

Façade Cleaning as a Means of Effective Building Maintenance

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Abstract:- The section of a building visible to the public is referred to as the façade. It is critical to keep a façade clean and properly kept in order to guarantee that it has retained its original elegance, strength, and so on. Facades are built of numerous materials, and each surface requires different cleaning chemicals and procedures. Inadequate cleaning procedures can cause significant damage to a building's façade. Façade cleaning should be part of a regular maintenance program and an early investigation procedure in order to get access for repairs or maintenance work. Building deterioration is mostly noticeable on the façade, regular façade care also functions as a preventative step in extending a building's lifespan. This study utilizes observation methods on various types of façades. Findings revealed that improper façade maintenance results in fast deterioration of buildings. This study recommends that façade cleaning should be done regularly in order to enable effective preservation of building materials, building components and the overall appearance as well.

Keywords:- Building maintenance, Façade, Façade cleaning, Maintenance plan, Service life.

I. INTRODUCTION

Buildings must be viewed as investments and managed as such in technical, economic, and social aspects throughout their service life. Because they are the visible component of the structures and have a close link with the environment, façades contribute significantly to the quality of the urban surrounds. The architectural façade has long been a fascinating subject of interest for building scholars and designers, integrating aesthetics and performance elements in a comprehensive perspective. Facades are the outermost shells of buildings which convey an image and a creative intent. They are increasingly becoming perceived as vital environmental regulators.



Fig. 1: Different building facades (Source:www.kaercher.com, 2021)

A properly well-designed façade can help a new structure perform at a higher level for its owners, inhabitants, and the environment as well. It can also enhance the performance of a particular structure. Facades can be made with numerous materials, such as Stainless Steel, Terra Cotta, Natural Stone, Anodized Aluminum, Duranadic Aluminum, Brick mortar, Precast Concrete, Cast in Place Concrete, Glazed Brick/Glazed Block, Bronze (Copper Alloys), and others. While all of these materials have different colors, textures, compounds, but they all have a few things in common. Their job is to protect the building from the elements, as well as define the character of the

building. They all have one thing in common: they all require maintenance to maximize their life cycle and aesthetic appearance. The one thing they all have in common is that they all require different types of maintenance, and the incorrect method can and will cause more harm than good, (Nicolas Francart, 2021). A deteriorated façade not only causes non-functionality issues within the home owing to water infiltrations, but it also causes social phenomena in the self-marginalized community. For these reasons, the significance of maintenance should be recognized, as should the awareness

of the decreased proportion of building expenses invested in that area.

II. FAÇADE & FAÇADE CLEANING

Because facades are a complex system to design, install, and maintain, they have a considerable influence on building performance. Walls, windows, and various types of cladding constitute facades (directly or indirectly fastened, continuous or discontinuous). Determining the elements of the facade is fundamental for evaluating maintenance

requirements based on some of the most probable anomalies and causes,(Silva, 2016)

To evaluate the durability performance of the facade, the adverse materials to which it is exposed must be known. Loads, stress, distortion, grime, radiation, extreme temperatures, dirt, pollution, salts, germs, plants, mildew, insects, and birds, to name a few, can all have a significant influence on a facade's performance, particularly when combined with insufficient structural elements.



Fig. 2: Different Building Facades (Source:www.kaercher.com,2021)

They can create separation, cracks, stains, loss of cohesion, as well as fastening issues. While the roof is very well understood to require preventive maintenance, handful owners comprehend that the vertical closure should as well require the same amount of corresponding devotion to preventative maintenance. According to(Pires R, 2018).The predominant inconsistency in painted rendered facades is discolouration produced by dirt deposition on the surface of the wall. with primary irregularities being "staining, change

of color or luminosity of the tiles" and "change of color of joints," which are both caused by dirt deposits, which can be found on adhesive ceramic tiling facades are similar, Color differences are the most prominent aberrations in natural stone coated façade. With a thorough understanding of a facade, proactive maintenance activities such as inspection, local repair, local replacements, cleaning, surface protection treatment and small and significant interventions can be planned ahead of time.



