BS 4592-4:2006

BRITISH STANDARD

# Industrial type flooring and stair treads –

## Part 4: Glass reinforced plastics (GRP) open bar gratings – Specification

ICS 91.060.30

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## Publishing and copyright information



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Committee reference B/208
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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 10, an inside back cover and a back cover.

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# Foreword

## Publishing information

This part of BS 4592 was published by BSI and came into effect on 29 December 2006. It was prepared by Subcommittee B/208/1, *Stairs and walkways – Industrial*, under the authority of Technical Committee B/208, *Stairs and walkways*. A list of organizations represented on this committee can be obtained on request to its secretary.

## Supersession

This part of BS 4592, together with Part 0, supersedes BS 4592-4:1992, which is withdrawn.

## Information about this document

This revision incorporates, where applicable, the requirements of BS EN ISO 14122-2 and BS EN ISO 1422-3. It also incorporates some of the requirements of BS 5395-3 that will be removed from BS 5395-3 in due course.

BS 4592 is published in seven parts, as follows:

- *Part 0: Common design requirements and recommendations for installation;*
- *Part 1: Metal open bar gratings – Specification;*
- *Part 2: Expanded metal sections – Specification;*
- *Part 3: Cold formed metal planks – Specification;*
- *Part 4: Glass reinforced plastics (GRP) open bar gratings – Specification;*
- *Part 5: Solid plates in metal and glass reinforced plastics (GRP) – Specification;*
- *Part 6: Glass reinforced plastics (GRP) moulded open mesh gratings – Specification*[1)].

The requirements in this part cover areas that are not addressed by BS EN ISO 14122, *Safety of machinery – Permanent means of access to machinery*, which is published in the following parts:

- *Part 1: Choice of fixed means of access between two levels;*
- *Part 2: Working platforms and walkways;*
- *Part 3: Stairways, stepladders and guard-rails;*
- *Part 4: Fixed ladders.*

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

1) In preparation.

## 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 4592 specifies requirements for the design, manufacture, supply and installation of glass reinforced plastics (GRP) open bar gratings intended for use in industrial flooring, walkways and stair treads.

It is not applicable where access to machinery is required, in which case the requirements of BS EN ISO 14122 apply.

*NOTE For the common requirements for industrial type flooring and stair treads, see BS 4592-0.*

In addition to the definitive requirements, this standard also requires the items detailed in BS 4592-0:2006, Clause **4** to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

# 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 4592-0:2006, *Industrial type flooring and stair treads – Part 0: Common design requirements and recommendations for installation*

BS 4592-1, *Industrial type flooring and stair treads – Part 1: Metal open bar gratings – Specification*

# 3 Terms and definitions

For the purposes of this part of BS 4592, the terms and definitions given in BS 4592-0, BS 4592-1 and the following apply.

*NOTE Definitions of some common terms are illustrated in Figure 1.*

### 3.1 Types of bar

**3.1.1 bearing bar**
member that carries the load between supports

**3.1.2 transverse bar**
member fixed at right angles to bearing bars to provide lateral restraint

### 3.2 Dimensions of gratings

**3.2.1 grating length**
overall measurement in a direction parallel to the bearing bars

**3.2.2 grating width**
overall measurement in a direction at right angles to the bearing bars

**3.2.3 grating depth**
overall depth of grating, which is usually the depth of the bearing bar

### 3.3 Pitch

**3.3.1 bearing bar pitch**
distance centre-to-centre of bearing bars

**3.3.2 transverse bar pitch**
distance centre-to-centre of transverse bars

**3.4 solid top grating**
open mesh grating to which a GRP plate is bonded to the top surface during manufacture

**3.5 starting edge**
distance from centre of first transverse bar to end of grating

**3.6 tread support**
either a shelf angle with the tread securely clipped, bolted or bonded to it or a flat plate fixed to each end of the tread, with each support having holes provided for fixing the tread between stair stringers

