

# Rebeauty

## Artistic Strategies for Repurposing Material Components



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Vandkunsten Architects

## BACKGROUND AND PARTNERS

Culture



Energy



Economy



### Challenge

The project addresses material waste - the 'dark side' of renovation in construction. The demolishing practice in the Nordic countries today is highly efficient in terms of separating construction debris and minimizing landfill. However, **discarded resources represent a triple capital related to economy, energy, and culture.** The challenge is to find new ways to access this value and implement the Circular Economy in construction.

### Project

NORDIC BUILT COMPONENT REUSE

18 months 2014-2015

### Partners

Vandkunsten Architects (DK)

Genbyg.dk (DK)

Asplan Viak (NO)

Malmö Högskola (SE)

Hjelness Consult (NO)

Architects

Reuse vendor

Engineering

University

Consulting

### Funding

Nordic Built

EUDP

### Most recent exhibition

La Biennale Architettura 2018, Danish Pavillon



## BACKGROUND AND PARTNERS

Culture Energy Economy



### Background

The competition win for major renovation of 1001 social housing units at Albertslund South  
Strategy for intense reuse  
Featured three resource capitals and their budgets

### Ambitions were cut from the project

#### New vision to impact decision makers

Supply the data missing regarding affordability and environmental benefits  
Show the beauty of such reuse strategy

### Project aims

It is the premise of this project that future construction practice must enable resource-preserving strategies, including:

**1/Repurposing building waste from demolishing, dismantling, and refurbishment.**

**2/Reversible construction principles known as Design for Disassembly (DfD).**



ARTISTIC DEVELOPMENT  
Premise for research and practice

Culture Energy Economy  
  €

# Without beauty No sustainability



# Reduce Reuse Recycle **Rebeauty**

**Rebeauty** is the continuous search for beauty through artistic strategies for repurposing sourced materials and components in reversible architecture.



## Rebeauty Method



- Interviews with market experts to state the:
  - Existing practice,
  - Volumes and availability of materials and components,
  - Types and lifetime of components,
  - Ease of mining



## 2. Ideation and Analysis Matrix

# COMBINATION OF TWO EXISTING SYSTEMS OF CLASSIFICATION Rebeauty Matrix

- Maps mined components according to building class

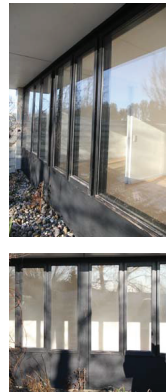
- Ideation and classification of new component concepts

### Reuse Potential\_Windows

Funktionstabel  
(Bygningsdele og grunddele)

- (1.) Bygningsbasis
- (2.) Primære bygningsdele
- (3.) Komplettering
- (4.) Overflader
- (5.) VVS-anlæg
- (6.) El- og mekaniske anlæg
- (7.) Inventar
- (8.) Fri
- (9.) Fri

UDGANGSPUNKT



FREMTIDIG BRUG

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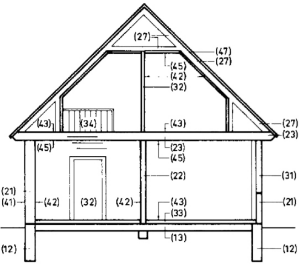


Diagram with Sfb system codes  
(Sfb = Samarbejtskomit en for Byggnadsfr gor)

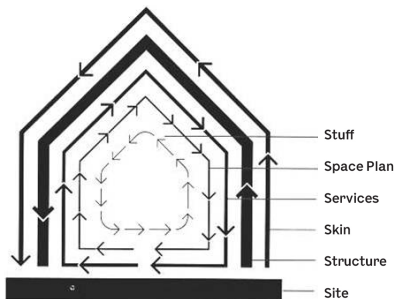
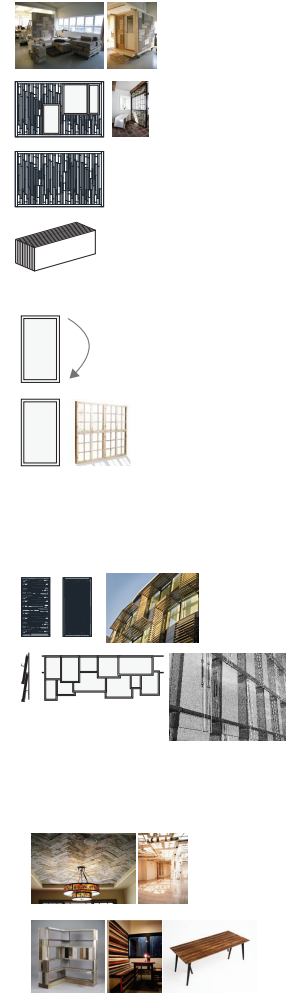
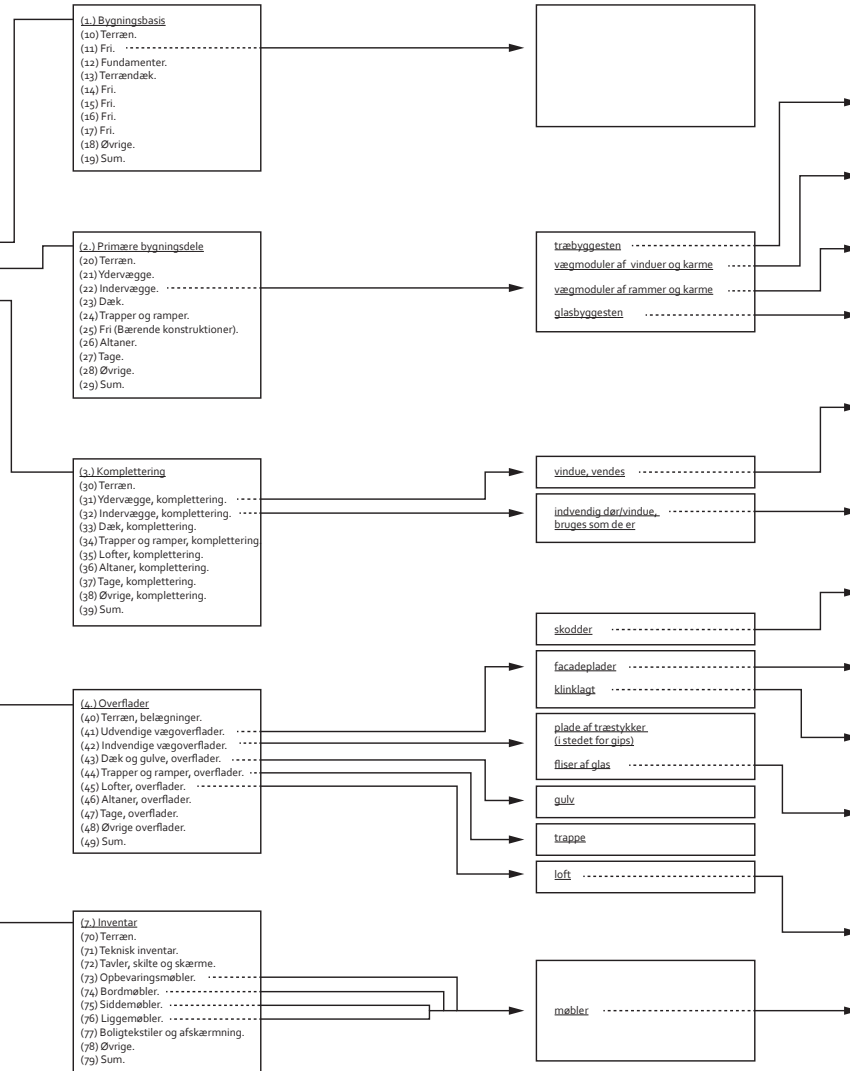


