CIVIL AVIATION DEPARTMENT

CIVIL AIRCRAFT ACCIDENT

Report on the Accident

to

Convair 880M VR-HFX

at Hong Kong International Airport

on

5th November, 1967

Price HK$7.50

C I V I L A V I A T I O N D E P A R T M E N T

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September, 1968.

Civil Aviation Department,
Accident Investigation Division,
Central Government Offices,
Hong Kong.

September, 1968.

Your Excellency,

I have the honour to submit the Inspector's report on the accident to Cathay Pacific Airways Convair 880M VR-HFX which occurred at Hong Kong International Airport on 5th November, 1967.

I have the honour to be
Sir,
Your obedient Servant,

R.S. Tomkins
Chief Inspector of Accidents

His Excellency the Governor,
Government House,
Hong Kong.

CIVIL AVIATION DEPARTMENT, HONG KONG
ACCIDENTS INVESTIGATION DIVISION

AIRCRAFT: Convair 880M VR-HFX. Engines: Four General Electric CJ805 - 3B.

OWNER: Cathay Pacific Airways, Ltd. Hong Kong.

CREW:

Captain	W.R. Jackson-Smith	Uninjured.
First Officer	I.P. Steven	"
Flight Engineer	J.K. Hickey	"
Check Captain	J.R.E. Howell	"
Senior Flight Purser	Chir Yung-mur	"
Flight Purser	Chen Chia-lun	"
Flight Hostess	Li Si-Yun	"
Flight Hostess	Lai-tak Chan	Slightly injured.
Flight Hostess	Lam Pui-sheung	Uninjured.
Flight Hostess	Warunee Werawatnapagool	"
Flight Hostess	Fumiko Kataoka	"

PASSENGERS: 116 - 1 killed
11 seriously injured
16 slightly injured

PLACE OF ACCIDENT: Hong Kong International Airport.

DATE AND TIME: 5th November, 1967, at 0235 hours. G.M.T.
(1035 hours Hong Kong Standard Time)

All times in this report are G.M.T.

SUMMARY

The aircraft was operating Cathay Pacific Airways (CPA) Scheduled Flight CX033 from Hong Kong to Bangkok but with an extra stop en route at Saigon. The take-off from Hong Kong was discontinued when severe vibration was experienced as a result of separation of a nose-wheel tyre retread, shortly before reaching V1. The aircraft failed to stop within the distance available, veered off the runway and over-ran the promontory to crash into the sea. The fuselage of the aircraft forward of the wing fractured in two places on impact and several persons were injured, one fatally. The probable causes of the accident were:

(i) loss of directional control developing from separation of the right nose-wheel tread;

(ii) inability to stop within the nominally adequate runway distance available due to the use of differential braking, impaired braking performance and an increase in tail-wind component and aircraft weight over those used in calculating the aircraft's accelerate/stop performance.

1. INVESTIGATION

1.1. History of the Flight.

The aircraft was operating CPA flight CX033 from Hong Kong to Bangkok but with an additional en-route stop at Saigon to carry a back-log of passengers.

Start up clearance was given at 0226 and the aircraft commenced to taxi out at 0231 for take-off on runway 13. A final wind check of 010/10 kts was passed by the Tower and acknowledged by the aircraft when take-off

/clearance.....

clearance was given. The crew did not consider this reported wind warranted alteration of the V1 speed which had been calculated as 135 kts using a nil-wind condition.

At 0234 the aircraft entered the runway at the extreme end and commenced take-off with a rolling start. First Officer Steven, who was piloting the aircraft from the left-hand seat, took the power to 1.5 EPR, after which the engineer took the engines up to maximum power. The aircraft accelerated normally but at a speed reported by First Officer Steven as slightly under 120 kts, a heavy vibration was experienced. The vibration increased in severity to such a point that F.O. Steven decided to discontinue take-off, called "abort", closed the power levers, applied maximum symmetrical braking and selected spoilers. Reverse thrust was selected some 4-5 seconds after the application of brakes, full power being applied throughout the rest of the deceleration phase.

The aircraft continued to run straight some distance after initial braking but then a veer to the right commenced. Opposite rudder was used but failed to check this, forcing the use of differential braking to the extent that eventually the right brake had been eased off completely and full left brake and rudder were being applied. This was only partly effective and the aircraft eventually left the runway and entered the grass strip. The turn to the right continued until finally the aircraft crossed the sea-wall heading 47° from the line of the runway and with a pronounced crab to the left.

The aircraft left the sea wall in a slightly nose-down attitude and still crabbing to the left. All four engines were separated on impact with the sea, the nose of the aircraft was smashed in and the fuselage above floor level between the flight deck and the leading edge of the wing was fractured in two places. The aircraft came to rest very quickly some 400 feet from the sea-wall and facing towards it, having spun to the right in coming to a stop. The two forward fuselage sections remained attached to the main part but sank fairly slowly to form an anchor in the mud 30 feet below the surface.

1.2. Injuries to Persons.

Injuries	Crew	Passengers	Others
Fatal	-	1	-
Non-fatal	1	27	-
None	10	88	-

1.3. Damage to Aircraft.

The aircraft was destroyed.

1.4. Other damage.

One high intensity elevated runway lamp was destroyed.

1.5. Crew Information.

The normal complement of two pilots was increased on this flight by the addition of a Check Captain whose duty was to monitor and assess the suitability of the other two pilots for higher appointments, the first officer's suitability for appointment to captaincy and the captain's suitability for appointment as Training Captain, both having completed the necessary training to fulfil these functions. For the purpose of the checks, the first officer was flying the aircraft from the left-hand seat whilst the captain occupied the right-hand seat and assessed his performance. The Check Captain occupied the jump seat behind the first officer from where he could monitor the performance of both pilots.

/Captain.....

Captain W.R. Jackson-Smith, aged 34, held a valid Airline Transport Pilot's Licence endorsed for Convair 880M aircraft, and a current instrument rating. At the time of the accident his total flying experience was 7,031 hours, of which 1,320 hours were in Convair 880. He completed an initial conversion course on Convair 880 aircraft in February, 1965, since when he passed proficiency and instrument rating checks within the prescribed periods. His last medical examination took place on 22nd August, 1967, and there were no limitations imposed. Captain Jackson-Smith had flown 71 hours and 14 minutes in the last 28 days, of which 16 hours and 9 minutes were flown in the last 7 days. He had been free from duty for a period of 49 hours and 50 minutes before this flight.

First Officer I.P. Steven, aged 34, held a valid Airline Transport Pilot's Licence endorsed for Convair 880M aircraft, and a current instrument rating. At the time of the accident his total flying experience was 6,812 hours, of which 1,107 hours were in Convair 880. He completed a conversion course on this type of aircraft in January, 1966, and flew this type of aircraft exclusively since then, passing proficiency and instrument rating checks within the prescribed periods. He commenced command training on 4th October, 1967, and had flown for 75 hours and 53 minutes in this capacity. His last medical examination took place on 12th September, 1967, and there were no limitations imposed. Mr. Steven had flown 71 hours and 49 minutes in the last 28 days, of which 13 hours and 40 minutes were flown in the last 7 days. He had been free from duty for a period of 41 hours and 22 minutes before this flight.

Mr. J.K. Hickey, aged 30, held a current Flight Engineer's Licence. He completed a course of training on the Convair 880 in September, 1967, and had flown 171 hours on this type of aircraft out of a total flying experience of 1,534 hours at the time of the accident. His last medical examination took place on 9th June, 1967, and there were no limitations imposed. Mr. Hickey had flown 46 hours and 56 minutes in the last 28 days, of which 2 hours and 35 minutes were in the last 7 days. He had been free from duty for a period of 57 hours and 43 minutes before this flight.

Captain J.R.E.Howell, aged 44, held a valid Airline Transport Pilot's Licence endorsed for Convair 880M aircraft and a current instrument rating. At the time of the accident his total flying experience was 19,567 flying hours, of which 2,658 were in Convair 880. He completed a conversion course on Convair 880 aircraft in 1963 and afterwards flew this type of aircraft regularly, successfully undergoing proficiency and instrument rating checks at the prescribed intervals. His last medical examination took place on 7th July, 1967, and there were no limitations imposed. Captain Howell had flown 80 hours and 47 minutes in the last 28 days, of which 13 hours and 40 minutes were flown in the last 7 days. He had been free of duty for a period of 41 hours and 22 minutes before this flight.

The pursers and flight hostesses had each been trained and examined within the last five months in their knowledge of emergency and evacuation procedures with satisfactory results.

1.6. Aircraft Information.

The aircraft, a Convair 880M, Serial Number 37, was manufactured by General Dynamics Convair, San Diego 12, California, U.S.A. The Certificate of Airworthiness issued by the Director of Civil Aviation, Hong Kong, on 18th November, 1965, was valid until 17th November, 1967.

