D16.2 DESIGN HANDBOOK FACADES (new build)

MULTICARE

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16.2 Design Handbook Facades (new built)

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1. Introduction

1.1 MultiCare project

The MultiCare project is a collaborative EU-funded initiative focused on advancing sustainable building solutions through innovative design, development, and implementation. As part of this project, the Amsterdam new-build pilot plays a key role in testing and scaling façade technologies that align with sustainability and energy efficiency goals. This pilot serves as a real-world application of the research and development efforts within the broader MultiCare initiative.

1.2 The purpose of the design handbook

This design handbook represents Deliverable 16.2: Intervention Design (New-Build Scenario) within Work Package 16 (WP 16): Amsterdam – Preparation and Virtual Demonstrator. It provides a structured approach to integrating façade prototypes from WP 11 into the Amsterdam new-build project while ensuring compliance with Dutch building regulations. By aligning design concepts, regulatory standards, and practical implementation, this handbook helps translate research into real-world application.

As part of WP 16, this deliverable focuses on the new-build scenario on Cruquiuseiland, addressing heat stress, energy efficiency, and resilience at both the building and neighborhood scale. The handbook builds upon the multi-criteria selection framework from WP 5 and integrates findings from parametric modeling and performance analysis to guide façade selection and adaptation. The outcomes of this intervention will inform WP 17, which focuses on the large-scale implementation of these façade solutions.

Façade integration in an early-stage project presents challenges, requiring flexibility, coordination, and adaptation. This handbook serves as a practical resource for architects, designers, engineers, and developers, ensuring that sustainable and high-performance façade systems are effectively implemented while remaining adaptable to project developments. It is designed to be applicable to different projects if needed.

1.3 Structure

This handbook is structured as follows:

1. The Amsterdam New-Build Project outlines the project's location, objectives, and design vision.
2. Dutch Building Regulations covers key requirements such as BBL 2024, BENG, TOjuli, and MPG.
3. Façade System Selection Framework presents the multi-criteria decision-making (MCDM) approach from WP 5 (Resilient-based framework and design tools for materials and building components).
4. OMRT Virtual Intervention analyzes parametric simulations of 1,728 façade variations for energy and thermal performance from task 16.3 (Virtual intervention modelling (new built & renovation scenario).
5. Proposed Design Options explores the selected façade systems, including composite panels, biobased materials, and green walls.
6. Challenges in the Building Process discusses planning, permits, and stakeholder coordination.
7. Steps to Look Ahead summarizes key takeaways and next steps for scaling implementation for WP 17 (Amsterdam Cruquiusweg – Implementation & Monitoring).

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2. The Amsterdam New Build Project

2.1 Developer, Architect, Contractor

The Maria Austria project is being developed by Midvast, with VURB Architects responsible for the architectural design. The main contractor for the project is WJ Projects, a construction company based in Amsterdam.

2.2 Location and Local Regulations

The project is located at Maria Austriastraat 961, 1087 JB Amsterdam, in the IJburg district, east of Amsterdam's city center, as shown in Figure 1. Originally constructed in 2001 as a KPN telephone exchange, the building was intended to support the growing communication needs of the newly developed IJburg neighborhood. However, due to rapid technological advancements, its original function became redundant.

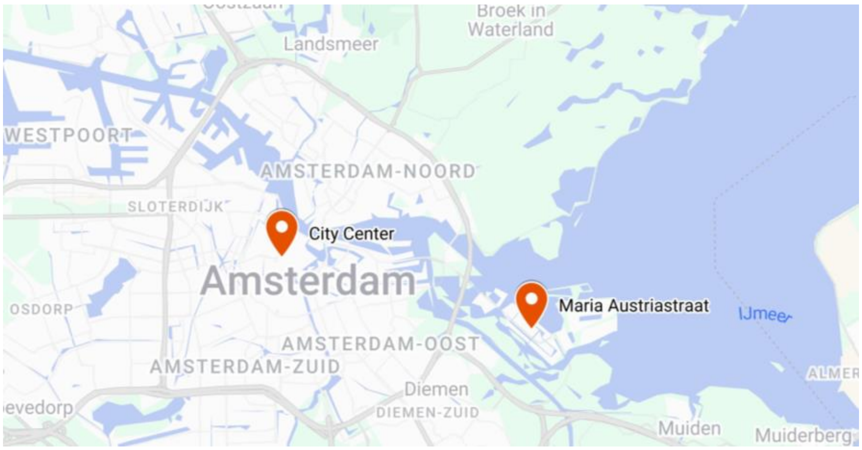

Figure 1. Map of Amsterdam with the location of the Maria Austriastraat

Maria Austriastraat is located at the interface of urban infrastructure and open water, as shown in Figure 2. The building on which this site was originally constructed has remained unused since completion, due to shifting technological demands and changing spatial needs. In response to this vacancy, Midvast has initiated the redevelopment of the building under the project name De Centrale. The redevelopment aligns with the broader urban renewal of the IJburg district, which focuses on increasing spatial efficiency, environmental performance, and climate resilience. The project incorporates measures for energy efficiency, climate adaptation, and compact residential typologies, and adheres to local regulations concerning sustainable construction, acoustic standards, and energy performance.

