

<b>FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT TO M/s AIR INDIA CHARTERS LTD, B737-800NG AIRCRAFT, VT-AXE, OPERATING FLIGHT IX-814(DXB-IXE) ON 14.08.2012 AT MANGALORE AIRPORT</b>			
<b>1</b>	Aircraft		
		Type	B737-800 NG
		Nationality	Indian
		Registration	VT-AXE
<b>2</b>	Owner		M/s International Lease Finance Corporation Ltd., Dublin 1, Ireland
<b>3</b>	Operator		M/s Air India Charters Ltd., Mumbai
<b>4</b>	Pilot – in –Command		ATPL holder
		Extent of injuries	None.
<b>5</b>	Co Pilot		CPL holder
		Extent of injuries	None.
<b>6</b>	No. of Passengers on board		166
	Extent of Injuries		None
<b>7</b>	Last point of Departure		Dubai (DXB) Airport.
<b>8</b>	Intended landing place		Mangalore (IXE) Airport.
<b>9</b>	Place of Incident		Mangalore Airport, N 12° 57' 37.1" E 74° 53' 46.1"
<b>10</b>	Date & Time of Incident		14.08.2012; 00:58 UTC.
<b>11</b>	Type of Incident		Aircraft undershoot the runway and made a heavy landing.

## **Foreword**

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under the 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 serious incident which may help to prevent such future accidents or incidents.

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## **SYNOPSIS**

M/s Air India Charters Ltd, Boeing B737-800NG aircraft VT-AXE, operating Scheduled passenger flight IX-814{Dubai(DXB) to Mangalore (IXE)} of 14<sup>th</sup> August, 2012 at 00:58 UTC, made an undershoot approach and hard landing at Mangalore Airport. POB: 172(2 Flight Crew+4 Cabin Crew+166 Passengers). There were no injuries to the persons onboard the flight. The aircraft suffered minor damages to its tyres and LH horizontal stabilizer.

The Ministry of Civil Aviation constituted a committee of inquiry to investigate the cause of the serious incident under Aircraft (Investigation of Accidents and Incidents), Rules 2012 comprising of Sh. S Durairaj, Chairman, Capt. G P S Grewal, Member and Sh. N S Dagar, Member Secretary.

The Committee of inquiry determines that the cause of the incident was due to incorrect control inputs on short finals during transition from IMC to VMC and apparent loss of momentary depth perception by the Captain due prevailing foggy and low altitude cloud conditions.

## **1. FACTUAL INFORMATION**

### **1.1 History of Flight**

M/s. Air India Charters Ltd., Boeing 737-800 NG Aircraft, VT-AXE, was operating scheduled passenger flight IX-813/814(Mangalore-Dubai-Mangalore) on 13<sup>th</sup>/14<sup>th</sup> August,2012. The flight crew (P1) had availed approximately 46 hrs of rest and P2 62:15 hrs of rest prior to commencement of flight operations. The pre flight medical with BA test was carried out at Mangalore and the crew was declared fit for duty. The flight crew had started their flight duty period at night from 15:30 UTC at Mangalore. The airborne time was at 16:27 UTC to fly the IXE-DXB-IXE route. Throughout this flight, Commander who was Check Pilot and occupying the left hand seat in the cockpit was performing the duties of the Pilot-Flying. The Co-Pilot who was occupying the right hand seat was performing the duties of Pilot Monitoring. The flight to Dubai was uneventful. From Dubai they took off for Mangalore at 21:10 UTC with 172 persons on board (POB) (2 Flight Crew+4 Cabin Crew+166 Passengers). The climb, cruise at Flight Level (FL) 350 and initial descent transpired without incident.

At time 00:05 UTC, approx 220 NMs from Mangalore at FL 350 the IX-814 flight crew had contacted Mangalore Area Control Centre(ACC) and obtained the Weather report at Mangalore, Calicut and Cochin. The Mangalore MET report received by flight crew for the time of observation 00:00 UTC was Wind 090 deg/03 Kts, Visibility 200 meters, Weather FOG Cloud SCT 300 ft, SCT 1200 ft, QNH 1008, QFE 996, Temperature 24deg.C, R/W-24. At 00:26 UTC IX-814 was released by Chennai ATC and came in contact with Mangalore ACC on 127.55 MHz and ATC, Mangalore advised IX-814 to descent to FL200. The flight crew acknowledged the flight level and requested for latest visibility at Mangalore. The controller from ATC, Mangalore had passed latest visibility as 800 Metres and also checked the aircraft Minima. At that time the Flight Crew reported minima required RVR 1200M.

At time 00:30 UTC Mangalore Tower Duty Officer opened Tower Watch after making arrangements to obtain manual RVR from airport duty Met official for the arrival IX-814 flight. The Visibility standby was declared by ATC (i.e. visibility<1500 Meters conditions). Mangalore ACC cleared the IX-814 to proceed MML VOR Hold and report joining. This was acknowledged by the aircraft at 00:33:33 UTC. The aircraft informed Mangalore ATC that they would like to hold at FL 200 and the same was approved by ATC.

The flight crew had reduced the aircraft speed to minimum and a hold was established at over head Mangalore at FL 200 from time 00:33 UTC to 00:39 UTC. At this stage, flight crew had approx 0:30 minutes and 0:50 minutes of hold time for Cochin and Calicut respectively. At 00:39:29 UTC latest observation of manual RVR 1200 Meters was passed to the IX-814 by ACC, Mangalore. The flight crew had reported their intention to descend further from FL200 and aircraft was also cleared by ATC to descent to 2200 feet and join VOR Hold and report joining. At 00:43 UTC aircraft entered Mangalore hold and was descending in the hold. At 00:47:12 UTC while passing at FL100 aircraft was changed over to TWR on 122.1 MHz. The flight crew contacted TWR and reported their intention to carry out ILS approach. At 00:47:41 UTC ATC Tower passed latest visibility as 800 Metres and RVR R/W-24 as 1200 metres and the same was acknowledged by flight crew as within MINIMA.

On confirmation from the crew that they were within their minima, the TWR had cleared IX-814 for ILS APP R/W-24 from MML and also advised to report leaving MML and descent to 2200 feet. At 00:49:50 UTC IX-814 reported leaving MML for ILS R/W-24. At 00:50:08 UTC the QNH 1008 and runway surface condition (DAMP) were passed to aircraft by TWR. At 00:55:16 UTC flight crew reported established on ILS passing 2100 ft and 6

DME. At 00:55:44 UTC Mangalore TWR sought confirmation from the aircraft whether it had approach Light Runway 24 in sight. On receiving a negative reply, asked the aircraft to report on finals for R/W-24 at time 00:55:51 UTC and this was acknowledged by flight crew. At 00:56:51 UTC TWR rechecked with flight crew whether aircraft on FINAL and on receiving 'affirmative' the ATC had issued a landing clearance to flight IX-814 with Wind Calm at time 00:56:59 UTC. As per landing card the Vapp speed was 146 Kts, Vref: 141 Kts, Flap: 40 deg for landing weight 65.7 tons.

At time 00:57:42 UTC on short finals the flight crew had disconnected the auto Pilot at 245' above air field elevation(AFE), and aircraft was on glide path at 0.8 DME and continued the approach. After the auto pilot disconnection, aircraft started approx.  $0.5^{\circ}$  nose down attitude with stabilizer input commanded by flight crew while the thrust remain relatively constant(65.5/65.6% N1) and the rate of descent was gradually increasing to a max ROD of 1056 ft/min prior to touchdown. During final approach the head wind gradually transitioned to left cross wind of approx.05 Kts in an anticlockwise direction. The aircraft was in pitch down attitude and remained at a nose down attitude until flare initiation by flight crew. During transition from automatic flight control under instrument flight conditions to manual flight control aircraft ROD gradually increased to high rate of descent (i.e. 1056 ft/min approx) and also descended below 3deg. Glide slope coupled with poor visibility conditions due fog and low altitude clouds.

