Regenerative Urban Spine

Regenerative Design Principles for the Existing Urban Street Section and Public Realm

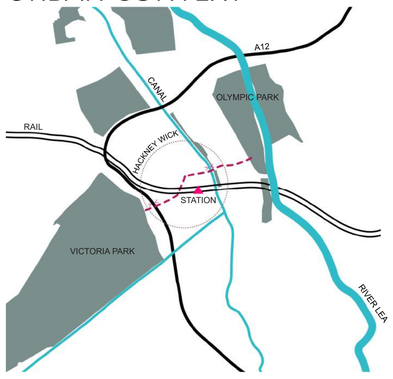
Marie Haase
University of Westminster
School of Architecture + Cites

INTRODUCTION

For sustainable development, cities must dynamically control and restrict their growth, save biodiversity and ecosystems, simultaneously lessen their influence on the microclimate, and increase their resistance to climate change. Global warming will influence cities' microclimates and require mitigation measurements to cool them down. The street section as a microsystem is in a constant direct interchange between the outdoor urban environment and its buildings and influences the microclimate of cities.

Based on environmental studies, the design project incorporates regenerative design techniques and natural components into the existing street section of Wallis Road in London, UK, working with the terrain through soil bioremediation and flood resilience measures. The developed prototype is a sustainable addition that adapts to the local environment and enhances the microclimate of the neighbourhood, pedestrian comfort, and ecological regeneration while reducing the effects of climate change on the urban population.

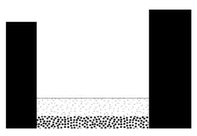
URBAN CONTEXT



Hackney Wick station is within a 5-10 minute walking distance of the Olympic and Victoria Park. The neighbourhood itself does not have many public green areas and is cut off by the A12 and canal on either side. Wallis Road is the direct pedestrian and cyclist route, shared with vehicle traffic, to connect both ends via bridges. Based on a community survey, the design suggests the pedestrianisation of Wallis Road and creates a new green link between Queen Elizabeth Olympic Park and Victoria Park.

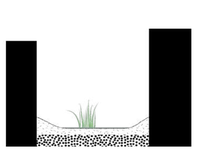
CONCEPT

00 Status Quo
Starting from the status quo with sealed polluted grounds and solid buildings, creating an urban canyon.

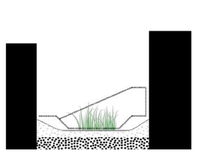


01 Mycoremediation
The street surface is opened, and the polluted soil is treated with mycoremediation (fungi) and compost to allow the pollutants to break down in 3-6 months.

02 Infiltration
The soil is excavated, and lower layers are treated, creating a swale in the middle of the canyon where water accumulates according to precipitation.

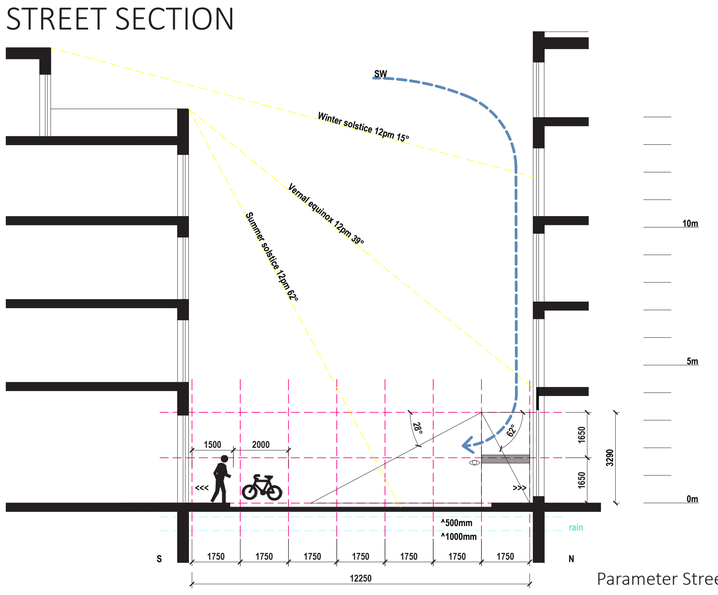


03 Phytoremediation
The remediated soil and water provide the base for further treatment of the soil with phytoremediation through plants and slowly growing a new ecosystem.

