METAL IN ARCHITECTURE

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Metal in architecture
Supplement

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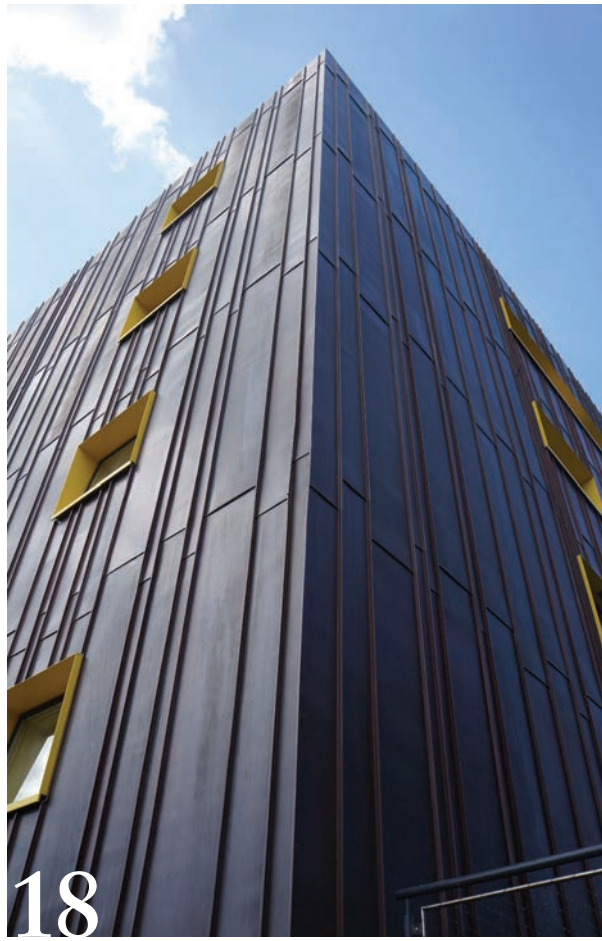

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FROM THE EDITOR

In the wake of Grenfell, as the inquiry continues to roll out a depressing litany of problems and loopholes within the construction industry, the focus has moved away from aluminium to other construction materials, such as insulation. However in this new world, which will need living in once Covid has eventually retreated, all of UK construction's procurement methods and commonly-used materials are now rightly under scrutiny.

The mainstream media – and then the public – tend to latch on to a few terms or phrases when it comes to seeking to blame something or someone for a disaster, although it's likely in Grenfell's case that no one person or team will ever be culpable. One of the terms would be aluminium, yet a quick look at the actual facts reveals that the panels used were composite aluminium 'sandwiches,' not solid aluminium – therefore targeting that material per se would be insane, yet also perhaps inevitable in the noise of current public discourse.

As more and more potentially causal factors become revealed within the product specification end of this horrendous saga, the only upside is that spotlight is turned away from one of the more important, useful and sustainable construction materials available.

While our project report in this supplement is a copper landmark in Bristol, balcony firm Alideck puts an impassioned case for aluminium on page 25. The firm's Richard Izzard explains how the fire regulations have unsurprisingly tightened – seeing timber and composite decking banned from the list available for high-rise balconies. However, aluminium, he says, has stepped into the breach, and asserts that for buildings that fail new EWS1 surveys now demanded by mortgage lenders, non-combustible materials will have to replace their combustible counterparts.

The problem, says Izzard, is that high-rise developments are reportedly still being completed which were designed when the regulations were emerging post-Grenfell, and feature what are now non-compliant materials. Surely a retrospective replacement, whether or not it's the perfect aesthetic solution, is likely to be on the cards?

On page 27, in a piece entitled 'Sustainability defined,' Andrew Cross of Kestrel Aluminium Systems explains what many might know, but bears repeating; that aluminium can be endlessly recycled, losing little of its original properties. This makes it the ultimate sustainable metal in mainstream use. Unfortunately the cost of aluminium continues to escalate, however with an ever keener focus on hitting our 2020 net zero carbon goal, the potential of the material to reduce projects' embodied carbon is luckily given greater weighting.

Also, if we are looking at extending upwards and outwards as a future sustainability maxim, rather than simply replacing existing buildings, do the lightweight properties of aluminium give it more potential to be seen as a worthy foe for steel frame in more sustainability-focused projects? Simple, light alu structures that harmonise with existing metal-framed buildings, or contrast with timber silhouettes, might well be something to look out for.

Enjoy the supplement!

James Parker
Editor

ON THE COVER...
The simply named 'Copper Building' by architects Ferguson Mann is a copper-clad apartment block in Bristol which replaces and takes cues from the Imperial Tobacco factory which used to sit on the site. Cover Image © Ferguson Mann

For the full report on this project, go to page 18

STEEL

Wilkinson Eyre's steel bridge reconnects Copenhagen harbour

A 160 m-long steel cycling and pedestrian bridge 160 metres long, has been built across the Inner Harbour in Copenhagen, with a design that conceals a "surprise" opening.

Designed by Wilkinson Eyre in conjunction with Urban Agency, the bridge forms a sweeping curve in plan that "reconnects the two misaligned axes of the Vester Voldgade and Langbrogade," said the architects. Since 2008, cycle traffic on the adjacent Langebro road bridge has increased dramatically, and a central part of the brief was to significantly improve their safety and experience. The new Lille Langebro bridge provides an alternative route for over 10,500 cyclists and pedestrians combined daily.

The shape of the two triangular steel edge beams gradually changes as the bridge crosses the water. At the quaysides, they are angled downwards below the deck, and as the bridge extends across, they gradually twist upward, maximising the clearance below deck, and "providing a perceived sense of security at mid span."

The "continuously flowing lines" of the bridge "offer no clues as to how the bridge opens," said Wilkinson Eyre. The two opening spans create a "surprise" as they pivot on their supports and swing apart at mid-span. This motion provides a spectacle for viewers to enjoy and results in a 35 metre-wide shipping channel.

Sustainability approaches for the bridge's 100-year design life, included creating resilient infrastructure and "ensuring the highest levels of material quality for the client and the city's residents." LED lighting has been installed across the length of the bridge, ensuring low levels of operational carbon and providing access at night.

The design has successfully responded to the client's vision to create a "subtle and elegant" transport link, said the architects, and has reportedly been well received by both locals and visitors to Copenhagen.

CORTEN STEEL

University restaurant offers unusual corten and concrete facade

Chapuis Royer Architectures have described their Diderot university restaurant in the centre of the Grenoble campus in Saint Martin d'Hères, France, as a "highly unusual concept to enliven the university dining experience."

Set on a site that already numbers several other works of architecture, the public areas face frontages composed of raw concrete facades, wooden slat screens, different elements made of corten steel, and large glazed bays. These materials were in part chosen to ensure durability and minimal upkeep, said the architects.

The building offers views towards the exterior, taking advantage of natural light, even in restaurant staff's work areas. The glazed bays on the ground floor allow the structure to "appear transparent," along with terraces, patios, and a bow window on the floor above.

The fifth, roof, facade consists of a concrete enclosure wall covered with insulating materials "to ensure visual and acoustic protection from the mechanical noise of the technical equipment," said the architects.

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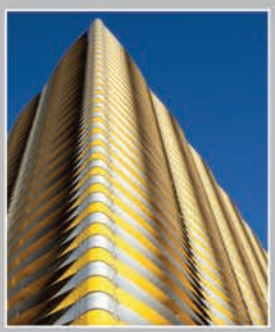



PERFORATED ALUMINIUM

Coffey Architects' perforated office completes in King's Cross

22 Handyside Street, a new office building designed by Coffey Architects, has now completed, featuring a skewed, pitched roof and a perforated aluminium facade.

