### Lighter Schools, Brighter Futures – Design Guide

#### Contents

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>2–4</td>
<td>Brett Martin Daylight Systems, The Natural Choice for Natural Daylight</td>
</tr>
<tr>
<td>3</td>
<td>Brett Martin Daylight Systems</td>
</tr>
<tr>
<td>3</td>
<td>Daylight in Education</td>
</tr>
<tr>
<td>4</td>
<td>Sustainability</td>
</tr>
<tr>
<td>4</td>
<td>Technical Advice and Assistance</td>
</tr>
<tr>
<td>4</td>
<td>Service and Value</td>
</tr>
<tr>
<td>6–9</td>
<td>The School of the Future</td>
</tr>
<tr>
<td>7–8</td>
<td>Daylighting the School of the Future</td>
</tr>
<tr>
<td>9</td>
<td>CABE Daylight Checklist</td>
</tr>
<tr>
<td>10–13</td>
<td>Natural Daylight and Sustainability in Schools</td>
</tr>
<tr>
<td>11</td>
<td>Carbon Emissions Targets</td>
</tr>
<tr>
<td>11</td>
<td>Sustainable Energy</td>
</tr>
<tr>
<td>12</td>
<td>20% Roof Area</td>
</tr>
<tr>
<td>12</td>
<td>Solar Control</td>
</tr>
<tr>
<td>13</td>
<td>BREEAM</td>
</tr>
<tr>
<td>14–17</td>
<td>Natural Daylight and the Learning Environment</td>
</tr>
<tr>
<td>16</td>
<td>Academic Performance</td>
</tr>
<tr>
<td>16</td>
<td>Student Behaviour</td>
</tr>
<tr>
<td>17</td>
<td>Results</td>
</tr>
<tr>
<td>18–25</td>
<td>Designing Naturally Daylit Schools</td>
</tr>
<tr>
<td>19</td>
<td>Design Challenge</td>
</tr>
<tr>
<td>19</td>
<td>Daylighting Product Options</td>
</tr>
<tr>
<td>20</td>
<td>Understanding Daylighting Materials</td>
</tr>
<tr>
<td>21–25</td>
<td>Daylight Systems (Domes, Vaults, Skylights, Panel Glazing)</td>
</tr>
<tr>
<td>26</td>
<td>Design Checklist</td>
</tr>
</tbody>
</table>
Section 1
Brett Martin Daylight Systems

“Natural Daylight is our business. It promotes health and vitality and is scientifically proven to improve the academic performance of children in schools. A completely sustainable resource, natural daylight also substantially reduces the carbon footprint of a school building by reducing the need for artificial lighting.”

Tom Ogilvie, Managing Director

The Natural Choice For Natural Daylight

Brett Martin Daylight Systems
Brett Martin Daylight Systems is in the business of natural daylight and has built a solid reputation as the industry specialists in the provision of daylight solutions. The company is the UK and Ireland’s leading manufacturer of rooflight systems and demonstrates an impressive rooflight portfolio consisting of the most extensive range of precision engineered rooflights available from a single source. With more than 50 years experience, Brett Martin Daylight Systems has an impressive record of involvement in the daylighting of a wide spectrum of building types, supplying over 700,000m² of rooflights every year.

Daylight in Education
This expertise extends into the education sector, where the company has partnered local authorities, architects, schools and other commissioning bodies in the development of daylight solutions for nursery, primary, secondary and tertiary education establishment needs. It includes the transformation of courtyards into classrooms, the provision of canopies and walkways, replacement rooflights for renovation schemes and the origination of bespoke daylight solutions for new build projects.
Sustainability
Natural daylight is the most abundant, sustainable natural energy resource available to man. Brett Martin specialises in the provision of daylight solutions to maximise the transmission of natural light into buildings to reduce the carbon footprint of buildings through the use of natural light energy. The company takes it’s environmental responsibility seriously and has attained the environmental standard ISO 14001.

Technical Advice and Assistance
Brett Martin Daylight Systems provides expert, impartial advice on design, specification and installation, therefore, early involvement is key. Technical Advisors are on hand to advise on the regulatory demands for daylighting the school of the future, to help in the specification of the most appropriate daylight system and to recommend the most suitable material options. The team is equipped to satisfy concerns and issues surrounding whole life costs and equivalent BREEAM ratings. Full on site support is also provided from site inspection for initial design recommendations, on site measurement for the production of technical drawings and finally installation.

