STRUCTURAL
TIMBER ASSOCIATION
Building solutions in timber

Furness Academy

Design and construction case study

Furness Academy has been hailed as a ground-breaking project - one of the largest educational facilities to be developed in the UK, using cross laminated timber (CLT), as the core structural component.

From conception to completion, this evaluation incorporates input from all contributors, with the aim of demonstrating the successful collaboration of specialist organisations working together professionally and coherently at all levels to ensure the safe delivery of an outstanding project - on time and within budget.

The Academy has achieved outstanding environmental performance for the structural frame with sequestered carbon values of -1395 tonnes of CO_{2e}.

STA MEMBER
X-LAM Alliance

CLIENT
Cumbria County Council

ARCHITECT
Halliday Clark

MAIN CONTRACTOR
Kier Construction

ENGINEER
BDP

TECHNOLOGY
Cross Laminated Timber (CLT)

X-LAM ALLIANCE
PARTNERS IN SOLID TIMBER CONSTRUCTION

Introduction

Cumbria County Council had an urgent requirement for a new Academy to be formed from the existing Alfred Barrow Thorncliffe and Park View Schools - proposing a development across the two sites - North and South.

From the initial concept for a split facility, to the final proposal for one outstanding centre of learning built on the 12.5 Ha South Site, the target for the new Furness Academy was to accommodate 1,200 pupils by the academic year 2013/14.

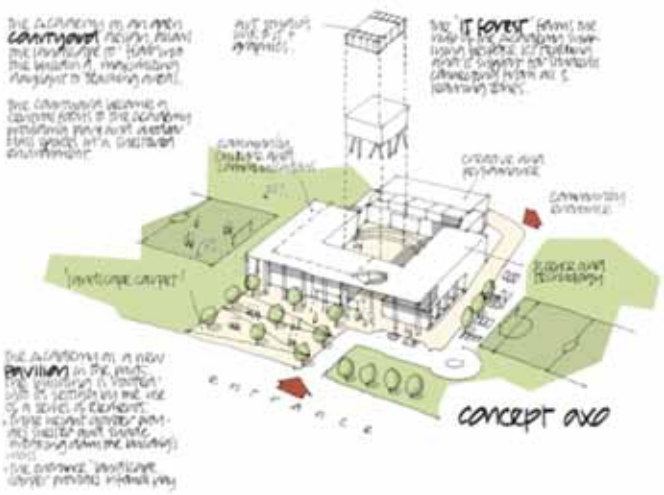
The new facility provides a first class learning environment delivering an unparalleled education for pupils, with additional accommodation allowing the school to meet its current and future challenges. Furness Academy aspired to be more than just a place of learning - at a social level it has been established as a hub for the local community and a beacon of change for the area.

A number of site constraints and considerations had to be addressed within the final design and delivery of the project. The choice of main contractor, architect, engineers and subcontractors were crucial to offer continual collaboration in order to achieve a successful outcome within a tight timeframe.

Access to the site at Furness Academy was not impeded, so transporting even the largest panels did not pose any difficulties, this is however a serious consideration in any project using large panels.

The site constraints and considerations included:

- Open vistas onto and from the site
- Site topography
- Retention of existing sports pitches
- Vehicular Access
- Reference to existing buildings
- Proximity to other building exits and road junctions



Images courtesy of Halliday Clark

Architectural overview

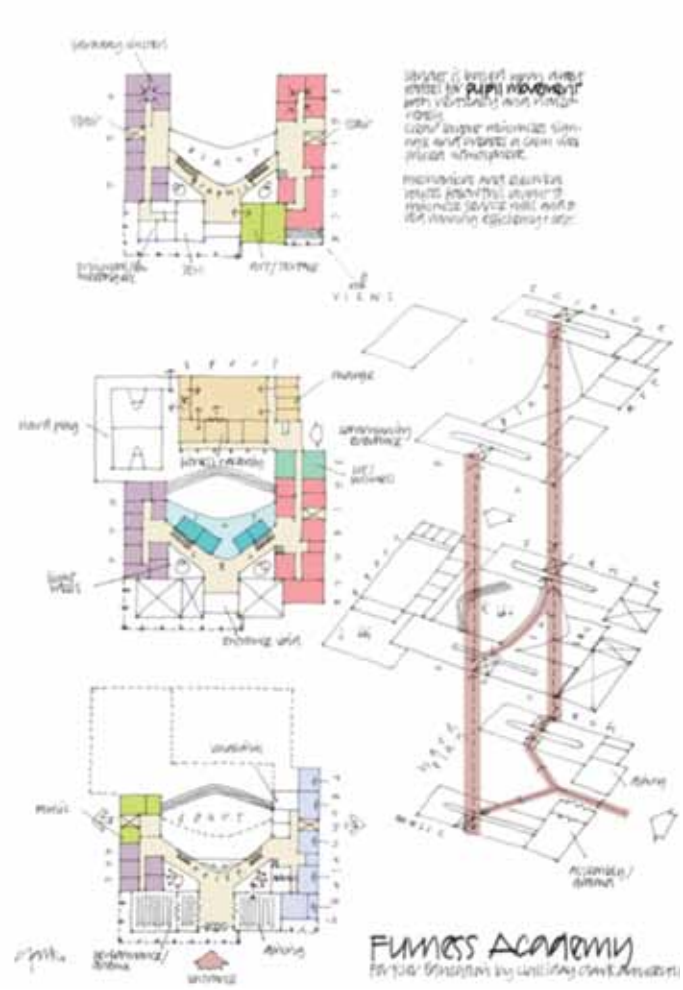
An holistic approach of positioning the user at the heart of the design process shaped the architecture around both the functional and social aspects of this project.

