January 2022

GD39 SUSTAINABILITY AND DURABILITY OF METAL ROOFING AND CLADDING SYSTEMS

SECTION 7: PRODUCTS

7.1 Products

The main components of any metal building envelope system are the metal profiled roofing and cladding sheets, sandwich panels or rainscreen panels which are manufactured from metals as indicated in sections 5 and 6. There are though other types of products, such as translucent sheets and rooflights manufactured from other materials such as glass reinforced plastic (GRP) and polycarbonate. This section gives an overview of the main types of products, commenting on their durability and use within a metal roofing, cladding or façade system.

Other components which are used to create and secure a metal roofing and cladding system are covered in section 8.

7.2 Profiled metal sheets

Profiled metal sheets are produced by roll-forming from various metals as indicated in sections 5 and 6, with the two most prominent being paint coated steel sheet and aluminium (either uncoated or paint coated). They are generally classified as self-supporting sheets as they can span from one support position to another without the need for a continuous support beneath them. They can be used as an un-insulated single skin sheet or as part of a site assembled built up double skin roof or wall cladding system.

The profiled sheets can be roll-formed in a variety of shapes and fixing types, but the most common ones are:

- Trapezoidal (or sinusoidal, see figure 7.1) through-fix sheets.
    - The sheet is connected to the structure or sub-structure with fasteners which penetrate the sheet.
    - The sheets are connected to each other by overlapping at the ends and sides. End laps will be at support positions and connected to the support with fasteners through both sheets.
    - Side-laps will be formed by overlapping one profiled rib from one sheet over another of the adjoining sheet, which are connected to each other using stitching fasteners. Side-laps on wall cladding may not have stitching screws in most applications.
    - As well as outer weathering sheets, trapezoidal through-fix sheets are used as liners and structural decking to form the inner layer of a site assembled built up double skin roof or wall cladding system. Liner sheets span from purlin/wall rail to purlin/wall rail and are typically 15 mm to 35 mm in profile depth. Structural decking sheets are typically 35 mm to 200 mm in profile depth and can be used spanning purlin/wall rail to purlin/wall rail but in thicker gauges and deeper profiles are more typically used to span rafter/column to rafter/column, see figure 7.2. Liner sheets can be supplied perforated either fully or partially (e.g., in the wide trough of the profile) to provide sound absorption properties to the roof or wall cladding system. Structural decking sheets can also be partially perforated, usually in a narrow band in the webs of the profile.

Figure 7.1 – Sinusoidal wall cladding profile

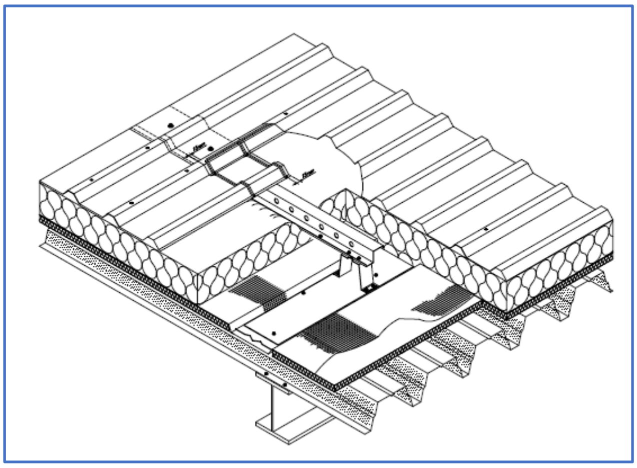


Figure 7.2 – Roof construction with web perforated structural decking sheet

- Structural liner trays
    - The trays are used as structural liners to form the inner layer of a site assembled built up double skin roof or wall cladding system, see figure 7.3. Internally they offer the appearance of a fixingless near flat (slightly profiled) surface.
    - Structural liner trays are a single profile width typically 500 to 600 mm wide with 50 mm to 200 mm upstand depth and can be used spanning purlin/wall rail to purlin/wall rail but in thicker gauges.
    - Deeper profiles are more typically used to span rafter/column to rafter/column. They can also be partially perforated, usually in narrow bands in the trough of the sheet.
    - Structural liner trays are side lapped by overlapping one return flange over the adjoining one and fixing through the tray upstand. The trays cannot be end lapped and are butt-jointed and fixed and sealed at a support position.

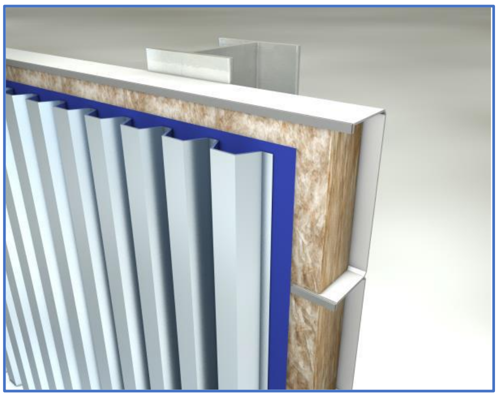


Figure 7.3 – Wall construction with structural liner tray

- Secret (or concealed) fix sheets
    - The sheet is connected to the structure or sub-structure with either a clip, bracket or is fixed through its concealed leading edge.
    - The sheets are connected to each other at side laps usually by a spring-snap technique where the upper profiled seam is pushed over the lower profiled seam which locks in place. They are often used in long lengths to eliminate the need for end laps to maintain the secret-fix appearance, but end laps are possible and would be dependent on the proprietary nature of the sheet.
    - This type of sheet is predominately manufactured from steel due to the requirements of the spring-snap jointing technique.

