ALUMINIUM VERSUS STEEL

THE ULTIMATE SHOWDOWN

Monkeytoe

EVERYTHING BETTER


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A NOTE FROM THE DIRECTOR

Aluminium has long been seen as a premium, quality product but now its versatility is really being realised. At Monkeytoe, we're passionate about encouraging 'Construction Influencers' to look at the whole picture when it comes to construction, and it's in this context that aluminium's true benefits shine.

Aluminium is a lightweight alternative – only 1/3 of the weight of steel – it has the ability to influence the building design. If considered early in the design stage, it can assist in reducing the loads applied to the substructure, especially considering roof plant platforms. With its lighter weight also comes ease of installation and reduced risk of damage to the product and surrounding structures, plus it always looks good.

Typically, the aluminium used is marine grade – essential in a country where our innermost region is still only 120kms from the coast. Additionally, the non-corrosive properties of aluminium mean that it doesn't require painting or galvanising – reducing lead times, expense, potential damage during transport, and any risk of corrosion if alterations need to be made after manufacturing.

As more and more in the industry look to 'Sustainability' and considers the total 'Life time cost' of a building, as opposed to a 'one-line item' – aluminium shines in its fullness. In seeking to create a proprietary system – the likes of which are not achievable with steel sections – Monkeytoe has harnessed aluminium's superior quality and versatility to provide a modular product suite to the construction market. Read on to understand more about why we're so passionate about aluminium as a building material of choice.

Tim Prestidge
DIRECTOR OF MONKEYTOE


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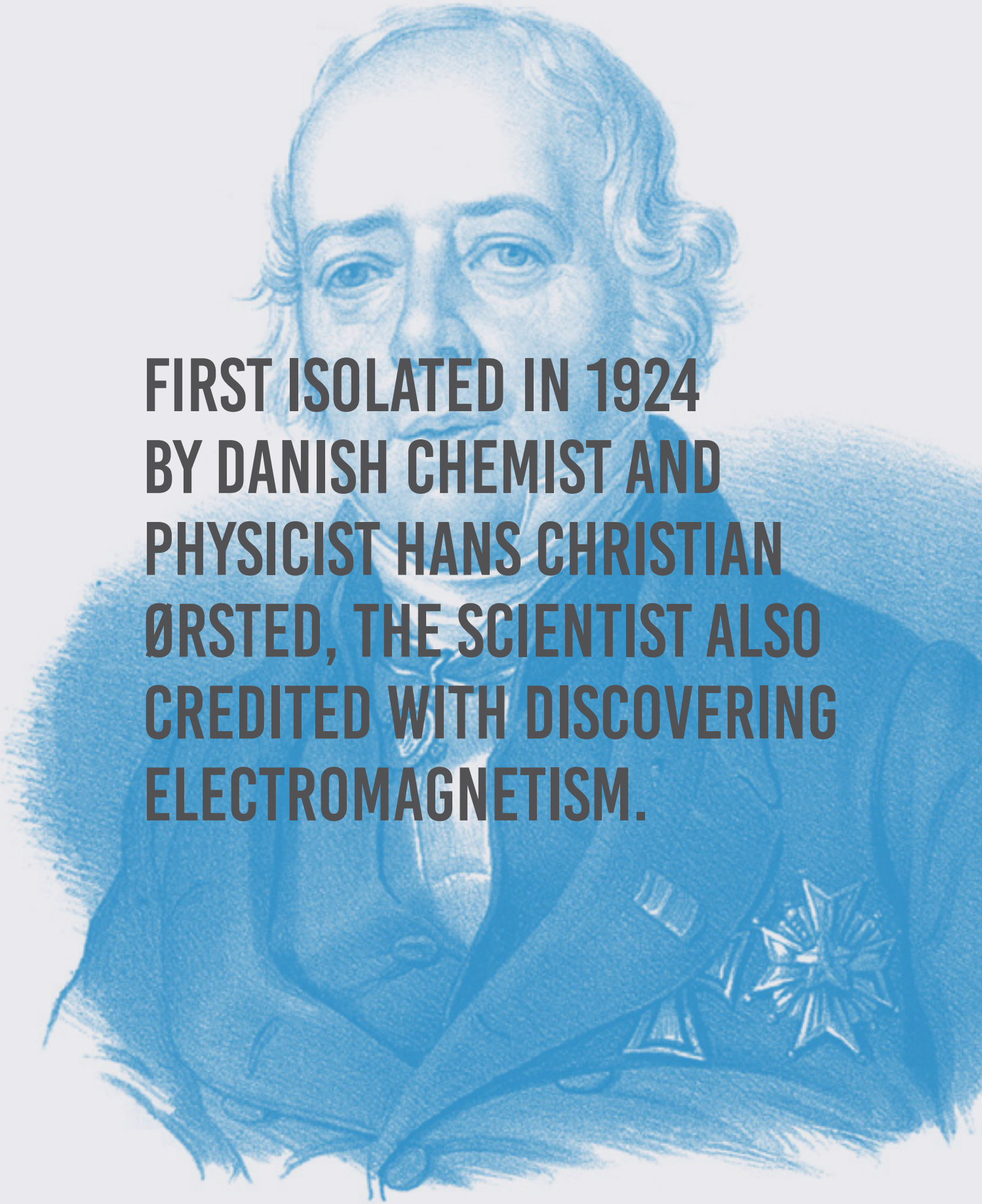


