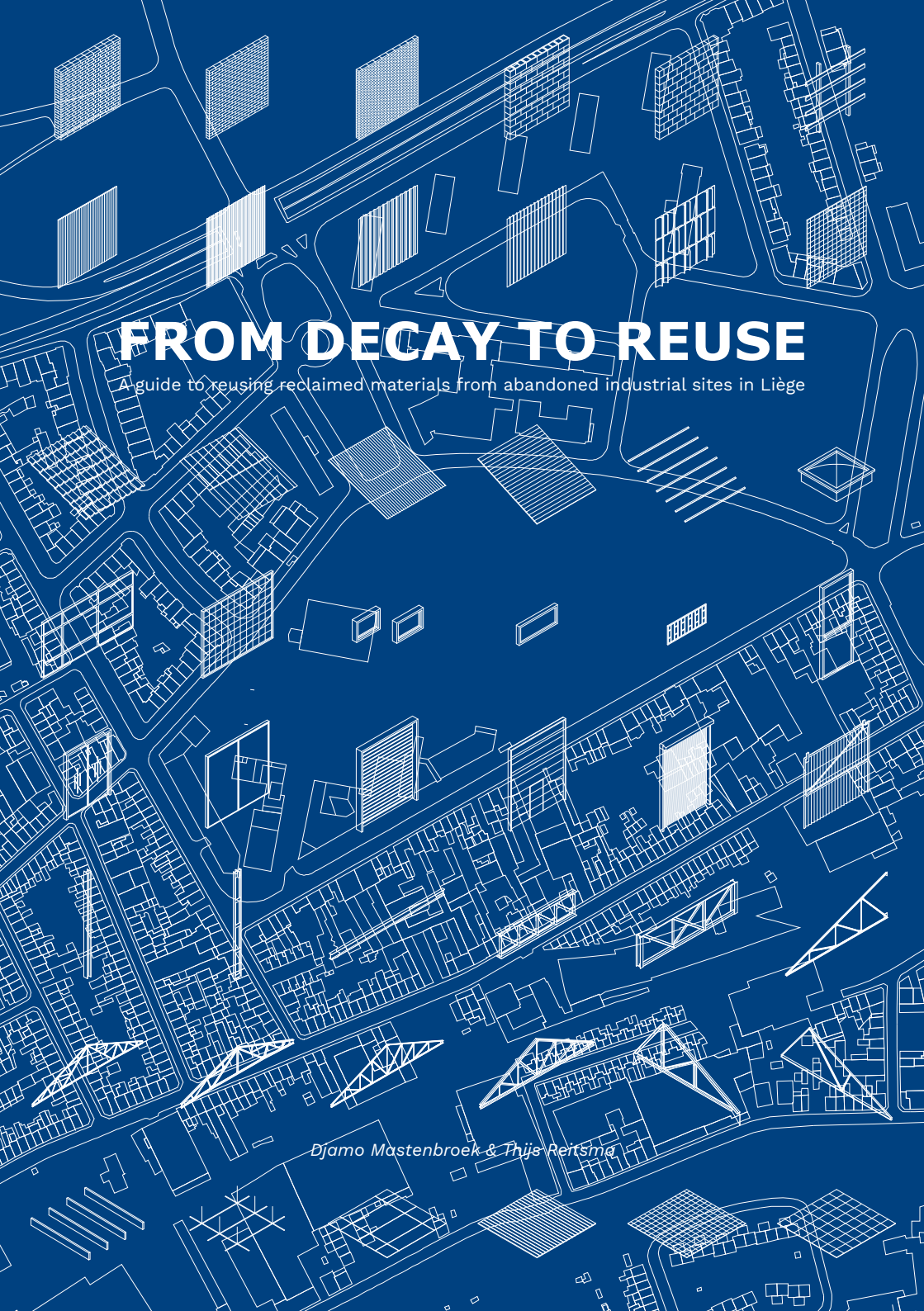


FROM DECAY TO REUSE

A guide to reusing reclaimed materials from abandoned industrial sites in Liège

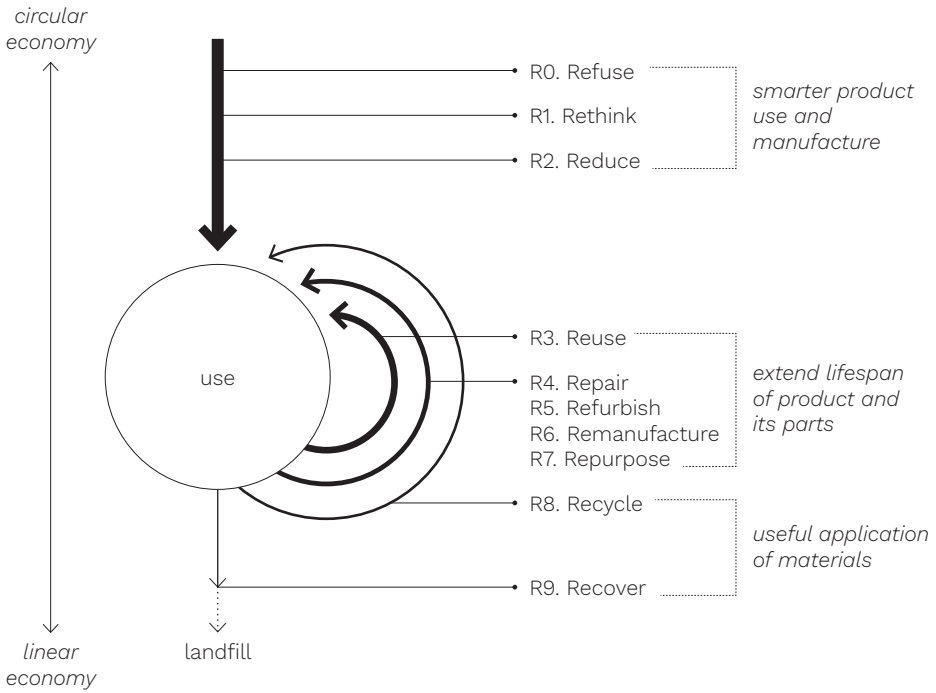
Djamo Mastenbroek & Thijs Reitsma

From Decay to Reuse
A guide to reusing reclaimed materials from abandoned industrial sites in Liège

Research booklet
Djamo Mastenbroek, Thijs Reitsma
June, 2023

Delft University of Technology
MSc Architecture, Urbanism and Building Sciences
MSc track Architecture
Urban Architecture graduation studio

Djamo Mastenbroek
Thijs Reitsma



re|fuse
making the product redundant by abondoning its function or by offering the same function with a radically different product

re|think
making the product use more intensive (e.g. through sharing products, or by putting multi functional products on the market)

re|duce
increasing the efficiency in product manufacture or use by consuming fewer natural resources and materials

re|use
using a component the same way as before; it retains both its form (geometry) and its function (use category).

re|pair
process of repair and maintenance of defective product so it can be used with its original function

re|fur|bish
improving, cleaning, re-equipping, and retrofitting of a component with the purpose of improving the components durability and usability.

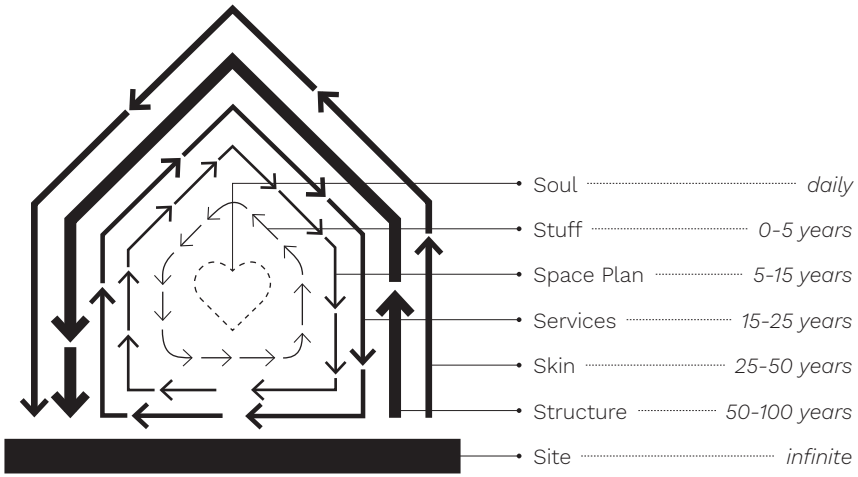
re|ma|nu|fac|ture
rebuilding a product back to its original manufactured form with parts that are new, repaired or reused. The remanufacturing process requires the replacement or repair of components that have become obsolete.

re|pur|pose
changing the function of a component, while retaining its form. It is not relevant whether the object's value is reduced or enhanced as a result of the process.

re|cy|cle
dissolution of the form (e.g. by breaking it up or melting it down) and reuse of the old materials in a similar production process, by which the function of the building material is often retained.

re|co|ver
burning of the materials with energy recovery. In a circular economy as few as possible materials end up in this phase.

Circular strategies within the production chain, in order of priority - adapted from Potting et al. (2017)



site
This is the geographical setting, the urban location, and the legally defined lot, whose boundaries and context outlast generations of ephemeral buildings. "Site is eternal."

struc|ture
The foundation and load-bearing elements are perilous and expensive to change, so people don't. These are the building. Structural life ranges from thirty to three hundred years (but few buildings make it past sixty for other reasons).

skin
Exterior surfaces now change every twenty years or so, to keep up with fashion or technology, or for wholesale repair. Recent focus on energy costs has led to re-engineered skins that are air-tight and better-insulated.

ser|vi|ces
These are the working guts of a building: communications wiring, electrical wiring, plumbing, fire sprinkler systems, HVAC (heating, ventilating, and air conditioning), and moving parts like elevators and escalators. They wear out or obsolesce every seven to fifteen years.

space plan
The interior layout, e.g. walls, ceilings, floors, and doors. Turbulent commercial space can change every three years or so; exceptionally quiet homes might wait thirty years.

stuff
Chairs, desks, phones, pictures; kitchen appliances, lamps, hairbrushes; all the things that twitch around daily to monthly.

soul
The people, the users of the building.

Shearing layers - adapted from Brand (1994)

In Liège, and especially Bressoux, a lot of buildings are left abandoned, therefore failing to comply to the potential of the space and materials and leaving Liège with a negative image. Simultaneously, a lot of new buildings in the area are constructed using purely new materials, seemingly neglecting their direct context and creating a sense of misplacement and gentrification as a result. To create sustainable and culturally fitting architecture, a connection between the local supply and demand of materials should be made, creating a circular building economy. This however requires a different approach to design and material management, raising many new challenges. An approach that is becoming increasingly popular is the act of reclaiming materials.

The act of reclaiming entails retrieving and recovering materials that have been previously used in a building or project, and which are then re-used in another project. The materials might be altered, re-sized, refinished, or adapted but are not reprocessed in any way, and remain in their original form. Abandoned buildings that are scattered through the neighbourhood of Bressoux can be read as a reservoir, a stockpile of material available for new developments and innovations. These buildings not just carry useable materials with them but also memory. This memory can sometimes leave traces of what was there, but it sometimes lets its history for the imagination of the spectator. Either way, the materials of the structures often resemble the era in which they were built, inseparable with the genius loci and thus cultural value of the place. Working with reclaimed materials is not just a matter of sustainability, it also entails a conscious approach to the world of existing qualities and the memories bound with them. Working with the existing might seem like an obstruction to the ability of inventing something new. On the contrary, it becomes apparent that the new always consists of a combination of the known. Like every other architectural design, working with reclaimed materials will give the possibility to make new combinations of qualities available to the city reservoir.

