In partnership with

CONSTRUCTION SCOTLAND INNOVATION CENTRE

STRUCTURAL TIMBER ASSOCIATION

Building offsite solutions in timber

Structural timber buildings fire safety in use guidance Volume 1 - Pattern book systems

STA fire safety research and guidance project

Version 2.2 - September 2022

Image courtesy of Stewart Milne Timber Systems Ltd

SITE SAFE

STA ASSURE

Defining the standard for structural timber

Copyright and limitations of the pattern book

The Structural Timber Association's objective in developing this pattern book was to provide resilient evidence-based solutions, in a way that has never previously been done in the UK.

This pattern book provides clarification of performance on different timber frame systems. It is the specifiers obligation that when seeking confirmation of the fire resilience of the systems as describe herein it is precisely the same as that being proposed and is suitable at the point of use. It is incumbent on the STA member to confirm this of their systems, and to provide additional tested information should their system differ in any way.

All data provided is for use by competent persons, from the structural timber industry and built environment, who understand the sector they work in. While this document has been prepared in good faith and all reasonable efforts have been made to ensure its adequacy and accuracy, no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by the Structural Timber Association.

STA Assure

Please note that timber frame systems performance declarations only apply when supplied and/or erected by STA member companies, operating under the STA Assure Quality Scheme. They do not apply to non-member companies engaged in the supply and install of timber frames, regardless of any similarity of systems.

Document revision history

v1.1 March 2020
Original document published.

v1.2 June 2020
Stakeholder support from Scottish Government Building Standards Division added to P5.

v1.3 July 2020
Stakeholder support from NHBC added to P5.

v2.0 March 2021
Updated to remove patterns which were expected to be available late 2020. For consistency the single leaf party wall roof spandrel (showing Fermacell) in v1.3 remains valid, but will be moved to STA Pattern Book Volume 3. Other specific changes are to Part 4 roof spandrel systems 10 and 11 of v1.3 which have been removed. Also added: links to Truss Rafter Association and reference to Engineered Wood Products activity, clarification of mineral wool density and the role of BRE Global in the reviewing process.

v 2.1 August 2022
Clarification of exposure to fire testing.

v 2.2 September 2022
Part 4 has become the section for floor patterns and includes REI30 metal web joist and I-joist solutions. Recommendations for the loading of floors in fire resistance testing are provided with an explanation about how the load influences the joist design.

Report made possible with funding from

SWEDISH WOOD

Scottish Forestry
Coilltearachd na h-Alba

Contents

Part 1 - Overview

Introduction

Timber frame construction is a traditional method of building, with a proven track record of mainstream compliance and longevity. It is widely recognised as the offsite construction system of choice, offering many benefits, including low carbon, cost effective, quality, speed and regulatory compliance.

Fire safety in use affects all forms of construction. All buildings must be designed to comply with the fire safety functional requirements of the building regulations, as a minimum standard. The STA has invested in an industry leading, fire in use research project to test commonly used timber frame wall, floor and roof make ups used in the UK marketplace. This work has been done in partnership with CSIC, University of Edinburgh, BRE Global and with the kind financial sponsorship of Swedish Wood, Scottish Forestry and STA manufacturing members.

In addition, the STA commissioned the University of Edinburgh and BRE Global to undertake research into various fire related matters associated with timber frame construction and material/system testing, providing further confidence in the pattern book produced and its use in the UK marketplace.

The pattern book output is part of the STA's library of fire in use best practise guidance. The STA library of documentation provides comprehensive guidance, information and recommendations on system specifications and good practise principles when using timber frame construction.

The STA believes this pattern book of EN tested systems to be the first of its kind, not seen in the timber frame sector before. The EN tested systems and best practise recommendations provide a comprehensive package of information for the design, specification and construction of timber frame buildings, up to 18m.

This information has been supported and endorsed by several industry and government stakeholders, providing deemed to satisfy style solutions and a unique reference library of information for clients, members and specifiers to use, with confidence.

The information will be regularly reviewed and updated by the STA Technical Committee and Board and is free to download from the STA website www.structuraltimber.co.uk

We hope you find the information provided, both functional and beneficial.

Chief Executive
Structural Timber Association

Company Registration Number: 3862401

Stakeholder engagement

One of the founding principles of the STA research and fire testing project, was to ensure the pattern book of systems created, was relevant to the UK marketplace, reflecting commonly used systems, with the recognition of key industry authorities and government stakeholders, to ensure the information was credible and reliable.

Throughout the project industry bodies such as NHBC and LABC have been kept abreast of progress, as well as Government Building Regulatory Authorities such as SGBSD and MHCLG. The outputs from the project have been peer reviewed by Milner Associates, in collaboration with BRE Global, to ensure they are technically robust and validated from independent experts.

All stakeholder organisations have welcomed the final guidance and are considering how best to recognise the industry guidance produced.

"The Scottish Government welcomes this pattern book which is the first in a series to be published freely online by the STA. This is a good example of collaborative working with industry, academia and fire test houses. This pattern book will drive up consistency of achieving the functional requirements of building regulations throughout Scotland."

Dr Steven Garvin, Head of Building Standards, Scottish Government Building Standards Division

"NHBC welcomes this pattern book which is the first in a series of industry guidance published freely online by the STA.The research and fire resistance testing undertaken is a good example of an industry readying itself for change, in a collaborative and robust way. NHBC supports the use of the guidance which will drive consistency and confidence in the marketplace."

Steven Odunmbaku, Technical Policy Manager, Standards, Innovation & Research, NHBC

Collaborations

The STA continue to collaborate with other industry groups, who have been undertaking similar EN fire resistance testing programmes, complimentary to the STA's work.

This has related to:

1. Timber floor and roof systems, applicable to both masonry and timber frame methods of construction.
2. Additional timber frame wall make-ups, commonly used in Ireland, which are outside of the UK building regulatory system.

These EN testing programmes were organised by the following organisations and supply chains:

- Timber floors - Engineered Wood Products Committee and supplier members
- Timber roofs - Trussed Rafter Association and supplier members
- Timber frame walls - Irish Timber Frame Manufacturers Association and Department of Environment, Ireland.

All fire resistance testing has been undertaken to the same test standard, BS EN 1365-1:2012 (walls) and BS EN 1365-2:2012 (floors). The test information continues to be evaluated between the STA, organisations and suppliers, in a collaborative way, with the intent of increasing the number of systems contained in this pattern book as part of future updates.

Acknowledgements

Construction Scotland Innovation Centre

Scotland's construction innovation centre focused on the built environment, supporting research and development into accelerating industrialisation, digital transformation, culture change and building sustainably, to drive transformational change across the construction industry.

Swedish Wood

Europe's leading timber promotional organisation, supporting research and development, into timber technology and use in the UK and overseas.

Scottish Forestry

The UK's leading forestry organisation, supporting the development of home grown timber and related technologies.

STA Manufacturing Members

STA manufacturing members, governed under the STA Assure Standard, for the design, fabrication and installation of timber frame buildings in the UK.

Advanced Timber Craft (Kudos) Ltd
Alexanders Timber Design Ltd
Angus Homes Ltd
Bartram Timber Frame Ltd
Castleoak Timber Frame Ltd
CCG (OSM)
City Building (Glasgow) LLP
Cornwall Timber Build Ltd
Cygnum Building Offsite
Deeside Timberframe Ltd
ETF (Northern) Ltd
Fforest Timber Engineering Ltd
Fleming Buildings
Flight Timber Products Ltd
Frame Homes / Frame UK Ltd
Frame Technologies
Frame-Tech Structures Ltd
FrameWork Synergies Ltd
Harmony Timber Frame Ltd
Horton Timber Homes Ltd
Hybrid Houses Ltd
Kalite Timber Frames Ltd
Kingspan Timber Solutions Ltd
Leadon Timber Frame Ltd
LF FastHouse Ltd
Local Homes (Accord)
Lowfield Timber Frame Ltd
Maple Timber Frame Merronbrook Ltd
MBC Timber Frame UK Ltd
MTE (Leicester) Ltd
Neatwood Homes Ltd
Norscot Joinery Ltd
Oakworth Homes Ltd
OFP Timber Framed Homes Ltd
Oregon Timber Frame Ltd
PEC Timber Frame Ltd
Pinewood Structures Ltd
Rob Roy Homes (Crieff) Ltd
Robertson Timber Engineering Ltd
Scotframe Timber Engineering Ltd
Seven Oaks Modular Construction Ltd
Shire Timber Structures Ltd
Southern Timber
Southern Timber Frame Ltd
Space4
Stewart Milne Timber Systems Ltd
Sticx Ltd
Sydenhams Timber Engineering Ltd
Target Timber Systems Ltd
Taylor Lane Timber Frame Ltd
The Timber Frame Company
Thomas Armstrong (Timber) Ltd
Timber Frame It SE Ltd
Timber Frameworks (Alba) Ltd
Truro Timber Frame Ltd
Walker Timber Group

Project team

The STA Board and members are indebted to the project team and collaborators, whom have spent 18 months developing and delivering this leading edge research and guidance project. Their sub-contracted and in-kind contributions will benefit the sector, clients and stakeholders. Their dedication, management and drive to complete this work has been unwavering, resulting in comprehensive information the sector can rely on with confidence for years to come.

