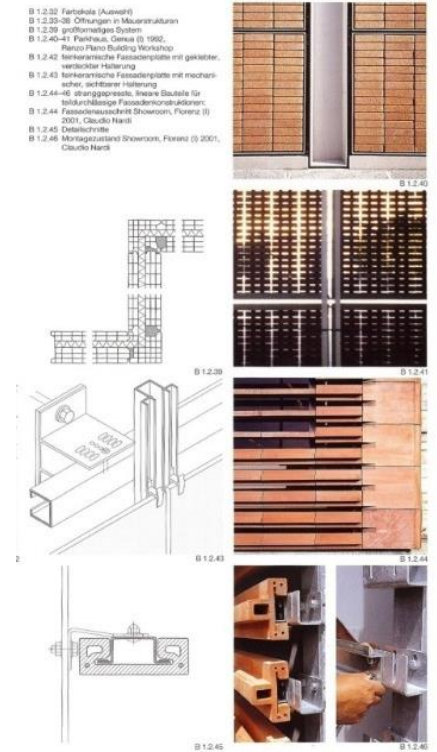
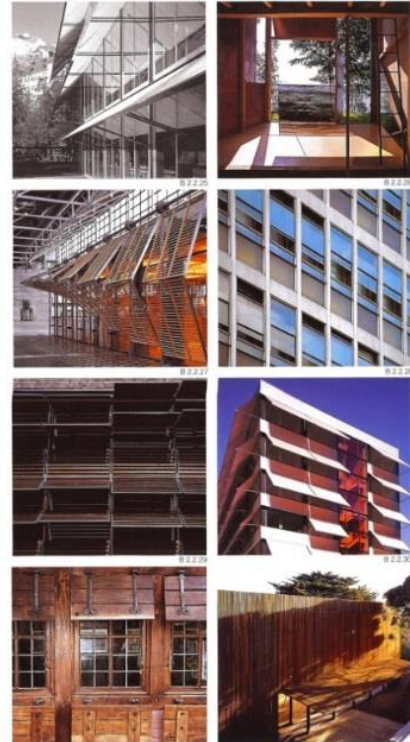
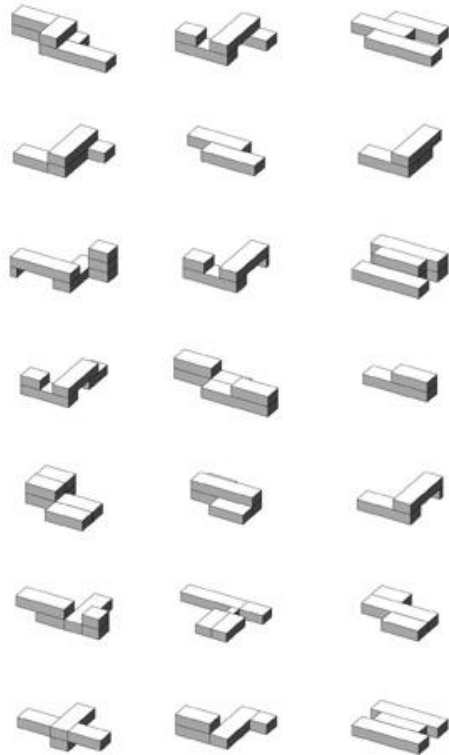




# Green Transformable Buildings

By reversible building design



Paradigm Shift towards Circular Buildings and Economy





# GLIMPSE OF THE FUTURE

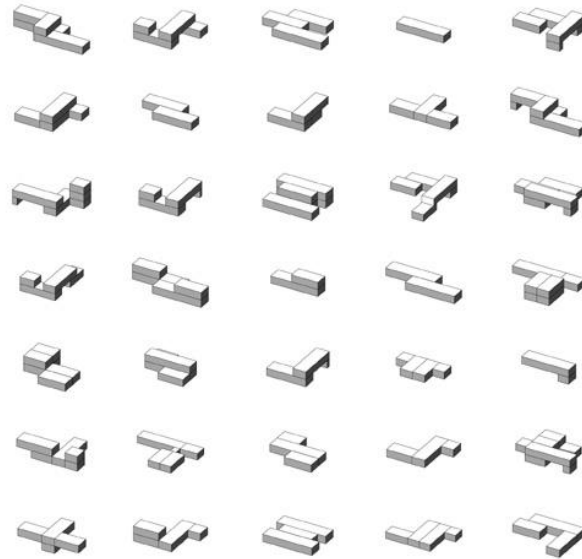
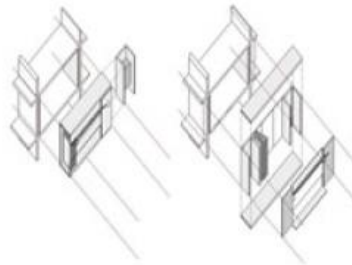
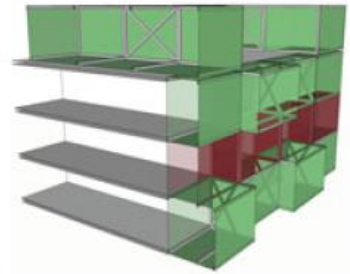
Due to technological and ICT revolutions, we are witnessing increasing acceleration of change almost on daily bases in all fields. These changes affect the way we communicate, work, learn, live, while trends and predictions risk to be overrun at the time they are identified as such. What is the physical answer to this increasing dynamics, considering the capacities of the planet and human physical and psychological needs?

*( Durmisevic 2015)*





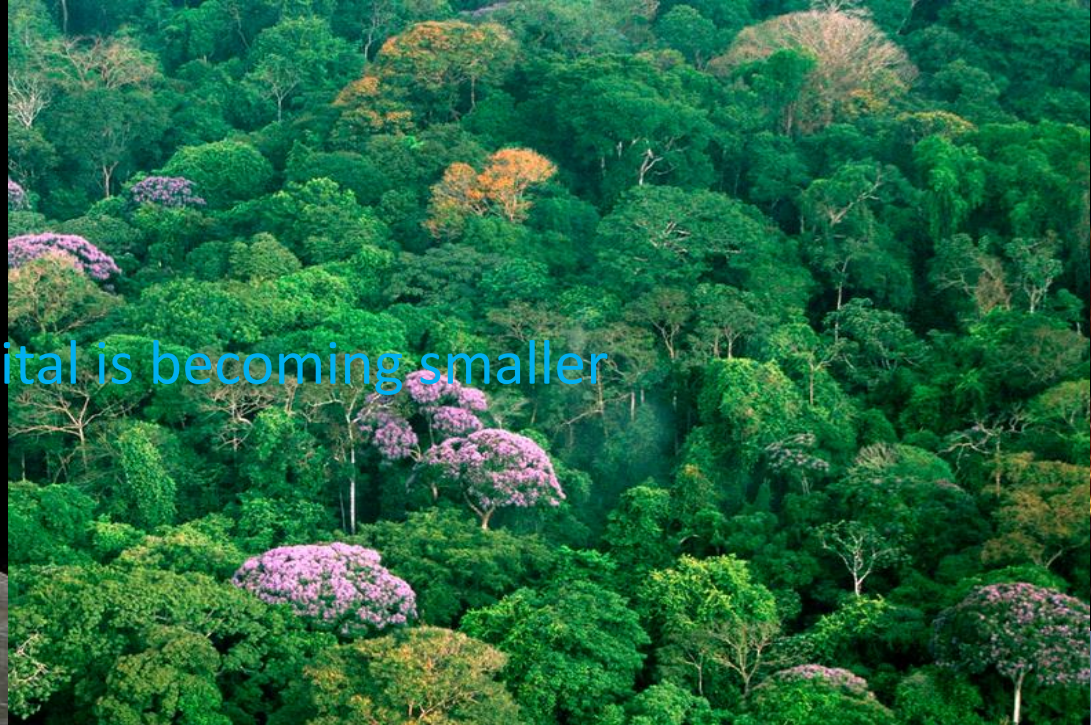
Upgradeable built environment







Environmental capital is becoming smaller



*Dr. Elma Durmisevic, Head of the research EU Horizon  
2020/BAMB Revisable Buildings Design, Design leader of GTB  
Lab and GDC pilots*



