HeliSafe ®

A new concept to reduce fatal and severe injuries in helicopter accidents

Uwe Heßmer
Autoflug GmbH, Rellingen, Germany

Abstract

HeliSafe® was a Research Project in the 5th Framework Programme of the European Commission. It started on 1st February 2000 and was finished 31st March 2003.

Due to crashes Helicopter fatalities are 10 times higher as compared with fixed wing aircraft. This is partly due to the inherent risky operation of helicopters close to ground and to the high complexity of the aircraft.

HeliSafe® is improving the survivability of occupants in helicopter crashes and minimising the risk of severe injuries in both cockpit and cabin. A reduction in fatal and severe injuries will be achieved by an Advanced Safety System based on interacting safety features like improved restraint systems consisting of airbags and advanced harness systems including inertia real in automatic mode, pre-tensioners, load-limiters, etc.

Special attention is paid on current crash statistics with the aim to reduce major injuries, which subsequently lead into fatalities. This will be achieved by the advanced Cabin Safety System concept. HeliSafe® has developed a concept and validated a numerical simulation tool to predict typical crash scenarios and simulate the response load on the human body with respect to the interaction of safety equipment. Parameter studies with the simulation tools assesses the different cabin safety layouts and equipment concepts

The most frequent injuries in helicopter crashes for the different crash scenarios, the instrumentation needed to assess the level of injury in a dummy and the injury criteria which could be use to measure the effectiveness are defined as well.

Helicopter manufactures and user can now optimise their new designs as well as existing helicopter for survivability of occupants in typical crash scenarios.

To achieve these interdisciplinary objectives, the HeliSafe partnership represents the airframer- the equipment industry, automotive supplier and research institutes.

Background

Currently, crash protection consists of safety features like energy absorbing seats and conventional harnesses .

Objectives

The main objectives of HeliSafe are

- to improve the survivability in cockpit and cabin
- to minimise the risk of injuries
- to analyse crash data in order to define typical crash scenarios, usable for simulations (fig. 3)

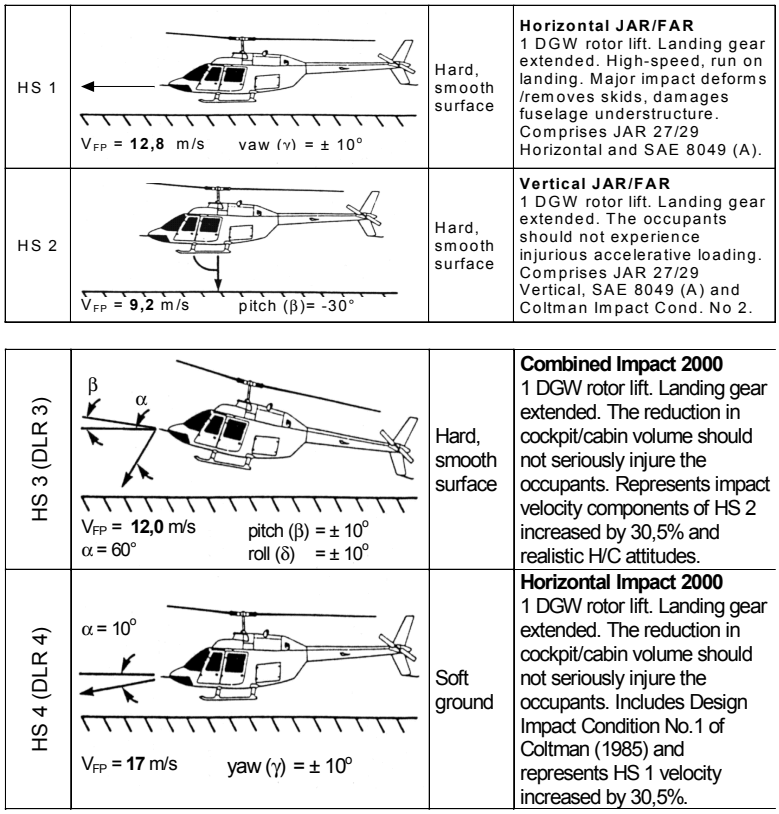

Figure 3: The HeliSafe Crash Scenarios

- the definition of injury criteria, the development of a simulation tool
- the integration of safety concepts developed in the automotive industry
- the definition of an advanced safety system concept by analysing interacting safety features for new

Figure 2: The HeliSafe Partner

H/C projects and for retrofit

- Recommendations for airworthiness standards

Cockpit and Cabin Specification

The objective of this task is the definition of a generic cockpit and cabin internal geometry (incl. seats, panels, harnesses etc.) for the simulation tool and for the full size mock-up, A full range of helicopters were analysed (1.7t up to 9.5t) and the structures surrounding frames, panels, stick etc. This led to the selected simplified generic cockpit and cabin and was then designed in 3D-CAD, to perform simulations.

Crash Scenarios

4 crash scenarios (based on existing crash data and airworthiness standards) were defined and a crash scenario data base has been created . Based on this a crash test dummy (ATD) was recommended. Within HeliSafe a modified FAA HYBRID III 50th male dummy and the respective MADYMO model will be used.

Injury Criteria

The most frequent injuries were identified and injury criteria were defined to assess the effectiveness of calculated and tested equipment. Those are based on existing automotive criteria.

Load Case Data Base

A data base containing the time-force and time-acceleration relations of the crash scenarios was established.

