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Requirements for Helicopter's Planer Construction Fatigue Testing

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Abstract

This paper determines the requirements for fatigue testing of full scale bench test to define the service life of helicopter structures. Which have direct influence on flight safety. so the research focus on solutions for how to extend total service life which have limited service life. In order to reasonably extend resource of limiting elements, presented close to real data about loading of these elements during the regular flight mode, as well as data of real scale model testing, strength analysis. Using this data evaluation of short time strength and durability of parts can be achieved.

KEY WORDS: *helicopters, service life estimation, full scale bench tests, requirements for fatigue testing*

1. Introduction

One of the most important exploitation criteria related to helicopter's structure is service life [1]. The structure consists of elements with limited service life. These elements have direct influence on flight safety. For example, these elements are: some separate structural elements of planer, blades and joints of main rotor, tail rotor, main gear-reducer, sub-reducer, tail reducer, main and tail shafts, etc. [2].

The only solution how to extend total service life of helicopter is rapid extension of the service life of those elements, which have limited service life till they match the value of helicopter planer service life value. In order to reasonably extend resource of limiting elements (elements which set the limits), there must be presented close to real data about loading of these elements during the regular flight mode, as well as data of real scale model testing, strength analysis, etc. [3,4]. Nowadays, there is limited selection of such materials, so it is necessary to perform real full scale testing in laboratory / stand in order to identify service life values of structural elements in flight mode. The obtained data should be used in additional (double check) calculation of service life of parts of structural elements of helicopter. These calculations must be pointed on evaluation of short time strength and durability of parts. As a result, a final report must be prepared with conclusions of reasonable extension of service life [5-7].

2. Main and Major Tasks during Full Scale Stand Experiments

The aim of fatigue testing is to choose the method of fastening mid and tail reducers in precise position and same is applied for planer construction (tail beam and fin) as well, with in are placement of reducers according fatigue requirements.

According to results of testing, following actions must be taken:

- The value of technical lifetime should be stated (period of lifetime, when it is possible to operate planer of helicopter due to economic considerations).
- The period of operation till first maintenance/observation.
- The duration of maintenance work must be defined in order to operate helicopter safely.
- The proper parameters of exploitation loads must be defined (ability to withstand loadings within particular period, with some fatigue cracks in construction).

Although the solutions of all above tasks are not possible only by "stand" testing of isolated parts (reducers, engine etc.), because such tests don't take into account the influence of "neighbouring" parts.

Planer constructions must be loaded in such a way that each zone is subjected to Indicated load.

3. Description for Selected Method of Loading

The aim of work related to calculation for method of loading of construction and method of fixing model, are defined conditions applied to planer, which are equivalent to fatigue during in-flight modes.

There are several methods, which are used to:

- Test isolated (stand-alone) aggregates on separate stands.
- Make evaluation of fatigue resistance of aggregates.

In case of real task, it is necessary to evaluate all construction: fastenings, aggregates, which are calculated according safety resource; elements of construction, which are calculated due to operational state and lifetime

Fatigue testing is being carried out on helicopter's planer (Fig. 1).

