SCI Steel Knowledge

Technical Information Sheet P426

Uninterrupted height of masonry cladding to light steel framing

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Introduction

Masonry cladding is commonly used on load-bearing light steel framed buildings, as shown in Figure 1. The masonry cladding is generally supported from the ground or a podium structure and the light steel frame provides lateral support to the cladding. Depending on the height of the masonry cladding, it may be designed to be vertically supported by the structural frame at specified intermediate floor levels. However, it is technically and economically beneficial to consider designing taller heights of ground- or podium- supported masonry cladding to light steel frames.

Figure 1 Masonry cladding on light steel framed buildings for an uninterrupted height of seven and eight storeys

The purpose of this Technical Information Sheet is to provide guidance on the factors to be considered in determining the acceptable height of ground-supported masonry (called 'uninterrupted height' in BS 5268). The factors to consider are:

- Ability of masonry to support its self-weight over the uninterrupted height.
- Effect of concentrated local loads due to large window openings.
- Differential movement between the masonry cladding and the light steel structure.
- Avoidance of disproportionate collapse of masonry cladding.
- Design of wall ties for local wind loads, especially at corners.
- Implications for the design of the structural frame.

Uninterrupted ground supported masonry has been used on light steel framed buildings up to 8 storeys (approximate height 22 m).

Multi-storey residential development using light steel framing with masonry cladding in London

Low-rise light steel framed housing with masonry cladding in Leeds

Multi-storey residential development using light steel framing with masonry cladding in Manchester

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Technical Considerations

Ability of the cladding to support its self-weight

The masonry cladding must be designed to have sufficient strength to resist the applied vertical loads, which are generally due to its self-weight. Openings within the masonry cladding for doors and windows will cause loads to be concentrated in the vertical masonry 'pillars' between openings, this effect should be considered in the design of the masonry.

Recommendations for the structural design of masonry are provided in BS EN 1996-1-1, BS EN 1996-1-2, BS EN 1996-2, BS EN 1996-3 and PD 6697.

Differential movement

Clause 6.2.6.8 of PD 6697 states that: *"Masonry cladding to framed buildings should be designed to prevent cracking as a result of stresses generated by differential movement between the masonry and the frame". The clause also states that: "Steel frame structures are not subject to shrinkage movement and so vertical differential movement is due only to thermal and moisture movements of the cladding"*. Clause 6.2.6.3.2 of PD 6697 states that: *"In general, unrestrained or lightly restrained unreinforced walls expand 1 mm/m during the life of a building due to combined thermal and moisture movement changes"*. This value of 1 mm/m is in agreement with the value quoted in NHBC Chapter 6.10.

Although BS 5628-1 has been superseded by PD 6697, it provides useful additional guidance which is not directly included in PD 6697. Clause 25.4 of BS 5628-1 states that clause 25.3.3 should be applied to external masonry cladding of framed structures and recommends that:

- The calculated differential movement is ≤ 30 mm.
- Separate lintels are used for outer and inner leaves.
- Movement-tolerant wall ties should be used.
- Soft joints under sills should be provided.

Flexible joints are provided around windows or doors and the masonry external cladding. Soft joints of sufficient depth are provided under cills to accommodate the expected level of vertical differential movement.

BS 5628-1, Clause 25.3.2 *"Limitation on uninterrupted height"* is applicable to twin leaf masonry cavity walls. The limitations in clause 25.3.2 should not be applied to steel framed buildings with masonry cladding.

BS EN 1996 does not provide specific recommendation for the design of masonry cladding to framed structures. The wall ties used in light steel framing permit relative vertical movement. They are generally flat stainless steel ties that are slotted into channels installed in line with the C sections in the wall. The channels are screw-fixed through the insulation to the C sections, as shown in Figure 2. Alternative types of movement tolerant wall ties are available.

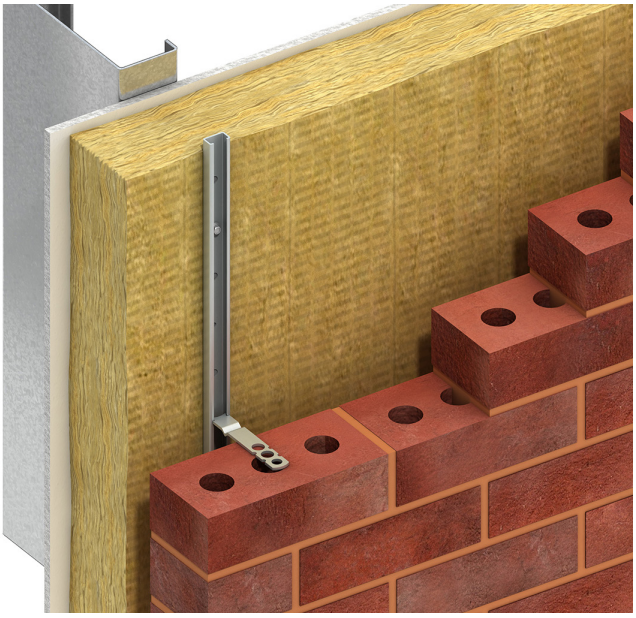

Figure 2 Movement-tolerant wall ties slotted into channels
Image courtesy of Ancon Ltd.

