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RECOURSE SHANGHAI

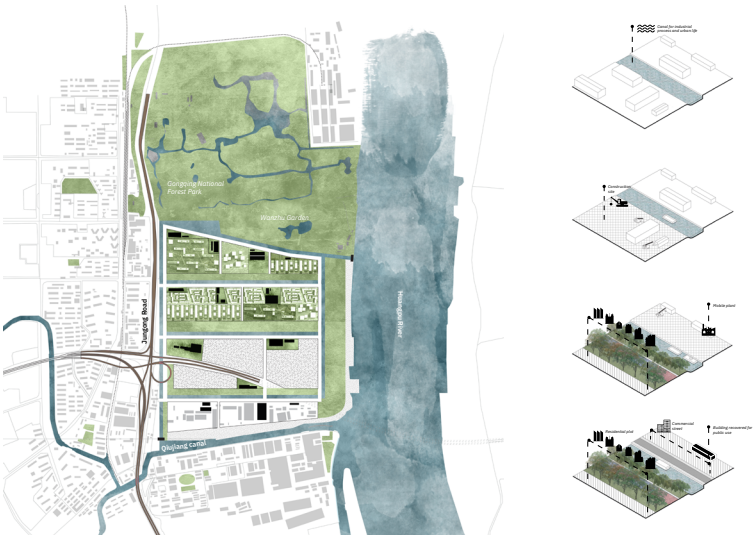
Executive summary

The city of Shanghai is facing a process of drastic urban changes under its master plan Shanghai 2017-2035, with goals such as limiting its population to 25 million, decreasing land area designated to construction, and increasing green areas per capita. One of the main objectives of this Master plan is to turn Shanghai into an Eco-city, setting an example for low-carbon development. Recourse Shanghai is a multidisciplinary project that aims to propose a methodology for the soft regeneration of an urban district in Shanghai, based on onsite recycling of Construction Demolition Waste, considering appropriate processes that reduce CO2 emissions and raw-material exploitation. The regeneration strategy consists in a progressive process not affecting dramatically the everyday life of the city but aiming for a reconnection between nature and urban environment.

The urban design concept consists on applying modularity in a mobile recycling plant, within the km0 methodology, which at the same time adds flexibility in the development of a progressive regeneration, adapting its production rate to the necessity of the project. In this pilot project, an area of study of 150 hectares on the eastern banks of the Huangpu River in Yangpu district has been selected.

The regeneration strategy consists, in a first step, in the development of new waterways for the industrial process, as infrastructure for water transportation of modular floating factories, while later on they will become central elements for the design of linear urban parks, increasing the quality of life and recovering the connection of the city of Shanghai with water. Inside this area, 185.000 m^2 of new canals would be built along with more than 30 hectares of green open spaces, boasting Shanghai as an eco-city and diversifying its cultural identity.

Key Words
Recycling Concrete, Soft Regeneration, Circular Economy, CO2 emissions, Urban Design.



Urban Design Proposal Masterplan and Axonometric Graphics of the plot´s proposal.