Service and Value
Every rooflight is manufactured in the UK in the Brett Martin Daylight Systems, BS EN ISO 9001:2008 quality approved factory with meticulous quality control and attention to detail, and are backed by long comprehensive guarantees, and delivered promptly to site. In addition to the technical support and installation teams, a dedicated customer service team, project manages each individual project every step of the way.
Section 2
The School of the Future

“Schools are there to give children the knowledge and skills they need to become active members of society. Many children are rightly worried about climate change, global poverty and the impact of our lifestyles. Schools can demonstrate ways of living that are models of good practice for children and their communities. They can build sustainable development into the learning experience of every child to encourage innovation and improvement.”

Alan Johnson, Secretary of State for Education and Skills September 2006

Daylighting the School of the Future

There are changing perceptions in the design of education facilities, with a new vision of the school as the hub of the community, encouraging and facilitating the development of hearts and minds. The design of the school itself is visionary and exploratory, a metaphor for the potential and promise the future holds for our children. The schools of the future are seats of inspirational learning which connect the exterior natural world with the interior educational space and are working examples of sustainability in action.

‘The school designer should assume that daylight will be the prime means of lighting when it is available’

Building Bulletin 90, Lighting Design for Schools – DfEE (Department for Education and Employment)

In the school of the future, daylight is a fundamental design criteria arising from the correlation between natural light and human performance and environmental sustainability. ‘Building Bulletin 90, Lighting Design for Schools’ recommends that “The school designer should assume that daylight will be the prime means of lighting when it is available” and in ‘Picturing School Design’, CABE (Commission for Architecture and the Built Environment) recommends that “The natural light in the [school] building should be of a high quality.”
Yet in ‘Assessing Secondary School Design Quality’ CABE found that over 50% of the schools completed in the last 5 years were mediocre or poor, performing badly on basic issues of environmental sustainability such as having sufficient natural daylight and ventilation.

CABE identified a large number of schools failing to achieve appropriate levels of natural light. Assessors reported examples of insufficient daylighting to classrooms. Typically, windows were too small or too few, major spaces such as drama rooms (not intended as black box spaces), assembly halls and sports halls had no source of natural light. A constantly observed failure was lack of daylight to circulation spaces, principally corridors. Top-floor corridors repeatedly did not take advantage of the availability of top-light, or plans for rooflights were omitted. The design typology in many of the schemes visited involved artificially lit corridors with classrooms on both sides at ground level producing corridors that were reported as ‘gloomy’, ‘miserable’ and ‘unrelelenting’.

Conversely, CABE identified that any negative factors associated with admission of daylight that require management, such as glare and overheating, can be easily and affordably overcome and that this has been well documented in the exemplars.
CABE daylighting checklist:

- Are the key spaces daylit for most of the year?
- Is there an imaginative use of daylight to create uplifting spaces?
- Are solar glare and solar gain well controlled?
- Are opportunities for rooflights utilised?
- Are halls and circulation areas well daylit?
- Are rooms located to maximise appropriate use of the appropriate daylight (e.g. artrooms on the top floor making use of rooflights)?
- How will the daylighting and solar control strategy be affected if different layouts are adopted?

A successful scheme will feature buildings and spaces that are oriented so that solar gain and glare can be controlled most effectively. It will minimise carbon emissions while offering a comfortable learning environment that is daylit for most of the year.
Section 3 - Natural Daylight and Sustainability in Schools

‘Modern rooflights when combined with a modern lighting system incorporating daylight sensors are effective in cutting a building’s energy consumption by reducing the need for lighting during daylight hours, helping to reduce the building’s carbon footprint.’

Carbon emission targets
DCSF (Department for Children, Schools and Families) has set a target on carbon emissions for all new school buildings of at least 60 per cent below those predicted for a notional building as set out in Approved Document L2A.

Sustainable Energy
Including rooflights significantly reduces the need for artificial light, dramatically cutting energy consumption and reducing the carbon footprint of a school building. ‘Standard specifications, layouts and dimensions 5 – Roof Coverings in Schools’, as issued by DCSF recommends that when used in conjunction with automatic lighting controls to turn the electric lighting off, or down, when there is sufficient daylight available, installing rooflights can significantly reduce the overall energy consumption of a school building thereby decreasing carbon emissions to the environment.

