FAÇADE MAINTENANCE MANUAL

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chapter 1 – INTRODUCTION

1.1.1 Introduction

Throughout the project's Curtain Wall and Glass Wall, a number of different materials and surface finishes have been used to create the desired architectural finish.

In order to maintain the quality of these materials and finishes it is recommended that the following cleaning and maintenance practices explained in the manual are adopted.

1.1.2 Revision Record

REVISION	EFFECTIVE DATE	SECTION AFFECTED	PREPARED BY
Issue 1	Dec02		

1.1.3 Distribution List

Copy	Company	Representative
1		
2		
3		
4		
5		
6		

1.1.4 Preparation

The Maintenance Team which includes the Project Manager, Design Manager, Site Manager and Quality Manager will be responsible for the preparation and checking of the Cleansing & Maintenance Manual.

1.1.5 Revisions

Revisions to the Cleaning & Maintenance Manual are the responsibility of the Maintenance Manager.
Details of any revisions required will be shown in the Revision Record Table 1.2.

1.2 PROJECT DETAILS

1.2.1 Project Description

The Project is the Design, Supply and Installation of Curtain Wall and Glass Atrium for the (Project
Name)…... at (Place)…….

1.2.2 Scope of Works

The Scope of Works to be carried out under this Sub-Contract comprise the Design, Supply, Installation of the Curtain Wall Cladding System and Glass Wall Point Fixed System
The Contract Works also comprise the preparation of a Maintenance Cleaning & Manual and As-Built
Drawings (to the extent as called for in the Contract Specification). The Manual shall demonstrate proper cleaning methods of the Contract Works and list types of cleaning agents, methods, and the
type of sealants and components to be used for cleaning, removal and replacement of the Contract Works.

1.2.3 Project Requirements

The following is a summary of Contract Works as stated in the contractor's specification:
1. Extruded aluminum curtain wall framing for all systems
2. Podium Canopies and Shop front
3. Aluminum Louvre's and Cladding
4. Clerestory Cladding
5. Stone Cladding
6. Stainless Steel Feature Curtain Wall
7. Expansion Joint
8. Flat Roof Waterproofing
9. Interior Fire Rated Wall
10. Podium Glass Screens

1.3 CLEANING IN GENERAL

1.3.1 Atmospheric Pollution

The installed cladding items are permanently exposed to the atmosphere and the pollutants within it. These pollutants and the reaction time of dirt on the surfaces will considerably affect the life span of the architectural finishes and eventually the structure.

Air pollution often contains carbon dioxide, carbon monoxide, sulphur dioxides, sulphur trioxide and various chlorides which when trapped within dirt layers and hydrated by rain water or moisture can cause acidic or alkaline attack to the structure.

If the installed materials are not thoroughly cleaned and rinsed down regularly, these acids and alkalis will embed themselves within the exposed surfaces and will eventually erode the surfaces and structure.

If the cleaning is not carried out at regular intervals, the degree of pollution and eventual resultant corrosion will become too strong to obtain a decorative appearance and will lead to irreparable damages.

1.3.2 Exclusion from Liability

Liability is excluded when:

a) Damages to installed materials caused by the supplier of the cleaning agents changing the composition of the recommended detergents.

b) Failure of the building owner to maintain a regular cleaning schedule, as highlighted in Chapter 3 of this maintenance and cleaning manual.

c) Failure of the maintenance crews to follow the cleaning agent manufacturer's and/or maintenance manual's recommendations on how to use the cleaning agents, which may result in damage to the installed materials.

Note: Lodha Group reserves the right to inspect all maintenance records held by the building owner
to ensure that the cleaning and maintenance undertaken by the owner adhere to the methods listed
within this maintenance and cleaning manual.

1.3.3 Cleaning Agents

In general, only neutral, non-abrasive cleaning agents are to be used.

Maintenance crews should always test cleaning agents on a small section of the material, preferably a section not normally visible to the general public, to ensure that there will be no reaction or surface damage.

It is recommended to use High Pressure Cleaning Devices either directly on the units or in close proximity to the units, as high pressure devises can dislodge gaskets, seals and/or setting blocks, or kick up grit and dirt from adjacent areas which may scratch or dent finished surfaces.

In cases of extreme doubt samples of cleaning agents can be sent for testing and analysis at a laboratory for confirmation.

1.3.4 Cleaning Agents Not To Be Used

- Solvents such as acetone, methyl-ethylketone, etc.
- Alkaline detergents with a ph Value of more than 7
- Acid based detergents with a ph Value of less than 5

Although many of the materials used within the project offer resistance to alkalis and acids, you should not directly apply detergents containing strong acids or alkalis (no matter what the form) as these substances can penetrate through the structures corroding, glazing beads, sealants and/or hollow sections, causing a reduction in life span of the installed components.

1.3.5 Cleaning Methodology

For light coverings of dust, a soft dry cloth (preferably made of 100% cotton) should be used to remove surface dust, working the surface from the top down. A soft, fine haired brush can also be used to remove dust and dirt from awkward corners.

For more permanent stains, such as grease and/or oil marks a water and neutral detergent solution should be used, applied with a soft cloth, working from the top down.

Once the units are considered clean, the surface should be rinsed with water to remove all traces of the detergent.

It should be remembered that the frames and glazing should be cleaned and rinsed down all at the same time.

Chapter 2 CLEANING PROCEDURES

2.1 STANDARD CLEANING AGENTS

2.1.1 Typical Cleaning Agents Available

Cleaning agents are arbitrarily divided into five groups:

a) Mild Soaps / Detergents and Non-Etching Cleaners

Mild soap and detergent cleaners can often be applied to products and areas without the use of protective clothing. In the case of stronger detergents, it is recommended that spot testing is carried out before use, as they could contain bleach which can discolour finish coatings.

Non-etching cleaners are alkaline or acid based formulations mixed with inhibitors, which permit the cleaners to remove soil without attacking the metal or finish. The nature of these chemicals, their strengths and the time they should remain on the product vary from cleaner to cleaner.

After cleaning the area should be thoroughly rinsed with clean water and dried.

b) Solvents and Emulsion Cleaners

While generally mild in there action, they are more effective on stains and soils than cleaners in the first group.

Solvent and emulsion cleaners may be used without difficulty on bare, anodized, conversion coated and porcelain zed metal.

When used on painted (and lacquered) finishes, solvent and emulsion cleaners should be spot tested first, as the wrong solvent or solvent-containing emulsion can remove the paint and clear organic coatings (lacquers).

Both mild cleaners and solvent-emulsion cleaners will remove dirt and some stains. They will not however, restore the appearance on metals and finishes that have weathered, nor remove heavy grime encrustation. For these conditions a more aggressive cleaner is required.

c) Abrasive Cleaners

Abrasive cleaners will restore weathered aluminum, stainless steel and copper to its natural brilliance, and remove most stains and grime

These cleaners are manufactured and sold under various generic descriptions including polish, cleaner, cleaner polish, wax-cleaner, wax-polish, metal brightener, scouring powder and the

like. Their effectiveness on various soils and darkened metals depends on their formulation and vigor of application.

Abrasive cleaners contain abrasives to which water, oil, wax, silicones, soap and an acid or alkali may be added, either singly or in combination. This allows the abrasives to cut away the dirt and surface oxidation, with soaps, acids and/or alkalis providing general cleaning.

Once applied and removed, traces of the wax, oil or silicones remain behind providing luster and a small measure of surface protection.

Fine Abrasive Cleaners

Abrasive cleaners containing fine grit or polishing agents may be sued with care on all finishes. Great care is necessary during application, as even the finest polishing agent is an abrasive and prolonged rubbing may dull a bright spectral finish in time and cut through thin coatings and forms of plating.

For the ultimate in spectral finishes the surface must be buffed.

Moderate Abrasive Cleaners

Moderate abrasive cleaners can dull a metal finishes and paint coating within a relatively short time. Cleaners in this group are often only used to remove heavy soil and oxides prior to final cleaning with a fine grit cleaner.

When this is done, the abrasive cleaner must be thoroughly removed before the fine polish is applied. Otherwise, a few grit particles may find their way unto the final cleaning pad and produce noticeable scratches.

During application, moderate abrasives produce a finely scratched surface. However, these fine scratches are easily blended into a matt or satin finishes by working the abrasive with grain of the finish.

Some combination abrasive cleaners containing steel wool must have all the steel particles left behind after cleaning thoroughly rinsed off otherwise, the steel particles will rust leaving unsightly stains. Combination abrasive cleaners containing stainless steel wool are therefore preferable.

Abrasive cleaner-polishes should be applied with a clean cloth and rubbed over soiled area. Once complete, the area should be polished using a clean, dry cloth.

Cleaner polishes leave a thin wax, or a wax-like coating, which gives additional protection. However, this film inhibits the adhesion of any subsequently applied paint or lacquer.

If the aluminum is to receive an organic coating, do not use cleaner-polish unless solvent cleaning is possible before application of the coating. If the cleaner polish contains silicones, even solvent cleaning may not assure good adhesion.

Large areas may be cleaned with the help of power driven polishes and buffers. Caution must be used to make certain the high speed wheel's edge doesn't cut into the finish and that pressure is kept moderate to avoid over heating the finish. Wheel pads should be changed frequently to make certain abrasive particles do not clump up and dig into the work.

d) Abrasive Cleaners

Coarse Abrasive Cleaners

Coarse cleaners are sometimes used to prepare anodized surfaces for painting. Pressure should be light to avoid deep scratches, which may be visible through the paint.

Coarse abrasive cleaners and moderate abrasive cleaners are sometimes compounded with active chemical cleaners. The combination produces a fast acting cleaner that must be used with care. Bare aluminum and most paint coatings are sensitive to chemical based cleaners which may etch the finish if permitted to remain on the surface for too long.

Anodized aluminum may develop white blemishes if chemical cleaners remain in place too long.

e) Etching Cleaners

Etching cleaners are normally added to water and applied to heavily weathered and soiled metal finishes. They should be applied with caution as they remove small quantities of the coating / metal each time they are used.

Etching cleaners are not normally used on painted, plated, anodized or conversion coated metals.

There is a number of proprietary etching cleaners formulated on the market and each manufacturer's directions in the matter of cleaner concentration, exposure, time and safety should be carefully followed.

Whether the etching cleaner is first applied to the top or the bottom of an area depends upon its size. Comparatively small areas such as store fronts and fixed barriers are best cleaned from the bottom up, as etching cleaner drips will affect already cleaned area far less than they will affect unclean areas. When large areas, such as tall buildings are to be cleaned with an etching cleaner, it is best to start from the top, as etching cleaner drips will to a large extent be isolated from the finished surface by the soil on the building's surface.

Cleaning power may be increased by using a fine abrasive such as pumice or fine steel or stainless steel wool or an abrasive nylon pad to rub the wet metal during the etching period.

For uniform results on metal finishes, always decrease the surface before the water-based etching cleaner is applied. Each area must be rubbed equally and soak periods must also be similar.

f) Special Cleaners

Special cleaners include steam, rotary wire brushes and abrasive blasting in this section. They are considered special because they require more than hand equipment during application. Pure steam may be applied without excessive caution on bare, plated and porcelain finished metals.

Pure Steam jets should not be brought too close, nor held too long on paint, as it may often soften
or reduce adhesion, nor on anodized or conversion coated finishes, which may brush or craze if overheated or exposed too long.

Adding chemical cleaners to steam increases its speed and efficiency of cleaning, but introduces the question of compatibility. Spot tests should therefore be carried out. If this is not practical, it is best to clean cautiously. Decrease exposure time and increase steam nozzle to surface distance.

Do not vary the cleaner concentration from that recommended by the manufacturer. Doing so may produce deleterious effects.

When a cleaner is added to the steam, the cleaned section must be washed down with clean water prior to drying.

Power driven wire brushes may be used to clean bare metal finishes when all other methods fail. The recommended method to gain an unmarred brush job is to keep the bristles vertical to the work, just touching the surface. The brush should be moved slowly and evenly over the entire surface.

Abrasive cleaners may or may not be added to the pads, depending on the cleaning action required. To produce sheen on the metal's surface, the pads are lubricated with soapy water, oil or grease.

Abrasive blasting produces roughened, matt appearance on metal surfaces by removal of metal. The resultant texture of the metal is dependent on the factors such as:

- Air pressure
- Position of the nozzle in relation to the aluminum surface

- Size of the blasting particles
-

Because the roughened surface attracts finger prints and collects and retains dirt, a coating is usually employed to preserve the appearance of the abrasive blasted metal.

Clean, fine abrasive applied with relatively low air pressure, should be suitable for removing heavy dirt deposits, or for preparing aluminum surfaces for painting or repainting.

Abrasive material should never be reused to clean other materials, as it may contaminate the surface.

Abrasive blasting should be carried using extreme caution on thin metal panels, as distortion of the panel may occur.

