

**VISOKA ŠOLA ZA PROIZVODNO INŽENIRSTVO**

**DIPLOMSKO DELO**

**SNOVANJE, KONSTRUIRANJE IN MKE ANALIZA  
OGRODJA ZA ULTRALAHKI HELIKOPTER**

**DEVELOPING, DESIGNING AND FEM ANALYSIS OF FRAME  
FOR ULTRALIGHT HELICOPTER**

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**Somentorica: NINA MOVH, dipl. inž. str.**

**Študijski program: Sodobno proizvodno inženirstvo**

**CELJE, 2015**

# **SNOVANJE, KONSTRUIRANJE IN MKE ANALIZA OGRODJA ZA ULTRALAHKI HELIKOPTER**

## **POVZETEK**

Diplomsko delo temelji na snovanju in konstruiranju ultralahkega helikopterja, ki ga je mogoče upravljati brez zapletenih mehanizmov in vzvodov. Zamisel je bila razvita iz analogije enostavnega načina krmarjenja krila motornega zrnaja. Na začetku diplomskega dela sta predstavljena zgodovina helikopterjev in trend napovedi razvoja za prihodnost. Proučitev zakonodajnih predpisov je omogočila pridobiti ključne podatke, ki so bili upoštevani že v fazi koncipiranja in iskanja delnih rešitev. V nadaljnji fazi snovanja so bili izbrani material za izdelavo ogrodij, predvidene mase vgradnih elementov ter pozicija težišča ogrodja. Na osnovi tega sta bila izrisana tridimenzionalna računalniška modela dveh izvedb ogrodij. Tako je bilo mogoče izvesti računalniško simulacijo statične analize z uporabo metode končnih elementov in analizirati togost ogrodij. Najustreznejši koncept ogrodja je bil izbran na osnovi ocene tehnične in ekonomske vrednosti v povezavi z analizo togosti. Za izbrano ogrodje pa so bili na koncu izrisani vsi detajli in tehnična dokumentacija za izdelavo.

**Ključne besede:** strojništvo, načrtovanje, ultralahki helikopter, ogrodje, metoda končnih elementov.

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## **SUMMARY**

The thesis is based on the design and constructing of an ultralight helicopter that can be operated without complicated mechanisms and levers. The idea was developed from analogies of a trike simple system of steering the wing. At the beginning of the thesis a history of helicopters and trend predictions for future development is presented. Examination of legislation has enabled to obtain key data, which were considered already at the stage of abstraction, as well as with searching of partial solutions. In a further design stage of the frame, the material has been chosen and prediction was made regarding the built-in elements masses as well as the position of the center of gravity. On that basis two three-dimensional computer models of the frames were plotted. Thus, it was possible to carry out computer simulation of static analysis using finite element method and analyze the rigidity of the frames. The most suitable concept of the frame was selected based on the assessment of technical and economic value in relation with the analysis of rigidity. All the details were plotted in the end and technical documentation was made for the selected frame.

**Keywords:** mechanical engineering, design, ultralight helicopter, frame, finite element method.