Advantages of building with rooflights
- Free natural light
- Less use of artificial light saves energy reducing CO₂ emissions
- Bright interiors
- Passive solar gain provides free heat
- Better building performance
- Reduced running costs
- Important aid to Part L compliance
- Quality natural light
- Harmful UV rays reflected

Disadvantages of building without rooflights
- Artificial light required
- Darker interiors
- Higher running costs
- Higher carbon dioxide emissions
- Difficult to meet Part L compliance
- Quality natural light wasted
- Quality natural light wasted
- Artificial light required
- Darker interiors
- Higher running costs
- Higher carbon dioxide emissions
- Difficult to meet Part L compliance
20% Roof Area
This guidance is in accordance with Part L of the Building Regulations. In order for a building to meet its CO₂ emissions targets, as set out by Part L 2006, a minimum performance standard for rooflights averaged over the whole roof has been set at 2.2W/m²K. Installing up to 20% of the roof area in rooflights is a practical solution to ensure the lighting levels within the building are adequate and will reduce the artificial lighting requirement. The notional building used in the Regulations assumes 20% roof area in rooflights and research shows that installing less than this amount will make compliance more difficult.

Solar Control
Independent research carried out by De Montfort University shows that in a large volume building, with evenly distributed rooflights and moderate internal heat gains, a rooflight area up to 20% will not cause solar overheating and may be the only way to admit natural light in a large building. This research is substantiated by the DCLG second tier document: ‘Designing with rooflights: Supporting the guidance in AD L2A & AD L2B (2006)’ (issued by the National Association of Rooflight Manufacturers) which shows that optimum reduction of carbon emissions will be achieved with a rooflight area up to 15-20% floor area. In addition BS 8206 part 2 provides information on recommended daylight factors in areas such as atriums.

Sport England, in the publication Sports Hall Design, support the inclusion of controlled daylight in sports halls, ‘Natural lighting creates the best daytime environment but light sources must be concealed or screened’.
BREEAM
The DCSF’s specific requirements for environmental sustainability within its capital programmes are that all new school buildings and refurbishment projects above a threshold 21 achieve at least a “very good” rating using BREEAM Schools (the Building Research Establishment’s Environmental Assessment Method), and that all new school buildings meet the reduction in carbon emissions set out. Whilst a BRE Green Guide Rating is currently in development the BRE helpdesk will assess such products on a project by project basis.

The graph plots CO₂ emissions resulting from the power used to provide artificial lighting and to replace heat loss through the roof against % rooflight area in the roof.

9am - 5pm requiring an illuminance level of 1000 lux
bright interior occupied when natural light is available

7am - 7pm requiring
illuminance level of 500 lux
very common lighting level
and occupation pattern

24 hour requiring an illuminance level of 200 lux
low light requirement and natural light not available for large periods of the building’s occupation
Section 4 - Natural Daylight and the Learning Environment

“Often we look at the design of a classroom but forget about more subtle factors such as how it would make people feel”

Head Teacher (CABE – Assessing Secondary School Design)

Natural daylight has enormous physiological benefits and there is much research evidence of a positive correlation between concentration, performance, results and improved natural daylight within educational facilities. It is a fact that school libraries with good daylight levels are used up to 50% more frequently.

“The environment of a given educational facility has a considerable effect on the daily activities of those using the facility. Students, teachers and staff can’t always verbalise what they like about the physical details of a building but they recognise the effect the building has on them. Research has shown that the condition of a school building definitely affects student achievement and student behaviour and that there are elements of facility design that are perceived to improve the learning climate.”

Maiden, 1998, p.40

Increasingly, research is demonstrating that the use of natural light impacts the performance of those who use a school building. It is critically important that the design, planning and construction of any school be based on the understanding that the physical facility influences the learning climate.
Academic Performance
In 1999, a rigorously documented study looking at the effect of daylighting on human performance was made public. The study, conducted by the Heschong Mahone Group, looked at the effect of daylighting on human performance. Maths and reading test scores were analysed for over 21,000 students from elementary schools in different regions of the western United States.

Students with the most daylighting in their classrooms progressed 20% faster in maths and 26% in reading in one year than those with the least. And students with a well-designed rooflight in their room (one that diffused the daylight throughout the room and which allowed teachers to control the amount of daylight) also improved 20% faster than those without a rooflight.

