12315 lbs. and flaps UP is within 78-80 knots. As per the co-pilot, just after start of the take-off roll (after gaining speed of 40 knots) aircraft started going to the left.

5. As per the commander there was no identifiable emergency to warrant and abort take-off nor was the aircraft uncontrollable. ADF, VOR, ILS, DME, FMS and GPS were functional. Whereas the co-pilot stated that Capt. repeatedly kept saying that the aircraft is getting out of control and he is unable to understand why aircraft is behaving like that. At that time, the co-pilot gave a reject take off call (rehne do). As per the co-pilot, the commander unstuck rapidly, probably, he might have thought that by taking-off, he will be in position to control the problem.

6. As per the system and controls of the aircraft the rudder pedal stiffness can exist only in case Yaw damper is 'ON'. Immediate normal reaction of the commander was therefore that yaw damper be put off. The yaw damp can be put off from the toggle switch available on the Front or by pressing the switch available on the control stick to first level. In addition it can also be put off by Yaw damper/auto pilot disconnect switch. From the CVR transcript (conversation between the crew) it appears that the commander has probably pressed the switch available on the control stick to put the yaw damper off and simultaneously told the co-pilot to put the yaw damp off. The co-pilot has pressed the toggle switch available on the front. During takeoff roll, the co-pilot had meekly told the Commander to reject take off (rehne do). At this crucial moment of take-off roll, there was confusion in the cockpit and there was failure of CRM.

7. The aircraft had rotated and lifted off almost from the left edge of the runway and in little left bank attitude. In view of the emergent situation in the cockpit,

the Commander probably carried out rotation at a lower speed than VR. The aircraft thereby stalled at a very low height and crashed.

In the hind sight, it is felt that the accident could have been avoided had the crew

- Put off the rudder boost switch.
- Avoided simultaneous action of putting off the yaw damp by the commander and co-pilot. Or
- Rejecting the take-off.

3. CONCLUSIONS:

3.1 Findings:

1. The aircraft was having valid certificate of Registration and Certificate of Airworthiness.
2. The Aircraft was issued Certificate of Release after carrying out daily inspection on the day of accident and there was no snag reported.
3. All the mandatory modifications were complied with and there was no deferred maintenance item or released under MEL.
4. No snag or defect was reported on the aircraft after 22.08.2013. prior to that also, there was no snag relating to aircraft controls.
5. Both PIC and the Co-pilot were having valid licenses with appropriate endorsements of Beechcraft King Air B-200.
6. PIC was not having 5 hrs. of PIC experience in the preceding 30 days.
7. Both the crew members held valid medical certificates as per the requirement.
8. The crew had undergone pre-flight medical examination and nothing abnormal was observed. The Breath Analyzer (BA) Test was negative. Post-flight BA Test was also carried out and was negative.
9. On the day of accident, pre-flight briefing among the crew members was carried out by using the documents prepared by a CPL holder (working as Flight Dispatcher).

10. The aircraft was parked in Haryana Government Hangar and was taxied from there under its own power to Bay No. D-2 in front of ATC Building. No abnormality was reported by the crew on the aircraft.
11. After boarding of the passengers, the aircraft was taxied out via Taxiway D and lined up for take-off.
12. No check-list was carried out by the crew for the flight. The conversation before take-off roll between the crew members was not relevant to the flight.
13. The Pilot has not reported any abnormality of aircraft parameters.
14. During the take-off roll, the pilot observed stiffness in the rudder control and the aircraft pulled slightly to the left.
15. On observing that the yaw damp was ON, both the crew members tried to put off the yaw damp & in the process yaw damp first got off and then on.
16. There was failure of CRM and the emergency of stiff rudder was not handled as per the checklist.
17. The crew failed to reject the takeoff.

3.2 Probable cause of the accident

The accident occurred due to stalling of left wing of the aircraft at a very low height. The contributory factors were:

- Failure on the part of the crew to effectively put off the yaw damp so as to release the rudder stiffness as per the emergency checklist.
- Checklist not being carried out by the crew members.
- Not putting off the Rudder Boost.
- Speeds call outs not made by co-pilot.
- Not abandoning the take-off at lower speed (before V1).
- Failure of CRM in the cockpit in case of emergency.
- Early rotation and haste to take-off.

4. SAFETY RECOMMENDATIONS

DGCA may carry out thorough regulatory audit of the organisation to ensure that procedures and systems are in place and meticulously followed for safe operations.

(R.S. Passi)
Chairman Committee of Inquiry

(Capt. Anil Chaudhari)
Member Committee of Inquiry

(Sh. Sanjeev Roy)
Member Committee of Inquiry

(Capt. Bindu Sethi)
Operations Expert

Capt. Bindu Sethi, IG, BSF (Air) has associated in the investigation as operational expert.

NEW DELHI
24/09/2015