SOLUTION?

As architecture students, we engage with the world's political, economic, cultural, and scientific challenges. But how much can we truly resolve through design?

Zheng Xiang
Selected Works 2023-2024
Columbia GSAPP
MS. Advanced Architectural Design Candidate

In architecture schools, we explore global political, economic, cultural, and scientific dilemmas. As architects, our capacity to address these complex issues is limited; they often demand collaborative efforts across various fields. In our academic environment, we sometimes venture into imaginative territories, proposing solutions that may seem far-fetched when viewed solely through the lens of design. But do these ideas have true value?

CONTENTS

01 SYMBIOTIC STRUCTURES

An Experiential Museum of Wind Power Technology

Keywords: *Wind Power, Renewable Energy, Energy Transformation, Material Cycle, Experiential Museum, Electrolytic Hydrogen Production*

Summer 2023, Advanced Architecture Tutorial
Instructor: Dan Wood, Layna Chen
Site: New York, USA
Individual Work

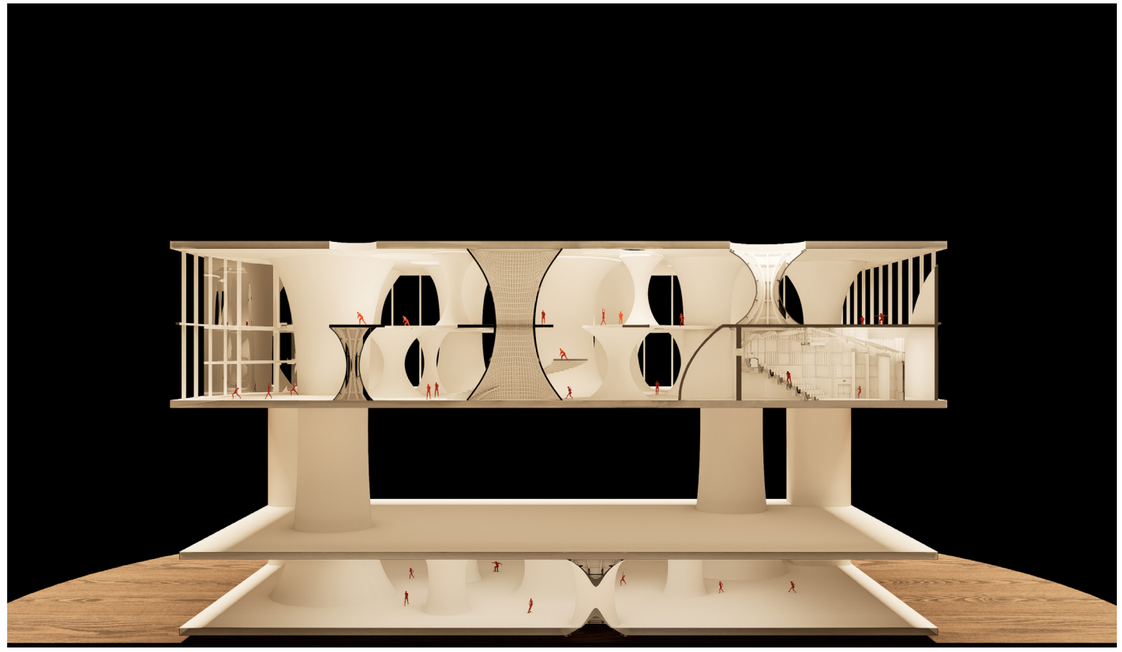
Symbiotic Structures is an experiential museum designed to harmonize human innovation with the natural world. This project aims to demystify wind power technology and showcase its sustainable potential. Through a unique architectural design featuring interwoven spaces and conical structures, visitors are guided through an immersive journey that highlights the seamless integration of renewable energy solutions. The museum not only educates but also inspires, offering a tranquil and enlightening environment that underscores the beauty of symbiosis between technology and nature.

Visitors are first greeted by a forest-inspired entrance, setting the stage for a narrative that spans the natural origins and technological harnessing of wind power. The museum integrates the process of in-situ direct electrolytic hydrogen production from seawater within its architectural design, specifically through structural cones that also function as housing for the electrolyzers. This technology forgoes the requirements for desalination and complex catalyst engineering, offering a streamlined approach to converting wind-generated electricity into hydrogen and oxygen.

The spatial design of the museum evolves from a linear to an interlaced composition, reflecting the interconnected nature of technology and the environment. This layout guides visitors through interactive displays that both demonstrate and explain the functioning of key technologies. An immersive section beneath the surface allows visitors to observe electrolyzers in operation, providing a clear depiction of the transformation of seawater into usable energy.

Above ground, the pathway leads to a demonstration of how the byproducts of hydrogen production, notably fresh water, are utilized in a hydroponic farming system within the museum. This segment showcases the principles of a circular economy, emphasizing the sustainable use of resources.

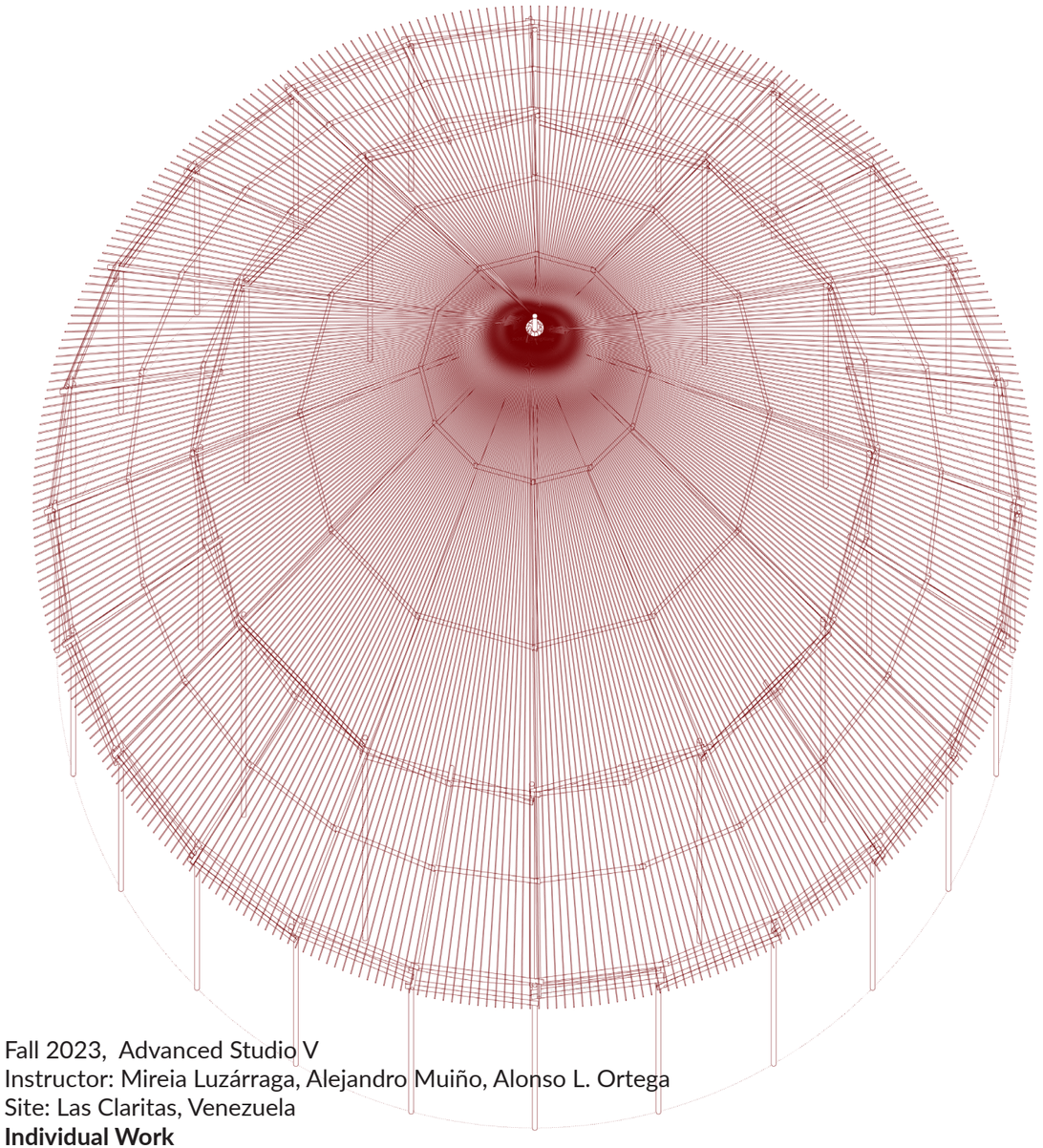
Symbiotic Structures is more than a museum; it is an educational platform that invites visitors to engage with and understand the cycles of renewable energy technologies, promoting a comprehensive grasp of the integration of these systems into daily life.



Zheng Xiang, Advanced Architecture Tutorial, 2023 Summer

02 RECLAIMING CONTROL

Mercury Remediation and Community Empowerment in the Venezuela Mining Arc: A Sustainable Approach through Ecological Planting



Fall 2023, Advanced Studio V
Instructor: Mireia Luzárraga, Alejandro Muiño, Alonso L. Ortega
Site: Las Claritas, Venezuela
Individual Work

Keywords: *Resource Exploitation, Extractivism, Indigenous Rights, Environmental Degradation, Illegal Mining, Ecological Preservation, Phytoremediation, Community Empowerment, Mercury Pollution.*

