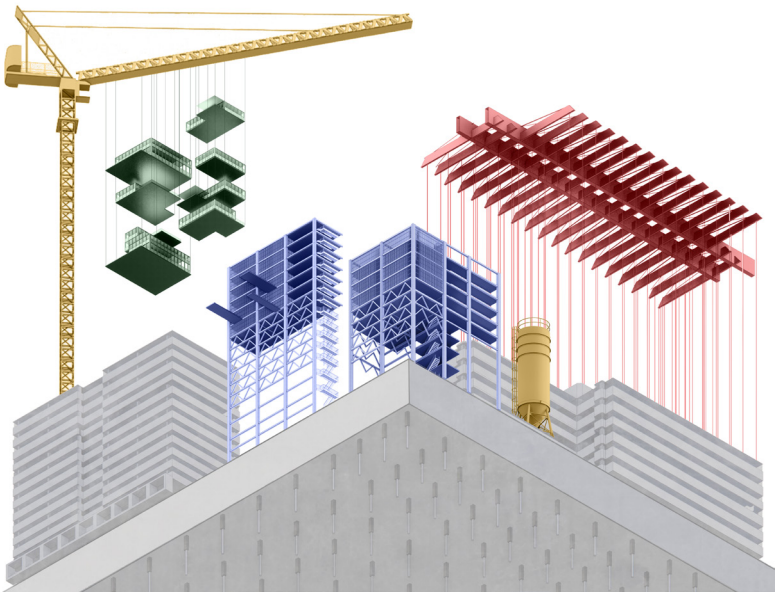
Under De-Construction

design for change

Dima Abdu



TECHNION
Israel Institute
of Technology

Dima Abdu

Under De-Construction

Final Project

Technology Based Design Studio

Instructors | Arch. Eitan Kimmel ,Arch. David Robins

Research Seminar

Instructors | Arch. Liat Eisen

Architecture and Town Planning Program

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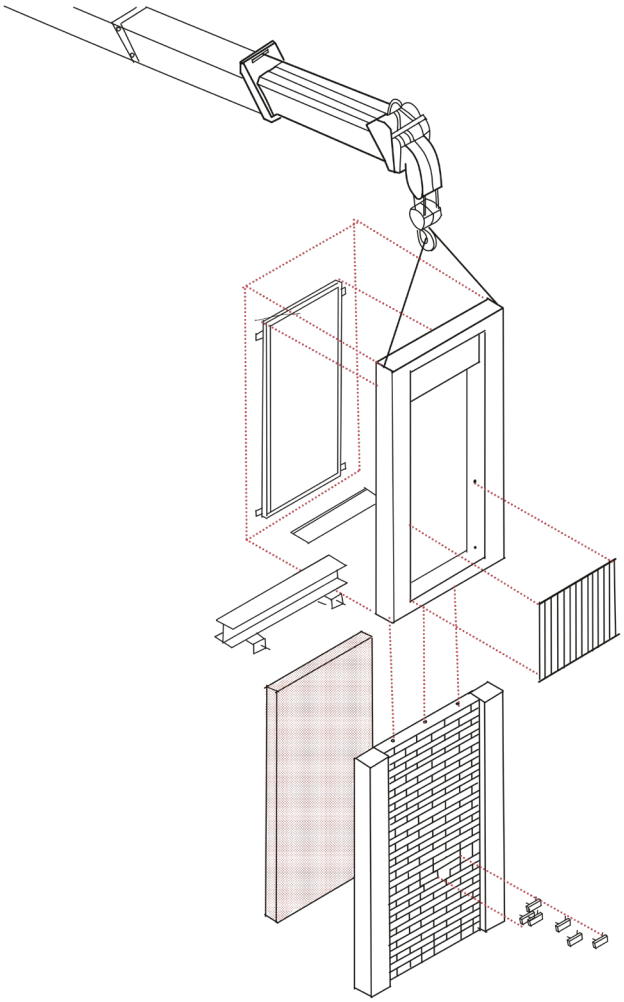
Contents

Abstract

The project examines the environmental and spatial impact of construction and deconstruction of buildings in cities. Introducing a shift from the traditional linear approach to a circular, sustainable model.

Clal Center in Jerusalem was selected as a case study, being one of many megastructures that create a gap in the city fabric. This gap stems from the strict form and immense footprint of the complex preventing adaptivity to any change occurring in the city.

The project aims to negotiate a form of living between the ‘temporal’ and the ‘permanent’ by proposing a flexible system of a prototype that adapts and changes. Benefitting from the block’s central location, and transforming the building’s specific vision into a dismantlable model that offers varied scenarios and guarantees multiple lives for the building.



Partial Facade exploded diagram: reversible connection detail between two materials or two parts of a building.

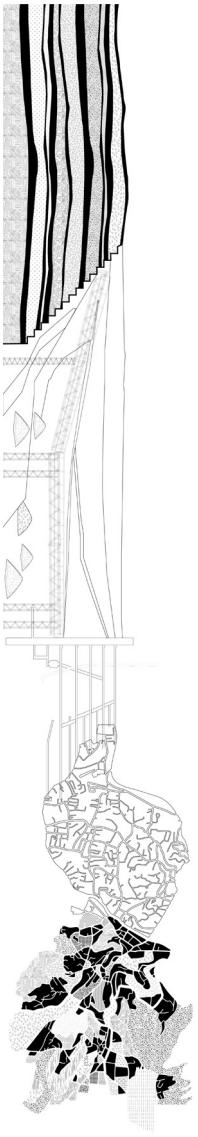
Aims

This project argues that buildings built for disassembly can adapt to a required change in cities, according to residence needs, reduce construction waste, and become 'material bank' for the future built environment.

To establish that argument, First, the project will provide data concerning construction waste and its treatment. Second, the project shows the difference between predictions and scenario buffered buildings, one planned for permanence and the other for change. Then the paper presents the term 'urban mining', viewing the city as storage for future materials. Afterward, It will present the theory of "shearing layers "by Stewart Brand of buildings (Brand 1994), each building has 6 layers with different lifespans. Subsequently planning a strategy for the chosen site and method of operation

The site chosen as a case study for this theory is "Clal Center" In Jaffa 97, Jerusalem. A megastructure in central Jerusalem, a cluster of buildings as an outcome of a prediction and a vision that eventually didn't get fulfilled.

This project aspires to find a strategy to break down an existing megastructure that doesn't serve the city anymore, into a sustainable system and find ways to integrate flexible building systems into the city fabric. the intervention seeks spatial varieties, different possible scenarios, ones that attract change and ones that don't. attempting to answer the following question:
How can architecture grant various lives to buildings? strategizing the flexibility of a megastructure adapting to different scenarios.



linear production mode: extracting raw materials producing them building then demolishing them to wate

Literature review

Problem statement

Our cities are being developed at an unprecedented rate of change, with an increasing population. We are all aware of the accumulating pressure on the natural environment, with the rise of climate change, to function as the main resource for all needs of humankind. A massive contributor to the pollution is construction waste after the built environment is demolished.