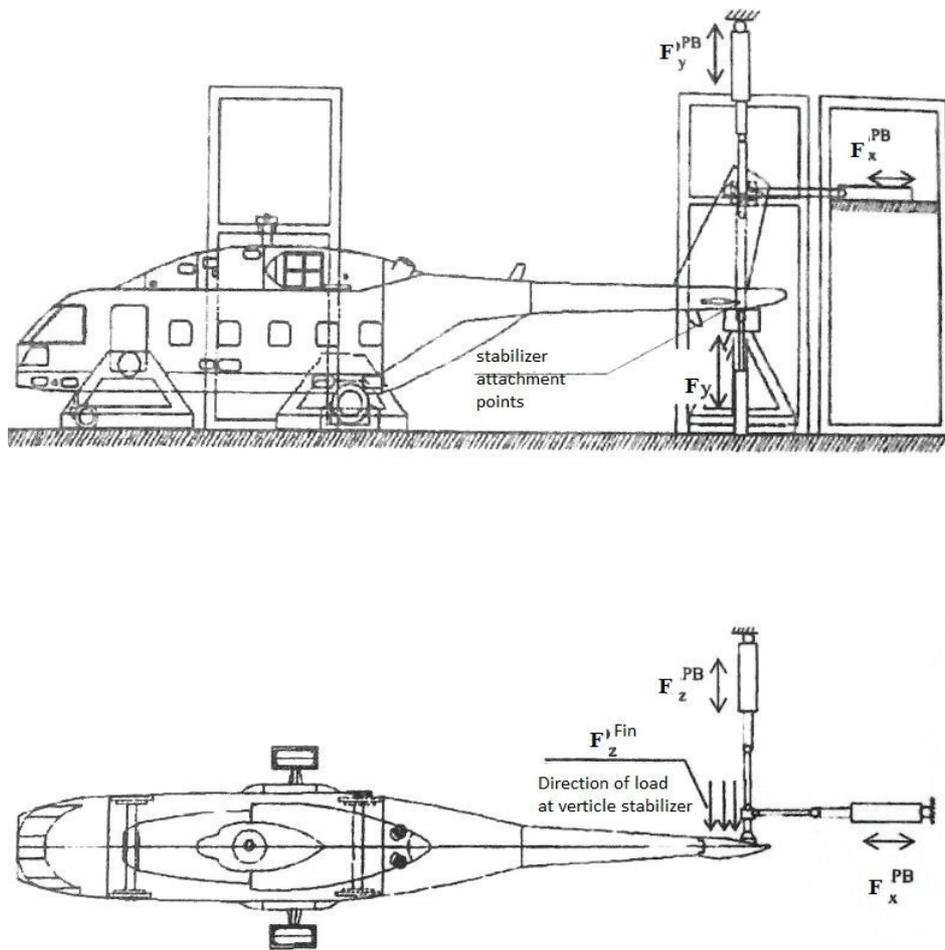


Fig.1 Model of experimental stand for testing of fatigue life of tail beam and vertical stabilizer of helicopter

Tail beam and fin beam of helicopter's with installed mid and tail reducers are objects of testing. Reducers are installed according regular (original) fastenings.

Joint points (with test objects) of testing stand must be identical to real model dimensions and technical solutions.

The coordinate system used in this experiment is shown in the Fig. 2.

X axis is aligned to flying direction (it is located in the middle of the fuselage), Y axis is perpendicular to X axis and is oriented up, X and Y axis are located in the middle of the fuselage (narrow plane), Z axis is perpendicular to XY plane, zero point of coordinate system is located on X axis, where it is being crossed by power frame.

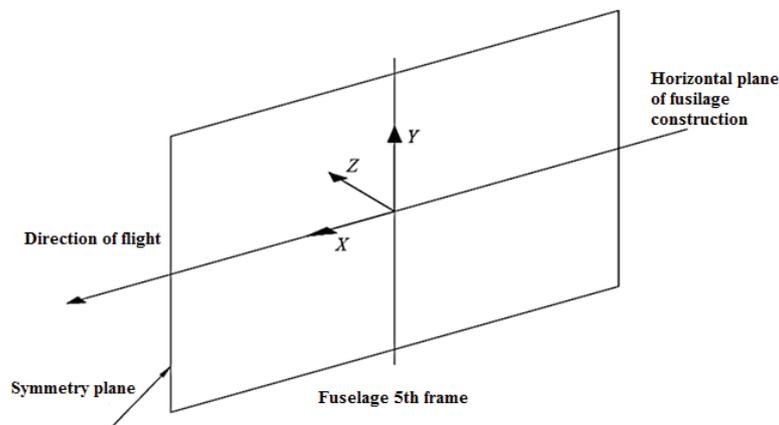


Fig. 2 Defined system of co-ordinates

Parameters to be measured: Number of loading cycles, measurement of strain in defined points during loading. In case of detection of cracks, damage and other defects during testing:

- full number of loading cycles must be noted, as well as values of applied loadings, defects sizes, location

places and photos;

- defects must be checked with nondestructive analysis methods, as well as object must be checked for compliance with drawings (especially in the area where defect occurred);
- proper act (documentation) must be filled.

4. Requirements for Testing Equipment

All measuring equipment must be certified and must have proper precise rate. This equipment must not exceed $\pm 5\%$ error in measurements.

Laboratory is responsible for selecting type of deformation sensors. Error measurement for deformation sensors must not exceed $\pm 5\%$ from maximum value of tension.

Requirements for testing stand:

- testing stand must have all necessary equipment, which provide possibility to do testing, if planer is fixed in one of the following ways:

- a. [on power floor] structural chassis frame is being used,
- b. planer is fixed by tail rotor shaft, landing gears do not touch the ground.

- Stand equipment must be able to apply static load (Fig. 1):

- a. to tail rotor at points FPBx,FPBY,FPBZ,
- b. to the joint point of fin,
- c. to spread load Ffinz, which is applied to fin.

- Stand must be equipped with system, which allows rapid control of applied loads and automatic registration of results.

5. Conclusion

In this paper basic technical requirements of bench test for real time full-scale testing of helicopters are formulated. The scheme of the device for bench test is shown. Requirements for the conditions of loading for testing are formulated. The adopted coordinate system, in which the X-axis is directed in the direction of flight of the helicopter and lies in the construction plane of the fuselage, maximally corresponds to the operating conditions.

Requirements for testing and measuring equipments are formulated. The obtained results of bench tests can be used in testing calculations of the resources of helicopter elements according to the criteria of short-term strength and endurance.

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