Hyperbody Non-Standard and Interactive Architecture

MSc3 Adaptive Architecture

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Introduction

Adaptive Architecture - Design driven change

Architectural praxis is in continuous change. The introduction of new drafting techniques, new products, new movements in architecture, new policy demands are open-ended dynamic developments. The field of operation is shifting from local and national to global and trans-national, professionals are on the move. Buildings have to keep performing in changing circumstances of both environmental and cultural context. The current call for sustainable building can be interpreted as the need for buildings which will not have to change at all, yet still they have to withstand change, and will eventually have to change themselves to sustain and do so in a sustainable manner as well.

Buildings remodel our environment thus architectural praxis is itself change. Adaptive Architecture is design, specifically dedicated to change. The techniques we apply thus incorporate change: parametric modeling as adaptive drafting technique, File To Factory (F2F) production as adaptive mode of fabrication, the combination of these techniques to reconfigure buildings in open-ended adaptation, real-time interaction as immediate adaptation of the building body. All these technical foundations introduce an openness to change which calls for novel structural adaptive design approaches.

Adaptive Architecture can thus be seen as architecture that handles changes at multiple spatial and temporal scales, in diverse areas of architectural praxis. We believe the most effective way to achieve this is to introduce design-driven active adaptation. Beyond adaptation as mere mechanistic response to technical necessities, we want to design architecture that plays an active role in introducing changes, towards its internal and external environment. Hyperbody's MSc3 studio is a research by design studio which focuses upon developing such actively adaptive design solutions.

A central term to the MSc3 studio's approach is morphogenomics. Morphogenomics, a relatively new research area, deals with the intricacies of morphological informatics. Morphogenomics (from the Greek morphê – shape and genesis – creation) focuses upon the informatics constituent behind the emergence of diverse morphologies. The informatics constituent specifically involves studying the structure, behavior, and interactions of natural and artificial systems that store, process and exchange information. These communicative processes serve as dynamic medium for mapping the morphological genome onto architectural space and structure. An underlying understanding of the material component, an inherent structuring medium of any morphology relates these studies to ways in which information and matter exist in superposition. The design process will thus be based on evolving intrinsic relational models between contextual data, environmental data and morphologies. A deeper understanding of morphogenomics leads to the ability to purposefully create morphogenomic designs that realize a chosen agenda of adaptations.

Design challenge

Adaptation is a principle applicable to individuals as well as to populations, with differences in elaboration though. While individual components or building designs can adapt as draft, in production and in use by changing geometry, assembly, appearance and other properties, an entire population can undergo evolutionary processes, over time and by numbers. Inspirations for applying such evolutions in

design can be the evolutionary processes of biological systems and technical systems. An understanding and application of evolutionary processes: how micro; molecular, organismic, to the macro; cognition and societal levels of self organized behavior results in the creation highly performative and self regulatory systems can thus be aptly seen as the fundamental motivation for creating design-driven adaptation.

Next to evolutionary traits, adaptation always takes place over time. Adaptive Architecture thus requires you to design not only in materials and space but also in time, inspired by the study of diverse models of time and temporalities present in technical and biological systems, and throughout the design process. Think of the wide diversity of lifecycles of the constituents of your own body, and all biological clocks that are running at the same time - day and night, breath, heartbeat, the shedding of your skin cells, the speed of your thought and vision. How a swarm of birds may synchronize their movements and actions in time to simultaneously change movement. Note the importance of not just the *what* and the *how*, but of the *when*, and find out how to apply this knowledge for designing truly adaptive architecture.

The MSc3 studio Adaptive Architecture will thus focus on the following two aspects, Evo-strategies and Design-driven temporalities. These focus points will not only lead the overall groups efforts but also channelize the efforts into two sub-threads, each to be followed by two of the four design teams:
Sub-Thread A: **Evo-strategies,** lead by Nimish Biloria
Sub-Thread B: **Design-driven temporalities,** lead by Christian Friedrich

Design Assignment

The Hyperbody educational assignment for this semester is to design a new building for the faculty of architecture. Addressing different scales, MSc1 and MSc3 students will collaboratively work on this design challenge. While MSc1 students will work on internal 'organs' (e.g. functional entities) within the faculty building, the MSc 3 students will work on the 'skin and bones' of the building.