FIRST ISOLATED IN 1924 BY DANISH CHEMIST AND PHYSICIST HANS CHRISTIAN ØRSTED, THE SCIENTIST ALSO CREDITED WITH DISCOVERING ELECTROMAGNETISM.

INTRODUCTION

01

From electrical components and construction materials to airplane fuselages and even the gleaming pyramidion atop the Washington Monument, aluminium has become a versatile and indispensable material used across many industries. But it was only comparatively recently – in 1824 – that it was first isolated by Danish chemist and physicist Hans Christian Ørsted, the scientist also credited with discovering electromagnetism.

Despite being one of the most abundant elements by mass in the earth's crust (only oxygen and silicon are more common) aluminium was initially so difficult to extract, and therefore so rare, that its value as a precious metal exceeded that of gold. The little that was available was prized as a decorative material and even made into jewellery. According to legend, Napoleon III would eat using aluminium dinnerware while guests were left to make do with gold.

It was not until the 1880s that aluminium became commercially viable to extract and produce. Its first notable architectural use was in the creation of the glinting facade of the dome of the church of San Gioacchino in Rome in 1898 when it was still a novel and luxurious material. In 1931, anodised aluminium building materials were first used in the construction of the tallest structure in the world at the time, the Empire State Building.

In the last few decades aluminium has taken enormous strides as a structural construction material; it's now employed for a diverse range of purposes. In fact, aluminium's chemical and physical properties, and its production lifecycle, offer significant advantages over other established building materials like steel.

AUCKLAND AIRPORT

- Walkways
- Aluminium Steps & Stiles

SO HOW DO THEY MEASURE UP

ALUMINIUM	STEEL
One square meter of Aluminium sheet 6mm thick has a weight of **16.2kg**	One square meter of Steel sheet 6mm thick has a weight of **47.1kg**
The specific gravity for aluminum is **2700kg/m3**	The specific gravity for steel is **7800 ton/m**
The average rate of penetration for corrosion of aluminium is approx. **0.00051mm/year**	The average rate of penetration for corrosion of steel is approx. **0.0445mm/year**

VS

Pound for pound, the capability of Aluminum in absorbing crash energy is **TWO TIMES** that of Steel

PHYSICAL PROPERTIES

02

Aluminium is one of the most versatile metals in use today. On average, it is nearly one third the density of steel – lending itself to use as a lightweight alternative for many construction components traditionally made with steel.

