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Mycotecture of Contamination

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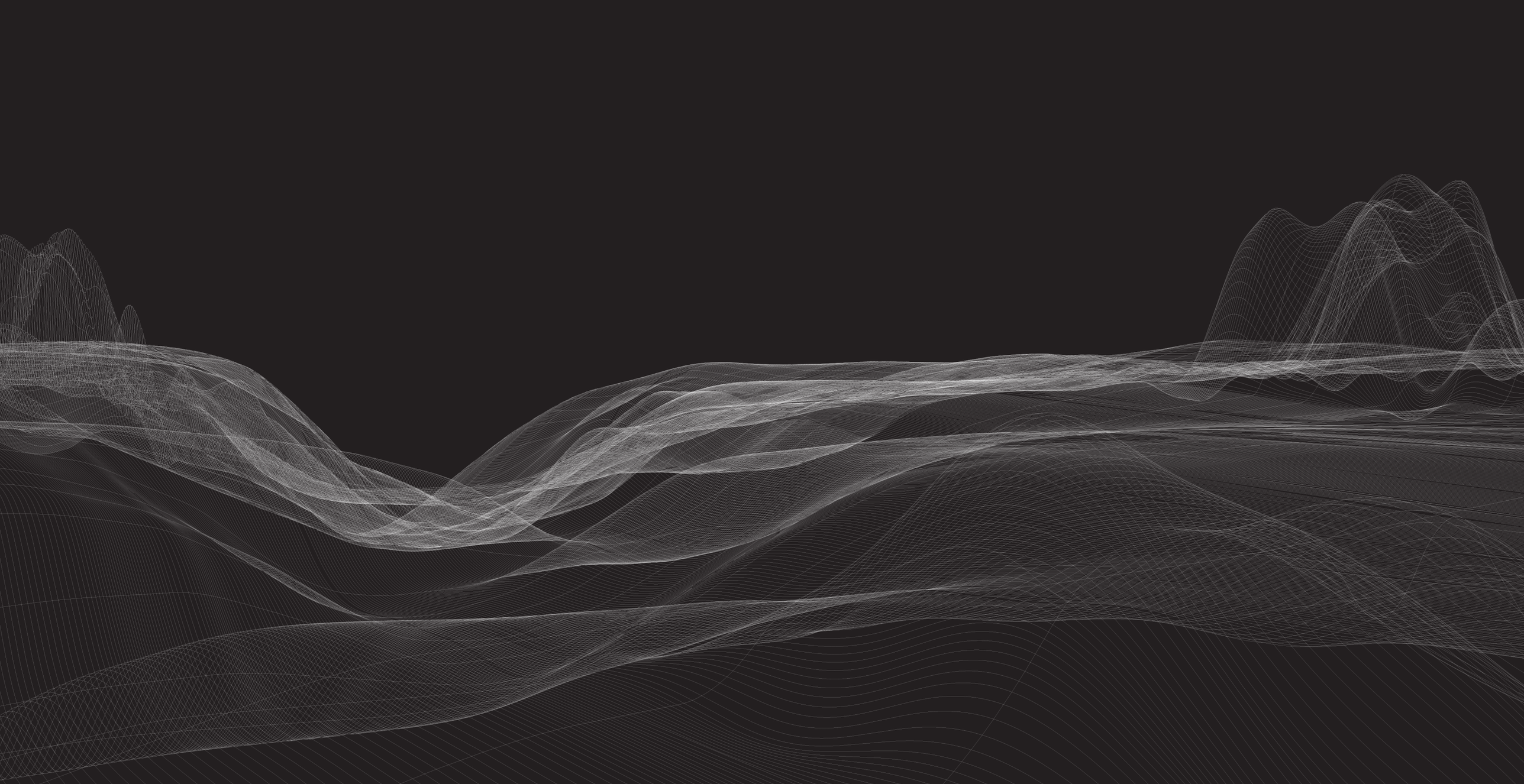

