

I. IDENTIFIKAČNÍ ÚDAJE

Název práce:	Tuhostní a pevnostní analýza nosné konstrukce turboprotulového motoru
Jméno autora:	Jakub Košťel
Typ práce:	bakalářská
Fakulta/ústav:	Fakulta strojní (FS)
Katedra/ústav:	Ústav mechaniky, biomechaniky a mechatroniky
Oponent práce:	Ing. Andrzej Cwik, MBA
Pracoviště oponenta práce:	CVUT, Fakulta strojní

II. HODNOCENÍ JEDNOTLIVÝCH KRITÉRIÍ

Zadání (Entering)	mimořádně náročné
<i>Hodnocení náročnosti zadání závěrečné práce. (Assessment of the complexity of the final thesis).</i>	
<p>The subject of the thesis was a stiffness and strength analysis of the turboprop engine truss. Thesis activities are concentrated on research of the mounting system for the turboprop engine, design and FEM strength and stiffness analysis of the mounting structure parametric model. Thesis provides proper balance between theoretical part and author's methodology selected for calculations and analysis provided in final chapters. Thesis gives brief description of the turbomachinery installation aspects, aircraft and propeller specification. Thesis gives detailed introduction to the properly selected inputs for flight environment, loads definitions and inputs for selected object concept and further approach in working chapters. The working part is thorough design assumptions selection, loads definition within defined flight envelope. The analytical approach is well based on defined truss model with adequate description of assumptions.</p>	

Splnění zadání (Fulfillment of the assignment)	splněno
<i>Posuďte, zda předložená závěrečná práce splňuje zadání. V komentáři případně uveďte body zadání, které nebyly zcela splněny, nebo zda je práce oproti zadání rozšířena. Nebylo-li zadání zcela splněno, pokuste se posoudit závažnost, dopady a případně i příčiny jednotlivých nedostatků. (Assess whether the submitted final thesis meets the assignment. In the comment, please specify the points of entry that have not been fully fulfilled or whether the work is extended compared to the entry. If the assignment has not been fully met, try to assess the severity, impact, and, if appropriate, the causes of the individual deficiencies).</i>	
<p>The fulfillment of the assignment is met. Existing mounting systems were reviewed for adequate object selection and computational model definition for further analysis.</p>	

Zvolený postup řešení (Selected solution procedure)	vynikající
<i>Posuďte, zda student zvolil správný postup nebo metody řešení. (Assess whether the student has chosen the correct procedure or method of solution.)</i>	
<p>The author of thesis progressed systematically towards definition of load modes definition of boundary conditions and dependence of system stiffness on geometry. The methodology is properly described and analytical process of FEM evaluation is properly set and evaluated.</p>	

Odborná úroveň (Professional level)	A - výborně
<i>Posuďte úroveň odbornosti závěrečné práce, využití znalostí získaných studiem a z odborné literatury, využití podkladů a dat získaných z praxe. (Assess the level of expertise of the final thesis, the use of the knowledge gained from the study and the specialized literature, the use of the data and the data obtained from the practice).</i>	
<p>The work and the way it is presented is of a professional level. The content is based on detailed study and understanding of professional literature. The comprehensible description of the individual definition of the flight envelope reconstruction is the value added exceeding bachelor thesis expectation. The theoretical study is adequate to let proceed with further work presented in next chapters. Assumptions, calculations, tools practical usage and the way of results presented had been properly set to analyze stiffness and strength of the selected structure according to defined loads and perform the sensitivity investigation of supporting structure design items.</p>	

Formální a jazyková úroveň, rozsah práce (Formal and language level, scope of work) **A - výborně**

Posuďte správnost používání formálních zápisů obsažených v práci. Posuďte typografickou a jazykovou stránku. (Assess the correct use of formal entries contained in the work. Assess the typographic and language page.)

The work structure is clear. The literature references are properly selected and adequate. Results oriented calculation, modeling and analytical portion is very comprehensible and legible. Tables, graphics and visual presentation of details is at adequate level.

Theoretical part formal language used can be further improved (some sentences only) providing description (i.e. of the flowpath towards the engine (paragraph 4.1.1) or combustion description (4.1.3.)) – but these paragraphs do not affect the scope of work. Conclusions (Chapter 10) is quite too short (but brief) comparing to wide scope of work. But this is only highlight for the future improvements and has no influence on the current assessment.

The scope of work is wide and the calculations and analytical part is properly described. Provided good balance between description, referred equations used and the way of results presentation.