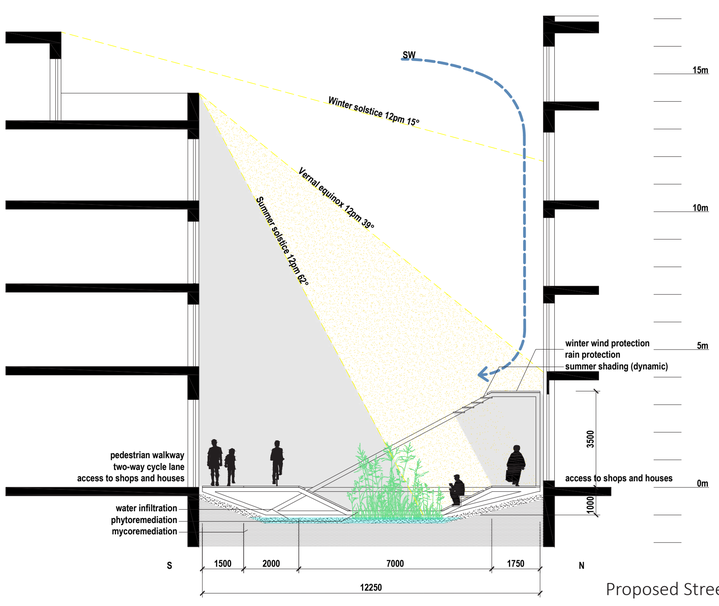


04 Infrastructure
To accommodate the functional needs of the street, a new structure is implemented to allow for pedestrian and cycle access. Creating a new ecological and sustainable link between the Olympic and Victoria Park.

