catnic®

White Paper

Thermally Broken Lintels

Energy transmittance value of
Psi value 0.02 to 0.05 W/mK

Introduction

Steel lintels are one of the mainstays of modern construction endeavour and achievement. They are used across many different building applications, from window heads to jambs and cills. In recent decades they have largely replaced more traditional methods, such as brickwork or timber formwork, as the modern, cost effective and structurally sound way to achieve aspirational architectural designs. Due to their ubiquitous nature a multitude of products is available to suit many different construction methods and building types.

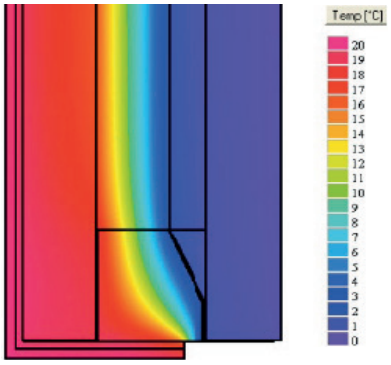
With steel lintel selection, specification and installation a complex blend of design, engineering, legislative compliance and workmanship, Catnic believes in the value of specialist technical support for the accurate scheduling of lintels, according to the intended build.

Here we examine the most effective procedure and outline the important criteria for identifying, specifying and installing steel lintels successfully.

Structurally sound

The structural soundness of a lintel, or any building component, needs to be a prime consideration for the specifier. The imposed loads acting on a lintel arise from one or a combination of masonry load, floor load and roof load. Safe working load (SWL) tables are therefore an important resource for the specifier. All lintel manufacturers produce these, detailing the maximum load that the lintel can support at a given length. The loads quoted should include a safety of at least 1.6 with deflection limited with a maximum of 0.003 multiplied by the effective span. For traditional cavity walls constructions, the floor and roof are generally supported off the inner leaf of masonry, which leads to non-symmetrical loading on the lintel. This non-symmetrical loading is expressed as the load ratio, which states the proportion of load on the inner leaf of masonry compared to the load on the outer leaf.

Typical load ratios are 1:1 for lintels supporting masonry only, 3:1 for lintels supporting masonry and timber floors, and 5:1 for lintels supporting masonry and concrete floors.



Two-dimensional temperature distribution, highlighting the effectiveness of the thermal break in the lintel.

Meeting the standard

The first consideration for any lintel selection has to be initial compliance with basic standards. This is in order that the lintels, and indeed all products used within a build, are structurally sound and fit for purpose. The NHBC will approve any product that has been accredited with a satisfactory assessment by an independent testing approvals authority. In addition steel lintels must be CE marked in accordance with BS EN 845-2:2013+A1:2016.

Thermal solutions

The thermal performance of each building component needs to be taken into account when specifying products and systems, with a view to important energy saving legislation and sustainability standards. Ideally these should be approached in a holistic manner that does not treat components individually. Instead they need to be designed to work together, forming an integrated and truly 'Fabric First' approach to the energy efficiency, sustainability and legislative compliance of the resulting building's performance.

Heat always flows from a warm area to a cold one, generally from the inside of a building to the outside. Where there are changes in the building fabric such as a corner, eaves, window head, etc, the heat flow can increase because of a reduction in the insulation or material passing through insulation layer. This is often referred as a thermal bridge or cold bridge. As a result of a thermal bridge there will be an increase in heat flow meaning that additional energy will required to maintain the overall internal temperature of the building, increasing energy costs and CO_2 emissions. Also it can mean the surface temperature local to the detail can be lower, allowing condensation to form leading to potential damp and mould growth in the worse cases.

This means wall detailing and the elements of the wall that represent the potential for thermal bridging must be carefully considered in order to achieve the optimum energy performance for the building. Thermal bridges must be taken into account when it comes to the increasingly complicated demands of the Fabric Energy Efficiency Standard, Part L and SAP compliance.

The thermal performance of a building is calculated by taking into account heat loss through the fabric of the building itself, such as walls, roof, floor, doors and windows, and through linear thermal bridges found at junctions between different elements of the building including window heads, jambs and cills.

