

# Additive Envelopes: Robotic Volumetric Porous Bricks for Habitat Reformation

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**Keywords:** Ceramic Printing, Non-Human, Biodiversity, Envelope Construction, Additive Manufacturing

The story goes that Lou Kahn, gathered his students into a room and began pontificating over personalized bricks in what has now become a canonic conversation: “You say to a brick, ‘What do you want, brick?’ And brick says to you, ‘I like an arch.’ And you say to brick, ‘Look, I want one, too, but arches are expensive, and I can use a concrete lintel.’ And then you say: ‘What do you think of that, brick?’ and the Brick says: ‘I like an arch.’ While this rhetoric pronounced the brick’s structural potentials due to the intrinsic disciplinary problems of stacking volumes, it undermined the Brick’s other potential capacities inherent to its volumetric nature. As such, with the arrival of post-modern construction that transformed the architectural envelope into a series of monofunctional layers within a rainscreen, it is not surprising that brick became flattened into a ‘sticker’ as an image-oriented scenographic pursuit neutered of its structural capacity. A two-dimensional graphic element easily commodified by neoliberal corporate culture, as evident from the thinly applied arches in recent facadist developer minded gentrification practices.

In lieu of complicity in this culture of thinning, the research pedagogy showcased in this studio championed a resistance to the thinning of the brick based on its volumetric capacity to perform other roles such as thermodynamics or playing host to ecology towards habitat restoration. The promise of this new constructive principle suggests a volumetric wall construction that re-balances the flora and fauna within the urban ecology, while simultaneously lowering the albedo of our buildings’ contribution to the Urban Heat Island. This advanced option studio worked closely with a brick heritage museum sited within a village historically associated with the manufacturing of brick for the 20th century. The studio worked closely with the docents and curators of the existing museum in the processes of site selection, immersive brick production history, and community engagement.

To investigate this volumetric promise, the studio engaged in research surrounding the production of new porous bricks utilizing additive robotic manufacturing of clay. Students began this studio through a visual analysis of 20th century graphic and line-based art, coupled with early physical tests of depositing clay material using a robotic extruder. This allowed each student to develop their own ‘toothpaste tectonic’ as a means

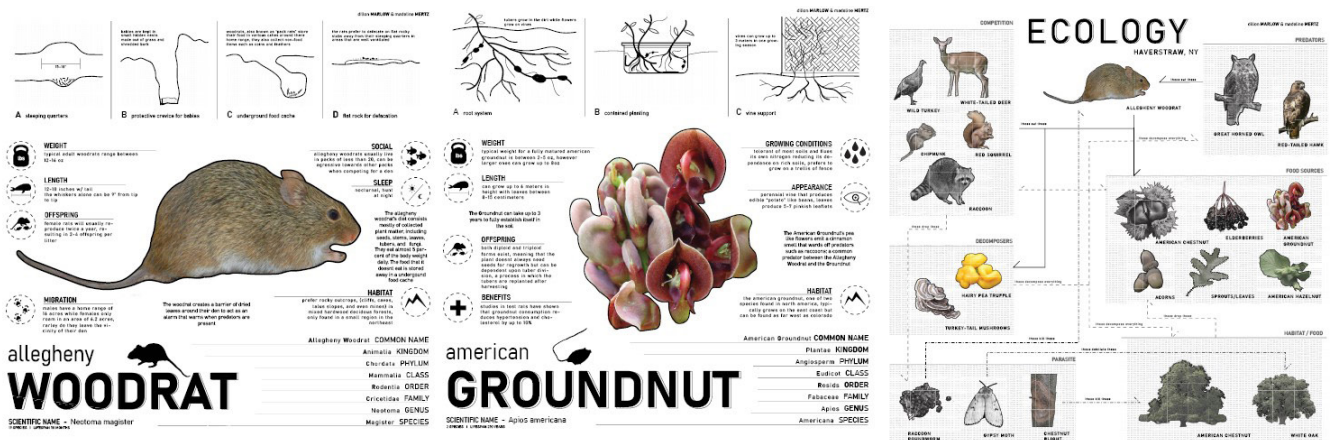


Figure 1. Mutualism Investigation between Allegheny Wood Rate’s ecosystem within the ecotone condition of the studio brief.

