ROCKING CRADLE

Reconstituting Geology on a Damaged Earth

Dana Cupkova, Matthew Huber, Edith Abeyta

The *Rocking Cradle* is an interactive installation comprised of multiple binder-jet-printed vessels integrated into a public tree nursery. Informed by hydrological and geological processes, the *Rocking Cradle* is conceived as a literal and figurative device for fostering environmental stewardship. Situating the tree nursery as a community space, these sand-printed vessels hybridize the typology of urban furniture with the behaviors of water flow, water collection, bird bathing, and growing native plants. Located in a polluted post-industrial landscape, the installation is conceived as a new form of ecological infrastructure that fosters stewardship through the instigation of urban play (Cupkova and Huber 2021). Co-authored through a series of environmental justice workshops, the semi-porous, stone-like surfaces carry embedded messages from local youth, thus becoming vehicles for local environmental consciousness intertwined with communal discourse.

The project engages the former steel mill site and its pollution patterns by drawing new awareness to its conflicted histories. Each vessel serves as a symbolic substrate that is formed from anthropogenic and earthen waste to create both a protective barrier and remediated ground for nurturing new plant life. Carrying forward technologies of water flow simulation (Cupkova, Azel, and Mondor 2015), the articulated surfaces build up a visual intuition for the ways in which landscapes behave entangled with cryptic text/plant graffiti to inspire new forms of empathy. The objects, through their geometric figuration, begin to care for the landscape they sit in. They cultivate new ecological

PRODUCTION NOTES

Design Team:	Epiphyte Lab, SoA CMU, Arts Excursion Unlimited
Client:	Center of Life
Status:	Built
Site Area:	40,000 sq. ft.
Location:	Hazelwood Green, Pittsburgh, Pennsylvania
Date:	2021

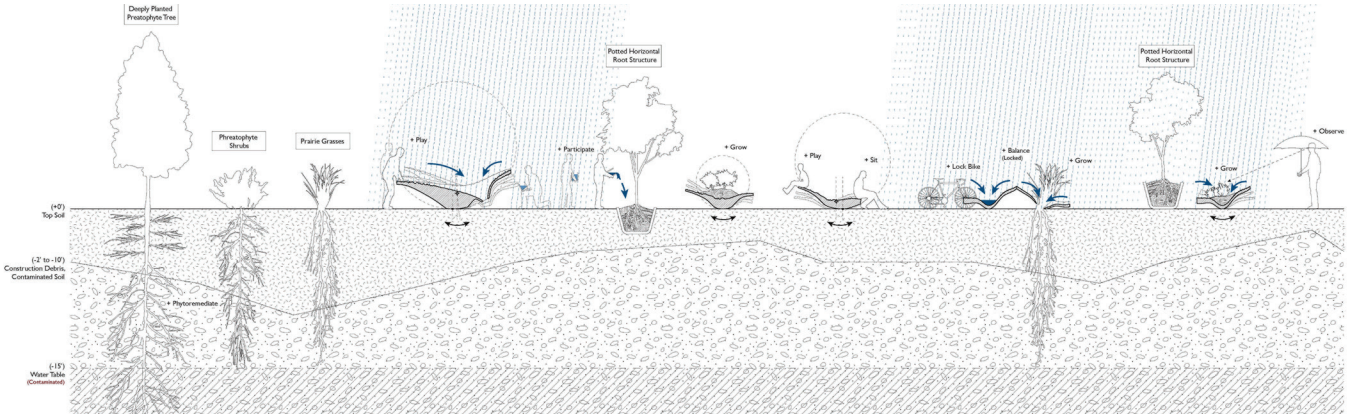
1 Tree nursery installation view of the Planter Rocking Cradle with carnivorous swamp plant at Hazelwood Green (©Massery Photography, 2022)

2 Sand-printed surface texture (©Epiphyte Lab 2020)

3 Nature drawing workshop (©Arts Excursions Unlimited 2020)

4 Calcification and new habitat growth due to surface rugosity (©Epiphyte Lab 2022)

5 Rock, mud and rainwater play (©Epiphyte Lab 2022)



6 Environmental stewardship concept diagram: *Rocking Cradle* variations exploring Human-Land-Seedling-Hydrology-Community engagement (©Epiphyte Lab 2020)

habitats and human interactions, thus opening up new modes of play and ecological intimacy.

