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RENEWAL MONUMENT

From the circular strategies to heritage renovation

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Thesis for Urban Challenge
MPDSD, Chalmers, Göteborg, Sweden

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UNIVERSITY OF TECHNOLOGY

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From the circular strategies to heritage renovation

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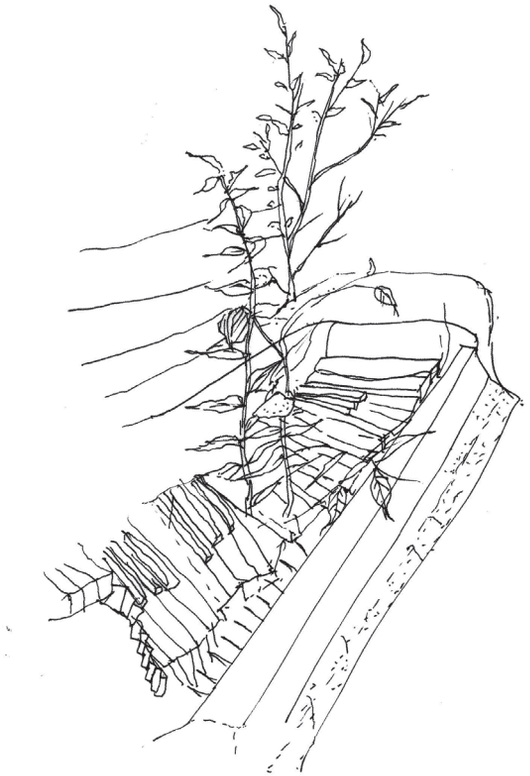
KEYWORDS:

Circular business model, industrial heritage renovation, pedagogy, recycling, eco system service.



ABSTRACT

It is inevitable to judge the growth economy from two sides. On the one hand, it boosts economic growth, but on the other hand, the wealth gap, material exhaustion, and waste pollution have been even more severe than the surface prosperity. The linear economy pattern is based on over-consumerism; each year, we leave behind an average of almost 560kg of rubbish per capita. The circular economy is in calling.

New public space is needed to rethink about the principle of the built environment, especially those industrial heritage from a new sight, a more circular and sustainable way. The building in the city is no more needed to focus only on increment and entropy increase but in need of transformation and renewal. Besides, to adapt the old building stock into the future circular economy, we must also adapt its original spatial qualities, facilities, structures, and functionalities to a more circular way. Thus, there is a complexity of different layers of circular principles that matter.

The design proposal is to transform an abandoned industrial heritage in Wuhan, called Hanyang Iron Works, into a spatial recycling experiential museum, including speculative design and conceptual drawing in the architectural and landscape design. Based on circular economy principles, the design is developed on six layers: circular business cycle, pedagogy cycle, eco-waste cycle, ecosystem service cycle, re-cycle, and material cycle. The six cycles are clarified as chart flow in the thesis and then testified in the design phase. In the end, the design elements like water, eco waste, municipal waste attached to each layer will be evaluated to show its potential for the circular transformation methodology.

The larger find is that when we start to renovate an abandoned building stock in the city, the matter we care about will be the social or cultural aspect and more from a more complex and multi-dimensional consideration for a circular future. To renew a building to fit into a new urban challenge is the substance of urban mining.

JOURNEY NAVIGATION

Figure Reading Instruction:
The figures and images are orginal unless references are provided specifically.

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ACADEMIC

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"...TRANSFORMING YOURSELF FROM BEING A PIECE OF CREATION

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Thanks a lot to my supervisor Emilio, who has assisted me with work management and mental support during the whole tutorial sessions, which enriches my thesis writing to be a pleasant and efficient process. I have experienced how pedagogical and memorable such a process could be.

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Great love and thanks to Liangyu Chen, who has helped me to achieve life-work balance and given me hundreds of transdisciplinary advice from Quantum Physics which involves graphics and simplified structure. I learned to be precise and simple at the same time though it takes great hard work to achieve the same height as you.

Besides, I also wanna give my gratitude to my friend Shiliang Zhang, who inspired me from machine learning aspects, and Juntian, who has supported me to emphasize the recycling issue of China. All my friends that we have discussed our projects with through the thesis writing, Prince, Yinan Huang, and Yige, and the groupmates of Urban Challenge, the lovely inspiration you have brought me is immeasurable. Special thanks to Naima, who have been so supportive and caring during the process, and help me out with patience and compassion.

Last but not least, I would like to say thank you to my family. The two-year studies record my growth abroad as it was the first time to leave you. But the love and care you have given me is so powerful and raises me up as when I was a kid.

Thank you!

Myself and those strong moments you create with me!

TO BECOME A CREATOR."

-Isha Sadhguru

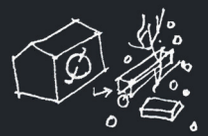
I INTRODUCTION

II BACKGROUND & CONTEXT

III CIRCULAR GROWTH TOOLKIT

IV DESIGN PHASE: TRANSLATION & EXPERIMENT

INTRODUCTION



>>REDESIGNING INDUSTRY LOGIC FROM BUILDING SCALE TO BUSINESS SCALE.<<

-Kasper Guldager Jensen
Architect, Senior Parner 3XN, Director GXN

A WHAT IF SPACE

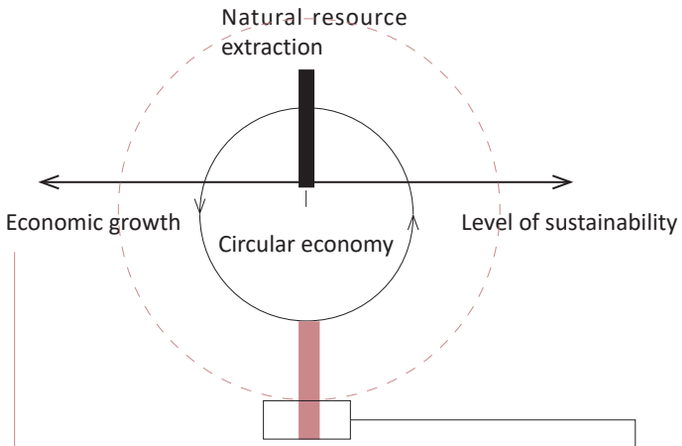
The city will inevitably sprawl fast as the economy and policy-driven urbanism lead to centralism for higher efficiency and resource densification. The city has been acting like a giant energy plant and consumes and produces constant waste and transports those wastes out to the outskirts. The movement was also followed by the tearing down of old buildings, and to some extent, the removal of the memories and identities of the city. While the value of the linear economy is overestimated, we get used to **the process of extraction, alteration, destruction, and disposal**. The city gradually becomes excluded from the previous locality and will continue to do so as the vicious cycle keeps on.

While we are faced with the crucial loss of local identity, material shortage, and **resource exhaustion** in the coming future, we are at a leverage point to re-examine the linear economy pattern that only pursues after the maximization of financial profit. Instead, we should take into account the **social, ecological, and economical sustainability** as a whole in order to achieve a balance in the long term. With the transformation of mindset into a circular economy and rethinking of the position of ecological, the proposed plan could recuperate the loss of the city, which has been left in silent desperation and social anxiety (Bratman, 2019).

At this point in time, where we are urgently trying to respect and redistribute natural resources, the evolution and transformation for a collective gain is an imperative part of our development(Acarolgu, 2018). We need to transform into a circular future of multiple values, ecological, cultural, economical aspects, and design for **ethics, equity, regeneration, sustainability, and ecosystem remediation**.

As the circular economic thinking has been fueled and inspired by the reflection of reductive industrialization, the abandoned industrial heritage in the city center has aroused my interest to apply creative and **regenerative systems** to transform, design and test on. The design project will be a testbed to showcase the different layers that are embedded in the social, ecological, and economical sustainability, and how we could use the **circular thinking toolkit** as a method of transformation to apply and realize the circular future for the industrial civilization that has lived past its time of glory.

MAIN QUESTIONS/OBJECTIVES



Why is the circular economy model so effective and efficient for the sustainable transformation of China?

How to translate the circular economy principles from social, economical and ecological aspects into the urabn design project?

How to transform an abandoned industrial heritage to share with sustainable lifestyles and circular economy principles in China?

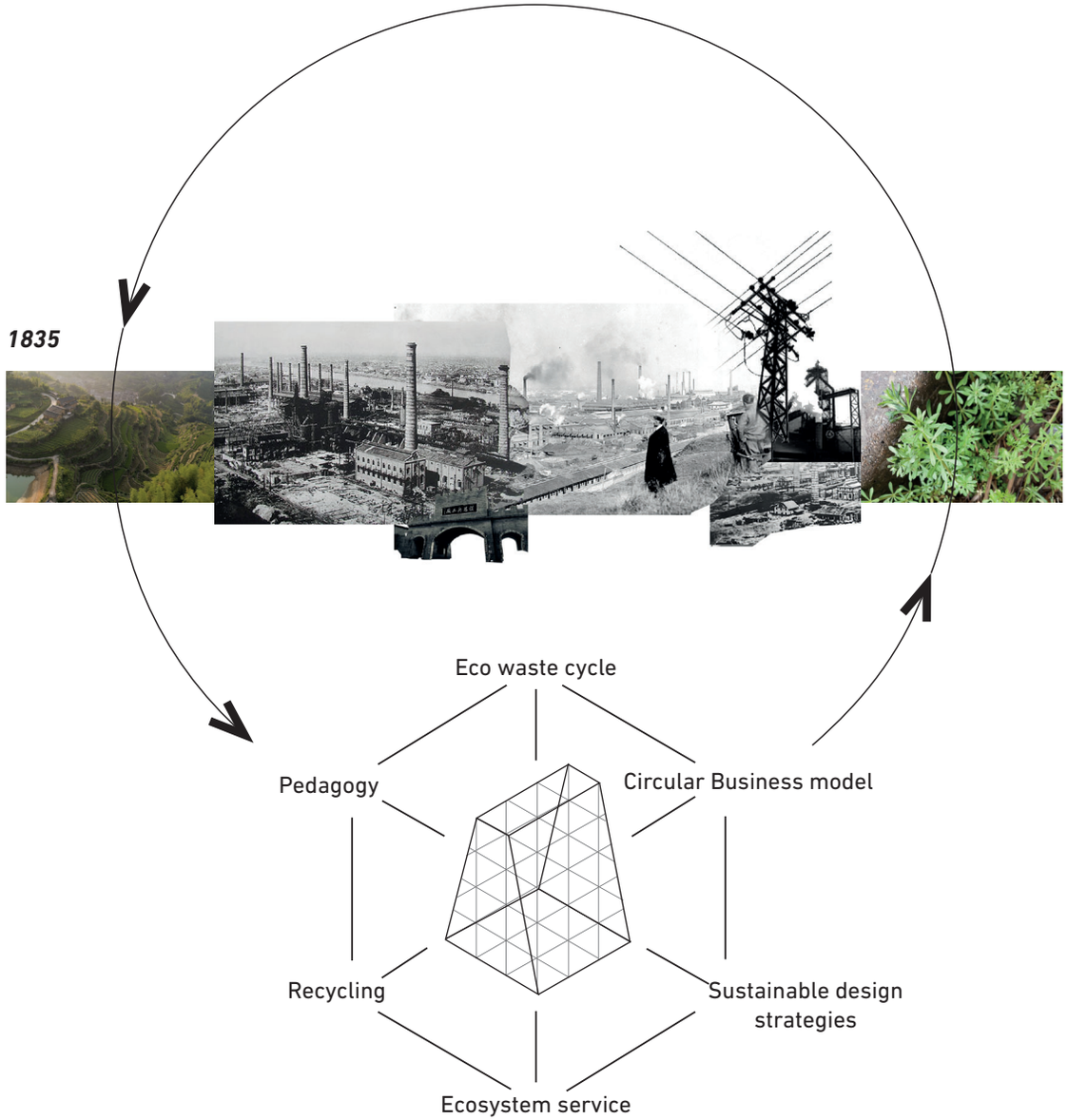
SYSTEMATIC CIRCULARITY

PURPOSE

My main motivation of creating such a “Renewal Monument '' in China is for the reason that I have seen the booming of public space emerging in China for years just to boost capitalism and consumption. There is a **lack of pedagogical public space** to be compatible with **sustainable lifestyles** and encourage to live for sharing. China has established its goal to achieve **“Carbon Neutrality by 2060”** which needs a transformation of industrial upgrading and lifestyle changes. Therefore, my purpose is to contribute to such grand effort by pioneering a renovation project of industrial heritage in Wuhan, China. That is why I have chosen Hanyang Ironworks as the testbed, not only for the familiarity but also its status as the symbols of the “awakening of industry” of China.

AIM

To build a **spatial recycling experiential museum**, transformed from a factorial heritage that is the Hanyang Iron works, is to make recycling process **visible, accessible, pedagogical and interactive**. On top of that, the natural composting and circulation process are invited, to not only follow its original ecoduct remediation function, but also give inspiration to the **industrial cycle** and upgrading. The site is going to be a speculative design on the **complexity of social, ecological and economical aspects** of circular economy.



METHODOLOGY

I have been thinking about various aspects when we design a building with respect to the surrounding natural elements. We could say that we have carried out the motto "Architecture follows nature", but I still try to find a concept starting from economic shift to explain how we could manifest an eco-based architecture following circular principles. In the thesis, I started from the foundation of the current linear business model in consumption patterns and construction aspects. From there, guided by the circular economy principles, six aspects of circular design methods have been distributed to different aspects of the site. They cover social, economical, and ecological aspects of the whole life cycle of the building. To anchor on the main principle of the circular economy model, the site is chosen to be an abandoned industrial heritage that is in need of transformation, reuse, and renewal. The methodology applied in the thesis are as following:

SITE INVESTIGATION AND MODELING:

The site model is based on the previous on-site study, mapping and photographing from aeroscape and viewscape. It is established to build a material bank and existing facilities of the site to simulate the actuarial situation of the site. The site model is an information bank and design testbed to iterate and showcase how every sketch and relevant toolbox application, could easily transform inspiration into renderings in order to visualize the result.

COLLAGES AS THE BASE OF CREATION:

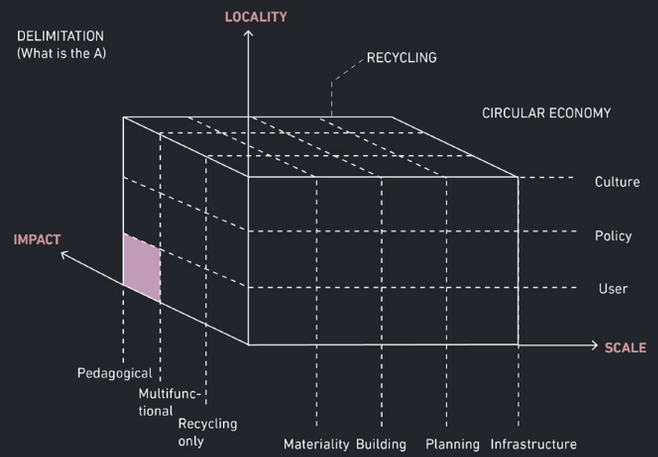
The collages are based on the photography of the site and the integration with digital models. It aims to showcase what the actuarial situation of the site is and display the flow of different cycles. To collage multiple angles and layers, we could have a perspective section, a bird view of the site, and a viewscape hybrid of photography and digital models. These materials could be utilized to to show the current flow of the site and how it has been adapted and transformed.

HAND SKETCHES AS EXPRESSION TOOL:

The hand sketches are the main tools to experiment in the design phase, and it is an expression of inspiration, progressing work as well as intuition. In the thesis, I have explored the method by sketching on the translucent paper over a print from a digital model, and layering ideas by overlapping more litmus paper, to express and explore various ideas step by step. In the thesis, the sketches are not only served as a process and an idea bank but also as a demonstration of how the cycle functions on the site, accompanied by written texts that clearly explains the ideas generation process.

REFERENCE PROJECT AND LITERATURE READING:

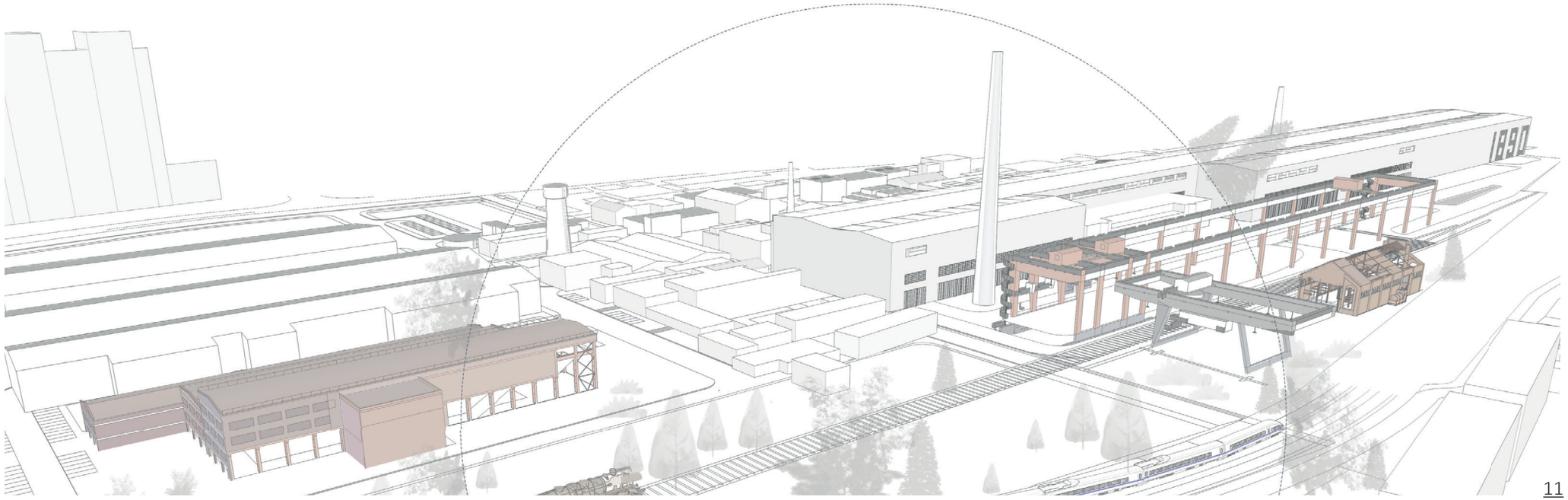
The project is based on general survey and dedicated research of the current work on circular economy written by architects, consultants, and journalists. It aims to give a solid and comprehensive background of the feasibility and realistic relevance. Additionally, it could serveas fountain of ideas to support the multiple layers of the project. The reference projects that I have included in the project are classified from functional types, which are museums, recycling centers, and micro recycling facilities. Whereas the literature study covers a thought map of the book, principles that are frequently discussed, and data to further support the background of the thesis.



PERCEPTION OF THE SITE

Wuhan is the city that I have lived in through my five-year bachelor's degree in Architecture. To me, it is a city full of complex emotions and memories where I have lived through many moments that are struggling, exciting about my starting trip as an architect. At that moment, every inspection is so clear and unforgettable to me. I could not say I love every aspect of the city, maybe even more towards the opposite side because of its lack of infrastructure management. On the other hand, it is full of progress and achievements that are guided by the strong ambition of more than one million university students who lives and develops the city. It is dynamic and lively, full of energy, but lacking management in the aspect of infrastructure, especially garbage management and recycling, which I'm passionate about. The city has a special character portrait when it comes to public building design due to its large number of highly educated young population in the workforce.

I had a project in the Iron Foundry Heritage of Wuhan during my third year of bachelor's studies. It was a fantastic process, but I did not have enough time to take on the conceptual aspect of the project seriously but instead focus on making more impressive illustrations. Regardless, I have been keeping warm, moving, and happy memories of a train journey that I took just for viewing the site from a passenger's perspective. I saw a big 1891 on one of the abandoned factory's walls, and it recorded its glory as one of the largest steel complexes in Asia, where I felt the magic of the site. It is located in the city center but has relatively low accessibility due to its desolate condition and poor planning. However, I could see its unique stature for the industrious renovation of China, and it was awarded as one of the 'Signs of China's Awakening'.



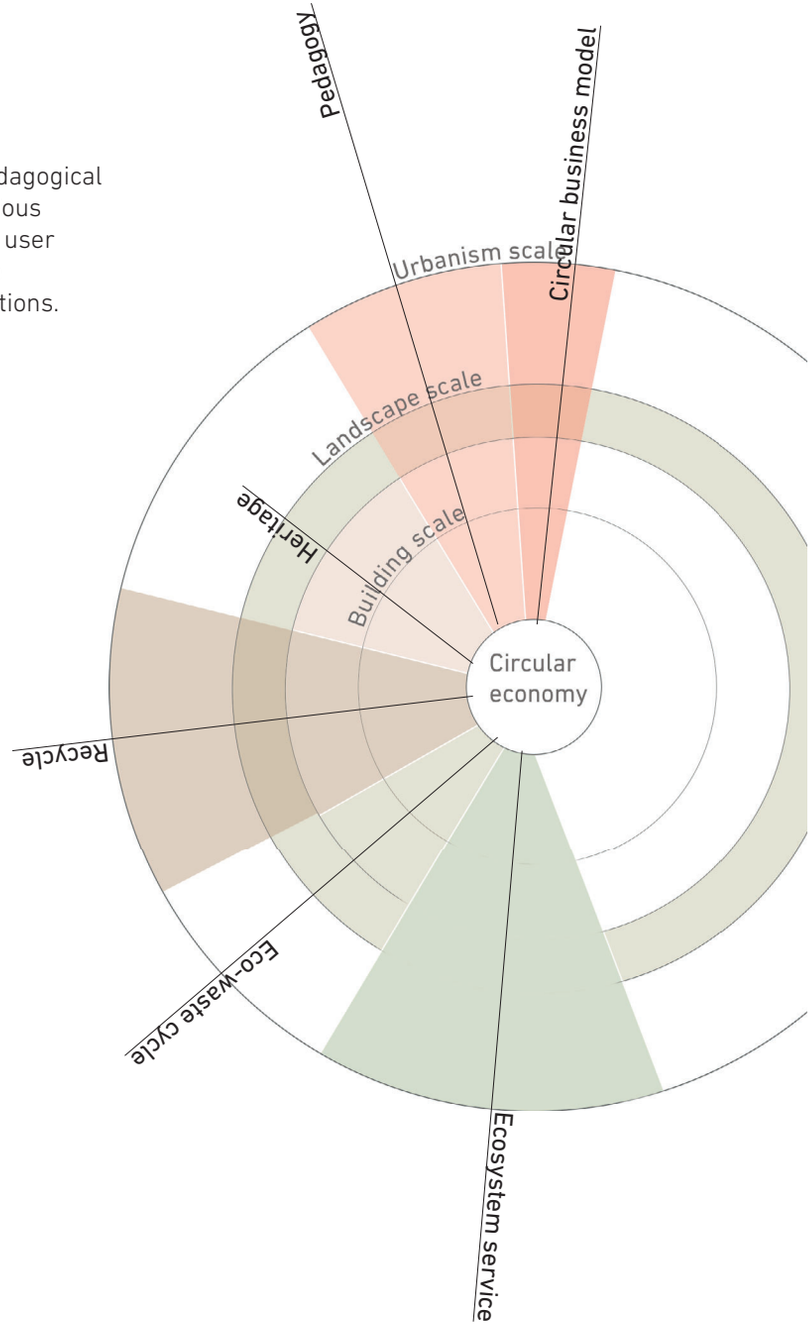
DELIMITATION

DELIMITATION
The diagram on the side shows the focus area of the thesis. Further explanations:

GEOGRAPHICAL DELIMITATION:
The project will be based at Hanyang Ironworks, Wuhan city, China. Since I have been living in Wuhan for five years during my bachelor's studies, I have access to the basic site information and context from my previous local investigation study.

AGENT DELIMITATION:
The project is based on the ongoing renovation plan for the Hanyang Ironworks into a mixed commercial and residential area. Therefore, the project has a strong connection to the future plan and previous existing building stock situation. The focus is put on interdepartmental collaboration and users within the Hanyang Ironworks, Vanke Real Estate, and Wuhan municipality. It will also include external actors like companies and NGO groups in order to prevent a top-down design structure.

The user experience design within pedagogical design methods will base on the fictitious but typical user portrait. However, the user investigation and interview will not be implemented due to pandemic restrictions.



" ***A system is a set of related components that work together in a particular environment to perform whatever functions are required to achieve the system's objective.***
-Diella Meadows "

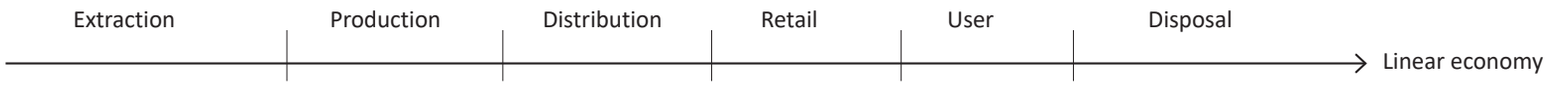
BACKGROUND & CONTEXT

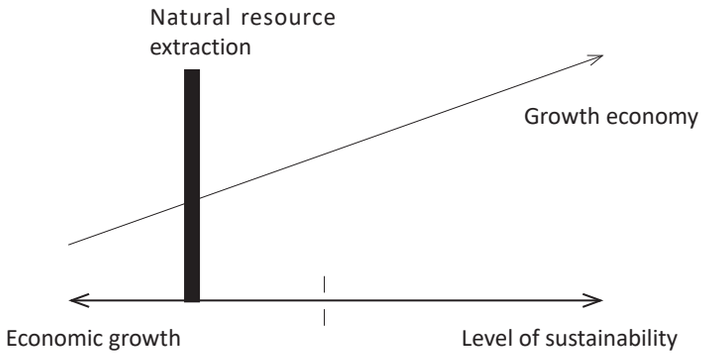
" >> SUPPORTING THE REGENERATION AND PRESERVATION OF THE NATURAL ENVIRONMENT, RATHER THAN CREATING HIDDEN COSTS IN THE FORM OF EXTERNALITIES. << -KLAUS SCHWAB

LINEAR ECONOMY: OUTCOME

We leave behind an average of almost 560 kg of waste per person every year. Whether or not we want to do something about this, the tasks ahead of us are far from simple. For years, we've been hearing in the media and in the workplace about sustainability, and the various initiatives driven by individual and corporate social responsibility, such as litter-picking, selective waste disposal, or donations. While such initiatives might be capable of successfully solving one or two local problems, truly **comprehensive sustainable solutions spanning multiple products and sectors** require an approach with broader horizons.

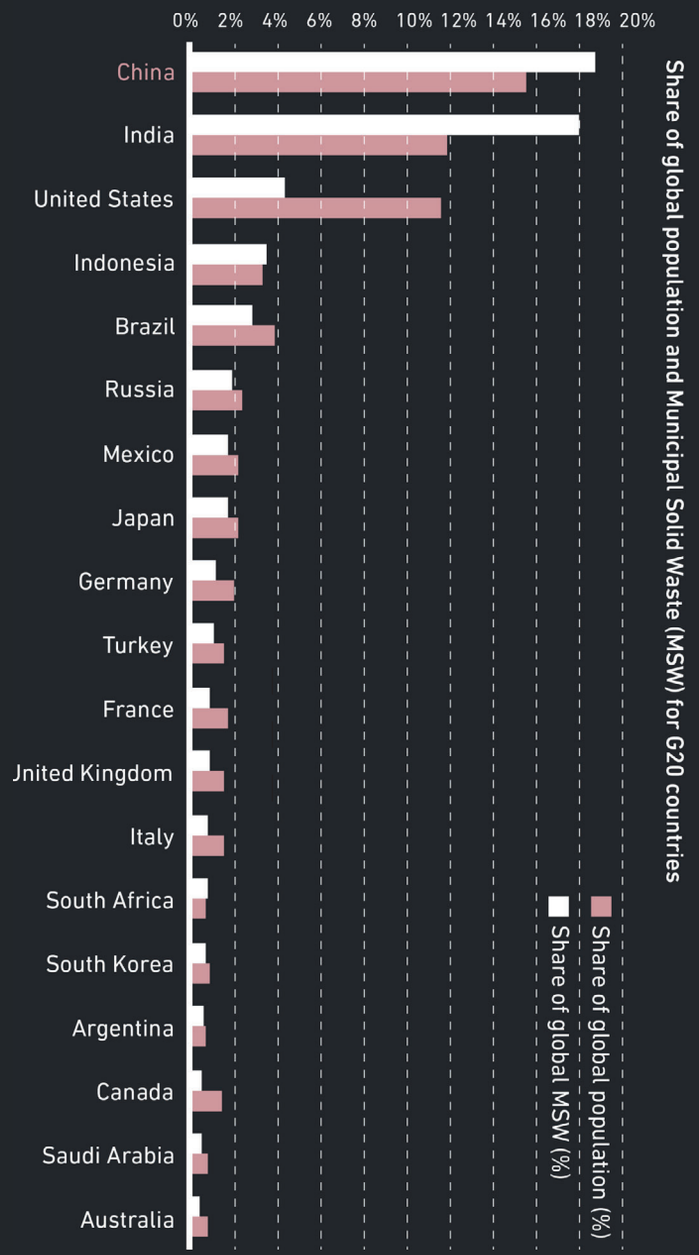
The circular economy is one that integrates the tools mentioned above, propagates them at a systemic level, and takes them to a higher level. Its objective is to cut down on waste and the use of resources through the **transformation of the products' life cycles.**



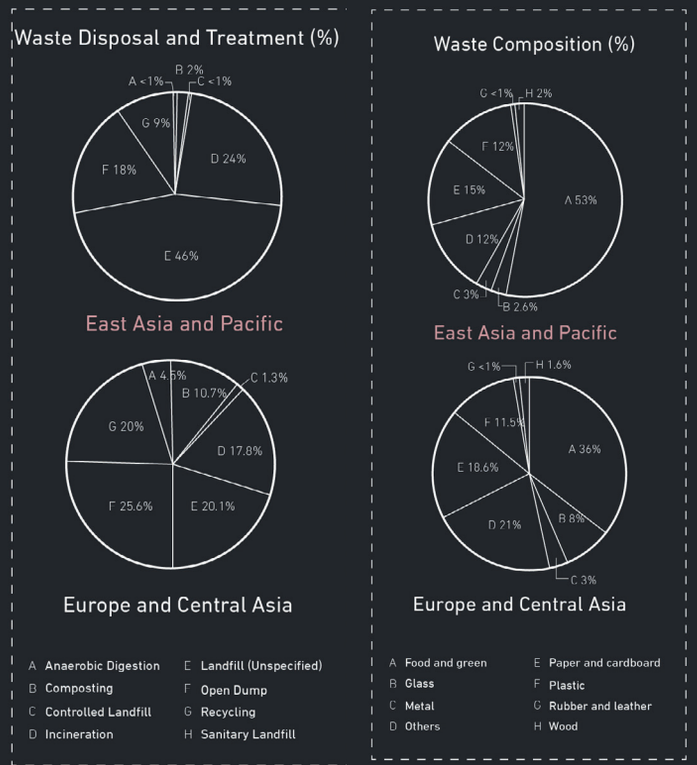


Growth economy

The traditional economic strategy values the increase of ability to produce goods and services to be the all encompassing benchmark that could be nicely summarized into an index or quantity, i.e. the gross domestic product (GDP) of a country (Acarolgu, 2018). Other factors and context such as **environmental impacts and social welfare** that could not be rigidly taken into account the benchmark of growth becomes externalities to the model of economic growth and background noise in the mindset of policy makers back in the day. These are the costs that are willfully ignored during the calculation of traditional linear economic growth that is unjust to those who have to bear such cost, either the current or future generation. With historical hindsight, such a development strategy is definitely too singular in purpose to be sustainable, although one could also argue the long term environmental consequence could be unclear at the time.



