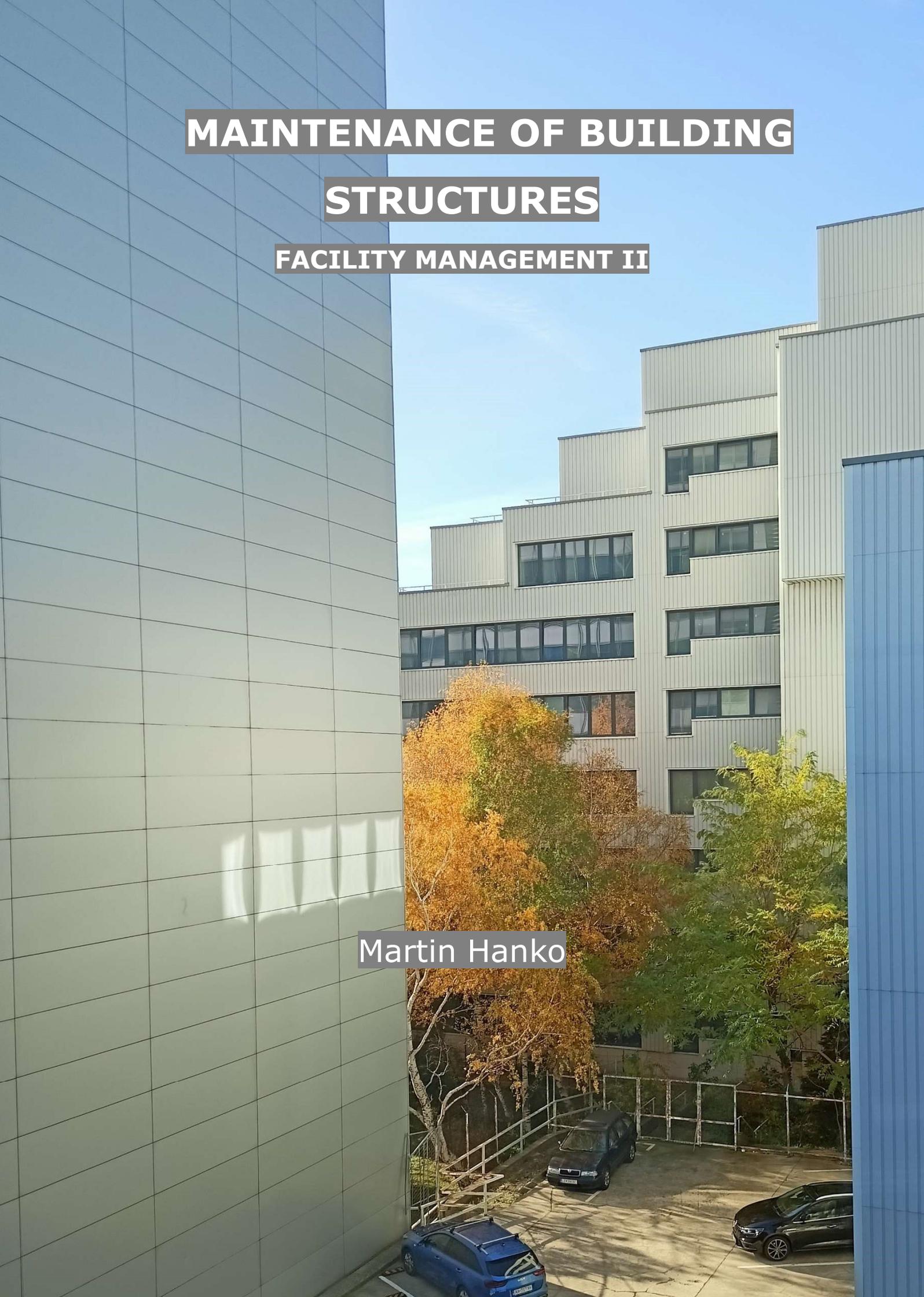


MAINTENANCE OF BUILDING

STRUCTURES

FACILITY MANAGEMENT II

Martin Hanko



MAINTENANCE OF BUILDING STRUCTURES FACILITY MANAGEMENT II

Martin Hanko

Stavebná a znalecká organizácia, s.r.o.
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Reviewers: Ján Karel, PhD., EUR ING
Ing. Veronika Horváthová

Cover designer: Martin Hanko

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INTRODUCTION

The university textbook expands knowledge in the fields of building maintenance planning, facility management, and building management. It is intended for students in a variety of undergraduate and graduate programs within Faculties of Civil Engineering at different universities. It is also suitable for learners participating in diverse courses, workshops, and seminars. The textbook explains the duties of facility and building managers, together with the internal building processes they are required to supervise and regulate. A particular focus is placed on **planning activities** in the domain of building management.

Planning in the field of building management and maintenance is not just an administrative task, but a **strategic pillar** that determines whether the property will benefit the owner or a financial burden. In a facility management environment, planning means the ability to anticipate and **prepare for natural degradation processes before they cause damage**. Its importance and impact can be observed on three key levels: economic, operational and strategic.

The most fundamental impact of planning is visible in money. Unplanned maintenance is almost always more expensive. When something goes wrong unexpectedly, the owner faces "accident surcharges", high prices for urgent material and a lack of available specialists. **Planning allows you to spread investments over time**. Thanks to the plan, the facility manager knows that in two years the façade will need to be repaired, and therefore he can allocate funds in advance. This prevents shock expenses that could endanger the cash flow of a company or a community of owners.

The building in which the maintenance is planned works like a "Swiss watch". The main importance of planning is to minimize breakdown. If an important pump replacement or air conditioning revision is scheduled for a weekend or off-peak period, building occupants will not even notice. Conversely, uncontrolled access leads to breakdown when the building is fully utilized, causing tenant dissatisfaction and loss of productivity. **Planning also ensures that legal revisions are not forgotten, eliminating the risk of legal penalties and increasing the safety of everyone in the property.**

In the long term, planning has a direct impact on the service life of building structures. Each material has its own wear cycle. If this cycle is controlled, the **life of the structure can be extended by decades**. This has a huge impact on sustainability – instead of demolishing and building new elements, the original ones are preserved thanks to planned maintenance. A building with a clear history of planned maintenance has a much higher value on the real estate market, because the buyer can be sure that not only water but also hidden investment debt will not "leak" into the property.

Building maintenance is a part of the technical management of buildings that provides maintenance of building construction and maintenance of technical equipment installed in the building. The building **maintenance manual** is an indispensable tool for effective maintenance management within facility management. This allows facility managers to efficiently **plan preventive maintenance**, minimize the risk of breakdowns, and extend the life of building. Facility managers play a key role in ensuring the smooth operation of the real estate and infrastructure in an organization. They are responsible for the management of the facilities, maintenance, and support services in the organization. The FM industry is growing rapidly, and the COVID-19 pandemic made safety and health a top priority. From an FM perspective, it is important to understand and optimize processes in three main areas: working environment, support processes, FM management. Effective management of FM processes contributes to the creation of an **optimal working environment and reducing costs, increasing the value of real estate and improving the image of the organization**.

Planning changes the entire philosophy of building management. It changes the facility manager from a "problem firefighter" to a "strategist" who has the building under control. The importance of planning is not that nothing goes wrong, but that we are ready for any change. The impact is a stable, safe and economically efficient environment that brings profit to the owner and comfort to the user.

1 MAINTENANCE OF BUILDING STRUCTURES

Building maintenance is not just about fixing something that has broken down. It's more like taking care of your health or servicing your car – the goal is to extend the life of your home and save money that you would otherwise have to spend on expensive emergency repairs. Every building, whether it is a family house or a large building, begins to age the moment you finish it. If we had to name the main culprit that destroys buildings, it is water. Moisture gets everywhere – in concrete, in bricks and under the roof. The biggest problem occurs in winter. When the water that has soaked into the masonry or crack freezes, it increases in volume (like ice in a bottle). This force is enormous and can tear plaster, break concrete and enlarge small cracks into large holes. Therefore, the basis of maintenance is to ensure that the water drains away from the house – that is, to have functional gutters, a good roof and a dry foundation. We often think that concrete lasts forever, but this is not the case. Over time, concrete naturally "weathers" and loses its ability to protect the iron reinforcement that is hidden in it. If moisture and air get to this iron, it will begin to rust. Rust is bulkier than the original iron, so it begins to press on the concrete from the inside until a piece of material cracks. We often see it on old balconies, where rusty reinforcement sticks out. By regularly coating and sealing cracks, we can prevent this. Wear and change of function is compensated by the maintenance of building structures, which leads to the maintenance of the desired building characteristics.

Maintenance are activities that are necessary to maintain the original standard and quality of the common parts of the building, the common facilities of the building and the accessories of the building, as well as the elimination of deficiencies detected by the service inspection. ¹

Building maintenance is "a part of the technical management of buildings that provides maintenance of building construction and maintenance of technical equipment installed in the building."

¹ Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

Building maintenance in terms of facility management: "represents a complex of services designed to ensure the safe operation of buildings and their technologies. It's a continuous process."²

According to STN EN 13306 maintenance is "a combination of all technical administrative and management activities throughout the life cycle of a building to maintain or restore the condition in which it can perform the required function."³

The standard defines the types of maintenance as preventive and after failure. Preventive maintenance according standard are: according to the current stage; predictive (according to the predicted state and with predetermined intervals. We recognizes types of maintenance such as: "regular preventive, evoked and emergency services"

1. Preventive maintenance is planned: "at regular intervals to reduce the amount of failure or deterioration of the building elements and structures."
2. Involuntary maintenance is an activity that: "performs outside the maintenance schedule on the basis of an administrator's request"
3. Emergency services are activities: "with the highest time priority in order to eliminate damage and restore the core function"

Preventive maintenance of building structures ensures reduced failure rate, extended service life.⁴

Types of maintenance of building structures are defined in terms of the quality of its execution:

1. Very good maintenance: "is planned, it is done regularly at specified times. It is necessary to periodically renew protective coatings, treat all minor faults, clean construction structures. "
2. Normal maintenance: "scheduled, regular repair cycles followed. The technical state of construction corresponds to its age. Smaller defects and failures, which do not affect the functionality of the construction, are rarely reflected in the construction. "

² SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

³ STN EN 13306. Maintenance. Maintenance terminology. Bratislava. SÚTN.

⁴ SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publishing SUT Bratislava. ISBN 978-80-227-3372-4

3. Neglected Maintenance: "It is done exceptionally hardly at all. The construction is visibly covered. Visible disturbances begin to appear before reaching the basic life. In emergency situations, construction works are repaired."⁵

According to the Construction Act, the service life of a building is defined as: "the period over which the building's performance characteristics correspond to the main building requirements."⁶

STN EN 13306 defines lifetime as: "The layout of a building fulfills the required task according to the defined use and maintenance conditions until the state of confinement is reached".⁷

Service life is defined as: "a period of time from the putting into operation of the building up to a situation where the required properties do not fall below the minimum that is defined as acceptable."⁸

The technical life of the building is: "the estimated number of years through which the building will fulfill its functions in accordance with the defined performance standards. Standards determine the requirements and level of the required operation. It is extended with regular maintenance of the building "

The economic life of the building is: "the estimated number of years through which the building will fulfill its functions with the expense that is appropriate."

The moral life of the building is: "the estimated number of years through which the social and scientific and technological increase will cause the obsolescence of the building to be extended through its modernization and renewal."⁹

Building structures of buildings are divided into two main fractions, depending on the lifetime impact of the building on: "elements of long and short term life."

⁵ MV a VP SR. The service life of building materials and apartment building structures. Bratislava. MV a VP SR in cooperation with the VVÚPS-NOVA, 1999. ISBN 80-88997-02-X.

⁶ Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act)

⁷ STN EN 13306. Maintenance. Maintenance terminology. Bratislava. SÚTN.

⁸ MV a VP SR. The service life of building materials and apartment building structures. Bratislava. MV a VP SR in cooperation with the VVÚPS-NOVA, 1999. ISBN 80-88997-02-X.

⁹ TRÁVNIK, I. et al.: Construction value management. 1998Publishing SUT. Bratislava. ISBN 80-227-1084-9

In violation or loss of features, elements of long-life functionality affect in principle the life of the building or end the life of the building, and their replacement or repair is extremely costly often unrealizable.

Elements of "long-term life" of buildings are:

1. "foundation,
2. vertical bearing structures,
3. horizontal load bearing,
4. construction of stairs and lifts (carrying),
5. roof-carrying structures. "

The elements of the building's short life have to be refurbished or replaced during its lifetime (even several times). They have the function of protecting elements with a long life and thus affecting the overall life of the building.

The elements of "short-term life" of buildings are:

1. "external finishes,
2. interior finishes,
3. insulation: thermal, moisture and water, acoustic and special,
4. tiles, floors,
5. coatings, paintings,
6. windows, doors,
7. locksmith,
8. plumbing,
9. roof covering,
10. joystick elements. "¹⁰

According to the Construction Act, the construction is defined as: "a constructional structure built by construction works of construction products which is firmly connected to the ground or whose installation requires the modification of the substrate."

¹⁰ FERENCIK, K.: Renovation of apartment buildings, repairs and insulation. Service life of building structures. [accessed at 2021-08-13]. Available at: http://www.k.ferencik.szm.com/ferencik_obnova_bd_zivotnost.html

The building is: "A spatially centered roofed building, including underground spaces that is technically suitable for construction and intended to protect people, animals or things, does not have walls but has a roof."

The construction design is: "produced by construction works of construction products"¹¹

Key Characteristics of the Building:

1. Durability and stability: The building is designed and built to withstand external influences and ensure long-term stability and durability.
2. Spatial boundary: A building defines an interior space that is separated from the outside environment by walls, roof, and floor.
3. Functionality and purpose: A building serves a specific purpose that defines its design, layout, and amenities. It can be housing, work, commerce, education, entertainment, storage, and many other purposes.
4. Architectural and aesthetic aspect: The building is not only a functional but also an aesthetic work that takes into account architectural principles, proportions, materials and visual impression.
5. Engineering solutions: The construction of a building requires engineering solutions in the field of statics, structures, technical equipment (heating, ventilation, electrical installations, plumbing) and safety.

Buildings can be divided according to various criteria, such as:

1. Purpose:
 1. Residential buildings: Family houses, apartment buildings, villas.
 2. Non-residential buildings: Administrative buildings, commercial buildings, industrial buildings, schools, hospitals, cultural buildings.
2. Construction system:
 1. Brick buildings: Made of bricks, blocks, stone.
 2. Reinforced concrete buildings: With a load-bearing structure made of reinforced concrete.
 3. Steel buildings: With a supporting structure made of steel.
 4. Wooden buildings: With a supporting structure made of wood.
3. Sizes and heights:
 1. Low buildings: With one or two floors.
 2. Medium-rise buildings: With several floors.

¹¹ Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act)

3. Tall buildings (skyscrapers): With tens of floors.

Examples of buildings:

1. Family house: A building intended for living for one family.
2. School: A building intended for education.
3. Hospital: A building designed to provide health care.
4. Office building: A building intended for administrative and office purposes.
5. Shopping center: A building with a lot of shops and services.

Buildings play a key role in the life of society. They provide us with space for living, working, education, relaxation and many other activities. They are an integral part of the urbanized environment and reflect culture, technical progress and societal needs.

It is important to distinguish between the terms "construction" and "building". According to the Building Act, a building is a subcategory of construction. This means that every building is a building, but not every building is a building. Construction is a broader term that includes, in addition to buildings, civil engineering structures (bridges, roads, tunnels, dams) and other construction works.

In short, a building is a complex and multifunctional space that combines architectural, engineering and functional aspects. It is an integral part of our environment and plays a key role in the life of society.

The lifecycle of a building is defined as: "the period from defining the purpose of the building over the design phase, the realization, the use phase and the possibility of terminating it by physical destruction of a building, renovation or sale."¹²

Operating costs are: "associated with the use phase of buildings and the sum of costs incurred for the operation of the building provided by supporting

¹² SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

activities"¹³ or maintenance of buildings. The cycle is: "a series of changes, stages, events, workings that repeat themselves with a certain regularity."¹⁴

The term "construction life cycle" refers to the time period from the initial idea of a building to its demise and liquidation, including all phases between these two extremes. It is a holistic approach that considers all stages of the building's existence and their interconnection. Understanding the life cycle of a building is crucial for the effective planning, implementation, operation and maintenance of buildings, as well as for minimizing their environmental impact.

The life cycle of a building is usually divided into several phases, with the exact breakdown varying slightly depending on the specific context. Some of the most cited phases include:

1. Pre-investment phase (Planning and design): This phase includes the definition of needs, the preparation of studies, the design of the construction concept, project documentation, obtaining a building permit and the preparation of documents for implementation. It is important to consider functional, aesthetic, economic and environmental aspects.
2. Implementation phase (Construction): This phase includes the construction of the building itself according to the approved project documentation. It includes earthworks, foundation of the building, implementation of load-bearing structures, external cladding, roof, installation of technical equipment and finishing work.
3. Operational phase (Use and maintenance): This phase represents the period during which the building is used for its intended purpose. It includes routine operation, maintenance, repairs, refurbishments, and upgrades. It is important to ensure the safety, functionality and comfort of use of the building.
4. End-of-life phase (Disposal/Recycling): This phase occurs after the end of the operational phase, when the building ceases to fulfil its purpose or is destined for extinction for other reasons (e.g. technical condition, change of the zoning plan). It includes the demolition of the building, the sorting and recycling of building materials, and the remediation of the area.

¹³ SOMOROVA, V.: Facility management. 2014. Professional publishing Prague. ISBN 978-80-7431-141-3.

¹⁴ Available at: <http://sk.wikipedia.org/wiki/Cyklus>

1.1 MAINTENANCE BY FACILITY MANAGEMENT

Building maintenance is not only one of the many tasks of facility management (FM), but also its very foundation and technical heart. If we imagine facility management as a comprehensive system of care for the environment in which people work and live, then maintenance is the engine that keeps this environment running. Its importance goes beyond simply repairing broken things; It is a strategic tool to protect investments, ensure smooth operations and create a healthy environment. Facility management is a multidisciplinary field that deals with the management and optimization of support activities in organizations to ensure the efficient functioning of real estate, infrastructure, and the working environment. Its goal is to integrate processes and services that support and increase the efficiency of the organization's core business and contribute to its economic growth and success.

FM takes care of everything that is not directly related to the main business of the organization but is necessary for its smooth operation.

The scope of facility management is broad and includes several areas, including:

1. Property management: Ensuring the operation, maintenance and repair of buildings and their technical equipment (e.g. heating, air conditioning, lighting, electrical installations, elevators).
2. Operation and **maintenance**: Planning and implementation of preventive maintenance, emergency repairs, revisions and inspections of technical equipment.
3. Energy management: Optimizing energy consumption, finding savings and implementing energy-efficient solutions.
4. Safety and Security: Ensuring the physical safety of buildings, fire protection, safety systems and occupational health.
5. Cleaning and hygiene services: Ensuring cleanliness and hygiene in and around buildings.
6. Logistics and postal services: Managing postal services, transporting materials and people.
7. Catering: Provision of catering services for employees.

8. Space management: Optimizing the use of workspaces, planning and implementing changes in the interior.
9. Environmental management: Minimizing the environmental impact of activities, waste management and recycling.

Different definitions of facility management emphasize different aspects of this multidisciplinary field. Together, however, they form a comprehensive picture of what facility management is and what importance it has for modern organizations. It is important to see FM as a strategic function that contributes to the **success of the organization** not only in terms of efficiency and cost, but also in terms of **employee satisfaction, safety, sustainability**, and overall value.

The main goals of facility management are:

1. Increase efficiency and productivity: Create an optimal work environment that supports employee performance.
2. Cost optimization: Efficient management of operating costs and the search for savings.
3. Ensuring health and safety: Creating a safe and healthy working environment.
4. Increasing the value of real estate: Taking care of real estate and its technical equipment in order to preserve its value.
5. Supporting the organization's core business: Ensuring that support processes run smoothly so that the organization can fully focus on its core business.

Maintenance is the element in facility management that gives building management professional weight. Without it, FM would be just an administrative service with no real impact on the physical essence of the building. An integrated approach to maintenance allows building owners to sleep peacefully, tenants to work efficiently, and buildings to age with honor. It is an investment in the future that pays off in the form of reliability, safety and lower total cost of ownership over the life cycle of the building.

The implementation of facility management brings a number of benefits to organizations, including:

1. Cost savings: Efficient management and optimization of operating costs.
2. Increase productivity: Create an optimal working environment.
3. Improving service quality: Professional management of support services.
4. Increasing employee satisfaction: Creating a comfortable and safe working environment.
5. Increasing the value of real estate: Taking care of real estate and its technical equipment.

Facility management is an important part of modern management of organizations and contributes to their effective functioning and success.

According to the International Facility Management Association (IFMA), Facility Management (hereinafter referred to as FM) is the "way in which organizations coordinate workers, work activities and work environments in organizations, including the architecture, business administration, technical and human science."¹⁵

Standard STN EN ISO 41011 defines facility management as: "Integration of processes within an organization to help ensure and develop agreed services that help and streamline the organization's core business."¹⁶

According to the BIFM: "The British National Association" currently IWFM (Institute of Workplace and Facilities Management) is FM: "By integrating many disciplinary activities into the building environment and diluting their impact on people and the workplace as part of the building"

According to the "GEFMA": "German National Organization of Facility Managers", FM is defined as: "analysis and optimization of all processes relevant to the costs associated with the building that are not part of its core business."¹⁷

The goal of FM is: "to reinforce all processes, with the help of which workers work with the highest efficiency in the workplace, thus ensuring the overall economic growth and success of the organization."¹²

¹⁵ SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

¹⁶ STN EN 15221-1. Facility management. Terms and definitions. Bratislava. SÚTN.

¹⁷ SOMOROVA, V.: Facility management. 2014. Professional publishing Prague. ISBN 978-80-7431-141-3.

Facility management is the management and maintenance of buildings and their surroundings, including the provision of all support services that are necessary for their effective functioning. This definition is concise and understandable to the general public.

Definition with an emphasis on strategy: Facility management is the strategic management of all aspects of the built environment in order to optimize costs, minimize risks and maximize value for the organization. This definition emphasizes the strategic importance of facility management for the success of an organization.

Definition with sustainability in mind: Facility management is a holistic approach to the management of the built environment that takes into account environmental, social and economic aspects in order to achieve sustainable development. This definition emphasizes the importance of sustainability in the context of facility management.

Management is: "a dynamic process in which managers in the context of an ever-changing environment endeavor, through the human potential of an organization, to achieve its goals in the efficient and efficient use of scarce resources."¹⁸

When comparing these definitions, we can identify several key elements that are repeated in them:

1. Integration: Facility management integrates various activities and processes to ensure the efficient functioning of the organization.
2. Support: Facility management supports the core business of an organization by ensuring that support processes run smoothly.
3. Efficiency: Facility management focuses on optimizing costs and maximizing value for the organization.
4. Environment: Facility management deals with the management and maintenance of the built environment, including buildings and their surroundings.

¹⁸ PAPULA, J., PAPULOVÁ, Z.: Strategy and strategic management. 2013. Publishing Iura Edition Bratislava. ISBN 978-80-8078-655-7.

5. **People:** Facility management takes into account the needs of the people who work in a given environment.

According to FM, the processes that take place in a building are divided into main and supportive. Building maintenance in facility management is one of the dominant support activities.

