EXTERNAL CARGO

DANGER CAUSED BY TURN UP OF ROPES

The helicopter external slingload operation (HESLO) is one of the most demanding helicopter manoeuvres. It requires a specially trained crew flying the helicopter as well as specially trained task specialists. Concerning flight safety another important factor is the choice of the load carrying equipment: The recoil behaviour of a rope due to a breakage of the attachment point (causing a shock loading) or any other reason may cause catastrophic damage to the helicopter.

In consideration of the fact that accidents happened due to wrongly selected or unsuitable load-carrying equipment, the Technical Oversight Service of the German Social Accident Insurance Institution for Transport and Traffic (Directorate of Occupational Health and Safety), being responsible for helicopter operations focused on this topic, carried out in cooperation with Enrico Ragoni, CEO of the Swiss company AirWork & Heliseilerei GmbH (A&H), systematic research into the specific behaviour of ropes. The ropes used most during transport or construction flights are made of steel or synthetic materials. A particular danger may occur under certain unloading conditions, e.g: breakage of the attachment point, causing an uncontrolled recoil of the rope. This scenario is obviously a life-threatening situation because the rope, or other elements of the load-carrying equipment, may enter into the main or tail rotor which would very likely lead to a crash.

The analysis of statistics up to 2006, showed that different steel and synthetic ropes recoil behaviour upon sudden unloading were relatively vague, despite the fact that this is of the greatest importance when selecting suitable ropes. The project leader, designers, engineers, etc will discover very quickly that they are entering into unknown territory.

After the initial theoretical research and investigations, the findings had to be confirmed through practical test experiments, which were conducted at a large shipyard in Hamburg Germany, who allocated a substantial crane for the tests. The astonishing result was that much of the load-carrying equipment used in commercial, as well as military aviation, was unsuited to the task. Some of the ropes, made of various materials and different constructions, that were tested behaved almost like rubber bands

PHOTOS: WULF BERTINETTI

RESTRAINT HARNESS
This picture shows a restraint harness which has to be protected from the front, allowing the crew member to stay on the skids to watch the external cargo.

(i.e: highly elastic) and in a real world scenario could have damaged the helicopter's fuselage or rotors.

Results data was accumulated in 230 individual tests that proved amongst other things that the following are unsuitable as load carrying or fixing ropes:

- Steel ropes without rotational freedom
- Woven polyamide ropes or straps
- Any ropes, straps, tethers or cables made of polyamide, polyester or steel with large elongation of their material and construction.

The quasi-static tests were followed by helicopter flight-tests. In the period 2011-2014 about 200 measurement flights in the weight categories 1400 and 2500 kg were carried out. In addition test flights were carried out with Human External Cargo (HEC) long lines in the categories 270-600 kg. Project leader Stephan Elfert developed special equipment for the purpose of measuring and recording the dynamic influences and forces that take effect on the load-carrying devices during load transport. Data was collected during specific calibration and measuring flights as well as during regular day-to-day helicopter operations. After only a few flights some surprising and unexpected results became apparent.

It was known that when picking up a load or putting it down, peaks in the load can occur, but what was surprising was the intensity and duration of the oscillating loads during normal flight maneuvers. The loads that were induced into the ropes were multiple times that of the static loads. The unexpectedly high load peaks, coupled with the remarkable duration of these peaks (of up to a few seconds) can substantially reduce the operating life of the load-carrying equipment.

As a consequence, an increase in the dimensioning factors of load-carrying equipment and the safety of the materials/tools used is unavoidable.

It was noticed that the 2.5 safety factor, which should have been in the range of

QUICK AND STABLE
This is a connecting piece permitting quick disconnection, which allows one-handed operation

elasticity, was exceeded regularly and which will cause a quicker premature ageing of the ropes than expected. These results led to an increase of the load factor from 2.5 to 3.0 in the dynamic-elastic area. Furthermore it is necessary that only ropes which are pre-distensioned and are non-twisting, should be used. A rotation-free steel cable has an inner core which is twisted in one direction, while the outer part is twisted in the opposite direction. Synthetic ropes should be braided with parallel strands to withstand any twisting.

The dangers from the use of ropes which are unsuited can be shown during one particular test during the trials:

A 50mm wide Polyamide strap, 30m long, with a metallic shackle at the end (1.6 Kg), was loaded with 14 kN prior to being released. The result was that the end of the strap recoiled over the entire length, with the shackle impacting the cargo hook of the crane, which in reality would have been the helicopter!

Another important intention of the trials is to answer the question whether or not a damper can be effectively applied. Utilizing a damper (in principle a coil spring with more elasticity than the rope) can be useful, but the following must be considered:

- Dampers must be placed between helicopter and load-carrying equipment
- Placing dampers at the lower end of the cable is not advisable (handling difficulties, intensified recoil, etc)
- Using a damper with very short ropes is problematic with regards to the recoil
- A correctly dimensioned damper has been proven to reduce load peaks by more than 30%.

All project partners agree that lower load peaks will not only have a positive effect on any kind of rope's lifetime (i.e: fatigue), but also in reducing the maintenance effort required for the helicopters. The trials and their results were introduced and explained in a series of seminars and information workshops

The 2015 seminar took place in Germany and consisted of two parts. Besides the measures to prevent the recoil of ropes, the second part should give a response, which personnel protection equipment for crewmembers and passengers is needed in missions with an opened sliding door.

To demonstrate the practical relevance the Federal Police's Air Squadron displayed an EC 155 which was equipped with an electrically driven Goodrich rescue hoist, so it was possible to highlight and to explain the advantages & disadvantages of different restraint harnesses on the helicopter. The position of a hoist operator at the opened sliding door may be different to the position of a photographer or cameraman who sits in the doorway and has to hold their camera in front of them. They have to be secured in a way that they are protected from falling out, yet they need to be free to move to the other side of the aircraft if required.

There are two main differences in the design of restraint harnesses, the protection between the fastening point in the helicopter and the restraint harness is possible from the front or back side of the harness. Both types have advantages and disadvantages depending on the intended usage.

For a harness which is secured from the front side, it is an advantage in the case that the crew member has to stay on the skids to watch the external cargo. It is a disadvantage if they are inside and the safety belt runs between their arms and body to the rear.

A series of training areas were set-up, the main one being at an EC155 police helicopter where practice rescue drills could be performed; with two others for various exercises. The personnel of the Winterberg mountain rescue service demonstrated

- how a rescuer can be secured on a slope in a way to free his hands
- and the safeguarding of a patient to prevent slipping off the slope.

The organizers offered a program which combined professional presentations in a lecture room as well as exploring the practical applications of different equipment.

The results of these trials deliver a valuable contribution to find the optimum choice for the best equipment being used for external cargo flights. Having the most suitable equipment is of the utmost importance to increase the flight safety when performing aerial work operations.

■ WULF BERTINETTI

PHOTO: WULF BERTINETTI