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ATTACHMENT _A

FINAL REPORT

ACCIDENT TO

NOMAD N22B 9M-ATZ

KOTA KINABALU

6th JUNE, 1976

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INVESTIGATION TEAM

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   Chief Test Pilot
2. D.R. Hooper
   Chief Designer

Govt Aircraft Factories
Australia

TERM OF REFERENCE

To determine the facts, conditions and circumstances pertaining to the accident with a view to establishing the probable cause thereof, so that appropriate steps may be taken to prevent a recurrence of the accident and the factors which led to it.

JABATAN PENERBANGAN AWAM
KEMENTERIAN PERHUBUNGAN
KUALA LUMPUR

AIRCRAFT ACCIDENT
REPORT NO :1/76

AIRCRAFT TYPE & REGISTRATION:	Nomad N22B, 9M-ATZ
ENGINE:	Two Allison 250-B-17B
REGISTERED OWNER:	Penerbangan Sabah, Kota Kinabalu, Sabah.
CREW:	Aircraft Commander, fatally injured.
PASSENGERS:	Ten, all fatally injured.
PLACE OF ACCIDENT:	Approximately 1 nautical mile on the extended Centre line of Runway 20, Kota Kinabalu Airport.
DATE & TIME:	6th June, 1976 at 1542 hours. All times in this report are local time Sabah/Sarawak.

SUMMARY

The aircraft was on a flight from Labuan to Kota Kinabalu with one pilot and ten passengers on board. After having been processed by the Kota Kinabalu air traffic control the aircraft was cleared to final to land on runway 20. On finals after having failed to acknowledge two landing clearances given by the tower controller the aircraft went into a spin and struck the sea bed in a steep nose down attitude killing the pilot and all ten passengers on board. The aircraft was substantially damaged beyond repair.

The report concludes that the probable cause of the accident was due to a Centre of Gravity position well outside the aft limit which caused the control column to run out of forward range as the nose pitched up when the flaps passed through 25° on the final approach to land.

1. INVESTIGATION

1.1. History of the Flight

At the time of the accident the aircraft, 9M-ATZ, together with another "Nomad" 9M-AUA was engaged on a Government Charter to convey V.I.P. personnel from Labuan to Kota Kinabalu, and the pilot-in-command of 9M-ATZ was the only crew member on board. The aircraft was positioned at Labuan by another Penerbangan Sabah pilot on the previous day. Both the aircraft commander and the aircraft remained in Labuan over night in preparation for a series of flights between Labuan and Kota Kinabalu which were to be carried out on the day of the accident.

On the first flight on 6th June, the aircraft departed from Labuan at 0635 hours and arrived at Kota Kinabalu at 0705 hours. It was refuelled and departed for Labuan at 1035 hours arriving there at 1105 hours. The aircraft then departed from Labuan at 1115 hours and arrived at Kota Kinabalu at 1145 hours where it was again refuelled. These flights were apparently carried out in a normal routine manner and the pilot did not report any aircraft unserviceability which required attention by maintenance engineers.

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During the periods when the aircraft was on the ground at Kota Kinabalu, the aircraft commander spoke to a number of acquaintances and stated that he was tired and that he was suffering from a mild stomach upset as a result, he believed, of food he had eaten on the previous night at Labuan.

The aircraft departed from Kota Kinabalu for Labuan at 1310 hours, and arrived at 1340 hours. On this flight, at the invitation of the aircraft commander, another pilot employed by Penerbangan Sabah occupied the right hand co-pilot seat. This pilot was not endorsed on the Nomad and he was not involved in the operation of the aircraft. He has reported that the flight was normal in all respects.

After arriving at Labuan, a quantity of baggage was delivered to the aircraft. The aircraft commander, loaded some of the baggage into the nose baggage compartment while the other pilot was instructed to load the remaining baggage into the rear baggage compartment. The aircraft was then taxied and parked at the VIP terminal to await the arrival of the passengers.

When the passengers arrived at the aircraft, it was found that ten persons wished to travel to Kota Kinabalu and as the aircraft was equipped with only nine passenger seats, the pilot who had accompanied the aircraft to Labuan was off-loaded to await the next flight and a passenger occupied the right-hand co-pilot seat.

Shortly before the take-off of 9M-ATZ, the other "Nomad" 9M-AUA departed with one crew member and twelve passengers with ultimate destination Kota Kinabalu via Kudat.

No passenger baggage was carried on this aircraft, however examination of the baggage salvaged from the wreckage of 9M-ATZ revealed that some of it belonged to passengers on Nomad 9M-AUA.

After the passengers boarded 9M-ATZ, the engines were started and the aircraft taxied for departure at about 1504 hours. The take-off appeared normal and the aircraft reported its departure to Labuan Tower at 1509 hours. During the flight to Kota Kinabalu, the aircraft cruised at an altitude of 5,000 feet and appropriate en-route position reports were made to air traffic control.

When the aircraft was some six miles from Kota Kinabalu and the pilot had reported visual flight conditions, it was cleared by air traffic control to descend to 3,000 feet and join a right-hand downwind circuit leg, to land on Runway 20.

