BRITISH STANDARD

Fences –

Part 14: Specification for open mesh steel panel

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 29 and a back cover.

Foreword

Publishing information

This part of BS 1722 was published by BSI and came into effect on 30 November 2006. It was prepared by Technical Committee B/201, *Fences*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 1722 supersedes BS 1722-14:2001, which is withdrawn.

Relationship with other publications

BS 1722 is published in the following parts:

- *Part 1: Specification for chain link fences;*
- *Part 2: Specifications for strained wire and wire mesh netting fences;*
- *Part 4: Specification for cleft chestnut pale fences;*
- *Part 5: Specification for close-boarded and wooden palisade fences;*
- *Part 7: Specification for wooden post and rail fences;*
- *Part 8: Specification for mild steel (low carbon steel) continuous bar fences and hurdles;*
- *Part 9: Specification for mild steel (low carbon steel) fences with round or square verticals and flat horizontals;*
- *Part 10: Specification for anti-intruder fences in chain link and welded mesh;*
- *Part 11: Specification for prefabricated wood panel fences;*
- *Part 12: Specification for steel palisade fences;*
- *Part 13: Chain link fences for tennis court surrounds;*[1)]
- *Part 14: Specification for open mesh steel panel fences;*
- *Part 16: Specification for organic powder coatings to be used as a plastics finish to components and mesh;*
- *Part 17: Specification for electric security fences – Design, installation and maintenance;*
- *Part 18: Specification for steel mesh site perimeter temporary fencing systems.*[2)]

Information about this document

It should be noted that no attempt has been made to standardize fences or gates of a purely decorative nature, nor to specify requirements for "patent" proprietary fencing systems. It is recommended, however, that such fences or gates should be designed in accordance with the relevant clauses of this part of BS 1722.

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1) Obsolescent.
2) Part 18 is in development and will be published as a Draft for Development (DD).

The principal changes introduced in this revision are to bring the requirements up to date with other parts of BS 1722 and to accommodate changes in cross references to other standards. This revision includes requirements for very high security fences and for concrete posts for fences.

This standard aims to establish minimum performance requirements for materials and workmanship. It specifies requirements for open mesh steel panel fences of four types:

a) a fence for boundary or general purposes up to 2 400 mm in height;

b) a fence for security purposes of minimum 2 400 mm in height;

c) a fence for high security use of minimum 3 000 mm in height;

d) a fence for extra high security of minimum 3 000 mm in height.

The general purpose fence is intended for use as a boundary marker or for those locations where it is deemed necessary merely to deter the casual intruder or trespasser.

The security fence is designed for use in areas where greater protection is required from vandalism or trespass, and can be considered suitable for use for general industrial security such as for industrial estates, airfields and oil installations.

The high security fence is designed for areas where protection against determined intrusion is required. However, it should be appreciated that it is not possible to install a fence that cannot be negotiated by a determined intruder given adequate time, freedom from observation and suitable climbing aids or tools for forcing an entry.

The extra high security fence does not permit finger holds and therefore cannot be scaled without climbing aids.

Choosing a fence is affected by factors such as the intended purpose, desired service life, aesthetic consideration and availability of components. The specifier can match a suitable choice of fence to its intended purpose by reference to Table 1 and Table 2 and also inform those installing the fence of the basic characteristics required.

Ground conditions might indicate that a variation in the length of a post or strut, or the depth, to which it should be set, is desirable. The posts and struts setting depths specified in this standard are intended for use in normal ground conditions but if special conditions exist that warrant a change in the specification, e.g. the ground is softer or firmer than usual, such a change should be agreed with the specifier.

NOTE The service life/durability is dependent on environmental conditions and can vary considerably. For this reason service life/durability is not included in this standard. For information relating to finishes and durability refer to the manufacturer.

This standard specifies requirements for fence materials and their combination and installation to provide a serviceable fence. Because a fence is made up of a number of separate components, of which the particular features can vary, a number of permissible combinations are available to the user. When preparing a specification for a fence, it is therefore important to give precise details of the requirements of the fence and of the site. Annex A provides details of the fence requirements and installation site that should be agreed between the fence supplier and purchaser. However, as conditions vary from site to site, Annex A should not be assumed to be exhaustive.

Use of this document

It has been assumed in the drafting of this part of BS 1722 that the execution of its provision is entrusted to appropriately qualified and experienced people. Before installation commences the Lead Installer should hold a current FISS/CSCS registration card skilled level (blue card) or equivalent and all other operatives should hold the basic fence operative card (green card) or equivalent.

At the time of publication of this British Standard the registration cards are validated by the Joint Fencing Industry Skills Scheme (FISS) and Construction Scheme Skills Certification Scheme (CSCS). FISS/CSCS maintains a national register of fence installers and operatives. There might be other schemes available.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Requirements in this standard are drafted in accordance with *The BSI guide to standardization – Section 2: Rules for the structure, drafting and presentation of British Standards*, subclause **11.3.1**, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this standard.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This part of BS 1722 specifies requirements for the following categories of open mesh steel panel fences:

a) Category 1: general purpose fences up to 2 400 mm high.

b) Category 2: security fences at least 2 400 mm high.

c) Category 3: high security fences at least 3 000 mm high.

d) Category 4: extra high security fences at least 3 000 mm high.

Requirements for the performance of panel fences for this standard are based upon loadings described in Clause **5**.

Maintenance of the fence after installation is outside the scope of the standard.

NOTE Annex A list items that should be agreed between the fence supplier and the purchaser.

2 Normative references

The following referenced documents are indispensable for 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 4-1, *Structural steel sections – Part 1: Specification for hot-rolled sections*

BS 405, *Specification for uncoated expanded metal carbon steel sheets for general purposes*

BS 1722, *Fences*

BS 3892, *Pulverized-fuel ash*

BS 4027, *Specification for sulfate-resisting Portland cement*

BS 4102, *Specification for steel wire for general fencing purposes*

BS 4449, *Steel for the reinforcement of concrete – Weldable reinforcing steel – Bar, coil and decoiled product – Specification*

BS 4482, *Steel wire for the reinforcement of concrete products – Specification*

BS 4483, *Steel fabric for the reinforcement of concrete – Specification*

BS 8500-1:2002, *Concrete – Complementary British Standard to BS EN 206-1 – Part 1: Method of specifying and guidance for the specifier*

BS 8500-2:2002, *Concrete – Complementary British Standard to BS EN 206-1 – Part 2: Specification for constituent materials and concrete*

BS EN 197-1, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*

BS EN 197-4, *Cement – Part 4: Composition, specifications and conformity criteria for low early strength blastfurnace cements*

BS EN 206-1:2000, *Concrete – Part 1: Specification, performance, production and conformity*

BS EN 287-1, *Qualification test of welders – Fusion welding – Part 1: Steels*

BS EN 480, *Admixtures for concrete, mortar and grout – Test methods*

BS EN 934, *Admixtures for concrete, mortar and grout*

BS EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding*

BS EN 1011-2, *Welding – Recommendations for welding of metallic materials – Part 2: Arc welding of ferritic steels*

BS EN 10210-1, *Hot finished structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery requirements*

BS EN 10210-2, *Hot finished structural hollow sections of non-alloy and fine grain steels – Part 2: Tolerances, dimensions and sectional properties*

BS EN 10219-1, *Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 1: Technical delivery requirements*

BS EN 10219-2, *Cold formed welded structural hollow sections of non-alloy and fine grain steels – Part 2: Tolerances, dimensions and sectional properties*

BS EN 10240, *Internal and/or external protective coatings for steel tubes – Specification for hot dip galvanized coatings applied in automatic plants*

BS EN 10244, *Steel wire and wire products*

BS EN 10255, *Non-alloy steel tubes suitable for welding or threading – Technical delivery conditions*

BS EN 10296-1, *Welded circular steel tubes for mechanical and general engineering purposes – Technical delivery conditions – Part 1: Non-alloy and alloy steel tubes*

BS EN 12620, *Aggregates for concrete*

BS EN 12839:2001, *Precast concrete products – Elements for fences*

BS EN 12878, *Pigments for the colouring of building materials based on cement and/or lime – Specifications and methods of test*

BS EN 10025-2, *Hot rolled products of non-alloy structural steels – Part 2: Technical delivery conditions for flat products*

BS EN 10056-1, *Specification for structural steel equal and unequal angles – Part 1: Dimensions*

BS EN ISO 1461:1999, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

DIN 1615, *Welded circular unalloyed steel tubes not subject to special requirements; technical delivery conditions*

3 Dimensions and general characteristics

Dimensions and general characteristics of fences shall conform to the requirements of Table 1 and Table 2 and Clause **5**.

