From heritage to sustainability:
Lessons from Delft's circular design approach

Architectural history thesis

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Fig. 1 - The Trompetstraat in Delft around 1910[1]

Fig. 2 - The Trompetstraat now[2]

[1] Prins, collectie stadsarchief Delft
[2] Veen, "Een zonnige Trompetstraat"

Abstract

In the pursuit of creating monumental and desirable cities with a sustainable character, the municipality of Delft has embarked on a journey of integrating sustainability principles into its urban development strategies. This paper traces Delft's evolution in sustainable design practices through a historical lens over the past three decades. While exploring the transition from experimental initiatives to mainstream adoption, it answers the research question ‘What was the municipalities approach that helped the historical houses in the old city center of Delft over the decades in regards of sustainability and what learnings can we take away from this development to complement the currently used sustainability measurements in the built environment?’

Drawing on archival documents, municipal records as well as literature, this thesis examines proactive measures such as financial incentives, strict construction requirements and policies that shaped Delft's identity as a leader in sustainable urban development. Through a comparative analysis of historical and contemporary approaches, the paper identifies key principles and practices that have contributed to Delft's success in balancing heritage preservation, urban livability, and environmental responsibility. Contextualizing Delft's experiences within broader discourses on sustainability offers insights into ecological consciousness, architectural innovation and urban resilience. By aligning local regulations with global sustainability principles, fostering collaboration between government, industry and civil society, and anticipating future challenges such as the EU's directive criminalizing environmental damage, Delft emerges as a model for crafting sustainable architectural legacies.

This research contributes valuable lessons and recommendations for architects, urban planners and policymakers worldwide. Ultimately, this research contributes to a deeper understanding of the interplay between heritage conservation, environmental sustainability and urban development, offering insights for shaping the cities of tomorrow.

Keywords sustainable urban development, circular design approach, municipality of Delft, evolution of sustainability, Sustainable Development Goals, collaboration and policy alignment

1. Introduction

"Monumental cities are more and more wanted; the more modern cities stay behind." is the headline of the Dutch national news website NOS.[3] Cities with a lot of monumental buildings are highly desirable. People are happy to live there and thus their populations are rising quickly is the conclusion of the *Atlas voor gemeenten,*[4] which is an organization that annually compares the biggest 50 municipalities of the Netherlands on 50 different aspects. Monumental cities now have a younger and more highly educated population than 'new town' cities, which makes these cities more interesting for companies to settle as 'working follows living'. In the NOS article, Delft is ranked sixth in the charts of cities with the most monumental buildings as a percentage of the total amount of buildings. Churches and town halls are examples of monumental buildings that are increasing the amount of monumentality of a city. The New Church is an important characteristic of the monumental city of Delft and its presence gives the area around the church a status of monumentality which, therefore, makes it a highly desirable place to live. A 2021 study by real estate advisor JLL has shown that Delft is the third most desirable city to live in in the Netherlands.[5]

Several studies have already emphasized the importance of protecting and persevering monumental cities. Besides a national shortage of available houses for Dutch citizens,[6] the world is facing another crisis in the name of climate change. Currently, effectively enhancing buildings' adaptability, reducing construction wastes and extending their service lives have become crucial strategies in the construction industry.[7] Sustainability, durability and longevity are key concepts in that,[8] but we tend to overlook the fact that monumental buildings, after so many decades, are still highly desirable buildings even though they were never initially designed with all these sustainability strategies in mind. They have an extremely high longevity and are continuously being restored to increase their service life even more. The insight into the importance of the aspect of sustainability came about at the end of the 20th century. What was the approach of the municipality at that time and how did they succeed in maintaining the desired, now monumental, buildings in the old city center while improving their circularity? In my opinion, we should solve the issue of sustainability of the construction industry at the roots, so not only by looking at alternative sustainable building materials but also by finding the solution of initial construction waste. Therefore the question of how we can design buildings that in 50 years will still be regarded desirable should be answered and we should learn from the proven-to-be effective measurements taken in the past, such as in the positive example of Delft. The research question of this thesis will therefore be *'What was the municipalities approach that helped the historical houses in the old city center of Delft over the decades in regards of sustainability and what learnings can we take away from this development to complement the currently used sustainability measurements in the built environment?'*

