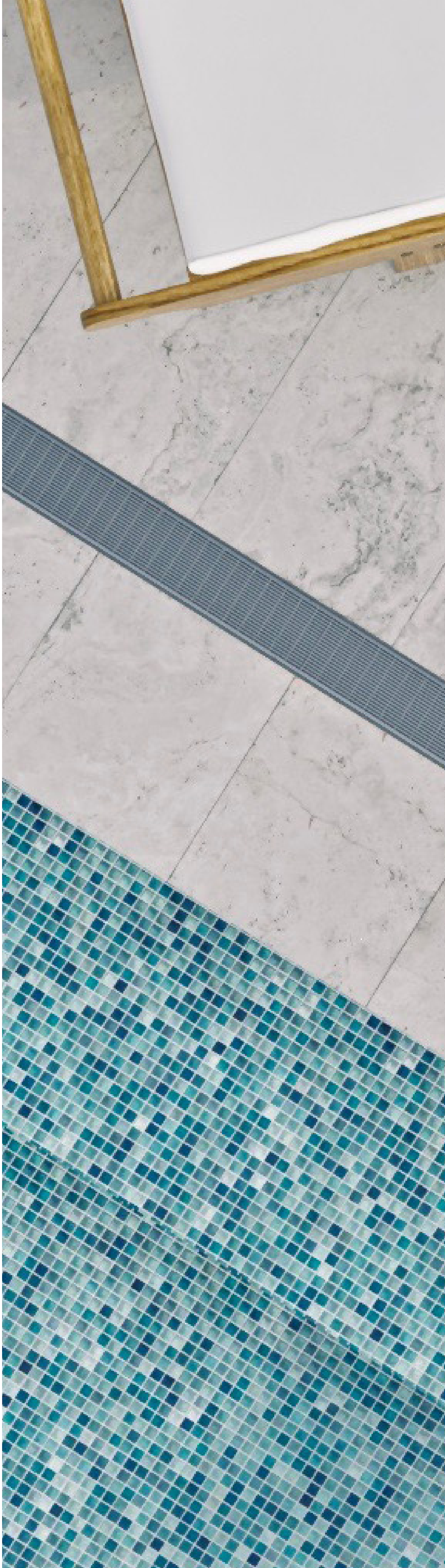
Preventing Corrosion in Construction

Strategies for Material Compatibility and Maintenance

Stormtech

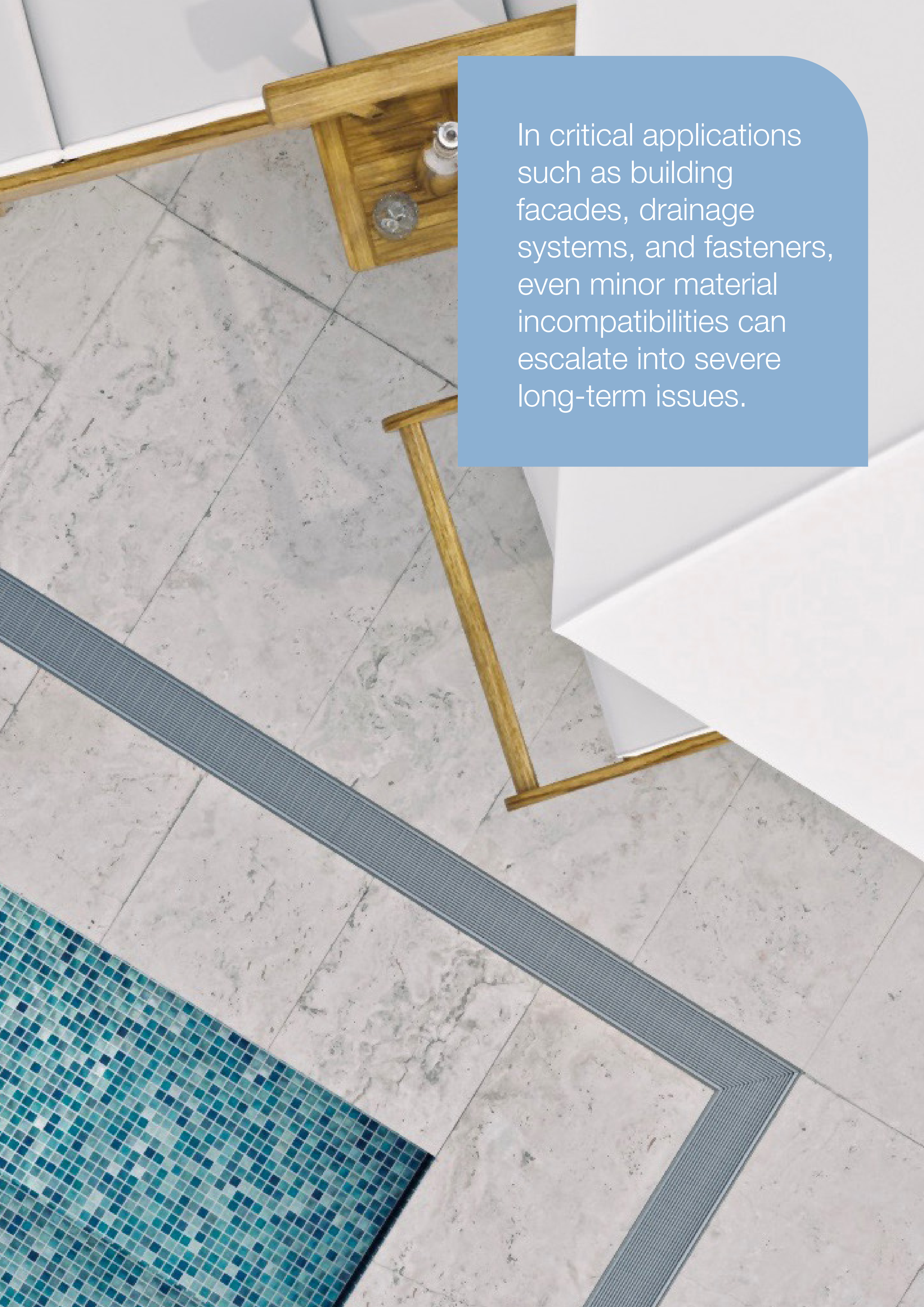


INTRODUCTION

In the built environment, the durability of structures hinges on thoughtful material selection and the implementation of sound design principles. While architects, engineers, and building designers often possess a practical understanding of material compatibility, this knowledge can become fragmented as projects progress from design to construction. As a result, incompatible materials may be used, or maintenance practices adopted by end users may inadvertently compromise the integrity of a structure. These mistakes can significantly impact the long-term performance of buildings and lead to costly remediation efforts.

Corrosion, a pervasive issue in construction, exemplifies the risks of overlooking material compatibility. Defined as the chemical degradation of materials, corrosion manifests in various forms, such as rust and staining, and can be influenced by environmental factors, material pairings, and chemical exposure. According to the Australasian Corrosion Association, corrosion costs the Australian economy an estimated $78 billion annually—a financial burden that is largely preventable.[1]

This paper examines the common causes of corrosion within the context of architecture and construction, emphasising the critical role of material compatibility in mitigating these challenges. It explores how strategic design decisions can minimise corrosion risks and underscores the value of proactive maintenance to extend the life cycle of materials.



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WHAT IS CORROSION?

Corrosion is the gradual degradation of a material's properties resulting from its interaction with the surrounding environment. While commonly associated with metals, this phenomenon affects nearly all material types, making it an inevitable challenge in the built environment. Corrosion compromises not only the structural integrity but also the aesthetic and functional properties of materials.

The most prevalent form of corrosion is electrochemical oxidation, a process that occurs when a material reacts with an oxidant such as oxygen, hydrogen, or hydroxide. In metallic materials, this reaction often leads to the formation of oxides or salts derived from the original metal. A familiar example is rust, which produces red-orange iron oxides, visibly altering the material's surface and signaling its structural degradation.