Project lead

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Martin Milner, Milner Associates, Critical Friend Services

Warrington Fire, Fire Testing Services

BRE Global, Fire Testing Services

Industry collaborations

Irish Timber Frame Manufacturers Association

Engineered Wood Products Committee

Trussed Rafter Association

Purpose and scope of the pattern book

The STA Fire Safety in Use Guidance provides a “suite of information” for use in the marketplace. Volume 1 is a Pattern Book of EN tested timber frame systems. The pattern book will evolve and grow as further systems are tested, validated and introduced. Volume 2 covers cavity barriers, providing technical information, compliance requirements and installation guidance on the correct fitting of cavity barriers. Future volumes will be developed and included within the suite of information. Items being considered for future volumes include for example, drylining specification and installation, and guidance on service penetrations.

The purpose of Volume 1: Pattern Book is to provide STA members, clients and specifiers with information on peer reviewed generic wall systems that are backed up by EN test evidence and supplementary research to create resilient fire safe solutions for timber frame wall, floor and roof systems.

Information is presented in the form of a pattern book, similar to Robust Details acoustic detailing. All the STA tested wall systems in Part 3 have been peer reviewed by Milner Associates in collaboration with BRE Global. The pattern book has been endorsed by verifiers and regulators, providing deemed to satisfy style solutions, underpinned with a high degree of technical due diligence, rigour and independent expert validation.

The pattern book includes recommendations and guidance on the design, specification and installation of various commonly used systems within timber frame buildings in the UK. The information provided relates to fire resistance compliance and good practise considerations. Fire safety in use is governed under the relevant building regulations functional requirements and technical handbooks.

The pattern book provides a platform to include additional systems in the future. Work is ongoing to peer review information provided for additional wall, floor and roof systems.

The pattern book does not cover bespoke or modified systems that differ from those tested. It is anticipated that in the future bespoke systems can be included in the pattern book once reviewed and validated.

Compliance of any system is the responsibility of the principle designer for the project/building. It is the legal duty of the principle designer to ensure regulatory compliance is demonstrated out with the use of this pattern book. Only people with a sound technical, design, construction and fire engineering knowledge from STA members, clients, designers, builders and specifiers of timber frame buildings, should use the pattern book.

This guidance does not cover fire safety during construction. This is governed under the Health and Safety HSG168 Standard. The STA has a comprehensive library of information on requirements and guidance, which can be downloaded via www.structuraltimber.co.uk

Part 2 - Research and testing

Background

The Fire in Use Project was an 18 month collaborative research project between the STA, the Construction Scotland Innovation Centre and The University of Edinburgh, supported by sponsorship funding from the Construction Scotland Innovation Centre, Swedish Wood, Scottish Forestry and a levy on STA manufacturing members.

The project goal was to produce a pattern book of generic EN tested timber frame wall, floor and roof systems to complement existing and new fire safety in use industry guidance. The outcome being to further enhance confidence in timber frame construction and provide a go-to reference manual for people to use.

All information is freely available to STA members, clients, designers, specifiers, builders and industry stakeholders via STA website www.structuraltimber.co.uk. The pattern book will be reviewed periodically, by the STA Technical Committee and Board, with updates and amendments issued accordingly.

The project was organised into four distinct, but connected work packages, running in parallel to gather the relevant data required for the pattern book.

1. The first stage was the completion of research into various aspects of timber fire safety and testing.
2. The second stage was the completion of a large programme of full-scale EN fire resistance testing.
3. The third stage was the collation of all research and test information for analysis, peer reviewed by Milner Associates in conjunction with BRE Global.
4. The final stage was the creation of the pattern book and engagement with stakeholders.

Research

A gap analysis was produced to ascertain the status of various historic and current fire safety in use design and test protocols and their relevance to the timber frame sector. This identified several key areas for further detailed research work to be undertaken to recalibrate current thinking and protocols on fire safety design and testing of timber frame systems suitable for current and future use.

The first area of research was material variability of plasterboard manufactured to BS EN 520:2004. This was conducted at The University of Edinburgh. The aim of this was to better understand plasterboard variability in the context of fire performance of finished wall systems. This research investigated Type A and F plasterboards available from three leading UK supply chains: British Gypsum, Siniat and Knauf.

The second element of research was on loading requirements for fire resistance testing of timber frame systems. A position paper has been produced to outline recommendations for the test loading of walls and floors when undertaking fire resistance testing. This was been produced by Milner Associates. This information provides a common playing field for load applications and a basis for system testing in the future.

A final element of research was to commission Milner Associates to gather all research and derive justifications and methodologies for the proposal of generic classifications for common materials and wall make ups noted in Part 3 and tested by STA. The focus was on Type A plasterboard, for presentation and peer review by BRE Global.

Milner Associates, working alongside BRE Global, were engaged by the STA to undertake a peer review of the fire research, including testing, results and materials.

STA has concluded that UK supplied 15mm Type A plasterboard (BS EN520:2004) from British Gypsum, SINIAT or Knauf is suitable for use in STA wall systems listed in this pattern book.

EN fire resistance testing

The STA tested a total of 11 wall systems, intended to meet 30 and 60 minute minimum REI compliance requirements. These included external, load bearing and party wall configurations. Some of these tests were research related and repeat tests to validate work undertaken. This has yielded 7 timber frame wall make-ups commonly used in the UK timber frame marketplace. These systems are specified in more detail within the pattern book.

All fire resistance tests were undertaken to EN 1365-1 test standards. A double socket was fitted within all external wall tests even though this is not a requirement of the test standard. Test loads were applied in line with the position paper developed as part of the early stage research (See Part 6) suitable for buildings up to 18m high, as defined in the building regulations: 15mm Type A plasterboards were used throughout, for the approved systems contained within the pattern book.

In addition, the STA continues to collaborate with other test programmes to better understand the differing wall, floor and roof systems, used in the marketplace as proprietary or generic systems, with validated EN test information, for future inclusion within the pattern book (expected during 2020).

Gap analysis

A gap analysis was completed by The University of Edinburgh to identify key areas of interest in the design and construction of timber frame systems that were beneficial to target as part of this research project. This included reviewing historic and current BS and EN information, industry specific information often referred to and used in the marketplace and relevant academic research conducted by various UK and European universities, including Vaxjo University in Sweden and Edinburgh Napier University.

The gap analysis provided two major areas of interest for further investigation. These were:

1. Load ratios applied as part of BS and EN fire resistance test standards.
2. Plasterboard variability, benchmarking and thermal response.

Following the completion of the gap analysis, further detailed research was undertaken and completed to inform the testing programme to be undertaken and the final pattern book.

1. Load ratios - fire resistance testing

Milner Associates prepared an initial thought paper on historic BS load ratios and EN load reduction factors, to inform a load ratio workshop, held at The University of Edinburgh. We gathered structural and fire engineers from multiple disciplines to discuss and determine appropriate load ratios to apply when undertaking the overall testing programme. Following the workshop, an STA position paper on load ratios was produced and test loadings calculated to EN standards for use in the tests.

The first seven systems tested as part of this research project were loadbearing elements tested to BS EN 1365-1:2012. The research noted that there are some differences between how BS standards and EN standards define “load ratio”.

To avoid confusion and clarify these differences, a detailed STA position paper on load ratios was produced by Milner Associates to inform the load applied in each of the tests. This was peer reviewed by BRE Global to ensure its appropriateness for use in the testing.

This information used to inform the physical testing and to engage stakeholders as part of the development of the pattern book. A simple laypersons summary is included within Appendix 1. This will inform members as to the STA recommendations for the appropriate load ratios to apply, for those wishing to undertake fire resistance testing of their own systems or materials.

2. Plasterboard variability and benchmarking: EN 520:2004

Plasterboard is produced to BS EN 520:2004. This is a manufacturing standard that governs production processes and provides quality assurance. It is not a declaration of fire performance of the board. It is permissible under BS EN 520:2004 to have controlled variation in board production. This provides flexibility to manufacturers. It is therefore important to recognise this in EN fire resistance testing and subsequent declarations of performance, of any construction system tested.

Following the gap analysis, University of Edinburgh undertook a programme of plasterboard material variability tests, for a small sample of 15mm and 12.5mm Type A plasterboard procured and used in the UK. Type A boards were selected as the most commercially viable and commonly used boards. The STA testing programme focused on the use of 15mm Type A boards, in consideration of the test pass thresholds being targeted and the more onerous EN fire resistance test standard being adopted.

These experimental research tests provided indicative information on the thermal response and material variability of various plasterboards with the intent of benchmarking them. This research was used to inform the final makeup of the walls, test programme and the thermocouple data to be collected as part of the overall testing programme.

The material variability research testing consisted of an experimental test series undertaken at The University of Edinburgh with the purpose of understanding, quantifying and benchmark their thermal response. The purpose of this testing exercise was to understand the plasterboard variability of three UK supply chains – British Gypsum, Knauf and Siniat boards, commonly available in the UK market.