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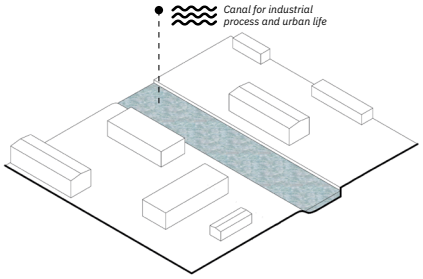
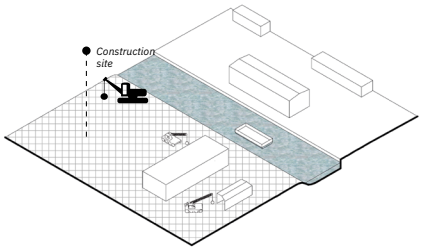
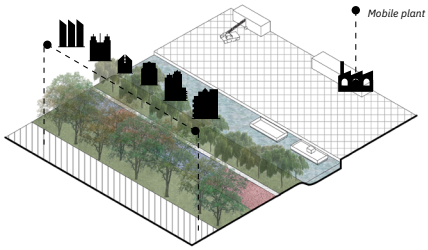
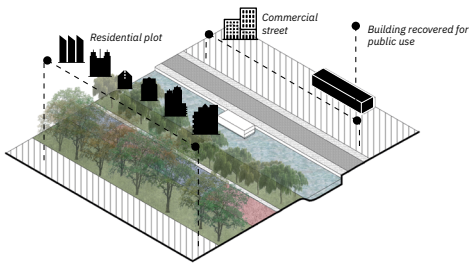
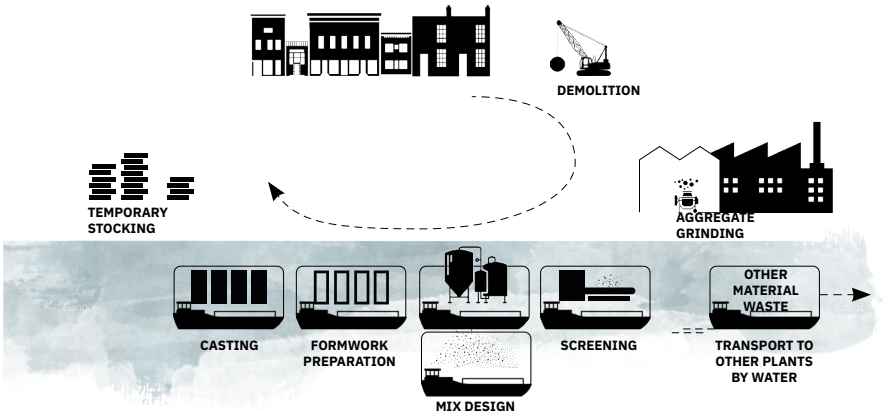


