

GD 12 COMPOSITE FLOORING SYSTEMS: SUSTAINABLE CONSTRUCTION SOLUTIONS

The purpose of this guidance document is to explain the need for sustainable development and to set out the contribution that composite flooring systems can make in the provision of more sustainable buildings.

WHAT IS COMPOSITE FLOOR CONSTRUCTION?

Composite floors comprise slabs and beams acting compositely together.

Composite slabs consist of profiled steel decking working together with in-situ reinforced concrete. The decking not only acts as permanent formwork to the concrete, but also provides sufficient shear bond with the concrete, so that the two materials act compositely together. Although principally for use with steel frames, composite slabs can also be supported on brick, masonry or concrete components.

Composite floor beams are hot-rolled steel sections that act compositely with the slab. Composite action is normally achieved by welding shear studs through the steel decking and onto the top of the beams before pouring the concrete. The shear connectors provide sufficient longitudinal shear connection between the beam and the cured concrete so that they act together compositely.

Together composite slabs and beams produce structurally and resource efficient flooring systems for a range of applications.



Profiled steel decking prior to concrete pour

WHAT ARE COMPOSITE FLOORS USED FOR?

Composite slabs have traditionally found their greatest application in steel-framed office buildings but they are also appropriate for the following types of buildings:

- commercial buildings
- industrial buildings and warehouses
- leisure buildings
- stadia
- hospitals
- schools
- cinemas
- housing
- car parks
- refurbishment projects

WHAT IS SUSTAINABLE DEVELOPMENT?

Since the Earth first industrialised in the 18th century, little thought has been given to conserving non-renewable resources or limiting damage to the environment as we have striven for greater productivity and increased profits.

Sustainable development recognises that this approach is *not* sustainable and endeavours to ensure a better quality of life for everyone, now and for generations to come, by managing social, environmental and economic considerations in a balanced way.

The UK government defines sustainable development [1] as:

- maintenance of high and stable levels of economic growth and employment
- social progress which recognises the needs of everyone
- effective protection of the environment
- prudent use of resources

WHERE IS THE EVIDENCE?

There is growing evidence that mankind is having a detrimental impact on our planet and its finite resources:

- Global population is currently doubling every 40 years and material consumption is doubling every 20 years. To sustain global population and consumption at current levels, it is estimated that we require 2.5 planet Earths!
- There is widespread evidence of the effects of global warming. The 1990s was the warmest decade since records began, 1998 was the warmest year on record, just beating 2001 into second place. The leading scientific authority on climate change, the IPCC, has concluded that 'most of the observed warming over the last 50 years is due to greenhouse gas emissions due to human activities' [2].

SUSTAINABLE CONSTRUCTION

Construction has an important role to play in delivering sustainable development because of both its contribution to the UK economy (8 percent of GDP), and the significant environmental and social impacts that buildings and other structures can have.

The impacts of the UK construction industry include:

- production and operation of buildings accounts for around 50 percent of the UK's total energy consumption
- the construction industry consumes more than 420 million tonnes of materials every year
- construction and demolition generate some 70 million tonnes every year

THE DRIVERS FOR MORE SUSTAINABLE CONSTRUCTION

Government strategy is to encourage all sectors of industry to adopt more sustainable policies and practices voluntarily. This encouragement comes with the implicit warning that failure to do so will result in legislation, in the form of regulations and fiscal measures. Examples already influencing construction industry practice include:

- tightening of the thermal performance requirements in the Building Regulations [3]
- the Landfill Tax
- the Primary Aggregates Tax
- the Climate Change Levy

At the European level also, there is a growing raft of EU legislation impacting the construction industry. Relevant examples include:

- Construction Products Directive (89/106/EC) which provides for common methods of performance evaluation of products across the EEA
- Landfill Directive (99/31/EC) which bans co-disposal of wastes and bans or restricts landfilling of other waste streams
- EC Regulation No 2037/2000 on ozone depleting substances
- Incineration Directive (2000/76/EC) which sets emission controls on incineration plants
- Directive on the energy performance of buildings (2002/91/EC)

THE BENEFITS OF SUSTAINABLE CONSTRUCTION

A sustainable business is a well-run, efficient and profitable enterprise; its long-term viability relies upon its relationships with all off its stakeholders. Whether investors, owners, suppliers, employees or customers, the aspirations of all stakeholder groups need to be understood and balanced to ensure the long-term success of an organisation.