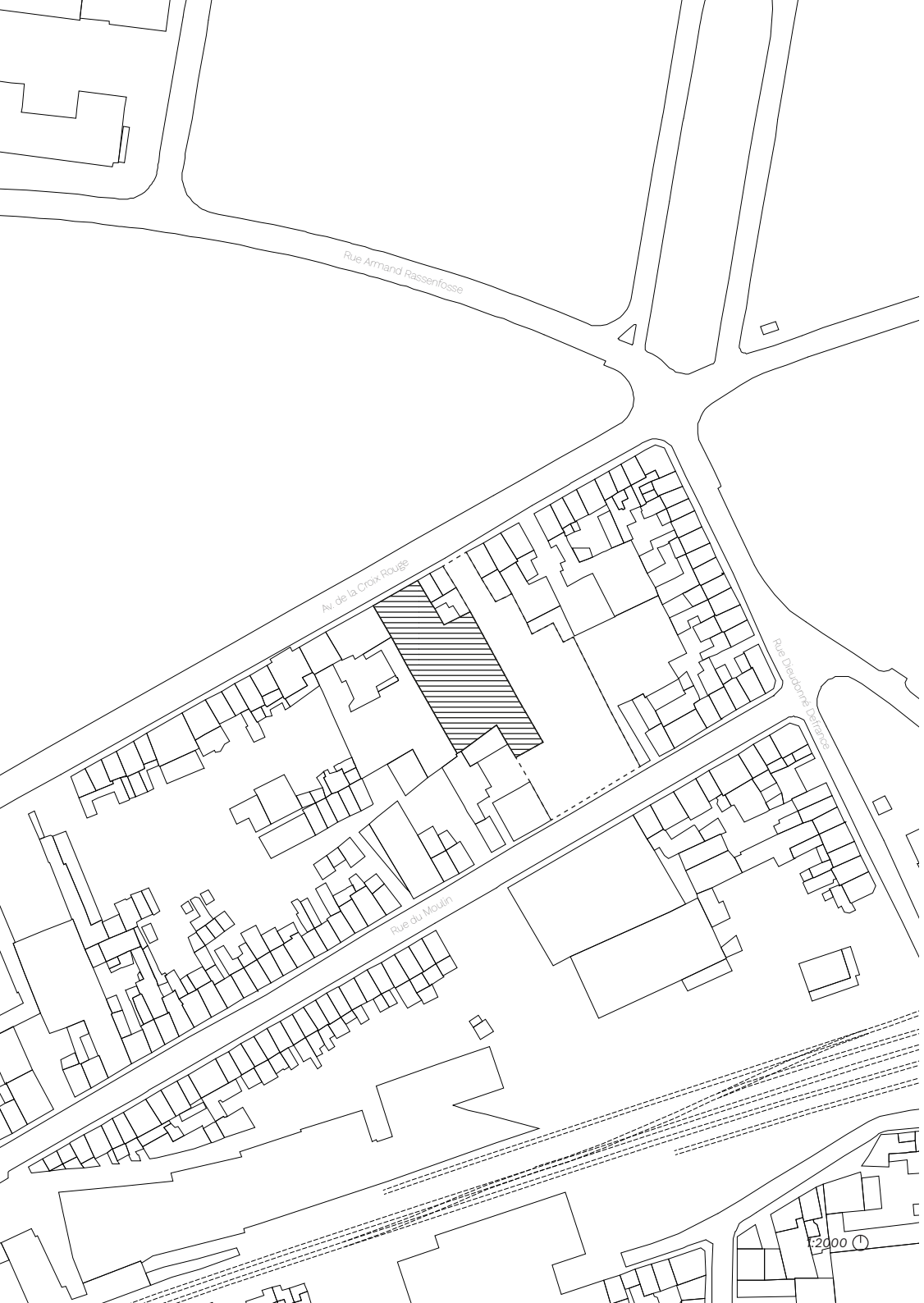
1:5000

01 MATERIAL CATALOGUE

To initiate the process of reclaiming local materials, a comprehensive assessment of the available resources is crucial. In this study, four vacant industrial buildings were selected as donor buildings for closer examination. Through a combination of site visits, extensive documentation including photographs, videos, archival drawings, and referencing relevant projects, the buildings were thoroughly deconstructed to identify and catalog the potential reusable materials they contained.

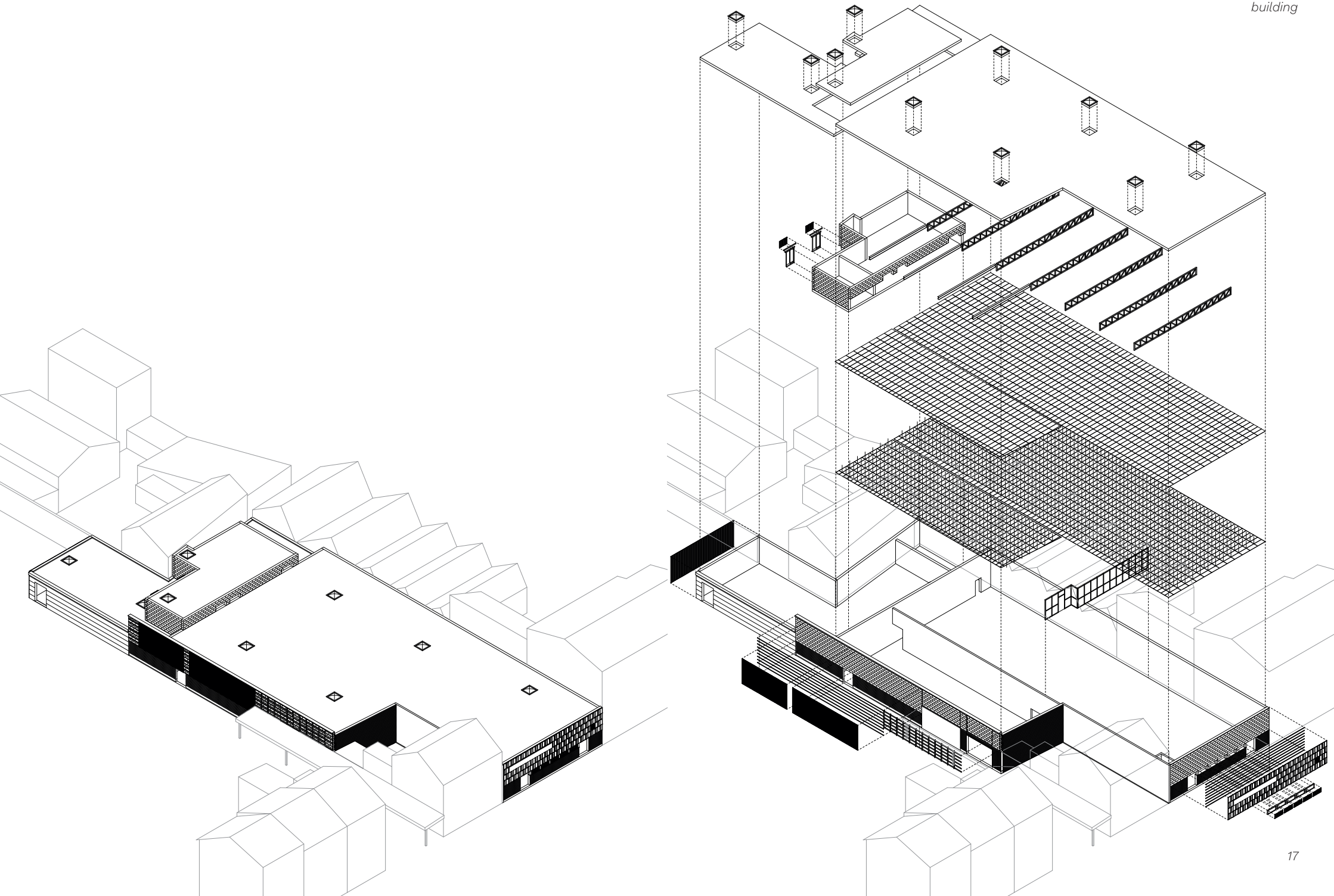
This meticulous documentation allowed for a detailed analysis of the buildings' components and materials, aiding in the identification of resources that could be salvaged and repurposed. By carefully documenting the materials found within these industrial structures, the groundwork was laid for further exploration into the potential applications and transformations of these reclaimed materials in future designs.

Through this initial phase of cataloguing and assessment, a solid foundation was established for the subsequent stages of the reclamation process, providing valuable insights into the available resources and their potential for reuse within innovative architectural projects.



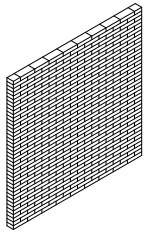
total area	2880 m²
built area	1298 m²
max. height	6.45 m
previous use	Warehouse

The building on Avenue de la Croix Rouge 266-270 is an old warehouse for Union coopérative, a department store that was located in the centre of Liège. The plot is located on both Av. de la Croix Rouge and Rue du Moulin whereas Rue de Moulin is the back entrance to the plot that is accessible for vehicles. The facade at Av. de la Croix Rouge is, apart from small window frames, completly closed off and gives no hint of what is happening inside. The main building is a one story building with a big span width construction in order to create the most useable square metres for storage.



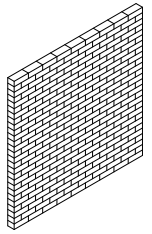
corrugated sheeting, brick work, door, timber framing, concrete masonry (picture by author)

corrugated sheeting, brick work, timber framing (picture by author)



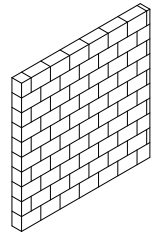
brick masonry (1)

ceramics - brown
210 x 100 x 40 mm

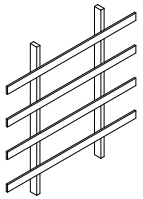


brick masonry (2)

ceramics - brown
215 x 101 x 65 mm

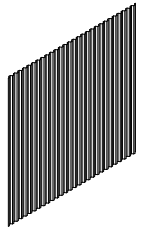


sand-lime masonry



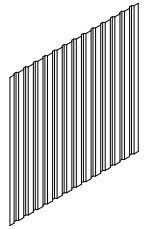
timber framing

wood - brown
20 x 50 mm
area:



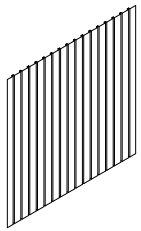
corrugated sheet (1)

steel - white
area: 60 m²



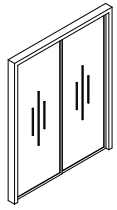
corrugated sheet (2)

steel - white
area : 35 m²



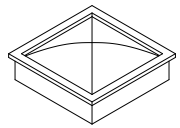
corrugated sheet (3)

steel - white
area : 2 m²



double exterior door

1x 1600x2000mm
2x 1600x1800mm

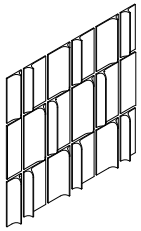


roof light

quantity: 10x

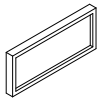
brick masonry, window grill, window frame, facade panel (picture by author)

concrete masonry, brick masonry, corrugated sheeting, roller door, roof light, timber framing (picture by author)



facade panel

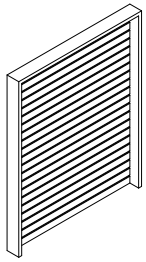
plastic - grey
30 x 80 mm
area: 40 m²



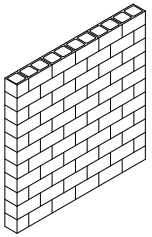
window frame

window grill

steel - white
1250 x 800 mm
quantity: 5

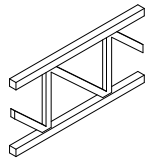


roller door (1)



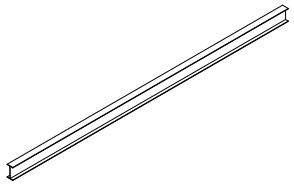
concrete masonry

concrete - grey
390 x 190 x 190 mm
area: 1000 m²



straight truss (1)

steel - grey
200 x 1000 mm
length: 7 x 15 m

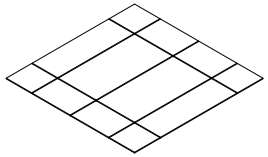


beam (1)

steel - grey
200 x 300 mm
length: 9 x 4 m

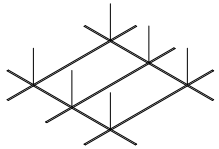
suspended ceiling panel, floor tiles, concrete masonry room divider, radiator, fixture (picture courtesy of realo.be)

wall tile, window frame, fixture (picture courtesy of realo.be)



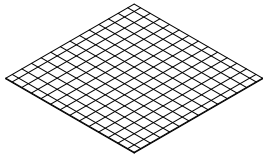
suspended ceiling panel

mineral fiber - white
600 x 1200 mm
area: 900 m²



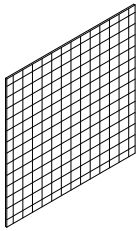
suspended ceiling system

aluminium
600 x 1200 mm spacing
area: 900 m²



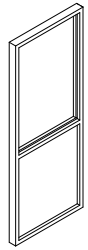
floor tile (1)

