THE SUSTAINABLE SHOPPING MALL

The Modern Mall

Heritage & Architecture Studio - Research paper

Semester 2023/2024

TU Delft
Delft University of Technology
Faculty of Architecture
and the Built Environment

A HOLISTIC APPROACH TO SUSTAINABLE RENOVATIONS OF MODERN SHOPPING MALLS IN THE NETHERLANDS

Author: Joël Lorenzo Moens - Student number: 4678443

Faculty of Architecture & the Built Environment, Delft University of Technology, Julianalaan 134, 2628BL Delft, The Netherlands

Graduation mentors

Meijers, L.	-	Architecture
Meijer, A.	-	Building Technology
Marulo, F.	-	Research
Quist, W.	-	Research

Research Paper Abstract

This paper explores holistic sustainability as a remedy for long term development of modern shopping malls in the Netherlands. Shopping malls are susceptible to changes and sometimes fail to create an equal balance between the environmental, social and economic aspects of sustainability, leading to vacant shops and lower quality of living in and around the mall. The insights presented in this paper, which assess the impact of past mall renovations on the three aspects of sustainability can be used to make future redesigns on modern shopping malls better resilient to changes. Assessing the embodied carbon dioxide of used materials in the renovations of open, partly covered and covered malls revealed that special attention needs to go the reuse of insulation materials and the loadbearing structure. It was not clear to what extend the structure of the mall influences the environmental aspect of sustainability. Assessing the life span expectancy of materials used during the renovations revealed that the interior of malls require more maintenance because of the implemented materials. Assessing the aesthetics and identity of the analyzed malls revealed that a partly covered mall is considered to be less coherent, whereas it also is considered bring more identity to the neighborhood.
A direct link can be made between the environmental and economic aspect of sustainability, while renovating a modern shopping mall. A suggestion for a more narrowly focused future studies would be to evaluate three different renovations that were done in the same shopping centre. This approach would make it more realistic to create links between the three sustainability aspects.

Keywords

Sustainability - renovation - shopping mall - economic - social - environmental - reuse - value

Introduction 1

If we as humans value something, which can be on various scales, it can become heritage (Howard, 2003). An architect should take this value (of other people and themselves) into account when making decisions about applying design interventions on an existing site/context (Howard, 2003). In our current society, redesigning the existing built environment is key for the sustainable future of our cities and contributes to societal challenges such as energy justice. The circular answer that fits the contemporary perception of sustainable redesign is found in reuse, which is also at the heart of the heritage discipline (Plevoets & Van Cleempoel, 2019). Modern heritage plays a big role in shaping our cities and societies, since the Modern movement (1925-1950) transformed built environments around the world in an unprecedented way (Tostões et al., 2022). Within this field, the modern shopping mall emerged first in the US, established by the Austrian architect Victor Gruen (Marchi, 2017). Gruen's shopping mall projects have been imbued with an ethical attention to social and environmental issues since his initial proposal of "The Regional Shopping Centre" in the early 1950s (Marchi, 2017). His idea of combining social and commercial functions in one building was initially being pushed away in the following decades (Carretero & Higueras, 2017), but in recent years the ideas of Gruen have been making a re-entry into the redevelopment of modern shopping malls. Shopping malls are now becoming more of a social gathering space again and are starting to lose their function as a place to buy products only (Aktas, 2011). Reusing modern shopping malls that have been abandoned or are being used inefficiently is essential to revitalising communities and improving standards of living (Grazuleviciute-Vileniske, 2006).

Problem statement and research question

Shopping centers are particularly susceptible to economic fluctuations, demographic shifts, local competition, and trends, leading to continuous adjustments in their internal environments, organizational structures, and technological systems (Mate, 2012). These factors can lead to developments in the mall that are motivated by short term interests, although malls are not always resilient to withstand the impacts of change. Most adjustments and renovations in shopping malls have been made with the goal of ensuring economic sustainability (Carretero & Higueras, 2017). However, research shows that a truly sustainable redesign should also focus on social and environmental aspects (Kamari et al., 2017) and create an equal balance between the three (Kamari et al., 2017). This is called a holistic approach to sustainability. Issues regarding the social and environmental aspects are sometimes ignored (Carretero & Higueras, 2017). That is why a lot of modern malls in the Netherlands have to contend with vacancy and a state of disrepair and they are required to undergo renovations (Ter Hark, 2022). As an example, retail expert Anja Overdiek states in an interview with Idalia Dlugosz (2019) that shopping mall "In de Bogaard" (Rijswijk) faces vacancy problems and needs to be more than just a shopping center. It used to be a buying machine, but that doesn't fit anymore in the contemporary demands.

Frameworks on a holistic approach to sustainable redesign have been developed in the past, but they have not been applied on Dutch modern shopping malls. This paper strives to give insights on applying holistic sustainable design solutions on Dutch modern shopping malls, by testing a holistic sustainability framework on three cases with different structures. Within this scope, it discusses how the outcome can be used for heritage redesign to preserve and boost possible environmental, social and economic values and make the mall better resilient to changes.

Therefor, the following research question and subquestions are formulated:

RQ: What is the effect of renovations in three Dutch modern shopping malls with different structures [covered, partly covered and open] on the environmental, social and economic aspects of sustainability?

1. *How can a holistic sustainability evaluation framework be applied to modern shopping malls?*

2. *How does a redesign of the shopping mall structure [covered, partly covered or open] influence the three aspects of sustainability?*

3. *How can the environmental, social and economic aspects be related to each other when renovating a Dutch modern mall?*

Theoretical framework 2

In 1987 the World Commission on Environment and Development launched a report in which sustainability was brought into the picture (United Nations, 1987). This required an abundant amount of research and actions on various environmental, social and economic fields and with this the three traditional pillars of sustainability were shaped. Figure 1 is used as an example to illustrate the relation between the three pillars.

Figure 1 - The 3 pillars of sustainability, by Lavalin (2021). Retrieved from https://careers.snclavalin.com/blogs/2022-3/three-pillars-of-sustainability-and-the-built-environment

This paper uses a definition by Aktas (2011, p.110) to understand what sustainable design means: "Sustainable design stands for a holistic creative process, which seeks to translate and embody global and regional socio-environmental concerns into products and services at a local level. This necessarily demands a system view of design."

To place this definition in the context of the architectural heritage sector, various articles and reports provide methods and techniques of minimizing the socio-environmental impact of interventions in existing architecture (e.g. Arfa et. al. (2022), Cathi Colla Architects (2019), Fatori & Bierbroek (2020) Plevoets & Cleempoel (2019), Puolamäki & Häyrynen (2014)). For each pillar of sustainability there are some guiding design principles following from the literature resources mentioned above:

Environmental sustainability relates to the materials, form and the systems linked to both the construction and its surroundings. The goal of redesigning in an environmental sustainable is to reduce the ecological footprint of the existing building by using less energy and minimizing pollution (such as soil, water and air pollution).

Social sustainability relates to the establishment of communities that are inclusive, secure, and healthy, and are effectively integrated into broader urban systems. The goal of redesigning in a social sustainable way is to support or enhance these existing communiteis. Cultural values, norms and traditions are taken into consideration with this.

Economic sustainability relates to finding a balance between cost and the value of something for the users/stakeholders/collective (on a bigger scale). The goal of redesigning an economic sustainable way is to ensure long term profitability while maintaining the above named balance.

Several rating systems including LEED, CASBEE and BREAAM have been developed to evaluate the environmental sustainability of buildings. However, these systems vary in their approach to assessing sustainability because they emphasize specific criteria that are relevant to local conditions (Al-Sakkaf et. al, 2021). None of these existing rating systems offer a comprehensive framework for evaluating all the three pillars of sustainability together. In order to measure the impact of a building renovation on the three aspects of sustainability, the holistic sustainability decision-making support framework for building renovation of Kamari, Corrao and Kirkegaard (2017) is used in this paper (see figure 2). This "wheel" of Kamari, Corrao and Kirkegaard was established by combining several research methods to create a modern sustainability focused decision-making tool for the (re)design of buildings. It can be used in every stage of the design process: from brainstorming on ideas during the starting phase up to the evaluation of executed designs. In this wheel, the three pillars (environmental, social and economic) are respectively translated into three objectives: functionality, accountability and feasibility. Kamari et al. (2017) used several stages of methods validated by two rounds of Delphi studies to subdivide the objectives into six indicators for building renovation purposes. These indicators are displayed in the internal circle, which is called the "Value Map"; a map that can be used to visualize a renovation case performance. Figure 3 demonstrates what such a visualization could like. The external circle shows the collection of requisite data on the pre-design.

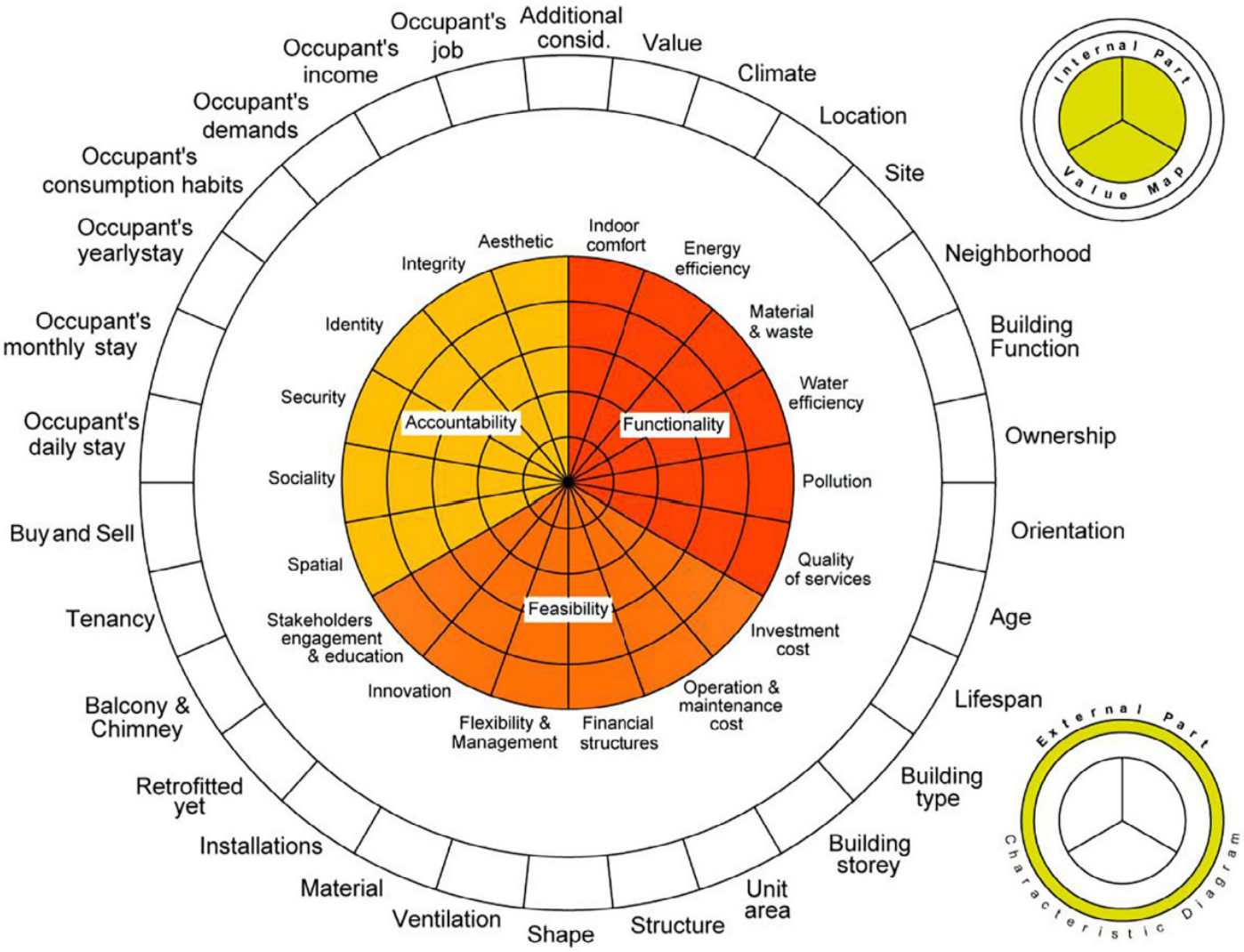


Figure 2 - Holistic sustainability decision-making support framework for building renovation, by Kamari et. al. (2017). Retrieved from https://www.sciencedirect.com/science/article/pii/S221260901730064X