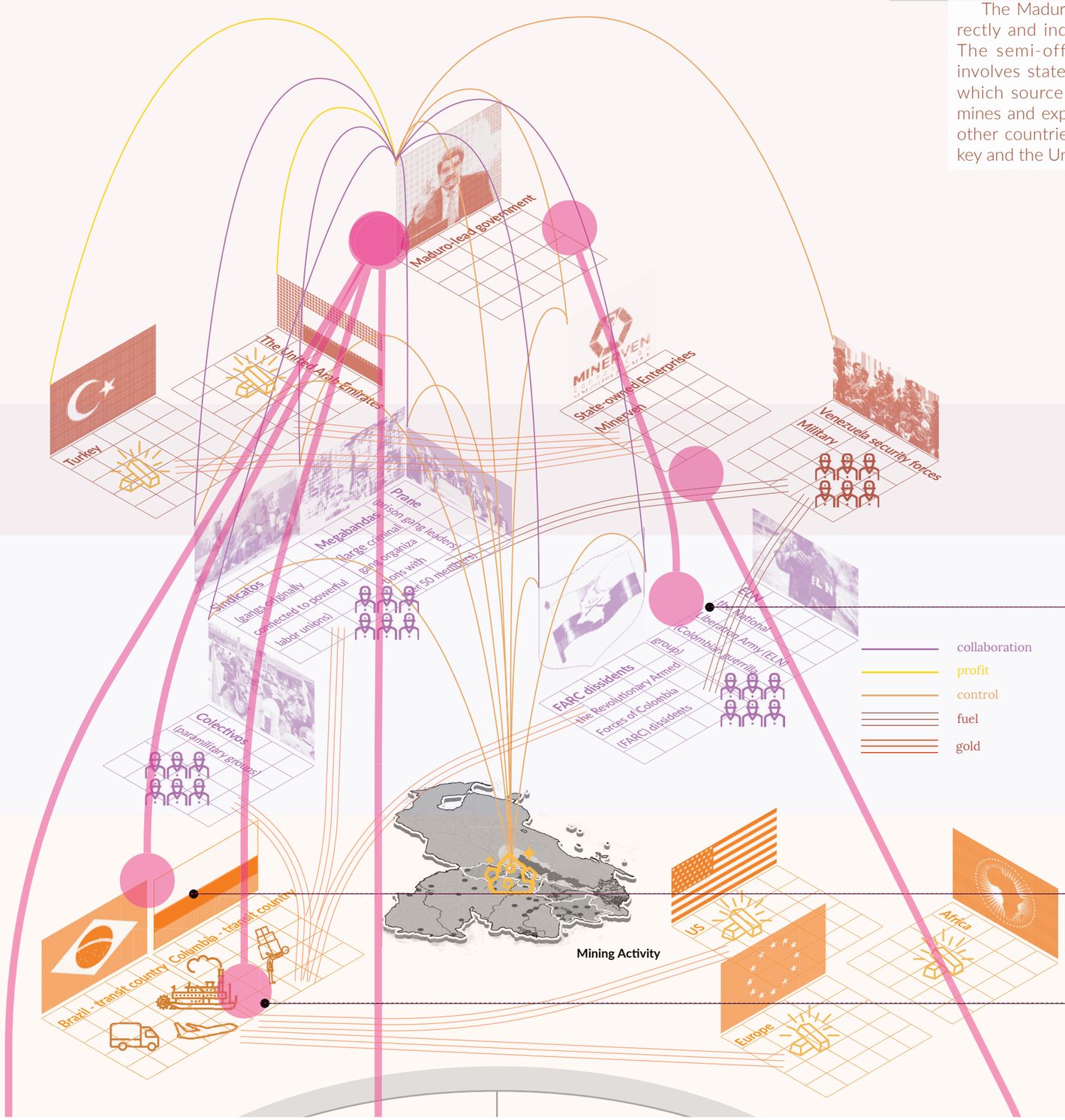
In the heart of Venezuela's verdant landscapes, where the Arco Minero unfurls its vast expanse, a narrative of untapped potential and unfulfilled promises takes root. This project, titled "Reclaiming Control: Mercury Remediation and Community Empowerment in the Venezuela Mining Arc," delves into the intricate tapestry of this region, rich in gold, diamonds, and a plethora of precious minerals, including the tech-critical coltan. Amidst the backdrop of one of the world's most significant gold reserves, the indigenous communities stand as guardians of an ecological and cultural heritage, now at the brink of irreversible change.

At the heart of this exploitation lies Las Claritas, a symbol of resilience and despair. Controlled by powerful syndicates, this mining area epitomizes the struggle for autonomy in the face of overwhelming adversity. The traditional hydraulic mining methods employed here, while effective in gold recovery, unleash a torrent of mercury into the environment, poisoning waterways and soil, and by extension, the very lifeblood of the indigenous communities.

In response to this dire scenario, the project proposes a beacon of hope through innovative environmental remediation and community empowerment strategies. Utilizing phytoremediation, plants like Brassica napus and Miscanthus giganteus are harnessed for their remarkable ability to extract mercury and gold from the polluted earth, offering a sustainable path to reclaim the land and provide for the community. The integration of traditional architectural elements in the design of a biomass plant not only respects cultural heritage but also ensures energy autonomy, marking a pivotal step towards self-sufficiency and resilience.

ANALYSIS

The Maduro regime benefits directly and indirectly from mining. The semi-official mining sector involves state-owned enterprises, which source minerals from illicit mines and export them officially to other countries, most notably Turkey and the United Arab Emirates.



Most of Venezuela's gold exports come from illegal mining. Throughout the mining process, various state security forces take a share of the profits. The military controls the fuel supply in the region and profits from selling it to gangs and guerrillas running fuel-hungry mines. Additionally, both the army and the national guard operate checkpoints along smuggling routes, where they take cash and gold as bribes.

A lot of the gold ends up in neighboring countries like Colombia, Brazil, and Guyana through smuggling. Armed groups use riverboats, airplanes, trucks, or even Venezuelan refugees to move the gold into these countries. In Colombia, they launder the gold and make it look like it's legally Colombian before it hits the global market.

Collaborating with the government of Colombia and the international community

to demobilize the National Liberation Army (Ejército de Liberación Nacional, orELN) and dissidents of the Revolutionary Armed Forces of Colombia (FuerzasArmadas Revolucionarias de Colombia, or FARC).

Working with the governments of Colombia and Brazil

Collaborate with neighboring countries, especially Colombia and Brazil, to secureitheir borders with Venezuela.

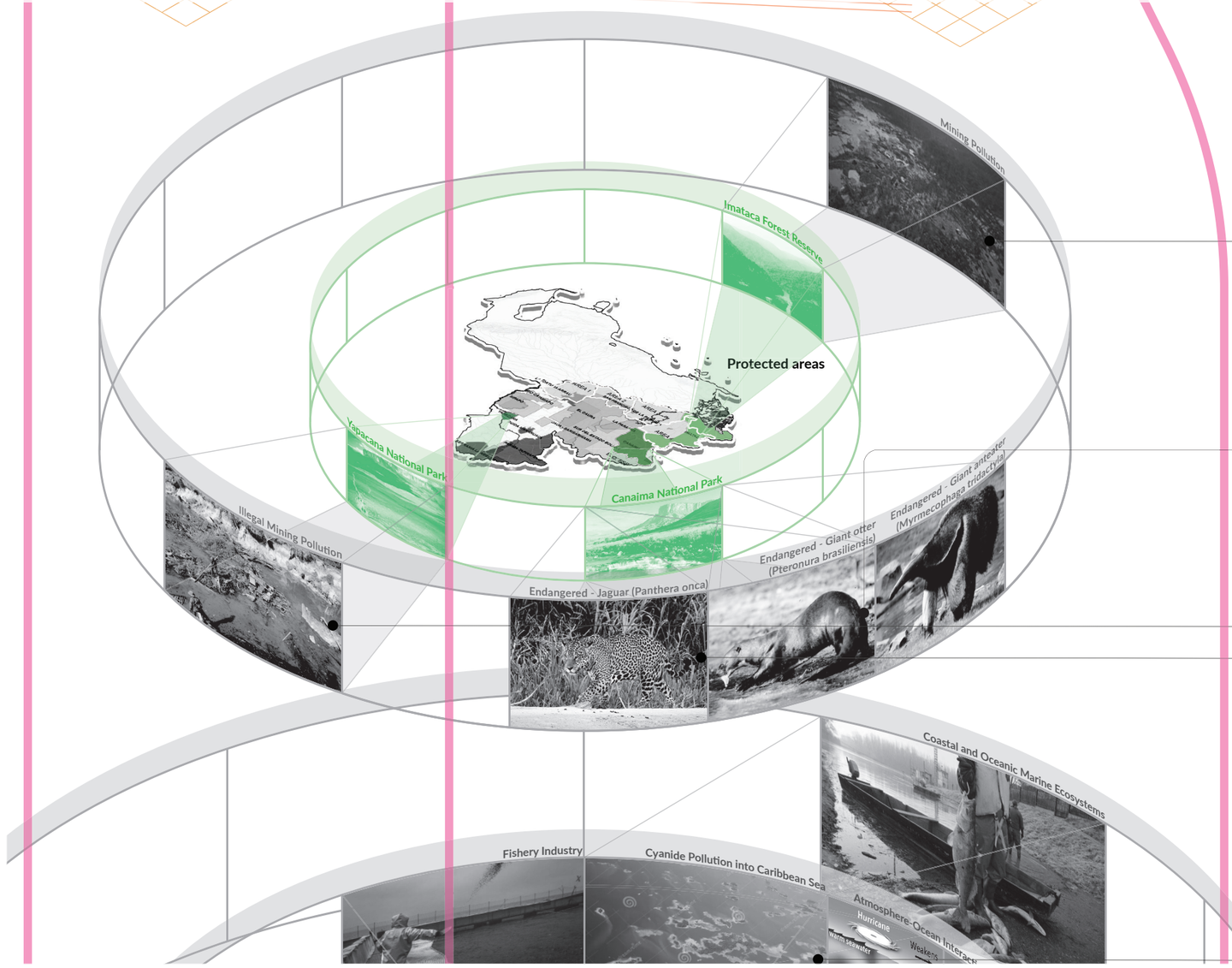
Blocking transport routes

Pressure transit countries, including the islands of Aruba, Bonaire, and Curaçao, tostop importing Venezuelan gold and other minerals.

Zheng Xiang, Advanced Studio V, 2023 Fall

The Arco Minero intersects with the Venezuelan Amazon rainforest, a biodiverse area containing 36 protected areas, including national parks and monuments. This rainforest is being illegally logged to make way for mines, roads, and mining camps. In the four years after the creation of the Arco Minero, over 2,821 square kilometers (approximately 1,090 square miles) of forest have been destroyed, 50 percent of that area in "protected territories."

The region slated for mining development includes the Parque Nacional Canaima (Canaima National Park) covers 30,000 square kilometers (12,000 square miles), and is a UNESCO World Heritage site. and is home to jaguars (Panthera onca), giant otters (Pteronura brasiliensis) and giant anteaters (Myrmecophaga tridactyla). The OMA also threatens the area's forests, which are home to endemic species (only found in one place in the world) that will be severely affected.



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Blocking transport routes

Pressure transit countries, including the islands of Aruba, Bonaire, and Curaçao, tostop importing Venezuelan gold and other minerals.

Siltation Prevention

Implement measures to prevent sediment runoff from mining activities that can suffocate mangroves and their associated aquatic life.

Mangrove Buffer Zones

Establish buffer zones around mangrove areas to protect them from mining-related activities.

Riparian Reforestation

Plant riparian vegetation to protect the riverbanks and provide shelter for giant otters.

Protection of River Ecosystems

Implement measures to protect the river ecosystems where giant otters reside, including regulating water quality.

