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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

Designated by Government to issue European Technical Approvals

Agrément Certificate No 89/2290
*Second issue**

WOLF PUNCHED METAL PLATE TIMBER FASTENERS

Connecteurs métalliques pour charpentes en bois
Nagelplatten als holzver bindungsmittel

Product

- *THIS CERTIFICATE RELATES TO WOLF PUNCHED METAL PLATE TIMBER FASTENERS.*
- *The fasteners are steel plates with integral nails, used to connect the members of internally-used framed timber structural components (such as trusses) at any angle within the same plane.*
- *Timber joints are fabricated under factory conditions, and it is essential that the fabricator and the equipment for assembly are approved by the Certificate holder in accordance with the conditions set out in this Certificate.*

These Front Sheets must be read in conjunction with the accompanying Detail Sheets, which provides information to specific products.

Regulations — Detail Sheet 1

1 The Building Regulations 2000 (as amended) (England and Wales)

The Secretary of State has agreed with the British Board of Agrément the requirements of the Building Regulations to which punched metal plate timber fasteners can contribute in achieving compliance. In the opinion of the BBA, Wolf Punched Metal Plate Timber Fasteners, if used in accordance with the provisions of this Certificate, will contribute or contribute to meeting the relevant requirements.

Requirement:	A1	Loading
Comment:		The fasteners have sufficient strength and stiffness, provided that the design loads are in accordance with the tinted areas in the *Structural performance* section of these Front Sheets and the accompanying Detail Sheets.
Requirement:	Regulation 7	Materials and workmanship
Comment:		The fasteners are acceptable. See the *Durability* section of the accompanying Detail Sheets.

2 The Building (Scotland) Regulations 2004

In the opinion of the BBA, Wolf Punched Metal Plate Timber Fasteners, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Regulations and related Mandatory Standards as listed below.

Regulation:	8	Fitness and durability of materials and workmanship
Regulation:	8(1)	Fitness and durability of materials and workmanship
Comment:		The fasteners can contribute to a construction satisfying this Regulation. See the *Durability* section and the *Installation* part of the accompanying Detail Sheets.
Regulation:	9	Building standards — construction
Standard:	1.1(a)(b)	Structure
Comment:		The fasteners have sufficient strength and stiffness to sustain the design loads and, therefore, can contribute to satisfying this Standard with reference to clause 1.1.1[(1)(2)]. See the tinted areas in the *Structural performance* section of these Front Sheets and the accompanying Detail Sheets.
		(1) Technical Handbook (Domestic).
		(2) Technical Handbook (Non-Domestic).

3 The Building Regulations (Northern Ireland) 2000

In the opinion of the BBA, Wolf Punched Metal Plate Timber Fasteners, if used in accordance with the provisions of this Certificate, will satisfy or contribute to satisfying the various Building Regulations as listed below.

Regulation:	B2	Fitness of materials and workmanship
Comment:		The fasteners are acceptable. See the *Durability* section of the accompanying Detail Sheets.
Regulation:	D1	Stability
Comment:		The fasteners have sufficient strength and stiffness, provided that the design loads are in accordance with the tinted areas in the *Structural performance* section of these Front Sheets and the accompanying Detail Sheets.

4 Construction (Design and Management) Regulations 1994 (as amended) Construction (Design and Management) Regulations (Northern Ireland) 1995 (as amended)

Information in this Certificate may assist the client, planning supervisor, designer and contractors to address their obligations under these Regulations.

See section:	6 *Practicability of installation* (6.2) in the relevant Detail Sheet.

Design Data

5 General

5.1 Wolf Punched Metal Plate Timber Fasteners have been assessed in accordance with the requirements of MOAT No 16 : 1979 and prEN 14545. The fasteners are suitable for use in making joints in timber framed structures. The Certificate holder's prescribed methods of applying the fasteners are considered satisfactory.

5.2 Framed structures incorporating the fasteners are designed using established engineering methods, including designs in accordance with BS 5268-2 : 2002 or, where appropriate, BS 5268-3 : 1998 and BS EN 1995-1-1 : 2004 (Eurocode 5), together with its UK National Annex.

6 Structural performance

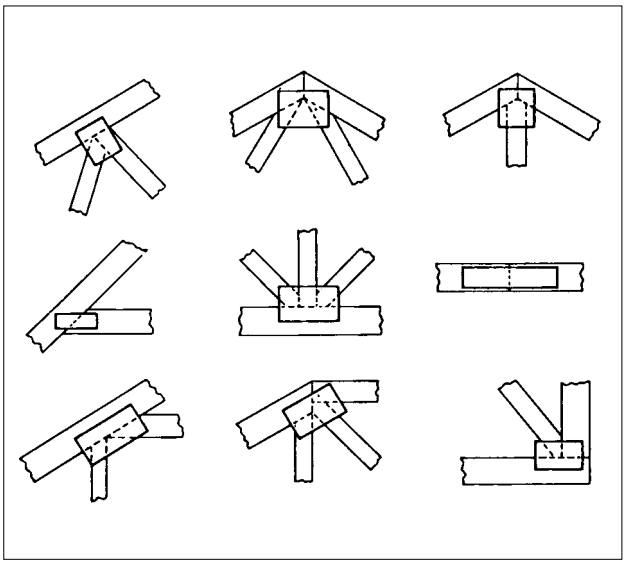
6.1 The strength of timber is influenced by the duration of loading. A similar effect applies to timber joints, except where the strength of the fastener is the limiting factor. Duration of loading, therefore, should be considered in accordance with the procedures recommended in BS 5268-2 : 2002, BS 5268-3 : 1998 or Eurocode 5 together with its UK National Annex.

6.2 The strength of a joint is generally dependent upon the lateral resistance of the nails. However, the limiting tensile, compressive or shear strength of the net section of the plates must not be exceeded.

Joint assembly

6.3 Timber members to be connected may be in line or meet at any required angle in the same plane; typical joints are illustrated in Figure 1.

Figure 1 Examples of typical joints



6.4 The fasteners must be embedded in both faces of each abutting member using special equipment supplied or approved by the manufacturer.

6.5 Each fastener must be embedded to achieve complete penetration of the nails without pressing the plate into the timber for more than one quarter of its thickness. There must be no significant gaps between the fastener and the timber.

7 Performance in relation to fire

When used in a structure subject to fire resistance requirements, an appropriate assessment or test, relating to that structure, must be carried out by a United Kingdom Accreditation Service (UKAS) accredited laboratory for the test concerned.

8 Timber treatments

8.1 The timber may be preserved with aqueous copper, boron compounds or organic solvent preservative applied in accordance with BS 8417 : 2003.

8.2 In Service Classes 1 and 2, the risks of fungal decay are low, and preservative treatment is only necessary where the insect hazard requires it. If a treatment is conducted:

- double vacuum treatments with organic solvent-based preservatives, and boron diffusion, do not have a corrosive effect on fasteners
- where CCA preservatives are permitted, the requirements of the Environmental Protection (Controls on Dangerous Substances) Regulations 2003, to ensure the preservative has adequately fixated before timber is marketed, will ensure that the risk of corrosion to metal fasteners is not present
- to prevent the risk of corrosion in residential and domestic constructions, arsenic-free aqueous copper preservatives used instead of CCA preservatives should be given adequate time for fixation before the fasteners are embedded.

8.3 Where copper / chrome / arsenic (CCA) preservative is used it is essential to allow sufficient time for the complete fixation of the preservative (about seven days) and to ensure that the timber is subsequently re-dried after fixation, before the fasteners are embedded.

8.4 When confined to the dry conditions specified in this Certificate the use of preservative-treated timber does not present a corrosion risk. In wetter conditions, however, the risk of premature corrosion of fasteners may be greater than with untreated timber. The risk of corrosion associated with the various forms of preservative treatment and with treatment with inorganic flame-retardant salts are described in BRE Digest 301 : 1985 *Corrosion of metals by wood.*

Bibliography

BS 5268-2 : 2002 *Structural use of timber — Code of practice for permissible stress design, materials and workmanship*
BS 5268-3 : 1998 *Structural use of timber — Code of practice for trussed rafter roofs*

BS 8417 : 2003 *Preservation of timber — Recommendations*

BS EN 1995-1-1 : 2004 *Eurocode 5 — Design of timber structures — Common rules and rules for buildings*

prEN 14545 *Timber structures — Connectors — Requirements*

MOAT No 16 : 1979 *Directive for the Assessment of Punched Metal Plate Timber Fasteners*

Conditions of Certification

9 Conditions

9.1 This Certificate:

(a) relates only to the product that is named, described, installed, used and maintained as set out in this Certificate;

(b) is granted only to the company, firm or person identified on the front cover — no other company, firm or person may hold or claim any entitlement to this Certificate;

(c) is valid only within the UK;

(d) has to be read, considered and used as a whole document — it may be misleading and will be incomplete to be selective;

(e) is copyright of the BBA;

(f) is subject to English law.

9.2 References in this Certificate to any Act of Parliament, Regulation made thereunder, Directive or Regulation of the European Union, Statutory Instrument, Code of Practice, British Standard, manufacturers' instructions or similar publication, are references to such publication in the form in which it was current at the date of this Certificate.

