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**AL Circle: How do you envision the future of aluminium in the construction sector? What trends or developments do you expect to see in the coming years?**

**AEC:** Despite rapid growth in transport applications, construction remains the largest end-use sector in North America (the U.S. and Canada), representing around 35% of total consumption.

We expect aluminium extrusion to continue to be a critical element in high-rise buildings – whether office or residential – and a major factor in other building segments, such as mid-rise and institutional buildings.

Extrusions' role in these structures will be driven by efforts to reduce the carbon intensity of buildings, ongoing improvements in building energy and resource efficiency, and increased focus on occupant health and well-being.

- **Reducing carbon intensity:** According to the United Nations Environment Program, buildings and their construction together account for 36% of global energy use and 39% of annual energy-related CO2 emissions; in the U.S., it is reported that residential and commercial buildings account for 40% of energy consumption. Reducing both the embodied carbon (from materials and construction) and the operational carbon (from building operations) must be a priority. Aluminium extrusions can facilitate this. But our concern cannot just be with new structures. 82% of U.S. commercial buildings were built before 2000, and many are significantly older. Many cities are implementing energy standards for these older structures, which will stimulate considerable retrofit activity, in which aluminium extrusions will have a significant role.

- **On-going gains in building energy and resource efficiency**: The development of lower-carbon primary aluminium and improved processes for using higher scrap content billet will continue to reduce the potential embodied carbon of our products. In addition, the use of extruded louvers, light shelves and shades, along with more energy efficiency fenestration framing will help reduce energy use and operational carbon.

- **Occupant health and well-being**: While carbon mitigation must be a priority, we must not lose sight of the fact that buildings are for people, and the way we build them can have a significant impact on their productivity, learning, mental health, and healing. Thus, we cannot overly constrain vision area and access to natural light. Rather the trend is for larger glass lites, necessitating high-strength extruded framing to balance the vision area with the structure needed – particularly for higher-rise projects.

A final development is the growing role of extrusions in infrastructure – bridge decking and railings, highway signage and lighting, etc. Extrusions' durability, design flexibility and lightweight increasingly make them an important component of such applications.

**AL Circle: In your opinion, what are the key advantages of using aluminium in construction projects?**

**AEC:**
**Design versatility and performance**: The versatility of the extrusion process allows for the manufacturing of "almost endless" shape configurations, which are highly sought after by engineers, designers, and architects for construction designs. Aluminium extrusions are lightweight, strong, high

strength-to-weight ratio, resilient, corrosion-resistant, non-toxic, electrically conductive, non-sparking, non-magnetic, and non-combustible. They can be designed and manufactured for custom projects in a wide range of sizes, shapes, and finishes. Aluminium extrusions are easy to fabricate and assemble, joinable in many ways, and available in various alloys to optimize desired performance.

**Customization**: Customization is at the top of the list when it comes to the benefits of designing and using aluminium extrusions in construction projects.

Aluminium extrusions are often preferred for the design of many products because of the ability to design custom profiles that meet various aesthetic, functional, and manufacturability requirements. Designing and producing a custom aluminium extrusion profile is also very cost-effective compared to machining a block of any material to the same design. If a building developer or an architect is looking to create a unique statement, customized designs with extrusion offer one way to do that – without significant cost or time penalty. For developers, architects, designers, and consumers, customization and personalization make the product feel unique.

**Local availability:** The Aluminium Extruders Council has more than 60 extruder member companies operating hundreds of plants, with over 450 extrusion presses ranging from 2” to 26” in circle sizes. These extruders are in 35 states and four Canadian provinces. The availability of domestically produced aluminium extrusions is not an issue, and local availability reduces the carbon burden of transporting final products from plant to job site.

**Sustainability**: Aluminium is one of the most recycled and recyclable materials in use today. In fact, nearly 75% of all

aluminium produced since the late 1800s is still in use today in some shape or form. Studies have shown that over 90% of extrusion used in construction projects is recycled at the end of life, in part due to the extensive recycling infrastructure in North America. It is estimated that U.S. extruders consume over four billion pounds of aluminium scrap each year. Aluminium recycling only takes approximately 5% of the energy needed to make primary aluminium. That 5% represents a saving equivalent to 90 million barrels of oil each year in the U.S.

