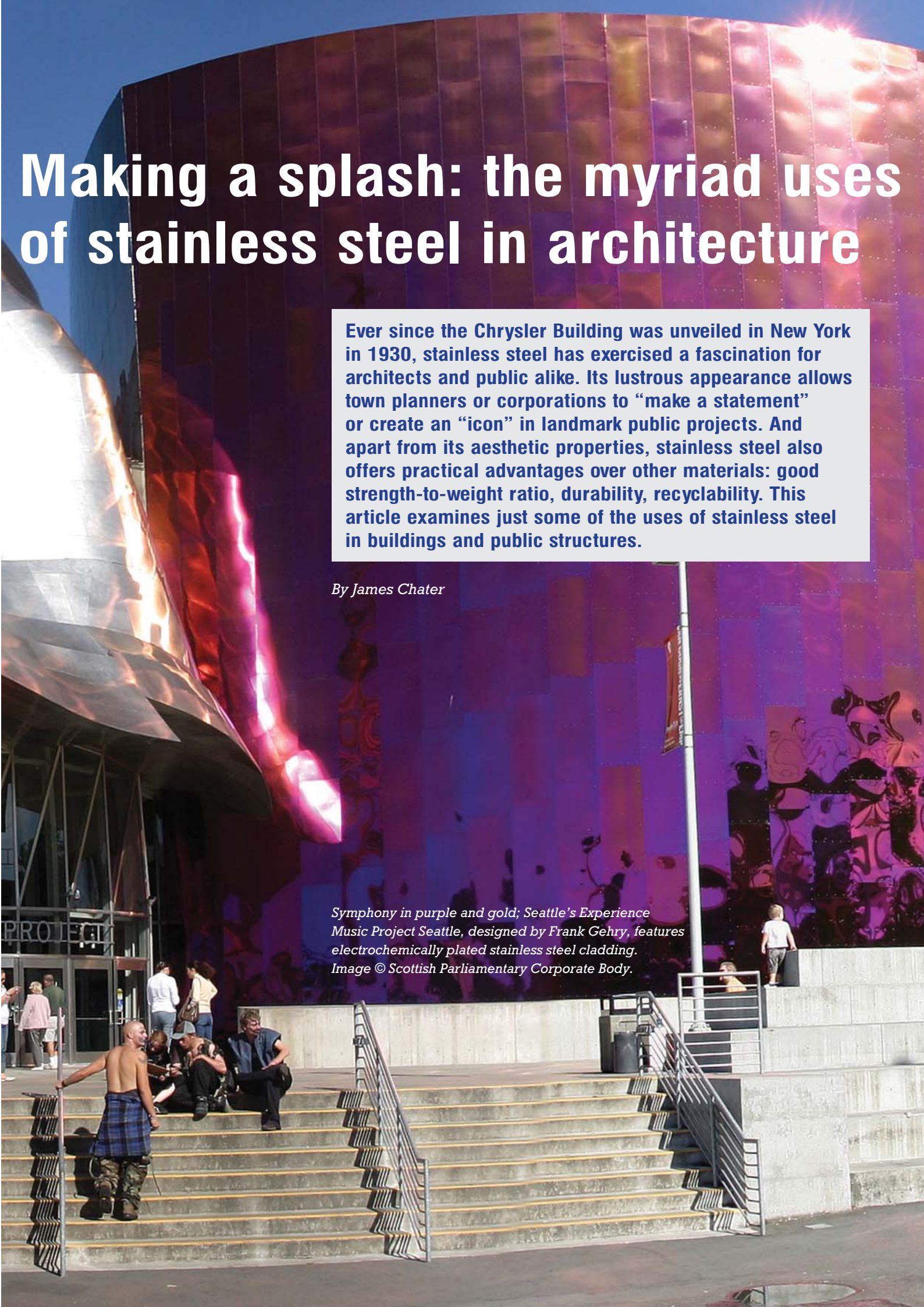


# Making a splash: the myriad uses of stainless steel in architecture

Ever since the Chrysler Building was unveiled in New York in 1930, stainless steel has exercised a fascination for architects and public alike. Its lustrous appearance allows town planners or corporations to “make a statement” or create an “icon” in landmark public projects. And apart from its aesthetic properties, stainless steel also offers practical advantages over other materials: good strength-to-weight ratio, durability, recyclability. This article examines just some of the uses of stainless steel in buildings and public structures.

