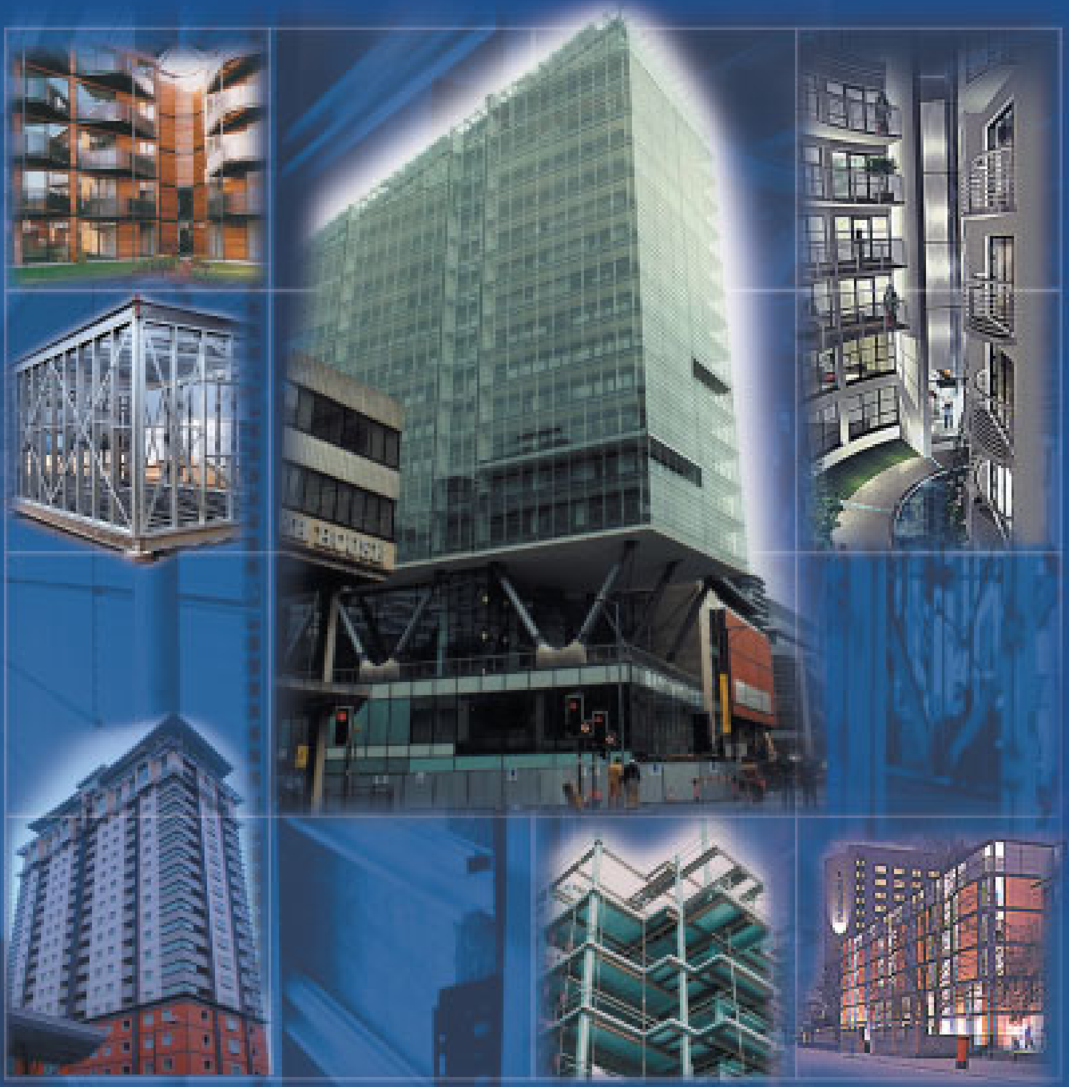
Better Value in Steel

Multi-storey Residential Buildings using Steel

Steel technologies to meet new housing demands



The Steel Construction Institute

Buildings

Case Examples

MODULAR CONSTRUCTION

Student Residence, Manchester

The Royal Northern College of Music commissioned Jarvis Construction to build a 9-storey, 1,000 bedroom student residence on the Oxford Road site, Manchester. The client wished to have the building ready at the start of the academic year. Construction took less than ten months, which was only possible using modular construction.

The light steel modules were manufactured by Ayrshire Steel Framing and were fully fitted out by Caledonian Ltd before delivery to site. An average installation rate of six modules per day was achieved.

The access cores were constructed in hot rolled steel.

MIXED MODULAR AND LIGHT STEEL CONSTRUCTION

Apartments in Fulham, London

A 6-storey mixed modular and light steel structure has been constructed at Lillie Road, Fulham for the Peabody Trust, by Forge Llewellyn. It consists of 40 prefabricated light steel floor and bathroom modules, together with a tubular steel structure to provide stability.