After applying the framework, a building renovation can be seen as successful if the desired level of performance is achieved (Kamari, 2017). The three objectives of renovating modern shopping malls in the Netherlands are interdependent, and it is then assumable to state that sustainable renovations that address all three aspects will be more effective in achieving long-term sustainability goals than those that prioritize one aspect over the others. In this research, Kamari's "wheel" will be adapted in order to make the framework more concise and better suitable for the evaluation of modern shopping malls in specific. The next chapter elucidates the method by which this process is accomplished and elaborates on the methods of testing the adapted framework to three cases to show whether it provides useful information on shopping mall renovations.

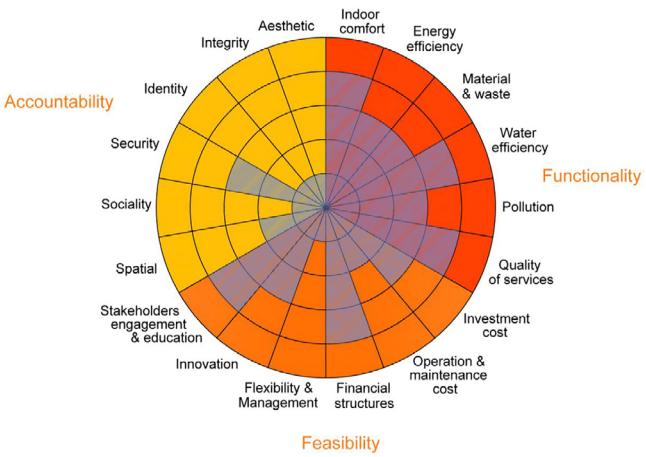


Figure 3 - Internal value map of the holistic sustainability decision-making support framework, by Kamari et. al. (2017). Retrieved from https://www.sciencedirect.com/science/article/pii/S221260901730064X

The core of this research is built around three shopping mall renovation cases. Figure 4 displays an overview of the research flow, by showing the developed methods that were used to analyse the three subquestions as stated in the introduction. The next section of this chapter delineates the method by which the Kamari wheel was modified to assess the sustainability of three renovation projects. This chapter then proceeds to explain how this assessment is conducted on the three cases and ends with an outline of the comparative analysis of the ensuing results.

Adapting the Kamari Wheel framework for application on modern shopping malls

In order to select indicators of the Kamari wheel that related the most to modern shopping malls, the research paper "Sustainable shopping mall rehabilitation" by Lin, Shih and Perng (2020) was used. The paper by Lin et al. focused on adaptive reuse of cultural heritage and determined the key indicators linked to the redesign of cultural shopping centers. 17 Investigated indicators that are involved with redesigning a shopping mall were ranked from "high importance" to "low importance" by combining the Delphi method with the Analytical Hierarchy Process (AHP). There had to be an overlap between the indicators used by Kamari et al. and Lin et. al to set up a framework that could be used to evaluate the renovation of three modern malls. For instance, the only indicators in Lin et al.'s paper that were related to the economic part of the Kamari wheel, touched the topic of the mall and were measurable were "easily maintainable" and "low operating cost". The process of choosing which indicators were applicable in this paper is illustrated in figure 5. Indicators that were ranked as "highly important" by Lin et al. (2020) were tried to put in the framework first. However, by questioning what would be feasibly researched for this paper and asking the question "*Providing author's knowledge and the available data, which indicators could be assessed in this paper, with the eye on still creating a framework that responds to holistic sustainability?*", the outcome, as shown in figure 5, entails three methods for a holistic sustainability assessment of Dutch modern shopping malls. Therefor, the indicators that are analyzed about the three case studies are: Material pollution (environmental pillar), identity and aesthetic (social pillar), operation and maintenance cost (economic pillar). The assessment methods involved are an eCO2 production assessment, a questionnaire and a life span assessment.

	Adapting the Kamari Wheel framework	*Documentation of 3 renovations*	*Framework application*	*Comparison*	*Conclusion*
Methods	Literature studies	Analyses (of archival documents), contacting the architects/contractors, site visits	Quantitative: eCO2 assessment and life span assessment Qualitative: Questionnaire	Cross-case analysis	Discussion, positioning in broader context
Subquestion	*How can a holistic sustainability evaluation framework be applied to modern shopping malls?*		*How does a redesign of the shopping mall structure [covered, partly covered or open] influence the three aspects of sustainability?*	*How can the environmental, social and economic aspects be related to each other when renovating a Dutch modern mall?*	

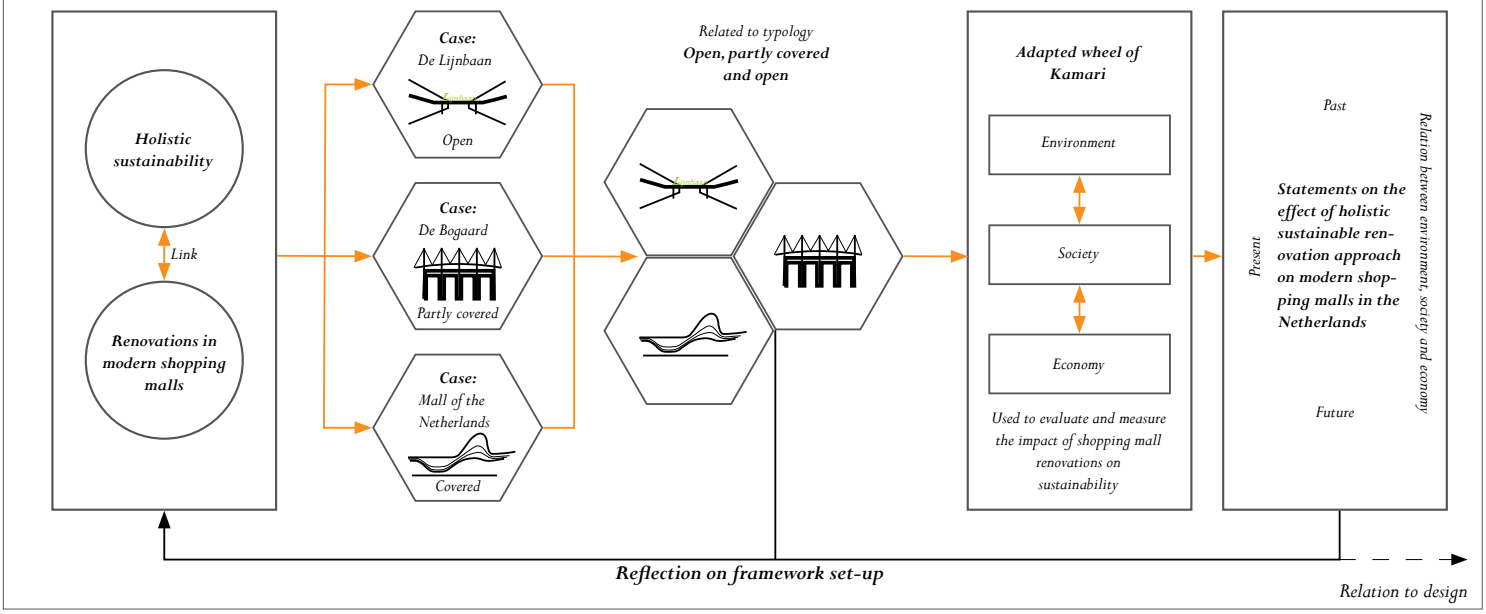


Figure 4 - Methodology chart, Creation by author (2023)

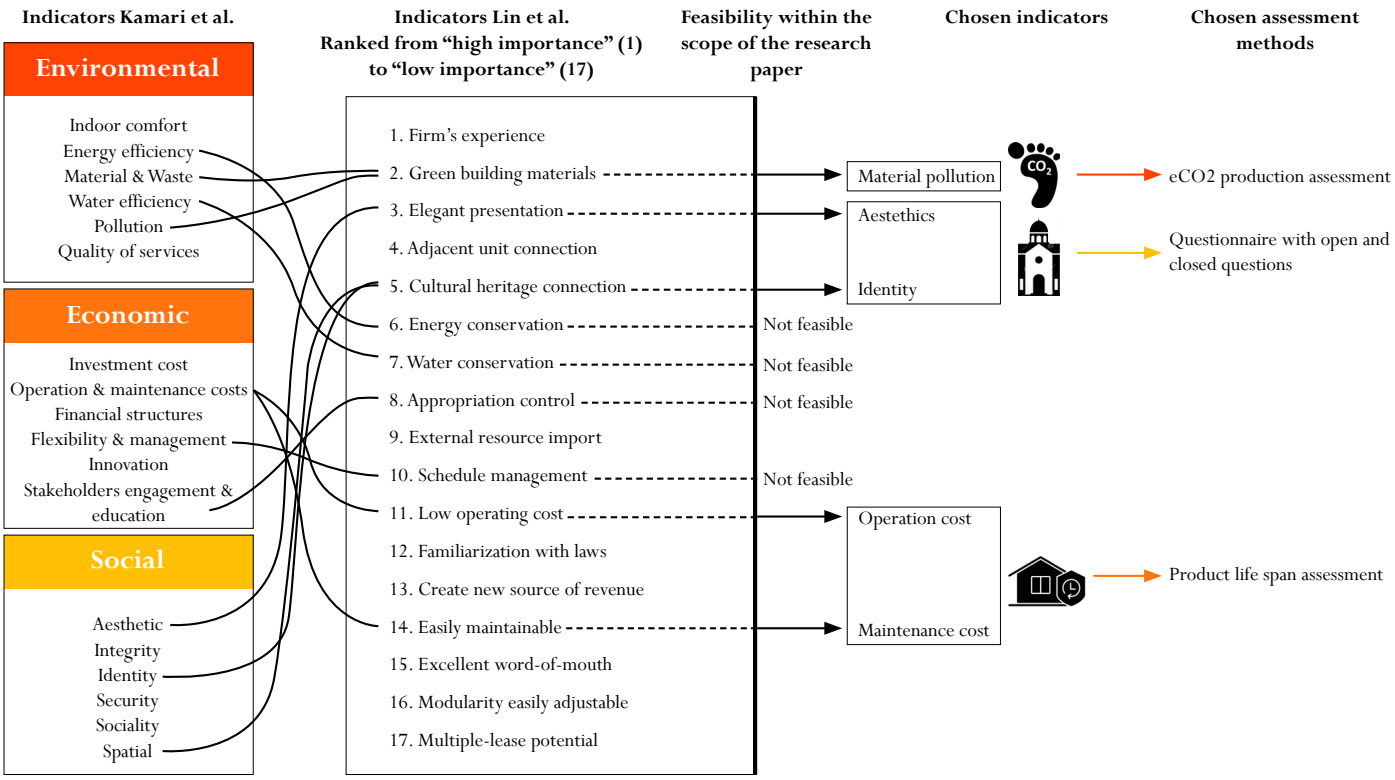


Figure 5 - From internal value circle of the Kamari wheel to an adapted concise sustainability wheel focused on shopping mall renovations in the Netherlands, by author (2023)

Cases: documentation of three renovations

The three cases that were chosen for an in-depth analysis and testing of the adapted framework are: "De Lijnbaan" (Rotterdam), "In De Bogaard" (Rijswijk) and "Westfield Mall of the Netherlands" (Leidschendam). The situation of the cases in the urban fabric is shown in figure 6, with the surrounding building structures in black.

