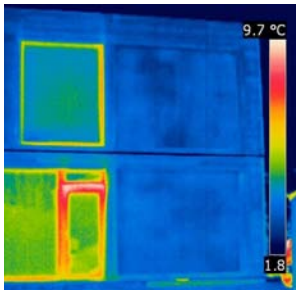
modcell®

straw technology

renewable schools

Philosophy



1. Introduction

ModCell Renewable Schools is a fast, affordable, turn-key solution, providing sustainable teaching space within existing school grounds.

The product is a prefabricated straw bale construction system that uses renewable materials and local labour to deliver a high quality, modern method of construction (MMC).

ModCell Renewable Schools are particularly well-suited to helping education authorities and school governing bodies meet the shortage of teaching spaces and need a rapid, cost-effectively and sustainable solution. It provides a high quality alternative for needs that are often assumed can only be met by temporary classrooms.

2. Educational Value

ModCell Renewable Schools are designed to meet the exact educational and pedagogic needs of each school, providing spaces and relationships between them that meet curriculum and functional requirements. They also meet Building Bulletin standards today and anticipate planned increases in Building Regulation standards, providing a future-proofed solution.

The material palette and construction method also lend themselves to teaching and learning opportunities being integrated into the design and construction process, providing important added value for students and the wider community.

All of this can be delivered at affordable cost per sq metre (depending on site conditions and constraints) ModCell can also meet the demanding PassivHaus specification if desired. Significant further economies of scale may be possible on a framework basis with multiple projects.

3. Economic Value

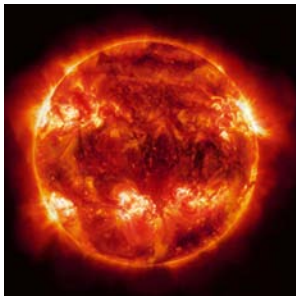
Straw is an agricultural bi-product that is natural, low carbon and renewable, as well as providing high levels of thermal insulation. ‘ModCell’ - so named for its modular system and cellulose-based material - uses these properties and combine them with offsite manufacturing to reduce the negative impacts of building on the environment.

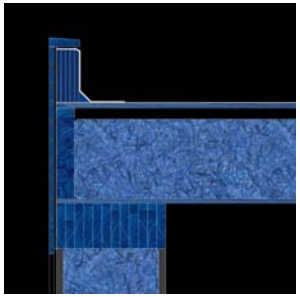
The prefabricated panels are constructed in a ‘Flying Factory’, a temporary manufacturing facility, normally located within ten miles of the construction site in an appropriate farm or light industrial building.

As well as providing diversification for rural economies - bringing normally under-utilised space into production - local skills, labour and materials can be deployed on every project.

Additional benefits of this manufacturing process include:
- quick and efficient installation on site;
- ability to scale up from single classroom extensions to whole schools;
- quality control;
- cost savings due to reduced construction time;
- waste reduction; and
- up-skilling, involvement and ownership by the local community.

Philosophy





4. Meeting PassivHaus Standards

As part of a four-year research programme in collaboration with the University of Bath, the BaleHaus @ Bath was the first prefabricated straw bale house to use ModCell panels. The concept is already designed using PassivHaus principles and meets Code for Sustainable Homes Level 4 “out of the box.” (mandatory for new housing from 2013).

Adherence to the specific criteria of the PassivHaus standard to allow certification is also possible using the ModCell system.

The outline specification for a PassivHaus in the UK [BRE, 2008] has one overarching requirement: the energy required for space heating must not exceed 15 kWh/m2/yr. To achieve this, five features that the ModCell system is being assessed against, along with steps that could be undertaken to meet these, are shown in the table opposite.

Our typical ModCell Renewable Schools specification delivers an appropriate balance between high environmental performance and affordability. Steps to achieve full PassivHaus certification above this standard specification are perfectly possible and we can advise on the additional cost of achieving this.

5. Performance and Design Quality

in ModCell Renewable Schools, performance and design quality are perfectly aligned.

Fire - It is a common misconception that straw buildings might pose an increased risk of damage through fire. ModCell panels actually have a 2 hour 15 minute fire rating (an hour and 15 minutes longer than required)

ModCell has been subjected to accelerated weathering tests on Bodmin Moor and a range of structural and performance tests under laboratory conditions in the BRE’s Centre for Innovation in Construction Materials at Bath University.

ModCell’s robustness and longevity is in line with conventional building techniques and materials such as brick and block.