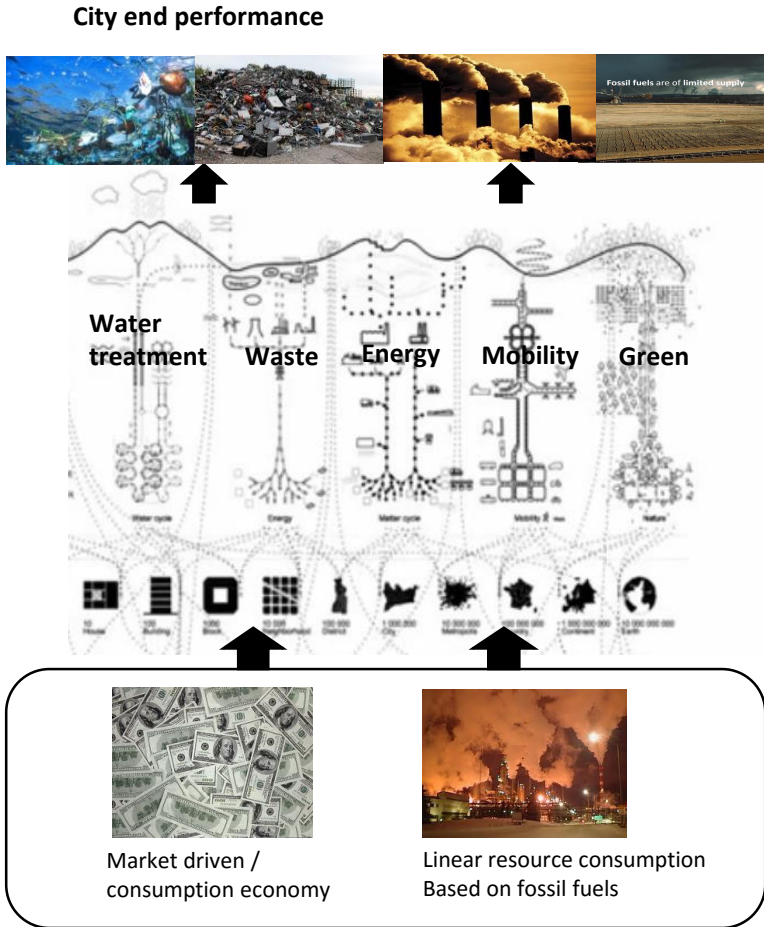
It is that through cities and buildings the mankind mediates its relationship to various stokes and flows of environmental capital.



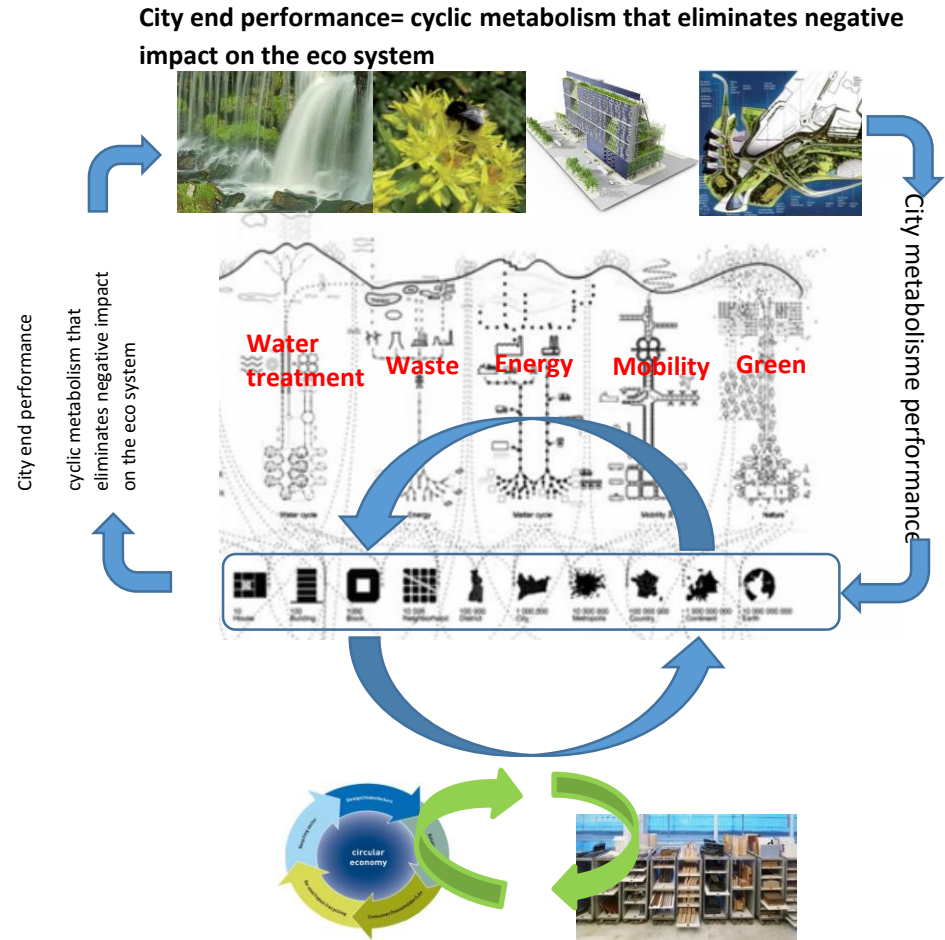
Considering the downstream of the resources we need to imagine a new world with new value system. In doing that, development of new design concepts and integrating innovative engineering and production technologies are key accelerants towards reversibility of the existing downstream of resource.

# Reversing the process of degradation

## The world of today



## The world of tomorrow



# the world of tomorrow is **upgradable world** with **dynamic** and reversible buildings

Whereby design needs to guaranty circular value chains, through which buildings and materials in buildings will sustain / increase their value.

**Instead of being designed for demolition and to become waste, reversible building design gives buildings capacity to reverse the processes and building structures back to the initial set of elements and to re-configure them to answer new requirements**



