



Architectural

 **Aurubis**

Facts & Figures

Architectural

- 100 %** • of architectural copper products are manufactured **by recycled raw-material**.
- 1995** • **first post-patinated copper product** was delivered from Pori mill.
- 13th** • **century and before**, historians believe that copper is used as roofing material.



Architectural products fabrication

Chicago (US)



Buffalo (US)



Avellino (Italy)



Mortara (Italy)



Yverdon-les-Bains (Switzerland)



Lyon (France)



Barcelona (Spain)



Emmerich (Germany)



Fehrbellin (Germany)



Hamburg (Germany)

Group headquarters



Lünen (Germany)



Röthenbach (Germany)



Stolberg (Germany)



Strass (Germany)



Zutphen (Netherlands)



Brussels (Belgium)



Olen (Belgium)



Birmingham (United Kingdom)



Pori (Finland)



Västerås (Sweden)



Finspång (Sweden)



St. Petersburg (Russia)



Dolný Kubín (Slovakia)



Pirdop (Bulgaria)



Istanbul (Turkey)



Prague (Czech Republic)



Seoul (Korea)



Tokyo (Japan)



Taipei (Taiwan)



Shanghai (China)



Hong Kong (China)



Dubai (UAE)



Bangkok (Thailand)



Ho Chi Minh City (Vietnam)



Singapore (Singapore)



Raw materials

Concentrates and recycling materials are the raw materials from which copper is produced.



Products

The copper is processed into products. Some products are already the result of copper production.



Slitting Centers

Service Centers located near our customers cut strips to the desired dimensions.



Sales and distribution

An international sales and distribution network markets our products.





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Aurubis Group

Our copper for your Life

The company's history is characterized by its dynamics and flexibility, from our founding as a stock corporation in 1866 to today.

Nowadays, the Aurubis Group is ideally positioned; with about 6,500 employees at production sites in Europe and the US and sales offices all over the world, Aurubis is one

of the leading integrated copper groups. Aurubis stands for innovative processes, cutting-edge technology, exemplary environmental protection, customer value and profitability.

Uniquely, Aurubis combines copper production with processing copper into tailor-made products. As a fully

integrated global copper company, Aurubis is a leader in smelting, fabricating, refining and recycling copper.

Aurubis shares are part of the Prime Standard Segment of the Deutsche Börse and are listed in the MDAX, the European Stoxx 600 and the Global Challenges Index (GCX).



Aurubis Architectural

Copper was one of the first metals used by man and is one of our oldest building materials, with unique properties and characteristics. With the twentieth century and international modern movement came a transformation from copper's historic role as a durable roofing material to a flexible architectural skin over any surfaces, including walls. The malleability of copper sheet allows it to be used as a covering for architectural elements of all shapes with minimal constraints. Surfaces can be flat, curved or faceted and used at any inclination or pitch, and in any environment. As a result, modern architects focused on copper as a comprehensive wrapping to express building form and maintain material continuity.

Architects continue to exploit this capability today, driven by the complex shapes made possible by computer aided design techniques. But with the move to postmodernism and beyond, many designers have also been keen to explore new manifestations of copper – very much as part of the dynamics of contemporary architecture and with a real sense of freedom.

REALIZING DESIGNS IN COPPER

This brochure provides an introduction to the architectural opportunities and unrivaled freedom that architects can enjoy by working in partnership with us to realize their designs in copper, no matter how innovative. It explores how

Aurubis Architectural redefines copper for contemporary design with the ongoing development of surfaces, forms and systems – not as a prescribed range of products to select from, but rather a source of inspiration for architects and the starting point for a creative partnership with us.

Our expertise and personal service are essential to developing your architectural visions in copper and we welcome early involvement with your projects. Our website www.aurubis.com/finland provides contacts, more detailed information and interactive tools to help you at each stage in the design and specification process.

