Wolf Systems, Engineering Ease.

easi-panel®

Metal Web Wall System

Technical Guide

easi-panel®

the factory-built wall panelling system, with strong environmental credentials

easi-panel® is an open web wall system comprising open web studs assembled from strength-graded timber flanges plated together with precision-engineered metal webs.

Being a metal web system, the panels are dimensionally stable and less likely to warp or twist even over long lengths. This makes easi-panel® ideal when high accuracy or large panels are required.

Factory manufactured for on-site ease and speed of construction

Factory assembly ensures a super efficient panel system, offering on-site accuracy and tight tolerances. Panels are light in weight and easy to handle, while open web construction makes it easy to route 'hidden' services and pipework within the cavity.

Optimal thermal efficiency

easi-panel® allows for high levels of insulation to be built into each scheme to meet required specification, up to and beyond Passiv Haus standards. Different kinds of insulation may be installed during the manufacturing or on-site build phases. The result is thermal performance that far exceeds that possible with traditional construction methods.

Environmental excellence

Concerns over energy costs, climate change and shortage in housing stock are all important influences on the future of construction and timber remains the most sustainable and environmentally-friendly construction method.

Add easi-panel® to the frame and specifiers can be sure of the highest quality, energy efficiency and thermal performance; the ideal solution for domestic or commercial schemes.

- Factory-built for quality and accuracy
- Combines the lightness of timber with the structural qualities of metal
- Structurally efficient wall stud system
- More thermally efficient than conventional wall systems
- Precision-engineered for easier installation
- Accurate factory-manufactured whole wall assembly dramatically reduces build times
- Can be factory-treated with preservative to meet regulatory requirements

Contents

Wolf Systems, Engineering Ease

Wolf Systems has developed its products and services to make complex or difficult timber engineering more straightforward - from the manufacture and supply of nailplates, metal webs and software for the design of roof trusses, metal web joists and timber frame wall panels, right through to our bespoke design services, training, machinery sales and outstanding customer support.

Our software is intuitive to use and our products engineered for outstanding performance and flexibility, making it easier to solve those difficult design problems and lower costs.

You'll also find Wolf a very easy and straightforward company to do business with: one that's driven by your needs, receptive to your ideas; proactive about support and entirely fair when it comes to both project timescales and pricing.

"reliable, helpful, there when you need them, products that are easy to use – these are just some of the reasons I chose to put Wolf Systems at the heart of our business"

Putting you at ease

Customer care is central to the Wolf Systems ethos and we strive to make it easy for you to access the help you need, when you need it. Our friendly and approachable team of specialists is always at hand to offer pragmatic advice and assistance, whether it's design, technical, training or service-related.

Choose to work with Wolf Systems and you can be sure your business is well supported, with the resources only a large and customer-led company can supply.

Part of the Wolf Group

Wolf Systems UK is an integral part of the Wolf Group – a family run business with over 45 years' experience in timber engineering, employing some 3000 staff across 21 European countries.

From our beginning in 1966 we have always been an unashamedly engineering centric business – but one that puts its customers first.

Our UK operation, established in 1988, serves the UK market and is head of software and product development for the company's timber engineering business.

Today we have a UK-wide network of licensed manufacturers and are justifiably proud of our reputation for making timber engineering as easy as possible for them.

The international size and scale of our business enables us to invest substantially in on going product and software development, resulting in technically advanced software, innovative products and a level of customer service recognised for excellence.

On top of world-class products, our customer services and design teams provide expert technical support and backup for software implementation, training and design.

We can also assist with manufacturing setup and provide a comprehensive range of machinery for the manufacture of components.

Easy on the Environment

Wolf Systems promotes timber engineering using sustainable resources. Recognising that our operations will have an impact on the local, regional and global environment, we continually seek to improve environmental performance by increasing energy efficiency, minimising waste and preventing pollution.

We strive to:

- Undertake all activities with the intention of reducing the company's environmental impact as far as possible.
- Conserve energy in our offices and manufacturing units.
- Save water in all our operations, through installation of water-saving devices and other measures, where applicable.
- Minimise waste in all our operations, by prevention of unnecessary packaging, reuse of materials and recycling.

In 2011 we installed 135kW of solar panels which produce ***40% of our electricity requirement*** *and save* ***50 tonnes of CO_2*** *each year.*

Industry Associations, Standards And Compliance

Industry Associations

Wolf Systems is an active member of the Trussed Rafter Association (TRA), the Structural Timber Association (STA), BM TRADA and the Engineered Wood Products Committee. Our association with the leading bodies within our industry is your assurance of the quality of our products and best practice across our services.

The Trussed Rafter Association (TRA) is the respected voice of the trussed rafter industry in the UK.

The Association is committed to stringent standards of quality and service and sets a professional benchmark for the industry.

Members include the principal manufacturers of trussed rafters, industry suppliers and professionals involved in roof design and construction.

TRA requires all its manufacturing members to have third party supervised Quality Assurance and Professional Indemnity insurance so helping to ensure quality and peace of mind for the customer.

The Timber Research and Development Association (TRADA) is an internationally recognised centre of excellence on the specification and use of timber and wood products.

TRADA is a company limited by guarantee and a not-for-profit membership-based organisation. TRADA's origins go back over 70 years and its name is synonymous with independence and authority. Its position in the industry is unique with a diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users.

The Structural Timber Association (STA) is currently the country's leading timber organisation, which represents a wide membership of businesses and people involved in construction using engineered timber, from across the UK.

The STA leads the industry on quality, health & safety, education, technical knowledge and customer service. The STA's activities include seminars, factory tours, research, provision of information, networking, advocacy and discussion.

The Irish Timber Frame Manufacturers' Association (ITFMA) is the trade association for the timber frame manufacturing industry in Ireland. It is an independently constituted company limited by guarantee with no share capital. All full members are represented on the Board of Directors. Voting on issues is not based on turnover. The Association is the recognised representative body for Timber Frame Manufacturers on the Island of Ireland and membership is synonymous with professionalism and quality. In addition, the ITFMA provides marketing, training and education of the timber frame concept.

Standards and Compliance

European Technical Approval is basically an assessment of a product to make sure it is fit for its intended use within each European Member State; in our case, the assessment of easi-joist® for use within domestic, industrial or commercial buildings.

This assessment is based on fulfilling the six essential requirements set out in the Construction Products Directive (CPD). There is no suitable design method for metal web joists in Eurocode 5 unlike trusses, hence the need for ETA to provide a harmonised design standard.

Wolf ETA Certificate No. ETA-07/0032

easi-joist® has been officially approved by Robust Details Ltd. under detail E-FT-3.

This means that easi-joist® used in timber frame flats, constructed as per E-FT-3 will not require pre-completion sound testing to prove compliance with Part E of the Building Regulations in England & Wales; saving time, money and the uncertainty of pre-completion testing.

The Irish Agrément Board is designated by Government to issue European Technical Approvals.

Irish Agrément Board Certificates establish proof that the certified products are 'proper materials' suitable for their intended use under Irish site conditions, and in accordance with the Building Regulations.

The Irish Agrément Board operates in association with the National Standards Authority of Ireland (NSAI) as the National Member of UEAtc.

Wolf IAB Certificate No. 07/0280

ISO 9000 is the internationally recognised standard for an organisation's internal Quality Management. The term 'quality' refers to all those features of a product or service which are required by the customer.

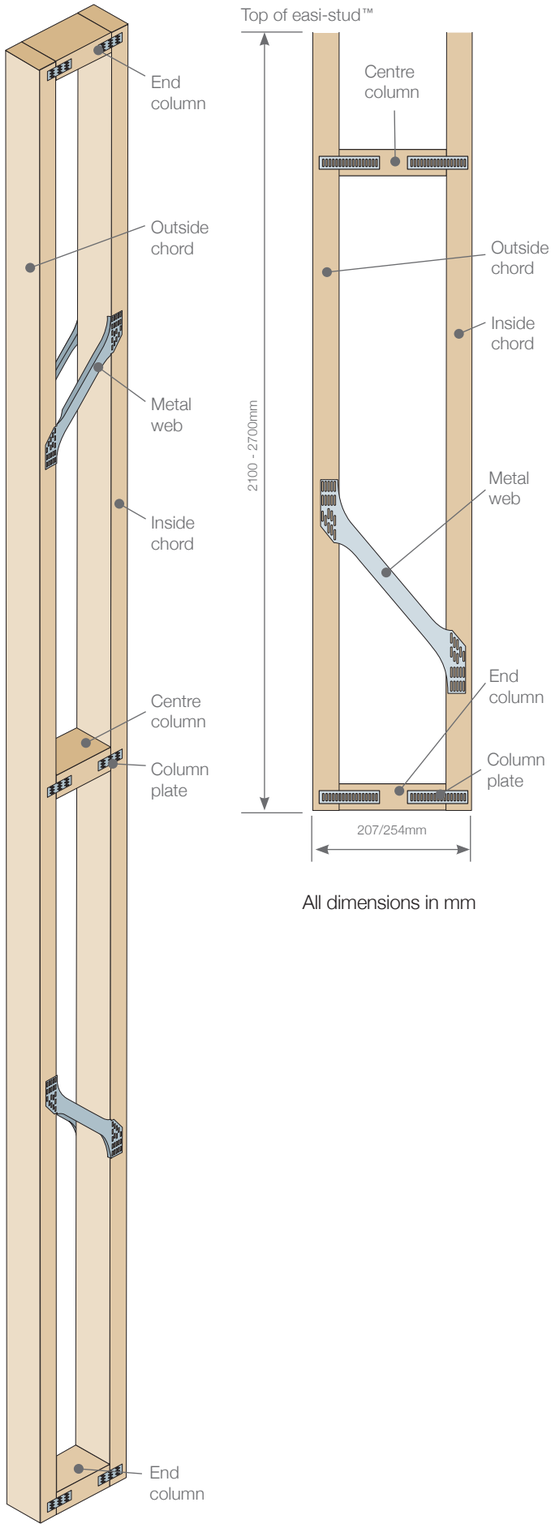
An organisation's 'Quality Management' refers to its actions to ensure that its products or services satisfy its customers' quality requirements and comply with any regulations applicable to those products or services.

Wolf Systems supplies all its products and services to ISO 9001 ensuring the highest standards are provided by our company.

easi-joist® is recognised for use in floor construction by the NHBC in the United Kingdom and Homebond in the Republic of Ireland.

NHBC is the standard setting body and leading warranty and insurance provider for new and newly converted homes in the UK.

HomeBond is the national organisation which since 1978 has enabled home builders to provide their customers with new home warranties and deposit and stage payments cover in Ireland.



All dimensions in mm

easi-stud™ Stud Definitions

The easi-panel® system comprises a number of parts that make up the complete wall structure.

easi-stud™ Typical Details

Timber

Timber used in the design of easi-panel® studs is kiln dried and strength graded, and complies with current European and British Standards.