Heat loss through the building fabric is expressed as a U value and measured in W/m^2K, while heat loss via linear thermal bridges is expressed as a psi (ψ) value and measured in W/mK. The total fabric heat loss is the sum of the combined fabric U value multiplied by the total area, plus the product of the psi value of junctions and their total length.

Due to their nature, enabling the structural span between openings above doors and windows across cavity walls, steel lintels have the potential to form an effective, yet unwanted, thermal bridge from the inside to the outside of a building. Therefore put simply: the lower their psi value, the better the overall thermal performance of the building envelope will be.

A trusted lintel manufacturer can provide free lintel scheduling and technical support to specifiers, housebuilders and developers to ensure optimum lintel specifications. Of course, all lintels from a reputable manufacturer can be used and will certainly comply with the Building Regulations. However, the psi value of all lintels specified must be taken into account when it comes to calculating heat loss and obviously, the lower the overall psi value, the better the resulting total fabric heat loss of the building will be.

Housebuilders and developers can derive lintel psi values from a number of sources. It is possible to work from the default values taken from BRE IP 1/06 or ACDs, these are the ones found in SAP calculators and really they present the worst case scenario, so are best avoided. The housebuilder or developer can alternatively look to the lintel psi values that the insulation and block manufacturers include with their typical thermal details. However, by far the best option is always to use the psi values provided by the lintel manufacturer themselves.

Further to this it is possible to achieve improved lintel psi values by using lintels without a base plate (removing the potential for additional thermal bridging) and thermally broken, or separate, lintels within cavity wall constructions. A lintel that incorporates a complete thermal break between the inner and outer leaf of a cavity wall will deliver the best possible thermal performance.

Consideration should be given to the detailing around a lintel. This need to be kept as simple as possible so that the reliance on site workmanship is removed and ensures the actual performance of the junction meets the design expectations. As an example a lintel with a flat top provides a consistent junction with the cavity wall insulation, maintaining the thermal performance of the junction.

Catnic's Thermally Broken Lintel has a BRE-certified energy transmittance Psi value of 0.02 to 0.05 W/mK with no compromise to structural performance. These lintels have been independently modelled by the BRE in a range of different wall constructions, and as a result, the range is listed on the BRE Certified Thermal Details and Products scheme. Catnic's Thermally Broken Lintel has been designed to cover all building types from small domestic dwellings to large apartment buildings, including buildings with concrete floor loads.

To specify or not to specify a damp proof course

Some lintels are designed with a built-in damp proof course but specifiers need to consider whether a separate damp proof course is required or not. This will be determined by referencing the exposure zone, the geographical position of the building, according to BS 8104:1992. This divides the UK into four zones, according to the levels of wind-driven rain experienced in each area. Exposure zones 1 and 2 are described as 'sheltered' and 'moderate', each is subject to less than 33l/m^2 or between 33l/m^2-56l/m^2 of wind driven rain per spell. Buildings in these areas, specified with lintels that have an integral damp proof course require no further damp proof course specification.

If the selected lintels have a damp proof course incorporated in their design and the building is located in exposure zones 1 or 2, there is no need for the specification of a separate one. In these instances specifiers need to remember that for a steel lintel to act as a damp proof course it must be a minimum of 140mm deep and manufactured from austenitic stainless steel or galvanised steel with an additional 40 micron powder coating.

On the other hand zones 3 and 4 of the UK, as defined in BS 8104:1992, demand that an additional damp proof course is specified, regardless of whether the lintels themselves feature this as part of their design. This is because these zones cover the west of England, the majority of Wales, Scotland and Northern Ireland. These zones are defined as 'very severe', subject to 56.5l/m^2-100l/m^2 and over 100l/m^2 of wind driven rain per spell. A separate damp proof course is required to fulfil the demands of both NHBC and Zurich Municipal technical requirements.

In all instances specifiers need to ensure a separate damp proof course is included in the building design where lintels without this feature are to be used.