STREET SECTION



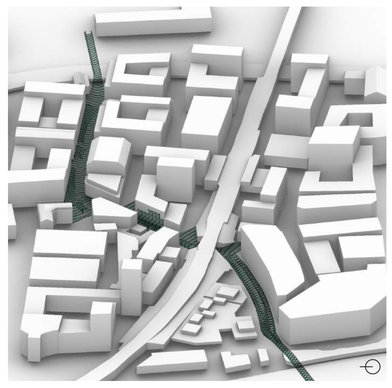
Parameter Street Section



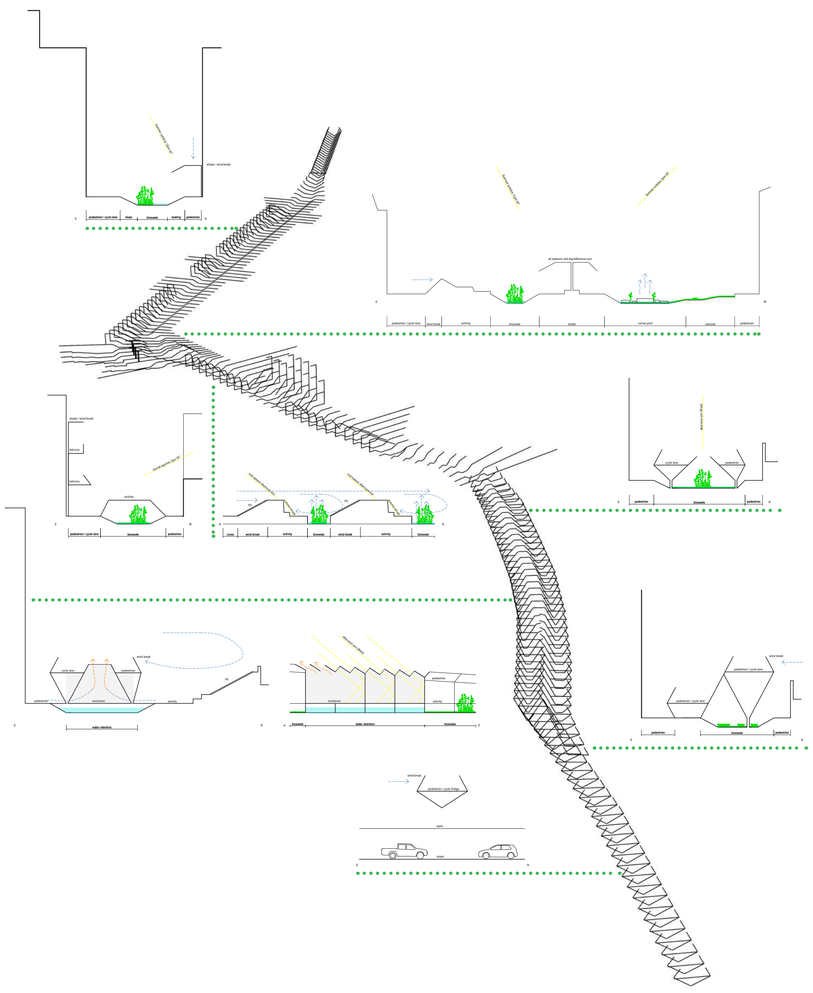
Proposed Street Section

PROCESS

The sectional approach is applied as a strategy to structure the 500-meter linear street canyon along Wallis Road. The principal sections are informed by environmental parameters and designed with passive and active environmental strategies (e.g. solar energy harvesting), developing a catalogue of possible structure variations. Using parametric tools to generate serial sections creates an urban spine that connects the principal sections and becomes an ecological infrastructure that enhances urban biodiversity and promotes sustainable transport.



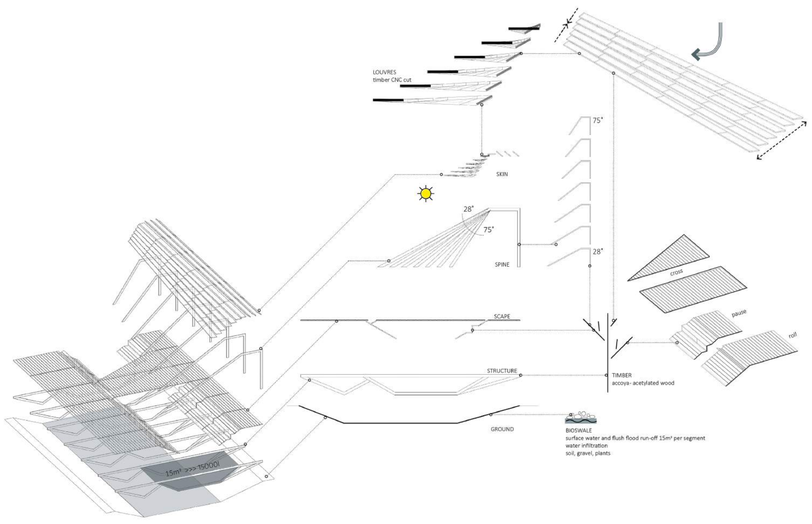
ENVIRONMENTAL PARAMETER



PROTOTYPE

A prototype is developed to enhance the pedestrian comfort and environmental performance of one of the principal street sections and its microclimate. Besides providing access to the buildings, new pedestrian walkways and cycle lanes are generated. Louvres span across the spine structure and provide adaptable shading and additional protection from downdraft winds.

The street section is newly designed and generates a new topography to allow for natural water infiltration and flash flood management as well as generating the basis for a new ecological corridor. The proposed wet bioswale is a trapezoidal-shaped open channel with dense vegetation in the middle of the street and shallow standing water. The water table depth varies according to precipitation level creating a long linear wetland, which temporarily stores water till natural infiltration and the slow settling of particles and bioremediation of pollutants occur (Kwok et al, 2018). The ten-year capacity in the event of a flash flood is set to 800mm with a max. 1000mm, which is orientated on recent flash floods in London in July 2021.