Preservative

Stud timbers may be treated with waterborne solutions, or with non corrosive spirit based organic solvents. Copper chrome arsenate and similar treatments are not recommended.

Features and Advantages

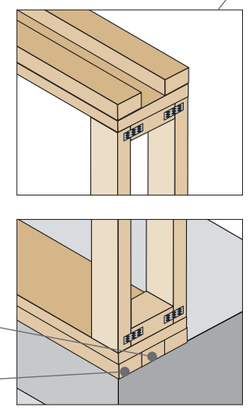
- The open web design accommodates thick layers of virtually uninterrupted insulation achieving U-Values as low as 0.11W/m²K.
- Minimal thermal bridging when compared to other systems
- Provides enhanced racking resistance
- Light and easy to handle
- Factory manufactured, made to measure
- Dimensional stability
- Reduced site wastage

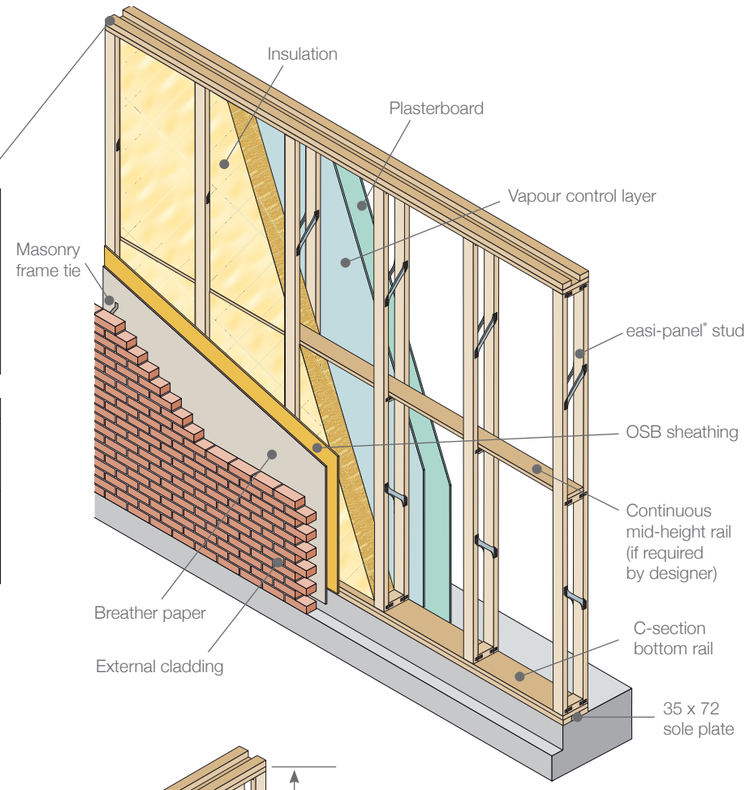
easi-panel® Panel Details

C-section top rail

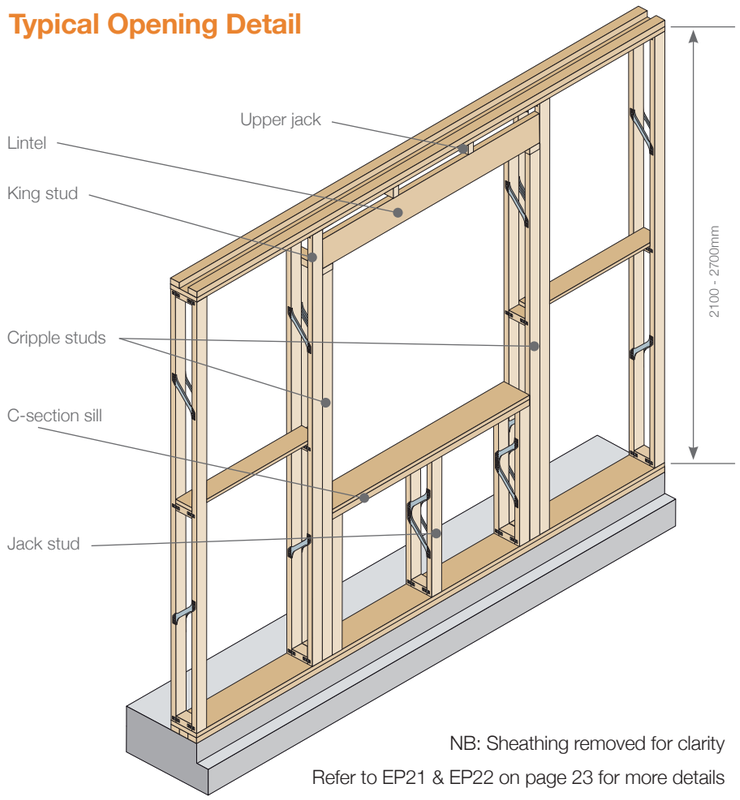
2No 47 x 72 flanges nailed to 9mm OSB/3 with 2.85ø x 50 nails @ 300mm c/c.

C-section bottom rail is identical.





Typical Opening Detail



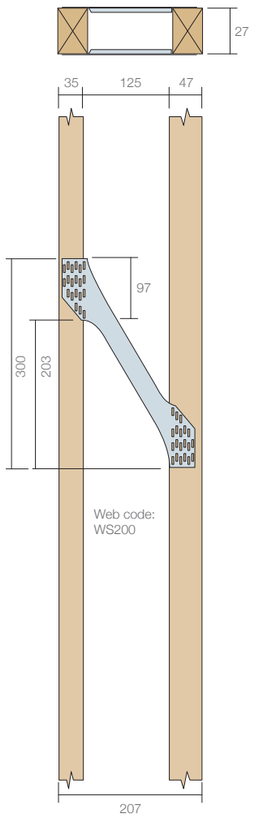
NB: Sheathing removed for clarity

Refer to EP21 & EP22 on page 23 for more details

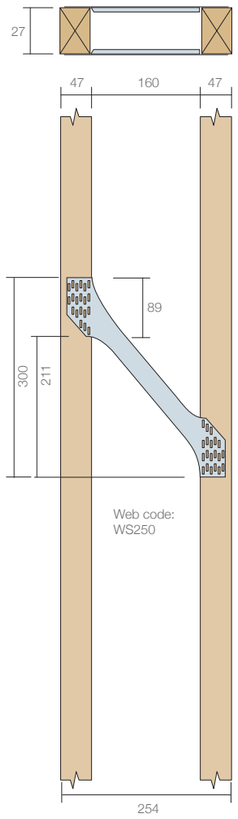
easi-stud™ Specification

There are two easi-stud™ options:

ES207



ES254



All dimensions in mm

Timber specification:

Timber for chords, end and centre columns are strength grade TR26 (C27 equivalent).

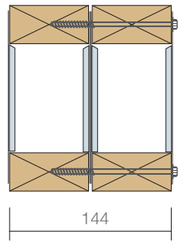
Centre and end column pieces:

35 x 72 x 125/160

Centre and end column nail plates:

Code: 0207

Size: 24 x 75 mm

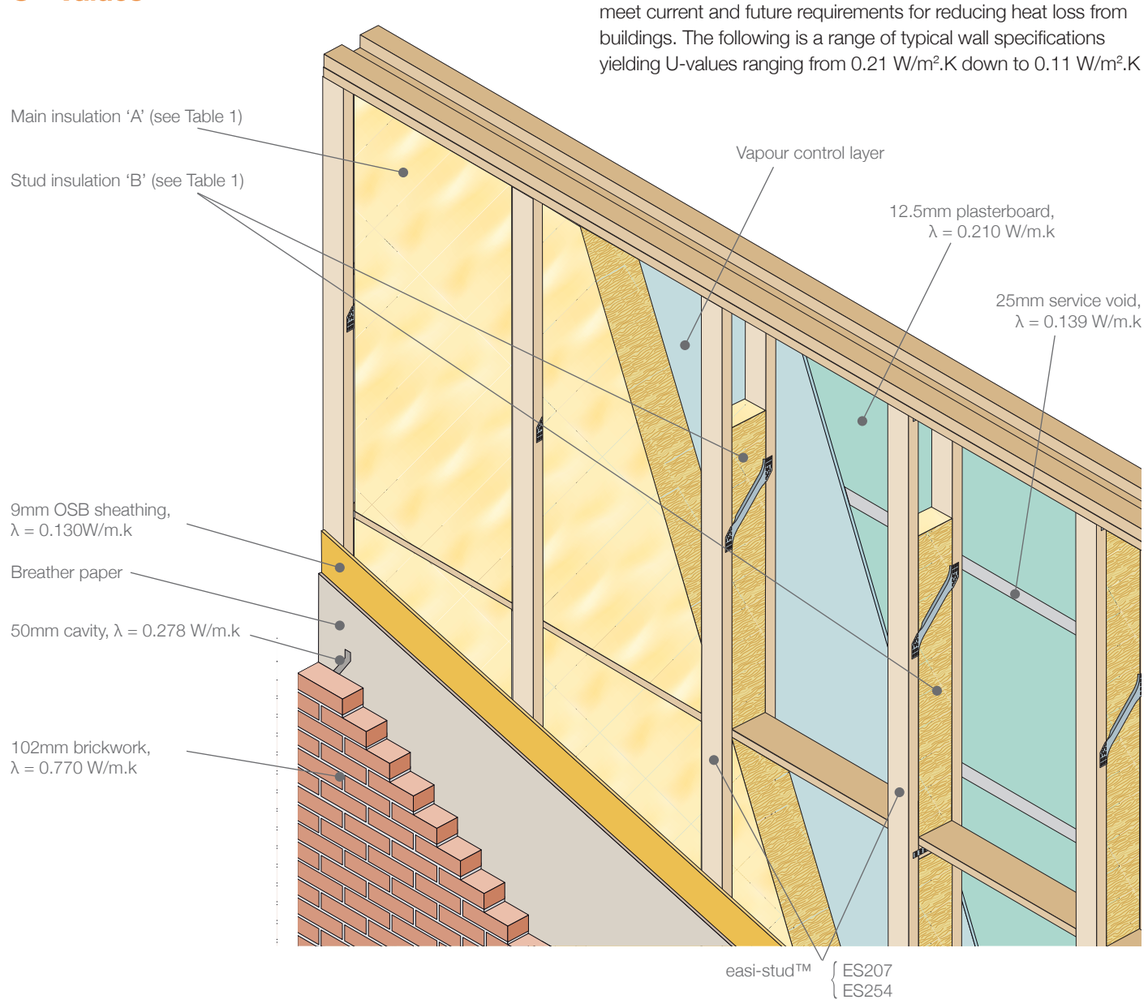


Fixing

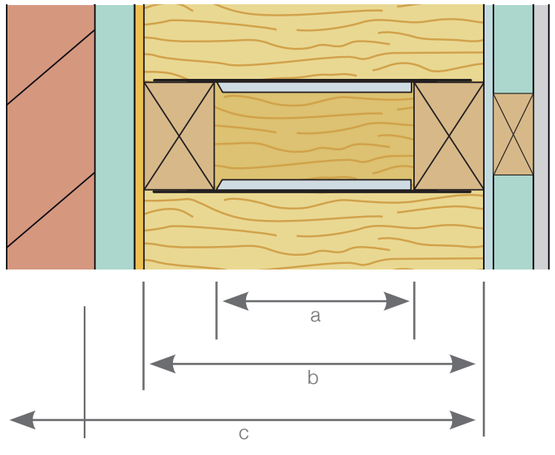
Fastening of multi-ply studs to be carried out to manufacturer's instruction using 5.5mm (or 6.0mm) Ø x 120mm self-drilling screws to BS EN 14592-2008 at 600mm centres max.