Habitat Preservation

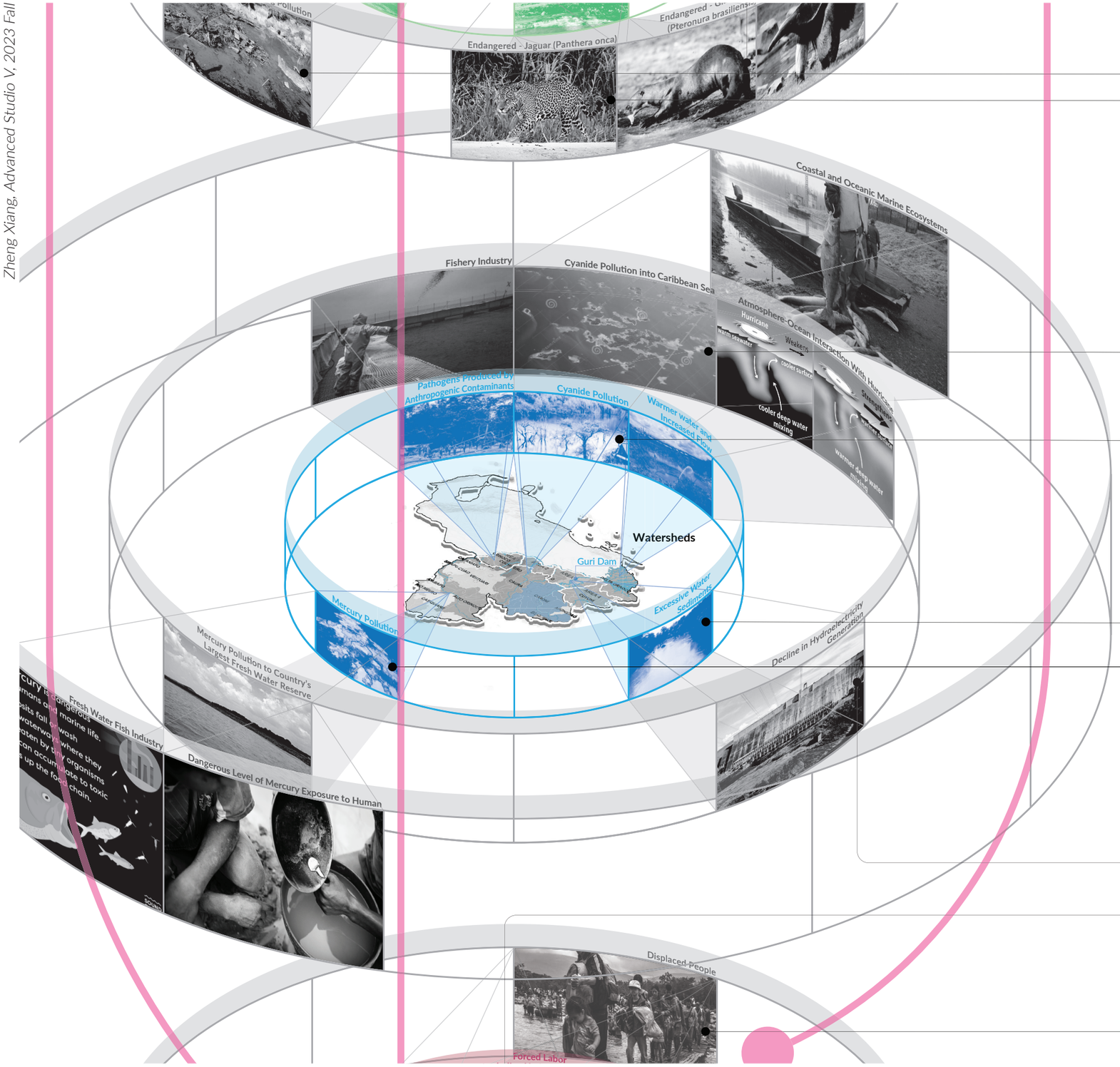
Designate areas with significant giant otter populations as protected habitats within the OMA.

Eco-friendly mining techniques

Protected Corridors

Establish protected wildlife corridors to allow jaguars to move between fragmented habitats without crossing mining zones.

Early Warning Systems



Eco-friendly mining techniques

Habitat Preservation

Designate areas with significant giant otter populations as protected habitats within the OMA.

Protected Corridors

Establish protected wildlife corridors to allow jaguars to move between fragmented habitats without crossing mining zones.

Early Warning Systems

Establish early warning systems for health issues related to mining pollution.

Restoration of Waterways

Implement measures to restore and protect water sources affected by mining pollution.

Water flow sediment treatment

Mercury pollution treatment

Mercury free mining

Alternative Energy Sources

Tourism Development

Develop ecotourism opportunities in the region to generate income and create jobs.

Cultural Preservation

Support the preservation of indigenous cultures and traditional knowledge.

Resettlement Plans

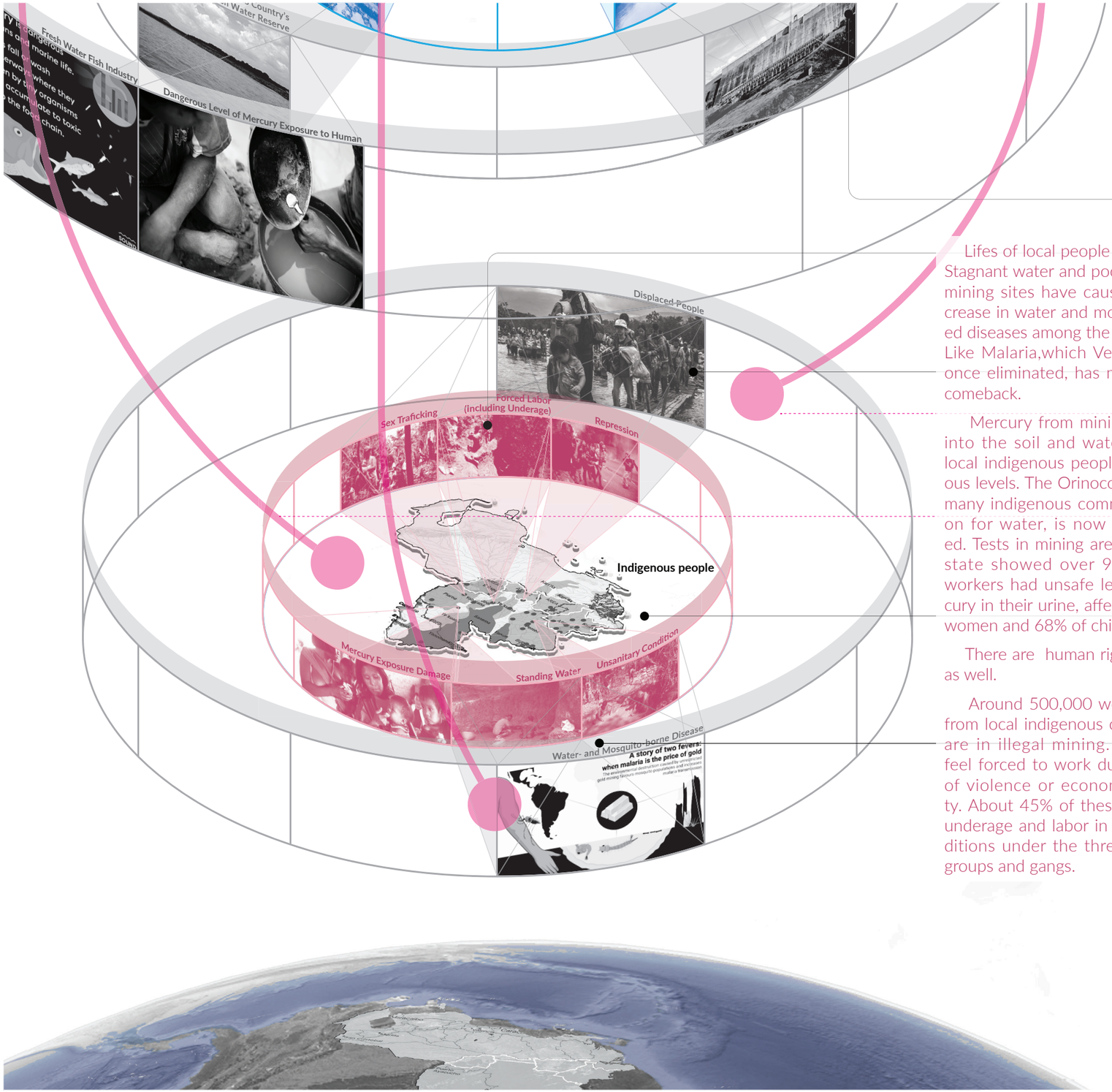
Develop fair and sustainable resettlement plans for displaced

Conservation Agreements

Half of the river areas in the southern Orinoco region overlap with the mining project. This area in Bolivar state has tons of freshwater and provides 65% of Venezuela's clean, renewable electricity. But mining is causing droughts and sediment buildup that's damaging power generation and the entire country's energy system.

Gold mining in Venezuela often uses mercury, which has seeped into nearby rivers used for drinking in Colombia and Brazil. Mining waste with mercury is leaking into rivers. Similar problems of Cyanide-contaminated water and Harmful pathogens from human-made pollutants are causing problems in fish industry and fresh water sources of nearby countries.

Zheng Xiang, Advanced Studio V, 2023 Fall



Lifes of local people are affected. Stagnant water and poor hygiene at mining sites have caused a big increase in water and mosquito-related diseases among the local people. Like Malaria,which Venezuela had once eliminated, has made a rapid comeback.

Mercury from mining is getting into the soil and water, exposing local indigenous people to dangerous levels. The Orinoco river, which many indigenous communities rely on for water, is now contaminated. Tests in mining areas of Bolivar state showed over 90% of mine workers had unsafe levels of mercury in their urine, affecting 87% of women and 68% of children.

There are human right problems as well.

Around 500,000 workers, many from local indigenous communities, are in illegal mining. They often feel forced to work due to threats of violence or economic necessity. About 45% of these miners are underage and labor in terrible conditions under the threat of armed groups and gangs.

Mercury free mining

Alternative Energy Sources

Tourism Development

Develop ecotourism opportunities in the region to generate income and create jobs.

Resettlement Plans

Develop fair and sustainable resettlement plans for displaced communities.

Traditional settlement repair and reconstruction

Cultural Preservation

Support the preservation of indigenous cultures and traditional knowledge.

Conservation Agreements

Encourage mining companies to enter into agreements to fund the protection and restoration of mangrove ecosystems

Free, Prior, and Informed Consent

Ensure that indigenous communities are given the opportunity to provide informed consent regarding mining activities on their ancestral lands

Human Rights Monitoring

Monitor and report on human rights violations associated with mining activities and seek accountability.

Healthcare Services

Improve access to healthcare services, particularly in areas impacted by mining operations.

Health Education

Provide education and awareness campaigns on the health risks associated with mining activities.

