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English Edition

DETAIL

Sustainable urban development – certifiable?
Heating and cooling with heat pumps
Vacuum insulation or eco-thickness?

01/11

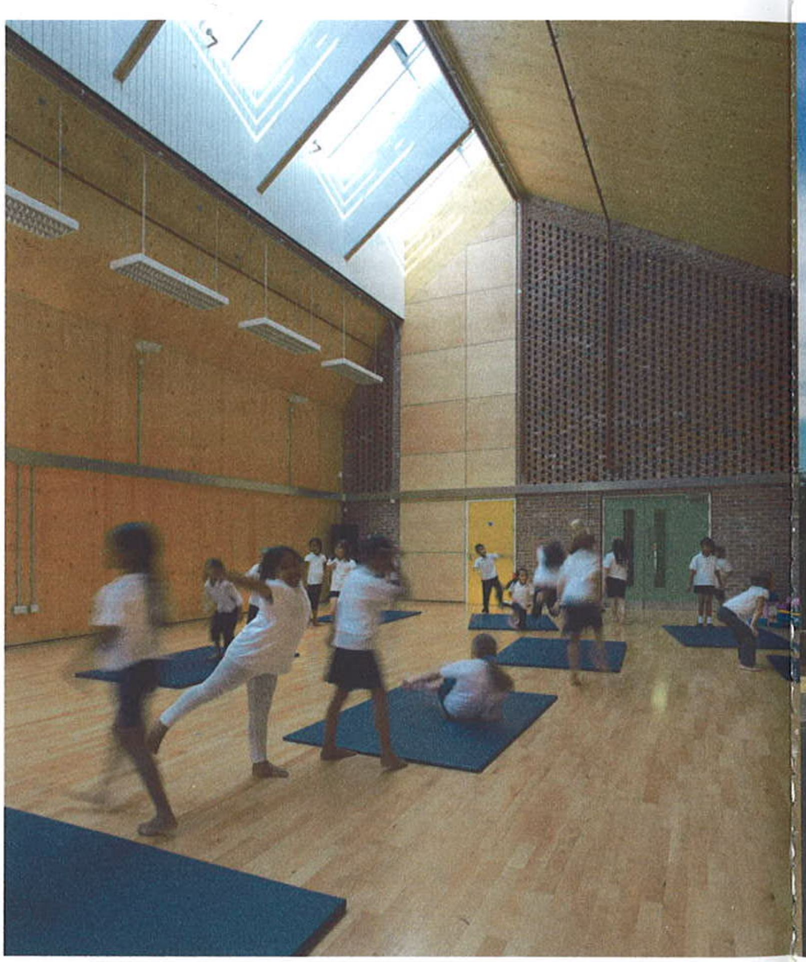
Green

Primary school in Wakefield

School experiment with tradition on its doorstep

Oliver Lowenstein

When the Labour party formed the new government in 1997, ministers vowed to turn around the social decline that afflicted many parts of Britain. Labour's 13 years saw massive building programmes, including the ambitious Building Schools for the Future (BSF) programme, as well as many other new schools funded by local authorities. BSF got off to a slow start, and has now been scrapped by the new Coalition Government. Still, across the country, through BSF and non-BSF projects, there are now – though admittedly, small in number – a new generation of buildings pointing the way towards a 21st century sustainable school architecture in the UK.
Sandal Magna in the outskirts of the West Yorkshire city, Wakefield is a case in point. Designed by Sarah Wigglesworth Architects, the primary school was commissioned in 2005 by Wakefield Council, and opened in September 2010. With costs rising during the economic boom, the project finally came within budget after a second tender process following the financial meltdown. The design actually dates from 2003, when Wigglesworth participated in the Government's "Exemplar Design" research initiative, in which 11 architectural practices developed a set of conceptual schools, to inspire the then nascent school building programmes. Today, unlike several of the other exemplars, with Sandal Magna, SWA have succeeded in realising a version of their original 'Big Rug' design.
Known for a playful bricolaging of the unexpected and imaginative uses of materials in earlier projects, the Wigglesworth practice have played it relatively straight with Sandal Magna, although the result remains unique and thought-provoking. The whole community were very clear that the design was to fit into the local "very bricky" neighbourhood. As a response Wigglesworth and project architect, Mark Hadden, developed a design of three linear buildings, divided into nursery and social space; staff, community and kitchen areas; and classrooms with ancillary teaching space. This multiple strip form, Wigglesworth believes, worked well on site: "It's very open and also allowed us to delineate areas."