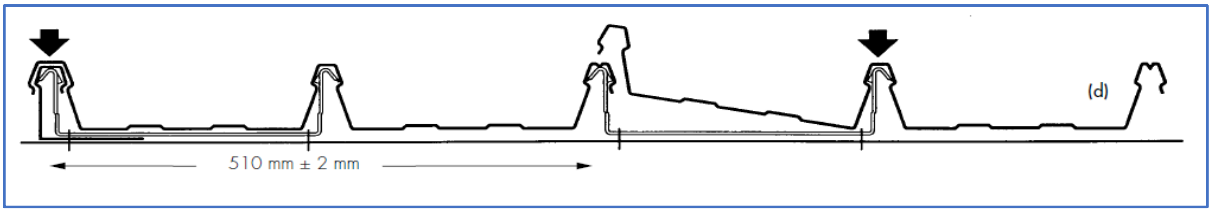


Figure 7.4 – Secret fix system with spring-snap over-lap joint with fixing brackets

- Standing seam sheets
    - The sheet is connected to the structure or sub-structure with either a halter or a clip.
        - A halter is a T-shaped connection with a bulbous head and flat base which is connected to the structure or sub-structure with fasteners through its base. Both the small and large seams of the adjoining standing seam sheets are installed over the bulbous head of the halter and locked into position on subsequent seaming of the sheets.
        - A clip is a connection where the hooked head of the clip is installed over the small seam of the standing seam sheet with its base fixed to the structure or sub-structure. The clip is subsequently locked into position as the large seam of the sheet is seamed over the small seam.
    - The sheets are connected to each other at side laps by being mechanically seamed together with a proprietary seaming machine. The process is known as 'zipping' and the mechanical seaming machine is commonly referred to as a 'zipping' machine, see figure 7.5. The sheets are often used in long lengths to eliminate the need for end laps to maintain the secret-fix appearance, but end laps are possible and would be dependent on the proprietary nature of the sheet.

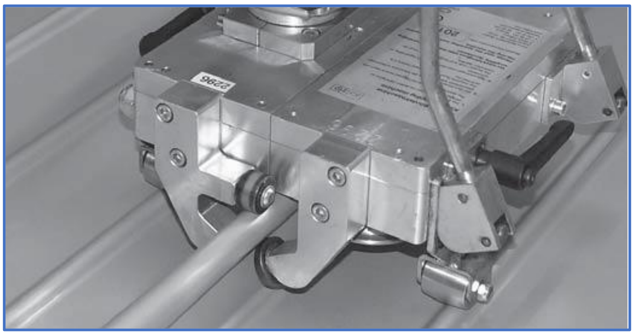


Figure 7.5 – Mechanically seaming standing seam sheets with 'zipping' machine

    - This type of sheet is predominately manufactured from aluminium due to the mechanical seaming process.

When designed and installed as per the manufacturer's recommendations profiled sheets will generally have a durability as that of the metal they are manufactured from. The durability performance and any limitations in use of the finish and/or metal will be as indicated in sections 5 and 6.

Further information on end lap sealing of metal roofing systems can be found in MCRMA Guidance Document GD19 *Effective sealing of end laps in metal roofing constructions*.

7.3 Sandwich panels

Sandwich panels, also known as composite panels, are factory produced roofing and wall cladding assemblies consisting of an inner and outer sheet of metal bonded to an insulation core, see figure 7.6.

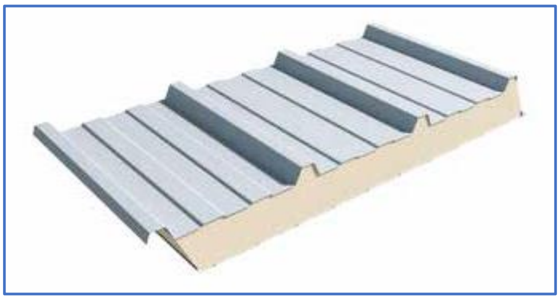


Figure 7.6 – Trapezoidal profiled insulated sandwich panel

The predominant metal used for both inner and outer sheets of a sandwich panel is paint coated steel. Sandwich panels produced with aluminium (either uncoated or paint coated) as the outer sheet are also used especially in standing seam variants; these panels may have a paint coated steel or an aluminium inner sheet.
The insulation core is predominantly polyisocyanurate (PIR) although when a wall cladding requires a higher level of fire performance mineral fibre cored panels are available. Panels are usually supplied with factory applied sealing strips to provide a degree of airtightness. The sandwich panel is available in a variety of depths each offering varying levels of thermal performance.

For roof panels the outer weathering sheet is a profiled metal sheet of a type and fixing method as the trapezoidal through-fix sheets and standing seam sheets (fixed with clips) described in 7.2 above. The end laps are created by butt jointing the panels and fixing through the overhang of the upper panel into or through the lower panel and into the supporting structure.

Secret or concealed fix outer sheet variations usually consist of raised side joints through which the panels are fixed to the structure. The side lap joint of adjoining panels and fasteners are concealed by the installation of a cover cap manufactured from a similar material and finish to the outer sheet of the roof panel. End laps are similar to that described above.

