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Multi-Storey Residential Buildings using *Slimdek*®

The residential building sector now demands more efficient, adaptable and higher quality buildings. In addition, the Government has called for more building in inner city locations and on 'brown field' sites to meet the target of 4 million new homes in 15 years. These demands will require a new way of building to higher density without impacting on already congested inner cities.

Steel construction is well placed to meet these demands, especially in the urban environment, where the benefits of speed of construction can be realised. The Egan Report 'Rethinking Construction' called for a re-examination of all aspects of construction to improve quality, to encourage innovation, and to maximise off-site prefabrication.

Slimdek® was developed to provide a floor construction of minimum depth without downstand beams, which offers an important benefit in the residential sector. With *Slimdek*®, fire protection costs are largely eliminated because the ASB beams are partially encased in the slab.

Light steel infill walls may be used both internally and on the façade, and provide a lightweight, adaptable and 'rapid dry envelope'.

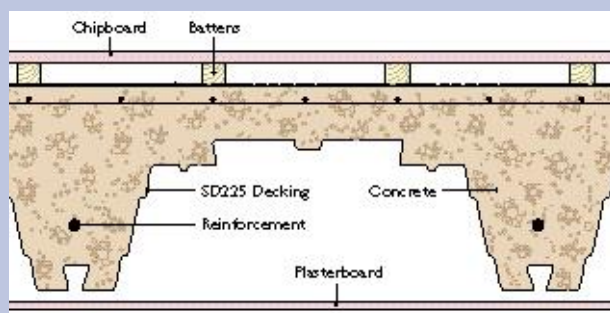


Slimdek® provides adaptable space by eliminating downstand beams

Slimdek® using deep decking

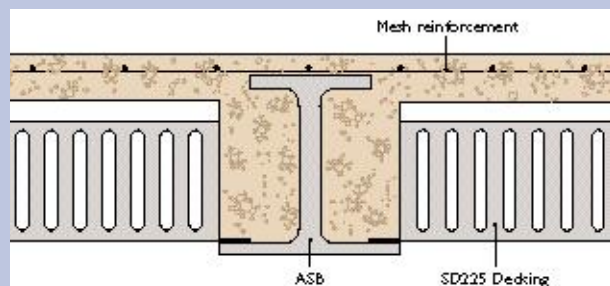
- Span range up to 9 m
- All building types
- Composite action without shear studs
- Shallow floor depth 300 to 350 mm
- Fire resistance 60 minutes (without protection)
- Acoustic insulation $D_{nT,w} \geq 60\text{dB}$

SD225 Decking



Cross-section through floor slab

ASB beam



Cross-section through beam

Light steel infill walls

- Floor to floor height 2.7 to 4 m
- Large window openings up to 2.4 m wide
- Self weight 0.5 to 0.8 kN/m²
- Separating and external walls
- Fire resistance 60 minutes (with board protection)
- Excellent acoustic insulation



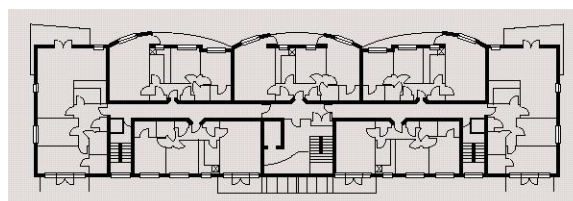
Case Examples of Residential Buildings using *Slimdek*[®]

Apartments at Penarth Marina

Three blocks of steel framed apartment buildings have been constructed by Bellway Homes, using *Slimdek*[®] next to the prestigious Penarth Marina, Cardiff. The blocks are 6 storeys high, with spans of 6 to 8 m. In all cases, the developer wished to have maximum flexibility of internal layout of the apartments, and to create large windows on the bay side (see layout of apartments, opposite).

The developer chose *Slimdek*[®] to eliminate downstand beams, which would reduce the flexibility of layout, and to reduce fire protection costs.

The time saving relative to conventional concrete construction was over 16 weeks, giving earlier return on the developer's investment.