Architects Feilden Clegg Bradley were keen to use lightweight prefabricated construction for this former school site because of its dramatically reduced impact on the locality during the construction process.

MIXED MODULAR AND COMPOSITE CONSTRUCTION

Residential and Commercial Development, Manchester

A total of 1,425 modules in light steel framing was installed on the Wilmslow Park site of Manchester University to create the largest modular building in the UK. The Architects for the module supplier, The Design Büro, designed this 7-storey modular building on a steel-composite 'podium' structure to house retail premises and a car park below ground. Modular construction allowed the building to be constructed rapidly and did not overload the podium structure.

This 'mixed' residential-commercial development also incorporates retail outlets, a health club, 130 key worker apartments (for rent) and six rooms for people with disabilities.

MODULAR CONSTRUCTION

Social Housing, London

Architects Cartwright Pickard, and the Peabody Trust pioneered the use of modular construction in the award winning Murray Grove social housing project (above) at Hackney, London.

The 5-storey building was constructed using 3.2 m wide modules supplied by Yorkon, with steel access walkways, balconies and access cores attached later. The building was constructed in only 40% of the time of a conventional building. Quality was ensured by off-site prefabrication.

The Raines Court project (right) by architects Allford Hall Monaghan Morris has extended the concept further by integrating balconies into the modules.

Value Benefits of Steel Construction

The benefits of 'fast track' steel construction are well understood in the commercial building sector and the same technology may be readily extended to multi-storey residential buildings in urban locations.

The financial and other performance benefits are:

SPEED OF CONSTRUCTION

All steel construction uses pre-fabricated components that are rapidly installed on site. In multi-storey buildings, construction periods can be reduced by at least 20%, in comparison to concrete construction, leading to:

- Savings in site preliminaries.
- Earlier return on investment.
- Reduced interest charges.

Time-related savings can easily amount to 2 to 3% of the overall project value. Importantly, in major residential building projects, the pre-sale of show apartments reduces the developer's working capital and cash flow.

REDUCED DISRUPTION TO THE LOCALITY

In inner city locations, it is important to reduce the disruption to the nearby buildings and roads by:

- Timing deliveries to site to suit traffic conditions.
- Reducing materials use and waste creation.
- Minimising noise and dust.
- Reducing the construction period.

Steel construction, especially highly pre-fabricated systems, dramatically reduce the impact of the construction operation on the locality.

FLEXIBILITY AND ADAPTABILITY

Steel construction provides long spans in which the space can be arranged to suit different layouts of apartments. *Slimflor*® and *Slimdek*® construction provide a flat soffit with complete flexibility of layout. All internal walls can be relocated, leading to fully adaptable buildings.

Modular construction achieves adaptability by being able to extend or modify buildings easily, as future demand changes. The modules are all potentially relocatable, although designed as part of permanent buildings.

QUALITY

Off-site prefabrication improves quality by factory-controlled production, and is less dependent on site trades and the weather. Also, steel does not suffer from creep or shrinkage and does not rot or decay if properly protected. 'Call-backs' are largely eliminated. Modular construction, where all the fit-out is done in the factory, achieves high levels of quality and reliability.

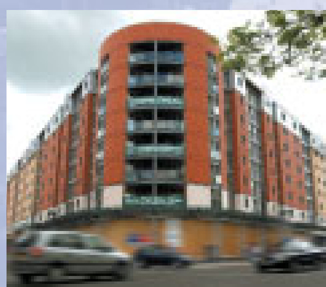
ENVIRONMENTAL BENEFITS

All steel construction is produced efficiently, and waste is minimised and recycled. Steel is potentially reusable and up to 40% of current steel production is from scrap. The faster construction process also reduces environmental impact.

8-storey light steel Metframe construction. This minimises the load on the underlying Brunel railway tunnel, Rotherhithe.

Steel frame before cladding on 4 and 6-storey development, Penarth Marina.

15-storey residential student block using Slimdek®, Portsmouth.



7-storey, residential student block Manchester in mixed composite and modular construction.

The design of residential buildings using various steel technologies is covered by SCI and Corus publications. The particular issues that are relevant to the choice of construction technology and compliance with the Building Regulations are:

Acoustic insulation

To meet Part E of the current Building Regulations, separating walls and floors are required to achieve an airborne sound reduction of over 52dB ($D_{nT,w}$). The 2003 Regulations now introduce a correction factor for low frequency sound. Satisfactory performance can be achieved by one of two approaches: either by mass with additional resilient layers, which is achieved by composite floors, or by multiple layers of boarding and additional insulation, which is appropriate for lightweight construction.

Composite floors and *Slimdek*® have achieved the status of Robust Standard Details to meet Part E of the Regulations, based on their excellent performance in on-site tests (see table, right).

