Cessna 182S, G-WHDP

AAIB Bulletin No: 6/2002	**Ref: EW/C2001/6/8**	**Category: 1.3**
Aircraft Type and Registration:	Cessna 182S, G-WHDP	
No & Type of Engines:	1 Lycoming IO-540-AB1A5 piston engine	
Year of Manufacture:	1988	
Date & Time (UTC):	23 June 2001 at 0914 hrs	
Location:	RAF St Mawgan, Cornwall	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 3
Injuries:	Crew 1 (Fatal)	Passengers 1 (Serious)
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilots Licence	
Commander's Age:	43 years	
Commander's Flying Experience:	391 hours (of which 266 were on type)	
	Last 90 days -19 hours	
	Last 28 days - 5 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The accident occurred when the pilot of a Cessna 182S lost control of his aircraft during the roll out phase of a landing on Runway 31 at RAF St Mawgan. The aircraft, which had touched down to the left of the runway centreline and maintained a higher than normal speed, veered to the right and then as power was applied ground looped to the left and departed the runway. It became airborne for a short distance before impacting with the ground and catching fire. After the runway excursion the aircraft was possibly affected by the rotor downwash from a Sea King helicopter positioned near the runway and air taxiing to take off. The passengers, one of whom was knocked unconscious in the impact, escaped with non-life threatening injuries. The pilot, who also escaped from the aircraft, was severely burned and died of his injuries nine days later.

History of the flight

The aircraft, with the pilot, his wife and two children on board, departed Elstree, Hertfordshire at 0730 hrs for a flight to RAF St Mawgan. The family planned to return to Elstree later the same day. The VFR flight to St Mawgan, conducted in VMC, was uneventful until the landing on Runway 31.

Runway 31 at RAF St Mawgan is 2,745 metres long and 87 metres wide. It has an arrester wire installed at each end. The first arrester wire is 420 metres beyond the 31 threshold. The Civil Air Terminal is situated near the far end of the runway. As the aircraft approached St Mawgan the pilot, with his wife sitting beside him in the front right seat, pointed out the arrester wires' position on the airfield chart for Runway 31 and explained to her that he intended to land beyond the first one.

At 0857:05 hrs the pilot contacted the St Mawgan approach controller advising him that his aircraft was inbound from Elstree with four persons on board. The controller offered him a Flight Information Service (FIS) and passed the 0900 hrs St Mawgan weather which was: Surface wind 320° calm, visibility 15 km, nil weather, cloud 3 octas at 1,500 feet, QNH 1017 mb, QFE 1002 mb, OAT +16°C. The controller then asked if the pilot was 'for a visual join' and if he was familiar with the airfield. The pilot replied that he was planning a VFR approach, that he hadn't visited St Mawgan 'for a year or so' but he did have the full details and a current Flight Guide. At 0859:59 hrs the controller informed the pilot that he was to join for a right base for Runway 31 and that there was "ONE ROTARY UP TO 3,000 FEET IN THE OVERHEAD, POSITION YOURSELF FOR 4 MILES FINALS FOR RUNWAY 31". The pilot acknowledged both the clearance and the traffic information.

At 0908:05 hrs the controller cleared the pilot into the Military Air Traffic Zone (MATZ) to join right base for Runway 31 and added "WE STILL HAVE ROTARY TRAFFIC UP TO 3,000 FEET IN THE OVERHEAD". At that time, the aircraft was in the Bodmin area commencing a descent from FL40 to level at 1,800 feet on the St Mawgan QFE. The descent was normal with the pilot reported as being relaxed and carrying out checks in a routine manner.

