



Technical Manual – Section 6

Lyttag[®] LWAC in Steel Decking and Composite Floors

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Introduction

Composite slabs consist of profiled steel decking with an in-situ reinforced concrete topping. The decking not only acts as permanent formwork to the concrete, but also provides sufficient shear bond with the concrete so that, when the concrete has gained strength, the two materials act together compositely. The composite interaction is achieved by the attachment of shear connectors to the top flange of the beam. The shear connectors provide sufficient longitudinal shear connection between the beam and the concrete so that they act together structurally. Composite slabs and beams are commonly used in the commercial, industrial, leisure, health and residential building sectors due to the speed of construction and general structural economy that can be achieved. Composite slabs may be used in steel framed buildings or supported off masonry or concrete components.

Using Lytag[®] lightweight aggregate concrete (LWAC) can increase the benefits of using steel decking for composite floor construction.

Benefits of Composite Construction

The main benefits of composite construction are:

Speed of construction

Bundles of decking can be positioned on the structure by crane and the individual sheets then installed by hand. Minimal reinforcement is required, and large areas of concrete floor can be poured quickly.

Safe method of construction

The decking can provide a safe working platform and act as a safety 'canopy' to protect workers below from falling objects.

Saving in weight

Composite construction is considerably stiffer and stronger than many other floor systems. Using steel decking along with Lytag lightweight aggregate concrete (LWAC) can significantly reduce the weight and size of the primary structure. Longer spans can be achieved when combining steel decking and LWAC. Consequently, foundation sizes can also be reduced.

Shallower construction

The stiffness and bending resistance of composite beams means that shallower floors can be achieved than in non-composite construction. This may lead to smaller storey heights, more room to accommodate services in a limited ceiling to floor zone, or more storeys for the same overall height. This is especially true for slim floor construction, whereby the beam depth is contained within the slab depth. Lytag LWAC can further assist in this benefit.



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Fire resistance

The floor thickness can be reduced compared to normal weight concrete for a given fire rating. Lytag LWAC does not spall and provides improved fire insulation.

Sustainability

Lytag lightweight aggregate is manufactured from a waste product, pfa from coal fired power stations, reducing the need for landfill and natural aggregate extraction. The LWAC can be recycled and the end of its life. The steel component has the ability to be recycled repeatedly without reducing its inherent properties.

Design of Composite Flooring

There are three key areas to be considered when designing composite flooring:

Strength of the Completed Floor

The main steel decking manufacturers all include lightweight aggregate concrete within their design recommendations. Generally this includes details of benefits in span lengths and floor thicknesses.

Strength of the Decking When the Concrete is Being Placed

One of the main advantages of composite beam/slab construction is that smaller section beams can be used. However, when the concrete is wet the steel deck must carry the weight of the floor and construction traffic. The most severe loading often occurs during construction. (Reference should be made to BS 5950: Part 4: Section 5). When using Lytag LWAC of the same thickness as normal weight concrete, unpropped spans can usually be 10-15% greater. In practice Lytag® LWAC slabs are invariably of a thinner section so unpropped spans can be increased even further.

Fire Performance

The three main requirements of a floor construction in fire performance tests are structural stability, integrity and insulation.

Lytag LWA is manufactured at temperatures around 1100oC. It therefore shows improved fire resistance compared to normal weight aggregates.

Material properties for lightweight concrete are given in BS EN 1994-1-2, Eurocode 4: Design of composite steel and concrete structures – General rules

- Structural fire design. This suggests that a further 10% reduction in slab depth is permitted for light weight concrete slabs (compared to normal weight concrete slabs) because of the better insulating properties of the aggregate.

Lytag LWAC has a significantly lower thermal conductivity than that of normal weight concrete and has no tendency to spall.



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General properties

For a complete list of properties for Lytag LWAC see Section 4 of the Lytag Technical Manual. Set out below is two key factors that should be considered in design.

Density

Lytag LWA and natural fine aggregate concrete is around 25% lighter than normal weight concrete and the strength to weight ratio is improved by about 33%.

Thermal Insulation

The thermal conductivity value of Lytag LWAC is about one third to one half that of normal weight concrete and therefore insulation requirements are easier to achieve.

