

Promoting Circular Building Adaptability in Building Transformation

An Action- and Design Research-Oriented Application

Workshop summary

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1. Overview of the case project and the organized workshop on 21-May 2024

The case project is a monumental office building that will be transformed into a multiple offices building. The building belongs to a multinational company specialized in different fields. **Table 1** briefly presents the profile of the case project.

Table 1: Case study profile

Item	Value
Year of construction	1907
Location	South Holland
Land area	6,059 m ²
Gross floor area	6,530 m ²
Lettable floor area	3,581 m ²
Number of floor plans	4 floors + roof
Building use	Office
Construction systems and materials	Brick, steel, concrete, and timber

On Tuesday 21-March 2024, a 2-hours reflection workshop was organized with the developing team of this project. This workshop focused on reflecting on the extent of considering a series of 33 circularity- and adaptability-related strategies (CBA strategies) in the redesign of the case project. These strategies are part of a developed framework by the research team for circular and adaptable building transformation (**Figure 1**). This framework brings together three components, namely CBA determinants and their strategies along with the factors that can facilitate or hinder implementing these strategies. This version of the framework is based on findings of three studies we carried out, namely literature review (Hamida *et al.*, 2023a), case studies (Hamida *et al.*, 2023b) and a participatory study (Hamida *et al.*, 2023c).

The framework maps these strategies to the 10 determinants of *circular building adaptability* – *the capacity to contextually and physically alter the built environment and sustain its usefulness, whilst keeping the building asset in a closed-reversible value chain*” (Hamida *et al.*, 2023). **Table 2** presents a brief description of these 10 determinants.

Summary of outcomes of workshop for the case project

Strategies for Circular Building Adaptability in Adaptive Reuse		Determinants of Circular Building Adaptability									Enabling and Inhibiting Factors																	Evaluation of the Strategies				
		Adaptability Determinants			Interrelated Determinants			Circularity Determinants			Enabling Factors										Inhibiting Factors											
		Functional Convertibility	Volume Scalability	Asset Refit-Ability	Configuration Flexibility	Product dismantability	Asset Multi-Usability	Design Regularity	Material Reversibility	Building Maintainability	Resource Recovery	The building Characteristics	Collaboration & Partnership/Industrial Symbiosis	Presence of Motivated/Capable Team	Economic Feasibility of Basic Strategies	New Business Models	Policy/Legislative Support	Enabling/Digital Technologies	Location of the Project	Quality and Performance Certification	Social Acceptance	Lack of Expertise	Technical Complexities with Building Products/Materials	Economic Infeasibility of Innovative Strategies	Tendency to Follow Traditional Paradigms	Lack of Data and Warranty on Old Materials	Legal and Legislative Restrictions	Fragmentation of the Building Industry				
Passive Strategies	1. Design Standardization				✗	✗		✗			✗	✗					✗					✗					✗	4	3	5	4	
	2. Separation of the Building Layers (e.g. Separated Walls)	✗			✗	✗					✗											✗	✗				✗	5	3	4	4	
	3. Open the Floor Plan		✗		✗						✗			✗								✗	✗			✗		4	3	3	3.3	
	4. Provision of Multi-Purpose Spaces						✗				✗			✗	✗							✗	✗			✗		4.5	3	4.5	4	
	5. Modularization of Spatial Configuration (Layout)	✗						✗			✗	✗		✗			✗					✗	✗			✗		4.5	3	4	3.8	
	6. Utilization of Standardized Building Products						✗	✗			✗			✗								✗						3	4	4.5	3.8	
	7. Provision of a Core for Building Services	✗									✗											✗	✗					3	3	3	3	
	8. Design for Surplus Capacity	✗	✗	✗							✗				✗			✗					✗	✗			✗		4	4	3	3.6
	9. Compartmentalization of Design	✗		✗							✗											✗	✗				✗		4	3	2	3
	10. Design for a Mixed Use (Multifunctionality)	✗									✗		✗	✗		✗		✗				✗	✗	✗	✗		✗		5	3	2	3.3
	11. Utilization of Secondary (Reused/Recycled) Materials							✗		✗	✗		✗	✗		✗			✗	✗	✗	✗	✗	✗	✗	✗	✗		5	2	1	2.6
	12. Utilization of Biobased (Biological) Materials							✗		✗	✗		✗		✗				✗	✗	✗		✗				✗		4	3.5	2	3.1
	13. Utilization of Circular (Reusable/Recyclable) Materials							✗			✗	✗	✗		✗	✗			✗	✗	✗		✗	✗			✗		5	3.5	2	3.5
	14. Alignment of the Interconnection Between the Floor Plans		✗								✗															✗			3	3	4	3.3
	15. Alignment of the Building Design with the Real Estate Strategy				✗						✗						✗												4	4	5	4.3

Legend

Literature-Based Strategy/Factor

Literature- and Practice-Based Strategy/Factor

Practice-Based Strategy/Factor

CO-Creation-Based Strategy/Factor

Co-Creation-Based Linking



































Theory-Practice-Based Linking

Excluded Connection by Participants

Revised Text in Workshop 2

Figure 1: The developed knowledge-based framework for circular and adaptable building transformation (Hamida *et al.*, 2024)

Summary of outcomes of workshop for the case project

Strategies for Circular Building Adaptability in Adaptive Reuse		Determinants of Circular Building Adaptability									Enabling and Inhibiting Factors																	Evaluation of the Strategies				
		Adaptability Determinants			Interrelated Determinants			Circularity Determinants			Enabling Factors										Inhibiting Factors											
																																
