ArcelorMittal

The
intelligent
construction
choice

Steligence®

"We developed the Steligence® concept because we fundamentally believe that we can help architects, engineers and property developers to collaborate to build more sustainable, cost-effective buildings."

Greg Ludkovsky

Building the case for change

Dr Greg Ludkovsky is Head of Global Research & Development and a Vice President at ArcelorMittal. He began his career as a physics researcher in Russia, holds 24 patents and is the author of numerous publications on physical metallurgy. In 2014, Ludkovsky received Platts Global Metals' Lifetime Achievement Award. Here, he introduces Steligence®, an innovative, science-based philosophy designed to help the construction industry create efficient, cost-effective, sustainable buildings.

"The construction industry, with its scale and influence, stands to lead the way towards the circular economy, decoupling growth from resource use, deriving value from waste, and improving the social, economic and environmental impact of buildings – throughout their lifecycle.

Today, even without the inclusion of the waste carbon emitted during the manufacturing of building materials, the built environment is responsible for more than 40% of global carbon emissions. Opportunities to minimise the environmental footprint of buildings, boost efficiency and save costs through pre-fabricating components, or reusing materials – are lost. This in turn means that affordable living and working spaces are often beyond reach. Only the privileged few have access to high quality, highly functional spaces. We need to ensure that construction and architecture become more democratic. But until now, there has been no scientific approach to guide the industry to making smarter choices.

We developed the Steligence® concept because we fundamentally believe that we can help architects, engineers and property developers to collaborate to build more sustainable, cost-effective buildings, making high-end solutions available to everyone. Not only that, we wanted our Steligence® philosophy to be thoroughly underpinned by science. That is why every aspect of it is based on peer-reviewed, unbiased scientific research.

Steligence® is a philosophy, delivering a holistic approach to construction. It promotes continuous innovation, enabling the construction community to analyse the social, economic and environmental impacts of diverse building options, maximise the use of intelligent materials, such as steel, and develop a building of complementary parts. At ArcelorMittal, we're designing our new headquarters for disassembly, so that every component can be used to create a future building. We hope this venture, and our philosophy, will serve as a blueprint to inspire others."

Steligence® is a construction philosophy, based on science. It proposes a solution to the competing demands of creativity, flexibility, sustainability and economics.

"Steel is the basis of architecture today, the basis of construction. Encapsulating the notions of both solidity and modularity, it enables buildings to take shape far more rapidly and efficiently."
Jean-Michel Wilmotte

How Cradle to Cradle® thinking promotes innovation and business opportunities

William McDonough is a globally recognised leader in sustainable development and the co-founder of the Cradle to Cradle® design philosophy. He is founder and director of William McDonough + Partners, and currently serves on the World Economic Forum's Global Future Council on the Future of the Environment and Natural Resource Security. Here, he discusses the origins of Cradle to Cradle®, and how it can be applied in the construction industry.

How did the Cradle to Cradle® concept start and what is it, in a nutshell?

I conceived Cradle to Cradle® with German chemist Dr Michael Braungart as a means of eliminating the concept of waste and of creating a compelling alternative to the way products are made within the current linear economy, which works on a 'take, make, waste' basis. Through the Cradle to Cradle® design philosophy, we focus on a more regenerative approach in a circular economy: 'take, make, retake, remake and restore'. There is no waste, only nutrients – either biological (returning to natural systems) or technical (returning to industrial systems). We promote an approach whereby all materials should be safe and healthy enough to become raw materials for new products – either as nutrients for the soil, or through reuse or recycling. And products should be made with renewable energy, clean water and in a way that's fair to everyone in the supply chain.

The fundamental difference to 'recycling' is that we're focusing on the quality of the materials we're putting back into the system. For us it's about improving materials or helping them to retain or improve their highest level of value – 'upcycling', if you will.

How are construction industry stakeholders reacting to Cradle to Cradle®?

Buildings provide immense utility, and the act of creating buildings presents an opportunity to make a significant contribution to society. Everyone can get involved. Architects and engineers are frequently inspired by the challenge of combining beauty or technical performance with 'the right thing to do'. In fact, when you design a building from the outset with disassembly and reuse in mind, it goes together more easily. Builders appreciate Cradle to Cradle® primarily because working with healthy materials is better for their health. For building users, healthy buildings are increasingly important, particularly as air quality continues to rise up the agenda, while from a business perspective, good indoor air quality leads to better productivity.

What's driving sustainability progress in construction – regulation or business foresight?

Regulation has always played an important part in building safety and sustainability. Today, there's a growing regulatory focus on health and safety and air quality in buildings, in addition to carbon management. For businesses, it often comes down to a question of reducing risk – if you ensure people are healthy and safe, you lose fewer days through sickness, for example. Similarly, if you design for disassembly and construct a building with healthy materials, you're effectively lowering the risk of costly renovations, detoxification or demolition processes in the future. You benefit from selling the building or materials on in a high quality, reusable condition.