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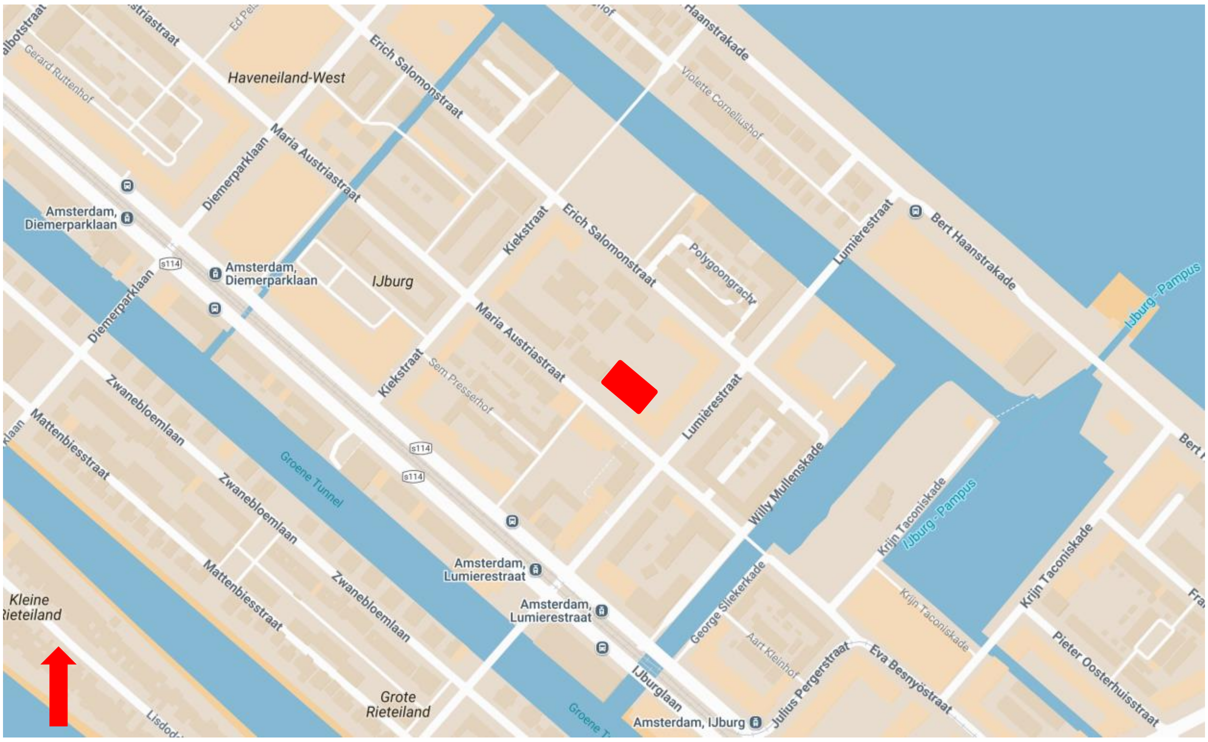

Figure 2. The project surroundings, with in red the location of De Centrale

2.3 Project Design

De Centrale has a rectangular footprint measuring 33 by 22 meters, with a total gross floor area of 726 m². The building comprises six storeys, each with a floor-to-ceiling height of 2.7 meters. The internal layout is composed of compact apartments of approximately 30 m², designed for short- to medium-term occupancy (ranging from 5 days to 6 months). This housing typology addresses the growing demand for flexible urban living arrangements.

The load-bearing structure consists of a modular steel frame, engineered to be demountable, allowing for disassembly, relocation, or reconfiguration. This approach facilitates circular construction by enabling the reuse of components and minimizing material waste. Additionally, the design incorporates the existing foundation and basement structure, reducing the need for new construction work below ground and significantly lowering the embodied carbon impact of the project.

As shown in Figure 3, the south-facing façade includes balconies with integrated sunshading elements, which help reduce solar heat gains during warmer periods, thereby limiting reliance on active cooling systems. The west façade, depicted in Figure 4, is clad with timber panel systems and trellis system, The implementation of green roofs further supports ecological performance by increasing rainwater retention, biodiversity, and mitigating the urban heat island effect.