This clearance was acknowledged by the aircraft commander.

The aircraft descended to 3000 feet on the downwind leg and was cleared for further descent and instructed to report passing 2000 feet. This instruction was also acknowledged by the aircraft commander.

During its approach, 9M-ATZ was the second aircraft in a traffic sequence of three aircraft all landing on Runway 20.

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The first aircraft, a Cessna 421, landed whilst 9M-ATZ was on downwind leg and the third aircraft, a Boeing 737, was being processed by air traffic control and progressively descended to follow 9M-ATZ in the landing sequence.

9M-ATZ reported high downwind and was cleared to final approach. Shortly thereafter, the preceeding aircraft having landed, 9M-ATZ was informed that it was number one in traffic and was again requested to report passing 2000 feet. The acknowledgement of this instruction was the last transmission received from the aircraft.

The tower controller observed 9M-ATZ carry out an apparently normal base leg and turn onto final approach. When the aircraft was lined-up on final approach, the tower controller transmitted "Tango Zulu cleared to land; wind is 280 degrees 5 knots". The aircraft did not acknowledge this transmission and it was repeated by the tower controller some seven seconds later. Again there was no acknowledgement from the aircraft.

Almost immediately, the controller observed the right wing of the aircraft dip momentarily and then rise to a level position after which the aircraft entered a spin to the right during which height was lost. Eye-witness evidence indicates that after one turn of the spin, the aircraft recovered momentarily in a nose down attitude but almost immediately the spin to the right re-commenced and the aircraft struck the sea-bed after passing through some two feet of water in a steep nose down attitude.

1.2. Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	10	0
Non-fatal	0	0	0
Others	0	0	0

1.3. Damage to Aircraft

The aircraft was completely destroyed by impact forces and the results of immersion in salt water.

1.4. Other Damage

There was no other damage.

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1.5. Crew Information

Pilot:	Aged: 42 years
Licence:	Commercial Pilot Licence (CPL) valid until 30 Nov.'76
R/T Licence:	Restricted
Aircraft Rating:	PA28-140/180, PA23 Aztec. PA34-200, N22B Nomad.
Instrument Rating:	Valid until 21 Aug. '76
Medical Certificate:	Valid until 3 Nov. '76
Last Competency Check:	10 Feb. '76
Initial Flying Conversion to Nomad N22B:	28 Oct. '75
Flying Experience Approximately total flying hours:	3062 hours
Approximately flying hours on type:	129 hours

The pilot's original flying log book was claimed to have been burnt in June 1969 and the replacement flying log book was claimed to have been stolen in November, 1975. The transfer of the total hours from the two previous flying log books cannot be authenticated, nor is it verified by the Company. The monthly summaries since the new log book was opened until the last entry on 12th April, 1976 was also never checked or verified by the Company. The total flying hours are only an approximation based on the available information in the pilot's new log book and from the Company's flight authorisation book.

As far as can be established from records available the pilot has a history of poor performances in flying. His training record and performance whilst with the Company has also been marginal.

The pilot first joined the Sabah Flying Club on 1st April, 1974. Penerbangan Sabah was then incorporated with the Sabah Flying Club and later became a statutory body coming under the jurisdiction of the Sabah Economic Development Corporation (SEDC). The pilot elected to join Penerbangan Sabah when it was transferred to SEDC on 1st November, 1974.

1.6. Aircraft Information

The GAF Nomad N22B is a multi-purpose twin engined high wing monoplane. The wing is strut braced and retractable undercarriage is fitted. Each General Motors Allison 250-B17B free turbine engine drives a three bladed Hartzell controllable pitch metal propeller. Full dual controls and a Collins three axis auto-pilot were fitted.

At the time of the accident the aircraft was fitted with eleven seats, including two side by side pilot seats and four VIP seats. In the cabin the first two V.I.P. seats faced the rear and the remainder of the seats were forward facing. Standard forward and aft baggage compartments were available in the aircraft.

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Manufacturer:	Government Aircraft Factories Australia.
Date of Manufacture:	1975
Certificate of Registration:	The aircraft was registered in the name of Penerbangan Sabah on 19th November, '75.
Certificate of Airworthiness:	Category:- Normal Sub-Divisions: a, b, c, d, e, f & i. (This therefore includes Transport Passenger Category) and valid until 18th November, 1976. The aircraft had been maintained in accordance with approved maintenance schedule P3/N22B Issue 1 dated 12th September '75.
Total time since built:	229 hours 21 mins. (the last flight is estimated as 25 min)
Time since last check:	47 hours 19 mins.
Total engine time:	229 hours 21 mins. (left) 229 hours 21 mins. (right)
Time since last inspection:	47 hours 19 mins. (left) 47 hours 19 mins. (right)

1.6.1 Aircraft Loading

Empty weight data for the aircraft was derived from the manufacturers original weighing report (CA 65). Examination of the wreckage showed that the original cabin configuration had been altered by the removal of the toilet and screens and the installation of standard Nomad rear seats. No other changes were made and an accurate empty weight could be established by calculation.