Feature	PassivHaus	Typical ModCell Renewable Schools Specification	Steps to enable ModCell system to meet PassivHaus standard
Opaque U-values	< 0.15 W/m²K	< 0.19 W/m²K	ModCell panels constructed with dry lining have been calculated to achieve 0.13 W/m²K
Window and door U-values	≤ 0.8 W/m²K	1.23-1.56 W/m²K	Triple glazing and frames with integrated insulation could be specified; this has a cost implication.
Air tightness (Air changes per hour)	≤ 0.6/hr @ 50 Pa	0.8/hr @ 50 Pa	Triple glazed windows could be specified to reduce air leakage further
Thermal bridging	Minimised and ideally eliminated	Designed out	Standard already met - no steps necessary
Mechanical ventilation with heat recovery	75% efficient or better, with a low specific fan power	Target in performance specification	Air heat recovery with under floor heating can be specified, achieving renewables target.

ModCell has a strategic partnering arrangement for design services with White Design (www.white-design.co.uk) and Integral Engineering Design (www.integral-engineering.co.uk) both respected nationally for their high quality, sustainable design skills and education portfolios.

As a result, ModCell Renewable School designs can be developed to meet clients’ specific needs, confident in the quality of design advice available to achieve this.

6. Conclusion

ModCell Renewable Schools provides an attractive, affordable solution where fast delivery, high quality and sustainability are key client requirements.

Process

A

Bales are ‘shived’ or trimmed to a standardised size.

B

Engineered pre-drilled timber arrives ‘flat packed’ minimising the embodied carbon resulting from transportation.

C

Panel frames are assembled in a flying factory. Often this is on the same farm as the source of the straw used in the panels.

D

Simple, logical detailing minimises construction time and allows for quick training of local labour.

E

Panels are filled with locally grown straw. This is compressed to avoid any settlement.

F

A base coat of lime render is applied directly to the straw using a render gun. A further skim coat is applied by hand.

G

Panels are transported on a low loader and delivered to site pre-rendered with a skim coat and a 2 hour + fire rating.

H

Panels are maneuvered using a crane and lifting straps. A fork lift loading device can also be used on a flat slab with enough space.

I

Panels are located onto a sole plate. This also assists when creating an air-tight seal between the base of the panel installation and concrete slab.

J

Panels are joined together to create an air-tight detail and maximise the integrity of the overall structure.

K

Other elements of construction are quick to install and provide simple, air-tight detailing.

L

Panels can be installed with other elements pre-fitted.

M

The completed BaleHaus @ Bath. The core structure took just 4 days to complete.

N

Finishing details can be applied after the installation of the core structure, resulting in a beautiful, affordable, sustainable building.

case study 01

Weydon Class Extension

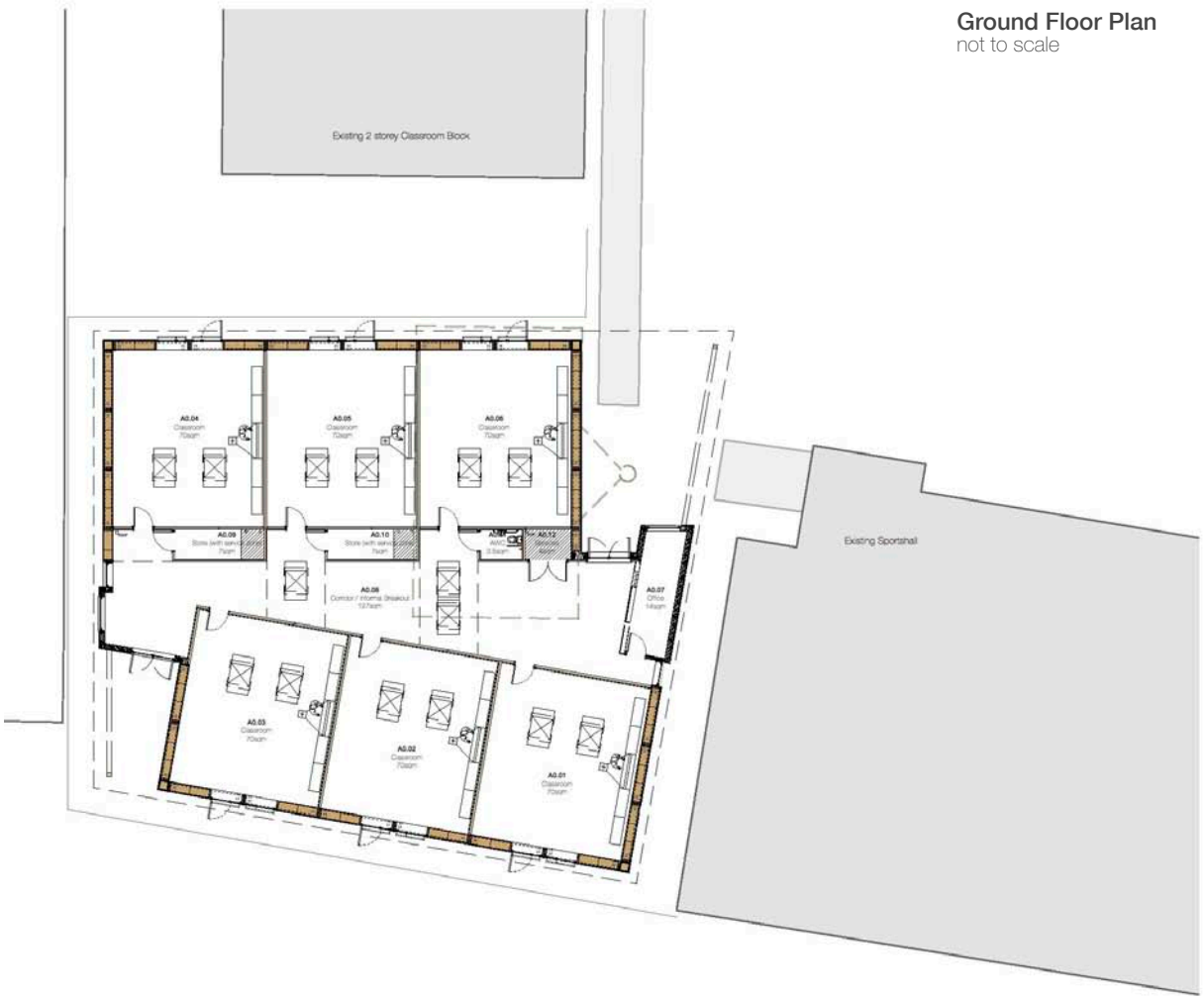
The concept behind Renewable Schools is to deliver a fast, turn-key solution providing sustainable teaching space within existing school sites.

