

(i)

ACCIDENT TO INDIAN AIRLINES
BOEING 737 AIRCRAFT VT-ECQ ON
APRIL 26, 1993 AT AURANGABAD.

REPORT OF
THE
COURT OF INQUIRY

HON'BLE MR. JUSTICE V.A. MOHTA
JUDGE
HIGH COURT OF JUDICATURE AT BOMBAY

ASSESSORS

1. Mr. S.N. Gupta,
Dy. Director (Air Safety)
Air India, Bombay

2. Capt. V.V. Mahesh,
Dy. Director (Ops) (Retd)
Air India, Bombay

SECRETARY

MR. L.A. Mahalingam,
Controller of Airworthiness,
Civil Aviation Department, Bombay

Bombay,

25th December, 1993.

(ii)

BROAD DETAILS OF THE ACCIDENT

- a. Aircraft : Type : Boeing-737-2A8
Nationality : Indian
Registration : VT-ECQ
Engines : P&W JT8D-9A;(2)
- b. Owner/Operator : Indian Airlines, New Delhi.
- c. Pilot-in-command : Capt. S.N. Singh
First Officer : Capt. Miss Manisha Mohan
Number of Crew : Six
Extent of injuries : 2 Cabin crew died & 1 cabin crew seriously injured.
- d. Number of Passengers : 112
Extent of Injuries : 53 died & 10 seriously injured.
- e. Place of Accident : 3½ kms NE of Runway 09 end of Aurangabad Airport.
Latitude 19° 52'30" N
Longitude 75° 26' 19" E
- f. Nature of Accident : Collision in take off phase with a lorry moving on a road at the end of Runway 09.
- g. Date & Time of Accident. : 26th April, 1993; 1306 IST

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PART-I
INTRODUCTION

This accident was unbelievable.

Boeing 737 aircraft in its take off phase hit a lorry laden with cotten bales moving on a perpendicular public road at a distance of 410 ft from Aurangabad 09 runway end in the hot noon of 26th April,1993.

The utter disbelief of a common man can be illustrated from the following spontaneous counter question that the lorry owner asked the lorry driver when the latter telephonically reported the accident to him "Were you flying?"

55 human lives were lost in the accident. The aircraft was totally damaged. Shri K.Gohain, Director of Air Safety, Bombay Region, was immediately appointed to act as Inspector of Accident under Rule 71 of the Aircraft Rules, 1937 (the Rules). Vide Notification dated 26th May,1993, issued by the Ministry of Civil Aviation, Government of India, (Annexure-A), I was appointed to conduct the formal investigation into the circumstances of the accident under Rule 75 of the Rules. Shri S.N.Gupta, Deputy Director (Air Safety), Air India, Bombay, and Capt.V.V.Mahesh, Deputy Director (Operation)(Retired), Air India, were appointed to act as assessors to assist the Court. Shri L.A.Mahalingam, Controller of Airworthiness, Civil Aviation Department, Bombay, was appointed to function as Secretary to the Court. I was then camping at Nagpur as a Vacation Judge. On 30th May,1993, Shri H.S.Khola, Director General Civil Aviation, accompanied by Shri Gohain and Shri Mahalingam personally came to Nagpur to brief me about the accident and the investigation carried on upto that period. I directed the Inspector of Accident to continue the investigation.

On 8th June, 1993, Shri S.T. Deo, Regional Director of Western Region, IA along with the other Officers of IA, DGCA and NAA met me at Bombay, and requested to visit the accident site. Accordingly, I along with the Assessors, the Secretary of the Court and the Inspector of Accident went to Aurangabad on 10th June, 1993 by a morning flight IC 492. Several other Officers also accompanied us. I visited the cockpit prior to landing at Aurangabad and had an aerial view of the crash site with respect to the airfield location. Immediately, on landing we visited the Airport, Control Tower and the Met Office. In the afternoon, we inspected the site of the accident. Notes and photographs were taken. Visit was completed in the evening. I permitted the wreckagees (which were being guarded by the police) to be removed from the site to their proper location to Delhi/Bombay. There was an urgency to remove the wreckagees because the rains were expected any day. The removal of wreckagees was permitted on the undertaking that the same would be available for inspection/test as and when required. I also granted approval for carrying out strip examination of the engines, wheel assemblies, elevator control surface components etc as proposed by the Inspector of Accident. We found that the view of runway 09 end from the Tower was hazy because the glass was not transparent and this was communicated to the Tower Officer. We returned from Aurangabad to Bombay next day by a morning flight.

I directed the Secretary to issue a Public Notice (Annexure -B) in English as well as vernacular languages in the leading national as well as local daily newspapers inviting any person having knowledge or information about the accident and who desires to make the representation concerning the circumstances or causes of the accident

to do so in the form of an affidavit on or before 5th July,1993. This Public Notice was accordingly published on or about 17th June,1993 in several newspapers from Bombay, Delhi, Calcutta, Madras, Aurangabad, Udaipur, Jaipur etc.

On 13th June 1993, I held a meeting with the Assessors and the Inspector of Accident, and had an informal discussion covering the follow-up action to be taken on certain components required for further investigation, programme of the team at DGCA Office, Delhi, pertaining to CVR and FDR read outs and visit to CTE,Hyderabad, for simulator exercises to be carried out there.

On 19th June,1993, our team visited DGCA Office at safdarjang Airport, New Delhi, where the team was received by Shri Brijesh Kumar, Joint Secretary and CMD of IA and Shri H.S.Khola,DGCA. The representatives of several organisations, like IA, Boeing etc., were also present. Advocate for IA was also present to participate in the CVR/FDR read outs. I expressed an opinion that at that stage legal representative was not necessary,since a copy of CVR/FDR transcript will be made available to everyone and the CVR can be replayed in open Court, if necessary. A letter containing the staff requirement was also handed over to the Joint secretary for speedy action. Some other administrative problems were also discussed with him. CVR read out was carried out several times. After going through the CVR transcript, it was decided that it should be resubmitted with refined words and minor corrections. The transcript for the earlier period of 17 minutes was also directed to be taken. The DGCA officials demonstrated to the team the foil type FDR read out along with calibration charts. We were informed

that the speed and altitude parameters were not found recorded in the FDR foil of the illfated aircraft.

On 20th June, 1993, the team visited the Palam Airport to acquaint with the maintenance set up and engine overhaul facilities for B-737 aircraft and its JT8D-17 engine. Shri H.S.Khola and Shri S.C.Jain, CEM of IA, accompanied the team, which was given a brief introduction on the maintenance programme of Boeing 737 aircraft. Demonstration on various aspects of flight controls, cockpit indications, lights, switches, thrust reverser etc., was given. The team was also shown around the facilities equipped for engine overhaul and maintenance. The jet shop is of latest technology with all facilities for JT8D and V2500 engines. Various engine modules and compressors along with the test bed for testing V2500 engine which is equipped with computerised arrangement with close circuit television facilities were shown and explained to the team.

On 21st June, 1993, the team visited the CTE, Hyderabad. The team was taken around the CTE by the Director Capt.R.P.Burnwal and Engineering Manager Operations Capt.M.V.V.Rao. Shri Khola and Flight Inspector of DGCA Capt M.S.Sharma accompanied the team. The Director of CTE explained the syllabus for initial and recurrent training for B-737 Pilot and Co-pilot. He also explained LOFT for the pilots. The flying records of P1 and P2 handed over to the Secretary. The Instructor Shri B.S.Sidhu explained the various RTOW calculations for Aurangabad Airport in addition to interpretation of various charts covering weight, wind, air speed etc., and compilation of load and trim sheet on B-737 aircraft. A trial compilation of load and trim sheet on B-737 aircraft using a load and trim computer was also demonstrated.

The team visited B-737 training simulator. It is a six axis training simulator of riddiffusion simulation fitted with JT8D-17 engines. Various flight exercises were carried out on the simulator, such as, normal rotation, slow rotation, under rotation, late rotation. These exercises were for various RTOW and different outside temperatures. The simulator was flown by Capt. Henry D'Costa for more than three hours. Prints of the various flights profile were also obtained.

On 22nd June,1993, the team was briefed about Cabin Crew training including initial and recurrent training syllabus. The various operation circulars-mandatory, recommendatory and informative - were shown. The operation of the elevator and horizontal stablizer along with structural attachment with the help of slides were also explained. The video film showing rotation technique and significant importance of V1,VR and V2 speed was also shown. We returned to Bombay on that day in the evening.

On receiving message that fresh read outs were ready, the team visited DGCA Office at New Delhi on 10th & 11th July,1993. The copies of full transcript of CVR were supplied. The detailed FDR data was not completed by that time and hence only limited comparison with reference to CVR read out like heading, vertical acceleration etc. was possible. The full CVR was replayed covering the entire tape. Various groups for conducting different analysis were formed. I informed the Inspector of Accident to include as far as possible all associated group reports in his main report and submit the same before the pre-hearing conference fixed in the Court room on 20th July,1993.

On 12th July 1993, the team visited the maintenance

facilities of IA at Calcutta where the accidental aircraft had last check C-2 inspection. The team was accompanied by Shri Kholia and Capt.J.R.D.Rao, RD of IA. The CEM of Calcutta explained to us the general maintenance activities of Calcutta base. We visited the hanger and also the instrument shop where FDR overhaul facilities and the calibration of B-737 FDR in the FDR Test Rig were explained.

On 19th July 1993, as suggested by the Assessors, I visited Air India facilities at Bombay. In the visit of JT8D Engine Overhaul Shop I inspected the stripped components from the PORT and STABD Engine of the illfated aircraft. Various components conditions and salient features of the strip Investigation report were explained to me. I also visited Air India Air Bus A-310 simulator where various flying profiles were demonstrated.

The first pre-hearing conference of the Court of Inquiry was held in Court Room No.46, II floor, High Court building at Bombay at 11.00 AM on 20th July 1993 as notified. I had earlier issued individual notices to as many as 11 parties who had expressed desire to participate in the inquiry. After hearing parties, I granted request of the following parties for giving them participant status :-

- 1) IA;
- 2) P1;
- 3) P2;
- 4) ICPA, Bombay;
- 5) Common Man's Forum, Bombay;
- 6) P & W;
- 7) Boeing Company, Seattle USA;
- 8) DGCA, Delhi.

None for NAA was present. Since its participation in the Inquiry was essential, I ordered it to be added as party. None for AIAEA & ARO & FOOA were present though they had requested for participant status.

On that day the Inspector of Accident submitted a report dated 18th July 1993 in two parts. Its copies were ordered to be supplied to all the parties. Parties were directed to file their detailed statements along with (a) the affidavits; (b) the documents on which they want to rely; and (c) the list and the detailed addresses of the witnesses they want to examine. It was decided by consent that the evidence of the witnesses in the first instance shall be given by filing the affidavits which will be considered as the examination-in-chief. I directed the parties to exchange copies on or before 17th August, 1993 and as suggested by all fixed the 2nd pre-hearing conference on 24th August, 1993. Similarly, by consent of parties, 27th August, 1993 was fixed as the date for commencing open public inquiry.

After the proceedings were over and parties dispersed, Shri K. V. Vishwanath, Member of the Committee of AIAEA and Shri Satyanarayan Pande, Jt. Secretary of ARO & FOOA approached me in the chamber renewing their request for grant of participant status. I called upon them to remain present in the Court on 24th August, 1993.

Vide communication dated 13th July 1993, the CTE, Hyderabad, categorically informed the Inspector of Accident that the quantitative data and analysis cannot be given by the simulation exercises carried out there on 21st June, 1993 as the simulator was only for the use

of pilot training and was equipped with JT8D-17 engines which are at variance with the engines fitted for the accidental aircraft. As noticed earlier, altitude and speed traces were not available on FDR foil and hence aircraft profile during take off with values of speed, height etc could not be estimated. The aircraft had prima facie failed to attain the prescribed height at the appropriate distance after lift off. For these reasons the Assessors as well as Inspector of Accident opined that simulation of the aircraft performance with various deviation of loads, rotation techniques in an engineering based performance computer or any other simulator having capacity to give output in an exact quantitative manner, was quite essential. On inquiry it was learnt that the Boeing Co. Seattle (USA) being the designer and the manufacturer of the type aircraft has the engineering simulator fitted with engine type on the accidental aircraft (JT8D-9A). Government of India and DGCA requested the Boeing Co. to assist the Court of Inquiry by providing the simulation exercises on simulator with a view to understand the scenario of the subject accident. Boeing Co. through its director Air Safety Investigation and Flight Test Mr John W. Purvis showed willingness and drew up a programme from 3rd August to 5th August, 1993. Diplomatic passport for me could not be prepared in time. Since I showed reluctance to travel without it, the programme was postponed by a week. The Court along with the Inspector of Accident went to Seattle where simulation exercises interspread with discussions were carried out on 10th, 11th and 12th August, 1993. Boeing Safety Investigation was represented by Mr. J. Dennis Rodrigues. Other experts who associated with the exercises and discussions were Mr. James W. Kerrigan, Principal Engineer Stability and Control and Aerodynamics and Mr Peteris A. Galins Lead

Engineer Performance Group. Capt. John H. Armstrong, Chief Pilot Air Safety flew the simulator. Evidence available from the CVR tape transcript, statements recorded by the Inspector, data regarding the Aerodrome, the road on which the truck was operating and various weather conditions and various loads on the aircraft were discussed. Exercises were carried out on various combinations of loads, aircraft speeds, environmental conditions, pilot actions/reactions, rotation techniques etc.

Study of "human factor" in the accident was involved. It was earlier suggested by the Inspector of Accident and the Assessors that as was done before, expert advice on the subject from the AMES Research Centre NASA, Moffett Field, San Francisco (USA) should be taken. Government of India contacted the AMES Centre through USA Government. The AMES Centre had agreed to tender the required advice and accordingly visit to the Centre was also fixed along with visit to Seattle. With the help of the Assessors, certain broad questions were formulated. Visit to the centre was finalized on 13th, 16th and 17th August, 1993 - 14th and 15th August being weekends - in consultation with Dr. Irving Statler, the Chief of Aero Space Human Factors Research Division. Accordingly we visited the Centre where we were received by Dr. Key Dismukes, the Chief Scientist. We had useful conferences with Dr. Statler, Dr. Dismukes and other experts like Dr. Barbara G. Kanki, Research Psychologist (Crew Factors Group), Mr. Linda Connell, research Psychologist. Team returned to India on 20th August, 1993.

Second pre-hearing conference was held as scheduled on 24th August, 1993 when the NAA appeared. Shri Satyanarayan Pandey, Jt. secretary of ARO&FOOA also

was present. The Inspector of Accident filed a supplementary report dated 23rd August, 1993 on simulation exercises, carried out at Seattle. Its copies were given to the parties. All parties were permitted to inspect the documents in the office. Parties expressed a desire for playing CVR tapes in the open Court on the next day. At the request of the parties, time to file rebuttal statements was extended upto 30th August, 1993. In this conference the MIA, Aurangabad appeared and requested for participant status. The said request was granted.

On 25th August, 1993 the CVR tapes were played in the open Court. After considering all suggestions, the points for determination in the inquiry were formulated.

On 30th August, 1993, the third sitting of the Court was held. Parties requested for extension of time to file rebuttal statements and affidavits upto 6th September, 1993. The said request was granted. The tentative list of witnesses to be examined, the order of their examination and the cross-examination were finalized. At the common suggestion of all the parties, 13th September, 1993 was fixed for recording of evidence. A tentative weekly calendar of the witnesses was prepared in advance.

Recording of oral evidence commenced on 13th September, 1993 and was completed on 8th November, 1993 in four sessions, with gaps in between as desired by the parties. First Session was held from 13th September to 24th September, Second Session from 4th October to 7th October, Third Session from 18th October to 29th October and Fourth Session from 3rd November to 8th November 1993. In all 29 days were

consumed in the process of recording evidence. This included even Saturdays. Sometimes evidence was recorded even after working hours. Total 28 witnesses as per List Annexure-C were examined. In all 146 documents as per List Annexure-D were exhibited in the Inquiry.

On 30th November, 1993 most of the parties filed written submissions and the inquiry was adjourned to 6th December for oral submissions.

On 2nd December, 1993 our team visited the Civil Aviation Training College at Allahabad to have first hand information on the training imparted by the College to NAA personnel accompanied by AVM H.M. Shahul, Member Operations. Mr. Shahul and Principal Mr. Raghavendra Rao explained to the team various features of training aids provided for ATC personnel covering ab initio training, eligibility training and advance training. UNDP project which is under implementation was also explained.

Oral arguments were heard from 6th December to 10th December, 1993.

The participants were represented by lawyers as under:-

Mr. S. J. Vazifdar with Ms. H. Barman and
Mr. Jai Munim, i/b Bachubhai Munim & Co.
for Common Man's Forum.

Mr. K. R. Bulchandani with Mr. D. D. Bodhanwalla,
i/b Kamal & Co. Advocates,
for M I A.

Mr. D. D. Udeshi with Mr. Bruce D. Campbell,
i/b M/s. Crawford Bayley & Co.,
for Boeing.

Mr.R.S.Puri and Mr.Punit K.Bhalla,
Advocates, i/b DAU & Associates,
for P & W.

Mr.V.C.Kotwal & Mr K.R.Parekh,Advocates,
for I C P A.

