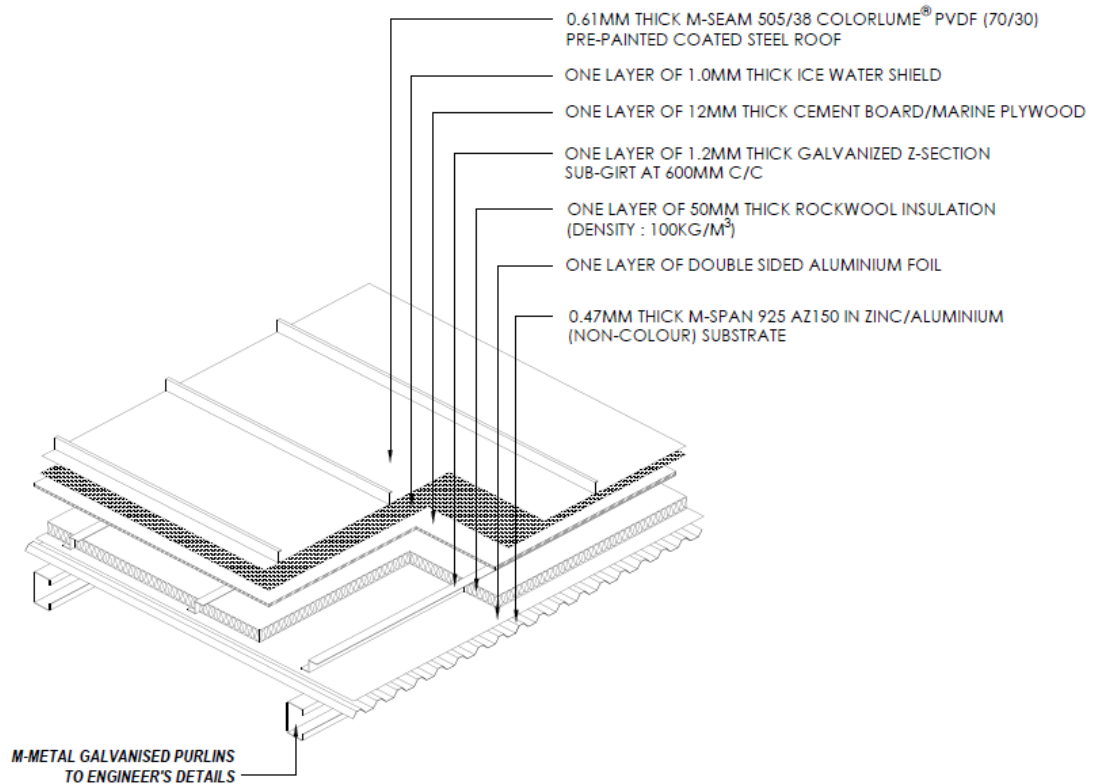
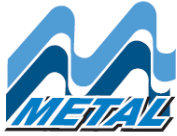


SUGGESTED SPECIFICATION FOR SOUND TRANSMISSION CLASS (STC) 45 BUILD-UP ROOF SYSTEM



ROOF BUILD-UP SYSTEM DESCRIPTION

- 1.0 The external metal roofing sheets for the build-up roof system shall be 0.61mm thick ColorLume® PVDF (70/30) factory pre-painted coated steel M-Seam 505/38 single-lock standing seam or approved equivalent.
- 2.0 One layer of 1.00mm thick Grace Ice & Water Shield® membrane.
- 3.0 One layer of 12mm cement board/marine (WBP) plywood.
- 4.0 One layer of rockwool thermal insulation.
- 5.0 Galvanized sub-girt.
- 6.0 One layer of heat/vapour radiant barrier.
- 7.0 One layer of substrate shall be 0.47mm thick zinc/aluminium alloy coated steel (non-colour) M-Span 925 or approved equivalent as an internal decking support for the roof system.



