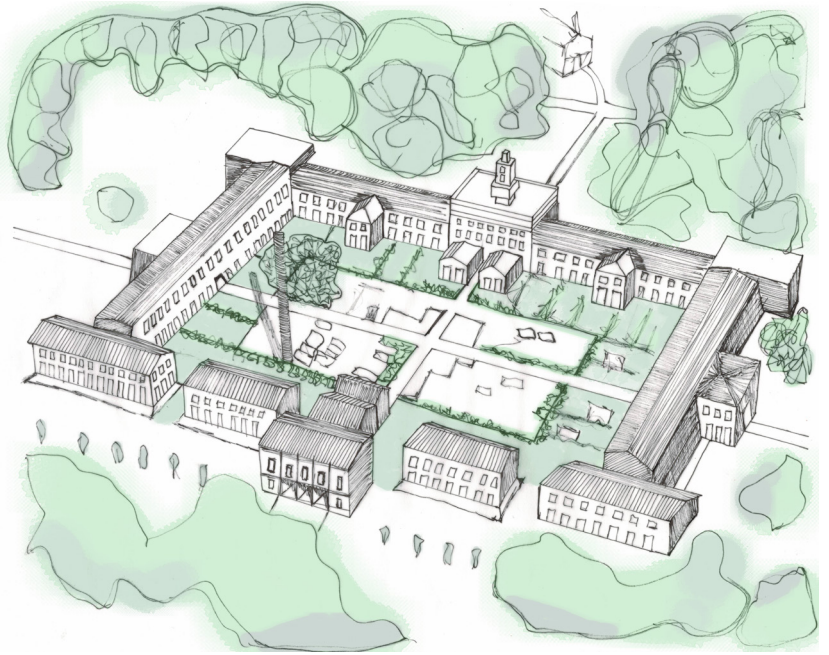
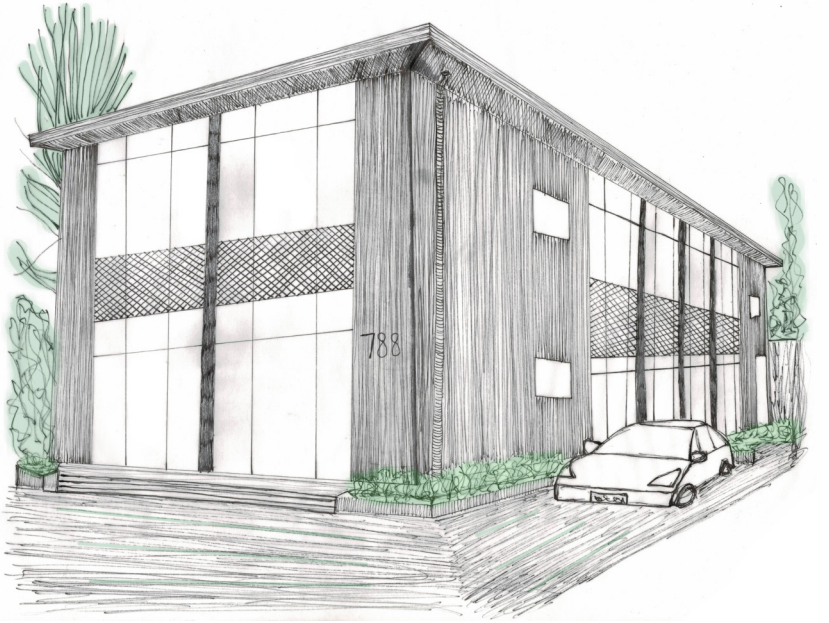
TU Delft BK Bouwkunde
Department of Management in the Built Environment

EXPLORING THE *APPLICABILITY* AND *EFFECTIVENESS* OF **CIRCULAR BUILDING ADAPTABILITY STRATEGIES** IN ***ADAPTIVE REUSE***





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Commissioner: prof.dr. Georg Vrachliotis
Company Mentor: Benny Duimel (Res & Smit)

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1. Introduction

1.1. Environmental Challenges

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1.1. ENVIRONMENTAL CHALLENGES

EU building sector contributes to:

42%

Energy Consumption

50%

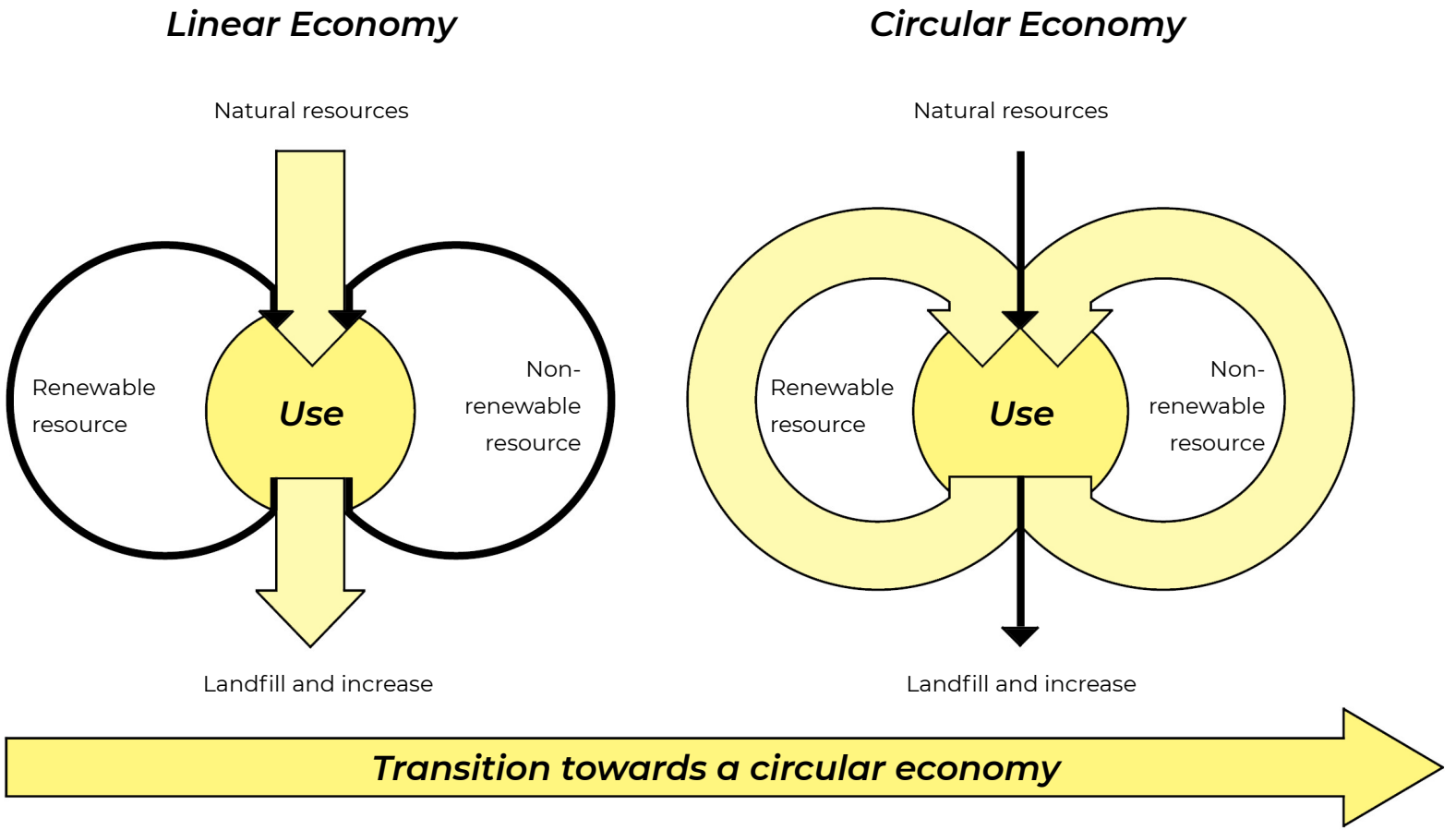
Extracted Materials

30%

Water Usage & Waste Generation

35%

Greenhouse Gas Emissions



Husain et al., 2021; Mrad & Ribeiro, 2022; Munaro et al., 2020; Potting et al., 2017

CE =
Circular Economy

1.2. DEFINITIONS

CIRCULAR ECONOMY

Production and **consumption** process

requires

minimum overall **natural resource extraction** and **environmental impact**

by

extending the *use of materials* and **reducing** the *consumption and waste of materials and energy*

Foster & Kreinin, 2020

1.2. DEFINITIONS

CIRCULAR ECONOMY

CE =
Circular Economy

Relation **Circular Economy (CE)** with the built environment?

Production and **consumption** process

requires

minimum overall **natural resource extraction** and **environmental impact**

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Foster & Kreinin, 2020; Hammond & Jones, 2008

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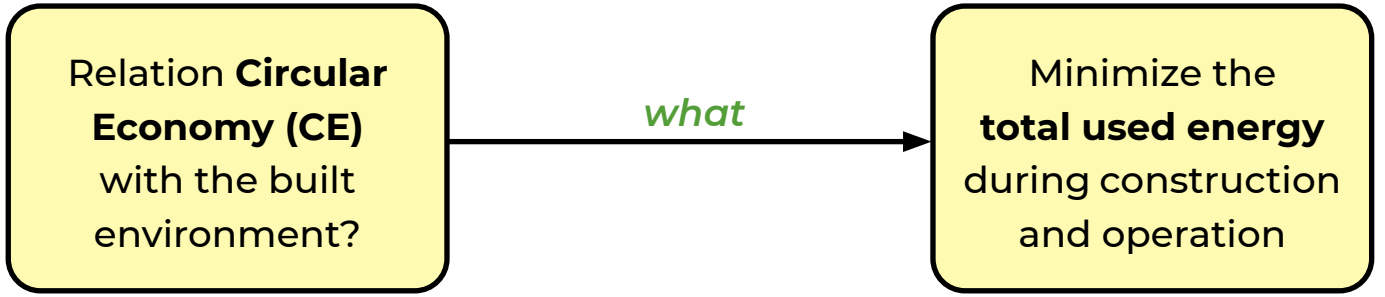

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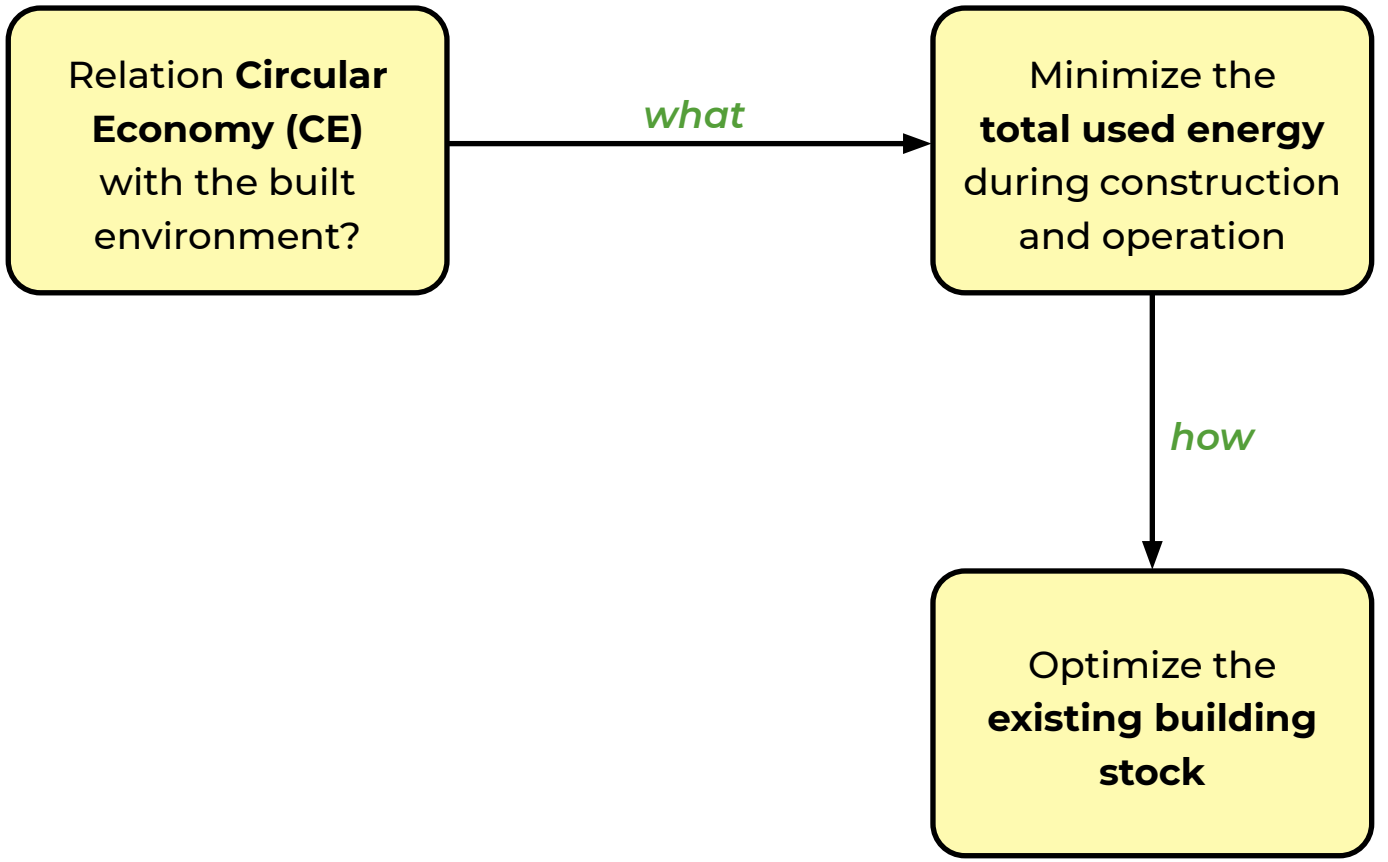

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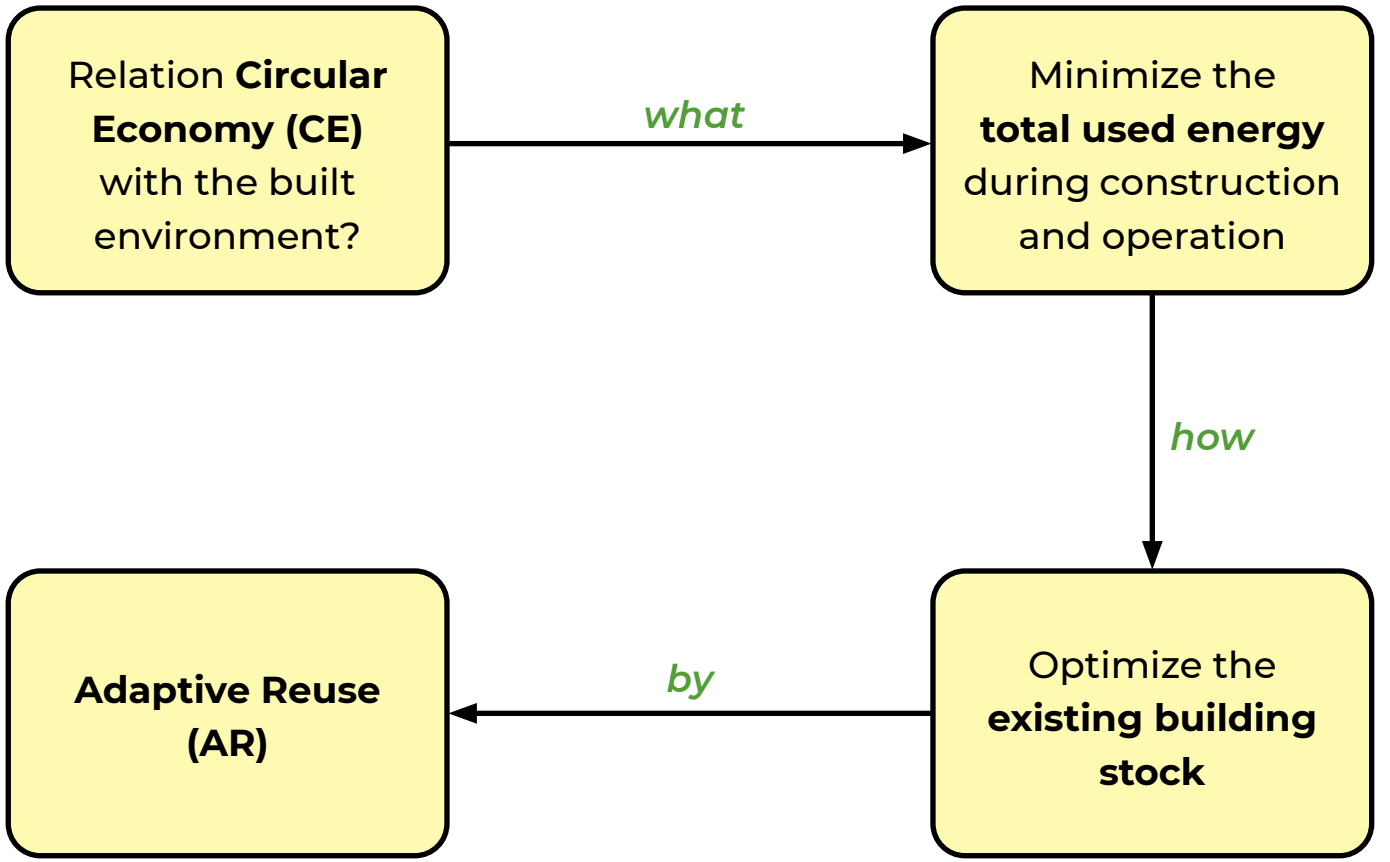