Student Behaviour
A study conducted by Paul Grocott Ph.D also measured the impact of different lighting environments on student behaviour and perceived behaviour. He found that under the lighting systems he tested, the students felt “the worst” under traditional fluorescent lighting. The teachers also felt their behaviour was “not at its best.”

The students felt “the best,” and the teachers felt they behaved “at their best”, under rooflights or natural lighting. The students found the natural light to be “comfortable” and the teachers appreciated the low glare, good colour rendition and good behaviour demonstrated under the conditions created by rooflights.
Results
A study conducted in 1995 by Michael Nicklas and Gary Bailey of Innovative Design also compared student achievement in three middle schools they had designed in North Carolina to achievement scores in other schools in the same state.

They found that students in classrooms with large windows and rooflights that let in natural light outperformed other students in their school district by 5-14% on end-of-grade tests.

So what is it about daylighting that might improve student performance? Nicklas and Bailey offered a number of informed guesses – improved visibility due to higher illumination levels and improved light quality, including better light distribution and colour rendition, absence of flicker and sparkle or highlights on three-dimensional objects, improved health, mood and behaviour, positive occupant response due to decreased daylight deprivation, and higher levels of alertness.

These support evidence that daylight has a profound effect on stimulation and regulation of the human body. It triggers the release of serotonin – the “feel good” hormone that regulates the human body and has been shown to help prevent SAD (Seasonal Affective Disorder).

Daylighting is one of several design features that are now recognised as important contributors to improved student performance, as well as reduced energy costs in keeping with the principles of sustainable design.
Section 5 - Designing Naturally Daylit Schools

“Daylighting is particularly important in schools because teaching and learning take place more effectively.”

Energy efficient design of new buildings and extensions, DfEE.

Design Challenge
In the past, schools have often used a standard layout of artificial lighting to illuminate classrooms and other areas of school use. Now, in keeping with the principles of sustainable design, it is important to create lighting plans that are suited to individual schools, sites and locality. Lighting requirements will vary significantly by region depending on the hours of direct available daily sunlight and the intensity of that sunlight in each different location. The design challenge is to take that information and fit the design to meet the specific needs of each individual school project.

Daylighting Product Options
BMDS provides a complete range of quality rooflight products to enable education specifiers to incorporate natural daylight as an integral design feature of the school building to satisfy current building regulations and sustainability targets and achieve the architectural vision of the facility.

☑ Dome rooflights – Mardome, Mardome Sunlight
☑ Vault rooflights – Marvault HF, Marvault RL, Multivault
☑ Pitched rooflights – Ritchlight Ultra, Ritchlight Mono
☑ Panel glazing systems – Xlok Express, Xlok Ultra
☑ Profiled rooflights – GRP and Polycarbonate Options
☑ Accessories – Access Hatches, Smoke Vents, Rainwater
Understanding Daylighting Materials
Brett Martin is the only European manufacturer of rooflights in polycarbonate, GRP, glass and PVC. We are also the only rooflight supplier to manufacture all of our own glazing materials. With the technical expertise to match, Brett Martin Daylight Systems provides impartial technical advice on rooflights and material selection to customer specifications.
Dome Rooflights – Mardome, Mardome Sunlight;
The Mardome rooflight range, with a choice of five design options, provides an effective daylight solution in both new build and refurbishment flat roof projects and can be tailored to meet the level of security, performance and aesthetics required.

Where safety is paramount automatic opening dome options are designed for smoke clearance, while access hatches allow entry on to the roof, either for maintenance purposes or as an emergency exit.

The Mardome Sunlight suntube option is a versatile solution for admitting natural light into smaller spaces such as corridors, washrooms and changing rooms facilities.

Ventilation
A choice of ventilation alternatives, including trickle and hinged vents, ensures the continuous circulation of fresh air to the school building in accordance with Part F of the Building Regulations.

Thermally Efficient Daylight
In order for a building to meet its CO₂ emissions targets as set out by Part L 2006 a minimum performance standard for rooflights averaged over the whole roof has been set at 2.2W/m²K. In practice, this is easily achieved by specifying the Tripleskin Mardomes which have a U value of 1.9 to 2.1W/m²K and significantly contribute to reducing the need for artificial lighting and ultimately reducing carbon emissions to the environment.
Vault Rooflights – Marvault HF, Marvault RL, Multivault;
Vaulted rooflights from Brett Martin Daylight Systems are easily incorporated in new or refurbished roofs. The range includes versatile vault rooflight systems capable of spanning between 1m to 9m.

