Metabolic Tectonics

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Historical conceptions of architecture view buildings as static artifacts within the ever-changing global network of natural, economic, and social processes. In most cases, our built environment resists rather than accommodates these ever-changing conditions, necessitating intensive renovation or redevelopment. More fundamentally, the realm of design is thought to neatly conclude with the completion of the building, thus rendering off-limits processes of subtraction, reconstruction, succession and change.

Modern industrial processes, and the static, standardized, mass-produced nature of the building materials resulting from them, further accentuate this paradigm. While modern industry gained its vitality by destructively and carelessly externalizing ecological and social harms, new paradigms in industry—ecological paradigms—instead seek to participate in ecologies in a conscious and intentional manner.

A dynamic tectonic approach is one architectural analogue of this fundamental shift in industrial production. This approach looks beyond the form and properties of building materials to the systems in which they participate, harnessing metabolic processes to open new realms of design. Consequently, architecture must be reconsidered as a continuous process, rather than an artifact with a designed end state. By doing so, processes of change and renewal could be inhabited, making construction process an integral and ongoing part of spatial experience.

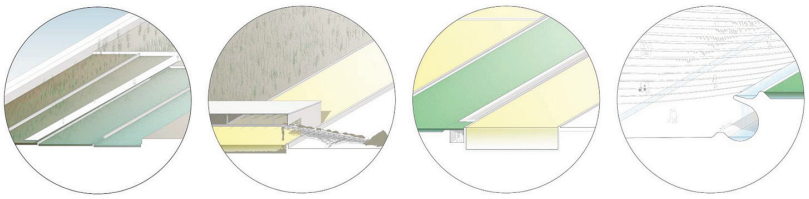
In this strategy, the role of the architect is repositioned as historically understood. By engaging and orchestrating the agency of a diverse field of both human and nonhuman entities; new ecological impacts, new modes of practice, and new aesthetic expressions can be generated, ones that change and evolve with the life of the city, the site and their processes. Metabolic Tectonics is this synthesis of industrial, ecological and architectural processes. Through the lens of de-industrialization in North American cities, a metabolic tectonic approach is explored through the potential relationships between industrial byproducts and metabolic processes. Inspired by the global natural processes cycling nutrients through the interaction of biotic and abiotic factors, a dynamic material system is developed transforming steel slag and carbon dioxide into a biomineralization landscape, where ecological production processes serve as spatial generators of architectural experience.

Explored at scales ranging from the urban, to the body, to the molecule; physical models of material deposition behaviour led to the development of architectural interventions that guide the hydrological flow of the systems to create a dynamic spatial experience of the fabrication process. Over time, visitors are able to visit and appreciate the waterfront's transformation from toxic industrial wasteland to a productive landscape, with a revitalized ecology. Generated by a tectonically focused design process, the architect's role is redefined as a generator of systems with particular capabilities rather than just a spatial artifact. Design agency is shared, as natural forces intervene in the system, providing opportunities for selectively relinquishing portions of control to other entities and processes. Thus, architecture is reconceptualized as a system of tectonics capable of generating dynamic spatial experiences over time, fostering a new understanding of production: industrially, ecologically, and—ultimately—architecturally.

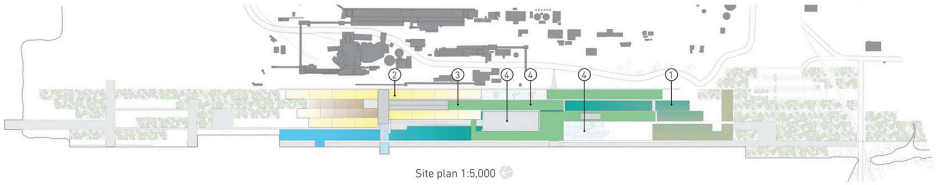
Metabolic Tectonics

Generated by the deployment of microbial production process, the biomineralization landscape on the waterfront of Hamilton's largest steel plant combines industrial production, ecological production and remediation. As slag is transformed through microbial activity, architectural interventions guide the hydrological flow of the systems to create a dynamic spatial experience of the fabrication process. Over time, visitors are able to visit and appreciate the waterfront's transformation from toxic industrial wasteland to a productive landscape, with a revitalized ecology.