Reverse the process of degradation







**Fortis Bank  
Amsterdam  
1998**



**Fortis Bank  
Amsterdam  
2014**

**Value degradation of buildings**

**and building materials**



**Fortis Bank  
Amsterdam  
2014**



**Fortis Bank  
Amsterdam  
2014**



**Dynamic and Circular Building is  
shaping the world of tomorrow.**

**The world in which  
building demolition and construction  
waste is **Design Mistake****

Durmisevic 2015

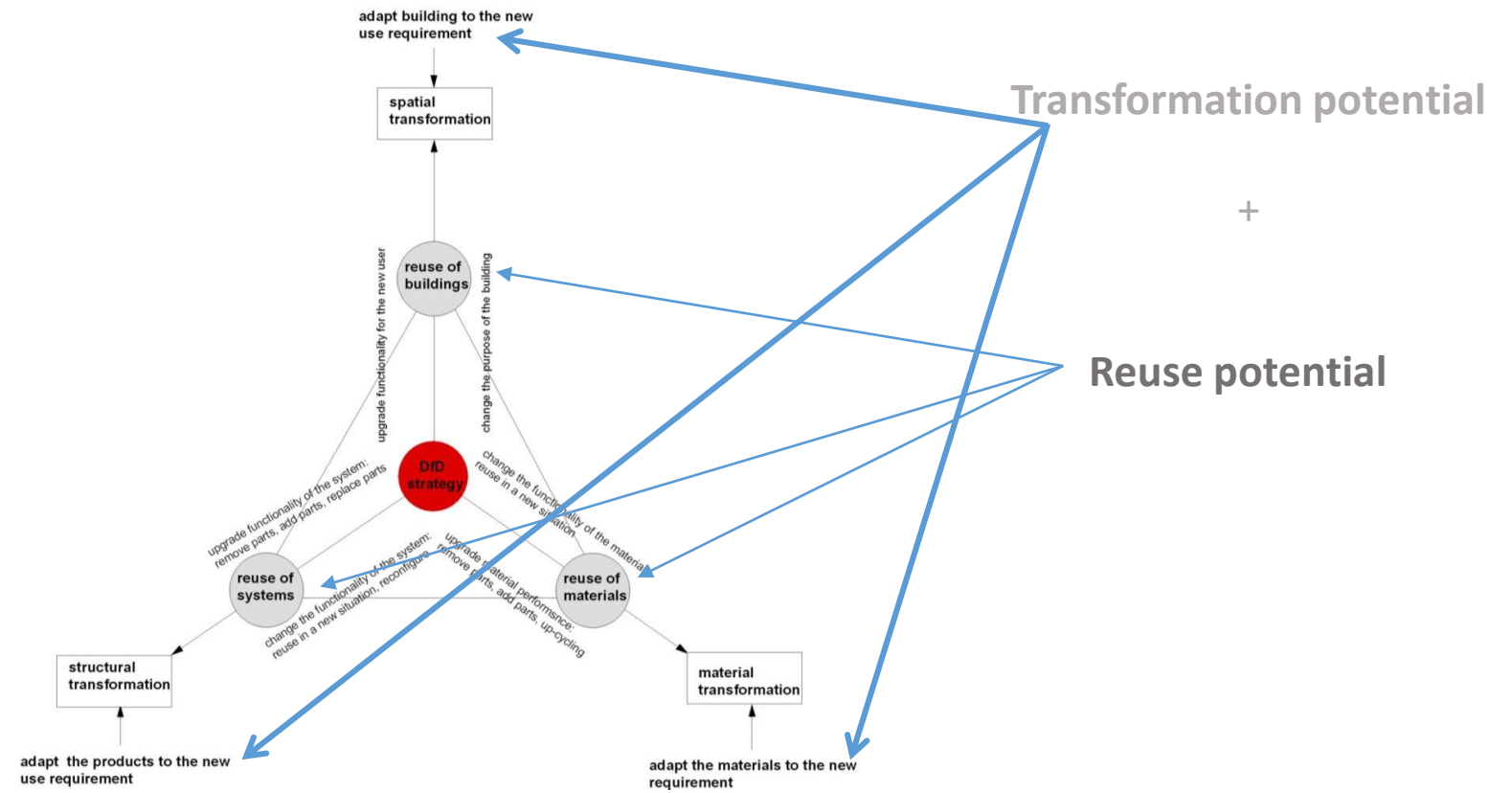
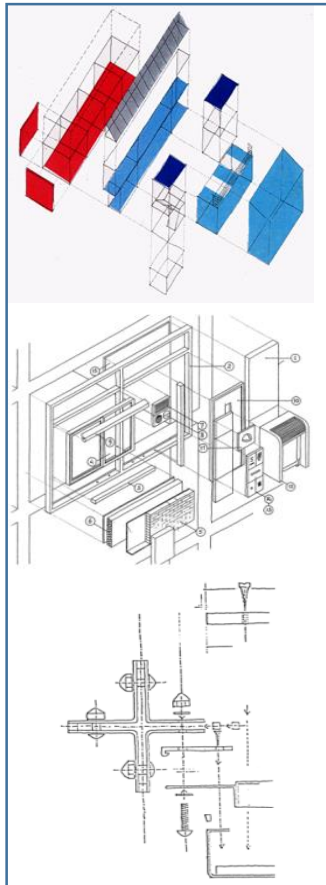


**Future Value = Reversible Building =**

**High Transformation capacity + High reuse potential**

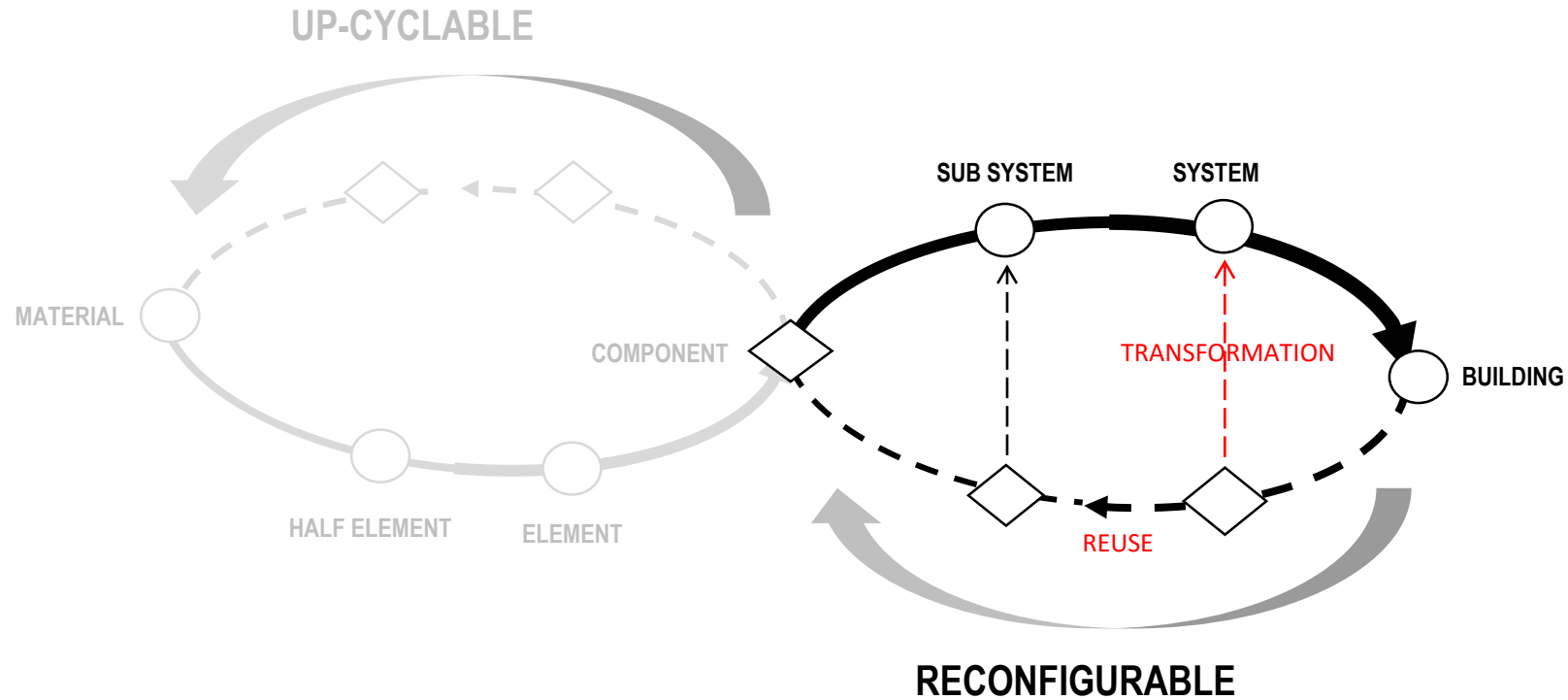


Design Task is to guaranty  
 long term value of buildings by **high transformation** and **reuse potential** of buildings and materials on three levels