Fig. 3: Window Cleaners And Steam Hose Used In Façade Cleaning (source:www.ranpc.com,2022)

III. BUILDING MAINTENANCE

Maintenance, according to (Merteinsson, 2021), incorporates all technical and administrative processes, such as supervision, which is necessary to reinstate a component to a state where it fulfills adequate performance criteria. Costs can occur at three stages of a building's life cycle: design, construction & usage and maintenance. Although construction and design expenses are important for a building with a service life of 34 plus years, about 80% of expenditures occur during the maintenance stage, and usage stage. The economic impact underscores the need of building maintenance. Maintenance plans with preset performance levels put in place from the design phase will enable for the maximization of global expenses while still satisfying users through the knowledge of the buildings' in-service behavior, deformation and proxies, and perhaps even the category and main causes of anomalies. A maintenance plan is an add-on document to the project which forecasts preventative maintenance procedures across various different time frames, with little inconvenience or interruptions to the structure's regular operation. It will not eliminate the possibility of unscheduled corrective maintenance activities, and it should be regularly updated, (Wellington, 2020).

The comfortability of a building is influenced by the building envelope. In this sense, facades determine the aesthetic of the building while also acting as a buffer to external hostility and a contact component between the interior and exterior (through visibility, light and ventilation).

Throughout a building's service life, its structural sections should maintain the performance standards established at the design phase, leading to the satisfaction of the user's demands. Only after assessing the performance of the building's elements, their estimated service life, degradation patterns, maintenance requirements, and the most prevalent irregularities can maintenance operations be planned. Subjective factors such as the user's acceptance of the plan based on their needs and expectations influence decision-making at this stage, distinguished between proactive (predictive and preventive) and reactive (corrective) maintenance actions. Preventive maintenance processes identify deterioration indications and take action before any substantial functional or physical change in the elements of the building happens. Unanticipated abnormalities are averted with frequent maintenance procedures. Extra labor is reduced, and the building's usage is not disrupted. Significant information on each element, including in-service efficiency, service life, proper maintenance techniques, degradation trends, and costs, is necessary to plan preventative measures. This maintenance strategy is inextricably linked to a conceptual reaction that may or may not match to actual in-use scenarios and should thus be validated. Predictive maintenance approaches, on the other hand, rely on inspections to identify each part's maintenance requirements. These checks are arranged, and maintenance activities are carried out depending on the assessment results on the components' decreasing status.

Predictive techniques rely on a plethora of technical and statistical data regarding the behavior of building parts.

Predictive maintenance operations require skilled personnel and precise diagnosis procedures to examine functional metrics, symptoms, irregularities, and related causes. This strategy should improve the ability to recognize when an intervention is needed when assessing deterioration scenarios, although prioritizing maintenance activities remains dependent on decision-makers' viewpoints.

A. Nature of Building Maintenance

The building owner prioritizes scheduled repair, yet they cannot afford to ignore the damage to their structure for an extended period of time. (Mydin, 2015). Building maintenance encompasses all aspects of the structure, including doors, toilets, rooms, furniture, roofs and walls. Façade cleaning is classified as planned maintenance, which is described as maintenance done with careful management and the use of records in line with a set program. Work to avoid problems that may arise predictably during the lifespan of the building, such as weekly window washing, daily floor cleaning, and painting the building façade once a year. Building upkeep is a global concern, and the haphazard construction method has exacerbated the problem. been meticulously calculated to assure the building's supremacy. The maintenance activities of the building consist of 4 separate main components as shown below:

- **Servicing:** This is basically a predefined cleanup cycle, and cleaning processes must be carried out on a regular basis; it is often referred to as routine maintenance. When more complicated equipment is added, more elaborate service schedules are required. Cleaning Frequency Varies Typically, Once a week, the windows are cleaned, the floor is cleaned once in a day and once in a week and the flues are cleaned every six months.
- **Rectification:** This work is frequently performed during the early phases of construction due to design issues, inherent flaws or inappropriate components, product damage during delivery or installation, including faulty assembly. It is an effective and efficient means of minimizing maintenance costs since they are preventable. In general, all that is necessary is correct installation, including components and materials suitable for its intended function. In most cases, the identical component has to be available. several responsibilities, including load-bearing, weatherproofing, and thermal insulation, while being aesthetically pleasing. Inability to satisfy any of these requirements may result in maintenance work.