COMMON TYPES OF CORROSION

The type of corrosion that develops on a metal surface depends on the exposure environment and the physical and chemical properties of the material. Understanding these common forms of corrosion is essential for designing durable structures and selecting appropriate materials:

- **Uniform corrosion** is characterised by a consistent attack across the entire surface of the metal exposed to a corroding agent.
- **Galvanic corrosion** occurs when two dissimilar metals come into direct or indirect contact in the presence of an electrolyte. The more reactive metal corrodes, while the less reactive metal remains protected.
- **Crevice corrosion** is a localised and highly penetrative form of corrosion that develops in confined spaces or crevices, such as joints or under deposits on a metal surface.
- **Pitting corrosion** manifests as small, concentrated holes or cavities on a metal's surface. These pits can penetrate deeply while leaving the surrounding metal unaffected, making this form of corrosion particularly insidious and difficult to detect.
- **Atmospheric corrosion** arises from the exposure of metals to natural environmental elements, including oxygen, water vapor, and pollutants. This form of corrosion is often seen as surface discolouration or degradation and is driven by chemical or electrochemical reactions with atmospheric components.
- **Erosion corrosion** occurs when a metal surface is subjected to the mechanical action of a flowing fluid. This mechanical wear accelerates chemical reactions, leading to the rapid degradation of the material.

CAUSES OF CORROSION

Corrosion is influenced by a range of factors that can be broadly categorised into material compatibility, environmental conditions, maintenance practices, design considerations, and inadequate protective measures. Understanding these causes is crucial to preventing material degradation and ensuring long-term durability.

- **Material incompatibility:** Combining materials with differing electrochemical properties can lead to galvanic corrosion, where the more reactive metal corrodes in the presence of an electrolyte. Similarly, incompatible coatings or finishes can exacerbate degradation.
- **Environmental factors:** Environmental factors such as moisture, salt, and pollutants play a significant role in accelerating corrosion. Specific conditions, like saline coastal areas, pool environments, or corrosive soils, exacerbate degradation through chemical reactions and localised damage.[2] Additionally, temperature fluctuations can weaken protective layers, further exposing materials to corrosive elements.
- **Improper maintenance:** Neglecting regular cleaning or allowing debris accumulation can trap moisture, creating a conducive environment for corrosion. Additionally, using incorrect cleaning agents or abrasive methods can damage protective layers, as seen when metals like aluminium, copper, or iron react with alkaline solutions such as drain cleaners.
- **Building design:** Design features that trap water or debris, such as crevices and joints, create areas highly susceptible to corrosion. Insufficient drainage or ventilation further exacerbates exposure to moisture. Ineffective waterproofing, especially in bathrooms, or inadequate priming can lead to accelerated degradation.
- **Inadequate protective coatings:** Failing to apply or maintain protective coatings leaves materials exposed to environmental elements. Over time, coatings may degrade if not reapplied. Additionally, contaminants such as dirt, grease, or oil left on surfaces during manufacturing or assembly can interfere with the effectiveness of these coatings.

UNDERSTANDING MATERIAL COMPATIBILITY

Material compatibility is the ability of different materials within a system or structure to coexist without triggering or accelerating corrosion. Ensuring compatibility prevents undesirable chemical, electrochemical, or environmental reactions that can degrade materials and compromise their performance. This principle is especially crucial in environments where moisture, chemicals, or temperature fluctuations are present, as these conditions can intensify corrosive processes.