2.2 CLEANING METHODOLOGY FOR GLASS PRODUCTS

2.2.1 Typical Glass Products

Glass products are available in five distinct types:

a) Laminated Glass

Laminated glass consists of two panes of glass permanently bonded together with a tough interlayer of plastic (PVB) under heat and pressure into a single piece. Laminated glass can be made using annealed, tempered, or heat strengthened glass and offers the following performance:

- Resists penetration from solid objects
- Reduces the danger of flying or falling glass, as once broken, laminated glass adheres to the interlayer
- Helps protect against UV light damage
- Dampens external noise
- Reduces glare without distortion

b) Annealed glass

Annealed glass is most commonly found in residential applications due to its performance.

- Easily cut to shape on site
- Easily broken into potentially dangerous shards
- Poor insulator and sound barrier
- Poor strength and bending characteristics

It will not be used on this project.

c) Tempered Glass

Tempered glass is made by rapidly cooling annealed glass that has been progressively heated to approximately 650 ◦C (its softening point) in a furnace, giving it the following characteristics:

- Tempered glass is 3 to 5 times stronger than annealed glass
- When broken, it crumbles into millions of small pieces, reducing the danger of falling shards
- The tempering process can cause optical distortion in the glass
- There is a potential for spontaneous breakage if invisible flaws in the glass are not spotted during manufacture

To reduce the chance of spontaneous breakage, **Heat Soak Testing** can be carried out on a predetermined percentage of the manufactured glass to check whether it has any flaws. If a flaw exists in the glass, the glass will shatter during Heat Soak Testing. If the glass does not break during the Heat Soak Testing, then major flaws do not exist.

d) Heat-strengthened Glass

Heat-strengthened glass is produced following a similar process to tempering. Annealed glass is heated to its softening point and then quenched by a uniform blast of air, giving it the following performance:

- Bending and impact strengths are approximately twice that of annealed glass
- May break like annealed glass

e) Insulating Glass

Insulating glass, also known as double or triple glazing, consists of two or more panes of glass separated by an air space in a frame. It can be made using annealed, tempered, heat strengthened
or laminated glass and has the following performance characteristics:

- Improved energy performance
- Noise reduction
- High resistance to soft particle impacts (hard particle performance is dependent on the type of glass selected)

Note: Each type of glass can have different surface treatments added to improve its thermal performance, light reflectance and/or visual appearance. And it is these specialist coatings that determine how the glass is cleaned and maintained.

2.2.2 Planned Cleaning and Maintenance of Glass Products

The cleaning and maintenance of glass products used throughout this station is dependent on the use of location of the building, and the architectural requirements of the glass.

The degree of soil/ dirt accumulated on the glass products and the intervals at which they should be cleaned will always depend on the factors of location, relevant to environmental conditions and use.

In cases of extreme pollution, the cleaning intervals for standard non-architectural glass products should be monthly, and for architectural glass products weekly clean-downs are recommended.

In cases of very low pollution, a bi-annual clean-down for standard non-architectural glass products is sufficient, whereas a monthly clean-down of architectural glass products would suffice.

2.2.3 Cleaning Recommendation for Glass Products

i. Routine cleaning of light soiling should be carried out as follows:

a) first clean the surrounding frame (if applicable) to prevent glass cleaning detergents from sitting in the accumulated soil around the frame below (follow the cleaning advise given in the relevant material cleaning section/s).

b) select a soft material (i.e. soft sponges, chamois, buckskin or cotton cloth) to apply the cleaning agent/s.

c) select a neutral / non-abrasive detergent cleaner and dilute according to the manufacturer's recommendations.

d) apply the detergent cleaner from top to bottom in a side-to-side motion on one side of the glass and up and down on the other (this allows the cleaner to see which side of the glass requires more cleaning), until the whole area is coated.

e) On completion, thoroughly wipe down the area with a clean, dry cloth, or rinse down each section with clean warm water, depending on which method is recommended by the cleaning agent manufacturer.

ii. For tougher staining (i.e. grease and/or oil) the following method should be used:

a) a general clean down, as stated in point (i) should be used to remove general dust and dirt.

b) after general soiling is removed, apply a neutral water-soluble emulsifiers

c) the application of Benzene to remove areas of grease and/or oil is acceptable, although it should be noted that when using cleaning agents like Benzene, protection should be applied to any sealants and/or other adhesives to prevent damage.

Once the cleaning is complete, the whole area (including sealant joints and frames) should be thoroughly rinsed with clean warm water.

iii. For heavy staining which cannot be removed using either of the above techniques, a fine granular liquid polish can be used to polish out the stain

It should be noted that only polishes that do not damage coated surfaces should be used and if in doubt Glass Manufacturer should be contacted to approve the proposed cleaning agent.

iv. Ceramic Fritted Glass can be cleaned using the same technique as expressed in point one. Although for heavier staining, the application of a soft calcium carbonate cream cleaner such as “Jif”, should be made in circular motion, from top down. To increase cleaning efficiency, the cleaning agent can be applied with a nylon type pad, such as “Scotchbrite”.

Once application is complete, the area should be thoroughly rinsed down with clean water and a soft brush. It is not recommended to wipe down the area with a wet cloth, as this can wipe any soil residue back into the fritted perforations.

Note: As clear tempered glass is resistant to weathering and most chemicals, it is important to check whether the detergent cleaner/s chosen to clean the glass will not directly affect the interfacing materials. i.e. the silicon sealant, EPDM gasket, or powder coated GMS.

2.4 STANDARD CLEANING METHODOLOGY FOR ALUMINUM PRODUCTS

2.4.1 Typical Aluminum Products

Aluminum is available commercially in at least seven different finishes, each with its own characteristics.

Aluminum care and cleaning programs must, therefore, be tailored to the metal’s finish as well as to the needs and conditions of the service.

Typical composition of each surface finish is as follows:

i. Non-finished – Bare

The surface is simply the metal’s own, self-produced oxide layer. It is thin but tough, transparent, tenacious and protective.

Bare finishes vary in appearance depending on fabrication technique. The texture may be smooth and mirror-like, similar to satin or embossed with stucco, wood grained or other patterns. With time, this surface may discolor. Under maritime conditions, the natural finish tends to turn grey, and under urban and industrial atmospheric conditions, it tends to turn brown or black.

ii. Anodized Finishes

The surface is finished with an extra-thick oxide coating produced by electrochemical treatment. The thickness of these anodic layers can vary between 0.05 millimeters to more than 1.5 millimeters, depending on application.

The anodic layer may be transparent or integrally colored; in both cases the metal's natural luster will be visible. Or the anodic layer may be pigmented, dyed or impregnated with lubricant, a wax or both.

When anodized aluminum is to be used architecturally, it is sometimes given a clear organic coating for protection against alkaline building products during construction and to facilitate cleaning afterwards. Generally, anodizing substantially improves aluminum's resistance to weathering.

iii. Chemical Conversion Coatings

Chemical conversion coatings are coatings generally created by chemical means alone. They are thinner and less abrasion resistant than anodic coatings, and most often they are used as a base paint. Occasionally, conversion coatings are used as final surfaces for products and utilitarian structures. These coatings may be clear or colored gold, grey, golden brown, green or blue-green.

iv. Paint Finishes

Paint finishes to aluminum are usually organic coatings of various kinds applied to the surface of aluminum. Typical coatings include Polyester Powder Coating and Polyvinylidene Flouride Coatings (PVF2 or PVDF).

In the factory, these coatings are usually applied over a conversion coating, with differing levels of firing. On site, the paint or clear organic coating (lacquer) may be applied to any weathered aluminum surface after it has been roughened mechanically or chemically, or treated with suitable wash primers.

v. Porcelain Enameled Finishes

Porcelain enameled finishes are ceramic coatings which have been fired permanently unto the surface of the metal. Porcelain finishes are very hard, impervious to soils, many acids and alkalis and these finishes come in many colors, with smooth textured surfaces.

vi. Plated Finishes

Plated finishes are produced by electro-depositing one or more different materials and aluminum. Gold, silver, copper and chromium are often used. Sometimes the plating metal is deposited directly unto the aluminum, and sometimes an intermediate metal is used.

The surface is finished with an extra-thick oxide coating produced by electrochemical treatment. The thickness of these anodic layers can vary between 0.05 millimeters to more than 1.5 millimeters, depending on application.

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vii. Laminated Finishes

Laminated finishes are produced by bonding a thin layer of wood, cloth, plastic or a combination of these materials and possibly others to the surface of aluminum. The care and cleaning required by the laminated surface is that required by the facing material. If there are different laminates in use, cleaning procedures will have to be tailored to the finish surface and not to the aluminum base material.

2.4.2 Cleaning Recommendations for Aluminum

In general, neither dirt nor oxidation materially affects the strength and service life of aluminum. Therefore, cleaning and surface care are only usually necessary for the sake of appearance. Aluminum, unlike most other metals, takes care of itself. Exposed to air, it combines with oxygen to form a tough, transparent, protective oxide coating. Aluminum is therefore often used without surface treatment. When surface is treated, and aluminum can be treated or 'finished' in more ways than any other metal, further protection is provided.

All finishes, including the non-finished or bare aluminum, maybe kept clean and bright with mild soap and water alone. However, if cleaning has been postponed for too long, and the dirt is especially tenacious, a more aggressive cleaner or cleaning technique may be required. In such cases, best results are obtained when the cleaner and the technique are matched to the soil and finish involved.

Matching the Cleaners to the Finish:

MILD ACTION ——— AGGRESSIVE ACTION								
FINISH	Mild soaps, detergents, non-etching cleaners	Solvents & emulsions	Abrasive (moderate duty)	Abrasive (heavy duty)	Abrasive cleaner polishes	Steel wool	Etching cleaners	Special cleaners
Bare (Mill)	S	S	U	U	U	U	T	T
Bare (Stain)	S	S	S*	U	U	S*	T	T
Anodized	S	S	S*	T	U	S*	U	T
Chemical Conversion	S	S	T	U	U	T	U	T
Painted	T	T	T	U	U	U	U	T
Plated	S	S	T	T	T	T	T	T
Proceilain	S	S	S	S*	S*	S	T	T

Code: S Normally safe, should not damage finish
T Spot Test before using
U Not usually used, may damage finish
S* Rub lightly in direction of grain

Note: The information in this table is provided merely for quick reference. In general, the mildest cleaners should be tried first and the more aggressive cleaners should only be used if necessary. It is suggested that the reader consult sections ___ before selecting a cleaner.

2.5 **STANDARD CLEANING METHODOLOGY FOR STEEL PRODUCTS**

2.5.1 Typical Steel Products and Coatings

Steel products and Coatings are available in number of formula:

i. Mild Steel (MS) – BS 5950 and BS 4360 set out the structural design and grade of steel to be used within a structure, with Grades 43 and 50 being the most common in construction. The main disadvantage with specifying a mild steel product without corrosive protection is that mild steel has a low resistance to oxidization, which at first forms an oxide film on the surface of the product (commonly known as rust) and then continues to attach deeper into the metal, eventually causing structural failure.

ii. Galvanized Mild Steel (GMS) – For the project, two main methods of galvanizing steel have been used:

a) Hot Dip Galvanizing is a coating of Zinc or Zinc-iron alloy layers, obtained by dipping prepared iron or steel in molten zinc. The purpose of coating iron and steel with zincalloy, is that unlike iron and steel, when zinc oxidizes, it forms a protective coating on the metal, which in turn considerably slows further atmospheric attack.

Galvanized coatings have a unique metallurgical structure which gives outstanding resistance to mechanical damage during transportation and installation, and due to the properties of the zinc-alloy, act as a bimetallic separator between mild steel and other dissimilar metals.

b) Cold Applied Metallic Zinc Rich Primers are commonly used on site where factory galvanizing is not possible, i.e. following site welding of GMS members. They should be applied in line with BS 4652 and if all oxidization is removed prior to application, zinc rich primer should provide increased protection against oxidization and atmospheric attack.

iii. Stainless Steel – The term stainless steel covers a wide range of corrosion that heat resistant iron-based materials, which contain at least 12% Chromium in addition to one or more other alloy elements.

Stainless steel is usually classified as Austenitic, Ferritic or Martensitic according to their basic metallurgical structure, with Austenitic Stainless Steels being the most common form of stainless steel used in the construction industry.

Austenitic Stainless Steels are alloys of chromium, nickel and iron and can be welded easily, usually with no preheat or post-heat treatments. Nickel is the most expensive alloying addition, so the most commonly used alloys are those which can contain low percentages of nickel and still remain austenitic, i.e.:

- 18% Chromium and 8% Nickel are known as 18-8 or 304 grades stainless steel
- 18% Chromium, 10% Nickel and 3% Molybdenum are known as 18-10-3 or 316 grade stainless steel
- The low carbon variants: 304L and 316L are more suitable where welding is required.
-

Note: GMS which has been either cut or welded on site will have Metallic Zinc Rich Primer applied to the area where the Hot Dip Galvanizing has been damaged. If an architectural finish is required, then an epoxy primer and polyester coating will be applied.