The 'typical' plan offers flexible classroom and breakout spaces, which can be adapted to suit the site conditions and boundaries.

At Weydon School in Surrey, a master-planning exercise ensured the new classroom block was in the right place relative to overall site needs. ModCell Renewable Schools was then selected as the optimum solution in competition with other providers of rapid deployment temporary and permanent modular systems.

Weydon school chose a solution with super-insulated ModCell walls, enclosing two sets of 3-bay classrooms, split with a tapered timber-clad street, all of which respond to student flows, landscape and existing buildings (see concept sketch).

This plan can be immediately adapted and replicated through adding or removing classrooms along the street, and adjusting the street offset to accommodate specific site demands. The result is a fully flexible, highly efficient solution with proven robust details, so eliminating any design, construction and lead time risks.



Ground Floor Plan
not to scale

Weydon

The Team

Construction technologies are based on site and client requirements. For Weydon School the most efficient was an equal split between ModCell (external load bearing walls), solid timber (internal load bearing walls) and timber studwork (street ends and roof). This solution offered an element of prefabrication, so helping to reduce on-site construction times, whilst maintaining flexibility to accommodate client and site demands.

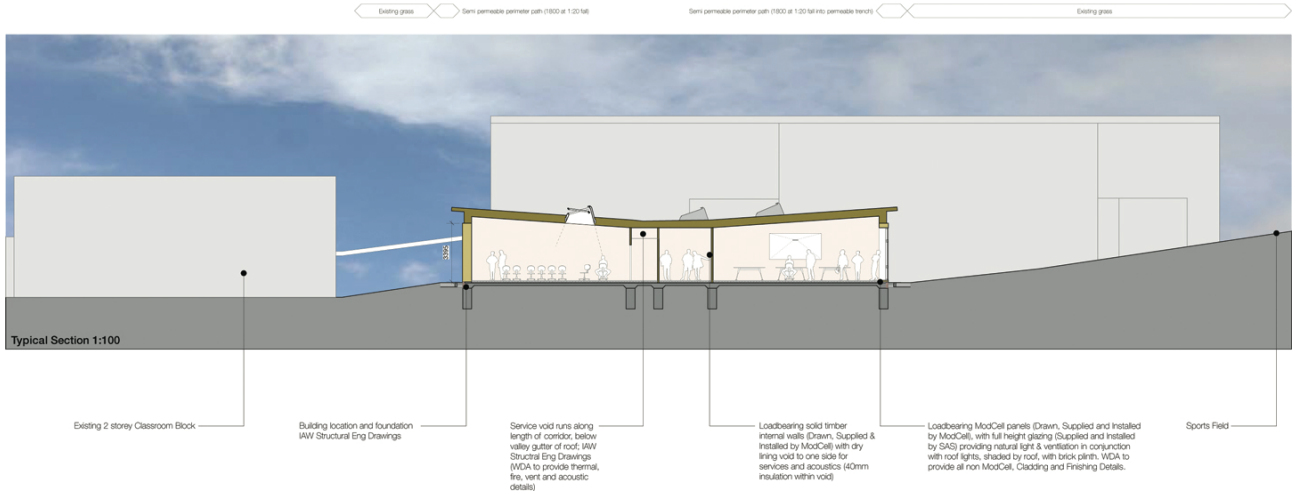
The design team at Weydon comprised: White Design - design team lead; IED - structural engineers; and E3 - environmental engineers. Together, the team developed a detailed planning submission within 2 weeks from project award.

