



OUTOKUMPU'S GUIDE FOR ARCHITECTS

How to design stunning durable façades with stainless steel

In this guide, we will walk you through all the key information on stainless steel as a façade material.



Should I choose stainless steel as the material for my façade design?

- If you are looking for a durable, yet versatile material that can be processed to form architectural structures in a variety of shapes and sizes, yes.
- If you wish to create stunning and timeless façades that will keep their appearance for decades, yes.
- If you want to build sustainable façades and report transparently to your clients on your sustainability performance, yes.

By reading this guide, you will gain a thorough understanding of the benefits of this durable and versatile material. We will go deeper into the properties of different stainless steel grades, discuss fabrication aspects and the importance of choosing the right surface finish. Finally, we will assess façades made of Outokumpu's stainless steel from a sustainability point of view. Join us in working towards a world that lasts forever.

Contents

- Stainless steel as a façade material 3
- Stainless steel grades for facade applications
on various environments..... 4
- Stainless steel fabrication explained 5
- Achieve durability by selecting the appropriate grade 8
- Ensure long life and aesthetic appeal with the proper surface finish 11
- Build sustainable architectural designs with stainless steel 15
- Conclusion17



Fig. 1. A detail of the entrance to 7 Bryant Park, New York which is clad with Outokumpu Deco Linen.



Stainless steel as a façade material

Façades are one of the most demanding applications of stainless steel. It is also the application that requires the most attention from Outokumpu's quality department in terms of optical uniformity. Our stainless steel expertise is built on long experience and on-going research, which helps to ensure a high level in paramount characteristics such as flatness and color consistency.

A building's façade material selection is critically important. The material must be visually appealing, low maintenance, and impervious to weather and pollution. Corrosion resistant and aesthetically versatile, stainless steel rises to those challenges easily. Good processability is also high in the pros column for stainless steel.

Stainless steel is an ideal material to create lasting solutions in demanding applications. Its uses are endless. In addition to established benefits such as durability, non-combustibility, low-maintenance, and high resistance to corrosion, Outokumpu stainless steel provides features that make it perfectly suited for today's demands towards a circular economy. While 100% recyclable, Outokumpu stainless steel also consists of over 90% recycled material.

But what makes stainless steel so durable and resistant to corrosion? Stainless steel is an iron alloy that contains chromium and molybdenum. The chromium on the steel's surface reacts with oxygen in the air and creates a solid and impermeable passive layer of chromium oxide. Different stainless steel grades contain different amounts of alloying materials, which means choosing the right grade for the façade is very important.



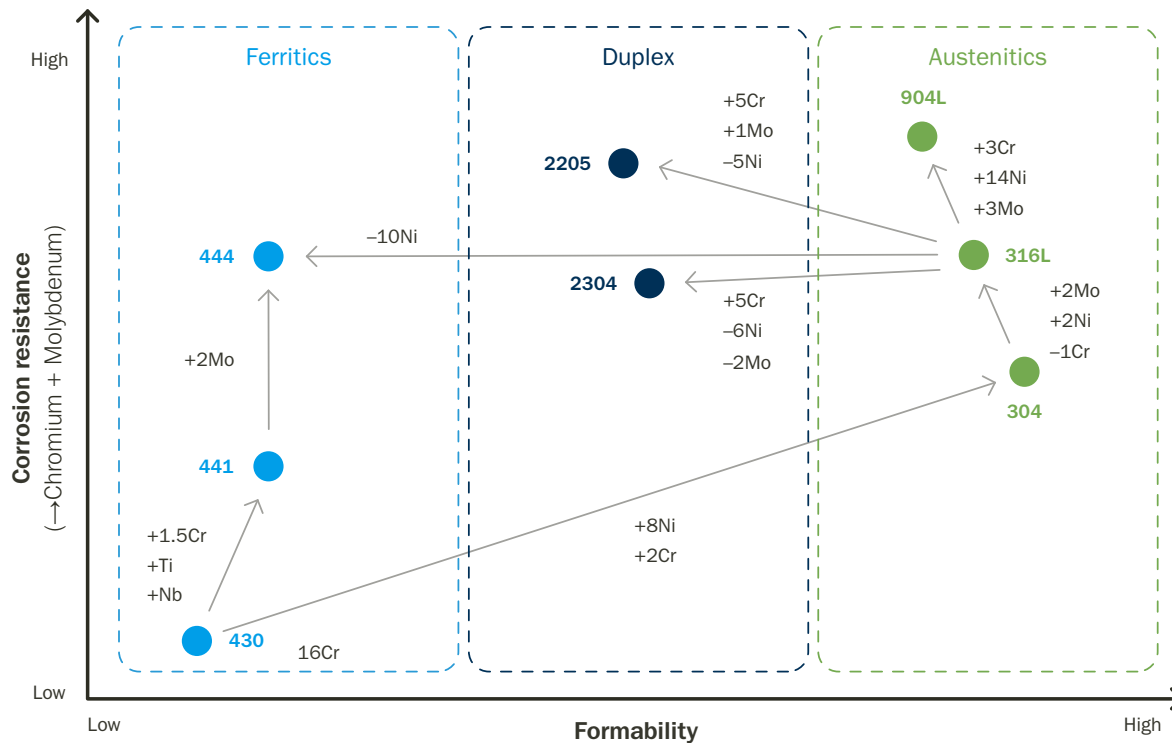


Fig. 2. Corrosion resistance vs. formability. Starting with the popular ferritic grade 430, which contains ~16% chromium and has a relatively low corrosion resistance and formability, the diagram shows how adding or removing nickel, molybdenum, chromium and other elements leads to other grades with improved properties.

