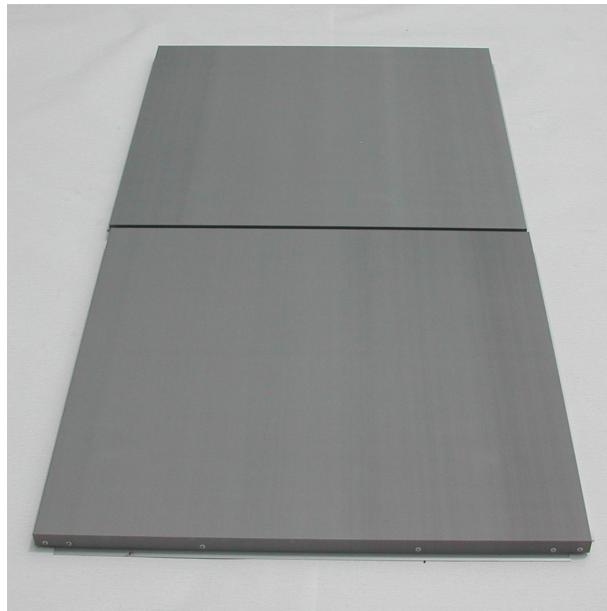


Zinc Composite Material
(ZCM)
- Series of ALPOLIC® -



Mitsubishi Chemical Functional Products, Inc.

Zinc Composite Material (ZCM) – Series of ALPOLIC® –

Zinc Composite Material (ZCM) is a sandwiched panel comprising of a chemically-weathered zinc metal and the fire-resistant core. It is suitable for the use of exterior applications such as soffits, awnings, parapets, rain screens, external claddings and roofs, especially when you feel insufficient with conventional building materials.

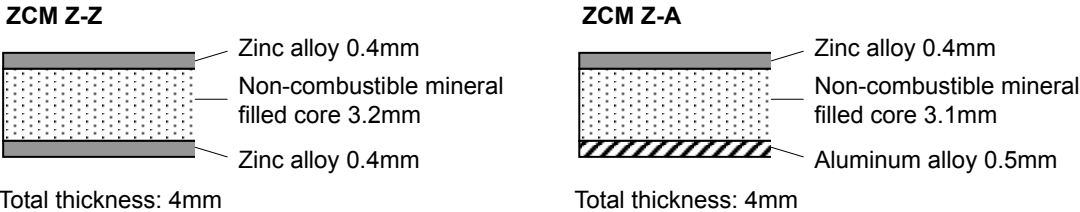
1. Features

- (1) **Zinc alloy skin:** The topside skin is a real zinc alloy weathered with a chemical conversion process, which later develops to a distinctive gray appearance through natural weathering.
- (2) **Long life:** Protected by the surface layers, zinc alloy has a long life. The annual erosion rate is normally 1 to 7 microns (3 microns in average), which indicates that 100 microns (0.1 mm) thick zinc lasts as long as 35 years to erode.
- (3) **Bending strength:** ZCM has a high bending strength (rigidity), attributed from the rigid shape of the cross section. ZCM 4mm, consisting of 2 pieces of 0.4mm thick zinc, is equivalent to nearly 3mm thick solid zinc sheet in bending strength (rigidity). The panel weight is only 50% of the solid zinc sheet.
- (4) **Flatness:** Generally speaking, composite materials have a better flatness than solid metals. ZCM is not an exception. The completed ZCM panels will be as flat as you have expected.
- (5) **Workability:** The machining performance of zinc alloy is quite similar to that of aluminum. We can cut, groove, fold and bend ZCM panels with the same machines and tools that we have used for Aluminum Composite Materials (ACM). In assembling with accessories, we can use the same aluminum extrusions.
- (6) **Installation:** Basically, the same fixing details as those for ACM are applicable to ZCM. You can choose the fittest one from a variety of installation details.

2. Material composition

ZCM has two grades, namely Z-Z and Z-A below:

ZCM Z-Z is composed of two pieces of 0.4mm thick zinc alloy skins and non-combustible mineral filled core. **ZCM Z-A** substitutes 0.5mm thick aluminum alloy skin for zinc alloy skin in backside. The topside zinc skin and the core material remain the same.