FOR EXAMPLE, ALUMINIUM IS FAVOURED IN THE SHIP-BUILDING INDUSTRY BECAUSE IT OFFERS WEIGHT SAVINGS OF UP TO 40%

Not only that, aluminium has a high strength-to-weight ratio. When alloyed with small amounts of other metals, such as magnesium or copper, it is comparable in strength to steel at a fraction of the weight. Copper alloys are used in airplane manufacturing for their high strength and light weight properties. In building construction, aluminium allows architects the opportunity to minimise the dead load on supporting structures without compromising the strength of the building as a whole - a key consideration for roofing and cladding applications.

Aluminium is also more malleable and ductile than steel. It can be spun into more intricate shapes without cracking or rupturing, which makes it suitable for making many different construction components, across a wide array of manufacturing contexts. It is also one of the few metals that can be cast using any metal casting process, including die casting, permanent mould casting and sand casting, so it's extremely versatile

CORDIS HOTEL

• Modular Fire Egress Stair

CLICK HERE FOR VIDEO & MORE ABOUT THIS PROJECT

COASTAL CLIMATES

Exposure to salt air is a key factor in Australia and New Zealand when selecting building materials that will be exposed to the elements. Aluminium alloys are suitable for coastal climates provided they do not contain copper. Most aluminium alloys used in construction today do not include copper and will have a long service life in salt air conditions.

CORROSION & WEATHER RESISTANCE 03

Aluminium's natural properties make it particularly useful for structures that are exposed to the elements. Its chemistry is quite different to that of iron and iron alloys (including steel) rendering it less vulnerable to structurally significant corrosion, even when it comes into contact with water and salt air. (Another reason the ship-building industry have a love of aluminium).

The science behind it is relatively simple... As we all already know, when metals come into contact with oxygen or other ambient oxidising agents they form oxide compounds. For iron, this produces ferric oxide or what we know as 'rust'. Aluminium is similar in that it also undergoes an oxidation reaction to produce aluminium oxide. However, what is less well known is that this process imparts quite different physical properties.

Rust is porous and, when it forms on the surface of a steel structure, it allows air and liquid to penetrate to the uncorroded iron beneath – resulting in further damage. Aluminium oxide also forms on the surface of aluminium structures, but unlike rust, it is impermeable and instead acts as a tight barrier coating that prevents further corrosion of the underlying metal.

Testing by the American Society for Testing Materials suggests that average rate of penetration for corrosion of aluminium is as low as 0.00051mm/year. For steel, this rate can be as high as 0.0445mm/year.

THE AVERAGE RATE OF PENETRATION FOR CORROSION OF ALUMINIUM IS AS LOW AS 0.00051MM/YEAR. FOR STEEL, THIS RATE CAN BE AS HIGH AS 0.0445MM/YEAR.

These might seem like miniscule numbers, but the impact is significant. Evidence from the shipbuilding industry shows that the aluminium alloys used to construct ocean-going vessels corrode roughly 100 times more slowly than their steel counterparts.

If you want to get even more technical, this natural resistance to corrosion is heightened by the process of anodisation. Basically, an electric current and an electrolytic solution can be used to artificially thicken and harden the aluminium oxide layer, adding extra protection from corrosion and abrasion.