Durability and corrosion resistance

The effects of moisture on all steel products are well documented. In order to combat these and ensure the selected lintels stand the test of time, specifiers should ensure all lintel are CE Marked in line with BS EN 845-2. This standard allows lintels to be manufactured from a controlled list of materials from: galvanised steel with a minimum zinc coating of 600g/m^2; galvanised steel with a minimum zinc coating of 275g/m^2, plus an additional organic coating; or austenitic stainless steel. The latter is a chrome nickel alloy. BS EN 1996 (Eurocode 6) governing the design of masonry structures implies that in certain conditions, namely all buildings over three storeys in non-aggressive environments and buildings located in aggressive environments such as coastal areas, only austenitic stainless steel should be used.

Fire safety

All lintels must be independently assessed in accordance with BS EN1363-1:2012 or BS 476-21:1978.

Structural specification

With more than 10,000 lintel variations from which to select for any building, the correct choice of lintel depends on a variety of factors, including the load on the lintel, the structural opening and the type of construction method used.

For lintel specification in cavity walls, measurements for the width of the outer lead, the cavity size and the inner leaf are required. Open back lintels are most common for cavity walls and these are suitable for standard duty through to extra heavy loading conditions, including direct roof and attic truss loading.

Lintels used in timber framed buildings must be suitably propped during construction, a time, cost and labour implication to consider. Timber frame lintels are supplied with lintel restraint clips. These must be fixed directly to the timber frame of the structure. The clips, in conjunction with pinch battens, help to minimise rotation of the lintel and allow for differential movement between the timber structure and the brick facing.

Lintels for external solid walls are available in three formats: a single element lintel that is designed to support a single leaf of brickwork; a two part lintel, shaped to carry two separate leaves of a 215mm fair face brick wall; a box profile lintel with a toe, for use in solid brick or block walls of 200-215mm thickness.

There are also three formats for internal wall lintels: corrugated lintels that offer a cost-effective solution for light loads; channel lintels for standard duty applications; box lintels that are sized to suit brick or block course heights. The latter format should be specified for heavier loads and wider openings.

In addition there is an array of lintels available for semi-circular arches, apex arches, bay windows and other curved openings. Whilst further architectural challenges can be achieved with special bespoke lintels that are specifically manufactured to order.

To determine the structural opening the intended lintel is to span, the specifier needs to measure the size of the open space between the walls where the door or window frame is fitted. A minimum 150mm should be added to each end of the opening to determine the length of lintel required.

The loading on a lintel could include that from roof trusses, upper floor joists and masonry work. This is where a reliable lintel manufacturer can provide additional technical support in determining the structural loads.

Accessories

In addition a trusted manufacturer should be able to provide all the lintel accessories required to complete the specification, offering a single source of technical advice and simplified supply chain for specifiers. Accessories to consider include arch centres for the construction of segmental arches in brickwork; weep vents and stop ends for removing water effectively from cavities; and soffit cladding to provide extra protection – particularly in areas likely to experience severe weather and wind driven rain.

Installation

Finally, having successfully specified a full schedule of lintels for a project it is vital that the specifier ensures these are handled and installed accurately and effectively once they arrive onsite. Contractors and trade professionals should be knowledgeable about lintels and be watchful for any damage incurred during transit and delivery.

Further criteria to consider are that the wall dimensions are accurate, the masonry overhang does not exceed 25mm and the masonry above each lintel has been allowed the time to cure prior to the application of floor or roof loads. Each lintel must be installed so that it is level along its length, there is a nominal 150mm end bearing at each end and the lintels are fully bedded on bricklaying mortar. No more than half of the safe working load should be carried by the outer leaf where a lintel carries an external cavity wall, and the point loads should not be applied directly to the flanges of lintels.

Taking the effects of moisture into consideration, in severe exposed conditions a separate damp proof course must be installed, regardless of whether or not the lintel has this as an integral feature. Meanwhile in coastal areas the use of soffit cladding should be considered and in all cases installation should take into account that window and door frames are located so that the drip on the lintel projects forwards of the frame.

Conclusions

With so many variables in the specification, scheduling and accurate installation of steel lintels, those responsible for lintel selection should rely on the technical expertise of their trusted manufacturer. Catnic's own lintel scheduling service, CLASS, is free to use and accessible via email and telephone. Our technical team can even visit a site in progress to help troubleshoot lintel challenges.

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