Diagram of lifetime layer-structured construction  
(Duffy/Brand)



## 2. Ideation and Analysis Matrix

# COMBINATION OF TWO EXISTING SYSTEMS OF CLASSIFICATION Rebeauty Matrix

- Maps mined components according to building class
- Ideation and classification of component concepts

Reuse potential\_Vinyl

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UDGANGSPUNKT      FREMTIDIG BRUG



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  - (6.) El- og mekaniske anlæg
  - (7.) Inventar
  - (8.) Fri
  - (9.) Fri

- (1.) Bygningsbasis
- (10) Terræn
- (11) Fri
- (12) Fundamenter
- (13) Terrændæk
- (14) Fri
- (15) Fri
- (16) Fri
- (17) Fri
- (18) Øvrige
- (19) Sum

- (2.) Primære bygningsdele
- (20) Terræn
- (21) Ydervægge
- (22) Indervægge
- (23) Dæk
- (24) Trapper og ramper
- (25) Fri (Bærende konstruktioner)
- (26) Altaner
- (27) Tage
- (28) Øvrige
- (29) Sum

- (3.) Komplettering
- (30) Terræn
- (31) Ydervægge, komplettering
- (32) Indervægge, komplettering
- (33) Dæk, komplettering
- (34) Trapper og ramper, komplettering
- (35) Lofter, komplettering
- (36) Altaner, komplettering
- (37) Tage, komplettering
- (38) Øvrige, komplettering
- (39) Sum

- (4.) Overflader
- (40) Terræn, belægninger
- (41) Udvendige vægoverflader
- (42) Indvendige vægoverflader
- (43) Dæk og gulve, overflader
- (44) Trapper og ramper, overflader
- (45) Lofter, overflader
- (46) Altaner, overflader
- (47) Tage, overflader
- (48) Øvrige overflader
- (49) Sum

- (7.) Inventar
- (70) Terræn
- (71) Teknisk inventar
- (72) Tavler, skilte og skærme
- (73) Opbevaringsmøbler
- (74) Bordmøbler
- (75) Sidsmøbler
- (76) Liggemøbler
- (77) Boligtekstiler og afskærmning
- (78) Øvrige
- (79) Sum



- betonbyggesten
- vægmoduler
- facadebeklædning

- fiser

- Facadeplader
- Klinklagt

- vinylfiser
- loft

- møbler

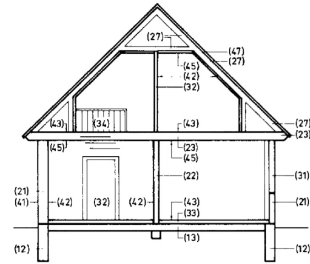
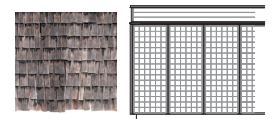
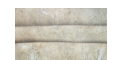
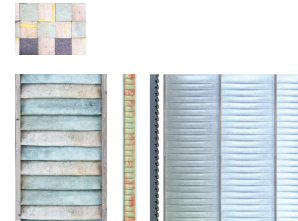


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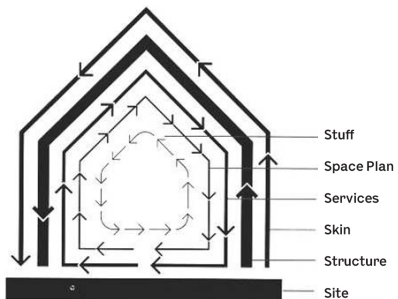


Diagram of lifetime layer-structured construction (Duffy/Brand)



### 3. Material Concept

- Technical development and Design for Disassembly
- Architectural visualization to assess cultural/aesthetic potential

Brick	Concrete	Glass	Metal	Soft Flooring	Wood
<b>B1.1</b> <b>Pantile Façade, Front Out and Vertical</b> LCA	<b>C1.1</b> <b>Cut Element Façade Brick</b> LCA	<b>G1</b> <b>Laminated Glass Brick</b>	<b>M1</b> <b>Ventilation Duct Façade</b> LCA	<b>S1</b> <b>Woven Screen</b> (2 prototypes)	<b>W1</b> <b>Interior Wall System</b> (3 prototypes) LCA
B1.2 Pantile Façade Front Out Horizontal	C.1.2 Cut Element Pavement	<b>G2</b> <b>Window Shingle Screen</b>	<b>M2</b> <b>Braided Drywall Stud Screen</b>	<b>S1.1</b> <b>Woven Screen Wicker Style</b>	W2 Shutter Screen
<b>B2.1</b> <b>Pantile Façade Back Out Vertical</b>	C1.3 Cut Element Infill	<b>G3</b> <b>Window Screen Wall</b> (3 prototypes) LCA	<b>M3.1.</b> <b>Sheet Origami Shingle Façade</b> (2 prototypes)	<b>S2</b> <b>Vinyl Pillow shingle façade</b>	
B2.2 Pantile Façade Back Out Horizontal	C2.1 Rubble Sack brick		<b>M3.2</b> <b>Metal Sheet Shingle</b>		
			M4 Cable tray Acoustic Wall Panels		

**Table 1.** 21 material concepts representing six material categories were developed and assessed using architectural methods. 14 concepts listed in bold were full-scale prototyped, in total 19 prototypes. LCAs were conducted for 5 selected cases.

### 3. Material Concept

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- Architectural visualization to assess cultural/aesthetic potential



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- Technical development and Design for Disassembly
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### 3. Material Concept

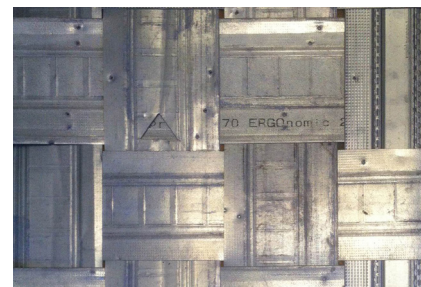
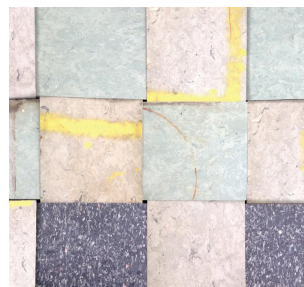
- Technical development and Design for Disassembly
- Architectural visualization to assess cultural/aesthetic potential



## 4. Material and Process Prototype

- DfD Details, architectural composition, sensed materiality
- Flow diagrams to time and document processes and tools used
- Practical handling, logistics, ease of construction, ease of remanufacture