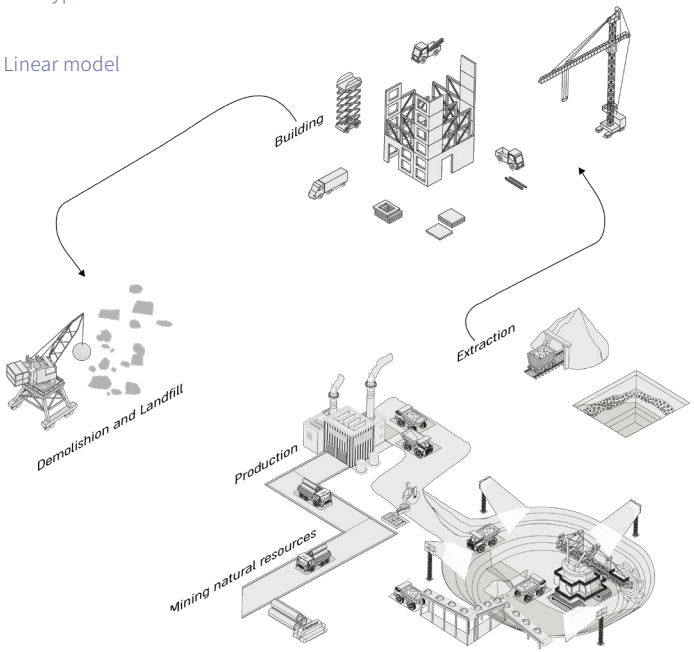
Construction waste is increasing, along with global warming. At a worldwide level, construction is responsible for about 40% of carbon emissions (UNEP and IEA 2018), 20–50% of the consumption of natural resources, and 50% of total solid waste (Vasilca et al. 2021). We can't solely blame the construction industry for this impact, the whole economy today is directed to exhaust our natural resources starting with mining, production, consumption then waste.

This issue doesn't concern only one city it's a worldwide phenomenon. As a global issue, planners are committed to making a strategic change, to build a sustainable more adaptable environment.

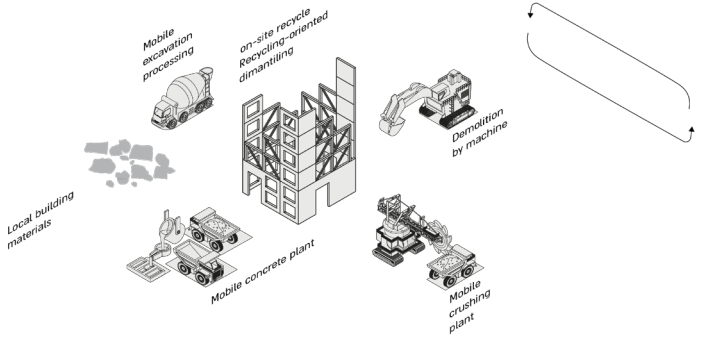
We as planners need to rethink our accumulating construction waste and create a more sustainable environment. This project views the city as a future material bank, rather than a source of upcoming waste from our current aging buildings. It argues that finding the balance between flexible, dismantlable buildings and permanent rigid buildings could offer varied opportunities and guarantee multiple lives for buildings. Fulfilling inhabitants' dynamic requirements and producing less waste.

Two types of construction models:

Linear model

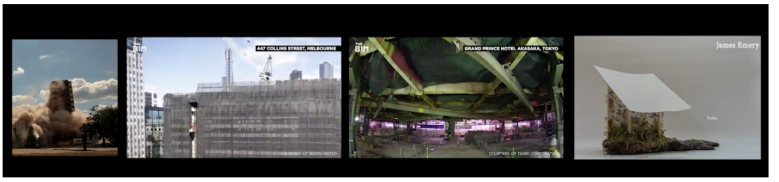


Circular model



Built environment and climate change:

The building industry is a major source of global greenhouse gas emissions, it consumes about 50% of mineral resources (Anink, Boonstra, and Mak 1996) and produces about 35% of waste (Solís-Guzmán et al. 2009). The built environment not only costs us natural resources, and pollutant gas emissions on a wide scale but also as residents in the city we are interrupted by noise pollution, dust, limitation in movement of pedestrians and drivers as one, and disruption of our whole urban environment for construction and destruction of buildings. Perhaps for a very important cause, which is to build our shelters, and homes and provide us with spaces that we need, nevertheless this work wants to question our intentions as planners and raise the question of whether we can plan things differently in a more sustainable way.



Credit from left to right:

1)B1M 2)B1M 3)PDi Magazine Jan Hermansson 4)Alchemy of the Tún - James Emery

video edited by me

Video showing different ways to demolish a building.

from left to right:

1) by explosives .

2) dismantling the building level by level .

3) dismantling it with a building cap to prevent pollution and noise in the city.

4) by organically dissolving.

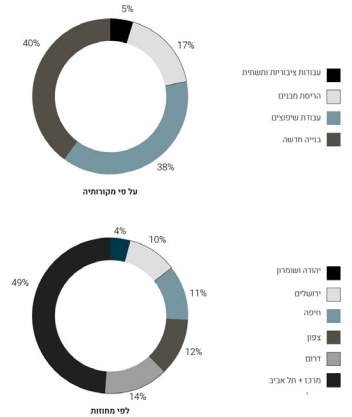
Waste

According to the world bank group By 2050, the world is expected to generate 3.40 billion tons of waste annually, increasing drastically from today's 2.01 billion tons. (Silpa Kaza, Lisa Yao, Perinaz Bhada-Tata and Woerden 2018). As city residents, we don't have to deal with waste, for sanitary and other reasons, we dispose of what we consumed out of sight, out of mind. As a result, we perceive waste as something that we don't need to cope with, since doesn't have an immediate impact on our lives. But waste is proof of production and consumption rate. To examine this perception of waste we raise the following question: is waste evidence of the absence of natural resources or proof of their richness? (Hebel, Wisniewska, and Heisel 2014).

Looking at the Israeli context, and construction waste in particular, According to State Comptroller's Report Israel generated 6.2 million tons of construction waste in 2019, out of which 2.19 million are dumped in illegal open areas in 2019. Only 55.4% is recycled Compared to the 70% that is the target set by the EU for 2020 (מסמך מבקר המדינה פסולת בנייה" 2021").

Building waste

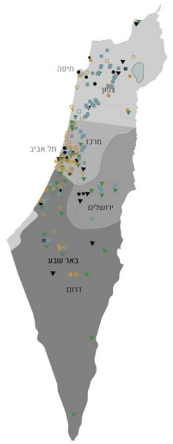
פסולת בנייה



מקור: המשרד להג"ס, בעיבוד משרד מבקר המדינה

Materials resources for construction

חומרי גלם לבנייה



חומרי גלם לבטון
- מחצבה לאגרגטים
- מפעל מלט (כפוס וזמלוד)
- מפעל סיד
- פלדה- מוטות זיון
- סיבי פלדה
- סיבי זכוכית

מפעלי בטון

מפעלי בלוקים
- בלוקים בטון
- בלוקים בטון תאי
- בלוקים קלים (פומיס)

חומרי גמר
- חומרי בידוד
- קירוי ואיטום
- זכוכית ואלומיניום
- חיפוי ריצוף וציפוי
- צבעות ומשטחים
- לוחות גבס ומצנט
- דלתים ורשתות

