e UČIONICA
ŠUMARSKOG FAKULTETA

PREDGOVOR

Radionica rekonstrukcije i opremanja prve e-učionice Šumarskoga fakulteta zamišljena je i realizirana kao istraživački projekt proveden na realnome modelu. Realni model predstavljen je kao klasična učionica, a nju je uz odgovarajuću ICT tehnologiju trebalo prilagoditi potrebama učinkovitoga savladavanja gradiva programa Šumarskoga fakulteta i suvremenomu načinu poučavanja. Radionica je zamišljena kao otvoreni intenzivni oblik rada i nastave po uzoru na već viđenu praksu koja se provodi u svijetu, kao što je, primjerice, *D-school*, a koja odgovara realnim uvjetima projektiranja namještaja i opremanja prostora, što je i jedan od poslova naših studenata po završetku studija. Projekt je služio kao edukacijska platforma koja je započela s radom 5. 12. 2014. i završila javnom obranom 2. 7. 2015.

Osim poticanja timskoga rada studenti su imali priliku raditi u svim fazama i detaljima projektiranja dotičući i područje drugih struka, kao što su termoizolacija, akustika i rasvjeta prostorije (za koju je provjeru izvršio ekspert za navedena područja). Ova suradnja potiče na razmišljanje o budućemu međufakultetskom sudjelovanju na sličnim projektima po uzoru na *D-school*.

Definicijom e-učenja ustanovljen je projektni zadatak koji je nadopunjen potrebama svih korisnika, što uključuje studente, čistačice i sistemskoga administratora, a pohvalno je i da je anketirana većina nastavnoga osoblja. Time se nastojalo udovoljiti što većemu broju potreba i želja koje doprinose učinkovitijemu rezultatu projekta, a time i provođenja nastave.

Budući da na Drvnotehnološkome odsjeku postoji diplomski studij *Oblikovanje proizvoda od drva*, ideja je bila pozvati studente i uključiti ih u projekt kako bi imali mogućnost upotrijebiti stečeno znanje na praktičnome primjeru. Dobra strana toga projekta bila je nepostojanje čvrstoga termina završetka projekta pa je studentima omogućeno da se prvenstveno posvete redovnoj nastavi, a u slobodno vrijeme pod vodstvom nastavnice / voditeljice projekta usavršavaju znanja o projektiranju i stvaraju projekt bez stresa. U sklopu rada na projektu održano je niz zajedničkih i individualnih konzultacija, prezentacija i predavanja koja su osim redovitoga sastajanja ponedjeljkom u slobodnome terminu za sve sudionike, sadržavala i izvanredne sastanke ili odlaske na stručne ekskurzije.

Od ukupno pozvanih šezdesetak studenata da se priključe projektu, odazvalo se devet studenata od kojih je dio odustao u početku. Projekt su pod vodstvom izv. prof. dr. sc. Silvane Prekrat izveli Lana Jarža i

Ana Mišetić, studenti 1. godine diplomskoga studija *Oblikovanje proizvoda od drva* te Valentino Slivar, student preddiplomskoga studija *Drvna tehnologija*.

Rješenja ponuđena tim projektom rezultat su proučavanja literature koja obrađuje nove mogućnosti uporabe ICT tehnologije u nastavnome procesu, projektiranje suvremenih učionica i radnih prostora, samostalnih istraživanja te terenskoga rada provedenoga na organiziranim stručnim ekskurzijama, kao što su posjeti tvrtkama Drvoproizvod, Rubinić, Ikea, Elgrad, Kircek.

U svrhu promidžbe toga projekta, a time i Drvnotehnološkoga odsjeka, a posebno diplomskoga studija *Oblikovanje proizvoda od drva* prezentiran je dio projekta na Tjednu dizajna organiziranome u Zagrebačkoj Laubi, gdje su izloženi plakati te je održana prezentacija u sklopu predstavljanja fakulteta. Projekt je predstavljen i na Drvnotehnološkoj konferenciji u Opatiji, također s izlaganjem plakata i predavanjem o obrazovanju visokoškolskih stručnjaka za inovacije.

Voditeljica diplomskoga studija *Oblikovanje proizvoda od drva*
Izv. prof. dr. sc. Silvana Prekrat

FOREWORD

The workshop on reconstruction and equipping of the first e-classroom of the Faculty of Forestry was conceived and realised as a research project implemented on a real model. The real model was presented as a classic classroom, which, with the appropriate ICT technology was to be adapted to the needs of the effective learning of the curriculum of the Faculty of Forestry and the modern teaching methods. The workshop was conceived as an open and intensive form of work in line with the already seen practice in the world, such as the *D-school*, which meets the realistic requirements of the designing of furniture and space furnishing, which is one of our students' jobs at the end of their studies. The project served as an educational platform which started its work on 5/12/2014 and ended with the public defense on 2/7/2015.

In addition to encouraging teamwork, students had the opportunity to work in all stages and details of design, thus also being in touch with areas of work of other professions, such as thermal insulation, acoustics and lighting of room (which was carried out by experts in these areas). This co-operation encourages us to think about the future inter-faculty participation on similar projects based on the *D-school* model.

The definition of e-learning established the project task which was complemented by the needs of all users, including students, cleaners and system administrators, and it is praiseworthy that the majority of staff members ware surveyed. This was aimed to meet the majority of needs and wishes which contribute to the most efficient project results, thus contributing to the teaching processes.

As there is a graduate study programme on *Wood Product Design* at the Department of Wood Technology, the idea was to invite students and have them involved in the project for them to have the opportunity to apply the acquired knowledge in a practical example. The good side of this project was the absence of a fixed term of the project completion, so it was made possible for the students to primarily be dedicated to the regular classes, and in their free time, under the guidance of their teacher / project leader, to perfect their knowledge on design and creation of a stress-free project. As part of the work on the project, a series of joint and individual consolations, presentations and lectures were held, which, apart from regular meetings on Mondays during free time of the participants, there were also included extraordinary meetings or professional excursions.

Of the total of sixty students who were invited to join the project, nine students responded of which several withdrew at the beginning. The project, led by Associate Professor Silvana Prekrat, PhD, was conducted by Lana Jarža and Ana Mišetić, students of 1st year of the graduate study programme *Wood Product Design* and Valentino Slivar, undergraduate student of the *Wood Technology*.

The solutions offered by this project are a result of the study of literature that deals with new possibilities of ICT technology in the curriculum, the design of modern classrooms and workspaces, independent researches and field work conducted on organised professional excursions, such as visits to the companies Drvoproizvod, Rubinić, Ikea, Elgrad, Kircek.

For promotion of this project, thus also promoting the Department of Wood Technology, and especially the graduate study programme of *Wood Product Design*, part of the project was presented at the Design Week organised in Zagreb Lauba, where posters were displayed and a presentation was held as part of the presentation of the faculty. The project was also presented at the Conference of Wood Technology in Opatija, also by featuring of posters and a lecture on education of higher education specialists for innovation.

Head of the graduate study programme *Wood Product Design*
Silvana Prekrat, PhD, Associate Professor

RIJEČ DEKANA

Pojam ICT-a u drvnoj tehnologiji kojoj pripadam po zvanju, povezan je uglavnom s tehnologijom prerade i obrade u proizvodnji namještaja i drvnih proizvoda. Ona je dio STEM područja, a njegova je važnost prepoznata i na državnoj razini.

Višegodišnje iskustvo obnašanja funkcije prodekana otvorilo mi je spoznaje o mogućnostima poboljšanja kvalitete izvođenja nastave s pomoću ICT tehnologije, i to podjednako za Drvnotehnološki kao i za Šumarski odsjek. Usvojena znanja i vještine korištenja informatičkom opremom povećavaju izravno konkurentnost naših diplomiranih inženjera na tržištu rada. ICT tehnologija s biranim specijaliziranim računalnim programima omogućuje osuvremenjivanje nastave u nekoliko segmenata koji bi u konačnici trebali rezultirati kvalitetnijim usvajanjem znanja. Jedan je od njih uporaba sustava za glasovanje s pripremom pitanja s pomoću računalnoga programa za numerički i grafički prikaz rezultata dobivenih odmah nakon izvršenoga testiranja. Zbog brze provjere i mogućnosti kontinuiranoga praćenja napredovanja svakoga studenta, provjeru usvojenoga gradiva moguće je izvoditi često. Dobiveni rezultati testiranja tijekom semestra omogućuju nastavniku prilagodbu metode i dinamike tijeka prezentiranja razumijevanju i stupnju usvajanja sadržaja kolegija tijekom nastave. Preuzevši čelnu funkciju Šumarskog fakulteta, opremanje prostora u kojem bi se vršila edukacija primjene ICT tehnologije u nastavi za mene je postala prioritet, a ukazala se i financijska mogućnost za izvedbu adekvatnog prostora u kojemu će se ona odvijati.

Za njezino projektiranje osim znanja arhitektonskoga projektiranja i projektiranja namještaja bilo je potrebno i iskustvo održavanja nastave s korištenjem ICT tehnologijom. Niz idejnih rješenja i izvedenih projekata na rekonstrukcijama i opremanju prostora fakulteta te veliko iskustvo korištenja računalom i računalnim programima u nastavi izv. prof. dr. sc. Silvane Prekrat značio je neupitan odabir voditeljice projekta rekonstrukcije i opremanja učionice za e-učenje. Hvalevrijedan je bio i njezin prijedlog uključenja studenata u navedeni projekt.

Iako tada nisam imao uvid u širinu i opseg projekta, vjerovao sam u uspjeh zbog iskustva projektiranja kojim se iskazala u već nekoliko prostora fakulteta. Osim toga ona je prva uvela korištenje računalnim programima koje je ostvarila brojnim donacijama tvrtki s kojima surađuje, a računala i računalni programi neizbježni su dio njezine nastave u predmetima kojih je nositeljica.

Dekan Šumarskoga fakulteta
Prof. dr. sc. Vladimir Jambreković

DEAN'S MESSAGE

The concept of ICT in wood technology, to which I belong by profession, is mainly connected with the technology of treatment and processing in production of furniture and wood products. It is a part of the STEM area, and its importance was recognized at the state level as well.

The many years of experience gained in the position of a Vice Dean, opened my understanding on the possibilities of improving the quality of teaching with ICT technology, equally of the Department of Wood Technology and the Department of Forestry. The acquired knowledge and skills of using IT equipment directly increase the competitiveness of our graduated engineers in the labour market. ICT technology with selected specialised computer software enables upgrading of teaching in several segments, which should ultimately result in better quality of acquisition of knowledge. One of them is the use of a voting system with the preparation of questions with computer software for a numeric and graphical display of obtained results immediately after testing. Due to the quick check and the possibility of a continuous monitoring of progress of each student, the test of the acquired knowledge can be frequently performed. The obtained test results during the semester allow the teacher to adapt the method and dynamics of the presentation to the understanding and the degree of the course content during the course. Having taken over the head function at the Faculty of Forestry, the equipping of the rooms where the education was to be provided with the use of ICT technology in teaching, a financial opportunity presented itself for the equipping of the adequate space in which it will take place. For its design, beside the knowledge of architectural design and furniture design, the experience of teaching with use of ICT technology was also needed. Many preliminary solutions and implemented projects on reconstructions and equipping of faculty space and a great experience of use of computers and computer programmes in teaching of Associate Professor Silvana Prekrat, PhD, meant an unquestionable selection of the project leader for reconstruction and equipping the e-classroom. Also praiseworthy was her proposal for the inclusion of students in the aforementioned project. Although I did not have the insight into the width and the scope of the project at that time, I believed in its success due to her experience in design which was already demonstrated in several faculty spaces. In addition to this, she was the first one to introduce the use of computer software which she made possible by numerous donations of the companies she works with, and computers and computer software are an inevitable part of her teaching in courses she teaches.

Dean, Faculty of Forestry
Professor Vladimir Jambreković, PhD

1.

UVOD
INTRODUCTION

Vremenom je učionica koja je do nedavno služila kao računalna, postala trošna i gotovo neupotrebljiva, tj. opasna za boravak. Budući da su u posljednjemu periodu nedostatci bili sve učestaliji, sitni popravci nastalih oštećenja, kao što je, primjerice, padanje žbuke sa stropa, bili bi samo polovično rješenje. Uz konstataciju da je potrebno modernizirati nastavu koja uključuje uvođenje elektroničke opreme koja iziskuje promjenu instalacija, dekan prof. dr. sc. Vladimir Jamreković donio je odluku o temeljitoj rekonstrukciji i opremanju učionice kako bi bila prilagođena današnjim potrebama u nastavi.

Prvi korak u projektiranju bila je analiza rješenja opremanja postojećih učionica na fakultetu pri čemu se u novome projektu nastojalo preuzeti dobra rješenja, izbjeći nedostatke ili, pak, sadržaj projektnoga rješenja prilagoditi novim potrebama učenja. Paralelno su se proučavali primjeri opremanja sličnih učionica u svijetu te je obrađivana literatura koja se odnosila na određivanje uvjeta koje treba ispuniti takav prostor i oprema u njemu. Izrada projekta planirana je i izvedena u 6 faza.

Over time, the classroom which up until recently was used as a computer classroom, has become worn out and almost useless, i.e. dangerous for stay. Since over the last period, the deficiencies were more frequent, minor repairs of resulting damages, such as, for example falling of the ceiling mortar, would only be a half solution. With the conclusion that it was necessary to modernise teaching which involved introduction of electronic equipment which requires a change of installations, the dean, Prof. Vladimir Jamreković, PhD made a decision on the thorough reconstruction and equipping of the classroom which would be adapted to today's teaching needs.

The first step in the design was an analysis of the solution of equipping the existing classrooms at the faculty, during which the new project would try to find good solutions, avoid deficiencies or, to adapt the content of the project solutions to the new learning needs. Examples of similar classroom equipment in the world were parallelly studied, and literature was used relating to the determining of conditions which are to be met for

Nit vodilja kroz projekt bila je funkcionalno rješenje učionice čiji je prijedlog rješenja utemeljen na multivarijantnoj analizi prostorije koja uključuje unaprjeđenje kvalitete boravka u prostoriji odabirom materijala i boja, definiranjem sadržaja i oblika namještaja i opreme, poboljšanjem mikroklime i smanjenjem zračenja nastalih djelovanjem elektroničke opreme, odabirom obloga i namještaja u skladu s funkcijom, akustičkim i ostalim tehničkim zahtjevima. Funkcionalnost je usmjerena na korisnika koji čini centralno mjesto projektiranja poštujući norme, pravila projektiranja i želje korisnika.

such space and the equipment in it. Project design was planned and implemented in 6 phases.

