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SCERIN-10 Workshop on Earth System Observations

Challenges and Opportunities for Urban Ecosystem Design:
Addressing Climate Change Through Architecture and Urban Planning

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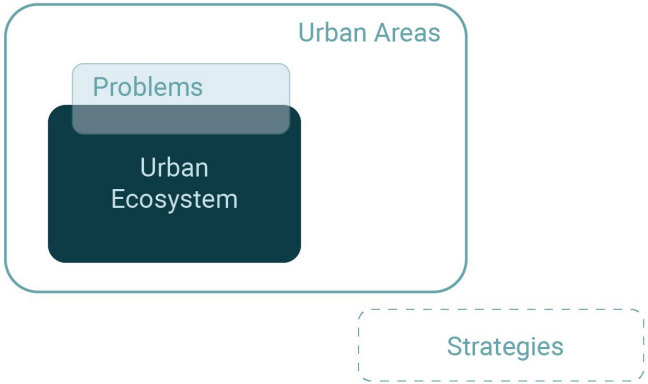

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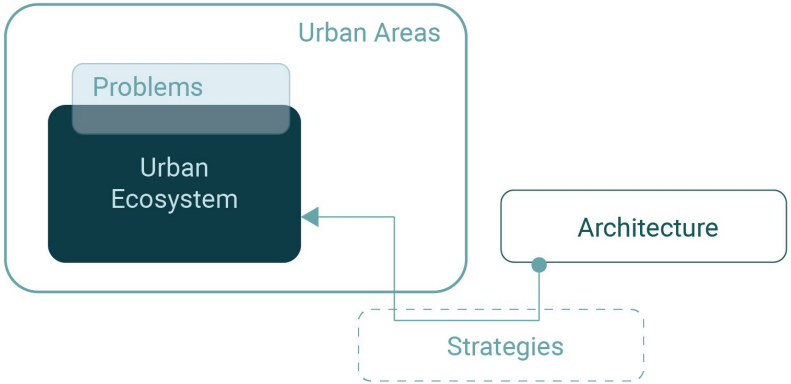

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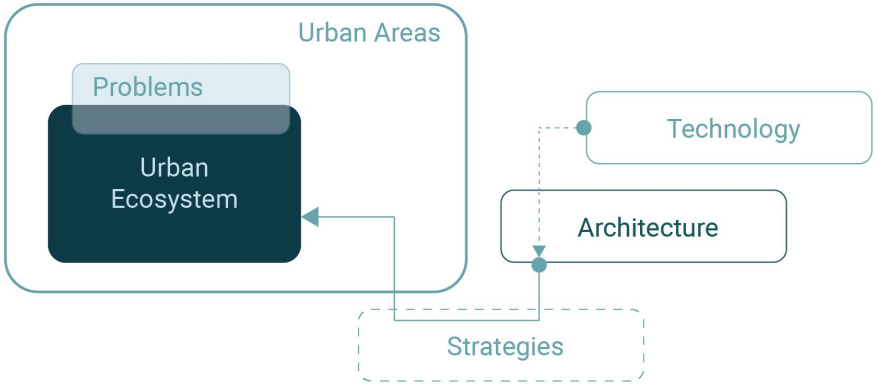

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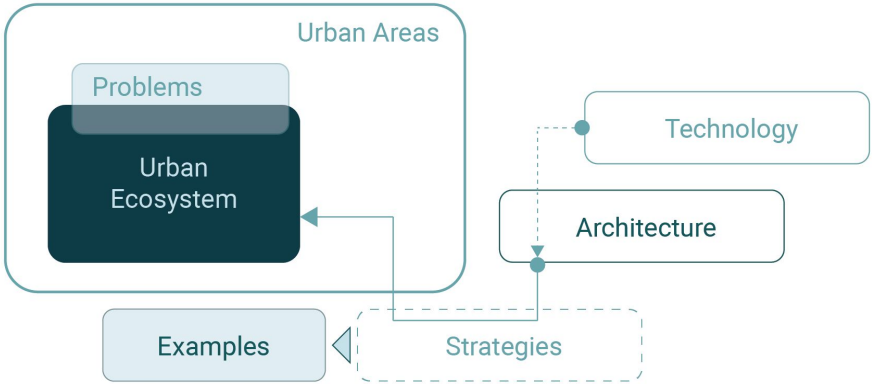

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Main problems for urban areas

There are several main problems that urban areas have to face recently from the point of architecture and urban planning in light of the climate crisis:

1. Urban Heat Island Effect
2. Flooding
3. Urban Sprawl
4. Energy Consumption
5. Air Pollution

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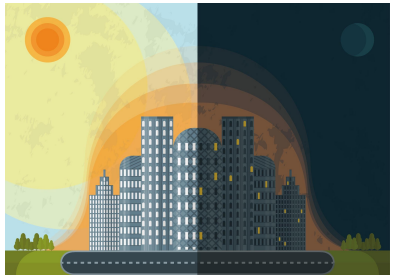

As cities grow and expand, they create what is known as an "urban heat island." This phenomenon occurs when the built environment absorbs and retains heat, causing temperatures to rise higher than in surrounding rural areas. UHIs can lead to health problems, such as heat stroke and increased energy consumption for air conditioning.