To answer the research question, this thesis will look into the measurements the municipality took in the way they approached sustainable construction over the past three decades, this will be addressed as the circular design approach. According to the Interaction Design Foundation,[9] what is meant by this is the practice of creating durable, reusable, repairable and recyclable products that generate zero waste to support a circular economy. The first timeframe that will be examined in this thesis will contain the circular design approach before the global awareness on the importance of sustainability where there will be zoomed in on the sustainability measurements taken by the municipality of Delft at the end of the 20th century. The book on Eco-Architecture, which is a bundle of several papers written around 2006, will be consulted as the circular design approach at the start of the sustainability movement. For the current and near-future approach, this thesis will dive into the emergence of the

[3] Jager, "Monumentale stad,"
[4] Marlet & Woerkens, "Atlas voor gemeenten 2015 – Erfgoed"
[5] Consultancy.nl, "De 10 beste steden van Nederland om in te wonen"
[6] Rijksoverheid, "900.000 new dwellings to meet increasing demands."
[7] Juan & Cheng, "Improving building longevity, adaptability and sustainability,"
[8] Pater & Cristea, "Systemic Definitions of Sustainability, Durability and Longevity,"
[9] Interaction Design Foundation, "What is Circular Design?"

Sustainable Development Goals as they reflect the way the circular crisis is currently being handled. Afterwards, the future approach will be determined by looking into how the new EU law on ecocide can be implemented in the measurements taken by the municipality of Delft. To visualize the measurements taken over the past decades, a practical example will be evaluated which will dive into the longevity of a well-known street in Delft; the Trompetstraat. Finally, this thesis will take the learnings found and apply them to the profession of architecture. The idea is that if architects will not only include sustainable material alternatives in their designs, but also think about how to extend the service life of their buildings by learning from investigating positive examples from the past, they can achieve environmental sustainability in future projects.

2. Literature review

This thesis will build upon three existing papers featured in the Eco-Architecture book by Broadbent and Brebbia. Each paper will elaborate on different insights into the harmonization between architecture and nature. The first paper is called '*The key word is Quality not Ecology',*[10] and it emphasizes the importance of sustainability in architecture. The second paper approaches architecture from a humanist point of view, analyzing social dialogue in relation to architectural production and design processes, it is named '*Architecture and Nature at the End of the 20th Century: towards a Dialogical Approach for Sustainable Design in Architecture.'*[11] In addition to these more theoretical approaches, the third paper called '*Design for Longevity'*[12] offers more practical solutions for the design phase of a building project.

This thesis will focus on the aspect of sustainability in the context of neighborhoods. There are lots of studies written about several angles regarding this context. For example, measuring the sustainability of neighborhoods in a literature review of 64 journal articles published between 2019 and 2021[13] suggests that criteria related to sustainable form and morphology are the most widely measured criteria. In addition, there is another study which was the first quantitative review that evaluates the principles for sustainable urban neighborhood development based on the available literature[14] which eventually provides starting points for developing a set of principles by bringing together the examined literature.

In another research, a comparative study of social sustainability indices in an old and a new texture neighborhood in Tehran[15] has been carried out to examine the social sustainability that has been raised over the last few years in urban planning and management. Finally, a paper evaluated the Sustainable Neighborhoods for Happiness Index (SNHI) which is a metric for assessing a community's influence on happiness and its potential sustainability[16] which has generated a Sustainable Neighborhoods for Happiness Distribution (SNHD) where measured communities can be compared.

This thesis will specifically focus on the evolution of the changing approach from the municipality for the neighborhoods in Delft in regard of sustainability. This will be a good addition to the available research as Delft is a good practical example of a city rising in popularity with a big monumental history, which is reflected in a large number of historical buildings. Even though it always had a beautiful image of these monumental houses in the old city center, it wasn't a very desirable city to live in the past which raises questions about the development of the city. How did the municipality manage to make Delft appealing and has the sustainability issue in the built environment had any effect on this development?

Studying sustainability measurements and the sustainable development of monumental cities over the past decades is crucial for the field of architecture for several reasons. Firstly, monumental cities often praise rich architectural heritage, representing significant cultural, historical and artistic value. Also, understanding how sustainability principles can be integrated into the preservation and adaptive reuse of historic buildings allows architects to contribute to the conservation of cultural heritage while ensuring its continued relevance in the modern world. Many monumental cities face challenges such as urban decay, population decline, and infrastructure obsolescence. By studying sustainable development strategies implemented in these cities, architects gain insights into how to regenerate urban areas while preserving their historic character. Architects have a professional responsibility to design buildings and urban environments that contribute positively to the (built) environment and to

[10] Hall, "The keyword is quality not ecology."
[11] Soria López, "Architecture and nature at the end of the 20th century,"
[12] Straka, "Designing for longevity."
[13] Khatibi et al., "Measuring the sustainability of neighborhoods,"
[14] Luederitz et al., "A systematic review of guiding principles for sustainable urban neighborhood development."
[15] Farhadikhah & Ziari, "Social sustainability between old and new neighborhoods."
[16] Cloutier et al., "The Sustainable Neighborhoods for Happiness Index (SNHI),"

design desirable neighborhoods. By studying sustainability in monumental cities, architects gain a deeper understanding of their ethical obligations and the potential impact of their design decisions.

