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The Impact of an Interface:

Exploring Concrete–Soil Entanglements

Susanne Trumpf

Introduction

In this essay about the subterranean environments of our urban landscapes, I revisit concepts of urban habitat and ecologies from the perspective of a cement interface. I advocate for a multidimensional examination of concrete and soil, considering their interrelationships and complexities to better understand the urban underground. The essay uncovers a fragile material interrelationship by questioning common practices that assess materials in isolation. This approach aligns with the premise that it is not the objects themselves but their relationships that form the foundation of a milieu (Prominski 2014).[1] To illustrate that concept, I will unpack the dynamic material relationships between concrete, soil and water. Here, concrete acts as an interface, forming the boundary between soil and water systems that are essential for urban ecological processes.

[1] Prominski (2014) uses the French geographer Augustin Berque's translation of 'milieu' referring to *fudo*, a Japanese concept integrating nature and culture.

The idea of using concrete as an interface between soil and water goes back to Roman times. In fact, the water-management strategies employed in the *pozzolane*-based roads[2] back then have not fundamentally changed: cambered road surfaces, combined with channels and ditches along the sides, are still frequently used to address runoff. Contemporary updates to these cementitious urban interfaces include drainage channels many kilometres long, underground floodwater storage and interception tunnels.[3] Such engineering solutions addressing flood control and stormwater management have long served to contain water that could not drain. However, by prioritizing technical efficiency, these single-function approaches have led to alterations in natural landscape systems that are now critiqued in light of climate change concerns. Extreme weather events, exceeding the capacity of these water-management solutions, have underscored the importance of facilitating water infiltration into the soil and spurred the development of concepts and materials that emphasize enhanced permeability of urban surfaces. Indeed, landscape architecture and urban planning discourses have long focused on addressing the effects of sealed surfaces (Margolis and Robinson 2007; Cupers and Miessen 2018), stressing the need for a more holistic and time-sensitive approach to effectively implementing nature-based concepts[4] in the urban realm (see Acosta and Ley 2023).

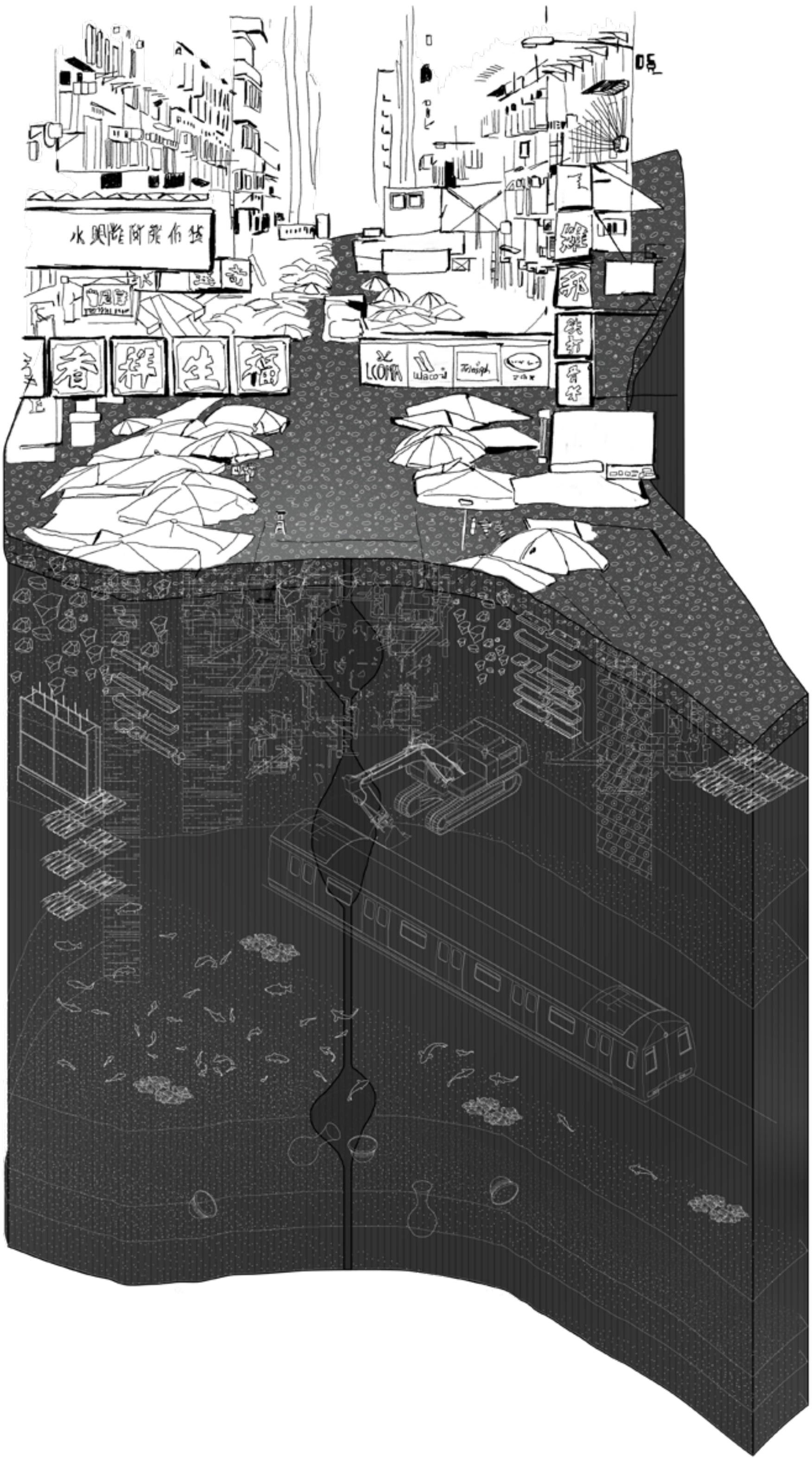
[2] Pozzolane, a volcanic ash material, was commonly used as a key ingredient in ancient Roman concrete. When mixing it with lime and water, a chemical reaction binds the material – similar to cement used today.
[3] Interception tunnels, typically constructed underground, divert water away from areas where it could cause flooding.
[4] Nature-based concepts embrace the integration of natural materials and processes. While concrete is commonly utilized in applications like eco-shorelines, permeable paving and as recycled aggregate, the need and scope of its use is frequently a subject of debates on material sustainability and environmental impact.