During the touch down the aircraft had right bank(5.6 deg) which resulted in aircraft right wheel first impacting undershoot area (i.e. compacted earth surface) at approx 105 feet from the beginning of R/W-24 with the approach speed of 151 Kts at time 00:57:56 UTC. After right wheel touched on the undershoot area, immediately a left bank(8.3 deg) was initiated by flight crew due to which aircraft left wheel touched down at approx.49 feet prior to the beginning of RW-24 threshold.

During the process of initial touchdown in the undershoot area the aircraft bounced immediately for about 20 ft RA and was airborne for a period of 7 seconds. During the bounce the N1 rpm was slightly increased to 76.3/68.3% from 65.5/65.6% .

Prior to second touchdown while flaring the aircraft pitch attitude was increased to 6.2 deg. and a right bank of 7.4 deg with speed brakes fully deployed. The second touch down was at 142 Kts with vertical acceleration of 2.007g at time 00:58:04 UTC on the R/W-24 approx.1900 ft from

threshold and maximum reverse thrust was commanded followed by maximum manual braking, to decelerate the aircraft rapidly on R/W-24.

Due to dynamic forward motion of the aircraft during first touchdown on the under shoot area all four wheels initially scraped on the Wet Mix Macadam(WMM) and Bituminous area of 49'(27' WMM+22' Bituminous) till 15 ft prior to R/W-24 threshold. During this period the loose stones/soil came out from the graded WMM area and damaged the aircraft's LH stabilizer on lower side and tyres. The aircraft wheel marks just prior to and after the threshold of R/W-24 were coinciding with aircraft wheel track distance 5.7 Meters. After second touchdown on R/W-24 the subsequent aircraft landing roll on runway 24 was uneventful.

The aircraft approach on short finals, touchdown and landing roll was not seen by ATC personnel on duty from ATC Tower due reporting of fog. During landing roll at time 00:58:57 UTC TWR checked with IX-814 its position and the flight crew reported approaching exit taxiway E. At 00:59:11 UTC TWR advised IX-814 to vacate Runway via taxiway E and after confirmation from Pilot that R/W vacated the ATC had cleared for further taxi clearance from taxiway E to bay 10 and the same was acknowledged by flight crew. At 01:00:50 UTC TWR again checked with flight crew whether aircraft requires any Follow Me assistance. The flight crew reported that taxiway is in sight and declined Follow Me assistance from ATC. At 01:02:53 UTC crew reported to ATC aircraft was fully parked at assigned bay 10.

The flight crew did not report to ATC, Mangalore on any abnormality or hard landing experienced by them after the arrival of aircraft. The AME was not present at the arrival Bay when the aircraft arrived. The aircraft was received by two aircraft technicians. Thereafter, both flight crew carried out post flight inspection and observed the aircraft damage and wheel damage. After Post flight inspection the PIC had written 'Suspected hard landing' in Aircraft Tech log.

Later, the AME had met the flight crew at Airport Terminal Building and took the briefing from flight crew about hard landing incident. Subsequently, AME arrived at Bay10 and inspected the aircraft. During AME inspection it was found that LH horizontal stabilizer lower inboard side leading edge was punctured with hole size approx. 1" X 0.75". Multiple scratches/scribes were found on LH side fuselage aft of LH wing for approx 0.5" to 1" length. #1 main wheel tyre was found damaged with several deep cuts and scratches and some areas were found chipped off. #2 tyre with minor scratches and #3 & #4 main wheel tyres found with multiple cuts on side wall areas around 3" to 4".

At 02:56 UTC while carrying out a routine runway inspection the runway safety team reported on Walkie Talkie that few stones/loose soil were scattered on runway 24 threshold. TWR instructed ATCO to clear the stones and report runway fit for operations. At 03:13 ATCO reported runway 24/06 cleared and fit for flight operation. ATCO who carried out runway inspection also reported suspected tyre marks of aircraft in undershoot area before the threshold of runway 24. Duty Officer informed ATC WSO and inspection was carried out to ascertain whether marks were of aircraft tyres. Subsequently, it was confirmed by ATC that the only one movement was of flight IX-814 arrived from Dubai and landed on runway 24. This incident occurred after the two R/W inspections carried out by ATCO at time 00:05 UTC and at 00:48 UTC on 14.08.2012, there were no abnormalities reported during these two inspections. ATC officials inspected the undershoot area and also aircraft parked on bay 10.

Subsequent arrival Aircraft reported the performance of PAPI and ILS as normal. Runway Safety Team had observed that the aircraft VT-AXE on bay 10 was undergoing necessary rectification on wheel replacement and structural inspection. On enquiry, the ground engineer attending to the aircraft reported damage to aircraft wheels and stabilizer due hard landing by aircraft. The aircraft tyre marks on undershoot area commenced approx. 105 ft prior to the Runway 24 threshold and ended at 15 ft beyond threshold. Observation of tyre marks in pre threshold area was informed to Airlines AME by Runway Safety Team. After carrying out detailed inspection, rectification, structural repair on horizontal stabilizer and all 4 wheels replacement as per Boeing recommendations the aircraft was released for further flight on 16.08.2012.

## 1.2 Injuries to persons:

Injuries	Crew	Passengers	Other
Fatal	0	0	0
Serious	0	0	0
Minor	0	0	0
None	6	166	0
Total	6	166	0

### 1.3 Damage to aircraft:

The following observations and damages were found during post flight inspection of aircraft.

- LH horizontal stabilizer lower inboard side leading edge found punctured with hole size 1 inch x 0.75 inch (approx)
- Multiple scratches/ scribes were found on LH side fuselage aft of LH wing (ranging from 0.5 inch to 1 inch approx length).
- #1 main wheel assembly found damaged with several deep cuts and scratches. Some areas were found chipped-off. #2 main wheel tyre found with minor scratches.
- #3 & #4 main wheel assembly found with multiple cuts on side wall areas (around 3-4 inches approx)

Photographs of the aircraft's damage and undershoot area are placed at Annexures 'A' & 'B'.

### 1.4 Other damage: NIL

### 1.5 Personnel information:

#### 1.5.1 Pilot-in-Command(Check Pilot/PF):

Pilot-in-Command	Check Pilot, Male, Aged: 57 Yrs
Licence	ATPL issued on 28.11.2007 valid till 27.11.2013
Type endorsements	B737-800 & P68C
Aircraft Rating	B737-800 initial endorsement on 30.5.2008 As P2 & on 28.07.2009 as P1 and last renewed on 28.11.2011 valid till 27.11.2013
Date of Joining AICL	05.11.2007
Instrument Rating	Renewed on 01.05.2012
FRT0 validity	Valid till 27.11.2016
RTR	Valid up to 14.05.2032
Medical Certificate	Class I renewed on 24.08.2012 and valid till 23.02.2013 Restrictions: Wearing of Corrective Bifocal Glasses, Advised to use Earplugs in noisy environment.
Date of Last Line/Route Check & validity	03.08.2012 and valid upto 02.02.2013
Date of last Proficiency/IR Check	01.05.2012 and valid upto 31.10.2012