Stainless steel grades for facade applications on various environments

Stainless steels are divided into categories based on their composition, from the microstructure down to the atomic level. Small differences in the lattice structures lead to the significantly different properties of ferritic, austenitic, and duplex stainless steel grades.

Austenitic grades are a popular choice for architectural applications

The key advantage of austenitic stainless steels in façade design is distinguished formability. They do not require post-weld treatment and can be readily welded by a full range of conventional welding methods.

The austenitic grade 316L is Outokumpu's most popular stainless steel alloy for curtain wall applications, due to its excellent mechanical and aesthetical properties, workability, corrosion resistance and relatively low cost.



Duplex grades offer superior corrosion resistance

Duplex stainless steels have a ferritic-austenitic microstructure. This results in high strength and exceptional corrosion resistance at a reasonable cost. Compared to other austenitic stainless steel grades with corresponding corrosion resistance, the nickel content of Outokumpu's Forta range duplex is lower. This means higher price stability and easier budgeting.

Other characteristic properties of duplex stainless steel grades include good abrasion and erosion resistance, good fatigue resistance, and low thermal expansion. Furthermore its ability for high energy absorption makes duplex a resilient facade material choice with high resistance to impacts and blasts and otherwise demanding environments.

Stainless steel fabrication explained

Stainless steel is a versatile material that can be processed to form complex architectural structures in a variety of shapes and sizes. Let us guide you through a few key fabrication points on forming, fixing, and green façades.

Know your stainless steels through and through – and form them with ease

With the right know-how, stainless steel can be formed flexibly in a number of processes such as stretch-forming, deep-drawing, or bending.

When it comes to bending, a simple rule of thumb is that bending radius equals thickness. When even sharper angles are required, a V-groove can be introduced on the other side of the sheet. This gives way for bending the material further and creating steep, rectangular edges, and corners.

One common concern among architects is how bending and other forming operations affect the surface finish and optical uniformity of a stainless steel façade. Outokumpu's surface finishes, like the renowned Linen finish, retain their pattern and structure excellently despite processing, providing the forming is conducted correctly.

All Outokumpu's stainless steel sheets can be supplied with a protective film. This ensures that the surface stays protected in further operations all the way until the façade element is installed onsite, and the film removed. Selecting a UV-resistant film helps to facilitate the removal of the film.

Stainless steel coils have a processing direction – the rolling direction. On architectural material which is coated with a protective film this processing direction is indicated by arrows printed on the film. For optimum color consistency, it is mandatory that this processing direction is strictly followed during further fabrication of the sheets and later during installation of the panels. All arrows should be facing the same direction when the façade panels are placed on the building.





Certain environments call for façade materials with especially high corrosion resistance, like the stainless steel grades in the Outokumpu Forta range. Duplex grades are also exceptionally strong, and materials with high mechanical values naturally present a forming challenge. When forming high-strength stainless steel grades, it is important to pay special attention to the springback of the material, and adjust the forming tools accordingly.

For more in-depth knowledge on fabrication techniques in relation to different types of stainless steels, see Outokumpu's Handbook of Stainless Steel and Sheet Metal Forming Handbook.

Choose your fixing method with care and according to the façade design

Façade cassettes made of stainless steel can be attached to the building either by screwing, gluing, or stud welding. The preferred method depends on the design of the façade, as this might limit the fixing techniques available in a specific situation.

When screwing, it is important to take galvanic corrosion into account by selecting screws made of a material that matches the nobility of the stainless steel façade. In this case, stainless steel screws are typically chosen for their corrosion resistance.

Gluing also delivers excellent results, provided that local standards are followed attentively. Façade panels can also be attached with a combination of gluing and additional screws.

Stud welding is an option favored when the finished façade panels appear to hang on the building without visible attachment points. If stud welding is not done carefully on the inner surface of the panel, it can result in a small dent on the outside, ruining the flat surface of the material.

However, Outokumpu's research proves that stud welding can be done successfully on stainless steel material down to a thickness of 2 mm. This allows attaching thin façade panels with stud welds that are invisible on the outside and leave the outer surface intact.

If you are looking for more detailed information on fixing techniques for a particular application, it is advisable to contact your fabricator directly – each fabricator has their own expertise and experience on what works best.