Aurubis Copper – Characteristics

Aurubis' products for architectural applications such as facades and roofs use phosphorus deoxidized copper, designated Cu-DHP and complying with EN 1172:2011 – "Copper and Copper Alloys: Sheet and Strip for Building Purposes". This pure and natural material exhibits a unique range of characteristics and performance benefits, including:

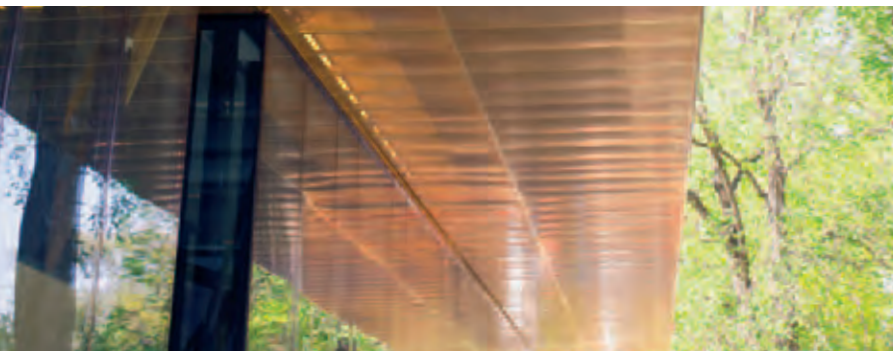
- » Protection by its patina against corrosion in any atmospheric conditions, durable and problem-free with no maintenance.
- » Exceptional, indefinite lifespan demonstrated over hundreds of years, and no underside corrosion issues.
- » Light weight as a flexible covering for any building elements, saving on structure and delivering low "lifetime" costs.

- » Easily formed at any temperature without becoming brittle in cold weather.
- » Low thermal movement and high melting point, avoiding stretching in hot weather.
- » Non-toxic and safe to work with impressive antimicrobial qualities ideally suited to touch surfaces inside buildings.

The impressive sustainability and environmental credentials of copper have been clearly demonstrated in the past. Although the copper industry is well-known for recycling, Aurubis' Nordic range is exceptional, with 100 % of copper produced for roofing and cladding applications over the last few years coming from recycled material. This material includes internal processing scrap (around 50-60 % of the recycled material). Embodied

energy and global warming potential figures are therefore less than half those for copper generally – already significantly lower than stainless steel and aluminum.

Copper can provide a complete external skin, wrapping around complex building forms with material continuity. Alternatively, it can give distinctive character to individual facade or roofing elements, particularly when used in conjunction with other high quality materials. In addition, there is growing interest in the use of copper for interior design.



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Architectural Opportunities

In addition to standard copper sheet, Aurubis explores new forms of copper architecture with designers, including textured surfaces, profiled sheets and pressed surfaces. Also, perforated or expanded copper sheets add new possibilities for transparency. Installation techniques and systems also help to define architectural character with texture and scale – ranging from traditional standing seam sheet installation techniques to panels, cassettes and other factory-made systems.

But the natural color changes leading to the development of copper's distinctive blue/green patina continues to fascinate architects and inform the development of Aurubis' Nordic Products, discussed next.

COPPER SURFACES

The natural development of copper patina is one of copper's unique characteristics. Within a few days of exposure to the atmosphere, the surface of Nordic Standard copper begins to oxidize, changing its color from the "bright" mill finish to a chestnut brown which gradually darkens over several years to a chocolate brown. Continued weathering can then result in development of the distinctive green patina – or blue in coastal locations. This process is an expression of the metal's propensity to revert to mineral compounds that resembles the ore from which it originally came. The patina film provides impressive protection against corrosion and can repair itself if damaged, defining the exceptional longevity of copper cladding.

Some rainwater is needed for the patina to form and its rate of development will depend on the water "dwell time" on a surface. As a result, vertical cladding and sheltered surfaces will take much longer to patinate naturally than exposed roofs. Airborne pollution also increases the rate of patination, which therefore takes longer in more remote, cleaner environments than in cities or industrial areas. The complex combination of factors determines the nature and speed of development of patination, giving copper unique, living visual characteristics developing over time in response to local conditions.