Date of last English language Proficiency	08.02.2011 Level-06 and life time.
Date of Last CRM Training	04.11.2011 and valid upto 03.11.2012
Date of last Monsoon Training	18.04.2012 and valid upto 17.04.2013
Date of last Simulator Refresher/Test	30.04.2012-and valid upto 29.10.2012
Familiarity with Route/IXE Airport flown for the last 12 months and Since Joining Company.	33 sectors flown from IXE for the last 12 months. <b>72</b> sectors flown from IXE since joining Company. ( Note: T/O and Landing is considered as one Flight)
Total flying Experience on all types (incl Previous to AICL)	7104:15 hrs
Total Experience on Type: PIC and Co-Pilot	PIC:2088:20 hours P2: 620: 50 hours
For the last 24 hrs including incident flight	07:30 hours
For Last 7 days	23:20 hours
For Last 30 days	80:30 hours
Total in last 90 days	213:30 hours
For Last 1 Year	680:15 hours
Rest Period Prior to duty Flight	46:00 hours
Check Pilot approval date	13.02.2012

The pilot has flown a total 4395:05 hrs while serving with the Indian Air Force (IAF) on various fighters Jaguar, Hunter, Marut and Trainers Kiran, Iskra, HPT and HT-2 aircrafts in the capacity of a qualified Fully Operational Fighter Pilot and Qualified Flying Instructor with A2 Category during his service of 32 Years till 4th November,2007. He has retired prematurely from IAF on 04 Nov 2007 after 32 Years of service. After retirement he joined in AICL at Mumbai on 5<sup>th</sup> November 2007 and completed his initial training on B737-800 released to fly on line as P2 after 10 Nos of Route Checks by DGCA approved check Pilot on 27<sup>th</sup> August 2008. He has started his airlines flying as P2 Contract Pilot from 2<sup>nd</sup> September, 2008 to operate B737-800. Subsequently, he completed his Command Training and was released as P1 on 1st August 2009. PIC is qualified to operate under Cat I ILS condition as per the Company/Airlines Policy.

### 1.5.2 Co-Pilot( PNF):-

Co Pilot	Line Pilot, Male, Aged 28 years
License	CPL issued on 17.12.2008 valid upto 16.12.2013
Type endorsements	B737-800, Cessna152 A, Duchess 76
Aircraft Rating	B737-800 endorsed on 23.12.2010 as P2 and valid upto 16.12.2013
Date of Joining AICL	27.05.2009
Instrument Rating	B737-800 renewed on 06.12.11 and valid upto 05.12.2012
FRTTO	Issued on 17.12.2008 valid upto 16.12.2013
RTR	issued on 25.11.2008 Valid upto 24.11.2013
Medical Certificate	Class I renewed on 19.01.2012 and valid upto 18.01.2013 Restrictions- Nil.
Date of Last Line/Route Check	13.8.2012
Date of last Proficiency/IR Check	05.05.2012
Date of last English language Proficiency	02.02.2011, 6 level
Date of last Monsoon Training	19.03.2012
Date of Last CRM Training	04.11.2011 valid upto 03.11.2012
Date of last Simulator Refresher/ Test	05.05.2012 and valid upto 04.11.2012
Familiarity with Route/IXE Airport flown for the last 12 months	41 flights
Flying Experience	
Total all types	1067:27 hours
Total on type	850:45 hours
Total in last 90 days	247:50 hours
Total in last 30 days	66:20 hours
Total in last 7 days	22:40 hours
Total in last 24 hours including incident flight	7:30 hours
Rest Period Prior to duty	62:15 hours



Prior to Joining Air India Express the Co-pilot had 216:42 Hrs experience and has flown a total 216:42 hrs on Cessna152A, Cessna172, Duchess 76-aircraft .The Co-pilot civil flying experience on different type of aircraft been as under:

Cessna152A : 151:12 hrs  
 Cessna172 : 36:12 hrs  
 Duchess 76 : 29:18 hrs  
 B737-800 : 850:45 hrs (as P1 Nil hrs & P2 850 hrs)

The Co-pilot has been flying on the B737-800 since 23.07.2011  
 He has been qualified as P2 w.e.f. 23.12.2010.

<b>Arrival AME Details</b>	Female, Aged 29 Years
Date of Joining AICL	01.06.06
Date of becoming AME	30.4.08
License Date of Issue/ Validity	11.8.05/03.9.13
Training on Cat. 'A'	4.8.08 to 12.9.08
Training on Cat. 'C'	30.11.09 to 18.1.10
Total Aviation Experience	11 years.
Total Experience as AME	4 years 5 months.
Last Refresher done	July 2011
Next Refresher due	June 2013

### **1.5.3 Cabin Crew**

**Details of Cabin Crew in tabulated format as below:-**

Cabin Crew Seat Location	L1	L2	R2	R1
Date of Birth	31/10/84	12/12/84	30/03/85	25/03/85
Date of joining training	08/02/2008	07/07/2009	03/01/2011	01/02/2011
Date of Initial training on B737-800 a/c	28/04/08 to 29/06/08	18/09/09 to 12/01/10	24/01/11 to 09/06/11	02/02/11 to 23/05/11
SEP initial Training Date and Validity	28/04/08, valid upto 27/04/09	18/09/09, valid upto 17/09/10	24/01/11, valid upto 23/01/12	02/02/11, valid upto 01/02/12
DG initial Training Date and Validity	04/06/08, valid upto 03/06/10	30/11/09, valid upto 29/11/11	18/03/11, valid upto 17/03/13	05/04/11, valid upto 04/04/13
Date of initial Practical training and Validity	Wet drill 29/05/08, validity 28/05/10	Wet drill 26/11/09, validity 25/11/12	Wet drill 10/03/11, validity 09/03/14	Wet drill 03/03/11, validity 02/03/14
	Fire drill 29/03/12, validity 28/03/15	Fire drill 13/09/12, validity 12/09/15	Fire drill 17/03/11, validity 16/03/14	Fire drill 02/04/11, validity 01/04/14
	Escape slide drill 29/03/12, validity 28/03/15	Escape slide drill 13/09/12, validity 12/09/15	Escape slide drill 07/03/11, validity 06/03/14	Escape slide drill 28/02/11, validity 27/02/14

Total experience on the B-737-800 Aircrafts as DGCA approved crew member		4 years & 1 mth	2 years & 6 mths	1 year & 2 mths	1 year & 3 mths
Date of Last refresher training and Validity	FS	26/03/12, validity 25/03/13	10/09/12 validity 09/09/13	17/01/12 validity 16/01/13	30/01/12 validity 29/01/13
	DG	08/04/11, validity 07/04/13	16/09/11 validity 15/09/13	18/03/11 validity 17/03/13	05/04/11 validity 04/04/13
	WD	08/04/10, validity 07/04/13	13/09/12 validity 12/09/15	10/03/11 validity 09/03/14	03/03/11 validity 02/03/14
Rest availed prior to operating IXE -814 of 14th Aug 2012		24 hrs	24 hrs	24 hrs	24 hrs

### 1.6 Aircraft information:

Name of Operator	Air India Charters Ltd
Aircraft Type	Boeing 737-800 NG
Registration Marking & S.N	VT-AXE & 29368
Year of Manufacture	2006
Validity of Certificate of Airworthiness, Category & sub-division	5.4.2014, Normal & Passenger/Mail/Goods
Total Flying Hrs / Cycles since manufacture as on 14.08.2012	Airframe 17678 hours / 7135 cycles
The last major check/inspection carried out on the aircraft	Phase 41/20500 hrs Check carried out on 28.6.2012 at aircraft 17431 hours /7047 cycles.

