

IN SEARCH FOR NOMADIC APPLICATION OF
ALUMINIUM FROM URBAN MINING IN THE
DESIGN OF A RECYCLE LEARNING CENTER

Research book

Urban Architecture/ Spolia
Hui Wing Hei Joanna
4908376

Introduction/

Examining buildings as shearing layers of change offers a lens of comprehending the adaptability of buildings in terms of structure, skin, services, space plan and stuff (Brand, 2012). Through close reading of several chosen adaptive reuse buildings around the site, inhabitants are highly dependent on the refurbishing of the ‘stuff’ layer which means alternating the furniture layout and material in the interior. The mode of inhabiting as ‘nomads’ who always plan to relocate prompts the site actors to practise informal ‘urban mining’. The material flow compresses the physical distance of the urban fragments and allows affordance of space at affordable cost. Being stemmed from context-led and theory-led inspiration, my research thesis is formulated: Nomadic application of materials from urban mining in post-industrial context. The thesis responds to the material and immaterial spolia that captivates the meaning of the site by exploring the potential of existing material stock and the ways of manipulating the materials. To further investigate, the main question is branched into the following sub-questions:

- 1. What is the relevance of urban mining in the context of the ever-changing post-industrial city?
- 2. What is the feasibility of urban mining in local and regional scale?
- 3. What are the semantic capital carried by the materials around the site?
- 4. How can urban mining and new composite materials fortify social capital and identity with consideration of traces on materials?
- 5. How can the site be reinvented ground-up with urban mining?

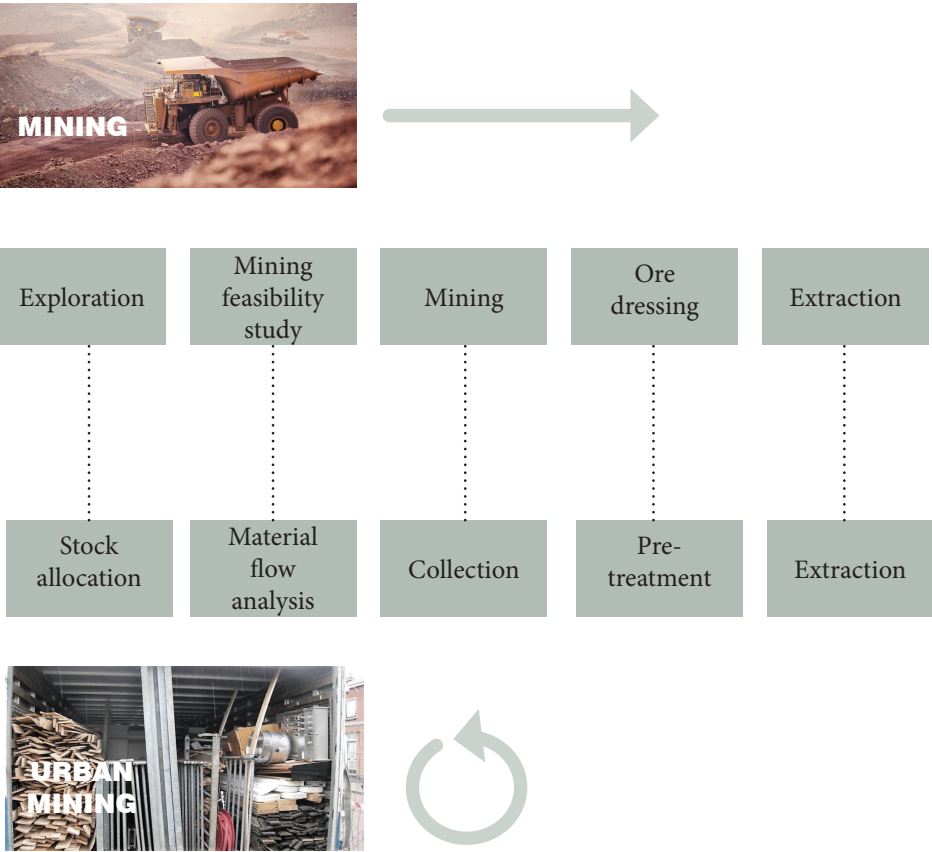
Urban Mining/

Urban mining is *the systematic reuse of anthropogenic materials from urban areas*. The anthropogenic materials refer to compounds and elements from products, buildings, and waste which were mined from the geo-sphere into the techno-sphere.

Metal production from natural ore has had a long history, even more than 200 years old after industrial revolution. First step is exploration of ores, and it continues feasible study (FS) for mining, mining, ore dressing and extraction. Man-made resources have also been treated in same way. The Exploration, FS and mining are corresponding to stock allocation, material flow analysis of target materials, collection of scrap, pre-treatment and extraction respectively. Establishment of collection system is essential in developing urban mining economically.

The value of mining and recovering of materials goes beyond achieving a circular economy, it also returns the historical nostalgia of the productive state of the city. The reclaiming of metal waste in Brussels is a highly sectoral urban infrastructure, paralleled by a variety of semi-autonomous public, private, and semi-private firms managing specific material flows. Urban mining, in this case, can help rescaling waste and resource governance from national and international to local scale.

What is urban mining?



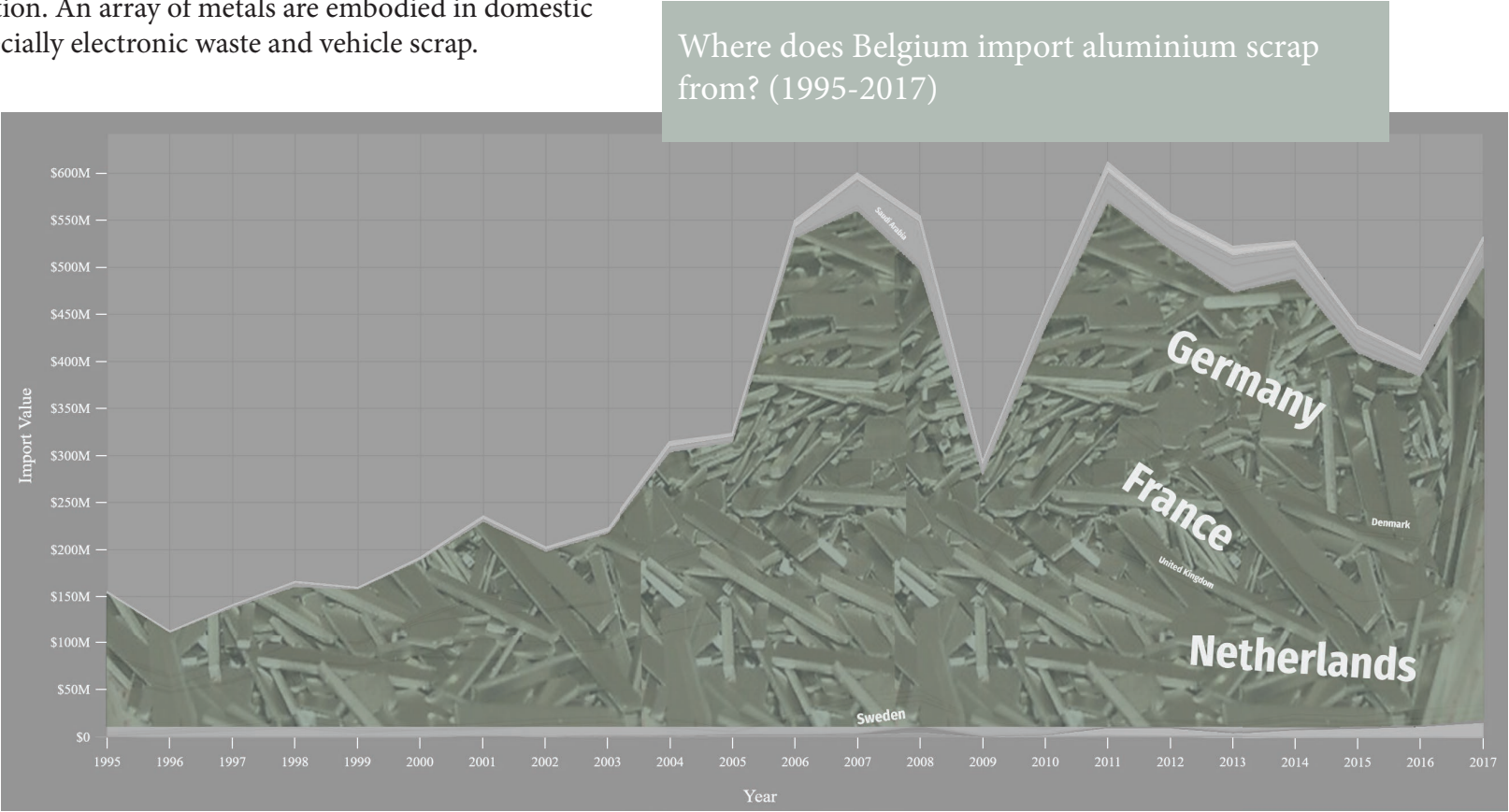
Relevance of urban mining in Brussels as a post-industrial city/