1.1.1 FACILITY MANAGER AND MAINTENANCE

The role of a facility manager in building maintenance is often compared to that of a director or conductor. He is not a person who necessarily has to hold a screwdriver in his hand, but he is a professional who is responsible for ensuring that all building systems work in perfect harmony, are safe and are economically sustainable. His work begins where simple repairs of defects ends, and extends to the strategic management of the entire life cycle of the construction. A facility manager is responsible for planning, managing, coordinating and controlling all activities related to facility management. He must have a broad knowledge of various fields such as technology, economics, law, safety and environmental management. Communication and management skills are also important.

A facility manager plays a crucial role in the efficient functioning of organizations by ensuring the smooth operation of real estate, infrastructure, and support services. His tasks are extensive and multidisciplinary, ranging from technical management of buildings to contract management and communication with suppliers.

The role of the facility manager is therefore about **balance**. It must balance the technical needs of the building with the financial capabilities of the owner and the comfort requirements of the users. He is an expert who turns an anonymous building into a living, safe and efficient space, and his greatest achievement is when users are not even aware of how much work is being done in the background to make everything work flawlessly.

In general, the tasks of a facility manager can be summarized in several key areas:

1. **Property and infrastructure management:** Ensuring the operation, maintenance, repair and modernization of buildings, technical equipment

(heating, ventilation, air conditioning, electrical installations, elevators, fire protection systems, etc.) and outdoor areas.

2. Operating cost management: Optimize costs for energy, water, waste, maintenance, cleaning, and other operational services.
3. Contract management with suppliers: Searching, selecting, concluding contracts and checking the performance of contracts with service suppliers (cleaning, guarding, maintenance, revisions, etc.).
4. Health and safety: Ensuring compliance with safety regulations, fire protection, occupational health and crisis management.
5. Space and Work Environment Management: Optimizing the use of space, planning and implementing changes in the interior, ensuring a comfortable and productive working environment.
6. Energy management: Monitoring and optimizing energy consumption, implementing energy-efficient solutions and reducing environmental impact.
1. Communication and reporting: Communication with the organization's management, employees, suppliers and other stakeholders, regular reporting on the status and performance of FM.

Specific activities that a facility manager performs include, for example:

1. Planning and budgeting: Developing annual plans and budgets for the FM department.
2. Keeping records of real estate and technical equipment: Recording information on condition, maintenance and inspections.
3. Organizing and coordinating maintenance and repairs: Planning preventive maintenance, dealing with emergency situations, and quality control of the work performed.
4. Developing and implementing safety regulations and procedures: Ensuring the safety of persons and property.
5. Monitoring and evaluation of key performance indicators (KPIs): Monitoring the effectiveness of FM processes and identifying areas for improvement.
6. Project Management: Carrying out minor construction modifications, refurbishments, and other projects related to property management.

7. Collaboration with internal departments: Communication and coordination with other departments in the organization (e.g., IT, HR, finance).

A successful facility manager should have a combination of technical, managerial and interpersonal skills. Important requirements include:

1. Technical knowledge: Knowledge in construction, technical equipment, energy and security.
2. Management skills: The ability to plan, organize, manage, and control.
3. Communication and interpersonal skills: The ability to communicate effectively with different groups of people.
4. Analytical and decision-making skills: The ability to analyze data, identify problems, and make the right decisions.
5. Knowledge of legislation: Knowledge of applicable laws and regulations in the field of property management, health and safety.

A facility manager plays a key role in ensuring the effective functioning of an organization. Its benefits consist of:

1. Reducing operating costs: By optimizing energy consumption, maintenance and other operational services.
2. Increasing employee productivity: By creating a comfortable and productive work environment.
3. Increasing the value of real estate: By taking care of real estate and its technical equipment.
4. Ensuring health and safety: Minimising risks and ensuring compliance with safety regulations.

Facility manager is responsible for the comprehensive management and operation of properties and support services, contributing to the efficient functioning and success of the organization. Its role is becoming increasingly important in the modern business environment, where the emphasis is on efficiency, sustainability and the quality of the working environment.

KPI "Key Performance Indicators" are: "Criteria that provide substantial information on the quality of the Facility Management Facility service."¹³

KPIs play a key role in facility management in measuring, evaluating and improving the performance of services provided and the overall effectiveness of property management and support processes. They are measurable metrics that provide objective information about the achievement of set goals and allow you to track progress over time.

KPIs in FM are defined as measurable values that demonstrate how effectively an organization is achieving key goals in building management, infrastructure, and support services. Their main purpose is:

1. Performance measurement: They provide quantifiable data on the efficiency of various FM processes and services.
2. Progress assessment: They allow you to monitor whether the organization is getting closer to the set goals and identify areas where improvement is needed.
3. Decision-making: They provide the basis for informed decision-making about resource allocation, process optimization, and change implementation.
4. Communication: They serve as a tool to communicate the performance of the FM department to the organization's leadership, clients, and other stakeholders.
5. Benchmarking: They allow you to compare your organization's performance with other organizations in the industry and identify best practices.

KPIs in FM can be divided into several categories according to the area they focus on:

1. Financial KPIs: They focus on the cost and efficiency of managing funds. Examples: Operating costs per square meter, maintenance costs, return on investment for FM projects.
2. Operational KPIs: They focus on the efficiency and quality of the services provided. Examples: the level of user satisfaction with cleaning services, the number of emergency interventions, the response time to requests.
3. Technical KPIs: They focus on the condition and functionality of technical equipment and infrastructure. Examples: energy consumption of a building, failure rate of technical equipment, maintenance efficiency.

4. Environmental KPIs: They focus on the environmental impact of activities. Examples: CO2 emissions, water consumption, amount of waste produced.
5. Human Capital Focused KPIs: They focus on employee satisfaction and productivity. Examples: FM staff turnover rate, number of training and training sessions.

Examples of specific KPIs in FM:

1. Energy costs per square metre (EUR/m²): Energy management efficiency indicator.
2. User satisfaction rate with cleaning services (%): An indicator of the quality of cleaning services.
3. Average Request Response Time (hours): An indicator of the effectiveness of the helpdesk or service department.
4. Failure rate of the heating system (%): An indicator of the reliability and condition of technical equipment.
5. Recycled share of waste (%): Environmental responsibility indicator.

When selecting and implementing KPIs, it is important to observe the following principles:

1. SMART criteria: KPIs should be Specific, Measurable, Achievable, Relevant, and Time-Bound (SMART).
2. Link to strategic objectives: KPIs should directly support the achievement of the organisation's strategic objectives.
3. Data availability: Ensure that relevant data is available to measure KPIs.
4. Regular monitoring and reporting: KPIs should be regularly monitored and reported to the organization's leadership.
5. Review and update: KPIs should be reviewed and updated regularly to reflect the changing needs of the organization.

KPIs are a key tool for continuous improvement in FM. Regular monitoring and analysis of KPIs allows you to identify areas where improvement is needed and implement corrective actions. Subsequent measurement of KPIs after the implementation of changes makes it possible to verify their effectiveness and monitor the progress made. This cycle of continuous improvement leads to

process optimization, cost reduction, increased service quality, and overall FM efficiency.

KPIs are essential for effective facility management. They provide objective performance information, track progress, and support data-driven decision-making. Their correct selection, implementation and regular monitoring are key to achieving the set goals and continuous improvement in FM.

Maintenance process sheets are: "thoroughly defined process parameters as well as a detailed description of the process. The process sheets also include an analysis of how the service works for the organization's core activities."¹⁹

Process sheets play an important role in facility management (FM) in standardizing, documenting and managing individual activities and processes. These are detailed descriptions of individual workflows that ensure the consistency, efficiency and quality of the services provided.

A process sheet is a document that details the sequence of steps required to perform a particular activity or process. It contains information on:

1. Purpose of the process: What the process is intended to achieve.
2. Process input and output: What resources are needed to start the process and what is its outcome.
3. Process steps: A detailed description of each step in chronological order.
4. Responsibilities: Who is responsible for each step of the process.
5. Resources and tools used: What materials, equipment, or software are used in the process.
6. Success criteria and measurements: How the success of the process is evaluated and what indicators are monitored.
7. Related documents and regulations: What standards, regulations, or internal guidelines apply to the process.

Process sheets have several key benefits in facility management:

¹⁹ STN EN 15221-3 Facility management. Part 3: Guidelines for quality in facility management. Bratislava. SÚTN.

1. Standardization of processes: They ensure a uniform procedure in performing the same activities, minimizing deviations and errors.
2. Increase efficiency: A detailed description of steps and responsibilities allows you to optimize processes and reduce waste of time and resources.
3. Improve quality of service: Standardized procedures ensure consistent quality of service delivery.
1. Facilitate the onboarding of new employees: Process letters serve as teaching material and facilitate the onboarding of new employees.
2. Improved communication: A clear description of processes facilitates communication between employees, suppliers, and clients.
3. Audit and control support: Process letters serve as a basis for internal and external audits and controls.
4. Risk management: By identifying critical points in the process and establishing control mechanisms, the risk of problems is reduced.

Process sheets can be used for a wide range of activities in facility management, such as:

1. Maintenance and repairs: Procedure for replacing a light bulb, repairing a faucet, checking the heating system.
2. Cleaning: The procedure for cleaning offices, sanitary facilities, common areas.
3. Safety and Security: Procedure for evacuating a building, dealing with fire, checking security systems.
4. Energy management: Procedure for reading energy levels, monitoring consumption, optimizing heating settings.
5. Space management: Procedure for moving offices, changing the layout of spaces, managing meeting rooms.

Although the structure of a process letter may vary slightly depending on the specific organization and type of process, it typically includes the following sections:

1. Process ID: Process name, version number, date created/updated.
2. Purpose of the process: A brief description of the purpose and objective of the process.

3. Scope: Which departments, buildings, or locations are affected by the process.
4. Definitions: Explanation of important terms used in the process.
5. Process Input: A description of the input information, materials, or resources.
6. Process procedure: A detailed description of each step in chronological order, including responsibilities, tools used, and success criteria.
7. Process output: A description of the process result.
8. Related documents and regulations: A list of relevant standards, regulations, directives and other documents.
9. Attachments (optional): For example, forms, checklists, diagrams.

When creating process letters, it is important to involve the employees who carry out the process in order to take into account their practical experience. Once the process sheets have been created, they need to be implemented, employees trained and complied with. Regularly reviewing and updating process letters is essential for their continued relevance and efficiency.

Process sheets are a valuable tool for effective facility management. Their correct creation, implementation and compliance contribute to the standardization of processes, improvement of service quality, increased efficiency and reduction of risks.

1.1.2 ARTIFICIAL INTELLIGENCE IN FM

The advent of artificial intelligence (AI) in the field of building management and facility management (FM) marks a fundamental technical revolution. While until now we have relied on fixed calendars or human intuition for maintenance, AI brings the ability to "predict the future" based on huge amounts of data. In the context of building structures, this means a shift from passive condition monitoring to active management of the building's lifespan.

From preventive to predictive maintenance The main benefit of AI is the so-called **predictive maintenance**. In a building equipped with sensors, artificial intelligence constantly monitors factors such as vibrations of load-bearing elements, moisture in the masonry, temperature fluctuations or micro-movements in cracks. While a human only notices a problem when it is visible to the naked eye, AI can identify anomalies in data much earlier. For example, by

analyzing vibrations in the machine park or stresses in a steel structure, an algorithm can predict a failure weeks before it actually occurs.

Facility Management (FM) plays a vital role in ensuring that buildings operate efficiently, safely and sustainably. It covers a wide range of responsibilities, including maintenance, space management, documentation, safety procedures and energy control. However, many organisations still rely on manual inspections, paper-based workflows and reactive responses to equipment failures, which often leads to higher operational costs and reduced system reliability ²⁰

With the rapid growth of smart technologies, Artificial Intelligence (AI) is becoming a transformative tool in FM. AI allows managers to analyse large quantities of building data, identify faults early and optimise maintenance planning. Research shows that integrating AI with IoT sensors, BIM platforms and Digital Twin technologies can significantly improve building performance and reduce downtime.²¹

This paper provides an integrated review of five scientific studies to explain how AI supports Facility Management, what advantages it brings and what challenges still limit its full adoption.

Facility Management is defined as the coordination of people, spaces, processes and technologies to ensure the functional performance of the built environment. It includes maintaining mechanical and electrical systems, managing energy use, ensuring occupant safety and supporting long-term asset performance. Modern FM depends increasingly on accurate data and timely decision-making, which makes digitalisation a key priority in the sector.

Maintenance is a core FM activity and can be classified into three major approaches:

Corrective maintenance: repairing equipment after it fails

Preventive maintenance: performing scheduled inspections

Predictive maintenance: anticipating failures before they occur

²⁰ Quinello, R. & Nascimento, P.T.S. (2025) The Use of Artificial Intelligence in Facilities Management: Potential Applications from Systematic Literature Review. *Artificial Intelligence and Applications*, 3(3), 223–235. DOI:10.47852/bonviewAIA52023691

²¹ Masud, S.B., Chowdhury, S.A., Abubakkar, M., Sozib, H.M., Bellal, R.B., Hoque, A. & Shafi, S.B. (2025) The Revolution of AI in Enhancing Infrastructure and Facilities Management. *Cuestiones de Fisioterapia*, 54(4), 5605–5624. DOI: 10.48047/bb97xk66

Predictive maintenance is gaining importance because it uses continuous sensor data to detect abnormal behaviour in building systems. A study on HVAC systems demonstrates that machine-learning models—such as autoencoders and LSTM networks—can successfully identify anomalies and predict failures, reducing downtime and energy waste. ²²

Predictive maintenance represents a major shift in FM because it allows organisations to move from reactive repairs to proactive planning. Sensors measure temperature, vibration, pressure and other operational variables. When the data is analysed through AI algorithms, facility managers receive early warnings, enabling timely interventions and preventing costly breakdowns.

Artificial Intelligence strengthens FM by analysing data patterns, detecting system faults and optimising maintenance tasks. Research shows that AI significantly improves infrastructure performance when combined with IoT devices and automated data collection. ²³

AI supports FM in several ways:

- Fault detection: recognising unusual system behaviour
- Predictive modelling: forecasting equipment performance
- Energy optimisation: adjusting building systems for efficiency
- Decision support: automating repetitive analysis tasks

One of the reviewed studies emphasises that AI helps reduce operational disruptions and maintenance costs by identifying issues earlier than traditional systems.

Building Information Modelling (BIM) provides structured digital data about building components, including material specifications, maintenance history and spatial information. When BIM is integrated with AI, facility managers gain improved asset classification, automated data extraction and more accurate fault detection. A systematic review shows that combining AI with BIM enhances

²² Bouabdallaoui, Y., Lafhaj, Z., Yim, P., Ducoulombier, L. & Bennadji, B. (2021) *Predictive Maintenance in Building Facilities: A Machine Learning-Based Approach*. *Sensors*, 21(4), 1044. <https://doi.org/10.3390/s21041044>

²³

Masud, S.B., Chowdhury, S.A., Abubakkar, M., Sozib, H.M., Bellal, R.B., Hoque, A. & Shafi, S.B. (2025) *The Revolution of AI in Enhancing Infrastructure and Facilities Management*. *Cuestiones de Fisioterapia*, 54(4), 5605–5624. DOI: 10.48047/bb97xk66

decision-making and maintenance planning, although challenges remain related to data standardisation and software interoperability.²⁴

BIM is especially useful for large facilities containing complex building systems, as it centralises information into a single digital environment accessible for FM tasks.

Digital Twin (DT) technology expands BIM by creating a real-time digital replica of a physical building. DTs integrate BIM data, IoT sensor streams and AI analytics to simulate building performance, detect faults immediately and optimise system behaviour. A recent study on mega-facilities such as hospitals and airports show that Digital Twins can reduce maintenance costs by 25% and improve energy efficiency by around 20%.²⁵

Digital Twins allow FM teams to:

- Monitor systems continuously
- Run predictive simulations
- Improve long-term planning
- Visualise equipment behaviour in real time

This combination makes DTs one of the most advanced tools in digital FM.

Despite the clear benefits of AI, several studies highlight that FM organisations face major barriers:

- Limited digital skills and training
- Lack of integration between digital platforms
- Fragmented organisational processes
- Resistance to adopting new technologies

A systematic review confirms that digital maturity in FM remains low, which slows down the transition to AI-supported operations.²⁶

These challenges indicate that successful AI adoption requires technical training, organisational readiness and improved software interoperability.

²⁴ Sampaio, R.P., Costa, A.A. & Flores-Colen, I. (2022) *A Systematic Review of Artificial Intelligence Applied to Facility Management in the BIM Context and Future Research Directions*. *Buildings*, 12(11), 1939. DOI: 10.3390/buildings12111939

²⁵

Abdelalim, A.M., Essawy, A., Sherif, A., Salem, M., Al-Adwani, M. & Abdullah, M.S. (2025) *Optimizing Facilities Management Through Artificial Intelligence and Digital Twin Technology in Mega-Facilities*. *Sustainability*, 17(5), 1826. <https://doi.org/10.3390/su17051826>

²⁶ Quinello, R. & Nascimento, P.T.S. (2025) *The Use of Artificial Intelligence in Facilities Management: Potential Applications from Systematic Literature Review*. *Artificial Intelligence and Applications*, 3(3), 223–235. DOI: 10.47852/bonviewAIA52023691

The combined findings show strong agreement across the reviewed studies regarding the value of AI in Facility Management. All studies emphasise that AI enables a shift from reactive problem-solving toward proactive and predictive maintenance. This transition leads to reduced downtime, improved operational efficiency and more effective use of resources. Predictive maintenance, supported by machine-learning models and IoT sensors, appears in every study as one of the most impactful applications of AI in FM.

Another important theme is the role of digital technologies—particularly BIM and Digital Twins—in enhancing AI's effectiveness. BIM provides structured information that AI can analyse, while Digital Twins offer real-time visualisation and simulation capabilities. This combination allows facility managers to understand system behaviour more clearly, anticipate failures, and evaluate the impact of maintenance decisions before implementing them in the physical environment.

However, the literature also consistently points to challenges. Many organisations lack the technical expertise needed to work with AI and advanced digital platforms. Another major barrier is the lack of interoperability between different software systems. In many cases, BIM models, IoT sensor networks and FM databases do not communicate smoothly, limiting the accuracy and usefulness of the data. Resistance to organisational change and limited budgets further delay digital transformation efforts.

Overall, the reviewed studies suggest that AI has the potential to dramatically improve Facility Management, but its success depends on more than just technological advancements. Training, system integration, data governance and organisational commitment are essential components of successful implementation. The future of FM will likely involve a combination of human expertise and AI-driven tools working together to create safer, more efficient and sustainable building environments.

This literature review shows that Artificial Intelligence significantly enhances Facility Management by supporting predictive maintenance, real-time monitoring and data-driven decision-making. When combined with BIM and Digital Twin technologies, AI enables more accurate simulations, reduces system failures and improves energy efficiency in complex buildings. However, low digital maturity, skill gaps and integration challenges continue to slow down AI adoption in FM organisations. To fully benefit from AI, FM teams must invest in training, digital

strategies and improved data integration across platforms. Overall, AI represents a powerful opportunity to transform Facility Management and support smarter, more sustainable building operations.

Thanks to AI, the building ceases to behave like a "dead" object and becomes more of a living organism that communicates with its administrator through sensors. The role of the facility manager is changing from "problem solver" to "data analyst". AI doesn't take away his job, but relieves him of uncertainty and routine, allowing him to focus on strategically increasing the value of the property. Ultimately, AI-managed buildings are not only safer and more resilient, but also much cheaper to operate for the long term

1.2 BUILDING MANAGEMENT AND MAINTENANCE

Structural maintenance is a key discipline in building management and facility management (FM), ensuring not only the physical existence of the building, but also its economic value and safety for users. While normal management often focuses on visible services such as cleaning or reception, **technical maintenance of load-bearing and non-load-bearing structures** forms an invisible foundation, without which the building would cease to fulfil its function.

In professional building management, maintenance does not start only when there is a visible failure, but with systematic monitoring of all elements of the building. In particular, **protection against moisture**, which is the most common trigger for degradation, requires critical attention. The building manager oversees the integrity of the foundation structures and horizontal insulation to prevent water from rising that could compromise the stability of the masonry.

Equally important is **the external cladding and façade**. Here, maintenance does not only look at aesthetics, but above all energy efficiency and weather protection. Regular inspection of expansion joints, seals around windows and the condition of thermal insulation systems prevents the formation of thermal bridges and the subsequent formation of mold, which reduces the quality of the indoor environment. A special chapter is **roof structures**, where even a small neglect of cleaning drains or repairing a small crack in waterproofing can lead to extensive damage to technologies and interior equipment.

Combining structural engineering expertise with building management processes yields measurable results. For the owner, this means **extending the life of the**

property and protecting the investment. A well-maintained building has a higher value in the market and lower operating costs. For tenants and employees, quality maintenance means safety and comfort. A statically stable building without leakage, with functional acoustics and a healthy microclimate is the basis for a productive environment.

In the past, we thought of building care as simple – there was a caretaker or handyman who repaired what had broken and a cleaner who cleaned the hallway. Today, however, the term Facility Management (FM) has been introduced. Although it sounds like a foreign corporate name, in practice it is a logical and inevitable shift. Modern buildings are full of technology, expensive materials and energy systems, so their management can no longer work on the principle of "I fix it when it falls". Facility management is about how to align space, people and technology so that the building works efficiently and cheaply.

Building management is a complex set of activities that ensure the smooth operation, maintenance and long-term functionality of a building. It includes a wide range of tasks, from technical services to administrative activities, with the aim of maintaining the building in optimal condition and providing users with a comfortable and safe environment.

Facility management (FM) is aimed at optimizing and streamlining the operation of buildings and all services associated with it. It is a modern approach to property management that goes beyond traditional maintenance and includes a wide range of activities from technical services to human resources management. Facility management is a complex and dynamic process that requires professional knowledge and experience. Its goal is to ensure that the building is functional, safe, comfortable and energy efficient. By implementing facility management, organizations can significantly improve their efficiency and reduce operating costs.

The current situation in the economy of the Slovak Republic is in a difficult situation. The field of facility management is no exception. Facility management is, according to the international organization of facility management, a way to coordinate workers, work activities and the work environment in organizations, which includes the laws of architecture, business administration, technical and humanities. The goal of FM is strengthening all processes with the help of which

workers work with the highest efficiency in the workplace and thus ensure the overall economic growth and success of the organization.²⁷

Standard ISO 41011 defines facility management as integrating processes within the organization, with the help of which agreed services are secured and developed, which help and make the basic activities of the organization more efficient.²⁸

The task of FM is to make correct decisions and manage all supporting activities of companies and organizations. At a time of rising energy prices, inflation, operating costs, wages, or increasing all inputs, the involvement of facility management is essential. The general effort is to ensure the functioning of businesses and organizations that facility managers and strategic management of organizations have the opportunity to influence.

Currently, the greatest degree of influence on the functioning of companies and organizations is exerted by:

- the state, together with possible regulations and measures,
- great market volatility, even increasing in all areas,
- security of supply chains,
- the international situation affecting a range of factors.

According to the available financial and statistical data, the current state only for selected indicators that have an impact on the operation of buildings: material prices, construction production and the actual construction of apartments - their quantity.

The general view of the situation of facility management in Slovakia in 2025 is influenced by two important events. The beginning of the year is still marked by the ongoing coronavirus pandemic, and the second event is the international situation in Ukraine.²⁹

During the coronavirus pandemic, providers largely implemented measures, e.g.:

²⁷ SOMOROVÁ, V., 2010. Údržba budov. Facility management. Bratislava: Publishing STU. ISBN 978-80-227-3372-4.