Total Flying Hrs/cycles/landing at Last major periodic inspection	A/c 247 hours/88 cycles/ 88 landings
Last periodic inspection	Transit Inspection on 13.8.2012 at Dubai

### **Weight and Balance Information:**

The Details of basic weight schedule were as follows:-

Aircraft Empty Weight	41604.68 Kgs
Max fuel capacity(At density of .785 kg/litre)	20427.35 Kgs
Maximum Takeoff weight	76883.00 Kgs
Empty weight CG (cm)	1677.58
Datum(from forward of front spar)	1371.6 cm
Maximum Permissible number of Passengers	189
Number of Crew	2+4

Weight	Actual Weights for IX-814	Maximum Permissible
Take Off Weight	75100 Kgs	75,760 Kgs
Landing Weight	65700 Kgs	66,360 Kgs
Zero fuel Weight	60306 Kgs	62,731 Kgs

### **1.7 Meteorological information:**

The Mangalore Airport is situated on the western coast of India. It is subject to active south west monsoon conditions, normally between June and September. In the month of May, generally pre-monsoon weather prevails with clouds and occasional thunder showers. The airport is situated on a table top plateau with surrounding undulating terrains and valley. Therefore Mangalore also witnesses phenomena like mist and low clouds at the edge of the airfield. However, in periods other than the SW monsoon, the weather is generally fair to fine with good visibility but for weather epochs such as mist or fog. A study of the weather at Mangalore airport revealed that Mangalore airport often faces unexpected weather patterns especially during the monsoon which is marked by the sudden emergence of clouds from the valley ground and a brief but strong spell of the rain, thereby drastically reducing the visibility within a short period.

TREND forecast is not issued by the Aerodrome Meteorological Office, Mangalore. Reduced visibility at Mangalore Airport in the morning during south west monsoon is not uncommon and the areas affected by reduced visibility are variable due to moving patches of fog.

In a not so active monsoon condition that prevailed over western Ghats on 14<sup>th</sup> August, 2012, chances for the development of low clouds amounting from SCT (3-4 Octa) to BKN(5-7 Octa) over a station are quite high and in such cases these low clouds may not precipitate but will be at a height very close to the ground (say 300 to 800 ft AGL). In view of prevailing not so active monsoon conditions with high humidity, fog (cloud at or close to surface) may also form and may advect with very little speed from the nearby valley. This is local feature associated with Western Ghats.

On 14<sup>th</sup> August, 2012 one Met official was at new control tower and other was at old control tower wherein Metrological office located. All Meteorological observations were made from the active new control tower on 13<sup>th</sup> night/14<sup>th</sup> early morning hours. Based on METAR/SPECIs, there was low clouds with base 300 ft and Fog prevailed around the time of the incident (00:30 – 01:00 UTC) with visibility 800 m and manual RVR at 00:37 UTC was 1200 Meters. The actual weather reports of Mangalore Airport around the time of aircraft landing were as follows:-

SPIN90 VOML 140000  
SPECI VOML 140000Z 09003KT 0200 FG SCT003 SCT012 24/23 Q1008=  
SPIN90 VOML 140030  
SPECI VOML 140030Z 11003KT 0800 FG SCT003 SCT012 BKN080 24/23 Q1008=  
**RVR (RUNWAY 24) 1200M REPORTED AT 0037 UTC**  
SAIN90 VOML 140100  
METAR VOML 140100Z 00000KT 0800 FG SCT003 SCT012 BKN080 24/23 Q1008=  
SAIN90 VOML 140130  
METAR VOML 140130Z 10003KT 0100 FG SCT003 SCT012 BKN080 24/23 Q1009=  
SAIN90 VOML 140200  
METAR VOML 140200Z 12003KT 1000 BR SCT003 SCT012 BKN080 24/23 Q1009=

As 800 Meters visibility was reported at 00:30 and 01:00 UTC and the incident occurred at 00:58 UTC, there is a possibility of fog and low cloud from nearby valley around the Table top RWY might have passed over the RWY but got cleared off around 01:00 UTC observations by Met official.

AICL follows the minima given in Jeppesen approach charts at all Indian stations. The weather minima prescribed by Jeppesen chart for ILS approach to Runway 24 at Mangalore Airport, for their B373-800NG aircraft was RVR:1200 meters and Decision altitude (height): 520'(212').

## **1.8 Aids to navigation:**

The flight crew used ILS CAT I for the landing; there were no observations on the functioning of the ILS or any other navigational equipment at Mangalore Airport or onboard the aircraft. There is no evidence to indicate that IX-814 experienced any navigational problem during the flight.

## 1.9 Communications:

The CVR and ATC tape recording indicate no failure of any communication equipment at Mangalore Airport or onboard the aircraft. There is no evidence to indicate that IX-814 experienced any communication problem during the flight.

## 1.10 Aerodrome information:

Mangalore Airport had a table top R/W 27/09 with a length of 1625 meters and runway 24/06 with the length of 2450 meters, which facilitates operations by aircraft such as Boeing 737-800 and Airbus 320. The R/W 24/06 provides night landing facilities and an ILS Cat-I. The Airport Rescue and Fire Fighting Services were upgraded to category 7.

Mangalore airport has latitude 12° 57' 43.40" N and Longitude 074°53' 23.20" E with an ARP elevation of 101.629 meters above mean sea level. Runway 24/06 has a concrete surface with dimensions 2450 x 46 meters, aerodrome elevation 103.07 meters and PCN 54/R/B/X/T. It is provided with runway strip of 75 meters of width on either side of runway centerline. The Primary runway 24 is a precision approach CAT I ILS runway and served with intermediate facilities(HIALS/SALS of 420 Meters/THR/END lights) and PAPI. PAPI was calibrated along with air calibration of ILS prior to the incident on 28<sup>th</sup> March, 2012 and valid upto 27<sup>th</sup> September, 2012. Simple Approach Lighting system for RWY 24 is available up to a distance of 420 meters from the runway 24 threshold. At the time of incident, Mangalore airport had a valid license.

The salient features of the Mangalore airport safety areas are as follows:-

License Validity of Mangalore Airport	15.12.2013
Runway Strip Length	2570 meters
Runway strip Width	150 meters.(A permanent exemption has been sought due to deep valleys on either side of the runway strip)
Length of the Runway 24/06	2450 meters
Width of the Runway24/06	46 meters
Location of Threshold for R/W 24/06	Immediately at the beg. of R/W
Runway 24 declared distances are Take off Run Available (TORA) Take off Distance Available (TODA) Acceleration Stop Distance Available (ASDA) Landing Distance Available (LDA)	2450 meters

Runway Longitudinal Slope for R/W 24 is as under:-	
<ul style="list-style-type: none"> <li>• From 0 m to 565m</li> <li>• From 564m to 1105m</li> <li>• From 1105 to 2450m</li> </ul>	+0.46% -0.56% 0%
RESA for R/W-06	90X90 meters
R/W-24 approach lighting system	HIALS/SALS of 420 meters

The undershoot area where the incident aircraft had touched down initially has a compacted earth surface and paved surface of Bituminous/Wet Mix Macadam for a total distance of 60 meters from the runway 24 threshold out of which first 15 Meters was paved surface of Bituminous/WMM from runway threshold and compacted earth surface for remaining 45 Meters.