9.3 This Certificate will remain valid for an unlimited period provided that the product and the manufacture and / or fabrication including all related and relevant processes thereof:

(a) are maintained at or above the levels which have been assessed and found to be satisfactory by the BBA;

(b) continue to be checked as and when deemed appropriate by the BBA under arrangements that it will determine; and

(c) are reviewed by the BBA as and when it considers appropriate.

9.4 In granting this Certificate, the BBA is not responsible for:

(a) the presence or absence of any patent, intellectual property or similar rights subsisting in the product or any other product;

(b) the right of the Certificate holder to market, supply, install or maintain the product; and

(c) the actual works in which the product is installed, used and maintained, including the nature, design, methods and workmanship of such works.

9.5 Any recommendations relating to the use or installation of this product which are contained or referred to in this Certificate are the minimum standards required to be met when the product is used. They do not purport in any way to restate the requirements of the Health & Safety at Work etc Act 1974, or of any other statutory, common law or other duty which may exist at the date of this Certificate or in the future; nor is conformity with such recommendations to be taken as satisfying the requirements of the 1974 Act or of any present or future statutory, common law or other duty of care. In granting this Certificate, the BBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the installation and use of this product.

BBA BRITISH BOARD OF AGRÉMENT
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In the opinion of the British Board of Agrément, Wolf Punched Metal Plate Timber Fasteners are fit for their intended use provided they are installed, used and maintained as set out in this Certificate. Certificate No 89 / 2290 is accordingly awarded to Wolf Systems Ltd.

On behalf of the British Board of Agrément

Date of Second issue: 20th December 2005

Chief Executive

**Original Certificate issued on 25th September 1989. This amended version includes reference to the revised national Building Regulations and changes to the* Timber treatment *statements.*

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

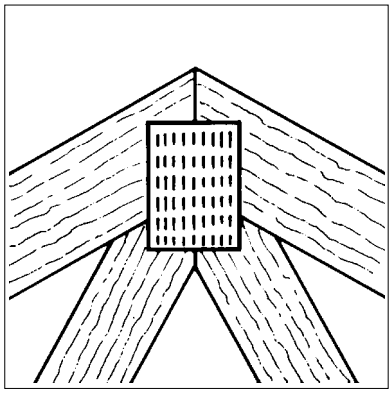
Wolf Systems Ltd

WOLF 100 PUNCHED METAL PLATE TIMBER FASTENERS

Certificate No 89/2290

DETAIL SHEET 2

Product



- *THIS DETAIL SHEET RELATES TO WOLF 100 ZINC COATED PUNCHED METAL PLATE TIMBER FASTENERS.*
- *This Detail Sheet must be read in conjunction with the Front Sheet and Detail Sheet 1, which give* Conditions of Certification, *details common to all Wolf Systems Ltd's certificated fasteners and the product's position regarding the Building Regulations respectively.*

Technical Specification

1 Description

1.1 Wolf 100 punched metal plate timber fasteners are galvanized mild steel plate having rows of integral nails pressed out to project at approximately right-angles to one face of the plates (see Figure 1). The slots so formed define the length direction of the fastener. Two nails are formed from each slot.

1.2 The fasteners are manufactured from material designation Z2 G275 to BS 2989 : 1982 *Specification for continuously hot-dip zinc coated and iron-zinc alloy coated steel : wide strip, sheet / plate and slit wide strip.* An upper limit on ultimate tensile strength is additionally imposed to ensure suitability for pressing. Reference should be made to BBA Information No 9 *Punched Metal Plate Timber Fasteners — Specification for Hot-Dip Zinc Coated Steel and Quality Control Guidance Notes.*

1.3 The dimensions and spacing of the nails are shown in Figure 2. The thickness of the plate including zinc coating is nominally 1.00 mm.

2 Sizes

The standard sizes of fastener are given in Table 1.

Figure 1 Typical Wolf 100 fastener

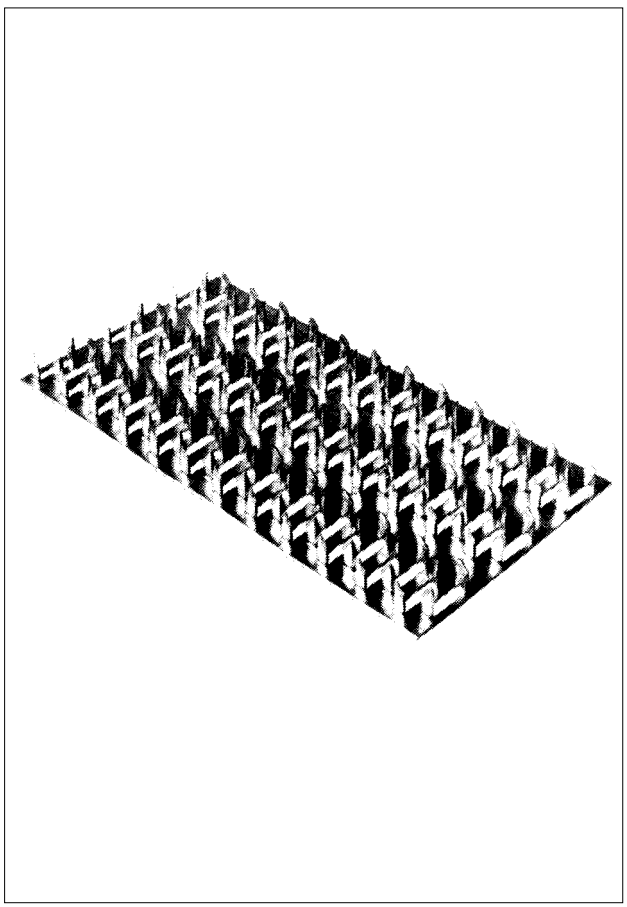


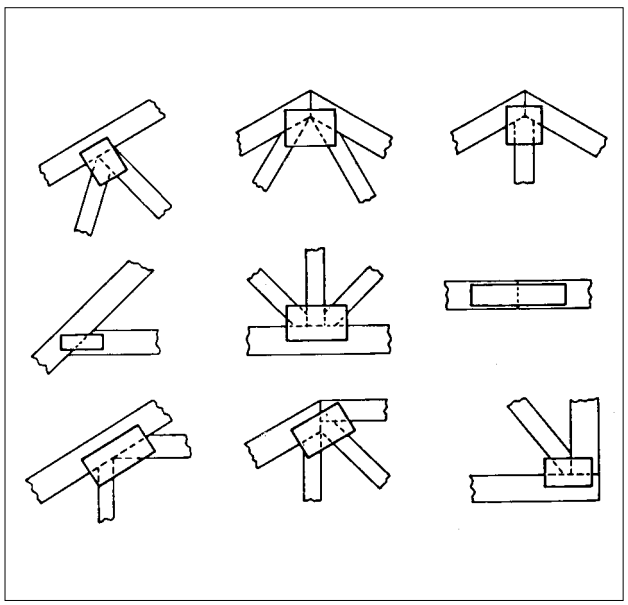
Table 1 Range of standard fastener sizes

Length (mm)	Width (mm)										
	24	36	48	60	72	84	108	120	144	168	216
75	x	x	x	x	x	x	x	x	x		
100	x	x	x	x	x	x	x	x	x	x	x
125	x	x	x	x	x	x	x	x	x	x	x
150		x	x	x	x	x	x	x	x	x	x
200		x	x	x	x	x	x	x	x	x	x
250			x	x	x	x	x	x	x	x	x
300				x	x	x	x	x	x	x	x
350							x	x	x	x	x
400									x	x	x

3 Identification

The fasteners are stamped with the manufacturer's identification mark, the legend *Wolf 100*, and are packed in boxes bearing the BBA identification mark incorporating the number of this Certificate.

Figure 2 Dimensions and arrangement of nails



Design Data

4 Timber species

This Detail Sheet covers the use of Wolf 100 fasteners in sawn or planed, treated or untreated, stress graded timber of minimum specified thickness of 35 mm, 0.0 + 1 mm divergence throughout a member (when measured at 20% moisture content) of the following species:

European whitewood
European redwood
Hem-fir
Spruce-pine-fir
Eastern Canadian spruce (princess spruce)
Western white spruce.

5 Structural performance

Lateral resistance

5.1 The lateral resistance of a fastener depends upon:

number of effective nails in the joint
species of timber and its moisture content
duration of load
direction of bearing of the nail with respect to the grain of the timber
angle of load to the fastener.

5.2 The number of effective nails in the joint shall be determined by omitting:

nails nearer than 6 mm to the edge of the timber, and
nails nearer than 6 mm to the end of the timber member in compression or tension measured parallel to the grain.

5.3 The permissible lateral load per effective nail for the fasteners under long term loading for the softwood species included in this assessment is given in Table 2. The permissible loads are specified for 15° increments of angle of load to the grain and nail orientation, as indicated in Figure 3.