Fig. 3. The ceiling of the Porsche Museum lobby in Stuttgart, Germany is clad with mirror polished Supra 316L/4404 stainless steel produced by Outokumpu.

Green façades can improve the quality of life in big cities – with stainless steel at the core

Outokumpu's stainless steel is a sustainable façade material with its high recycled content, recyclability, and durability. However, in the near future, it may be that making the façades green is a key to an even more sustainable and climate-resistant urban development, one that may improve the quality of life in big cities worldwide.

Increasing the density with sealed façade surfaces can create heat islands that strongly influence the quality of life in big cities. In urban areas, there is not much horizontal space available for greenery, but the façades of high-rise buildings could bring a lot of vertical areas for greenery that can be used to fight CO₂ pollution, increase biodiversity, improve water management, and bind fine dust from the air.

Buildings can benefit from green façades with increased insulation and protection against environmental influences, such as scorching heat. This, in turn, can help with human well-being, as the green façade can help with thermal comfort. Noise protection and stress reduction can also be expected.

But, as any gardener knows, greenery has a way of wearing through most materials, which is why stainless steel and green façade design go hand in hand. Planting trays and mesh materials for climbing plants need to be durable and not corrode when exposed to water and soil, making stainless steel the optimal solution.

Fig. 4. The Heron Tower in London, UK, consumed 185 tons of stainless steel with a Deco Linen finish as a facade cladding.

Achieve durability by selecting the appropriate grade

Stainless steel is a wonderfully durable façade material. With its various finishes, it is also visually appealing. It does not need much maintenance and it is impervious to weather and pollution. However, this only applies, if the environment is taken into consideration and the appropriate grade is selected.

What makes stainless steel durable and corrosion resistant?

In corrosion protection, the most important elements are chromium and molybdenum. The alloying content in the steel creates a thin but sturdy chromium oxide passive layer on top of the surface, which prevents the iron in the steel from getting into contact with oxygen, and therefore inhibits rusting.

If scratched or otherwise locally destroyed, this protective layer has the ability to ‘self-heal’ by instantaneously repassivating in an oxidising environment. In this way, the electrochemical reactions causing corrosion are effectively brought to a halt and kept at bay.





Corrosivity classes according to ISO 9223, outdoor environments, and examples of typically used stainless steel grades. Table 1

Corrosivity category	Corrosivity	Outdoor environment	Typically used stainless steel grades
C1	Very low	Dry or cold zone: Central Arctic/ Antarctica and certain deserts.	4016, 4521, 4307, 4372, LDX 2101®
C2	Low	Temperate zone: rural areas and small towns. Dry or cold zone: deserts and subarctic areas.	4016, 4521, 4307, 4372, LDX 2101®
C3	Medium	Temperate zone: urban areas and coastal areas with low deposition of chlorides. Subtropical and tropical zone: areas with low pollution.	4521, 4301, 4404, LDX 2101®, 2304
C4	High	Temperate zone: polluted urban areas, industrial areas, coastal areas without spray and exposure to de-icing salts. Subtropical and tropical zone: areas with medium pollution.	4404, 4438, 4439, 904L, 254 SMO®, 4565, 2304, 2205, 2507
C5	Very high	Temperate and subtropical zone: industrial areas, coastal areas and sheltered positions on coast line.	904L, 254 SMO®, 4565, 654 SMO®, 2205, 2507
CX	Extreme	Subtropical and tropical zone: extreme industrial areas, coastal and offshore areas.	254 SMO®, 4565, 654 SMO®, 2507

Note! For load bearing details in swimming pool buildings high alloyed austenitic grades must be used due to the risk of stress corrosion cracking, see EN1993-1 part 4.

However, chlorine ions can harm stainless steel by damaging the passive chromium oxide layer. For this reason, buildings in coastal areas or on streets where deicing salt is used require special attention to the alloying content in the façade material. This is also why chloric detergents should never be used on stainless steel.

Whether a particular stainless steel is corrosion resistant in a specific environment depends on the combination of the chemical composition of the stainless steel grade and the aggressiveness of the environment.

Choose the right stainless steel grade for your façade design project

To define the appropriate grade of stainless steel for your façade design project, you must first take into account the atmospheric corrosion and climate of your target location.

How much does it rain? Is it close to the sea? Is deicing salt an issue? How often does the façade need to be cleaned, for example due to pollution? Also, humidity, temperature, and dirt accumulation should be considered.

These factors make up the ISO corrosivity classification C1–CX. The classes C1–C2 are mainly relevant for indoor applications, whereas C3–CX constitute the playing field of façade design for large outdoor buildings.