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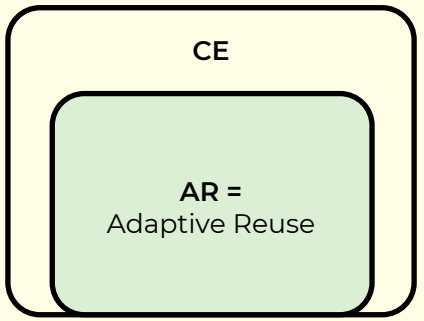


1.2. DEFINITIONS

ADAPTIVE REUSE

Conversion of a facility or part of a facility

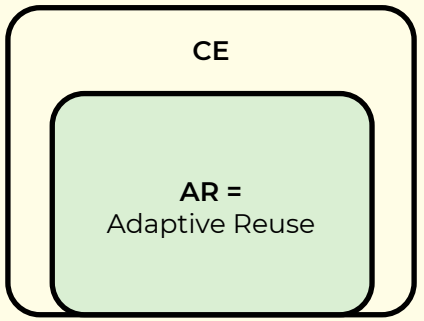
to

a use significantly **different**

from

that for which it was **originally designed**

Iselin & Lemer (1993)



Conversion of a facility or part of a facility

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1.2. DEFINITIONS

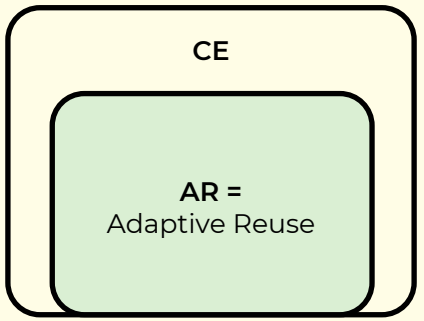
ADAPTIVE REUSE

Incorporating environmentally friendly **design principles**

Challenges

Maintaining the building's **historical character**

Iselin & Lemer (1993)



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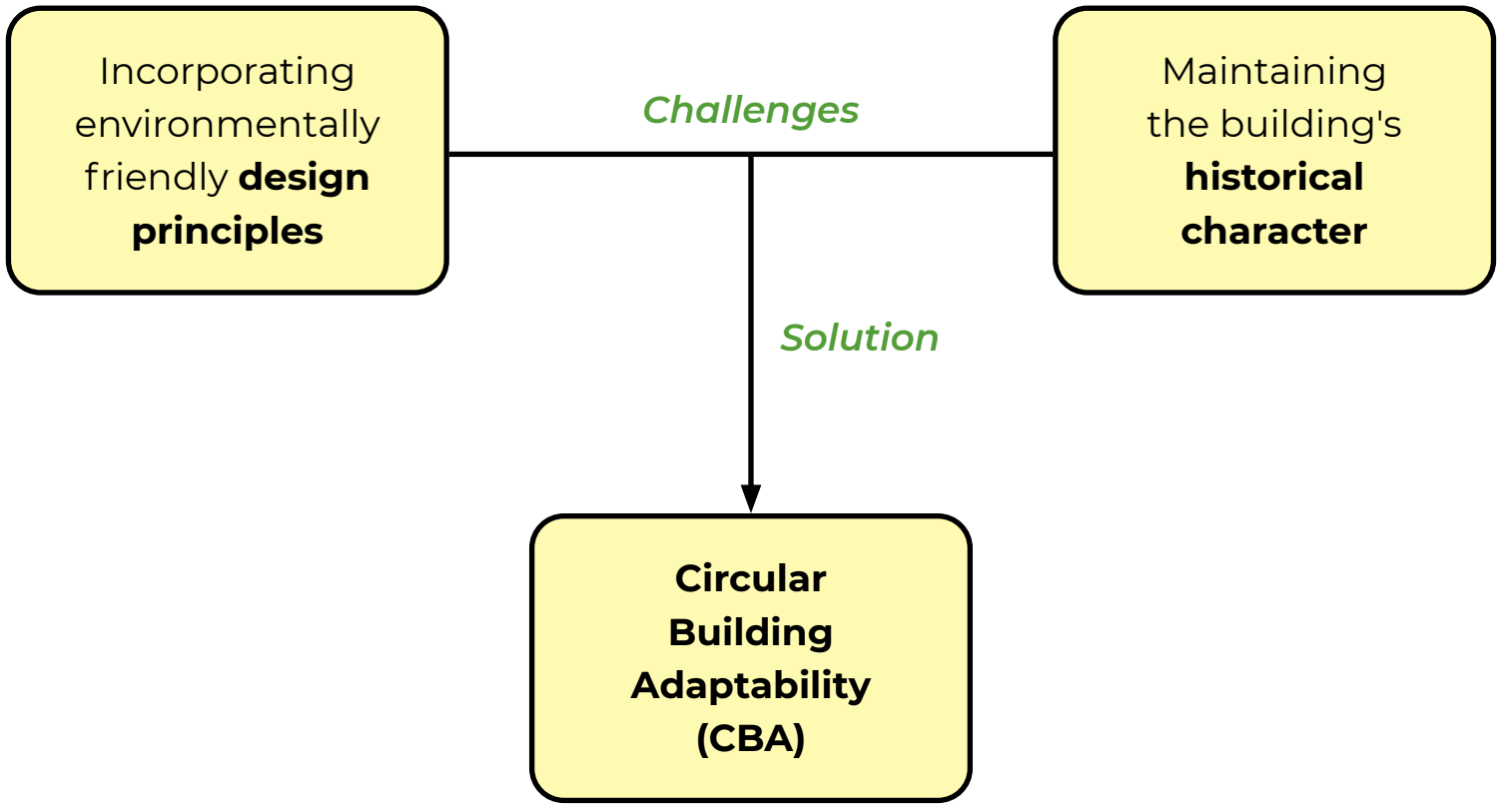

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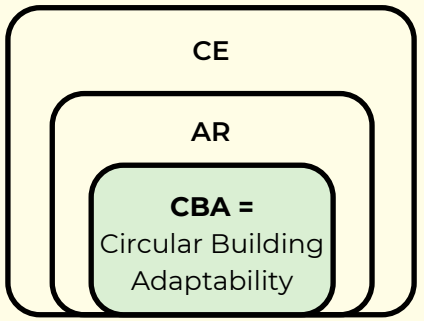


1.2. DEFINITIONS

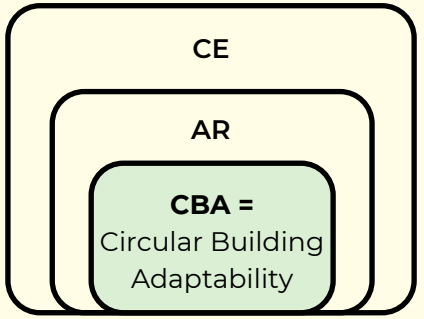
CIRCULAR BUILDING ADAPTABILITY

Capacity to **contextually** and **physically** alter the built environment and **sustain its usefullness**

while

keeping the building asset in a **closed-reversible value chain**

Hamida et al., 2022



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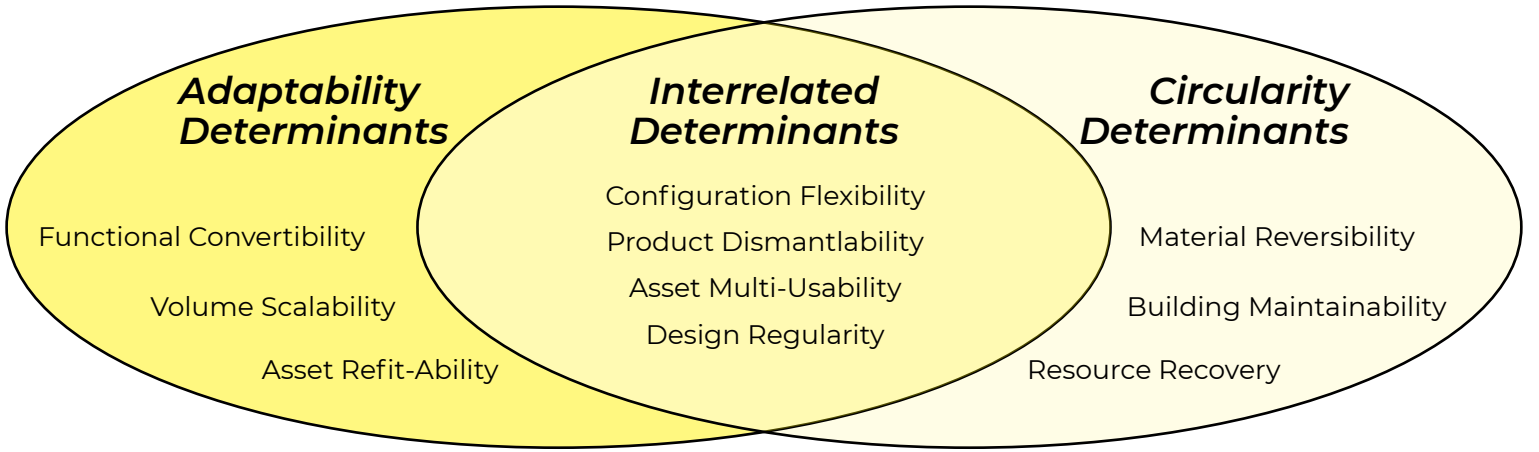

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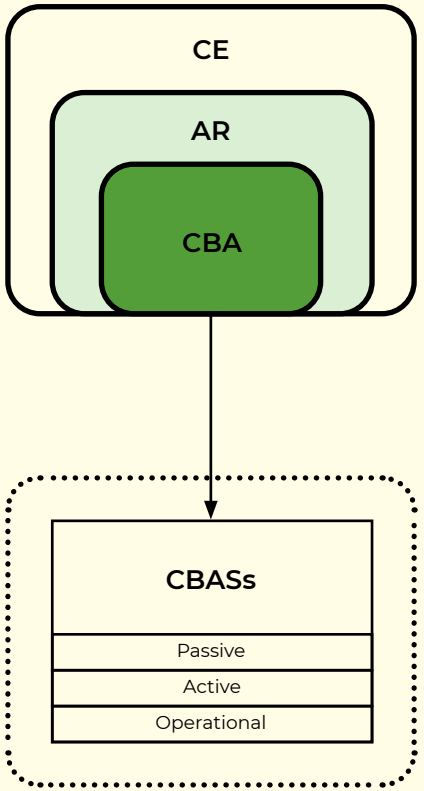
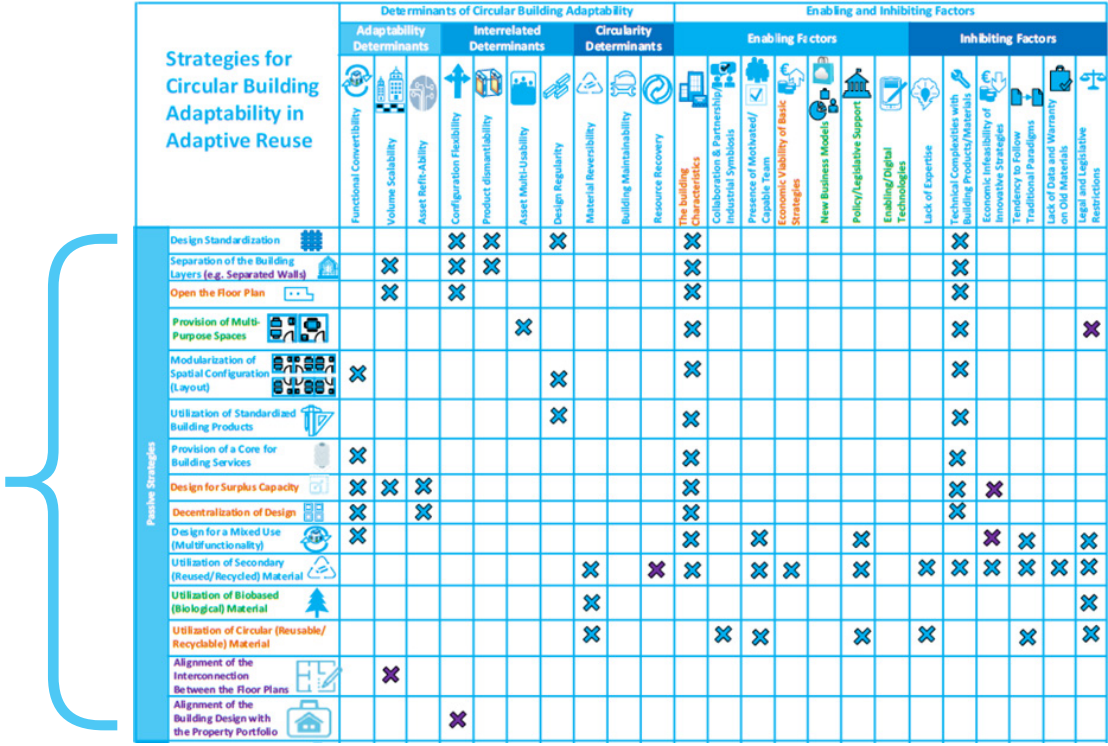


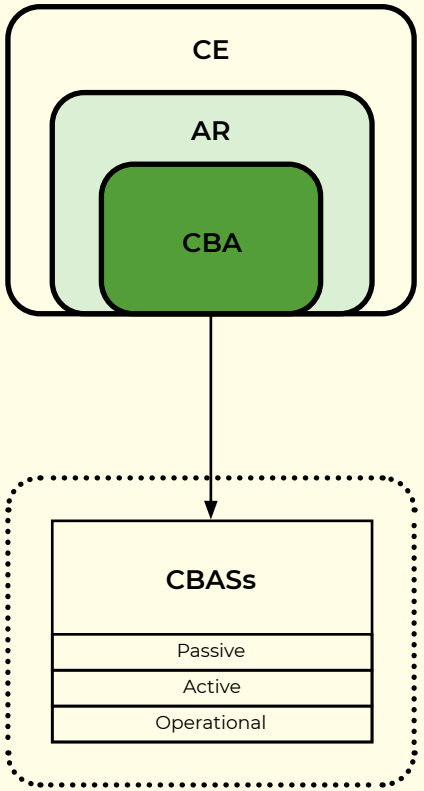
CBA-AR =
Circular Building Adaptability in Adaptive Reuse

CBASs =
Circular Building Adaptability Strategies

1.3. CBA-AR FRAMEWORK

- **15 Passive CBASs:**
  - Building Design





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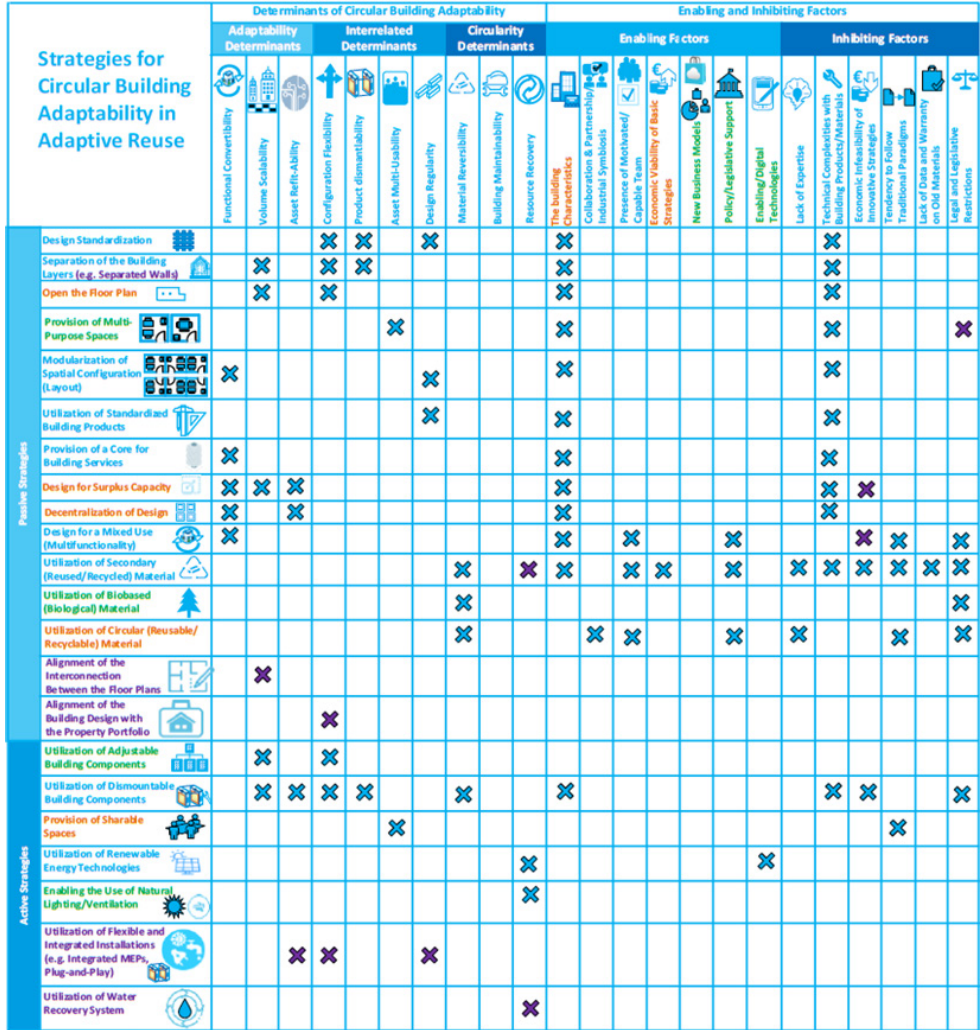
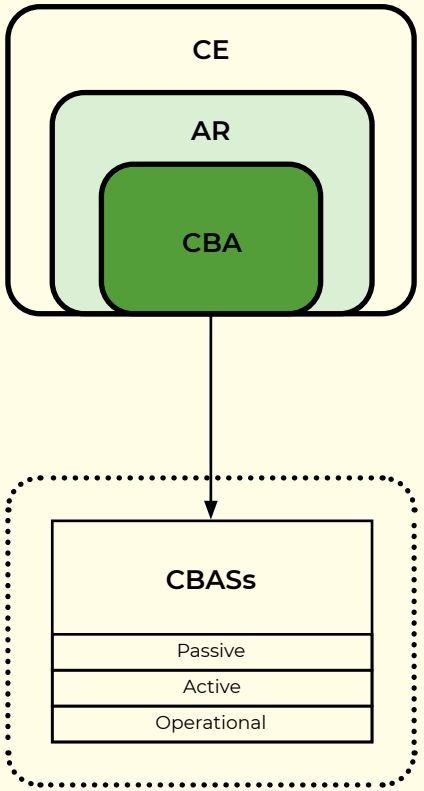
1.3. CBA-AR FRAMEWORK