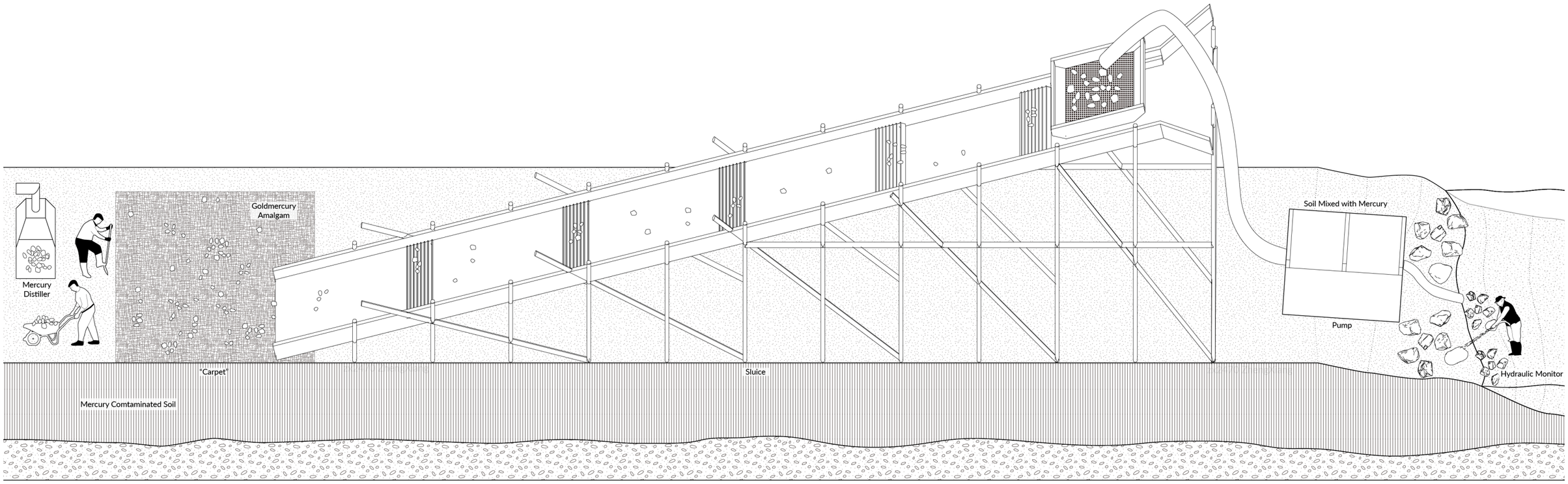
The workers and residents in this area are being exploited.

The water and soil pollution is adversely affecting the health of the residents.

The area is under the control of sindicatos, which wield more power than government or military authorities.

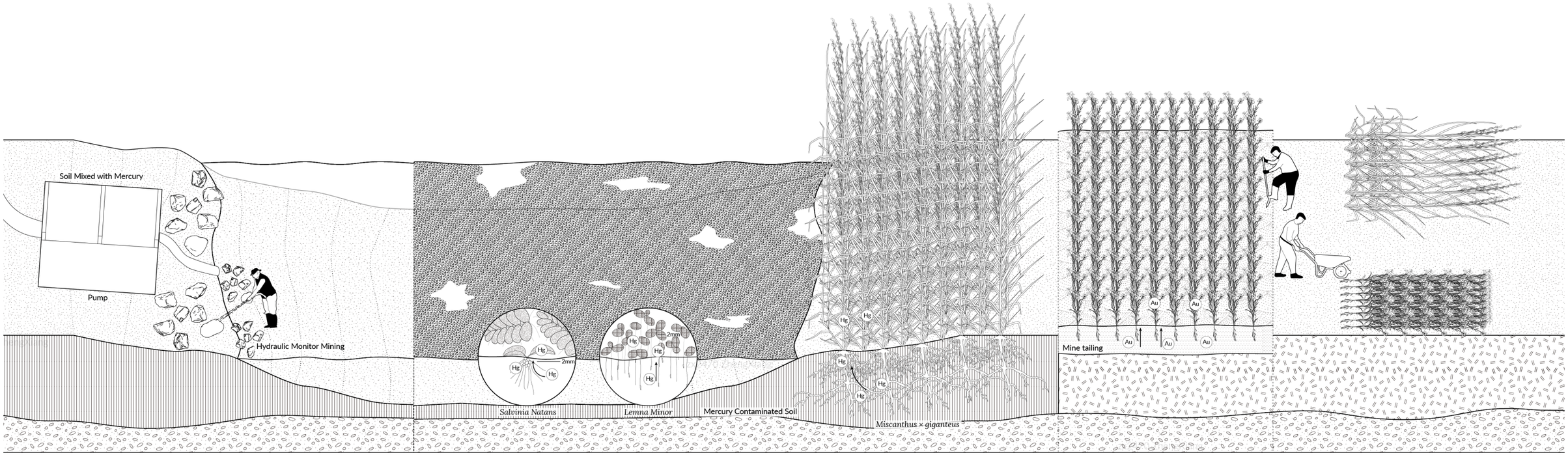
Therefore, interventions in this site have a limited budget and are better off being self-funded.

SOLUTION



Upon examining the current methods of mining and gold refining, it has been found that these techniques achieve a gold recovery rate of 70% to 90%. Old mine tailings are only reprocessed when vein material is depleted. Furthermore, when tailings or lower-grade materials are transported to independent mills, the profits benefit the mill owners rather than the miners.

To clean mercury from the soil, the plant Miscanthus giganteus, a superaccumulator of mercury, also serves as an effective biofuel plant. It is unusually efficient at converting solar radiation into biomass, and its water use efficiency ranks among the highest of any crop. The power density of a plantation with this yield falls between the average power densities of wind and hydro power. As previously mentioned, hydro power, the main source of electricity in Venezuela, is now unstable due to climate change and mining. Las Claritas is experiencing frequent blackouts. With funds from gold collection, a small biomass plant could be built to supply the community and generate profits.

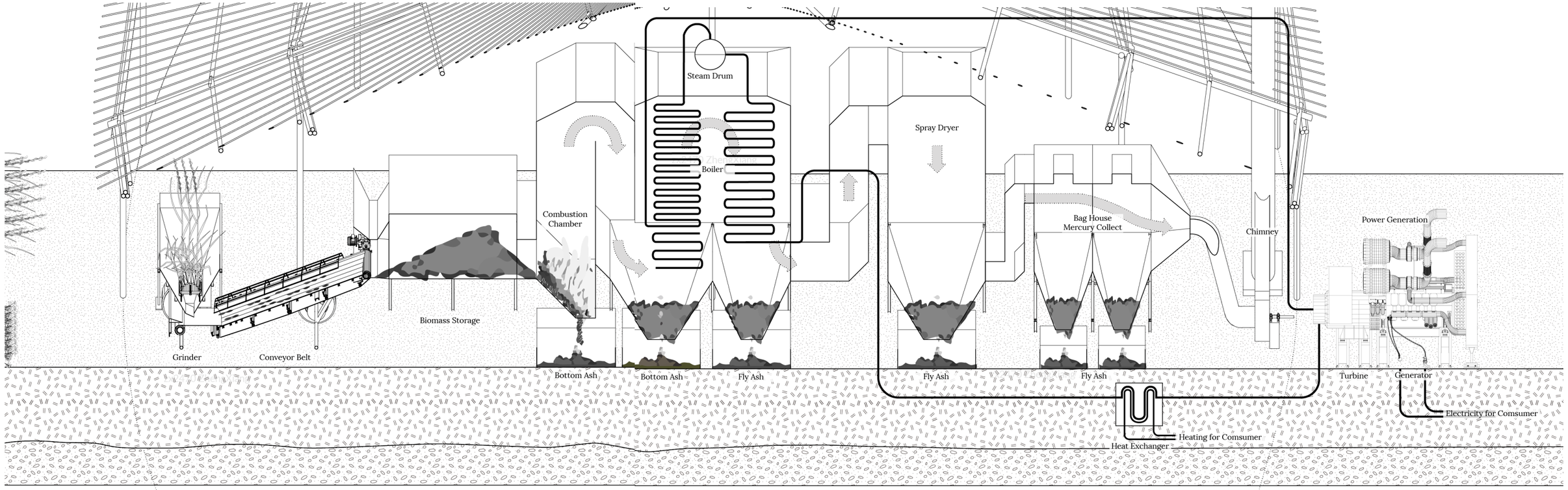


Similarly, Salvinia natans and Lemna minor most efficiently collect mercury from water when cultured at a weight ratio of 1:2.

They can be dried, burned, and the mercury can then be collected.

This plant, Brassica napus (rapeseed), when inoculated with Aspergillus niger strains and treated with ammonium thiocyanate (NH4SCN) or ammonium thiosulfate, exceeds the hyperaccumulation criterion of 1 milligram of gold per kilogram of plant biomass.

By burning the plant and collecting the ash that contains gold, funding for other interventions can be secured.



The plants are collected, shredded, and combusted to heat water vapor, which generates electric power. The excess heat can provide heating and hot water for the community. Ashes containing gold or mercury and distilled mercury are collected.

Through this process, the community can profit and gain some relief from the control of the sindicatos.

03 THE BIOCHAR PATH

Circular Utilization of Agricultural Waste and Architectural Sustainability in Indonesia

Keywords: *Biochar Utilization, Agricultural Waste Valorization, Low-carbon building materials, Sustainable Construction, Circular Built Environment.*

Spring 2024, Advanced Studio VI
Instructor: David Benjamin, Steven Lin
Site: Cianjur, Indonesia
Individual Work

In areas like Cianjur, where a bumper rice harvest has led to widespread open burning of agricultural residues, a major environmental challenge has arisen, releasing harmful particulate matter and greenhouse gases into the atmosphere. Converting this agricultural waste into biochar is a transformative solution that not only mitigates the harmful effects of open burning, but also serves as a sustainable alternative for the construction industry.

When blended into concrete, biochar not only matches the strength of traditional materials with mix ratios as high as 30%, but also significantly reduces the carbon footprint, contributing positively to the well-being of the planet.

Cianjur, a site marked by high rice straw production, low urbanization, and untapped building potential, is an ideal test ground for this new approach. To ensure that local farmers, predominantly small landholders, can benefit from the production and utilization of biochar, the project will employ Kon-Tiki kilns as the primary biochar production tool. These kilns are simple in design, cost-effective, produce minimal pollution, and are efficient, making them well-suited to the needs of local farmers.

Farmers will receive guidance from the education center's experts on various aspects of biochar production and biomass storage. The produced biochar can be used as a soil amendment, with the surplus sold to biochar concrete production facilities, generating additional income for the farmers.