Failure of floor ornamentation, floor slabs damage due to moisture penetration, floor coverings on solid concrete ground, and gaps between floor slabs in wall panels to minimize wind and rain damage are typical occurrences. Rectification effort can be decreased by developing and implementing performance and installation criteria.

- **Replacement:** This is unavoidable since the material will deteriorate at different rates depending on the conditions of usage. The majority of replacement work is performed due to bad look rather than actual damage to materials or components. As a result, acceptable lifespan is frequently associated with subjective judgements about the aesthetics of change. Furthermore, determining the material's durability or life span is a particularly tough technological endeavor due to the complexity of the environment and the difficulties in estimating how much the material will change before being removed. Renovation is another type of maintenance that involves restoring the major structure to maintain or improve the initial design and specifications. Minor modifications and alterations to the basic structure may be included.
- **Protection:** The role of security encompasses both the labor of managing functions and the aesthetics of buildings. Because structures are vulnerable to damage and faults caused by environmental factors such as different change in climate and intensity of usage, protection should be given throughout the building's life cycle. It has the ability to reduce future flaws and harms. It can ensure that all constituents in use are long-lasting. A Building's outside surfaces, for example, are painted to regulate weather and fungal invasion.

At various periods of a building's existence, various risk management strategies should be implemented. A condition survey should be undertaken prior to taking occupation of a facility.

B. Condition surveys

Building façade condition surveys are a specialized activity. It is critical that you hire someone who is appropriately qualified, skilled, and insured to carry them out. A condition survey of your building's façade could very well show the number and severity of flaws. A condition survey is essential for identifying any major problems that require immediate correction. The skilled eye may notice warning signals of impending breakdown months or even years well before collapse. Problems that must be addressed in the long run might be incorporated in a scheduled maintenance program. A site visit will be required for the condition survey.

This should at the very least include:

- Craze and cracks Surface coatings
- Joints with free mobility Joint sealants
- Corrosion Damage
- Handrails Maintenance tools
- Weep holes and vents that are damp
- Moving components for plumb and level
- Weep holes and vents that are damp
- Specifications for materials and construction Fixtures and fasteners

Once a risk has been recognized, an adequate scheduled maintenance program will assist in managing and minimizing your exposures from façade flaws.

C. Planned inspection and maintenance

Since the late 20th century, all innovative and redeveloped structures have also been instructed to provide a maintenance handbook. You must check that it has been brought up to date and that all necessary maintenance has been conducted. According to best standards, all structures must have a maintenance manual. When there is no maintenance handbook, one should be written based on the condition survey results. This is the only way to guarantee that an appropriate maintenance schedule is followed. All façades require some level of upkeep in order to function properly. Early discovery of flaws can save money on costly repairs or replacements later on. The kind of façade and the estimated design life will define the extent of inspection and maintenance required. Safe access to the façade and any disruption to the inhabitants must be considered while establishing the inspection and repair timetable. It is improbable that all of the components of the façade will age at the same pace, (Claudia Ferreira, 2021). This should be reflected in the inspection and maintenance schedule. Larger components in façades, with the exception of regular cleaning, are typically low-maintenance. Joints between panels require special attention since a failure of sealants or gaskets may allow water to penetrate, causing corrosion of fixings and damage to the facade.