- 8.0 Galvanized Structural Purlins to Engineer's Details
- 9.0 Related ColorLume[®] factory pre-painted Flashings and Cappings.
- 10.0 Fasteners/Sealants
- 11.0 Quality Assurance
- 12.0 Approved Installer.

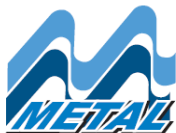
WORKS INCLUDED FOR THIS SECTION

- A. The work of this Section includes all labour, materials, equipment and services necessary to complete the metal roof and wall cladding and flashings as shown on the drawings and specified herein, including but not limited to the following:
 - 1. ColorLume[®] PVDF pre-painted steel roofing, fascias and related flashings.
 - 2. Connection hardware for attachment of ColorLume[®] PVDF pre-painted steel sheets to building structure
 - 3. Sealant between ColorLume[®] PVDF pre-painted steel panel roofing, components and adjoining construction, sealants around penetrations in the roof and cappings and between cappings and flashings.
 - 4. Drilling and tapping of structure as required for fastening of all work included in this Section.
 - 5. Cutting and flashings required for roof penetrations.
 - 6. Roof insulation and vapour barrier below metal roofing.
 - 7. Drainage Layer, waterproofing membrane below metal roof and accessories as shown on drawings and specified herein.

1.0 EXTERNAL ROOF PROFILE

Where shown in the Drawings, the external metal roof sheets shall be 0.55mm BMT (Base Metal Thickness) or 0.61mm TCT (Total Coated Thickness) ColorLume[®] VF-20L PVDF (70/30) factory pre-painted coated steel M-Seam 505 conceal-fixed standing seam or approved equivalent.

The profiled sheets shall have a rib height of 38mm and an effective cover width of 505mm to be supplied complete with conceal fixing clips as manufactured by M Metal Pte Ltd. The sheets shall be installed using conceal fixing clips fixed directly to sub-girt spaced at 600mm centre in accordance with the manufacturer's recommendations. The M-Seam 505/38 ribs must be locked and seamed to complete the installation of the roof. The colour shall be for one side and be selected by the Architect/SO.



The base material shall be protected steel sheet manufactured with a minimum yield stress of 300MPa (Grade G300) and metallic hot-dip zinc/aluminium alloy coating comprising 55% aluminium, 43.5% zinc and 1.5% silicon. The minimum coating mass for the zinc/aluminium alloy coated steel shall be AZ200 (200g/m² minimum coating mass).

The material performance intended for the manufacture of the profiled roof and wall cladding for use in the building industry shall conform to Singapore Standard 370:1994 Specification for Metal Roofing.

Material Performance Test

Typical Properties	Test Standards (Method)	Correspond to Singapore Standard SS370:1994*
T-bend Test	ASTM D 4145-10	AS 2728
Pencil Hardness	ASTM D 336-09e2	ASTM D 3363
Colour	ASTM D 2244-11	SS Part E3
Specular Gloss	ASTM D 523-08	SS 5 Part E1
Dry Film Thickness	ASTM D 7091-05	SS 5 Part B1
Impact Resistance	JIS K5600-5-3	ISO 6272
Humidity Resistance	JIS K5600-7-2	SS 5 Part G6
Gross Cut Adhesion	JIS K5600-5-6	ISO 2409

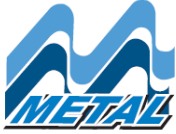
Corrosion & Weathering	Test Standards (Method)	Correspond to Singapore Standard SS370:1994*
Salt Spray Test	ASTM B 117-090	SS 5 Part G1
Weathering Test	ASTM 154-06	SS Part G4
Acid Resistance (10% v/v HCL)	JIS K5600-6-1	ISO 2812

* Specification for Metal Roofing – Singapore Environment

The finish coat shall be ColorLume[®] VF-20L PVDF (Fluorocarbon) factory pre-painted 2-coat/2-bake high performance Polyvinylidene Fluoride with more than 70% of KYNAR 500[®] or HYLAR 5000[®] paint system.

