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	Hanlin Stuer
Student number	5016959

Studio		
Name / Theme	City of the Future Graduation Studio	
Main mentor	Joran Kuijper	Architecture
Second mentor	Piero Medici	Building Technology
Third mentor	Maurice Harteveld	Urbanism (Urban Design)
Argumentation of choice of the studio	The two main reasons for the choice of the City of the Future graduation studio were its multidisciplinary approach to futures of cities and the possibility to explore one's own fascinations. I had a fascination with how cities and metropoles will tackle even greater densification to achieve compact urban landscapes keeping liveability in mind. I wanted to look into the design of underground spaces. This requires a multidisciplinary approach which is exactly what this studio advocates.	

Graduation project	
Title of the graduation project	**Think Deep; Idiosyncratic architecture for the underground, as an integrated extension of our urban fabric.**
Goal	
Location:	Farringdon Station Area, Farringdon, London, United Kingdom
The posed problem,	With cities projected to continue to grow due to lack of rural opportunities[1], and more than 60% of the world population predicted to be living in cities by 2030[2]; it is thus important to consider development of the underground as an integral part of the city of the future. While a lot of research has been conducted into new methods of planning, construction, and governance of

[1] *Architecture and technology*.
[2] United Nations, 'World Urbanization Prospects The 2018 Revision'.

	underground developments, one major issue is often mentioned but not tackled[3]. That is about how to make these new spaces more liveable and people-centred. This is the "key to getting this largely untapped resource accepted as a natural extension of the city"[4]. With vast underground transportation networks used by commuters every day, the question is not whether or not people will use the underground, but how to make it more attractive that just a means of efficient traveling and make it an integrated extension of the urban fabric. Two other important aspects are how to deal with the existing urban fabric and how we can optimally make use of the underground, embracing its idiosyncratic qualities.
research questions and	Main research question: • How can underground spaces be designed to respond to the cities' needs and create a new idiosyncratic addition to the city? Sub research questions: • What idiosyncrasies does the underground possess which make it distinctive and identifiable? • What can the development of underground spaces provide for the systems of the city? • Who/What can benefit from further development of the underground? • What types of underground spaces exist and how do they relate to their context? • Which functions can make good use of the idiosyncrasies of the underground? • How can the architecture respond to the underground as a resource of space, water, energy, and geomaterials? • What is essential to make underground spaces liveable? • What socio-psychological benefits can the underground provide for its users? • How can we avoid creating social hierarchy in underground spaces?

[3] Endicott, Johnston, and Lin, *Underground Cities*; Admiraal and Cornaro, *Underground Spaces Unveiled*; Golany and Ojima, *Geo-Space Urban Design*.
[4] Endicott, Johnston, and Lin, *Underground Cities*.

	• What ethical questions are there to consider when developing in the underground? • How can a symbiotic above- and under-ground landscape be created?
design assignment in which these result.	The project aims to create an idiosyncratic architectural language which will allow a design in which there is no under- or above-ground but a symbiotic urban landscape in which people seamlessly travel through the groundscape created within the density of the existing urban fabric. After analysing and research the site, the aim is to create an urban hub of which Farringdon station will be part of. The hub will make use of the existing underground spaces to facilitate better distribution of commuters. Also new spaces transitioning seamlessly between the above- and under-ground will be designed to create a liveable urban hub which also houses public spaces and a maker's market to provide more job opportunity and spaces for people with a lower education level which face unemployment problems in this area.

Process

Method description

Different research tools will be used to complete this graduation project. Initially literature was used to better understand the topic and the scope so that the research plan could be better defined. Then further literature, case studies/precedents, and talks with other people from relevant fields other than my mentors will guide my design research process. After P1, the design process started parallel to the research process. The aim is to also show this in the research paper, parallel to researching the conclusions drawn or information gained will be applied to the site and design assignment (where possible). This will provide concept and form a of research by design process. This methods will be used in researching all four topics: theory, city, building, and human(e).

Literature

The annotated bibliography is divided into main literature, literature about theory, city, and building. The main literature sources were used (with a few other supporting sources) to produce the research plan. Main literature sources will also further guide the research and design phase. Other literature is focused on more detailed information which will help to answer the sub-questions formulated in the problem statement.