The building is located on the corner of Handyside Street and York Way within the 67-acre King's Cross development. Internally, the design looks to maximise the use of light and space to promote wellness for the building's occupiers. It spans over 36,000 ft^2 and is targeting BREEAM Outstanding.

The building's form was determined by three factors, said the architects: the position of the sun, the site perimeter and the site's structural grid. Like its neighbouring building, the King's Cross Sports Hall, 22 Handyside Street sits above underground railway tunnels meaning it "needed to be super lightweight," said Coffey Architects. Responding to these elements, they shifted the three-storey building diagonally. This helped "balance the weight of the building" as well as improving the orientation for maintaining heat and maximising the views out.

22 Handyside Street is built of lightweight concrete and steel, with a facade composed of glazed curtain walling and perforated aluminium panels. These silver sections "enliven the building both inside and out, with perforations artfully reflecting the trees of Handyside Gardens," said the architects. The material "maximises ambient light levels and reflects the colours of the London sky throughout the day." Behind the patterned facade, its interior spaces are naturally lit.

To further improve wellbeing, Coffey Architects worked with Townshend Landscape Architects to enhance the public realm with planting to the east including seating and pockets of planting and cycle parking to the south.

ANODISED ALUMINIUM

Colorado museum has facade of 9,000 diamond alu panels

American architecture firm Diller, Scofidio + Renfro (DS+R) have announced the recent completion of the U.S. Olympic and Paralympic Museum, located at the base of the Rocky Mountains in Colorado Springs.

DS+R's design incorporates around 20,000 square feet of galleries, a 130-person auditorium, event spaces, and a cafe. The 60,000 ft^2 museum showcases the accomplishments of athletes at the games while displaying the history of the national team. At the centre of the complex, a terraced hardscape plaza provides views of surrounding mountains.

The building's facade features over 9,000 folded anodised diamond-shaped aluminium panels, the skin wrapping four overlapping petal-like volumes that spiral around the internal structure. Each metallic panel is "animated by the light quality in Colorado Springs," said the architects, producing gradients of colour and shade that give the building "another sense of motion and dynamism."

The aluminium, developed by Lorin Industries, was selected as it was lighter than other materials such as stainless steel. With less material being required, the supporting structure no longer needed to be as expensive to hold up the facade panels. The panels are 100 per cent recyclable, helping to meet the project's LEED requirements.

Working alongside a committee of Paralympic athletes and people with disabilities, the architects' design is said to have created one of the most accessible museums in the world. "From entrance to exit, people with or without disabilities can tour the facility together and share a common path," said the architects. All visitors ascend to the top floor by lift, and ramps guide them down a gentle-grade downhill circulation path that enables easier movement.

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COMMENT

An introduction to standing seam roofing design

Standing seam roofs are a popular choice with architects and specifiers looking for a design that really stands out. Simon Walker of SIG Zinc & Copper discusses what architects and specifiers should consider when designing standing seam roofing

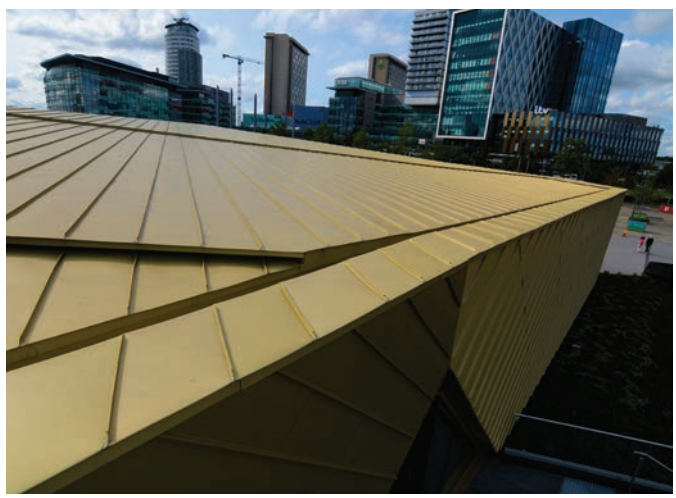
Traditional standing seam has been in use for over a century, having been originally used on ecclesiastical buildings. Before long, strip standing seam was available panels were made up in short sheets and jointed, which was time consuming. Nowadays, modern profiling means you can cover up to 12 metres in a single strip. As a result, standing seam roofing is probably one of the most cost-effective ways of installing a zinc roof, and today can be seen on a wide range of building types.

Appearance

Standing seam roofs are created using light gauge metals such as zinc, copper, aluminium or stainless steel. To achieve the desired aesthetic appearance seams follow the line of maximum pitch. The seams themselves are fairly fine, but in sunny weather the shadows they cast are clearly visible on the surface of the roof.

A unique characteristic is the subtle quilting that can appear naturally under different light conditions

A unique characteristic of the malleable metals used in standing seam roofing is the subtle quilting that can appear naturally under different light conditions. This brings a bit of visual 'vibration' to the building which many architects appreciate but your client might be less keen. Quilting is more noticeable on steeply pitched roofs and facades.



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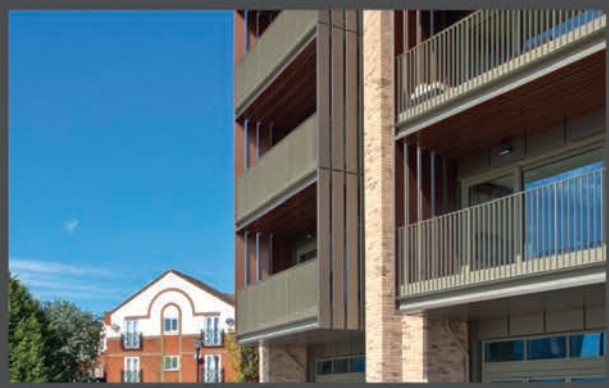

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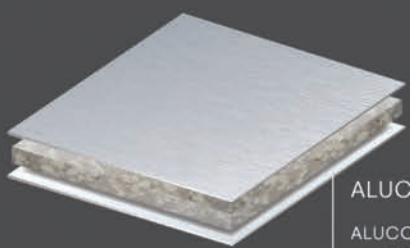

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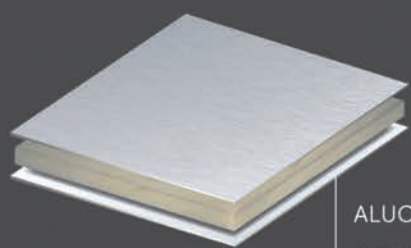

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Roof build-up

Standing seam roofing can be installed over a ventilated or non-ventilated roof construction allowing you to choose the best solution for the characteristics of your project. Trays are not self-supporting and require a fully or almost fully supporting substrate against which they rest and to which their clips are fixed.

Choosing which design is the most appropriate for a particular project depends on many factors and is best discussed on a project-by-project basis.

The standing seam joint

The longitudinal joint is a 25 mm high double lock standing seam. The double lock welt of the seam is raised above the water drainage part of the tray.

The standing seam is formed by profiling or folding strips and sheets into trays. An 'undercloak' is formed along one edge (this is the edge that is fixed with clips) and an 'overcloak' along the other. To make the joint, the overcloak is welted around the undercloak of the adjoining tray, covering the clips. The two trays are then seamed up using seaming irons or seaming machines.