### 1.11 Flight recorders(CVR/DFDR):

#### 1.11.1 CVR

The aircraft is equipped with Honeywell Cockpit Voice Recorder P/N.980-6022-001, S/N 120-12982. The actual recording for this CVR was for the last 2 hours 5 minutes. The Conversations are recorded on the Captain's channel, Copilot's channel, Observer's channel and an Area channel which records conversations/other sounds in the cockpit. The CVR was removed from the aircraft after the incident. A full analysis was carried out of the approach and landing phases of the flight. Salient observations made from the CVR tape transcript are given below:

Time UTC	Salient CVR observations
00:05:56 to 00:27:05	Flight IX 814 to Mangalore where the reported visibility was 200 m at the time initial contact with ATC, Mangalore. Alternate planning for diversion was discussed including the weather of Calicut and Cochin along with fuel calculations. IX-814 was holding over MML at FL200.
00:27:12 to 00:37:53	The visibility improved to 800 m. Initially, minor confusion was heard from the Captain's conversation regarding the visibility and CMV concept. The Captain reported to the first officer that first time he was carrying out approach under marginal weather conditions.
00:47:51	IX-814 was cleared for VOR ILS approach R/W 24 via MML at 00:47:56 when the RVR reported was 1200 metres by ATC.

00:55:28	Aircraft established on ILS RWY 24.
00:55:39 to 00:57:46	At about 6 NMs ATC confirming from IX-814 whether approach lights in sight?. The aircraft reported 'Not as now'.
00:55:28	Aircraft was cleared to land on RWY 24 by ATC.
00:56:58	PIC asked Co-Pilot P2 to look out for lights.
00:57:27	500 feet auto call out
00:57:35 to 00:57:42	Approaching minimums callout was given by the P2 at 0:57:35 and auto callout at 0:57:38. Minimums Auto callout was heard and runway straight ahead (00:57:41) before disconnecting the autopilot at 00:57:42.
00:57:48	After the decision height had been reached and the first officer had called 'Lights in sight'. Immediately 100' auto call out was heard.
00:57:52 to 00:57:56	All radio altitude auto callouts (50 ft,40ft,30ft,20ft) were heard. An unusual scraping sound was heard followed by bounce and second touchdown.
00:58:08	Sound like engine Thrust Reverser Operation.
01:00:48 to 01:00:52	Tower to IX-814 confirm any follow me service required. P2 reported Not required.
01:02:51	Aircraft fully parked at Bay 10.
01:03:27 to 01:03:48	Ground to Cockpit contact established. Aircraft received by Ground Technician and parking brakes released
01:04:04	Comments from flight Crew on hard landing incident. The Captain reported that "less than 50 feet when they were about to flare out, there was a right cross wind and when they commenced to flare out they lost the depth perception. After the bounce they had the runway in sight and they were coming back on the runway they decided to continue....Never in his life". Co-Pilot informed PIC that less than 800.
01:08:28	Electrical power Switched off. CVR CB pulled out.
2:20:30 to 2:25:33	Electrical Power again Switched ON. CVR CB pushed in. Arrival AME was discussing on Mobile phone in Cockpit about the hard landing incident and also recorded that she was not present when the aircraft arrived to Bay 10.



### **1.11.2 DFDR**

Flight Data Recorder (DFDR) stores airplane parameters and system data for a minimum of last 25 hours of operation. DFDR protects the parameters and the system data. If there is an airplane incident, these parameters supply data on flight conditions and airplane systems operation. Airline personnel can also use the data to make an analysis of system performance during airplane maintenance.

The DFDR gets and stores airplane parameters from airplane systems and sensors. The DFDR keeps this data for use during a flight mishap investigation. The DFDR protects the data from heat and water. The DFDR records parameters that are necessary for regulatory agencies.

Aircraft Condition Monitoring System (ACMS) data from the Flight Data Acquisition Unit (FDAU) goes through the data loader control panel to a data loader. The data loader can store data from the FDAU on a disk. Commonly known as PCMCIA Card. This PCMCIA card, P/N.SSIATA-256-3000, S/N.203 having capacity of 256 MB.

The data loader control panel switch lets one select the transfer of ACMS data. One can transfer data from a disk in the data loader to the FDAU through the data loader control panel.

The Control Display Unit (CDU) controls the ACMS functions in the FDAU. The DFDR operates automatically when one of the engines is in operation or the airplane is in the air. It also operates on the ground when the TEST/NORMAL switch on the flight recorder test module is in the TEST position. The flight recorder test module shows the condition of the recorder system. If there is a system fault, amber OFF light comes on, The OFF light also comes on when the system is switched OFF.

As per the DFDR read out, the approach was observed Stabilized with correct Speed, Pitch and Roll attitude with landing flap configuration flaps 40 and engine thrust of 63-66% N1 till the time the Autopilot A was Engaged. At 00:57:41 UTC the Autopilot and Auto throttle were disengaged at Baro altitude of 245' while flying a stabilized approach. During final approach the head wind gradually transitioned to left cross wind of approx.5 Kts in an anticlockwise direction.

After disconnecting the autopilot, a forward pressure on the elevator control wheel was observed from the captain's side. Due to forward pressure on the elevator the Pitch attitude appears to be lowered by a degree, glide slope - 0.5 dot(-0.04 DDM), ROD -1048 ft/min & 157' AFE at 00:57:47 UTC. At 00:57:49 UTC altitude 124 ft AFE, Speed 147 Kts, Glide Slope below one dot(-0.09 DDM). At 00:57:51 UTC altitude 87' AFE, Speed 148 Kts, Glide Slope below two dots (-0.17 DDM). The rate of descent was observed to be high approx -1000 ft/min at 00:57:55 (just prior to first touchdown). A constant engine power was observed with no change in N1 was observed till touchdown. At 00:57:54 UTC GPWS alert warning also recorded for one second at 39 feet radio altitude.

At 00:57:56 the aircraft touched down with a high rate of descent of about 900 ft/min. Thrust is seen to be constant till touchdown (65.5/65.6% N1). Incorrect flare technique was observed. A right bank was observed before touchdown. Winds were slightly left cross wind condition at touchdown. A constant N1 is observed with no reduction from the approach N1. Right wheel appears to have contacted the ground first at a bank angle of 5.6 degrees and high vertical g of 3.253 units. After touchdown a sharp left bank of 8.3 degrees (max) was observed (at 00:57:58). Aircraft bounced for 7seconds with maximum of 20' radio altitude and increase of N1 was observed (76.3/68.3%) from 65.5/65.6%. Winds recorded was approx 3kts left cross wind conditions.

Before the second touchdown at 00:58:04, Rate of Descent was observed to be - 328 ft/min. during flare with a pitch attitude increased to 6.5 degrees and a right bank of 7.4 degrees. At touchdown the high vertical g of 2.007 units was recorded. Control wheel inputs were only from the P1 side. The FDR indicate that the cross wind component was shifting from the right to left (169 to 126 degrees) during the period from 00:57:40 UTC to 00:57:56 UTC. In the last 4 seconds before the touchdown of the aircraft there is a change in the left cross wind direction from 145 deg to 126 deg in anti-clockwise direction. This induced a cross wind component of about 2-3 knots.

At first touchdown, the auto brake got activated and the speed brake lever was partially deployed to 11.4 degrees (at 00:57:57 UTC) and increase in brake pressure was observed to be 225 psi and 279 psi respectively. A second touchdown was observed after 7 seconds from the first bounce. Auto braking action and speed brake deployment were observed fully after second touchdown.

### **1.12 Wreckage and impact information:**

The aircraft tyre marks in the undershoot area clearly reveals that there was impact damage during aircraft first touchdown on the undershoot area prior to runway-24. Aircraft touchdown on undershoot area with the right gear tyre mark of approx.105 ft distance and left gear tyre marks of about 49 ft before threshold indicates a total travel of 105 ft on the mud surface prior to runway 24 threshold.