Case studies and field visits

Case studies on vernacular examples, utopian concepts, and modern theories will be conducted. This will help to understand different approaches, uses, and cultural perceptions of underground spaces. Many can be found in the main literature sources. Others will be found during field trips to the Architecture Biennale in Venice, a visit to Milan, and if possible a visit to Helsinki.

Conversations with professionals

Conversations with professionals from different fields will be held to maximise input from different disciplines and gather different perspectives. This tool can also test the concepts designed in the fourth method, research by design, by discussing them with people who have different views on the matter.

Research by design

To ultimately work towards an architectural expression of the research an overarching method will be used: research by design. Where possible, the research will be translated into drawings or little designs forming a catalogue of information.

Literature and general practical references

Bibliography

Main literature

Admiraal, Han, and Antonia Cornaro. *Underground Spaces Unveiled: Planning and Creating the Cities of the Future*. London: ICE Publishing, 2018.

Han Admiraal and Antonia Cornaro are specialists in the world of underground spaces. This book talks about the issues that are associated with the sustainable development of urban underground space, the benefits, the possibilities, and some examples. Being published in 2018 it gives a good overview of recent developments and ideas about the underground.

Architecture and technology: future of cities. Madrid: Norman Foster Foundation, 2021.

This book is a collection of lectures and essays by experts who held talks at the Norman Foster Foundation about the future of cities. It is not specifically about the underground. However, as I am addressing future needs of cities this is a very interesting book about that and also gives insight into how different people from different disciplines and backgrounds think.

Endicott, John, Pamela Johnston, and Nancy F. Lin, eds. *Underground Cities: New Frontiers in Urban Living*. London: Lund Humphries, 2020.

This book is published by the company Aecom to review possibilities of the underground. It has many texts from experts about what the underground can provide for the city and a lot of examples of successful underground projects. It gives a good overview of what is done, and what is important to look into for the future of underground developments.

Golany, Gideon, and Toshio Ojima. *Geo-Space Urban Design*. New York, NY Chichester: Wiley, 1996.

For being published in 1996, Geo-Space Urban Design is quite ahead of its time. Golany had a strong fascination with the development of the underground and put all of his research into it in this book. It is extremely interesting and provides a strong basis to work on. By reading it critically and adding new things which help better reflect contemporary needs,

norms, and values this book can help a lot. It will provide better understanding of the underground and what can be done with it.

Mastenbroek, Bjarne, Esther Mercredy, and Iwan Baan. *Dig It ! Building Bound to the Ground*. Köln [Paris]: Taschen, 2021.

This book is a thick collection of projects and examples of how buildings have related to the ground throughout history. Starting from the hunter-gatherers who lived in caves all the way will examples from the 21st century. This book gives comprehensive analysis of examples and different ways of interacting with the (under)ground.

Underground and theory

Caves as the Origin of Architecture, 2023. https://www.youtube.com/watch?v=uE8hjzIRlFg&ab_channel=LouisianaChannel.

Cave_bureau is a relatively young architecture firm, but they have a strong conviction which they state clearly in their manifesto. I find this manifesto very interesting, especially how they relate to the cave as where architecture started. It is interesting to explore their way of thinking and critical view on the built environment.

Lindner, Christoph, and Andrew Hussey, eds. *Paris-Amsterdam Underground: Essays on Cultural Resistance, Subversion, and Diversion*. Amsterdam University Press, 2013. https://doi.org/10.1515/9789048518203.

Part of the underground has always been used as shelter and places for cultural resistance. This is definitely a part of history which helped shape the contemporary ideas surrounding the underground. This book will give an insight into that world, even if it is focused on two western European capitals.

Macaulay, David. *Underground*. Boston: Houghton Mifflin Company, 1979.

David Macaulay wrote this children's book about the underground. The most interesting part are the illustrations. They are a very interesting representation of how the underground can be represented with different drawings, drawn from different perspectives and using different techniques. This will be interesting to learn from in terms of ways of representation.

Macfarlane, Robert. *Underland: A Deep Time Journey*. First published as a Norton paperback. New York, N.Y: W.W. Norton & Company, 2020.