ceramics - white
150 x 150 mm
area: 650 m²



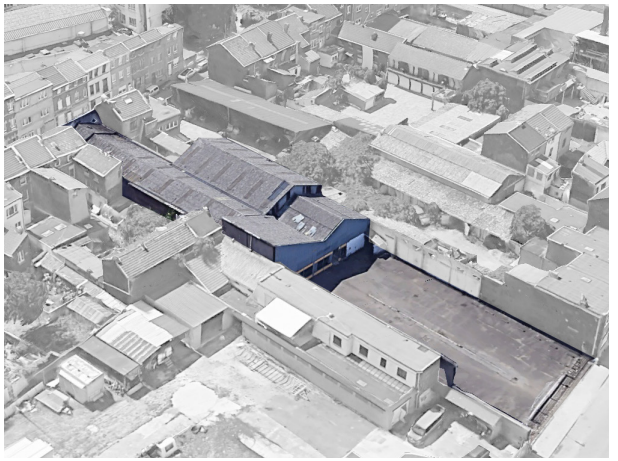
wall tile

ceramics - blue
150 x 150 mm



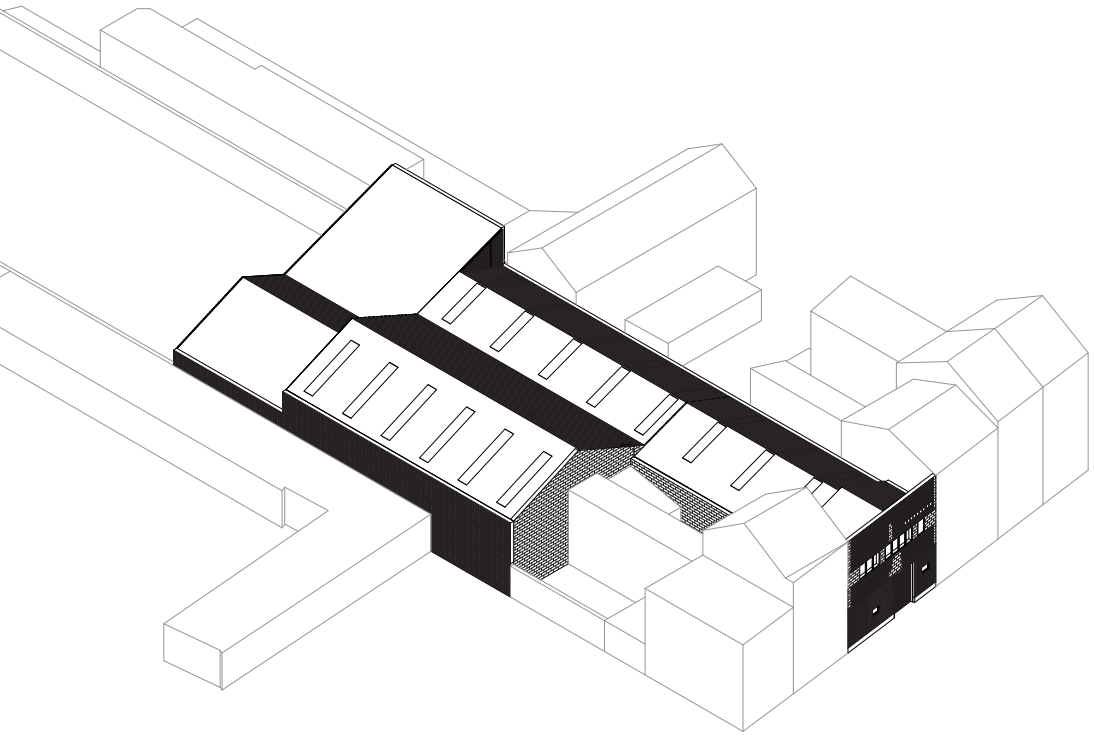
room divider

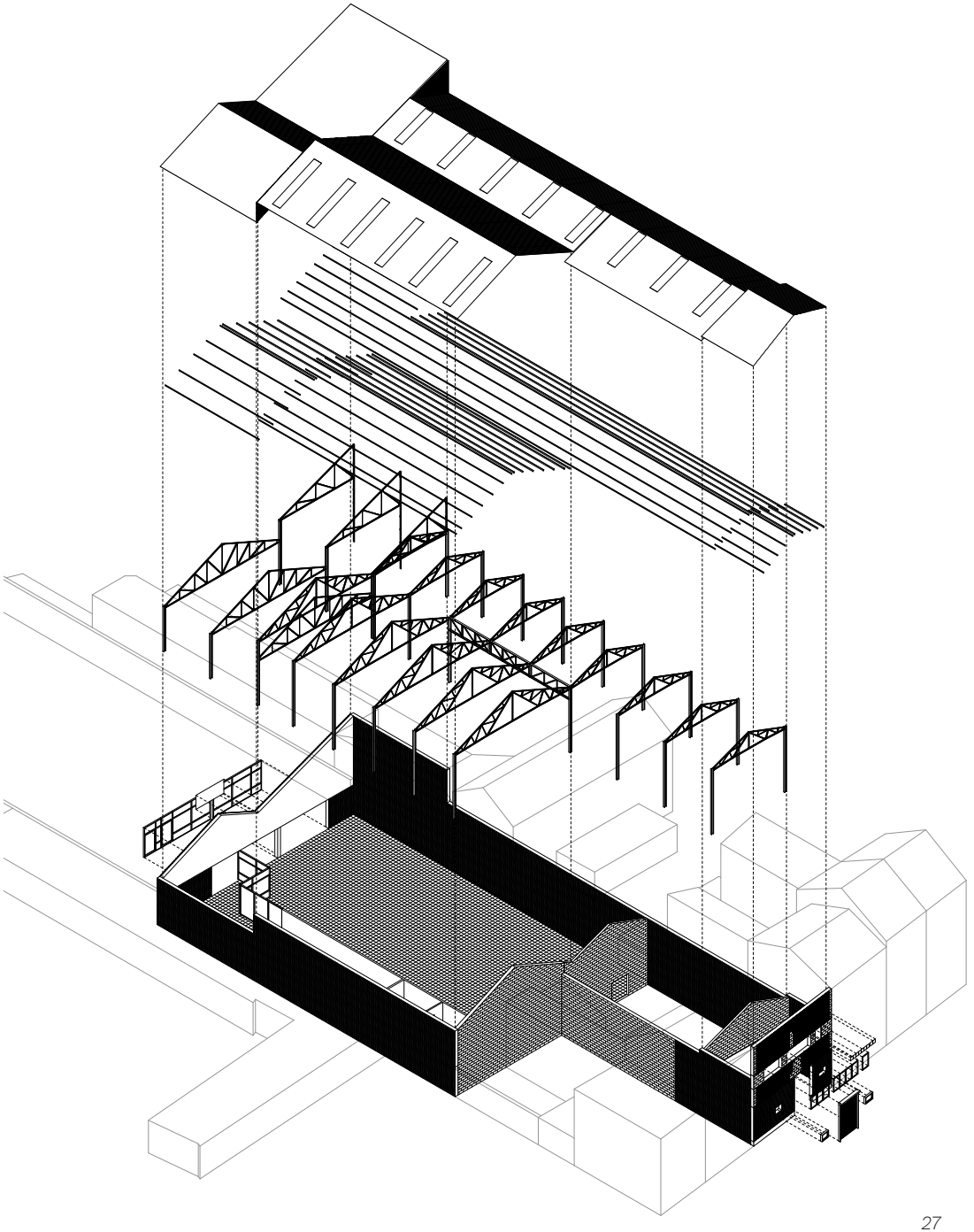
wood - brown
1000 x 2700 mm
quantity: 16



total area	1520 m²
built area	838 m²
max. height	9 m
previous use	Metallurgical workshop

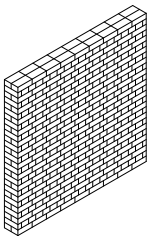
The building on Avenue de la Croix Rouge 190 was originally a metallurgical workshop. Throughout the years the building served multiple functions such as a warehouse, workshop, butcher and a building material store. The building is currently ocassionaly used by the Church of Pentecost. In the 1980s the building went through a transformation where the roof construction and the facade facing Av. de la Croix Rouge was replaced. The part of the building facing Rue de Moulin was struck by a fire and left damage to the facade. As far as known this part of the building is currently vacant.



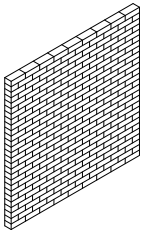


brick masonry, concrete masonry, corrugated sheeting, roller door (picture by author)

brick masonry, corrugated sheeting, curtain wall (picture by author)

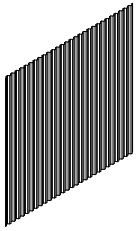


brick masonry (3)
module format

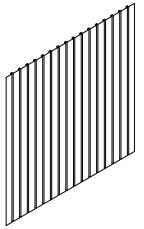


concrete masonry (2)
dikformat - running bond

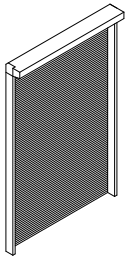
timber framing



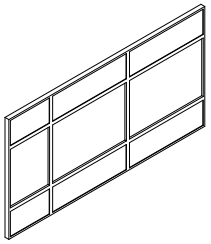
corrugated sheet (1)
plastic - white



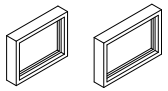
corrugated sheet (3)
steel - grey



roller door (2)



curtain wall



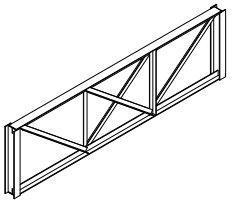
windows

concrete masonry, pitched truss (picture by author)

curtain wall, floor tiles (image courtesy of Int. Church of Pentecost)

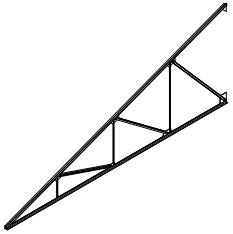
column

steel - brown
200x300x5800mm
quantity:



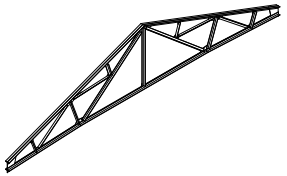
straight truss

steel - brown
200x1400x4250mm
quantity: 3x



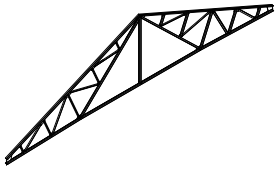
single pitch truss

steel - brown
150x7500x3000
quantity: 3x



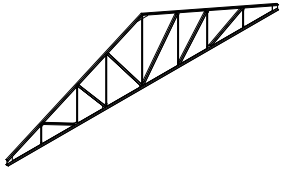
fink truss (1)

steel - brown
150x7500x1500mm
quantity: 9x



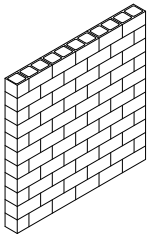
fink truss (2)

steel - brown
150x12000x2700mm
quantity: 6x

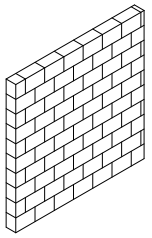


howe truss (1)

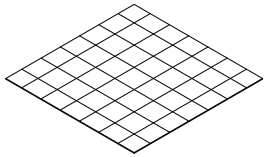
steel - brown
150x12000x2700mm
quantity: 3x



concrete masonry

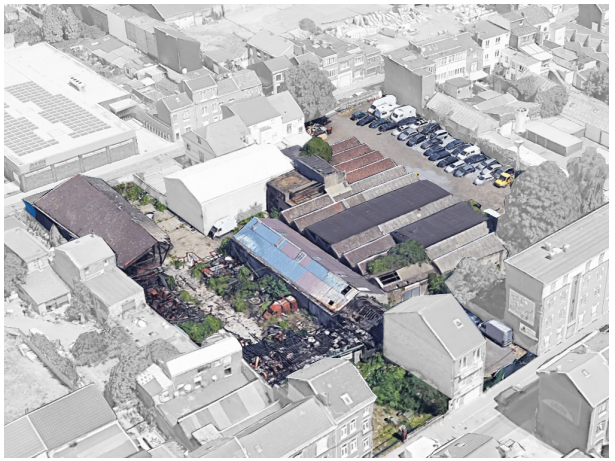


sand-lime masonry



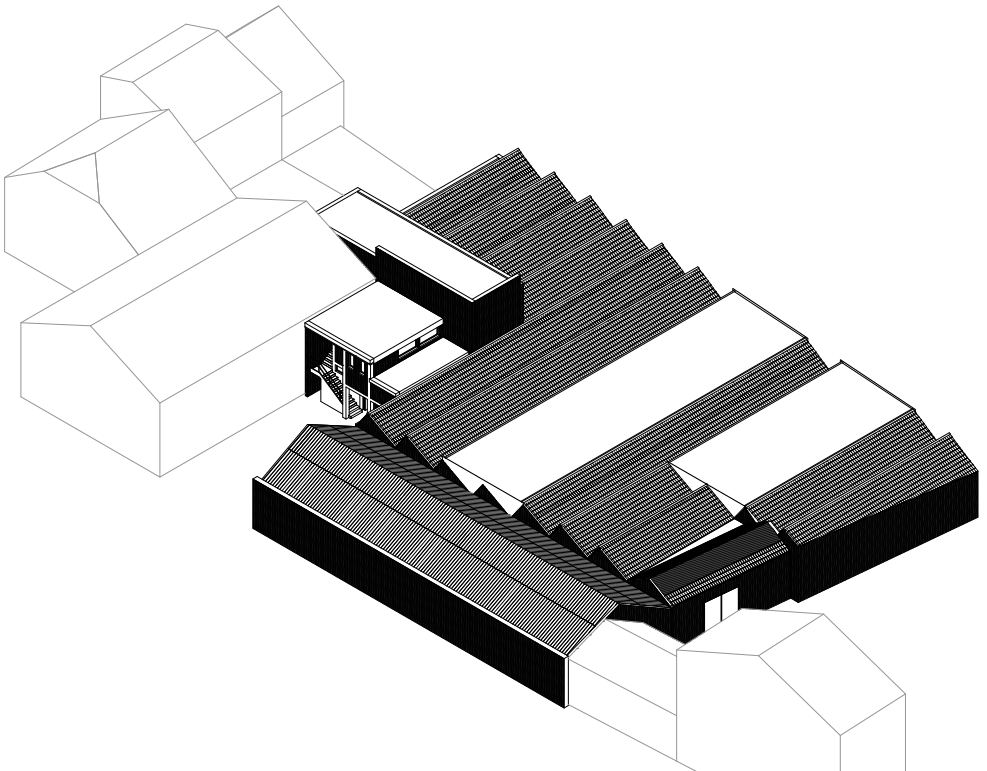
floor tiles (2)

