illbruck
making it perfect.

Differential Movement Solutions

For Timber Frame Construction

Optimising Timber Frame Construction

Timber frame provides an attractive alternative construction method for buildings of all types including schools, hospitals, hotels and residential accommodation.

The introduction of alternative panel products such as Glulam and Cross Laminated Timber (CLT) has provided increased appeal as designers can utilise the aesthetics provided by these products in addition to their structural function.

Timber frame is growing dramatically as a chosen construction type, as developers turn to speedier methods to help meet demand for over 250,000 new homes per year.

Cover shot and others courtesy of the Structural Timber Association.

Differential Movement

One of the key issues of which designers and builders of timber frame construction should be aware, is differential movement (sometimes referred to as 'settlement').

This means that the internal timber frame backing walls – and any components fixed to them – will settle over a period, typically of several months but possibly up to two years after construction. Settlement occurs through two primary mechanisms, the first being shrinkage of the timber as it loses moisture, and this can continue right up until the building is occupied and heated. The second is compression and closing of the joints in the timber frame construction. This too can be influenced by the shrinkage, but also by the building loading.

This movement will be in conflict with the external façade (typically brickwork), which may itself expand, but by much less than the frame. The higher the building, the greater the extent of the differential movement. This can be considered as cumulative when considering upper floors. There is more differential movement on the top floors of a building than at the bottom and different cases must be incorporated into any design.

In this brochure, we address these problems and specifically show how windows can be effectively sealed to the structure without being adversely affected by differential movement.

Maintaining Thermal Efficiency

Whilst the integrity of the external weather seal is the primary concern, solutions for enhancing thermal performance and high levels of airtightness (down to Passive House standard) should also be examined.

Although the exterior may appear the same as a masonry building, in reality the inside is more likely to be better insulated than a traditional structure as the engineered timber framework provides opportunities to cost effectively provide higher levels of insulation. The benefits of timber frame inside the completed building are therefore realised whilst maintaining a traditional external appearance.

With increasing emphasis in building design on the 'Fabric First'* approach, timber frame is proving extremely well suited to this concept due to high thermal efficiencies and the level of off-site construction involved, providing accuracy, consistency and robustness in terms of airtightness. Using illbruck not only solves differential movement issues but also assists with achieving airtightness.

* Visit www.fabricfirst.co.uk and www.fabricfirstacademy.co.uk for more information

Sealing of Windows

Conventional ‘wet’ sealants, such as silicones, are frequently unsuitable for sealing the perimeter of windows in timber frame buildings. Even high performance silicones can’t cope with the movement levels experienced, particularly in higher rise builds.