At 0911:00 hrs a Sea King helicopter (callsign SRG 170), operating on the Tower frequency, was cleared to land at the south dispersal. The Cessna pilot continued his descent and, having passed slightly through the runway extended centreline at 4 nm, corrected his track to establish on a 2 nm final for Runway 31. At some time during the right turn onto finals, the pilot pointed out to his passengers a yellow Sea King helicopter to the left of the runway. Because of the turn, the passengers initially saw the helicopter to their right. One of the passengers described it as being 'on the ground' and the 'rotor blades appeared not to be moving' (a second yellow Sea King helicopter was parked on the south dispersal). At 0912:35 hrs the pilot was instructed with "ONE ROTARY IN THE CIRCUIT (to) CONTINUE WITH MAWGAN TOWER". The pilot checked in on the tower frequency at 0913:20 hrs as the aircraft reached short finals and at 0913:48 hrs was cleared to land. Eighteen seconds later, at 0914:05 hrs, the crew of the Sea King, which had landed, requested taxi clearance. The Cessna at this time had not yet crossed the runway threshold.

Just before touch down the pilot was seen by his wife to be moving the rudder trim wheel with a 'measured movement from left to right'. At about that time his daughter, sitting in the rear right seat, saw him slightly 'recoil' his head as if in surprise. She believed that this was her father reacting to the Sea King, which was now airborne and visible to her through the left front window of the aircraft.

The ATC assistant, using binoculars from her viewpoint in the tower, confirmed that the aircraft's landing gear was down and the flaps were lowered. She described the approach as 'stable but high and steep'. This was confirmed by the tower controller. At 0914:33 the aircraft was seen by the assistant to touch down normally at a point (see Figure 1 - JPG 60kb) approximately 180 metres beyond the first arrester wire.

The aircraft touched down slightly to the left of the runway centreline. It appeared not to reduce speed significantly and moments later began to increase speed making a positive turn to the right crossing the runway centreline. The commander of the Sea King, which by now had left the south dispersal and was closer to the runway, saw the aircraft to his right, on the centreline of the runway, at a speed he described as 'too slow to get airborne but too fast for a taxi'. He turned his helicopter hard left through 90° away from the runway and in doing so lost sight of the aircraft.

As the aircraft veered to the right, the tower controller became concerned and checked with the pilot that he was still in control. The pilot did not respond and his aircraft passed through the runway centreline to a point midway between the centreline and the runway's right edge. By now, the pilot had applied full power and the aircraft had entered a tight skidding turn to the left. The aircraft continued to turn through approximately 110° to the left, re-crossed the centreline and struck a substantial runway edge light on the left side of the runway. The aircraft then adopted a high nose up attitude and became airborne rising to a height of about 5 to 6 feet. It cleared access road 'M' (a road crossing the runway and running north from the south dispersal) and descended again striking the grass with the left wing tip in a nose down attitude. The aircraft veered further to the left whereupon the right wing struck the edge of the grass. It then slewed to the right and came to rest with the nose wheel and right main wheel detached.

The tower controller sounded the crash alarm when he saw the aircraft strike the runway edge light and the fire crew, who had also witnessed the accident, immediately initiated the 'State 1' crash response.

Rescue and survival aspects

A fire broke out on the left side of the cockpit immediately the aircraft came to rest. The pilot exited through an opening to his left as the left door had detached in the impact. Fuel, from a disconnected fuel hose in the left wing root, had contaminated his clothing and caught alight. He managed, however, to extinguish most of the flames by rolling on the ground. He then moved around the front of the aircraft to assist his family. His wife, seated in the front right seat, received a serious head injury and was unconscious. She was, however, pulled out of the aircraft onto the ground by the older of the children, who had exited through the right door that had come open in the impact. Fire officers who arrived on the scene removed the occupants to a safe distance and applied foam from one of the appliances to extinguish the aircraft fire. Their response time was such that both fire appliances arrived on scene 35 and 40 seconds respectively after the aircraft struck the ground. A fireman who entered the cockpit shortly after the accident found the ignition, battery master switch and the row of light switches all in the 'OFF' position.