Since the trays are only fixed along their seams, the distance between trays is determined according to expected wind loading, and tied in to commercially available coil widths.

Be aware that angle standing seam joints are limited to use on slopes pitched at least 25° or above.

When designing standing seam roofs architects should always consider the implications of the pitch and environmental conditions

Choosing the right cross joint

It is sometimes necessary to join standing seam trays end to end. This may be to introduce an expansion joint, as part of the flashing work around a chimney or skylight, or to produce a change in tray width on a conical roof.

There are different joint types available and the degree of roof pitch will determine which detail should be specified.

Fixing

Each tray is anchored using hidden clips that are hooked into the seam and normally screwed or nailed to the substrate below. If the length of the tray is under 1.5 metres, fixed clips can be used throughout. Trays over 1.5 metres require a combination of fixed clips and sliding clips to allow for thermal movement of the trays, and provision for movement at eaves and ridge.

The distribution of the fixed clips depends on roof pitch – the steeper the pitch, the higher the band of fixed clips is positioned.

Avoiding pitfalls

When designing standing seam roofs architects should always consider the implications of the pitch and environmental conditions. For example careful consideration is needed when designing for particularly windy locations. The bay width of the trays will need to be narrowed otherwise an unwelcome fluttering noise can be generated by the movement of the pans of the trays or at worse, the standing seams can be lifted.

We would always recommend choosing a supplier or manufacturer with comprehensive technical support. The supplier should be able to provide technical information, including details, NBS Specifications, 3D build-up, and warranties.

It is also a good idea to look at the installation site with an experienced and accredited installer and take all these factors into account when determining joint type. A FTMRC registered and reputable hard metal roofing contractor should carry out the installation.

Want to learn more?

Why not attend a RIBA Approved CPD such as SIG Zinc & Copper's 'Specifying Hard Metals: Choosing the Right Product for the Project' which aims to help specifiers demystify the confusion surrounding hard metal specification.

Simon Walker is category manager at SIG Zinc & Copper


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COMMENT

Steel windows' split personality

Darren Lloyd of the Steel Window Association looks ahead at how the separate properties inherent to steel windows help them take key new roles beyond the pandemic

The terms 'heritage,' 'high performance' or even 'futuristic' are all applicable to the products on offer from members of the Steel Window Association (SWA). This helps explain the diversity of the project types they are involved in undertaking, and the relatively positive position in which the organisation finds itself as a challenging year draws to an end.

The SWA is unusual amongst construction industry trade bodies in that members work together in a truly collaborative way, not just lobbying legislators, but on continued testing and joint new product development, while also ensuring the robustness of what is an international supply chain. Furthermore, with varying skillsets, areas of speciality and regional spread, the companies ensure the entire UK and all of the sectors are covered.

Despite numbers of their staff having been furloughed during the early months of the pandemic, when much of the construction industry was forced to cease work, all SWA member companies are now back to something approaching their pre-Covid level of activity, and are managing to keep lead times on orders at an operable level.

This project-friendly state of affairs is partly due to the fact that sub-contractors, like the galvanisers and powder coating specialists, have continued operations serving a wider client base. Also, there have been no serious interruptions to the supply of hot-rolled steel profiles from the manufacturers.

While there have been widely reported shifts within the UK economy – most notably in terms of retail and the proportion of employees continuing to work from home – the consequential effects actually present fresh opportunities for steel window and door manufacturers.

Estate agents have noted a definite desire amongst many purchasers wanting to relocate to larger homes in rural locations, including those seeking to move from apartment blocks to houses with their own garden.

Although steel windows have not been the fenestration solution of choice for the volume developers since the mid-20th century, they are widely found in period properties which also tend to benefit from larger outside space than estate houses. Older stock is therefore likely to continue providing SWA members with a steady stream of refurbishment work, especially

All SWA member companies are now back to something approaching their pre-Covid level of activity, and are managing to keep lead times on orders at an operable level

where conservation rules or listed status dictates like-for-like replacement: generally involving use of the traditional SMW profiles or upgrading to W30 profiles for improved thermal efficiency. And where owners are carrying out alterations or extending buildings, there is often a demand for new doors or windows which closely match the existing. For example, many Victorian and Edwardian homes have had their kitchen or living spaces opened up through the installation of steel framed screens incorporating double doorsets.

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Alternatively, several members are able to carry out detailed restoration work, often involving the insitu repair of even the earliest metal windows, including wrought iron frames and those containing leaded lights. Aiding them in this work is a manufacturer which produces a comprehensive selection of architectural ironmongery and brassware in both traditional and contemporary finishes – such as 'oil-rubbed' brass.

A further work stream is expected to come through the repurposing of old high street stores or office buildings, where conversion to residential use – without sacrificing their architectural integrity – is likely to require an upgrade from W20 or earlier Universal Suite windows to W30 or W40 units – delivering far better thermal efficiency. Significantly, the selection of systems available through the SWA enables consultants and their clients to bring the energy performance of refurbishment or remodelling work within the requirements of Part L of the Building Regulations.

Another of the Approved Documents, Part B which covers fire performance, was revised two years ago, changing the way in which internal doorsets of all types are tested, so that now under BS476 Part 22 (1987) Clause 8 they must be subjected to fire on both sides. Unfortunately, this has caused a backlog of work for the UK's accredited laboratories; and although the SWA has successfully concluded indicative testing on window elements, along with their beading, full certification for such internal applications is not expected until next year.

Of course, one of the key reasons why both specifiers and building occupants are very keen on steel fenestration is its robustness and heightened security; which is why in commercial and retail applications, where high value contents must be protected, steel is the primary option for fabricating 'bandit resistant' screens. Extending this benefit still further across the market, SWA is well advanced with development work to make multipoint locking available for inclusion within all the suites of profiles, enhancing resistance to both jemmying and 'hard body impacts.'

Looking ahead, with the expectation that the economy will follow the 2021-22 growth profile projected by the IMF, the SWA intends to continue being proactive in its dealings with the market

Finally, it is anticipated that the continuing development work being conducted on the W50 TB suite – where the dual section profiles are physically split by a high-performance thermal break, providing far better energy performance and a striking personality of their own – will lead to increased use on apartment complexes and commercial buildings.

Looking ahead, with the expectation that the economy will follow the 2021-22 growth profile projected by the IMF, the SWA intends to continue being proactive in its dealings with the market. Across its membership, there remains sufficient capacity to deliver projects for clients in all construction sectors.

Darren Lloyd is the president of the Steel Window Association

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A copper partner for corten

Phase 2 of a major residential development in Bristol is an industrially inspired block of apartments faced in copper, designed to complement a former tobacco company HQ. James Parker reports

Ferguson Mann Architects (FMA) were appointed to design Urban Splash's 422-apartment Lakeshore residential scheme in Bristol in 2003. The first phase includes the refurbished former UK headquarters of tobacco giant Imperial Tobacco, Imperial House, a 1970s Grade II-listed office designed in corten steel by internationally renowned practice SOM.

Straddling a lake, within 10 acres of parkland, alongside a retail park, the building now houses 127 spacious apartments that benefit from the original architecture, with high ceilings, full-height windows, and balconies. There are a further 143 in the refurbished low-rise podium beneath, and 16 in a converted adjoining east wing overlooking the lake and restored landscape, including an orchard and new allotments.