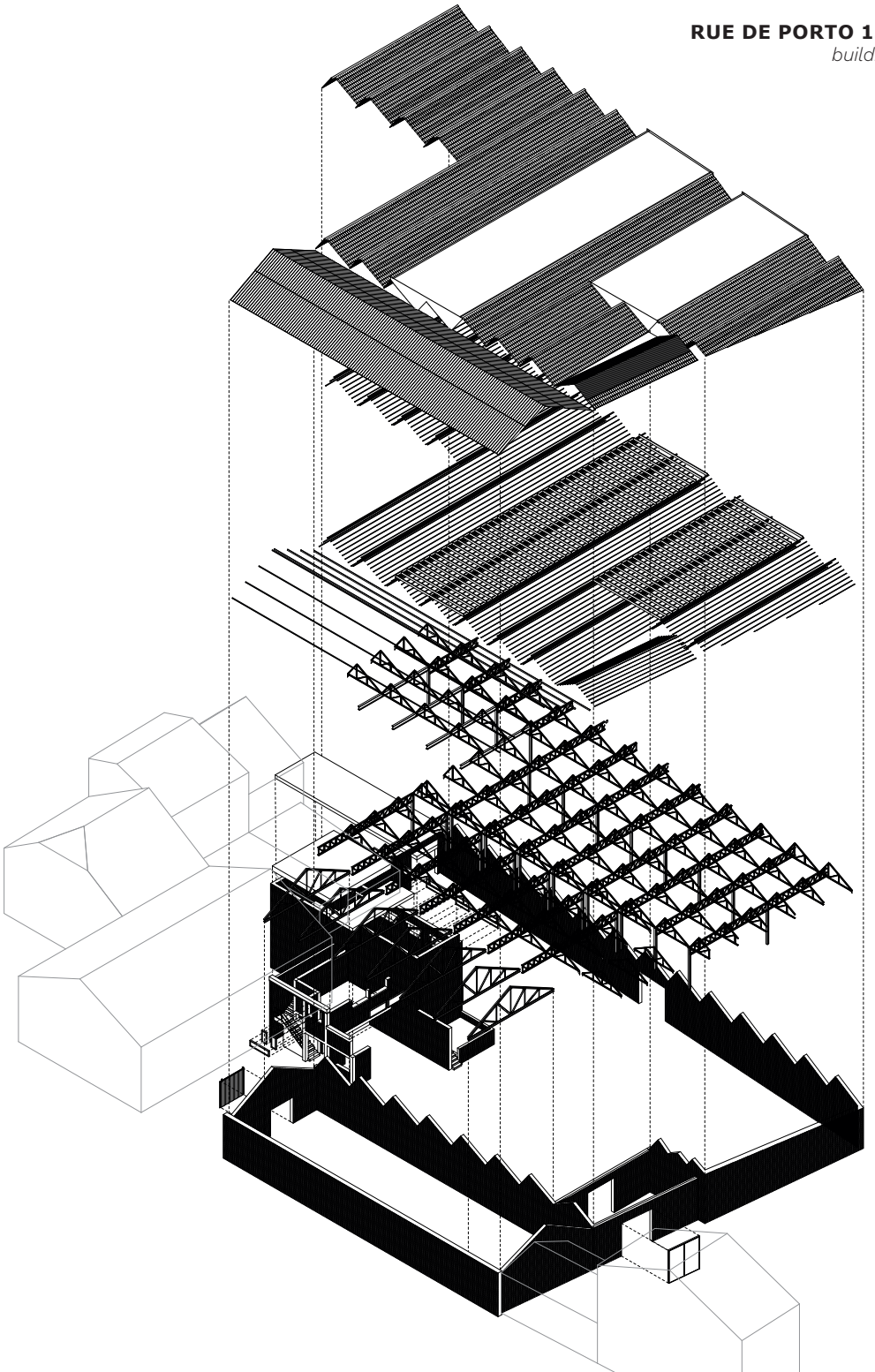
ceramic
300 x 300 mm



total area	4500 m²
built area	1290 m²
max. height	4,3 m
previous use	Metal foundry

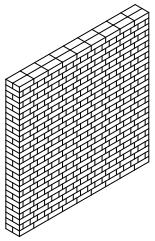
The building on Rue de Porto 139 is an old metal foundry that also served as a warehouse and car storage. The building is centred between Rue de Porto and Rue Raymond Geenen and is identifiable by a typical saw tooth roof structure. From both streets you can only get a glimps of the building from different angles. The plot has also served a timber factory and distributor which unforunately was burned down causing damage to the roof structure of the building. Although the building is currently vacant objects such as tables and chairs do show a sign of occupation.





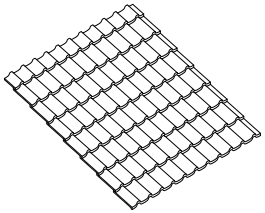
brick masonry, corrugated sheeting, ceramic roof tile, door (picture by author)

brick masonry, corrugated sheeting, sliding door, straight truss (picture by Wiktoria Paszek)



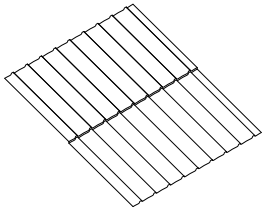
brick masonry [3]

module format



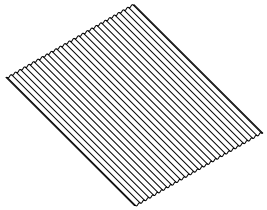
ceramic roof tile

ceramic



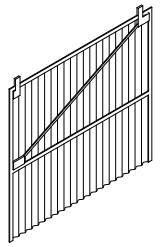
corrugated sheet [4]

steel



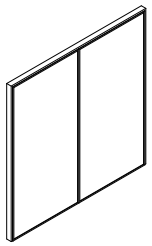
corrugated sheet [5]

plastic - translucent



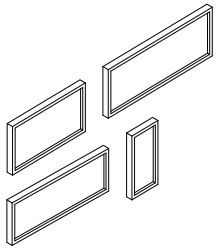
sliding door

steel, corrugated sheet
2600x2400mm



double exterior door [2]

aluminum
3000x3000mm

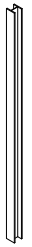


windows

steel frames
2x 1400x800, 3x 2000x800,
2x 1800x700, 2x 500x1100 mm

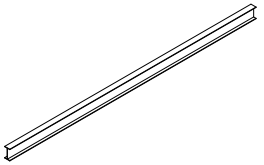
brick masonry, column, straight truss, dual pitch truss, timber framing, paving tiles (picture by author)

window frames, timber framing (picture by author)



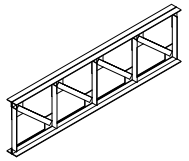
column

steel - brown red
200x200x3800mm
quantity: 27x



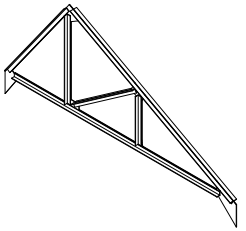
beam

steel - brown red
200x300x7300mm
quantity: 4x



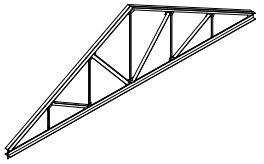
straight truss [2]

steel - brown red
150x700x500/625mm
7x10m, 7x14-16m, 4x4,5-5m



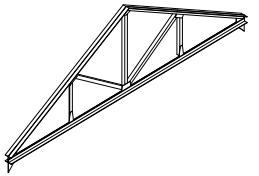
dual pitch truss

steel - brown red
100x3600x1400mm
quantity: 98x



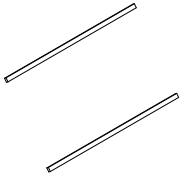
howe truss [3]

steel - brown red
150x9000x1300mm
quantity: 7x



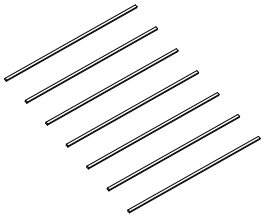
howe truss [4]

steel - brown red
100x4100x1300mm
quantity: 3x



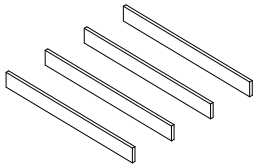
timber roof batten

wood
40x40mm
±750m



steel roof batten

steel - brown red
30x30mm
±2000m

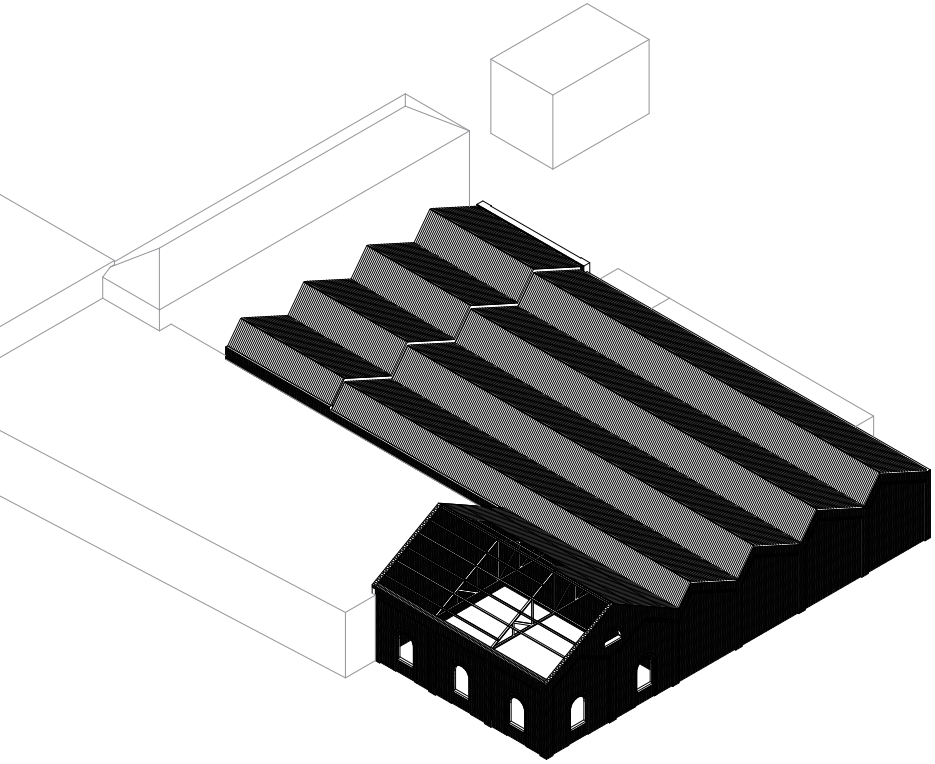


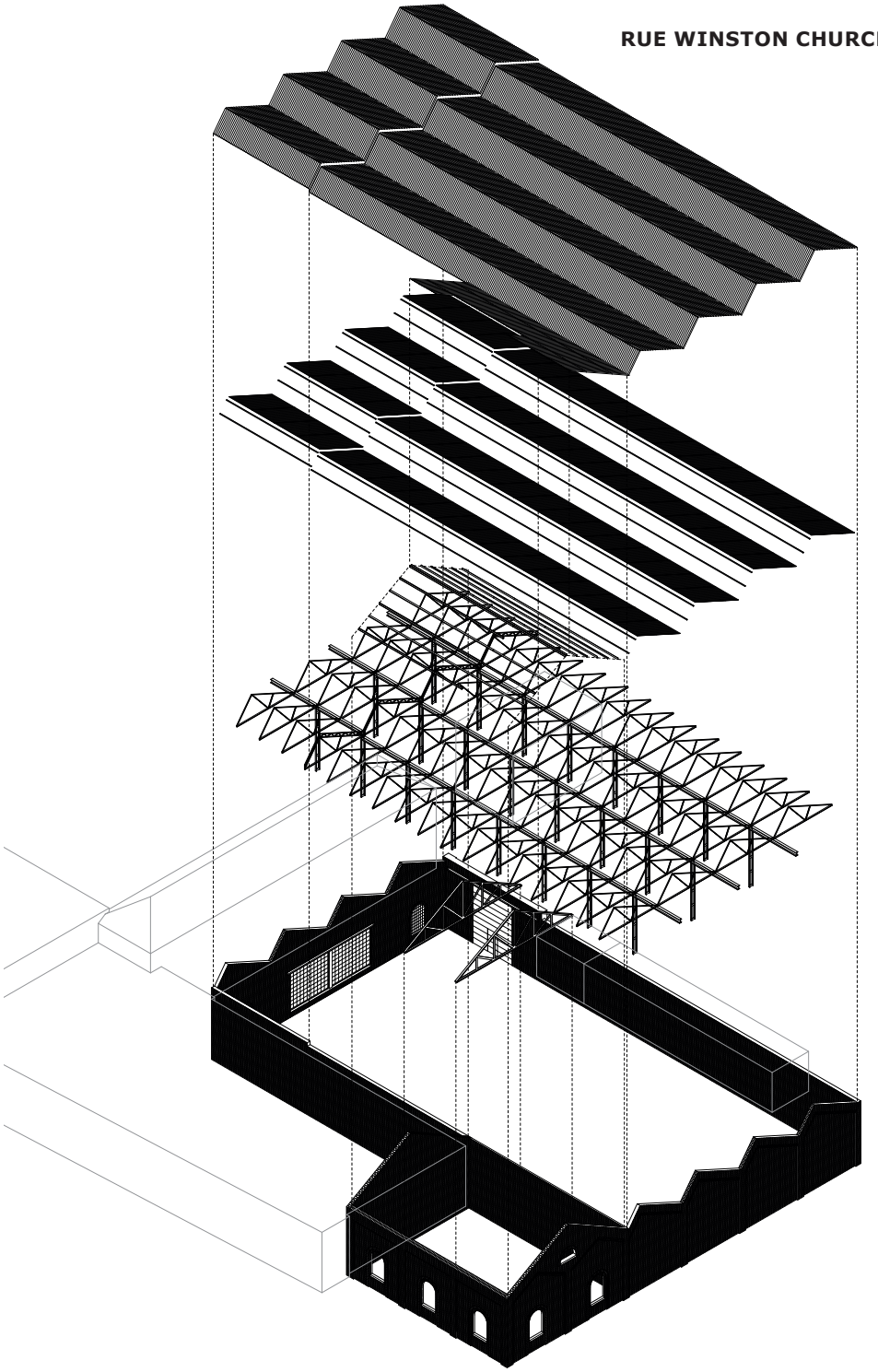
timber framing

wood
30x200x3600mm
quantity: 140x

total area	1400 m²
built area	1296 m²
max. height	6 m
previous use	copper foundry

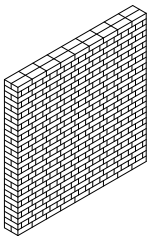
The buildng at Rue Winston Churchill 229 is an old copper foundry that was owned by J & J Dewandre. The building is characterised by its saw tooth roof construction, brick work and its windows. In its current state the building is decaying whereas a part of the roof from the bigger building is missing. While there seems no sign of activity the building is still in use as a storage space.