Report1. Sourcing from Smith, N. (2019, July 10). US Tops List Of Countries Fuelling The Mounting Waste Crisis. Verisk Maplecroft



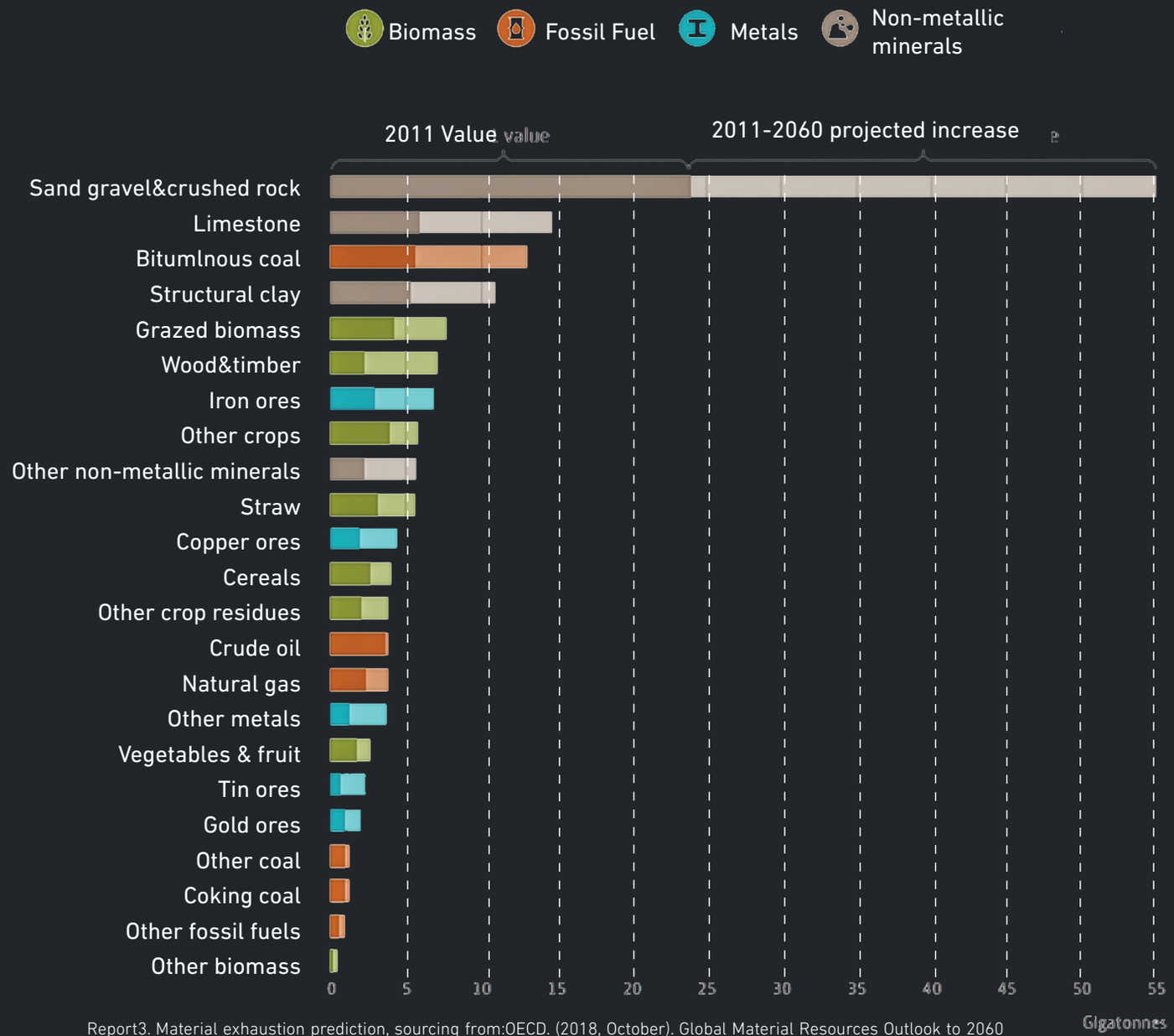
Report 2. Sourcing from World bank group. (2018). What a waste 2.0-A global snapshot of solid waste management to 2050.

Consquence on the waste management

Total quantity of municipal solid waste for G20 countries

In the past few decades, China has been mostly focused on economic growth as the benchmark for success. The stark contrast to such monumental progress is the waste produced alongside the development. As shown in the infographics, China and India are among the top municipal solid waste producer globally, as well as being the only ones that create more share of waste than the population percentage-wise globally. This indicates a grave issue that could trace back to the mono-focused growth economic development strategy. In such a mindset, environmental maintenance that takes care of long-term human welfare is more often or not in direct conflict with short-term economic growth, and the lack of such consideration has already lead to significant consequences as of late.

Construction materials dominate total materials use in 2011 and 2060



Report3. Material exhaustion prediction, sourcing from:OECD. (2018, October). Global Material Resources Outlook to 2060 – Economic drivers and environmental consequences

Consquence on the material exhaustion

Construction materials dominate total materials use in 2011 and 2060

According to an OECD (Organisation for Economic Co-operation and Development) report on the global material resources outlook, the consumption of construction material is predicted to nearly double by 2060, which is alarming in terms of environmental consequence (OECD, 2018). The projection relies on the assumption that the world population surpassing 10 billion as well as the living standard of the global population would be improved to current levels in OECD countries. In particular, fast-growing developing countries that incline to promote further infrastructure construction projects could be the main contribution to such a rise in consumption. The environmental impact would mostly be caused by the extraction of various minerals, which could be severe in a global context. Therefore, the environmental awareness in architectural design could be a saving grace to counterbalance this inevitable growth that should be transformed into a sustainable and circular endeavour.

CIRCULAR GROWTH

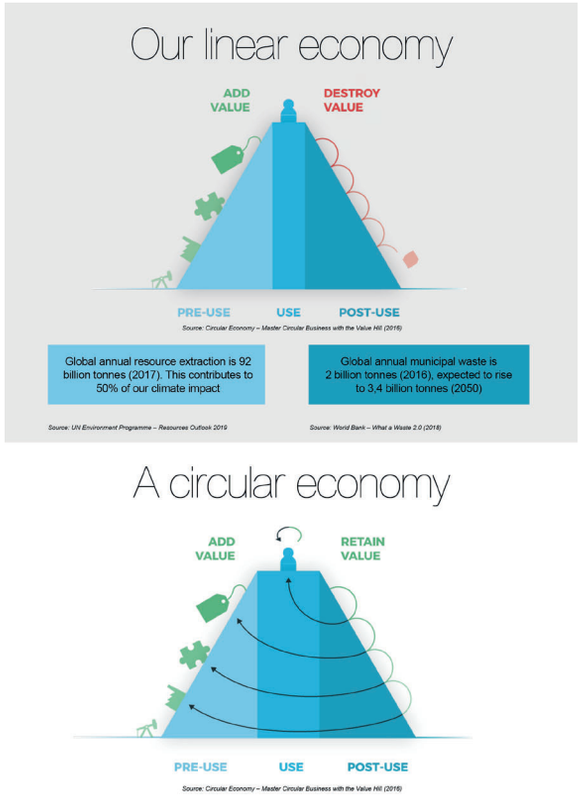
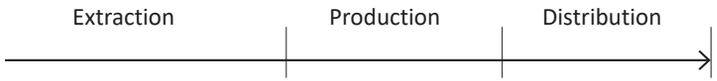
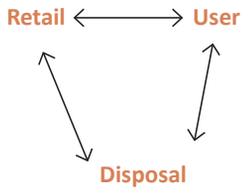


Fig 1, Design for sustainability-comparison between our linear economy and circular economy [Illustration] (Dam, 1019)

An artistic response to circular economy is portrayed in Act Two of Break Down (2001), where the artist systematically pulverized and shredded every single one of his possessions after having completed an exhaustive three-month sorting of his inventory (Sooke, 2016). At the end of this destruction, all that remained was almost six tonnes of granulated garbage. For Michael Landy, the implication was straightforward: 'if the whole world ends up with 7227 things, then we won't have a planet.'





This constitutes a lost portion that could be returned to the economy, resulting in savings of **USD 1 trillion** a year in raw material usage by 2025.

Obviously, a circular economy does not imply an end to private possessions. For most of us, it is an inseparable characteric of the experience of being alive. That being said, the global population has increased by 1.4 billion in the intervening years from then, and the consumption of resources by fast-growing economies such as China has increased at a rate of 14% per year. We could not continue on our living habit of owning and disposing of our 'stuff' in the same way as before. Through better design, the circular economy aims to keep valuable materials in use and retain more additional value from products and components. The outcome should be improved accessibility and affordability to all the love and comforts that we desire in our homes, but through a new relationship the resources that regenerates the larger economy, of which we are all part of.

Therefore, think and reflect on yourself before you share all your possessions. There could be many better, more circular ways to deal with your clutter.

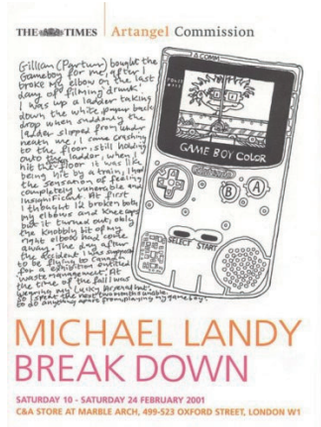
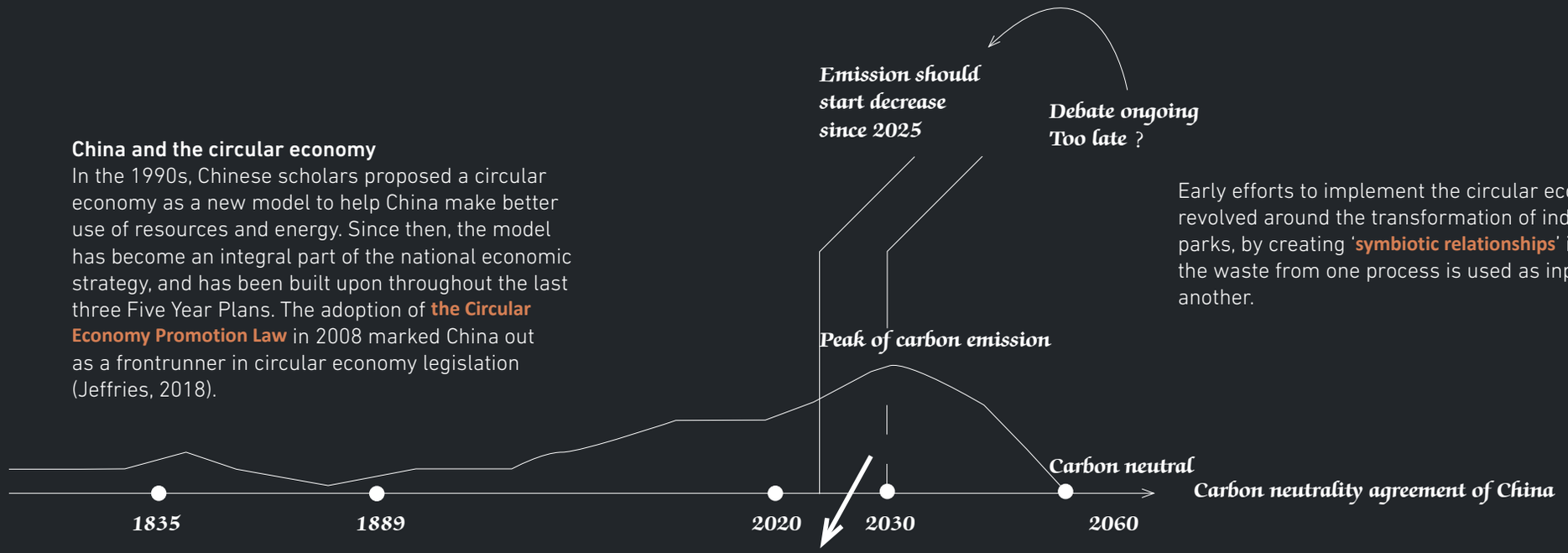


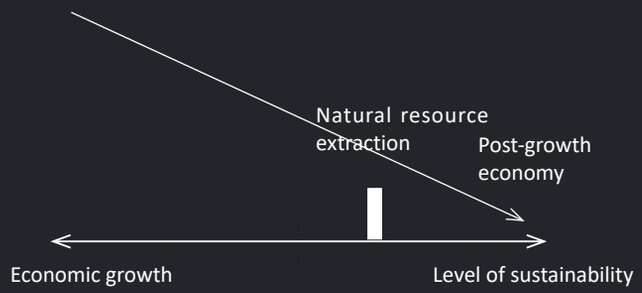
Fig 2, Poster for Michael Landy's Break Down (Landy, 2001)

CARBON NEUTRAL 2060 POLICY OF CHINA

China and the circular economy
In the 1990s, Chinese scholars proposed a circular economy as a new model to help China make better use of resources and energy. Since then, the model has become an integral part of the national economic strategy, and has been built upon throughout the last three Five Year Plans. The adoption of **the Circular Economy Promotion Law** in 2008 marked China out as a frontrunner in circular economy legislation (Jeffries, 2018).



Early efforts to implement the circular economy revolved around the transformation of industrial parks, by creating '**symbiotic relationships**' in which the waste from one process is used as input for another.



Post growth economy

Today, there are four main components to China's circular economy strategy (Jeffries, 2018):

1.Circular production-to embed reducing, reusing and recycling into whole production processes

2.Circular systems of industry, agriculture and services-to follow the principle of optimising industrial processes, greatly supporting circular production

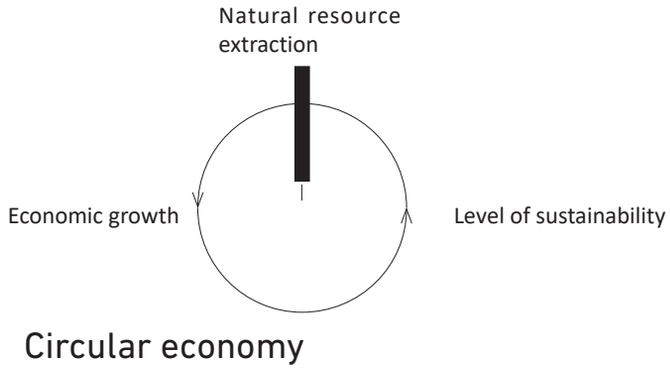
3.Growth of recycling industry-to recycle and reuse urban waste streams, focusing on re-manufacturing and renewable energy

4.Green consumption ('circular values')-to guide citizens towards smart, healthy and safe consumption.

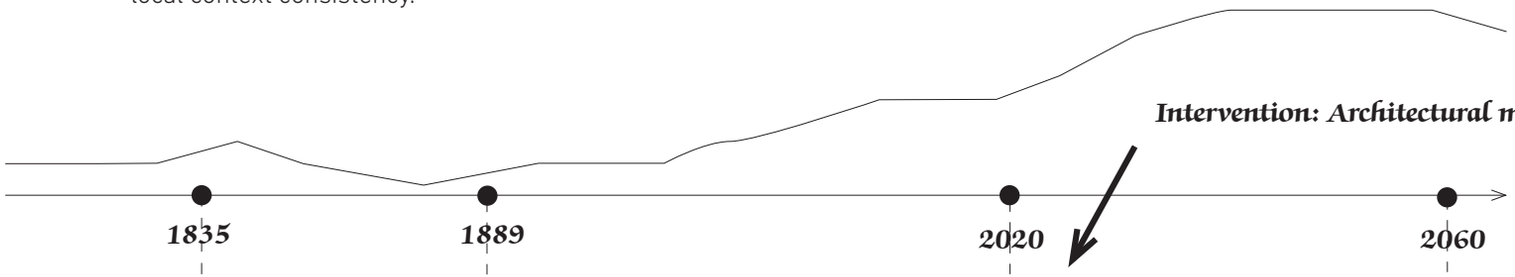
MANIFESTO

The purpose is to study the cyclic design methods in the architectural design, focusing on three aspects: social, ecological, and material aspects in the existing building stock for renovation. The social aspects are focused on stakeholders, the circular business model, and the building's functionality. Simultaneously, the ecological aspects show a specification on rainwater collection, solar energy, and indoor biodiversity for the building stock. At the same time, the material aspects include reusing, repairing and functionalization of the material that are on-site and produced locally, as an effective medium for local context consistency.

Therefore, conceiving and adopting a sustainable development strategy have been on the agenda for Chinese authorities in recent years. Such a strategy would be **circular in nature, prioritizing the reduction of pollution and recycling of waste to refuel and stabilize the economy**. The grand scale adaptation into such an eco-economic cycle would require a monumental time and effort, thus contribution from each sector of society should be encouraged to promote such transition.



Circular economy



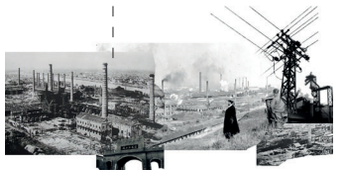


Fig 3. Natural ecosystem (Peters, 2019)

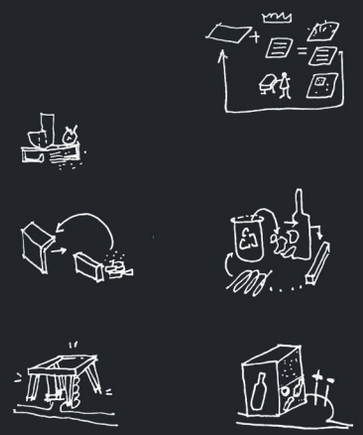
Fig 4. Withered factory (Tuchong, 2016)

The thesis outlines the six circular cycles we need to consider when moving from a linear design thinking approach to a circular one, covering different scales from landscaping and architectural heritage rehearsal plan, as tested on the Industrial Heritage of Hanyang Iron Work.

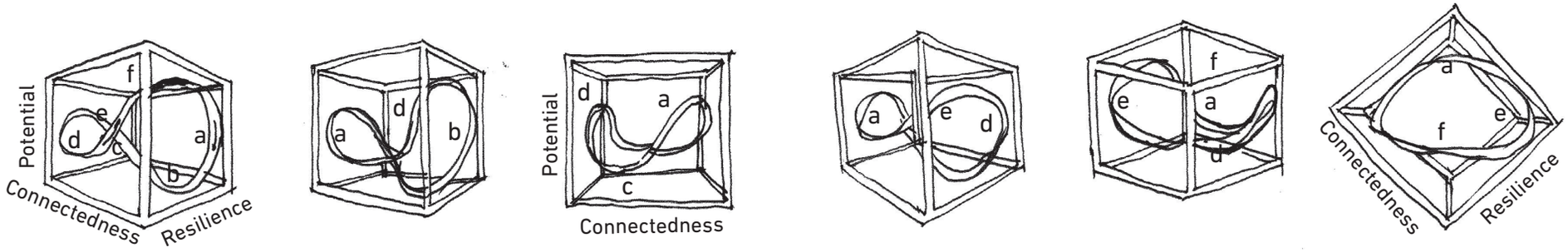
>>INSIDE AND OUTSIDE, SACRED AND PROFANE, SICK AND HEALTHY, NATURAL AND CULTURAL.<<

-Etienne Turpin

III CIRCULAR GROWTH TOOLKIT



COMPLEXITY AMONG SOCIAL, ECOLOGICAL AND ECONOMICAL ASPECTS



The practice of translating circular systematic design methods into renovation plans involves multiple perspectives. It is believed that architecture should not be regarded as a separate part from the ecosystem. In this particular case, the architectural design plays an even more significant role when we see the part that a desolate heritage site constitutes in the local eco-cycle and cultural context.

A method called **Eco-circular Transformation Thinking**(ECTT) is developed to view an existing building as a whole that has been integrated into the natural and cultural cycle. The renovation is based on each layer of the site aspects: **eco-cycle, economic supportive system, building stock, waste treatment, energy flow, and interaction with users**. The waste treatment consideration in the hypothesis means that the building resources are intended to be extracted from the **material bank** of the existing heritage itself rather than external sources. The six layers of renovation are supposed to create a self-sufficient future for the existing abandoned building, to transform the site from a monument for the linear past into a **manifesto for a circular future.**

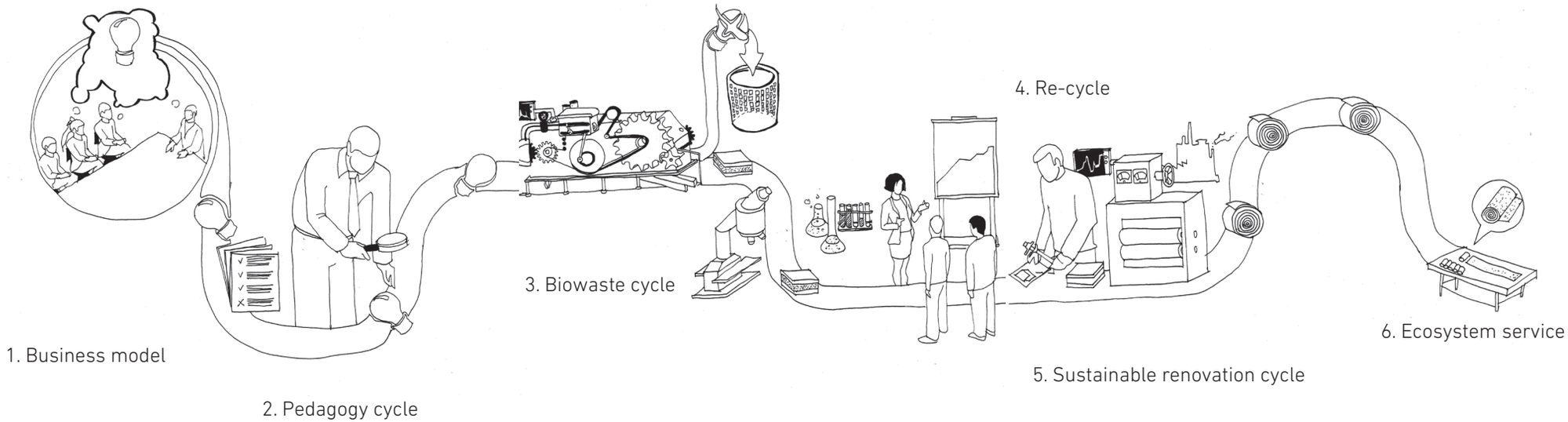
ECO
- combining form

Definition of eco-
:"1: habitat or environment
ecospecies
2: ecological or environmental
ecocatastrophe"
(Merriam-Webster, n.d.)

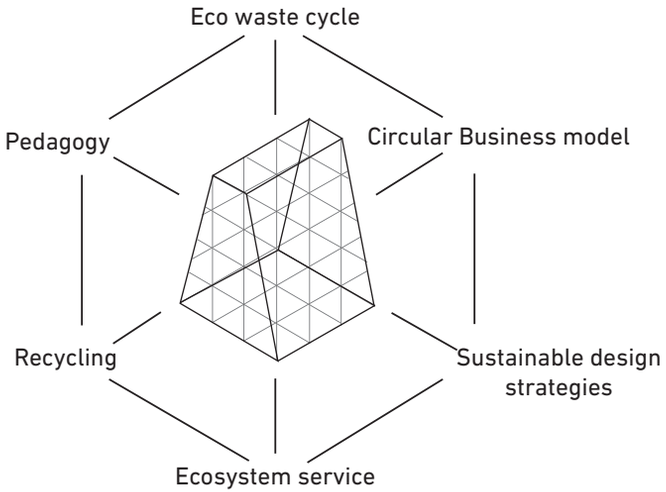
CIRCULAR
adjective

Definition of circular (Entry 1 of 2)
:"1a: having the form of a circle : ROUND
a circular orbit
b: moving in or describing a circle or spiral
a circular staircase
2a: of or relating to a circle or its mathematical properties
a circular arc
b: having a circular base or bases
a circular cylinder
3: CIRCUITOUS, INDIRECT
4: marked by or moving in a cycle
5: being or involving reasoning that uses in the argument or proof a conclusion to be proved or one of its unproved consequences
6: intended for circulation
a circular letter"
(Merriam-Webster, n.d.)

SIX LAYERS FOR CIRCULAR GROWTH



Circular business model integration and relevant format of business commercial activities



The Eco-circular Transformation Thinking method comprises six layers of cycles based on the respective aspects of the building heritage:

1. Business cycle
2. Pedagogical cognition for circulation
3. Biowaste cycle
4. Waste treatment cycle
5. Material bank reuse and design for sustainability
6. Eco-system sensitive landscape cycle

The project will showcase each layer of renovation method on the abandoned industrial site and see how it has and will influence the future of the industrial heritage such that it could be reborn as a museum for circular development.

LAYER 1

Business cycle

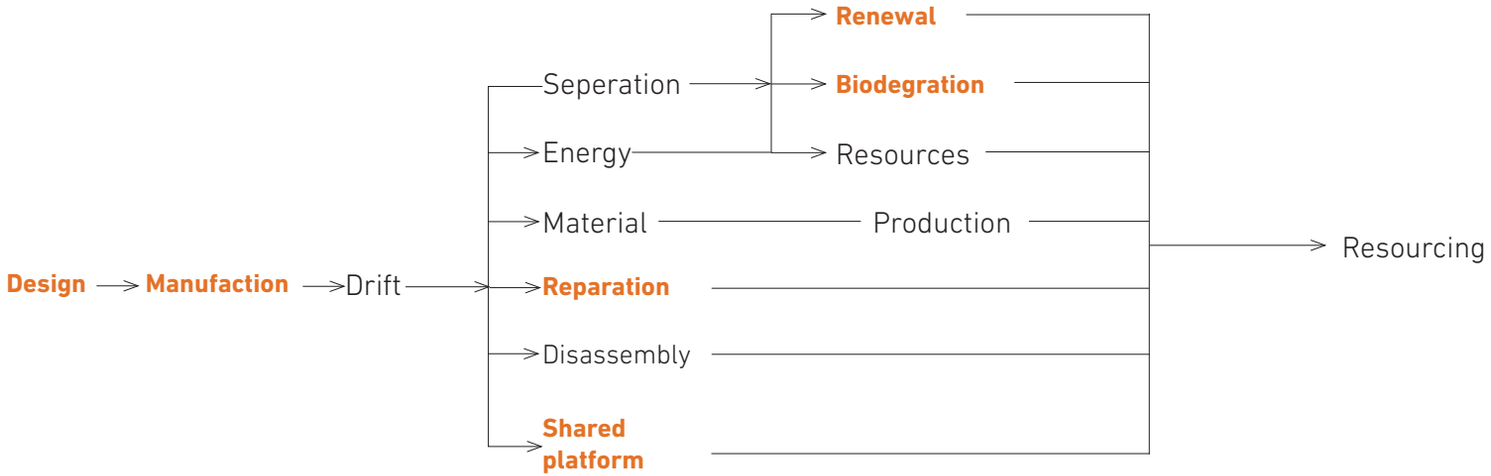
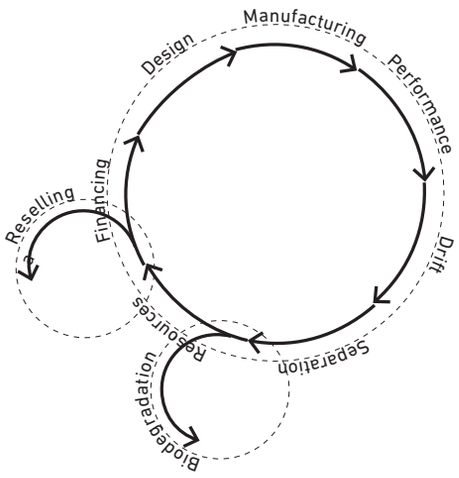
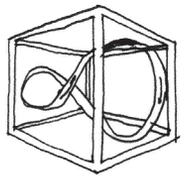


Fig 5. Circular business model integration and relevant format of business commercial activities



The Keywords:

- Design+Development
- Growing+Extraction
- Materials combining+Transmutation
- Transportation
-Rental



BUSINESS CYCLE

Definition of business cycle
: "a cycle of economic activity usually consisting of recession, recovery, growth, and decline."
(Merriam-Webster, n.d.)

LAYER 2
Pedagogy cycle

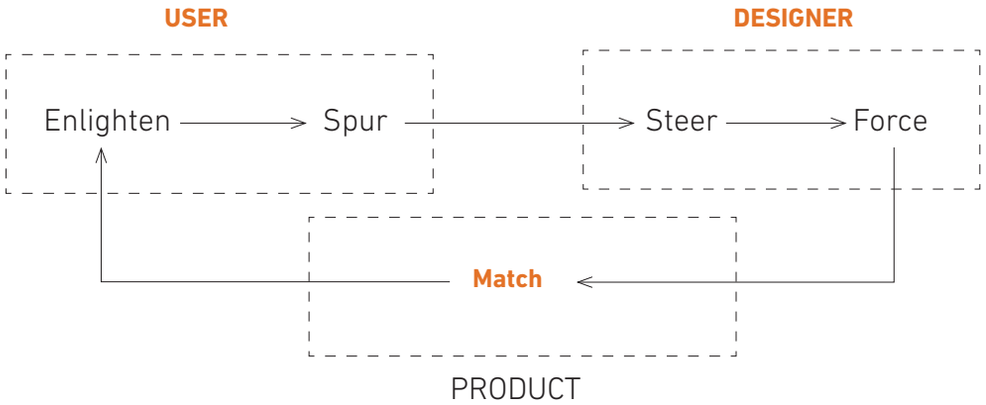
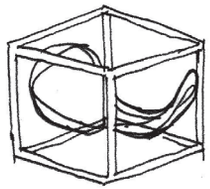
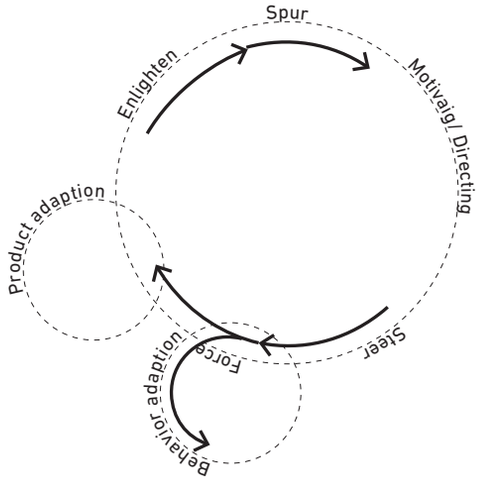


Fig 6.Different design strategies that can be used to design for sustainable behaviour(Lidman & Renström, 2011)



PEDAGOGY

Definition of pedagogy
: "the art, science, or profession of teaching especially : EDUCATION "
(Merriam-Webster, n.d.)