U - Values

The easi-panel® wall system provides a number of options to meet current and future requirements for reducing heat loss from buildings. The following is a range of typical wall specifications yielding U-values ranging from 0.21 W/m².K down to 0.11 W/m².K



Dimensions mm			
Web ref	a	b	c
ES207	125	207	368
WS254	160	254	415



The configuration of metal web and timber chords provides a virtually uninterrupted insulation zone. 3D thermal numerical modelling carried out by C4Ci Ltd supported by Guarded Hot Box tests conducted by the National Physical Laboratory demonstrate that the metal webs contribute very low levels of thermal bridging when calculating U-values for the wall system. The increase to the U-value is approximately 0.01 W/K.m, compared to an identical wall (identical battens, spacing and insulation), but with no metal clips. The comparable increase moving to a solid stud is approximately 0.03 W/K.m, over the 'identical wall,' with no metal clips.

Table 1

U-values for common wall constructions

Ref	Insulation Type / Description	λ W/m.k
x1	Polyurethane (PU) – rigid/foam	0.023
x2	Mineral wool – rolls/batts	0.036
x3	Warmcel Cellulose fibre – bagged fibre	0.036
x4	Mineral wool – rolls/batts	0.038
x5	Mineral wool – rolls/batts	0.040
x6	Mineral wool – rolls/batts	0.044

Stud Ref	Insulation configuration: Main Insulation 'A'	Insulation configuration: Insulation between Stud Flanges 'B'	U-Value† W/m2.K
ES207	x1	x1	0.13
	x4	x1	0.18
	x2 / x3	x2 / x3	0.18
	x5	x1	0.18
	x4	x4	0.19
	x5	x5	0.19
	x6	x6	0.21
ES254	x1	x1	0.11
	x4	x1	0.15
	x2 / x3	x2 /x3	0.15
	x5	x1	0.16
	x4	x4	0.16
	x5	x5	0.16
	x6	x6	0.18

† Includes a calculated adjustment of + 0.01 W/m2.K to take account of discrete thermal bridging by the metal webs.

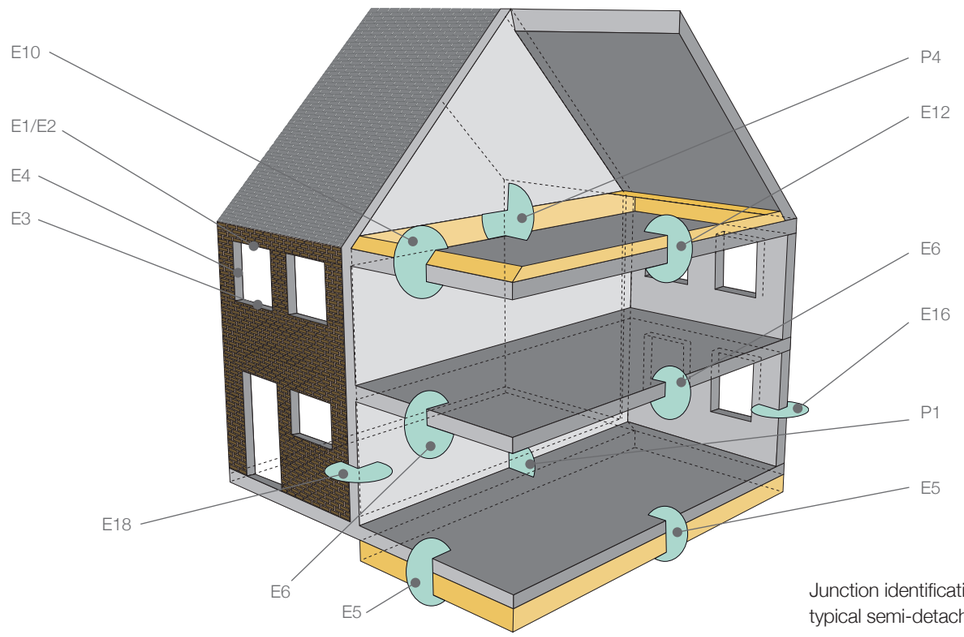
Wall Design Factors - Thermal Performance

Ψ (Psi) Values (Linear thermal bridging)

The following Ψ-values have been calculated for use in the UK SAP calculations.

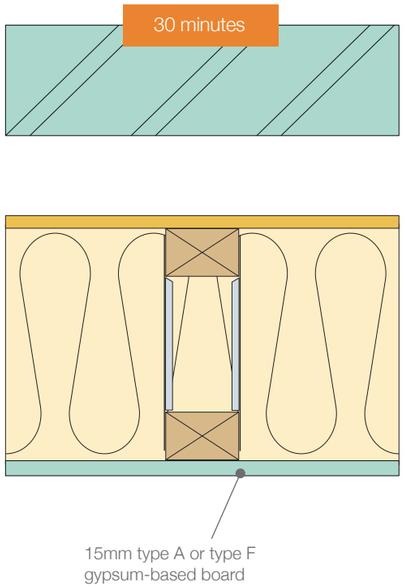
SAP Table K1 Reference	Description	Ψ-value/1 W/m.K	f – factor/2	TM Certificate No. /3
E16	External corner	0.050	0.816	C4TM-000635
E17	Internal corner	-0.041	0.937	C4TM-000636
E18	Party wall	0.037	0.918	C4TM-000635
E5	Ground floor parallel to PC beams	0.065	0.827	C4TM-000638
E5	Ground floor perpendicular to PC beams	0.060	0.827	C4TM-000639
E6	Intermediate floor parallel	0.037	0.926	C4TM-000640a
E6	Intermediate floor perpendicular	0.038	0.926	C4TM-000640b
E7	Party floor	0.050	0.938	C4TM-000641
E10	Eaves (insulation at ceiling level)	0.046	0.908	C4TM-000642
E12	Gable (insulation at ceiling level)	0.045	0.906	C4TM-000643
E1/E2	Lintel	0.049	0.876	C4TM-000644
E3	Sill	0.024	0.905	C4TM-000645
E4	Jamb	0.030	0.874	C4TM-000646
Party wall junctions (Twin 89mm stud, 100mm cavity fully filled with mineral wool)				
P1	Ground floor	0.028	0.955	C4TM-000647
P4	Roof (insulation at ceiling level)	0.042	0.939	C4TM-000648

/¹ - Calculations are based on junctions modelled using the ES207 stud with a 50mm cavity and 100mm brickwork outer leaf. These Ψ-values can also be used for similar constructions that incorporate the ES254 stud.
/² - f-factors greater than 0.75 present no risk of surface condensation or mould growth.
/³ – These PSI value certificates are available on request from Wolf Systems Ltd.

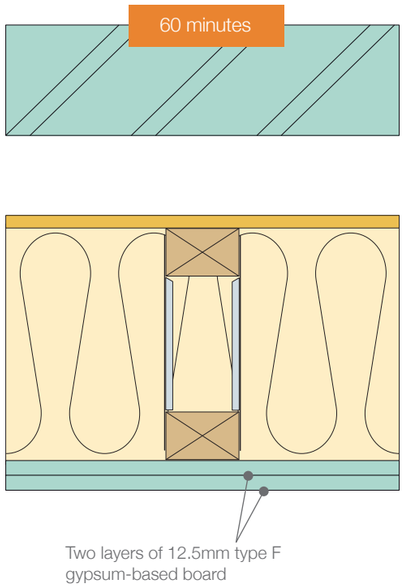


Junction identification on a typical semi-detached dwelling

Fire Resistance



Subject to fire tests and assessments



Cavity Barriers & Firestops

The easi-panel® wall system can use conventional methods and products to prevent the spread of fire through cavities.

Firestops are used within the structure to ensure that fire cannot circumvent fire resisting elements such as walls or floors. They are generally non-combustible board or mineral wool and are installed at:

- Walls between dwellings
- Floors between dwellings
- Other fire compartment separations

Cavity barriers are used within cavities to prevent fire spread. Rigid types include timber battens or non-combustible board. Flexible types are based on mineral wool. Cavity barriers are required:

- Around all openings in external walls
- At the top of an external wall cavity
- At the junction between compartment walls or floors and external walls
- At the junction between a compartment wall that separates buildings and an external wall
- At the junction between a floor and an external wall (in Scotland and Northern Ireland)
- At vertical or horizontal centres not exceeding:
- 15m in Scotland
- 8m in Northern Ireland

Typical examples of cavity barrier and firestop installation are included in the wall detailing section in this manual.

General

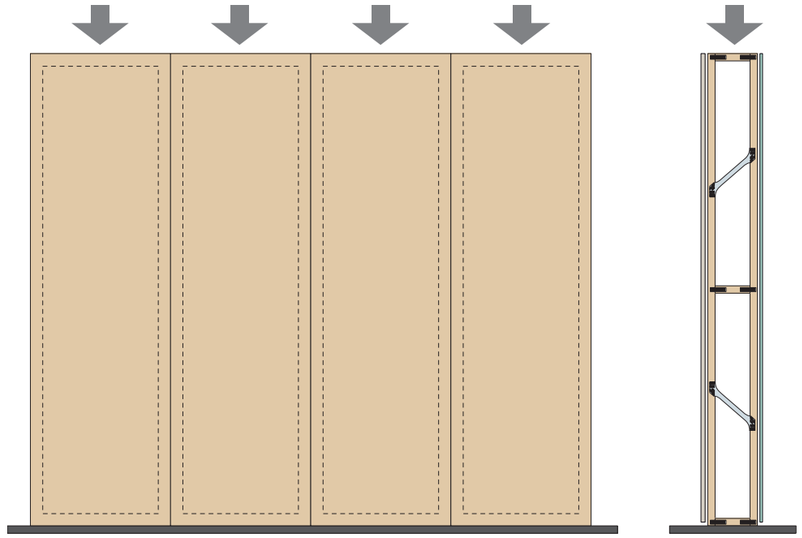
The additional depth and efficiency of easi-panel® metal web studs provides enhanced resistance to wind loading and good all round structural performance.