We use the following materials for each component:

- Zinc alloy: Zn-Cu-Ti alloy consisting of Zn>=99.5%, Cu=0.2%, Ti=0.1%.
- Aluminum alloy: 3105-H14, coated with a wash coating in the backside.
- Core material: The established non-combustible mineral filled core used for ALPOLIC®/fr with the same content.

3. Surface finish

Initial finish: The topside zinc skin is initially finished with a chemical conversion layer formed in the production line. The color is Silver Light Gray close to a naturally produced protective layer.

Natural color change: The initial layer is gradually replaced with a naturally produced layer (zinc carbonate) through natural weathering. This change takes place so slowly that the color change is almost imperceptible from its appearance. After several years of natural weathering, the zinc surface reaches a stable gray color.

4. Dimensions & product tolerance

Panel thickness:	4mm		
Standard panel size	Width:	914mm (36")	
	Length:	Less than 5000mm (197")	
Product tolerance	Width:	+/-2.0mm	
	Length:	+/-4.0mm	
	Thickness:	+/-0.2mm	
	Diagonal difference: Maximum 5.0mm		

Bow ^{Note:}

ZCM Z-Z; 0.5% (+/-5mm/m) of the length and/or width

ZCM Z-A; 0.8% (+/-8mm/m) of the length and/or width

Note: Due to lamination of dissimilar metals, the bow tolerance of ZCM Z-A (0.8%) is slightly larger than that of ZCM Z-Z (0.5%). According to our test, this extent of bow will lessen after fabricated into a tray-panel, and will not hurt the visual appearance virtually. However, if a flatter surface is necessary, rectify the bow by means of the methods shown in "6. Processing method."

5. Characteristics

(1) Physical properties

The following table shows principal properties of ZCM in comparison with ALPOLIC®/fr 4mm composed of 0.5mm thick aluminum skins. Although the panel weight is heavier than ALPOLIC/fr, ZCM is comparable with ALPOLIC/fr 4mm in most properties.

	ASTM	Unit	ZCM Z-Z	ZCM Z-A	ALPOLIC/fr
Thickness	-	mm	4	4	4
Specific gravity	-	-	2.7	2.3	1.9
Weight	-	kg/m ²	10.8	9.3	7.6
		psf	2.21	1.91	1.56
Thermal expansion / contraction	D696	mm/mm/°C	(P)28x10 ⁻⁶ , (T)20x10 ⁻⁶	(P)25x10 ⁻⁶ , (T)22x10 ⁻⁶	24x10 ⁻⁶
		in/in/°F	(P)15x10 ⁻⁶ , (T)11x10 ⁻⁶	(P)14x10 ⁻⁶ , (T)12x10 ⁻⁶	13x10 ⁻⁶
Thermal conductivity	D976	kcal/m.hr.°C	0.36	0.37	0.39
		W/m.°K	0.42	0.44	0.45
Thermal resistance	D976	m ² .hr.°C/kcal	0.40	0.31	0.19
		m ² .°K/W	0.34	0.27	0.16
Deflection temperature	D648	°C	115	115	116
		°F	239	239	241

Note: The thermal expansion/contraction of ZCM is slightly different between directions. This tendency becomes clearer in ZCM Z-Z than Z-A. In the above table, P and T indicate "Parallel to Rolling Direction" and "Traverse to Rolling Direction" respectively.

(2) Mechanical properties

The following table shows the mechanical strength of ZCM. As zinc metal is analogous to aluminum metal in mechanical strength, ZCM is quite similar to ALPOLIC/fr 4mm in strength. In terms of rigidity, ZCM panel is equivalent to 3.1mm thick solid aluminum sheet, while ALPOLIC/fr 4mm is equivalent to 3.3mm thick aluminum.

	ASTM	Unit	ZCM Z-Z	ZCM Z-A	ALPOLIC/fr 4mm
Tensile strength	E8	MPa, N/mm ² psi	30 4400	37 5400	49 7100
0.2% proof stress	E8	MPa, N/mm ² psi	27 3900	35 5100	44 6400
Elongation	E8	%	20	6	5
Flexural elasticity (E)	C393	MPa, N/mm ² psi	33×10 ³ 4.8×10 ⁶	34×10 ³ 4.9×10 ⁶	40×10 ³ 5.8×10 ⁶
Flexural rigidity (E×I)	C393	kN.mm ² /mm lb.inch ² /inch	180 1.6×10 ³	180 1.6×10 ³	210 1.9×10 ³
Punching shear resistance	D732	N/mm ² psi	28 4.1×10 ³	28 4.1×10 ³	32 4.7×10 ³

Note: The mechanical properties of ZCM are different between parallel and traverse directions. The parallel shows 15-40% higher strength than the traverse does. The above is the smaller values and applicable to the wind load calculations.