²⁸ STN EN ISO 41011: 2024. Facility management. Vocabulary

²⁹ Stavmag.sk, 2024. Stavebný materiál v roku 2024 – aké sú prognózy vývoja cien? [accessed at 2024-11-09]. Available at: <https://stavmag.sk/2024/06/09/stavebny-material-v-roku-2024-ake-su-prognozy-vyvoja-cien/>

- implementation of new guidelines and measures in health and safety, regular informing of employees,
- cancellation of larger events,
- introduction of home office, stoppage of work/business trips,
- digitization,
- other measures.

During the coronavirus pandemic, clients largely implemented measures, e.g.:

- increased cooperation with facility managers, facility management providers,
- introduction of home office, stoppage of work/business trips,
- implementation of new health and safety guidelines, regular informing of employees,
- cancellation of larger events,
- digitization,
- other measures.

The current situation is significantly influenced by the situation in Ukraine, international sanctions, and the related measures of state authorities. Providers of facility management services as well as clients must solve and propose several measures.

Facility management service providers claim:

- high inflation in all market segments and pressure to increase wages (including the minimum wage),
- high inflation, increasing prices of materials, technical equipment, and the necessity of opening tendered contracts due to increasing operating costs of buildings,
- lack of goods, late delivery times and related penalties,
- reduction of areas in administrative buildings by the introduction of "home office" and the resulting pressure to reduce prices while maintaining the same quality of building management, property management,
- high competition between FM service providers, unfair practices in competition,
- compared to the previous period, there is a general shortage of workers and equally qualified workers. An improvement would be an increased quality of education (education, postgraduate education, professional education),

- the time allocated for the training of workers increases. Applying new control IT systems and the increasing complexity of operating these systems. The unification of IT systems in facility management would help,
- additional.

Clients of facility management services in the context of the current situation are implementing measures:

- reduction of operating costs by introducing a "home office" and reduction of own space needs, increased interest in the use of shared offices,
- reducing investments in buildings (reconstruction, modernization),
- due to inflation and the increase in the prices of goods, the opening of selection procedures, tenders, e.g.: energy, furniture, services,
- additional.

1.2.1 BUILDING MANAGER AND MAINTENANCE

Building management is a complex activity that includes all actions related to maintaining a building in good technical and functional condition. This is a long-term process that requires a systematic approach and expertise. Building management is important, especially from a financial point of view.

Regular maintenance and repairs extend the life of the building and delay the need for costly renovations or even new construction.

Energy efficiency, optimization of water consumption and regular revisions of technical equipment significantly reduce operating costs.

Good building management increases the value of the property and improves its attractiveness to potential tenants or buyers.

Regular inspections and repairs ensure the safety of building occupants and increase their comfort.

The management of the building must comply with the legislation in force to avoid penalties.

Key areas of building management from a financial point of view:

Energy efficiency: Implementation of energy-saving measures such as insulation, replacement of windows, installation of solar panels or heat pumps.

Maintenance and repairs: Regular inspections and repairs of all technical equipment, such as heating systems, air conditioning, electrical installations, etc.

Refurbishment: Planning and executing major renovations that are essential to maintain the functionality and value of a building.

Insurance: Ensuring comprehensive insurance of the building and its facilities against various risks.

Facility management: Comprehensive management of all services related to the operation of the building, such as cleaning, security, management of green areas, etc.

Financial aspects of building management:

Budgeting: Drawing up a detailed budget for maintenance, repairs, and refurbishments.

Evaluating the return on investment: Analysis of the costs and benefits of individual measures.

Cost optimization: Finding the most advantageous suppliers and materials.

Financing: Raising funds for the implementation of investment actions.

Building management is a strategic activity that has a significant impact on the economy of the owner or operator of a building. A well-managed building is a long-term investment that brings savings, increases the value of the property and ensures the comfort and safety of its users.

Floor area: the area of all rooms of an apartment or non-residential space without the area of the balcony, loggia and terrace, except for the terrace, which is not a common part of the building; the floor area of the apartment also includes the area of rooms that make up the accessories of the apartment.

Common part of the building: the part of the building necessary for its essence and safety, in particular the foundations of the building, the roof, the corridor, the walls in contact with the exterior, the façade, the entrances, the staircases, the terrace, the attic, the horizontal load-bearing and insulation structures, the vertical load-bearing structures, as well as the room of the building, which is intended for the common use and location of technological equipment, in particular the laundry room, boiler room, drying room or pram room.

Common equipment of the building: technological equipment that is intended for common use and serves exclusively this building, even if it is located outside the building, in particular:

- an elevator,
- equipment for the production of heat and hot water,
- air conditioning,
- common electrical and telecommunication wiring,
- lightning rod,
- chimney,
- water connection,
- heat transfer connection,
- sewer connection,
- electrical connection,
- gas connection,
- telecommunication connection.

Accessories of the building: buildings located on the adjacent land, which are intended for common use and serve exclusively this building, while they are not a construction part of the house, in particular shelters, sheds, gazebos

Operation: activities and means necessary for the regular maintenance of the common parts of the house, common facilities of the building, accessories of the building and the adjacent land in a condition suitable for their proper use; mandatory revisions of technical equipment according to the Act No. 314/2001 Coll. on Fire Protection³⁰, Act No. 124/2006 Coll. on Occupational Health and Safety and on Amendments to Certain Acts³¹, Act No. 355/2007 Coll. on the Protection, Promotion and Development of Public Health³² and on Amendments to Certain Acts, Act No. 56/2018 Coll. on Product Conformity Assessment, Making a Specified Product Available on the Market³³ and on Amendments to Certain Acts.

³⁰ Act No. 314/2001 Coll. on Fire Protection, as amended.

³¹ Act No. 124/2006 Coll. on Occupational Health and Safety, as amended.

³² Act No. 355/2007 Coll. on the Protection, Promotion and Development of Public Health, as amended.

³³ Act No. 56/2018 Coll. on Product Conformity Assessment, Making a Specified Product Available on the Market, as amended.

Maintenance: activities that are necessary to maintain the original standard and quality of the common parts of the building, the common facilities of the building and the accessories of the building, as well as the elimination of deficiencies detected by the service inspection.

Repair: removal of partial physical wear and tear or damage to the common parts of the building, common facilities of the building and accessories of the building due to their restoration to their previous condition or working order.

Reconstruction: interventions in the common parts of the building, common facilities of the building and accessories of the building, which mean a change in their quality or technical parameters.

Modernisation: renewal, improvement or extension of the facilities and usability of the common parts of the building, the common facilities of the building and the accessories of the building.

Storage space: a part of the non-residential space in the building designated by the occupancy certificate of the building authority for storage, which is physically separated from other parts of this non-residential space, if it is not an accessory of the apartment.

Building Rules: a set of rules and principles of observing good morals in the exercise of the rights and obligations of owners and tenants of apartments and non-residential premises in the building, persons who live with the above persons in the same household, as well as persons staying in the building, when using the common parts of the building, common facilities of the house, accessories of the house and adjacent land approved by the owners of apartments and non-residential premises in the building.³⁴

Building management is carried out by the association of owners of apartments and non-residential premises in the building (hereinafter referred to as the

³⁴ Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

"community") or by another legal entity or natural person with whom the owners of apartments and non-residential premises conclude a contract on the performance of administration (hereinafter referred to as the "building manager (BM)").

Owners of apartments and non-residential premises in the building are obliged to ensure the building management by the community or BM. The obligation to manage the building arises on the day of the first transfer of ownership of the apartment or non-residential space in the building. The obligation to manage a building does not apply to family houses, houses in which all apartments and all non-residential premises are owned by the same owner; the obligation to manage arises if at least one apartment or one non-residential premises is acquired by another owner.

Building management is the procurement of services and goods by which the BM or community provides the owners of apartments and non-residential premises in the building:

- operation, maintenance, repairs, reconstruction and modernization of common parts of the house, common facilities of the house, adjacent land and accessories,
- services related to the use of an apartment or non-residential premises,
- maintaining a house account in a bank,
- recovery of damages, arrears in the operation, maintenance and repair fund and other receivables and claims,
- other activities that are directly related to the use of the building as a whole by individual owners of apartments and non-residential premises in the building.

Several forms of building management must not be agreed at the same time for the administration of the building. For administration in one building, there may be a contract with only one BM or only one contract of community.

Building manager (BM) may be a legal entity or a natural person entrepreneur who has the management and maintenance of the housing stock in the scope of business or in the subject of activity; manager who manages apartment buildings must also meet the conditions under special regulation 246/2015 Coll. The activity of the building manager may be performed only in accordance with Act 182/1993 Coll.

Any change, cancellation, merger or merger of building managers cannot be to the detriment of the owners. The building manager is obliged to immediately inform the owners of apartments and non-residential premises in the building about this fact.

Building manager is obliged to keep separate analytical accounts separately for each house he manages. The funds obtained from payments for services from the owners of apartments and non-residential premises in the building and the funds of the operation, maintenance and repair fund (hereinafter referred to as the "property of the owners") must be kept separately by the BM from the BM's bank accounts, separately for each managed building. The owners of the house account opened by the BM in the bank are the owners. The BM is competent to dispose of the funds in the account of the building and to exercise the rights and obligations of the depositor to this account according to Act 118/1996 Coll. on Deposit Protection.

The property of the owners is not part of the property of the BM.

The property of the owners may not be used by the BM to cover or pay liabilities that are not directly related to the activity associated with the building management.

The BM may not use the property of the owners for his own benefit or for the benefit of third parties.

The property of the owners cannot be part of the bankruptcy estate of the BM or the subject of enforcement of a decision under special regulations directed against the property of the building manager.

The building manager is liable to the owners of apartments and non-residential premises in the building for all damages incurred as a result of non-fulfilment or insufficient performance of his obligations arising from Act 182/1993 Coll. or from the contract on the performance building management.

Owners will conclude a written contract with BM on the performance of administration. A contract on the performance of building management, its amendment or termination is binding for all owners, if they are signed by the BM and a person authorized by the owners, while the authenticity of the signatures of these persons must be officially certified. Owners cannot terminate the contract on the performance of building management. The BM is obliged to deliver the approved contract and, if it is amended, the full text of the contract to each owner within 30 days of its approval by the owners of the apartments and non-residential premises in the building.

The building manager is obliged to submit to the owners a report on his activities for the previous year related to the building, in particular on the financial management of the building, on the condition of the common parts of the building and the common facilities of the building, as well as on other important facts related to the building management, by 31 May of the following year at the latest. At the same time, he is obliged to account for the use of the operation, maintenance and repair fund, payments for services distributed to individual apartments and non-residential premises in the building.

On the day of the end of the building management, all rights and obligations arising from contracts related to the building management and which were concluded on behalf of the owners of apartments and non-residential premises in the building, or from contracts concluded on the basis of the decision of the owners, to a new BM or to the community.

If the building manager fails to submit to the owners a report on his activities for the previous year concerning the house, a statement of the use of the fund for operation, maintenance and repairs and payments for services within the period referred to in paragraph 2 in Act 182/1993 Coll, he shall not be entitled to payments for the management until they are submitted; The BM is also not entitled to payment for management if he does not submit a repair plan for the following calendar year by 30 November of the current year. If, on the day of the end of the building management at the latest, the BM does not transfer the balance of funds in the house account in the bank to the account established by

the new administrator or the community, he is obliged to pay interest on late payment to the account of the house established by the new BM or community.

Communication between the owners and the BM is ensured by the representative of the owners elected by the owners. Only the owner can be a representative of the owners. The owner's representative informs the owners about the activities of the BM and about important issues related to the building management. The representative of the owners is obliged to apply the requirements of the owners to the BM in accordance with the contract on the performance of BM and the adopted decisions of the owners. The representative of the owners is not entitled to decide on matters that can only be decided by the owners.

OBLIGATIONS OF A BUILDING MANAGER

When managing a building, the BM is obliged to:

1. manage the property of the owners with professional care in accordance with the terms of the contract on the performance of building management,
2. ensure the protection of the rights of owners and prioritize their interests over their own,
3. represent the owners in the recovery of damage caused to them by the activities of third parties or by the activity of the owner,
4. exercise rights to the property of the owners only in the interest of the owners,
5. monitor payments for performances and payments of advances to the maintenance and repair operation fund from the owners and recover the arrears that have arisen,
6. convene a meeting of owners as needed, at least once a year, or when requested by the owners who have at least a quarter of the votes,
7. to prepare and submit annually by 30 November to the owners a repair plan for the following calendar year, which will take into account in particular the wear and tear of materials and the condition of the common parts of the building and the common facilities of the building, and to propose the amount of the fund for the operation of maintenance and repairs of the building for the calendar year,

8. submit a proposal for a voluntary auction of an apartment or non-residential premises in a building to satisfy claims on the basis of a decision,
9. file an application for enforcement proceedings,
10. to ensure all other activities necessary for the proper performance of the building management in accordance with the contract on the performance of building management and Act 182/1993 Coll,
11. to publish on an ongoing basis on the spot in the building usual in the common parts of the building or on the website of the BM, if he has one, the procedure for the procurement of goods and services, as part of ensuring the operation, maintenance, repair, reconstruction and modernization and all other activities related to the building management, including individual price offers.

When procuring services and goods, the BM is obliged to negotiate the most favourable conditions that could be negotiated for the benefit of the owners. The BM is obliged to follow the decision of the owners on the selection of a supplier, unless it is a matter of ensuring professional inspections and tests of technical equipment, which the BM is obliged to perform during the building management.³⁵

The BM or the community is entitled to process the personal data of the owners of apartments and non-residential premises in the building for the purposes of the building management in the scope of name, surname, date of birth, birth number, address of permanent or temporary residence, apartment number, telephone number, e-mail address, account number and bank code.

The BM or chairman is obliged to ensure the removal of a defect or malfunction of technical equipment that has been detected by checking the safety status of technical equipment if it poses an immediate threat to life, health or property, even without the consent of the owners of apartments and non-residential premises in the building.

³⁵ Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

The BM or chairman is obliged to ensure the removal of defects, malfunctions or damage to the common parts of the building, common equipment of the building and accessories, even without the consent of the owners, if they pose an immediate threat to life, health or property.

The Operation, Maintenance and Repair Fund finances expenses related to the costs of operating, maintaining and repairing the common parts of the building, common facilities of the building, common non-residential premises, accessories and adjacent land, as well as expenses for the renovation, modernization and reconstruction of the building. The Operation, Maintenance and Repair Fund also finances repairs of balconies, loggias and those terraces that are common parts of the building. The funds of the Operation, Maintenance and Repair Fund can be temporarily used to pay for services related to the use of apartments and non-residential premises in the building in the event of a temporary shortage. After bridging the lack of funds to pay for this performance, the said funds will be returned to the Operation, Maintenance and Repair Fund.

RIGHTS AND OBLIGATIONS OF OWNERS OF APARTMENTS AND NON-RESIDENTIAL PREMISES IN THE BUILDING

The owner has the right to inspect documents related to the building management or the drawing of the operation, maintenance and repair fund and make extracts, depreciations and copies of them.

Owners are obliged to enable the elimination of deficiencies identified by checking the safety status of technical equipment. If the owners of apartments and non-residential premises in the building do not allow the removal of the identified deficiencies in the technical equipment, they are responsible for the damage caused.

The owner who is structurally modifying an apartment or non-residential premises is obliged to grant access to the apartment or non-residential premises to the BM or the chairman in order to check whether the building modifications do not endanger, damage or alter the common parts of the building or the common facilities of the building. If the owner does not allow entry to the apartment or non-residential premises, the BM or chairman is obliged to notify

the relevant building authority of the implementation of construction modifications to the apartment or non-residential premises.

The ownership is inextricably linked to the co-ownership of the common parts of the house, common facilities of the building, accessories and co-ownership or other common rights to the land.

The owner has the right and obligation to participate in the building management and to decide by voting as a co-owner on all matters relating to the building management, common parts of the building and common facilities of the building, common non-residential premises, accessories and land developed by the building or adjacent land.

Decisions of the owners are made at the meeting of the owners or by written vote. For the purpose of deciding on the owners, the meeting of the owners is also considered to be the meeting of the owners.³⁶

³⁶ Act 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

2 MAINTENANCE MANUAL OF THE BUILDING STRUCTURES

Owning a property without a maintenance plan is like driving a car without an oil change – it works for a while, but the consequences are inevitable and always expensive. Building structures, whether they are single-family houses, apartment buildings or industrial halls, are subject to the constant influence of weather, aging of materials and operational loads. Planned maintenance is not just an "extra cost", but a strategic tool to manage these impacts. The basic argument for planning is the relentless mathematics of building physics. In practice, the rule of cost growth is often cited, which says that 1 euro invested in prevention saves 5 euros in timely repair and up to 25 euros in dealing with an emergency situation. When you plan roof maintenance (e.g. cleaning, puttying), it costs you hundreds of euros. If you neglect maintenance and it starts to leak, the water degrades the thermal insulation, plasterboard and plaster, which makes the repair run into the thousands. In the worst case, with long-term leakage, the statics will be disturbed (e.g. rotting of the truss), which represents a general reconstruction for tens of thousands. Thus, planning keeps your money in check and protects the value of the asset, which decreases faster than any other asset when neglected maintenance. In the current dynamic environment of construction and property management, FM plays a key role in ensuring the efficient operation and long-term sustainability of buildings. One of the important tools within FM is the building maintenance manual. This document is a comprehensive source of information that serves as a basis for planning, implementation and control of maintenance activities throughout the life of the building. A building maintenance manual is a detailed document that contains all relevant information about a building in terms of its maintenance. It includes technical data, maintenance procedures, inspection frequencies, spare parts lists, supplier contacts and other important information. It can be processed in printed or electronic form and should be updated over the lifetime of the building. One of the prerequisites for improving the maintenance of building structures is the creation of a maintenance manual which sets out the maintenance rules as defined in the plan for the use of public works. Wear and change of function is

compensated by the maintenance of building structures, which leads to the maintenance of the desired building characteristics.

Building maintenance is a part of the technical management of buildings that provides maintenance of building construction and maintenance of technical equipment installed in the building. Building maintenance in terms of facility management represents a complex of services designed to ensure the safe operation of buildings and their technologies. It's a continuous process.³⁷ According to STN EN 13306 maintenance is a combination of all technical administrative and management activities throughout the life cycle of a building to maintain or restore the condition in which it can perform the required function.³⁸ Standard STN EN ISO 41011 defines facility management as integration of processes within an organization to help ensure and develop agreed services that help and streamline the organization's core business.³⁹ The goal of FM is to reinforce all processes, with the help of which workers work with the highest efficiency in the workplace, thus ensuring the overall economic growth and success of the organization.⁴⁰

2.1 THE IMPORTANCE OF THE MAINTENANCE MANUAL IN FM

The maintenance manual plays an irreplaceable role in FM in several respects:

1. **Efficient maintenance planning:** The manual provides precise information about the maintenance requirements of individual devices and systems in the building. This allows facility managers to efficiently plan preventive maintenance, minimize the risk of breakdowns and extend the life of the building.
2. **Cost optimization:** With accurate maintenance information, service and repair costs can be optimized. Preventive maintenance, based on information from the manual, is generally less costly than reactive fault management.

³⁷ SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

³⁸ STN EN 13306. Maintenance. Maintenance terminology. Bratislava. SÚTN.

³⁹ STN EN ISO 41011. Facility management. Terms and definitions. Bratislava. SÚTN.

⁴⁰ SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

3. Increased safety: Regular inspections and maintenance, carried out according to the instructions in the manual, contribute to increasing the safety of the building for its users. This prevents accidents caused by neglected maintenance.
4. Improved uptime: A well-maintained building with functional systems ensures smooth operation and minimizes downtime caused by failures.
5. Increase in property value: A building with a demonstrable maintenance history and complete documentation, including a maintenance manual, has a higher value in the real estate market.
6. Support for audits and inspections: The maintenance manual serves as an important basis for audits and inspections, demonstrating compliance with maintenance regulations and standards.
7. Facilitate the transfer of information: The manual facilitates the transfer of information between individual members of the FM team and between suppliers. It ensures continuity and effective communication.

2.2 CONTENTS OF MAINTENANCE MANUAL OF THE BUILDING STRUCTURES

The maintenance manual should contain the following information:

1. General information about the building: Basic information about the building, its layout, building materials, etc.
2. Technical data on equipment and systems: Description of individual devices and systems (e.g. heating, ventilation, air conditioning, wiring, plumbing), their technical parameters, diagrams and drawings.
3. Maintenance procedures: Detailed descriptions of maintenance activities for individual equipment and systems, including the frequency of maintenance, necessary tools and materials.
4. Spare parts lists: Lists of recommended spare parts for each device, including order numbers and supplier contacts.
5. Contacts for suppliers and service organizations: A list of contacts for equipment suppliers and service organizations that provide maintenance and repairs.
6. Preventive Maintenance Plans: Schedules for preventive inspections and maintenance activities.

7. Review and control documentation: Records of the revisions and controls performed, including dates, results, and any deficiencies found.

The Building Maintenance Manual is an indispensable tool for effective maintenance management within facility management. Its implementation brings several benefits, from cost optimization and increased safety to extending the life of the building and increasing its value. Therefore, the maintenance manual should be considered an integral part of the documentation of any building and should be updated regularly.

2.3 CURRENT SITUATION IN LEGISLATION AND THE USE OF THE MANUAL

Unlike the Slovak Republic in the Czech Republic, the legislation does not require the obligation to draw up a plan for the maintenance of public works. Paradoxically, many large-scale buildings and residential homes have a processed manual of building use under different names, such as: the standard user guide, the user guide, and building managers.

According to the Finnish National Construction Standards, the "Building and Construction Manual" is mandatory for the construction project to draw up a "Use and maintenance manual", ie a manual of use and maintenance for residential and work buildings, also to be developed when changing the purpose of an existing building. The manual must include the planned lifetime of the building and the building structure. The building will not pass through the building approval unless the manual is completed and handed over to the investor.⁴¹

At present, sustainable building management is a stable part of Dutch governmental environmental policy. Research in the Netherlands focuses on new construction projects and "sustainable maintenance" of buildings.

In Slovakia Building Act 25/2025 Coll. obliges the owner of the building to keep the building in good condition so that there is no risk of fire and hygiene defects,

⁴¹ Ym.fi: Use_and_maintenance_manual. [accessed at 2022-12-10]. Available at: http://www.ym.fi/enUS/Land_use_and_building/Legislation_and_instructions/The_National_Building_Code_of_Finland/Use_and_maintenance_manual

so as not to impair or jeopardize its appearance and maximize its usefulness.⁴² Under Act 254/1998 Coll. on public works⁴³, the builder must ensure that the plan for the use of public works is drawn up. The planner and the contractor must work together. The plan must be designed so that during the use phase "there is no danger to persons, property" or that the public building is not damaged or that it is not "prematurely worn". The law defines the content of the plan: "rules of use, rules of technical inspections, maintenance rules, correction rules." The plan is processed during construction. The Ministry of Construction and Regional Development of the Slovak Republic published in 2001 a practical manual for the elaboration of the plan. The contents of the Maintenance Manual of Buildings is proposed in Table 2.1.

For large building projects, the investor may entrust the designer with a building maintenance manual that is being processed during the implementation phase. The manual for private work does not have the content given by the legislation. Private investors consider building construction to be maintenance-free at extra costs, neglecting their need, and thus increasing repair costs, often damaging objects.