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Figure 3. South facade of the Maria Austriastraat

Figure 4. North and west facade of Maria Austriastraat

2.4 Selected Façades for the MultiCare Project

In collaboration with the development team and architect, the optimal location for installing the 22 MultiCare panels was identified based on spatial analysis, technical feasibility, and architectural integration. The west-facing façade was selected as the most appropriate location, as shown in Figure 5. This choice aligns with the agreement and approval provided within the framework of the MultiCare programme.

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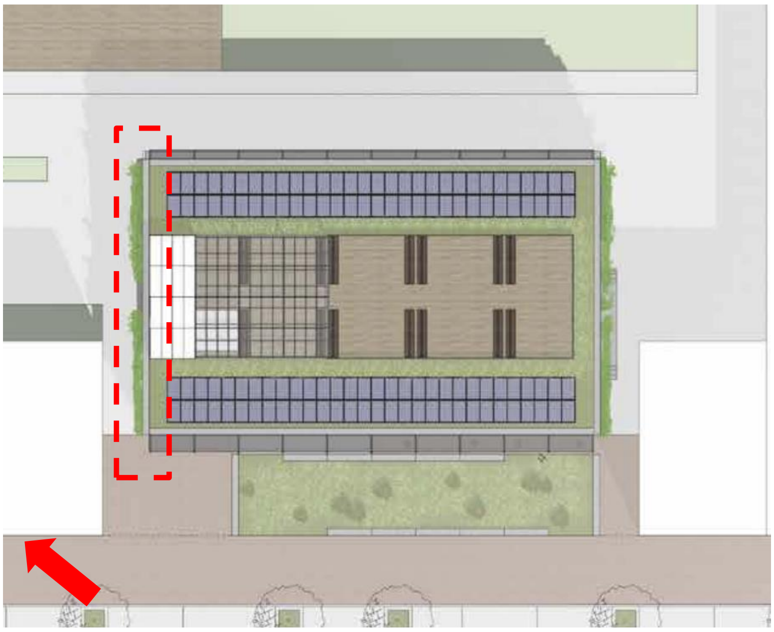

Figure 5. Overview of De Centrale project with the west facade highlighted

The west façade offers favorable conditions in terms of solar exposure, physical accessibility, and design compatibility. The existing trellis system on this façade also presents the potential for future integration of a green façade, which may further enhance environmental performance and spatial quality. By aligning the panel installation with the building's architectural expression, the intervention preserves aesthetic continuity while contributing to the project's energy performance objectives. This façade provides adequate surface area and avoids interference with balconies or programmatic functions, making it both technically feasible and visually coherent.

2.5 Design Specifications

To ensure a well-integrated and functional facade design, a set of requirements was established in collaboration with the architect and developer. This list outlines key parameters and boundary conditions that guide the design process, ensuring alignment with structural, aesthetic, and sustainability goals. These requirements address aspects such as material selection, thermal performance, integration of the solar panels, and compliance with local building regulations. By defining these conditions early in the process, the facade design remains adaptable while maintaining consistency with the overall architectural vision. The full list of requirements is included in *Appendix 1*.

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3. Dutch Building Regulations

Façades play a crucial role in ensuring that buildings meet Dutch regulations for safety, energy efficiency, and sustainability. These regulations, shaped by national policies and EU directives, define performance criteria that impact material selection, design strategies, and construction methods.

This chapter provides an overview of the key regulatory frameworks affecting façade design, including the new Besluit Bouwwerken Leefomgeving (BBL) 2024, MilieuPrestatie Gebouwen (MPG), Bijna Energie Neutrale Gebouwen (BENG), and TOjuli standards. By understanding these frameworks, architects and developers can ensure compliance while balancing performance, aesthetics, and environmental responsibility.

3. 1 Overview of the Façade Regulations

In the Netherlands, façade design must adhere to multiple regulatory requirements to ensure sustainability, energy efficiency, safety, and occupant comfort. These requirements are based on national legislation and European directives, providing a structured foundation for building design.

Besluit Bouwwerken Leefomgeving (BBL) 2024

Replacing Bouwbesluit 2012, the BBL 2024 introduces an updated regulatory framework that aligns with environmental sustainability and urban livability goals. The official code reference for this decree is BWBR0041297. For façades, the BBL strengthens requirements related to:

- Circular construction – Emphasizing the reuse of materials and reducing environmental impact.
- Climate resilience – Addressing wind loads, precipitation, and overheating risks.
- Fire safety – Enhancing fire-resistant materials and evacuation strategies. (not investigated in the MULTICARE project)
- Biodiversity – Encouraging green façades and nature-inclusive design. (to be investigated in WP17)

These new regulations emphasize adaptability, durability, and the integration of innovative materials to future-proof façade designs.

