

A strong but lightweight aggregate

With sustainability becoming an increasingly integral part of any construction project, using sustainable materials in concrete is becoming common practice. Here we look at Lytag – a secondary aggregate – and how it has been used in some high-profile projects across the UK.

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There is hardly a structure in the world that doesn't use concrete. Its versatility, durability and cost-effectiveness make it a key component in today's built environment. For the construction industry as a whole, increased legislation and client demands are driving sustainability into every construction process, and as one of the most widely used construction materials, concrete has an important part to play.

However, just being sustainable isn't enough. Any construction material must perform and meet all industry

standards to give specifiers the confidence that it will have no adverse effect on the long-term performance of the structure. To ensure performance on both counts, secondary materials (such as pulverised fuel ash (PFA), the by-product of coal-fired power generation), are seeing greater uptake as they have both a proven track record in construction as well as strong environmental credentials by diverting waste from landfill and preserving our quarried resources.

One such aggregate that uses secondary materials to create a high-quality product is Lytag. First manufactured in the 1960s, long before sustainability was a focus, it is made by sintering PFA to produce a strong but lightweight aggregate. When used in concrete, it provides the same structural integrity as traditional aggregate but is around 25% lighter. Such a characteristic helps reduce the weight of concrete, an issue that has caused designers to compromise their ideas because of the dead weight.

Lightweight aggregate concrete

Lytag can be used in a range of concrete applications. Known as a lightweight aggregate concrete (LWAC), it is not just confined to the commodity market. Indeed, with the use of suitable lightweight aggregates (LWA) and good mix design technology, all types of concrete may be produced successfully. Structural LWAC with oven-dry densities of the order of 1750kg/m³, and strengths exceeding 70MPa, are achievable using lightweight coarse aggregate and natural sand.

Advances in admixture technology, along with tailored aggregate gradings, have made it possible to increase the range of concretes available. It is fairly straightforward to produce pumpable and self-compacting LWAC, using both coarse and fine lightweight aggregate, with oven-dry densities in the region of 1450kg/m³ and strengths in excess of 40MPa. As a result, with both coarse and fine lightweight aggregates, even greater weight reductions of around 35% can be achieved.

LWAC is a widely accepted alternative to normal-weight concrete (NWC) with design requirements included in BS 8110⁽¹⁾ *Structural use of concrete*. Also, BS EN 206⁽²⁾, the European concrete Standard and the complementary British Standard, BS 8500⁽³⁾, contain references for the specification of LWAC.

As well as concrete, Lytag can be used as a screed to reduce weight loading on structural slabs significantly. By combining Lytag aggregate with cement and water a no-fines mix can be produced, which can be laid down to a depth of 25mm. It is also advantageous when thicker sections are required (perhaps on a roof where falls are to be formed) in keeping weight to a minimum. The open texture of the Lytag no-fines then requires a thin topping of traditional sand:cement to produce the smooth finish required for thin flooring materials. Lytag no-fines screeds or bonded fills reduce weight by around 50% over traditional sand:cement screeds, with densities in the region of 1100kg/m³ and strengths ranging from 6 to 10MPa.

Using LWAC

At Heathrow's Terminal 5, BAA contractor Vetter UK – a subsidiary of Laing O'Rourke – specified LWAC floor screed as opposed to traditional screed to minimise the weight on the upper floor, which was a key consideration when working over such a large area.

Lytag floor screed was chosen for both the main termi-

Figures 1 below and 2 opposite: The use of Lytag in the construction of Heathrow T5.



(Photos: Lytag Ltd.)



nal (126,000m²) and also for the first of two smaller satellite buildings (25,000m²), the second of which will be constructed by 2011. Two different types of Lytag screed were specified: a structural lightweight concrete screed for the back-of-house handling areas; and no-fines for the passenger facilities. The no-fines screed and the structural concrete screed were supplied by London Concrete's Heathrow plant.

The no-fines Lytag screed was laid to a thickness of 85mm with a 20mm topping of sand:cement screed. After some initial experimenting in pumping the no-fines screed in the quantities required to progress the contract, a Putzmeister pneumatic screed pump was used. Vetter UK was impressed with how well the structural concrete screed pumped through a mobile concrete pump and the quality of the finish achieved. The lightweight concrete screed was power-floated and although Vetter UK were warned they may get the lighter material 'pimpling' on the top, the mix and finish were perfect.

In the handling areas, the structural screed was the final finish for the floor and therefore it needed to have the structural integrity to be able to ensure that regular vehicle traffic could be accommodated without damage to the surface. Lytag lightweight concrete offered the same strength as traditional concrete but was around 25% lighter, so it could be easily incorporated within the structure, minimising the additional loading to the building.

Construction on Terminal 5 brought together modern construction techniques as well as sustainability, and minimising environmental impact of the new terminal was a vital component in the planning and management of the entire project. Using sustainable materials was one method that helped deliver this important element.

At Wimbledon Centre Court, LWAC was used in the precast units that would add a further six rows of seating on

the east, north and west sides of the 13,000-seat stadium. Galliford Try, the contractor appointed by the All England Lawn Tennis Club, specified Lytag concrete as it was possible to produce units that were around 25% lighter than would have been achievable using NWC. This meant that the contractors did not need to undertake support work to the existing surrounding structure. As a result, the overall weight of the extension, which also covered the press boxes, media office, changing rooms and committee rooms situated below, was significantly reduced.

Concluding remarks

LWAC has been extensively used throughout the construction industry for decades and has proven its worth as a high-quality material that can reduce the weight of concrete. As a result, architects, specifiers, engineers and contractors have had the flexibility to deliver structures that would otherwise have required compromise without the use of lightweight materials. As sustainability becomes a fundamental of all areas of construction, the fact that these materials have such a strong track record will mean greater uptake, helping to improve the construction industry's overall environmental footprint. ■

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References:

1. BRITISH STANDARDS INSTITUTION, BS 8110. *Structural use of concrete. Part 1: Code of practice for design and construction*. BSI, 1997.
2. BRITISH STANDARDS INSTITUTION, BS EN 206. *Concrete. Specification, performance, production and conformity*. BSI, 2000.
3. BRITISH STANDARDS INSTITUTION, BS 8500. *Concrete. Complementary British Standard to BS EN 206-1*. BSI, 2002.