euro inox
The European Stainless Steel Development Association

Stainless Steel and its Visual Impact

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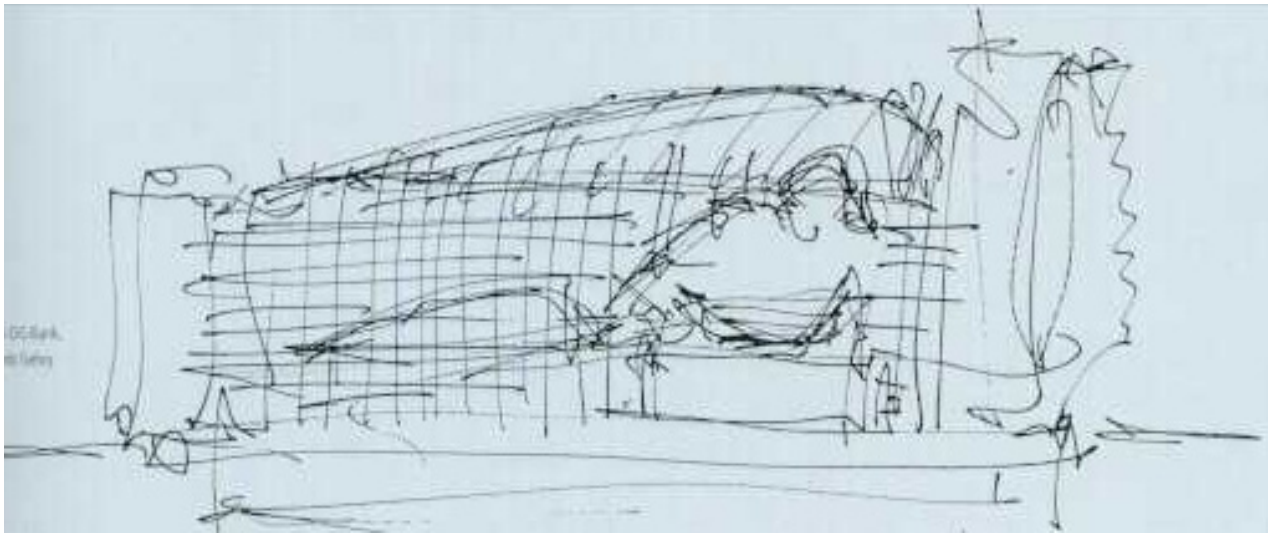


© Frank O. Gehry

My thanks first of all to renowned architect Frank Gehry for this reproduction of an early sketch. It illustrates my thought process in preparing this presentation.

The easier part of the preparation was setting out the basic structure and timing: this is the frame-work that I came up with. The introduction, the main topics; the visual impact of stainless in buildings, their locations and functions: applications of surface finishes used, where and how: then a summing up and conclusions. In about 25 minutes from now we will all know if I have got that part of it right.

The challenge came when I tried to select the examples that I might use to help demonstrate the visual impact of stainless steel in architecture, the leading mass medium of public art. There was so much to choose from. So I started by looking at a list of reference buildings that I try to keep up to date.

So many buildings

These are buildings where we, members of Euro Inox, have been involved in some way: they may be interesting or spectacular or perhaps just ordinary, simply functional buildings. Some are quite new, some are older. Others, by the standards of certain property developers, are probably ancient. But that is another discussion, for another day. And they are not all located here in Europe either: increasingly they are to be found as far afield as China, Hong Kong, Malaysia, the United States and beyond. I also looked at my thesaurus, dictionnaire des synonymes, for some inspiration. I always need plenty of inspiration!