Solar Radiation
Due to the gradient variation of the spine structure and adjustable louvres, the solar radiation levels are even out along the street.

Flood
Rainwater infiltration and retention along the bioswale allow for controlled surface water management.

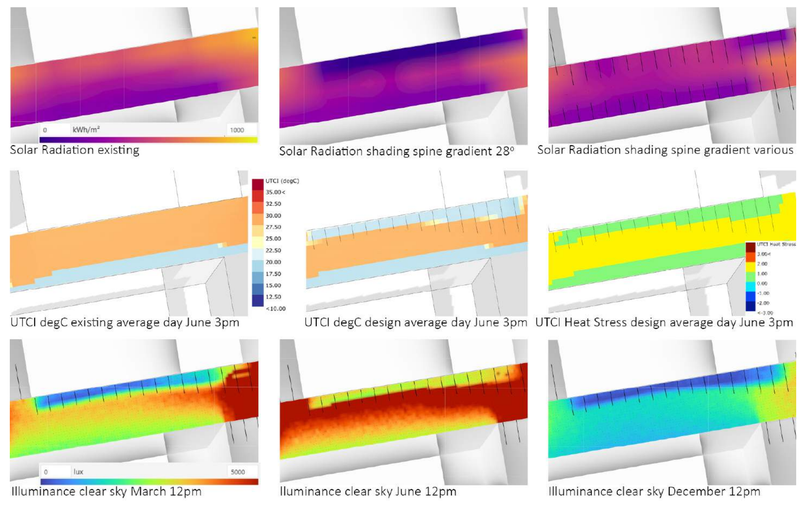
Biodiversity
The bioswale acts as a natural biotope, enhances biodiversity, and creates a new ecosystem.

Sustainability
The pedestrianisation of Wallis Road promotes sustainable transport and reduces localised air pollution.

Regeneration
The remediated soil allows for an ecological renewal of the site.

MicroClimate
Surface material change, newly introduced vegetation, and localised shading positively affect the microclimate.

RESULTS



From the performance analysis of the principal section variation, the following results can be drawn from the computer simulations:
Due to the gradient variation of the spine structure and applied louvres, the solar radiation levels received can be even out along the street with values below a summer monthly average of 75 kWh/m², equivalent to no more than an hourly average of 300 Wh/m² along the edge of the louvres and shading the walkway during midday and in the afternoon. In summer, the UTCI temperature can be reduced by 5°C under the shading, and no heat stress is experienced. Winter thermal comfort can mainly be achieved through adequate closing and as shown in the analysis, the UTCI levels can be influenced by wind protection, resulting in either no thermal stress or moderate cold stress. Illuminance levels stay in the range under the shading, and adjustable louvres allow for seasonal adaptation. However, when natural daylight levels are reduced, additional lighting is required for winter and evening.

CONCLUSION

Based on the performance analysis of the design, it is concluded that the project has a positive impact on the overall environmental condition of the street section along Wallis Road. The key findings highlight the benefits, especially for summer and a warmer climate, which in its isolated state might not have a large enough impact on the urban heat island effect but certainly on the local microclimate and initiates the discussion of how the street section and urban public realm are designed for new build as well existing neighbourhoods. With London street's cover of 30% for the city's core and the future motor vehicle traffic reduction as stated in the London Plan, it opens up the possibility of creating very different street scenarios, which could better adapt to its environment, the pedestrian needs and be more resilient to and mitigate climate change. In the case of London, this means adapting to increased solar radiation levels in summer, higher possibility of flash floods and better ecological treatment of polluted soils to increase natural surface water run-off and infiltration. The developed prototype and its variation show that it is possible to incorporate multi-criteria design elements on a typical street section of 12.5m width through a systematic approach by multidirectional thinking deriving in a regenerative design for the urban canyon.

»»» Marie Haase # 077 60216435 @ w1818506@my.westminster.ac.uk