



## Soil and Protoplasm

### Designing the Hylozoic Ground Component System

Philip Beesley

The concept of hylozoism has its origins in ancient Greece, and refers to the belief that all materials possess life. Hylozoic Ground, the latest in a sequence of projects led by Philip Beesley, examines this idea in relation to a palette of subtle and synthetic materials that weave together dynamic interactions that at first simulate a primitive form of life. Naked hyperbolic meshworks are organised as a 'geotextile terrain'; a fundament to the act of creating the earth itself, the meshworks are dressed with a primitive intelligence, layers of structure, muscle, wet chemistry, neurons, memory and an active circulation system. The resultant assembly offers the template for a responsive architectural system, a practical system that lives and breathes, that knows where it is and who is in proximity. Could this form the basis of a system that cares, and architecture of hope and optimism?

The Hylozoic Ground project is a collaboration between architects and engineers in Canada, Britain and Denmark, which is developing new layers of synthetic soil as a primary architectural building system. Organised as a textile matrix, Hylozoic Ground<sup>1</sup> is a manufactured environment supporting responsive actions and 'living' technologies. It is conceived as the first stages of self-renewing functions that might take root within a future architecture. It can be described as a suspended geotextile,<sup>2</sup> gradually thickening and offering a fertile matrix as it draws materials from its surroundings. It consists of an array of articulated meshwork filters and protocell circulation systems programmed to pursue methods for building synthetic earth. Dense groves of frond-like 'breathing' pores, tongues and thickets of twitching whiskers are organised in spiralling rows that curl in and around a complex assembly. A distributed array of proximity sensors activates these primitive responsive devices, stirring the air in thickened areas of the matrix. Akin to the functions of a living system, this embedded machine intelligence allows human interaction to trigger breathing, caressing and swallowing motions, and hybrid metabolic exchanges within this material. These empathic motions ripple out from hives of kinetic valves and pores in peristaltic waves, creating a diffuse pumping that pulls air, moisture and stray organic matter through the filtering membranes within the system. This paper examines the cultivation of the Hylozoic Ground project as a speculative prototype in new frontiers of architectural matter. It examines an engagement between soil and protoplasm as a fertile territory for architectural enquiry.

Can soil be constructed? Soil has always been the *prima materia* of architecture. But contemporary soil does not quietly offer itself to the enlightened framing of space. Soil eliminates and viscerates space. It might seem to stand silently, apparently offering secure mass and compression, available as a plastic, friable resource for framing human territory. Yet soil *desires* collapse. The soil crust of the earth covers and disguises myriad layers formed from condensation and deposition. Soil consumes space, erasing and absorbing daily circumstance within its unspeakably silent, primal fertility. Soil's inexorable infolding of matter within matter negates space, compacting interminably into dark.

Yet soil also desires springing growth. The soil crust of the earth seethes with a myriad of seeded viscera, minuscule fragments gathering and efflorescing, redolent with chorusing oceans of growth to come. Soil's inexorable flowering genesis of matter building upon matter overwhelms and saturates space, riddling voids, boiling and flaming outward. The stuttering oscillation of soil's alternating collapse and expansion sends shivering waves that tangle and choke certainty. Soil's lumpen, sodden masses counter any enlightened world of social construction. The ambivalence latent within soil makes it a monstrous doppelgänger for architecture.

The soil of a fever-laced biosphere speaks of inflamed flux, efflorescent growth oscillating in wild swings punctuated by unspeakable silence. Standing within this tumbling ground, posture pulls toward spasm. The yawning, viscous ground induces queasy vertigo. Legs unconsciously tense themselves, reptile-brain-inflected posture tensed by the inward pulling, elastic meniscus underfoot. The shift of this posture inverts any confidence within an outward gaze. Any bounded territory recedes.

Might an opening appear within this wilderness? Within ancient Greek and Roman texts that dwell on the origins of cities can be found descriptions of openings amid blood-soaked thickets of darkened soil. Tacitus and other ancient Roman writers pursued their own people's origins in primal dwelling. These texts speak of wilderness, and of an opening within the wild, a 'ludens' that offered sanctuary from the atrocities of unbounded surrounds. The Hylozoic Ground project follows these steps of Tacitus. The project has origins in the site of Rome, in the opening within the metaphorical wilderness that, according to the texts, preceded the bounded eternal city. Entangled within the instrumental systems of this installation lies a sheltering open space of asylum.

