**THE FRINGE**

21st century Schrebergarten

LAGI 2022 Mannheim

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**Chapter 1: DIY Gardening for Everyone**

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**Context, Masterplan**

*Redefining the fringe between the city and the park*

We choose a strip of land on the north side of Spinelli Park, adjacent to the residential area in Mannheim, as the site for the proposal and named the project 'the FRINGE', which refers to both the edge of Spinelli Park, the main site of BUGA23, and the edge of the urban residential area of the city.

In this project we want to blur the boundaries between the artificial and the natural, the public and the private, to redefine the transitional space between the city and the park, and to explore a lifestyle that is compatible with the needs of the individual and the spirit of sharing.

At the same time, through the creative application of renewable energy solutions, the project addresses the dependency of urban public activities on civic electricity system and establishes a sample of sustainability that can live in symbiosis within the urban context.

**Water Tower**

*Reusing a familiar monumental figure of Mannheim*

Taking into account Mannheim's pleasant climate and abundant precipitation in all seasons, water is selected as the most important renewable energy source for this proposal with three water towers installed on the site, whose shape evolved from the building type of traditional water tower.

It is meanwhile a response to two historical landmarks of the city, the Mannheim Water Tower and the telecommunications tower in Luisen Park. Each water tower is topped with a metal bowl that collects and saves rainwater and condensed water vapoured from the air, with a low-adhesion alloy surface.

The water stored at the base of tower can also be pumped to the top to recharge water for the bowl, accumulating initial gravitational potential energy for the water.

**Eco-aqueduct**

*A combination of gravitational energy storage system and skywalk for leisure*

The eco-aqueduct is an analogy of ancient Roman aqueduct, forming the crucial horizontal design element of the proposal. In the past people built aqueducts to transport water for domestic use while in the future a new type of aqueduct is designed to transport energy.

The bottom of the aqueduct is lined with bundles of water pipes originally connected from the sky bowl of the water tower. With the initial velocity generated by gravity, the water inside the pipes flows along the elevated aqueduct in a direction away from the water tower. As it flows, the friction between the water and the inner surface of the water pipes is converted into electricity (triboelectricity), which provides the surrounding gardens with the energy needed for lighting and irrigation.

The eco-aqueduct is used not only to store the waterpipe generators, but also to create a high-line water-friendly platform for local residents and visitors. A skywalk is designed to attach to the elevated aqueduct, installing a pressure-sensitive paving that produces piezoelectricity (converting the pressure generated by people walking into electricity), which supplements the electricity apart from triboelectricity and meanwhile provides auxiliary power for the lift pumps of the water tower.

**Schrebergarten, 2 Types**

*A garden for Everyone*

We intend to define a new type of Schrebergarten that belongs to the 21st century. Traditionally, Schrebergarten were privately owned and locals could lease the land for their own use in perpetuity as needed. A Schrebergarten on the FRINGE could be shared to address the demand of Schrebergarten which exceeds supply at present.

There could be two types, one still open to local residents, where the garden could be rented and maintained by one or more families together. The other could be open to all the public, including the locals, long-term and short-term visitors, inviting everyone to participate in gardening and planting, so that the Schrebergarten, a unique contemporary German symbol of culture and life, can be fully displayed and made known to a wider audience.

The public paths at ground level and the elevated eco-aqueduct together define the boundary between the two types of garden, allowing for a free switch between public and private activities. Accordingly, two types of small houses have been designed, a translucent 'tent' for exclusive use and a fully transparent 'tent' for public use, to meet the needs of local residents and visitors for indoor rest, recreation and social interaction. Unlike traditional Schrebergarten, electricity can be supplied for the new type of Schrebergarten of the 21st century, but only generated from renewable sources on site in order to achieve zero energy consumption for the FRINGE.

**Chapter 2: Collecting Micro Power**

Triboelectricity, Piezoelectricity, and Gravitational Energy Storage System

**Energy Resource from Nature**

*Collecting water and wind power by triboelectric charging*

There is a long history in man’s utilization of hydraulic power, but Mannheim is not a fitting city for building major hydropower stations. Opposite to that, we propose a new way of generating electric power from water movement - triboelectric charging.

As briefly introduced in Chapter 1, along the aqueduct system is bundles of airtight pipes released from the sky bowl of the water tower. With the initial velocity generated by gravity, the water inside the pipes flows along the elevated aqueducts. As it flows, the friction between the water and the inner surface of the water pipes is converted into electricity.

The highest power density can be up to 8.84 μW/cm3.

Wind orientation in Mannheim is specifically north-south most frequent. Also working with triboelectric effect, our idea is to create a kind of kinetic installation that captures wind power. We call it “Wind Chime”.

Technically, it's a nanogenerator that consists of two plastic strips inside a tube that vibrate or slap together when there's airflow. Like a balloon rubbed against your hair, the two pieces of plastic become charged when they separate, a phenomenon known as the triboelectric effect. The electricity generated by the two strips of plastic is captured and stored.

A breeze of 1.6 m/s is enough to power the triboelectric nanogenerator of the design.

The nanogenerators performed best when wind speeds were between 4 and 8 meters per second, which allowed the two plastic bands to swing in sync.

**Human as Resource**

*Generating electricity from human daily activities*

We design the hard paving surface of the skywalk bridge as piezoelectric nanogenerator that generates electricity from stepping pressure. Piezoelectric generators are inserted into the walkway pavers to harvest the energy of walking or jumping.

Civilians are encouraged to make good use of the skywalk for leisure. At the same time, their day activities become resources of clean energy.

Series of wind chimes are placed along walk ways. Apart from natural wind power, they can also capture micro wind caused by human passing by - gardener’s interactions between neighbor schrebergarten plots, and also movements from walk ways. This is an additional application of triboelectric nanogenerators.

**Gravitational Energy Storage System**

*Dealing with the load difference between peak and valley*

The general system we propose is two folds - one system collects micro power of wind and human movement during the day, the other stores and releases electricity power during the night.

We design the latter as a gravitational energy storage system that functions via water transformation. The energy generated by the aforementioned system during daytime can be stored by the mechanism of pumping water up to the top container of the three water towers.

This is a modern version of pumped-hydro energy storage system. The bowl shape container at the top works also as a collector of rain water and condensed water vapoured from the air.

Water released from the tower, runs through series of round airtight pipes, reaches the water collector at the end of skywalk. Such water, together with rainwater harvested from hard paving landscape, return back to the container at the base of the three water towers.

**Chapter 3: Environmental Impact Summary**

Material, Construction, and Energy

**Lightweight Materials and Prefabrication**

The site following its former use as U.S. Military’s Spinelli Barracks, deserves more careful human input than ever before. In our mind, the majority of the land will be renatured with trees and soft landscapes, whereas only the FRINGE between the city and the park is designated to accommodate human activities.

In the zone of the FRINGE, we consider construction activities on site as minimal as possible. Most structure members for the skywalk and water tower are made out of high-stressed steel in factories, and then assembled on site. The same principle goes to the making of schrebergarten tents, for which lightweight materials such as timber and polycarbonate are particularly considered fitting.

Paving materials for walkways and the skywalk shall also be locally sourced and prefabricated.

**Energy Storage and Supply**

Below chart indicates estimated energy generated and stored PER YEAR by our proposal.

|  |  |  |  |
| --- | --- | --- | --- |
| Type | Energy Generated per Unit | Quantity | Total |
| Wind Triboelectric | 45000W/m2/Y | 1000m2 | 45MW |
| Water Triboelectric | 23000W/m3/Y | 10000m3 | 230MW |
| Piezoelectric | 48000W/m2/Y | 2500m2 | 120MW |