Výběr zdrojů, korektnost citací (Source Selection, Correct Quotation) **A - výborně**

Vyjádřete se k aktivitě studenta při získávání a využívání studijních materiálů k řešení závěrečné práce. Charakterizujte výběr pramenů. Posuďte, zda student využil všechny relevantní zdroje. Ověřte, zda jsou všechny převzaté prvky řádně odlišeny od vlastních výsledků a úvah, zda nedošlo k porušení citační etiky a zda jsou bibliografické citace úplné a v souladu s citačními zvyklostmi a normami. (Explain to the student's activity in acquiring and using study materials to solve the final work. Characterize the choice of sources. Assess whether the student has used all the relevant resources. Verify that all elements taken over are properly distinguished from their own results and considerations, whether violation of citation ethics has occurred and whether bibliographic quotes are complete and in accordance with citation habits and standards.)

Thesis provides reference to adequate literature selection. Sources used are correctly and appropriately quoted and used in the work. It is based not only on domestic literature but also on foreign positions and sources on international level. The advantage of the thesis is basing on sources which used to be typical for activities on higher than Bachelor thesis level. Apart from engines, propeller, installation structure, flight mechanic aspects and FEM educational references, thesis' information sources are also hardware manufacturers direct positions (i.e.: [12], [17], [19]). Thesis is also referring to the Aviation Regulations for details used in adequate way ([13], [18], [22]). The object created for calculations and analysis was also based on the professional source [7].

Další komentáře a hodnocení (More comments and ratings) **A - výborně**

Vyjádřete se k úrovni dosažených hlavních výsledků závěrečné práce, např. k úrovni teoretických výsledků, nebo k úrovni a funkčnosti technického nebo programového vytvořeného řešení, publikačním výstupům, experimentální zručnosti apod. (Explain to the level of the main results of the final thesis, eg to the level of the theoretical results, or to the level and functionality of the technical or program-generated solution, publication outputs, experimental skills,)

Thesis takes into consideration generated by author flight envelope assumed for object of analysis on the higher level than it could be expected from the bachelor thesis approach (paragraph 7.2.1). To support parametric model definition, flight envelope was defined to respect flight conditions and simulate numerous loads at different cases. Reference to the Aviation Regulatory CS-23 requirements (paragraph 7.2.2) is additional thesis advantage.

III. CELKOVÉ HODNOCENÍ, OTÁZKY K OBHAJOBĚ, NÁVRH KLASIFIKACE (TOTAL EVALUATION, QUESTIONNAIRE, DRAFT CLASSIFICATION)

Shrňte aspekty závěrečné práce, které nejvíce ovlivnily Vaše celkové hodnocení. Uvedte případné otázky, které by měl student zodpovědět při obhajobě závěrečné práce před komisí.

Summarize the aspects of the final work that most affected your overall assessment.

The work and the selected process used leading to thesis results is considered to be beneficial. It is based on proper theoretical support, adequate study of the existing hardware solutions for thesis object of and study of inputs and methods that could be used for analysis and the selected process. Model definition, inputs, boundary conditions, loads, are properly selected. Calculations and analysis way is properly defined. Methodology steps are properly defined to show the progress of the work from theoretical part to final results. Calculations and analysis is properly presented and results are visualized. Worked out methodology therefore leading to final results is properly selected from literature and overall approach exceeds bachelor thesis level. The methodology, the results which are clearly and comprehensibly laid out and can be used for follow-up activities. Proposed is to develop thesis towards the experimental application taking the benefit from the parametric approach with FEM analysis. Based on this thesis review and the level of familiarization with calculation and analytical approach and tool usage (FEM) it could be possible to further develop subject and author skills towards FEM (ANSYS or other software). Worked out methodology, created models, selected loads baseline and author approach for looking for solutions can be strong start for next stage. Next stage can be oriented on structure cracking predictions, cracking behavior and propagation analysis or more sophisticated research object models development oriented on turbomachinery or propeller imbalance.

Please indicate any questions the student should answer in defense of the final thesis before the commission.

Knowing the wide scope of work and thesis objectives I would like to indicate typical question, suggested after work completion:

1. What would you improve in your work taking a chance to repeat it?
2. Which point in provided methodology could be further developed towards next thesis selection on higher stage?

Předloženou závěrečnou práci hodnotím klasifikačním stupněm **A - výborně**.

present the submitted final thesis by selecting the grade.

The submitted final thesis evaluates classification grade **A - excellent**.

Datum: 24.8.2017

Podpis: Andrzej Ćwik