Prior to its purchase by Cathay Pacific Airways in November, 1965, the aircraft had been operated and maintained by VIASA (Venezuela), and at the time of purchase had completed 5,799 hours flight time.

The aircraft was ferried to Hong Kong where a certain amount of

/work.....

work was carried out on it by Hong Kong Aircraft Engineering Co. Ltd., in order to modify it to Cathay Pacific Airways requirements and to integrate it into this companys continuous maintenance and overhaul system. The total airframe hours to the time of the accident were 11,369. A Certificate of Maintenance, dated 26th September, 1967, was issued by Hong Kong Aircraft Engineering Co. Ltd., valid for 60 days or 420 flying hours.

The last predeparture check was carried out by Hong Kong Aircraft Engineering Co., on 5th November, prior to the take-off during which the accident occurred. The certified maximum allowable take-off weight is 193,000 lbs. and the centre of gravity range from 21.4% to 32% MAC. The weight for this flight had been calculated by the Company's Traffic Office as 182,458 lbs and the centre of gravity as 28% MAC. However, the loading calculations have been subject to critical re-examination and one of the Saigon bound passenger's baggage was found to have been underweighed by at least 110 kilos. It is considered likely that other similar instances occurred in the cases of certain other Saigon bound passengers, and making allowance for these and all other factors, it is considered that the weight of the aircraft was in the region of 183,207 lbs i.e. 749 lbs in excess of that shown on the load sheet. At this weight the centre of gravity would be 27.9%.

1.7. Meteorological Information.

The routine half-hourly meteorological observation for the airport at 0230, i.e. five minutes before the accident, was:

Surface Wind	- 020° 10 knots with gusts to 20 knots.
Visibility	- 20 kilometres.
Cloud	- 1/8 2,500 feet 6/8 4,000 feet
Temperature	- + 23° C
Dewpoint	- + 13° C

At 0233 the surface wind was passed to CX033 by the Control Tower as being from 010° at 10 knots.

Five minutes after the accident the following special observation was made by the airport meteorological office:

Surface Wind	- 010° 12 knots
Visibility	- 20 kilometres
Cloud	- 1/8Sc 2,500 feet 6/8Sc 4,000 feet
Temperature	- + 24° C
Dewpoint	- + 14° C
Relative Humidity	- 53%
QNH	- 1014.6 millibars

The wind readings contained in the observations and that reported by the Control Tower, were taken from the anemometer at the northwest end of the runway. However, the hills and tall buildings surrounding the airport can cause considerable variation in wind strength on different parts of the runway, and on this occasion the enemometer at the northwest end of the runway was recording stronger winds than the apparently more exposed anemometer at the southeast end. The winds were:

Location	10 minute mean wind centred at commencement of take-off	Range of wind direction	Maximum gust.
Southeast end of runway	010°10 kt	350° - 030°	20 kt.
Northwest end of runway	360°13 kt	340° - 020°	23 kt.

/Based.....

Based on the mean winds there was a tail-wind component of 10 knots at the beginning of the runway reducing to approximately 6 knots towards the end of the runway. However, owing to the uneven terrain, the gust factor at Kai Tak is rather high, particularly with northerly winds and it is quite common for the maximum gust to be more than twice the mean wind over a short period of time. It is, therefore, feasible that the tail-wind effect on the aircraft was higher than indicated by the mean wind and that a mean tail-wind component of the order of 10 kts is a possibility.

1.8. Navigation Aids.

Navigation aids were not a factor in this accident.

1.9. Communications.

Communications with the aircraft were normal.

1.10. Aerodrome and Ground Installations.

Runway 13 is 8,350 feet long and 200 feet wide and is built on a promontory which stands 14½ feet above mean sea level. There is an encompassing grass strip which allows an over-run of 300 feet between the end of the runway and the sea-wall and provides a strip width of 250 feet between the right edge of the runway and the sea-wall. The runway is in the main of tarmac finish and it has no longitudinal slope. There is a lateral slope for drainage purposes and the effect of this was that approximately 1565 feet before crossing the sea-wall the aircraft entered a slight down-hill gradient, dropping some 3.45 feet over a distance of 1200 feet after which it entered an up-hill gradient rising some 2.67 feet over a distance of 295 feet. The runway surface was dry at the time of the accident and the associated grass strips were very hard and dry, the aircraft's wheels leaving no measurable depth of track as they crossed the area.

1.11. Flight Recorder.

A Fairchild Flight Recorder model 5424-240 was installed on 11th August, 1967, in the rear of the aircraft at Station 1264. The instrument had been calibrated by the manufacturer on 26th April, 1967. The following parameters were recorded: time, vertical acceleration, indicated magnetic heading, pitch, altitude and indicated airspeed. The inputs were:

Vertical Acceleration - from accelerometer in the left wheel well.
Indicated Magnetic Heading - from captain's RMDI at 1 second intervals.
Pitch - from the co-pilot's Horizon Director Indicator.
Altitude - at 1 second intervals from co-pilot's static pressure system.
IAS - at 1 second intervals from co-pilot's pressure and static system.

The recorder was recovered intact from the wreckage and was found to have been functioning satisfactorily except that it was not possible to find a valid scribe line for the heading parameter. The recorder was examined by the manufacturer but post accident calibration was not possible due to corrosion.

1.12. Wreckage.

(a) Ground Marks.

An inspection of the runway revealed a trail of pieces of tyre rubber starting at a point 4,580 feet from the beginning of the runway.

/The.....

The first of these may be assumed to approximate to the onset of the vibration experienced in the aircraft and the increase in the severity of the vibration was consistent with the increase in the quantity of rubber which had been shed as the aircraft progressed down the runway.

At a point 5,290 feet down the runway, braking marks from the left main wheels were identified and 500 feet beyond this, braking marks from the right main wheels were observed. From the point of first braking marks the aircraft had continued down the runway just to the left of the centre-line more or less on a straight line, but at a point 1,150 feet from the first brake mark, a swing to the right commenced. The first marks from the nose wheels appeared 1,930 feet beyond the first braking marks and were significantly closer to the right wheel than the left, indicating an angle of crab of the order of 5 degrees. The wheel marks continued to veer right until at a point 489 feet from the end of the runway the nose-wheel crossed the side of the runway on to the grass, demolishing an elevated runway light in doing so. The aircraft then crossed the grass strip leaving continuous scuff marks, with the nose-wheel marks progressively closing with the right wheel marks until finally on crossing the sea-wall they overlapped. At this point the aircraft heading was 182° and the crab angle had increased to some 15°, indicating that the aircraft was in potential ground loop situation. The sea-wall is sloped to the sea at an angle of 33° and rubber smears from the right and nose-wheels ended at the top edge of the horizontal surface of the wall, indicating the wheels lifted cleanly without rolling down the slope of the wall. On the other hand, the marks from the left main wheels, which were last to cross the wall and were then supporting the entire weight of the aircraft, ran down the sea wall to a point 20 inches from the top surface. From the point that marks from each set of wheels first appeared, they ran unbroken until they crossed the sea wall except that the nose-wheel marks faded out over a length of some 75 feet just before leaving the runway.

The distance from the first brake marks on the runway, which were of the left main wheels, to the point where the nose-wheels crossed the sea-wall was 3,310 feet.

A drawing showing the wheel marks and the aircraft's attitude is at Appendix 'B'.

(b) Examination of Wreckage.

The fuselage and mainplanes of the aircraft aft of the leading edges remained floating and suffered very little damage except in the immediate area where the forward fuselage had broken away. Although severely damaged in the vicinity of the fractures and in the area of the nose which had absorbed the shock of impact, almost all the front portion of the aircraft was still attached to the main body of the aircraft by means of the flying control and other cables.

The nose section forward of the leading edges of the mainplanes had separated at Station 622 at the top and bottom and left side and on the right side at Station 565. The nose section had itself broken into two sections around Station 429. There were indications that this section had broken away from the main body as the result of an impact from the left as well as from the front. The crew compartment itself had suffered very little internal damage, the major damage being located between Stations 622 and 429.

An internal examination of the cockpit was carried out immediately subsequent to the salvage with the following results:

The emergency brake selector was in the "OFF" position with lock-wire still intact.

Emergency Brake Pressure - 2900 PSI

/Nose-wheel

Nose-wheel Brake Switch	- On
Anti-skid Selector Switch	- On
Stabiliser trim indicator	- L.H 12¼ R.H 14
Stabiliser Position Indicator on Captain's Panel	- 3^{o} NU
Stabiliser Trim Shut Off	- Closed
Rudder Trimmer Indicator	- 8 Left
Aileron Trimmer Indicator	- O
Landing Gear Selector	- Down
Flap Selector	- Up
Spoiler Speed Brake Selector	- Stowed Position
Main Gear Speed Brake Selector	- Stowed Position
Power Levers	- Reverse Range
Fuel Levers	- Run
Auto Pilot Yaw Damper	- Off
Flight Engineer's Fuel Selector Switches	- Normal for take-off
Left hand Pilot's Seat Position	- 7 Holes forward
Right hand Pilot's Seat Position	- 7 Holes forward

All landing gear was in the "DOWN" and locked position. The main gear was intact but there were fractures at the main drag struts of the nose gear. The main landing gear doors were in the "OPEN" position.