A station medical orderly and two paramedics from the air ambulance based at the airfield attended the injured who were transported to hospital in Truro. The two adults were airlifted in the air ambulance and the children in a Search and Rescue Sea King helicopter.

The pilot suffered burns to an estimated 74% of his total body surface and despite maximum support in a specialist burns unit died nine days later. The post-mortem examination revealed no

evidence of any pre-existing medical condition which might have caused or contributed to the accident.

Aircraft weight and balance

It was calculated that the aircraft weight at takeoff was 2,992 lb which was below its maximum permitted take-off weight of 3,100 lb. The CG was at 127,000 lb/in aft of the datum placing it in the centre of the moment envelope. For its arrival, the aircraft's landing weight was calculated to be 2,872 lb; 78 lb below the 2,950 lb permitted. Its CG remained in the centre of the permitted envelope

The Sea King helicopter (callsign SRG 170)

The Search and Rescue (SAR) Sea King Mk 3A, normally crewed by two pilots, a radar operator and a winchman, was being operated only by the two pilots. They arrived at St Mawgan at 0740 hrs in order to carry out a number of post maintenance test flights. Both pilots, although not based at the airfield, had carried out their Sea King conversion courses at RAF St Mawgan and were familiar with the airfield operating procedures. They had also carried out post maintenance test flights on a number of previous occasions and were properly qualified and authorised.

At about the time of the Cessna's arrival at St Mawgan the Sea King crew were about to commence the final test flight which involved a radar serviceability check to be conducted at about 1,000 feet along the coast. The crew landed from their penultimate flight on the south dispersal and ground taxied to the Helicopter Maintenance Flight (HMF) hangar in order to collect a third crewmember required to operate the radar during the forthcoming test.

The crew had been having trouble with the helicopter's radios. Interference in the form of a loud background hum occurred when a transmission was made from their helicopter. This was, however, merely an irritation and by reducing the volume, the crew were able to minimise the hum but still have adequate reception.

After the radar operator boarded the aircraft he secured himself in his seat at his radar console in the front left of the passenger cabin. Following a brief discussion amongst the crew, the Sea King commander, who was seated in the right seat, commenced a ground taxi. He made a left turn around a parked Sea King and headed in a northerly direction to exit the south dispersal. He intended to lift into a high hover over the grass area to the south of Runway 31, just to the west of taxiway 'L', and then obtain his departure clearance.

The driver of a fuel tanker vehicle, cleared to drive east along the southern taxiway, saw the Sea King as it approached the exit from the south dispersal. He stopped his vehicle and, concerned that there might be a possible confliction, reversed back along the taxiway to ensure adequate clearance from the Sea King. At the same time, the tower controller instructed the Sea King to hold its position. The crew of the Sea King, seeing the stationary tanker, informed the controller that they were happy to lift. The controller responded by reporting the surface wind. The Sea King then lifted in a rolling take-off and climbed to air taxy with low forward speed. As the helicopter hover taxied from the tarmac surface and over the grass, cuttings from the freshly mown grass started to recirculate in the rotor downwash. In order to prevent these being ingested by the engines the Sea King commander applied approximately 95% twin torque and climbed to about 50 feet before levelling off and continuing the high hover taxi.

RT transcript

RT transmissions made to and from St Mawgan ATC were routinely recorded. Relevant extracts of the transcripts produced from both the Tower and Approach frequency recordings are tabulated in chronological order below:

Time (UTC)	From	To	Speech Transcription
0910:53	SRG170	Tower	S170 finals gear down to land in dispersal
0911:00	Tower	SRG170	S170 clear land circuit SW calm
0912:22	Approach	G-WHDP	G-DP are you visual with the aerodrome
0912:24	G-WHDP	Approach	Affirm DP just overshot and coming onto 4 mile final now
0912:32	G-WHDP	Approach	Sorry for the overshoot just went through a little cloud
0912:35	Approach	G-WHDP	G-DP roger one rotary in the circuit, continue with Mawgan Tower 123.4
0912:41	G-WHDP	Approach	Mawgan Tower 123.4
0913:26	Tower	G-WHDP	G-WHDP Mawgan Tower join Runway 31 QFE 1002 circuit clear
0913:48	Tower	G-WHDP	G-DP clear to land SW calm
0914:05	SRG170	Tower	S170 we would like to taxi for the taxiway, lift from there to operate approximately 1,000 feet over the coastline
0914:14	Tower	SRG170	170 roger if you hold your present position and let the tanker go in
0914:19	SRG170	Tower	We are happy to lift now. (different voice) We are good VMC and we are having a good look now
0914:34	Tower	SRG170	170 south westerly calm
0914:45	Tower	G-WHDP	(unclear words) DP he is visual with you. Are you in control?
0914:52	Tower	SRG170	170 land please

Ground marks and impact parameters

Rubber skid marks, left by the aircraft tyres, were evident at various points along the runway. A skid mark on the runway, approximately 420 metres from the arrester wire, indicated where the aircraft began to veer to the right. This mark was believed to be from the left main landing gear and was displaced 8.45 metres left of the runway centreline. The aircraft continued to veer to the right and, 53.3 metres from the start of the skid mark, crossed the runway centreline markings at an angle of 20°. There was then a gap of 26 metres in the marks as the aircraft reversed its turn. At a position 17.5 metres to the right of the centreline the aircraft started to veer to the left. It reached a

maximum displacement of 25.3 metres right of the centreline before the skid marks showed that it re-crossed the runway centreline 149.5 metres from the initial centreline crossing point. It then struck a runway edge light with the right wheel. As it departed the runway onto the grass, a gouge from the tail 'tie down' ring was evident.

The aircraft departed the runway and crossed access road 'M' whilst airborne for some 90 metres and on an approximate heading of 210°. No impact marks were found on the access road. The next point of contact with the ground was in the grass 40 metres from the western edge of access road 'M', where an impact mark made by the left wing tip was found. The main impact point was located about 12 metres short of the northern edge of the Southern taxiway. It was evident from the ground marks here that the aircraft was yawed to the left and in a nose down attitude. The nosewheel struck the ground heavily causing a deep circular impression in the soil. The force of the impact broke off the nosewheel and subsequently a 5 metre long gouge in the soil was produced by the nosewheel strut. Twelve propeller strike marks were identified to the left of the nosewheel gouge marks. The initial spacing of these was 15 cm apart. Assuming a propeller RPM at full throttle of 2,500 RPM, the strike marks indicate that the aircraft was travelling at a ground speed of approximately 35 kt at the main impact point.

As the aircraft continued the right main wheel struck the ground heavily and broke away due to the excessive side loads caused by the large amount of left yaw. The right wing tip also impacted the ground, causing the outer one third of the wing to be severely distorted upwards. The aircraft then skidded onto the paved surface of the southern taxiway before coming to rest. Lateral scrape marks on the right wing, nose cowl and propeller spinner and on the surface of the taxiway indicated that the aircraft was yawed almost 90° to the left as it slid onto the taxiway. The right landing gear strut then dug into the paved surface and yawed the aircraft 90° back to the right immediately prior to it coming to rest.

The pilot's door (left hand) had broken away from its hinges and was found near the front left side of the aircraft. The impact sustained by the right wing had displaced the roof of the cabin to the left, shearing the windscreen posts. The disruption of the left windscreen post was severe enough to detach a rubber fuel hose on the left wing tank fuel outlet pipe, in the left wing root. Leaking fuel from this pipe ignited resulting in the left side of the cabin and the engine cowl being badly damaged by fire and causing severe burns to the pilot.

