

Granular Configurations: Attending to the Material Politics of Planetary Design

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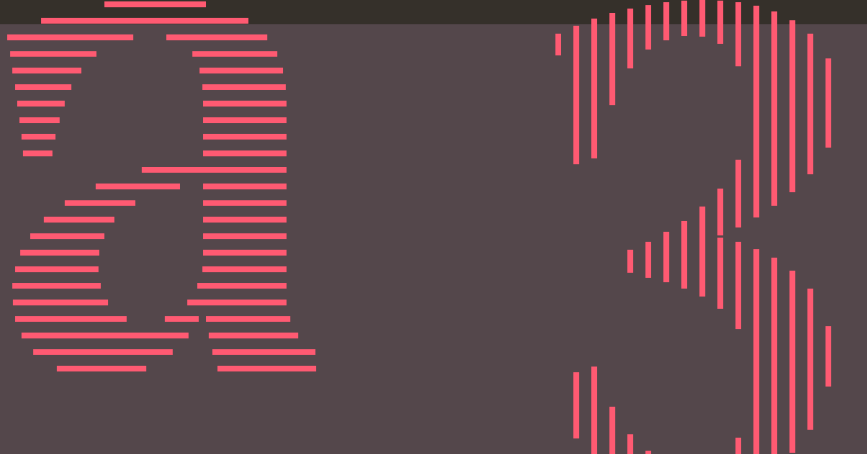
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This paper examines how planetary design is materially enacted through the granular politics of sand. Moving beyond abstract accounts of planetary entanglement, it traces how sand's trajectories—across extraction zones, supply chains, and reclaimed coastlines—compose volatile and uneven urban futures. Drawing on research in Southeast Asia and the Netherlands, the paper shows how sand operates not merely as a construction input but as a medium of speculation, disruption, and socio-ecological harm. Through the lens of granular configurations, I develop a methodological framework that foregrounds friction, partiality, and multi-temporality in the making and unmaking of environments. This approach unsettles dominant narratives of design as coherent or systemically integrated, revealing instead its contingent, contested, and more-than-human formations. Attending to sand's granular materiality opens new possibilities for situated, accountable, and reparative practices in an increasingly unstable world.

Keywords

 granularity

 granular configurations

 planetary design

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 material politics

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Granular Configurations: Attending to the Material Politics of Planetary Design

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PLANETARY ENTANGLEMENTS AND THE MATERIAL POLITICS OF DESIGN

We are living in a time when the boundaries between the human and the non-human, the local and the global, and the natural and the artificial are increasingly difficult to discern. Planetary entanglements—defined by intricate and dynamic interrelations among biological, geological, ecological, and technological processes—compel a profound rethinking of how we design, research, and inhabit the world. Within this shifting landscape, design itself has undergone a conceptual transformation. Rather than being limited to discrete objects or bounded sites, design is now increasingly understood as a world-making force—an activity that shapes environments, relations, and futures on a planetary scale (Colomina & Wigley, 2016; Escobar, 2018; Fry, 2012).

This expanded horizon casts design as a mode of intervening in and organizing environments, ranging from the molecular to the atmospheric. Yet, as design becomes planetary, it also becomes more abstract. Framed through relational ontologies, global infrastructures, or systemic adaptivity (Ingold, 2013; Irwin et al., 2015; Yaneva & Zaera-Polo, 2017), design risks being decoupled from the situated, material, and often frictional practices through which worlds are actually made and unmade. This tendency mirrors critiques raised within debates on planetary urbanization, where scholars have argued that abstraction may flatten differences and obscure situated histories, ecologies, and struggles (Ruddick et al., 2018).

To counter these universalizing drifts, we need approaches that reintroduce materiality, partiality, and situated practice into accounts of the planetary (Haraway, 1988). Doing justice to the frictions that compose planetary life requires analytic tools capable of holding multiple scales and temporalities on the same plane without collapsing them into a single explanatory frame. It also requires attending to *how* the planetary is enacted through

concrete practices, infrastructures, and materials, and how these enactments generate uneven conditions of vulnerability, possibility, and change.