White Design and the design team were then novated across to the main contractor to provide all the subsequent design and construction details, whilst attending site to oversee works to completion with both the client and construction team.

ModCell, subcontracted by the main contractor, developed fabrication drawings from the planning details and provided prefabricated straw bale and solid timber panels to site within 16 weeks from planning submission. ModCell also assisted in the installation, taking only 3 weeks to complete the erection of the walls.

The main contractor managed all the onsite works, working closely with White Design and the client, and took a further 14 weeks to handover the building. This strong relationship was a key element in the overall success of the project in terms of cost, quality and timescale.

Elevations
not to scale



Weydon

The Build

During Construction

3D Visualisation

Build Complete

case study 02

Castle Park Primary School Learning Plaza

The Raw Material

A new style of educational thinking has been incorporated in the Castle Park new school extension, a learning plaza for 60 students

Designed by White Design for Monmouthshire County Council

Castle Park

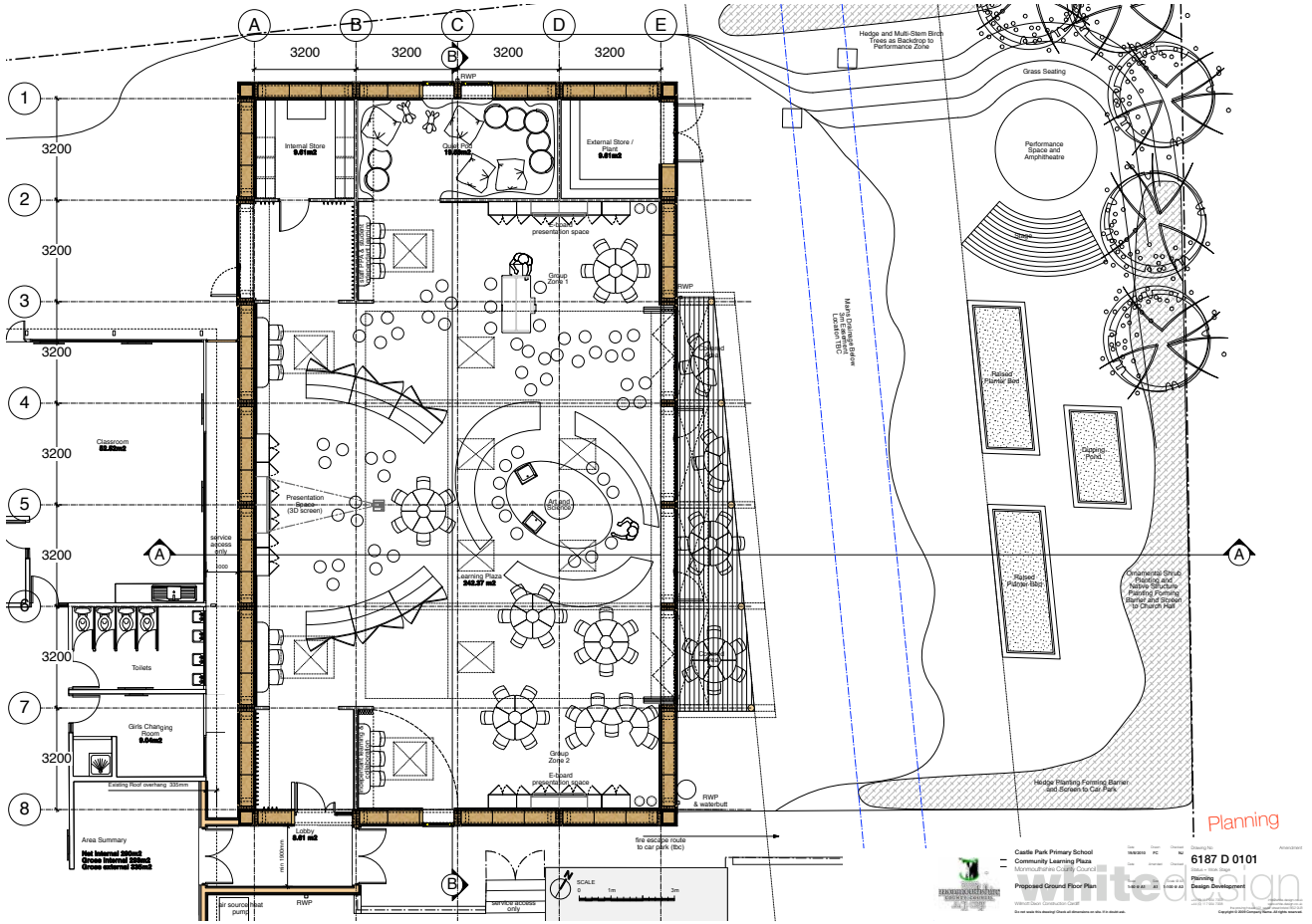
The Scheme

The Learning Plaza will be a flexible and technologically-rich learning environment for a combined group of Year 5 and 6 children at Castle Park Primary School. In addition to being flexible, the open plan nature of the Plaza will also increase the school's ability to adapt this space in the longer term to the requirements of new national strategies as they come on stream. The Plaza will also adapt well to new approaches to learning and teaching as they are developed by the local authority and school.

The building design adopts a 'passive first' approach to sustainability. In essence, the building fabric acts as a moderator of the external climate, whilst the heating, ventilation and lighting installations deal with the reduced demands of the moderated internal climate. The building is highly insulated, with 26 ModCell panels; selected for its insulation values and airtightness properties.

As the Plaza is next to the existing school, with classrooms in operation just a couple of metres away from the new Plaza location, ModCell has the added advantage of the quick erection time on site, reducing disturbance to the school. The panels will take only 1 week to erect during the February half term 2011.

The panels will be constructed at the flying factory less than 5 miles away from the school, using Monmouthshire straw.