For wall panels the outer weathering sheet can be produced in a variety of profiles from flat, through micro-ribbing to trapezoidal ribs (as per the roof panels). Trapezoidal profiled outer sheet sandwich panels are normally installed vertically with end and side lap joints created in the same manner as roof panels. Flat and micro-ribbed outer sheet sandwich panels are installed horizontally. Side lap jointing method is generally concealed fixings in an interlocking tongue and groove type joint. End laps are usually butt jointed and finished with a metal top-hat profile jointing strip.

The inner liner sheet is usually profiled with a very shallow profile depth of only a few millimetres to give a near flat appearance.

Sandwich panels can also be used as a structural roof liner to support other metal outer roofing sheets or as a backing wall to support rainscreen panels.

When designed and installed as per the manufacturer's recommendations sandwich panels will generally have a durability as that of the metal they are manufactured from. The durability performance and any limitations in use of the finish and/or metal will be as indicated in Section 5.

Further information on the installation of sandwich panels on roofs can be found in MCRMA GD17 *A guide to site installation of insulated roof panels*.

Further information on end lap sealing of metal roofing systems can be found in MCRMA Guidance Document GD19 *Effective sealing of end laps in metal roofing constructions*.

7.4 Rainscreen panels

Metal rainscreen panels for use in a built-up wall system can be fabricated from a wide variety of metals in their natural uncoated condition or with a pre-coated finish.

The rainscreen panel's shape and subsequent fixing and jointing methods can be varied from flat face-fixed panels to more intricate shaped planks and cassettes with discrete and secret fix connecting systems. Figure 7.7 shows a discrete fixed cassette panel with interlocking horizontal laps.

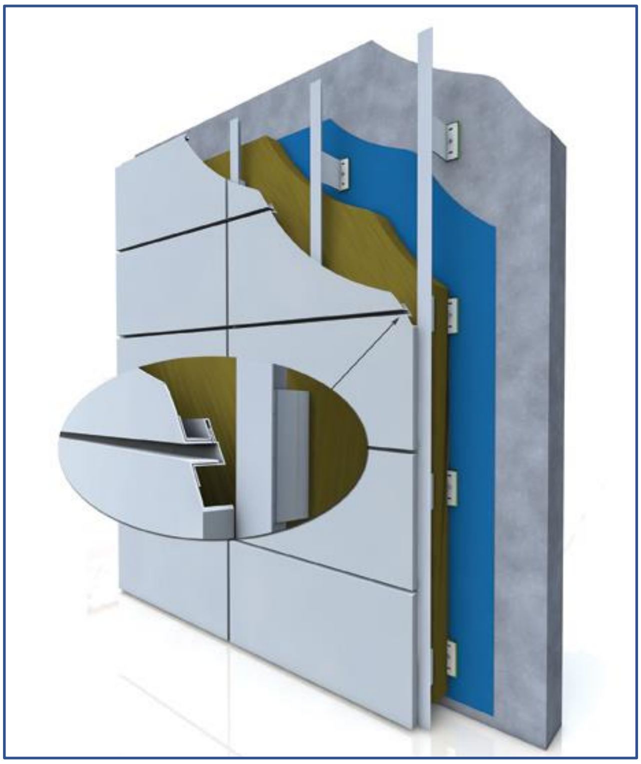


Figure 7.7 – Metal cassette rainscreen panel system with discrete fixings

The durability performance and any limitations in use of the finish and/or metal will be as indicated in sections 5 and 6.

7.4.1 Aluminium composite materials (ACMs)

Rainscreen panels can also be fabricated from aluminium composite materials (ACMs) which generally consist of two 0.5 mm thick aluminium sheets bonded either side of lightweight core material, e.g., low density polyethylene with mineral fillers.

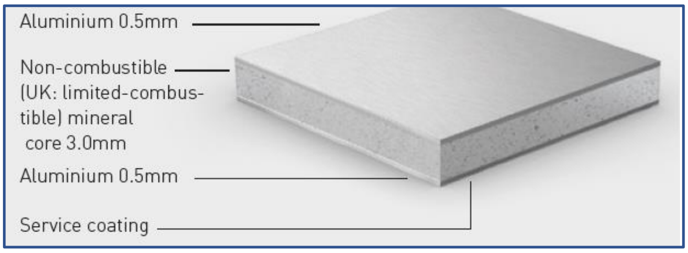


Figure 7.8 – Typical ACM build up with limited combustible core

The core material composition will be dependent upon the fire classification of the ACM. The overall thickness of the ACM is typically 4 to 6 mm.

The outer aluminium weathering sheet is normally anodised or coated with an aluminium colour coating, e.g., PVDF.

BBA certificates for these types of products indicate that they will perform effectively as a cladding with an ultimate life of at least 30 years. The coating's decorative performance will depend upon the type, colour, building location, façade aspect and the atmospheric environment. PVDF coatings or anodised oxide layers can be expected to retain a good decorative appearance for up to 20 years in a non-corrosive environment and up to 15 years in coastal or severe industrial environments. Further advice for aluminium coatings is given in section 5.

7.5 Rooflights

Rooflights for metal roofing systems are available in several different types such as in-plane site assembled rooflights, in-plane factory assembled insulating rooflight (FAIRs), barrel-vault rooflights and modular rooflights. Each type is recommended for different types of metal roof system.

