



BSI Standards Publication

Recommendations for the design of timber structures to Eurocode 5: Design of timber structures

Part 1: General – Common rules and rules for buildings

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Foreword

Publishing information

This part of PD 6693 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 January 2025. It was prepared by Subcommittee B/525/5, *Structural use of timber*, under the authority of Technical Committee B/525, *Building and civil engineering structures*. A list of organizations represented on these committees can be obtained on request to the committee manager.

Supersession

This part of PD 6693 supersedes PD 6693-1:2019, which is withdrawn.

Relationship with other publications

This Published Document is a background paper that gives non-contradictory complementary information for use in the UK with the Eurocode for design of timber structures, BS EN 1995-1-1, and its National Annex.

Information about this document

This is a full revision of the document, and introduces the following principal changes:

- introduction of structural properties of strength class TR26 timber;
- restriction on lateral load-carrying capacity of glued lap joints;
- extended recommendations for exchange of information between building designer and component designer;
- re-ordering and clarification of Annex E on bracing of trussed rafter roofs; and
- extended details in Annex E relating to plasterboard ceiling diaphragm load tables and eaves connection details for rafter bracing.

This publication can be withdrawn, revised, partially superseded or superseded. Information regarding the status of this publication can be found in the Standards Catalogue on the BSI website at knowledge.bsigroup.com, or by contacting the Customer Services team.

Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Presentational conventions

The guidance in this document is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

Additional commentary, explanation and general informative material is presented in smaller italic type.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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Introduction

When there is a need for guidance on a subject that is not covered by the Eurocode, a country can choose to publish documents that contain non-contradictory complementary information that supports the Eurocode. This Published Document, which has been prepared by BSI Subcommittee B/525/5, *Structural use of timber*, provides just such information and has been cited as a reference in the [National Annex \(NA\) to BS EN 1995-1-1](#).

1 Scope

This Published Document gives non-contradictory complementary information for use with [BS EN 1995-1-1](#) and [NA to BS EN 1995-1-1](#).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[BS EN 1995-1-1:2004+A2:2014](#), *Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings*

[NA to BS EN 1995-1-1:2004+A2:2014](#), *UK National Annex to Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in [BS EN 1995-1-1:2004+A2:2014](#) and the following apply.

3.1.1 attic truss

trussed rafter that is designed to allow a habitable room within the roof space

3.1.2 bay

length of a member measured between adjacent nodes

[SOURCE: [BS 5268-3:2006](#) (withdrawn), 3.11]

3.1.3 chord member

member of the external profile of the truss

NOTE For example, a rafter or a ceiling tie.

3.1.4 girder truss

multiple trussed rafter that:

- supports a width of roof greater than 2,5 times the normal truss spacing within the roof or greater than 1,5 m whichever is the lesser; or
- directly supports other trusses; or
- supports another girder

3.1.5 racking discontinuity

door opening or other large opening, the dimensions of which exceed stipulated limits

NOTE A large opening includes, e.g. a window.

3.1.6 trussed rafter

structural assemblage of timber members of the same thickness, fastened together in one plane by punched metal plate fasteners

[SOURCE: BS 5268-3:2006 (withdrawn), 3.3]

3.1.7 wind girder

structural element set in the plane of the chords of a roof truss construction to transmit external wind forces to the supporting structure and to the foundations

[SOURCE: BS 5268-3:2006 (withdrawn), 3.7]

3.2 Abbreviated terms

For the purposes of this document, the following abbreviated terms apply.

LVL	laminated veneer lumber
OSB	oriented strand board
UDL	uniformly distributed load

4 Design responsibilities

On every project one person should assume overall responsibility as building designer and be clearly defined as such. The building designer should be responsible for ensuring the integration of the design of the various building components including the detailing of suitable connections between the building components and their support structure. The building designer should be responsible for ensuring adequate provision is made for the stability of the building as a whole, as distinct from, and in addition to, the stability of individual components, including the detailing of all elements of bracing required in the building. The building designer should provide relevant information, including the information listed in [Annex A](#), to all parties involved in the design of the building.

5 Effective anchorages of timber floors to walls for buildings of Consequence Class 2a

For timber frame walls, the guidance for the effective anchorages of timber floors in buildings of Consequence Class 2a given in [Annex B](#) may be followed.