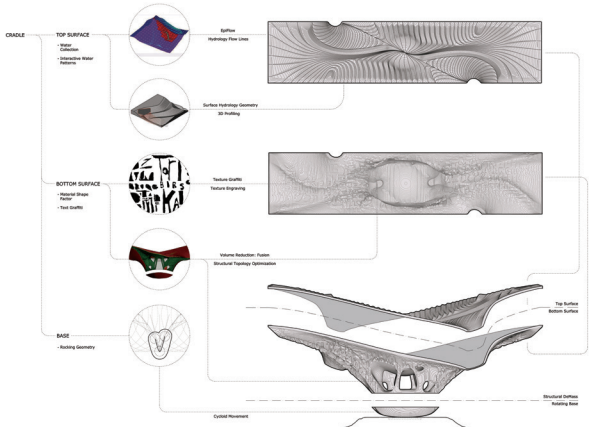
The *Rocking Cradle* is also a prototype rooted in ongoing material-technology research that proposes a novel cradle-to-cradle design process for architectural components to be manufactured directly from local construction waste and earthen materials. The body of the cradle combines shaping strategies for volume (Craveiro et al. 2017) and surface figuration with complex patterning (Dunn and Halpin 2009) derived from balancing behaviors (Clifford et al. 2019) to enable the rocker to become a structural component, as well as a substrate for ecological processes.

Such shaping strategies consider the life-cycle of construction from a cradle-to-cradle perspective (Faludi et al. 2019). Cementitious materials such as concrete, because of the volume used, are some of the greatest contributors to the global increase of CO_2 levels. Two interconnected strategies are employed here to subvert this status quo: reducing construction waste by using the material in binder-jet manufacturing, and reducing the overall volume of the material used through material-specific shape-sensitive component design (ExOne 2022). By advancing the additive manufacturing of earthen and non-cementitious materials, CO_2 production can be significantly reduced. This approach shifts issues of advanced manufacturing into a framework of ecological design. Shape-factor plays a central role in the formation of the cradle, tuning volume distribution within the mass, and combining structural and ecological factors with a composite of granular waste materials.

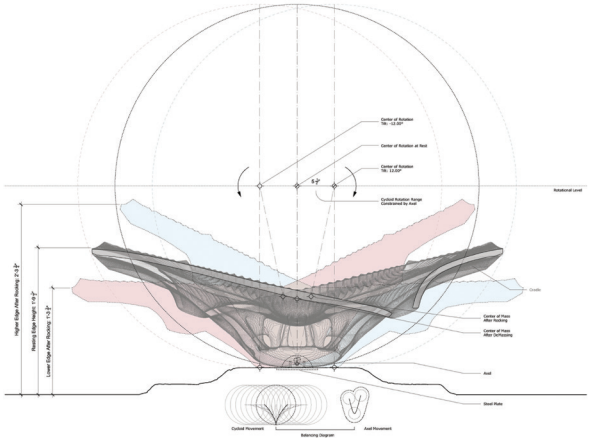
Rocking Cradle aligns structural and ecological potential (Cupkova and Clifford 2018) with a desire to integrate landscape awareness, its history, and presence directly into the architectural form, behavior, and experience. Surface articulation enabled by binder-jet-ting technology provides an opportunity for traces of text—a voice that typically would only be transient—to be embedded into and carried forward more permanently within the object

7 Text graffiti workshop at the Center of Life (©Arts Excursions Unlimited 2021)

8 Joy of water play on a hot day at the Bird Bath Rocking Cradle (©Massery Photography 2022)



9 Design workflow diagram of computational shaping integrates water pathways, text graffiti, and balancing, while using minimal material mass (©Epiphyte Lab 2022)



10 Diagram of mass balancing strategy using cycloid movement (©Epiphyte Lab 2022)

itself. The layered operation of shaping the vessels also allows for a collective adaptation of the form and carving of messages to communicate growth. The *Rocking Cradles* care for and support human-land-seedling-hydrology-community engagement while connecting the past with the future. As extreme climate actions intensify, questions of public space will increasingly elide with those of planetary ecology, and the boundary-challenging expansiveness of ecological flow. Arising from entanglements of landscape abuse and the impact on humans and non-humans alike, the R*ocking Cradle* actively considers revitalization and emergence of new forms of urban gardening. As we grow food and oxygenating plants in this contaminated soil, we precipitate the landscape to body-contamination pathways. *Rocking Cradle* intends to offset the current cycle while using its body as a device for future land stewardship.