A critically acclaimed book which has won many prizes. It is a fictional story telling the non-fictional story of the Earth's underworlds as they exist in myth, literature, memory, and the land itself. This will be a very interesting book about the existing ideas about what the underground is, as well as what is factually in the underground. It may also help steer me towards a better understanding of what the underground can represent, positively.

Melo Zurita, Maria De Lourdes. 'Challenging *Sub Terra Nullius* : A Critical Underground Urbanism Project'. *Australian Geographer* 51, no. 3 (2 July 2020): 269–82. https://doi.org/10.1080/00049182.2020.1723829.

A more theoretical and philosophical paper about how the development of the underground should be approached.

Nix, Chris, Siddy Holloway, David Bownes, and Sam Mullins. *Hidden London: Discovering the Forgotten Underground*. New Haven: Yale University Press, 2019.

A small book about the forgotten underground in London. It could be interesting to explore why it was forgotten, what is done with it now, and what potentials are. Also all the different kinds of functions it has served since its construction.

Pimlott, Mark. *The Public Interior as Idea and Project*. Heijningen: Jap Sam Books, 2016.

Pimlott, Mark, and Eleonoor Jap Sam. *Without and within: Essays on Territory and the Interior*. Rotterdam: Episode Publ, 2007.

Mark Pimlott writes (in both books) extremely interestingly about public spaces and public interiors. Which is also a major element of underground spaces. These books can help me inform on ways to look at public spaces and public interiors (thus underground spaces) and also help guide me in my design of them later. [He also writes about the underground space in Montreal in *The Public Interior as Idea and Project* which is interesting for the beginning of my research]

Soules, Matthew. *Icebergs, Zombies, and the Ultra-Thin: Architecture and Capitalism in the Twenty-First Century*. First edition. New York: Princeton Architectural Press, 2021.

This book talks about the capitalistic forces which have driven a lot of architecture. I have always been interested in the effect of it on how the current world is constructed and viewed an maybe it can also help improve my proposals for the underground or better understand why it isn't yet being developed as much as the above ground. The title also mentions icebergs, they have hummocks and bummocks, as I see it these skyscrapers are the hummocks and the underground is the unexplored bummock. I am interested in why he mentions icebergs in his title.

Stalter-Pace, Sunny. *Underground Movements: Modern Culture on the New York City Subway*. Science, Technology, Culture. Amherst: Univ. of Massachusetts Press, 2013.

Similarly to the book about Paris-Amsterdam underground, this book will help get a better understanding of the underground culture and how underground has influenced culture in such big cities such as New York.

Underground and city

Bai, Yun. *Underground Engineering: Planning, Design, Construction and Operation of the Underground Space*. London [England] ; San Diego, CA: Academic Press, 2019.

Recent scientific papers about the planning, design, construction, and operation of underground spaces help to keep up with current technology and also provide valuable comparisons between these publications and the books in the main literature which also cover this topic.

Banham, Reyner, and Todd Gannon. *Megastructure: Urban Futures of the Recent Past*. Facsimile edition. New York, New York: The Monacelli Press, 2020.

A classic about many visionary and utopian ideas about the future cities originally published in 1976. What was considered crazy ideas back then might not be as crazy today as we see with projects such as The Line. So it is interesting to revisit these provocative ideas and gain another perspective (of the recent past) on cities.

Broekmans, Tess, and Catja Edens. *The Spontaneous City*. Amsterdam: BIS Publishers, 2010.

Many literature (such as the books from Mark Pimlott) suggest that successful cities and public spaces stem from human interaction and spontaneousness. This theory from Urbahn on how to approach urban design is also interesting and could be something to inform later research and design.

Broere, Wout. 'Urban Underground Space: Solving the Problems of Today's Cities'. *Tunnelling and Underground Space Technology* 55 (May 2016): 245–48. https://doi.org/10.1016/j.tust.2015.11.012.

A paper with a short summary of what underground spaces can provide to help solve the problems of today's cities. Here two things are valuable: the problems of today's cities, and how underground space can contribute to solving them.