For timber floors supported on masonry walls, Figure 1 to Figure 13 in [PD 6697:2019](#) may be used for the effective anchorages for buildings of Consequence Class 2a.

NOTE This guidance is in accordance with the NA to BS EN 1991-1-7:2006+A1:2014, NA.2.43.

6 Horizontal tie forces for Consequence Class 2b timber buildings of load-bearing wall construction

For timber buildings of load-bearing wall type construction, as an alternative to expressions (A.3) and (A.4) in [BS EN 1991-1-7:2006+A1:2014](#), the design tensile load (kN/m), T_i , in the peripheral and internal horizontal ties should be determined according to:

$$T_i = \max \begin{cases} 5 \\ 0,8L(g_k + \psi_1 q_k) \end{cases} \quad (1)$$

where:

- g_k is the characteristic permanent action (kN/m²);
- ψ_1 is the factor for frequent value of a variable action;
- q_k is the characteristic variable action (kN/m²);
- L is the span of the floor element being tied together between vertical supports (m).

7 Assignment of timbers to BS EN 338 strength classes [[BS EN 1995-1-1:2004+A2:2014](#), 3.2]

7.1 Assignment of temperate hardwoods

The assignment of temperate hardwoods to [BS EN 338](#) strength classes should be in accordance with [Table 1](#).

Table 1 — Assignment of temperate hardwoods to BS EN 338 strength classes

Strength class	Grade (in accordance with BS 5756)	Species commercial name	Source	Botanical identification
D30	TH1	European oak	UK	<i>Quercus petraea</i> / <i>Quercus robur</i>
D24	TH2	European oak	UK	<i>Quercus petraea</i> / <i>Quercus robur</i>
D40	THA ^{A)}	European oak	UK	<i>Quercus petraea</i> / <i>Quercus robur</i>
D30	THB ^{A)}	European oak	UK	<i>Quercus petraea</i> / <i>Quercus robur</i>
D24	TH1	Sweet chestnut	UK	<i>Castanea sativa</i>

^{A)} Grades THA and THB are only obtainable in cross-section sizes with no dimensions less than 100 mm and cross-sectional areas greater than 20 000 mm².

7.2 Assignment of large cross-section British-grown Douglas fir

For sizes where the cross-sectional area exceeds 20 000 mm² and both cross-sectional dimensions are at least 100 mm, British grown Douglas fir, of SS grade in accordance with [BS 4978](#), may be allocated to strength class C24.

7.3 Characteristic properties of strength class TR26

The characteristic strength and stiffness properties of strength class TR26 (formerly declared in [BS EN 14081-4:2009](#), which has been withdrawn) are given in [Table 2](#).

Table 2 — *Characteristic properties of strength class TR26*

Properties	Symbol	Class TR26
Strength properties (N/mm²)		
Bending	$f_{m,k}$	28,3
Tension parallel	$f_{t,0,k}$	17,6
Tension perpendicular	$f_{t,90,k}$	0,4
Compression parallel	$f_{c,0,k}$	22,9
Compression perpendicular	$f_{c,90,k}$	2,6
Shear	$f_{v,k}$	4,0
Stiffness properties (kN/mm²)		
Mean modulus of elasticity parallel	$E_{0,mean}$	11,0
5-percentile modulus of elasticity parallel	$E_{0,k}$	7,4
Mean modulus of elasticity perpendicular	$E_{90,mean}$	0,37
Mean shear modulus	G_{mean}	0,69
Density (kg/m³)		
Mean density	ρ_{mean}	444
5-percentile density	ρ_k	370

8 Factor $k_{c,90}$ for compression perpendicular to grain [BS EN 1995-1-1:2004+A2:2014, 6.1.5]

For bottom chords of trusses made from solid softwood timber and reinforced with punched metal plate fasteners over a support, the value of $k_{c,90}$ may be taken as:

$$k_{c,90} = 1,5 \quad (2)$$

9 Effective lengths of compression members [BS EN 1995-1-1:2004+A2:2014, 6.3.2]

9.1 The effective length of a compression member should be either:

- in accordance with Table 3 for the particular end conditions; or
- derived from the deflected form of the compression member as affected by any restraint and/or fixing moment(s), the effective length being the distance between adjacent points of zero bending between which the member is in single curvature.