100% pre-mixed concrete

10% ground biochar
90% pre-mixed concrete

20% not ground biochar
80% pre-mixed concrete

20% ground biochar
80% pre-mixed concrete

30% ground biochar
70% pre-mixed concrete
more water

30% ground biochar
70% pre-mixed concrete

Converting this agricultural waste into biochar is a transformative solution that not only mitigates the harmful effects of open burning, but also serves as a sustainable alternative for the construction industry.

After pyrolysis under certain temperature and time, the biomass is charred, then after milling and some treatment if necessary, it can replace part of the portland cement in the concrete.

30% ground biochar
70% portland cement
0.00502kg C/kg

30% ground biochar
70% portland cement
0.00502kg C/kg

100% portland cement
0.226kg C/kg

When blended into concrete, biochar not only matches the strength of traditional materials with mix ratios as high as 30%, but also significantly reduces the carbon footprint, contributing positively to the well-being of the planet.

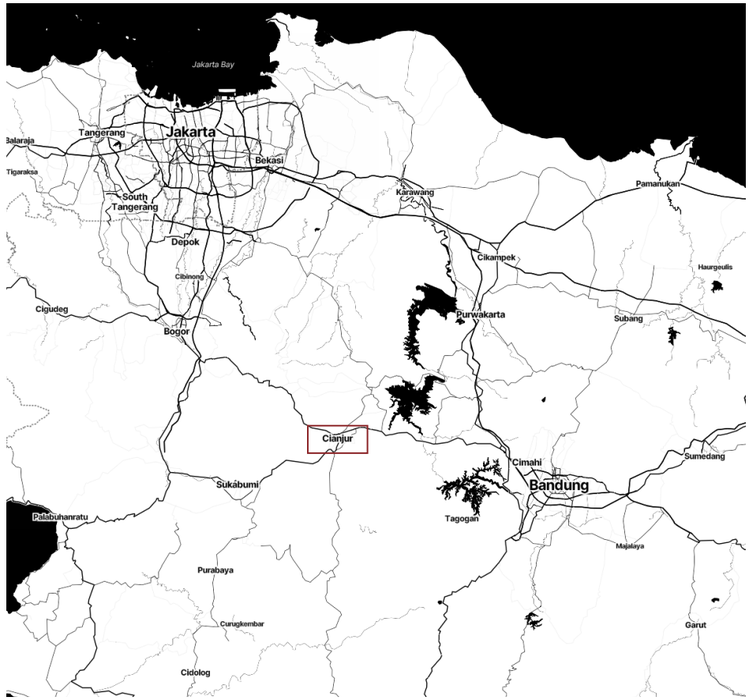
Comparing to other normal building material, this number is much lower.

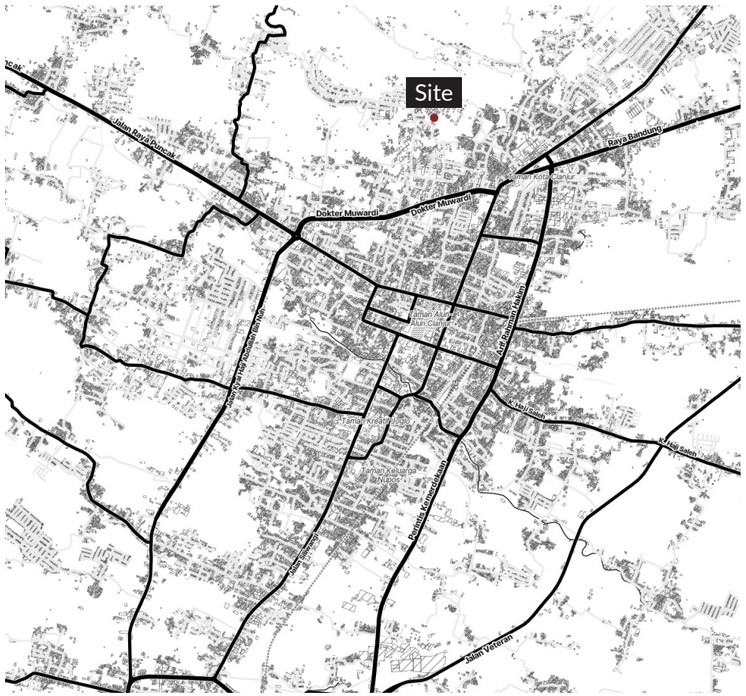
Red Brick
0.040kg C/kg

Cianjur, a rice-producing region in Indonesia, is an ideal test ground for the biochar-based approach due to its high rice straw production, low urbanization, and untapped building potential.

This town is well-known as a rice-producing area, which contributes to its substantial agricultural waste in the form of rice straw.

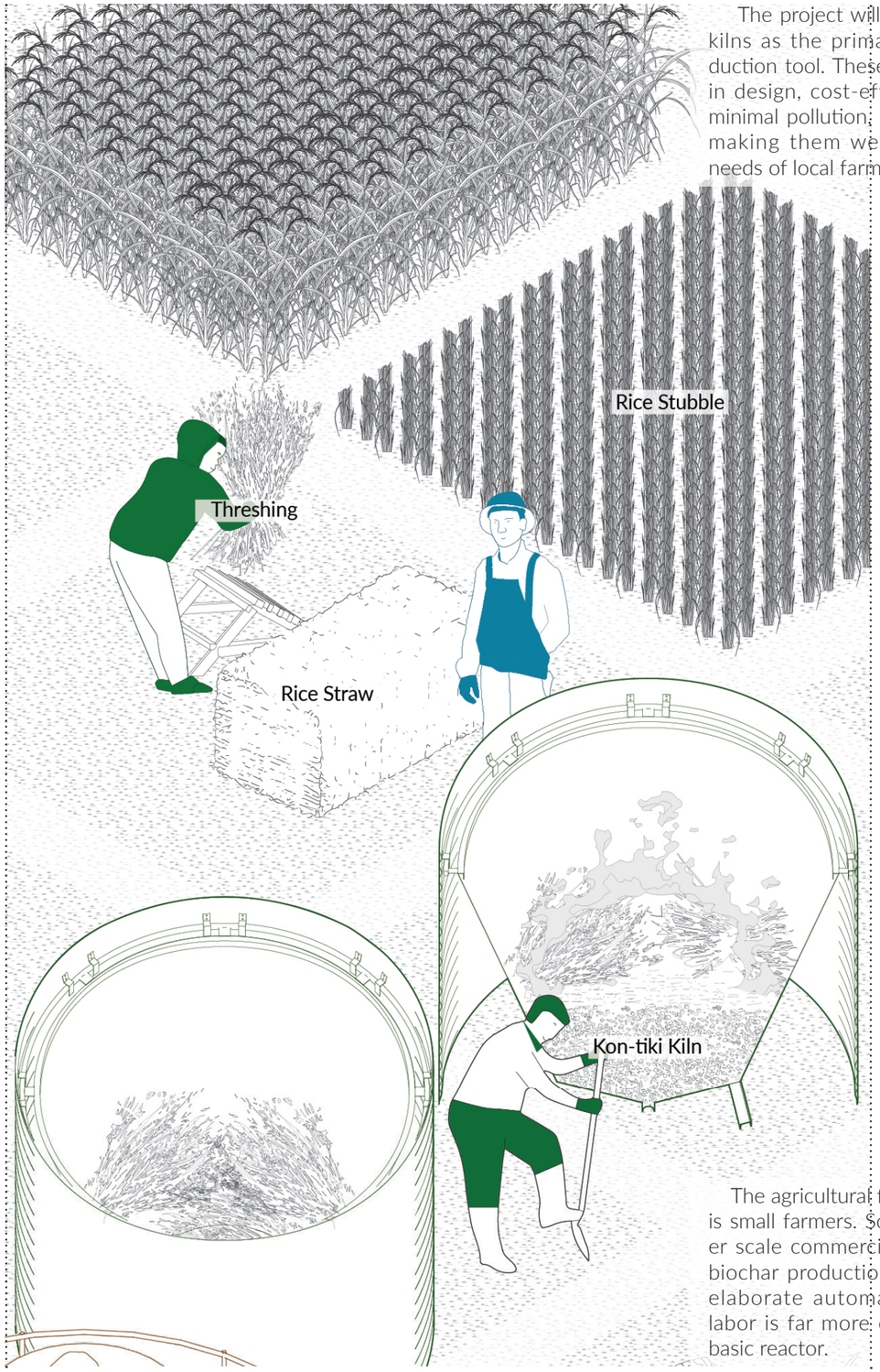
Cianjur's location along one of the main roads between Jakarta and Bandung has led to low urbanization, with some residents commuting to work in Bandung. This combination of high agricultural waste and low urbanization presents an opportunity to implement sustainable waste management practices using biochar.