Because the malls have a different typology (covered, partly covered and open) and are embedded in distinct urban structures, these alterations might

Figure 6 - Map of cases in the urban fabric, Own creation (2023)

Westfield Mall of the Netherlands
Redevelopment complete mall
MVSA_2016-2021

In de Bogaard
Redesign Prinsenpassage and Bogaard square
AGS architecten & DELVA_2001-2021

Lijnbaan
Renovation of façades and Forum Rotterdam
WDJA & OMA_2017-2019

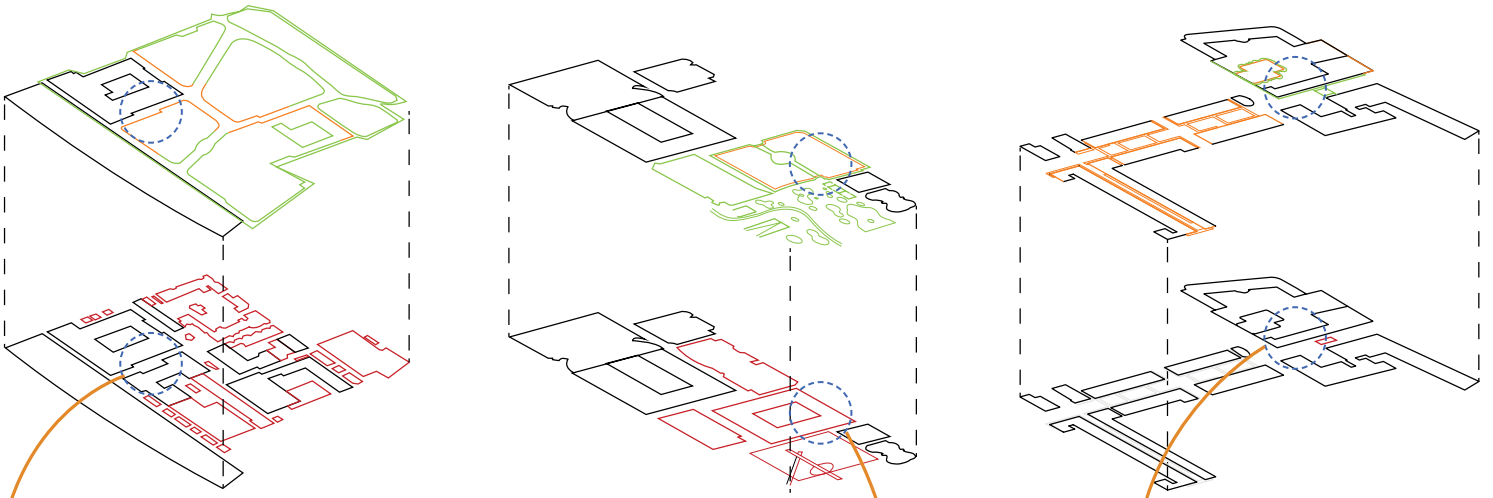


Figure 7 - Axonometry of a recent renovations of three case studies, creation by author (2023)

Westfield Mall of the Netherlands

Figure 8. Retrieved from: https://indebuurt.nl/denhaag/toen-in/fotoserie-zo-zag-winkelcentrum-leidsenhage-er-vroeger-uit~144973/#slide-1

Figure 9. Retrieved from: https://www.google.com/maps/@52.0883614,4.384095,3a,90y,323.86h,107.34t/data=!3m6!1e1!3m4!1sAF1QipOinaDBR7dCzLZ07V8Gak-3I6nhHO_KWnOHPMhuZ!2e10!7i9000!8i4500?entry=ttu

In de Bogaard

Figure 10. Retrieved from: https://www.worldbuildingsdirectory.com/entries/westfield-mall-of-the-netherlands4

Figure 11. Retrieved from: https://www.google.com/maps/@52.0365433,4.3174399,14z?entry=ttu

Lijnbaan

Figure 12. Retrieved from: https://mei-arch.eu/projecten/de-lijnbaan/

Figure 13. Retrieved from: https://www.wdjarchitecten.nl/projecten/winkels-horeca-h-h-de-klerk/

have had different impacts on the environmental, social and economic aspects of sustainability and are therefore interesting to investigate. "Westfield Mall of the Netherlands" is fully covered during the last renovation in 2016, which makes it look like a solid enclosed structure in the open street structure of Leidschendam. "In de Bogaard" functions as a hybrid, which has open spaces as well as covered spaces and was designed as the first shopping block of the Netherlands in 1963. "De Lijnbaan" has an open structure without a roof above the public place and can be seen as a shopping street with different functions in the centre of Rotterdam.

In figure 7 on page 7 schematic overviews of the most recent renovations are depicted in one axonometry per mall. The most recent renovations were chosen for analysis because crucial information about the majority of other past interventions was lacking, such as the justifications for material selection. The parts that are either demolished, restored or newly added are shown in the pictures of figures 8-13. These pictures are representative for characteristic parts of the renovations and are analyzed in terms of the three aspects of sustainability by using the adapted framework.

Framework application on three cases

The following paragraphs provide a concise description of the three assessment methods that were executed on the three malls in order to retrieve valuable information about the mall renovations that related to the social (qualitative), environmental and economic (quantitative) aspects of sustainability. This step is illustrated in the last column of figure 5.

eCO2 assessment to measure material pollution

The material pollution that was emitted during the three renovations in this paper is critisized by determining the ecological footprint of the main materials that were used and re-used during the renovations. Therefor (e)CO2 factors or estimates are used, available in literature or specific material information collections such as from Hertz and Halding (2021), Ruuska (2013) and databases as Ökobaudat (2023), in which CO2 impacts per kilograms of materials are collected (Caruso et al., 2020).

Life span expectation to make statements about operation and maintenance costs

In recent years, life cycle analysis (LCA) procedures have been developed to evaluate the environmental and economic impact of the building's design, construction, and operation phases (Caruso et al., 2020). Generally speaking, a building's lifespan is the period of time after the project's completion during which it is defect-free. The operation and maintenance phase marks the final stage of the project's life cycle, so that is why the key data utilized in this paper to speculate about operation costs and the frequency of maintenance is the estimated lifespan of the building materials (Al-Sakkaf et. al, 2021). Data on the lifespan of used materials is obtained through data sheets of Etoolglobal (2015). A longer lifespan expectancy of building materials suggests that the investment cost in the long term should be able to cover periodic checks and adjustments in order to achieve more economic sustainability (Milani, 2005).

Participatory questionnaire to make statements about aesthetic and identity

In order to make statements about the identity and aesthetics before and after the renovation of the case studies, specific information of the conducted questionnaires attached in the appendix B was analyzed. Ten randomly picked shoppers per case study were asked to participate in the questionnaire. The questions were formulated in such a way that they could be used for each mall.

Comparison

To investigate what the relation is between the three aspects of sustainability while renovating a Dutch modern mall, a *cross-case analysis* was used that involved comparing and contrasting the findings from the cases to identify patterns, similarities, and differences. Conclusions are drawn on options to renovate modern malls in a holistic sustainable way and criticised the obtained results.

The multifaceted analyses as described in the previous chapter yielded several findings per sustainability aspect within the adapted framework. Documentation of old and new building structures and materials was of utmost importance in order to assess the environmental, social en economic impact of the renovation of the analyzed malls. This documentation was based on archival records, documents that were provided by the architects/contractors and on-site observations. Sections and front views of the main building components for each case are included in Appendix A. "

The assessment on the embodied carbon dioxide per renovation based on tables 1-3 on page 11 is described in the next section "*Environmental sustainability in the Dutch modern shopping mall*."

Tables 4-6 on page 12 compare the estimated lifespan per material, from which statements are formed in the section "*Economic sustainability in the Dutch modern shopping mall*."

Statements on identity and aesthetics of the renovations are made by comparing results of the participatory questionnaire about social sustainability of the malls. These results are shown in simplified form in tables 7-9 on page 13.

Environmental sustainability in the Dutch modern shopping mall

An analysis of the embodied carbon of building materials used during the renovations of the three case studies yields one important finding: While improving the existing building stock with better insulation is necessary for energy efficiency and improving indoor comfort, doing so comes at a significant upfront carbon cost. A research by Lim et al. (2021) underscores this with findings indicating that EPS manufacturing has a significant negative impact on the environment, while recycling was determined to have the least negative environmental effects overall and could potentially be used as the new end-of-life treatment for EPS.

This emphasises the need for a nuanced strategy for environmentally conscious insulation tactics, one that carefully balances short-term environmental effects with long-term advantages. This generaly affects all renovations in modern shopping malls, but in the case of transitioning an open mall to a covered one demands a deliberate consideration, due to increased insulation material requirements.

A special point of attention while renovating a modern mall in an environmentally sustainable way is to determine precisely how aluminum or steel structures and windowframes are reused or recycled, since the carbon emission per square meter of material are very high. Especially steel and aluminum seem to be outstanding in terms of eCO2 pollution for the shopping malls, demaninding special attenion from the partly covered and covered mall, since new steel and aluminum structures are prominent in these renovations.

Economic sustainability in the Dutch modern shopping mall

The building layers as depicted in figure 14 (Brand, 1994) function as a benchmark to compare the life span of the building materials in the cases. The building skin is the layer that is often exposed to weather conditions and needs to be inspected periodically (Brand, 1994).