Sitting between the corten building (which includes 36 apartments allocated for tenants of Housing Association Aster Homes) and the retail park, but lying perpendicular to it, is a large new addition. A long, rectilinear and copper-clad structure sits over a newly constructed three-storey car park, housing 136 apartments. Simply titled 'Copper Building,' this striking edifice replaces and takes cues from the demolished Imperial Tobacco cigarette factory which previously sat on the site. It also provides a complementary materiality to the corten steel which in turn enhances the robust semi-industrial appeal of the development as a whole.

The project architects Ferguson Mann say that "without the factory building, the north edge of the site felt incomplete, so we wanted to create a design that would reference the previous building in form and language." The new form encloses and provides a punctuation to the site along the road which divides it from the retail park, and completes the approach and entrances to the existing building by integrating entrances across the site.

Genesis

FMA had a track record of working with Urban Splash on similar major refurbs, including working on an array of "fantastic listed buildings in Plymouth," project architect Nick Brown tells *ADF*. In 2003, the developer purchased the derelict site in the south west of Bristol, and FMA were appointed to help "bring it back to life." Phase 2 was a Design & Build contract with FMA working for Urban Splash, before being novated to contractor WRW Construction.

FMA has a strong history in the residential sector generally, across a wide portfolio of projects from masterplanning to single bespoke homes, and larger apartment developments such as the Lakeshore scheme. The context for the project is a high need for good quality homes in the areas, especially ones with large areas of external green amenity space, says Brown.

One of "countless challenges" on the project, reports the architect, was a site that was difficult to develop. He says that the Copper Building element itself became a problem when the overall project had to be split into several phases due to the 2008 recession. However, the architects were keen to work with Urban Splash again, Brown describing them as a "visionary


© Urban Splash

Photos © Ferguson Mann

client, with a habit of transforming unloved buildings and places." FMA were excited to tackle what was "a hugely interesting existing building, with the landscape and the lake," despite the severely derelict nature of the site.

Another challenge faced by the project team was a delay before the Copper Building began construction (it had been intended it would start immediately following Phase 1's completion). On the back of high demand, apartments in that initial phase became fully occupied, and the contractors had to deal with a tight site plus new residents in an adjacent building, and a live 24-hour car park.

Brief

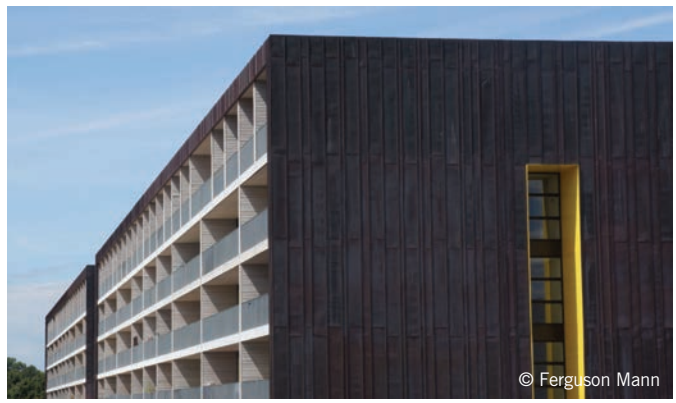
The client's brief to the architect was to create an "enjoyable and special place to live, rather than delivering a certain number of units," and this freedom helped the designers to make something which matched their vision. FMA worked closely with the developers to hone the proposals over "a number of years," including those for the Copper Building itself. It consists of a mix of one-bed, two-bed and duplex apartment types.

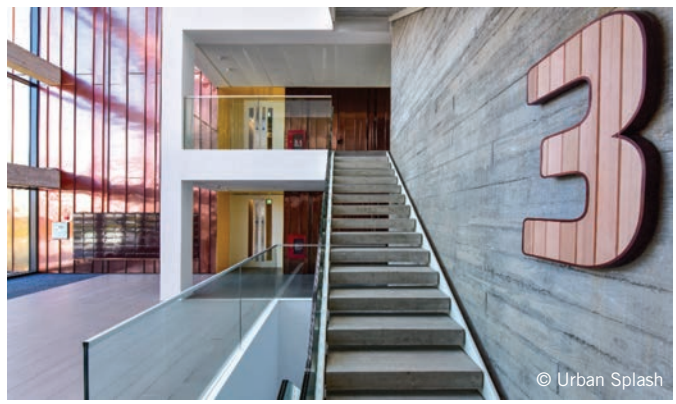
With the project having to be split into phases, after phase one was completed in 2012 the architects took the opportunity to revisit the brief for the new building. With the form already having been fixed by obtaining planning approval, the architects reordered the interior to ensure the maximum number of rooms would benefit from south facing views. The layout and elevations, including the fenestration arrangement, ended up completely different in the reconfigured version.

The architect says an "innovative section at top floor level" creates a dual-aspect duplex in order to maximise the number of south facing rooms; all have open plan living spaces and views across the lake. South-facing balconies, each of which are full apartment width, allow residents to make the most of the views. The entire elevation has floor-to-ceiling sliding glazed doors so you can open the living space onto the balcony. And being enclosed on both sides means they can function as another 'room' that can be enjoyed all year round.

Form & structure

The "rigorous" 3.6 metre-wide structural grid that defined all elements of the Mies-inspired Phase 1 building was a "key driver" in the Copper Building's design, says Brown. He adds that the designers "played





"We needed a material that was going to speak of the industrial heritage of the site, yet in a warmer, more refined way"

Nick Brown, FMA Architects

with this principle to bring more variation to the facade," including a mix of 3.6 metre, 7.2 metre and 10.8 metre bays to support the mix of apartments.

The structure is a simple reinforced concrete frame with columns and flat slabs, plus a lightweight SFS infill and rainscreen cladding. Although the car park delivered during Phase 1 was designed to have the new four-storey building sitting above it, the fact that they ended up being constructed at different times created challenges, Brown admits. A key part of the brief was also to create "generous and inspiring" common areas, and the full-height atrium entrance area is one element that fulfils this.

As well as being clad in a manner that complements its corten steel cousin, says Brown, the two buildings were further brought together by the creation of a new entranceway "that opens up a view down the original structure, echoing that now lost connection between factory and office."

Materials

The building was originally planned to be clad with corten steel cassettes to match the existing building's facades, and also tying into the history of the factory that occupied the site. Budget considerations once the project had been phased meant that corten became unviable across the 180 metre-long volume, however the architects also had reservations about it being "a bit unfriendly on a residential building of this scale."

The architects settled on a specification of Nordic Brown Copper manufactured by Aurubis. Brown explains this choice: "We needed a material that was going to speak of the industrial heritage of the site, yet in a warmer, more refined way." In addition, as it was a largely north-facing facade, the architects wanted a material that would patinate subtly over time.

FMA had recently used the same durable cladding on another building, although the Copper Building was designed first – "it took longer to deliver due to its larger

"Urban Splash are a visionary client, with a habit of transforming unloved buildings and places"

Nick Brown, FMA Architects

scale." However Brown adds that this delay did mean that the designers had the benefit of seeing the copper on the other project weather slightly before it was installed here, reinforcing their expectations.

Precise execution by the contractors was key to success, as the thin reveal trims needed to align with a vertical cladding seam both above and below, but the window locations alternated from one bay to the next across four storeys. Close coordination between trades was crucial to ensure that the tolerances could be accommodated, with little margin for error. At the outset, the installer set out a full-size bay to review the various problems with the architects, allowing details to be refined into a workable solution, says Brown. He is pleased to report that they "executed the finished cladding to perfection."