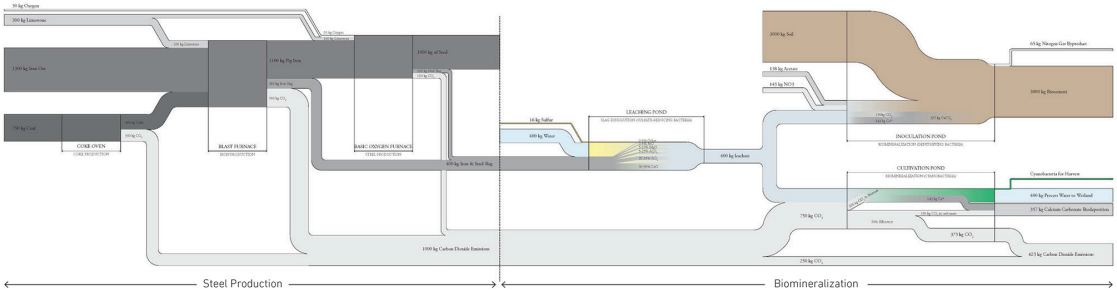
First the slag is deposited into a series of leaching ponds where sulfate-reducing bacteria help dissolve the rock into its individual compounds. The calcium rich leachate is then guided into cyanobacteria cultivation ponds that are injected with waste carbon dioxide emissions to produce supersaturated calcium carbonate solution, leading it to precipitate solid minerals along surfaces.

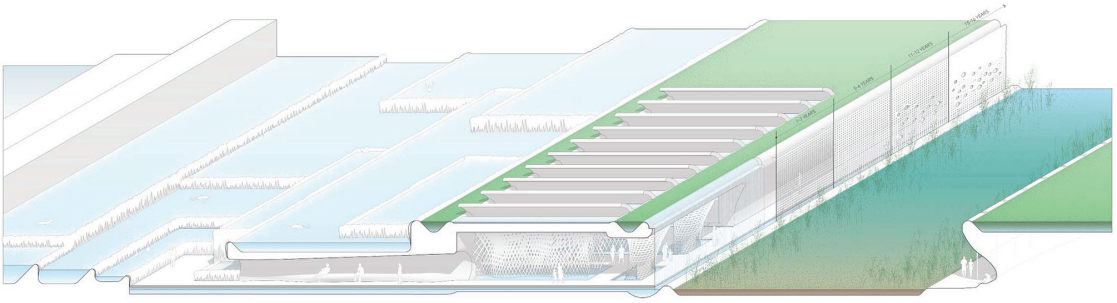


1. Wetland
2. Slag leaching
3. Cyanobacteria cultivation
4. Mineral deposition



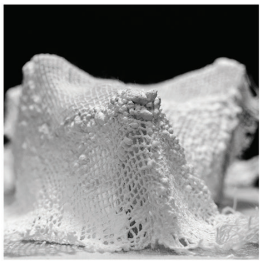
Site plan 1:5,000



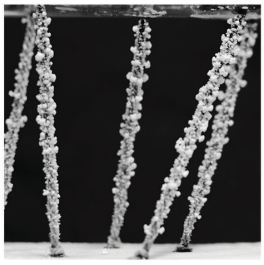


Oblique section at pools 1:200

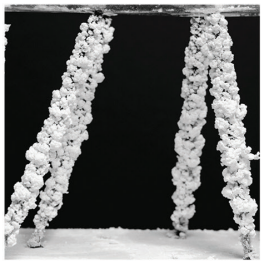
Capillary Deposition Model | 3 days



Capillary Deposition Model | 10 days



Gravity Deposition Model | 12 days



Gravity Deposition Model | 45 days

Pavilion

Pavilion structures are grown on fabric mesh draped over posts in mineralization ponds. Minerals form along the surface as water is drawn up by capillary force, and evaporates. Each pavilion is formed by a unique pattern with thin and thick zones that vary from the shape of the mesh and evaporation rate of the water with the change of the seasons. These structures are distributed throughout the site serving a variety of public programmatic needs.

Pool

Terraces that cascade down from the edge of cyanobacteria cultivation ponds are fed by its overflow as it spills over the curved edge falling to the next level. As the mineral saturated water cascades over the surfaces they become mineralized, increasing in thickness over time. Pool levels vary as seasonal temperatures affect their evaporation, while the flow rate remains constant.

Gallery

For a twenty metre span, five cultivation ponds are supported with concrete beams and their bottoms glazed creating a glowing gallery beneath. Spanning between the floor and ceiling are hundreds of fibrous strands each held in a cultivation pond with a rubber gasket. As the top of the strand absorbs mineral saturated water from the cultivation pond, it flows down into the gallery space through gravitational force. Each strand thickens along its length, growing in pace with flow and evaporation rates.