Mr.N.A.K.Sarma,Advocate,
for N A A.

Mr.R.T.Walawalkar,Ms.A.M.Desai,Advocates,
for Pl.

Mr.Alok Mahajan,Advocate i/b
Messrs. Mahajan & Associates, Solicitors
and Advocates,
for P2.

Mr.Aspi Chinoy, Mr.Lalit Bhasin, Miss Neena
Gupta,Advocates,i/b Messers Bhasin & Co.,
for I A.

ARO & FOOA was neither represented by any one
nor it participated in the Inquiry.

Under Rule 75(2) of the Rules which are framed by the Central Government in exercise of powers conferred by Section 5 and 8(2) of the Aircraft Act 1934, such formal investigation/inquiry is to be held in open Court in such manner and under such conditions as the Court may think most effectual for ascertaining the causes and circumstances of the accident. Though the Court has been endowed by Rule 75(3) of the Rules with all powers of the Civil Court under the C.P.Code, neither that Code nor Evidence Act strictly apply to the Inquiry. Court can thus obtain the required information and collect evidence from all sources and through all possible channels without being fettered by

the rules of procedure and evidence. Part IV Chapter 4 of ICAO Manual of Aircraft Accident Investigation gives guidance for evaluating the evidence. The basic approach to be adopted is that of a domestic tribunal exercising quasi judicial functions. The main care to be taken is to see that the basic principles of neutral justice are not violated and a person or party against whom any information or material is used, is given fair chance to explain it. As per Rule 75(6) of the Rules, the Court is to report to the Central Government not only its findings as to the causes and circumstances of the Accident, but also to make observations and recommendations for the cancellation, suspension or endorsement of any licence or certificate issued under the Rules.

All the above approaches, objects, factors and principles have been kept in view in this Inquiry.

PART-II

A. FACTUAL INFORMATION

A.1 HISTORY OF THE FLIGHT :

At about 1306 IST on Monday, the 26th April, 1993, IA scheduled flight (IC-491) crashed no sooner it took off from Aurangabad Airport. It was Boeing 737, aircraft VT-ECQ. This hopping flight originated at Palam Airport, New Delhi with last destination Santacruz Airport, Bombay. Intermediate stops were Jaipur, Udaipur, and Aurangabad.

Commander of the flight was Capt. S.N. Singh. The First Officer was Capt. Manisha Mohan. Total number of cabin crew was four - two Airhostesses and two flight pursers. Considering the total number of flight hours, no change of crew was involved. IC 491 departed Palam on schedule and landed at Aurangabad Airport at 1230 about 30 minutes late. While landing at Aurangabad it carried 79 passengers, out of which 18 passengers were bound for Aurangabad. Aircraft was refuelled, baggages, freight were loaded and 51 passengers boarded at Aurangabad, thus raising the total number of passengers to 112 at the time of take off from Aurangabad.

ATC Aurangabad suggested runway 27 for take off. But at the instance of the Commander, ATC gave clearance for using runway 09. The aircraft taxied from apron, upon entering the runway turned right backtracked towards the beginning of the runway and commenced a rolling take off after turning at the dumbell.

Aircraft lifted up almost at the end of 6000 ft runway and impacted heavily with a lorry carrying pressed cotton bales running from North to South on a high way known as Beed Road located perpendicularly outside the Airport boundary wall at a distance of 410 ft from the end of runway. The aircraft left main landing gear, left engine bottom cowling and thrust reverser, the APU shroud drain mast impacted the left side of the truck at the height of nearly seven feet from the level of the road. After the impact, the aircraft continued on its flight path, with the left landing gear liberated, followed by liberation of the left engine thrust reverser, portion of the left horizontal stabiliser leading edge and portion of the left elevator surface. The liberated parts were strewn on open area to the East of the road. The cotton bales were opened by the impact and loose cotton was spread on and around the road.

The aircraft continued the flight in the left turn and went through the high tension electric wires running East-West at about 35 ft above the ground level at a distance of nearly 3 kms North-East of the runway. It crashed into the ground. From the first point of impact in the open field, the ground marks were towards North-East. The final rest position was about $\frac{1}{2}$ kms from the wires. The aircraft fuselage had split and separated into two pieces at aft of the wing trailing edge location. The cabin sections in both portions caught fire. 53 passengers, 2 members of the cabin crew were fatally injured. 11 passengers received serious injuries. The Commander, the First Officer and two cabin crew members who were in the first section of the cabin, and 59 passengers were the lucky survivors.

The senior fire foreman in the watch tower saw the aircraft getting airborne near the runway end and impacting the moving truck on the road with its undercarriage. On noticing the falling landing gears and the left direction of the aircraft, the senior fire foreman apprehended danger and without loss of time ordered turn out in the Fire Station. One CFT and one jeep which had started initially, saw smoke coming out from the field on the left and hence they proceeded in that direction through the rough fields. The duty ATC tower officer saw the aircraft after getting airborne gaining some height turning left and then losing height. He switched on the siren. He received the "May-day" call from the aircraft by that time. He saw smoke and alerted airport firemen transmitting crash in North-East direction at about 7 kms. He also received a R/T call "It has crashed".

One ambulance coming to Aurangabad from Nanded had also proceeded towards the scene. The occupants of the ambulance first noticed the smoke and then the split portion of the crashed aircraft on the field. They also saw dead passengers lying in the open area between the two portions. Some of the passengers had already come out of the wreckage from the left front cabin entry door and some by jumping out from the breakway fuselage portion. The right side of the emergency window could not be opened. One passenger at the rear could come out from the rear left door after opening and jumping through it. The cabin crew at the rear received fatal injuries due to fire. The flight crew came out of the aircraft through the cockpit sliding window.

Survivors assembled under a tree. Some of injured were taken in an ambulance to the hospital.

Upon receiving information from the ATC Tower, the City Police moved its men and machinery towards the site. IA staff at the airport mobilised the available IA bus and the staff and moved towards the direction of the site. The NAA officials from the airport equipped with walkie-talkie for maintaining two way communication with tower, also proceeded to the site. By the time, the ambulance started shifting the injured passengers towards the main road, other vehicles arrived. The safety vehicles got engaged to douse the fire. The other vehicles were utilised for removing the injured to hospital. The Municipal Corporation, fire fighting services, fire fighting vehicles also arrived and supplemented the fire fighting and rescue efforts. The safety personnel went into the wreckage after dousing the fire flames.

The accident occurred in the forenoon when the sun was brightest on that hot day. The main wreckage was strewn in plot no.361 having geographical location as :Latitude 19° 52' 30" and Longitude 75° 26' 19"; average elevation of 1900 ft AMSL and at an aerial distance of 3.½ kms from the end of runway 09.

A.2 INJURIES TO PERSONS :

Injury	Index	Crew	Passengers	Others
Fatal		2	53	nil
Serious		1	10	nil
Minor		2	06	nil
None		1	43	-

One injured passenger Shri Gupta died in the hospital

on 22nd May,1993.

A.3 DAMAGE TO AIRCRAFT:

The aircraft was fully destroyed partly by impact and mostly by post impact fire.

A.4 OTHER DAMAGE :

A.4.1 Truck:

M/s Billing Roadways' Truck No. HR 29A 8295 carrying 36 pressed cotton bales filled upto cabin height of the truck going to Panipat from Coimbatore received damage to its left side body on its metallic sheet 2 vertical iron members were got uprooted and folded inwards. The right side body of the truck was also damaged and bent in outward direction.

A.4.2 High Tension Wires :

The three electric high tension wires belonging to MSEB,Aurangabad-Jalna feeder line usually carrying 33 KV,but fortunately having no power supply at that time, got snapped.

A.5 PERSONAL INFORMATION :

A.5.1 Name of Commander :

Capt.S.N.Singh,

Date of birth : 25th March,1955.

ALTP No.1266 issued on 29th September,1978,was valid upto 15th October,1993. He was advised to wear corrective lenses while exercising privileges of the licence. Last medical on 8th April,1993.

Total experience (as on 31st March,1993)
4963.50 Hrs., B-737 experience 1720.15 hrs.
PIC experience on B 737 is 140.35 hrs.

Commander obtained the B-737 type endorsement on his licence on 17th April,1986,and was found fit to fly B-737 aircraft as Co-pilot. He had earlier undergone B-737 Technical Conversion Course, B-737 simulator training by day and night at the CTE,Hyderabad, followed by flying checks on the aeroplane by day and night. In these checks, his proficiency was adjudged as Standard by the Instructor Pilot and Examiner.

He commenced command training on B-737 on 11th June,1989. this training was, however, discontinued on 16th June,1989, at his own request. During the above training, the Instructor pilot at the end of the 4th Session on the CTE's Simulator had recorded some adverse observations on his proficiency on 16th June,1989.

When appeared for his ALTP licence renewal medical examination at Institute of Aviation Medicine, Bangalore, on 13th September,1989, he was declared temporarily medically unfit for two weeks due to ECG abnormality, TMT & Echocardiograph. Thereafter, on 16th October,1989, he was investigated upon by the Classified Specialist on Aviation Medicine and Cardiologist who considered him to have no cardio-vascular disability and was certified fit both medically and surgically. His ALTP licence had a limitation from September,1978 which requires him to use corrective lenses while exercising the privileges of his licence.

Subsequently, on 10th November, 1989, he satisfactorily completed the B-737 Technical Refresher & IR/LR Simulator training and check at CTE, Hyderabad and was found fit. He was found fit for PIC training on 27th February, 1990 by the check pilot who had overall assessed him as standard. He was again taken up for B-737 PIC training by the IA on 2nd April, 1991, and he completed satisfactorily the training and check on Simulator and flying checks by day on the aircraft at CTE, Hyderabad. He also completed the flying checks by night on the aircraft on 17th July, 1991 with a different DGCA approved examiner who also assessed him as standard. He was thereafter taken up for LOFT, wherein after completion of 14 flights he was put through additional LOFTS to reach the required standard. On 23rd October, 1991, he failed to pass the B-737 performance refresher test and was, therefore, stopped for being rostered for route flying. He was made to undergo the B-737 performance course on 9th December, 1991. In his PIC Route Check (day and night), reports of 1st December, 1991 and 2nd December 1991 respectively, the check pilots certified him to be "FIT to fly as Pl-Std." However, on the subsequent PIC Route Check (day) report of 4th December, 1991, another check-pilot assessed his inflight performance as below standard with knowledge of performance, planning, crew briefing as poor. CTE, Hyderabad recommenced his 10 PIC route checks and Dir. of Operations IA advised CTE, Hyderabad, to arrange the 9th and 10th PIC route checks with Examiners Capts. H.F. Mistry and L. Lingam. However, since Capt. Mistry was not available, the said route check was required to be done either by Capt R.C. Moulay or Capt. R.L. Kapur. In all the 10 routes check reports

including those of Capt.Lingam and Capt.Moulay, the assessment of Capt.S.N.Singh has been made as standard and fit to fly as PIC. Capt Singh was granted B-737 type PIC endorsement by DGCA Office on the 16th January,1992. Thereafter, he was again sent to Hyderabad CTE for undergoing B-737 Technical Refresher/LR check prior to renewal of his licence. He completed LR check on B-737 simulator and B-737 technical refresher in July,1992 satisfactorily. Thereafter,he was route checked as a Commander by Check pilot Capt I.David on 9th October,1992 and was cleared to fly as Pilot in Command on B-737 aircraft. His last simulator IR/LR refresher as Pl on B-737 aircraft was carried out at CTE on 29th October,1992 by Capt.R.P.Burnwal who had assessed him "Fit".

He was not earlier involved in any aircraft accident. Preceding the date of accident, he had flown for 07:40 Hrs in the last 7 days period and 57.00 hrs. in the last one month period.

A.5.2. Name of First Officer :

Capt (Miss)Manisha Mohan,
Date of Birth : 26th December,1962
SCPL No.946 valid upto 18th May,1993.
Last medical on 21st April,1993.
Total flying experience 1172.48 hrs.
First Officer experience on B-737
921 hrs.(as on 31st March,1993.

She joined CTE,Hyderabad, on 10th October,1988,and was then holding CPL No.1824. She underwent technical endorsement course on B-737 aircraft from 24th October,1988 to 4th December,1988.

During the course, she had to undergo one retest for

flight/navigation/instrument and another retest for consolidated system. After the course, she appeared for DGCA special technical examination for issue/endorsement of ALTP wherein she failed in the technical paper, but passed in the performance paper. In the subsequent examination held on 15th/16th February, 1989, conducted by the DGCA, she passed the technical examination. She underwent training at CTE, under Instructor Capt S.K.Rao from 13th April 1989 to 11th May 1989 and her performance was rated standard. Thereafter, she was taken up for simulator training from 12th May, 1989 to 30th May 1989. She had undergone flying checks on B-737 simulator on 31st May, 1989 for the purpose of type endorsement under examiner Capt L.Machanda. Her proficiency was rated as standard. She was subjected to flying test by day and night by examiner pilot and LR/IR check by examiner pilots on 26th September, 1989 where her overall assessment was rated as standard and fit for P2 endorsement on B-737 aircraft by both the examiners. Her licence CPL 1824 was endorsed with B-737 type on 6th October, 1989.

After completing training at CTE, Hyderabad and release as First Officer on 2nd November, 1989 on B-737 aircraft, she was posted to Delhi on 24th December, 1989. DGCA while endorsing type aircraft on her licence and in view of the entries in her training progress report at CTE from 25th July 1989 to 17th September, 1989 advised IA on 12th October, 1989 that her next IR/LR/RC should be carried out with an examiner and her performance to be monitored with regard to speed control approach profile and height profile appreciation. IA had subjected her to route check fortnightly for the next six months and the

Check/Instructor/Examiner pilot were advised to lay special emphasis on the above aspects. An examiner carried out her licence renewal check on 16th March,1990 on B-737 six axis simulator and was also checked on the above points. Her performance was assessed as standard.

After having passed all the papers of the SCPL examination, she was checked on the simulator as well as on the aircraft for issue on SCPL and her performance was found standard fit for issue SCPL by both approved examiners and was issued with SCPL No.946 by the DGCA. Her last IR check was carried on 12th August,1992 by Capt. Burnwal on 26th February,1993. She had also completed satisfactorily the A.320 performance/technical course from 14th September,1992 to 23rd October,1992 at CTE,Hyderabad.

She was not involved in any aircraft accident earlier. Preceding the accident she had flown for 09.35 hrs in the last 7 days period and 28.05 hrs in the last one month period.

A.5.3. Cabin Crew Details :

Mr.Nim,Staff No.200107,Date of Birth 7th September,1959, joined IA on 23rd August,1980 and promoted to Inflight Supervisor on 7th November,1989. He had undergone the last refresher course on 17th December,1992. On the accident flight, his duty station was in t he front galley.

Ms.Anita Dabas,Staff No.243051,Date of Birth 11th December,1965, joined IA on 9th February,1987 and had undergone the last refresher course on 28th September,1992. On the accident flight, her duty

station was in the front galley.

Ms.L.Raman Yadav, Staff No.217115, Date of Birth 19th January,1962 joined IA on 20th May,1985 and had undergone the last refresher course on 2nd November,1992. On the accident flight, she was positioned at the rear galley. She received fatal injuries.

Mr.Vivek,Staff No.209449, Date of Birth 3rd January,1962 joined IA on 7th October,1982 and had received promotion as Inflight Supervisor on 30th June,1991. He had undergone the last refresher course on 10th December,1992. On the accident flight, he was positioned at the rear. He received fatal injuries.

A.5.4 Crew Rostering & Familiarity with Route :

P1 & P2 were paired to fly together for the first time only to operate the accidental flight.

During the last 6 months preceding the date of accident, Capt.S.N.Singh had flown to/from Aurangabad on four occasions viz. IC 491 of 4th March,1993,23rd March,1993; 31st March,1993; and 21st April,1993.

The Co-pilot during the above 6 months period had flown to/from Aurangabad on three occasions viz. of 20th November,1992; 28th February,1993; and 28th March,1993.

A.6 AIRCRAFT INFORMATION

It was a short medium range Boeing 737-200 VT-ECQ Aircraft with sitting capacity of 126 passengers, manufactured by M/s.Boeing Co.,Seattle, (USA), equipped with two wing pod mounted turbofan engines (P&W JT8D-9A).

Aircraft received registration Certificate No.2096 by the Civil Aviation Department on 18th July,1974. It was issued Airworthiness Certificate No.1642 under normal category on 26th September,1974 which was last validated upto 18th April,1994. It bore Manufacturer Serial No.20961 and it arrived in India on 2nd October,1974.

The aircraft had done 43887 hrs and 50554 cycles till the time of accident. It was subjected to Check C-2 Inspection at IA base, Calcutta, from 18th February till 23rd February,1993 at 43634.45 hrs/50233 cycles. Thereafter the first Flight Release Certificate was issued which was valid upto 44134 hrs/3rd May,1993, whichever is earlier. There was no carried forward snag on the aircraft on the date of accident.

The aircraft had two engines. LH engine type P&W JT8D-9A (Sr.No.P-687725) had done total 30471.45 hrs/34238 cycles and had done 4062.50 hrs/5154 cycles since last overhaul and 368 hrs/445 cycles since last HSI Inspection on 10th November,1992. After this inspection, the engine was installed on the left position of the aircraft.

