Stainless Steel, Architecture and the Environment.

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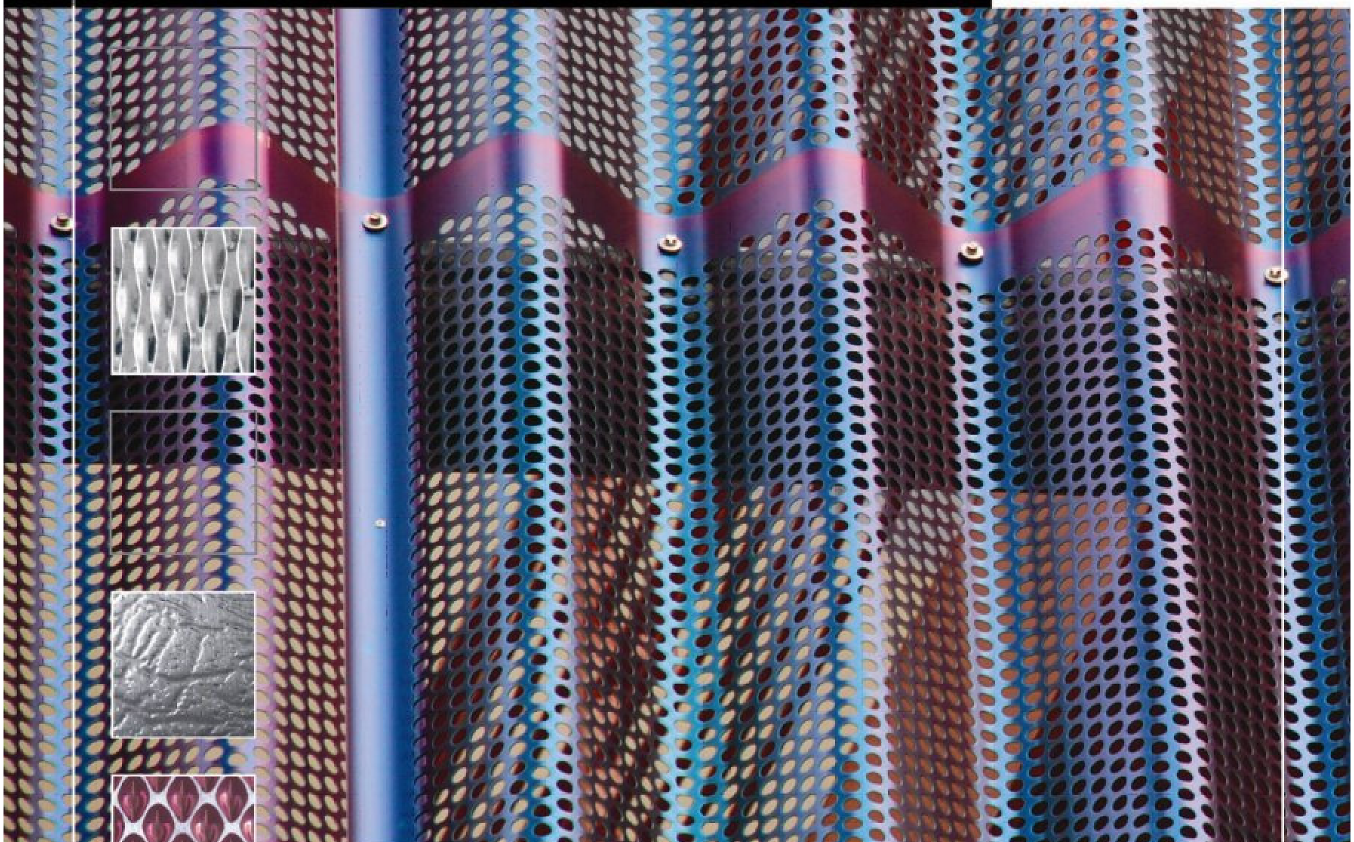

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Stainless Steel, Architecture and the Environment

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1 Introduction and Aims

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Stainless steel is generally understood to be an environmentally friendly product, and through it's widespread specification in areas such as hospitals, restaurants etc is also understood to be a hygienic choice.
In architectural and industrial applications, stainless steel represents a long lived product, which when specified correctly will stand up to the specific rigours of a given environment, even the harshest offshore applications.
Stainless steel is a highly recyclable and recycled product, helping greatly with the sustainability of the primary resources required for it's production.
It is the intention of this report is to pull together information from varied sources in support of these statements and to provide an overview of the green credentials of stainless steel as an architectural choice.