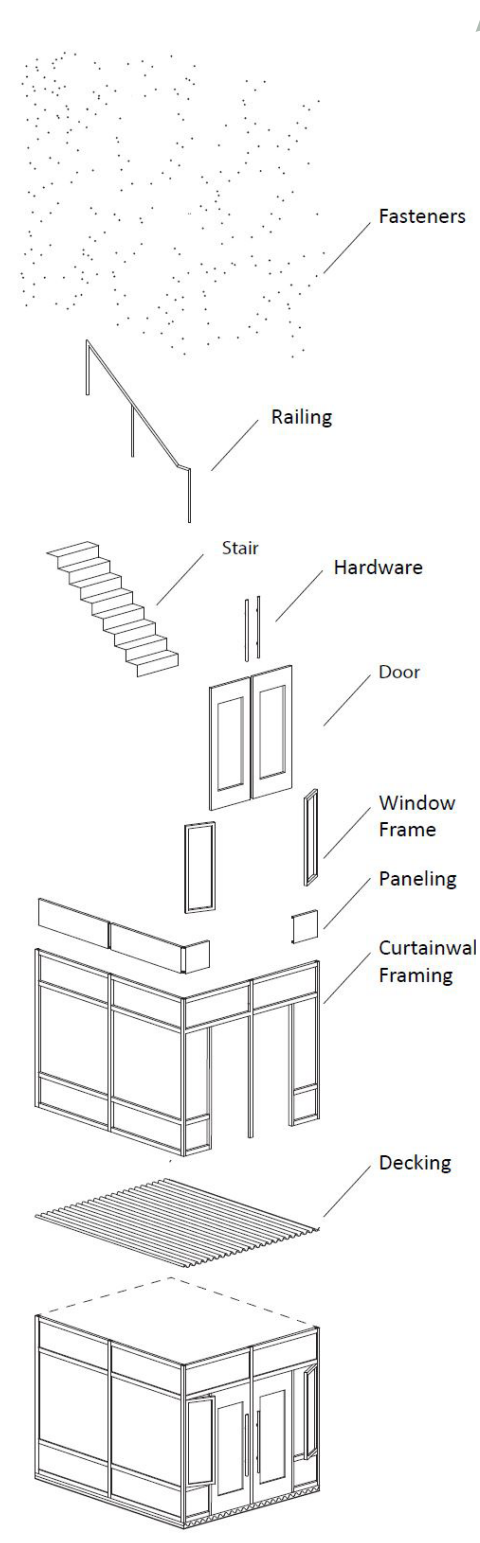
Construction and demolition waste (CDW) alone constitute a third of non-household waste in Brussels. Brussels can be viewed as an urban mine with its post-industrial background and the immense exporting industry at present. Dissecting the urban fabric into layers, from paving, building envelopes to interior finishes the whole city becomes a material quarry which can be readily be mined. Brussels is a dynamic flow of aggregates, wood, metals, stones, bricks and the list goes on.

The city owns a promising hibernating anthropogenic stock of metals underground and on-surface, static and flowing. The metals embodied in infrastructure, building and domestic level. Upon de-industrialization, a lot of factories were moved out from Brussels, leaving behind an invisible stock of infrastructure system disconnected such as power cables and gas pipes. Dormant supply of metals such as steel structure and aluminium window frames can be found in disused factories and warehouses that are readily subject to demolition. An array of metals are embodied in domestic waste stream especially electronic waste and vehicle scrap.

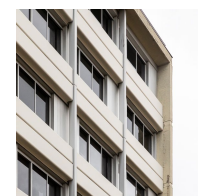
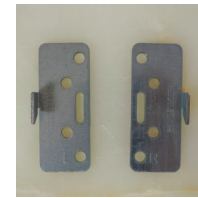
Aluminium is an ubiquitous material applied on miscellaneous layers of the built environment. Since it is highly recyclable, 75 percent of the aluminium ever mined from the geo-sphere is still in use. Although the number of CDW management initiatives in Brussels are increasing, the import of aluminium from other European countries is still on a rising demand. Moreover, the examination of the material cycle of aluminium suggests the indifference of material culture embodied by building materials for the sake of efficiency and mechanicalization. This poses a potential improvement in closing the loop of production and consumption of aluminium with consideration of the semantic value forged upon interaction between humans and materials.

What are the potential materials to be mined?





Size:S/
shorter lifetime



Size:L/
longer lifetime



Feasibility/

80% of CDW would be sorted directly on the construction site. The leftover (approximately 150,000 tonnes) would be sorted in the center of sorting. Most of the companies linked to the processing of waste is located on the outskirts of the regions and this is explained by the nature of the activities which requires generous space to block off nuisances (dust, noise pollution, etc.) from residence. Also, there are only three parks for collection of waste for all sizes. The phenomenon of decentralization, together with the inhomogeneity of the regulations between the regions, put the logistics of CDW into dilemma.

However, the recycling and collection facilities are mostly situated along the Brussels Canal and connected to ring roads surrounding the city of Brussels as well as other smaller towns south of Brussels. The designated site in Anderlecht is one of the potential spots for developing into a hub for urban minng.

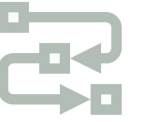
Material flow analysis (MFA)/

MFA frames a research methodology based on the concept of the anthroposphere being a metabolic network(Brunner & Rechberger, 2004). It is related to the mapping of material flow and stocks that the transportation and process of each investigated material can be tracked. Thus, MFA is constructive as a basis for designing the recovery process of materials.

Geographical information systems (GIS) takes a prominent role in actualizing MFA with its ability to create cartographic visualization, manage spatial data and form a spatial database for urban mining studies.

With GIS, the status quo of materials was be identified and extrapolated and the results generated give a taxonomy of layers of the urban environment for organizing the logistics of architecture intervention to be designed.