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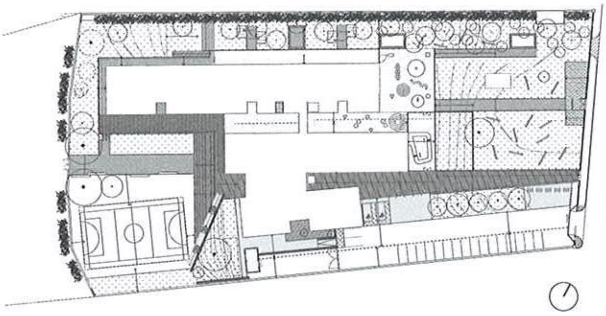
The school as a teaching tool

Having already instigated green school programmes, the school's energetic head teacher, Julia Simpson, was enthusiastic to see how a whole new school could build on this concept. Given the sustainability agenda, the architects wanted to explore how the buildings could showcase sustainability in action, using them as learning and teaching tools. They had become aware of cross-laminated timber, and proposed using this material in combination with brickwork, a hybrid yet to be explored. Although the Council were initially cautious about using what was still, in 2007, an unfamiliar construction, Wigglesworth and Hadden received the green light after a cost comparison show-



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Client:
Wakefield Metropolitan District Council, Wakefield; NPS North East, Castleford
Architects:
Sarah Wigglesworth Architects, London
M&E Consultant:
Max Fordham LLP, Cambridge
Structural engineers:
Techniker Ltd, London
Quantity surveyor and planning supervisor:
NPS North East, Castleford

1 Inside view of the hall
2 Access zone with the classroom wing on the left and the hall on the right
3 Site plan Scale 1:2000
4 General view with the clock tower on the right

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ed that prices between cross-laminated and conventional timber construction were highly comparable. The architects began developing an expressed aesthetic for the buildings, using exposed brick cross-walls, and cross-laminated timber roofs, walls and small extensioms. This also meant exposing the services in classrooms. "We wanted to make the services fun by putting the pipe-runs on display", says Wigglesworth.
Both brick and KLH panels are deployed most effectively in the main hall, where the brickwork's simple, though striking perforations break up one face, absorbing sound, while creating a mottled, dappling effect. Looking up, the ceiling's entire 18.5 metre span is achieved in massive wood; the effect is a calming, reflective heart to the school. From this centre, the separate classroom buildings are joined by glazed links overlooking a sequence of smaller spaces, including the library and computer rooms for children to use. These are not rooms, rather spaces integrated into the school's overall circulatory design. The classrooms, in turn, lead out into partially enclosed, partially open linear play areas, the equivalent to the yard spaces of the local rows of terraced housing.
With the school now up-and-running, a proposal for a post-occupancy research grant, developed and led by Sheffield University researchers, is currently under review. This aims to address an acknowledged weak spot in the new wave of sustainable schools: their actual performance. Alongside such conventional post occupancy evaluation (POE), the aim is to inform the basis for the new sustainable curriculum which, the head, Simpson, is planning. If the bid is approved, Sandal Magna could provide much needed understanding for integrating sustainable architecture with that of the needs of environmental education. That would be a significant extra to a project which is already at the forefront of this first wave of British sustainable schools.


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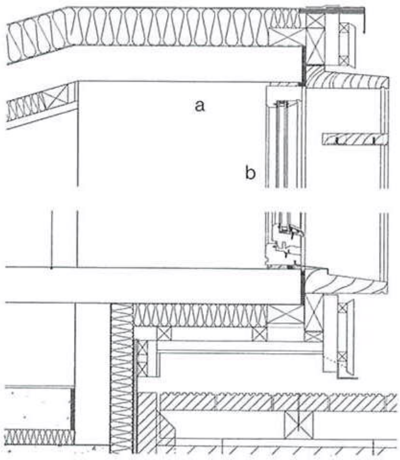