Understanding Concrete and Soil

From both cultural and scientific perspectives, perceptions of soil and concrete differ considerably. Soil is formed through processes of decay, decomposition and sedimentation, with physical components like sand, silt and clay being eroded and weathered by wind and water. In contrast, concrete is shaped into objects, surfaces and finishes, with the exothermic reaction of mixing water, sand and cement representing a process of creation. However, considering the intricate formation processes of both materials, the perceived dichotomy between soil and concrete is less distinct than it may initially seem. In urban settings where concrete and soil interact, the processes of decay and creation overlap – becoming indistinguishable. Similar to soil, concrete experiences deterioration processes, such as cracking, weathering and erosion, over time. Building upon Ingold's (2007: 7) assertion that "the surface of materiality is an illusion," I contend that cementitious interfaces must be understood as part of a living environment, encompassing an ongoing and generative process.

I walk around the densely populated streets of Mong Kok, Hong Kong, and observe one of the many excavation processes that unfold daily. A jackhammer breaks apart the patched concrete pavement, an excavator transfers the concrete rubble and soil onto a truck, and the excavated materials vanish from the urban scene as quickly as the noise of the tools once excavation is completed. The mixture of rocks, rubble and soil is transported to a fill bank located on the outskirts, where it is compacted and combined with excavated material from other construction activities around the city. Every day, approximately 36,500 tonnes of concrete and soil extracted from various locations are deposited at this site to weather, decompose and ultimately form a new soilscape. A portion of the displaced urban material is utilized for one of the city's reclamation projects, resulting in a new, likely sealed urban ground comprising a mixture of eroded concrete and soil.

[5] Public Fill Reception Facilities, also known as fill banks in Hong Kong, collect materials such as rocks, concrete, asphalt, rubble, bricks, stones and earth. These materials are collectively defined as public fill (CEDD 2019).

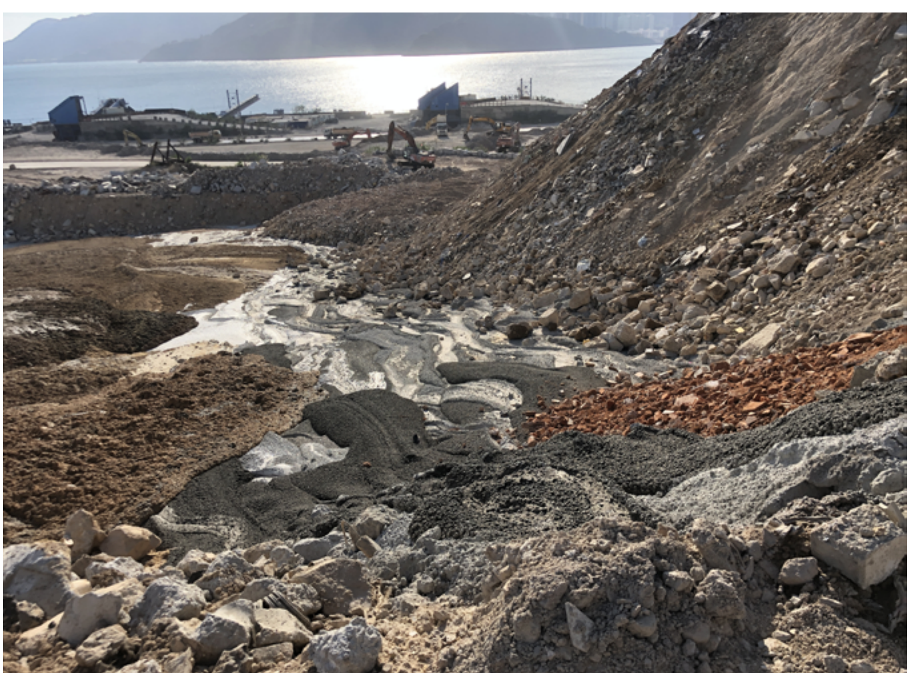


A streetscape in Mong Kok, Hong Kong. Drawing: Madison Appleby, 2022.