For metal built-up double skin insulated roof systems, the recommended rooflight solution is an in-plane site assembled rooflight. This consists of separate profiled translucent sheets matching the profiled metal outer and liner sheet and can include separate intermediate layers to make triple or quadruple skinned systems for increased thermal performance.

FAIRs are recommended for use with sandwich panel roof systems and are designed to match a specific proprietary system and overall depth, see figure 7.9. They are supplied with intermediate layers to make triple or quadruple skinned systems or can incorporate translucent insulation for increased thermal performance.

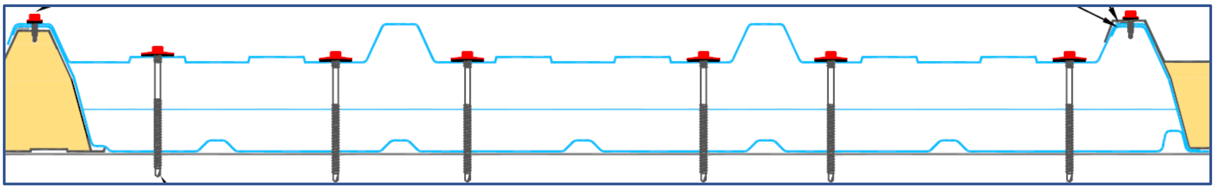


Figure 7.9 – Factory assembled insulated rooflight (FAIR) with sandwich panel system

Barrel-vault rooflights are usually used with standing seam and secret fix roof systems and for low roof pitches. They can also be used with other systems typically running along a ridge rather than downslope. They can be supplied as triple or quadruple skin units or as a single or double skin unit over a separate translucent profiled liner to construct a multi-layer assembly.

Modular rooflights (including polycarbonate domes and pyramids, and flat glass units) fixed to a kerb upstand can be used with most types of metal roof systems. with profiled roofing systems, see figure 7.10.

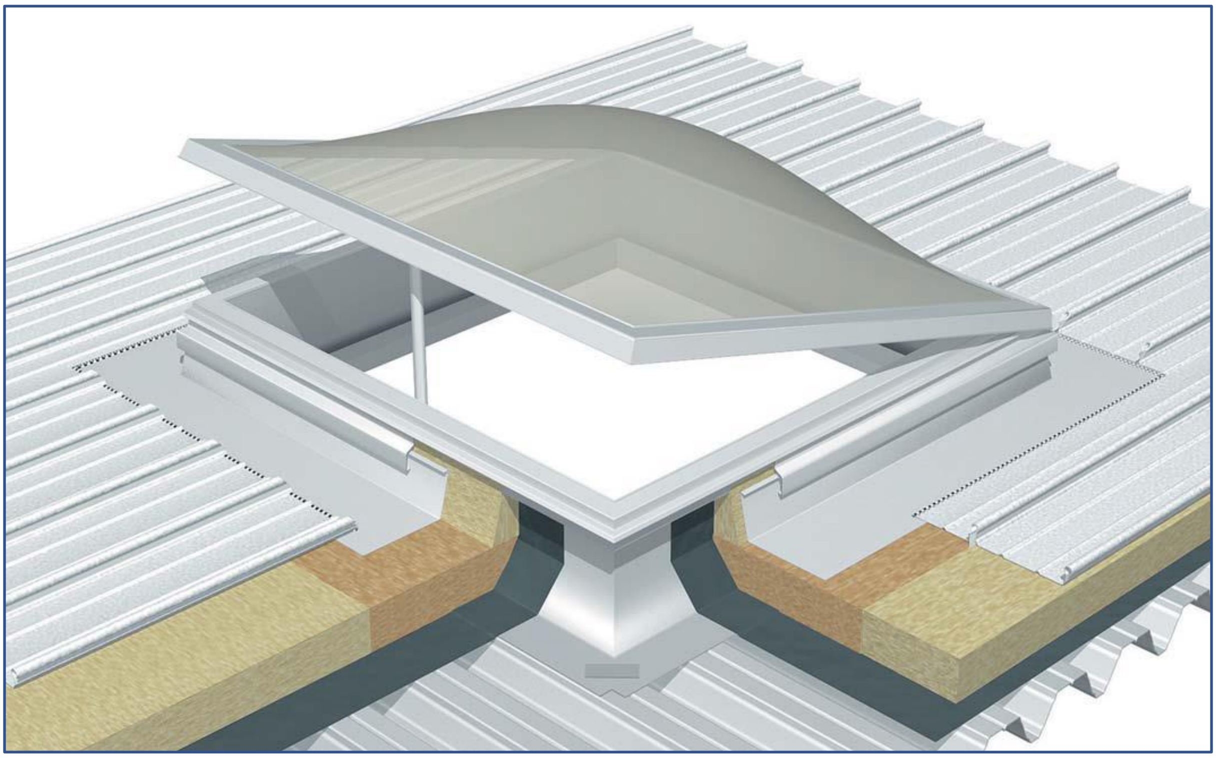


Figure 7.10 – Modular domed polycarbonate rooflight on insulated kerb upstand and welded soaker

The kerb upstand is usually incorporated as part of a soaker detail to provide drainage around the upstand where these are formed mid-slope. Proprietary soaker units are available for use with through fix profiled systems to end lap with the sheets. Site welded soakers can be utilised with aluminium standing seam systems at low roof pitches and site fabricated upstands (e.g., in-situ GRP or PU weathering) can be used with coated steel roof systems.