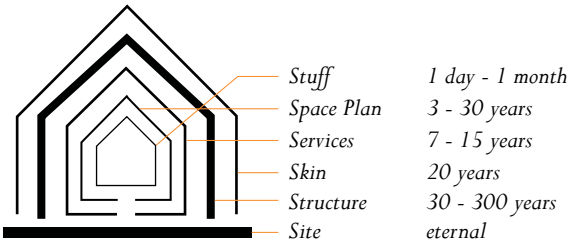


Figure 14 - Building layers of Brand, life cycle of building elements. Brand (1994), edit by author. Retrieved from https://www.researchgate.net/publication/228865622_INNOVATING_BUILT_HERITAGE_ADAPT_THE_PAST_TO_THE_FUTURE/figures?lo=1

Tables 4-6 confirm this by showing that most materials that are exposed to changing weather conditions are chosen to be long lasting. For instance, for both the renovations of the Bogaard and the Lijnbaan there was chosen for a robust façade finish that will last a long time. It can be seen in Appendix A that a brick façade and a self-supporting façade of prefabricated concrete have a life expectancy of 81 to 86 years, whereas in the case of the interior of the Mall of the Netherlands, the choice was made for a demountable aluminum construction that serves as a frame for the shops' own infills. This was probably chosen because it makes it easily adjustable in order to keep up with changing shopping trends, but it also means that the structure

will have to be replaced or renovated sooner, resulting in additional costs. It is claimed from the Mall of the Netherlands website that 80 per cent of the materials used during the renovation were recycled, so it is likely that the aluminium frames from the previous design were also reused, extending the life of the material in a sustainable way.
Concluding, when renovating an open, partly covered or covered shopping mall in an economic sustainable way, creating a robust exterior facade with high life expectancy materials like brick or concrete reduces maintenance and operation costs in the long run. Using demountable low life expectancy materials in the interior of partly covered and covered malls might come with aditional maintenance costs, but opens possibilities for the mall to change the interior façades quickly.

Social sustainability in the Dutch modern shopping mall

In this paper aesthetics and identity were considered as representative facets of social sustainability within a shopping center and were assessed through a structured questionnaire among random participants. To determine the visitor's view on aestethics of the three malls after renovation, participants could indicate on a scale of 1 to 5 in a closed question to what extent they found the mall cohesive and pleasing to the eye. Under the "findings" column in tables 7-9, the most important remarks given by participants are summarized. The Bogaard emerged as the least aesthetically pleasing mall with a score of 2,1. Answers to the open-ended question supported this by mentioning that the mall had many different spaces that did not feel coherent. It can be assumed that as well open as closed spaces are meant here, since the shoppers were asked these questions on various locations throughout the mall. Furthermore, the Bogaard was described as outdated. The Lijnbaan and Mall of the Netherlands both scored significantly higher on this aspect. Descriptions such as "clean", "spacious", "unique"and "pretty views" support this. The fact that the Mall of the Netherlands was the most recently renovated, may have contributed to being more aesthetically pleasing to the public, hence the new design is matching with the contemporary trend. It can be concluded that the mix of different styles in a partly covered mall had a negative impact on participants describing the mall as aesthetically pleasing.

A countering finding is that the Bogaard, with its various spaces, does generate a sense of identity among participants. It therefore scores a 4,4 on average on a scale of 1 to 5, which is higher than the scores of Lijnbaan and the Mall of the Netherlands. Because of many landmarks and memories associated with the Bogaard, visitors feel that the mall is characteristic for the neighborhood. It was therefore noticeable that in the covered Mall of the Netherlands, visitors knew very little about the mall's relationship with its surroundings or the participants did not come from the neighborhood themselves.
A similar pattern emerged at the Lijnbaan, where some participants were not residents of the local neighborhood and perceived the open Lijnbaan as an integral part of the broader city of Rotterdam rather than as a distinct standalone shopping center. There was no specific mention of a connection with the surrounding urban environment, even though distinctive features like the repeating facade were noted for fostering a sense of identity. It is conceivable that a partly open mall in a smaller city fosters a stronger sense of identity amongst visistors, which strengthens social sustainability both inside and outside the mall.

Comparison

Comparing the outcomes of the sustainability assessment amongst each other let to revealing an interdependence between the environmental and economic aspect of sustainability: Renovating a Dutch modern mall often comes with the replacement or addition of insulation materials. By choosing an insulation type with a long lifespan such as recycled EPS (EPS Group, 2023), the reuse of this material can be promoted in the future and this therefor creates both less eCO2 emissions and less maintenance costs. Reuse is a key term here that promotes both aspects of sustainability.

It can also be stated that indicators influence each other within one aspect of sustainability. For instance, a coherent interior design of a luxurious covered mall might be experienced as aesthetically pleasing, but this has a negative impact on the identity that the mall has in the neighborhood.

Characteristic building materials for renovation	eCO_2	Source
High end insulation with patio covering (outdoor tiles)	*3300-4200 g/kg*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013).
Prefabricated reinforced concrete columns and beams	*120,5 g/kg*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013).
Double glazing	*2740 g/kg*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Recycled aluminum frame	*2264 g/kg (if properly recycled) Up to 10930 g/kg if not properly recycled*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013) *Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Newly attached part concrete foundation	*140 g/kg*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).

Table 1. Mapped eCO2 for important building materials used for a characteristic façade renovation of the Lijnbaan. By author (2023)

Characteristic building materials for renovation	eCO_2	Source
Concrete (partly outside)	*±100 g/kg Up to 510 g/kg if it is Aerated Reinforced concrete*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Steel profile with average recycled content in Germany	*±1000 g/kg*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Brickwork	*230 g/kg*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Double glass	*1370 g/kg per sheet Total of 2740 g/kg*	*Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Bricks/tiles	*Reused*	*Assumption made from pictures.*

Table 2. Mapped eCO2 for important building materials used for a characteristic façade renovation of the Bogaard. By author (2023)

Characteristic building materials for renovation	eCO_2	Source
Steel structure	*Await mail*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013).
EPS insulation covered with bitumen (burned)	*3300 g/kg*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013) *Ökobaudat,* Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen (2023).
Demountable aluminum partitioning	*2264 g/kg (if properly recycled) Up to 10930 g/kg if not properly recycled*	*Carbon footprint for building products*, VTT Technology, A. Ruuska (2013) *Sustainable light concrete structures,* Springer tracts in civil engineering, K.D. Hertz & P. Halding (2022).
Marble (Portuguese)	*15520 g/kg*	*Ökobaudat,* Bundesministerium für Wohnen, Stadtentwicklung und Bauwesen (2023).

Table 3. Mapped eCO2 for important building materials used for a characteristic façade renovation of Westfiel Mall of the Netherlands. By author (2023)

Characteristic building materials for renovation	Estimated lifespan	Source
High end insulation with patio covering (outdoor tiles)	*Depending on insulation type 36-100+ years*	*Building component life expectancy*, Etoolglobal (2015).
Prefabricated reinforced concrete columns and beams	*81 years*	
Double glazing with recycled aluminum frame	*44 years*	
Recycled aluminum frame	*44 years*	
Newly attached part concrete foundation	*110 years*	

Table 4. Lifespan of important building materials used for a characteristic façade renovation of the Lijnbaan. By author (2023)

Characteristic building materials for renovation	Estimated lifespan	Source
Concrete (partly outside)	*81 years*	*Building component life expectancy*, Etoolglobal (2015).
Steel profile with average recycled content in Germany	*86 years*	
Brickwork	*86 years*	
Double glass	*36-50 (clean glass)*	
Bricks/tiles	*Reused*	

Table 5. Lifespan of important building materials used for a characteristic façade renovation of the Bogaard. By author (2023)

Characteristic building materials for renovation	Estimated lifespan	Source
Steel structure	*83 years*	*Building component life expectancy*, Etoolglobal (2015).
EPS insulation covered with bitumen (burned)	*100+ years (EPS)* *19 years (bitumen)*	*EPS – Technical briefing*, EPS Group (2023). *Building component life expectancy*, Etoolglobal (2015).
Demountable aluminum partitioning	*31 years*	*Building component life expectancy*, Etoolglobal (2015).
Marble (Portuguese)	*25 years if maintained well*	

Table 6. Lifespan of important building materials used for a characteristic façade renovation of the Mall of the Netherlands. By author (2023)

Social sustainability indicator	Sort question/statement	Findings (answers)
Aesthetics	Closed: This shopping mall is aesthetically well put together (coherent and a pleasure for the eye).	Score: 4,3 out of 5
	Open: What do you find elegant, special or less pretty about this mall?	The mall is being called spacious, clean, light and it is often subject to change.
Identity	Closed: If I think of this city, then this shopping mall comes to mind.	Score: 3,3 out of 5
	Open: Which parts of this mall give identity to the neighborhood that it is situated in?	A few of the participants were not from the area and did not know the neighborhood very well. Change is a typical description that is given.

Table 7. Results of questionnaire related to social sustainability focused on the Lijnbaan. By author (2023)

Social sustainability indicator	Sort question/statement	Findings (answers)
Aesthetics	Closed: This shopping mall is aesthetically well put together (coherent and a pleasure for the eye).	Score: 3,8 out of 5
	Open: What do you find elegant, special or less pretty about this mall?	The mall is called straight, unique and with a pretty view on crossroads. A lot of elements are identical and some green is lacking according to two of the participants.
Identity	Closed: If I think of this city, then this shopping mall comes to mind.	Score: 3,0 out of 5
	Open: Which parts of this mall give identity to the neighborhood that it is situated in?	Various cultures are represented in shops according to two participants. A sculpture is being described as a point of recognition, the facades are characteristic and the crossing metro is addressed.

Table 8. Results of questionnaire related to social sustainability focused on the Bogaard. By author (2023)

Social sustainability indicator	Sort question/statement	Findings (answers)
Aesthetics	Closed: This shopping mall is aesthetically well put together (coherent and a pleasure for the eye).	Score: 2,1 out of 5
	Open: What do you find elegant, special or less pretty about this mall?	It is mentioned that there are a lot of different spaces and they are not coherent. It is outdated, but has some new elements.
Identity	Closed: If I think of this city, then this shopping mall comes to mind.	Score: 4,4 out of 5
	Open: Which parts of this mall give identity to the neighborhood that it is situated in?	A lot of parts give identity to the mall according to various participants. The C&A, the green squares and the V&D used to give it identity. The mall serves the neighborhood.

Table 9. Results of questionnaire related to social sustainability focused on the Mall of the Netherlands. By author (2023)

Discussion and reflection 5

This paper emphasises how complicated it is to take into account a variety of sustainability factors, when renovating modern shopping malls. Architectural reasoning and taking on a well-balanced sustainability assessment focused on three pillars can lead a design towards minimizing the negative impact of building renovations on the environment. Nevertheless, it should be taken into account that methods to get the required data are time consuming and not always accurate. Not all the necessary information for this research project was available, which let to uncertainty in the description and visualization of the shopping malls in the first place. Several factors made it a challenging task to analyze the malls: Data of older renovations got lost in the archive, focus on sustainable design has been developing only in the past few years according to the architects of the Lijnbaan and the Bogaard and sensitive information about emissions for example was sometimes private. In order to obtain specific results from the employed methods, it was only feasible to compare one or two indicators per sustainability aspect. A further elaboration on the findings is expounded in the next paragraphs.

Environmental sustainability

Besides making a statement about choosing the right insulation type during a mall renovation, no significant conclusions could be drawn in terms of the embodied carbon compared between a covered, partly covered and open mall. That is because it was hard to determine where the used materials in the renovations came from, whether they were recycled or not and whether they are going to withstand future transformations.

Economic sustainability

The life expectancy of materials in a facade depends on many factors, such as the climate in which the building is located, the intensity of use of the building and the construction method (Ding, 2014). As a result, it is not possible to make accurate statements about an average life expectancy per covered, partly covered and open mall, because some building products may need replacement earlier and could be less sustainable in economic terms than expected on beforehand. This can often only be said after completion of the building, by making critical analyses with professional tools such as Building Modelling Information (BIM), which has to be done by experts. This can result in a 10% reduction in rework and wasted materials from field corrections and offers new chances to maximize material value, reduce waste and index a building's potential for potential disassembly or reuse (Cousins et al., 2018). This would lead to a proper and more accurate collection and assessment of the required data about the life span of a renovation project. This is also confirmed by Kamari et al. (2017) in the conclusion of their paper.