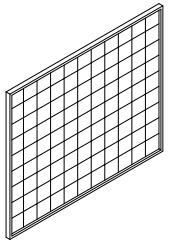


brick masonry, corrugated sheeting, roof tiles (picture by author)

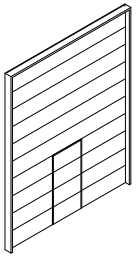
brick masonry, ceramic roof tiles, roller door, window frames (picture by Simon van Soolingen)



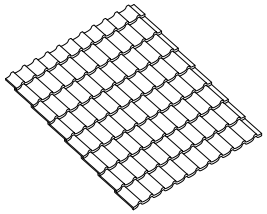
brick masonry [3]
module format



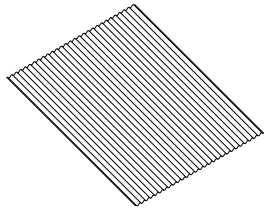
window
steel framing



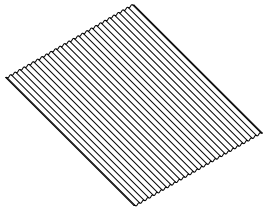
roller door



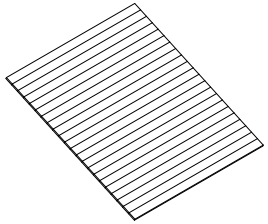
roof tiles
ceramic



corrugated sheets
steel



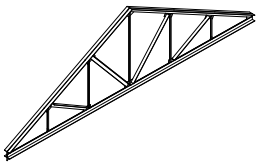
corrugated sheets
plastic - translucent



roof decking
wood

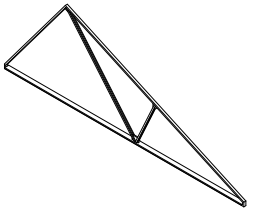
brick masonry, pitched truss, steel frame work (picture by author)

brick masonry, roller door, belgian truss, column, roof decking (picture by Simon van Soolingen)



howe truss

column



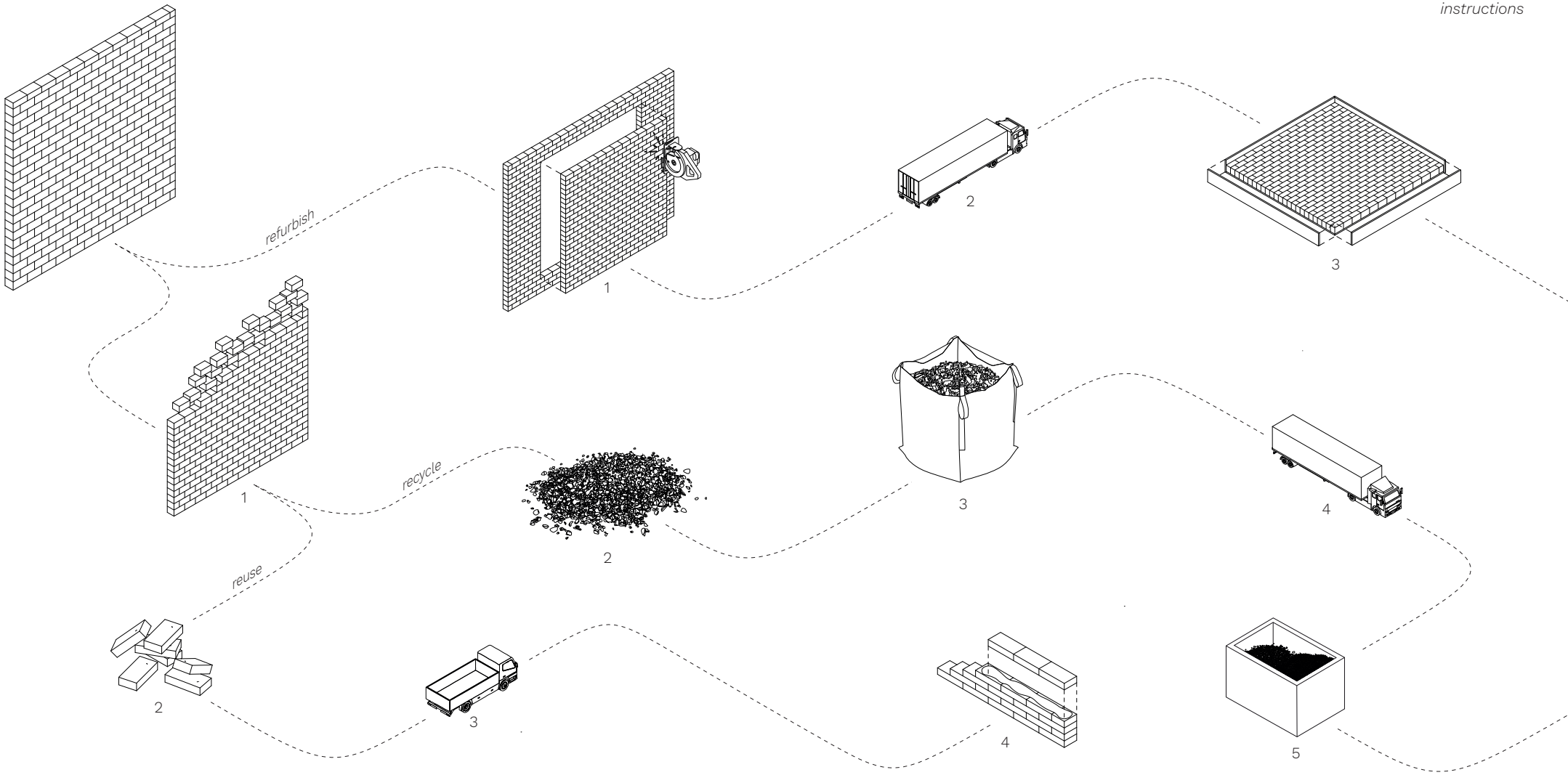
dual pitch truss [2]

02 PROCESS

Once the cataloging of the materials from the vacant industrial buildings is complete, the focus shifts towards understanding the various processes required to effectively reuse these materials. While some materials may be suitable for direct reuse, others may need to undergo specific alterations or treatments to meet specific design needs. In this context, the most frequently encountered materials, namely brick masonry, concrete masonry, timber structures, and ceramics, are given special attention.

For each of these materials, a thorough analysis is conducted to determine the most appropriate processes for reclamation and reuse. This includes examining factors such as the structural integrity, condition, and potential limitations of each material. Techniques and methods for cleaning, refurbishing, and transforming the materials are explored, ensuring that they can be repurposed in a manner that aligns with the desired design objectives.

By addressing the unique characteristics and challenges associated with each material type, a comprehensive understanding is developed regarding the necessary processes for their successful reuse. This knowledge serves as a guide for architects and designers seeking to integrate these reclaimed materials into their projects, facilitating sustainable and resource-conscious design practices.



Instructions for reusing

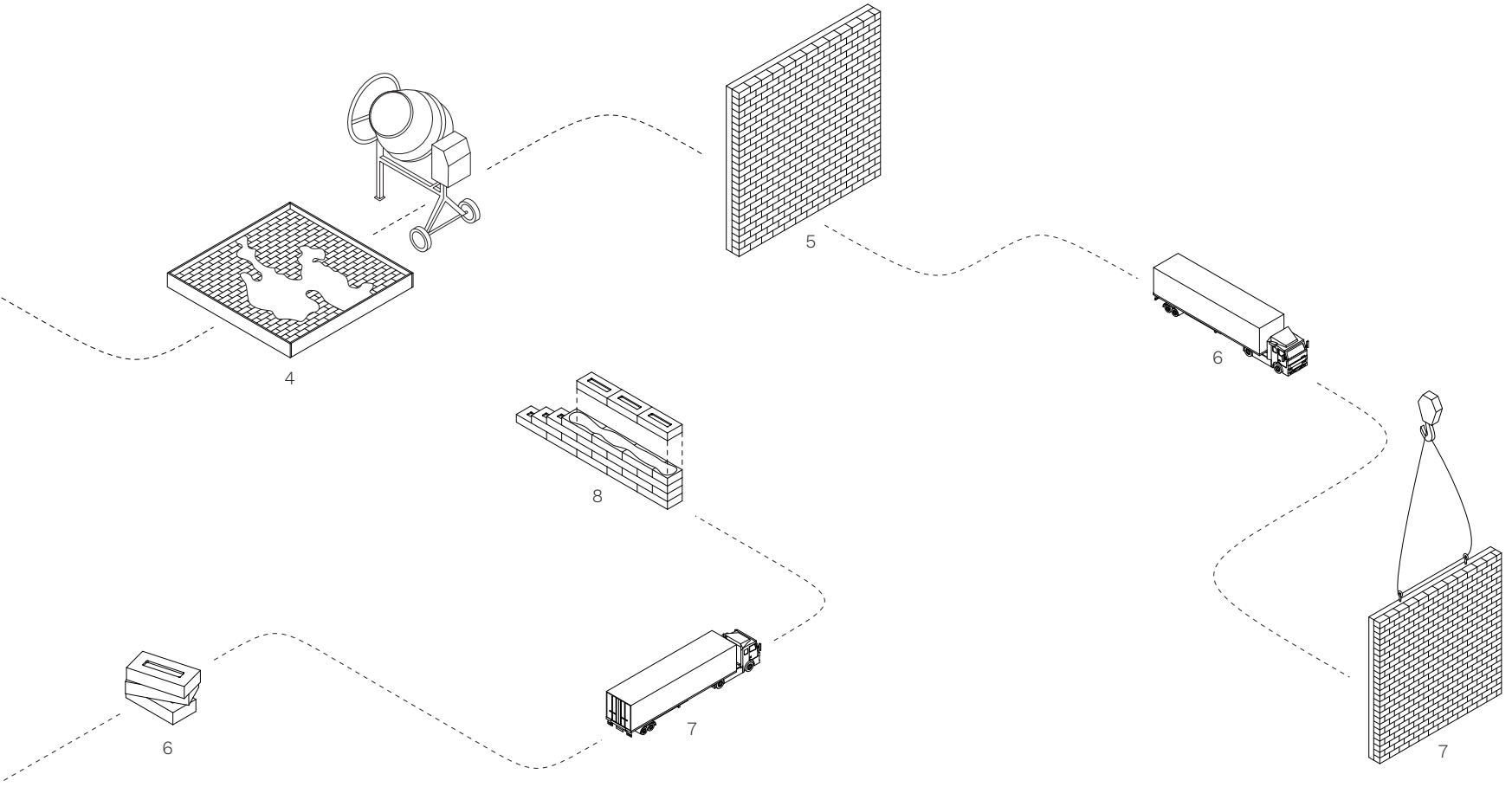
1. Dismantle bricks from the donor building
2. Clean the bricks from mortar residue and prepare the bricks for transportation
3. Transport the bricks
4. Reuse the bricks on a new construction site

Instructions for recycling

1. Dismantle bricks from the donor building
2. Bricks are grinded down
3. Ceramics is being seperated from non-ceramic material and stored in big bags
4. The (virtually pure) ceramic is broken again into very small grains of approximately 1mm and is supplied as a secondary raw material to the factory

Instructions for refurbishing

1. Cut out a section of the brick wall from the donor building
2. Prepare the section for transport
3. Assemble a cast around the brick wall section
4. Pour concrete on top of the brick wall section and let dry
5. Dismantle the cast and unveal the new prefab brick component
6. Transport to the new construction site
7. Assemble on site following Design for Disassembly methods