Table 2 Permissible loads per effective nail (Newtons) for fasteners in planed members†*

Angle of load to fastener length	Angle of load to grain of member						
LONG-TERM LOADING	0°	15°	30°	45°	60°	75°	90°
0°	64	62	58	53	49	47	46
15°	61	60	56	52	49	47	46
30°	58	57	54	51	48	46	45
45°	57	56	53	50	47	45	44
60°	55	54	52	49	46	45	44
75°	54	53	51	48	46	45	44
90°	53	52	50	48	46	45	44

* For sawn members use 0.90 of the values.
† For spruce-pine-fir, Eastern Canadian spruce and Western white spruce use 0.95 of the values.

5.4 The permissible lateral load for medium, short and very short term duration of load should be obtained in accordance with BS 5268 : Part 2 : 1988 by modifying the long-term permissible loads given in Table 2 by the following factors:

Medium term (eg dead + snow, dead + temporary imposed) 1.12

Short term (eg dead + imposed + wind*, dead + imposed + snow + wind*) 1.25

Very short term (eg dead + imposed + wind)† 1.25

* For wind, short term category applies to class C (15 s gust) as defined in BS Code of Practice CP 3 : Chapter V : Part 2 : 1972 *Code of basic data for the design of buildings : Loading : Wind loads*.

† For wind, very short term category applies to classes A and B (3 s or 5 s gust) as defined in CP3 : Chapter V : Part 2.

Tensile strength

5.5 The maximum tensile force acting on the fasteners, for all four categories of load duration, must not exceed the following:

Force acting in direction of fastener length — 79 Nmm^{-1} of fastener width

Force acting in direction of fastener width — 66 Nmm^{-1} of fastener length.

Compressive strength

5.6 The maximum compressive force acting on the fasteners, for all four categories of load duration, must not exceed the following:

Force acting in direction of fastener length — 47 Nmm^{-1} of fastener width

Force acting in direction of fastener width — 49 Nmm^{-1} of fastener length.

5.7 The loads given in section 5.6 were derived from tests and are based on a typical factor of safety for general use. Where failure of the fastener will result in forces being taken in end bearing and the joint will not be subject to stress reversal, the permissible values for compressive force may be modified by multiplying by 1.5. A suitably qualified engineer shall be responsible for considering the merits of each application and deciding upon the appropriate permissible value.

Shear strength

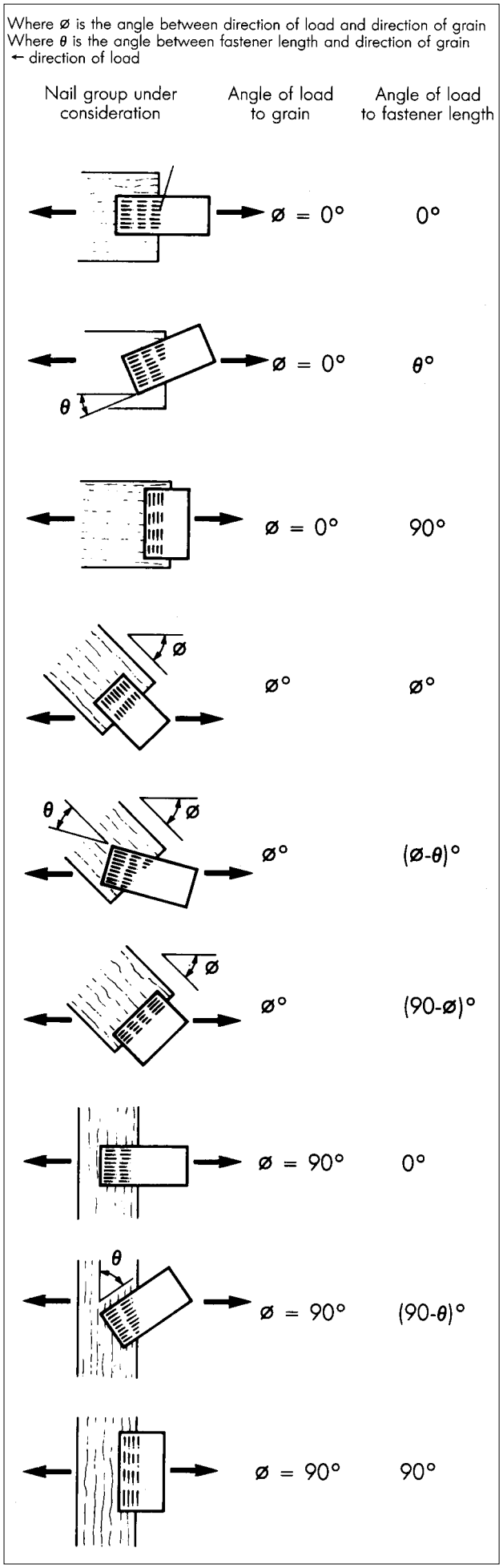
5.8 The maximum shear force acting on a fastener, for all four categories of load duration, must not exceed the value given in Table 3 for the angle α, the angle between the fastener length direction and the direction in which the load is acting.

*Table 3 Maximum shear forces**

Angle α	Nmm^{-1} of shear line
0	38
15	38
30	40
45	50
60	46
75	34
90	20
105	25
120	30
135	31
150	41
165	39

* Values for intermediate angles can be interpolated.

Figure 3 Angle of load to grain and nail orientation



6 Practicability of installation

The fasteners are easy to embed using the commercial platen or roller press equipment normally employed for truss fabrication.

7 Durability

The fasteners have a zinc coating (see section 1.2 of this Detail Sheet), which will give adequate protection against corrosion in normal internal domestic situations, where the moisture content of the timber does not exceed 18% for any significant period and does not exceed 22% at any time.

Technical Investigations

The following is a summary of the technical investigations carried out on Wolf 100 punched metal plate timber fasteners.

8 Tests

8.1 Tests were carried out on 205 full-size structural joints, assembled using the commercial equipment normally employed. The results were assessed to determine the permissible loads and stresses for the fasteners.

8.2 Three species of timber were used in the test joints, European whitewood, European redwood and Western white spruce. Existing data on the relative strength of species were used to derive values for use with other species. The tests examined:

variations in strength within species

effects of direction and type of loading

effects of fastener orientation

compressive, tensile and shear properties of fasteners.

8.3 Tests were conducted to determine the thickness and quality of galvanizing.

9 Other investigations

9.1 The permissible loads, derived from the tests referred to above, were compared with the estimated maximum loads to cause a joint slip of 0.8 mm. These latter load values however, were consistently higher than those based on maximum load values. In general, the maximum initial slip in joints in tension, at the permissible long-term loads, will not be greater than 0.23 mm and the average initial slip not greater than 0.16 mm.

9.2 Existing data on the durability of punched metal plate timber fasteners were examined.

9.3 Existing data relating to cyclic loading on fasteners in dwellings and similar structures were examined and the effects found to be insignificant.

9.4 An assessment was made on the practicability of joint assembly.

9.5 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Date of issue: 25th September 1989

Director

Recreated in QX 25.4.02 (SM)

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

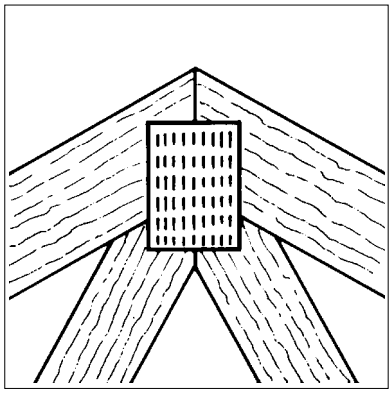
Wolf Systems Ltd

WOLF 12N PUNCHED METAL PLATE TIMBER FASTENERS

Certificate No 89/2290

DETAIL SHEET 3

Product



- *THIS DETAIL SHEET RELATES TO WOLF 12N PUNCHED METAL PLATE TIMBER FASTENERS.*
- *This Detail Sheet must be read in conjunction with the Front Sheet and Detail Sheet 1, which give* Conditions of Certification, *details common to all Wolf Systems Ltd's certificated fasteners and the product's position regarding the Building Regulations respectively.*

Technical Specification

1 Description

1.1 Wolf 12N Punched Metal Plate Timber Fasteners are galvanized mild steel plates, having rows of integral nails pressed out to project at approximately right-angles to one face of the plates (see Figure 1). The slots so formed define the length direction of the fastener. One nail is formed from each slot and alternate rows of nails face in opposite directions.

1.2 Wolf 12N fasteners are manufactured from material designation Z2 G275 to BS 2989 : 1982 *Specification for continuously hot-dip zinc coated and iron-zinc alloy coated steel : wide strip, sheet / plate and slit wide strip.* An upper limit on ultimate tensile strength is additionally imposed to ensure suitability for pressing. Reference should be made to BBA Information No 9 *Punched Metal Plate Timber Fasteners — Specification for Hot-Dip Zinc Coated Steel and Quality Control Guidance Notes.*

1.3 The dimensions and spacing of the nails are shown in Figure 2. The thickness of the plate, including zinc coating, is nominally 1.25 mm.

2 Sizes

The standard sizes of fastener are given in Table 1.