- a) **Component durability**
There are four types of durability periods for façade components;
 - Short - components that require maintenance at short intervals, often every two to five years, both for protection or cosmetic purposes.
 - Medium - components where the initial maintenance is expected to last between five and 10 years.
 - Long - components with an expected initial maintenance period of 10 to twenty years.
 - Very long - Components that will not be maintained over the design life of the structure.
- b) **Inspection frequency**
Inspection frequency is classified into three levels;
 - Routine - ongoing, regular observations that the user should do as part of the building's tenancy. This sort of observation should be fostered to generate feedback.
 - General - visual examinations of key items performed at intervals prescribed in the maintenance manual under the supervision of a properly qualified individual.
 - Detailed - a thorough inspection of the façade by a sufficiently trained team or group of individuals at intervals stated in the maintenance manual, but no more than once every five years.

D. Whole life performance

A well-planned program will significantly limit the occurrence of unanticipated repairs and hence minimize disturbance. Adopting a structured maintenance approach will improve overall performance. Scaffolding is frequently used in façade maintenance. This may be both disruptive and costly to occupiers' companies. Sharing the cost and frequency of access amongst maintenance tasks is a good concept.

IV. TYPES OF FAÇADE CLEANING

All façade cleaning attempts, in general, fall into one of four categories: abrasive, chemical, non-chemical, or a combination of these procedures. While non-chemical water soaking may partly succeed in dissolving dirt and washing it away from a brick façade, it may be necessary to combine this procedure with an appropriate cleaning agent (chemical) to handle areas with strong stains. To establish the optimum façade cleaning process for their building, the building owner and/or manager should speak with a design specialist, (Ashan Senel Asmon, 2020).

A. Water cleaning methods

a) Water Soaking:

To dissolve and help remove dirt, a slow, constant stream of water is utilized, which is a particularly successful approach since the filth swells and softens. A manifold of pipes and nozzles is constructed for this purpose. Following the water soaking, it is advised to hand wash with brushes or rinse with a 400 psi (pounds per square inch) water spray. For each water-soaked façade cleaning task, the design professional selects the appropriate:

- time spent soaking (in hours).
- the amount of gallons of water per minute produced by each nozzle; and
- the nozzle spacing.



Fig. 4: Steam Hose Used In Masonry Façade Cleaning

(source:www.massus.com, 2018)

b) Pressure Washing:

Impurities are blasted from the façade by pressurized water, measured in pounds per square inch (psi). This method may be used to remove light to moderate atmospheric and biological impurities from stone, masonry, and concrete. This method of eliminating grease and oil stains with warm water (no hotter than 160 degrees Fahrenheit) may be useful. The design expert prescribes pressure cleaning, also known as power washing, depending on four parameters:

- psi pressure rating;
- the pace of water flow;
- the kind and size of the spray tip; and
- separation from the substrate



Fig. 5: Water Pressure Hose Used In Façade Cleaning

(source: www.massus.com2018)

c) Steam/ hot-pressurized cleaning;

Although it is not widely employed, it can be helpful in eliminating built-up deposits and flora hiding between the façade. It may also be used to clean brickwork that is susceptible to the acids included in some chemical cleansers.

B. Chemical cleaning methods

Chemical cleaning chemicals, designed by businesses to combat "tough" façade stains, operate by decomposing the stains and enabling them to be washed away. Chemical cleaners are classified into four types: organic solvents, acidic cleansers, alkaline cleaners and special non-sudsing detergents.

There are several and distinct commercial chemical cleansers for various types of façade surfaces: Some are made to get rid of effervescence and salt stains. Others are usually used to clean surfaces of surplus mortar, grout stains, as well as debris. Others are better suited for usage on masonry with a high metallic content. Restoration cleansers are available to tackle severely unclean and extensively carboned brickwork seen in different urban areas or high pollution zones. Commercial poultices aimed for places where pollution has entered the substrate rather than being

on the surface are available for a variety of surfaces. To protect glass, polished stone surfaces, and metal from the destructive effects of acidic brick cleaners, strippable masking materials are offered.