In fact it was the bright yellow PPC aluminium reveals of the variously sized windows that caused more of a design challenge, in terms of how they would appear in the finished result. Providing the intended playful contrast with the more restrained copper hues, they required more experimentation, which was undertaken through a series of onsite mockups.

A standing seam envelope with variations in spacing of that seam was a further device to "enliven the elevations" which appears "quite random at first," says Brown. However, there's an underlying pattern of bays and connections between alternating windows.

Sustainability

The project as a whole offers some innovative design which harnessed the benefits of the original structure to provide sustainability benefits. For example in Phase 1 the new central atrium brings in light to the deep plan but also enables passive design measures such as stack effect natural ventilation of apartments. The project achieved an EcoHomes 'Excellent' rating thanks to high external wall insulation levels, and a combination of ground source heat pumps using boreholes, and biomass-powered underfloor heating.

Photos © Urban Splash

On the Copper Building, the highly air-tight envelope includes triple-glazed windows, and the south facing elevation maximises useful solar gain and daylighting. The footprint of the new building is within that of the previous factory building so the ecological impact has been minimised, and surrounding vacant and underused areas have been repurposed as allotments for the residents, while the lake has been decontaminated to benefit biodiversity.

Conclusion

This is a project which tackled a hiatus and being split into two, but architects used it to their advantage, reengineering for a better end product. Another piece of pragmatic design is that in choosing copper, the design doesn't quite replicate, but works with the now fashionable weathered looks of a worthy example of 1970s commercial architecture, retained for the future.

Now the two buildings sit comfortably together, metal-clad relations with differences and similarities, and in that sense replicating the natures of the office and factory that were inherent to the personality of the site. Brown concludes that the architects felt they "would have a conversation with each other without having to be an exact replica of the materials used." The warm new copper look has gained the project strongly positive feedback from locals, which speaks to the carefully controlled specification as well as design by FMA. ■

PROJECT FACTFILE

Architect: Ferguson Mann Architects
Client: Urban Splash & Places for People
Structural engineer: Buro Happold
MEP consultant: Hoare Lea
Project manager: Broadfield Project Management
Employer's agent: AECOM
Main contractor: WRW Construction

The answer for high-rise balconies and beyond?

In the wake of Grenfell, Building Regulations have rapidly shifted to a more fire-safe position – Richard Izzard of AliDeck explains how aluminium suppliers have responded quickly to provide an increased range of options for balcony specification

Fire safety is paramount post-Grenfell, the specification of non-combustible materials in the external envelope of high-rise buildings is now mandated in the revised Building Regulations. With balconies clearly defined as 'specified attachments' to the external envelope, the new more-stringent regulatory environment requires balcony materials to be equally fire-safe, removing previously common materials, such as timber or composite decking, from the options available to specifiers.

Rather than curse the limitations of these necessary changes, architects and specifiers have rapidly embraced the new opportunities made available to them by the increasingly sophisticated metal balcony component systems that manufacturers have delivered to the market in response to the evolving legislation.

Aluminium in particular has risen to the fore, with several manufacturers reacting to the situation by developing comprehensive aluminium systems for balconies, some of which include decking boards, support joists, pedestals, soffit cladding, balustrades, and more.

What became clear in the aftermath of Grenfell was the real paucity of non-combustible materials for balconies, with timber or composite being the long-established de facto standard materials and little else commonly available. As Approved Document B began to be amended, though, non-combustibility became an absolute requirement and aluminium was soon recognised as the main viable choice.

Off-the-shelf compliance

To satisfy the new regulations, all materials must be certified to EuroClass A1 or A2-s1, d0 ratings. Aluminium easily achieves this standard, and, when powder-coated to Qualicoat standards, no smoke emission and no production of flaming droplets.

The compliance guarantee that these fire ratings deliver to specifiers is invaluable, allowing for essentially 'off-the-shelf' specification of relevant products and peace-of-mind that proposals are robust and, most importantly, safe.

By specifying aluminium balcony components, an architect can be sure that their design is compliant from conception to construction. Over the last 12 months in particular, it has become clear that architects and designers have recognised and embraced this simple and guaranteed route to compliance.

It has by no means been a smooth transition, though. As regulations began to evolve following Grenfell, and against a backdrop of the unrecognised implications for balcony design, many new and in-progress developments fell between the cracks and were completed with timber or composite decking across their balconies.

We're still seeing newly completed high and low-rise developments that have non-compliant materials in their balcony and terrace decks. It is a major problem and has resulted in a huge amount of

We're still seeing newly completed high and low-rise developments that have non-compliant materials in their balcony and terrace decks

With balconies clearly defined as 'specified attachments,' the new more stringent regulatory environment requires balcony materials to be equally fire-safe

almost brand-new timber or composite decking needing to be stripped out and replaced with a non-combustible alternative, creating large and clearly needless additional expense.

Fortunately, greater clarity was provided to the industry through recent Government Advice Note updates which specifically defined balconies as part of the external building envelope, resulting in non-compliant specification becoming increasingly less common.

Building a fire-safe future

These new requirements and their associated costs and upheavals are appropriate responses to a genuine and inarguable set of problems within the construction sector, brought to the fore by the Grenfell tragedy.

New legislation is currently before Parliament in the Fire Safety Bill and the Building Safety Bill, the draft texts of each placing a considerable focus on construction methods and practices as well as non-combustibility of materials. When these new laws reach the statute books in due course, a clear and concise framework will hopefully have been achieved to allow the industry to move towards a fire-safe future.

What is certain, however, is that whatever shape the new legislation takes as it travels through Parliament, there will be no backsliding on the outlawing of combustible materials in high-rise new-build developments.

An additional impact on the non-viability of combustible materials was recently recognised in the External Wall Fire Review scheme. Developed by the Royal Institute for Chartered Surveyors and the Building Societies Association, this scheme (more commonly known as EWS1) was designed to provide lenders with a standard fire survey for buildings above 18 metres in height.

Government advice in January 2020 broadened the scope of affected buildings to essentially all multi-occupancy buildings of any height, leading to mortgage lenders requiring successful EWS1 surveys for many more properties than originally envisioned. This immediately resulted in a new log jam, and potentially years of delays for homeowners and their buyers.

For buildings that fail the EWS1 survey, the only solution is for all combustible materials to be replaced with non-combustible alternatives. While many of these failed buildings have profound fire safety issues affecting multiple aspects of the entire construction, there are not insubstantial numbers of buildings failing simply due to the presence of combustible materials just in balconies. Lenders are simply refusing to accept any risk when it comes to providing mortgages on properties that contain combustible components.

With comprehensive aluminium balcony systems available to directly replace combustible timber or composite decking, this particular issue has been a relatively simple issue to resolve, albeit at considerable expense. It underlines, though, the importance of manufacturers developing complete, off-the-shelf compliant systems for architects and designers to not only solve these issues but to prevent them from occurring in the first place.

Safe, strong, sustainable

There are other features beyond non-combustibility that play no small part in aluminium's overall suitability as the replacement for timber or composite in balconies. Durability, weight, sustainability, and cost are all areas where aluminium performs exceptionally well compared to other non-combustible materials. It's this comprehensive package of benefits that has made extruded aluminium systems the new de facto standard for balcony, terrace, and walkway design.