PORT OF AUCKLAND
- Stairs
- Handrails
- Service Platforms

CLICK HERE FOR VIDEO & MORE ABOUT THIS PROJECT

CORROSION & WEATHER RESISTANCE

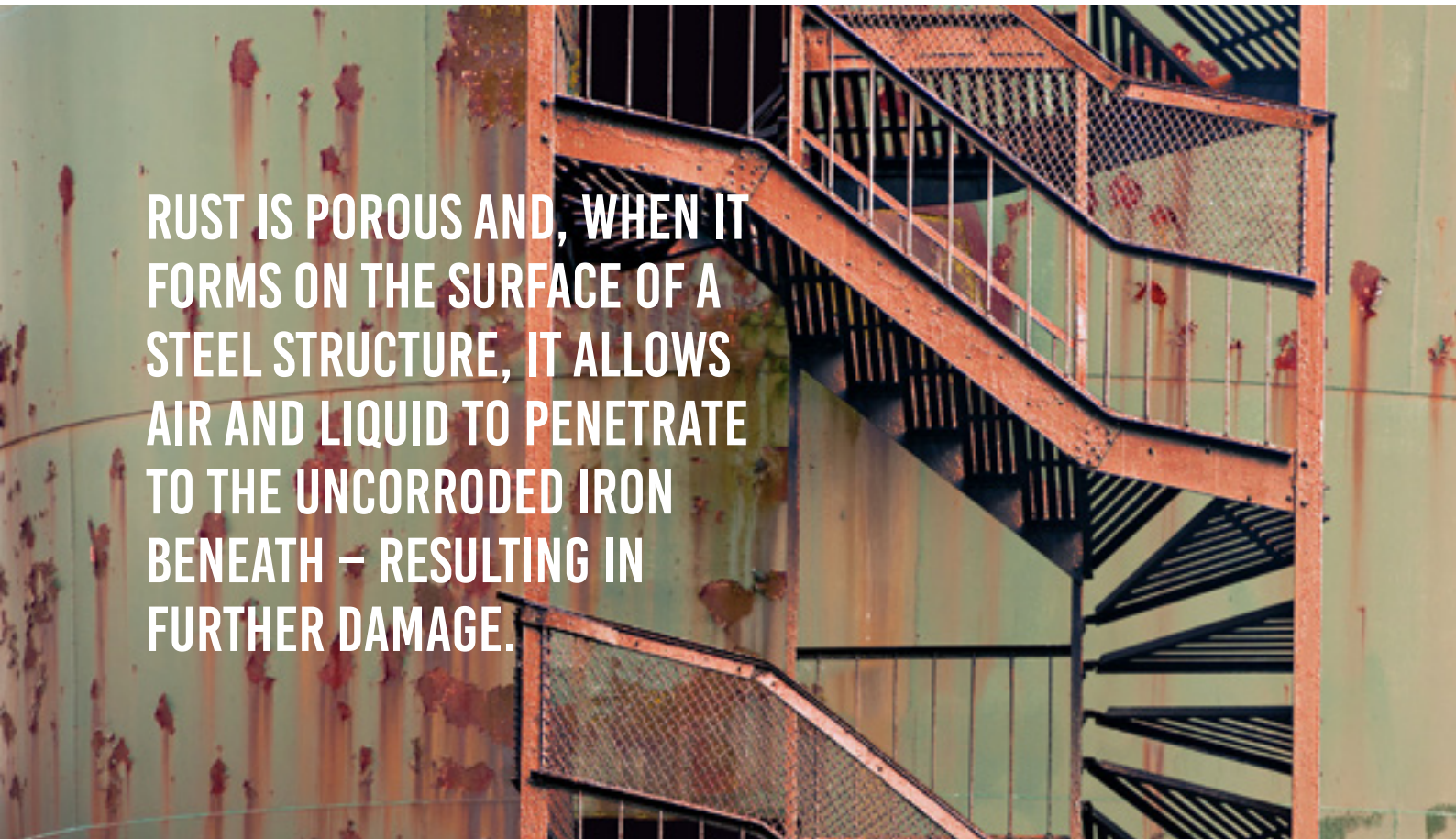
03

The galvanisation of steel works in a similar way by creating a protective surface layer – albeit of a different metal, usually zinc. During this process, a sacrificial layer of zinc is added, which corrodes to form a layer of zinc oxide. This performs a similar function to that of aluminium oxide in that it protects the underlying metal from oxidation. However, it offers significantly less protection because if the surface is scratched and the steel beneath becomes exposed, it will corrode.

In case it's not clear already, one of the key benefits of using aluminium in an outdoor or external setting is that if the surface of the metal is damaged and the oxide layer is removed, a new layer will naturally form thereby preventing any further corrosion.

When it comes too selecting materials, alloy content is a key factor in determining how resistant aluminium is to corrosion. Modern building materials are most often made from 'pure' alloys which have a high aluminium content and offer the best protection.