These continuous run rooflights have been successful in meeting the daylighting requirements in a number of school projects being successfully specified for use in canopies, walkways, sports halls, libraries, canteens and atriums.

The range: Marvault HF is a vault rooflight system with a maximum span of 9m and unrestricted length; Marvault RL barrel vaults, in 60º and 180º profiles, are capable of spanning up to 5m; Multivault factory assembled GRP rooflights, for any metal roof, are capable of spanning up to 4m over any length.

Thermally Efficient Daylight
Vaults are available in a range of material options to satisfy or improve on minimum U value requirements as set out in Part L 2006.
Skylights – Ritchlight Ultra, Ritchlight Mono;
These architecturally significant pitched skylights can be configured as a pyramid, gable or hip with a lantern to the base if required, to any size, in a variety of frame colours and glazing options. A mono pitch option is also available.

Suitable for both new build and refurbishment school projects, each precision engineered Ritchlight Ultra is custom built to specification and has been specified extensively for use in school atriums, libraries, entrance halls and receptions.

The fully thermally-broken frame, virtually eliminates any additional heat loss through the frame, which is traditionally associated with skylights, and eradicates any cold spots, minimising the risk of condensation.

Ventilation
In accordance with building regulations, top hung vents can be specified for the Ritchlight Ultra skylight, with either manual or electrical operation. The electrical venting can also be specified with rain, wind and heat sensors.

Thermally Efficient Daylight
Ritchlight Ultra skylights satisfy or improve on minimum U value requirements as set out in Part L 2006.
Panel Glazing Systems - Xlok Express, Xlok Ultra;
Xlok is a versatile interlocking panel glazing system ideal for pitched glazing, vertical glazing, covered walkways, covered play area and replacement glazing of northlights. This system has been specified extensively for a variety of education projects from covered play areas and courtyards, to, corridors and sports halls.

The systems, Ultra (25mm) and Express (16mm), are capable of spanning up to 3.0m between supports, with top hung vents and a non fragile option, are fully factory assembled for fast and simple site installation.

Ventilation
In accordance with Building Regulations, Xlok panel glazing systems are available with top hung vents which can integrate with any ventilation or sensor system.

Profiled Rooflights
Brett Martin Daylight Systems manufactures profiled rooflights in both GRP and polycarbonate for site assembly in metal clad roofs. All sheets achieve the highest levels of profile accuracy and cover a range of options including safety levels, U values and fire ratings. Single, double and triple skin rooflights are available.

Naturally daylit reception – Marazion School
Covered walkways – Whitecross High School
Section 6
Design Checklist

Design Guidance Notes
Care should also be taken when specifying rooflights that the following are considered:

- Light transmission levels.
- The effect of increased rooflight area in reducing carbon emissions as calculated by an approved calculation tool, as required by Part L2 of Building Regulations.
- Solar overheating – the maximum internal gain allowed in Building Regulations Part L2 is 35 W/m² from all elements, including lighting, occupants, internal processes and solar gain. See NARM guidance and CIBSE guide TM37 – ‘Design for improved solar shading control for guidance on solar overheating’. Externally mounted shading devices are more effective than tinted window film as they control both the heat gain and solar glare.
- Non-fragility rating.
- UV degradation.
- Compatibility with the proposed roof covering system.
- Loads caused by snow, ice, standing water and self weight. Guidance on loadings is available in BS 5516 and BS 6399 part 2 and 3.
- Deflection caused by wind loads.
- The performance in fire shall conform to the requirements of Building Regulations.
- Where upstands are required to ensure that the rooflight is above the plane of the finished roof, it shall be suitably insulated.
- An Acoustic Expert should check that the proposed glazing construction will achieve the required indoor ambient noise levels and intrusion of rain noise as stated in the acoustic section of this report.
- Within atria consideration shall be given to using the rooflights for ventilation and smoke control as required under BS 5588 part 7.
- Consideration shall be given to effective drainage of rainwater and condensation from the glazing. If water is allowed to collect on surfaces close to horizontal, problems with sediment build up and long term etching may become apparent.