The main conclusions of the research were that there are small differences between the density and water content of the different plasterboards available on the market. In addition to this there can be slight differences between boards of the same brand manufactured in different batches or locations. The boards tested were all classified according to manufacturing standard BS EN 520:2004.

Timber frame wall systems EN test methodology and approach

STA testing program

The STA testing programme prioritised open panel timber frame external, loadbearing and party wall make ups commonly used in the UK marketplace, representing approximately 80% of the timber frame systems used.

It is recognised that there are a variety of more bespoke timber frame systems used in the marketplace. However due to finance, time and test laboratory availability, it was not feasible to test every permutation within this project.

The STA test programme was completed over three phases, with intermediate reviews and refinement incorporated as test outcomes were established and research data gathered.

The principal building designer and client, using bespoke timber frame systems, have a duty of care to ensure any bespoke systems being used are appropriately tested and compliant to the building regulations and functional standards.

Test standard

All EN fire resistance tests conducted were done in accordance with the test standard BS EN 1365-1:2012 for loadbearing walls. The decision to test in accordance with EN standards was taken to reflect the general movement towards the more onerous European test standards, as opposed to the current BS test standards, historically used in the marketplace. This test standard is applicable to both internal and external loadbearing walls. Tests were conducted to demonstrate compliance above the required REI 30 or 60 minute functional standards required by the building regulations.

Test providers

Fire resistance testing was undertaken at BRE Global and Warrington Fire with differing sized furnaces and loading mechanisms. The size and loading arrangements of the test specimens was therefore dictated by the size of the furnace in each test facility. This provided variety and valuable learning from recognised independent test authorities, all of whom were UKAS accredited.

Services

Although not required under the test standard, a push fit plastic double socket was fitted in the bottom corner off external wall assemblies tested by STA (WT1-WT4).

Research data

Additional research orientated thermocouples were included within all tests undertaken. This provided valuable research data to help inform the performance of tested systems under fire.

Test loading

Each system tested by the STA was loaded to the maximum stud capacity of 100% in accordance with EN load reduction factor design criteria. Appendix 1 provides more information.

Resilience

The fire safety of buildings requires more than passing tests and compliance with minimum code levels. This pattern book of solutions takes into consideration working practises, specifications and detailing. The solutions include higher levels of resilience and improved specifications, sensitive to critical areas of fire safety compliance. This provides resilience to accommodate, real world practises during design, specification, procurement and construction.

Test reports

Test reports were completed for all tests undertaken. These were collated and checked for accuracy against the design and as-built test specimens. Test reports are governed under STA intellectual property and copyright laws. These are not for release to 3rd parties. As a requirement of developing the pattern book, test reports were made available for BRE Global peer review, as well as verifiers and regulators. The pattern book provides deemed to satisfy style solutions, accepted by verifiers and regulators, without the need to provide test reports.

All STA test reports for the wall systems shown in Part 3 of the pattern book were assessed by BRE Global; reviewing materials and specifications adopted by the STA. All test reports, findings and thermocouple data were analysed.

Generic material and supplier classifications

Following the STA testing, Milner Associates undertook an assessment of generic material classifications of Type A plasterboard, PIR and mineral insulations, used in the STA testing programme, from a range of suppliers in the UK.

This assessment was specific to the wall testing undertaken by the STA. This cannot be interpolated for use in bespoke external walls, roof and floor applications tested by others.

The STA research and testing programme focused on the use of 15mm Type A boards for wall make ups, in consideration of the resilience required, loadings applied, services incorporated and the more onerous EN fire resistance test standard being adopted.

The assessment work reviewed the plasterboard material variability research undertaken, the test outcomes, the thermocouple test data under fire load test conditions and the resilience built into the test pass thresholds.

This supported the agreement to specify generic classifications of materials noted below from a variety of mainstream UK suppliers:

1. Type A Plasterboard - manufactured to BS EN 520:2004, from British Gypsum, Siniat or Knauf.
2. Polyisocyanurate Insulation (PIR) - manufactured to BS EN 13165
3. Glass Wool Insulation - manufactured to BS EN 13162:2012 (+A1:2015) and EN 13172:2012
4. Drylining Screws - manufactured to BS EN 14566
5. Stone Wool Insulation - manufactured to BS EN 13162:2012

Future third party EN fire resistance testing

The STA has been working in partnership with other timber building system associations and supply chains, to gather test information for future inclusion within the STA Pattern Book. This collaborative approach will provide a greater range of EN tested systems available to members, clients and specifiers as part of a whole building approach to design.

These systems have been individually or collectively tested to EN 1365:1 or 2:2012 fire resistance tests for load bearing elements (wall, floor and roof applications) by the relevant governing trade association, organisation or supplier. These were not tested as part of the STA research programme, are not included in this edition of the guidance and await further review.

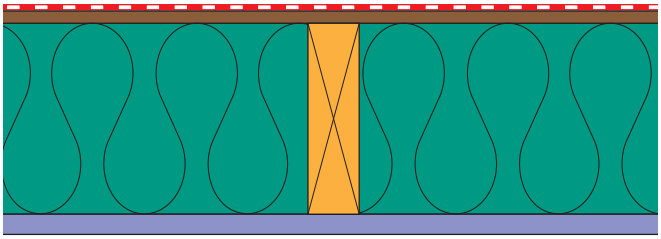
Pattern Book - tested systems

Each system has been drafted into a Pattern Book approach providing simple to understand, key information based on test evidence. REI classifications are used in fire resistance testing to represent failure modes. The failure classifications are R = loadbearing capacity, E = integrity and I = insulation.

STA tests reports of the Pattern Book have been checked for accuracy by the STA working party. The full test reports are controlled documents, governed under intellectual property and copyright by the STA. All research and test information are governed by the STA Technical Committee and Executive Board.

Part 3 - Generic wall systems

1. WT1 external wall (REI 30 minutes)

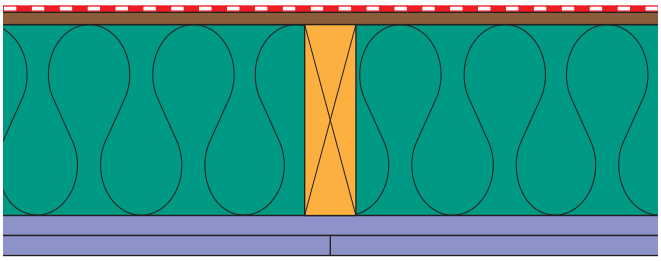


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Plasterboard face

	MATERIAL	FIXING
INNER FACE	1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Horizontal board joints require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS
	Vapour control layer or vapour check plasterboard	VCL stapled to studs and top/bottom rails
OUTER FACE	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding)	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
	Breather paper and marker tapes ***NOTE:*** *Differing breather membranes have no detrimental impact on the fire resistance performance*	Stapled to studs and top/bottom rails
INSULATION	Minimum full fill mineral wool roll, with minimum thermal conductivity of 0.040 W/mK and density of 18kg/m^3 (glass or stone wool)	Friction fitted without fixings
STUDS	Minimum 38mm x 140mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *Studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

2. WT2 external wall (REI 60 minutes)

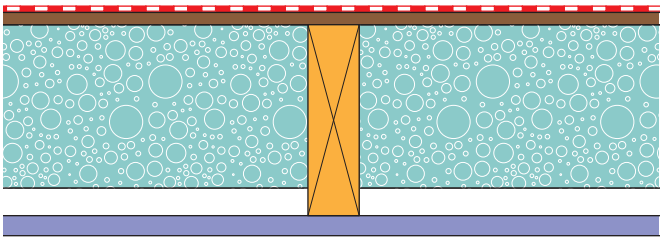


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Plasterboard face

	MATERIAL	FIXING
INNER FACE	Final layer - 1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Plasterboard to have staggered vertical joints*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS
	First layer - 1 x minimum 15mm Type A, D or F plasterboard. The board joints do not need to be taped and filled ***NOTE:*** *Horizontal board joints in both layers, require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS
	Vapour control layer or vapour check plasterboard (Type A)	VCL stapled to studs and top/bottom rails
OUTER FACE	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding)	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
	Breather paper and marker tapes ***NOTE:*** *Differing breather membranes have no detrimental impact on the fire resistance performance*	Stapled to studs and top/bottom rails
INSULATION	Minimum full fill mineral wool roll, with minimum thermal conductivity of 0.040 W/mK and density of 18kg/m^3 (glass or stone wool)	Friction fitted without fixings
STUDS	Minimum 38mm x 140mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *Studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