It's clear that these qualities give aluminium a long service life without the need for a finishing process like galvanization or the application of a coat of paint – though anodisation and coating can augment the protective properties. For evidence we need look no further than the cladding atop the dome of the church of San Gioacchino, which is still in excellent condition over 120 years after it was installed!



SAFETY

04

In case we needed any more evidence to make a case for aluminium, aluminium alloys have been shown to be completely neutral in their effect on air, soil and water quality. They do not easily react with most substances and present no significant chemical hazard to building occupants.

Additionally, aluminium provides an effective barrier against airflow, light and microorganisms and can be used strategically in the design of different structures to exploit these traits.

ITS ALLOYS ARE CLASSED AS NON-COMBUSTIBLE BUILDING MATERIALS WITH A MELTING POINT OF ABOUT 650°C.

FIRE SAFETY

In general, aluminium has a greater capacity to absorb energy than steel, a trait that has seen it become a material of choice for structures designed to resist fire and explosive blasts, and in the development of bullet-proofing technology. When used appropriately, aluminium provides a high level of fire protection which goes some way to explain its widespread use in the construction of oil platforms.

Aluminium has a number of characteristics that can contribute to the overall fire safety of a structure. Its alloys are classed as non-combustible building materials with a melting point of about 650°C. It also does not emit any toxic gases once this point is reached, reducing the potential health risks to occupants, and the internal damage to a structure, during a fire.

Moreover, structural aluminium maintains its mechanical strength up to a temperature of approximately 250°C thereby reducing its fracture and yield point. Alloys can be designed that further raise this to 300°C.

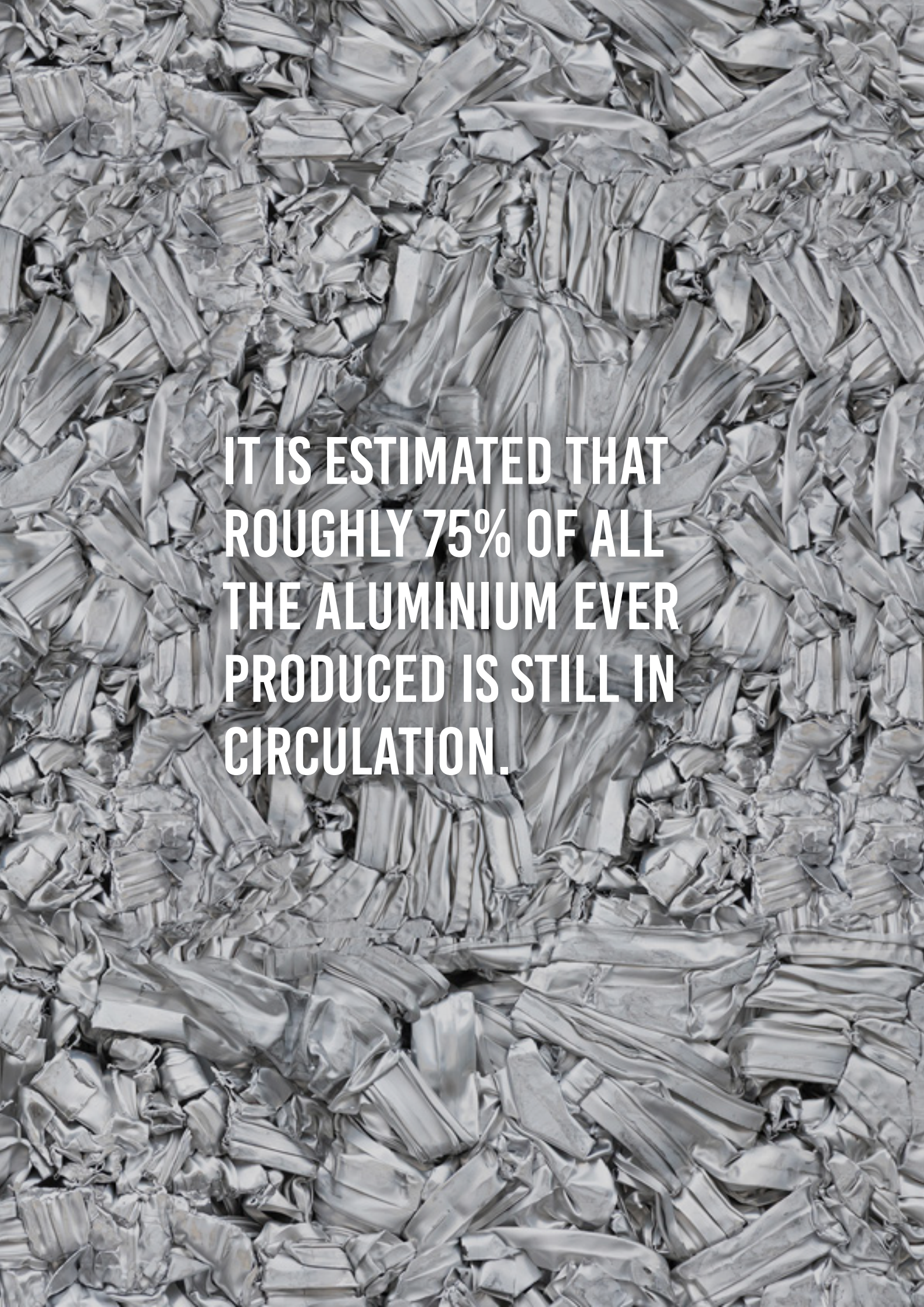
When exposed to heat, aluminium's high reflectivity means that it absorbs less radiant energy – in other words, it takes longer to heat up. This makes it an ideal lightweight material for roofing as it will moderate the internal temperature increase on hot sunny days.