Wreckage examination

Continuity of the flight controls was confirmed by a combination of operating the controls and examination of the control cables. The ailerons were jammed because of impact damage sustained by the wings. The flap lever was found in the 'UP' detent and examination of the flap actuator confirmed that the flaps were in the up position. The rudder trim was slightly to the left of central and the elevator trim wheel was set 1/2 inch nose down. The rudder pedals were jammed and the rudder trim wheel chain had come off the lower cog due to disruption of the floor. There was no evidence of any pre-impact failure of the flying controls.

The propeller pitch control was set to fully fine and the mixture control was fully rich. The cowl flaps were two divisions short of fully open and the throttle was wide open. The throttle friction nut had been tightened to the extent that a large amount of force was required to move the throttle and it could only be moved with considerable effort. Once the friction nut was loosened the throttle operated normally and full range of movement was verified at the fuel/air control unit. The throttle rod however was bent to the right at about the point where it exited the friction nut and a consistent

witness mark was found on the throttle rod. The reason for the bend in the throttle rod could not be determined. Correct operation of the mixture and propeller controls was confirmed. The fuel tank selector was slightly to the right of the 'BOTH' position and a significant quantity of fuel was collected from each of the fuel tanks. All the exterior light switches were found to be in the 'OFF' position.

Examination of the nose and main landing gears did not reveal any evidence of pre-impact failures. The brake discs and pads were in good condition, evenly worn and showed no evidence of binding. The nosewheel, left and right main landing gear tyre pressures were measured at 42psi, 32psi and 38psi respectively. The manufacturer's recommended tyre pressures are 49psi for the nosewheel and 42psi for the main wheels. Tests carried out by the manufacturer at the lower tyre pressures revealed that there were no handling difficulties at speeds up to 60 kt. Testing above 60 kt was not carried out as above this speed the aircraft would become airborne.

Helicopter operations at RAF St Mawgan

The RAF St Mawgan Flying Order Book provides guidance for helicopters arriving or departing and for both ground and air taxiing. Whilst the helicopter crew were familiar with operating from, and had undertaken training at RAF St Mawgan, they were not current signatories to the Flying Order Book. Under 'Helicopter RT procedures' it stated that, prior to taxying, a transmission was to be made to ATC requesting taxy and stating to what point the aircraft was requesting to taxy. The taxiing instructions are reproduced below:

> *Rotary Wing Taxying Procedures.*
>
> *Medium and Heavy Helicopters. Aircraft are normally to ground taxy from either south or west dispersal. Hover taxying to their departure point may commence once the aircraft has reached either Point A or Point B (see Figure 1) as shown on the map at Annexe B. Helicopters may also request "Line up 02" and, on having received clearance from ATC, may lift to the hover on the threshold of Runway 02.'*

Sea King rotor downwash study

A study was carried out by a commercial research company to record data of the three-dimensional wind speed created by a hover taxiing helicopter. The purpose of the study was to establish if the rotor downwash from the Sea King had contributed to the accident. A Mk4 Sea King helicopter reproduced the profile flown by the Sea King at RAF St Mawgan with the same orientation and distances relative to the Cessna's track. An All Up Weight of 17,000 lb +/- 500 lb, was used to replicate that of the helicopter on the day of the accident. The data was gathered in similar surface wind direction and speed conditions to that which existed on the day of the accident.

Relative positions of the helicopter and Cessna were derived from witness evidence and the time base provided by the ATC transcript. The Cessna was fitted with a GPS navigation system that recorded every thirty seconds, the position of the aircraft as well as the ground speed at that point. Despite the intense fire in the cockpit area the navigation unit information was downloaded and provided a record of the aircraft's ground position and speed. It was possible, using the GPS data and witness evidence, to estimate the aircraft's performance between data points. Thus the 'worst case' relative positioning of the Sea King and the Cessna could be used to determine the effect, if any, of the rotor downwash.

It was concluded that there was no effect from the rotor downwash on the Cessna during the turns to the right and left on the runway. A maximum wind increase of 25 kt some 21 seconds after the helicopter applied 95% twin torque was recorded however at a data test point positioned where the Cessna would have passed over vehicle access road 'M'. This wind increase could best be described as a sudden gust.