The guiding idea through the project was a functional solution of the classroom whose solution proposal was based on the multivariate room analysis which include improvement of the quality of stay in the room by the selection of material and colours, by defining the content and the shape of furniture and equipment, by improving the microclimate and by reduction of radiation generated by the operation of electronic equipment, by selection of coverings and furniture in line with the function, acoustic and other technical requirements. The functionality is focused on the user who makes the central design spot being compliant with the standards, design rules and user desires.

2.

PROJEKTNI ZADATAK
PROJECT TASK

Projektnim zadatkom predviđena je prenamjena učionice za e-učenje koja pod pojmom funkcionalne mogućnosti održavanja nastave podrazumijeva upotrebu najnovije informatičke opreme i računalnih programa usmjerenih prema potrebi modernoga izvođenja nastavnih jedinica.

Budući da projektni zadatak nije definirao pojedinosti, nakon proučene literature te anketiranja budućih korisnika projektni zadatak je dobio dopunu koja treba definirati: Sadržaj opreme i namještaja, raspored instalacija, namještaja i opreme učionice, toplinsku učinkovitost učionice, akustiku učionice, odnos ugrađenih materijala i svjetla u odnosu na odbljesak, ekološčnost i oporabnost upotrijebljenih materijala, estetska svojstva odabranoga materijala, produktivnost rada pod utjecajem boja, tekstura i biljaka, održavanje i čišćenje, image Drvnotehnološkoga odsjeka, projektiranje namještaja prilagođenoga namjeni učionice, potrebama i željama korisnika te podzastupljenim skupinama (invalidima u kolicima i nadprosječno visokoj i niskoj populaciji studenata) s rješenjem odlaganja kaputa, torba i osobnih stvari.

The project task envisages the conversion of the e-learning classroom which, under the concept of functional possibility of teaching, implies the use of the latest computer equipment and computer programs directed to the needs of modern presentation of teaching units. As the project task did not define the details, following the studied literature and future users survey, the project task was given a supplement which specified the areas to be defined: Contents of equipment and furniture, layout of installations, furniture and classroom equipment, classroom thermal efficiency, classroom acoustics, relationship of installed materials and light in relation to glow, ecologicity and usability of the materials used, aesthetic properties of the selected materials, work productivity under the influence of colours, textures and plants, maintenance and cleaning, Image of the Department of Wood and Technology, Design of furniture customised for classroom use and the needs and wishes of users for the under-represented groups (disabled persons in wheelchairs and over- and under-average height population of students), design of storage of coats, bags and personal belongings.

1. Faza Stage 1

PROJEKTNI ZADATAK PROJECT TASK

Naručitelj, Predavanja, Literatura Contractor, Lectures, Literature

Definicija e-učenja Definition of e-learning
Projektiranje prostora Design of space

Učionica Classroom
Projektiranje namještaja Design of furniture

Potrebe i želje korisnika User needs and wishes
Definiranje opreme / Definition of equipment

2. Faza Stage 2

SNIMAK POSTOJEĆEGA STANJA CURRENT STATUS RECORDING

Izmjere, Snimanje, Tehnička dokumentacija Measuring, Recording, Technical documentation

Izmjera prostora
Measuring of space

Izrada tehničkih crteža prostora
Creating technical drawings of space

Snimanje potrebnih građevinskih radova rekonstrukcije
Recording of required construction works of reconstruction

Termovizijsko snimanje
Themovisual recording

Izrada troškovnika građevinskih i obrtničkih radova
Creating bill of quantities of construction and trade works

3. Faza Stage3

DEFINIRANJE DODATNIH UVJETA I ODABIR MATERIJALA
DEFINING ADDITIONAL CONDITIONS AND SELECTION OF MATERIALS

Literatura, Ankete, Izmjere, Terenski rad Literature, Surveys, Measuring, Field Work

Tehnička svojstva
Technical Properties

Estetska svojstva
Aesthetic Properties

Image fakulteta
Image of the Faculty

Rasvjeta
Lightning

Potrebe i želje korisnika
Needs and wishes of users

Uvjeti radne učinkovitosti
Work efficiency conditions

Tehnologičnost
Technologicality

Ekologičnost
Ecologicality

Oporaba
Recycling

Tržište
Market

Cjenovni razred
Pricing Class

4. Faza Stage 4

IDEJNA RJEŠENJA NAMJEŠTAJA I UČIONICE I ODABIR ZA DALJNJU RAZRADU
PRELIMINARY DESIGN OF FURNITURE AND CLASSROOM AND SELECTION FOR FURTHER DEVELOPMENT

Skice, 3D modeli Drafts, 3D models

Idejno rješenje interijera 1 i 2
Conceptual interior design 1 and 2

Idejno rješenje interijera 3 i 4
Conceptual interior design 3 and 4

5. Faza Stage 5

IZRADA TEHNIČKE DOKUMENTACIJE PREPARATION OF TECHNICAL DOCUMENTATION

Proračuni, Grafička dokumentacija, Tekstualna dokumentacija Calculations, Graphical Documentation, Textual documentation

Tehnički crteži
Technical drawings

Tehnički opisi
Technical Descriptions

Sastavnice
Bill of materials

Ponude
Quotations

Troškovnici
Bill of Quantities

6. Faza Stage 6

PROMIDŽBA PROJEKTA PROJECT PROMOTION

Virtualni model Fizički model Prototip 3D modeli i vizualizacije Virtual Model Physical Model Prototype 3D models and visualisations

Izložbe
Exhibitions

Web
Web

Brošura
Booklet

Letak
Leaflet

Obrana projekta
Project defence

REALIZACIJA
REALIZATION

3.

SNIMKA ZATEČENOGA STANJA
CURRENT STATUS REPORT

ANALIZA STANJA PROSTORIJE

Budući da je riječ o rekonstrukciji postojeće učionice, bilo je potrebno utvrditi postojeće građevinsko stanje prostorije. Iako postoji dokumentacija u obliku tlocrta, izvršena je izmjera koja je potvrdila da stanje na tlocrtu nije odgovaralo izmjerenome. Osim toga sačuvani tehnički crteži zgrade sadržavali su samo tlocrte, pa je za crtanje zidova i vertikalnih presjeka trebalo izvršiti dodatna mjerenja. Na temelju izmjera izvedeni su tehnički crteži tlocrta kao i nacrt sva 4 zida.

Izvršen je pregled električnih i mrežnih instalacija s brojem i pozicijama priključnih utičnica i prekidača. Radi utvrđivanja potrebnih radova rekonstrukcije izvršen je pregled stanja zidova i stropa. Izmjerene su površine zidne i podne obloge te volumen kaljeve peći predviđene za rušenje.

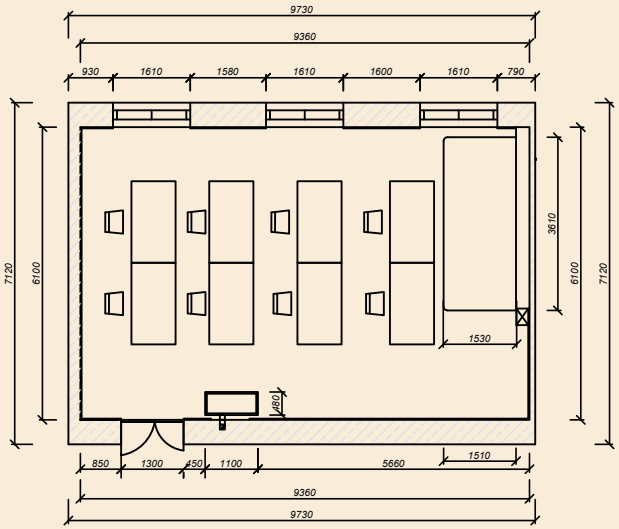
ROOM CONDITION ANALYSIS

Since it was a matter of the reconstruction of the existing classroom, it was necessary to establish the existing construction status of the room. Although there is a documentation in the form of a ground plan, measuring was carried out which confirmed that the condition on the ground plan did not match that which was measured.

Besides, the preserved technical drawings of the building contained only ground plans, so additional measuring needed to be done for the drawing of walls and vertical sections. Based on the measuring, technical drawings of the ground plan as well as the plan of all 4 walls.

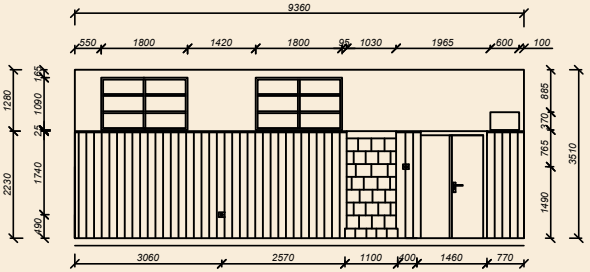
An inspection was conducted of electrical and network installations with the number and positions of sockets and switches. To determine required reconstruction works, an inspection of the state of walls and ceiling was conducted. Measured were the surfaces of the wall and floor coverings and the volume of the tile stove planned for demolition.

TLOCRT

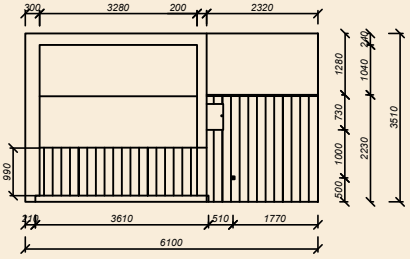


SJEVERNI ZID

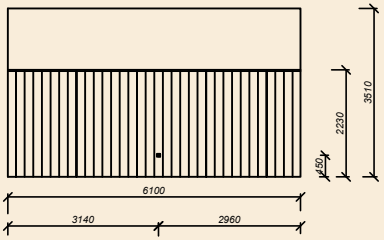
JUŽNI ZID



ISTOČNI ZID



ZAPADNI ZID



TERMOGRAFSKO SNIMANJE

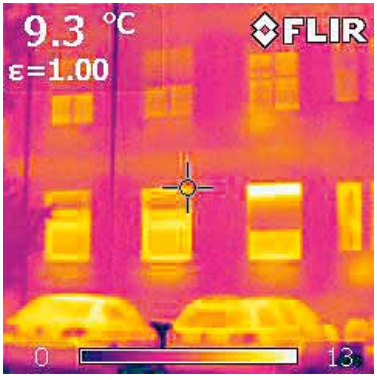
Pri projektiranju obavljeno je termografsko snimanje kako bi se provjerila toplinska izolacija i izvršili uvidi u eventualna toplinski nepovoljna mjesta koja je potrebno sanirati. Termovizijske snimke prikazuju kritična mjesta na spoju sjevernoga zida i stropa, na plohama oko doprozornika, uz prozorsku klupčicu te iza radijatora. Kako se projektnom idejom predviđa uklanjanje postojeće zidne obloge (lamperije), uklanjanje dotrajale električne i mrežne instalacije koja će naknadno biti ugrađena podžbukno, izoliranjem sjevernoga zida postiglo bi se smanjenje toplinskih gubitaka.

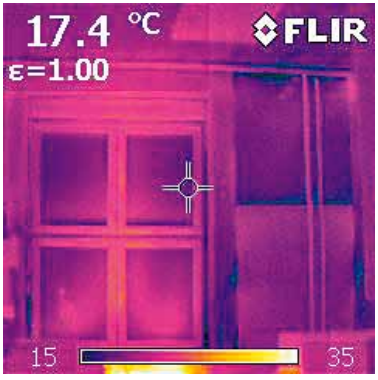
Raspon vidljivih razlika u temperaturi jasno je upućivao na potrebu izvedbe bolje izolacije, a pomišljalo se i na uključivanje u projekt *Renew school*, kojim bi bilo potrebno izmijeniti postojeće prozore drvoaluminjskim.

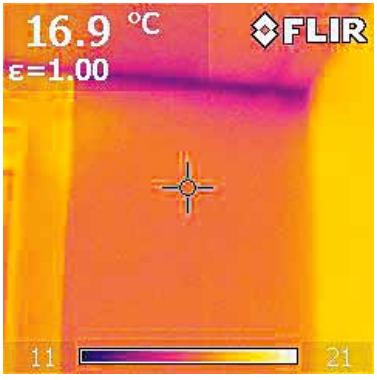
THERMOGRAPHIC RECORDING

Thermographic recording was conducted for the design to check the thermal insulation and to have an insight into the potential thermally inadequate points which needed to be repaired. The thermovisual recordings show critical points on the joint of the northern wall and ceiling, on the areas around the window casing, at the window sill and behind the radiators. As the project idea envisages the removal of the existing wall coverings (wood panelling), the removal of overdue electrical and network installations which would subsequently be concealed under the plaster, by the isolation of the north wall, the reduction of the thermal losses would be achieved.

The range of visible differences in temperature clearly indicated the need for a better insulation, and considered was the participation in the *Renew school* project, through which it would be required to replace the existing windows with wood-aluminium windows.







4.

POPIS POTREBNIH GRADEVINSKIH I OBRTNIČKIH RADOVA

THE LIST OF REQUIRED CONSTRUCTION AND FIT-OUT WORKS

Pregledom učionice, popisom potrebnih građevinskih i obrtničkih radova te uvidom u literaturu, određeni su dodatni uvjeti dopune projektnoga zadatka.

Na temelju izvršenoga pregleda i termovizijskoga snimanja popisani su predviđeni potrebni građevinski i obrtnički radovi radi izrade troškovnika.

Postavljanjem dodatnih uvjeta nastojalo se izbjeći sljedeće: odlaganje torba na podu, korištenje utičnicama i prekidačima različitoga oblika i postave na raznim visinama te dodatnih strujnih i mrežnih kablova za računala. Također je utvrđeno da se minimalnim ulaganjem u izolaciju zidova mogu postići velike energetske uštede pri grijanju prostorije.

With the inspection of the classroom, a listing of required construction and trade works and the insight into the literature, additional conditions were added to the project task.

Based on the performed inspections and thermovisual recording, the required construction and trade works were listed to make a bill of quantities.

By setting the additional requirements, it was an intention to avoid the following: storing bags on the floor, use of sockets and switches of different shapes and placement at various heights and additional electrical and network cables for computers. It has also established that through a minimum investment in the insulation of walls, great energy savings can be achieved in room heating.

5.

