Part V

What is a Metal Composite Material (MCM)?—Core Material and Performance

The most important point to note about the core material is that this is generally where the largest amount of combustible material occurs and the performance of the core dictates the fire performance for both the MCM and the MCM system. While a number of different chemical compositions and formulas that can be used, the core material generally falls into either a "standard" or a "fire resistive" core.

Standard Core Material

When ACM was first introduced to North America, the common core material was an extruded polyethylene (PE) and many of the "standard" products available today continue to use this type of core. The common practice was to extrude a flat sheet of core material and adhere the metal skins in a single continuous process. This method allowed the use of the heat of the core to aid in the creation of the bond between the core and the metal skins. As an alternate, it is possible to separate the two processes, however, a number of production issues are introduced including potential issues with bond strength and overall panel flatness.

The standard core material meets all of the code requirements for panel use below 40' above grade. The primary criteria is the ASTM E84 which measures the surface flame spread of a material. The code requires this value to be less than 25. As a point of reference, the flame spread of a red oak flooring panel is used as a baseline and equated to a value of 100. What is important to remember about this flame spread value is the metal skin material protects the core material from contributing to the fire during initial exposure.

There are other plastic materials which have been used successfully in place of polyethylene, but keep in mind the true definition of an MCM a panel that contains a solid **plastic** core.

Fire Resistive Core Material

As MCM became more accepted in the construction world, the application of this type cladding continued in high-rise construction. The concern over fire performance is different once the cladding is used above 40'. At one time, the codes required an arbitrary maximum heat content for the cladding assembly of 6000 Btu's/SF. Since the standard core materials were in excess of that rating, MCM manufacturers each developed a core that would meet the requirement. While the 6,000 Btu limit eventually was dropped by the codes, a full scale fire test was developed to measure the actual performance of the wall cladding assembly when exposed to a realistic fire. In the United States, NFPA 285 was developed, and in Canada, NRC/ULC S134 was developed to

show real world performance. The Class A flame spread was still required, and to be used above 40', passage of this additional test is required.

There is no single formulation required to meet these criteria and each company developed its own formulation and production parameters. The most common solution was to replace a portion of the combustible material with either fire retardant chemistry or with an inert filler that would not promote flame spread.

Companies have promoted core color or core density as a performance attribute, however the most important points regarding the core remain:

- Solid Core Material: The skins of ACM are relatively thin (0.019") and can easily telegraph any surface imperfection including a discontinuity in the core, such as a honeycomb or corrugated core would produce. Higher gloss or highly reflective finishes exaggerate these imperfections and lead to visual problems with the panel and finish.
- Bond Strength between the Core and Skins: A standard was previously set at 22.5 in-lbs/in for the bond strength between the core and skin material. This strength was not a simple shear or tension test, but a peeling test that would truly show that the material will not delaminate over time. This test, ASTM D1781 (climbing drum peel), has been used by this industry since the 1980s and is included in the acceptance criteria (AC25) used to develop evaluation reports for MCM products and systems.

Part VI

Thoughts and Final Discussion Points

Alternate Cores:

There are a number of products on the market that tout themselves as MCM which use alternate cores to the solid (extruded) plastic cores that are a key component in the IBC definition of metal composite material (MCM). As stated in Part V, the level of support for the thin-skin material and the continuous bond between the core and the skin are critical to long term performance of the MCM panels. Water intrusion, aging, and general environmental conditions can influence the bond strength that keeps MCMs from delaminating or simply remaining flat for the expected lifespan of the building. Only the solid plastic cores have decades of experience on these aspects. Others can show test reports, but that does not necessarily equate to confidence in the long term performance and flatness of the panel.

Combustibility:

One area of concern are panels which use a metal core in addition to metal skins and refer to the panel as “noncombustible”. Since there are no noncombustible adhesives available, MCA remains unconvinced that these panels will not promote flame spread when exposed to a fire. The actual test used to determine noncombustibility, ASTM E136, specifically states it does not apply to laminate of composite materials, thus, this avenue should be closed to these products. Unfortunately, the IBC still contains this loophole and allows these products to be treated as noncombustible.

Research to support this case was completed after the Grenfell Tower fire in England in the summer of 2017. Metal core with metal skin panels were thought to be a solution to replace traditional MCM panels on similar construction, however when tested to the English full scale fire test (BS8414), the metal core with metal skin panels also failed the criteria. More testing was completed with this type of panel in Australia using their version of NFPA 285 and these metal core with metal skin panels also failed the test.

MCA is not advocating that metal core with metal skin panels not be used, simply suggesting that a panel system which contains ANY combustible elements be tested to the accepted standard that has provided safe construction for over 30 years: NFPA 285 and NRC/ULC S134.

Summary

What was once a small, focused, industry that offered a lightweight alternative to solid plate, has expanded into an industry which offers varied materials and manufacture, however, certain key performance requirements must be met. The end product may look visually similar when first installed, but long term flatness, delamination, and fire performance can vary from product to product. The end user must be certain the panels meet the code requirements used as an MCM. This includes:

- Solid Plastic Core: No foam plastic or other core materials qualify. Foam plastic is regulated by a different set of criteria located in IBC Chapter 26.
- Metal Skins on Both Sides of the Core: To protect the core material from damage, fire, and to provide a quality finish or appearance. Single sided panels do not protect the plastic core from both directions and are prone to losing flatness due to differing expansion rates.
- Fire Safety: Conformance to NFPA 285 when used above 40' (IBC required starting in 2021). NFPA 285 has been around for over 30 years and it is only in 2021 that the upper limit of panel use without that test is 40'. NFPA 285 and NRC/ULC S134 are recognized as criteria that maintains safe construction in North America based on hundreds of tests performed and years of successful performance.

The choice of material is in the hands of the designer, but the choice of the owner and end users determines the type of performance required for a building to be considered safe and acceptable. Consider all aspects of the cladding before making a final decision of the "right" MCM on your building.