The Sea King viewed from the Cessna cockpit

A trial was carried out using a Sea King Helicopter, which flew the same profile as that flown by the Sea King on the day of the accident. A second helicopter with a stabilised video camera mounted beneath it was used to reproduce the track and flight path of the Cessna. It was flown on a steep approach at the same speed as the Cessna and levelled at approximately 5 to 10 feet above Runway 31 to simulate the touch down. It was accepted that the eye height of the Cessna pilot would have been lower than the camera and of the pilot flying the camera helicopter. The image presented to the Cessna pilot of the Sea King, given the same relative positions of the two aircraft derived from the plot, was however similar. The Sea King used was also dark in colour and not as conspicuous as the yellow helicopter involved on the day of the accident.

The trial demonstrated that if the Cessna pilot had seen the Sea King climbing and considered it to be a conflict, stopping on the runway would have been possible. The execution of a go around even in the very late stages of the approach, immediately prior to touch down would potentially have placed the aircraft in the path of the Sea King.

Analysis

The Cessna

Post accident inspection of the aircraft found the throttle to be in the fully open position, with the flaps UP and the cowl flaps OPEN, in accordance with the 'after landing' check list. It was not possible, without using a large amount of force, to close the throttle until the friction had been released. From the configuration of the aircraft, therefore, it appeared that the pilot was trying to execute a 'go-around' from the runway at the time of the accident even though he did not make any comment to his passengers regarding his intentions.

Furthermore, a colleague, who had been in the aircraft with the pilot on another occasion and in a similar landing situation recalled that when the aircraft had veered to the left on touchdown, the pilot had carried out a 'go-around' by retracting the flaps fully, applying full power and taking off for a further circuit.

If the pilot had been concerned about any potential conflict with the Sea King his best option would have been to stop on the runway. By closing the throttle after landing and applying the brakes the aircraft would have stopped some distance before the point at which the Sea King might have entered or crossed the runway. Even from the point where the aircraft was seen to accelerate, there still remained some 200 metres of stopping distance available.

The pilot however, increased the power. This had the effect of accelerating the aircraft and applying a yawing moment to the left. Coincident with this he had to correct the veer to the right by applying left rudder to prevent the aircraft departing to the right side of the runway. The combined effect of the power and rudder inputs caused the aircraft to enter a skidding turn to the left. The effect of raising the flap would also have affected the stability of the aircraft on the ground. The

pilot was seen by his passengers to have both hands on the control column trying to maintain control of the aircraft and the passenger in the rear right seat clearly heard the noise of the tyres 'screeching loudly' as the aircraft 'hurtled across the width of the runway without slowing'. In the situation in which the pilot found himself, removing the power by closing the throttle would, with sufficient space available, have allowed him to slow the aircraft and correct the skid. With both hands on the control column, however, this was not possible.

As the aircraft left the runway it struck a substantial runway edge light structure with the right main landing gear. The passengers described the aircraft manoeuvring as if in a 'whirlwind' or 'sandstorm' being 'blown from left to right'. From their recollection of events it was not clear whether this was on or after the aircraft had left the runway. It is possible that these manoeuvres occurred as the Cessna was airborne crossing vehicle access road 'M' with its progress being influenced by the rotor downwash from the Sea King. The aircraft's tail tie-down ring however gouged the grass as it became airborne. The wings were therefore at a high angle of attack and despite full power being applied the aircraft may have stalled and rolled to the left before being influenced by any effect of the rotor downwash. The exact relative positions and ground speeds of the two aircraft could not be determined therefore it is uncertain exactly which was the case.