Wall design involves the interaction of vertical loads transmitted from the roof to the foundation and horizontal wind loading. Designs should be executed or checked by a Structural Engineer.

The following is a summary checklist for design:

1 Uniform vertical loading from above

Uniform vertical loading from the roof and the floors and walls of the upper storeys



Check the axial capacity of the easi-stud™ and the bearing capacity of the top and bottom rails.

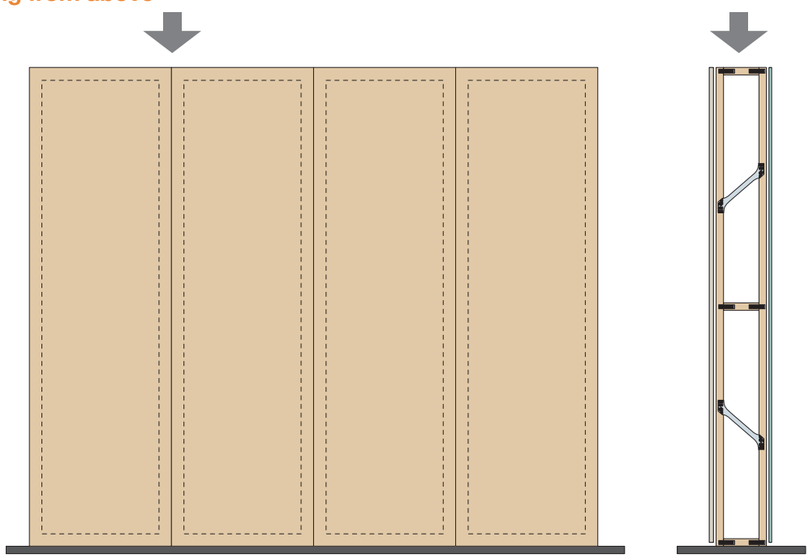
easi-panel® design information:

In most platform timber frame designs the Designer can assume a load distribution of 35%/65% between the outside and inside flanges respectively at the top of the wall studs. The metal webs will redistribute this load to 43%/57% at the bottom of the wall stud, in the case of ES207 studs, and 50%/50% in the case of ES254 studs.

2 Concentrated vertical loading from above

Concentrated vertical loading from highly loaded structural elements such as roof girder trusses or primary floor beams.

Check the axial capacity of the easi-stud™ and the bearing capacity of the top and bottom rails. Provide multiple studs where necessary.



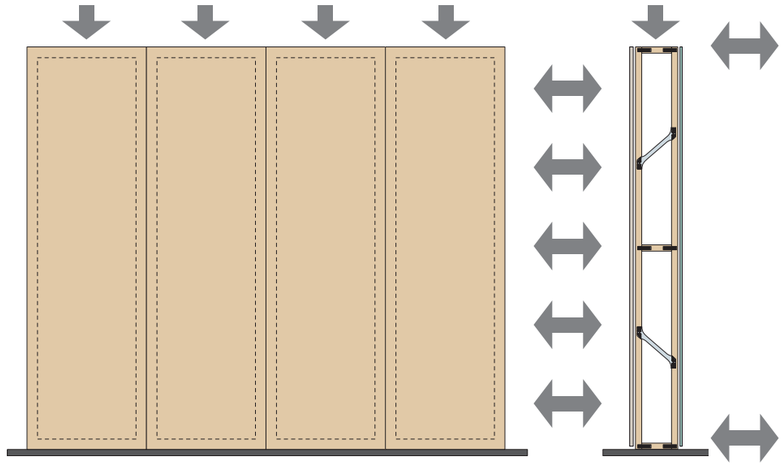
3 Wind loading normal to the wall panels

Reversible wind loading normal to the wall.

Check the capacity of the easi-stud™ for the various combinations of axial loads and bending moments.

Check the horizontal deflection of the easi-stud™.

Check the capacity of the fixings at the top and bottom of the panels to resist wind load.



easi-panel® design information:

Designers can use the following values for the easi-stud™ bending capacity and stiffness:

easi-stud™ Reference	Design Standard			
	BS EN 1995-1-1 :2008		BS 5268-2 :2006	
	$M_{max,k}$ kNm	EI Nmm²	$M_{adm,LT}$ kNm	EI Nmm²
ES207	2.40	72.0 x 10^9	0.98	72.0 x 10^9
ES254	2.90	86.0 x 10^9	1.18	86.0 x 10^9

4 Wind loading parallel to the wall panels

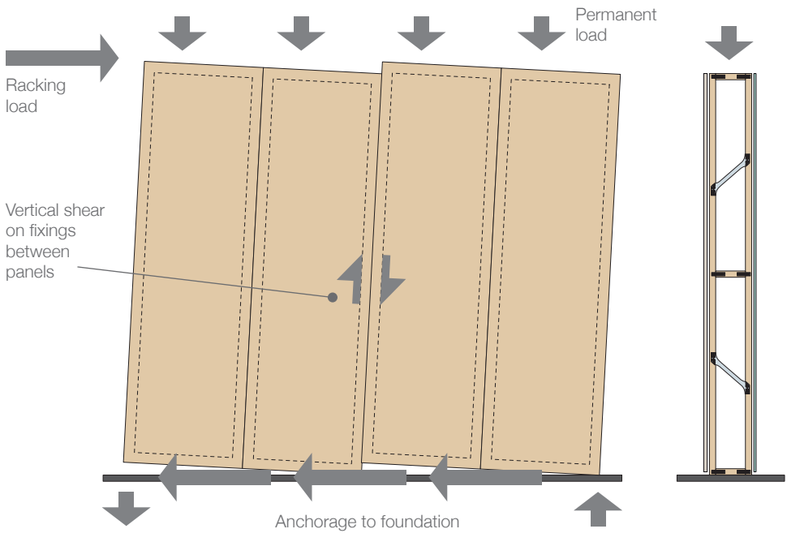
Reversible wind loading parallel to the wall (including horizontal loads from the roof and upper storeys).

Check the racking capacity of the easi-panels®.

Check the capacity of the fixings at the bottom of the panels to resist sliding due to wind load.

Check the capacity of the wall panel anchorage to resist overturning due to wind load.

Check the capacity of the 'panel to panel' fixings to transfer design shear force across the wall.



easi-panel® design information:

Designers can use the following values for the easi-panel® racking capacity:

easi-stud™ Reference	Design Standard	
	BS EN 1995-1-1 :2004	BS 5268-2 :2006
	F_v,Rk kN/m	R_b* kN/m
All easi-panel® studs	3.35	2.43

Approximate panel dimensions: 2400mm x 2400mm

Studs centres not greater than 600mm

Sheathing: 9mm OSB-3

Sheathing fixing: 2.85mmØ x 50mm smooth shank nails, fixed at:

- 150mm centres on the sheet perimeter
- 300mm centres on intermediate studs

*Design by applying the following design modification factors to Rb :

Applicable	Not Applicable
K102 Nail spacing K103 Board thickness K104 Height K105 Length K106 Openings K108 Interaction	K101 Nail diameter K107 Vertical load

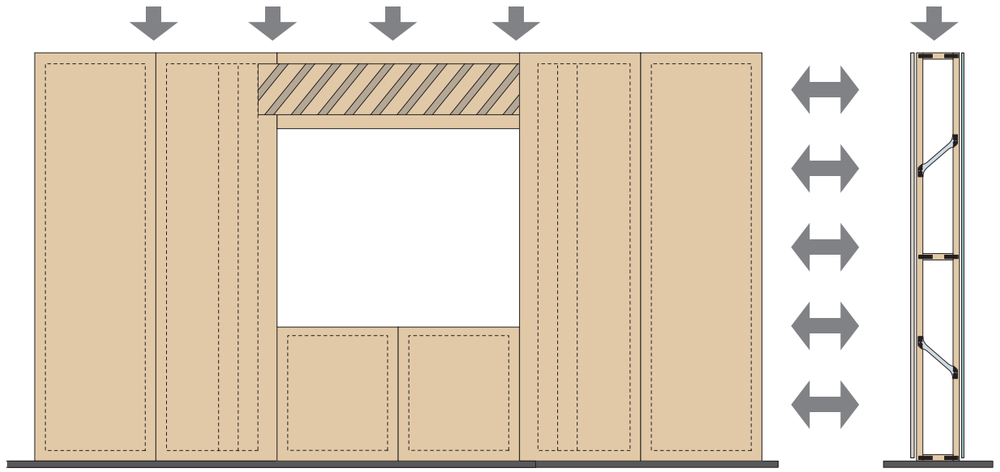
5 Vertical and horizontal loads around openings

Vertical loading from the roof and the floors and walls of the upper storeys and wind loading normal to the wall panels.

Check the axial capacity of the easi-stud™ cripple studs and the bearing capacity of the bottom rails.

Check the capacity of the easi-stud™ either side of the opening for the various combinations of axial loads and bending moments. Provide additional studs if required.

Check the horizontal deflection of the easi-stud™.

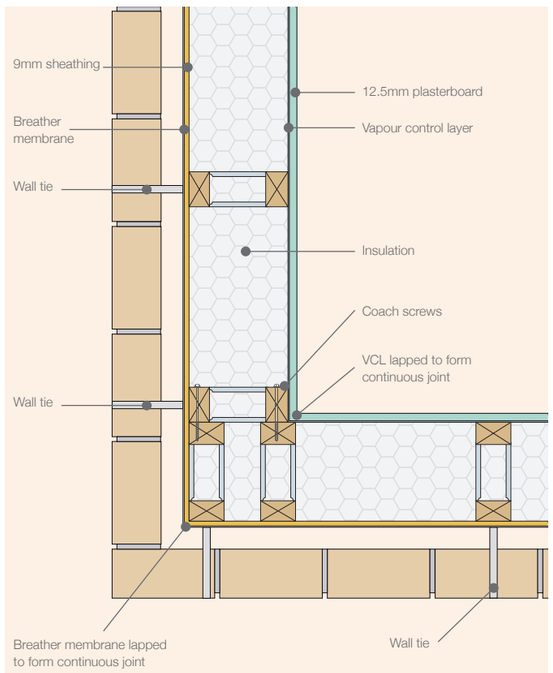


- Lintel is designed by the Structural Engineer
- Studs may need to be provided in locations specifically for:
  - fixing wall ties
  - fixing sheathing and dry lining