Further information on rooflights can be found in technical documents published by the National Association of Rooflight Manufacturers (NARM). Further information on sealing profiled rooflights into metal roofing systems can be found in MCRMA Guidance Document GD19 *Effective sealing of end laps in metal roofing constructions*.

7.5.1 Rooflight materials

Rooflights can be manufactured from several materials, such as glass reinforced polyester (GRP), polycarbonate, glass, UPVC etc.

Glass is generally only used as a roof lighting solution for metal roofing systems in flat planes such as in a modular rooflights or as insulated glazing units (IGUs), fitted or bonded into a glazing bar system.

UPVC was used in the past for rooflight sheeting in metal roof cladding but becomes very brittle when exposed to UV radiation and is very seldom used nowadays in the UK.

In the UK the main materials used with metal roof systems are GRP and polycarbonate and the durability of these materials will be discussed below.

7.5.1.1 Glass reinforced polyester (GRP)

In metal roof systems, GRP is used for in-plane rooflights (both built-up and FAIRs), see figure 7.11 and in barrel-vault rooflights.

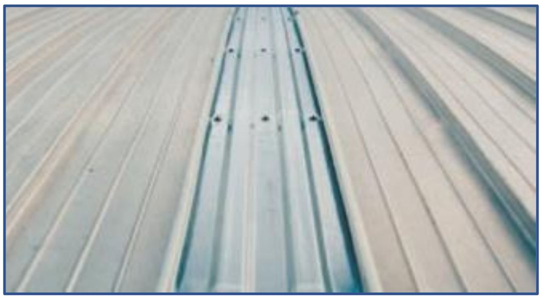


Figure 7.11 – In-plane GRP rooflight

GRP is a thermosetting material and once formed cannot be reformed by heat as with thermoplastic materials. Translucent GRP rooflights are generally produced using a pultrusion manufacturing process to produce profiled sheets or flat sheets. The material includes UV inhibitors and UV absorbing film protecting the outer surface for increased durability in minimising discolouration or surface erosion and to prolong their service life and also provide high levels of diffused light transmission. Pigments can be added to provide coloured tints to the rooflight.

GRP rooflights should be used in a thickness and glass-fibre reinforcement type to be used as part of an assembly providing the required levels of non-fragility performance. GRP is a stable material and should perform satisfactorily for a minimum of 25 to 30 years in most circumstances dependent upon certain product parameters such as weight of material, specification of GRP reinforcement, UV protective film etc.

GRP is not affected by contact with any other materials and generally has good resistance to coastal and normal industrial atmospheres and excellent resistance to most pollutants and chemical atmospheres. The use of specialist surface protection (e.g., PVF film) can improve the resistance especially in severe industrial environments or where pollutants might condense on the rooflights in liquid or solid form. In these circumstances advice should be sought from the rooflight manufacturer.

GRP's durability is very dependent upon the surface protection layer and care should be taken when handling and installing the rooflight so that it is not damaged as this could lead to a reduction in the service life and also have an adverse effect on the non-fragility status of the rooflight. Surface protection films can be damaged by scratches and severe abrasion. Prolonged contact with sea water and sand can also erode the surface protection layer.

The surface should be cleaned with warm water and a weak or mild detergent solution using a soft bristle brush or cloth. Use of abrasives, chemicals, pressure washers, hard brushes, scouring pads or sharp tools can affect the rooflight's long term durability and potentially its weathertightness at end and side laps and should be avoided. Old rooflights which have been discoloured severely or where the surface has eroded to expose glass fibres should be replaced.

7.5.1.2 Polycarbonate

In metal roof systems, polycarbonate is used for in-plane rooflights as a multi-wall profile, in barrel-vault rooflights (see figure 7.12) or as domed modular rooflights.

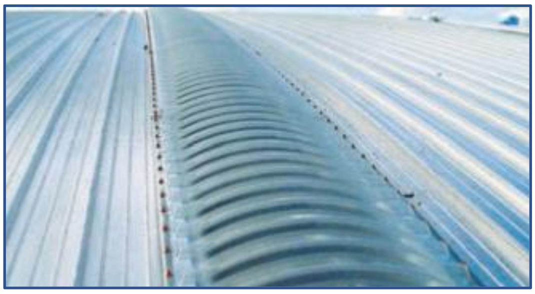


Figure 7.12 – Polycarbonate barrel vault rooflight

Polycarbonate rooflights are manufactured using an extrusion manufacturing process to produce profiled sheets or flat sheets and can also be extruded as a multiwall structured sheet. It is produced with an integral UV absorbing surface layer of co-extruded UV protective material to prevent loss of structural strength and minimise long term discoloration or loss of light transmission.

Polycarbonate is a thermoplastic material which can be reformed (e.g., by vacuum forming) into 3-D forms such as domes for modular rooflights or curved for barrel vault rooflights. Polycarbonate is a naturally clear material providing high levels of non-diffused light but can be manufactured with opal tints to diffuse light and/or reduce solar heat gain with reduced levels of light transmission.

Polycarbonate rooflights should be used as part of an assembly providing the required levels of non-fragility performance.