The following situations were considered as to why the aircraft veered to the right soon after touchdown and then carried out a ground loop to the left:

Encountering wake vortex

The effect on the aircraft during initial touchdown caused by residual turbulence created by the Sea King when landing in the south dispersal was considered. From the evidence of the crew, it was estimated that the Sea King was over the southern taxiway abeam the arrester wire more than three minutes before the Cessna crossed it. This was above the two minutes minimum spacing for aircraft (including helicopters) with crossing flight paths specified in the Manual of Air Traffic Services (MATS) Part 1 for aircraft in the weight categories of 'small', for the Sea King, and 'light' for the Cessna. Furthermore, the rotor downwash trial proved that there was no effect on the Cessna as the Sea King lifted into the high hover taxi manoeuvre. The trials showed that the longest time for the increased surface wind to return to normal was 25 seconds.

Avoiding conflict

The Cessna pilot should have heard the RT exchange between the tower controller and the Sea King pilot when the intention to take-off and operate along the coast had been declared. He would have assumed that his landing clearance implied that the Sea King would hold clear of the runway until his landing was complete. In the final stages of the approach, just prior to the touchdown, the Cessna pilot was seen to recoil his head as if in surprise and move the rudder trim to the right. The order in which these occurred however could not be established.

The pilot's attention would have been focussed on the runway during the later stages of the approach. It is possible however that he detected the movement of the large yellow helicopter lifting into the hover, albeit some 600 metres away. Whether his surprise was as a result of seeing the Sea King lifting, hearing the Sea King transmission at 0914:19 stating that they were "happy to lift" or encountering an

unforseen problem with the landing could not be established. Whilst he is thought to have registered surprise he did not express any reason or behave in an alarmed manner. He continued his landing which witnesses described as normal apart from touching down slightly left of the centreline. If the pilot had been concerned, after touchdown, at the progress of the Sea King, bringing his aircraft to a stop as quickly as possible would appear the most natural reaction. The pilot may have judged, however, that the best way to avoid the Sea King was to pass ahead of it and avoid the rotor downwash. This would account for the aircraft maintaining speed and then accelerating. To attempt a go-around in order to resolve any potential conflict would seem an unlikely reaction considering the relative positions of the two aircraft. Consideration must be given however to the possibility that the pilot thought that carrying out a go-around was the only way to avoid a potential conflict with the helicopter. Post accident investigation showed that the aircraft was in a configuration for take-off. The pilot would have been fully occupied trying to regain control of the aircraft in a rapidly deteriorating situation and probably would not have had any spare capacity to appreciate external events. With the throttle friction applied so tightly, as was found, and with both hands on the control column, it would have been very difficult to close the throttle.

Expediting clear of the runway

As in the case above, the Cessna pilot was probably aware after touchdown that the Sea King was about to depart. He therefore may have tried to expedite his progress to the terminal exit at the far end of the runway in order to minimise the delay to the Sea King's departure. The width of the runway and lack of peripheral cues, however, may have led him to perceive he was travelling slower than in reality.

Having touched down with the throttle either closed or with some power still applied, the aircraft speed, according to witnesses, was maintained at an estimated speed of about 50 kt. In trying to regain the centreline or possibly move to the right side of the runway towards a taxiway exit the aircraft veered to the right. From the moment this occurred, the pilot would have been trying to correct the path of the aircraft on the runway. The acceleration in the right turn meant that some power had been applied but with the aircraft passing through the centreline, full power was now applied and the throttle friction apparently tightened. The flaps were selected UP and full power applied although it is not known in which order this was carried out. The only reason for applying full power as he crossed the centreline therefore would have been to convert the landing into a further take-off.