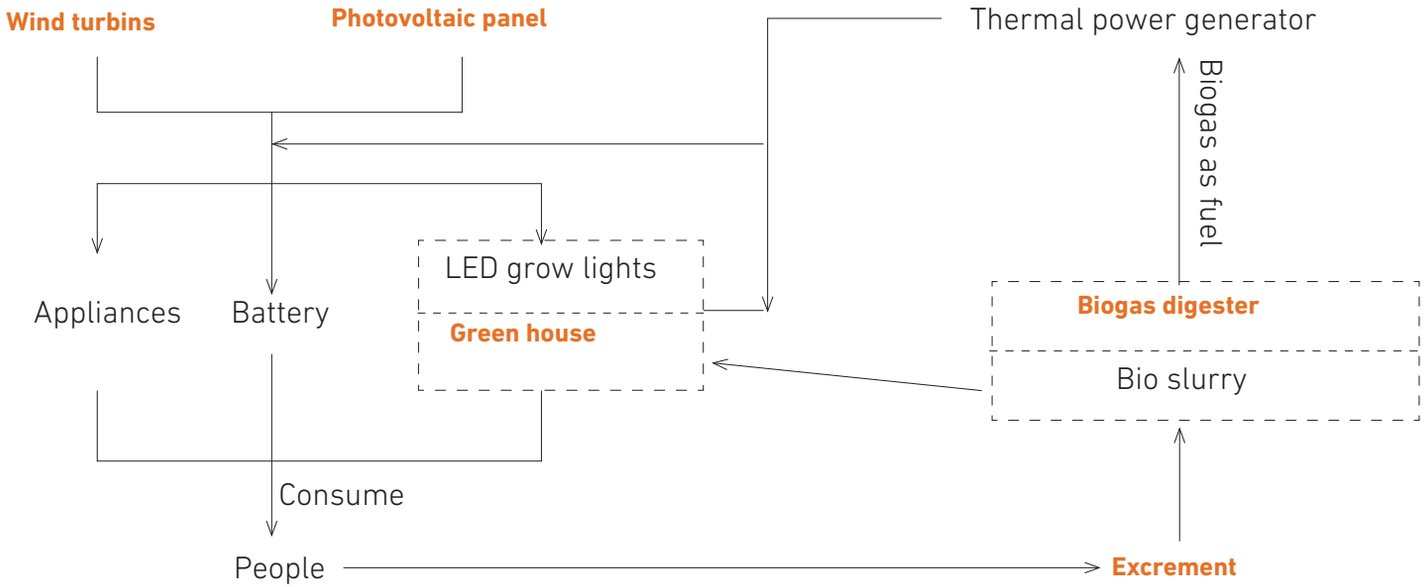


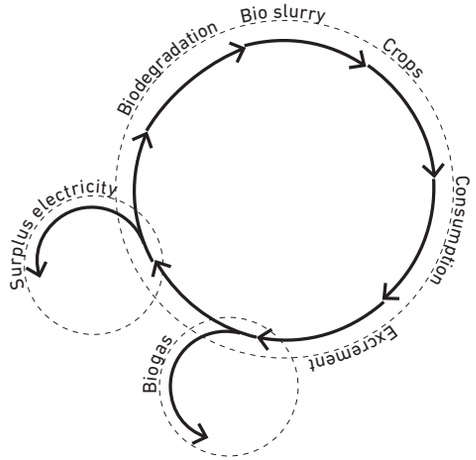
The key actors in the site:

- Use in control
- Motivating
- Directing
- Designer in control
- Behavior adaption
- Product adaption

LAYER 3

Biowaste cycle

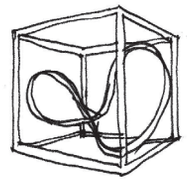




The key elements/functionalities:

- Kitchens that open onto the central courtyard
- Restaurants
- Shops
- Rensidential lobbies
- Service entry
- Organoponicos
- Low concrete beds serviced by drip irrigation into private couryards
- Sunshine for crops

Fig 7, Biowaste and solar power supportive circ ular system, inspired from Infinite Cycle Sustainable Model (Ning, 2020)



BIOWASTE

Definition of biowaste
: "waste (such as manure, sawdust, or food scraps) that is composed chiefly of organic matter."
(Merriam-Webster, n.d.)

LAYER 4

Re-cycle

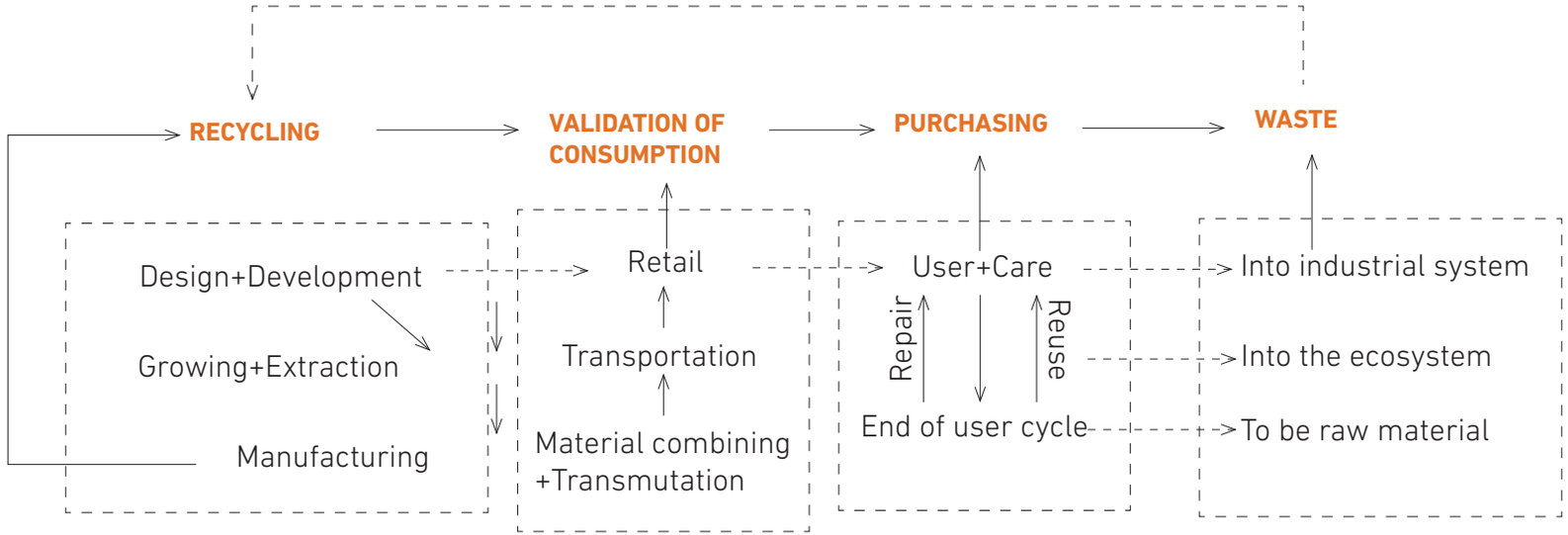
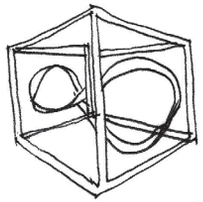
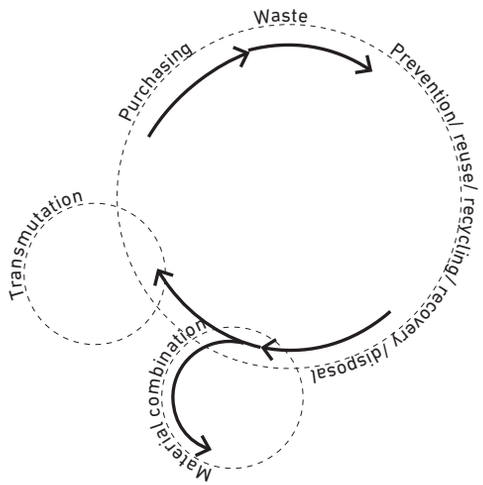


Fig 8.Recycling flow and integrated circular economy stratigies, inspired by Recycling flow (Acaroglu, 2020)



RECYCLE

Definition of recycle
:"1: to pass again through a series of changes or treatments: such as
a: to process (something, such as liquid body waste, glass, or cans) in order to regain material for human use
b: RECOVER
c: to reuse or make (a substance) available for reuse for biological activities through natural processes of biochemical degradation or modificationgreen plants recycling the residue of forest firesrecycle ADP back to ATP
2: to adapt to a new use : ALTER
3: to bring back : REUSE"
(Merriam-Webster, n.d.)



The key process of recycling:

- Circular shopping mall
- Waste sorting
- Recycling
- Validation of consumption

LAYER 5
Sustainable renovation cycle

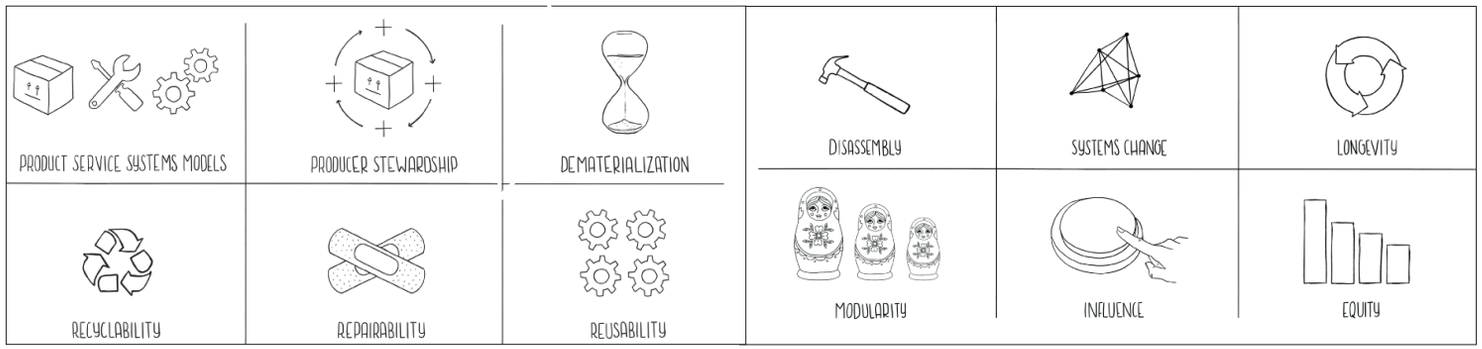
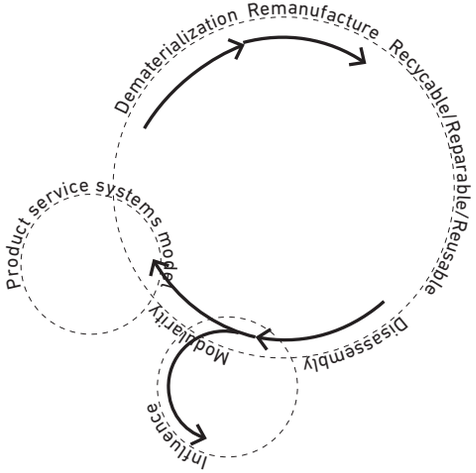
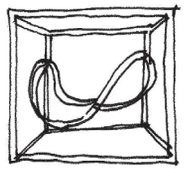


Fig 9.Sustainable design strategies (Acaroglu, 2021)



The key principles:

- Reusable resources
- Disasseblable
- Traceable
- Resale
- Recycling



RENOVATE

Definition of renovate
:"1: to restore to a former better state (as by cleaning, repairing, or rebuilding)
2: to restore to life, vigor, or activity : REVIVE
the church was renovated by a new ecumenical spirit"
(Merriam-Webster, n.d.)

LAYER 6

Ecosystem service cycle

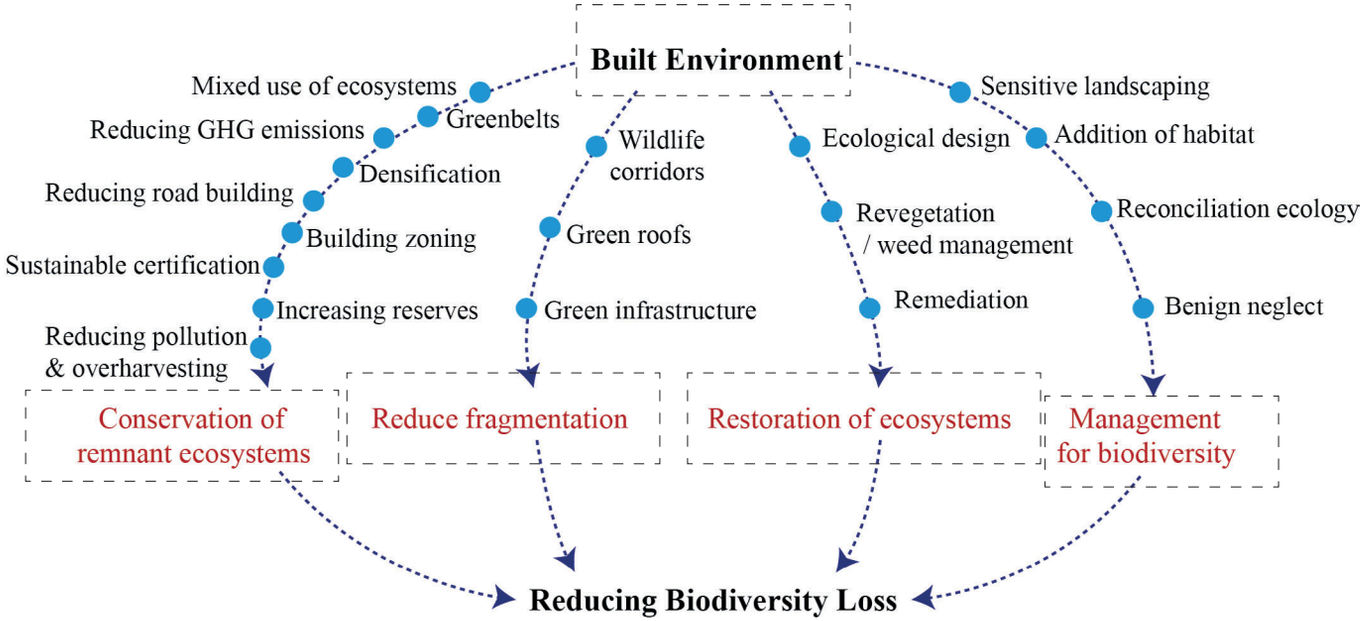
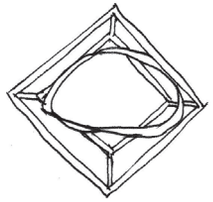
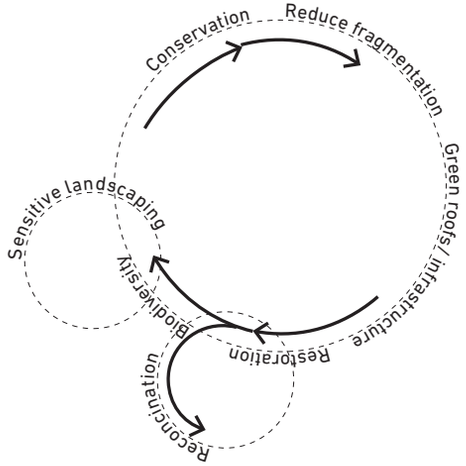


Fig 10. Ecosystem service affiliated infrastructure relating to built environment(Zari & Mainguy, 2014)



ECOSYSTEM

Definition of ecosystem
:1: the complex of a community of organisms and its environment functioning as an ecological unit
2: something (such as a network of businesses) considered to resemble an ecological ecosystem especially because of its complex interdependent parts.
(Merriam-Webster, n.d.)



The key natural exsitence:

- Greenbelt
- Building zoning
- Wildlife corridors
- Green roofs
- Green infrastructure
- Remediation
- Sensitive landscaping
- Additioon of habitat

Manual of Recycling

Buildings as Sources of Materials

Annette Hillebrandt
Petra Riegler-Floors
Anja Rosen
Johanna-Katharina Seggewies

Edition DETAIL

Fig: Urban Mining design strategy
(Based on Annette.H et al. Manual of Recycling 2019 page 15)

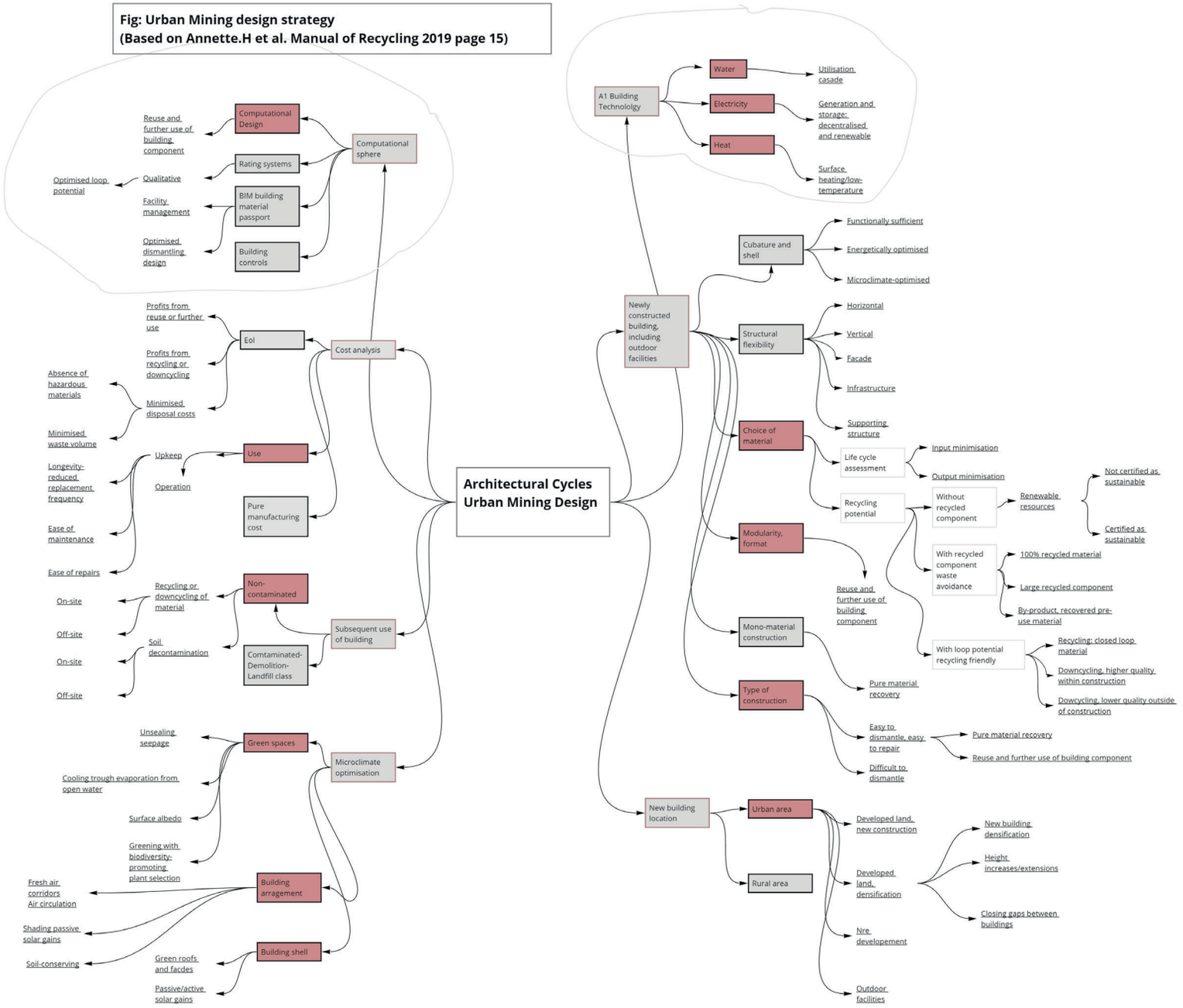


Fig 11. Urban mining design strategies, based on chapter Circularity in Architecture(Hillebrandt et al., 2019)

REFERENCE PROJECTS RELATED TO SPATIAL EXPERIENCE

Fig12. BingDing Wood Kiln Factory Renovation / AZL architects (Li, 2019)

Fig13. Concept: reuse the exsiting structure/facilities(Li, 2019)

Fig14. The Riparian House / Architecture BRIO (Huber, 2016)

Fig15. Concept: Eliminate the boundary between architecture and nature (Huber, 2016)

REFERENCE PROJECTS RELATED TO FUNCTIONALITY

Peer to peer sharing-lending marketplace	Community asset sharing and creative spaces	How to relieve technology anxiety	Circular furniture
Re-define our relationship with stuff	Tool library and sharing depot Free access to the physical building Donate and share their tools through one central location Exchange skills and knowledge, for young people, can be trained and mentored	Modular repair kit, facilities for easy repairs and upgrades	Modern living change the patterns of living and furniture cycles more rapidly Mobile workforce, 'lifestyle' industry Re-styles: logistics, cleaning, repairs, storage and making some profit

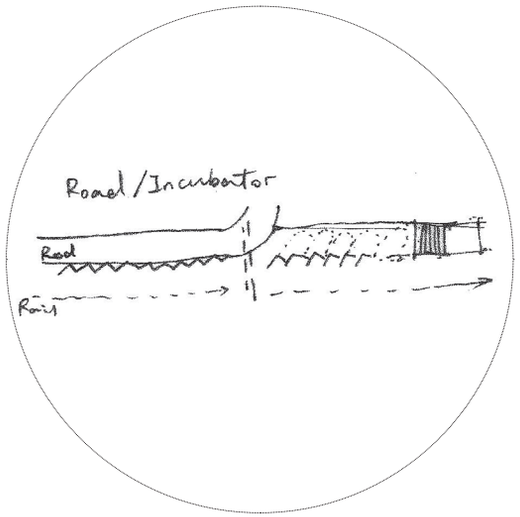
REFERENCE PROJECTS RELATED TO RECYCLING

Fig16. The interior of Smestad Recycling Center (Brodey, 2016)

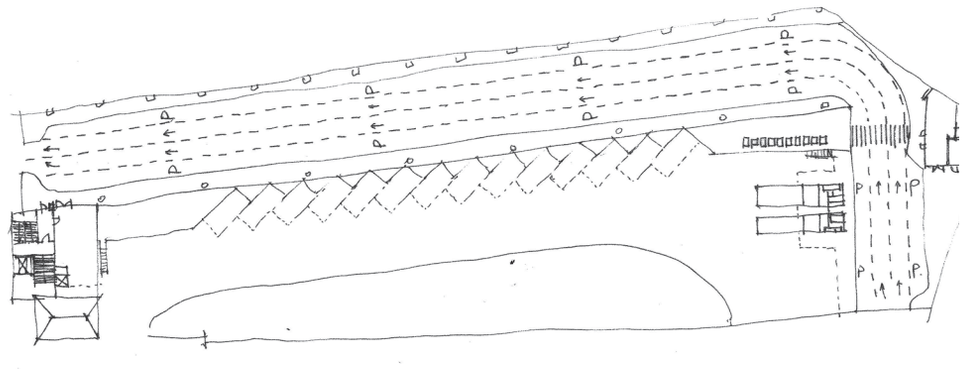
FIRM: Longva arkitekter
TYPE: Public› Recycling
STATUS: Built
YEAR: 2015

Smestad Recycling Centre / Longva arkitekter

Smestad Recycling Center represents a new building typology, which facilitate the indoor waste handluing for the public. There is an integrated, climatised service and office building on one end of the building, with functionalities like cafeteria, changing rooms and hazardous waste management and technical rooms, whereas the other end is for the public. The plan on the right side emphasizes its most important design criteria - the operational logistics and maximal traffic flow.



WHAT I TAKE: Appropriation to the site-frame crane renovation to recycling assembly



Plan sketch to illustrate the operational logistics and maximal parking and flow

REFERENCE PROJECTS RELATED TO RECYCLING

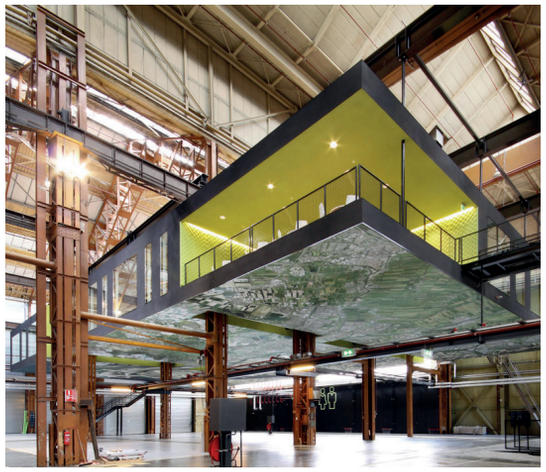
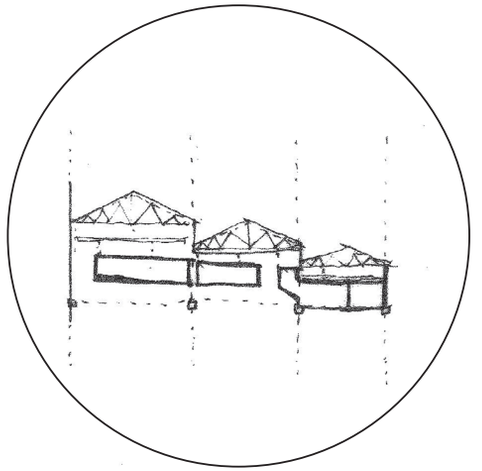


Fig17 .The floating innovation floor (Peekstok, 2012)

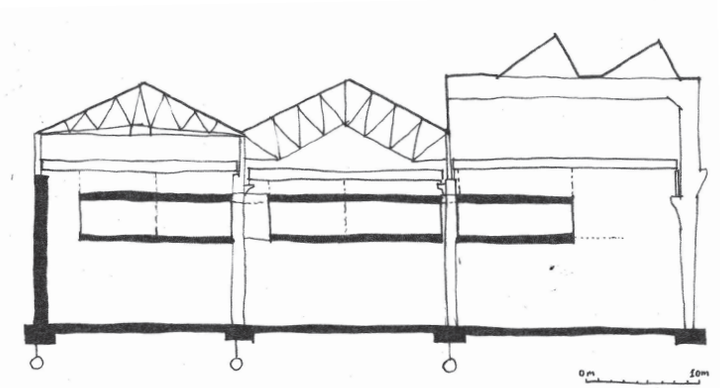
FIRM: Groosman
TYPE: Commercial › Office
STATUS: Built
YEAR: 2012

RDM Innovation Dock / Groosman

Floating office is the concept to reuse the disused hoisting cranes with a floating innovation floor to introduce a second useable level. The floating cubes is to follow the sustainable building strategies of disassembly, modularity and recyclabity.



WHAT I TAKE: Appropriation to the site-Hanyang iron works section



Section sketch to illustrate the disassembly, functionaluty proporties of the connection

IV DESIGN PHASE: TRANSLATION & EXPERIMENT

HISTORICAL NARRATIVE OF THE SITE

1889

Establishment

The blast furnace of the Hanyang Iron Plant started smelting and the iron plant was completed and put into opesration, marking China's awakening.

1895

Development

During the First World War, the demand for steel increased, and Hanyang Iron Works ushered in a short-lived boom and became a world-class steel company. Its products were sold all over the world and Hanyang Iron Works was booming.

1921

Dilemma

During the Second World War, the equipment in the factory was moved to Chongqing, and the remaining equipment was blown up during the conflicts surrounding the area.

1952

Success

Hanyang Iron and Steel Plant is reformed, which was placed under the management of Wuhan Iron and Steel Group, and Hanyang Iron and Steel Plant re-emerged, and develop quickly.

1990

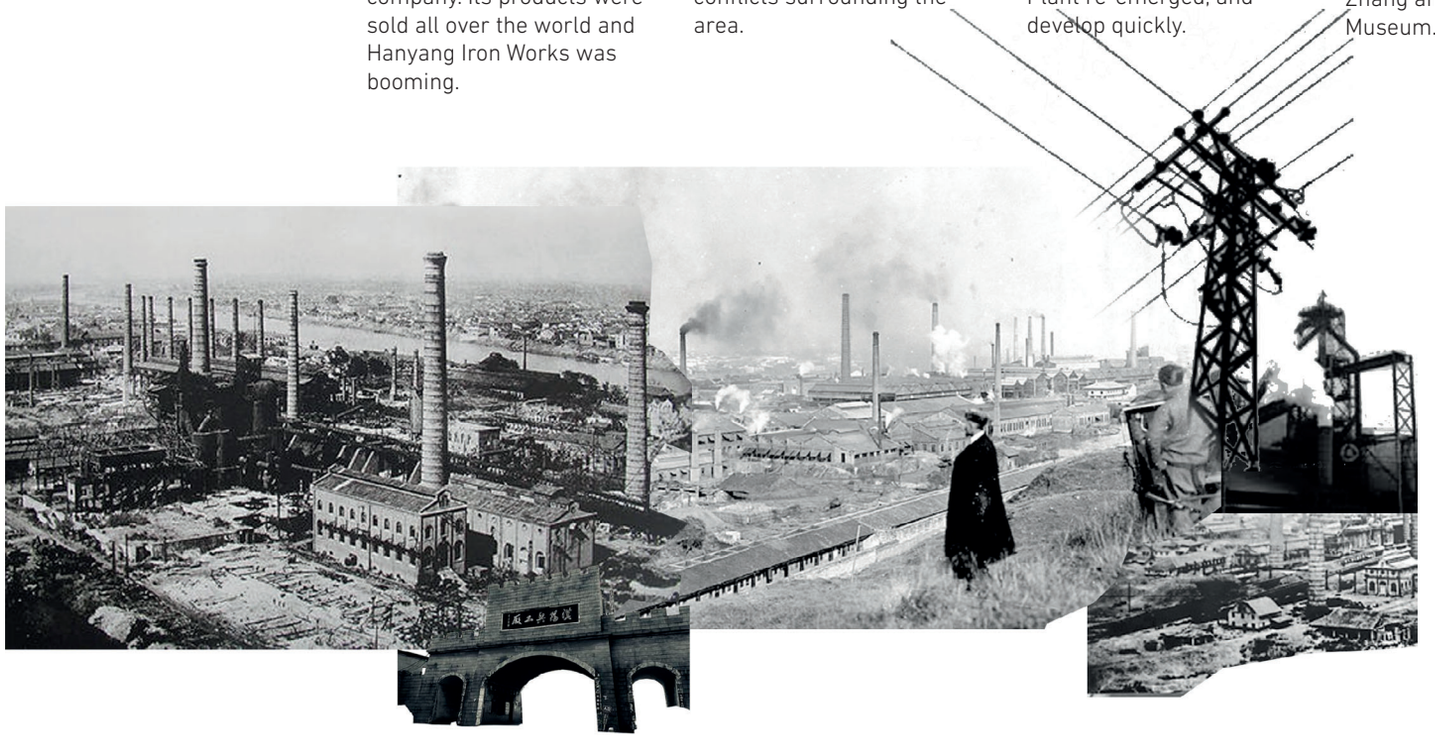
Transformation

The main part of Hangyang Iron Works move to other area, which is facing the functional transformation with a new settle of museum called Zhidong Zhang and HangYang Iron Museum.

2011

Industrial heritage

The converter workshop was rated as a cultural relic protection unit by the Municipal Bureau of Culture and listed as a first-class industrial heritage.