Tell us more about the business case for sustainability

When businesses open themselves up to Cradle to Cradle® innovation, they often discover that they can make significant savings – through using healthier materials, for example. Also, the concept of 'products as a service' can also be incredibly cost-effective. If you're leasing or lending products to consumers, it adds immense marketing value because you're forging a direct relationship with your customer and you retain the value of your materials (a bit like storing them in a warehouse). You can respond quickly to their needs and upgrade products cost effectively, because you're recovering your own materials.

Once businesses start to see materials and products as perpetual assets, they realise it's a smart way to achieve growth, particularly in a resource-scarce world. And the more we can demonstrate the financial benefits of Cradle to Cradle®, the more obvious it will become and the more people will engage with it. It's starting to happen, but it's just beginning.

How do you see steel within the Cradle to Cradle® concept? Is it better to recycle or reuse it?

Steel is especially wonderful in being an inherently recyclable building material. Beyond that, it's important to think about every aspect of steel products, including coatings and alloys, considering the health of every material and its potential for reuse.

Steel retains more value if it's extracted from a building in a reusable form because it's an engineered, high performance material. If you design a standard steel beam or column of a certain length and quality, it can be used again and again over generations – it becomes currency. In that sense, you can start to think of a building as a 'material bank'. When the building reaches end of its current use and form, you derive value from the components.

“We must take a holistic view... and explore materials with fresh eyes, creating a building of complementary parts and optimising the interaction between every component.”
Prof. Olivier Vassart

Prof. Olivier Vassart
ArcelorMittal Global R&D,
construction and infrastructures

Taking a holistic approach to sustainable construction

Professor Dr Olivier Vassart is head of ArcelorMittal's Construction, Infrastructures and Long Carbon sector. He is also Professor of Steel and Composite Structures at the Catholic University of Louvain, Belgium. Here, he explores the importance of a holistic approach to sustainable construction.

The big picture

Within this new reality, it is important to recognise that buildings are not stand-alone entities. They are an integrated part of the urban landscape, interacting with the environment and communities on a daily basis, long after the construction phase. It is not an exaggeration to suggest that buildings must become ‘living entities’, evolving to meet the needs of our rapidly changing towns and cities, with the capacity to change their use and even their dimensions throughout their lifetime.

To make progress on this journey, we must take a holistic view. We have made significant strides on reducing building energy consumption through the widespread use of more effective facade and insulation systems. Now, we must step up our focus on resource efficiency and material health, designing buildings that maximise the strengths and characteristics of sustainable construction materials. We must explore materials with fresh eyes, creating a building of complementary parts and optimising the interaction between every component. Given its unmatched recyclability and increasing potential for reuse, steel is the clear material of choice, paving the way to significant improvements in a building’s environmental impact throughout its lifecycle.

Steel also delivers the flexibility that is so integral to developing the buildings of tomorrow. Yet many buildings today, with their multiple internal columns and load-bearing walls, seem blind to the pressing need for flexibility. Using steel, with its wide-span capability, permits internal arrangements that can be freely organised, again and again. This adaptability allows buildings to regenerate multiple times before becoming outdated.

Similarly, versatility is a vital prerequisite when it comes to creating a building that interacts positively with its environment. Consider, for example, the people who enter and exit buildings every day; immediately then, urban transport planning becomes part of the mix. Building facades also interact with pedestrian traffic in terms of colour, shape, light and texture. Using steel enables architects and building owners to fully embrace this interactivity, reshaping the urban landscape. Steel is the ideal material – versatile and durable, with the potential for use in infinite combinations.

In summary, the rapid and ongoing evolution of urban society, combined with climate and environmental pressures, creates challenges for the construction industry. But the industry must adapt to face these challenges. Architects, engineers and construction contractors will need to take new parameters into account in both the design and construction phases.

These considerations sit at the heart of ArcelorMittal’s new approach to construction, ‘Steligence®’. Described as ‘the intelligent construction choice’, our philosophy allows the industry to optimise buildings in a holistic way, using a sophisticated, multi-criteria methodology that ensures optimum interaction between all parts of the building and the urban environment.

Steel: first choice for visionary architects

Professor Pierre Engel is ArcelorMittal's Chief Engineer and has responsibility for the construction of the company's new Luxembourg HQ. He also teaches at the School of Architecture of Paris Val de Seine, focusing on steel structures and advanced construction technologies. Here, he discusses the demonstrable benefits of using steel as a primary building material for today's structures.

The invention of perspective by Leon Battista Alberti in the Italian Renaissance was a defining moment for architects. They relinquished the status of 'master masons' to become visionary artists, creators of often ground-breaking building concepts. Naturally, the existence of viable materials and technologies was fundamental to the realisation of that concept. Today, steel is the material that best reflects the architect's sketches. Its precision, strength and rigidity combine to produce an unparalleled finesse, best illustrated by the creations of architects such as Ludwig Mies van der Rohe and Renzo Piano.

Steel is also a leading choice for engineers, helping to deliver the architect's vision in an efficient, cost-effective, sustainable way. For property developers, it is integral to developing flexible, affordable spaces with layouts that can evolve to serve different purposes over time.

