

SOLUTIONS: TECTONICS/TIMBER

Wooden tots

Nottingham University students designed this timber-framed building for a South African nursery school and then built it in seven weeks



MICHAEL STACEY

At the heart of Noah's Ark Nursery School in Jouberton, approximately 160km south west of Johannesburg, is a timber-framed structure. This school was designed – and later built in seven weeks this spring – by second year architecture students at Nottingham University's School of the Built Environment.

Not content with just designing and building the nursery, the students are also raising £25,000 towards the £34,000 cost for the materials. The 180 second year students began working on designs for the school last autumn and, via a competition, a shortlist of three schemes was reached by Christmas. At this point, seven fifth year students were introduced to optimise the designs, leading specific work packages.

One project was selected for construction and a detailed optimisation of the design was undertaken by 35 students, including the trial erection of timber trusses in Nottingham. Tim Heath head of the School of the Built Environment, conceived this project with charity Education Africa, and it was led by second-year architectural tutors Adrian



Canopy round the building.

Friend and Rashid Ali.

A North West Province-based gold mining company, AngloGold Ashanti donated the land for the nursery school and it also provided accommodation, logistics and consultants.

The chosen design has a fluid plan form wrapping around to create a courtyard. The section rises and falls to create a dynamic undulating form, seeking to make an

'It's an adventurous design and we are looking forward to making a difference'

inviting and stimulating place of learning for young children. The roof section has been designed to provide shade and ventilation above the classrooms. One of the second-year students in the winning team, Matthew Powell, says: "It's an adventurous design and we are looking forward to making a difference."

The nursery school serves 80 children and comprises four classrooms, a kitchen and ancillary accommodation. The school's design was finalised in South Africa after consultation with the schoolteachers who would be working there. The repetitive timber-framed bay system of construction facilitated these changes without any major changes to the structure.

The success of this and other five projects at Nottingham has led to the establishment of a project office. This will help serve the community within which we work, be it local or international, and provide design and construction experience. This is of particular importance in the current economic climate when students may not be able to work in practice and fully participate in a year out. A network of project offices is being established in conjunction with Portsmouth, London Metropolitan and Sheffield Universities, to share experience and best practice.

Michael Stacey is professor of architecture at the University of Nottingham and director of Michael Stacey Architects.



BUILDING WITH TIMBER

Timber is a statistically variable material – the strength of each timber section is not identical and this governs the detailing of timber structures. Timber joists in the wooden floor, are at 300mm centres so that each joist can share the load with its neighbour. The stress grading of timber – introduced after the second world war – greatly advanced the

structural use of timber in contemporary construction.

The trusses were designed in Nottingham using British metric section sizes – 50 x 200mm – that turned out not to be available in South Africa. They were therefore rounded up to a 50 x 228mm, and are arguably over-engineered for their final role.

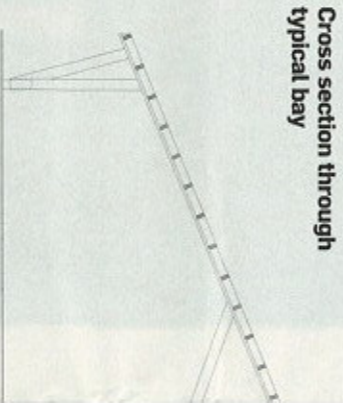
It should be noted that the school has been designed to

withstand hurricane loadings and building it nearly exhausted the local supply of hurricane clips. A detailed cutting plan was developed that significantly reduced

waste. This ensured an economy of the use of materials that was essential – the students understood where every penny came from and where every penny was spent.

A jig was made to ensure that each truss was accurately made. Some 520 timber sections formed the 26 trusses and a system of labelling was developed – akin to the markings of a medieval carpenter. One student took on the role of inspecting each truss to make certain that it was complete and bolted down satisfactorily.

Fifth year student Matthew

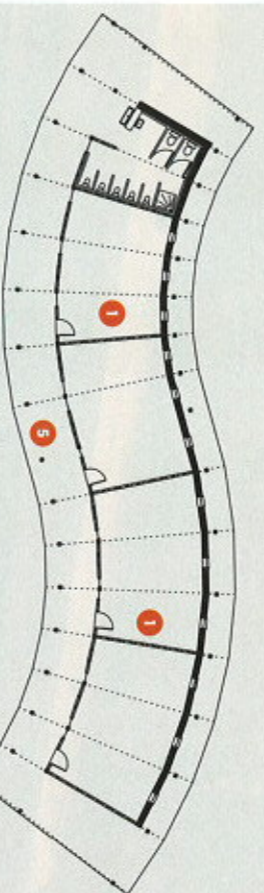


Cross section through typical bay

Wingrove who led the timber package says: "Once the trusses had been raised, the bay system of construction allowed various tasks to progress in a linear way along the building, which allowed the large work force to be used effectively."

The trusses were constructed from rough sawn South African pine and were

DETAILED OPTIMISATION AND CONSTRUCTION



Ground floor plan

- 1 Classrooms
- 2 Headteacher's office
- 3 Store
- 4 Kitchen
- 5 Roof overhang

The winning scheme underwent a detailed optimisation process, which continued on site until all the details were complete. The Nottingham students thought through the construction as far as possible, and researched the availability of materials in South Africa. The aim was to balance use and buildability without diminishing the ambition of the project.

The plan form was modified to make a sine curve with external radii of 24 and 26m. The school is formed of two bay types: eight convex bays and 16 concave bays.