Nordic Products

Over the last few decades, Aurubis has developed a range of factory-applied surface treatments to provide the various stages of oxidation and patination straightaway. The processes involved are very similar to those taking place over time in the environment and utilize copper mineral compounds, not invasive chemical treatments. Essentially, they bring forward the environmental changes without taking away the integrity of Aurubis copper as a natural, living material.

Aurubis' Nordic Products include variable intensities of green or blue pre-patination and brown pre-oxidation. Copper alloys brass and Nordic Royal – a golden alloy – are also available, adding to a rich palette of colors and surface textures. All Nordic Products form an integral part of the copper and are not coatings or paint. Ongoing changes will continue over time with all Nordic Products depending on the local environment, ranging from quite rapid with Nordic Brass to minimal for Nordic Royal. Nordic Surfaces are supplied with a protective sheet to the finished face.

Aurubis' Nordic Products are illustrated on the following pages. But Aurubis works closely with architects in developing custom-made surfaces and other techniques, in addition to the ranges shown here, and our early involvement with the architectural design process is essential.





NORDIC STANDARD MILL FINISH COPPER

Nordic Standard is mill finish copper without any additional surface treatments carried out in the factory. It has the traditional “bright” finish that will develop and change in the environment, as described earlier.

Ongoing changes will continue over time with all Nordic Products depending on the local environment.





Nordic Brown products are useful to minimize hand and other construction prints which can occur for a short time after installation with “bright” standard copper.

NORDIC BROWN PRE-OXIDIZED COPPER

Nordic Brown products are pre-oxidized at Aurubis’ factory to give the same oxidized brown surface straightaway that otherwise develops over time in the environment. The thickness of the oxide layer determines the color: both Nordic

Brown Light and the darker Nordic Brown versions are available.

Nordic Brown products are useful to minimize hand and other construction marks which can occur for a short time after installation with

“bright” standard copper. But light and dark versions can also be combined – perhaps with other finishes such as Nordic Standard – to create various visual effects.





NORDIC GREEN NORDIC BLUE PRE-PATINATED COPPER

Nordic Green and Nordic Blue products offer designers unparalleled design freedom and the ability to determine the type and intensity of green or bluish patina for each project with choices of “Living” surfaces. In a carefully controlled factory process, pre-oxidized copper is treated with specifically formulated copper compounds to create the desired patina colors and heat-treated to chemically bind them to the copper.

