

Greener Concrete – delivering design flexibility and greater sustainability



View of City of London and Swiss Re Tower



As the sustainability agenda rises to the top of the construction industry's priority list, it is imperative when building tall that design innovation is not compromised. Gareth Moores, Executive Chairman of Lytag Ltd, explores how innovative designs and sustainability can walk hand in hand.

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Gareth Moores is Executive Chairman of Lytag Ltd - a leading supplier of secondary aggregate. Over the last 20 years, Gareth has worked with some of the world's biggest players including CEMEX and Lafarge and has developed a wealth of experience and knowledge about the use of lightweight concrete in building tall, having worked on high profile tall building projects including the Gherkin and Canary Wharf.

Of the 100 tallest buildings in the world, almost a third have been completed in the last five years – clearly showing the direction in which urban construction is heading. Space for both commercial and residential developments is already at a premium in cities all over the globe, and as the population of urban areas grows apace, the competition for space to live and work is set to increase. Buildings are reaching new heights: when completed the Mile High Tower in Saudi Arabia will be the height of four Empire State Buildings. But even as building tall becomes the norm, the concept is not without controversy. Debate over the impact of skyscrapers on our environment is especially pronounced in London, where the flurry of tall buildings constructed has caused some high-profile figures including the Prince of Wales to lament the changes to the London skyline. But despite the negative media coverage, the skyscraper phenomenon is growing in terms of number, innovation and height.

Meeting Expectations and Requirements

Much is expected of tall buildings by today's clients and occupants, and even more will be demanded by those of tomorrow. Floor space must be optimised; buildings must offer the finest level of purpose-specific performance and create innovative and original designs that capture people's imagination. They must reflect the values and needs of the occupant in order to stay ahead of the competition. At the same time, the environment has become a priority for the construction industry, driven in part by targets and legislation put in place by Governments worldwide. Industry response has been positive and is becoming increasingly global – the first international standard for sustainable construction has recently been launched by the International Organisation for Standardisation, allowing the industry to judge performance against an international benchmark. But with such

separate aims, requirements for innovative design and for sustainability can appear contradictory – are there approaches that can satisfy both demands in a congruent and feasible way?

Concrete

For architects and engineers designing tall buildings, material choice is a key opportunity to tick the sustainability box and simultaneously open up design possibilities. Concrete is one material where a number of options are available. The versatility, durability and cost-effectiveness of the material make it a key component in today's built environment and building tall is no exception. Sears Tower in Chicago (442 metres tall) contains enough concrete to build an eight-lane highway five miles long, and the World Trade Centre (built 1970-1) used enough concrete to build a sidewalk five feet wide from New York City to Washington, a distance of 204 miles. As such a fundamental component in construction, choosing the appropriate concrete to suit a project's requirements represents a prime opportunity towards meeting the design and sustainability challenges faced when building tall.

Lightweight Aggregate (LWA)

One option is to use LWA in concrete in the place of traditional aggregate. This can open up design possibilities by overcoming restrictions caused by concrete's dead weight, and choosing LWA made from secondary material can also help a project to meet requirements for more sustainable construction. LWA is well known for use in a variety of construction applications such as screeds, fills, and in structural concrete, and provides architects, engineers and contractors with the flexibility to deliver structures that would be unachievable or require design or time scale compromises with heavier material.

Using lightweight aggregate in concrete makes significantly lighter material than that made with traditional aggregate – for example, using LYTAG makes a lightweight concrete

approximately 25 per cent lighter but with the same structural integrity. Greater spans can be designed, and the number and width of columns can be reduced because the lighter floors need less support – building owners and occupiers can enjoy maximised usable floor space, additional square footage that can be of great commercial value. In terms of construction, time and labour savings are considerable thanks to the weight reduction.

Whilst benefiting the construction process, the sustainability advantages of using secondary aggregates are also crucial importance as concern for the environment grows.

Secondary aggregate avoids the quarrying of natural materials and can be made from a variety of materials including colliery spoil, china clay waste, and power station ashes. LYTAG, as an example, is manufactured by sintering pulverised fuel ash, the by-product of coal fired power stations. As a result using the material reduces demand on natural aggregate and also diverts waste from landfill, a particular focus for making construction more sustainable. In the UK, for example, the Government has introduced a target of halving the amount of construction, demolition & excavation waste currently sent to landfill by 2012, and materials efficiency is a key approach to achieving this. For example, one stipulation in the 2012 Olympic development is that 25 per cent of aggregates must be recycled.

Swiss RE

Using lightweight aggregate in concrete is a proven practice – LYTAG has been in use for more than forty years – and many high profile buildings have benefited from the performance and sustainability advantages of using the material. One example is the Gherkin, which was opened in London in 2004. Developed by Swiss Re and designed by architect Norman Foster of Foster and Partners, the 40-storey building has been designed to appear less bulky than other buildings of a comparable size. Using the lightweight aggregate not only enabled the distinctive tapered shape of the building to be

structurally feasible, but also boosted the sustainability credentials of the project, which specified recycled materials whenever possible. The structural concrete in the 180 metre high tower was made using 4-12mm LYTAG coarse aggregate (now 4/14mm), and 4/8mm LYTAG was used for no fines screeds.

For the Gherkin, and many other of the structural projects LYTAG has been used in such as those at Canary Wharf, choosing the material has played a major part in helping the building to meet design and environmental objectives. It is the lightweight qualities of the secondary aggregate, coupled with the additional performance benefits the material offers – such as improved thermal and insulation properties – that enable the construction teams to reach both design and sustainability aims.

Of course, it's not just the choice of materials that are going to help a building be determined as sustainable. Energy efficiency, for example, is now one of the key performance indicators of a project, especially with this year's introduction of energy performance certificates. However, it does play an important part in improving sustainability.

The versatility and sustainability of materials are both important factors in tall building construction, particularly as the expectation for more innovative designs and taller structures is coupled with greater demand for 'greener' buildings. Using concrete made with lightweight, secondary aggregate can be a quick win in terms of making a build more sustainable, whilst also offering opportunities for design and engineering that can take building tall forward in delivering innovation and performance.