Some seats were not located in the usual positions but the actual positions could be obtained from the seat remains on the seat rails and by reference to the location stations stamped upon the rails. Seat weight data was available from manufacturer's reports.

Prior to the departure from Labuan on the accident flight the aircraft had 800 lb. of fuel.

The baggage recovered from the aircraft was weighed and allowance for water content established to determine the calculated dry weight of the baggage. The baggage recovered from the forward baggage compartment amounted to 177 lbs. This baggage was trapped in the remains of the aircraft nose. The maximum load permitted in the forward baggage compartment is 400 lbs. It is estimated that a load of 325 lbs. was placed in the aft baggage compartment and a further 90 lbs.of personal effects was distributed throughout the cabin near the occupants. The maximum permissible load in the aft baggage compartment is 198 lbs.

The calculated take off weight was 8065 lbs. This was below the maximum take off weight of 8500 lbs. but the Centre of Gravity was at 43.61% mean aerodynamic chord (MAC). This is outside the prescribe rear limit of 38.5% MAC.

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During the flight to Kota Kinabalu, it is calculated that 200 lbs. of fuel was burnt off leaving 600 lbs. of fuel. The Centre of Gravity moved from 43.61% to 43.76% MAC and the weight reduced to 7865 lbs. at the time of the accident.

The basis for the above figures can be seen in Appendix A.

1.7 Meteorological Information

On the short sector (61 miles) between Kota Kinabalu and Labuan, route forecasts are not provided as the pilot has access to actual aerodrome weather observations by radio from the air traffic control facilities located at the two aerodromes.

Meteorological observations are made at Kota Kinabalu Aerodrome at half-hourly intervals, on the hour and the half-hour. The weather observation made at 1530 hours on 6th June, 1976, some 12 minutes prior to the accident was:

slight rain,
wind 270 degrees 3 knots
visibility 30 kilometres
2/8 cloud based at 1500 feet
3/8 cloud based at 2000 feet
6/8 cloud based at 18000 feet
QNH altimeter setting 1008 millibars
temperature 28 degrees Celsius

The weather observation made at 1600 hours on 6th June, 1976 some 18 minutes after the accident was:

fine
wind calm
vasibility 30 kilometres
2/8 cloud based at 1500 feet
5/8 cloud based at 28000 feet
QNH altimeter setting 1008 millibars
temperature 28 degrees Celsius.

There was no evidence that the weather conditions contributed in any way to the accident.

1.8 Aids to Naviation

The flight was conducted under the visual flight rules and the availability or serviceability of radio navigation aids was not a factor in the accident.

1.9 Communications

Communications between the aircraft and the Control Towers at Labuan and Kota Kinabalu were recorded on continuously running magnetic tape. Relevant parts of the transcript have been included in para 1.1. History of the flight.

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1.10 Aerodrome and Ground Facilities

The aerodrome at Kota Kinabalu has a single sealed runway aligned 021/201 degrees magnetic and 9800 feet in length. The aerodrome is equipped with high intensity runway lights and thereis a VASIS on Runway 02. There are no approach aids for landing on Runway 20.

1.1. Flight Recorder

There is no requirement for this aircraft to be equipped with a flight recorder and none was fitted.

1.12 Wreckage

The aircraft struck the ground/water with considerable force in a near vertical sense. There was no evidence of forward speed relative to the ground and it was clear that the aircraft struck at an angle of at least 60° to the horizontal. Damage to both mainplanes and engines confirmed that the aircraft was not turning at impact.

The wreckage occupied an area of about 40 ft. by 40 ft. in shallow water. It was on the centre line of runway 20 some 5676 ft. short of the threshold and 177 ft. out from the jetty or cat walk which runs parallel to Jalan Pantai Sembulan. The wreckage was facing away from the approach to runway 20 on a heading of approximately 020°.

Due to the rescue work which took place before the Investigating Team arrived some evidence was lost due to considerable damage which was inflicted on the wreckage during the process of moving and separating major components.

The angle of impact was such as to cause the fuselage, aft of stn 292, to fail on the lower side. This allowed the rear portion of the fuselage to rotate up and over the front fuselage with the top of the fin and rudder coming to rest in the cockpit area. The mainplanes had both moved forward at impact, following the failure of the wing struts at their inboard ends. The cockpit area was badly crushed on impact.

The structure forward of the stub wings was foreshortened to about two feet, as a result the cockpit area was very badly compressed. The centre fuselage frames and structure were essentially intact and the damage sustained was consistant with the impact. The main cabin floor was still in one piece and it was noted that the seat attachments were in place. Seat structures failed as a result of the impact and rescue work. The rear fuselage, tailplane and fin was complete and relatively undamaged apart from the top of the fin and rudder. The top of the fin above wl 198 was crushed in the leading edge area by about one foot.

The fin main spar failed due to compression buckling about one foot above the base of the fin. There was no evidence of pre-crash failure in the structure or tailplane.

The mainplanes which were still attached were found to have been moved upwards relative to the fuselage by about 40° each during the rescue. It was evident that the impact had caused both mainplanes outboard of stn. 144 to be crushed in the leading edge area.