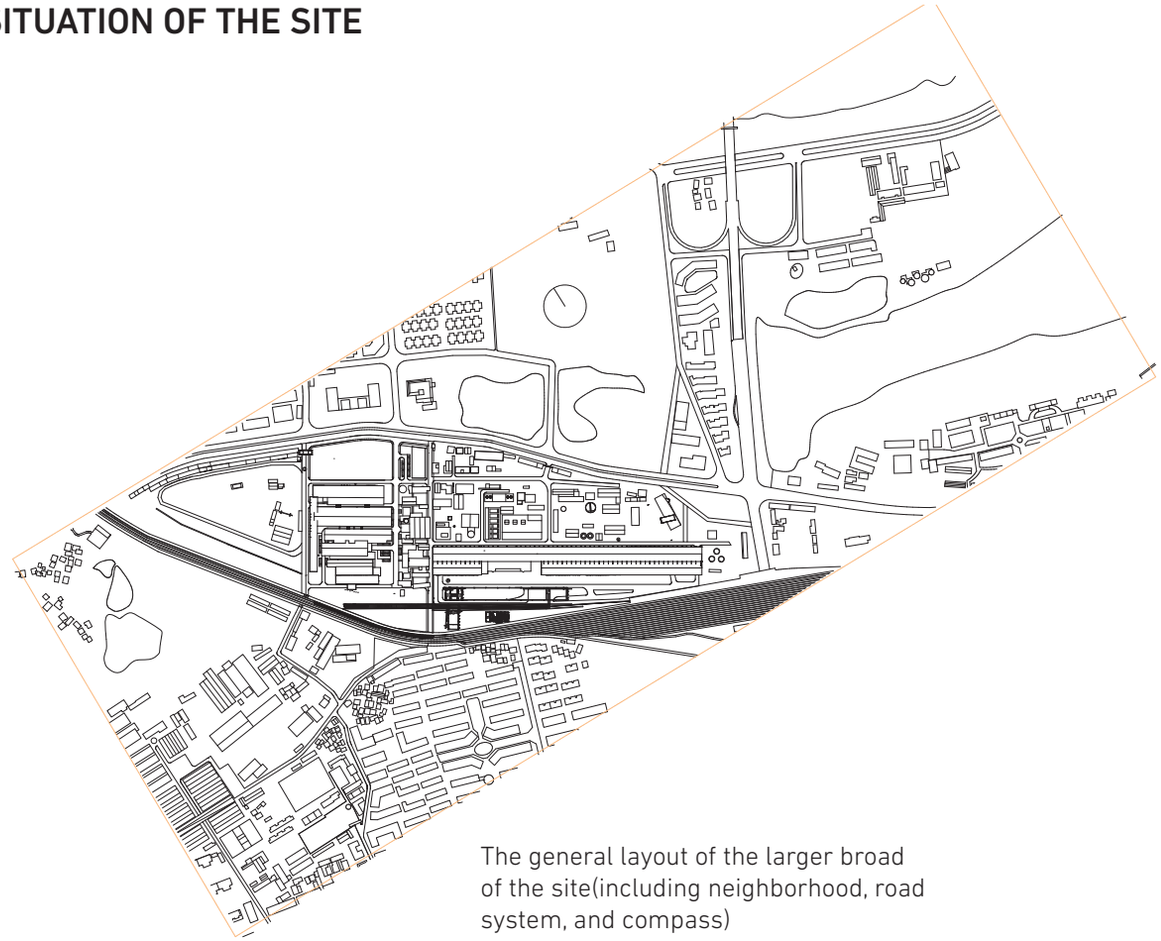


2013

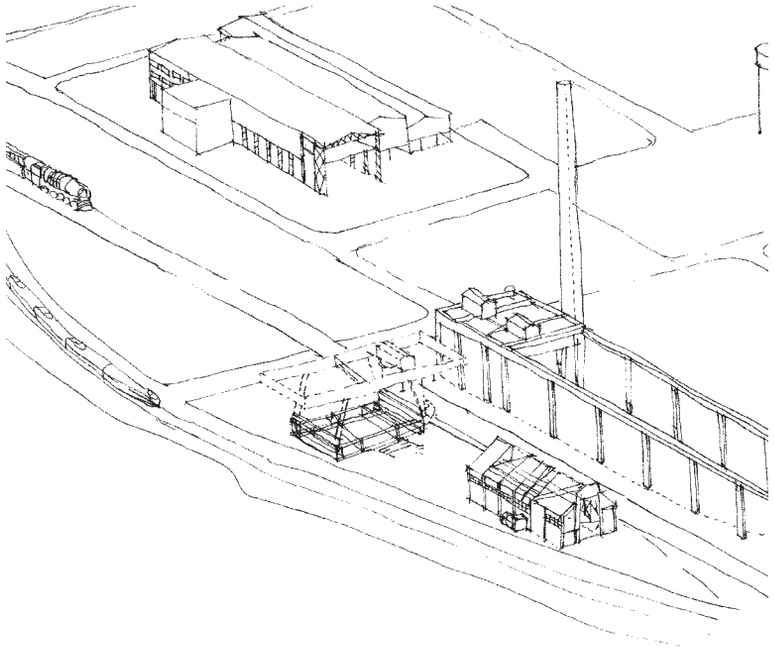
Protection planning

In the "Wuhan City Industrial Heritage Protection and Utilization Plan" approved in 2013, about 25 hectares of land of the Hanyang Iron and Steel Plant was designated as an industrial heritage construction control area.

SITUATION OF THE SITE



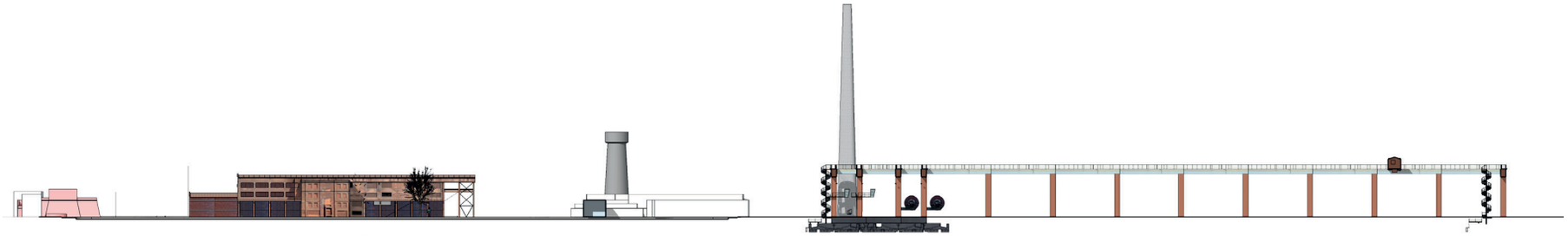
The general layout of the larger broad of the site(including neighborhood, road system, and compass)



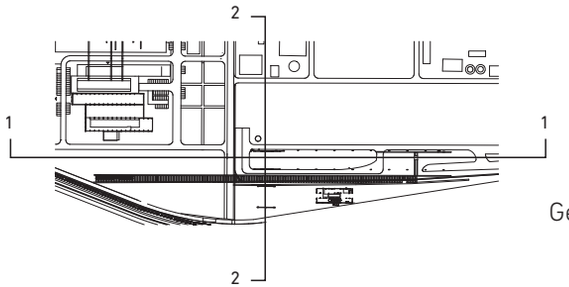
Surroundings of the Hangyang Ironworks
The Hangyang Ironworks is the diamond-shaped **industrial complex** at the center of the map. The site of this project is located at the southern tip of the complex, where **a few warehouses and railway tracks** are constructed. There are multiple entrances into the complex either by road or railway. The complex is covered in natural foliage and surrounded by operational railways, dense population residences as well as agricultural areas.

Sketch of the site
The sketch provides a better understanding of the layout of the site, including the relative scale and position of the facilities available for renovation, possible **transport options and access points**, as well as an eagle-eyed viewed overlook impression.

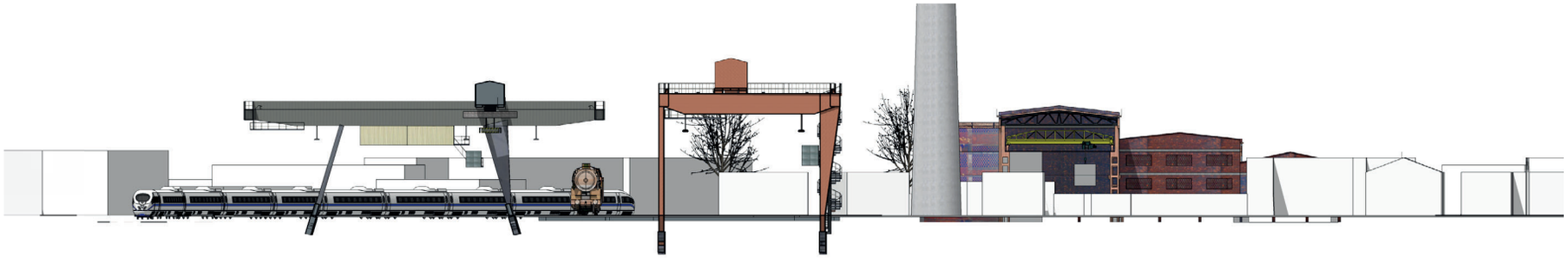
Section of the site



1-1 section view (Crosscut section through frme crane)



General floor plan (instruction plan)

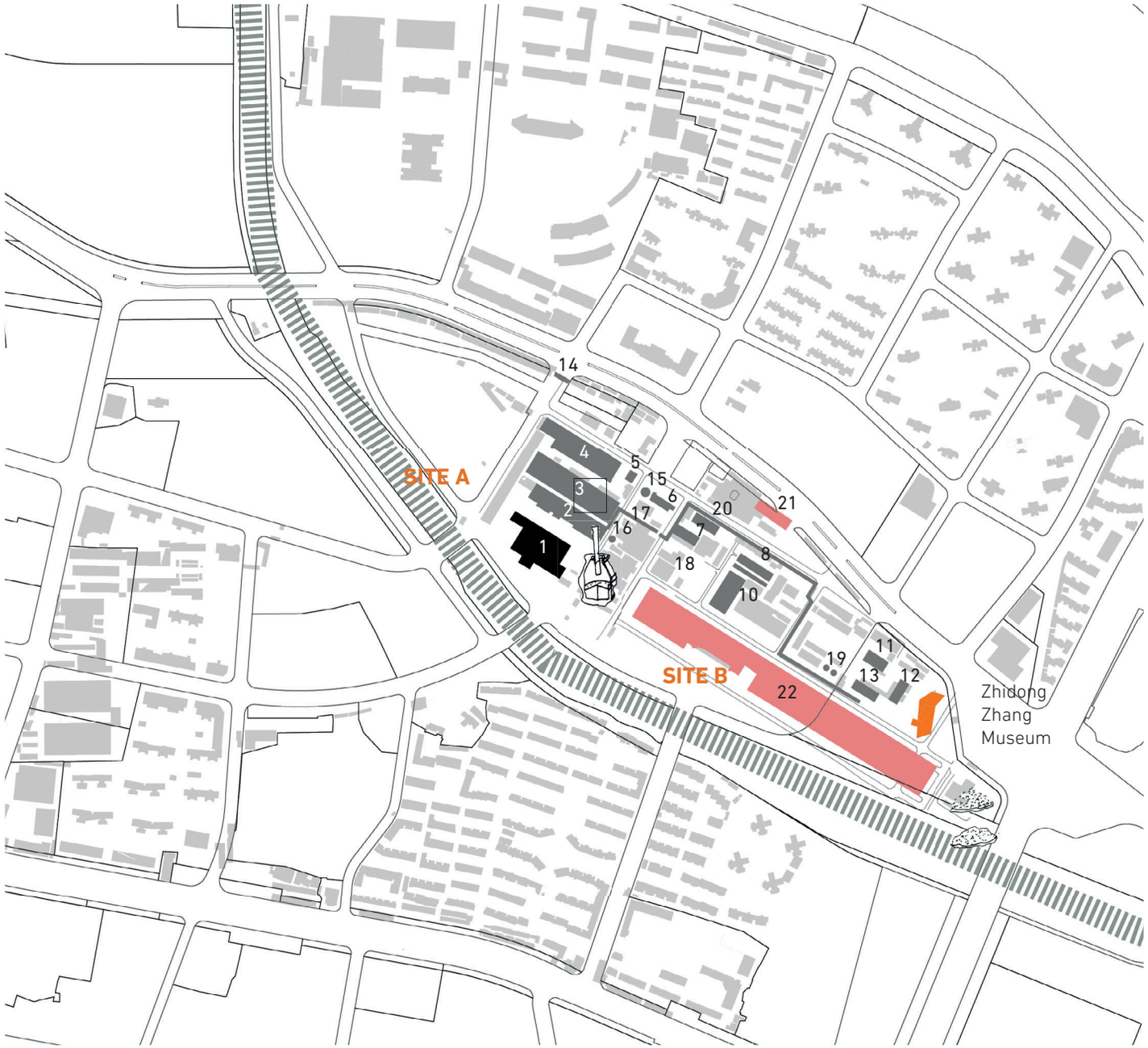


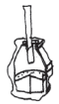
2-2 Sectional drawing (longitudinal section of the frame crane and gate crane)

SITUATION OF THE SITE

There are versatile remaining facilities on the site, like chimneys, abandoned rail tracks, and many old factories are functioning as warehouses. In the project plan, I will select one of the warehouses as my site and plan to complete a master plan for the whole park to be the center of a circular economy. In recent years, the municipal party committee and government have developed scientific urban development planning and overall planning of the industrial layout to promote industrial upgrade, reform, and development. Moreover, formulation of industrial heritage protection plans has been drawn, including better protection and utilization of steel industrial, cultural heritage for increasing urban charisma.

It's crucial to know and understand what resources and materials are available on-site in order to optimize their usage in a renovation project, thus a survey is conducted for this purpose.





Level	No.	Function	Basic situation					Rating of Value				Comprehensive
			Layer	Height	Years	Structure	Size	Historical	Artistic	Social	Technical	
	1	Workshop	1	12	1960		5208	10	10	8	9	37
	2	Workshop	1	12	1960		4092	8	8	7	7	30
	3	Workshop	1	12	1970		6638	7	8	7	7	29
	4	Workshop	1	15	1980		4628	8	8	7	7	30
	5	Office building	3	9	1980		651	5	5	6	5	21
	6	Pump room	1	10	1970		479	7	8	7	7	29
	7	Workshop	3	27	1970		1350	7	8	7	7	29
	8	Office building	1	3	1980		823	5	5	6	5	21
	9	Office building	1	3	1980		383	6	7	7	6	26
	10	Sewage room	1	16	1990		1846	6	7	7	6	26
	11	Loading station	1	4	1980		765	7	7	7	6	27
	12	Workshop	3	16	1960		728	8	8	7	7	30
	13	Oxygen plant	3	16	1960		1152	8	8	7	7	30
	14	Gatehouse		8	1958		-	8	8	7	7	30
	15	Pool		-	1960		-	8	6	7	7	28
	16	Water tower		30	1960		-	8	8	7	7	30
	17	Pipeline		-	1960		-	7	7	6	6	26
	18	Chimney		60	1960		-	7	6	5	5	23
	19	Oxygen tank	1	4	1970		-	5	6	5	5	21
	20	Gatehouse		8	1958		-	8	8	7	7	30
	21	Plant	1	12	1970		1244	5	2	2	1	10
	22	Plant	1	20	2000		28387	2	2	2	2	6

SITE A

SITE B

Evaluation of existing facilities

In such a study, the details of existing facilities are gathered and summarized in a table, including the functionalities, year of construction, structural elements, and physical dimensions. Each of the said facilities is then evaluated on four scales: historical significance, artistic value, social impact, and technical complexity. For a better comparison between different facilities, a comprehensive index is listed the sums up the values across various categories, which provides more insights for the decision-making process in the later design phase.

2013

Protection planning

Industrial Heritage Classification Comprehensive Score Sheet (Based on "Wuhan City Industrial Heritage Protection and Utilization Plan",2013)

cast iron

Light steel frame

Precast frame

Brick and concrete

SITE SELECTION

1960

SITE A

1. **Ecological succession** based on time factor
2. High reuse value
3. Pedagogical adaptation to museum and art workshops
4. Variable and **diverse** spaces

S
O
W
T

More **functional limitation**, for example, unable to be developed as major commercial center or energy plant for recycling

1. More exsitied facilities, structure, historical feastures to be reused
2. More accessible for **pedagogical** and artist circular center

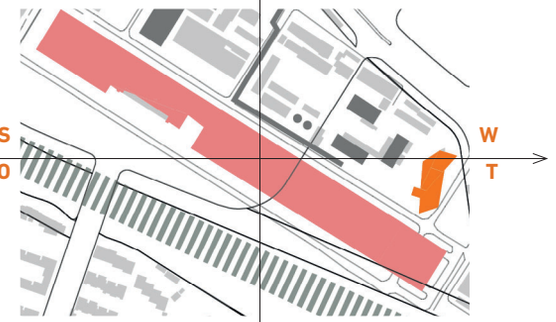
1. Limitation according to plan,2013[1]
2. Less like a recycling center but a recycling-themed experience museum and **circular center**

2000

SITE B

1. Larger space and more flexibility
2. **Less limitation** as for functional changes

1. **Lower reuse value** while all the light steel frame structures are new and easily upcycled to be rebuilt
2. The building is still in use and not totally abandoned as a warehouse



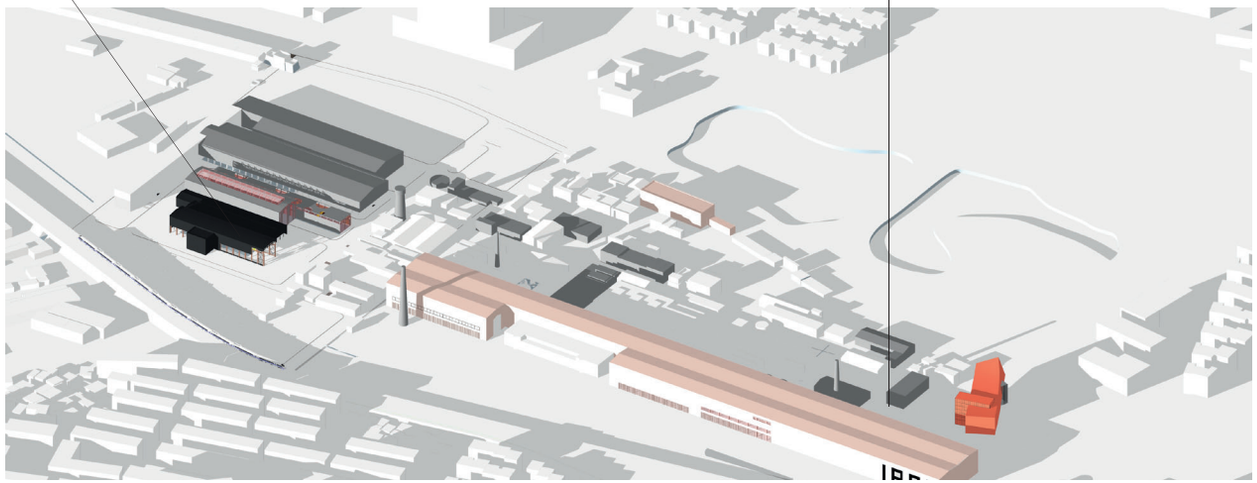
Larger space with potential to be an **energy plant** and garbage sorting center

1. If Energy plant or manufation center is more like a factory and **less interactive** public building with too many security restrictions
2. Lack of knowledge about energy factory

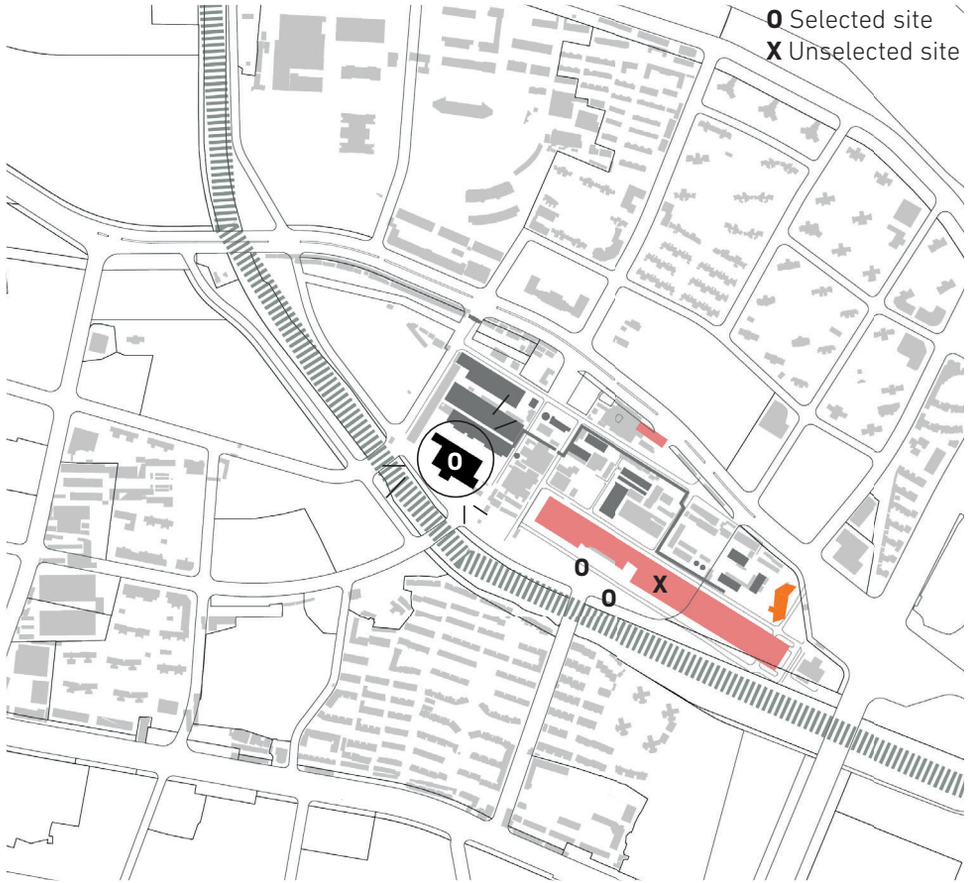
2018

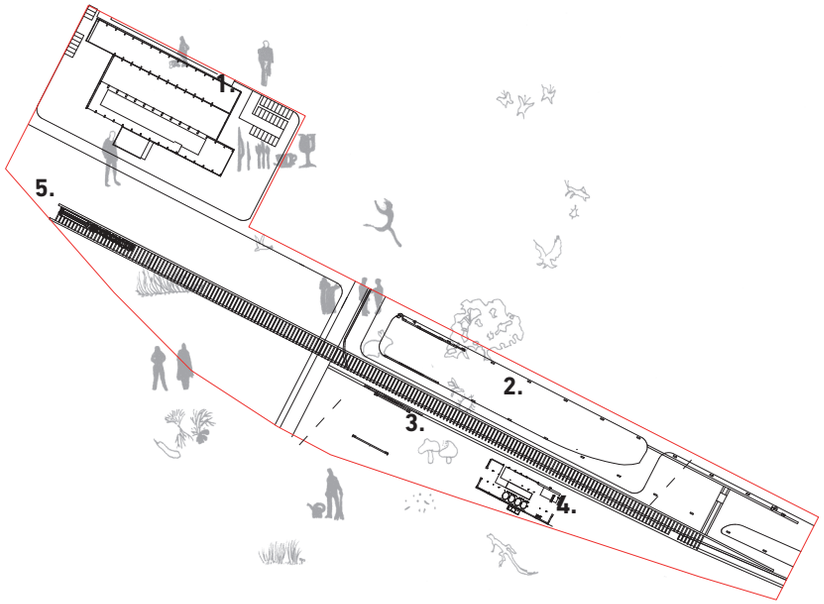
Renovation

For the factorial heritage, combining transformation and expansion to introduce commercial and business functions, art workshops, innovative business incubators, etc. Thus a site selection between the transfer workshop and warehouse plant is set and compared.



Physical dimension





The selected building position

The building we are going to transform is the original transfer workshop, built in 1960, which has the comprehensively highest **historial, artistic, social and technical value** of the whole factorial areas. The size of it is 5208 m^2, with one layer height of 12 meters, and structured by cast iron and light steer framework. The building has a high preservation value, and several **original facilities** such as weightlifting and production flow machines has been still, which could be important thread to think about **reuse and renewal**.

The selected site area

Surrounding the workshop, there are close connection to a **railway and crane facilities** abandoned as a wild garden at current stage. The building has a close connection to the natural elements within a walking distance, and transparency, to the viewscape of the **succession** of the natural park. The railway has grown as a partly **eco-duct** of the urban ecosystem, and the wilderness has played a particular ecosystem service provider.

EXSITING FACILITIES/STRUCTURE

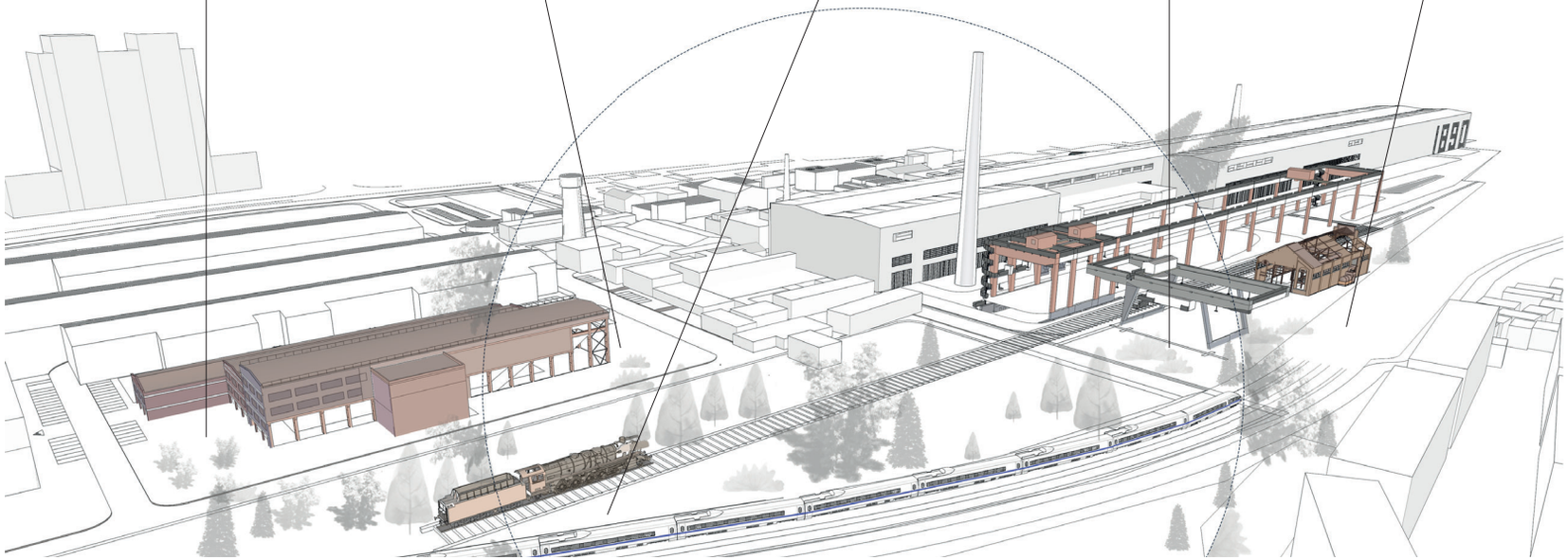
Fig18. Transfer workshop(Tuchong, 2017)

Fig19. Abandoned train(Tuchong, 2018)

Frame crane & gate crane

Abandoned warehouse

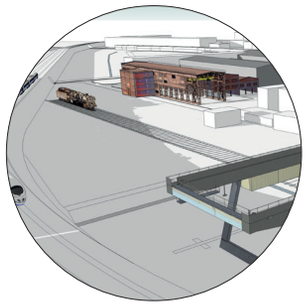
Interior | Old Building | Newly built building | Outdoor facilities | Landscape urbanism | Exterior



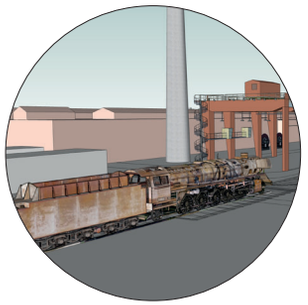
An bird eye view for the site and dynamic scenario

EXSITING FACILITIES/STRUCTURE

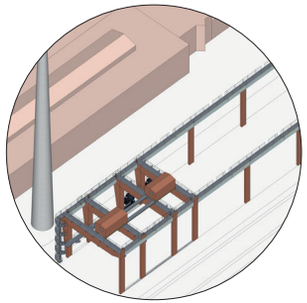
Vison for ecological succession



Spare field



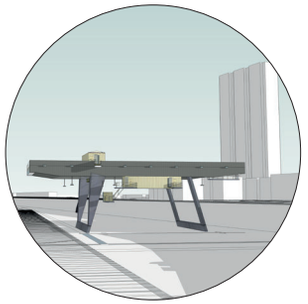
Train and Railway



Frame crane

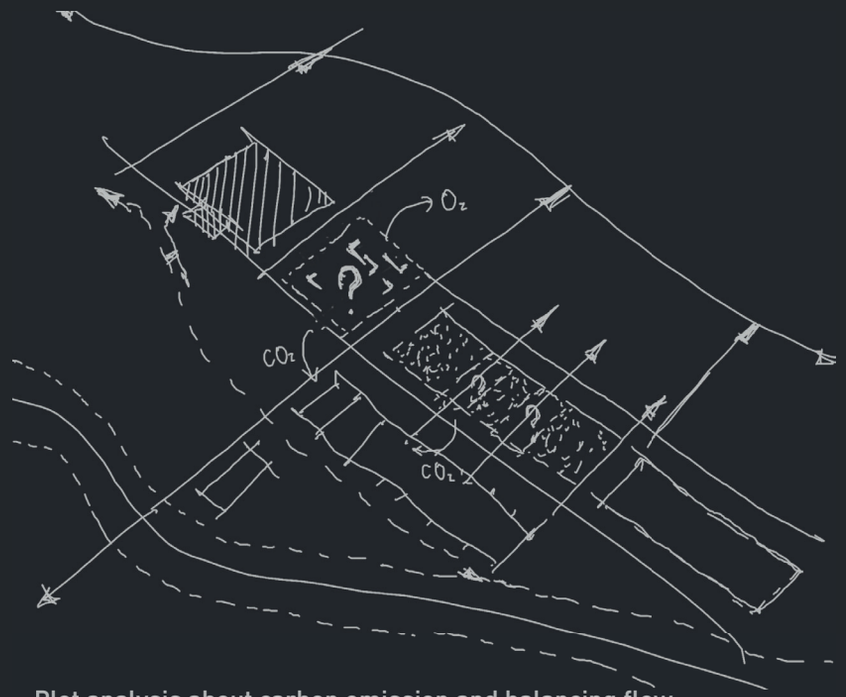
Abandoned warehouse

Frame crane



Gate crane

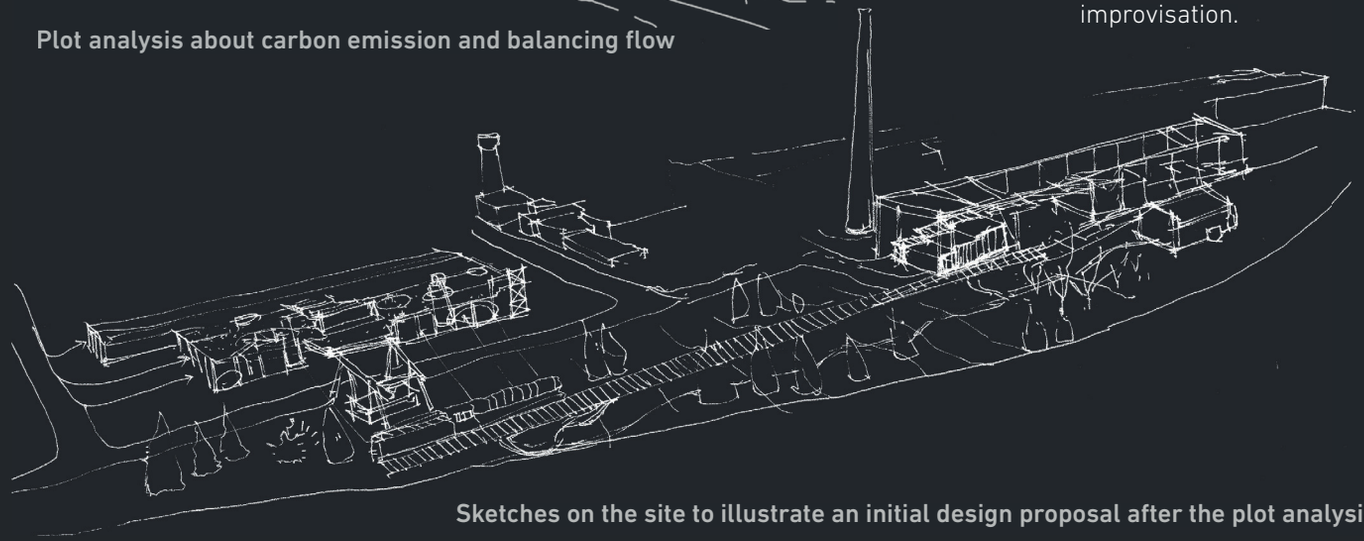
EXPERIMENT



Plot analysis about carbon emission and balancing flow

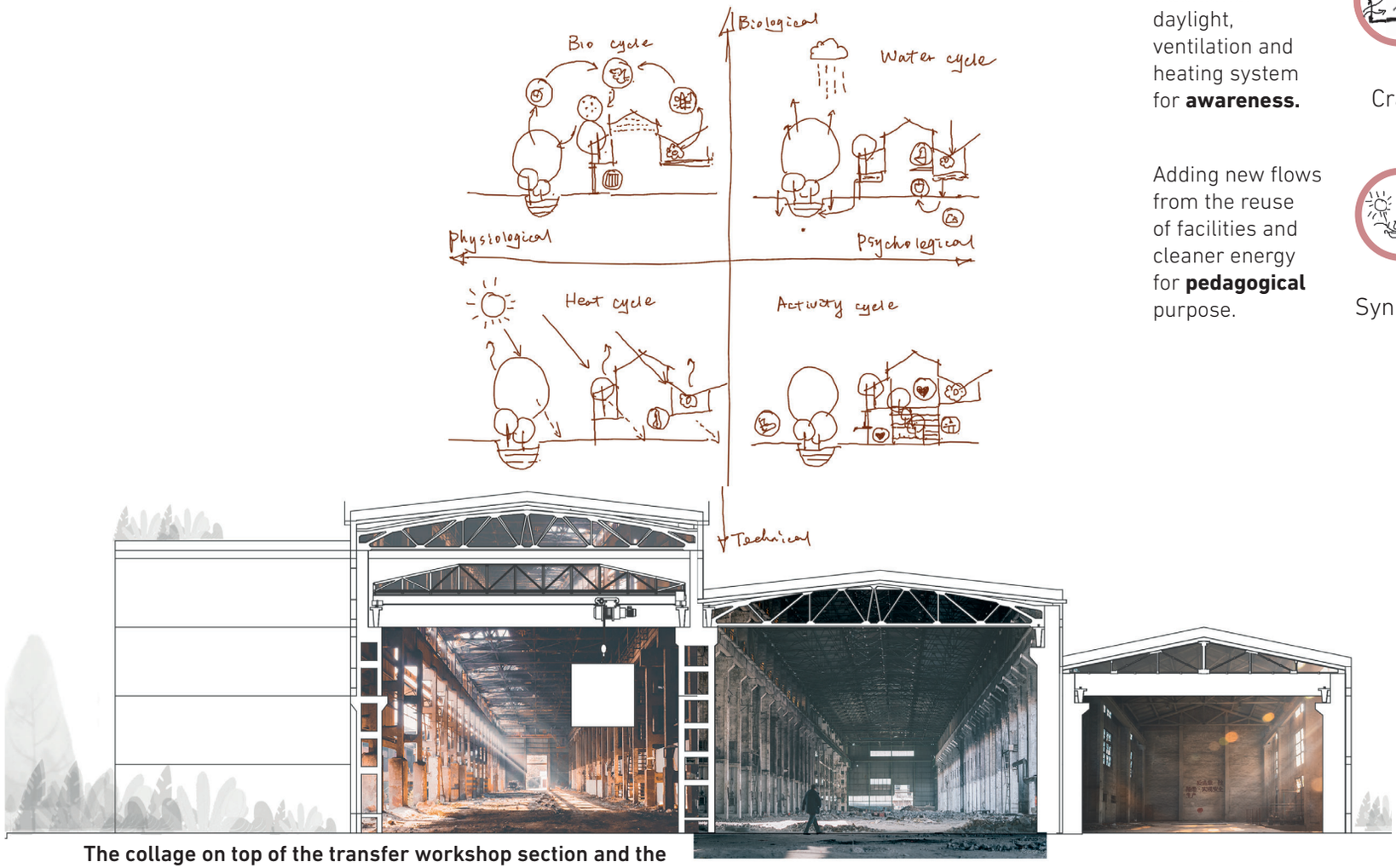
If we recall the memory that we stand in front of an old building as it welcomes us to come inside, we could pounder deeply about the nature and meaning of its existence within such a thought-provoking scenario. As time moves on, we would deem such buildings that are too obsolete and cumbersome to adapt to the change, which would inevitably be left in disarray. Those unfortunate beings would be tucked away and made way for new generations of artifacts. The burning passion and the corresponding hard work of the previous architects that designed and realized the building would also fade away eventually, which is a heavy feeling if we could relate to that sense of loss and decay. We would have to wonder, is there any possible economic pattern that could give old buildings a **newborn purpose** rather than tearing them down mercilessly?