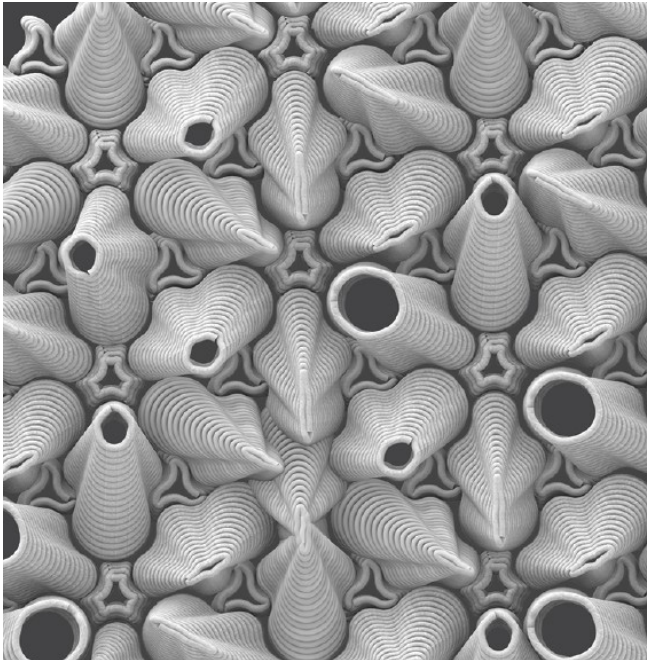


Figure 2. Habitat Designed for the Terrapin turtle Estuary.



Figure 3. Vertical Habitat for the Black Rat Snake



Figure 4. Robotic Lab time with students using a robotic 3d printer.

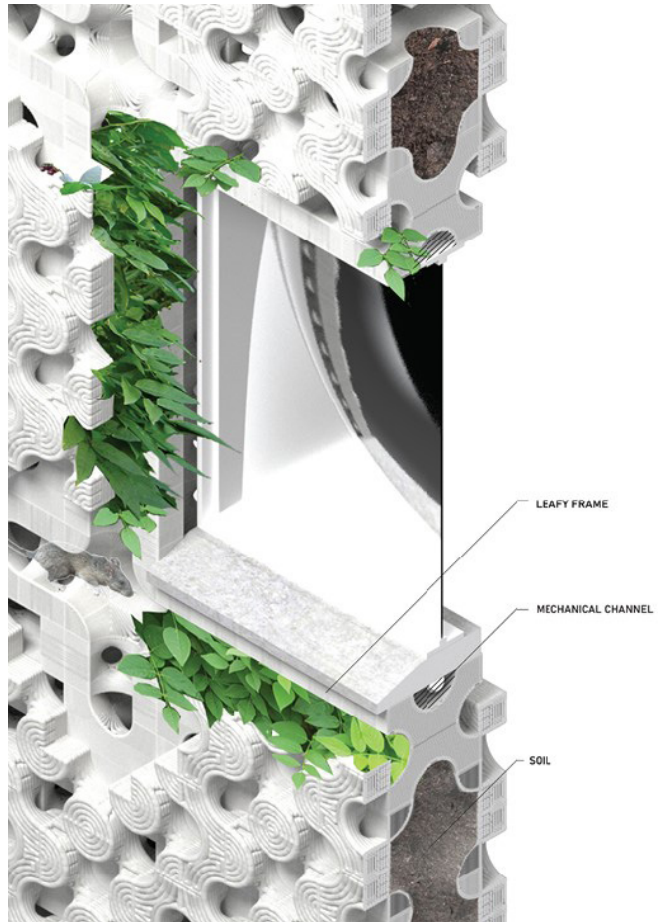


Figure 5. Sectional isometric of a wall designed for the WoodRat



Figure 6. An early mockup assembling featuring twelve peices of ceramic printed geometry in stoneware , for the habitat of the woodrat.

of unlocking the potentials of creating a series of bricks made from volumetric lines. Simultaneously, research groups were assigned a fauna pest, native to the ecological ecotone of the village, for which they were asked to document its habitat, analyze its ecological web, and identify a flora species that serves a mutualistic relationship. The study of these flora and fauna provided a poche program around which researchers would design the porosity of their robotic fabricated brick walls with specific intention of creating a multi-agent architectural envelope. Pests such as the Black Rat Snake, the Allegheny Woodrat, and the Long-eared bat were intrinsically chosen for

their polemic means of indicting the modern practice of creating a thin envelope membrane segregating humanity from the larger urban ecology by “re-examin[ing] our deeply engrained preconceptions of the ‘pest’ This ethos, became the backbone of the studio’s argument wherein, “we cannot wave the banner of biodiversity, yet disregard the habitats that are disappearing where we live .”

Over the course of several early weeks, students engaged in exercises that asked for the rendering of the ornamental approach to pronouncing the three agents embedded within a double



Figure 7. A distributed museum designed by the studio as a collective masterplan for the lowlands of the historic brickyards.

wythe volumetric wall construction. Critical to the evaluation of these wall construction was the drawing representation technique of the Section Perspective for the evaluation of ornamental apertures of varying scales for fauna, flora, and human. These apertures, produced through the manipulation of the clay extruder and bond work, informed “ornament as the figure that emerges from the material substrate [ as an ] expression of embedded forces through processes of construction, assembly and [ literal ] growth .” The design of these walls was explored through stack based physical model, unit fabrication at 1:1, and drawing culminating in a first speculative project for an accessory dwelling unit within a peri-urban condition as an architectural hut capable of sustaining life for the human, flora and fauna simultaneously.