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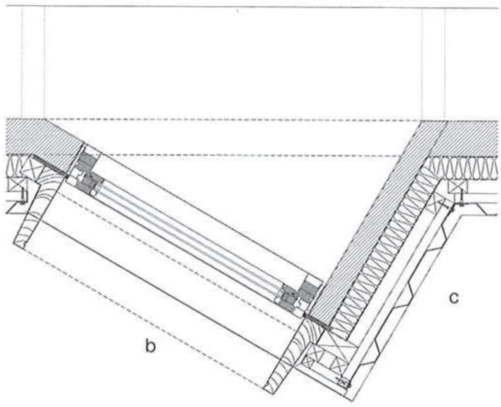


planting, quiet zones and games. Each classroom has direct access to the outdoor playgrounds and views to the surrounding landscape.
The head teacher, Julia Simpson, and her deputy and 'green champion' Ann Smith, were particularly interested in how the design for their new building could support the school in developing their sustainable curriculum, and in embedding ecological thinking into the daily routines and management practises of the school through such activities as recycling, a walking bus, healthy eating programmes and physical exercise.

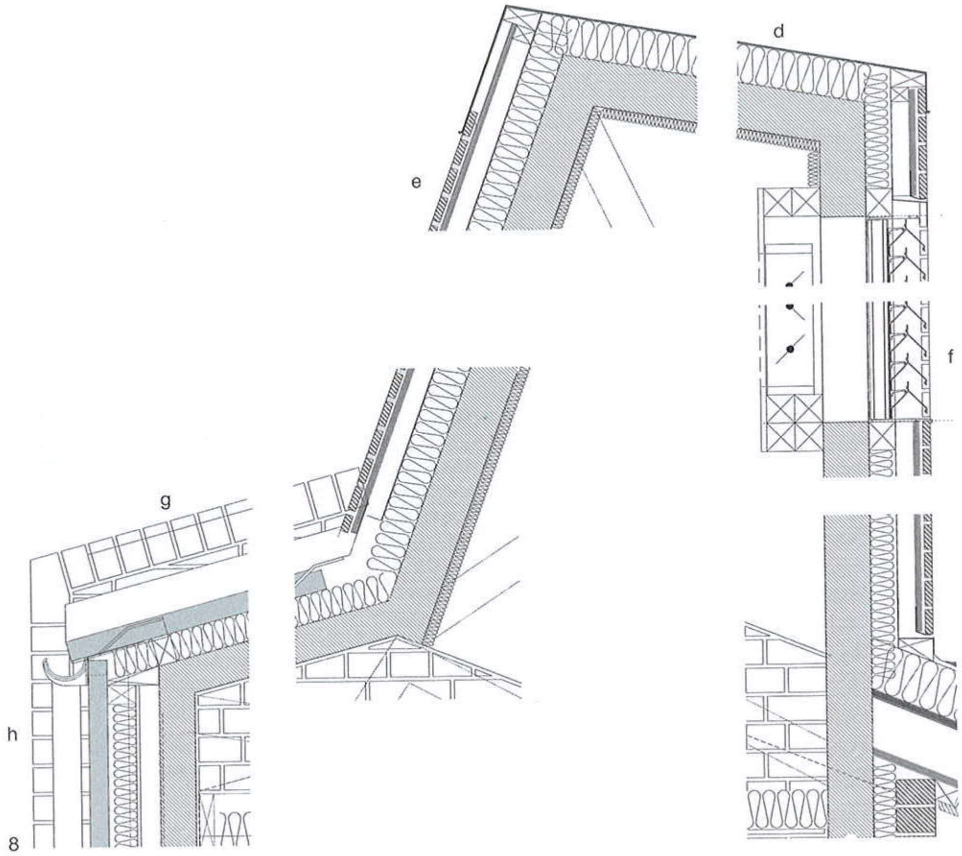
Construction and energy concept
The new school is anticipated to be one of the most carbon efficient in the UK, with calculated CO_2 emissions some 60% lower than in an actual median primary school in England measured in 2002/03, withcalculated energy consumption some 70% less. The actual emissions are anticipated to be slightly higher than this, but very probably still some 50% below median values. Funding for the low energy requirement was secured from the former DCSF Standards Fund to supplement a range of sustainable features for the school. These include:
- natural ventilation throughout, assisted by wind towers over classrooms
- a ground source heat pump to provide heating and hot water
- 80 m^2 of photovoltaic solar panels to power the ground source heat pump
- a masonry cross-wall structure providing thermal mass throughout the classrooms
- ceilings and walls fabricated out of cross-laminated timber
- a set of allotments for pupils within the school grounds for growing vegetables.