Calculations using different structural simulation tools –(rigid body (figure 4), Hybrid Code and FEM) were performed. With the calculated crash loads the first baseline crash simulation was performed.

Definition of the Simulation Software

The Helicopter Occupant Simulation Software (HOSS) concept (figure 5), which is based on existing simulation codes, provides the framework for the numerical evaluation of advanced cabin safety systems by computer simulation. The concept itself is code independent. The HOSS concept is centred on the analysis of the cockpit/cabin environment and the interaction between safety features and occupants in a crash scenario.

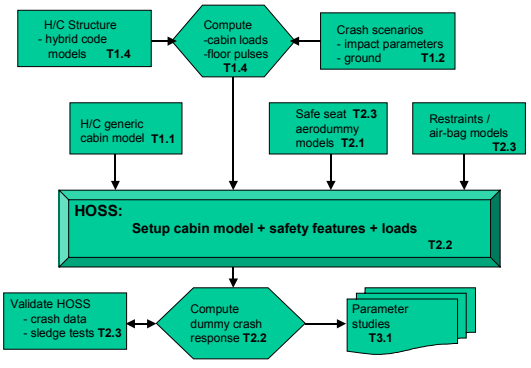

Figure 5: The HOSS Concept

The various codes being used in the project are:

Hybrid codes (KRASH, MECANO,VEDYAC) for the global crash analysis of H/C structures and crash pulses

Multibody codes (MADYMO, VEDYAC) for simulation of dummy response loads

FE codes (MADYMO-FE, PAM-CRASH) for simulating structural deformations and advanced safety features (e.g. airbags)

Model Set-up and Validation

The Validation of the software will be based on sledge test data of an unmodified cabin mock-up and experimental data taken from an existing helicopter crash, which The different software tools will be validated and evaluated independently with the same test data (figure 6).

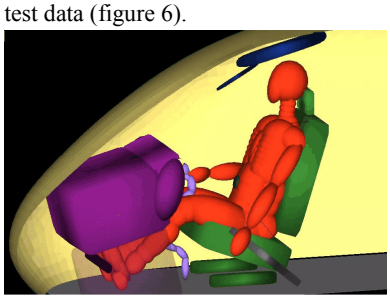

Figure 6: Model Set-up (HS1)

Mock-up

For the crash test a cockpit mock-up and

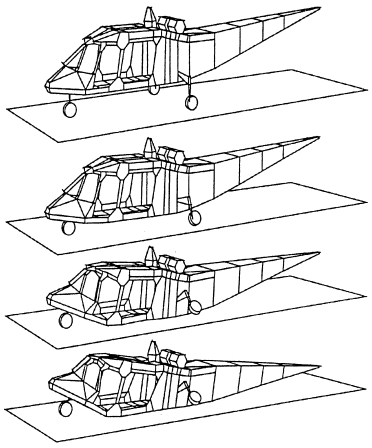

Figure 4: PTM´s VEDYAC (Rigid Body)

a cabin test rig incl. the interior (control panels, cyclic stick, etc.) has been designed and manufactured. Also samples of the proposed safety

equipment for use in final tests will be designed and prototyped. In these mock-ups new and/or enhanced equipment concepts will be integrated and tested. With the mock-ups the baseline and final sled tests will be performed

HeliSafe – Work performed

- baseline tests
- validation of HOSS
- an advanced occupant safety concept has been developed
- parameter studies with crash safety features like seats, seat position, shock attenuation, harnesses, airbags and interior
- the new safety concepts are validated in sled tests

Conclusion and Results

The aim of this EU supported research programme HeliSafe, to enhance the survivability in helicopter was demonstrated. The proposed results will be achieved . The main results are:

- Requirements for safety devices should be more detailed and explicitly named in "Seats, Berths, Litters, Safety Belts and Harnesses" (CFR 14.29.785 "Seats, Berths, Litters, Safety Belts and Harnesses", FAA, January 1, 2000)
- Current safety equipment is not capable of reducing the risk of injury. New technologies to protect occupants have to be introduced into the helicopter environment rather than just strengthen the current systems, to significantly reduce the risk of major and fatal injury.
- Current requirements do not cover 30% of the real impact conditions. Helisafe will test more realistic scenarios.
- Aviation authorities demand a triangular pulse shape for testing purposes. HeliSafe propose the use of a new generic helicopter pulse shape for certification procedures
- flight data recorders for all helicopter types are recommended (mandatory in UK MTOW > 2730 kg).
- Crash test dummies have to be modified for use in helicopter crash tests for accurate results.
- A new interacting safety feature concept is needed for occupant safety (figure 7).

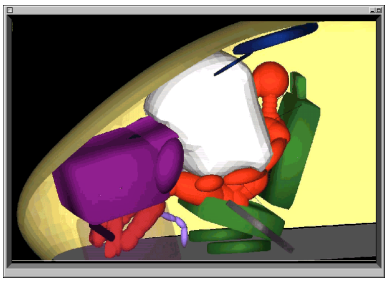

Figure 7: HeliSafe – The Future

About the author:

Uwe Heßmer

- Head of Development, Mechanics and Textiles, Autoflug GmbH & Co., Industriestraße 10, D-25462 Rellingen, Germany.
- Tel.: +49 4101 307 143; Fax: +49 4101 307 121
- Email: U.Hessmer@autoflug.de