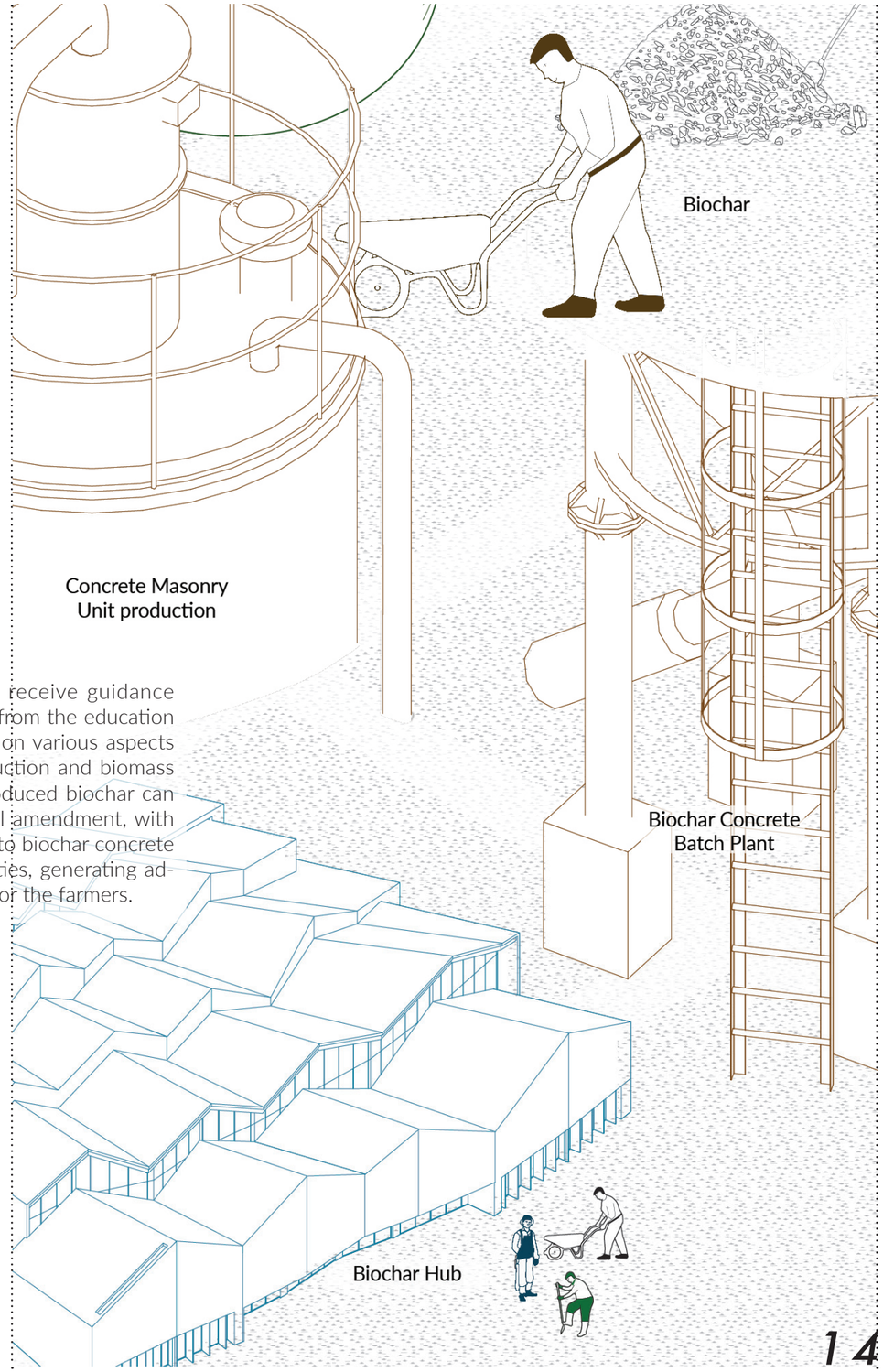


The Cianjur Biochar Innovation Hub is designed as an education center. It is located adjacent to the local university to foster collaboration with their biochar-related research efforts.

The project will employ Kon-Tiki kilns as the primary biochar production tool. These kilns are simple in design, cost-effective, produce minimal pollution, and are efficient, making them well-suited to the needs of local farmers.



The agricultural form of indonesia is small farmers. So instead of larger scale commercial and industrial biochar production, which require elaborate automation to reduce labor is far more of the cost than basic reactor.



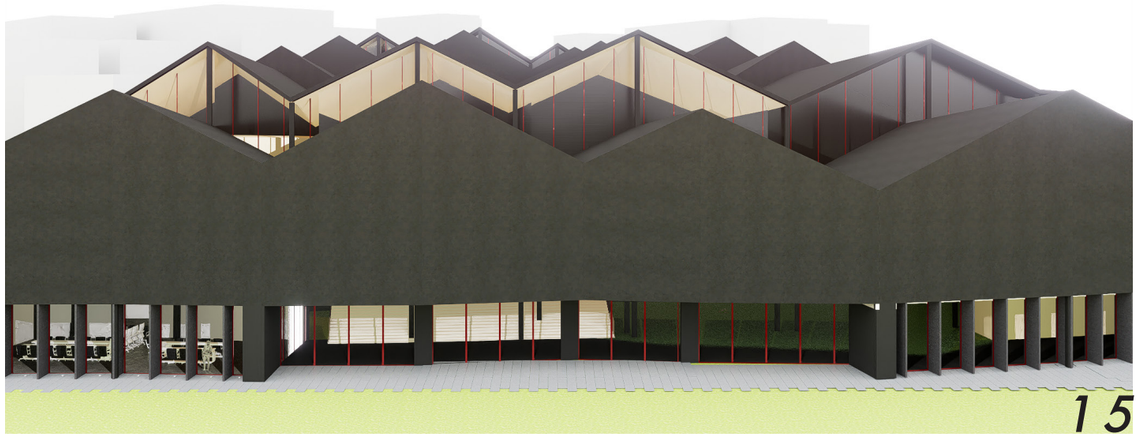
Farmers will receive guidance and supervision from the education center's experts on various aspects of biochar production and biomass storage. The produced biochar can be used as a soil amendment, with the surplus sold to biochar concrete production facilities, generating additional income for the farmers.

Zheng Xiang, Advanced Studio VI, 2024 Spring

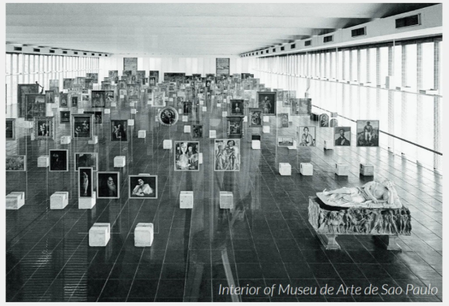
There is workshop space, meeting areas, research lab. A platform for researchers, industry professionals, and the local community to come together and explore the potential of this innovative solution.

The hub aims to provide a space for visitors to experience, learn, and exchange ideas about the use of biochar concrete as a building material.

It will serve as a a sample of a building utilizing biochar concrete.



English | Português


Interior of Museu de Arte de Sao Paulo

Houses or Museums?

Lina Bo Bardi, 1958

What should come first, houses or museums? Everything at once: the houses, the schools, the museums, the libraries. Urban Planning cannot ignore cultural issues. If in the construction of new neighbourhoods, new housing forms the basis of the city plan (and by housing we also mean the market, the schools and the public services like the hospital and the post offices), the planning of a city cannot overlook two key public buildings that still today are considered an intellectual luxury: the Museum and the Library.

Museum? What is a museum? In everyday life, when we want to describe a person, thing or idea that is outdated, not practical or useful, we often say 'they belong in a museum'. The expression is a clear indicator of the place museums occupy in contemporary culture, the perception of them as dusty, useless spaces. Sometimes museums are merely the stage for the exhibitionist antics of architects who, rather than designing them to showcase the 'pieces', create complex confections with a decorative character that gets in the way of the 'museology'. On other occasions, the museum is the setting for dilettantes, for ladies who lunch looking for something to fill in the time, who dabble in sculpture, painting or ceramics and exhibit their handicraft in 'museums' that generally lack the one thing that ought to be there: namely, a real collection of painting and sculpture, The modern museum has to be a didactic museum, able to marry conservation with the message that it is the art that must be highlighted, while everything else has a far more modest role. This has to be clearly understood by the architect, who should never use the commission as an opportunity for self-aggrandising pyrotechnics such as you find, for example, at the Castello Sforzesco, where Michelangelo's celebrated Pietà has been encased in a kind of monument that almost immediately acquired some less than respectful nicknames, or like it happened at the exhibition of the Beistegui Collection at the Louvre in Paris, which was displayed against a series of walls draped in red velvet and gold better suited for a jockey club than to a museum.

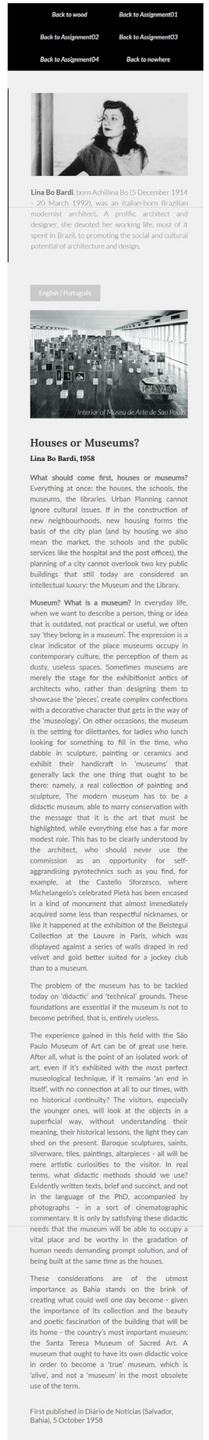
The problem of the museum has to be tackled today on 'didactic' and 'technical' grounds. These foundations are essential if the museum is not to become petrified, that is, entirely useless.

The experience gained in this field with the São Paulo Museum of Art can be of great use here. After all, what is the point of an isolated work of art, even if it's exhibited with the most perfect museological technique, if it remains 'an end in itself', with no connection at all to our times, with no historical continuity? The visitors, especially the younger ones, will look at the objects in a superficial way, without understanding their meaning, their historical lessons, the light they can shed on the present. Baroque sculptures, saints, silverware, tiles, paintings, altarpieces - all will be mere artistic curiosities to the visitor. In real terms, what didactic methods should we use? Evidently written texts, brief and succinct, and not in the language of the PhD, accompanied by photographs – in a sort of cinematographic commentary. It is only by satisfying these didactic needs that the museum will be able to occupy a vital place and be worthy in the gradation of human needs demanding prompt solution, and of being built at the same time as the houses.

These considerations are of the utmost importance as Bahia stands on the brink of creating what could well one day become - given the importance of its collection and the beauty and poetic fascination of the building that will be its home - the country's most important museum: the Santa Teresa Museum of Sacred Art. A museum that ought to have its own didactic voice in order to become a 'true' museum, which is 'alive', and not a 'museum' in the most obsolete use of the term.

First published in Diário de Notícias (Salvador, Bahia), 5 October 1958

Lina Bo Bardi, born Achillina Bo (5 December 1914 - 20 March 1992), was an Italian-born Brazilian modernist architect. A prolific architect and designer, she devoted her working life, most of it spent in Brazil, to promoting the social and cultural potential of architecture and design.



04 WEB DESIGN & DEVELOPMENT

Learning HTML, CSS and JavaScript to Create Work for the Web Browser as a Means of Representation, Speculation and Communication

Fall 2023, Coding for Spatial Practice
Instructor: Celeste Layne
Individual Work

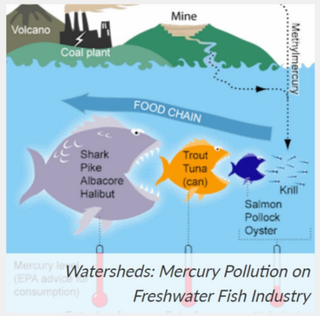
Link to the website, check the responsive design and codes here: https://zx2470.github.io/hello-wood/assignments/assignment05/HousesOrMuseums05.html

The **Orinoco Mining Arc** in Venezuela is a large-scale mining project that has raised concerns due to its significant impact on natural ecosystems and indigenous communities. This initiative, spanning an area rich in biodiversity, has led to deforestation, habitat destruction, and contamination of water sources. Protected areas and watersheds are particularly affected, disrupting delicate ecological balances. Indigenous people, who rely on the land for their livelihoods, face displacement and the loss of their traditional way of life. Additionally, the mining arc has witnessed illegal mining activities, further exacerbating environmental degradation and posing serious threats to both the environment and the well-being of local communities. This webpage aims to highlight these issues, shedding light on the consequences of the mining arc on protected areas, watersheds, and the indigenous population.

More about Orinoco Mining Arc...

