3. KOKKUVÕTE

Käesoleva bakalaureusetöö peamiseks eesmärgiks oli projekteerida ning valmistada reaalne prototüüp reguleeritava kõrgusega multifunktsionaalsest võimlemiskangist, mille tulemusel sai töö autor praktikas rakendada oma oskusi raalprojekteerimise, tugevusanalüüside koostamise ning keevitamise valdkonnas.

Kõigepealt viidi läbi turu-uuring, kus analüüsiti kokku kümmet erinevat Eesti turul saada olevat sarnast toodet, millest selgus, et keskmine treeningpuur maksab 616 eurot; selle kõrgus ei ole üldjuhul reguleeritav aga kui on, siis reguleerimissammuks on tavaliselt 10 sentimeetrit; keskmine võimlemiskangi läbimõõt on 31 millimeetrit ning kandevõime 270 kilogrammi; ruumi võtab keskmine treeningpuur 0,82 m^2; see on pulbervärvitud; lisafunktsioone on keskmiselt vaid üks.

Järgnevalt kinnitati projekteeritava toote tehnilised näitajad, millest olulisim oli maksimaalne koormus. Selleks valiti 300 kilogrammi, olles nii turu keskmisest veidi suurem. Sobilike profiilide valimiseks koostati tugevusanalüüsid, mis aitasid veenduda profiilide võimekuses. Autori poolt teostatud koormustestist selgus, et tugevusarvutused olid koostatud korrektselt ning toode pidas silmapaistvalt koormusolukorrale vastu.

Toote disainimisel lähtus autor põhimõtetest, et toode oleks lihtsasti kokkupandav, mugavalt ja kiirelt reguleeritav, lahtivõetuna kompaktne, võimaldaks tõstekangi kasutamist koos tootega ning oleks robustne, et vältida valesti kasutamisest tulenevaid võimalikke ohuolukordi. Kõik nimetatud kriteeriumid said täidetud ning lõpliku tootega on autor rahul.

Töö tulemusel sai autor lähemalt tuttavaks keevitustehnoloogiaga ning omandas seejuures uusi teadmisi ja oskusi. Keevitamisel esines mõningaid raskusi, mis olid seotud varasema kogemuse puudumisega ning detailide kindlalt fikseerimise keerukusega. Siiski saavutati autori hinnangul keevitamisel arvatust parem õmbluse kvaliteet. Lisaks tunneb ta end tulevikus sel alal oluliselt kindlamalt.

Pärast keevitamist valmistati toode ette värvimiseks. Selleks lihviti esmalt keevisõmblused siledaks ja harjati kõik värvitavad detailid üle, eemaldamaks neilt oksiidikihi. Värvimine toimus pneumaatilise värvipüstoliga välitingimustes, mistõttu takistasid lendav tolm ja tugev tuul perfektse viimistluse saavutamist. Siiski loeti värvikvaliteet piisavalt heaks, et parandusi ei pidanud tegema.

Autor peab enda poolt loodud lahendust keskmisest paremaks, sest see on reguleeritava kõrgusega ning võimeline kandma suuremat raskust (300 kilogrammi). Samuti on loodud lahendus kõikide eelduste kohaselt konkurentsivõimeline, olles hinna poolest keskmisest soodsam (omahinnaga 363 eurot). Täpsema ülevaate konkurentsivõimest annaksid põhjalikud hinnaarvutused, kuid nende teostamist ei pidanud autor antud töö raames vajalikuks.

4. SUMMARY

The main goal of this bachelor's thesis was to design and manufacture a physical prototype of an adjustable multifunctional gymnastics bar so that the author could put their skills of CAD modelling, structural analyses and welding into practical use.

To begin with, a research of the Estonian market was carried out by analysing ten similar products. The conclusion was as follows: the average training rack costs 616 €; it is usually not height adjustable, otherwise the adjustment increment is 10 cm; the average gymnastics bar diameter is 31 mm and the average maximum load is 270 kg; it needs 0,82 m^2 of floor space; it is powder coated; it has only one extra function.

As the next step, the technical parameters of the product were chosen, the most important of which being the maximum load. The maximum load was chosen to be 300 kg, to be slightly above average. Structural analyses were completed to choose the proper standard material profiles, which confirmed the performance of said profiles. As was seen from the load test, the analyses were done correctly, and the product passed the test with flying colours.

The overall design of the product had to account for easy assembly, compactness when disassembled, the option to use a barbell bar with the product and robustness, to avoid potentially hazardous situations caused by the misuse of the product. All the criteria were met and the author is pleased with the outcome.

As a result of the thesis, the author became more familiar with welding and acquired numerous new skills as well as new knowledge. Some difficulties were met during the welding process that were related to the lack of previous experience and the difficulty to securely fix some parts to the workbench. Still, a better weld quality was achieved than previously thought possible by the author. In the future, the author will also feel more confident when faced with welding.

After the welding was completed, the product was prepared for paintwork. Firstly, the welds were ground smooth using an angle grinder. After that, the parts were cleaned of their oxide layer using a wire brush. The painting process took place outdoors. Due to dust and strong winds a perfect finish could not be achieved, however, the quality of the paintwork was deemed good enough and no further work was required.

The author believes their product to be better than average due to it being height adjustable as well as being able to carry a larger maximum load (300 kg). Also, the newly made product is estimated to be competitive on the Estonian market, being more affordable than its competitors (with a net cost of 363 €). A more precise overview of the competitiveness could be achieved with more in-depth price calculations, but the author did not think these to be necessary for this thesis.