MYCOTECTURE OF CONTAMINATION

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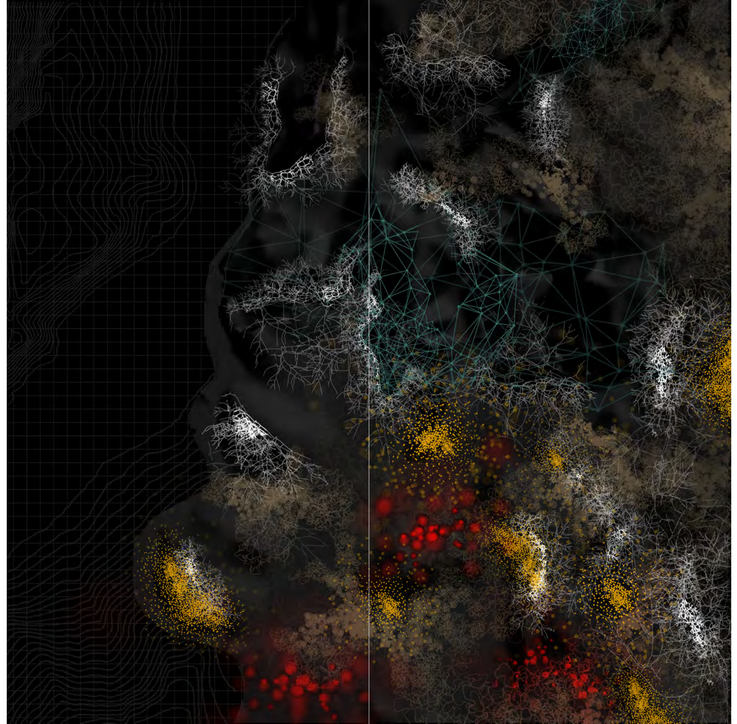
December 14th, 2020



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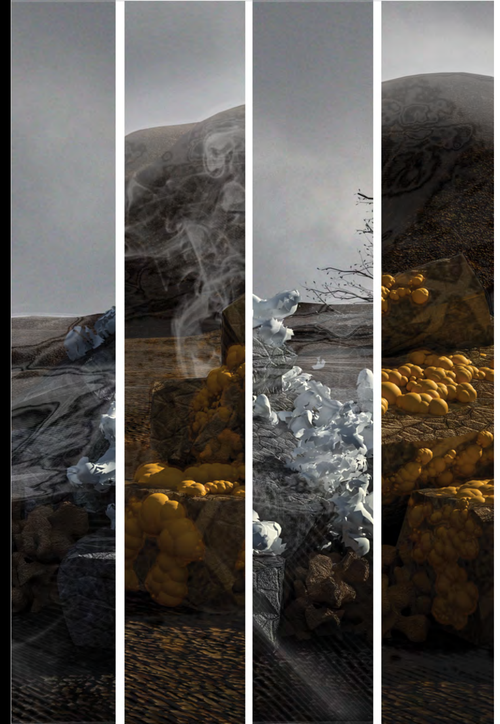
INTRODUCTION



Mycotecture of Contamination

CONTENTION

Humankind has stripped the planet from its resources, leaving behind an abundance of contamination. Humankind's built environment no longer meets the standards set by our turbulent planet. Humankind has lost the privilege of agency in design and construction.

This thesis situates living organisms, specifically mycelium, as the primary designer of the built environment. The investigation uses contamination to fuel mycelium growth and create emergent forms whilst executing remediation strategies for contaminated sites. Human-centric processes have created intense environmental contamination; harnessing this contamination will create new architectural forms that consequently remove humankind from decision-making in architecture, relegating him to an indirect contributor. Environmental contamination and destruction will now serve a material purpose in architecture; harnessing the power of contamination will give it purpose. As environmental contamination continues to reproduce, the resultant architecture will morph in accordance. Employing nature's cyclical processes of growth and decay, this constantly evolving architecture will unseat humankind's stagnant ideas of space. Through a combination of organic and inorganic methods of implementation and manipulation, this architecture will embrace the resultant repugnant aesthetic and defy the firmly established notions of hygiene and cleanliness.