Figure 1 Typical Wolf 12N fastener

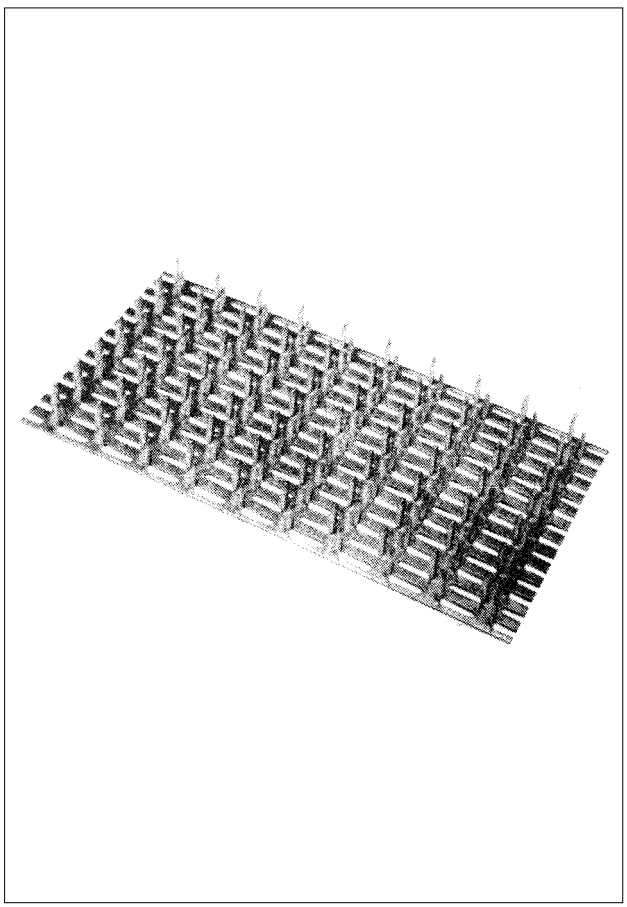


Figure 2 Dimensions and arrangement of nails

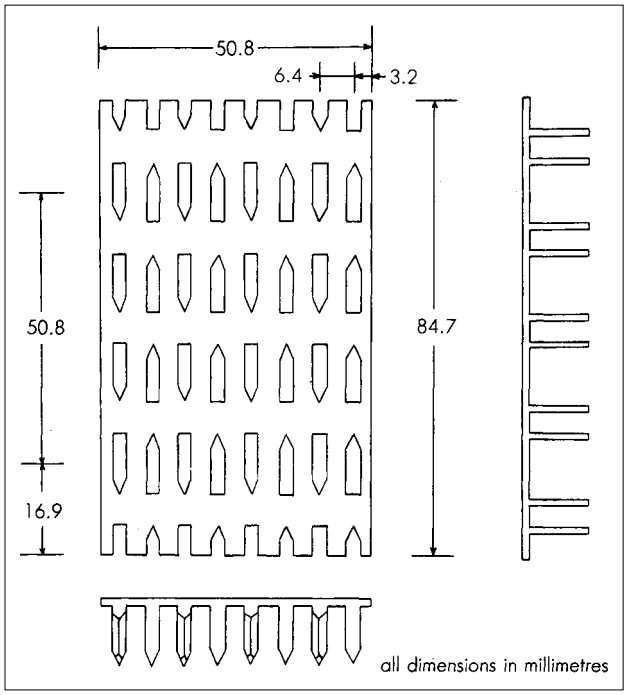


Table 1 Range of standard fastener sizes

Length (mm)	Width (mm)								
	32	51	63	76	89	102	127	152	178
76	1	1	1	1	1	1	1	1	0
102	1	1	1	1	1	1	1	1	0
127	0	1	1	1	1	1	1	1	0
152	0	1	1	1	1	1	1	1	0
178	0	0	1	1	1	1	1	1	0
203	0	0	1	1	1	1	1	1	0
228	0	0	0	1	1	1	1	1	0
254	0	0	0	0	1	1	1	1	0
304	0	0	0	0	0	1	1	1	1

1 denotes fastener size covered by this Certificate
0 denotes fastener size not covered by this Certificate

3 Identification

The fasteners are stamped with the manufacturer's identification mark *Wolf 12N*, and are packed in boxes bearing the BBA identification mark incorporating the number of this Certificate.

Design Data

4 Timber species

This Detail Sheet covers the use of Wolf 12N fasteners in sawn or planed, treated or untreated, stress graded timber of minimum specified thickness of 35 mm, 0 + 1 mm divergence throughout a member (when measured at 20% moisture content) of the following species:

European whitewood
European redwood
Hem-fir
Spruce-pine-fir
Eastern Canadian spruce (princess spruce)
Western white spruce.

5 Structural performance

Lateral resistance

5.1 The lateral resistance of a fastener depends upon:

number of effective nails in the joint
species of timber and its moisture content
duration of load
direction of bearing of the nail with respect to the grain of the timber
angle of load to the fastener.

5.2 The number of effective nails in the joint shall be determined by omitting:

nails nearer than 6 mm to the edge of the timber,
nails nearer than 6 mm to the end of the timber member in compression, and
nails nearer than 10 mm from the ends of timber members in tension measured parallel to the grain.

5.3 The permissible lateral load per effective nail for the fasteners under long-term loading for the softwood species included in this assessment is given in Table 2. The permissible loads are specified for 15° increments of angle of load to the grain and nail orientation, as indicated in Figure 3.

Table 2 Permissible loads per effective nail (Newtons) for fasteners in planed members*

Angle load to fastener length	Angle of load to grain of member						
	0°	15°	30°	45°	60°	75°	90°
LONG-TERM LOADING							
0°	99	94	83	71	62	57	55
15°	97	92	81	70	62	57	55
30°	95	91	80	70	61	57	55
45°	86	83	75	67	60	56	55
60°	77	75	70	64	59	56	55
75°	76	74	69	64	59	56	55
90°	75	73	69	63	59	56	55

* For sawn members use 0.95 of the values.

5.4 The permissible lateral load for medium-, short- and very short-term duration of load should be obtained in accordance with BS 5268 : Part 2 : 1988 by modifying the long-term permissible loads given in Table 2 by the following factors:

Medium term (eg dead + snow, dead + temporary imposed)	1.12

Short term (eg dead + imposed + wind*, dead + imposed + snow + wind*)	1.25
Very short term (eg dead + imposed + wind)†	1.25

* For wind, short term category applies to class C (15 s gust) as defined in CP 3 : Chapter V : Part 2.

† For wind, very short term category applies to classes A and B (3 s or 5 s gust) as defined in CP3 : Chapter V : Part 2.

Tensile strength

5.5 The maximum tensile force acting on the fasteners, for all four categories of load duration, must not exceed the following:

force acting in direction of fastener length — 127 Nmm^{-1} of fastener width

force acting in direction of fastener width — 72 Nmm^{-1} of fastener length.

Compressive strength

5.6 The maximum compressive force acting on the fasteners, for all four categories of load duration, must not exceed the following:

force acting in direction of fastener length — 81 Nmm^{-1} of fastener width

force acting in direction of fastener widths — 59 Nmm^{-1} of fastener length.

5.7 The loads given in section 5.6 were derived from tests and are based on a typical factor of safety for general use. Where failure of the fastener will result in forces being taken in end bearing and the joint will not be subject to stress reversal, the permissible values for compressive force may be modified by multiplying by 1.5. A suitably qualified engineer shall be responsible for considering the merits of each application and deciding upon the appropriate permissible value.

Shear strength

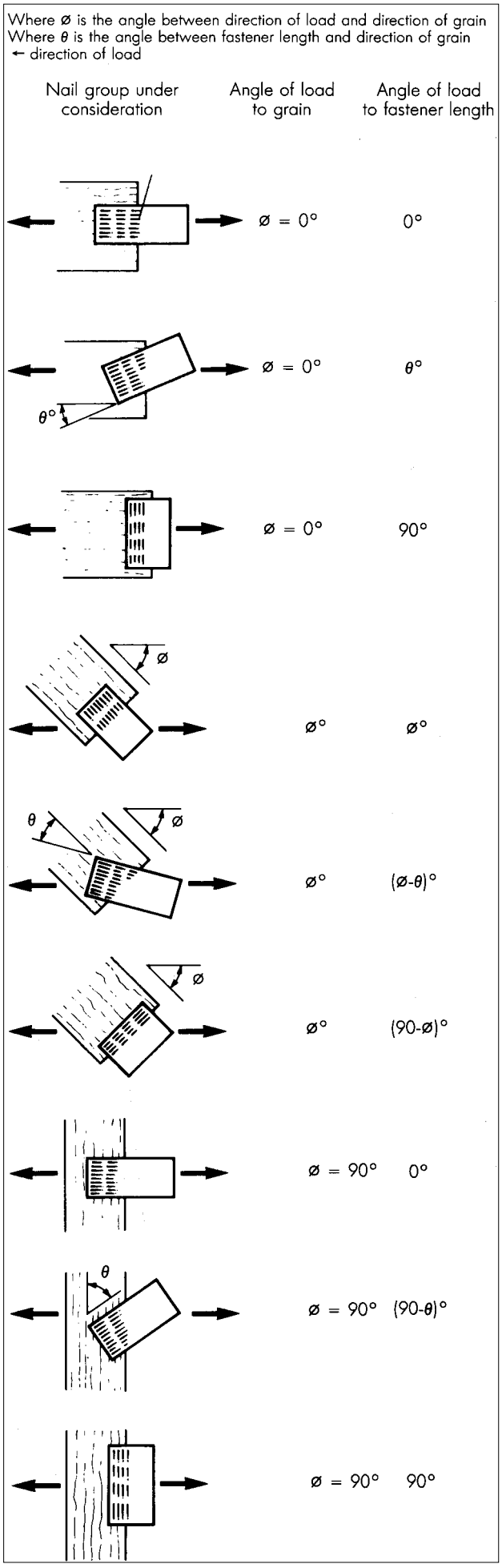
5.8 The maximum shear force acting on a fastener, for all four categories of load duration, must not exceed the value given in Table 3 for the angle α, the angle between the fastener length direction and the direction in which the load is acting.