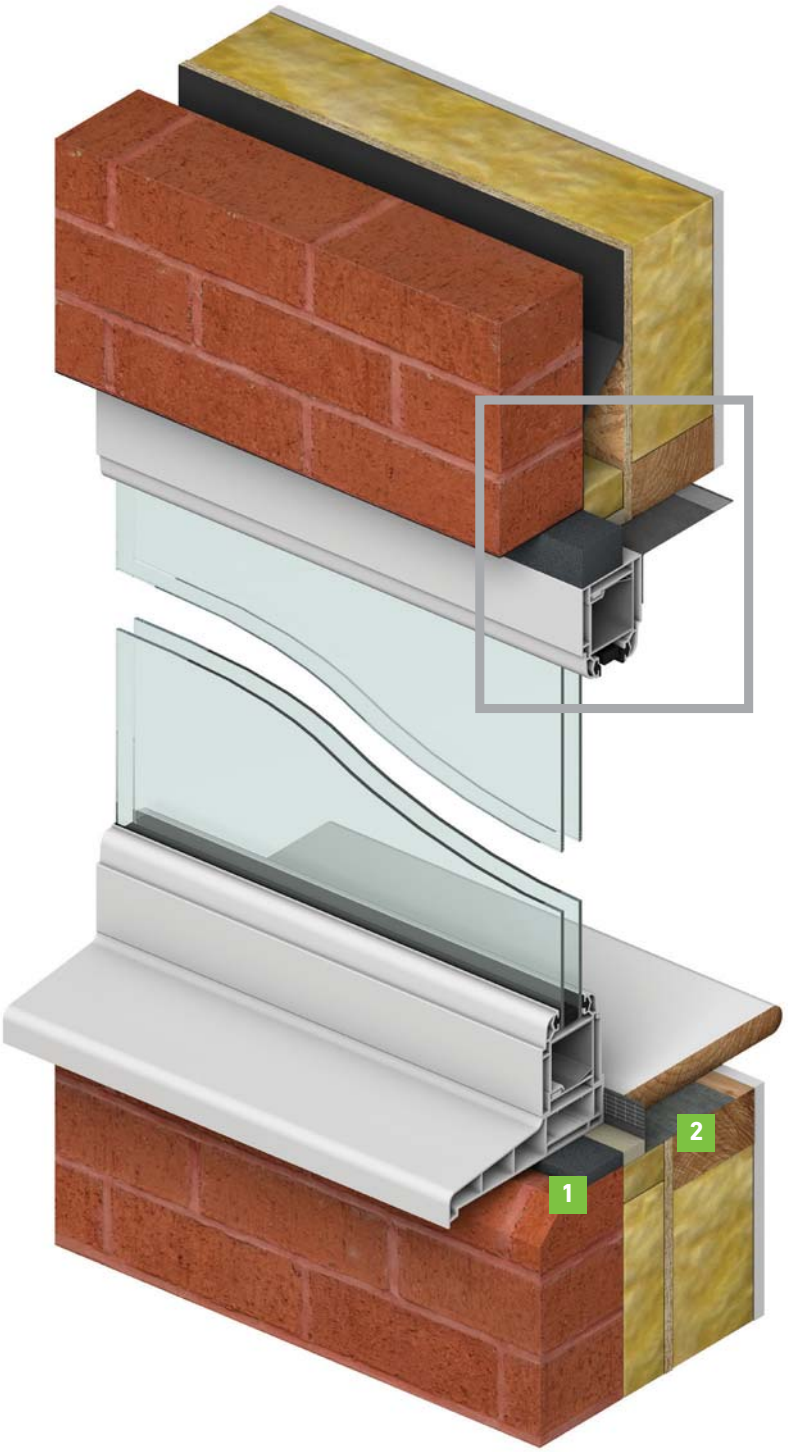
Impregnated foam tapes such as TP450 Compriband Timber Max have been proven to work and accommodate the settlement over several years of specification in the industry.

They are suitable for sealing the head and cills on builds up to 5 storeys, where the differential between initial application and future movement can be up to 37 mm. In these applications, the tape either expands (at the head) or compresses (at the cill) during the ongoing settlement.

Additionally, at the jambs of the window TP601 Compriband e is able to slide against the adjoining brickwork cladding and maintain the perimeter weather seal. This tape can be applied to the edge of the window prior to erection of the cladding and then the encapsulating sleeve is removed once the mortar has dried.

Correctly using the illbruck system for sealing windows in a timber frame construction avoids

- Failed unslightly silicone at jambs and heads with resulting weather ingress
- The need for costly return site visits to replace failed silicone
- Cills lifting and rotating due to downward movement
- Windows under compression deflecting and failing to operate.



1
TP450 Compriband Timber Max
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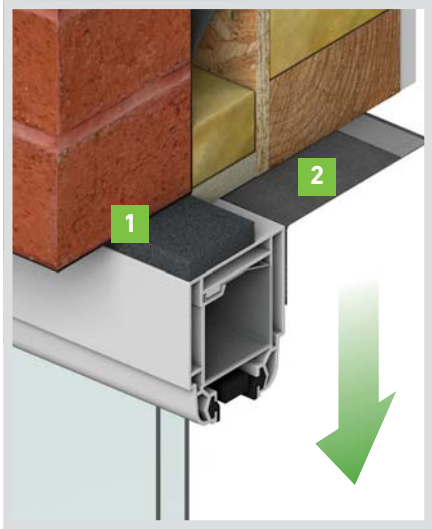
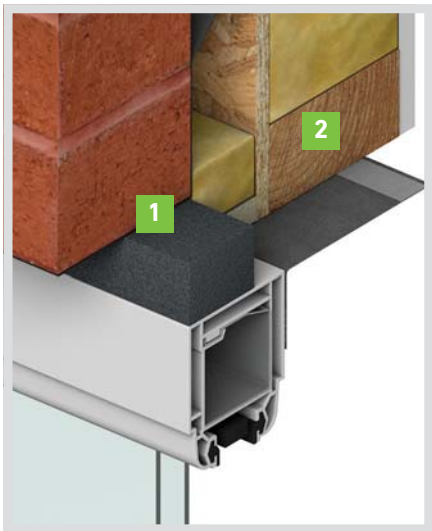
2
ME500 Duo Flexible Window Membrane



Head Detail: Showing TP450 and ME500 BEFORE settlement with force exerted from the upper floors and roof.