(3) Dent (Impact) test by Du-pont method

Steel ball weight (kg)	Height (mm)	Dent depth (mm)	
		ZCM	ALPOLIC/fr 4mm
0.3	300	0.5	0.5
0.5	500	1.3	1.3
1.0	300	1.5	1.4
1.0	500	2.0	1.9

(4) Mechanical properties of skin metals

Zinc and aluminum skins used for ZCM have the following mechanical properties, which are applicable to structural calculations. Refer to Appendix.

	ASTM	Unit	Zinc alloy	Aluminum alloy
0.2% proof stress	E8	MPa, N/mm ² psi	168 24×10 ³	152 22×10 ³
Flexural elasticity	C393	MPa, N/mm ² psi	87000 13×10 ⁶	70000 10×10 ⁶

(5) Fire performance

ZCM passes the following fire tests.

Country	Test Standard	Specimen	Result & Classification
U. K.	BS476, Part 6 BS476, Part 7	ZCM Z-Z & Z-A 4mm thick	Class 0 Class 1
U.S.A	ASTM E-84 (Tunnel Test)	ZCM Z-Z & Z-A 4mm thick	Class A Flame spread: 10-25 Smoke develop: 40-80

Note: We do not have extensive fire tests about ZCM yet. We estimate that ZCM will have a lower fire resistance than ALPOLIC/fr 4mm has, because of the lower melting point of zinc alloy.

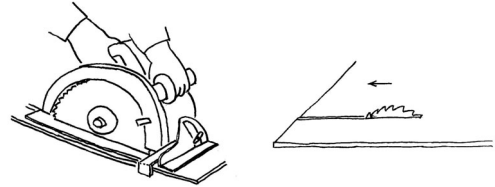
6. Processing method

As the machining performance of zinc metal is quite similar to that of aluminum metal, we can process ZCM with the same machines and tools that we have used for Aluminum Composite Material (ACM). The working parameters are also the same, as long as the processing is in the extent of usual range. Namely, we can cut ZCM with circular saws, fold it after grooving with router, bend it with a 3-roll bender and press brake, and weld it with hot-melt adhesive.

(1) Cutting

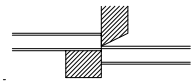
Saw cutting

Various types of circular saws including table saw, hand circular saw, and panel saw can cut ZCM. Suitable saw blade is carbide-tipped blades for aluminum or plastic use.



Shear cutting

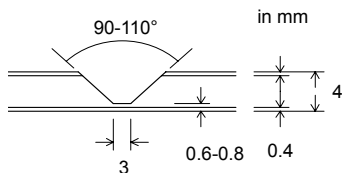
A square shear permits an efficient sizing work. Generally, the most suitable clearance is 0.1mm and rake angle is 1°30'. Either droop or burr appears on each edge.



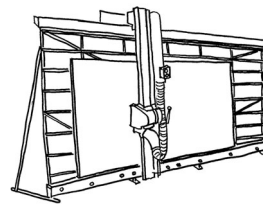
(2) U-Grooving

We can fold ZCM after U-grooving in the backside. Two types of machines are available for U-grooving. One is a circular cutter type and the other is a router type. The former includes hand grooving machines and panel saws, and the latter includes hand routers and CNC routers.

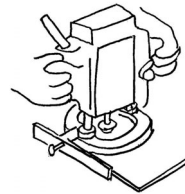
The typical U-groove shape is as shown below. It is important to leave 0.2 to 0.4mm of core material: namely, the remaining thickness becomes 0.6 to 0.8mm including metal thickness.



Panel saw and grooving cutter



Handy router and router bit



(3) Folding

After U-grooving, we can fold ZCM with folding jig. The typical folding procedures are as follows:

To ensure a straight line of folded corners, fold panels on a flat worktable. To prevent zinc skin from cracking, hold folding work at 10°C (50°F) or higher temperature.