Instructions for recycling

5. The secondary raw material is then processed in a clay preparation, which consists of 80% primary clay mix and 20% secondary raw material
6. New bricks are made with the mixture of primary clay mix and raw material
7. New bricks are being transported to the construction site
8. These so called ‘ciclobricks’ are being stacked according to the traditional method

storing reclaimed bricks
© Lendager

cutting out a brick panel
© Lendager

storing cut out brick panels
© Lendager

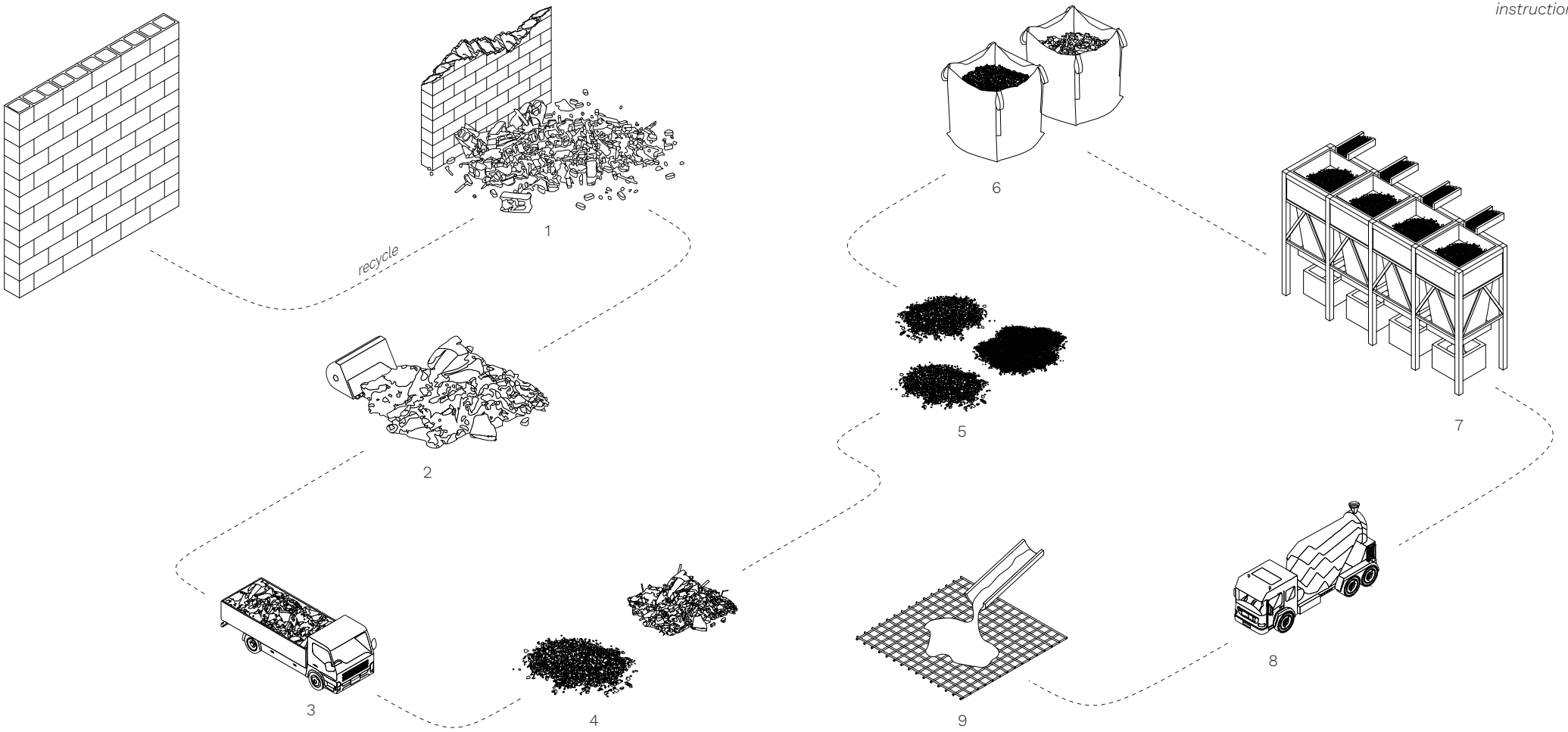
application of brick panels in a facade
© Architects' Journal

prefab brick component
© Moors Beton

reuse of reclaimed bricks
© SalvoWEB

sorting bricks on site
© FCRBE

seperating bricks during demolishment
© New Horizon



Instructions for recycling

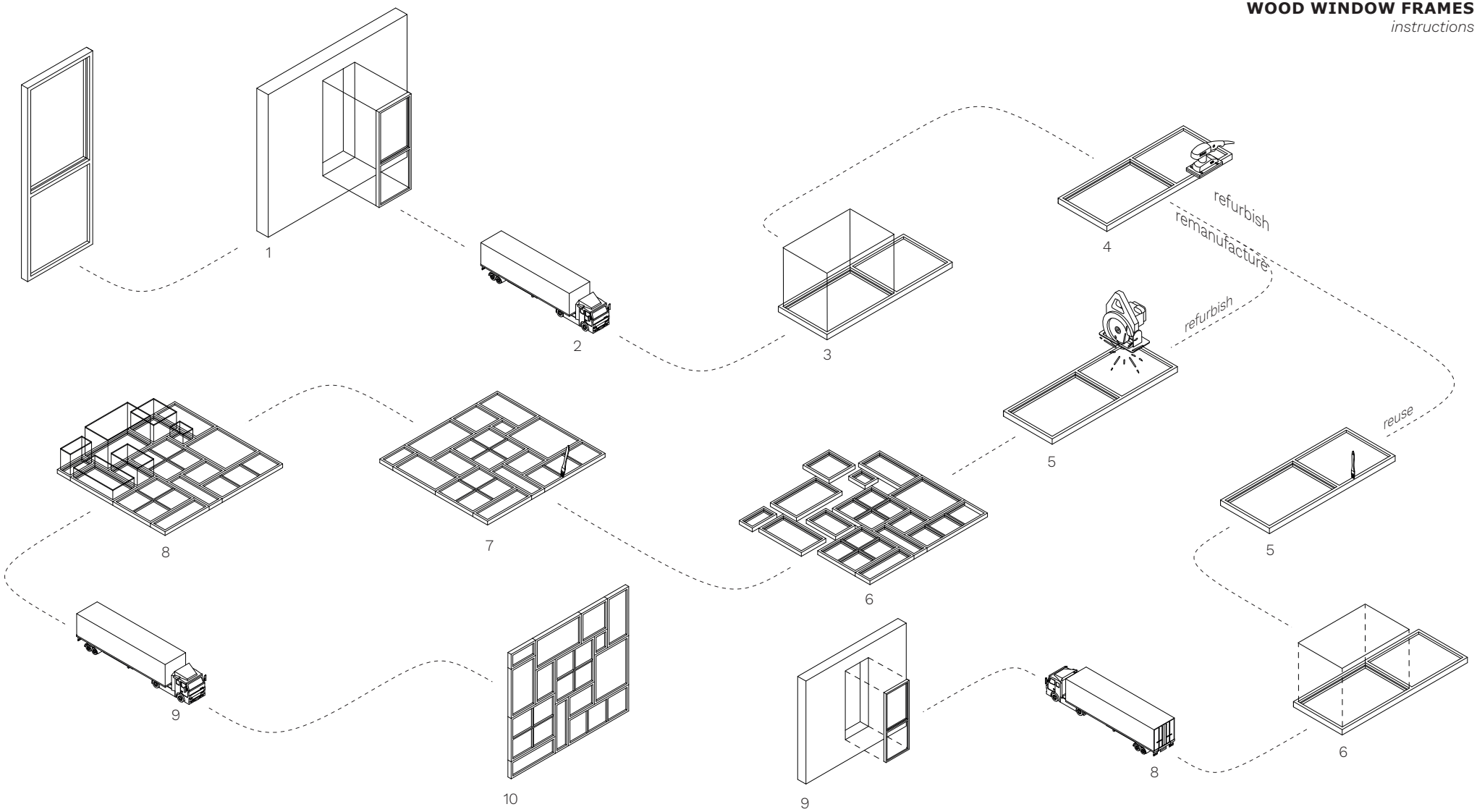
1. Dismantle concrete from the donor building
2. Harvest the disassembled concrete and try to seperate it from non-concrete materials as much as possible
3. Transport the concrete to a concrete concrete processing plant (New Horizon)
4. Seperate the concrete from waste materials (steel, plastic, mortar, etc.)
5. Through the use of the Smart Liberator the concrete is being seperated into raw materials; sand, gravel and cement
6. The different materials are being stored in big bags and are ready to be used for new concrete production
7. New concrete is produced from the materials that is harvested from the seperation of concrete
8. Wet concrete is being transported to a building site within a radius of 50 kilometers
9. Wet concrete is being used on site for floors and walls

New Horizon urban mining facility
Zaandam, © author

New Horizon urban mining facility
Zaandam © author

the smart liberator
concrete recycling facility, Zaandam, © New Horizon

storing raw materials
urban mine facility, Zaandam, © author



Instructions for refurbishing

1. Carefully disassemble the window frame from the donor building
2. Transport to the workshop
3. Quality check and removing of the glass
4. Sand the wooden window frame to prepare it for further processing
5. The window frame is repainted and if necessary hardware is replaced
6. New glass is placed into the window frame
7. Window frame is being transported to a new or existing building
8. Refurbished window frame is placed for new use

Instructions for remanufacturing

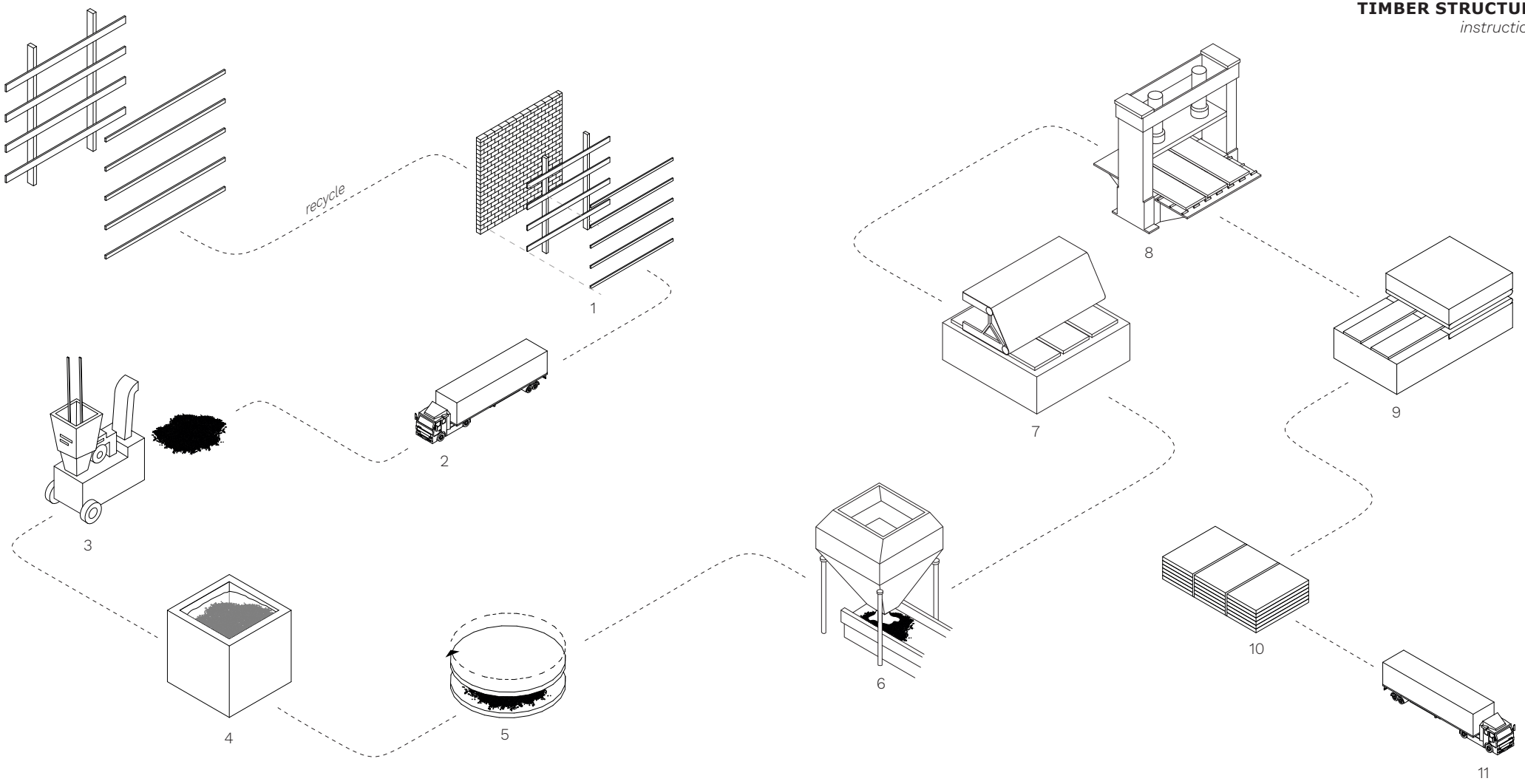
1. Disassemble the window frame from the donor building
2. Transport to the workshop
3. Quality check and removing of the glass
4. Sand the wooden window frame to prepare it for further processing
5. The sizing of the window frame is altered if a resizing of the frame is desirable
6. A variety of window frames are placed to form an assembly of different frames
7. The new frame is repainted
8. New glass panels are placed back into the different window frames
9. The new window assembly is transported to a new building
10. Application of the new window assembly

application of remanufactured window frames
Digital City, © CHSarquitectos

assembly of different window frames
© Opalis

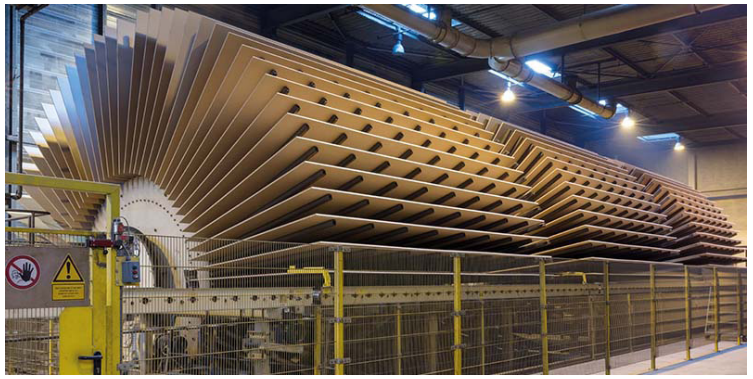
storage of wooden window frames
© Opalis

application of remanufactured window frames
Kamikatz Public House, © Hiroshi Nakamura & NAP