The RH engine type P&W JT8D-9A, (Sr.No.P-674483) had done total 31076 hrs/47984 cycles and 10621 hrs/13414 cycles since last overhaul. The last HSI inspection was done at 6773 hrs/8938 cycles and it had done 3848 hrs/4476 cycles thereafter. The engine was installed on the right side of the aircraft and thereafter it had done 785.55 hrs/951 cycles since then.

Empty weight of the aircraft including the fixed equipment is 25239 Kgs; the operating empty weight

is 27532 Kgs; the maximum total weight authorised at brake release is 49442 Kgs; and the maximum commercial load authorised with fuel and oil tanksfull is 8910 Kgs. At the operating empty weight 27532 Kgs; the CG position is 1686.0 cms aft of the datum or 28.3% MAC. The maximum zero fuel weight of this aircraft is 39916 Kgs. CG limits for this aircraft is from 12% to 25% MAC.

A.7 METEOROLOGICAL INFORMATION :

The ATC records the aircraft actual time departure 1305 IST (0735 UTC). Prior to the departure, the following Metars were issued by the Aurangabad Meteorological Office and conveyed to the Aurangabad ATC:

0730 UTC Winds 180/06 kts; Vis 8Kms; Clouds
2/82500 ft.(750m)

Temp.39,DP 17,QNH 1011 HPa (29.88in).

0700 UTC Winds 149/07 kts; Vis 8 Kms; Clouds 4/8
2500 ft (750m)

Temp 38,DP 17,QNH 1012 HPa (29.90 in)

0630 UTC Winds 210/05 kts; Vis 8 kms; Clouds 4/8
2500 ft(750m)

Temp.38,DP 17,QNH 1012 HPa (29.90in).

After the accident the Met Office had taken readings at time 0750 UTC with the following observations recorded in their Current Weather Register :

0750 UTC: Winds 260/06 kts;

Vis 10 Kms; Clouds 2/8 2500 ft;

Temp.38.8,DP 16.6, QNH 1011.4 HPa (29.87in)

The ATC tape transcript reveals that while giving take off clearance to the aircraft, the ATC passed the winds as 180/05 kts, and that start up was given about 6 min.45 sec prior to the aircraft reported "Rolling". Its actual departure as recorded by Tower was 0735 UTC. Therefore at the start up the 0700 UTC Metar was available at Tower for transmission to aircraft on ground.

The Hygrograph Chart No.53/59 was set at 0846 hrs on the date of accident by the Meteorological Deptt. at Aurangabad and removed at 2002 hrs. The said chart reveals that prior to the accident the humidity was 30% at 1200 hrs as well as 1230 hrs. The value decreased to 29% at 1300 hrs and was on decreasing trend till 1800 hrs to 26%. Between 1200 hrs and 1800 hrs there was no abrupt and significant change in the humidity values. The rainfall chart No.919/70 set at 0848 hrs on the date of accident and removed at 2003 hrs on that date indicates nil mm of rainfall. Also the temperature chart no.135/60 set at 0846 hrs and removed at 2002 hrs on the date of accident reveals temperature of 38°C at 1200 hrs and 1230 hrs, 38.5°C at 1300 hrs and at 1330 hrs. The highest temperature recorded is 40.3°C at 1410 hrs on that date. This chart reveals that there had been a gradual increase in the temperature from the time the chart was set in the morning. At the time of the accident, there had been no abrupt and significant changes in the temperature values. The atmospheric pressure chart (Microbarograph No.Fuiez 131) set at 0840 hrs and removed at 2000 hrs on the date of accident indicates that at 1200 hrs the pressure was 944.8 HPa; 1230 hrs was 944.4 HPa; 1300 hrs was 943.8 and 1330 hrs was 943.3 HPa. The pressure chart trace as recorded for values over the airfield does not indicate any abrupt and

significant changes in the atmospheric pressure values over the airfield at the time of accident. The trend is gradual decrease to 940.5 HPa at 1705 hrs.

The DIWE record which gives values of wind direction and speed in a graphical manner reveals that from 1200 hrs till 1330 hrs the winds were variable both in speed and direction and the winds prevalent were shifting from the North-Easterly to South-Easterly direction. At around 1300 hrs the winds as traced on the graph were about 140/06 kts giving a headwind component for runway 09.

A.8 AIDS TO NAVIGATION :

The accidental flight was conducted under visual references. No navigational aids were involved. However, there were no reported difficulties with the aids.

A.9 COMMUNICATION:

There were no reported difficulties in communications between the ATC and the aircraft.

A.10 AERODROME INFORMATION:

Aurangabad Airport has only one runway at orientation 09/27 (exact 087°/267°). Its length is 6000 ft x 150 ft. It has coordinates 19°51'49" N & 75°23'55" N. The runway strength is 40 LCN and has an elevation of 1907 ft amsl. The TORA and ASDA for runway 09 is 6000 ft and TODA IS 6360 ft. The elevation of the runway at 09 beginning is 581.61 meters (1908 ft) and has a downward slope towards runway 27 beginning which is 573.5m (1880 ft). The average slope percentage is-0.4.

There is brick boundary wall of average 3 ft height on the East adjacent to which is North-South public road known as Beed road. From 1975 to 1985/86 gates in the form of barriers were provided on that road inline with the extremities of the airport. These gates were closed during aircraft movements. These gates were however not in existence since 1986 and upto the date of accident. Subsequent to the accident, NAA in association with the local police and administration got the barriers reerected, with police on duty for regulating the traffic and aerodrome watch and ward staff to coordinate between the Tower and the traffic police at the time of aircraft movement.

At Aurangabad, which is a domestic airport, there were no Fixed Distance Markers installed on the date of accident. However, subsequent to the accident they were installed by NAA at every 1000 ft interval.

A.11 FLIGHT RECORDERS :

B-737 aircraft VT-ECQ was fitted with a Fairchild CVR Model A100 (S/N 6316) and Fairchild FDR Model No.109D (S/N 577). Both the above units were retrieved from the wreckage and taken to the DGCA laboratory at Delhi for preparing read outs.

A.11.1 Cockpit Voice Recorder :

The CVR unit was examined by a Group constituted by DGCA for preparing the transcript. The CVR unit was structurally intact and was exposed to post impact fire. Test switches were burnt extensively. Upon stripping of

the unit, it was found that the stainless steel body had smoke signatures. The electronic cards were extensively burnt including the cable harness. The internal recording mechanism including the tape and reel assembly were in sound condition. Full transcript of CVR is given as Annexure-F.

A.11.2 Flight Data Recorder :

The FDR which is of a foil type has the flight data embossed on the foil by means of scribes. The unit was examined at DGCA laboratory (Technical Centre), on 27th April, 1993 and it was found structurally integral and exposed to extensive fire. The backcover with plug assembly was missing and the electronic assembly unit containing power supply and cards were extensively damaged. After the working mechanism was taken out it was observed that the cassette assembly containing the foil was exposed to heat and the portion of the foil exposed outside the cassette window had a powdery deposit due to exposure of the foil to heat. It was also observed that the air speed stylus and the altitude stylus had disengaged from the capsule mechanism and were freely moving up and down. Under normal conditions the altitude stylus remains in the lower portion and the air speed stylus remains in the upper side of the foil in contact with the foil surface. The heading and vertical acceleration marks were available on the foil surface. The salient observations as given by the Group constituted by DGCA from the FDR foil are as follows:

- i) The Air Speed and Altitude tracing were missing from beginning of the foil.
- ii) Both the Air Speed and Altitude stylus had disengaged after last foil change as such no tracing was available on these two parameters for previous flights also.

- iii) The heading, vertical acceleration, and time traces were available on the foil.
- iv) The aircraft after entering the runway proceeded west heading, i.e. towards runway 27 end and after turning from the left side aligned on heading for take off from 09 runway.
- v) The estimated aircraft lift off is from the 'G' trace at about 7 seconds prior to the first impact experienced by the aircraft.
- vi) From the aircraft transmission of "...Rolling..." to the transmission "Rotate" is 35 seconds and the lift off is estimated at 4 seconds after "Rotate" transmission.

A correlation chart of the FDR trace and the CVR recordings pertaining to the accident portion of the flight is Annexure-G.

A.12 WRECKAGE AND IMPACT INVESTIGATION :

A.12.1 General :

The aircraft soon after lift off hit the truck loaded with cotton bales moving on the Beed road just outside the airport boundary wall. The truck was moving from South to North on the road, i.e. from right to left in relation to the path of the taking off aircraft. The centre line of the Beed road is 410 ft ahead of the runway 09 end.

On impact with truck, the marks of the aircraft left main wheels got imprinted on the left side wall of the truck at a height of 7 ft from the road level. The outboard tyre mark was 6'4" aft of the truck cabin. The

total height of the truck super structure was 11 ft from the road level and the cotton bales were laden upto nearly the same height. The two vertical angle iron members supporting the side wall were folded inward, i.e. in the direction of the aircraft flight path. The right side of the truck body wall upto the rear most location was found bent outwards by about 60". Cotton from the bales was found strewn on the other side of the road heavily spread over an area of 80' x 120' with six cotton bales remaining intact. The truck in its final stop position had moved ahead on the road from the strewn cotton location.

The aircraft left engine rear bottom just forward of the thrust reverser cowl and the APU shroud drain mast on the left side of the fuselage aft of the trailing edge flaps contacted the truck body wooden super structure and iron members at the top. The left engine thrust reverser with its fittings including the cowl and the APU shroud drain mast got liberated. A piece of "U" shape iron fitting of the truck body for affixing the top horizontal wooden beam of the truck was retrieved entangled with the thrust reverser cowl. The drain mast shroud had evidence of sharp and stright contact damage on its outward face in the fore and aft direction. The left engine thrust reverser deflector doors did not have evidence of impact damage on their outer surfaces. The thrust reverser tail pipe section had a sharp bent inwards in the longitudinal axis at its bottom. The APU shroud drain mast was retrieved close to the boundary wall on the road side. A portion of the thrust reverser of the left engine was at 630 ft from the runway end towards the right of the centerline and the thrust reverser lock actuator mechanism was at 1080' from the runway end to the left of the centreline. The thrust reverser cowling was located

at 810' from the runway end on the left of the centerline and to the left of the main wheel position. The thrust reverser tail pipe flange was at 850' from the end on extended runway centreline and the thrust reverser fairing was at 815' from the runway end adjacent to the tail pipe flange location.

The left main gear after impact of the wheels with the truck body side wall get liberated at its hinged trunion on the wing spar together with its actuator and the walking beam. The landing gear portion retaining the wheels and the inner tube of the shock strut bounced on the ground and snatched barbed wires from fencing across the road and these wires entangled with the wheel bogie. Both the main wheel tyres were found deflated with extensive damage. This part is located 810' from the runway end in the fields across the road to the left of the extended centreline. The port landing gear actuator assembly was found at 1070' from the runway end to the left of the extended centerline.

The liberation in flight of heavy mass from the port landing gear and the port engine thrust reverser assembly with the aircraft nose up attitude resulted in these heavy liberated masses contacting the port side horizontal stablizer and the elevator hinged to the stabilizer at its rear end. The outer portion of the horizontal stabilizer from the port side of the aircraft, measuring 98" spanwise was located at 600' from the runway end on the right side of the extended centerline and the outer portion of the port side elevator measuring 115" spanwise was located at 875' from the runway end on the left of the extended certerline. The leading edge of the horizontal stabilizer measuring 55" length from the torn edge was severely crumbled and jagged with black

deposits on it. The upper and lower skin exhibited clean tear in the fore and aft direction. The above damage on the tail side, indicate chordwise tear of the horizontal stabilizer continuing upto the port elevator as a result of impact with heavy mass at the leading edge of horizontal stablizer.

The above liberated parts were localised within an area of 500' x 260' in the field East of Beed road in line with direction of flight.

After losing the above parts, the aircraft still remaining, in flight impacted a set of three overhead electrical wires at a height of 21' from the ground at about 3½ Kms. North East of runway end depicted on plot 361 of Aurangabad. These wires belong to the MSEB, Aurangabad-Jalna feeder line and usually carry 33 KV power. Luckily at that time the power supply in the above high tension wires was not there due maintenance. The aircraft snapped all the three wires almost at its middle location between the two support poles 400' apart.

At 100' ahead of the wires the left engine bottom initially contacted the ground leaving longitudinal drag mark for 59' after which at a further distance of 90' the left engine again contacted the ground for a further distance of 60'. At 44' after the left engine had contacted the ground for the second time the aircraft right main wheels touched the ground and the scarmarks of the wheels moving on the ground was evident for 70'. At this distance the aircraft still moving forward collided with 2 trees standing across the path. Both the trees were severed at their ground level and the branches were thrown forward to a distance of 59' and 69'. After the

above impact with trees, aircraft left side flap parts and left engine cowl pieces started dropping on the ground. The left engine forward mount was retrieved 95' from the impact with the trees and the engine rear mount was retrieved at a further distance of 180' from the trees. The left engine devoid of its mounts finally rested at 350' from the impact point with the trees leaving ground scars. After losing the left engine on the trail a deep impression mark for 37' was evident on the ground which is made by the nose landing gear as the nose landing gear lock actuator was found at 15' forward from the end of this ground mark. Thereafter at 110' forward of the nose wheel contact mark the right engine oil tank and engine cross shaft were found on the trail. Other engine components line hydraulic pump, nose cowl, fan discharge casing, engine fire seal system were progressively dropped out as the aircraft continued moving forward over the ground. The right main landing gear bay portions were found dropped at 745' from the impact with the two trees. The right main landing gear severed from the shock absorber inner tube was lying at the rear of the forward fuselage portion. The outboard main wheel assembly of the right side landing gear got detached from its axle and was located far from the wreckage in unburnt condition. The tyre was holding pressure. The nose landing gear with its shock absorber was separated from the fuselage and was lying unburnt at left of the main wreckage.

At 1160' from the overhead MSEB wires the aircraft still moving forward on ground on its fuselage belly, impacted a Babool tree of 18" diameter fully uprooting the tree from its roots. Pieces of the right

side wing spar were found embedded in the bottom portion of the tree trunk with a part of the spar twisted in a "S" shape.

On impact with the Babool tree, the aircraft fuselage split open in the vertical plane, into two separate portions at aft of the wing trailing edge, i.e. just aft of the 19th cabin window from the front. The rear portion of the split fuselage section retained the structure from the aft cargo door rearwards and the remainder section of the fuselage was with the forward portion of the split fuselage. The forward portion of the fuselage with portions of the main wings attached to the fuselage on both the sides, at the wing root ends, moved forward for 190' before coming to final stop. The rear portion of the split fuselage was lying upside down and tilted to the right side resting on the right horizontal stabilizer and elevator and the vertical fin/rudder and the split portion of the fuselage was lying 106' from the Babool tree and to the right of the trail.

A.12.2 Fuselage:

The aircraft fuselage containing the cockpit, cabin and the cargo hold sections was in one piece till impact with the Babool tree at a distance of 1160' from the MSEB high tension wires. After impact with the Babool tree with the right side of the nose section and the right wing spar, the fuselage split into two sections aft of the wing trailing edge.

The front portion with the cockpit moved forward for 190' and its final stop position was facing a

magnetic heading of 045°. The cockpit interior section was intact with no signs of any fire damage. However, there is evidence of black soot deposits on the overhead cockpit panels and the roof adjacent to the cockpit door.

The cockpit entry door was jammed in the closed position. The right side of the fuselage nose section aft of the radome was torn circumferentially with tree branches embedded in it. The left side emergency escape rope in the cockpit was found deployed and the right side rope was in stowed position. Both the cockpit side windows were found in open position. The cockpit seats were on their locations without any damage. In the cabin section of the fuselage front split portion, the left main forward entry door was in full open position. The right main front entry door was in an unlocked condition with the door handle in the open mode, but the door was jammed inwards in its cutout near the closed position. The cabin section had extensive fire damage and the roof of the cabin aft of the cockpit upto the top level of the cabin windows was totally consumed by fire. On the right side the fuselage skin upto the 12th window from the front was available and on the left side the skin upto the 7th window from the front was available. The cabin interior was totally burnt including the seats and the floor board above the front cargo hold had caved in with fire damage. The floor board rear of the cargo hold and over the main wheel bay was consumed by fire. The front cargo hold was partially consumed by fire with baggages therein also damaged by fire. The fire damage in this portion of the fuselage indicates spread of fire from the rear of the split portion towards the front.

The rear portion of the split fuselage which was in an inverted position had severe fire damage right upto

the rear galley and rear toilet. The right rear cabin door was in closed position and the left rear cabin door including the adjacent fuselage section was consumed by fire. The interior of the rear cabin including the seats and floor board and roof was consumed by fire. The rear cargo hold interior was consumed by fire. The rear fuselage belly skin which was towards the top after the rear portion got inverted, was available on the wreckage. The tail section bottom of the fuselage including the housing of the Auxilliary Power Unit did not have any longitudinal grazing marks and/or impact signatures on the skin. The available skin on the rear portion of the split fuselage had evidence of circumferential rub marks with wrinkles indicating that after having split the rear portion of the fuselage had rolled over to its inverted position. A set of three passenger chairs in totally burnt condition was found entangled on the branches of the Babool tree which had fallen on the ground due impact.

