

Book Review: “Museum of Modern Aluminum” – Bridging Industry and Art through Sustainable Design

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Abstract

The book *Museum of Modern Aluminum from Manufacture to Architecture* documented an innovative architectural project by HAS Design and Research Company that redefines the application of aluminum in contemporary architecture. Inspired by the organic form of a dandelion and the ecological landscape of Thailand's Koh Kret Island, the Museum of Modern Aluminum (MoMA) integrates aluminum as both a structural and aesthetic element, showcasing its lightweight, malleable, and sustainable properties. The design features a dynamic façade composed of modular aluminum strips, paired with energy-efficient LED lighting that simulates the glow of fireflies, and landscape spaces that blend artificial and natural elements. This project not only highlights the potential of aluminum in green architecture but also explores cultural transplantation, urban memory, and the balance between innovation and tradition. Through detailed case studies and reflections on materiality, this book offers insights into sustainable design practices and reveals the evolving role of aluminum in shaping future-built environments.

Keywords

Museum of Modern Aluminum; Aluminum application; Ko Kret Island; Sustainable architecture; Green design; Cultural transplantation

1. Introduction

The book *Museum of Modern Aluminum from Manufacture to Architecture* (Figure 1) illustrated the project from concept to construction. Museum of Modern Aluminum (MoMA) is an extraordinary architectural design by HAS Design and Research for a client with a background in aluminum manufacturing. In this book, the authors elaborated on the design process from site visits, unique solutions, multiple attempts, to final implementation. The authors also demonstrated the lightness, malleability, and sustainability of aluminum through the form of the building, the material selection, and the spatial design. In addition, the authors chronicled the core concept of the project, “manufacturing”, as well as presenting new perspectives on the relationship between human beings and nature.

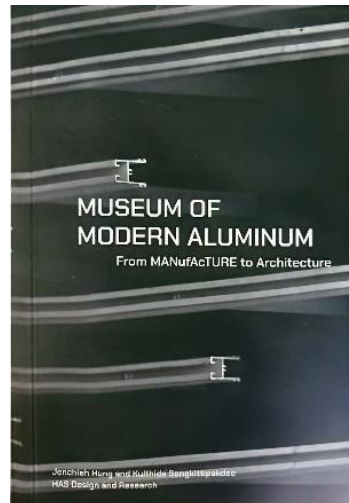


Figure 1. Museum of Modern Aluminum from Manufacture to Architecture.

2. Project Overview

The MoMA project innovatively applies aluminum in architecture while raising important theoretical questions. From an innovation diffusion perspective (Rogers, 2003), it demonstrates how industrial materials can be reimagined for architectural artistry. The modular façade embodies circular economy principles (Ellen MacArthur Foundation, 2015) through its reusable components, yet deeper engagement with regenerative design could enhance its sustainability impact. The firefly-inspired lighting abstractly references Ko Kret Island's ecology, presenting opportunities to better connect industrial materials with local cultural identity through participatory design approaches. This demonstrates how material innovation intersects with sustainability theory and cultural representation in contemporary architecture.

The exterior design of the building (Figure 2) is inspired by the fireflies, with the building's overhanging elements swaying in the wind, creating a sense of lightness and symbolising the softness and vitality of nature. Starting from the aluminum signboards commonly found in the streets, the architects studied the properties of aluminum and used it as the main element of the building to create a unique architectural texture that reflects the importance of aluminum in modern architecture.

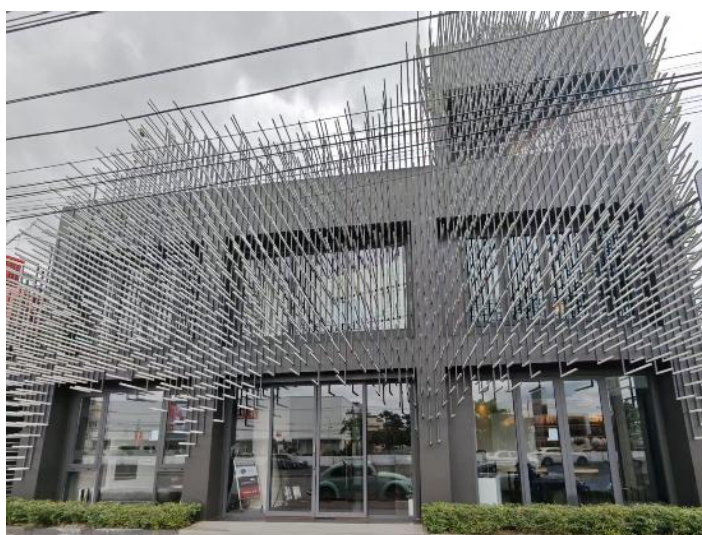


Figure 2. Exterior design of MoMA. Photo by author.