When I see the factory with this thought in mind, I figure out a profound way of understanding the building, which is to capture and seize its features by music — how it bursts into a melody through the materiality, the structures, and the texture that is touched or knocked, padded or fluted. To me personally, the circular architecture there is the **flow**, the **rhythm**, and the **time** spent in the space, which could be interpreted into a unique melody for every building through improvisation.



Sketches on the site to illustrate an initial design proposal after the plot analysis

Collages



The collage on top of the transfer workshop section and the current situation On top of the collage are four cycle images to show four different natural aspects from bio cycle, water cycle, heat cycle and activity cycle. It shows how the building section connects to the external space, and how to break the facade of the building to emerge the workshop into one part of ecosystem service of the whole area. The drawing is shown as the preface to dig into multiple and complex layers of cycles on the site, and question on what circular economy could inspire us on the landscape and architectural design.

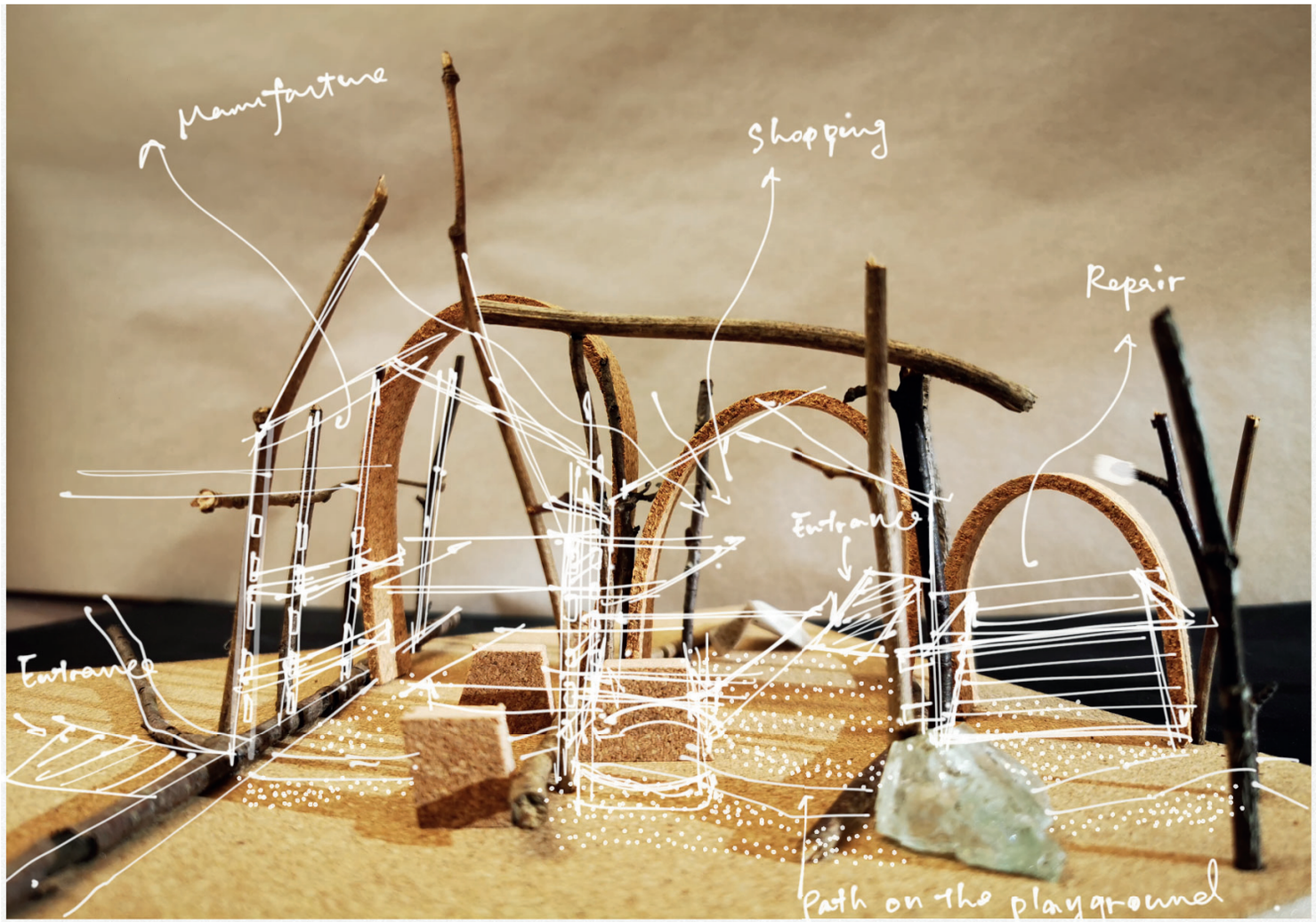
Re-introduce traditional daylight, ventilation and heating system for **awareness.**

Craft

Adding new flows from the reuse of facilities and cleaner energy for **pedagogical** purpose.

Synergy

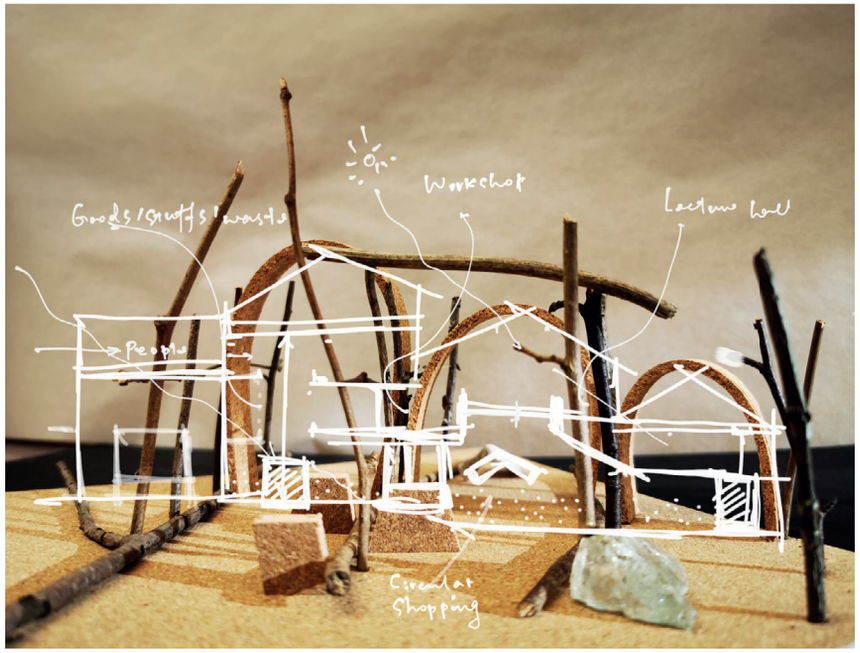
Conceptual modelling



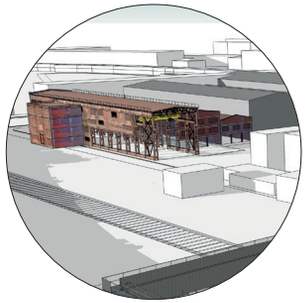
Analogical Modelling of conceptual renovation operations: the possible design proposal on the transfer workshop

In this phase, several wood branches are used to illustrate the exciting structure of the transfer workshop. The horizontal wooden bemas are the symbol of **weightlifting facilities** thaht has a special connection to other spaces. In the center portion, there are three archs which identifies that the transfer workshop has three different height with different possible utility layers as well as the relationship and rhythm of the spaces. On the bottom, there are several placed stones that represent the machines and **existing furnaces**. The sketches on top of the photo of the model are the inspiration gathered after the physical modelling and it shows the functional manifestation of the building. On the left side, where the highest layer is located, there is presumed to be a **manufacturing space**. In the middle, there could be a **circular shopping center**. The **repair functional unit** is await to be set On the right side.

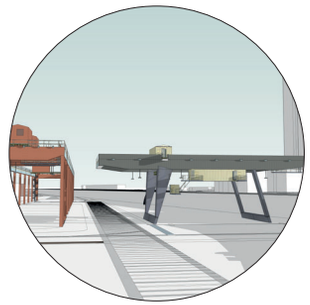
MODELLING



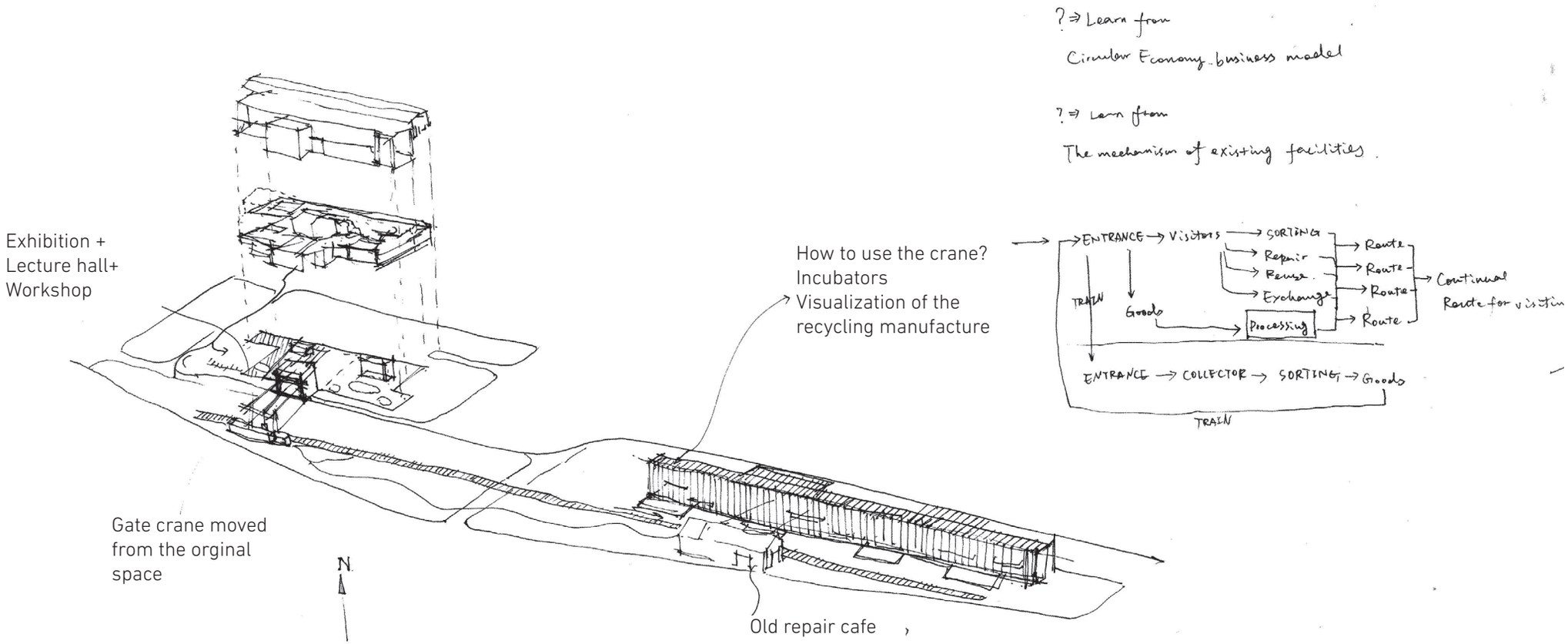
Another design attempt on the transfer workshop
This drawing on top of the same physical model photo is another design attempt with a specific focus on the manufacturing process and original workflow of the site. It shows how the goods could be lift up by the weightlifting facilities and it has a horizontal order from left to right that is: **goods entrances**(first floor) + **guest entrance**(third floor)- **workshop**(interaction) - **lectural hall**. Considering the previous design proposal, it shows an interesting combination altogether:
Left: entrance + manufacture
Middle: workshop + circular shopping mall
Right: lecture hall + repair space



The anallogical simulation of manufacture space and external space
The connection to the natural and external elements is the crucial point of the spacial recycling experiential museum. The drawings illustrate that the outline framework of the crane that moved from the original site to the southern side of the transfer workshop. The wooden sticks aligned on the ground are the same as the manufacturing space that has a open connection to the landscape.



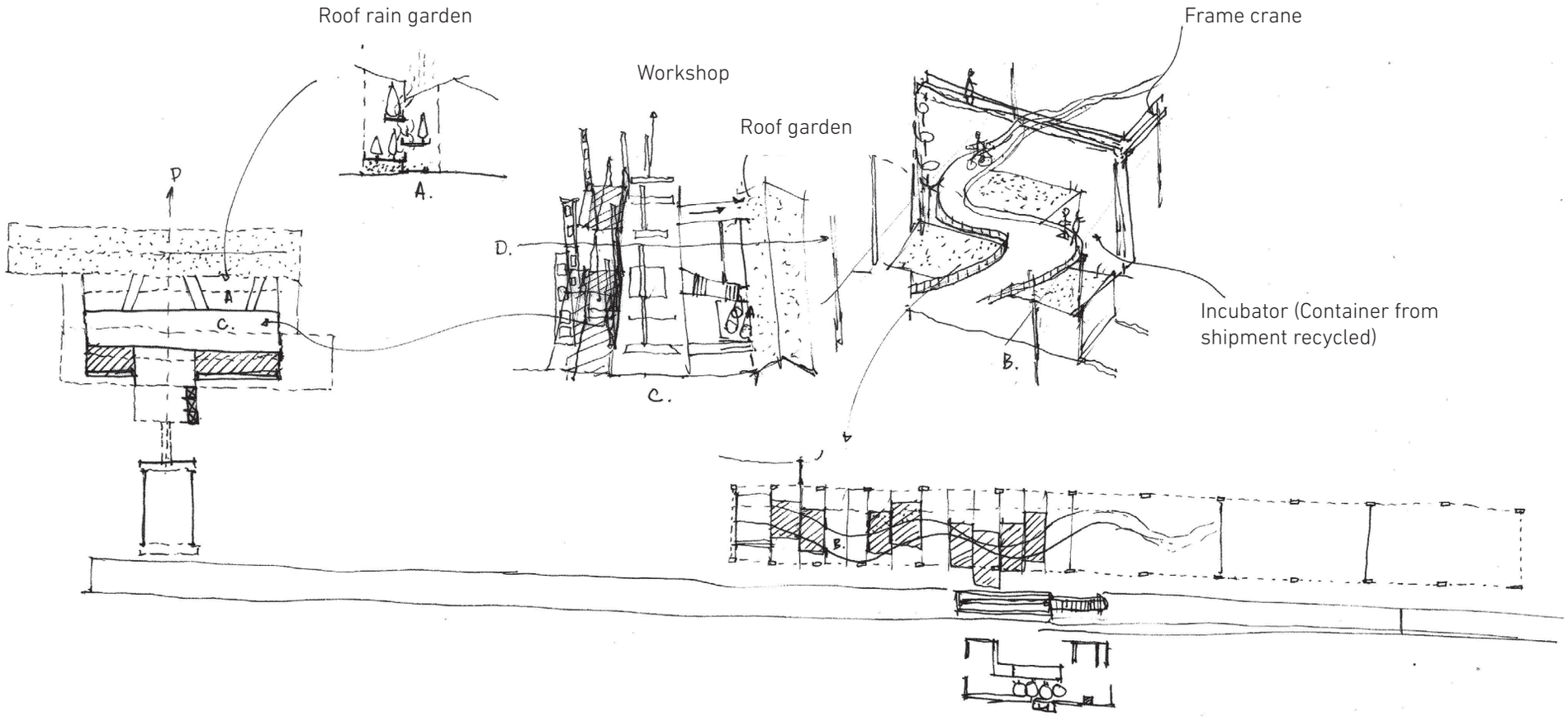
Design attempt



Functionality and workflow of the site

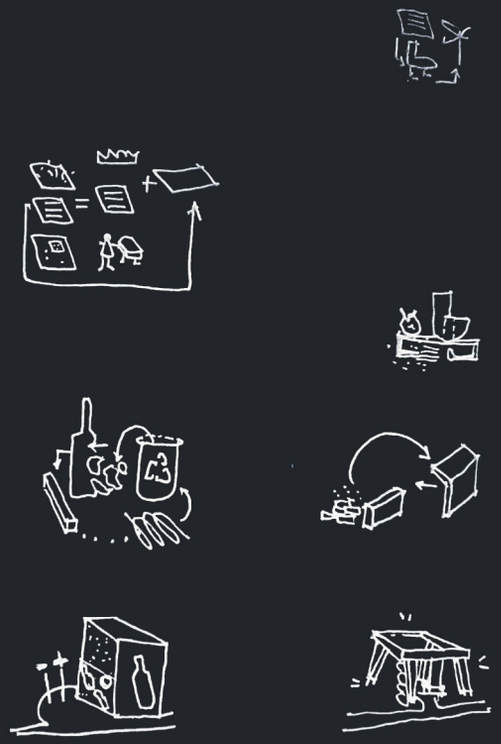
Perception is by sketch on an expansive workshop operation, and be given the observation about combining recycling functionality with the outdoor spaces as public area and be more pedagogical and inviting for citizens to use the space.

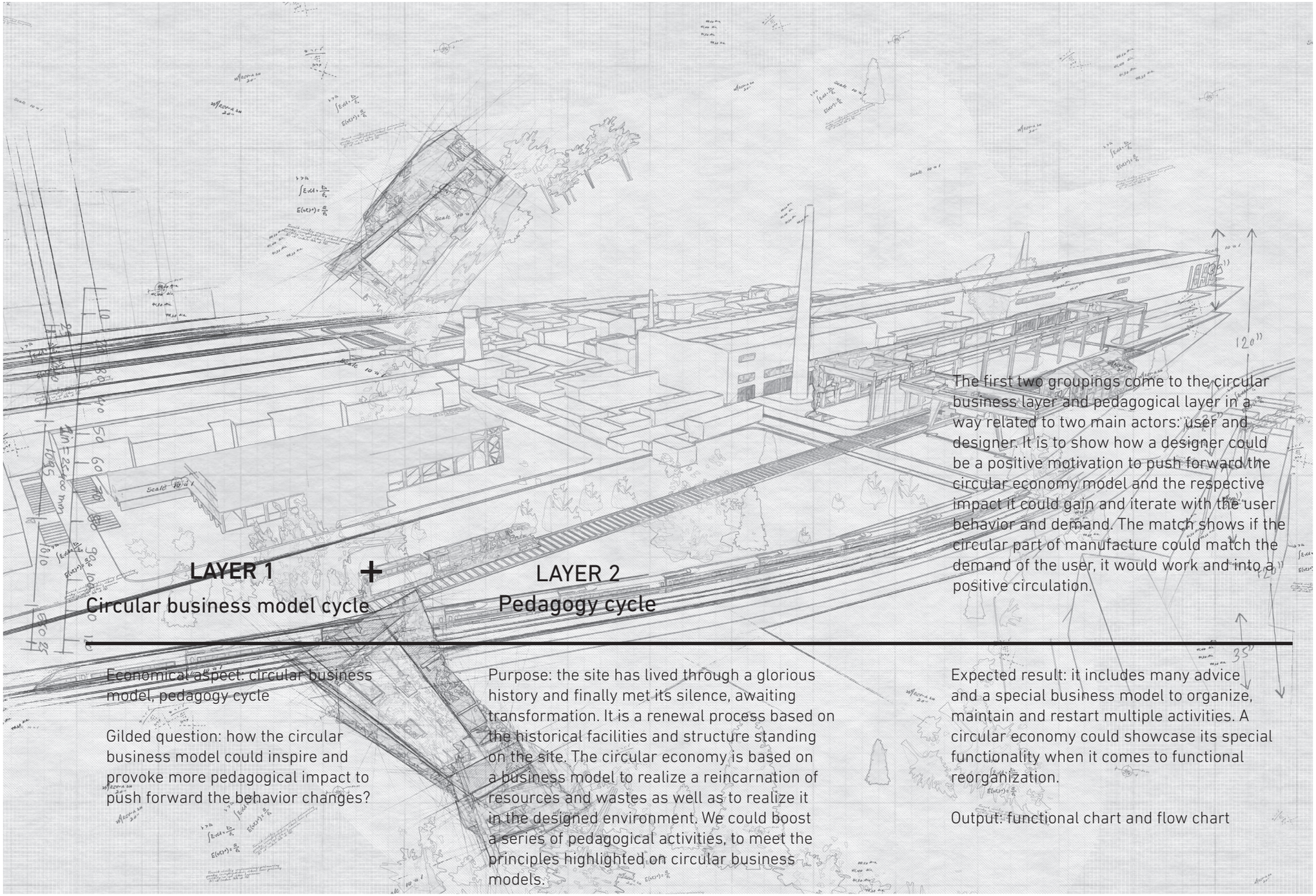
Design attempt



The internal space and external space of the design proposal
The graph shows different parts of the design and how the conceptual functionality graph steps further into a spatial morphology as visualized on the surface, This sketch is a design manifestation stage to find more form language to speculate each functional diagrams before. From this stage, we will layer our design into six cycles to dig into the complexity of the renovation, recycling, publicity and ecoservice issues.

IV DESIGN PHASE: TRANSLATION & EXPERIMENT





LAYER 1

Circular business model cycle

+

LAYER 2

Pedagogy cycle

The first two groupings come to the circular business layer and pedagogical layer in a way related to two main actors: user and designer. It is to show how a designer could be a positive motivation to push forward the circular economy model and the respective impact it could gain and iterate with the user behavior and demand. The match shows if the circular part of manufacture could match the demand of the user, it would work and into a positive circulation.

Economical aSpect: circular business model, pedagogy cycle

Gilded question: how the circular business model could inspire and provoke more pedagogical impact to push forward the behavior changes?

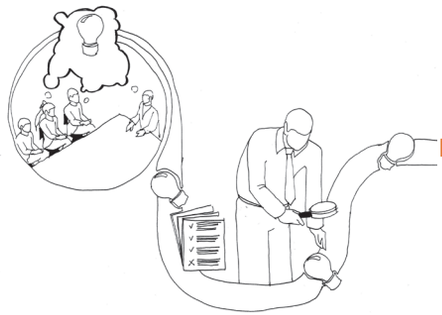
Purpose: the site has lived through a glorious history and finally met its silence, awaiting transformation. It is a renewal process based on the historical facilities and structure standing on the site. The circular economy is based on a business model to realize a reincarnation of resources and wastes as well as to realize it in the designed environment. We could boost a series of pedagogical activities, to meet the principles highlighted on circular business models.

Expected result: it includes many advice and a special business model to organize, maintain and restart multiple activities. A circular economy could showcase its special functionality when it comes to functional reorganization.

Output: functional chart and flow chart

LAYER 1

Circular business model cycle



Design → Manufaction → Drift

- Seperation → Renewal
- Seperation → Biodegration
- Energy → Biodegration
- Energy → Resources
- Material → Production
- Reparation
- Disassembly
- Shared platform

Production → Resourcing

LAYER 2

Pedagogy cycle

DESIGNER

Steer ← Force

USER

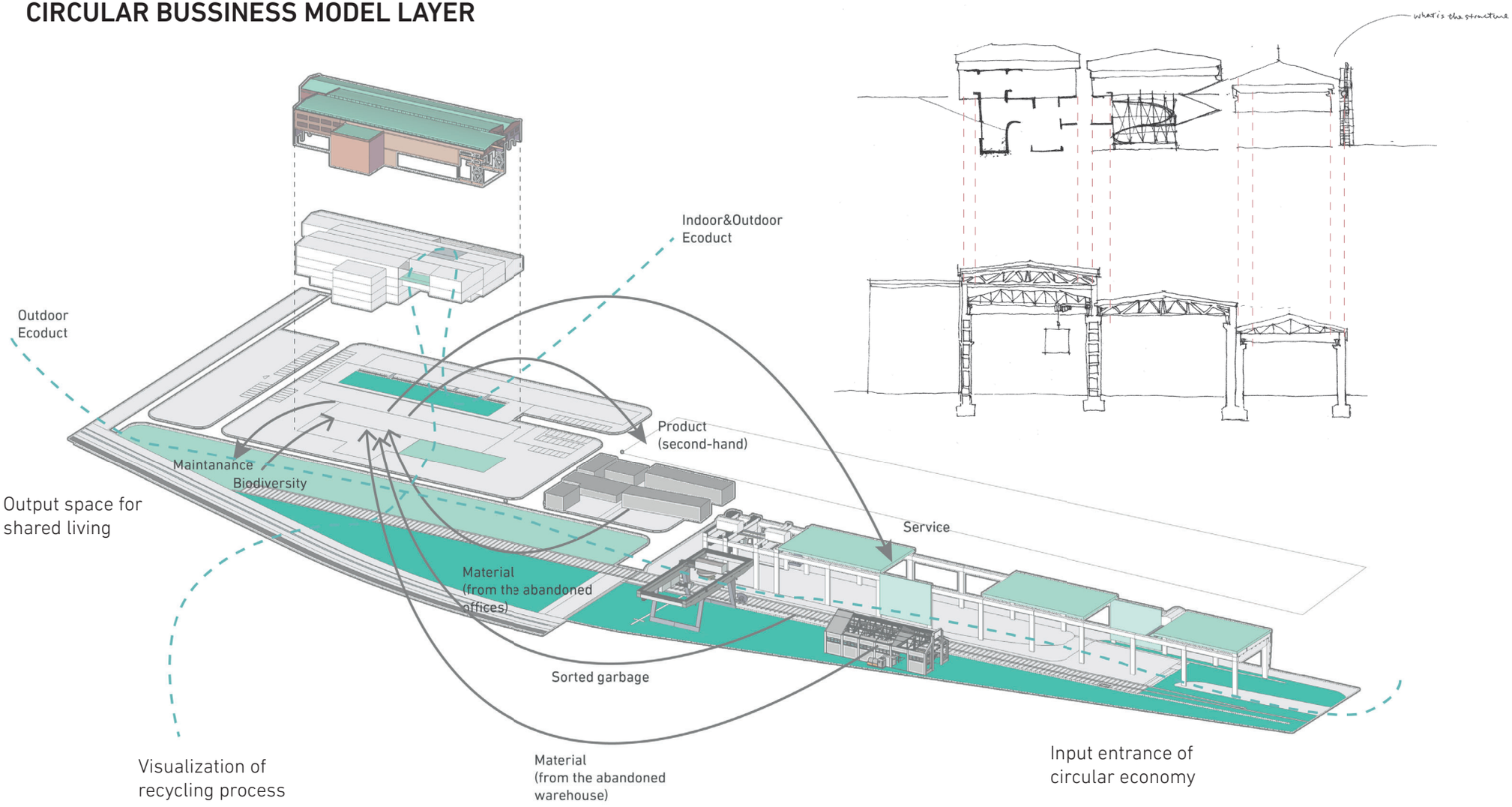
Enlighten ← Spur

Match

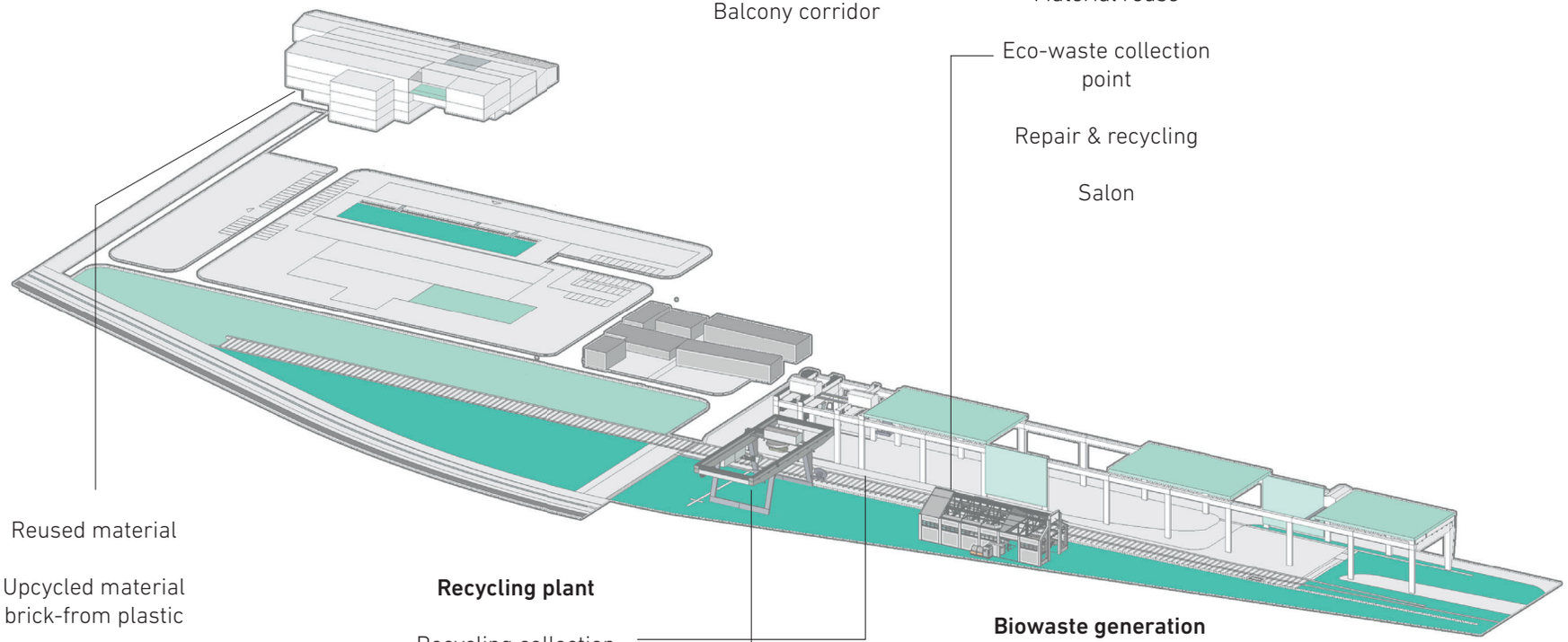
PRODUCT

L1+L2

CIRCULAR BUSSINESS MODEL LAYER



PEDAGOGY LAYER



Facade + Rooftop

Green roof

Vertical garden

Solar panels

Leisure seating area

Cantilevered greenhouse

Balcony corridor

Repair cafe

Material reuse

Eco-waste collection point

Repair & recycling

Salon

Reused material

Upcycled material brick-from plastic

Entrance for goods/ visitors

Recycling plant

Recycling collection assembly

Incubators

Bicycle path

Train trail(Renovated)