DEFINIRANJE DODATNIH UVJETA I ODABIR MATERIJALA

DEFINITION OF ADDITIONAL CONDITIONS AND SELECTION OF MATERIALS

ODREĐIVANJE POLOŽAJA RADNIH MJESTA STUDENATA I NASTAVNIKA

Kriteriji određivanja položaja i razmještaja radnih mjesta

Osnovno je pravilo projektiranja uvažavanje potreba i želja svih korisnika. Stoga je sastavljena anketa i provedeno je anketiranje svih korisnika (studenata, nastavnika te su izvršene konzultacije sa čistačicama i administratorom mrežnoga sustava). Broj i položaj radnih mjesta studenata i nastavnika uvjetovan je površinom učionice, veličinom radnoga mjesta te normama za projektiranje učionica i namještaja. Uz postojeći razmještaj promatrano je i šest izvedaba razmještaja radnih mjesta unutar učionice.

DETERMINING THE POSITION OF WORKPLACES FOR STUDENTS AND TEACHERS

Criteria of determining the position and placement of workplaces

The principal rule of design is the appreciation of the needs and wishes of all users. Therefore, a survey was prepared and it was conducted on all users (students, teachers and consultations are conducted with cleaners and the network administrator). The number and position of workplaces of students and teachers was conditioned by the size of the classroom, the size of the workplace and the standards for the design of classrooms and furniture. With the existing layout, six more layouts of workplaces in the classroom.

U ovome dijelu projekta provjerava se sukladnost norma s pojedinim rješenjima koje se odnose na: vidljivost projekcije s obzirom na veličinu i udaljenost, horizontalni i vertikalni kut gledanja projekcije sa svih predviđenih mjesta u učionici, razmak između redova klupa te dimenzije radnoga mjesta.

Definirani su sljedeći kriteriji:

Pristup profesora studentu, uklopljenost postojećega nadsvjetla, pristup za osobe s invaliditetom i smanjenom pokretljivošću, kut zakretanja glave pri gledanju prezentacije, vidljivost uvjetovana udaljenošću od projekcije, vidljivost uvjetovana kutom pod kojim se gleda na projekciju, stupanj odbljeska vanjskoga svjetla na monitor, rješenja postave strujnih i mrežnih vodiča, dostupnost računala administratoru mrežnoga sustava, osvijetljenost prostora vanjskim svjetlom, vidljivost ulaznih vrata s radnoga mjesta, veličina prostora za nastavnika, raspoloživost količine zida za ploču i projekciju, površina radnoga prostora za studenta, mogućnost nadzora rada studenata, iskoristivost prostora zidova za police i ormariće, oblik i raspoloživa širina i dubina radnoga mjesta za studenta, dostupnost prozora radi otvaranja i čišćenja.

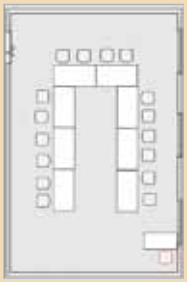
S obzirom na zadane kriterije svakomu je kriteriju pridodana ocjena koja predstavlja povezanost kriterija i kvalitete u predočenome rasporedu radnih mjesta.

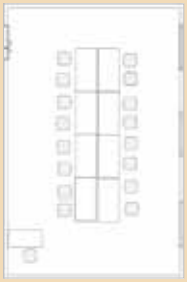
Rješenja su zadovoljavala sa 64 – 84 bodova od ukupnih 100.

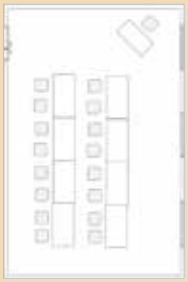
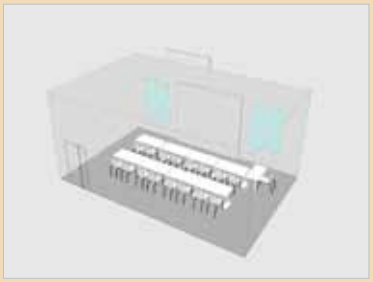
Za daljnju razradu izabrana su 2 rješenja s najvećim brojem bodova (84 i 78).

Oba koncepta predviđaju oblaganje istočnoga i zapadnoga zida drvenom oblogom. Koncept 1 s klasičnim (poprečnim) rasporedom radnih mjesta za oblaganje

Izvedaba razmještaja radnih mjesta unutar učionice
Layouts of workplaces within the classroom





In this part of the project, the conformity of standards with individual solutions were checked relating to: projection visibility in terms of size and distance, horizontal and vertical viewing angle of projections from all planned places in the classroom, the distance between the rows of benches and workplace dimensions.

The following criteria were defined:

The access of the professor to the student, the fit of the existing lights above, access for disabled and limited mobility persons, angle of the head rotation when viewing the presentation, visibility conditioned by the distance from the projection, visibility conditioned by the angle at which the projection is viewed, the degree of external light glare on the monitor, placement solutions of electrical and network conductors, computer availability to the network administrator, lightning of the room by external light, visibility of entrance door from the workplace, the size of space for the teacher, availability of the size of the wall for the board and the projection, the size of the workspace for the student, the possibility to supervise the student work, the usability of the wall space for shelves and cabinets, shape and available width and depth of workplace for the student, window availability for opening and cleaning.

Given the set criteria, each criterion was assigned a grade which represents the correlation of criteria and quality in the layout of the workplaces.

The solutions met between 64 – 84 points out of the total of 100.

For further elaboration, 2 solutions with the highest number of points (84 and 78) were selected.

Both concepts envisage lining of the east and west wall with a wooden covering. Concept 1 with the classic

koristi se punom oblogom na koju je na zapadnome zidu predviđena ugradnja interaktivne ploče, a na istočnome namještaj za odlaganje. Za 2. koncept s uzdužnim razmještajem radnih mjesta predložena je letvičasta obloga koja predviđa različite mogućnosti odlaganja na objema stranama, dok je interaktivna ploča smještena na južnome zidu nasuprot prozora.

(transversal) layout of workplaces for lining uses a full covering for which an interactive whiteboard is planned to be installed on the west wall, and on the east wall furniture for storage. For Concept 2 with longitudinal layout of workplaces, proposed was panel covering which provides different options of storage on both sides, whereas the interactive whiteboard is located on the south wall opposite the window.

Potrebe korisnika učionice

Prema rezultatima ankete koje su provedene sa svim djelatnicima koji sudjeluju u izvođenju nastave može se zaključiti da se većina nastavnika koristi ili se ima u planu koristiti ICT tehnologijom u nastavnome procesu, a čak se 59 % nastavnika koristi programom Merlin ili to misli učiniti u skoroj budućnosti. S obzirom na velik broj predanih zahtjeva za e-kolegije koji je uslijedio nakon anketiranja, potreba će rasti. Iz ankete je vidljivo i da 32 % nastavnika ima potrebu za korištenjem CAD/CAM računalnim programima, što je bio također važan kriterij pri odlučivanju opremanja učionice. Vrijednost izvršenoga anketiranja odnosi se i na daljnji proces opremanja ostalih predavaonica jer su ustanovljene navike nastavnoga osoblja koje nastavu održava uglavnom stojeći (91 %), dok neki i stoje i sjede (19 %). Zanimljiva je i iskazana želja za korištenjem interaktivnom pločom (35 %), a potrebu za održavanjem videokonferencija izrazilo je 49 % anketiranih, dok bi 51 % voljelo imati mogućnost uvida u sadržaj računala studenata sa svojega radnog mjesta.

Osim navedenoga korisnici su izrazili želju da bi učionica trebala imati poruku identiteta Drvnotehnološkoga odsjeka i Šumarskoga fakulteta te je radi toga poželjno upotrijebiti drvo i drvne materijale za namještaj i

The requirements of classroom users

According to the results of the survey conducted on all employees participating in teaching, it can be concluded that most teachers uses, or is planning to use ICT technology in the teaching process, and even 59 % of teachers uses the Merlin program or is considering doing so in the near future. Given the large number of submitted applications for e-courses which followed the survey, the need will increase. The survey also shows that 32% of teachers have the need to use CAD/CAM computer programs, which was also an important criterion for the decision on the equipping of the classroom. The value of the conducted survey also relates to the further process of the equipping of other lecture halls because it was also established that the teaching habits of the teaching staff who teach mostly standing (91%), whereas there are some who both sit and stand (19 %). Also interesting was an expressed wish to use an interactive board (35 %), whereas the need to hold videoconferences was expressed by 49% of the respondents, while 51 % would love to have the opportunity to see the content of the student computers from their workplace.

Beside the above mentioned, the users also expressed their wish for the classroom to have a message of the

Raspored radnih mjesta i pozicije invalidne osobe – 84 bodova

The layout of workplaces and a position of a disabled person – 84 points

Raspored radnih mjesta i pozicije invalidne osobe – 78 bodova

The layout of workplaces and a position of a disabled person – 78 points

uređenje interijera. Ostale želje također su razmatrane u idejnim rješenjima opremanja, no nije bilo moguće zadovoljiti baš sve, a one su bile sljedeće: upotreba svijetlih boja, zeleni pod, kutak za odmor – trosjed, barska stolica, veći monitor za predavača, dobra rezolucija projektora, održavanje i obnavljanje dotrajale računalne opreme, dobra akustika, smanjenje jeke, nevidljivi kablovi, suvremeni dizajn, opremanje učionice drvom, drveni pod, drveni materijali u interijeru s vidljivom teksturom, uklanjanje torba s poda.

identity of the Department of Wood and Technology and the Faculty of Forestry, and it was therefore desirable to use wood and wood materials for furniture and interior decoration. Other wishes were also considered in the preliminary solutions of equipping, but it was not possible to satisfy all of them, but they were as follows: use of bright colours, green floor, a rest corner – a tree-seater, a bar stool, a larger size monitor for the lecturer, good projector resolution, maintenance and renewal of obsolete computer equipment, good acoustics, echo reduction, invisible cables, modern design, equipping the classroom with wood, wooden floor, wood materials in the interior with visible textures, removing bags from the floor.

Određivanje vrste i broja namještaja

Iz uvida veličine raspoloživoga prostora, literature za projektiranje učionica za nastavu uz pomoć ICT tehnologija kao i anketiranja nastavnoga osoblja i studenata definirane su potrebe opremanja sljedećim namještajem:

- Stol za nastavnika 1 kom
- Radni stol za studente s 2 radna mjesta – 7 kom
- Radni stol za podzastupljenu skupinu studenata u koju pripada 1 invalidna osoba u kolicima
- Radni stol za nadprosječno visoke osobe – 1 kom
- Govornica za predavanja uz koju predavač stoji – 1 kom
- Police za odlaganje
- Ormari za pohranu raznoga sadržaja
- Ormarić/polica za pisač A4
- Cvjetnjak
- Vješalica za kapute.

Determining furniture type and colour

From the insight into the size of available space, the literature for the classroom design for classes with assistance of ICT technology as well as the surveyed teaching staff and students, defined were the needs for the equipping with the following furniture:

- A teacher desk 1 pce
- A workdesk for students with 2 workplaces – 7 pces
- A workdesk for under-represented group of students with 1 disabled person in a wheelchair
- Workdesk for above average tall persons – 1 pce
- A lecture stand where the lecturer stands – 1 pce
- Shelves for storage
- Cabinets for storage of various contents
- Cabinet/shelf for A4 printer
- Flower bed
- Coat hanger.

Određivanje dimenzija radnih mjesta

U ovome projektu u jednoj od inačica (koncept 1) upotrijebljeni su prepravljani postojeći stolovi čije su dimenzije 170 x 92 x 71 cm. Budući da su za rad predviđeni novi monitori manje debljine od postojećih, širina ploče je s 92 cm smanjena na 65 cm. Polazište za određivanje dimenzija radnih mjesta bile su norme uz prilagođavanje antropometriji i zdravstvenomu stanju korisnika kao i informatičkoj i ostaloj opremi koja će biti korištena.

Uvjeti opremanja učionica za podzastupljene skupine studenata

Uvidom u programski ugovor za akademsku godinu 2014./2015. i izabrane ciljeve i aktivnosti koji su predviđeni za provedbu u navedenoj akademskoj godini, u projektno rješenje u okviru cilja 2 – Olakšanje pristupa studiju podzastupljenim skupinama studenata uzete su u obzir potrebe za osiguravanjem prostorne pristupačnosti za studente s invaliditetom, što je navedeno u aktivnosti 2. Podzastupljena skupina u ovome projektu odnosi se na studente sa smanjenom pokretljivošću koji se koriste invalidskim kolicima. Na temelju literature, kao što je pravilnik o osiguranju pristupačnosti građevina osobama s invaliditetom i smanjenom pokretljivosti, uzete su u obzir dimenzije potrebne za neometano kretanje i rad. Za njih je predviđeno 1 radno mjesto koje je inkluzivno pa se njime mogu koristiti i ostale osobe, te je otvor ulaza, tj. vratno krilo dimenzijama prilagođeno za prolaz invalidskih kolica.

Osim navedene grupacije studenata izmjerom je ustanovljen velik raspon visina studenata od 156 do 200 cm. Iako visinom 50 % studenata ulazi u skupinu od 176 do

Determination of workplace dimensions

In this project, in one of the versions (Concept 1) used were the adjusted existing desks whose dimensions were 170 x 92 x 71 cm. As for the work are planned new monitors of lesser width from the existing, the width of the board was reduced from 92 cm to 65cm. The starting point for determining the dimensions of workplaces were the standards with the adjustment to anthropometry and health status of the user, as well as the computer and other equipment to be used.

Conditions for equipping of classrooms for the under-represented groups of students

By inspecting the program contract for the academic year 2014/2015 and the selected objectives and activities planned for the implementation in the mentioned academic year, in the project solution within objective 2 – Facilitating access to the study to the under-represented student groups were considered the requirements for facilitating space accessibility for students with disabilities, as listed in activity 2. The under-represented group in this project refers to students with reduced mobility using wheelchairs. Based on the literature, such se the rulebook on the facilitating access to building for persons with disability and reduced mobility, dimensions required for unhindered movement and work were considered. For them, 1 workplace is provided, which is inclusive and it can be used by other persons as well, and the entrance opening, i.e. the door dimensions are adjusted for the passage of wheelchairs.

In addition to the mentioned group of students, through the measuring, it was established that there is a large range of student heights from 156 to 200 cm. Although,

186 cm, malen, ali ne beznačajan broj studenata izvanprosječnih je antropometrijskih veličina. S obzirom na broj takvih osoba predviđen je jedan povišeni stol s 2 radna mjesta, pa je njegova visina uvećana za 5 cm.