MilieuPrestatie Gebouwen (MPG)

The MPG measures the environmental impact of a building's materials over its entire lifecycle. The MPG requirements are incorporated within the BBL, specifically in Chapter 5, which deals with sustainability aspects of buildings. For façades, this assessment includes:

- The sustainability of materials, favoring recyclable, biobased, or low-impact resources.
- The lifecycle impact, from production to disposal, emphasizing circularity.
- The use of reusable materials to reduce waste and align with circular construction principles.

Stricter MPG thresholds are being introduced to support national sustainability goals, directly influencing material choices and construction techniques for façades.

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Bijna Energie Neutrale Gebouwen (BENG)

Derived from the EU Energy Performance of Buildings Directive, the BENG standard establishes energy performance criteria for nearly zero-energy buildings (nZEB). These requirements are detailed in the BBL under Articles 5.2 to 5.6, which outline the energy performance indicators and standards that new buildings must meet. Façades play a crucial role in meeting these standards through:

- Thermal insulation to minimize energy loss and improve efficiency.
- Solar gain management by optimizing glazing, shading, and façade orientation.
- Airtightness to reduce energy leaks and enhance performance.

Façade designs must support compliance with the three key BENG indicators:

1. Limiting total energy demand.
2. Reducing primary energy consumption.
3. Increasing the share of renewable energy used in the building.

TOjuli (Temperatuuroverschrijding juli)

The TOjuli requirement ensures that buildings prevent excessive indoor temperatures during summer months, reducing reliance on mechanical cooling. The TOjuli requirement is specified in the BBL under Article 5.7. Façades contribute to this by:

- Integrating shading devices such as overhangs, external blinds, or dynamic facades.
- Selecting glazing with appropriate solar heat gain coefficients.
- Balancing insulation and natural ventilation to regulate indoor temperatures effectively.

Compliance with TOjuli is critical for maintaining thermal comfort and aligning with Dutch climate adaptation goals.

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4. Façade System Selection framework

In the previous chapter, we outlined the key Dutch building regulations influencing façade design. These regulations directly impact material choices, structural requirements, and energy performance criteria, all of which play a role in selecting the most suitable façade systems. To structure this selection process, the *MultiCare* project has developed a multi-criteria framework for resilient façades and components, as detailed in *Work Package (WP) 5*.

4.1 Multi-Criteria Framework for Façade Selection

The deliverable *5.1* provides an overarching framework for assessing and designing resilient and sustainable façade systems. This framework consolidates findings from *Task 5.1* and *Task 5.2* and serves as a structured method for evaluating façade solutions across different project contexts. The framework will be further refined in *Deliverable 5.2*, which will present a catalogue of pre-calculated façade solutions for the three demonstration projects in Bucharest, Amsterdam, and Acerra.

The framework defines the following key steps in the façade selection process:

- Identification of façade systems and components to be assessed.
- Definition of decision-making criteria, categorized into compliance-based, environmental, economic, and resilience factors.
- Evaluation based on compliance criteria, ensuring alignment with building codes and regulations.
- Further assessment of compliant systems based on environmental impact, economic feasibility, and resilience performance.
- Multi-criteria analysis (MCA) to rank façade systems, assigning a performance score to enable direct comparison.

4.2 Decision-Making Criteria and Façade Evaluation

The decision-making framework presented in *task 5.2 (Multi-hazard resilience-based framework at sub-system level)* categorizes façade evaluation into two primary phases. First, façade systems must meet compliance-based criteria dictated by local building codes and Dutch regulations. Systems that pass this initial assessment undergo further evaluation based on extended MultiCare criteria, which assess their full life cycle across five key phases: Initial Construction, Operation, Maintenance, and Demolition. The assessment considers:

- Material and fabrication costs in the initial construction phase.
- Global warming potential and life cycle emissions.
- Resilience to environmental hazards, integrating technical and social resilience considerations.
- Long-term economic and environmental performance, incorporating hazard-related impacts.

This structured evaluation ensures that façade systems are selected not only for their regulatory compliance but also for their long-term sustainability and resilience.

4.3 Preliminary Façade System Selection

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For the Amsterdam demonstrator project, the façade selection process incorporates key design and operational parameters, including:

- Structural requirements, including load-bearing capacity and design for disassembly.
- Building physics requirements, such as thermal insulation minimum Rc value of 4,7 m²K/W, airtightness qv10 ≤ 0,2 dm³/s.m², and moisture control so a construction must prevent harmful condensation or moisture accumulation
- Building height constraints, influencing wind loads and material choices.
- The solution must be cost-effective and comply with performance requirements within a maximum budget of €313/m² (excluding VAT).
- Logistics and site constraints, impacting prefabrication and on-site assembly feasibility.

Based on these parameters, three façade options have been identified using the selection tool developed in *WP 5.1*. These options will undergo further assessment in *WP 5.2* to determine the most suitable solution for integration into the Amsterdam project.