- **15 Passive CBASs:**
  - Building Design
- **7 Active CBASs:**
  - Building Configuration
  - User Intervention



Hamida et al., 2023



CBA-AR =
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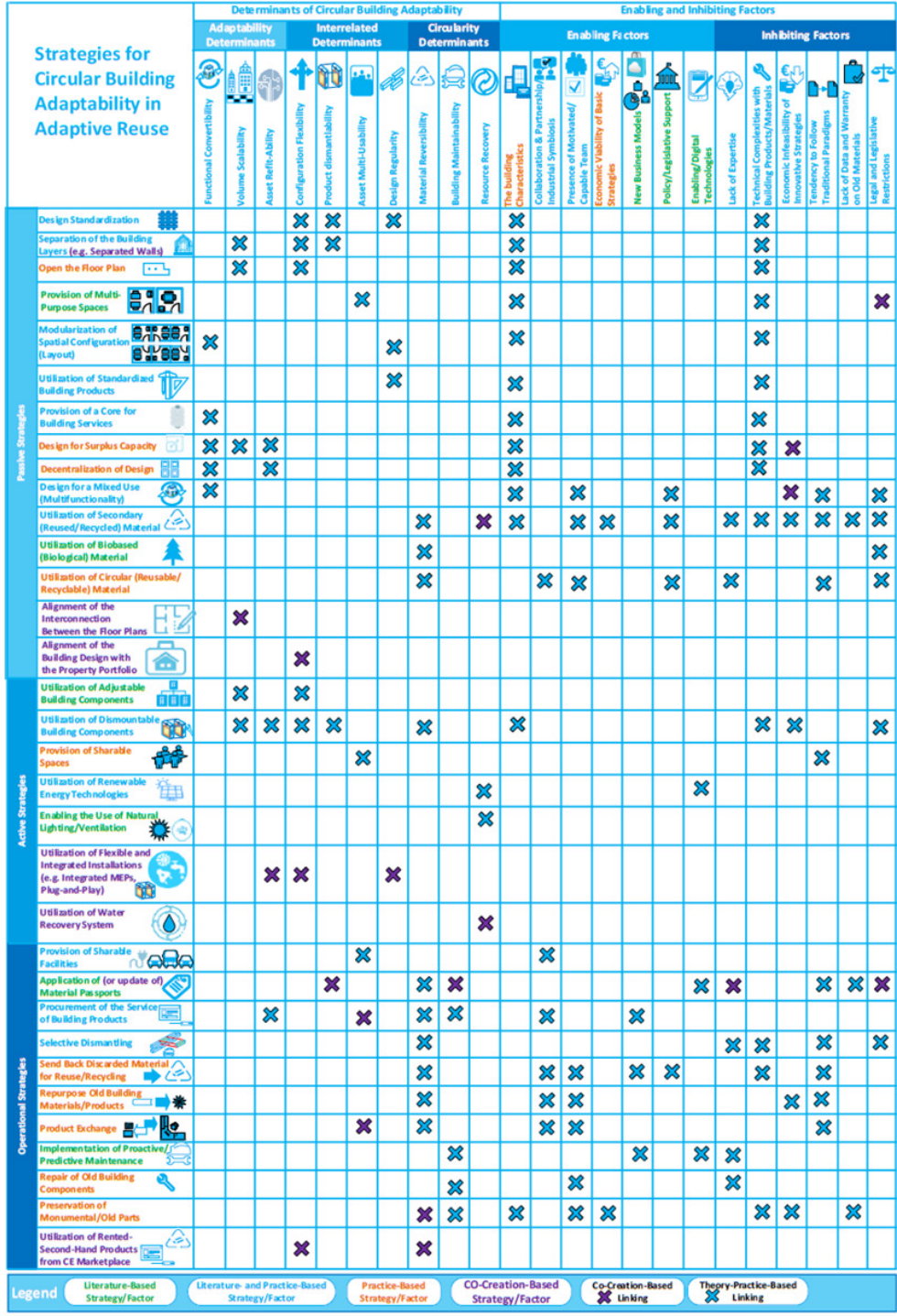
1.3. CBA-AR FRAMEWORK

- **15 Passive CBASs:**
  - Building Design
- **7 Active CBASs:**
  - Building Configuration
  - User Intervention
- **11 Operational CBASs:**
  - Process Oriented Solutions



Hamida et al., 2023

1.4. PROBLEM STATEMENT

Plenty of research about the potential of the **CBA-AR Framework**, but...

Limited practical implementation

The **CBASs** have never been tested or ranked based on **evidence from real projects**

1.5. RESEARCH AIM

Explore the ***applicability*** and ***effectiveness*** *of* Circular Building Adaptability Strategies **(CBASs)** *in* **Adaptive reuse projects** within the Dutch context

2. Research Methodology

2.1. Research Design

Main Question

How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?

2.1. RESEARCH DESIGN

SQ-A

What are the effective ways to use the CBA-AR framework in the **design & decision-making processes** of adaptive reuse projects?

CBA-AR =
Circular Building Adaptability in Adaptive Reuse

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?	
Research Questions	

2.1. RESEARCH DESIGN

SQ-B

What are the **most applicable and effective** design-oriented CBASs for circular and adaptable adaptive reuse projects?

CBASs =
Circular Building Adaptability Strategies

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?	
Research Questions	
SQ-A: What are the effective ways to use the CBA-AR framework in the design & decision-making processes of adaptive reuse projects?	

2.1. RESEARCH DESIGN

SQ-C

How can **design-oriented CBASs** be applied and effective in adaptive reuse projects?

CBASs =
Circular Building Adaptability Strategies

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?	
Research Questions	
SQ-A: What are the effective ways to use the CBA-AR framework in the design & decision-making processes of adaptive reuse projects?	
SQ-B: What are the most applicable and effective design-oriented CBASs for circular and adaptable adaptive reuse projects?	

2.1. RESEARCH DESIGN

Kind of Research

Theoretical
&
Empirical

Approaches

Case Study
&
Research-through-Design (RtD)

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?	
Research Questions	
SQ-A: What are the effective ways to use the CBA-AR framework in the design & decision-making processes of adaptive reuse projects?	
SQ-B: What are the most applicable and effective design-oriented CBASs for circular and adaptable adaptive reuse projects?	
SQ-C: How can design-oriented CBASs be applied and effective in adaptive reuse projects?	

2.1. RESEARCH DESIGN

Methods

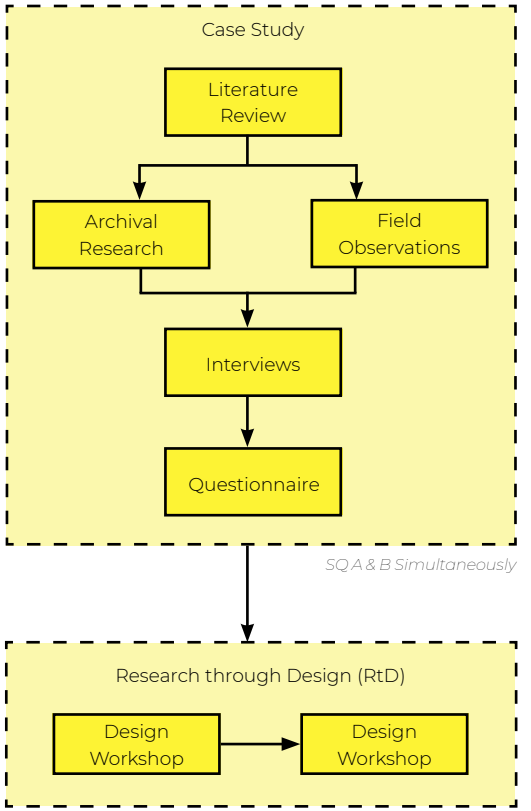
Literature Review
Archival Research
Field Observations
Interviews
Questionnaires
Design Workshops

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?

Research Questions	Approach & Methods
SQ-A: Theoretical & Empirical What are the effective ways to use the CBA-AR framework in the design & decision-making processes of adaptive reuse projects?	Case Study
SQ-B: Empirical What are the most applicable and effective design-oriented CBASs for circular and adaptable adaptive reuse projects?	*SQ A & B Simultaneously*
SQ-C: Empirical How can design-oriented CBASs be applied and effective in adaptive reuse projects?	Research through Design (RtD)

2.1. RESEARCH DESIGN

MQ: How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?

Research Questions	Approach & Methods
SQ-A: Theoretical & Empirical What are the effective ways to use the CBA-AR framework in the design & decision-making processes of adaptive reuse projects?	
SQ-B: Empirical What are the most applicable and effective design-oriented CBASs for circular and adaptable adaptive reuse projects?	
SQ-C: Empirical How can design-oriented CBASs be applied and effective in adaptive reuse projects?	

3. Theoretical Research

3.1. Overview

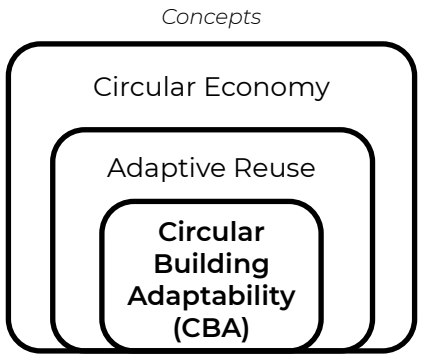
3.2. Design & Decision-Making Processes

SQ-A

What are the effective ways to use the CBA-AR framework in the **design & decision-making processes** of adaptive reuse projects?

CBA-AR =
Circular Building Adaptability in Adaptive Reuse

3.1. OVERVIEW


Concepts
Circular Economy
Adaptive Reuse
Circular Building Adaptability (CBA)

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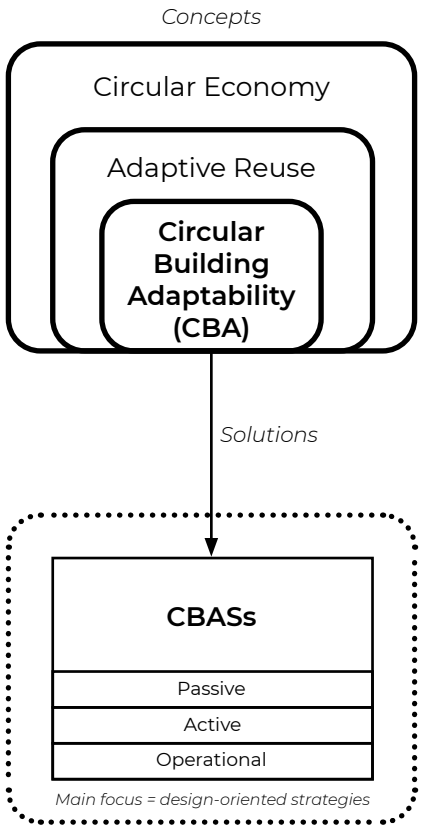
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Passive
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Operational
Main focus = design-oriented strategies