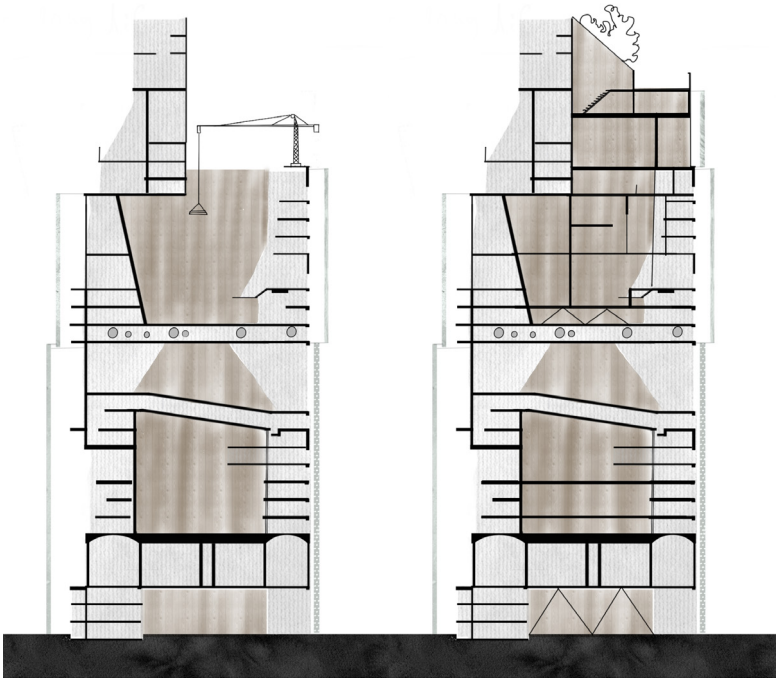
מקור: readymix

Linear vs circular:

Currently, the built environment is following a linear method (Hebel, Wisniewska, and Heisel 2014), where there is a beginning and an end to each construction process. First, the materials are mined, then transported to the factories where the materials get processed, afterward, the materials get transported to the construction site, built, and used for a certain amount of time (depending on many factors like maintenance and adaptability), then gets deconstructed and becomes another type of waste that we want to dispose of it by burying it in a landfill, burning it or sending it to another land to get rid of it. Each one of the methods for waste treatment has its pros and cons, yet the main issue emerging other than pollution is the lack of available land for landfills.

In comparison to a circular economy method, a circular economy is a system that targets zero waste and no pollution throughout materials' lifecycles. Upon material's lifetimes, materials can be either recycled in a regenerative cycle or treated organically back to nature (Nobre and Tavares 2021)is now appearing as a global trend, affecting macro, meso and microenvironments, ranging from governments, global organizations (such as the UN. It also suggests a new way of thinking, for example, cradle-to-cradle use of materials, such as carpets, that can be rented from a company for a certain time of use and then renewed or disposed of by the same company.

Reconsidering the way, we perceive the built environment; we need to create a circular process to follow instead of the current linear one. The suggested method aims to avoid generating waste rather, than transform materials and reuse them.



Possible Scenario in Strategized building

Case Study

Clal Center is chosen as a case study to implement the theory because it is one of the first attempts to create a megastructure mall in Israel that turned out to be a burden within the cityscape over the years.

This project argues that “Clal Center” and many other structures if built differently, can be changed according to what the city needs with the ability to be disassembled. As mentioned before, we can’t predict the future, we need to strategize for different scenarios. This project will show two scenarios in which this site can exist and function, to manifest the planning strategy for a sustainable future.

Seeking to benefit from the block’s central location, and trading the building’s unfulfilled potential and large footprint for a dismantlable space that can adapt according to possible scenarios.

Clal Center - central area

Photo: Nadav Podoler

Site

Clal Center, Jerusalem, a high rise located between Jerusalem city center and Mahne Yehuda market, In Jaffa Street. Clal Centre is an office and commerce complex, made out of a cluster of three buildings. The first building (Clal building) is situated in the north part of the block it is 16 (60m) stories high and the three-level spiral around with a skylight above. The second building is located on the south border of the block, it is 10 stories high (30m).

Both buildings include 2 double-height stories (6m) for commercial use. They are connected by an enclosed space between them for commercial use as well. The space between the buildings creates a continuous commercial use from one building to another, with double-height floors.

Exterior of Clal Center on the corner of Jaffa Road and Kiah Street, Jerusalem, Israel

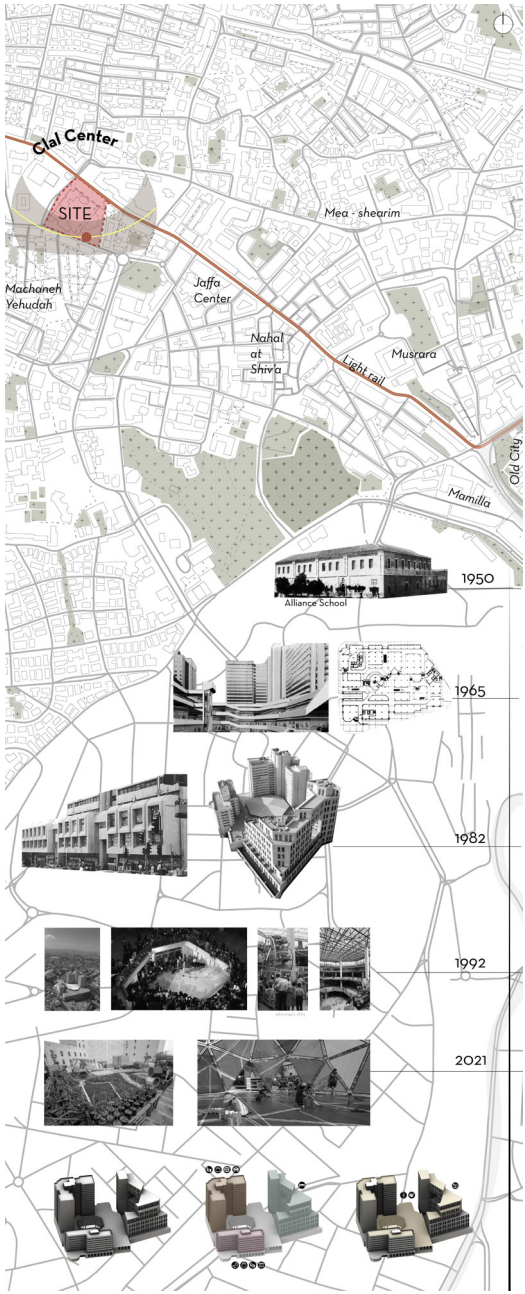
credit: Yoninah

edited by Dima Abdu

History

Clal Center was designed by the architect Dan Eytan, the construction period lasted from 1972 till 1992. Built years 1968-1982, the design was aimed to create a continuous pedestrian flow between the city center and the market.

The site on which Clal center resides used to be a campus for the Alliance Vocational School, the first Jewish trade school in Jerusalem (רקנאיורק דוד 2005). The school closed in the ’50s, and up until the construction in 1968, there were workshops and printing companies. Eventually “Clal: company bought the land, destroyed the historical school building, and constructed the Clal center of today.


Clal Center
SITE
Mea · shearim
Machaneh Yehudah
Jaffa Center
Nahal at Shiva
Musrara
Light rail
Old City
Mamilla
1950
Alliance School
1965
1982
1992
2021

Megastructure – a failed predictions

The original plan intended to create “Clal Center” by developing commercial and cultural activities along the way. Only the first building with the three-level spiral around a central atrium with a skylight was executed as planned, the rest of the plans changed along with the constructions. The urban goal and ambition for this project were never achieved, today it is a run-down site and considered to be one of the least popular places around the city despite it being in the city center. (D. Eytan / R. Lahav-Rigg, n.d.). today the complex is used for offices and commercial use.