America Square, London
Courthouse, Strasbourg
Canary Wharf, London
Museum Tampa, USA
QEQM Gates, London
Expo Centre, Singapore
Waterloo Station, London
LG HQ Building, Seoul
Nat West Tower, London
Pharmacie Labs, Uppsala
Sainsburys, Plymouth
Halle Concert, Manchester
Brook House, London
KL Int Airport, Malaysia
Royal Albert Dock, London
NCPM, Sheffield
Cheung Kong, Hong Kong
Comm. Bridge, London
Jin Mao Tower, Shanghai
Puerta de Europa, Madrid
Cabot Square, London
Lantau Bridge, Hong Kong
Finishing Dept, Sheffield
Lowry Centre, Manchester
Jubilee Extension, London
Blue Cross, Chicago
Millennium Bridge, York
Broadgate West, London
MRT Terminal, Singapore
Hendrix Museum, Seattle
Nokia Building, Finland
Hermitage, St. Petersburg
Museum, Heidleburg
Mayo Clinic, Minneapolis
Planetarium, Bristol
Tunnel Rail Link, Kent
O'Connell St. Spire, Dublin
Cathedral, Liverpool
Limehouse Link, London
Euro Disney, Paris
Lyceum Theatre, Sheffield
Petronas Towers, Malaysia
Footbridge, Derbyshire
Science Park, Leicester
Reichstag, Berlin
Reflector, Nottingham
Spectrum Bldg, Glasgow
Herne Bay Pier, Kent
Bridewell Street, Bristol
LUXX Beacons, Bristol
University Wales, Bangor
Don Valley, Sheffield
Costa Mesa, California
Bus Repair, Doncaster
Kellogg Bldg, Manchester
Chrysler Bldg, New York
Savoy Theatre, London

68 & 56

There I found a list of 68 different building types and 56 varieties of building materials. Too many to list here so these are just a few. Plenty of choice for you and for your clients: plenty of opportunity for us and plenty of competition for stainless steel finishes too. This was also evident when I searched for appropriate applications of stainless and finishes in or around these locations.

Houses Stations Churches Art Galleries Museums Concert Halls Theatres Bridges Walkways Science Parks Monuments Court Houses Apartments Offices Theme Parks Industrial Banks Canopies Retail Shops Gateways Airports Tunnels Exhibition Centres Sports Stadia

So many applications

Increasingly, designers have recognised new opportunities and benefits in working with this modern hygienic material, which is lightweight, strong and inert. Stainless steel is also a material that will keep its promise of durability and long life, though not at a high cost to our environment. It is an economic material that is easily available in a wide range of forms and, is ready to use in an array of finishes. Now the choice of grade and thickness of material to be used can be determined by engineering and application design needs. To some extent similar criteria apply to the selection of surface finish and these issues have been very well covered by previous speakers. However it is within surface finish that the creator has the greatest scope to realise and express the appearance of his or her design concept, to create a unique, lasting visual impact. And there are plenty of finishes to choose from.

Balustrading Tunnel linings Wall ties Street Furniture Fixings Bolts Nuts Screws Washers Lintels Roofing sheets Joist hangers Handrailing Floorplate Signage Sinks Plumbing & Drainage Urinals Cable ladders Lamp posts Ventilation ducts Door furniture Wall planks Wind tunnels Wire ropes & cables Gates Curtain walling Fire dampers Blast walls Roof linings Ceiling tiles Reinforcement bar Rock anchors Vent louvres Lift cars Escalator panels Swimming pool furniture Feature cladding Fire doors Rail platform seating Door entry systems Window furniture Space frames Bridge enclosures Power cable supports Banding & strapping Lightning conductors Cable Ladders

So many finishes

From subdued, low-reflective greys, to bright mirror images, where the chrome-look in stainless steel can be seen at its best. And from soft textures that change with natural light, to heavy, durable raised patterns that cope so well with the hustle and bustle of modern life. But these finishes are not here by chance. Tops of this list are the common mill finishes for flat rolled products. So if you are designing a building for Paris or Prague, for Tiannamen Square or the Arctic Circle, you can be sure that these finishes will be immediately recognisable and available the world over. As for the others, they are there because people like you wanted them. They are not all everyone's favourites, but there is something within the range to meet most tastes. And if there is not something already available, you can always do it yourself.

