Technology|Architecture + Design

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/utad20

Geomorphic Tectonics

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Intractable Divisions?

Current approaches to the architectural object and the concepts of tectonics exhibit significant limitations in their capacity to address compound sustainability problems and environmental degradation caused by rapid urbanization, densification, and construction. These limitations arise in large part from the connected perceptions

1. that urban form is composed of discrete systems and objects,
2. that architectures need to be discrete objects that must be set apart from their surroundings, and
3. that tectonics needs to conform to and affirm the implied divisions. In general terms, the restraints stem from the perceived dichotomy between the human-made and the natural and preclude a more integrative approach. An alternative approach might focus on intensive integration rather than separating architectures and their settings.

In search of a general theory of architecture, Gottfried Semper described four elements of which all architecture can be said to consist: the *hearth*, *roof*, *enclosure*, and *mound*. Semper posited that these four elements are articulated and arranged following local circumstances, climate, and culture (Semper 1851, 55). Today, however, local differences and diversity of architecture have disappeared, especially in urban settings, and a more generic range of buildings and tectonic articulations prevail. In this context, the *mound* and related earthworks constitute no longer a primary part of tectonics. Instead, earthworks are frequently relegated to the leveling of sites, excavation to accommodate underground spaces, and modest applications to facilitate green roofs.

◁ Figure 1. Stabilizing concrete grid in forest over road, Japan, 2017. (Credit: vasa)

▷ Figure 2. The two swimming pools on the beach at Leça da Palmeira, Portugal, 2008. This project was designed by Álvaro Siza Vieira from 1959 to 1973. (Credit: Christian Gänshirt CC BY-SA 4.0, via Wikimedia Commons)

This tendency derives in part from the Modernist credo that had positioned the "natural" site as the enemy of humans and the "natural" ground as a source of illness (Le Corbusier 1967, 55–56). This led to the postulation of the conception of new ground as part of a new architecture, with the new ground too being separated from its setting. The persistent belief further intensified this development that leveling the site constitutes an indispensable proto-architectural action to provide a site that is easier to survey, maintain, build upon, and use. However, today any site with complex terrain can be surveyed with relative ease using surveying technology such as unmanned aerial vehicles (UAVs) equipped with various sensors. Furthermore, contemporary construction methods and technology, especially landscape engineering solutions, provide the means for construction on uneven terrain. However, the question regarding the "use" of ground is more complex. Addressing this matter involves a clear definition of "use" and "users" and, in the context of complex sustainability problems and environmental degradation, considerations concerning a broad range of aspects related to the integration of architecture and environment (Hensel 2022, 460–70), and more specific questions related to mineral and land rights from a multi-actor perspective (Hensel 2019).

Reimagining Ground

John Rajchman suggested that "'ground' is a word … [that] may be said to have a conceptual potential that one can exploit to suggest new ways of thinking and perhaps also of building" (Rajchman 1998, 77–78). Numerous contemporary thinkers contemplated this matter and extended the related terminology to allude to various ground-related traits embodied in expressions such as territory, terrain, soil, etc. Bruno Latour, for instance, proposed a new concept or political actor that he termed the *Terrestrial*, which involves "two complementary movements that modernization has made contradictory: attaching oneself to the soil, on the one hand, becoming part of the world on the other" (Latour 2017, 92). The *Terrestrial* thus "brings together the opposing figures of the soil and the world," inheriting from soil "materiality, heterogeneity, thickness, dust, humus, the succession of layers, strata, the attentive care it requires," and from the world "the recording of forms of existence that forbid us to limit ourselves to a single location, preclude keeping ourselves inside whatever boundaries there may be" (Latour 2017, 92). The latter implies that "it makes no sense to force the beings animating the struggling territories that constitute the Terrestrial back inside national, regional, ethnic, or identity boundaries … The subversion of scales and temporal and spatial frontiers defines the Terrestrial" (Latour 2017, 93). The concept of the *Terrestrial* offers an inroad towards reimaging cities as continuous landforms defined by features that provide for and engender colonization of ground from a multi-factor perspective. This involves nondiscrete architectures that are embedded in their setting in such a manner as to give a new continuous and continuously articled terrain and invites envisaging an alternative tectonic resolution that blends architecture, landscape architecture, and landscape engineering.

How might one then picture such an alternative tectonic? Interesting examples can be found in the landscape-related fine art photos of Toshio Shibata, specifically his work on landscape engineering structures in the natural landscapes of Japan. The portrayed structures often serve the purpose of steep slope

△ Figure 3. Sand deposits off Hallig Hooge, Germany, 2020. (Credit: Federal Waterways Engineering and Research Institute, Karlsruhe, Germany CC BY-SA 2.0, via Wikimedia Commons)

stabilization and related water management. What is of interest is how structures and terrain are enmeshed and follow the existing landform while also introducing a new hybrid terrain that frequently transitions from challenging surface constructions to gridded structures, to geotextile nets, to stepping of landscape and the use of vegetation for soil stabilization (Figure 1). While these constructions do not provide typical architectural enclosures, it is nevertheless easy to imagine how this might be done. Another noteworthy example is Alvar Siza's Tidal pools in Leça da Palmeira, Portugal (1966), and how the pools and related constructions are integrated into the existing natural terrain of the rocky and sandy beach (Figure 2). In urban contexts, however, natural landforms and terrain features may have been entirely eradicated. In this case, it is useful to envisage architectures that provide terrain through construction, keeping existing soil on site to use extensively in articulating the architecture, often in multifunctional and possibly even structural terms. Different actors or species can then colonize such architectures because of the conditions set out by a tectonic resulting from blended construction and landscape.