In view of mycelium's ability to recycle carbon, nitrogen, and other vital elements, this investigation targets mycelium's digestive power to decompose toxic waste and pollutants whilst creating a new type of architecture. Organic and non-organic residue from landfills, crude oil, and toxic ash will be utilized to fuel the growth of mycelium and manipulate its development during the construction process.

ORGANIC FACTORS

Mycelium Experiments

- Growth Behavior
- Growth Outcomes
  - Forms
    - organic forms
    - parasites
    - meshes
    - solids
  - Decomposition of Materials
    - aluminum
    - plastic
    - grains
    - hair
- Growth Possibilities
  - Favorable/Unfavorable Growing Conditions
    - temperature
    - humidity
    - oxygen
    - water
    - light

INORGANIC FACTORS

- Favorable Pre-Existing Site Conditions
- Implementation of Site Strategies
  - mold, scaffold, soft template
- Site Evolution

→ Emergent Forms + Site Remediation

02
TYPOLOGICAL INNOVATION

Photo: Barbra Imhof, *Growing as Building, Mycelium Material Experiments*

Mycotecture of Contamination

MYCOREMEDIATION

Mycotecture presents a new approach to design, encompassing natural processes of growth and decay as part of the design process. Mycelial innovations are opening a new avenue for designers to utilize living systems as architectural material. Capable of consuming a wide variety of substrates, mycelial materials serve as a new material resource of great potential. Bringing a new meaning to the world of living architecture, mycelium's ability to continue growing holds untapped potential negating fundamental concepts of a static built environment. This removal of control for designers, brings forth evolving emergent systems of natural imperfection.

In lieu of mycelium's capacity to process various toxic materials the project approaches contaminated sites using strategies of mycoremediation. As David Gissen discusses in Subnatures humans have ignored the natural world for too long; deeming certain natures as foul and excluding them from any interaction with humans. Ignoring foul landscapes has led to intense contamination. Contaminated sites are left derelict as humans continuously build and rebuild, leaving disintegrating landscapes behind them. This thesis presents an opportunity to reconfigure human relations with contaminated landscapes, remediating both the site and the relationship between nature and architecture.

Mycoremediation, coined by Paul Stamets, refers to the bioremediation strategy for contaminated sites which uses fungi-based technology as its primary actor. Based on precedents of mycoremediation, the project was able to develop remediation strategies for each site condition. Each intervention is site specific, utilizing the contamination present on the site and implementing techniques of molding, scaffolding, and the use of soft templates.

MYCOREMEDIATION STRATEGIES

Oil Soaked Hair

Oyster mushroom primordia fruiting from oil-saturated hair. Hair has been used for oil spills, and with the addition of mycelium, presents new opportunities for remediation.

Paul Stamets - Mycelium Running

Accelerated Decomposing

Aspergillus tubingensis breaks down polyurethane. Mycelial growth on organic matter and contaminated soils can accelerate decomposition processes and break down toxins.

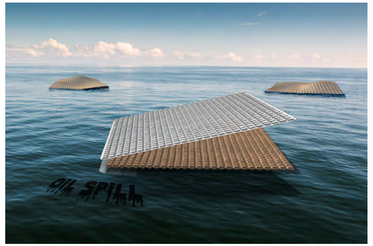
Dr. Jean Borel - The Sierra Club

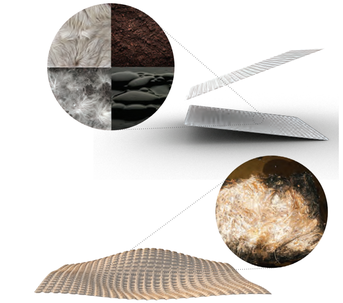
Toxic Ash Run-off

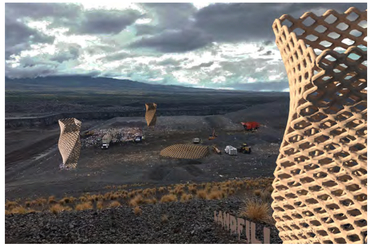
Toxic ash from wildfires presents unique issues due to the possibility of toxic ash run-off spreading toxins to surrounding areas. Wildfire toxic ash filtration using wattles.