Apartments at Portishead

Developer, Crest Nicholson, went through a Value Engineering exercise to demonstrate that *Slimdek*[®] was the best choice for the 6-storey apartment block on this brownfield site. The Corus Framing's *Surebuild* system was also used for the low-rise houses. The site (see left) at Portishead, Bristol is a complete regeneration of the former docks, and eventually will provide 2,000 new houses and apartments.

The self-weight of the construction was significantly less than a reinforced concrete solution, leading to savings in piling costs. Architecturally, the use of *Slimdek*[®] provided open column free bay windows, and gave complete flexibility of internal layout.

Student residence, Portsmouth

A 15-storey student residence was commissioned by developer, UNITE, to meet Portsmouth University's requirements for high quality student accommodation.

The building was opened in February 2002. A total of 328 bedrooms are provided. The shallow 2.7 m floor-floor height was achieved using *Slimdek*[®], and the space was designed to be retro-fitted in the future as a hotel or apartments.

The structure consists of 280 ASB 100 and 280 ASB 136 beams internally and 250 x 150 RHS for the edge beams. Floor spans ranged from 5 to 7.7 m. The steelwork and floors were completed in only 18 weeks out of the 60 week contract.

Modular bathrooms were manufactured by UNITE at their Bristol factory. A strict 'just in time' delivery to site was adopted because of the limited storage of materials on site, which was achieved by the *Slimdek*[®] system.



Publications

For SCI publications, please contact Publication Sales:

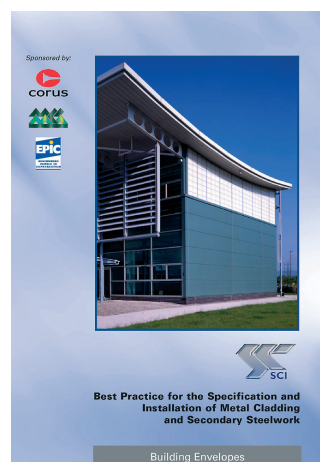
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Design energy efficient buildings that meet the needs of your clients

Changes to the Building Regulations, together with rising energy prices, have pushed energy efficiency to the top of the building client's agenda, with important implications for designers and contractors. These issues are addressed in two recent SCI publications, P346 and P347. These publications, which give guidance on the specification and installation of metal cladding systems and the procurement of single storey sheds respectively, are now available for a limited offer price of only £50 (+P&P).

Save nearly 50% (inc. P&P)



Best practice for the specification and installation of metal cladding and secondary steelwork

Cat Ref: P346

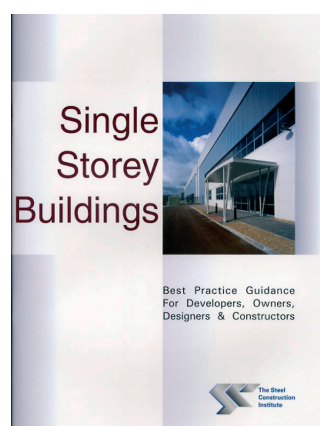
Author: M D Heywood

This publication promotes a greater understanding of the issues faced by the construction team during the specification and installation of metal cladding systems and insulated panels. It presents practical guidance that will enable the project team to deliver a building envelope that meets the demands

of the latest Building Regulations and creates an energy efficient and sustainable building. By explaining the issues faced by the architects, engineers and contractors that make up the construction team, this publication aims to promote better co-operation on site and in the design office, leading to an improved

quality of construction and better value for the client.

Although written with site practitioners in mind, much of the guidance should also be useful to architects and structural engineers involved in the specification of the building envelope and supporting structure.



Single Storey Buildings - Best practice guidance for developers, owners, designers and constructors

Cat Ref: P347

Author: Edited by G K Raven and M D Heywood

Experience shows that successful 'shed' construction relies on the interdependence of various parties in the supply chain. Rising client expectations, Health & Safety regulations and sustainability initiatives are all driving

improvements in this important market for steel construction, but the potential benefits to clients are not always being realised, due to supply chain fragmentation. This publication describes the interrelationships between the

players in the project team and explains how decisions made by one party can unwittingly have adverse impacts elsewhere along the supply chain.