METHODOLOGY

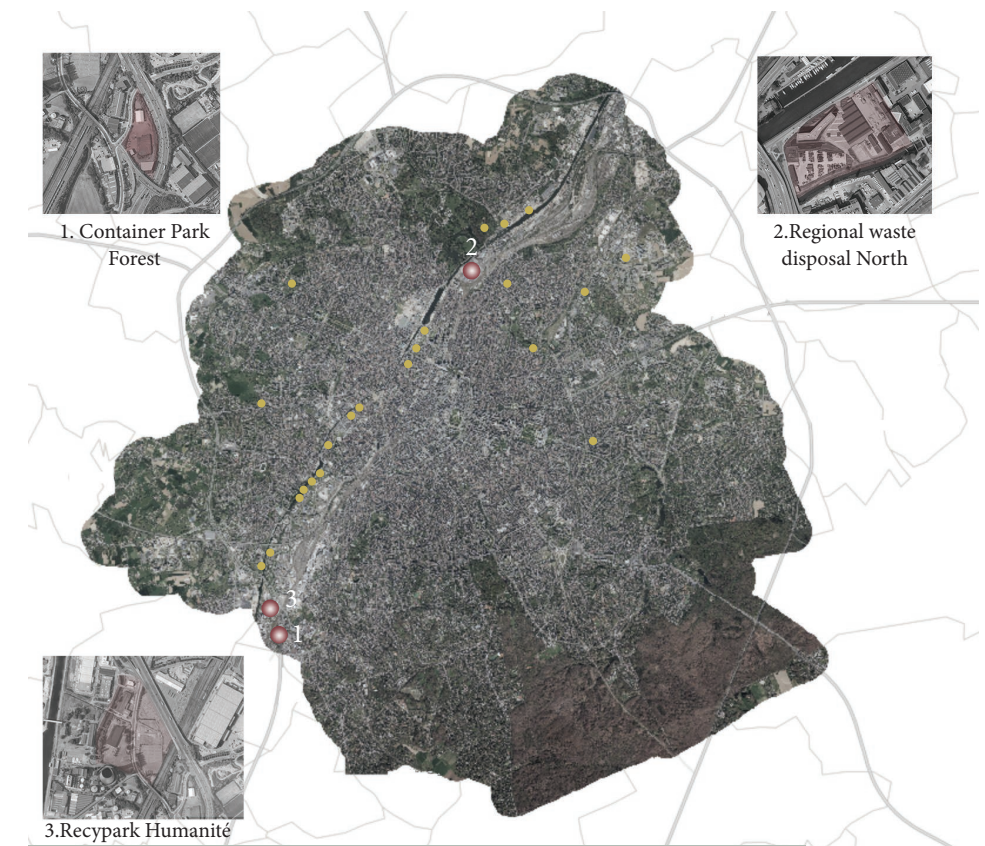


Transportation network hierarchy in the Brussels



- National road
- Inter-district route
- Major road
- Neighbourhood collector

What is the feasibility of urban mining to be developed in Brussels?



Distribution of the recycle park, main centers for the collection / sorting of waste in the Brussels

- CDW collection/sorting centers
- Recycle park

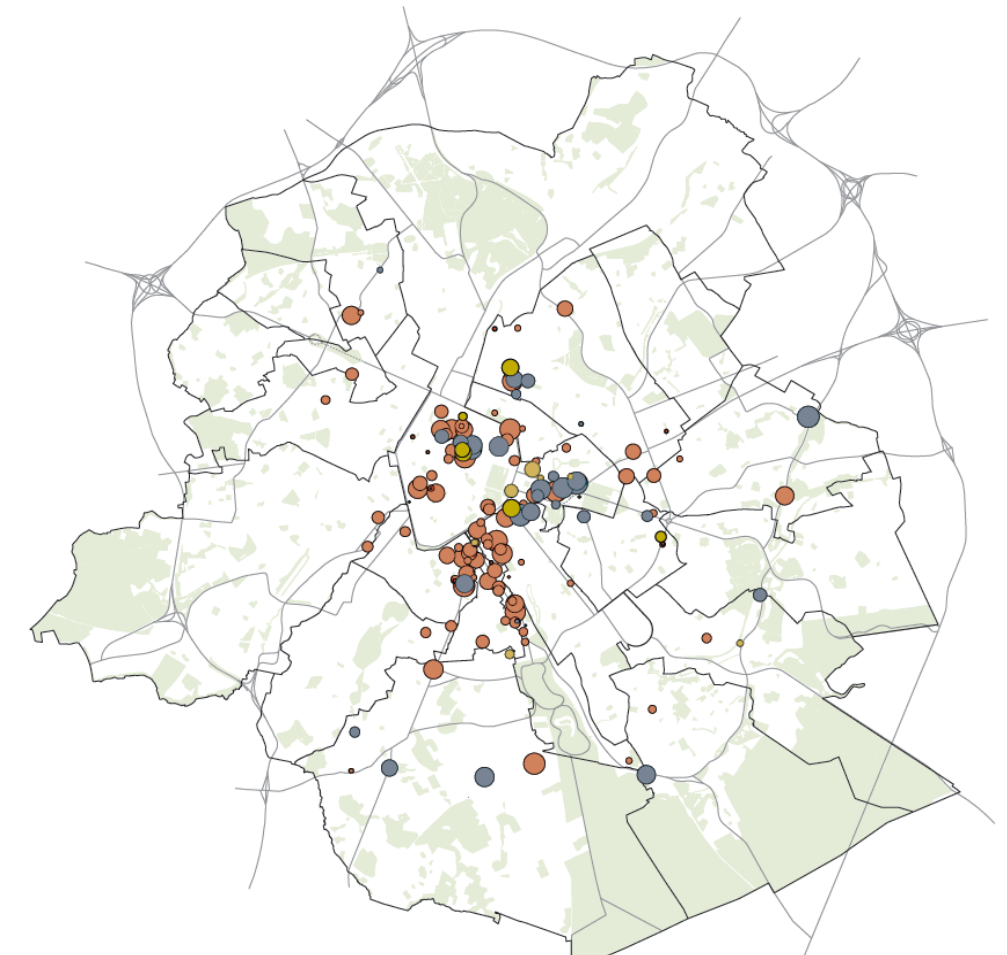
Unstable programme/

The end of the 1970s was marked by a first overproduction crisis which led to a decrease in office production volume. Also, development of a series of renovation programs (e.g. modernization of several office towers, gradual extension of the building stock of the European institutions, renovation of the building stock from the post-war years), and rehabilitation programs or programs for the re-allocation of important sites (state administrative district, Tour and Taxis) took place.

The reconversion of office buildings into dwellings was almost non-existent at the beginning of the 1990s, and has been gaining ground, in particular in neighborhoods where such an operation no longer generates economic loss due to the rapid increase in the value of residential property compared with the value of offices. The current slow down in economic activity, the relatively high vacancy rates, will also influence the future of office building production. The residential sector is becoming a stronger urban function, competing with the service sector in certain neighborhoods.

Concentric or axial growth may be observed, starting at the original political and economic command center, followed by a relative decrease of central neighborhoods in the volume of production due to the emergence of secondary hubs in areas further from the center and in the eastern and southern outskirts of Brussels. These are the potential material banks of CDW which can feed in the material loop of urban mining.