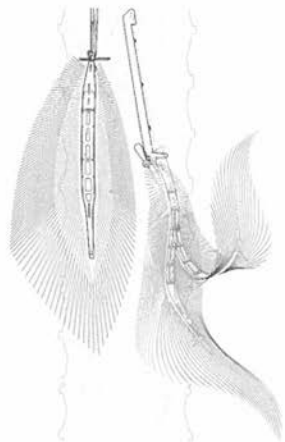
Recent finds in Rome confirmed new poignant details of these city foundations described by Tacitus. Excavation work in the past two decades has revealed a labyrinthine topology lying within the Palatine, the artificial mountain that formed the inner sanctuary of the original city. Within this labyrinth are revealed traces of a tiny infant body deposited under Porta Mugonia, the original north gate of the eternal city. The burial appeared to be one of a series of public sacrifices. Following the lot of Remus, the twin-brother alter-ego of Rome who was slain at the edge of the first city by Romulus, the first father of the city,



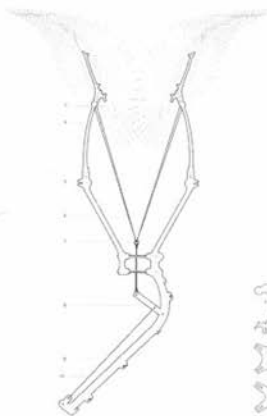
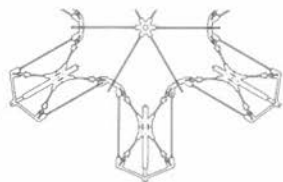
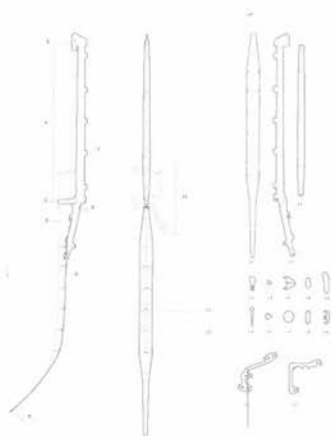
Breathing pores in motion

Hylozoic Soil, '(in)posición dinámica'

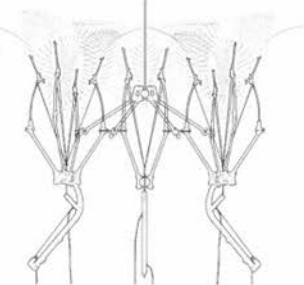
Festival de Mexico, Mexico City, 2010. © PBAI/Pierre Charron.



Breathing pore assembly diagram



Filter layer assembly diagram



a series of human burials, and literally hundreds of other 'substitution' burials embodied in carved models of swaddled infants – 'first fruit of the first family' – lie within the foundations of ancient buildings throughout Rome. Hovering over these shadows of father and abject twin, and located at the centre of this constellation of burials, a first 'primitive hut' spoke to the ancient citizens of Rome about their own primal origins. A thicket of branches was raised over the sanctuary of Romulus's tomb at the edge of the Palatine. This shelter was maintained for hundreds of years during Rome's years as a republic, bespeaking depths of brimming blood imbued within that earth. The labyrinthine grove that is constructed within the Hylozoic Ground project can be seen as a renewed version of this primitive construction.