Polycarbonate can perform satisfactorily for typically 15 to 25 years with suitable UV protection and when used in correct applications. Polycarbonate may not be suitable for use in some coastal and industrial environments and advice should always be sought from the rooflight manufacturer as to their appropriateness in those conditions.

The durability of polycarbonate is heavily dependent on the integrity of the UV protection layer to maintain its structural strength and it is vulnerable to premature failure if it becomes damaged even with minor scratches that could penetrate the UV co-extruded layer. Care should be taken when handling and installing the rooflight so that it is not damaged.

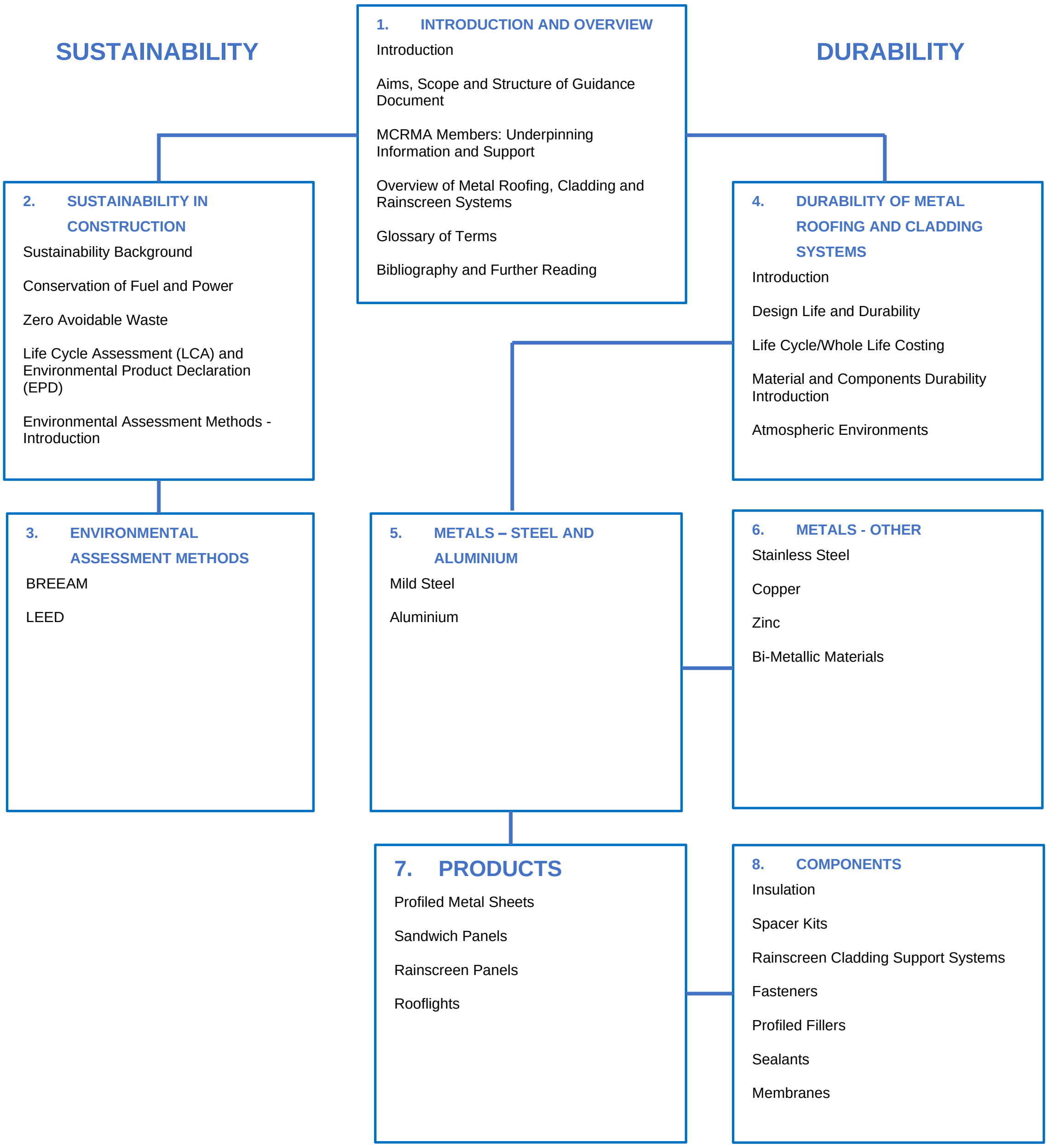
The UV protection layer can be damaged by scratches and severe abrasion in use and would need to be checked during regular roof inspections to assess its ongoing integrity. Prolonged contact with sea water and sand can also erode the surface protection layer.

Polycarbonate can be attacked, especially if under stress, when in contact with some common chemicals and materials including plasticisers such as those found in plastisol coated steel and PVC tapes, and some solvents and adhesives. Timber treated with some types of preservative (e.g., copper-chrome-arsenic formulation), can also attack polycarbonate rooflights. Prolonged contact with water (e.g., water that is trapped between seals at laps) can cause cracking and loss of strength of the material, especially if the trapped water becomes heated by the sun.

Polycarbonate is a hygroscopic material (i.e., it naturally absorbs small amounts of moisture) and has a high coefficient of thermal expansion ($66 \times 10^{-6} K^{-1}$) which is approximately 5.5 times that of steel and 3 times that of aluminium. The material should not be put under permanent thermal stress, so accommodation of thermal movement at fixings when connecting to other materials is critical, e.g., using oversize fixing holes. The rooflight manufacturer's detailing and installation recommendations should always be followed.