1D	2D	2B	2R
Ground	Polished	Brushed	
Mirror	Dull Rolled	Low Lustre	
Textured	Patterned	Coloured	
Bead-blast	Shot-Peen	Etched	
Terne coat	Tin Plated	Painted	

Anish Kapoor

Here is a recent sculpture by Anish Kapoor called Sky Mirror, at the Nottingham Playhouse in UK. It is 6 metres diameter and weighs over 8 tonnes in 316 grade stainless. The plate has been cut, fabricated, welded and polished to this mirror finish. This work was not done by the stainless manufacturer: it was reported that it took about 3 months for a specialist contractor in Finland to completely polish both sides.

Sky Mirror, Nottingham Playhouse, Nottingham, England
Anish Kapoor

I would like to take a moment to clarify a point on my descriptions of grades in this presentation. Already you will have noticed that I have referred to 316 grade and I may later refer to 304. This is not to be disrespectful of EN European Standards. It is easier this way to differentiate between the main stainless groups, rather than trying to point to specific EN Series numbers in the description of an application.

To help you to select the exact specification number, there are information sheets that show the EN Series cross-referenced with the national or traditional number series. These information sheets, which also provide relevant chemical, mechanical and other property data are freely available – do ask me afterwards if you want to know more.

Equally, the names or the serial numbers of these finishes should only be used to indicate groups or types of finishes or finishing processes, rather than one individual, distinct appearance. Appearance is highly subjective. Normally, there will be differences between similar products supplied by the same or by different manufacturers or processors. Sometimes these differences will be subtle, sometimes they will be blatant. It is important to remember that it is not enough to specify 'Polished' or 'Bead-blasted' just in the same way that it is not enough to specify simply 'stainless steel'.

There is no need to write down all these details at this time: far better to get a copy of the "Euro Inox Guide to Stainless Steel Finishes". An excellent reference handbook, it is available in printed brochure or CD-ROM formats and in several languages. It tells the story, from the coarse, organic texture of hot rolled plate to the delicate artistic etchings on mirror polished sheets.

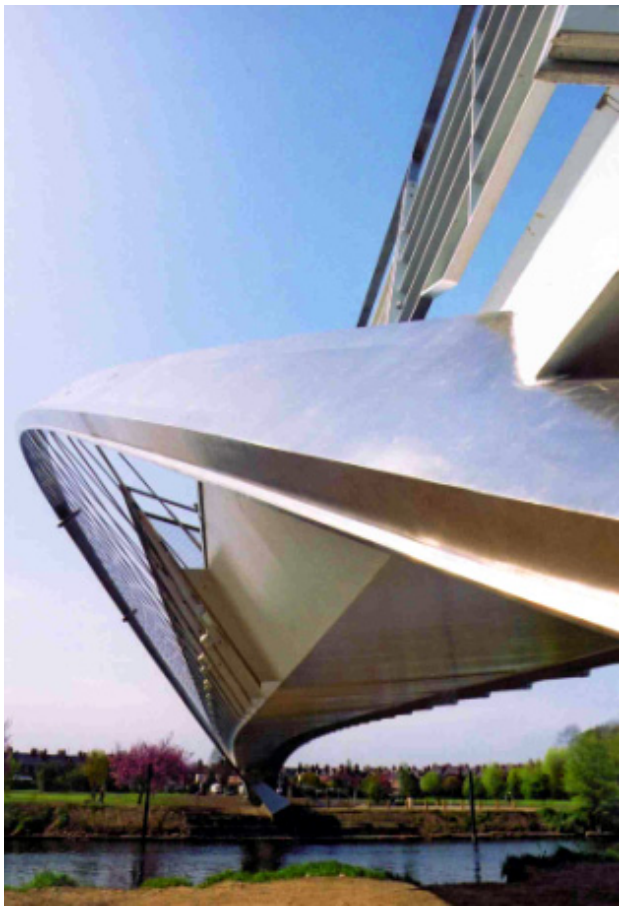
Before we move on, I would like to say 'Thank you'. Because no buildings would be here today were it not for the architects and engineers who designed them and, of course, the clients who paid for them. So for those buildings you are seeing here, for those you yourselves have designed and, for those yet to come, thank you, architects, engineers and, of course clients, everywhere.