Overall, This thesis offers a focused investigation into Delft's municipal approach to sustainability, providing valuable insights into the city's transformation from a less desirable urban center to a rising star among monumental cities. By examining Delft's evolution within the context of its historical significance and architectural heritage, this research fills a critical gap in understanding how sustainability initiatives have contributed to the city's revival and desirability. In addition, the study of sustainability in monumental cities provides architects with valuable insights, tools, and approaches for addressing contemporary urban challenges while honoring the past and building a more sustainable future. It enables architects to play a proactive role in shaping resilient and environmentally conscious built environments that enrich the lives of current and future generations.

3. Circular design approach before the global awareness of the importance of sustainability (1996)

The archive on sustainable building[17] states that Delft has a tradition in the area of sustainable construction as building sustainably has been stimulated by the municipality since 1981. Back then, they first introduced financial incentives and a more strict program of requirements for housing construction. As an early adapter, Delft built up great recognition on a national and international level. The *Nationaal MilieubeleidsPlan* (National Environmental Policy Plan) in 1989 was the first governmental report to emphasize the construction industry as a target group. It was expected that it was possible to establish a lot of environmental gain in this industry, especially in the area of energy, materials and quality of the built environment. The many pilot projects, experiences with incentives over the years before and the introduction of the national plan of action *Duurzaam Bouwen* (Sustainable Building) of Deputy Minister Tommel confirmed these expectations.

The short introduction and motivational proposal in the minutes of the Delft municipal meeting, on the 6th of August in 1997, states that sustainable construction has passed the experimental stage. This meeting was preceded by a brainstorming session held in June 1996. In 1991 the municipality had taken on the decision of "*proceeding in sustainable construction*" with mandatory sustainable construction as the main objective. In 1997, the authorities changed this objective to "*sustainable construction is becoming the standard. Delft will, by default, only build or renovate sustainably with attention to housing, buildings and public space*." An important note that was made contained that sustainable building also meant sustainable preservation. They state that especially in an old, historic city like Delft, with relatively few planned, new constructions in the upcoming years, it is important to shift the emphasis from the sustainable construction policy to the existing building stock. That is why, in the years following 1997, the focus will more than ever lie on sustainably renovating and maintaining, especially in housing projects.

Besides a few instruments in the role of planner or client, the municipality is strongly dependent on external parties for reaching the set goals. In the proposal, the Department of Maintenance & Environment of the municipality of Delft, pushes for a sustainable construction industry by introducing the "Sustainable Construction List". This list states a minimal level to which all buildings and renovations should comply to eventually make sustainable construction the norm. An example of a requirement on the list which complies with the importance of longevity of a building, is the measure to integrate flexibility in the land use plan and the urban area plan.

In conclusion, the coordinated efforts of the municipality of Delft towards sustainable construction since 1981 have played a pivotal role in shaping the city's identity as both a monumental and desirable urban center with a sustainable character. By pioneering financial incentives and strict construction requirements, Delft gained national and international recognition as an early adopter of sustainable building practices. The integration of sustainability into municipal policies accentuated Delft's commitment to environmental development and preservation, particularly within its historic context. This proactive approach not only ensured the longevity and resilience of Delft's architectural heritage, but also positioned the city as an attractive destination for residents and businesses seeking sustainable urban environments. The introduction of initiatives like the Sustainable Construction List further reinforced Delft's status as a leader in sustainable urban development, promoting the adoption of environmentally responsible practices across the construction industry. Overall, Delft's strategic emphasis on sustainability in both new construction and renovation projects has been influential in acquiring its reputation as a monumental and desirable city with a sustainable character, embodying a harmonious balance between heritage preservation, urban livability, and environmental responsibility.