Materials

All buildings part of this cluster that makes the center, are constructed from concrete, the dividing walls are made out of concrete and plaster and the façade cladding is stone. The pro-Jerusalem Society dictated the law for stone-facade in Jerusalem to create visually unified materials (יעל בלקין 2009).

צילום: הרמן חנניה, לע"מ

Central space of clal center before closing the main square with a glass ceiling

Reasons for failure

It's challenging to understand exactly why this project failed miserably in the center of Jerusalem. A lot of sources repeat the same idea. One of many reasons leading to the unsuccessful project was that the construction process was stopped and delayed many times because of the ongoing war at the time in Israel. Hence the team wanted to finish as quickly and economically as possible, resulting in cheap finishing materials that didn't last long (ידרנ איג 2018). The second reason was for the ownership of stores in the mall, which they sold to different individuals and companies instead of renting them, unlike most malls. Consequently, every store in the building was owned by a different entity and couldn't do any collective decisions over the building, whether for renovations or intervention or any sort of change. No one took care of or maintained the hallway because each has their own space to worry about. The third reason is the hardship in orientation in space. Although the architect dan Eytan planned a spiral pathway, stairs, and elevators to ensure easy access and movement in the building, the building itself after being built had a lot of criticism for being hard to orientate inside the space, users not understanding where to go and how to get to another place from where they are standing.

Urban renewal

Although the site didn't fulfill its vision, in 2016 a group called "MUSLALA" opened a terrace on the rooftop of the clal center rooftop in-order to revive the central site. The space aims to connect art, environmental awareness, and sustainable thinking in this public area ("MUSLALA" 2022).

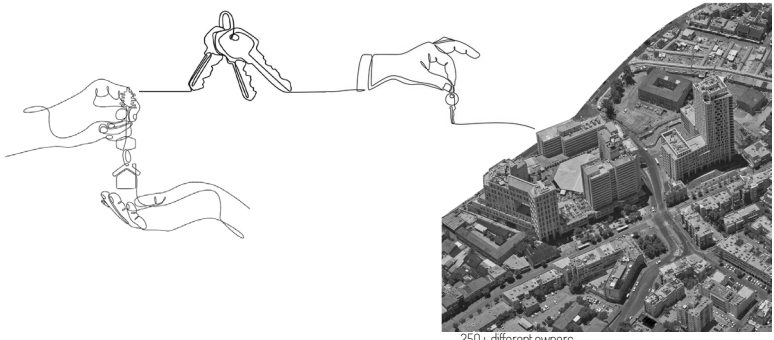


Diagram : Clal center 250+diffrent owners

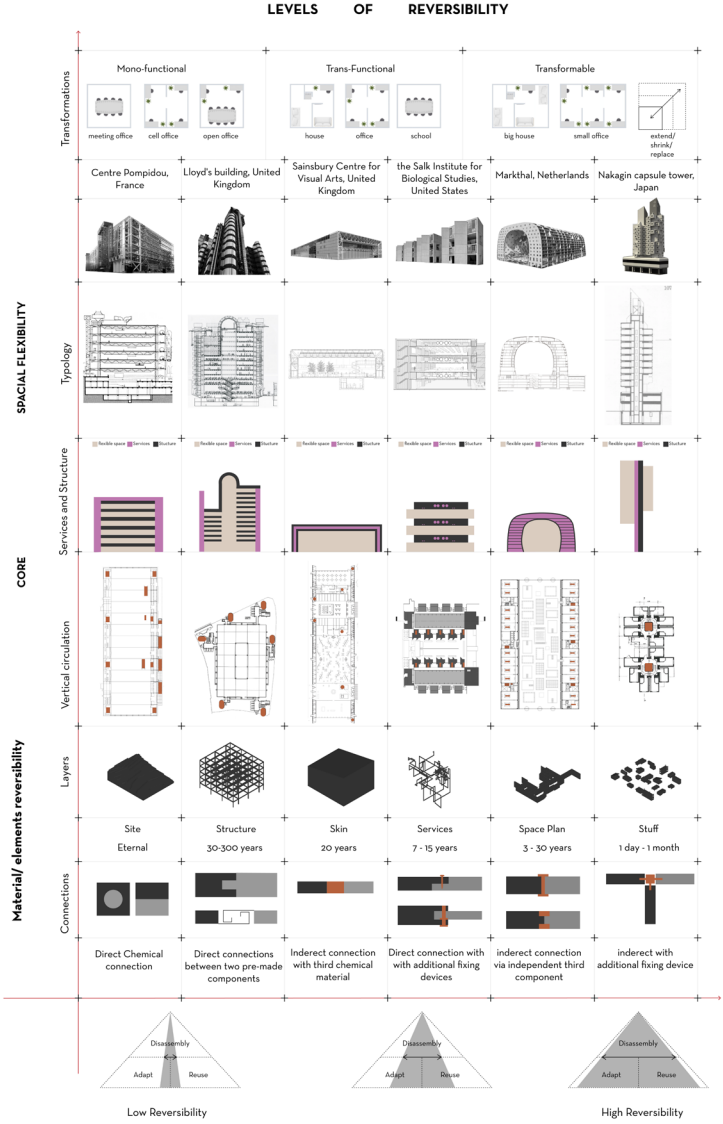
© 2022 MUSLALA

Mythology

Towards sustainable environment: Reversible constructions

In search of a more sustainable way to construct our built environment, we need to learn more about the reason that we don't pursue this method already. To create a building that can be dismantled and used again for different purposes, we require a building that could adapt to different functions, a building that has dismantlable connections with no use of glue, that could be taken apart and reassembled, maintaining its material quality.

We can learn about that field from a movement called Design for Deconstruction (DfD), which researches and develops new structural system concepts(SA Rogers 2018). And The Urban Mining and Recycling (UMAR) Experimental unit in Switzerland("UMAR," n.d.). As well as many other architectural firms that investigate this field, for instance, In the handbook "reversible construction" by Canal Architects we understand the history of reversible construction. The book gives examples of such buildings and results in 7 principles that are guides for reversible construction (Rai, Singh, and Upadhyay 2017). The principles take into account changing built volume that could accommodate different functions, fire standards, services, vertical connectivity, light, and ventilation. Emphasizing the importance of column-slab as the structural element composing the building.