4.4 Multi-Criteria Decision-Making (MCDM) in Façade Design

To systematically evaluate façade systems, *WP 5.1* employs Multi-Criteria Decision-Making (MCDM) methodologies. Within this framework:

- Multi-Attribute Decision Making (MADM) is used to compare and rank predefined façade solutions.
- Multi-Objective Decision Making (MODM) is later applied to optimize design parameters within the selected system.

For the *Amsterdam project*, MADM has been chosen as the primary assessment method, as it provides a structured ranking of façade options based on predefined selection criteria. MODM will be implemented in later phases to refine and optimize the chosen façade system.

4.5 Towards a Catalogue of Pre-Calculated Façade Solutions

The framework outlined in *WP 5.1* forms the foundation for *WP 5.2*, which will compile a façade typology catalogue for the three MultiCare demonstrator projects. This catalogue will include:

- Defined typologies based on structural, environmental, and economic performance.
- Pre-calculated façade solutions, evaluated according to the multi-criteria framework.
- Implementation guidelines, ensuring adaptability to various architectural and urban contexts.

By developing this structured approach, the MultiCare framework provides a data-driven methodology for selecting façade systems that meet compliance, performance, and sustainability goals. The outcomes of *WP 5* will serve as a reference for future projects, ensuring that façade solutions are optimized for both new-build and renovation scenarios.

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5. OMRT Virtual Intervention

The selection of an optimal façade system requires a structured approach that integrates multiple performance criteria, balancing energy efficiency, embodied carbon, climate resilience, and circularity. In Work Package (WP) 16, task 16.2, a parametric multi-criteria assessment was conducted to evaluate façade performance across different urban contexts in Amsterdam. This analysis was carried out on the Cruquius project before the amendment was accepted by the EU. For further explanation, see WP 22 and D6.3. Using the design handbook derived from WP 5 as a foundation, representative façade systems and materials were incorporated into this assessment, ensuring that the selected designs align with both sustainability goals and Dutch building standards.

The analysis covered a broad range of new-build scenarios, representative of the Dutch climate and regulatory landscape. Additionally, a similar parametric model was developed for renovation cases in the Amsterdam historical center, carefully adapted to its unique climatic conditions and performance requirements. By modeling different façade configurations, this assessment provides a comprehensive framework for integrating high-performance façade solutions into both new and existing buildings.

5.1 Multi-Criteria Analysis with OMRT

Building upon the façade performance principles outlined in the previous chapter, the multi-criteria analysis was conducted in collaboration with OMRT, utilizing their advanced simulation platform. This methodology allowed us to evaluate 1,728 different façade variants, assessing their impact on key performance indicators such as energy efficiency, thermal comfort, and climate resilience.

The analysis incorporated multiple variables, including:

- TOjuli compliance to prevent overheating in summer conditions.
- BENG energy efficiency requirements, ensuring minimal energy demand.
- Night ventilation strategies to enhance passive cooling.
- Shading solutions, such as blinds and sunscreens, to optimize solar gain.
- Window-to-wall ratio (WWR) and its influence on daylight access and heat loss.
- Thermal resistance (Rc values) for walls and glazing performance.
- U-values and g-values for doors and windows, ensuring insulation quality.
- Infiltration rates (Qv;10) to measure airtightness and air exchange efficiency.

5.2 Key Findings and Next Steps

The parametric analysis conducted in *WP 16.2* has provided valuable insights into the most effective façade configurations for both new-build and renovation projects in Amsterdam. These findings will be further refined in collaboration with *Hoelscher* to ensure real-world applicability, forming the basis for large-scale implementation in *WP 17*. The results emphasize the importance of performance-based façade selection, integrating sustainability, energy efficiency, and climate resilience into architectural and urban planning processes.

A key challenge identified is daylight performance, particularly for lower-floor apartments surrounded by taller neighboring structures. The analysis reveals that meeting the NPR4057 daylight norm is difficult in some configurations, especially with highly insulative glazing options. While larger Window-to-Wall Ratios (WWR) improve daylight

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access, high WWRs also increase energy demand. The study highlights that a balance between glazing performance and WWR is necessary, with design modifications encouraged for lower-floor apartments to improve daylight conditions.

For energy performance, the analysis confirms that timber construction significantly enhances insulation and airtightness, helping to meet BENG 1 heating demand thresholds. However, due to timber's low thermal mass, cooling demand remains a challenge. The study finds that night ventilation can reduce energy demand by up to 10-12%, depending on WWR, shading, and infiltration rates. Additionally, façade materials and passive cooling strategies must be carefully selected to mitigate overheating risks while ensuring compliance with BENG 1 criteria.