Table 1 **Basic characteristics of suitable expanded metal for panel fences**

Category	**Height of fence (excluding topping)** mm	**Typical applications**	**Typical expanded metal specifications**							
			BS 405 reference	**Vertical centres of mesh (LWM)** mm	**Horizontal centres of mesh (SWM)** mm	**Strand**		**Mass**		**Solidity**
						Thickness mm	**Width** mm	**Uncoated** kg/m^2	**Galvanized** kg/m^2	%
1	Max. 2 400	General purpose fence	Special	76	64	2.00	2.00	0.96	1.056	12
			EX41	100	50	2.50	2.69	2.08	2.288	11
2	Min. 2 400	Security	Special	76	64	3.00	3.00	2.21	2.431	14
			EX42	100	50	3.00	3.53	3.106	3.417	16
3	Min. 3 000	High Security	EX44	100	50	3.00	5.03	4.66	5.126	20
			EX37	76	34	3.00	3.58	4.96	5.456	24
			EX32	50	23	3.00	3.12	6.52	7.172	31
4	Min. 3 000	Extra high security	Special [A)]	10 (SWM)	70 (LWM)	3.00	5.50 Main strand	9.00	9.90	38

NOTE 1 LWM denotes centre to centre of longest way of mesh; SWM denotes centre to centre of shortest way of mesh.

NOTE 2 "Special" refers to meshes designed by manufacturers in accordance with BS 405 but which do not have a specific reference number.

NOTE 3 Hot dip galvanizing refers to BS EN ISO 1461.

[A)] Category 4. Aperture finger grip proof. Probe "no go" 11 mm diameter.

Table 2 **Basic characteristics of suitable welded mesh for panel fences**

Category	Height of fence (excluding topping)	Typical applications	Typical welded mesh specifications				
			Vertical mesh spacing	Horizontal mesh spacing	Vertical wire diameter	Horizontal wire diameter	Solidity
	mm		mm	mm	mm	mm	%
1	Max. 2 400	General purpose boundary fence	200	50	5	7	14
			200	50	6	8+8 [A]	16
			50	50	3	3	12
			75	25	3	3	16
			12.5 [B]	12.5 [B]	3	3	20
2	Min. 2 400	Security	75	75	3	3	16
			100	25	4	4	12
			200	50	5	5	13
			150	50	5	5	14
			12.5	50	4	4	36
			50	50	3	3	12
3	Min. 3 000	High security	50	50	4	4	16
			75	25	4	4	16
			75	25	3	3	16
4	Min. 3 000[C]	Extra high security	12.5	75	4	4	36
			12.5	75	3	3	21
			12.5[D]	12.5	4	4	58

[A] 8+8 indicates a double horizontal wire.
[B] Mixed mesh panel wire 50 mm and 12.5 mm meshes along the panel.
[C] Category 4. Aperture finger grip proof. Probe "no go" 11 mm diameter.
[D] Double skin.

4 Materials

4.1 Infill

Typical infill meshes shall be as given in Table 1 and Table 2.

NOTE 1 Specifications for expanded metal and welded mesh are contained in BS 405 and BS 4102.

NOTE 2 Examples of typical expanded metal and welded mesh panels are shown in Figure 1 and Figure 2.

4.2 Steel posts

NOTE 1 See ***4.4*** *for steel fittings.*

Steel posts shall conform to the requirements of Clause **5**. The tops of tubes or hollow section posts shall be closed by either a welded cap or a push fit plastic cap.

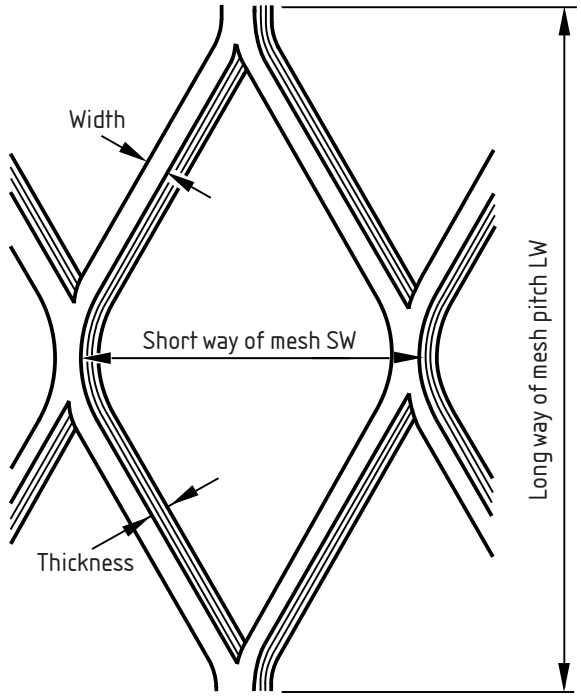
NOTE 2 Recommended steel grades and details of corrosion protective treatments that can be applied are given in Annex B.

NOTE 3 Tolerances of +50 mm and –25 mm are permissible on the specified lengths of steel posts when determining the actual lengths.

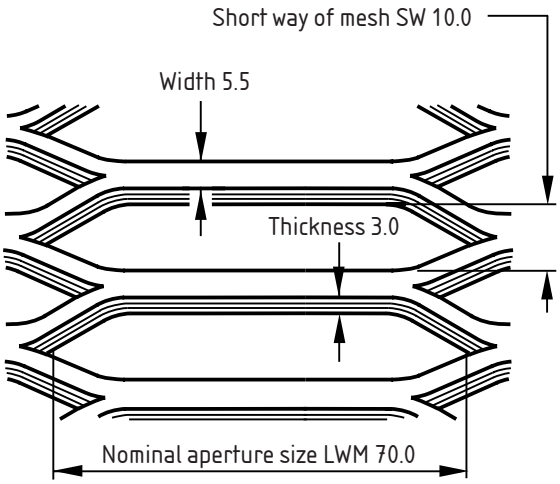
The steel post sections shall have a section moment of inertia of at least 5.4 cm^4 for fences up to 1 800 mm high and 12.5 cm^4 for fences over 1 800 mm high. The wall thickness shall be at least 2.5 mm for general purpose fences and 3.5 mm for high and maximum security fences.