*By James Chater*

*Symphony in purple and gold; Seattle's Experience Music Project Seattle, designed by Frank Gehry, features electrochemically plated stainless steel cladding. Image © Scottish Parliamentary Corporate Body.*





## Increased consumption

Prestige, style, an impression of lightness or transparency, hygiene, ease of maintenance, safety... what's not to like about stainless steel in buildings? Its use is growing also thanks to increasing awareness of stainless steel's relatively low life-cycle costs and its sustainability. And rapid urbanization in Asia's fast-growing economies, particularly China and India, is an important factor.

Airports are a highly visible case in point. The expansion in the aerospace industry has resulted in airport newbuilds and refurbishments throughout the world. Recent projects in Asia and the United States almost all use stainless steel to a greater or lesser extent: Suvarnabhumi Bangkok International Airport, Doha International Airport, and Dallas/Fort Worth Airport Terminal are just three examples. Stainless steel is not only used on roofs and facades, but also in the interiors: walls, escalators, screens and so on. Skyscrapers are a classic virility symbol for high-growth economies, with new buildings breaking the world record for height with increasing frequency. Their impact is often enhanced by stainless steel cladding. The two Petronas Towers in Kuala Lumpur, the tallest structures in the world when completed in 1996, consumed 2,400 tonnes of 2.5mm type 316 stainless steel. The Jin Mao Tower in Shanghai, completed in 1999, is a pagoda-like structure whose exterior



*The Petronas Towers feature a diamond-faceted facade consisting of 83,500 square metres of stainless steel extrusions.*



*Outokumpu has been contracted to supply stainless steel for the façade of China's tallest skyscraper, the Ping An Finance Centre in Shenzhen, China. The building under construction, 2013 (1), and an image of how it will look when it is finished in 2016 (2).*

curtain wall is made of glass, stainless steel, aluminium and granite. Last year Outokumpu won the bid to provide cladding for the Ping An Finance Centre in Shenzhen, China. It will be the largest stainless steel façade in the world and, when the building is finished in 2016, it will be the tallest skyscraper in China.



*The Jin Mao Tower in Shanghai, China. Its exterior curtain wall is made of glass, stainless steel, aluminium and granite.*



Metro stations, bus stops, public benches, children's playgrounds, walkways, underpasses, footbridges, sound absorption barriers, chimneys, ventilation shafts... these are just some of the public amenities where stainless steel shines. Two countries are especially keen on using stainless in this way: Italy and India. The first has one of the highest per capita consumptions of stainless steel in the world; India's is much lower but is expanding rapidly.

## Practical and aesthetic

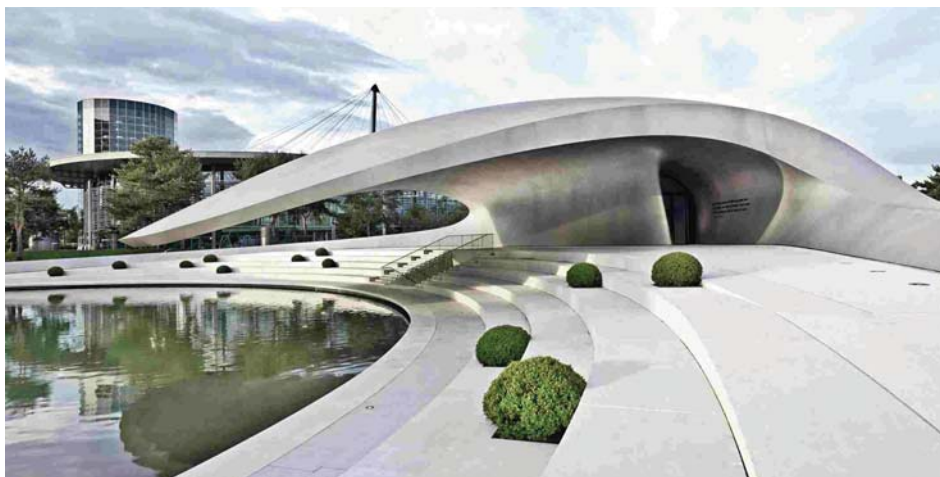
The forms of stainless steel in buildings are as varied as the material itself. They range from the purely functional to the aesthetic; in many cases aesthetic considerations combine with functional ones to make stainless steel a highly attractive choice. Some stainless parts you never see: plumbing and stainless rebar are two examples. But in general, stainless steel is highly visible, and its appearance is a major motive for its use.