The available outside surfaces of the split portions of the fuselage do not have any evidence of the blackening due fire streaking rearwards as a result of forward motion of the aircraft.

A.12.3 Wings :

Both the wings at the final wreckage were found attached at their root ends with the fuselage. The outboard portion of the right wing measuring 30' from its tip and the outboard portion of the left wing measuring 16.5' from the tip were lying upside down on their respective sides away from the main wings. The leading edges of both the wings had signs of impact damage. The wings top sections had no carbon soot deposits. However

the fire damages were evident inside the fuel chambers of the wings. Portions of the right wing front spar were found embedded in the trunk of the Babool tree.

A.12.4 Engines :

The right engine (S.no.P 674483) was totally stripped of its cowlings and was located close to the main wreckage with its bottom components and accessories left behind on the wreckage trail prior to the aircraft impacting the Babool tree. The left engine (S. no. P-687725) lying 650' prior to the main wreckage location, had its nose cowl attached severely damaged with the cowl bottom portion pushed inwards into the engine towards the attached nose spinner. The engine as a whole was bowed downwards stretching open at its HPC flange joint around 12 O' Clock position with crumbling of the bottom section.

Both the engines were transported to Air India Engine shop at Bombay for strip examination. The P & W representative was also associated in the said examination. From the strip Investigation Report it is revealed that :

1. Both the engines had received heavy secondary damage caused by impact of the left engine initially with the truck and subsequently with the ground. The right engine had damaged due to impact with the ground.
2. There was no basic failure of any part of the engine or any significant gas path deterioration in either engine prior to impact, which could have prevented either from being capable of developing full rated thrust during the take off.

3. There is no indication on either engine of any internal/external fire and there is no penetration of the engine casings of either engine due to release of any uncontained particles as a result of internal failure of the engines.
4. The Pt2 sense line in the nose dome of both engines were free from blockage and the available Pt2/Pt7 lines of the left engine and the Pt7 probe of the right engine were also found free from blockage. The above indicates uninterrupted signal to the cockpit indicators on engine pressure ratio (EPR) used for determining power generation.
5. The left engine was rotating at low RPM when impacted with the ground and the right engine was rotating at very high speed when impacted with the ground. The lower RPM of the left engine was as a result of the separation of its thrust reverser follow up cable when the said engine thrust reverser impacted the truck and got liberated in flight.

A.12.5 Flight Controls :

The aircraft had performed the take off with its trailing edge flaps set at Flap 5 position. Even though at the wreckage, the flap lever in the cockpit was found at position 1 and free to move to any selection, the measurements of the travel of the flap screw jacks, viz. No.1 & No.8, i.e. both sides outboard flap screw jacks, No.4 and No.5 screw jacks, revealed that the flaps at the time of accident flight were set to position 5. Also the two leading edge slat actuators, were found extended

without any evidence of heating due fire. The slat actuator pistons were found bent and deformed in their extended position indicating that the slats were also extended at the time of accident flight.

The cockpit selection of the THS was found at 5 units Up(Green Band). The dimensional check at the wreckage of the stabliser screw ball nut position with respect to the acutator assembly was found at 18" and also with reference to its stop position was found at 7.5" which confirms that the THS was selected to and was at 5 units Up position during the accident flight. The trimmable horizontal screw jack assembly (S.No.481) removed from the wreckage when examined in the shop showed free movement of the ball nut on the screw jack. There was no end play between the ball nut and the scre jack threads. Also there was no damage observed on the cable and drum assembly. The functional check indicated that a torque value of 50-55 inch pounds was required to operate the screw jack assembly against the maximum limit of 84" pounds. The trimmable horizontal surface on the right side had no damage due to impact except the tail portion of the fuselage tilted to right and had caused the THS on the right to buckle. An outboard portion of the THS on the left side measuring 98" had earlier been liberated from the main surface due impact with heavy mass detached in flight after the left under carriage and left engine thrust reverser had impacted the truck. The remaining portion of the left THS retained with the aircraft carry continuation of the damage on the leading edge at the torn and inflight liberated section of the left THS.

The rudder control surface had no evidence of pre-impact damage and the rudder surface was found jammed

with its trailing edge at 6" to the left of its neutral position. The rudder pedals in the cockpit were free to take any position. The rudder trim knob in the cockpit was to its full left beyond its graduation marking. The rudder trim actuator piston inside the tail compartment was in the extend position by 3/4th" corresponding to the full right trim. This can be attributed to impact damage. The rudder control PCU was found extended by 3" which corresponds to 6" left rudder. The standby rudder actuator piston was found extended by 3.5" which also corresponds to 6° of left rudder.

The aileron surfaces on both sides of the wings were found attached to the trailing edges of the wings sections. The aileron trim selection in the cockpit was set at 2.5" units to the left.

The elevator surface on the left side measuring 115" span wise was liberated soon after impact of the aircraft with the truck. The right side elevator was intact and attached at its location aft of the right THS. This elevator surface had buckling damage after the aft fuselage portion had turned upside down and in its final rest position and was tilted towards right supported by the right THS outboard portion. The elevator Power Control Unit S.No.8005 did not have any external damage and was checked functionally in the shop and was found satisfactory. No external leaks were also observed during the testing. The elevator Power Control Unit on System "B" S.No.2214 was also found satisfactory during the functional check in as is condition and no leaks observed during the testing. The elevator feel computer S.No. ES 608 was also tested in the shop as per the overhaul manual procedures and no discrepancy observed.

A.12.6 Explosives :

The Bomb Detection and Disposal Squad Bureau of Civil Aviation Security, Bombay, on carrying out investigation at the wreckage on the very day of the accident, has submitted that none of the typical characteristics associated with on board explosion such as metal fractures, spiked fragments, fissuring, vaporisation on fragment surfaces, pitting, erosion, flowering and curling was observed. The human bodies also did not reveal explosion related signatures. The front and rear cargo holds, retrieved baggages also give no traces of explosion.

A.13 MEDICAL & PATHOLOGICAL INFORMATION :

Toxicological testings of the blood sample of the Commander and the First Officer completed by the Dy. Director, Regional Forensic Science Laboratory Government of Maharashtra, Aurangabad, were negative for alcohol and drugs. On their clinical examinations by the medical officer, nothing adverse was detected.

A.14 FIRE :

There was no inflight fire. Apparently there was a fire after the impact, after the fuselage had split.

A.15 POST MORTEM REPORTS :

As per Post Mortem reports about a dozen deaths out of 55 were attributable to crash forces per-se. Most of the deaths are as a result of post crash fire. Of the eleven, five were having pelvic fractures and six spinal

fractures. Five died strapped on their seats and six having spinal fractures died perhaps as a result of non use of seat belts for whatever reasons.

PART-III

B. ANALYSIS

B.1 ISSUES INVOLVED AND UNQUESTIONABLE FACTS:

In consultation with all the participants and considering the stand taken by them, following points for determination were formulated :

- 1) Was the aircraft and/or engine performance defective?
- 2) Was there a sabotage by explosive or otherwise?
- 3) a) Was the Aircraft overloaded?
b) If yes, what was the extent of over loading, and its contribution in degrading the Aircraft performance?
- 4) Was there commander's and/or First Officer's error?
- 5) Have the weather conditions - such as wind shear, temperature and/or down draft adversely affected the aircraft performance?
- 6) Was the Aurangabad Airport and its surroundings properly maintained?
- 7) a) Does the Aurangabad Airport require improvement?
b) If yes, in what manner?
- 8) Were adequate post-accident actions taken by the crew, the Indian Airlines, the National Airport Authority or local Authorities?
- 9) What conclusions and recommendations?

The broad unquestionable factual matrix is this :

- (a) The illfated Boeing 737 VT-ECQ had a sitting capacity of 126 passengers.

- (b) This hopping IC-491 Delhi-Jaipur-Udaipur-Aurangabad-Bombay flight left Delhi 30 minutes late.
- (c) The crew were qualified.
- (d) The aircraft was airworthy as per certifications.
- (e) The first three sectors of the flight were uneventful. The flight arrived at Aurangabad 25 minutes late at about 12.30 hrs. with total 79 passengers -61 bound for Bombay and 18 for Aurangabad.
- (f) It was a hot summer noon. The halt at Aurangabad was 30 minutes. 51 passengers were boarded there thus making a total of 112.
- (g) At Aurangabad, there was an unusually long waiting list of passengers.
- (h) Capt. Mulherkar of IA (SOL) bound for Bombay met Pl in the cockpit immediately after the flight landed at Aurangabad and Pl asked the Trim Man to accept Capt. Mulherkar and family consisting of 4 members within the RTOW.
- (i) Pl gave the RTOW of 42.6 Tons. ATOW as per L & M Sheet was 42546 Kgs.
- (j) The ATCO gave runway 27 for the departure but on request of Pl, clearance by runway 09 was given.
- (k) The TORA as regards runway 09 was 6000' and the TODA was 6360'. The width of the runway was 150'. The 3' high boundary wall of the airfield is at a distance of 340' from the end of runway markings. At about 6410' from beginning of runway 09, outside the boundary wall lies a 20' wide North-South Aurangabad-Beed State high way running nearly perpendicular to the runway. High

way is situated 4.9' below runway end level. Airport Obstruction Chart is Annexure-E.

- (i) Traffic on the road was shown to be regulated during flying hours in the Obstruction Chart of the Airport.
- (m) Mobile traffic on the road was regulated with the aid of barriers and manned by staff of the erstwhile Civil Aviation Department and State Police from 1975 to 1984 or so. system of regulation had stopped thereafter and it did not exist on the eventful day.
- (n) The aircraft commenced the rolling take-off at 13.05 hrs. and left mother earth at about 5800' from the beginning of runway 09, i.e. virtually of the end of runway. The aircraft impacted with a lorry laden with cotton bales moving from South to North at a distance of about 50' from the boundary wall. The aircraft's left landing gear, the left engine thrust reverser and APU shroud drain mast impacted the left side of the lorry in line with the centre line of the runway at a height of 7' from the road level, 2.1' above the runway end level.
- (o) The aircraft turned to the left climbed some height, thereafter started losing height, crashed through nonlive high tension electric wires at a height of about 50' from the runway end level. It was dragged along the ground for some distance. It impacted the trees, the fuselage was split into two, and then it came to rest. The fire broke out and the interior of the rear portion of the aircraft was nearly completely burnt.
- (p) 53 passengers and two cabin crew received fatal injuries at the crash site itself. One passenger

- succumbed to the injuries later on.
- (q) There were no impact marks on the runway surface or on the boundary wall.
 - (r) The FDR was recovered but the air speed and altitude tracings were missing on the foil as the respective stylus had disengaged from the internal mechanism from the very start.
 - (s) During the whole take off stage from the time of start-up clearance to the time of impact 25:06 to 32:34 as per time shown in transcript of CVR (Annexure-F) no abnormality or emergency was transmitted.
 - (t) When the aircraft was on the ground, there was a talk about climb limit weight between P1 and P2. It culminated in the utterance about 4 minutes before the start-up by P2 to the effect "everything is fine. Only nothing should happen Yahi hai bus".
 - (u) As per CVR transcript (i) Between the noting "engine sound increases" in the transcript and the stabilised call, there was a 2 second interval (ii) Between the stabilization call and the Vr call, there was a 27 second interval (iii) Between the Vr call and the impact, there was an 11 second interval (iv) Between the Vr call and the utterance of P1 "leave it leave it" there was a 8 second interval with the absence of any verbal communication.

B.1.1 Was the aircraft and/or engine performance defective?

In the first place, it will have to be noticed that on the fateful day, there were no carried forward snags. The aircraft landed at Aurangabad with no

complaint having been made regarding its performance or airworthiness. In the pilot defect report for the earlier sectors, no entries were made. P2 (Wt.27) has clearly stated that the sectors were uneventful and no snag was experienced. AME posted at Aurangabad had carried out the Check-A Inspection Schedule including walk around security checks as indicated by the Inspector of Accident Shri Gohain (Wt.1) in his report Exh.2. P1 (Wt.28) had signed the Pilot's Certificate for General Fitness of aircraft before flight at Aurangabad. P1 and P2 have both confirmed in their statements (Exhs.134 & 29 respectively) that during the take off run, the engines were operating normally and there was no abnormality and that the take off run was smooth and the acceleration was normal. Vr speed was attained within a distance of 4200' at the timing of 32 seconds from commencement of the take off run and within 27 seconds of the stabilisation call. These timings and distances are nearly equal to the optimum stipulated in the PEM for the existing conditions.

In CVR transcript at the time 32:12, P2 informed P1 that all engine parameters are normal. The aircraft had already undergone a major C2 check and no fresh inspection in respect of the engines was due at the time of the accident. Engine Strip Investigation Report attached to Exh.2 categorically states that there was no basic failure of any part of the engines which could have resulted in the loss of power of any of the engines. There was no indication of an internal/external fire on any of the engines nor any sign of uncontained failure. The said report clearly states that Engine 1 was running at a lower RPM as compared to Engine 2 due to the impact with the truck. The Pt7 probes along with their air

manifold on both engines were free from any blockage. The Pt2 sense line in the nose dome of the respective engines were also free from any blockage. The report concludes with the statement that there is no reason for any of the engines not developing sufficient power as and when the same was demanded. No evidence on record indicates any defect.

The conclusion is thus inevitable that both engines were operating properly until the time when the aircraft impacted the truck after which only as a direct result of the damage sustained from the impact, the left engine ran at lower RPM.

The aircraft was received by IA in 1974. It had a Certificate of Airworthiness by the DGCA which was valid upto 18th April, 1994 (Exh.145). At the time of accident, the aircraft had accumulated 43888.45 hrs and 50557 cycles. The aircraft had flown 251.30 hrs since the last flight release certificate, viz. Check C2 inspection had been carried out. At the time of accident, 246 flying hours were left for next major check as per Mr Mahapatra (Wt.14).

Some doubt was attempted to be created on behalf of P1 about malfunctioning of Elevator Control System. But suggestion appears to be altruistic. The PORT and STABD elevators provide the primary pitch control of the aircraft around its lateral axis. The elevators can be controlled through two independent systems (i) manual (ii) automatic through the autopilot system. The autopilot elevator and pitch system consist of (i) the pitch channel unit, (ii) the power control unit, and (iii) the autopilot control panel. The flight crew are required in the Before Take off Check list to confirm

before every flight that the elevator system is operating properly. P2 had conducted such functional check of the elevators before Delhi, Jaipur, Udaipur and Aurangabad take off as admitted by her. In her evidence she has fairly confirmed the existence of free and full movement from the elevators. There was no flight crew defect report prepared on the elevator or any other aircraft system.

Elevator system was operated without problem manually by the pilot's movement of the control column during the take off and landings at Delhi, Jaipur and Udaipur and was operated without problem by the autopilot system during the cruise phase of flight between these cities and to Aurangabad. P2 is categorical in her statement that the sectors were uneventful and the flights were smooth. At no stage any snag on the aircraft was experienced. Even P1 in his statement (Exh.29), did not recall any abnormality. The in-service performance of the elevators on the three flights leading to Aurangabad thus shows that the elevators were fully functional. This confirmation was obtained when P2 pushed and pulled the column through the full range of elevator travel and saw that the elevators had free and full movement. The verbal acknowledgement that the elevators were fully functional seconds before take off appears at 28:41 in the CVR transcript. No abnormality was experienced or reported even during the take off roll. There was no pilot complaint on the CVR about high or low column forces, jammed controls or any other problem whatsoever with the elevator system.

After the collision with the truck, the left engine thrust reverser separated from the left engine and crashed into the left horizontal stabilizer and the left elevator, which were torn from the aircraft and were

found in a field immediately east of the Beed Road. Even with only the right elevator and a part of the left elevator operational, the aircraft was able to climb approximately 50' above the ground at a distance of approximately 3 Kms from the truck. Climbing movement of the aircraft has been noticed by several witnesses like Mr. Anil Machhar (Wt:4), Mr. S.K. Hussain (Wt.8), Mr. Gosavi (Wt.13) and Mr. Shilpin Patel (Wt.21).

The elevator components were found to be fully functional in the examination shortly after the accident.

The investigators had also tested the elevator feel computer which provides elevator feel to the flight crew through column forces and found it to be satisfactory as per Overhaul Manual as per Exh.2. From all these circumstances, it is clear that the elevators were fully operational during the accident take off.

Three factors are highlighted : (i) This aircraft had experienced three bird hits; (ii) number of mal-functions with the autopilot system in the months preceding the accident were reported; and (iii) the elevator feel computer system may have suddenly failed so as to inhibit the Captain's ability to accurately feel elevator operation.

Now, there is no material to hold that the bird hit is indicative of elevator failure. Two of the three bird hits experienced by the accident aircraft occurred during final approach or landing when large elevator inputs may not be appropriate. In none of the bird hit events did the flight crew report having noticed a problem with the elevator system as is clear from Exh.2. It is true that there were a number of reported snags and corresponding corrective actions with the autopilot

system as per Exhs.13 & 88. There were two types of problems experienced when the autopilot system was engaged, the stabilizer out of trim light illuminated and the pitch channel tripped. These problems have no relevance to the accident take off. The stabilizer light and pitch channel snags were related to the autopilot system; the snags existed only when the aircraft was being flown by autopilot. The autopilot does not control the elevators when the autopilot is disengaged. At the time of the take off in Aurangabad, the aircraft was being operated manually and the autopilot system was disengaged as admitted by P2. This flight crew had operated the elevators both manually and through the use of the autopilot for earlier segments and there was no problem with any part of the autopilot system. Even if the snag in the autopilot system was there, it is difficult to appreciate how that could have effected P1's ability to manually rotate the aircraft. On failure of one of the two hydraulic pressure systems that operate the elevator feel control computer system "feel differential" light illuminates in the cockpit's forward overhead panel. The crew experienced no such problem. As stated by Mr.Mahapatre (Wt.14) even with failure of the system, the feel system will continue to operate normally with only one functioning hydraulic system. There is absolutely no material to indicate that the aircraft and/or engine performance was defective and had contributed or caused the accident. Therefore, this point will have to be answered in the negative.