Regarding TOjuli (overheating risk), the results indicate that smaller WWRs (40-50%), combined with high-performance glazing and night ventilation, effectively control indoor temperatures. Larger ventilative openings further reduce TOjuli values, particularly in upper-floor and corner apartments, which are more prone to overheating. However, the study suggests that TOjuli calculations may occasionally overestimate overheating risk due to limitations in the methodology. In critical cases, a more detailed assessment using GTO (Gewogen Temperatuur Overschrijding) is recommended to provide a more accurate representation of thermal comfort.

The cooling load assessment confirms that solar shading is essential, particularly for configurations with high WWRs (70%). Glazing with low g-values (< 0.4) significantly reduces peak cooling loads, making it possible to meet the 35 W/m² threshold even without external blinds in some cases. The study reinforces that the façade envelope has a greater impact on cooling demand than ventilation and infiltration, highlighting the importance of optimizing glazing, shading, and façade materials to reduce overall energy consumption.

These insights will guide the next steps in developing a standardized workflow for integrating façade performance analysis into large-scale architectural projects. By refining the parametric approach and ensuring compliance with Dutch regulations, the results of *WP 16.2* will contribute to the scaling and optimization of sustainable façade solutions for Amsterdam's urban development.

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6. Proposed System

The selection of an optimal façade system is a critical step in ensuring that the building meets sustainability, energy efficiency, and aesthetic goals. Based on the findings from WP 5 and 11, various façade solutions are being explored for the Amsterdam site. These solutions incorporate innovative materials, modular construction techniques, and nature-based elements to enhance building performance while aligning with Dutch regulations.

6.1 Current Façade System Selection

At this stage, the composite panel system is being used as the benchmark for the Amsterdam project. This system provides a balance between durability, ease of installation, and thermal performance, making it a practical choice for modular construction. Additionally, low-carbon materials from the MultiCare catalogue and the material selection tool developed are being integrated to reduce embodied carbon and improve overall sustainability.

Alongside these materials, a green living wall system is being explored as part of the façade design. This system aims to enhance biodiversity, improve air quality, and provide additional insulation benefits, contributing to both environmental performance and urban aesthetics.

6.2 Extended Façade System Options

Beyond the composite panel system, additional façade concepts are being considered to further enhance resilience and ecological benefits. These include:

- Biobased materials – Incorporating Tylord biobased panels, which offer a sustainable alternative to conventional cladding while maintaining structural integrity.
- Water retention systems – Exploring solutions that improve façade water management and reliability, potentially reducing strain on urban drainage systems.
- Decentralized green wall systems – Investigating options for an integrated façade ecosystem, combining living vegetation with modular façade elements to improve building microclimate and stormwater absorption.

6.3 Prototype Development and Testing

The prototype façade systems are being developed and tested to evaluate thermal performance, structural durability, and adaptability to the Dutch climate. This process ensures that each system meets BENG energy efficiency standards, TOjuli overheating thresholds, and BBL 2024 resilience requirements. By analyzing factors such as heat retention, acoustic performance, and modularity, the testing phase will guide the final selection of the façade system for the Amsterdam project.

6.4 Impact on Building Performance, User Comfort, Circularity

The proposed façade solutions are expected to have a significant impact on building efficiency, occupant well-being, and circularity. The integration of low-carbon materials, water retention strategies, and living walls will enhance thermal regulation, reduce urban heat island effects, and contribute to a healthier indoor environment. Additionally, the modular and demountable nature of the system supports circular construction principles by enabling material reuse, reducing waste, and facilitating future adaptations. These features ensure ease of installation and maintenance, making the solution suitable for both new-build and retrofit applications while promoting long-term sustainability.

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6.5 Next Steps

Moving forward, comparative testing of the façade systems will be conducted to determine the most efficient and scalable solution for implementation. The selected façade configuration will be refined based on real-world performance data, ensuring that it meets the sustainability and resilience targets outlined in the MultiCare framework.

In Figure 5, different facade options are presented, which are currently being discussed. On the left, we see the benchmark option designed by the architect. Moving to the right, option number two features a selection of bio-based materials. Option three focuses on living green walls with plug-and-play solutions.

To support decision-making, Table 1 below provides an overview of the key advantages and disadvantages of each option, including considerations such as sustainability, complexity, and warranty availability.