Effectiveness of the Strategy in Promoting CBA	Applicability in Practice (e.g. Constructability)	Economic Feasibility	Over all Score (Average)																													
Active Strategies	16. Utilization of Adjustable Building Components 	✗		✗						✗												✗	✗				✗	4	4.5	3	3.8	
	17. Utilization of Dismountable Building Components 	✗	✗	✗	✗			✗		✗	✗	✗										✗	✗			✗	✗	5	4.5	4.5	4.6	
	18. Provision of Shareable Spaces 					✗				✗				✗				✗		✗				✗				3	3	5	3.6	
	19. Utilization of Renewable Energy Technologies 								✗	✗		✗					✗	✗	✗	✗				✗					3	5	5	4.3
	20. Enabling the Use of Natural Lighting/Ventilation 								✗	✗										✗									4	3	4	3.6
	21. Utilization of Flexible and Integrated Installations (e.g. Integrated MEPs, Plug-and-Play) 			✗	✗			✗															✗	✗				✗	4	5	5	4.6
	22. Utilization of Water Recovery System 									✗										✗			✗	✗				✗	5	3	4	4

Legend

Literature-Based Strategy/Factor

Literature- and Practice-Based Strategy/Factor

Practice-Based Strategy/Factor

CO-Creation-Based Strategy/Factor

Co-Creation-Based Linking























































































































































Theory-Practice-Based Linking

Excluded Connection by Participants

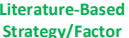
Revised Text in Workshop 2


Figure 1: The developed knowledge-based framework for circular and adaptable building transformation (continue) (Hamida *et al.*, 2024)

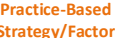
Summary of outcomes of workshop for the case project


Strategies for Circular Building Adaptability in Adaptive Reuse		Determinants of Circular Building Adaptability										Enabling and Inhibiting Factors																Evaluation of the Strategies				
		Adaptability Determinants			Interrelated Determinants			Circularity Determinants				Enabling Factors										Inhibiting Factors										
																																
		Functional Convertibility	Volume Scalability	Asset Refit-Ability	Configuration Flexibility	Product dismantlability	Asset Multi-Usability	Design Regularity	Material Reversibility	Building Maintainability	Resource Recovery	The building Characteristics	Collaboration & Partnership/Industrial Symbiosis	Presence of Motivated/Capable Team	Economic Feasibility of Basic Strategies	New Business Models	Policy/Legislative Support	Enabling/Digital Technologies	Location of the Project	Quality and Performance Certification	Social Acceptance	Lack of Expertise	Technical Complexities with Building Products/Materials	Economic Infeasibility of Innovative Strategies	Tendency to Follow Traditional Paradigms	Lack of Data and Warranty on Old Materials	Legal and Legislative Restrictions	Fragmentation of the Building Industry				
Operational Strategies	23. Provision of Shareable Facilities 																											5	5	5	5	
	24. Application of (or update of) Material Passports 																											5	5	3	4.3	
	25. Procurement of the Service of Building Products 																											4	2.5	2	2.8	
	26. Selective Dismantling 																											5	2	2.5	3.2	
	27. Send Back Discarded Material for Reuse/Recycling 																											5	4	3	4	
	28. Repurpose Old Building Materials/Products 																												5	4	2	3.6
	29. Product Exchange 																												5	2	3	3.3
	30. Implementation of Proactive/Predictive Maintenance 																												4	4.5	3	3.8
	31. Repair of Old Building Components 																												4.5	4	4	4.2
	32. Preservation of Monumental/Old Parts																												4.5	5	2	3.8
	33. Utilization of Rented-Second-Hand Products from CE Marketplace 																												4.5	2	3.5	3.3


Legend


 Literature-Based Strategy/Factor


 Literature- and Practice-Based Strategy/Factor


 Practice-Based Strategy/Factor

 CO-Creation-Based Strategy/Factor

 Co-Creation-Based Linking

 Theory-Practice-Based Linking

 Excluded Connection by Participants

 Revised Text in Workshop 2

Legend

Literature-Based Strategy/Factor

Literature- and Practice-Based Strategy/Factor

Practice-Based Strategy/Factor

CO-Creation-Based Strategy/Factor

Co-Creation-Based Linking

Theory-Practice-Based Linking

Excluded Connection by Participants

Revised Text in Workshop 2

Figure 1: The developed knowledge-based framework for circular and adaptable building transformation (Hamida *et al.*, 2024)

Table 2: A brief description of the 10 determinants of circular building adaptability

Determinant	Brief description
<i>Configuration flexibility</i>	The capacity to reconfigure the layout of spaces without utilising external resources and producing waste.
<i>Product demountability*</i>	The capacity to dismantle components and products in a building without inflicting damage and producing waste, so that they can be reused in the building or another building
<i>Asset multi-usability</i>	The capacity to offer a multiplicity of the use of building assets, so that maximising the efficiency of their utilisation
<i>Design regularity</i>	The capacity to provide a regular pattern in the spatial layout and composition of the physical assets in the building, so that facilitating the reuse and remanufacturing of the building components and products afterwards
<i>Functional convertibility</i>	The capacity to y to repurpose the function of a building or part of it, so that promoting its longevity while keeping its value
<i>Material reversibility</i>	The capacity to efficiently provide, utilise and reuse the materials in the building within a reversible value chain.
<i>Building maintainability</i>	The capacity to prolong the utility of the building assets and sustain their performance
<i>Resource recovery</i>	The capacity to regenerate the building resources in a manner that reduces the use of new materials and energy consumption
<i>Volume scalability</i>	The capacity to increase and decrease the size of a building and its spaces in a response to the demands of user or organisation, so that alleviating the shortage and redundancy in the spatial use of the building.
<i>Asset refit-ability</i>	The capacity to efficiently provide state-of-the-art building assets and technologies, while avoiding waste generation or over-invested solutions.