[17] Municipality of Delft, "Duurzaam bouwen uit de steigers"

4. Circular design approach at the start of the movement (2006)

In recent decades, the relationship between humanity and nature has gained significant attention in our societal consciousness, as we increasingly recognize the detrimental impact of human activities and production on the environment. Within this context, architects are faced with numerous controversies and uncertainties regarding their responsibilities towards nature. What exactly shapes sustainability within the realm of architecture? Why is it essential to preserve nature? Is it solely to minimize pollution and ensure human survival, or do we also value nature for its inherent beauty, aesthetic appeal, and profound serenity? According to Soria López[18] sustainability, in essence, aims to foster a more rational utilization and stewardship of nature, thereby facilitating a harmonious coexistence between humanity and the environment. López states that even if we are able to reproduce all natural systems someday and are able to guarantee human survival, then nature will have ceased to exist and only man, that is artifice, will prevail.

Quality not Ecology by van Hal
The paper of van Hal[19] delves into the pivotal role of opinion leaders in cultivating ecological awareness among architects. The behavior of opinion leaders is of great importance in driving innovation within a system. In the context of this thesis, where the focus lies on the adoption of ecological innovations in architecture, architects emerge as the primary opinion leaders. Within the Dutch architectural community, those interested in ecological innovations often belong to the category of cultural creatives. The projected growth of cultural creatives bodes well for the integration of ecological innovations within the architectural field.

The economic downturn of 2006 had significant consequences for the architecture industry as the priorities of Dutch architects shifted towards accommodating client demands, often resulting in a pragmatic approach prioritizing quality. An architect's characteristics determine their potential as opinion leaders in eco-architecture. By 2006, architects dedicated to environmental concerns, so-called eco-architects, constituted a minority within the profession, limiting their influence on their peers who had yet to embrace environmental consciousness.

Many renowned architects emphasized that environmental considerations were just one aspect contributing to the overarching goal of architectural quality, alongside aesthetics, comfort, and cost-effectiveness. As a consequence, they did not want their work to be linked with green terminology like *'eco-architecture'*. To address this disconnect, the Royal Institute for Dutch Architects proposed a new approach termed *'vital architecture'* in 2006, while the Foundation for Smart Architecture introduced 'smart architecture' as an alternative paradigm. These initiatives urged stakeholders across the architectural spectrum to adopt practices that prioritize sustainability and resilience.

According to the Foundation for Smart Architecture, *'smart architecture'* serves as a counterpoint to the pessimism often associated with traditional ecological architecture since the 1960s. By embracing the *'green challenge'* as a catalyst for innovation, *'smart architecture'* stands for optimism and proactive problem-solving. The foundation assumed that environmental concerns would fundamentally reshape architecture. Research from 2006 indicated that framing ecological challenges as opportunities for innovation was an effective strategy for enhancing architects' ecological awareness, making the foundation's work particularly promising. From personal experience as an architecture student, the conclusion can be drawn that the term *smart architecture,* in fact, did catch on better than *vital architecture* as it is currently used more often in lectures. In conclusion, opinion leaders cannot change the legislation, but they can introduce an optimistic approach.

[18] Soria López, "Architecture and nature at the end of the 20th century,"
[19] Hall, "The keyword is quality not ecology."

Designing for Longevity by Straka

Straka[20] states that even people who thought in the 1990s that the notion of 'global warming' was just a scare tactic by environmentalists are slowly accepting that something is happening. Despite Canada's commitment to the Kyoto agreement, greenhouse gas emissions surpassed targets by a significant margin in 2006. The construction sector accounts for a substantial portion of Canada's resource consumption and waste generation. Straka's paper explores strategies for improving these grim statistics within the construction industry.

Buildings are designed to last a certain amount of years. Straka states that there are three types of building structures. Temporary structures are usually in place for less than a year, regular structures (including housing) are expected to last 30-50 years and the third structure, which includes buildings of social importance, should last 100 years. However, 100 years often is not what they are designed to last for. The document *'Guidelines on Durability in Buildings'* addresses design issues related to the creation of durable buildings. The selection of building components to comply with design requirements affects the service life and influences the overall durability of a building. The guidelines are of high importance as they offer insights into designing buildings for longevity and resilience, emphasizing the importance of appropriate maintenance throughout a building's lifespan. Unfortunately, this document gives recommendations only. When referring to the life of a building it is necessary to consider the building as a series of systems, each having a different lifespan.

Construction projects have significant environmental implications, spanning from site development to potential demolition. Therefore, the design process must prioritize durability, energy efficiency, and minimal environmental impact. Renovation, rather than demolition, can substantially reduce the environmental footprint associated with construction. Architecture, spatial planning and flexibility are paramount in determining a building's potential for reuse.