The factory process can be accurately controlled so that, as well as

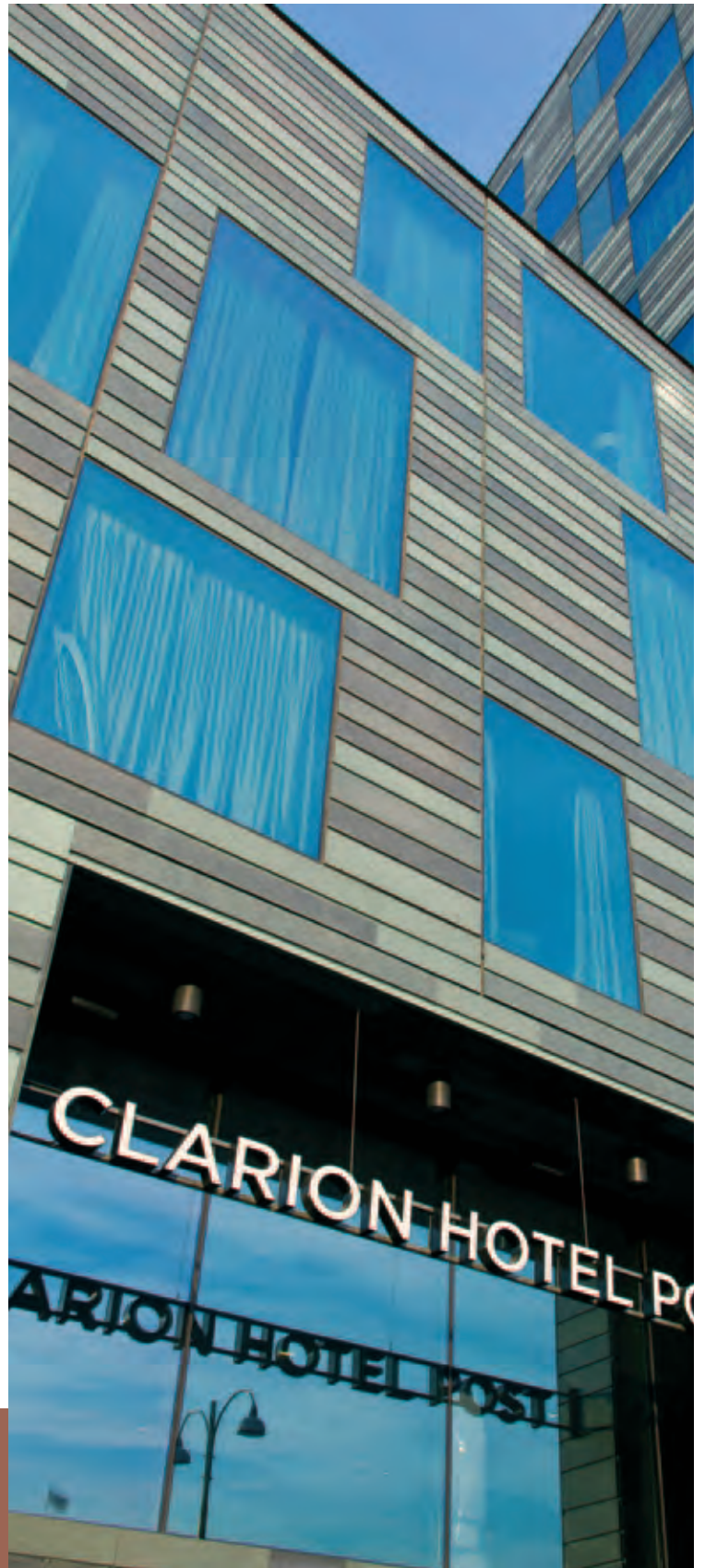
the solid green patina color, other intensities of patina flecks can be created, revealing some of the dark oxidised background material. Aurubis’ experts can also work in partnership with architects to develop special individual levels of patination to meet their design requirements or to match historically patinated copper on existing buildings.

The material is easily bent and formed, and there are no limitations on the length of pre-patinated copper sheet or strip because

whole coils are treated on the production line, not just limited size sheets. Nordic Green and Nordic Blue are available in sheets or coils with one treated surface.

MINERAL-BASED GREEN

The most common compound found in natural patinas all over the world is the copper sulfate mineral brochantite. Aurubis’ factory-applied patinas have been developed with properties and colors based on the same brochantite mineralogy. Brochantite is a light blue color but in many locations impurities and



other components in the air add a yellow tint to give the naturally developed patina a green hue. In the same way, Nordic Green is produced with a hint of iron sulfate yellow component added to the blue copper sulfate, replicating the natural green.

Nordic Green and Nordic Blue products offer designers unparalleled design freedom.



MINERAL-BASED BLUE

In marine climates, the natural copper patina contains some copper chloride, giving it more of a blue color and this is emulated with Nordic Blue. Brochantite is a light blue color and Aurubis' Nordic Blue patination is 100 % brochantite.

By its nature, Aurubis' pre-patination process encourages the con-

tinuing formation of natural patina by releasing copper sulfate to react with the copper below. As a result, just like natural patina, Nordic Green and Nordic Blue undergo continuous changes through environmental exposure dependent upon local atmospheric and rainfall conditions.

By its nature, Aurubis' pre-patination process encourages the continuing formation of natural patina.