The Sea King

As the Sea King approached the intersection of the south apron and the southern taxiway, the tower controller transmitted to the Sea King,'170 ROGER, IF YOU HOLD YOUR PRESENT POSITION AND LET THE TANKER GO IN'. The Sea King pilots were unaware of the landing Cessna and the commander considered the transmission more as a question than an instruction. As the tanker was stationary and the Sea King was still moving, he considered it would expedite the movement of both tanker and helicopter if he lifted off and moved out of the way. This would be achieved by hover taxiing to the grass area south of Runway 31, between taxiway 'L' and vehicle access 'M'. The Sea King crew transmitted 'WE ARE HAPPY TO LIFT NOW, WE ARE GOOD VMC AND WE ARE HAVING A GOOD LOOK NOW'. The Sea King pilot on hearing the transmission of the

tower controller '170 SOUTH WESTERLY CALM' believed that this was an implied clearance to lift from his position on the south apron and transition onto the grass.

The Sea King crew did not hear any of the transmissions made between ATC and the pilot of the Cessna. It was estimated, from a reconstruction of events, that the Sea King was stationary, rotors running, outside the HMF hanger for approximately 1 minute 20 seconds from 0912:25 hrs to 0913:45. hrs. During this time the radar operator and a ground crewman were cleared to approach the aircraft. The ground crewman was passed the flight test report by the commander and the radar operator boarded the aircraft, checked his safety equipment and connect his helmet to the aircraft intercom system. The commander's hearing would have been affected with an increase in ambient noise level brought about by his open flight deck window during his interaction with the ground crewman. Furthermore, the crew had lowered the volume of their radio station boxes to overcome the background noise problems. They were still able to hear transmissions although at times with some difficulty. It is also possible that during the transmissions made between the Tower and the Cessna from 0913:20 hrs to 0913:48 hrs the crew were discussing the forthcoming flight on intercom. The radar operator did not hear any of the tower transmissions because the radio volumes on his station box had been turned down during maintenance. He only became aware of this when the helicopter lifted into the hover and he had not heard any of the normal pre take-off transmissions.

Conclusion

It was concluded that the Cessna crashed following a loss of control during an attempt to carry out a 'go-around'. The activity of the Sea King and the loss of control by the pilot of the Cessna were two distinct, and for the most part, unrelated events occurring at the same time. The plot constructed of the relative positions of each aircraft considered in conjunction with the rotor downwash trial established conclusively that the rotor downwash from the Sea King did not play any part in the Cessna leaving the side of the runway.

The Sea King crew were not aware of the landing Cessna or the tower/Cessna RT exchanges as they had been fully occupied in their pre-taxi discussions. They would have been advised of the landing traffic had they called for departure but their intention was to ground taxi and lift into the hover and then call for departure. As the 'hold' instruction was given in order to let the bowser through, no mention of the Cessna was required to be given by the tower controller. There was a misinterpretation, by the Sea King crew, that the instruction to hold position was a suggestion rather than an instruction. The offer to proceed was made by the helicopter pilot with good intent in order to try to assist the controller by quickly clearing a route for the tanker to proceed. This offer appeared to have been accepted when the controller transmitted the surface wind to the pilot. The controller however mistakenly believed that the Sea King crew were visual with the Cessna.

The possibility that the pilot of the Cessna was distracted by the actions of the Sea King could not be discounted. If that was the case, the option to stop on the runway by closing the throttle and applying the wheel brakes was available. The higher than normal speed maintained by the Cessna after landing was more likely an attempt to expedite clearing the runway than trying to take avoiding action. It is possible that expeditious runway clearance was either not to delay the departure of the Sea King or to reduce the time taken to travel to park at the Civil Air Terminal at the far end of the runway. The loss of directional control on the runway was attributed to the high ground speed and the attempt to carry out a 'go-around'. The go around was probably attempted to resolve the difficulties, experienced by the Cessna pilot, in maintaining directional control.

The outflow of air from the Sea King's downwash possibly affected the Cessna, when it became airborne and crossed vehicle access 'M'. The turbulence created by the downwash could have added to the Cessna pilot's control difficulties. It is also possible that the low speed and increasing high angle of attack of the Cessna as it rotated into the air may have caused the aircraft to stall and descend quickly after becoming airborne.