2.5.2 Cleaning Recommendations for Steel Products / Coatings

i. Mild Steel

Due to the poor corrosive resistance of mill finished mild steel and the speed at which its surface collects and unsightly layer oxidization, mill finished mild steel has not been used within the Sub-Contract Works.

ii. Galvanized Mild Steel

The majority of GMS products used within the Sub-Contract Works have been coated in the following manner, due to the requirement to provide architecturally finished steel:

- First the mild steel components are Hot Dip Galvanized to BS 729 Part 1
- Then a two-pack epoxy primer is applied
- Finally, a two-pack polyurethane finish coat is applied

Due to this, the recommended cleaning method should closely follow that of painted aluminum.

- Using a soft cloth or soft-haired brush, clean down the selected area, removing light dirt and surface dust.

- Should dirt remain, then select a clean soft cloth and apply a mild, non-abrasive detergent cleaner from top down, ensuring that all areas are coated. Use a soft-haired brush to apply cleaner to corners, rebates and returns.

- Once the area has been coated, thoroughly wash it down from top to bottom with clean water, ensuring that each corner, rebate and return has all the cleaning agents rinsed out.

- For tougher stains, i.e. grease and/or oil, after the general clean down, apply a neutral water soluble emulsifier, remembering to thoroughly rinse down the area with clean water afterwards.

- For the heaviest of stains which cannot be removed using either of the above methods, apply a mild acting, non-abrasive cream cleaner polish with a nylon-type pad (not forgetting to check its effect on the finish coat by spot testing it) and rinse it down with warm, clean water.

iii. Powder Coated GMS

The Polyester Powder Coating provides a durable and architecturally smooth finish. The recommended cleaning method should follow closely a typical painted coating as follows:

- Using a soft cloth or soft-haired brush, clean down the selected area, removing light dirt and surface dust.

- Should dirt remain, then select a clean soft cloth and apply a mild, non-abrasive detergent cleaner from top down, ensuring that all areas are coated. Use a soft-haired brush to apply cleaner to corners, rebates and returns.

- Once the area has been coated, thoroughly wash it down from top to bottom with clean water, ensuring that each corner, rebate and return has all the cleaning agents rinsed out.

- For tougher stains, i.e. grease and/or oil, after the general clean down; apply a neutral water soluble emulsifier, remembering to thoroughly rinse down the area with clean water afterwards.

- For the heaviest of stains which cannot be removed using either of the above methods, apply a mild acting, non-abrasive cream cleaner polish with a nylon-type pad (not forgetting to check its effect on the finish coat by spot testing it) and rinse it down with warm, clean water.

2.6 DETAILED CLEANING METHODOLOGY FOR STEEL PRODUCTS

CLEANING AND MAINTENANCE MANUAL

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Chapter 1 – INTRODUCTION

1.1 GENERAL INTRODUCTION

1.1.1 Introduction

This manual is for cleaning and maintenance of the Stainless Steel Feature in the project. Although most of the materials used in those features are stainless steel, a number of different materials and surface finishes have been used to create the desired architectural finish.

1.1.2 Preparation

The Maintenance Team which includes the Project Manager, Design Manager, Site Manager and Quality Manager will be responsible for the preparation and checking of the Cleaning & Maintenance Manual.

1.1.3 Revisions

Revisions to the Cleaning and Maintenance Manual are the responsibility of the Maintenance Manager.

1.2 PROJECT DETAILS

1.2.1 Project Description

(Name of Project) is a _____
_____
_____

1.2.2 Scope of Works

The Scope of Work under this Sub-Contract comprises the Design, completing design calculations including the effects of high wind speed on feature, producing manufacturing drawings, shop fabrication, delivery to site and installation. The stainless steel features are to be installed fit for purpose, and fully finished ready and ready for hand-over. The stainless steel feature shall be designed and installed, using current and recognized good practice. _____ will ensure the final design and installation is functional and durable, supply and installation contractor, is deemed to have included for all necessary materials, installation work, fixing, coordination, planning, etc. to bring the work to an acceptable and satisfactory completion.

The Contract Works also comprises of the preparation of a Maintenance and Cleaning Manual and As-built Drawings (to the extent as called for in the Contract Specification). The Manual shall demonstrate proper cleaning methods of the Contract Works and list types of cleaning agents, methods and the type of sealants and components to be used for cleaning, removal and replacement of the Contract Works.

1.3 MATERIALS

1.3.1 Overview

_____
_____

1.3.2 Stainless Steel Sheets (Alloy SS 316)

_____
_____

1.3.3 Galvanized Steel

_____
_____

1.4 CLEANING IN GENERAL

1.4.1 Atmospheric Pollution

_____
_____

1.4.2 Exclusion from Liability

Liability is excluded when:

i. Damages to installed materials caused by the supplier of the cleaning agents changing the composition of the recommended detergents.

ii. Failure of the building owner to maintain a regular cleaning schedule, as highlighted in Chapter 3 of this Maintenance and Cleaning Manual.

iii. Failure of the maintenance crews to follow the cleaning agent manufacturer's and/or maintenance manual's recommendations on how to use the cleaning agents, which may result in damage to the installed materials.

NOTE: LODHAGROUP reserves the right to inspect all maintenance records held by the building owner, to ensure that the cleaning and maintenance undertaken by the owner adheres to the methods listed within this maintenance and cleaning manual.

1.4.3 Cleaning Agents

In general, only neutral, non-abrasive cleaning agents are to be used.

Maintenance crews should always test cleaning agents on a small section of the material, preferably a section not normally visible to the general public, to ensure that there will be no reaction or surface damage.

It is not recommended to use **High Pressure Cleaning Devices** either directly on the units or in close proximity to the units, as high pressure devices can dislodge gaskets, seals and/or setting blocks, or kick up grit and dirt from adjacent areas which may scratch or dent finished surfaces.

In cases of extreme doubt, samples of cleaning agents can be sent to a Laboratory for review and recommendation.

1.4.4 Cleaning Agents not to be used

- Solvents such as acetone, methyl-ethylketone, etc.
- Alkaline detergents with a pH Value of more than 7
- Acid-based detergents with a pH Value of less than 5

Although many of the materials used within the project offer resistance to alkalis and acids, you should not directly apply detergents containing strong acids or alkalis (no matter what the form), as these substances can penetrate through the structures corroding components, glazing beads, sealants and/or hollow sections, causing reduction in life span of the installed components.

1.4.5 Cleaning Methodology

For light coverings of dust, a soft, dry cloth (preferably made of 100% cotton) should be used to remove surface dust, working the surface from top down. A soft, fine haired brush can also be used to remove dust and dirt from awkward corners.

For more permanent stains, such as grease and/or oil marks, water and neutral detergent solution should be used, applied with a soft cloth, working from top down.

Once the units are considered clean, the surface should be rinsed with clean water to remove all traces of the detergent.

It should be remembered that the frames and glazing should be cleaned and rinsed down at the same time.

Chapter 2 CLEANING PROCEDURES

2.1 STANDARD CLEANING AGENTS

2.1.1 Typical Cleaning Agents Available

Cleaning agents are arbitrarily divided into five groups:

a) Mild soaps / detergents and non-etching cleaners

Mild soap and detergent cleaners can often be applied to products and areas without the use of protective clothing. In the case of stronger detergents, it is recommended that spot testing is carried out before use, as they could contain bleach which can discolor finish coatings.

Non-etching cleaners are alkaline or acid-based formulations mixed with inhibitors, which permit the cleaners to remove soil without attacking the metal or finish. The nature of these chemicals, their strengths and the time they should remain on the product vary from cleaner to cleaner.

After cleaning, the area should be thoroughly rinsed with clean water and dried.

b) Solvents and Emulsion Cleaners

While generally mild in there action, they are more effective on stains and soils than cleaners in the first group.

Solvent and emulsion cleaners may be used without difficulty on bare, anodized, conversion coated and porcelain zed metal.

When used on painted (and lacquered) finishes, solvent and emulsion cleaners should be spot tested first, as the wrong solvent or solvent-containing emulsion can remove the paint and clear organic coatings (lacquers).

Both mild cleaners and the solvent-emulsion cleaners will remove dirt and some stains. They will not however, restore the appearance on metals and finishes that have weathered, nor remove heavy grime encrustation. For these conditions a more aggressive cleaner is required.

c) Abrasive Cleaners

Abrasive cleaners will restore weathered aluminum, stainless steel and copper to its natural brilliance and remove most stains and grime.

These cleaners are manufactured and sold under various generic descriptions including polish, cleaner, cleaner polish, wax cleaner, wax polish, metal brightener, scouring powder and the like. Their effectiveness on various soils and darkened metals depends on their formulation and vigor of application.

Abrasive cleaners contain abrasives to which water, oil, wax, silicones, soap and acid or alkali may be added, either singly or in combination. This allows the abrasives to cut away the dirt and surface oxidation; with the soaps, acids and/or alkalis providing general cleaning.

Once applied and removed, traces of the wax, oil or silicones remain behind providing luster and a small measure of surface protection.

- **Fine Abrasive Cleaners**

  Abrasive cleaners containing fine grit or polishing agents may be used with care on all finishes. Great care is necessary during application, as even the finest polishing agent is an abrasive and prolonged rubbing may dull a bright spectral finish in time and cut through thin coatings and forms of plating.

  For the ultimate in spectral finishes, the surface must be buffed.

- **Moderate Abrasive Cleaners**

  Moderate abrasives can dull metal finishes and paint coating within a relatively short time. Cleaners in this group are often only used to remove heavy soil and oxides prior to final cleaning with a fine grit cleaner.

  When this is done, the abrasive cleaner must be thoroughly removed before the fine polish is applied. Otherwise, a few grit particles may find their way unto the final cleaning pad and produce noticeable scratches.

  During application, moderate abrasives produce a finely scratched surface. However, these fine scratches are easily blended into a matt or satin finishes by working the abrasive with grain of the finish.

Some combination abrasive cleaners containing steel wool must have all the steel particles left behind. After cleaning, thoroughly rinse off, otherwise the steel particles will rust leaving unsightly stains. Combination abrasive cleaners containing stainless steel wool are therefore preferable.

Abrasive cleaner polishes should be applied with a clean cloth and rubbed over the soiled area. Once completed, the area should be polished using a clean, dry cloth.

Cleaner polishes leave a thin wax, or wax-like coating, which gives additional protection. However, this film inhibits the adhesion of any subsequently applied paint or lacquer.

Large areas may be cleaned with the help of power-driven polishers and buffers. Caution must be used to make certain the high speed wheel's edge doesn't cut into the finish and that pressure is kept moderate to avoid over-heating the finish. Wheel pads should be changed frequently to make certain abrasive particles do not clump up and dig into the work.

- **Coarse Abrasive Cleaners**

  Coarse cleaners are sometimes used to prepare anodized surfaces for painting. Pressure should be light to avoid deep scratches, which may be visible through the paint.

  Coarse abrasive cleaners and moderate abrasive cleaners are sometimes compounded with active chemical cleaners. The combination produces a fast-acting cleaner that must be used with care. Bare aluminum and most paint coatings are sensitive to chemical-based cleaners which may etch the finish if permitted to remain on the surface too long.

  Anodized aluminum may develop white blemishes if chemical cleaners remain in place too long.

- **Etching Cleaners**

  Etching cleaners are normally added to water and applied to heavily weathered and soiled metal finishes. They should be applied with caution as they remove small quantities of the coating / metal each time they are used.

  Etching cleaners are not normally used on painted, plated, anodized or conversion coated metals.

  There are a number of propriety etching cleaners formulated on the market and each manufacturer's directions in the matter of cleaner concentration, exposure time and safety should be carefully followed.

  Whether the etching cleaner is first applied to the top or the bottom of an area depends upon its size. Comparatively small areas such as store fronts and fixed barriers are best cleaned.

from the bottom up, as etching cleaner drips will affect already cleaned areas far less than they will affect unclean areas. When large areas, such as tall buildings are to be cleaned with an etching cleaner, it is best to start from the top, as etching cleaner drips will, to a large extent be isolated from the finished surface by the soil on the building's surface.

Cleaning power may be increased by using a fine abrasive such as pumice or fine steel or stainless steel wool, or an abrasive nylon pad to rub the wet metal during the etching period.

For uniform results on metal finishes, always degrease the surface before the water-based etching cleaner is applied. Each area must be rubbed equally and soak periods must also be similar.

- Special Cleaners
  Special cleaners include steam, rotary wire brushes and abrasive blasting in this section. They are considered special because they require more than hand equipment during application.

o Pure steam may be applied without excessive caution on bare, plated and porcelain finished metals.

  Steam jets should not be brought too close, nor held too long on paint, as it may soften or reduce adhesion, nor on anodized or conversion coated finishes, which may blush or crazeif overheated or exposed too long.

  Adding chemical cleaners to steam increased its speed and efficiency of cleaning, but introduces the question of compatibility. Spot tests should therefore, be carried out. If this is not practical, it is best to clean cautiously: Decrease exposure time and increase steam nozzle to surface distance. Do not vary the cleaner concentration from that recommended by the manufacturer. Doing so may produce deleterious effects.