### **1.13 Medical and pathological Information:**

Both the cockpit crew were medically fit for flying and had undergone pre-flight medical examination after reporting for flight duty at 15:30 hrs at Mangalore Airport. They had been declared to be 'Not under the influence of alcohol' prior to operating the flight. The FDTL/FTL requirements were met in respect of both the crew members.

### **1.14 Fire:**

There was no fire.

### **1.15 Survival aspects:**

The incident was survivable.

### **1.16 Tests and research: Not applicable**

### **1.17 Organizational and management information:**

Air India Charters Ltd., is a Public Sector Undertaking (PSU) of Government of India. Headquartered in Mumbai, India, this subsidiary of Air India's operating low cost carrier operating from India to destinations in the middle East, South and South East Asia. The airline has scheduled operator permit S-14 issued in Pax/Cargo Category which was issued on 22.04.2005 valid till 21.04.2013. It has B737-800 aircraft in their fleet as on 14.08.2012 there were 21 aircrafts operating to 27 stations out of which 13 were International stations and 14 were domestic stations. The Chairman and Managing Director of Air India who is also the Chairman of Air India Charters Ltd. AICL has a mixed intake of pilots. While there are Captains and First Officers employed directly on contract, First Officers from Air India are also sent to AICL for Command conversion. In addition, number of foreign pilots have also been employed in AICL. AICL has a simulator for Boeing 737-800 aircraft at Mumbai. AICL operates to some of the critical airfield such as Mangalore, Calicut, Pune. AICL has 12 Check Pilots, 1 instructor & 4 Examiners.

### **1.18 Additional information:**

All statements from the ATCOs confirm that the proper checklists before opening the watch of the aerodrome were followed that included METAR, Runway inspection etc. Visibility was 200m and improved to 800m. A runway inspection was done before opening the watch and a second runway inspection was done before the landing of the aircraft. Before the landing of the aircraft a manual RVR was checked with the help of CFT (Crash Fire Tender) and RVR was 1200m. Runway was declared fit for operations.

Full Runway 24/06 was not visible from the tower due to fog at Airport. The ATCOs at the tower were reportedly unable to sight the IX-814 aircraft's movement for almost 'two minutes' in landing profile due fog at Airport despite the visibility then been reported as 800mts by the MET officials. The reduction in visibility around the time of incident which could not be clearly seen through the tinted glass at new ATC tower. The Aircraft landing lights were seen by ATCOs while the aircraft passed in front of the tower. Same was stated by the fire department officer as well. Follow me service was offered by the ATC but was declined by the Captain.

The Airlines arrival AME was not present at the time of aircraft arrival. The aircraft was attended by only two aircraft technicians who handled RT on arrival are not fully qualified and experienced to handle the situation in the event of any hydraulic leak or fire/smoke during aircraft landing and taxiing at Airport. As per Airlines policy the aircraft departure/arrival shall be handled only by qualified AME.

04 AMEs were posted at Mangalore airport but only one AME was allocated to attend IX-814 flight on the day of incident and her duty time starts from 06:00 IST to 14:30 IST on 14.08.2012. The IX-814 scheduled arrival time is 06:25 IST but normally the aircraft land 15 minutes before scheduled arrival time for the sector IXE-DXB-IXE. On 14.08.2012 there was a delay of 3 minutes due aircraft hold for weather improvement at Mangalore Airport.

Since the AME was not present at the time of aircraft arrival, she carried out late post flight inspection and did not report to ATC about VT-AXE hard landing incident. The flight crew pulled out CVR CB at 01:08:26 UTC after secured cockpit check list. The CVR CB was found again pushed in at 02:20:30 UTC for five minutes duration. During that time AME's conversations were recorded from 02:20:38 UTC to 02:25:33 UTC and thereafter CVR CB was pulled out.

### **1.19 Useful or effective investigation techniques: Nil**

## **2. ANALYSIS**

### **2.1 Serviceability and Performance of the Aircraft:**

Boeing 737-800NG aircraft VT-AXE was manufactured by M/s. Boeing Aircraft Company, Seattle, USA. The aircraft had a valid Certificate of Airworthiness. It was maintained by approved Aircraft Maintenance Planning as per maintenance schedule. All relevant DGCA and manufacturer MODs for airframe and the engine were complied with as on 14/08/2012. Scrutiny of the snag register did not reveal any snag relevant to the incident. The last CRS (Certificate of Release to Service) issued on 28<sup>th</sup> June 2012 and valid till 27<sup>th</sup> August 2012. Engineering document scrutiny did not reveal any carried forward snag. Last Transit check was carried out on 13.08.2012 at Dubai and AME confirmed nil defects on the aircraft and the aircraft released to service from Dubai to Mangalore. After departure from Dubai the aircraft landed at Mangalore Airport. During Post Flight Inspection the AME noticed that the VGTD 3.3604 g. There were damages to LH horizontal stabilizer inboard lower side leading edge, LH side fuselage aft of LH wing, all four( #1,#2, #3 & #4) main wheel tyres were found with multiple cuts and few chipped-off portion as well. All relevant photos were attached as an Annexure B.

Load and Trim sheet of the sector revealed that the aircraft was operated within load limit. The take off/landing and CG of the aircraft was within the prescribed limits. The aircraft takeoff weight was 75,100 Kg against Max 75,760 Kg and landing weight was 65,700 Kg against 66,360 Kg.

Hence aircraft and its performance is not a contributory factor to this incident.

### **2.2 Operational Analysis**

Following Operational/CRM/Human Factors and related contributory factors were deliberated in the event:

**2.2.1 CVR/DFDR analysis:** The aircraft was pitched down by the Captain after disconnecting the autopilot at time 00:57:42 UTC. After the pitch down there has been a steady increase in Rate of Descent from 720 ft/min to 1056 ft/min at time 00:57:49 UTC. The auto minimums callout was at time 00:57:38 UTC. 'Light visible' call out was at time 00:57:46 UTC. Approach was carried out below Decision Altitude without sufficient visual reference.

At approx 130' AFE the runway threshold lights were visible as per CVR recording, the time period between the 100', 50' callout and first touchdown was in the region of 9 seconds, the short time period reflecting the high rate of descent.

At 00:57:51 UTC aircraft altitude was 87 ft AFE, Speed 148 Kts, CDI Glide Slope bar indicated two dots fly up indication(-0.17 DDM). The winds were light and variable. Aircraft touchdown with high rate of descent of -744 ft/min and a right bank of 4.6 deg. Due to over correction by left bank (-5.8 deg) and momentum of the landing aircraft, the left wheel also touched the ground heavily. FDR shows delay in flare maneuver and during touchdown the N1 was 65.5% and high vertical g of 3.253 was recorded. The aircraft had bounced. After the bounce the second touchdown was on the right wheel with high vertical g of 2.007. The aircraft bounce is due to no thrust change, delay in flare and high rate of descent at touchdown.

The speed brake was partially deployed on first touchdown but not fully extended. This could have produced some extra drag during second touchdown, after which the spoilers were fully deployed. CVR analysis revealed that in the critical phase of the landing both crew were occupied in trying to locate the runway lights and not adhering to the airlines SOP. Also from the CVR analysis it revealed that they made no attempt to execute go-around which led to undershoot the runway. It was observed that after the first touchdown aircraft had a long bounce of 7 seconds and attained 20' radio altitude, during this period aircraft was unstable Captain tried to land the aircraft instead of executing a safe go-around as per SOP.