Now, clearly, it will not be possible today to look at each finish used on every building in all of these locations. So here is a short tour, aimed at showing you a selection of architectural and structural applications around the world where stainless steels have been chosen by architects, by engineers or by owners, who have recognised the benefits of a material that combines practicality and durability with prestige and economy.

QEQM

I want to start with a celebration. This decorative gateway was paid for by public funds and it commemorates the long life of the mother of our Queen, bless her! She is over 100 years now. Sadly, and despite her Royal lifestyle, she is unlikely to see another 100 years, but that cannot be said of the stainless. The design uses plate, strip, bar and wire, all of which have been cut, shaped, brazed, burnished, polished, welded, acid-cleaned and electro-polished. What other materials could withstand such treatment that actually enhances its appearance and helps to keep it looking good for many, many years to come.

HRH Queen Elizabeth,
The Queen Mother Commemorative Gates,
Hyde Park, London



Millennium Bridge, York, England
Whitby Bird & Ptrs., Engineers
Duplex 2205/316

York Bridge

To make certain that this bridge would be strong enough to give lifetime support, the engineers, Whitby Bird & Partners, designed the structure in high-strength, Duplex 2205 stainless. The main arch, which spans 80 metres, is a welded box section, produced from 75 mm and 20 mm thick plate. Several shorter lengths of section were fabricated, then curved to the final arch profile, delivered to site then welded end-to-end and erected.

This is the new Millennium Bridge in York, in Northern England and, to ensure the appearance of the bridge remains in good condition, the stainless plate was cleaned and polished before and after welding and fabrication. Even though Duplex 2205 has very high corrosion resistant properties, the surface has been given a clean-cut polished finish, with a very smooth micro-surface roughness of less than 0.5 microns R_a.

Millennium Bridge,
York, England
Whitby Bird & Ptrs.,
Engineers
Duplex 2205/316

Incidentally, it is believed that the 75 mm thick plate was the largest stainless plate ever to have been polished for an aesthetic engineering application, anywhere in the world. Furthermore, we understand that, to date, this is the longest single span, of Duplex stainless in a structural application.

Stainless was recognised as the most appropriate material for other high-strength or high-wear parts of the bridge. The bridge is already very popular with local people and it has become a busy tourist attraction in the region. The durable nature of the 316 grade used in the balustrading and other public areas will ensure a long service life. The attractive surface finish will also help this process as it should be very easy to clean, so that everyone visiting the bridge or living nearby can take pride in its appearance. Pride in appearance is important not just to us, but also to those who have to live with the results of our work.

Elevated Walkway
Goyt Valley, Derbyshire, England
Derbyshire Consulting Engineers
316

Derbyshire

But not all bridges are big and spectacular. This is a simple elevated walkway, which has helped to open up a delightful part of the countryside that was previously closed to the public. Derbyshire Regional engineers who designed and built it have won many accolades for their work, which shows too how stainless, aluminium, wood and stone can work so well together. Once again, smooth polished surfaces will reduce the risk of staining and help keep down public spending on maintenance.

Tsing Ma

It will be a little more difficult to maintain this structure, not because of the materials used, but because of the sheer size of the installation. The Tsing Ma Crossing to Hong Kong's new airport has stainless deflector cladding to cope with high winds in the South China Seas – possibly up to 250 km/hour. I am told it is the world's longest suspension bridge. The grade is 316 with high Molybdenum and the surface finish is 2D. This is a basic mill finish and it would not have been my first choice but it may help with a plan that we have heard of, to paint the bridge red. Design of the bridge is by Mott McDonald engineers.

