Graduation Plan

Master of Science Architecture, Urbanism & Building Sciences

Graduation Plan: All tracks

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	**Akhilesh Singh Shisodia**
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Studio		
Name / Theme	City of The Future	
Main mentor	Maurice Harteveld	Urbanism (Public Space and Urban Design)
Second mentor	Fransje Hooimeijer	Urbanism (Environmental Technology and Design)
Argumentation of choice of the studio	My primary motivation for the above preferences is drawn from the choice of scale and treating the 'city' as an entity or object of experimentation. I am interested in deciphering urban codes, and simulating scenarios for cities to find alternate spaces and dynamic functions. I wish to explore changing nature of a city and its identity with respect to current transitions in technology, focusing on value of urban resources like real-estate, data and space augmentation. With the rising rate of urbanization and European Commission's efforts towards reducing net land take, cities are set towards intense densification of infrastructure and spatial functions to achieve compact urban systems. Exploring the subsurface uses and their potential to supplement demand of public/mobility space from surface produces an interesting opportunity to access untapped real estate before exploitation from the private sector. The studio provides a balanced mix of incorporating digital trends and vision development towards imagining subsurface habitability.	

Graduation project	
Title of the graduation project	The Subsurface as a Collective Geography: Designing Underground Space for Urban Systems Integration
Goal	
Location:	Amsterdam, Netherlands
The posed problem,	Assessing the potential and planning for zone-based underground space development as a collective functional geography in the city of Amsterdam.
Research questions and	1. What is the extent of current underground space inventory in the city of Amsterdam? 2. How to map/visualize the existing underground assets in the city of Amsterdam in a participatory manner?

	3. How to integrate isolated project-based underground development into a holistic subsurface network? 4. How to phase and design the Groundscape according to the needs of public life and infrastructure development? 5. How to regulate use of underground to maintain a balance between public functions and development feasibility?
Design assignment in which these results.	• Devising a toolbox to assist with context-based underground development • Testing the application of the toolbox within different transformative spaces in Amsterdam and their connection with existing underground infrastructure networks. • Recommendations to better plan and regulate use of underground spaces according to future transitions

Problem Definition:
Urban areas generate high demand for urban spaces to accommodate a broader range of activities associated with growth, given the rising rate of urbanization and over two-thirds of the human population projected to be city dwellers by 2050 (UN-DESA, 2014). Consequently, cities are rapidly developing into complex and sprawling infrastructure reservoirs, limiting the capacity of vital natural ecosystem services. In recent decades, brownfield development has directed its focus towards the subsurface, with the onset of initiatives like "net zero land take by 2050" set by the European Union (European Commission, 2016). It has become imperative for planners internationally to strive for UN Sustainable Development Goal 11 (SDG-11) to achieve a sustainable ratio of land consumption and population growth. Expanding the public realm in cities through brownfield underground development can help close the gap between demand and supply of habitable land within cities, especially in urban areas housing contextual heritage.

There are various socio-cultural agents to be accounted for, which influence the experience of the subsurface. With appropriate structuring of policy and design, underground built environments can potentially link diverse uses like transit, work, recreation, and more.

Netherlands National Policy Strategy for Infrastructure and Spatial Planning (NNPSISP) recognizes efficient use of subsurface as a goal to maintain resource competitiveness taking into account groundwater, energy supply, minerals, infrastructure and utilities and public spaces. The current urban underground use has been reserved for densification of infrastructure networks like transportation, parking, energy resource. Hence, there exists a dichotomy of infrastructure vs life that separates the Groundscape into two different realms. If expansion stays dominated by such functions, the window of opportunity for utilizing the untapped subsurface for public use would eventually close.

The lack of development strategy inclusive of underground spaces poses risk of exploitation by private sector eventually resulting in super-basements that are value-centric. Underground spaces need a strategic spatial vision where the subsurface ecology is taken into account and developed in coherence with public life, integrating it with existing infrastructure networks.

Process

Method description

The methodology for this research is based on achieving the following aims on the basis of identified gaps:

1. Platform Generation: Interdisciplinarity in designing and planning for underground spaces.

2. Volumetric Planning: Urban development projects should consider 3D spatial phasing and design instead of point-and-line infrastructure networks.
3. Perception Study: To identify the types of users and their respective needs to be served by subsurface functions, it is important visualize and expose the existing underground potential in a spatial manner.
4. Designing Underground spaces and functions that are conscious of future transitions, transformability and supplement functional needs of the surface in a symbiotic manner.