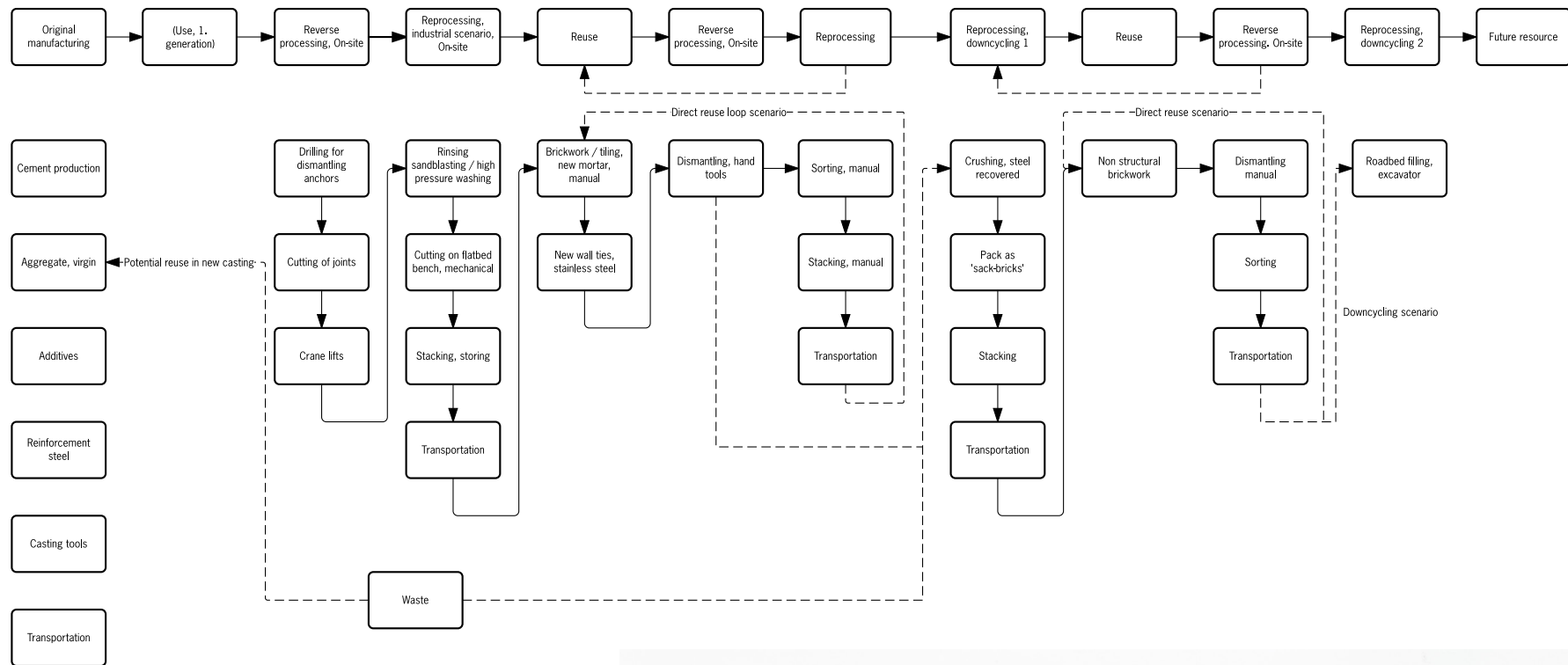




# 5. Assessment

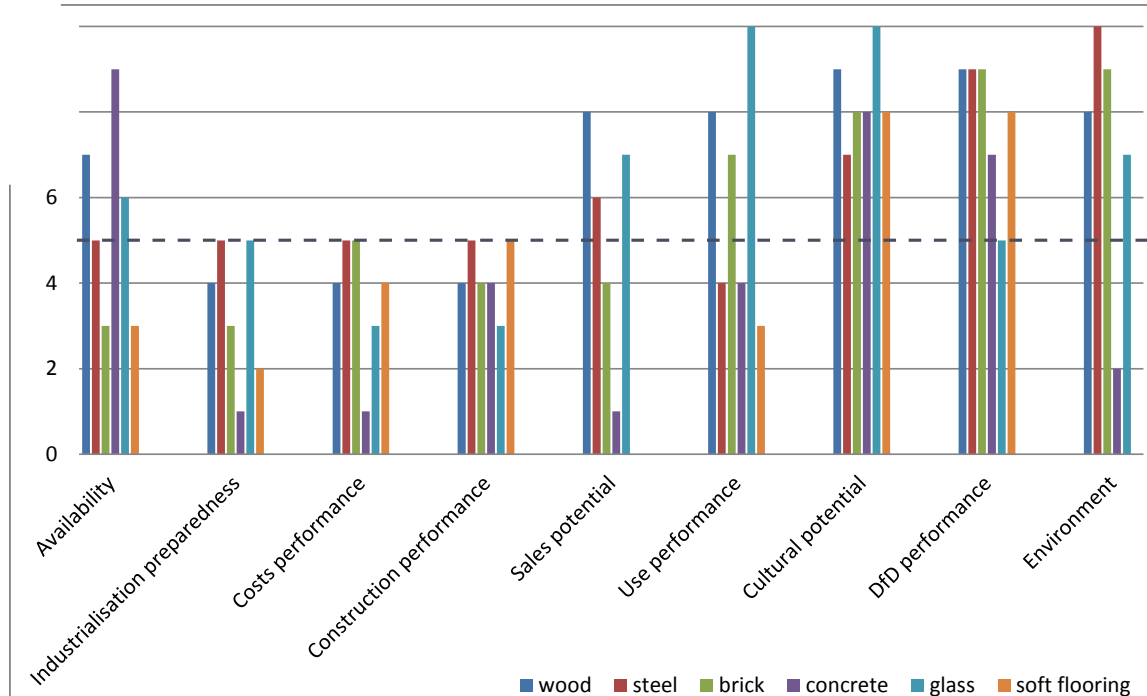
## FLOW DIAGRAM FOR CONCRETE PROTOTYPE

- Cultural, based on prototypes and visualizations (by architects)
- Economic, based on Flow diagrams and practical handling experiences (by reuse vendor and remanufacturer)
- Environmental, LCA, Based on Flow diagrams and data from comparable conventional products



## 5. Assessment

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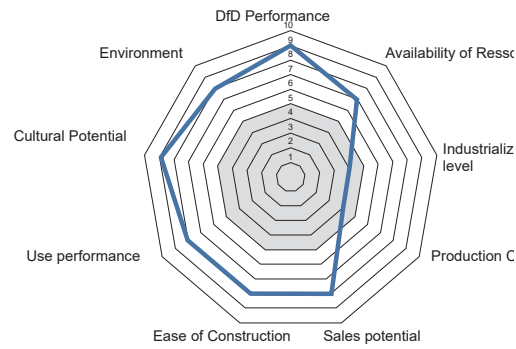


Availability	€
Industrialization preparation	€
Cost performance	€
Construction performance	€
Sales potential	€
In Use Performance	€
Cultural Potential	€
DfD Potential	€
Environment (LCA)	€