Tsing Ma Bridge, Hong Kong
Mott MacDonald
316/2D

CTRL

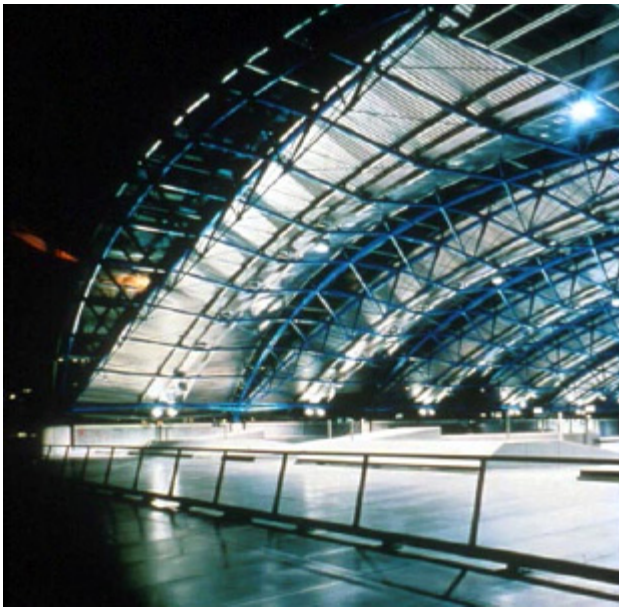
We British are a little behind you French in the high-speed rail-link development programme, but we will get there. Soon! These are bridge parapet covers on the Channel Tunnel Rail Link that connects Eurotunnel to London. They help to control noise, mainly from the train wheels. So far around 8000 square metres of stainless grade 316 2B in 2 mm thick has been polished to a clean-cut surface with roughness below 0.5 microns R_a.

This material has been perforated with over 13 million tiny holes. And an even sillier statistic, the panels have been subjected to a total of 69,000 bending operations. There is not much more one can say about bridge parapet covers, especially these. However it seems to me their design resembles that of the front of a Eurostar train. Maybe that's just a coincidence?

Channel Tunnel Rail Link
Kent, England
Bridge parapet covers

Waterloo

This is the Waterloo International in London for Eurostar, designed by Nicholas Grimshaw Partnership, for the high-speed rail-link to Brussels, Paris and beyond. Textured and patterned finishes are used extensively in public contact areas where long-life good looks are an essential attraction for passengers.
The roof, which we see here, is in grade 316 with high Molybdenum. Roof panels are 0.9 mm thick, with gutters and supports in 3 & 5 mm and all have a Matt-rolled finish. The high Molybdenum content of the material, the smooth surface finish and a strict cleaning regime are some of the features of the design that will help protect the 125 year warranty that was required by the building owners. Only another 116 years to go!



Waterloo International Terminal, London
Nicholas Grimshaw & Ptrs

Liverpool

The only link I could find between London's Waterloo and this building was football. Last week, Arsenal FC from London were defeated by Liverpool in the football cup final. My sympathies to Duncan Munro, Director of the British Stainless Steel Association, who is in the audience – he is such a keen fan of North London football.
This building is in Liverpool. It is the Metropolitan Cathedral. The concrete roof, previously covered with 5 mm thick aluminium was leaking badly and was replaced by 0.5 mm thick stainless - one tenth of the thickness. The architect was Vis Williams Pritchard. It is a Roman Catholic Cathedral so my mother would have said that the stainless steel should be made in heaven. It was not. It came from Sweden – not even close. But I am sure she would have been happy to see the sparkle that the cold rolled stainless surface gives to the building and the area around it, even on a dull day. The roof pitch is approximately 45 degrees and, to prevent damage by high winds, a special perforated, standing seam cover is used to help equalise wind pressures.

Metropolitan Cathedral, Liverpool
Vis Williams Pritchard Architects

Glasgow

Some of the architectural press spoke unkindly about this building in Glasgow, by local architects, Murray and Dunlop. But sometimes that form of criticism can reflect well on the architect and badly on the press. There is no doubt that the re-cladding of this previously drab office block has helped to transform this commercial area of Scotland's second city. It is of the same family of material as the Liverpool Cathedral but the mirror-type finish is as supplied from the mill. It is 2R or Bright Annealed.