In addition, aluminium is a relatively good conductor – allowing the heat that it does absorb to quickly dissipate. During a fire, this helps to prevent the formation of high heat zones within a structure and can contribute to earlier detection of fires by thermal sensing equipment. In a rooftop scenario, this quality allows aluminium panels to conduct heat out of the structure and into the environment, further slowing the temperature rise within.

ALLOWING THE HEAT THAT IT DOES ABSORB TO QUICKLY DISSIPATE. DURING A FIRE, THIS HELPS TO PREVENT THE FORMATION OF HIGH HEAT ZONES

The comparatively lower melting point of aluminium, when compared to iron, can also be strategically employed to mitigate some aspects of a building fire. If a fire becomes so hot that it causes aluminium roofing to melt, this can create openings for smoke and heat to escape. This feature is currently being exploited in industrial settings to help minimise the damage to the interior of buildings in the event of a major fire.

Finally, aluminium is a non-magnetic and non-sparking metal, traits that make it suitable for use where explosive vapour mixtures may be present. In the event of a chemical spill, aluminium is an ideal material for structures involved in ventilation as it lowers the likelihood of a fire, or secondary fires, starting on the exterior of the building.


IT IS ESTIMATED THAT
ROUGHLY 75% OF ALL
THE ALUMINIUM EVER
PRODUCED IS STILL IN
CIRCULATION.

SUSTAINABILITY

05

The qualities discussed above make aluminium an excellent choice of material for energy efficient structures. But even before it becomes part of a building, aluminium has one of the most sustainable production life cycles of any metal.