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This resulted in the mainplanes suffering increasing crushing damage towards the tip such that the tip chord had been reduced by about 50%.

The stub wing structure and wing struts were only damaged as a result of the impact.

The fuel system was checked and found satisfactory; fuel LP filters indicated some contamination of the stbd. system and less in the port. The stbd. filter contamination was not sufficient to restrict flow to that engine.

The flying controls of the aileron/flaps, spoilers, tailplane and rudder were all examined in detail and apart from the rudder control torque shaft under the pilots pedals, which was missing, it was possible to trace all parts. Only one link in the inboard flap hinge port side displayed an unusual failure, this was therefore sent for expert metalurgical examination. There is, however, a second link for the inboard port flap which would take the full load should the other link fail. Only the flap position could be established beyond doubt at a setting of 25°.

Though not conclusive, it is possible from witness marks on the fin, that the tailplane was set in a full UP position. The damage found throughout the flying control system was consistent with the impact forces when the aircraft struck the ground. There was no evidence of pre-crash failure. The tailplane trim position was established at 10D which is full down. This position can only be related to a very aft C of G position. The rudder trim position was contradictory in that the cockpit indication was 4R yet the chain position on the rudder trim screw jack was virtually neutral.

The undercarriage was found to be down and locked with no indication of pre-crash failure. The autopilot fitted to this aircraft had been declared unserviceable and whilst it was not possible to establish whether it was selected on, there is no reason to suppose that it was.

An examination of the engine control settings proved inconclusive due to contradictory settings on the same engine. It was evident that the impact forces had distorted the true settings of the controls. It was therefore decided to split both engines at the 4th stage turbine face. Examination of the third stage turbine nozzle and the 4th stage turbine indicated that both engines were operating above flight idle but well below maximum power. The most likely power setting was probably around 30 psi torque. It was also evident from the 3rd stage nozzle examination of both engines that the port was at a slightly higher power setting than the stbd. This evidence was contradicted by the propeller damage which indicated substantially the same power from both engines.

With the exception of the right engine torque indication and the stallwarning audio there was no evidence to indicate pre-crash failure of the cockpit indications. However, it was only possible to establish the following instrument and system control positions.

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Pilots ASI	86 kts
Pilots clock	3 hours 41 mins. 27 secs.
Both altimeters	1008 mb
Fuel select left	ON
Fuel select right	ON
Crossfeed	BOTH

The right engine torque indication failed at some stage because the fuse protecting the torque circuit had blown. Examination of the various system components indicated that the fuse probably blew as a result of a wiring short circuit on the back of the torque indicator at impact. The aural warning circuit breaker had tripped. Examination of the aural box mounted in the cockpit indicated that again impact damage was probably responsible for tripping the circuit breaker. One of the effects of this circuit breaker when tripped would be to mute the stall warning system vanes mounted on the port mainplane leading edge.

In view of the Visual Flight Rule procedure being used at the the time of the accident it is reasonable to assume that instruments had no bearing on this accident.

Communication equipment of the aircraft consisted of two VHF Nav/Comms, two ADF's and one HF radio. It was noted that only the VHF equipment was selected ON. Therefore only the positions of the VHF selector have been included.

Radio NAV. 1	-	113.1 MHz (KK VOR IDENT VJN)
Radio COM. 1	-	119.1 MHz (KK APPROACH)
Radio NAV. 2	-	Between 112.15 MHz & 113.1 MHz
Radio COM. 2	-	119.1 MHz (KK APPROACH)

The communication equipment is considered to have no bearing on this accident and there is no reason to believe it suspect.

There was no evidence of explosion or any form of sabotage.

1.13 Medical and Pathological Information

Post Mortem examinations showed that all the occupants had died from extensive multiple injuries. There was no evidence that the pilot was suffering the effect of alcohol or drugs apart from an anti-malarial called chloroquine.

1.14 Fire

There was no evidence of fire either in the air or after the subsequent impact with the water.

1.15 Survival Aspects

This was not a survivable accident.

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1.16 Tests and Research

1.16.1 Flap link Examination

The report from Australia indicated that the link failed due to overload in bending. There was no evident of pre-failure cracks and the material properties were typical of a 2024 alloy which had been heat treated to T851 temper standard.

1.16.2 Handling report

The Government Aircraft Factory of Australia produced a report covering the handling properties of the Nomad. The data from this report has been used in compiling the graphs at the end of this report.

2. ANALYSIS & CONCLUSIONS

2.1 Analysis

There is no evidence to suggest any failure of the aircraft or its systems prior to the accident. The last maintenance was carried out on the preceeding Friday when an attempt to rectify a recurring defect of "undercarriage fails to retract after take-off" proved inconclusive. This was due to the intermittent nature of the defect and in any case would have no bearing on the events leading up to the end, because it would have been apparent during take-off from Labuan. The failed link in the port inboard flap inner hinge could not have affected the situation because the port inboard flap is connected in two places and the second link did not fail. The stall warning failure which has not been conclusively proved due to the impact could possibly, though unlikely, have been contributory too, but not the cause, as it is merely a warning of approach to the stall.