The finish composition is as follows:

- Finish coat: Polyvinylidene Fluoride (PVDF) with more than 70% KYNAR 500[®] or HYLAR 5000[®] paint system of 20µm nominal dry film thickness on the top or weather side. The finish colour shall be selected by the Architect/SO.
- Primer coat: High anti-corrosion inhibitive polyurethane primer of 5µm dry film thickness each on both sides.
- Backing coat: Light grey corrosion resistant polyester coat of 10µm nominal dry film thickness.
- Gloss: Nominal gloss level of 25 - 30% (60 degree reflection angle).



2.0 MEMBRANE UNDERLAYMENT

The membrane underlayment shall be 1.0mm thick Grace Ice and Water Shield®. The membrane comprises of two waterproofing materials – an aggressive rubberized asphalt adhesive backed by a layer of high density cross laminated polyethylene. The rubberized asphalt surface is backed with a foldless release paper that protects its adhesive quality. During installation, the release paper is removed, allowing the rubberized asphalt to bond tightly to the cement board / marine (WBP) plywood.

3.0 CEMENT BOARD / MARINE (WBP) PLYWOOD

One layer of 12mm thick cement board or marine (WBP) plywood bonded with undiluted Phenol Formaldehyde Resin at high temperature and pressure laid over rockwool and fixed to sub-girt.. The WBP Plywood, if selected, shall conform to BS 1088 and/or BS EN 636-3

4.0 THERMAL INSULATION

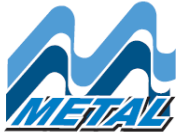
The thermal insulation shall consist of one layer of 50mm thick rockwool with density of 100 kg/m³. This layer shall be of high quality with excellent thermal, acoustic and fire properties and shall be laid on top of heat/vapour barrier and tightly between the sub-girt.

5.0 SUB-GIRT TO SUPPORT THE EXTERNAL METAL ROOF

All Zed or Omega sub-girt shall be 1.2mm thick galvanized coated steel sections of 45mm height and installed at 600mm centre to secure the external metal roof. All sub-girt shall be produced from high-tensile G450 steel with Z275 zinc alloy coating mass conforming to AS 1397. All sections must be installed in accordance with the manufacturer's recommendations.

6.0 HEAT/VAPOUR RADIANT BARRIER

The layer of heat/vapour radiant barrier shall be heavy-duty double-sided aluminium reflective foil bonded with flame retardant adhesive and reinforced with glass fiber to be laid over the substrate.



7.0 **INTERNAL METAL SUBSTRATE**

The internal substrate shall be 0.42mm BMT (Base Metal Thickness) or 0.47mm TCT (Total Coated Thickness) zinc/aluminium coated steel (non-colour) M-Span 925 or approved equivalent.

The trapezoidal profiled substrate shall have ribs of 26mm height spaced at 92.5mm centre with an effective cover width of 925mm as manufactured by M Metal Pte Ltd.

The profile shall come with a unique feature of double anti-capillary grooves at its side-lap for excellent water tightness performance.

The substrate material shall be protected steel sheet manufactured with a minimum yield stress of 550MPa (Grade G550), metallic hot-dip zinc/aluminium alloy coated steel comprising 55% aluminium, 43.5% zinc and 1.5% silicon. The minimum coating mass for the zinc/aluminium alloy coated steel shall be AZ150 (150g/m² minimum coating mass).

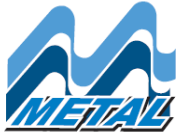
The material performance intended for the manufacture of the profiled roof and wall cladding for use in the building industry shall conform to Singapore Standard 370:1994 Specification for Metal Roofing.