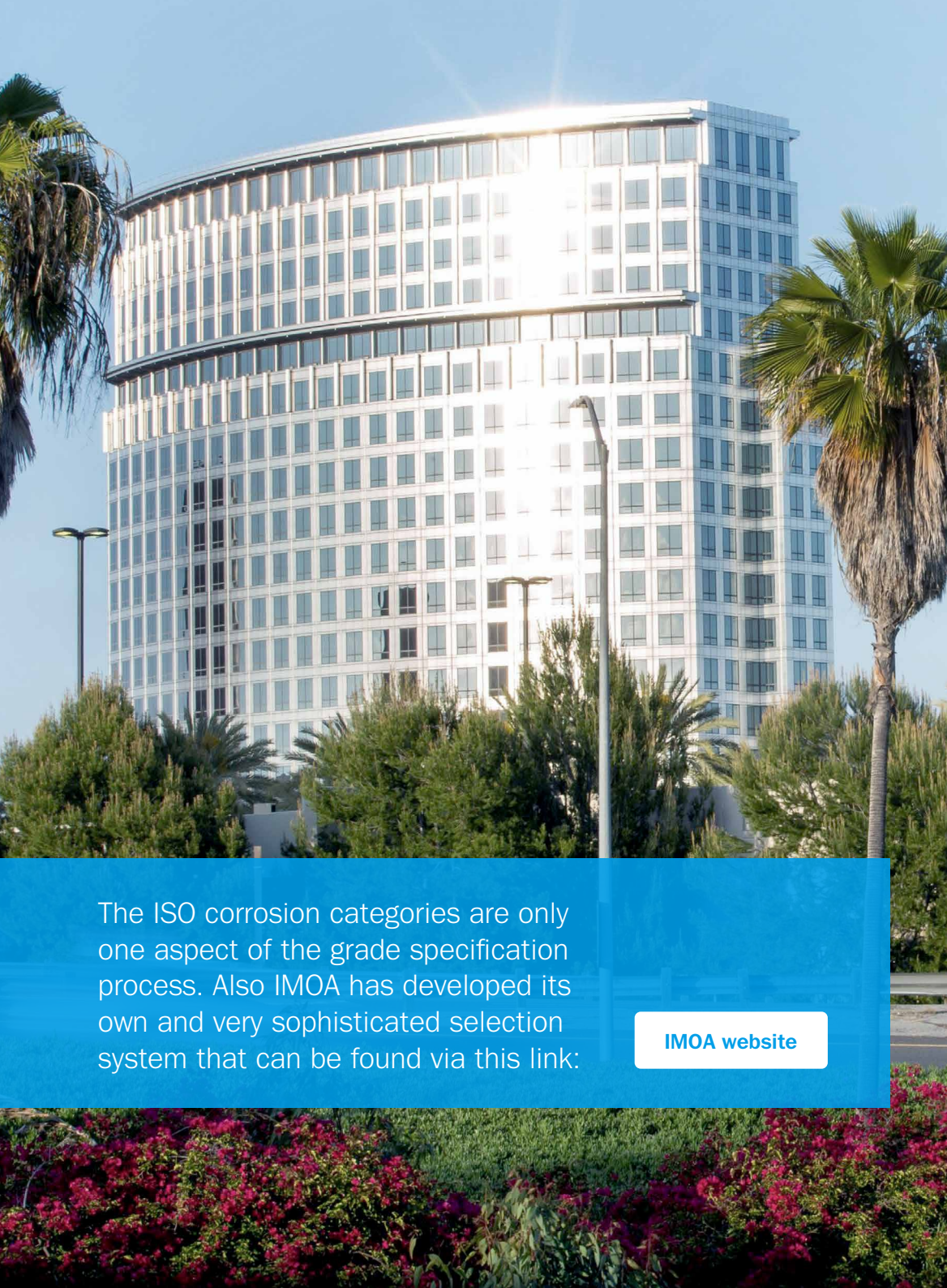


Fig. 5. The Plaza Tower Costa Mesa in Los Angeles.

Some environments are more challenging and some require less corrosion resistance, but a suitable grade can be found for virtually any environment. Outokumpu's own knowledge on material selection is founded on decades of hands-on experience and field test results, which can also be employed to determine which grade is best suited for a specific façade design project in a new location.

There are several different tools and guidelines available from Outokumpu to facilitate material selection: material data sheets, a collection of Corrosion Knowledge Guides, as well as our Corrosion Handbook. For deeper insight and more detailed advice on the right grade for your façade design project, please consult our experts.

Example of long-term success with stainless steel: Plaza Tower in Costa Mesa

The Plaza Tower Costa Mesa in Los Angeles is a shining testament of the durability of stainless steel as a façade material. Designed by renowned architect César Pelli and built in the 1990s for IBM, the 21-story structure's façade is still in excellent condition with no signs of wear or fading after 30 years.

Pelli designed a glamorous tower, whose most striking detail is its stainless steel surface, especially on the western face, which makes a broad curve to reflect the sunset. Stainless steel was his material choice due to its long-lasting qualities and what he called "an aesthetic expression of advanced technology."

The Plaza Tower in Costa Mesa became Outokumpu Nirosta's first large-scale architectural façade. The scale of the project made

The ISO corrosion categories are only one aspect of the grade specification process. Also IMO has developed its own and very sophisticated selection system that can be found via this link:

[IMO website](#)



production extremely demanding, but success established Outokumpu as the leading supplier in the sector.