  When a cleaner is added to the steam, the cleaned section must be washed down with clean water prior to drying.

o Power-driven wire brushes may be used to clean bare metal finishes when all other methods fail. The recommended method to gain an unmarred brush job is to keep the bristles vertical to the work, just touching the surface. The brush should be moved slowly and evenly over the entire surface.

  Abrasive cleaners may or may not be added to the pads, depending on cleaning action required. To produce sheen on the metal's surface, the pads are lubricated with soapy water, oil or grease.

o Abrasive blasting produces a roughened, matte appearance on metal surfaces by removal of metal. The resultant texture of the metal is dependent on factors such as:

- Air pressure
- Position of the nozzle in relation to the aluminum surface
- Size of the blasting particles

Because the roughened surface attracts finger prints and collects and retains dirt, a coating is usually employed to preserve the appearance of the abrasive blasted metal.

Clean, fine abrasive, applied with relatively low air pressure, should be suitable for removing heavy dirt deposits, or for preparing aluminum surfaces for painting or repainting.

Abrasive material should never be reused to clean other materials, as it may contaminate the surface. Abrasive blasting should be carried out using extreme caution on thin metal panels, as distortion of the panel may occur.

2.2 STANDARD CLEANING METHODOLOGY FOR STEEL PRODUCTS

2.2.1 Typical Steel Products and Coatings

i. Mild Steel (MS)

BS 5950 and BS 4360 sets out the structural design and grade of steel to be used within a structure, with Grades 43 and 50 being the most common in construction.

The main disadvantage with specifying a mild steel product without corrosive protection is that mild steel has a low resistance to oxidization, which at first forms an oxide film on the surface of the product (commonly known as rust) and then continues to attack deeper into the metal, eventually causing structural failure.

ii. Galvanized Mild Steel (GMS)

For the project two main methods of galvanizing steel have been used:

- Hot Dip Galvanizing is a coating of Zinc or Zinc-iron alloy layers, obtained by dipping prepared iron or steel in molten zinc. The purpose of coating iron and steel with at zinc-alloy is that unlike iron and steel, when zinc oxidizes it forms a protective coating on the metal, which in turn considerably slows further atmospheric attack.

  Galvanized coatings have a unique metallurgical structure which gives outstanding resistance to mechanical damage during transportation and

installation, and due to the properties of the zinc-alloy act as a bimetallic separator between mild steel and other dissimilar metals.

- Cold applied metallic zinc rich primers are commonly used on site where factory galvanizing is not applied, i.e. following site welding of GMS members. They should be applied in line with BS 4652 and if all oxidization is removed prior to application zinc rich primer should provide increased protection against oxidization and atmospheric attack.

iii. Stainless Steel

The term stainless steel covers a wide range of corrosion and heat resistant iron-based materials, which contain at least 12% Chromium in addition to one or more other alloy elements.

Stainless steel is usually classified as Austenitic, Ferritic or Martensitic according to their basic metallurgical structure, with Austenitic Stainless Steels being the most common form of stainless steel used in the construction industry.

Austenitic Stainless Steels are alloys of chromium, nickel and iron and can be welded easily usually with no preheat or post-heat treatments. Nickel is the most expensive alloying addition, so the most commonly used alloys are those which contain low percentages of nickel and still remain austenitic, i.e.:

18% Chromium and 8% Nickel are known as 18-8 or 304 grade stainless steel

- 18% Chromium, 10% Nickel and 3% Molybdenum are known as 18-10-3 or 316 grade stainless steel
- The low carbon variants: 304L and 316L are more suitable where welding is required.

Note: GMS which has been either cut or welded on site will have Metallic Zinc Rich Primer applied to the area where the Hot Dip Galvanizing has been damaged. If an architectural finish is required, then an epoxy primer and polyester coating will be applied.

2.2.2 Cleaning Recommendations for Steel Products / Coatings

i. Mild Steel

Due to the poor corrosive resistance of mill finished mild steel and the speed at which its surface collects unsightly layer oxidization. Mill finished mild steel has not been used within the Sub-Contract Works.

ii. Galvanized Mild Steel

The majority of GMS products used within the Sub-Contract Works have been coated in the following manner, due to the requirement to provide architecturally finished steel:

- First the mild steel components are Hot Dip Galvanized to BS 729 Part 1
- Then a two-pack epoxy primer is applied
- Finally a two-pack polyurethane finish coat is applied

Due to this, the recommended cleaning method should closely follow that of painted aluminum.

- Using a soft cloth or soft-haired brush clean down the selected area, removing light dirt and surface dust

- Should dirt remain, then select a clean soft cloth and apply a mild, non-abrasive detergent cleaner from top down, ensuring that all areas are coated. (Use a soft-haired brush to apply cleaner to corners, rebates and returns.)

- Once the area has been coated, thoroughly wash it down from top to bottom with clean water, ensuring that each corner, rebate and return has all the cleaning agents rinsed out.

- For tougher stains (i.e. grease and/or oil) after the general clean down, apply a neutral water soluble emulsifier, remembering to thoroughly rinse down the area with clean water afterwards.

- For the heaviest of stains this cannot be removed using either of the above methods. Apply a mild acting, non-abrasive cream cleaner polish with a nylontype pad (not forgetting to check its effect on the finish coat by spot testing it) and rinse it down with warm clean water.

iii. Recommended Cleaning Methodology for Stainless Steel

Requirement	Suggested Method	Comments
Routine cleaning of light soiling	Use neutral soap / detergent or dilute (1%) ammonia solution in warm water. Apply with a clean sponge, soft cloth or soft-fibre brush, then rinse with clean water and dry.	Satisfactory on most surfaces
Fingerprints	Use neutral detergent and warm water, alternatively, hydrocarbon solvent	Proprietary spray-applied polishes available to clean and minimize remarking
Oil and grease marks	Hydrocarbon solvent	Alkaline formulations are also available with surface formulas
Stubborn spots, stains and light discoloration. Water marking and light rust staining	Use mild acting/ non-abrasive creams and polishes. Apply with soft cloth or soft, sponge and rinse off residue with clean water and dry.	Avoid cleaning pastes with abrasive formulas, cream cleaners are available with soft calcium carbonate additions, e.g. 'Jif' Avoid solutions containing chloride
Adherent hard water scales and mortar / cement splash	10-15% per volume solution of phosphoric acid. Use warm, neutralize with dilute ammonia solution, rinse with clean water and dry.	Proprietary formulations are available with surfactant additions. Avoid the use of hydrochloric acid-based mortar removers.
Heat tinting or heavy discoloration	a) use a mild acting, non-abrasive cream or polish as described above b) if this does not remove the staining apply the non-abrasive cream or polish with a nylon-type pad (Typical type available 'Scotchbrite')	a) is suitable for most finishes b) when applying the cleaning agent follow the contours of the finish / grain
Badly neglected surfaces with hardened, accumulated grime	Apply a fine, abrasive paste as often used in car body	May brighten dull finishes. To avoid a patchy appearance,

deposits	refinishing, e.g. 'T-Cut'. Once application is complete, polish out all the paste material, rinse clean with warm water and dry.	the whole surface should be treated.
Paint / Graffiti	Apply a proprietary alkaline or solvent paint stripper, depending upon paint type. Use soft, nylon or bristle brush on Hyclad Finishes.	Apply as directed by cleaning agent manufacturer.
Note:As stainless steel is a very strong and durable material, always check whether the materials interfacing with the steel stainless, will not be damaged by the application of the specified stainless steel cleaning agent.		

2.3 CONCLUSIONS AND

RECOMMENDATIONS 2.3.1

Common Sense Cleaning Rules

a) Match Cleaner to Finish

Steel wool, strong acids, strong alkalis and abrasive cleaners should never be applied indiscriminately; though in their place strong cleaners, used correctly, are highly effective.

b) Make a Spot Test to be Sure

The few moments spent testing a cleaning agent and procedure on an unobtrusive portion of the surface finish is good insurance against a poor reaction between the cleaning agent and surface finish.

Always use the same concentration and technique planned for the entire job.

Ensure the agent is thoroughly rinsed off and inspect the area for stains and possible surface reactions.

It is recommended to test lacquered and painted finishes for softening and possible dissolution at the same time.

c) Watch Cleaning Frequency

Cleaner – product contact time should not be estimated, but carefully timed. Therefore, the manufacturer's directions should always be closely followed and prolonged contact avoided.

j) Remove All Cleaning Agents Thoroughly

Water-based cleaners should be rinsed with clean water, after which the part or area is permitted to dry or is wiped dry.

Cleaners containing wax, oil or silicones should be removed with a dry soft fibre cloth. Traces of cleaner should not be left in cracks or corners.

k) Clean Each Side of Glass a Different Application Stroke

When cleaning glass it is prudent to clean one side of the glass using an up and down motion and the other in a left to right motion. That way should further cleaning be necessary, the direction of the marks will determine which side of the glass needs more work.

2.4 RECOMMENDED CLEANING & MAINTENANCE FORMS AND REPORTS

In order to minimize the misuse of cleaning agents and monitor their effectiveness during the cleanings and maintenance process, the Cleaning & Maintenance team must establish and maintain the following propose reports forms to better assist the Cleaning & Maintenance work:

- The compatibility of proposed cleaning agents and specialist materials

- The frequency and effectiveness of scheduled maintenance and cleaning

CHAPTER 3 – MAINTENANCE PROCEDURES

3.1 INSPECTION AND PREVENTATIVE MAINTENANCE

Preventative methods of maintenance, including scheduled inspections, programmed replacement and regular cleaning are all-important parts of maintenance strategy.

It is recommended that the cleaning of materials exposed to the outside elements should be at monthly intervals. As explained early, any build up of dirt or soil containing pollutants, may result in a concentration of corrosive reaction.

It is recommended that inspections of all installed materials be made at 6 monthly intervals to check for any signs of damages, corrosion on the materials.

The inspection crew should use gondola to inspection the face panel of the Stainless Steel Features for any loose connection or any panel puncher. The inspection should also include the water weep hole for any filter congestion for damage.

Also, soon after a major earthquake occurs, the Maintenance crew should inspect all Stainless Steel Feature's steel brackets for hairline fracture or cracks. Also, the maintenance crew should check all fasteners for damage or losses. The maintenance crew would have to remove the back panels and curtain wall panels accordingly to inspect the steel brackets and fasteners. In order to correctly remove the Stainless Steel Feature's back panel, please contact Glazing Expert or refer to the AS-BUILT drawings. As for removal of the curtain wall panels, please contact Glazing Contractor or refer to their technical manual. Furthermore, if there are suspicious cracks or damage to the steel brackets and fasteners, please contact Glazing Expert or any authorized contractors immediately for professional advice. For correct design and position of the steel brackets, please refer to the AS-BUILT drawings.

Suitable remedial or replacement work should be made to any blemished items.

It should be noted that the procedures suggested should only be used as a guide and no dot absolve the Maintenance Crews / Contractors from their obligations, as it is of equal importance that the Maintenance Crews / Contractors carry out their own research, prior to commencing maintenance works.

3.2 LIST OF MAIN COMPONENTS

The following list indicates where main materials used within the Contract Works were sourced.

Material	Product	Manufacturer	Contacts
Galvanized steel brackets	Steel Fabrication		
Sealants	Sealants		
Stainless Steel Sheets	Medallion Face		
Stainless Steel Bolts	Fasteners		

3.3 LIFE EXPECTANCE SCHEDULE

The following schedule has been formulated in line with the recommendations listed within BS 7543:1992 “Durability of Buildings and Building Elements, Products and Components” and BS 8210: 1986 “Building Maintenance Management”.

The expected Design Life of the whole works is listed as a minimum of fifty years, placing it within the Maintenance Category Four “Normal Life”. The Glass Entrance Box’s components can be categorized as Two “Maintainable”, which means they will last with periodic treatment for the life of the works.

The level of Maintenance can be categorized as Level 2 “Scheduled Maintenance Plus Repair”. Whereby, maintenance work should be carried out at a predetermined schedule to maximize component life spans.

The effects of failure of any one of the components can be listed as Category H “No exceptional problems”. As with each section of works, replacement will not interrupt the building’s use, compromise security, endanger health or be costly to repair.