Category	Primary Effect	Secondary Effect
Protected Areas	Yapacana National Park	Illegal Mining Pollution
Protected Areas	Canaima National Park	Endangered Jaguar
Protected Areas	Canaima National Park	Endangered Giant Otter
Protected Areas	Canaima National Park	Endangered Giant Anteater
Protected Areas	Imataca Forest Reserve	Mining Pollution
Watersheds	Mercury Pollution	Freshwater Fish Industry

Watersheds: Mercury Pollution



Watersheds: Mercury Pollution on Freshwater Fish Industry

Mercury pollution from gold mining can have significant and far-reaching impacts on freshwater ecosystems and the freshwater fish industry. Mercury is often used in artisanal and small-scale gold mining (ASGM) to extract gold from ore. The process involves amalgamation, where mercury is mixed with gold-containing materials to form a gold-mercury amalgam. Unfortunately, this practice leads to the release of mercury into the environment, with serious consequences for aquatic ecosystems and the organisms that inhabit them, including freshwater fish.

Watersheds	Mercury Pollution	Dangerous Level of Mercury Exposure to Human
Watersheds	Excessive Water Sediment	Decline in Hydroelectricity Generation
Watersheds	Warmer Water and Increased Flow	Atmosphere-Ocean Interaction With Hurricane
Watersheds	Cyanide Pollution	Coastal and Oceanic Marine Ecosystems
Watersheds	Pathogens Produced by Anthropogenic Contaminants	Fishery Industry
Indigenous People	Mercury Exposure Damage	
Indigenous People	Standing Water	Water- and Mosquito-borne Disease
Indigenous People	Unsanitary Condition	Water- and Mosquito-borne Disease
Indigenous People	Repression	Displaced People
Indigenous People	Forced Labor (including the Underage)	Displaced People
Indigenous People	Sex Trafficking	Displaced People

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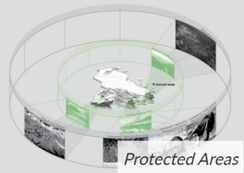
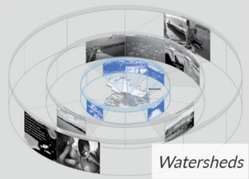
Click To Choose Category...

All

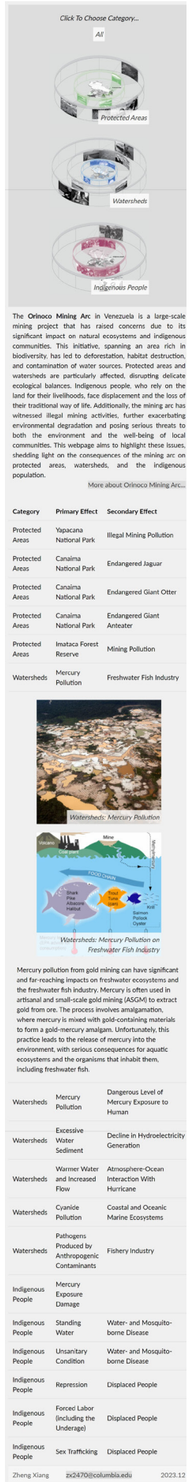


Protected Areas



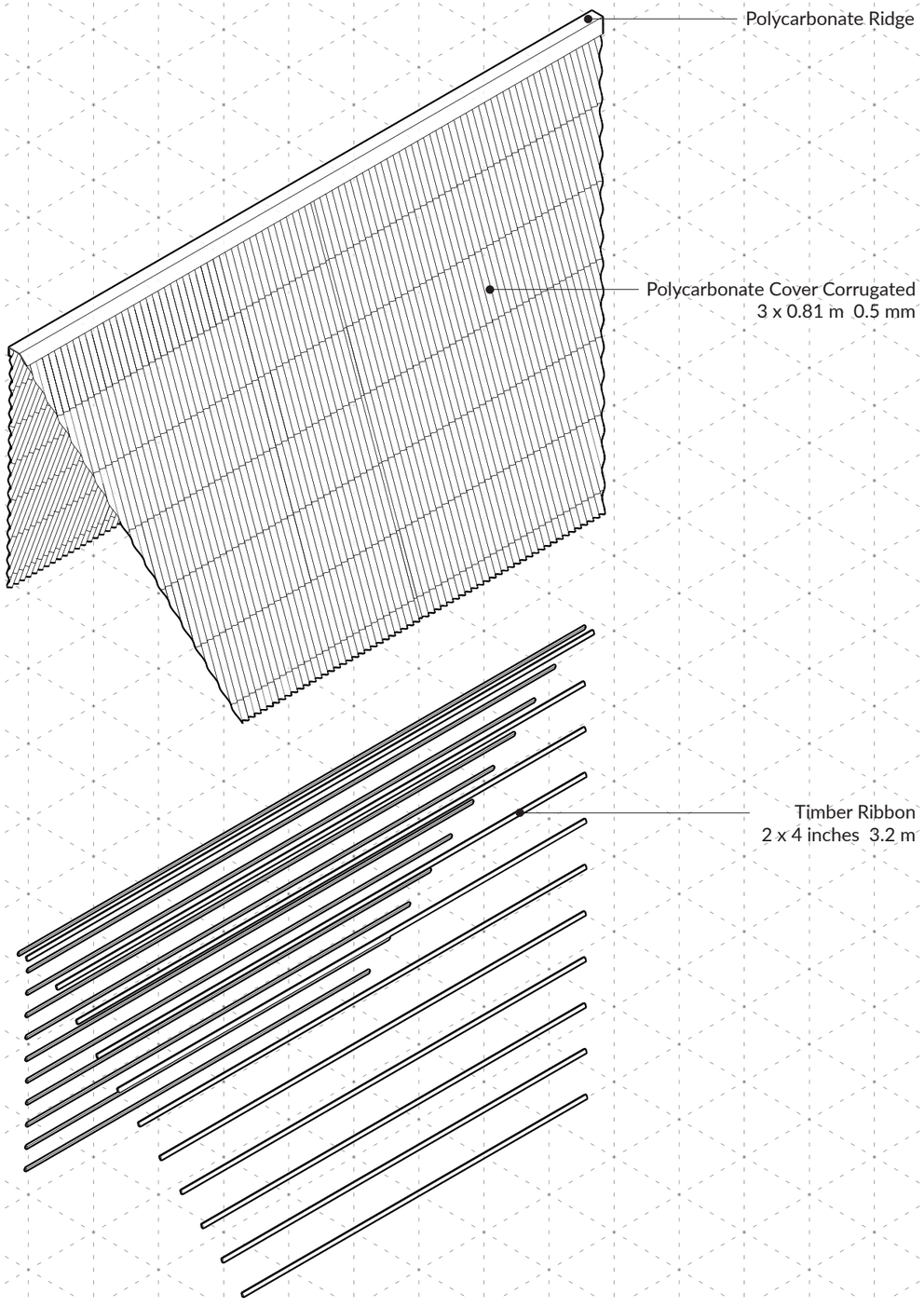
Watersheds

Indigenous People



Link to the website, check the responsive design and codes here: https://zx2470.github.io/hello-wood/final/index.html

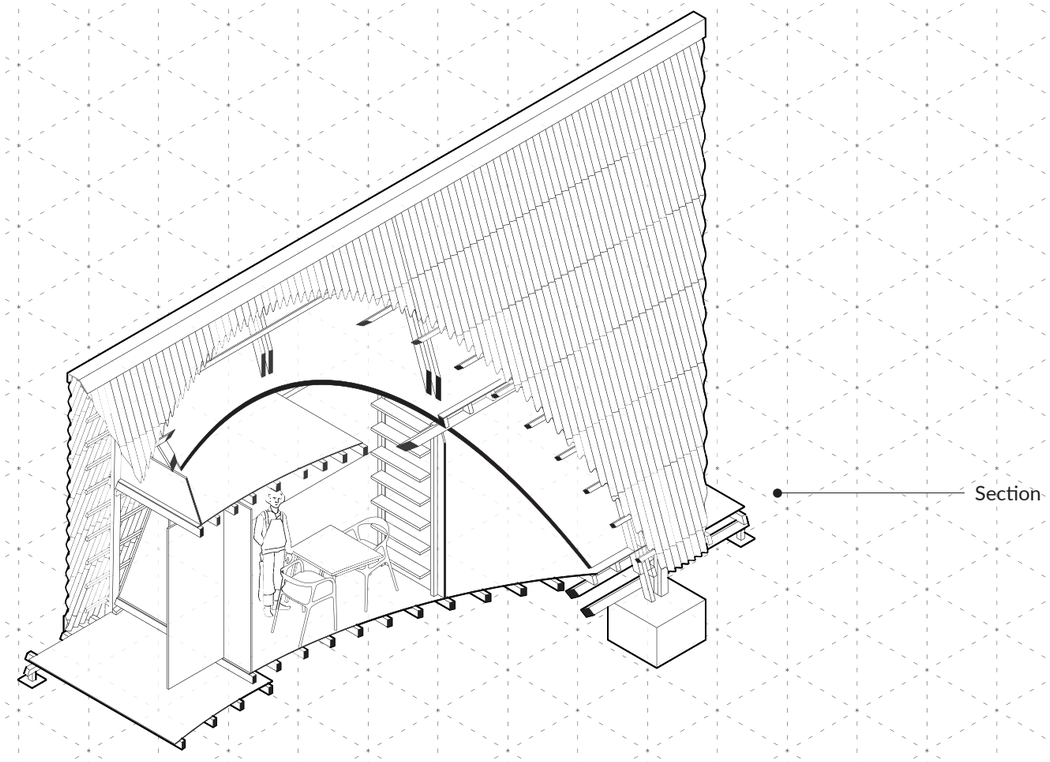
Zheng Xiang, Visual Studies & Computation, 2023 Fall