Table 3 — *Effective lengths of compression members*

End condition	Ratio of effective length to actual length
Restrained at both ends in position and direction	0,7
Restrained at both ends in position and at one end in direction	0,85
Restrained at both ends in position but not in direction	1,0
Restrained at one end in position and in direction and at the other end in direction but not in position	1,5
Restrained at one end in position and in direction and free at the other end	2,0

- 9.2** The effective lengths of compression members in trussed rafters should be in accordance with [Table 4](#).

Table 4 — *Effective lengths of compression members in trussed rafters*

Types of truss member	Direction of buckling	Effective length
Internal member	In plane	0,9 × member length measured on its centreline
Internal member	Out-of-plane	0,9 × member length measured on its centreline
Chord member	In plane	At joint nodes: $\min \begin{cases} \text{distance between adjacent points of contraflexure} \\ \text{max of adjacent bay lengths} \end{cases}$ In bays: $\min \begin{cases} \text{bay length} \\ \text{distance between adjacent points of contraflexure} \end{cases}$
Chord member	Out-of-plane	At joint nodes: Check not required where longitudinal binders are fixed and suitably restrained In bays: - For roofs braced in accordance with Annex E, $0,01bL_{\text{bay}}$, where b is the thickness of the rafter (in mm) and L_{bay} is the length of the rafter bay along the slope (in m); - For sheathed roofs, distance between tiling battens, sheeting rails or other suitable restraint points.

- 9.3** In the absence of a more detailed calculation, the out-of-plane slenderness ratio for a member of a multiple-ply truss may be based on an effective thickness:

$$t_{\text{eff}} = k_r nb \quad (3)$$

where:

- t_{eff} is the effective thickness of the multiple-ply truss;
- n is the number of truss plies;
- b is the thickness of the truss plies, assuming that all plies are of the same thickness;
- $k_r = 0,9 - 0,1 n$.

- 9.4** The effective length of storey height wall studs sheathed on one or both sides should be taken as 0,85 times the length of the stud when considering buckling out of the plane of the wall. Timber wall studs sheathed on one or both sides may be assumed to be fully laterally restrained in the plane of the wall.

10 Limits on notches and circular holes in joists and studs for which no calculations are required

- 10.1** For simply supported joists, supporting uniformly distributed loading, of solid timber, glued laminated timber or LVL of depth, h , less than 250 mm and at centres not exceeding 610 mm with a notch of depth, h_{notch} , the effect of notches need not be calculated where:

- a) $h_{\text{notch}} \leq 0,125h$; and
- b) the notch is located at the top edge of the joist between 0,07 and 0,25 of the span from the nearest support.

- 10.2** For simply supported joists, supporting uniformly distributed loading, of solid timber, glued laminated timber or LVL of depth, h , less than 250 mm and at centres not exceeding 610 mm with a hole of diameter, d_{hole} , the effect of holes need not be calculated where all of the following apply:
- a) $d_{\text{hole}} \leq 0,25h$;
 - b) the hole centre is equidistant from the top and bottom edges of the joist;
 - c) the hole is located within 0,25 and 0,4 of the span from the nearest joist support; and
 - d) centres of adjacent holes are at least $3d_{\text{hole}}$ apart. Where adjacent holes are not of the same diameter, the maximum diameter should be used for d_{hole} .
- 10.3** The distance between the edge of a notch conforming to **10.1** and the edge of the nearest hole conforming to **10.2** should be at least 200 mm.
- 10.4** For studs of solid timber, glued laminated timber or LVL of depth, h , less than 250 mm and at centres not exceeding 610 mm, having a hole diameter, d_{hole} , the effect of holes need not be calculated where all of the following apply:
- a) $d_{\text{hole}} \leq 0,25h$;
 - b) the hole is central in the depth of the member;
 - c) the distance between the end of the member and the closest hole is not less than the maximum of 150 mm and 0,05 times the length of the member between supports; and
 - d) the spacing between the holes is not less than $3d_{\text{hole}}$.

11 Design of beams with holes

11.1 Design of beams with circular holes

- 11.1.1** For beams of solid timber of a minimum strength class C24 in accordance with **BS EN 338**, glued laminated timber or LVL of width b , and depth h , with a circular hole of diameter d_{hole} , where all of the following apply:

- a) the beam has a rectangular cross-section, and the grain runs essentially parallel to the length of the member;
- b) the axis of the hole runs parallel to the width of the beam;
- c) d_{hole} should be smaller than both $0,4h$ and 200 mm;
- d) the hole centre is equidistant from the top and bottom edges of the beam;

NOTE If the hole centre is not equidistant from the top and bottom edges of the beam, then the calculation is based on a larger hole whose centre is equidistant from the top and bottom edges of the beam and within which the actual hole is entirely contained.