The second part of the semester asked students to design a distributed new brick museum on the former site of the lowland brick yards in village, a site which was formed by the 1905 landslide due to the extraction of clay. Students worked collectively as a studio to produce a masterplan for a new distributed museum, consisting of separate linked buildings each with a program guided by their fauna, ecology, and tectonic printing studies. This new campus was inclusive of house for guest curator’s and the Allegheny wood rat, a gallery with a shedding double skin born of the multi-layer printing process to play host to local snakes, a domical series of classrooms submerged in the estuary water for the terrapin turtle, and vertical library burrowed into the landslide clay wall to provide a roost

for bats within its eaves. The workflow of the studio, which mandated weekly engagement with robotic lab technology, simultaneous to research and drawing established a feedback loop wherein the physical tests of the deposition informed the visual investigations and aesthetic matter of the proposed building architecture. The textural product of the façades and built architect was deeply established in the volumetric nature of the lines and porous investigations of robotic printing. The final work of the studio was presented to the community via an exhibition held at the existing museum entitled, consisting of prototypical façade modules, as well as visual drawings of the potentials for the museum and its coordinated ecological habitat restoration.

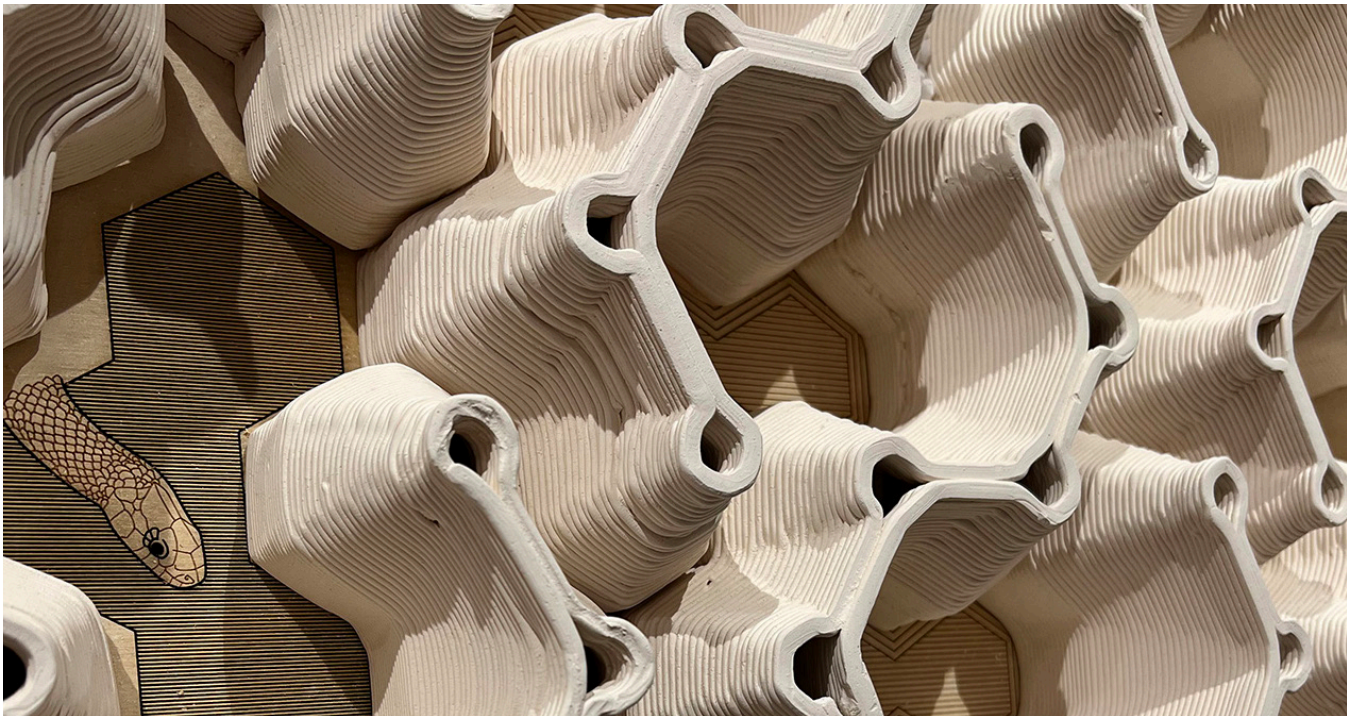


Figure 8. An example facade prototype on display in the final exhibition at the local heritage brick museum by the Black Rat Snake Group.



Figure 9. An image of the overall end of semester exhibition at the local heritage museum.

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## ENDNOTES

1. Louis Kahn. Transcribed from the 2003 documentary 'My Architect: A Son's Journey by Nathaniel Kahn'. Master class at Penn, 1971.
2. Joyce Hwang. Living Among Pests – Designing the Biosynthetic City Next Nature, September 24, 2013, <https://www.nextnature.net/story/2013/living-among-pests-designing-the-biosynthetic-city>
3. Ibid.
4. Farshid Moussavi and Michael Kubo. The Function of Ornament, ACTAR, Harvard Graduate School of Design. May 1, 2008.