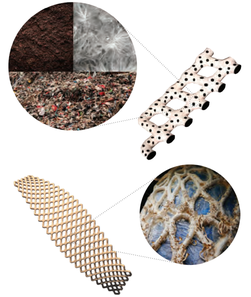
Fire Remediation Action Coalition

MYCOREMEDIATION SITE STRATEGIES









03
MATERIAL EXPERIMENTATION

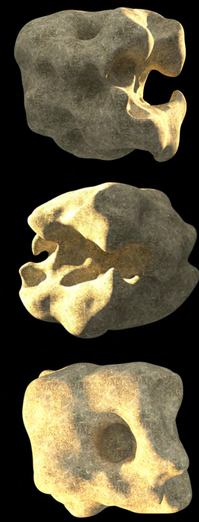
Mycotecture of Contamination

MATERIAL EXPERIMENTATION

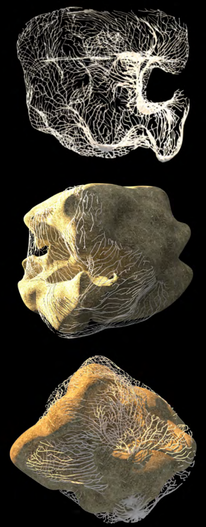
Physical material experimentation is instrumental in the development of the project. This thesis seeks to utilize organic building materials that are climate sensitive and hold possibilities for emergent architecture. The investigation will explore hybrid materials with the ability to grow using mycelium in conjunction with material substrates of contamination.

Following Manuel Delanda's *Matter Matters*, the investigation explores the importance of imperfections, extensive and intensive, and material expressivity. The project explores opportunities for emergent properties in architectural design in conjunction with inorganic manipulations to control emergence. The project derives its forms using simulations of biological growth as a means of exploring large-scale architectural possibilities from small-scale observations. Through our experiments and research, we developed an understanding of the possibilities of growth as well as the behavior of mycelium in response to environmental factors. These mycelial growth outcomes allowed us to start developing a language of representing organic growth forms to inform our design process.