2.4 PROCESSING OF THE MAINTENANCE MANUAL OF BUILDING STRUCTURES

Most building maintenance is currently being implemented as so-called "Induced maintenance". Such a maintenance task can cause triple to four times the cost increase than the same repair if implemented with a maintenance plan. This practice is ineffective. The roles of maintenance that are being invoked are mostly focused on repairing existing phrases, not on the cause of the failure, thereby increasing frequency and repair and maintenance costs. As a result, it is necessary to focus on preventive maintenance (planned). Maintaining and storing reliable information about the state of the building and its structures is essential for quality maintenance planning.

The optimal functioning of the building is conditional on the application of FM, which has an impact on the efficiency of maintenance of building structures.

⁴² Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act)

⁴³ Act 254/1998 Coll. on public works, as amended

The purpose of facility management is to create, improve, plan and maintain the indoor environment of the building with minimum resource requirements in such a way as to strengthen the main activities of the company, both the investor and the tenants of the building.

Tab.2.1: Proposed contents of Buildings Maintenance Manual⁴⁴

Parts	Definition	Contents	
Terms of Use of Buildings	Define the requirements for adequate use to prevent early wear and damage to health and property	Construction part	bearing capacity, cleaning and management work
			education of users
			building structures resistance to the action of chemicals
			proposal manipulation of doors, windows and fastening objects on building structures
			communication for the transport of specific equipment
		Technical and technological part	define requirements for secure, cost effective and trouble-free operation
			regulations, instructions, manuals
The Technical Inspection	Their task is to determine the current condition and the severity of defects in structures and technical and technological equipment in order to prevent future failures	Inspections are focused on:	
		discovery of deficiencies and defects during the warranty period and the subsequent application of remedies by the manufacturer / contractor	
		finding faults at an early phase, where correction could result in increased financial costs	
Rules for	Define the course of planning.	Maintenance Schedule	elements with long service life: foundations, vertical loadbearing structures, horizontal load-bearing

⁴⁴ SOMOROVÁ, V.: Facility management. 2014. Professional Publishing. Praha. ISBN 978-80-743-1141-3

	Their output is maintenance schedule		structures and roofs, staircase
			elements with short-lived: treated wall surfaces, floors, filling the openings, metalwork, plumbing and joinery
		Repair and Maintenance	defined time intervals for preventive maintenance
			provides employment and financial resources
			setting standards of maintenance

In the following section, according to this content, examples of maintenance manuals for specific building structures, whether with a long service life or a short life, are processed in detail.

1. Identification data of building:

characteristics and purpose of construction

2. Maintenance of construction

- a) *Description of construction* (structure composition, layer thickness and material composition)
- b) *Rules of use of the construction* (who is responsible, what we must not do with the building structure, how we should use the structure, what needs to be done)
- c) *Construction maintenance rules* (who is responsible, how we take care of the construction, how we clean it, and planned repairs in the future and the periodicity of repairs)
- d) *Inspection rules* (who is responsible, subject to control and how often he performs it)
- e) *What to do in case of failure, who to contact* (supplier, apartment building manager, emergency service (in case of technological equipment))

Point b) and c) can be together because sometimes it is difficult to determine what is use and what is maintenance of building structure.

3 MAINTENANCE MANUAL FOR AN INTENSIVE ROOF

3.1 BASIC DESCRIPTION

An important ecological and architectural element of the apartment building is the intensive green roof, designed for the purposes of recreation and relaxation of residents. An intensive roof is designed as a vegetation roof system with a sufficiently thick layer of substrate that allows the cultivation of various types of plants – from grasses and perennials to shrubs, small trees or smaller trees. Therefore, the roof includes a rainwater retention system, drainage layers and waterproofing with increased resistance to root overgrowth.

Its purpose is multiple:

1. Recreational and relaxation space: The roof provides the possibility of relaxation, planting greenery and small equipment (flower pots, benches or flower beds).
2. Improving the microclimate: Vegetation cools the surroundings of the building, reduces dust and dampens noise, which is beneficial in urban environments.
3. Rainwater retention: The roof contributes to reducing runoff into the sewer, reduces the risk of overloading it during heavy rainfall, and promotes responsible rainwater management.
4. Energy efficiency: A vegetation roof acts as additional thermal and sound insulation, improving indoor comfort and reducing the energy loss of the building.

An intense green roof is not only beautiful, but also useful. However, it is important to keep in mind that an intensive green roof requires constant care and regular maintenance.

3.2 INTENSIVE ROOF - MATERIAL CHARACTERISTICS

For the proper functioning of an intensive green roof, it is essential that the roof cladding is designed as a multi-layer system.

The composition of the intensive roof of an apartment building includes:

1 Vegetation layer

Material: lawns, perennials, low shrubs and smaller woody plants

Function: aesthetic and ecological value, improvement of microclimate, recreational space

2 Intensive substrate

Material: recycled crushed brick, expanded clay, slate, composted bark

Function: permeable substrate designed to create non-compaction artificial soil

Manufacturer: Intensive substrate BauderGREEN SUB-IM UK th. 400 mm

3 Filter layer

Material: Filter fleece made of fine polypropylene geotextile with a density of 125 g/m²

Function: separates and traps the substrate in front of the drainage layer

Manufacturer: BauderGREEN FV 125

4 Drainage layer

Material: HDPE drainage board

Function: drains excess rainwater, protects the substrate from waterlogging

Manufacturer: BauderGREEN DSE 40 (40 mm thick)

5 Separation layer

Material: fiber protective mat protects waterproofing and thermal insulation

Function: prevents damage to the waterproofing when the thermal insulation is laid

Manufacturer: BAUDER GREEN FSM 600 (600 g/m²) th. 4 mm

6 Waterproofing layer

Materiál: PVC-P fólia odolná voči koreňom a mechanickému poškodeniu

Funkcia: hlavná hydroizolácia strechy, chráni konštrukciu pred prenikaním vody

Výrobca: Fólia Fatrafol 818 hr. 2 mm

7 Separation Layer

Material: geotextile

Function: protects waterproofing and thermal insulation

Manufacturer: Fatrafol Geotextile 200 g/m² th. 5 mm

8 Thermal insulation

Material: extruded polystyrene (XPS) resistant to mechanical damage

Function: reduces heat loss, protects the roof structure and root system

Manufacturer: Fatrafol XPS th. 150 mm

9 Vapor barrier 0.2 mm

Material: water vapor diffusion resistant PE film

Function: prevents the penetration of steam from the interior into the roof cladding, protects the insulation from condensation

Manufacturer: Fatrafol PE vapour barrier th. 0.2 mm

10. Load-bearing structure

Material: reinforced concrete ceiling slab 250 mm

Function: roof load-bearing structure, ensures load-bearing capacity for all layers and loads on vegetation and people

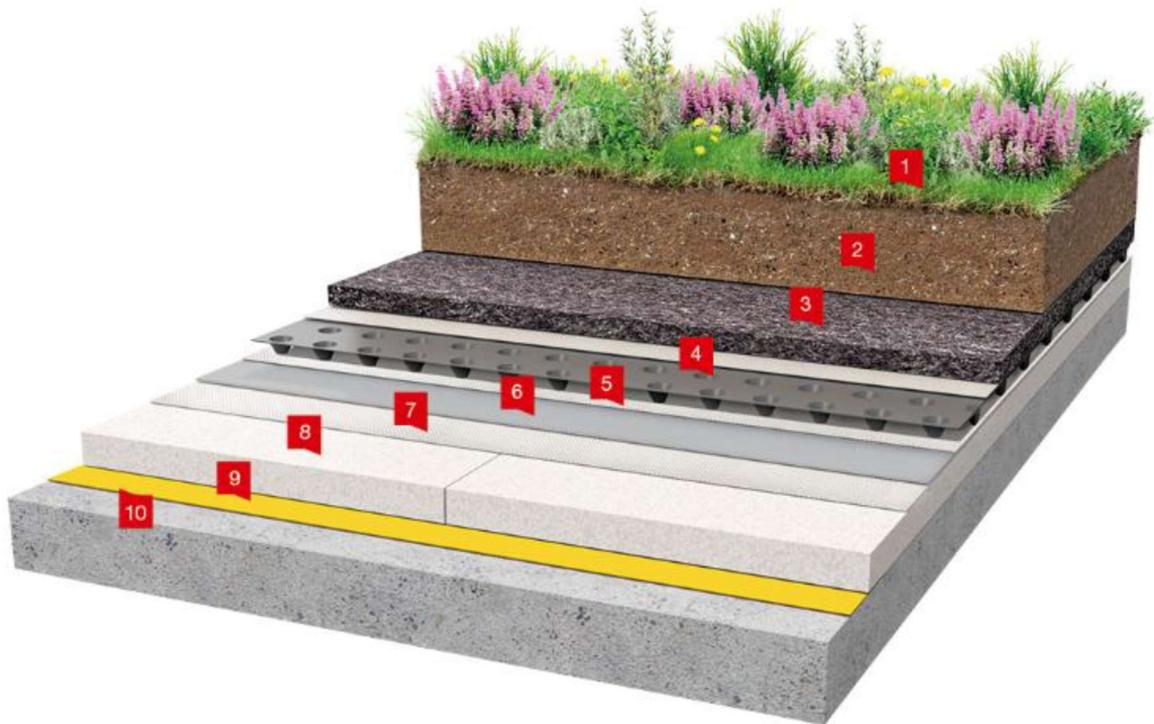


Figure 1 Intensive roof composition⁴⁵

3.3 INTENSIVE ROOF – USE

The intensive roof is designed as a recreational and ecological space with vegetation. To maintain its functionality and safety, it is necessary to follow the principles of use:

⁴⁵ FATRAFOL. INTENSIVE UNIVERSAL F. [Online]. Dostupné z: <https://www.fatrafol.cz/produkty/izolace-strechy/zelene-strechy/intensive-universal-f/>

1. **Movement on the roof:** It is only allowed on marked paths and paved areas. Moving outside of these areas can damage the vegetation layer, drainage and waterproofing.
2. **Maximum load:** The roof is designed for normal occupancy and light equipment. The exact load value is specified in the project (250 kg/m²).
1. **Handling heavy objects:** When moving benches, planters or garden furniture, protective pads must be used to minimise local overloading of the vegetation layer.
2. **Prohibited activities:** Barbecue, fire activities, parking motor vehicles or storing heavy objects outside paved areas.
3. **Personal safety:** Use non-slip shoes; when working near the edges of the roof, we recommend barriers or safety ropes; avoid moving on the roof during strong winds, snow or frost.

3.4 INTENSIVE ROOF – MAINTENANCE

Regular maintenance is essential to ensure the aesthetic, ecological and technical performance of the roof. This requires continuous care (4–12 interventions per year), which includes:

Season	Activities	Utilities	Frequency
spring	removal of self-seeded trees and weeds	garden shears, small shovel, gloves	as needed (1x per period)
	mowing the lawn	Secateurs, lawn mower, gloves	3 to 12 times a year depending on the vegetation
	Fertilization	Fertilizer suitable for roof vegetation systems	1x a year in spring, according to the substrate manufacturer's recommendations
	Replanting and	garden shears,	as needed, minimalne

	replacing damaged plants	small shovel, gloves	1x per year
	Substrate replenishment	lopata, rukavice	as needed
Summer	monitoring of substrate moisture (watering)	Spray head hose or automatic	in the first weeks and during drought
	Weeding	garden shears, small shovel, gloves	2 to 4 times a year during the period
	mowing the lawn	Secateurs, lawn mower, gloves	3 to 12 times a year depending on the vegetation
Autumn	removal of leaves, garbage and other impurities from the substrate and drainage elements	broom, rake, leaf suction vacuum, gloves	1x per month or after windy and rainy periods
	Autumn fertilization	Fertilizer suitable for roof vegetation systems	according to the substrate manufacturer's recommendations
	inspection of drainage elements and paved areas	gloves, broom, water and flow test	min. 1 to 2 times a year
	mowing the lawn	Secateurs, lawn mower, gloves	Last mowing before winteru

Winter	control of inlets, drains	gloves, broom, water and flow test	as needed
	Winterization irrigation system	Gloves	From frost

3.5 INTENSIVE ROOF – REGULAR INSPECTIONS

Regular inspections guarantee the safe and efficient operation of the roof system, which are:

Component	What?	Who?	Frequency	How?
Vegetation layer	Plant condition, root overgrowth	Building Management / Gardener	1x per month	Visual inspection, measurement of substrate moisture
Drainage layer and drains	Blockages, water flow	Building Management / Handyman	1x per quarter	Visually, water flow test
Waterproofing	Mechanical damage, water ingress	Professional company / qualified technician	1x in 2 years	pressure or water test
Supporting structure	Cracks, deformations, load-bearing capacity	Professional company / structural engineer	1x in 2 years	Visual inspection, static assessment
Irrigation and fertilizers	Functioning of the system	Building Management / Gardener	1x per week	Water control, fertilizer level control

3.6 INTENSIVE ROOF – FAILURES

In the event of a breakdown or unusual condition of the intensive roof, it is necessary to react quickly to prevent damage to vegetation, waterproofing and the supporting structure. The most common failures include leakage, uneven vegetation growth, clogging of drainage elements or damage to surface layers.

In the event of a malfunction, abnormal condition, regular inspection, service intervention or maintenance of an intensive roof, it is necessary to fill in the following form. The completed form is used to record, identify the problem and ensure timely professional intervention.

3.7 LEGISLATIVE FRAMEWORK

The operation and maintenance of the intensive roof is regulated according to Slovak and European regulations, which ensure safety, environmental protection and proper maintenance:

Main legislation:

1. The Building Act (Act No. 25/2025 Coll.) - regulates the design, implementation and operation of buildings, including roof structures.
2. Basic principles of green roof design according to STN EN 1187 and STN EN 15026
3. EN 15026 and EN 12056-3 for humidity and drainage control
4. Manufacturers' manuals

Recommendations:

1. All maintenance and inspection activities should be documented in case of inspection or revision.
2. When intervening in waterproofing, load-bearing structure or drainage elements, it is necessary to comply with all legislative requirements and standards.
3. Regular training and briefing for building management personnel increases safety and reduces the risk of breakdowns or damage.

3.7 RECOMMENDED SOURCES

GREEN ROOF. Green roofs: Everything you need to know. [Online]. Available at: <https://www.zelenastrecha.eu/zelene-strechy.html>

FORBI.SK. How to design a green roof according to STN EN 1187 a STN EN 15026: Layering, drainage and maintenance in practice. [Online]. Available at: <https://forbi.sk/224571/ako-navrhnut-zelenu-strechu-podla-stn-en-1187-a-stn-en-15026-vrstvy-odvodnenie-a-udrzba-v-praxi/>

ASB.SK. Vegetation on roofs. [Online]. Available at: <https://www.asb.sk/stavebnictvo/realizacia-stavieb/vegetacia-na-strechach>

FLAT ROOF. Green roofs. [Online]. Available at: <https://www.plochastrecha.sk/eshop/zelene-strechy/c-28/resultpage/2.xhtml#initialPage=1>

FATRAFOL. INTENSIVE UNIVERSAL F. [Online]. Available at: <https://www.fatrafol.cz/produkty/izolace-strechy/zelene-strechy/intensive-universal-f/>

BAUDER. Extensive Plant Substrate. [Online]. Available at: <https://www.bauder.co.uk/green-and-blue-roofs/green-roofs/extensive-plant-substrate>

AN ECO-FRIENDLY ROOF. Green Roof Maintenance Manual. [Online]. Available at: <https://www.ekologickastrecha.sk/manual-pre-udrzbu-zelenej-strechy>

LAND-ART GARDENS. Care and layers of green roof that you must not miss. [Online]. Available at: <https://zahrady-landart.sk/blog/starostlivost-a-vrstvy-zelenej-strechy-ktore-nesmiete-vynechat>

SLOV-LEX. Slov-lex - Electronic Collection of Laws. [Online]. Available at: <https://www.slov-lex.sk/>

4 MAINTENANCE MANUAL FOR A PITCHED ROOF

4.1 BASIC DESCRIPTION

A pitched roof is one of the basic building elements of a building, the main task of which is to protect the building from weather conditions and ensure effective drainage of rainwater. Thanks to its shape and slope, it offers excellent thermal insulation properties, architectural variability and long-term durability. When designing a pitched roof, it is necessary to take into account the slope, the structure of the truss, the snow or wind load, and especially the appropriate choice of roofing.

The most commonly used types of roofing include traditional tiled roofs, which are characterized by high durability, natural appearance and good acoustic properties. A modern alternative is metal roofs, which offer low weight, quick installation and a wide range of forming options. In recent years, the extensive green roof has also been gaining popularity, combining a sloping structure with a composition that allows low vegetation to grow; It provides environmental benefits, improves the microclimate and contributes to the energy efficiency of buildings.

This seminar paper focuses on individual types of pitched roofs, their material properties, construction solutions, methods of use, maintenance, regular inspections and legislative requirements related to them.

Types of pitched roofs:

Monopitch roof

is a simple type of roof, most often used in the construction of low-energy and passive houses. It is often mistaken for a flat roof. Its inclination is greater than 10° and allows it to create large glazed areas facing the sunny side, through which energy flows into the interior and allows energy savings. The roof drains rainwater to one side because it has only one sloping plane.

Gable roof

is the most common roof shape. It is often used in the construction of houses in the countryside, because it has a simple shape with two sloping planes and its

appearance fits into the surroundings without any problems. The roof slope can vary from 25 to 45°, which makes it possible to create housing in the attic, glaze the roof, or it is possible to build triangular-shaped gables for windows and balconies. Gable roofs are especially suitable for locations with increased precipitation, the intensity of which should directly affect their slope.

Hipped roof

It is used in the construction of elongated houses, in which the attic has the form of mansards, illuminated by dormers and roof windows. The hipped roof consists of two shorter sloping planes in the shape of a triangle, two longer trapezoidal planes and a connecting ridge. It is therefore a longitudinal gable roof, which is finished on both sides with a sloping chamfer, which is called a hip. Its design is not only more laborious, but also more expensive compared to previous types of roofs. This type of roof is often used for roofing L-shaped houses.

A tent roof is basically a hipped roof, but it has the shape of a pyramid, most often above a square floor plan. All its faces have the same shape and size and meet at one point. In the past, when building hipped roofs, the rule was that the height of the roof is equal to the length of the side of the square floor plan, but today tent roofs are built only more rarely and when they do, then in a flatter design.

The mansard roof has a massive appearance and is used wherever it is necessary to make the most of the attic space. Its construction is quite demanding, because its slope surfaces must be bent so that their upper part has a smaller slope and the lower part has a greater slope.

The mansard roof has a massive appearance and is used wherever it is necessary to make the most of the attic space. Its construction is quite demanding, because its slope surfaces must be bent so that their upper part has a smaller slope and the lower part has a greater slope.

Roofing can be divided into two main types – folded and large-format. Folded roofing, as the name suggests, consists of individual roof tiles that are laid next to each other. Folded roofing includes fired, concrete or sheet metal roofing. Large-format roofing, on the other hand, is made up of large parts.

4.2 MATERIAL CHARACTERISTICS

Light roofing and heavy roofing

Folded coverings are further divided into light and heavy coverings. Light ones include, for example, sheet metal roofing. Heavy roofing is referred to as concrete or burnt roofing. In practice, this division is meaningless. "We will not primarily deal with the own weight of the roofing, which makes up only a small part of the load, but with the static effect of the entire roof structure on the building. That is, the weight of the truss, battens, slab flap, thermal insulation, suspended ceilings, plumbing elements and additionally installed elements, such as photovoltaics," notes structural engineer Ing. Peter Jiroušek.

„The dead weight of lightweight eternit roofing is only 5.5 percent of the load. If we use concrete roof tiles for the same house, they will contribute 15.7 percent to the load. The increase in the weight of the roof by about 0.3 kN/m² means that in relation to the total weight of the roof layer, the own weight of the roofing is relatively insignificant," summarizes Petr Jiroušek. So which is the best lightweight roofing? It depends on your personal preferences, so the light covering can also be made of concrete.

Ceramic (brick) tiles

Made of fired clay, characterized by a long service life (often 80–100 years) and color fastness. They are eco-friendly, vapour-permeable and ideal for areas with changeable weather. Their disadvantage is their higher weight, which places higher demands on the load-bearing structure of the truss.

Concrete tiles

They are made from a mixture of cement, sand and pigments. They are very durable, more affordable than ceramics, and have excellent strength. Concrete gains higher hardness over time, but the covering becomes heavier and can be more prone to moss fouling, especially in shady areas.

Composite and plastic tiles

Modern alternatives with low weight and good weather resistance. They are mainly used where it is necessary to lighten the roof structure. They have a long service life, but a higher price.

Folded (double-standing) sheet

It is an elegant and durable roofing ideal for both modern and historic buildings. The sheet metal strips are connected on the roof by folding, which ensures high

waterproofing and wind resistance. Titanium-zinc, aluminum or copper sheet is used.

Moulded sheet metal tiles (sheet metal "tiles")

It looks like classic tiles, but is significantly lighter. It is suitable for pitched roofs with a slope of approx. 12–14°. Assembly is easy and various color modifications are possible. The disadvantage may be higher noise in the rain if a high-quality under-roof layer is not used.

Trapezoidal sheet

It is used for simple roofs, outbuildings or modern architectural solutions. It is very durable, affordable and suitable even on low slopes. Aesthetically, it looks more technical than shaped tiles.

4.3 USE AND MAINTENANCE

The use of a pitched roof consists mainly in its proper functioning throughout the life of the building. The roof must provide protection against precipitation, wind, noise and temperature fluctuations. In order for it to fulfil its purpose, it is important to adhere to the following principles:

1. Do not load the roof structure beyond the scope of the project. Inappropriate addition of unplanned elements (e.g. heavy solar panels or superstructures) can lead to static overloading of the truss.
2. Ensure proper drainage function. Rainwater drains, gutters and downspouts must not be blocked by dirt to prevent leakage and damage to the masonry.
3. Make sure that the roof is properly ventilated. The under-roof structure must have an airflow, which minimizes the risk of condensation, mold formation and reducing the lifespan of the insulation.
1. In case of extreme weather conditions (heavy snowfall, wind, hail), it is necessary to regularly check the condition of the roofing and, if necessary, safely remove snow from the roof.

4.4 REGULAR CHECKS

Regular visual inspections it is recommended to carry it out at least **twice a year** – in spring and autumn – possibly after extreme weather. The following are checked:

1. condition of the tiles or sheet metal covering (cracks, displaced pieces, corrosion),
2. seals around penetrations (chimney, ventilation, roof windows),
3. roofing foils and battens (in the case of an accessible attic).

Roof and gutter cleaning

1. It is advisable to remove leaves, moss, fallen branches or dirt deposits from the roof.
 - Gutters and downspouts should be cleaned **at least twice a year** to prevent overflow and leakage.

Roofing treatment and repair

1. **Tiled roofs:** replacement of cracked or loose tiles.
2. **Sheet metal roofs:** inspection of screw connections, surface treatment and inspection of possible corrosion.
3. In the case of folded roofs, check the tightness of the joints.

Inspection and maintenance of drainage elements

This includes checking gutter hooks, downspouts, leaf traps and gaskets. A malfunctioning drainage system can cause extensive damage.

Maintenance of the truss and insulation

In the case of an accessible attic, it is necessary to observe:

1. the presence of moisture or mold,
2. the state of thermal insulation,
3. possible traces of leakage.

Expert reviews

It is recommended to carry it out **once every 3–5 years** by a specialist who will assess the general condition of the roof structure, anchoring of the roofing, statics and ventilation.