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2. **Flooding**
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With climate change comes more frequent and intense weather events, including floods. This is a significant problem for urban settlements, particularly those built in low-lying or flood-prone areas. Improper drainage systems and urbanization can exacerbate flooding and cause severe damage to buildings and infrastructure.

Main Problems for Urban Areas

There are several main problems that urban areas have to face recently from the point of architecture and urban planning in light of the climate crisis:

1. Urban Heat Island Effect
2. Flooding
3. **Urban Sprawl**
4. Energy Consumption
5. Air Pollution

Rapid urbanization has led to unplanned expansion and sprawling urban areas. This type of development can increase transportation demand, energy use, and greenhouse gas emissions. It also leads to a loss of natural habitats and biodiversity.

There are several main problems that urban areas have to face recently from the point of architecture and urban planning in light of the climate crisis:

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2. Flooding
3. Urban Sprawl
4. **Energy Consumption**
5. Air Pollution

Buildings account for significant energy consumption in towns. Poorly designed buildings and infrastructure can contribute to unnecessary energy use and greenhouse gas emissions.

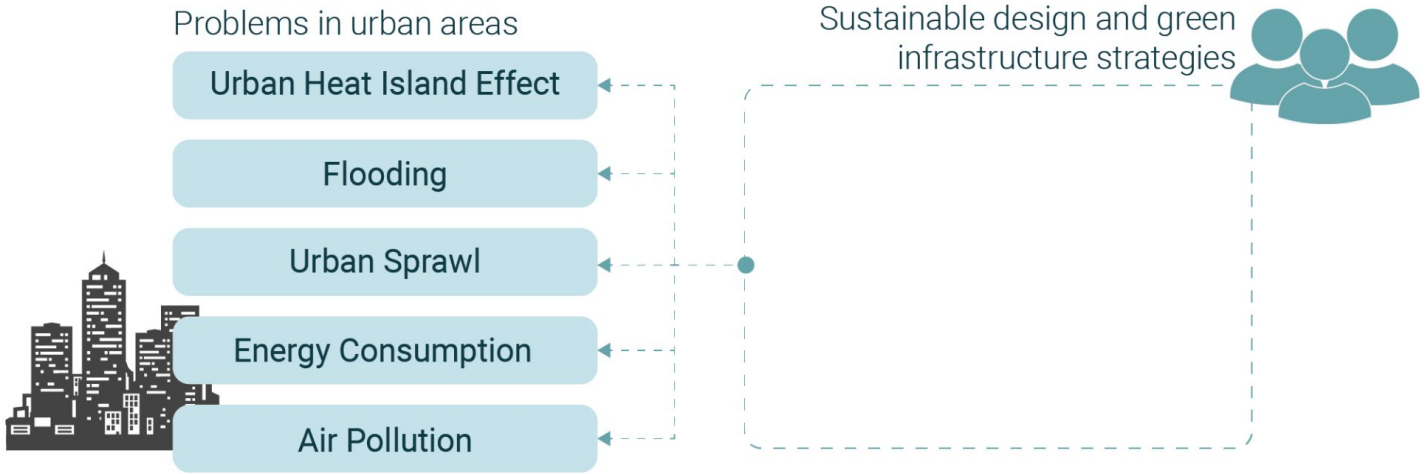
There are several main problems that urban areas have to face recently from the point of architecture and urban planning in light of the climate crisis:

1. Urban Heat Island Effect
2. Flooding
3. Urban Sprawl
4. Energy Consumption
5. **Air Pollution**

Traffic congestion and building emissions can lead to increased air pollution, negatively affecting human health.

Problems in urban areas

- Urban Heat Island Effect
- Flooding
- Urban Sprawl
- Energy Consumption
- Air Pollution