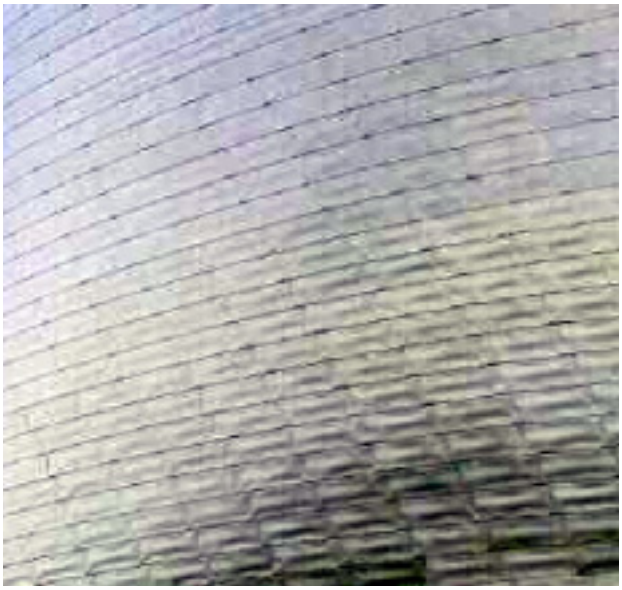
During manufacture, this material is softened in an inert atmosphere of Nitrogen and Hydrogen. Because there is no oxygen, there is no oxidation, so the bright, cold rolled finish is preserved throughout.

The architect Frank Gehry has designed several buildings in Düsseldorf that use similar material and they are a spectacular attraction, loved by the public and highly acclaimed by the architectural press.

Spectrum Building
Glasgow, Scotland
Murray & Dunlop Architects

Gehry

Gehry's most famous building today is the Guggenheim gallery in Bilbao. It has a wonderful carbon steel structure supporting Titanium rainscreen cladding. This is a picture of a small section. Titanium is an excellent material that has been with us for many years and, like stainless, can be used to help produce dramatic building forms.



Guggenheim Gallery
Bilbao, Spain
Frank Gehry, Architect
Titanium

Lowry

Similar effects to Bilbao can be produced in stainless too and with its comparable long life expectations, stainless is a more readily available, better understood option at a much lower cost. The Lowry, a new arts centre, originally conceived by the architect Sterling, has recently been completed by Michael Wilford Architects and Buro Happold engineers. It is in Salford, not far from Liverpool, in the north-west of England.

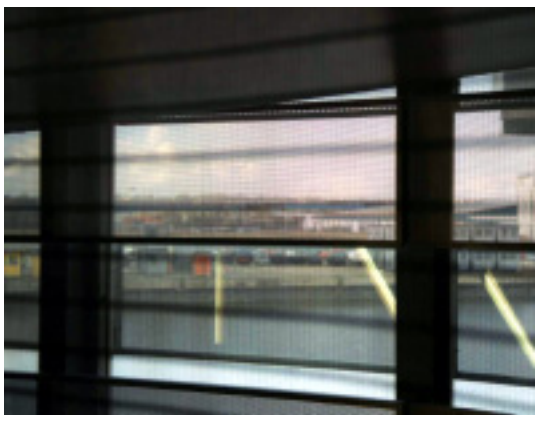
The Lowry building
Salford, England
Michael Wilford, Architect
Buro Happold, Engineer

The Lowry cladding uses a pre-fixed clip system similar to that used for fully supported roofing. Bilbao is, I understand, a hang-on method. The main cladding elements here are in 316 in 0.5 mm thick with a Matt-rolled finish. One of the roofs is in 5 mm thick Duplex 2205 with an acid-pickled finish. Glazing bars, in 316, have a smooth polished finish as does the main tower on the right, where panels are extensively perforated.