Precedents of flexible reversible buildings

Urban mining

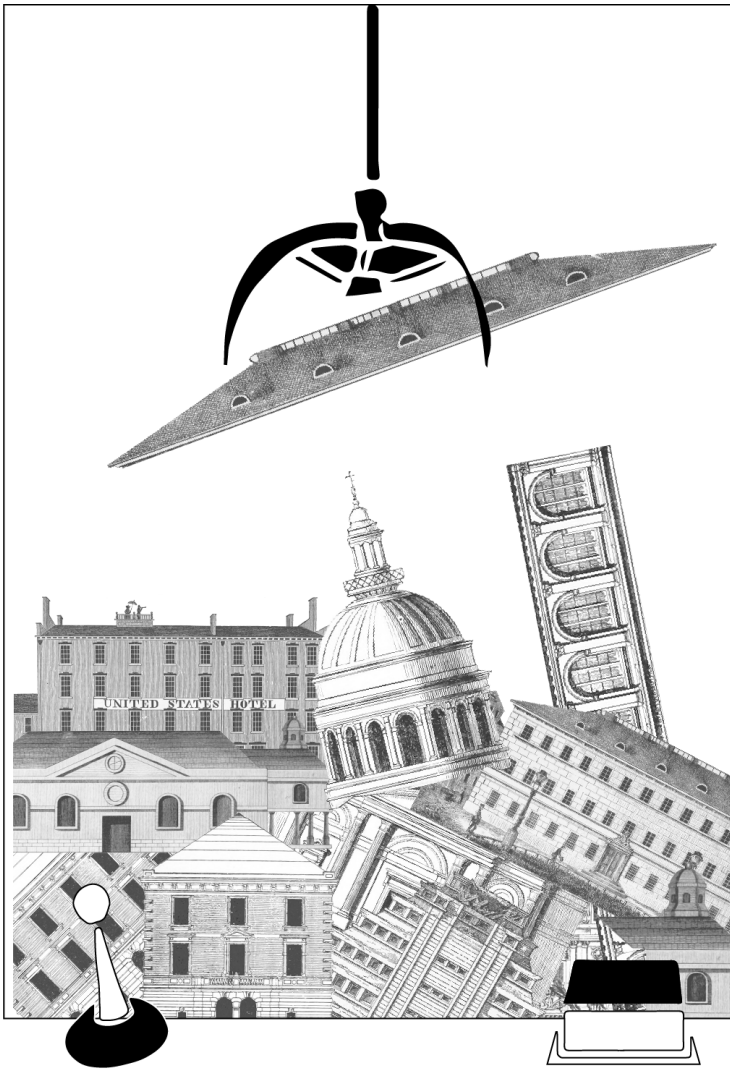
Another term relating to this matter is urban mining which is the process of recovering and reusing a city's materials, for instance, materials from building, infrastructure, or old materials that aren't needed anymore.

Mining the built environment is a recent phenomenon yet not a new concept, "urban metabolism" was coined by Wolman (1965) as a model to facilitate the description and analysis of the flows of the materials and energy within cities.

Throughout history, Materials were reused from one place to another. The Colosseum's stones were used as a source of housing building material for several years. As well as the "Ise Jingu" grand shrine in Japan that gets rebuilt every 20 years for the past 1300 years. A shrine that is designed to be dismantled. This ceremony is held to achieve immortality through cycles and rebirth(Armada 2012). By dismantling, they could transfer building parts from one shrine to another if needed.

Another example is the Crystal Palace (1851) at Sydenham, built to host the Great Exhibition in Hyde Park, London. Made of cast iron and plate glass, the 92,000-square-meters building with an interior height of 40 meters was designed to be temporary, simple, and easy to transport. When needed to be transported it was packed up and moved to South London for reassembly, and it remained there until its destruction by fire in 1936 (SA Rogers 2018).

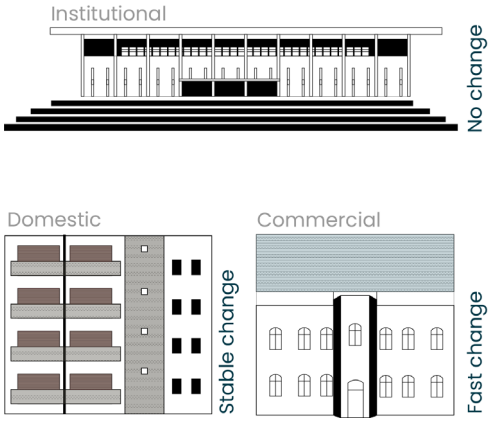
Most of our built buildings are not planned to be dismantled or reconfigured, subsequently, most of the materials that don't serve us anymore we consider waste because you can't separate most



Harvesting building materials and parts from a city or an urban area.

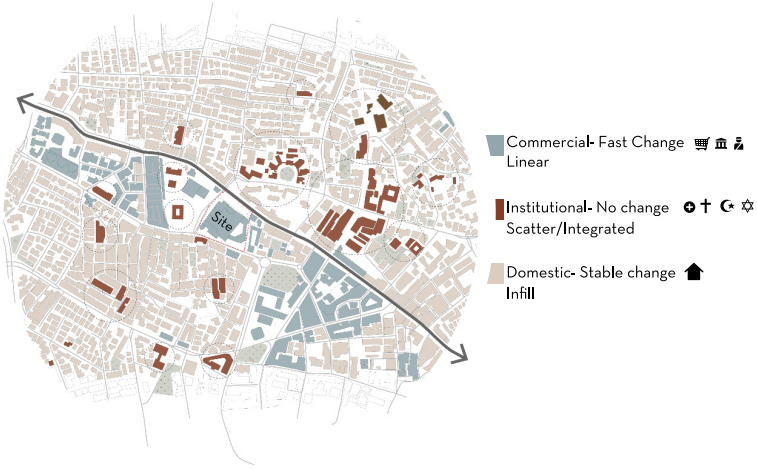
built materials from another, let alone recover elements, due to the use of glue in constructions. All we end up with is construction rubble that only can be recycled through an expensive process. Upcycling reapplies objects in different contexts viewing waste as one of the biggest resources available to us (Hebel, Wisniewska, and Heisel 2014).

Through urban mining, not only we can create buildings from recovered materials, but also build out of “waste” or cultivated materials. Cultivated materials are biological materials that can be grown and processed to build with, such as mycelium (Hebel and Heisel 2017).



Small scale: building's different paces of change

institutuinal - no change , domestic - stable change , commercial - fast change.



Big scale: different paces of change in the urban fabric

institutuinal -Infill , domestic Scattered/integrated , commercial - linear.

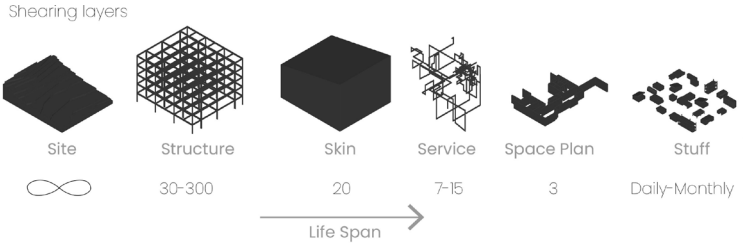
Building's layers

The diagram by Stewart Brand and Donald Ryan shows us the different layers buildings have, and each layer has a different Lifespan (Brand 1994). In the diagram, there are 6 layers of a building: Site (eternal), Structure (50 years approximately), Skin (30 years), Service (15-20 years), Space Plan (5-7 years), and Stuff, in other words, furniture that changes every day. Each layer needs a different maintenance frequency and has different requirements.

To build a city that allows the dismantling of the built environment and its materials to be mined and then rebuilt again, we need to understand the requirements of each layer and the accessibility of each layer. Changing the use of the building and reusing it might be challenging because the services being spread inside the building limit what kind of use it would be and the height of the ceiling as well. Often the drawback of recycling is the degradation in quality as a result of reprocessing or remanufacturing. For that reason, we need to evaluate the reuse of buildings as the highest value strategy to build a sustainable environment.

Prediction vs Strategy

As planners we got proven over and over again, that planning spaces could work perfectly on paper and fail miserably in real life. We can never predict a building's future uses (Brand 1994). Thereby we need to strategize and create different scenarios that lead to different outcomes yet, hold the same essence of place and rules of flexibility.