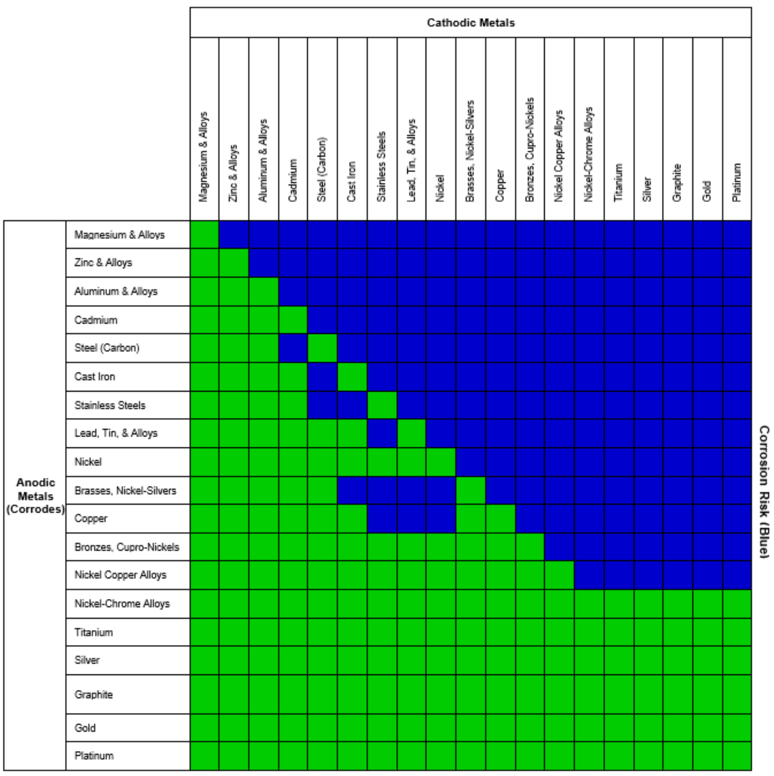
Properly matching materials is essential for maintaining structural durability, reducing maintenance needs, and extending the system's lifespan. In critical applications such as building facades, drainage systems, and fasteners, even minor material incompatibilities can escalate into severe long-term issues. By prioritising material compatibility during the design and construction phases, professionals can create systems that perform reliably and sustainably over time.

A material compatibility chart is a reference tool used to determine how different materials interact when combined in a system or exposed to specific environmental conditions. There are a variety of material compatibility charts available that focus on different materials and chemical processes.

For example, see Figure 1 “Galvanic corrosion chart”. Tools such as this chart help designers, engineers, and construction professionals in selecting compatible materials for systems and structures. To reduce the risk of galvanic corrosion, certain metals should not be paired together. The galvanic corrosion chart below highlights metal combinations that pose the greatest risk of corrosion.

In another example, Figure 2 “Chemical compatibility chart” below focuses on 304 and 316 grade stainless steel's ability to withstand certain media varies based on chemical processes.

Figure 1. Galvanic corrosion chart



Source: https://industrialmetalservice.com/metal-university

Figure 2. Chemical compatibility chart

Chemical	SS-304	SS-316
Acetic Acid 20%	B	A
Acetic Acid, Glacial	C	A
Ammonia, liquid	B	A
Boric Acid	B	A
Calcium Hypochlorite	C	C
Chromic Acid 5%	B	A
Formaldehyde 100%	C	A
Hydrogen Gas	A	A
Hydrogen Peroxide 10%	B	B
Hydrogen Peroxide 100%	B	A
Hydrogen Sulfide (aqua)	C	A
Hydrogen Sulfide (dry)	C	A
Isopropyl Acetate	C	A
Lye: KOH Potassium Hydroxide	B	A
Nitrating Acid (<1% Acid)	C	A
Ozone	B	A
Phthalic Acid	B	A
Salt Brine (NaCl saturated)	B	A
Sodium Hydroxide (80%)	C	B
Stannous Chloride	C	A
Sulfur Dioxide	D	B
Sulfur Dioxide (dry)	D	D
Sulfur Trioxide (dry)	D	A
Sulfuric Acid (<10%)	D	B
Tannic Acid	B	A
Tetrachloroethane	B	A
Zinc Sulfate	B	B

Legend:
A: Excellent resistance
B: Good (minor effect, slight corrosion or discolouration).
C: Fair (moderate effect, not recommended for continuous use).
D: Severe Effect (not recommended for any use).

