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	Tsz Kwan Chan
Student number	5949432

Studio		
Name / Theme	Architectural Crossover Design	
Main mentor	Johan van Lierop	Design
Second mentor	George Karvelas	Building Technology
Argumentation of choice of the studio	Alper Alkan (Research)	

Graduation project	
Title of the graduation project	Digital Agora: Transforming Madrid's Data Infrastructure into Democratic Commons

Goal	
Location:	Plaza de Colón, Madrid, Spain
The posed problem,	We face a triple crisis in digital infrastructure where each element reinforces the others, creating a cycle of diminishing democratic control. The loss of data sovereignty, the weakening of digital democracy, and the isolation of resource consumption are not separate challenges but deeply intertwined problems that together undermine civic engagement with our digital environment.

The loss of data sovereignty directly impacts democratic processes: as citizens lose control over their personal data to private infrastructure, their ability to participate in and influence digital civic life diminishes. Corporate algorithms increasingly shape public discourse, political engagement, and collective decision-making without democratic oversight. The rapid spread of misinformation - now moving six times faster than truth across our networks - amplifies how digitalization can erode democratic discourse when citizens lack control over their information environment. This weakening of digital democracy drives ever-increasing demands for computing power, leading to massive resource consumption in hidden data centres. The |

	deliberate concealment of this infrastructure - consuming enough power in Madrid alone to heat 456,000 homes annually - reinforces our loss of data sovereignty by making these systems inaccessible to public oversight. This cycle intensifies as cities expand their digital infrastructure. Madrid's planned 300% increase in data centre capacity by 2026 exemplifies how technical expansion without civic integration deepens the crisis. More hidden infrastructure enables more private control over data, which weakens democratic participation in digital space, requiring more processing power, leading to more hidden facilities - a self-reinforcing cycle of democratic disconnection. Breaking this cycle requires recognizing how these crises feed each other. We cannot strengthen digital democracy without confronting data sovereignty; we cannot reclaim data sovereignty without making infrastructure visible; we cannot justify visible infrastructure without addressing resource integration. As cities worldwide rapidly expand their digital capacity, they face a critical choice: continue this cycle of concealment and disconnection or develop new architectural models that make digital infrastructure visible, accessible, and democratic.
research questions and	**Main Question:** WHAT IF Madrid's invisible digital infrastructure is transform into civic spaces that strengthen data sovereignty and democratic participation? **Operative Question:** 1. WHAT architectural interventions can transform hidden data centres into civic spaces? 2. WHERE can design strategies bridge centralized processing and community control? 3. WHAT kind of programme matter in combating digital misinformation? 4. WHICH data centre resources (heat, water, power) best integrate with urban systems? 5. WHAT IF historical civic evolution informed new digital infrastructure typologies?
design assignment in which the result.	This research aims to develop an architectural intervention for Madrid's Plaza de Colón that transforms hidden digital infrastructure into a new form of civic institution. The site's historical evolution from Royal Mint to National Library to public plaza creates a compelling context for

reimagining the next iteration of civic information infrastructure. Using a three-layer framework inspired by cloud-fog-edge computing architecture, the project explores how data centers can evolve from their current state of deliberate invisibility into accessible public spaces that strengthen democratic participation in the digital age.

The expected outcome will:
1. Propose a new architectural typology at Plaza de Colón that integrates technical requirements for data processing with spaces for public interface and democratic oversight
2. Create visible connections between digital infrastructure flows (energy, water, data) and existing urban systems
3. Develop strategies for combining fact-checking facilities and media literacy centers with data processing infrastructure
4. Design adaptable frameworks that can be implemented across different urban contexts
5. Demonstrate how architecture can address the triple crisis of data sovereignty, democratic participation, and resource isolation

This research will contribute to broader discussions about digital infrastructure's role in urban life, offering both immediate architectural solutions for Madrid and adaptable strategies that other cities can implement as they face similar challenges in digital transformation.

Process

Method description

This research employs a multi-layered methodological approach that combines theoretical analysis with practical design investigation to transform Madrid's digital infrastructure into civic spaces. The methodology unfolds across three main phases, each utilizing specific tools and techniques to bridge theoretical understanding with practical design solutions.

Part 1: Analysis & Mapping (Documentation)
- GIS-based spatial mapping of Madrid's digital infrastructure networks, identifying critical intersections between data centers, power grids, water systems, and public spaces. This mapping will reveal hidden patterns of infrastructure and potential integration points.
- Historical analysis of Plaza de Colón's evolution from Royal Mint to National Library, documenting transformations in civic architecture, public access, and institutional power through archival research and architectural documentation.
- Actor Network Theory (ANT) mapping to trace complex relationships between:
- Human actors (citizens, operators, policymakers)
- Non-human actors (data centers, infrastructure networks, environmental systems)
- Intermediaries (policies, technologies, spatial practices)

- Field observation and photographic documentation of existing data center sites and their urban context
- Quantitative analysis of resource flows including energy consumption, water usage, and data processing capacity

Part 2: Framework Development (Analysis)
- Synthesis of cloud-fog-edge computing principles with architectural strategies to create a three-layer spatial organization model that bridges technical requirements with public accessibility
- Comparative analysis of international precedents in civic data infrastructure and media literacy centers, focusing on successful integration strategies
- Resource flow analysis documenting energy, water, and data patterns through systemic diagrams and technical studies
- Development of programmatic relationships between technical spaces, verification facilities, and public interfaces
- Creation of adaptation strategies for different urban contexts and cultural conditions