* The word “demountability” was adopted in the workshop instead of “dismantlability”

During this workshop, the design and research team worked together on identifying three types of the CBA strategies, namely the strategies that have been considered; the strategies that are possible; and the strategies that are impossible for the case project. The participants were asked to reflect on the aspects that could facilitate or hinder implementing these strategies, also map the considered strategies to the floor plans of the building. In overview, 16 strategies have already been considered in the definitive design of Het Groote, 12 perceived as possible, and 5 have been perceived as impossible (**Figure 2**). The outcomes of the workshop indicates that the 10 determinants of circular building adaptability would be promoted according the definitive design. It is worth noting that 11 strategies were implemented in the project original design and use of the case project, namely:

- Design Standardization
- Design for surplus capacity
- Modularization of Spatial Configuration
- Provision of multi-purpose spaces
- Provision of a core for building services
- Utilization of biobased (limited such as timber)
- Reuse of old building materials (partially)
- Utilization of reusable products (partially – e.g partitions)
- Enable the use of natural lighting
- Provision of sharable spaces
- Preservation of monumental/old parts

Summary of outcomes of workshop for the case project

Strategies for Circular Building Adaptability in Adaptive Reuse	Determinants of Circular Building Adaptability										Enabling and Inhibiting Factors										Evaluation of the Strategies										
	Adaptability Determinants			Interrelated Determinants			Circularity Determinants				Enabling Factors					Inhibiting Factors					Evaluation of the Strategies										
	Functional Convertibility	Volume Sustainability	Asset Refitability	Configuration Flexibility	Product Reversibility	Asset for Usability Fit	Design Repeatability	Material Reversibility	Building Maintainability	Resource Recovery	Collaboration & Partnership	Industrial Symbiosis	Presence of Multi-skilled/ Capable Team	Economic Feasibility of Basic Strategies	New Business Models	Policy/Legislative Support	Enabling Digital Technologies	Location of the Project	Quality and Performance Certification	Social Acceptance	Lack of Expertise	Technical Control Issues with Building Products/Materials	Economic Infeasibility of Innovative Strategies	Tendency to Follow Traditional Perceptions	Lack of Data and Warranty on Old Materials	Regulatory and Legislative Restrictions	Fragmentation of the Building Industry	Effectiveness of the Strategy in Promoting CBA	Applicability in Practice (e.g. Constructability)	Economic Feasibility	Overall Score (Average)
Passive Strategies	1. Design Standardization			X	X		X				X	X					X					X					X	4	3	5	
	2. Separation of the Building Layers (e.g. Separated Walls)	X		X	X						X											X	X			X	5	3	4	4	
	3. Open the Floor Plan	X		X							X		X									X	X			X	4	3	3	3.3	
	4. Provision of Multi-Purpose Spaces					X					X		X	X								X	X			X	4.5	3	4.5	4	
	5. Modularization of Spatial Configuration (Layout)	X					X				X	X		X			X					X	X			X	4.5	3	4	3.8	
	6. Utilization of Standardized Building Products						X	X			X			X								X						3	4	4.5	3.8
	7. Provision of a Core for Building Services	X									X											X	X					3	3	3	3
	8. Design for Surplus Capacity	X	X	X							X				X								X	X			X	4	4	3	3.6
	9. Componentization of Design	X		X							X											X	X			X	4	3	2	3	
	10. Design for a Mixed Use (Multi-Functionality)	X									X		X									X	X	X	X	X	5	3	2	3.3	
Active Strategies	11. Utilization of Secondary (Reused/Recycled) Materials							X	X	X	X	X		X				X	X	X	X	X	X	X	X	X	5	2	1	2.6	
	12. Utilization of disassembled Materials							X	X	X	X	X		X				X	X	X	X		X			X	4	3.5	2	3.1	
	13. Utilization of Circular (Reversible/Recyclable) Materials							X		X	X	X		X	X			X	X	X	X		X			X	5	3.5	2	3.5	
	14. Alignment of the interconnection between the floor plans	X								X															X		3	3	4	3.3	
	15. Alignment of the Building Design with the Real Estate Strategy									X							X										4	4	5	4.3	
	16. Utilization of Adjustable Building Components	X		X							X												X	X			X	4	4.5	3	3.8
	17. Utilization of Dismountable Building Components	X	X	X	X			X			X	X	X									X	X			X	5	4.5	4.5	4.6	
	18. Provision of Shareable spaces					X					X			X				X							X	X	3	3	5	3.6	
	19. Utilization of Renewable Energy Technologies									X	X	X	X				X	X	X	X			X				3	5	5	4.3	
	20. Enabling the Use of Natural Lighting/Ventilation									X	X								X					X			4	3	4	3.6	
Operational Strategies	21. Utilization of Flexible and Integrated Infrastructures (e.g. Integrated MEPs, Plug-and-Play)			X	X		X															X				X	4	5	5	4.6	
	22. Utilization of Water Recovery System								X										X				X			X	5	3	4	4	
	23. Provision of Storage Facilities					X					X		X	X	X	X	X	X	X				X				5	5	5	5	
	24. Application of (or update of) Material Passports				X			X	X		X	X					X		X			X	X	X	X	X	5	5	3	4.3	
	25. Procurement of the Service of Building Products			X		X		X	X		X			X												X	4	2.5	2	2.8	
	26. Selective Dismantling							X			X	X		X	X							X	X	X	X	X	5	2	2.5	3.2	
	27. Send Back Discarded Materials for Reuse/Recycle							X			X	X		X	X				X	X		X	X	X	X	X	5	4	3	4	
	28. Repurpose Old Building Materials/Products							X			X	X		X	X				X	X		X	X	X	X	X	5	4	2	3.6	
	29. Product Exchange					X		X			X	X		X	X				X	X		X	X	X	X	X	5	2	3	3.3	
	30. Implementation of Protective/Preventive Interventions								X					X	X			X				X	X			X	4	4.5	3	3.8	
	31. Repair of Old Building Components								X				X	X								X	X			X	4.5	4	4	4.2	
	32. Preservation of Monumental/Old Parts							X	X		X		X	X								X	X			X	4.5	5	2	3.8	
	33. Utilization of Rented-Second-Hand Products			X				X			X	X		X			X								X	X	X	4.5	2	3.5	3.3