Sand—one of the most widely used yet least examined materials in the built environment—offers such a lens. Despite its seeming mundanity, sand is foundational to the infrastructures that organize modern life: it is the basis of concrete and glass, buildings and roads, and the primary material through which land reclamation and coastal engineering projects reshape shorelines and extend urban frontiers. It also constitutes beaches, riverbeds, and seabeds, forming part of the dynamic sedimentary systems that sustain coastal ecologies.

As it circulates through global extractive economies and local informal markets (Beiser, 2018; Torres et al., 2017), sand moves across multiple registers—geological, ecological, economic, and political—binding together sites that are otherwise treated as disconnected. At the same time, sand is deeply implicated in the violent and uneven geographies of resource extraction that underwrite urban development and infrastructural expansion, from the dispossession of coastal communities to the ecological degradation of river systems and littoral zones (Bisht, 2021; Lamb et al., 2019; Marschke & Rousseau, 2022).

Once extracted, sand enters complex logistical networks. It must be graded, washed, sieved, and certified before it becomes usable in concrete, glass, or land reclamation. These processes illustrate how design is not merely applied to materials but actively produces them. Sand becomes material through classificatory regimes and through the infrastructures that support these regimes (Richardson & Weszkalnys, 2014). Standardization makes granules interchangeable across distant geographies, transforming sediment from Cambodia, the North Sea, or the Arabian Gulf into compatible units of urban expansion.

Simultaneously, sand's granular nature evades attempts to manage it. Granular materials are composed of discrete particles that interact through friction, collision, and compaction. Consequently, granular materials are inherently unstable and difficult to govern: they settle, shift, erode, compress, liquefy, and reconfigure under changing conditions of pressure, moisture, and movement (Jaeger et al., 1996). While sand's granular physics enables its ready extraction, transport, and transformation, its very transience unsettles the durability and predictability of the landscapes it helps to produce.

As a granular material, sand prompts a shift in the analytic register. Its mobility and indeterminacy unsettle modernist assumptions of permanence and mastery, reframing design as a situated practice attuned to

dynamic and often unpredictable environments. It allows us to think of accumulation and erosion, stability and instability, construction and dissolution simultaneously. Granularity foregrounds the ceaseless movements, circulations, and frictions through which environments are designed, inhabited, and continually remade. Highlighting how matter is mobilized, standardized, and transformed in service of urban and planetary futures reveals how futures built on sand remain fragile, contested, and perpetually in flux.

Attending to granularity does not simply scale planetary processes down; rather, it reveals their constitutive materialities and the socioecological frictions they generate (Tsing, 2004, 2015), offering a way to apprehend planetary urbanization not as an abstract system but as a set of situated, granular configurations (Büsse, 2025). Focusing on sand, therefore, offers more than a descriptive account of a single material. It provides a method for understanding the material politics of design: how materials participate in design processes, how design practices emerge from material activity, and how these dynamics unsettle assumptions about agency, scale, and intention (Bennett, 2010; Blok et al., 2016).

This reconceptualization draws inspiration from feminist, postcolonial, and environmental humanities scholarship that emphasizes relational ontologies, material entanglements, and situated epistemologies (Haraway, 1988; Todd, 2016; Yusoff, 2018). It builds on recent calls to theorize urbanization not only through infrastructural or financial flows but also through the metabolism of matter—its extraction, circulation, and transformation (Dawson, 2021; Jamieson, 2021). In doing so, it aligns with efforts to provincialize urban theory (Robinson, 2006; Simone, 2004) and foregrounds the uneven terrains through which planetary processes materialize.

A notable contribution in this regard is geographer William Jamieson's work on "granular geography" (2021). Examining Singapore's extensive sand imports, Jamieson demonstrates how granular substances mediate territorial formation, producing a compelling account of the ways matter can unsettle and reorder spatial arrangements. His intervention foregrounds the spatial and geopolitical implications of granularity, showing how the movement and accumulation of sand reconfigure jurisdictional boundaries, environmental relations, and state imaginaries.