Examination of the main gear tyres revealed definite signs of extensive sideways scuffing. The direction of the scuffing indicated that the aircraft had been sliding towards the left. Apart from the indications of scuffing and the presence of salvage damage, there was nothing abnormal in the condition of the main gear tyres. Tyre pressures were checked after the accident and found to be approximately correct. All tyres with the exception of the right front outer had been retreaded.

Examination of the nose landing gear revealed that the right hand tyre had stripped a considerable portion of its tread (Appendix 'C'). The left hand tyre showed signs of rather more than normal wear as well as signs of sideways scuffing. Both tyres were found to be inflated to approximately the correct pressure when checked subsequent to the accident. Both tyres had been retreaded.

It was evident that at some period whilst separating from the body of the tyre, some portions of tread had struck the right nose steering cylinder and the rigid hydraulic supply line to it as well as parts of the adjacent structure. It was established however during subsequent checks that although the pipe had suffered distortion, its serviceability had not been impaired.

During the inspection of the nose gear it was found that the electrical harness to the nose brake anti-skid unit had become detached from the unit itself. It was also found that the tubular structure which supported this harness and the brake's hydraulic flexible line had distorted and fractured. As the electrical harness supplied power for actuating the nose brakes, particular attention was given to determining the cause of rupture. During the towing operation entailed in the recovery of the wreckage, the nose portion had dragged along the sea-bed and several wire hawsers had become entangled around the nose-wheel landing gear and its associated equipment. It was concluded from the manner in which the flexible hydraulic line and the electrical conduit had become displaced from their original positions within their cleating, and from the evidence of rust marks on the line and conduit and the lack of evidence of rubber impact around them, that the harness had become detached from the anti-skid as the result of entanglement of the wire hawsers.

/Although.....

Although there was a certain amount of damage to the actuating system, it was established that the leading edge slats and Kreugers were in the extended position.

Although the flap lever was found to be selected in the "UP" position it was determined that impact damage to control cables had caused the flaps to be selected "DOWN" but the flap lever selected into the "UP" position.

Whilst the aircraft was still in the water, it was apparent that the spoilers were in the extended position and it was subsequently ascertained from eye-witness evidence that these had been extended at some time prior to the accident.

No abnormalities were found either in the aileron controls and their associated trim system or in the elevators and horizontal stabilizer trim system other than those attributable to accident damage. Similarly, no pre-accident abnormality could be found in the main rudder controls.

During the inspection on site it was noted that the rudder trimmer was in the extreme nose-right position whilst the cockpit trim indicator showed 8 left. It is concluded that the rudder trim and its controls were displaced as the result of impact or salvage. There was nothing unusual with the main rudder controls apart from that associated with impact or salvage.

The hydraulic system was subjected to a detailed examination and it was found that the various accumulator pressures were normal except that of the No.2 accumulator, which it was considered became discharged owing to operation of the main landing gear door open valve at some stage during impact.

A functioning check of the brakes was carried out on site and it was ascertained that all brake units at the wheels were operating and satisfactorily releasing. Gauges were installed and readings were taken. It was found that whilst the left pressures were around 1700 PSI, the right were around 1320 PSI. The required pressure is 1750 PSI to 1800 PSI. In view of the low pressure on the right side, full deflection of the right brake metering valve was maintained for 30 seconds but there was no increase. The maintenance manual states that the difference between left and right pressures should not exceed 50 PSI. Pressure at the nose-wheels was recorded at 900 - 1000 PSI, the normal pressure being 1000 PSI. The mechanical system for the operation of the brakes was examined and although there was considerable damage to the system including the cables, it was confirmed by the types of damage that this was a result of impact and salvage.

Further tests were carried out on site in connection with the anti-skid system, the results of the test showing no abnormality.

As there was some doubt as to the aircraft's steering capability, a function check of the nose-gear was carried out as a unit in the workshops. It was not advisable to route more than 600 PSI to the gear on account of impact and salvage damage but the leg steered satisfactorily in both directions with this pressure.

All four power plants had become detached on impact with the sea and were recovered intact some days after recovery on the main body. The engines were examined in the presence of the manufacturer's representative to ascertain the extent to which they were under power on impact and to determine whether they were in reverse thrust at that time.

It was concluded that the engines were in full reverse thrust at the time of impact with the sea and that they were producing a high degree

/of power.....

of power, the manufacturer being of the opinion that all four engines were operating at above 83% RPM.

(c) Workshop and Bench Check of Components.

Brake Metering Valves. Both valves were checked and conformed to the specification that they achieve 1800 PSI maximum pressure. The right hand valve was despatched to the manufacturer for an expert opinion on the discrepancy between bench check pressures and those noted on site, the verdict being that the malfunction appeared to be the result of wear. The overhaul life recommended in the approved maintenance schedule is 12,500 hours whilst the valve itself had achieved only 7,438 hours. As a result of this finding, periodic maintenance checks were immediately introduced by CPA to ensure that maximum pressures at the wheel brake units were being achieved at maximum brake pedal deflection.

Skid Detector Units (Nine). Most of these units had suffered deterioration due to immersion and as a result it was not possible to carry out a full functional check on them. It was nevertheless possible to check that each unit was not giving a skid signal and would not, therefore, contribute to brake malfunction.

Skid Control Box. This unit was despatched to the manufacturers for a complete functional check and although the results were perforce rather inconclusive due to the deterioration of the unit during immersion, it is considered unlikely that the Control Box was malfunctioning at the time of the accident.

Modulating Valve and Accumulator. The valve operated satisfactorily when bench checked and produced satisfactory flow rates in the closed and open position. The filters in the valves were checked and found to be free of foreign matter.

Skid Control Valves. All valves were functioned on the hydraulic test bench. A gauge was attached to the inlet or metered pressure line and another gauge to register the pressure at the brake port. Pressure was applied and the valves electrically operated to simulate the skid condition. All valves by-passed and functioned correctly with the exception of that serving the left hand inboard rear wheel brakes. When this valve was functioned the pressure from the brake port dropped to zero and a skid condition existed at the valve irrespective of whether or not electrical power was applied. When the valve was partially disassembled it was found that the main control slide was partially seized due to scoring along two of its lands. This seizure had the effect of not allowing the return spring to reposition the valve after de-energising the solenoid.

Although all brakes functioned correctly at the site test, it was considered possible that this valve was malfunctioning during the brake application at the time of the abort, thus reducing the braking effect of the left main wheels by 25%. There had, in fact, been a previous case of this type of malfunction, the existence of which was first suspected when a wheel was found by physical check to be cold after heavy braking had been used.

Emergency Brake System Shuttle Valves. The valves were checked and found to be satisfactory.

Brake Units. All brake units were disassembled and examined in detail. Nothing abnormal was found.

Hydraulic Filters. All filters in the hydraulic system were checked for contamination and found to be satisfactory.

Hydraulic Fluid. Samples of hydraulic fluid were analysed with satisfactory results.

/Nose tyres.....

Nose Tyres. Both nose tyres, together with the numbered pieces of tread recovered from the runway, were despatched to Messrs. Goodyear Tyre Company, who had originally manufactured the tyres and who had sub-contracted the last re-tread on the failed tyre, for an expert opinion as to the reason for the tread separation. Messrs. Goodyear carried out a detailed examination and submitted a comprehensive report, relevant sections being that: the differential between the two nose-wheel tyres was 0.19" and was well within the normal limits for tyre matching; the beads, innerliner and carcass of the stripped tyre were sound and had lost approximately 60 - 70% of the tread; separation of the tread had developed directly underneath tyre piece No. 10 (Appendix C, photograph 190-68E); there was a further evidence that a separation developed in the wide outboard rib of the area circled between X and 10 (Appendix 'C', photograph 190-68N).

On the basis of their examination, Messrs. Goodyear reached the following conclusions:

i) Separation developed in the retreaded tyre at one point in the shoulder and possibly at two points on the sidewall.

ii) These separations could have been in the retread prior to take-off or developed during take-off.

iii) There was no evidence of a defect in the tyre or retread which might have led to such separations.

iv) In their opinion, the separations were initiated by impact, such as may result from hitting runway markers or edges, foreign objects on the runway, etc.

v) Although portions of the tyre tread were missing from one tyre, both tyres were still capable of retaining air and carrying a load.