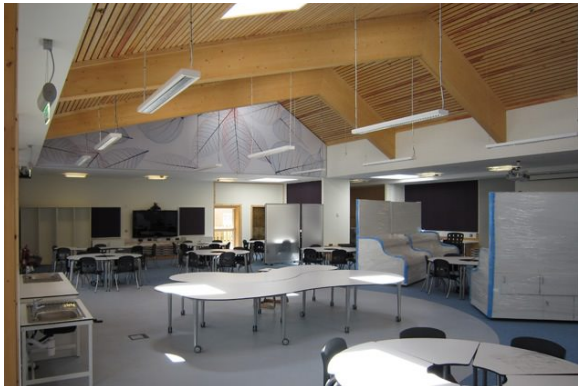


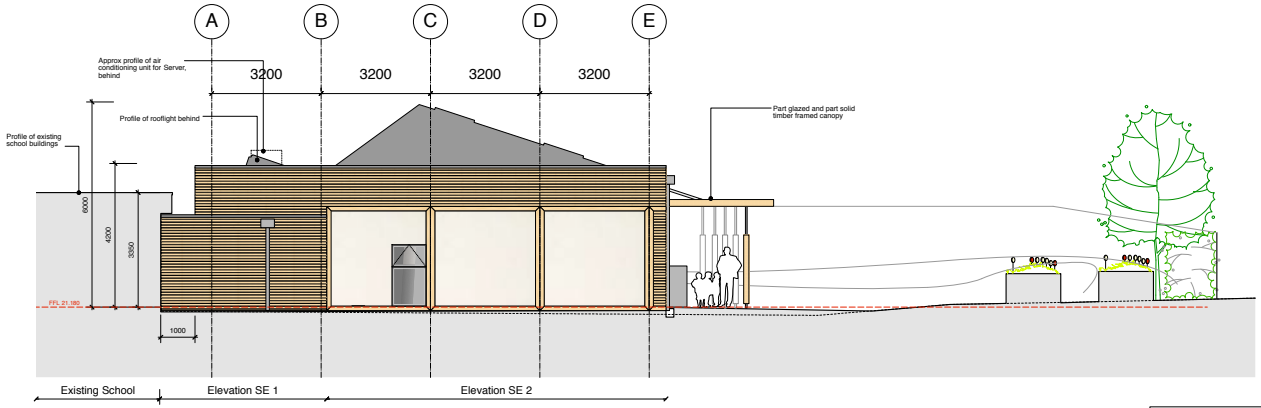
Ground Floor Plan
not to scale

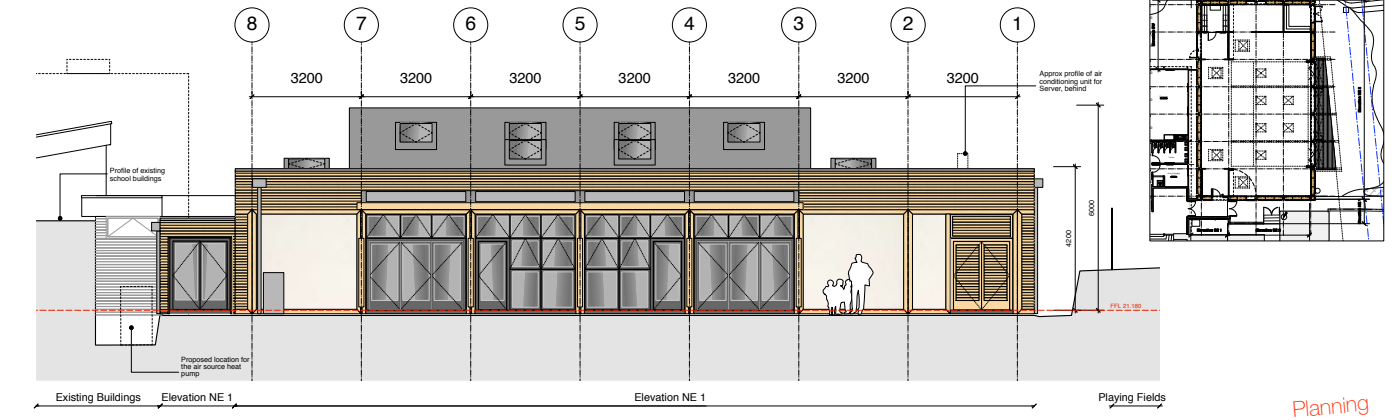
Castle Park

The Scheme

Elevations
not to scale







SCALE
0 1m 3m

Planning

Castle Park Primary School
Community Learning Plaza
Monmouthshire County Council
Elevations 1
Willmott Dixon Construction Cardiff

6187 D 0301

Planning
Design Development

whitedesign

case study 03

Holme Lacy Student Campus - Straw Bale

New student facilities for Herefordshire College of Technology

Designed by Hewitt Studios with Integral Engineering Design for the College's campus at Holme Lacy, the 100-seat cafe uses ModCell straw bale panels and features a 'green' sedum wall and terrace seating area. Local students helped to construct the pre-fabricated timber frame.

Local materials were an important part of the low environmental impact design. Nearby Pound Farm provided 60 straw bales, while timber came from Western Red Cedar trees growing in the college's 150 acres of forest and woodland. The building is self-sufficient, providing its own on-site energy generation through solar and wind power. Other environmental features such as super-insulation and passive environmental controls also help to minimise embodied energy.

Rob Dunne, Assistant Principal, said the project was a great success:
"This is all home-grown stuff - it's not only reducing the building's carbon footprint but also connecting the structure to its local environment."

Providing a welcome hub for both socialising and learning, the café is designed to be dismantled after 15 to 20 years and all components can be re-used or re-cycled. Post-graduate students at Nottingham University plan to use the building as a research model to test new environmental technologies.

The Straw Bale Cafe

Holme Lacy

The extension was conceived as a College learning aid in low-impact environmental design with the following features:

• Prefabricated Construction: The building structure was prefabricated in order to minimise environmentally disruptive on-site works. It was assembled by a workforce comprising of 4 Nottingham University post-graduate students.

• Demountable: The building is designed to be dismantled at the end of its 15 year design life and most components can be re-used or re-cycled.

• Energy efficient: The building requires very little heating/cooling as the straw bale insulation is approximately 3 times better than current Building Regulations require. The building is naturally ventilated and makes use of natural daylight where possible. All artificial lights are on motion / daylight sensors.

• On-site energy generation: The building generates up to 6kW of green electricity from a combination of photovoltaic panels and wind turbine.

• Local Materials: The cedar cladding/boarding and organic straw insulation come from the college estate. Varieties for the green planted wall were sourced from local nurseries.

Text and images supplied by Hewitt Studios LLP

The Scheme

case study 04

May Park Primary School

May Park Primary School, situated off Coombe Road in Eastville, Bristol, provides a site with significant opportunity to increase student numbers and expand from a two form entry to a four form entry primary school under Bristol City Council's draft 'School Organisation Strategy'.

The expansion of the school is being carried out over three phases recognising different time and programme pressures, with minimal disturbance to the school day throughout the construction period.

Phase one, was delivered using the ModCell System, provides the school with a four room classroom extension to the north of the main existing school building. The sympathetic design has seen White Design working along side ModCell to construct an environmentally conscious, highly insulated, prefabricated timber framed extension.