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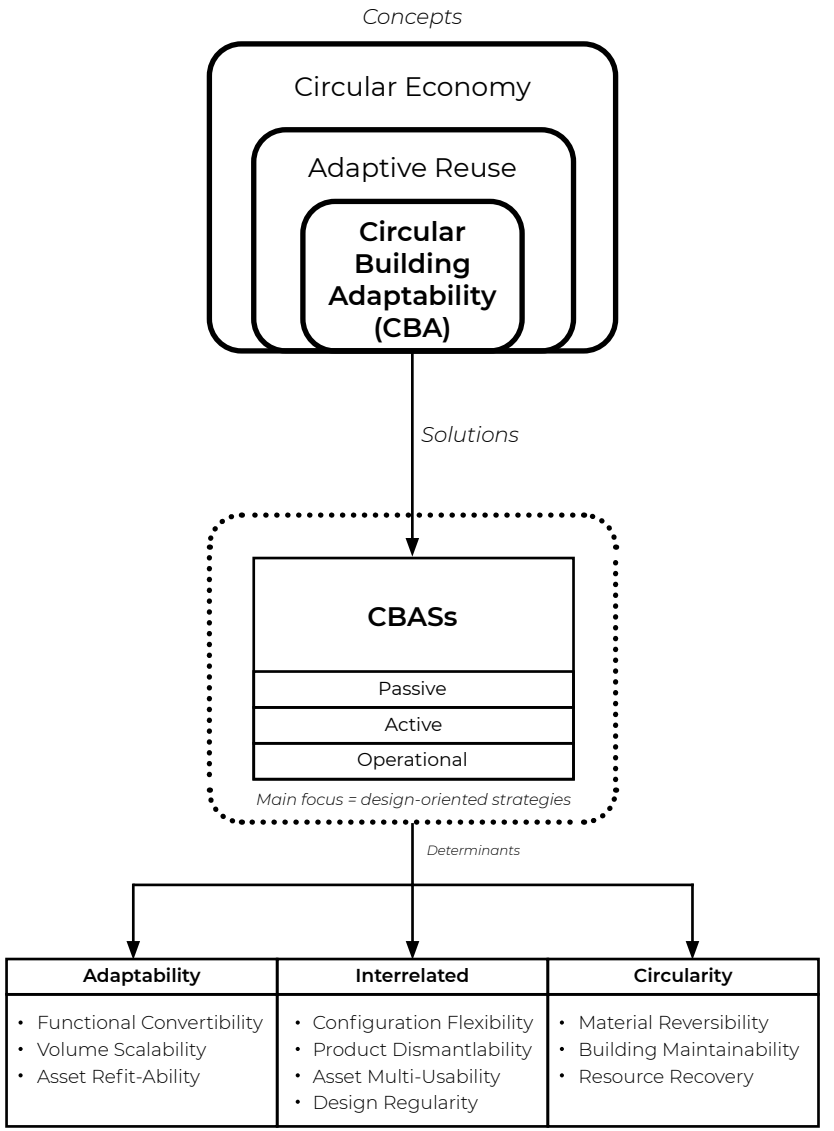
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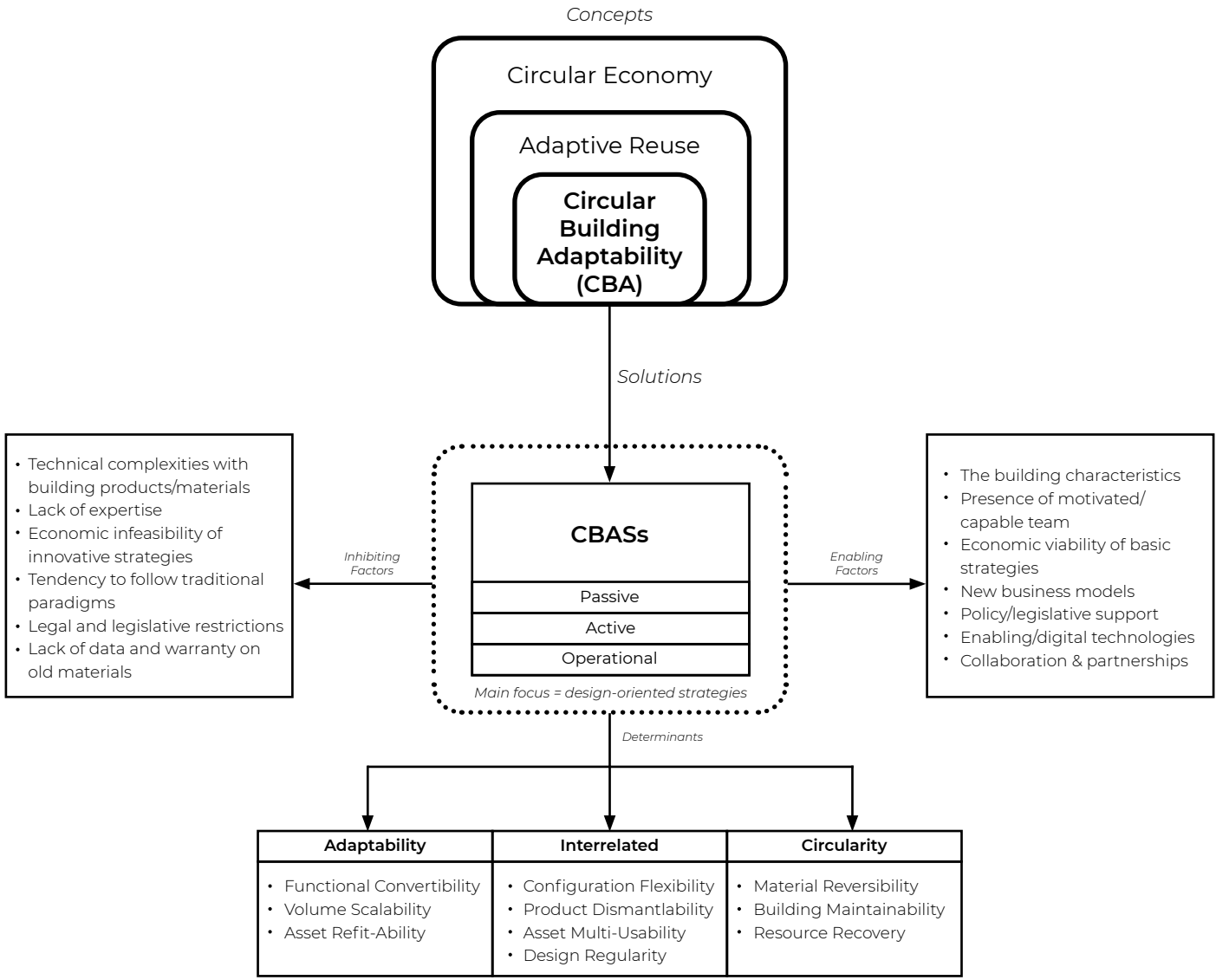
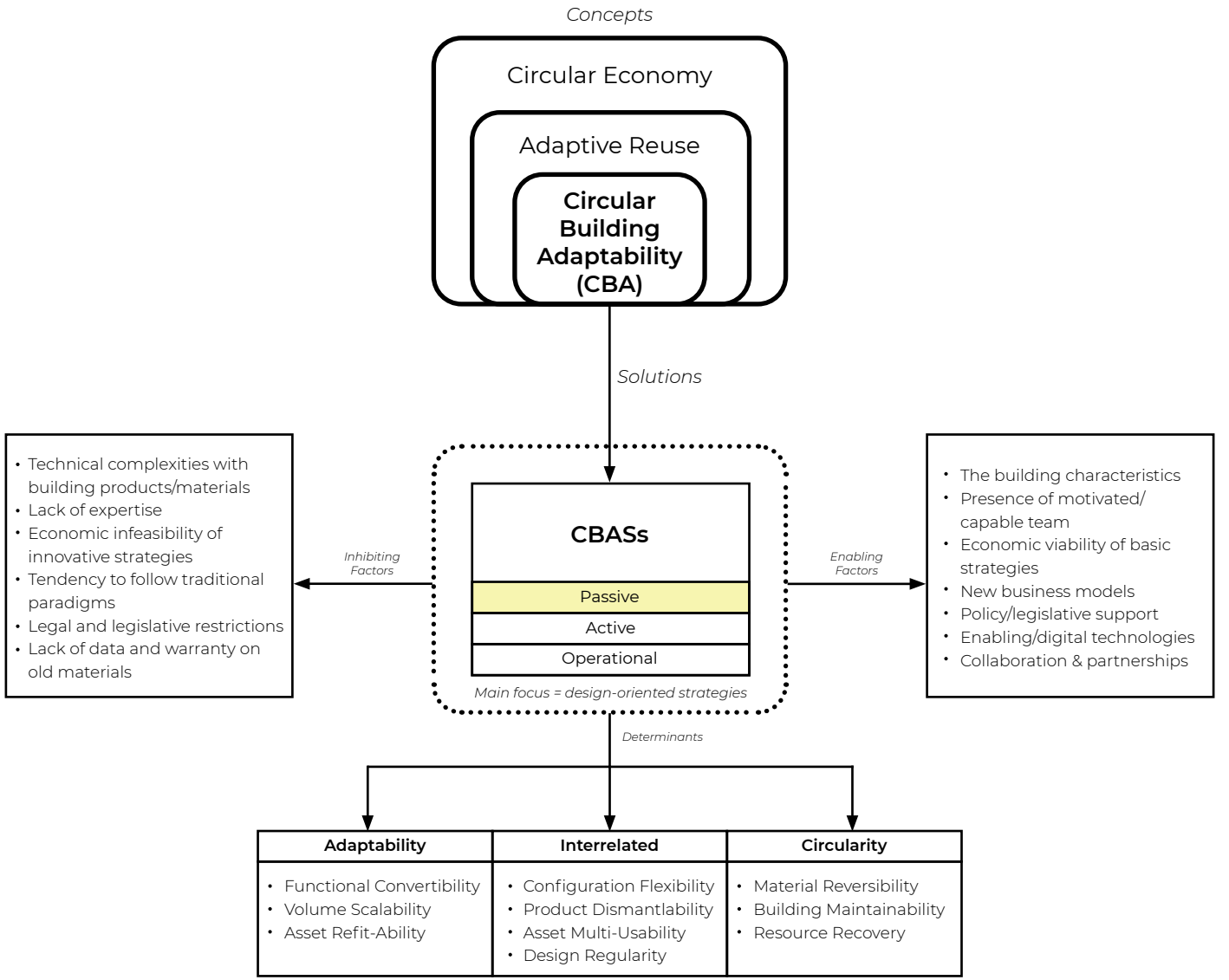
Determinants
Adaptability
Functional Convertibility
Volume Scalability
Asset Refit-Ability
Interrelated
Configuration Flexibility
Product Dismantlability
Asset Multi-Usability
Design Regularity
Circularity
Material Reversibility
Building Maintainability
Resource Recovery

3.1. OVERVIEW

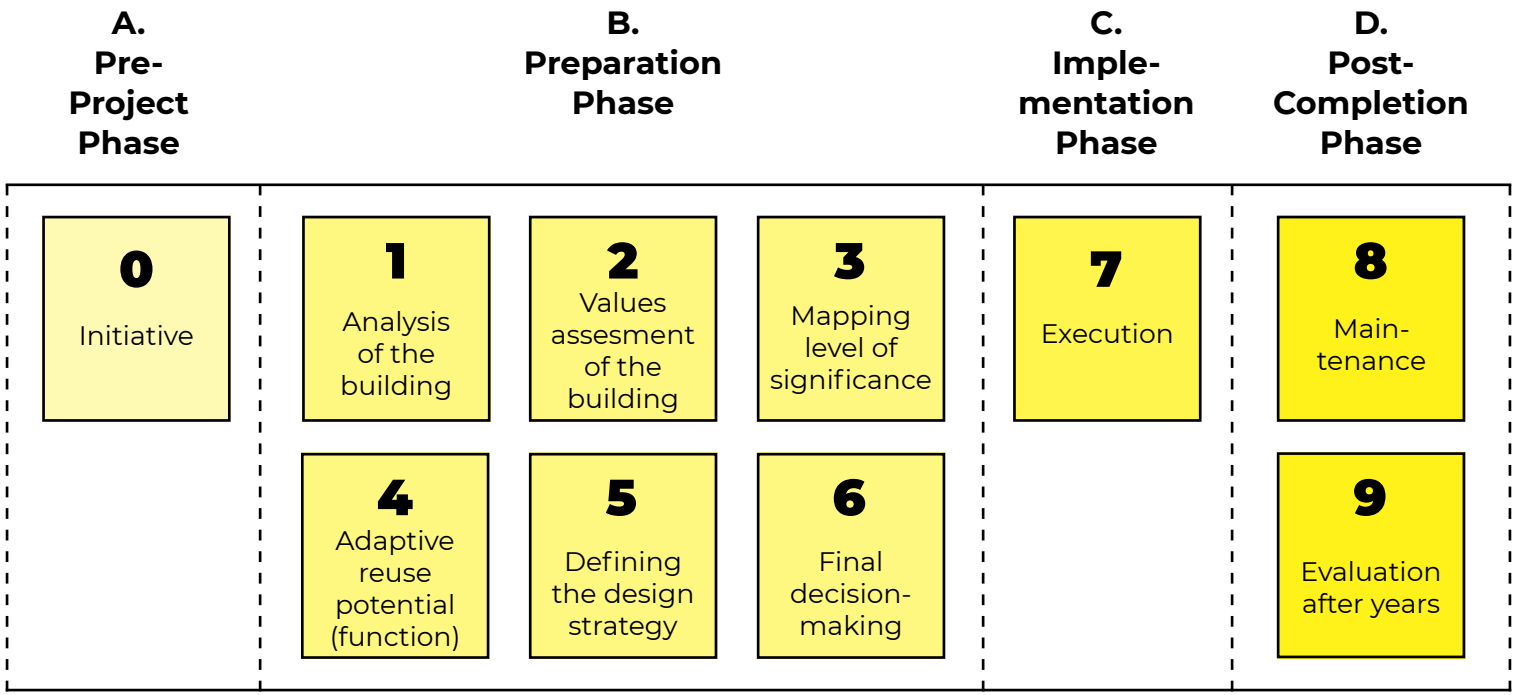

Concepts
Circular Economy
Adaptive Reuse
Circular Building Adaptability (CBA)
Solutions
• Technical complexities with building products/materials
• Lack of expertise
• Economic infeasibility of innovative strategies
• Tendency to follow traditional paradigms
• Legal and legislative restrictions
• Lack of data and warranty on old materials
Inhibiting Factors
CBASs
Passive
Active
Operational
Main focus = design-oriented strategies
Enabling Factors
• The building characteristics
• Presence of motivated/ capable team
• Economic viability of basic strategies
• New business models
• Policy/legislative support
• Enabling/digital technologies
• Collaboration & partnerships
Determinants
Adaptability
• Functional Convertibility
• Volume Scalability
• Asset Refit-Ability
Interrelated
• Configuration Flexibility
• Product Dismantlability
• Asset Multi-Usability
• Design Regularity
Circularity
• Material Reversibility
• Building Maintainability
• Resource Recovery

3.1. OVERVIEW

Focus only on the 15 design-oriented, **passive CBASs**



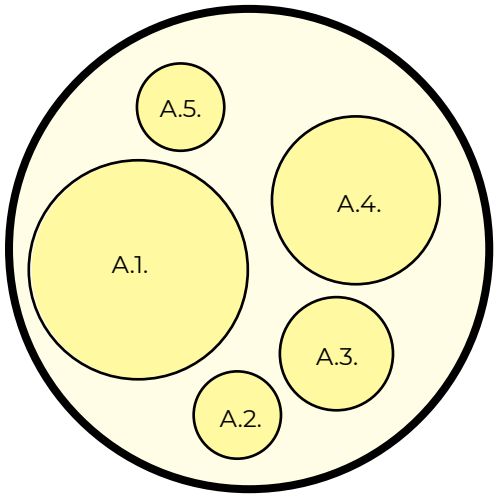
3.2. DESIGN & DECISION-MAKING PROCESSES



Arfa et al., 2022

3.2. DESIGN & DECISION-MAKING PROCESSES

A. Pre-Project Phase



A.1. Initiative
A.2. Idea forming
A.3. Decision on starting the adaptation process
A.4. Definition of actors

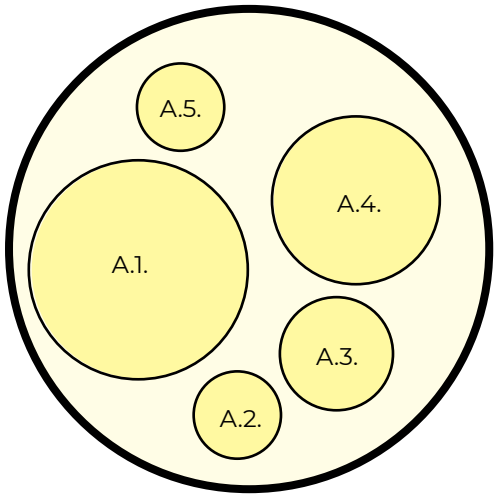
0

Arfa et al., 2022

3.2. DESIGN & DECISION-MAKING PROCESSES

A. Pre-Project Phase

B. Preparation Phase



A.1. Initiative
A.2. Idea forming
A.3. Decision on starting the adaptation process
A.4. Definition of actors

0

B.1. Analysis
B.2. Feasibility

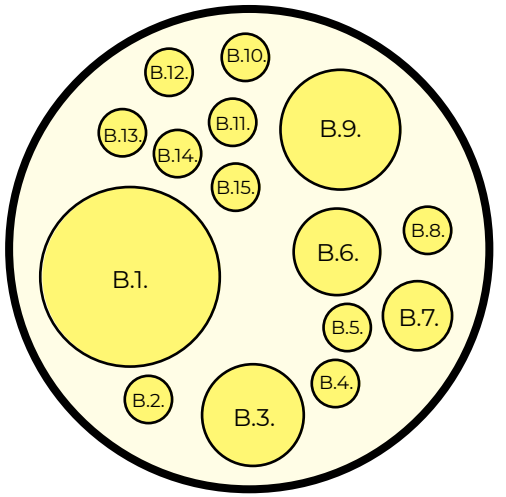
1

B.3. Values assessment
B.4. Evaluation of the building

2

B.5. Mapping level of significance

3



B.6. Definition of adaptive reuse potential
B.7. Definition of an appropriate function
B.8. Decision on functional changes

4

B.9. Definition of design strategies
B.10. Decision on conservation actions
B.11. Elaboration

5

B.12. Final decision-making
B.13. Contract negotiation
B.14. Refining

6

B.15. Participation of stakeholders

Arfa et al., 2022

4. Empirical Research (1)

4.1. Cases: C1-C2-C3

4.2. Key Informants

4.3. Cross-Case Analysis

4.4. Within-Case Analysis

SQ-B

What are the **most applicable and effective** design-oriented CBASs for circular and adaptable adaptive reuse projects?

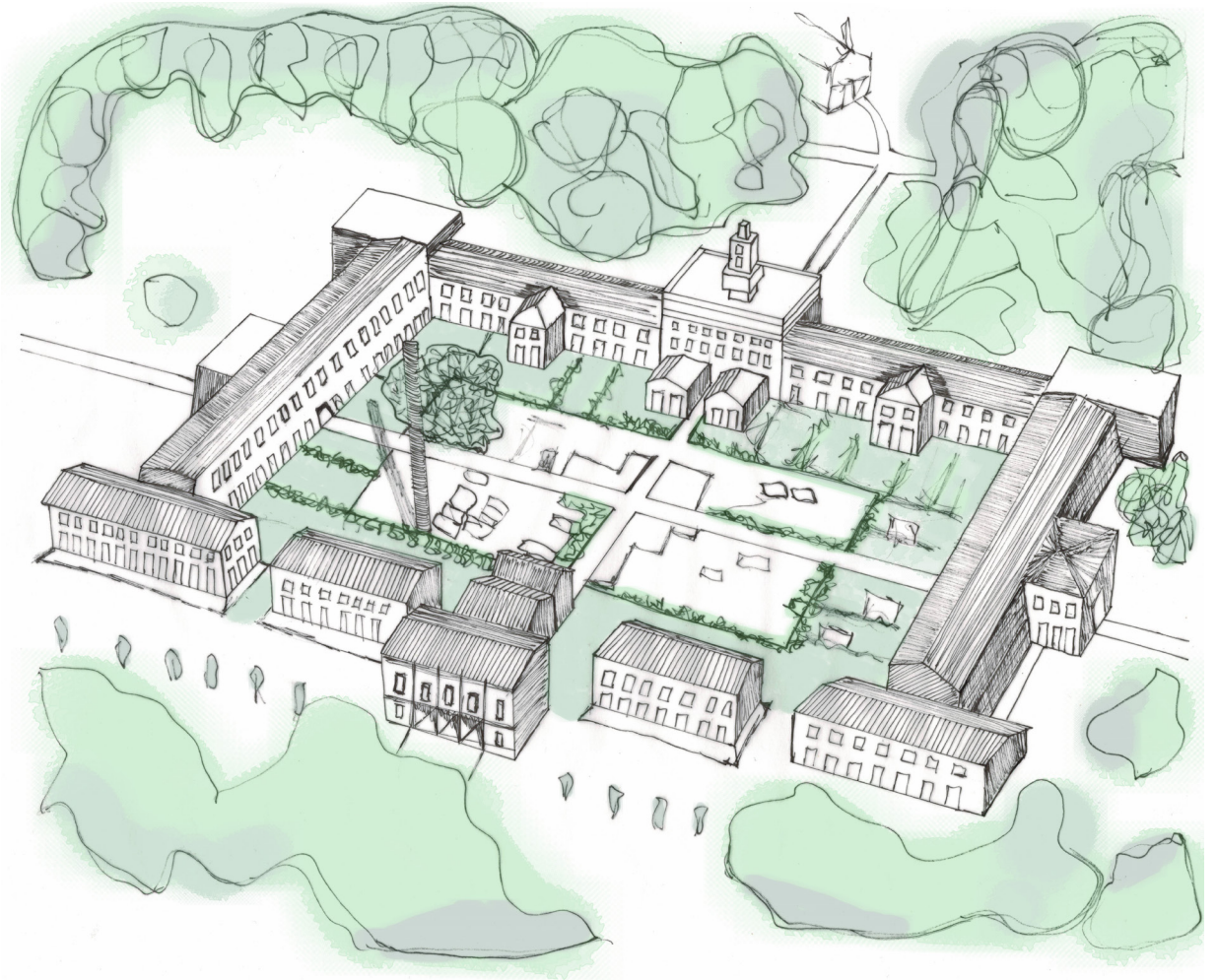
CBASs =
Circular Building
Adaptability Strategies

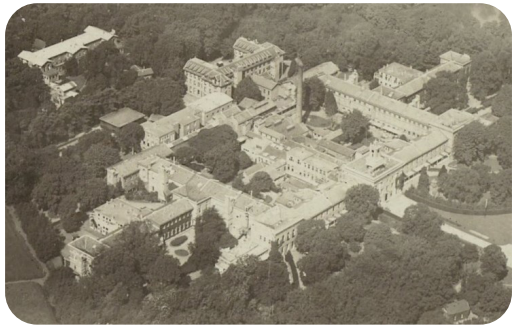
4.1. CASES

C1
Bloemendaal
realised

The first psychiatric hospital in the Netherlands transformed into a residential community for the higher segment.