Undoubtedly there have been certain maintenance lapses and unexplainable and frequent repetitive snags in the aircraft as is clear from evidence of Mr Gohain (Wt.1) and Mr Mahapatra (Wt.14). Maintenance of aircraft specially when it is old requires much more attention

than it has received. Occurrence of the repetitive snags and non-placement of parts because the part number did not match disengagement of styluses in the FDR are some of the features which are not healthy and the explanations in this regard are not very convincing. But that is a different part of the story.

B.1.2 Was there a sabotage by explosives or otherwise?

This possibility has to be completely ruled out. There is no material whatsoever to suggest a sabotage by explosives or otherwise. It is no one's case either. Mr.V.L.Jadhav of the Bomb Detection & Disposal Squad, inspected the accident plane on that very day. According to his report Exh.144 as well as Exh.2 both the forward and rear holds were nearly intact with the retrieved baggage inside showing no traces of any explosion. None of the characteristics associated with on-board explosion like metal fractures, spiked fragments, fissuring, vaporization on fragment surfaces, pitting, erosion, flowering and curling were observed.

The point is thus answered in the negative.

B.1.3(a): Was the aircraft over-loaded?

As per the L & M Sheet, the ATOW was 54 Kgs. less than RTOW. IA asserted about correctness of the sheet at the initial stage of Inquiry, but as the Inquiry progressed, successive affidavits were filed before this Court modifying the ATOW and the final figure given was 118 Kgs more than RTOW. In correctness of the L & M Sheet to the extent of 172 Kgs is admitted at the end of the Inquiry. The answer to the question, therefore, has to be in the affirmative.

B.1.3(b): If yes, what was the extent of over-loading, and its contribution in degrading the aircraft performance?

It is nearly impossible to establish the exact weight of the aircraft at the time of take off and consequently the exact extent of over-loading. No direct evidence is available. Reliance on inferences and guess work is inevitable. Thus the endeavour has to be made an estimate which should be minimum wrong.

The original P & B manifest though allegedly prepared by Mr Rapatwar (Wt.5) contemporaneously with the checking-in has not seen the light. Another P & B manifest, (Exh.28) has been produced. It is reported to have been prepared by one Mr.Jain from IA who arrived at Aurangabad in the evening of the fateful day. Several IA officials including Mr.Rajendra Sahai (Wt.25) have admitted that Exh.28 does not correctly reflect the checked-in baggage of the passengers who boarded the aircraft. It is pertinent to notice that every successive re-calculation of the weight of passengers and baggage with respect to this flight has revealed new mistakes. Mr.Rajendra Sahai (Wt.25) asserted that the Baggage Record Card System prevailed at Aurangabad at the material time. No reference to this System was made to the Inspector of Accident by any one. The card for the relevant flight was not produced in the Court. Mr.Rajendra Sahai promised to produce it after a day or two. It was not produced even thereafter and he stated that even after the search the document was not found and was perhaps destroyed after a few days of the flight because there was no need. In the cross-examination, he admitted that during the search the cards for some other

flights of April 1993 at Aurangabad were found. All this looks very unnatural. Destroying the card only for this flight and that too after the accident cannot be in normal course. Circumstances warrant drawing adverse inference against IA for non-production of these vital documents.

The passengers, their hand baggage, checked-in baggage and varieties of cargo comprised the pay load of the aircraft. The baggage tags are serially numbered but not accounted for. They are not even used serially. such utilisation of baggage tags leaves scope for manipulation and can create varieties of problems even in case of a mistake.

The checked-in baggage reflected in the manifest for Ex-Aurangabad passengers is too low. Average of the checked-in baggage of 24 Ex-Jaipur passengers was over 10 Kgs per head and the average of Ex-Aurangabad passengers was 2.5 Kgs per head.

The flight coupon has a provision for entering the number of pieces of hand baggage and their weight, but it appears that there is no practice of these details being entered fully. It is very unlikely that any passenger would have neither checked-in baggage nor hand baggage. Those who do not have any checked-in baggage would invariably have hand baggage and such hand baggage is likely to be heavier. Only 7 Ex-Aurangabad passengers had checked-in baggage as per Exh.28. It is on record that some passengers were seen carrying heavy hand baggages in the cabin one of them being Capt.Mulherkar. In the whole background, it would be reasonable to assume that the total hand baggages with respect of Ex-Aurangabad passengers must have considerably exceeded the calculated in built passenger weight.

List of retrieved baggages, Exh.8. weight of which was 1 ton shows that out of 83 parcels listed therein, 19 parcels were weighing in excess of 20 Kgs and some were in the range of 18 to 20 Kgs. The claim of IA that a retrieved baggage was in semi-wet condition and therefore, that also ought to be taken into consideration, does not appeal. Even if the baggage was wet initially due to fire fighting operations, it cannot remain in that condition for about a week in the hot summer at Aurangabad. Water marks may remain but not the water.

The aircraft had split into two. Rear portion turned upwards. It suffered the most by fire. Only one passenger Mr. Shilpin Patel (Wt.21) could survive. From the photographs (Annexure-H) in the Album (Exh.79) it is apparent that most of the baggage in the rear hold and the hand baggage of the passengers in the rear must have been burnt. It is in evidence of Mr. Gosavi (Wt.13) that most of the salvaged baggage was from the front hold. Even baggage in the front hold could not have been intact. It is true as contended by IA that from few examples of short delivery of baggage inference about short delivery in every case cannot be drawn. So is the case with examples of full delivery of baggage to which my attention was drawn. In situations like this law of averages has to be applied. Weight of checked-in baggage is shown to be 740 Kgs. that of cargo only 3.6 Kgs. and that of POT 58 Kgs. To this excess weight of hand baggage (which is not calculated in the built in passenger weight), weight of heavy suitcase carried by passengers in the cabin, difference in the actual and manifested weight - mistaken or otherwise - of the luggage cargo etc. will have to be added. Kilo by kilo calculation is too theoretical to be resorted to.

It is pertinent to notice that by telex message (Exh.129) dated 25th April, 1993 issued by Aurangabad to IA HQrs. a bigger aircraft was asked for on 26th April, 1993 to clear the committed load.

In the above background estimate the over-loading by about 1 ton would be reasonable.

For slightly reasons the Inspector of Accident has also estimated the over-loading by about 1 ton. Some participants have supported this estimate. According to IA the over-loading cannot in any case exceed 500 Kgs. According to some participants over-loading was much more. P2 has given the maximum estimate at 4.65 tons as detailed below:

a)	Over-load on account of excess baggage	... 1.00 ton
b)	Over-load on account of 32 extra passengers, as explained above.	... 2.20 ton
c)	Over weight condition on account of 2° rise in temperature (as stated by Mr.Gohain in his cross-examination at page 20).	... 0.50 ton
d)	Over weight condition on account of RTOW not being obstacle limited (as stated by Mr. S.K. Mukherjee in the course of his cross-examination at page 272).	... 0.95 ton

	Total over weight condition of aircraft.	... 4.65 ton

I will take up for consideration the estimate given by P2 since this is the maximum figure suggested in the course of oral hearing. No justification for these figures and basis were shown from the record. Take for example the weight of 32 passengers. No doubt Exh.129 gives a message that Aurangabad will not be in a position to clear more than 80 passengers on the Basic/Advance aircraft and in view of the committed load Dash -17 aircraft should be sent on 26th April,1993. but from that factor alone the weight of 32 passengers cannot be added in calculating the over-load when RTOW has been calculated on the basis of weight of 112 passengers. It is true that the maximum booking reservation capacity fixed for the flight for summer 1993 was 100 passengers. but as rightly contended on behalf of IA, if the passenger load is within the stipulated RTOW, no question of over-loading can arise irrespective of the maximum reservation capacity stipulated for the month. From the evidence of Mr.Rajendra Sahai (Wt.25) it appears that IA has a system of allocating load/capacity on various flights/sectors for the purpose of reservation of seats on confirmed basis. After a sector has been allocated a particular passenger capacity, the central space control will confirm bookings only upto the said allocated capacity. Thereafter all bookings will automatically be transferred by the computer to the waiting list. The available pay load for a particular flight/sector is computed keeping in view the lowest average monthly pay load of that sector for the corresponding months/period in the previous year. The allocation only determines the total confirmed reservations that will be accepted and has no bearing on the number of passengers that can be actually uplifted on a particular flight depending upon

various factors. Of course, in no case the RTOW can be allowed to be exceeded.

The possibility of exceedance of ATOW to such higher degree has to be rejected even on scientific basis, provided by simulation exercises. In all three simulation exercises were carried out. The first was at CTE, Hyderabad in June 1993 in presence of the Court, the Assessors and the Inspector of Accident. Simulator at CTE, Hyderabad is only a training Simulator not fitted with type engine and got fitted with higher powered JT8D-17 engine. As clearly confirmed by Mr. B.S. Siddhu on behalf of CTE, Hyderabad in the letter (Exh.18) dated 13th July, 1993 the Simulator was unable to give quantitative analysis, which was most essential in this Inquiry considering the background of the accident. Vital altitude and speed traces were missing from the FDR foil.

Hence aircraft profile during take off with values of speed, height, etc. could not be estimated. The aircraft had prima-facie attained much lower height than the prescribed height at the appropriate distance after lift off. For these variety of reasons the Inspector of Accident in his report (Exh.2) opined that simulation of the aircraft performance with various deviation of loads & rotation techniques in an engineering based performance computer or any other Simulator having capacity to give output in an exact quantitative manner was inevitable in this Inquiry. The Assessors were also of the same view. I was informed after making enquiry that the Boeing Co. at Seattle has the engineering Simulator fitted with type engine JT8D-9A. Government of India and the DGCA contacted the Boeing Co. which readily agreed to provide the simulation exercises.

Second simulation exercises were thus performed in August 1993 in that Simulator in presence of the Court and the Inspector of Accident. Exh.3 is the supplementary report of the Inspector of Accident on the gist of the result of the various exercises carried out there. Exh.19 are the graphs of some of the exercises. The results established that even with a weight of 44 tons and higher temperature and a normal rotation the aircraft lifts off at 4905/4933' even after allowing 100' for a rolling take off and is at an height of 35' before 5850' and with a weight of 42.5 tons and under rotation to 6° the aircraft lifts off at 5760-5800' and is at an height of 3' at 6500-6600'. It is clearly established that even an excess load of 1.5 tons could not cause a lift off at 5800/5850' and this could only be caused by delayed and/or slow and/or under rotation. Thus, late lift off and lower climb gradient achieved in this case could be attributable to the over weight if its extent was 6.5 tons as rightly stated by Inspector of Accident (Wt.1).

Third simulation exercises were reportedly performed at CTE, Hyderabad on 16th October, 1993 by the IA at the fag end of the Inquiry without even informing the Court. All of a sudden affidavit of Mr.S.K.Mukherjee of CTE, Hyderabad was sought to be filed with a prayer to examine him as a witness. The procedure followed by IA and the prayer was vehemently opposed. Even though course followed by IA was unusual, I granted the prayer on 21st October, 1993 in the interest of fair Inquiry since the participants were to have opportunity to cross-examine him. Main thrust of testimony of Mr.Mukherjee (Wt.24) has been that since Vr was achieved at normal time and speed, over weight by more than 200 or 300 Kgs had to be ruled out. Now the results obtained in CTE Simulator cannot suddenly become

quantitatively so fine as not to make allowance even for 1 ton exceedance of weight. Its limited capacity and the difference in engine power had not undergone any change after first exercises in June 1993. Capt. Rao (Wt.17) has categorically stated that difference in weight by about 500 Kgs would make no difference in the simulation results. In this background, this evidence cannot be relied upon to hold that over weight was not even by one ton.

Next aspect is whether the over-loading and/or placement of excessively disproportionate baggage in the forward hold of the aircraft or free seating of the passengers had adversely affected the CG and consequently aircraft's performance in take off phase. The Inspector of Accident (Wt.1) in Exh.2 as well as in his oral evidence, has confirmed that even if 1 ton of under-manifested load was placed in the forward hold, CG of the aircraft would still have remained in the permissible range of 12% to 26% MAC. The CG, as indicated in L & M Sheet for the entries therein for take off from Aurangabad, was 21.3 %.

Free seating of 112 passengers in the aircraft of 126 seats capacity would have negligible effect on the CG. Mr. Rajendra Sahai (Wt.25) has deposed that having regard to the well established concept of passenger choice (window, aisle, remainder) free seating would not affect CG. In any event in the flight which is substantially full, there is a very little scope for passenger weight imbalance. Free seating of the passengers even as per Boeing Co. would have negligible effect on CG. In the Trim Sheet format supplied, the cabin has not been divided into three different zones for the purposes of distribution of passenger load. The above stand of the manufacturers is based on the well recognised concept of passengers seat choice and the fact that a margin for

passenger movement/change in allocated seats has been built into the CG limits.

It is true that IA with the approval of DGCA had subdivided the cabin into three compartments but that is with a view to provide added safety margin. Boeing Co. had permitted free seating on the basis of CG range from 5% MAC to 33% MAC. IA with the approval of DGCA has curtailed the range from 12% MAC to 26% MAC in order to provide a further margin to take care of any difference that might exist between the actual and calculated CG due to passenger movement. Testimony of certain IA witnesses from Aurangabad about putting all the Aurangabad cargo in the rear hold only, even though load destined to Aurangabad was off loaded from front cargo hold appears to be unnatural but this feature cannot have impact on the otherwise abundant and weighty material on record.

It is, therefore, not possible to accept that the distribution of load and free seating of passengers had affected the CG beyond permissible limits and consequent result was the requirement of additional input for lift off and the proper climb gradient.

The possibility of over-loading and/or improper loading even as a direct contributory factor to the accident has to be ruled out in view of clear evidence (as discussed later) about the cause of late lift off and improper climb gradient of the aircraft which resulted into the accident.

But it appears that the over-loading had an indirect effect. Indirect effect was on Pl's action due

to his consciousness about the over weight condition in the hot summer time of the departure of the flight, though he was not aware of the extent of over-loading. Captain Mulherkar (SOL) who was a Senior Captain of IA, had come to the cockpit with the Trim Man soon after the flight's landing at Aurangabad with a personal request to P1 to accommodate him and his family (4 persons) in the flight which clearly indicated to P1 that there was rush of wait list passengers. P1 asked Trim Man to accommodate Captain Mulherkar in the flight within RTOW. It was hot summer noon at Aurangabad. Temperature was rising. From the Trim Sheet, it was clear that the ATOW was very close to the RTOW. RTOW was calculated at 42.6 tons. Even on the basis of the parameters considered by P1, RTOW would have been 42.3 tons. The average weight of 4 passengers with baggage etc. would come to 300 Kgs. It appears that P1 deliberately added this weight to RTOW to avoid any possible embarrassment to the commercial staff in accommodating Captain Mulherkar and his family when there was a long waiting list of passengers. Calculations were neither as per Metar nor as per any supposed observation of the wind sock. P1 made very rough calculations and stipulated a higher RTOW. Having done so it bothered both P1 & P2, P1 thought that somehow he would be able to take off, but he was not sure if the climb limit weight will be crossed. P2, who was junior to P1, however was worried. All this is clear from the cockpit conversation at CVR time 18:20 to 21:01. I reproduce for ready reference the concluding part of the conversation at CVR time 20:44 to 21:01.

"20:44 P2 P1 Hain right right acha aapne uska
thirty eight kar lya OK OK thik hai
thik hai.

P1 P2 Does not matter _____ (laugh).

21:01 P2 P1 Everthing is fine only nothing should
happen yahi hai bas."

P1 & P2's claim that the conversation in the cockpit for almost two minutes with respect to the climb limit weight was just of a theoretical and casual nature, does not carry conviction. The matter was within the special knowledge of the cockpit crew and hence they were duty bound to explain this unusual dialogue. Their explanation is not convincing. The words "nothing should happen" in the whole context cannot mean change in temperature as was suggested by the cockpit crew. If indeed the worry was about temperature, they have not explained as to why they chose not to find out if the temperature had changed before commencement of take off even as fresh Metar was available at 1300 hrs i.e. 5 minutes before the departure. They have not even given explanation as to what they would have done at the eleventh hour, if the temperature and other parameters had changed. It is pertinent to notice that when the Trim Sheet was brought for signature, P1 even did not bother about the male, female, child distribution though those figures were not available. The distribution was quite important under the circumstances. P1 & P2 have accepted in their testimony that the response to a climb limit weight could be a delayed rotation/lift off, resulting in additional speed build up on the ground and a more acute second segment climb. It is pertinent to notice that at

CVR timings 32:35 after the landing gear hit the lorry, P2 instantaneously remarked "Shit Sir what have you done."