Functional change of office buildings in Brussels from 1997 to 2017



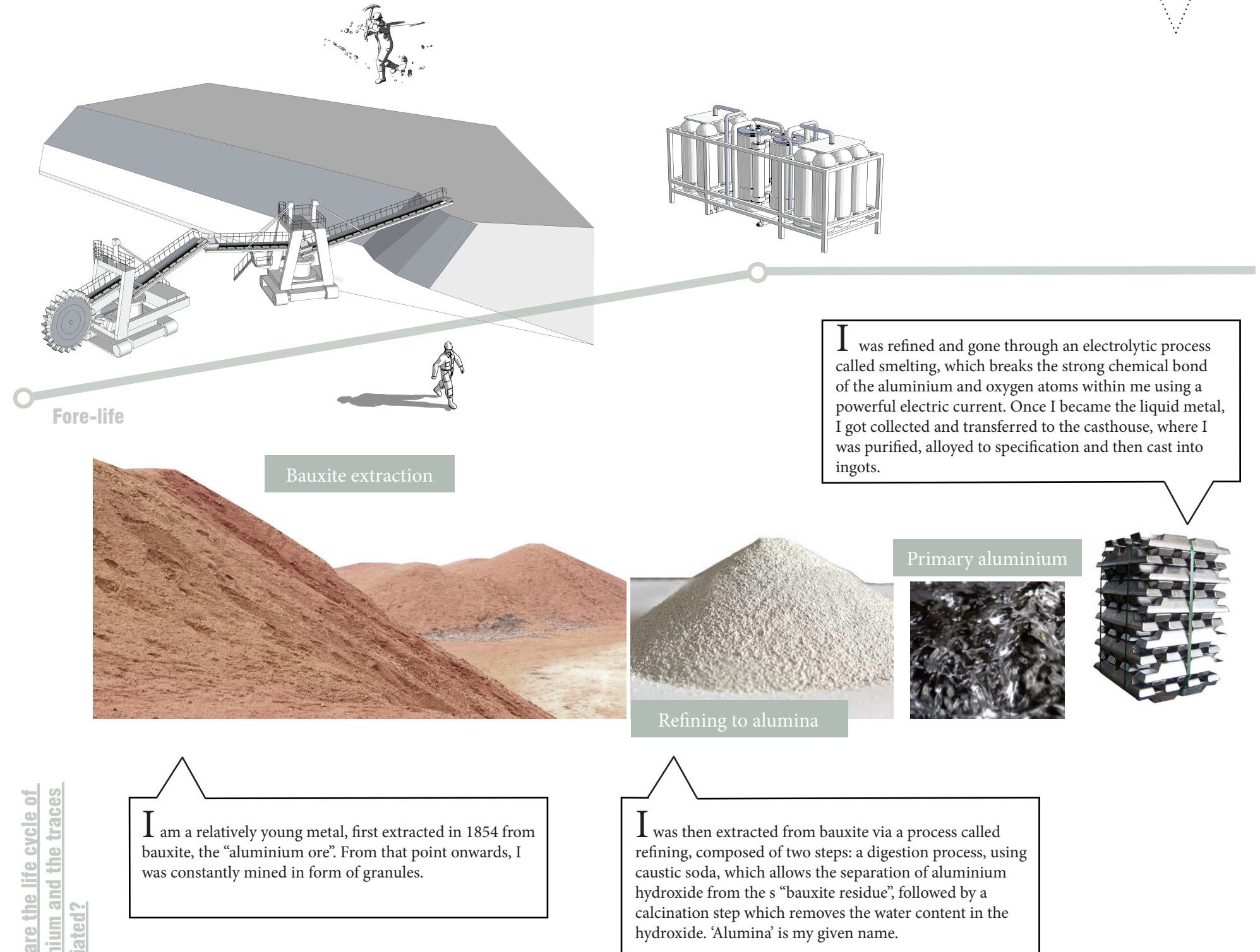
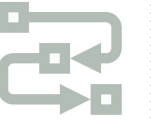
Office buildings converted to:

- Housing
- Industrial
- Commercial

*Phenomenology/
Integrating the essence of descriptive and hermeneutic phenomenology, autobiography of materials was preferred as the documentation medium than biography because it is more communicative in terms of expressing the sensory experience with its first-person narrative. Thereby, the fore life, present life and future life of material were documented to build a collection of autobiographies in which the boundaries of research subject and object are blurred. To fill in the chapters of the autobiographies, inspired by the saying "Things create people as much as people make them," (Tilley, 1999, p.76).*

The illustrated autobiographies weld the distinction between abstract verbal description and sensual experience with hybrid of collages, mapping, illustrated timeline and text as a new metaphorical language.

METHODOLOGY

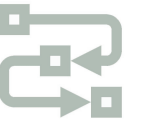


What are the life cycle of aluminium and the traces associated?

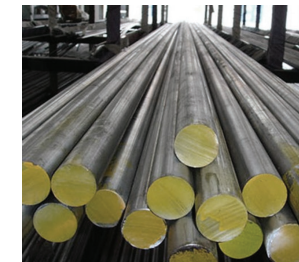
Phenomenology/

Phenomenology is applicable to examine the material literacy of the site users and how to take a great leap from material-human interaction to bottom-up design. Interactions with materials result in alterations, imperfections and ultimately unique objects, which carry traces of time and life (Rognoli & Karana, 2014). Therefore, types of trace developed along the life cycle of material were identified and individual participants were asked probing questions to understand what type of traces were perceived as aesthetic and meaningful. The impact of material traces can be evaluated and incorporated in the reinvention of materials.

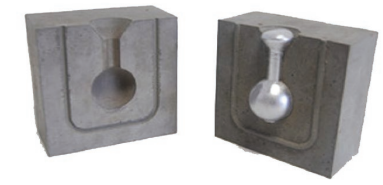
METHODOLOGY



Extrusion grants me endless shapes and profiles. The process consists of pushing a hot cylindrical billet of aluminium through a shaped die. Aluminium alloys can be extruded into complex shapes for multi-functional features.

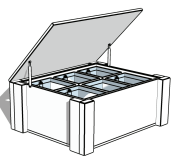


Extrusion



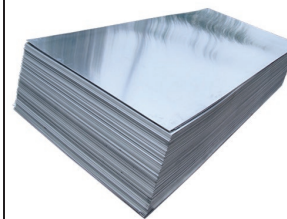
Casting

When I am molten, I can also be used for die casting, permanent mould casting and sand casting. Castings can also be made in any size and form.



Anodizing

Present life



Hot rolling



In order to obtain me as flat products, large aluminium slabs are fed into rolling mills that turn aluminium into sheets of various thicknesses. The process normally begins with a hot rolling method, taking me in form of a block back and forth through a reducing roller. Final rolling is through a cold roll process.

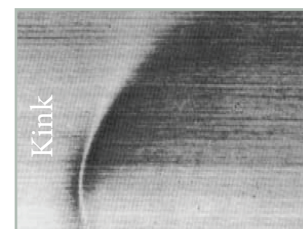
Anodizing is an electrochemical process whereby to reinforce the natural oxide film on the aluminium surface, increasing my hardness, corrosion and abrasion resistance. Anodizing gives a very decorative silver matte surface finish, and coloured surfaces can also be obtained by sealing metallic dyes into the anodized layer.

TRACE of fabrication



Crease

A sharp deviation/wrinkle from flat in the sheet.



Kink

An abrupt bend from flat which is caused by localized bending during handling the coil.



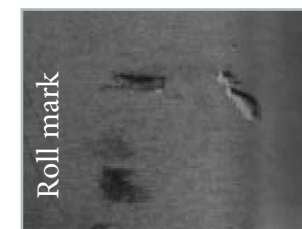
Stretch line

Alloys which have been drawn or stretch formed in which some areas receive little deformation.



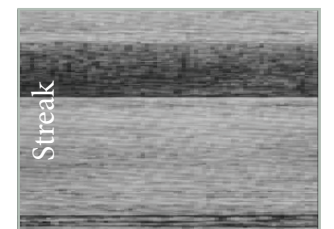
Diagonal line

Diagonal bands caused when stretching to produce good flatness.