Figure 2: Outcomes of reflecting on the considering implementing the CBA strategies in the case project

At the end of the workshop, the participants concluded that the strategies need to be well-explained and supported by concrete examples - especially the possible ones. Furthermore, it has been concluded that the scale and contribution of the strategies need to be determined. Therefore, the following are the outcomes of the workshop reported and narrated in line with the participants' preferences, considering the description of the CBA strategies and their examples.

2. Key outcomes and observations

2.1 The considered CBA strategies in the initial redesign of the case project and their examples

Out of the 33 included CBA strategies in our framework, 16 strategies have already been considered in the initial design of the case project, namely:

- Design standardization
- Separation of the building layers
- Provision of multi-purpose space
- Modularization of spatial configuration
- Utilization of standardized building products
- Provision of a core for building services
- Compartmentalization of design
- Utilization of biobased materials
- Alignment of the interconnection between the floor plans
- Alignment of the building design with the real estate strategy
- Provision of shareable spaces
- Enabling the use of natural lighting/ventilation
- Provision of shareable facilities
- Selective dismantling
- Implementation of proactive/predictive maintenance
- Preservation of monumental/old parts

Following is a reflection on the aforementioned 16 strategies have been considered in the definitive design of the case project:

S1. Design standardization

- *Strategy description:* Unitizing the design of building layout and compositions, in terms of their geometry and dimensions, in a repetitive and unitized manner.
 - *Example of its considerations:* Layout of walls, and some installations such as acoustics (**Figure 3**).
 - *Other remarks:* Still there will be an exploration of the possibility to standardize the ceiling. The participants indicate that these standardizations can promote configuration flexibility, design regularity and product demountability.
-



Strategy description: Composing and aligning the physical layers of the building in a separate manner corresponding to their expected service life

Example of its considerations: The plan is to use fitout products (e.g. office stuff) that will last for 10-15 years while the partitions will be demountable and last for 20-25 years (Figure 3).

Other remarks: The original structure of the building is integral as it has lasted for more than a century. The flexibility of the walls would enhance the possibility of reconfiguring spaces and merging them afterward.

S4. Provision of multi-purpose spaces

Strategy description: Providing a spatial zone or room(s) within the building that can be sharable and used by many users

Example of its considerations: Using the hall as a multi-usable space, such as a café, a co-working space and a congress hall (Figure 4), also the office spaces in the ground and second floors can be used as meeting rooms.

Other remarks: The hall will be flexible in terms of its use and fitout.