Straka emphasizes the importance of designing future projects with adaptive reuse potential and environmental impact in mind. Durability, lifecycle evaluations and economic considerations are integral to selecting building systems. Good design, flexibility and adaptability are key factors in extending a building's lifespan and minimizing environmental impact. Prolonging the lifespan of buildings is essential for reducing the environmental impact of construction. Very importantly, design issues have to be addressed as these have the biggest impact on building reuse. It is not only the architecture that differentiates one project from another, but also the reputation of the building. To move forward, it is essential that design issues are addressed and that clients become educated about their investments, according to the author.

Insights for Delft's Sustainable Urban Development

The insights obtained from the discourse on sustainability in architecture, as presented by Soria López, van Hal and Straka, offer valuable perspectives on the intersection of environmental consciousness, architectural innovation, and urban development. In the context of Delft's aspiration to embody a monumental and desirable city with a sustainable character, these discussions illuminate key principles and practices that can inform the city's approach to sustainable urbanism. López points out that by recognizing nature not only as a resource to be exploited but also as an entity worthy of preservation for its intrinsic value, Delft can cultivate a deeper appreciation for its natural heritage while striving for sustainable urban development. As Delft seeks to nurture its architectural landscape in harmony with environmental imperatives, the growth of opinion leaders who promote design principles can activate a cultural shift towards eco-consciousness within the city's architectural sphere, according to van Hal's findings on opinion leadership. Straka's discourse on designing for longevity and environmental impact emphasizes the significance of durability, adaptability and lifecycle considerations in architectural practice. By prioritizing these principles in urban planning and development, Delft can not only mitigate the environmental footprint of its built environment but also enhance the resilience and longevity of its architectural heritage.

[20] Straka, "Designing for longevity."

In essence, the insights offered by Soria López, van Hal, and Straka join to inform Delft's quest to integrate its monumental heritage with a sustainable future. By embracing the principles of environmental stewardship, architectural innovation and long-term planning, Delft can aspire to not only be a city of historical grandeur but also a beacon of sustainable urban living for generations to come.

5. Circular design approach now and in the future (2016-2026)

Introduction of the Sustainable Development Goals by the UN (2016)
The Sustainable Development Goals (SDGs) were first introduced at the United Nations Conference on Sustainable Development in Rio de Janeiro in 2012.[21] The primary aim was to establish a comprehensive set of global objectives addressing the critical political, economic, and environmental challenges confronting humanity. The SDGs succeeded the Millennium Development Goals, which initiated a worldwide campaign in 2000 to combat poverty, notably contributing to the fight against HIV/AIDS. While the MDGs propelled progress in various domains over 15 years, they lacked a specific focus on environmental issues. For 15 years, the MDGs drove progress in several important areas but they were not yet focused on the environmental area. The SDGs form an urgent call to transition towards a more sustainable trajectory, building upon the foundation laid by the MDGs and addressing contemporary global challenges. Comprising 17 interconnected goals, the SDGs accentuate the interdependence of different areas of development, emphasizing that success in one domain affects success for others.

The introduction of the SDGs coincided with the landmark agreement reached at the COP21 Paris Climate Conference in 2015. This accord established common standards and actionable targets aimed at mitigating carbon emissions, addressing climate change risks, and averting natural disasters. The SDGs embody a collective commitment to inclusivity, ensuring that no individual or community is left behind in the pursuit of a sustainable, secure, and prosperous world. The origin of the Sustainable Development Goals can be traced back to the Rio+20 summit in 2012, when representatives from 70 nations were appointed. This group convened its inaugural meeting in early 2013 and subsequently published a draft outlining 17 key suggestions, which later evolved into the 17 SDGs.

SDG 9, industry, innovation and infrastructure, SDG 11, sustainable cities and communities, SDG 12, responsible consumption and production, and SDG 13, climate action, emphasize the importance of a circular design approach in the building industry.[22] The Dutch government provides several recommendations for sustainable construction on its website,[23] for example, to take the reuse of the building parts into account when designing and choosing materials and to recycle materials released during the demolition of the building. They also advocate against choosing for demolition, although it is the easier option, but to first research if the building is suitable for renovation or repurposing.