So how does Steligence® help architects, engineers and developers to achieve flexibility and sustainability, and save costs? Firstly, and most importantly, it's a holistic, science-based solution to building designed to address the primary challenges faced by the global architectural, engineering and construction community. What's more, in creating Steligence®, we have specifically set out to help the whole community collaborate towards optimising every aspect of the building.

Of course, as with any science-based methodology, it is important to offer robust evidence of its effectiveness. We therefore conducted a comparison between a typical eight-storey office building in Europe, built using traditional construction methods, and an optimised building scenario developed using Steligence®, leveraging best-in-class steel products.

We discovered that the Steligence® scenario delivers benefits across ten fundamental aspects of construction – delivering multiple social, environmental and economic benefits. Firstly, from a social perspective it helps to lower the impact of construction on the local community through reduced transport needs and traffic congestion. For building users, optimal thermal behaviour leads to improved comfort levels in summer. It also lowers the building's impact on the environment, helping developers to achieve higher scores in leading sustainable building certifications (such as BREEAM and LEED) and opening up access to the green building market.

Last but not least, steel delivers economic benefits across the board: both through its lightweighting credentials, and the opportunities it offers to optimise spaces or maximise the number of storeys, accelerate the pace of construction and create spaces that can easily be given a new lease of life in the future. Ultimately, using steel significantly reduces the total cost of ownership of the building.

Given that the Steligence® concept has been subjected to extensive, independent peer review, it's clear that it represents a very interesting and attractive philosophy, with the potential to help our professions resolve the apparently competing demands of creativity, flexibility, sustainability and economics.

"It's a holistic, science-based solution to building, designed to address the primary challenges faced by the global architectural, engineering and construction community."

Prof. Pierre Engel
Head of ArcelorMittal new HQ construction project

Economic

Optimal space and height
Use of the Angelina™ beam and Cofraplus® 60 compact floor enables greatly reduced building height resulting in average 11% cost savings across facade, stairs and core elements.

Lighter weight foundations
Steel foundation solutions, less than half the weight of equivalent structures, can result in average 39% foundation cost savings, like-for-like.

More flexible office space
Using the Angelina™ beam, un-interrupted spans of up to 13 m can be achieved. Consequent reduction in columns allows easy reconfiguration of office space and therefore increased rental value.

Speed of construction
Best-in-class steel solutions using 13 m spans can be erected up to twice as fast as concrete equivalents in 8 m and 5 m spans, resulting in up to 24% construction costs saving.

Reduced cost of ownership
Total costs of building ownership, taking into account all economic benefits, are at least 15% less than when using traditional materials, when all components of the concept are applied.

Environmental

Lower environmental impact
With comparatively lower environmental impacts, such as when using Magnelis®, and higher recycling rates than other building materials, steel is the first choice for sustainable construction. Steel enables access to the green building market with consequent increase in property value.

Higher sustainability ratings
Buildings using ArcelorMittal steel solutions attain higher levels of certification in building rating schemes, such as BREEAM and LEED, than those built with traditional materials.

Social

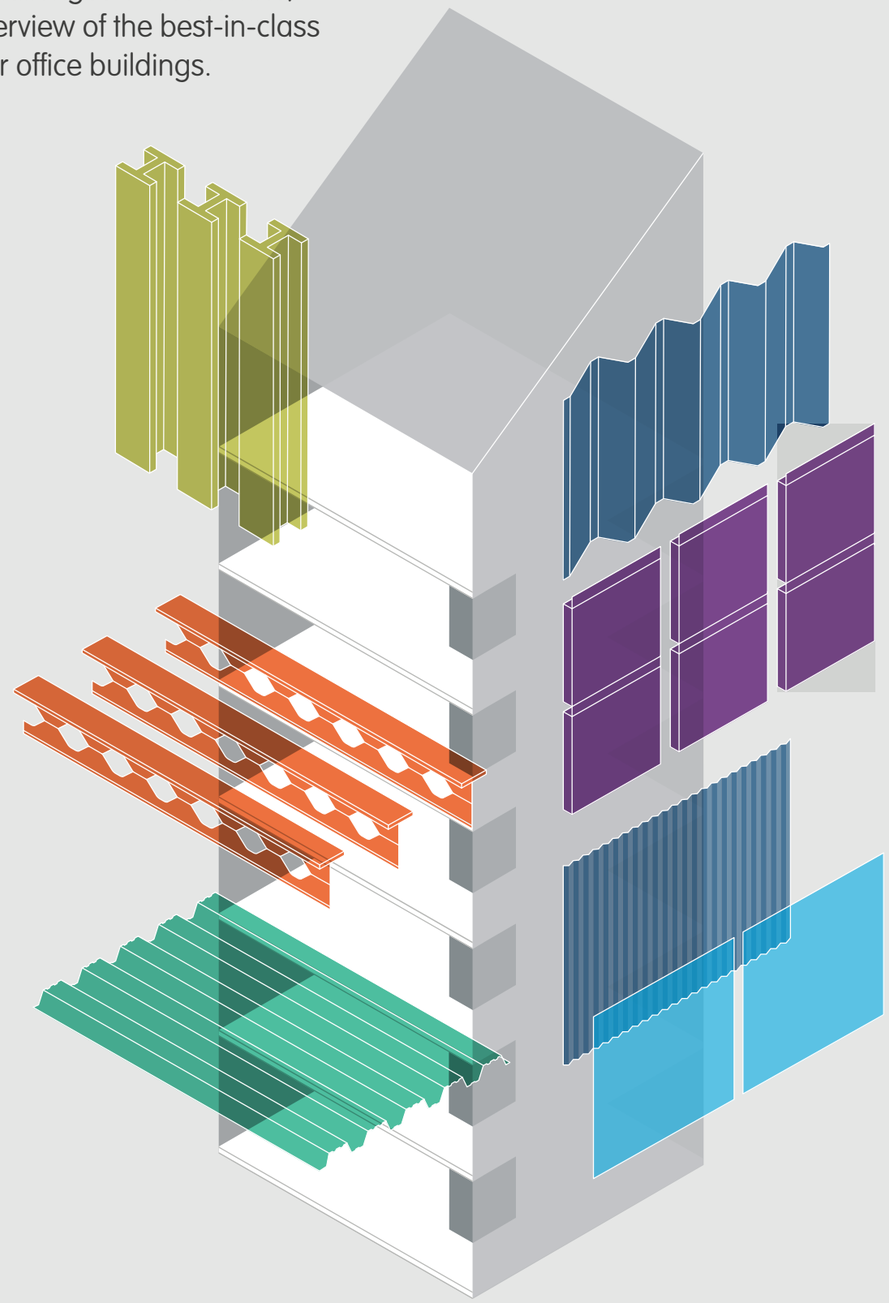
Improved comfort
Steel buildings provide a more comfortable environment for building users due to optimised thermal behaviour during warm weather.