With engines under power at the time and no evidence of sabotage, explosion or fire it is clear that the aircraft was not the cause of the accident.

Pathological tests on the pilot proved that he was reasonably fit at the time and not suffering from the effects of alcohol or drugs; though there is other evidence to suggest he was tired and had a mild stomach disorder.

The aircraft was fitted with duplicate flying controls and a passenger is permitted to occupy the co-pilot's seat in the absence of another qualified pilot. However, the pilot-in-command should brief any such occupant not to interfere or obstruct the flying of the aircraft. In investigating probable causes of the accident, an examination of the rudder pedals indicated that to sit comfortably on the seat which only has vertical adjustment, the feet can be placed under the pedals. Very little clearance is left and any sharp backward movement of the pedals (eg. engine failure on take off) could over-ride the feet and possibly cause jamming of the rudder pedals. It is however most unlikely that jamming of the pedals took place in this case.

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The loading of the aircraft was found to be incorrect for the flight in that the centre of gravity position was significantly aft of the aft limit prescribed for this aircraft.

It was evident from handling information supplied by the manufacturer that there is a point, as the centre of gravity position moves significantly aft of the centre of gravity aft limit, when the forward control column stop position is reached. Forward movement of the control column is intended to lower the aircraft nose or prevent the nose from moving up. If the forward stop is reached when the nose of the aircraft is still moving up, then a loss of control must occur because airspeed and stability are lost. The point at which the control column meets the stop is a resultant of power, flap setting, centre of gravity position and airspeed.

It is apparent, and there is no reason to believe otherwise, that the aircraft was on a normal approach to Kota Kinabalu runway 20 with flaps set at 20°, power 30 psi torque and an approach speed of about 86 knots. By reference to Appendix B Case D, it can be seen that the control column position was in trim giving a tailplane angle of 3.5° forward. At this point, the control column has only 0.5° range available which whilst still sufficient allowed little room for manoeuvre. For the final phase of the approach, the flaps are lowered to the landing position of 40° followed by a decrease in airspeed to give about 66 kts. over the runway threshold.

When flaps are lowered anywhere in the range of 0° to 25° there is a positive pitch up movement of the nose which must be corrected, apart from preventing approach to stall, but also to stop the aircraft from climbing again due to the large flap area. Therefore, as the flaps were lowered on the final approach to 25° the control column had to be moved further forward to correct the nose up tendency described above. By reference to Appendix B Case E for a steady state trimmed condition at 25° flap we have a tailplane angle of 3.85° which is within $.15^{\circ}$ of the forward travel limit. However, in this case, it was a transient condition because the flaps had just been lowered to 25°. Therefore it was necessary to over-correct with the control column thereby hitting the forward stop in an attempt to hold the nose down. It is therefore apparent that there was insufficient movement left of the control column to prevent the nose from moving further up. This resulted in a loss of airspeed which by reference to Fig. 2 requires an even further forward position of the column to correct the situation. Therefore at this stage, it was not possible to retrieve the situation which deteriorated rapidly into the stall condition.

An unusual aspect about this approach was that it is not recomaended procedure to select 25° of flap. Normal practise is to move directly to the landing flap (40°) position. The Nomad aircraft is however fitted with a spring loaded flap selector in that if the selector is released it moves to the off position thereby stopping the flaps at the particular position reached when the selector is released. In this particular case, it is highly probably that the pilot was selecting 40° landing flap when he was forced to release the flap selector and place two hands on the control column because the column forces had increased considerably with the nose still rising causing loss of airspeed followed by the stall and a spin.

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It is important to consider the factors which led up to this situation and the reason why the aircraft managed to complete the preceeding part of the flight without incident.

To consider the second question first it is necessary to study the implications of Fig. 2. From this figure it can be seen that the point of running out of forward control column movement is a function of four factors, namely centre of gravity position, flap position, power setting and to a lesser extent airspeed. The figure demonstrates that as flaps are lowered the tailplane incidence is increased (control column moving forward) significantly with the worst case at 25° of flap. Also clear is that when both power is increased or centre of gravity moves aft the tailplane incidence is again increased. By comparing Cases A, B, C, D and E which cover the various phases of the fatal flight it becomes clear why the aircraft was able to complete the earlier part of the flight without loss of control.

On the day of the accident the pilot had flown successfully from Labuan to Kota Kinabalu twice starting the first trip at 0635 hours local. It is evident that in order to take off at 0635 hours he must have been up by 0530 hours at the very latest. The amount of sleep that night could not be determined with any accuracy but he did have to get up at some time early in the morning to let in his two friends who were staying with him at a local hotel. At the time of the accident he had been up for approximately 10 hours. According to the Company Operations Manual a duty period starts from two hours before departure time to one hour after flight. Therefore as he took off at 0635 and suffered the fatal accident at 1542 he had already been on duty for an official time of 11 hours 7 mins. - this is in excess of the Company duty period of 10 hours.