50 % of students are in the group of 176 to 186 cm, which is small but not insignificant, the number of students of above averaged is of anthropometric sizes. Regarding the number of such persons, a raised desk with 2 workplaces is planned, and its height is increased by 5 cm.

Računala i računalni programi

Prema rezultatima ankete može se zaključiti da se većina nastavnika koristi ili se ima u planu koristiti ICT tehnologijom u nastavnome procesu. S obzirom na velik broj predanih zahtjeva za e-kolegije koji su uslijedili nakon anketiranja, potreba će rasti. Popis potrebne opreme i računalnih programa prilagođen je zahtjevima nastavnoga osoblja. S obzirom na veliku potrebu korištenja CAD programima i opterećenosti postojećih računalnih učionica, oprema koja se predlaže uključuje i mogućnost rada s CAD/CAM programima.

Computers and computer software

According to the survey results, it can be concluded that most teachers use, or intend to use ICT technology in the teaching process. Given the large number of the submitted applications for e-courses, which followed the survey, the need will increase. The list of the required equipment and computer programs is adjusted to the requirements of the teaching staff. Given the great need to use CAD programs and the load of existing computer classrooms, the proposed equipment included the possibility of work with CAD/CAM programs.

Popis računalne opreme je sljedeći:
- 17 grafičkih radnih stanica
- 17 monitora podesivih prema visini i nagibu
- 1 interaktivna ploča s konzolnim projektorom
- 1 mrežni A4 printer
- bežična mreža
- elektronski sustav za glasovanje.

The list of computer equipment is as follows
- 17 graphic workstations
- 17 adjustable height and tilt monitors
- 1 interactive board with a console projector
- 1 network A4 printer
- wireless network
- electronic voting system.

Ostalu predviđenu oprema u učionici sačinjavaju:
- nova stropna rasvjeta
- nova zidna rasvjeta
- uređaj za klimatizaciju prostorije.

The other planned equipment in the classroom includes:
- new ceiling lighting
- new wall lighting
- air conditioning.

Uslijed dugogodišnje suradnje izv. prof. Silvane Prekrat s tvrtkom PRIOR inženjering d. o. o., Autodeskovi računalni programi već su dulje vrijeme besplatni te postoji dovoljan broj slobodnih licencija koje se mogu instalirati.

Od ostalih programa potrebnih za suvremeno izvođenje nastave u anketi navedeni su: CAT LOG, Photoshop, Alphacam, Top Solid Wood, Corpus, Wood WOP, Megatischler, Sketchup, Inventor, Schowcase, Solidworks, Lumion, Woodwork for Inventor i Fusion 360.

Većina nastavnika navela je potrebu za specifičnim računalnim programima, no velik broj nije naveo točno ime programa, a programi se odnose na područje matematičkih metoda, upravljanje troškovima i proizvodnjom, simulacije, ključ za identifikaciju vrsta drva te mjerenja na slici kao i uređenje eksterijera.

Učionicu za e-učenje i modernu nastavu čini i dodatna oprema kao što je:

Elektronski sustav za glasovanje za testiranje i brzu provjeru znanja studenata s istodobno prikazanim rezultatima testiranja.

Adobe Connect sustav za suradnju i učenje na daljinu koji omogućuje komunikaciju i interakciju sa suradnicima, klijentima i partnerima, kao i učinkovitu edukaciju korisnika, bez obzira gdje se nalaze.

Adobe Captivate i Adobe Presenter služe za izradu interaktivne multimedijalne nastave.

LanSchool služi za upravljanje računalnim (učionicama), omogućuje nadzor rada studenata na računalima, komunikaciju profesora s pojedinim studentom ili pojedinoga studenta s ostatkom korisnika, sastavljanje ispita i izvoz rezultata nakon završetka testiranja.

Due to the long-term cooperation of Associate Professor Silvana Prekrat PhD with the company PRIOR Engineering Ltd., Autodesk computer programs have been free of charge for a long time, and there is a sufficient number of free licenses that can be installed.

Of the other programs required for modern teaching listed in the survey were: CAT LOG, Photoshop, Alphacam, Top Solid Wood, Corpus, Wood WOP, Megatischler, Sketchup, Inventor, Schowcase, Solidworks, Lumion, Woodwork for Inventor and Fusion 360.

The majority of teacher mentioned the need for specific computer programs, but a great number did not specify the exact program name, and the programs relate to the area of mathematical methods, cost management and production simulation, wood identification key and measurements in the picture as well as exterior design.

The e-Learning classroom and modern teaching also include additional equipment such as:

Electronic voting system for testing and quick check of student knowledge with simultaneous presentation of test results.

Adobe Connect system for cooperation and distance learning which enables communication and interaction with associates, clients and partners, as well as efficient user education, regardless of their location. **Adobe Captivate i Adobe Presenter** are used to create interactive multimedia teaching.

LanSchool is used for management of computer (classrooms), provides supervision of student work on computers, communication between a professor and individual students of an individual students with the remainder of users, preparation of exams and export of results after the completion of test.

MATERIJALI ZA OPREMANJE UČIONICE

Drvo i drvni materijali

Danas na tržištu postoje mnogi materijali koji bi po raznim kriterijima mogli biti upotrijebljeni za opremanje interijera učionice i izradu namještaja. Dva su ključna kriterija koja su ovu učionicu činila kompleksnijom. Prvi je taj da je učionica namijenjena e-učenju, što uključuje upotrebu računala, a drugi da učionica treba biti opremljena i sustavom konferencije na daljinu. Nakon nedavna useljenja u novouređenu učionicu za svakodnevnu klasičnu nastavu u kojoj je velik problem loše riješena akustika nije zanemarivo ni traženje nastavnika da se posebno obrati pozornost na sprečavanje jeke, a u izricanju želja korisnika uporaba drva u projektu bila je najučestalija.

Pregledom literature koja obrađuje različite aspekte upotrebe materijala od tehničkih do psiholoških izbor je bio relativno jednostavan. Potvrda za višekriterijskim odabirom drva kao materijala za opremu interijera nalaze se najvećim dijelom u japanskim, ali i norveškim, kanadskim i austrijskim istraživanjima. Drvo kao materijal za oblaganje poda i zidova izabrano je iz nekoliko razloga: estetike, trajnosti, akustike, toplinske izolacije, mogućnosti izrade različitih oblikovno konstrukcijskih rješenja i oporabnosti te zbog blagotvornoga učinka na psihičko i fizičko zdravlje.

Istraživanje provedeno na sveučilištu British Columbia govori da se boravak u interijeru s velikim učešćem drva odražava na smanjenu percepciju bolova, brži oporavak, smanjeni odlazak na bolovanje, bolju pozornost pri praćenju nastave, veću kreativnost, smanjenu agresivnost i bolje međuljudske odnose.

MATERIALS FOR EQUIPPING OF CLASSROOMS

Wood and wood materials

In the market today, there are many materials which, by different criteria, could be used for the equipping of the classroom interior and the making of furniture. There are two key criteria which this classroom made even more complex. The first is that the classroom was intended for e-learning, which included the use of computers, and the second was that the classroom should also be equipped with a remote conference system. Following a recent move into a newly refurbished classroom for a day-to-day classical classroom where the great problem was a poorly solved acoustics, it could not be neglected teacher's request for special attention to be paid for the prevention of echoing, and it was one of the most frequent ones expressed by the users who use wood in the project.

By reviewing literature dealing with different aspects of the use of materials from technical to psychological, the choice was relatively simple. The confirmation of a multicriteria selection of wood as material for the equipping of the interior can be found mostly in Japanese, but also in Norwegian, Canadian and Austrian researches. Wood as a covering material for floor and walls was selected for many reasons: aesthetics, durability, acoustics, thermal insulation, possibilities of production of variously shaped construction designs and restoration, and due to its beneficial effects on mental and physical health.

A study conducted at the University of British Columbia states that staying in the interior with a large part of wood reflects on the reduced perception of pain, faster recovery, a decrease in sick leave, better attention in class, greater creativity, reduced aggressiveness and batter interpersonal relationships.

Podne obloge

Za podnu oblogu za sva idejna rješenja odabrana je hrastovina, prvenstveno zbog otpornosti na habanje i laka održavanja. Osim toga hrastovina je relevantan predstavnik naše zemlje i struke, a za ranije opremljene učionice korištena je javorovina i jasenovina.

Floor Coverings

For floor covering for all preliminary solutions oak was selected, primarily due to resistance to tear and wear and easy maintenance. In addition to this, oak is a relevant representative of our country and profession, and for previously equipped classrooms, maple and ash wood were used.

Zidne obloge

U idejnim rješenjima ponuđena su 2 različita koncepta oblaganja zidova od kojih je jedan izveden kao puna obloga, a drugi letvičast. U obama konceptima obloženi su istočni i zapadni zid učionice. Oblaganje punom oblogom predložen je za 1. koncept s klasičnim (poprečnim) rasporedom radnih mjesta, a za oblaganje su predložena 2 materijala:

1. Hrastova obloga od tzv. seljačkoga poda, sastavljena na utor i pero te postavljena na vertikalnim odstojnim letvicama izvedena u 3 nijanse površinske obrade uljem od kojih je jedna identična podnoj oblozi.

2. Zidne obloge od perforiranih akustičkih ploča oplemenjene hrastovim furnirom, čiji je zadatak poboljšanje prostorne akustike apsorpcijskim svojstvima, smanjenje buke i vremena reverberacije. Pritom je na zapadnome zidu predviđena ugradnja interaktivne ploče s projektorom, ozvučenjem i kamerom, a na istočnome namještaj za odlaganje. Vješalica za kaputе nalazi se uz ulaz u učionicu i smještena je na južnome zidu.

Zbog predviđene ugradnje interaktivne ploče na južnome zidu, letvičasta obloga prezentirana u 3. i 4. konceptu ima veću površinu od 1. i 2. koncepta. Uz oblogu oblikovani su dodatni elementi kao što su police, kuke i stalci koji se mogu prema potrebi postavljati i

Wall coverings

In preliminary solutions, 2 different concepts of wall covering were offered, of which one was as a full covering and the other was a slat covering. In both concepts, the eastern and western walls of the classroom are covered. The full covering was proposed for Concept 1 with classical (transversal) layout of workplaces, and 2 materials were proposed for covering:

1. Oak covering from the solid oak floor, put together on the tongue and groove and placed on vertical spacers in 3 shades of surface treatment of oil of which one is identical to the floor covering.

2. Wall coverings made of perforated acoustic panels enhances wit oak veneer, whose task is to improve spatial acoustics by absorption properties, noise reduction and reverberation time. On the western wall, an interactive whiteboard with a projector, sound equipment and camera is planned, whereas on the eastern wall a storage furniture is planned. The coat hanger is located at the entrance to the classroom and is located on the southern wall.

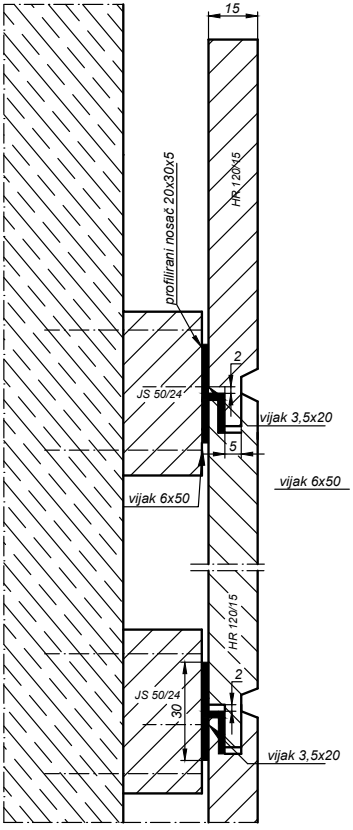
Due to the planned installation of the interactive board on the southern wall, the panel covering presented in Concept 3 and 4 has a larger surface than 1 and 2. With the covering, additional elements were made such as

uklanjati s obloge. Oni služe za odlaganje knjiga, kaputa, biljaka, slika i plakata.

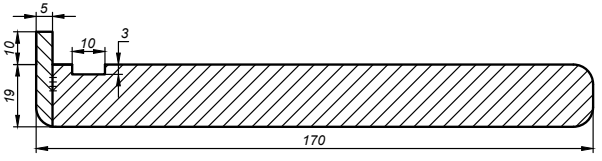
Širina letvica iznosi 10 cm, a razmak između njih 2 cm. Ispod letvica predviđena je ugradnja pozadinske led rasvjete. Za izradu jednobojne obloge predviđena je izrada letvica od hrastovine ili za niži cjenovni razred iz jelovine što ujednačenije teksture, bez kvrga, dok je u dvobojnoj inačici predviđen umetak od 3 reda tamnijih jasenovih letvica.

shelves, hooks and stands which can be placed and removed as required from the covering. They are used for storing of books, coats, plants, paintings and posters.

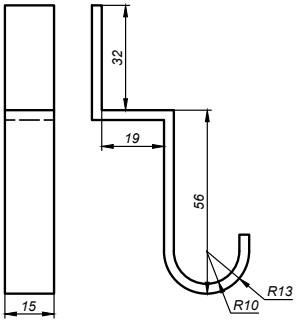
The slat width is 10 cm and the distance between them is 2 cm. Underneath the slats, backlight LED lighting is planned. To produce a single-coloured covering, planned is a slat made of oak or made from a lower priced class fir wood, with a more uniform texture, with no knots, whereas in the two-coloured variant, an insert of 3 rows of darker ash tree slats was planned.



POLICA



VJEŠALICA




DRVO JE PRVO!

Boje

Pregledom literature također je zamijećena uloga boje u radnim prostorima, a posebno učionicama. Predviđene boje za interijer učionice su žuta, bijela i zelena. Odabrane su iz sljedećega razloga:

Žuta je optimistična boja koja podiže koncentraciju, energiju te pozitivno utječe na kreativnost i opće duševno stanje čovjeka. Ona je povezana sa srećom, radošću i intelektom.

Ako je previše zastupljena, može postati iritantna jer izaziva osjećaj emotivne rastresenosti.

Bijela boja vizualno čini površinu većom nego sto jest u stvarnosti, a odlična je podloga u isticanju drugih boja i predmeta.

Prevelika koncentracija bijele boje u prostoru odiše sterilnošću i strogoćom.

Zelena boja je boja prirode, zdravlja, samopoštovanja, osjećajnosti i vitalnosti. To je boja koja najviše odmara ljudsko oko. Dobar je izbor za intelektualni rad jer potiče kreativnost.