Less site traffic
Steel requires fewer site deliveries than comparative materials, resulting in less traffic congestion and so reduced impact on the urban environment.

Greater creativity
Steel cladding solutions offer an unparalleled choice of creative, attractive finishes, adding materially to the urban landscape.

ArcelorMittal best-in-class steel components

A building is a 'living entity' comprised of many diverse components. Steligence® proposes a holistic approach, ensuring every steel component interacts in a complementary way, addressing the fundamental architectural and construction challenges of economics, sustainability, flexibility and creativity. Here, we provide an overview of the best-in-class steel products which are used to bring this approach to life for office buildings.



HISTAR®

HISTAR® steels show a high strength and low alloy content, offering considerable weight reduction and cost savings, and time saving in the fabrication process. HISTAR® combines strength with toughness at low temperatures and outstanding weldability. The application of Quenching and Self-Tempering (QST) thermo-mechanical treatment allows all HISTAR® grades to offer improved guaranteed values for yield strength over the whole range of section sizes. HISTAR® is available CE-marked and with min. specified yield strengths of 355 MPa and 460 MPa.

HD sections

H-sections are hot-rolled wide-flange structural steel shapes used for the construction of buildings, bridges and nearly any type of general or special structures and machines. HD-sections are heavy duty H-sections, particularly suited for use as building columns, long span or heavy duty trusses, transfer trusses, outriggers, belt trusses, heavy girders and moment frames. Building columns made of hot-rolled H-shapes of HD 400 size series (= UC 356 x 406) are very convenient to connect because of the same measurement between the flanges. ArcelorMittal offers the widest range of dimensions in hot-rolled H sections and the world's heaviest HD columns.

Angelina™

A new generation of castellated beams for sustainable structures, Angelina™ beams are lightweight, long-spanning, structural elements enabling the design of vast column-free spaces. They present an efficient, cost-effective alternative to trusses and open-web joist systems, combining function with flexibility, integrating technical installations and optimising the weight-height or load-weight ratio.

Cofraplus® 60 composite floors

ArcelorMittal's Cofraplus® floor decks are trapezoidal steel sheets with open ribs and specific embossment, to ensure composite action with concrete used in floor constructions, which permits significant weight, time and cost savings. The profile serves as shuttering for the fresh concrete and as reinforcement in the final stage. Its easy handling and flexible application makes it suitable for almost every project and renovation works, while being fully recyclable at the end of a building's service life.

Cofraplus® 60 guarantees economical transportation and quick installation due to its large cover width of 1035 mm. The deck with a height of 58 mm is normally manufactured from 0.75 mm gauge steel, but is also available in 0.88 mm, 1.00 mm and 1.25 mm according to the project specification. The profile is designed for medium spans up to 3.6 m without props and even up to 6.0 m while propping during the concreting, with total slab thicknesses starting from 110 mm. Finish can be simply galvanized or colour coated to enhance aesthetics or corrosion resistance.

Cofraplus® 220

The long-span floor system for car parks, office buildings and renovation projects, Cofraplus® 220 provides outstanding performance. With a low overall weight, it spans up to 6.0 m without temporary propping. It guarantees maximum flexibility using wings or connectors, and brings the advantages of a continuous slab design. Additionally, it allows for easy handling and fast installation, and clean and safe construction.