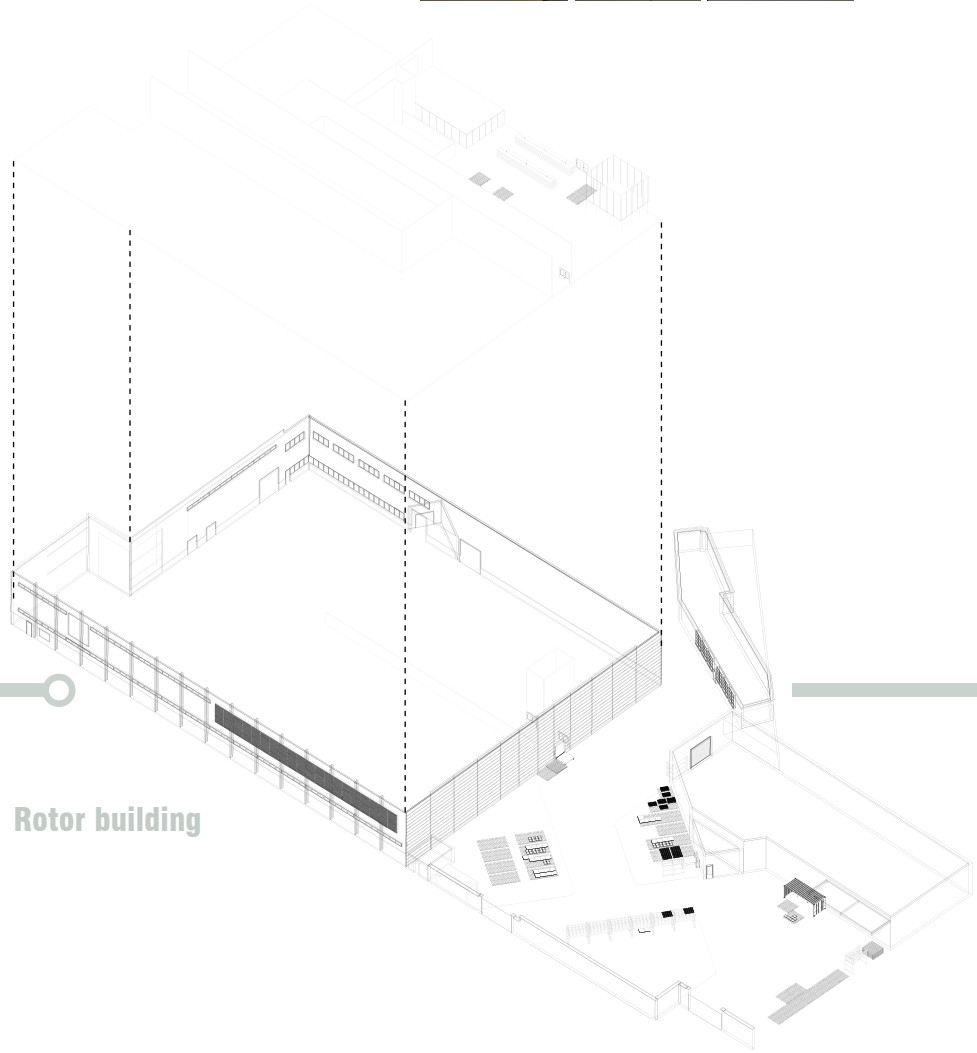
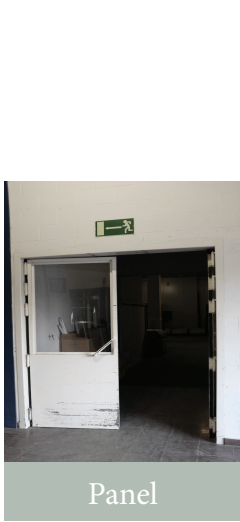
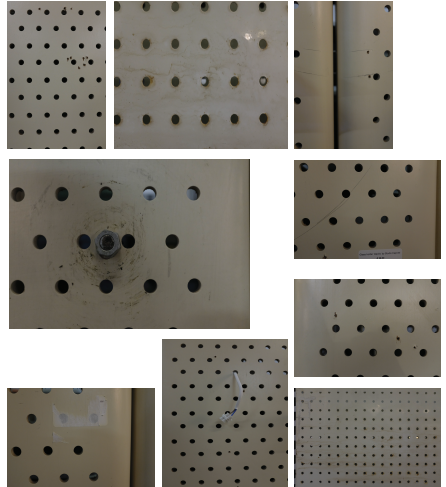
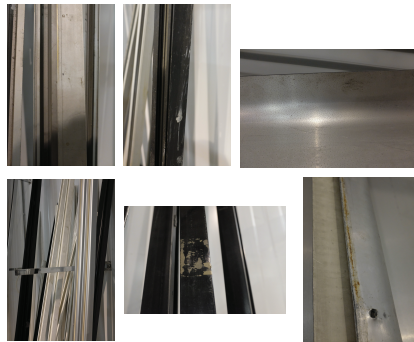
Roll mark

A small repeating raised on rolled products caused by the opposite condition on a roll.

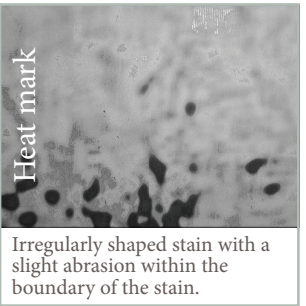
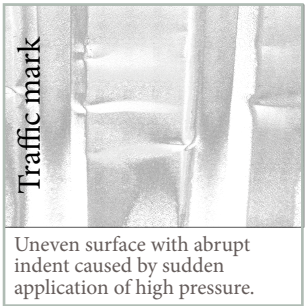
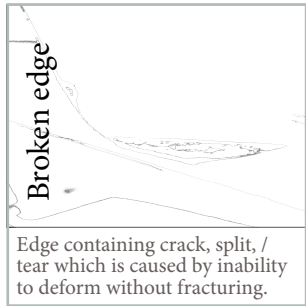
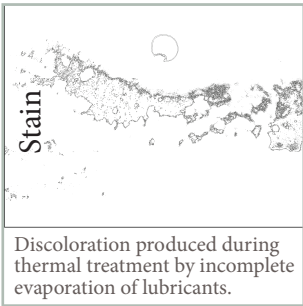
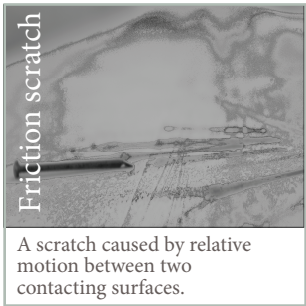
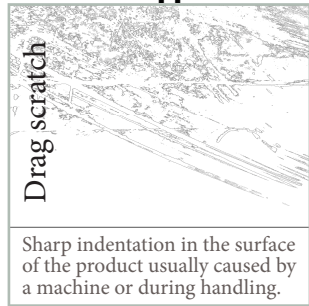


Streak

A non-uniform appearance on an anodized surface caused by heterogeneities in metal alloy.



TRACE of application





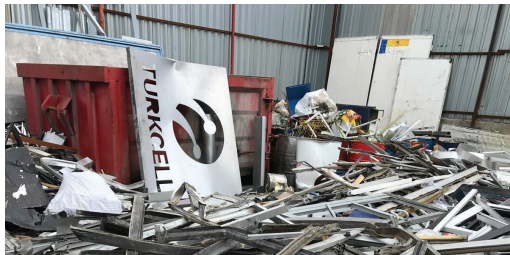
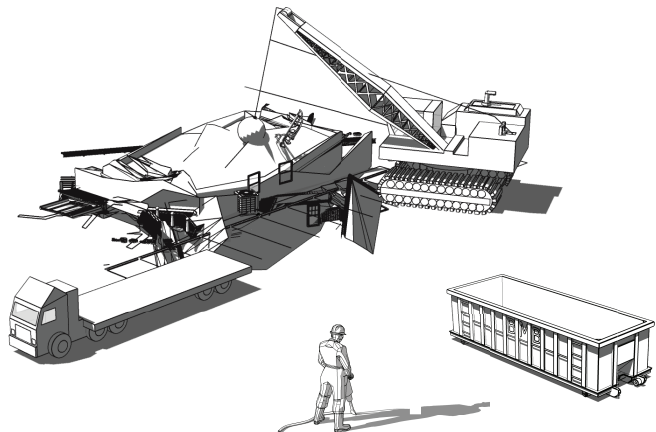
Exterior panel



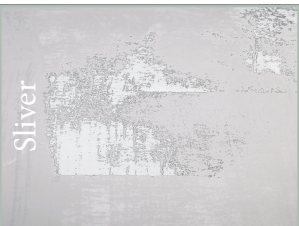
Cladding



Gate

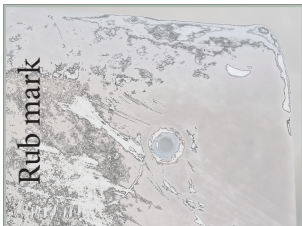


Demolition and collection



Sliver

Thin fragment of aluminum partially attached due to surface damage or residual liquation.