Figure 1 **Example of typical expanded mesh**

Dimensions in millimetres



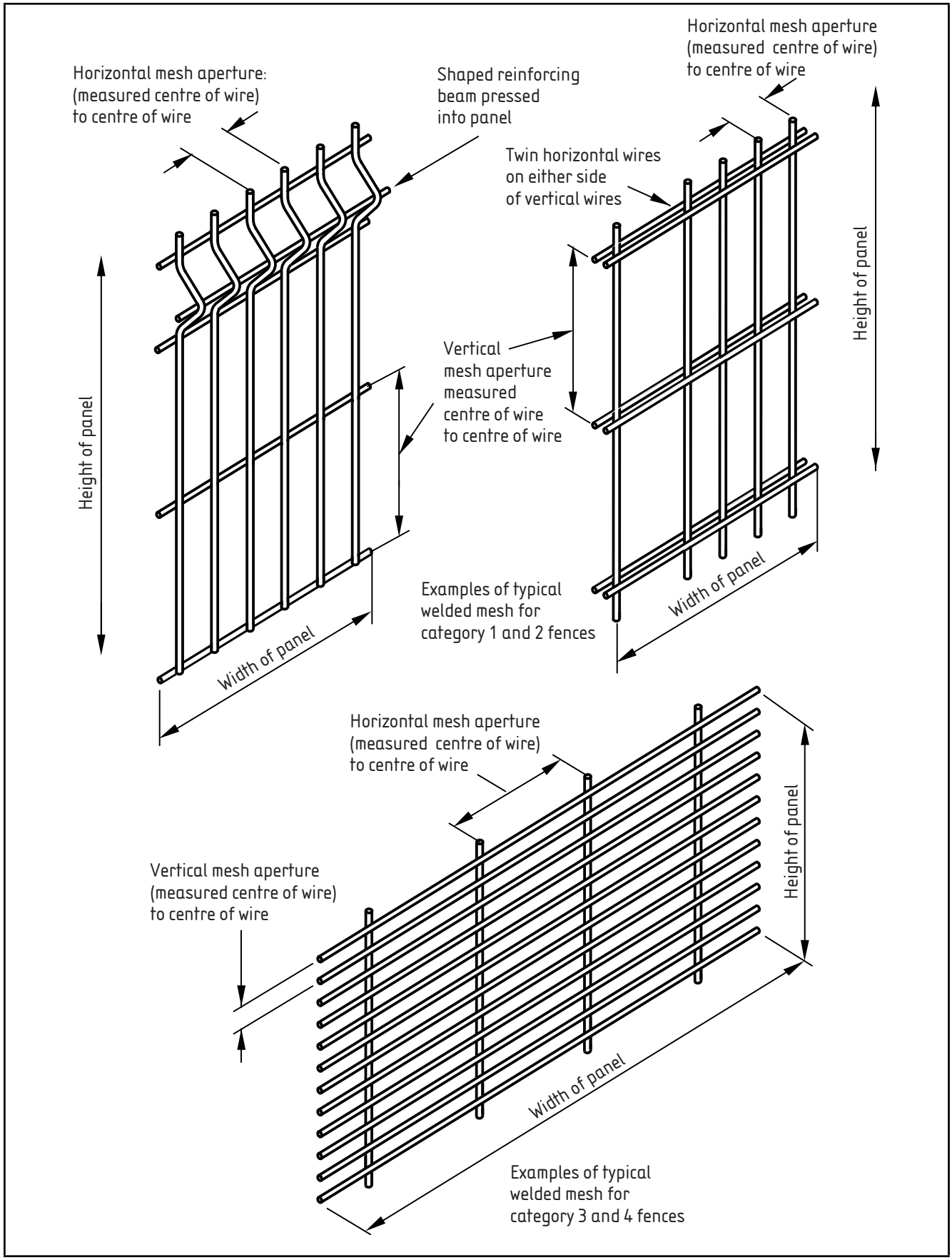
a) Categories 1, 2 and 3



b) Category 4

NOTE See Table 1 for characteristics of expanded metal for panel fences.

Figure 2 **Examples of typical welded mesh**



4.3 Concrete posts

4.3.1 Materials

Concrete posts shall be of steel reinforced concrete conforming to BS EN 12839 and Annex C.

4.3.2 Tolerance on size

Concrete components shall conform to their specified sizes within the following tolerances:

a) a demoulding draw allowance of up to 4 mm on each of two opposing sides;

b) an allowance on length of ±1%;

c) an allowance on cross-sectional width of ±3 mm.

NOTE Cross-section should be measured about the centre lines of the post.

4.3.3 General construction

Posts shall be holed for fixing line wires, etc. Holes for bolts shall allow the bolt to be freely inserted. Holes for wire shall be at least 6 mm in diameter. All holes shall be free from obstructions and accurately positioned within ±5 mm.

Posts for barbed wire, etc. shall have integral extensions or holes for attaching extension arms.

The long arrises formed in the base of the mould shall either be rounded or all sharp edges shall be removed. The arrises formed at the top of the mould shall be free from overfill.

The heads of posts shall be either weathered or half rounded in order to prevent lodgement of water.

4.4 Fittings

Panel to post connections shall be of sufficient strength to conform to the requirements of Clause **5** in order to transfer the specified panel load to the posts.

Protective treatment of fittings shall be carried out in accordance with Annex B.

4.5 Other materials

Posts can be manufactured from materials other than steel or concrete but shall be capable of withstanding the loading conditions stated in Clause **5**.

NOTE For comment on service life/durability see the Foreword.

5 Design

5.1 Loading

5.1.1 Wind loading

The wind loading for a particular fence system shall be determined in accordance with Annex D and tested in accordance with Annex E.

NOTE 1 The design requirements of this standard are based upon a dynamic wind loading (q) (see CP3-V-2) at right angles to the plane of the fence of 900 N/m².

NOTE 2 The wind loading is dependent upon the dynamic pressure, solidity and drag coefficient.

NOTE 3 In situations of extreme exposure or abnormal loading an appraisal should be carried out and the design criteria should be specified.

5.1.2 Personnel loading

The fencing components shall be capable of resisting a load of 700 N every metre at a height of 1.1 m above ground level when tested in accordance with Annex E (see **E.2**).

5.1.3 Testing

Fences shall be tested in accordance with Annex E to the loadings specified in **5.1.1** and **5.1.2** as follows:

a) Category 1 (general purpose fences): load testing is not required.

b) Category 2 (security fences): the fencing system shall, when tested in accordance with Annex E, carry the loading as described in **5.1.2** without exceeding the deflection specified.

c) Category 3 (high security fences): the fencing system shall, when tested in accordance with Annex E, carry the loading as described in **5.1.1** and **5.1.2** without exceeding the deflection specified.

d) Category 4 (extra high security fences): the fencing system shall, when tested in accordance with Annex E, carry the loading as described in **5.1.1** and **5.1.2** without exceeding the deflection specified.

5.1.4 Test requirements

The fence shall be deemed to satisfy the requirements of this standard if, during testing in accordance with Annex E the deflection at no time exceeds $\frac{\text{fence height}}{10}$ and always recovers to $\frac{\text{fence height}}{50}$ or is easily rectified to within this limit.

5.2 Toppings

Where required, further security against climbing shall be provided by fixing a topping such as barbed wire, barbed tape or rotating deterrents to the fence [see **A.3**b)]. Where barbed wire is used a minimum of three lines of barbed wire shall be provided. The lowest line shall be not more than 150 mm from the top of the fence panel and the other lines shall be spaced at not more than 200 mm below the top of the extension arm.

NOTE The use of barbed tape might be subject to local planning regulations.

5.3 Security against burrowing

If burrowing is a risk, one of the following measures shall be used:

a) a concrete sill conforming to **6.3** shall be provided, or;

b) the panels shall be extended by 150 mm and embedded in the concrete sill [see a)], or;

c) the panels shall be extended by 300 mm and buried in the ground.

6 Foundations and sills

6.1 General

Posts for panel fences shall be set in concrete.

The foundations for security fences in categories 2, 3 and 4 shall be designed to take account of ground conditions and conditions of service.

6.2 Holes for post foundations

The dimensions of the holes, excavated to receive the posts and concrete, shall conform to **8.2.1**, **8.2.2** and **8.2.3**. Holes shall be sized to provide at least 75 mm of concrete on all sides of the post.

6.3 Concrete sills

Where a concrete sill is specified it shall be formed of in situ concrete and be continuous between posts under the line of the panels. The sill shall be at least 125 mm wide × 150 mm deep and cast with the top at or within 50 mm of ground level.

The panel shall sit on top of the sill. If required, the panel shall either be cast in the sill or fixed to the top of the sill.

6.4 Concrete for post foundations and sills

Concrete for bases of posts, sills and intermediate supports shall be at least one part cement to 10 parts 20 mm all in ballast to BS EN 12620 mixed with the minimum requisite quantity of clean water, or grade C8/10 or ST2 concrete to BS 8500-1:2002 and BS 8500-2:2002. The concrete shall be placed in position before the commencement of the initial set.

7 Construction of gates

7.1 General

Gates shall be fabricated from steel tubes or hollow sections and joints shall be continuously welded, with all corners mitred or saddled square. The section sizes and grades of steel selected shall be of sufficient strength to satisfy the gate type, size and load specified by the purchaser (see Annex A).

