

IMPLEMENTATION OF A NEW ELECTIVE TEACHING COURSE IN CIVIL ENGINEERING WITHIN IPA PROJECT

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Abstract: Student participation is an important aspect of teaching. This type of inspiring active learning can be done in many ways, but primarily it comes from encouraging students to work with their classmates, deepen their learning by team work and display their understanding of topics. In an academic school year 2018/2019, within the undergraduate academic studies at the Department of civil engineering and geodesy, 4th year of the Structures program, a new elective course was accredited: Contemporary composites based on agriculture, industry and construction waste. The main goal of the course is understanding the importance of application of waste materials in construction industry in the scope of sustainable development and environmental protection. The course is organized in the way the students are encouraged to be active members of the class, working in groups in laboratory and creating eco-friendly building materials. The outcomes of first two years of the course implementation are briefly presented in this paper.

Key Words: elective course, sustainable development, team work, laboratory, eco-friendly material

1. INTRODUCTION

In an academic school year 2018/2019, in accordance with the Law on Higher Education of the Republic of Serbia, within the undergraduate academic studies at the Department of civil engineering and geodesy, 4th year of the Structures program, a new elective course was accredited: Contemporary composites based on agriculture, industry and construction waste.

The curriculum of the course was created within the project activities of the Eco Build IPA INTERREG project, in order to transfer the acquired knowledge and experience during the implementation of the project to the new generation of civil engineers, which will enable the sustainability of the project results. In addition, this course will contribute to the application of project results in engineering practice after the project implementation period [1].

The main goal of the course is understanding the importance of application of waste materials in construction industry in the scope of sustainable development and environmental protection. Within the course, students will get to know about the availability of waste materials in the world and in Serbia. These materials could be used as a substitution for aggregate or binder in cement composites: pastes, mortars, concretes. Mastering knowledge on the properties and possibilities of application of cement composites based on selected waste materials is one of the main outcomes of the course.

Acquired knowledge from the course is used in engineering practice. Students are competent to select the adequate waste material depending on necessary concrete composite properties. Principles of sustainable development and environmental protection are the modern topics the course incorporates. First classes of the course are dedicated to exploring the availability of waste materials from agriculture, industry and construction in the world and in Serbia and collecting some available materials for laboratory exercises. Production, preparation and testing of basic properties of selected waste materials which are used as aggregate in concrete (crushed bricks, crushed old concrete, expanded glass and alkali activated fly ash) and for substitution of part of cement (fly ash, silica fume and biomass-ashes such as rice husk ash, wheat straw ash, soya straw ash and cob corn ash) are conducted within practical exercises in the Laboratory for testing of materials at the Department of civil engineering and geodesy.

Classes include: lectures, auditory and laboratory practice and consultations. In laboratory exercises, students will design and cast mortar and concrete mixtures and test basic properties of fresh and hardened cement composites, blended with selected waste materials. A part of the practice is used for computing, where students through different tasks connect the presented course content with the construction practice.

Laboratory exercises on the application of collected locally available waste materials include:

- characterization: testing of basic physical and mechanical properties of the material;
- production of eco-friendly building material - composite, containing a large amount of waste material.

The outcomes of first two years of the course implementation are briefly presented in this paper.

2. IMPLEMENTATION OF NEW ELECTIVE COURSE IN THE TEACHING PROCESS

Up till now, students of three generations had an opportunity to choose and attend the classes within the new course, among 4 available elective courses. Based on their selection, it can be stated that there is a growing interest

on the new course. Numbers of students attending the course per year, as well as the percentage share of the new course are presented in Table 1.

Table 1. Numbers of students attending the course per year

School year	Total number of student in 4 th academic year	Number of students attending the new course	Percentage share of the new course
2018/19	55	16	29,1%
2019/20	48	14	29,2%
2020/21	35	15	42,9%

All students of generations: 2018/19 and 2019/20 have already passed the course and its exam successfully.

Students of the first generation, when the course was implemented, have gone through detailed laboratory experimental programme and created their own modern eco-friendly composites composed of different waste materials from AP Vojvodina - Figure 1-2. Students, divided in three groups, were given semester tasks with the goal to produce eco-friendly building product, by using selected waste material, test its mechanical, physical and eco properties and compare them with the properties of traditional cement-based materials. These eco composites were produced from locally available biomass ashes: wheat and soya straw based materials. During the whole semester, students got the instructions and consultations by teaching professors and assistant and, with the little help of lab technician, actively worked independently in laboratory, trying to create adequate waste-based civil engineering product. At the end of semester, based on the laboratory work and obtained results, students prepared and presented their work and got the feedback and grades from professors - Figure 3.

One group of students was chosen to participate at the international student conference CoNStruction in November 2019 and share their gained knowledge and results to the wider audience of students from the country and abroad - Figure 4. In this way, students published their first scientific paper in the Proceedings of an international conference and enriched their curriculum vitarum.



Figures 1-2. Laboratory preparation of modern eco friendly building materials



Figure 3. Semester defence of laboratory work



Figure 4. Participance of the students on the international student conference CoNStruction

Due to the corona outbreak, second generation of students was unable to carry out the whole planned experimental programme, as only three weeks were predicted for laboratory exercises. Nevertheless, the students completed their reduced semester tasks successfully and presented the results to the teachers in the safe conditions - Figure 5-8.



Figure 5-6. Laboratory preparation of modern eco friendly building materials



Figures 7-8. Semester defence of laboratory work

All these activities offered opportunities for students to learn the values of teamwork, individual and group responsibility, competition, diversity, and a sense of culture and community. In addition, presenting their own work to other people publicly (extracurricular activities) may increase students' sense of engagement or attachment to their faculty and, consequently, contribute to higher grades and lead to their greater success further in the teaching process.

The main goal of the course has been achieved, as the students were encouraged to be active members of the class, thinking on their own, using their brains, resulting in long-term memory retention. Not only the students' knowledge is improved, but their interest, strength, knowledge, team spirit and freedom of expression is increased, as well.

In aiming for full engagement of the students, it was also essential that they perceive activities as being meaningful, hence the course should've produced some product and it was a created eco building composite, with the satisfactory properties, comparable with the properties of traditional materials. To strengthen students' sense of competence in learning activities, in the first year of the course implementation, the best semester work was awarded by providing participation and publishing scientific paper in an international conference.

3. CONCLUSIONS

This paper briefly described the two-year implementation of a new elective course, accredited within the undergraduate academic studies at the Department of civil engineering and geodesy, at the 4th year of the Structures program: Contemporary composites based on agriculture, industry and construction waste. The course was introduced via IPA CBC Interreg project Croatia-Serbia: Agricultural Waste – Challenges and Business Opportunities (Eco Build).

The main goal of the course is understanding the importance of application of waste materials in construction industry in the scope of sustainable development and environmental protection. Within the course, students get to know about the availability of waste materials in the world and in Serbia. These materials could be used as a substitution for aggregate or binder in cement composites: pastes, mortars, concretes. Mastering knowledge on the properties and possibilities of application of cement composites based on selected waste materials is one of the main outcomes of the course.

Within the course, professors enhance the students' motivation by giving them a prominent voice in learning activities. Students work in groups in laboratory trying to solve given problems, with the guidance of the professors and present their semester work to the audience. Based on the two-year experience of the course implementation, it can be stated that this kind of active learning got students actively engaged with what they are studying; they tend to understand more, learn more, remember more, enjoy it more and be more able to appreciate the relevance of what they have learned.

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4. REFERENCES

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