Two hundred tonnes of stretch-leveled Outokumpu Supra 316L/4404 grade with a Deco Linen textured finish, supplied in sheets 3 meters in length, 1.5 meters in width, and with a thickness of 1.8 millimeters were used to complete this demanding project. Outokumpu's Dillenburg plant supplied the façade material with consistent color, quality, and embossing. The fine, textured Linen pattern embossed on the panels diffuses reflections and creates a warm, lively feeling.

Ensure long life and aesthetic appeal with the proper surface finish

Stainless steel has a unique way of adapting to the surrounding landscape and weather conditions by reflecting blue skies, white clouds, golden sunsets, and green trees. Embossing with a fine pattern like Linen brings out a mixture of these colors, resulting in a homogeneous, smooth, metallic look.

Compared to aluminum, stainless steel has a stronger metallic appearance. This honest material does not need to be coated or anodized, which on the one hand leaves the surface of the material true and unmasked. This is also one

of the key reasons for the low maintenance requirement, as stainless steel never needs to be repainted.

Stainless steel keeps its look and does not decay or fade over time. It can always be brought back to its initial condition via cleaning, even after long periods of neglect. Aluminum, on the other hand, decays slowly and will need to be replaced eventually. Replacing entire façades is a massive inconvenience when it comes to tall buildings.

Desired technical and aesthetical qualities are created with dedicated processing techniques

A broad array of production processes such as rolling, etching, annealing, polishing, brushing, blasting, and embossing shape the surface finish of the various Outokumpu flat products. Exploitation of all these techniques provides a comprehensive portfolio of surface finishes, each with individual properties.

Focus can either lay on the technical or on the aesthetical quality of the surface finish. For instance, durability can be a technical characteristic, whereas sparkle constitutes an aesthetic feature.

Outokumpu brings along a dedicated surface finish team and decades of experience producing various surface finishes with outstanding quality, consistency, and exceptional properties in terms of reflectiveness and roughness. At Outokumpu, we also customize finishes upon special request and work on developing novel finishes with new features to meet the changing market demand.



General surface finish definitions.

Table 2

Designation according to ASTM A480	Description
No. 3	Intermediate polished finish This is a linearly textured finish that may be produced by either mechanical polishing or rolling. Average surface roughness (Ra) may generally be up to 40 micro-inches (1 µm). A skilled operator can generally blend this finish.
No. 4	General purpose polished finish This is a linearly textured finish that may be produced by either mechanical polishing or rolling. Average surface roughness (Ra) may generally be up to 25 micro-inches (0.6 µm). A skilled operator can generally blend this finish. There may also be overlapping measurements of surface roughness for both No. 3 and No. 4 finishes.
No. 6	Dull satin finish This finish has a soft, satin appearance and has a reflectivity that is lower than a No. 4 finish. It is used for architectural applications and ornamentation where high luster is undesirable or to contrast brighter finishes. It is typically produced by brushing a No. 4 finish.
No. 7	Glossy finish This finish has a high degree of reflectivity. It is produced by buffing a finely ground surface, but the gritlines are not removed. It is primarily used for architectural or ornamental purposes.
No. 8	High-gloss finish This highly reflective, smooth finish is typically produced by polishing with successively finer grit abrasives, then buffing. It is also commonly referred to as mirror-polished finish.

State-of-the-art Sendzimir rolling, annealing, skin-pass, and tension-leveling technology allow, for example, for a homogeneous embossing depth, for perfect flatness or hassle-free formability. Most of the finishes can be produced up to a width of 1,500 mm (59.1 inches) and in thicknesses down to 0.3 mm (0.012 inches).

Outokumpu offers a comprehensive selection of surface finishes

Stainless steel is available in a wide selection of surface finishes: matt (2B), glossy (2R), patterned (2M), colored, polished, mirror polished, and bead blasted.

The American Society for Testing and Materials (ASTM) has provided very general surface finish definitions, see Table 2.

As these definitions are quite generic, and do not include bead-blasted, electropolished, or heat-colored finishes, each supplier has different definitions for their own parameters. This is why you should never mix materials from different suppliers for one project.



Fig. 6. Extract of Outokumpu surface finish portfolio.

Special surfaces for stainless steel – the Outokumpu Deco range

The Outokumpu Deco range covers a wide variety of stainless steel surface finishes. These decorative claddings that perfectly match the designer's vision and offer functionality and elegance to various exterior and interior applications.

Patterning of stainless-steel leads to an enhanced combination of design and function. We offer a large variety of patterned surface finishes, and each pattern can have different reflection properties (versions Star, Matt and Supermatt).

Outokumpu's first and still the most used pattern is the Linen finish, originally invented for elevator applications and mostly produced in Outokumpu's Dillenburg cold rolling mill. With its circles and horizontal lines, it imitates the structure of linen fabrics.