Figure 6. Different facade options that are consider for the project (more to be investigated in WP17)

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Benchmark architectural design	**Bio-based material façade**	**Living green wall (plug-and-play)**
Original façade as designed by the architect	Façade using timber, bio-composites, or other renewable materials	Modular system with integrated vegetation and irrigation
Pro • Proven performance and standard detailing • Low technical risk and predictable cost • Aligns with initial architectural vision • Comes with standard warranty from suppliers	Pro • Reduced embodied carbon • Supports circular construction goals • Compatible with prefabrication • Warranty possible, depending on supplier	Pro • Needs further testing for durability and weather resistance • Potentially higher up-front cost • Material availability may be limited
Con • Limited sustainability impact • Lower potential for innovation • May underperform in energy and material circularity	Con • Needs further testing for durability and weather resistance • Potentially higher up-front cost • Material availability may be limited	Con • Complex in installation and maintenance • Long-term performance depends on upkeep • Warranty coverage is difficult due to the innovative nature of the system

Table 1. Comparative overview of façade options

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7. The challenges in the building process

The development of a building project comes with a variety of challenges, ranging from design coordination and permitting procedures to planning delays and stakeholder alignment. These factors can significantly impact the project timeline and require careful management to ensure smooth progression from concept to realization.

7.1 Planning Challenges and Subsidy Requirements

One of the key challenges in this project is the alignment between the subsidy requirements and the building's design process. The subsidy framework demands that many technical and design specifications be determined early on, while in reality, not all building requirements are fully defined at this stage. This creates a gap between what is expected for funding approval and the natural evolution of the design and construction planning. Balancing these aspects requires flexibility in decision-making while ensuring that the project remains eligible for financial support.

7.2 Coordination Between Design and Construction

Another significant challenge is the coordination between design and construction planning. Architects, engineers, and builders often have different perspectives on what is feasible and how the building should function. While architects focus on aesthetic and spatial experience, engineers and builders prioritize structural integrity, material efficiency, and practical execution. Bridging these viewpoints is crucial to developing a façade system that meets both design aspirations and technical constraints.

7.3 Stakeholder Alignment and Decision-Making

Every stakeholder in the process—clients, architects, engineers, and developers—brings different expectations and priorities. Clients have specific requirements and budgets, while each architect may have a unique vision that does not always align with the technical and regulatory limitations. Engineers, on the other hand, tend to be reactive rather than proactive, often responding to designs rather than shaping them from the beginning. This can lead to delays and redesigns if engineering feasibility is not fully integrated early in the process. Ensuring clear communication and collaboration between all parties is key to preventing misalignment and inefficiencies.

7.4 Permit Requests and Regulatory Delays

Navigating the permit process is another challenge that can cause significant delays. Regulatory approval depends on compliance with Dutch building codes, zoning regulations, and environmental assessments. However, permit approval timelines can be unpredictable, especially when new façade technologies or sustainable construction methods are involved. Delays in permit approvals can disrupt construction schedules, requiring contingency planning and flexible timelines to mitigate risks.

7.5 Unforeseen Technical and Logistical Issues

Construction projects frequently encounter unexpected challenges, from material availability issues to logistical constraints on-site. Additionally, matching design intent with real-world execution can reveal unforeseen difficulties, requiring on-the-spot adjustments. Ensuring efficient problem-solving mechanisms and adaptability within the project team is essential to overcoming these hurdles.

7.6 Managing Expectations and Maintaining Progress

Ultimately, successful project execution relies on managing expectations while maintaining forward momentum. Ensuring alignment between subsidy requirements,

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design evolution, technical feasibility, and regulatory approvals is an ongoing challenge. By fostering proactive collaboration, strategic planning, and clear communication, the project team can navigate these complexities and work towards a seamless implementation of the façade system.

7.7 Performance, Warranty, and Risk of Façade Panels

A specific challenge in this project is ensuring the long-term performance and reliability of the prefabricated façade panels. While innovative façade systems can offer high sustainability and energy performance, there is often limited data on their long-term behavior, especially in varying urban conditions. Issues such as durability, weather resistance, and thermal performance over time must be carefully assessed. Furthermore, questions around manufacturer warranties and responsibilities in the event of failure introduce legal and financial risks. The lack of established industry standards for some new façade products complicates procurement and contract structuring. Addressing these concerns requires clear agreements on warranty conditions, maintenance obligations, and risk allocation, particularly when using novel or prototype components.

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8. Steps to Look Ahead

With this handbook, we establish the first steps toward integrating a structured approach for selecting and implementing resilient façade systems. By consolidating regulatory requirements, performance analyses, and multi-criteria decision-making, this document provides a foundation for data-driven façade design in the Amsterdam new-build project.

8.1 Key Takeaways

This report highlights the critical aspects of façade selection and implementation, focusing on sustainability, energy efficiency, and regulatory compliance. The key findings include:

- Regulatory Alignment – Dutch building regulations, including BBL 2024, BENG, MPG, and TOjuli, set clear performance benchmarks for façade design, influencing material choices and energy strategies.
- Multi-Criteria Analysis – Using OMRT's parametric approach, over 1,728 façade variations were analyzed to optimize performance in daylight access, thermal comfort, and energy efficiency.
- Façade System Selection – The MultiCare framework WP 5 (Resilient-based framework and design tools for materials and building components) provides a structured methodology for evaluating façade solutions based on compliance, environmental impact, and resilience.
- Challenges in Implementation – From subsidy requirements to permit delays and stakeholder coordination, multiple factors influence the feasibility of façade integration in new projects.