The building façade utilizes modular aluminum strips (Figure 3) arranged in a hexagonal pattern. The aluminum strips vary in four lengths (350 mm, 450 mm, 550 mm, and 650 mm), creating a dynamic texture that changes with light and perspective. This design embodies the principles of parametric design and modularity, aligning with the theory of innovation diffusion in the architectural field (Rogers, 2003). Standardized prefabricated aluminum components are used in MoMA, highlighting the potential of sustainable design in terms of scalability and replicability.

The aluminum pieces on the side façade are parallel to the walls (Figure 3). This parallel design renders a unique aluminum structure that not only is visually striking for passing vehicles and pedestrians, but also has excellent thermal insulation properties and dampens noise, thereby providing new ideas for the use of building materials in tropical regions.

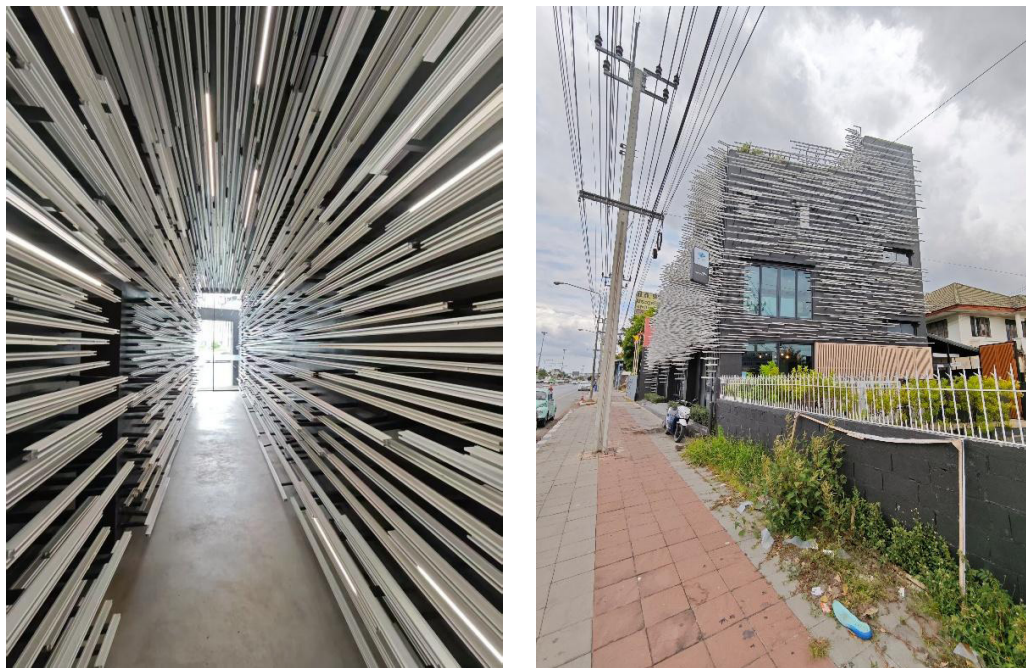


Figure 3. Entrance made with aluminum strips (left) and side façade of MoMA (right). Photos by author.

The team's lighting design was inspired by the project's proximity to Ko Krot Island known for its fireflies at night. The designers installed LED strips and spot lights on the aluminum bars, which are combined with LED lighting, to present different lighting effects at different times of the day. The LED strips are lit at dusk and sunset, while only the spot lights are switched on late at night, imitating the fireflies on Ko Krot Island.