Pub Ref	Full Price	Offer	P&P	
			UK	ROW
P346	£50	-		
P347	£40	-		
Total	£90	£50	Free	£12

Offer ends 30 May 2007

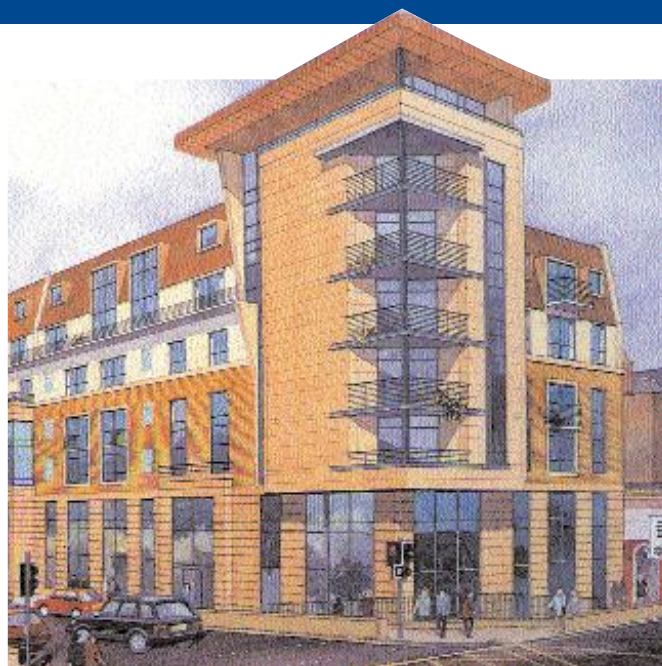
Apartments in Glasgow

Developer Westpoint Homes commissioned an 8-storey *Slimdek*® structure for its city centre site in Glasgow in order to benefit from increased speed of construction and the reduction of site storage of materials and waste, in



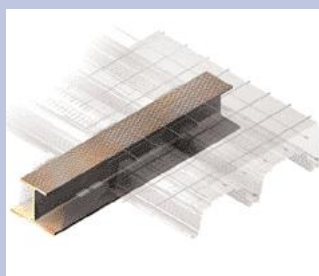
comparison with concrete construction. In order that the columns would not protrude into the room space, small square hollow section (SHS) columns were designed to fit within the separating walls. This would not have been possible using Universal Columns.

Acoustic tests were carried out on the as-built construction. The tests confirmed the excellent acoustic insulation of the separating floors, which use a resilient layer developed by Danskin Ltd. The resilient layer was able to accommodate all pipes and electrics. Separating non-load bearing walls were constructed using double layers of light steel wall panels. These also achieved excellent acoustic insulation.



CONSTRUCTION ISSUES

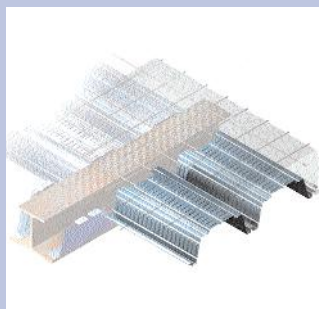
Asymmetric Slimflor Beams



The *Slimdek*® construction system comprises Asymmetric *Slimflor* Beams (ASBs) supporting deep decking and in-situ concrete. Ten sizes of ASBs are available, ranging from 280 ASB 74 to 300 ASB 249 in size. Spans of up to 9 m may be designed.

ASB beams do not generally require fire protection for up to 60 minutes fire resistance. The ASBs can be perforated for ducts and pipes (openings of 160 mm depth can be created).

Profiled decking



SD225 deep profiled decking is 225 mm deep and is used for unpropped spans of up to 6 m. Unpropped construction is preferred, but spans of up to 9 m are possible by temporary props at 3 m spacing. The final slab depth is typically 300 mm.