Source: Standard specifications, layouts and dimensions 5 – Roof Coverings in Schools
Case Studies
Daylight Systems For School Building Programmes
Ashford School

Product: Marvault HF
Material: Marlon ST Longlife and Marlon FSX Longlife
(structured and solid polycarbonate with UV protection)

An architecturally significant Marvault HF barrel vault, double glazed in Marlon ST and FSX polycarbonate sheet with electrical opening vents and trickle vents, optimises natural daylight whilst reducing glare and the risk of solar overheating. The overall impact is a diffused natural light in the school cafeteria area, creating an ultra modern light, bright, well ventilated social area.

Architect: Miller Bourne Partnership
Main Contractor: Baxall Construction
Oakfield High School, Wigan

Product: Ritchlight Ultra
Material: Marlon ST Longlife
(structured polycarbonate sheet with UV protection)

Daylight design has been fully integrated into the architectural vision of Oakfield High School with long runs of Ritchlight Ultra lantern skylights admitting natural daylight into corridors which is borrowed by adjacent classrooms. In addition, the pyramid skylights over the main hall and school gym ensure that natural daylight is the prime means of lighting in these areas.

Architect: NPS North West
Main Contractor: Walter Carefoot & Sons (Construction) Ltd
St Mary’s Primary School,
Product: Marvault RL
Material: Marlon FSX Longlife (solid polycarbonate with UV protection)

Whitecross High School, Hereford
Product: Xlok Express
Material: Marlon ST Longlife (structured polycarbonate with UV protection)
Canopies and Walkways

These canopies and walkways have been designed to complement the architecture of the school building whilst transforming outdoor space into an all weather amenity.

Orchard Special School,
Product: Xlok Ultra
Material: Marlon ST Longlife (structured polycarbonate with UV protection)
At Castle Park School extensive natural light and direct visual contact with the outside environment was a priority for both environmental sustainability and known physiological benefits. Extensive Marvault barrel vaults installed over the swimming pool and sports hall integrate the facilities, whilst dome rooflights in the circulation routes achieve a comfortable transition from the naturally lit classrooms.

Architect: Smith and Kennedy Architects
Main Contractor: Cleary Doyle
Hummersknott School and Language College, Darlington

**Product:** Marvault HF, Xlok  
**Material:** Marlon ST Longlife and Marlon FSX Longlife  
(structured and solid polycarbonate with UV protection)

The admission of natural light into areas where vertical light, through windows, would not reach and natural ventilation were the two prime reasons for including rooflights in the redevelopment of Hummersknott School and Language College. An 8m x 3m Marvault barrel vault cascades light into the first floor gallery and eatery below while vented Xlok Ultra panel glazing provides natural light and ventilation in the classrooms.

**Architect:** Spaceworks  
**Main Contractor:** Walter Thompson Contractors
Bristol Sports Academy
Product: Site Assembled Rooflights
Material: Trilite GRP
Gyms and Sports Halls

The considerately designed and engineered natural light in these Sports Halls not only has a positive impact on athletic performance, it also improves amenity value, significantly offsetting the cost and reducing the environmental impact associated with artificial lighting.

Harrogate Grammar School
Product: Xlok Ultra
Material: Marlon ST Longlife
(structured polycarbonate with UV protection)

Oakfield High School
Product: Ritchlight Ultra Pyramid Lantern
Material: Marlon ST Longlife
(structured polycarbonate with UV protection)
Varndean School

Product: Ritchlight Ultra
Material: Antisun glass

Ritchlight Ultra skylights were used to maximise natural light and ventilation in the second floor library at Varndean Secondary School. The two hipped 3.4 x 2.4m Ritchlight Ultra skylights which lie end to end on the flat ridge of the 750m² extension, are fitted with electrical opening vents automatically controlled with temperature and rain sensors.

Architect: Brighton and Hove City Council
Main Contractor: ROK
Coppins Green Primary School, Clacton

Product: Marvault HF
Material: Marlon ST Longlife and Marlon FSX Longlife
(structured and solid polycarbonate with UV protection)

Cleverly designed, this Marvault HF barrel vault glazed in opal Marlon ST insulating polycarbonate sheet with manual opening vents creates a bright and airy classroom whilst controlling solar glare and heat build up for a comfortable, naturally lit and well ventilated classroom.

Architect: Finetrack Ltd
Main Contractor: Crispen and Borst Ltd
UK and Ireland Sales Enquiries

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