The project had to be delivered within very tight time constraints to ensure it was ready for the new term. From handover of site to children starting lessons was achieved in just 8 Weeks and the ModCell superstructure of external walls, partitions and roof was erected in just 7 days.

Phase two is the largest construction phase that takes advantage of the underused, poorly drained grass land to the north of the site. It will provide 16 classrooms, a kitchen, a hall plus special educational (SEN) and ancillary facilities within a two storey building with landscaping and the addition of an all weather 'MUGA' pitch.

May Park Primary School

case study 05

Hayesfield School - Nucleus building

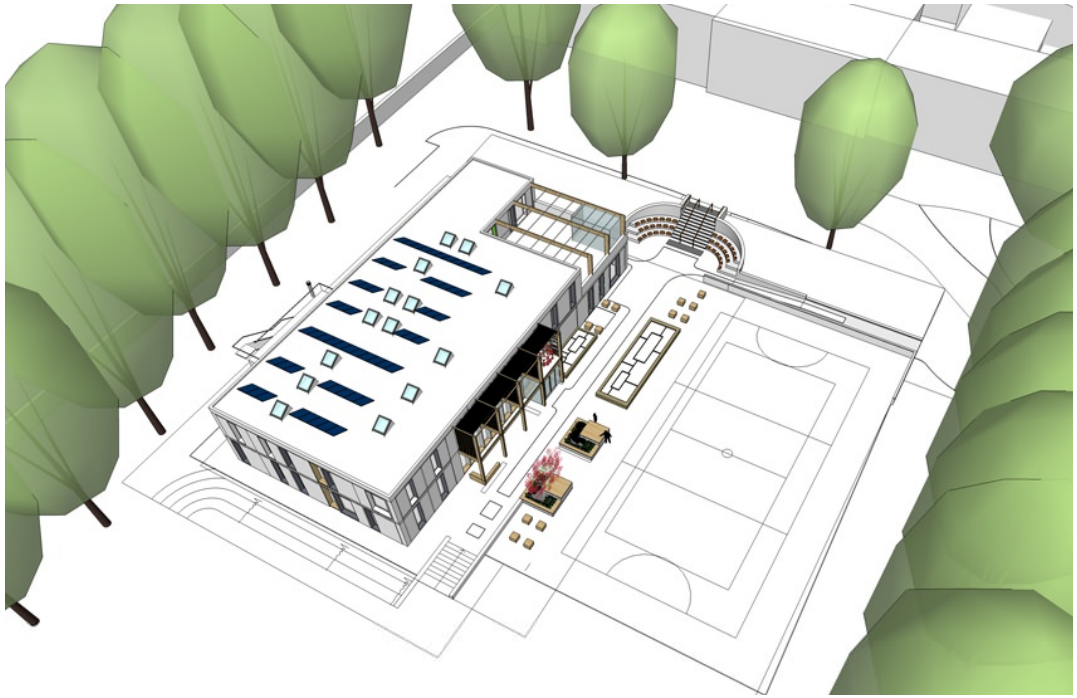
New science facilities at Hayesfield Girls School

Hayesfield Girls' School is a Technology College with an emphasis on innovation in science, technology engineering and mathematics (STEM). The new building is to be known as the Nucleus building. The School works with Trust partners to enhance specific STEM activities and courses for students such as research projects looking at environmental monitoring of buildings and working with scientists in residence.

The proposed building incorporates an efficient layout of labs and classrooms arranged around a Super Lab and double-height learning resource centre, and will allow the school to extend its provision of STEM teaching through an integrated approach to learning.

Sustainability is a key driver for the new building which will visibly demonstrate low energy design, construction, materials and use to all users and act as a learning resource, demonstration model and catalyst for sustainable thinking and initiatives for the whole school. The building was built from a versatile and efficient ModCell straw bale cladding system eliminating the need for a separate structural frame and increasing speed of build on site through pre-fabrication. Sixth form students gained hands-on work experience when they helped to assemble the ModCell panels at the nearby Flying Factory.

An 'A-rated' Demonstration Energy Certificate (DEC) was targeted by maximising passive performance through a highly efficient envelope enhanced by low energy use products and services, but critically through an ongoing consultation with the school user group to enhance understanding of the way that the building will most efficiently operate in use.