With reference to Messrs. Goodyear's conclusion that the separations were initiated by impacts, C.P.A. has no record of such impacts having occured. Subsequent to the accident, the company decided to discontinue the use of re-treaded nose-wheel tyres on Convair 880M aircraft.

(d) Surface skid-resistance.

In order to obtain an assessment of the skid-resistance of the runway and grass areas, tests were carried out with a portable skid resistance tester over the track of the aircraft. Although this machine is designed for road use, it gave a good indication of the comparative skid resistance of the runway and grass areas. The values over the runway ranged from 92 to 103 with the readings averaging at 99; the grass surface produced values ranging from 49 to 67 with an average reading of 61, indicating a significant fall-off in resistance to skidding in this area.

Loading Calculations. Fuel spillage and loss of baggage in the crash and during subsequent salvage operations did not permit accurate recalculation of the weight of the aircraft by reweighing the total load carried. However, a detailed investigation was made into the calculation of the aircraft's weight and the accuracy with which this was compiled.

A reassessment was made of fuel load, fuel burn-off during taxying, actual passengers and crew weights as compared with the standard weights used in load-sheeting, cabin and hold baggage, cargo, mail and duty-free liquor.

During these investigations it was found that one of the Saigon passengers had been recorded as having 7 pieces of baggage weighing 130 kilos, whereas five of these which had been left off the aircraft because of lack of space weighed 152 kilos and the other two, still damp from their

/immersion.....

immersion, weighed 88.5 kilos. One of these pieces had in fact been broken into prior to the examination and articles to a weight of 19 kilos removed. On this basis the actual weight of this passenger's baggage was at least 240 kilos as against the recorded 130 kilos and may have been as high as 260 kilos.

This one disclosed instance of irregularity in baggage weighing led to consideration of whether further such instances took place during the passenger processing or baggage handling prior to the flight departing, particularly in the case of Saigon bound passengers many of whom make a business of travelling to Hong Kong to purchase merchandise for re-sale in Saigon.

There appeared to be 28 passengers in this category, 20 of whom had presented baggage which weighed more than twice the free allowance of 20 kilos. Of these 20, 3 had pooled their baggage but since they had 168 kilos between them it was considered a potential irregularity, making a total of 18 potential cases.

The problem of deciding what fraction of the baggage weight had been entered on the flight coupon and passenger manifest remained, and in the known case the weight had been approximately halved. This is a convenient method of calculation but so too is the omission of 100 kilos from the total weight. Since the latter calculation produced the higher figure it was decided to adopt that method and it was assumed therefore that in each of the 18 cases baggage had been underweighed by 100 kilos thus bringing about a discrepancy of 1800 kilos in the weight of the Saigon baggage. Since the shut-off baggage was subjected to two independent weighings on different days and since both totals were reasonably coincident it was considered that this excess of 1800 kilos could have been loaded on to the aircraft, provided the freight compartments had sufficient capacity.

It was established that the forward freight compartment had been loaded with baggage which appeared to contain personal property and with musical instruments, and that the freight officer's assessment of the load in this compartment was reasonable. Since the heavier pieces were loaded into the rear compartment it was necessary to determine whether this compartment was capable of containing this load.

The freight officer supervising the loading of this compartment estimated each of the 73 pieces at 17 kilos, a total of 1241 kilos, whilst the load sheeter estimated the load in this compartment at 1130 kilos. It is considered that there is a possibility that both these figures were wrong and that 1737 kilos is the probable weight of baggage that the compartment contained.

On this basis and taking into account adjustments of weight resulting from passenger weights, fuel load, etc., it is calculated that the weight of the aircraft at take-off was probably in the region of 183,207 lbs. i. e. 749 lbs in excess of that shown on the load sheet and 207 lbs in excess of that used by the pilots to calculate V1 speed.

1.13. Fire

There was no fire.

1.14. Survival aspects.

(a) The evacuation.

All seats aft of the wing leading edges were relatively intact and secured to the floor but those forward of the mainplane were generally extensively damaged due to the fuselage damage between stations 429 and 622.

/The forward.....

The forward break in the aircraft fuselage was immediately aft of the forward toilet and buffet and in front of the first row of passenger seats (Appendix 'D'). There was considerable tangled wreckage in the area of the break making passage through the area impossible and isolating crew in the forward fuselage from the passenger cabin. Distortion and wreckage also blocked the cockpit door and sealed this area off from the buffet area and the forward main entrance door. The second break in the fuselage ran diagonally from the seventh row of seats on the left side immediately forward of the wing leading-edge to cross the fifth row of seats on the right side. The overall effect of the fuselage damage was that there were three isolated compartments, two of which were in the first section of the fuselage whilst the central fuselage section and the main rear portion which were still linked together comprised a third compartment. However, the depressed ceiling in the area of the second fracture and the general litter of passengers hand-baggage restricted movement along the aisle in this compartment but did not completely prevent it. The first compartment contained two pilots and the engineer, the second contained two flight hostesses and the check-pilot (who had taken a ditching position here when it became apparent that ditching was imminent), and the third compartment contained all the passengers and the remainder of the cabin crew.

The rapid ingress of water into the forward fuselage when the aircraft came to rest made urgent escape from that area imperative. The cockpit crew were able to evacuate very quickly through the sliding windows but the two hostesses and the check-captain were trapped, being unable to open either the jammed main entrance door or the cockpit door nor able to move past the wreckage obstructing the aisle leading to the passenger cabin. The first officer was alerted to this situation by calls for assistance and swam to the door. By bracing his legs on the fuselage he was finally able to add sufficient leverage to that applied by the check pilot from the inside to open the door just enough for the occupants to squeeze through.

Meanwhile, in the passenger compartment an initial tendency to panic was quickly suppressed by the firmness of the cabin crew, particularly the senior flight purser, in shouting instructions to the passengers.

Many passengers in the central fuselage section had been injured during the impact, one of these being fatally injured when the top part of the fuselage broke above her and struck her head. The water level in this area rose fairly rapidly and the recollections of passengers are somewhat confused, but several escaped through the breaks in the fuselage whilst others made their way across the fracture line to the rear part of the fuselage. None recollected having time to put on a life vest but on arrival at the scene the airport rescue launch threw out life-saving gear to support persons in the water until they could be taken aboard. One life-raft was also launched from the aircraft and was used to pick up persons still swimming in the water. The cockpit crew assisted in this operation and subsequently re-entered the floating portion of the aircraft to assist in the rescue operation and to ensure that all passengers had been evacuated.

The rear section of the fuselage was floating tail down with the open end taking water only slowly so that the occupants in the rear of the cabin remained quite dry. The senior flight purser rightly resisted pressure from passengers to open the rear main-door, as this would have caused the aircraft to sink rapidly, and directed evacuation to be made through the over-wing exits. These had been opened very quickly by passengers, and evacuation continued in an orderly manner, although in the initial stages the large quantity of hand baggage, including bulky articles, which had been strewn around the floor during the crash, was a considerable impediment to rapid evacuation. When the passengers realised the aircraft was not in immediate danger of sinking, many of them delayed their exit or tried to return to search for personal belongings so that the cabin crew had to urge them out through the exits on to the wings.

/Prior.....

Prior to take-off, instructions had been given regarding the location of life jackets and emergency exits but a demonstration of how to don life jackets had not been made because of the limited time between passengers boarding and take-off.

(b) Rescue Services

The crash alarms in the Control Tower were depressed when the aircraft was seen to start to veer off the runway. These alarms ring in the Airport Fire Station, at the jetty near the southeast end of the runway where the rescue vessel is moored and in RAF Station Sick Quarters at Kai Tak. The coxswain of the fireboat was on the jetty as the aircraft sped by on the runway. Realising from the aircraft's heading and speed that a crash was probably imminent he boarded the fireboat and instructed the crew to start the engines and cast off. The crash alarm bells started ringing as the boat left the pier. The distance from the jetty to the floating aircraft was approximately 700 yards and the fireboat arrived at the scene between 1 and 2 minutes after the impact.

The Airport Fire Station, alerted by the alarm, made an immediate response with all vehicles and drove along the runway to the sea wall at its nearest point to the scene of the crash. The Airport Fire Station is approximately 2800 yards from this part of the airport promontory and by the time the officer-in-charge of the fire station arrived at the scene (some 2 or 2½ minutes later) the evacuation of the cabin was underway and survivors were already standing on the wings.

The aircraft crash procedure at Hong Kong airport requires that the City Fire Service, the Police, Hospitals and the Hong Kong Auxiliary Air Force are alerted by aerodrome control by specially provided direct lines from the Tower. All these organisations had been alerted by 0238 hours and notified of the position of the crash and the number of persons on the aircraft. A helicopter of the Auxiliary Air Force which had been waiting to cross the runway had also observed the accident and was cleared to proceed to the scene.