Linen is available in three different version: regular, without slubs (lines), and vertical. Without slubs the pattern becomes less directional. Vertical Linen, on the other hand, is designed for vertical applications, such as column claddings. Since 1986, Outokumpu has supplied the Deco Linen finish for over 64 building façades worldwide.

Individual patterns can also be developed according to specific needs. For improved formability, a recovery annealing is applied after embossing and, due to tension leveling, the best possible flatness can be achieved. The Deco range is available on Core, Supra, Moda and Forta grades, and other grades are available on request. To compare the Deco finishes, see our Deco range page for the Comparison tool.

Specialized surface finishes developed to tackle sunlight glare issues

In recent years, the glare of sunlight from shiny façades has been a hot topic, as some countries have made restrictions on the amount of reflectance allowed. The challenge is that with dull surfaces the façade may appear “lifeless”, which goes against the lively appearance usually associated with stainless steel façades.

Outokumpu’s development of lower-reflecting surface finishes has led to newer versions of the classic Linen finish: Linen Star, Linen Matt, and Linen Supermatt. These finishes offer a neatly decreased glare while still maintaining a smooth, sparkling, and sprightly appearance.

In recent years, Linen Supermatt has proved to be a fine choice for cladding projects in strictly regulated countries such as Singapore.

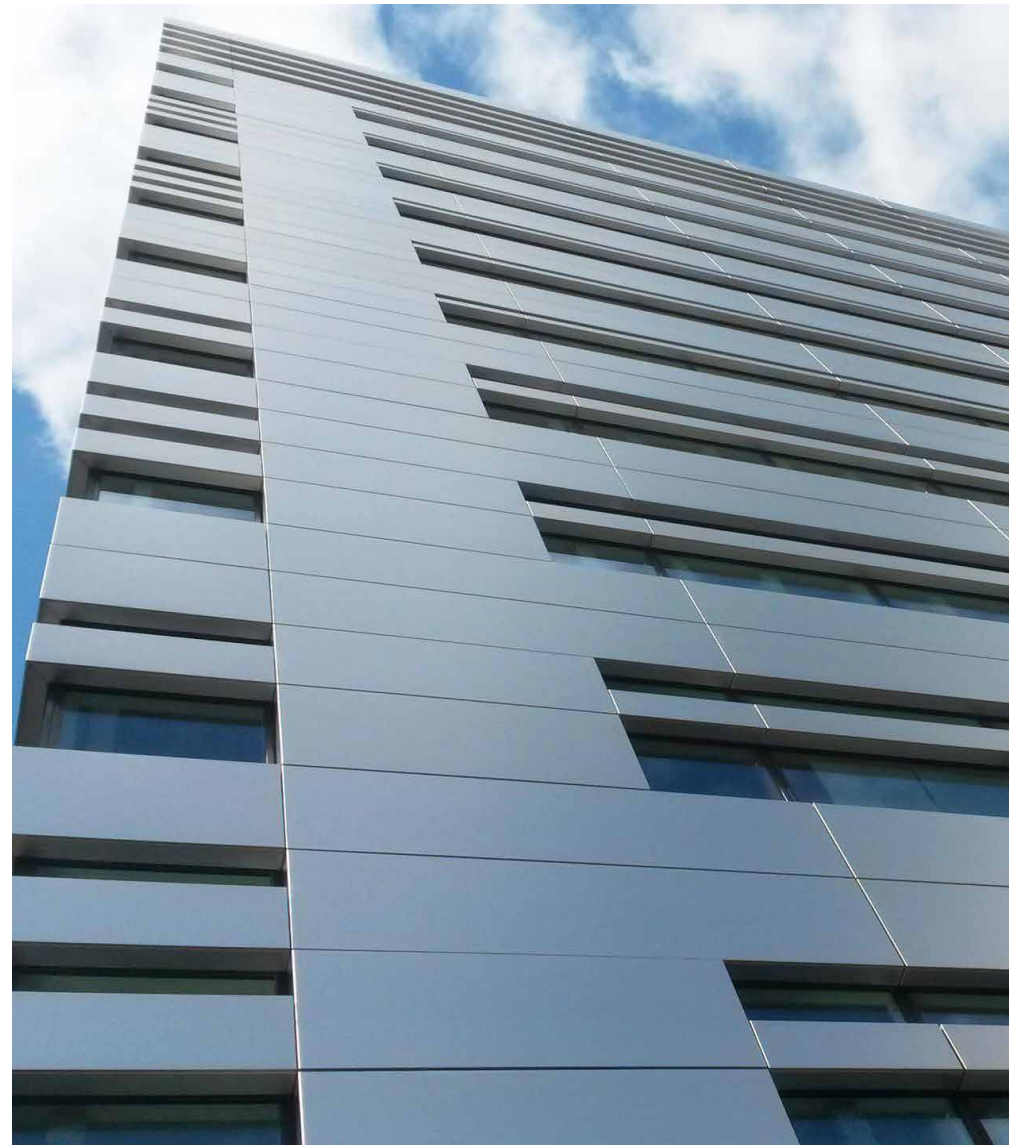


Fig. 7. 5 Broadgate in London, UK has a unified and perfectly flat surface patterned with a timeless and classic Deco Linen surface finish.