Conceptual diagram edited by me based on Brand's 6S shearing layers.

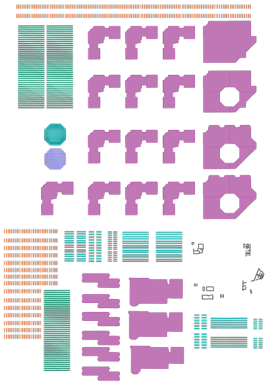
Conflicts of the dismantled buildings

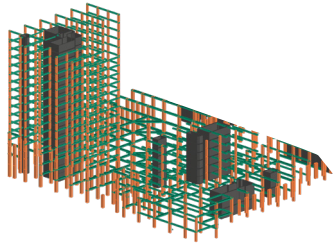
In search of flexible, adaptable architecture, we come to face a few contradicting principles. First, Sullivan's 1896 famous axiom "Form follows function", suggests that the starting point for a building's design should be its purpose. This contradicts the design that aims for buildings to be multifunctional or undefined functions. We also see this conflict with Frank Lloyd Wright's principle that extends the teaching of his mentor Sullivan by changing the phrase to" Form and function should be one, joined in a spiritual union". Because the buildings designed for disassembly are built to accommodate many different functions, as required.

Secondly, In Stewart brand's book "How buildings learn" he writes the phrase "Function melts form" in which he explains that there is a constant opposition, especially in housing, where there is an everyday routine, the way we operate in space, movement, and activities, that results to changing the space accordingly.

Not only we are faced with a theoretical dilemma, but the physical world is also challenging when creating a dismantled building. Architects and planners understand the limitation of building in the physical world. Such as Fire standards and land use.

In France, for instance, the first building permit with no pre-defined building use has been issued to the Canal Architecture agency for a construction project in Bordeaux. It was designed by the set of rules they dictated to build a flexible building.





breaking down the existing structure into layers according to their lifespans: core columns beams, floors and facade.

Strategy

To plan the intervention, I have set seven guiding principles to guide the planning process.

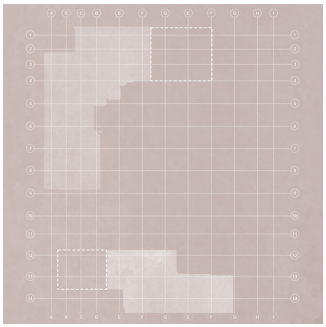
1)the intervention will try to maintain as much as possible of the existing building. to allow a change in the site few parts would be demolished as minimal as possible. That means that the three levels of underground parking will be maintained which means any added structure has to be built upon the existing grid.

2) we can divide the site into three different levels of flexibility, the core, the building's enclosed space, and the temporary structure. The core includes the elevator and the stairs that connect all floors and all the services in the building, such as electrical cables, pipes, service rooms, etc.

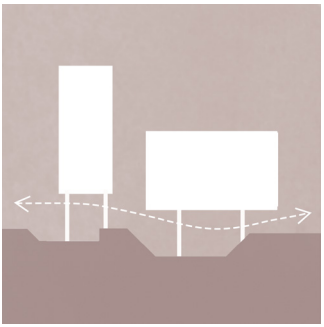
3) The building's enclosed space which is the space between the skin and the core, would be defined as a stable change. And the temporary structure, built from wood, would connect the buildings and would accommodate no specific program but would serve the neighborhood's community throughout workshops or live/work space.

The existing structure includes two double-height floors, that surround the whole area on which the complex is built, this attribute creates a gap in the city fabric. The megastructure interrupts the pedestrian city flow. Since the current building has only two entrance points. One can see the clear contrast between the Clal center, megastructure scale, and the "red roofs" two – four-floor buildings neighborhood.

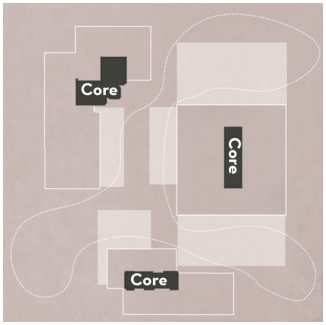
Previous grid, minimal demolishment



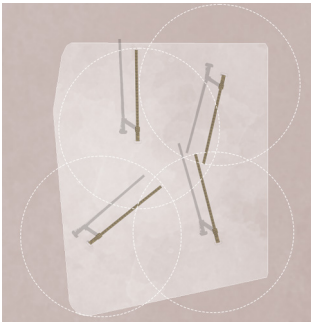
Open city level plan



different life span -Different flexibility levels



Intersecting crane radius



4) add to the existing structure a new building that would allow modularity. The new structure would have a structural beam on top that would “hang” all of the building structure. that way the city level would be freed up. Moreover, that structure would allow rooms “boxes” to be inserted in and out of the building granting different types of spaces on different floors.

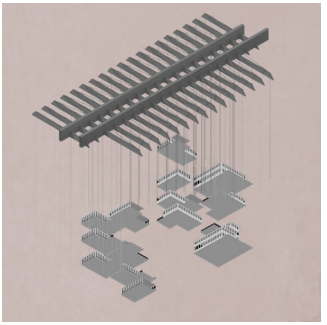
5) to allow expansion/ shrinking at all times, the site would be covered in 4 cranes that assure full site coverage at all times.

6) every function in the site would serve a sustainable purpose for the community. Such as a recycling plant, environment center, or community workshop.

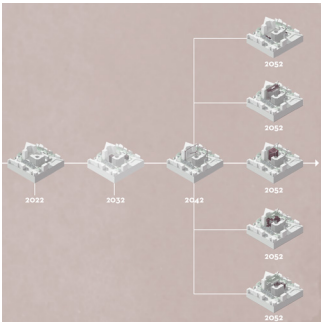
7) instead of planning a prediction that may or may not work, we could plan different seniors in which the building could be fulfilled.

Sustainable
varied functions

Modular "boxes"



Scenarios over
timeline



Intervention

Timeline

Step 1- Demolish and upcycle the first two double-height floors, to allow accessibility to the site, clearing the obstruction.

Step 2- Upcycle the skin of the buildings, as it was built from cheap materials during those hard economic times and falling apart today.

Step 3- Create 4 different courtyards, underground, to grant natural light inside and to create different public spaces for users. Contrary to the abandoned central space today, different courtyards could attract different users and could accommodate different programs.

Step 4- Erect four different cranes are erected scattered among the site.

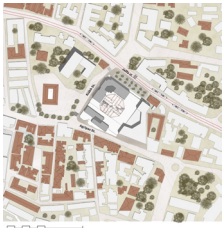
Step 5- Construct the new flexible building.

Step 6- Construct the beam structure on top of the new building to hang the different types of rooms or “boxes”.

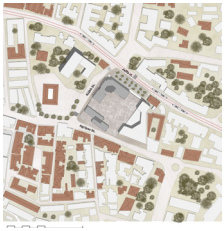
Step 7- Construct temporary wooden structures. The construction could have different spatial forms and geometry but we can explain one possible scenario that could be fulfilled to understand the complex.

Step 7 - Create different possible scenarios.