The area of the impact point lies close to the Quarantine Anchorage area and to the routes taken by passenger ferries and other vessels crossing between various places on the Kowloon mainland and points on Hong Kong Island. Consequently, the crash was observed by several vessels which hastened to the scene. The first vessel to arrive was a Port Health launch which immediately manoeuvred alongside the aircraft and began rescue operations. This vessel was quickly followed by the airport rescue vessel, a privately owned launch and a ferry boat which between them rescued the remaining persons from the aircraft's wings and the water. Three other ferries carried out searches in the area but wisely did not attempt to approach close to the aircraft because their large size and limited manoeuvrability could have posed an additional hazard. Divers from the airport rescue launch searched the submerged section of the fuselage immediately after arrival to ensure that there were no casualties in this section.

Meanwhile the first land rescue units had been followed by support units from outside the airport, including 14 ambulances, and an ambulance and fire rescue control point was set up on scene.

The RAF supplied 3 helicopters which were on the scene within 15 minutes of the crash and together with the Auxiliary Air Force helicopter assisted in rescue operations and the carriage of survivors to hospitals after initial examination by the doctors at the rescue control point. Forty four people were conveyed to hospitals, seventeen of these being discharged after treatment. Seventy two passengers and eleven crew members were conveyed to the airport terminal.

The rescue operation was conducted efficiently and expeditiously and this in combination with the disciplined performance of duty by the

/cabin staff.....

cabin staff, the smooth sea-state and the buoyancy of the main part of the aircraft, accounts for the 100% survival of persons who lived through the break-up of the aircraft on impact.

2. ANALYSIS AND CONCLUSIONS.

2.1. Analysis.

Three separate but interacting abnormalities were experienced on this flight, firstly the vibration rapidly increasing in severity, secondly the swing to the right which the pilots were unable to correct, and finally the failure to stop within the nominally adequate runway distance available. These abnormalities are examined in some detail in the reconstruction and analysis of the flight.

2.1.1. Reconstruction of the flight.

The three pilots are in general agreement regarding the sequence of events leading to the accident. Prior to boarding the aircraft, Captain Jackson-Smith checked the load-sheet and, having rounded the recorded weight upwards to 183,000 lbs, calculated V1 as 135 kts. This calculation was also checked by the other two pilots and the "bugs" (movable index markers) on the airspeed indicators were subsequently set accordingly. No decrement was made for possible tail-wind conditions as the reported wind condition and that subsequently notified by the control tower were considered not to have any significant effect on the calculation of V1, bearing in mind the reserve of runway length available over and above that required for accelerate/stop purposes.

A rolling take-off was made from the first lead-in to the runway and was normal in all respects until the vibration commenced. Abort action was stated to have been taken promptly except that there was a delay of 4 - 5 seconds in applying reverse thrust, which was then used at full power throughout the remainder of the aircraft's travel; it is estimated that the reverse thrust became effective 9 - 11 seconds after the abort sequence commenced. No swing was experienced at the time of application of brakes or reverse thrust, and the control column was held forward throughout. All pilots have stated that deceleration from the brakes was considerably less than they expected from application of maximum brakes. The anti-skid selector had been placed on during the cockpit check and the anti-skid malfunction light was not seen to come on during the attempt to stop.

Both the pilots at the controls were applying full brakes but neither of them felt the anti-skid cycling; Mr. Steven stated that he thought that he should have been able to feel this, had it been operating, despite the vibration which was being experienced.

When the veer to the right commenced, normal corrective action failed to straighten the heading so that finally, just before the aircraft left the runway, Mr. Steven had applied full lateral control to the left, full left rudder and was using the left brake only, at maximum pressure, but still could not correct the swing.

On initial interview he could not recall using nose-wheel steering but on a subsequent interview he said that although he had no recollection of taking hold of the nose-wheel steering, in the latter stages he was aware of trying to keep the aircraft straight by nose-wheel steering as the aircraft was pulling off to the right. This was just after the swing started and while still on the runway. He felt that the nose-wheel steering was reducing the severity of the swing to the right. His memory of this action had been prompted by recollection of the heavy vibration of the steering wheel.

However, the position of the nose-wheel relative to the longitudinal axis of the aircraft when turn to the right commenced could not

/be determined.....

be determined. There is a possibility that had the nose-wheel already been deflected to the right at the time steering was first attempted, Mr. Steven may have failed to bring the nose-wheels fully round to the central position. In fact off-set steering to the left would be necessary to maintain straight ahead travel in cases when the right nose-wheel tyre was of smaller diameter than the left.

The control column had been held forward throughout the abort sequence and no attempt was made to correct the swing by differential power settings nor were emergency air brakes used. The pilots estimated the aircraft was still travelling at 80 - 90 kts when it crossed the sea-wall, and shortly before this they had braced themselves for the impact in the knowledge that the aircraft could not be stopped in time.

The flight recorder read-out and analysis differs significantly from the pilot's recollections both as regards maximum speed attained during the take-off and the speed at which the aircraft crossed the sea-wall. Pilot evidence was that vibration commenced at a speed around 120 kts and the abort decision was taken at a speed of about 122 kts. The recorder shows that no significant decrease in the rate of acceleration occurred until after an indicated airspeed of 133 kts had been attained; there was then a reducing build up of speed to 137 kts over the next 2 seconds, after which deceleration commenced and continued down to a speed of 35 kts when the recording terminated. It is considered that the left brake took effect at the 133 kts point but as the engine RPM had not yet decayed, residual engine thrust initially out-balanced the effect of the left brake over the following 2 second period, during which and allowing for a ten knot tail wind component, close to 500 feet of runway would be covered, i.e. a distance similar to that between the start point of the marks left by the left and right wheels respectively. After the right wheel brakes took effect, an average deceleration of over 7½ feet/sec^2 was achieved and as reverse thrust, as used on this occasion, made a minor contribution to the total braking force, giving a theoretical decrease in scheduled stopping distance of only 50 feet, it is apparent that the brakes were in fact operating with a considerable effect. It is considered that the pilot's opinions that the brakes were barely working arise from:-

(a) the poor deceleration in the initial period;

(b) non-awareness of the very high speed which had been reached, as indicated by the flight recorder, when take-off was discontinued;

(c) inexperience of discontinuing take-off at such a high speed and aircraft weight;

(d) the psychological effect of these factors associated with their awareness of the rapidly approaching sea-wall, the closeness of which would be exaggerated by line-of-sight cut-off towards the ground;

(e) the roughness of the journey over the grass area which would give a false impression of speed, as evinced by their assessment of a speed of 80 - 90 kts on crossing the sea-wall whereas the recorder gives an indicated speed of around 40 kts.

The correlation of the pieces of rubber and the tyre marks found on the runway were plotted and are shown at Appendix 'B'. The first shedding of rubber occurred around 4,580 feet from the beginning of the runway, and tyre marks resulting from application of the left hand wheel brakes first appear some 710 feet further down the runway, i.e. approximately three

/seconds.....

seconds later in terms of the aircraft's speed. The major shedding of rubber in this period occurred approximately 1 second after the initial separation and would bring a heavy increase in vibration. In this context the examination of the damaged nose-wheel tyre confirmed that the first two pieces of thrown tread were those marked X and 1 and this would indicate that the pattern of pieces of rubber found on the runway generally followed the sequence of separation, even though the pieces of tread would have been thrown off during various phases of the tyre's rotation and would have been subject to varying forces, such as those imparted by the aircraft's momentum, centrifugal force of the wheel and the engines' jet blast.

A second major shedding of rubber took place some 6,080 feet down the runway and because of the 'tied' nose-wheel system this caused a progressive "down-hill" castoring of the nose-wheels which initiated the swing to the right. Some 790 feet after this commenced, the nose-wheel tyres began to leave marks on the runway for the first time but by this point the aircraft had a pronounced crab to the left with heavy side loads on the wheels and it is considered that it was this force rather than braking effects which caused the impressions to be left.

The nose-wheel marks were significantly nearer to those of the right main wheels than the left ones, but the distance varied, presumably in proportion to the effectiveness of the pilot's attempts to straighten the aircraft. Finally, as the left main wheels entered the grass, reduction in skid resistance reduced the effectiveness of asymmetric braking at the time when the aircraft's speed had fallen to around 80 kts, thus entering the range where nose-wheel steering became fully effective just as rudder effectivity was decreasing rapidly. From this point on, the crab angle increased and the turn tightened up to the point where deflection of the main wheel tyres reduced the cornering capability of the tyres and the effect of asymmetric braking until the aircraft reached a potential ground loop situation shortly before crossing the sea wall.