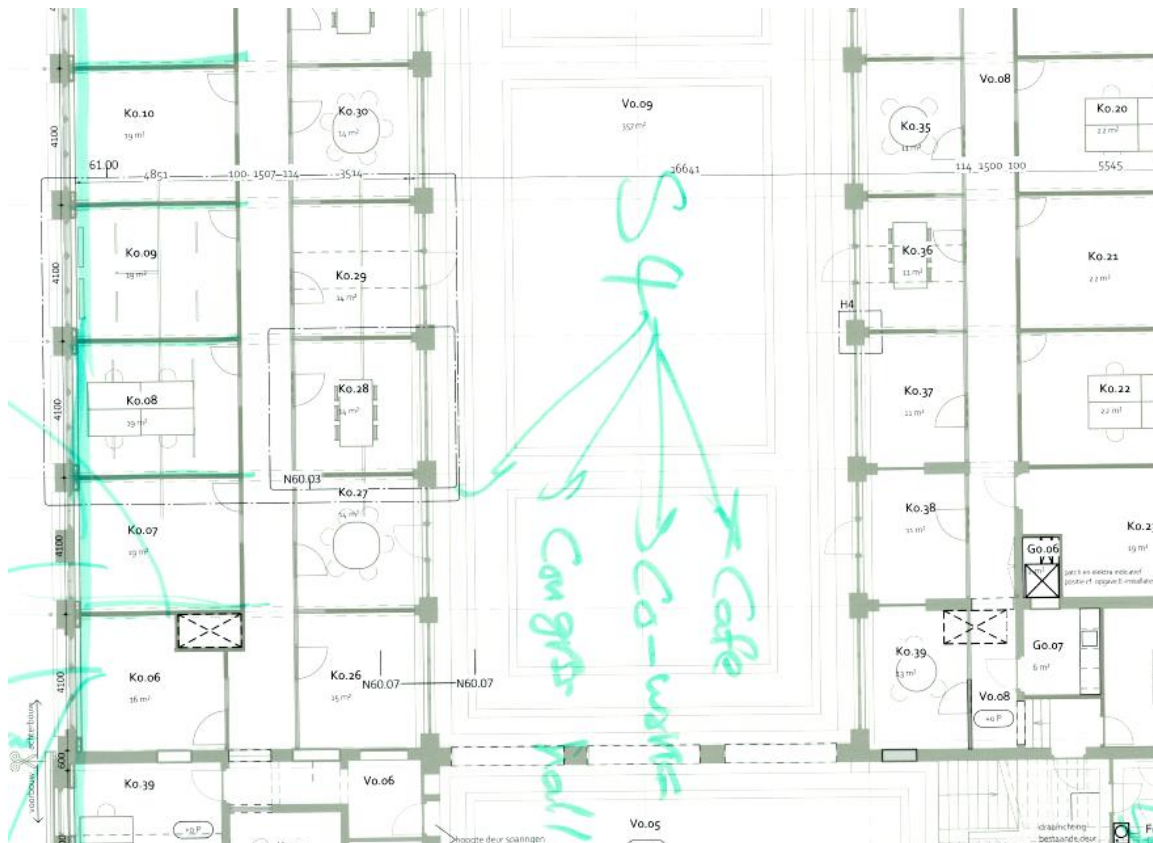


Figure 4: Mapping the fourth strategy “provision of multi-purpose spaces” to the hall in the ground floor

S5. Modularization of spatial configuration

Strategy description: Configuring the spatial layout in a manner consisting of repetitive modules

Example of its considerations: Designing the floor plan in a manner that consists number of offices of the same size (Figure 4).

Other remarks: The original design of the building is modular, which as facilitates modularizing the new layout.

S6. Utilization of standardized building products

Strategy description: Utilizing building products that have standardized size and quality.

Example of its considerations: Standardized doors, ceiling and partitions.

Other remarks: The existing fitout of the building is not standardized throughout the building.

S7. Provision of a core for building services

Strategy description: Providing a core in the building that vertically brings together the building services.

Example of its considerations: Providing a service core in the building that brings the MEP and circulation services together.

Other remarks: The original design of the building has already a service core. However, this service core will be improved further ([Figure 5](#)).

S9. Compartmentalization of design

Strategy description: Dividing the building into independent compartments (zones), either horizontally or vertically, with their technical systems so that future changes can be easily made on the compartment level.

Example of its considerations: It has been done on the floor levels

Other remarks: For the case project, vertical compartmentalization could not be possible because this may conflict with the requirement of preserving monumental elements.

S12. Utilization of biobased materials

Strategy description: The use of components and products that are made of biological materials.

Example of its considerations: Biobased paint and insulations will be used in the project.

Other remarks: It has been considered to use biobased partitions provided by [Respace](#).