Architects are acutely aware of the value of good design, not only for the ability to 'lift the spirits' but also for the added value it brings to the community, believing that good architecture is fundamental in attracting students and staff to the school and that education is ultimately about economic and social regeneration.

In essence, the quality of the environment delivered through architecture can bring about lasting positive cultural change.

Key design drivers

- Flexible design
- Improving lives through learning
- Sustainable with low environmental impact
- Strong concept with accessible presence with community integration
- Inviting presence and identity - high visibility within the town
- Safe, friendly, secure
- Links between internal and external aspects
- Three learning zones
- ICT focus
- Sports and applied mathematics specialisms
- Quality external sports and play spaces



Design concept

The central location of the new Academy utilises the existing topography to best advantage, providing multiple benefits including:

- Presenting the Academy entrance and approach to the public from Park Drive
- Linking of the new building into the existing sports pitches
- The compact design allows more opportunities for developing a variety of landscape environments and minimises the impact of the building footprint
- Provides excellent engagement between the internal and external teaching spaces
- The construction of the Academy retains the existing estate functions
- Clear separation of public and private uses

The driver for the main building form was to minimise its impact on the site and the internal uses dictated how the building was massed. A simple pavilion style was conceived where internal uses could be stacked to best utilise space and be integrated by creating informal links.

These rooms surround an internal courtyard space, offering a combined shelter and play area. The design also maximises the use of natural daylight and ventilation to further enhance the internal environment.

The northern element of the building houses the sports facilities which are wrapped around the double height volume of the sports hall and changing rooms and are all directly accessible from outside. The block also contains the Energy Centre situated in a compact and easily serviced position.

The scheme was designed to comply with current legislation, using the most advanced construction techniques and materials ensuring energy efficiency throughout the build and beyond. Great consideration was given to the building fabric, thermal and solar performance to create a sustainable, energy efficient building with as much natural lighting as possible and with the provision of excellent system controls and monitoring capabilities.

The strategy and concept design of the Academy's topography was to capture the experience and enhance the journey for each pupil, through learning in the landscape. The physical characteristics of the school grounds have been used to create 'experiences' which benefit all site users.

The landscape plays an important role in attracting people to the Academy, utilising and enhancing the existing positive features and character of the site to form a striking view from nearby and further afield.



Structural philosophy

The structural requirement was to maximise the flexibility of the learning environment by providing a 7m clear span between external and internal CLT walls. This improved the general building arrangement, consisting of two advanced teaching spaces either side of an internal corridor. Working closely with the manufacturer and specialist contractor team, a 20m super XL panel was selected to span the full width of the block. This permitted a structurally and thermally efficient continuous slab, offering an added benefit of speed of erection.

The project is one of the largest cross laminated timber schools in the UK, featuring a hybrid structure to produce an efficient optimised design, using a combination of CLT and structural steelwork to create spaces that respond to the architectural design drivers. Areas such as the canteen and art rooms use long span steelwork to minimise internal walls or structural columns. In reduced span areas CLT walls are used.

The project exposes the visual quality of the material in selected use areas such as sports and assembly halls. In these areas double height walls are combined with glulam or steelwork to create light and flexible facilities for the school.