2.1.2. Accelerate/Stop performance.

The aircraft's runway length requirements are calculated on the basis of acceleration to V1 followed by braking to a complete stop, with one engine inoperative and three engines at idle power (no reverse) and spoilers fully extended. Consequently, either sub-standard acceleration or sub-standard braking could cause an aircraft to exceed the distance nominally required. Based on the Convair Performance Data Report ZA-22M-005 1.2.1962 "Take-off Segments", a distance of approximately 4,425 feet is required at a weight of 182,458 lbs and zero wind velocity to accelerate the aircraft to a V1 speed of 135 kts; approximately 4,980 feet at 183,207 lbs and a ten knot tailwind to a V1 of 134 kts. Based on the peak speed attained and the actual shedding of rubber, it has been estimated that on the occasion of the accident the distance consumed in accelerating to 134 kts was 4,760 feet. Taking into account the rolling start and possible variations in tail wind component, it is concluded that acceleration was not sub-standard, and this was corroborated by the rate of acceleration deduced from the flight recorder read-out. Consequently, the inability to stop within the distance available must be attributed to the deceleration phase.

In order to measure the actual deceleration performance against the design performance, the Aircraft Engineering Division of the United States Federal Aviation Administration and the Convair Company were consulted regarding the effect of various relevant factors on the scheduled performance of the aircraft. It was ascertained that the low pressure of the braking system; the presence of a ten knot tail wind component; inoperative nose-wheel braking; the assumed increased weight of the aircraft; and the actual maximum speed attained on take-off as inscribed on the flight recorder, would extend the required accelerate/stop distance to 8,650 feet as against

/the 8350 feet...

the 8,350 feet of runway available. However, under the circumstances of this particular flight, even this stopping distance would have been inadequate because of the further impairment of the braking performance arising out of the aircraft swinging off the runway. This aspect is now examined:-

2.1.3. Effect of Swing Conditions.

The aircraft's swing to the right and the critical situation which then arose would degrade the overall braking performance as follows:

(i) In an attempt to control the swing, differential braking was employed at a point estimated by the pilot to be some 1670 feet after the brakes were first applied. This was progressively increased until the left wheels only were being braked at a point approximately 2,420 feet after initial application of brakes.

(ii) Nose-wheel braking cuts out automatically whenever the steering angle exceeds 7^{o} or differential braking is employed. The shimmy of the nose-wheels caused by the tread separating in combination with the application of differential braking and the crabbed attitude of the aircraft at various stages of the deceleration phase are considered to have rendered nose-wheel brakes largely inoperative. It is significant that whereas heavy marks from the main-wheel tyres appear on the runway shortly after the abort decision was made and whilst the aircraft was still running more or less in a straight line down the runway, marks from the nose-wheel tyres do not appear until the swing has set in and a pronounced crab developed with resulting heavy side forces on the tyres.

(iii) Allowing a 10 second delay in achieving full reverse power, the aircraft had commenced to swing right before reverse thrust reached maximum effect. The component of reverse thrust decelerating the aircraft was therefore reduced, due to the aircraft being at an angle to the line of travel. In addition, reverse thrust is most effective at higher speeds and becomes progressively less effective as the aircraft decelerates. A theoretical reduction of 100 feet in stopping distance to be gained by use of reverse thrust would therefore be reduced to approximately 50 feet.

(iv) The swing on to the grass brought about a reduction in the skid resistance of the ground surface thus impairing the capability of the only brakes remaining in use to stop the aircraft and check the swing. In this context it is noted that a study made by the Technical Services and Training Centre of Trans World Airlines has concluded:-

(a) To obtain the maximum cornering capability, a wheel must be rotating freely (no braking) at approximately a 15 degree slip angle on a clean dry runway. Maximum cornering capability will be reduced by any or all of the following factors:-

i) Other than a clean dry runway.
ii) Greater than maximum slip angle for existing conditions.
iii) Application of brakes.

(b) When a wheel is producing a cornering force less than its maximum capability, any braking will reduce its cornering capability.

/(c) If a wheel.....

(c) If a wheel is operating at its maximum braking (as maintained by the anti-skid system) little, if any, cornering capability is available regardless of slip angle.

(d) When a wheel is producing its maximum cornering capability for the existing conditions, any braking will immediately result in the loss of practically all cornering capability.

(e) With the cornering capability of the tyres lost or even reduced, other existing side forces on the aircraft may become predominate and affect its track.

(v) The wheel braking force which remained available was not used to the end of the aircraft's ground run, as the pilots were compelled to discontinue use of the brakes and brace for impact shortly before crossing the sea-wall.

2.1.4. Pertinent Observations.

The pilots were under the impression that there was a reserve stopping distance of over 1,000 feet available whereas this was considerably reduced by a tail wind component and, to the relatively minor extent of 45 feet, by the higher weight of the aircraft.

However, the reserve runway distance would have been sufficient to bring the aircraft to a stop had not directional control difficulty and impaired braking efficiency further increased the aircraft's stopping distance - a situation which the pilots could not foresee and which did not become apparent until after the decision to stop had been made.

2.2. Conclusions.

(a) Findings.

(i) The crew members were properly licensed and sufficiently experienced to carry out the flight.

(ii) The documentation of the aircraft was in order except that there was an established discrepancy of 110 kilos in baggage weight.

(iii) The total weight of the aircraft was probably 749 lbs approximately in excess of the load sheet weight and 207 lbs in excess of that used by the pilots to calculate V1 speed.

(iv) Calculation of V1 was based on a nil wind condition at 135 kts whereas the increased aircraft weight and the presence of a tail wind component of the order of 10 kts required a V1 of 134 kts.

(v) Take-off was abandoned when the stripping of the tread of the right nose-wheel tyre caused severe vibration.

(vi) The Flight Data Recorder indicates that the decision to abort was made shortly before a speed of 133 kts was reached as against the speed of 122 kts reported by the pilot. The maximum speed attained during the accelerate phase exceeded the corrected V1 speed of 134 kts by 3 kts. However, the decision to abort was made within the corrected V1 speed.

(vii) During the pilots' attempts to stop the aircraft, further progressive stripping of the tyre caused a swing to the right to develop. This swing to the right required the use of directional braking and rendered nose-wheel braking largely inoperative, factors which greatly degraded the aircraft's braking performance.

/(viii) Defects.....

(viii) Defects in the right hand metering valve and, possibly, the main control slide in the skid control valve to the left hand inboard rear wheel further reduced the effectiveness of the main wheel brakes.

(ix) Examination of the aircraft revealed that 60 - 70% of the tread from the right nose-wheel tyre had stripped off during take-off.

(x) The method of donning life-jackets was not demonstrated prior to take-off although emergency exits were pointed out.

(xi) The evacuation of the aircraft was orderly and the rescue services responded efficiently to the accident alert.

(b) Probable Causes.

The probable causes of the accident were:

(i) Loss of directional control developing from separation of the right nose-wheel tyre tread.

(ii) Inability to stop within the nominally adequate runway distance available due to the use of differential braking, impaired braking performance and an increase in tail-wind component and aircraft weight over those used in calculating the aircraft's accelerate/stop performance.

3. RECOMMENDATIONS.

It is recommended that:

(a) In order to detect partial malfunction of the braking system at an early stage, the temperature of an aircraft's wheels should be checked after each flight. Any wheel which is abnormally cool under the circumstances of the flight should be treated as suspect and subjected to detailed examination.

(b) Traffic staff should ensure that the quantity and size of hand baggage admitted to cabin areas is not such that the evacuation time for the aircraft is likely to be adversely affected.

(c) Traffic Management responsible for aircraft loading should introduce effective measures to prevent the incorrect weighing and recording of aircraft load, whether as the result of error or malpractice.

4. COMPLIANCE WITH REGULATIONS.

The investigation was conducted under the provisions of the Hong Kong Air Navigation (Investigation of Accidents) Regulations, 1951.

It was not necessary in this case to give effect to the provisions of Regulation 8 (5)(relating to the opportunity of persons who may be blameworthy to be heard) since the evidence of error or malpractice in baggage handling could not be attributed to any identifiable person or persons.

R.E. Downing.
Inspector of Accidents.

Civil Aviation Department
September, 1968.

List of Appendices.