To meet requirements for impact sound insulation, a battened floor, or screeded floor on a resilient layer is required. Double layer light steel separating walls are also accepted as Robust Standard Details. Guidance is presented in several SCI publications (see sources of information).

Thermal insulation

The external walls and roof should satisfy the requirements of Part L of the Building Regulations in terms of thermal efficiency. In steel construction, this is achieved by 'warm frame' construction in which the majority of insulation is placed externally to the frame. A U value of 0.2 W/m²°C can be achieved by closed cell insulation in a 'warm frame' with supplementary mineral wool insulation between the light steel wall studs.

A variety of cladding materials may be used; brickwork, 'rain-screen' cladding, or insulated render, to create the desired architectural appearance.

Structure

Steel structures are stiff and highly robust to damage or impact. Long spans can be created, which lead to freedom of internal fit out and flexible use of space. Tests on composite structures after fit-out demonstrate excellent performance in-service. *Slimdek*® achieves a minimum structural depth of 300 mm and eliminates downstand beams. Rectangular or Square Hollow Section columns can be designed to fit in light steel separating walls.

Steel structures can be easily adapted or extended by connections to the steel elements.

Fire resistance

Fire resistance periods of 30 or 60 minutes are generally required in residential buildings. This is achieved by one or two layers of fire resisting board, which are also required for acoustic insulation purposes. In *Slimdek*®, the partially encased ASB beams do not require additional fire protection in residential buildings.

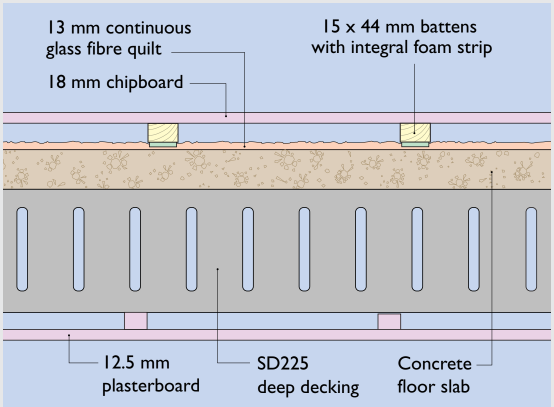
Installation

Steel construction is highly pre-fabricated and is installed by specialist companies. Deliveries can be timed 'just in time' to meet local conditions. Module sizes are limited by transportation and 4 m is the sensible maximum for most trunk roads. An installation rate of 6 to 10 modules a day can be achieved.

Acoustic test results for separating floors

	Airborne sound reduction		Impact sound transmission	
	$D_{nT,w}$	$D_{nT,w}+C_{tr}$	$L'_{nT,w}$	$L'_{nT,w}+C_i$
Current Building Regulations (mean)	≥52 dB		≤61 dB	
New Building Regulations 2003 (min)		≥45 dB		≤62 dB
Enhanced (*Quiet Homes*) Standard*		≥50 dB		≤57 dB
Measured - *Slimdek*® with battened floor	62 dB	54 dB	48 dB	49 dB
Measured - *Slimdek*® with screed on resilient layer	65 dB	56 dB	45 dB	
Measured - Composite slab with battened floor	67 dB	60 dB	34 dB	

* *Including spectrum adaptation terms*



Acoustic details for separating floor in Slimdek®

Light steel infill walls

Slimdek® eliminates the need for downstand beams

Typical light steel module being installed.

SUPPLIERS OF *SLIMDEK*®

Corus Construction and Industrial
PO Box 1, Scunthorpe, Lincolnshire
DN16 1BP
Tel: 01724 405060

LIGHT STEEL AND MODULAR MANUFACTURERS

Contact The Steel Construction Institute

SOURCES OF INFORMATION

SCI PUBLICATIONS

Building Design using Cold Formed Steel Sections: Residential Buildings in Light Steel Framing (P301)

Composite Slabs and Beams using Steel Decking: Best Practice for Design and Construction (P300)

Modular Construction using Light Steel Framing: Residential Buildings (P302)

Multi-storey Residential Buildings using *Slimdek*® (P310)

Value and Benefits Assessment of *Slimdek*® (P279)

Case Studies on *Slimdek*® (P309)

Design of Asymmetric *Slimflor* Beams using Deep Composite Decking (P175)

Rapid Dry Envelope (P283)

Composite Flooring (P285)

Acoustic Performance of Light Steel Framing (P320)

Acoustic Performance of *Slimdek*® (P321)

Acoustic Performance of Composite Floors (P322)

CORUS PUBLICATION

Slimdek® Manual

CASE STUDY INFORMATION

www.steel-sci.org/lightsteel

Publication P329

The Steel Construction Institute
Silwood Park, Ascot, Berkshire
SL5 7QN
United Kingdom
Tel: 01344 623345 Fax: 01344 622944