Thus at the time of the accident he had already exceeded duty time by 67 minutes. Therewas some suggestion by a witness that he was tired but this is inconclusive because it is not known how much sleep he had that night. It is possible that he was suffering the effects of his previous evening's food because he specifically complained of feeling unwell before leaving on the last flight to Labuan at 1310 and again before departing from Labuan at 1509 on the final flight.

Throughout this enquiry it became clear that the operating procedures carried out by the Company pilots had become quite casual and were certainly not of a professional standard. There are specific requirements laid down by the Law that load sheets must be prepared before each public transport flight and a copy left on the ground. This was not carried out on this occasion and indeed it is not clear that any pilot of this Company ever raised one.

A V.I.P. flight, according to the Company Operations Manual, required that an IFR flight plan be filed; this again was not done. Investigation of the Company procedures indicated that the Operations Manual generally calls up all the legal, and many of the recommended requirements. However, the problem appeared to be that the Company did not ensure that its procedures were used. The Company should have a monitoring system to cover such problems.

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One example of an area which the Company should have monitored is crew rest period. Had this been recorded properly by the Company, then this pilot would not have been required to carry out the last flight from Labuan to Kota Kinabalu.

It is quite obvious that many of the procedures listed in the Operations Manual have not been used by the pilots. In addition, Technical Log entries were of such a poor standard as to make the document meaningless.

Thus the scene appears to have been set where this pilot, not in the habit of completing many of the requirements or procedures called for by the company, did no more than a casual walk around of the aircraft at Labuan, and sat in the cockpit when the final loading was completed oblivious to incorrect distribution of the load. Against this background with V.I.P. passengers boarding the aircraft and many other people evidently standing around it is possible that the pilot was not in control of the loading. It is, of course, not known what pressures were on the pilot with such important passengers, to get on with the flight.

Therefore the final flight of 9M-ATZ took off at 1509 hours from Labuan not overweight but grossly outside the aft C of G limit with a pilot possibly under a little pressure to get back to Kota Kinabalu, feeling ill and probably tired. It has already been explained why the flight proceeded to the approach phase without incident but a couple of points are worth mentioning about the later stages of this flight. Firstly the pilot failed to comply with the request of Kota Kinabalu ATC to report passing 2000 ft. and subsequently did not respond to the ATC landing clearance given twice. Secondly the tailplane trim was found to be conclusively in a full down position. There is no way to determine the trim position for the cruise phase of the flight but it is very probable that the full down trim was selected for the initial approach at 20° flap. It should have been apparent to the pilot that this trim position was not normal and could really only be due to a loading problem.

It is possible that he noticed this situation and became pre-occupied with it to the point of failing to respond to ATC instructions. Investigation of the pilot's history indicated that he had some difficulty in passing both ground and air tests and only succeeded in gaining a Nomad endorsement on his licence in February, 1976 following a series of poor write-ups from the company check pilots.

Finally there is a requirement for any operator of a Public Transport undertaking to be granted approval to use a new aircraft type before commencing operations. Such an approval is not given until the Department is satisfied with the Operator's operation and maintenance. This Organization neither had such an approval for the Nomad nor had any application been made for one.

2.2. Conclusions

a. Findings

1. The aircraft had been maintained in accordance with an approved maintenance schedule.

2. The pilot was licensed on the type.

3. There was no evidence that any precrash defect or malfunction of the aircraft, its engines or service was a causal factor.

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4. There was no evidence of sabotage, fire or explosion.

5. The aircraft struck the ground 1¼ miles short of the threshold at a near vertical angle during an approach to runway 20 at Kota Kinabalu.

6. The aircraft was loaded within the prescribed weight limit.

7. The aircraft Centre of Gravity position was calculated to be well outside the approved aft limit.

8. The load sheet had not been prepared.

9. The passenger manifest was not completed.

10. No IFR flight plan was filed as required by the Operations Manual for V.V.I.P. flights.

11. A VFR flight plan had been filed.

12. The fuel load figures had not been entered in the Technical log.

13. The Technical log defects section had not been cleared in accordance with recommended practice.

b. Causes

The pilot lost control of the aircraft when he ran out of forward control column range as flaps were lowered through 25^{0} on the approach to land, due to a Centre of Gravity position which was well aft of the approved rear limit.

3. Recommendations

3.1 Any Operator undertaking Public Transport work must posess the necessary approval to use a new aircraft type before commencing operations.

3.2 Penerbangan Sabah should be restricted to the operation of aircraft and helicopters under 6000 lbs. maximum weights until such time as the Company Operations and Engineering procedures together with the Management personnel have been improved to the satisfaction of the Civil Aviation Department.

3.3 An Aeronautical Information Circular should be issued to all pilots and operators stressing the importance of complying with the load, fuel, defect, weather and acceptance procedures before any flight.

OMAR SAMAN
Chief Inspector of Accidents
Civil Aviation Department
Malaysia.