**2.2.2. Weather analysis:** A study of the weather at Mangalore airport revealed the fact that Mangalore airport often faces unexpected weather patterns especially during the monsoon which is marked by the sudden emergence of clouds from the valley ground and a brief but strong spell of the rain, thereby drastically reducing the visibility. Reduced visibility at Mangalore Airport in the morning during active south west monsoon is not uncommon and the areas affected by reduced visibility are variable due to moving patches of fog. Aerodrome Meteorological Station does not issue TREND forecast.

Due to fog at airport, the tower controller did not have visual contact of the landing aircraft which was cleared for an ILS approach RWY-24. Aircraft was advised to report runway lights in sight. The visibility for the period then was reported to be 800 meters while none of the tower officials were able to sight the aircraft's landing profile and its exit from Runway 24 after landing presumably due to low visibility. This underscores the fact that visibility at the time of incident may not have been same that was reported at 00:30 UTC MET

REPORT and manual RVR reported by the Met official at 00:37 UTC. Sudden changes in RVR can occur due to the natural variability in the density of fog. The aircraft landed at 00:58 UTC. The visibility and RVR reported at 01:00 UTC was 800 meters and at 01:30 UTC was 100 meters. This shows a decreasing trend in the visibility. The sudden reduction in visibility around the time of incident which could not be clearly seen through the tinted glass at new ATC tower placed a constraint upon the Met officer in informing the revised weather information to the pilot who, with the updated visibility, could have possibly gone around without carrying out the approach, thereby avoiding the whole incident.

The weather information provided to the crew was as given by the approach plate (RVR 1200 meters). This information was given with a manual assessment of the visibility. The weather minima prescribed by Airlines(AICL) for ILS approach to Runway 24 at Mangalore Airport, for their B373-800NG aircraft was RVR:1200 meters and Decision Altitude(Height): 520'(212'). It was observed from the weather report that the visibility was in a deteriorating trend. It is likely that the crew was subject to visibility lower than what was expected or reported by the ATC/Met. The visibility information was very critical in the preparation and decision to be made by the crew with respect to the landing. It is also evident from the CVR that the approaching minimum call out was given by P2 at 282 ft AFE at approx.0.8 DME. Subsequently, 'lights in sight' call out was given at 174 ft AFE. At this time aircraft was below the glide slope with increasing ROD and Pilot could not control the aircraft prior to touch down.

**2.2.3 Meteorological services at Airport:** It is pertinent to mention here that the 'observation post' of the meteorological office is located far behind the control tower, at a distance of about one kilometer, in the old Terminal Building. However, additional man power is posted at the new control tower during bad weather situations to provide spot weather observations. On 14<sup>th</sup> August one meteorological official was at new control tower and the other one was at old control tower wherein Met. office is located. All Meteorological observations were made from the active new control tower on 13<sup>th</sup> night/14<sup>th</sup> early morning hours.

**2.2.4 Location of ATC tower:** The control tower reportedly experienced a considerable variation in the "visibility factors" from that of the observations posted by MET officials during the period of occurrence of the incident IX-814, which points towards the 'subjectivity' that exists in visibility observations. For instance, nearest location of the runway edge from control

tower is 182 meters. However, the ATCOS at the tower were reportedly unable to sight the IX-814 aircraft's movement for almost 'two minutes' in this profile due to fog at Airport despite the visibility then being reported as 800mts by the MET officials. The sudden reduction in visibility around the time of incident which may not have been noticed by the Met officer through the tinted glasses at ATC tower.

**2.2.5 The Cross wind component:** The FDR indicates that the cross wind component was shifting from the right to left (169 to 126 degrees) during the period from 00:57:40 UTC to 00:57:56 UTC. In the last 4 seconds before the touchdown of the aircraft there is a change in the wind direction from 145 deg to 126 deg. This induced a cross wind component of about 5 knots which may be negligible.

**2.2.6 Procedures:** The inadequacy of approach preparation is evident with the work load distribution with respect to monitoring of flight instrument during the visual segment of approach was not adequately covered during approach briefing. Had the Co-Pilot monitored the instruments and called out rate of descent, pitch attitude and glide slope deviation promptly the PIC could have taken a decision of go-around immediately. Due to lack of the above the decision taken by the P1 to continue may be one of the contributory factors to the event. CVR readout does not reveal any advisory comment by the Co-Pilot towards the decision to land by the P1 and it appears that the Co-Pilot was also focused on trying to identify the approach lights.

**2.2.7 Sharing of workload in the flight deck :** Normally low visibilities due to fog compromise the quality and reliability of the visual cues on which the pilot-flying relies for vertical guidance; therefore, only the timely and proper integration of flight instrument data into the flight can detect (or) prevent undesired excursions from the correct flight path. The CVR and FDR analysis shows evidence of both crew carrying out the same task of looking out for the runway approach lights. There was no evidence about the monitoring the instruments of the aircraft during this phase hence no corrective action by P1 or go around call was given by P2. The increased ROD during the last few seconds of the approach is indicative of the flight crew attempting to get a visual reference on the runway and during this period both crew did not realize the aircraft pitch attitude, ROD & glide slope deviation. This may be a situation of not adequately sharing the workload and not adhering to the SOP.

**2.2.8 Damage to aircraft and its tyres(Analysis):** There was a puncture in LH horizontal stabilizer inboard lower side leading edge, multiple scratches were found on LH side fuselage and aft of LH wing and #1, #2, #3 & 4 main wheel tyres found with multiple cuts and some portion of tyre were also chipped-off. The above damages clearly confirm the aircraft had initially touched down



on the undershoot area since IX-814 was first arrival aircraft at Mangalore Airport after the runway inspection by AAI officials and no other aircraft landed at airport prior to the routine runway inspection.

**2.2.9 Undershoot Area:** The WMM mixture provided for smooth flushing purpose prior to beginning of Runway 24 threshold has got stones that are embedded upon the mixture. Due to natural factors, this surface is very vulnerable for easy wear and tear leading to loosening of stones which has the potential to turn into a FOD (Foreign Object Damage) when the surface is hit upon, even accidentally by any aircraft. In the present case, the aircraft IX-814 made a hard touch down upon this surface. The aircraft tyre marks commenced approx. 105 ft prior to the threshold and ended at 15 ft beyond threshold. The aircraft tyre marks prior to R/W-24 threshold were coincided with aircraft wheel track distance 5.7 Meters and also in the undershoot area. The initial touchdown of the aircraft in the undershoot area led to dislodging of the stones from the WMM mixture laid on the area before the beginning of the RWY.24. The cause of aircraft's wheel damages, puncture in LH stabilizer and scratches found in fuselage and wing skins are the result of flying loose stones from WMM mixture.

**2.2.10 Non reporting to ATC:** The flight crew did not report the hard landing incident to the ATC, Mangalore even after switched off the aircraft and seeing the damage to aircraft and its wheels during post flight inspection. The Captain could have reported the hard landing incident on R/T so that ATC could be warned of possible debris on the runway threshold. The arrival AME who carried out late post flight inspection also did not report the damages due hard landing to ATC, Mangalore.

**2.2.11 RWY safety team:-** Runway inspection was carried out by a member of Runway Safety Team at approx. two hours after the IX-814 landing. He collected some loose stones in the runway threshold area and also found aircraft tyre markings on the undershoot area. The same was reported to ATC tower after the completion of runway inspection. However, the reason for dislocation of stones from WMM mixture on to the runway threshold and aircraft tyre marks were not analysed by the Runway Safety Team prior to its removal. Also the presence of loose stones in the undershoot area were not perceived as a safety hazard by the Runway Safety Team during the routine runway inspections. The FOD in the form of loose stones on the Runway was not verified by either ATC or by RST member with any other external agency. This clearly shows that the runway inspection team members are not adequately aware about investigating deviations observed from normal situations as in this case the value of material evidence like aircraft tyre marking in the undershoot area and loose stones in such incidents.