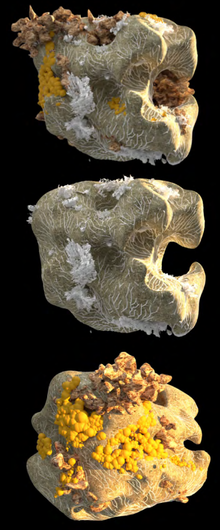
EMERGENT PROPERTIES CATALOGUE



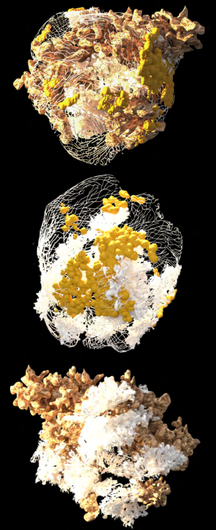
Thickness, Holes, and Bumps



Transparencies and Screens

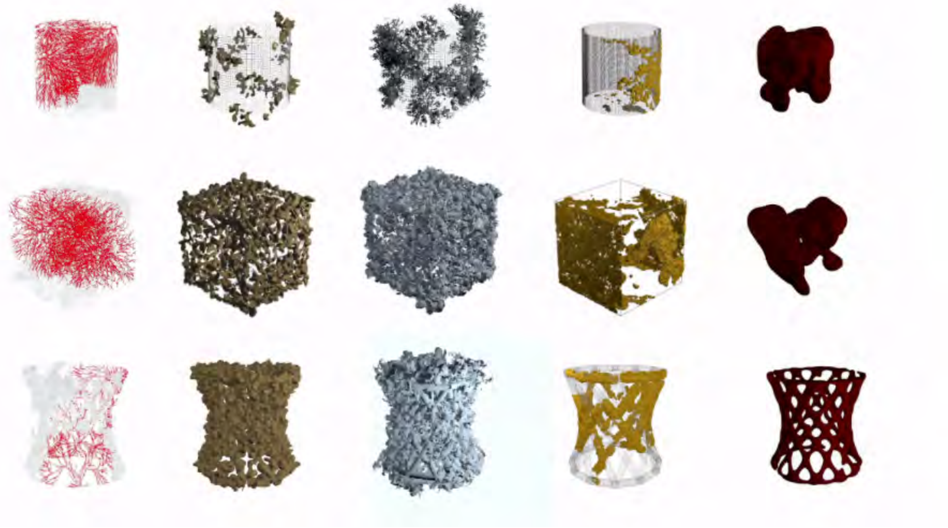


Colors



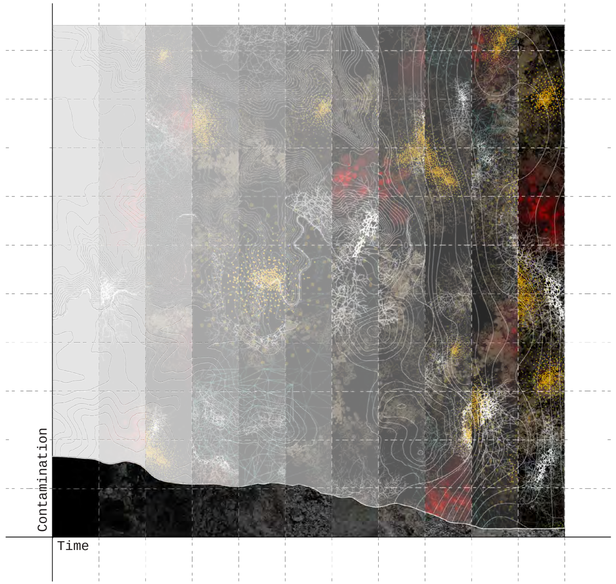
Textures

GROWTH SIMULATIONS



Click here to view simulation

04
SITE + ENVIRONMENTAL CONDITIONS



MYCOREMEDIATION: CHANGE OVER TIME

Over time, the mycelium will start to decompose the contaminants and toxins of the site as well as consume any other organic matter on the site, resulting in a slow progression of site decomposition and remediation. Inversely, as the site begins to decompose, the mycelium will have a greater chance of grow

The three different types of contamination create varying landscapes that influence growth patterns on the site. The main factors that create and affect different growth conditions are humidity, temperature, light exposure, and airflow. Each environmental condition would have a direct correlation to the possible growth conditions on the site. By extrapolating understandings of mycelial growth patterns, it is possible to project potential growth conditions of mycelium based on an environmental analysis of the site.

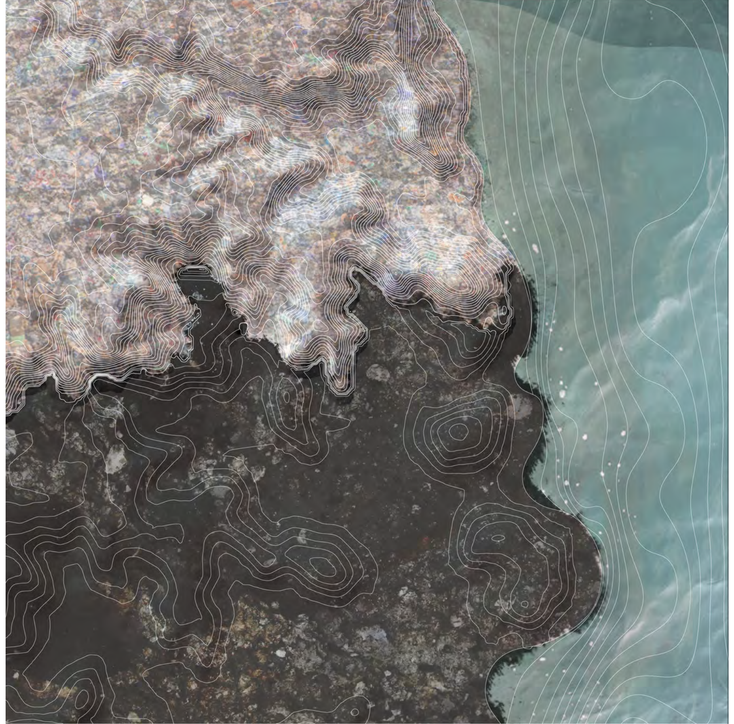
CONTAMINATED SITE TYPES

In order to fully explore the growth conditions of mycelium and its outcomes, a site was produced and its growth possibilities over time were projected. The site is composed of three types of contaminated sites: a landfill, a burnt area of toxic ash, and an oil spill.