Social sustainability

In terms of aesthetics, a mall with open and closed spaces, dating from different periods in time, can be seen as incoherent, whereas an open mall that is embedded in the city structure as a street is more often described as unique and spacious with a coherent style. A covered mall can evoke clean and modern feelings, provided that it forms a coherent whole. An analysis of identity brought different findings, stating that the partly covered mall is more likely to be associated with bringing identity to the neighborhood.

The questionnaire was based on the whole shopping mall, and not on the characteristic part where analysis on the building materials was focused on, so it is not possible to relate the findings directly to the environmental and economic aspects of sustainability, hence the findings on this aspect are more qualitative in nature.

Relation to the theoretical framework

It appeared after narrowing down the research methods in the first stage of the project, that assessing the holistic sustainability of past renovations has still been a topic that is difficult to understand to the fullest. The nature of this paper afterwards turned out to be an implementation of a very concise framework focused on specific parts or materials of shopping malls, whereas the intention was to create comprehensive framework that could state differences and needs in the sustainability of mall renovations. It was discovered that sustainability assessment methods can only be validly and scientifically compared when the conditions are identical, encompassing factors such as context, climate, and construction date. For future research, it

could be suggested that three different renovations in the same shopping mall are analyzed for the purpose of creating comparable outcomes and making valid statements on the difference in impact on the three pillars of sustainability. The statements in this paper therefor can only be made on surface level.

A criticism focused on the wheel of Kamari, is that stating that "the intent is an optimum of all requirements" (Kamari et al., 2017, p.345), can be seen as a self-contradicting statement, since this study has shown that some elements in the framework counter each other in reality. For instance, when analyzing the material cycle of a building renovation, some building materials might have a high life expectancy and low maintenance costs, but also a negative impact on the environment with high carbon emissions if not produced sustainably. In reality the so-called "simplified sustainability decision-making framework" (Kamari et al., 2017, p.344) needs expert views, interviews and extensive data analyses that take into account the urban context and various other given existing details of the shopping mall to require the needed information to evaluate a renovation, which is not as simple as it seems. Only in this way, an extensive and coherent value assessment can be created. So, given that contemporary shopping malls face vacancy problems and imbalances in the three sustainability aspects, there is no all-encompassing solution that finds an answer to this problem.

However, the paper of Kamari et. al (2017) also puts this possible counterpoising and complexity into perspective and even states that "a renovation strategy can clearly be considered far better than another, even without calculation of a value precisely. Precise scores matters less than the process to make the final decisions," (Kamari et al., 2017, p.344). So taking this into consideration, each study on sustainability helps to set up a dialogue between stakeholders and creates a general knowledge base on a renovation project.

To further enliven this discussion, additional studies into sustainable building alternatives is encouraged. While maintaining the fundamental principles of social, economic, and environmental sustainability in contemporary urban development, such initiatives have the potential to lessen the environmental impact of mall renovations and other building renovations or transformations.

In this paper, a holistic sustainability assessment was conducted on three Dutch modern shopping malls with either an open, partly covered or covered structure. By combining sustainability indicators of Kamari et al. (2017) with indicators linked to modern shopping malls (Lin et al., 2020), the complexity of the existing Kamari wheel was reduced and focused on a specific building type: The modern mall. The new framework revealed influences of the mall's structure on the researched indicators of sustainability. The results found by comparing the analyses of the malls stress various issues that should be taken into account when renovating in a holistic sustainable way:

- Reusing existing building materials such as insulation, benefits both the environment and the economy, as seen in the renovation of partly covered and covered shopping malls, given that the existing materials still have a high life expectancy.
- When a shopping mall is covered, the interior finish might undergo frequent changes in order to keep up with shopping trends. Most malls choose for a robust exterior finish, because it minimizes periodical maintenance and reduces operational costs.
- A partly covered mall in a smaller city gives more identity to the neighborhood then open and covered malls, but is not always appreciated by visitors in terms of coherence and aesthetics.

If not researched on the same scale, the social aspect of sustainability does not relate directly to the environmental and economic aspect.

Relevance

Sustainability is a condition that must be re-examined over time (Butters, 2014). This certainly applies to shopping malls, because according to Faber and D'Angiolella (2017) clients expect more and more of their experience in the mall. So it is important that such buildings are updated frequently. From an academic perspective, the critical examination of past design interventions in modern shopping malls and the mapping of their sustainability features is an essential contribution to the field of sustainable design. This paper provided insights into the effectiveness of past sustainability interventions, as well as identified areas for improvement and innovation in future designs.

Bibliography

Aktas, G. G. (2011). Sustainable Design Proposals in Shopping Center Public Interiors. INTERNATIONAL JOURNAL of ENERGY and ENVIRONMENT, 6(1). https://www.naun.org/main/NAUN/energyenvironment/17-568.pdf

Al-Sakkaf, A., Bagchi, A., Zayed, T., & Mahmoud, S. H. (2021). Sustainability assessment model for heritage buildings. Smart and sustainable built environment, 12(1), 105–127. https://doi.org/10.1108/sasbe-03-2021-0049

Arfa, F. H., Lubelli, B., Zijlstra, H., & Quist, W. (2022). Criteria of "Effectiveness" and Related Aspects in Adaptive Reuse Projects of Heritage Buildings. Sustainability, 14(3), 1251. https://doi.org/10.3390/su14031251

Carretero, J., & Higueras, E. (2017). The suitability of sustainable retrofitting means for shopping malls,in an environmental and urban background. A resume of the methodology. UPLanD, Journal of Urban Planning, Landscape & environmental Design, ISSN 2531-9906, 2017, Vol. 2, No. 2, 2(2), 85–96. https://doi.org/10.6092/2531-9906/5259

Caruso, M., Pinho, R., Bianchi, F., Cavalieri, F., & Lemmo, M. T. (2020). A life cycle framework for the identification of optimal building renovation strategies considering economic and environmental impacts. Sustainability, 12(23), 10221. https://doi.org/10.3390/su122310221

Cousins, F., Yost, T. B., & Bender, G. (2018). Think circular–Reducing embodied carbon through materials selection. MRS energy & sustainability. https://doi.org/10.1557/mre.2018.3

Ding, G. (2014). Life Cycle Assessment (LCA) of Sustainable Building materials: An Overview. In Elsevier eBooks (pp. 38–62). https://doi.org/10.1533/9780857097729.1.38

Dlugosz, I. (2019, 16 mei). 'Probleem met winkelleegstand Rijswijk kan nog 10 jaar duren'. Het AD. https://www.ad.nl/den-haag/probleem-met-winkelleegstand-rijswijk-kan-nog-10-jaar-duren~afba16fe/

EPS - TECHNICAL BRIEFING. (2023). https://www.eps.co.uk/. https://www.eps.co.uk/pdfs/long_life_durability_and_cost_effectiveness.pdf

Etoolglobal. (2015). BuildingComponentLifeExpectancy [Dataset]. https://etoolglobal.com/wp-content/uploads/2015/10/BuildingComponentLifeExpectancy.pdf

Faber, M., & D'Angiolella, R. (2017). The Role of Shopping Centers in a Sustainable Future Society. ACROSS. https://www.across-magazine.com/role-shopping-centers-sustainable-future-society/

Fatori, S., & Biesbroek, R. (2020). Adapting cultural heritage to climate change impacts in the Netherlands: barriers, interdependencies, and strategies for overcoming them. Climatic Change, 162(2), 301–320. https://doi.org/10.1007/s10584-020-02831-1

Grazuleviciute-Vileniske, I. (2006). Cultural heritage in the context of sustainable development. ResearchGate. https://www.researchgate.net/publication/228466259_Cultural_Heritage_in_the_Context_of_Sustainable_Development

Gylling, G., Knudstrup, M., Heiselberg, P., & Hansen, E. K. (2011). Holistic Evaluation of Sustainable Buildings through a Symbiosis of Quantitative and Qualitative Assessment Methods. The 27th International Conference on Passive and Low Energy Architecture.

Hertz, K. D., & Halding, P. S. (2021). CO2 Data. In Springer eBooks (pp. 203–205). https://doi.org/10.1007/978-3-030-80500-5_11
Howard, P. (2003). Heritage: Management, Interpretation, Identity. A&C Black.

Kamari, A., Corrao, R., & Kirkegaard, P. H. (2017). Sustainability focused decision-making in building renovation. International journal of sustainable built environment, 6(2), 330–350. https://doi.org/10.1016/j.ijsbe.2017.05.001

Lim, Y. S., Izhar, T. N. T., Zakarya, I. A., Yusuf, S. Y., Zaaba, S. K., & Mohamad, M. A. (2021). Life cycle assessment of expanded polystyrene. IOP conference series, 920(1), 012030. https://doi.org/10.1088/1755-1315/920/1/012030

Marchi, L. Z. (2017). Victor Gruen: the environmental Heart. The Journal of public space, 2(2), 75. https://doi.org/10.5204/jps.v2i2.94

Mate, K. (2012). Remediating Shopping Centres for Sustainability. Reinventing Architecture and Interiors: the past, the present and the future. IE International Conference, 1–10.

Milani, B. (2005). BUILDING MATERIALS IN A GREEN ECONOMY: COMMUNITY-BASED STRATEGIES FOR DEMATERIALIZATION [Thesis]. University of Toronto.

Plevoets, B., & Van Cleempoel, K. (2019). Adaptive Reuse of the Built Heritage. Routledge eBooks. https://doi.org/10.4324/9781315161440

Puolamäki, L., & Häyrynen, M. (2014). CERCMA Cultural Environment as Resource. Nordiske Arbejdspapirer. https://doi.org/10.6027/na2014-920

Ruuska, A. (2013). Carbon footprint for building products: ECO2 data for materials and products with the focus on wooden building products [Online boek]. VTT Technology. https://www.vttresearch.com/sites/default/files/pdf/technology/2013/T115.pdf

Sustainable Development: An Introduction to the Three Pillars of Sustainability - Cathi Colla Architects. (2019, 12 januari). Cathi Colla Architects. https://cathicollaarchitects.com/resources/sustainable-development-an-introduction-to-the-three-pillars-of-sustainability/