The answer to this question, therefore, is as under :

Over-loading was to the extent of approximately 1 ton. CG was within permissible limits. Over-loading did not contribute in degrading the performance of the take off. However, it had the indirect effect.

B.1.4 Was there Commander's and/or First Officer's error?

V speeds entered in the bug card were $V_1 = 126$, $V_r = 128$ and $V_2 = 132$. These speeds were adjusted in the indicator by P2. P2 has stated that she was continuously monitoring the instruments from 80 kts to V_r call and she had given the respective calls when the relevant speeds were reached in the instrument. It is, therefore, safe to conclude that at CVR time 32:12, 32:22 and 32:23 the speeds 80 knts, V_1 and V_r respectively were reached. Luckily in this case the cockpit crew were available for giving evidence about their decisions and actions which can be divided for the purpose of analysis into two stages. The first upto the moment of sighting the truck and the second thereafter.

From the CVR as well as testimony of P1 & P2, it is clear that the aircraft attained its V_r speed within 32 seconds of commencement of take off run and within 27 seconds of stabilisation approximately 4200' down the runway. That the aircraft left the mother earth nearly

at the end of runway is an admitted position. Mr.S.K.Hussain's (Wt.8) statement that the aircraft lifted off at about the digits "27" painted at about 5800'from the beginning of runway 09 has gone unchallenged. Considering the 6000'runway length the aircraft failed to lift off for about 1800'additional distance. It is also admitted position that nose of the aircraft came up for the first time at CVR time 32:30,i.e. approximately 7 seconds after the rotate call. I have already held that the aircraft's degraded performance could not be attributed either to the defective performance or over weight. This failure can, under the circumstances, either be attributed to (i) delayed rotation and/or delayed rotation coupled with under rotation or (ii) the freak weather conditions such as wind shear, temperature or down-draft. The later possibility has to be ruled out. Neither at the time of take off nor subsequently have the cockpit crew referred to a sudden freak weather or to a sudden dropping off of air speed in the ASI. This aspect is dealt with in greater details separately at later stage under an independent next topic.

There is mass of evidence to conclude that the take off pattern was the consequence of delayed and/or under rotation for nearly 5 to 7 seconds. According to Mr.Sathe (Wt.11) not only was the lift off delayed but the nose wheel coming up was also delayed. It is pertinent to notice that during the entire period from CVR 32:23 to 32:30 when the aircraft must have travelled approximately 1800' on the ground neither P1 nor P2 made any comment or displayed any consternation either by statement or gesture regarding the existence of any abnormal situation. P1 admits that this delay in lifting off was most normal. This establishes that P1 had taken a mental decision to adopt a take off pattern

entailing delayed lift off and low climb gradient in first segment. That the aircraft lift off was late and the climb gradient was much lower than expected, is a conclusion also in the report (Exh.2). P1 & P2 have admitted that the response to climb limit weight could be a delayed rotation/lift off, resulting in additional speed build up on the ground and a more accurate climb. P1 has confirmed that the delayed rotation, slow rotation and under rotation would all have the same effect of higher take off speeds, longer take off distances and enhanced climb gradient. Statement of P2 at CVR timing 21:01 that "everything is fine only nothing should happen "Yahi hai bas", has already been discussed earlier. All circumstances indicate that the adopted rotation technique was in fact a response to P1's conclusion that the ATOW was exceeding the RTOW.

In the three statements made by P1 to the Inspector of Accident immediately after the accident (Exhs 29,30 and 31), he has stated that (i) the take off run was smooth and acceleration normal,(ii) practically the full length of runway was used for achieving V1 and Vr speed, (iii) normal rotation had just been initiated at about 500' from the runway end,(iv) when he saw the lorry on the take off path, he pulled the control column back and (v) nose went up but the aircraft did not climb and the landing gear hit the lorry. Exhibits 133,134 and 135 are similar such statements of P2. P1's initial case was of an abnormally delayed attainment of Vr speed at 5500' and spotting of the lorry just at the moment of initiation of rotation, resulting thereafter in a fast over rotation. The above version is not borne out from the CVR transcript and other material on record to the effect that Vr speed had been attained by the aircraft within the optimum time and distance of about 4200' and

about 32' seconds.

Realizing this P1 & P2 have departed from their earlier statements in their testimony and stated that Vr had been attained at 4200-4500'. To explain the long gap of time and distance for the lift off after attainment of Vr speed, P1 has belatedly come out with a completely new and inconsistent case in the Inquiry and in his testimony. P1's explanation that whenever he had referred to Vr, he had meant lift off, cannot be accepted. According to P1, he had initiated rotation 1 second after the rotate call but the aircraft had not responded, this had necessitated him to give additional input as a result nose wheel had come up though with difficulty and at that stage he had spotted that lorry plying on the road. P2 has tried to support P1 but their versions about the time and distance of the nose wheel coming up are quite conflicting. According to P2, nose wheel first came up 7 seconds after the Vr and according to P1 it came within 4 seconds after the Vr.

Although the cockpit crew had earlier stated that they had seen the lorry immediately after the rotation call and just at the point when rotation had been initiated, P1 now stated that he had seen the lorry 4 seconds after the rotation call after he had given additional input and when the nose wheel had already come up to 6°. His explanation is untenable. P1 has made number of inconsistent statements even in his testimony including as to when he had seen the lorry for the first time. He first stated that he saw the lorry just after initiating the rotation when he was approximately 1000' from the lorry i.e. at 5400' on the runway. This was consistent with an initiation of rotation at 5400' and approximately 6 seconds after Vr call. He subsequently

changed the version and stated that he saw the lorry for the first time at CVR time 32:27 i.e. 4 seconds after the Vr call, after he had allegedly given additional input and when the aircraft nose had already come upto 6°, got disoriented on noticing the lorry and did not react for 2 seconds and thereafter commenced a fast and over rotation at CVR time 32:29. It is pertinent to notice that even according to P1, the aircraft body angle was at 6° at 32:29, i.e. about 6 seconds and about 1400' after the rotate call. P1 agreed that failure of the aircraft to lift off for 4 seconds after Vr necessitating additional input even before he had spotted the lorry, was extremely relevant abnormal feature. He had no explanation to offer for not mentioning this in his three earlier statements to the Inspector.

The position is clear that Vr was attained at about 4100' and at 31:23 CVR time. At this point of time, none of the cockpit crew had sighted the lorry. In fact the lorry was first sighted 5 to 6 seconds later. Hence P1's reactions at 31:23 to the rotation call will have to be viewed in the context of not noticing the lorry then. The claim of pilot reaction time of 2 seconds to initiate rotation after the rotate call, does not appear to be convincing though provided by the Operations Group in its report. During the take off, the Commander has to be alert and in all attention to the crucial instruments and to anticipate situations. The V1 and Vr calls from the First Officer are not wake-up calls. As admitted, even when the rotate call is actually received, the Commander is ready and waiting for the call to initiate rotation. At V1 call itself the Commander brings the control column to central position and would be keeping his eye on the ASI too. It is not

as if the Commander will initiate rotation only if the P2 gives the call and not otherwise. Captain Rao (Wt.17) has clearly stated that as the First Officer gives the rotate call, the Commander too is just about starting the rotation. Two seconds in take off path are crucial and it means about consumption of about 450' runway.

Even if the margin of 1 second is given, rotation call ought to have been initiated latest by 32:24 CVR time. It is undisputed that on initiation of rotation, the aircraft nose goes up. P2 has stated that the nose of the aircraft had come to 6 to 7° body angle when she looked out for the second time. According to the cockpit crew the lorry had been sighted 4 to 5 seconds before the impact, which means at CVR time 32:30. In other words the lorry was first seen about 6 seconds after the rotate call. As stated by Captain Rao (Wt.17) the aircraft will lift off in 4 to 5 seconds after rotation. Thus the lift off should have occurred at 32:28 i.e. before the lorry was sighted. If the lift off had taken place at 32:28, the aircraft would have already achieved a height of atleast 35' above runway level over the road at the time of sighting the lorry. In such an event, even on sighting the lorry, the P1 might not have "panicked" as stated by him. By merely continuing the flight he would have effected a take off climb without any cause for concern.

Numerous inconsistencies in the testimony of P1 and P2 when viewed separately as also when compared to each other exist. The late lift off has been belatedly explained by various theories such as pilot reaction time, requirement of application of additional input, disorientation on suddenly noticing the lorry and total

non-reaction of two full seconds due to panic. In the background stated above these explanations appear to be altruistic.

P1 was a slow and unclear witness. He took time, even to answer simple questions. His ability to comprehend questions, formulate his answers and level of professional knowledge and confidence was very low. He did not mind even equating rotation with lift off. He was a slow learner as is clear from his professional and training background as detailed in Exh.2. He failed even in the routine annual performance refresher test. He was required to be put through over 100 extra LOFTS. He had failed in the final route check. Capt Rao (Wt.17) not only has confirmed statement about him in Ex.2 but also explained the additional efforts and training required before P1 managed to get PIC rating.

Low level professionalism and slow responses of P1 led him to decide rashly that if he were to allow extra speed build up before initiating rotation, he would be able to tide over the situation. In the process, he did not almost certainly initiate rotation on rotate call. But left few seconds to pass. Allowing an extra second perhaps would have made no difference. But he consciously but recklessly took at least 5 seconds to initiate rotation and thereafter suddenly pulled the stick on noticing the lorry. All incorrect decisions. As Capt.Rao (Wt.17) put it, P1 ought to have continued the normal rotation even on noticing the lorry and in that case without doubt the aircraft would have been atleast 25' high over the Beed-Road even if with one engine after traversing 600'.

Some participants made a grievance about Pl choosing to have a rolling take off run. Advantages and disadvantages of a rolling take off as against static take off have been explained by Capt.Rao (Wt.17). IA policy allows full discretion to the Pilot for either rolling take off, or static take off. Pl cannot be faulted for exercising discretion in a particular manner especially when he had taken care not to lose any length of runway.

Pilot error accounts for more aircraft accidents than any other cause. Pilot carries the highest risks and responsibilities. Consequently, highest level of skill and safety is demanded from him. Facing unexpected emergencies is a part of his highly sophisticated profession. No doubt even a pilot does not cease to be human being and is bound to be distracted by an unexpected emergency. But "panic" is an abhorrent word for him. Continuation of panic condition for long is quite obviously a dangerous situation. In this background, becoming panicky on suddenly noticing a running lorry on the road at the end of runway and remaining in that condition for two seconds in a vital take off phase was a clear example of total lack of professionalism in Pl. On his own showing he was an inefficient pilot.

As noticed earlier, two vital parameters of airspeed and altitude were missing from the foil in FDR and hence the Correlation Chart of FDR and CVR where lift off is estimated only from the not so reliable 'g' trace loses its significance especially when there is mass of other evidence to determine the point of lift off.

Can P2 be also faulted along with P1 is the next aspect. It is not possible to come to the conclusion that P2 had consciously concurred with the P1's incorrect actions and rotation technique and take off pattern. Though she was junior she had passed a polite but meaningful remark that "everything is fine only nothing should happen yahi hai bas". The system of functioning between P1 and P2 is such that one cannot reasonably expect the P2 to be more forceful. Her hands had gone instantaneously near the column on realisation of the incorrect action of P1 but P1 said "leave it, leave it" as is clear from CVR time 32:31. At CVR time 32:35 she remarked "shit, Sir what have you done". At CVR time 32:53 also P1 remarked "Leave it, leave it". In the entire background to expect her to take charge of the situation from P1 would be too unrealistic.

There certainly exists one aspect which needs consideration and that is about her supporting the wrong stand of P1 in the testimony. She could have easily deserted her senior in this Inquiry by passing the whole buck upon him, but she chose a risky course of supporting the senior colleague. Her attitude as a human being may be worth appreciating but not as a responsible First Officer who is expected to disclose whole truth in such inquiries which are held in larger public interest of taking measures to prevent the recurrence and colossal loss of human lives. Public interest ought to have prevailed over other personal considerations. But ideal is not always practical in life.

To conclude this point, there was Commander's error but not First Officer's error. The error was a delayed initiation of rotation and following wrong rotation technique in the take off.

B.1.5 Have the weather conditions - such as wind shear, temperature and/or down draft adversely affected the aircraft performance?

Schedule time of the arrival of the flight at Aurangabad was 1205 hrs. It arrived at 1230 hrs, 25 minutes late. Metar reports received from ATC, Aurangabad (Exh.69) indicated to weather as follows at 12:30 hrs (0700 UTC).

Winds 140/07 kts. viz 8 Kms
Clouds 4/8 2500' (750 m)
Temp. 38, DP 17, QNH 1012 HPa (29.90 in)

The flight departed at 1305 hrs (IST). At this time the Metar of 1300 hrs (0730 UTC) was available. The said Metar was as under :

Winds 180/06 kts, viz 8 Kms
Clouds 2/8 2500' (750 m)
Temp. 39, DP 17, QNH 1011 HPa (29.88 in)

Mr. Sathe (Wt.11) was performing ATC duties at the material time and it is clear that following Meteorological information as available at 1200 hrs (0630 UTC) was passed to Pl.

Winds 210/05 kts, viz 8 Kms
Clouds 4/8 2500' (750 m)
Temp. 38, DP 17, QNH 1012 HPa (29.90 in)

As per the evidence, the winds between 1200 and 1315 hrs ranged from 3 to 12 kts. and the direction was varying. DIWE revealed that from 1200 hrs till 1330 hrs

the winds were variable both in speed and direction and the winds prevalent were shifting from North-East to South-East. The CVR recording at times 12:26, 12:29, 12:52, 13:00 mentions that at the time of approach/landing by the flight to Aurangabad the winds were gusty and the aircraft had experienced a sink, but that sink was neither significant nor abnormal. Cockpit crew chose not to report even though they are required to report wind shear condition. Aurangabad does not have any instrument to detect low level wind shear. Accordingly, wind shear cannot be detected on instrument and the same can only be experienced by the aircraft.

P1 has stated in the earlier statements to the Inspector of Accident that the aircraft's failure to lift could be the consequence of wind shear/weather phenomenon. However, both during the take off and even subsequently, neither P1 nor P2 referred to any steep falling off of air speed. ASI would drop suddenly in case of a wind shear. In the CVR transcript, after the rotate call, there is no reference to retardation by weather phenomenon or wind shear. At the stage of oral evidence and oral hearing, this possibility, so seriously advanced earlier, was only half-heartedly put forward. There is no other evidence also to hold that there was a phenomenal change in the weather condition so as to contribute to the degradation of the aircraft's performance. Indeed, there is evidence to the effect that the weather was clear.

The conclusion is thus inevitable that there was neither wind shear nor down draft at the material time. Temperature at the runway must have been high, but this was to the knowledge of P1.

B.1.6 Was the Aurangabad airport and its surroundings properly maintained?

Two aspects are highlighted (i) Absence of fixed distance markers on the runway (ii) unregulated/unnotified mobile traffic on Beed road beyond the boundary wall of the aerodrome.

There were fixed distance markings on the runway surface. They have specific pattern and distance criteria. The fixed distance markers were not there on or before the date of accident. Afterwards they have been installed. These markers are short structures on the runway sides beyond the edge showing the distance left for the end of that runway. Installation of these markers are not mandatory under AIC. ICAO does not recommend. But they are certainly useful. Because of insistence of ICPA, now a policy decision has been taken to install them at all airfields. It is stated that its absence contributed to the accident in question because the P1 had no means to know the length of consumed runway in the take off. This is not correct. Capt. Rao (Wt.17) and others have stated that there was no time/distance criteria for attainment of V1 & Vr. P2 has admitted that these markers are more useful for landings. For all these reasons, it cannot be said that absence of these markers has in any way contributed to this accident.

The NAA has taken over the airport in 1986 after its formation under the National Airports Authority Act 1985, which has come into force with effect from 1st June, 1986. Before that it was managed by DGCA. The NAA was duty bound to assess and limit obstacles to aircraft operations even in the immediate proximity of the

aerodrome. Aurangabad airport has only one runway at orientation 09/27. Annexure-I is the chart of Aurangabad airport from Jeppesen Manual. The runway is 6000' in length and 150' in width. Since 1974-75 before which runway length was 4500', TORA is 6000' for both the runways. At the end of runway 09 there is a clear way of 360'. TODA for runway is thus 6360'. ASDA and LDA are 6000' for both the runway. There is no stop way at either ends. Runway end lights on runway 09 are situated at 6011'. There is a clear way of 329' comprising of a paved surface of 184' and unpaved surface of 145'. Immediately thereafter there is a boundary wall. The distance between the boundary wall and the middle of the Beed road is 50'. The level of the Beed road is 4.9' below the runway end level. Top of the wall is below the runway end level. Under the ICAO Annexure 14 which has been expressly made applicable to India under AIC 7 of 1976 dated 31st March, 1976 (Annexure-J), the obstacle Clearance Plane is a surface starting from the end of clear way. The obstacle clearance plane is at an inclination of 2% (1:50) and any object which protrudes above this plane is considered an obstacle which is required to be limited/removed if possible. Obstacle Charts are required to be prepared for all airports and any object including mobile traffic which protrudes above an inclined plane of 1.2% is required to be noted in the Obstacle Chart of the airport. The existence of obstacles are also noted in the AIC/AIP for that airport.