The LIGHT IS team went through a number of tests and reviews before installing the lights, including changing the colour of the paint to a different shade and adjusting the length of the aluminum wires to different densities. Based on the results of the model and in order to reduce costs, the original colour-changing lights and automatic control system were eliminated, and finally monochromatic LEDs with standard switch controls were used and the size was increased so that each bulb had a different brightness. Custom light strips illuminate U-shaped channels along 1.8-meter-long beams and 1.2-meter-long tracks, creating a visual effect of floating metal during the day and a sense of depth at night. In the entrance tunnel, 29 randomly arranged 1.5-meter LED light strips are reinforced, while 900 LED dot matrix lights on the feature wall (Figure 4 and Table 1) project the ABBW logo through precisely arranged cross panels.

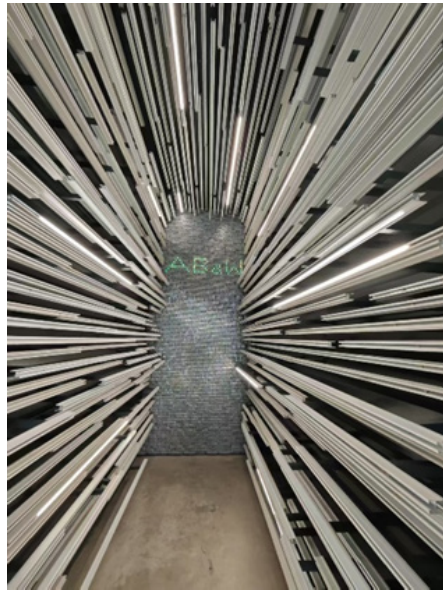


Figure 4. LED dot lights wall. Photo by author.

At night, the building’s lighting interacts with the metal to create a unique scene. However, the question of whether future power savings from the project might accrue by using solar panels should be assessed. Other future adaptations also could further enhance its sustainability and cultural impact of the design. For instance, integrating solar-responsive aluminum cladding or photovoltaic-coated panels could reduce reliance on grid electricity while maintaining aesthetic continuity. Additionally, smart lighting systems with adaptive brightness controls—linked to occupancy sensors or natural light levels—could optimize energy use beyond the current LED configuration.

Table 1. Lighting design of MoMA

Area	Fixture Type	Installation Position	Qty/Length	Installation Method
Main Façade	Custom LED Strips	U-channel of upper rails	Ordered by aluminum strip length	350mm/450mm shorts reflect to long lines
Side Façade	Integrated LED System	1.8m beams/1.2m rails	Matches layout	Horizontally parallel, U-channel outward
Entrance Tunnel	1.5m LED Strips	Wall/ceiling U-channels	29 lights (10 on each side + 9 on the ceiling)	Random arrangement, avoiding heights
LED Dot Wall	LED Dot Matrix	Cross panels (40-60mm)	~900 components	Arranged to form ABBW logo

The project includes a landscaped space and the Trop team has reproduced the natural landscape of the Ko Kret Island, while also using aluminum in the paving to create a ‘floating island’ landscape. Seasonal planting creates the atmosphere of an urban eco-site. It is noteworthy that the project connected architecture with nature in a new approach, recreating “nature” with man-made objects and conveying the author’s idea that ‘nature is not only a green space, but also includes humanity and the nature of the city’.

3. Innovation and Sustainability

The MoMA exemplifies how aluminum's sustainable properties—high recyclability, energy-efficient production, and long-term durability—align with green building standards like Leadership in Energy and Environmental Design (LEED) and the United Nations Sustainable Development Goals (UN SDGs). By innovatively using aluminum as a refined building material (SDG9), the MoMA transforms a busy urban roadside into a tranquil public space, improving the local micro-environment and directly contributing to sustainable cities and communities (SDG11). Agreements and standards such as the UN SDGs, the ISO 14000 series of standards, and others set sustainability goals for the construction industry and promote innovation in materials and design. Aluminum is an ideal material for “green” buildings due to its high strength, low weight, good recyclability, and durability. The use of aluminum can significantly improve the energy efficiency of buildings, reduce their environmental impact, and meet the aesthetic demands of modern architectural design (Biedrońska & Misiotek, 2009). In recent years, sustainable aluminum systems not only have demonstrated their superior environmental performance and economic benefits in the construction industry, but also have provided effective solutions for promoting sustainable development. Through sound design, material selection, and technology application, aluminum systems can meet the needs of modern construction while reducing environmental impact and promoting the efficient use of resources (Efthymiou et al., 2010).

