What is a Metal Composite Material (MCM)?

Part 1: Introduction

Simple question, right? Well, maybe not so simple. According to Wikipedia, the definition of a composite material is a "material that is made from several different substances."

No focus on the type of materials; the bond between materials; or the finished product performance. In fact, concrete and reinforced carbon graphic material can also be considered composite materials. Point taken, but in this instance to narrow the focus down to construction and even more so into the area of exterior cladding with a metal surface (face, skin, etc.), the International Building Code (IBC) defines a metal composite material (MCM) as:

> **Metal Composite Material (MCM).** A factory-manufactured panel consisting of metal skins bonded to both faces of a solid plastic core.

Taking that a step further, the IBC has an entire section dedicated to the use of MCM in construction (Section 1406). The section contains considerable detail about physical and fire performance and the required testing to allow the use of MCM on a variety of construction types. However, IBC Section 1406 has only been around since 2000 and the use of MCM in North America dates back to the late 1970s. Take a look at some history:

The first Aluminum Composite Material (ACM) was created in 1969 by Alusuisse in Zurich, Switzerland, but it wasn't until 1977 that the first ACM was produced in North America. By the early 1980s, there were several companies worldwide producing ACM and shipping to North America for architectural projects and by the 1990s, there were several companies manufacturing ACM in North America. This was in addition to a number of companies from around the world providing ACM for the construction industry in North America. To make things even more confusing, processes were developed to use alternate skin materials such as copper, zinc, steel, stainless steel, and even titanium. With this skin material change, the product name had to be broadened to Metal Composite Material (MCM). Today, the number of manufacturers continues to grow worldwide and the variation in product offering and quality also continues to expand.

Between combinations of materials with cores of solid plastic, metal honeycomb, metal corrugated, honeycomb plastic and even wood and skins of aluminum and alternate metal - the list of components is almost endless for products that go by the name "composite material" And with each variation, in cores or skins, new variables and concerns can enter the performance discussion.

The one constant that remains in place since the origin of MCM in North America is that the core material cannot contain foam plastic material. The building code has always looked at foam plastic, and foam plastic containing materials, as a different type of product due to concerns over fire. These foam plastic products, and assemblies containing foam plastic, are specifically regulated in IBC Chapter 26. (See Figure 1.)

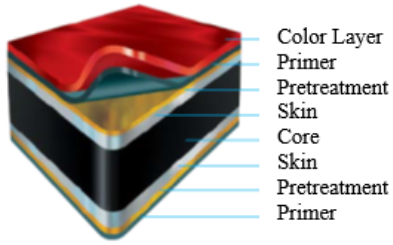

Figure 1

One of the other significant variables seen in the industry over the years is the MCM production process. The typical manufacturing process is to extrude or place a core material between two continuous metal skins with some type of bonding technology, that includes a combination of adhesive, heat, and pressure, to keep the components together; run the assembly through a series of heated rollers under a considerable amount of pressure; and end with cutting the panel to length. Various manufacturers have tried to create composite panels in a batch process, however consistent visual appearance and bond strength between the core and the skins has been limiting factors. Continuous panel production in a controlled factory environment has proven to be the most common practice to ensure a high quality and a consistent panel product.

As we continue through the different parts of this paper we will discuss some of the product variances available in the market and what impact choices of core material, skins, and finishes can have on the end product and the MCM performance over the life of the building.

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Part II: Production

Part I of this series discussed the history behind MCMs and a bit about the manufacturing process. Part II dives a little deeper into the production and quality control of the MCM panels.

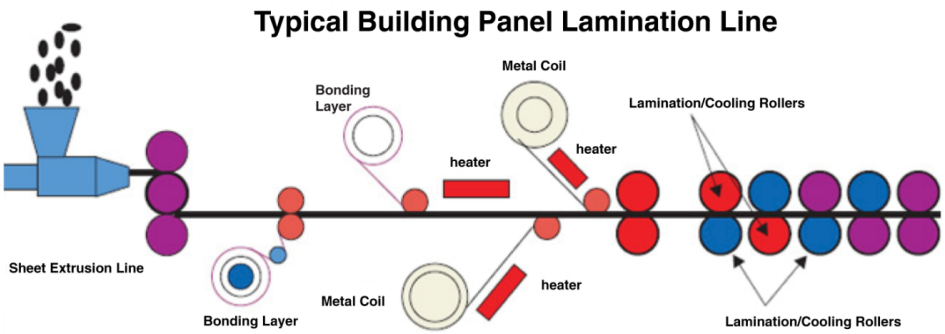

Figure 2

The production process is fairly straightforward. (See Figure 2) Typically, a full width sheet of extruded core material is produced from compounded materials, followed by the application of a bonding layer that will adhere the elements together, an aluminum sheet material, typically precoated to the desired color finish, is added to provide structural stability and flatness. The entire assembly is heated and passed through lamination rollers that apply significant pressure to bond the individual elements. At this point, what you have is a bonded sheet at a high temperature that must be cooled in a controlled process to maintain the bond integrity and flatness as it cools.

It sounds simple, but what really is happening is a semi-soft malleable core is becoming more rigid as it cools between two metal skins. The skins are generally aluminum and are also at a high temperature and cooling as the process continues. The metal contracts as it cools making the entire assembly want to move, twist, and bow until the finished panel reaches ambient temperature. Without the controlled addition of heat and pressure, the required bond strength to keep the panel together won't be attained. It is this controlled cooling that creates the level of panel flatness required by the end user.

The key takeaways from the production of the MCM are that the quality of the bond strength and panel flatness will make the panel structurally and visibly acceptable even after years of environmental exposure. Based on many hundreds-of-thousands of square meters of experience, it was determined that a bond strength, both as-manufactured and after controlled exposure, of 100N-mm/mm was adequate to ensure that a panel would remain bonded over time. This performance value has been built into the requirements used by all major manufacturers and code required certification programs have been developed to evaluate the acceptability of the finished MCM. Overall flatness is a major visual concern for an exterior cladding. This is defined in the MCA White Paper: *Visual Acceptance Parameters for Metal Composite Material (MCM) Panels and Panel Systems.*

Now that you know more about the history and production of MCM panels. The next part of this discussion will cover some of the differences between products. The core, skins, metals used, and finishes. It also will discuss some of the impacts these choices can make on the finished product and what it means to the end customer.

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