Technical Information Sheet P408

Light Steel Load-Bearing Walls

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Light steel load-bearing walls are used in light steel framing and modular construction. The light steel walls are fully load-bearing because they support floor loads, loads from walls above and resist lateral wind loads. They generally include bracing to provide lateral stability to the building. Light steel load-bearing walls use vertical C sections (studs) of typically 100 mm depth. Both internal and external walls may be designed as load-bearing.

Key benefits

The benefits of load-bearing walls in light steel construction are:

- Rapid installation allows floors above to be installed straight away without needing time to acquire strength.
- The construction process is 'dry', so that shrinkage is eliminated.
- Design flexibility; stud size, spacing and steel gauge can be selected to suit specific design requirements and can be varied over the height of the building.
- Compression resistance can be over 80 kN for 100 mm x 1.6 mm thick C sections with boards attached to both sides.
- C sections can be placed in pairs for highly loaded locations.
- Large openings for doors and windows can be incorporated within light steel walls using suitable lintels and jambs formed from light steel sections.
- Excellent fire resistance; periods of up to 120 minutes can be achieved using multiple layers of fire resistant plasterboard.
- Light steel walls can achieve excellent acoustic insulation; over 60 dB when using double layers of plasterboard and insulating quilt between the vertical C sections.
- Long design life; design life predictions for light steel framing in a 'warm frame' environment are in excess of 250 years.
- Buildings up to 12 storeys high have been designed with light steel load-bearing walls and joisted floors. Light steel load-bearing walls are also used to support concrete floors formed on composite metal deck.

Forms of Construction

Light steel load-bearing walls use vertical C sections (referred to as studs) that span between a top and bottom track formed from a light steel U section. The C section size and spacing are selected based on the structural requirements. The spacing is also selected to be compatible with standard plasterboard widths and sheathing board sizes. The wall may include mid-height noggins to provide lateral restraint to the studs if required by the structural design.

Wall panels are typically pre-fabricated as storey-high units or, may be site assembled from C sections that are delivered cut-to-length but this is less common. Panels may be delivered to site pre-boarded with insulation installed or as bare steel panels depending on the system and site requirements.

A 9 storey light steel frame hotel in Liverpool

Light steel load-bearing wall with lintel formed from a light steel truss

Load-bearing light steel walls with light steel roof joists

Construction Details

Components

The vertical C sections are fitted between the top and bottom tracks, and are typically 75 to 150 mm in depth, with 100 mm being the most common depth. They are cold rolled from galvanized steel strip of 1.2 to 3.0 mm thickness. However, deeper sections and thicker steel are available. Load-bearing wall panels are typically storey height and are therefore 2.4 to 3.0 m in height for most residential type applications.

C sections are placed at a maximum of 600 mm centres. Closer spacings or multiple studs may be used for heavily loaded walls. Double or even triple studs may be required for jambs either side of openings and lintels may be formed using various methods. For single door and other small openings, horizontal C sections are used for lintels and cills, for larger openings light steel trusses may be used to form the lintel to transfer loads across the opening.

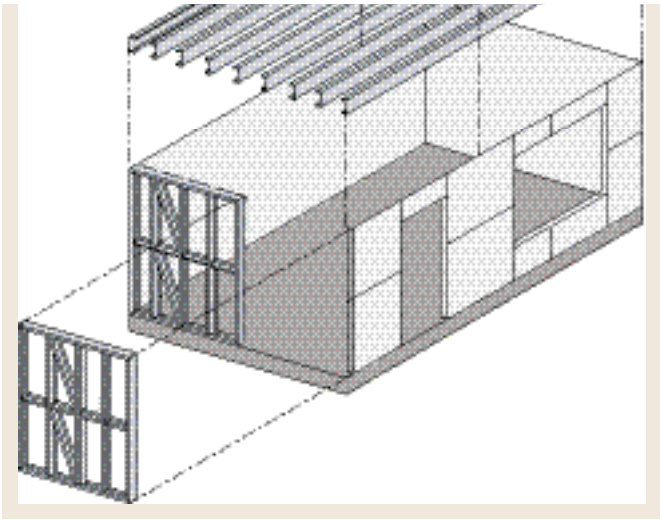

Figure 1 Panel construction of light steel load-bearing walls

Material Specification

The steel used to form load-bearing walls should be a galvanized strip steel produced in accordance with BS EN 10346: 2015. These steels have a specified minimum proof strength and tensile strength which is required for structural design.

Commonly used steel grades are S350GD+Z275 to S450GD+Z275. The first number indicates the yield strength of the steel (in N/mm^2) and the second number indicates the coating. Z275 is a zinc based galvanising of 275 g/m^2 and is sufficient to give excellent durability performance.