*Table 3 Maximum shear forces**

Angle α	Nmm^{-1} of shear line
0	51
15	45
30	44
45	49
60	51
75	57
90	37
105	37
120	40
135	44
150	57
165	52

* Values for intermediate angles can be interpolated.

Figure 3 Angle of load to grain and nail orientation



6 Practicability of installation

The fasteners are easy to embed using the commercial platen or roller press equipment normally employed for truss fabrication.

7 Durability

Wolf 12N fasteners have a zinc coating (see section 1.2 of this Detail Sheet), which will give adequate protection against corrosion in normal internal domestic situations, where the moisture content of the timber does not exceed 18% for any significant period and does not exceed 22% at any time.

Technical Investigations

The following is a summary of the technical investigations carried out on Wolf 12N Punched Metal Plate Timber Fasteners.

8 Tests

8.1 Tests were carried out on 200 full-size structural joints, assembled using the commercial equipment normally employed. The results were assessed to determine the permissible loads and stresses for the fasteners.

8.2 Three species of timber were used in the test joints, European whitewood, European redwood and Western white spruce. Existing data on the relative strength of species were used to derive values for use with other species. The tests examined:

variations in strength within species
effects of surface finish
effects of direction and type of loading
effects of fastener orientation
compressive, tensile and shear properties of fasteners.

8.3 Tests were conducted to determine the thickness and quality of galvanizing.

9 Other investigations

9.1 The permissible loads, derived from the tests referred to above, were compared with the estimated maximum loads to cause a joint slip of 0.8 mm. These latter load values, however, were consistently higher than those based on maximum load values. In general, the maximum initial slip in joints in tension, at the permissible long-term loads, will not be greater than 0.30 mm and the average initial slip not greater than 0.15 mm.

9.2 Existing data on the durability of punched metal plate timber fasteners were examined.

9.3 Existing data relating to cyclic loading on fasteners in dwellings and similar structures were examined and the effects found to be insignificant.

9.4 An assessment was made on the practicability of joint assembly.

9.5 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Date of issue: 26th March 1991

Director

Recreated in QX 25.4.02 (SM)

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

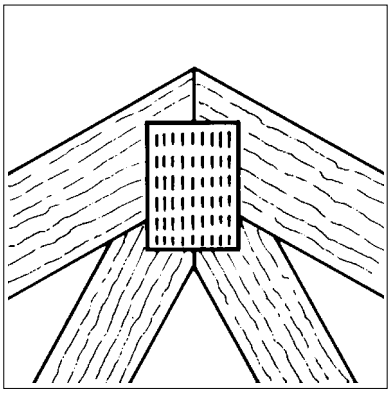
Wolf Systems Ltd

Certificate No 89/2290

DETAIL SHEET 4

BRITISH SITKA SPRUCE FOR USE WITH WOLF PUNCHED METAL PLATE TIMBER FASTENERS

Product



• THIS DETAIL SHEET RELATES TO THE USE OF STRENGTH GRADED BRITISH SITKA SPRUCE WITH THE PUNCHED METAL PLATE TIMBER FASTENERS DESCRIBED IN THE ACCOMPANYING DETAIL SHEETS.

This Detail Sheet must be read in conjunction with the Front Sheet, Detail Sheet 1 and the appropriate Detail Sheet for the particular fastener design. The Front Sheet gives the Conditions of Certification *and Detail Sheet 1 gives the product's position under the Building Regulations.*

Technical Specification

1 Description

British sitka spruce must be strength graded in accordance with BS EN 518 : 1995 or BS EN 519 : 1995.

Design Data

2 General

This Detail Sheet is for use only in conjunction with the accompanying Detail Sheets to supplement the information therein.

3 Structural performance

3.1 British sitka spruce is suitable for use with the punched metal plate timber fasteners described in the appropriate Detail Sheet.

3.2 The permissible lateral load per effective nail for fasteners in British sitka spruce should be taken as equivalent to that given for European whitewood.

3.3 In accordance with the requirements of BS 5268 : Part 2 1996 all British sitka spruce for structural work should be strength graded in accordance with the requirements of BS EN 518 : 1995 or BS EN 519 : 1995.

4 Practicability of installation

Fasteners are easy to embed in British sitka spruce using the commercial equipment normally employed for truss fabrication as detailed in the appropriate Detail Sheet.

Technical Investigations

The following is a summary of the technical investigations carried out on British sitka spruce.

5 Tests

5.1 Tests were carried out with selected fasteners on full-size structural joints of British sitka spruce. The joints were assembled using the commercial equipment normally employed and tests were conducted in accordance with prEN 1075.

5.2 Existing data on the relative strength of species were examined.

5.3 An assessment was made on the practicability of joint assembly.

Bibliography

BS 5268 *Structural use of timber*
Part 2 : 1996 *Code of practice for permissible stress design, materials and workmanship*

BS EN 518 : 1995 *Structural timber. Grading. Requirements for visual strength grading standards*

BS EN 519 : 1995 *Structural timber. Grading. Requirements for machine strength graded timber and grading machines*

prEN 1075 *Timber structures — Test methods — Joints made with punched metal plate fasteners*

Electronic Copy

On behalf of the British Board of Agrément

Date of issue: 16th March 2000

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BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

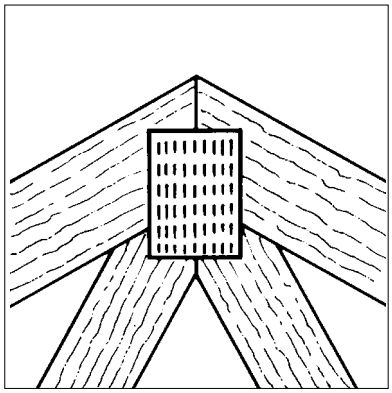
Wolf Systems Ltd

WOLF 126 PUNCHED METAL PLATE TIMBER FASTENERS

Certificate No 89/2290

DETAIL SHEET 5

Product



• *THIS DETAIL SHEET RELATES TO WOLF 126 PUNCHED METAL PLATE TIMBER FASTENERS.*

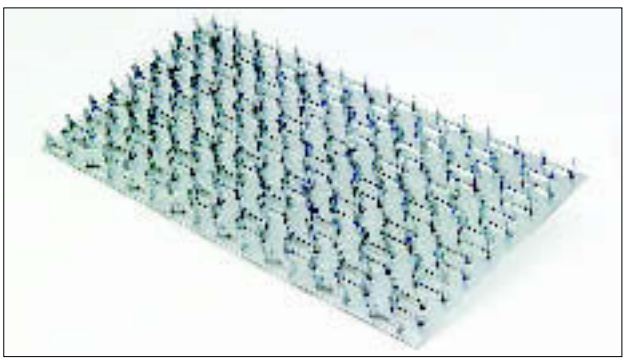
This Detail Sheet must be read in conjunction with the Front Sheet and Detail Sheet 1, which give Conditions of Certification, *details common to all Wolf Systems Ltd's certificated fasteners and the product's position regarding the Building Regulations respectively.*

Technical Specification

1 Description

1.1 Wolf 126 Punched Metal Plate Timber Fasteners are galvanized mild steel plates, having rows of integral nails pressed out to project at approximately right-angles to one face of the plates (see Figure 1). The slots so formed define the length direction of the fastener. Two nails are formed from each slot.