Rub mark

A rub mark can occur by metal-to-metal contact, handling and movement in transit.



Coating drip

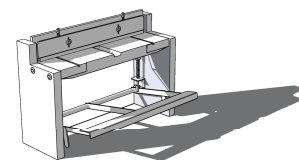
A non-uniform extraneous deposit of coating on the coated sheet.

After reaching the end of my service life from demolished building, I am collected as scrap. My disused portion is also harvested during the primary aluminium production or at any of the processes leading to final fabrication.

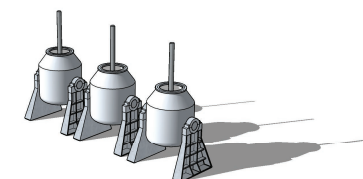
I, in form of aluminium scrap, am sheared and reduced in size by cutting.



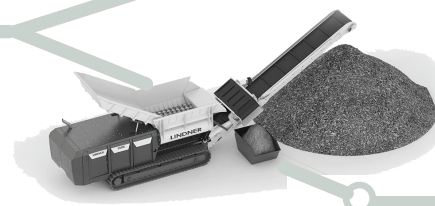
Shearing



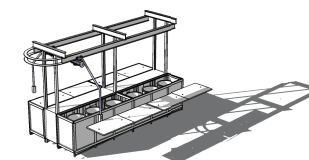
Remelting



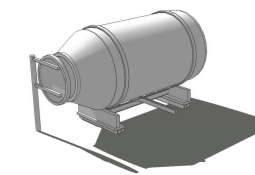
Remelters mainly process the sorted part of me in form of wrought alloy scrap in dry hearth furnaces to produce extrusion billets or rolling slabs.



Shredding



Separation



Refining



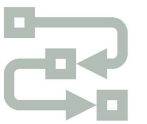
If I am mixed with other metals as alloys or soil, I will be out into refiners which melt all kinds of scrap, under a salt layer. I will then end up as casting alloys for foundries that produce metal castings.

In primary shredding, I am mixed with other composites as bulky waste. Long metal part is used to produce a sortable product that is reduced in volume by a multiple. The final grain either ends up as a product directly in the cycle or is further processed until it melts down. While in Fe metal deposition, an overband magnet can be used to easily sort my ferrous parts out.

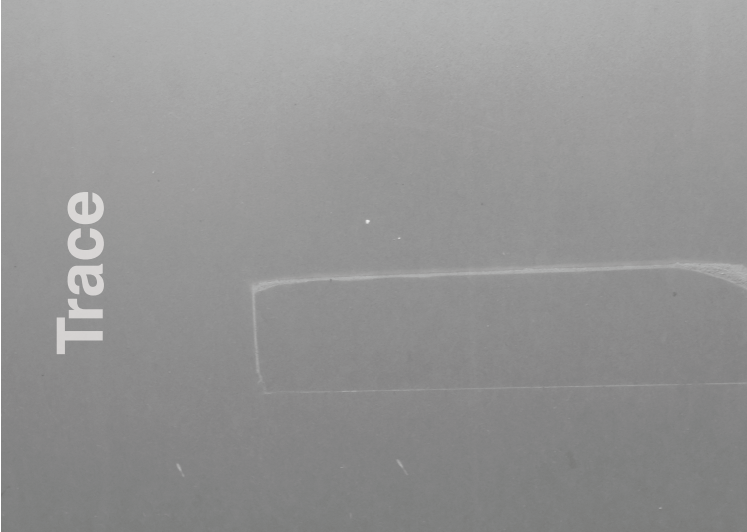
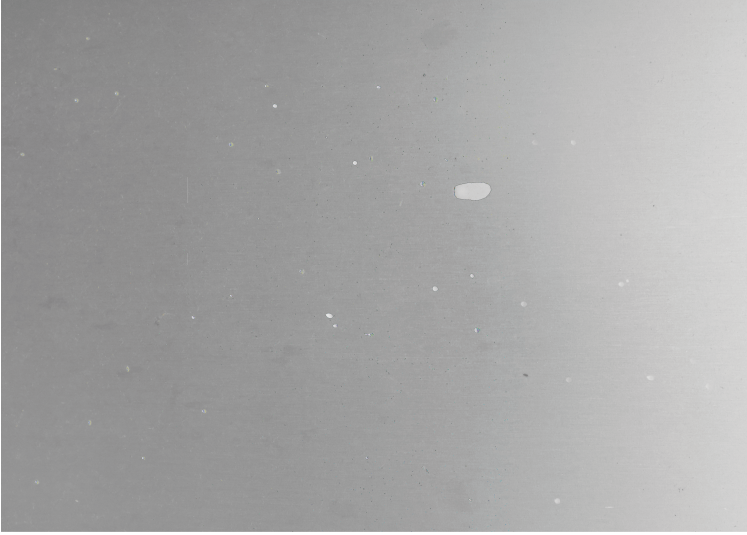
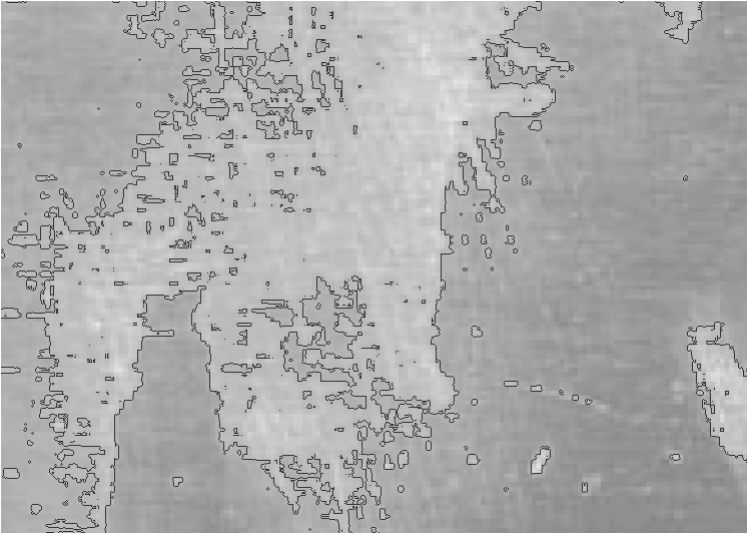
After shredding, I am still combined with other materials such as steel or plastics, which are most frequently mechanically separated before being molten: by eddy current and sink-float separation.

*Sensory experience mapping/
Interactive semi-structured interviews will be conducted with a matrix of activities and vocabulary to elicit the emotional expression of research participants instead of relying on their self-elaboration.
The interview will map out the interviewees' intuition and reflection*

METHODOLOGY



Afterlife



THE DOOR

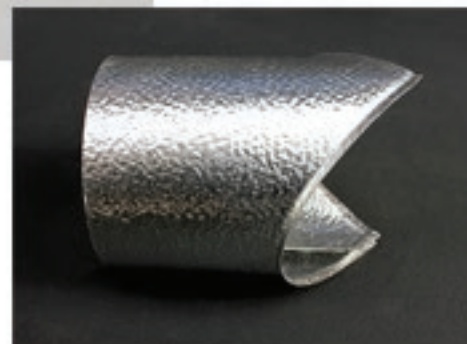
What is the trajectory of
aluminium?



Atomium, the Belgian pavilion for the first World Exposition after World War II.



Gun Metal Bench,
Xavier lust, 2006



An aluminium piece with hammered.

“A warm hand stroke on my cold and flush skin. The man moved closer to me and examined my presence, casting shadow on reflective body. The touch was seamless until he gave one of the very fine scratches. It was a wound caused by pallet truck being moved in haste, a mark of collision, speed and transition. Having protected the lift lobby of the building for years, I am still loaded with traffic of men and goods. After checking on my scratches, he pushed and knocked on me. The interaction put a smile on his face, ‘The compactness of aluminium has never failed to give me peace of mind and sense of security since my early childhood,’ he whispered, ‘it used to finish the exterior of Atomium, the giant walk-in sculpture of iron atom. My grandpa used to bring me there when I was young to experience the lift elevating at bullet speed. It is reflective and desirable especially on sunny days.’