And now, we are seeing many producers investing in the manufacturing and supply of low-carbon aluminium to help further reduce $CO_2$ emissions. This is driven by several factors, including increasing pressure from consumers and investors to reduce carbon emissions, as well as regulatory initiatives aimed at curbing greenhouse gas emissions.

**AL Circle: How has the adoption of aluminium in the construction sector evolved over the years?**

**AEC:** Several decades ago, residential window and door applications were a major market for North American extrusions. That market, however, has been largely captured by competitive materials – vinyl at the low end and wood at the high end. Currently there is some increased use of aluminium for residential applications featuring large glass lites and window walls; however, the major uses of aluminium extrusions in the construction market are for high-rise offices and residences in urban areas, institutional buildings and mid-rise/mixed-use developments.

When it comes to the extrusions themselves, there have been important evolutions in the finish, thermal-break technologies, and size:

**Finish:** Initially, aluminium extrusions were primarily supplied unfinished. This was fine since aluminium is adequately protected by the thin, transparent oxide which covers its surface on exposure to air, requiring no additional protective coating. Finishing technologies began to emerge in the subsequent years, giving architects and consumers new decorative options. Anodic coatings were first developed, adding a durable, porous oxide film on the surface of the aluminium, increasing the protection already provided by the natural aluminium oxide layer. Coloured anodic coatings yield various colour options as an integral part of the oxide film. Paints and lacquers also became popular among architects pursuing a wide selection of colours and gloss ranges. From modified acrylic to polyester polymers to fluorocarbons for high-performance organic coatings on architectural extrusions and panels to powder coating, which is applied in the form of a finely ground powder of colouring agents and resinous materials with additives, paints have contributed to increased aesthetic properties and surface protection performance.

**Thermal-improvement technology**: During the 1980s, window manufacturers began to learn that aluminium frames were insufficient for insulation purposes. Aluminium's conductivity is a liability when you want to keep heat or cold at bay. For window framing, you want the heat to stay on the outside in the summer and the cold to stay on the outside in the winter to maximize energy efficiency and occupant comfort. Similarly, if you are designing a door for a supermarket freezer cabinet, you want the cabinet to stay cold and the aisle to remain temperate. For such applications, aluminium extrusions are today designed using a variety of thermal breaks or barriers. Such thermal barriers typically employ a polyurethane or polyamide material with a low coefficient of thermal conductivity to separate the inner and outer sections of extrusion, thereby providing increased insulation and

minimizing heat transfer from one side to the other. While energy codes are increasingly demanding, ongoing advancements in thermal break and window technology has allowed aluminium-framed windows to continue offering an energy-efficient solution.

**Size availability**: Over the years, we have seen an increased number of glazing contractors seek larger extrusions to reduce the need for joining and assembling multiple smaller size parts. Larger extrusions also provide greater structural integrity, specifically when used on monumental architectural curtainwall projects designed with large glass areas. With the reduced need for additional joining and assembling of various profiles, large extrusions contribute to the overall aesthetic of a building's façade. In addition, the fewer components used, the less cost for handling, fabrication, and assembly. Working with various shape configurations mean more dimensional tolerances to be factored into the design and fabrication of the finished curtain wall unit.

**AL Circle: What role do aluminium extrusions play in the construction sector, and how do they contribute to its advancement?**

**AEC**: Aluminium extrusions are used in a vast array of products deemed vital components to the construction sector, including healthcare facilities, government offices, manufacturing and utility facilities, and infrastructures. In fact, many national "critical infrastructures", as declared by the U.S. Department of Homeland Security, use products made from, aluminium extrusion. Aluminium extrusions have become increasingly indispensable in manufacturing renewable energy applications used in buildings and infrastructures: photovoltaic mounting systems, wind turbine structures, solar panel and module frames, large-scale concentrated solar power farms, inverter housings, and HVAC

systems.

The building and construction market heavily relies on many products that are used or made from aluminium extrusions:

- Residential, commercial, institutional doors, windows, skylights, thresholds, screens, awnings, canopies, sunrooms, patio enclosures, railing systems, storm shutters, sunshades, and rainscreens.
- Pre-engineered buildings, structures, manufactured housing, mobile homes, interior wall panels and partitions.
- Duct and louvers for ventilation systems.
- Curtain walls, storefronts, and commercial entrance doors.
- Bridges and highway signposts, brackets, railings, and light poles.
- Shower and tub enclosures, venetian blinds, swimming pools.
- Stadium seating and grandstands.
- Residential, commercial, and institutional solar panel framings and brackets.
- Electric vehicle charging stations.