Build sustainable architectural designs with stainless steel

Stainless steel is a superb material for sustainable architecture as it is 100% recyclable and long-lasting. The advantages of Outokumpu's high performance stainless steel in sustainable design include:

- stainless steel designs meet service life requirements of 75 years and longer
- low maintenance when properly specified
- Outokumpu's regular production has the lowest carbon footprint in the stainless steel industry
- Circle Green, Outokumpu's new emission-minimized product line has a furthermore significantly reduced carbon footprint compared to our regular production
- over 90% recycled content
- all stainless steels are 100% recyclable without any dilution of their properties
- high recapture rate, reusable as a valuable raw material without any downcycling
- alloying elements are encapsulated and there are no volatile organic compounds (VOCs)
- stainless steel can help to reduce building energy requirements and toxic run-off, and minimize water use



For these reasons, stainless steel helps to gain credit in green building ratings such as Leadership in Energy and Environmental Design (LEED) and Breeam. Outokumpu's environmental product declarations (EPDs) conform to international standards and provide a reliable overview of the climate burden of the façade design.

This streamlines calculating your overall sustainability performance and makes it easier to report transparently to your customers.

Outokumpu – the global leader in sustainable stainless steel

At Outokumpu, we are at the heart of moving society towards more ecologically, socially, and economically sustainable solutions. Our aim is to become the industry benchmark for sustainability and be the customers' first choice in sustainable stainless steel.

We are committed to the Science Based Targets initiative's 1.5-degree target to mitigate climate change. Our emissions reduction ambition covers all direct and indirect emissions, as well as those of our supply chain.



High recycled content lays the foundation for a circular economy

Stainless steel is not only fully recyclable, but also made from recycled material to begin with. Outokumpu's mill in Tornio in northern Finland is the largest material recycling center in Europe. The mill annually recycles over one million tons of metal – the equivalent of the weight of 100 Eiffel towers.

Outokumpu's stainless steel has an exceptionally high recycled content at 90%. This figure stands out globally, as the recycled content of stainless steel ranges between 20–90% worldwide.

High recycled content saves considerable amounts of resources and energy, and significantly reduces waste, making it one of the most effective ways to reduce the environmental impact of production processes.

The lowest carbon footprint in the stainless steel industry has now been even further reduced

Outokumpu's carbon footprint of regularly produced stainless steel is less than 30% of the global industry average. This already makes Outokumpu the sustainability leader in the industry. Key reasons for our low carbon footprint are our own ferrochrome, high recycled content, and the use of low carbon electricity.

But in order to underline and strengthen our leadership in sustainable stainless steel, Outokumpu has developed the new emission-minimized product line, Circle Green.

It has the smallest emission intensity in the world, with a 92% lower carbon footprint than the global average and 64% lower than Outokumpu's regular production.



Outokumpu Circle Green, answers the global need for more sustainable and long-lasting products that can help to build a more sustainable future. The production of this “green” stainless steel is the first of its kind, as no other manufacturer has been able to produce stainless steel with such low emission levels.

The unprecedented emission reduction was achieved with improvements throughout the whole stainless steel production chain. Reductions in upstream raw material emissions were key to this success as they contribute the majority of stainless steel's total carbon footprint. Meticulous production and quality optimization led to higher energy efficiency. Biogas, biodiesel, bio coke, and low-carbon electricity have been used to eliminate 95% of all scope 1 and 2 CO₂ emissions. While these bio-based materials have all been tested previously in production, they were used together for the first time ever to set the new standard for sustainable stainless steel – Outokumpu Circle Green.

We help our customers develop solutions that reduce climate burden by means of the right material choices. On an annual level, our clients are able to reduce their carbon footprint by 8 million tons.