2 Properties of Stainless Steel

2.i Corrosion resistance

Stainless Steels (Steels containing a minimum of 10.5% chromium) show excellent levels of corrosion resistance across the board of applications. It is the presence of an inert, self forming and healing layer of chromium oxide which gives stainless steel it's corrosion resisting properties, isolating the iron in the metal from the atmosphere. The corrosion resistance of the material can be further enhanced through addition or manipulation of the content of specific alloy metals in the stainless steel.

Architecturally, Stainless steel is globally accepted as an excellent choice for specifiers. Global references such as the Chrysler building in New York, which has been in situ for more than 80 years having only been cleaned on 2 occasions, reinforce this fact and a vast array of other documented evidence exists in support of it. In summary 316 (1.4401) is the grade of stainless steel most suitable for polluted, industrial or marine environments on account of it's higher corrosion resistance than other standard grades such as 304 (1.4301). Therefore in urban façade type applications where pollution coupled with the likelihood that a regular cleaning regime will not exist or be adhered to, 316 would generally be the specification of choice.

2.ii Durability

The mechanical properties of stainless steel when considered alongside the corrosion resistance, make it a highly durable product. Stainless steel consequently has a very long life cycle when compared to alternative architectural materials such as Aluminium or other steels. I have included in the appendices a typical mill test certificate for 316 (1.4401) grade stainless steel, showing chemical and mechanical properties.(Appendix 1)

2.iii Recyclability

The recycling characteristics of stainless steel can be summarised as follows:

1. Stainless steel is 100% recyclable.
2. It can be continually recycled without any degradation of it's properties or performance.

3. The recovery rate of steel construction products from UK demolition sites is currently around 94% with 84% going for recycling and 10% being directly re-used.(Source: 'Stainless Steel and Sustainable construction', BSSA 2004)
4. Stainless steel has a very high recycled content. Globally it was concluded, following a case study by the International Stainless Steel Forum (ISSF) ref, that the recycled content of stainless steel is 60%. In Europe the ISSF calculates that the input of recycled steel stands at 70%

These figures make stainless steel the most recycled material in the world!

3 Sustainability and Environmental impact

Due to the very high levels of recyclability and recycling, stainless steel has an environmental impact significantly lower than would exist if production was purely from primary material sources as can be demonstrated in the below section of this report.

3.i Energy Consumption, emissions and waste through manufacturing

Recycling aside, due to increased efficiencies and working practices, it was calculated that energy consumption used in the production of stainless by the Outokumpo mill in Sheffield had fallen by 70% over the 20 years to 2004 (Source BSSA)

In conjunction with improvements in manufacturing practice, the increasingly high level of recycled content in stainless steel helps reduce the energy consumption, emissions and consequently the carbon footprint of the producing mills. The paper 'how to quantify the environmental profile of stainless steel' (Hiroyuki Fujii et al 2005) employing Life Cycle Inventory (LCI) and Life cycle Assessment (LCA) figures for stainless steel, enables comparison of primary production (that using ***purely new*** raw material components), with production based on ***purely recycled*** material.

Definitions (source; ISSF);

Life Cycle Assessment (LCA) is a tool to assist with the quantification and evaluation of environmental burdens and impacts, associated with product systems and activities, from extraction of raw materials in the earth to end of life and waste disposal. It is being increasingly used to assist with decision making for environment related strategies and materials selection.

Life Cycle Inventory (LCI) is one of the phases of a life cycle assessment (LCA). LCI data quantifies the material, energy and emissions associated with a given functional system (for example the manufacture of 1KG of stainless steel coil)

The paper demonstrates that as recycled content of stainless steel goes up, the primary energy used in the stainless steel production falls.
This principle can be summarised by the listed data for 304 2B raw material showing the 2 extreme scenarios of 100% primary material based production against a 100% recycled case as demonstrated in the same paper.

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This lists the energy required, Co2 emitted and waste generated in the *__production__* of 1KG of stainless

304 2B	**100% Primary Case**	**100% Recycled Case**
Energy (MJ/Kg)	73	23
C02 (Kg / Kg)	7.10	3.90
Waste (Kg/Kg)	2.80	0.6

**Because no direct data exists for the 100% primary situation, which doesn't exist in practice, this was calculated using LCI and LCA which were used and adjusted to give hypothetical data for the two cases shown above.

Note; These figures do not allow for credits for recycling at the end of life, which would further widen the result.