Problems in urban areas
Urban Heat Island Effect
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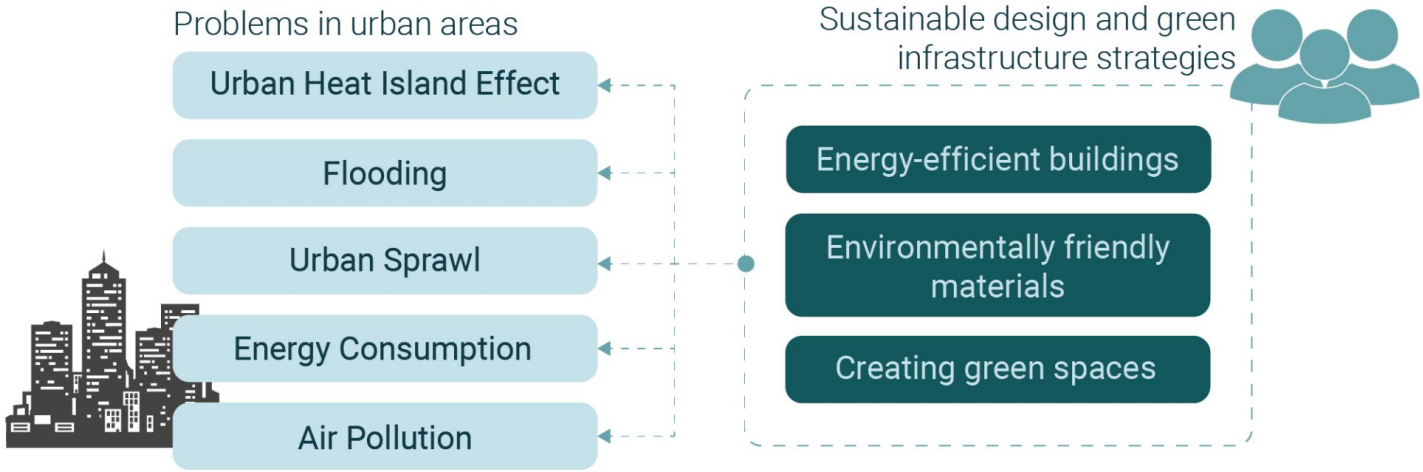
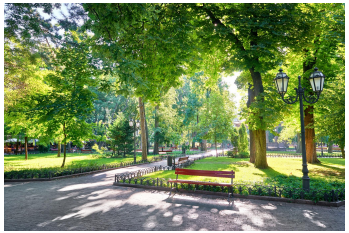
Sustainable design and green infrastructure strategies


Problems in urban areas
Urban Heat Island Effect
Flooding
Urban Sprawl
Energy Consumption
Air Pollution
Sustainable design and green infrastructure strategies
Energy-efficient buildings
Environmentally friendly materials
Creating green spaces

HOWEVER,

General strategies applicable for urban areas have to be carefully considered when it comes to urban ecosystems



Urban ecosystems

interconnected system of living and nonliving components within an urban environment, including plants, animals, humans, buildings, infrastructure, and natural systems.

Urban ecosystems are closely interconnected with urban areas, as they **exist within and alongside the built environment of cities**, providing numerous benefits to cities and their inhabitants.

Recognizing and preserving these connections is crucial for sustainable urban development and enhancing the overall resilience and livability of cities.

A few examples of the types of urban ecosystems that can be found in urban areas:

- Parks and Green Spaces
- Urban Forests
- Riparian Zones
- Rooftop Gardens and Green Roofs
- Urban Wetlands
- Urban Agriculture
- Brownfields and Vacant Lots

The specific characteristics and composition of urban ecosystems vary depending on the geographical location, climate, and level of human intervention in each city.

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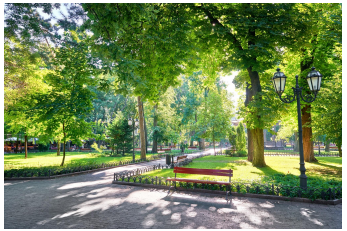

Urban parks, gardens, and green spaces are vital components of urban ecosystems. They often consist of landscaped areas, trees, lawns, and recreational facilities. These spaces provide habitats for various plant and animal species, contribute to biodiversity, and offer recreational opportunities for residents.

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Riparian zones are ecosystems that occur along the banks of rivers, streams, and other water bodies within urban areas. These areas can support a diverse range of plant and animal species, including wetland vegetation and aquatic life. Riparian zones help improve water quality, control erosion, and provide habitats for wildlife.

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Urban agriculture involves the cultivation of crops and the raising of animals within urban areas. Community gardens, rooftop farms, and vertical farming systems are examples of urban agriculture. These ecosystems provide local food production, promote sustainable farming practices, and contribute to food security in cities.

Role of Architecture

The challenges and opportunities for sustainable urban ecosystems significantly impact the field of architecture. Here's how:

- Sustainable Design Principles
- Resilient Building Design
- Urban Heat Island Mitigation
- Integration of Green Spaces
- Adaptive Reuse and Retrofitting
- Collaboration with Urban Planners
- Integration of Technology
- Education and Advocacy

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Incorporating strategies to mitigate risks such as extreme weather events, rising temperatures, and sea-level rise. For example, designing structures with flood-resistant features, elevated foundations, and resilient materials can enhance the building's ability to withstand climate-related challenges.

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Mitigating the urban heat island effect by incorporating green infrastructure and using materials with high solar reflectance. Design strategies such as green roofs, vertical gardens, and increased vegetation can help reduce heat absorption, improve air quality, and create more comfortable microclimates within urban areas.