4.5 MALFUNCTIONS AND CONTACT

Pitched roof failures most often occur as a result of improper implementation, aging of materials, extreme weather conditions or neglected maintenance. These failures can significantly affect the functionality of the roof, cause leakage or damage to load-bearing structures.

Roof leakage

The most common malfunction that occurs when the roofing is damaged, leaks around penetrations (chimney, roof windows) or when tiles or sheets are poorly laid. Leakage can lead to damage to insulation, mold and degradation of the truss. **Displaced or damaged tiles / loose sheets**

Strong winds, frost or mechanical stress can cause the roofing to loosen or break off. With metal roofs, screws or joints can come loose, which reduces stability and waterproofing.

Corrosion of sheet metal coverings

It occurs with older sheets or when the protective surface layer is damaged. Corrosive spots can grow into holes that allow water to pass through.

Moss overgrowth and dirt

Especially typical for tiled roofs in shade or humid environments. Moss retains moisture, which shortens the life of the covering and can damage the surface of the tiles.

Drainage system malfunctions

Clogged gutters and downspouts cause water to flow out of the system, which can damage the façade, masonry and gutter boards.

Cracked or degraded truss

The most serious malfunction, usually caused by prolonged leakage, excessive snow load or wood pest. A damaged truss threatens the statics of the entire roof.

4.6 LEGISLATION ON PITCHED ROOFS

The design, implementation and maintenance of pitched roofs in the territory of the Slovak Republic is governed by several legal regulations, technical standards and binding procedures. The legislation sets minimum requirements for building safety, health protection, energy efficiency and fire regulations. Compliance with

these standards is essential for the proper functioning of the roof structure, its long service life and safe use.

Construction Procedure Act

The basic document is **Act No. 25/2025 Coll. (Building Act)**, which regulates:

1. conditions for the design and implementation of constructions,
2. the obligation to obtain a building permit or notification,
1. requirements for the documentation of the truss, roofing and drainage.

If it is a reconstruction of the roof, replacement of roofing or intervention in the load-bearing structure, it is often necessary **to report** the construction or obtain **a building permit**, especially if the shape of the roof or its parameters changes.

Decree on Technical Requirements for Buildings

An important document is also **Decree No. 532/2002 Coll.**, which provides:

1. requirements for construction safety,
2. protection against moisture and leakage,
3. principles of anchoring roofing and connection of transfers,
4. requirements for roof drainage.

The decree emphasizes the need to use materials that comply with regulations and are certified according to applicable technical standards.

Fire regulations

Pitched roofs must meet the requirements of **Act No. 314/2001 Coll. on Fire Protection** and relevant implementing decrees. For roofs, the following is required in particular:

1. maintaining distance distances,
2. correct installation of chimney penetrations and chimney liners,
3. use of non-flammable or flame-retardant materials in critical parts,
4. Properly designed fire penetrations.

Energy performance of buildings

According to **Act No. 555/2005 Coll.** The roof must meet the requirements for thermal protection and energy efficiency. This means:

1. use of appropriate thermal insulation,

1. compliance with the minimum thermal resistance according to the STN standard,
2. The right solution for thermal bridges.

New roofs must meet **the A0 energy class** for new buildings.

Technical Standards (STN)

The design and implementation of pitched roofs is mainly based on the following standards:

- **STN 73 1901 – Roof design**

It determines the design principles for pitched and flat roofs, minimum roofing slopes, ventilation and roof cladding composition.

- **STN 73 0035 – Snow and wind loading of structures**

It determines the dimensioning of the truss according to the load in individual snow and wind areas of the Slovak Republic.

- **STN EN 1995-1-1 (Eurocode 5)**

It deals with the design of wooden structures, including trusses.

- **EN 14437 – Tile and concrete tile coverings**

It defines the requirements for installation and properties of tile coverings.

- **EN 14782 – Self-supporting sheet metal roofing**

It solves the requirements for sheet metal roofing systems.

Although STN standards are not legally binding, in the construction industry they are considered to **be a professional standard**, the observance of which is required during the design and approval of a building.

Obligations of the building owner

According to the legislation, the owner is obliged to:

1. keep the roof in a safe condition,
2. carry out regular inspections;
3. eliminate malfunctions in a timely manner,
4. provide professional supervision for major modifications.

4.7 CONCLUSION

Pitched roofs are one of the most important structural elements of any building, as they ensure the protection of the building from the weather, increase energy efficiency and significantly affect the overall architectural appearance of the

building. The right choice of roofing, construction system and technical solution is crucial for the long-term functionality and reliability of the roof.

The main types of coverings, the most commonly used in practice – tile and sheet metal – were presented in the work, along with their properties, advantages and limitations. We also focused on the use and maintenance of pitched roofs, which are essential for maintaining their lifespan. Regular inspections, proper maintenance and timely repair of failures significantly reduce the risk of emergency conditions and extend the life of the roofing and truss.

Typical disorders, methods of their identification and the importance of professional control were also described. The legislative framework shows that roof structures must meet strict requirements in terms of safety, fire protection and energy efficiency, which underlines the need for professional design and quality implementation.

Overall, it can be stated that a pitched roof is a complex building element that requires thorough preparation, professional processing and regular care. Only in this way can it reliably perform its function and protect the building for decades.

4.8 RECOMMENDED SOURCES

<https://www.stavebnik.sk/clanky/typy-striech.html>

<https://www.kmbeta.sk/prehľad-typy-stresnej-krytiny>

<https://www.ruukki.com/svk/produkty-pre-strechy/o-strechach-ruukki/strechy-v-skratke/udrzba-strechy?>

<https://forbi.sk/225141/udrzba-stresnych-krytin-stn-en-1304-490-14782/>

<https://www.spravastrech.cz/nase-cinnost/sprava-a-udrzba-strech/pravidelne-kontroly-strech>

https://www.mystandards.biz/standard/stn-731901-2005-oprava1-1.9.2005.html?utm_source=chatgpt.com

https://www.lamina.sk/blog/kontrola-strechy-pred-zimou-a-ponej/?utm_source=chatgpt.com

5 MAINTENANCE MANUAL FOR A FAÇADE

5.1 BASIC DESCRIPTION

The façade is a structural element of a building with an important aesthetic, protective and technical function. It is the first line of defense against weathering, mechanical stress, biological pollution and temperature fluctuations. A well-designed façade significantly extends the life of the curtain wall and currently also plays a fundamental role in achieving the energy efficiency of buildings. Modern construction places increased emphasis on the durability of materials, reduction of maintenance costs, ecological solutions and the overall visual impression of the building.

Façade systems have undergone significant development in recent decades. In addition to traditional plaster facades, ventilated tiles and, as part of the sustainability trend, vegetation walls have also been expanded. Each system has specific technical requirements, different advantages and specific installation and maintenance requirements. The aim of this manual is to provide a coherent professional summary of these façade solutions, while maintaining clarity in selected parts where precise points are important – especially in maintenance and standard requirements.

Facades pose a potential risk of fire spread, so they must comply with fire response requirements and fire strips. For taller buildings, the use of flammable insulators and cladding is limited.

Thermal insulation systems must ensure the thermal resistance of the external cladding prescribed by the standard, while the thickness of the insulation increases depending on the thermal parameters of the building and the selected material.

5.2 MATERIAL CHARACTERISTICS - FAÇADE PLASTERS

Façade plasters are the most widely used type of surface treatment of buildings due to their versatility, aesthetic variability and availability. The plaster systems are compatible with ETICS contact insulation systems, but are also used in the renovation of solid masonry without insulation. Their function is to provide a

cohesive, protective and aesthetically pleasing surface that resists weather loads, pollution, biological pests and mechanical damage.

Characteristics and types of plaster

Plasters are divided according to the binder into:

- mineral plasters, which are very vapour-permeable but less elastic
- acrylic plasters with high elasticity, but lower vapour permeability
- silicate plasters that form a chemical bond with the substrate
- silicone plasters that combine elasticity, low absorbency and self-cleaning effect

Choosing the right type of plaster affects not only the aesthetics, but also the service life of the entire façade, especially in areas with increased humidity or air pollution.

Application and Technology Requirements

The correct technological procedure is essential for the long-term functionality of the plaster. Before application, the reinforcing layer must be matured and evenly dried. The substrate is primed with a suitable primer. The plaster itself is applied over the entire surface with a stainless steel trowel, then the desired structure is created. The application conditions are strict – temperature 5°C to 25°C, avoiding direct sun, wind and rain. Unreasonably rapid drying can cause uneven discoloration, cracks, or layer separation.

5.3 MAINTENANCE OF FAÇADE PLASTERS

Regular annual inspections:

1. visual inspection of the surface (dust, smog pollution)
2. biological infestation (algae, fungi)
3. Inspection of surface integrity (cracks, punctures)
4. Inspection of details (window sills, flashing, joints)
5. Checking for possible leaks and humidity maps

Recommended maintenance:

1. façade cleaning every 3-5 years
2. renewal of the coating every 10–15 years
3. use only mild detergents without acids and solvents

Biotic infestation:

1. removal using special cleaning products, subsequent application of preventive protection
2. Avoidance of long-term shielded damp surfaces

Repairs for mechanical damage:

1. cutting out the damaged part of ETICS
2. addition of insulator, reinforcing layer and plaster
3. adherence to the overlaps of the reinforcing fabric at least 10 cm

5.4 MATERIAL CHARACTERISTICS FAÇADE CLADDING

Façade cladding provides more durable protection of the building than plaster and is especially popular in modern and representative buildings. Ventilated cladding systems ensure moisture removal and contribute to a stable microclimate of the building.

Characteristics of cladding systems

The cladding is mounted on a load-bearing substructure, which can be a metal or wooden grate. An important element is the ventilated air gap between the cladding and the thermal insulation. This gap ensures air circulation and wicks away moisture, reducing the risk of condensation. Tiles are made in different materials, which allows for different architectural solutions.

Types of materials

1. Wood with a natural look
2. high-strength ceramic or brick strips
3. Long-lasting stone
4. composites that have a stable color and are durable
5. metal cladding typical of modern architecture

Application and technical principles

Installation is carried out according to the technical data sheets and must include the exact placement of anchoring elements, expansion joints and ventilated

holes. The substructure must be properly aligned so that the cladding looks uniform. Improper assembly may cause deformations, leakage, or loosening of the elements.

5.5 TILE MAINTENANCE

1. Occasional cleaning with pressurized water at low pressure
2. Inspection of joints, bolts and substructure
3. renewal of the wood finish every 2-3 years
4. Inspection of corrosion of metal elements
5. Monitoring the condition of expansion joints

5.6 MATERIAL CHARACTERISTICS OF THE VEGETATION (GREEN) WALL

Vegetation walls are a modern ecological solution that combines architecture and greenery. These walls create microclimatic benefits such as lowering the façade temperature, absorbing dust and improving air quality. In cities, they are an important element in reducing overheating and contribute to the sustainable management of rainwater.

Types of green facades

1. climbing facades, where plants grow after a structure or wire system
2. modular facades that contain panels with their own substrate
3. hydroponic facades, where plants are grown without soil in a special nutrient system

Design and technical requirements

Vegetation walls require a comprehensive technical solution, which includes a load-bearing structure, securing statics, an automatic irrigation system, drainage, filtration elements and protection against root overgrowth. Fire safety is also important, as dried vegetation can pose a risk of flames spreading.

5.7 MAINTENANCE OF VEGETATION WALLS

Ongoing maintenance:

1. regular inspection of irrigation and water circulation
2. Nutrient supplementation according to plant type
3. monitoring the health status of the stand
4. removal of weeds and dead plants

Seasonal activities:

1. cutting and shaping plants (2× per year)
2. Substrate replenishment in modular systems
3. Filter cleaning and pump inspections

Risks:

1. risk of drying out of plants in the event of an irrigation failure
2. Root overgrowth to the façade
3. technical malfunction of the irrigation system

5.8 RECOMMENDATIONS FOR DESIGN AND IMPLEMENTATION

When designing the façade, it is essential to take into account the climatic conditions, the orientation of the building, the requirements for energy efficiency, aesthetics and maintenance. The durability of the entire system depends on the quality of the details – plinth, window connections, window sills, corners and endings. During implementation, technological procedures are strictly followed and a complete certified system from one manufacturer is used. Arbitrary interventions in the façade, such as the installation of satellites or the anchoring of objects without the appropriate fastening system, can lead to damage to the thermal insulation and leakage.

5.9 CONCLUSION

The façade is one of the most important structural elements of a building. In addition to its aesthetic function, it protects the building from external influences and plays a fundamental role in energy regulation. The different types of façade systems – plaster, cladding and vegetation walls – have their own specific advantages and requirements for installation and maintenance. Their long-term service life is conditioned by compliance with legislative requirements, technical standards and regular maintenance. A well-designed and properly maintained façade is an investment that will ensure the protection and aesthetic value of the building for many years.

5.10 LEGISLATIVE FRAMEWORK AND STANDARDS

Facades must be designed and implemented in accordance with legislation that sets out the safety, hygiene requirements, technical suitability and energy efficiency of buildings. When implementing them, it is necessary to take into account the legal regulations on the use of construction products, fire safety and thermal parameters.

1. Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act)
2. Decree No. 532/2002 Coll. on General Technical Requirements for Construction
3. Decree No. 364/2012 Coll. on Energy Performance of Buildings
4. EU CPR Regulation No. 305/2011 (construction products)
5. STN 73 2901 – Plaster design
6. STN EN 13499 – ETICS s polystyrenom
7. EN 13500 – ETICS with Mineral Wool
8. ETAG 004 / EAD 040083-00-0404 - European document for ETICS systems
9. STN 73 0540-2 – Thermal Engineering Requirements for Building Structures

10. STN 73 0802 – Fire safety of buildings – external surfaces
11. EN 14411 – Ceramic cladding elements
12. EN 1991-1-4 – Wind Load
13. STN 74 4505 and related standards – Wood and wood cladding
14. Material standards for composites, metal cladding, stone and hydroponic systems (by manufacturer)

5.11 RECOMMENDED SOURCES

<https://www.sk.weber/>

<https://www.knaufinsulation.sk/>

<https://www.sk.weber/files/sk/2021-04/%C5%BDivotnos%C5%A5%20a%20u%C5%BE%C3%ADvanie%20ETICS%202020.pdf>

<https://mib.sk/manual-verejnych-priestorov/principy-a-standardy/vegetacne-steny/>

6 MAINTENANCE MANUAL FOR A LIVING FAÇADE

6.1 BASIC DESCRIPTION

A living façade (Vertical Garden, Moss Wall, Biosystem) is an integrated building-biological system that covers part or all of the vertical surface of an object using plant or lichen/moss materials. The device is designed as an active, semi-automatic system that provides aesthetic value, thermal insulation, sound absorption and active air filtration. The system consists of several key components: a load-bearing substructure, a substrate or modular system, selected vegetation (plants, mosses, lichens), an automated drip irrigation system, a collection drainage tank and a monitoring system.

In the case of this project, the main solution is Machcement technology, which uses a special concrete or cement composite with a low pH and porous structure, designed for quick and stable colonization of moss and lichens. The moss layer acts as a natural biofilter. The purpose of the device is to reduce the overheating of the façade (heat island effect), improve air quality and provide unique aesthetics. The operator of the facility is the owner of the building or the administrator, who ensures regular irrigation operation, maintenance, biological controls (pests, diseases) and communication with a specialized horticultural/biological service organization. The living façade is designed for long-term operation with an expected lifespan of the load-bearing elements of 50 years and the need for regular renewal or replenishment of vegetation (cyclically, 3-10 years) while observing the conditions specified in this manual.

6.2 MATERIAL CHARACTERISTICS

Modular and load-bearing façade system

The load-bearing and modular façade system forms the basic structural element that holds the substrate, vegetation and irrigation system. The system is designed as a ventilated façade to avoid moisture problems in the load-bearing wall. The load-bearing system is primarily composed of vertical aluminium or stainless-steel profiles with anti-corrosion surface treatment, anchored to the load-bearing perimeter wall. Thermal inserts are inserted between the anchoring

elements and the perimeter structure, which eliminate the formation of thermal bridges, thus ensuring the energy efficiency of the building envelope.

The front of the system consists of either prefabricated mach-cement panels or plastic modules with a special geotextile. Machcement panel is a composite that serves as an optimal starting surface for moss growth and is resistant to mechanical damage and UV radiation. A properly sized air gap also actively helps to reduce the surface temperature of the façade in the summer months, thus contributing to the overall cooling effect of the building and increasing comfort in the interior. It is forbidden to place heavy objects on the system, lean on ladders or interfere with it without permission.

Machcement panels are located on the main southern and western surfaces of the building. The panels are anchored to system stainless steel brackets, which are attached to the load-bearing structure of the perimeter wall. A ventilated gap (min. 50 mm) is created between the panel and the original façade to prevent condensation and overheating.

The supporting structure of the moss cement panels consists of aluminum profiles and a system of stainless-steel anchors. The fasteners are exclusively stainless steel (A4). The panels are fixed to the profiles using system hidden tabs, the strength of which must be regularly checked.

On parts with a higher moisture load and where flowering plants and climbing plants are expected to grow, a system with hydro-geotextile is used. These modules are anchored similarly to machcement but contain a network of bags or felt layers that are filled with a lightweight substrate.

With this system, protection against frost and wind in the winter months and the correct irrigation settings are critical. The panels and their geotextile parts must be visually inspected for mechanical damage and rupture of the textile layer, which can lead to a complete failure of the system (substrate leaching).

Irrigation and drainage system

A living façade requires automated and regular watering. An irrigation system (drip irrigation) includes pumps, filters, distribution pipes and drip irrigators (nozzles) located discreetly at the roots or at the top of the moss cement panels.

It is recommended to use water from a drainage tank (recycled rainwater/wastewater from irrigation) for irrigation.

The individual sections of the façade are divided into separate irrigation zones, controlled by a control unit and solenoid valves. The system is equipped with humidity and weather sensors to optimize water consumption.

The drainage system drains excess water from the bottom of the façade to the collection tank. Maintenance includes regular cleaning of filters, checking the functionality of drip caps and calibrating humidity sensors.

AC part, inverter and grid connection

The control unit of the system is located in the technical room and is used to automatically control irrigation cycles, nutrient dosing and monitoring of key operating parameters (humidity, temperature, pH of water). The unit communicates with external sensors and sends fault alerts (water leakage, pump failure, low nutrient levels) to the facility manager. The unit must be protected from moisture and mechanical damage. The internal software arrangement of the control unit must not be interfered with by an unprofessional person. All interventions can only be performed by a technician of the system supplier.

6.3 USE OF A LIVING FAÇADE

The living façade system is designed to be fully automatic and does not require an operator in its normal operation. The main duty of the user and the administrator is to ensure the electrical supply of the control unit and pumps and to prevent unauthorized access to the technical rooms with the irrigation system.

Building occupants may not:

1. Handle visible elements of the irrigation system (drip heads, pipes).
2. Remove or damage moss cement panels or geotextile modules.
3. Throw objects into drainage gutters.
4. Store objects, support ladders, or install other devices on the supporting structure without approval.

In the event of visually detected defects (e.g. large water leakage, yellowing of vegetation, missing panels), the administrator or service organization must be informed immediately.

6.4 MAINTENANCE AND CLEANING

Control and replenishment of vegetation

The maintenance of a living façade has a biological and technical component. Biological maintenance is usually carried out quarterly (4 times a year) and includes:

1. Vegetation Visitation: Checking the condition of moss and plants, identifying diseases, pests and unwanted weeds.
2. Trimming and shaping: Removing dry or overgrown plant parts.
3. Moss replenishment: Inspection and local replenishment/application is carried out on the moss cement panels
4. moss slurry to ensure full coverage (generally once a year or as needed).
5. Weeding: Removing unwanted plants from modules and drainage gutters.

All work, especially at heights, must be carried out by a specialized company using platforms or rope technology.

Irrigation System Maintenance

Regular maintenance of the irrigation system is critical for the survival of vegetation and is carried out monthly or quarterly:

1. Pump and filter inspection: Cleaning and replacing filters and screens if necessary.
2. Drip Maker Functionality: Visual check that all drip heads are working (flush or replace
3. clogged nozzles).
4. Pipe inspection: Check for leaks, damage, frost cracks, especially during wall transitions.
5. Sensor calibration: Verification and calibration of pH, humidity and temperature sensors.
6. Winter shutdown: Before winter (before the onset of frost), a complete drain of water from the system (air flushing) and shutdown of the pumps to protect against frost damage are carried out.

Maintenance of the load-bearing structure

The supporting structure (aluminium and stainless steel profiles) is inspected once a year and after exceptional weather events (strong winds, storms):

1. Visual inspection of joints: Verification of the tightening of all screws and clamps.
2. Corrosion: Visual inspection of stainless steel and aluminum elements (for example, the presence of rust at the points of contact).
3. Anchorage check: Check the loosening of anchor elements in the perimeter wall.
4. Drainage gutter: Clearing the bottom gutter of substrate, leaves, and other debris that would obstruct water drainage.

If deformations of the profiles or loosening of anchors are detected, it is necessary to contact the specialist company that carried out the installation to assess the static stability.

Safety during maintenance

In all work on a living façade, the protection of persons is crucial, especially against falling from a height and against objects falling on the pavement/public space under the façade.

1. Work at height: Access to the façade is only permitted to persons with a valid authorisation for work at height (platforms, rope technology, scaffolding). Personal protective equipment (PPE) must be used at work.
2. Safety delimitation: The area under the workplace must always be demarcated with barriers, tape and warning signs to prevent injury to persons from falling tools, branches or water.
3. Electrical equipment: Interventions in the control unit and pumps may only be carried out by a professionally qualified electrotechnical person. Before working on the pumps, it is necessary to disconnect the electrical power.
4. Chemicals: When using any chemicals (fertilizers, pesticides, fungicides), it is necessary to observe safety data sheets (SDS) and use appropriate PPE (gloves, safety goggles).

6.5 REGULAR INSPECTIONS AND REVISIONS

Regular inspections and revisions are a prerequisite for the safe and reliable operation of the Living Façade system. The owner or manager of the building is responsible for ensuring them.

A visual inspection of the condition of the panels, structure and access roads is carried out at least once every three months by the building manager. During this inspection, it is assessed whether the machete cement panels are not heavily soiled, cracked or mechanically damaged, whether the supporting structure does not show signs of deformation, whether the anchors are loose, whether there are no unwanted water deposits around the panels and whether there are no objects in the system that could damage vegetation or drainage. This inspection also includes a brief assessment of the condition of vegetation (moss, plants) according to the available humidity and pH monitoring.

Once a year, an extended inspection of the system is carried out, during which, in addition to the panels and the structure, the condition of irrigation cable routes, passages through the building envelope structures, the tightness of waterproofing penetrations and the condition of the irrigation control unit are checked in more detail. This tour is provided by the administrator in cooperation with a professional botanical/engineering company.

At intervals determined by legal regulations and project documentation, periodic professional inspections and tests of electrical equipment (pumps, control unit, sensors) are carried out by an inspection technician. During these revisions, measurements of electrical quantities are carried out, the functionality of protection against electric shock is checked and the condition of surge protectors is assessed. The interval of periodic inspections is usually in the range of three to five years, depending on the type of building and the nature of the environment. A revision of the static attachment of the façade structure is carried out separately, during which the condition of anchoring elements, welds and connections to the metal parts of the external cladding is assessed. The interval for revision of static anchorage is usually four years, but the exact interval is determined by the relevant technical standard and static assessment.