The introduction of the Sustainable Development Goals by the UN in 2016 marked a pivotal moment in global efforts to address pressing socio-economic and environmental challenges. For historical towns like Delft, the SDGs provided a framework for integrating sustainability principles into urban development strategies. This aligned with the city's aspirations to maintain its monumental heritage while fostering a sustainable character. SDG 9 aligns with Delft's commitment to sustainable construction practices, as evidenced by initiatives to prioritize the reuse of building materials and explore alternatives to demolition. By embracing a circular design approach, Delft can preserve its architectural heritage while minimizing environmental impact and promoting resource efficiency. SDG 11 aligns with Delft's vision of creating an urban environment that balances historical preservation with modern sustainability principles. Through initiatives aimed at promoting responsible consumption and production (SDG 12) and mitigating climate change (SDG 13), Delft can enhance its desirability as a city while ensuring the well-being of its residents and the broader community.

In conclusion, the introduction of the SDGs provides Delft with a comprehensive framework for advancing its sustainability agenda while preserving its historical charm. By aligning local initiatives with global sustainability goals, Delft can continue to thrive as a model of urban development that harmonizes heritage preservation with environmental stewardship.

[21] UNDP, “Background on the goals”
[22] United Nations, “The 17 goals”
[23] Rijksoverheid, “What is sustainable building and construction?”

Future approach (2026)

"Countries will have two years to put the updated directive, which covers crimes 'comparable to ecocide', into national law" is the headliner of the article published by Mølgaard Henriksen on *EuroNews.Green* on February 27th, 2024.[24] With this, the European Union has become the first international body to criminalize the most serious cases of environmental damage. Ecosystems destruction, including habitat loss and illegal logging, will be punished with tougher penalties and prison sentences under the EU's updated environmental crime directive. This will also influence the building industry as the availability of materials will now become dependent on sustainable logging. The entry of this new law is a massive step forward in terms of sustainability and it will support the importance of a circular design approach. Evidently, it will speed up sustainable developments also in the building industry as CEOs of big companies will be held accountable for their actions in terms of sustainability.

Unlike previous regulations, which primarily focused on individual actions, this directive targets crimes comparable to ecocide, including ecosystem destruction and habitat loss. This shift towards stricter penalties and prison sentences not only accentuates the severity of environmental offenses but also acknowledges the interconnectedness of ecological health and human well-being. In the context of Delft's future approach to sustainable construction and neighborhood preservation, the municipality can draw valuable lessons from this development. By aligning local regulations with the principles outlined in the ecocide law, Delft can reinforce its commitment to sustainability and resilience. For instance, stricter penalties for illegal logging and habitat destruction can inspire the use of sustainable building materials and practices within the city. Moreover, holding CEOs accountable for their ecological actions can encourage corporate responsibility and promote innovation and collaboration between public and private sectors to promote reaching its sustainable development goals. Ultimately, integrating the principles of the ecocide law into Delft's municipal future approach can help the city maintain its monumental charm while fostering a sustainable character that benefits both current and future generations. By imposing stricter penalties for environmental crimes such as destruction, Delft can safeguard its historic and cultural heritage. Preservation of the city's monumental charm relies on protecting its natural surroundings and architectural treasures from irreversible damage. Aligning local regulations with the ecocide law can intensify the use of sustainable building materials and practices in Delft's construction projects.

[24] Mølgaard Henriksen, "EU Parliament votes to criminalize most serious cases of ecosystem destruction"

6. Longevity in practice: the Trompetstraat

To visualize the municipality's approach to a sustainable neighborhood, this thesis will shine a light on the longevity of the Trompetstraat as a practical example. The Trompetstraat is a very idyllic, small street in the old city center of Delft. As it is located right behind the New Church, every historic image available has the church in the background serving as a great point of reference. The oldest data from the land registry,[25] which was collected around 1830, mentions a mason as the owner of the then largely undeveloped site who initially used it as a kitchen garden. At the time of reconstruction, the owner started building four small houses in the back of his field which later formed the Trompetstraat. In the 1950s and 1960s, the street still was a real working-class neighborhood, with a furnisher workshop, a metal turner garage and factory workers. Currently, the street is populated with modern-day Young Urban Professionals with all kinds of climbing plants next to their front door.

The collage of images taken in the Trompetstraat (figure 3) shows a timeline of the developments of the street. Images between the 1960s and early 2000s are very hard to find, but the images show that the main development of the street view in that period was the growing importance of the presence of greenery. The car had disappeared from the cityscape, which points out the increasing awareness of designing a more pleasant built environment for the inhabitants instead of for the commute. Overall, the buildings of the Trompetstraat have remained the same during all these decades. Apparently, there was no need for demolition and construction over renovation. The street became a desirable place to live, assumably partly due to the presence of the monumental New Church. The broad sense of history of the neighborhood encouraged the flexibility of its users in terms of adaptability.