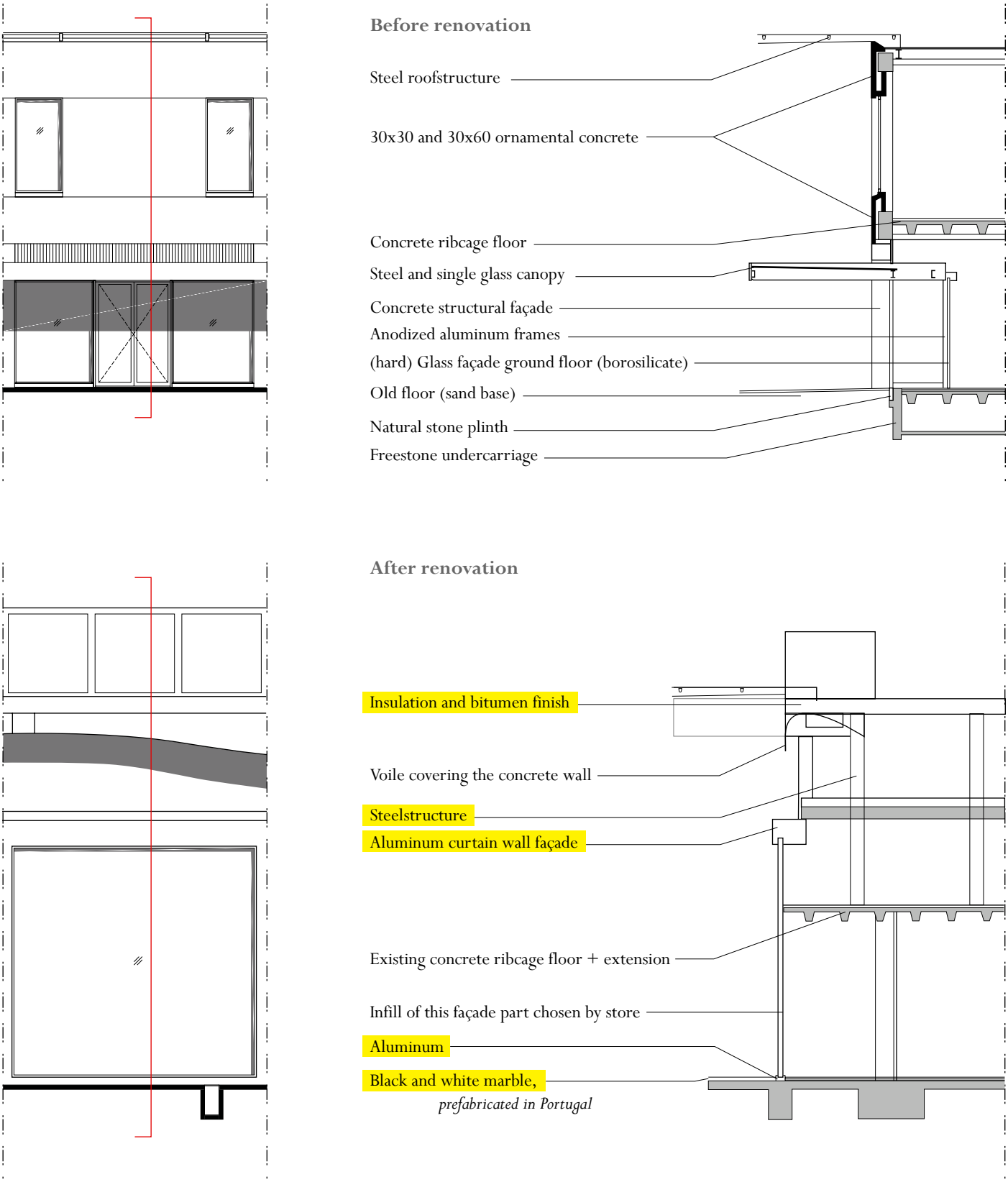
Ter Hark, P. (2022, 27 oktober). Wijkwinkelcentra veranderen van karakter en samenstelling. Locatus. https://locatus.com/blog/wijkwinkelcentra-veranderen-van-karakter-en-samenstelling/

Tostões, A., Anelli, R., Bergdoll, B., Graf, F., Haspel, J., Pottgiesser, U., Potucek, J., Torrent, H., Yamana, Y., & Zaicek, M. (2022). Modern Heritage: Reuse, Renovation and Restoration. Birkhaüser.

United Nations. (1987). Report of the World Commission on Environment and Development: Our common future. In Sustainable development UN (A/42/427). https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

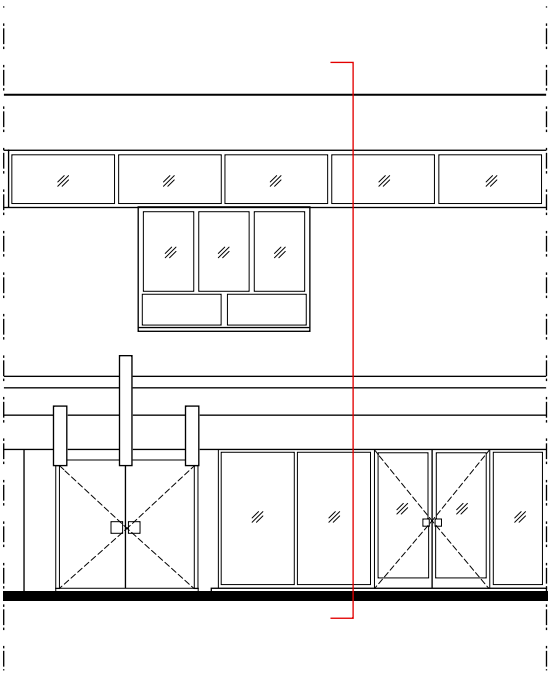
Appendix A

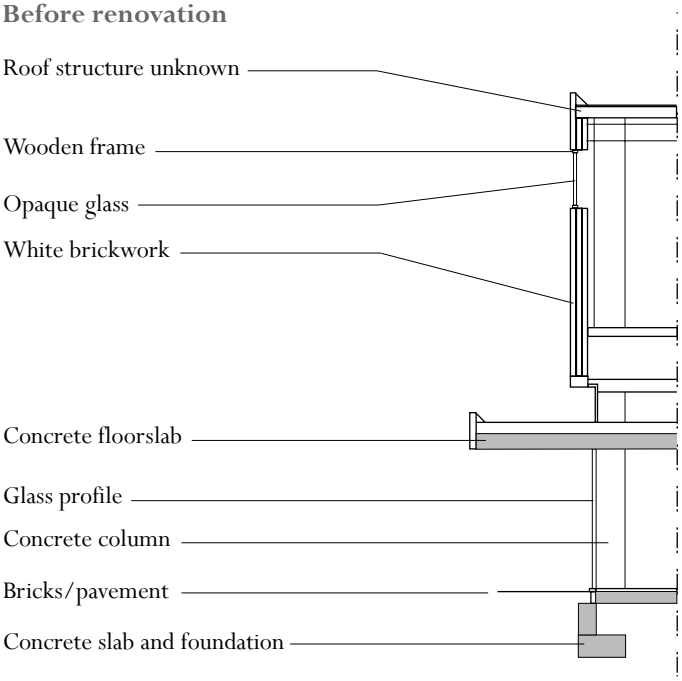
Westfield Mall of the Netherlands, *Leidschendam*
Characteristic façade part

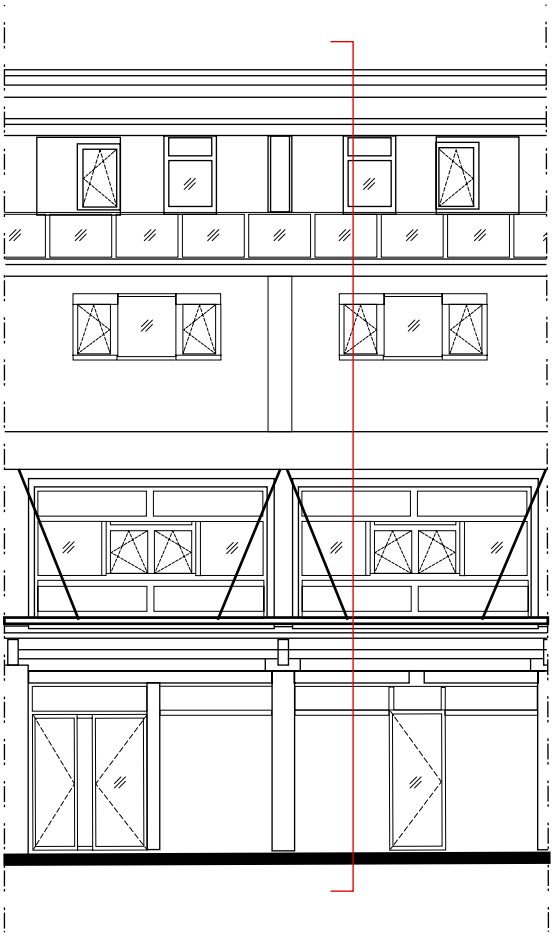


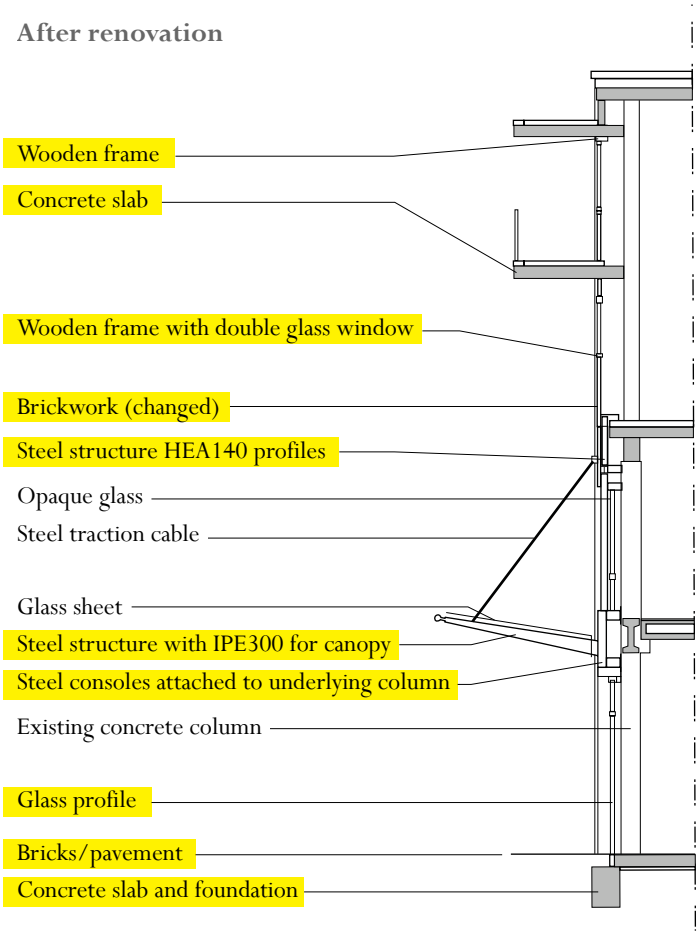
= Building materials that were filtered out by assuming that these materials were either constructive or very much present in the architectural view of the design.