Type of inspection	Description of the action	Interval	The act is performed by
Visual status check Facades	dirt, cracks, loose panels, vegetation condition	1× in 3 months	Administrator / Expert Company

Biological maintenance (moss)	application of moss slurry, pruning, Pest control	1× in 3 months / 1× per year	Professional firm
Panel cleaning – façade	washing the panels with soft water, Secure access	1× per year	Administrator / Expert Company
Inspection of the supporting structure	tightening of screws, corrosion, deformations, drainage channel	1× per year	Inspection Technician
Professional examination and examination EZ (revision)	measurements, pump and control tests according to STN and EN	3-5 years	Inspection Technician

6.6 FAILURES AND EMERGENCY CONDITIONS

A malfunction of the Living Façade is considered to be a condition when the system does not work as expected, switches to error mode, or the condition of the vegetation noticeably decreases. Typical manifestations of a malfunction are error messages on the display of the control unit (e.g. low water pressure, pump failure), long-term irrigation failure in dry weather, unusual sounds or odours from the utility room, or visible damage to the panels after wind or hail events. An emergency condition is considered to be an extensive water leak or the fall of a part of the façade module.

If a malfunction is detected, the user must not interfere with the control unit or the electrical part of the device. In the event of a large-scale water leak, the administrator can immediately shut down the irrigation system according to the manufacturer's instructions by turning off the pump's main circuit breaker. Subsequently, he immediately contacts the contracted service company

(technical and botanical), the designer or the installation company of the system, which will perform professional diagnostics and eliminate the malfunction.

In the event of a fire in the building or in its immediate vicinity, it is necessary to immediately call the fire brigade and, when the event is reported, announce that the Living Façade system is installed on the façade of the building with the possibility of the presence of a damp substrate or moss. The substrate system, even if it is filled with water, does not pose such a risk as electrical equipment, but firefighters must be informed about the presence of electrical parts (pumps, control units) and the anchoring system.

For the needs of a specific building, the manual will include contact information for the administrator and the service organization. In the event of a malfunction or damage to the Living Façade, it is necessary to contact the administrator of the administrative building company XXX + contact

PROCEDURE FOR THE OCCURRENCE OF A MALFUNCTION OF THE LIVING FAÇADE SYSTEM:

1. Do not interfere with the control unit or electrical parts.
2. If it is safe to do so, turn off irrigation (only when water leaks):
 - Turn off the main pump circuit breaker.
3. In the event of a major emergency (e.g. landslide):
 - Define the space under the façade to avoid endangering people.
 - Contact the administrator and structural engineer.
4. In the event of a fire:
 - Call 112 or 150.
 - To notify the firefighters that the Living Façade system is installed on the façade and where the main switch for pumps and electrical control is located.

Contacts:

xxx

6.7 LEGISLATIVE FRAMEWORK

The living façade on the building is subject to legislation in the field of building law, safety of technical equipment (electric pumps and control), water

management (irrigation and water recycling) and the requirements of the relevant technical standards.

In the field of water management, the legislation governing water abstraction and use must be respected, especially in the recycling of rainwater for irrigation and in the disposal of surplus water and nutrients. The equipment must be implemented in accordance with the technical conditions of the relevant water company and with any permits for water abstraction and discharge.

In the field of safety of technical equipment, the control unit and irrigation pumps are considered to be reserved technical equipment electrical. The operator is obliged to ensure that design, installation, repairs, maintenance and revisions are carried out only by persons with appropriate professional competence and authorizations according to the applicable legislation. At the same time, it must comply with the deadlines for regular professional inspections and tests, which are set for electrical equipment, depending on the environment and the type of building.

From a construction point of view, the installation of the Living Façade (machement panels on the supporting structure) is considered a construction intervention in the building. Depending on the extent, the load on the load-bearing structure and the location in the area, it may be a construction modification that is subject to notification or a building permit. The procedure is determined on the basis of consultation with the designer and the relevant building authority.

When designing, installing, testing and maintaining the system, it is necessary to comply with the relevant technical standards for anchoring systems, standards for wind loads and fire safety regulations (especially in terms of the speed of fire spread through the façade system). When handing over the work, the designer, the installation company and the inspection technician are also obliged to hand over to the operator documentation containing a list of standards and legal regulations that were applied in the design and implementation of the system.

This manual for the use and maintenance of the Living Façade forms an integral part of the construction documentation. The owner and users of the building are obliged to familiarize themselves with it and follow it when using and maintaining the system in order to ensure safe, reliable and long-term operation of the equipment.

A living façade, especially in relation to mache cement, is subject to several legal regulations and technical standards. In the overview:

Energy and water management

- Act No. 364/2004 Coll. on Water (Water Act) – regulates water management, including rainwater abstraction water for irrigation and discharge of excess water (depending on the nutrients used).
- Act No. 17/1992 Coll. on the Environment – general requirements for environmental protection, relevant to habitats and biodiversity supported by the façade.

Safety of technical (electrical) equipment

- Decree of the Ministry of Labour and Social Affairs of the Slovak Republic No. 508/2009 Coll. – details for ensuring OHS when working with technical electrical equipment, determination of reserved technical equipment, deadlines for professional inspections and tests, requirements for inspection technicians.

Building Legislation and Mechanical Stability

- Placing the system on the façade is an intervention in the construction, which is why the construction legislation is followed – the Spatial Planning Act (No. 200/2022 Coll.) and the related Construction Act / New Building Act, which are gradually replacing the original Act No. 50/1976 Coll. on Spatial Planning and Building Regulations.
- STN EN 1991 (Eurocodes) – loading of structures – applies mainly to wind loads, panel weights (including water and vegetation) and additional snow loads.
- The specific type of procedure (notification to the building authority / building permit / technical change only) depends on the the area of the façade, the total load on the load-bearing structure and local regulations – will be determined by the designer and the relevant building authority.

Technical standards for Façade and irrigation systems

- EN 13645 – Green walls – a set of standards covering the requirements for the design, installation and maintenance of living facades (depending on regional and national adaptations).
- STN EN 12845 – Fixed fire extinguishing equipment.

- Fire safety requirements for façade systems – specifies national requirements for the spread of fire on the façade (relevant if the façade system contains organic and flammable materials).

6.8 RECOMMENDED SOURCES

1. <https://sk.wikipedia.org/>
2. <https://www.researchgate.net/topic/Green-Walls>
3. Green architecture, Green facades and roofs – Manual, 2023, Publisher STU
4. <https://www.vertikalegarten.at/>
5. <https://www.biomason.com/>
6. <https://www.zelenestrechy.sk/>
7. <https://www.drip-irrigation.com/>
8. <https://www.fassaden-gruen.de/>
9. <https://www.skge.sk/> (Slovenská rada pre zelené budovy)
10. Technical design of the irrigation system from Bio-Tech Solutions, s.r.o.
11. <https://www.enviroportal.sk/>
12. Vladimír Kovář, Architecture in the context of sustainability, 2018, SK
13. Zuzana Kováčiková, green walls – technology and features, 2020, Alfa Publisher
14. <https://www.hunterindustries.com/>
15. <https://www.sfz.sk/> (Slovenský zväz záhradníkov)
16. <https://www.archinfo.sk/>
17. <https://www.mossart.sk/>
18. <https://www.enviro.gov.sk/> (Ministerstvo životného prostredia SR)
19. <https://www.isocarp.org/>
20. <https://www.building-systems.eu/>
21. <https://www.stavebnictvo.sk/>
22. <https://www.gardena.com/>
23. Google (2025). Gemini (generative language model) (for content processing and generation)
24. DeepL SE. (2024). DeepL Translator (online translation tool). <http://www.deepl.com>
25. Laws, decrees and standards (modified for the Living Façade):
STN 73 3050 – Loading of buildings (Static load of water, substrate, wind).

EN 1991 (Eurocodes) – Loads on structures.

Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act).

Act No. 200/2022 Coll. on Spatial Planning (new Building Act).

Act No. 364/2004 Coll. on Water (Water Act).

Decree of the Ministry of Labour and Social Affairs of the Slovak Republic No. 508/2009 Coll. (for revisions of electrical equipment – pumps and control).

EN 13645 – Vertical gardens (Green walls) and related standards for façade systems.

STN 73 0810 – Fire safety of buildings (relevant for façade systems).

7 MAINTENANCE MANUAL FOR BALCONIES AND LOGGIAS

7.1 BASIC DESCRIPTION

Balconies and loggias represent a valuable architectural and functional part of residential and commercial buildings. They are extended living spaces that enhance the quality of living, provide a private outdoor space and contribute significantly to the aesthetic value of the building. However, from the point of view of facility management, these structures are among the most demanding elements to maintain and control. As a result of direct and constant exposure to weather conditions (rain, frost, UV radiation) and mechanical stress, they are subject to intense degradation. Neglected maintenance can lead to serious consequences: from damage to waterproofing and moisture infiltration into the building structure, through corrosion of metal elements and destabilization of railings, to costly static failures. Professional management of these spaces is not just about aesthetics; It is an essential tool to protect the investment, ensure the safety of people and property, and avoid high costs for later repairs.

Architectural and structural characteristics

A proper understanding of design differences is the basis for effective management, determination of responsibilities and maintenance planning. A balcony is defined as an extended cantilever structure that protrudes in front of the façade line of a building. It is freely accessible from at least three sides, and its weight is not exclusively the load-bearing walls of the building, but the cantilever slab or beam system. This design principle causes specific requirements for deflection control and drainage.

The loggia, on the other hand, is recessed or recessed into the floor plan of the building. It is surrounded by walls on three sides and is usually open only by one (front) side. Its floor is supported by building walls or columns, which makes its static behavior and building load significantly different from that of a balcony. The loggia offers better protection against wind and precipitation, which can have a positive effect on maintenance, but on the other hand, it can limit the natural lighting of the interior.

Structural Systems and Static Behavior

It is crucial for facility management to understand that a balcony as a cantilever is prone to deflection, which can cause disruption of the waterproofing layers and poor drainage. Standards (such as the British standards referenced in BS EN) set the permissible limits of this deflection that must be controlled. A loggia, as a supported slab, has other risks, often related to the proper drainage of the inner corner and the connection of waterproofing to the perimeter walls. In both types, the thermal bridge continuity – the point where the structure breaks the thermal envelope of the building – is critical, which can lead to heat loss and condensate formation.

7.2 MATERIAL CHARACTERISTICS

The choice of materials during construction or renovation determines future maintenance, safety and durability costs.

Materials for railings and cladding

Stainless steel: The most suitable choice for long life and low maintenance. It only requires occasional washing. The initial investment is higher. Surface treated steel (e.g., galvanized and painted): Common and affordable. A critical point of maintenance is the inspection of corrosion in places of surface damage, on welds and in the lower parts of the posts. Repainting is essential.

Glass (panels): Provides an unbeatable view. Maintenance includes cleaning and especially checking the fastening bolts and sleeves that ensure stability.

Wooden/wood-aluminium structures: Aesthetically pleasing, but require regular treatment with impregnations and coatings against moisture and UV radiation.

Requirements for fire-safe materials

In relation to fires such as the Grenfell Tower, regulations have been tightened in many countries (including the EU and the UK). For residential buildings over 11 metres, the materials used for balconies (classified as 'specified allowances') must be non-sleepable classes A1 or A2 according to BS EN 13501-1. This applies to all structural elements, including cladding, railings and floor coverings. For roof terraces that are classified as roofs, an assessment of the entire

composition as a system according to BS EN 13501-5 is required, with the highest class BROOF(t4) being unrestricted. Substitution of any element in a certified system without further testing is inadmissible and causes non-compliance.

7.3 RULES OF USE

For damage prevention and safety risks, facility management must establish clear rules:

Prohibition of imposing heavy loads (e.g. excessive amount of pots with soil, furniture) exceeding the permissible load (usually 150-200 kg/m² for balconies, 300-500 kg/m² for loggias). Prohibition of the use of open flames (charcoal grills, fireplaces) on balconies and loggias of higher floors. Prohibition of separate glazing or construction modifications without the consent of the building management. Balcony glaze may require a building permit (especially for terraces) and changes the aerodynamics and load of the building. Obligation to keep gutter openings and drains clean and permeable. Notifying the building administration of any damage or unusual condition (cracking, corrosion, railing deflections).

7.4 PREVENTIVE AND REGULAR MAINTENANCE PLAN

Preventive maintenance is an investment that reduces the total cost of living many times over. The plan must be based on the principles described in the facility management resources: element inventory, categorization, and frequency assignment.

Daily/Weekly (Performed by a user/regulated employee): Removal of visible debris, checking that drains are not blocked by leaves.

Monthly: Visual inspection of the integrity of surfaces and railings by the user.

Quarterly (Performed by FM technician): Deeper surface cleaning, handrail joint tightness inspection, corrosion inspection.

Semi-annual/Yearly (Performed by a specialized technician): Comprehensive inspection according to Chapter 5, waterproofing inspection (water-permeable tests), inspection of static elements (studs, brackets), re-jointing and sealing of movable joints.

Seasonal maintenance calendar

Adapting maintenance to the season maximizes its effect.

SOUTH AFRICA: After the winter season: Detailed inspection of frost damage (cracks, peeling), inspection and cleaning of drainage systems after snow melts, removal of moss and algae.

SUMMER: Inspection of UV damage (fading of paints, degradation of plastics), application of protective impregnations (wood, stone), control of deflections under heat.

FALL: Intensive removal of fallen leaves and organic material that shades drains and promotes rot. Inspection of railings against winter storms.

WINTER: Ensuring safe drainage of melting snow and ice, prohibition of the use of road salt (causes corrosion), removal of icicles burdening the structure.

7.5 PERIODIC INSPECTIONS AND INSPECTION PROTOCOLS

Frequency, scope and responsibilities

Routine inspection (quarterly): Performed by a facility management technician. Visuals, basic measurements.

Detailed inspection (annual): Carried out by a certified engineer or a specialized firm. It includes non-destructive tests (hammer test for tile separation, paint thickness measurement, corrosion inspection), inspection of all mechanical joints.

Special inspection (after extreme events): After strong winds, earthquake, fire or when a serious defect is found. A specialist answers.

Inspection checklist and documentation

Every inspection must be documented. The protocol must include:

1. Identification of the building and the specific balcony/loggia.
2. Date and name of the inspector.
3. Photo documentation of the condition.
4. Completed checklist with rating (e.g.: Condition: Good / Needs correction / Critical):

Floor surface: Cracks, deformations, prevention of drainage, condition of joints.

Railing/cladding: Stability, corrosion, strength of fillings, fastening.

Waterproofing and drainage: Condition of the gutters, permeability, signs of infiltration (stains under the structure).

Ends of structure and connection to the building: Signs of cracking plaster, breakout, moisture.

Static elements (visible): Corrosion of brackets, condition of fastening screws.

5. Recommendations for corrections with prioritization.

6. Signature of the inspector.

7.6 PROCEDURE IN THE EVENT OF A BREAKDOWN AND EMERGENCY SITUATION

Identifying and escalating the problem

Level 1 (Minor Damage): E.g. loose handrail screw, small crack. Report to the administrator, repair as part of regular maintenance.

Level 2 (Moderate Damage): E.g. extensive corrosion, blocked drain causing regular waterlogging, visible sagging. Immediate reporting. Delimitation of space, temporary measures, planned quick repair.

Level 3 (Emergency condition): E.g. significant deflection or loosening of part of the railing, large cracks in the bracket, signs of waterproofing breakage. Immediate emptying of the space and its closure. Contacting the emergency service and statistics. Reporting to any authorities according to the regulations.

Emergency plan and communication protocol

The FM team must have a consulted and approved emergency plan, which specifies:

Contacts: Telephone numbers for the emergency construction company, structural engineer, firefighters (in case of fire), building manager, FM director.

Closure procedure: Who is entitled to decide who will physically secure entry.

Communication with residents: How and when residents will be informed about the accident and safety measures.

Documentation of the event: Photographs, a record of the measures, later a protocol on the cause of the accident and the repairs made.

7.7 LEGISLATIVE FRAMEWORK AND NORMATIVE REQUIREMENTS

Building and technical regulations

In Slovakia, the basis is the Building Act and regulations such as STN 73 4301 Residential buildings and Eurocodes (e.g. EN 1991 Structural loads), which determine wind, snow and human loads. As mentioned in, European standards (EN) are harmonized with national (BS EN), creating a uniform framework for design and assessment.

Fire Safety and BS 8579 Standard

The BS 8579:2020 Balconies and Terraces standard provides clear definitions and guidelines. From the FM's point of view, it is critical that balconies are classified separately from roofs for fire safety purposes and are subject to the requirements for the reaction to fire class of materials (according to BS EN 13501-1). The use of incorrect, flammable cladding materials can cause a fire to spread rapidly between floors, as past tragedies have shown.

Operating obligations

According to the regulations on management and safety on construction sites, the "client" (which can be the owner or facility manager) has a duty to ensure that the risks associated with maintenance, repairs and future changes are managed even during the operation of the building. This means that when planning major maintenance interventions on balconies, it is necessary to carry out a risk assessment, ensure safe access for workers and minimise risks to residents.

7.8 CONCLUSION

Comprehensive management of balconies and loggias is a systematic process that begins at their creation with the selection of the right materials and continues throughout their lifetime with regular maintenance, inspections and timely repairs. The main goal of facility management is to move from an emergency, reactive approach to a proactive and planned model. Investing in quality preventive maintenance, training for staff and clear communication channels with residents brings many returns. Not only does it save high costs on

complex repairs and increase safety, but it also directly increases the value of the property and the satisfaction of users, for whom these outdoor spaces are an important part of the quality of living. An approach based on evidence, documentation and respect for the legislative framework is a prerequisite for the responsible and sustainable operation of modern buildings.

7.9 RECOMMENDED SOURCES

Total Care Services Maintenance. (2025). Mastering Balcony and Terrace Maintenance: Preserving Outdoor Living Spaces. Available from: <https://totalcareservicesmaintenance.com/blogs/mastering-balcony-and-terrace-maintenance-preserving-outdoor-living-spaces>

STHS Law. (2023). Balcony, Terrace, Loggia – which of them requires a building permit? Available from: <https://sths-law.com/en/>

Balconies.global. (2021). Balcony Maintenance on High-Rise Buildings. Available from: <https://balconies.global/resources/balcony-maintenance-high-rise-buildings/>

CFPA Europe. (2024). Fire safety of balconies and terraces. Available from: <https://cfpa-e.eu/fire-safety-of-balconies-and-terraces-fire-protection-association/>

Gomez Corporate Consult Limited. (2023). The facility manager's guide to building a practical maintenance schedule. Available from: <https://gomezconsult.com/the-facility-managers-guide-to-building-a-practical-maintenance-schedule/>

Balconies.global. (2025). How do BS EN Standards Affect Balcony Design. Available from: <https://balconies.global/resources/bs-en-standards/>

Vilcekova, S. et al. (2021). Influence of the Adaptation of Balconies to Loggias on the Lighting Climate inside an Apartment Building under Cloudy Sky. *Sustainability*, 13(6), 3106. Available from: <https://www.mdpi.com/2071-1050/13/6/3106>

Act No. 25/2025 Coll., Building Act and on Amendments to Certain Acts (Building Act)

8 MAINTENANCE MANUAL FOR SKYLIGHTS

8.1 BASIC DESCRIPTION AND MATERIAL CHARACTERISTICS

A skylight is a building structure mounted on the roof, the primary purpose of which is to bring natural daylight to the interior of the building, especially to staircases, corridors and communication cores. In apartment buildings, point dome skylights or linear strip skylights are most often used.

Description of structural layers

The design of the skylight in apartment buildings is governed by the requirements of STN EN 1873 (plastic skylights) and EN 14963 (glass skylights), while individual manufacturers use standardized system solutions. The technical section of the dome skylight contains the following basic layers and elements (listed according to VELUX Commercial and Fakro documentation):

Top Dome (PC or PMMA)

The upper shell of the skylight can be *single-skinned, double-walled or three-skinned*.

- **Polycarbonate (PC)** is the most common choice for apartment buildings due to its high impact resistance and good optical properties.
- **PMMA (acrylic)** has higher transparency (up to 92%) and UV resistance, but is less impact-resistant.

The dome is made in the form of a molded part with a rounding that promotes water drainage and increases strength.

Lower dome or inner shell

In double-walled and three-walled designs, there is a second or third inner dome shell:

1. made of polycarbonate or PMMA,
2. mounted by means of spacers,
3. creates an intermediate layer of air that improves thermal insulation properties ($U \approx 0.9\text{--}1.4 \text{ W/m}^2\text{K}$) – values given by both VELUX and Fakro.

Spacer frame and interlayer air cavity

A closed air cavity is created between the individual domes, which acts as an insulating layer – similar to double glazing in windows.

The spacer frame is usually made of plastic or aluminum and provides:

1. the stability of the dome,
2. uniform pressure distribution,
3. the exact geometry of the substrate for screwing.

Skylight support frame

A support frame – often referred to as a base frame – has the following characteristics:

1. it is made of anodized aluminum (corrosion resistance),
2. carries the dome and transfers the load to the skylight base,
3. contains grooves for fastening EPDM gaskets.

The aluminium frame is designed to allow installation in various types of roof compositions (PVC, bitumen, TPO, FPO).

EPDM Gaskets

Gaskets ensure the watertightness of the frame and dome joint.

1. according to manufacturers, they are UV and ozone resistant,
2. However, they harden over time, so it is recommended to check them 1× a year and treat them with silicone oil to extend their lifespan.

EPDM gaskets are fitted into precise grooves in the frame so that the pressure on the gasket is evenly distributed.

Skylight base

The upstand ensures that the skylight is raised above the roof level and has a height: 150–300 mm according to STN 73 1901 (protection against leakage and snow).

Pedestal may refer to:

1. thermally insulated (e.g. PVC sandwich),
2. galvanized sheet metal,
3. Aluminum system.

The task of the pedestal is to create a stable transition between the roof cladding and the skylight.

Anchoring elements and joints

The dome is attached to the frame with stainless steel screws (usually A2 or A4). According to EN 1873, they must meet tests for strength, resistance to wind buoyancy and temperature changes.

Connections must be:

1. evenly spaced,
2. tightened according to the manufacturer's assembly code,
3. inspected during annual maintenance.

Connection to waterproofing (flashing)

According to STN 73 1901, the skylight must be connected to the roof waterproofing by a system solution:

1. PVC foil (e.g. Fatrafol 810),
2. TPO foil,
3. bituminous modified strips (SBS).

Manufacturers (VELUX Commercial, ACO) recommend:

1. hot-air welding of foils with a base,
2. foil overlap min. 80 mm,
3. inspection of the seal annually.

This detail is crucial – 80% of skylight failures occur in the skylight-waterproofing joint.

Shading and additional elements

Some skylights may contain:

1. internal shading roller shutters,
2. insect webs,
3. ventilation chimneys,
4. control mechanisms for opening (manual, electric).

Materials used

Polycarbonate (PC): high impact resistance, UV stabilization, light weight. According to the ACO Rooflight Domes manual, the PC has up to 250 times the resistance of glass.

PMMA (acrylic): high light transmittance (up to 92%).

Laminated safety glass (VSG/ESG): mainly used for glass skylights according to EN 14963.

Aluminium frames: corrosion-resistant, commonly used in VELUX Commercial skylights.

EPDM seals: UV resistant, commonly used in all skylights (Fakro, Velux).