Note: Additional details may be available on request from Wolf Systems

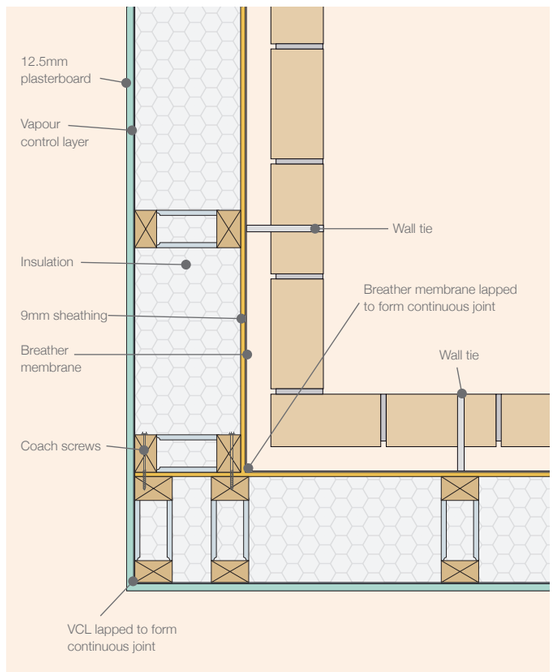
EP1 - External corner

Ψ=0.050



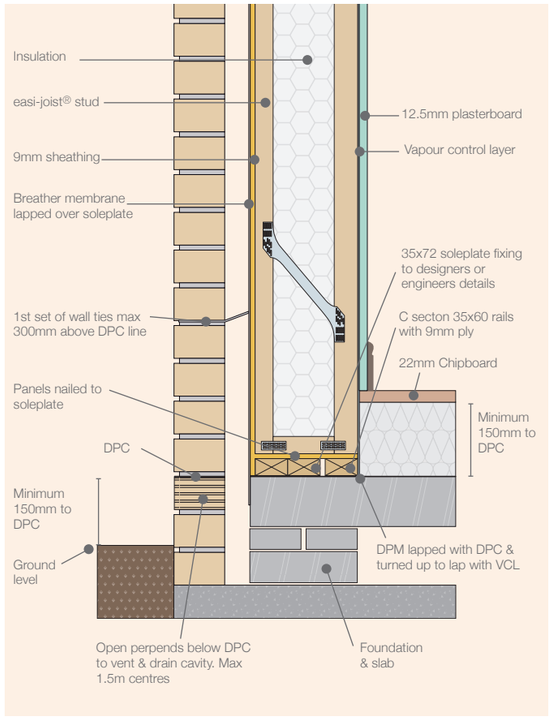
EP2 - Internal corner

Ψ=0.041



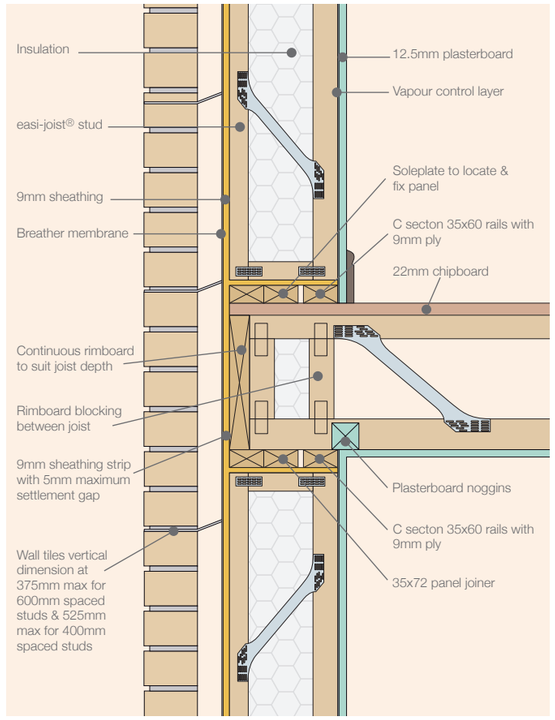
EP3 - Ground floor

Ψ=0.060 / 0.065



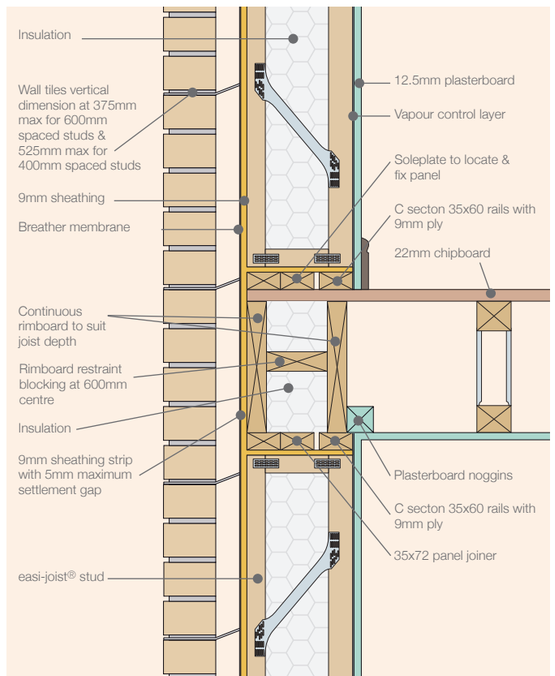
EP4 - Intermediate floor (joists perpendicular)

Ψ=0.038



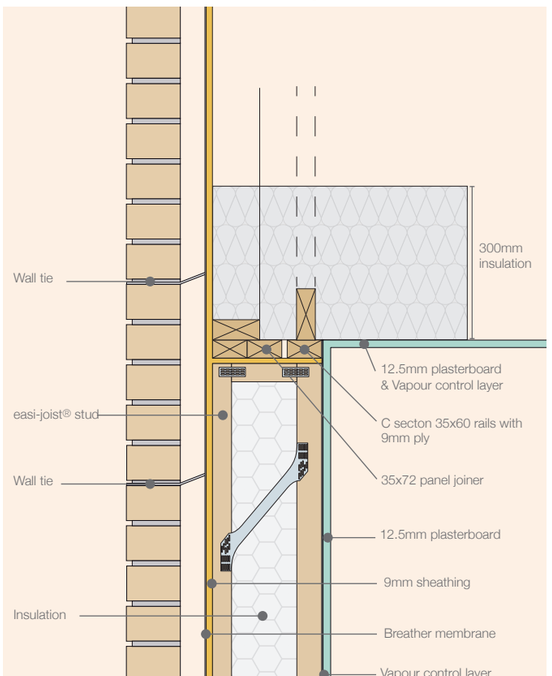
EP5 - Intermediate floor (joist parallel)

Ψ=0.037



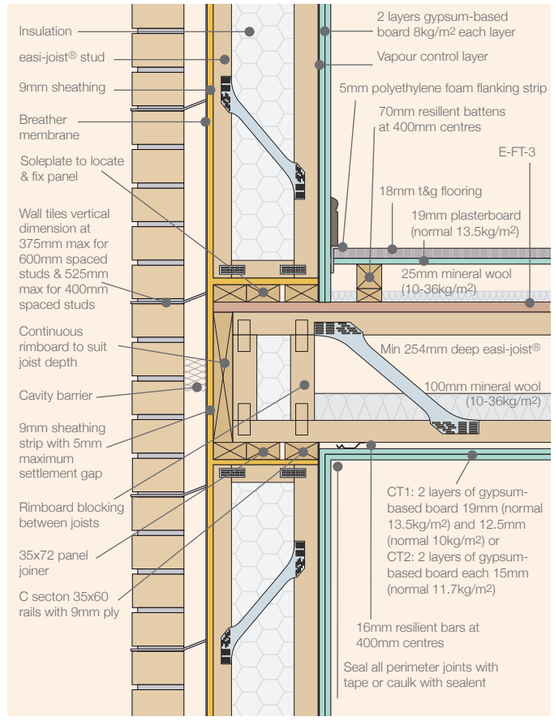
EP6 - Gable (insulation at ceiling level)

Ψ=0.045



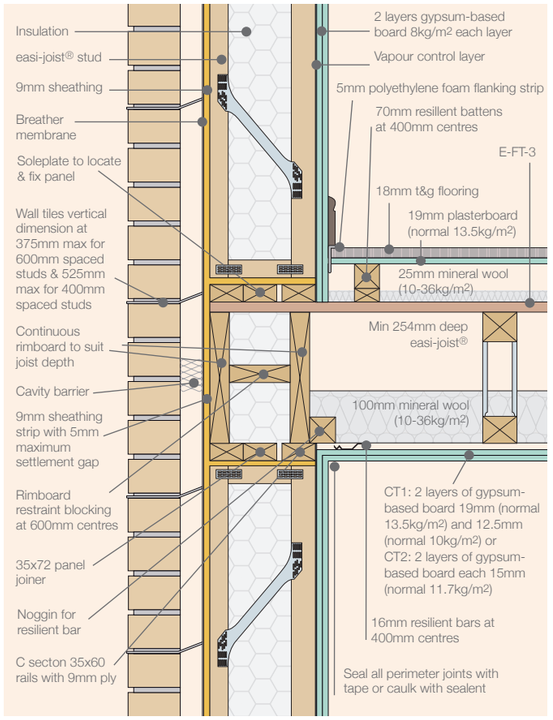
EP7 - Party floor (joist perpendicular)

Ψ=0.050

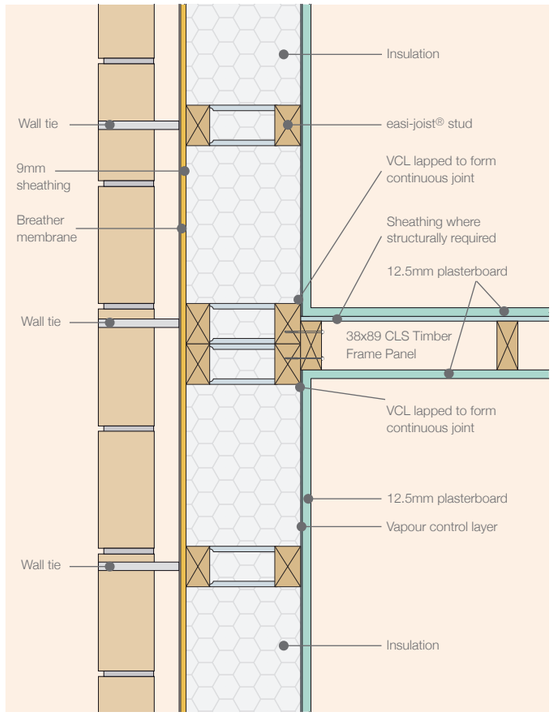


EP8 - Party floor (joist parallel)