- e) the distance from the hole centre to the nearest end of the beam is a minimum of $4d_{\text{hole}}$ or h ; and
- f) the distance from the hole centre to an adjacent hole centre is a minimum of $4d_{\text{hole}}$ or $1,5h$ or 300 mm.

It should be verified that:

$$\sigma_{t,90,d} \leq f_{t,90,d} \quad (4)$$

where:

$\sigma_{t,90,d}$ is the design tensile stress perpendicular to the grain at the hole location;

$f_{t,90,d}$ is the design tensile strength perpendicular to the grain.

11.1.2 The design tensile stress perpendicular to grain at the hole location, $\sigma_{t,90,d}$ should be calculated as:

$$\sigma_{t,90,d} = \frac{1,8V_{\text{hole},d}d_{\text{hole}} + 0,07M_{\text{hole},d}}{bh^2} \quad (5)$$

where:

- $V_{\text{hole},d}$ is the design shear force acting on the beam at the hole centre, in N;
 $M_{\text{hole},d}$ is the design moment acting on the beam at the hole centre, in N·mm;
 b , h and d_{hole} are taken in mm.

11.1.3 The verification of the bending strength of a beam which contains a circular hole should be based on the properties of the residual cross-section at the hole position.

11.2 Design of beams with rectangular holes

11.2.1 For beams of glued laminated timber or LVL of width b , and depth h , with a rectangular hole of depth h_{hole} and length l_{hole} , where all of the following apply:

- the beam has a rectangular cross-section, and the grain runs essentially parallel to the length of the member;
- the axis of the hole runs parallel to the width of the beam;
- the corners of the hole are cut to a minimum radius of 15 mm;
- h_{hole} should be smaller than both $0,2h$ and 200 mm;
- the hole centre is equidistant from the top and bottom edges of the beam;
NOTE If the hole centre is not equidistant from the top and bottom edges of the beam, then the calculation is based on a larger hole whose centre is equidistant from the top and bottom edges of the beam and within which the actual hole is entirely contained.
- l_{hole} should be smaller than both $0,5h$ and $2,5h_{\text{hole}}$;
- the distance from the hole centre to the nearest end of the beam is a minimum of $4l_{\text{hole}}$ or h ; and
- the distance from the hole centre to an adjacent hole centre is a minimum of $4l_{\text{hole}}$ or $2h$ or 300 mm.

It should be verified that:

$$\sigma_{t,90,d} \leq f_{t,90,d} \quad (6)$$

where:

- $\sigma_{t,90,d}$ is the design tensile stress perpendicular to the grain at the hole location;
 $f_{t,90,d}$ is the design tensile strength perpendicular to the grain.

11.2.2 The design tensile stress perpendicular to grain at the hole location, $\sigma_{t,90,d}$ should be calculated as:

$$\sigma_{t,90,d} = \frac{2,7V_{\text{hole},d}h_{\text{hole}} + 0,07M_{\text{hole},d}}{bh^2} \quad (7)$$

where:

- $V_{\text{hole},d}$ is the design shear force acting on the beam at the hole centre, in N;
 $M_{\text{hole},d}$ is the design moment acting on the beam at the hole centre, in N·mm;
 b , h , and h_{hole} are taken in mm.

- 11.2.3** In the verification of the bending strength of a beam which contains a rectangular hole, the design bending stress at the hole location, $\sigma_{m,d}$ should be calculated as:

$$\sigma_{m,d} = \frac{M_{hole,d}}{W_{net}} + \frac{0,25V_{hole,d}l_{hole}}{W_r} \quad (8)$$

where:

$$W_{net} = \frac{b(h^3 - h_{hole}^3)}{6h}$$

$$W_r = \frac{b(h - h_{hole})^2}{24}$$

12 Characteristic properties of fasteners

Designers may calculate default characteristic properties for several types of fastener from the expressions given in [BS EN 1995-1-1:2004+A2:2014](#). Manufacturers of fasteners are obliged to make a declaration of performance for any of their fasteners that fall within the scope of [BS EN 14592:2008+A1:2012](#), which has been withdrawn. These declarations of performance might provide alternatives to the default characteristic values as well as values for types of fastener not covered by the expressions in [BS EN 1995-1-1:2004+A2:2014](#).