Although he liked my reflective quality, he also anticipated my other possible appearances, ‘Xavier lust benches all around Brussels exhibit the lightweight and thinness that aluminium affords. I cannot resist the seduction of its flexibility shown by merely bending a piece of metal. I like how aluminium can play and immerse into light. The hammered texture can hint the affordance of its traces and at the same time be mischievous with light!’

What form will I take in the next stage?”

Security

IMMERSIVE

DESIRABLE

Speed

Still & calm

Everyday

FLEXIBILITY

Seductive

Reflective

Hard

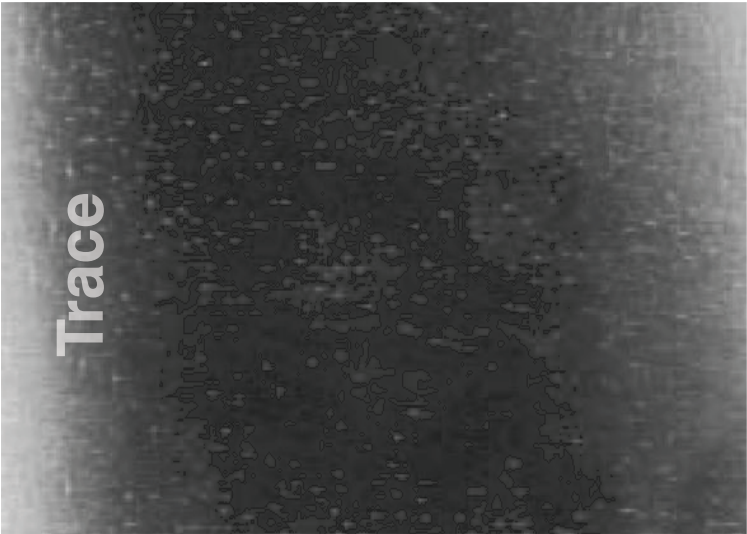
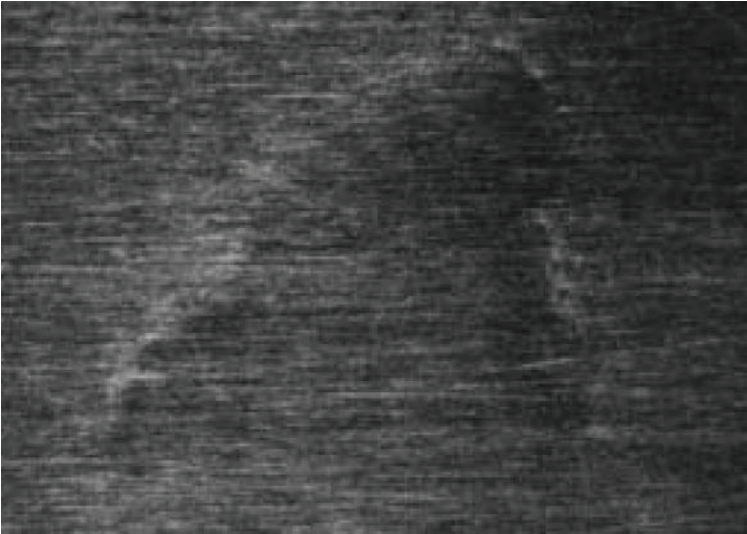
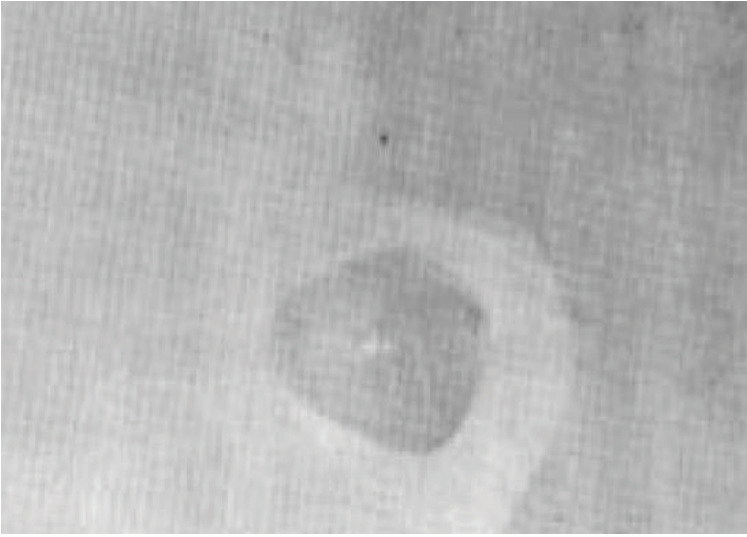
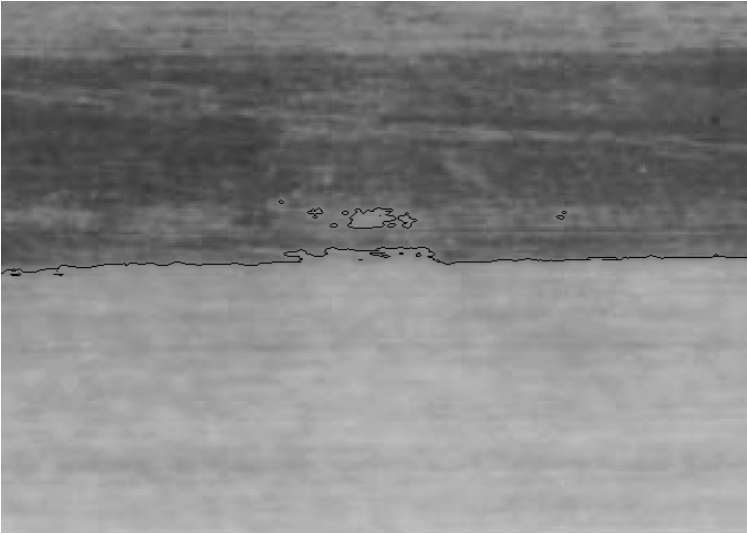
lightweight

PLAY WITH LIGHT

thin

FLEXIBILITY

COMPACTNESS



Trace

What is the trajectory of
aluminium?



THE DOOR HANDLE

Smooth
CLEAN
dull
PLASTICITY
TOY-LIKE

Hard
cold



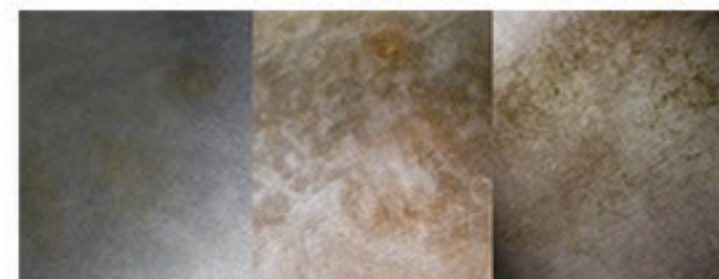
Affordable, lightweight and anodized aluminium cookware.



Aluminium foil can be wadded up into a polished ball.



Amalgam starts to stretch out when mercury is introduced to the aluminium plate.