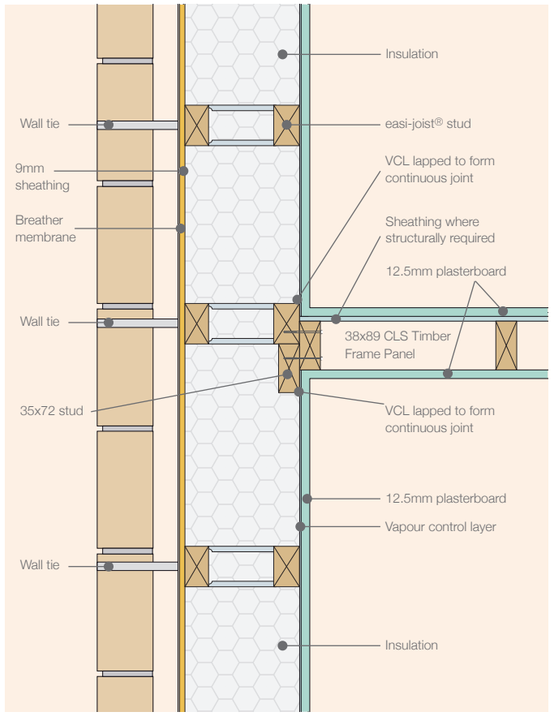
Ψ=0.050



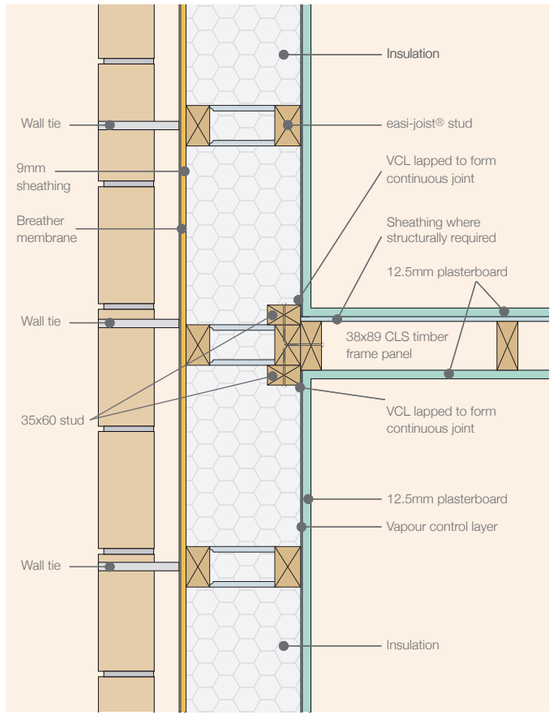
EP9 - Load bearing partition (option 1)



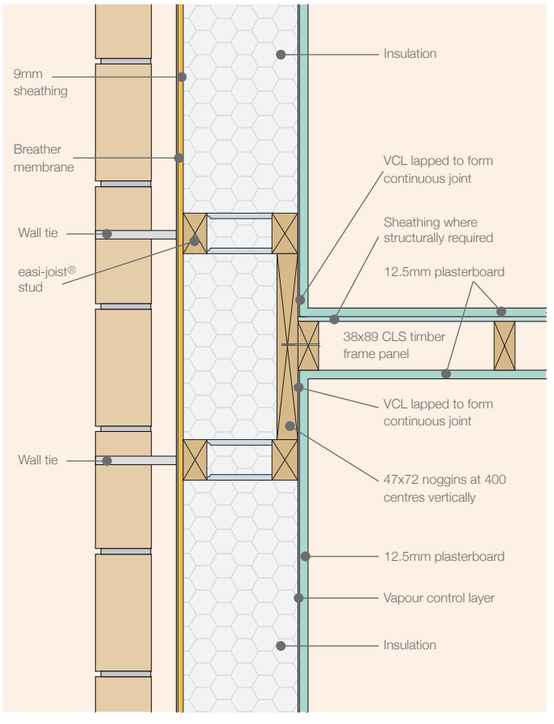
EP10 - Load bearing partition (option 2)



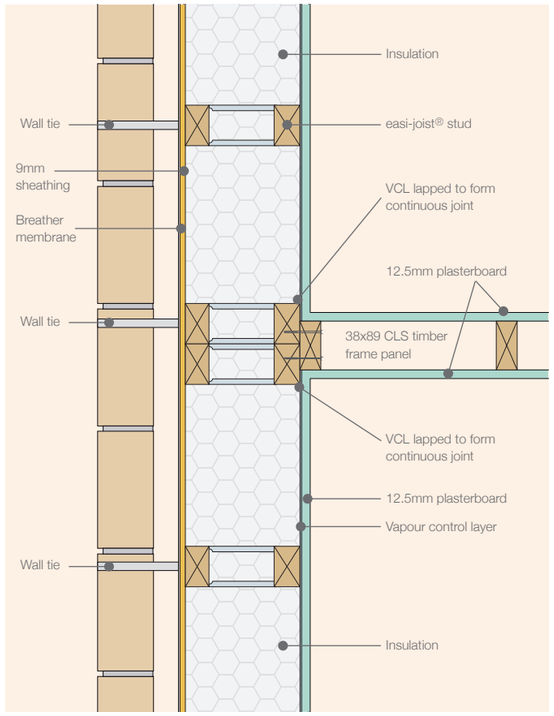
EP11 - Load bearing partition (option 3)



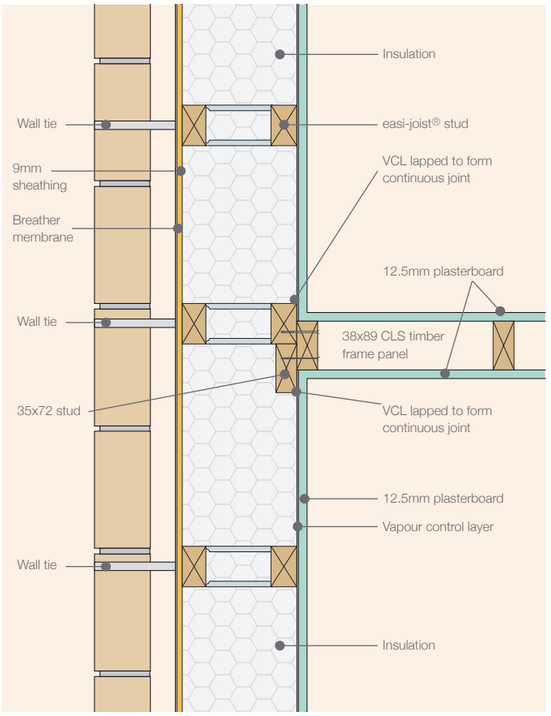
EP12 - Load bearing partition (option 4)



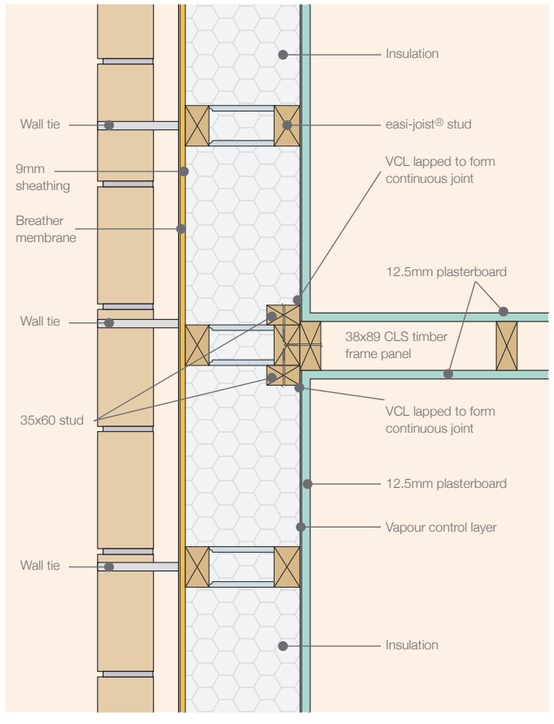
EP13 - Non load bearing partition (option 1)



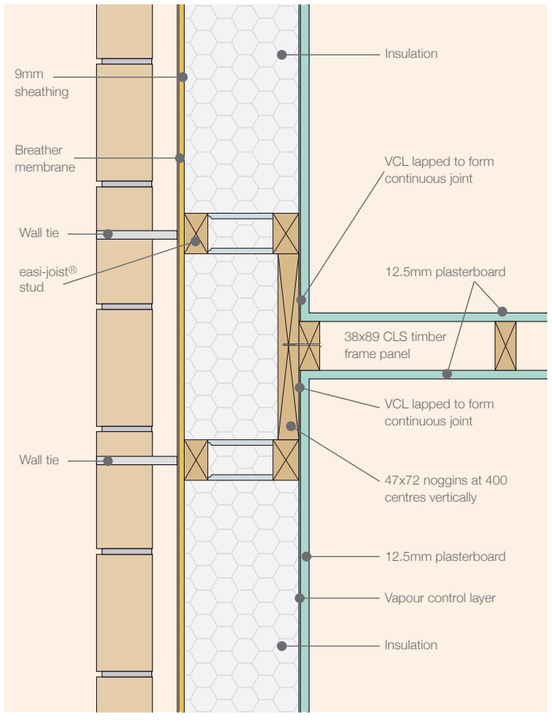
EP14 - Non load bearing partition (option 2)



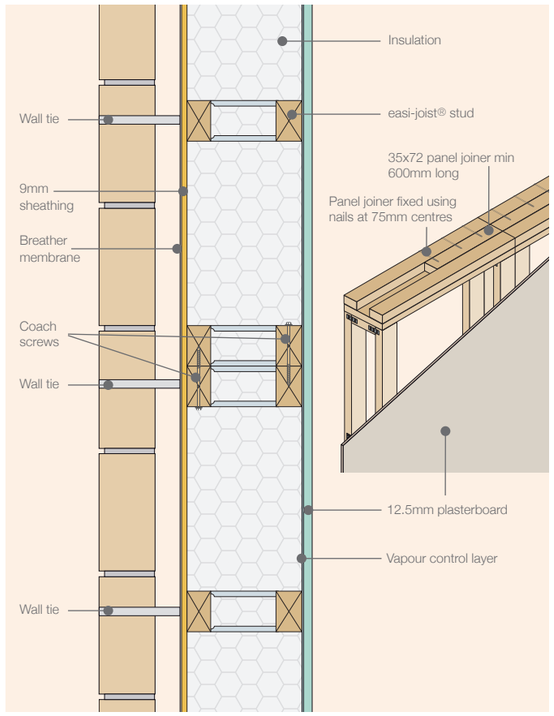
EP15 - Non load bearing partition (option 3)



EP16 - Non load bearing partition (option 4)

