# Redesign and Development of a Certified Ladder System

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Topic: Redesign and development of a package of certified ladder system and related components.

**Background Information**

The client, Wemeco Products BV, is a company specializing in the development, manufacturing, and distribution of high-quality innovative metal products designed for various applications within public spaces. Their portfolio includes hatches used in road infrastructure and steps integrated into emergency escape routes. This project was initiated due to a growing market interest in certified ladder systems integrated with hatches. Wemeco currently offers custom-designed ladders that are uncertified, leading to inefficiencies and repeated redesigns. The assignment aimed to redesign these ladders to meet stringent EU norms and standards, ensuring consumer safety, market access, and quality assurance.

**Practical Relevance of the Assignment**

The assignment's objective is highly relevant as it addresses the critical need for safety and compliance in ladder systems used in various industrial and commercial settings. By ensuring that ladders meet EU norms, the company can enhance product safety, boost consumer confidence, and facilitate trade within the European market. Additionally, certified ladders integrated with hatches align seamlessly with Wemeco's existing product portfolio, addressing market demands more efficiently.

**Main Research Question**

The main objective of the project was to redesign and develop a certified package of ladders and related products that meet industry standards and safety regulations. This included various types of ladders and necessary accessories to enhance functionality and convenience.

**Approach and Intermediate Results**

The project employed the triple diamond design process, a comprehensive framework that enhances the design process by incorporating multiple phases:

*Understanding the Project Aim*: This involved analyzing and integrating different standards and regulations, including EN 14396, EN 14122-4, and EN 14094-1, to ensure compliance with legal and safety requirements.

*Conducting Market Research*: The market analysis phase involved reviewing existing products and understanding market needs, the importance of compliance, and potential challenges.

*Formulating Requirements*: A list of requirements was created to define clear design criteria and objectives, connecting research with component design.

*Design and Simulation*: Various designs were generated and simplified to carry out simulations. Multiple design iterations were tested using Solidworks simulations, employing the Finite Element Analysis (FEA) method to evaluate performance.

Design Finalization: After necessary iterations, the final design was reached, ensuring compliance with norms and requirements.

**Results and Limitations**

The redesigned ladder system was tested through simulations and hand calculations, demonstrating that it meets and exceeds required safety standards. Stress analysis indicated that all components remained within safe limits under expected loads. However, the simulations need validation through real-life testing, including loading tests and environmental exposure tests. The study also highlighted potential improvements in material savings and strength through redesigning sheet metal rungs and exploring intermediate platforms for maximum height utilization. The current norms do not provide tests for wall brackets used in the ladder system, suggesting the need for further testing to enhance safety and reliability.

**Conclusions and Recommendations**

The project successfully redesigned the ladder system, ensuring compliance with multiple safety standards, while optimizing the final design by using less materials than the original designed ladders by the company. The validation through simulations and manual hand calculations confirmed the robustness and reliability of the design. Recommendations for further steps include:

*Prototyping and Real-life Testing:* To verify simulation results under prescribed load conditions.

*Exploring Redesigns for Material Savings*: Utilizing design features such as bends, hems, embosses, and ribs for increased strength and weight reduction.

*Designing Intermediate Platforms*: For maximum height utilization and compliance with placement and load-bearing requirements.

*Testing Wall Brackets:* To determine the clamping force and enhance overall safety and reliability.

This project underscores the importance of integrating regulatory compliance with practical design considerations to develop safe and efficient products.