Table: LIFE EXPECTANCY SCHEDULE

Material / Component	Action causing deterioration	Effect of deterioration	* Service Life: (Years)	Design Life: (Years)
Stainless steel bolts	Bimetallic corrosion, acids and salts in solution attack	Unsightly rust staining, stress cracking to nickel sulphite inclusions	50 – 60	60+
Silicone sealant	Movements, solar radiation temperature changes, atmospheric attack	Sealant cracks or detached	10 – 15	20
Galvanized mile steel support steel	Bimetallic corrosion, acid and salts in solution	Unsightly rust staining	50 – 60	60+
Grade S316 stainless	Bimetallic corrosion, acids and salts in solution	Unsightly rust staining	50 – 60	60+
Note: *Experience has shown that service life can be short as the ranges indicated. However, Good Maintenance Procedures will help extend a product's service life				

Recommended Cleaning Methodology for Stainless Steel

Requirement	Suggested Method	Comments
Routine cleaning of light soiling	Use neutral soap / detergent or dilute (1%) ammonia solution in warm clean water. Apply with a clean sponge, soft cloth or soft-fibre brush, then rinse with clean water and dry.	Satisfactory on most surfaces
Fingerprints	Use neutral detergent and warm water, alternatively, hydrocarbon solvent.	Proprietary spray-applied polishes available to clean and minimize remarking.
Oil and grease marks	Hydrocarbon solvent	Alkaline formulations are also available with surface formulas.
Stubborn spots, stains and light discoloration. Water marking and light rust staining	Use mild acting / non-abrasive creams and polishes. Apply with soft cloth or soft, sponge and rinse off residue with clean water and dry.	Avoid cleaning pastes with abrasive formulas, cream cleaners are available with soft calcium carbonate additions, e.g. 'Jif'. Avoid solutions containing chloride.
Adherent hard water scales and mortar / cement splashes	10-15% per volume solution of phosphoric acid. Use warm, neutralize with dilute ammonia solution, rinse with clean water and dry.	Proprietary formulations are available with surfactant additions. Avoid the use of hydrochloric acid-based mortar removers.
Heat tinting or heavy discoloration	a) Use a mild acting, non-abrasive cream or polish as described above. b) If this does not remove the staining apply the non-abrasive cream or polish with a nylon-type pad. (Typical type available 'Scotchbrite').	a) Is suitable for most finishes b) When applying the cleaning agent follow the contours of the finish / grain
Badly neglected surfaces with	Apply a fine, abrasive paste as often used in car body refinishing, e.g. 'T-	May brighten dull finishes.

hardened, accumulated	Cut'. Once application is complete, polish out all the paste material, rinse	To avoid a patchy appearance, the whole surface should be
Paint / Graffiti	Apply a proprietary alkaline or solvent paint stripper, depending upon paint	Apply as directed by cleaning agent manufacturer.
Note:As stainless steel is a very strong and durable material, always check whether the materials interfacing with the steel stainless, will not be damaged by the application of the specified stainless steel cleaning agent.		

2.7 STANDARD CLEANING METHODOLOGY FOR STONE PRODUCTS

2.7.1 Typical Stone Products

For this project's stone cladding, the following cleaning guideline should be followed in conjunction with the stone supplier's instructions.

2.7.2 Cleaning Recommendations for Stone Products

i. Routine cleaning of light soiling should be carried out as follows:

a. First clean the surrounding frame (if applicable) to prevent cleaning detergents from sitting in the accumulated soil around the frame (follow the cleaning advise given in the relevant material cleaning section/s.

b. Select a soft material (i.e. soft sponges, chamois, buckskin, or cotton cloth) to apply to the cleaning agent/s.

c. Select a neutral/ non-abrasive detergent cleaner and dilute according to the manufacturer's recommendations.

d. Apply the detergent cleaner from top to bottom in a side-to-side motion on one side of the glass and up and down on the other (this allows the cleaner to see which side of the glass requires more cleaning) until the whole areas is coated.

e. Upon completion, thoroughly wipe down the area with a clean dry cloth, or rinse down each section with clean, warm water, depending on which method is recommended by the cleaning agent manufacturer.

ii. For tougher staining (grease and/or oil) the following method should be used:

a. A general clean down, as stated in point (i) should be used to remove general dust and dirt.
b. After general soiling is removed, apply neutral water-soluble emulsifiers.
c. The application of Benzene to remove areas of grease and/or oil is acceptable, although it should be noted that when using cleaning agents like Benzene, protection should be applied to any sealants and/or other adhesives to prevent damage.
d. Once the cleaning is complete, the whole area (including sealant joints and frames) should be thoroughly rinsed with clean warm water.

iii. For heavy staining which cannot be removed using either of the above techniques, the application of a soft calcium carbonate cream cleanser, such as "Jif", should be made in a circular motion, from top down. To increase cleaning efficiency, the cleaning agent can be applied with a nylon type pad, such as "Scotchbrite".

Once application is complete, the area should be thoroughly rinsed down with clean water and a soft brush. It is not recommended to wipe down the area with a wet cloth, as this can wipe any soil residue back into the perforations.

2.8 DETAILED CLEANING METHODOLOGY FOR STONE PRODUCTS FOR

Cleaning Exterior Stone

1. General

1.1. Information, size of area and items to be cleaned
- 1.1.1. Location, size or area and items to be cleaned
- 1.1.2. Location, size and number of test panels
- 1.1.3. Areas not included in cleaning contract
- 1.1.4. Location, size and description of materials requiring protection
- 1.1.5. Building and property boundaries

2. Description

2.1 General – This section pertains to the furnishing of all labor, materials, equipment and services necessary for the complete cleaning of exterior stone as indicated on the plans and described in these specifications.

2.2 Re-pointing, sealing and replacement – Re-pointing or sealing of joints and replacement of stone is not included in the cleaning contract.

3. Related Sections (to be determined by design requirements)

4. Requirements

4.1 General – the plans, general conditions, supplementary general conditions and executed agreement are all part of this section as if written out in full.

4.2 Certification – furnish certified statements, as required, attesting that all materials to be used to meet the requirements specified and approved.

4.3 Scheduling – furnish architect with schedule of cleaning operations indicating time of day work will be performed. The wet method of cleaning shall not be performed when temperatures reach 35 degrees or lower.

4.4 Test Area(s) – clean for approval by Architect one 4-foot x 4-foot test area for each type of soiling, stone variety and finish required to be cleaned. Test panels shall be located to include intersection of horizontal and vertical joints. The approved panel(s) shall be the standard for cleaning methods and finish of all areas to be cleaned.

4.5 Protection – furnish for approval by Architect types of materials and surfaces from damage, moisture, and staining. If other refurbishing operations are being conducted, protect cleaned stone areas with an approved no staining covering.

4.6 Cleaning – after the surface has been cleaned, it shall be rinsed with potable water, applied at the temperature and pressure of the municipal water supply.

5. Materials

5.1 Water – shall be potable, no staining and free of materials detrimental to the surface being cleaned.

6. Method (to be determined by approved test areas)

6.1 Hydraulics – water at varying pressures between 300 and 600 psi and at municipal supply temperatures, shall be jetted against the surface to be cleaned.

6.2 Hydro-air – Air, at a maximum pressure of 800 psi and water, combined at the nozzle, shall be sprayed against the surface to be cleaned.

6.3 Steam Water Jet – hot water, produced by combining steam at a maximum pressure of 150 psi and cold water at the nozzle, shall be sprayed against the surface to be cleaned.

Supplemental Information

Cleaning Exterior Stone

1. The purpose of this section is to give the Architect or specification writer the basic information to prepare a specification for the cleaning of exterior building stone.

2. Exterior stone is considered in this section to be all stone used on exterior of a structure (either as a structural component or as a facing material), with the exception of polished finished marble. Even though polished marble is not recommended for exterior usage, it is occasionally used on stone fronts, column facings, and similar treatments. Polished finished marble is covered under the cleaning of interior marble in the STONE MAINTENANCE section.

3. The ideal in maintaining stone is to clean it a periodic intervals, at least annually, depending on atmospheric conditions, by simply hosing down with clean water. This will prevent accumulation of dirt and impurities.

4. Where dirt has accumulated on older structures over a long period, a combination of methods may have been employed to properly clean the stone. Steam water jet is satisfactory for removing most accumulation.

No chemicals are to be sued which would be injurious to the stone.

5. Brushes may be necessary in the removal of certain surface impurities. Fiber brushes are
recommended.
6. The intent of this guide specification is to allow the contractor to choose which of the methods he desires to employ. By cleaning and inspection of test panels, the architect can determine if the method is satisfactory. This procedure eliminates the possibility of improper
cleaning, since the owner and architect can see what results will be obtained prior to commence of the total contract. It also gives the cleaning contractor a standard to work toward, making definition of the cleaning more specific for all parties concerned.

7. Further reading suggestions:

7.1 Cleaning Masonry – Review of the literature, Clayford T. Grimm, P.E., Construction Research Center, University of Texas at Arlington, 1988

7.2 Cleaning Stone and Masonry – James B. Clifton, editor, ASTM Special Technical Publication 935, 1983

7.3 Keeping It Clean, Anne E. Grimmer, US Department of the Interior, National Park Service, US Government Printing Office, Washington, DC 20402, 1988

7.4 Special Maintenance Procedures for Uneven Surface Stone

Thermal Finish Granite, Natural Cleft State and Natural Cleft Quartz-based (Sandstone) Stone.

Daily maintenance becomes difficult if dirt is allowed to accumulated on uneven surfaces. Although at this time, the MIA does not endorse application of either stone impregnators or sealers, some have found them to be effective. Always test impregnators or sealers on inconspicuous small areas to determine the desirability of the finished appearance. Some sealers may darken the color of the stone.

Impregnators penetrate stone, closing pores either completely or partially below the surface. Color and texture should not be affected. Daily vacuuming, washing and mopping can remove dirt.

Sealers from a slight build-up, closing stone pores at the surface. The sealer may level the surface slightly making regular maintenance somewhat easier. Some sealers create a matte (non-reflective) finish. Others may produce a satin gloss. Current industry thinking is that the stone should be allowed to “breathe”, to allow passage of moisture in order to prevent efflorescence or other staining. Do not apply sealers or impregnators for at least four weeks after installation in order to allow moisture to evaporate from the setting bed so that it may cure properly.

Refer to proceeding Section 7.0, “Stain Removal”, for stain removal instructions.

7.5 Execution Paint and Paint Stain Removal

7.5.1 Paint should be removed only by use of a commercial type “heavy liquid” pain stripper available from hardware stores and pain centers. Such strippers are normally hydroxide types, that is, they contain caustic soda or lye. DO NOT USE ACIDS OR FLAME TOOLS to strip paint from stone. Follow Manufacturer’s directions for use of these products, taking care to flush profusely with clean water after use. Use only wood or plastic scrapers and stiff fibre or jute brushes for removing the sludge and curdled paint.

7.5.2 Normally, latex and acrylic paints will not cause staining. Oil-based paints, linseed oil putty, and “Architectural Grade” caulks and sealants may cause oily stains. These stains should be attached as in 7.4 above.

7.5.3 When removing paint and paint stains from vertical stone surfaces, take care to protect unpainted stone from run-off. If oil-based paint is accidentally dripped or overrun, remove immediately with a clean cloth bearing acetone or mineral spirits to preclude oil staining. Latex paint drips should be whipped off immediately with a damp cloth and run-off into the stone. If possible, remove the sources of moisture to prevent further oxidation of the iron and or steel is embedded in stone little can be done to prevent a continuation of oxidation and resultant staining, except to cut off the moisture to supply to the metal. Superficial, fresh stains will usually come off with a vigorous scrubbing. Seated stains may be removed by the application of a “Naval Jelly” or other commercial “Rust Remover”, following manufacturer’s directions to use. If these remedies fall, often abrasion with a scouring powder followed by a second application of the commercial rust remover will remove the stain. Should this fail, apply a poultice for not more than ½ hour using either sodium hydrosulphite citrate solution. Unfortunately, deep-seated, rusty stains caused by prolonged neglect or from embedded metal (anchors, ties, etc.) may not be removable my any means.

7.6 Copper and bronze (cuprous and cupric) stains: These stains appear as green or muddybrown colorations and result from the action of moisture on nearby or embedded bronze, copper and brass items. Before applying stain removal, cure the cause. Clean attached or nearby metal items and coat them with a quick drying, clear coating such as varnish, shellac, or a plastic spray-on/ brush-on coating. If possible, remove sources of moisture to prevent further oxidation of the cuprous metal. When the source of stain is embedded anchor, tie or other device, the only remedy is to cut off the moisture at its source.

Coating would be impossible.

After eliminating the moisture or protectively sealing the material, attack the stain with this poultice, mix a thick paste the consistency of peanut butter, composed of kaolin of Fuller's earth, ammonia or sal ammonia (ammonium chloride((NH4Cl) (which can be purchased at most pharmacies). If sal ammonia and table salt mixed in equal quantities into the poultice base. Apply the poultice thickly over the entire stain, beyond the limits of the stain, and leave it until dry. Remove with a non-metallic spatula and rinse thoroughly. Cover with plastic and allow drying. Repeat if necessary.

7.6.1 Lead – Stains caused by leads will appear as yellow or orange colorations and may appear at a distance from the source. These is no use attacking the stain if the source cannot be removed, in as much as lead in virtually non-reactive to chemicals, and any lead salts that my form will be extremely difficult to reduce.

7.6.2 Inks are frequently formulated from some metallic salts and the stains caused by inks should be attacked with the same methods as recommended for iron stains. Non-metallic ink stains can frequently be removed using a poultice or white blotter soaked in wood or grain alcohol, followed by a flushing with household ammonia. Often, a bleaching poultice (see 7.2.1) will be needed to remove any remaining coloration.