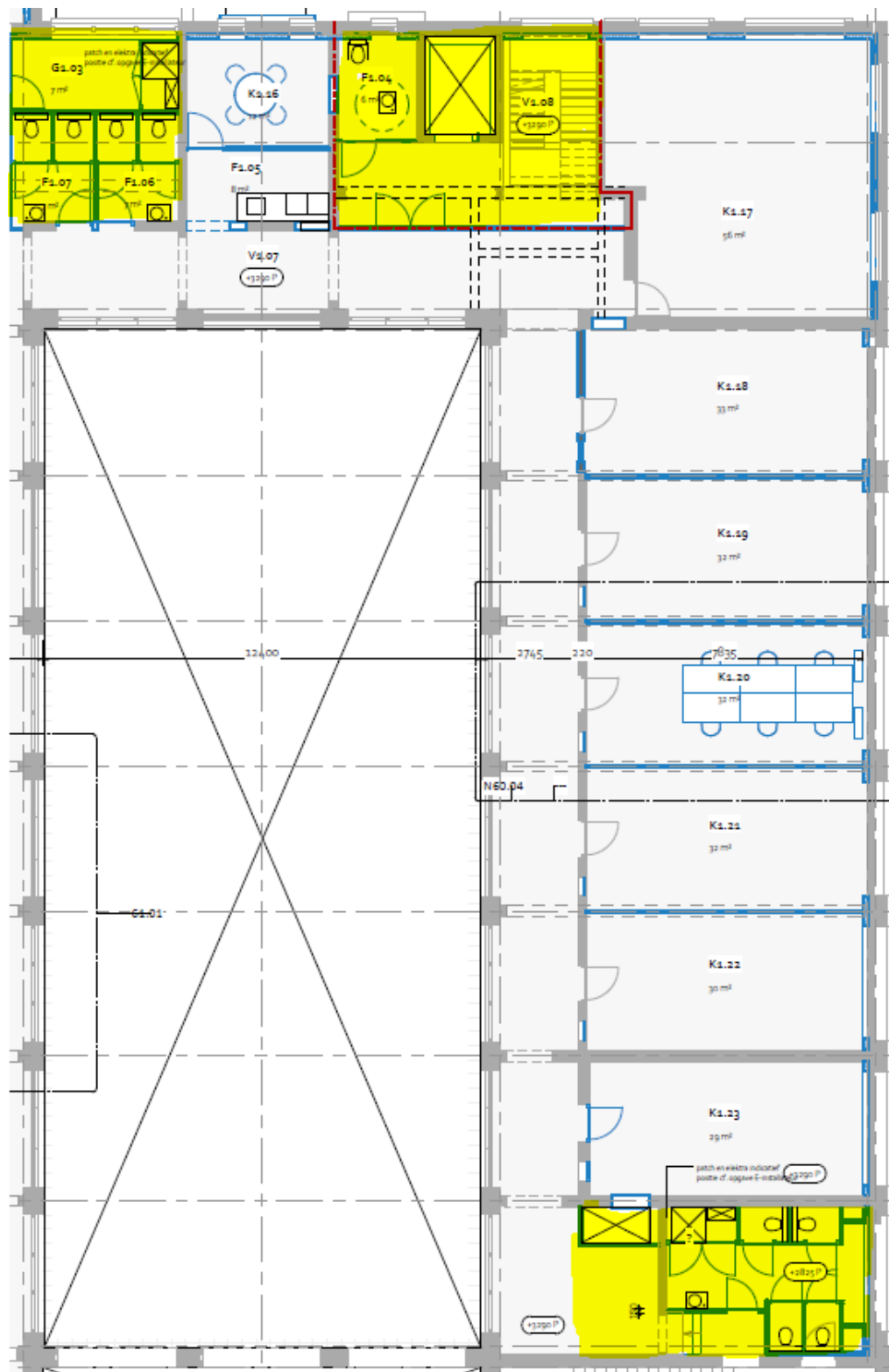


Figure 5: Repetitive location of the toilets and circulation elements in the each floor

S14. Alignment of the interconnection between the floor plans

Strategy description: Coordinating to connection between the floor plans in terms of services and circulations

Example of its considerations: Locating the plumbing services, shafts and other installations in the same location in each floor (Figure 5).

Other remarks: This strategy was not possible for the stairs because of restrictions related to fire safety and the preservation of another monumental staircase in the building.

S15. Alignment of the building design with the real estate strategy

Strategy description: Alignment between the building design and the organizational business strategy

Example of its considerations: Redeveloping heritage buildings as a means to preserve monumental assets. Another example is providing different functions in the building as a means to diversify sources of income.

Other remarks: The re-design of the case project is made in a manner that would preserve the monumental elements of the building.

S18. Provision of shareable spaces

Strategy description: Providing spaces or rooms within the building that can be used by different users of the building

Example of its considerations: The hall, toilets, and meeting rooms will be shareable spaces by different tenants

Other remarks: This strategy is in line with the principles of CE, as it maximizes the efficiency of using building spaces as a resource; thereby reducing the need for individual spaces.

S20. Enabling the use of natural lighting/ventilation

Strategy description: Facilitating using natural lighting and ventilation instead of artificial lighting/ventilation.

Example of its considerations: All windows can be open in all office rooms located along the facade, but not in the meeting rooms.

Other remarks: This strategy contributes to resource renewability, as using natural lighting/ventilation is a way of using resources in a manner that reduces the need to consume nonrenewable resources.

S23. Provision of shareable facilities

Strategy description: Provision of facilities, such as products, that can be used by different users.

Example of its considerations: Charging stations and pantries

Other remarks: This strategy can maximize the efficiency of using existing assets by maximizing the number of users of a particular asset; thereby reducing the need for providing more assets.

S26. Selective dismantling

Strategy description: The process of removing building components and products part by part to avoid their damage and facilitate their reuse

Example of its considerations: Removing the old building partitions, ceiling tiles, vaults and lighting fixtures systematically by demounting them part by part

Other remarks: Most of the old building products and components are being removed in this way, such as windows.

S30 Implementation of proactive/predictive maintenance

Strategy description: Implementing maintenance on the building in a regular basis to prevent any form of building collapse or deterioration.

Example of its considerations: Maintenance of the façade

Other remarks: There will be operational maintenance

S32. Preservation of monumental/old parts

Strategy description: Preserving existing monumental components and products used in the building, both externally and internally.

Example of its considerations: The used finishes, products, old radiators, and components in the building hall.

Other remarks: This strategy is in line with the real estate strategy of the developer, and it is mandatory by the municipal law.

2.2 Possible CBA strategies for the case project and their exemplary solutions

In the workshop, seven strategies have been perceived as possible for the case project, also they have neither been excluded nor planned yet. These twelve strategies include the following:

- Utilization of secondary (reused/recycled) materials
- Utilization of reusable/recyclable materials
- Utilization of adjustable building components
- Utilization of dismountable building components
- Utilization of renewable energy technologies
- Utilization of flexible and integrated building installations
- Procurement of the service of building products
- Send back discarded material for reuse/recycling
- Repurpose old building materials/products
- Products exchange
- Repair of old building components
- Utilization of rented-second-hand products from CE market places

Following is a reflection on the aforementioned 12 possible strategies for the case project:.

S11. Utilization of secondary (reused/recycled) materials

Strategy description: The use of second-hand products or secondary materials in the new design

Example of its considerations: The use of second hand furniture items and building products, such as second hand office fitouts (e.g. second hand desks, chairs, and couches). Possible providers are the follows:

- [Multi Ration](#): For office products such as call booths
- [Goedkope Kantoorinrichting](#) and [Welltrade](#): For office furniture such as desks and chairs.

Other remarks: Available products in the aforementioned stores, as market supply, need be aligned with the project specific requirements (demands) in terms of quantitate and quality.