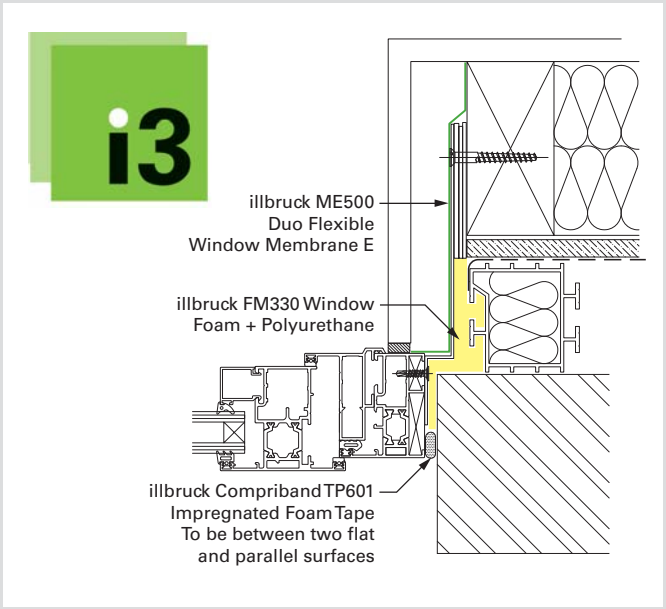
Head Detail: Showing TP450 and ME500 AFTER settlement.

NB. The reverse situation occurs at the cill.

TP450 Compriband Timber Max applied at the head

TP450 Compriband Timber Max applied at the cill

The i3 Window Sealing System



Timber Frame detail at jamb showing full i3 solution to provide an effective weatherseal, thermal insulation and air tightness after settlement.

How it works: keeping 'inside tighter than outside'.

The i3 System focuses on the small, localised areas around the perimeter of windows and the interfaces between window and structural openings.

Proper sealing is an effective interaction of the outer, middle, and inner sealing zones on the principle of 'inside tighter than outside.' By selecting the appropriate products from our range of components, various combinations can be created to suit the installation criteria. The resulting system will meet all the requirements of modern sealing technology. The result is an externally weatherproof but vapour permeable system that prevents warm, internal air penetrating joints and forming condensation.

Types of Timber Frame Construction

Structural insulated panels (SIPS)

Open panels

Closed panels

Glulam

Cross laminated timber (CLT)

There are various types of timber frame to select from. The basic structural function and fast buildability offered by SIP's (Structural Insulated Panels) and open and closed panels, comprise a major part of the current market. But the visual appeal, and strength provided by Glulam and CLT (Cross Laminated Timber) have increased their popularity. These latter constructions are subject to less differential movement and can be used in higher buildings with very little constraint.

Why movement occurs

Before timber is used for a structure it is cut down to rough sawn sizes, planed all round, and cut to tight tolerances. It is also kiln dried down to a maximum 20% moisture content (super dried is also available), reprocessed to final size, and strength graded. Movement occurs due to compression perpendicular to the grain and changes in moisture content affect the timber size (this reduces to 10-12% in a heated and occupied building).

Differential movement

Timber frame shrinkage occurs throughout the structure. For every 38mm of horizontal cross grain timber, 1mm of movement is likely to occur. This movement is typically differential to free standing external cladding (e.g. brickwork) and requires specific attention when detailing.

The behaviour of the facade also has to be considered, as this can increase the degree of movement experienced by the window perimeter joint to head and cills. For example, steel sheet claddings expand and contract with temperature, whilst clay masonry/ brickwork expands (typically 1mm per metre height).

The anticipated movement of facade should be added to the timber frame settlement values for the overall joint movement figure. Movement joints need to be sealed and because sealants cannot compress to zero, the final constructed joint depth should be calculated as follows:

Gap size = frame shrinkage* + façade expansion + minimum compressed sealant depth (residual joint)

Gap sizes will vary dependent on height of the frame and whether or not the façade (internal or external) is fixed or independent of the structure.