All these products have contributed and continue to contribute to the advancement of buildings in terms of energy and resource efficiency, occupant health and wellbeing, and environmental sustainability.

As the building community pursues the greater use of renewable energy, it is imperative to mention that aluminium extrusions and extrusion-based assemblies play a prominent role in wind power solutions – including the use of bus bar to carry the electricity generated by the turbine to inner-tower structural elements, to meet the energy needs of cities and local municipalities. This is why aluminium extrusions are central to the large-scale deployment of renewable energy in the United States.

**AL Circle: Why do you think aluminium recycling is critical to extrusion's sustainability story?**

**AEC**: Aluminium's embodied carbon trails only concrete and steel in construction applications, making it a target of carbon mitigation initiatives. The recyclability of aluminium, combined with a robust infrastructure for collecting, processing and remelting end-of-life aluminium components, along with the substantial use of raw materials with significant scrap content, allows extrusions' embodied carbon to be minimized. An average industry EPD completed by the AEC in 2022 showed that, in the aggregate, the billet consumed by the industry had 53% recycled content. Further, a sensitivity analysis of that data showed that increasing the recycled content to 70% would reduce the industry's Global Warming Potential (measured in $CO_2$ equivalents) by almost 25%. Use more recycled content, and reduces carbon emissions.

**AL Circle: How does aluminium compare to other traditional construction materials regarding sustainability and environmental impact?**

**AEC**: No other material offers recyclability without the loss of properties that aluminium does. In addition, the use of aluminium raw materials (billet) with high recycled content, combined with prime sourced from low-carbon (e.g. hydro-powered) smelters, provides a low embodied carbon material. The appropriate specification of raw materials can lead to extruded products with low embodied carbon. And all are recyclable at the end of life.

Extrusions can also minimize operational carbon, with sunshades, light shelves, louvers, and similar devices helping to enhance the use of natural light and reduce energy usage in buildings.

The robust infrastructure for recycling extrusions makes aluminium recycling a reality, not just a theory. Studies have shown that over 90% of aluminium in buildings is recycled at the end of life, with similar results for aluminium in autos. Over 40 casthouses in North America, most of which are AEC members, are devoted to melting scrap, along with various levels of prime, and producing billet for the next generation of extruded products.

**AL Circle: What efforts or initiatives are being undertaken by the Aluminium Extruders Council (AEC) to promote using aluminium in the construction sector?**

**AEC**: One of the Council's key missions is to encourage additional usage of aluminium extrusions. Given the importance of the construction sector to the extrusion market, the Council has active programs to educate potential users about the benefits and practicalities of using extrusion in construction applications and to further enhance the material's sustainability credentials:

- **Education**: The Council routinely presents webinars and workshops aimed at construction users. These are designed to educate the participants on the extrusion process, various construction (and other) applications, and the process of effectively designing extruded components. Most offer continuing education credit to construction professionals. Similar information on the Council's website is designed to provide a ready-on-use resource covering the same topics. The most recent addition to these educational resources is an extensive module on the benefits of extrusion used in the educational building environment.

**Sustainability**: The Council recently completed its second industry average EPD, based on data for 38% of North American extrusion production. This builds on the Council's first effort in 2016. Subsequently, the Council commissioned a sensitivity analysis to demonstrate the impact that both scrap content and prime metal source can have on the Global Warming Potential of extruded products; this effort was designed to provide the data needed for productive discussions between product specifiers and extruders on the optimal raw material for a given product or project. In addition, the Council's new Sustainability Team, comprised of members across the value chain, is pursuing initiatives to clarify how pre-consumer scrap should be burdened in EPD and similar calculations and assist extruder members in quantifying and mitigating their carbon footprint.

The Council's approach is anchored in the conviction that extruders cannot act by themselves. Successful use of extrusions requires collaboration across the supply chain of metal and finishing suppliers, extruders, downstream building product producers, architects, and contractors. Thus, we regularly meet with these upstream and downstream partners to determine how best to advance the use of extrusion in construction.