

Heavy problem, light solution

A nifty material switch on the £52m redevelopment of West Thames College is helping Osbourne Construction get off on the right footing

PROJECT REPORT

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When demolition work on the existing college buildings got under way in July last year, structural engineer Aecom was confident that its design would allow for a cost-effective and simple foundation solution.

But after the initial trial pits and boreholes were dug, it realised that the information it had been working to on the site's ground conditions was wrong, and the soil was far more disturbed than expected.

Once the existing foundations had been removed, AECOM's design team had to work quickly to re-evaluate the pad foundations originally planned, knowing that if it switched to a piled solution the programme time could be pushed far beyond what was required by the client.

But equally important would be the impact on the project's environmental credentials, as the additional CO₂ emissions associated with piling operations would substantially increase the building's carbon footprint.

AECOM associate director Russell Thomas reflects on this

being the most stressful part of the project to date: "The biggest challenge so far from a design point of view was once we got onto site, having to redesign the foundations while there was a guy standing over you with a shovel asking where you wanted the next hole."

To avoid a complete overhaul of the initial design solution, the decision was taken to incorporate Lytag aggregate into the concrete used throughout the building's design, with the aim of reducing the loads just enough to retain the pad foundations a viable option.

Although slightly larger than previously planned, and with the foundations going to clay instead of gravel as initially anticipated, the new design solution has worked perfectly and the project is still running to programme.

The light stuff

"To help us keep the loads down, AECOM chose to adopt lightweight concrete for the whole frame to reduce the dead weight of the structure," explains Mr Thomas. "With some support from Lytag [the company of the same name] we developed mixes and a whole approach for making the whole frame out of lightweight concrete, which is not that typical."

"By doing that it meant that we could avoid piles and just get away

"Aecom adopted lightweight concrete for the whole frame to reduce the dead weight"

RUSSELL THOMAS, AECOM



Future-proofed with a flat slab

with using pads instead, as well as all the environmental benefits of using Lytag – which were high on the client's agenda – and we managed to develop the structure to significantly improve the carbon footprint of this new building."

The material was first used almost half a century ago. Consisting of fly ash, a waste product from coal-fired power stations, it allows concrete to retain the same level of structural strength while being 50 per cent lighter than natural aggregates.

Lytag's spokesman Cor Benjamin claims: "If you are using a Lytag concrete as opposed to a traditional standard concrete and you replace just the stone in your concrete with Lytag aggregate, you're giving yourself a weight saving of about 25 per cent. So your cube of concrete, instead of weighing 2.4 tonnes, will weigh about 1.8 tonnes, depending on the mix."

"In this case taking a quarter of the weight out solved a problem. If you're using it elsewhere you could stick an extra number of floors on top or have smaller foundations."

At the college, as well as providing a quick and easy solution for building foundations on troubling



ground conditions, the lower weight of the overall structure has meant a decrease in the number of structural columns needed, reducing concrete use while aiding the designers with their plans for an adaptable, future-proofed structure.

With AECOM needing to be mindful of the adaptability of spaces within the college, although structural steel was used wherever possible, a concrete frame was always going to be the most sensible choice.

Mr Thomas explains: "Part of the design brief from the college was for future-proofing the building. You can have a classroom and teaching layout now, but in ten years' time, with developments in IT, that might not be suitable. We

The third phase includes construction of a sound-insulated theatre spanning the top three floors of the new learning resource centre



In addition to reducing the overall structure's deadweight, some of Lytag's additional properties have lent themselves well to other aspects of the college's design. Within the concrete works there are certain fair-faced concrete elements which will be left untouched after the concrete has set for aesthetic purposes. On one wall in what will be the college's new refectory, the concrete is embossed with a design including fine detail that is only achievable due to the particulate nature of the aggregate being easier to manipulate than traditional aggregate.

Sound choice

Lytag also confers enhanced sound insulation properties when compared to normal aggregate. It is estimated that its use can improve the acoustic insulation on a wall using Lytag by between 3 to 7 decibels, which will help isolate noise associated with the building's occupied use from the surrounding area.

All of these benefits, however, come at a slightly higher cost than that of traditional aggregate. But Mr Thomas is assured that on balance the use of Lytag on this project has allowed the team to break even while keeping to a tight schedule.

“We did an analysis of it and although Lytag, or lightweight concrete, was more expensive it was cost-neutral because you need less reinforcement as the concrete weighs less. It's a phrase I've used a lot, but contrary to popular belief taking a more environmentally friendly approach actually saved us money on this job. We didn't need piles, we needed less rebar and so the costs were less.

“So there's a double benefit. Not only are we getting those savings there, it's the environmental benefits. I think piles typically contribute to about 4 per cent of a building's carbon footprint, and by avoiding using piles you've have a greener building, but you're also diverting something that would otherwise have just gone to landfill. So it's about as green as concrete gets.”

needed to use concrete to give the client the flexibility of layout. With a flat slab you can put your partitions and your services anywhere.

“This gives you the freedom of distribution both now and in the future. That was a driving force and steel would have limited that. But by taking the design approach that Aecom did we gave them the flexibility and with a very green frame.”

Having a blast

To further reduce the college's carbon footprint, almost 40 per cent of the cement used in the new building was replaced with blast furnace slag, another waste product of the steel and power generation industries. All of this worked to further mitigate the

large amounts of CO₂ typically involved in cement production.

“As a design practice Aecom have striven very hard on this job to make this as green as a concrete frame could be,” adds Mr Thomas. “One of the prime things we did was to replace as much of the cement as possible in the concrete. Cement production is responsible for something like 7 per cent of the world's carbon emissions, a massive amount.

“I was astonished. That came from the Concrete Society, so if anything they probably trimmed the figure down. So on this job, we used a by-product of the power and steel industries, blast furnace slag, to replace up to 40 per cent of the

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cement in the job.

“Not only are we reducing the carbon footprint of the building as a whole because there's a lot less cement in it, but you don't need to quarry fresh cement and produce it, and you're using a by-product of an industry that would otherwise go to landfill. Better still, these cement replacements are cheaper as well as environmentally sounder. So there have been a whole load of those double benefits on the job.”