Scale: Total of 14.600 m^2
Monumentality: yes
Trigger: vacancy, obsolescence and change of owner





Before

During

After

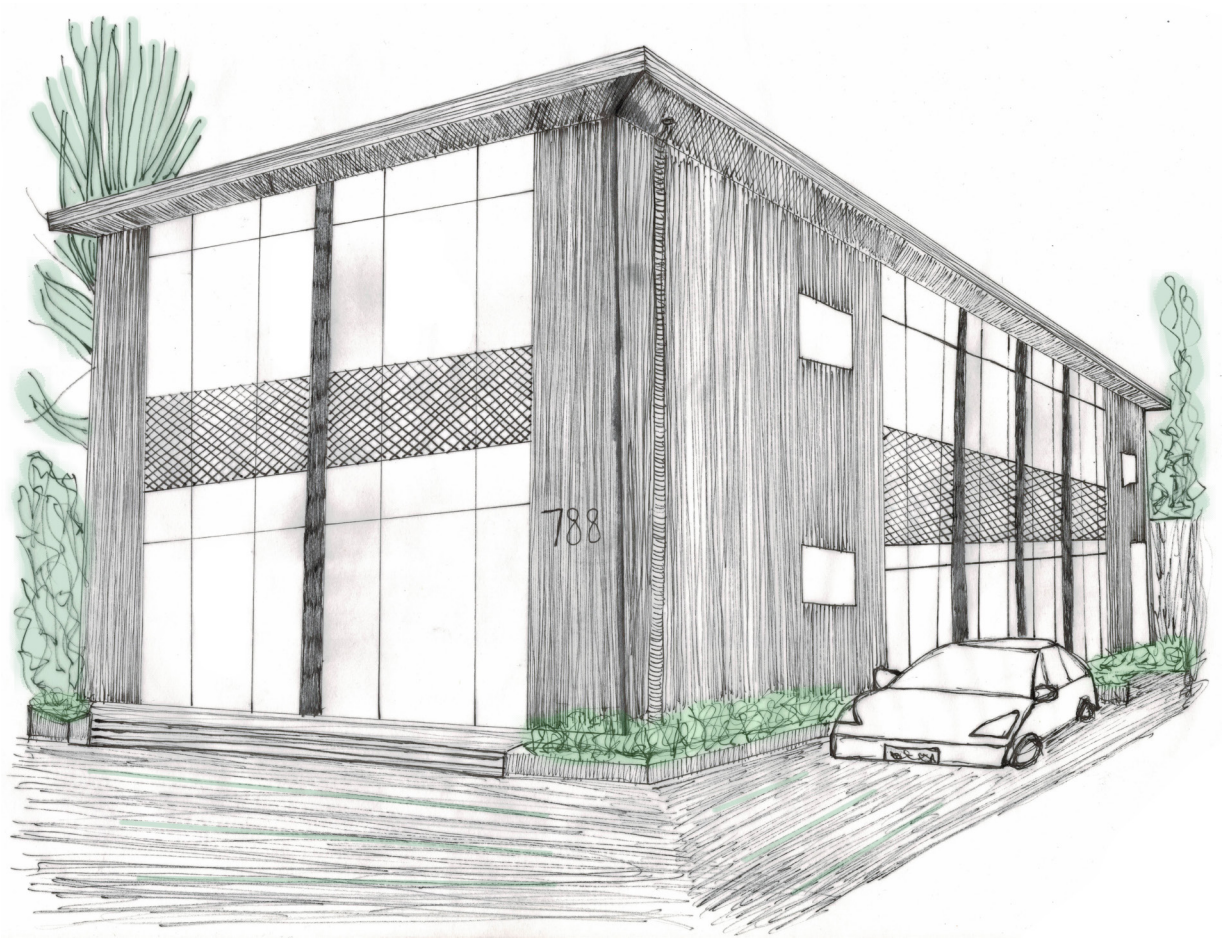
Heilijgers, 2024; Res & Smit BV, 2016

4.1. CASES

C2
Amsterdam
realised

An educational building transformed into offices. During the transformation, a possible change of function to residential was also taken into account.

Scale: Total of 470 m²
Monumentality: no
Trigger: vacancy and change of owner



Before

During

After

Stadsarchief Amsterdam, 2024; Res & Smit BV 2018

4.1. CASES

C3
Alkmaar
realised

A former commercial building transformed into a mixed-use complex with commercial and residential functions.

Scale: Total of 520 m²
Monumentality: only front façade
Trigger: change of owner

Front

Back

Before

After

Regionaal Archief Alkmaar, 2024

4.2. KEY INFORMANTS

14 Interviews with experts

16 Completed questionnaires

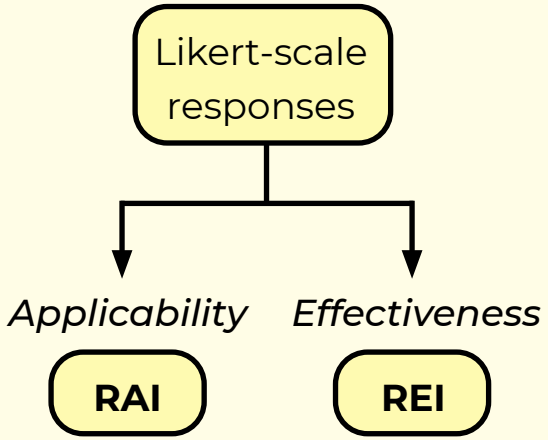
Case 1	Case 2	Case 3
1. FH - Contractor	**6.** AB - Architect	**11.** HH - Circularity Expert
2. HvM - Sub-contractor	**7.** DD - Technical Architect	**12.** NJ - Contractor
3. PS - Architect	**8.** EB - Project Manager	**13.** RJR - Architect
4. RT - Construction Engineer	**9.** RvD - Developer	**14c.** MS - Owner Developer
5. RB - Landscape Architect	**10.** WK - Architect	
14a. MS - Owner Developer	**14b.** MS - Owner Developer	

4.3. CROSS-CASE ANALYSIS

Likert-scale responses

Passive Strategies	Strategies for Circular Building Adaptability in Adaptive Reuse (CBASs)	Applicability										Effectiveness									
		Responses					n	Results & Interpretation				Responses					n	Results & Interpretation			
		Extremely Applicable	Very Applicable	Applicable	Somewhat Applicable	Not Applicable		Mean	RAI (%)	Rate	Rank	Extremely Effective	Very Effective	Effective	Somewhat Effective	Not Effective		Mean	REI (%)	Rate	Rank
Exploring the Applicability and Effectiveness of Design-Oriented (Passive) CBA Strategies - ***Cross Case Analysis C1-C2-C3***																					
1	Design Standardization	2	7	1	5	1	*16*	2,25	56,25	A	6	6	4	3	2	1	*16*	2,75	68,75	VE	4
2	Separation of Building Layers (e.g. Separated Walls)	0	5	8	3	0	*16*	2,13	53,13	A	9	1	7	3	5	0	*16*	2,25	56,25	E	8
3	Open the Floor Plan	5	8	3	0	0	*16*	3,13	78,13	VA	1	6	7	2	1	0	*16*	3,13	78,13	VE	1
4	Provision of Multi-Purpose Spaces	4	8	1	3	0	*16*	2,81	70,31	VA	2	3	10	3	0	0	*16*	3,00	75,00	VE	2
5	Modularization of Spatial Configuration (Layout)	1	4	4	4	3	*16*	1,75	43,75	A	14	1	7	2	3	3	*16*	2,00	50,00	E	11
6	Utilization of Standardized Building Products	3	4	6	3	0	*16*	2,44	60,94	A	4	4	5	2	4	1	*16*	2,44	60,94	E	7
7	Provision of a Core for Building Services	4	2	6	2	2	*16*	2,25	56,25	A	6	2	3	6	3	2	*16*	2,00	50,00	E	11
8	Design for Surplus Capacity	0	4	2	5	5	*16*	1,31	32,81	SA	15	1	4	4	4	3	*16*	1,75	43,75	E	14
9	Decentralization of Design	1	5	5	5	0	*16*	2,13	53,13	A	9	3	1	7	5	0	*16*	2,13	53,13	E	9
10	Design for a Mixed Use (Multifunctionality)	2	2	5	5	2	*16*	1,81	45,31	A	13	1	6	4	2	3	*16*	2,00	50,00	E	11
11	Utilization of Secondary (Reused/Recycled) Material	1	5	5	5	0	*16*	2,13	53,13	A	9	4	5	4	3	0	*16*	2,63	65,63	VE	5
12	Utilization of Biobased (Biological) Material	0	6	9	1	0	*16*	2,31	57,81	A	5	2	6	6	2	0	*16*	2,50	62,50	E	6
13	Utilization of Circular (Reuseable/Recyclable) Material	1	5	5	4	1	*16*	2,06	51,56	A	12	1	7	3	3	2	*16*	2,13	53,13	E	9
14	Alignment of the Interconnection Between the Floor Plans	2	6	6	2	0	*16*	2,50	62,50	A	3	3	10	3	0	0	*16*	3,00	75,00	VE	2
15	Alignment of the Building Design with the Property Portfolio	0	8	4	3	1	*16*	2,19	54,69	A	8	0	4	6	4	2	*16*	1,75	43,75	E	14

4.3. CROSS-CASE ANALYSIS



Passive Strategies	Strategies for Circular Building Adaptability in Adaptive Reuse (CBASs)	Applicability										Effectiveness									
		Responses						Results & Interpretation				Responses						Results & Interpretation			
		Extremely Applicable	Very Applicable	Applicable	Somewhat Applicable	Not Applicable	n	Mean	RAI (%)	Rate	Rank	Extremely Effective	Very Effective	Effective	Somewhat Effective	Not Effective	n	Mean	REI (%)	Rate	Rank
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3	Open the Floor Plan	5	8	3	0	0	*16*	3,13	78,13	VA	1	6	7	2	1	0	*16*	3,13	78,13	VE	1
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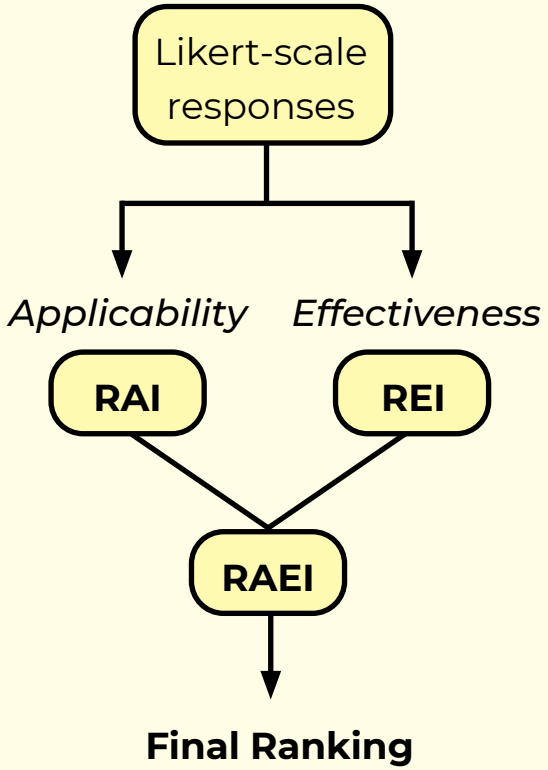
4.3. CROSS-CASE ANALYSIS



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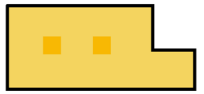
4.3. CROSS-CASE ANALYSIS: RAEI SCORES

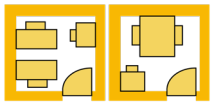
Outcomes are based on C1-C2-C3

61,04



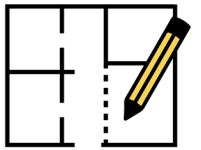
1.
Open the Floor Plan

52,73



2.
Provision of Multi-Purpose Spaces

46,88

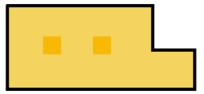


3.
Alignment of the Interconnection Between the Floor Plans

4.3. CROSS-CASE ANALYSIS: RAEI SCORES

Outcomes are based on C1-C2-C3

61,04



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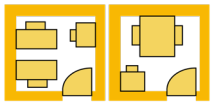

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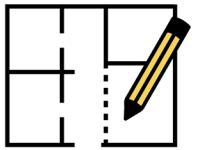
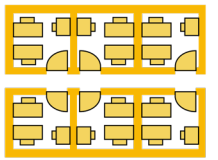


3.
Alignment of the Interconnection Between the Floor Plans

22,66

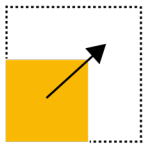
13.
Design for Mixed-Use

21,88



14.
Modularization of Spatial Configuration

14,35

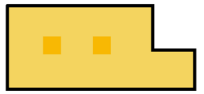


15.
Design for Surplus Capacity

4.3. CROSS-CASE ANALYSIS: RAEI SCORES

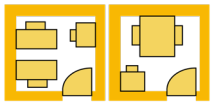
Outcomes are based on C1-C2-C3

61,04



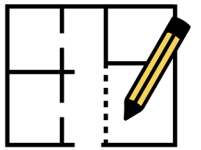
1.
Open the Floor Plan

52,73



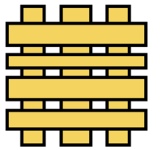
2.
Provision of Multi-Purpose Spaces

46,88



3.
Alignment of the Interconnection Between the Floor Plans

38,67



4.
Design Standardization

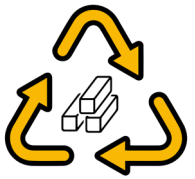
37,14

5.
Utilization of Standardized Building Products

36,13

6.
Utilization of Biobased Material

34,87

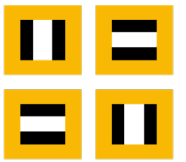


7.
Utilization of Secondary Material

29,89

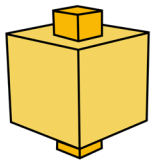
8.
Separation of the Building Layers

28,23



9.
Decentralization of the Design

28,13



10.
Provision of a Core for Building Services

27,39

11.
Utilization of Circular Material

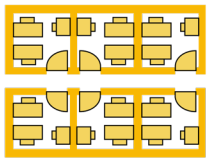
23,93

12.
Alignment of the Building Design with the Property Portfolio

22,66

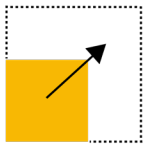
13.
Design for Mixed-Use

21,88



14.
Modularization of Spatial Configuration

14,35



15.
Design for Surplus Capacity

C1

Design
Standardization

4.4. WITHIN-CASE ANALYSIS

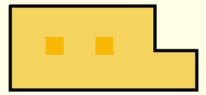
Standardized window structure

*''This detail could be developed because it was **replicated 150 times**, creating a kind of standard that could also be used in future projects".*