Composite SlimFloor Beam

The Composite Slim-Floor Beam (CoSFB), combines the advantages of composite design with traditional slim-floor construction. CoSFB allows much more easily competitive solutions for long spanning floors and is a perfect response for modern sleek and sustainable structural architecture. Further savings can be made in steel and concrete when CoSFB is combined with Cofraplus® 220.

Magnelis®

Magnelis® is an innovative metallic coating offering protection in the harshest environments and up to a 25-year guarantee. It is suitable for a wide range of structural outdoor applications, including sub-structures of ventilated facades, composite floors, purlins for roofs, side rails for walls, rainwater systems, and light steel framing. It can also be used for appliances and electrical equipment, agricultural and industrial structures, solar arrays and transport infrastructures.

Magnelis® are also perfectly adapted for building indoor applications such as heating, ventilation and air conditioning equipment (ducts, air treatment units etc), cable trays, raised floors, composite floors etc. Thanks to its unique composition, Magnelis® leads to longer component lifetimes and reduced maintenance costs, while having a reduced environmental footprint. Magnelis® is produced on a classic hot dip galvanising line with a molten bath comprising zinc, 3.5% aluminium and 3% magnesium.

Mascaret®

Mascaret® is a system designed to filter daylight by means of perforations and a tailored profile shape. The perforations create transparency, filtering light depending on time, weather and season and help create a dynamic indoor environment. The system can be used for vertical or horizontal sun-shading.

Coque MD®

Coque MD® is a flat facade cladding system with invisible fixings to a supporting rail. Suitable for new buildings or renovation, blind walls or walls with punched windows, it can act as a covering on masonry walls, concrete walls or steel trays. Changing the Coque MD® panel is straightforward, even when placed mid-facade, and does not require the dismantling of a full row of panels or a complete gable wall. It comprises an invisible fixing system with dedicated supporting rails and adjustable angle profiles to attach to the bearing structure.

Pearl pre-painted steel

PEARL is a galvanised steel coated with a polyvinylidene fluoride (PVDF) multilayer resin. PEARL offers a pearly shine to create interesting light and colour effects. Available in multiple shades it produces the effect of changing colours on the facade, according to viewing angle. It offers exceptional resistance to ultraviolet radiation and enhanced resistance to contamination and external deterioration. PEARL is applied on the new ZMevolution® galvanised coating giving a reduced environmental footprint.

Irysa® pre-painted steel

IRYSA® is a galvanised steel coated with a highly durable, anti-corrosion, thermosetting polyester paint. Unique in the marketplace, this range gives an iridescent sheen, providing outstanding aesthetic effects and colour variations. IRYSA® can be widely used in hot, coastal locations such as the Caribbean. IRYSA® is applied on the new ZMevolution® galvanised coating giving a reduced environmental footprint.

Granite® Silky Shine

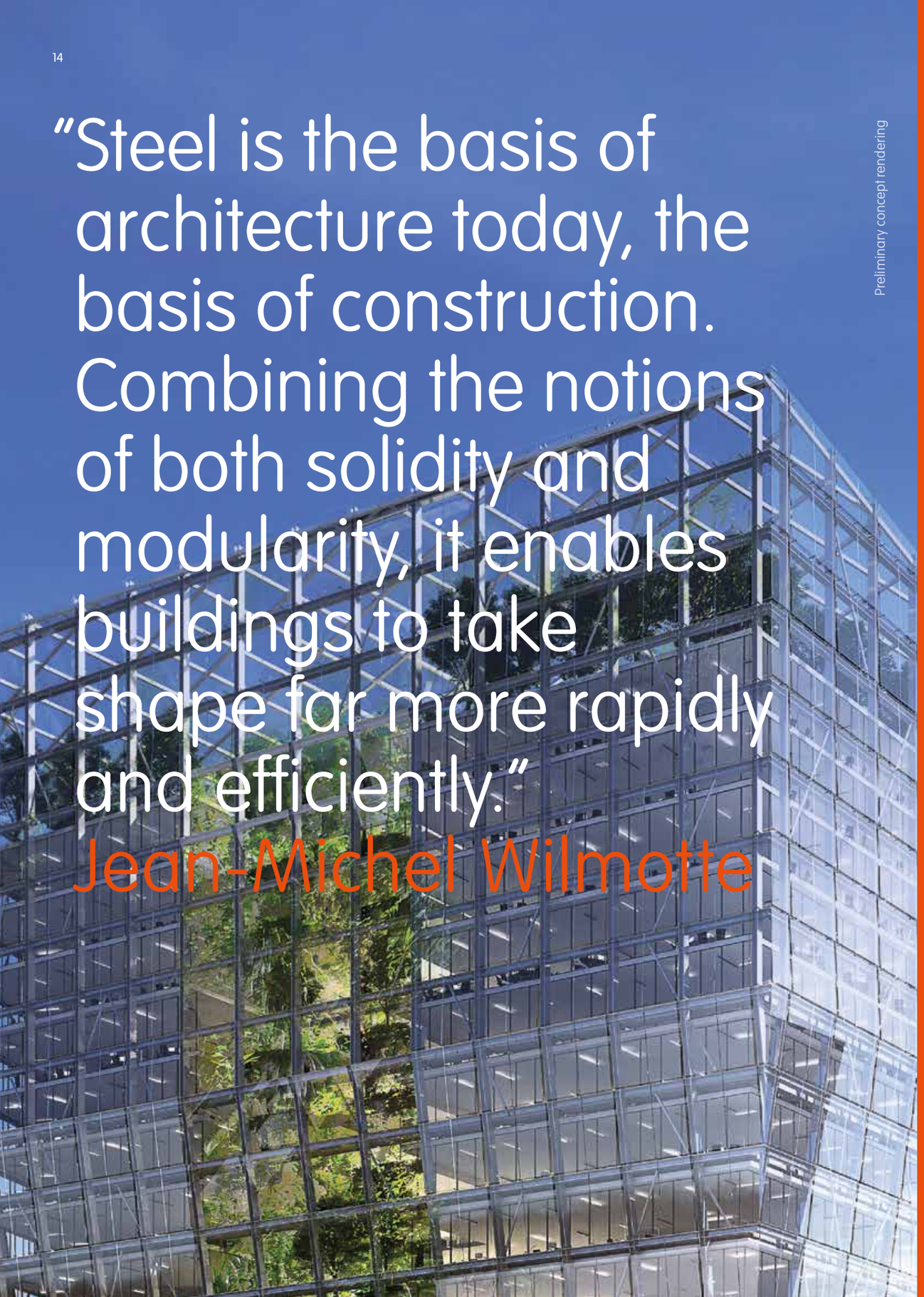
Granite® Silky Shine is a pre-painted steel for facade systems with a high-gloss finish that enhances the visibility and impact value of buildings, adding an elegant feel to the facade. Its high performing PVDF paint system provides an exceptional level of UV resistance and stability over time for all colours.