8.2 Next Steps for Scaling Implementation

To further develop and scale the façade solutions explored in this handbook, the following steps will be taken:

1. Refining the Façade Catalogue – The pre-calculated solutions from *WP 5.2* (Multi-hazard resilience-based framework at sub-system level) will be further developed, creating a standardized library of adaptable façade systems for future projects.
2. Validating Real-World Performance – The selected façade configurations will be tested in WP11 (Plug and play low-carbon resilient facade systems) and monitored during construction to compare modeled performance with actual outcomes in WP17 (Amsterdam Cruquiusweg – Implementation & Monitoring)
3. Integration into Broader Architectural Workflows – The façade selection framework will be refined to streamline integration into design processes, making it more accessible for architects and developers.
4. Scaling for Large-Scale Deployment – Insights from this project will inform WP17, supporting the wider implementation of resilient façade systems in other urban developments across Amsterdam.

By following these steps, the project aims to bridge the gap between research and real-world application, ensuring that façade innovation contributes to sustainable, high-performance urban developments.

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GLOSSARY

ACRONYM	FULL NAME
CA	Consortium Agreement
EC	European Commission
EASME	The Executive Agency for Small and Medium-sized Enterprises
GA	Grant Agreement
PC	Project Coordinator
WP	Work Package
TL	Task Leader
DoA	Description of Action
PSC	Project Steering Committee
SQM	Scientific and Quality Manager
DEC	Dissemination and Exploitation Committee
KOM	Kick-off meeting
GER	General Exploitable Result
AB	Advisory Board
PM	Person month
M	Month
BBL	Besluit Bouwwerken Leefomgeving (Building Environment Decree)
MPG	MilieuPrestatie Gebouwen (Environmental Performance of Buildings)
BENG	Bijna Energie Neutrale Gebouwen (Nearly Energy-Neutral Buildings)
TO-july	Temperatuuroverschrijding juli (Temperature Exceedance July)

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Appendix I: Requirement list

	Parameters	Flexible in parameter needed	Expected value	Boundary conditions minimum	Boundary conditions maximum	Notes
Key results (optimizable variables	Price (euro/m2)	y	Cost per square meters – Preferably 300 euro / m2 closed facade and open facade 550 euro/m2 for open part	250/525	only high if it has a business case	
	Carbon lifecycle	n.p.			(ex. fully biobased or circulair)	
	Total thickness	y		300mm	400mmm or more (only if the business case support it)	
Variabels that can be changed within the boundary conditions (minimal requirements)	Facade performance (RC value)	y	6	4,7		
	Facade openings performance (RC value)	y	0,8 (preferably light weight)	1,2 (u)	(ex vacuumglas)	
	Structural	y	prefered to also have a loadbearing panel in de library	non-loadbering self supporting hsb panel	can be used structural version and support balconies	
	Opening Ration	y	40%(glass)	20%	~%	
	Facade finish	y	timber durable	Brick strips	~ (living facade)	
	Durability	n.p.	60 years, prefaberbly no maintance	7 year painting cycle		
	Speed: Installing panel (panel/day on avg)	n.p.	20 panels per day	20 panels per day		
	Scaffolding	n.p.	no scaffolding	no scaffolding		
	Crane (—>Weight panel)	n.p.	electrical	normal	electrical	

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	Facade Panel size witdh (mm)	y	3600	3000	6000	
	Facade Panel size height (mm)	y	2700	2600	~ (3500)	
	Fire safety	n.p	Class B			
	MPG	n.p	to find out how to do this (mpg 0,4)			
	Facade performace TO July	n.p	less overheating in the hottest days. to find out how to do this, —> (lower than 1.2)		Changing to environmental situation (phase changing materials or low tech shading)	
	Reusability	n.p	Buyback guarantee for materials	standard offer	fully reused	
	Energy production	y	none	none	fully panelized	
	Green wall	y	none	none	fully panelized and low tech and labour maintenance	
	Health of people and strucutre	n.p.	damp-open construction / vapor permeable	none	damp-open construction, visual connection with the green	
	Ventilation	n.p.	none	none	natural ventilation with high effficincy	
	Remountable and upgadebale	n.p.	none	none		
Details	Aesthetics of the element	y	adhere to design of architect	no designed production seams and fasteners		
	Easthetics of the window detail	y	architectural details			

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	material	y	affordable but nice looking (biobased) materials (task to architect)			
	Material optimization	y	optimize the amount of materials in structure (want to look into this)			

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