13 Yield moment of annular ring-shanked nails [[BS EN 1995-1-1:2004+A2:2014](#), 8.3.1.1(4)]

For annular ring-shanked nails produced from wire having a minimum tensile strength of 600 N/mm², the following characteristic value for yield moment $M_{y,Rk}$ should be used:

$$M_{y,Rk} = 0,3 f_u d^{2,6} \quad (9)$$

where:

f_u is the tensile strength of the wire, in N/mm²;

d is the nail diameter, being the minimum outer cross-sectional diameter of the unprofiled part, in mm.

NOTE Annular ring-shanked nails are not grooved nails as referred to in [BS EN 1995-1-1:2004+A2:2014](#), 8.3.1.1(4).

14 Diameters for evaluating lateral load-carrying capacities of screws [[BS EN 1995-1-1:2004+A2:2014](#), 8.7.1]

- 14.1** Screws should conform to [BS EN 14592:2008+A1:2012](#), which has been withdrawn.

NOTE [BS EN 14592:2008+A1:2012](#) [BS EN 14592](#), which has been withdrawn, requires that screws have a nominal diameter (d) equal to the outer thread diameter and may be:

- screws which have their threaded part turned down from the original rod diameter, such that the outer thread diameter is equal to the smooth shank diameter; or
- screws produced by rolling or forging, such that the outer thread diameter is greater than the smooth shank diameter.

- 14.2** For full-threaded and part-threaded screws the rules in [BS EN 1995-1-1:2004+A2:2014](#), **8.2**, should be applied using an effective diameter d_{ef} instead of d in the Johansen expressions.
- 14.3** Minimum distances from an unloaded edge perpendicular to grain can be reduced to $3d$ if the spacing parallel to grain and the end distance are at least $25d$.

15 Axially loaded screws [[BS EN 1995-1-1:2004+A2:2014](#), 8.7.2]

- 15.1** For connections with screws in accordance with [BS EN 14592:2008+A1:2012](#), which has been withdrawn, with $d < 6$ mm and $0,6 \leq d_1/d \leq 0,75$, the characteristic withdrawal capacity in solid timber may be calculated in accordance with expression 8.38 in [BS EN 1995-1-1:2004+A2:2014](#), **8.7.2**, using the following values for $f_{\text{ax},k}$ and k_d :

$$f_{\text{ax},k} = 0,032\rho_k \quad (10)$$

$$k_d = 1,0 \quad (11)$$

where:

- $f_{\text{ax},k}$ is the characteristic withdrawal strength perpendicular to grain, in N/mm²;
- ρ_k is the characteristic timber density, in kg/m³;
- d is outer thread diameter of screw, in mm;
- d_1 is inner thread diameter (thread root diameter) of screw, in mm;
- k_d is the adjustment factor for screws.

- 15.2** For connections with screws in accordance with [BS EN 14592:2008+A1:2012](#), which has been withdrawn, with $d < 12$ mm and $d_h/d \leq 2,5$, the characteristic head pull-through capacity in solid timber may be calculated in accordance with expression 8.40b) in [BS EN 1995-1-1:2004+A2:2014](#), **8.7.2**, using the following value for $f_{\text{head},k}$:

$$f_{\text{head},k} = 12(\rho_k/350)^{0,8} \quad (12)$$

where:

- $f_{\text{head},k}$ is the characteristic head pull-through strength perpendicular to the grain, in N/mm²;
- ρ_k is the characteristic timber density, in kg/m³;
- d is outer thread diameter of screw, in mm;
- d_h is the head diameter of the screw, in mm.

16 Connections made with punched metal plate fasteners [[BS EN 1995-1-1:2004+A2:2014](#), 8.8.1]

- 16.1** Unless the anchorage strength of punched metal plate fasteners, when placed directly over finger joints, has been determined in accordance with [BS EN 1075](#), finger-jointed timber may not be used in trussed rafters.
- 16.2** Where k_{sys} is used for the member design of a truss made with punched metal plate fasteners, k_{sys} may also be used for the anchorage design, but not for the steel plate design of the punched metal plate fastener connections.