To reduce differential movement :

- Load floors/roof earlier (before external cladding is erected)
- Protect timber from weather prior to use to minimise moisture uptake
- Use bricks which have low expansion rate due to moisture uptake

* from compression at joints, uptake of jointing, creep and elastic shortening

Design and installation guidelines

- Ensure the compressed size of the tape is considered in the gap width calculation
- Ensure there is enough coverage between the window frame and the brickwork to form a seal.
- All site operatives should be aware that the windows should not be installed in the centre of the brickwork opening

Product Range

TP450

Compriband Timber Max

- Anthracite colour

Usage: window installation

A soft and flexible open cell polyurethane foam, impregnated with an acrylic based, UV stabilised resin. The resin is water repellent and contains a fire retardant. TP450 has a self-adhesive side to aid initial location and is easy to apply in any weather. Additionally, TP450 has both thermal and acoustic insulation properties. TP450 is designed for use in a wide variety of movement joints up to 50 mm wide and can accommodate up to 37 mm of movement.

Particularly suitable for sealing the head and cills of windows installed in timber frame construction. Extensively tested, TP450 has a proven reputation across the UK and Europe.

Product benefits

- Accommodates up to 37 mm joint movement within 50 mm max gap
- Weather seal and vapour permeable
- Accommodates differential movement on timber frame constructions up to 5 storeys
- Effective seal – no wet sealants
- Weather resistant
- Expands/contracts whilst maintaining joint seal
- The TP450 external face must be protected from UV with a cover trim when expanded above 30 mm

Size	Joint Width (mm)	Tape Width (mm)	Roll Length (m)
14 / 4-10	4-10	14	5.8
15 / 5-15	5-15	15	4.5
25 / 10-24	10-25	25	5.0
40 / 13-40	13-40	40	5.2
50 / 13-50	13-50	50	5.2

TP601

Compriband e

- Foam sealing tape – grey (black available in size 3-7 mm)
- Encapsulating film – clear
- Adhesive release film – red

Usage: window installation

TP601 is a weather-retardant, impregnated, open cell, polyurethane soft foam, enclosed before use in a polypropylene film with a bonding adhesive on one side for fixing.

The tape is intended for the external, recessed perimeter sealing of windows and doors. The tear-off, encapsulating film permits the post-installation expansion of the foam strip, thus ensuring an effective weather seal.

Product benefits

- Factory or site application with activation at any time
- 600 Pa weather resistance
- Can be applied before frame installation

Nominal Joint Width (mm)	Maximum Joint Width (mm)	Metres / Carton
3	7	50
3	7	200
5	10	50
5	10	200
7	12	50
7	12	100

Typical Example of Compriband Timber Max Selection Guide for a Timber Frame Building

The differential movement joint of a structure should be provided by the timber frame manufacturer. However if illbruck are provided with details of the differential movement on each floor, we can help specify the correct sizes of tape that should be used at each location in the construction.

	Engineered Joist		Softwood Joist	
Level	Settlement	Compriband Reference	Settlement	Compriband Reference
Ground cill	2 mm	TP450 14/4-10 (assuming 6-10 mm gap)	2 mm	TP450 14/4-10 (assuming 6-10 mm gap)
Ground head	2 mm	TP450 14/4-10 (assuming 4-8 mm gap)	2 mm	TP450 14/4-10 (assuming 4-8 mm gap)
1st cill	7 mm	TP450 15/5-15 (assuming 12-15 mm gap)	12 mm	TP450 25/10-24 (assuming 22-24 mm gap)
1st head	7 mm	TP450 15/5-15 (assuming 5-8 mm gap)	12 mm	TP450 25/10-24 (assuming 10-12 mm gap)
2nd cill	13 mm	TP450 25/10-24 (assuming 23-24 mm gap)	23 mm	TP450 40/13-40 (assuming 36-40 mm gap)
2nd head	13 mm	TP450 25/10-24 (assuming 10-11 mm gap)	23 mm	TP450 40/13-40 (assuuming 13-17 mm gap)
3rd cill	19 mm	TP450 40/13-40 (assuming 32-40 mm gap)	33 mm	TP450 50/13-50 (assuming 46-50 mm gap)
3rd head	19 mm	TP450 40/13-40 (assuming 13-21mm gap)	33 mm	TP450 50/13-50 (assuming 13-17 mm gap)

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