The plan form is broken into two blocks with the smaller block housing the ancillary accommodation and toilets.



Fifth year student Jonathan Hore says of the optimisation process: "The introduction of types and repetition, instead of randomisation, made the building of the superstructure components far simpler and made prefabrication possible." The construction became a system of prefabricated chunks and site dimensioned link pieces.

OTHER STRUCTURAL ELEMENTS

Walls

The lightweight outer walls are clad in Onduline, known as Coroline in the UK. This is a sinusoidal corrugated sheet made from bitumen impregnated organic fibres. Saint-Gobain Isover donated all of the mineral wool used to insulate the school. Thermal mass was introduced to moderate the internal classroom temperature via a concrete slab and walls of earth filled bags. The concrete slab was power floated by a local contractor and before the final levelling, red and yellow oxides were added to colour the school's floor. Internal partitions are primarily of timber studwork clad in oriented strand board. The walls of the toilet block were built from brick.



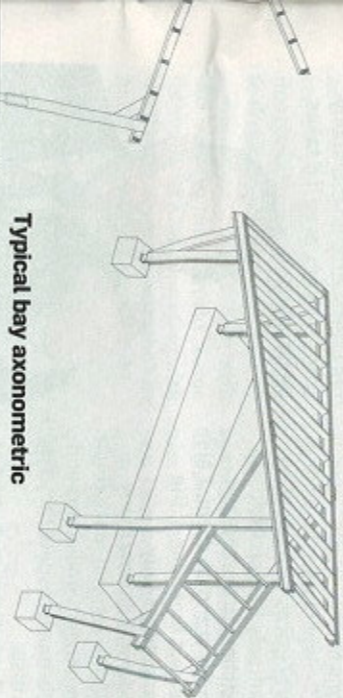
Box frame windows in a wall of earth-filled bags.

Window frames

The window box frames were intended to be temporary, however the team quickly realised that these frames offered a number of advantages: fixings for off-the-shelf windows; formwork for the concrete lintels; and a stop detail for the coloured render finish of the

earth bag walls. This detail was developed into a shading system as it was noted on site that after 1pm the sun would penetrate into the school despite the roof overhang.

Three types of window boxes were developed depending on the location and orientation of the windows.



Typical bay axonometric

sanded on site by the large student work force to save money. The detailing was designed to relate to the skills of the students. However the students expressed their concern about the quality of the pine and many sections had to be returned because they were warped. Currently, demand for pine in South Africa is outstripping supply.

The area of North West Province has a high termite population, so to protect the timber structure from attack, the ground below the slab was prepared with an anti-termite treatment, the base detail of the trusses is a pair of steel angles, raising the timber 150mm from the slab, and creosote was applied to the end grain of the timber trusses.



The roof is galvanised steel.

Roof
The roof is clad in profiled galvanised steel sheet. This could have been overlapped to create the fan-like roof, however this was rejected and a bespoke metal gutter was formed between each roof bay to articulate the presence of the roof trusses.



Metal gutter between bays.

This is a rare example of a more elaborate detail being opted as the articulation of roof trusses was considered important.

Overstory timber windows provide a good level of natural light for the classrooms but are protected from solar gain by the fan shaped roof.



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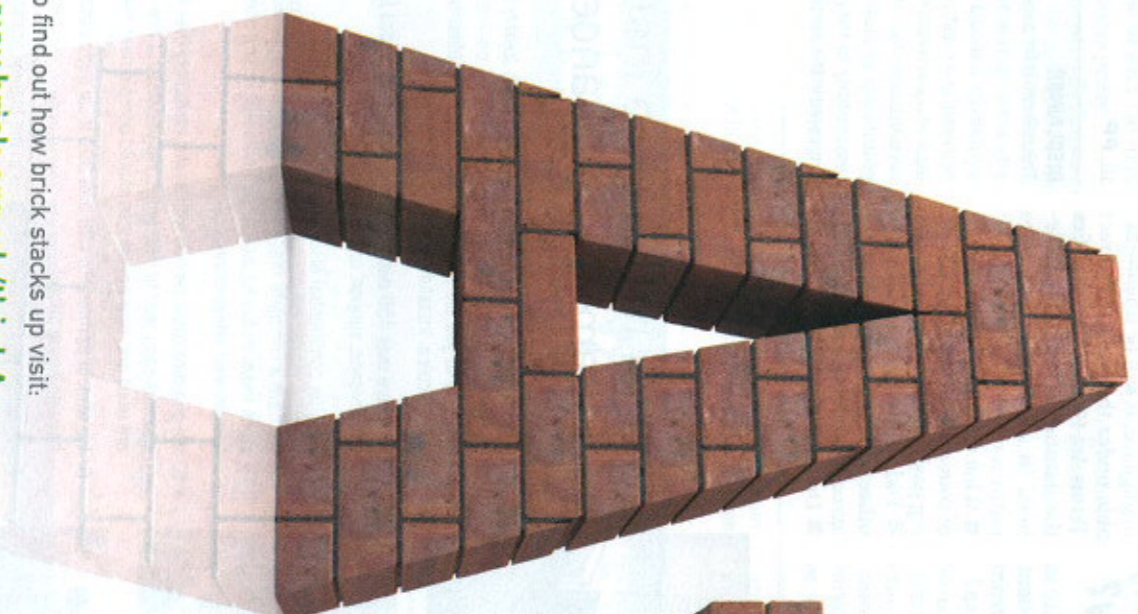
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