NORDIC ROYAL COPPER ALLOY

Nordic Royal is an alloy of copper with aluminum and zinc, giving it a rich golden through-color and making it very stable. It has a thin protective oxide layer containing all three alloy elements when produced. As a result, the surface retains its golden color and simply

loses some of its sheen as the oxide layer thickens with exposure to the atmosphere to give a matte finish.

It behaves differently from other Aurubis copper products over time and does not develop a blue or green patina.

Nordic Royal is an alloy of copper with aluminum and zinc, giving it a rich golden through-color and making it very stable.



When exposed to the atmosphere, Nordic Brass begins to darken within weeks.

NORDIC BRASS COPPER ALLOY

Nordic Brass is an alloy of copper and zinc with a distinctive golden yellow color. When exposed to the atmosphere, the surface begins to darken within weeks and can change to a dark brown in around a year – unlike Nordic Royal alloy, which retains its original color.

A weathered brownish surface is also available to provide the same oxidized brown surface that otherwise develops over time in the environment.





NORDIC BRONZE COPPER ALLOY

Nordic Bronze is an alloy of copper and tin with a similar color to Nordic Standard initially. When exposed to the atmosphere, the surface gradually changes to a stable dark chocolate brown.



Nordic Bronze gradually changes to a stable dark chocolate brown.

Nordic Systems

Apart from standard copper sheet, Aurubis is constantly exploring new forms of copper with designers, creating extra dimensions of modulation, texture and transparency for architectural surfaces. The final ingredient in designing with copper is the installation technique or system, which adds “grain” and structure to the external skin of the building, helping to define its character. Aurubis provides an extensive range of factory pre-fabricated Systems for facades or roofs, as well as copper sheets or coils and other copper items.

Most of these products are supplied by Aurubis, and others are developed in a close working relationship with our specialist partners. In many cases, these products can be supplied with choices from Aurubis’ Nordic Products as well.





Traditionally, copper has been used as a lightweight, fully supported covering to roofs, walls and other building elements.

Traditional Techniques

Traditionally, copper has been used as a lightweight, fully supported covering for roofs, walls and other building elements. Here, sheets of copper are jointed using double lock standing seams (or angle seams for vertical cladding) visually defining the copper bays, interrupted by cross-welt joints running longitudinally. A more modern

interpretation of fully-supported, standing seam technology is Long Strip. In this case, copper trays are prefabricated with profiles and installed in long lengths – perhaps 10 m or more – eliminating cross-welts and creating a strong linear appearance. Long Strip is an efficient and cost-effective method where mechanization can be maximized

both for prefabrication and jointing on site. Aurubis copper can be supplied in cut-to-size sheets or in coils to suit any system. In particular, Aurubis is unique in its ability to supply any of its Nordic Products in coils for Long Strip.

Prefabricated Systems

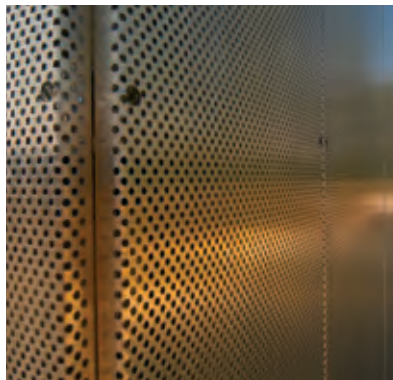
Apart from traditional systems, various standard or tailored prefabricated systems are available in Aurubis copper. They offer the benefits of consistency and accuracy, being fabricated under controlled off-site conditions, as well as different visual characteristics helping to define the architecture.

Aurubis products are available in a variety of ranges and providing a wide choice of visual scale and detail. Just a few examples are shown here. Full technical information is available in the Designer's Tools sections of each range on the website www.aurubis.com/finland.



PROFILED SHEETS

Aurubis offers an extensive choice of roll-formed or welded profiled sheets in the full range of Nordic Products: full technical details are available on the website. Other custom-made profiles can also be provided to order.