COMMON PLACES TO FIND CORROSION

Pool areas are highly prone to corrosion due to the release of trichloramines, a chlorine-based gas that accumulates near the pool surface, especially in indoor environments. This gas is not only a regulated health hazard under AS 1668 Part Two but also highly corrosive to metals, often causing tea staining on stainless steel components.

Bathrooms frequently experience corrosion from failed waterproofing layers, leading to leaks and pooling that degrade subfloor materials. These failures often result from inadequate surface preparation or improper priming before applying waterproofing membranes.

Other common areas include roofing, where unwashed eaves collect dust and debris that accelerate corrosion, and concrete structures, where a poorly prepared, cracked or eroded concrete slab can create a porous environment that accelerates the risk of corrosion in reinforcing steel. Another risk lies in incompatible metals embedded into concrete. Due to their reactive nature, many aluminium alloys cannot be embedded directly into concrete.[3]

Treated timber (CCA) should not come into direct contact with metallic components due to the highly corrosive nature of the chemicals used in the treatment process. Corrosion can also occur indirectly when runoff carries trace chemicals, creating corrosive leachate that affects nearby metal components. Stainless steel is significantly more resistant to this type of corrosion compared to aluminum and carbon steel.

DESIGN CONSIDERATIONS TO AVOID CORROSION

To mitigate the risk of corrosion in built environments, thoughtful design strategies must go beyond merely complying with standards and regulations. While Australian Standards and the National Construction Code provide essential guidance, adhering only to the minimum requirements will not deliver optimal long-term outcomes. Exceeding these benchmarks ensures enhanced durability and performance over time.

Selecting materials suitable for the specific environmental conditions is crucial. Corrosion-resistant materials like stainless steel, aluminium, or coated metals are essential in harsh environments, such as marine settings. Components and fasteners should be made from the same or compatible materials to minimise the risk of galvanic corrosion, avoiding highly dissimilar metal pairings, such as copper with aluminium or steel. Off-the-shelf solutions are not always viable; materials must be chosen with purpose and environmental resilience in mind.

Protective coatings, such as paint, galvanisation, or powder coating, serve as effective barriers against corrosive elements. Designs should also prioritise moisture control by incorporating features like proper drainage systems and avoiding crevices or tight spaces where water can collect. Metals should not be placed in direct contact with porous materials, such as wood or plaster, without appropriate protective measures, as these materials can retain moisture and exacerbate corrosion.

Effective drainage and waterproofing systems prevent standing water, a major contributor to corrosion. This can include sloped surfaces, drainage paths, and waterproof seals in moisture-prone areas. Additionally, ensuring structures are designed for easy access, with features such as removable panels or inspection ports, facilitates regular cleaning, maintenance, and early