Step 0



Step 1



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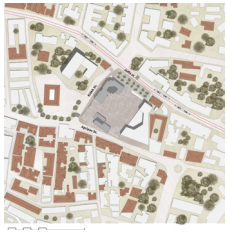

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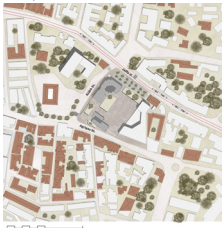

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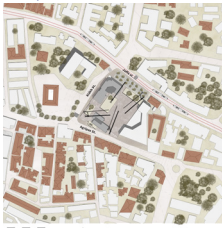
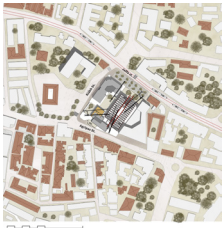
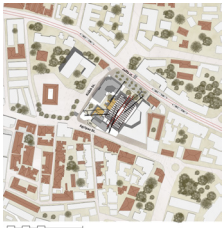


Step 5

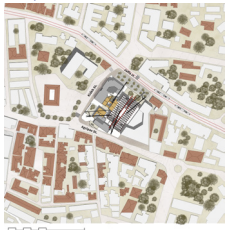
Step 6

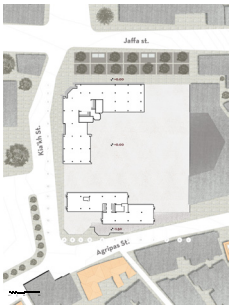


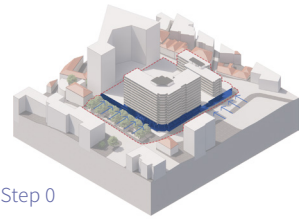
Step 7



Step 7-2







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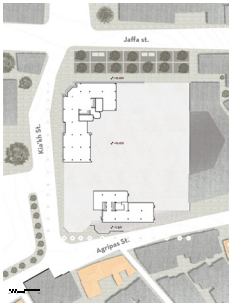
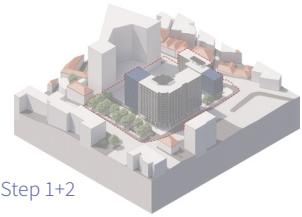
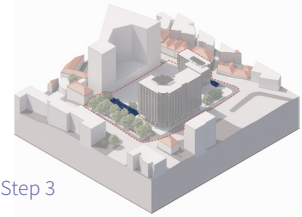


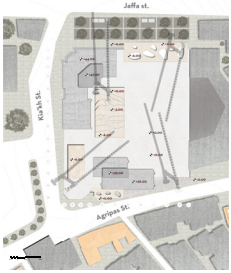


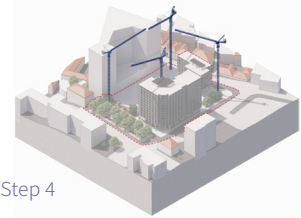
Step 1+2

Step 6



Step 3





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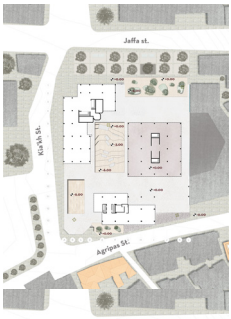

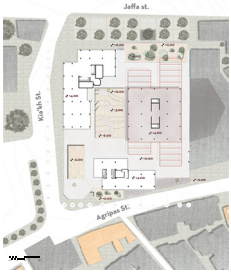

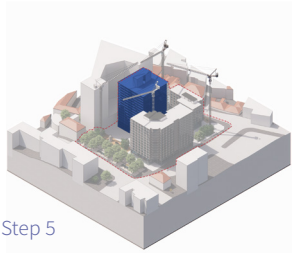

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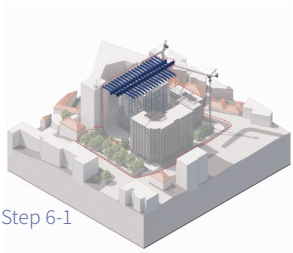
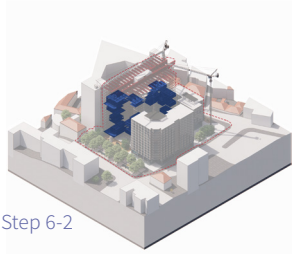
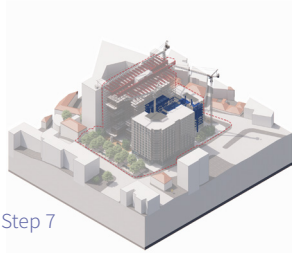


Step 6-1



Step 6-2



Step 7

Proposal

by perceiving the built environment as layers with different life spans the project tackled the permanence of the abandoned site, creating three levels of flexibility, the core the building floor, and everything in between. the project suggests a new way of building, a steel hanging structure that allows the flow of pedestrians and allows structure reversibility. unlike concrete steel can be easily recycled, and it retains its strength through recycling.

the wooden structures that connect to the complex in the site create a place that can be dismantled and modified at any time. the wooden structure generates connections between each building that allows movement between each building.

the old buildings are preserved and used for different functions, their demolished parts are upcycled. each component in the site has a different change of pace, commercial (offices, shops), institutional (environmental center), and domestic (housing).