A. List of Abbreviations.

B. Ground Marks and Aircraft Attitude.

C. Photographs of Failed Nose-wheel Tyres.

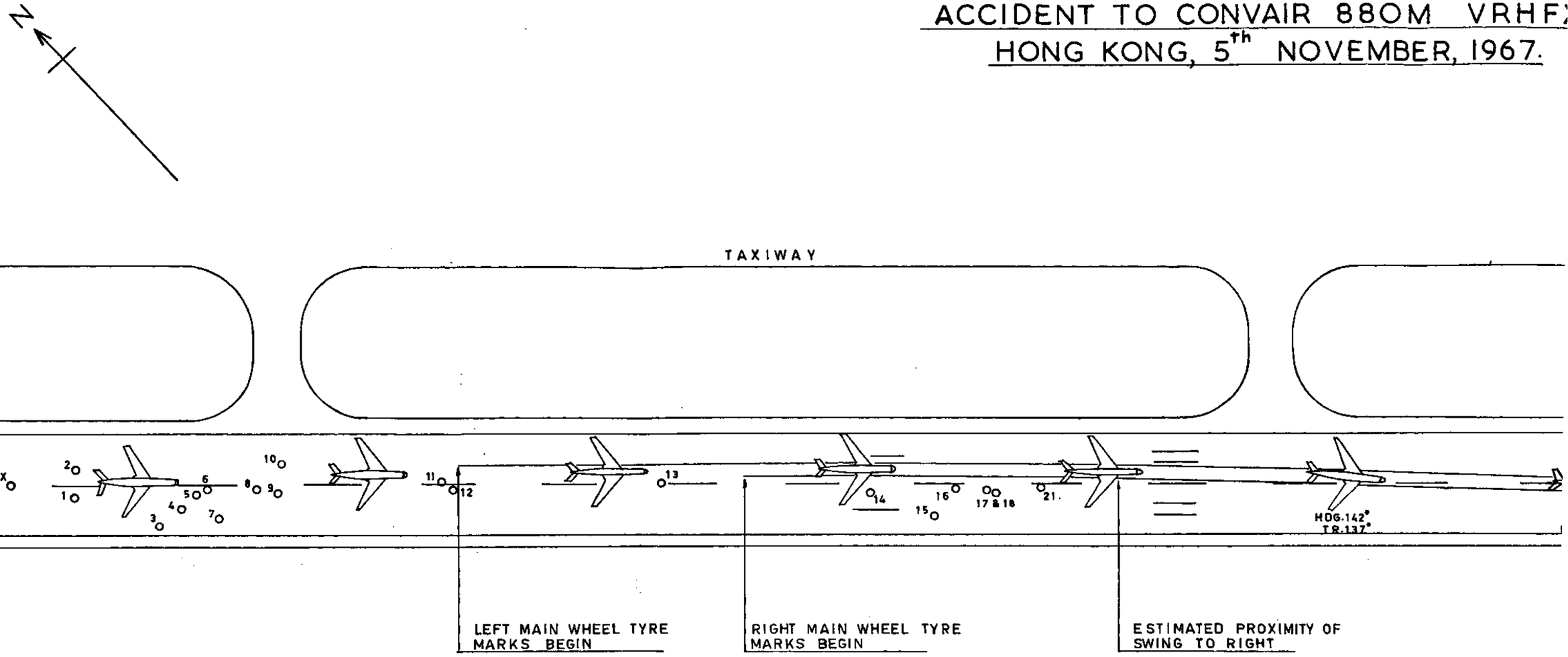
D. Emergency Exits and Fuselage Fractures.

APPENDIX A

LIST OF ABBREVIATIONS USED IN THE REPORT.

CPA	- Cathay Pacific Airways, Ltd.
EPR	- Engine Pressure Ratio; a ratio of pressures, usually the maximum cycle pressure (compressed delivery pressure) to air intake pressure or ambient pressure (depending on specific applications).
FDR	- Flight data recorder.
IAS	- Indicated air speed.
ISA	- International Standard Atmosphere.
kts	- Knots.
MAC	- Mean aerodynamic chord.
PSI	- Pounds per square inch.
RAF	- Royal Air Force.
RMDI	- Radio Magnetic Direction Indicator.
RPM	- Revolutions per minute.
V1	- Decision speed in the event of an engine failure on take-off; at which take-off may be abandoned or continued.
VIASA	- Venezolana Internacional de Aviacion S.A.
ft/sec^2	- Acceleration or deceleration in feet per second per second.

ACCIDENT TO CONVAIR 880M VRHF
HONG KONG, 5th NOVEMBER, 1967.



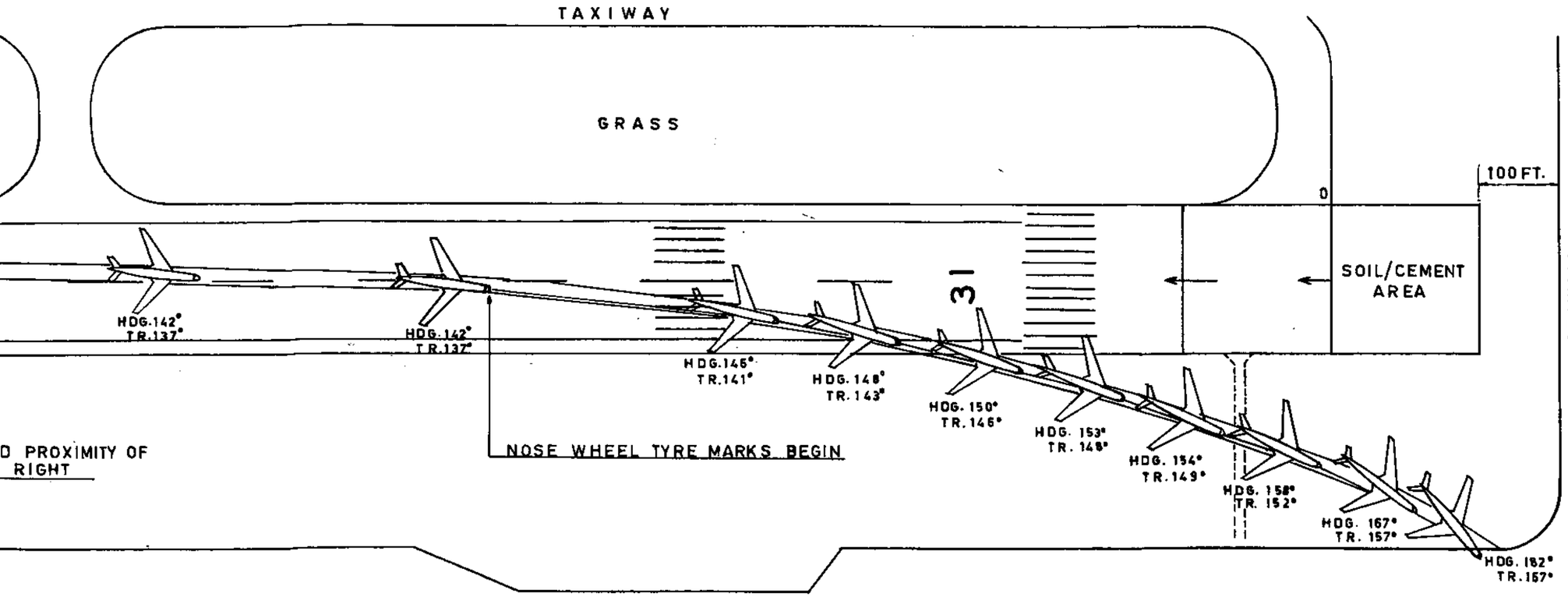
LEGEND

POSITION OF TYRE PIECES COLLECTED BY D. C. A. X 1

WHEEL MARKS BASED ON POST ACCIDENT SURVEY

WHEEL MARKS & AIRCRAFT ATTITUD

ONVAIR 880M VRHFX
5th NOVEMBER, 1967.