While Jamieson's analysis illuminates how sand materially shapes territory, my approach departs by mobilizing granularity not only as an object of analysis but as a methodological lens. Rather than focusing solely on the spatial effects of shifting sand, I treat granularity as a mode of attending to the material politics of design—one that highlights how socio-material practices compose, contest, and anticipate planetary futures. This shift redirects

attention from the territorial outcomes of sand's circulation to the situated, speculative, and often contested configurations that produce the conditions for urban and environmental transformation.

In what follows, I use sand as a lens to examine planetary entanglements and to articulate a more granular understanding of the material politics of design. By doing so, I foreground the frictional and partial nature of planetary world-making and offer an approach that complicates universalizing narratives of design. This perspective seeks to make visible how planetary processes are enacted in practice, and how attending to their granular materialities opens new ways of thinking, designing, and inhabiting an increasingly unstable planet.

SAND AS A MEDIUM OF SPECULATION, DISRUPTION, AND PROMISE

My understanding of sand emerges from years of research on the material politics of land reclamation in Southeast Asia and the Netherlands. In these settings, sand is not simply sediment but a medium through which ambitions of national development, speculative urbanism, and climate-change mitigation take shape. In the Netherlands, the use of sediment to engineer territory is embedded in a centuries-long project of hydraulic manipulation that has defined the Dutch delta as a technological artifact. From the medieval drainage of peatlands and the construction of dikes to the massive polder systems of the 17th century, land reclamation has been central to agrarian production and the consolidation of state power (Van Koningsveld et al., 2008).

The 20th century only expanded these ambitions through the creation of storm-surge barriers, sluices, and dams, effectively entrenching sand management and reclamation as cornerstones of Dutch identity and infrastructural modernity. In recent decades, Dutch engineering has shifted from hard-edged control toward approaches that work *with* dynamic sedimentary processes. Large-scale nourishments, such as the sand engine (*Zandmotor*), rely on the strategic deposition of millions of cubic meters of sand offshore, allowing tides and currents to distribute sediment gradually along the coast (De Vriend & Van Koningsveld, 2012).

While framed as innovative, nature-based solutions to sea-level rise, such interventions nonetheless depend on the continuous extraction, displacement, and redistribution of granular matter, rendering Dutch territorial stability materially contingent on offshore sediment reserves and global dredging capacities. The Netherlands' expertise in hydraulic engineering and sediment management now circulates globally, influencing reclamation and

coastal-design practices from the Persian Gulf to Southeast Asia, where it is translated and adapted to very different geological, economic, and political conditions.

In Southeast Asia, land reclamation is frequently entwined with spectacular visions of urban and economic transformation. Projects such as Singapore's Marina Bay or Manila Bay in the Philippines exemplify how sand becomes a tool for manufacturing premium real estate, attracting global investment, and materializing national aspirations. Singapore is often cited as the paradigmatic case in which land reclamation and nation-building are mutually reinforcing processes (Chua, 2020; Jamieson, 2017). Over the past fifty years, the city-state has expanded its landmass by roughly a quarter, reshaping not only its physical coastline but also its social fabric, economic, and geopolitical horizons. These expansions rely on vast quantities of imported sand, circulating through both formal planning regimes and informal extraction economies (Global Witness, 2010).

Unlike the Dutch context—where sediment interventions are embedded in a temperate delta with strong regulatory institutions, long-standing hydraulic expertise, and centralized water governance—Southeast Asian reclamation unfolds within uneven state capacities and highly financialized development regimes. These differing conditions enable more speculative and ecologically disruptive practices than those typically sanctioned in the Netherlands.

Contrary to the popular assumption that sand is abundant, it is a finite resource whose removal destabilizes the riverine, coastal, and deltaic ecologies that depend on sediment flows for biodiversity, flood regulation, and shoreline integrity. The Mekong Delta, for instance, has suffered decades of unregulated dredging to fuel Singapore's expansion, accelerating bank erosion, altering sediment regimes, and undermining livelihoods reliant on fisheries and agriculture (Bravard et al., 2013; Jordan et al., 2019). Resistance movements have emerged across Southeast Asia, though often constrained by political repression and the transboundary nature of the trade. These struggles illuminate how sand extraction is embedded in broader political economies of resource frontiers, environmental governance, and urban speculation (Bisht, 2021).