NOTE 1 Recommended steel grades and details of corrosion protective treatments that can be applied, are given in Annex B.

The overall height of the gate, when fixed, shall match the height of the adjacent fencing.

NOTE 2 Gates can be of single or double leaf type and suitably braced to prevent any natural frame distortion when the gate is under load, rendering it unservicable.

NOTE 3 An infill panel can be used above the gate to make up the height of the fence.

The distance from the bottom edge of the gate to the surfaces of the road shall not exceed 75 mm when the gate is in the closed position.

NOTE 4 Compensation might be required for cambers or obstructions.

The gate shall be infilled with mesh panels of the type used in the main fence unless otherwise agreed between the supplier and specifier. The panels shall be secured to the gate such that the gate is capable of resisting the same loading as the main fence, and that its removal is prevented except by destruction.

When installed, the gates shall provide a comparable degree of security to the adjacent fence.

If the fence is fitted with a topping (see **5.2**), a topping shall also be included on the gate.

7.2 Hinges

Hinges and posts shall be designed to take the full load of the gate plus an allowance for superimposed vertical loads equal to 100 kg applied at the nose of the gate leaf. A device to secure gate leaves in the closed position shall be fitted, e.g. hinges.

Hinges shall be designed so that it is impossible to remove the gate by lifting at the hinges when they are in the closed and locked position.

7.3 Drop bolts and slam plates

Drop bolts shall be fitted to each gate leaf in such way that they cannot be removed, but allow the gate to be secured in both the open and closed position.

Slam plates shall be fitted to single leaf gates and one leaf of a double leaf gate so as to withstand full swing slamming without deformation.

7.4 Locking devices

A locking device shall be fitted at approximately mid-gate height (but not exceeding 1 500 mm from ground level) in such a way that when operated the gate is securely held in the closed position.

NOTE The locking device should be specified at the time of enquiry or order (see Annex A).

7.5 Gate posts

Gate posts shall be of a sufficient strength to properly support the gate, even when subject to all loading criteria (see Annex A). Posts shall be either concrete or steel.

Concrete posts shall conform to Annex C.

Steel posts shall be constructed from steel hollow or open sections, with all joints continuously welded. The tops of hollow section gate posts shall be closed by either a welded cap or a push fit plastic cap. Sufficient anchoring shall be provided to support and retain steel gate posts after installation, e.g. steel base plates fitted to the bottom of posts.

NOTE 1 Recommended steel grades for posts, baseplates and caps, and details of corrosion protective treatments that can be applied to these materials, are given in Annex B.

Gate posts, which can be freestanding or combined gate pillar and end posts, shall be equipped with fittings to suit the gate and fence panel requirements [see **A.3**d)].

7.6 Welding

All welding operations shall be carried out in accordance with BS EN 1011-1 and BS EN 1011-2, by suitable personnel qualified according to BS EN 287-1.

8 Installation

8.1 Level and line

8.1.1 Level

The top of the fence shall follow approximately the level of the ground along the length of the fence.

NOTE Unless specified (see Annex A) the installation of the fence does not include work required to cut or fill the ground to vary levels, nor does it cover special work to secure culverts, ditches, etc.

The presence of any electricity, gas, water or other underground services shall be established prior to commencement of excavation, drilling or erection in the working area.

8.1.2 Line (security fences in categories 2, 3 and 4)

The line of the fence shall be set out in such a manner that changes of direction are formed as obtuse angles, no angle being less than 130°.

NOTE Any opening below or through the fence should be protected in accordance with the purchaser's detailed requirements (see Annex A).

8.2 Posts

8.2.1 General

Holes for posts shall have vertical sides.

NOTE It is realized that the ground at the top of the hole is damaged during digging. This is acceptable provided that the damage is limited to the top of the hole and does not extend down such that the hole itself is tapered out towards the top.

When installing posts for general purpose fences, after insertion of the post, the hole shall be filled to at least half its depth with concrete which shall be well rammed as the filling proceeds (see also **8.2.3**). The remainder of the hole shall be filled with backfill which shall be well rammed before initial setting of the concrete.

When installing posts for security fences in categories 2, 3 and 4 the specified design requirements of Clause **5** (see **5.1.3**) shall be met.

8.2.2 Positioning

NOTE For ground sloping conditions, see Annex F.

Posts shall be provided at intervals, measured centre-to-centre, of not more than 3 000 mm.

The post foundation dimensions for general purpose fences shall be as given in Table 3. For security fences in Categories 2, 3 and 4 the specified design requirements of Clause **5** (see **5.1.3**) shall be met.

Table 3 **Post foundations for general purpose fences**

Fence height	**Depth in ground**	**Hole size (min.)**	
		mm	
mm	mm	**Square**	**Round (augered)**
1 800	600	450	300
2 400	750	450	450

8.2.3 Gate posts

A hanging post and a shutting post shall be provided for single gates. Two hanging posts of the same cross-section shall be provided for double gates.

Gate posts shall be set in the ground 750 mm, or to a minimum depth equating to one third of the fence height less 75 mm, whichever is the greater. The hole for gate posts shall be at least 450 mm square in plan.

NOTE The size of gate post foundations should be specified by the purchaser (see Annex A).

After installation of the gate posts, the hole shall be filled completely with concrete which shall be well rammed as the filling proceeds. Concrete around steel posts shall be filled to a height of approximately 50 mm above the adjacent ground level and finished with a weathered top to prevent accumulation of water.

8.3 Infill panels

Infill panels shall conform to Table 1 and Table 2.

NOTE See also Annex A.

8.4 Cranked tops and extension arms

Cranked tops or single extension arms shall point in the direction specified by the purchaser at the time of ordering (see Annex A).

Extension arms shall be supplied for posts not having integral cranked tops. Double extension arms, if specified, shall consist of two single arms in "V" configuration fixed on opposite sides of each post. Where barbed wire or barbed tape is specified inside and outside a fence having posts with cranked tops, single extension arms shall be used pointing in the direction opposite to that of the integral cranked tops.

8.5 Bolts

Unless tamper resistant fixings are used, all bolts to fencing shall be burred over. Any damage to galvanized coating shall be made good (see **B.2**).

9 Statement of conformity

9.1 Fence manufacturer

On delivery, the manufacturer/supplier of the fence shall provide the installer with a certificate, conforming to **9.3**, confirming that the fence and/or gates are manufactured in accordance with the client's instructions.

*NOTE This certificate can be in the form of an invoice, provided this conforms to **9.3**.*

9.2 Fence installer

On completion, the fence installer shall provide the end user with a certificate, conforming to **9.3**, confirming that the installation and materials used are in accordance with the client's instructions.

*NOTE This certificate can be in the form of an invoice provided this conforms to **9.3**.*

9.3 Certificate

In addition to the requirements of **9.1** and **9.2**, the certificate shall also include the following information:

a) the supplier's name and address;

b) the contract or order number;

c) the date of delivery or installation, as appropriate:

d) the purchaser's name and address.

9.4 Statement

The manufacturer and/or installer shall make a statement to the effect that it is their policy to conform to a previously client agreed and documented specification and to offer goods and/or services accordingly.

NOTE This could be done by inclusion in trade advertising and "terms of trading" statements supplied with quotations.

Annex A (informative) Specifying an open mesh steel panel fence

A.1 General

When preparing a specification for a fence it is important that precise details of the requirements of the fence and the installation site are provided. This annex lists those items that should be specified at the time of ordering the fence. As conditions vary from site to site, this annex should not be assumed to be exhaustive.

A.2 Site conditions

The following items should at least be agreed between the supplier and the purchaser at the time of enquiry and/or order:

a) the line and length of fence (see Clause **8** and Foreword);

b) the height of fence (see Table 1 and Table 2);

c) the type of fence (see Table 1 and Table 2);

d) site preparation (see **8.1.1**):

   1) site clearance;

   2) cutting or filling of ground level;

   3) ground sloping conditions (see Annex F).

e) any specific requirements for non-standard post lengths due to ground conditions (see Foreword);

NOTE The requirements for the lengths of posts and struts in this standard and foundation sizes are for "normal" ground conditions. This standard does not cover conditions of particularly firm or soft ground, where other lengths or foundation sizes might be required.

f) the number and position of any gates (see Clause **7**).