## Cladding

No wonder, therefore, that stainless steel cladding has so often been used on the exteriors of buildings. This has several advantages. Cladding is an effective way of weather-proofing a building. Its grey sheen can reflect sky



and trees during daytime and city lights at night, and variety can be obtained by changes in light and lighting. Different finishes can reflect and refract the light in different ways. A highly special effect is obtained in the artists' studios of the University of Wales at Aberystwyth, where a crinkly effect, similar to aluminium foil, refracts the light of sky and trees. An important type of finish is electrochemical colour. At the new head office of Ronstan International Pty Ltd, stainless steel panels have been electrochemically blackened then vibration-finished to enliven the colour. An especially fine example of colouring is Frank Gehry's Experience Music Project in Seattle, with its electrochemical golds and purples. Another important element in cladding is shape. Postmodern architecture is renowned for its playful, irregular shapes, for example the tumbling exteriors of Frank Gehry. This plays to one of stainless steel's greatest advantages, its ease of formability: the material can be made to undulate, billow, tumble or cascade, the only limitation being the architect's imagination. This aspect of contemporary building design is made possible thanks to modern computer-assisted design and fabrication software. In this way modern buildings tend to resemble sculptures, and it is no coincidence that sculptors too resort frequently to austenitic stainless steel. Sculpture-like buildings include many of Gehry creations, for instance the Samsung Museum of Modern Art in Seoul, South Korea, with its stainless steel "waterfall"; and the Porsche Pavilion, Autostadt, Wolfsburg, fashioned in sheets of 361Ti in a way designed to reflect the style of the cars exhibited inside.



*The Porsche Pavilion, Autostadt, Wolfsburg. Photo: Michael Barera.*



*Scottish Parliament, Edinburgh, with Holyrood Park and Arthur's Seat in the background. Image © Scottish Parliamentary Corporate Body.*

### Architectural history

Stainless steel has been used in buildings since the 1920s. A company owned by Harry Brearley, who is often credited with the invention of stainless steel, provided the martensitic alloy used in the entrance canopy of the Savoy Hotel, London, in 1929. The following year saw the completion of the Chrysler Building in New York, with its roof spire in austenitic type 302. This remained intact until 1995, when a few panels showing signs of pitting corrosion had to be replaced. The 1950s saw the completion in New York of the Sacony-Mobil Building, the coarse-finish cladding of which was thoroughly cleaned in 1995 using soap, water and ammonia.

### Structural support

Similar effects can be obtained with roofing. Although in titanium and not stainless steel, Gehry's rose-tinted winery in the Rioja region of Spain is an especially delightful, fanciful example.

In Edinburgh, the Scottish Parliament made extensive use of stainless steel in the exterior and interior, but its most notable feature is the stainless steel roofs, which reflect the contour of the hills immediately behind the building. Stainless steel roofs also have an obvious structural function in providing light but strong and leak-proof covering. In London, the pavilion at the church of St Martin-in-the-Fields is crowned with a domed roof in 10mm 316L with a bead-blasted finish. The New Parliament Library building in Delhi, India, has a dome which consumed 38 tonnes of stainless steel, spanning 16 metres. Stainless steel can also provide structural support in the form of columns. Two pavilions recently built in front of Leinster House, the seat of the Irish parliament in Dublin, were provided with bead-blasted stainless steel columns. In Canberra, Australia, the 200-tonne type 304 stainless steel flagpole is believed to be the largest free-standing stainless steel structure in the world.