We wanted to optimize daylight throughout, both because it is uplifting and because it reduces the use of energy. The north facing classrooms were carefully designed for the required daylight levels, and the corridors, hall and foyer/cafe space are all top lit with an excellent quality of light.
We worked closely with Max Fordham's (Environmental and Services Engineer) to develop a passive environmental design aimed at reducing the use of energy by incorporating on-site energy generation and use of low embodied energy materials. The following describes some of these issues:
Masonry cross-walls are the primary construction elements supporting the timber ceilings but importantly, they also provide thermal mass at both low and high levels. By omitting headers from the walls at high level we could make the walls porous and use them to assist ventilation (in the classrooms) and help improve acoustic absorbtion (in the hall). In the case of the classrooms, the ventilation system works as follows: two classrooms are placed to each side of the WCs, and above the WC area is a brickwork tower, terminating with a louvre panel on the outside. Fresh air enters the classroom through low level vents on the north side, concealed by a bench seat. The air is passed over a heating coil in winter. Stale air from the classrooms is drawn by stack effect and wind pressure through the vent holes situated at a high level in the classroom walls, into the ventilation tower, and from there, is expelled to the outside. The tower is divided in two halves vertically down its centre so as not to permit cross-contamination between classrooms. (The WCs are vented separately using fans and ducts). In the hall, the missing headers expose black acoustic panels installed behind the facing wall, improving the sound quality within this large volume. Ventilation, here, is provided by opening rooflights. All louvres are operated by a building management system which measures temperature and CO_2 concentrations.
A main services distribution trench runs the length of the building from the plant room in the south-west corner. Services rise from the trench in cupboards behind each WC block and are distributed at a high level to their required destination. Service runs are mainly exposed because most surfaces are fair faced. We mapped out all the runs and the positions of outlets on the walls, conceiving of the conduits as vines creeping everywhere. In the classrooms we designed a horizontal metal grid to carry the lighting, cables, copper sprinkler pipes, IT runs and curtain track (to make changing rooms); grey biscuit-like acoustic absorbers made from recyclable polyester fibre are hung from the ceiling above this. Thus, all the elements of the interior are individually featured and placed on view for the children to observe and, hopefully, enjoy.

Pioneering a new construction method
Following from our experience of designing an exemplar school in 2003 (schemes commissioned by the Department for Education as benchmarks for the Building Schools for the Future programme), SWA were keen to construct the building out of timber where possible. During the design phases we compared two approaches: softwood studwork in combination with glulam beams versus cross-laminated construction using solid wood panels. A cost comparison was carried out which suggested that costs were almost the same for the two methods. We decided to opt for the cross-laminated timber because we were interested in seeing how it performed in practice.
The timber ceilings rest on the brick cross-walls which are the primary loadbearing elements. This combination of timber on brickwork had not been tried before, and we worked with our structural engineer, Techniker, and the manufacturer KLH to achieve a suitable method of attaching the timber to the brickwork. While the use of cross-laminated timber components meant that time on site was reduced, this was counterbalanced by the time taken to work through all the design issues.

6 South elevation of library
7 ICT and library shed: horizontal and vertical sections through facade Scale 1:20
a Roof:
Single ply roofing membrane
Thermal insulation, PIR, 100 mm
Vapour barrier
Cross-laminated timber ceiling, 94 mm
b Window:
Fixed shading louvres, red western cedar timber, 175 × 30 mm
Window board reveals: red western cedar timber
Double glazed window in timber frame, top part fixed, bottom part can be opened
c Opaque facade:
Profiled glass-fibre reinforced plastic sheeting on softwood battens, 38 × 50 mm
Breather membrane
Thermal insulation, PIR, 60 mm
Vapour barrier
Cross-laminated timber, 60 mm