S13. Utilization of circular (reusable/recyclable) materials

Strategy description: Use of building products and components that are made of reusable and or recyclable materials

Example of its considerations: Use of desks that are made of wood (biobased material) and recyclable steel such as the provided desks by a company called [BUUR](#). The provided partitions by [Respace](#) are an example of using circular materials as well.

Other remarks: This is still under consideration in the definitive design, but has not been incorporated yet.

S16. Utilization of adjustable building components

Strategy description: use of building products that are versatile and can fit the needs of individual users

Example of its considerations: Flexible fitouts such as chairs and desks that can be adjusted as per the needs of individual users. Another possible application could be the use of folding walls.

Other remarks: The participants indicated that this strategy needs further clarification. Therefore, this strategy can be rephrased as “utilization of adjustable building products to users” or “utilization of in-use adjustable building products”. Not that Arbo standard for office furniture requires using adjustable desks and chairs.

S17. Utilization of dismantlable building components

Strategy description: Using building components that can be easily dismantled.

Example of its considerations: The provided interior partitions by [Respace](#) are demountable. In addition, a large office booth, provided by a company called [Officelab](#), has been considered by the developing team as a plug-and-play product in the second floor ([Figure 6](#)).

Other remarks: N/A

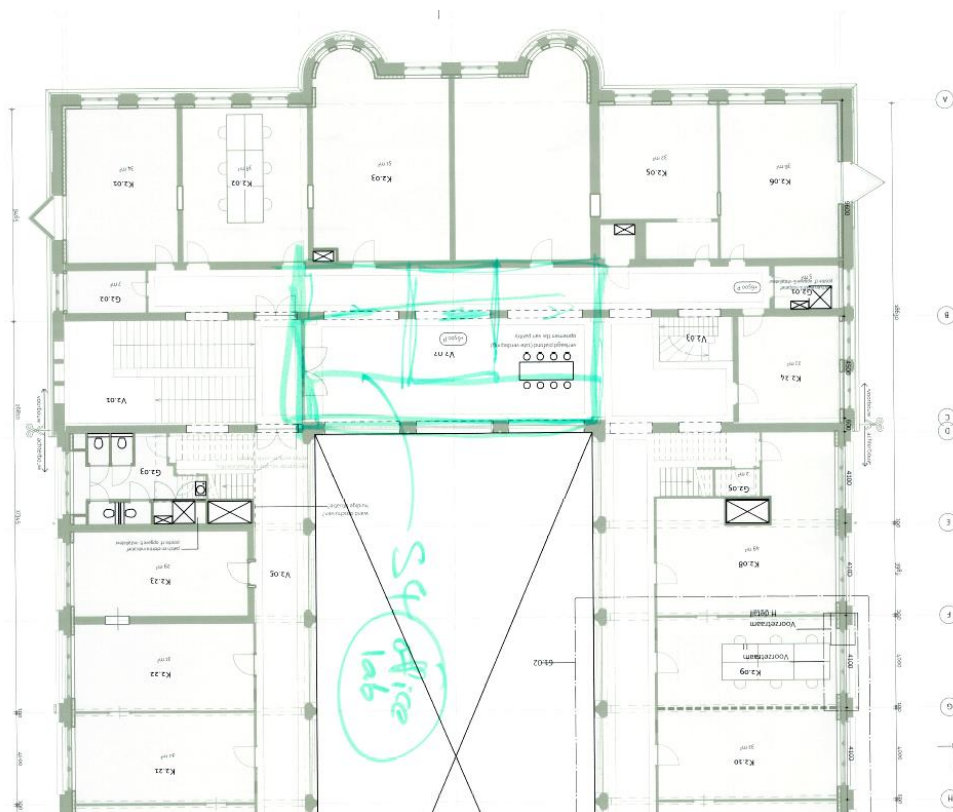


Figure 6: Proposed location of the plug-and-play office booth

S19. Utilization of renewable energy technologies

Strategy description: Renewable resource based systems in generating building electricity

Example of its considerations: PV panels (option: [Zonne Installateurs](#)) and PVT panels.

Other remarks: There is a limited budget for this project, which may be an obstacle to the use of solar panels in this project. In fact, there has been a possible cooperation that might fund providing solar panels to the project. The additional load of the panels on the structure is a technical barrier. Furthermore, adding solar panels could not be compatible with the required measures for preserving the monumental appearance of the building, and therefore, the use of such a technology will be restricted to the flat roof. [Ekwadraat](#) could be possible to communicate on the economic feasibility.

S21. Utilization of flexible and integrated building installations

Strategy description: Using flexible building installations that bring together different systems.

Example of its considerations: Using plug-and-play office cells on the second floor, in which these cells include noise insulation and lights. Another example is using plug- and play wall partitions that integrate other service into the composition of the walls.

Other remarks: The participants proposed investigating the impact of the different strategies.

S25. Procurement of the service of building products – (product-als-dienst.)

Strategy description: Purchasing building products in a form of service instead of owning the products

Example of its considerations: Leasing elevators ([such as the M-Use elevator from Mitsubishi](#)), office cells ([such as the office lab](#)), and lights (such as [Trilux](#), and [LUMECO](#))

Other remarks: The lights seem to be feasible, but the compatibility of the leasable lights with the existing lighting fixtures and new design needs to be investigated. Procuring building products as a service has been deemed to be economically infeasible by the developing team, because of limitations with the project budget. On the other hand, there is an economic advantage of providing building products as a service, namely saving the costs of expected repairs. Obsolescence-wise, providing building products as a service facilitates replacing these products with new ones or returning them to the provider; thereby avoiding waste generation.