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Instead of demolishing structures, architects can find innovative ways to repurpose and upgrade them to be more energy-efficient and sustainable. This approach reduces construction waste, preserves cultural heritage, and promotes sustainable urban regeneration.

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- **Integration of Technology**
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Integrating technology into the designs. This includes using advanced modeling and simulation tools to optimize building performance, incorporating smart technologies for energy management, and integrating IoT systems for efficient resource use and building automation.

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- **Education and Advocacy**

Educating clients, stakeholders, and the public about the importance of sustainable design. By advocating for sustainable practices and sharing their knowledge, architects can drive positive change and encourage the adoption of sustainable architecture principles at a broader scale.

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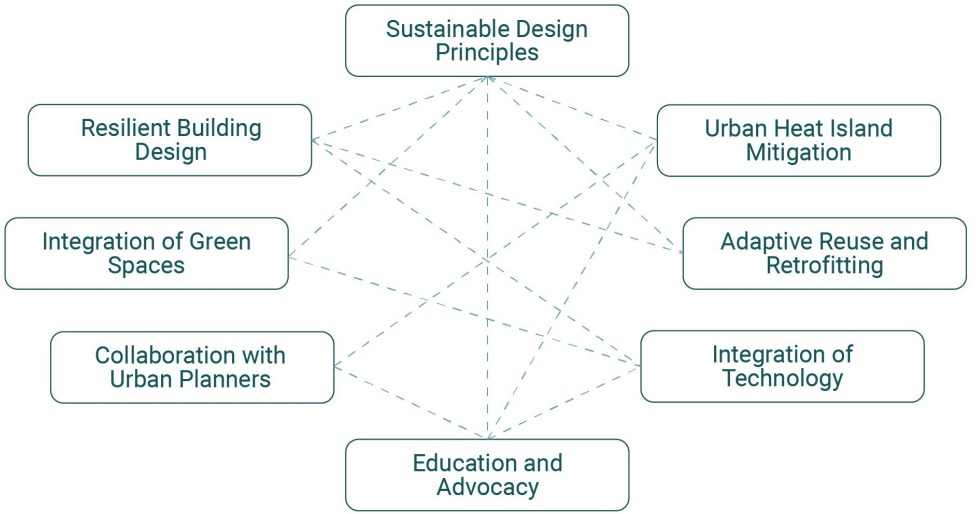

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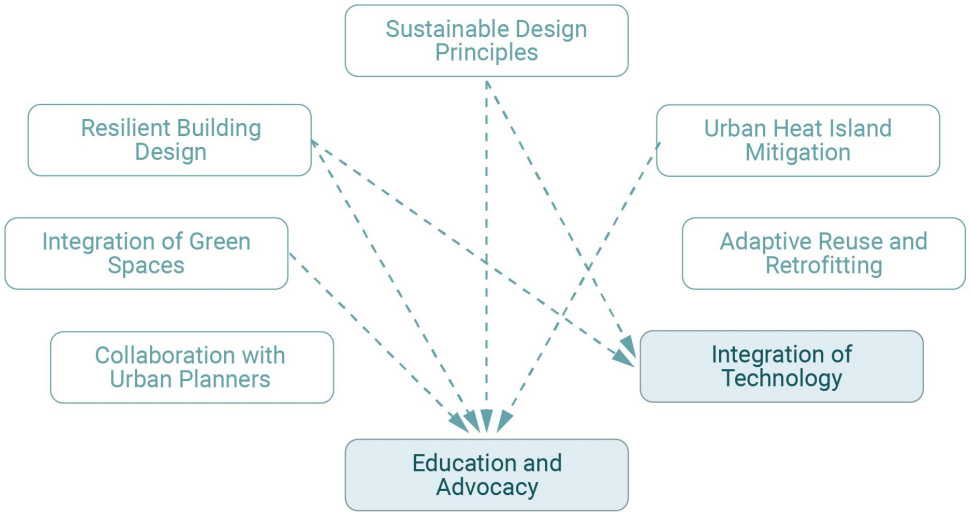

Technology for urban ecosystems

Technology plays a significant role in empowering architects to design and create sustainable urban ecosystems. Here are some ways technology can help architects in this context:

- Building Information Modeling (BIM)
- Energy Analysis and Simulation
- Sustainable Material Selection
- Environmental Sensors and IoT Integration
- Virtual and Augmented Reality
- Computational Design and Parametric Modeling
- Digital Collaboration and Communication
- Data-Driven Design Decisions