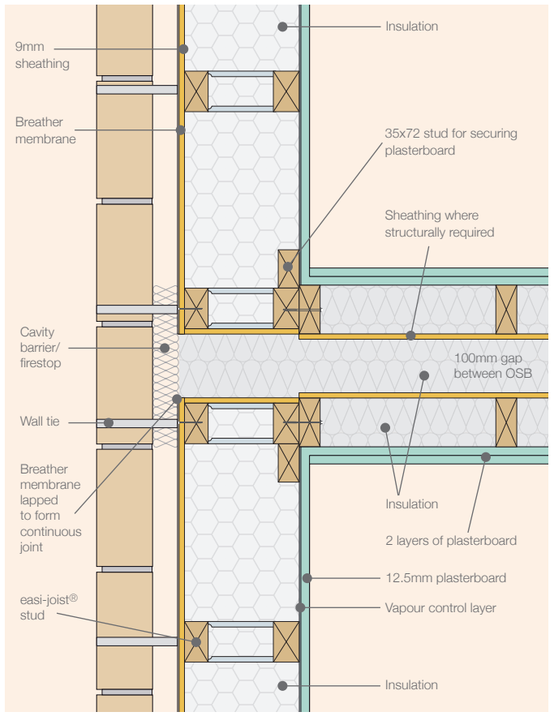


EP17 - Panel joint



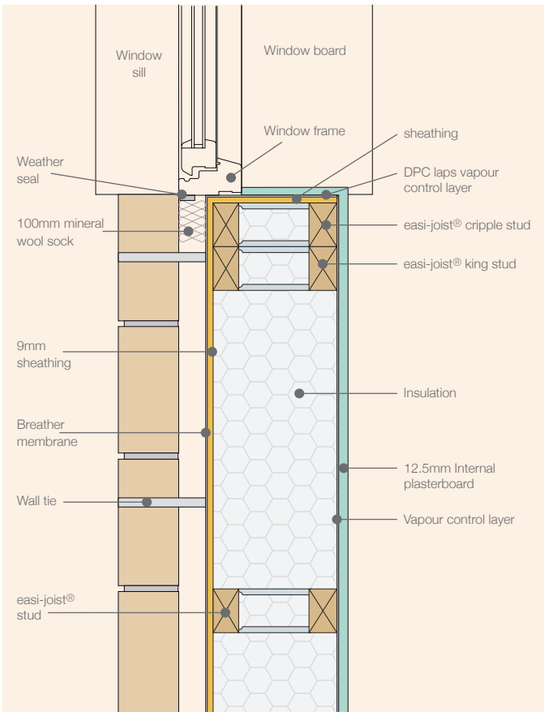
EP18 - Party wall

Ψ=0.037



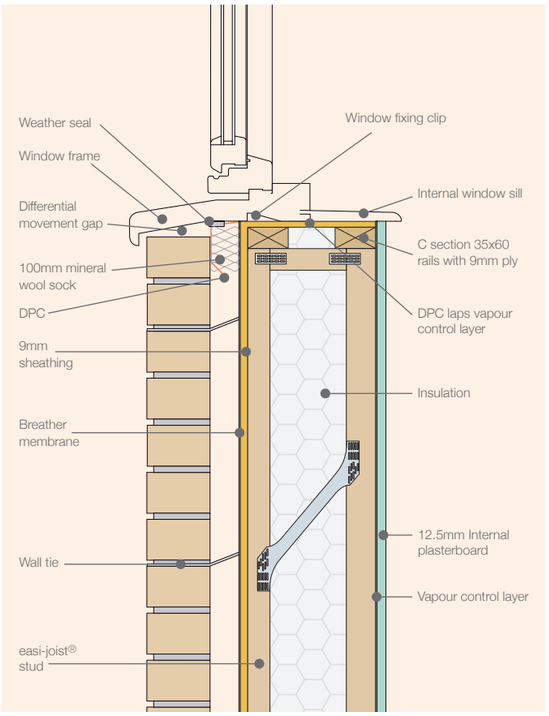
EP21 - Window jamb

Ψ=0.030



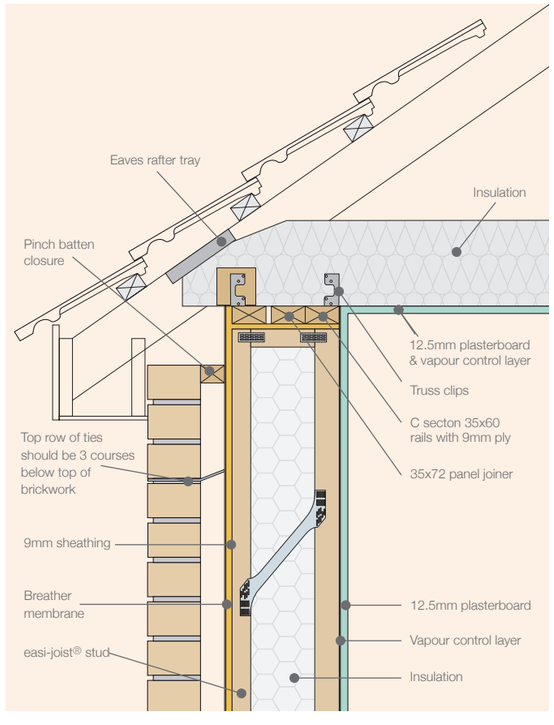
EP22 - Window sill

Ψ=0.024



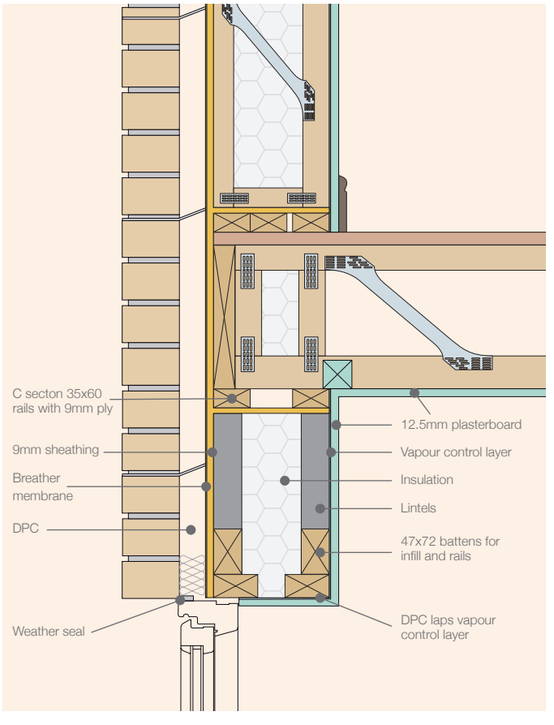
EP19 - Eaves (insulation at ceiling)

Ψ=0.046



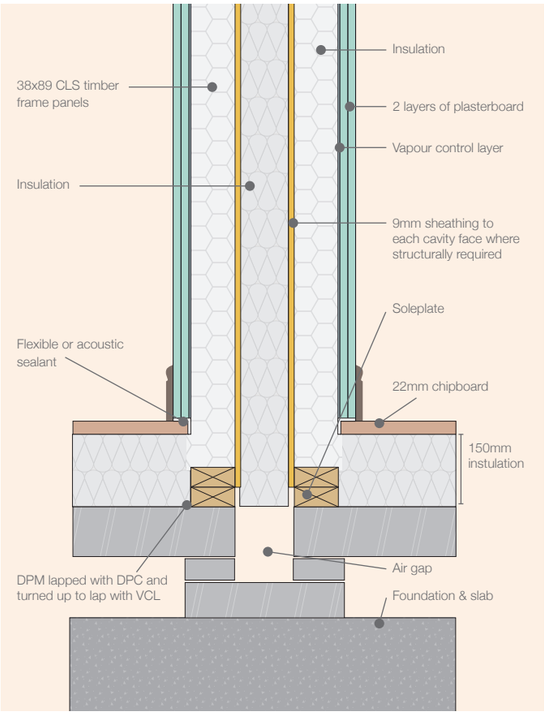
EP20 - Window Head

Ψ=0.049



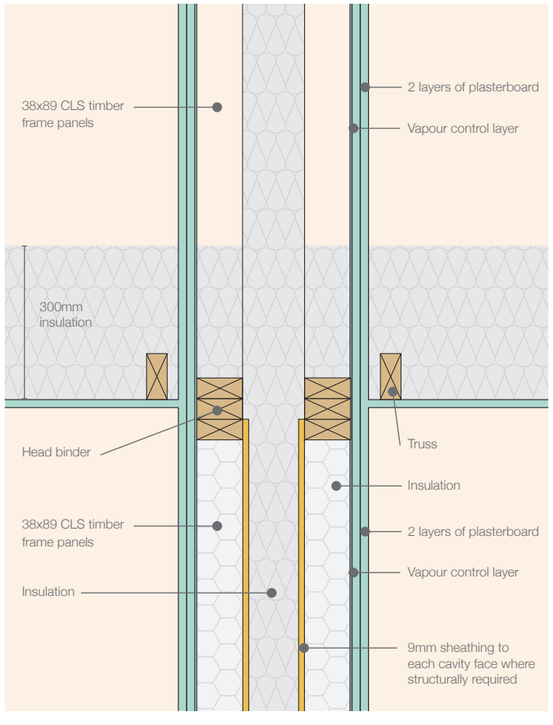
EP23 - Party wall - ground floor

Ψ=0.028



EP24 - Party wall - roof void

Ψ=0.042



General

The requirements and guidance for the transportation, site storage and handling of easi-panel® wall system panels are no different from those for conventional factory made timber frame wall panels.

easi-panel® wall system suppliers will ensure that processes and guidance are in place to address the following:

- Foundations are prepared and checked for dimensional accuracy, level and squareness
- Panels stored on site are:
  - clear of the ground
  - covered
  - ventilated
- Lifting is carried out
  - safely
  - in a manner that that does not damage the wall panels
  - using fabric slings attached to designated lifting points
- Temporary bracing is fitted to support the panels until they are fully fixed and integrated in to the building structure

Further information on good site practice for timber frame erection can be obtained from:

- Structural Timber Association (formerly UKTFA) www.structuraltimber.co.uk/

  and

- TRADA www.trada.co.uk

Tolerances

The key to all successful frame erection is ensuring that the substructure is constructed properly and within tolerance.

Concrete and masonry substructures should adhere to the following tolerances;

- Level: +/- 5mm
- Edge line: +/- 10mm

Panels/studs should be erected within:

- 10mm plumb over storey height
- 10mm horizontal alignment over the wall length. Usually controlled by the sole plate

Laps and Fabric Continuity

In order to achieve an airtight, moisture-resistant and thermally-efficient external envelope site installation should adhere rigorously to good practice for lapping and continuity of:

- dpc s'
- vapour control layers
- insulation
- breather membranes

Health and Safety

General

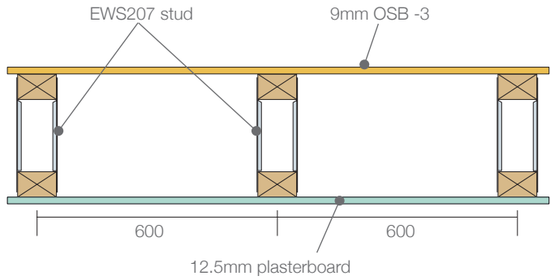
There are no additional Health and Safety issues to be considered when handling easi-panel® wall system panels than for conventional factory made timber frame wall panels.