17 Misalignment tolerances in punched metal plate fastener joints [BS EN 1995-1-1:2004+A2:2014, 8.8.5.1]

The joint design should allow for a minimum misalignment of the punched metal plate fastener of 5 mm simultaneously in two directions parallel to the edges of the plate.

18 Trusses with punched metal plate fasteners [BS EN 1995-1-1:2004+A2:2014, 9.2.2]

18.1 The actions that may be considered in the design of trussed rafters are given in [Annex C](#).

NOTE Recommendations for the support of water tanks in trussed rafter roofs are given in [Annex F](#).

18.2 To take account of practical factors such as handling, the size of members and span should be restricted in accordance with the following limits.

- a) Spans of trussed rafters manufactured in timber of target thickness between 35 mm and 47 mm should conform to the following:

$$\text{Span} \leq t \times 345 \quad (13)$$

where:

t is the target thickness of timber.

NOTE 1 The use of mechanical handling equipment is particularly important for trussed rafters of more than 47 mm in thickness during their manufacture, loading, offloading and erection in order to prevent damage.

NOTE 2 Where a 2-ply truss is fixed together in the factory and mechanical handling equipment is utilized the member thickness t can be taken as two times the individual ply thickness.

- b) The maximum bay length of any top chord or bottom chord member, when measured on plan on the lower-edge position, should not exceed the appropriate value given in [Table 5](#). These limits may be increased by 50% when applied to top chord extensions such as overhangs or hip rafters.
- c) The overall length of any internal member should not exceed the appropriate value given in [Table 5](#). The overall length is the actual cut length as measured on the centreline of the member.

Table 5 — Maximum lengths of internal members and maximum bay lengths of chords

Member width mm	35 mm thick timbers			47 mm thick timbers		
	Top chord	Bottom chord	Internal member	Top chord	Bottom chord	Internal member
60	—	—	2 400	—	—	3 500
72	1 900	2 500	3 600	3 300	3 300	5 200
84	2 090	2 740	4 030	3 440	3 780	5 580
97	2 300	3 000	4 500	3 600	4 300	6 000
120	2 600	3 400	—	3 900	5 000	—
145	2 800	3 700	—	4 100	5 300	—

18.3 To account for loading eccentricities in girder trusses, the tension component perpendicular to the direction of the chord (T) (see [Figure 1](#)) should be multiplied by the modification factor, K_e , given in [Table 6](#). This should be applied to the check on chord splitting strength, to both the chord and web anchorages and to plate steel capacity checks. Additionally, any joint in a girder truss which is subject to a tension force perpendicular to grain should have a minimum fastener bite (d_{bite}) in any chord member not less than 0,5 times the member depth.

Figure 1 — Tension stress condition perpendicular to grain at joints

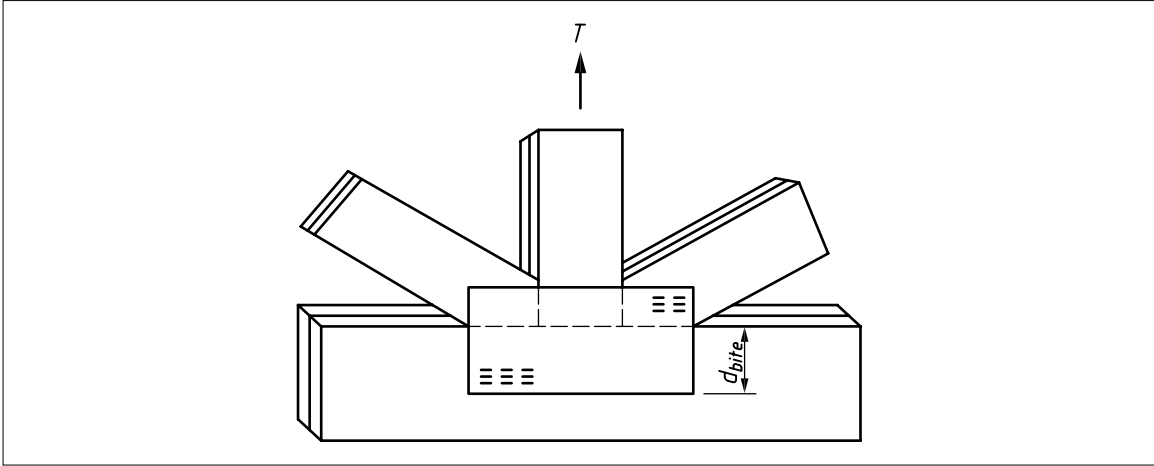


Table 6 — Modification factor, K_e , to account for loading eccentricities in girder trusses

Number of piles in girder truss	Modification factor, K_e
2	1,33
3	2,00
4	3,00

18.4 For trusses made with punched metal plate fasteners and supporting a floor imposed load $\geq 1,5 \text{ kN/m}^2$, all joints, except chord splices, should be designed using axial forces 50% greater than the axial forces utilized for the member design. Additionally, the minimum fastener bite on to chord members should be 0,5 times the member depth.

