Architecture Master's Thesis Call for 2024-2025

HABITAT WEAVES: Adaptive Architectural Skins for Local Biodiversity Boost in Urban Areas

start: November 2023

duration: eight months and possible follow-up for 2 years

supervisor: Milena Stavric,

co-supervisors/ institutions: Asya Ilgün / PhD candidate at the IAM, TU Graz
Artificial Life Lab, Inst. of Biology, Uni Graz)

deadline for the application: 15.10.2023

application on: mstavric@tugraz.at and zeliha.ilgun@uni-graz.at

Project description:

In recent years, numerous countries have increasingly turned their focus towards biodiversity within urban planning, emphasising interdisciplinary collaboration. A noteworthy development in this regard is the ÖNORM regulation in Austria, specifically addressing the integration of vertical greenery into urban landscapes. This regulation underscores the manifold advantages of well-designed vertical greenery, notably its potential to activate underutilised urban spaces with multifunctional surfaces. Such surfaces serve the dual purpose of augmenting biodiversity and mitigating the ecological impact of green space loss due to urban development. **This master's thesis seeks to explore the creation of adaptive architectural models that can address these objectives by transforming neglected urban areas into microclimatic environments suitable for the flourishing of native wildflowers and insect populations, particularly wild bees.**

Throughout the master's thesis journey, in addition to supervision, the student will be an important part of the research team "Habitat Weaves", an international and international research project that is expected to start in the spring of 2024 and last until the end of 2025. The collaborative team includes Asya Ilgün (Artifical Life Lab[1], Uni Graz and IAM, TU Graz) and Phil Ayres[2] (Chair of Biohbyrid Architecture, Royal Danish Academy), Ove Mattman (microbiologist and biodesigner based in Zürich), Phänomena[3](curatorial team and local insect experts who are actively engaged in the development of the large-scale demonstration of an experimental structure. This structure will be a part of the Phänomena Biodiversity Lab, scheduled for installation in spring 2025, in Dietikon, Switzerland. international and interdisciplinary team for regular progress discussions. Pending successful funding, there exists the prospect of continued involvement in this project following the completion of the master's thesis. This master's thesis offers an exceptional opportunity for an aspiring architecture student to contribute significantly to the advancement of architectural practices that harmonise with nature, enhance biodiversity, and address ecological challenges in urban environments.

The thesis will follow a structured approach, comprising the following phases:

Phase 1: Theory and Context

During the first phase, the student will carry out

[1] https://alife.uni-graz.at/
[2] https://adk.elsevierpure.com/en/persons/phil-ayres
[3] https://www.phaenomena.ch/erlebnis-biodiversitaet

- a literature review on ecosystem-oriented design, emphasising the current need to maintain insect ecosystems in designed and/or built environments for and understanding the importance of building materials in maintaining urban ecosystems.
- site investigation in the city of Graz to engage with and document the introduced parks and accidental ecosystems (spaces left over after planning- SLOAPs)using multi-media methods such as photography, filming, drawing, iNaturalist (citizen science for biodiversity research), and alternative methods if desired.
- identify areas in the city of Graz that could benefit from an architectural intervention by learning about and observing what other species require in terms of spatial and material related factors, as well as nutritional resources in cities.
- attending tutorials on material-led design methods, biodesign and biofabrication as research direction in the architectural building and thinking for reducing biodiversity loss caused by present urbanisation practises
- consider how digital technology might aid in the design and construction of habitats that serve both non-human and human needs in a variety of ways.
- Submit a 2-pages descriptive essay on their findings.

During this phase, the supervisors will provide additional reading (or watching) material as well as necessary connections to local experts on the topics of ecology, biodiversity, insect ecology, botany, and horticulture.

Phase 2: Prototyping and Geometry Exploration

The study will begin the geometrical investigation phase after establishing the ground knowledge and settling on their potential intervention spots. Habitat Weaves proposes geometrical and manufacturing techniques for constructing thick scaffolding in which other living species can thrive. As a result, the student will have a framework from which they can establish their design method. The inspiration for these prototypes will be derived from the intricate geometries found in skin cells, including recently discovered Scutoid patterns. These prototypes will be designed to self-support including the additional loads which can occur during the lifetime of the structure. The core of this thesis is hands-on prototyping and testing of 1:1 models with the aim of discovering the structural design possibilities, as the structural design of these experimental designs is critical for the safety of the inhabitants, as well as the potential to upscale the assembly to architectural scale, such as façade installations, garden walls, urban furniture, and more. This process will be facilitated by the digital workshop at the Institute of Architecture and Media (IAM), utilizing techniques such as additive manufacturing or casting.

Phase 3: Parametric Modelling and Fabrication

Building upon the lessons learned from the initial prototypes, the study will progress to develop an adaptive three-dimensional parametric model using Rhinoceros3D and its plugin Grasshopper3D. This model will be fine-tuned to accommodate specific fabrication parameters and adapt to diverse urban contexts. The primary focus of fabrication methods will centre around clay 3D printing and large-scale biopolymer 3D printing.

Phase 4: Architectural Demonstration

The culmination of this research will involve identifying suitable urban spaces within the city centre of Graz, Austria, for architectural interventions. Here, the focus and challenge will be integrating local ecosystem-related interactions and site related parameters into the 3D model and form. Subsequently, during the spring of 2024, the model's performance will be tested in the city of Graz, with a particular emphasis on its ecological impact.