Spectacular reclamation projects have proliferated across the region in recent years. Forest City—an artificial island and “eco-smart” city in Johor—and Melaka Gateway—originally envisioned as a multi-island development off the coast of Malacca—were designed to attract international residents and channel global capital flows, largely from China, in order to materialize ambitious visions of urban and economic transformation (Cipriani,

2022; Moser, 2018). Both projects have stalled due to political contestation, financial uncertainty, and shifting state priorities, leaving behind only partially formed landforms. These unfinished terrains have become sites of ecological improvisation, where intertidal flats attract migratory birds, mangrove seedlings take root in newly sheltered sediment pockets, and tidal flows carve microhabitats along their incomplete shorelines. Despite their impending ruination, these projects reveal how speculative urbanism produces landscapes that are at once engineered and indeterminate—territories where the mobilization of sand generates not only developmental ambition but also unexpected socioecological reconfigurations.

These brief vignettes from my research sites illustrate how sand's movements are inseparable from the geopolitical contexts, infrastructural ambitions, and extraction economies through which contemporary territorial futures are forged. Sand does not merely provide the material substrate for new urban surfaces: it actively conditions the socioecological relations through which futures—planned, contested, or emergent—come into being. Its speculative capacity is always shadowed by its disruptive force: extraction, circulation, and deposition unsettle ecologies, redistribute environmental risks, and generate frictions that reverberate across communities and habitats. Dredging reshapes littoral environments, sediment removal accelerates erosion and biodiversity loss, and the commodification of sand sustains informal economies that bind local livelihoods to volatile geopolitical dynamics. These disruptions expose the profound fragility of the very futures that sand is mobilized to secure, underscoring how unevenly the benefits and burdens of reclamation are distributed.

Attending to sand as a lively and contested design material makes visible the granular politics through which planetary urbanization is both assembled and rendered vulnerable. Across these different contexts, sand extraction operates through a shared planetary logic: it converts sedimentary landscapes into design-ready material, producing global inequalities and ecological precarity. Yet each case also reveals distinct sociopolitical dynamics, demonstrating the irreducible situatedness of planetary processes. Following sand thus clarifies that planetary design is never abstract or universal: it is always grounded in place-specific histories, regulatory regimes, and struggles over land, labor, and ecology.

GRANULAR CONFIGURATIONS: REORIENTING DESIGN AS PLANETARY PRAXIS

Granular configurations challenge dominant assumptions of design as intentional, coherent, and future-oriented. Rather than presenting

design as the outcome of deliberate planning, this approach foregrounds it as performative and contingent, shaped by unruly materials, uneven power relations, and conflicting sociotechnical imaginaries (Büsse, 2023). As a methodological lens, granular configurations trace the socio-material processes through which sand becomes a design material—its extraction, classification, circulation, accumulation, and (de)stabilization. Through this perspective, planetary design appears not as a unified system but as a constellation of frictional arrangements. In this sense, it resonates with Jennifer Gabrys' notion of "*planetary praxis*" (2018), which reframes planetary engagement as an ongoing, situated negotiation with heterogeneous environments, infrastructures, and modes of inhabitation rather than the management of a singular, coherent Earth system. Granularity thus compels us to conceptualize the planetary not as a stable totality but as a terrain of interruption, contingency, and contested ecology.

Recognizing these configurations requires acknowledging that design operates across multiple, interwoven scales and temporal registers. Coastal expansion through land reclamation makes this dynamic explicit: it simultaneously draws on ecological time—marked by sediment flows and tidal rhythms—and industrial time—structured by project cycles, resource logistics, and political urgency. Engaging with these entangled temporalities challenges linear narratives of development and control foundational to modernist design ideologies, calling instead for speculative, reparative, and responsive approaches attentive to histories of extraction, colonization, and ecological disruption (Puig de la Bellacasa, 2017). Sand does not simply build cities; it also haunts them, carrying residues of lost ecologies, signaling extractive pressure, and foreshadowing infrastructural fragility.