# Reversible building design

## Keeping materials in a use loop

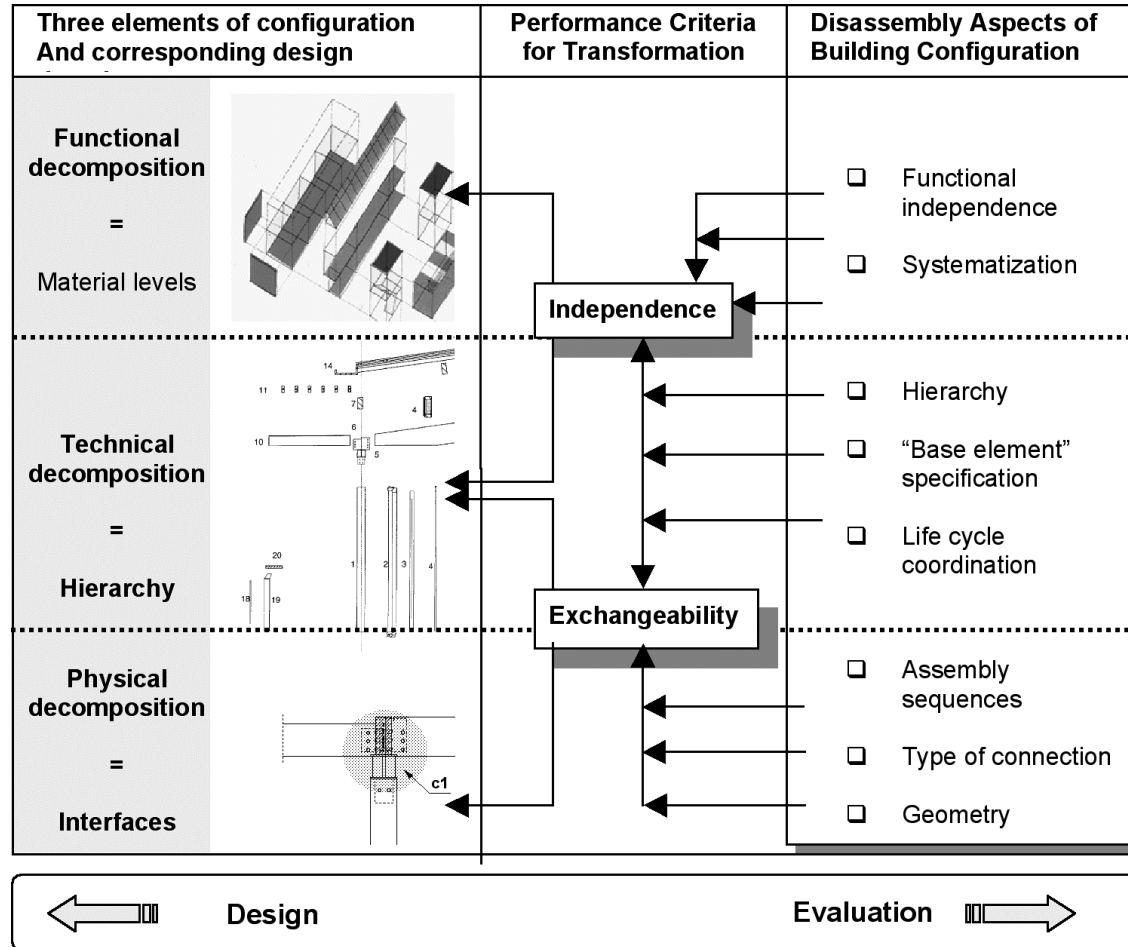




TRANSFORMATION CAPACITY



REUSE POTENTIAL

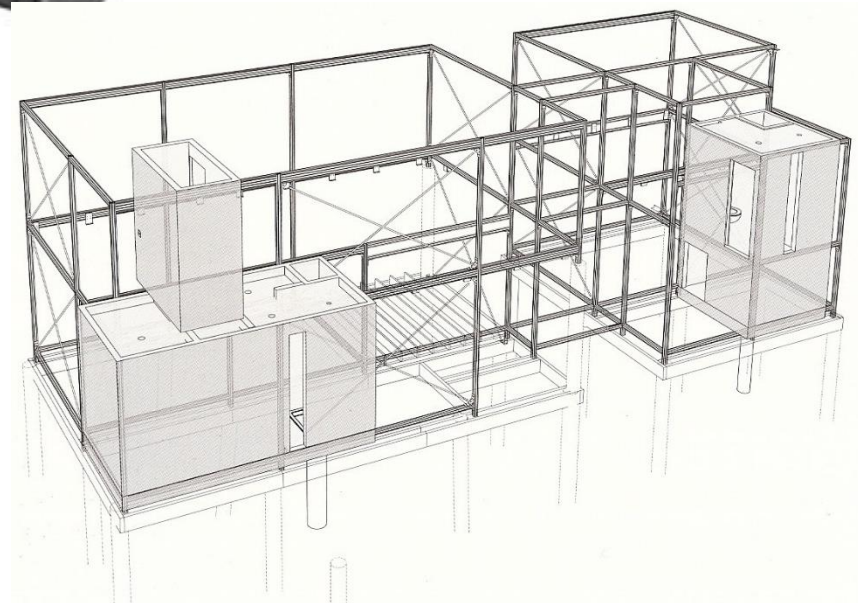


## REVERSIBLE BUILDING DESIGN PROTOCOLS

# Independency



**Independency  
indicator of  
Transformation**  
Expending the reuse of  
building, systems and  
components through  
Modularity  
Replicability  
Upgradability

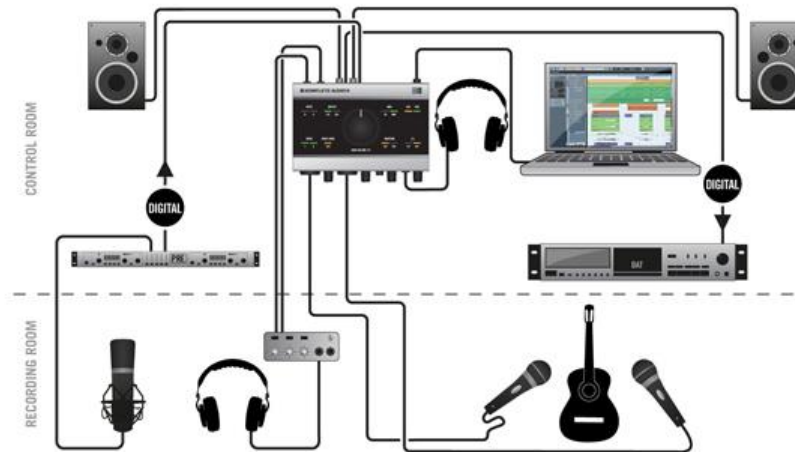
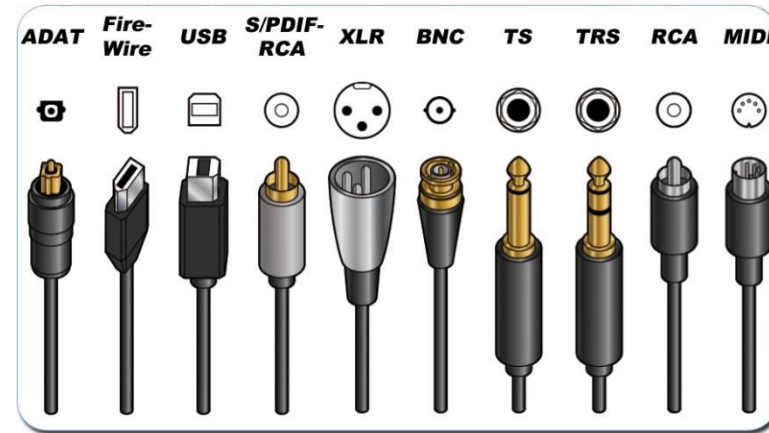