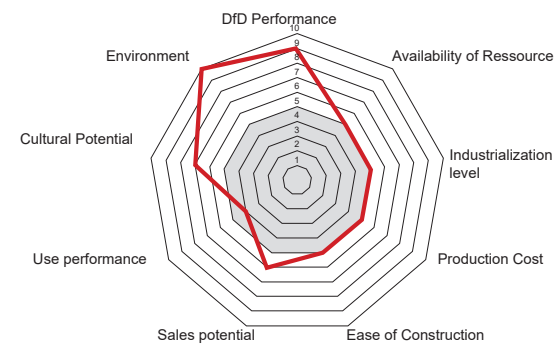


## 5. Assessment

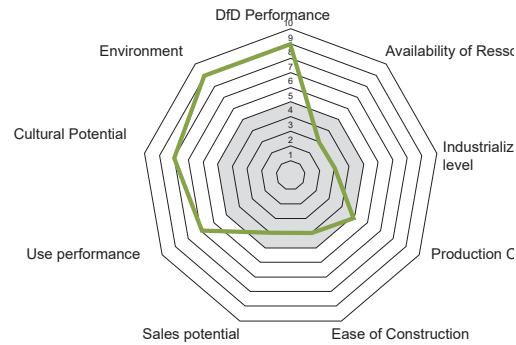
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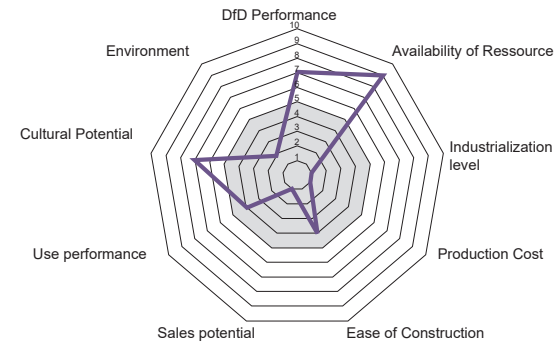
Wood



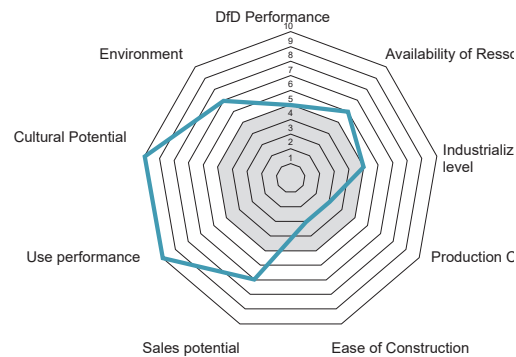
Metal



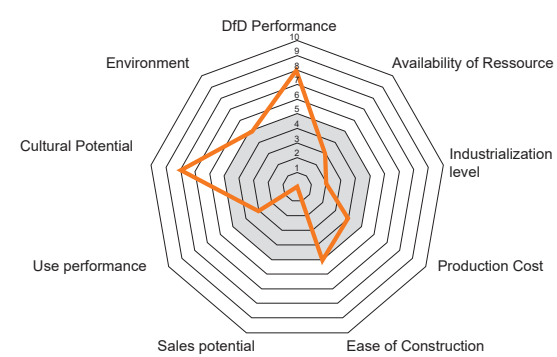
Brick



Concrete



Glass



Soft Flooring

## Conclusions

Selected components currently defined as waste, can indeed be transformed into high quality architectural design.

**LCAs for wood, glass, and brick prototypes** - but not for the concrete prototype showed that repurposing components potentially impact climate and environment significantly less than with use of new components.

Cost connected with rehabilitation processes often exceed the price of new products, mainly due to the high degree of human labour.

### **Further development**

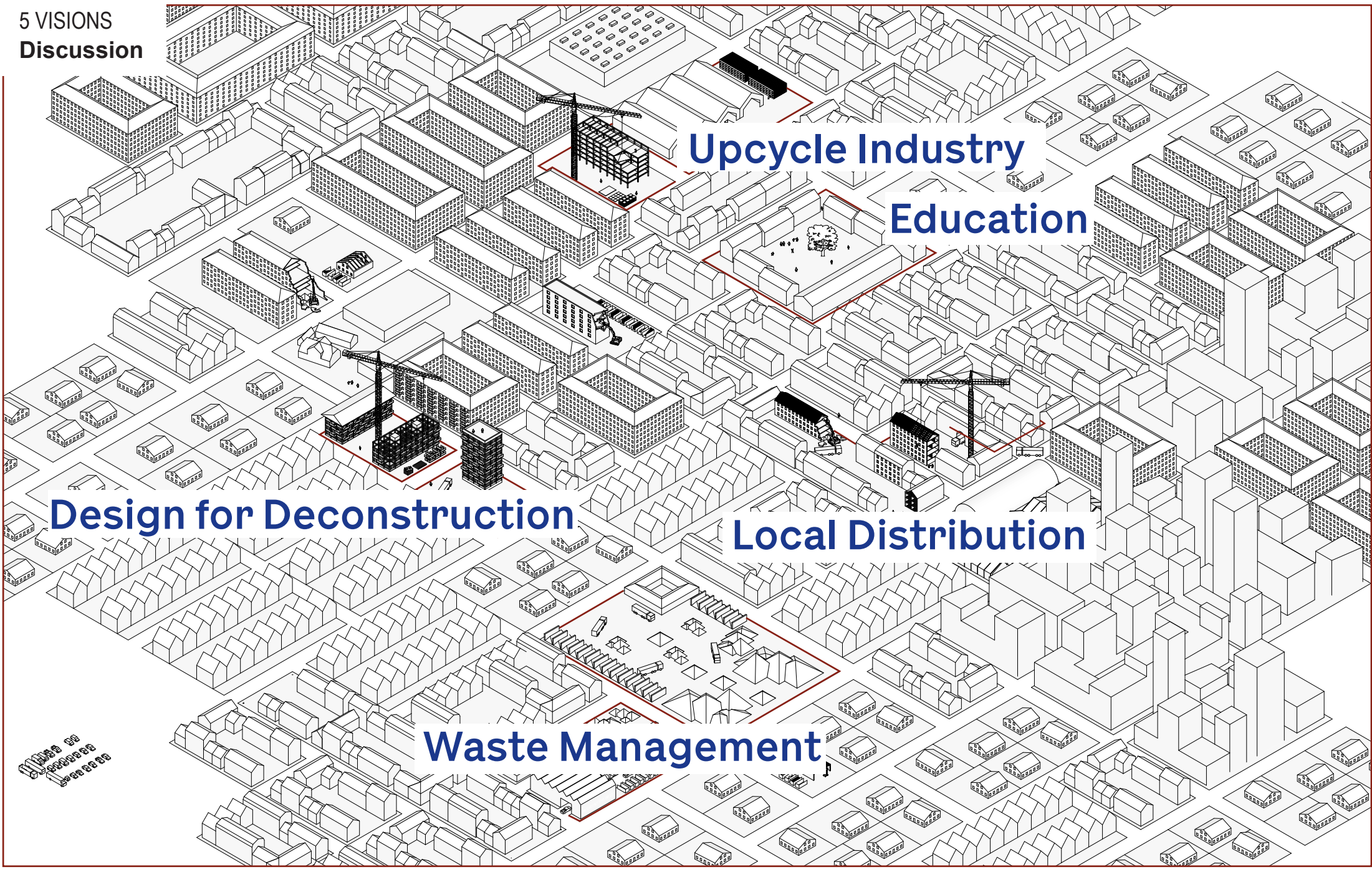
As the project challenges the regimes of current regulations and market conditions, numerous obstacles and dilemmas have been revealed, including:

>> **A technological gap**, where a mutual dependency exists between the critical demand for secondary products and the invention of more advanced demolition tools.