8 Vertical section through ventilation chimney Scale 1:20
d Roof (top):
Zinc sheet roofing with welded joints
Breather membrane
Thermal insulation,PIR, 100 mm
Vapour control layer
Cross-laminated timber, 120 mm
Acoustic lining, 35 mm
e Roof (front):
Clay facing brick slip cladding, 25 mm
Plywood substrate, 15 mm
Softwood battens, 50 × 50 mm
Breather membrane
Thermal insulation, PIR, 100 mm
Cross-laminated timber, 120 mm
Acoustic lining, 35 mm
f Metal chevron louvres powder coated to match cladding
g Roof (lower part):
Corrugated fibre cement roof sheeting
Breather membrane
Thermal insulation, PIR, 75 mm, between softwood battens, 50 × 75 mm
Vapour control layer
Cross-laminated timber, 94 mm
h Wall (upper part):
Corrugated fibre cement cladding
Breather membrane
Thermal insulation, PIR, 75 mm
Plywood substrate, 9 mm
Softwood battens, 50 × 50 mm
Vapour control layer
Cross-laminated timber, 94 mm
9 Vertical section through classroom Scale 1:20
i Classroom roof:
Corrugated fibre cement roof sheeting
Breather membrane
Thermal insulation, PIR, 125 mm
Vapour barrier
Cross-laminated timber, 208 mm
j Timber slatted ceiling liner with 50 mm mineral fibre acoustic linerboard
k Classroom facade (upper part):
Corrugated fibre cement cladding
Breather membrane
Thermal insulation, PIR, 60 mm
Vapour barrier
Cross-laminated timber, 94 mm
l Classroom facade (lower part):
Timber curtain wall with double-glazed timber/aluminium windows
Parapet: Metal louvres, powder coated to match cladding
m Cavity for ventilation unit
front cover: perforated birch plywood with fire retardant, 12 mm
Window sill: birch plywood with fire retardant, 18 mm, on softwood battens, 50 × 50 mm
n Floor:
Rubber tiles, 2 mm
Sand cement screed with underfloor heating, 110 mm
Damp proof membrane, LDPE
Thermal insulation, PIR, 40 mm
Self-adhesive tanking membrane
Reinforced concrete floor slab, 225 mm



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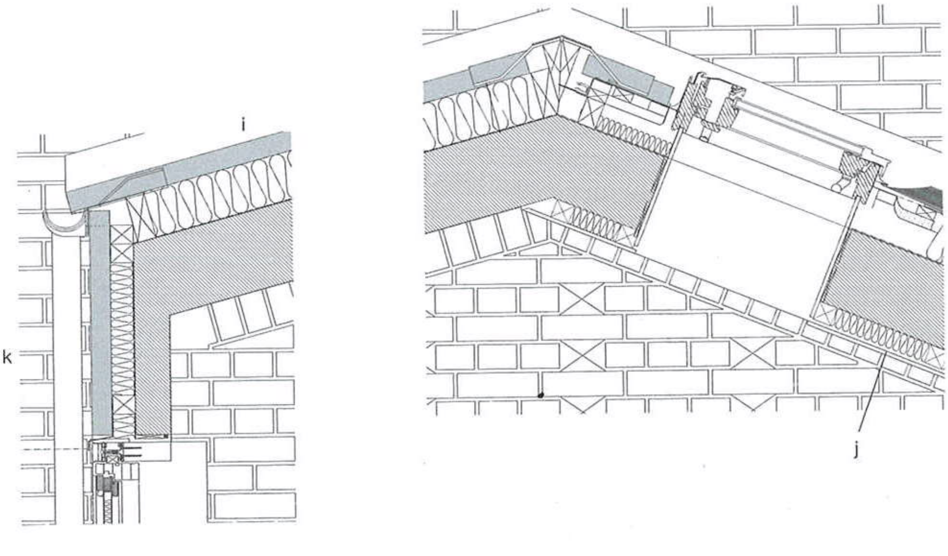

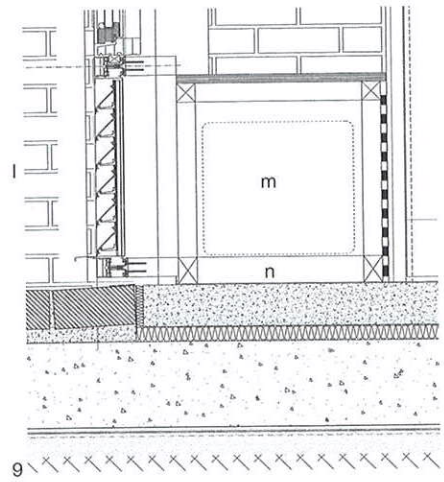

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