A.3 Construction of fence

The following items should at least be agreed between the supplier and the purchaser at the time of enquiry and/or order:

a) the type of infill:

   1) expanded metal, welded mesh or other (see Table 2);

   2) mesh size (see Table 1 and Table 2);

   3) type of protective treatment (see **B.2**).

b) topping (see **5.2**):

   1) barbed wire;

   2) barbed tape;

   3) rotating deterrents;

   4) other.

c) posts:
   1) material of posts:
      i) steel (see **4.2**);
      ii) concrete (see **4.3**);
      iii) other materials (see **4.4**).
   2) if steel:
      i) type of section (see **4.2**);
      ii) type of protective treatment (see **B.2**);
      iii) type of cap required (see **7.5**).
   3) foundations: size and post embedment depth (see **8.2.2**);

d) fittings: particular requirements for protective treatments (see Annex B);

e) gates (see Clause **7**):
   1) width of opening (measured as width between faces of gate posts):
      i) single leaf gate;
      ii) double leaf gate[3)];
      iii) direction of opening.
   2) type of hinge (see **7.2**):
      i) top:
         - plate and pin;
         - block and band.
      ii) bottom:
         - heel and socket;
         - plate and pin.
   3) foundations: size and post embedment depth (see **8.2.3**);
   4) gate locking requirements (see **7.4**).

[3)] For all gates over 2 m wide.

Annex B (normative) Steel components and protective treatment

B.1 Material form

Steel posts and gates shall be produced from the following:

a) rolled steel angle (RSA)[4] or angle re-rolled from railway lines[5];

b) rectangular or square hollow sections (RHS);

c) circular hollow sections (CHS) or round tubes;

d) I/H open sections[6] [rolled steel joists (RSJ), universal beams and universal columns].

B.2 Material grades

The steel grade(s) employed shall be specified by the customer (the purchaser, fence designer, supplier, component manufacturer, fabricator or erector, as applicable), on the basis of the mechanical properties, formability and weldability required. Appropriate mild steel grades shall be selected from Table B.1.

As a general guideline, steel grades shall have a minimum yield strength in excess of 175 N/mm^2, unless the design permits lower strength materials to be employed.

NOTE 1 Tubes and hollow sections can be hot or cold formed.

Where components are to be hot dipped galvanized, the purchaser shall confirm with the supplier that the steel composition is suitable.

NOTE 2 A non-exhaustive range of recommended material grades is given in Table B.1.

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4) Fence posts only.
5) Re-rolled angles are normally produced from steel sections.
6) Gate posts only.

Table B.1 **Recommended steel grades**

Material	**Dimensional standard**	**Material standard**	**Material grade** [A]
Rolled steel angle	BS EN 10056-1	BS EN 10025-2	S185/S235JR/S275JR/S355JR
Circular, square or rectangular hollow section	BS EN 10210-2	BS EN 10210-1	S235JRH/S275J2H/S355J2H
	BS EN 10219-2	BS EN 10219-1	S235JRH/S275J2H/S355J2H
Circular tubes	BS EN 10255	BS EN 10255	S195T
	BS EN 10296-1	BS EN 10296-1	E155 [B]/E190/E195/E235/E275/E355
	DIN 1615	DIN 1615	ST 33
I/H sections – rolled steel joists, universal beams and universal columns.	BS 4-1	BS EN 10025-2	S185/S235JR/S275JR/S355JR
Plate for baseplates, caps, etc.	—	BS EN 10025-2	S185/S235JR/S275JR/S355JR

[A] Where applicable, the use of equivalent alternative or more enhanced grades than those shown (e.g. grades with low temperature impact properties) is permissible, provided that they meet the necessary requirements for formability, weldability or galvanizing.

[B] Only where the design loading permits.

B.3 Protective treatment

Steel components and fabrications shall be suitably protected against corrosion by hot dip galvanizing in accordance with BS EN ISO 1461 or BS EN 10240.

All loose scale, oil and dirt shall be removed from the surfaces before treatment. Closed hollow sections to be hot dipped galvanized shall be provided with the necessary drain holes.

NOTE 1 If agreed between the purchaser and supplier, one or more of the following alternative treatments can be applied:

a) Thermal spray coating of zinc or aluminium in accordance with BS EN 22063.

b) Organic powder coating in accordance with BS 1722-16.

c) Painting in accordance with BS EN ISO 12944 Parts 1 to 8, as applicable, to meet durability requirement H.

NOTE 2 Guidance on the appropriate protective coatings to use in specific environments and recommended coating thicknesses can be found in BS EN ISO 14713.

Wire shall either be zinc coated in accordance with BS EN 10244 or plastic coated in line with BS 4102.

B.4 Renovation and repair of hot dipped galvanized coating

The fence shall be inspected after erection and any damaged areas found in the hot dipped galvanized coating shall be repaired in accordance with one of the procedures set out in BS EN ISO 1461:1999, **6.3**.

NOTE 1 These include, thermal spraying with zinc for use of a suitable zinc rich paint. The zinc content of such paint should conform to BS 4652 (i.e. at least 80% in the dry film).

The coating thickness in the repaired area shall exceed that of the local galvanized coating layer.

NOTE 2 For guidance on suitable proprietary coating repair products; reference should be made to The Galvanizer's Association http://www.hdg.org.uk.

Annex C (normative) Concrete components

C.1 Materials

C.1.1 Cement

Cement for concrete shall be:

a) Portland cement (ordinary or rapid hardening) conforming to BS EN 197-1;

b) Portland blastfurnace cement conforming to BS EN 197-4; or

c) sulfate-resisting Portland cement conforming to BS 4027.

C.1.2 Aggregate

Aggregate for concrete shall conform to the requirements of BS EN 12620.

Aggregate shall not exceed 10 mm nominal size.

C.1.3 Admixtures

Admixtures for concrete shall conform as follows:

a) pigments: BS EN 12878;

b) pulverized-fuel ash: BS 3892;

c) concrete admixtures: BS EN 480 and BS EN 934 and used in accordance with BS EN 12839.

C.1.4 Chloride content

For chloride content the requirements of BS EN 206-1:2000, **5.2.7** shall apply.

Calcium chloride and chloride based admixtures shall not be added to concrete containing steel reinforcement.

C.1.5 Reinforcement

Reinforcement for concrete shall conform to BS 4449, BS 4482 or BS 4483.

C.2 Moulds

Moulds shall remain rigid during placing and compaction of the concrete and shall prevent loss of water, grout or mortar. Moulds shall produce finished components accurately within the specified size limits.

Timber moulds shall be of closely jointed planed timber.

C.3 Manufacture

C.3.1 Mixing

Concrete shall be mixed in a mechanical mixer until uniform in colour and consistency.

C.3.2 Placing and compaction

Concrete shall be placed as soon as practicable after mixing, and shall be thoroughly compacted by vibration, tamping or other method so that on demoulding the surface is free from honeycombing and other large blemishes (see **B.4**).

NOTE Blemishes do not include small surface voids caused by entrapped air or water.

C.3.3 Location of reinforcement

Reinforcement shall be prefabricated and located during placing and compacting of the concrete so that the cover of concrete measured from main external faces and from the top of a post or strut is at least 15 mm, or 10 mm if the section is 100 mm × 100 mm or less.

The length of the assembled reinforcement shall be at least equal to the minimum length of the component, minus up to 100 mm to allow for the minimum cover and up to 75 mm to allow for cutting, prefabrication and location.

Reinforcement shall extend beyond the centre line of the uppermost line wire hole or beyond the top edge of the uppermost rail fixing point, as appropriate.

NOTE If the ends of components are splayed, each bar can be of equal length.

C.3.4 Protection from freezing

Materials that have been exposed to below freezing point shall not be used unless completely thawed.

Components shall not be moulded if the mould is below freezing point. The temperature of fresh concrete shall be not less than 5 °C at the time of placing.