3.ii Other environmental considerations

- There is little or no run off or contamination from a stainless steel product making it hygienic and resulting consequently in little or no pollution of our land and waterways.

- Lower requirement for regular cleaning on account of high corrosion resistance, results in reduced run off of detergents or other specialist cleaning products into our waterways. As discussed in an earlier section of this report, the Chrysler building has been cleaned twice in more than 80 years.

- Due to high levels of recycling, there is significant reduction in the impact on land fill disposal of stainless steel, reducing further it's environmental impact. Recycling of stainless steel is commercially driven, rather than through tax breaks for recyclers and is therefore self sustaining.

- Again on account of the recycled content of stainless, the pressure on mining of primary resources such as nickel or molybdenum ore is reduced again helping to minimise the physical damage and pollution associated with mining.

3.iii Industry awareness looking forward

The Steel Construction sector, led by the Steel Construction Sector Sustainability Committee, launched a sustainability strategy in 2002. This body in conjunction with the rest of the sector reviews progress against four sustainable development objectives defined by UK government.

- Social Progress which meets the need of everyone
- Effective protection of the environment
- Prudent use of natural resources
- Maintenance of high and stable levels of economic growth and employment

The full version of the strategy, which addresses a number of other initiatives can be downloaded from the following source;
http://www.steelconstruction.org/steelconstruction/view?entityID=99&jsp=source&sessionID=-1225454882317&entityName=document

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In addition to the strategy detailed above, A continually self imposed pressure by Stainless Steel mills to reduce their environmental impact will continue to build on Stainless Steel's strong reputation as a building material to meet modern demands. New techniques and ideas continue to push back the boundaries of what can be achieved.

For example, one of the major environmental issues connected with Stainless Steel production is dust emissions and soil contamination resulting from metals settling out of these emissions. The stainless steel manufacturing process generates large amounts of dust. To minimise emissions to the environment these are collected using filters. In 2007, 60,000 tonnes of dust and scales were collected in filters by Outokumpo and from these, 21,000 tonnes of metal were recovered and re-used in the steel production process thereby reducing emissions, and reducing the burden on primary materials for the manufacturing process.

Outokumpo positions itself at the forefront of environmentally conscious steel production, reducing where possible their environmental and ecological burden. In their own report, 'Outokumpo and the environment 2007', The group describes a project initiated to assign an ***environmental cost*** to the raw material value, with the aim of employing resources in the most efficient way, maximising value, whilst using as little resource as possible and thereby further minimising their ecological burden.

4 BREEAM, the Green Guide and environmentally aware construction

BREEAM (Building Research Establishment Environmental Assessment Method) is the longest established assessment method for buildings and is used to describe a buildings performance in environmental terms. Developers and designers are encouraged to consider a range of issues at the earliest opportunity during the development process to achieve the optimal score for the design planned. The issued certificate, in the range; Pass, Good, Very Good or Excellent can then be used for promotional purposes in a climate ever more conscious of collective environmental responsibility.
The types of areas assessed are;

- Management,
- Health and wellbeing,
- Energy,
- Transport,
- Water,
- Materials,
- Land use and Ecology,
- Pollution.

Category scores are issued and environmental weightings applied to give a single score from which the rating is derived. (Source; BRE website)

The BRE Green Guide to Specification is a publication which provides guidance on the environmental impact of elemental specifications for roofs, walls, floors etc for specifiers, designers and their clients. This thereby enables them to make informed choices in the design of the building. LCA data for different materials is used to assess various elemental

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construction systems and assign them ratings against various categories such as their effect on

- Climate change,
- Fossil fuel depletion,
- Ozone depletion,
- Human toxicity to air and water amongst other things and then assign that particular element a *summary rating* in the range A-C.

The section of The Green Guide associated with external wall cladding systems, observes in the words of the Authors that, 'Stainless steel cladding profiles extremely well, combining the benefits of lightweight cladding together with good recycling attributes, and consequently gives relatively low embodied energy and pollutant emissions'. The system rated in the guide incorporating stainless steel cladding (Stainless Steel cladding and coated steel lining panel, galvanized steel fixing rail, insulation, plasterboard internal wall on steel stud) achieves an A rating whereas of all the other wall cladding systems mentioned, most perform only a B rating.

5 Rimex Metals and the environment

Rimex Metals are a manufacturer of specialist metal finishes, primarily in stainless steel. For external facade cladding applications, Rimex would recommend 316 (1.4401) grade stainless steel, identified earlier in this report as the correct specification for harsh external environments.