Typical floor plan 4th floor +14.00

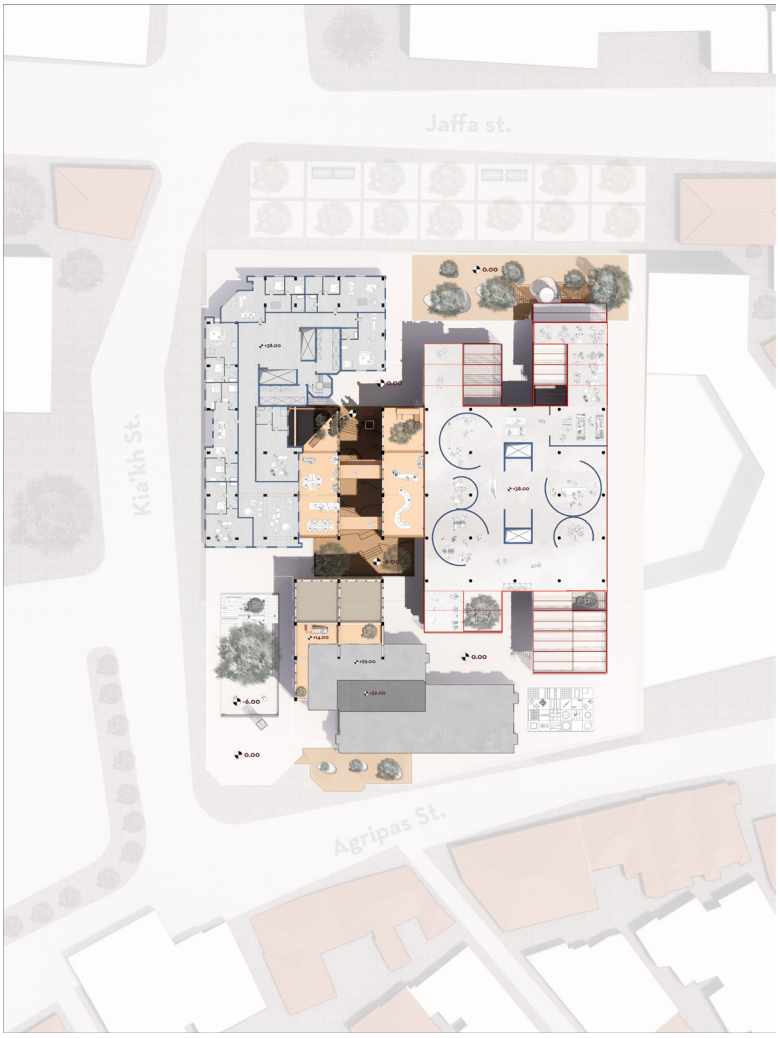
Summary

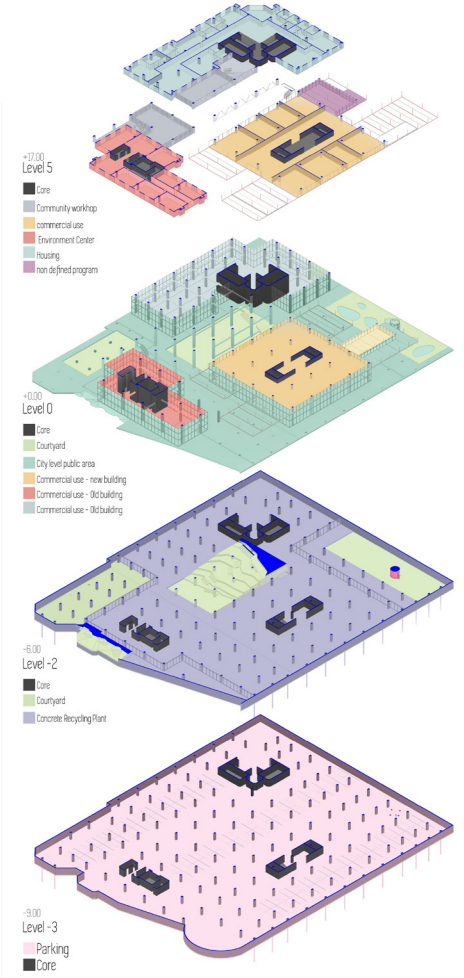
Clal center is not the only abandoned megastructure site in Israel, there are many others. Such as Tel-Aviv central station which also resides in a central location and extends over many dunams. The project acquired tools and strategies showing how to intervene in similar sites, making Clal center merely a case study.

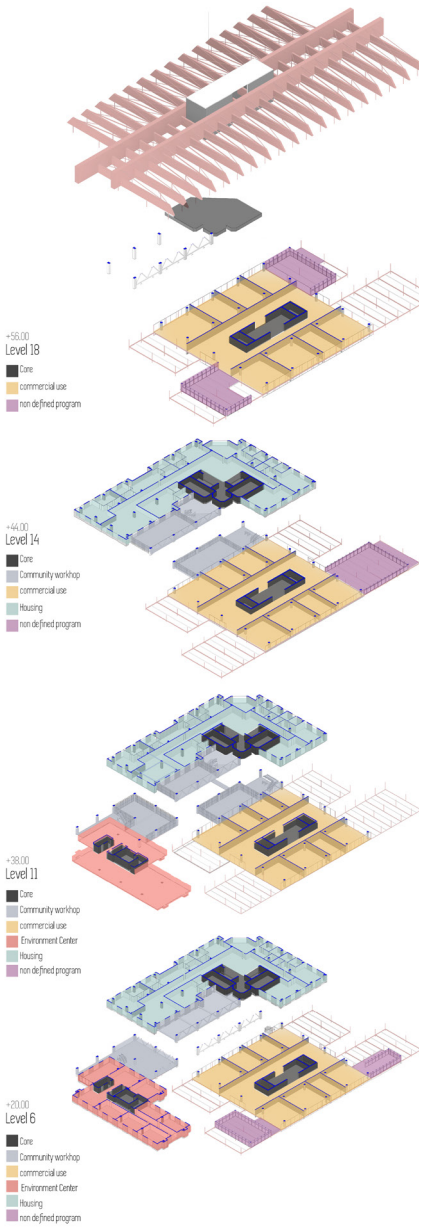
The proposal attempts to fill the gap in the city fabric of central Jerusalem where the existing megastructure prediction failed, enabling different levels of changes throughout the site and allowing community and pedestrian integration. furthermore, the intervention grants varied spaces for the users, to use temporarily and permanently.

the project aims to motivate a change of consciousness for planners to strategize according to the circular model, not according to the linear model. In addition, the project aspires to motivate the public to take an active part in the recycling process and understand the different lifecycles of materials and the rate at which we are consuming different types of products that include a lot of different materials.

Typical floor plan 12th floor +38.00

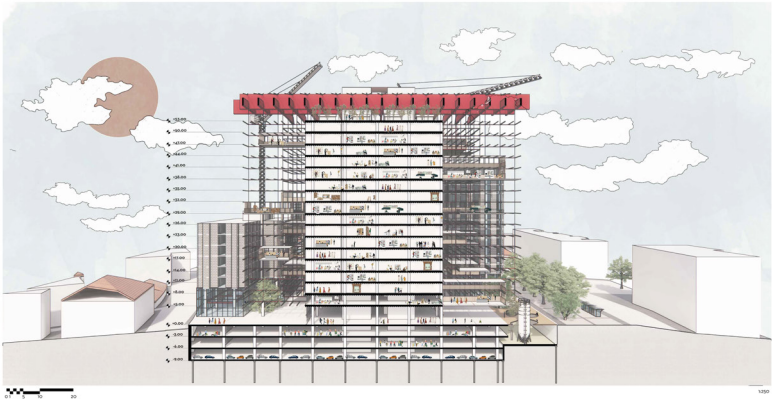



+17.00
Level 5
Core
Community workhop
commercial use
Environment Center
Housing
non defined program
+0.00
Level 0
Core
Courtyard
City level public area
Commercial use - new building
Commercial use - Old building
Commercial use - Old building
-6.00
Level -2
Core
Courtyard
Concrete Recycling Plant
-9.00
Level -3
Parking
Core


+56.00
Level 18
Core
commercial use
non defined program
+44.00
Level 14
Core
Community workhop
commercial use
Housing
non defined program
+38.00
Level 11
Core
Community workhop
commercial use
Environment Center
Housing
non defined program
+20.00
Level 6
Core
Community workhop
commercial use
Environment Center
Housing
non defined program

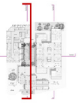
Section 2

Section 3

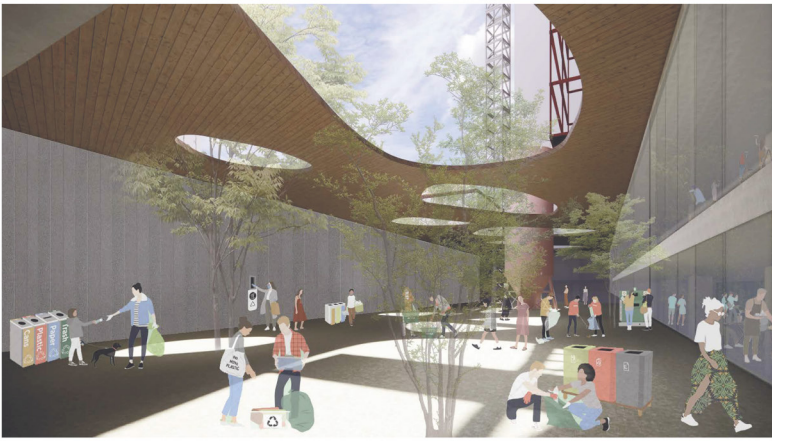


Section 1

1:250



Level -2 view



Outside centeral area view

Indoors view - wooden strcture

Outside view - looking at northern elevation

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