6 APPENDIX

6.1 APPENDIX A: REFLECTION

GRADUATION PROCESS

How is your graduation topic positioned in the studio?

This thesis project is a part of the "Reuse of Load-Bearing Components: Design from Existing Stocks" graduation topic within the theme of "Sustainable Structures." It engages two chairs within the Building Technology track – Structural Design and Design Informatics. The graduation project was conducted under the guidance of Dr. Stijn Brancart and Dr. Serdar Asut of the respective departments. The thesis encompassed the topics of structural design, computational design, and circular design.

How did the research approach work out (and why or why not)? And did it lead to the results you aimed for? (SWOT of the method)

The research approach adopted for this graduation project proved to be effective in achieving the intended goals, although it also had certain strengths, weaknesses, opportunities, and threats (SWOT).

Strengths:

- Comprehensive Literature Review: The project began with a thorough literature review, which provided a strong foundation of knowledge on the topic and informed subsequent research and design decisions.
- Industry Interviews: Conducting interviews with industry professionals allowed for valuable insights into the current practices, challenges, and opportunities related to steel reuse. These firsthand perspectives enriched the research and provided practical input for developing the proposed design workflow and computational tool.
- Holistic Design Approach: The project took a holistic approach by considering the entire lifecycle of steel, including production, reuse, and disposal. This approach enabled a comprehensive understanding of the environmental and economic implications of steel reuse.

Weaknesses:

- Limited Sample Size: The number of industry professionals interviewed may have been limited, which could have restricted the breadth of perspectives and potential challenges identified.
- Time and Resource Constraints: The project's timeline and resource limitations may have impacted the depth of research and the extent of data collection and analysis.

Opportunities:

- Innovation and Advancement: The proposed design workflow and computational tool present opportunities for innovation and advancement in the field of steel reuse. The project provides a solid foundation for further development and refinement of these tools to enhance their effectiveness and usability.

- Collaboration and Partnerships: The research findings and recommendations can serve as a basis for collaboration between stakeholders in the construction industry, including designers, contractors, and stockholders, to foster sustainable practices and promote steel reuse.

Threats:

- Resistance to Change: The implementation of steel reuse practices may face resistance within the industry due to established norms, lack of awareness, or perceived challenges. Overcoming these barriers and driving widespread adoption may be a significant challenge.

In conclusion, while the research approach had some limitations and challenges, it overall yielded positive results. The combination of literature review, industry interviews, and the development of a design workflow and computational tool enabled a comprehensive analysis of steel reuse practices. The findings and recommendations provide valuable insights and guidance for promoting sustainable construction practices and enhancing the integration of reclaimed steel in projects.

If applicable: what is the relationship between the methodical line of approach of the graduation studio (related research program of the department) and your chosen method?

The methodical line of approach for this graduation thesis involved conducting a literature review and case study analysis to gain an understanding of the topic's relevance. This was followed by interviews with industry professionals to explore the current application of steel reuse and to gain insights into the existing workflow process and challenges faced in integrating reclaimed steel. Building upon this knowledge, a design workflow was proposed, which included strategies to address the identified challenges and enhance steel reuse implementation. Additionally, a computational tool comprising a digital inventory and matching tool was developed to tackle the industry's challenges. The design workflow and computational tool were tested through a design case study, demonstrating their proof of concept. The matching tool provided valuable data for calculating environmental impacts, such as transportation emissions and energy consumption during repairs of reclaimed steel elements.

While the methodical line of approach in "structural design" and "computational design" may differ, the chosen method for this thesis project complements and aligns with these fields. The emphasis of structural and computational design is on optimizing performance, exploring design iterations, and evaluating structural behavior through simulation and analysis. However, the main challenge identified through interviews was the "unestablished design process" to find suitable matches between design elements and available stocks. To address this, the graduation project focused on developing a matching tool that provides environmental results and can be integrated into a structural analysis program for verification. Thus, while there may be differences in emphasis, the chosen method aligns with the proposed method of the graduation topic.

How are research and design related?

The research and design aspects of this graduation project are closely interrelated and mutually supportive. The research phase, including the literature review, case study analysis, and interviews with

industry professionals, provided the foundation and knowledge base necessary for informed design decisions. It allowed for a comprehensive understanding of the current practices, challenges, and opportunities in the field of steel reuse. Based on the insights gained from the research, the proposed design workflow and strategies were formulated to address the identified challenges and improve the process of implementing steel reuse. In addition, the development of a computational tool, including a digital inventory and matching tool, efficiently tackled the specific challenges faced in the industry. The design phase implemented and tested the proposed solutions, further validating and expanding upon the research findings. In summary, the research informed design decisions enabled a comprehensive and practical approach to address the challenges of steel reuse in the construction industry.

Did you encounter moral/ethical issues or dilemmas during the process? How did you deal with these?

During the process of this graduation project, several moral and ethical issues and dilemmas were encountered. One prominent issue was the consideration of environmental sustainability in the construction industry. As the project focused on promoting steel reuse, it was essential to address the potential conflict between economic interests and environmental responsibility. To deal with this ethical issue, a strong emphasis was placed on conducting a thorough literature review and research on the environmental impacts of steel production and construction practices. This allowed for an informed understanding of the benefits and drawbacks of steel reuse, enabling the development of strategies and recommendations that aligned with sustainable principles. Additionally, the interviews with industry professionals provided valuable insights into the practical challenges and ethical considerations associated with steel reuse. Their perspectives and experiences helped shape the proposed design workflow and computational tool to address these concerns effectively.