7.7 Execution – Oil and Grease Stains

7.7.1 Oil, grease, linseed oil and perspiration stains normally must be dissolved chemically so the source of stain can be flushed or rinsed away. CAUTION: Acetone (di-menthly ketone) (CH3 2CO) is a widely available solvent that produces good results on most oils and greases. Mineral spirits and white (unleaded) gasoline can be used as substitutes for acetone. However, the use of flammable or explosive liquids in cleaning operations by inexperienced applicators should be avoided.

7.7.2 After removing as much of the source of the stain as possible, make a poultice, or saturate a white blotter with the solvent, and apply over the remaining stain, covering beyond the stain limits. Allow the solvent to dry, then remove the poultice, and rinse with water. Repeat if necessary.

7.7.3 Do not use solvents containing color agents or oils. Avoid these solvents, turpentine, leaded gasoline and kerosene. When water spotting has disappeared from complete drying, inspect for remaining soil. A second poultice application may be necessary. CAUTION: Do not use a poultice containing bleach on dark-colored stone.

7.8 Excelsior, leaves, bark, bird, droppings and foods may cause pinkish-brown stains in the presence of moisture. Outdoors, with the sources removed, normal sun and rain action generally bleach out the stains. Indoors, use hydrogen peroxide or chloride bleach soaked in a blotter or sponge, or mixed with kaolin of Fuller's earth as a poultice.

7.8.1 Tobacco stains are usually receptive to the same treatment described in 7.2.2 above.

7.8.2 Urine stains, if long-seated due to neglect, should be attached with strong chlorinebleach poultice. Areas around urinals and water closets should be lightly sprinkled with a chlorine-bleaching powder cleanser, dampened and left overnight periodically as a preventive measure.

7.8.3 Iodine stains will usually fade of their own accord with time. To hasten fading, apply a poultice of isopropyl (rubbing) alcohol (CH3) (2CH); methyl (wood) alcohol (CH3OH) or ethyl (grain) alcohol (C2H5OH).

7.8.4 Fire and smoke stains, caused by burning wood or paper, can be removed with a commercially available “Fireplace Cleaner” or by washing with a solution of caustic soda (sodium hydroxide) (NaOH).

Note: As caustic soda is very corrosive, extreme care must be taken to protect skin, eyes and clothing from burns. Rinse the area well with clean cool water after using either of these remedies.

7.9 Execution – Metallic stains

7.9.1 Metallic stains chemically required treatment with a reduction agent, i.e. an agent that will attack the metallic salts and reduce them to soluble, colorless salts that can be rinsed away or drawn out by poultices.

7.9.2 Iron (ferrous and ferric) stains

These generally appear as red-brown stains resembling rust and result from the action of moisture on adjacent or embedded iron of steel. Before attempting the removal of this stain, cure the cause. That is, clean and paint accessible ferrous items to prevent over splash housekeeping maintenance on a frequent basis. However, such large installations should be given periodic overall cleaning consistent with economy or as necessary to remove accumulated pollutants. The cleaning of multi-story installation should only be done by qualified contractors who have the craftsmen, equipment, resources and technical expertise to execute the cleaning work properly, as well as perform any repair, resetting or reporting that may be found necessary during the initial inspection. Consult the listings of MIA members to obtain the required services. Generally, the processes used in multi-story cleaning will be similar to normal procedures, except that pumps for wash and rinse water should be employed to economize on the amount of time required due to the inherent high costs of labor and support equipment necessary to the undertaking.

8. Specialty Finishes

8.1 Description

Specialty finishes are surface finishes other than “polished” or “honed” and often are provided as specialty treatments under specific trade names. Such treatments usually are patented or copyrighted products of the supplying contractor. Examples of such specialty finishes are polymer coatings, texturing treatments, and a variety of chemically-produced surface conditions.

8.2 Uses

Specialty finishes are provided to meet the requirements of service under which traditional polished, textured or honed finished prove inadequate, are subjected to unusual hazards, or do not satisfy the ever-broadening requirements of designers. Examples of the applications of specialty finishes are polymer coatings for liquordispensing and food service tops; or textured surfaces for special lighting effects, décor enhancement, graffiti resistance and maintenance reduction.

8.3 Normal Maintenance

Consult literature or instructions furnished by the supplying contractor for care and remedial measures pertinent to the specific specialty finish. (Always request for this information when the installation is first made)

9. Special Cleaning Procedures General Poultice Method

Note: Marble, limestone, travertine and onyx are calcareous stones, alkaline in nature. Acids such as those contained in milk, wine and beer, fruit juices and vinegar, will etch a polished finish. Strong alkaline, such as ammonia, will “burn” a polished finish. Most confuse the etch and “burn” marks with stains. The following procedures are given for the removal of staining. Contact a MIA Member regarding polishing of etched or “burned” surfaces.

Description

The “General Poultice Method” is a special cleaning procedure for the removal of deepseated, time-set dirt and grime. The poultice may be applied to honed; sand finished or polished stone and is particularly useful on intricate carvings, mouldings and other detailing difficult to scrub. The general poultice is essentially a strong cleaner, applied by way of a holding medium that concentrates its effort over a period.

Uses

The poultice is used primarily to attack and reduce heavy deposits of normal soiling, or to remove stains resulting from the action of moisture on normal soiling. For specific stains, i.e. stains whereof the origin is known see Section 7.0 “Stain Removal”.

Execution

Mix kaolin or Fuller’s earth with a common laundry bleach for a 6%. (for estimating purposes, figure a consumption rate of one pound of paste per square foot of surface). Moisten the surface of the stone with the same liquid which made the paste, wetting the stone beyond the extent of the stained areas. Apply the poultice paste to the stone with a wood or plastic spatula, insuring a uniform coat about ¼ inch thick. Cover the entire area to be cleaned and somewhat beyond, to prevent the soil from being forced into cleaned stone. Insure the poultice is in full contact with the stone, with no entrapped air pockets or voids. Tape plastic sheeting over the poultice is to prevent quick drying-out and allow it to act for 48 hours. After this standing period, dampen the poultice with clean, cool water to prevent undue dust generation. Remove the poultice with a wood or plastic spatula to avoid scratching. Rinse the cleaned area thoroughly with clean water, blot or wipe off excess water; allow the work bleaching agents to work on stains and dirt. On vertical surfaces, always work from bottom to top. Rinse thoroughly then wipe dry with cotton, cotton flannel, burlap or chamois skin. Wipe well to avoid steaks. If further cleaning is needed, make a paste to the consistency of syrup using a mildly abrasive alkaline cleaning powder and clean potable water. Apply the paste uniformly over the surface with a broad brush and allow standing until dry. Then use a medium bristle brush with additional water and scrub the surface vigorously. (Additional cleaning powder may be added at this point). Rinse thoroughly and dry as described above.

Maintenance Problems

Preventions & Cures: For honed stone used on furniture tops and the like, follow care practices as described in Paragraph 1.4 for polished stone.

Note that any flooring surface, regardless of how it is finished, is slippery when wet. Care should be taken to promptly remove liquids or foreign materials that might result in safety hazards before permitting pedestrian traffic.

Regular daily mopping of traffic surfaces should be done as described in Section 10, “Stone Floors”.

In areas where normal care and cleaning prove inadequate, see Section 7 “Stain Removal”.

10. Stone Floors

10.1 Description

"Stone Floors" broadly include any honed finish stone that is a terrific surface.

10.2 Use

The "Stone Floors" category includes treads floors and thresholds.

10.3 Normal Maintenance

Honed finish floors, treads and thresholds subjected to traffic, should be regularly mopped or scrubbed in a manner that will not leave a hazardous, slippery film. Stone surfaces should be first wetted with hot, clean water. Lightly sprinkle an abrasive cleaner (i.e. a chlorine-bleaching type household scouring cleaner. Do not use bleaches on dark-colored stone) over the wet stone, or put one to two handfuls into the pail of 2-3 gallons of hot clean water. Using a scrubbing motion, mop the stone surfaces with this solution (or with clean hot water if cleaner is sprinkled directly on the stone). Rinse thoroughly with clean hot water and dry with mop or cloths. Power scrubbers (RPM less than 375) can also be used for cleaning as described above.

10.4 Maintenance problems – preventions and cures

Generally follow guidelines presented in paragraph 9 above. See Section 7 "Stain Removal" for areas that do not respond satisfactory to normal housekeeping procedures.

10.5 Special Conditions and Procedures

Often it is desirable to protect special interior areas and to enhance the coloration of honed stoned in areas where a polished finish is not practical. In such cases, sealers may be applied after the stone has been cleaned to minimize maintenance and prevent staining around toilets and urinals and sealers should only be applied to clean interior stone. Follow the manufacturer's direction for application and subsequent maintenance.

In all cases, sealers should be a clear, hard-finish type suitable for traffic surfaces, and definitely "non-yellowing". Do not use soft-finish waxes, paste wax, or resins. These coatings collect dirt and grit. Some acrylic base, liquid floor "waxes" advertised as "nonyellowing" can be used in place of "permanent" sealers, but may give limited life.

11. Exterior Stone

11.1 “Exterior Stone” is a general term denoting a stone installed in a situation where temperature, moisture and air-borne contaminants are regulated primarily or solely by the forces of nature.

11.2 Uses

Exterior stone can be used in a honed, textured or a polished finish in discouraged for exterior applications due to susceptibility to damage by air-borne acids and wind-driven dust.

11.3 Normal Maintenance

In accessible areas, routinely follow maintenance procedures as specified in Section 12.3 for Polished Stone or Section 13.3 for Honed Stone, as applicable. The large expanse of stone traditionally found on exterior any mode in an exterior environment. However, the use of a polished finish marble or limestone is multi-storey installations generally will make it impractical or uneconomical to perform.

12. Stone Maintenance – Polished Interior Stone

12.1 Polished stone has a glossy surface that reflects light and emphasizes the color and marking of the material.

12.2 Uses

Polished interior stone has traditionally appeared as wall veneer. It is also seen in the form of furniture and desktops, counter and lavatory tops, tables and other items of designer quality, as well as tiles for commercial and residential installation.

12.3 Normal Maintenance

Normal “Housekeeping” maintenance involves only periodic washing with clean, potable water and neutral (pH-7) cleaners. “Soap less” cleaners are preferred because they minimize streaking and filming. However, mild phosphate-free, biodegradable liquid dish-soaps, soak flakes or powders, which contain no aromatics, are acceptable if rinsing is thorough. Stone surfaces should be first wetted with clean, hot (not boiling) water. Then, using the cleaner solution (following manufacturer’s directions), wash in small overlapping sweeps, from bottom-up if a vertical surface. Rinse thoroughly with clean, potable water to remove all traces of soap or cleaner solution. Change the water in the rinse pail frequently. Dry with soft cloth or cotton-flannel and allow to thoroughly airdrying. Chamois skin may be used in lieu of cotton cloth in this process. Note that any flooring surface, regardless of how it is finished, is slippery when wet. Care should be

taken to promptly remove liquids or foreign materials that might result in safety hazards before permitting pedestrian traffic.

12.4 Maintenance Problems – Prevention and Cures

Generally, prevention will save a great deal of time spent on cures and remedies, especially since damages to stone are often irreparable.
Polished stone should receive the same care and consideration that is given a fine wood finish. Spills of any type should be immediately removed and water-rinsed. Coasters should be placed under all glasses, particularly those containing liquors or citrus juice. Hot plates should be used under heated dishes. In addition, place mats or felt bottom should be placed under china, ceramics, silver and bric-a-brac to prevent scratching of polished finishes.

See Section 7 “Stain Removal”, for cases where nominal care and cleaning procedures have not been followed.

13. Honed Interior Stone

13.1 Description

A honed finish is a satin smooth surface with relatively little light reflection.

13.2 Uses

Generally, a honed finish is preferred for floors, treads, thresholds and other pedestrian traffic locations where heavy traffic would wear off a polished finish.
As a rule, honed finishes are more susceptible to soiling than polished finishes, because a honed surface is slightly more porous and absorptive than polished finish. However, the honed finish is easier to restore because it will sustain harsher cleaning efforts.

13.3 Normal Maintenance

Normal “Housekeeping” maintenance of a honed finish involves as-needed washing with clean, potable water and neutral (pH-7), mildly abrasive cleaners. Commercially available, “Soft-scrub” or other thick liquid cleaners and chloride-bleach type scouring powders are ideal for this purpose. Simply mix in clean water according to manufacturer’s directions.

CAUTION: Bleach should not be used on dark colored stones because it may lighten their color.

Surfaces should be first wetted with hot, clean water. Then using, a mildly abrasive, alkaline cleaner and a medium bristle brush, wash in overlapping swirl.