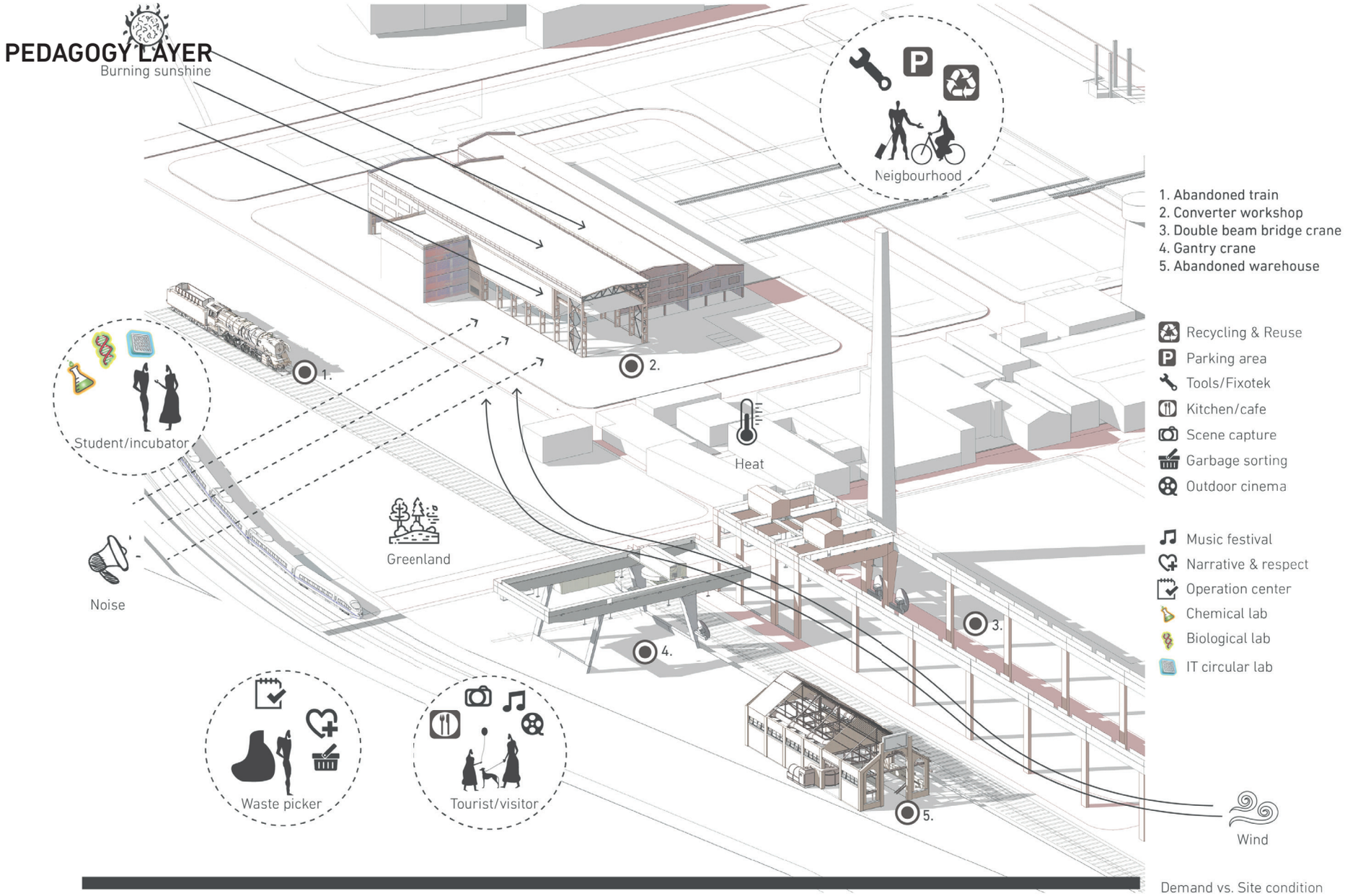
Biowaste generation

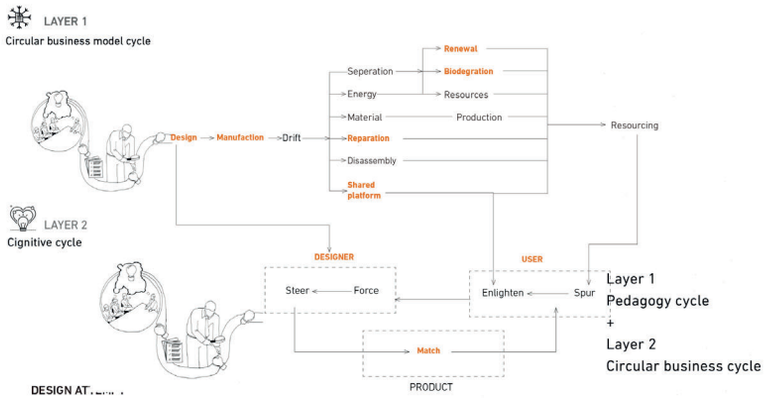
Slurry collection

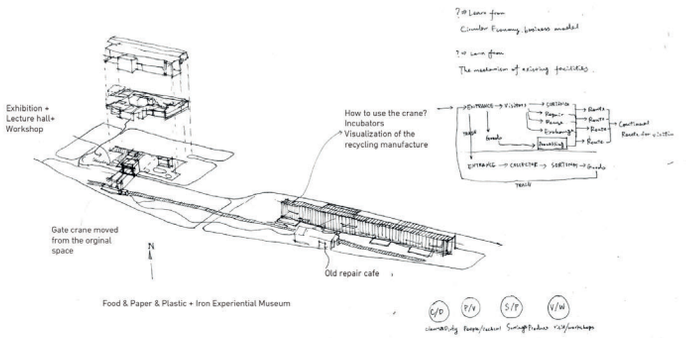
Seperate outdoor toilet

Purification plant

Rain-water collection

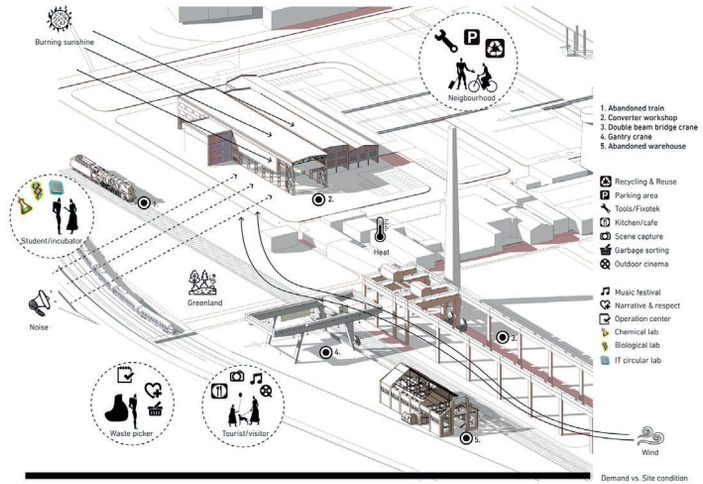

PEDAGOGY LAYER
Burning sunshine
Neigbourhood
1. Abandoned train
2. Converter workshop
3. Double beam bridge crane
4. Gantry crane
5. Abandoned warehouse
Recycling & Reuse
Parking area
Tools/Fixotek
Kitchen/cafe
Scene capture
Garbage sorting
Outdoor cinema
Music festival
Narrative & respect
Operation center
Chemical lab
Biological lab
IT circular lab
Student/incubator
Heat
Greenland
Noise
Waste picker
Tourist/visitor
Wind
Demand vs. Site condition





Functionality and workflow of the site
Perception is by sketch on a explosive workshop operation, and be given the observation about combining recycling functionality with the outdoor spaces as public area and be more pedagogical and inviting for citizens to use the space.

Rendering for the economic aspect



Intraction among the site, stakeholders and activities

Layer 1
Pedagogy cycle

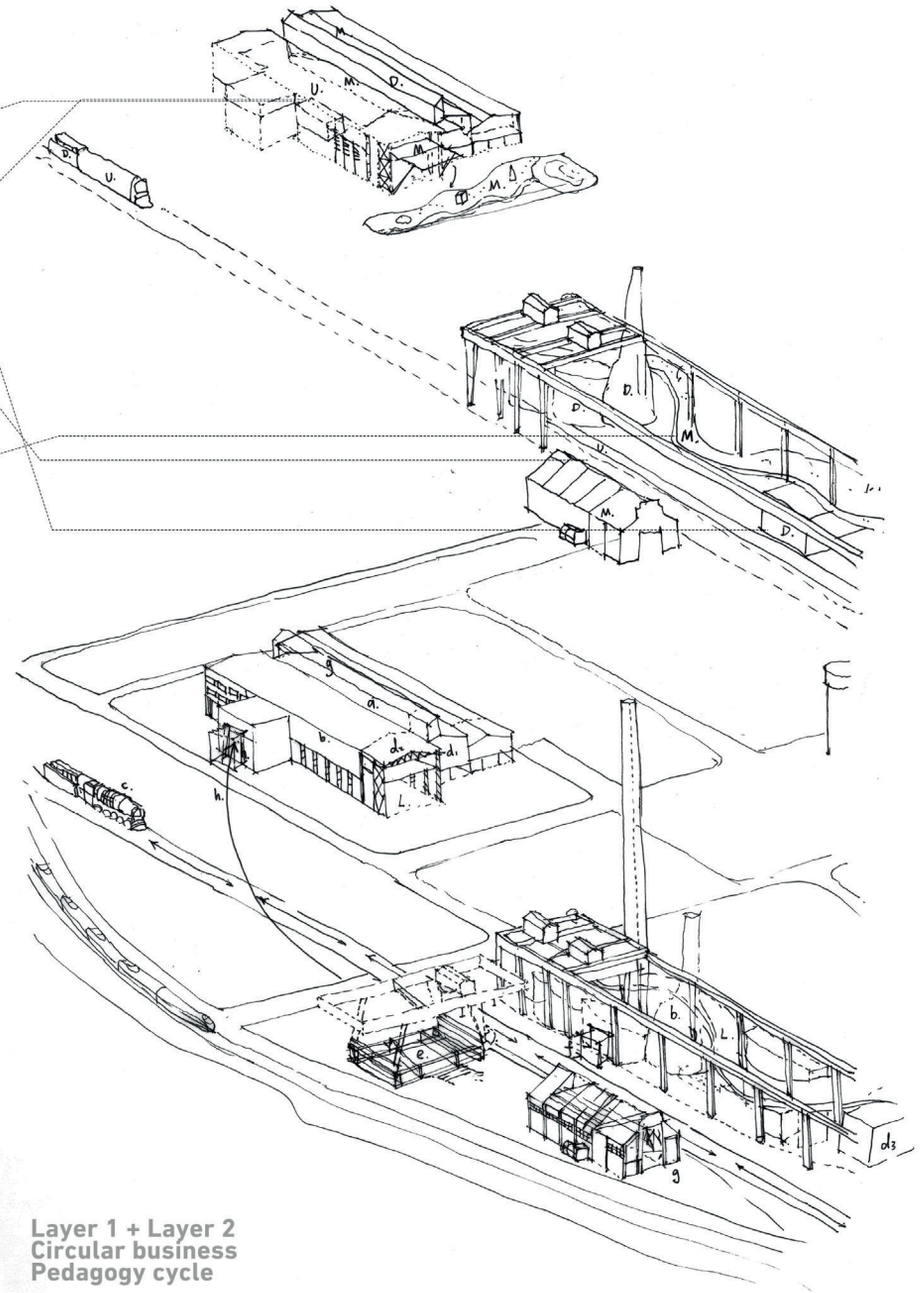
D. Designer
- Steer
- Force

U. User
- Spur
- Enlighten

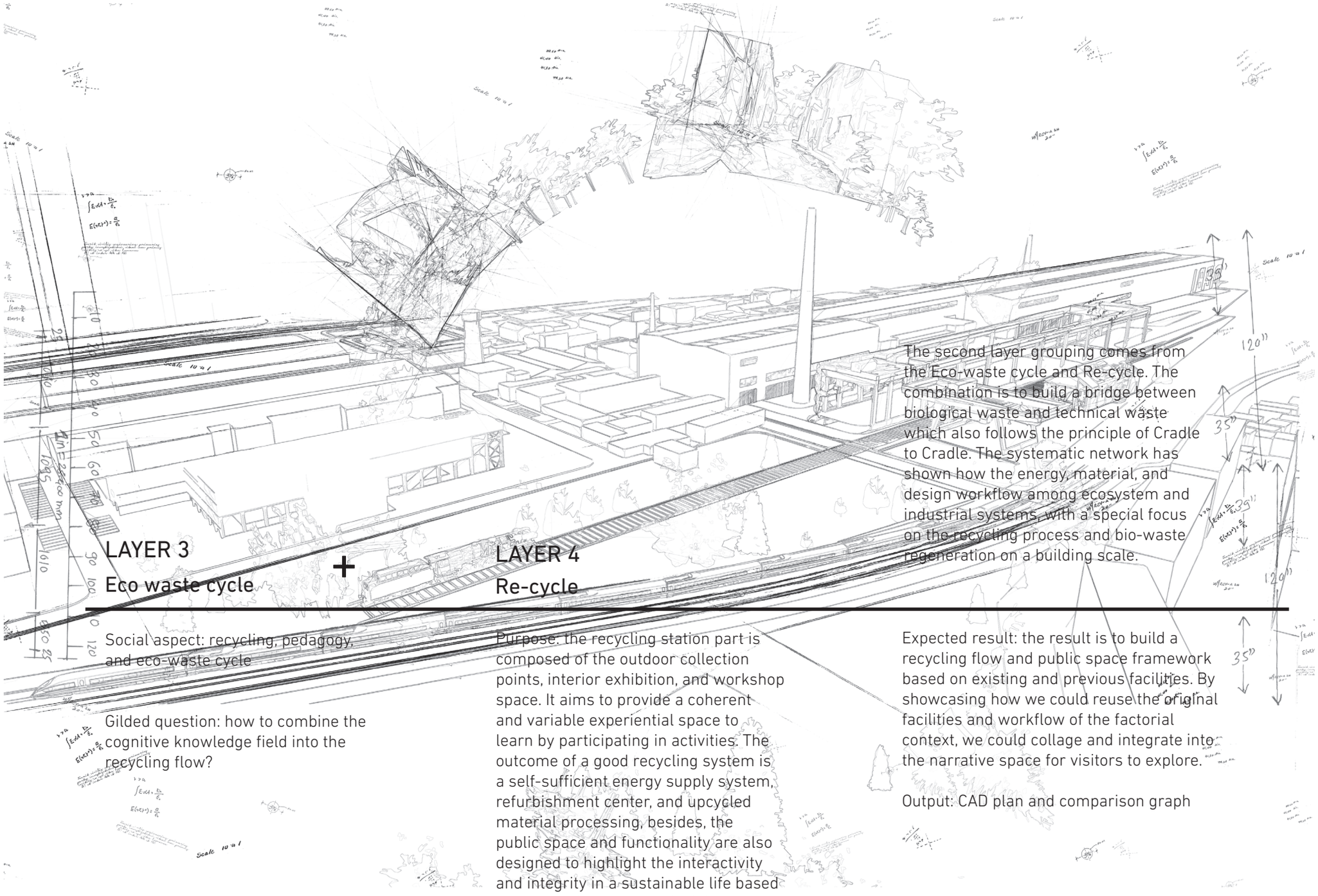
M. Match

Layer 2
Circular business cycle

a. Design
b. Manufacture
c. Drift
d. Seperation
- Renewal
- Biodegration
- Resources
e. Energy
f. Material
g. Reparation
h. Disassembly
i. Shared platform



Layer 1 + Layer 2
Circular business
Pedagogy cycle



LAYER 3
Eco waste cycle

+

LAYER 4
Re-cycle

The second layer grouping comes from the Eco-waste cycle and Re-cycle. The combination is to build a bridge between biological waste and technical waste which also follows the principle of Cradle to Cradle. The systematic network has shown how the energy, material, and design workflow among ecosystem and industrial systems, with a special focus on the recycling process and bio-waste regeneration on a building scale.

Social aspect: recycling, pedagogy, and eco-waste cycle

Gilded question: how to combine the cognitive knowledge field into the recycling flow?

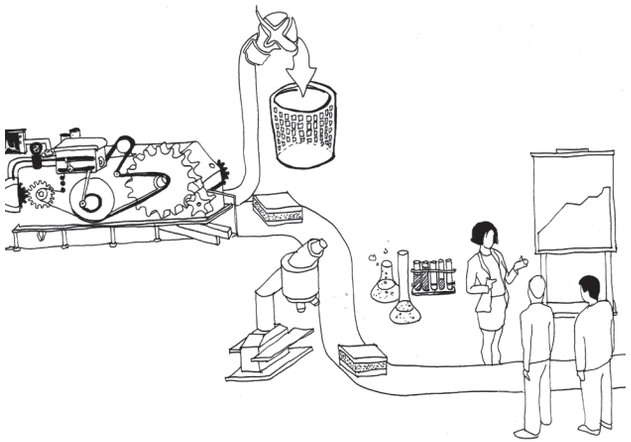
Purpose: the recycling station part is composed of the outdoor collection points, interior exhibition, and workshop space. It aims to provide a coherent and variable experiential space to learn by participating in activities. The outcome of a good recycling system is a self-sufficient energy supply system, refurbishment center, and upcycled material processing, besides, the public space and functionality are also designed to highlight the interactivity and integrity in a sustainable life based on a shared economy principle.

Expected result: the result is to build a recycling flow and public space framework based on existing and previous facilities. By showcasing how we could reuse the original facilities and workflow of the factorial context, we could collage and integrate into the narrative space for visitors to explore.

Output: CAD plan and comparison graph

LAYER 5

Eco waste cycle



Wind turbins

Photovoltaic panel

Thermal power generator

Biogas as fuel

Appliances

Battery

LED grow lights

Green house

Biogas digester

Bio slurry

Consume

People

Excrement

LAYER 4

Re-cycle

RECYCLING

VALIDATION OF CONSUMPTION

PURCHASING

WASTE

Design+Development

Growing+Extraction

Manufacturing

Retail

Transportation

Material combining + Transmutation

User+Care

Repair

Reuse

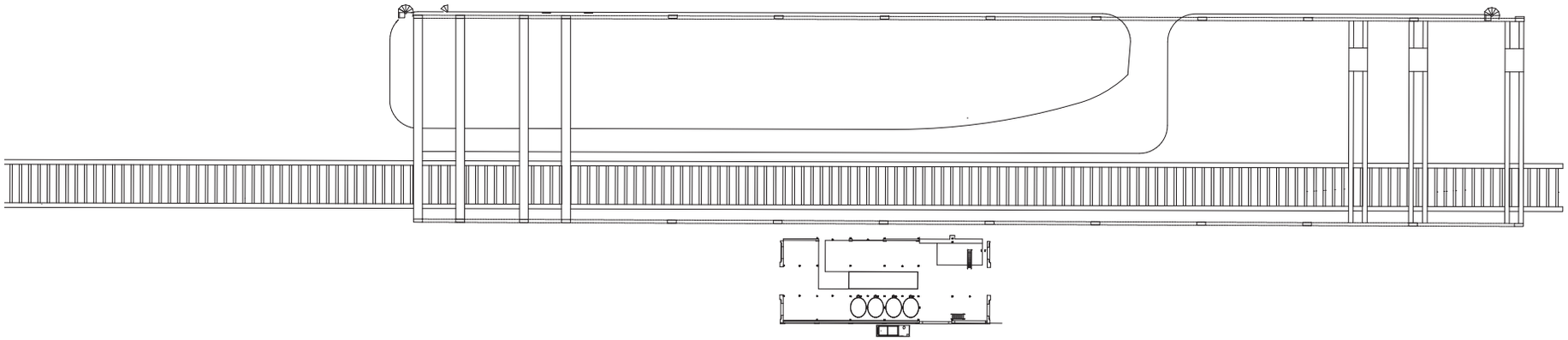
End of user cycle

Into industrial system

Into the ecosystem

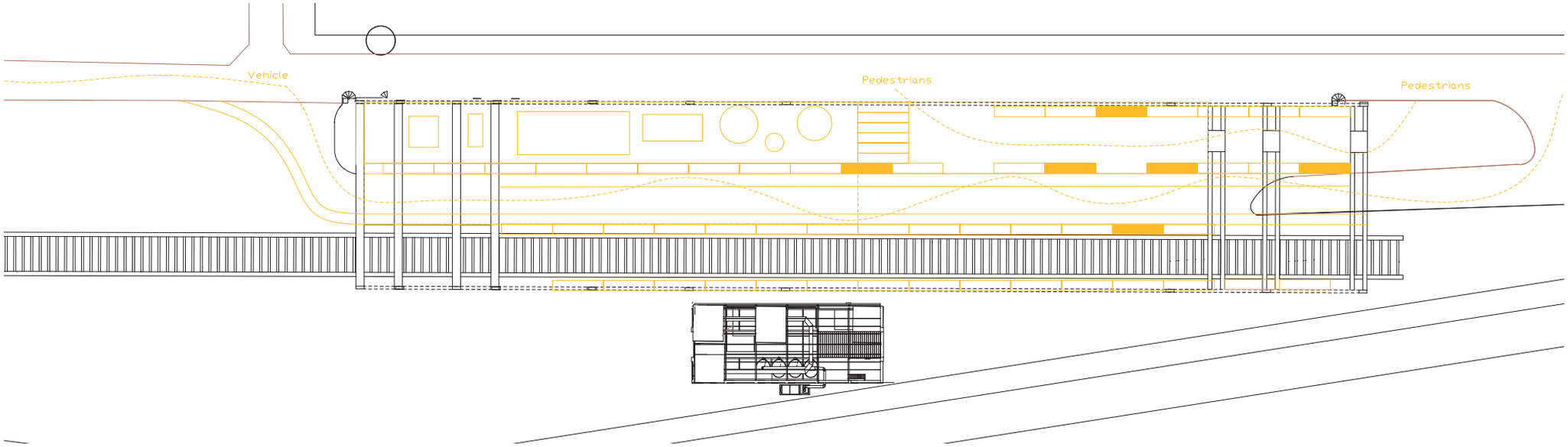
To be raw material

L3+L4

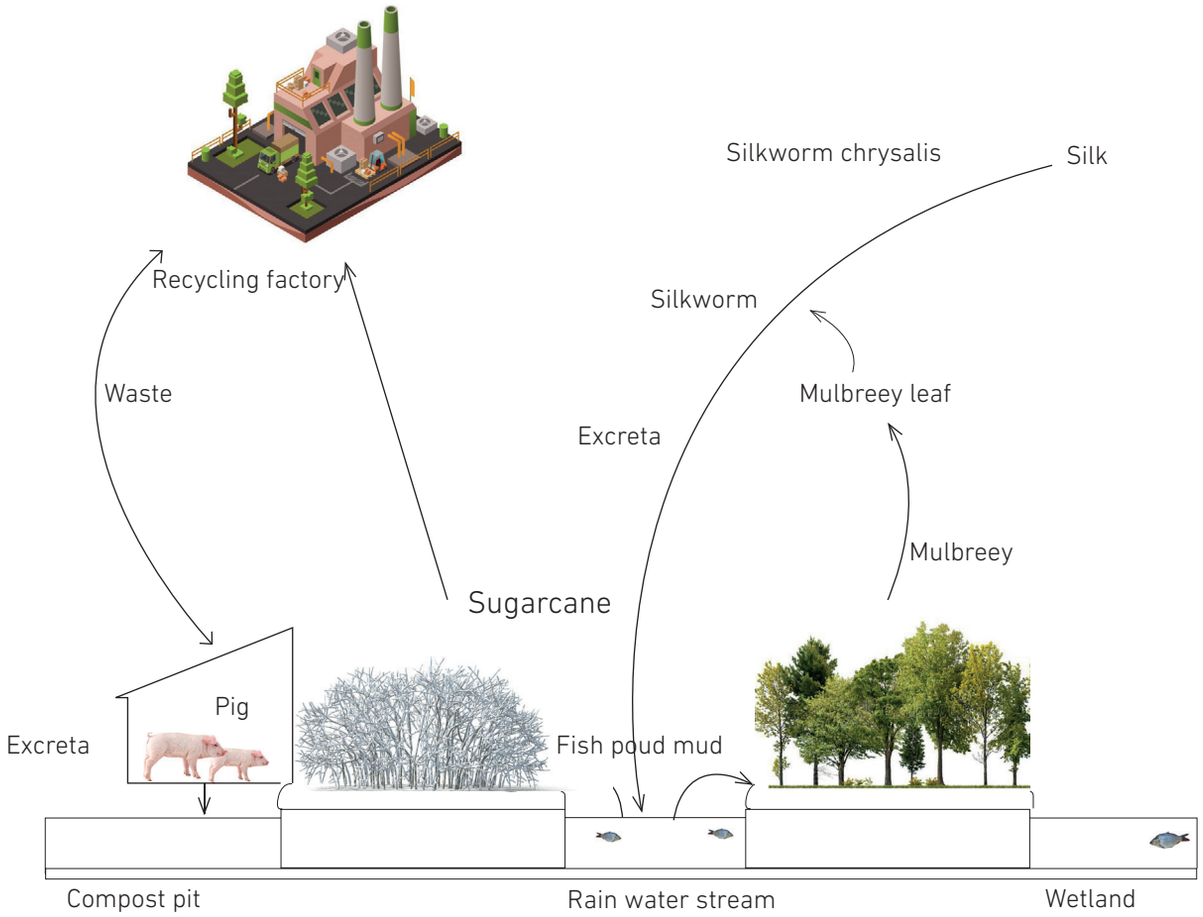


Original facilities

Added equipment for recycling



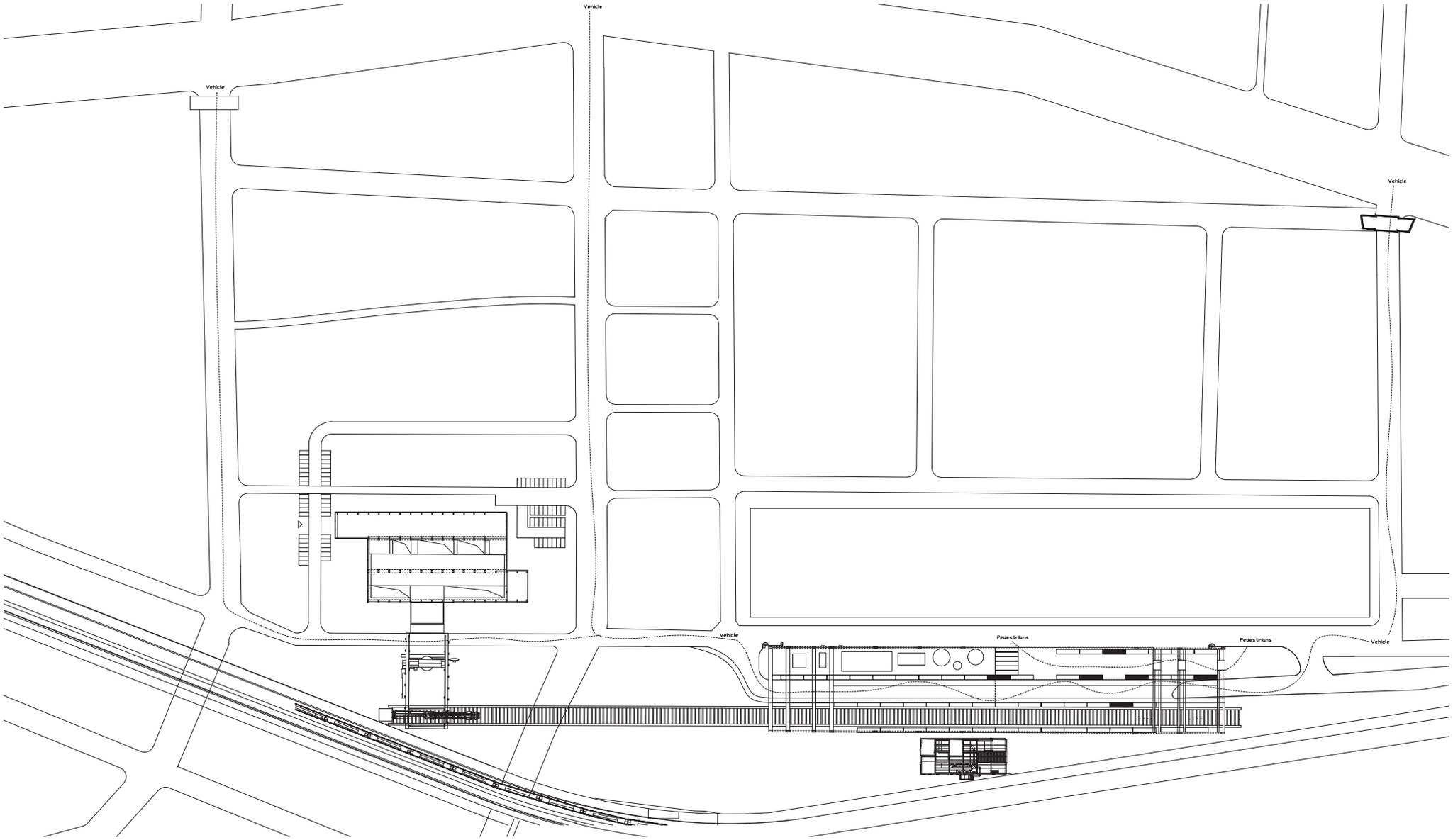
ECO-WASTE CYCLE LAYER

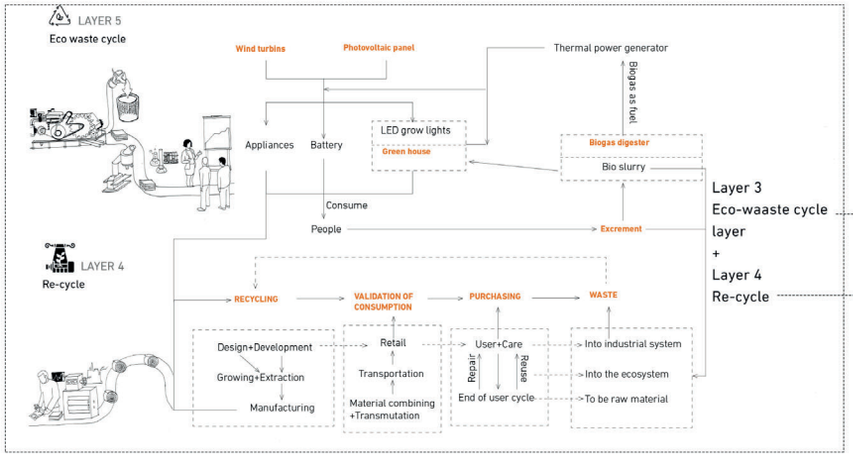


Water and Land Exchange Syste- Sangji Fsih Pond Model

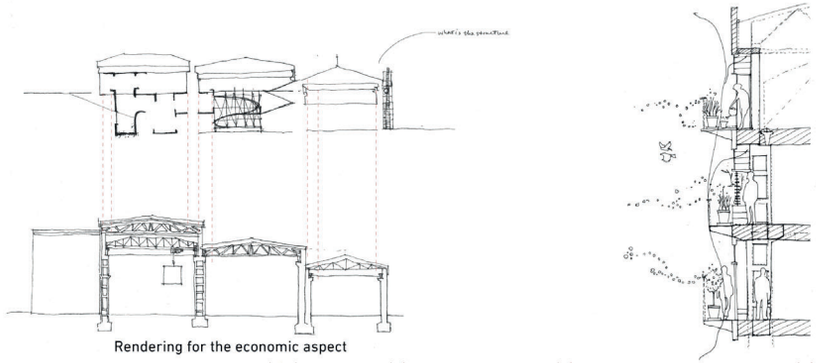
Objectives:

Food
Species habitat
Microclimate
Local air quality
Noise reduction
Binding of carbon and carbon dioxide
Buffer for extreme weather events
Erosion protection and preservation of fertile soil
Wastewater treatment and reduction of storm-water flow
Pollination
Biological pest control
Increased value of real estate
Tourism
Education

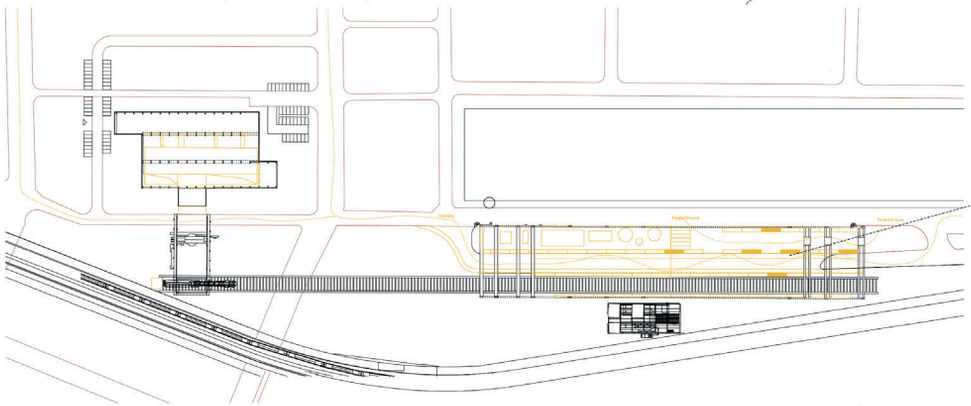

Vehicle
Vehicle
Vehicle
Vehicle
Pedestrians
Pedestrians



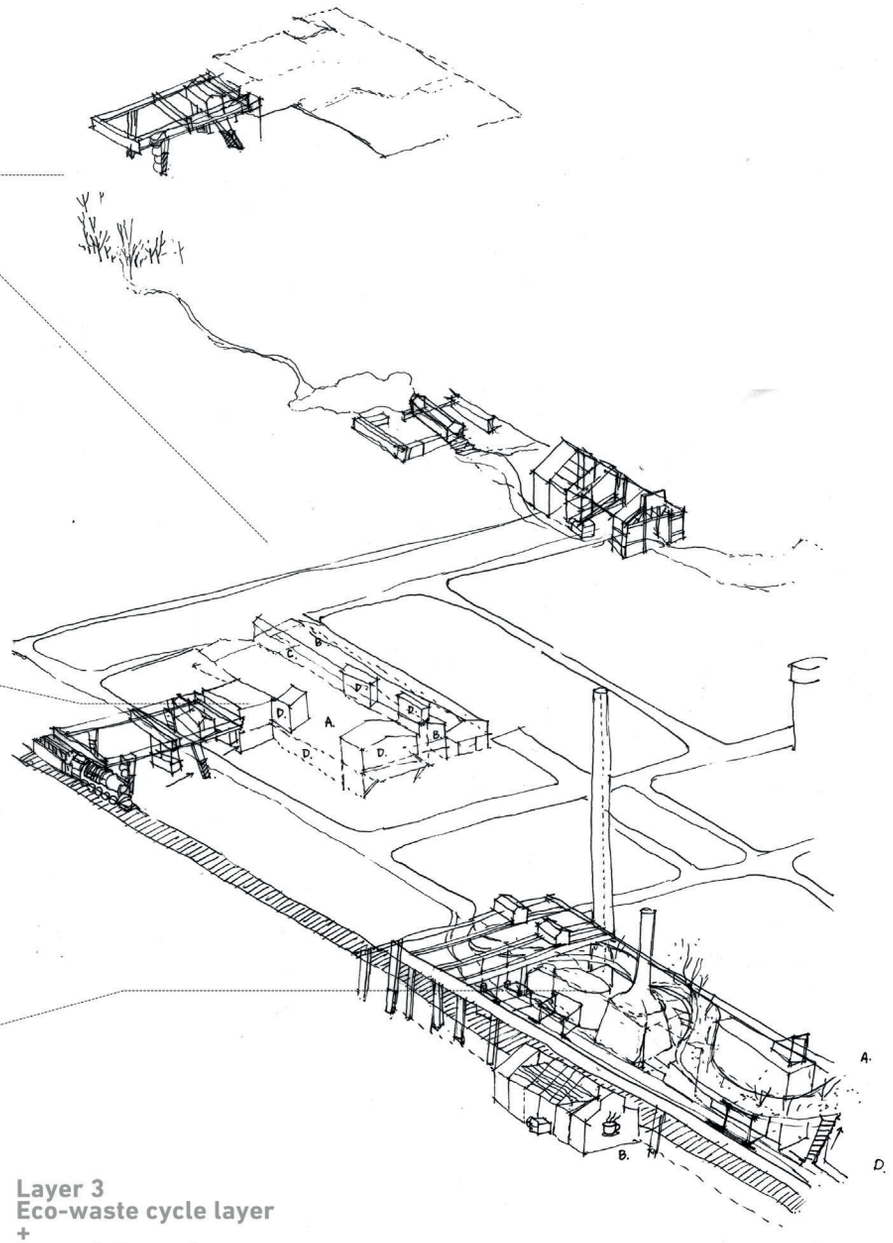
Layer 3
Eco-waaste cycle
layer
+
Layer 4
Re-cycle



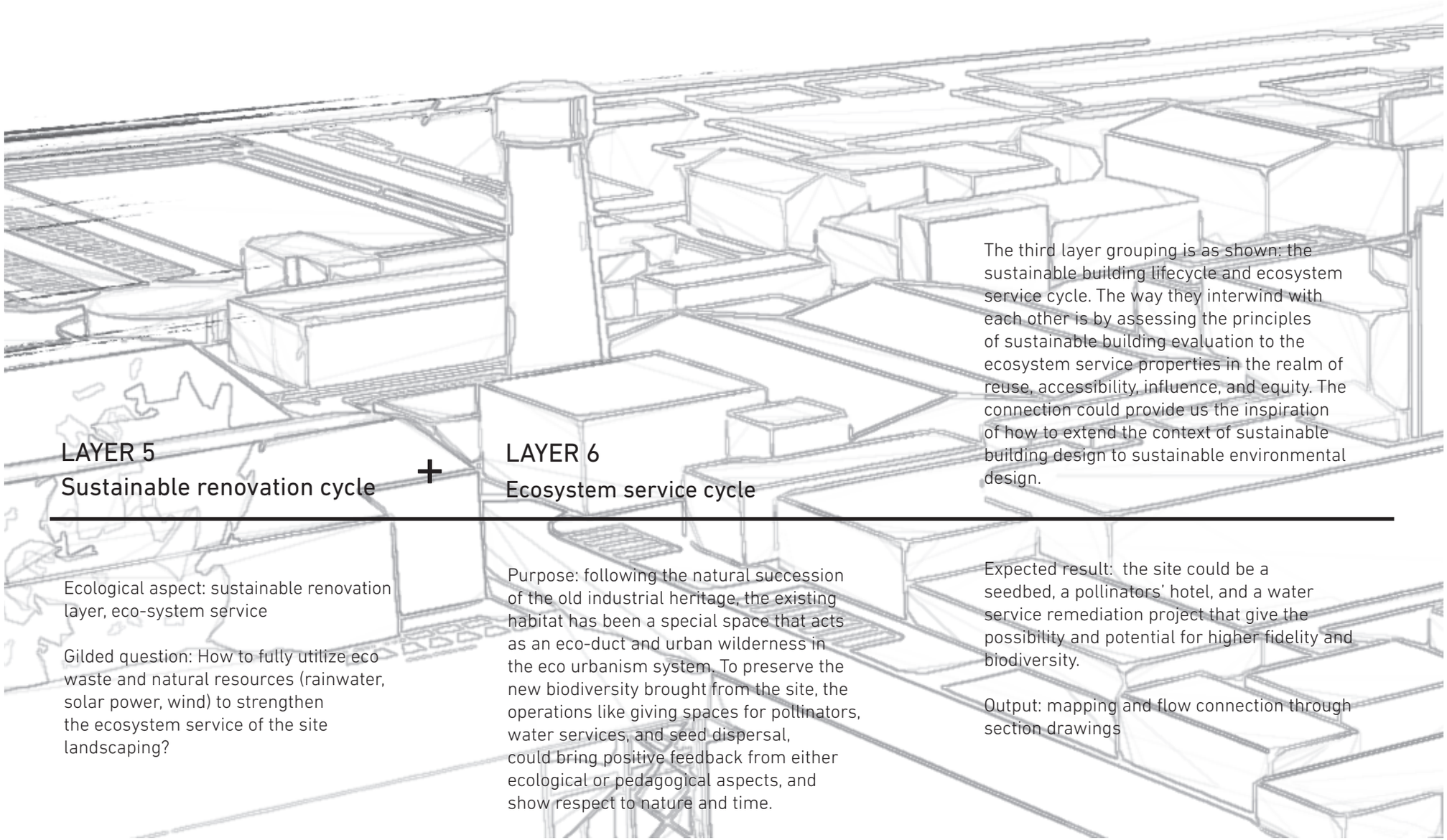
Rendering for the economic aspect



Rendering for the economic aspect



Layer 3
Eco-waste cycle layer
+
Layer 4 Re-cycle



LAYER 5
Sustainable renovation cycle

+

LAYER 6
Ecosystem service cycle

The third layer grouping is as shown: the sustainable building lifecycle and ecosystem service cycle. The way they interwind with each other is by assessing the principles of sustainable building evaluation to the ecosystem service properties in the realm of reuse, accessibility, influence, and equity. The connection could provide us the inspiration of how to extend the context of sustainable building design to sustainable environmental design.

Ecological aspect: sustainable renovation layer, eco-system service

Gilded question: How to fully utilize eco waste and natural resources (rainwater, solar power, wind) to strengthen the ecosystem service of the site landscaping?

Purpose: following the natural succession of the old industrial heritage, the existing habitat has been a special space that acts as an eco-duct and urban wilderness in the eco urbanism system. To preserve the new biodiversity brought from the site, the operations like giving spaces for pollinators, water services, and seed dispersal, could bring positive feedback from either ecological or pedagogical aspects, and show respect to nature and time.

Expected result: the site could be a seedbed, a pollinators' hotel, and a water service remediation project that give the possibility and potential for higher fidelity and biodiversity.

Output: mapping and flow connection through section drawings

LAYER 5
Sustainable renovation cycle

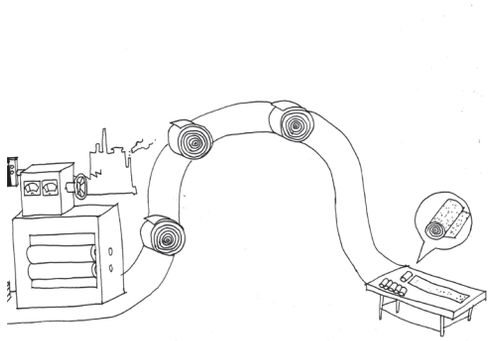
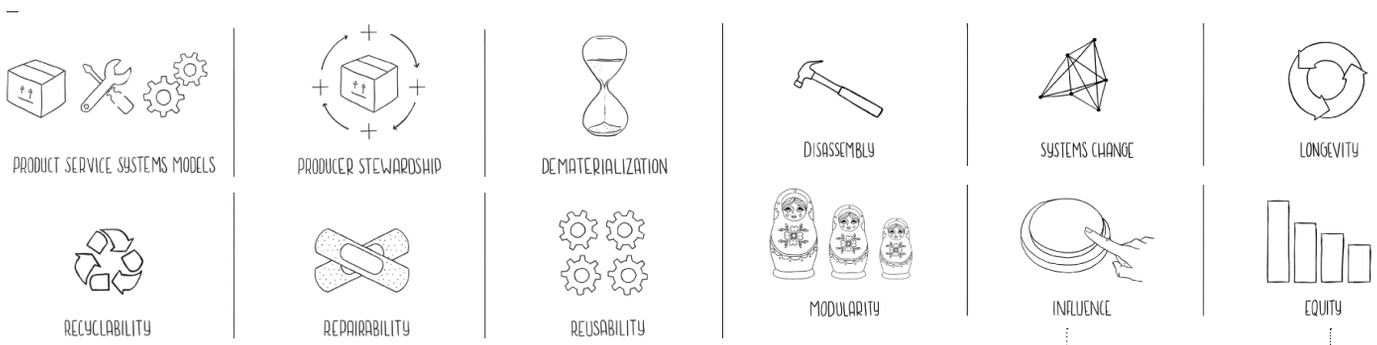


Fig. Sustainable design strategies
retrieved from: https://medium.com/disruptive-design/quick-guide-to-sustainable-design-strategies-641765a86fb8



LAYER 6
Ecosystem service cycle

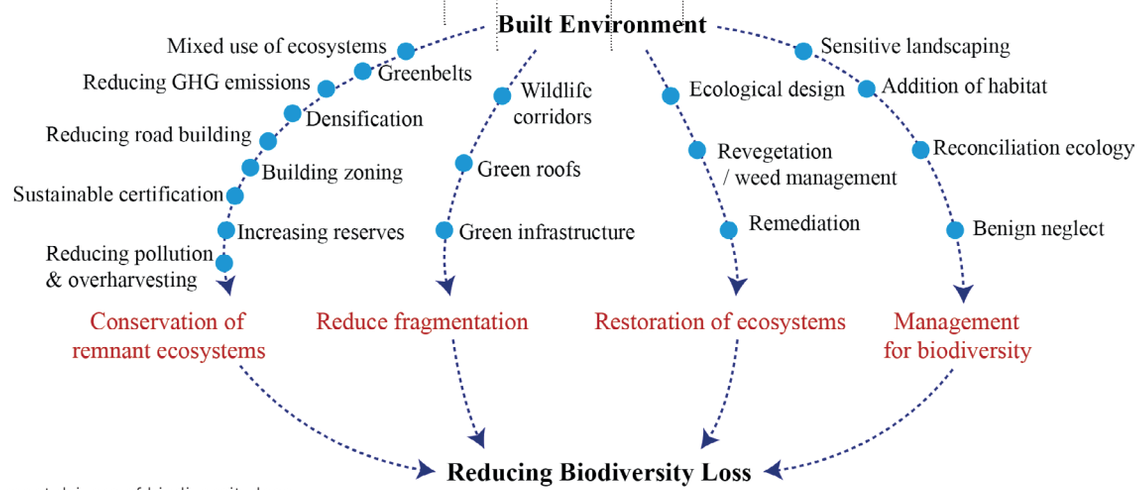
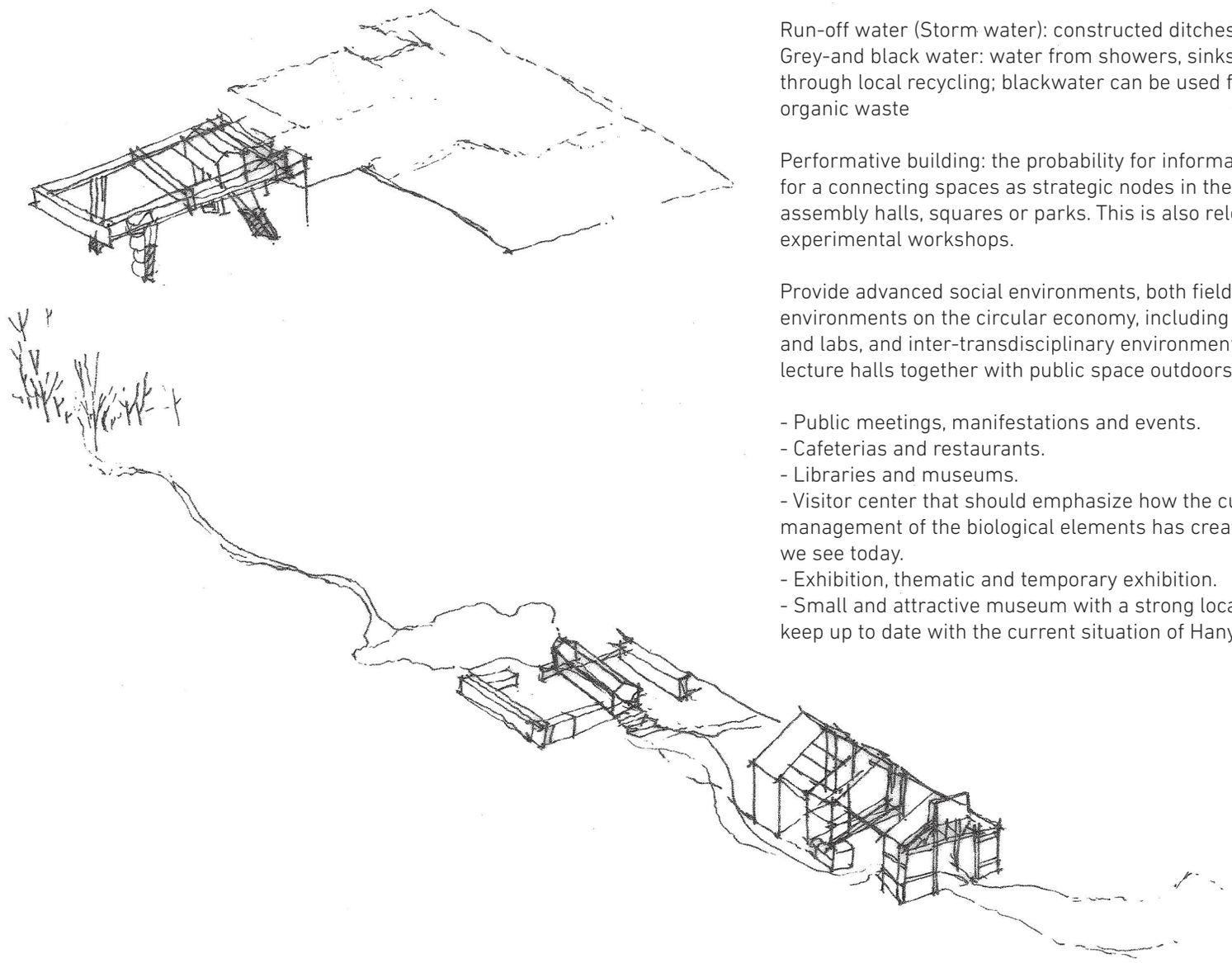


Fig. Built environment drivers of biodiversity loss.
retrieved from: Maibritt Pedersen Zari, "Ecosystem Services Analysis in Response to Biodiversity Loss Caused by the Built Environment", S.A.P.I.EN.S [Online], 7.1 | 2014, Online since 12 November 2014, connection on 26 April 2021. URL: http://journals.openedition.org/sapiens/1684

L5+L6

ECOSYSTEM SERVICE LAYER



Water service:

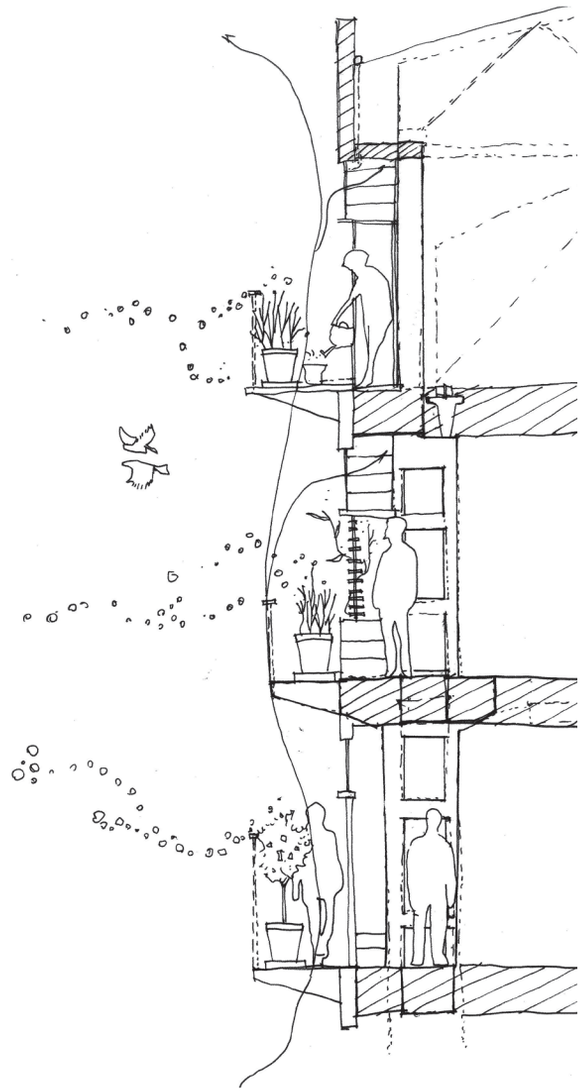
Run-off water (Storm water): constructed ditches/wetland
Grey-and black water: water from showers, sinks and kitchens(greywater) through local recycling; blackwater can be used for biogas together with organic waste

Performative building: the probability for informal meetings could be added for a connecting spaces as strategic nodes in the spatial network: cafeterias, assembly halls, squares or parks. This is also relevant to laboratories and experimental workshops.

Provide advanced social environments, both field of specific research environments on the circular economy, including departments, incubators and labs, and inter-transdisciplinary environments like foyers, cafeterias and lecture halls together with public space outdoors or in-between.

- Public meetings, manifestations and events.
- Cafeterias and restaurants.
- Libraries and museums.
- Visitor center that should emphasize how the cultivation and waste management of the biological elements has created the unique environment we see today.
- Exhibition, thematic and temporary exhibition.
- Small and attractive museum with a strong local connections that we could keep up to date with the current situation of Hanyang Iron works.

ECO-WASTE CYCLE LAYER



Purpose:

- For building: offer extra insulation, wind break and reduce temperature fluctuations.
- Reduce the need for heating and cooling during extreme weather during winter and summer.
- Improve air quality.

Performative buildings Green roofs could be designed to offer nesting sites for wild bees. South facing brownfields, in this case, exposed gravel and sand, are potential nesting sites for many species of wild bees, some of them red-listed. Vegetation on the roofs, especially of flowering perennials like shrubby cinquefoil and orpine, could facilitate movement and offer foraging. Flowering plants on walls and roofs promote pollination. Putting up hollow sticks (e.g. short bamboo sticks) on the walls supply nesting sites for many wild bees. An uneven wall surface also acts as a wind break, creating lee zones closest to the climate shell and thus reducing the need for heating inside the building. Sunny yards should have a continuity of flowering shrubs and plants, as well as vegetables, fruits and berries requiring pollination (e.g. squash raspberry and apples)(Barthel, 2013).

LAYER 3
Sustainable renovation cycle

Fig Sustainable design strategies
retrieved from: https://medium.com/disruptive-design/quick-guide-to-sustainable-design-strategies-641765a86fb8

LAYER 6
Ecosystem service cycle

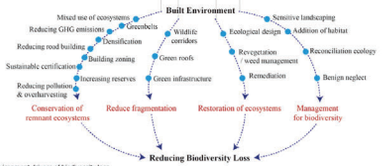
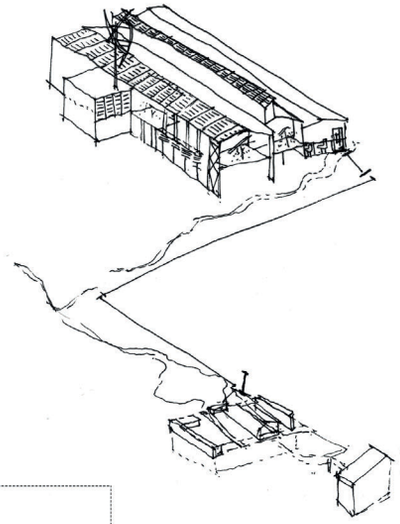


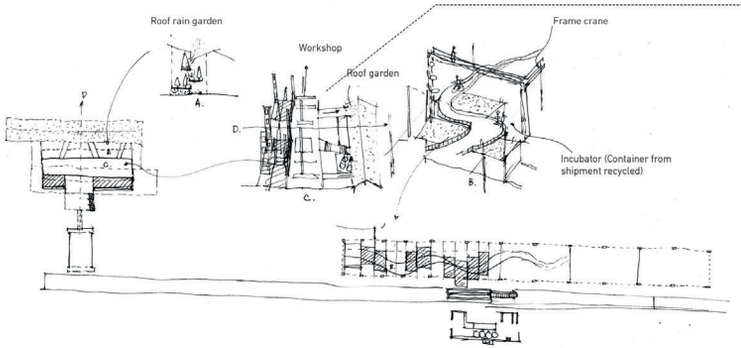
Fig Built environment drivers of biodiversity loss,
retrieved from: Maibritt Pedersen Zari, "Ecosystem Services Analysis in Response to Biodiversity Loss Caused by the Built Environment", S.A.P.I.EN.S [Online], 7.1 | 2014, Online since 12 November 2014, connection on 26 April 2021. URL: http://journals.openedition.org/sapiens/1484

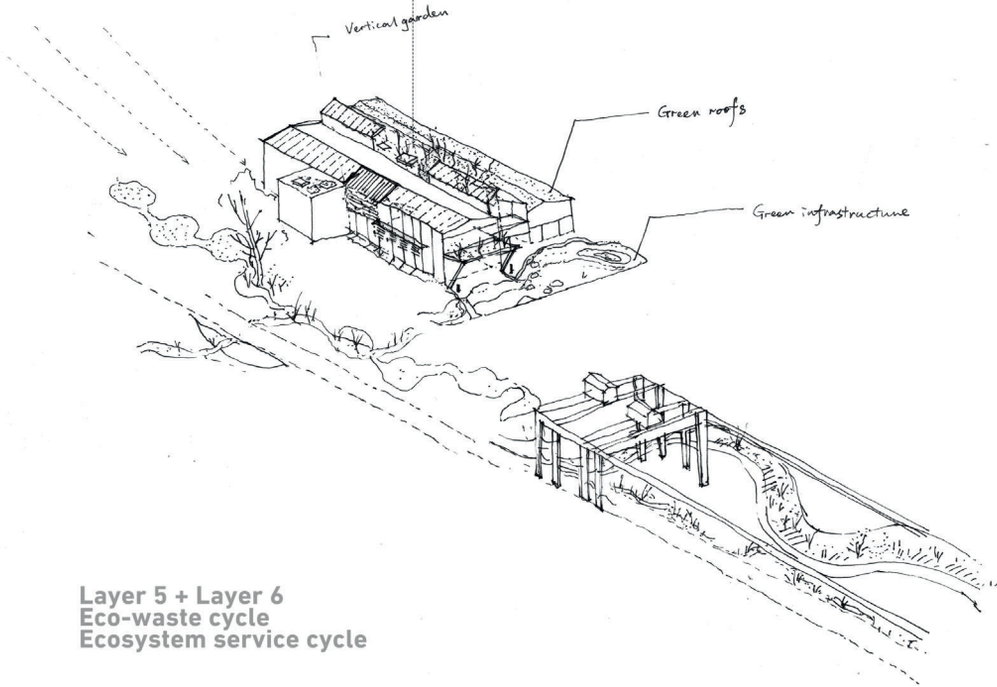
Layer 5
Sustainable ren-
ovation cycle
layer