These planetary entanglements likewise unsettle research paradigms grounded in objectivity, universality, and scalability. Granular configurations foreground principles central to feminist science studies and the environmental humanities—partiality, situatedness, relationality, and friction (Haraway, 1988; Tsing, 2004). As sand circulates through transnational supply chains and juridical regimes, it accumulates layers of legal ambiguity, labor struggle, and ecological violence that resist reduction to global models or abstract indicators.

Methodologically, this necessitates rethinking how urban environments are observed and interpreted. Attending to granular configurations involves "listening" to sediment, reading infrastructural decay and transformation as archives of social and environmental processes, and tracing the often-invisible residues of extraction, speculation, and environmental change that underwrite present-day conditions. These residues bear the imprint of

slow violence and reveal uneven ecological feedback loops linking localized degradation to broader planetary shifts (Nixon, 2011).

A granular methodology begins from place—riverbanks, sand quarries, dredging sites, or stalled reclamation projects. Rather than leaping scales or homogenizing experience, it insists on grounded, ethnographic, and materially sensitive engagement. This does not reject planetary thinking but reconfigures it through the specificity of the granular. As De la Cadena and Blaser (2018) argue, friction is not a problem to be resolved, but a site of encounter where epistemic regimes collide and alternative worlds come into view. Such an approach calls for transdisciplinary collaboration across geography, political ecology, design, anthropology, and adjacent fields. Navigating the granular involves crossing disciplinary thresholds, acknowledging asymmetries of knowledge and power, and embracing lateral, layered, and experimental methods.

Conceptualizing the planetary through granularity thus offers a critical reorientation for design research in an entangled world. By attending to materials such as sand, scholars and practitioners are invited to engage with differentiated, frictional, and temporally uneven planetary processes. This orientation challenges abstraction and mastery, foregrounding complexity, partiality, and ethical responsibility. In doing so, design emerges as a situated and speculative practice embedded within geological and ecological processes, while research adopts multi-scalar, experimental, and reparative methodologies capable of grappling with the uneven material conditions of planetary urbanization.

CONCLUSION

This paper has traced how sand provides a powerful lens through which to rethink the material politics of design. Beginning from planetary entanglements—where ecological, infrastructural, and political processes co-constitute one another across scales—I have argued that design cannot be understood as an abstract, coherent, or universal project. Instead, it emerges through situated, frictional, and often contradictory practices that take shape through specific materials, infrastructures, and ecologies. Sand's trajectories illuminate this condition. Its geomorphological origins, extractive economies, speculative mobilizations, and socio-ecological consequences expose how planetary worlds are composed from unstable, shifting, and contested material grounds.

Sand is a particularly generative analytical device because it renders visible dynamics that are otherwise difficult to apprehend within debates on planetary urbanization, environmental change, and material poli-

tics. At once planetary and hyper-local, sand forms over hundreds of years before it circulates through contemporary supply chains, linking remote coastlines to urban megaprojects, informal extraction economies to state-led visions of urban futures. Its quiet ubiquity—in concrete, glass, reclaimed land, and digital infrastructures—means that it underpins much of the built environment while remaining conceptually overlooked. This makes sand uniquely suited to reveal the taken-for-granted material substrates of modern life.

Attending to sand also foregrounds the frictions of globalization: uneven regulatory regimes, ecological degradation, smuggling networks, and the violent geographies of resource extraction that produce profoundly uneven conditions of vulnerability and possibility. Given that sand registers multiple temporalities—from deep geological processes to the accelerated rhythms of speculative urbanism—it enables analyses that hold long-term planetary dynamics alongside situated, short-term transformations. Its granular and mobile qualities draw attention to dispersed labor, fragmented sovereignties, and the everyday practices through which planetary formations are assembled and contested.

By foregrounding granular configurations, this paper calls for a methodological and conceptual shift in design research. Granularity offers a way to apprehend the planetary without succumbing to abstraction. It advances an analytics that moves with materials, attends to friction, and holds multiple temporalities in view. Such an approach destabilizes conventional binaries and situates design within the dynamic, uncertain, and contested terrains of planetary life. In doing so, it reframes design not as the realization of prefigured futures but as an ongoing engagement with the socio-material conditions through which planetary worlds are continuously made, unmade, and reconfigured. □

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