C. Abrasive cleaning method;

Included are any procedures that physically wear away the building surface to remove dirt, discolorations, or coatings. Certain materials that strike or abrade the surface under pressure, as well as abrasive instruments and equipment such as rotary wheels, power sanding disks, wire brushes, and belt sanders, are employed in such procedures. However, abrasive cleaned facades are just no longer frequently used since this method eliminates the façade's outermost protective coat, rendering it susceptible to rapid weathering and disintegration. Subsurface stains cannot be removed using abrasive cleaning procedures.



Fig. 6: Permanent Damage Done On Masonry Façade Due To Abrasive Cleaning

(source;www.massus.com, 2018)

D. Cleaning preparation;

Before beginning a façade cleaning plan, it is necessary to identify the various types of façade on the structure and select the optimum cleaning process for each. It is vital to recognize the many sorts of façade. Some masonry bricks, for example, may include impurities such as iron particles that may react with specific cleaning solvents, resulting in stains. Cover or otherwise shield any structural parts that are not accessible to cleaning yet are vulnerable to damage.

V. FAÇADE RISK FACTORS

A façade is prone to a variety of risks that may demand costly repair or replacement during the course of its life. Factors impacting the quantity of facades and hence the long-term viability of housing stock have been thoroughly examined. The caliber of constructional components at completion, technical aspects of the aging process, maintenance processes and practices, and maintenance degree were defined as façade preliminary factors. Stated below are some of these factors;

- Technological and practical design and construction.
- Use and environmental factors that contribute to the aging process.
- The level of upkeep that has addressed the aging process.

In this study, the risk factors of facades are listed as;

- design (water-tightness, water flow control, stress accommodation, accessibility and material performance)
- environment and usage
- building's profile
- construction (quality)
- maintenance (quality)

VI. IMPORTANCE OF FAÇADE CLEANING

Building facades should be cleaned on a regular basis to remove pollutants, dirt, stains, and ugly markings. A clean façade may not only improve public perception, but it can also help attract building tenants and users, as well as make a good contribution to the surrounding neighborhood (AJ Preita, 2018).

Regular façade cleaning may expose portions of the building that have been impacted by or are subject to various forms of issues. For example, removing a seedling during the cleaning process can operate as a preventative step, preventing aggressive root growth that could harm the façade (or even contribute to some form of structural failure). Cleaning off grime and stains may uncover additional structural flaws.

VII. NEGLECT OF FAÇADE CLEANING

There might be serious issues if facades are not properly maintained. Simply covering cracks beneath render, for example, will not fix the fundamental problem, and the fissures may develop further, causing catastrophic damage. The fundamental source of issues, rather than merely the symptoms, must be discovered and treated. It may be required to speak with a façade cleaning and restoration professional.

Cleaning may be part of the initial investigative procedure before repairs are made in some cases. A clean façade, devoid of grime, stains, and other undesired elements, provides a better surface for restoration work and makes identifying issues simpler.



Fig. 7: Neglected Facades Showing Signs Of Rot And Degradation (source: pmac.ie, 2022)

VIII. FAÇADE MAINTENANCE

A façade maintenance plan is a proactive method that allows building managers to document the characteristics of the façade system based on materials used, condition assessment, repair needs, financing expectations, and other criteria. The façade is the external weatherproof envelope of a structure, (Helen Garmstonl, 2015). In modern buildings, the façade is often linked to the framed structure and contributes nothing to structural integrity. A non-loadbearing vertical building enclosure is another name for this sort of façade. The building façade is an essential aspect of the exterior envelope of a structure that is subject to diverse weathering agents such as rain and UV radiation to name a few.

Important concerns must be considered at the design phase of the facade in order to achieve future maintainability. To determine the responsiveness of individual insights to the value of maintainability, an algorithm was developed employing the pruning approach. A sensitivity study revealed that the upkeep of a building's facade is heavily reliant on (Guidelines on periodic facade inspection, 2022).

- wall upkeep in terms of accessibility and flexibility
- choosing of a facade system,
- specifications,
- material performance characteristics such as endurance and maintainability.