>> **A technological challenge** in documenting compliance with current critical limits for toxins in waste as well as technical quality.

>> **A cultural gap**, where the aesthetics of wear and tear challenge normal expectations towards buildings' appearance.'

>> **LCAs are difficult to obtain in the field of reuse** because of the numerous variables and the difficulties in documenting the exact processes.



Upcycle Industry

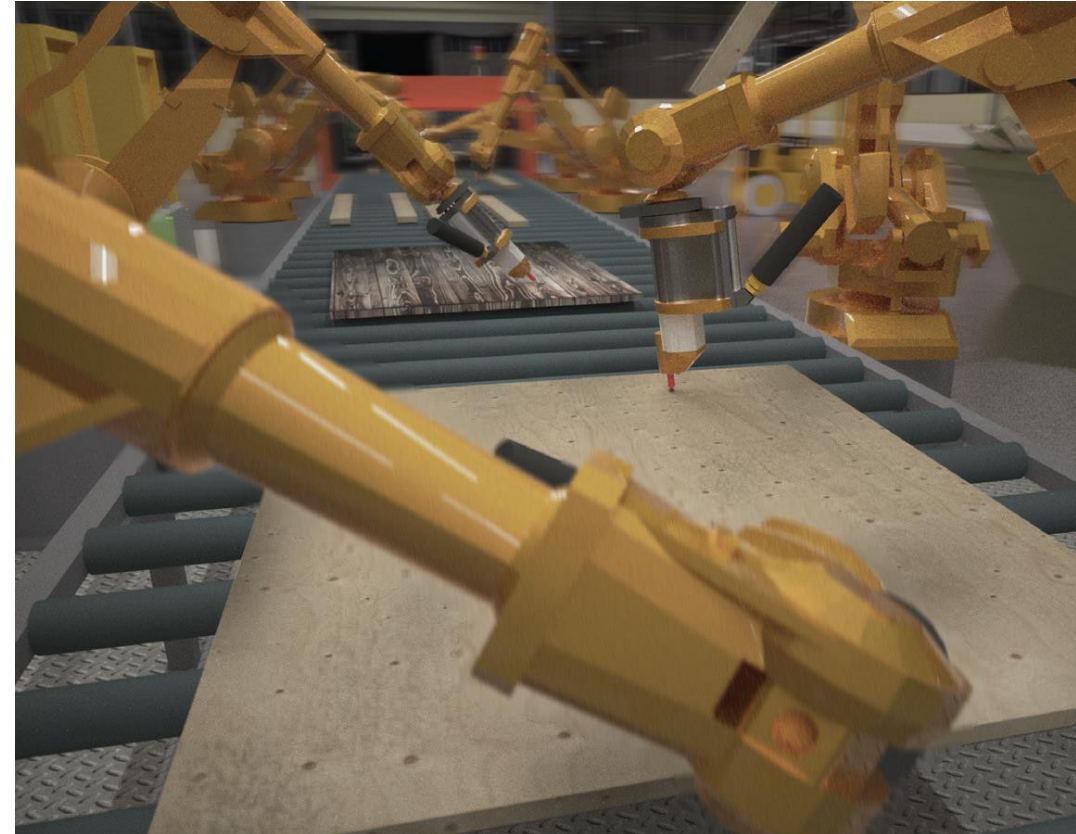
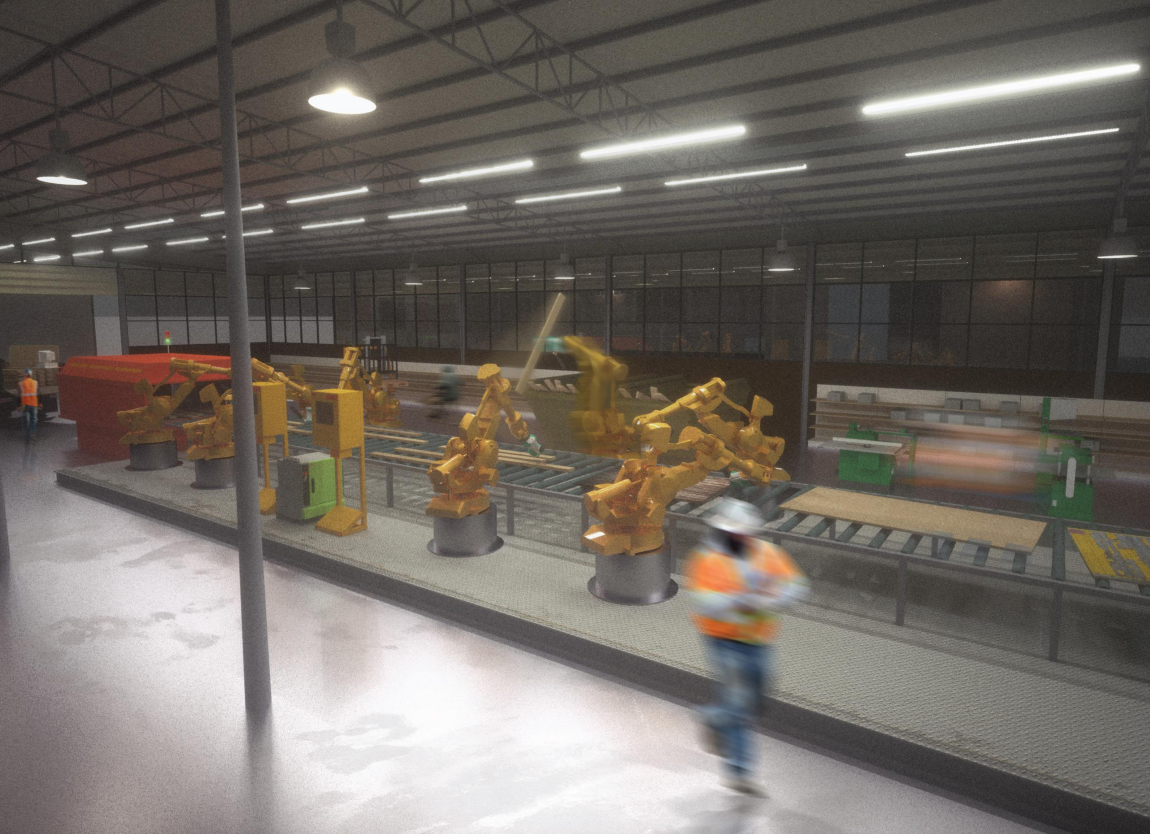
Education