S27. Send back discarded material for reuse/recycling

Strategy description: Sending back discarded materials and products to recycling or reuse firms; thereby avoiding waste development.

Example of its considerations: Sending back old ceiling tiles, plumbing fixtures, lighting boxes, doors, and wall panels for reuse firms such as [Gebruiktebouwmaterialen](#) and [BUURMAN](#). Possible products to be sent include lighting and plumbing fixtures.

Other remarks: Many of these aforementioned building products are physically deteriorated, and thus, reuse firms are not willing to purchase them. Another possible firm is [Snellen tweedehandsmaterialen](#), Vervol, Overdie and Oogstkaart.

S28. Repurpose old building materials/products

Strategy description: Reusing existing building materials or products in a manner that differs from the original purpose for which these products and materials were made

Example of its considerations: Reusing old products as decoration elements. For instance, old closets in the second floor can be reused in the hall as decoration elements. In addition, ceiling timber can be reused in the reception room as finishes (**Figure 7**).



Figure 7: Possible scenario for repurposing old building materials/products

Other remarks: These suggestions need to be figured out with the developing team.

S29. Products exchange

Strategy description: Exchanging extra or surplus building products with another second-hand or new products, instead of sending those products to waste

Example of its considerations: Exchanging old building products with other second-hand/new building products. For example, exchanging the old products and materials with another second hand ones through providers of second hand building materials.

Other remarks: N/A

S31. Repair of old building components

Strategy description: Exchanging extra or surplus building products with another second-hand or new products

Example of its considerations: A repair of the facade has been implemented. Repairing the old ceiling tiles in first and ground floor and reuse them in one of the two floors, while selling the extra ones. Some of the old plumbing fixtures can be reused in the small toilets. Repairing elements of the staircase will be implemented. Repairing old radiators and wall panels can be feasible.

Other remarks: David van Duffelen can be contacted about the so-called “Circulaire plafondpanelen”. Benefits if repairing existing systems is means to prolong the longevity of the physical assets, thereby reducing the need for material resources. It might be cost-effective for expensive systems – such as radiators.

S33. Utilization of rented-second-hand products from CE marketplaces

Strategy description: Leasing second-hand building products instead of buying them

Example of its considerations: Renting second-hand office booths.

Other remarks: The disadvantage of this strategy is that it might be economically infeasible in long term comparing purchasing new ones.

2.3 The CBA strategies that were deemed impossible for the case project

Five strategies have been deemed to be impossible for the case project, namely:

- Open the floor plan (it's already open and the new design of the new model (multiple offices) runs counter to this)
- Design for surplus capacity : Because the building was already designed for that
- Design for a mixed-use: because of the regulations of the main owner + the location of the project and the zoning policy
- Utilization of water recovery system
- Application of (or update of) material passports

S3. *Open the floor plan*

Strategy description: Providing an open space within the floor plan that can be divided afterward based on the changing requirements of users.

Example of its considerations: Providing an open-office space a zone within the floor plan that can be adapted by the tenant.

Other remarks: The advantage of this strategy is that companies can rent the workplace and adapt it in a manner that aligns with their business strategy. The disadvantage of this strategy is that tenants adopt a maladaptive design, by using none-dismountable or wet-connections, which can result in an extensive renovation afterward.

S8. *Design for surplus capacity*

Strategy description: Design the building and its system for extra capacity, exceeding the project requirements, so that future demands can be met.

Example of its considerations: Oversizing dimensions of spaces, vertically or horizontally, and providing technical systems with a capacity the exceeds the building demand

Other remarks: This strategy is impossible for the case project because the project was already designed for extra capacity, by oversizing the height of the ground floor, on which an additional floor was already added. Cost-wise, this strategy can be costly and has a low return.

S10. Design for a mixed-use

Strategy description: Configure the building in a manner that accommodates different functions and can facilitate future repurposing.

Example of its considerations: Accommodating residential and non-residential uses in the building.

Other remarks: This strategy has been impossible because of the requirements of the seller. Note that this strategy can be hindered by the zoning policy of the municipality, and also requires extra costs.

S22. Utilization of water recovery system

Strategy description: Using a system that can treat and circulate the water within the building.

Example of its considerations: N/A.

Other remarks: Impossible because of the configuration and composition of the monumental floors

S24. Application of (or update of) material passports

Strategy description: Documenting the materials used in the building and their specifications.

Example of its considerations: Register the newly added products and their properties

Other remarks: It is not seen as economically feasible strategy, but it has been recommended and perceived as a promising action to take in the project for the future (especially for the new assets). Having a documentation of the used building products and materials in the building eases the reuse or selling of these assets afterwards.

3. Opportunities, General remarks and comments

Below is a list of comments that were given by the participants at the end of the workshop:

- The framework needs to be described more simply (from general to specific), to ease its comprehension by people from practice. Steps need to be described. In other words, the framework needs to be more prescriptive than descriptive.
- The framework needs to be more dynamics.
- Adding percentages pertaining to the impact of the strategies could be useful.
- *Adding further explanations of the possible advantage(s) advantages of implementing each of the CBA strategies.*
- Connecting the strategies to the building levels (e.g. products/space) can be useful.
- The outcomes of this workshop need to be aligned with what Mohammad has been reporting about the available materials and possible companies.

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