Companies that do not comply with relevant environmental legislation or change their business practices to minimise the impact of related fiscal measures will find it increasingly difficult to survive, let alone prosper!

Business benefits of becoming more sustainable include:

- avoidance of reputational damage and risk
- avoidance of legal risks and penalties
- cost savings through greater material efficiency
- reduced energy and Climate Change Levy costs
- improved investment rating
- competitive advantage

STEEL CONSTRUCTION SECTOR'S SUSTAINABLE DEVELOPMENT STRATEGY

In December 2002, the steel construction sector formally launched its sustainable development strategy.

Developed by Tata, the Steel Construction Institute (SCI) and the British Constructional Steelwork Association (BCSA), in consultation with all parts of the sector, the strategy reviews progress made in moving towards sustainability and sets out the agenda for a more sustainable future. The MCRMA and its members contributed to the development of the strategy, subscribe to its goals and are supporting its implementation. Key messages of the strategy are shown below.

KEY MESSAGES

A review of the steel construction sector's current position has demonstrated that:

- Steel construction is efficient, competitive and makes a significant contribution to the national economy.
- Buildings can be rapidly constructed using steel-based components that are efficiently manufactured off-site and therefore are of high quality and with few defects.
- Steel framing and cladding systems provide the scope, in association with other materials, to design buildings with low overall environmental impacts.
- Steel-based construction systems provide flexible spaces which have the potential to be easily modified and adapted so that the life of the building can be extended by accommodating changes in use, layout and size.
- Steel is 100 percent recyclable and can be recycled without degradation of properties. Surveys indicate that more than 90 percent of steel from construction is recovered for recycling or reuse.
- Off-site manufacture facilitates less itinerant working conditions that, in addition to being safer, promotes stability in the workplace, encourages skills development and fosters good local community relations.

THE WAY FORWARD

More remains to be done however and to move forward, the sector strategy outlines 25 new initiatives to support more sustainable construction. It also outlines the sector's long-term commitment to sustainability by outlining programmes of work to:

- improve supply chain engagement and reporting
- support the selection of responsible contractors
- encourage the adoption of environmental reporting
- support the development and acquisition of information required by the industry to enable informed decision-making
- evaluate progress and awareness and develop measurable targets.

The full version of the strategy can be downloaded from the websites hosted by Tata Steel, SCI and BCSA at:

www.tatasteelconstruction.com

www.steelbiz.org

www.steelconstruction.org

SUSTAINABILITY BENEFITS OF COMPOSITE FLOOR CONSTRUCTION

Composite flooring systems offer clients and designers a number of benefits which address the social, environmental and economic dimensions of sustainable construction.

Speed of construction

Composite flooring systems facilitate fast-track construction; up to 400 square metres of decking can be installed by one team in a day! Speed, simplicity of design and affinity for steel-framed buildings make composite floors the system of choice where time, and hence speed of construction, are key drivers.

Steel decking can be ordered 'off-the-peg' and delivered to order, efficiently stacked on lorries that can carry many square metres of decking in a single load.

Rapid construction minimises plant hire costs, in particular craneage. The use of the decking as a safe working platform during construction speeds up the work of other and follow-on trades and offers logistical benefits on congested sites. The minimal steel reinforcement required can be fixed quickly and large areas of floor poured using pumped concrete.

By shortening the construction programme, the impacts on neighbours and the public within the vicinity of the construction site, such as noise, dust and traffic congestion are minimised.



Efficient transportation of steel decking to the construction site

Resource efficiency

Composite flooring systems are structurally efficient, thereby minimising the resources used in constructing the building (particularly concrete) and reducing the waste generated when it is necessary to deconstruct it. Less concrete means fewer site deliveries and less localised traffic congestion.