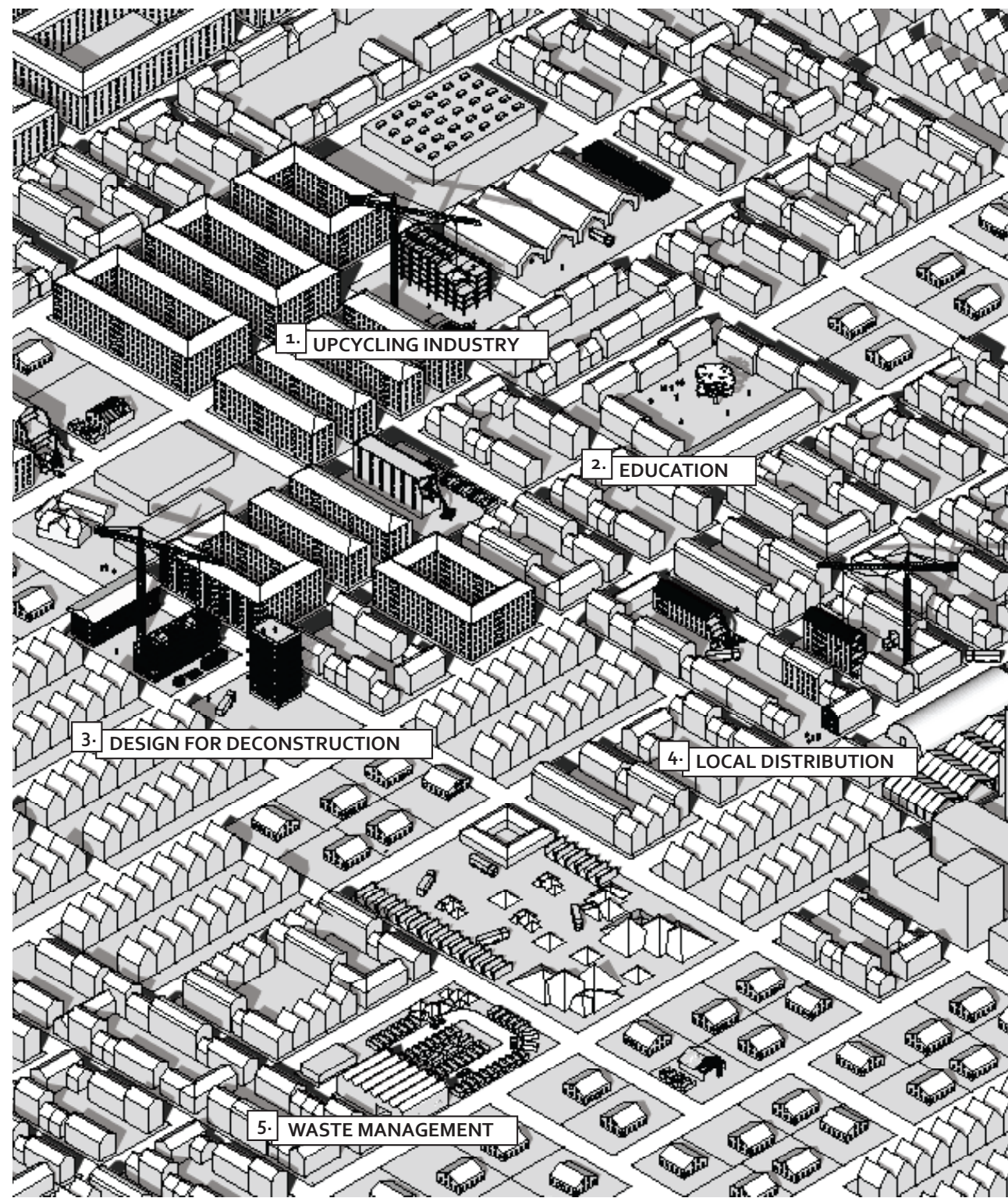
Design for Deconstruction

Local Distribution

Waste Management

5 VISIONS  
**Wood Treatment Facility**





# 5 initiatives

promoting a higher degree of component reuse

## UPCYCLING INDUSTRY

The manufacturing of new building components from reused materials is a whole new industry.

DIY STORE

UPCYCLING FACTORY

Used construction timber is tested for strength and categorized before reentering the building industry

Production of facade tiles from used ventilation ducts

Refitting of windows for upcycling

Materials are processed and upcycled for another lifecycle. DIY stores, lumberyards a.o. redistribute the materials.

Production of facade tiles from used vinyl floors

OBSOLETE CONCRETE BUILDING

Used facade cladding, ventilation ducts, construction wood, vinyl floors and other used materials enter the upcycling factory

Precast concrete panels are dismantled, cut on the site and reused as tiles

# 1. UPCYCLING INDUSTRY

## Organizing design processes

*"The target is to change the status of dismantled building components from waste to value - from a mere resource for down-cycling into a resource of identity".*

The traditional design process operates on the background of a product market with a stable stock of familiar products in well-known dimensions and of reliable qualities. With a practice of reusing components from one building to the next, there is a need for more flexible methods for designing the geometry and describing the construction work.

The project aims at developing design models with clear hierarchies of construction in order to obtain less interdependency between different building layers. Hereby a wider tolerance can be achieved, which will permit a higher degree of unpredictability in size and quality.



**EXTENDED LIFECYCLE**

The components from a discarded balcony can get another lifespan if implemented in a new building. Rails from the handlebars is used locally in another building project, while the concrete bottom is cut into new building blocks for reversible use.

## EDUCATION AND KNOWLEDGE

The faculty of component reuse will nurture specially trained experts to be able to give advice on recycling potentials and gentle demolition practice.

FACULTY OF COMPONENT REUSE

# 2. EDUCATION

## Expertise in waste management

Issue:

Missing knowledge...

Reaction:

Knowledge of the demolition process and the recycling of building components becomes a specialty propelled at educational establishments. Specially trained experts will be able to give advice on recycling potentials and gentle demolition practice.

This knowledge is channelled into society to generate a wider understanding of the need to recycle more building components.