If there is change in the situation depicted in the obstacle chart and AIC/AIP or if there is a new obstacle which is not depicted on the obstacle chart, the Airport

Authority is required to issue a NOTAM bringing the same to the notice of the airlines or the aircraft operators. From 1985 the obstacle charts are prepared by the NAA but are issued under the authority of DGCA after they are received from the NAA. The assessment and limitation of obstacles is under the purview of the NAA's Directorate of Air Routes & Aerodromes. Regular surveys of the areas in the vicinity of the aerodrome are required to be conducted. As per the DARA(O) circular mobile traffic on a road is taken as having a height of 5.5 meters (approx. 18') for the purposes of obstacle limitation and/or issuance of NOCs. Beed road is 4.9' below runway end level and the centre of the Beed road is situated 50' from the clearway and about 200' from the end of basic strip. If the obstacle clearance plane is computed from the end of the clearway, mobile traffic would protrude 12.1' above the obstacle clearance plane ($18 - 4.9 = 13.1 - 1 = 12.1$ ft.) and has a gradient of 26% against the permissible 2%. If the obstacle clearance plane is computed from the end of basic strip, mobile traffic would protrude 9.1' above the obstacle clearance plane ($18 - 4.9 = 13.1 - 4 = 9.1$ ft.) and have a gradient of 6% against the permissible 2%. The height of mobile traffic is to be computed at 12' only as indicated by Mr. Mahalingam (Wt.12). The traffic would protrude 6' or 3' above the obstacle clearance surface commencing from the clearway or the basic strip respectively and would have a gradient of 14% or 3% against the permissible 2%.

Drop barriers were installed on both sides of the Beed road sometime in 1975 to regulate traffic from

plying on the road during aircraft operations and the said barriers were in use till about 1985. Obstruction Chart 9/1977 (Exh. 20) was prepared while Aurangabad airport was under the control of the DGCA and at a time when traffic on the Beed road was restricted during the aircraft operations. The Obstruction Chart shows barriers on the Beed road and accordingly shows no obstructions for take off from runway 09. AIC 16/1986 pertaining to Aurangabad (Exh. 72) accordingly does not disclose the existence of any obstruction for take off from runway 09. Sometime during 1985 the practice of regulating traffic along the Beed road during aircraft operations was stopped. For the next several years the NAA and its officials not only failed to take any steps to regulate the traffic on the Beed road but also failed to notify the DGCA and aircraft operators that contrary to the AIC and the obstacle chart (which depicted regulated traffic), traffic on the Beed road was not being restricted during the aircraft operations. In 1988 survey of Aurangabad airport was conducted. No change was made to the published obstacle chart or AIC. In September, 1991, Senior Aerodrome Officer, Aurangabad forwarded to the DGCA information for the updating of AIC 8/86. Even at this juncture either the NAA or the Aerodrome Officer failed to inform the DGCA that the obstacle chart and AIC did not reflect the correct picture about non-regulated traffic. In April 1992 an obstacle survey of Aurangabad airport was conducted. the survey map showing all the obstacles in a tabulated form was

placed before the DARA(O) in October, 1992. The survey map clearly showed that mobile traffic on the Beed road constituted first impact obstacle protruding 2.836 meters (9') above the obstacle clearance plane. On enquiry being made the surveyors categorically informed the DARA(O) that traffic on the Beed road was not being regulated during aircraft operations as is evident from Exh.65 September 1992 survey map of the aerodrome and the testimony of Mr.Mahalingam. No steps were taken in the matter of either limiting the obstacle by arranging for regulation of the traffic during aircraft operation or notifying the DGCA and aircraft operators that the AIC and the obstacle chart did not correctly reflect the ground reality vis-a-vis the existence of mobile traffic on the Beed road. Mr.Mahalingam agreed that if traffic on the road was an obstruction and was required to be regulated it would be the duty of the NAA to take up the matter with the appropriate local authority for the erection of barricades on the road. He further agreed that once the NAA had learned that the obstacle chart OBS 9/1977 did not correctly reflect the actual position regarding the traffic on the Beed road, the NAA should have issued a NOTAM or revised the chart. Nothing was done. A policy decision was taken to ignore the matter on the ground that the obstruction was marginal. In the cross-examination, Mr.Mahalingam admitted that the traffic as depicted in the NAA survey could not be considered as marginal.

During April, 1993, the NAA officers posted at Aurangabad comprised Mr.Ghate, Senior Aerodrome Officer, Mr.Sathe, Aerodrome Officer and two Assistants. It is clear that none of them was either aware of their duties or responsibilities in the matter of assessing and

limiting the obstacles or refused to bother themselves on this subject. According to Mr.Ghate (Wt.10), it was not the duty of NAA officers at Aurangabad to examine whether anything constituted an obstacle or not. Mr.Ghate agreed that if he found an obstacle not disclosed in the AIC he was duty bound to caution pilots and also attempt to have the same removed. He agreed that from survey chart (Exh.65) he was aware that mobile traffic on the Beed road constituted first impact obstacle not disclosed in the AIC. Mr.Ghate's stand is that he was concerned only with area within the aerodrome boundary walls and was not concerned with anything beyond it. He agreed that before keeping watch he was required to study the Aurangabad obstacle chart OBS 9/1977 and that if he had seen the chart he would have realised that traffic on the Beed road was required to be regulated as the traffic on the Beed road would constitute an obstacle and that his earlier statement to the contrary was incorrect.

In the RTOW chart for runway 09 there is no provision for such an obstacle. Aurangabad is a short field runway and it has been shown that an obstacle of 7.1' situated 400' from the runway end would result in reduction by 600 Kgs of the climb RTOW.

As late as in September 1992, survey was conducted by NAA. Survey report (Exh.65) shows that the mobile traffic on the road has been shown as first impact point. In spite of the gates being shown on all obstruction charts of Aurangabad airport and the officials of NAA being aware that traffic was not being controlled in the course of daily aircraft movement, NAA did not change or cause to be changed the AIC of Aurangabad airport Exh.72. It is pertinent to notice that

The AICs of certain other airports such as Jaipur where mobile traffic on the roads immediately outside the vicinity of such airports is operating, reflects the mobile traffic as obstructions in approach and take off areas as is clear from AIC Exh.74. Mr. Mahalingam has admitted that the DGCA was not informed that there was a change in the ground situation regarding the existence of unregulated traffic on the Beed road. Mr. Sathe (Wt.11) has admitted that it would be his duty to report any obstacle within 20 Kms radius of the aerodrome and that he realised that it was a mistake not to anticipate moving traffic as a hazard.

Under all these circumstances, the conclusion is inevitable that there has been a failure and neglect on the part of the NAA in not regulating the traffic on the Beed road during aircraft operations. In any case the absence of regulation of mobile traffic ought to have been shown in the obstacle charts. Atleast NOTAM about the changed condition of unregulated mobile traffic ought to have been issued.

IA's submission is that had correct position been disclosed, the climb RTOW would have been reduced by 600 Kg. since Aurangabad is a short field runway and had an obstacle of 7.1' (12 - 4.9) situated 400' from the runway. According to IA, P1 planned his take off profile and speeds on the basis that there was no obstacle in the take off path during the first segment and this feature had contributed to the accident. This submission is not correct. It cannot be said that either IA or the ICPA or cockpit crew operating from Aurangabad airport had no knowledge of the existence of unregulated mobile traffic on the road. P1 has stated in his testimony that he had

operated from Aurangabad several times before, when it did occur to him that the traffic on the Beed road could be a hazard. ICPA Regional President Capt. Ashar (Wt.22) has also admitted that he had himself operated from Aurangabad several times and had seen moving traffic on the said road from the flight. Mr. Surender Kumar (Wt.7) in his testimony, has made no secret of the fact that during his duty at the Aurangabad the feature of not putting the cross bars on the Beed road did strike him, there was discussion about this feature between the officials of IA at Aurangabad but he did not bring this to the notice of any one. It is unfortunate that even an active body like ICPA has failed to take up this serious matter with the appropriate authorities for number of years. Everyone showed indifference towards this serious matter and is now trying to pass the buck on the other.

Stoppage of practice of regulation of mobile traffic is a typical and classic example of communication gap/absence of interaction between the high officials as well as the responsible public bodies. Some times the price of an indifferent and callous attitude can be heavy. Nation as well as individuals had to pay it in this case. It may however be mentioned that after the accident the traffic has been regulated during operation timings by the NAA with the aid of local police.

The NAA has raised certain legal issues. One is that AIC No. 7 of 1976 issued by DGCA applying the standards and recommended practices contained in ICAO Annexure 14 has no legal force. India is a Member State of the ICAO. A large part of the law relating to Civil Aviation is directly or indirectly derived from provisions of conventions on international aerial

navigation. They are in the nature of multilateral treaties between States and form part of our municipal law to the extent they are applied to India by our laws. In this context, Sections 4, 5 and 5A of the Aircraft Act, 1934 and Rule 133A of the Aircraft Rules 1937 framed thereunder are relevant. Section 5 refers to the general rule making power of the Central Government. Sections 4 & 5A & Rule 133A are reproduced below for ready reference.

"4. Power of Central Government to make rules to implement the convention of 1944- The Central Government may, by notification in the Official Gazette, make such rules as appear to it to be necessary for carrying out the Convention relating to International Civil Aviation signed at Chicago on the 7th day of December, 1944 (including any Annexure thereto relating to international standards and recommended practices) as amended from time to time."

"5A. Power to issue directions- (1) The Director General of Civil Aviation or any other officer specially empowered in this behalf by the Central Government may, from time to time, by order, issue directions, consistent with the provisions of this Act and the rules made thereunder, with respect to any of the matters specified in clauses (b), (c), (e), (f), (g), (h) and (m) of sub-section (2) of section 5, to any person or persons engaged in aircraft operations or using any aerodrome, in any case where the Director General of Civil Aviation or such

other officer is satisfied that in the interests of the security of India or for securing the safety of aircraft operations it is necessary so to do.

(2) Every direction issued under sub-section (1) shall be complied with by the person or persons to whom such direction is issued."

"133A. Directions by Director General - The Director General may, through Notices to Airmen (NOTAMS), Aeronautical Information Circulars (AICs) Notices to Aircraft Owners and Maintenance Engineers and publication entitled civil airworthiness requirements, issue special directions not inconsistent with the Aircraft Act, 1934 (22 of 1934) or these rules, relating to the operation, use, possession, maintenance or navigation of aircraft flying in or over India or of aircraft registered in India."

By virtue of authority conferred by Section 4, Rule 16 of the Aircraft Rules has been made and Schedule IV to the Rules contains such of those ICAO annexures which are made statutorily binding in the country. Annexure XIV does not find place in that schedule. The submission is that the only way to enforce Annexure XIV is through special provisions meant for the topic contained in Sec.4 of the Aircraft Act and no other. Based on this very reasoning is the next submission that Rule 133A is ultra-vires the Act. The submissions cannot be accepted. Section 5A empowers the DGCA or any

other specially empowered officer to issue by an order binding directions with respect to any of the matters specified in Clauses (b), (b) to (h) and (m) of subsection (2) of Section 5. The only limitation put on the directions is that they should be consistent with the provisions of the Act and the Rules made there under. Any order under Section 5A which is not inconsistent with the provisions of the Aircraft Act and the Rules made there under is valid and the only fact that such order pertains to the ICAO Annexure would make no difference. Rule 133A is quite specific. It does not violate the source of its existence viz. Sections 5, 7 & 8(2) of the Act.

It is contended that when a statute prescribes a method to do certain act or thing it can be done only in the manner prescribed and in no other manner. In support of this proposition my attention was drawn to some decisions including the well known case of State of Gujarat vrs Shantilal Mangaldas AIR 1969 SC 634. The context of the decision is altogether different. Basic principle is well settled but it cannot be applied in a vacuum. All depends upon the letter as well as spirit of the enactment concerned. The purpose & whole scheme of the enactment has to be kept in mind and various provisions are to be read together and not in isolation. So read, required authority in the DGCA is ample. It is clear that DGCA can issue special directions even on matters covered by any ICAO Annexure and bring it into force even though it is not made applicable by the Central Government through rule making power, provided the directions are not inconsistent with the Act or the Rules. AIC No.7/1976 is one such valid direction and has binding effect. Indeed it is so treated and acted upon

by the NAA so far and it is too late into the day to question its validity.

The second legal submission is that the Beed road, being outside the boundary wall of the airport could not be regulated by the NAA under the National Airports Authority Act, 1985 and the Rules & Regulations made there under and hence it was not a part of its legal duty to regulate it. Section 2(i) of the NAA Act states that words and expressions used in the Act but not defined shall have the meaning assigned to them in the Aircraft Act. Section 12 of the said Act specifies the functions of the NAA. Section 12(3)(c)(j)(o) & (p) are relevant. Section 33(1) is important. It reads thus :

"33.(1) The Authority or any officer specially authorised by it in this behalf may, from time to time, by order, issue directions, consistent with provisions of the Aircraft Act, 1934, and the rules made thereunder, with respect to any of the matters specified in clauses (f), (h), (i), (j), (k), (m), (p), (qq), and (r) of sub-section (2) of section 5 of that Act, to any person or persons engaged in aircraft operations of using any aerodrome of civil enclave, in any case where the Authority or the officer is satisfied that in the interests of the security of India or for securing the security of the aircraft it is necessary to do so."

Section 38 is the Regulation making power. Section 38(2)(h) empowers the NAA to make regulations providing for "securing the safety of aircraft, vehicles and persons using the aerodrome or civil enclave and

preventing danger to the public arising from the use and operation of aircraft in the aerodrome or civil enclave".

At this stage the definitions of the words "Manoeuvring area" and "Movement area" given under Rule 3 of the Aircraft Rules call for attention. They respectively read as under :

"manoeuvring area" means that area of an aerodrome which is to be used for the take-off and landing of an aircraft and for the movement of aircraft associated with the take-off and landing.

"Movement area" means the area of an aerodrome which is intended for the surface movement of an aircraft and includes the manoeuvring area and aprons.

The Beed road just touching the boundary wall cannot fall outside the area controllable by the NAA. Indeed it was never so treated so far. Mr. Sathe (Wt.11) has ultimately agreed that it was his duty to report any obstacle within 20 Kms radius of the aerodrome.

My attention was invited to Section 9A of the Aircraft Act pertaining to the power of the Central Government to prohibit or regulate construction of buildings, planting of trees etc and so also Section 13 of the Indian Railways Act which provides that the Central Government may require that, within a specified time suitable gates, chains, bars stiles or hand-rails be erected or renewed by the railway administration at places where railway crosses a public road on the level

and further that persons be employed to open and shut such gates, chains or bars etc. It is true that no such specific power is to be found in the NAA Act. It is also true, as rightly contended on behalf of the NAA, that the NAA Act is vague and unclear leaving scope for avoidable controversies and waste of public time and money in resolving them and that it deserves to be dressed up properly by legislative amendments. But this desirable feature will have no effect on the matter at hand. Hence it is clear that the NAA had failed to maintain the Aurangabad airport's surroundings properly.

B.1.7. (a) Does the Aurangabad airport require improvement?

(b) If yes, in what manner?

Aurangabad is a major tourist centre on international map and attracts rush of not only national tourists but also international tourists. It is also a fast developing industrial town. Many times there is a rush of air passengers. Aurangabad's climate is generally hot. In Summer season it is extremely hot and this season lasts for a long time. Flights operate also in the noon time when temperature is at its peak. It has short runway. There were occasions when the Commander refused to fly the aircraft without off loading either the passengers or the cargo, as a result the flight was delayed. Mr. Anil Shah (Wt.26) has given account of his frustrating experience on 16th April, 1993 on the very flight at Aurangabad. Capt. Tyagi refused to fly due to over loading. There was continuous delay and flight took off only after passengers were off loaded twice. The

first improvement that is needed is the extension of runway, preferably towards beginning of runway 09 and by additional 3000' and/or shifting of the Beed road at the end of 09. It is stated that mushrooming of constructions adjoining the runway is of great magnitude. This also needs be checked forthwith.

The mobile traffic on Beed road adjoining the boundary wall was initially regulated for number of years during flying hours but since 1985 or so, the regulation had been stopped. Now, the stop barriers have been installed and the traffic is being regulated. This practice must not be stopped until the ground situation is materially altered. The fact that there are practical difficulties in guarding the barriers is no reason to be slack in the performance of duty.

Airports are designed and constructed to provide relief and comfort to passengers after flying in a cramped, uncomfortable flying machine. Airports all over the world are conceived as technological dream spaces, equipped with the latest array of electronic and mechanical equipments and presenting a dazzling spectacle of modern transport. In India passenger terminals often resemble rural railway stations and the facilities available or rather the lack of them do not present a good picture of the country's civil aviation record. It is true that ideal is not always practical since there are many constraints, but the goal has to be ideal. All improvements cannot be made in a day or two and will have to be done in phases but beginning has to be made.

Aurangabad airport needs extension and modernisation. Even the ordinary facilities are sadly

lacking. During our team's first visit to Aurangabad, we noticed that the view of the runway 09 and Beed road from the ATC tower was hazy because the glass was not transparent and this had to be brought to the notice of the tower officer. Fixed distance markers were not installed at the time of accident, but now they have been installed. It is necessary to provide ATIS broadcast service to ensure that latest weather and other information is available to the cockpit crew. Modern landing system should also be installed. No doubt all this requires finance which is scarce but from the long range point of view this may be more economic and profitable.