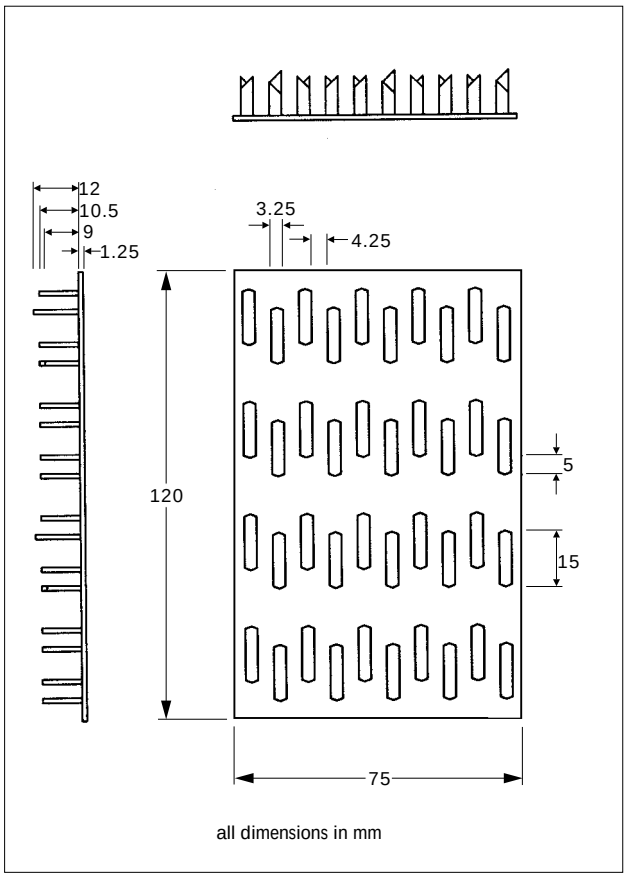
Figure 1 Typical Wolf 126 fastener



1.2 Wolf 126 fasteners are manufactured from material designation Z250 GD (1.0242) + Z275 to BS EN 10147 : 2000. An upper limit on ultimate tensile strength is additionally imposed to ensure suitability for pressing.

1.3 The dimensions and spacing of the nails are shown in Figure 2. The thickness of the plate, including zinc coating, is nominally 1.25 mm.

Figure 2 Dimensions and arrangement of nails



2 Sizes

The standard sizes of fastener are given in Table 1.

Table 1 Range of standard fastener sizes

Length (mm)	Width (mm)													
	30	45	60	75	90	105	120	135	150	165	180	210	240	300
60	1	1	0	0	0	0	0	0	0	0	0	0	0	0
90	1	1	1	1	0	0	0	0	0	0	0	0	0	0
120	1	1	1	1	1	1	1	1	1	0	0	0	0	0
150	1	1	1	1	1	1	1	1	1	1	0	0	0	0
180	0	1	1	1	1	1	1	1	1	1	1	1	0	0
210	0	0	1	1	1	1	1	1	1	1	1	1	0	0
240	0	0	1	1	1	1	1	1	1	1	1	1	1	1
300	0	0	0	1	1	1	1	1	1	1	1	1	1	1
360	0	0	0	0	0	0	1	1	1	1	1	1	1	1
420	0	0	0	0	0	0	0	0	0	1	1	1	1	1
480	0	0	0	0	0	0	0	0	0	0	1	1	1	1

1 denotes fastener size covered by this Certificate.
0 denotes fastener size not covered by this Certificate.

3 Identification

The fasteners are stamped with the manufacturer's identification mark *Wolf 126*, and are packed in boxes bearing the BBA identification mark incorporating the number of this Certificate.

Design Data

4 Timber species

This Detail Sheet covers the use of Wolf 126 fasteners in planed, treated or untreated, stress graded timber of minimum specified thickness of 35 mm, –0.0 +1 mm divergence throughout a member (when measured at 20% moisture content) of the following species:

- European whitewood
- European redwood.

5 Structural performance

General

5.1 The anchorage strength of a fastener depends upon:

- the effective anchorage areas in the joint
- duration of load
- direction of bearing of the nail with respect to the grain of the timber
- angle of load to the fastener
- timber density
- timber moisture content.

5.2 The effective anchorage areas in the joint shall be determined by omitting:

- nails nearer than 5 mm to the edge of the timber
- nails nearer than 8 mm to the end of the timber member in tension or compression measured parallel to the grain.

In relation to BS 5268-2 : 2002

Anchorage strength

5.3 The permissible anchorage strengths per unit area for the fastener under long-term loading for the softwood species included in this assessment are given in Table 2. These are specified for 15° increments of angle of load to the grain and fastener length (see Figure 3).

5.4 The permissible anchorage strength for medium-, short- and very short-term duration of load should be obtained in accordance with BS 5268-2 : 2002 by modifying the long-term permissible anchorage strengths given in Table 2 by the following factors:

- Medium term 1.12
- Short term and very short term 1.25

Table 2 Permissible long-term anchorage strength ($N mm^{-2}$) per fastener in planed members

Angle load to fastener length	Angle of load to grain of member						
	0°	15°	30°	45°	60°	75°	90°
0°	1.13	1.08	0.97	0.85	0.76	0.70	0.68
15°	1.08	1.03	0.94	0.83	0.75	0.70	0.68
30°	1.02	0.99	0.91	0.82	0.74	0.70	0.68
45°	1.00	0.97	0.89	0.81	0.74	0.69	0.68
60°	0.97	0.94	0.88	0.80	0.73	0.69	0.68
75°	0.97	0.94	0.88	0.80	0.73	0.69	0.68
90°	0.97	0.94	0.88	0.80	0.73	0.69	0.68

Anchorage stiffness

5.5 The initial slip in joints in tension, at the permissible long-term loads, was in the range of 0.07 mm to 0.23 mm (average 0.16 mm).

Tensile strength

5.6 The maximum tensile force acting on the fasteners, for all four categories of load duration, must not exceed the following:

- force acting in direction of fastener length — 116 $N mm^{-1}$ of fastener width
- force acting in direction of fastener width — 81 $N mm^{-1}$ of fastener length.

Compressive strength

5.7 The maximum compressive force acting on the fasteners, for all four categories of load duration, must not exceed the following:

- force acting in direction of fastener length — 60 $N mm^{-1}$ of fastener width
- force acting in direction of fastener widths — 50 $N mm^{-1}$ of fastener length.

Shear strength

5.8 The maximum shear force acting on a fastener, for all four categories of load duration, must not exceed the value given in Table 3 for the angle α, the angle between the fastener length direction and the direction in which the load is acting.

Figure 3 Angle of load to grain and nail orientation

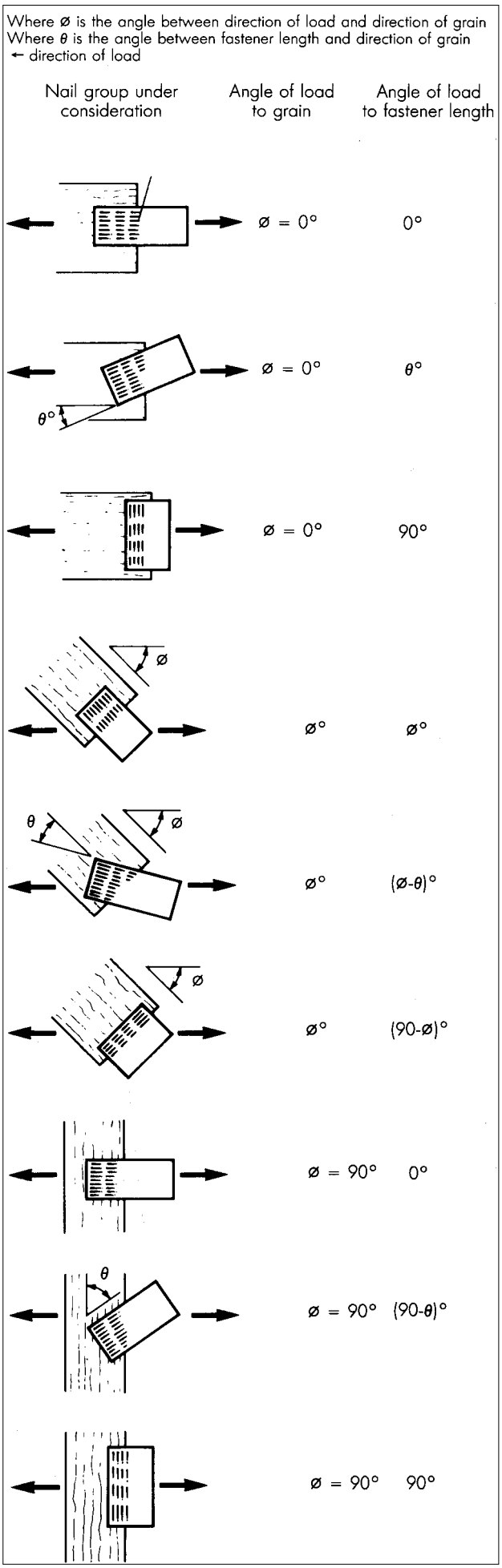


Table 3 Maximum shear forces(1)

Angle α	Nmm^{-1} of shear line
0	46
15	50
30	63
45	78
60	56
75	42
90	27
105	44
120	50
135	53
150	51
165	52

(1) Values for intermediate angles can be interpolated.

In relation to prEN 1995-1-1 (Eurocode 5)

Anchorage strength

5.9 The anchorage strength of the fastener may be determined in accordance with prEN 1995-1-1 (August 2003) using the anchorage properties given in Table 4 declared for strength class C27. These properties may be evaluated for other strength classes by modifying the values given in Table 4 by $(\rho_k / 370)^{0.5}$ (where ρ_k is the characteristic density of the strength class concerned).