Chen, Renpeng, Gang Zheng, and Changyu Ou, eds. *Proceedings of the 2nd International Symposium on Asia Urban GeoEngineering*. Springer Series in Geomechanics and Geoengineering. Singapore: Springer Singapore, 2018. https://doi.org/10.1007/978-981-10-6632-0.

Recent publication on geoengineering, this approaches these underground spaces form a geoengineering point of view. Which is especially important when taking ecology of the underground into account.

Doyle, Michael R. 'Mapping Urban Underground Potential in Dakar, Senegal: From the Analytic Hierarchy Process to Self-Organizing Maps'. *Underground Space* 5, no. 3 (September 2020): 267–80. https://doi.org/10.1016/j.undsp.2019.04.004.

This could be an interesting read about the mapping of underground potential. Mainly to learn what methods were used, what prerequisites, in order to possibly apply a similar approach in search of a site for the design.

Frampton, Adam, Clara Wong, and Jonathan Solomon. *Cities without Ground: A Hong Kong Guidebook*. Rafael, Calif.: Oro editions, 2012.

The underground is not the only things in cities, it needs to be connected with the above ground. This book talks about this verticality in Hong Kong and also shows interesting ways of representation, by "deleting" the ground.

Khoo, Chee-Min, and Teik-Aun Ooi. 'Geotechnical Challenges and Innovations in Urban Underground Construction – The Klang Valley Mass Rapid Transit Project'. *Geomechanics and Tunnelling* 16, no. 3 (June 2023): 243–62. https://doi.org/10.1002/geot.202300007.

Geotechnical challenges is something I really don't know a lot about but definitely something I would like to take into consideration. As it is mentioned by Han Admiraal that even though the geological cycles of the Earth are on a different timeline than what we can plan for we are starting to feel the effects of mankind on these cycles.

Peng, Fang-Le, Yong-Kang Qiao, Soheil Sabri, Behnam Atazadeh, and Abbas Rajabifard. 'A Collaborative Approach for Urban Underground Space Development toward Sustainable Development Goals: Critical Dimensions and Future Directions'. *Frontiers of Structural and Civil Engineering* 15, no. 1 (February 2021): 20–45. https://doi.org/10.1007/s11709-021-0716-x.

Recent paper with information about the current approaches of the development of urban underground space.

Qiao, Yong-Kang, Fang-Le Peng, Xiao-Lei Wu, and Yong-Peng Luan. 'Visualization and Spatial Analysis of Socio-Environmental Externalities of Urban Underground Space Use: Part 1 Positive Externalities'. *Tunnelling and Underground Space Technology* 121 (March 2022): 104325. https://doi.org/10.1016/j.tust.2021.104325.

———. ‘Visualization and Spatial Analysis of Socio-Environmental Externalities of Urban Underground Space Use: Part 2 Negative Externalities’. *Tunnelling and Underground Space Technology* 121 (March 2022): 104326. https://doi.org/10.1016/j.tust.2021.104326.

Recent paper with information about the socio-environmental externalities of urban underground space. This can inform certain socio-psychological topics that need to be researched.

Shannon, Kelly, and Marcel Smets. *The Landscape of Contemporary Infrastructure*. Rotterdam: nai010 publishers, 2016.

Interesting urbanists on the landscape of infrastructure. The underground plays a big role in the infrastructure of cities (and countries, or even across countries) so understanding of that topic is also important.

Underground Engineering for Sustainable Urban Development. Washington, D.C.: National Academies Press, 2013. https://doi.org/10.17226/14670.

Information about more sustainable approaches to development of the underground.

Von Der Tann, Loretta, Stefan Ritter, Sarah Hale, Jenny Langford, and Sean Salazar. ‘From Urban Underground Space (UUS) to Sustainable Underground Urbanism (SUU): Shifting the Focus in Urban Underground Scholarship’. *Land Use Policy* 109 (October 2021): 105650. https://doi.org/10.1016/j.landusepol.2021.105650.

First of all, she attempts to define underground spaces of subterranean spaces. Secondly, also suggests a new approach to underground urbanism.