The surface should be cleaned with warm water and a weak or mild detergent solution using a soft bristle brush or cloth. Use of abrasives, chemicals, pressure washers, hard brushes, scouring pads or sharp tools can affect the rooflight's long term durability and potentially its weathertightness at laps and should be avoided.

7.6 STRUCTURE OF GD 39



Pictorial overview of MCRMA guidance document GD39: Sustainability and durability of metal roofing and cladding systems

7.7 GLOSSARY OF TERMS

BRE Green Guide to Specification Generic product LCAs and EPDs form the basis of the BRE (Building Research Establishment) Green Guide to Specification (Green Guide). Initially published as a simple to use 'green guide' to the environmental impacts of common building materials and products. It has undergone regular updates and expansion as an online version which provides guidance for specifiers, designers and their clients on the relative environmental impacts of many elemental specifications for roofs, walls, floors etc.

BREEAM (Building Research Establishment Environmental Assessment Method) A voluntary scheme which can be used to assess the environmental performance of most types of building (new and existing). Developed by BRE (Building Research Establishment) it is the world's longest established environmental assessment system and is used internationally as well as in the UK.

COP (Conference of the Parties) 26 The 26th Meeting of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC). The COP26 conference was held in Glasgow in November 2021 hosted in partnership by UK and Italy. Previous notable COP conferences took place at Kyoto (COP3) in 1997 and Paris (COP21) in 2015. These and other conferences have led to commitments to climate change, reduction of greenhouse gases and keeping global temperature rise this century below 2°C (preferably 1.5°C) above pre-industrial levels have been agreed.

CSR (Corporate Social Responsibility) The self-regulated responsibility of companies to society in areas such as the environment, the economy, employee well-being etc. Most companies, especially larger ones, now report on their CSR, a major element of which is the carbon footprint of a company's activities and their efforts to reduce it.

Environmental assessment method/rating system A methodology and/or rating system where various environmental impact factors are assessed against given criteria and points/credits are awarded. The total number of points/credits obtained will provide an indication of the environmental friendliness of a building design and its operation. The use of environmental assessment methods and rating systems can help encourage clients, developers and design teams to design and construct more sustainable buildings which are more energy efficient, climatic responsive, material and resource efficient, have healthier indoor environments for occupants and limit waste emissions and pollution.

EPD (Environment Profile Declaration) The results of an LCA are published in an EPD which is developed to a common format e.g., to the principles and procedures given in ISO 14025. The overall goal of an EPD is to communicate verifiable and accurate information on the environmental aspects of products that are not misleading. An EPD also provides the basis of a fair comparison of the environmental performance of products.

Greenhouse Gases Greenhouse gas emissions from human activities strengthen the greenhouse effect, causing climate change. Some of the gases occur naturally in the atmosphere, while others result from human activities. The seven greenhouse gases which contribute directly to climate change are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). The largest contributor to global warming is carbon dioxide (CO_2) which makes it the focus of many climate change initiatives.

LCA (Life Cycle Assessment) An assessment of the environment impacts of a product over its life cycle to a given methodology e.g., compliance with ISO 21930, considering several environmental issues. This life cycle of the product is often referred to as '*cradle to grave'*, where the *'cradle'* is the extraction of raw materials and the *'grave'* is the product's disposal and will consider the product's use over the building's life expectancy. A variation is a '*cradle to cradle'* life cycle where the disposal stage is replaced with a recycling process that produces material suitable for manufacturing a new product. LCAs are often broken down further into '*cradle to gate*' and '*gate to gate*' life cycles which can be useful for a manufacturer as a means of identifying internal processes for environmental improvements.

LCC (Life Cycle Costing) An LCC will consider all relevant costs over the defined life of a building covering construction costs, operation and occupancy costs, maintenance costs, renewal costs, and end of life costs as well as any environmental costs.

LEED (Leadership in Energy and Environmental Design) Green Building Rating System A voluntary, standard for developing high-performance, sustainable buildings developed by the US Green Building Council (USGBC). Although developed in and for the USA it is used internationally including the UK.

NDC – Nationally Determined Contributions National action plans on how countries will meet their commitments to climate change, reduction of greenhouse gases and rise in global temperature.

Net Zero Carbon/Net Zero Total greenhouse gas emissions going into the atmosphere e.g., from a particular process are equal to (or less) than the removal of greenhouse gases out of the atmosphere.

WLC (Whole Life Costing) A WLC will cover all the costs in an LCC as well as non-construction costs and incomes.

ZAW (Zero Avoidable Waste) The prevention of waste being generated at every stage of a project's lifecycle, from the manufacture of materials and products, the design, specification, procurement and assembly of buildings and infrastructure through to deconstruction. At the end of life, products, components and materials should be recovered at the highest possible level of the waste hierarchy, whilst ensuring minimal environmental impact.

7.8 BIBLIOGRAPHY AND FURTHER READING

The following is a list of support documents and publications that were used in the development of this guidance document, and which will provide further reading on the subject.