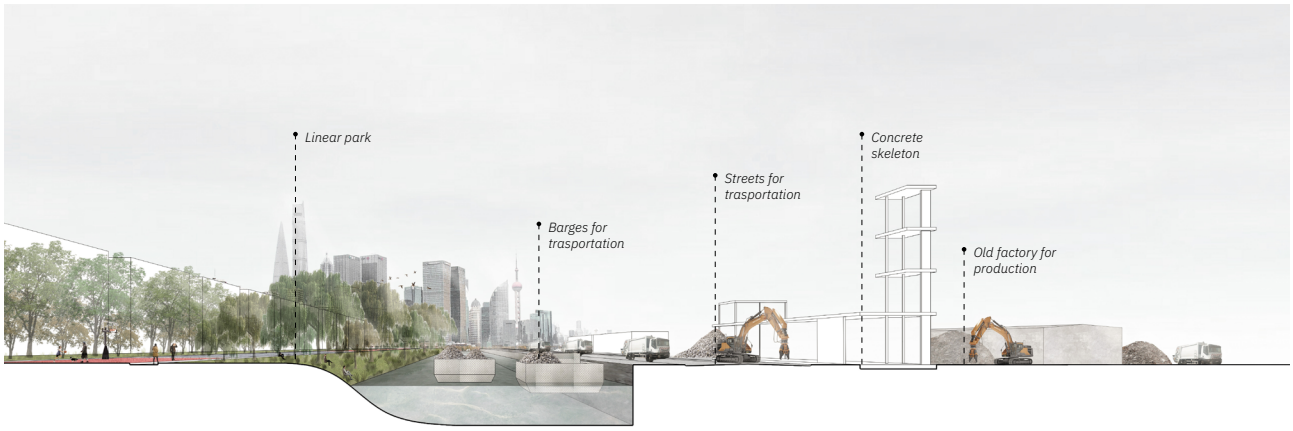


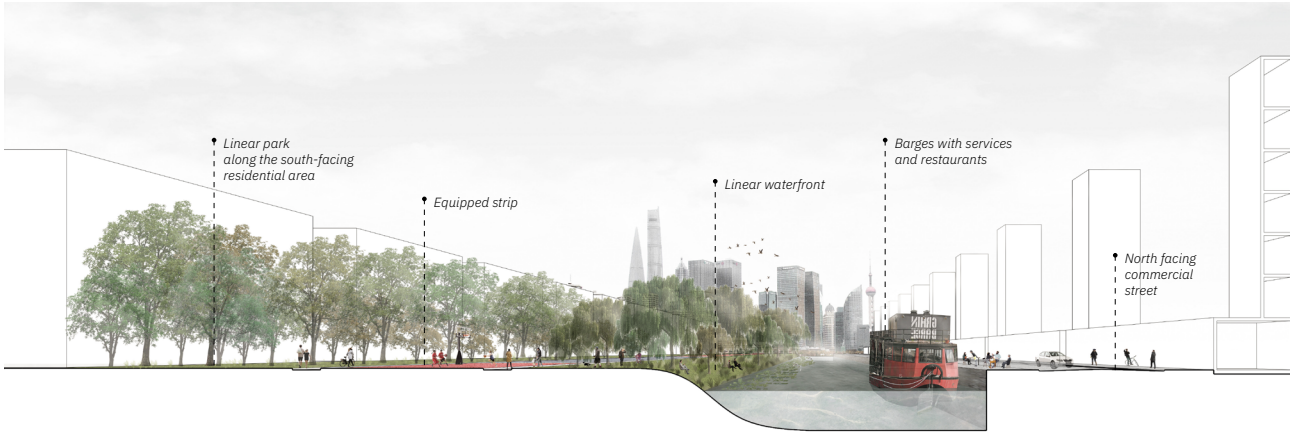




Phases of the Urban Design: New inner canal, Demolition of the buildings, Linear Park, Development of the plot.


DEMOLITION
TEMPORARY STOCKING
AGGREGATE GRINDING
CASTING
FORMWORK PREPARATION
SCREENING
OTHER MATERIAL WASTE
TRANSPORT TO OTHER PLANTS BY WATER
MIX DESIGN


Linear park
Barges for trasportation
Streets for trasportation
Concrete skeleton
Old factory for production


Linear park along the south-facing residential area
Equipped strip
Linear waterfront
Barges with services and restaurants
North facing commercial street

Project description written by the Principal Academic Tutor

The multidisciplinary project was developed according to the "research by design" method: students from different backgrounds actively collaborated addressing an urban vision characterized by soft regeneration tools proposed by the teaching group. The vision of a "soft regeneration" of an urban district in Shanghai is opposed to the current restructuring practices based on the tabula rasa. A progressive substitution strategy is proposed, maintaining some buildings and infrastructures (for reasons of economic opportunity and not only for historical memory). According to this vision, it is also possible to imagine the in-situ maintenance of a part of the population that would be relocated in the new buildings, according to a phasing process, similar to the positive results with the urban restoration interventions of the Italian historical centers in the 1980s -90.

Consistent with this model of intervention, the multidisciplinary project should define a regeneration strategy as a "continuous building site", as an alternative to the strong spatial and temporal discontinuities produced in the demolition reconstruction process routinely used in China. Particular attention was also given to the design of green open spaces, considered as key elements to implement the strategies for urban resilience and sustainability being developed in China. Such strategies are based on a new relationship of the city with its urban waters, as expressed by the government initiative Sponge City program launched in 2015 that aims at a new joining of urban and natural systems, implemented by embedding a continuous network of green areas in the urban organism.

Finally, as demonstrated by Vaclav Smil in his Making the Modern World (Wiley, 2014), China is the largest consumer of cement and concrete in the world. From the viewpoint of environmental preservation and effective utilization of resources, it is beneficial and necessary to reuse waste concrete as recycled concrete aggregate (RCA) for new concrete. In the recent years, intensive researches on this topic have been carried out in Europe, USA, and China. The city of Shanghai in its Master Plan 2016-2035 is proposing the vision of a "more dynamic, more attractive, more sustainable" city, developing pilot projects for "healthy and low carbon way of life". The multidisciplinary project "RECOURSE SHANGHAI" aims to propose a pilot project for the soft regeneration of an urban district of Shanghai, based on in situ recycling of concrete from demolished buildings.

Team description by skill

Alfonso Moya: as a civil engineering, Alfonso participated in the design of the circular process of recycling of concrete, assessing in the detailing of concrete production. Also, he developed the data to estimate the configuration of buildings in Shanghai.

Pierinna Lopez: as an architect with an urbanism background, she did an urban site analysis during the workshop in Shanghai. Also, as specialized in sustainable and landscape architecture, she researched and focused on the design of the urban regeneration of canals of the project.

Giovanni Palmiotto: as an architect specialized in interior design, Giovanni managed the project detailing in terms of determining the design phases and designing the layout, visualization of the project with the developing of masterplan, sections and views. He also handled the final report design.

Ilaria Pugliese : as an urbanist architect, Ilaria worked on the research of the historic connection of Shanghai as a Watertown and She handled the design of the general layout of the project with the master plan, sections and axonometric graphics. She also developed the final presentation of the project video.