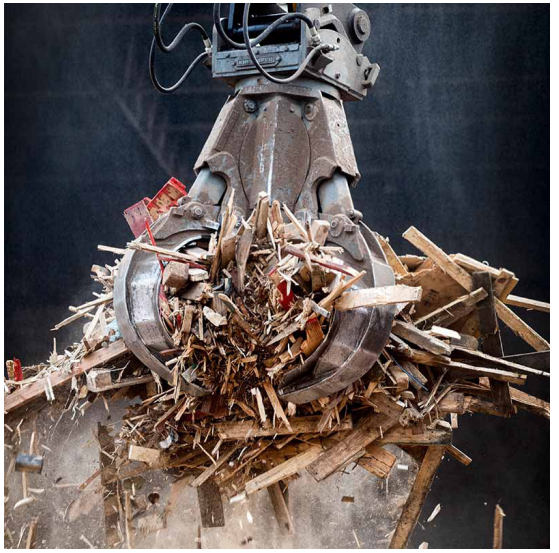
Instructions for recycling

1. Timber structure is removed from the donor building
2. Timber is transported to the factory
3. Magnetic impurities are removed after which the timber is ran through a chipper. The materials are then seperated by size
4. The timber chips are washed and then compressed to remove the water
5. The timber chips are ran through a refiner which shreds them into small pieces
6. Resin is added to help the fibers bond and then put into a very large dryer that is heated by gas or oil
7. The dry combination is ran through a drum compressor equipped with computerized control to guarantee proper density and strength
8. Resulting pieces are cut into correct size with an industrial saw while the pieces are still warm
9. The MDF boards are ran through a sanding machine
10. The MDF boards are packaged and stored
11. Newly produced MDF boards are transported to a new building site



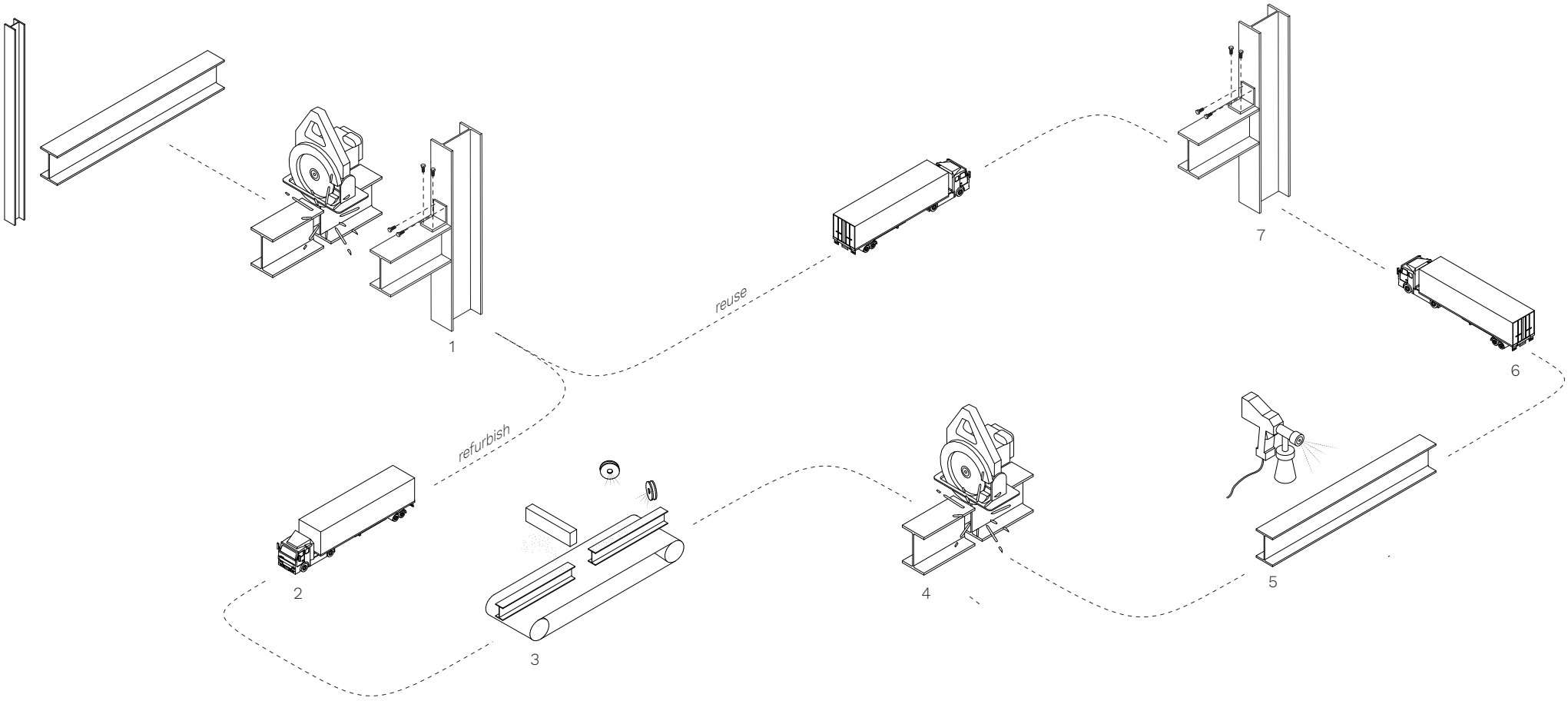
MDF board production
© Unilin

MDF board production - cutting process
© Woodworking Network



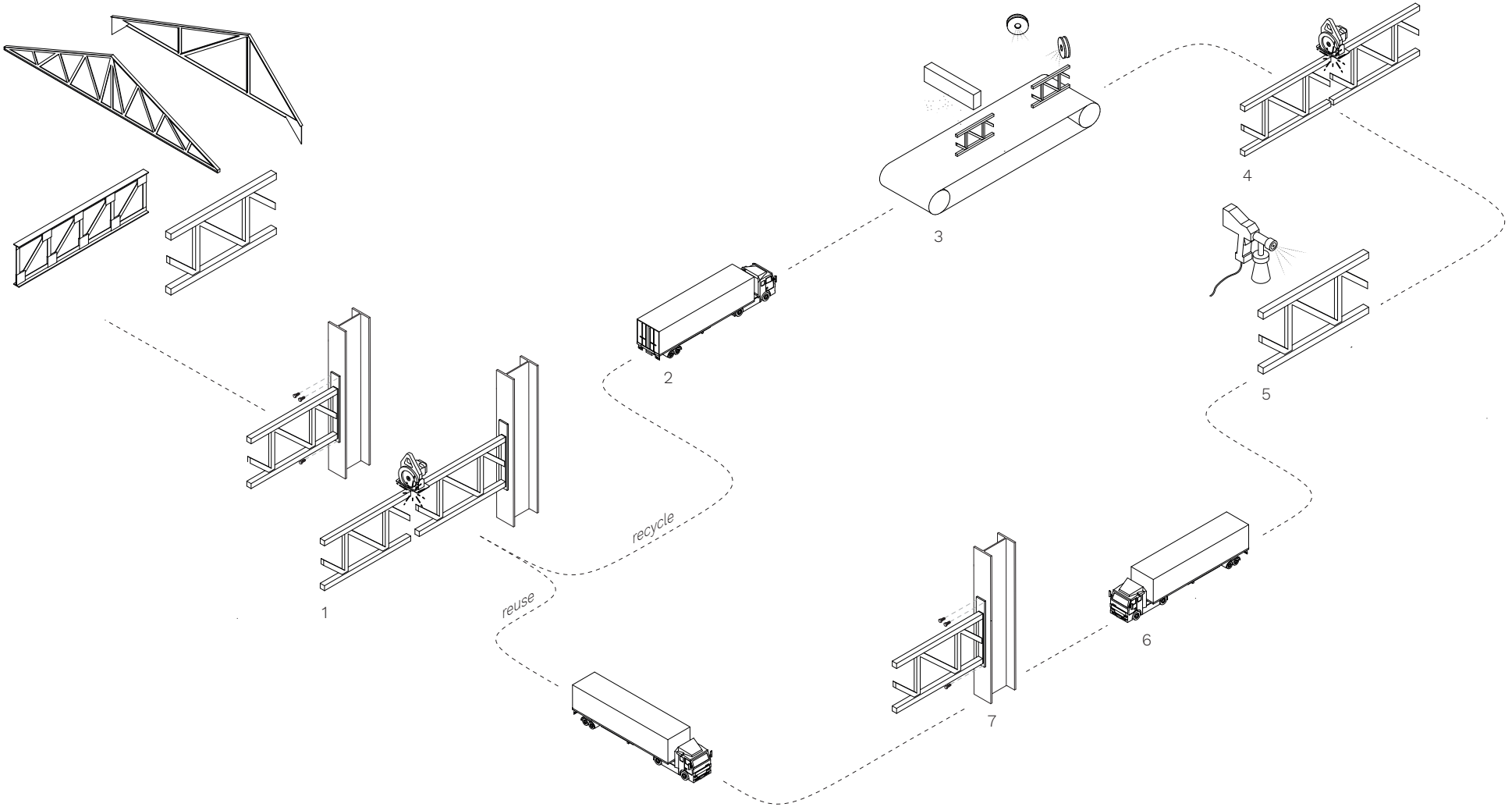
harvesting reuseable timber
© Unilin

MDF board production - adding resin
© Action Tesa



Instructions for refurbishing

1. The elements assembled by bolting can be dismantled mechanically, or by cutting as close as possible to the connections in orderto maximise the length of the recovered elements
2. Steel beams are either transported to a steel workshop or when applicable in its current state, a new building site
3. Cleaning the steel beams by shot blasting the steel
4. Steel beams are altered to specific needs; length, additional elements, etc
5. A new coating is applied to correspond to the new requirements
6. Steel beams will either be stored or transported to a new building site
7. The reclaimed steel beam will either be welded or bolted on site

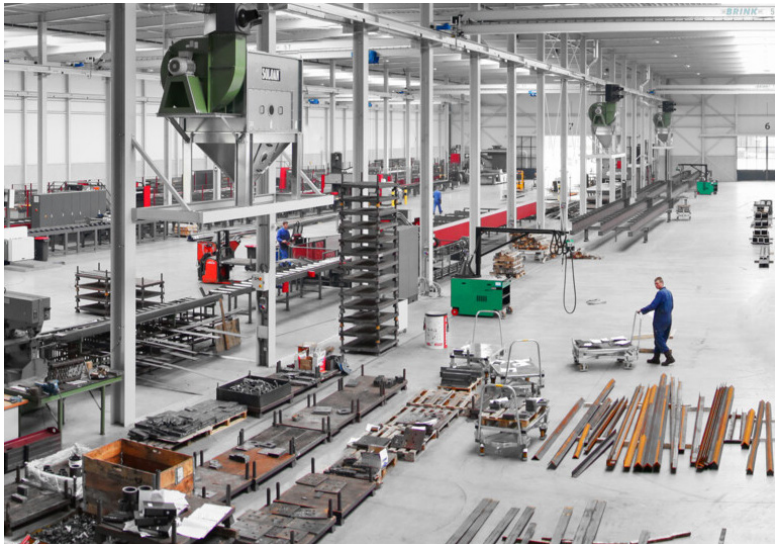


Instructions for refurbishing

1. The elements assembled by bolting can be dismantled mechanically, or by cutting as close as possible to the connections in orderto maximise the length of the recovered elements
2. Steel trusses or rafters are either transported to a steel workshop or when applicable in its current state, a new building site
3. Cleaning the steel trusses or rafters by shot blasting the steel
4. Steel trusses or rafters altered to specific needs; length, additional elements, etc
5. A new coating is applied to correspond to the new requirements
6. Steel trusses or rafters will either be store” or transported to a new building site
7. The reclaimed steel truss or rafter will either be welded or bolted on site