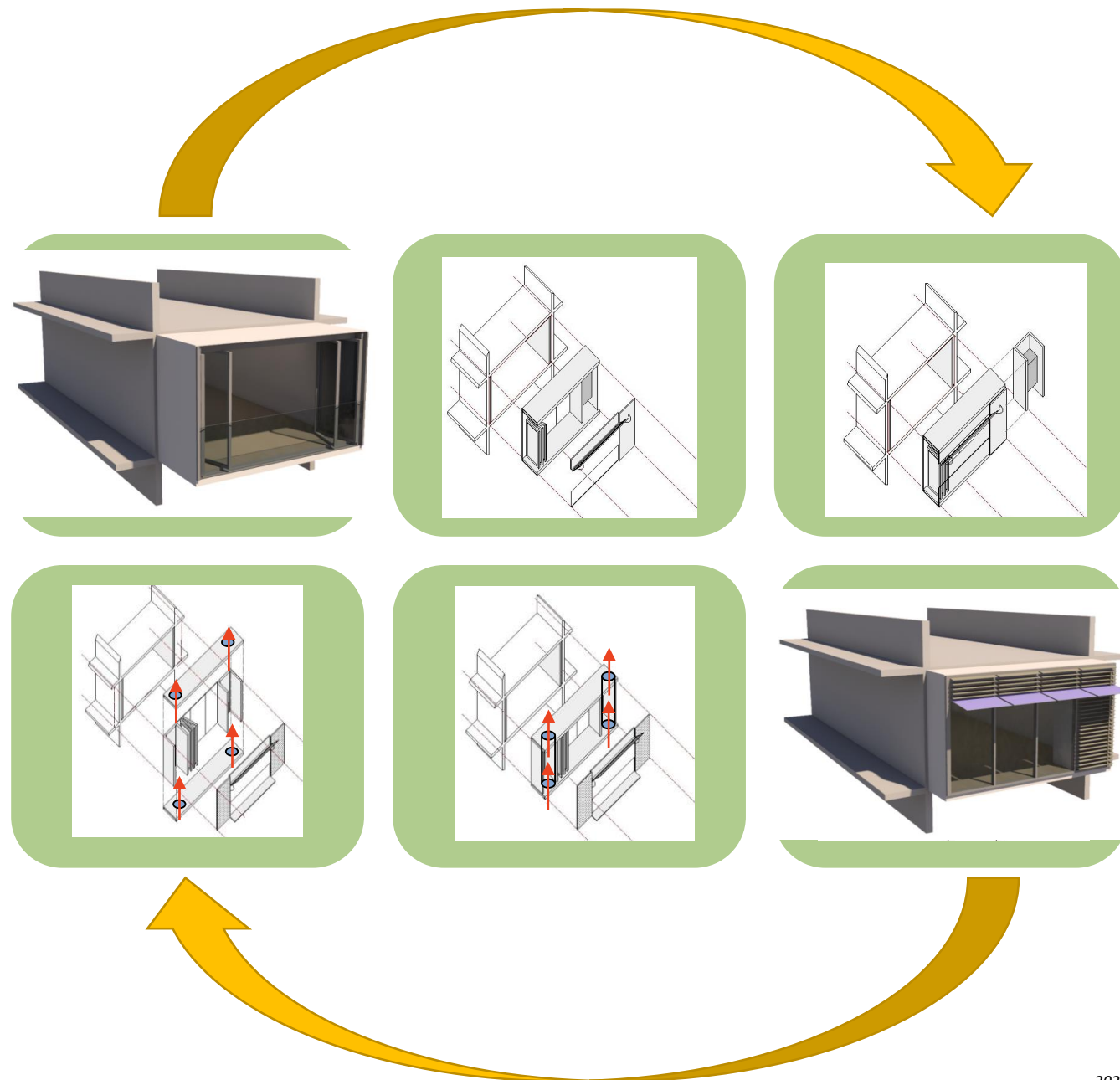


# Exchangeability

Exchangeability  
indicator of  
transformation

Standardization of  
Interfaces for  
increased  
Reuse potential

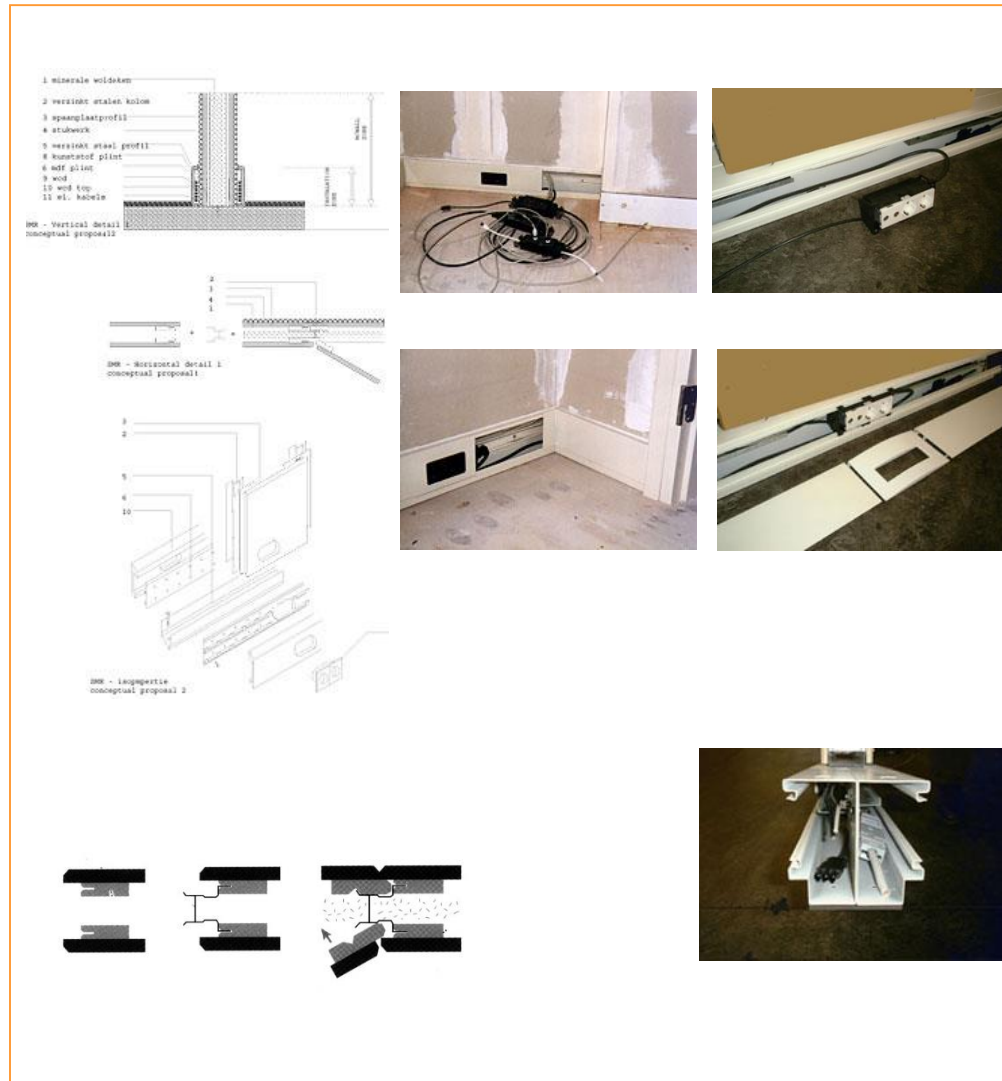






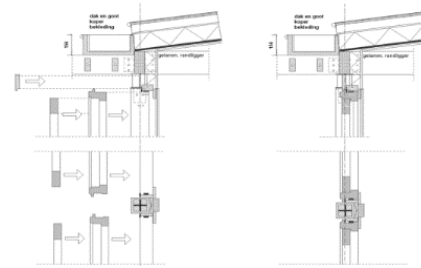
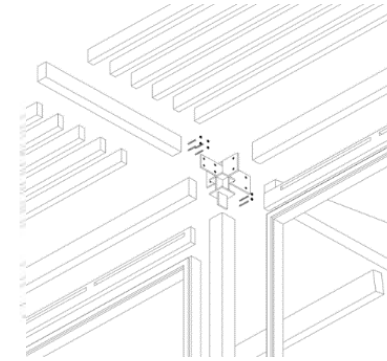
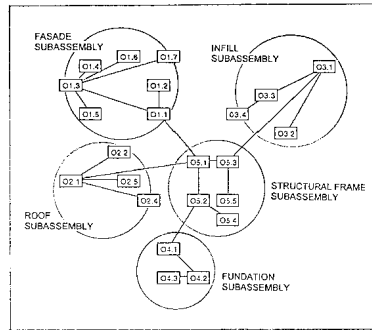
projectname  
SMR wall system

Flexible wall system for  
housing  
Design 2000  
In corporation with:  
Polynorm, Corus TU Delft





Relational diagram between building components



## DEMOUNTABLE FAMILY HOUSE TE BILTHOVEN

Demontable Family House has been designed by Durmisevic as a part of a PhD project (“Transformable building structures”) at the TU Delft  
In Collaboration with  
M.P.Evelein

# Measures for Future Value

- Up-cycling
- Element/Component reuse
- Adaptive
- Design quality (Prevention by design)



# Domain of the designer | 4<sup>th</sup> dimension

kg =

TEKLA STRUCTURES MATERIAALLIJST							Pagina: 1	
Model: G01791-745-001							Project: G01791-745	
							Datum: 04.06.2012	
							Tijd: 15:11:07	
Profiel	Pos	Kwaliteit	Aantal	Lengte(mm)	Opp. (m <sup>2</sup> )	Gewicht(kg)		
B33.7/2.65	10	S460	20	686	0.08	1.4		
B33.7/2.65	11	S460	20	546	0.06	1.1		
				24635	2.71	49.9		
KK70/3	6	S460	10	1634	0.44	10.0		
KK70/3	9	S460	10	1634	0.44	10.0		
				32672	8.82	200.3		
KK100/3	2	S460	2	14100	5.50	126.2		
KK100/3	3	S460	2	14100	5.50	126.2		
				56400	22.00	504.7		
KK100/4	4	S460	2	1210	0.47	14.2		
KK100/4	5	S460	2	1210	0.47	14.2		
KK100/4	8	S460	18	1010	0.39	11.8		
				23020	8.89	269.3		
KK200/100/4	1	S460	11	3000	1.76	53.9		
				33000	19.34	593.2		
PL4*405.9	12	S460	70	1300	1.07	16.5		
				91000	74.78	1157.0		
PL8*1398	14	S460	8	3020	8.97	281.5		
				24160	71.79	2251.8		
PL8*1448	13	S460	2	3020	9.27	290.9		
				6040	18.55	581.8		
Totaal:					226.87	5607.9		