Part 3: Design Development (Synthesis)
- Site-specific intervention strategies at Plaza de Colón, testing framework applications through architectural proposals at multiple scales:
    - Urban scale: Infrastructure network integration
    - Building scale: Spatial organization and program distribution
    - Detail scale: Technical systems and public interfaces
- Iterative design development through:
    - Physical models exploring spatial relationships
    - Digital models testing technical integration
    - Architectural drawings investigating public accessibility
    - 3D visualizations communicating infrastructure flows
- Development of phasing strategies for implementation between 2025-2050, considering:
    - Technical evolution of data processing requirements
    - Growing needs for public verification spaces
    - Changing resource management demands
- Production of final documentation including:
    - Technical drawings and specifications
    - System integration diagrams
    - Program distribution plans
    - Public interface details
    - Implementation guidelines

This comprehensive methodology aims to create a framework that addresses both immediate architectural challenges at Plaza de Colón and broader questions about digital infrastructure's role in urban life. The research will produce strategies that can be adapted for different urban contexts while responding to site-specific conditions and local needs.

Literature and general practical references

Theoretical Frameworks

Bratton, Benjamin H. *The Stack: On Software and Sovereignty*. Software Studies. Cambridge, Massachusetts: MIT Press, 2015.

Klingmann, Anna, and Marc Angélil. *"Hybrid Morphologies, Infrastructure, Architecture, Landscape."* Daidalos, no. 73 (1999): 16–25.

Parks, Lisa, and Nicole Starosielski. *Signal Traffic: Critical Studies of Media Infrastructures*. The Geopolitics of Information. Urbana, Ill. Chicago, Ill. Springfield, Ohio: University of Illinois press, 2015.

Methodology

Latour, Bruno. "On Actor-Network Theory: A Few Clarifications." *Soziale Welt* 47, no. 4 (1996): 369–81.

Data Center

Corbo, Stefano. *Exteriorless Architecture: Form, Space, and Urbanities of Neoliberalism*. Routledge Research in Architecture. New York, NY: Routledge, 2023.

Hoosain, Mohamed Sameer, Babu Sena Paul, Susanna Kass, and Seeram Ramakrishna. "Tools Towards the Sustainability and Circularity of Data Centers." *Circular Economy and Sustainability* 3, no. 1 (March 2023): 173–97. https://doi.org/10.1007/s43615-022-00191-9.

Maak, Niklas, and Neil Holt. *Server Manifesto: Data Center, Architecture and the Future of Democracy*. Berlin: Hatje Cantz, 2022.

Young, Liam, ed. *Machine Landscapes: Architectures of the Post-Anthropocene*. Architectural Design Profile, no 257. Oxford: John Wiley & Sons, 01.

Infrastructure Network

Graham, Stephen, ed. *Disrupted Cities: When Infrastructure Fails*. New York London: Routledge, 2010. https://doi.org/10.4324/9780203894484.

Vasques, Thiago Lara, Pedro Moura, and Aníbal De Almeida. "A Review on Energy Efficiency and Demand Response with Focus on Small and Medium Data Centers." *Energy Efficiency* 12, no. 5 (June 2019): 1399–1428. https://doi.org/10.1007/s12053-018-9753-2.

Data as Information

Gleick, James. *The Information: A History, a Theory, a Flood.* Fourth Estate paperback ed. London: Fourth Estate, 2012.

Democracy and Public Space

Mitrašinović, Miodrag. *Public Space Reader*. Milton: Taylor & Francis Group, 2021.

Mooshammer, Helge, Peter Mörtenböck, and Ross Exo Adams, eds. *Platform Urbanism and Its Discontents*. Rotterdam: Nai010 uitgevers, 2021.

Portugali, Yuval, ed. *The Crisis of Democracy in the Age of Cities*. Cities Series. Cheltenham, UK Northampton, MA: Edward Elgar Publishing, 2023. https://doi.org/10.4337/9781803923055.

Reflection

My investigation into digital infrastructure has reinforced architecture's unique position as a multidisciplinary field that bridges technical systems, social needs, and urban processes. Initially approaching data centers purely as technical facilities to be integrated into urban fabric, I came to realize how architectural thinking must engage with broader societal challenges. The research has evolved from focusing solely on infrastructure visibility and resource flows to considering how spatial design can support media literacy, democratic participation, and public understanding of digital systems in our increasing digital society.

This shift reflects architecture's critical role in synthesizing diverse fields of knowledge. When examining Madrid's data centers, I discovered that meaningful intervention requires understanding not just technical requirements and urban systems, but also information theory, democratic processes, and social practices. Architecture's strength lies in its ability to translate complex technological and social relationships into tangible spatial experiences. Rather than seeing technical and social aspects as limitations, I've learned to embrace architecture's role as a mediator between different disciplines, creating spaces that can bridge the gap between digital infrastructure and civic life.

The project exemplifies how architectural education at TU Delft prepares us to tackle complex contemporary challenges. Through the Architecture & Urbanism track and the Heterogeneous City studio, I've developed tools to analyze and respond to the multiple layers of urban infrastructure - from physical networks to social systems. These perspectives have helped transform what began as technical study into a richer exploration of how architecture can support democratic digital futures.

The investigation has taught me that architecture's impact comes not from trying to solve every aspect of complex challenges, but from creating frameworks where technical, social, and environmental solutions can coexist and interact. Through this lens, the project has become less about making infrastructure visible and more about designing spaces that enable new relationships between citizens and their digital environment. This multidisciplinary approach allows architecture to contribute meaningfully to contemporary challenges even when direct solutions lie beyond its traditional scope. The limitations I initially perceived have ultimately led to more nuanced and potentially impactful architectural propositions.