For other aspects of structural design reference should be made to appropriate British Standards or Eurocodes e.g. BS EN 1994-1-1 Eurocode 4 Design of composite steel and concrete structures.

Construction

Bay Sizes

Bay sizes up to 3,000 m² have been cast in one operation. Factors contributing to larger bay size construction include:

- Thermal movement due to heat of hydration is reduced due to the lower coefficient of expansion of Lytag LWAC.
- Early drying shrinkage is reduced.
- Tensile strain capacity is higher
- The elastic modulus is lower.

Curing

The water absorbed into the cellular structure of the Lytag LWA during batching is a positive aid to curing. This considerably reduces the risk of shrinkage cracking and improves long term strength and durability. It should not however be used as an alternative to good curing practice.

Cracking

Lytag LWAC has a high tensile strain capacity which gives excellent resistance to cracking as well as explosive/seismic loading.

Propping

Longer unpropped spans associated with reduced dead load can reduce temporary works requirements.



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Fixings

The rigidity and load bearing capacity of fixings in Lytag LWAC is similar to that obtained in normal weight concrete. Drilling and cutting is easier with less wear on tools due to the physical properties of the Lytag LWA pellets. Test certificates are available from most fixings manufacturers

Power Floating and Trowelling

Lytag LWAC is often direct finished and apart from normal considerations regarding timing and ambient conditions no special measures are necessary.

Additional Features

- Thinner slabs result in reduced concrete volumes
- Floor to floor heights can be kept to a minimum
- Steel decking provides a safe working platform
- External scaffolding is not necessary
- Concreting can proceed on successive floors simultaneously
- Reinforcement is normally mesh and is easy and quick to install
- Additional holes are easy to form
- With permanent metal stop ends joinery is kept to a minimum
- Cranage is kept to a minimum
- The finished floor acts as a continuous firebreak and if it is fully tied to the framework will act as a brace for wind loads



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Steel deck manufacturers

The principal UK steel deck manufacturers are listed below and have all carried out test work with Lytag LWAC:

Richard Lees Steel Decking Ltd.
Moor Farm Road West, The Airfield, Ashbourne, Derbyshire,
DE6 1HD
Tel +44 (0)1335 300999 Fax +44 (0)1335 300888
www.rlsd.com
e-mail rsls.decks@skanska.co.uk

Holorib, Ribdeck AL, Ribdeck E60, Ribdeck 80 and Ribdeck 210

Corus Panels and Profiles,
Severn Drive,
Tewkesbury Business Park, Tewkesbury, Gloucestershire,
GL20 8XT
Tel +44 (0) 845 30 88 330 Fax +44 (0) 845 30 11 013
www.corusconstruction.com/en/products/floors/ e-mail technical@ coruspanelsandprofiles.co.uk
e-mail sales@ coruspanelsandprofiles.co.uk

C46, CF51, CF70, CF100, CF210 and SD225

Structural Metal Decks Ltd,
The Outlook Ling Road Tower Park Poole Dorset BH12 4PY
tel 01202 718898 fax 01202 714980
www.smdltd.co.uk
e-mail contactus@smdltd.co.uk R51, TR60 and TR80



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Shear stud and installation equipment Nelson Stud Welding UK Limited
Rabans Lane Industrial Estate Aylesbury HP 19 8TE U.K.
Tel 44.(0) 1296.435142 Fax 44.(0) 1296.487532

C S W Coldform Ltd.
Valley Way
Welland Industrial Estate Market Harborough Leicestershire
LE16 7PS
Tel +44 (0) 1858 410600 Fax: +44(0) 1858 466536

Cutlass Fasteners, Ltd., Old Boston Trading Estate, Penny Lane, Haydock, Lancs. WA11 9SS UK
Tel +44 (0) 1942 712387 Fax +44 (0) 1942 722306

REFERENCES

BS 5950-4:1994 Structural use of steelwork in building. Code of practice for design of composite slabs with profiled steel sheeting

BS EN 1994-1-2 2005 Eurocode 4: Design of composite steel and concrete structures – General rules – Structural fire design

Lyttag Technical Manual – Section 4 Design Guidance for Lytag® LWAC

BS EN 1994-1-1 2004 Eurocode 4. Design of composite steel and concrete structures. General rules and rules for buildings



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