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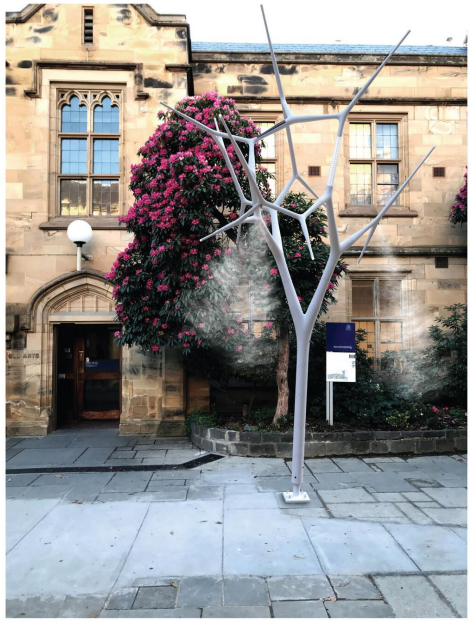
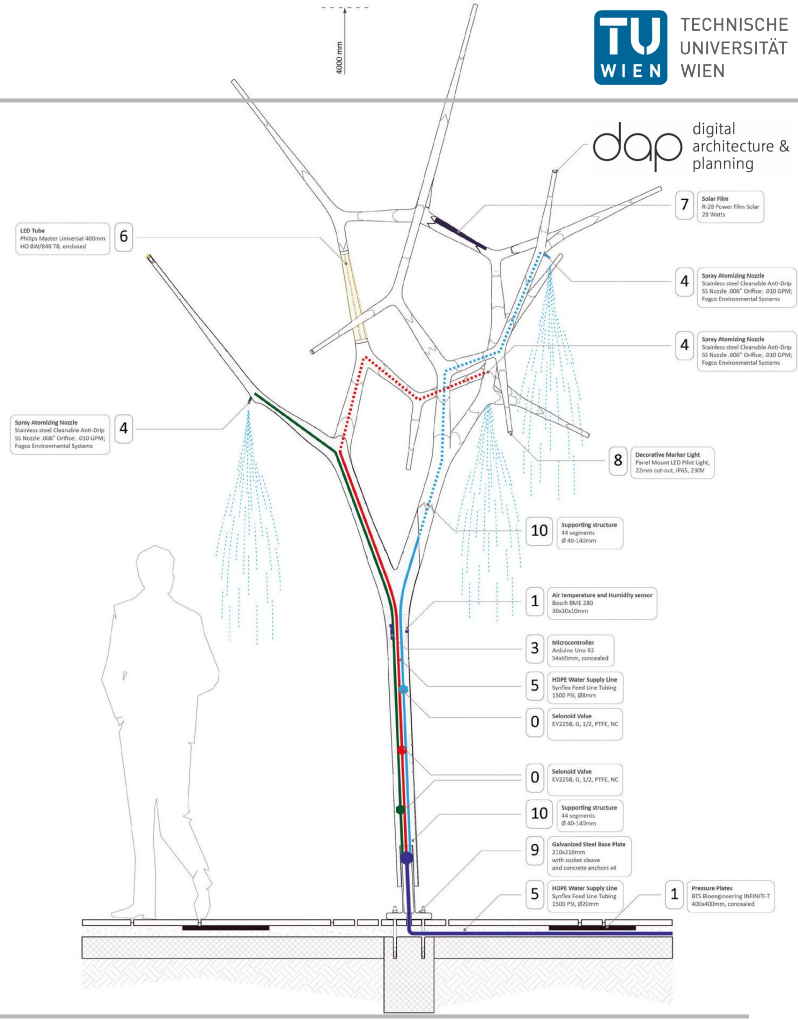
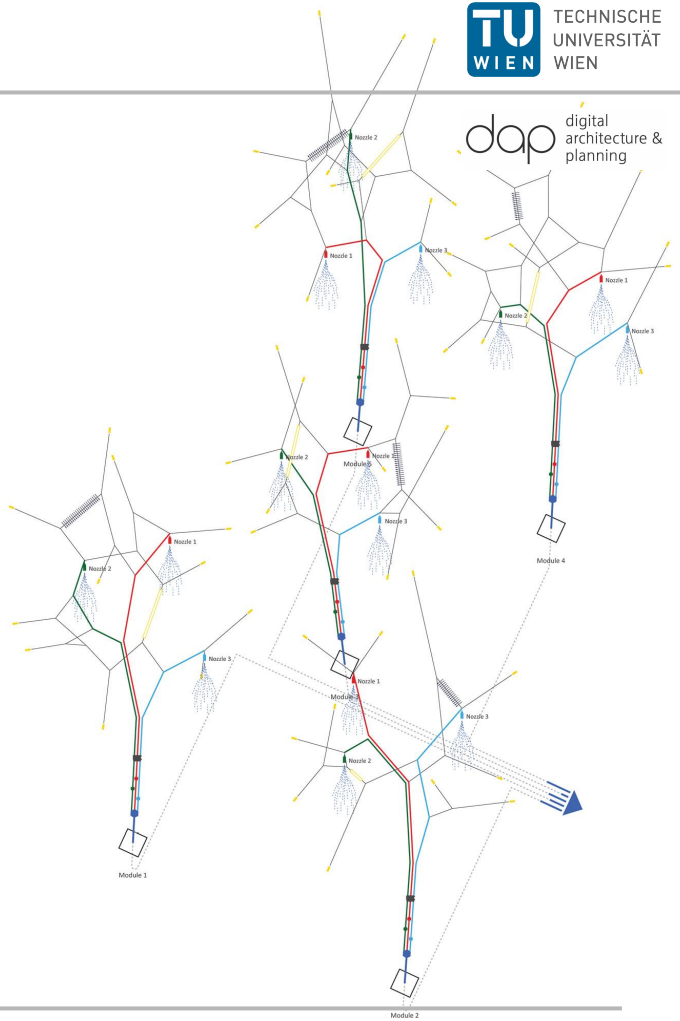