The Lowry building
Salford, England
Michael Wilford, Architect
Buro Happold, Engineer

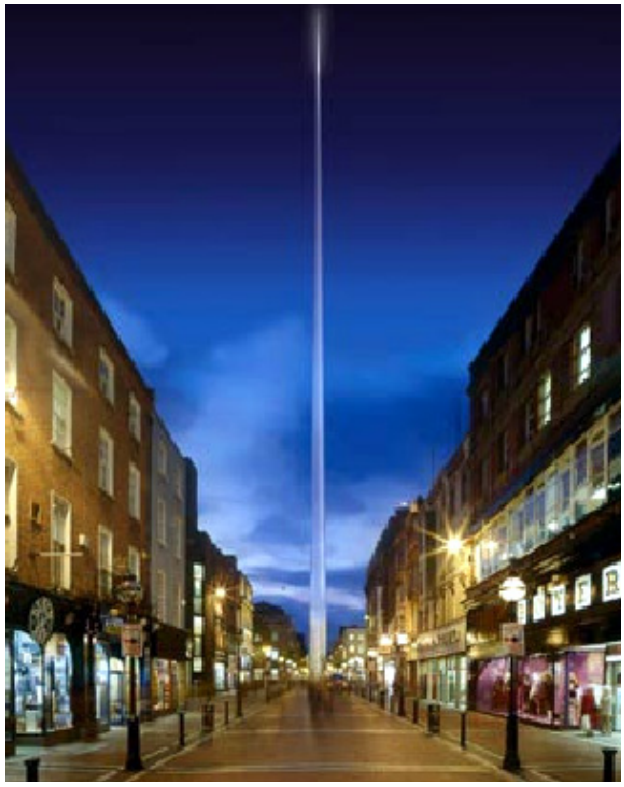
Polished and perforated panels are seen on the distinctly angular exterior cladding and there is plenty of good, precise detailing here too. In the background you can see the new Liebeskind building for the Imperial War Museum. A little too much aluminium there for me, but it promises to be another stunning building well worth visiting.

I think the architect must have attended a Euro Inox or British Stainless Steel Association seminar, because the use of stainless throughout is quite extensive. The lightweight exterior cladding is carried into the building and here they have cleverly used stainless mesh as a security curtain. But this is also a shade as well as an attractive feature in an otherwise bland corridor. Let's leave Britain again and go across the sea to Ireland, my homeland.



Spire of Dublin

Ian Ritchie Architects of London won the competition to provide Dublin with their most striking of new Millennium monuments. This spire will be erected in the city centre next year. It will be 130 metres high, constructed in a 316 grade plate. Thickness of the tapering pyramid sections will be 35 mm at the base and 6 mm at the tip. The surface will begin as 1A, basic hot-rolled and will be ground to a smooth grit finish, below 0.5 microns R_a. Welds will be ground smooth before everything is bead blasted to a surface standard that has been extensively tested for stain resistance, vandal resistance and cleanability.



The Dublin Spire, Dublin, Ireland
Ian Ritchie Architects
Ove Arup, Engineers

Blue Cross Blue Shield
Chicago, USA
Lohan & Co Architects

Chicago

Much further West is Chicago where the Blue Cross Blue Shield Medical Insurance company headquarters are clad in a smooth texture bright annealed surface called Linen Cambric. For the bottom floors, or those close to street level, architects Lohan chose grade 316 to resist the rigours of the Chicaco winters: for all the upper floors they were able to specify the same pattern in grade 304. And they match perfectly.

Normally, 304 and 316 materials in the same surface condition are difficult to tell apart. And, if you ensure that sheets are fabricated and erected on the building with the same rolling or polishing direction, the overall appearance will be more consistent.

Jin Mao

Consistency of performance is a vital aspect of any material but consistency of appearance is equally, maybe more so. Skidmore Owings & Merrill designed the Jin Mao Tower to service Shanghai's new growing financial sector and it now stands proud in the Pudong district a stunning view in all directions. Flat panel cladding in 2.5 mm thick 2R textured, again Linen Cambric, is complimented by bright polished tubular sections over the entire exterior.