Life cycle =



$$\text{CO}_2 \text{ footprint} = \frac{\text{kg} * \text{CO}_2/\text{kg}}{\text{Lifecycle} * X}$$

CO<sub>2</sub>/kg =





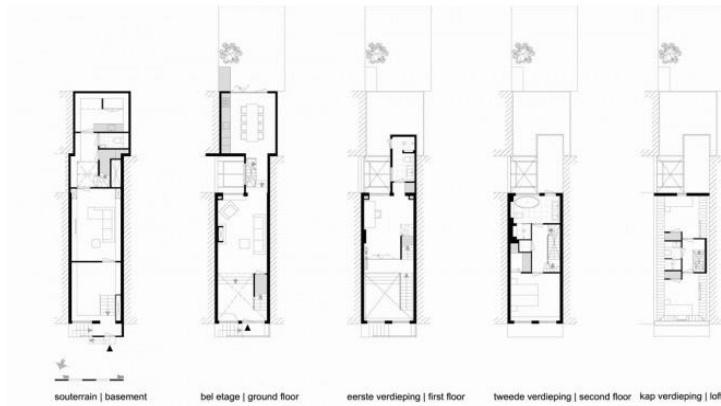
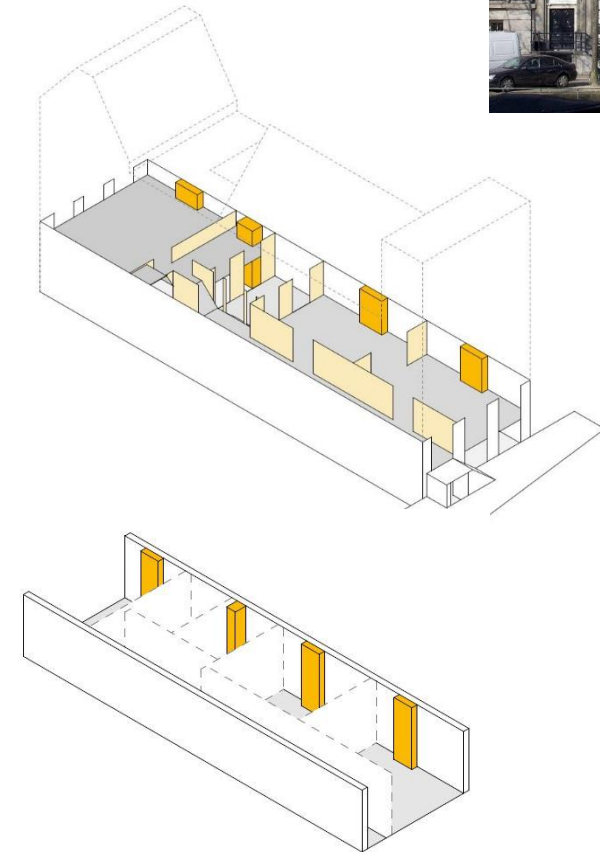
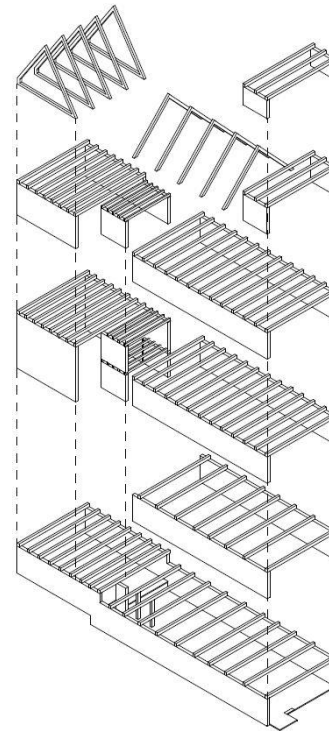
# Reversible monuments





# Canal house, Amsterdam

Frederic Blancard (1620, 1728)



*Dr. Elma Durmisevic, Head of the research EU Horizon 2020/BAMB Reversible Buildings Design, Design leader of GTB Lab and GDC pilots*

Bos et al. (2012) Mixed-use, in the case of flexible buildings



### Sustainable future:

Technology is a tool to provide better quality of life.

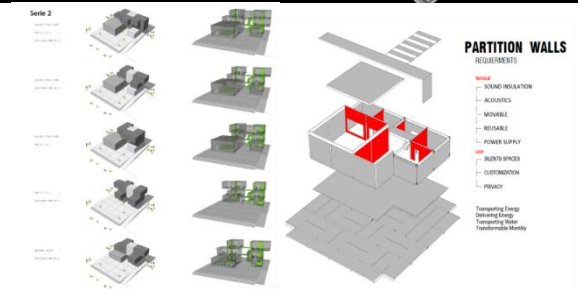
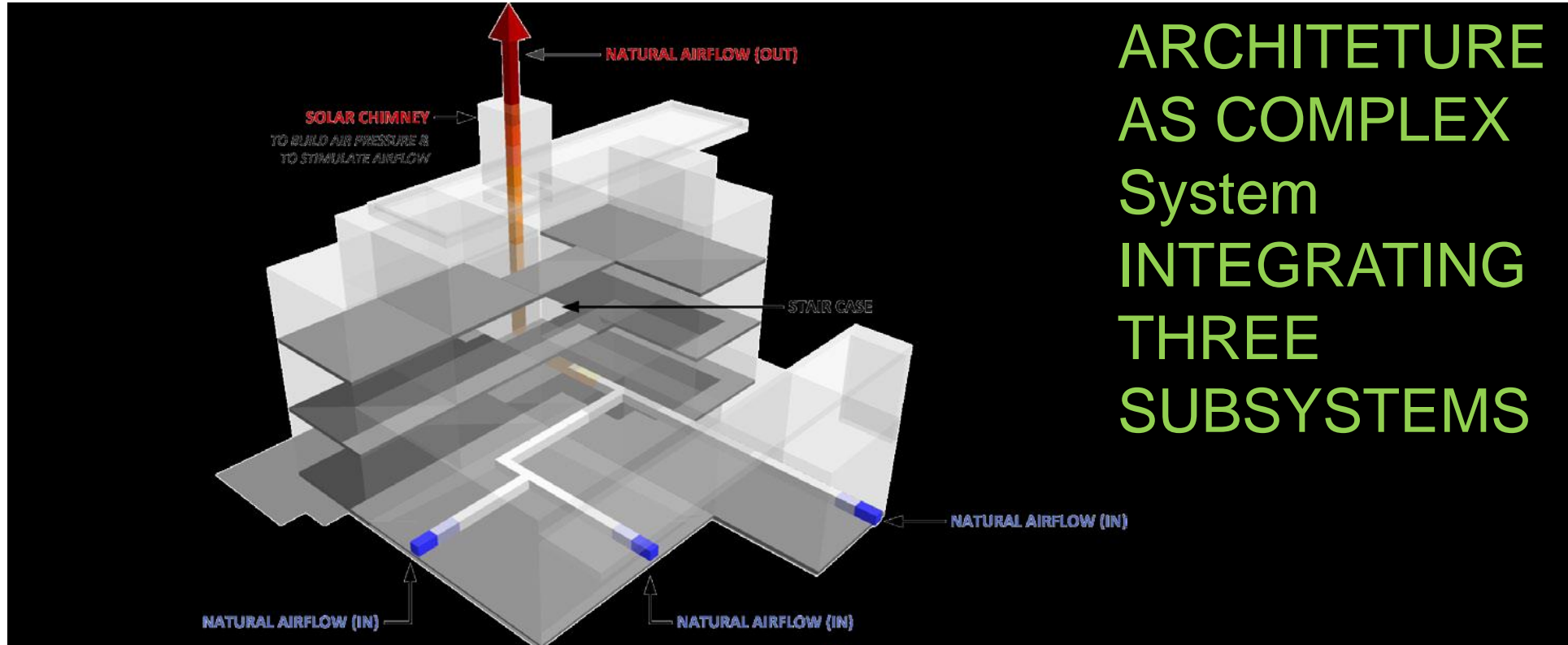
However psychological human needs often overrule physical ones.