Composite floor systems are stiffer, stronger and lighter than many other floor systems. This means that the weight and size of the primary structure and the foundations can often be reduced; again, minimising resource consumption and end-of-life waste generation.

Economic benefits

The benefits of fast construction and resource efficiency translate directly into economic benefits to the client. In prestigious city centre locations attracting high rents, fast construction means that developers can start earning rents sooner; often a significant barrier to financing new developments.

Using resources carefully through 'smart' design not only preserves resources and has positive environmental benefits but can also save money!

HEALTH AND SAFETY

Composite flooring has several health and safety benefits, both in the factory during production and on site, during construction:

- decking is manufactured under factory conditions that provide a much safer and less hostile working environment than the construction site
- steel decking provides a safe working platform for workers on that floor and protects workers below from falling objects
- steel decking can be efficiently stacked in bundles, minimising site storage and easing access and movement around the construction site.

OFF-SITE MANUFACTURE

Composite steel decking is manufactured from coils of hot-dipped galvanised steel sheet. The coil, which is typically only 0.7 to 1.25mm thick, is split to the required width, cold, roll-formed to the required profile and cut to length as specified by the designer.

The fully automated process is fast and efficient producing decking with very few defects. Consequently, steel wastage is minimal (typically only 1-2 percent) and is 100 percent recycled into new steel products. There are no emissions to air or water.



Safe and efficient production of decking under factory conditions

Factory working facilitates accurate and quality workmanship, and also reduces dependence on itinerant site workers, so fostering the development of family life and local community relationships and encouraging staff development and retention.

FABRIC THERMAL STORAGE

In multi-storey, commercial office buildings, cooling is often the most significant operational energy use. Fabric energy storage, or thermal capacity, is a measure of the amount of energy that the structure of a building can absorb. Excess heat energy stored in the building fabric during the day is removed by overnight cooling, for example by blowing cool night air over the flooring system.

Research undertaken by Oxford Brookes University [4] has dispelled the myth that 'heavy' buildings are required to achieve high levels of fabric energy storage and proved that relatively light steel frames, and associated composite or other types of floor slab, are able to provide high levels of fabric energy storage. Furthermore, because they minimise material use, they offer other positive environmental benefits.

FLEXIBILITY AND ADAPTABILITY

By extending the life of buildings greater value is extracted from the materials used to construction them. Composite construction, in particular when used with long-spanning steel frames, can create large, open and flexible spaces which can accommodate changes of use in response to the changing needs of the building owner or occupier.

END-OF-LIFE

Steel can be recycled again and again without degradation in terms of its properties or performance. The recovery rate of steel construction products from UK demolition sites is more than 90 percent [5]. An established, international infrastructure ensures that scrap steel is efficiently and economically recovered, traded and recycled.

WHAT YOU CAN DO

Below are eight guiding principles to implement more sustainable construction:

- Understand what sustainable development means for you, your clients and your customers.
- Use whole life thinking, best value considerations and high-quality information to inform your decision-making.
- Design to minimise operational environmental impacts.
- Where possible, extend the life of buildings by renovation and refurbishment.
- Design for flexibility, to extend building lifetimes.
- Use products and materials that can be easily and efficiently recycled.
- Engage organisations within your supply chain about sustainable development.
- Select responsible contractors who have embraced sustainable development principles.

REFERENCES

- 1 A Better Quality of Life: The Strategy for Sustainable Development for the UK. Department of the Environment, Transport and Regions. 1999.
- 2 Climate Change 2001: The Scientific Basis. The Intergovernmental Panel on Climate Change.
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- 4 Ogden, R and Kendrick, C (1997) Thermal capacity of steel-framed buildings. The Steel Construction Institute.
- 5 Ley, J., Sansom, M. and Kwan, A. (2002): Material flow analysis of the UK steel construction sector. Conference proceedings from steel in sustainable construction: IISI World Conference 2002, Luxembourg.

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Tel: 01633 895633 info@mcrma.co.uk www.mcrma.co.uk

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