Aluminium is strong and highly durable, able to withstand decades of use with minimal wear, yet is only a third of the weight of steel, delivering a low structural load and allowing building designs to be streamlined. A further key property is that it does not corrode or rust, even when exposed to wet environments over many years, and when powder-coat finished provides a near-zero maintenance solution for use in balconies, walkways, and terraces, with just simple surface cleaning required.

In plentiful natural supply and with expected product life spans of up to 60 years, aluminium systems are fast becoming the ideal solution for 21st century architecture. As manufacturers continue to develop comprehensive aluminium product lines for all areas of a building's construction, the material's inherent benefits plus its major contribution to fire safety will make it key in specification for much more than balconies and decking.

Richard Izzard is managing director of AliDeck

Sustainability defined

With increasing pressure to specify building systems offering clearly defined sustainability, Andrew Cross of Kestrel Aluminium Systems gives his thoughts on the use of aluminium as a key building component

The Birmingham Modpod

In construction terms, aluminium is considered to be a 'permanent' material as, unlike some other metals, it loses none of its inherent properties as a consequence of repeated recycling. The World Green Building Council has set a target to make all buildings 'zero carbon' by 2050 so, with demands to reduce carbon emissions and the environmental impact of production processes, use of materials which embody recycling as an inherent feature are becoming increasingly significant.

Aluminium is now used across a wide range of sectors and, as a matter of interest, is still very much the most valuable item in our recycling collection. From an emissions perspective, use of pre and post-use aluminium greatly reduces energy consumption and adds tangible value to the economics of production. To put this into perspective, it saves around 95 per cent of the energy consumed in the 'primary' production process.

For those specifying metal window and door systems there is, therefore, a clear

Aluminium curtain wall and window system on the Coton House estate in Rugby

Aluminium is considered to be a 'permanent' material as, unlike some other metals, it loses none of its inherent properties as a consequence of repeated recycling

incentive to use a raw material that can be reused on an infinite basis. In terms of enabling building designs to achieve the highest level of BREEAM certification, aluminium can also provide tangible benefits in terms of assessment of an asset's environmental, social and economic sustainability through use of standards developed by BRE. In addition, it enhances specific aspects of technical performance such as thermal, acoustic and energy efficiency.

Use of natural materials, timber in particular, undoubtedly has its supporters, but most natural materials offer limited potential for recycling. Deforestation, dwindling resources and a generally adverse effect on the environment can only become a bigger issue as demand for greater sustainability increases. By contrast, aluminium products made using recycled material present consistently low environmental impact while offering strength, durability, stability and greatly reduced weight compared to steel. Among the many other benefits they have to offer, natural corrosion and UV resistance enable the specifier to forecast with considerable accuracy the cost of maintenance over a system's design life.

While there has long been an economic incentive to recycle aluminium, there is now greater organisation in the construction industry in terms of post-use collection, evaluation and sorting. The CAB (Council for Aluminium in Building) is now actively promoting use of higher grades of aluminium scrap while seeking the active involvement of all members of the supply chain in the management of material re-use. One of the aims of its Closed Loop Recycling Scheme is to formalise sorting of scrap into specific wrought alloy groups. Until the scheme was introduced any such grading had been voluntary, but the initiative reflects a widespread chain of thought that a requirement will ultimately be placed on architects to specify 'embodied carbon' content. This means main contractors will need to provide clearly demonstrable evidence of sustainability in all aspects of their supply chain.

To achieve greater efficiency in terms of thermal transmittance, high performance fenestration design is becoming increasingly sophisticated. Aluminium can be formed into complex and diverse profile shapes, a feature which makes it ideal for contemporary designs. From a manufacturer's perspective, working alongside specifiers offers considerable benefits in terms of product development.

This is being seen across the construction spectrum and is highlighted, for example, in the modular construction of affordable homes such as the prototype two-bedroom detached 'modpod' in Hockley. Commissioned by Birmingham City Council, it was built offsite and craned into place, in this case in little more than an hour. Critical features of its design include 60 mm casement windows designed by Kestrel Aluminium, to provide a high standard of airtightness using low U-value glazing units. They not only provide high performance and aesthetic value, but are designed to be easily broken down into their component parts when the need for replacement arises.

Among aluminium window and door manufacturers, those which stand out are achieving differentiation by demonstrating a combination of discernible sustainability and an intent to improve their eco-performance. The material's 'permanence' and its undoubted flexibility and versatility will pave the way for products of increasing environmental value. If we add to this the widely accepted ecological argument against use of PVCu and tangible evidence provided by aluminium window and door systems with a design life which has already spanned several decades the case for its use has never been stronger.

Andrew Cross is marketing manager of Kestrel Aluminium Systems

Copper – the inside story

Graeme Bell of Aurubis says that copper has a wide range of uses in architectural interiors alongside external applications, and explores the various surface treatments available

Copper has seen a dramatic change from its historic role in roofing prestigious buildings to a thoroughly modern external skin for contemporary architecture. And its role as an interior surfacing material is growing as well, with a surprising diversity of natural colours, patterns and textures, inviting innovation from architects, blurring distinctions between inside and out.

Copper and its alloys – such as brass and bronze – enjoy unique characteristics, particularly in terms of safety, sustainability and long-term performance, wherever they are used. Copper is also safe to handle, as well as being non-brittle and predictable to work. With an 'A1 (non-combustible material)' fire classification to EN 13501-1, copper is inherently fire-safe and suitable for cladding tall buildings, using appropriate constructions. It is also, therefore, rated 'Class 0' for surface spread of flame, making it suitable for wall and ceiling surfaces in communal areas. Particularly important today, copper is non-toxic, its inherent antimicrobial qualities making it ideal for touch surfaces.

Performance

Copper's exceptional longevity – it's conservatively regarded as having a 200 year life – is due to the patination process which ensures extreme durability without maintenance and resistance to corrosion in virtually any atmospheric conditions. This natural development of a distinctive patina when used externally defines the material, with colours changing over time dependent upon local environmental conditions, including rainfall and air quality.

Within a few days of exposure to the atmosphere, the surface begins to oxidise, changing its colour from a 'bright' mill finish to chestnut brown, which darkens over several years to a chocolate brown. Continued weathering can eventually result in the distinctive green or blue patina seen on older roofs. Obviously, copper used internally or sheltered from rainfall will not change and develop in this way.

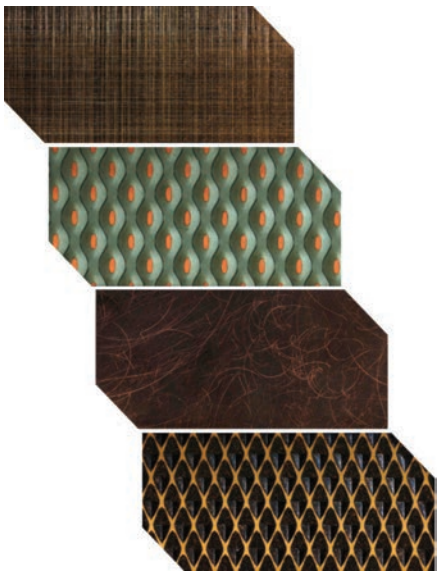
MUSÉE ATELIER AUDEMARS PIGUET
In this museum in the Swiss Jura by architects BIG, thin brass ribbons interlace to protect a double-spiral of structural glass from the sun; the suspended ceiling is formed from perforated brass panels

A 'living material'

Modern factory-applied surface treatments can provide 'straightaway' oxidisation and patination of copper surfaces to a selected level – and these can also be used internally. Essentially, they bring forward the environmental changes without taking away the integrity of copper as a natural, living material, and are not coatings or paint. Some of the processes involved are very similar to those taking place in the environment and utilise copper mineral compounds, not 'alien' chemical actions.