### Mesh and wire

Finally, one extremely important manifestation of stainless steel on buildings is mesh. Mesh screening can be attached to the exterior or interior of buildings to achieve several purposes and effects: to screen sunlight and heat, to reflect various kinds of lighting, or to cast a veil over a building in such a way as to reduce glare and reflexion while leaving the building's basic outline visible. Two outstanding examples are the interior of the Mitterand Centre of the Bibliothèque Nationale de



*The garden foyer of the Scottish Parliament contains 12 skylights shaped like giant leaves. The roof glazing is supported by stainless steel connectors. Between the skylights are panels and coffers of stainless steel. Image © Scottish Parliamentary Corporate Body. Image © Scottish Parliamentary Corporate Body.*

France, overlooking the left bank of the river Seine in Paris; and the two moveable stages that comprise the Spielbudenplatz, Hamburg, which are clad in spiral mesh in type 316L for weatherproofing and to protect the backstage area from vandalism and graffiti. In daytime the structures look closed, but at night they are illuminated from within.

### Grades used in architecture

Grade choice for architectural construction does not change very quickly. The standard austenitic grades 304, 304L, 316 and 316L are easy to fabricate and are well suited to the undulating, curved shapes that

characterize postmodern architecture. They are also the grades which are easiest to colour electrochemically. The first two grades are habitual for interiors and can be used for exteriors if pollution and corrosive factors such as salt are present. The last two grades are more suitable for the exteriors of buildings located in polluted and corrosive environments such as large sea ports, cities with large volumes of traffic, heavily industrial zones, or areas where high temperatures and humidity are combined. In these conditions, 316Ti is also a suitable choice.

In recent years duplex, especially lean duplex, has made some inroads. It is stronger than austenitics for the same

### Titanium

On buildings, titanium is sometimes used as an element in the alloy 316Ti. More strikingly, pure titanium has been used as a cladding or roofing material in several prestige projects, notably in buildings designed by Frank Gehry. These include the Guggenheim Museum in Bilbao, Spain; the Marques de Riscal winery in Spain's Rioja region, with its soft pink panels; the Lewis Library at Princeton University; the Ontario Art Gallery, Ottawa, Canada; and several others. Recently titanium has gone out of fashion, probably because of its cost and because the same swooping, colourful effects can be achieved with austenitics.

weight, therefore ideal for load-bearing and structural functions such as roofs and arches. Duplex has been used in several footbridges (the mast of the Rhyl Harbour Footbridge, Wales; a footbridge in Siena, Italy; a bridge over the river Brenta at Corte di Piove di Sacco near Padua, Italy). In the new terminal at Doha International Airport, Qatar, AL2003 and 2205 were used. In the Star City Casino, Sydney, duplex 2205 was used to create drum and cone structures that look very light and transparent. Shotpeened duplex was used at a UNESCO site in Northern Ireland, the Giant's Causeway, for a five-metre-high, sculpture-like column. Montanstahl's new head office in Stabio, Switzerland, is clad in LDX 2101® with a polished Scotch Brite finish.

### Sources

[www.euro-inox.org](http://www.euro-inox.org);  
[www.nickelinstitute.org](http://www.nickelinstitute.org);  
[www.outokumpu.com](http://www.outokumpu.com)

### Swimming pools

Of all civic buildings, swimming pools are the ones where the higher grades of stainless steel are likely to be found. This is due to the corrosion caused by the combination of heat, humidity, bacteria and human fluids interacting with chlorine. After an accident in a Swiss pool caused by stress corrosion cracking, swimming pools have been forced to use higher grades. Types 304(L) and 316(L) are normally suitable for the splash zones that are regularly cleaned, but fasteners and other load-bearing parts that are not accessible for cleaning require more highly alloyed grades, such as alloys 24, 926 or 254. For more details, see European standard EN 13451-1.

### Finishes

Choosing the correct finish is just as important as choosing the right grade. This is graphically illustrated by the stainless steel cladding of Gehry's Walt Disney Concert Hall in Los Angeles. When the mirror-finish panels were erected, the heat and the glare became intolerable for passers-by and nearby residents. The problem was solved by applying a combination of vibrational and orbital sanding to the exterior.



*Designed by Frank Gehry, the Walt Disney Concert Hall, new home of the Los Angeles Philharmonic, is designed to be one of the most acoustically sophisticated concert halls in the world. Its stainless steel 316 skin is composed of convex and concave undulating surfaces.*