CONSERVATION ENGINEERING: INNOVATIONS FOR BIODIVERSITY-FRIENDLY CONSTRUCTION

Abstract. Against the backdrop of the biodiversity crisis, the construction, transport and infrastructure industries are called upon to develop and implement construction methods that are as compatible with nature as possible. We feature five experiments and prototypes to illustrate how these new challenges can be met. The examples are the final student projects of a new training course for "Conservation Engineer" at Carinthia University of Applied Sciences. The projects range from biodiversity-safe design and construction to structural elements of façade design, a roof or a concrete structure. Biodiversity-enhancing elements can be placed on balconies and gardens, in public open spaces and in open landscapes. Even facility management offers far-reaching opportunities to promote natural development and biodiversity. These examples show the types of technical and entrepreneurial possibilities that are already available in the field of conservation engineering.

Keywords: Nature conservation, civil engineering, conservation engineer, eco-innovation, prototypes, entrepreneurship.

1 INTRODUCTION

The climate and biodiversity crises are closely intertwined and are considered major societal challenges of the 21st century. All economic sectors and all areas of society are called upon to make their contributions to improve the situation. Among many other activities, the global Business and Biodiversity Initiative of the IUCN - International Union for Conservation of Nature (https://www.iucn.org/theme/business-and-biodiversity) aims to 1.) value biodiversity in business; 2.) deliver net gain of biodiversity; and 3.) invest in nature.

If the activities of companies and industries are to go beyond Corporate social responsibility and Public relations measures, tremendous competence and expertise will be required. New training formats, job profiles and professional fields need to be defined and developed. The Carinthia University of Applied Sciences (CUAS) has developed a new training programme for conservation engineers in the field of civil engineering. This educational offer was first launched in 2017. It aims to deliver the technical, ecological and legal bases that are necessary to efficiently and cost-effectively implement nature conservation in construction sites, infrastructure projects and business development. Thus, a new professional field was developed in this emerging sector. The main technical principles are presented in the Handbook on Conservation Engineering ("Handbuch Naturschutzfachkraft", [1]). The book

also includes a comprehensive overview of the literature, which is not included in this article due to lack of space. The training is conducted equally by teachers from science and industry. The innovations presented here were developed under this framework of instruction.

2 METHODS

The Conservation Engineer study programme is designed for students with previous education and relevant professional experience. Through coursework with different teachers, applied approaches and problems from practice, they are gradually guided towards an applied final project. The practical partner of the course, E.C.O. Institute of Ecology is an ecological consulting and planning company that provides a regularly updated catalogue of topics. The final student project must be a practical solution, a real measure that is implemented in construction, an experiment or the development of a prototypical solution. The results are made publicly available in a brochure [2] [3] [4]. They also help to illustrate the formation and identity of the new professional field.

3 INNOVATIVE PROTOTYPES

3.1 SNOW-MAKING RESERVOIRS: FLOATING ISLANDS FOR BIODIVERSITY

Artificial snowmaking and the necessary infrastructure sometimes pose considerable ecological problems. Artificial reservoirs are problematic because the fluctuating water level and concrete design make them inhospitable spaces. Wildlife expert **Marc Trattnig** developed and tested floating micro-islands that can be placed in the reservoirs. *Floasity* can either be planted or equipped with an appropriate substrate and left to natural succession (Figure 1). In his project, wood and concrete were tested for the floats. The wooden island modules were covered with coconut fabric into which humus and a seed mixture were placed. The module was successfully tested in a water basin. For the concrete islands a mixture with light-weight additives such as expanded clay or perlite was used. In contrast to the wooden version, the light-weight concrete version requires further tests to achieve the necessary qualities. The concept proves to be very useful in snow-making reservoirs and is transferable to a number of other artificial water bodies (Trattnig in [2]).

