CEA DR400/180R, G-BJUD, 11 November 2001 at 1420 hrs

AAIB Bulletin No: 8/2002	**Ref: EW/G2001/11/10**	**Category: 1.3**
Aircraft Type and Registration:	CEA DR400/180R, G-BJUD	
No & Type of Engines:	1 Lycoming O-360-A4A piston engine	
Year of Manufacture:	1973	
Date & Time (UTC):	11 November 2001 at 1420 hrs	
Location:	Lasham Airfield, Hampshire	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - Nil
Injuries:	Crew - None	Passengers N/A
Nature of Damage:	Nose Landing Gear collapsed, damage to propeller and lower section of engine cowling	
Commander's Licence:	Private Pilots Licence	
Commander's Age:	38 years	
Commander's Flying Experience:	389 hours (of which 200 were on type)	
	Last 90 days - 81 hours	
	Last 28 days - 0 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and AAIB examination of the NLG	

Synopsis

The aircraft experienced a Nose Landing Gear (NLG) collapse on landing as a result of a fatigue failure of the NLG upper support bracket. This was associated with a non-standard weld at the junction of the upper bracket and the top section of the NLG leg.

History of the flight

The flight was intended to be the first of three visual circuits for the purpose of maintaining the pilot's currency for towing gliders. After touching down on Runway 27 from a normal 65 kt approach, the pilot kept the nose of the aircraft high using 'up' elevator, in order to gain aerodynamic braking effect and at the same time applied moderate wheel braking. As the speed

reduced and the nose wheel made contact with the ground, it immediately began to shimmy. The pilot moved the stick fully back to unload the wheel, but the shimmy continued, and so he then moved the stick progressively forwards in an attempt to engage the nose wheel steering mechanism, thinking that this might damp the vibration. At this point, the NLG collapsed, causing the four bladed wooden propeller to strike the asphalt runway surface and stop the engine. The aircraft slid for a short distance with the nose in contact with the runway and came to rest half way between the runway centreline and the left edge of the runway. The pilot opened the canopy and instructed the passenger to exit the aircraft whilst he made it secure, before vacating the aircraft himself. There were no reported injuries to either of the occupants. The wind was northerly at less than 5 kt, with no significant weather, and the visibility was estimated by the pilot to have been about 10 km.

It was apparent from an initial examination of the aircraft that the NLG had collapsed under the fuselage due to a failure of the NLG upper support bracket. All four tips of the propeller were worn away by contact with the runway and minor damage was caused to the underside of the engine cowling.

Background information

The Robin DR400 has a fixed tricycle landing gear, with a steerable NLG. The NLG is somewhat unconventional in that the oleo is offset to one side of the steering pivot axis. Two brackets located at the top of the oleo strut attach the nose leg to the steering pivot mechanism, Figure 1 (jpg 40kb). The upper bracket is braced by a diagonal tube, which is welded at its lower end to the side of the oleo strut, the vertical landing gear loads being reacted as compression in this tube and tension in the upper bracket. The steering input rod is connected to the upper bracket. Both the upper and lower brackets are normally attached to the oleo strut by circumferential fillet welds around the lower side only of each bracket.

There is a history of in-service problems of cracking in the circumferential weld of the lower support bracket and of cracking in this bracket in the area under the NLG lock. To address this problem, the aircraft manufacturer, Avions Pierre Robin (now Apex Aviation), issued Service Bulletin (SB) No. 101 in 1983, which is classified as mandatory and requires a repetitive dye penetrant inspection of the lower bracket and the weld. The latest revision of SB 101, Revision 3, does not permit any weld repairs to be carried out and, if cracks are found which are in excess of the allowable limits quoted in the SB, the NLG must be returned to the manufacturer for repair. There is no requirement in SB 101 to inspect the upper bracket.

NLG history

The NLG was removed from another aircraft and installed on G-BJUD in October 1994 at 5,673 airframe hours. Landing gear cycles are not recorded, as there is no life limit on the gear. The NLG and Main Landing Gears (MLGs) were removed for overhaul and refitted in March 1997, at 6,632 airframe hours. The NLG was removed again during a 50-hour Check in July 2000, at which time a crack was found whilst performing the inspections stipulated in SB 101, in the lower bracket in the area under the NLG lock. According to the SB, the NLG should have been returned to the manufacturer for inspection and repair but the lower bracket was in fact weld repaired and the NLG reinstalled.

G-BJUD was used almost exclusively as a glider tug. Assuming an hours/flights ratio of 1:5, which is typical for this type of operation, the NLG could have completed in excess of 2,700 cycles since

its previous removal in July 2000 and in excess of 12,000 cycles since being installed on the aircraft. This is in addition to the cycles accumulated prior to being installed on G-BJUD. At the time of the accident, the aircraft had flown a total of 8,202 hours.

Engineering investigation

The fracture surfaces on the upper bracket were subjected to metallurgical examination. The bracket had fractured across its narrow sections at the front and back of the oleo strut and around the weld, Figure 2 (jpg 65kb). There was evidence of fatigue cracks originating at the outer edges of the narrow sections of the bracket. The crack on the forward part of the bracket had advanced the furthest and had turned through 90° and begun to propagate vertically down the wall of the oleo strut. It was evident from the corrosion on the surfaces of this fracture that the crack had been present for a significant period of time. By contrast, the fatigue crack at the rear of the bracket had developed more recently and had propagated to a much lesser degree.

The welded region had two weld deposits, comprising a circumferential fillet weld beneath the bracket and a sealing weld above it, Figure 3 (jpg 65kb). The NLG upper support brackets on several similar Robin aircraft were inspected and these were found without welds on the upper side of the brackets. The manufacturing drawing for the NLG, obtained from the aircraft manufacturer showed that the upper bracket should be welded only on the lower side. The upper weld on G-BJUD's bracket was therefore unusual. The appearance of the fracture surfaces of the welds was indicative of a tensile overload failure and detailed examination of the welds showed that they were of poor quality with excessive gas porosity. In the case of the lower weld, there was evidence of poor penetration of the weld into the parent material. It was apparent that the fatigue cracking had progressed to the extent that the welds were no longer capable of maintaining structural integrity under the normal landing loads and had therefore failed in tensile overload, causing the NLG to collapse. Should the crack in the lower support bracket weld have been present for some time prior to being repaired, then the fatigue cracking in the upper bracket welds may have been exacerbated by the additional loading transferred to the upper bracket as result of this crack.

It was not possible to establish from the aircraft records when the upper weld had been carried out. It is possible, therefore, that the upper sealing weld was carried out as a non-standard repair at some time prior to the landing gear being installed on G-BJUD. It could also not be determined if the fatigue cracks in the upper bracket had been present when the NLG was removed in July 2000 for the weld repair to the lower bracket. If these cracks had been present in July 2000, the possibility exists that they might have been identified had the NLG been returned to the manufacturer for repair in accordance with the instructions in SB 101.

Conclusions

Generally, there has been no history of cracking problems with the NLG upper support bracket. The NLG on G-BJUD collapsed as a result of the detachment of the upper support bracket due to the progression of fatigue cracks originating in the narrow sections of the bracket. The bracket failed when the fatigue cracks had progressed to the point where the welds, which were of poor quality and one of which was non-standard, were unable to withstand the normal landing loads and failed in tensile overload.