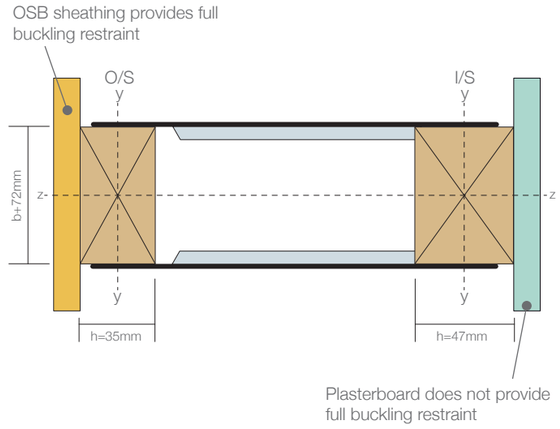
easi-panel® wall system suppliers will ensure that processes are in place to manage Health and Safety issues at all stages from design through to completion.

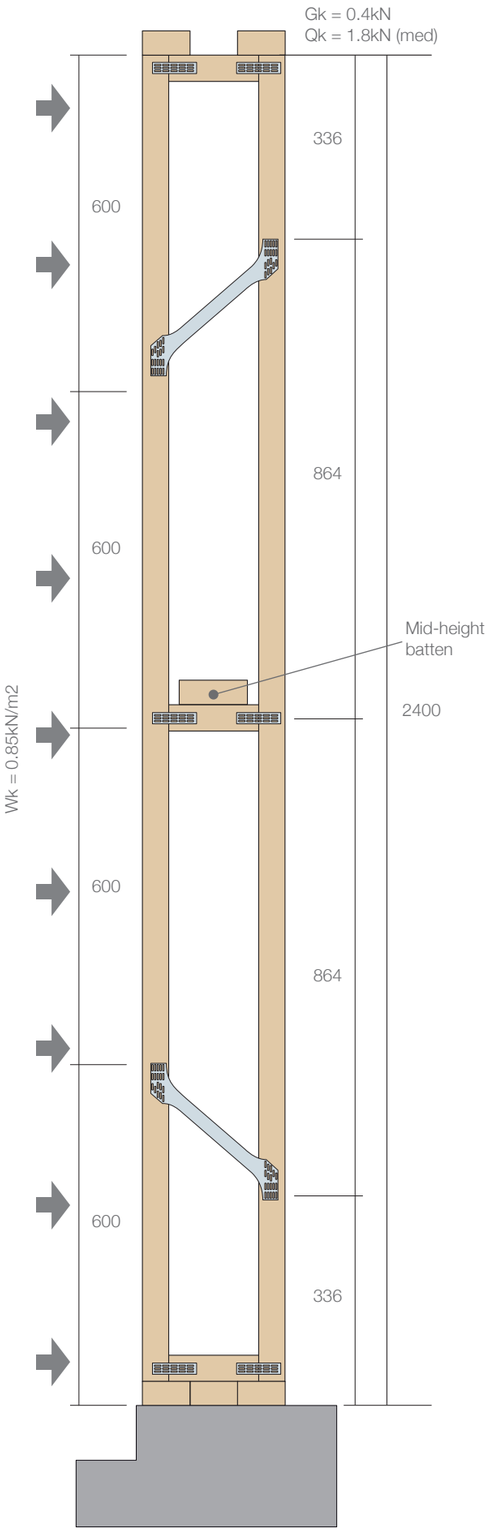
UKTFA Health and Safety Code of Practice

This document, produced by the UKTFA (now available from the Structural Timber Association www.structuraltimber.co.uk), provides full guidance on applying the legal requirements of the Management of Health and Safety at Work Regulations to the planning and execution of timber frame works.

Example EC5 calculation







	Outside flange O/S	Inside flange I/S	Units	EC5 ref
Geometric properties:				
b =	72	72	mm	
h =	35	47	mm	
A=b x h =	2520	3384	mm²	
Effective lengths:				
Ley =	600	864	mm	
Lez =	0 (due to sheathing)	1200	mm	
2nd moment areas:				
Iy =	257250	622938	mm⁴	
Iz =	1088640	14461888	mm⁴	
Radius of gyrations:				
ry =	10.01	13.6	mm	
rz =	20.8	30.8	mm	
Slenderness ratios:				
λy =	59.4	63.7		
λz =	0	57.8		
Timber strength properties:				
Stud flange and C-section rails C27 + tests on EWS207 stud				
Char. compression par, $f_{c,0,k}$		22	N/mm²	
Char. bending $f_{m,y,k}$ =		27	N/mm²	
Char.compression perp, $f_{c,90,k}$ =		2.6	N/mm²	
5th percentile MoE, $E_{0,05}$ =		7700	N/mm²	
Char.Moment Capacity, $M_{y,k}$ =		2.4	kNm	From test
Flexural rigidity, EI =		72.0 x 10^9	Nmm²	From test
Partial safety factors:				
Permanent load factor, γ_G =		1.35		Table NA.A1.2 (B)
Variable load factor, γ_Q=		1.50		
Combination factor for variable actions:				
Medium term vertical load, Ψ_0		0.7		Table NA.A1.1
Wind load, $\Psi_{0,w}$ =		0.5		
Material factor, γ_m =		1.3		Table 2.6 solid
Actions:				
G_k =		0.4	kN	
Q_k =		1.8	kN	
W_k =		0.85	kN/m²	
Vertical load distribution	G_k	Q_k	G_k	Q_k
Top of stud: 35% / 65%	0.14	0.63	0.26	1.17
Mid height of stud: 39% / 61%	0.16	0.70	0.24	1.10
Bottom of stud: 43% / 57%	0.17	0.77	0.23	1.03
load combination 1 - permanent only: N1d = γ_G. G_k				
Top of srud:		0.19		0.35
Mid height of stud:		0.21		0.33
Bottom of stud:		0.23		0.31

	Outside flange O/S	Inside flange I/S	Units	EC5 ref
Load combination 2 - permanent + variable loads (wind dominant):				
Vertical loading: $N2_d = \gamma_G . G_k + \Psi_0 + \gamma_G + Q_k$				
Top of stud:	0.85	1.58	kN	
Mid height of stud:	0.95	1.45	kN	
Bottom of stud:	1.04	1.39	kN	
Lateral loading: $W2_d = \gamma_Q . W_k$				
$W2_d$		1.28	kN/m²	
M2y,d = W2d x L2/8 =		1.11	kNm	
Load combination 3 - permanent + variable (at sole plate): $N3_d = \gamma_G . G_k + \gamma_Q . Q_k$				
Bottom of stud	1.39	1.85	kN	
Modification factors (Service Class 2):				
$K_{mod,perm}$		0.6		Table 3.1
$K_{mod,med}$		0.8		Table 3.1
$K_{mod,inst}$		1.0		Table 3.1
System strength factor, K_{sys}		1.1		6.7
Bearing factor, $K_{c,90}$		1.0		6.1.5.(2)
Design strength of the studs: The critical design load case for the stud is load combination 2				
Design compressive strength:				
$f2_{c,0,d} = K_{mod,inst} \cdot K_{sys} \cdot f_{c,0,k} / \gamma_m$ =		20.48	N/mm²	
Design moment capacity:				
$M2_{y,Rd} = K_{mod,inst} \cdot K_{sys} \cdot M_{y,k} / \gamma_m$ =		2.23	kNm	
Design strength of the bottom rail (C-stud with C27 chords): The critical design load case for bottom rail is load combination 3				
Design compressive strength:				
$f3_{c,0,d} = K_{mod,inst} \cdot K_{c,90} \cdot f_{c,90,k} / \gamma_m$ =		1.6	N/mm²	
Buckling resistance factors:				6.3.2
Relative slenderness (y-y) $\lambda_{rel,y} = (\lambda y / \pi) \cdot \sqrt{(f_{c,0,k} / E_{0,05})}$				Equ'n 6.21
$\lambda_{rel,y}$ =	1.01	1.08		
Relative slenderness (z-z) $\lambda_{rel,z} = (\lambda z / \pi) \cdot \sqrt{(f_{c,0,k} / E_{0,05})}$				Equ'n 6.22
$\lambda_{rel,z}$ =	0	0.98		
β_c		0.2		Equ'n 6.29
Factor K_y =0.5 [1 + $\beta_c \cdot (\lambda_{rel,y}-0.3) + \lambda^2_{rel,y}$]				Equ'n 6.27
K_y =	1.13	1.16		
actor K_z =0.5 [1 + $\beta_c \cdot (\lambda_{rel,z}-0.3) + \lambda^2_{rel,y}$]				Equ'n 6.28
K_z =	0.47	1.05		
y-y instability factor $k_{cy} = 1/ (k_y + \sqrt{(k^2_y - \lambda^2_{rel,y})}$				Equ'n 6.25
k_{cy}=	0.61	0.55		
z-z instability factor $k_{cz} = 1/ (k_z + \sqrt{(k^2_z - \lambda^2_{rel,y})}$	1.00	0.70		Equ'n 6.26

	Outside flange O/S	Inside flange I/S	Units	EC5 ref
Stud chord axial compression capacities:				
$N2_{y,Rd} = k_{c,y} \cdot f2_{c,0,k} \cdot A =$	31.48	38.12	kN	
$N2_{z,Rd} = k_{c,y} \cdot f2_{c,0,k} \cdot A =$	51.61	48.51	kN	
$N2_{Rd} =$	31.48	38.12	kN	Minimum capacity
Axial load design ratios ($N2_d$ / $N2_{Rd}$) =				
	0.03	0.04		
Bending moment design ratio ($M2_{y,d}$ / $N2_{y,Rd}$) =		0.50		
			0.50 + 0.04 <1.0	Ok
Bearing stress on C-section flanges:				
$\sigma 3_{c,0,k} = H3_d / A =$	0.55	0.55	N/mm²	
$f3_{c,0,k} =$	1.6	1.6	N/mm²	
Bending design ratio ($\sigma 3_{c,0,d}$ / $f3_{c,0,d}$) =		0.34	<1.0	Ok
Lateral deflection due to wind load:				
$\delta_{inst} = \frac{5 \cdot s \cdot W_k \cdot H^4}{384 \cdot EI} = 3.06mm$	H /300 = 2400 / 300 = 8.0mm			Ok

Note

This calculation represents just one valid method of designing an easi-joist®.

Design engineers may use alternative design methodologies to best suit the project or local regulations.

Glossary of Terms

Bearing The area of a member receiving structural support.

Column A vertical timber block fixed between the chords of an easi-joist®.

Deflection Vertical deformation due to loading.

easi-joist® An engineered joist made from stress graded timber chords fixed with galvanised steel webs.

easi-panel® An engineered wall panel assembled using a derivative of easi-joist® as studs.

OSB Oriented Strand Board - a composite product made from strands of wood and glue.

Rimboard A product used on the perimeter of a building to enclose the floor structure.

Services Pipe work, ducting and cables laid within the floor zone.

Sheathing OSB or plywood sheets nailed to timber frame panels to provide racking resistance.

Web A diagonal galvanised steel strut fixed into the chords of an easi-joist® with pressed nails.

Version: 6th Edition, July 2015.

Notes

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CI/SfB (23.9)