Table

Siliceous Stones	Calcareous Stones
Quartz-based stones (Sandstone, quartzite, brownstone, bluestone, greenstone)	Marble Travertine Limestone
Slate Serpentine	Hard limestone Onyx

Suggestions

Plan a regular maintenance program whether it is performed on a daily, weekly or even yearly basis.
For example, some of the damage ascribed to “acid rain” done to building exteriors, statuary and monumental stone might have been prevented by the simple expedient of washing once yearly. Any attempt to maintain, re-polish, renovate or restore stone must begin with the most gently treatment to remedy the problem. First, try washing the surface with water. Next, wash with a neutral detergent (pH7) and rinse with clean water. Continue in this manner until the gentlest, most effective treatment has been found.

How to Identify Stone

Correct identification of the type of stone to be cleaned, refinished, renovated or restored is a most important first step in the process. Some stones may accept certain procedures while others may react disastrously. Here are a few suggestions that can be used to identify dimension stone correctly.

Stone Color and Appearance

These are the first clues. A long with color, metallic deposits in the stone may be visible which will distinguish it as a certain type.
Quartz-based stones vary widely in color due to different materials and clays contained in the stones.

These stones can be light gray to yellow to green as well as red in color. A dark, reddish brown “sandstone”)also known as brownstone) was widely used in the construction of buildings in the northeastern United States and Canada in the early 1900’s because it was locally available and plentiful.

Granite and marble are quarried throughout the world in almost every color of the rainbow. The colors result from the minerals, which are found in the stones. Marble normally shows “veins” or high concentrations of minerals in varying patterns. Minerals in granite will typically appear as small flecks distributed throughout the stone, often creating what is best described as “salt and pepper” look.

Limestone is widely used building stone in North America because it is readily available. Much domestic limestone is gray and corrosive. Protective body covering is necessary when acid is used to buff in color while some pastel shade of yellow and pink are also available. Imported limestone can be found in light beige to brown colors. A distinguish characteristic of many is the presence of fossils that are frequently visible in the stone.

Slate is normally dark green, black, gray or dark red and is uniform in color although some veined varieties from overseas have recently been introduced. State is most commonly used as a flooring material. It can normally be recognized by a distinct cleft pattern.

Stone Competition

Natural stone can be classified into two general categories according to its composition: siliceous stone and calcerous stone. Knowing the category is important when selection of cleaning and restoration products is made.

Siliceous Stone is composed mainly of silica or quartz-like particles. It tends to be very durable and relatively easy to clean with milk acidic solutions.

Calcerous Stone is composed mainly of calcium carbonates. It is sensitive to acidic cleaning compounds and frequently needs different cleaning procedures than siliceous stone.

A simple acid sensitivity test can be made to find out whether the stone is siliceous or calcareous. To the test, a small amount (4 oz.) of muriatic acid and an eyedropper are needed. Select an inconspicuous area several inches away from any mortain joints and apply a few drops of the acid unto the stone surface. CAUTION: Acid with calcareous stones, the acid droplets will begin to effervesce, or “fizz” vigorously. If little or no reaction occurs, the stone can be considered siliceous.

This test may not be effective where surface sealers and polishes have been applied. If a sealer or polish is suspected present, chip away a small piece of stone and apply the acid to the uncovered surface.

Weathering and soiling patterns can also indicate the type of stone. Limestone’s and marbles often show a definite “wash” pattern that is caused by the reaction of the calcareous stones to higher levels of exposure to rain and other surface waters. Stone elements which protrude from the façade or are suited immediately below gutters will often look “cleaner” compared to adjacent stone because they are exposed to much higher levels of water and related abrasion. Conversely, siliceous materials such as quartz-based stone and granite will frequently appear “dirtier” in those areas of the façade exposed to higher amounts of water.

Stone Finishes

The type of finished surface that is, or was, on the stone should also be considered when prescribing maintenance procedures. Polished stone, such as marble and limestone and travertine, is highly sensitive to acidic cleaning solutions and should be cleaned using procedures different from those used on unpolished stone. Sculpted and other carved stone is frequently more porous than flat stone, making their surfaces more susceptible to weathering. In addition, carved or heavily textured stone will have considerable more surface area.

While knowing what kind of stone to be worked on is an important step, it is not a guarantee. Environmental effects, usage as well as repairs and previous maintenance make each project unique. Suggested procedures should be tested in small sample areas before starting large-scale operations to ensure capability between the stone and products selected for use.

1. All flooring surfaces become slippery when wet. Not just hard-finish floor surfaces, such as vinyl, wood, ceramic tile, terrazzo and stone, but even shag carpeting. Accordingly, it is simple courtesy as well as prudent management to reduce the hazards caused by wet flooring surfaces as well as to remind preoccupied public building patrons of the unavoidably increased hazards they face which are caused by bad weather.

2. Standard instructions should be written, given to building maintenance personnel and prominently posted at all janitorial workstations.

   Here is a suggested guideline, which, while no means is guaranteed to be complete, suggests a beginning to such instructions.

Special Bad Weather Maintenance Instructions

When the outside weather turns wet, or when ice or snow starts to stay on ground, janitors and building maintenance personnel shall:

a) spread runners from each outside door into lobbies and corridors, to help dry shoe soles;
b) Place bright-colored, ‘slippery when wet’ pylons on walking surfaces where people using the building are likely to see then;
c) Mop or shovel walking surfaces as often as necessary to remove standing water, ice or snow.

3. The owner, with the help of safety experts, should examine the building, the surrounding area and the other factors already discussed to determine if any additional instructions are needed for janitors, other maintenance personnel, tenants or the general public.

4. Naturally, local building and safety codes should be studied and followed. However, there is no “magic” answer that produces absolutely “safe”

Some experts measure the slipperiness of floor surfaces by mathematical calculation called the “coefficient of friction”. Rough floor surfaces such as thermal finish granite or abrasive finish marble or limestone, have higher “coefficients of friction” than smooth surfaces and so are supposed to be “safer”. But, while the slip resistance qualities are improved, uneven walking surfaces can create entirely new hazards.

Many floor surface treatments are advertised as “slip resistant”. However, their application can change surface appearance and characteristics, potentially harming the walker in some as yet unforeseen manner.

5. The point in all this that the maintenance of floors for durability, beauty and safety requires common sense, periodic review and expert consultation. Experience shows that the overwhelming number of floor maintenance and safety problems arise from factors which everybody realizes could have been avoided with forethought, common sense and regular attention-after the problem occurred.

Regular and serious thoughts should be devoted to safety and maintenance. Advice of experts should be sought. Most problems can be avoided this way, all to the building owner’s peace of mind and financial benefit.

Chemical Compatibility

When an owner becomes dissatisfied with the performance of a surface treatment or impregnator used on stone floors, the reaction is to throw out the old and immediately apply a new treatment. But, it is not so logical when you realize chemicals in the new product may be incompatible to those in the old. This fact is well-known by those who maintain vinyl floors and is the reason why manufacturers make a “family of products”. The polish is compatible with the sealer; the stripper is compatible with the polish’ the sealer is compatible with the stripper, etc. Products to be used on stone floors should have similar compatibility.

Damage for Moisture

Water is a remarkable liquid. It refreshes us. It grows the goods we eat. It provides a surface for low cost transportation on which goods may be moved to the marketplace. But, in consideration, if it occurs in the wrong place, it can be destructive.

Water, penetrating exterior wall cavities through defective flashing or unsealed joints, can cause efflorescence on masonry. In the form of condensation in cavity walls, water prevented from reaching the atmosphere by blocked weeps can dislodge masonry in freeze-thaw climate.

Moisture coming through a floor slab seeks the quickest and easiest possible pathway to evaporate into the atmosphere. Often the veining or micro cracks in the structure of some stone provide that path. The moisture carries all the salts from the earth, the slab and the stone, which happen to dissolve on its way, and deposits them in form of crusts, or “blisters” on the surface of the stone as it evaporates. The appearance is that “faulty” stone was supplied.

A simple isolation membrane may have prevented virtually all moisture from reaching the stone, thus preventing the problem.

6. Maintenance Commentary

Definition of Terms

a) Maintenance – scheduled cleaning, specific procedures and inspections performed on a daily, weekly or other regular basis to keep the stone in proper condition.

b) Refinishing – re-polishing of dull, once-polished marble, limestone or granite floors and walls. Refinishing of traffic patterns, for example.

c) Renovation – cleaning and re-polishing of neglected dimension stone surfaces.

d) Restoration – large scale remedial actions taken to restore a structure or area to its original or acceptable “near original” condition. Generally applies to historic structures; may require replacement of dimension stone units as well as thorough maintenance refinishing and renovation.

Why Refinishing of Marble Floors Became Necessary

There has been an unprecedented demand for dimension stone in the last decade. The industry has never experienced when the Roman Emperor Augustus boasted he had taken a city of bricks and turned it into a city of marble and thus established the glory of Imperial Rome. The dimension stone industry was ready to serve the demand. Improved cutting, fabrication and polishing techniques had been developed. Stone could be cut faster and thinner, and finished more accurately than ever before. Stone tiles become widely available. For the first time ever, an owner or designer could make a selection from available hard-finish materials, which include polished marble, granite and limestone.

Until the late 1970's the standard commercial floor was a honed finish marble. Because of their convenient sizes (12"x12"x3/8", etc.) designers began to put polished finish marble and hard limestone tiles on commercial floors. Almost immediately owners began to complain about dulllooking traffic patterns in an otherwise shiny floor.

(Unless there is an extremely large volume of foot traffic, polished granite generally experiences little loss of gloss.)

Immediately, a new industry sprang into being. Floor refinishing. Refinishers use a number of different methods ranging from the traditional grinding (to produce a honed finish), to the newer use of chemical impregnators and surface treatments assisted with various regrinding methods employing steel wool or industrial diamond faced pads as well as the application of various "secret" compounds.

As this is being written in the spring of 1891, it is with knowledge the MIA has founded, initially, a limited study of the effects of several different proprietary maintenance and refinishing methods, plus the traditional regrinding method, on several of the most popular marbles and lime stones. The study will be conducted at an independent test laboratory.

It should be noted here how marble is polished. Marble (along with hard limestone and travertine) is a calcitic stone, alkaline in nature. At the mill or shop, a progressively smoother, honed finish is
created as the stone proceeds along the marble's honed, satin-smooth non-reflective surface. The polishing wheel is lowered and starts to rotate putting pressure on the stone. The friction produces heat, which in turn causes a chemical reaction between the stone and the compounds, which creates the glossy finish.

Slip-Resistance of Dimension Stone Surfaces

Although this Manual cannot be a comprehensive safety or maintenance guide, it is recommended that the following information be distributed to owners of commercial or other public-access buildings or structures in which dimension stone is installed.

The produces, sales agent, distributor or installing contractor of the dimension stone furnished, although committed to supplying a top quality product, cannot be comprehensive advisors on its safe installation, design, intended use and many others beyond the control and scope of the stone representative.

Owners of buildings in which dimension stone floors are installed should consult qualified safety engineers, architects and other qualified persons to evaluate safety and maintenance in the public use of buildings upon the specific location, climate, installation, design, intended use and may others beyond the control scope of the stone representative.

Owners of buildings in which dimension stone floors are installed should consult qualified safety engineers, architects and other qualified persons to evaluate safety and maintenance requirements for the specific use intended, which neither the stone producer, sales agent, distributor, installing contractor nor the MIA can warrant or guarantee.

With the careful planning and maintenance beautiful stone flooring can be safely used and enjoyed for many years as an integral component of well-designed, aesthetically appealing buildings.

That being said, the following are a few common sense precautions, which while in no manner intended as complete safety or maintenance instructions, will help avoid some of the more obvious problems.

GENERAL MAINTENANCE – SHOPFRONTS AND CANOPIES
Maintenance Manual for Stainless Steel Panels

A. And Aluminum Panels

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1. The maintenance methods for the two types of surfaces

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The Maintenance Methods for the two types of surfaces

A. The maintenance methods for stainless steel surfaces

i. The Causes of Corrosion

Stainless steel has high resistance against rust, but it can be rusted. Various ambient conditions may make stainless steel polluted or rusted.

Stainless steel has high resistance against corrosion and rust because it contains chromium, which can oxidize with the oxygen in the air to form a thin protective layer on the surface. Such layer can protect stainless steel against further oxidation (i.e. rusting) and corrosion caused by various types of corrosive factors. However, if such thin layer is damaged by a certain type of corrosive factor and such damage occurs at a place where chromium does not have direct contact with oxygen, stainless steel will be rusted.

However, if such corrosive factor is eliminated and chromium is allowed to oxidize with the oxygen in the air, an antioxidant layer will be formed and stainless will regain its high resistance against corrosion.

These are many corrosive factors that can make stainless steel polluted and rusted. The main factors are the fine airborne iron particles and various types of gasses in the air and the salt particles contained in the sea breezes. These particles or gases may attach to or accumulate on the surfaces of a stainless steel object.