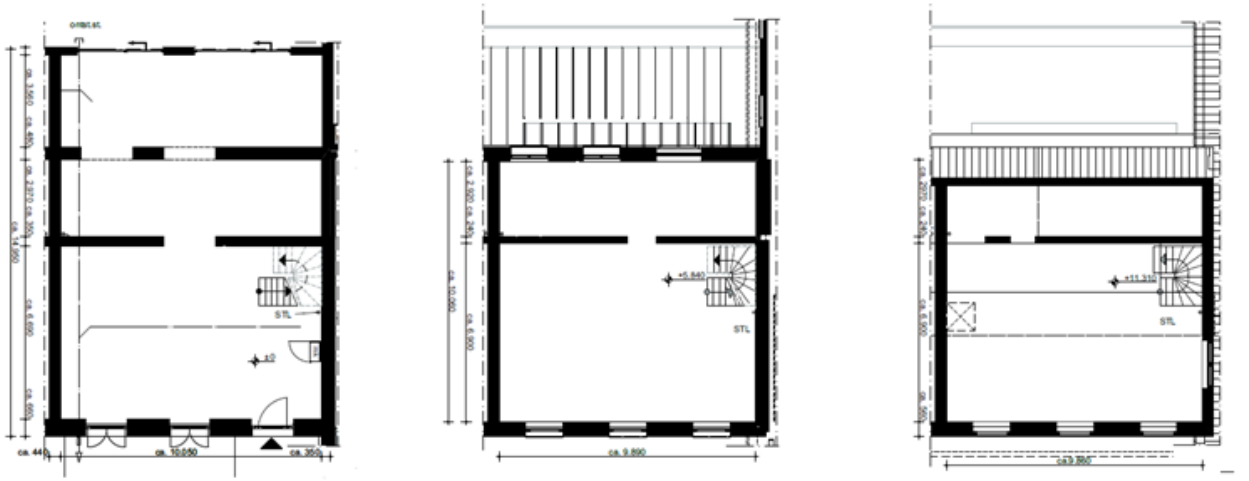
C.V. C van Bloemendaal et al., 2016

4.4. WITHIN-CASE ANALYSIS

C1



Open the Floor Plan

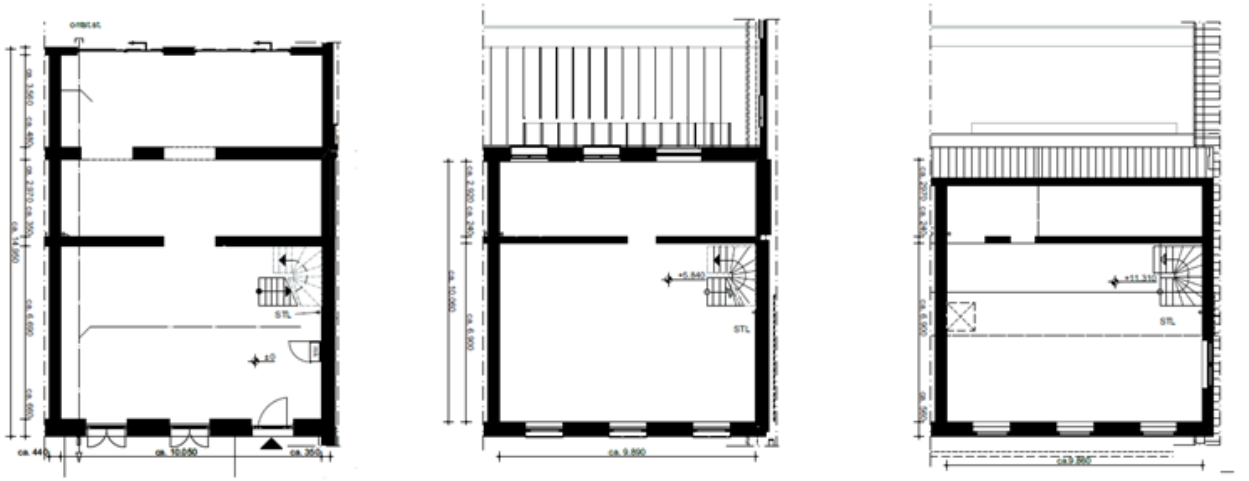


*"The floor plans were **entirely open and flexible**, providing an investor with the possibility to arrange the spaces as they wish".*

Heiko Hulskar Architecten, 2016

4.4. WITHIN-CASE ANALYSIS

C1



Open the Floor Plan

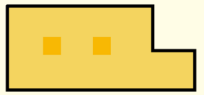
Provision of Multi-Purpose Spaces

*"The floor plans were **entirely open and flexible**, providing an investor with the possibility to arrange the spaces as they wish".*

*"The 6.5-meter high ceilings allowed flexible room configurations, giving residents the **freedom to personalize their living spaces**".*

Heiko Hulskar Architecten, 2016

C2

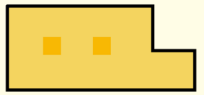


Open the Floor Plan

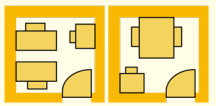
4.4. WITHIN-CASE ANALYSIS

*''The **column structure** serves as the load-bearing component, which makes [name of C2] **flexible and facilitates reconfiguration**''.*

C2



Open the Floor Plan



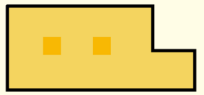
Provision of Multi-Purpose Spaces

4.4. WITHIN-CASE ANALYSIS

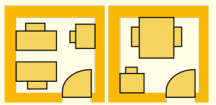
*''The **column structure** serves as the load-bearing component, which makes [name of C2] **flexible and facilitates reconfiguration**''.*

*''We **adapted the layout to our way of working**, with open spaces for collaboration and meeting rooms for conversations".*

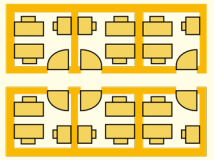
C2



Open the Floor Plan



Provision of Multi-Purpose Spaces



Modularization of Spatial Configuration

4.4. WITHIN-CASE ANALYSIS

*''The **column structure** serves as the load-bearing component, which makes [name of C2] **flexible and facilitates reconfiguration**''.*

*''We **adapted the layout to our way of working**, with open spaces for collaboration and meeting rooms for conversations".*

4.4. WITHIN-CASE ANALYSIS

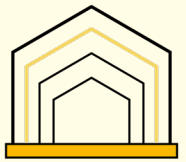
C2

Design for Surplus Capacity

4.4. WITHIN-CASE ANALYSIS

C2

Design for Surplus Capacity



Separation of the Building Layers

Res & Smit BV, 2018

4.4. WITHIN-CASE ANALYSIS

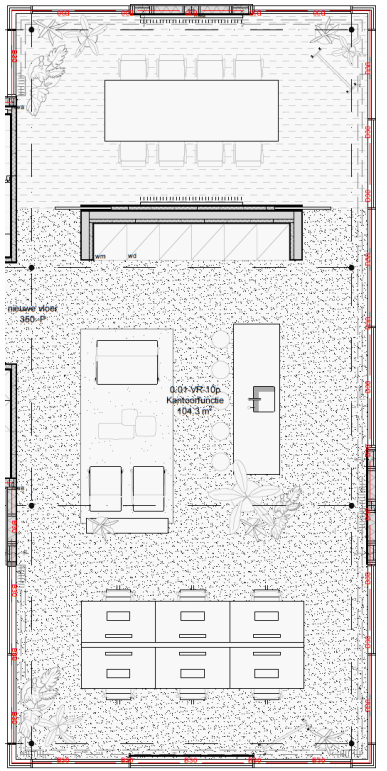
C2

Design for Surplus Capacity

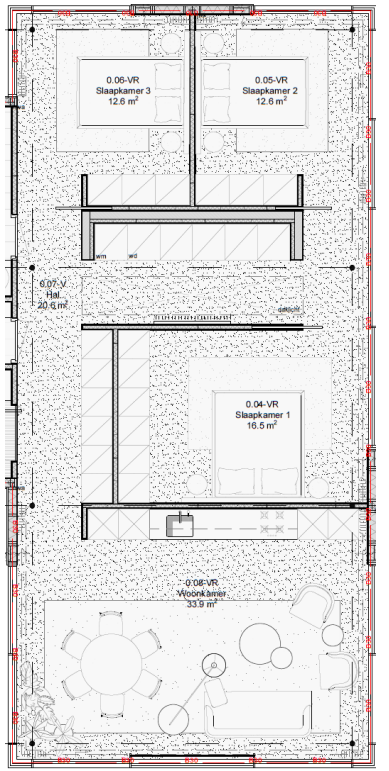
Separation of the Building Layers

Design for Mixed-Use

Office



Residence



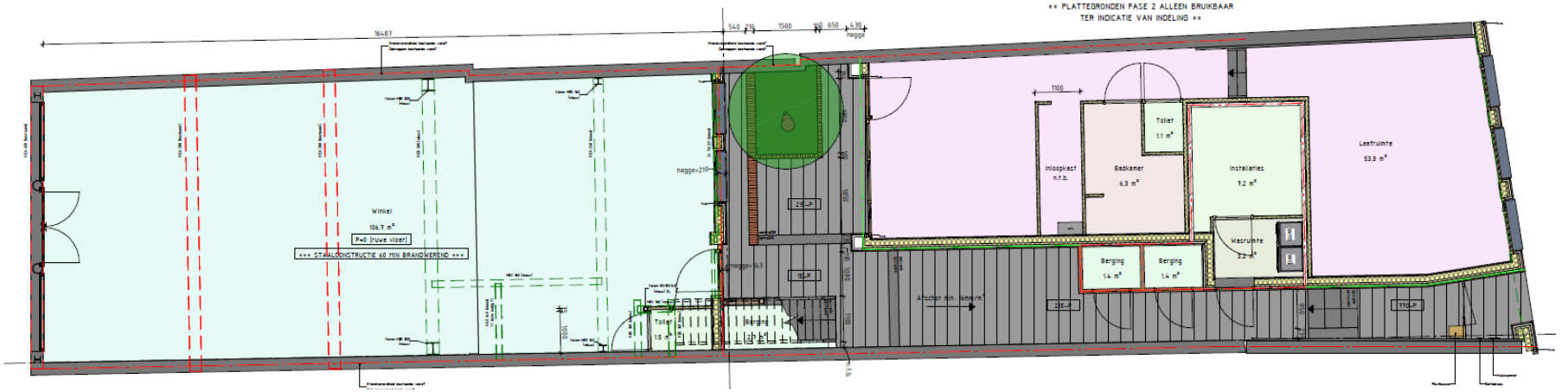
*"A **double permit application** was submitted during the renovation and extension of [name of C2], allowing for the creation of residences within the existing structure".*

Res & Smit BV, 2018

4.4. WITHIN-CASE ANALYSIS

C3

Design for Mixed-Use

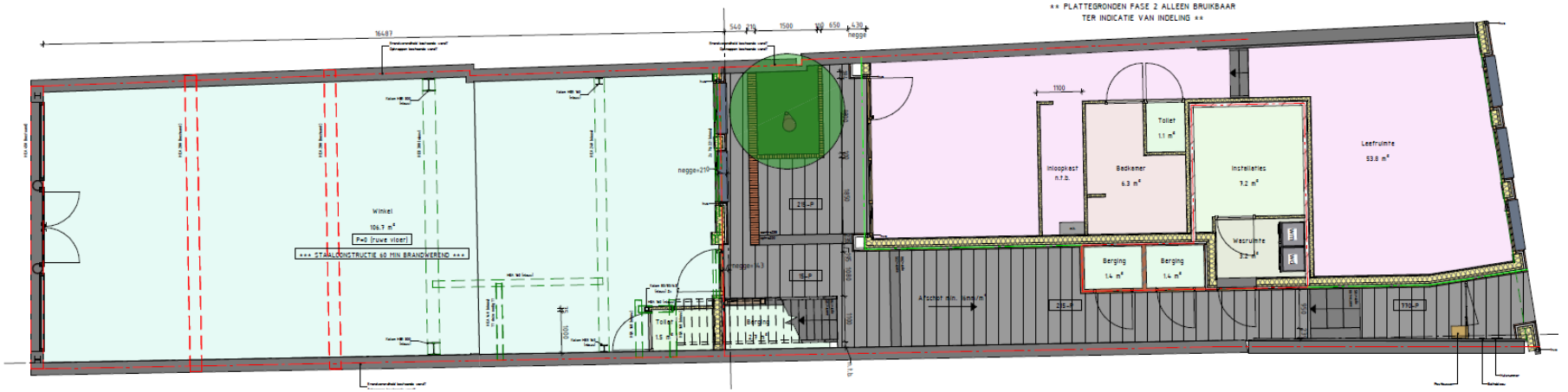


4.4. WITHIN-CASE ANALYSIS

C3

Design for Mixed-Use

Provision of a Core for Building Services



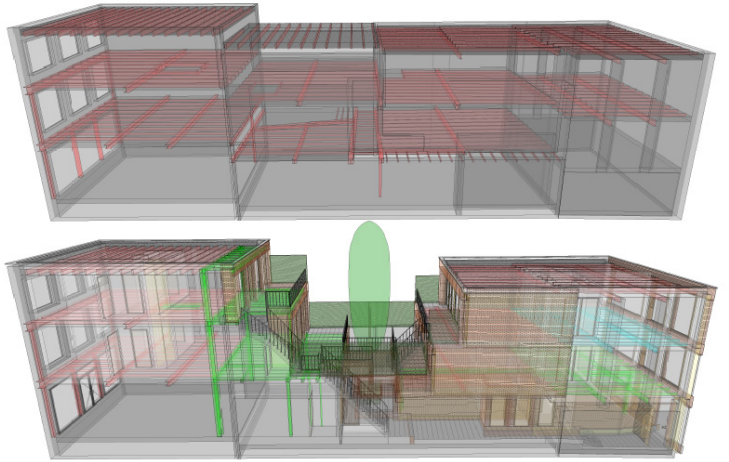
*"The limited space necessitated smart design, so **by centralizing the installations**, we avoided allocating extra space for technical equipment in each apartment".*

Res & Smit BV, 2021

C3

Alignment of the Building Design with the Property Portfolio

4.4. WITHIN-CASE ANALYSIS

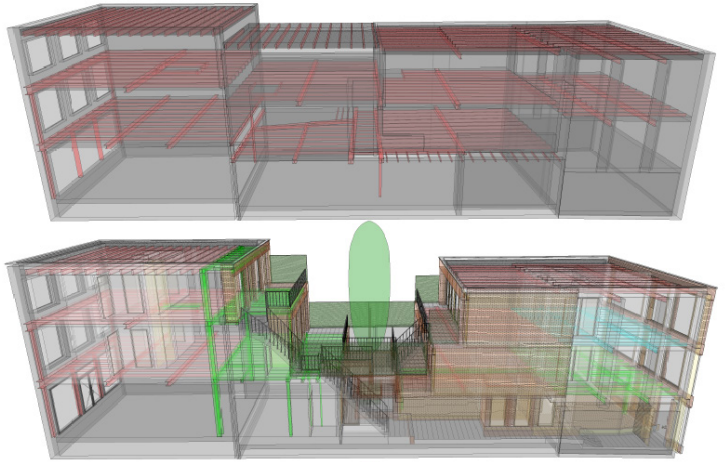


*"This approach ensures that individuals have **privacy in their own spaces** while also providing opportunities and facilities for **connecting with the neighbourhood and other residents**".*

Res & Smit BV, 2021; Up Architecture, z.d.

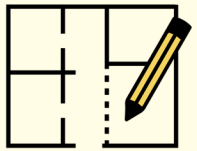
4.4. WITHIN-CASE ANALYSIS

C3

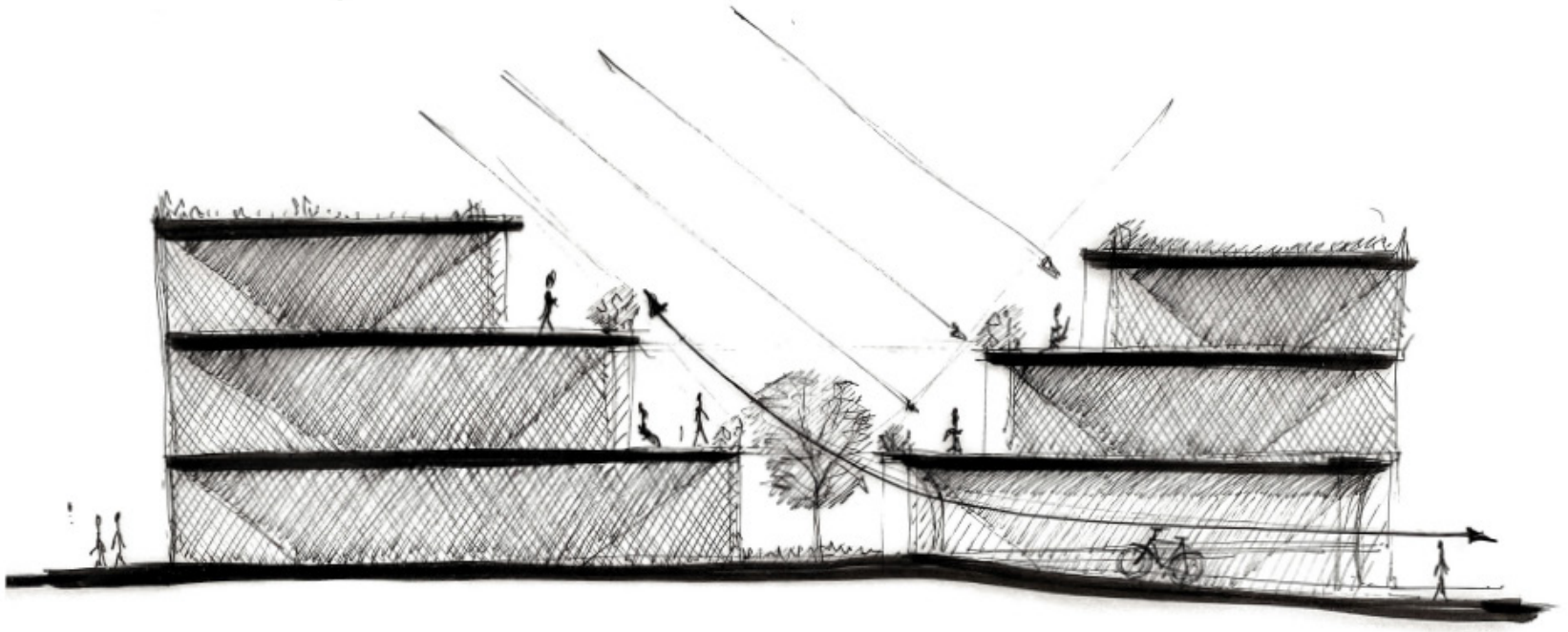


*"This approach ensures that individuals have **privacy in their own spaces** while also providing opportunities and facilities for **connecting with the neighbourhood and other residents**".*

Alignment of the Building Design with the Property Portfolio



Alignment of the Interconnection Between the Floor Plans



Res & Smit BV, 2021; Up Architecture, z.d.