1. ponuđeno se rješenje odnosi na obloge od hrastovoga seljačkog poda i obloga od drvnih perforiranih ploča. Za strop i zidove na kojima se nalaze zidne obloge predviđena je bijela boja na kojoj će se dobro isticati elementi različitih nijansa žute hrastove obloge.

2. Koncept se odnosi na letvičaste obloge ispod kojih je bojan zid zelenom bojom, dok su ostala dva zida te strop bojani bijelom bojom.

Colours

By reviewing literature, it was also noticed the role of colours in workspaces, especially in classrooms. The planned colours for classroom interior are yellow, white and green. They were selected for the following reasons:

Yellow is a colour of optimism which raises concentration, energy and positively influences creativity and general mental state of a person. It is connected with happiness, joy and intellect.

If there is too much of it, it can become irritating as it causes a sense of emotional distraction.

White colour visually makes the space bigger than it actually is, and it is a great background for highlighting other colours and objects.

Excessive concentration of white colour in the room exudes sterility and rigidity.

Green colour is a colour of nature, health, self-esteem, sensitivity and vitality. This is the colour which relaxes the human eye the most. It is a good choice for intellectual work which stimulates creativity.

1. the offered solution relates to coverings of solid oak flor and covering of wood perforated panels. For ceiling and walls where there are wall covering, planned is white colour where elements of different shades of yellow oak covering will stand out.

2. the concept refers to the slat wall coverings under which the wall is painted green, whereas the other two walls and the ceiling are painted in white.

Uloga biljaka u prostoru

Osim što prisutnost biljaka regulira vlagu u prostoru, neke biljke umanjuju elektromagnetska zračenja i pročišćuju zrak, što je posebno važno za prostore u kojima su prisutna računala. Istraživanje provedeno na Cardiff University's School of Psychology govori o smanjenju ugljikova dioksida za 75 %, ugljikova monoksida za 10 – 25 %. Osim toga, ističe se 15 % veća radna učinkovitost u radnim prostorima uz prisutnosti biljaka. Isto se odnosi i na istraživanja provedena u učionicama. U navedenim istraživanjima broj biljaka nije imao utjecaj. Zbog svega navedenoga u projektu su predviđene biljke, a pri odabiru biljaka vodilo se računa i o njihovu jednostavnom i nezahtjevnom održavanju koje podrazumijeva rijetko zalijevanje. Kao i za drvne obloge u 1. konceptu s oblogama od hrastovoga seljačkog poda ili drvnih perforiranih ploča predviđena je jedna veća biljka visine 1,5 m *ficus lirata* s postavljenom posudom za cvijeće na podu učionice, dok je za 2. koncept s letvičastim zidnim oblogama predviđeno nekoliko manjih biljaka *ficus begnamina*, koje bi bile ovješene na drvnu stijenu.

Rasvjeta

Pri određivanju rasvjete vodilo se računa o normama rasvijetljenosti prostorije koja je potrebna za učionice za rad na računalu. Zbog negativnoga utjecaja refleksije potrebno je bilo predvidjeti površine namještaja i podova manjega sjaja zbog čega je također predloženo cjelovito drvo hrastovine, čije su površine uljene. U literaturi je pronađeno ekonomsko-tehničko istraživanje isplativosti pojedinoga tipa rasvjete s obzirom na cijenu rasvjetnih tijela te trošak kroz određeno razdoblje.

Role of plants in space

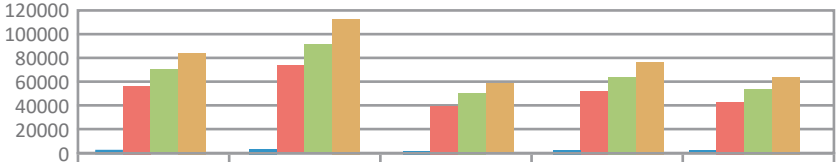
In addition to the presence of plants regulating moisture in the environment, some plants reduce electromagnetic radiations and purge air, which is particularly important for spaces where computers are present. A research conducted at the Cardiff University's School of Psychology talks about reduction of carbon dioxide by 75%, carbon monoxide by 10 – 25%. Besides, it is noted a 15% higher work efficiency in workplaces where plants are present. The same applies to the researches conducted in classrooms. In the researches, the number of plants did not have any effect. Due to the, plants were planned in this project, and when selecting plants, it was considered their simple and undemanding maintenance which involves rare watering. As for wood coverings in Concept 1. with coverings of oak peasant floor or wood perforated panes, planned is a bigger plant 1.5 m in height *ficus lirata* with a placed plant pot on the classroom floor, whereas for Concept 2. with slat wall coverings planned are several smaller plants *ficus begnamina*, which would be hung on a wooden wall.

Lighting

When determining the lighting, standards of room lighting were considered required for classrooms for work on computers. Due to the negative impact of reflection it was necessary to anticipate surfaces of furniture and floors of lesser shine due to which it was also proposed a full oak tree, whose surfaces are oiled. In the literature, an economical and technical study of feasibility of a lighting was found, relating to the price of lighting bodies and the cost over a certain period.

Pregled troškova rasvjete
Overview of lighting costs

(kn)



		FLUO	CFL	Halogena	LED žarulje	LED cijevi
	Trošak energije za 1 god. Energy cost for 1 year.	2841,35	3762,16	1841,62	2420,41	1973,16
	Trošak energije za 20 god. Energy cost for 20 years.	56827,05	75243,21	36832,32	48408,15	39463,20
	Trošak energije za 25 god. Energy cost for 25 years.	71033,81	94054,01	46040,40	60510,19	49329,00
	Trošak energije za 30 god. Energy cost for 30 years.	85240,58	112864,82	55248,48	72612,23	59194,80

6.

IDEJNA I IZVEDBENA RJEŠENJA NAMJEŠTAJA

PRELIMINARY AND IMPLEMENTED DESIGN OF FURNITURE

Poznato je da kvalitetan namještaj čine usklađena međusobna interakcija oblika, materijala, konstrukcijskoga i tehnološkoga rješenja, kojim je izveden proizvod. Što je bolja sinergija između navedenih elemenata to će ukupna kvaliteta biti bolja.

Za učionicu i sadržaj koji bi se izvodio u njoj, definirane su potrebe za oblikovnim rješenjima 16 radnih mjesta za studente s predviđenim barem jednim radnim mjestom za osobe sa smanjenom pokretljivošću, jednim radnim mjestom za nastavnika, prostorom za smještaj pisača, prostorom za odlaganje uredskoga materijala, priručnika i sitne informatičke opreme, kaputa, jakna i kišobrana. Usto je trebalo predvidjeti mjesto za smještaj sobnih biljaka.

Uzevši u obzir direktive, norme i izmjere te potrebe i želje korisnika određene su minimalne dimenzije površine radne ploče stola koje su bile polazište za prijedloge oblikovnih rješenja. Za sva ponuđena oblikovna

It is well-known that a good quality furniture forms harmonious interaction of shapes, materials, constructional and technological solutions with which the project was made. The better the synergy of these elements, there will be a better total quality of it all.

For the classroom and the content to be performed in it, defined were the requirements for design solutions for 16 workplaces for students with planned at least one workplace for persons of reduced mobility, one workplace for a teacher, space for storing the printer, space for storing office supplies, manuals, small IT equipment, coats, jackets and umbrellas. It was also necessary to plan space for placement of indoor plants.

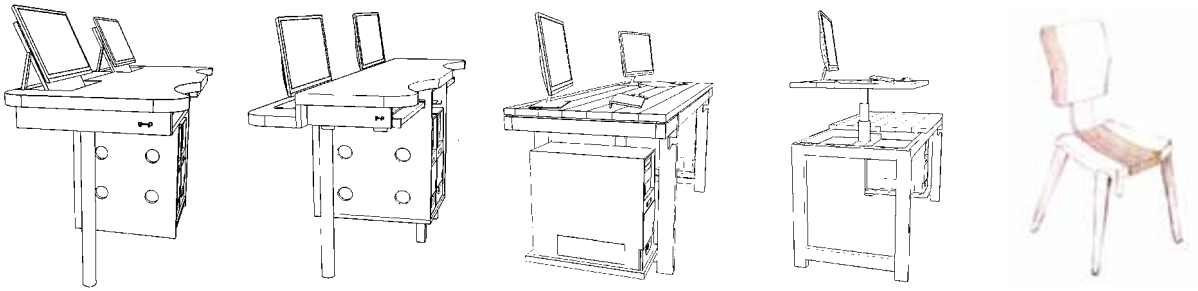
Considering the directives, standards and measurements and requirements and wishes of users, minimum dimensions of desk surface were determined which were the starting point for the design solutions proposals. For all offered design solutions of furniture

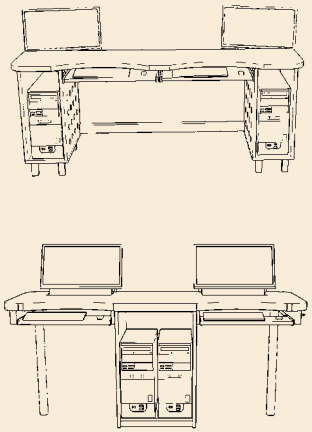
rješenja namještaja uz ostale inačice predloženoga materijala predviđena je uporaba hrastovine. Za plohe kao što su ploče stolova te ostali namještaj za odlaganje predviđene su ploče od širinski i širinsko-dužinski lijepljene hrastovine.

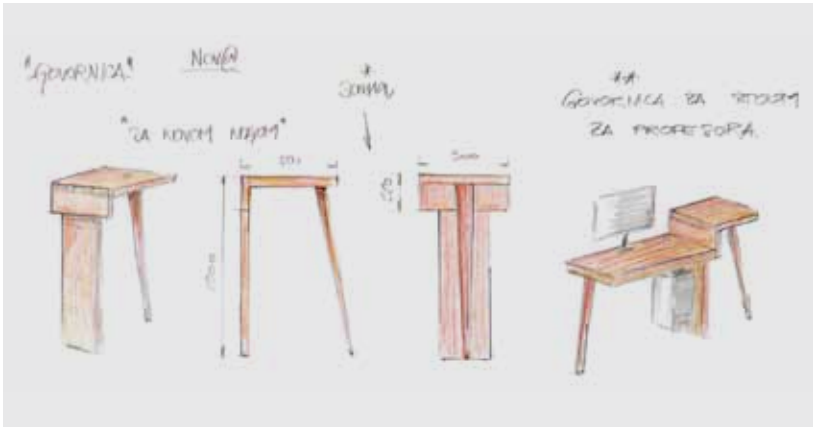
Potaknuti pregledom namještaja na tržištu te osobnim istraživanjima ponuđene su prve skice stolova koje su se vremenom razvijale.

with other versions of the proposed material, the use of oak was planned. For surfaces such as desk panels and other furniture for storage, planned are panels from edge glued and finger jointed oak . Encouraged by the overview of furniture on the market and personal researches, offered were the first drafts of desks which were developed over time.

Početne ideje u skicama
Initial ideas in drafts







Iz početnih skica izdvojila su se
4 KONCEPTA.
From the initial drafts,
4 CONCEPTS were identified.

KONCEPT 1

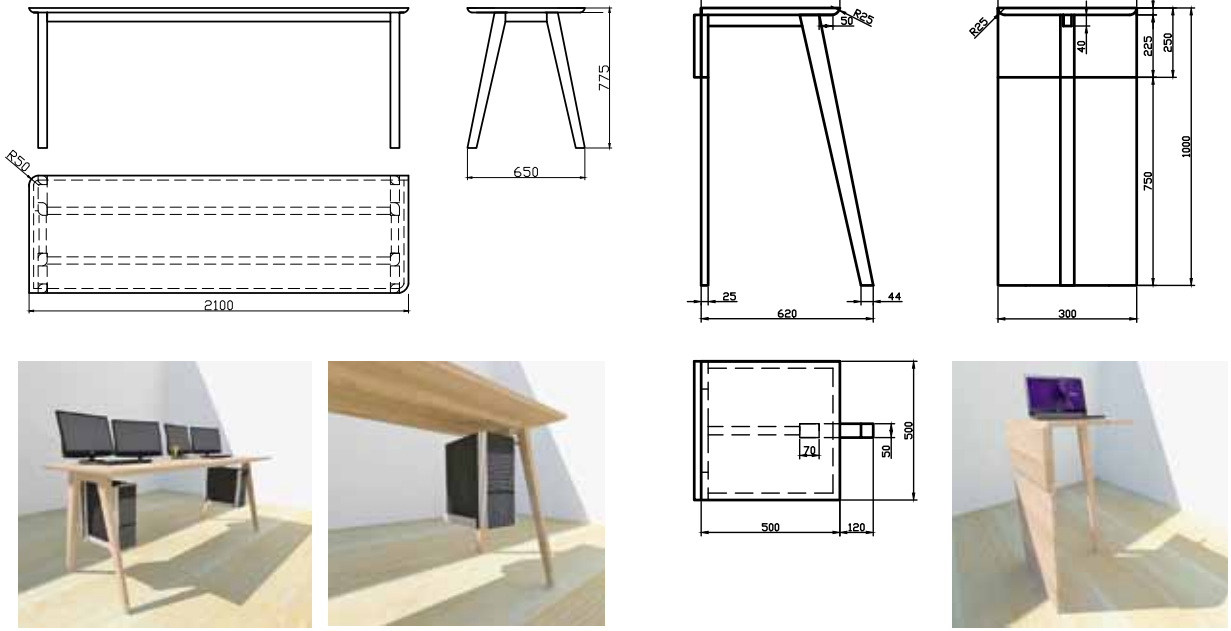
Ovim konceptom predviđeno je korištenje postojećih metalnih nožišta za koje je predviđeno bojanje u bijelu boju. Predviđena je zamjena postojeće ploče od iverice oplemenjene melaminskom sivom folijom s pločom od dužinsko-širinski sastavljenih elemenata.