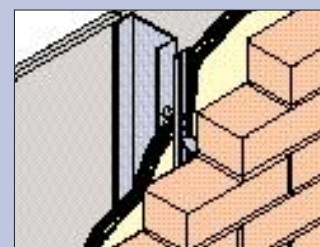
Reinforcing bars, typically of 16 or 20 mm diameter, are placed in the ribs of the decking to

provide the necessary fire resistance. Composite action leads to excellent stiffness of the slab and reduced sensitivity to vibrations.

End diaphragms support the ends of the decking and prevent loss of concrete during construction. Hangers may be screw-fixed or clipped to the decking to support services and the suspended ceiling.

Light steel infill walls

Light steel infill walls use C sections of 75 to 200 mm depth that are roll formed from galvanised steel of 1.2 to 2.4 mm thickness (although 0.55 mm thickness is often used for lightweight partitions). Single layers of fire resisting board provide up to 30 minutes fire resistance, but two layers and an insulating quilt are required for 60 minutes fire resistance.



Double C sections in separating walls achieve excellent acoustic insulation. Special details have been developed for the attachment of these walls to the floor to prevent local acoustic 'flanking losses'.

Construction Efficiency

'Just in time' delivery of steelwork and decking to site requires little site storage of materials. Decking is placed as bundles where it is to be used. Modern safety requires the use of netting to protect the operatives. Concrete is placed by pumping and pour volumes of up to 100 m³ per day can be achieved.

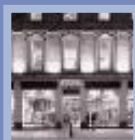


Light steel infill walls can be easily installed as a 'dry' operation creating a 'Rapid Dry Envelope' for easy access for follow-on trades. The same technology may be used for both internal and external walls.

Benefits of Slimdek® 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 principal benefits are due to:



MINIMUM CONSTRUCTION DEPTH

The principal benefit of Slimdek® is its minimum construction depth, typically 300 mm, which is important in residential construction with restrictions on building height and in extensions to existing buildings. Services and light fittings can be located between the ribs of the deep decking.



FLEXIBILITY AND FUTURE ADAPTABILITY

Slimdek® construction provides spans of up to 9 m allowing the space to be arranged to suit different layouts of apartments. The flat soffit achieves complete flexibility of layout without downstand beams. Rectangular Hollow Sections as edge beams provide a neat edge to the slab for attachment of cladding. All light steel internal walls can be relocated, leading to fully adaptable buildings.



SPEED OF CONSTRUCTION

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

- Savings in site preliminaries
- Creation of a 'Rapid Dry Envelope'
- Earlier return on investment
- Reduced interest charges.

These time-related savings in financial terms 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.

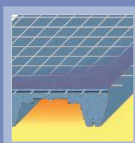


REDUCED DISRUPTION TO THE LOCALITY

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

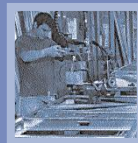
- Timing deliveries to site to suit traffic conditions
- Reducing materials use and waste creation
- Minimising noise and dust
- Reducing the construction period.

Steel construction dramatically reduces the impact of the construction operation on the locality.



REDUCED FIRE PROTECTION

ASB beams and deep decking do not require additional fire protection for 60 minutes fire resistance, and hence this additional cost and activity are eliminated. For longer periods of fire resistance, board protection or intumescent paint may be applied to the exposed bottom flange of the ASB.



IMPROVED 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. Call-backs due to cracking are eliminated. Furthermore, modular components, such as bathrooms, achieve much greater levels of quality.



RETHINKING CONSTRUCTION

Slimdek® satisfies the objectives of 'Rethinking Construction' by innovation, prefabrication, improved quality and client benefits. Slimdek® is a highly engineered efficient construction system that has been the subject of considerable research.