Conclusion

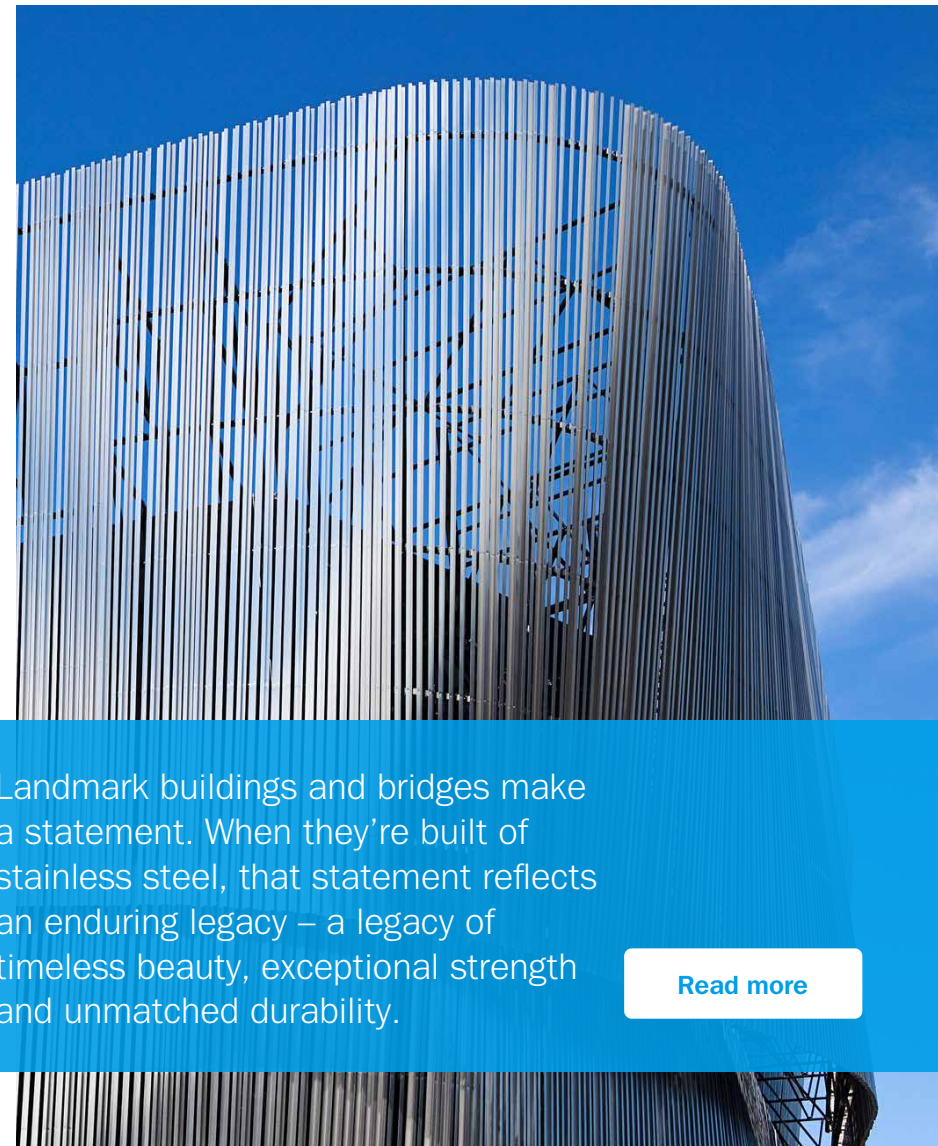
A brief review of the key benefits of stainless steel as a façade material:

- Stainless steel is a durable, yet versatile material that can be processed to form architectural structures in a variety of shapes and sizes.
- With stainless steel, you can create stunning and timeless façades that will keep their appearance for decades.
- Outokumpu's stainless steel is ideal for constructing sustainably and reporting transparently to your clients on your sustainability performance. The use of Circle Green in buildings will reduce their carbon footprint and therefore contributes to create more sustainable cities.

Our experts are happy to help with any further questions.

[Contact us](https://expertise.outokumpu.com/Facade-Design-Guide-Contact-Us)

<https://expertise.outokumpu.com/Facade-Design-Guide-Contact-Us>



Landmark buildings and bridges make a statement. When they're built of stainless steel, that statement reflects an enduring legacy – a legacy of timeless beauty, exceptional strength and unmatched durability.

[Read more](#)

Fig. 8. The Stockholm Waterfront project's most visible part, the Congress Centre, incorporates a spectacular stainless steel façade.

Material beyond aesthetics.

Make a lasting sustainability statement that supports your design and the planet in equal measures by choosing the stainless steel with the world's smallest carbon footprint.

Outokumpu Circle Green® is a breakthrough in stainless steel production achieved using renewable and low-carbon energy forms, up to 100% recycled raw materials and reinvented production processes. **Join the Industrial Evolution.**



Working towards a world that lasts forever

We work with our customers and partners to create long lasting solutions for the tools of modern life and the world's most critical problems: clean energy, clean water, and efficient infrastructure. Because we believe in a world that lasts forever.



Information given in this document may be subject to alterations without notice. Care has been taken to ensure that the contents of this publication are accurate but Outokumpu and its affiliated companies do not accept responsibility for errors or for information which is found to be misleading. Suggestions for or descriptions of the end use or application of products or methods of working are for information only and Outokumpu and its affiliated companies accept no liability in respect thereof. Before using products supplied or manufactured by the company the customer should satisfy himself of their suitability.

MODA, CORE, SUPRA, FORTA, ULTRA, DURA, THERMA and DECO are trademarks of Outokumpu Oyj.

PRODEC, EDX, FDX, FDX 25, FDX 27, LDX, 253 MA, 254 SMO, 654 SMO, LDX 2101, LDX 2404 are registered trademarks of Outokumpu Oyj.

outokumpu.com