Fig 3. - Images of the Trompetstraat over the years[26]

[25] Van Veen, “Trompetstraat 95”
[26] Own work, “Collage of the Trompetstraat”

7. Take-away for future projects

In exploring the evolution of sustainable design approaches over the past three decades, from 1996 to 2026, valuable insights into the intersection of architecture, sustainability, and longevity have been gathered. By examining the initiatives and policies implemented by the municipality of Delft and the broader global context, key lessons can be learned that can inform future architectural projects aiming for sustained desirability and environmental responsibility.

1996: Embracing sustainable construction as the standard
The early stages of Delft's sustainable construction journey, marked by initiatives in the late 20th century, laid the foundation for the city's enduring commitment to environmental stewardship. Delft embarked on a journey to embed sustainable construction as the norm rather than the exception. Financial incentives and stringent construction requirements spearheaded by the municipality shifted the focus from experimental to mandatory sustainable practices, this way the municipality laid the groundwork for a paradigm shift in the construction industry. This gained Delft national and international prominence as a frontrunner in sustainable building practices. One key takeaway from this era is that municipalities play a pivotal role in driving sustainable urban development, as evidenced by Delft's early adaptation of sustainable construction policies and its positive development.

2006: Navigating architectural innovation
As the architectural landscape evolved in the early 21st century, Delft encountered new challenges and opportunities in integrating sustainability into design practices. Insights from this era shed light on the importance of opinion leadership, innovative strategies, and economic realities in shaping sustainable architecture. The early 2000s saw a shift in terminology and approach, as architects struggled with integrating ecological considerations into their designs. The emergence of the terms *"vital architecture*" and *"smart architecture*" reflected a broader understanding of sustainability beyond mere environmental concerns. Municipal interventions played a crucial role in promoting these new paradigms and fostering a culture of innovation. A key learning from this period is that sustainability encompasses more than environmental stewardship; it encompasses resilience, adaptability and societal relevance. Architects must embrace a multifaceted approach that considers the long-term impact of their designs on both the built and natural environments.

2016: Embracing global sustainability goals
The adoption of the Sustainable Development Goals (SDGs) in 2016 signaled a global commitment to addressing pressing environmental and social challenges. SDGs related to sustainable cities and communities, responsible consumption & production and climate action accentuated the importance of a circular design approach in the building industry. Governments and organizations began advocating for strategies that prioritize reuse, recycling and responsible resource management in architectural practice. Delft's alignment with the SDGs confirms the city's commitment to integrating global sustainability principles into local practices. Delft's emphasis on circular design principles, as outlined in SDGs 9, 11, 12 and 13, accentuates the importance of resource efficiency, responsible consumption and climate action in shaping sustainable urban environments. Another main takeaway of this period is that collaboration between government, industry and civil society is essential for achieving sustainable development goals and fostering resilient, livable cities.

2026: Anticipating future challenges and opportunities
The year 2026 marks a pivotal moment with the European Union's directive criminalizing environmental damage, including ecosystem destruction. This legislative action underscores the growing recognition of the importance of sustainable practices in all industries, including construction. CEOs and decision-makers are held accountable for their environmental impact, driving a rapid transition towards more sustainable business practices and design approaches. This new development proves that legal mandates and corporate accountability are powerful drivers of sustainability in the built environment. Delft faces new requirements and opportunities in the realm of

sustainable architecture, driven by global environmental consciousness and legislative advancements. Architects and developers must proactively seek out sustainable solutions, prioritize responsible sourcing and construction practices, as well as advocate for policies that support long-term environmental stewardship. Lessons from this era offer valuable guidance for navigating future challenges and seizing opportunities. The implementation of the EU's updated environmental crime directive emphasizes the growing urgency to address environmental degradation and promote sustainable practices in the building industry. Holding CEOs of big companies accountable for sustainability actions highlights the role of corporate responsibility in driving sustainable development and innovation.