Urban play also offers an immense opportunity as a vector of curiosity and provocation of intimacy and empathy between humans, objects, and landscapes. Arising anew from an ossified post-industrial landscape, the *Rocking Cradle* intertwines human interaction and the ecological imagination.

ACKNOWLEDGMENTS

The *Rocking Cradle* project has been conceived as a part of the funded research "CRuMBLE: Construction Rubble Manufacturing for Building Life-cycle and Environment," a research-manufacturing framework that proposes a novel cradle-to-cradle design process for ecological architecture manufactured directly out of construction waste and earthen materials by integrating recycled construction waste as a powder aggregate mixture to create new pathways for direct non-toxic chemical activation with water-based binders in binder-jet printing. PIs: Dana Cupkova, Josh Bard, CoPI: Robert Heard; Industry Partners: ExOne, Michael Brothers Hauling.

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SoA CMU Team: Design and Research Lead: Dana Cupkova; Design

11 Arts Excursions Unlimited team with Planting Rocking Cradle: Edith Abeyta with two high school students,Tayshaun Watkins and Samuara Green, enrolled in the Start on Success Pittsburgh program (Photo ©Lake Lewis)

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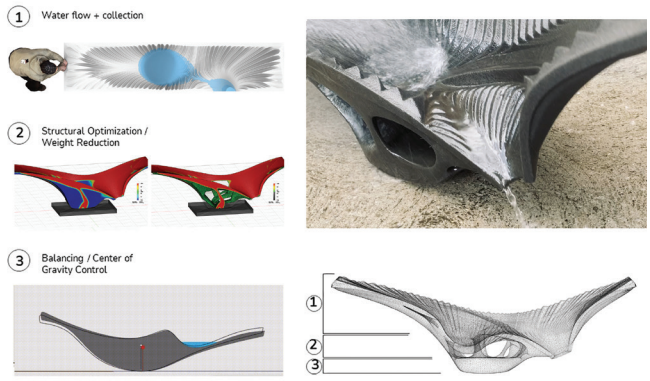
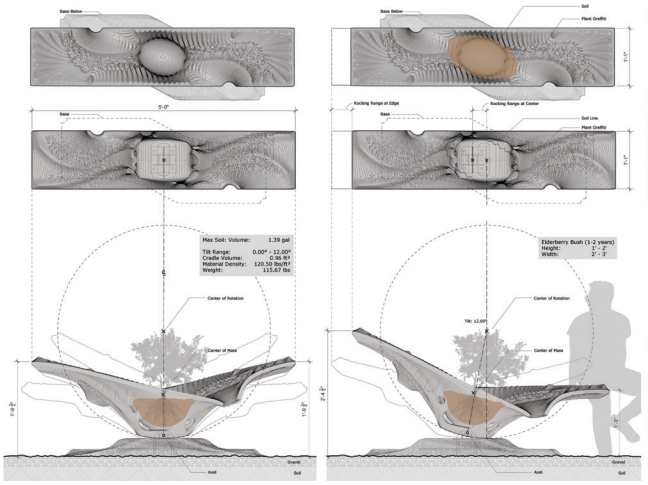


12 Shaping strategy diagram (©Epiphyte Lab 2021)



13 Drawing and computational analysis of a fabrication mesh model for *Planting Rocking Cradle* (©Epiphyte Lab 2022)

14 View at the *Water Collection Rocking Cradle* (©Massery Photography 2022)

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Dana Cupkova holds an Associate Professorship at Carnegie Mellon School of Architecture and directs Epiphyte Lab, Architectural Design + Research Collaborative. Engaging issues of environmental stewardship in design, Dana's work is situated at the intersection of built environment and ecology, focused on computational methods, materiality, embodied energy, and advanced manufacturing frameworks, with a particular interest in thermodynamics, and construction waste streams.

Matthew Huber holds the position of Special Faculty within the School of Architecture at Carnegie Mellon University, where he teaches issues of digital production, environmental ethics, building performance, and the influence of scientific practices and culture on architectural discourse. His previous experience in architectural practice involved developing projects simultaneously between large-scale planning with material and tectonic expression.

Edith Abeyta is a visual artist living in North Braddock, Pennsylvania. Focused on issues of equity and environmental justice, her works combine post-consumer goods, particularly clothing, and participatory gestures to form temporary installations and sculptures that explore collectivity, labor, and exchange. She frequently collaborates with other visual artists, poets, scholars, and the public. Edith leads the Arts Excursions Unlimited, a community-owned project dedicated to increasing the cultural connectivity of the citizens of the greater Hazelwood community.