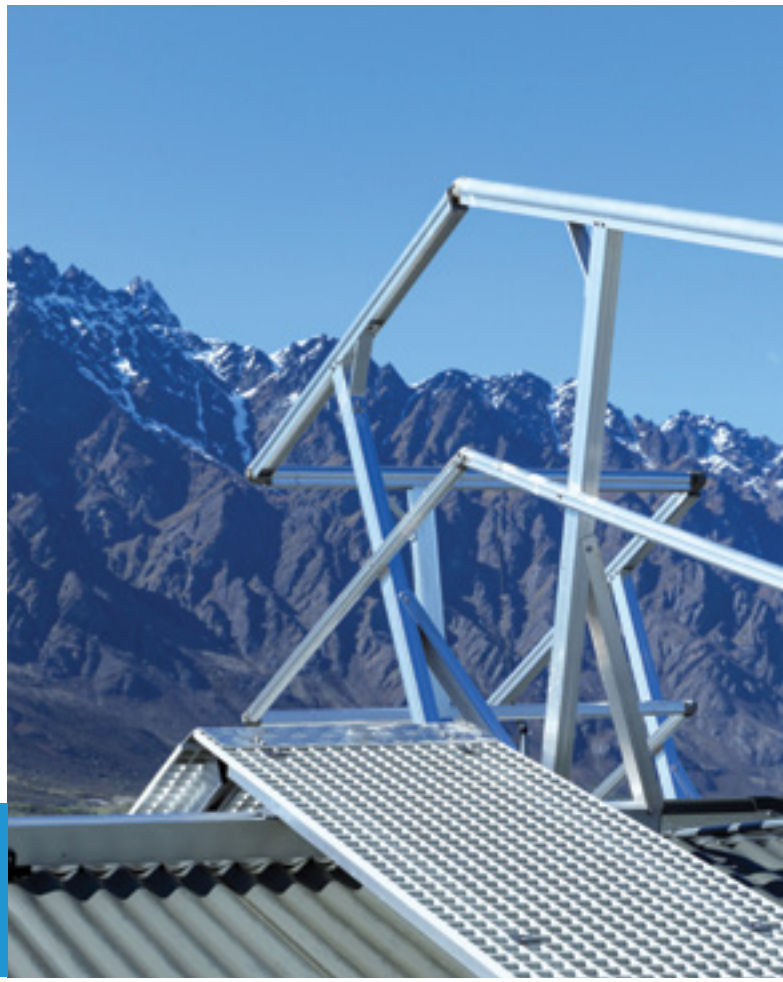
RECYCLING

Aluminium is remarkable in the extent to which it can be recycled. In the European Union, more than half of the current aluminium production uses recycled raw materials and this proportion continues to rise.

At present, it is estimated that roughly 75% of all the aluminium ever produced is still in circulation owing to both its long lifespan and strong economic incentives to reuse deconstructed aluminium components.

A big factor driving these high rates of aluminium recycling is the retention of its original properties at the end of the recycling process; it can be reused as pure aluminium or alloyed with a variety of other metals in much the same way as newly extracted aluminium. In Europe, over 70% of used aluminium cans are recycled in a process that sees that same metal used to make new cans in less than 60 days. So, not only does aluminium have a long lifespan, it can be reincarnated ad infinitum.

Another key factor is cost. One of the biggest costs in the primary production of aluminium is the energy required to extract it from ore; smelters require large amounts of electricity to drive the extraction process. By comparison, the recycling of aluminium uses approximately 5% of the energy expended in the extraction stage. This provides an enormous economic incentive to reuse aluminium instead of expanding mining operations.