The MSc 3 students will be divided in four groups, each focused upon a specific adaptive concept for developing four Faculty of Architecture proposals. This dynamic skin, being the largest organ of the building body constitutes the faculty's outer envelope. It may be designed to change its form and topology - open up, collapse locally, form a loop and the like. The bones are the structural support of the building. As such they can be either an exo-skeleton integrated into the skin, or distinct entities which pierce and structure the interior, stretching the volume of the faculty building. The adaptive behaviors of your design can be from being kinetic in nature and serve as essential real-time contextual response systems for the proposed faculty designs. In any case the skin not only demands the development of an active interaction pattern with the global context (weather, sunlight, wind, water) but also needs to perform optimally at a local level (interaction with the occupants). The skin could thus take up the form of an active communication membrane which adapts its topology and behavioral profile to best serve the interactive cause for which it was conceived. Similarly, the bones operate on both the exterior and the interior of the building.

The MSc 1 students on the other hand will be developing the Faculty's organs (functional entities which would fit within the zones designed by the MSc 3). A collaboration between the two Masters studios is mandatory in order to develop dynamic relationships between the dynamic skins + bones and the functional organs to develop a holistic design. MSc3 and MSc1 teams are to operate as complementary of each other. They should thus deliver two non-overlapping parts of complete faculty designs which connect to be more than arbitrary combinations of their parts but form a holistic architectural designs. The design interactions between the complementary teams will neither operate top-down nor bottom-up but as a 'balance of forces'. A rule of thumb is that at no time you should wait for the input of your collaborators, yet at any time you have to react to your team-members and the complementary team.

Studio Stages

At the end of each stage, the corresponding tasks should be completed.

Week 1-5 | Stage 1: Concept (abstract machines)
In the first weeks, you will follow introductory lectures and become acquainted with theory and techniques of adaptive architecture. Within this time, you will also develop with your teammates a vision of your design goal, and formulate and build accordingly an 'abstract machine', which is an operational diagram which combines the architectural concept of your design with its parameterization. All these elements should be finalized by the end of this stage, so you can continue with the next steps on a solid foundation.

Week 6-11 | Stage 2 : Parametric design (associative models)
In the second stage, you will start to apply your gained knowledge of parametric techniques to model your design as application of the abstract machine and find shape languages and relations of features which should ensure that within your parametric plan your original concept and vision can be achieved, even in changing circumstances. Changing circumstances will be provided even within the design studio, as you have to find a common design together with your complementary MSc1 team.

Week 12-16 | Stage 3: Integrated Fabrication
The parametric model has to be ready at the beginning of the third stage of the design studio, which is dedicated entirely to fabrication. You will utilize the parametric models to produce with CNC machinery as well fixed models of an adaptation sequence as models which illustrate the real-time interactive aspects of your designs. For this purpose, you will follow workshops in F2F fabrication and interactive tinkering.

Week 16-19 | Stage 4: Presentation
The fourth and last stage of the design you will spend improving all your earlier work and preparing your presentation.

Studio organization

Each Tuesday morning will start with a review of your projects, followed by group discussions and individual meetings with design tutors. Apart from this all students will communicate their design progress via a Design studio blog, which has to be updated every Friday (mandatory) with the latest state of the design projects. The 'hard' data exchange , consisting of a text file, an image and a 3D model, takes place next to the 'soft' exchange within the studio and is to be the main means of communication. The interface is to be minimal but binding. Tutors and other students will comment on your project on-line over the weekend and on Monday. The design review taking place on the following Tuesday will be based on your blog posts.

Every group is thoroughly responsible for developing a Faculty project by collaborating with another group of the MSc 1 studio. The reasoning and defense for choosing the MSc 1 group to collaborate with shall also be a mandatory session for every MSc 3 group.

Your designs will be evaluated based on the groups individual qualities, on their performance in the overall system and, as an additional factor, on your commitment to the design studio activities. In the course of the semester you are obliged to deliver following compulsory material for each of your projects:

- detailed high-resolution 3d representation showing the project and all its features
- detailed drawings of the complete project, including at least a plan, 2 sections, side views and perspective drawings of the complete setup with all relevant details. In case of projects of variable form, several states of it need to be presented
- working interactive/parametric model [preferred] or a detailed flowchart [minimum] of the

designed skins, including relations to all relevant elements of its environment and all possible design conditions

- 500 word project description
- material and structural study
- detailed representation of the stages of collaboration and integration of the Msc 3 project with the Msc 1 project.
- 3d model in .vmo format
- additional material requested by tutors, depending on the specificity of the project