1. U-groove Leave 0.2-0.4 mm core.	2. Folding jig Folding jig is made of aluminum or steel angle.	3. Fold Use a little longer jig than folding length.	4. Roundness Suitable roundness is 2-3 mm R.	5. Support Support with aluminum angle, if necessary.

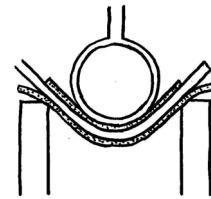
(4) Bending with press brake

We can bend ZCM with press brake. In bending with press brake, use a top die having almost the same radius as the bending radius. The following table shows the minimum bendable radius in comparison to ALPOLIC/fr 4mm. ZCM's bendable limit is smaller than ALPOLIC/fr's.

Roll direction	Minimum Bendable Radius (mm)		Exception
	ZCM 4mm	ALPOLIC/fr 4mm	
Traverse	20	80	ZCM Z-A, concave 50
Parallel	30	100	70

Note: ZCM Z-A, when it is bent to concave (zinc skin inner), shows a larger bendable limit.

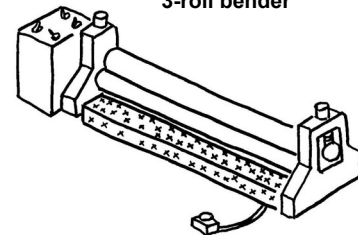
Bending with press brake



(5) Bending with 3-roll bender

We can use manual or electric-drive 3-roll bender for bending ZCM. The minimum bendable limit is normally 250mm in radius, but it depends on the length of the bender and the type of the machine.

3-roll bender



(6) How to rectify the panel bow

Compared with ZCM Z-Z and ALPOLIC/fr, the bow (warping) tolerance of ZCM Z-A is slightly large, 0.8% or +/-8mm/m due to lamination of dissimilar metals. According to our test, this extent of bow lessens to harmless level after folding into a tray-type panel, and the bow is virtually invisible in appearance. However, if the flatter surface is required, the panel bow can be rectified by one of the following methods.

By 3-roll bender: Let ZCM panels pass through 3-roll bender prior to grooving.

By stiffening with aluminum profiles: Stiffen ZCM panels with aluminum profiles by fixing with double sided tape.

Generally, ZCM's bow is not a partial distortion such as center buckles and edge waves, but a gradual entire warping.

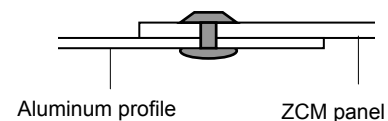
(7) Joining method

Accessory materials

In assembling ZCM panels with accessories, we can use the same aluminum profiles that we have used for Aluminum Composite Material (ACM). Aluminum profiles do not require special surface finishes in normal exterior conditions. However, when ZCM panels locate in moist or corrosive conditions, coat the aluminum profile with paints to ensure electric insulation between zinc and aluminum in order to prevent galvanic corrosion. See "9. General notes" below.

Rivet and bolt/nut

We can use rivets, bolt/nut and tapping screws for junction between ZCM and aluminum profiles. Use aluminum blind rivet. We can do riveting work from one direction. Use bolt/nut and tapping screw made of aluminum or stainless steel to prevent galvanic corrosion.



Adhesives

We can use commercial adhesives for joining and assembling of ZCM. The adhesives must be reliable in and suitable for exterior conditions. We have successfully used the following adhesives for fabrication and assembling work of ALPOLIC/fr, and these are suitable for ZCM as well. However, these adhesives are only locally available in Japan. If you are interested in these adhesives, please contact distributors or our office.

Brand name	Adhesive type	Manufacturer	Remarks
Diabond SG350	Acrylic	Nogawa Chemical	2-part, 5-15 min curing
Super X No.8008	Silyl-modified	Cemedine	1-part, 1-2 hrs curing

Double-sided tapes

Double-sided tape like 3M's VHB tape is effective in joining ZCM to other materials. Adhesion test held on 3M's VHB Y-4920 has shown good adhesion with both sides of ZCM Z-Z and Z-A.

Sealant

In order to ensure the waterproofing of joints between panels, normally a sealing material is used. The sealing material shall meet the performance required for the exterior atmospheric conditions. Silicone, modified silicone or polysulfide sealant are used. Adhesion tests show good adhesion between zinc and the following sealant.