Classification by function

fixed skylights – non-openable, used for illumination,

openable skylights – ventilation or access for service,

smoke skylights (SHEV) – designed for smoke and heat extraction according to STN EN 12101-2.

Lifespan

The lifespan of high-quality skylights (polycarbonate or glass) is 20–30 years if maintenance is observed, which is stated by several manufacturers – Fakro and Velux.

8.2 USE OF SKYLIGHTS

The use of skylights in apartment buildings is predominantly passive – except for openable or smoke skylights, which must not be used incorrectly.

Recommendations for users:

Do not tamper with the skylight or its opening mechanism (confirmed by VELUX Commercial in the data sheet), do not step on the dome during roof maintenance – polycarbonate does not break easily, but it can deform, cover the skylight with objects or stored material, do not destroy or interfere with the wiring and control of the openable types.

8.3 MAINTENANCE

Skylight maintenance is defined by the STN 73 1901 roof standard and manufacturers' recommendations (VELUX, Fakro, ACO).

Maintenance frequency

Visual inspection (2× per year) – recommended by ACO Rooflight domes.

Seal inspection (1× per year) – recommended by Fakro and Velux.

Dome cleaning (1× per year) – spring cleaning with mild detergent.

Inspection of anchoring elements (1× per year) – according to STN 73 1901.

Inspection of smoke skylights (1× per year) – mandatory according to the Decree of the Ministry of the Interior of the Slovak Republic No. 94/2004.

Cleaning

According to the VELUX manual, it is recommended to use:

soft cloth, non-aggressive detergent, lukewarm water.

Polycarbonate domes must not be cleaned with gasoline, thinner and organic solvents – the surface may be damaged (confirmed by ACO documentation).

Seal Inspection

EPDM gaskets age, harden and can let water through over time. Manufacturers recommend:

1× annually visually inspect, treated with silicone oil to prolong the service life.

Inspection of structural joints

The following are checked:

tightening of screws (EN 1873 prescribes strength requirements),

condition of flashing and flange according to STN 73 1901,

waterproofing around the skylight (PVC/bitumen connection).

8.4 REGULAR INSPECTIONS

The administrator of an apartment building is responsible for:

provision of inspections in accordance with Act No. 182/1993 Coll.,

ordering a service company,

keeping records of inspections.

A professional service company must perform:
inspection of mechanical damage (dome cracks, damaged glass),
checking the functionality of the opening (motor, hinges),
inspection of smoke skylight electronics according to STN EN 12101-2,
CO₂ cartridge test (for SHEV systems).

Checklist

2× per year: surface pollution, cracks, UV degradation, leakage

1× per year: gaskets, joints, opening functionality, wiring

8.5 FAULTS AND FAULT PROCEDURE

The most common malfunctions:

Leakage

The most common problem with older skylights – usually a damaged seal or poor waterproofing connection. According to STN 73 1901, the skylight flange must be properly connected to the waterproofing coating.

Solution: professional resealing or flashing repair.

Dome rupture

It occurs in the event of hail or mechanical impact. Polycarbonate is highly durable, but not indestructible.

Solution: replacing the top of the skylight.

Condensation between jackets

It occurs when the joints of the double dome are broken – according to EN 1873, permanent condensation must not occur.

Solution: replacement of the gasket or the entire part.

Not opening the openable skylight

Reasons: jamming, freezing of hinges, engine failure. For smoke skylights, a functionality test is mandatory.

The solution: expert service.

UV degradation and tarnishing

Especially with older PMMA skylights – the manufacturer Fakro states a gradual reduction in the light transmittance of the material.

Solution: replacement of the dome or professional polishing.

8.6 LEGISLATIVE FRAMEWORK

EN 1873 (prefabricated plastic skylights) – strength and functional requirements.

EN 14963 (glass skylights) – resistance tests.

STN 73 1901 (roofs) – method of connection, anchoring and maintenance.

EN 12101-2 – smoke and heat extraction systems.

Act No. 182/1993 Coll. – definition of common parts of the house, obligations of the administrator.

Decree of the Ministry of the Interior of the Slovak Republic 94/2004 – annual tests of smoke and heat extraction equipment.

Decree No. 364/2012 Coll. – technical requirements for buildings (light, lighting).

8.7 RECOMMENDED SOURCES

VELUX Commercial – Product Manual for Dome Rooflights.

<https://commercial.velux.com>

FAKRO – Technical documentation of skylights. <https://fakro.sk>

STN 73 1901 – Roof design.

Decree No. 364/2012 Coll. – Technical requirements for constructions.

EN 12101-2 – Smoke and heat extraction.

Decree of the Ministry of the Interior of the Slovak Republic No. 94/2004 – Fire Systems and Revisions.

Act No. 182/1993 Coll. on the Ownership of Flats and Non-Residential Premises.

ACO Plastics – Rooflight Domes Technical Documentation. <https://www.aco.com>

VELUX Commercial – Technical Specifications for Dome Rooflights (Construction & Components). Available at: <https://commercial.velux.com>

9 MAINTENANCE MANUAL FOR WINDOWS AND BALCONY DOORS

9.1 BASIC CHARACTERISTICS AND TECHNICAL DESCRIPTION

This manual sets out the principles for the correct use, maintenance, inspection and diagnosis of Schüco window and door systems installed in an apartment building. The document provides comprehensive technical information to the users of the building, the administrator and service technicians and is based on the manufacturer's official technical documents and applicable standards.

Schüco LivIng Classic – Technical Catalogue 2024, p. 3.

The manual applies to all plastic (Schüco LivIng 82, CT70) and aluminium window systems (Schüco AWS 70/75/90), Schüco VarioTec/AvanTec fittings, sealing systems and insulating glass according to EN 1279. It determines the principles of their use and maintenance in residential buildings.

Life with windows – CT70 Classic, 2020, p. 4

Normative framework

The operation and evaluation of the properties of Schüco windows is governed by European and Slovak technical standards, which define the requirements for breathability, waterproofness, wind resistance, thermal protection, glazing and installation. STN EN 14351-1+A2:2016

The Schüco LivIng Classic 82 system is a modern plastic window system with a 7-chamber construction and an installation depth of 82 mm. It allows the installation of insulating glass with a thickness of 16–54 mm. The manufacturer offers two variants of sealing:– AS (two sealing planes),
– MD (three sealing planes) for increased airtightness and acoustic attenuation.
Schüco LivIng Classic – Technical Catalogue 2024, p. 8

Thermal insulation properties

The LivIng 82 frame profile achieves a U_f value of up to $0.96 \text{ W}/(\text{m}^2\text{K})$, depending on the configuration. In combination with triple glazing, the window can achieve parameters suitable for both low-energy and passive buildings.

Schüco LivIng Classic – Technical Catalogue 2024, p. 9

Sealing systems

The MD (Middle Gasket) system includes a central stop gasket that improves tightness against infiltration airflow, increases sound insulation and improves the stability of the sash under wind stress.

Schüco LivIng Classic – Technical Catalog 2024, p. 12

The Schüco CT70 Classic system is a 5-chamber PVC window system with an installation depth of 70 mm. It is characterized by a double stop seal, deeper glass placement and is especially suitable for renovations and standard residential buildings. Life with windows – CT70 Classic, 2020, p. 6

Thermal insulation properties of the CT70 system

The CT70 profile allows the use of double or triple glazing and achieves thermal insulation values suitable for ordinary residential buildings. Compared to LivIng 82, it provides lower insulation parameters, but excels in versatility of use.

Život s okny – CT70 Classic, 2020, p. 7

Schüco aluminium window systems (ALU systems)

Schüco AWS – 70.HI, 75.SI+, 90.SI+ Series

Schüco AWS aluminium systems use a multi-part profile with a polyamide thermal bridge, high static rigidity and a modular concept. The systems enable the implementation of slender frame structures as well as large-size glazing.

Schüco AWS – Technical Prospectus P4035, 2023, p. 26

Thermal insulation parameters

The declared Uf values for aluminium systems are:

–	AWS	90.SI+:	Approx.	0,71	W/(m ² K),
–	AWS	75.SI+:	Approx.	0,92	W/(m ² K),
–	AWS	70.HI:	Approx.	1,5	W/(m ² K).

Schüco AWS – Technický prospekt P4035, 2023, p. 26–28

Insulating glazing (IGU)

Schüco windows use insulating glass according to EN 1279. Double and triple glazing, safety glass (VSG, ESG), acoustic glass according to EN 12758 and

special functional layers (solar, solar control, safety) are available. LivIng 82 allows you to install glass up to 54 mm thick.

Schüco LivIng Classic – Technical Catalogue 2024, p. 14

Schüco fittings – VarioTec / AvanTec

Schüco VarioTec fittings form the supporting and closing system of the sash, enabling tilt-and-turn operation. The mechanism ensures uniform pressure of the sash around the entire circumference, thus improving airtightness, watertightness and sound insulation. Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 2–3

Schüco system seals (EPDM)

The profile seals are made of EPDM material with a long service life, high UV stability and ozone resistance. There are two stop gaskets in AS systems, three in MD systems, which significantly improves breathability and sound insulation. Schüco LivIng Classic – Technical Catalogue 2024, p. 12

9.2 USE OF WINDOWS AND BALCONY DOORS

Basic principles for using Schüco window systems

Schüco windows and balcony doors are designed for common user opening, closing, tilting ventilation and micro-ventilation. The system allows precise control of the sash thanks to the VarioTec fittings, which ensure even pressure and a stable position of the sash in different opening modes. When handling, it is necessary to use appropriate force and ensure that nothing obstructs the movement of the sash. Tatra-Trade – Installation and maintenance of Schüco windows, 2020, p. 1–2

Microventilation (micro-slot)

Schüco systems enable so-called micro-ventilation – a slight offset of the sash from the frame by means of a special handle position. This mode is used for controlled air exchange, especially in winter, when intensive ventilation is not desired. Microventilation does not replace regular burst ventilation, but it helps to reduce condensation during normal use.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 2

Proper impact and transverse ventilation

The most effective form of ventilation is short, intense burst or transverse ventilation (approx. 3–7 minutes), during which the internal air is quickly exchanged without significantly cooling the structures. With long ventilation on the ventilator, there is unnecessary heat loss and the risk of condensation on the interior surfaces. Life with windows – CT70 Classic, 2020, p. 11

Correct closing and sash pressure

For the window to function properly, it is important to:

1. full sash closure,
2. correct fit of the locking points into the frame,
3. uniform circumferential pressure,
4. do not tilt objects into the closing area,
5. Do not handle the sash in excessively strong winds.

Improper closing reduces airtightness, causes blowing and wear of the fittings.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 2–3

Behavior of windows in winter

In winter, condensation may appear on the inner surface of glass and frames. It is a phenomenon caused by:

1. low surface temperature of the glass,
2. increased air humidity in the room,
3. insufficient ventilation,
4. shielding with curtains/blinds that prevent the flow of air around the glass.

Proper ventilation and maintaining a lower relative humidity reduces the risk of condensation. Schüco LivIng Classic – Technical Catalogue 2024, p. 18

Behavior of windows in summer

In summer, there may be higher stress on frames and fittings due to thermal expansion. Materials (especially PVC) may deform slightly, which may temporarily affect the ease of opening. This phenomenon is normal and subsides

with the change in temperature. Schüco LivIng Classic – Technical Catalogue 2024, p. 5

The frame is divided into **an outer and an inner part**, which are separated **by a thermal insulation insert** (thermal break). Such a design significantly reduces heat transfer from the interior to the exterior and prevents condensation on the surface of the frame.

Functional significance of the structure:

1. prevents uncontrolled heat transfer through aluminum, which is highly thermally conductive,
2. increases the energy efficiency of the window,
3. eliminates the feeling of cold around the frame,
4. significantly reduces the risk of condensation in the internal contact zones,
5. improves overall comfort of use.

Handling balcony doors

Balcony doors are structurally similar to window sashes, but due to the greater weight, it is necessary to ensure the smooth movement of the sash:

1. regular lubrication of bearing points,
2. do not let the door "flare" freely in the wind,
3. always close in strong winds,
4. Do not use the handle as a support when opening the door to the side.

Tatra-Trade – Installation and maintenance of Schüco windows, 2020, p. 3

9.3 MAINTENANCE OF WINDOWS AND BALCONY DOORS

General Maintenance Principles

Schüco windows and doors require regular maintenance to ensure their long-term functionality, stability, airtightness and safety. Maintenance mainly concerns fittings, seals, frames and glazing. Windows need to be kept clean and dry, free of debris in the area of drainage grooves and shut-off points. Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 1

Frame cleaning (PVC and ALU)

PVC and ALU frames are cleaned with a soft cloth and lukewarm water with the addition of a mild detergent. No abrasive cleaners, solvents or harsh sponges are used, which can damage the surface of the profile. For aluminium profiles with a surface finish (anodizing, powder coating), it is necessary to use only the cleaning agents recommended by the manufacturer.

Schüco LivIng Classic – Technical Catalogue 2024, p. 21

Seal Maintenance (EPDM)

The seals in Schüco profiles are made of EPDM, which is resistant to UV radiation, temperature changes and ozone. Seals need to be treated twice a year with a special preparation based on silicone or glycerin to preserve their elasticity and sealing effect. Regular maintenance extends the lifespan and improves the acoustic and thermal properties of windows.

Tatra-Trade – Installation and maintenance of Schüco windows, 2020, p. 2

Hardware maintenance (VarioTec / AvanTec)

Fittings are the mechanical component of the window and require regular lubrication at least once a year. They are lubricated:

1. moving parts of fittings,
2. Closing points;
3. hinges,
4. supporting elements of the wing.

Only oil or spray intended for window fittings is used. No WD-40, graphite or technical petroleum jelly are used.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 3

Inspection of drainage grooves

At the bottom of the window frame there are drainage channels that drain moisture out of the profile. Clogging them can cause water retention, damage the frame, and reduce tightness. The grooves need to be checked regularly and dirt removed.

Schüco LivIng Classic – Technical Catalogue 2024, p. 16

Glazing maintenance

Glass panes are cleaned with soft rags or soft rubber squeegees. No abrasive powders, acids or cleaning agents containing ammonia are used. For larger glass formats, it is advisable to avoid sudden changes in temperature (e.g. do not direct a stream of hot water to cold glass).

Život s okny – CT70 Classic, 2020, s. 12

Maintenance intervals

Minimum recommended intervals:

1. frame and glass – every 2-3 months,
2. seals – 2× per year,
3. fittings – 1× per year,
4. drainage holes – 2-4× per year,
5. inspection of the function of fittings – 1× per year,
6. check the sash adjustment – as needed.

These intervals correspond to the manufacturer's recommendations and the practice of tilt-and-turn systems.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 3

9.4 REGULAR INSPECTIONS OF WINDOWS AND BALCONY DOORS

Regular inspections ensure the long-term functionality and safety of window structures. Inspections are carried out by the end user, the facility manager or an authorized service center, depending on the nature of the operation.

Checks performed by the user

The user performs visual and functional inspections approximately every 2-3 months. The aim is to identify basic operating errors, clogged grooves, seal damage or impaired hardware function.

In particular, the User checks:

1. proper closing of the sash,

2. free operation of the handle,
3. Tilt function
4. intact seals without cracks or deformations,
5. clean drainage (drainage) holes,
6. cleanliness of frames, glass and pressure surfaces,
7. the presence of condensation in the interior (as a signal of insufficient ventilation).

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 1

Inspections performed by the facility manager

The administrator performs extended inspections 1-2× per year. It is a set of technical actions that verify the functionality, safety and overall condition of window elements within the entire apartment building.

The administrator checks:

1. condition of external window sills and connection to the frame,
2. the condition of the external frame seals and any joint failures,
3. functionality of all balcony doors,
4. flatness of the sashes in typically loaded windows (staircase, common areas),
5. the condition of surface finishes of ALU frames (scratching, chalking),
6. shading status, if it is part of the window (blinds, nets).

Schüco Living Classic – Technical Catalogue 2024, p. 5

Inspections carried out by an authorized service center

The professional service is obliged to carry out an in-depth technical inspection every **2 years**, or as needed (in case of deteriorated function, hardware service or complaint).

The service checks:

1. sash adjustment in three axes (height, downforce, lateral adjustment),
2. the function of forging closing points,
3. condition of load-bearing hinges and their load-bearing capacity,
4. microventilation function,

5. wear of moving parts,
6. tightness of circumferential seals,
7. the condition of thermal elements in the frame (insulation zones, chambers).

At the same time, the service performs:

1. complex lubrication of fittings,
2. Adjusting the pressure according to the seasonal position (summer/winter),
3. inspection of drainage channels from the side of both the frame and the sash.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 3

Frequent check-ups: Recommended

Type of inspection	Who performs	Interval
Visual inspection of frames, glass, seals	User	2–3 months
Inspection of drainage holes	User	2–4 per year
Checking the function of the balcony door	User	3 months
Technical insp. of windows of all apartments	BM	1× per year
Insp. of the surface treatment of ALU frames	BM	1× per year
Professional fittings setup	Authorized service	1× per year
Comprehensive service insp. of the system	Authorized service	Every 2 years

Life with windows – CT70 Classic, 2020, p. 12

Method of keeping records of inspections

For apartment buildings, it is advisable to keep records of the inspections carried out in a separate document or table. The records usually include:

1. the date of the inspection;
2. who carried out the inspection,
3. identification of the apartment / window,
4. a list of identified deficiencies;
5. recommended actions,

6. service interventions performed,
1. the date of the next inspection.

Such records serve as a basis for the administrator and the service when dealing with defects or complaints.

Schüco LivIng Classic – Technical Catalogue 2024, p. 22

9.5 THE MOST COMMON MALFUNCTIONS AND METHODS OF ELIMINATING THEM

Faults in Schüco window and door systems usually relate to malfunction of the fittings, leaks, difficult handling or problems caused by neglected maintenance. Most common problems can be identified by visual inspection or diagnosis by a service technician.

Difficult to open or close the sash

Symptoms

1. the sash rubs against the frame,
2. difficult transitions between positions (open/tilt/close),
3. irregular resistance when handling the handle,
4. The handle does not want to turn into the correct position.

Probable causes

1. loose or worn fittings,
2. lack of lubrication,
3. displacement of the sash due to thermal expansion or settlement of the building,
4. dirt in the interlocking points.

Recommended procedure

1. check the free operation of the handle,
2. check the closing points,
3. lubricate the moving parts of the fittings,

4. In case of persistent problems, adjust the sash (height, downforce, lateral shift).

Tatra-Trade – Installation and maintenance of Schüco windows, 2020, p. 3

Blowing around the frame or sash

Symptoms

1. draughts around the window,
2. feeling cold around the perimeter of the frame,
3. gentle "fizz" of air.

Possible causes

1. Unsealed or incorrect closure points
2. damaged EPDM gasket,
3. insufficient wing pressure,
4. improper assembly or loose anchoring elements.

Recommended solutions

1. check the function of the fittings and the pressure of the sash,
2. lubricate the locking points and verify their locking,
3. check the gaskets and replace them if damaged,
4. If the problem comes from the installation, contact the service or the implementation company.

Schüco LivIng Classic – Technical Catalogue 2024, p. 18

Condensation on glass or frame

Internal condensation (interior)

It arises in:

1. high humidity in the room,
2. low glass temperatures,
3. insufficient ventilation,

4. shaded by curtains that prevent air circulation.

Solution: regular burst ventilation, removal of airflow barriers, maintaining recommended humidity values (40–55%).

External condensation (exterior)

This is a normal physical phenomenon in high-insulation glass, when the surface temperature of the glass is lower than the air temperature.

Život s okny – CT70 Classic, 2020, s. 11

Non-draining water from drainage holes

Symptoms

1. water accumulates at the bottom of the frame,
2. moisture or stains when the window sill is attached,
3. slow drainage of the window after rain.

Causes

1. clogged drainage channels,
2. incorrect connection of the window sill,
3. deformation of the frame.

Solution

1. clean drainage holes,
2. check the slope of the window sill,
3. verify the correct position of the sash and seals,
4. In case of installation errors, contact the service.

Schüco LivIng Classic – Technical Catalogue 2024, p. 16

Sash jamming or sagging

Symptoms

1. the sash "falls" when closing,
2. significant rubbing against the frame,
3. The handle cannot be turned smoothly.

Causes

1. hinge utilization (especially at balcony doors),
2. loose bolts of supporting elements,
3. excessive weight of glazing,
4. long-term absence of maintenance.

Solution

1. hinge adjustment (sash lift),
2. Inspection and tightening of all joints,
3. possible replacement of worn load-bearing parts.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 3

Forging failures

Typical fittings failures:

1. non-functional micro-ventilation mode,
2. non-locking points,
3. loose hinge bolts,
4. excessive friction in the mechanism,
5. Worn guide arms.

Solution

1. lubrication of all moving parts,
2. setting of closing points,
3. tightening of joints,
4. replacement of damaged parts,
5. Always use original Schüco parts when replacing fittings.

Tatra-Trade – Schüco Window Adjustment and Maintenance, 2020, p. 2–3

Contact details for troubleshooting

All failures that cannot be solved by routine maintenance must be reported:

Authorized Service:

xxxxs.r.o. Official service partner for plastic and aluminium systems.

Tatra-Trade – Setting and maintenance of Schüco windows, 2020

9.6 RECOMMENDED SOURCES

Schüco LivIng Classic – Technical catalogue, Schüco International KG, 2024.
Life with windows – Schüco CT70 Classic, Tatra-Trade s.r.o., 2020.
STN EN 14351-1+A2: 2016 – Windows and doors. Standard for product properties.

Schüco CT70 Classic – Technical documentation of the system, Schüco International KG.

Schüco CT70 Classic – Thermal and technical parameters of the system, Tatra-Trade s.r.o.

Schüco AWS – Technical documentation P4035, Schüco International KG, 2023.
Schüco AWS – Thermal insulation parameters of systems AWS 70/75/90, Schüco International KG.

Technical documentation of insulating glass (IGU) according to EN 1279, Schüco International KG.

Tatra-Trade – Schüco window setup and maintenance, service manual, 2020.

Schüco – Technical data sheets on EPDM seals and their maintenance, Schüco International KG.

OpenAI. (2024). *ChatGPT (GPT-5.1) [generative language model]*.
<https://chat.openai.com>

DeepL SE. (2024). *DeepL Translator [online translation tool]*.
<https://www.deepl.com>

Use of assistive tools

Digital tools supporting the technical expertise of the document and stylization of the text were used in the processing of the work. The ChatGPT language model (GPT-5.1, OpenAI, 2024) was used to summarize expert evidence, search for sources, and edit the language.

The DeepL translation tool (DeepL SE, 2024) was used to translate selected foreign-language technical documents.

All information obtained through these tools has been verified, supplemented and critically assessed by the author.

10 MAINTENANCE MANUAL FOR A DOOR

Doors are the basic element of an apartment building, which fulfills the function of protection, separation of spaces, access regulation, safety of people and property, thermal and sound insulation, or aesthetics. Proper use, regular maintenance and professional inspections significantly extend their lifespan and minimize the risk of breakdowns. This part of the manual is devoted to a comprehensive description of the door, material characteristics, recommended use, maintenance, inspections, troubleshooting and legislative framework.

10.1 BASIC DESCRIPTION AND MATERIAL CHARACTERISTICS

Entrance door of an apartment building

Entrance doors are the most stressed type of doors in an apartment building. Their construction must be resistant to weather conditions, mechanical damage, vandalism and must provide an adequate level of safety.

Description:

1. An entrance door usually consists of a metal frame, a leaf, a glass panel (safety double glazing or triplex), a self-closer, a threshold part and a security lock.
2. They are usually supplemented with electronic systems: house doorman, chip access, electric lock.