Methodology:

1. To map the extent of existing underground inventory in the city of Amsterdam, a detailed literature study would be conducted and infrastructure networks would be mapped using GIS, secondary data and expert interviews. A platform of experts composed of a wide range of stakeholders, was generated to advise upon the same.
2. Through a prototypical approach, the collection and surveying of these infrastructure network and isolated spaces would be conducted using LiDAR scanning (Using phones and tablets). This approach shows potential to be integrated in the existing Digital Twin of the city i.e., 3D Amsterdam, to be interacted with by different stakeholders.
3. A suitability analysis would be conducted for integration of isolated underground spaces with transit networks and other functions. Spatializing the underground from the previous step would help conduct perception study of preferred elements in underground public spaces.
4. Through appropriate literature and generating a pattern language, a toolbox would be prepared for phasing and design of 3 different transformative spaces chosen within the city of Amsterdam. The toolbox would assist the designing of typologies of urban underground corridors for each site.
5. By benchmarking case studies and stakeholder consultation, recommendation would be made to regulate balanced use of underground spaces with respect to public vs. private functions to result in a Comprehensive Zone-Based Development strategy inclusive of subsurface functions.

Literature and general practical preference

- The research consults theories derived from the Groundscape concept by Dominique Perrault and EPFL SubLab for designing collective surface and subsurface environments for public use and suggesting design tools to improve the current perception of underground spaces.
- The subsurface in cities is layered with a dense infrastructure landscape. An increase in infrastructure construction and the potential of designing public spaces underground makes it imperative for the subsurface spaces to be visualized and incorporated in the existing Digital Twins for cities. This research involves a literature review to devise a suitable methodology to use LiDAR technology to visualize underground spaces and analyze their potential to be used in 3D Digital Twins by different stakeholders depending on several parameters of technological suitability.
- A panel of experts connected to ITACUS (a part of International Tunneling and Underground Space Association) were consulted to understand the integrated system of activities related to construction and design of urban underground systems with appropriate feasibility.
- Literature on Pattern language would be used to devise a toolbox for context-specific subsurface design interventions.

Key Literature:

1. Underground Urbanism (By Elizabeth Reynolds, 2020): Exploring potential strategies to supplement surface functions through underground zonal planning in major cities like Amsterdam, London, Paris and Singapore.
2. Carpark Futures: Opportunities in the Underground (DPA-X for Indigo group, 2020): Envisioning future infrastructure systems inclusive of public functions, incorporating underground spaces to form an active Groundscape.
3. Ontwerpen Vanuit De Doorsnede (2022): Designing the subsurface as a building block for the future-proof city.
4. Superground/ Underground: Seoul New Groundscape (2019): multi-city complexities and integration of mutually beneficial surface and underground design proposals.
5. Think Deep: Planning, Development and use of underground space in cities (ISOCARP, ITACUS, 2015): Networking underground archaeological and cultural sites, taking into account cost and technological thresholds.

Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

Urban planners and Architects should lend special focus to the reconstruction and appropriation of transition interface between the surface heritage and underground. This interface links masses of similar characteristics to form unified spaces. Programs in these help spaces steer a narrative for the user and connect different timelines of growing city heritage in the same space. The 'shared' nature, scalability and growing viability of the subsurface directs important concerns towards the dimensions of systems approach and spatial design while planning for underground development. While the window of injecting public functions in already densifying infrastructure networks slowly diminishes, Underground urbanism may provide an alternative skeleton to support such a landscape as an integrated supplement to the surface. Since underground expansion remains a relatively unchartered territory, it brings many experimental opportunities to produce denser, cohesive and unique city models which account for public experience, co-habitation and co-working.

The goals of the project align with 'The City of the Future' studio. The studio takes into account current transitions in cities in a way where a mutual link is developed between the 'new space' and 'new user'. Underground spaces have been a relatively untapped resource. As a result, including this asset within existing planning frameworks requires a wider systems perspective of space and its value for private/public functions. Incorporating the subsurface for extension of the Groundscape would require reimagining the current infrastructure networks, flow of people and certainly the structure of the city fabric itself.

Development of integrated underground spaces should be sustainable, transition-driven, feasible, and open-ended to account for future transitions. Hence, the topic aligns with the goals of sustainable and compact cities under the Masters track of Urbanism.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

The current underground spaces are regarded as a realm of lost orientation and hence, considered in separation to surface functions. Bringing public life underground would introduce citizens to a wider set of functions and at the same time it would help alleviate the perception of the subsurface. The resultant spaces would offer wider public functions and at the same time, would help free-up space on surface to be used for functions like housing and extended infrastructure.

The previous use of underground spaces has been limited to isolated design projects and tunneling for infrastructure expansion. This research is aimed at generating dialogue for integrating project-based development into a wider system of spaces as step towards compact cities. It also promotes the need of vertical and 4-D planning of spaces for more sustainable and efficient urban life. With the help of a toolbox, interventions and instruments like use of light and lineation can be studied as an essential part for planning the subsurface. It is important to consider the cost-benefit and real-estate aspects of underground space for it to not turn exclusive for private sector functions. Subsurface use should be regulated by an appropriate platform of authorities for resultant spaces to be inclusive to people as well as infrastructure. It is the right time and opportunity for urbanists to intervene and ensure the development of visions that incorporate just-use of subsurface assets in a sustainable manner, and take into account future urban transitions.