Figure 16. Characteristic façade of Westfield mall of the Netherlands before and after renovation. Own creation (20235



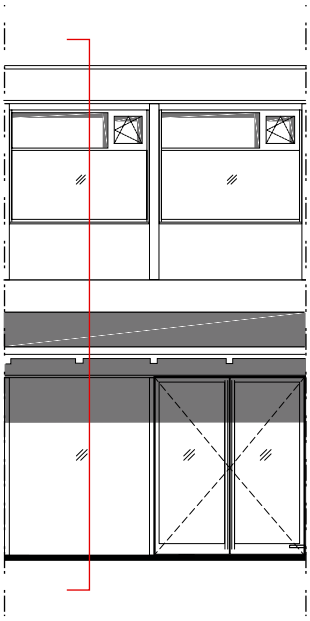


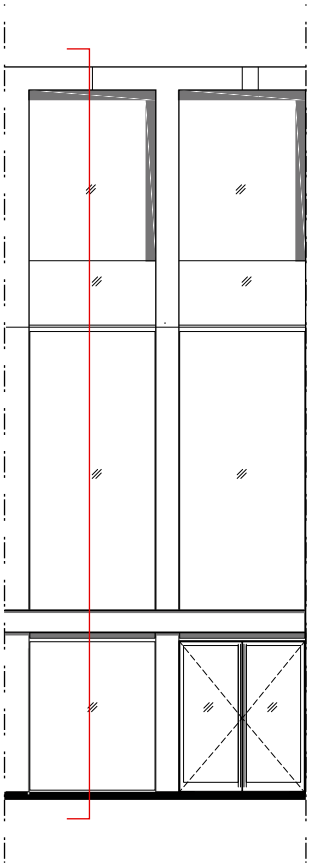


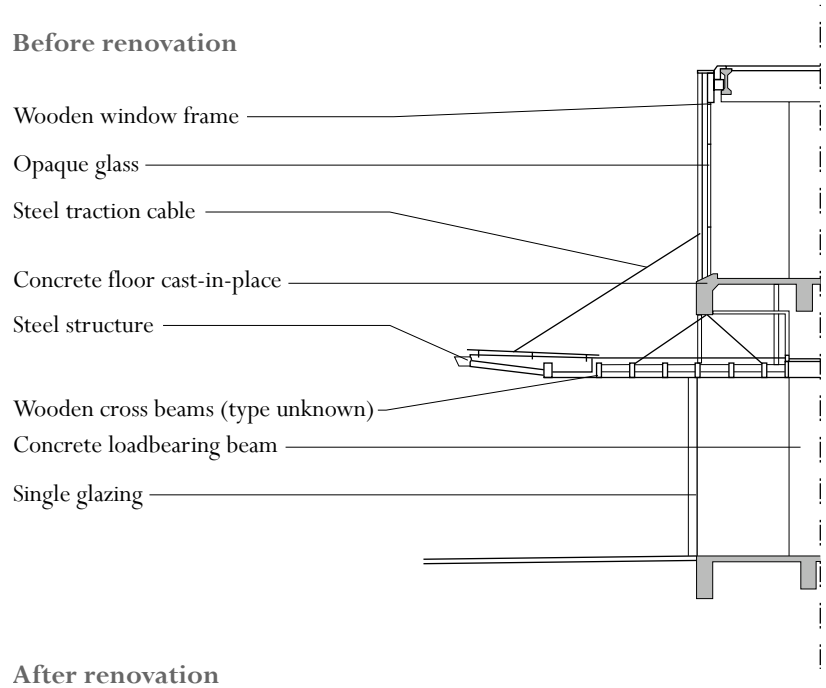


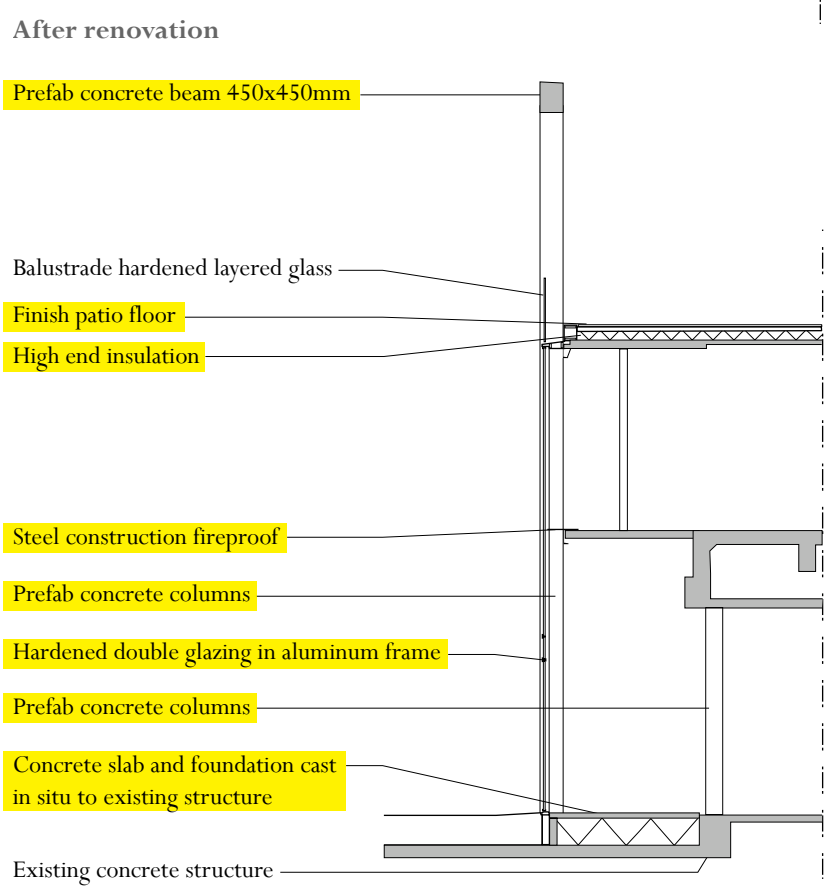
= Building materials that were filtered out by assuming that these materials were either constructive or very much present in the architectural view of the design.

Figure 17. Characteristic façade of the Bogaard Prinsenpassage before and after renovation. Own creation (2023)









= Building materials that were filtered out by assuming that these materials were either constructive or very much present in the architectural view of the design.

Figure 18. Characteristic façade of de Lijnbaan Forum Rotterdam before and after renovation. Own creation (2023)

Appendix B

Leeftijd: Winkelcentrum: April 2023

Vragenlijst – Sociale duurzaamheid in het winkelcentrum

Deze enquête is anoniem en doeleinden zullen uitsluitend binnen het gebruik van de TU Delft blijven.

In de architectuurwereld zijn er een aantal eigenschappen van een gebouw of van de gebouwde omgeving die het ontwikkelen van een duurzame leefomgeving beïnvloeden. Wanneer er wordt gesproken over sociale duurzaamheid, dan gaat het over het veilig, gezond, inclusief en aantrekkelijk ontwikkelen van een gemeenschap. Ook cultuur en traditie zijn kenmerken van een sociaal duurzame samenleving.

Een winkelcentrum bevat verschillende vormen van openbare ruimte en beïnvloedt het gedrag en het welzijn van mensen in de gemeenschap. Voor mijn afstudeeronderzoek zou ik graag informatie van gebruikers over verschillende winkelcentra willen verzamelen om te bepalen welke aspecten van het winkelcentrum van invloed zijn op sociale duurzaamheid en waar verbeterpunten te vinden zijn. De vragen gaan over het winkelcentrum in zijn geheel.

Geef in de onderstaande 6 vragen aan in hoeverre u het eens bent met de stellingen door de bolletjes van 1 (oneens) tot 5 (zeer eens) te kleuren.

1. **Dit winkelcentrum zit esthetisch goed in elkaar (samenhangend en plezierig voor het oog)** *(Esthetiek)*

   1 2 3 4 5

   ○ ○ ○ ○ ○

NOTES

2. **Deze plek is uniek en heeft een eigentijdse stijl** *(Integriteit)*

   1 2 3 4 5

   ○ ○ ○ ○ ○

3. **Als ik aan deze stad denk, dan denk ik aan dit winkelcentrum** *(Identiteit)*

   1 2 3 4 5

   ○ ○ ○ ○ ○

4. **Ik voel me veilig in dit winkelcentrum** *(Veiligheid)*

   1 2 3 4 5

   ○ ○ ○ ○ ○

5. **Dit winkelcentrum is inclusief en bereikbaar voor iedereen met of zonder handicap van welke afkomst dan ook** *(Sociaal)*

1 2 3 4 5
○ ○ ○ ○ ○

6. **Ik voel me prettig in de verschillende ruimten van het winkelcentrum en het voelt logisch om van plek naar plek of van winkel naar winkel te bewegen** *(Ruimtelijk)*

1 2 3 4 5
○ ○ ○ ○ ○

Geef op de onderstaande 6 vragen antwoord in een paar zinnen. Als de vraag niet op u van toepassing is, vul dan de reden in waarom niet.

Wat vindt u mooi, bijzonder of minder mooi aan dit winkelcentrum? *(Esthetiek)*

Functioneert dit winkelcentrum goed als winkelcentrum? Of zou u deze plek beter geschikt vinden voor een andere functie?

(Integriteit)

Welke onderdelen van dit winkelcentrum geven identiteit aan deze buurt?
(Identiteit) Tekenen mag ook

Op welke plekken voelt u zich het veiligst en waar het minst veilig? *(Veiligheid)*

Welke herinneringen heeft u aan dit winkelcentrum die u bij staan? *(Sociaal)*

In welk opzicht vindt u dat de laatste renovatie de ruimten in het gebouw of in de omgeving heeft veranderd? *(Ruimtelijk)*

Uitleg over de laatste renovatie kan gevraagd worden.

REFLECTION

Joël Moens - 4678443

Faculty of Architecture & the Built Environment, Delft University of Technology, Julianalaan 134, 2628BL Delft, The Netherlands

Graduation mentors

Meijers, L.	-	Architecture
Meijer, A.	-	Building Technology
Marulo, F.	-	Research
Quist, W.	-	Research

The Modern Mall

Heritage & Architecture Studio - Reflection paper

Semester 2023/2024

Introduction

Step by step, over the past year, I have developed part of a modern Dutch shopping mall into an indoor market and cultural centre, while reusing most of the existing building structure. The learning and decision-making process of this project has been shaped by analysing the evolution of existing modern shopping centres in the Netherlands and investigating possible design solutions that would revitalise buildings in the modern mall that have lost value over time. This process of trial and error and anticipation of my design choices through my research topic (holistic sustainability) has brought several insights and realisations that have helped me to become a better architect and contribute to the academic and professional world. This reflection paper speculates on the benefits of my research and design process for the professional world within the heritage and architecture sector. Therefor, in the next paragraphs conclusions are drawn by linking the outcomes of the research and design to the original problem statement, the followed methodology and the design approach.

Relation between the topic, the problem and the research outcome

The modern shopping mall, typically comprising a set of interconnected buildings with different functions, has a distinct function in the neighborhood and is integrated into the urban fabric. The architectural elements give identity to the ensemble and reveal important time layers of transformation and adaptation. The unravelling of the complex relationships that modern shopping malls have with the economy, society and the environment during the first phase of the graduation studio revealed several reasons why many modern shopping centres in the Netherlands are struggling with vacancy and a state of disrepair. Keeping as up to date as possible in terms of trends and short-term ecconomic interests resulted in frequent renovations of many shopping malls (Ter Hark, 2022). In recent years, social and environmental aspects have sometimes been ignored during these renovations, leading to an imbalance between the three pillars of sustainability (Carretero & Higueras, 2017). This problem acted as a starting point for my design tactics and led to the analysis of the economic, social and environmental qualities of the shopping centre, as shown in Figure 1.

Rethinking the role of the modern shopping mall in our society and applying an innovative (re-) design to a specific case offered an opportunity to break through the stigma of renovating malls in a way that only serves short-term benefits. In my design, reuse is considered as the heart of heritage and designing through the use of existing and future time layers reveals the (hi)story of a mall. This, besides carefully speculating about long-term benefits, places my graduation topic in an all-embrasing centre of the mastertrack Architecture, with an eye to designing for the future, since one of the most important next steps for architects is updating the existing building stock. If we consider the definition of heritage according to P. Howard, author of the book Heritage - Management, Interpretation, Identity (2003), there is no limit to what can fall within the scope of heritage: "[…] what do people wish to conserve or collect, to protect from the ravages of time? The simple answer is 'everything'." (Howard, 2003, p. 54).