**Design is the place where purpose and meaning revive the matter.**

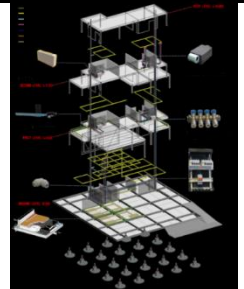
**This makes design become fundamental to our physical and psychological comfort and key to sustainable wellbeing.**



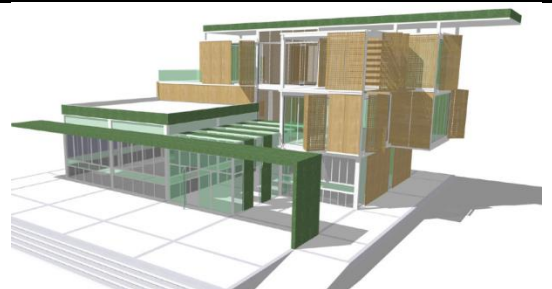
# ARCHITETURE AS COMPLEX System INTEGRATING THREE SUBSYSTEMS



Dynamic space configuration

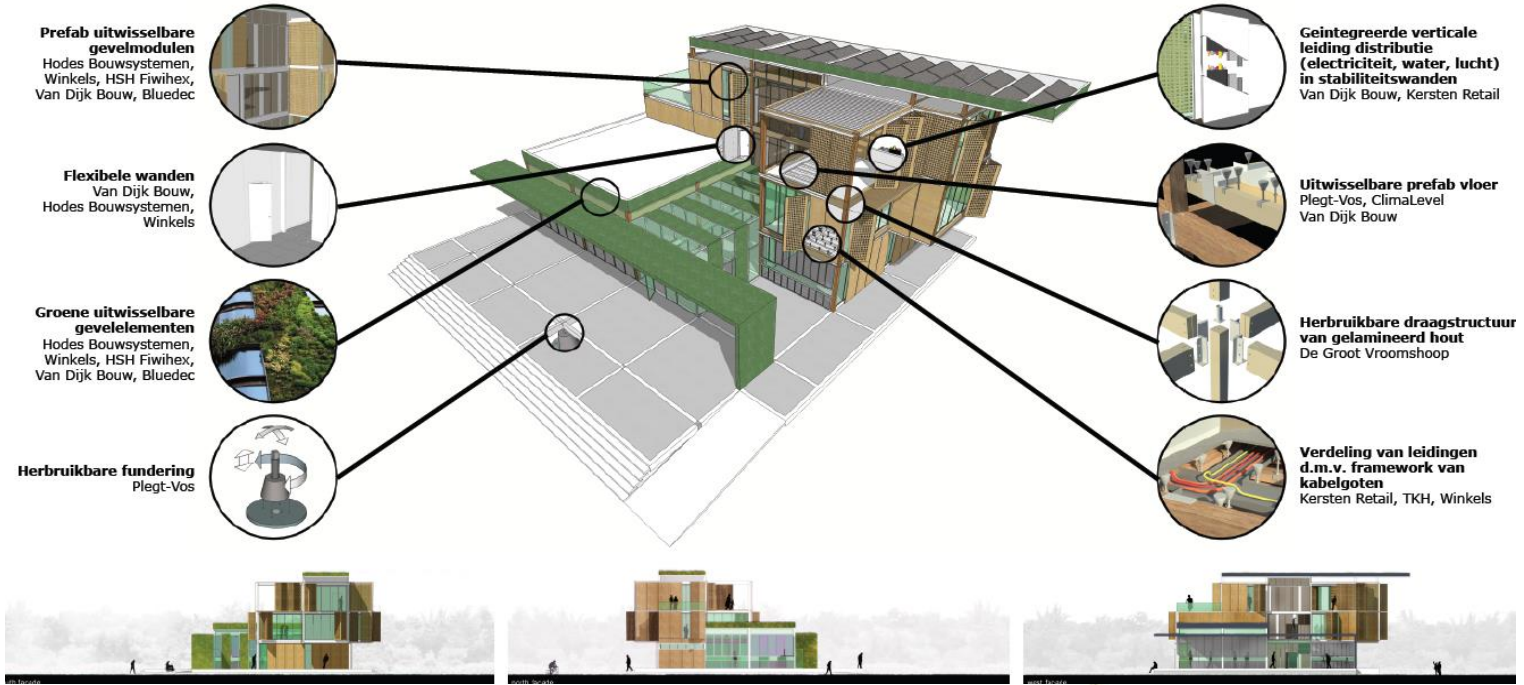


Dynamic structural configuration



Dynamic Esthetics

# Laboratory for Green Transformable Buildings



Dr. Elma Durmisevic, Head of the research EU Horizon 2020/BAMB Reversible Buildings Design, Design leader of GTB Lab and GDC pilots



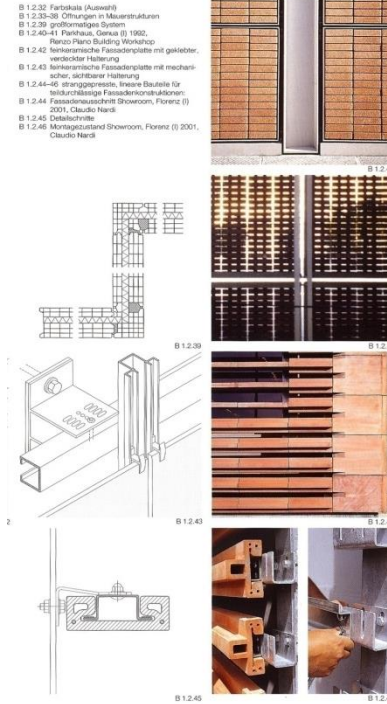
Elements of reversible buildings

adaptability

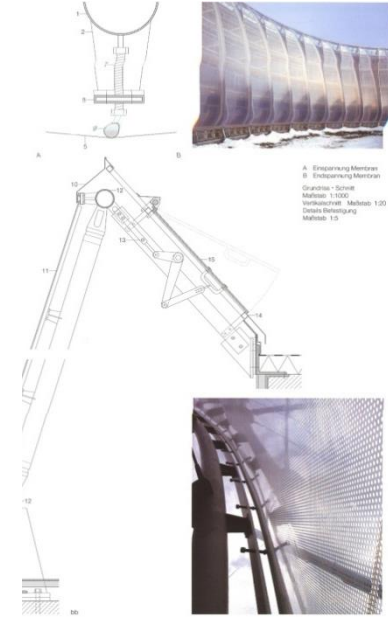


Reuse

- B 1.2.32 Farbakula (Kauzsch)
- B 1.2.35-38 Öffnungen in Mauerstruktur
- B 1.2.39 großformatiges System
- B 1.2.40-41 Parkhaus, Genoa (I) 1982, Renzo Piano Building Workshop
- B 1.2.42 Sekularistische Fassadenplatte mit geleiteter, verdickter Halterung
- B 1.2.43 Sekularistische Fassadenplatte mit mechanischer, seitlicher Halterung
- B 1.2.44-46 straggipressile, lineare Bauteile für lastübertragende Fassadenstrukturen
- B 1.2.44 Fassadenaußenstrich Showroom, Florenz (I) 2001, Claudio Nardi
- B 1.2.45 Detailschritte
- B 1.2.46 Montagezustand Showroom, Florenz (I) 2001, Claudio Nardi



Smart Materials upcycling

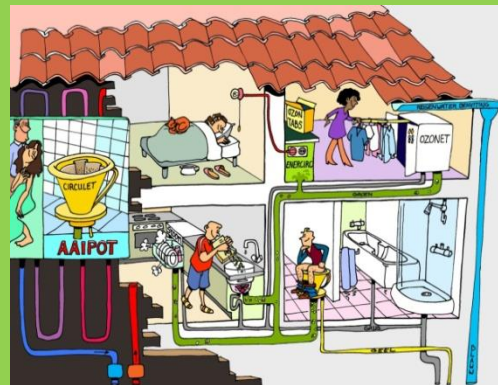


Elements of green buildings

energie



water



green





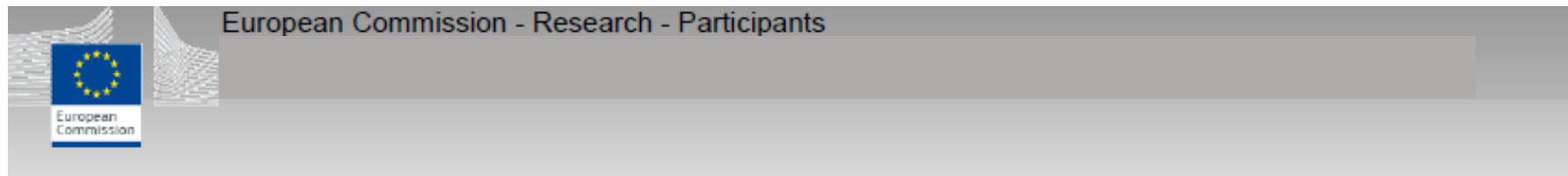
## Story behind Reversible Buildings/**BUILDINGS AS FLOWERS**

Design building as a flower that make people happy, Flower as a source of inspiration, curiosity, positive feeling and expression of love, Flower that is self regulated and adjustable to the climate, and extends its life through future flowers ...