Zhang, Yangbin, Zhiqiang Xie, Fengshan Jiang, Tong Xu, Shouquan Yang, Siqiao Yin, Fei Zhao, et al. ‘Evaluating the Socioeconomic Value of Urban Underground Space in Kunming, China, Using the Entropy Method and Exponential Smoothing Prediction’. *Journal of Urban Planning and Development* 149, no. 2 (June 2023): 05023001. https://doi.org/10.1061/JUPDDM.UPENG-4123.

Socioeconomic value of new urban spaces is becoming more and more important as investment in these new spaces and infrastructure aren’t just cost-driven anymore but more value-drive which now often includes social values.

Practical references

- Theory
  - MXC – Minnesote Experimental City – Athelstan Spilhaus
  - Ecopolis – Guy Rottier
  - The Great Victorian Way – Joseph Paxton
  - Road Town – Edgar Chambless
  - Lower Manhattan Expressway – Paul Rudolph
  - Mission Île de la Cité, Paris – Dominique Perrault
  - Groundscape fictions – Dominique Perrault
  - Quartier des Halles competition entry – OMA+XDGA
- Landscape
  - Cappadocia cave houses
  - Derinkuyu
  - Place Ville-Marie
  - Rehabilitation of Tabriz Bazaar - ICHTO
  - Hong Kong – Cities without Ground

- Lightwalk, Seoul – Dominique Perrault
- EWHA Womans University, Seoul – Dominique Perrault

- City
  - Place Ville-Marie [+masterplan Ville Intérieur], Montreal – Architects I.M. Pei & Associates
  - Place Bonaventure, Montreal – ARCOP
  - « Underground masterplan » of Helsinki
  - Derinkuyu
  - Rehabilitation of Tabriz Bazaar – ICHTO
  - Hong Kong – Cities without Ground
  - Mission Île de la Cité, Paris – Dominique Perrault
- Building
  - Grand Louvre / National Gallery (Washington), East Wing – I.M. Pei
  - Temppeliaukio Church, Helsinki – Timo and Tuomo Suomalainen
  - Underground Swimming pool, Itäkesus – HKP, Architects Arkkitehtitoimisto
  - Cappadocia cave houses
  - Fun Palace – Cedric Price
  - São Paolo Museum of Art – Lina Bo Bardi
  - Neue Nationalgalerie, Berlin – Ludwig Mies van der Rohe
  - Villejuif IGR Station, Paris – Dominique Perrault
  - EWHA Womans University, Seoul – Dominique Perrault
  - Forschungsgebäude GLC, Zurich – Boltshauser Architekten

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)?

   The city, big cities and metropoles (in my case), will continue to densify in the future. This brings many up and coming issue which needs to be tackled. One solution is going downwards, which is what my project aims to explore. Furthermore, it weighs in on the transition that cities are going through in order to become more liveable. The proposed solution to the raised issues cannot be tackled through one field (master track) alone but needs to be thought of from multiple perspective. Not only does this align with the multidisciplinary aspect of this studio, it also aligns with the goal of the master track to work in multi-disciplinary environments creating integrated solutions for the built environment[5].

   Graduating from the Architecture track does mean that the end result will be an architectural design. One can see the proposed groundscape network/hub as a building with inside and outside parts, public and private, above- and under-ground. Architectural design is needed to meet the requirements of such a structure, making it liveable, attractive, comfortable, efficient, etc.

[5] https://www.tudelft.nl/onderwijs/opleidingen/masters/aubs/msc-architecture-urbanism-and-building-sciences

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

With the continued densification of cities the scarcity of above ground space will pressure further exploitation of underground spaces. It is important to better understand this resource and develop more suitable approaches to the design of this extension of the city of the future.

By designing an idiosyncratic language for the future development of underground space it can contribute to it being taken into consideration more often as a viable option of urban development. It could also help to make underground spaces more accessible and willingly accessed.

Better and more intense use of the vast resource that is the underground can also improve the liveability of cities. Helping solve problems that result from the increased densification that is needed. Such as congestion, land prices, and lack of public space. It will also increase the volume of what can be considered the ground floor of the city, which is inarguably the most important level. It can facilitate the creation of a more three dimensional urban landscape in which liveability and accessibility are improved.