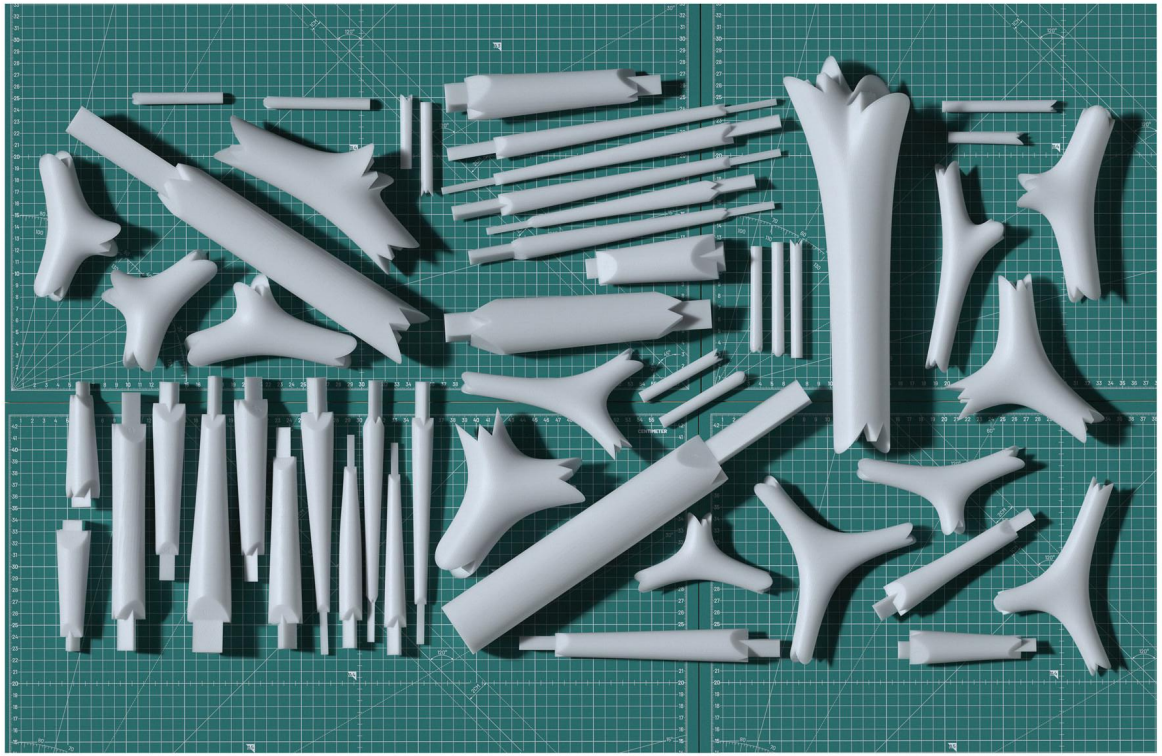
Mechatronic system connected to the water supply, containing sensors, microcontroller and actuators