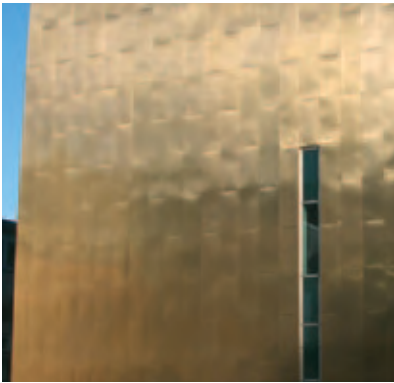
PERFORATED AND EXPANDED MESH

Aurubis offers a range of standard perforation patterns on its copper sheet with any Nordic Products, as well as special customized patterns. Variable perforation sizes can be used to create subtle patterns, "super graphics" and even text. Our partners can also provide expanded copper sheet with any Nordic Product to suit particular requirements.



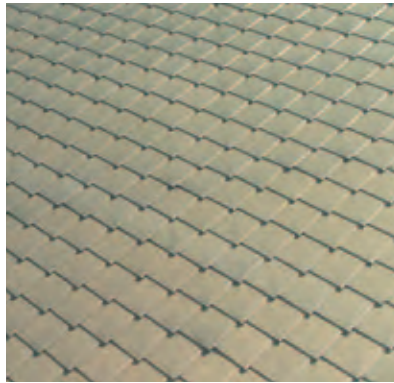
PREFABRICATED TRAYS

Prefabricated tray is a fully-supported 0.5 - 0.6 mm thick copper tray, pre-formed to be ready for fast, efficient installation.



PANELS

For facades, self-supporting copper panels pre-formed on two sides can be used vertically, horizontally or diagonally to give a linear, striated appearance. Various shapes and sizes are available.



SHINGLES

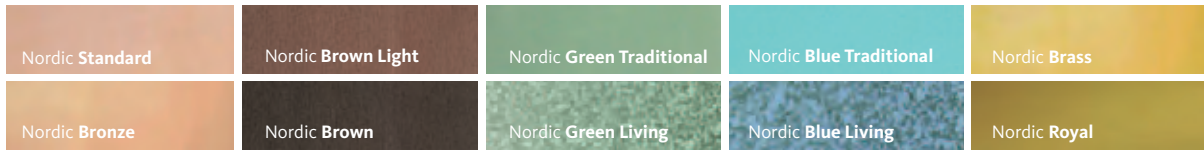
Fully supported copper elements for facades or roofs, shingles offer a distinctive “fish scale” appearance with shapes including squares, diamonds, rhomboids and rectangles in various sizes.



CASSETTES

For larger flat areas, cassettes have squarer proportions with folded edges on all four sides. Various types and sizes are available.

Product Range



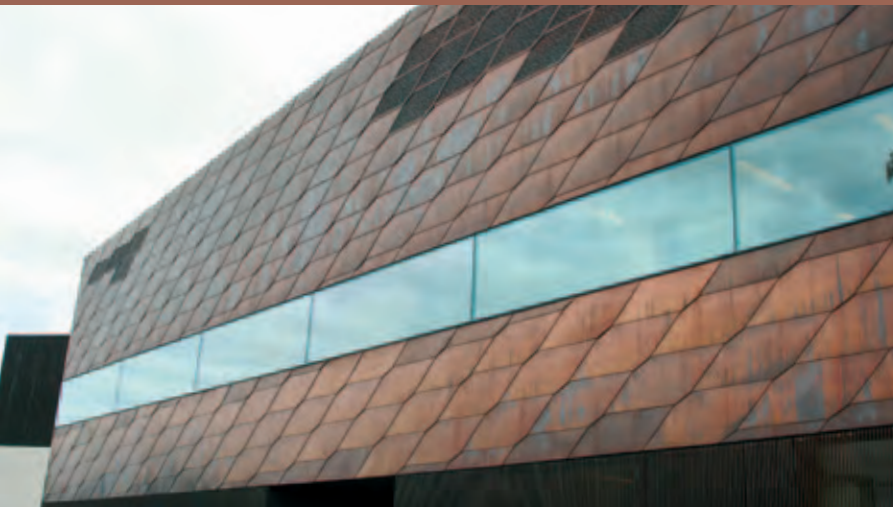
| Product | Alloy | Thickness range mm | Maximum width mm |
|----------------------------|---|--------------------|------------------|
| Nordic Standard | Cu-DHP | 0.3-4.0 | 1100 |
| Nordic Brown & Brown Light | Cu-DHP | 0.5-1.5 | 1000 |
| Nordic Green & Blue | Cu-DHP | 0.5-1.5 | 1000 |
| Nordic Royal | CuAl ₅ Zn ₅ Sn ₁ | 0.5-1.5 | 1000 |
| Nordic Brass & Weathered | CuZn ₁₅ | 0.5-2.0 | 1000 |
| Nordic Brass 30 | CuZn ₃₀ | 0.5-2.0 | 1000 |
| Nordic Bronze | CuSn ₄ | 0.5-2.0 | 780 |