Sealant type	Brand name	Manufacturer	Result
Silicone	SilPruf SCS2000	GE	Good adhesion without primer
Silicone, Less Stain	SilPruf SCS9000	GE	Ditto
Modified Silicone, 2-parts	Hamatite Super II	Yokohama Rubber	Good adhesion with primer
Polysulfide, 2-parts	Hamatite SC-M500	Yokohama Rubber	Ditto

7. Installation method

(1) Fixing detail

ZCM is quite comparable with Aluminum Composite Materials (ACM) in most properties. Therefore, essentially, the same fixing details as those for ACM are applicable to ZCM. If you have a particular case, please contact distributors or our office.

(2) Optical difference by direction

ZCM shows optical difference between directions as metallic-colors do. Therefore, it is important to arrange ZCM panels in the same direction to avoid the optical (color) difference.

(3) Panel strength

ZCM is quite comparable with ALPOLIC/fr 4mm in panel strength. Therefore, ZCM's strength design is almost similar to that of ALPOLIC/fr 4mm. See Appendix in detail.

(4) Thermal expansion/contraction

The thermal expansion ratio of ZCM is almost the same as aluminum metal. Therefore, temperature change will not cause a movement between ZCM and aluminum extrusions. However, the thermal expansion of steel and concrete is almost one half, and some movement will occur. This movement must be relieved with a suitable method. The thermal expansion difference between directions of ZCM is so small that we can neglect it in most cases.

(5) Accumulation of water

Accumulating water may cause a serious corrosion of zinc alloy. Therefore, the design shall permit a proper drainage of moisture to avoid accumulation. Especially stagnant water in backside of ZCM panels must be drained through drain holes.

8. Maintenance method

(1) Natural weathering

Generally, we do not need special cleaning of ZCM panels as far as panels locate in normal external atmospheric conditions. The topside zinc alloy is initially finished with a chemical conversion layer formed in the production line, and a naturally produced layer emerges through natural weathering and replaces the initial layer. These layers protect zinc metal for long time without cleaning.

(2) Color of natural layer

The naturally produced layer contains very small content of different zinc compounds and may show slightly different colors depending on the atmospheric conditions. Typically, the color tends to be blue-gray in rural area, light to dark gray in urban area and white-gray in coastal area. All these colors are natural and normal reactions.

(3) Self-repairing

Zinc surface is self-repairing. Leave small scratches as they are, and a naturally produced layer will gradually repair them over time. Do not apply touch-up paints that may cause spot color changes.

(4) Chemical corrosion

Chemical substances, adhering and accumulating on zinc alloy, might cause white or black stains. These stains

often occur with acid cleaners for ceramic tiles, chemical components from hot spring, and salty components in coastal area. In these cases, we have to remove the chemical substances with water rinse to avoid accumulation.

(5) Fingerprint

It is very difficult to remove fingerprints on zinc alloy. Therefore, do the fabrication work using glove in order not to leave fingerprints on zinc surface.

9. General notes

(1) Galvanic corrosion

Contact between different metals will cause an electrochemical reaction under moist conditions. As zinc has a lower corrosion potential than copper and iron, galvanic corrosion will accelerate the corrosion of zinc alloy with these metals. Use stainless steel and aluminum for screws and rivets for assembling ZCM panels.

(2) Color difference between production lots

It is possible that the color of initial finish shows an obvious difference between production lots. We recommend ordering the full quantity for the project in one order. Even in one production lot, slight color difference may exist in the initial finish, although it is produced in a continuous chemical process.

(3) Handling

When you handle a long ZCM panel, hold the middle of the panel in addition to both ends, because ZCM is heavier than ALPOLIC/fr 4mm and tends to have a large warping with its dead load.

(4) Storing and transportation

Store the panels in a less humid and ventilated indoor places. Avoid contact with wet surface and keep dry during transportation and at construction site.

(5) Protective film

The ZCM surface is covered with a peeling-off film to protect from scratch during fabrication and installation. Remove the film soon after the installation is completed. Leaving the film long after installation may cause an extreme difficulty in removing the film.

Technical service:

For further information or technical assistance on ZCM, please contact:

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