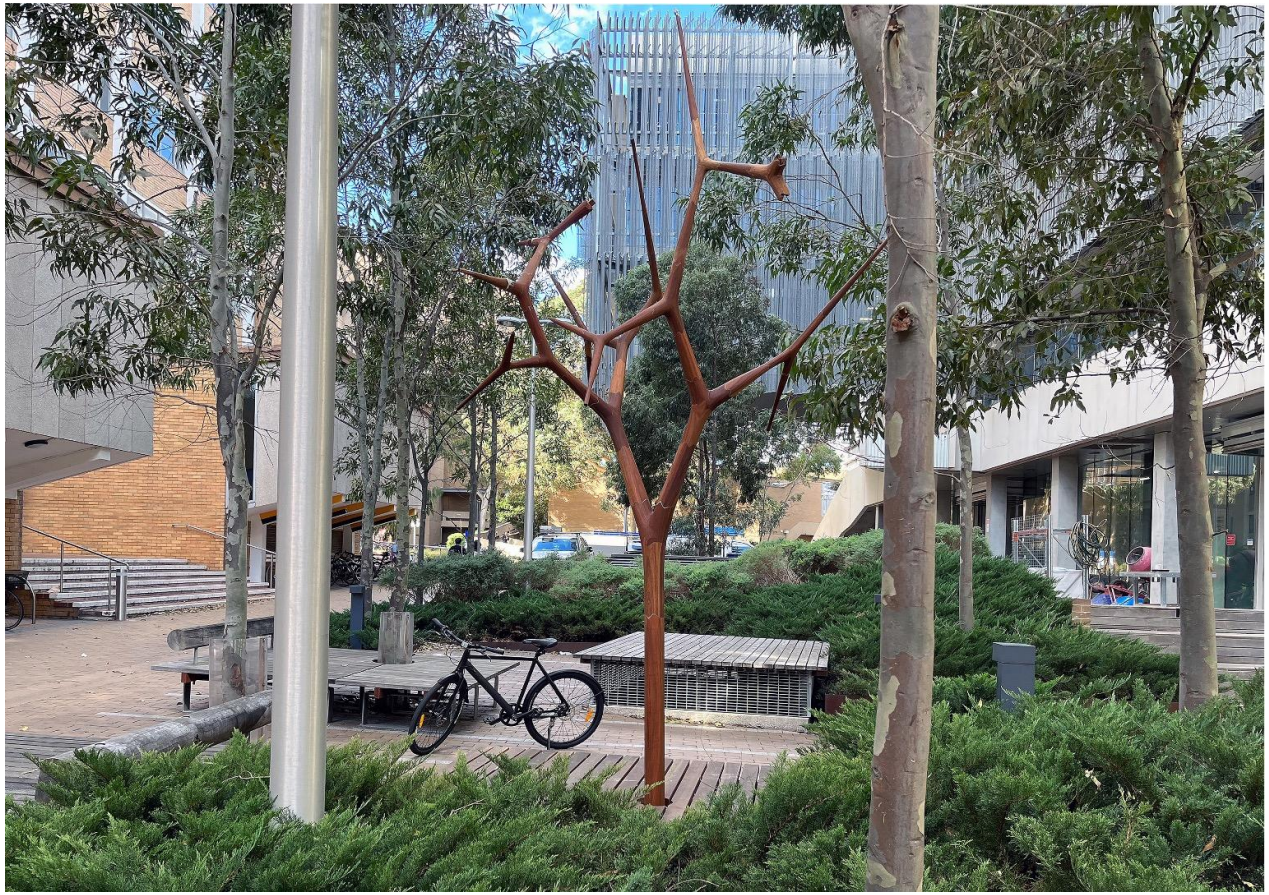


Modular design provides multiplication of the system. Water supply is required while power supply could be achieved via batteries.



Model and prototype 3D models were segmented in order to be generated via 3D printer.





Melbourne School of Design, University of Melbourne

Education and Advocacy

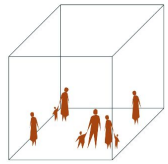
By advocating for sustainable practices and sharing their knowledge, architects can drive positive change and encourage the **adoption of sustainable architecture principles at a broader scale**.

The studio focuses on the design of volumetric and landform strategies and the more detailed architectural design of development sites that are part of the Vienna masterplan for the Nordbahnhof area “Freie Mitte”.

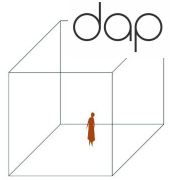
The aim is to explore a synthesis of architecture and landscape, and more specifically the building envelope as a multi-species space.

"Through modularity, we imagined different units that could then be united and combined to establish eco-systems."

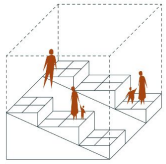
"Each major green area is connected to a common space : the urban forest to a collective working space, the vegetable gardens to a multigenerational learning area, and finally the meadows to the common space adaptable for different events."