These processes can enable designers to determine both the colour and intensity of patina for each project from the start. As well as a solid patina colour, other intensities can be created, revealing some of the dark oxidised background material as 'living' surfaces.

Particularly important today, copper is non-toxic, its inherent antimicrobial qualities making it ideal for touch surfaces



One particular recurring architectural theme is material continuity, blurring the boundaries between outside and in

Alloys of copper have also grown in popularity. They include bronze, an alloy of copper and tin which gradually changes to a dark chocolate brown when used outside, and brass, which can also be supplied pre-weathered. An innovative alloy of copper with aluminium and zinc enjoys a rich, golden through-colour which remains very stable, just developing a matt surface – but no patination – over time.

As well as roofing and external cladding, copper and its alloys are also the metals of choice for interior design, contributing a distinctive tactility to door furniture and handrails, and a visual richness to lighting and other fittings, championed by leading designers such as Tom Dixon. Increasingly, they are being applied as high-quality finishes for walls, doors, ceilings, elevators, highlight surfaces, bars, splashbacks and counters, exploiting the materials' unique performance characteristics.

Mechanically applied surface treatments

Most recently, various copper surfaces and alloys have been made available with a diversity of mechanically applied surface treatments, adding an extra dimension. The latest developments in abraded and embossed mechanical surface treatments are particularly suited to interior design, adding another level of close-up visual richness, texture and tactility.

These treatments include embossing to provide regular patterns of raised or recessed forms, some also abraded to reveal highlights of the base material colour for additional design effects. Grindings are also available with linear, cross-hatched or curved-swirl hairlines to give distinctive matt surfaces. These surface treatments, combined with the natural living colours of copper and its alloys, offer real design freedom, adding a richness and opulence to public areas. They can also provide an inherent warmth and sense of quality to 'highlight' surfaces in homes as well.

Forms & systems

Apart from traditionally-jointed, rolled material supported by a substrate, various other forms of copper are increasingly being explored by innovative designers. For example, copper can be supplied in profiled sheets or extremely flat honeycomb panels, and it can be pressed to provide surface textures and modulation. The material can also be perforated, expanded or woven as mesh, giving varying degrees of transparency. When used internally, of course copper can be used in an even wider range of forms and systems, free from the constraints of weather-proof detailing.

One particular recurring architectural theme is material continuity, blurring the boundaries between outside and in with external copper cladding simply continuing past fully-glazed walls. When used outside, it's important to remember that ongoing changes to copper, including pre-oxidised and pre-patinated, as well as alloys such as brass and bronze, will continue over time depending on the local environment. Again, this does not generally apply to interior applications and designers should understand and, indeed, celebrate the divergent developments of internal and external copper.

Graeme Bell is Nordic Copper sales and marketing manager at Aurubis

PARAMOUNT HOTEL, EARL'S COURT
External screens of perforated and opaque copper tiles arranged in chevron patterns also add an Art Deco feel to the boutique hotel's interior
© Katherine Lu

Aesthetics, performance and buildability

Jonathan Lowy of VMZinc discusses what architects should be looking for when specifying zinc, and its long-standing attributes ranging from aesthetic appeal to maintenance, durability and recyclability

If you're like me, then working from home – or should that be living at work – is the new normal. However, this is not the case for those actually constructing buildings and in particular installing zinc roofs and walls. In a creative industry such as architecture much can be done via a screen, but there are undoubtedly limits in what is possible online. Sketching, mock ups and making maquettes fortunately still have their place not only in design, but also in training and further education.

Since the first zinc roof was installed in Liege in Belgium in 1809, the craft of the installer has been critical to both the beauty and performance of a zinc roof or wall. At a time when less academic forms of education are again being championed, a skilled zinc installer is a vital asset to any project where zinc has been specified. While companies play a large role in training, this can be supplemented by Basic Competency Programme training and Specialist Applied-skills Programmes in zinc which includes 30 days of off-job but hands-on training. A further 18 months of apprenticeship can lead to a Level 3 NVQ Diploma in Heritage Skills metal roofing. Installers who have followed this type of training, are capable of installing almost any zinc roof or wall that has been dreamt up on or off line!

Buildings of all uses that are clad in zinc vary greatly, from small to large, curved to angular, and simple to complex. The aesthetic appeal of zinc is always important but so is the limited maintenance, durability and recyclability at the end of the service life. A correctly designed and installed zinc roof or wall has a service life of 100 years following the BRE Environmental Product Declaration EN15804. In this brief article, we will not go into how European Norms may be affected in the coming months and years, but currently they are still used by

Galerie d'Art, Krems, Austria

Since the first zinc roof was installed, the craft of the installer has been critical to both the beauty and performance of a zinc roof or wall

the UK's Building Research Establishment. The 100 year service life also only requires very limited maintenance, as the best way to keep a zinc roof looking great is for rain to fall on it. However, all good things come to an end, and at the end of a long life, zinc is 100 per cent recyclable and indeed close to 99 per cent is actually recycled.

One of the more traditional projects completed in the last few years was at Poundbury in Dorset where Quinlan and

The Duchess of Cornwall Inn, Poundbury

Zinc does need good design and high quality installation, but it can be used on a large array of building types in many architectural styles

Francis Terry Architects designed, amongst other buildings, the Duchess of Cornwall Inn. The project not only includes a number of decorative dormers but also a zinc balustrade. Pre-weathered zinc was chosen for a number of reasons; the low weight of zinc when compared to stone or even lead meant that the supporting structure did not have to be quite as large, and the material's malleability and as always its aesthetics were also critical to the choice. Finally, whilst the building does have Palladian inspiration it is also reminiscent of Parisian buildings associated with Baron Haussmann, where stone facades often combine with slate and zinc roofs.

Now for something very different indeed. Right next to Wembley Stadium in north west London, White Ink architects designed a residential project called South West Lands. Brick, balconies and red pigmented pre-weathered zinc combine to create a building with a distinctive warehouse feel. Due to the residential nature and height of the building it was critical that the facade, including the standing seam zinc panels, was composed entirely of materials with limited or no combustibility (A1 or A2 following EN13501-1).

Zinc is not only used on large buildings but also smaller projects, an excellent example being the RIBA House of the Year 2019 – House Lessans designed by McGonigle McGrath Architects. The house is built in the rolling County Down landscape on a site previously occupied by old farm buildings, some of which have been re-used, and the pitched roofs and walls in pre-weathered zinc reflect some of these buildings' materiality.

Finally, zinc can and is used on some very avant-garde projects. In Krems, Austria on the banks of the Danube, Marte and Marte Architects used engraved zinc shingles to clad an art gallery in the form of a revolving cube. While the site is in a UNESCO World Heritage Site, the Krems Art Gallery continues the Austrian trend of architectural innovation in old town centres with the House of Music in Linz and the Kunsthaus in Graz being other well known examples.

To summarise, zinc does need good design and high quality installation, but it can be used on a large array of building types in many architectural styles to form not only attractive but highly sustainable roofs and walls – while remaining very cost-effective.