4. Empirical Research (2)

4.5. Case: C4

4.6. Case Study Design

4.7. Workshop 1

4.8. Workshop 2

SQ-C

How can **design-oriented CBASs** be applied and effective in adaptive reuse projects?

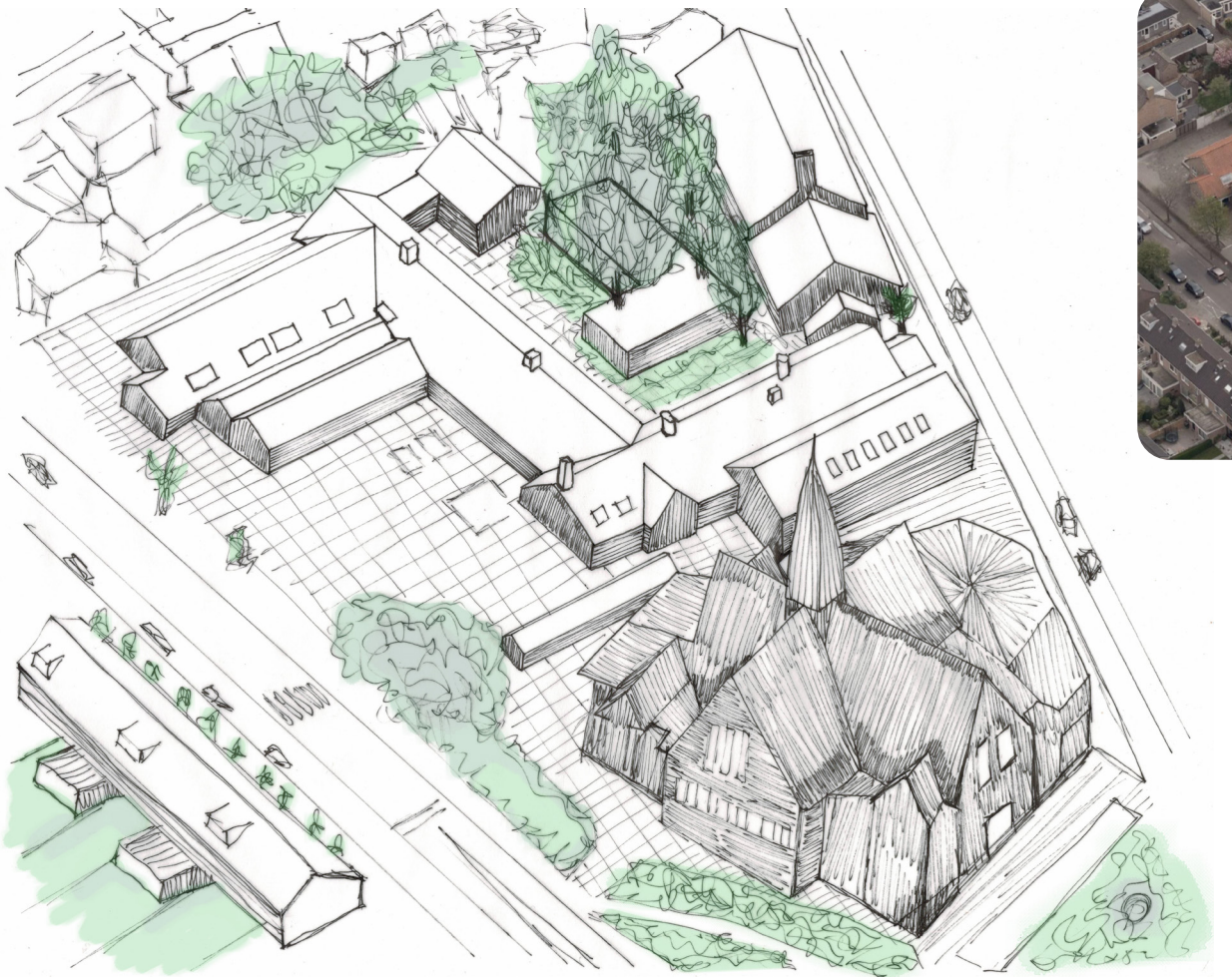
CBASs =
Circular Building Adaptability Strategies

4.5. CASE: C4

C4
Westland
ongoing

Transformation of an educational building into a residential complex intended for housing seniors and young people with care needs.

Scale: Total of 4210 m²
Monumentality: yes
Trigger: vacancy and change of owner



Omgevingsloket, 2023

4.6. CASE-STUDY DESIGN

C4

First step is to cluster the CBASs in 3 themes

CBASs

C4

First step is to cluster the CBASs in 3 themes

4.6. CASE-STUDY DESIGN

CBASs

Theme 1: Integrated Spaces

*Maximizing the utility of space by incorporating **shared or multi-functional areas** that can accommodate different activities.*

C4

First step is to cluster the CBASs in 3 themes

4.6. CASE-STUDY DESIGN

CBASs

Theme 1: Integrated Spaces

*Maximizing the utility of space by incorporating **shared or multi-functional areas** that can accommodate different activities.*

Theme 2: Design Flexibility

*Ensuring that adaptive reuse projects can **easily be modified or adapted for future needs** without significant structural changes.*

C4

First step is to cluster the CBASs in 3 themes

4.6. CASE-STUDY DESIGN

CBASs

Theme 1: Integrated Spaces

*Maximizing the utility of space by incorporating **shared or multi-functional areas** that can accommodate different activities.*

Theme 2: Design Flexibility

*Ensuring that adaptive reuse projects can **easily be modified or adapted for future needs** without significant structural changes.*

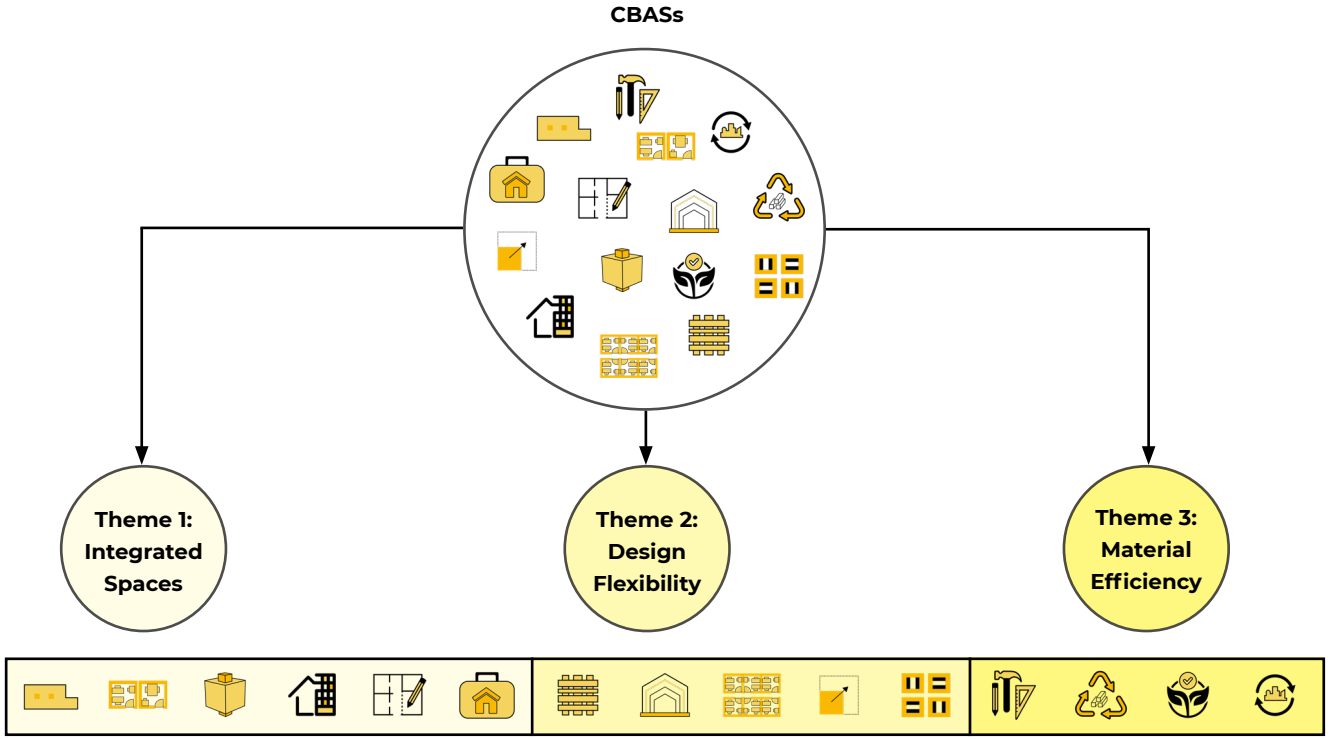
Theme 3: Material Efficiency

*Optimizing the use of resources by **reducing waste** and ensuring that building materials can be **reused or recycled at the end of their life cycle**.*

4.6. CASE-STUDY DESIGN

C4

- Knowledgeable about CBASs
- Not directly involved with C4



4.7. WORKSHOP 1

C4

Workshop 1 Participants

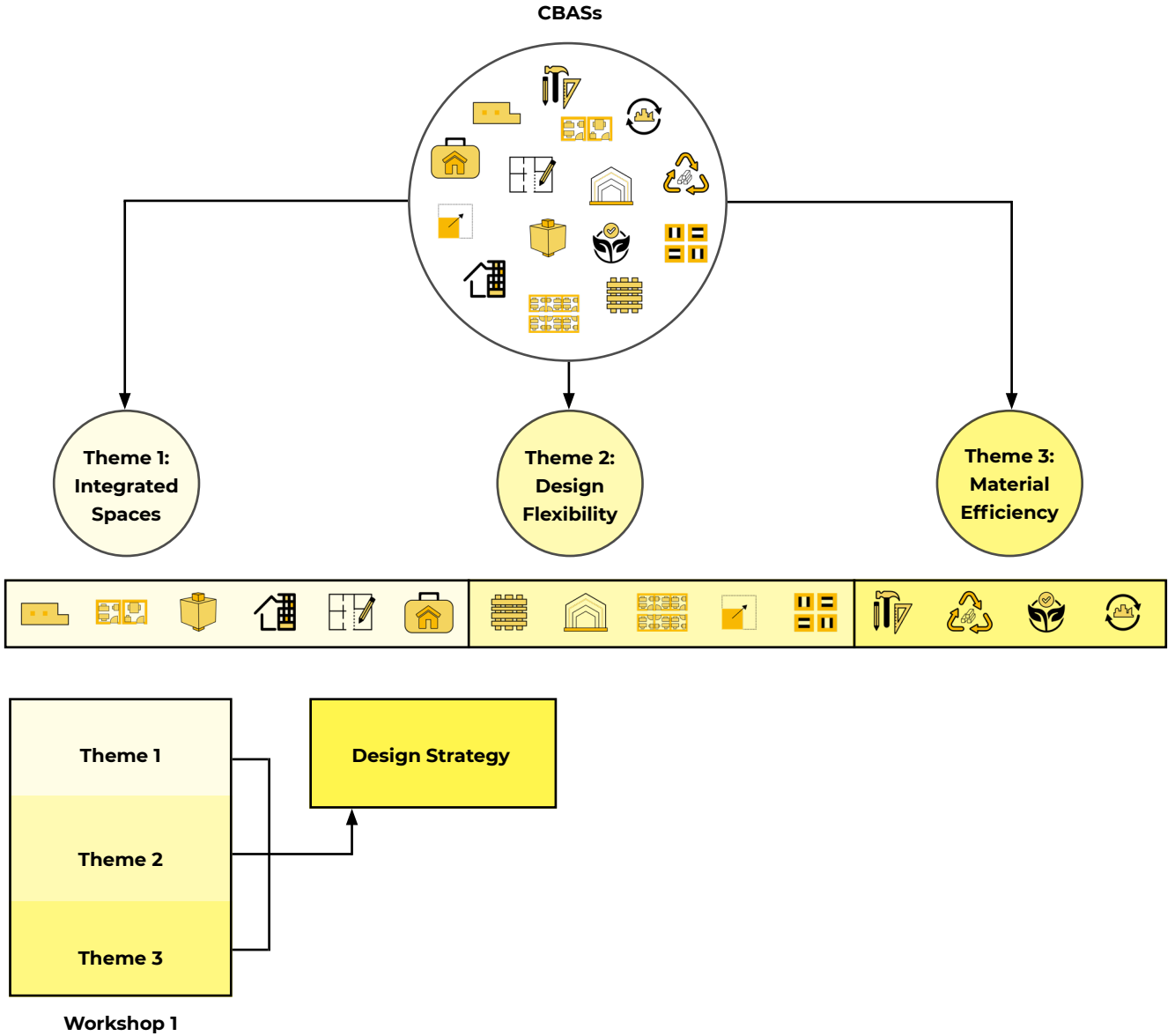
5. RB - Landscape Architect

8. EB - Project Manager

9. RvD - Developer

13. RJR - Architect

14abc. - MS Owner Developer



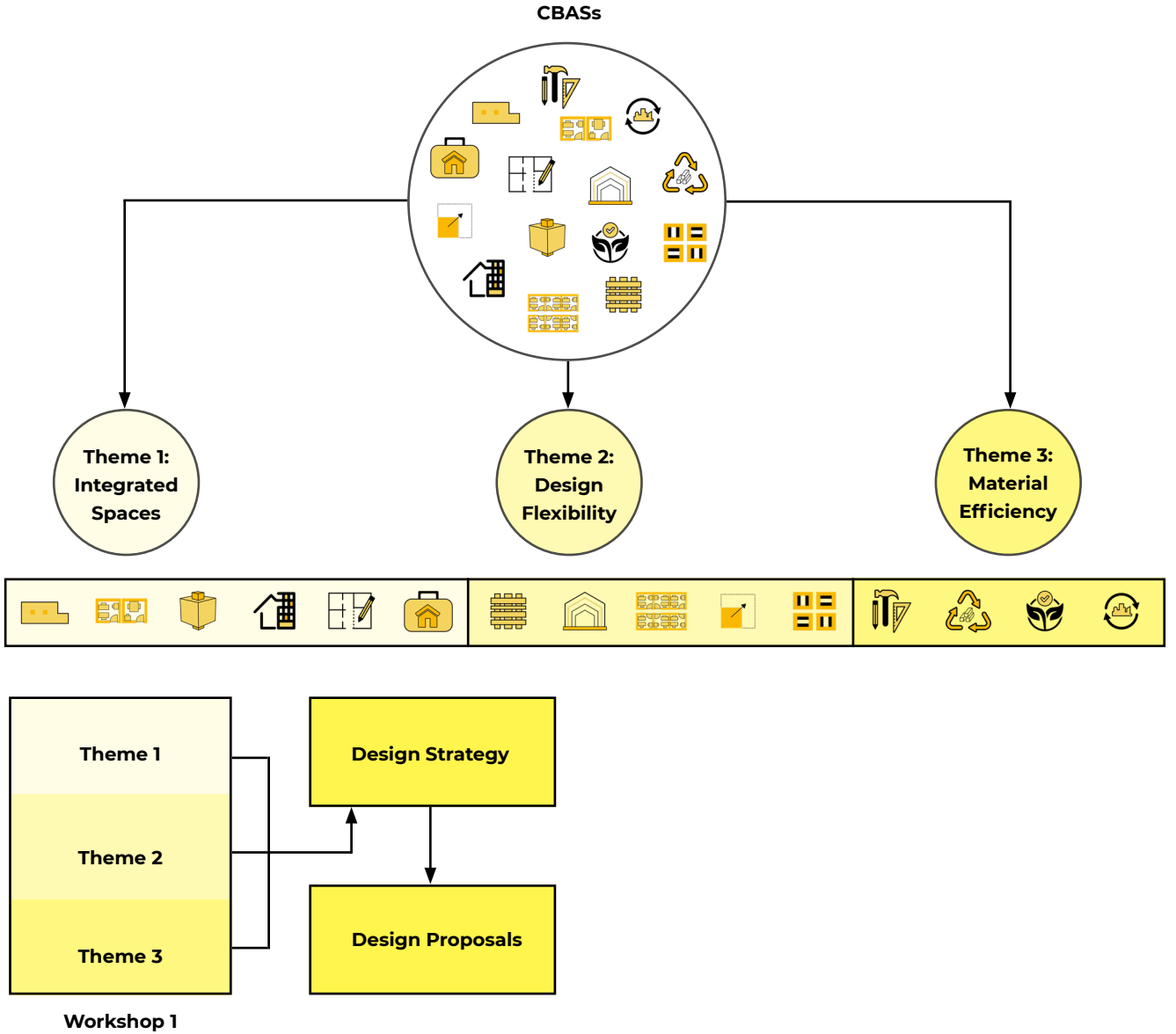
4.7. WORKSHOP 1: DESIGN STRATEGY

Theme 1: Integrated Spaces	Theme 2: Design Flexibility	Theme 3: Material Efficiency
		
1. Removing non-load-bearing walls to create flexible and open residential spaces; thereby improving adaptability for future uses. **2.** Creating multifunctional spaces by transforming the sports facility into a community center that support various community and recreational activities. **3.** Centralizing essential building services within easily accessible cores. **4.** Fostering community engagement by creating yards around the school building that facilitates interaction, promotes shared activities like gardening, and improves the social environment. **5.** Designing for long-term flexibility and adaptability to meet changing needs.	**6.** Using modular and demountable construction methods for new construction, and preserving the historical sections of the building where possible. **7.** Future-proofing the building by reserving space for potential growth and designing for additional technical systems or structural elements. **8.** Designing housing units to function independently for low-care needs.	**9.** Using standardized building components for easier reuse. **10.** Integrating biobased, renewal materials like timber frame construction and prefabricated wooden units for all new construction. **11.** Evaluating the building's condition to determine if materials from demolished sections can be reused in new construction. Where feasible, these materials will be retained to preserve historical integrity and minimize waste.