3. WT3 external wall (REI 30 minutes)

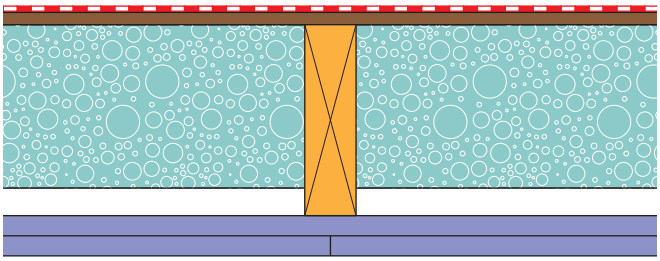


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Plasterboard face

	MATERIAL	FIXING
INNER FACE	1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Horizontal board joints require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS
	Vapour control layer or vapour check plasterboard (Type A)	VCL stapled to studs and top/bottom rails
OUTER FACE	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding)	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
	Breather paper and marker tapes ***NOTE:*** *Differing breather membranes have no detrimental impact on the fire resistance performance*	Stapled to studs and top/bottom rails
INSULATION	Minimum 120mm PIR Insulation (0.022) ***NOTE:*** *PIR insulation can be fitted anywhere between the timber with 0 to 20mm maximum air gap behind the plasterboard or sheathing*	Tightly site fitted between studs, in accordance with manufacturer's recommendations or factory fitted using metal clips to timber frame manufacturer's details ***NOTE:*** *Gaps greater than 2mm must be filled with intumescent sealant*
STUDS	Minimum 38mm x 140mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *Studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

4. WT4 external wall (REI 60 minutes)

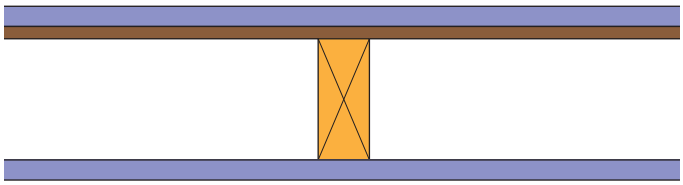


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Plasterboard face

	MATERIAL	FIXING
INNER FACE	Final layer - 1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Plasterboard to have staggered vertical joints*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS
	First layer - 1 x minimum 15mm Type A, D or F plasterboard. The board joints do not need to be taped and filled ***NOTE:*** *Horizontal board joints in both layers, require minimum 38mm*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS
	Vapour control layer or vapour check plasterboard (Type A)	VCL stapled to studs and top/bottom rails
OUTER FACE	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding)	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
	Breather paper and marker tapes ***NOTE:*** *Differing breather membranes have no detrimental impact on the fire resistance performance*	Stapled to studs and top/bottom rails
INSULATION	Minimum 120mm PIR Insulation (0.022) ***NOTE:*** *PIR insulation can be fitted anywhere between the timber with 0 to 20mm maximum air gap behind the plasterboard or sheathing.*	Tightly site fitted between studs, in accordance with manufacturer's recommendations or factory fitted using metal clips to timber frame manufacturer's details ***NOTE:*** *Gaps greater than 2mm must be filled with intumescent sealant*
STUDS	Minimum 38mm x 140mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *Studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

5. WT5 internal loadbearing wall (REI 30 minutes)

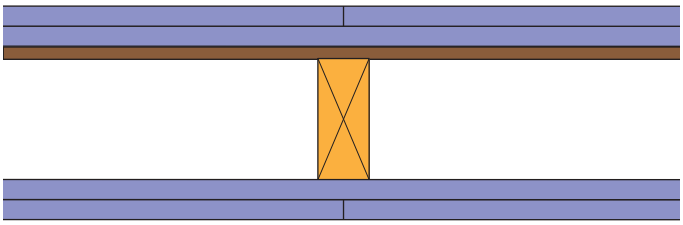


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Each side separately

	MATERIAL	FIXING
INNER AND OUTER FACE	1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Horizontal board joints require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS Tightly site fitted between studs, in accordance with manufacturer's recommendations or factory fitted using metal clips to timber frame manufacturer's details
INSULATION	Optional - for acoustic/thermal purposes, full or partial fill, mineral wool roll insulation (glass or stone wool) ***NOTE:*** *The addition of mineral wool insulation has no detrimental impact on the fire resistance performance*	Friction fitted without fixings
STUDS	Minimum 38mm x 89mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *The addition of studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
UNSHEATHED OPTION	1 x row 38mm x 89mm C16 CLS timber mid height noggins, staggered ***NOTE:*** *The addition of mid-height noggins has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud/noggin connection
SHEATHED OPTION	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding) ***NOTE:*** *Sheathing is an optional requirement for structural purposes* ***NOTE:*** *The addition of sheathing has no detrimental impact on fire resistance*	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

6. WT6 internal loadbearing wall (REI 60 minutes)

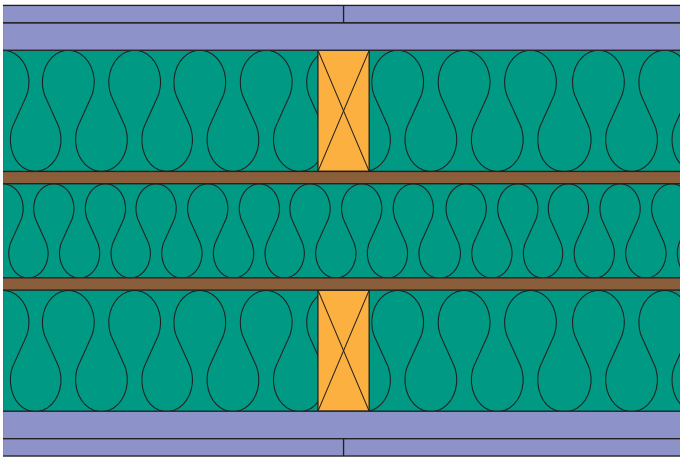


VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Fire exposure	Each side separately

	MATERIAL	FIXING
INNER AND OUTER FACE	Final layer - 1 x minimum 15mm Type A, D or F plasterboard. All joints mesh taped and filled ***NOTE:*** *Plasterboard to have staggered vertical joints*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS
	First layer - 1 x minimum 15mm Type A, D or F plasterboard. The board joints do not need to be taped and filled ***NOTE:*** *Horizontal board joints in both layers, require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS
INSULATION	Optional – for acoustic/thermal purposes, full or partial fill, mineral wool roll insulation (glass or stone wool) ***NOTE:*** *The addition of mineral wool insulation has no detrimental impact on the fire resistance performance*	Friction fitted without fixings
STUDS	Minimum 38mm x 89mm C16 CLS timber @ 600mm CTRS ***NOTE:*** *The addition of studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
UNSHEATHED OPTION	1 x row 38mm x 89mm C16 CLS timber mid height noggins, staggered ***NOTE:*** *The addition of mid-height noggins has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud/noggin connection
SHEATHED OPTION	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding) ***NOTE:*** *Sheathing is an optional requirement for structural purposes* ***NOTE:*** *The addition of sheathing has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
NOGGINS	Timber ancillary or structural noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

7. WT7 Party wall (REI 60 minutes)



VERIFICATION DETAILS

Based on testing to	BS EN 1365-1:2012 (loaded)
Load applied	100% of in-service design capacity
Field of application	Wall panels up to 2.7m high
3rd party peer review	Milner Associates in collaboration with BRE Global
Robust details	Compliant with wall types E-FT-1 and E-FT-2
Fire exposure	Each side separately

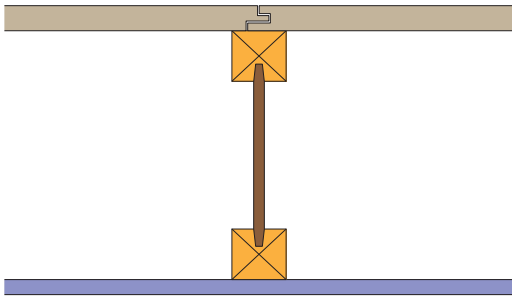
	MATERIAL	FIXING
INNER AND OUTER FACE	Final layer - 1 x minimum 12.5mm Type A plasterboard. All joints mesh taped and filled ***NOTE:*** *Plasterboard to have staggered vertical joints. All Horizontal board joints in final layer, require minimum 38mm x 63mm C16 timber noggins at board joint*	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS
	First layer - 1 x minimum 19mm Type A plasterboard (Gyproc Plank), 600mm x 2400mm fitted horizontally and staggered, no noggins on long edges. The board joints do not need to be taped and filled	In accordance with BG, Knauf or Siniat fixings requirements Typically, 3.5mm x 45mm self-tapping drywall screws @ maximum 300mm CTRS
INSULATION	Studwork - minimum 90mm mineral wool party wall acoustic roll (18kg/m^2), between studs in each partition (glass or stone wool)	Insulation rolls friction fitted vertically between studs
	Cavity - minimum 50mm glass wool party wall acoustic roll (min 18kg/m^2) to cavity between each partition (glass or stone wool)	Insulation rolls friction fitted horizontally in 600mm wide layers and butt jointed
STUDS	2 x 38mm x 89mm C16 CLS timber @ maximum 600mm CTRS in a separated twin leaf formation, with minimum 50mm cavity space between sheathing ***NOTE:*** *The addition of studs at closer centres and multiple stud clusters, has no detrimental impact on fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud

7. WT7 Party wall (REI 60 minutes) cont.../

	MATERIAL	FIXING
UNSHEATHED OPTION	Subject to structural engineer's design requirements, 1 x row 38mm x 89mm C16 CLS timber mid-height noggins, staggered to each timber partition, maybe required ***NOTE:*** *The addition of sheathing has no detrimental impact on the fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud/noggin connection
SHEATHED OPTION	Minimum 9mm sheathing (OSB/3, plywood or euro-class A1/A2 boarding) to cavity faces ***NOTE:*** *Sheathing can be absent, single sided or double sided (back to back) In accordance with Robust Details wall types E-WT-1 and E-WT-2* ***NOTE:*** *The addition of sheathing has no detrimental impact on the fire resistance performance*	In accordance with structural engineer's fixing requirements Typically, 2.81mm x 50mm smooth shank nails @ 150mm CTRS (perimeter) and 300mm CTRS (intermediate studs)
NOGGINS	Timber ancillary noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

Part 4 - Generic floor systems

8. IF-IJ intermediate floor, I-joist, 12.5mm plasterboard (REI30 minutes)



VERIFICATION DETAILS

Based on testing to	BS EN 1365-2 and BS EN 1995-1-2
Load applied	$g_k \leq 0.5^1$kN/m²
	$q_k \leq 1.5$kN/m² (medium-term), or
	By calculation based on the stress indices $SI_{M,fi}$ and $SI_{V,fi}$ (see Part 7.2 Recommendations on the loading of floors during a fire test)
Verified joists	Staircraft: TFSi-joists
Peer review	Milner Associates in collaboration with BRE Global
Exposure	From underside

	MATERIAL	FIXING
JOISTS[2]	Minimum 220mm deep proprietary engineered I-joists @ maximum 600mm centres without or with resilient bar @ maximum 400mm centres to manufacturer's structural design and installation criteria ***NOTE:*** *Minimum 45mm x 45mm wide strength graded softwood flanges with minimum 11mm thick OSB/4 web*	Joists to be supported at the bearing on the bottom flange and fixed in accordance with the manufacturer's instructions Resilient bar, if required, to be fixed to every joist in accordance with the manufacturer's instructions
CEILING LINING[2]	Minimum 1x 12.5mm gypsum plasterboard Type A or F, with or without board edge noggings/perimeter noggings, with all joints taped and filled Direct fixed to the joists Or fixed to resilient bar	Self-tapping drywall screws fixed in accordance with the manufacturer's instructions @ maximum 230mm centres Minimum Ø3.5 x 42mm screws Minimum Ø3.5 x 25mm screws
CEILING PENETRATIONS[2]	**Downlighters:** Maximum 1 no. downlighter[3] per m², at least 600mm apart positioned anywhere in the ceiling lining Tested as part of an REI30 floor assembly to BS EN 1365-2 or as a service penetration with EI30 classification to BS EN 13501-3 for the application or verified by manufacturer's test data for the application	In accordance with the manufacturer's instructions
	SVP and mechanical ventilation ducts: In accordance with national guidance[4] or Fire stopped with an EI30 classified product to BS EN 13501-3 for the application or verified by manufacturer's test data for the application	In accordance with the manufacturer's instructions
	Pendants and detectors: In accordance with national guidance[4]	

8. IF-IJ intermediate floor, I-joist, 12.5mm plasterboard (REI30 minutes) cont.../

	MATERIAL	FIXING
INSULATION[2]	Void cavity only	N/A
FLOOR DECK[2]	Min. 18mm T&G wood-based structural flooring (e.g. P5 particleboard, OSB/3 or plywood) T&G deck joints to be glued in accordance with the deck manufacturer's instructions	Typically, Ø2.8 x 65mm threaded nails or Ø4.0 x 60mm screws at 600mm centres with D4 adhesive or other equivalent to give the same fixity (not a fire specific dependency)

NOTES:

1 *The maximum permitted permanent load excludes the partition load allowance in the accidental fire condition*

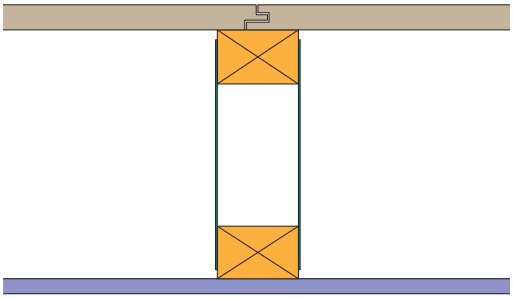
2 *Floor components to meet all other functional requirements: structural, acoustic, etc.*

3 *See STA website for document 'Tested downlighters achieveing REI30 minutes' for a list of products known to have been tested or assessed as part of an REI30 floor assembly*

4 *National guidance:*

- *England and Wales: Approved Documents*
- *Scotland: Technical Handbooks*
- *Northern Ireland: Technical Booklets*

9. IF-MJ intermediate floor, metal web joist, 15mm plasterboard (REI30 minutes)



VERIFICATION DETAILS

Based on testing to	BS EN 1365-2 and BS EN 1995-1-2
Load applied	By calculation based on the stress indices $SI_{M,fi}$ and $SI_{V,fi}$ (see Part 7.2 Recommendations on the loading of floors during a fire test)
Verified joists	ITW: SpaceJoists Mitek: Posi-Joists Wolf System: easi-Joists®
Peer review	Milner Associates in collaboration with BRE Global
Exposure	From underside

	MATERIAL	FIXING
JOISTS[1]	Minimum 219mm deep proprietary engineered metal web joists @ maximum 600mm centres without or with resilient bar @ maximum 400mm centres to manufacturer's structural design and installation criteria ***NOTE:*** *Minimum 45mm x 60mm wide strength graded soft-wood chords with minimum 0.9mm thick steel webs to BS EN 10346*	Joists to be supported by bearing on the bottom chord or top-hung. Perimeter details to be designed for the application Strongbacks to be fixed in accordance with the joist manufacturer's instructions Resilient bar, if required, to be fixed to every joist in accordance with the manufacturer's instructions
CEILING LINING[1]	Minimum 1x 15mm gypsum plasterboard Type A or F, with or without board edge noggings/perimeter noggings, with all joints taped and filled Direct fixed to the joists Or fixed to resilient bar	Self-tapping drywall screws fixed in accordance with the manufacturer's instructions @ maximum 230mm centres Minimum Ø3.5 x 42mm screws Minimum Ø3.5 x 25mm screws
CEILING PENETRATIONS[1]	**Downlighters:** Maximum 1 no. downlighter[2] per m^2, at least 600mm apart positioned anywhere in the ceiling lining Tested as part of an REI30 floor assembly to BS EN 1365-2 or as a service penetration with EI30 classification to BS EN 13501-3 for the application or verified by manufacturer's test data for the application	In accordance with the manufacturer's instructions
	SVP and mechanical ventilation ducts: In accordance with national guidance[3] or Fire stopped with an EI30 classified product to BS EN 13501-3 for the application or verified by manufacturer's test data for the application **Pendants and detectors:** In accordance with national guidance[3]	In accordance with the manufacturer's instructions

9. IF-MJ intermediate floor, metal web joist, 15mm plasterboard (REI30 minutes) cont.../

	MATERIAL	FIXING
INSULATION[1]	Void cavity only	N/A
FLOOR DECK[1]	Min. 18mm T&G wood-based structural flooring (e.g. P5 particleboard, OSB or plywood) T&G deck joints to be glued in accordance with the deck manufacturer's instructions	Typically, Ø4.0 x 60mm screws at 200mm centres without adhesive, or Ø2.8 x 65mm threaded nails or Ø4.0 x 60mm screws at 600mm centres with D4 adhesive or other equivalent to give the same fixity (not a fire specific dependency)

NOTES:

[1] *Floor components to meet all other functional requirements: structural, acoustic, etc.*

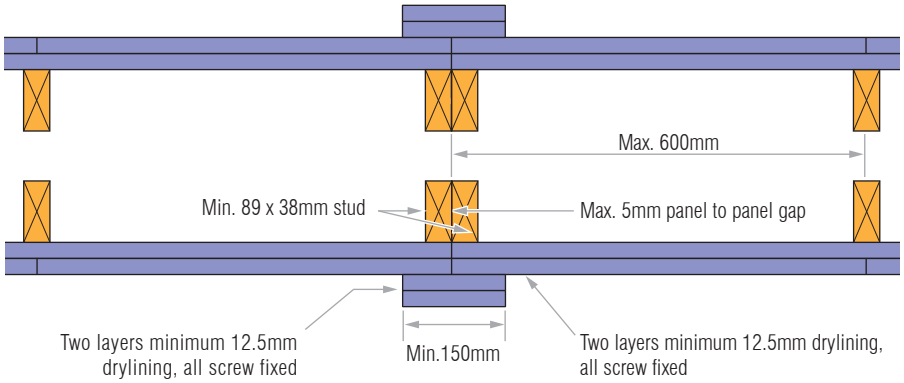
[3] *See STA website for document 'Tested downlighters achieveing REI30 minutes' for a list of products known to have been tested or assessed as part of an REI30 floor assembly*

[3] *National Guidance:*

- *England and Wales: Approved Documents*
- *Scotland: Technical Handbooks*
- *Northern Ireland: Technical Booklets*