Fig. 8 :Automated Façade Cleaning Device

(source:www.manntech.com, 2022)

Why should a building's façade be cleaned? The subject of aesthetics is the first that springs to mind. After all, a clean infrastructure looks to be more inviting than a dirty one. A clean building gives the public a more welcome impression, rendering it a much more enticing real estate option. A building appears best whenever it's free of the dust, filth, and stains that obscure its most prominent and, at times, most fragile feature, the "façade". Although, one should note that not all building facades require the same degree of attention. The location, purpose, and geographic and climatic circumstances of a structure all have a part in determining the degree of cleaning work required to attain the desired look.

While aesthetics are the most visible and major factor for cleaning a building façade, revealing the substrate for evaluation and restoration is a close second,(Saviz Moghtadernejad, 2019). When the façade is splattered with grime, dust, and/or a coating, judging the condition of a brick base is practically difficult. To evaluate if parts of the façade do have to be repaired, restored, or resealed, or, in certain situations, to accurately identify the substrate, the façade must be cleansed of any items that impede comprehensive assessment. Another purpose to clean the façade is to remove dangerous pollutants like sulfur and nitrogen oxides, as well as other acid rain pollutants. These contaminants hasten the degradation of the façade. Cleaning the façade of a building opens the pores and allows for regular moisture evaporation. If a waterproofing layer stops moisture from escaping from a stone wall, it will remain trapped.

IX. MAINTENANCE PLAN

The complete structure requires maintenance from the inception stage of construction through the period of residence, as well as executing the inspection procedure while in use or occupation.(Madureira S., 2017).The following recommendations were made:

- Building owners are required to maintain their premises on a regular basis, which includes keeping maintenance records.
- Maintenance experts should be included in the design team to advise other members, professional colleagues on the consequences of their design solutions for maintenance and alternative, simple-to-maintain building methods.
- All professionals in the built environment should broaden their horizons on the different tasks at hand. Each of them should not be competing in project development They should consider all maintenance tasks to be part of the plan, which must be capable of carrying out successfully and efficiently in the construction business to achieve excellent project output and subsequent minimum maintenance requirements, quality craftsmanship and efficient supervision at every level of project production should be optimized.
- To help in the successful operation of maintenance, every structure and property should have a well-detailed maintenance plan, program, and schedule. Property owners should consider the requirement for these maintenance tasks and budget a proportion of the initial expenditure accordingly of the property for future maintenance costs during the property's life span Building owners must also schedule days in their hectic schedules to successfully 'house-keep' their property should use caution when using the property in order to decrease the incidence of fault and consequent damage cost of recurring maintenance.
- Building inspections must be done on a regular basis in order to resurrect the destroyed parts of a structure and preserve the health and safety of structure users as well as the building's performance. To minimize certain accidents occurring in neglected structures, the government should develop a building maintenance program.(John C. Crittenden, 2015).

X. CONCLUSION

Cleaning a façade is a no-brainer when it comes to building upkeep, as previously said. Maintaining a building's façade may pay dividends in more ways than one. Regular upkeep, thorough cleaning, and targeted repairs may extend the life of your facility and keep tenants satisfied.increase real estate value, keep the buildings aesthetics as well and prevent costly damage. A regular regime of periodic façade and building cleaning also helps identify structural issues sooner, enabling problems to be addresses earlier and remedied appropriately as well as to prevent unnecessary expenditure on any façade faults which could have been dealt with much earlier in the service life. So to answer the question “is façade cleaning an effective means of building maintenance?”, yes it is, as the above highlighted points have shown.

XI. RECOMMENDATION

The recommendations towards the study are stated below;

- The employment of a well-rounded building manager should be strictly seen into, especially for buildings of a large scale and large occupancy.
- General inspection routines should have a more detailed assessment of building facades, as it is normally overlooked especially in low-rise buildings.
- Depending on the type of building, routine, general or detailed inspection can be carried out and must be strictly adhered to.

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