The principle products supplied for architecture by Rimex Metals (Textured and Coloured products) are manufactured via processes that *contribute* to the environmental strengths of stainless steel as an architectural product, rather than detract from them.

1. The Patterning processes helps to increase the visual and performance life of a product, pushing back the architectural need to replace it and again reducing the burden on stainless production. The rolling process increases the rigidity of the stainless steel leading to greater resistance to impact damage, improved optical flatness and the concealment of scratches and abrasions through the existence of the pattern and light interplay with it. For this reason they are often specified for wall / column claddings in transit terminals and public buildings such as hospitals and schools, and lift car claddings.
2. The colouring process is a chemical process that thickens the naturally existing chromium oxide layer that naturally forms on stainless steel by between 0.02 and 0.36 microns. The presence of this thickened layer leads to light interference effects and the impression of colour. It is *not* achieved through a paint or dye application. A study conducted into the performance of the coloured finishes produced via the INCO process as employed by Rimex, found that stainless steel coloured via this route showed enhanced corrosion resistance over uncoloured sample pieces in both accelerated corrosion and accelerated pitting tests. (R.Blower and T.E Evans; INCO European Research and Development Centre). This enhanced corrosion resistance will also extend the life cycle of the product, potentially reducing pressure on raw material production with all that that entails.

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Rimex Metals are committed to reducing the effects of their activities on the environment wherever possible and a copy of their environmental statement accompanies this report (Appendix 2)

6 Conclusions

Stainless steel is an inherently green material in that it is 100% recyclable without any degradation or deterioration of quality. The stainless steel we are producing now could and should be in use in centuries to come. It is the most recycled material in the world

The stainless steel industry is increasingly committed to improve manufacturing techniques and practices, using raw materials as efficiently as possible and keeping to a minimum any environmental impact caused. Recycling is a crucial part of this and LCI and LCA data, which is increasingly available, will assist in this ongoing process.

There are specific tools such as BREEAM and the Green Guide available to assist clients, designers and specifiers in the selection of materials and systems in the development of environmentally sensitive construction projects. Stainless steel performs very well as a cladding choice according to this methodology and publication.

Rimex Metals as a finisher of raw stainless steel do through certain production techniques such as texturing and colouring act to enhance the operational life of the product. Rimex are committed to work with environmental bodies and within European guidelines, to minimise their environmental impact.

7 Appendices See separate documents

Appendix 1 **Example of a mill test certificate**
Appendix 2 **Environmental Statement**

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7 References

BRE environmental profiles http://www.bre.co.uk/page.jsp?id=53

How to quantify the environmental profile of stainless steel (Hiroyuki Fujii and Toshiyuki Nagaiwa, ISSF Fellows (Nippon Yakin Kogyo Co.Ltd, Tokyo, Japan), Haruhiko Kusuno, (ISSF) Staffan Malm, (ISSF Brussels, Belgium) November 2005
http://www.worldstainless.org/NR/rdonlyres/4AD88A29-6C1E-42F8-B235-B4176E901658/2432/Howtoquantifytheenvironmentalprofileofstainlessste.pdf

Introducing coloured stainless steel – a novel product and new process R.Blower and T.E Evans; INCO European Research and Development Centre, Birmingham

Life Cycle Assessment data http://www.nickelinstitute.org/index.cfm?ci_id=205&la_id=1

Outokumpo and the Environment 2007, Outokumpo

Stainless steel the green material, Designer Handbook; Specialty Steel Industry of North America (SSINA)

Stainless Steel and Sustainable construction – Special British Stainless Steel Association report Feb 2004. http://www.bssa.org.uk/publications.php?id=63

The Green Guide to Specification, Jane Anderson and David Shiers (3rd edition)

http://www.steelconstruction.org/steelconstruction/view?entityID=99&jsp=source&sessionID=-1225454882317&entityName=document

Organisations;
www.bre.co.uk (BRE)
www.bssa.org.uk (British Stainless Steel Association)
www.nickelinstitute.org (Nickel Institute)
www.worldstainless.org (International Stainless steel Forum)

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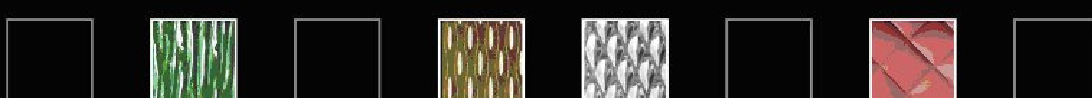

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