Part 5 - Generic roof spandrel systems

10. Type 1: Twin leaf party wall roof spandrel (EI60 minutes)



FIELD OF APPLICATION

For roofs with ridge no greater than 4m

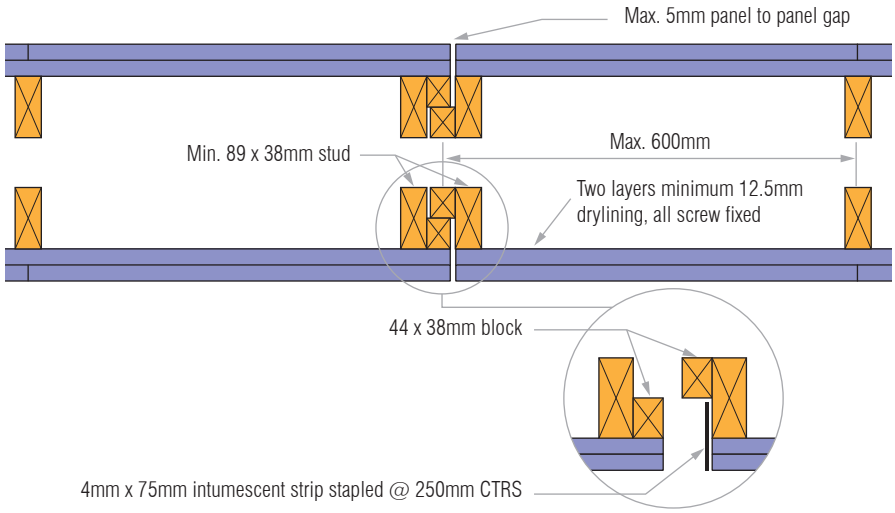
Assessment based on EN 1995-1-2:2004 Design of timber structures, Part 1-2, General, Structural fire design

Fire exposure to each side separately

Not part of Milner Associates/BRE Global peer review

	MATERIAL	FIXING
INNER FACE	1 x minimum 12.5mm Type A, D or F plasterboard fitted and staggered, no horizontal joints	In accordance with BG, Knauf or Siniat fixing requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS ***NOTE:*** *No tape and fill finish at board joints*
	Final layer - 1 x minimum 12.5mm Type A, D or F plasterboard fitted and staggered, no horizontal joints ***NOTE:*** *All plasterboard sheets to be full height, to avoid horizontal board joint*	In accordance with BG, Knauf or Siniat fixing requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS ***NOTE:*** *No tape and fill finish at board joints*
PANEL TO PANEL JOINT	2 x minimum 12.5mm x 150mm Type A, D or F plasterboard cover strips, with staggered joints ***NOTE:*** *Panel to panel joints can be vertical and horizontal. Cover plates to be butt jointed and staggered over joints*	First cover strips - 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS Final cover strip - 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS ***NOTE:*** *No tape and fill finish at cover plate joints*
	Panel to panel fixings ***NOTE:*** *Maximum 5mm permissible tolerance gap at panel to panel abutment. Over clad with plasterboard cover plates*	In accordance with structural engineer's fixing requirements Typically, 2.8mm screws @ 300mm CTRS angled at 45 degrees, cross fixed each side, through plasterboards with minimum 25mm timber embedment
INSULATION	None	N/A
STUDS	Minimum 38mm x 89mm C16 CLS timber @ 600mm CTRS	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

11. Type 2: Twin leaf party wall roof spandrel (EI60 minutes)



FIELD OF APPLICATION

For roofs with ridge no greater than 4m

Based on linear seal fire test to EN 1363-2

Two layers of 12.5mm drylining based on EN 1995-1-2 (2004) verification; Design of timber structures, Part 1-2, General, Structural fire design

Fire exposure to each side separately

Not part of Milner Associates/BRE Global peer review

	MATERIAL	FIXING
INNER FACE	1 x minimum 12.5mm Type A, D or F plasterboard fitted and staggered, no horizontal joints	In accordance with BG, Knauf or Siniat fixing requirements Typically, 3.5mm x 38mm self-tapping drywall screws @ maximum 300mm CTRS ***NOTE:*** *No tape and fill finish at board joints*
	Final layer - 1 x minimum 12.5mm Type A, D or F plasterboard fitted and staggered, no horizontal joints ***NOTE:*** *All plasterboard sheets to be full height, to avoid horizontal board joint*	In accordance with BG, Knauf or Siniat fixing requirements Typically, 3.5mm x 60mm self-tapping drywall screws @ maximum 300mm CTRS ***NOTE:*** *No tape and fill finish at board joints*
PANEL TO PANEL JOINT	2 x 38mm x 44mm deep, C16 softwood timber batten staggered to each panel end to form Z-joint Minimum 4mm x 75mm intumescent fire seal strip, fitted to one side of joint (Tenmat, ventilated fire seal strip or similar) ***NOTE:*** *Maximum 5mm permissible tolerance gap at panel to panel abutment, fire sealed with Intumescent strip* ***NOTE:*** *Panel to panel joints can be vertical and horizontal*	Typically, 14mm anticorrosion staples @ maximum 250mm CTRS ***NOTE:*** *Strip to extend full depth of double plasterboard lining and timber batten, so as to be visible once installed*
	Panel to panel fixings	In accordance with structural engineer's fixing requirements Typically, 5.8mm x 102mm long screw face fixed at maximum 300mm CTRS, down centre of Z-joint/battens ***NOTE:*** *No tape and fill or intumescent mastic required at Z-joint plasterboard butt joint*
INSULATION	None	N/A
STUDS	Minimum 38mm x 89mm C16 CLS timber @ 600mm CTRS	In accordance with structural engineer's fixing requirements Typically, 3.1mm x 88mm twist shank nails, 2 per stud
NOGGINS	Timber ancillary noggins, as required ***NOTE:*** *The addition of noggins has no detrimental impact on the fire resistance performance*	Typically, 3.1mm x 88mm twist shank nails, 2 per stud to noggin

Part 6 - Additional systems in 2020

Other UK and Irish trade associations have developed fire safety guidance for their members and the wider construction sector. Part 5 includes further information on the additional systems and the guidance available, however it should be noted that the neither the systems or guidance have been part of the Milner Associates/BRE Global peer review.

Timber roof truss systems

The Truss Rafter Association (TRA) represents the major engineered metal plate timber roof system suppliers used in the UK. TRA roof truss solutions are applicable to masonry and timber frame construction used in the UK.

Trussed roof systems are commonplace in the UK, reflecting a high degree of uniformity and the generic use of punched metal plate roof truss components, used within their system design criteria.

The new TRA guidance provides builders with design options to meet the fire resistance requirements for trussed rafter ceiling constructions. The construction details on the technical card are shown by test to provide 30 minutes' fire resistance, in line with European Standards. Please contact info@tra.co.uk for further information regarding the guidance.

Timber wall systems

For the Republic of Ireland marketplace, the Irish Timber Frame Manufacturers Association (ITFMA), in partnership with the Department of Housing and Local Government responsible for building regulations, have undertaken a comprehensive EN fire resistance test programme and have developed their own guidance, endorsed by building regulators.

The technical guidance, available on the Irish Government website, details fire resistance compliance for walls, intermediate floors and trussed roofs in dwellings. ***Supplementary Guidance to Technical Guidance Document B (Fire Safety) Volume 2 - Dwelling Houses*** is available to download **HERE**

Engineered timber floor systems

The STA Engineered Wood Products Committee (EWPC) represents the major engineered timber floor system suppliers in the UK. These floor systems represent I-joist and metal web suppliers, providing solutions applicable to masonry and timber frame construction methods used in the UK.

Floor systems are typically proprietary to reflect the bespoke nature of each engineered joist component used and their system design criteria. The STA is collaborating with EWPC to gather proprietary test information with a view to developing generic classifications and specifications for metal web and I-joist floor systems, that require a REI fire resistance requirement of 30 and 60 minutes, for domestic and compartment floor compliance.

The STA are working with the EWPC to have their information peer reviewed and validated. The first two floor patterns are now available (see Part 4) with more expected to follow later in 2022 or early 2023.

Part 7 - Supporting appendices

1. EN 1365-1:2014 fire resistance testing for walls

Recommendations on the loading of walls during a fire test

Purpose

To provide advice on the procedure to establish the loads used for fire resistance testing of walls to BS EN 1365-1.

Who should read this

Engineers, structural timber building system suppliers, designers, specifiers and product development consultants, with a sound knowledge of product testing and fire design principles.

Historically, fire tests were carried out either for 100% or 60% load ratio, where the 100% load ratio corresponded to the full permissible load that the structural timber element could be stressed to at ambient temperature design. The term load ratio was defined in the withdrawn BS 5269 4.2: Clause 2.3 from 1980 for walls as:

"The ratio of actual axial load to the permissible axial load in a stud in the cold condition, expressed as a percentage."

A similar definition does not feature in the Eurocode structural design framework. However, the term load ratio or degree of utilisation has a specific, clearly defined, role in structural fire engineering design. It relates to the loads applied at the fire limit state to the resistance at ambient temperature.