25 January, 1977.

Appendix A

Aircraft Loading

Actual loading data used for para 1.6.1

1. Take off case

ITEM	WEIGHT(LBS)	STATIONS(INS)	INDEX UNITS	REMARKS
Aircraft as weighed	4853	194.22	942.56	From Form CA65 dated 3.11.75
Toilet	-17	311.18	-5.29	Not fitted
Toilet partition	-22	296.82	-6.53	Not fitted
Engine Oil	30	141.00	4.23	
Pilot	135	118.5	16.00	
2 Seats Row 1	68	164.00	11.15	
2 Seats Row 2	68	213.00	14.48	
1 Seat Row 3A	15	246.00	3.69	
1 Seat Row 3B	15	249.00	3.70	
1 Seat Row 4	15	277.00	4.15	
2 Seats Row 5	28	316.00	8.85	
A/C Wt.- no pax/fuel/baggage	5198	192.17	996.99	
1 Passenger in Co-pilot's seat	130	118.5	15.41	
2 Passengers in Row 1	390	167.0	65.13	) Wt.
2 Passengers in Row 2	275	210.0	57.75	) includes
1 Passenger in Row 3A	140	245.0	34.30	) one brief-
1 Passenger in Row 3B	140	248.0	34.72	) case per
1 Passenger in Row 4	150	276.0	41.40	) passenger
2 Passengers in Row 5	350	315.3	110.35	) each
Front Baggage	177	50.7	8.97	) weighing
Rear Baggage	325	353.7	114.95	) 10 lbs.
A/C loaded but no fuel	7265	203.71	1479.97	
Fuel at T.O.	800	198.77	159.02	
A/C loading at T.O.	8065	203.22	1638.99	

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- C of G position as % MAC (Mean Aerodynamic Chord)

$$= \frac{\text{(C of G Station - C of G Datum) x 100}}{\text{Mean Aerodynamic Chord}}$$

For T.O. $= \frac{(203.22 - 172.26) \times 100}{71.00}$

FOR T.O. = 43.61% MAC

2. Accident Case

ITEM	WEIGHT(LBS)	STATIONS(INS)	INDIX UNIT	REMARKS
A/C at T.O.	8065	203.22	1638.99	
Less fuel consumed	-200	198.77	-39.75	
A/C load at time of accident	7865	203.33	1599.24	

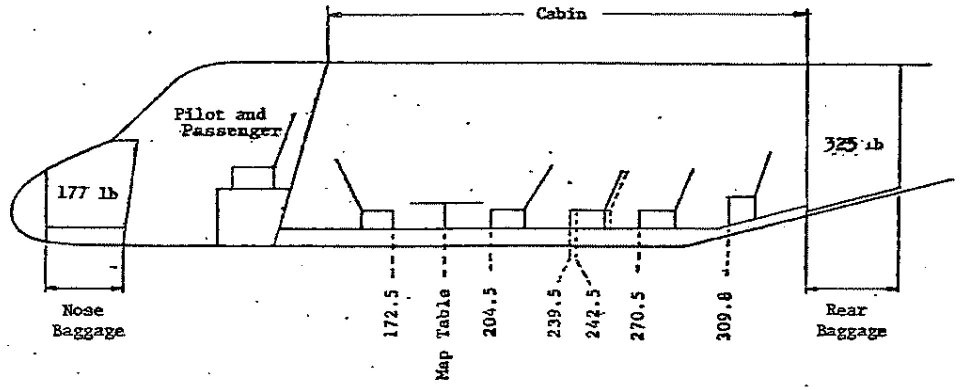
Therefore C of G position as % MAC

$$= \frac{(203.33 - 172.26) \times 100}{71.00}$$

FOR ACCIDENT CASE = 43.76% MAC

Notes: 1. MAC loading edge datum is 172.26 ins. aft of datum.
2. Mean Aerodynamic Chord is 71.00 ins.

Fig. 1



	Nominal Station Datum	Seat CG Station (in)	Personnel CG Station	WEIGHT LBS	
				(5)	(5)
Cabin	172.5	164.0	167.0	230	140
	204.5	213.0	210.0	120	135
	239.5	246.0	245.0	130	
	242.5	249.0	248.0		130
	270.5	277.0	276.0		140
	309.8	316.0	315.3	170	160
Pilot	-	-	118.5	135	
Co-Pilot	-	-	118.5	130	
Nose Baggage	50.7 (4)	-	-	177	
Rear Baggage	353.7 (4)	-	-	415	

NOTES

(1) ~~VIP-Seats -~~ seat C.G. is assumed to be at the same C.G. as a commuter or utility seat with headrest i.e. 8.5" from seat datum towards back squab. Personnel C.G. is assumed 7.5" from seat datum towards back squab.

(2) Centre fuse seats: seat C.G. is at 6.5" from seat datum towards back squab ~~and personnel C.G. is 5.5" from~~ seat datum towards back squab.

(3) Rear fuse seats: see customer options G111 and fig.Z Ch.1-40-00 of Weights and Balance Manual.

(4) Refer Weights & Balance Manual Ch. 1-60-00 Fig.5

(5) L.H. column for L.H. cabin seats and R.H. column for R.H. cabin seats.