Bracing

An important structural feature of load-bearing light steel walls is the role they play in providing lateral stability to the building. There are three principal means of providing stability of frames in the vertical plane:

Integral bracing – C sections are fixed diagonally between vertical studs within the depth of the wall studs. The diagonal bracing members must be securely connected to the vertical studs to ensure the transfer of forces in tension and compression.

X bracing – Cross flat straps of thin strip steel are fixed on the external faces of the studs. These straps act only in tension and may sag unless pre-tensioned during installation. The cross flats should be fixed to every vertical stud, and multiple screws are required at the end connections.

Diaphragm action – Walls may be sheathed with suitable board materials (e.g. OSB, cement particleboard, plywood, specialist gypsum-based boards) to provide a structural diaphragm. There is no established calculation method for determining the shear resistance of boarded light steel walls. Therefore, testing is required to determine the wall panel shear resistance and stiffness.

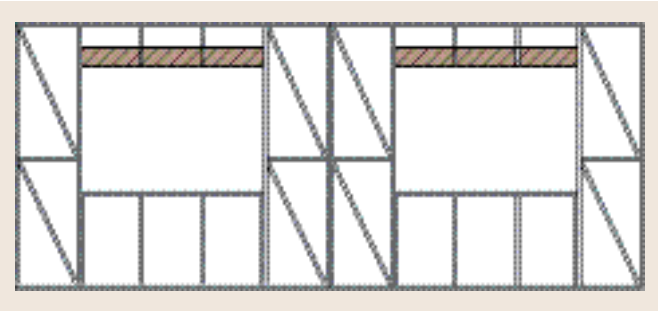

Figure 2 Wall panels with window openings and integral bracing

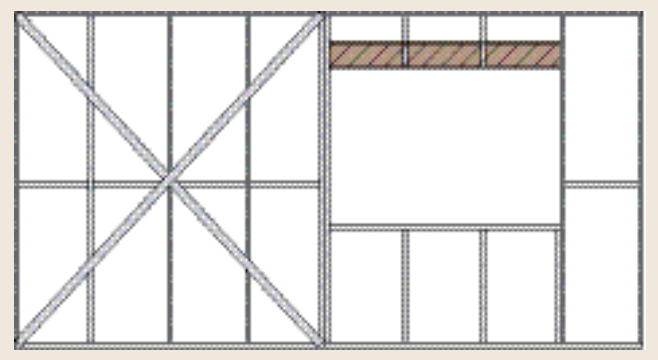

Figure 3 Wall panel with X bracing and adjacent panel with window opening

Structural Design Resistance

Vertical studs in load-bearing light steel walls must be designed for axial loads from the floors and walls which they support and for bending due to lateral wind load and eccentricities of floor loads.

Structural resistance can be calculated in accordance with BS EN 1993-1-3:2006 and the appropriate National Annex for the country where the building will be situated.

Axial resistance and bending resistance are dependent on the cross section properties of the C section and the steel grade but also on the length of C section (i.e. wall height) and the restraint provided by attached components of the wall (e.g. noggins and boards).

The combined axial load and moment resistances for typical 100 mm C sections of three steel thicknesses are shown in Figure 4, calculated in accordance with BS EN 1993-1-3: 2006.

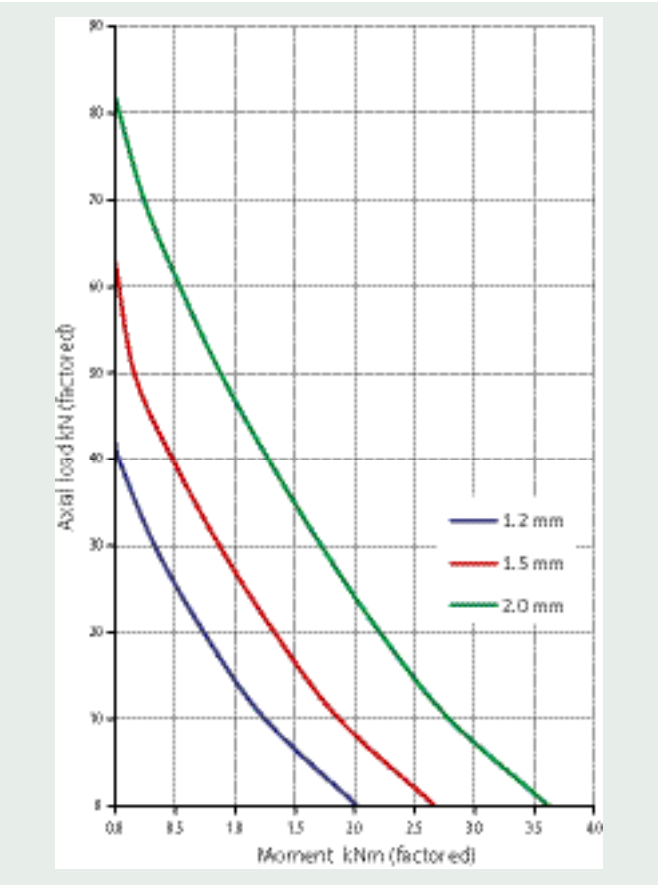

Figure 4 Combined moment and axial load resistance for a 100 mm C section (S390 steel), 2.5 m height with mid-height restraint

Deflection Limits

Deflection limits for walls depend on the type of cladding or internal finishes that they support. Deflections must be limited to prevent damage to finishes and to ensure that claddings can perform as intended.