In light of the aforesaid, we can see that stainless steel may become rusted. If we adopt the following maintenance methods, the nice appearance of a stainless steel object may be kept.

ii. Factors of Pollution and Rust

a) Sands, dusts or fine iron particles from a nearby road or building which is under construction or from the nearby automobiles may attach to the surface of a stainless steel object.

b) The surface of a stainless steel object may be polluted by the harmful chemicals such as sulphite contained in the exhaust discharged from automobiles or buses.

c) The surface of a stainless steel object may be polluted by the dusts and corrosive factors sent out from factories, garbage incinerators or air conditioners.

d) The surface of a stainless steel object may be polluted by the corrosive gases generated from a hot spring.

e) The salt particles contained in the sea breezes may attach to the surface of a stainless steel object

f) A small amount of one of the chemicals used for the cleaning or disinfecting purpose may attach to the surface of a stainless steel object.

g) The surface of a stainless steel object may be polluted by fingerprints or the dirt/grease on human hands.

h) The surface of a stainless steel object may be polluted by a surface protective coating.

iii. Maintenance Methods

a) If a rust is caused by iron particles or other types of metallic particles:

If rust is caused by iron particles and such is mild, we can use a piece of sponge or cloth with chemically neutral cleaning agent or soupy water to wipe off the rust.

b) If rust is caused by corrosive factors in the air

The surface of a stainless steel object is easily polluted by the corrosive factors sent out from a factory or automobiles; sometimes, rust in the form of small spots may occur on the surface. Most of such rust is caused by the corrosive factors contained in the exhaust discharged from automobiles, air conditioners and factors.

c) If rust is caused by the salt particles

Even SUS #316 stainless steel becomes rusted in a short period if it is positioned at a place near a coast. In addition, such rust occurs than the one caused by other factor. The maintenance method described in “1” may be used.

d) If rust is caused by one of cleaning chemicals used

We can use chemically neutral cleaning agent to clean the rust. If the rest cannot be cleaned by such agent, we may use a cleaning chemical to clean it.

e) If the surface of a stainless steel object is polluted by fingerprints or dirt on human hands

We can use a piece of sponge or cloth with chemically neutral cleaning agent or alcohol to wipe off. Afterwards, the affected area should be rinsed off thoroughly with clean water.

iv. Matters that we should be aware of

a) There are various types of causes of pollution and rust for stainless steel, so an appropriate maintenance method should be used.

b) When we use a cleaning chemical to clean off pollution or rust, we should first try such chemical on a small spot to see whether a satisfactory result may be achieved. If yes, such chemical may be used for a large-scale cleaning. When we clean up a spot of pollution or rust, we should also clean up all the area near such spot.

c) After we use a cleaning chemical for such cleaning, it is imperative that we rinse the affected area with clean water so that no amount of the chemical will remain on the surface. In addition, we should wear a pair of rubber gloves when doing the cleaning since such chemical may be harmful to the skin of our hands.

d) When we use a piece of cloth or scrubber or Nylon-made sponge or a brush to clean the surface, we should move it along the grains formed on the surface to avoid damaging the surface.

Though steel-made cleaning tools, such as steel brush or sandpaper may be used to clean serious pollutions or rust, their use on the surface of stainless steel should be strictly prohibited in any regular cleaning because they will harm the surface and such harm may then cause the accumulation of iron particles on the affected area (hence causing such area to rust) (not applicable to no. SUS #316 surface).

B. The maintenance methods for PVDC coating surfaces

PVDF coating can protect a surface for a long period. However, if such surface is not maintained, dusts and pollutants in the air and corrosive factors may speed up the deterioration of the coating and the corrosion of the base material. The following maintenance methods are recommended so as to ensure the nice appearance and to protect the base material.

i. Main factors of pollution

a) The pollution, corrosion and wear caused by salt particles, sands in the winds and dusts

b) The pollution and corrosion caused by fumes and metallic particles sent out from factories

c) The pollution and corrosion caused by the waste gases discharged in a city or fine iron particles sent out from a railway

d) The pollution and corrosion caused by acid rain

ii. Cleaning methods

a) If the pollution is mild, we can use chemically neutral cleaning agent (after being diluted) to wipe off and then use clean water to rinse it off.

b) If the pollution is serious, we can dip a piece of sponge or cloth in an organic solvent (containing alcohol) for a short period and then wipe it off with the sponge or cloth

iii. Frequencies of cleaning

a) If a building is located in an industrial area near a sea, such cleaning should be done twice or three times a year

b) If a building is near factories or a sea, such cleaning should be done once or twice a year

How to use automatic sliding doors and pull doors

A. Automatic sliding doors

i. How to use automatic sliding doors

Automatic sliding doors are easy to use. When a person is within the detection area of a door, it will open automatically. After the person is no longer in such area, the door will close automatically.

ii) Matters that we should be aware of

- The voltage should be maintained at a stable level
- No object should be present under the sensor
- The tracks should be maintained in an unblocked condition at all times
- Periodic maintenance should be carried out
- We should watch for the safety of children when such door opens or closes

B. Pull doors

i. How to use pull doors

- Such doors have a door closer. When we need to open it, we just have to push it in the clockwise or counter-clockwise direction. After such door is opened, it will return to its closure condition automatically.

- If we want the door to remain at an open condition, we only have to move it to 90degrees and its hinge will not return the door to a closure condition at this angle.

- When a two-door unit needs to be locked, we first insert the upper and lower pins of one of these doors into the corresponding holes and then we can lock them up.

ii. Matters that we should be aware of

- When we open or close a pull door, we should pay attention to any persons near the door.

- When a pull door moves in a direction and has not come to a full stop, we should avoid pushing it in an opposite direction.

- The door closer is a hydraulic device and the time such hinge takes to return or close the corresponding door may be adjusted. If the time is shortened, more force will be needed to open the corresponding door.

3. CONCLUSIONS AND RECOMMENDATIONS

Common sense cleaning rules

a) Match cleaner to finish

Steel wool, strong acids, strong alkali's and abrasive cleaners should never be applied indiscriminately; though in their place strong cleaners, used correctly, are highly effective.

b) Make a spot test to be sure

The few moments spent testing a cleaning agent and procedure on an unobtrusive portion of the surface finish is good insurance against a poor reaction between the cleaning agent and surface finish.

Always use the same concentration and technique planned for the entire job. Ensure the agent is thoroughly rinsed off and inspect the area for stains and possible surface reactions.

It is recommended to test lacquered and painted finishes for softening and possible dissolution at the same time.

c) Watch cleaning frequency

Where optimum appearance is desired and frequent cleaning is necessary, use mild cleaners.

Abrasive cleaners can often wear away the hardest finishes.

d) Follow the manufacturer's recommendation

Cleaners should not be applied indiscriminately. Varying concentrations and temperatures, or extending the time to which the finish is exposed to the cleaning agent, all in an effort to speed up the cleaning process, may produce disastrous results.

e) Do not mix cleaning agents

It is not recommended that cleaning agents be mixed to make new formulas of a agent, as the resultant mixture may be harmful to the finishes and hazardous to the user's health.

f) Avoid drips and splashes

Cleaning agents harmless to some materials may damage other materials upon contact. Therefore, always rinse down areas thoroughly after cleaning, removing run-downs as quickly as possible.

g) Do not vary cleaner concentration

In most instances, increasing or decreasing cleaner concentration from that recommended by the manufacturer leads to highly unsatisfactory results.

h) Avoid extreme temperatures

Heat accelerates chemical reactions. Therefore, cleaners exposed to extreme temperatures during application may become over-active, or its solvent may evaporate before the job is done.

In either event, the metal may be streaked or stained.

On the other hand, cleaning should not be carried in very low temperatures as low temperatures reduce chemical activity, possibly stopping the action of the cleaning agent entirely.

For the best cleaning results, outdoor cleaning should be conducted on mild cloudy days, or in the shade.

i) Watch the clock

Cleaner product contact time should not be estimated, but carefully timed. Therefore, the manufacturer's directions should always be closely followed and prolonged contact avoided.

j) Remove all cleaning agents thoroughly

Water-based cleaners should be rinsed with clean water, after which the part or area is permitted to dry or is wiped dry.

Cleaners containing wax, oil or silicones should be removed with a dry, soft fibre cloth. Traces of cleaner should not be left in cracks or corners.

k) Clean each side of glass using a different application stroke

When cleaning glass, it is prudent to clean one side of the glass using an up and down motion and the other in a left to right motion. That way should further cleaning be necessary, the direction of the marks will determine which side of the glass needs more work.

RECOMMENDED CLEANING AND MAINTENANCE FORMS AND REPORTS

In order to minimize the misuse of cleaning agents and monitor their effectiveness during the cleaning and maintenance process, the following reports forms have been generated to document:

- The compatibility of proposed cleaning agents and specialist materials
- The frequency and effectiveness of scheduled maintenance and cleaning

The forms are:

- Review Form for Proposed Cleaning Agents
- Cleaning & Maintenance Report

These can be found in Appendix A.

MAINTENANCE PROCEDURES

Inspection and Preventative Maintenance

Preventative methods of maintenance, including scheduled inspections, programmed replacement and regular cleaning are all-important parts of maintenance strategy.

It is recommended that the cleaning of materials exposed to the outside elements should be at monthly intervals. As explained early, any build up of dirt or soil containing pollutants, may result in a concentration of corrosive reaction.

It is recommended that inspections of all installed materials be made at 6 monthly intervals to check for any sings of damages, corrosion on the materials.

Suitable remedial or replacement work should be made to any blemished items

It should be noted that the procedures suggested should only be used as a guide and do not absolve the Maintenance Crews/ Contractors from their obligations, as it is of equal importance that they Maintenance Crews/ Contractors carry out their own research, prior to commencing maintenance works.

LIST OF MAIN COMPONENTS

The following list indicates where main materials used within the Contract Works were sourced.

Material	Product	Manufacturer	Contact
Anodized Panels	4mm thick Natural Anodized Aluminum Panel		
Anodized Aluminum Extrusions	Anodized Extruded Profiles		
GMS Support Steel & Brackets	Steel fabrication		
Atrium Steel Structure	Steel supplier		
Atrium Steel Structure	Steel fabrication		
Glass	Insulated glass		
Revolving Door	Door set		
Sealants	Sealants		
Stone	Granite		

LIFE EXPECTANCY SCHEDULE

The following schedule has been formulated in line with the recommendations listed within BS 7543: 1992 “Durability of Buildings and Building Elements, Products and Components” and BS 8210: 1986 “Building Maintenance Management”.

The expected Design Life of the whole works is listed as a minimum of fifty years, placing it within Maintenance Category Four “Normal Life”. The Glass Entrance Box’s components can be categorized as Two “Maintainable”, which means they will last with periodic treatment for the life of the works.

The level of maintenance can be categorized as Level 2 “Scheduled Maintenance Plus Repair”. Whereby maintenance work should be carried out to a predetermined schedule to maximize component life spans. The effects of failure of any one of the components can be listed as Category H “No exceptional problems”. As with each section of works, replacement will not interrupt the buildings’ use, compromise security, endanger health or be costly to repair.

Table: LIFE EXPECTANCY SCHEDULE

Material / Component	Action causing Deterioration	Effect of Deterioration	* Service Life (Years)	Design Life (Years)
GMS anchors, bolts, plates and inserts	CO2 emissions cause Carbonation concrete, rain causes corrosion	Cast-ins corrode and can cause spalling of concrete	50 – 60	60+
Mild steel support frame and trusses	Exposure to gasses and moisture cause oxidization, commonly known as rust	Unsightly rust staining, stress cracking in weld and connections	50 – 60	60+
Anti-corrosion coating to MS Frame and Trusses	High temperatures, ultra-violet light and chemical attack. Stress corrosion.	Blistering and detachment of coating causing rusting of the exposed steel	15 – 20	25
Stainless steel spiders, planars, fins and fixings	Bimetallic corrosion, acids and salts in solution	Unsightly rust staining, stress cracking	50 – 60	60+
Laminated tempered glass, heat soak tested	High temperatures, ultra-violet light and chemical attack	Delamination , discoloration of inter-layer	25 – 30	30+
Insulated glass, Heat strengthened	High temperatures, ultra-violet light and chemical attack	Remote chance of spontaneous breakage due to nickel sulphite inclusions	25 – 30	30+
Silicon sealant	Movements, solar radiation temperature changes, atmospheric attack	Sealant cracks or detached	10 -15	20
Galvanized mild steel Support steel	Oxidation causing corrosion of the structural members	Unsightly rust, eventual structural failure	50 – 60	60+
Anodized aluminum panels	High temperatures, ultra-violet light and chemical attack	Blistering and detachment of coating, oxidization of aluminum	15 – 20	30
Grade S316 stainless steel	Bimetallic corrosion, acids and salts in solution	Unsightly rust staining	50 – 60	60+

Electric door motors	Poor maintenance, dam, dirt build-up	Burn-out / fusing	25 – 30	50
Control sensors and switches	Bimetallic corrosion across points	Burn-out, arcing across points	5 – 10	10
Note: *Experience has shown that service life can be as short as the ranges indicated. However, Good Maintenance Procedures will help extend a product's				