Furthermore, throughout the project, there was a commitment to transparency, integrity, and open communication. This involved acknowledging and discussing the limitations and potential biases of the research and design decisions. By being aware of these ethical considerations and openly addressing them, the project aimed to ensure the reliability and credibility of the findings. Ultimately, the project sought to strike a balance between economic feasibility, environmental sustainability, and social responsibility. Ethical considerations were woven into the fabric of the research and design process, enabling a holistic approach that accounted for the moral implications of promoting steel reuse.

SOCIETAL IMPACT

To what extent are the results applicable in practice?

The results of the thesis project have significant applicability in practice, aiming to facilitate the implementation of steel reuse in construction projects. While steel reuse is not a new concept and is already being implemented to some extent, the objective of this research is to address the existing challenges that hinder the successful integration of reclaimed steel. These challenges often result in increased project costs, time delays, and coordination difficulties. By developing a comprehensive design workflow and a computational tool, the research provides practical strategies to overcome these

challenges and enhance the adoption of steel reuse in practice. The proposed methods and tools offer valuable insights and solutions that can be applied by industry professionals to optimize project outcomes, increase efficiency, and promote sustainable construction practices. Through stakeholder engagement and continuous refinement, the research outcomes have the potential to drive positive change and transform the way steel reuse is implemented in the construction industry.

To what extent has the projected innovation been achieved?

The projected innovation has been achieved to a considerable extent. The lack of a well-established design workflow for projects implementing reused steel has been addressed through the development of a comprehensive design workflow in this project. Additionally, the absence of a public match tool to facilitate the exchange of information between material providers and material seekers has been tackled through the development of a matching tool. The successful feedback obtained from interviewees during follow-up conversations further confirms the achievement of the projected innovation.

While there may still be opportunities for refinement and enhancement, the projected innovation has made significant strides in addressing the existing gaps and challenges in the reuse of steel in construction projects. It has provided practical solutions and tools that can contribute to the successful implementation of steel reuse, thereby promoting sustainability and circularity in the industry.

Does the project contribute to sustainable development? And what is the impact of your project on sustainability (people, planet, profit/prosperity)?

The project significantly contributes to sustainable development by addressing crucial issues in the construction industry, including the escalating embodied carbon emissions, inadequate waste disposal management, and the depletion of non-renewable resources. The implementation of steel section reuse in new buildings aligns with the principles of circular construction, thereby mitigating the detrimental environmental impacts associated with the steel industry. By promoting resource efficiency and reducing the demand for new steel production, the project positively impacts the sustainability pillars of people, planet, and profit/prosperity. It offers potential benefits such as reduced carbon footprint, minimized waste generation, and the preservation of natural resources. Through the adoption of sustainable practices, the project fosters a more environmentally conscious and responsible construction sector, contributing to a more sustainable future.

What is the socio-cultural and ethical impact?

By implementing steel reuse in building projects, the project contributes to a shift in societal attitudes towards more environmentally friendly and resource-efficient construction methods. It encourages a cultural change by raising awareness about the importance of reducing carbon emissions, minimizing waste, and conserving natural resources. From an ethical standpoint, it addresses the need to mitigate the negative environmental impacts of the steel industry and promotes the concept of circular economy, which emphasizes the responsible use and reuse of materials. Furthermore, the project's socio-cultural impact extends to multiple stakeholders within the value chain by encouraging collaboration and

knowledge sharing among material providers, material seekers, and other industry professionals. Overall, the socio-cultural and ethical impact of the project lies in its potential to reshape industry norms, raise awareness about sustainable construction practices, and foster a sense of responsibility towards the environment and circularity in the building industry.

What is the relation between the project and the wider social context?

The project influences and is influenced by various social, economic, and environmental aspects.

- Social: The proposed design workflow and computational tool have the potential to benefit the wider construction industry by sharing knowledge, best practices, and tools. This can foster collaboration and encourage the adoption of sustainable practices beyond the scope of the project itself, promoting positive social change in the industry as a whole.
- Economical: The project can potentially reduce construction costs by utilizing reclaimed materials, enhance resource efficiency, and create new opportunities for businesses involved in the steel reuse value chain.
- Environmental: By promoting the reuse of steel sections in construction, the project contributes to reducing environmental impacts associated with steel production and waste generation.

How does the project affect architecture / the built environment?

The project's impact on architecture and the built environment is significant, as it promotes circular design principles, impacts structural design approaches, develops computational tool advancements, and contributes to the broader integration of sustainability in architectural practices. It promotes circularity by encouraging stakeholders to consider the lifecycle of materials and their reuse potential, rather than relying solely on the linear "take-make-dispose" approach. The project impacts the traditional structural design approaches as integrating reclaimed steel elements in construction projects requires engineers and contractors to consider demountability of structural elements and requires stockholders and fabricator to perform repairs in order to assure the quality of the reclaimed steel. The project's development of computational tools, such as the matching tool and digital inventory, facilitates the exchange of information between material providers and seekers, enables informed decision making, and enhances design efficiency. Finally, the project integrates sustainability ideals and encourages industry professionals to think beyond aesthetics and consider the environmental, social, and economic impacts of their design choices.

6.2 APPENDIX B: INTERVIEW REPORTS

INTERVIEWS:

2. Designer and engineers
3. Material passports
4. Stock companies
    - Provide a copy of my stock list template that is referenced within interviews
    - CST – stock list
    - SIG – stock list, example of test results
5. Matching tool – HTS, ARUP
6. CSM – steel manufacturers and assembly
    - CE mark
    - Design list & Tekla model