C.3.5 Maturing

Components shall not be used unless:

a) the concrete has a strength of 45 N/mm^2, as tested in accordance with **C.5**; or

b) they have been allowed to mature under suitable conditions for at least 28 days at normal ambient temperatures.

C.4 Surface characteristics

C.4.1 Surface finish as cast

The surface finish shall be assessed against the reference photographs in BS EN 12839:2001, Annex B. Furthermore, the total area of blowholes shall not exceed 3% of the concrete surface and no blowhole shall exceed 150 mm^2.

NOTE It is acknowledged that semi-dry cast posts might have a more visually open surface texture than shown in these photographs.

C.4.2 Surface finish as treated

The requirements of BS EN 12839:2001, **5.3.2** shall apply.

C.5 Tests

To demonstrate compliance, testing shall comprise of initial type testing and factory production control in accordance with BS EN 12839:2001, Clause **6**.

C.6 Product information

The manufacturer shall give the following information on at least one product by unit of packaging, delivery notes, certificate or any documentation supplied with components in accordance with BS EN 12839:2001, ZA.3:

a) Name (or identifying mark) and address of the manufacturer.

b) Last 2 digits of the year in which the marking was affixed.

c) BS 1722 and BS EN 12839: Elements for Fences.

d) Loadbearing capacity, expressed in newtons according to the result of initial type testing, rounded down to the nearest 10.

Annex D (normative) Calculation of wind forces

Drag coefficients of fences shall be in accordance with Table D.1.

The uniformly distributed load (UDL) on fences shall be calculated as follows:

$$\text{UDL} = \frac{\text{Dynamic pressure} \times \text{CD}\{(\text{solidity} \times \text{panel area}) + \text{post area}\}}{\text{panel area}}$$

NOTE *The dynamic pressure can be taken as 900 N/m².*

Table D.1 **Drag coefficients of fences (CD) (force normal to fence)**

Type of member	**Solidity** [A] %				
	5	**10**	**20**	**30**	**50**
CD flat members (e.g. flat bars)	1.90	1.80	1.60	1.50	1.30
CD round members (e.g. welded wire mesh)	1.15	1.10	1.02	1.00	0.96
CD diamond members (e.g. expanded metal)	1.33	1.30	1.26	1.24	1.22

[A] Solidity % is the percentage of fence infill area which is solid and thus provides wind resistance.

EXAMPLE:

fence: 3 m high

post centres: 2.4 m

solidity: 20%

post area: 0.04 m²

round members

therefore:

$$\text{UDL} = \frac{900 \times 1.02\{(0.20 \times 7.2) + 0.04\} = 188.7 \text{ N/m}^2}{7.2}$$

Annex E (normative) Test procedure

E.1 Wind loading test

E.1.1 Test layout

Three panels of fencing shall be tested in either the vertical or the horizontal position (see Figure E.1). The width of panel (*W*) and height of panel (*H*) shall be the maximum dimensions used for the fencing system. The two inner fence posts and the middle panel of fencing shall comprise the test panel.

Fence posts shall be mounted horizontally or vertically in a manner that represents the most onerous service support condition.

The fencing system shall be installed in accordance with the manufacturer's instructions.

The displacement of the fence posts and the mesh shall be measured at the locations shown in Figure E.1.

The displacement measuring equipment shall be calibrated.

NOTE Attention is drawn to the desirability of independent calibration of the measuring equipment.

E.1.2 Procedure

Zero all displacement measuring devices, which shall be positioned at the tops of the inner fence post, the top of the test panel on the centre line and at position H/2 on the centre line (see Figure E.1). Apply uniform loading, to all three panels, in five increments up to the design wind load calculated in accordance with Annex D.

Record displacements at each load increment.

Leave loaded with the design wind load for 30 min. Record displacements after this period and then unload.

Record displacements on unload.

After unloading visually inspect the fencing systems for signs of distortion of any components.

Repeat the test with the loading in the opposite direction.

E.2 Personnel loading test

E.2.1 Test layout

The test layout shall be the same as for **E.1.1**.

E.2.2 Procedure

Zero all displacement measuring devices.

Apply a line load, to all three panels, in five increments up to a maximum of 0.36 kN/m. The line load shall be applied at a distance of 1.1 m from the base of the fence posts (ground level).

Continue with the procedure of **E.1.2** to complete the test.

E.3 Acceptance criteria

At no time during the wind loading and personnel loading tests shall the fencing system deflect more than $\frac{H}{10}$. The fencing system shall recover or be easily rectified on site, to $\frac{H}{50}$.

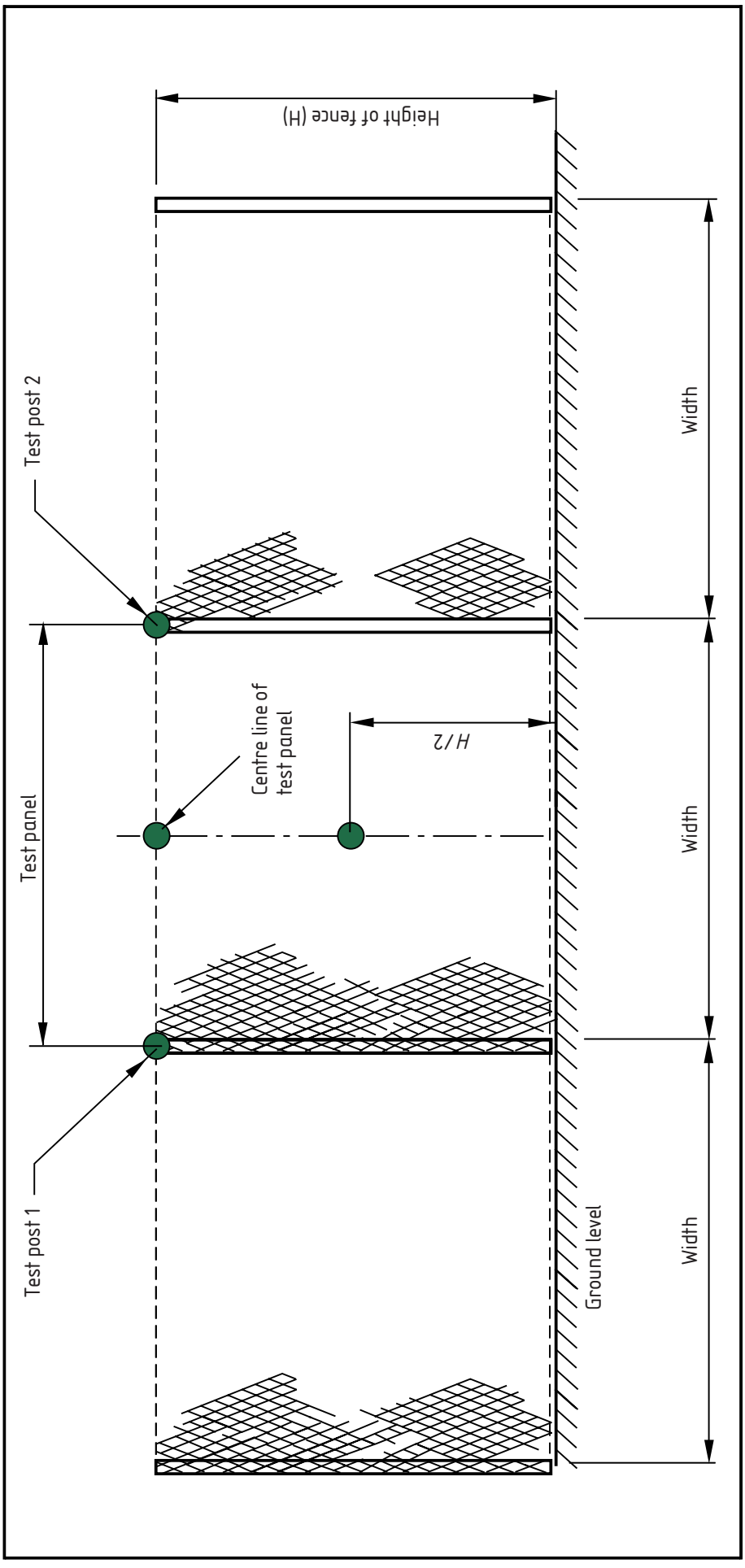


Figure E.1 **Plan view for vertical loading – Elevation for horizontal loading**

Annex F (informative) Ground sloping conditions

Methods used for ground sloping conditions are illustrated in Figure F.1, Figure F.2, Figure F.3 and Figure F.4.