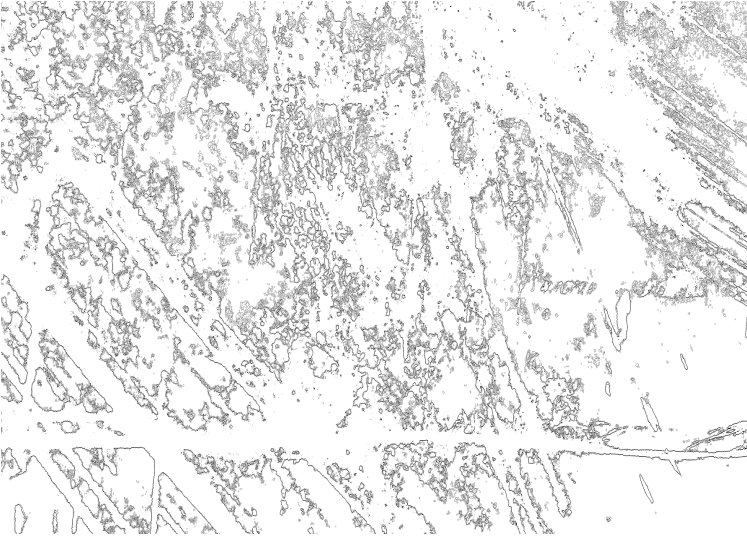
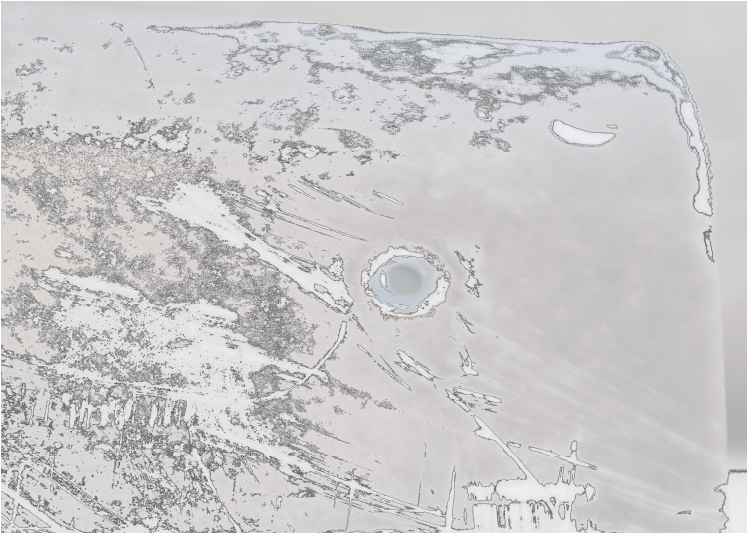


Patina finishes on aluminum showcase craftsmanship and character.

“A beam of light woke me up from hibernation since the start of winter. I was grabbed and picked by my master from the container where I have slept in for long. With my lever and trim plate being held, I was slowly rotated and pressed. ‘My first instinct to interact with the handle is to pull because of its grip profile. For me, aluminium is ubiquitous and can be found in all building layers,’ my master explained. He rubbed the mild scratch adhered to my lever caused by friction, ‘I can be disappointed when the aluminium surface is too smooth and flat, although it is manufactured to mean like this. Natural scars can give characteristics to this dull piece, for example, patina can accommodate varying degrees of scratching and brushing, enhancing the aesthetic and craftsmanship quality of the metal.’

I sensed the telepathy between him and aluminium. His flashback of memories associated with the metal is the cookware at his home where he had been living at since his birth and the aluminium foil ball appeared in Pee wee Herman’s comedy. After a series of pounding, tapping, and polishing, the rough pile of aluminium foil can be altered into a polished ball. He once even mixed mercury with aluminium that aluminum amalgam was formed and grew into a tall but brittle tower which was very delicate. It seems that my high plasticity granted me a playful nature that goes beyond my smooth and cold status quo.”

Hopeful
BORING
Disappointment
NOSTALGIC
Surprising
ORDINARY
Unpredictable
Everyday



Trace

What is the trajectory of
aluminium?



THE CLADDING

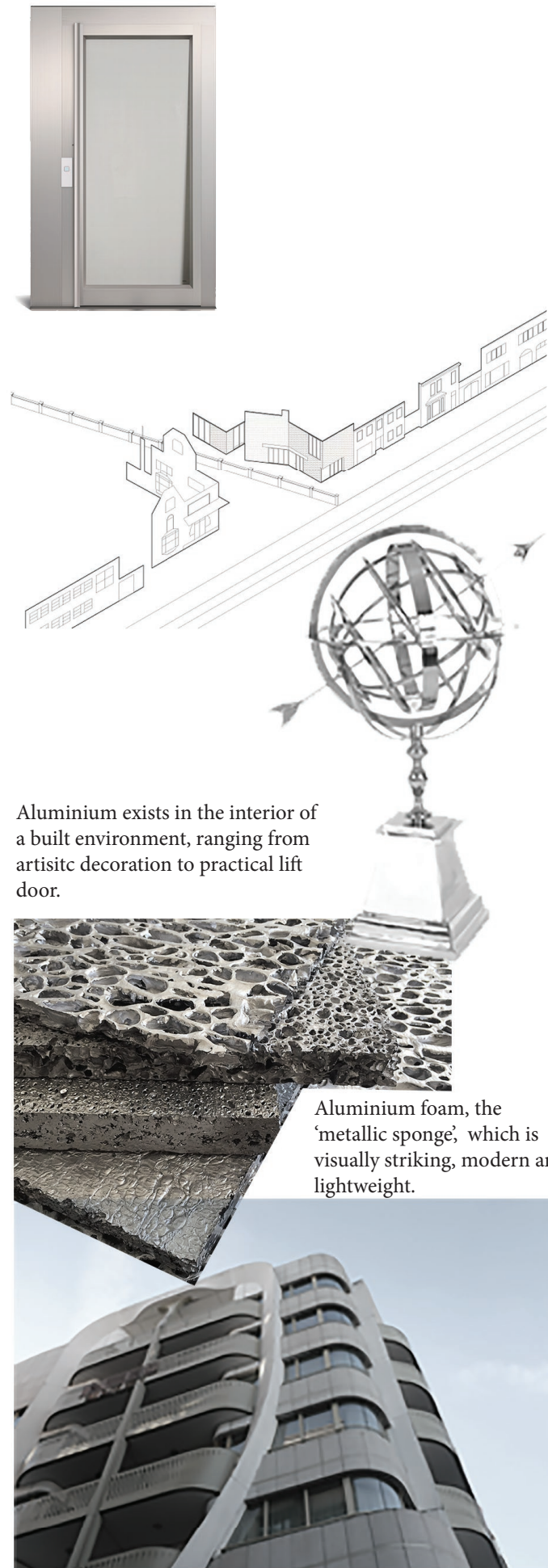
Dull Matte

SOLID Slim

 Heavy

 TOUGH

SCRATCHY



Aluminium exists in the interior of a built environment, ranging from artistic decoration to practical lift door.

Aluminium foam, the 'metallic sponge', which is visually striking, modern and lightweight.

A series of curved vertical aluminium frames with variations in depth and the repeating rhythm at Le Toison d'Or, Brussels, 2016.

“I have been lying on the rack for weeks after a long trip from Paris. The building that I was shedding is no longer standing and I am waiting for my new mission. The traffic and weather have corroded my appearance and I can hardly impress someone again to take me home. This morning, I got in touch with my new master finally. He brushed off the dust adhered to me, stroked and rubbed along the profile of my extruded profile. ‘The powerful yet calm presence of aluminium always draws immense respect from me. It has accompanied me since childhood, from the sculpture decoration at home to the lift that I took everyday at my apartment building. The silence that the metal grants is incredibly heart-wrenching,’ he uttered softly and I felt as if we have encountered sometime before with scattered scenes of déjà vu. His fingers followed my abraded surface, ‘The flaking edges and marks remind me of the previously legendary state of Belgium being a grand exporter of metal products. Despite having been undergone the prolonged recession of our economy around 1970s, the material still radiates resistance and now it becomes one of the major exports of the country again. I like how it is silent but provoking; elegant but sophisticated within an entity. I think perforated aluminium foam or curved and wavy expression would tell the antagonistic qualities that the material carries, both sturdy and expressive.’ At that junction, I realized he is not my new master but an old friend.

Modern **POWERFUL**

PROTECTIVE Futuristic

Elegant Reisant

SOPHISTICATED **Expressive**