Estetic® BioAir

Estetic® BioAir is an innovative pre-painted steel made with 100% bio-sourced resin, designed specifically for indoor use. Estetic® BioAir has been given three stars and the 'OK biobased' label by the European environmental inspection agency Vinçotte. Three stars indicates that the paint contains between 60 and 80 percent of renewable carbon.

Advantages are multiple:

- Low levels of volatile organic compounds (VOCs)
- Improves indoor air quality
- Free of chromates and heavy metals



Preliminary concept rendering

"Steel is the basis of architecture today, the basis of construction. Combining the notions of both solidity and modularity, it enables buildings to take shape far more rapidly and efficiently."

Jean-Michel Wilmotte

Pushing architectural boundaries with steel innovation

Architect Jean-Michel Wilmotte is Founder and President of Wilmotte & Associés – the designers of multiple visionary structures, including ArcelorMittal's new global headquarters in Luxembourg. Here, he explores the evolving role of the architect and explains the creative, functional and sustainability potential of steel.

How do you see the role of the architect today?

The role of the architect is, above all, that of someone who listens, who listens to his client and creates a project using the client's vocabulary and personality – a space that reflects his client's needs. It is through this dialogue, this relationship of trust, that we can invent extraordinary buildings. Then it's about execution – the technology, the time, and of course, achieving the right financial balance.

How can steel help architects achieve their goals?

Steel is an exceptional material. It can meet all the needs of any architect. With its strength and versatility, it can be used to create any type of building. Overall, I think steel is the basis of architecture today, the basis of construction. Combining the notions of both solidity and modularity, it enables buildings to take shape far more rapidly and efficiently, compared to conventional building materials.

How does steel help you meet your creative vision while achieving flexibility and sustainability?

If you really want to strive towards sustainability, it's firstly important to use local materials. This way, you can minimise transport to the site. Today, there's also a lot of discussion about building steel buildings that can one day be disassembled, with the components used as raw materials for new buildings.

This 'Cradle to Cradle®' approach is very interesting; it suggests a system of modules that form the building, which can then be dismantled at end of life, and then reused (as distinct from recycled) to create a new building.

Tell us about the Ferrari Sporting Management Centre in Maranello – why did you use steel and how does this reduce the carbon footprint of the building?

So, in the case of Ferrari, the dimensions of the steel beams allowed us to achieve large spans (of 15-20 metres), avoiding the need for multiple columns throughout the building's natural space. It was also a question of speed – we only had 16 months to build a 30,000m² factory, and we could only meet that deadline with steel. Using steel helped us to minimise the building's carbon footprint both in terms of the building itself and construction transport. And even at this scale, we could dismantle the building and reuse elements of it elsewhere. Another example would be the Bernadine Monastery in Dijon, France.

So, from racing cars to monasteries! What was the role of steel for this project?

We realised that steel was a good choice because it allowed us to recreate the silhouette of a 16th century roof in an efficient way, while using the totality of the space. We restored the buildings in three weeks, including the roof. It was spectacular. In a historic stone building, it's important to help people understand the benefits of using steel over traditional materials, so we highlighted the strength and effectiveness of steel as a material.

You have just won the tender to build ArcelorMittal's new headquarters in Luxembourg. What was your conceptual response to the brief?