ENVIRONMENTAL BENEFITS

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

Building Technology

The design of multi-storey steel framed buildings using Slimdek® is well covered by SCI publications. The particular issues that the designer should address relating to Building Regulation approval are:

Fire resistance:

Composite slabs can achieve up to 120 minutes fire resistance. In deep decking, reinforcing bars are placed in the ribs and mesh reinforcement in the topping. Typically, 20 mm bars in the ribs achieve the required fire resistance.

Partially encased ASB beams in Slimdek® achieve up to 60 minutes fire resistance without additional fire protection. This can be increased to 90 minutes with one layer of fire resisting board on the soffit of the beam. It is also possible to contain small SHS column sections within walls so that they can be fire protected by the wall boarding.

Acoustic insulation:

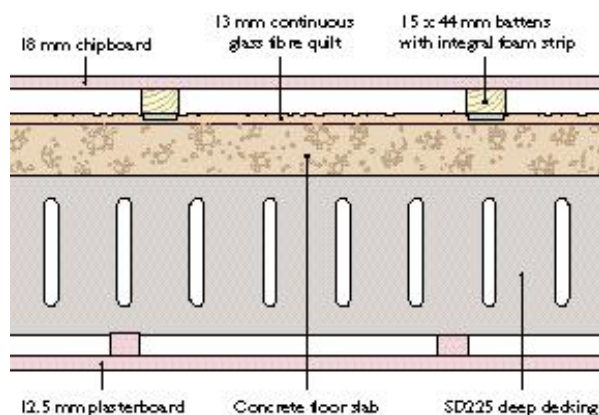
To meet Part E of the current Building Regulations, separating floors and walls are required to achieve an airborne sound reduction of over 52 dB ($D_{nT,w}$), and this can be provided by one of two approaches: either by mass, which is appropriate for concrete or composite floors; or by multiple layers of boarding and additional insulation, which is appropriate for lightweight construction.

For Slimdek®, adequate airborne sound reduction can be achieved with a plasterboard ceiling. To meet the Building Regulations for impact sound insulation, a battened floor is generally required.

Acoustic tests on apartments using Slimdek® construction have demonstrated an airborne sound reduction of over 60 dB, with no additional sound transfer through the steel structure (see table below).



Fire protection to ASB beam



Acoustic details for separating floor



Separating wall using light steel sections



Thermal insulation in an external wall

FORM OF CONSTRUCTION	ACOUSTIC PERFORMANCE	
	Airborne sound reduction	Impact sound transmission
Building Regulations (current)	> 52 dB ($D_{nT,w}$)	< 61 dB ($L'_{nT,w}$)
Slimdek® with plasterboard ceiling	57	60
Slimdek® with battened floor and plasterboard ceiling	62*	48*
Slimdek® with screed and plasterboard ceiling	60	53

* Data from project in Glasgow - see SCI P309: Case Study 4

Thermal insulation:

The external walls and roof should satisfy the requirements of the new Part L of the Building Regulations in terms of thermal efficiency. This is achieved by 'warm frame' construction in which the majority of the insulation is placed external to the frame. A U value of 0.2 W/m²C can be achieved by 2 layers of closed cell insulation in a 'warm frame'.

Sources of information on Slimdek®

Corus Slimdek® Manual, 2001.

Design of Asymmetric Slimflor Beams Using Deep Composite Decking: (P175).

Environmental Floor Systems: (P181).

Composite Beams and Slabs Using Steel Decking: Best Practice for Design and Construction: (P300) (with Metal Cladding and Roofing Manufacturers Association).

Value and Benefits Assessment of Slimdek® Construction: (P279).

Slimdek® Case Studies: (P309).

Sources of information on Light Steel

Building Design Using Cold Formed Steel Sections: Acoustic Insulation: (P128).

Building Design Using Cold Formed Steel Section: Light Steel Framing in Residential Buildings: (P301).

Case Studies on Light Steel Framing: (P178).

Suppliers of Slimdek®

Corus Construction and Industries

Corus Precision Metal Forming (for decking)

Further Information on Slimdek®

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For Case Study information on light steel framing, refer to SCI web site: www.steel-sci.org/lightsteel

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