Figure 1. Design and test of Floasity (Photos: Marc Trattnig)

3.2 FAÇADE DESIGN: COMPROMSING WITH THE GREAT SPOTTED WOODPECKER

By nature, the Great Spotted Woodpecker uses soft rotting wood to build its breeding cavity. If this is not available, it looks for alternative possibilities on house façades and can cause considerable damage. It prefers polystyrene façades with a rough plastered surface. The rough structure of the plaster resembles tree bark. The insulation material Styrofoam has a similar texture to rotten wood, and its hollow sound resembles that of rotten wood. The damage that the woodpecker causes to the plaster allows moisture to penetrate the insulation layer of the house. Painter **Nadine Edlinger**'s experiment aims to offer the woodpecker an alternative nesting opportunity. Her *mini façade* consists of a rectangular wooden frame and a back wall (Figure 2). The frame is filled with polystyrene and the front is plastered. The woodpecker can nest in the mini façade without damaging the house façade. To prevent the woodpecker from making further holes in the façade outside the *mini façade*, it is necessary to distract the bird by repellent spirals or anything that glitters, reflects, moves and makes noise (Edlinger in [4]).

Figure 2: Design and test of the alternative mini façade (Photos: Nadine Edlinger).

3.3 BALCONIES AND GARDENS: LASER-CUT INSECT HOTEL KIT

About 54,000 animal species live in Austria, and over 98% of them are insects or arachnids. When it comes to species protection, these animals must not be disregarded. Yet, for many people, insects cause more disgust than admiration. So how can we promote this unpopular group of animals? The best way is to start with the very young and take away their fear of spiders, wasps, hornets and other arthropods. In this context, **Tadeja Mischkulnig**, student of construction engineering, developed a custom insect hotel kit (Figure 3). It is made of laser-cut plywood plates. The individual parts are quickly assembled to form a nesting aid. The small nesting aid can find a place on every balcony and can be extended on all sides due to its hexagonal shape. Even if this measure cannot stop the extinction of species, it at least conveys to people how important it is to treat nature responsibly. Maybe it will even make some people rethink their English lawns and tidy gardens (Mischkulnig in [4]).

Figure 3: Concept and design of the insect hotel kit (Photos: Tadeja Mischkulnig).

3.4 CONCRETE SURFACES: INCREASED PASSABILITY FOR WALL LIZARDS

Wall lizards inhabit sunny rocks, scree slopes, stony grasslands, gravel banks along rivers and a multitude of built structures. However, if these structures have smooth, vertical surfaces, they can become insurmountable obstacles for the lizards, and the areas for reproduction and foraging can no longer be reached. The zoologist **Lukas Köstenberger** investigated the extent to which the wall lizards' climbing skills are sufficient to overcome concreted vertical surfaces (Figure 4). For the pilot test, three slabs with different surface textures were produced and integrated into a semi-natural experimental area. Here the wall lizards proved their excellent climbing skills and moved easily on the smooth surfaces in a vertical and also horizontal direction. This indicates that smooth concrete surfaces over small areas do not represent a barrier for wall lizards. However, if large areas of drystone walls are grouted or concreted, valuable habitat with hiding places and winter quarters is lost (Köstenberger in [3]).

Figure 4: Experiment on passability of different concrete surfaces for wall lizards (Photos: Lukas Köstenberger).

3.5 HIGH-VOLTAGE PYLONS: CONSTRUCTION OF BAT-HOUSES

Old attics and beams are valuable habitats for certain bat species. These are increasingly being closed off or renovated and can no longer be used by bats. An alternative can be the "Bat House" that was developed by civil engineer **Patrick Rupp** (Figure 5). In his work for an Austrian electricity provider, Patrick is responsible for the maintenance of high-voltage power lines. In the process, high-voltage pylons can be used to construct bat houses. Appropriate static and safety aspects must of course be considered. To ensure that the bat house is accepted by the flying animals, the right location and the right habitat must be identified. The house should be at least four metres above the ground so that the bats are protected from natural enemies. If the surroundings of the pylons can be upgraded ecologically, new green infrastructures can be developed (Rupp in [2]).

Figure 5: Conceptualising bat-houses in high-voltage pylons (Photos and sketches: Patrick Rupp).

4 CONCLUSION

This limited selection of technical innovations shows the potential of conservation engineering to address the range of conflicts between nature conservation and civil engineering. The need for innovation, as well as the potential economic opportunities for solutions, are gradually becoming visible. CUAS, as an organisation focusing on real-world application of technologies and solutions, is the perfect institution to promote and support such developments and efforts. Finally, the authors emphasise that experiments involving protected species may only be carried out under precise conditions and with the approval of the respective authorities. Harm to plants and animals must be avoided in all situations.

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