There are also several variations available on living surfaces. On request further information of tailor-made surfaces. Please note that the colors on this brochure are for reference only.

References

| Page | Object | Location | Material | Architect | Year |
|---------------|-----------------------------------|----------------------|----------|--------------------------------|------|
| Cover | Splashpoint Leisure Centre | Worthing, UK | ● | Wilkinson Eyre Architects | 2013 |
| 3 | Dolomitenblick | Sesto, Italy | ● | Plasma Studio | 2012 |
| 4 | Dudley Evolve | Dudley, UK | ● ● ● | Metz Architects | 2013 |
| 5 | Roslin Institute | Midlothian, Scotland | ● | HDR Architecture | 2009 |
| 6, 15 | SHK Museum | Stockholm, Sweden | ● | Wingårdh Arkitektkontor | 2010 |
| 7, back cover | Longyearby Research Center | Svalbard, Norway | ● | Jarmund & Vignaes | 2005 |
| 8, 16 | Cathedral Lund | Lund, Sweden | ● | Carmen Izquierdo | 2012 |
| 9 | Skellefteå Kraft Office | Skellefteå, Sweden | ● | General Arkitekture | 2010 |
| 9 | Ventspils Library | Ventspils, Latvia | ● | India Architect | 2009 |
| 10-11, 23 | Seinäjoki Library | Seinäjoki, Finland | ● | JKMM-Architects | 2012 |
| 11 | Seeheim House | Seeheim, Germany | ● | Fritsch + Schlüter | 2011 |
| 12-13 | Nordahl Grieg School | Bergen, Norway | ● | LINK signatur AS, Team Bergen | 2010 |
| 13 | Hotel Post | Gothenburg, Sweden | ● ● ● | Semre'n och Månsson arkitekter | 2012 |
| 14 | Castle Stuart | Inverness, Scotland | ● | G1 Architects | 2010 |
| 15 | Clarion Hotel Trondheim | Trondheim, Norway | ● | Space Group | 2012 |
| 15, 20 | Serafino Consoli Offices | Grumello, Italy | ● | Mangili & Associati | 2010 |
| 16 | Nya Strömkajen | Stockholm, Sweden | ● | Marge Arkitekter | 2013 |
| 17 | Holland Park School redevelopment | London, UK | ● ● ● | Aedas | 2013 |
| 17 | Adelaide Oval redevelopment | Adelaide, Australia | ● | Walterbrooke | 2013 |
| 18 | Tidemill School | London, UK | ● | Pollard Thomas Edwards | 2010 |





Imprint

Editor

Aurubis Finland Oy
Kuparitie, P.O. Box 60
FI-28101 Pori, Finland
Tel: +358 2 626 6111
www.aurubis.com/finland

CONTACT FOR ARCHITECTURAL

Aurubis Finland Oy

Phone: +358 2 626 6111

info-pori@aurubis.com

architectural-products@aurubis.com

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Photos:

Julian Abrams, cover
Hertha Hurnaus p. 2,
Lennart Hyse p. 5, 13,
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