From an academic perspective, the critical examination of past design interventions in modern shopping malls and the mapping of their sustainability features is an essential contribution to the field of sustainable design. Understanding past successes and failures strengthens future design decision arguments. My research paper provided insights into the effectiveness of past sustainability interventions, as well as identified areas for improvement and innovation in future designs. This resulted in generalised conclusions that raised design questions (see Figure 1). In reality, the redesign of the Bogaard meant that focusing on these questions alone did not result in a comprehensive design that included answers to all architectural elements such as light, texture and space. They mainly served as a basis for the design, from which other design decisions followed. This process is explained in the next paragraph.

Process of research and design

Since the start of this graduation project, research and design were interdependent. Untangling the variety of possibilities and choosing strategies that fit my subject and story made me reflect on my own interests. What did I want to accomplish with this project and how could I position myself as a contributor to the architecture of our contemporary society? Learning

Research conclusions

- Partly covered mall gives identity to the neighbourhood.
- Covered, partly covered and open malls evoke contrasting feelings on aesthetics.
- A partly covered mall with different architectural styles tends to be seen as incoherent.

- No significant conlusion, because ECO2 is dependent on too many factors.
- Choose insulation type carefully, especially when covering a roof.
- It is of great importance how materials are recycled.

- Life expectancy of materials depends on many factors.
- Critical analysis can be conducted by BIM after building completion.
- Demountable interior finishes make it easy to follow the shopping trends.

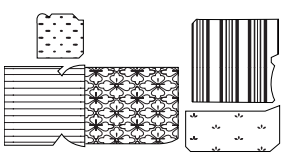
Design questions

How can "In de Bogaard" remain a strong identity for the neighborhood? How is the building used by the shopper?

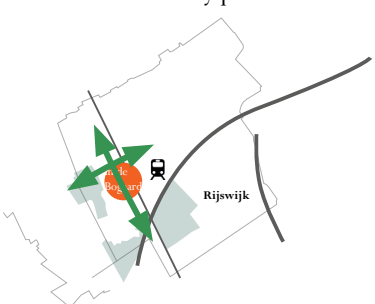
What materials of the existing building can be reused?
How can local building products be recycled?
What climate does the building need?

How long can the building elements last before they need maintenance or replacement?

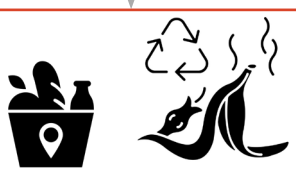
Design starting points



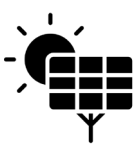
Conserve identity per block



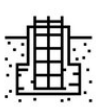
In the Bogaard as transition between green zones and city



Support local foods and turn waste into products

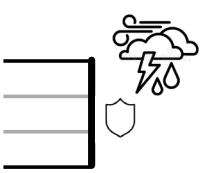


Energy supplying roofs



Keep building structure intact

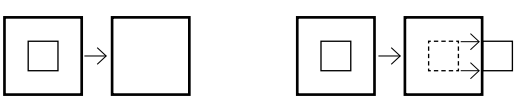
Provide flexible/adaptable indoor spaces with demountable finish



Create robust façades with long lasting material

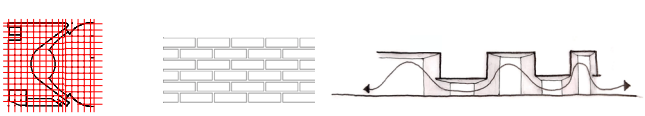
Design strategies

REDUCE.



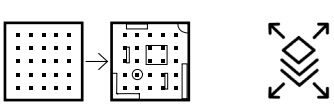
CREATE SPACE BY MOVING AND REMOVING ELEMENTS

REUSE.



REUSE AND REVIVE THE STRENGTHS OF THE BUILDING

REFILL.



MAKE USE OF THE PLAN LIBRE TO CREATE A FLEXIBLE LAYOUT FOR FUNCTIONS THAT FIT THE CONTEMPORARY TRENDS AND DEMANDS

Figure 1 - Research to design chart, Own creation (2023)

and reading about holistic sustainable design interventions enhanced my view on the role of an architect in the future and made me think in a critical way before applying a design strategy. Looking back at the countless options that a designer has while making decisions taught me that there is no definitive or perfect answer or solution to updating the existing building stock in the most sustainable way. Rather, what prevails is the justification of the choices by linking them to research findings and articulating alternative possibilities that have been considered.

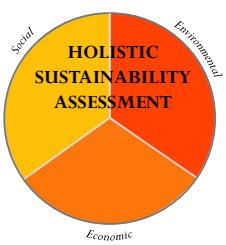
My focus on the research part waned slightly in the second half of the project as the outcomes did not fully meet my expectations. It was challenging to link the analyses of existing cases with the redesign of a different building, since the external factors that vary from case to case provide different values that should be taken into account before applying a renovation strategy. For example, where the Mall of the Netherlands may fit the profile for transforming it into an international orientated shopping hub, the Bogaard may not, since it has a different function in the neighborhood. However, by making steps in design process in the second part of the graduation and creating a narrative that touched upon architectural elements from a large to a small scale, the bridge between the research to design has been shaped. This process is illustrated by the "Research to design chart" (Figure 1) on the previous page. The design strategies that evolved from this chain of analyses were applied to a redesign of "De Terp", a vacant building that is part of modern shopping mall "In de Bogaard" (Rijswijk). The original plan was to transform this building into a multifunctional complex in a holistic sustainable way. In reality, I had to narrow down the research in order to obtain valid information on the three aspects of sustainability. The following section explains this.

Methodology and approach evaluation

The outcome of this graduation project differs significantly from my vision at the beginning of the project. I started my research work with the ambition to apply the wheel of Kamari (Kamari et. al, 2017) comprehensively to three different typologies of the Dutch modern shopping mall. By assessing the sustainability of mall renovations according to the methods described by Kamari, a complete framework on "how to renovate a modern mall in a sustainable way" would have been established. However, given the amount of time and resources, the assessment framework was translated into an evaluation tool for identity and aesthetics (social sustainability), eCO2 footprint (environmental sustainability) and lifespan (economic sustainability), while focusing on the most important building materials used during the renovation. The following methods shown per sustainability aspects were set up in order to make valid statements about (indicators of) holistic sustainable renovations:

Method: Questionnaire with open and closed questions

Method: Material ECO2 production assessment per intervention



Method: Life cycle assessment (LCA) during retail & use phase > Life span

Figure 2 - Research methods per indicator, Own creation (2023)

It is essential to recognise the small steps that were taken despite the research paper's complex and demanding nature, which mainly led to observational insights and constrained solutions. The gained insights in sustainable design decision-making have given me the knowledge to make educated considerations in design solutions, leading to material choices and space considerations. For instance, a cement-based bio composite material was used for the new façades around the Terp which has a low carbon footprint in comparison to panels that were used to clad the Terp in previous years and it has a long life span. The wayfinding system in the building is based on the amount of natural light entering the building, which reduces the amount of unnecessary material used to indicate a route.

What I learned from my work and the way of working

My interest on sustainable design grew with each piece of information that I found and it made me

more comfortable in making design decisions based on sustainable values. This is because the graduation process taught me how to be critical about existing assessment tools and how to carefully select sustainable strategies that enhance an existing building in a holistic way. Investigating by making, drawing and looking at the existing is crucial to develop architectural plans based on buildings that are seen as heritage. To let it all come together also made me realise what I do not like, for instance, that on this moment pursuing doctoral studies would not fit my aspirations.

During the third academic period (P3), I felt that pieces were coming together by connecting the three pillars of sustainability to the design of "De Terp" through applying the design strategies that followed from the research. Presenting what you are working on is different than presenting what you have worked on. This presentation greatly affected my research and design process in a positive way, leading to the finishing of the puzzle in P4. The progression presentation P2 was for me very challenging, as the process of untangling all the research components required a significant effort to create a coherent and logical outcome. Linking two research papers of Kamari (2017) et al. and Lin et al. (2020) made it able to compare states of shopping centres before and after renovation. An example of this comparison of three indicators applied to the Bogaard are shown in Figure 3. It is important to acknowledge that the speculative nature of my research and design results is due to the inherent limitations associated with retrieving building material data from open source databases. A margin of error has been introduced in Figure 3, represented by a dotted line. This serves as a transparent indication of the potential variability and uncertainty associated with the data and opinions incorporated into the research and design process.

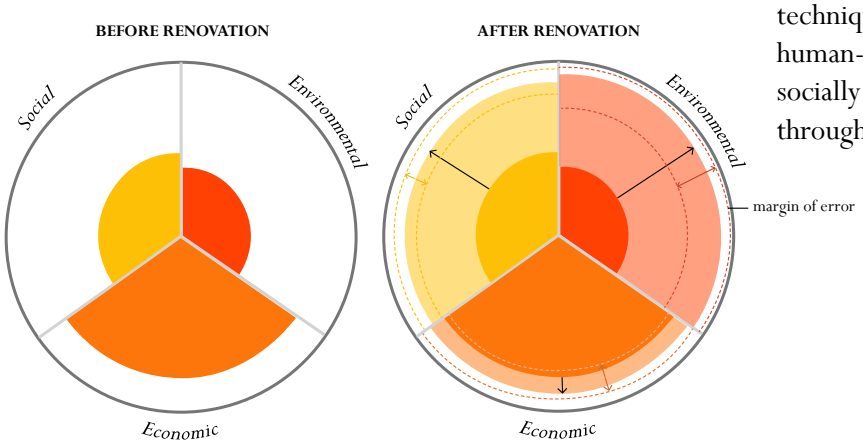


Figure 3 - Adapted Kamari wheel applied to the renovation of the Bogaard, own creation (2023)

Transferability

Testing the simplified sustainability framework on three cases did not not yield definitive outcomes that could directly aid others seeking to conduct more thorough research on Dutch modern shopping malls. Nevertheless, the discussion provides suggestions of future research approaches and potential pitfalls when considering holistic sustainability as a topic. The paper of Kamari et. al (2017) puts possible counterpoising and complexity into perspective and even states that "a renovation strategy can clearly be considered far better than another, even without calculation of a value precisely. Precise scores matters less than the process to make the final decisions," (Kamari et al., 2017, p. 344). So taking this into consideration, each study on sustainability helps to set up a dialogue between stakeholders and creates a general knowledge base on a renovation project.

My research might be of use while redesigning a shopping mall or heritage related building, since most of the conclusions are broad and have an advisory nature. To further enliven this discussion, additional studies into sustainable building alternatives is encouraged. While maintaining the fundamental principles of social, economic, and environmental sustainability in contemporary urban development, such initiatives have the potential to lessen the environmental impact of mall renovations and other heritage renovations or transformations. Literature research has also shown that advancements in Building Information Modeling (BIM) and related software tools can play a significant role in reducing the environmental impact of buildings in the future. It can facilitate more accurate cost assessments of a project in the long run as well. Besides that, my research paper demonstrated that qualitative research techniques such as questionnaires provide a quick and human-centered way to understand how projects are socially constructed, assisting stakeholders in navigating through sustainable trade-offs during the design phase.