Aluminum façades combine aesthetic innovation with functional performance, addressing the challenges of tropical climates through thermal regulation and acoustic mitigation measures. However, a comprehensive life cycle assessment (LCA) method reveals key contradictions in their sustainability narrative. The average carbon footprint of global primary aluminum production is as high as 14.8 kg CO₂/kg, while Europe, with its low-carbon production processes, has kept this figure at 6.3 kg CO₂/kg, more than 50% lower than the global average. In terms of energy efficiency, aluminum recycling has a significant advantage, requiring only 5% of the energy needed for primary aluminum production (European Aluminium, 2025). Therefore, in order to improve sustainability, the aluminum industry needs to increase the content of recycled materials, adopt cleaner production processes, and explore mixed materials to achieve a balance between performance and ecological efficiency.

HAS Design and Research also committed to the innovative use of aluminum in architectural design and the museum has become an innovative attempt to use aluminum in Thailand. HAS's latest work continues the concept of the relationship between humans and nature, etc. HAS's ingenious use of aluminum in building façades, interiors, structural components, and landscaping provides a wealth of possibilities for architectural design. Aluminum Grotto and Public Ground, a new work by HAS, continues the experimental use of aluminum materials by the Modern Aluminum Museum, adopting aluminum strips as the basic element of the building. Aluminum Grotto and Public Ground uses aluminum bars to create an artificial cave, recreating the scene of a natural valley, which also is in line with the traditional Thai hammock “Tai toon (ใต้ถุน)”, the open space underneath a Thai stilt house that usually is used for storing objects, pounding rice, or resting, thereby creating a unique spatial experience for the project. In particular, the lighting design of these two projects is noteworthy, but it will be interesting to see how energy efficiency and the integration of new energy sources will work in the future following green building principles.

Effective cooperation between architects and metal companies is an essential part of making aluminum work better as a building material. In this book, the authors recorded communications and compromises with clients who own aluminum companies regarding the use of aluminum and the design of the exterior. In a study

that surveyed architects and metal companies separately, there was a common interest in the use of aluminum, but there were differences in concerns and information needs. Architects are more concerned with the design suitability and environmental impact of the material, while metal companies are concerned with market competitiveness and technical applications (Radlbeck et al., 2005). Thus, it can be seen that the communication and cooperation between architects and aluminum companies is an interesting and worthwhile element of this book.

4. Social and Cultural Influences

HAS Design and Research skillfully reproduced the ecological landscape of Ko Kret Island and the night view of fireflies in the project, creating a new connection between humans and nature, which also can be regarded as a place of memory for Ko Kret Island. Urban memory cannot be separated from urban culture and urban culture is the essence of urban memory. In this project we see a new strategy to stimulate urban culture and memory. Urban memory is not necessarily created only by remodelling the original address, but also by transplanting the original landscape, creating a new urban memory, and awakening people's impression of the original landscape.

Cultural transplantation is a deliberate and dynamic process in the creation of anthropogenically-derived landscapes, emphasizing agency, intentionality, and motive rather than passive borrowing or superficial influence. Cultural transplantation is a complex process full of challenges and opportunities. It not only changes the way cultural phenomena are transmitted and received, but also reshapes cultural identities and forms of social organization. At the same time, however, we should consider the transferability of culture, which is defined as the degree of adaptation and deformation of cultural phenomena when they are transferred from one cultural environment to another. Specifically, transferability is the central element of cultural transfer, which not only determines the degree of acceptance of a cultural phenomenon in a new environment, but also involves its deformation and adaptation in the process of dissemination (Malinowska, 2014). For this project, the design team extracted the nighttime firefly landscape and local street signs from Ko Kret Island as the main elements. The transferability of these two elements certainly is recognized, but their adaptability in a new context must be considered. de la Torre (2013) pointed out that the value of cultural heritage was determined through conscious decisions and unspoken values of specific people and institutions. Authenticity is no longer just about physical replica, but more about the transmission of cultural meaning and values. Consequently, in this project the singular use of aluminum bars to reflect the narrative of the local street signs could be seen as an oversimplification of the cultural context. Similarly, merely reproducing the fireflies of Ko Kret Island at night lacks an expression of the island's culture itself. While this method of extracting elements to reflect cultural meaning does facilitate the connection of everyday elements to high class architecture, this expression of cultural transplantation and design fails to reveal the deeper meaning of culture.