Recommended deflection limits for different common cladding types are given in Table 1. However, cladding manufacturers may specify their own deflection limits.

APPLICATION	DEFLECTION LIMIT
Full height glazing	Height/500
Masonry	Height/350
Board/rendered finish	Height/250
Steel cladding	Height/200
Rain-screen systems	Height/250

Table 1 Suggested deflection limits for external walls

The deflection limit of height/350 for light steel walls restraining brick or blockwork assumes that there will be a stiffening effect from the masonry. The deflection calculation should be based on the second moment of area of only the steel wall panel.

Other Performance Requirements

Other performance requirements relevant for load-bearing light steel walls include: fire resistance, thermal insulation, air-tightness and acoustic performance. References for guidance relating to these are provided in the final section on Sources of Information.

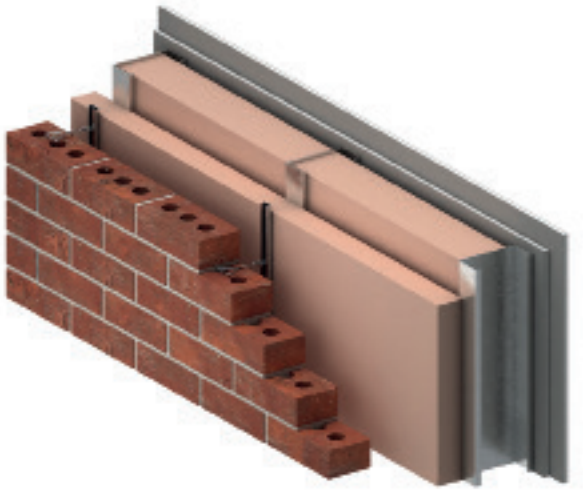

Figure 5 Typical example of warm frame construction with masonry outer leaf

Sources of Information

Other technical information sheets

The following technical information sheets give further details on specific topics related to light steel construction.

- ED010: Light steel solutions for all applications
- ED011: Light steel residential buildings
- ED012: Light steel framed housing
- ED013: Light steel infill walls
- ED014: Light steel modular construction
- ED015: Acoustic performance of light steel construction
- ED016: Fire safety of light steel construction
- ED019: Thermal performance of light steel construction
- ED020: Sustainability of light steel construction
- ED021: Robustness of light steel construction
- ED022: Durability of light steel construction
- P407: BIM and 3D modelling in light steel construction
- P409: Value benefits of light steel construction

Best Practice Guidance

The Light Steel Forum have produced a series of information sheets which provide guidance on best practice in light steel framing. These cover four key areas of the design and construction process:

- ED027: Design and construction
- ED028: Pre-start requirements
- ED029: Installation
- ED030: Follow-on trades

Bibliography

The following publications may be referred to for more information on load-bearing light steel walls.

Lawson, R.M., Way, A.G.J. and Yandzio, E.
Building design using cold formed steel sections: Residential buildings (P402).
The Steel Construction Institute, 2015.

BS EN 10346: 2015
Continuously hot-dip coated steel flat products. Technical delivery conditions.
BSI, 2015.

BS EN 1993-1-3: 2006
Eurocode 3: Design of steel structures. Supplementary rules for cold formed members and sheeting (incorporating corrigendum Nov. 2009).
BSI, 2009.

Lawson, R.M., Francis, K.
Energy efficient housing using light steel framing (P367).
The Steel Construction Institute, 2007.

Lawson, R.M. and Way, A.G.J.
Durability of light steel framing (P262 - 2nd Edition)
Steel Construction Institute, 2009.

Manufacturers

The following manufacturers are members of the Light Steel Forum and are active in the light steel framing and modular construction sector and may be contacted for further information.

Ayrshire Metals Ltd - www.ayrshire.co.uk
BW Industries Ltd - www.bw-industries.co.uk
Fusion Building Systems - www.fusionbuild.com
Hadley Steel Framing Ltd - www.hadleygroup.com
Kingspan Steel Building Solutions - www.kingspanpanels.co.uk/sbs
Metek UK Ltd - www.metek.co.uk
Saint-Gobain - www.saint-gobain.co.uk
Sigmat Ltd - www.sigmat.co.uk

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