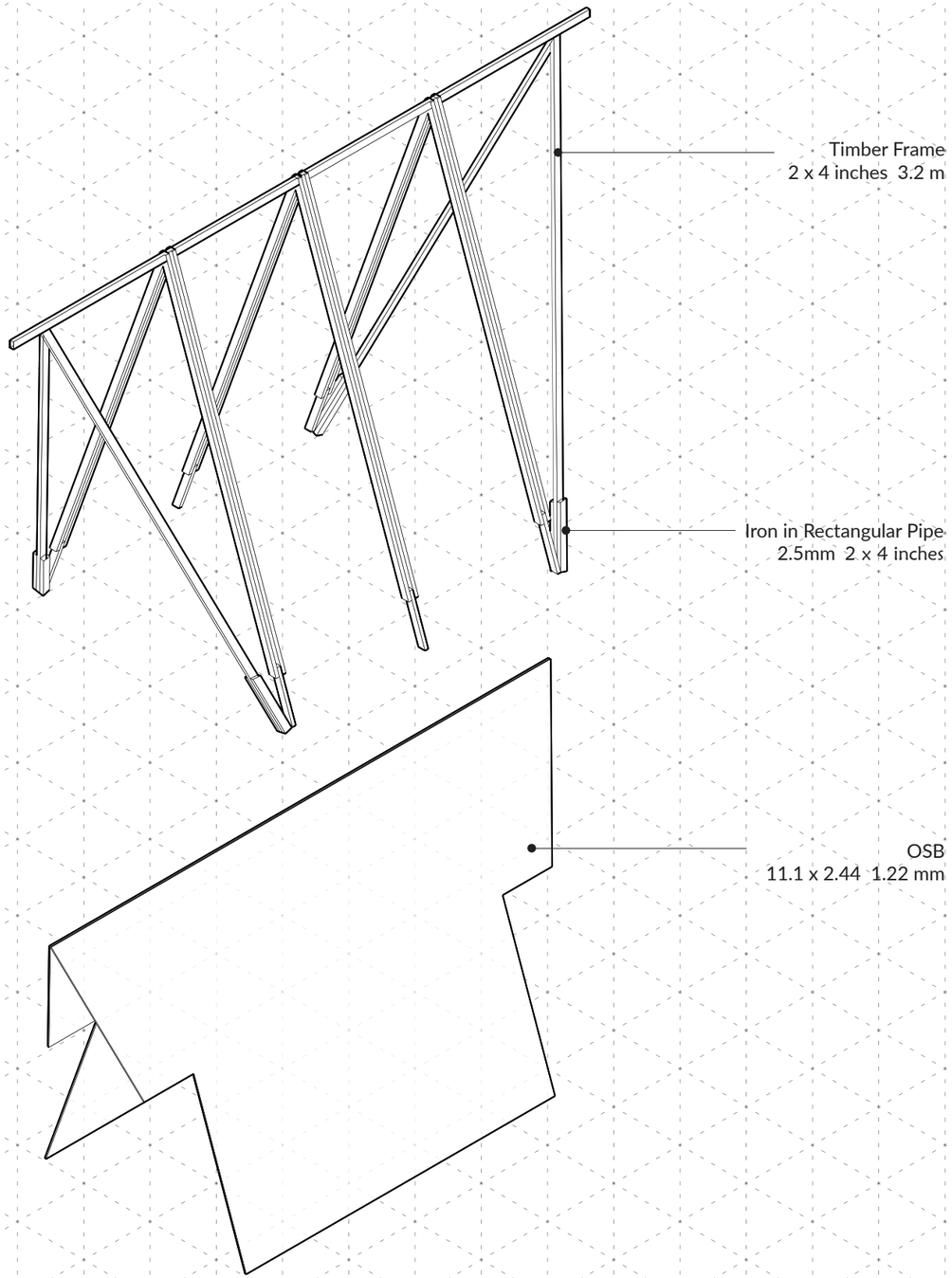


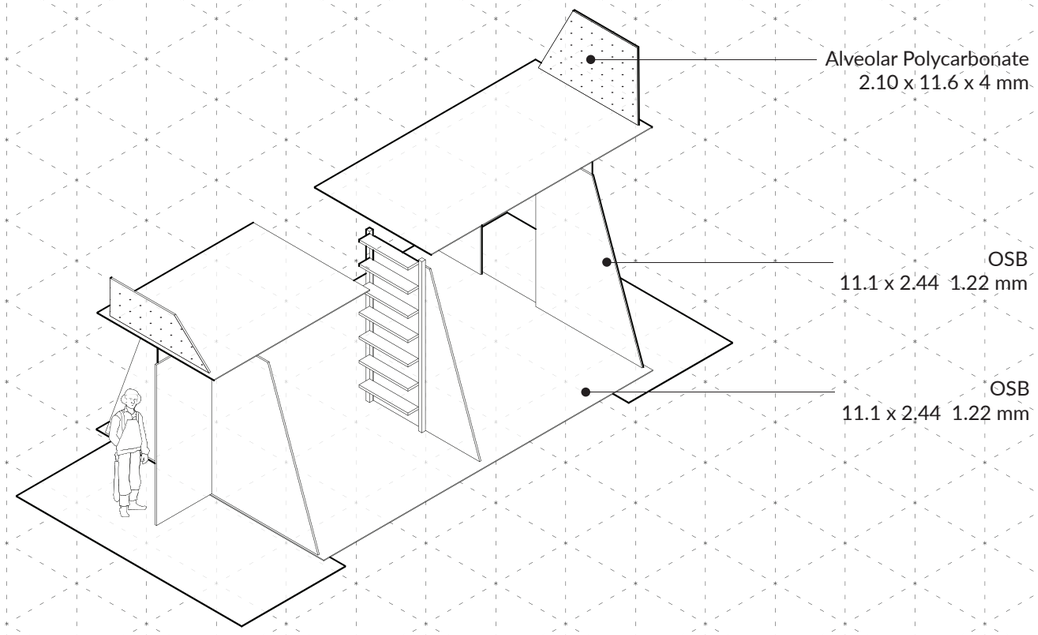
Spring 2024, Seminar of Section
Instructor: Marc Tsurumaki
Individual Work

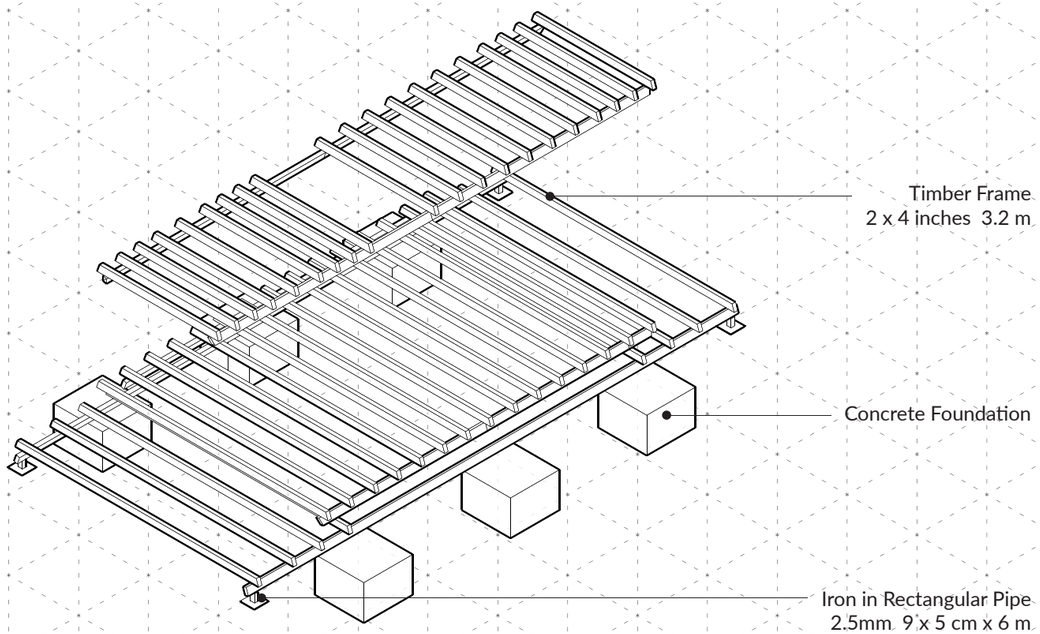
05 SEMINAR OF SECTION

Section Study and Drawing Production of Selected Project
Project: Hua Fai Youth Center / Estudio Cavernas



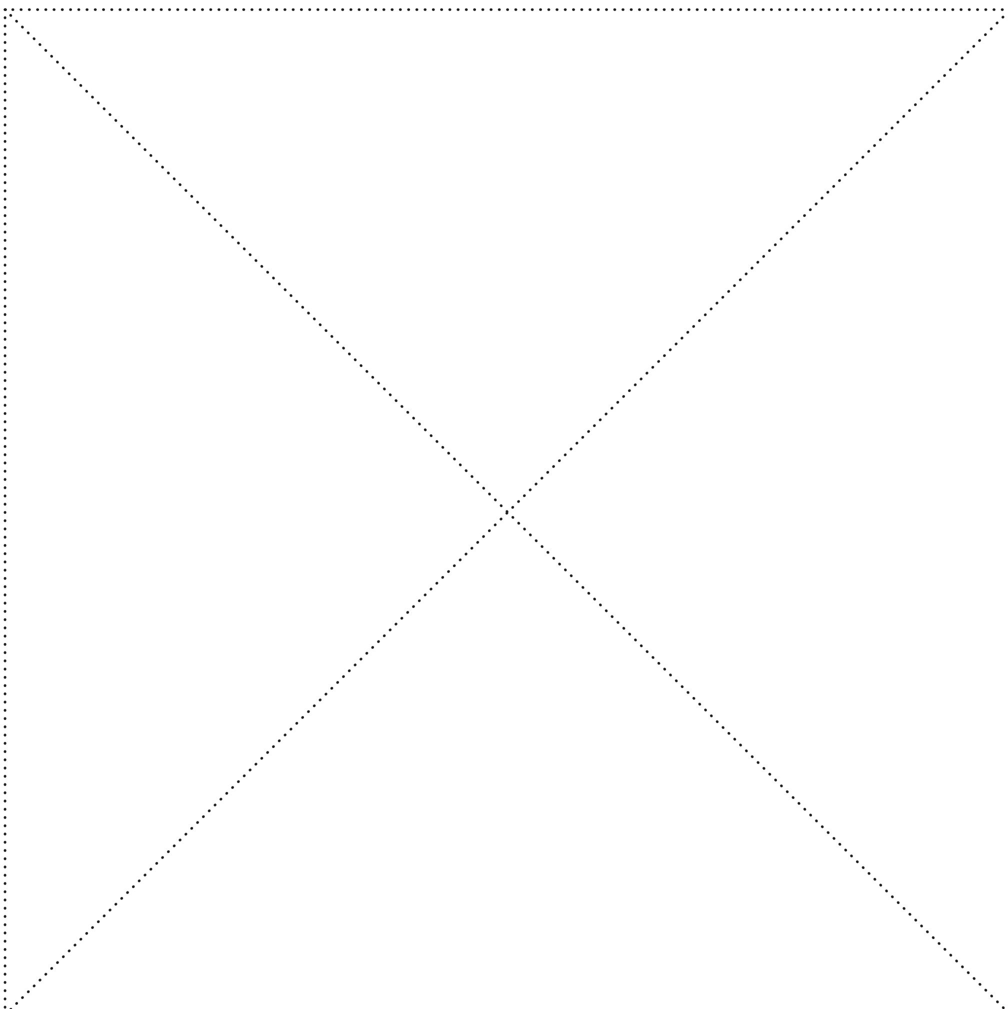






Zheng Xiang, Visual Studies & Representation, 2024 Spring

SOLUTION?



Zheng Xiang
Selected Works 2023-2024
Columbia GSAPP
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