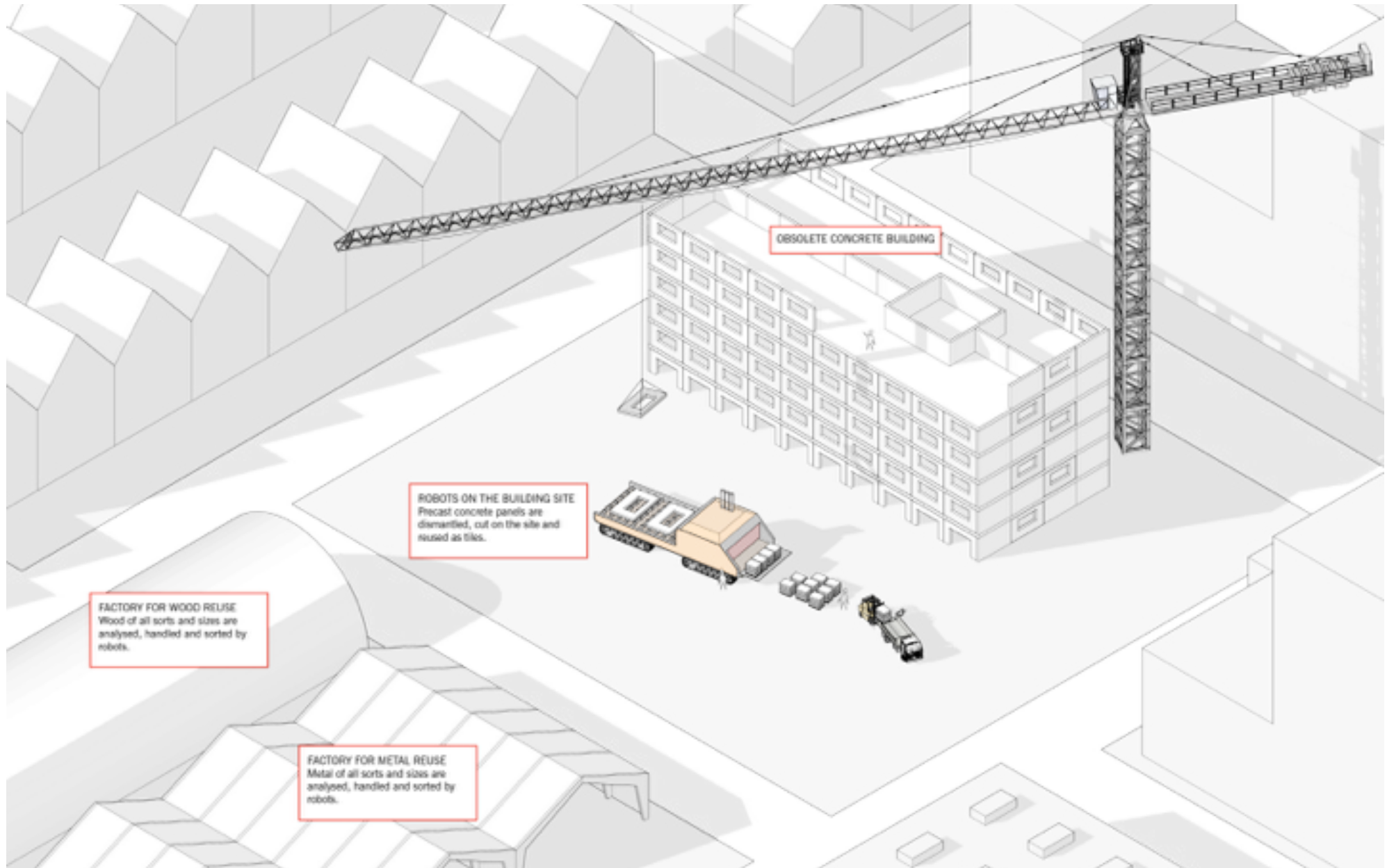
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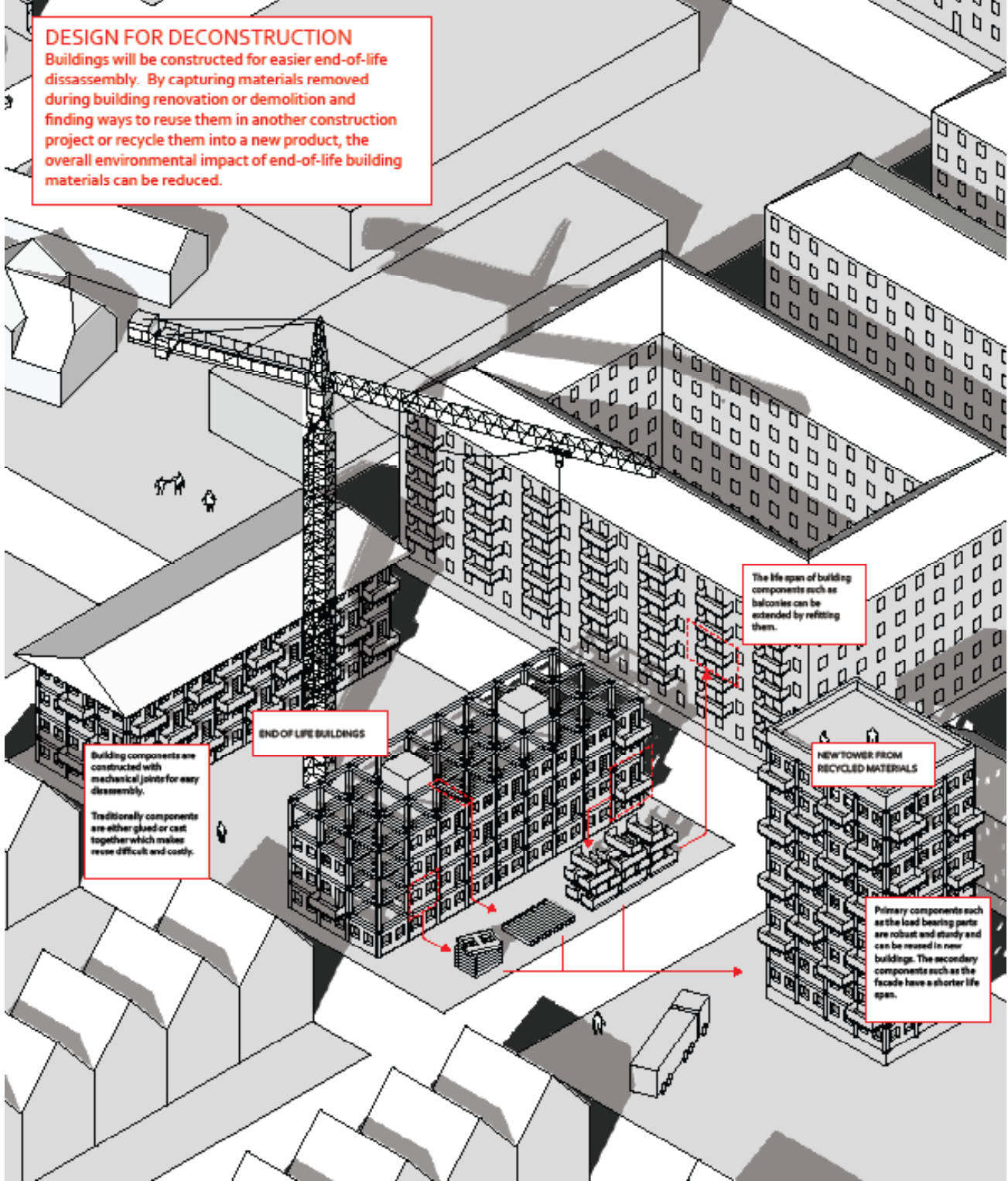


## 5 VISIONS

### Robots on the building site



**DESIGN FOR DECONSTRUCTION**  
Buildings will be constructed for easier end-of-life disassembly. By capturing materials removed during building renovation or demolition and finding ways to reuse them in another construction project or recycle them into a new product, the overall environmental impact of end-of-life building materials can be reduced.