We wanted to show the creative possibilities of steel. The new ArcelorMittal HQ should be exemplary, just like the material. And it's an incredible opportunity to create an exceptional steel building in the homeland of steel. While these days we tend to associate Luxembourg with banking, it has a long history of steel making and is still an important player in that industry. So we wanted the building to be inspirational, referring through the materials used to the history of the country.

Can you talk us through some of the steel innovations at the new headquarters?

We have developed systems of false acoustic ceilings that also provide heat and light, and a partitioning system that will highlight the presence of steel. All these elements of interior architecture are complementary to the external structure. The project will be a real technical laboratory for the possibilities of steel. It will be a journey of incredible discoveries. We are even looking for carpets made from braided steel wire, and we will seek to braid steel with other materials, and use cast steel and steel encased in glass.

Jean-Michel Wilmotte
Architect, urban planner, designer

Manfred Grohmann
Bollinger + Grohmann

Engineering the buildings of the future

Professor Manfred Grohmann is a civil and structural engineer and co-founder of leading structural engineering firm, Bollinger + Grohmann. The firm specialises in projects involving complex geometries, often manifested in innovative facade treatment. He is also Professor for Structural Design at the School of Architecture at the University of Kassel, Germany. Here, he discusses the importance of collaboration, disruption and sustainability in engineering the buildings of the future.

Raising productivity is a significant challenge across the construction industry. With no real improvements in the past few decades, there's a real need for disruption. At a technical level, I'm convinced this disruptive force will involve pre-fabrication. This is a vital step to saving energy and reducing waste, labour costs and time efficiency on site.

More than that, we must break down the barriers between architects, engineers and developers, and collaborate to design for the future, placing a far greater focus on sustainability.

And it's not just about minimising energy consumption. We must consider the entire life cycle of our buildings – it's about designing buildings that are flexible enough to withstand the demands of the future, and can be disassembled and reused, in line with Cradle to Cradle® principles.

Steel is the optimum material for this because you can shape it in any form and reuse it 100%. It responds to today's needs for creative office spaces, and could be adapted to the needs of office buildings in 30 or 50 years' time. What's more, it allows you to achieve an excellent load-bearing capacity with the minimum of cross section – for both vertical and horizontal beams.

The new ArcelorMittal HQ is an example of a building of the future. It has an exo-skeleton structure, which means the load-bearing structure is outside the facade. We're developing a special beam system similar to the Angelina beam to create completely column-free interior spaces. That's a real benefit. When combined with the pre-fabricated cofinal steel flooring system, we can span almost 90 metres between the two exterior facades – column-free. Integrating the finishing ceiling earlier generates cost savings and means we don't need to include a suspended ceiling for the offices.

In designing this building, we also wanted to represent ArcelorMittal's full bandwidth of products – from construction to automotive. For example, our architects and engineers are working with the building developer to explore the use of high strength automotive steel – which is even more slender than normal steel – into our building.

In the same way, tomorrow's engineers must keep an open mind and adopt a cross-disciplinary approach to the work. Cooperation will change dramatically, aided by technology. And not as we see it now – we will see the evolution of new interfaces that promote a far more fluid exchange between the disciplines. This will be central to breaking down the barriers, and will have a fundamental impact on raising productivity.

"We must break down the barriers between architects, engineers and developers, and collaborate to design for the future, placing a far greater focus on sustainability."
Prof. Manfred Grohmann

Charting the evolution of steel facade engineering

Kenneth Zammit is Group Director of the facade engineering team at design and engineering consultancy, BuroHappold. The firm has contributed to the creation and reinvention of iconic buildings including the London 2012 Olympic Stadium, the Great Court of the British Museum and the European Investment Bank headquarters. Here, he discusses the evolution of steel facade systems and treatments, and considers the sustainability potential of steel.

How have steel facade treatments and systems changed over the last ten years?

The increased use of robotic and laser welding in steel fabrication has brought significant change for us. As this becomes increasingly widespread and cost-effective, it is helping to optimise tolerances in facade fabrication methods, significantly improving both the precision and straightness of the final product, compared to hand welding. This is critical to facade elements because we often work within tolerances of just a few millimetres.

Are these systems primarily about different aesthetic surface finishes?

To achieve true success in facade engineering, we need to achieve a balance between multiple, opposing parameters. We must consider aesthetics in parallel with structural and thermal parameters. Of course, these parameters affect different aspects of the design. Achieving the right balance can be quite complicated. It involves a considerable number of iterations and close collaboration with the architects.

What are architects looking for in metallic external finishes and how is the steel industry responding?

Architects are seeking depth in the expression of a material finish – in the texture and the way the light interacts with the facade. As a result, we see new products being developed, particularly metallic products, to achieve this effect. For example, we have been working with ArcelorMittal on developing the company's Magnelis® coatings, which use magnesium in combination with zinc and aluminium, in order to deliver greater durability. This coating also has 'self-healing' properties, which is a game-changer for the protection of steel products, as it means the steel still benefits from the same level of protection, even when there is slight damage to the service coating.

How do you see the potential of steel, from a sustainability perspective?