In conclusion, Delft's journey towards sustainable architecture illuminates the path towards crafting buildings that endure as highly desired and sustainable architectural legacies. By embracing proactive municipal leadership, fostering opinion leadership within the architectural community, aligning with global sustainability goals and anticipating future challenges, Delft sets a precedent for cities worldwide striving to achieve architectural excellence with environmental stewardship. As architects and urban planners, we must pay attention to these lessons and continue to innovate, collaborate and prioritize sustainability in shaping the cities of tomorrow. Cities that are not only desirable but also monumental in their commitment to a sustainable future. By integrating circular design principles and prioritizing the reuse of building materials, future architectural projects in Delft and beyond can minimize environmental impact while preserving the city's historic charm and cultural heritage. By anticipating future challenges and opportunities, such as stricter environmental regulations and corporate accountability, architects and urban planners will be empowered to proactively address emerging sustainability issues and foster resilient, livable cities that stand the test of time. Ultimately, these takeaways serve as guiding principles for architects and urban planners seeking to create cities that are not only aesthetically pleasing and environmentally sustainable but also socially inclusive, economically vibrant and culturally rich. Cities that inspire admiration, foster well-being and leave a lasting legacy for generations to come.

8. Conclusion

In addressing the main research question of this thesis, *'What was the municipalities approach that helped the historical houses in the old city center of Delft over the decades in regards of sustainability and what learnings can we take away from this development to complement the currently used sustainability measurements in the built environment?'* this thesis has uncovered a multifaceted journey spanning three decades of sustainable architectural evolution in Delft and beyond.

Through a comprehensive examination of historical policies, theoretical frameworks and contemporary global initiatives, the pivotal role of municipalities in shaping sustainable urban development has been clarified. From the early adoption of sustainable construction practices in the late 20th century to the integration of circular design principles in response to global sustainability frameworks, Delft's trajectory exemplifies the iterative nature of sustainable urban planning and design. Reflecting on the research process, the importance of interdisciplinary engagement and a nuanced understanding of the socio-political context in which architectural decisions are made has to be recognized in order to come to desirable, sustainable and monumental cities. By synthesizing insights from architectural theory, urban planning literature and environmental policy, a holistic narrative that accentuates the interconnectedness of environmental, social and economic factors in shaping sustainable built environments can be constructed.

Looking forward, there are several avenues for future work on this thesis topic. Firstly, continued empirical research into the implementation and efficacy of sustainable design strategies in historic urban centers like Delft can provide valuable insights for urban planners, architects and policymakers. Longitudinal studies tracking the environmental performance and social impact of sustainable development initiatives can inform evidence-based decision-making and contribute to ongoing discourse within the field. Furthermore, there is a need for ongoing dialogue and collaboration between academia, industry and government to address emerging challenges and opportunities in sustainable urban development. By fostering interdisciplinary partnerships and knowledge exchange platforms, we can facilitate the co-creation of innovative solutions that respond to evolving societal needs and environmental imperatives. In terms of contributions to the field, this thesis offers a nuanced understanding of the historical context and contemporary dynamics shaping sustainable urban development in historic city centers. By tracing the evolution of sustainable design approaches and critically examining their implementation in a real-world context, this thesis provides valuable insights for practitioners, scholars and policymakers grappling with the complex challenges of urban sustainability.

In conclusion, this thesis serves as a testament to the transformative potential of sustainable architecture and urban planning in fostering resilient, equitable and desirable built environments. As we navigate the uncertainties of the 21st century, the lessons learned from Delft's sustainable journey remind us of the importance of proactive stewardship and collective action in shaping a more sustainable future for generations to come.

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Appendix

1. Outline

I) *Thesis statement:* The historical houses in the old city center of Delft are iconic and highly desired places to live, but how have they grown over the decades regarding sustainability?

Research question: 'What was the municipality's approach that helped the historical houses in the old city center of Delft over the decades in regards to sustainability and what learnings can we take away from this development to complement the currently used sustainability measurements in the built environment?'

II) Literature review

III) Circular design approach before the global awareness of the importance of sustainability (1996)
   A. Sustainability measurements taken by the municipality of Delft at the end of the 20th century

IV) Circular design approach at the start of the movement (2006)
   A. Quality not ecology by van Hal (about the importance of sustainability in architecture)
   B. Designing for longevity by Straka (offers practical solutions)

V) Circular design approach now and in the future
   A. SDG proposal by the UN (2016)
   B. Future approach, the new law on ecocide (2026)

VI) Longevity in practice: the Trompetstraat

VII) Take-away for future projects
   A. In 1996
   B. In 2006
   C. In 2016
   D. In 2026

VI) Conclusion
   A. Reflection on the previous chapters
   B. Possible future work on this topic