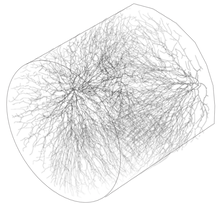
LANDFILL
Substrate: organic + inorganic
Landscape: steep slopes
Temperature: moderate to cold

TOXIC ASH
Substrate: organic + toxins
Landscape: moderate to low slope
Temperature: warm to hot

OIL SPILL
Substrate: organic (hair) + petroleum
Landscape: requires implementation
Temperature: cold



GROWTH TYPES + FAVORABLE ENVIRONMENTAL CONDITIONS



MYCELIAL GROWTH

WARM - ENCLOSED

75-80 & DARK

FRUITING GROWTH

WARM - EXPOSED

75-80 & LIGHT

STUNTED GROWTH & DIE-OFF

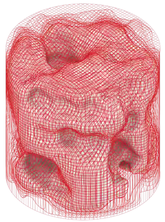
FREEZING

BELOW 32

INFECTION

HUMIDITY/AIRFLOW

HIGH HUMIDITY,
LOW AIRFLOW

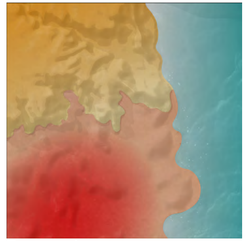


DECAY

HOT

ABOVE 100

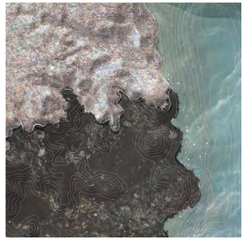
ENVIRONMENTAL ANALYSIS



Temperature

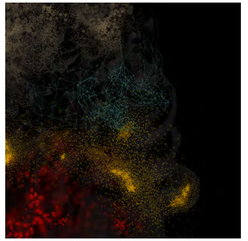
Light/Shade

Moisture



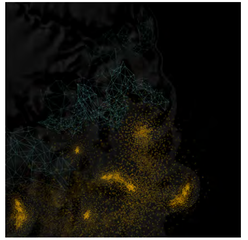
Site Substrate

GROWTH SITE PLAN

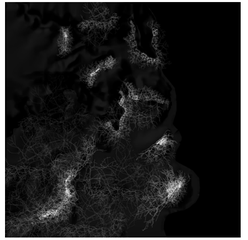


Temperature

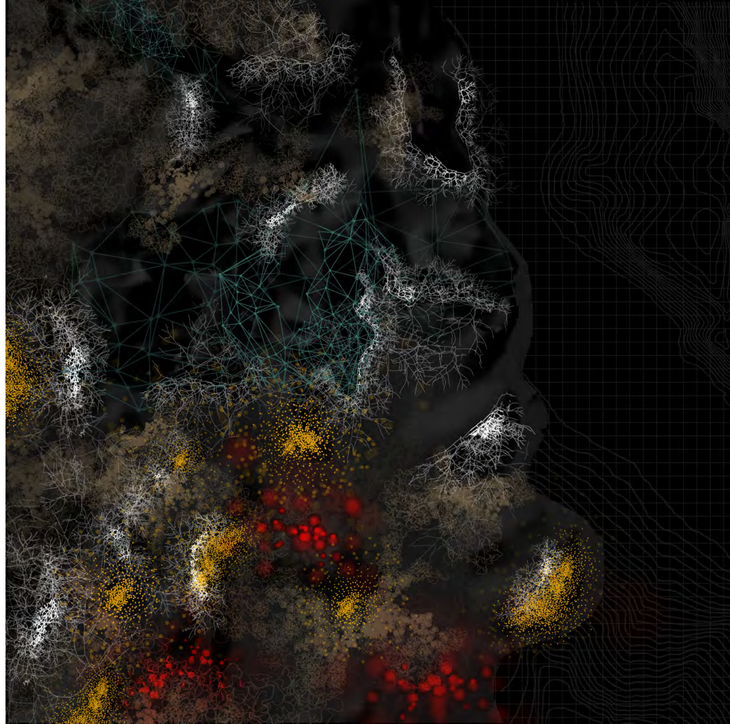
Light/Shade



Moisture



Site Substrate



05
REFERENCES

David Gissen, Subnature: Architecture’s Other Environments (New York: Princeton Architectural Press, 2009).
Gissen discusses a new way to look at environmental forces such as dust, mud, gas, smoke, debris, weeds, and insects in architecture. Much of today’s sustainable methods for design pertain to the removal/cleansing of said environmental forces; however, Gissen discusses how these elements can be used as tools in architecture which speaks directly to this thesis’ intention to utilize pollution as a material resource.

Ilya Prigogine and Isabelle Stengers, Order out of Chaos, Man’s New Dialogue with Nature (New York: Bantam Books, 1984).
Prigogine and Stengers discuss two important themes of classic science: order and chaos-- how a new order emerges from the chaos of the system at the point of collapse. They reference the notion of splitting up problems to their smallest components and its reverse-- this idea is valuable to this thesis because the exploration intends for a new order to emerge in the realm of architecture from the chaos that are climate change and contamination.

Weinstock, M. (2010). The architecture of emergence: The evolution of form in nature and civilisation. Chichester, U.K: Wiley.
Emergence is an innovative new field in the realm of architecture today. This text discusses how natural systems have evolved and maintained themselves and it explores how these methods of emergence can be applied to artificial intelligence, information systems, economics and climate studies. The findings in this text will inform this investigation as it relates to the self-maintenance of natural systems.