Jonathan Lowy is operational marketing manager at VMZinc

Colour and texture expand the use of metal in architecture

Powdertech Corby specializes in developing and applying unique ranges of powder coating materials that follow trends in design and developments in technology. Metals are rightly prized for their striking appearance and can offer a wide variety of styles to the designer and architect. Clinical, modern, technological steel, warm and homely copper and bronze, vintage or industrial rusted steel and verdigris copper. Powdertech's Evolution™ and Anomatch™ ranges of finishes reflect the beautiful shades and textures of patination on metal and smooth mesmeric anodised aluminium, at the same time as protecting the metal from corrosion and weathering. New shades in both these ranges will be available in 2021.


Evolution™ 'Sahara' - a glowing finish

Aluminium and steel can also be transformed to appear as other materials, especially useful when, for instance, the look of stone, wood or terracotta is required, but without the weight or expense of these materials. Powdertech has a Landscape™ range of finishes that includes over 30 different colours resembling the shades and textures of Terracotta and of Stone; all can be used on aluminium and steel. The warmth and comfort of terracotta has become very popular over the past year, perhaps reminiscent of the holidays we are missing. Powdertech Wood Finish, in 35 shades, smooth and texture finish, has been popular for many years and is A2 fire rated.

There are many exciting developments in texture for architectural metals and these work particularly well with Powdertech's Collections, where the colours can achieve an even richer more vibrant hue across the textured surface offering exciting alternatives for interior designers and landscape architects.


Evolution 'Peat Fire' on a barn roof.

Where once, powder coatings simply fulfilled their primary role as metal protectors, they are now a design element in their own right, celebrating the natural beauty of metal or transforming that metal into another material entirely. Follow Powdertech Corby on Linked In and Instagram to stay in touch with our latest additions to Powdertech Collections.

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Specifying commercial cladding refurbishment

James Burton, Sales Manager at specialist coating manufacturer **Bradite**, advises what to consider when refurbishing commercial and industrial cladding. Most of the commonly encountered external cladding on buildings can be over coated using Bradite One Can which is both primer and finish, with excellent adhesion and anti corrosive properties. Steel and non-ferrous metals must be properly prepared and primed while wood, fibreglass, concrete and mineral substrates should be free of contamination, dust and efflorescence. Suitable existing epoxy and polyurethane coatings should be cleaned and abraded as necessary. Bradite One Can is a cross linking, anti corrosive water thinned coating that's easy to apply and can offer a 10-year maintenance cycle. Full BS 4800, RAL and NCS Colours are available, while specific corporate colours can be achieved by using Bradite's extensive colour mixing database. Good preparation is the key to a successful finish. Bradite recommends high pressure water cleaning to remove all loose and flaking paint, salts and other contaminants. A detergent like Bradite TD39 should be used combined with scrubbing and high pressure water cleaning to remove any oil contamination not removed by high pressure cleaning alone.

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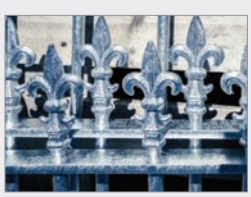

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ADAPTA® presents its new ETERNAL collection within the VIVENDI® UDS range for architectural planning and design. All the colours have been developed in a two-coat system providing excellent durability, and the application of a second layer of transparent Eternal clear coat ensures unparalleled chemical resistance. Worthy of special mention is the system's resistance of colour and gloss to light in compliance with international quality specifications such as Qualicoat Class 3, GSB Premium and AAMA 2605-17.

adaptacolor@adaptacolor.com www.adaptacolor.com

Nordic Brass Spirals

Nordic Brass copper alloy helps to define a new museum designed by architects BIG (Bjarke Ingels Group) in the Swiss Jura mountain region.

The Musée Atelier for Audemars Piguet houses the watchmaker's collection of timepieces, linked to the original workshop and slotted discretely into the hillside landscape with a grass roof. The plan form is conceived as a pair of parallel spirals, referencing mainsprings – the beating heart of the complicated mechanical watches that the company is famed for – formed of structural glazing, creating column-free space.

The watch reference also extends to the restrained materiality of the building, as many watch parts are made from brass. A band of Nordic Brass cladding crowns the curved glass facades, with a transparent brise-soleil screen extending down over the glazing and clerestory windows. This screen is formed from interlaced Nordic Brass ribbons, adding depth and varying transparency from different viewing angles. It was carefully adapted to the changing curvature of the plan

and differing height requirements for solar protection around the building.

Internally, perforated panels of Nordic Brass clad ceilings that track the gently sloping terrazzo flooring with brass joints. The ceiling also acts as a cooling medium with the Nordic Brass providing efficient thermal conductivity.

Copper and its alloys enjoy unique characteristics particularly in terms of safety, sustainability and long-term performance. With an 'A1 (non-combustible material)' fire classification to EN 13501-1, copper is inherently fire-safe and suitable for cladding tall buildings, using appropriate constructions. It is also, therefore, rated 'Class 0' surface spread of flame, making it suitable for wall and ceiling surfaces. Particularly important today, copper is non-toxic and its inherent antimicrobial qualities make it ideal for touch surfaces.

The extensive Nordic Copper range of architectural copper products is available from Aurubis, part of the world's leading integrated copper group and largest copper recycler.

g.bell@aurubis.com
www.nordiccopper.com

New 70mm window system with flexible U-Values

AluK's brand new C70S aluminium window system uses three different foam insulation options to give specifiers flexibility to dial the thermal efficiency either up or down, depending on the performance and budgetary requirements of their project. In hi mode, performance is an impressive 1.1 W/m^{2}K with triple glazing and 1.3 W/m^{2}K with double glazing, but if the project demands are lower, then the C70S can be specified in standard or partial mode to deliver slightly higher U-Values but at lower cost. In terms of aesthetics, the C70S matches the slim 89 mm sightlines of AluK's widely specified 58 BW window system and can actually be used alongside that system to achieve a consistent overall look. It has been designed to suit low, mid and high-rise applications for both residential and commercial projects. AluK has ensured that it can be installed anywhere from exposed coastal locations to noisy, urban environments, with class-leading wind and weather performance and the option of 50 mm acoustic glazing in the TBT and open out configurations. Water tightness at 1500 Pa is the highest achievable in a UK test house and more than double the 600 Pa industry standard.

01291 639 739 www.alukgb.com/c70s/aluk-c70s-window-system

More than 1000 steel windows

When **Steel Window Association** member, Cotswold Casements, was approached to look at a tender for a brand-new housing estate in Oxfordshire, the scale of the project was immediately apparent – over 1000 steel windows! Steel windows were selected as the preferred option due to their environmentally-friendliness; the steel sections themselves are manufactured from recycled steel. In addition, steel windows look amazing, are designed for long-life and enjoy optimal performance. The windows are from the W30 range.

www.steel-window-association.co.uk

A "bubbly" facade part of a major project

A massive transformation of one of the most famous brewery sites in the world, has resulted in a stunning and vibrant new city district in the heart of Copenhagen. With a combination of both modern and historic architecture, the Carlsberg City District will provide both office and residential buildings, as well as cafes, shops, hotels and schools. The facade design for the entrance depicts refreshing golden bubbles, leaving you to imagine your favourite Carlsberg tipple. The facade was manufactured and supplied by **RMIG** using RMIG ImagePerf to create the pattern of the bubbles.

01925 839 610 www.rmig.com

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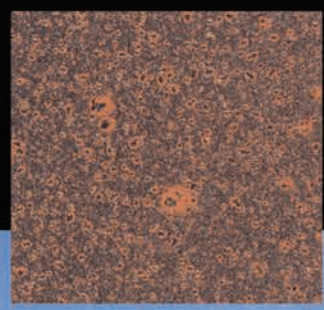

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