B.1.8. Were adequate post-accident actions taken by the crew, the Indian Airlines, the National Airport Authority or local authorities?

Fire fighting team at the airfield was in the state of preparedness during the take off stage. This is clear from the fact that even before crash siren was heard, Mr. Gosavi (Wt.13) on seeing something falling off from the underside of the aircraft, started off with his vehicles in the general direction of the aircraft. Several passengers and the surviving cabin crew have stated the CFTs and ambulance reached the scene of crash within a few minutes.

Fire service for this flight was of the required category V as per IA Operations Manual. Aurangabad airfield has Cat.V fire service. Mr. Sathe (Wt.11) testified that earlier in the day because one CFT had started giving trouble the category was wrongly brought down to IV. The earlier flight IC-492 was accordingly

forewarned before landing and the flight was operated. After discussing with Mr. Gosavi, Mr. Sathe subsequently realised that even with the remaining CFT the category could be maintained at V because of its capacity and the nature of the foam used. Accordingly during the operation of the illfated flight IC-491, the fire service was of category V. As a matter of fact even the CFT which had earlier given trouble was put into operation a little later. The local authorities such as Police, Municipal Corporation, all reached the spot with their men and machinery within reasonable time and took all reasonable steps which were possible under the circumstances to remove injured to the hospital. There was great confusion and consequent delay no doubt, but not major failure to take actions.

Some passenger witnesses made a complaint about the cold indifference of the crew barring the cabin crew Mrs. Dabas (Wt.6), towards them after they came out on the ground. It is in evidence that cabin crew Mr. Nim (Wt.9) had himself become injured. Hence he could not have helped much. According to the witnesses, P1 was just standing in silence in a corner after jumping out from the cockpit window. P1's statement is that he jumped inside the cabin from the front door to save passengers. Evidence about P2's role is conflicting. There is no clear evidence to find fault with the crew on this aspect.

There was some debate also about the cockpit crew not declaring emergency after the aircraft hit the lorry. This was primarily and essentially a duty of P1. One view point was that emergency ought to have been declared. The other was that it was risky since there would have been a panic in the cabin which would have

perhaps led to more damage and that there was really no time. Both the points of view are quite balancing. In this situation, benefit of doubt has to be given to the cockpit crew on this aspect.

Thus taking overall picture in view, this point will have to be answered in the affirmative.

B.2 OTHER OBSERVATIONS:

Capt. Mulherkar (SOL) was a factor in the accident. The existing IA's system of no reservation, no waiting list for SOL passengers is most unsatisfactory, counter productive, embarrassing and impractical. It often has a strain on the healthy relationship that is necessary between employer and employee. Situations like the one which have arisen in this case viz requirement of out of way accommodating and obliging a colleague in violation of the policy must be commonly arising. Feeling of brotherhood and mutuality of interest is human. This leads to temptation to cut corners in order to accommodate a colleague and indulgence in practices which are not conducive to the safety of operation of flight. Leave Travel Concession by rail/road is not available to IA employees, even as an alternative in lieu of free/concessional air passage. From the above entitlement it can be seen that there is no way in which the staff can plan its holidays due to uncertainty of availability of flight. The situation of SOL being required to come to the traffic counter to ascertain if there is any seat available after all the fare paying passengers are checked-in, is very awkward. Embarrassing situations of going through frustrating experience of carting the family including children to the airport and drawing blank at the last minute because the ticket is 'subject to load' have to be dispensed with. Denial of

the seat in the very airline in which one is working cannot create goodwill for the employer. Undoubtedly, huge finance is involved considering the large number of employees but proper balance can be struck, if necessary, by giving reduced number of confirmed concessional tickets or by giving option to have Leave Travel Concession by other transport.

The IA Pilot training leaves much to be desired. Even Sivaraman Committee Award states :

"IA should meticulously examine indepth the existing training procedures in the Central Training establishment, Hyderabad, in such a manner that discipline to observe meticulously rules and regulations during flights is inculcated among pilots."

Training by mock exercises for evacuation in unexpected emergencies does not exist. This has a potentiality of panic situations when such emergencies actually arise, as happened in this case. One passenger Shilpin Patel (Wt.21) could though with great difficulty and in an injured condition, come out of rear exit but air-hostess Mrs.Laxmi Raman Yadav could not even open her seat belt and met with an unfortunate death in a hanging position tied to the seat belt when the rear fuselage turned up side down.

Moreover, it seems to me that saree is not a very proper dress for the air-hostess. It can create difficulties in emergency operations and hence alternate dress, preferably Salwar-Kameez, can be thought of for them.

P1's poor & dismal record of training has been already noticed. He seems to a "pushed up" candidate. Extra care ought to have been taken before issuing to him a PIC grade. No attention seems to have been paid to his record even thereafter. He was freely allowed to operate even on critical airfield like Aurangabad and that too in hot summer. This was an undesirable feature.

There have been repetitive snags in certain spare parts. Maintenance of spare parts leaves much to be desired. Disengagement of two styluses in the FDR from the very beginning was an unfortunate classic example of absence of work ethics. No proper explanation about the circumstances in which that could happen is forthcoming. It is extremely necessary that CVR and FDR are periodically monitored for ensuring compliance with safety rules.

Heavy hand baggages were freely allowed in the flight. More effective control and regulations pertaining to checked-in as well as hand baggage is necessary. Large size hand baggage is a safety hazard as it blocks the emergency exit passages. It can also result in over-loading since the average weight of hand baggage taken into account is only 4 Kgs. Hand baggage limit of size 115 cm (sum of length, breadth and height) should be strictly enforced and the airport security should be entrusted with this responsibility as the airlines may not be in a position to enforce it. A basket type measure /device of appropriate size i.e. 115 cm. total of length, breadth and height should be provided at the airline's check-in counter as is done by some foreign airlines. Only that hand baggage which can fit in that measure and no other, should be permitted.

No passenger could open exit window. Pre-flight briefing of passengers, particularly those seated near location of exits should be strictly enforced and it should be assured that only those passengers who can operate the emergency exit be allowed to sit near those exits.

Agitations are started by the ICPA at the drop of a hat even on smaller personal issues without bothering for passengers convenience, but the public issue like unregulated mobile traffic on Beed road was never taken up though that feature was well known even to the Pilots and the ICPA.

Evidence on record clearly establishes the total communication gap between officials of the NAA about regulation of mobile traffic on Beed road. Each has tried to pass the buck on the other. Responsibilities of the officials are not fixed and specified and this is one of the causes for undesired situations. There is also a communication gap between different public organisations like the IA & NAA. Work culture/ethics is also lacking leading to disasterous results. Serious attention to improve upon the fast deteriorating conditions has to be paid by all concerned, failing which credence will be provided to current propoganda of the IA being at the lower rung of performance record as compared to other airlines.

I am informed that several recommendations made in earlier Reports under Rule 75 of the Aircraft Rules (which have been accepted by the Government) have not been implemented despite lapse of considerable time. Constitution of Court for Inquiry is not just an empty

formality to be performed. There is no use of having these Inquiries in case even the accepted recommendations are not implemented. There has to be an inbuilt mechanism to implement them.

PART - IV

C. CONCLUSIONS

C.1 FINDINGS :

1. There was no defect either in the aircraft or in the engine performance.
2. There was no sabotage by explosives or otherwise.
3. The aircraft was over-loaded. Its extent was about 1 ton. However, this over-loading as such did not contribute in degrading the performance of the aircraft.
4. There was Pl's error in initiating delayed rotation and in following wrong rotation techniques.
5. Weather condition did not affect the aircraft's performance.
6. Aurangabad airport and its surroundings were not properly maintained. The NAA failed to perform its duty of regulating mobile traffic on the Beed road during aircraft's operation. The NAA also failed in not showing the unregulated traffic in the Obstacle Charts and also not issuing NOTAM about stoppage of practice of regulating traffic.
7. Aurangabad airport requires improvements. Those improvements include (i) extending the runway

length preferably by additional 3000' (ii) making permanent arrangement about regulating the traffic on the Beed road, and (iii) providing modern facilities at the airport considering Aurangabad's importance as an international tourist centre and developing industrial town.

8. By and large adequate post-accident actions were taken by the NAA and others.

C.2 CAUSE OF ACCIDENT :

Causes of the accident were (i) Pilots' error in initiating late rotation and following wrong rotation technique, and (ii) failure of the NAA to regulate the mobile traffic on the Beed road during the flight hours.

PART - V

D. RECOMMENDATIONS

1. Urgent steps for implementing the accepted recommendations made in the earlier Reports should be taken.
2. The National Airport Authority Act 1985 should be suitably amended, inter-alia by incorporating specific provisions on the lines of Section 13 of the Indian Railways Act, for regulation of mobile traffic as regards roads close to the runways.
3. AICs/Obstacle Charts for all airports and the conditions prevalent at such airports and their vicinity should be jointly reviewed annually by the NAA, DGCA and the Operators.
4. The Senior Aerodrome Officer at the airport should be expressly entrusted with the duty of assessing, noting and limiting the obstacles in the vicinity of that airport.
5. The Senior Aerodrome Officer should also be required to carry out the regular surveys in the area of vicinity of the airport and must be required to forthwith communicate the NAA Headquarters and the Operators, the existence of obstacles not noted in the AICs/Obstacle Charts.
6. The NAA must communicate to the DGCA and all Operators of any obstacle which is not noted in

the AIC/Obstacle Chart and pending that, must forthwith issue NOTAM regarding the existence of the same.

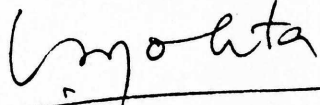
7. The Senior Aerodrome Officers and ATC officers must be trained in all respects of the assessment and limitation of obstacles.
8. The clarification should be made to indicate the precise duty and power of the DGCA, NAA and Government in the matter of control and limitation of obstacles in the vicinity of an airport.
9. Runway of Aurangabad airport should be extended preferably by additional 3000' towards beginning of runway 09. Airport should be modernised by providing modern landing systems & ATIS broadcasts service to ensure that the latest weather and other information is made available to pilots.
10. Beed road should be shifted. Permanent suitable arrangement to regulate the mobile traffic during flight hours should be made.
11. Since the statutory Notification SO-988, dated 5th January, 1988 issued by the Government of India does not either specifically refer to the clear way or give any special definition of "clear way", the Notification should clarify the whole position including about the starting point of Obstacle Clearance Plane and/or about the point at which the aircraft should be at 35' height.

12. Extra care ought to be taken before giving grade of PIC in cases where the grade is made with difficulty.
13. Mock exercises for evacuation in emergencies should be provided for in the training of both cabin & cockpit crew by the IA.
14. Prescribed dress of air-hostesses should be changed since saree can create obstacle in emergency operations. Salwar Kameez dress or any other suitable dress may be better.
15. Hand baggage limit of size of 115 cm. (sum of length, breadth and height) should be strictly enforced and the airport security should be entrusted with this responsibility.
16. A basket type measure or device of appropriate size i.e. 115 cm. (total of length, breadth and height) should be provided at the airline's check-in counter as is done by some foreign airlines. Only that hand baggage which can fit in that measure and no other, should be permitted.
17. Greater inter-action between Operators, Crew, NAA and DGCA should be ensured to eliminate communication gaps resulting into the safety hazards.
18. Pre-flight briefing of passengers, particularly those seated near location of exit, should be enforced and it should be assured that only

those passengers who can operate the emergency exit, should be allowed to sit near those exits.


19. The record keeping of major components by IA should be computerised since it needs improvement in view of many discrepancies and repetitive snags noted.
20. The existing system of no reservation, no waiting list for SOL passengers should be suitably changed.
21. Work culture should be introduced in all the Organisations.
22. The Command endorsement given to Capt. S.N. Singh should be cancelled.
23. Co-pilot endorsement of Capt. S.N. Singh should be suspended for a period of three years.
24. Suitable departmental actions against all those who have failed in their duties should be initiated.

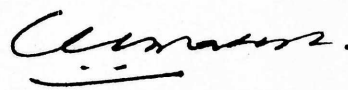
25. Mr. Gosavi, Senior Fire Foreman who, even without waiting for any instructions from higher up or for siren, promptly moved with CFT in the direction of the aircraft, should be suitably rewarded.



(V.A. Mohta)
Court

We agree


(S.N. Gupta)
Assessor



(V.V. Mahesh)
Assessor

Place : Bombay

Dated : 25th December, 1993.

PART - VI

ACKNOWLEDGEMENTS

All that remains is to acknowledge the guidance/help that I have received in conducting this formal investigation and in making this Report.

For a non-technical person like me this task - involving highly technical aspects - would have been impossible without the able guidance of Assessors Mr. S.N. Gupta and Capt. V.V. Mahesh - both stalwarts in their respective fields. I was immensely benefitted by their knowledge and experience. I am grateful to them.

Mr. L.A. Mahalingam, the Secretary to the Court of Inquiry is a silent and patient Administrator. Whole brunt of administration was on his shoulders. His frail personality bore the irksome burden without any sign of stress or strain. I thank him for all the timely as well as untimely troubles he has taken.

In Mr. K. Gohain, the Inspector of Accident, I found not only a very knowledgable person but a person brimful with devotion to work and sincerity of purpose. Hats off to his capacity for hard work. His approach to the investigation was extremely fair. He was a willing worker and I think I fully exploited him. All thanks to him for so willingly being allowed to be exploited.

The parties were represented by able lawyers. They rendered great help in conducting this Inquiry. Their professional skill and standard was of high quality

and the cup of co-operation was brimful. I am indebted to them for excellent legal assistance.

The Ames Research Centre (National Aeronautics & Space Administration), Moffett Field, Sanfransisco (USA) is a very busy Organisation burdened with much heavier national tasks. Yet, as before, it showed no hesitation to assist the Court in penetrating into human mind and behaviour in such crisis situations. Dr. Irving C. Statler, Chief of Aero Space Human Factors Research Division, helped a lot in making arrangement for the conferences with the experts on various fields under the able leadership of Dr. Key Dismukes, the Chief Scientist. No words would be sufficient to express my gratitude to them and other experts like Dr. Barbara G. Kanki, Research Psychologist Crew Factors Group, Mr. Linda J. Connell, Research Psychologist for presenting various possible human behavioural angles involved and rendering to us all the help and courtesies.

Boeing Co., Seattle rendered great help in this Inquiry by providing services of their engineering Simulator for the type aircraft. Company's able officials (i) Mr. John W. Purvis, Director, Air Safety Investigation & Flight Test, (ii) Mr. J. Dennis Rodrigues from Boeing Safety Investigation, (iii) Mr. James W. Kerrigan, Principal Engineer, Stability & Control & Aerodynamics, (iv) Mr. Peteris A. Galins, Lead Engineer, Performance Group, and (v) Capt. John H. Armstrong, Chief Pilot Air Safety, who flew the Simulator time and again, rendered help and guidance which proved to be very useful in the Inquiry. Our programme had to be re-scheduled which must have upset their schedule and caused

inconvenience to them. They all deserve highest appreciation. My sincere thanks to them for all the help and courtesies.

Various sub-groups were formed for different types of investigations, without which completion of this Inquiry would not have been possible. I am thankful to all those who were associated with the different onerous task of investigation.

IA staff at CTE, Hyderabad headed by Capt.R.P.Burnwal and assisted by Capt.M.V.V.Rao, showed to us the institution and its working. Capt.D'Costa flew the Simulator several times. I am thankful to them for all the assistance and courtesy.

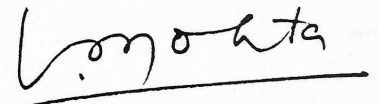
IA staff at Delhi & Calcutta workshop respectively headed by Mr.Jain and Capt.J.R.D.Rao showed to us their shops with great interest. I am thankful to them.

AVM H.M.Shahul (Member Operations), NAA took lead in showing NAA's Civil Aviation Training College at Allahabad. Principal of the college Mr.Raghavendra Rao and his team explained to us various features of the training aids, UNDP project, infrastructure, basic Radar, ATC Radar Control, Computer Hardware, special equipments like VOR, DME, etc. used in training. I am thankful to them.

Recording of evidence replete with technical words and phrases cannot be an easy task for those who are not familiar with those words and phrases. Evidence was recorded sometimes on non-working days, sometimes by

cutting short recess and sometimes even after regular Court hours. My Private Secretary Mr. R.R. Tapadia and Personal Assistant Mr. P.G. Kulkarni, who did that work and the work of typing the Report deserve special mention. Mr. K. Udayakumar, Stenographer, Office of the Director of Airworthiness, helped them in preparation of the Report. Mr. J.S. Chorge and Mr. K.M. More, Section Officers and other members of the staff worked hard. I record my sincere appreciation for all of them for putting such hard work and giving excellent co-operation without which completion of this difficult task within short time of 3½ months from the day of starting of recording oral evidence, would have been impossible.

Mr. H.S. Khola, DGCA is a well known figure. I had occasion to meet him in the course of this investigation. Hardly one comes across such a balanced and knowledgable personality. I cannot complete this exercise without recording the above indelible impression.



(V.A. Mohta)