Vertical movement of light steel framing is generally small. The vertical movement of the frame due to load is typically less than 1.5 mm per storey. The thermal movement due to a 20°C change in temperature is 0.6 mm per storey.

Avoidance of disproportionate collapse

Masonry cladding should be designed to avoid disproportionate collapse of several storeys of cladding by an accidental event (e.g. vehicular impact). It is recommended that a layer of bed joint reinforcement should be included in the masonry at each floor level.

Masonry not directly part of the damaged area is tied to the frame through the wall ties and hence is prevented from falling from the structure. Significant vertical distortion of the masonry may occur, but this is deemed acceptable in an accidental load case.

Implications for frame design

The weight of masonry supported by the ground or a podium should be included in the permanent actions used for the calculation of the Equivalent Horizontal Forces for Eurocode design, or the Notional Horizontal Forces for design to BS 5950.

Technical Considerations cont...

Design of wall ties

The wall ties must be designed to resist local positive and negative wind pressures, which depend on the building location, the building height, the site exposure and the location on the building façade.

The required length of wall tie will depend on the cavity width and its embedment length. The required fixing length depends on the thickness of external insulation and the sheathing board. For semi-rigid or flexible insulation, compression sleeves should be used around the fixings to provide the necessary support. Wall ties must be installed in accordance with the manufacturer's instructions.

The horizontal and vertical spacing of wall ties must provide the minimum density of ties per m2 determined from the design. It is necessary to increase the density of ties around windows by reducing their vertical spacing.

Examples

These buildings demonstrate the successful use of uninterrupted masonry cladding. The buildings are a selection of the many light steel frame buildings constructed with masonry cladding over more than five storeys. Appropriate detailing, as described in this information sheet, has been used to allow for the differential movement between the steel frame and the masonry cladding.

Mayflower Gantry Court, Southampton

This residential development constructed in 2011 used Metsec's light steel framing and has seven storeys of uninterrupted ground supported masonry cladding.

Examples cont...

Eastbank, Manchester

This eight storey residential development used light steel framing, designed and constructed by Sigmat. It has a mixture of façade finishes including seven and eight storeys of masonry supported on a ground-storey podium.

Myatts Field, Brixton

This social and private housing development in south London has over 500 units and was completed in 2015. It used Metek's light steel framing system and the 5 storey brickwork with large windows was ground supported.

Causewayend, Aberdeen

This student accommodation project was built in 2015 using Fusion Building System's light steel framing. It has six storeys of uninterrupted masonry cladding.

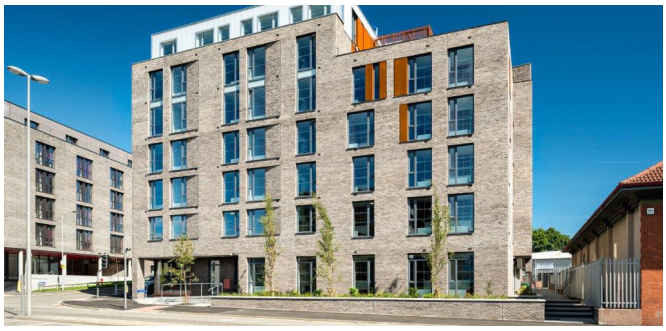

Image supplied by Robertson Group

Sources of Information

Crispin Street, London

This student accommodation building was constructed in 2005 using structural light steel frame walls and floors provided by Metsec. It utilises eight storeys of uninterrupted ground supported masonry.

Summary

Masonry cladding can be used on light steel framed buildings with an uninterrupted height of more than five storeys. There is no requirement in either BS 5628 or in BS EN 1996 for masonry cladding to be supported by the structural frame at specific intervals. However, the junction details and ties must make specific allowance for the predicted relative movement.

Technical information sheets

This technical information sheet is part of a series on specific topics related to light steel construction, which have been produced by the Steel Construction Institute in collaboration with the Light Steel Forum.

References

BS 5628-1:2005 - Code of practice for the use of masonry - Part 1: Structural use of unreinforced masonry. BSi, 2005. (Superseded)

BS EN 1996-1-1:2005 - Eurocode 6 - Design of masonry structures - Part 1-1: General rules for reinforced and unreinforced masonry structures. BSi, 2009.

PD 6697:2010 - Recommendations for the design of masonry structures to BS EN 1996-1-1 and BS EN 1996 2. BSi, 2010.

NHBC Standards Chapter 6.10 - Light steel framing. NHBC, 2018

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

BW Industries Ltd

Etex Building Performance

Fusion Building Systems

Hadley Steel Framing Ltd

Kingspan Steel Building Solutions

Metek Plc

Saint-Gobain

Sigmat Ltd

Vision-Built Manufacturing Ltd

voestalpine Metsec plc

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