QUEENSTOWN AIRPORT

- Walkways
- Ladders
- Aluminium Handrails


ALUMINIUM MAY
ONCE HAVE BEEN
KNOWN AS THE METAL
OF KINGS, BUT TODAY
IT IS A VERSATILE
AND SUSTAINABLE
MATERIAL

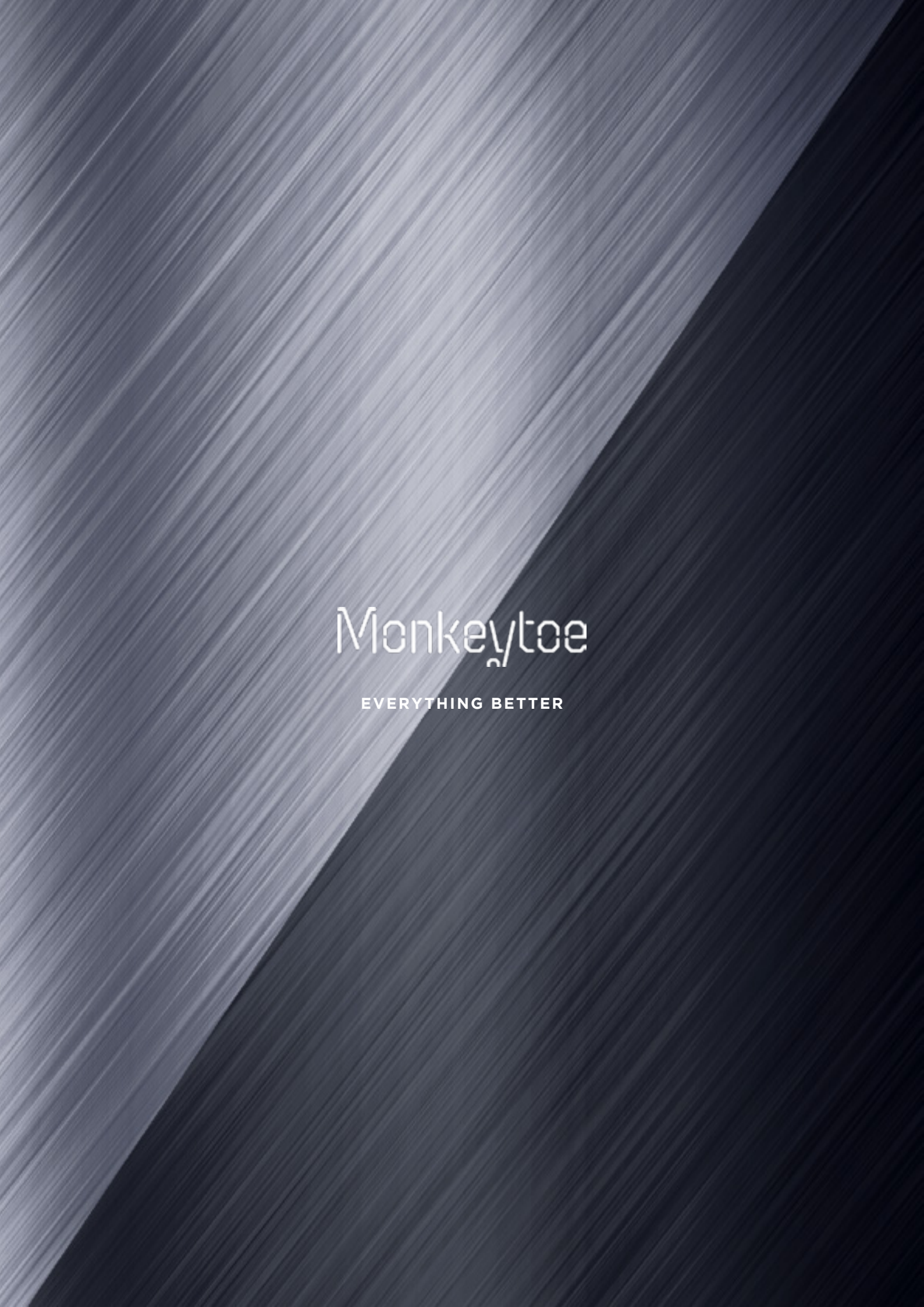
USE IN ROOF STRUCTURES

06

Aluminium and its alloys offer many benefits over steel as a construction material, particularly for use in roof access structures:

- **Highly robust. MonkeyToe mounts are manufactured from marine grade, high-tensile aluminium.**
- **Lightweight. Single mounts come in three models: Standard (0-80kg), Heavy Duty (80-150kg) and Super Duty (150-300kg) depending on the roof pitch and the actual physical dimensions, or you can ask our consultants for a special design.**
- **Easy, fast installation. Each mount comes with all fixings and roof connection brackets, delivered as a boxed kitset to allow for easy installation.**
- **Modular, adjustable assembly.**
- **Supplied with PS1 ready for council sign off.**

Aluminium may once have been known as the metal of kings, but today it is a versatile and sustainable material that continues to revolutionise the manufacturing and construction industries.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