Manuel DeLanda, “Matter Matters,” Domus 884-897 (2005).
DeLanda’s 13 columns on matter address key concerns regarding design and material. Each column focuses on a different lens on why matter matters. The most pertinent columns for the development of this investigation are the importance of imperfections, extensive and intensive, and material expressivity.

Timothy Morton, Hyperobjects: Philosophy and Ecology after the End of the World (University of Minnesota Press, 2013).
This text discusses object-oriented ontology and the relationship between human and non-human objects. This text parallels the focus of this investigation by treating human and nonhuman things as coequal and rejecting the correlationist and anthropocentric tendencies of most ethical systems.

Beesley, Philip. Hylozoic Ground: Liminal Responsive Architectures. Toronto: Riverside Architectural Press, 2010. Print.
Hylozoic Ground is an interactive social environment arranged as a textile matrix installation that responds to actions, dynamic material exchanges, and ‘living’ technologies. The installation is focused on self-renewing functions which directly informs tis investigation’s idea of self-renewing, self-regulating living architecture.

In Hebel, D., & In Heisel, F. (2017). Cultivated building materials: Industrialized natural resources for architecture and construction.
Hebel and Heisel’s work informs the reader on cultivated building materials. Specially useful for this thesis is the text’s focus on mycelium and the various ways the organism can be manipulated as a cultivated building material.

Gruber, Petra & Imhof, Barbara & Hoheneder, Waltraut & Speck, Thomas & Vermeulen, Angelo & Vincent, Julian & Gudenus, Viktor & Oberwinkler, Tanja. (2016). Built to Grow: Blending Architecture and Biology.
This text focuses on a new “living architecture” which investigates growth and dynamic patterns in nature or biomimicry. This work is important for our research because of its focus on living architecture and notion of imitating emergent patterns in nature.

Stamets, P. (2005). Mycelium running: How mushrooms can help save the world. Berkeley, Calif: Ten Speed Press.
Stamets’ work is a manual on how we can capitalize mycellium’s digestive power to decompose toxic waste and pollutants. Even though our investigation looks at waste and pollutants as a resource, the text informs our research by breaking down the different ways mycelium can be manipulated and used as a tool in “mycorestoration”.