Elena Lopes: as a chemical engineer, Elena focused on the estimations of CO2 emissions related to the regeneration process and on the environmental impact of certain processes that are part of the methodology. She also guaranteed the correct coherence of every delivery.

Roberto Calcagno: Roberto supported in the research and design of the circular process specifically related to China and to the project of recycling as a Production and Technological Innovation Engineer. He introduced the principles of modularity and flexibility in the process for economic and environmental benefits

Nicola Gaudiano: as a team controller, Nicola managed expenses and deliveries of the whole project. Also, as a Management Engineer, he helped in the definition of processes for the project, analysis of the stakeholders in depth and in the process of research anddetermining the circular economy design in collaboration with Roberto.

Goal

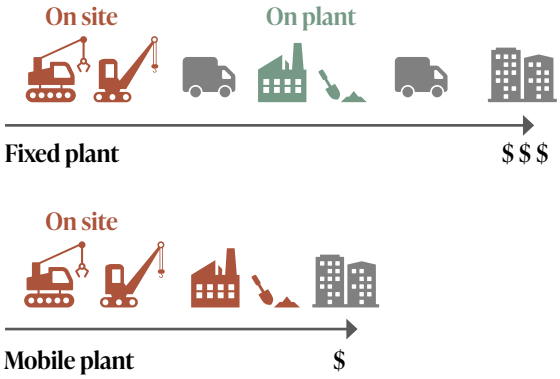
As demonstrated by Vaclav Smil in his Making the Modern World (Wiley, 2014), China is the largest consumer of cement and concrete in the world. From the viewpoint of environmental preservation and effective utilization of resources, it is beneficial and necessary to reuse waste concrete as recycled concrete aggregate (RCA) for new concrete. In the recent years, intensive researches on this topic have been carried out in Europe, USA, and China. The city of Shanghai in its Master Plan 2016-2035 is proposing the vision of a "more dynamic, more attractive, more sustainable" city, developing pilot projects for "healthy and low carbon way of life".
The multidisciplinary project "RECOURSE SHANGHAI" aims to propose a pilot project for the soft regeneration of an urban district of Shanghai, based on in situ recycling of concrete from demolished buildings. The main innovation would be to imagine a process of circular economy based entirely on the transforming neighborhood, eliminating the transport of waste in recycling plants outside the city. In this process of "kilometer zero" self-regeneration, the recycling plant would need to be designed as a leading player: a green and silent factory in the middle of the city, for the production of prefabricated concrete panels, rebirth bricks and blocks as well as structural frameworks. This would be also an answer to a 2017 governmental regulation, that prescribes that in the future an ever-increasing proportion of new buildings in China should be realized with the use of prefabricated elements (for structural and non-structural parts) to limit the polluting emissions generated by a traditional cast-in place concrete casting.
The multidisciplinary nature of the project will be guaranteed by the team of teachers and students, coming from the disciplines of architecture, urban design and landscape architecture, materials engineering, industrial eco-design, environmental engineering, civil engineering, management engineering, built environment management, urban economics. Potential beneficiaries would be the City of Shanghai (in relation with the "Shanghai 2035" Urban Plan), the SICES (Sino-Italian Center for Sustainability) based at the Tongji University in Shanghai (with the possibility to use this project as a start-up research platform), and the industrial sector of concrete recycling plants as well as international producers of formwork and Chinese real estate developers.

Understanding the problem

According to statistics of the World Bank, in 2019 China was the highest populated country in the world with 1,39 billion people, of which 24.2 million live in Shanghai, the most populated city of the country. Its high population and the tradition of concrete construction has taken China to be largest consumer of cement and concrete in the world, in fact, it consumes about 55% of cement worldwide. This high percentage of cement consumption is directly related to the high levels of contamination of China, considering that worldwide cement production represents the 8% of CO2 emissions in the world, and 2 billion tons of waste are produced annually by the construction industry only.

Furthermore, according to a survey carried out by the municipality, Shanghai's citizens highlighted as important development goals an eco-city with green areas as social and cultural spaces for their recreation. With Shanghai´s 2035 Masterplan, the city aims at a renovation not only in terms of new buildings but also in the distribution of its green spaces, therefore a methodology needs to be defined in order to guarantee the final product of the city with renovated buildings and a greater amount of public-green spaces, with a minimum production of CO2 and limiting the disposal of the demolition waste.