Elma Durmisevic

# Reversible Building Design Symposium part II



Horizon 2020

# Buildings as Material Banks

Integrating Materials Passports with Reversible Building Design to  
Optimize Circular Industrial Value Chains



UNIVERSITEIT TWENTE.

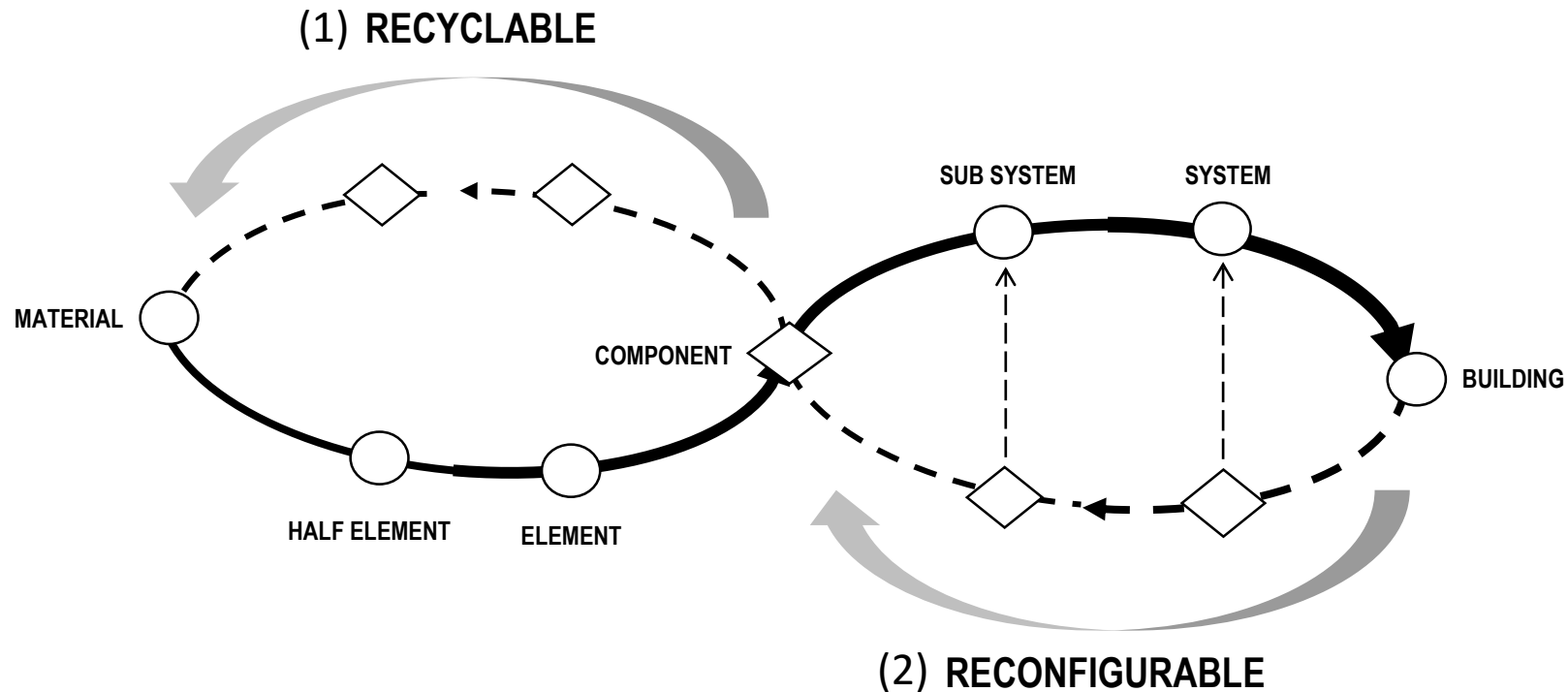




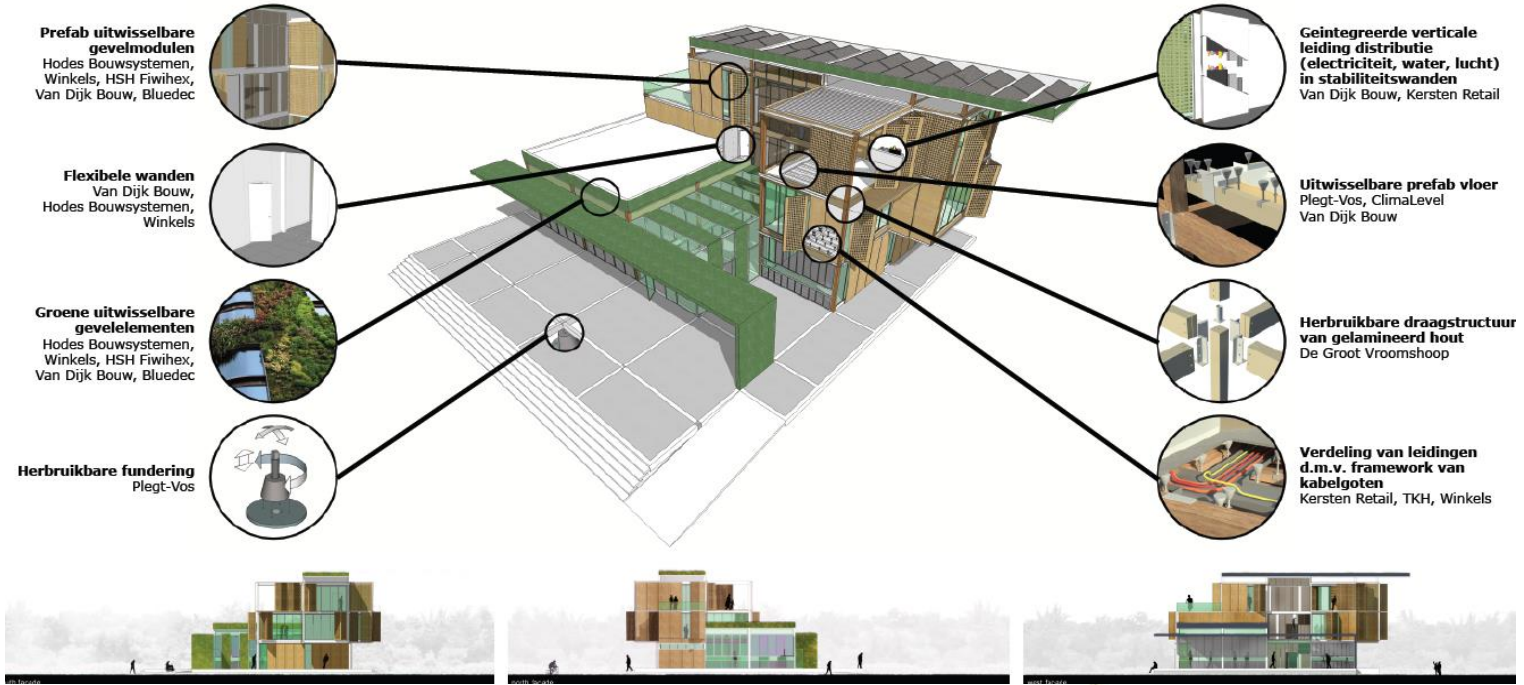
**THE AIMS of BAMB** (*Buildings as Material Banks*) are:

- the prevention of construction and demolition waste,
- the reduction of virgin resource consumption and
- the development towards a circular economy addressing the EU Work Programme on Climate action.

**BAMB METHOD:** In order to improve the value of building materials for recovery two complementary value adding frameworks will be developed and integrated, **(1) materials passports** and **(2) reversible building design**.



# Laboratory for Green Transformable Buildings



Dr. Elma Durmisevic, Head of the research EU Horizon 2020/BAMB Reversible Buildings Design, Design leader of GTB Lab and GDC pilots