### **3. COCLUSIONS:**

#### **3.1 Findings:**

1. The aircraft (VT-AXE) was certified and maintained in accordance with prescribed procedures.
2. The flight crew was certified and qualified to conduct the flight. They had undergone the requisite pre-flight medical examination and they had been certified as not being under the influence of alcohol.
3. The CG of the aircraft was within the prescribed limits.
4. All navigation and approach aids were functional and were operating normally at the time of incident.
5. The commander had a total flying hours of 7104:15 hrs of which 2709:10 hrs were on type. First Officer had a total flying experience of 1067:27 hrs and 850:45 on type.
6. The crew had flown the previous sector from Mangalore to Dubai and the flight was uneventful.
7. There was no evidence of defects or malfunction in the aircraft which could have contributed to the incident.
8. The take off/landing weights and CG of the aircraft were within the prescribed limits. The aircraft takeoff weight was 75,100 Kg against Max 75,760 Kg and landing weight was 65,700 Kg against 66,360 Kg. The aircraft has valid C of A and CRS.
9. The Meteorological records revealed that the visibility is measured manually. The airport is susceptible to frequent weather changes due to its geographical location. The measurement is dependent upon human judgment which may not be accurate and can become a potential safety hazard.
10. Modern instrumented RVR system capable of displaying changing visibility is not available at Mangalore Airport.
11. The aircraft executed an ILS approach on autopilot. Significant deviations from the glide path were observed subsequent to the point of auto pilot disconnect.

12. Flight continued below Decision Height without adequate visual reference to runway threshold lights or runway touchdown zone or PAPI.
13. Flight Crew failed to monitor the instrument references, after the transition to visual references and thereafter(i.e. during the visual segment of an instrument approach).
14. First officer (PNF) was distracted from his duties to monitor flight instrument due Captain's instruction to look out for runway lights.
15. The aircraft has been put into a pitched down attitude by the captain in order to gain better visual reference of the runway/runway lights.
16. Captain seems to be concentrating on gaining visual reference at low altitude and in the process losing focus on high rate of descent, aircraft pitch attitude and flying below glide slope.
17. The FDR/CVR shows that Radio callouts in feet (50, 40, 30, 20) are heard but no actions were observed for landing i.e. flare or thrust reduction.
18. Incorrect landing procedures followed by Commander resulting into an improper landing.
19. The Captain did not receive the appropriate assistance he could expect from First Officer during un-stabilized approach after auto pilot disconnection.
20. The flight crew failed to respond in a proper and timely manner to excessive and deteriorating glide slope deviations and rate of descent by either initiating a go-around or adjusting pitch attitude and thrust to ensure a safe landing procedure.
21. The aircraft first touched down on the right wheel 105 feet short of threshold of the landing runway 24 threshold followed by left wheel touching abruptly on the wet mix macadam part at 49 ft short of runway threshold. While initial touchdown the rate of descent of 1056 ft/min and an N1 of 65.5% with a recorded vertical acceleration of 3.253g (against the limit value of 2.1g) before bouncing and touching down again with 2.007g on runway.
22. The hard landing of the aircraft (3.253g) can be attributed to an abnormal high rate of descent of 1056 feet/min, followed by late initiation of the flare by the Captain at the time of first touchdown.

23. Aircraft wheel touched the undershoot area of runway 24, the loose stones and debris from wet mix macadam part were blown off the ground that appeared to have hit the aircraft's wheels & surfaces.
24. A bounce of about 20 feet resulted due to heavy touchdown/ROD.
25. The Captain had gained visual reference with the runway after the aircraft bounce and an additional thrust was applied to recover from the bounce. The aircraft touched down again on the right wheel and this time the touchdown was on the runway.
26. In the post flight inspection the flight crew observed damage to aircraft and its wheels but made no attempt to inform the ATC in the interest of safety for other aircraft operated at Airport.
27. The flight crew reported only 'suspected hard landing' in aircraft tech log. The aircraft damages were not recorded after post flight inspection.
28. The Flight Crew did not comply with operator SOPs.
29. The Airlines arrival AME was not present at the time of aircraft arrival. The aircraft was received by two aircraft technician. The two technicians are not fully qualified and experienced to handle the situation in the event of any hydraulic leak or fire/smoke during aircraft landing and taxiing at Airport. Not receiving the aircraft by AME is in violation of the Airlines policy where in the aircraft departure/arrival shall be handled only by qualified AME.
30. The arrival AME who carried out late post flight inspection of aircraft did not report to ATC, Mangalore about damage to aircraft due hard landing incident.
31. The runway inspection team members at Mangalore were not adequately aware on the runway surface the deviations observed from normal situations as in this case the value of material evidence like aircraft tyre marking in the undershoot area and loose stones in such incidents.
32. Being a Class III Met Office at Mangalore Airport trend forecasts of weather are not available. Manual RVR reading is made available on request by ATCO.

### **3.2 Probable cause of the Serious Incident:**

The Committee of Inquiry determines that the probable cause of the incident was due to incorrect control inputs on short finals during transition from IMC to VMC and apparent loss of momentary depth perception by the Captain due prevailing foggy and low altitude cloud conditions.

Contributing to the incident were:

1. Not initiating go-around on short finals after autopilot disconnection while flying under marginal weather conditions and inadequate visual reference.
2. Inadequate crew co-ordination/CRM during the final approach for the landing under marginal weather conditions.
3. Captain's failure to scan/monitor and control the aircraft attitude on short finals.
4. Both Pilots fixated on visual cues (especially after minimums/autopilot disconnection) on looking out lights instead of looking in and out, to guard against visual illusions.


### **4. SAFETY RECOMMENDATIONS:**

1. The Air India Charters enhance immediately its crew awareness of hazards of landing under reduced visibility trend IMC to VMC with cross wind and review its crew training on landing under marginal weather and low visibility conditions.
2. Appropriate corrective training as deemed fit should be planned for the Captain and First Officer. The emphasis should be given for operations in marginal weather conditions. The practice approaches with transition from IMC to VMC conditions in cross wind with and without the use of automated approaches.
3. The Air India Charters shall ensure prompt reporting of any abnormality noticed by flight crew/AME during the flight to all concerned authorities/ATC in the interest of safety. In the event of any possibility that any debris or FOD may have resulted from the flight or take off/landing profile of any aircraft, the flight crew must inform ATC by fastest means so that if chance of damage to other aircraft operated at Airport may be prevented by Runway Inspection by Airport Operator under such circumstances.

4. To prevent similar nature of incident and considering the peculiar weather phenomena at Mangalore the reporting procedures for Visibility at Mangalore may be re-assessed as topography leads to localized patches of low clouds/visibility.
5. Meteorological Services at Mangalore Airport may need to be revamped/ rationalized by competent authority.
  - (i) Installation of Transmissometer with Automatic Weather Observation System (AWOS) may be considered at Mangalore Airport so that it will give instant RVR values when visibility drops. Meteorological office may be upgraded to issue TREND forecast round the clock.
6. AAI may consider the installation of runway center line lights in view of the table top operation surrounding topography and frequently changing weather phenomenon.
7. Airport Runway safety team needs to be more active and effective at Mangalore Airport.

  
(S.DURAIRAJ)  
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**Capt. G.P.S. GREWAL,**  
**Member-Operations**

  
**Sh. N.S.DAGAR**  
**Member-Secretary**