Not only demolishing old buildings and constructing new ones is becoming a problem in China, but the average lifespan of buildings is not as high as in Western countries. Therefore, the methodology must consider reduction of CO2 and solid waste also for buildings that may be in 25-30 years. High pollution and waste from the construction industry may find a common solution in circular economy. Huang et all describe the management of the Construction Demolition Waste (CDW) by the 3R principle (reduce, reuse, recycle), a methodology to which China is pointing in the last ten years with its legislation, however, barriers such as lack of specialized workforce and immature recycling technology, still prevent from further development.



Visit to the project area in Shanghai

Exploring the opportunities

While carrying out the research, several alternatives of methodologies were found, therefore a criterion of comparison was established in terms of efficiency, sustainability, eco-friendly and economic benefits.
First of all, the plant for recycling may be a fixed plant on-site, contributing with high quality and a stable output, however it will imply transportation-derived costs and pollution and the disposition of a great land for the installation. On the other hand, using mobile plants implies more proximity to the demolition site, with economic efficiency, flexibility and possibility to optimize production with a modular and scalable design, while reducing almost to zero transportation costs and pollution.
Secondly, after researching about the historic evolution of Shanghai and learning from the local Landscape Institute the lost connection of the city with water and its intention to recover it, traditional setting on land is compared with the construction of canals not only to facilitate the setting of the recycling plant along the construction site, but also as an alternative for enriching the cultural characteristic of the city in a post regeneration phase. Using barges instead of wheeled vehicles would also represent saving in terms of CO2 emissions.
Moreover, having in mind the short average lifespan of buildings and the principle of Circular Economy of extending the life of elements, a comparative was established between processes of recycling demolition waste and deconstruction, considering economic, environmental, time efficiency. Using prefabricated concrete elements will allow to deconstruct buildings and extend the life of the elements, been an eco-friendlier solution and accomplishing the construction of a new building in a shorter period. The cost difference between demolition (usually cheaper) and deconstruction has been solved in Western countries with proper legislation, i.e. tax reduction for the donation of used prefab elements. However, the deconstruction process presents also economic benefits in terms on job creation.

Generating a solution

For this pilot area of the city of Shanghai with an area of 150 hectares, 30 hectares are projected to become parks: area of linear parks along the waterfronts to meet requirements of the city's masterplan. Besides, the application of circular economy principles for the recycling of concrete in situ will result in saving in terms of CO2 emissions (1560 tons), and of raw materials consumption for the new concrete (900.000 of tons do not need to be extracted). Which means that applying this km0 recycling methodology represents a significant improvement in the effect of the regeneration over the environment with respect to traditional methodologies.

The innovative model of Recourse Shanghai brings concrete recycling on-site through a system of canals and barges. This solution allows to easily manage the movement of raw materials and of demolition waste. At the same time, it reduces costs and emissions. Barges adoption is a smart decision because they reduce the traffic movements into and out of site and ease site logistics, particularly where space and site access are restricted.

The recycling process has been designed following Circular Economy principles through modular floating factories that will receive concrete demolition waste to produce new prefabricated elements that will be used in new buildings. These elements will also be temporarily stocked in barges until the set-up of new buildings is done.
With respect to the urban design, it consists on a first phase where the new channels with the existing water system, provides a circular course, regulated by dams to manage the water level of the main channels, and integrating a dock at the top, with a section relationship more consistent with existing water basins. And a second phase where there will be demolitions of buildings and then the reuse of existing buildings of major architectural Interest to be preserved, which can represent the historical memory of the place. Then, there will be a reuse of such buildings as containers for the temporary operation of machinery for the mobile plant and then be used as places for collective functions.

In line with the Masterplan 2017-2035, this pilot project will increment green space per capita in the city, fundamental in a heavily-polluted Shanghai to reduce the environmental footprint of an urban regeneration project. Most of these green open spaces placed along new canals that will not only add modularity and flexibility in the soft regeneration process but will also add value to the linear parks and help recover the connection of the city with water. Recourse Shanghai constitutes a seminal case study, showing how the application of avant-garde technologies and principles can reduce the pollution associated to quarry mining, transportation and waste disposal. With the application of such principles, urban regeneration of cities can become more affordable and sustainable at large, improving urban planning worldwide.

Finally, all of this strengthens the function of representation in the rewriting of the urban fabric and the materials derived from the demolition are therefore preserved and selected for processing and reuse for the production of new prefabricated that takes place in the temporary plant set up in the selected existing sheds.

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