Material Performance Test

Typical Properties	Test Standards (Method)	Correspond to Singapore Standard SS370:1994*
T-bend Test	ASTM D 4145-10	AS 2728
Pencil Hardness	ASTM D 336-09e2	ASTM D 3363
Colour	ASTM D 2244-11	SS Part E3
Specular Gloss	ASTM D 523-08	SS 5 Part E1
Dry Film Thickness	ASTM D 7091-05	SS 5 Part B1
Impact Resistance	JIS K5600-5-3	ISO 6272
Humidity Resistance	JIS K5600-7-2	SS 5 Part G6
Gross Cut Adhesion	JIS K5600-5-6	ISO 2409

Corrosion & Weathering	Test Standards (Method)	Correspond to Singapore Standard SS370:1994*
Salt Spray Test	ASTM B 117-090	SS 5 Part G1
Weathering Test	ASTM 154-06	SS Part G4
Acid Resistance (10% v/v HCL)	JIS K5600-6-1	ISO 2812

* Specification for Metal Roofing – Singapore Environment



DESIGN PERFORMANCE

Maximum Support Spacing

Type of Span	Base Metal Thickness
	0.42mm (Standard)
Roof (mm)	
Single Span	1500
End Span	2100
Internal Span	2300
Unstiffened Overhang	200
Stiffened Overhang	450
Wall (mm)	
Single Span	2200
End Span	3100
Internal Span	3300
Overhang	150

These numbers represent the maximum span that can be achieved for foot traffic and have no relationship with capacity to withstand resistance to wind uplift.

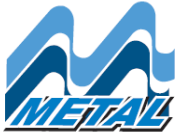
Limit State Wind Pressure Capacity – kPa

M-Span 925 – 0.42mm BMT (Base Metal Thickness)										
Span Type		Span (centre to centre) - mm								
		900	1200	1500	1800	2100	2400	2700	3000	3300
Single	Serviceability	3.45	2.67	1.94	1.29	0.80	0.48	0.32	0.24	-
	Strength*	10.85	8.70	6.70	4.98	3.68	2.92	2.58	2.53	-
End	Serviceability	3.12	2.71	2.31	1.93	1.58	1.27	0.99	0.74	-
	Strength*	7.94	6.46	5.08	3.88	2.95	2.36	2.04	1.92	-
Internal	Serviceability	3.47	2.99	2.54	2.13	1.76	1.46	1.21	0.99	0.79
	Strength*	9.09	7.53	6.08	4.79	3.78	3.11	2.69	2.48	2.34

* Reduction factor of 0.90 has been applied. These capacities are based on tests carried out by the Cyclone Testing Station of James Cook University and in accordance with the requirements of Australian Standard AS 1562.2-1992 Resistance to wind Pressure for Non-cyclonic Regions.

8.0 STRUCTURAL PURLINS TO ENGINEER'S DETAIL

Structural Cee or Zed purlins required to support the roof system shall be sized to Engineer's details and manufactured by M Metal Pte Ltd from high tensile steel G450 grade, (450MPa minimum yield stress) with a minimum Z275 (275g/m²) zinc coating mass. Bridging accessories are manufactured from steel with minimum yield strength of 300MPa and a minimum zinc coating of Z275.



All purlin sections shall be supported by submission of section properties, purlin capacity calculations, bridging capacity calculations and a performance warranty, produced and detailed for this project. All sections shall be produced from galvanised steel to AS1397 with coating mass of at least 275gms/m² and designed in accordance with AS4600 or BS5950.

Where required for structural or installation purposes, bridging shall be installed using pre-made components to manufacturer's instructions. All other accessories shall be supplied by M Metal Pte Ltd.

All work shall be completed in a workman like manner prior to installation of the roof and wall cladding material.

9.0 RELATED FLASHINGS AND CAPPINGS

All flashings and cappings as per shape and profile as shown in the Drawings shall be 0.61mm TCT (Total Coated Thickness) ColorLume[®] VF-20L PVDF factory pre-painted as per roof colour selected by the Architect/SO.