Table 4 Characteristic anchorage properties

Description (unit)	Symbol	Magnitude
Characteristic anchorage stress (Nmm^{-2}):		
at 0° to grain and fastener length	$f_{a,0,0,k}$	2.80
at 90° to grain and fastener length	$f_{a,90,90,k}$	1.69
Constant	k_1	–0.516
	k_2	+0.458
	α_0	+0.893

Anchorage stiffness

5.10 The plate slip modulus per nail plate per mm^2 of anchorage area is 6 Nmm^{-1} mm^{-2}.

Steel plate strength

5.11 The steel plate strength of the fastener may be determined in accordance with the code using the properties of the steel plate given in Table 5.

Table 5 Plate properties

Description (unit)	Symbol	Magnitude
Characteristic plate tension strength (Nmm^{-1}):		
at 0° to fastener length	$f_{t,0,k}$	203
at 90° to fastener length	$f_{t,90,k}$	142
Characteristic plate compression strength (Nmm^{-1}):		
at 0° to fastener length	$f_{c,0,k}$	102
at 90° to fastener length	$f_{c,90,k}$	87
Characteristic plate shear strength (Nmm^{-1}):		
at 0° to fastener length	$f_{v,0,k}$	80
at 90° to fastener length	$f_{v,90,k}$	47
Constant	γ_o	0°
	k_v	1.03

6 Practicability of installation

6.1 The fasteners are easy to embed using the commercial platen equipment normally employed for truss fabrication.

6.2 Precautions are necessary during handling and subsequent use due to sharp edges on the product. Care should be observed and gloves worn to avoid injury.

7 Durability

Wolf 126 fasteners have a zinc coating (see section 1.2 of this Detail Sheet), which will give adequate protection against corrosion in normal internal domestic situations, where the moisture content of the timber does not exceed 18% for any significant period and does not exceed 22% at any time.

Technical Investigations

The following is a summary of the technical investigations carried out on Wolf 126 Punched Metal Plate Timber Fasteners.

8 Tests

8.1 Tests in accordance with BS EN 1075 : 2000 were carried out on full-size structural joints, assembled using the commercial equipment normally employed. The results were assessed to determine the permissible and characteristic stresses for the fasteners.

8.2 European whitewood was used in the test joints. The tests examined:

- variations in strength within species
- effects of direction and type of loading
- effects of fastener orientation
- compressive, tensile and shear properties of fasteners.

8.3 Tests were conducted to determine the thickness and quality of galvanizing.

9 Investigations

9.1 Existing data on the durability of punched metal plate timber fasteners were examined.

9.2 Existing data relating to cyclic loading on fasteners in dwellings and similar structures were examined and the effects found to be insignificant.

9.3 An assessment was made on the practicability of joint assembly.

9.4 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

BS 5268-2 : 2002 *Structural use of timber — Code of practice for permissible stress design, materials and workmanship*

BS EN 1075 : 2000 *Timber structures — Test methods — Joints made with punched metal plate fasteners*

BS EN 10147 : 2000 *Continuously hot-dip zinc coated structural steels strip and sheet — Technical delivery conditions*

prEN 1995-1.1 : 2003 *Eurocode 5. Design of timber structures — General rules and rules for buildings (together with United Kingdom National Annex)*

BBA BRITISH BOARD OF AGRÉMENT
TECHNICAL APPROVALS FOR CONSTRUCTION

On behalf of the British Board of Agrément

Date of issue: 11th December 2003

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TECHNICAL APPROVALS FOR CONSTRUCTION

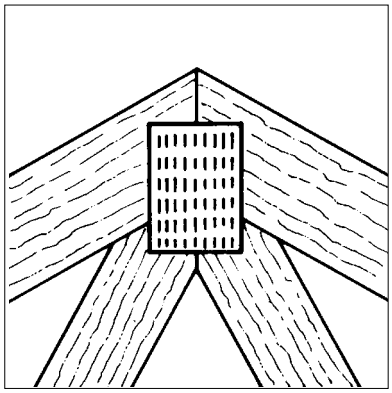
Wolf

WOLF 101 PUNCHED METAL PLATE TIMBER FASTENERS

Certificate No 89/2290

DETAIL SHEET 6

Product



- *THIS DETAIL SHEET RELATES TO WOLF 101 PUNCHED METAL PLATE TIMBER FASTENERS.*

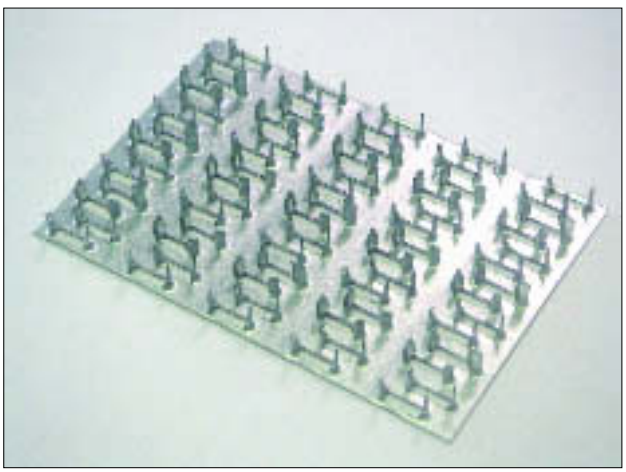
This Detail Sheet must be read in conjunction with the Front Sheets, which give Conditions of Certification*, details common to all Wolf's certificated fasteners and the product's position regarding the Building Regulations respectively.*

Technical Specification

1 Description

1.1 Wolf 101 Punched Metal Plate Timber Fasteners are galvanized mild steel plates, having rows of integral nails pressed out to project at approximately right-angles to one face of the plates (see Figure 1). The slots so formed define the length direction of the fastener. Two nails are formed from each slot.

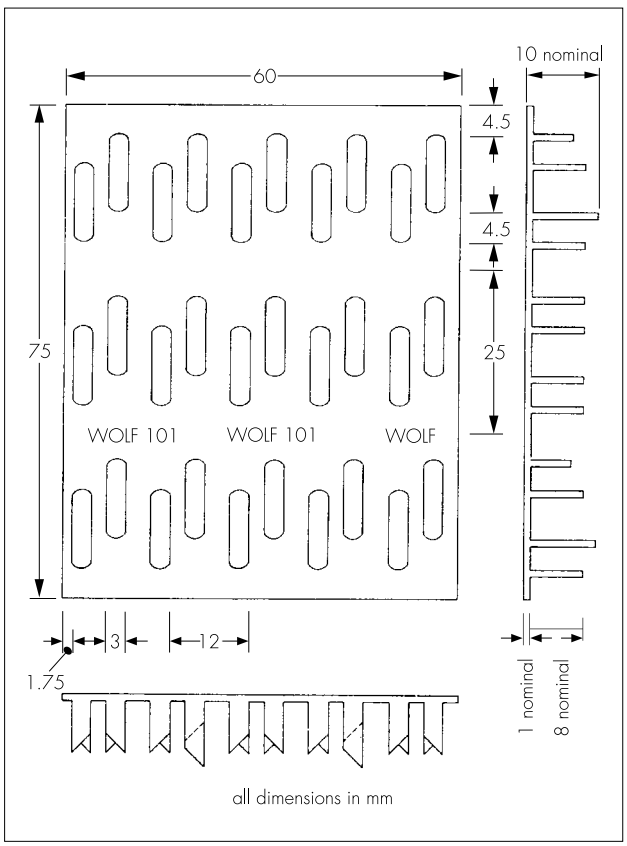
Figure 1 Typical Wolf 101 fastener



1.2 The fasteners are manufactured from material designation EN 10326 — S280GD + Z275 — N in accordance with BS EN 10326 : 2004. An upper limit on ultimate tensile strength is additionally imposed to ensure suitability for pressing.

1.3 The dimensions and spacing of the nails are shown in Figure 2. The thickness of the plate, including zinc coating, is nominally 1.0 mm.

Figure 2 Dimensions and arrangement of nails



2 Sizes

The standard sizes of fastener are given in Table 1.

Table 1 Range of standard fastener sizes[1]

Length	Width (mm)											
(mm)	24	36	48	60	72	84	108	120	144	168	180	216
75	X	—	—	—	—	—	—	—	—	—	—	—
100	—	X	X	X	X	X	X	—	—	—	—	—
125	X	X	X	X	X	X	X	X	X	—	—	—
150	—	X	—	X	X	X	X	X	X	X	—	—
200	—	—	—	X	X	X	X	X	X	X	—	X
250	—	—	—	X	X	X	X	X	X	X	—	—
300	—	—	—	—	—	X	X	X	X	X	X	X
350	—	—	—	—	—	—	—	—	X	X	—	X
400	—	—	—	—	—	—	—	—	—	—	—	X

(1) X denotes a standard fastener size.

3 Identification

The fasteners are stamped with the manufacturer's identification mark *Wolf 101*, and are packed in boxes bearing the BBA identification mark incorporating the number of this Certificate.

Design Data

4 Timber species

This Detail Sheet covers the use of Wolf 101 Punched Metal Plate Fasteners in planed, treated or untreated, stress graded timber of minimum specified thickness of 35 mm, Θ.0 +1 mm divergence throughout a member (when measured at 20% moisture content) of the following species:

- European whitewood
- European redwood.