Hayesfield Nucleus

Hayesfield sixth form students assemble ModCell panels

The Scheme

Hayesfield Nucleus

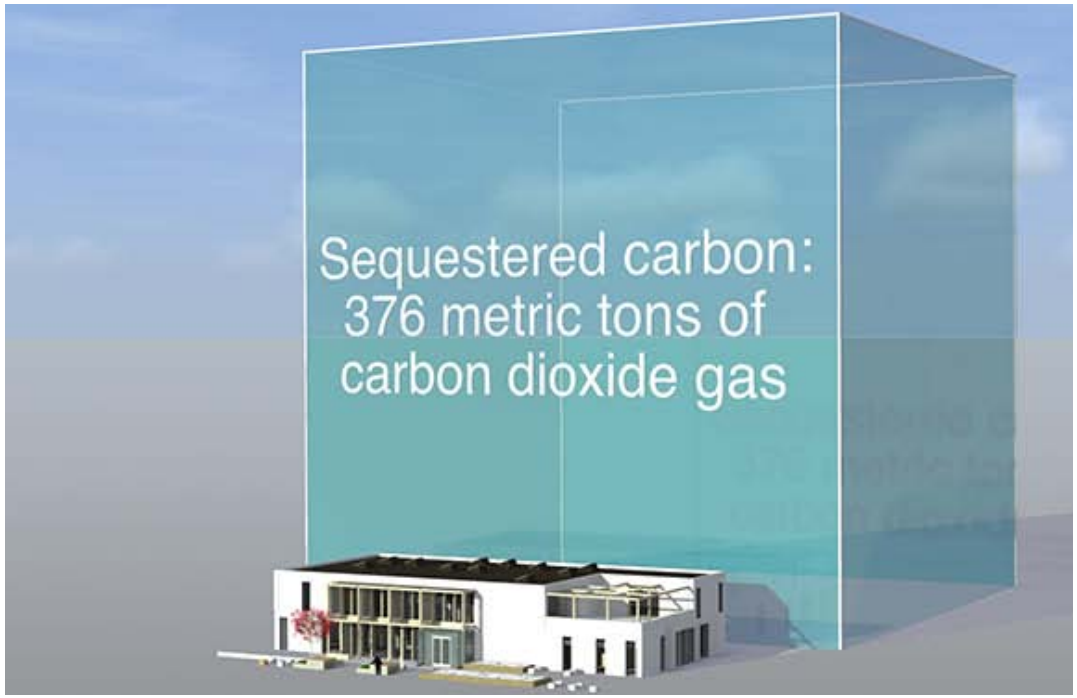
A typical 3m x 3.2m ModCell panel sequesters 1,400kg of CO_2

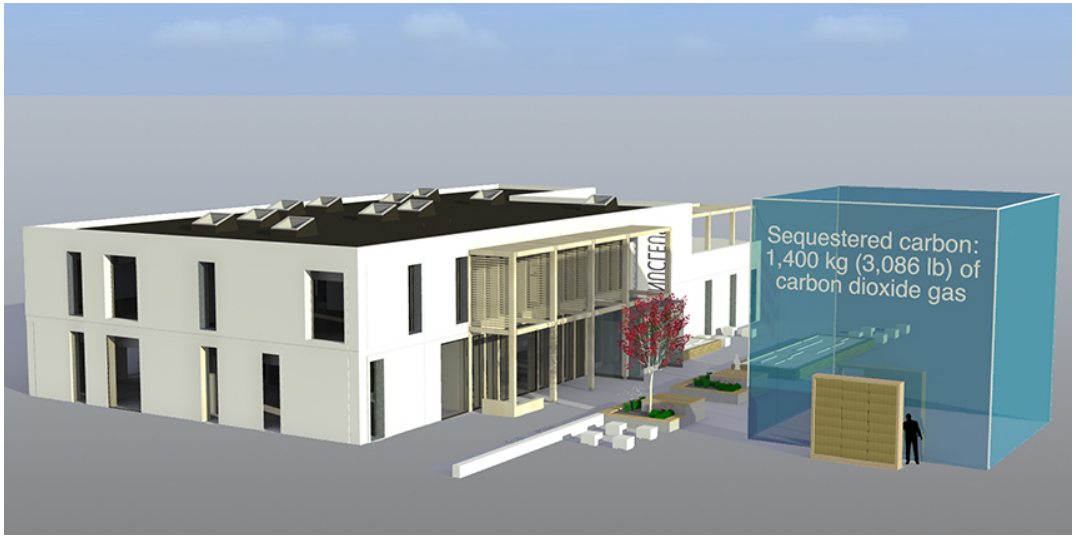
The 1100m^2 Hayesfield Nucleus building sequestered 376,000kg (376 metric tons) of atmospheric CO_2 gas within the structure of the building. The Carbon Dioxide is banked within the building for the lifetime of the school.

This set of images communicates the carbon sequestration capabilities of ModCell products.

Images courtesy of Carbon Visuals www.carbonvisuals.com

CO_2 Visualisation of sequestered carbon





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straw technology

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