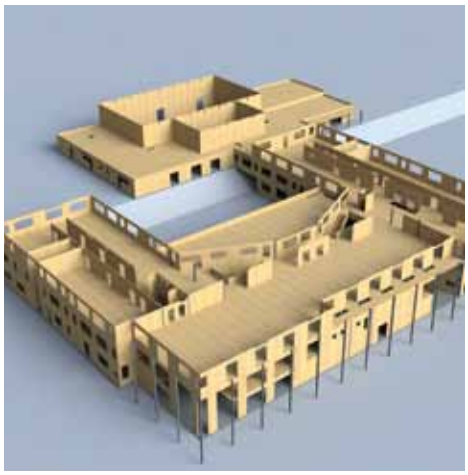
The selection of CLT as the principal material has enabled the main contractor to reduce programme time for the frame construction as well as accelerating follow-on packages by integrating architectural and building services opening requirements into the fabrication process.

Feature staircase

A cascading, visually exposed CLT staircase forms a central hub to the Academy. Careful structural design was required in order to maximise the visual impact and showcase the aesthetic appeal and natural warmth of the exposed engineered timber. As well as being a focal point, the staircase forms a connection between the two wings and the ICT suite.

Sports hall

CLT is used to great practical and visual effect in the main sports hall. The fully enclosed CLT box with long span glulam roof beams, offers good sound insulation and a robust surface - ideal for a sports hall. The coordination of roof panels and spacing of beams are sympathetic to the overall aesthetic appeal of the space.



Integrated structural steel and cross laminated timber elements

To match the vision and the aspiration of the client with a design that promotes flexible use of internal spaces, steel was integrated into the structure to create large, open classroom wings that could be subdivided into smaller spaces with lightweight, non-load bearing partitions.

This method of construction was chosen to allow alterations to the layout to be made quickly and efficiently by the client without the need for additional checks and structural modifications.

Connections

The CLT is connected to a suspended concrete slab already insitu, that bears onto vibro compacted foundations. Proprietary brackets were used for speed of installation to enable a connection between the CLT and the foundations to be formed.

Steel and timber connections around external canopy

The CLT panels are fixed to the structural steel hollow support frame, utilising BIM technology to ensure the co-ordination between the steel and CLT fabrication is seamless for onsite erection.

Onsite story

Site conditions proved far from ideal and the team experienced heavy rain, wind and snow throughout the 22 week construction period. This presented particular challenges for panel unloading, erection and associated plant movements. In some cases panels were up to 20m in length, so temporary sub propping was necessary to ensure large panels were not vulnerable to the effects of high winds.

The extreme weather conditions also had an impact on moving the CLT panels around the site, as the usual method of transporting with forklifts was not suitable. In these instances crane lifts were required to unload and install the panels in a single operation.

The health and safety considerations around moving panels of this size on site with large plant were considerable and required careful scheduling. Consequently additional planning was required to schedule deliveries of materials to coincide with panel lifts as part of the erection sequence. These operations added to the total crane time on site and required stringent monitoring.

In total an astounding 1988 white wood spruce cross laminated timber panels and 184 tonnes of steel were delivered over the course of the 22 weeks in 57 loads.

Building performance

Following completion of the project, acoustic testing (carried out by BDP) and air permeability testing (carried out by HRS Services) took place. The Academy is ventilated via both mechanical and natural methods depending on room location and type. Indoor ambient noise level measurements were taken in line with the Association of Noise Consultants (ANC) Guidelines, Noise from Building Services for mechanical and mixed mode ventilated areas.

For naturally ventilated rooms, measurements were undertaken in line with the ANC Good Practice Guide for Acoustic Testing of Schools where three measurements of five minute periods were taken at three locations within each room. The acoustic testing demonstrating 'good passes' for airborne sound to partitions and floor and a 'good pass' on impact sound to floors.

The envelope air tightness test was carried out in line with the following standards:

- ATTMA TSL2 Oct 2010 Issue – Measuring Air Permeability of Building Envelopes (Non Dwellings)
- BS EN 13829:2001 Thermal performance of buildings – Determination of Air Permeability of Building = Fan pressurisation method.
- The building was pressurised using the HRS Services 'MIDIFAN' System. The MIDIFAN System was set up in the front entrance door. Pressure differences across the MIDIFAN and the building were measured with air temperature probes located central and external to the building. Wind speeds at the start and end of the test along with barometric pressure were also measured.
- The Air Permeability tests revealed excellent pass results of 1.79$m^3/(h.m^2)$ for the Sports Hall and a further 'good pass' result for the general building achieving a value of 3.22$m^3/(h.m^2)$, compared to the original design specification, where both were required to meet maximum 7.5m^3 ($h.m^2$).

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