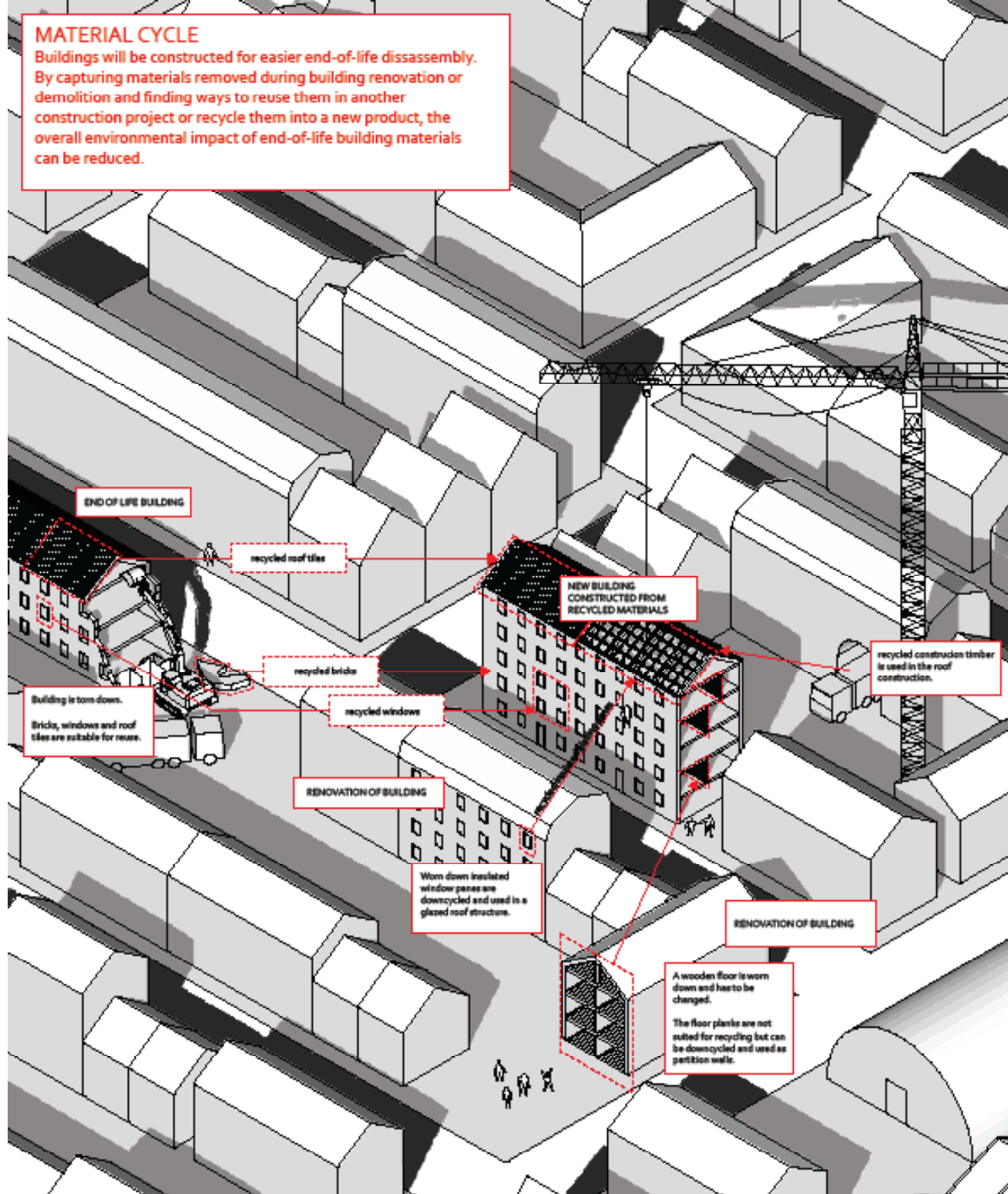


# 3. DESIGN FOR DECONSTRUCTION

DfD

## MATERIAL CYCLE

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# 4. LOCAL DISTRIBUTION

Preparing material for direct reuse

## WASTE MANAGEMENT

At the recycling depot a new feature is added - *The Material Distribution Unit*.

Here, all waste is screened before entering the depot. Materials with potential for reuse is sent to the reprocessing industry (see page xx). The materials not suited for reuse is sorted traditionally before being sent to the recycling plant (see page xx).

**RECYCLING PLANT**  
This is the last stop before waste is either incinerated, crushed or melted.

**RECYCLING DEPOT**  
Waste is deposited before being sent to the recycling plant.

Waste is sent to the recycling plant

**MATERIAL DISTRIBUTION UNIT**  
Screening and categorisation of materials depending on quality, fractioning, potential for reuse etc.

Bridges - to be cleaned and reused  
Construction timber - to be tested and reused  
Ventilation ducts - to be reprocessed as facade tiles  
Windows - to be reused in new buildings or in green houses  
Scrap wood - to be recycled eg. as cladding or inner walls

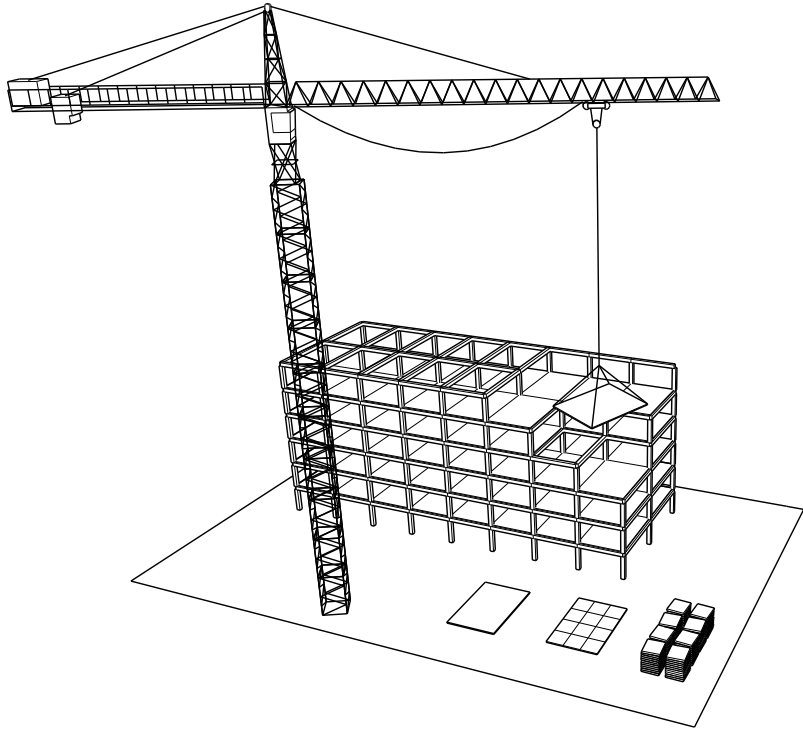
Materials are distributed for reuse

Materials enter here

**WASTE NOT THE WASTE**

# 5. WASTE MANAGEMENT

## Salvaging and distribution



# .Technology CONCRETE ROBOT DECAPITATOR