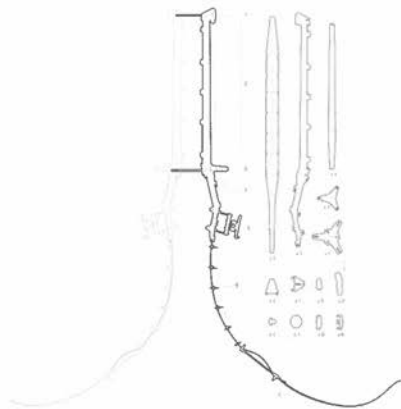
In the constructions of the Hylozoic Soil series, sheltering and gently nurturing qualities of construction offer nourishment, while dimensions of darkness and 'alterity' reside just below the surface.<sup>3</sup> A flux of viscous, humid atmospheres creates a hybrid-expanded protoplasm with constantly changing boundaries. The structural core of the Hylozoic environment is a flexible meshwork skeleton of transparent, lily-shaped ribbed vaults and basket-like columns. Dozens of sensors that detect the presence of visitors through changes in space, light and touch are spread throughout the Hylozoic environment. They function like the space-reading sonar employed by dolphins and bats and feed impulses into an embedded network of microcontrollers, working in concert with, and guiding, device movements. Alongside mechanised component systems, a wet system has been introduced into the environment, supporting simple chemical exchanges that share some of the renewing functions of a human lymphatic system. The meshwork stretches and billows, creating a hyperbolic gridshell topology that surrounds occupants in the space. It is assembled from small acrylic chevron-shaped tiles that clip together to form a pleated diagrid textile structure. Columnar elements extend out from this membrane, reaching upward and downward to create tapered suspension and mounting points. Tension rods support the scaffold with toothed clamps that bite into the ceiling and floor surfaces.

#### Breathing pore assembly diagram

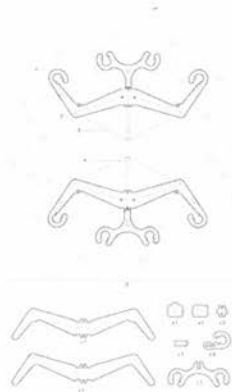
- 1 Breathing pore assembly actuated position
- 2 Breathing pore assembly rest position
- 3 Adjustable shape memory alloy (SMA) clip
- 4 SMA lever
- 5 Lever
- 6 Tensioned tendon
- 7 Strengthening gusset for main spine
- 8 Gland clip
- 9 Copolyester tongue
- 10 Tongue clip
- 11 Arm units for attachment to mesh
- 12 Tension struts
- 13 Feather

#### Filter layer assembly diagram

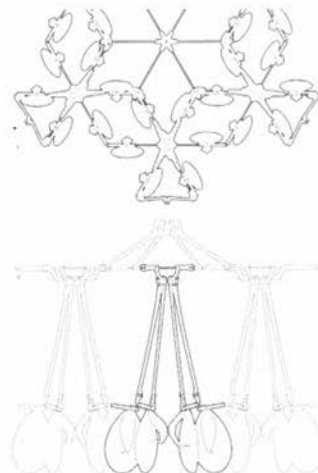
- 1 Filter cluster plan
- 2 Filter cluster elevation
- 3 Filter feather
- 4 Leaf spring
- 5 Connection to adjacent filters
- 6 Tension cable
- 7 Tension hook
- 8 Lever arm
- 9 Shape memory alloy (SMA) actuator
- 10 Sled assembly



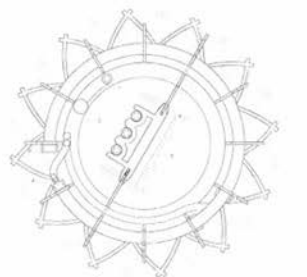
Sensor lash assembly diagram



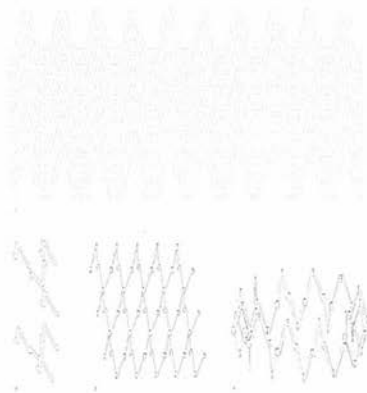
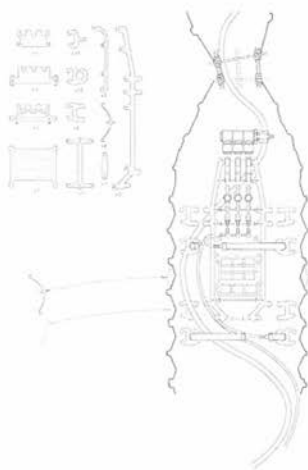
Swallowing actuator assembly diagram - second generation



Cricket layer assembly diagram



Swallowing actuator assembly diagram - third generation



Chevron assembly diagrams