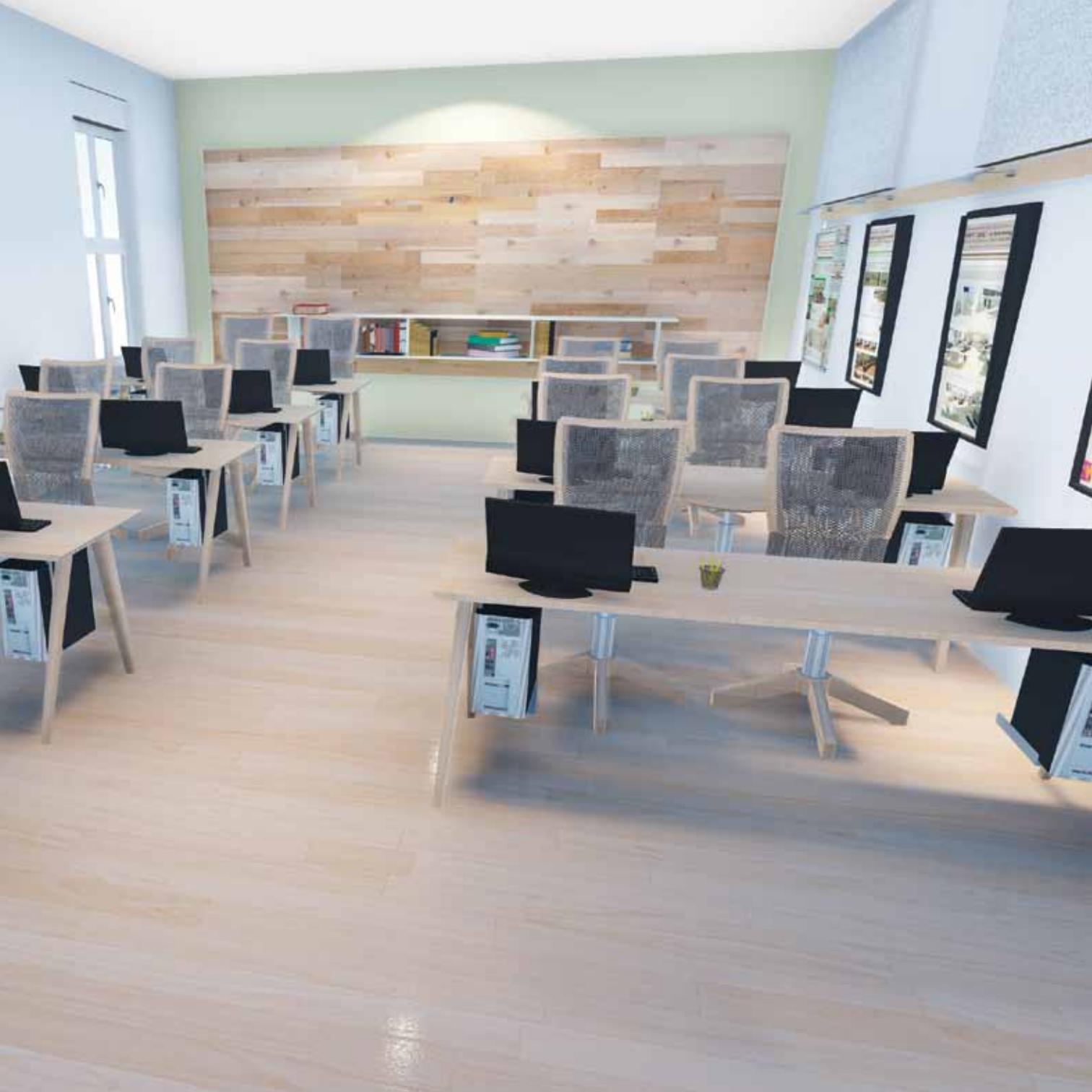
This concept envisages the use of the existing metal table frame for which it was planned to be painted white. It is anticipated the replacement of the existing panel made of fibreboard overlaid by melamine coated grey foil with the panel from finger jointed oak.

KONCEPT 2

Oblikovno rješenje 2 nadogradnja je 1. koncepta pri čemu je oblikovano i nožište stola, čija je izrada također predviđena od hrastovine. U obama idejnim rješenjima kućište računala smješteno je na standardni metalni viseći stalak. Prva dva koncepta podrazumijevaju opremanje učionice smještajući ih poprečno u prostoriju čime je omogućena veća duljina stola na koji bi se moglo po potrebi smjestiti po 2 monitora za svako radno mjesto. Uz ovaj koncept projektirana je i govornica za stajaće radno mjesto s otklopnom policom kojom je moguće povećati površinu ploče. Tlocrtni oblik ploče asimetričan je i dijagonalno sadržava dva kuta i dva zaobljenja, a rub stola zaobljen je kako bi se vizualno smanjila debljina ploče.

The design solution 2 is the upgrade of Concept 1 where the desk table frame was also shaped, whose design was also planned to be of oak. The first two concepts include equipping the classrooms by placing them transversely in the room, enabling a longer desk length where 2 monitors are planned to be accommodated for each workplace. In addition to this concept, a podium is designed with the folding shelf which could increase surface of the board. The layout plan of the board is asymmetrical and diagonally comprises of two angles and two roundings, whereas the desk is rounded to visually reduce the thickness of the board.





KONCEPT 3

Način rada s položenim ekranom kakav se često rabi u opremanju američkih računalnih učionica rezultirao je 3. idejnim konceptom čija je ploča stola u dvije razine, niža za monitor i viša za odlaganje papira potrebnih za rad i pisanje rukom. Osim toga stol ima pomičnu policu za smještaj tipkovnice, a kućišta računala smještena su u korpusne sklopove s dodatno izbušenim rupama zbog bolja prozračivanja kućišta računala – radnih stanica. U početnoj fazi smještaj kućišta računala bio je predviđen u središnjemu dijelu stola, a na objema stranama bile su postavljene metalne noge kružnoga poprečnog presjeka. Zbog nedovoljne stabilnosti koju je imao ovaj stol, progiba ploče koja bi se s vremenom povećavala te nedovoljnim hlađenjem kućišta računala razvojem ovog koncepta izmijenjeno je prvotno rješenje te su odbačene metalne noge, a odlaganje kućišta računala predviđeno je u 2 korpusna sklopa na lijevoj i desnoj strani stola. Upotreba položenoga monitora omogućuje smanjenje dubine stola.

The method of work with the monitor laid flat as is often used in equipping American computers classrooms resulted in Concept 3 idea whose desk panel was in two levels, a lower one for the monitor and a higher one for the storage of papers required for work and handwriting. In addition to this, the desk has a movable shelf for the keyboard, whereas the computer casings area placed in the corpus assemblies with additionally made holes for better ventilation of computer cases – workstations. In the initial phase, the placement of the computers case was planned to be in the central part of the desk, and on both sides, were to be placed metal legs of a circular cross section. Due to the inadequate stability of this desk, deflection of the panel which would increase over time and insufficient cooling of the computer case, with the development of this concept the initial solution was changed and metal legs were dropped out, whereas for the storage of the computer casing 2 corpus assemblies on the left and the right side of the desk ware planned. The use of the monitor laid flat allows the decrease of the desk depth.

KONCEPT 4

Velik broj različitih elemenata, velik udio materijala te složenija i dugotrajnija izrada namještaja predložena 3. konceptom iznjedrila je jednostavnije oblikovno rješenje. Izrada puluutora na nožištu stola prikrit će razliku u dimenzijama, nastalu bubrenjem ili utezanjem uvjetovanu različitim smjerovima elemenata u sklopu. Kućišta računala smještena su na policama koje su učvršćene u poveznike nogu. Ta konstrukcija dodatno učvršćuje nožište. Glodani dio noge stola tvori kuku koja služi za odlaganje torbe. Materijal koji je predviđen za ovaj koncept također je hrastovina, no ploču stola moguće je izvesti ivericom oplemenjenom furnirom, folijom ili laminatom kombinirajući različite boje i nijanse.

Za potrebe nastavničkoga radnog mjesta za dio ploče stola predviđeno je izvedba s pomicanjem po visini. Time se omogućuje rad na različitim visinama prilagođenim sjedećemu ili stajaćemu načinu rada.

A great number of different elements, a high share of materials and a more complex and durable furniture design proposed by Concept 3 resulted in a simpler design solution. The making of half-grooves at the desk foot will mask the difference in dimensions, resulted from swelling or shrinkage conditioned by the different directions of the elements in the assembly. The computer cases are placed on the shelves which are fastened in the apron of the legs. This structure additionally strengthens the talble frame. The milled part of the desk leg forms a hook which serves for storing of bags. The material planned for this concept is also oak, but the desk board can be made from veneer overlaid fibreboard, foil or laminate combining different colours and shades.

For the needs of the teacher workplace, for the part of the desk panel, a height adjustable version is planned. This allows work at different heights adjusted to a sedentary or standing mode of work.

7.

PREDSTAVLJANJE PROJEKTA
PRESENTATION OF THE PROJECT

Tijekom izrade projekta ponuđena je mogućnost prezentiranja idejnih rješenja. Prvo je uslijedilo na najvećemu hrvatskom dizajnerskom događanju, tjednu dizajna #tdzg u Laubi, koji se održavao od 8. do 16. svibnja 2015. Projektna su rješenja prikazana na plakatima te su održane javne prezentacije na kojima je rad studenata na projektu iskorišten kao prilika promoviranja Šumarskoga fakulteta s posebnim naglaskom na javnosti manje poznat Drvnotehnološki odsjek. Na Drvnotehnološkoj konferenciji u Opatiji, održanoj od 1. do 2 lipnja 2015., projekt je predstavljen u sklopu predavanja izv. prof. dr. sc. Silvane Prekrat *Visokoškolsko obrazovanje kao preduvjet za razvoj i inovacije u sektoru prerade drva*. Istodobno u predvorju kongresne dvorane zajedno s ostalim izlagačima bili su izloženi plakati s idejnim rješenjima projekta buduće učionice.

Na Šumarskome je fakultetu 2. srpnja 2015. održana završna prezentacija koja je osim informiranja bila kao i u realnome životu u službi privole investitora na realizaciju projekta. Uz studente i nastavnike Šumarskoga fakulteta u publici su bili i pozvani uzvanici.

During the design of the project, an option of presentation of preliminary solutions was offered. The first one was at the greatest Croatian designer event, the Design Week #tdzg at Lauba, which was held from 8th to 16th May 2015. The project solutions were displayed on posters and public presentations were held where students' works used in the project were used as an opportunity to promote the Faculty of Forestry with a special emphasis on the publicly less known Department of Wood Technology. At the Wood Technology conference in Opatija, held from 1st to 2nd June 2015, the project was presented as part of the lecture of the Associate Professor Silvana Prekrat PhD *Higher education as a pre-requisite for development and innovations in the wood processing sector*. At the same time, in the lobby of the congress hall, together with other exhibitors, exhibited were posters with conceptual solutions of the future classroom project.

At the Faculty of Forestry, on 2nd July 2015, a final presentation was held, where, besides informing was also in real life in service of the consent of investors for the

Predavanje o e-učenju na Šumarskome fakultetu dr. sc. Marka Vucelje bila je dobar uvod u opravdanost potrebe za učionicom, čija su rješenja predstavljena, a informacijama o informatičkoj opremi koja je predviđena u učionici važan doprinos pružili su i dobavljači opreme iz HSM informatike.

realisation of the project. In addition to the students and teachers of the Faculty of Forestry, there were also invited guests in the audience. The lecture on e-learning at the Faculty of Forestry of Marko Vucelja, PhD, was a good introduction on the justification of the need for the classroom, whose solutions were presented, and with the information on the IT equipment planned for the classroom was an important contribution was provided by the equipment supplier from HSM informatika.

PROGRAM ZAVRŠNE PREZENTACIJE

Uvodna riječ – Silvana Prekrat
E-učenje na Šumarskome fakultetu – Marko Vucelja
Projektni zadatak – Silvana Prekrat
Uloga materijala, teksture, boje i biljaka u opremanju učionice – Ana Mišetić
Idejna rješenja zidnih obloga – Ana Mišetić
Idejna rješenja namještaja učionice 1 i 2 – Lana Jarža
Idejna rješenja namještaja učionice 3 i 4 – Valentino Slivar
Softverska rješenja za interaktivnu edukaciju – Dejan Rogan, HSM infromatika
LanSchool, Adobe Captivate, Adobe Presenter, Adobe Connect
Interaktivni uređaji u edukaciji – Željko Čačinović, HSM informatika
Turning Technologies sustav za glasovanje i Globisens mjerni uređaji

THE FINAL PRESENTATION PROGRAM

Introductory word – Silvana Prekrat
E-learning at the Faculty of Forestry – Marko Vucelja
Project task – Silvana Prekrat
Role of materials, textures, colours and plants in classroom equipment – Ana Mišetić
Preliminary design of wall coverings – Ana Mišetić
Preliminary design of furniture for classrooms 1 and 2 – Lana Jarža
Preliminary design of furniture for classrooms 3 and 4 – Valentino Slivar
Software solutions for interactive educations – Dejan Rogan, HSM informatika
LanSchool, Adobe Captivate, Adobe Presenter, Adobe Connect
Interactive devices in education– Željko Čačinović, HSM informatika
Turning Technologies voting system and Globisens measuring devices

Odluka o izboru idejnih rješenja namještaja i opremanja učionice koji će se realizirati prepuštena je krajnjim korisnicima koji su prisustvovali prezentaciji. Sudionici su ujedno mogli isprobati dio opreme koja je predviđena za buduću učionicu. Uz Adobe Captivate i Adobe Presenter korišten je sustav za glasovanje, kojim se vrlo brzo i točno došlo do sljedećega rezultata glasanja: Za ambijent u kojemu se najbolje osjećaju 98 % ispitanika odabralo je drvo i biljke. Za odluku o uzdužnome ili poprečnome rasporedu radnih stolova studenata trebale su dodatne konzultacije jer je rezultat bio neriješen. Za punu hrastovu oblogu zidova u 3 nijanse glasalo je 39 %, za oblogu s perforiranim akustičnim pločama 18 %, za letvičastu u 2 boje 36 % te za jednobojnu letvičastu 7 % sudionika. Za namještaj s ukošenim (koso postavljenim) nogama glasovalo je 33 %, za ugradnju hrastove ploče na postojeće metalno nožište 20 %, za stolove s policama za tastaturu 18 % te za stolove s mogućnošću odlaganja torbe na kuku noge 29 %.

Nakon uspješno završenoga projekta zaslužili smo malo zajedničkog druženja u društvu prof. dr. sc. Božidara Lapainea, čije neizmjerno iskustvo rezultira uvijek korisnim primjenjivim savjetima.