The base material shall be protected steel sheet manufactured with a minimum yield stress of 300MPa (Grade G300), metallic hot-dip zinc/aluminium alloy coated steel comprising 55% aluminium, 43.5% zinc and 1.5% silicon. The minimum coating mass for the zinc/aluminium alloy coated steel shall be AZ200 (200g/m² minimum coating mass).

The finish coat shall be ColorLume[®] VF-20L PVDF (Fluorocarbon) factory pre-painted 2 coat/2 bake high performance Polyvinylidene Fluoride with more than 70% of KYNAR 500[®] or HYLAR 5000[®] paint system.

The finish composition is as follows:

- Finish coat: Polyvinylidene Fluoride (PVDF) with more than 70% KYNAR 500[®] or HYLAR 5000[®] paint system of 20µm nominal dry film thickness on the top or weather side. The finish colour shall match the roof as selected by the Architect/SO.
- Primer coat: High anti-corrosion inhibitive polyurethane primer of 5µm dry film thickness each on both sides.
- Backing coat: Light grey with anti-corrosion polyester coat of 10µm nominal dry film thickness.
- Gloss: Nominal gloss level of 25 - 30% (60 degree reflect angle).

10.0 FASTENERS/SEALANTS

Corrosion free fasteners and connections shall be designed to withstand the positive and negative pressures due to local wind loads as defined by the prevailing Building Code.



The fasteners used to secure the panels or flashing formed from the ColorLume[®] factory pre-painted steel coil shall be compatible with the cladding material used. Self drilling fasteners with EPDM non-conductive washers must be used where applicable and have to be fixed to the products in accordance to manufacturer's recommendations. The fasteners used for installation of roofing sheets to the purlin/structural supports shall conform to AS3566 – Class 3 or Class 4. Fasteners shall be selected to match the life expectancy and be compatible with the roof and wall cladding.

The standing seam fasteners shall be hidden and allow for thermal movement in the form of fixed & sliding clips.

Sealant shall be an approved adhesive material, suitable for application and providing a seal between the sheets or structure. The colour of the sealant shall be selected by the roofing specialist.

11.0 QUALITY ASSURANCE

For actual installation of roofing, use only competent and skilled roofers completely familiar with and specifically trained and experienced in the application of materials specified herein, and the manufacturer's currently recommended methods of installation.

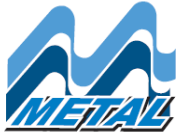
All products need to be checked for compatibility with adjacent materials before installation. It is important to check implications of direct contact between materials and also water runs from one material to another.

Zinc/Aluminium (non-colour)/ColorLume[®] VF-20L (70/30) PVDF coated steel shall not have direct contact with copper, lead, green or treated timber, stainless steel and mortar or concrete.

All roof and wall cladding should be handled with care at all times to preserve quality of its finish and product capabilities. Pack should be stored above ground on site and be kept dry.

The Contract Documents define the required profiles; the Contractor is responsible for the design of the system and the development of the details, within the limitations established by the Contract Documents, in strict accordance with the Manufacturer's recommendations, in order to conform to the set criteria herein. Shop drawings shall be prepared for the Architect's approval prior to commencement of the installation work.

All work of this section, as shown or specified, shall be in accordance with the requirements of the Contract Documents. In addition, all work shall be executed so as to meet all applicable requirements of the building regulations in Singapore.



12.0 APPROVED INSTALLER

The metal roofing, fascia sheets, flashings, cappings, openings, pipe flashings and others shall be provided and installed by an approved Specialist who can be an approved manufacturer or the Manufacturer's duly authorised representative.

It is essential that only approved installers of the specified products install it. There must be specialist input for the design detail by the cladding specialist to ensure the construction details are in accordance with the manufacturer's recommendations for the specified profile products.

All works shall be fixed in a workman like manner, leaving the job clean and weather-tight. All debris (nuts, screws, cuttings, filings etc.) shall be cleaned off daily.