When planning a loadbearing wall fire test to BS EN 1365-1 the sponsor of the test must decide what load to apply to the panel to be tested. The guidance in BS EN 1365-1 and BS EN 1363-1 is unclear and open to interpretation.

The STA recommends to suppliers or system developers, that a common approach to loadings should be applied. By doing this, there is a common playing field, where similar products, systems and materials can be tested in a harmonised way, providing confidence to end users, procurement teams, STA members and clients

Loading in fire event (load ratio)

The Eurocodes provide guidance on the reduction of ambient temperature design loading to account for the reduced probability of this load being present during the accidental fire event. This fire load reduction is facilitated by the factor η_{fi} which should not be confused with the load ratio from the former British Standard.

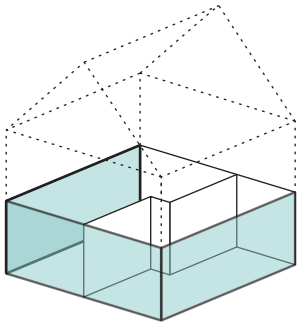
BS EN 1995-1-2 provides a load reduction factor (η_{fi}) for the accidental fire combination. It is derived from the proportion of imposed load (Q_k) to dead load (G_k) for project-specific application or adopted as a set value of 0.6 for general application and 0.7 for areas susceptible to the accumulation of goods including access areas.

Level of load applied at fire test

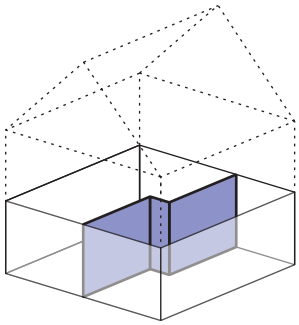
The concept of further reducing the load during a fire test could be used in addition to the fire load reduction factor as it has merits for commercial advantage within products/systems used in distinct markets such as housing. The level of load, related to the utilisation of structural elements, is in normal practice well below 100% of maximum load capacity.

For example, a dry lining and insulation type assembly may be chosen to be tested at 60% or 80% load level typical for two-storey house walls. However, the maximum load on the wall would be limited to that maximum utilisation ratio.

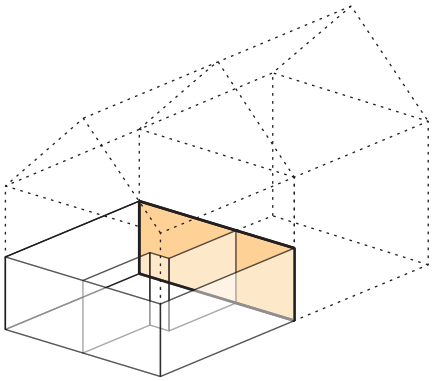
The level of load discussed above is comparable to the load ratio according to BS 5268-4.2, historically used for fire testing to BS 476-21. Typical utilisation ratios for walls in residential development:



External wall
50%-80%



Internal wall
80%-100%



Party wall
50%-100%

STA recommended approach

Establishing the magnitude of the structural load for EN fire test; to convert the ultimate limit design load for structural strength into the ultimate limit design load during the accidental fire event, the STA recommends the characteristic capacity of the element is multiplied by the appropriate load reduction factor ηfi and the medium-term load duration factor K_{mod} and then divided by the material modification factor γ_M.

For general application, the ultimate limit design load for the accidental fire event should be the load applied to the loadbearing wall assembly during the fire test.

A test load should consider the relevant limitations of the assembly, e.g. axial compression of a stud and compression perpendicular to grain at the stud bearing. An indicative procedure is outlined in Figure 1.

Structural load on wall element for EN fire test

STUD	SAWN TIMBER
Load application (axial centric load):	
Duration of load (medium term k_{mod}):	**0.8**
Material safety factor (γM):	**1.3**
System factor (k_{sys}):	**1.1**
Cross-section factor (k_h):	**as calculated**
Lateral restraint along length (k_{cy}, k_{cz}):	**as calculated**
Effective length coefficient:	**0.85**

Maximum design load in stud: $$F_{c,0,d} = \frac{k_{mod}}{\gamma_M} \cdot f_{c,0,k} \cdot k_{c,y} \cdot k_{sys} \cdot k_h \cdot A$$

PLATE	SAWN TIMBER
Load application (axial centric load):	
Duration of load (medium term k_{mod}):	**0.8**
Material safety factor (γM):	**1.3**
System factor (k_{sys}):	**1.0**
Compression perpendicular to grain ($k_{c,90}$):	**1.25**
Effective bearing width: Intermediate stud with continuous rail	

Maximum design load at bearing: $$F_{c,90,d} = \frac{k_{mod}}{\gamma_M} \cdot f_{c,90,k} \cdot k_{c,y90} \cdot k_{sys} \cdot E_{ef}$$

WALL ASSEMBLY CAPACITY PER STUD

$$F_{stud,d} = \min (F_{c,0,d} \cdot F_{c,90,d})$$

FIRE LOAD REDUCTION FACTOR AND LOAD LEVEL	TYPICAL VALUE
Project specific or global agreed (η_{fi}):	**0.6**
Desired level of load (*Level of load*)	**100%**

$$F_{stud,test} = \eta_{fi} \cdot \frac{Level\ of\ load}{100} \cdot F_{stud,d}$$

Total applied load in the fire test:

$$F_{wall,test} = (\text{number of studs in the tested wall}) \cdot F_{stud,test}$$

Figure 1: Establishing the magnitude of the structural load for a product assembly in EN fire test

2. EN 1365-2:2014 fire resistance testing for floors

Recommendations on the loading of floors during a fire test

Summary

When planning a loadbearing floor fire test to BS EN 1365-2 the sponsor of the test must decide what load to apply to the floor panel to be tested. For generic floor elements, where there is no prior knowledge of the geometry or load, the sponsor must choose a load that will cover the flooring system for the widest range of possible applications. To derive the loading for fire testing, the sponsor should therefore calculate the load which produces the maximum stress levels permissible in the persistent (normal) design situation and reduce them by an appropriate factor in recognition that the fire design situation is an accidental design situation where different factors of safety apply.

Test load for a solid timber joisted floor

The limiting load for a joisted floor system can be calculated as the load that will exceed ULS strength checks according to Eurocode 5. For most floor designs, the strength of the floor will be limited by the bending strength of the timber, but for engineered timber joists there may be other strength verifications that will govern. The uniformly distributed load to be applied to the fire test floor panel can be summarised as the lesser of the bending strength check and the shear strength check:

$Q_{k,\,test} = \eta_{fi}\ (M_{Rd} \cdot \frac{8}{sl^2}) - G_{k,\,test}$	(1)
$Q_{k,\,test} = \eta_{fi}\ (F_{V,Rd} \cdot \frac{2}{sl}) - G_{k,\,test}$	(2)

Where,

$Q_{k,test}$ = is the load to be applied to the floor test assembly

η_{fi} = is the reduction factor to convert the normal loading to fire loading

M_{Rd} = is the design bending resistance of the joists

$F_{V,Rd}$ = is the design shear resistance of the joists

s = is the spacing of the joists

l = is the span of the joists

$G_{k,test}$ = is the characteristic self-weight of the tested floor assembly

Converting the test load into a limiting load for design

With knowledge of the load that was applied during the fire test, the designer must ensure that the equivalent bending and shear stresses are not exceeded in the normal temperature design in accordance with the direct field of application of BS EN 1365-2:

"The maximum moments and shear forces, which when calculated on the same basis as the test load, shall not be greater than those tested."

The designer can do this by using the stress index. The stress index is defined as the minimum ratio of the applied bending moment and shear force resulting from the applied load. For floor joists the two governing design strength checks are the shear and moment capacity which, for a uniformly distributed load, can be described as:

$SI_{M,fi} = \frac{M_{Ek,test}}{M_{Rk}} = \frac{(G_{k,test} + Q_{k,test})sl^2}{8.M_{Rk}}$	(3)
$SI_{V,fi} = \frac{F_{V,Ek,test}}{F_{V,Rk}} = \frac{(G_{k,test} + Q_{k,test})sl}{2.F_{V,Rk}}$	(4)

Where,

$SI_{M,fi}$ = the ratio between the bending moment resulting from the load applied to the joist during the test and the characteristic bending strength of the joist

$SI_{V,fi}$ = the ratio between the design shear force resulting from the load applied to the joist during the test and the characteristic shear strength of the joist

$M_{Ek,test}$ = the bending moment in the joist resulting from the load applied during the test

$F_{V,Ek,test}$ = the shear force in the joist resulting from the load applied during the test

M_{Rk} = the characteristic bending strength of the joist

$F_{V,Rk}$ = the characteristic shear strength of the joist

The stress index can be considered to be the proportion of the characteristic strength property that can be mobilised in the accidental fire design condition as limited by the load applied during the fire test. The stress index can be used by the designer to verify the accidental design bending and shear capacity of the joist using the equations 5 and 6 respectively:

$\frac{M_{Ed,fi}}{M_{Rd,fi}} = \frac{M_{Ed,fi}}{M_{Rk}SI_{M,fi}} \leq 1.0$	for a UDL:	$\frac{(G_k + \psi_{1,1}Q_k)sl^2}{8.M_{Rk}SI_{M,fi}} \leq 1.0$	(5)
$\frac{F_{V,Ed,fi}}{F_{V,Rd,fi}} = \frac{F_{V,Ed,fi}}{F_{V,Rk}SI_{V,fi}} \leq 1.0$	for a UDL:	$\frac{(G_k + \psi_{1,1}Q_k)sl}{2.F_{V,Rk}SI_{V,fi}} \leq 1.0$	(6)

Where,

$M_{Rd,fi}$ = is the design bending capacity of the joist limited by fire resistance

$M_{Ed,fi}$ = is the design bending moment applied to the joists in the accidental design situation

$F_{V,Rd,fi}$ = is the design shear capacity of the joist limited by fire resistance

$F_{V,Ed,fi}$ = is the design shear force applied to the joists in the accidental design situation

G_k = is the characteristic permanent load

Q_k = is the characteristic variable load

$\psi_{1,1}$ = is the combination factor for the accidental fire design condition

The fire load reduction factor η_{fi}

The recommended value for the fire load reduction factor η_{fi} = 0.6 is provided in Note 2 of clause 2.4.2(3) of BS EN 1995-1-2. This value is recommended for all of Europe despite there being significant variation in the self-weight and imposed load on floors, as well as different psi values used to combine actions. In the UK, where there are commonly used floor build-ups and clearly defined imposed load factors and psi values, it can be shown that the reduction factor η_{fi} will rarely be above 0.5.

Taking some common floor build-ups in the UK:

USAGE	G_K	Q_K	G_K/Q_K	$\psi_{1,1}$	η_{fi}
Residential	0.50	1.50	3.0	0.5	**0.43**
Residential	0.75	1.50	2.0	0.5	**0.46**
Flats	1.00	1.50	1.5	0.5	**0.49**
Flats	1.25	1.50	1.2	0.5	**0.51**
Corridors	0.50	250	5.0	0.5	**0.40**
Corridors	1.00	2.50	2.5	0.5	**0.44**
Plant Room	1.00	4.00	4.0	0.5	**0.41**
Load Ratio to achieve = η_{fi} 0.6	3.00	1.50	0.5	0.5	**0.60**

Table 1: Fire load reduction factor η_{fi} for different UK floors

The data given in the above table can be summarised in the following chart:

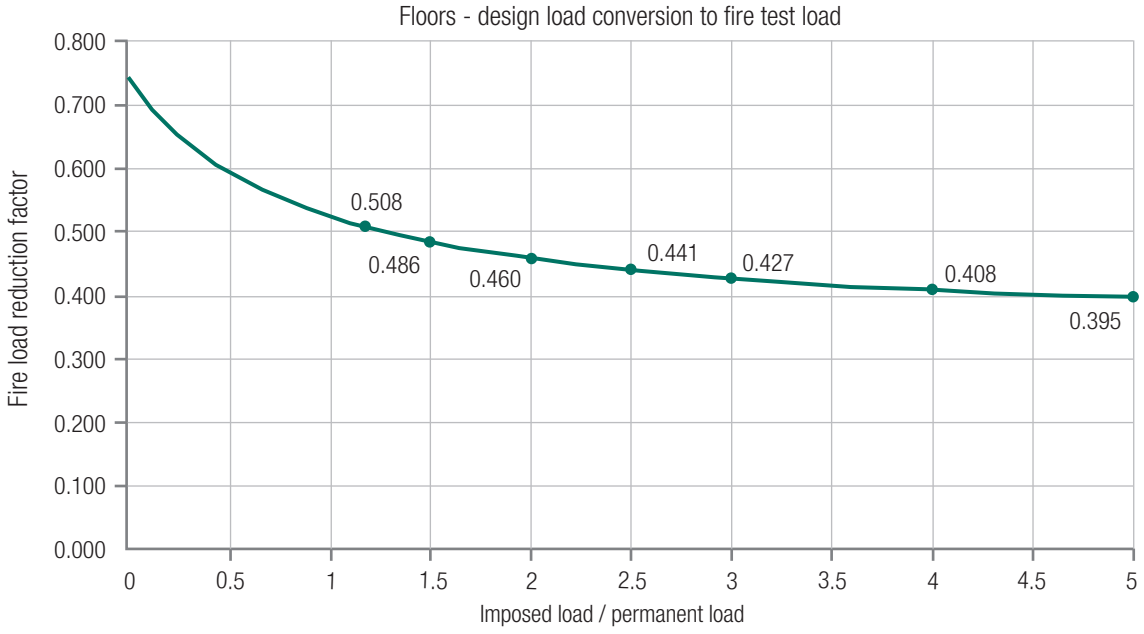
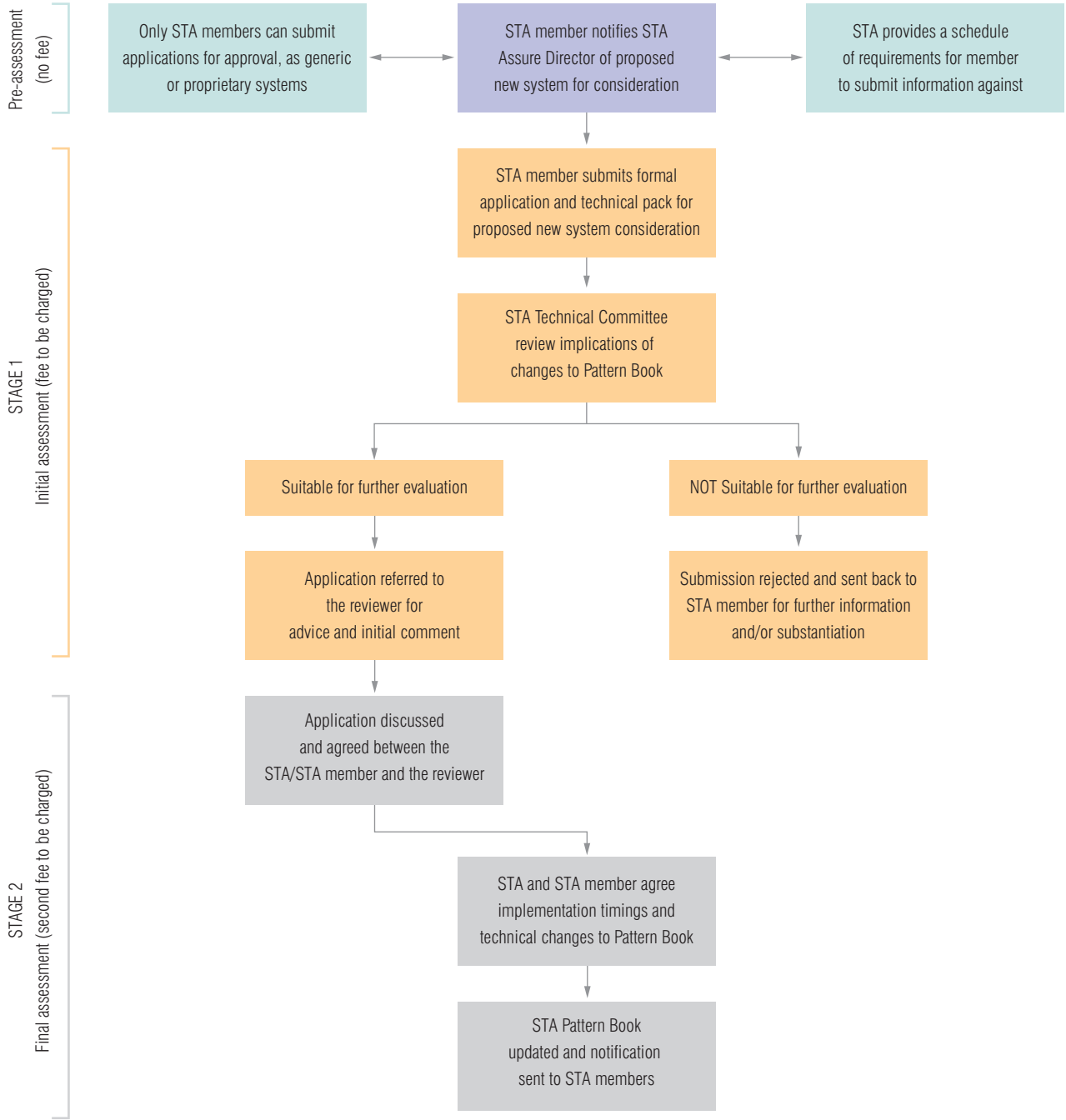


Figure 2: Variation of the fire load reduction factor η_{fi} for different UK floors

Furthermore, it is common for the design of timber floor joists to be limited by serviceability considerations to limit the deflection and vibration performance of the floor. This means that floor joists are rarely stressed to the limit of their strength and the test sponsor may choose to further reduce the load applied to the fire test. However, if the sponsor chooses to reduce the fire test load by stiffness, then the in-service strength of the joists should be limited to ensure that the required fire performance of the floor is achieved in accordance with the direct field of application of the BS EN 1365-2 fire test by the methodology provided above.

3. Future systems approvals process flow chart



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