Material characteristics:

1. **Metal elements:** steel, aluminium – powder-coated surface.
2. **Glass panels:** safety laminated glass, tempered glass.
3. **Seals:** EPDM elastomers resistant to variable temperature and UV radiation.
4. **Locking systems:** safety classes according to EN 1627.

Inter-apartment doors (corridors – cellars – common areas)

Description: This door separates the different parts of the building. They reduce the spread of noise, odours and at the same time serve as fire barriers.

Material characteristics:

1. **Construction:** steel or fire-resistant wooden doors with fire-resistant filling.
2. **Surface treatment:** abrasion-resistant laminate or varnished surfaces.
3. **Fittings:** self-closers, fire locks, panic fittings.

Doors to technical rooms (pram room, engine rooms, technical areas)

Description: Doors must provide controlled access only to authorised persons, must be mechanically robust and often supplemented with security features.

Material characteristics:

1. Steel doors with reinforced construction.
2. Higher-end safety locks.
3. Ventilation grilles for utility rooms.

10.2 USE

Proper use of doors is the basis for their longevity and functionality.

Standard doors

1. **Grasp the doorknob:** Grasp the door handle or knob firmly.
2. **Turn the handle:** Turn the knob or handle to release the latch. You may also need to pull the handle upwards.
3. **Push or pull:** While the handle is turned, push the door away from you or pull it towards you to open it.
4. **Pass:** Once you have opened the door enough, go over the threshold.

Automatic doors

1. **Approach the sensor:** Stand in the activation zone and the door will open automatically.
2. **Attention:** Before closing the door, make sure that there are no people or objects in its path.
3. **For garage/sectional doors:** Do not block the movement of the door, and if it has a passage door (gate), make sure it is closed before lowering the main gate.

Locked doors

1. **Insert the key:** Insert the key into the lock.
2. **Turn the key:** Turn the key approximately one full turn to unlock the door

and release the locking mechanism.

3. **Open the door:** Use the handle to open the now unlocked door in the usual way.

Recommended principles of use

1. Before opening any door, especially automatic or heavy-duty doors, make sure that there are no persons, animals, or objects in the door path.
2. Do not exert excessive force when opening and closing the door.
3. Do not secure the self-closers with objects (brick, stone, pulley) – it causes damage to the mechanics.
4. Minimize impact closing, which can damage the door frame, glass or lock.
5. Do not use the door to carry large-sized objects that may damage the hinges.
6. In the case of electronic inputs, do not attempt to force the lock over.
7. Be careful with doors that can be affected by the wind and close them if there are heavy drafts.

Specific recommendations by door type

1. **Entrance door:** always check when entering that the sash is closed and the lock is engaged.
2. **Fire doors:** must be closed at all times; do not block them.
3. **Technical doors:** access only by authorised persons.

10.3 MAINTENANCE

Door maintenance includes mechanical, aesthetic and security aspects.

Routine maintenance

1. Cleaning surfaces with mild, non-abrasive products.
2. Cleaning glass panels with a conventional glass cleaner.
3. Lubrication of hinges 1–2 times a year with silicone or graphite lubricant.
4. Checking the functionality of the self-closer, seals and hinges.
5. Visually inspect the door for signs of damage, wear or corrosion.
6. Regularly check the lock frame, lock cylinder, door handle and other parts of the lock for leaks, and tighten the fastening screws if necessary.
7. Lubricate the hinges, roller pins and roller bearings.

8. Clean door panels and moving rail tracks.
9. Clean the top, bottom, and side gaskets.
10. Make sure that all moving parts of the lock are free of debris.

To clean/lubricate the lock cylinder:

1. Spray detergent into the cylinder until it starts to leak.
2. Insert and remove the wrench without turning it (so as not to spread dirt inside).
3. Clean the key.
4. Repeat the process until there is no dirt left on the key.
5. Then apply lock oil and turn the key to unlock/lock the lock.

Recommended preparations

Cleaning/Lubricating (General): neutral with pH 6–8, chlorine-free. Silicone oil, technical oil for fittings.

Cleaning/Lubricating (Locking Products):

1. We recommend using a special cleaner (e.g. Assa Lock Cleaner) to clean the lock cylinder and a special lock oil (e.g. Abloy or Assa lock oil) for lubrication. Other detergents or lubricants may damage the cylinder.
2. Always use interlocking oil after cleaning with detergent, as detergent has chemically active properties.
3. Lubricate the latches on the side with a special interlocking lubricant (e.g. Assa lock lubricant).
4. **Protective:** preparations for metal surfaces against corrosion.
5. **Gaskets:** Lubricate the top, bottom, and side gaskets with silicone oil.
6. **Warning:** Never use corrosive or chemically active substances to clean the lock.

Recommended Maintenance Frequency

Lubrication and technical maintenance of interlocking products should be carried out at least twice a year or monthly in case of frequent use and aggressive or dusty environments.

Frequency	Operation	Performed by
Routine cleaning	1× per month	User
Every 6 months	Check the top, bottom, and side seals for signs of wear	User
	Clean the moving tracks of the rails	User
	Lubricate hinges, locks, roller bearings, and roller pins	User
Every 12 months	Check the balance of the door and adjust it if necessary	Technician
	Check the rollers, cables and their connection points for signs of damage	Technician
	Check and test the safety systems of the drive (photocells, sensors, etc.)	Technician

10.4 REGULAR CHECKS

Who performs the inspections

1. **Building manager** – visual inspection, administration.
2. **Professional company** – mechanical and safety elements.
3. **Authorized person** – fire doors.

What is being checked

1. Hinges, gaskets, glass, self-closing.
2. Locks, fittings, electronic controllers and access systems.
3. Functionality of fire protection elements.
4. Stability of the door leaf and frame.
5. Checking the integrity of the door panel hinges.
6. Checking the balance of doors, damage or wear of cables, rollers and panels.
7. Spring break protection check.
8. Checking the manual operation of the door.

9. Visual inspection of the door closer – whether it is complete and free of major damage.

How often

1. **Basic visual inspection:** monthly.
2. **Professional inspection of mechanics (Technician):** per year.
3. **Control of EPS/access systems: min.** 1× per year.
4. **Fire doors:** according to decree 2× per year.
5. **Automatic System Inspection (Technician):** Annually by a qualified specialist.
6. **Door closer inspection and maintenance:** At least twice a year. On the front door, the closers should also be checked when the outside temperature permanently drops below -3°C.
7. **Balance check of doors, hinge cables, panels and drive safety systems (Technician):** Every 12 months
8. **Repeated inspection of all annual points, in addition to checking the shaft, bottom bracket, drum to shaft fastening, shaft connecting bolts, rail assembly fastening and door fastening to the ceiling lintel :** Every two years

10.5 MALFUNCTIONS AND THEIR SOLUTION

The most common malfunctions include poor door closing, creaking hinges, loose fittings, malfunctioning self-closer or damaged glass.

Typical disorders

1. Non-functional self-closer: the door does not close – professional adjustment required.
 1. **Note:** This can also be due to improper operation of the lock (e.g. blockage of the deadbolt by dirt or wear) or damage to the door (lowering, curvature).
 2. **Oil leak or jammed door closer:** The closer drive rod must be removed and a professional must be called.
2. **Swinging hinges:** caused by high load or wear.
3. **Damaged glass:** immediate replacement for safety.
4. **Lock problems:** jamming, malfunctioning cylinder.

5. **Automatic door does not open/close when a button is pressed:** It can be caused by obstructions between sensors (photocells), disconnection of the control block from the mains, closed door deadbolt, or switching the automatic system to manual mode.
6. **The automatic door closes, but opens again as soon as the closed position is reached:** This may be due to obstructions in the door movement zone.

Troubleshooting

1. **If the automatic system does not respond:**
 1. Check for obstructions between the sensors. If necessary, remove obstructions.
 2. Check that the control block is connected to the mains.
 3. Check that the automatic system has not been switched to manual mode.
 4. Check that the door latch is not closed (if the lock is operated manually).
2. In the event of a drive failure or power failure, the drive can be switched to manual mode. In this case, disconnect the electricity and activate the emergency start. If the door is in automatic mode, release the drive from the door using a rope connected to the drive guide rail, pulling downwards.
 1. Caution: If the door is not in the closed position, switching the drive to manual mode is prohibited.

Fault Resolution Contacts

1. **Recommended position in the manual:** contacts, reports, service company, emergency service.
2. **Property manager:** phone/e-mail
3. **Service company for fittings and doors:** phone/e-mail
4. **Access control system service:** phone/e-mail
5. **Emergency assistance (24/7):** phone/email

10.6 LEGISLATIVE FRAMEWORK

The legislation regulates the safety, fire resistance and technical characteristics of doors.

Applicable technical standards

- **STN EN 14351-1** – Windows and doors.
- **STN EN 1627 – 1630** – Burglary resistance.
- **STN EN 1154** – Door closers.
- **STN 73 0802** – Fire safety devices.

Laws and Decrees

1. **Construction Products Act.**
2. **Fire Protection Act.**
3. **Decree of the Ministry of the Interior of the Slovak Republic on technical requirements for fire doors.**

10.7 RECOMMENDED SOURCES

EN 14351-1: Windows and doors – standard.

EN 1627 – 1630: Door security classes.

STN 73 0802: Fire safety of buildings.

<https://dvere-erkado.cz>

<https://www.sapeli.cz/sk/dvere>

https://www.hoermann.de/fileadmin/_country/hoermann.com/documentations/single_double_leaf_steel_doorsets/SK_Ein-und_zweifluegelige_Stahltueren_low.pdf

<https://www.dvere-hormann.cz/ke%20stazeni.htm>

https://sakumetall.ee/uksetehas/wp-content/uploads/sites/2/2015/06/17.00.09-T%C3%B5stukse-kasutus-ja-hooldusjuhend_ver07_eng.pdf

Text Editing: <https://chatgpt.com/>

RECOMMENDED SOURCES

ABD RASHID, M. F., et al. The User Requirements for Building Maintenance Management Systems in Malaysian Public Universities.

ABDELALIM, A.M., ESSAWY, A., SHERIF, A., SALEM, M., AL-ADWANI, M. & ABDULLAH, M.S. (2025) *Optimizing Facilities Management Through Artificial Intelligence and Digital Twin Technology in Mega-Facilities*. *Sustainability*, 17(5), 1826. <https://doi.org/10.3390/su17051826>

ABUIMARA, Tareq, et al. Current state and future challenges in building management: Practitioner interviews and a literature review. *Journal of Building Engineering*, 2021, 41: 102803.

AZUBUIKE, Odenigbo, et al. Building Maintenance Deficit: Evidence from Public Polytechnics in South-East, Nigeria. *Asian Journal of Advanced Research and Reports*, 2024, 18.11: 98-109.

Act 25/2025 Coll., Building Act and on amendments and supplements to certain acts (Building Act)

Act 254/1998 Coll. on public works, as amended

Act 182/1993 Coll. on ownership of apartments and non-residential premises as amended.

Act 314/2001 Coll. on Fire Protection as amended.

Act 124/2006 Coll. on Occupational Health and Safety as amended.

Act 355/2007 Coll. on the Protection, Promotion and Development of Public Health as amended.

Act 56/2018 Coll. on Product Conformity Assessment, Making a Specified Product Available on the Market as amended.

Act 116/1990 Coll. on the lease and sublease of non-residential premises as amended.

Act 246/2015 Coll. on administrators of apartment buildings and amending Act No. 182/1993 Coll. on ownership of apartments and non-residential premises, as amended.

Act 543/2002 Coll. on Nature and Landscape Protection

Act 25/2006 Z.z. on Public Procurement and on Amendments to Certain Acts

ADEOYE, Moses Adeleke, et al. Building a Better Future: Strategical Approaches in Tackling Poor Maintenance in Nigerian Public Secondary Schools. *Mimbar Ilmu*, 2024, 29.1: 9-16.

Decree 24/2003 Coll. which implements Act no. 543/2002 Z.z. on Nature and Landscape Protection

BOUABDALLAOUI, Yassine, et al. Predictive maintenance in building facilities: A machine learning-based approach. *Sensors*, 2021, 21.4: 1044.

CALVERT, Richard Ernest; COLES, D. C. H.; BAILEY, G. J. Introduction to building management. Taylor & Francis, 1995.

Cbre.sk: Facilities management. [accessed at 2023-11-13]. Available at: <https://www.cbre.sk/en-gb/services/manage-properties-and-portfolios/facilities-management>

CHACÓN, Rolando, et al. Digital twinning of building construction processes. Case study: A reinforced concrete cast-in structure. *Journal of Building Engineering*, 2024, 84: 108522.

COOKE, Brian; WILLIAMS, Peter. *Construction planning, programming and control*. John Wiley & Sons, 2025.

DANIEL, Owusu; ACKOR, Owusu Eugene; KOBINA, Essilfie Richard. Evaluating the Practices of Building Maintenance Management in Higher Education Institutions in Kumasi.

Decree 24/2003 Coll. which implements Act no. 543/2002 Z.z. on Nature and Landscape Protection

DROBNYI, Viktor, et al. Construction and maintenance of building geometric digital twins: state of the art review. *Sensors*, 2023, 23.9: 4382.

DUIVENVOORDEN, Eva, et al. Managing public space—A blind spot of urban planning and design. *Cities*, 2021, 109: 103032.

FERENCIK, K.: Renovation of apartment buildings, repairs and insulation. Service life of building structures. [accessed at 2021-08-13]. Available at: http://www.k.ferencik.szm.com/ferencik_obnova_bd_zivotnost.html

Government Regulation no. 391/2006 Coll. About Minimum Safety and Health Requirements for the Workplace

HANKO, M.: Streamlining the maintenance of building structures in the FM system. Dissertation thesis. STU Bratislava, 2017.

HAUASHDH, Ali, et al. Strategic approaches towards achieving sustainable and effective building maintenance practices in maintenance-managed buildings: A combination of expert interviews and a literature review. *Journal of Building Engineering*, 2022, 45: 103490.

HJALTADÓTTIR, Rannveig Edda; HILD, Paula. Circular Economy in the building industry European policy and local practices. *European Planning Studies*, 2021, 29.12: 2226-2251.

HOSSAIN, Md Uzzal, et al. Circular economy and the construction industry: Existing trends, challenges and prospective framework for sustainable construction. *Renewable and Sustainable Energy Reviews*, 2020, 130: 109948

Ifma.org: 11 Core Competencies of FACILITY MANAGEMENT. [accessed at 2023-10-10]. Available at:

https://ifmacdn.azureedge.net/sfcdn/docs/default-source/marketing/pd-pages/11-core-competencies_oct2020.pdf?sfvrsn=2

Ifma.org: What is Facility Management? [accessed at 2023-11-13]. Available at: <https://www.ifma.org/about/what-is-fm/>

JUSTICE, Esla Joseph. *APPRAISAL OF BUILDING MAINTENANCE AMONG LANDLORDS IN MINNA METROPOLIS, NIGER STATE*. 2023. PhD Thesis.

MASUD, S.B., CHOWDHURY, S.A., ABUBAKKAR, M., SOZIB, H.M., BELLAL, R.B., HOQUE, A. & SHAFI, S.B. (2025) *The Revolution of AI in Enhancing Infrastructure and Facilities Management*. *Cuestiones de Fisioterapia*, 54(4), 5605–5624. DOI: 10.48047/bb97xk66

MOHAMMADI, Alireza, et al. Applying lean construction principles in road maintenance planning and scheduling. *International journal of construction management*, 2022, 22.12: 2364-2374.

NOTA, Giancarlo; PELUSO, D.; LAZO, A. Toro. The contribution of Industry 4.0 technologies to facility management. *International Journal of Engineering Business Management*, 2021, 13: 18479790211024131.

OGUNBAYO, Babatunde Fatai, et al. Review of culture in maintenance management of public buildings in developing countries. *Buildings*, 2022, 12.5: 677.

OVCHARENKO, Ievgen, et al. SPATIAL ORGANIZATION MANAGEMENT: MODELING THE FUNCTIONING OF ECO-CLUSTERS IN THE CONTEXT OF GLOBALIZATION. *Journal of Hygienic Engineering & Design*, 2022, 40.

PETANI, Fabio James; MENGIS, Jeanne. Technology and the hybrid workplace: the affective living of IT-enabled space. *The International Journal of Human Resource Management*, 2023, 34.8: 1530-1553.

QUINELLO, R. & NASCIMENTO, P.T.S. (2025) *The Use of Artificial Intelligence in Facilities Management: Potential Applications from Systematic Literature Review*. *Artificial Intelligence and Applications*, 3(3), 223–235. DOI: 10.47852/bonviewAIA52023691

SALZANO, Antonio, et al. Existing assets maintenance management: Optimizing maintenance procedures and costs through BIM tools. *Automation in Construction*, 2023, 149: 104788.

SAMPAIO, R.P., COSTA, A.A. & FLORES-COLEN, I. (2022) *A Systematic Review of Artificial Intelligence Applied to Facility Management in the BIM Context and Future Research Directions*. *Buildings*, 12(11), 1939. DOI: 10.3390/buildings12111939

SARBINI, Noor Nabilah, et al. Review on maintenance issues toward building maintenance management best practices. *Journal of Building Engineering*, 2021, 44: 102985.

SANDANAYAKE, Malindu Sasanka. Environmental impacts of construction in building industry—A review of knowledge advances, gaps and future directions. *Knowledge*, 2022, 2.1: 139-156.

SANZANA, Mirza Rayana, et al. Application of deep learning in facility management and maintenance for heating, ventilation, and air conditioning. *Automation in Construction*, 2022, 141: 104445.

SCAIFE, Anthony D. Improve predictive maintenance through the application of artificial intelligence: A systematic review. *Results in Engineering*, 2024, 21: 101645.

SIGNORINI, Martina; DEJACO, Mario Claudio; LUPICA SPAGNOLO, Sonia. The evolution of digital building logbook: Exploring building information gathering systems to boost building maintenance and renovation. *Applied Sciences*, 2025, 15.2: 771.

SOMOROVÁ, V.: Determination of the Optimum Variant of the Material Solution of Building Construction from the Aspect of Effectiveness of the Real Estate Development. In *Advanced Materials Research: selected, peer reviewed papers from the 2014 3rd Global Conference on Civil, Structural and Environmental Engineering (GCCSEE 2014)*. Chengdu, China, 21.-22.10.2014. s. 2454-2458.

SOMOROVA, V.: Facility management. 2014. Professional publishing Prague. ISBN 978-80-7431-141-3.

SOMOROVÁ, V.: Building maintenance. Facility management. 2010. Publisher SUT Bratislava. ISBN 978-80-227-3372-4

SOMOROVÁ, V.: Civil engineering in practice. 2011. Publishing SUT Bratislava. ISBN 978-80-227-3589-6 [accessed at 2021-08-13]. Available at: http://www.svf.stuba.sk/docs//dokumenty/skripta/stavebne_inzinierstvo_v_praxi_viera_v_smorova.pdf

STN EN 13306 Maintenance. Maintenance Terminology. Bratislava. SÚTN.

STN EN 15341 Maintenance. Key Performance Indicators. Bratislava. SÚTN.

STN EN ISO 41011. Facility management. Terms and definitions. Bratislava. SÚTN.

STN EN ISO 41011: 2024. Facility management. Vocabulary

TEMELJOTOV SALAJ, Alenka; LINDKVIST, Carmel Margaret. Urban facility management. *Facilities*, 2021, 39.7/8: 525-537.

VAN WINDEN, C.; DEKKER, Rommert. Rationalisation of building maintenance by Markov decision models: A pilot case study. *Journal of the Operational Research Society*, 1998, 49.9: 928-935.

Ym.fi: Use_and_maintenance_manual. [accessed at 2022-12-10]. Available at: http://www.ym.fi/enUS/Land_use_and_building/Legislation_and_instructions/The_National_Building_Code_of_Finland/Use_and_maintenance_manual

ZHAO, Jianfeng, et al. Developing a conceptual framework for the application of digital twin technologies to revamp building operation and maintenance processes. *Journal of Building Engineering*, 2022, 49: 104028.

CONCLUSION

In conclusion, neglected maintenance does not only cause linear deterioration but leads to a progressive acceleration of degradation. A small crack in the façade (negligible in terms of cost) lets in water, which freezes in winter, tears off the plaster, exposes the masonry and a few years later requires static intervention. **Quality maintenance is therefore an economical investment in extending the life** of an asset, not just an operating expense. Therefore, examples of manuals for the maintenance and use of selected building structures have been processed in this university textbook, namely various roofs, facades, balconies and loggias, skylights, windows and balcony doors and interior doors.

Facility managers play a crucial role in planning, coordinating, and controlling FM activities, requiring knowledge in various fields such as technology, law, safety, and sustainability. FM is essential for the efficient operation of organizations by focusing on optimizing support processes rather than just managing buildings and technical equipment. Key areas include the working environment, support processes, and FM management, which encompass spatial planning, **building maintenance**, cleaning, safety, and environmental management. Overall, FM is integral to modern organizations, offering strategic benefits by optimizing support functions, ensuring sustainability, and contributing to economic success. In the context of building and property management, **FM is crucial for efficient operation and sustainability of buildings, with a building maintenance manual as a key tool**. This manual contains detailed information for planning, implementing, and controlling maintenance activities, encompassing technical data, maintenance procedures, inspection schedules, and supplier contacts. A well-maintained building benefits from **optimized costs, increased safety, improved uptime, higher property value, and support for audits**.

In professional facility management, maintenance does not start with a visible failure, but with systematic monitoring of all elements of the building. In particular, **protection against moisture**, which is the most common trigger for degradation, requires critical attention. The facility manager oversees the

integrity of the foundation structures and horizontal insulation to prevent water from rising that could compromise the stability of the masonry.

Equally important is **the external cladding and façade**. Here, maintenance does not only look at aesthetics, but above all energy efficiency and weather protection. Regular inspection of expansion joints, seals around windows and the condition of thermal insulation systems prevents the formation of thermal bridges and the subsequent formation of mold, which reduces the quality of the indoor environment. A special chapter is **roof structures**, where even a small neglect of cleaning drains or repairing a small crack in waterproofing can lead to extensive damage to technologies and interior equipment. One of the most critical tasks is the supervision **of statutory reviews and controls**. The building must meet several standards – from fire safety through electrical wiring to inspections of gas equipment or pressure vessels. The facility manager keeps precise documentation and keeps an eye on the revision calendar. This not only protects the safety of all people in the building but also protects the owner from huge fines and legal risks in the event of insurance claims.

Maintenance of building structures in facility management is about constant attention to detail. It is a process that turns a passive building into a long-term functional and safe object, while the key to success is professional planning, early diagnosis and the use of modern materials and technologies. Thanks to AI, the building ceases to behave like a "dead" object and becomes more of a living organism that communicates with its administrator through sensors. The role of the facility manager is changing from "problem solver" to "data analyst". AI doesn't take away his job, but relieves him of uncertainty and routine, allowing him to focus on strategically increasing the value of the property. Ultimately, AI-managed buildings are not only safer and more resilient, but also much cheaper to operate for the long term.

Ultimately, the goal of facility management is for the owner or tenant to "ignore" the building at all. If everything works, is warm, clean, safe and operating costs are low, it means that the management of the building is set up excellently. It is an invisible service that turns an ordinary building into a pleasant and functional environment for living or working.

**MAINTENANCE OF BUILDING STRUCTURES
FACILITY MANAGEMENT II**

Martin Hanko

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