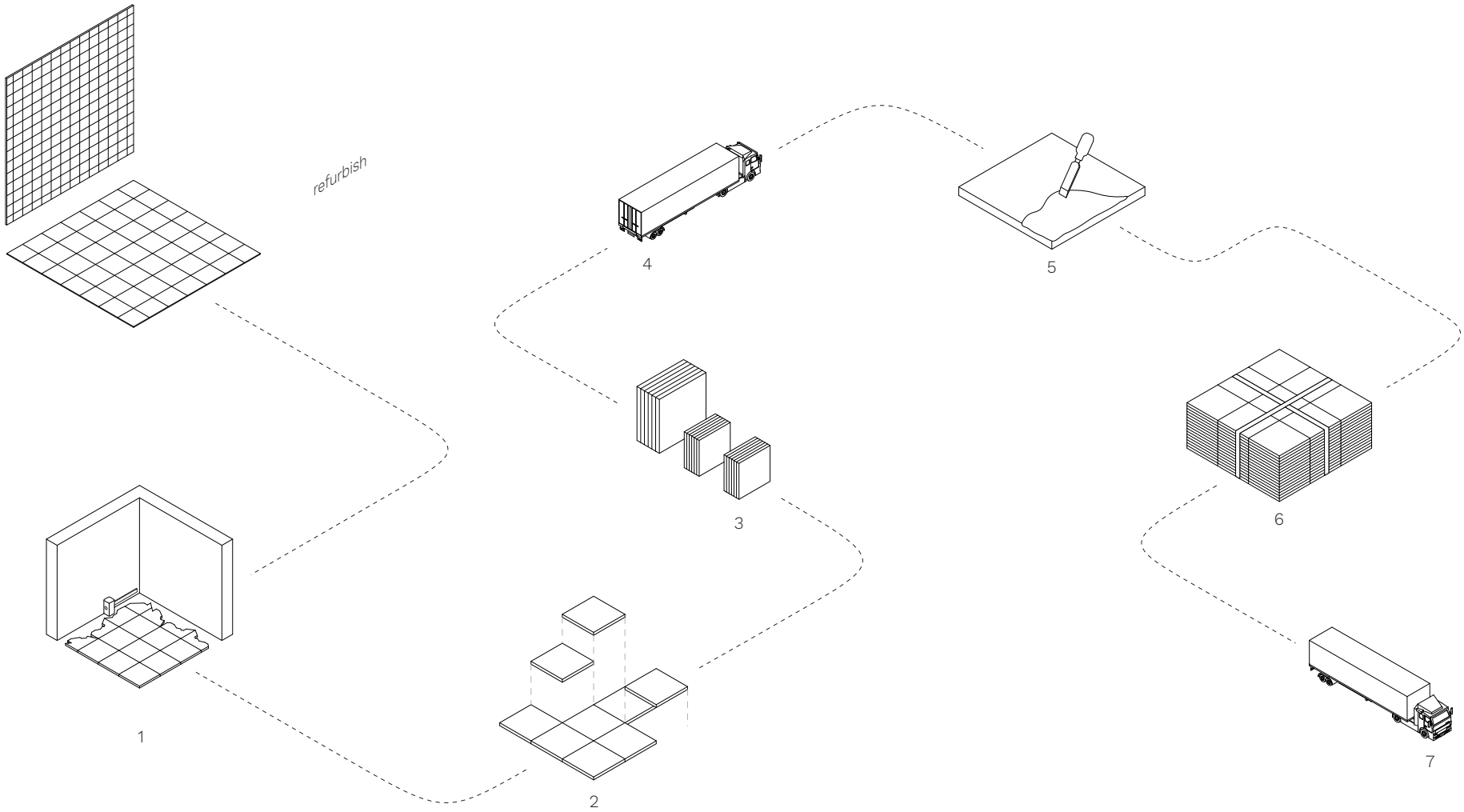
sandblasting steel structures
© coating.nl

application of reused steel constructions
© Circulair Staal



steel structure reuse facility
© C. van den Brink

stored steel structures
© Opalis



Instructions for reusing

1. Weaken the tension within the tiles by freeing 2 sides (perpendicular) of the tiles to be detachted. Break the non-free edge lines
2. Carefully remove the tiles after freeing the edge lines
3. Store tiles by size, colour, quality and degree of cleaning needed. Store the tiles on their edge to avoid the risk of scratching the glaze
4. Tiles are being transported to a workshop. The necessary precaution must be taken during transport and delivery in order to minimise breakage
5. Clean the tiles by removing remains of mortar on the underside and edges of the tiles. Perform this step with the use of a sharp tool
6. Store the tiles in bulk on pallets, in boxes or reconditioned in bundles and make sure to be stored away from frost and bad weather to minimize damage
7. Transport of the tiles to a warehouse or a new building site where the reclaimed tiles can be applied

removal of reuseable ceramic tiles

ceramic tile storage

cleaning of reclaimed ceramic tiles

outdoor tile storage

03 LOCAL PARTNERS

In the final phase of the material reclamation process, it becomes essential to identify potential partners or collaborators who possess the necessary capacity and expertise to execute the various processes involved. This step ensures that the reclaimed materials can be effectively transformed and integrated into new architectural designs.

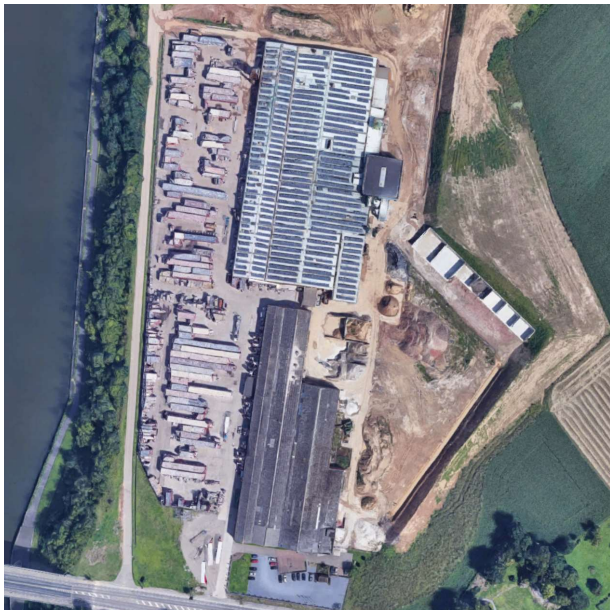

LOCAL STAKEHOLDERS
potential local partners
Atelier 3D2
CMV
Inter-Beton
TPB
Maison Delardin
Aciers Fins de la Sarre
Mélens & Delardin sprl
door buildings
Vandersanden
1/100000

Wienerberger

distance: 34km
products: ceramic products

current services: sales, production and distribution

demanded activities: recycling of donor ceramics



Vandersanden

distance: 34km
products: bricks

current services: sales, production and distribution

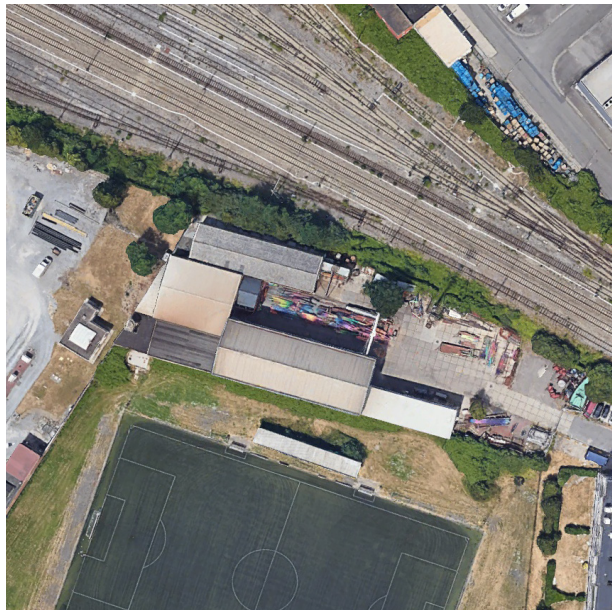
demanded activities: reusing donor bricks

Melens & Dejardin sprl

distance: 2 km
products: steel work

current services: production and distribution

demanded activities: reusing donor steel constructions

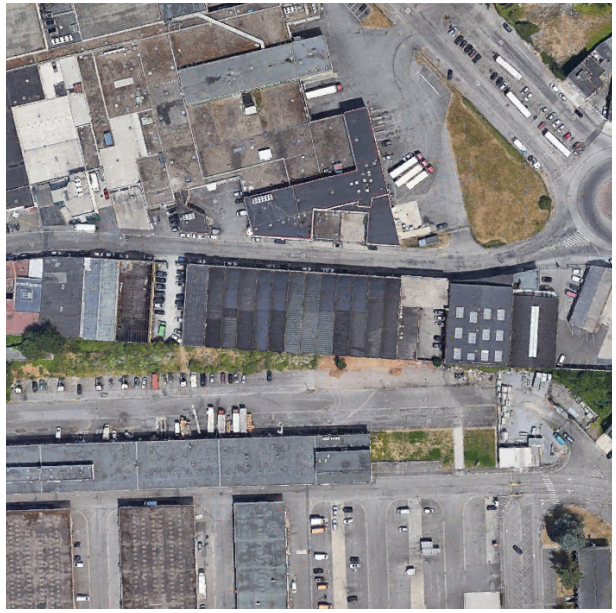


Aciers Fins de la Sarre

distance: 3 km
products: steel construction

current services: distribution and sales

demanded activities: storing and remanufacturing donor steel constructions

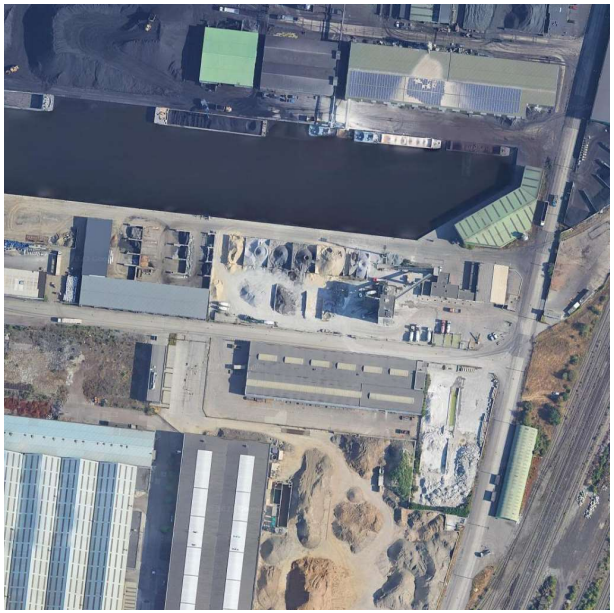


CMIX

distance: 5 km
products: all types of ready mixed concrete

current services: sales, production and distribution

demanded activities: recycling of donor concrete

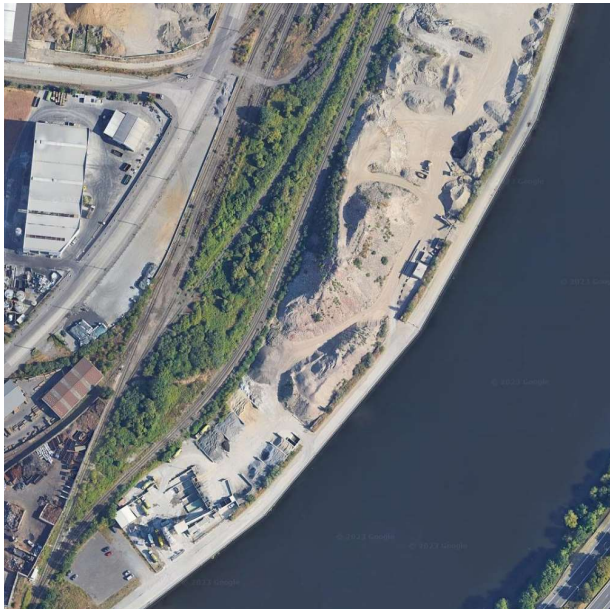


Inter-Beton

distance: 5 km
products: ready mixed concrete

current services: sales, production and distribution

demanded activities: recycling of donor concrete



TPB

distance: 9 km
products: timber structure and building elements

current services: sales, production and distribution

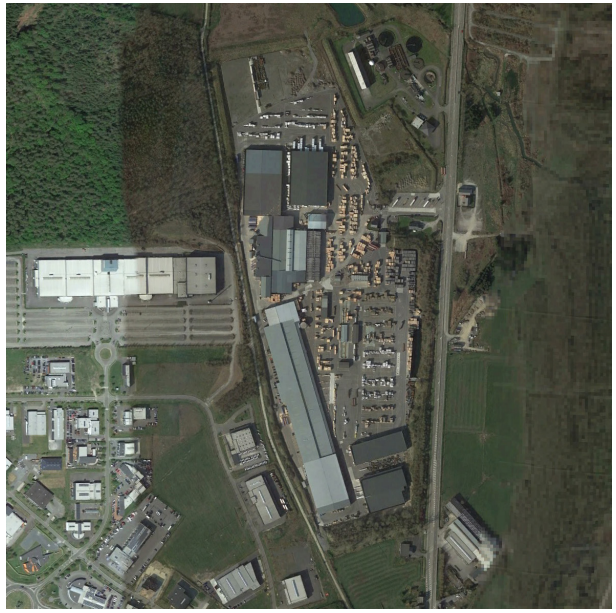
demanded activities: recycling and reusing timber structures

Rabotage et Séchage du Bois

distance: 57 km
products: wood planning and drying

current services: sales, production and distribution

demanded activities: recycling donor timber elements



Atelier SiO2

distance: 6 km
products: ceramic products

current services: remanufacturing and restoration

demanded activities: restoring and remanufacturing donor ceramics

Maison Dejardin

distance: 4 km
products: ceramic ware

current services: sales and production

demanded activities: remanufacturing ceramics