D PROXIMITY OF
RIGHT

POSITION OF BUOY
5 P.M. 5/11/67

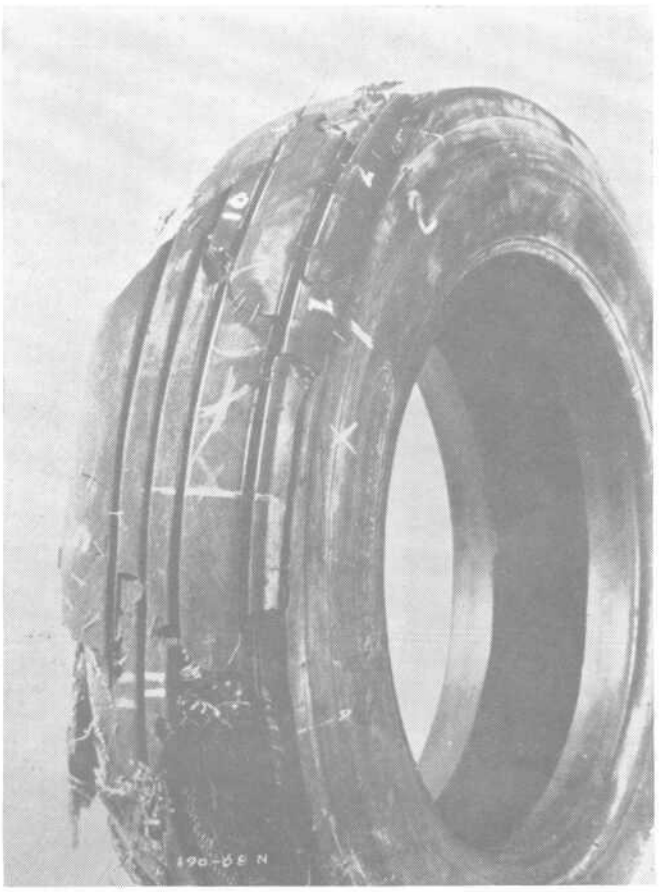
AIRCRAFT ATTITUDE

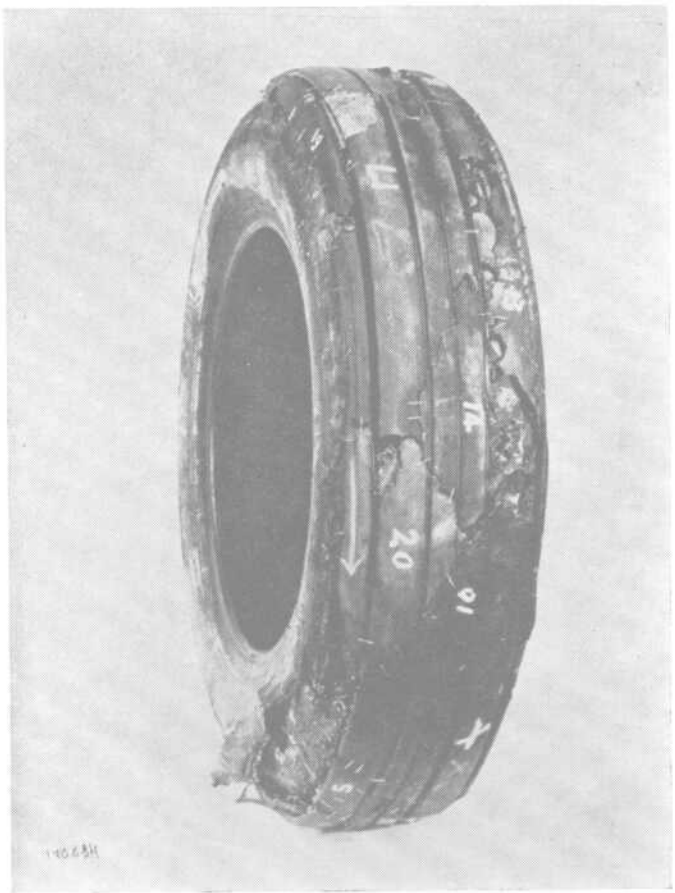
FT. 100 0 100 200 300 400 500 FT.

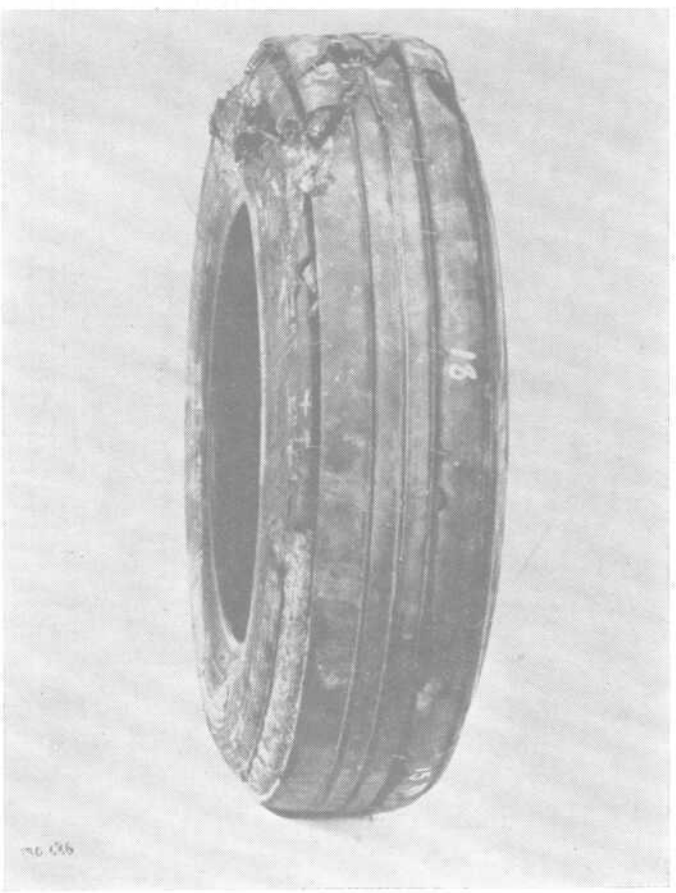
SCALE IN FEET

APPENDIX C

ACCIDENT TO CONVAIR 880M VRHFX HONG KONG ON 5TH NOVEMBER, 1967 PHOTOGRAPHS OF FAILED NOSE-WHEEL TYRE

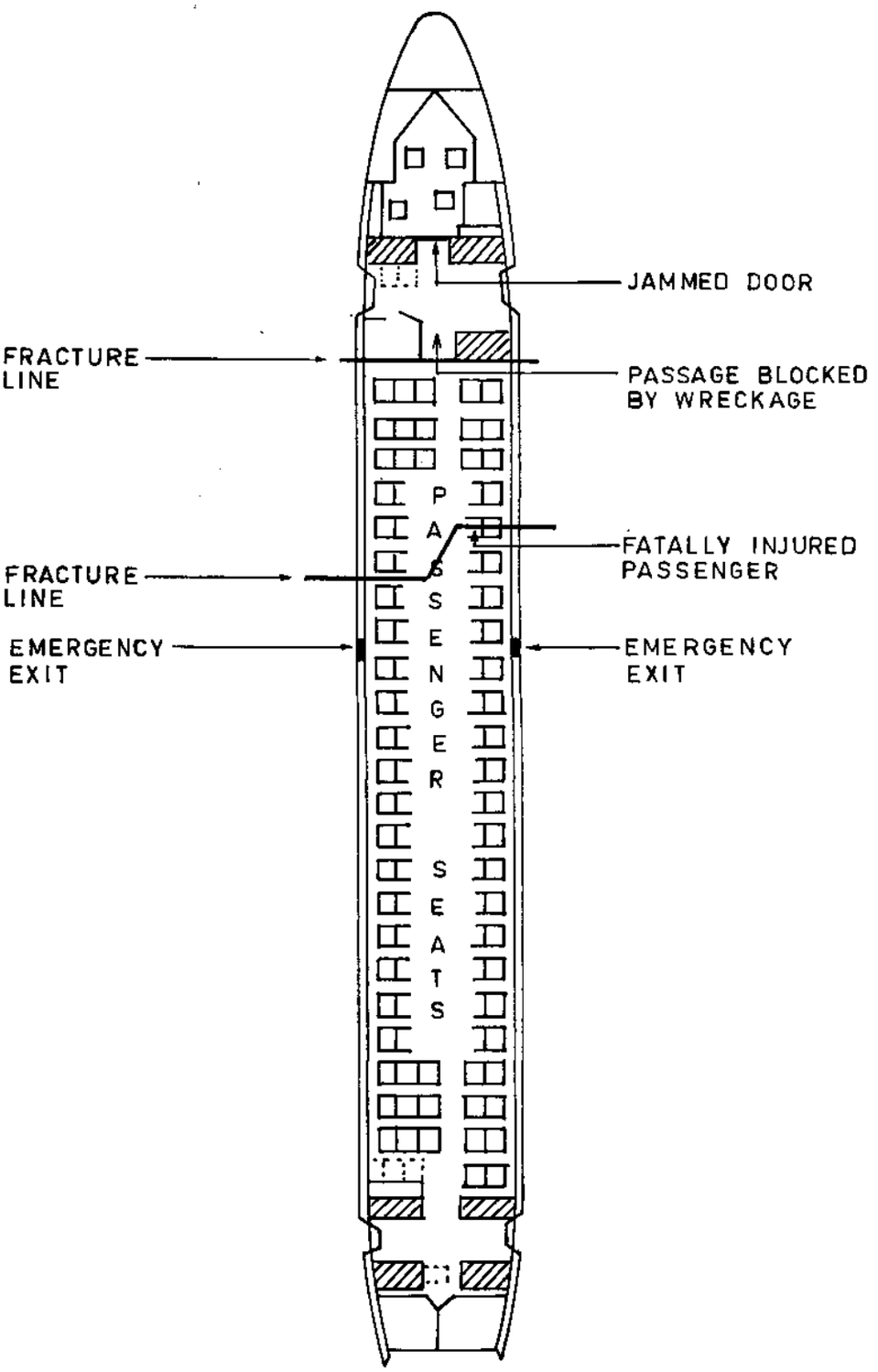






APPENDIX D

EMERGENCY EXITS & FUSELAGE FRACTURES



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