SERIOUS INCIDENT

Aircraft Type and Registration:	Bell 206L-4 Longranger IV, G-PTOO
No & Type of Engines:	1 Allison 250-C30P turboshaft engine
Year of Manufacture:	1995
Date & Time (UTC):	3 March 2011 at 1512 hrs
Location:	London City Airport
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Tail rotor balance weight detached, damage to tail rotor gearbox mountings and tail boom
Commander's Licence:	Commercial Pilot's Licence
Commander's Age:	46 years
Commander's Flying Experience:	2,200 hours (of which 480 were on type) Last 90 days - 30 hours Last 28 days - 15 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot

Synopsis

The pilot carried out a precautionary landing at London City Airport, after the onset of vibration during the cruise. Examination revealed that a bolt, securing balance weight assemblies to a tail rotor blade, had failed due to the formation of a crack in the bolt shank which propagated in fatigue. The helicopter manufacturer confirmed that this was the first reported occurrence of this nature relating to this design of tail rotor system.

History of the flight

Whilst in cruising flight, the pilot experienced the onset of a high frequency vibration through the airframe and flight controls. The pilot declared a PAN and made a precautionary landing on an area of grass beside the runway at London City Airport. An inspection of the helicopter revealed that a tail rotor balance weight assembly had detached from one of the tail rotor blades. The balance weight assembly, together with a fractured section of its securing bolt was discovered close to the helicopter.

Description

Each tail rotor blade is balanced by the use of individual weights mounted on a bracket to form an assembly. Two such assemblies are installed on each blade, one either side of the blade root, see Figure 1. They are held in place by a bolt which passes through both

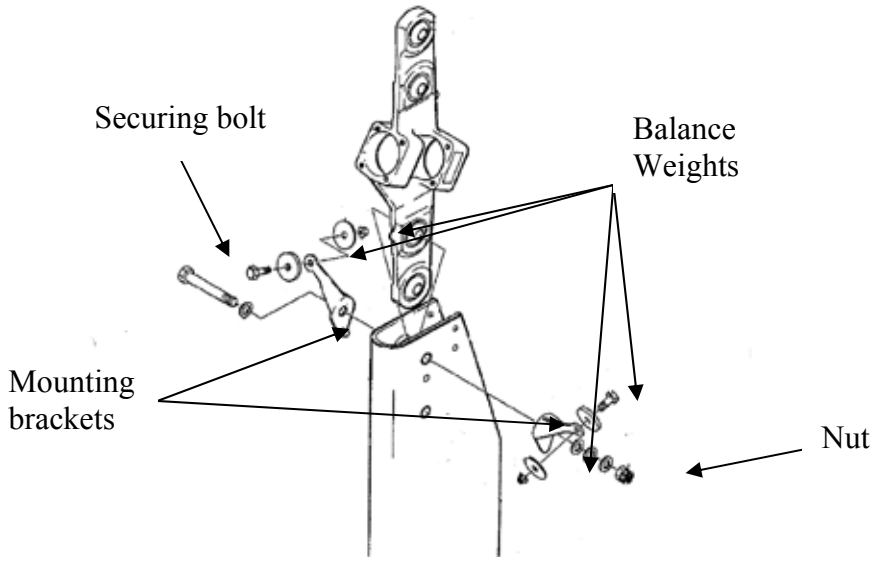

Figure 1

Tail rotor balance weights and brackets
(Courtesy of Bell Helicopters)

assemblies and the blade. The bolt is secured using a castellated nut, which is prevented from loosening by the installation of a split pin.

Investigation

Failure of the securing bolt allowed the associated tail rotor balance weight assemblies to become loose, producing the vibration experienced by the pilot. The discovery of the balance assembly, which detached from the tail rotor blade, near to the helicopter, indicated that it had remained on the tail rotor blade until the later stages of the flight. An inspection of the helicopter revealed additional damage to the tail rotor gearbox mountings and the associated structure of the tail boom.

The bolt had failed approximately 12 mm from the end of its shank and included the securing nut and associated split pin. The remaining portion of the bolt had remained in-situ, retaining the second balance weight assembly to the tail rotor blade. Examination of the remains of the bolt showed that a crack had formed within the bolt shank. This had propagated due to a fatigue mechanism until the bolt shank fractured in overload. The initiation point of this crack was found to coincide with a section of the bolt shank where the cadmium plating had been worn away by contact with the structure of the tail rotor blade, but no cause for the initiation of the crack could be identified.

Prior to removal of the bolt securing the balance weight assemblies to the remaining tail rotor blade, the 'break-away' torque of the nut was measured and found to be within the expected values. Inspection of the bolt showed a similar, but less pronounced, wear pattern on the cadmium plating of the shank. The bolt was sectioned to determine if a crack was present in its shank; no evidence of crack initiation was found.

The tail rotor hub assembly fitted to the Bell 206L-4 is subject to a 2,500 flying hour overhaul requirement. The helicopter's records confirmed that the last

overhaul of the tail rotor assembly had been carried out 1,691 flying hours prior to the incident and whilst the helicopter had been operating on another national register. The records did not contain any detailed information regarding the overhaul of the tail rotor gearbox hub. Therefore, it was not possible to verify the history of the failed balance weight bolt.

The tail rotor hub assembly fitted to the Bell 206L-4 is also fitted to the Bell 407 and 427 helicopter types. The helicopter manufacturer confirmed that there have been no reported failures of the bolts securing the tail rotor blade balance assembly bolts on any of these types.