Jin Mao
Pudong, Shanghai, China
Skidmore Owings & Merrill

Petronas

Like Jin Mao, the Petronas Twin towers, tallest in the world, use the Linen Cambric type 2R texture finish. Again, all in 316. Tubular elements feature very prominently on the exterior where architects Cesar Pelli and the client wanted a consistently bright, reflective finish that would mirror the growing success of this fast developing region. Approximately 75,000 panels of Linen Cambric were supplied, all to appearance criteria that were agreed with and, strictly monitored by the architect and cladding contractor. I know many of these panels, personally!

Petronas Twin Towers
Kuala Lumpur, Malaysia
Cesar Pelli & Associates

VVIP Building
Kuala Lumpur Int. Airport, Malaysia
Razaly Associates, Architects

KLIA

The new Malaysian national airport is built in reclaimed jungle, between Kuala Lumpur and Singapore. The stainless steel is pre-painted on the topside with PvF2 to help reduce reflectivity on the roofs of the enormous buildings and to allow them to blend with the surrounding jungle vegetation. Some of the roofs have fully welded seams allowing the special Asian roof shapes to keep out the heavy winter rainfall.

St. Petersburg

We are on the way back to Europe now and, if we stop off in St. Petersburg, we can see the beautiful Hermitage museum in St. Petersburg. The roof suffered from years of neglect and the valuable contents of the galleries were at risk. The same material that was used on the Malaysian airport works well here too. The painted finish restores a rightful air of tradition to the fully supported roof. Well, the short tour is over, so lets look forward to the future and whatever it brings.

Hermitage Museum, St. Petersburg, Russia
Gerard Prins, Architect
Evers Partners, Consulting Engrs

Expectations or fantasy?

- Fingerprint resistant
- Self-cleaning
- Coloured alloy
- Photo cellular
- Microbiological
- Organic

Future

Now, we manufacturers try hard to satisfy the needs of designers, with an increasing range of finishes, grades and forms. But we must also try to keep in mind the possible risk that this array of choices might become overwhelming to you as well as to ourselves.

Gehry New York

Some of these ideas may be fanciful or even fantastic, but look at Laser technology for example – it's no longer the science fiction it was twenty years ago. Here we see a design model of a building by Frank Gehry. The fabrication of the cladding may be easy: making the Swiss Army pocketknife in the foreground could cause some difficulties!

So we must all try to continue working together to overcome difficulties, to work on the basics: consistently high standards of all round quality and reliability should be the goals of us all. Every day. But it is not simply a question of surface finish.

Music Theatre
New York, USA
Frank Gehry, Architect

Chrysler

It seems that every presentation on stainless steel has to contain a picture of this building. Is this the third time today? But I make no excuses for including it here now. An architect, engineer or owner made some very brave decisions around 70 years ago. They chose what was then the new wonder material, stainless steel, for the cladding on this building. It is grade 302 with a 2B finish. Some components were replaced during a cleaning programme in the 1950s and again in the 1990s but the original material is still there today. It looks as good as ever and is expected to last at least another sixty years.

Chrysler Building
New York, USA

The Right Choice

Why has this happened? Because the right choices were made: from materials selection, through manufacture, erection and maintenance. These criteria are equally important in the decisions that you make today. They are the essence of success in any industry sector, not just architecture, building and construction.

- material
- grade
- finish specification
- design
- manufacture
- assembly
- maintenance
- environmental fit

Court of Human Rights

Well now we are back home in France. The court of Human Rights in Strasbourg where the architect, Richard Rogers, wanted the outside of the building to have an appearance that was reminiscent of pewter, a traditional material that has kept its air of good, common quality over the centuries. Grade 316 is used in 2mm thick for the cladding: the surface finish is low reflective, Matt rolled.

One of the reasons for choosing this fairly basic finish was the relatively limited use of manufacturing resources. It is a relatively short, basic process but with delightful results. Closer to nature is what the architect liked and how different that seems to the polishing of the sky mirror we saw earlier. Now it is up to you to be the judge, to decide what is best for you. And we will try to help you to find the right solution, to make the right choice.

Court of Human Rights
Strasbourg, France
Richard Rogers Ptrs., Architect