Appendix B

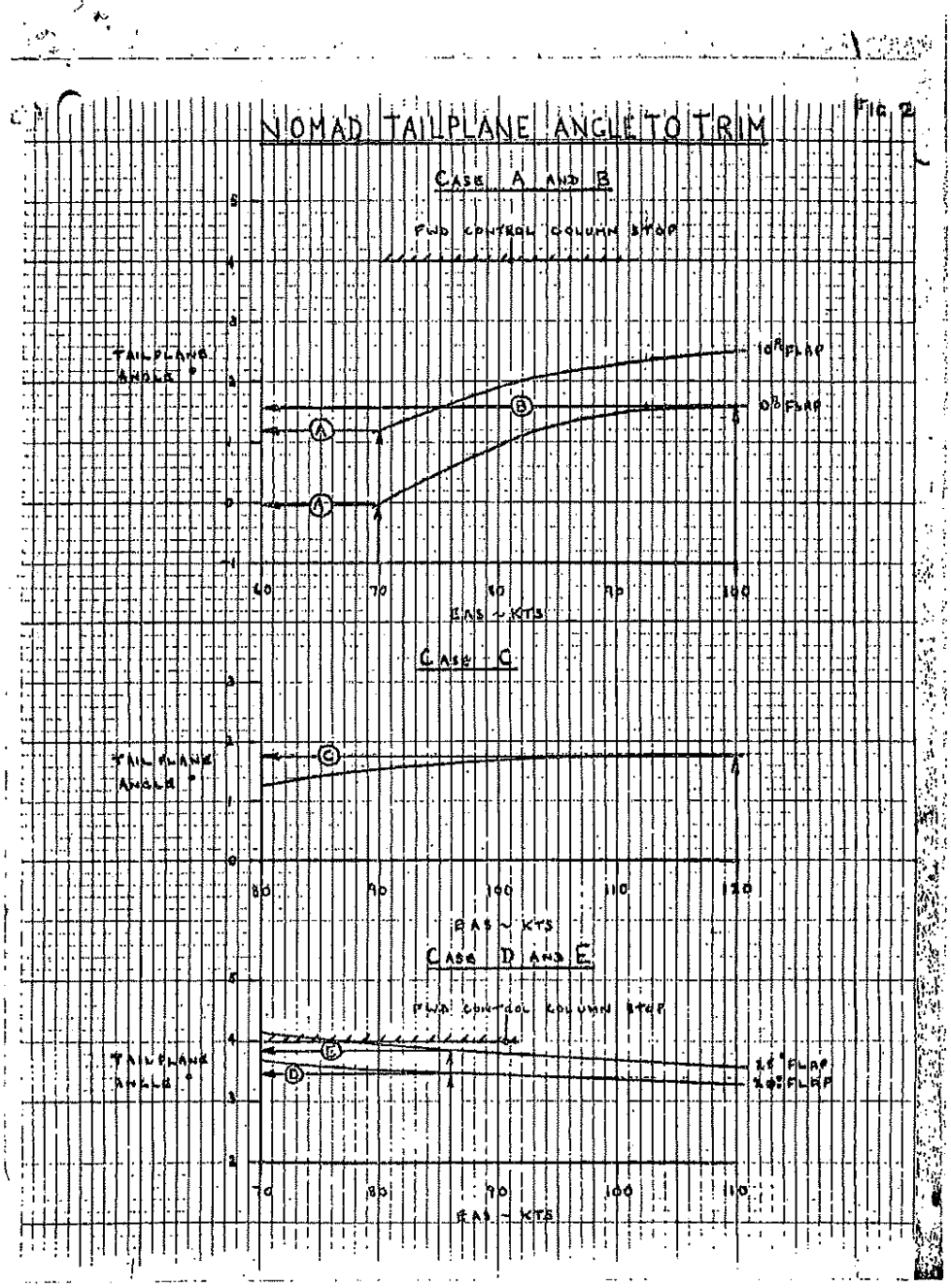
Aircraft Handling

The following information and graph has been derived from the Government Aircraft Factory Project Note N2/52 dated July 1976.

So that paragraph 2.1 Analysis may be understood it is necessary to consider the position of the control column for the various phases of flight. The following cases are intended to illustrate the various conditions of flight experienced in a tabular form for ease of reference. The first column is intended to allow easy cross reference to the graph. Column three to six are intended to give the actual flight parameters assumed in arriving at the tailplane angles listed.

CASE	FLIGHT PHASE	C OF G POSITION % MAC	POWER PSI	AIRSPEED KTS	FLAP POSITION	TAILPLANE ANGLE	REMARKS
A	Take Off	43.60	90+	70	0 or 10	-0.04 or 1.1	Safe
B	Climb	43.60	90	100	0	1.57	Safe
C	Cruise	43.70	60	120+	0	1.76	Safe
D	Initial Approach	43.76	30	86	20	3.46	Moving towards forward stop
E	Final Approach	43.74	30	86	25	3.85	Almost on stop no margin for transient excursions

Therefore it can be seen that the flight could be carried out successfully up to the approach phase where it can be seen that the control column is moving towards the forward stop in the initial approach and probably reached the forward stop when an attempt was made to check the nose pitch up as the flaps were passing 25° with power set about 30 psi.



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