I see great opportunities for steel, particularly in the areas of lifecycle costing and reuse. The provenance, characteristics and future life of steel components can be captured with technology such as RFID, giving all stakeholders a clear view of the profile and lifecycle of every component.

I believe it's vital that the reuse of steel components is considered right from the concept stage, with detailed plans developed for disassembly and reuse. This requires collaboration between designers, architects, suppliers and contractors. The return on investment is significant, delivering substantial cost savings at the disassembly stage, for example.

Where materials such as steel are recycled, it's important to think in terms of 'upcycling' rather than recycling (which can often result in downgrading the material). I would like to see more secondary raw materials being used in applications where they deliver even better performance.

How do you see steel facade engineering developing in the future?

To really push the boundaries of facade engineering, we need more commercially viable options for the 3D printing of components. This would yield infinite possibilities in the fabrication of complex geometries and would allow us to create components with intricate detailing, fulfilling aspirations for a filigree look. In short, there would be no limit to the imagination in terms of shape or organic forms.

Kenneth Zammit
Facade engineer, BuroHappold

"It's vital that the reuse of steel components is considered at the beginning, at the concept stage."

Kenneth Zammit

"Steel plays a key role in simple, slender structures. Quite simply, it is essential to achieving both the architect's and the engineer's vision."

Prof. Vincent de Ville de Goyet

The benefits of steel in slender structures

Professor Vincent de Ville de Goyet, of leading civil engineering consultancy Bureau Greisch, explains the benefits of using steel in slender, monumental structures.

Tell us about the inspiration for your trademark slender structures. What role does steel play in achieving your vision?

Our founder, the celebrated engineer and architect, René Greisch, believed that the best solution was a simple structure. We have continued to take inspiration from his vision, designing iconic structures around the world, from bridges and roads to civil and industrial buildings. Steel plays a key role in simple, slender structures, from multiple perspectives - aesthetics, flexibility and space, and speed of assembly. Quite simply, steel is essential to achieving both the architect's and the engineer's vision.

Could you talk us through the benefits in more detail?

Firstly, the span length between columns is larger using steel components, which gives the architect greater freedom with their structure, and creates more spaces within the building. Similarly, when we design bridges, we can achieve longer span lengths with steel, which is particularly important with span lengths of more than 500 metres. Steel's strength to weight ratio is also vastly superior to that of conventional materials, and this is integral to achieving a slender structure. Lightweight steel structures are ideal for a large roof, for example. Beyond the structure itself, steel brings considerable benefits from an assembly perspective too.

Take us through the assembly of the dome at Liège Guillemins station in Belgium – how did using steel help you achieve greater efficiency?

When we designed the 35-metre high Liège Guillemins station, we knew that disrupting the trains would be out of the question. So, instead of using a crane to construct the main part of the dome, we opted for a far more rapid, time-efficient solution – we pre-assembled five steel arches at a time and pushed them into place from a temporary platform at the front of the station. This allowed us to assemble a roof structure of 4,500 tonnes with zero disruption to the railway. We could only accomplish this kind of feat using steel. It was an impressive sight. We used a similar method for the spectacular Millau Viaduct in southern France.

How has steel construction changed over the last decade, and why do you see education as key to the construction industry's future?

Steel construction has changed considerably over the last ten years, as the quality of steel has gone from strength to strength. Research and education are playing an important role in the evolution of advanced construction methods and practices too. We collaborate regularly with Liège University to explore innovative solutions to complex engineering issues, and progress our proprietary software programme. My engineering team and I also deliver regular lectures and support PhD students' research. I believe educating tomorrow's engineers and technicians is vital to the future of construction.

Professor Vincent de Ville de Goyet
Structural engineer, Bureau Greisch

A final word

In a rapidly urbanising world facing significant climate and resource challenges, the construction industry stands to lead the way in delivering healthy, sustainable buildings. Succeeding on this journey requires collaboration across the industry and a holistic approach to determining social, environmental and economic impacts. Steligence® is a comprehensive, science-based solution offering stakeholders throughout the architectural, engineering and construction community the opportunity to optimise every aspect of a building. It is an essential tool in the drive towards sustainable design, providing an in-depth comparison of the performance of steel when compared to other building materials.

Best-in-class steel solutions enable the flexibility and creativity necessary to fulfil the architect's vision, while fully responding to engineers' and constructors' requirements for technical excellence, outstanding sustainability performance and affordability. Further, using steel lowers a building's environmental impact, helping to boost sustainable building certification scores and facilitate access to the green building market.

As a 100% recyclable material, steel can be transformed into secondary raw materials for use in multiple applications. However, as resource efficiency and circularity gain in importance, a further potential of steel lies in its suitability for reuse. ArcelorMittal has set out to demonstrate the 'reusability' credentials of steel in its new headquarters in Luxembourg, which will celebrate steel in all its forms, and in particular, its ability to continue delivering value as an integral material for future buildings.

For further information on Steligence®, please visit
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Steligence® is a construction philosophy, based on science. It proposes a solution to the competing demands of creativity, flexibility, sustainability and economics.