18.5 In splice joints the minimum length of the connector plate should be $0,8h + 80$ where h is the depth of the timber member, in mm.

19 Masonry shielding to wall diaphragms

Where timber frame walls are clad by masonry veneer, the external wind loading transferred to the timber structure may be determined using the information given in [Annex D](#).

20 Simplified analysis of wall diaphragms [BS EN 1995-1-1:2004+A2:2014, 9.2.4.3]

COMMENTARY ON CLAUSE 20

Clause 20 gives a simplified method of analysis for wall diaphragms of platform framed timber buildings consisting of timber framing connected on one or both faces to a wood-based sheathing. The method applies to wall diaphragms that are connected to the underlying timber construction or foundations either by bottom rail connections or by a combination of bottom rail connections and tiedowns.

20.1 Construction of wall diaphragms

20.1.1 Timber frame

- 20.1.1.1** The timber frame consists of timber studs, not exceeding 610 mm centre to centre, between horizontal top and bottom timber rails. The timber framing members should be a minimum thickness of 38 mm, a minimum depth of 72 mm and a minimum strength class of C16, in accordance with [BS EN 338](#).
- 20.1.1.2** The connection between horizontal rails and studs should comprise a minimum of two ring-shanked nails of diameter $\geq 3,1$ mm and having a penetration into the stud ≥ 45 mm, or equivalent.

20.1.2 Wood-based panel sheathing

- 20.1.2.1** The sheathing should conform to [BS EN 13986](#).

NOTE For plasterboard see Clause [21](#) and Clause [22](#).

- 20.1.2.2** Shear buckling of the sheathing sheets may be disregarded, provided that:

$$b_{\text{net}}/t \leq 100 \quad (14)$$

where:

- b_{net} is the clear distance between studs;
 t is the thickness of the sheathing.