Approved Document B Volume 2 – *Buildings other than dwellinghouses – Fire Safety (for use in England)*

Aurubis – *Copper Book for Architecture*

BES 6001 – *BRE Framework Standard for Responsible Sourcing*

BRE BR502 – *Sustainability in the built environment: An introduction to its definition and measurement*

BRE Digest 489 – *Wind loads on roof-based photovoltaic systems*

BRE Information Paper IP 13/10 – *Cool roofs and their application in the UK*

BREEAM – *BREEAM UK New Construction – Non-domestic Building (United Kingdom) – Technical Manual – 2014*

BREEAM – *BREEAM UK New Construction – Non-domestic Building (United Kingdom) – Technical Manual - 2018*

BS ISO 15686-5:2017 – *Buildings and constructed assets. Service life planning. Life-cycle costing*

BS 7543:2015: *Guide to durability of buildings and building elements, products and components*

BS EN 1990: 2002+A1: 2005 (incorporating corrigenda December 2008 and April 2010) – *Eurocode – Basis of structural design*

NA to BS EN 1990: 2002+A1: 2005 (Incorporating National Amendments No.1) – *UK National Annex for Eurocode – Basis of structural design*

BS EN 15804: 2012+A2:2019 (incorporating corrigenda February 2014 and July 2020) – *Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products*

BS EN ISO 14001:2015 – *Environmental management systems. Requirements with guidance for use*

BS EN ISO 9001:2015 – *Quality management systems. Requirements*

BS EN 14782:2006 – *Self-supporting metal sheet for roofing, external cladding and internal lining. Product specification and requirements*

BS 5427:2016+A1:2017: *Code of practice for the use of profiled sheet for roof and wall cladding on buildings*

BS EN ISO 12944-2 *Paints and varnishes. Corrosion protection of steel structures by protective paint systems. Classification of environments*

BS 476-22:1987 – *Fire tests on building materials and structures. Part 22: Method for determination of the fire resistance of non-loadbearing elements of construction*

BS EN 506:2008 – *Roofing products of metal sheet. Specification for self-supporting products of copper or zinc sheet*

BS EN 1172:2011 – *Copper and copper alloys. Sheet and strip for building purposes*

BS EN 988:1997 – *Zinc and zinc alloys. Specification for rolled flat products for building*

BRE – *BRE Building Elements: Roofs and roofing: Performance, diagnosis, maintenance, repair and the avoidance of defects - Third Edition*

BSSA – *Stainless Steel and Sustainable Construction*

CAB – *Aluminium & sustainability: a 'cradle to cradle' approach*

CLC/GBC – *Zero Avoidable Waste in Construction*

CLC/GBC – *The Routemap for Zero Avoidable Waste in Construction*

Constructing Excellence – *Sustainable Construction: An Introduction*

Constructing Excellence – *Whole Life Costing*

CP 143-5:1964 – *Code of practice for sheet roof and wall coverings. Code of practice for sheet roof and wall coverings. Zinc*

CPA – *COP26 – An Introduction*

CPA – *Net Zero Carbon – What on Earth does it mean?*

CPA - *A guide to understanding the embodied impacts of construction products*

CWCT Technical Note 33 - *Breather membranes and vapour control layers in walls*
CWCT – *Guidance on built-up walls*
Euro-Inox – *Technical Guide to Stainless Steel Roofing*
Euro-Inox – *Cleaning Architectural Stainless Steel*
Hydro – *Circular economy – the design perspective. From theory to implementation*
International Molybdenum Association (IMOA) – Which *stainless steel should be specified for exterior applications?*
ISO 21930:2017 - *Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services*
ISO 14025:2006 - *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*
MCRMA Article – The factors to consider when installing PV panels
MCRMA Membership Charter
MCRMA Guidance Document GD01 – *Built up systems and spacer stability*
MCRMA Guidance Document GD08 – *An introductory guide to rainscreen support systems*
MCRMA Guidance Document GD11 – *Fixings and fastenings for rainscreen systems*
MCRMA Guidance Document GD12 - *Composite flooring systems: Sustainable construction solutions*
MCRMA Guidance Document GD17 – *A guide to site installation of insulated roof panels*
MCRMA Guidance Document GD19 – *Effective sealing of end laps in metal roofing constructions*
MCRMA Guidance Document GD21- *Thermal performance of buildings: non-domestic construction*
MCRMA Guidance Document GD22 – *Installing renewables on metal roofs: A checklist*
MCRMA Guidance Document GD28 – *Mineral wool insulation installation: Best practice guide*
MCRMA Guidance Document GD 33 – *Fasteners for metal roofing and wall cladding: design, detailing and installation guide*
MCRMA Guidance Document GD 34 – *The definition of cladding within the construction sector*
NARM Technical Document NTD09 2014 - *Rooflights: glass, polycarbonate or GRP?*
NARM Technical Document NTD15 2018 - *A guide to rooflights for profiled sheeted roofs*
NFRC – *Profiled sheet roofing and cladding – The NFRC guide to design and best practice (Blue Book)*
NFRC Technical Bulletin 36 – *Performance standards of building strip sealants in metal clad buildings*

RICS NMM3 - *New rules of measurement: Order of cost estimating and cost planning for building maintenance works*

RICS Guidance Note – *Life cycle costing*

UK Government – *COP26 Explained*

USGBC – *LEED v4 for Building Design and Construction*

USGBC – *LEED v4.1 for Building Design and Construction*

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Tel: 01633 895633 info@mcrma.co.uk www.mcrma.co.uk