Thresholds in Time

Recent research shows that geodiversity can support biodiversity (Tukiainen et al. 2019). This suggests that linking architectural form and construction with geomorphology, the study of landforms and landform evolution (Stetler 2014), could underpin a multi-actor and multispecies approach to the design of buildings and cities. In this context, two questions arise: (1) How can construction provide landform and geodiversity; and (2) How can construction embrace landform evolution?

Tackling these questions requires replacing the model of hard thresholds that underlies the understanding of architectures as discrete objects that are set apart from their surroundings and urban form as composed of discrete sets of systems and objects. As suggested above, architecture and cities can be considered and designed as continuous and continuously differentiated terrain, thereby providing a constructed geodiversity.

A key question is how to address the dynamic aspect of landform evolution and how natural landforms and soils are non-equilibrium thermodynamic systems (Almquist 2020). Dynamic geomorphic processes are generally not incorporated and maintained in human interventions and constructions. Instead, the transformative impact of geomorphic agents is neutralized through constructional means, and humans have become the dominant geological and geomorphological agents by neutralizing natural geomorphic agents (Price et al. 2011). Commonly consolidated terrain and ground are preferred for construction, and where nonconsolidated landscapes are settled upon, constructions stabilize terrain and ground and prevent perceived risks for humans.

To address this problem it is helpful to examine Josef Reichholf's critique of the currently prevailing approach to living nature preservation, which focuses on equilibria or consolidation of what has been observed, e.g., maintaining the number of elephants in each region within the limits of natural fluctuation. Reichholf referred to this approach as the maintenance of *dynamic equilibria* and contrasted this with another system that he termed *stable disequilibria* aims to care for and support more significant dynamics, such as evolution, which can lead to the disappearance of species. These two approaches are at odds with one another since preserving a status quo requires consolidation, which runs counter to the more significant dynamics of change. The same can be said about the issue of consolidating landforms. What is needed, then, is a *stable disequilibria* approach to landform dynamics.

Throughout history, examples of humans coping with and inhabiting dynamic environments existed. An interesting example is represented by the so-called Hallig Islands, small naturally formed islands without protective dikes, located in the Wadden Sea of the German and Danish North Sea, where the water of the sea and its tidal changes and currents dynamically shape the equilibrium between land and sea through sediment deposition or erosion (Meier et al. 2013) (Figure 3). Since the Hallig Islands have no dikes, they are subjected to the impact of springtides that flood, reshape, and sometimes eradicate these small islands. Humans have used these islands for centuries for cattle and sheep grazing and constructed shelter for humans and animals that consist of large mounds and buildings built on top of these mounds. Examples like these are invariably examined in terms of a clear distinction between landscape and architecture, island, and house, and the rise the house is constructed upon, thereby reinforcing the discreteness of architecture and the related established tectonic tradition. Alternatively, it would be possible to understand the entire Hallig island complex and its exchange with the surroundings as an architecture. Water currents and tides, salt and sediment deposition or erosion, and plant and animal species form an environment in which humans intervene with subtle methods to secure some level of equilibrium while at the same time not obstructing the natural dynamics that continually reshape this environment. However, with rising sea levels and more severe floods, these small islands are now at risk of being washed away. Currently considered solutions to this threat are the implementation of dikes or using bulldozers to maintain the shore. Still, the shore is where biodiversity is the greatest and where numerous migrating seabirds come for breeding. With heavy equipment maintaining the shoreline, this biodiversity is bulldozed away. This points toward the fact that there are currently no approaches or models for addressing environments undergoing rapid change, posing high-risk factors for humans. In Germany, this led to a discussion that such risk areas should perhaps no longer be settled upon by humans, which further highlights the need for ways of working with stable disequilibria.

The critical question least examined today is how to imagine an integration of architecture and environment in such a manner as to provide geodiversity and biodiversity while incorporating the dynamics that shape these diversities. While this involves risk on some level, the obstruction of environmental dynamics entails the much greater risk of fundamentally altering or damaging the environment so that it becomes uninhabitable for many actors. In the example of the Hallig Islands, the dynamic interactions between different systems are well studied and documented by various disciplines. The challenge today lies in mapping this knowledge onto architectural thinking and design en route to geomorphic tectonics and architecture and environment integration. In this effort, one should not be irritated by strenuous objections from a conservative AEC sector and instead insistently pursue a path towards alternative architecture and contemporary tectonics.

Acknowledgment
The authors acknowledge TU Wien Bibliothek for financial support through its Open Access Funding Programme.

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