The decision on the selection of the design solutions for the furniture and equipment of the classroom which will be realized will be left to the end users who attended in the presentation. Participants could also test some of the equipment which was planned for the future classroom. With Adobe Captivate and Adobe Presenter, a voting system was used, which quickly and accurately showed the following voting results: For the environment they felt the best, 98% of respondents selected wood and plants. For the decision on the longitudinal or transversal layout of student workdesk, additional consultations were required as the result was undecided. For the full oak coverings of the walls in 3 shades, 39%, for coverings with perforated acoustic panels, 18%, for slats in 2 colours 36%, and for a single-coloured 7% of respondents voted. For furniture with a slope (slope positioned) voted 33 %, for the oak panels to be installed in the existing metal table frame 20 %, for desks with shelves for keyboards 18% and for desks with the possibility of storing bags on leg hooks 29 %.

Following the successfully completed project, we deserved a bit of a socializing in the company of Professor Božidar Lapaine, PhD whose immense experience always results in applicable advice.

Radni ručak povodom uspješno prezentiranoga projekta
Radni ručak povodom uspješno prezentiranoga projekta

1. U kojemu od ambijenata biste se najbolje osjećali?

A Drvo
B Drvo i biljke
C Umjetni materijali
D Umjetni materijali i biljke

2. Koje je od navedena 2 rasporeda radnih mjesta za Vas bolje rješenje?

A Poprečni raspored
B Uzdužni raspored

3. Koje Vam se od predloženih rješenja obloga najviše sviđa?

A Panelna obloga od hrastovih elemenata
B Panelna obloga od akustičkih ploča
C Letvičasta obloga od jasenovine i hrastovine
D Letvičasta obloga od jelovine

4. Koji biste primjer oblikovnoga rješenja namještaja izdvojili kao najbolji?

1. Which environment would you feel best in?

A Wood
B Wood and plants
C Artificial materials
D Artificial materials and plants

2. Which of the listed 2 workplace layouts is a better solution for you?

A Cross sectional layout
B Longitudinal layout

3. Which of the proposed solutions of the coverings do you like best?

A Panel covering of oak elements
B Panel covering of acoustic panels
C Panel covering of ash and oak wood
D Panel covering of fir wood

4. Which example of the furniture solution design would you single out as the best one?

8.

RAZVOJ PROIZVODA ODABRANOGA OBLIKOVNOG RJEŠENJA NAMJEŠTAJA I OPREMANJA

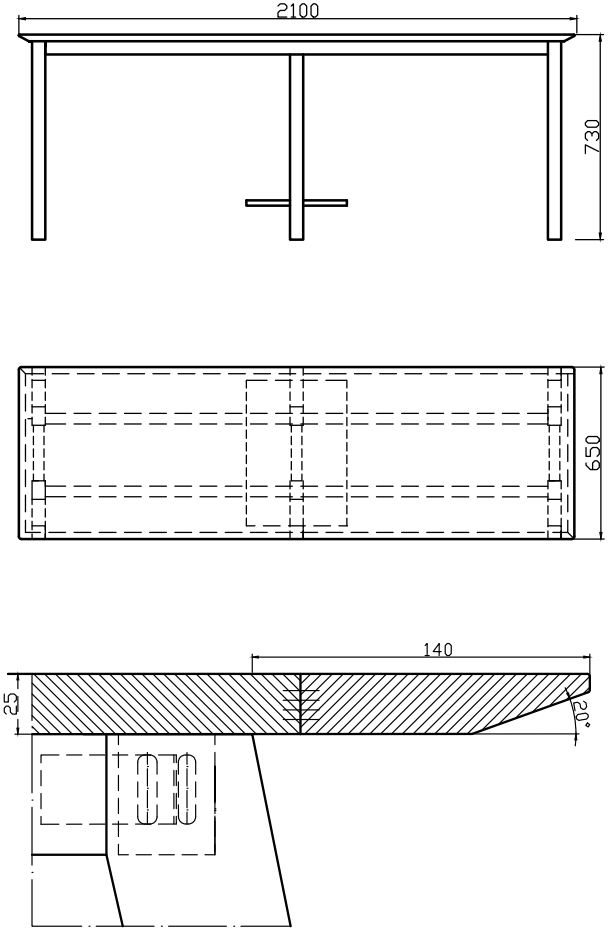
PRODUCT DEVELOPMENT OF THE SELECTED MODEL SOLUTIONS OF FURNITURE AND EQUIPMENT

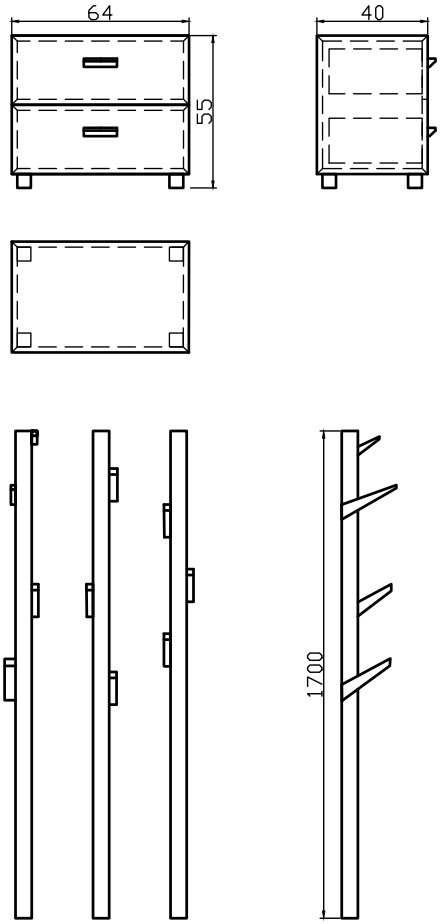
U želji da se izbjegnu metalni dijelovi na namještaju, početno rješenje s ovješenjem metalnim stalcima za kućišta računala zamijenjeno je drvenom policom, a tlocrtni oblik stola postao je simetričan sa zaobljenim uglovima, dok je i dalje zadržan djelomično zaobljeni i skošeni glodani rub kojim se ploča stola vizualno stanjuje. Uz stol redizajnirani su i ormarići, čiji su rubovi korpusa i prednjaka ladica profilirani jednako kao i stolovi. Odlučeno je također da stolice budu izrađene iz hrastovine te da oblikovno budu prilagođene stolovima. Ormarić s ladicama ujedno je i stalak za laserski pisač. U budućnosti se predviđa kupnja 3D printera, koji već ima predviđeno mjesto na drugome ormariću. Govornica je zbog ugradnje pametne ploče odbačena kao nepotrebna, a elementi vješalice oblikovani su pre-

In the desire to avoid metal parts on furniture, the initial solution with the suspension metal stands for computer cases was replaced by a wood shelf, and the desk shape plan became symmetrical with the rounded corners, while the partially rounded and sloping milled edge was retained, which makes the desk panel visually thinner. Along with the desk, also redesigned were cupboards, whose edges of the corpus and the drawer fronts were profiled as well as the desks. It was also decided that their shape should be adjusted to desks. The drawer cabinet is also a laser printer stand. In the future, a purchase of a 3D printer is planned, which already has a planned place on another cabinet. The podium, due to the installation of the smart whiteboard, has been rejected as unnecessary, and the elements

ma nogama stolica i stolova. Konačno definiran sadržaj koji je potrebno odlagati uvjetovao je izbacivanje police i izradu 2 ormarića s ladicama. Prethodno ispitana čvrstoća konstrukcijskih sastava prilagođena je raspoloživoj tehnologiji odabranoga izvođača radova.

of a coat hanger were shaped to the legs of chairs and desks. Finally, the content was defined which needs to be stored, which resulted in the ejection of a shelf and making of 2 cabinets with drawers. Previously tested strength of the structural systems was adjusted to the available technology of the selected contractor.





9.

RADOVI
WORKS

Za projekt opisanoga obujma potrebno je prijevremeno planirati investiciju. Uvjeti za početak radova bili su ostvareni sredinom srpnja 2016. godine. Završetak grubih radova trebao se obaviti do početka jesenskoga roka ispita. Za projektni tim to je značilo gubitak godišnjega odmora. Razdoblje koje je uslijedilo značilo je nastavak rada na projektu jer je bilo potrebno dopuniti proizvodnu dokumentaciju, zatražiti ponude, odabrati izvođače i nadzirati radove, uputiti reklamacije. Zbog većinom vrhunskih izvođača radova u odnosu na slične projekte reklamacija je bilo izuzetno malo.

Malen i uspješan tim dokazao se i u ovome dijelu koji nije uvijek tekao glatko, a odluke su se morale donositi brzo. U toj fazi tim je dobio pojačanje s prodekanom prof. dr. sc. Stjepanom Pervanom, koji je olakšao posao preuzevši dio povezan s dokumentacijom javne nabave te komunikacijom s dekanom i računovodstvom, a bio je na raspolaganju i za hitne intervencije, kao što je kupovina sitnoga materijala koji je trenutno bio potreban na gradilištu. Veliko olakšanje u radu uslijedilo je dekanovim odobrenjem troškovnika.

For the project of the described volume it was necessary to plan the investment early. The conditions for the commencement of works were met in mid-July 2016. The completion of rough works should have been done by the beginning of the autumn term of exams. For the project team, this meant a loss of annual leave. The period which followed meant the continuation of work on the project as it was necessary to supplement the production documentation, requested quotations, select contractors and supervise works, file complaints. Due to the mostly top contractors, in comparison to similar projects, there were significantly fewer complaints.

A small and successful team proved themselves in this part, which did not always run smoothly, and decisions had to be made quickly. At that stage, the team received reinforcement with the vice Dean Professor Stjepan Pervan PhD. Who made the job easier by taking over the part related to documentation of public procurement and communication with the dean and accounting, and he was also available for emergency

Uslijedili su radovi demontaže i rušenja, popravaka fasade uz prozore. Početkom kolovoza započeli su radovi postavljanja podkonstrukcije za obloge zidova, razmještaj radijatora, izoliranje vanjskoga zida, pripremu i postavu podnih i zidnih obloga, spuštanje stropa, ugradnju električne i mrežne instalacije te ventilacije. Uskoro je postavljena i interaktivna ploča s projektorom, kamerom i ozvučenjem, a paralelno je izrađivan namještaj. U razdoblju sastavljanja namještaja volontirao je student 1. godine Drvnotehnološkoga odsjeka Vid Kvakan. Zbog propisa javne nabave nabava informatičke opreme uslijedila je u 2017. godini nakon čega su instalirani računalni programi za koje će biti provedena obuka.

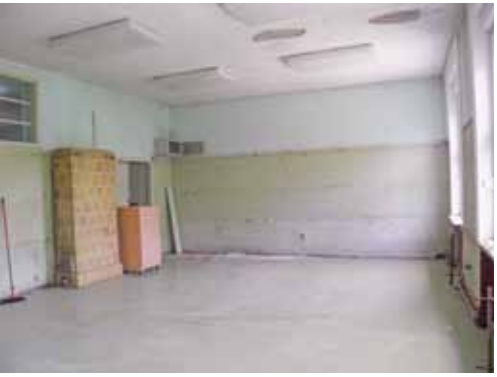
Student 1. godine, Vid Kvakan

interventions such as purchase of minor materials which were urgently needed on the construction site. Great relief in work followed by the dean's approval of bill of quantities.

Following were dismantling and demolition works, repairs of the façade with the windows. At the beginning of August, works commenced on placement of substructures of wall coverings, radiator arrangement, insulation of external wall, preparation and laying of floor and wall coverings, lowering of ceilings, electric and network installation and installation of ventilation. Soon, an interactive whiteboard wish projector, camera and sound system was setup, and furniture was being made at the same time. In the period of furniture production, Vid Kvakan, a student of the first year of the Department of Wood Technology, volunteered. Due to the procurement regulations, the procurement of IT equipment followed in 2017 after which computer programs were installed for which training will be conducted.

Student of the first year, Vid Kvakan

RADOVI REKONSTRUKCIJE I OPREMANJA UČIONICE U RAZLIČITIM FAZAMA









WORKS OF RECONSTRUCTION AND EQUIPPING
OF CLASSROMS AT DIFFERENT STAGES

10.

PRIPREMA ZA RAD U UČIONICI
PREPARATIONS FOR WORK IN CLASSROOMS

Dan za edukatore događanje je koje u Muzeju suvremene umjetnosti redovito organizira tvrtka HSM Informatika. Ono je namijenjeno nastavnicima koji sudjeluju u svim razinama obrazovanja kako bi se upoznali s mogućnostima unapređenja uz pomoć informatičke opreme. Uz izv. prof. dr. sc. Silvanu Prekrat tu su manifestaciju u nekoliko navrata pohađali dr. sc. Marko Vucelja, član Povjerenstva za e-učenje Šumarskoga fakulteta te CARNetov sistemski inženjer, Microsoftov koordinator Mihael Šutalo, univ. bacc. ing. comp.

Osim predavača tvrtke HSM informatike na Danu za edukatore sudjeluju i nastavnici koji prezentiraju svoje primjere i iskustva od kojih je moguće doznati i rješenja na poteškoće s kojima su se susretali.

Korištenje CAD/CAM računalnih programa nezaobilazno je drvnoj struci pa tako treba slijediti i trendove i osposobljavanja studenata za budući rad.

Osim univerzalne opreme za e-učenje su predviđeni i prema iskazanim potrebama nastavnika i stručni računalni programi za čiji je odabir također trebalo izvršiti pripremu.

The event Day for Educators is regularly organised by the company HSM Informatika in the Museum of Contemporary Art. It is intended for teacher participating in all levels of education to get acquainted with the possibilities of improvement with the help of IT equipment. In addition to Associate Professor Silvana Prekrat, PhD, this event was also attended on several occasions by Marko Vucelja PhD, a member of the e-Learning Committee of the Faculty of Forestry and the CARNet system engineer, Microsoft Co-ordinator Mihael Šutalo, *univ. bacc. ing. comp*.

In addition to the lecturers of HSM Informatika, the Day of Educators is also attended by teachers who presented their examples and experiences from which it was also possible to find out solutions for difficulties they encountered.

Use of CAD/CAM computer programs is unavoidable in wood industry, so it is necessary to follow trends and train students for future work.