4.8. WORKSHOP 2

C4

- Unfamiliar with CBASs
- Directly involved with C4



4.8. WORKSHOP 2

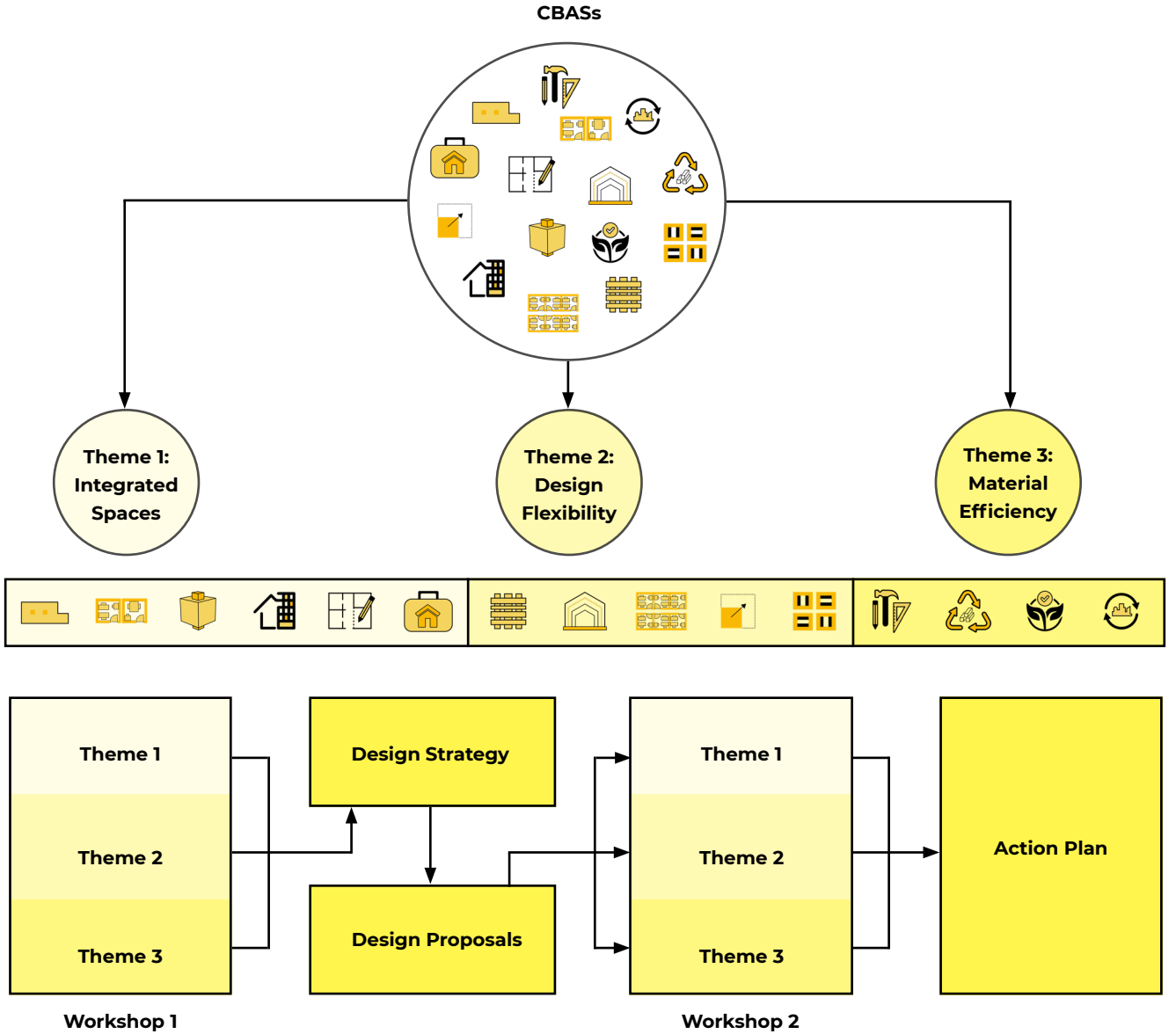
C4

Workshop 2 Participants

15. MP - Owner (Housing Corporation)

16. BD - Project Manager

17. NA - Architect

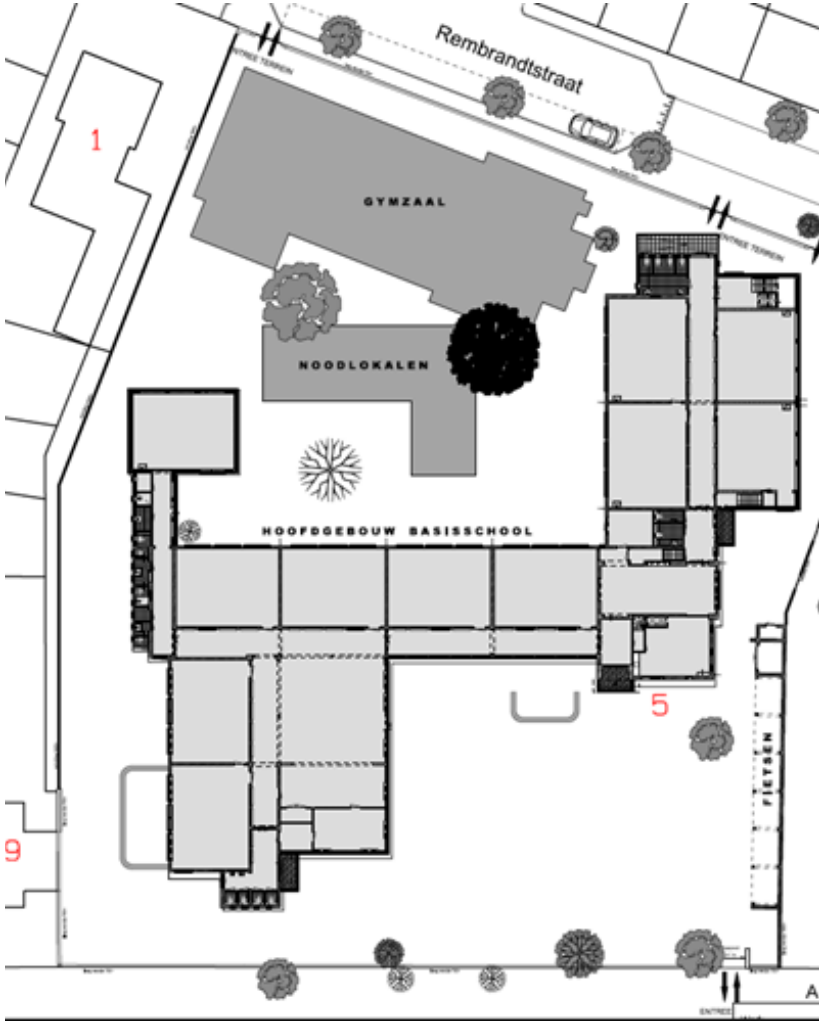


4.8. WORKSHOP 2 - DESIGN PROPOSAL

C4

Design for Mixed-Use

Provision of Multi-Purpose Spaces



*"Instead of demolishing parts, the structure can be used to **integrate housing units**, allowing for flexible and open layouts within them".*

Res & Smit BV, 2022

C4

Design for Mixed-Use

Provision of Multi-Purpose Spaces

4.8. WORKSHOP 2 - ACTION PLAN

''Initially, we explored transforming the sports facility—a large open space—into residential units by adding non-load-bearing walls. However, the ***limited number of units made the project financially unfeasible****''.*

Res & Smit BV, 2022

5. Conclusion

5.1. Answers

5.2. Recommendations

5.1. ANSWERS

SQ-A

What are the effective ways to use the CBA-AR framework in the **design & decision-making processes** of adaptive reuse projects?

Early stage planning & collaboration among stakeholders

CBA-AR =
Circular Building Adaptability in Adaptive Reuse

5.1. ANSWERS

SQ-A

What are the effective ways to use the CBA-AR framework in the **design & decision-making processes** of adaptive reuse projects?

CBA-AR =
Circular Building Adaptability in Adaptive Reuse

Pre-project phase
(Planning phase)

Early stage planning & collaboration among stakeholders

Knowledge-sharing & informative tool consiting of 3 components

CBA-Determinants
CBASs
Inhibiting & Enabling Factors

5.1. ANSWERS

SQ-A

What are the effective ways to use the CBA-AR framework in the **design & decision-making processes** of adaptive reuse projects?

CBA-AR =
Circular Building Adaptability in Adaptive Reuse

Early stage planning & collaboration among stakeholders

Pre-project phase
(Planning phase)

Knowledge-sharing & informative tool consiting of 3 components

CBA-Determinants
CBASs
Inhibiting & Enabling Factors

Preperation phase
(Design phase)

Benchmarking tool - assessing feasibility of selected CBASs

5.1. ANSWERS

SQ-B

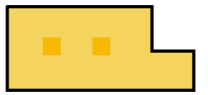
What are the **most applicable and effective** design-oriented CBASs for circular and adaptable adaptive reuse projects?

CBASs =
Circular Building Adaptability Strategies

3 most applicable and effective CBASs

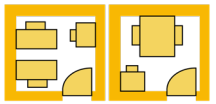
Building characteristics

61,04



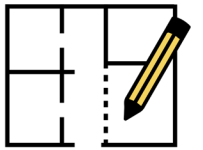
1.
Open the Floor Plan

52,73



2.
Provision of Multi-Purpose Spaces

46,88



3.
Alignment of the Interconnection Between the Floor Plans

5.1. ANSWERS

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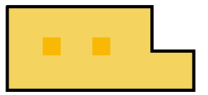

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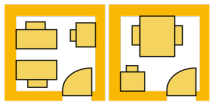

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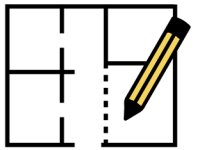


3.
Alignment of the Interconnection Between the Floor Plans

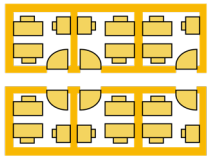
3 least applicable and effective CBASs

Legal & structural challenges

22,66

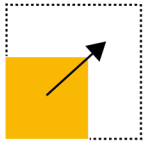
13.
Design for Mixed-Use

21,88



14.
Modularization of Spatial Configuration

14,35



15.
Design for Surplus Capacity

5.1. ANSWERS

SQ-B

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3 most applicable and effective CBASs

Building characteristics

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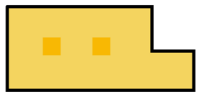

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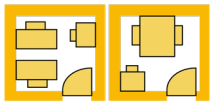

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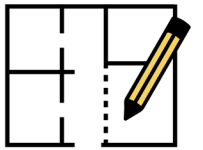

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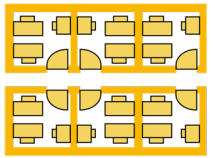

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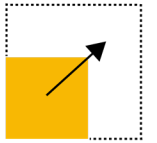


15.
Design for Surplus Capacity

These outcomes are based on the **specific cases** that were examined in this research

5.1. ANSWERS

SQ-C

How can **design-oriented CBASs** be applied and effective in adaptive reuse projects?

Current

Lack of knowledge hinders innovation and implementation of CBASs

leads to

Missed opportunities for implementing adaptable and sustainable design strategies

CBASs =
Circular Building Adaptability Strategies

5.1. ANSWERS

SQ-C

How can **design-oriented CBASs** be applied and effective in adaptive reuse projects?

CBASs =
Circular Building Adaptability Strategies

Current

Lack of knowledge hinders innovation and implementation of CBASs

leads to

Missed opportunities for implementing adaptable and sustainable design strategies

Desired

Learning about the CBASs during the **early planning phase**

by

Brainstorming and **knowledge-sharing** workshops

5.1. ANSWERS

Main Question

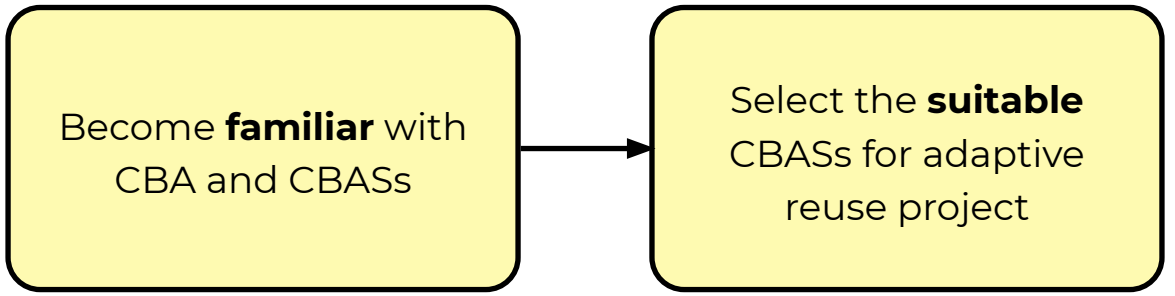
How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?

Become **familiar** with CBA and CBASs

5.1. ANSWERS

Main Question

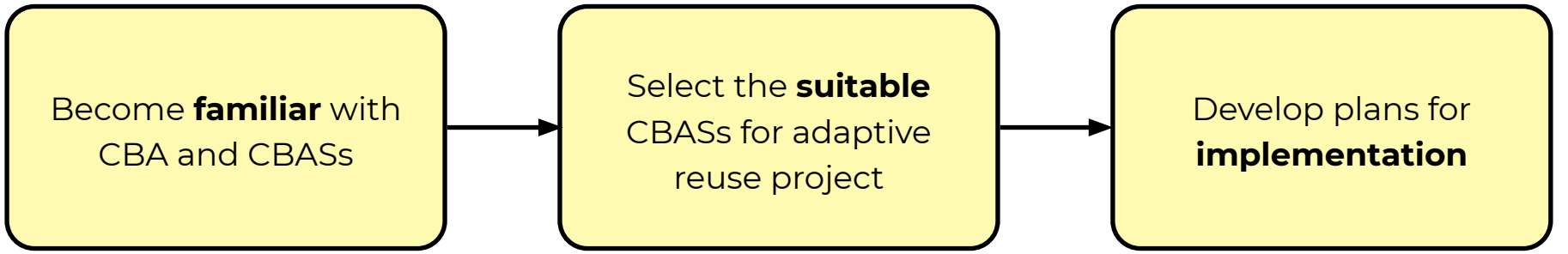
How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?



5.1. ANSWERS

Main Question

How can the ***applicability*** and ***effectiveness*** of design-oriented circular building adaptability strategies **(CBASs)** be promoted in ***adaptive reuse*** projects?



5.2. RECOMMENDATIONS

Academics

Explore and assess the **active and operational CBASs** within the CBA-AR framework

5.2. RECOMMENDATIONS

Academics

Explore and assess the **active and operational CBASs** within the CBA-AR framework

Practitioners

Draw inspiration from the cases examined in this research

Explore and get acquainted with the CBA-AR framework in order to integrate suitable CBASs

Recognize that **each case is unique**

5.2. RECOMMENDATIONS

Academics

Explore and assess the **active and operational CBASs** within the CBA-AR framework

Practitioners

Draw inspiration from the cases examined in this research

Explore and get acquainted with the CBA-AR framework in order to integrate suitable CBASs

Recognize that **each case is unique**

Policymakers

Invest in training and educating stakeholders on the benefits and practical applications of CBASs

Consider **guiding applicants for transformation permits** on the design-oriented CBASs

Interested in what the **CBA-AR Framework** has to offer for your projects?

Take a look at my complete master thesis or visit www.cba-ar.com by scanning this QR-code

Together with Mohammad b. Hamida, I have developed this website as a knowledge platform for circular and futureproof building transformation.

Any Questions or Concerns?

THANK YOU!

TU Delft BK Bouwkunde

Department of Management in the Built Environment

Linked-In

P5 - 28.10.2024

Fatih Sarikaya 4866320

LIMITATIONS

Active & operational strategies are excluded

Limited to the **Dutch** building industry

Types of cases included were different, as each one presented unique characteristics

↓

Need to focus more on inner-city, complex projects

Economic feasibility was not examined

Small number of cases & professionals