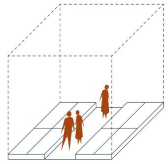
Public Area



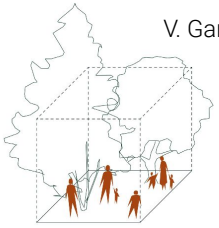
Private Area



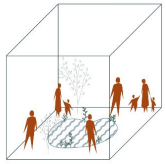
V. Garden on a Slope



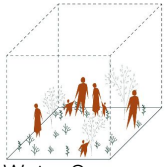
Vegetable Garden



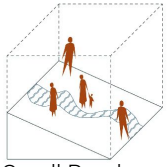
Urban Forest



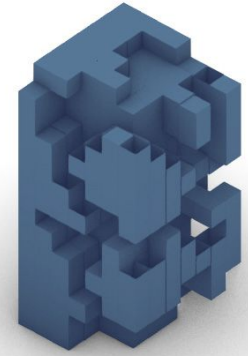
Meadow



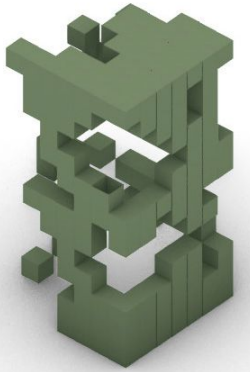
Water Source



Small Pond

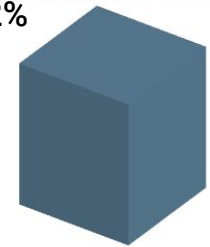


Built Volume

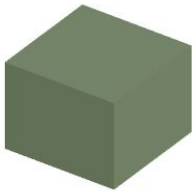


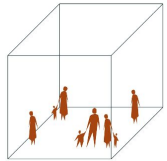
Soil + Biomass Volume

62%



38%





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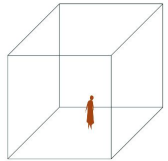

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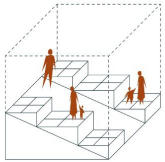

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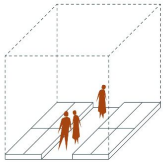

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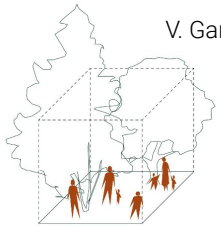

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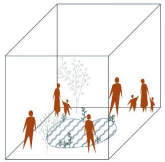

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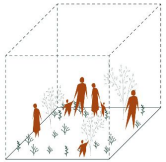
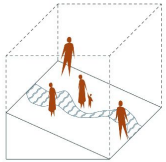
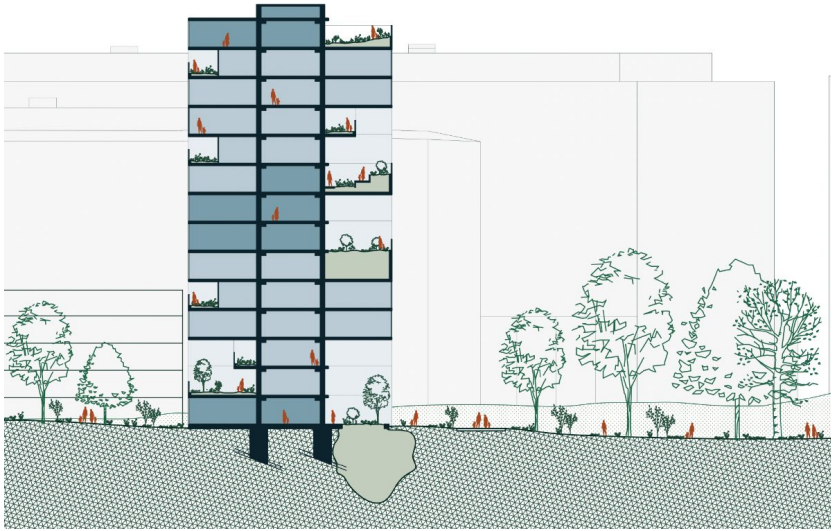
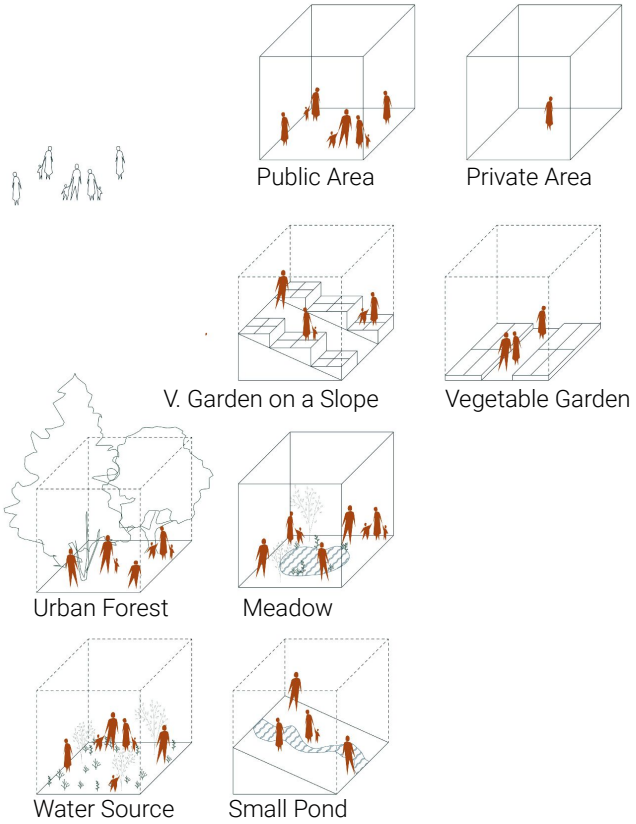


Water Source



Small Pond




Public Area
Private Area
V. Garden on a Slope
Vegetable Garden
Urban Forest
Meadow
Water Source
Small Pond

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