Whether the concrete particles in this mix are truly integrated as part of the soil is yet to be determined, questioning the often normative disciplinary definitions. For instance, it has been suggested that materials resistant to decay are problematic from an ecological standpoint, as they cannot be transformed into soil (Puig de la Bellacasa 2014: 29). Regardless of whether we view such residues as an integral part of soil, concrete can here no longer be considered as an urban surface but has turned into a (soil-)horizon in the terrestrial ecosystem. Given the vast timescale involved in this generative process of decay, reaching from two centuries (marked by the emergence of Portland cement) to geological time (estimated at 4.6 billion years), the chronology is complex. The multifaceted nature of urban residues has been explored under various temporal definitions, ranging from “slow humanly driven sedimentation” (Clemmensen 2022: 46) to “fast geologies” (Donald and Millar 2023). To enhance properly informed, time-based decision-making, I support the call for greater attention to abiotic processes of decay, such as erosion and sedimentation, within the landscape context (Clemmensen 2022). Adopting this approach will deepen our understanding of the critical factors that shape soil–concrete entanglements and their influence on urban-environmental processes.

Revealing Below-Ground Material Interactions

The interrelationship between concrete and soil remains even without blending the two materials. Sealed concrete surfaces not only affect urban-environmental processes above ground, but they also modify subterranean material interactions. Unlike soil, which gradually absorbs and captures heat before slowly releasing it, concrete rapidly takes in larger quantities of heat and releases it quickly. The combination of increased heat stress and diminished water infiltration into soil layers beneath concrete surfaces results in altered urban substrates that are typically drier, more compact and contain



Urban soils, redefined as construction waste and public fill, consigned to the Tseung Kwan O Area 137 Fill Bank, Hong Kong. Photo: Ceci Wong, 2021.

lower levels of organic matter. It is essential to recognize that moist soil ecosystems are vital for maintaining soil oxygen content, carbon storage and supporting greater amounts of microbial mass (Fierer 2017). Yet our understanding of the microbial world beneath our feet remains limited. Over the past century, the extensive use of concrete may have led to species adaptation or extinction, higher temperatures potentially accelerating the growth of certain fungi while retarding others, and the spread of invasive species without our knowledge (Geisen et al. 2019). These less-attended organisms represent part of a complex dynamic system interacting with and responding to anthropogenic material transformations.

The multitude of concrete interfaces in a street in Mong Kok once again serves as an apt example to illustrate the spatial complexity of such environments. From an above-ground perspective, one might easily overlook the presence of soil in one of the modestly vegetated pocket parks as it seamlessly integrates with the sealed surfaces. A handful of native shrubs, mostly Indian hawthorn, endure in the grey, lifeless, dry and hardened urban soil. In contrast, just a short distance away a seemingly contradictory phenomenon can be observed: a lush sprout of the same species thrives in a crack within the concrete pavement, appearing vibrant and resilient despite its apparently compromised habitat. In essence, the behaviour of soil systems beneath the interface does not always correspond with the observable above-ground conditions. The below-ground microbial world, for example, may be both negatively affected and positively supported by the concrete interface.

Previously considered unwanted weeds, such vegetation is now celebrated as “superheroes of ecosystem services” (Toland 2020: 137). Landscape architects and ecologists are increasingly recognizing the potential of these resilient and self-sustaining plant communities, which thrive in seemingly suboptimal habitats such as roadsides, cracks and building facades. Drawing upon this analogy, there is an opportunity to integrate the discourse on below-ground biodiversity into existing conversations about spontaneous vegetation, ultimately promoting a more comprehensive understanding of urban ecosystems.

Conclusion

The significance of landscape-centred temporal views for generating new insights into soil processes is increasingly apparent (Meulemans et al. 2017; Sieweke 2023). Landscape architecture practice and applied research have prototyped efforts that prioritize long-term material processes (Bargmann 2013; Kennen and Kirkwood 2015). While these approaches necessitate further development and monitoring, the avenues for integrating material transformations into urban practice are available and poised to enhance our understanding of the distribution, abundance and temporality of various material-related phenomena.

When assessing the urban-environmental values of concrete, it is crucial to further reframe our understanding of ‘creation’ by examining the dichotomy between relationship and object. We must delineate the role of concrete interfaces within this landscape approach that not only recognizes the complex and dynamic culture–nature relationships between concrete, water and soil but also acknowledges that each facet of these relationships embodies properties that are not static. Instead, they continuously evolve and need to be reinterpreted over time and in each unique setting.

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