U suradnji s tvrtkom Communiter Ad Decus (CAD) d. o. o. na Šumarskome je fakultetu 31. 5. 2016. Bojan Čabradi, mag. ing. mech. održao u popunjenoj dvorani zainteresiranih nastavnika i studenata Drvnotehnološkoga odsjeka Šumarskoga fakulteta predavanje pod naslovom CAD/CAM rješenje za izradu 3D digitalnoga prototipa namještaja. Program *Woodwork for Inventor* namijenjen je projektiranju i proizvodnji namještaja. Glavne su značajke toga programa trodimenzionalno projektiranje namještaja s dodavanjem i prilagodbom materijala, postavljanjem i prilagodbom spojnih i veznih elemenata povezanih s katalozima proizvođača i distributera okova, izvođenje spojeva kao što su provrti za moždanike ili podužne rupe za zaobljene čepove, automatska izrada sastavnica dijelova, automatizirani CAM te integracija u Autodesk Vault.

U prezentaciji je prikazano projektiranje, vizualizacija te izrada korpusnoga namještaja, no jednako tako program je prilagođen za zahtjevniju geometriju kakva je, primjerice, za dijelove namještaja od cjelovitoga drva u stoličarstvu ili u drvenim sklopovima ojastučenoga namještaja.

U sklopu redovne nastave studenti 2. godine diplomskoga studija Oblikovanje proizvoda od drva sudjelovali su 31. 1. 2017. u jednodnevnoj radionici u tvrtki PRIOR inženjering d. o. o. iz Zagreba. Prior se bavi prodajom Autodeskovih rješenja, edukacijom i pružanjem tehničke podrške korisnicima od 1992. godine i imaju status Autodeskova *Gold* partnera i Autodeskova ovlaštenoga trening i certifikacijskoga centra. Dugogodišnja suradnja s Priorom toga je puta proširena s upoznavanjem programa *Fusion 360* za studente Drvnotehnološkoga odsjeka. Jednodnevna radionica u kojoj su studenti mogli samostalno isprobati rad u programu za parametarsko trodimenzionalno modeliranje održana je u novim

Beside the universal equipment for e-Learning in the classroom, also planned, and in accordance with the expressed needs of teachers, are professional computer programs for whose selection it was also necessary to make some preparations.

In co-operation with the company Communiter Ad Decus (CAD) Ltd. on 31/05/2016 at the Faculty of Forestry, Bojan Čabradi, *mag. ing. mech.* before the fully filled lecture hall of the interested teachers and students of the Department of Wood and Technology of the Faculty of Forestry, held a lecture titled CAD/CAM solution for the making of 3D digital prototype of furniture. The *Woodwork for Inventor* program is intended for design and production of furniture. The main features of this program are three-dimensional design of furniture by adding and adjustment of material, setting and adjustment of joint and connecting elements associated with catalogues of the producers and distributers of fittings, making of joints such as holes from dowels or rounded mortice and tenon, the automated CAM and integration in Autodesk Vault.

The presentation showed design, visualisation and production of corpus furniture, but the program is equally adjusted for a more demanding geometry which is, for example, for parts of furniture from the solid wood in chair production or in wooden assemblies of upholstered furniture.

As part of regular curriculum, students of year 2 of the graduate study of Wood product shaping took part on 31/1/2017 in a one-day workshop in the company PRIOR inženjering Ltd. from Zagreb. Prior has engaged in sales of Autodesk solutions, education and providing technical support to users since 1992 and has Autodesk *Gold* partner status and Autodesk authorized training and certification centre. The long-standing co-operation


PRIOR

prostorijama tvrtke Prior, koji je poznat po edukaciji korisnika Autodeskovih programskih paketa prema službenom Autodeskovu programu, koje su pohađali i nastavnici Šumarskoga fakulteta. U uvodnome dijelu predavanja predstavljene su mogućnosti rada s programom koji pokriva sve faze razvoja proizvoda od koncepta do pripreme za 3D printanje modela i izradu proizvoda na CNC stroju. S velikim zanimanjem studenti su slušajući upute iskusnog edukatora Zdenka Kožara uspješno savladavali zadatke koji su se odnosili na izradu 3D modela s pripadajućom tehničkom dokumentacijom i vizualizacijom.

with Prior on this occasion was extended with the introduction of the *Fusion 360* program for students of the Department of Wood Technology. A one-day workshop where students could independently test working in the program for parametric three-dimensional modelling was held in the new premises of the company Prior, which is known for education of users of Autodesk program packages in accordance with the official Autodesk program, which was also attended by the Faculty of Forestry teachers. The introductory part of the lecture presented possibilities of working with the program which covers all phases of product development from the concept to the preparation for 3D model printing and production of products on the CNC machine. With great interest, the students listened to the instructions of the experienced educator Zdenko Kožar, successfully mastered tasks relating to the 3D model production with accompanying technical documentation and visualisation.

POGOVOR

Kao tim nadamo se da smo ispunili zadaću proširenoga projektnog zadatka te da smo ponudili rješenja koja su ponajprije u službi korisnika misleći pritom jednako na nastavnike, studente, a i one koji se bave održavanjem, kao što su čistačice ili administratori mreže. Nadamo se i da smo osim potreba ispunili i većinu želja. U svakome slučaju ovim smo projektom pokušali odabrati materijal, boje, oblikovna i konstrukcijska rješenja birajući ih odgovorno, sagledavajući različite aspekte s pristupom kakav bi trebao biti u realnome radu na sličnim projektima. Pri oblikovanju namještaja vodili smo računa o normama, a dimenzije prilagodili studentima Šumarskoga fakulteta. Ponosni smo na učionicu koja će, nadamo se, služiti dugo na korist djelatnicima i studentima Šumarskoga fakulteta te široj zajednici. Puno smo naučili i ovo će nam iskustvo biti posebno korisno u budućemu radu, a drago nam je da smo svojim entuzijazmom i volonterskim radom financijski smanjili troškove fakultetu. Iako se takav projekt prvi put izveo na fakultetu, voljeli bismo biti poticaj i nekome drugom timu da na temelju znanja, velikoga truda i entuzijazma stvori nešto slično.

Voditeljica projekta
Izv. prof. dr. sc. Silvana Prekrat

EPILOGUE

As a team, we hope to have fulfilled the task of the extended project task and that we have offered solutions that are primarily in the service of users, thinking equally of teachers, students, but also those who deal with maintenance, such as cleaners and network administrators. We hope that we have fulfilled not just the needs but also most of the wishes. In any case, with this project we have tried to select the material, colours, shape and construction solutions, choosing them responsibly, looking at different aspects with the approach as it should be in real work on similar projects. In designing furniture, we took into account the standards, and dimension were adjusted to the students of the Faculty of Forestry. We are proud of the classroom, which, we hope, will serve a long time to the benefit of the employees and students of the Faculty of Forestry and the wider community. We have learnt a lot and this experience will particularly be useful in future work, and we are delighted that with our enthusiasm and volunteer work we have reduced financial costs of the faculty. Although this is the first time a project like this one has been conducted at the faculty, we would like this to be an incentive to another team to create something similar based on their knowledge and great effort and enthusiasm.

Project Manager
Associate Professor Silvana Prekrat, PhD









SURADNICI NA PROJEKTU
PROJECT COLLABORATORS

VALENTINO SLIVAR

Zanimanje: Magistar inženjer drvne tehnologije - Diplomski studij Oblikovanja proizvoda od drva
Zaposlenje: Martinić-Art Interijeri na funkciji konstruktora, nadzora i voditelja radova.
Diplomski rad: 2017. Utjecaj temperature zavarivanja na čvrstoću rotacijski zavarenog spoja. Mentor doc. dr. sc. Ivica Župčić
Nagrade tijekom studija: Dekanova nagrada za studiranje u roku uz položene sve upisane predmete (ak.god. 2013/2014.); Nagrada Akademik Dušan Klepac za najboljeg studenta diplomskog studija Oblikovanje proizvoda od drva (ak.god. 2015./2016.); Nagrada Akademik Milan Anić za najboljeg studenta u generaciji, koji je u roku predviđenom studijskim programima završio preddiplomski i diplomski studij (ak.god. 2016./2017.); Pohvala Summa Cum Laude s ocjenom 4,935.
Značajni radovi, projekti i izložbe: 2015. Ambienta Zagreb: 2 prototipa stola za učionice; 2015. Tjedan dizajna Zagreb: prototip radnog stola za projekt Razvoj novih proizvoda od Slavonskog hrasta i projekta e-učionice; 2016. Tjedan dizajna Zagreb: U sklopu grupe Enable Table izložen prototip stolića Lava

Occupation: Master Engineer of Wood Technology – Wood Product Design
Employment: Martinić-Art Interiors on the Function of Constructors, Supervisors and Project Managers.
Master's Thesis: 2017. The influence of welding temperature on the strength of a rotational welded joint. Mentor: Assistant Professor Ivica Župčić, PhD.
Awards during the study: Dean's awards for study within the deadline of all completed subjects (2013/2014); Academician Dušan Klepac Award for the Best Graduate Student Degree Design of Wood Products (2015/2016); Academician Milan Anić Award for the best student of the generation, who graduated undergraduate and graduate studies (2016/2017) within the envisaged study programs.; Praise Summa Cum Laude with a score of 4,935.
Significant works, projects and exhibitions: 2015 Ambienta Zagreb: 2 prototypes of classroom tables presented at the fair; 2015 Design Week for Zagreb: Work Desk Prototype for the Project Development of New Products from the Slavonian Oak ; 2016. Design Week Zagreb: Within the Enable Table Lava table prototyp

ANA MIŠETIĆ

Zanimanje: Magistra inženjerka drvne tehnologije - Diplomski studij Oblikovanja proizvoda od drva
Zaposlenje: Hobby Shop - Brković Trade d.o.o. Dubrovnik u funkciji izrade ponuda i tehničke dokumentacije za namještaj po mjeri, trodimenzionalno modeliranje i izrada vizualizacija.
Diplomski rad: 2016. Postojanost poliuretanskog laka iz utekućenog drva pri ubrzanom izlaganju ultraljubičastom zračenju. Mentor Prof. dr. sc. Vlatka Jirouš Rajković
Nagrade tijekom studija: Pohvala *Summa Cum Laude* s ocjenom 4,858.
Značajni radovi, projekti i izložbe: 2016. Tjedan dizajna Zagreb idejno-oblikovno rješenje poličara; 2016 Erasmus+ razmjena, jednosemestralni Eksperimentalni laboratorijski rad na Biotehničkoj fakulteti Sveučilišta u Ljubljani.

Occupation: Master Engineer of Wood Technology – Wood Product Design
Employment: Hobby Shop - Brković Trade Ltd. Dubrovnik in the function of making offers and technical documentation for custom furniture, three-dimensional modeling and visualization.
Master thesis: 2016 Durability of polyurethane varnish from liquefied wood at accelerated exposure to ultraviolet radiation, Mentor: Professor Vlatka Jirouš-Rajković.
Awards during the study: Praise *Summa Cum Laude* with a score of 4,858.
Significant works, projects and exhibitions: 2016. Week of design of Zagreb's: Shelves conceptual-design solution; 2016 Erasmus + exchange, one-semester experimental laboratory work at the Faculty of Biotechnology of the University of Ljubljana.

JARŽA LANA

Zanimanje: Magistra inženjerka drvne tehnologije - Diplomski studij Oblikovanje proizvoda od drva
Zaposlenje: Dizzconcept d.o.o Zagreb, u funkciji izrade ponuda i tehničke dokumentacije za namještaj, trodimenzionalno modeliranje i izrada vizualizacija.
Diplomski rad: 2016. Razvoj drvene radne stolice. Mentor: izv. prof. dr. sc. Silvana Prekrat.
Nagrade tijekom studija: 2016. Rektorova nagrada Sveučilišta u Zagrebu za znanstveno istraživački rad: ˝Lupa˝ ormarić za pohranu uzoraka za prepoznavanje anatomskih karakteristika drva. Mentorica Izv. prof. dr. sc. Silvana Prekrat; Pohvala *Magna Cum Laude* s prosječnom ocjenom studija 4,823.
Značajni radovi, projekti i izložbe: 2016. Međunarodna konferencija A.L.I.C.E. Ljubljana, Principles of sustainable storage furniture, rad u koautorstvu**;** 2015. Tjedan dizajna Zagreb stolić izrađen u suradnji s tvrtkom ˝DrvoTrgovina˝ Projekt idejnih rješenja stola i govornice promocije slavonskog hrasta**;** 2016. Tjedan dizajna Zagreb idejno-oblikovno rješenje nove ksiloteke Šumarskog fakulteta, konferencijski stol od bagremovine za ured Prodekana Šumarskog fakulteta u Zagrebu; 2016. Mjesec oblikovanja Ljubljana: Stol za objedovanje Serious.

Occupation: Master Engineer of Wood Technology – Wood Product Design
Employment: Dizzconcept Ltd Zagreb, in the function of making bids and technical documentation for bending three-dimensional modeling and visualization.
Master thesis: 2016. Development of a wooden working chair. Mentor Associate Professor Silvana Prekrat, PhD**.**
Awards during the study: 2016. *Rector's award* of the University of Zagreb for scientific research work: "Lupa" a storage cabinet for samples to identify the anatomical characteristics of wood. Mentor: Associate Professor Silvana Prekrat, PhD; Praise *Magna Cum Laude* with an average grade of 4,823.
Significant works, projects and exhibitions: 2016 International Conference of A.L.I.C.E. Ljubljana, Principles of Sustainable Storage Furniture, co-operative work Ambienta. 2015 Design Week Zagreb, Coffee table made in cooperation with the company "DrvoTrgovina"; 2016. Design Week Zagreb, Design solution of the new xyloteka for Faculty of Forestry, and conference table made from acacia for the Vice dean Faculty of Forestry in Zagreb; 2016. Month of Design Ljubljana: Dining Table Serious.

Izdavač: Sveučilište u Zagrebu, Šumarski fakultet
Za izdavača: Prof. dr. sc. Vladimir Jambreković
Urednica: Izv. prof. dr. sc. Silvana Prekrat
Grafičko oblikovanje i priprema za tisak:
Ana Hruškar Varović, Denona d. o. o. Zagreb
Prijevod i lektura: SPESS d.o.o.
Tisak: Denona d. o. o. Zagreb
Naklada: 500 kom
Mjesto i datum: Zagreb, 2018.
ISBN 978-953-292-055-0

Publisher: University of Zagreb, Faculty of Forestry
For the publisher: Vladimir Jambreković, PhD, Professor
Editor: Silvana Prekrat, PhD, Associate Professor
Graphic design and preparation: Ana Hruškar Varović,
Denona d. o. o. Zagreb
Translation and proofreading: SPESS
Printing: Denona d. o. o. Zagreb
Edition: 500 copies
Place and date: Zagreb, 2018
ISBN 978-953-292-055-0