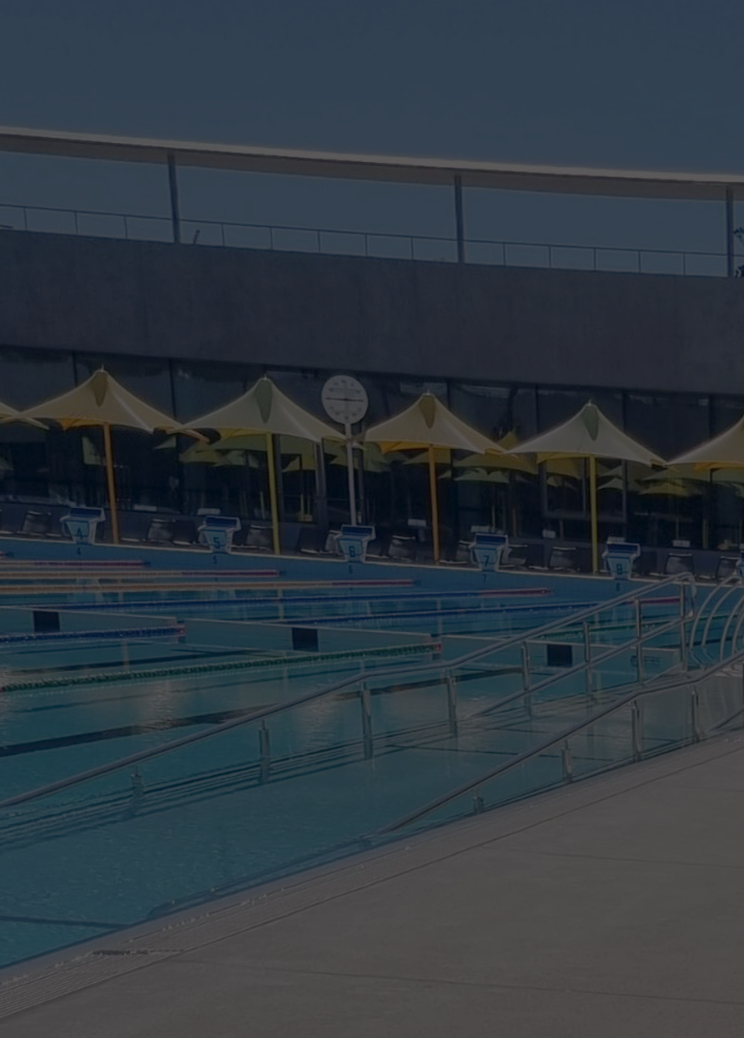
PROACTIVE MONITORING AND MAINTENANCE

Proactive monitoring and maintenance are essential strategies for preventing corrosion and extending the lifespan of materials. Regular cleaning, appropriate cleaning methods, and systematic inspections play a critical role in identifying and mitigating potential issues before they escalate.

Keeping metallic surfaces clean and free of debris is vital. Dirt, grime, and organic matter, such as leaves or mould, can trap water, creating an environment conducive to degradation. Regularly clearing debris from joints, crevices, and drainage systems prevents water stagnation, while ensuring that gutters, vents, and other structural elements remain unobstructed.

Proper cleaning methods are equally important. Harsh or abrasive cleaners can strip protective coatings or finishes, leaving surfaces more vulnerable to corrosion. Instead, non-abrasive tools and cleaning agents specifically designed for the material in question should be used to preserve the integrity of protective layers and finishes.

Scheduled inspections are critical for detecting early signs of corrosion, such as discolouration, pitting, or flaking. High-risk areas, including joints, fasteners, and areas beneath coatings, should be closely examined. Identifying and addressing these issues early prevents further deterioration and helps maintain the structural integrity and aesthetics of the system.



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MADE TO LAST: STORMTECH PRODUCTS

Stormtech is a trusted name among architects, designers, and building professionals, offering high-quality architectural grates and drainage systems that combine innovative design with exceptional durability. Known for their ease of installation and versatility, Stormtech products are used in a variety of applications, including bathrooms, thresholds, driveways, and pools, as well as specialised drains for various industries.

With over 35 years of expertise, Stormtech has set a new benchmark in drainage solutions, providing products designed to exceed Australian Standards and address the challenges of corrosion in built environments.

One of Stormtech's standout features is their commitment to using materials that maximise corrosion resistance while maintaining strength and functionality. Their drainage channels are constructed from marine-grade 316 stainless steel and environmentally sustainable uPVC, ensuring they withstand harsh conditions, including high-humidity areas and saline environments. This makes them suitable for a wide range of applications, from residential bathrooms to outdoor pools.

Stormtech also offers industry-leading warranties, with coverage of up to 10 years on the workmanship of all grates and channels. These extended warranties, combined with the company's rigorous quality control and Global GreenTag Level A Gold certification, demonstrate their commitment to sustainability and durability. By providing technical support and products that are both easy to maintain and built to last, Stormtech helps professionals confidently specify drainage solutions that mitigate corrosion risks while ensuring long-term performance and environmental responsibility.

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All information provided correct as of January 2024

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