Layer 6
Ecosystem service layer



DESIGN ATTEMPT

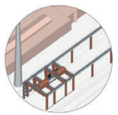




Vison for ecological succession

Spare field

Train and Railway



Frame crane

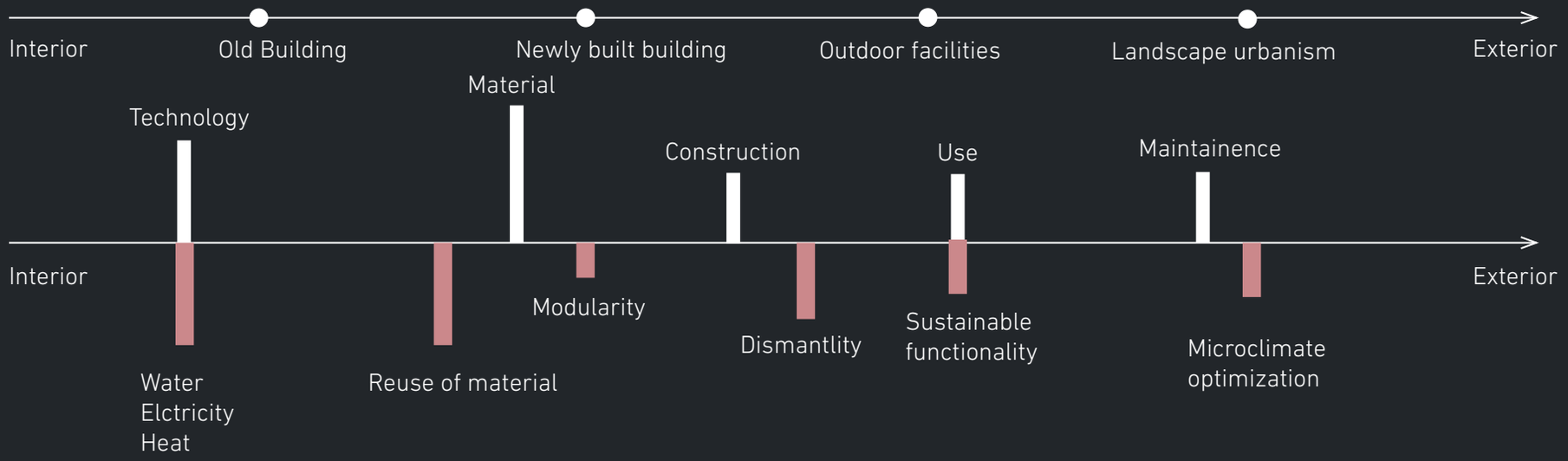
Abandoned warehouse

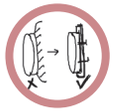
Frame crane

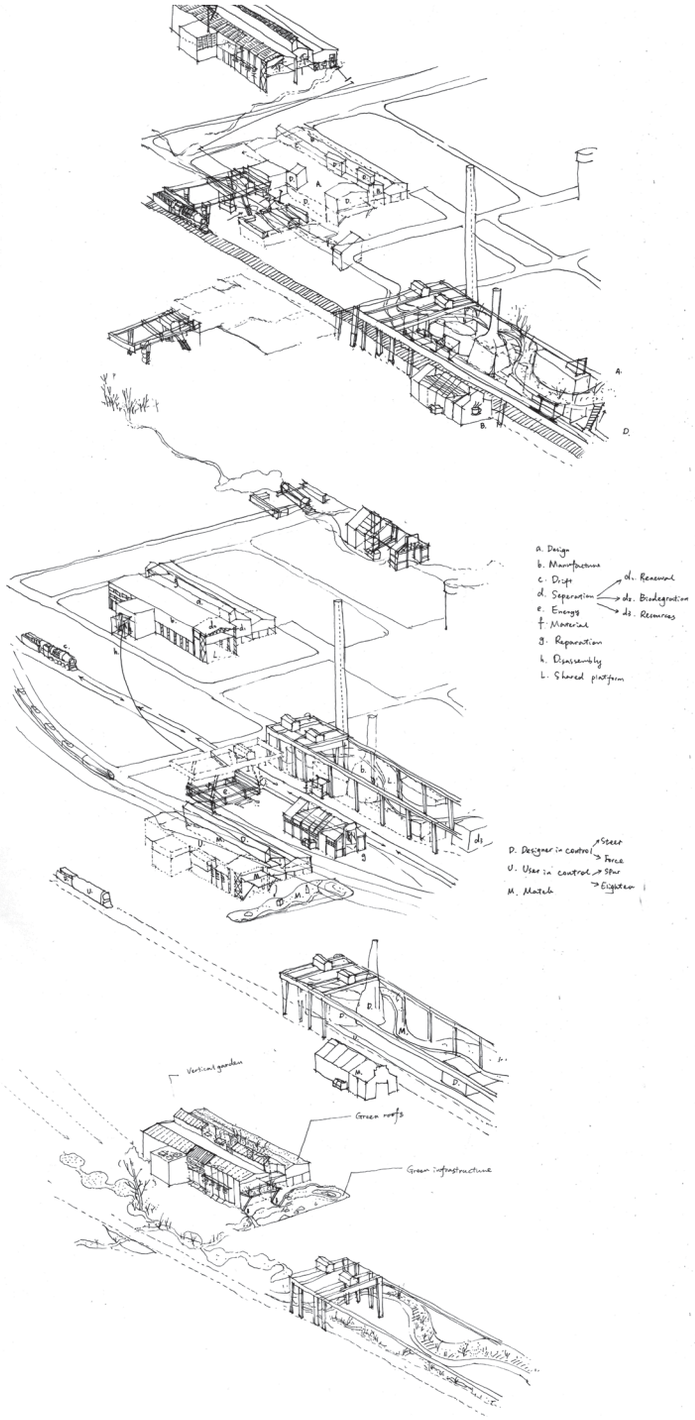
Gate crane

Layer 5 + Layer 6
Eco-waste cycle
Ecosystem service cycle

EVALUATION
Zero emission architectural model



	Old Building		Newly built building		Outdoor facilities		Landscape urbanism		Exterior	
	WATER ELCTRICITY		REUSE OF MATERIAL		MODULARITY DISMANTLITY		SUSTAINABLE FUNCTIONALITY		MICROCLIMATE OPTIMIZATION	
TECHNOLOGY	Understand the machanism and component of the original facilities and make full use of them **circularly**.	 Machanism	Avoid binders, but if necessary, use binders that are dissolvable.	 Dissolvable	To accurate the use of dismantable conjunction details, the slab could be easier reused,	 Disassembly	Appropriate new function for old facilities and structure for reuse and **pedagogy.**	 Appropriation	The integration of techs with natural resources like solar energy and rain water to circulate a flow.	 Natural
CONSTRUCTION	Re-introduce traditional daylight, ventilation and heating system for **awareness.**	 Craft	Study about the machanical joints for easy assembly and disassembly, and start to refactor.	 Refactor	Create a component when the composition of elements become too complex to handle.	 Component	Regard the 'museum' as the life-cycle records of the building.	 Records	When the rain water drainage exposed on the ground, it could nutrient the eco-system service with biodiversity.	 Biodiversity
MATERIAL	Adding new flows from the reuse of facilities and cleaner energy for **pedagogical** purpose.	 Synergy	Reuse the material on the site and transformed to be new form in the renovation project.	 Reuse	To make each panel module, the manufacture of the material could be more organized and re-structured.	 State	The material that has been recycled could be manufactured to be different side-product to enrich the system.	 Side-product	The building stock is as material bank to provide new composition to a new-built building with context.	 Compose
USE	Adding new flows from the reuse of facilities and cleaner energy for **pedagogical** purpose.	 Bio-waste	The reuse and re-positioning if existing facilities on the site is essential to introduce new functionality.	 Re-position	The material could be easier to be transformed and repaired by the techs of prefabrication.	 Prefabrication	Clearer waste management requires a sorting signal to inform and educate about the benefits of recycling.	 Signal	The placement of landscape infratructure is to build share platform between nature and human.	 Share
MAINTAINENCE	Establish repair office with familiar works on the site **circularly**.	 Repairation	To circulate the material upcycling could be a positive factor.	 Upcycle	The replacement of material that could be made on site.	 On-site	The interaction mode could be more benefical to strenghthen publicity.	 Interaction	The wetland by rainwater provides new biodiversity.	 Biodiversity



	Old Building		Newly built building		Outdoor facilities		Landscape urbanism		Exterior	
	WATER ELCTRICITY		REUSE OF MATERIAL		MODULARITY DISMANTLITY		SUSTAINABLE FUNCTIONALITY		MICROCLIMATE OPTIMIZATION	
TECHNOLOGY	Understand the machanism and component of the original facilities and make full use of them **circularly**.	Machanism	Avoid binders, but if necessary, use binders that are dissolvable.	Dissolvable	To accurate the use of dismantable conjunction details, the slab could be easier reused,	Disassembly	Appropriate new function for old facilities and structure for reuse and **pedagogy.**	Appropriation	The integration of techs with natural resources like solar energy and rain water to circulate a flow.	Natural
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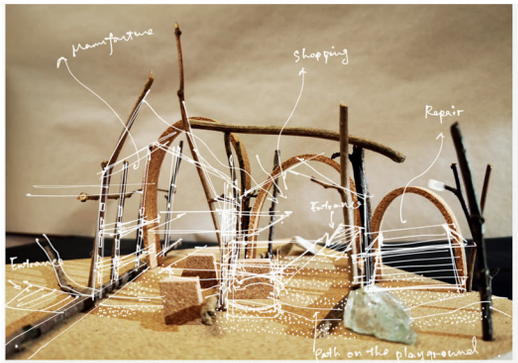
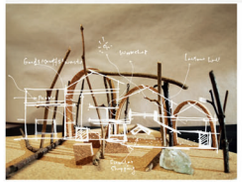
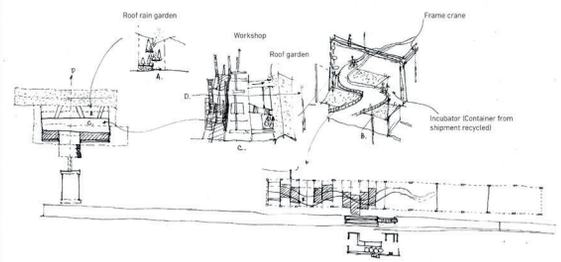
MAINTAINENCE	Establish repair office with familiar works on the site **circularly**.	Repairation	To circulate the material upcycling could be a positive factor.	Upcycle	The replacement of material that could be made on site.	On-site	The interaction mode could be more benefical to strenghthen publicity.	Interaction	The wetland by rainwater provides new biodiversity.	Biodiversity

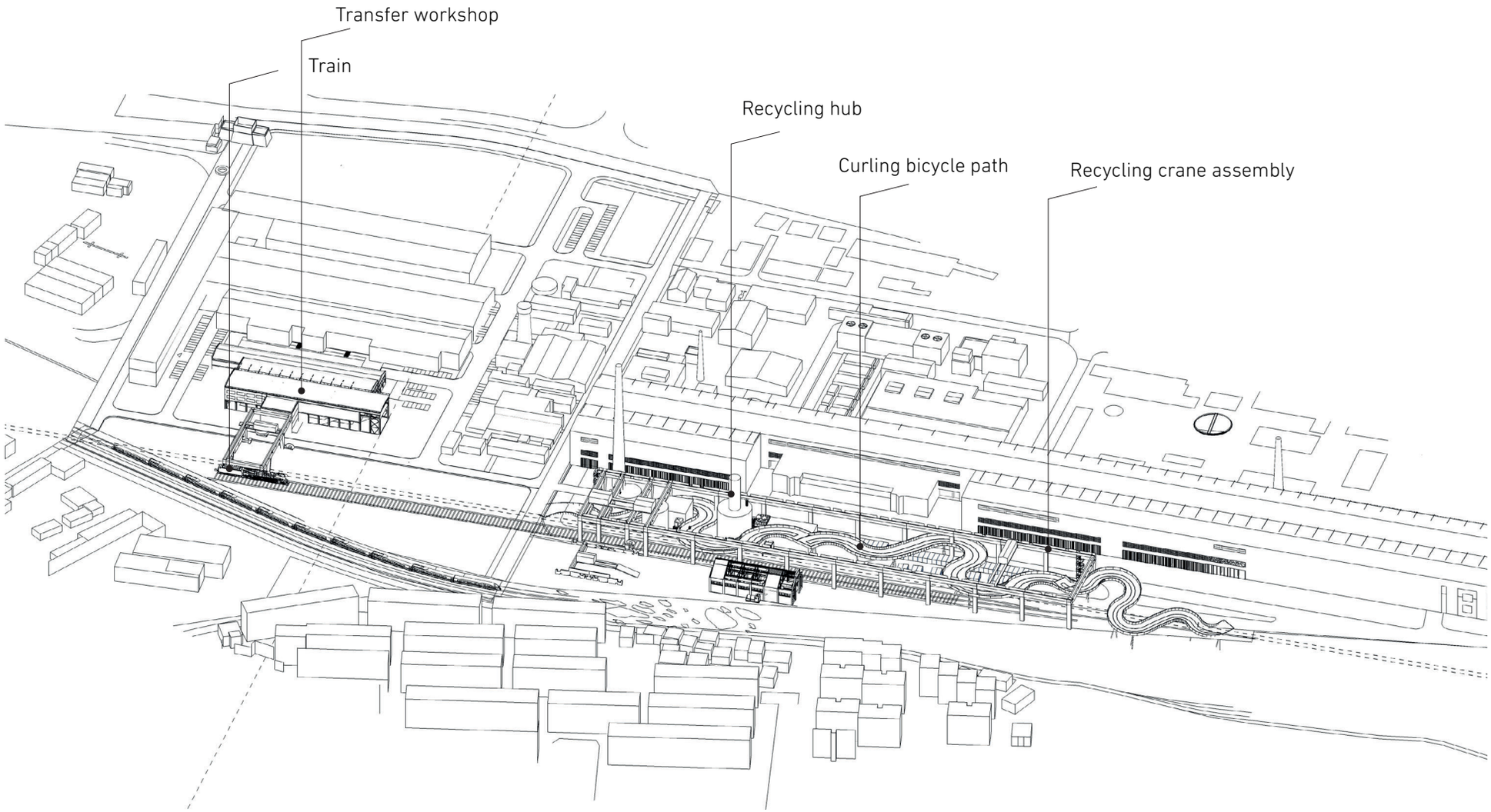




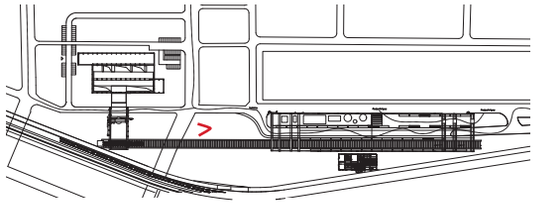
DESIGN ATTEMPT



IV DESIGN PHASE: TRANSLATION & EXPERIMENT

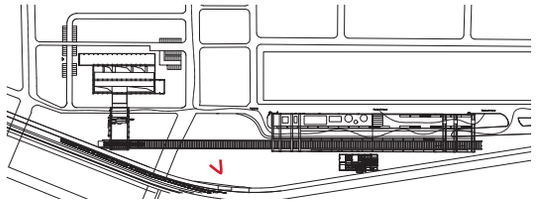


Line drawing of the final design bird-view perspective
The curling bicycle path is across the frame crane to set a sky corridor to have a view of the recycling hub and the surrounding landscaping. Under the sky corridor is the garbage and goods collecting and sorting space, along with the incubators that have transformed from the upcycled material on the site. The trail is set as a conveyor belt to take the round trip from the transfer workshop to the recycling crane assembly. It has dynamic accessibility and flexibility while the functionality and spatial configuration of thesis architectural components change along with the moving train.

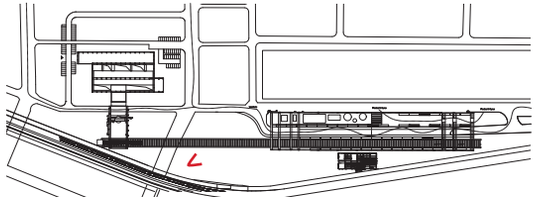


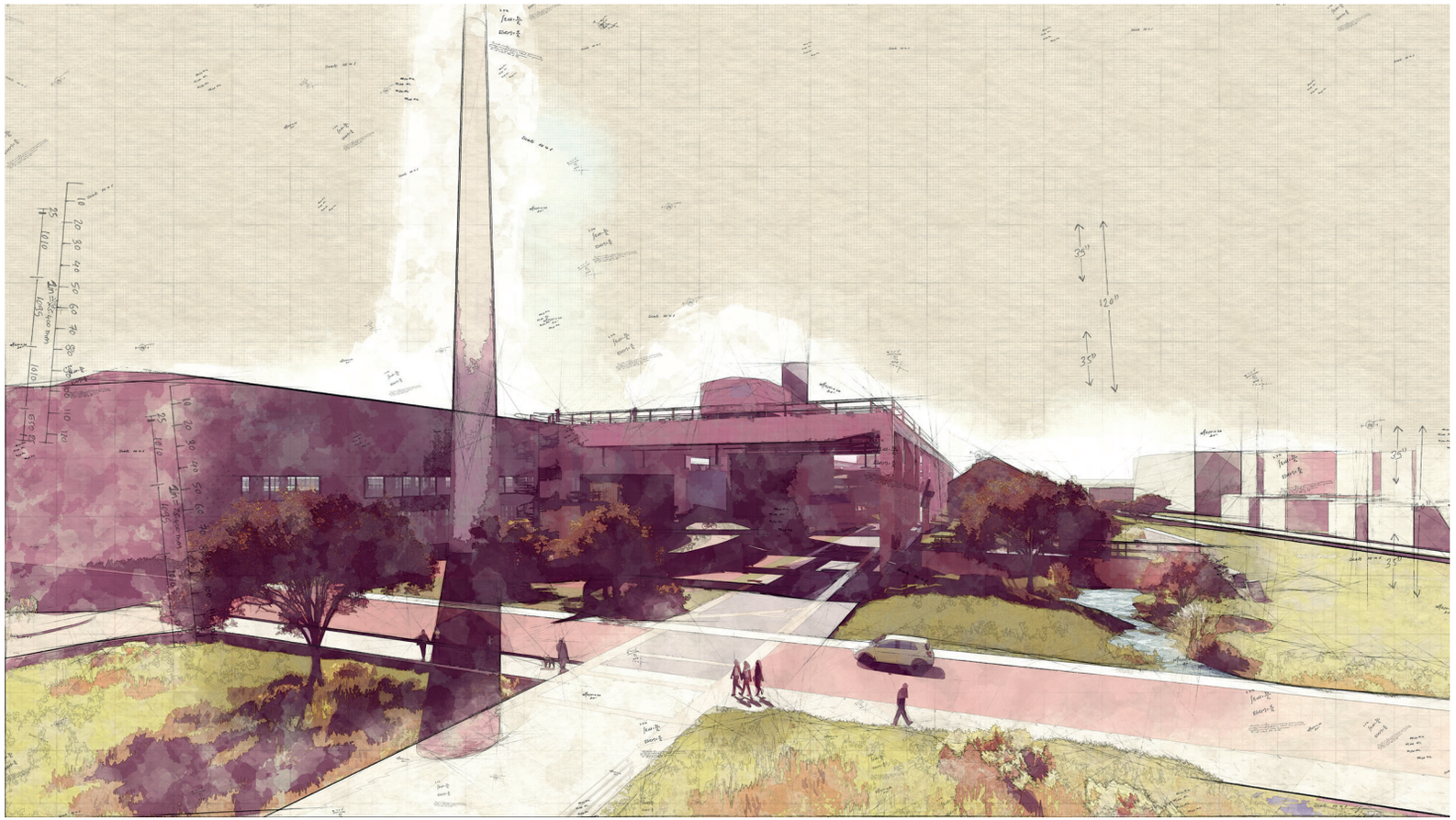
From the meadow to see the gate crane as the entrance of the transfer workshop

The view has captured the moment the train arriving at the gate crane, where it could unload the goods and staffs to the workshop. The visitors will climb up to the third floor of the workshop, while the goods and materials will be sent to the ground floor waiting for re-manufacturing and artistic processing.

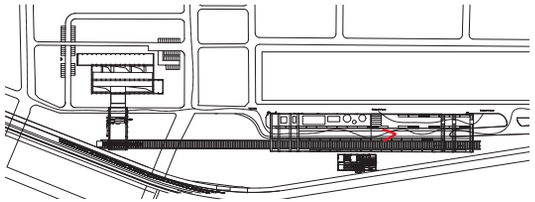


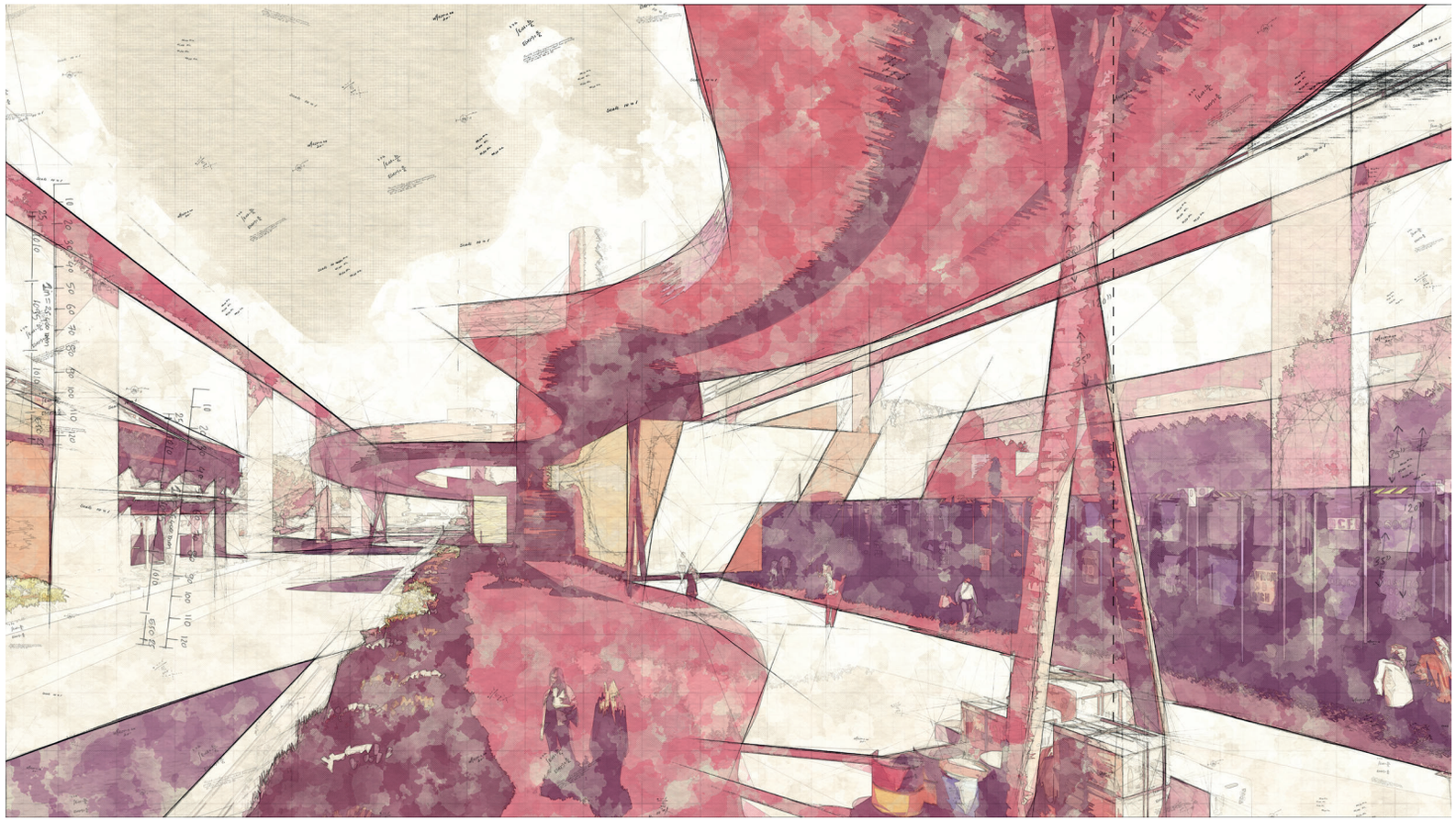
The wetland collecting rainwater from the rooftop, rain-interior garden, running surface stream as a purification pond
This scene shows the seasonal changes while the monsoon weather would come with a rainstorm, the rainwater on the site is sponged in the green foliage of the site to converge into the wetland area. The wetland is to alter the drainage pipe underneath the ground and expose to increase the ecosystem service function for increasing both biodiversity and landscape richness.





The round trip to the recycling hub and recycling crane assembly from the transfer workshop by train
The frame crane is transformed into a recycling assembly consists of a recycling hub with an exposed upcycling process, collecting and sorting hub, incubators, and a sky corridor for bicycles and pedestrains who have finished recycling to take a stroll into visiting the hub. The intention to create the diversion of people is to create a more interactive atmosphere for visualizing and collaborate in the recycling process.





Underneath the bicycle sky corridor are the recycling assemblies for incubators and garbage sorting
The curling bicycle cast a good shade on the ground which provides a dynamic lighting environment to share and interact within the recycling assembly. On the side is the railway trail to cooperate with the weight lifting facilities of the crane to move goods and containers. People could enjoy the recycling process and take few steps up to the sky corridor to take the tour to the recycling hub and join in the pedagogical space of the open upcycling facilities.

DISCUSSION

Architecture follows landscape

It has been a long journey since I choose forest typology as the primary tool to understand the complex system in the built environment. The landscape's vertical layering and flat terrain deepen my understanding of the ecosystem, whether it's for an ecological or architectural world. So from this on, as an architect, I could not hold my thought back to exceed the context of the building itself and see architecture as part of the landscape's ecosystem.

When we use the word "follow," we would quickly remind ourselves of the famous motto "architecture follows function" from Louis Henri Sullivan. However, we could say the landscape is to manifest that it is no longer just the accessory of building. The boundary of the indoor and outdoor has immersed and disappeared permanently. The landscape has been limited largely by the unpredictable climate and terrain, but added more wilderness and uncertainty on the other hand. As human beings, we live in houses for privacy and safety. Gradually, every dwelling and public space turns to be the same of priorities that diminish our feeling of uncertainty and wilderness.

If we could stand on the ground of the roughness of the industrial remnant at this moment, we would like to be more pedagogical for awakening people of not only those glory of the times passed, but also a concern for the environment, and the empathy for the fate of mankind, we do need to reconsider the value of the wilderness and uncertainty. My answer will be to break down the boundary of the ruined wall and wild meadow, to extend and eventually mold those into one.

The working site of my choice has the tracks of a rough but wild ecological succession that has came and gone, as seen on the rust of the existing facilities. To make the building part of the larger discourse of the urban ecosystem, we would need to create more spaces for nature in the building. In particular, this could be achieved by adding a green roof and façade, cantilevered greenhouse, and interior rainwater garden; exposing the rain drainage to be a stream inside the building; and extend it to the outdoor landscape. Architecture could be the reverse extension of nature, as it has been captive just for the time without humans.

Ecological circularity

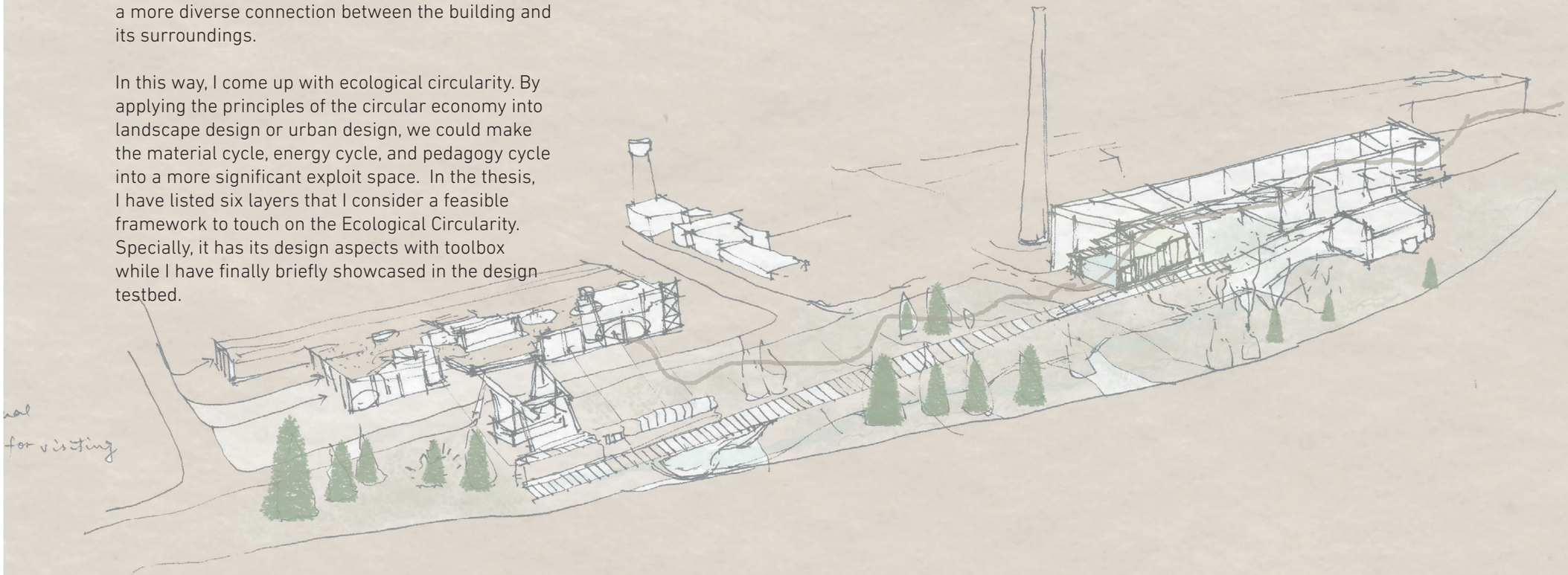
The circularity highlighted in the economic aspect has been focusing on real estate development, especially the building itself. There are many principles to mention, like disassembly, modularity, and longevity across the life span of the building. However, the circular economy has more context than just looking into the life span and sustainability of the building design tactics, but circularly, to landscape, even ecosystem scope. Nature has told us how to be circular. The plants get nutrients and eventually turns into spring mud for the next generation. The building is like a tree that could not be separated from the natural elements nearby, but it connects to every pulse, every movement following the change of seasons like the landscape itself. Architecture deserves the freedom of breathing, like how our human beings are symbiosis with buildings that we are fused and combined with. The natural elements that have been separated by the façade of the building are in call of taking back and let rainwater, sunshine, and wind come again.

Especially in the climate of subtropical monsoon in Wuhan, the urgent demand has been proved by the long tradition of patio and overhead layer in the wooden framework in the traditional designs. However, with the advancement in technologies, lots of effort has been put forward to make people feel convenient. In contrast, the natural, passive, and symbiosis with nature and surrounding have been ripped apart and dismissed altogether. Today, it is time to rethink the meaning of convenience, how

DISCUSSION

strong the feeling has taken us away from other species, other natural existence, and the spirituality of life. The ways we look for better solutions or technics for realizing the interior circularity and making architecture along more self-independent and self-sufficient are not enough. In a way, it needs a more diverse connection between the building and its surroundings.

In this way, I come up with ecological circularity. By applying the principles of the circular economy into landscape design or urban design, we could make the material cycle, energy cycle, and pedagogy cycle into a more significant exploit space. In the thesis, I have listed six layers that I consider a feasible framework to touch on the Ecological Circularity. Specially, it has its design aspects with toolbox while I have finally briefly showcased in the design testbed.



REFLECTION

Design as testbed

The way I mention design as a testbed may sound bold and ambitious. It is my essential understanding and take-away from the process of thesis writing. In the beginning, I consider the design proposal as the results. That puts me down to the tangled situation of whether or not I should focus more on the research part or the design part. At the beginning of thesis writing, they are fragmented. During the later phase, I finally wake up to understand the design is like a translation recording every information we collected from the process, and it is like integration and manifestation. While we research, finding the proper way to align the data and array similar properties while specifying those particular elements that are essential. The way we conduct research is the consequence of how we present our analysis; that is why we need to examine our way of analyzing and mapping the information.

Sketch as manifestation

Sketch has been my tool to perceive the world and express my own feeling for almost 20 years, since the first time I pick up the paintbrush. It is a sensitive, flexible, fragile but versatile tool that could easily follow the mind in real-time. The mind has two thining models; one is divergent thinking, the other is systematic logic linear thinking. The former has been proven to have a closer relationship with creativity, imagination, and joy, which is in the designer's need. I have been exploring many ways to help with divergent thinking, like computation, algorithm, and digital expression; however, they are helpless when I want to find the spark of inspiration. Finally, through the thesis writing, I realize the sketches could be the best spark, exceeding its original meaning of tool and inspiration and spark itself. With pen, and paper, the thoughts hidden and intertwined in mind could be manifested and developed. So, as an experimental expression, I tried to write and draw every graph of design proposals as sketches from my hand and heart. It has been of great help to help me reach out to reality and liberate my thoughts and imagination.

Self-acceptance brings with creativity

It is an ongoing reflection, for myself and for everyone and every moment that inspire me constantly. The writing process has witnessed the resilience of my self growing and the project systematic context. Though I have tackled so many incidents like surgery and tears after that, I have regained my capacity of production with the encouragement from everyone I encountered and every time i reopen the sktches paper, the splendid calmness captured me. The secret, I could write down here is that: do not be afraid of fear, prepare for the worst situation, you will know life has never assured a best result but only expereience that makes you become superior to your previous self.

REFERENCE

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