In addition, excessive cultural transplantation can lead to homogenization of the landscape. For example, in recent years, some regions in China have created "new ancient towns" in order to attract tourists, but ultimately the revenue is not satisfactory and tourists still tend to prefer the authenticity of historical ancient towns. Some studies have shown that the key to solving the problem of homogenization of reproduced cultural landscapes lies in the creation of unique urban IPs and increasing the "memory points" of the attractions, so as to enhance the cultural experience of tourists (Ge, 2025). Therefore, the cultural elements of Ko Kret Island are not unilaterally appropriated in this project, but the impact of this museum on the culture of Ko Kret Island

also should be taken into consideration, including whether it can serve other purposes for Ko Kret Island while avoiding the problem of homogenization.

MoMA was completed in 2022 and will face new challenges in the future. For example, fireflies will no longer be the most iconic symbol of Koh Krot Island over time and aluminum billboards eventually will be replaced. The direct appropriation of these static cultural textures and visual elements will become outdated or forgotten. Therefore, how to break through the cultural expression of static and simple visual elements will be the greatest challenge in the future. First, it is essential to establish closer connections with local residents and communities, fostering interactions between people, nature, and industrial products, or introducing seasonal landscapes to enrich the cultural significance of the architecture, thereby achieving sustainable renewal.

To deepen cultural engagement, the MoMA could collaborate with the Ko Kret Island community through rotating exhibitions that highlight local craftsmanship or seasonal cultural festivals, transforming the space into a living platform for shared narratives. Emerging technologies like augmented reality (AR) also might bridge static architectural elements with interactive storytelling, allowing visitors to explore the island's firefly ecology or aluminum's industrial history dynamically. These strategies would align with the project's innovative design and goals for long-term sustainability and cultural vitality.

5. Conclusion

There is no doubt that the MoMA is HAS Design and Research's outstanding attempt to use aluminum in architectural design and the project shows the industrial history, modern application, and artistic potential of aluminum from different perspectives. HAS Design and Research skillfully applied aluminum to the building's façade, the interior decorations, and structural components of the landscape design, which provides a wealth of possibilities for the architectural design. In this book, HAS Design and Research not only demonstrated the diverse applications of aluminum in modern architecture, but also reflects a deep understanding of local Thai culture and craftsmanship. MoMA provides a rich narrative filled with innovative ideas and the creative use of materials, but it also opens up a discourse on the balance between aesthetic innovation and practical, sustainable building practices in modern architecture. Also, the same Innovativeness of the Modern Aluminum Museum is continued in HAS Design and Research's subsequent work, Aluminum Grotto and Public Ground, which likewise demonstrates the potential for new applications of aluminum in local Thai architecture.

The MoMA minimized environmental impact while maintaining structural and design flexibility, with aluminum's lightweight nature further reducing energy consumption in the transport of materials and construction. However, broader adoption requires increasing recycled content, cleaner production methods, and hybrid material innovations to balance performance and eco-efficiency.

Indeed, MoMA's current challenge lies in transcending the mere transplantation of visual elements to become a medium for cultural self-renewal. This requires design that not only responds to formal traditions but also addresses the implicit needs of contemporary communities—such as local industries, ecological wisdom, or social change—so that the space becomes a witness to cultural vitality rather than a static display object. Culturally, while the firefly motifs abstract Ko Kret Island's ecology, material culture studies (Miller, 2010) suggest opportunities to better connect aluminum's global materiality with local craft traditions. Future iterations could benefit from participatory design with local communities to move beyond aesthetic appropriation towards authentic cultural co-creation.

Human Subjects

Not involved.

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Data Availability Statement

All data in this article are sourced from the original text of the book *Museum of Modern Aluminum from Manufacture to Architecture*. Data may be obtained from the corresponding author upon reasonable written request.

Use of Generative Artificial Intelligence (AI) and AI-Assisted Technologies

Generative Artificial Intelligence (AI) and AI-Assisted Technologies were not involved in writing the manuscript.

Author Contributions

Shouwen Tan: Conceptualisation, Methodology, Investigation (data collection/documentation), Data Curation, Formal Analysis, Writing-Original Draft. **Patiphol Yodsurang:** Conceptualisation, Supervision, Project Administration, Writing-Review & Editing.

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