5 Structural performance

General

5.1 The anchorage strength of a fastener depends upon:

- the effective anchorage areas in the joint
- duration of load
- direction of bearing of the nail with respect to the grain of the timber
- angle of load to the fastener
- timber density
- timber moisture content.

5.2 The effective anchorage areas in the joint shall be determined by omitting:

- nails nearer than 5 mm to the edge of the timber
- nails nearer than 6 mm to the end of the timber member in tension or compression measured parallel to the grain.

In relation to BS 5268-2 : 2002

Anchorage strength

5.3 The permissible anchorage strengths per unit area for the fastener under long-term loading for the softwood species included in this assessment are given in Table 2. These are specified for 15°increments of angle of load to the grain and fastener length (see Figure 3).

5.4 The permissible anchorage strength for medium-, short- and very short-term duration of load should be obtained in accordance with BS 5268-2 : 2002 by modifying the long-term permissible anchorage strengths given in Table 2 by the following factors:

- medium term 1.12
- short term and very short term 1.25

Table 2 Permissible long-term anchorage strength (Nmm²) per fastener in planed members

Angle of load to fastener length	Angle of load to grain of member						
	0°	15°	30°	45°	60°	75°	90°
0°	0.897	0.877	0.827	0.767	0.716	0.682	0.671
15°	0.872	0.855	0.811	0.758	0.712	0.681	0.671
30°	0.847	0.833	0.795	0.749	0.708	0.680	0.671
45°	0.839	0.825	0.789	0.745	0.706	0.680	0.671
60°	0.830	0.817	0.783	0.742	0.705	0.679	0.671
75°	0.800	0.790	0.763	0.730	0.699	0.678	0.671
90°	0.771	0.763	0.743	0.717	0.693	0.677	0.671

Anchorage stiffness

5.5 The initial slip in joints in tension, at the permissible long-term loads, was in the range of 0.07 mm to 0.16 mm (average 0.12 mm).

Tensile strength

5.6 The maximum tensile force acting on the fasteners, for all four categories of load duration, must not exceed:

- force acting in direction of fastener length — 81 Nmm⁻¹ of fastener width
- force acting in direction of fastener width — 67 Nmm⁻¹ of fastener length.

Compressive strength

5.7 The maximum compressive force acting on the fasteners, for all four categories of load duration, must not exceed:

- force acting in direction of fastener length — 45 Nmm⁻¹ of fastener width
- force acting in direction of fastener width — 38 Nmm⁻¹ of fastener length.

Shear strength

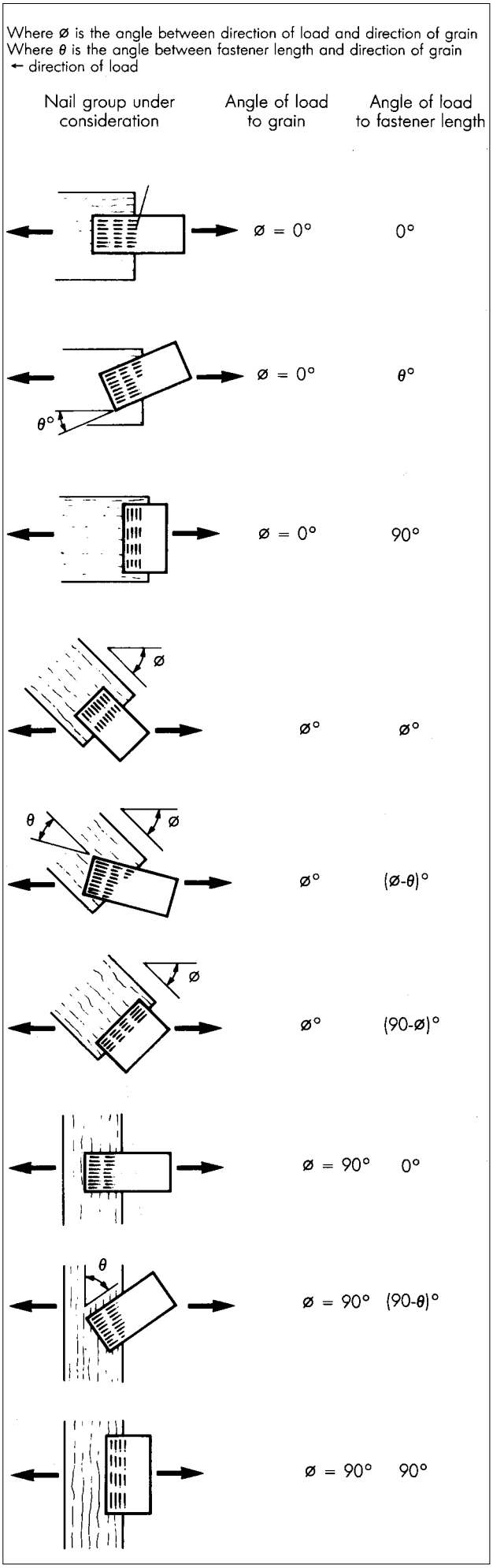
5.8 The maximum shear force acting on a fastener, for all four categories of load duration, must not exceed the value given in Table 3 for the angle α, the angle between the fastener length direction and the direction in which the load is acting.

Table 3 Maximum shear forces[1]

Angle α	Nmm⁻¹ of shear line
0	35
15	35
30	41
45	39
60	43
75	35
90	19
105	30
120	34
135	34
150	36
165	37

(1) Values for intermediate angles can be interpolated.

Figure 3 Angle of load to grain and nail orientation



In relation to BS EN 1995-1-1 : 2004 (Eurocode 5)

Anchorage strength

5.9 The anchorage strength of the fastener may be determined in accordance with BS EN 1995-1-1 : 2004 using the anchorage properties given in Table 4 declared for strength class C27. These properties may be evaluated for other strength classes by modifying the values given in Table 4 by $(\rho_k / 370)^{0.5}$ (where ρ_k is the characteristic density of the strength class concerned).

Table 4 Characteristic anchorage properties

Description (unit)	Symbol	Magnitude
Characteristic anchorage stress (Nmm^{-2})		
at 0°to grain and fastener length	$f_{a,0,0,k}$	2.21
at 90°to grain and fastener length	$f_{a,90,90,k}$	1.65
Constant	k_1	0.229
	k_2	0.181
	α_0	+0.524

Anchorage stiffness

5.10 The plate slip modulus per fastener per mm^2 of anchorage area is 6.6 Nmm^{-1} mm^{-2}.

Steel plate strength

5.11 The steel plate strength of the fastener may be determined in accordance with the code using the properties of the steel plate given in Table 5.

Table 5 Characteristic plate properties

Description (unit)	Symbol	Magnitude
Characteristic plate tension strength (Nmm^{-1})		
at 0°to fastener length	$f_{t,0,k}$	141
at 90°to fastener length	$f_{t,90,k}$	116
Characteristic plate compression strength (Nmm^{-1})		
at 0°to fastener length	$f_{c,0,k}$	77
at 90°to fastener length	$f_{c,90,k}$	65
Characteristic plate shear strength (Nmm^{-1})		
at 0°to fastener length	$f_{v,0,k}$	60
at 90°to fastener length	$f_{v,90,k}$	33
Constant	γ_0	0.367
	k_v	1.66

6 Practicability of installation

6.1 The fasteners are easy to embed using the commercial platen or roller press equipment normally employed for truss fabrication.

6.2 Precautions are necessary during handling and subsequent use due to sharp edges on the product. Care should be observed and gloves worn to avoid injury.

7 Durability

The fasteners have a zinc coating (see section 1.2), which will give adequate protection against corrosion in the Service Classes 1 and 2 defined in BS 5628-2 : 2002 and BS EN 1995-1.1 : 2004.

Technical Investigations

The following is a summary of the technical investigations carried out on Wolf 101 Punched Metal Plate Timber Fasteners.

8 Tests

8.1 Tests in accordance with BS EN 1075 : 2000 were carried out on full-size structural joints, assembled using the commercial equipment normally employed. The results were assessed to determine the permissible and characteristic stresses for the fasteners.

8.2 European whitewood was used in the test joints. The tests examined:

- variations in strength within species
- effects of direction and type of loading
- effects of fastener orientation
- compressive, tensile and shear properties of fasteners.

8.3 Tests were conducted to determine the mechanical properties of the steel and its thickness and quality of galvanizing.

9 Investigations

9.1 Existing data on the durability of punched metal plate timber fasteners were examined.

9.2 Existing data relating to cyclic loading on fasteners in dwellings and similar structures were examined and the effects found to be insignificant.

9.3 An assessment was made on the practicability of joint assembly.

9.4 The manufacturing process was examined, including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

Bibliography

BS 5268-2 : 2002 *Structural use of timber — Code of practice for permissible stress design, materials and workmanship*

BS EN 1075 : 2000 *Timber structures — Test methods — Joints made with punched metal plate fasteners*

BS EN 1995-1.1 : 2004 *Eurocode 5. Design of timber structures — General rules and rules for buildings*

BS EN 10326 : 2004 *Continuously hot-dip coated strip and sheet of structural steels — Technical delivery conditions*

prEN 14545 *Timber structures — Connectors – Requirements*

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