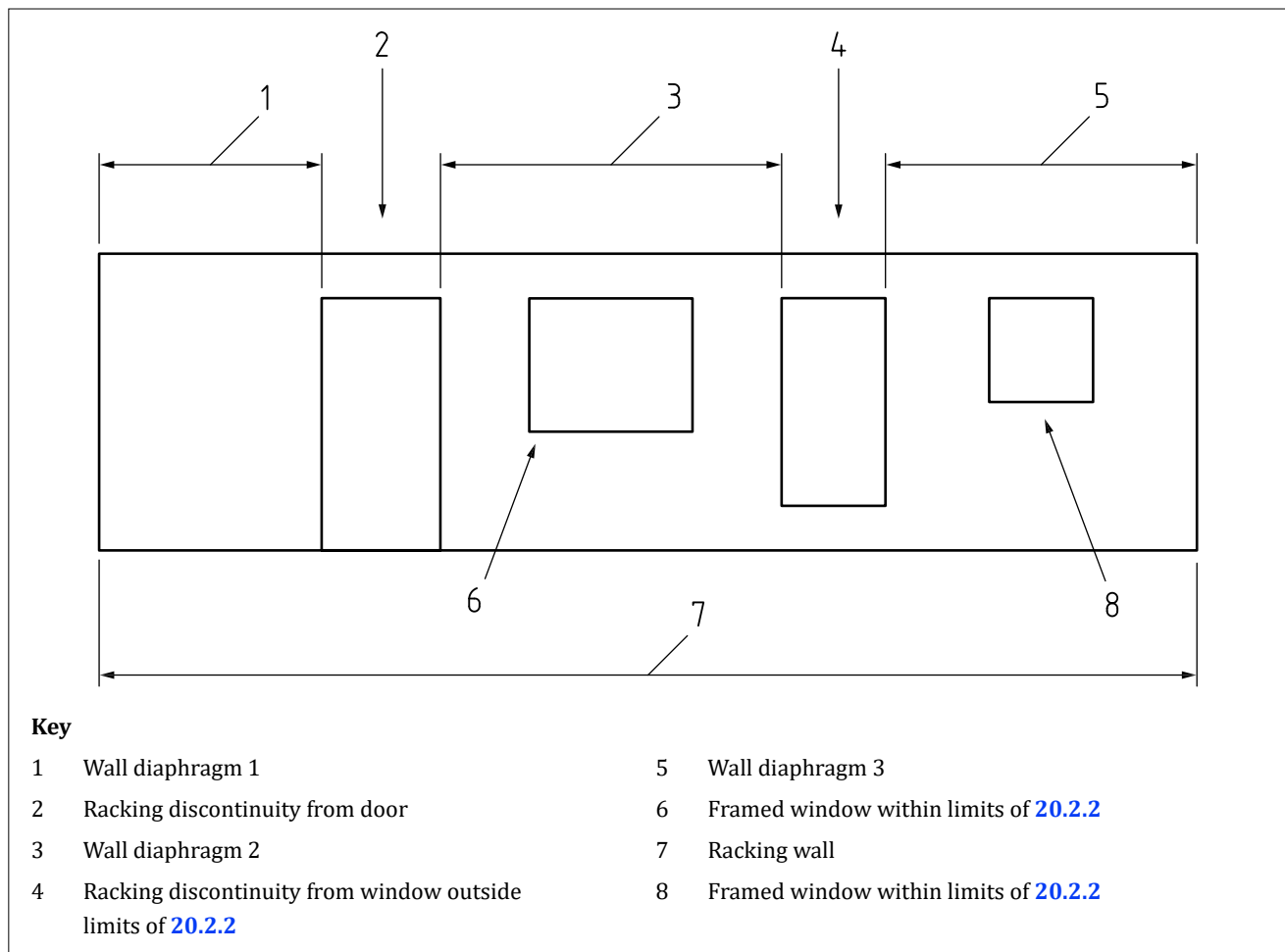
20.1.3 Fasteners connecting sheathing to timber framing

- 20.1.3.1** The diameter of the fasteners connecting the sheathing to timber framing should be no greater than 0,09 times the stud thickness. Additionally, where two sheathing sheets are connected to the same stud, the fastener edge distance for both the stud and sheathing sheet should be a minimum of three times the fastener diameter.
- 20.1.3.2** The fasteners fixing the sheathing to the framing should be equally spaced around the perimeter of each sheathing sheet at a maximum distance of 150 mm. Fasteners fixing the sheathing to the framing within the perimeter of a sheathing sheet should be equally spaced at a distance not more than twice the perimeter fastener spacing.

NOTE For further details on the construction of timber frame wall diaphragms refer to the TRADA publication, *Timber frame construction* [[1](#)].

20.2 General arrangements of wall diaphragms

- 20.2.1** A racking wall is a sheathed timber frame wall, usually located in a direction parallel to the wind load, and often extending between return walls. A racking wall may comprise a single wall diaphragm or, if it contains racking discontinuities, it may comprise more than one wall diaphragm (see [Figure 2](#)).

Figure 2 — Division of racking wall into wall diaphragms

20.2.2 Racking discontinuities are door openings or large openings such as windows that exceed any of the following limits.

- a) The vertical dimension of the opening is greater than 0,65 times the wall diaphragm height.
- b) The height to the underside of the opening is less than 0,25 times the wall diaphragm height.

20.2.3 A wall diaphragm may contain framed openings of dimensions within the limits given in 20.2.2 a) and 20.2.2 b), provided that their effects on racking strength and stiffness are taken into account (see 20.5.2.8).

20.2.4 Small openings within a length of wall diaphragm comprising only full height sheathing sheets may be allowed without reducing racking resistance if all of the following conditions are met.

- a) The opening does not exceed 300 mm in both length and height where the opening is framed.
- b) The opening does not exceed 150 mm in both length and height or 200 mm in diameter where the opening is unframed.
- c) The edge distance from the opening to any edge of a sheathing sheet is at least the maximum dimension of the opening.
- d) Only one such opening is allowed in a sheathing sheet and the spacing between such openings is at least 1 200 mm.

20.2.5 No more than two sheathing sheets of a length less than 600 mm should be used consecutively along the length of wall diaphragm.