Figure F.1 **Method 1: up to 20°**

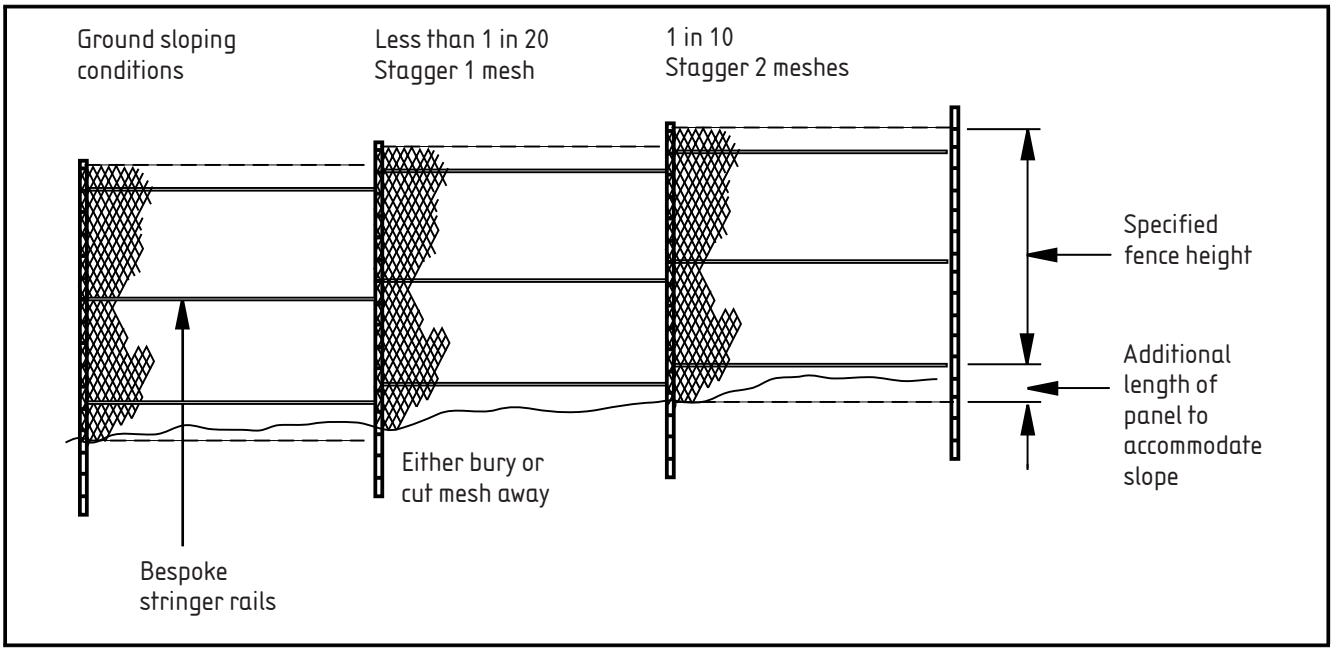


Figure F.2 **Method 2: over 20°**

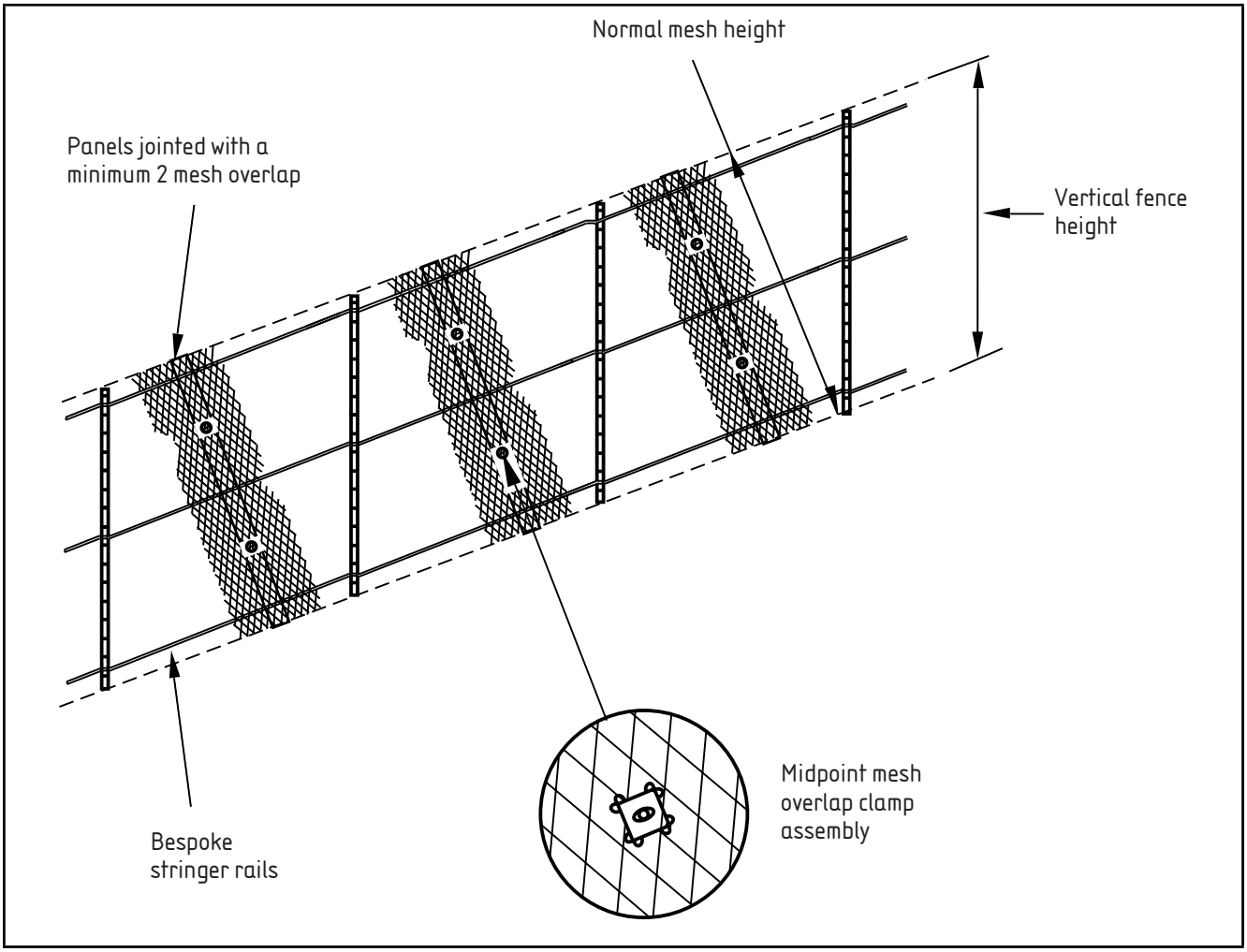
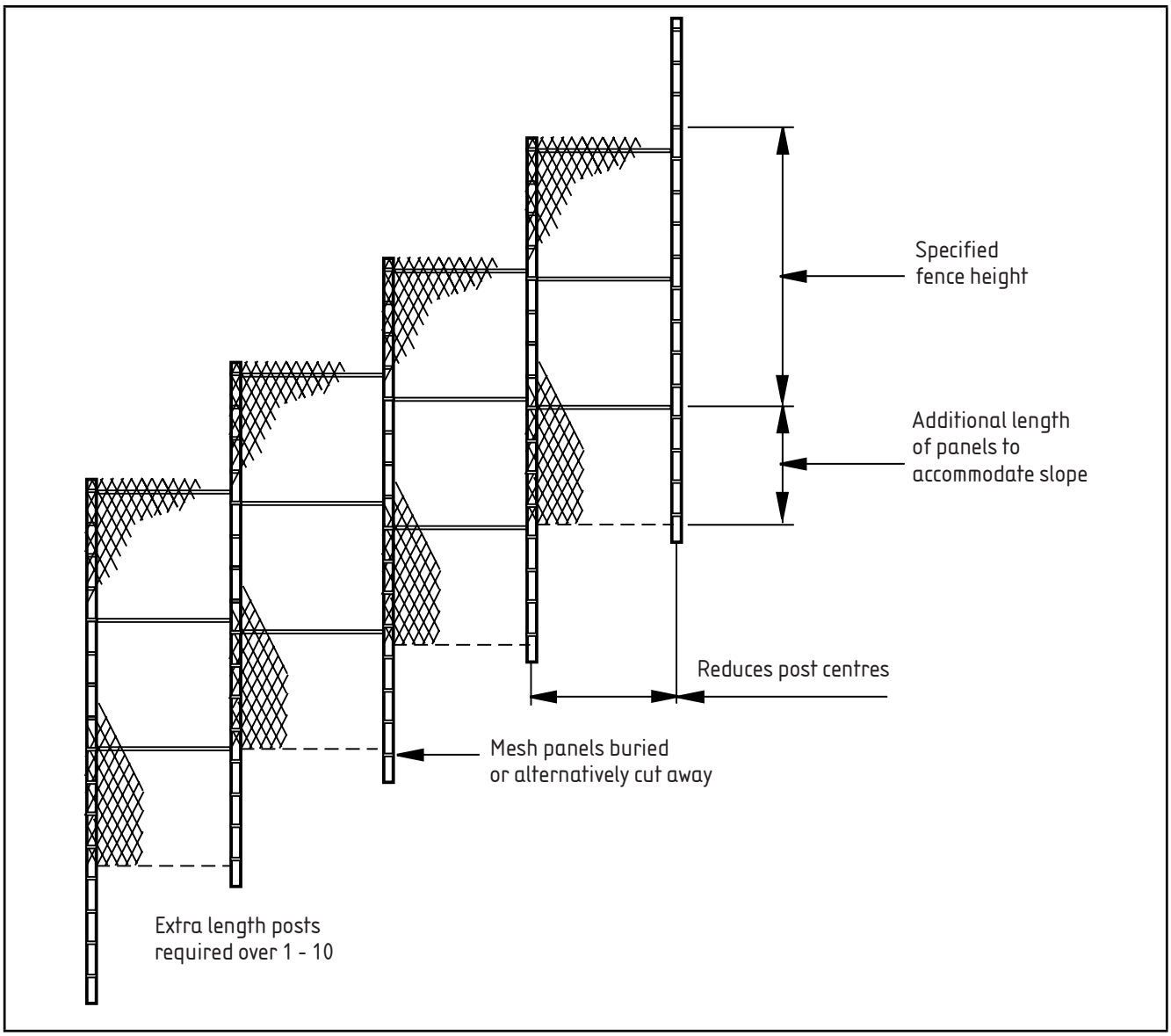


Figure F.3 **Method 3: approximately 45°**



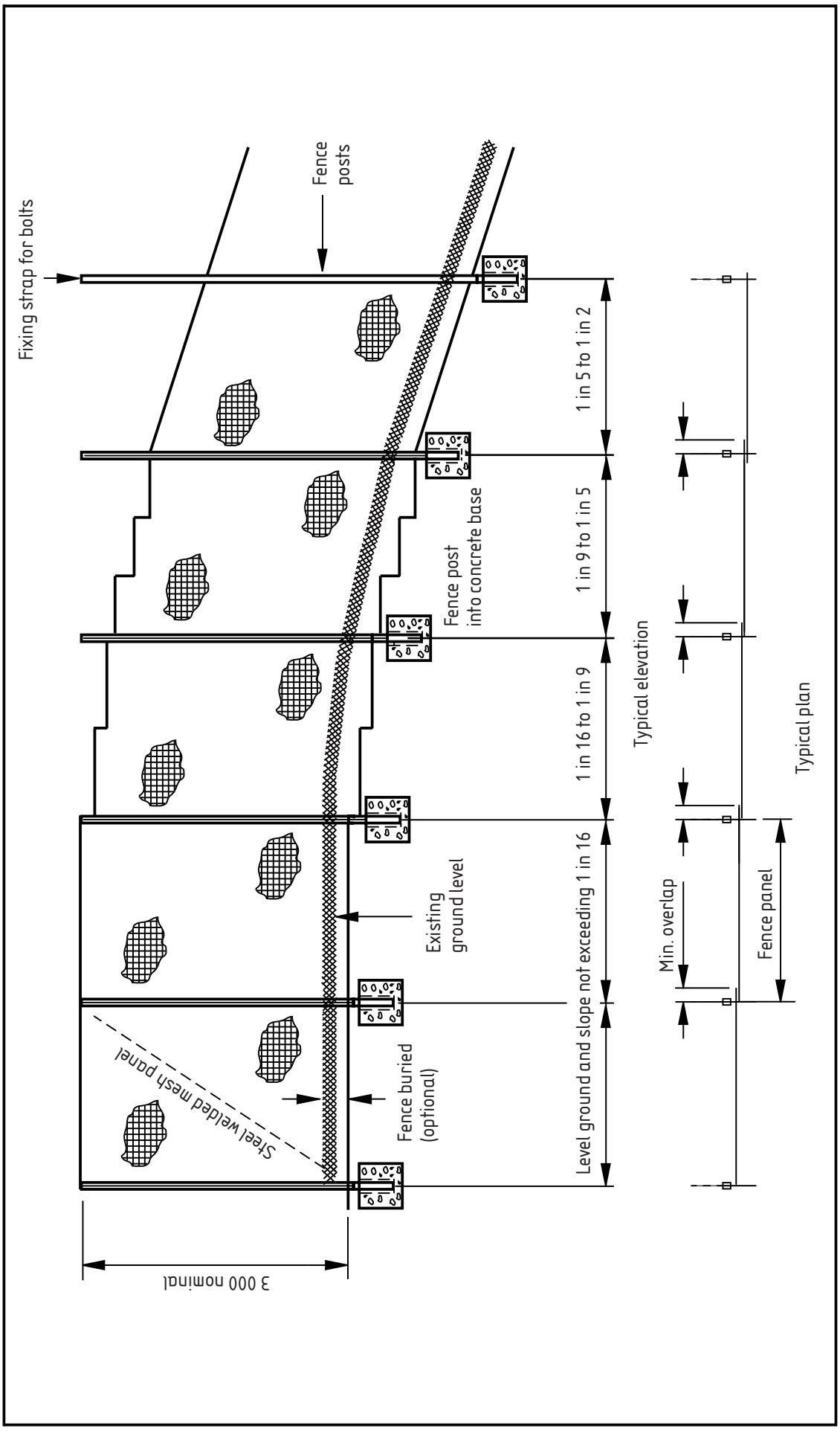


Figure F.4 **Alternatives to Figure F.1, Figure F.2 and Figure F.3**

Bibliography

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 4652, *Specification for zinc-rich priming paint (organic media)*

BS 1722-16, *Fences – Part 16: Specification for organic powder coatings to be used as a plastics finish to components and mesh*

BS EN 22063, *Metallic and other inorganic coatings – Thermal spraying – Zinc, aluminium and their alloys*

BS EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods*

BS EN ISO 12944-1, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction*

BS EN ISO 12944-2, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classification of environments*

BS EN ISO 12944-3, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 3: Design considerations*

BS EN ISO 12944-4, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 4: Types of surface and surface preparation*

BS EN ISO 12944-5, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 5: Protective paint systems*

BS EN ISO 12944-6, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 6: Laboratory performance test methods*

BS EN ISO 12944-7, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 7: Execution and supervision of paintwork*

BS EN ISO 12944-8, *Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 8: Development of specifications for new work and maintenance*

BS EN ISO 14713, *Protection against corrosion of iron and steel in structures – Zinc and aluminium coatings – Guidelines*

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