Figure 1 **Grating terms**

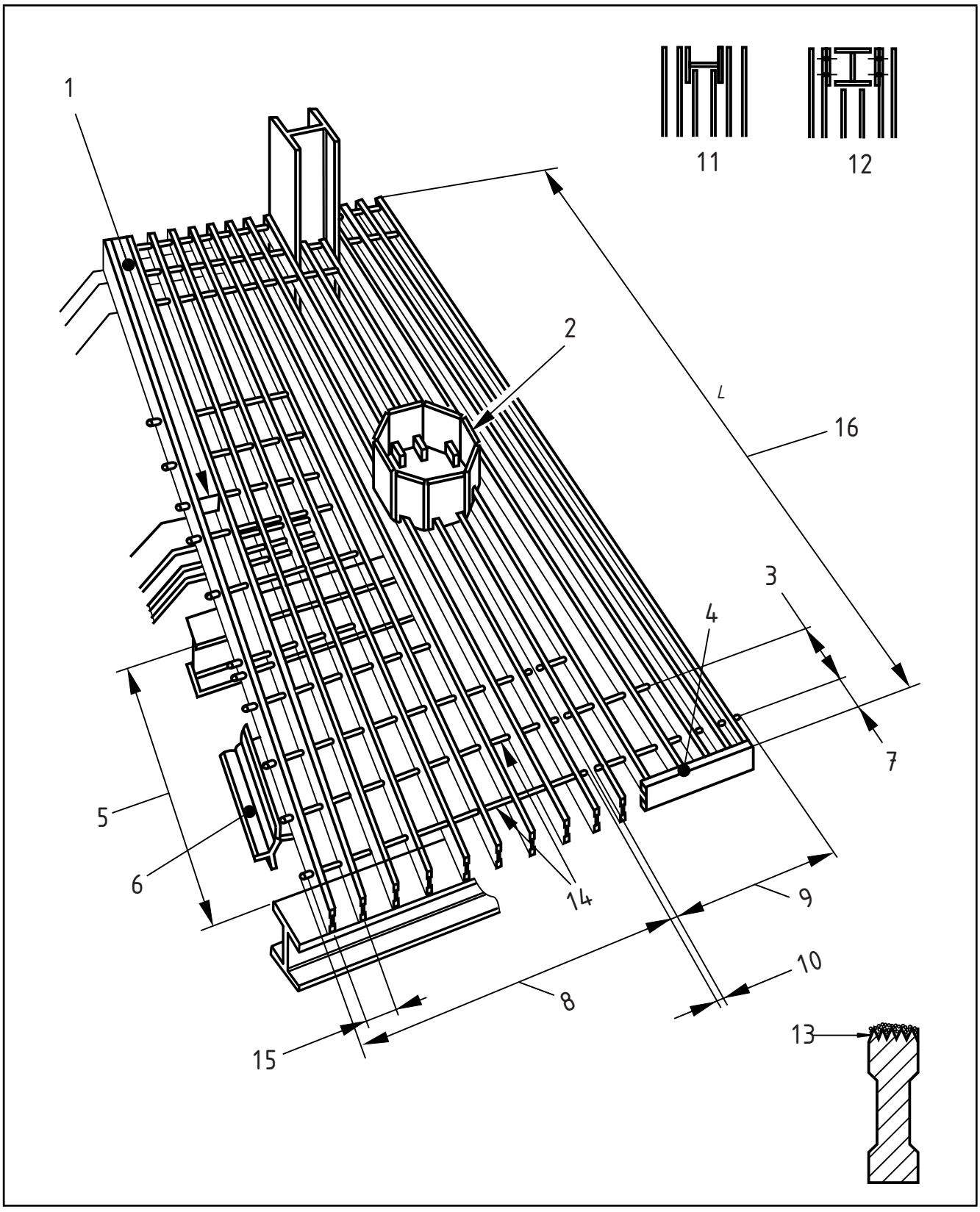


Figure 1 **Grating terms** *(continued)*

**Key**

1 Slip resistant strip (nosing) at top of stairs or step-off point
2 Curved toe plate
3 Transverse bar pitch
4 Binding bar, only where essential
5 Effective span
6 Special pultruded GRP curb angle section (as alternative to galvanized mild steel)
7 Starting edge
8 Standard panel width
9 Make-up panel width
10 Erection clearance
11 Bearing bars to follow profile of cut-out
12 Toe plate bolted/pinned and bonded to bearing bar
13 Top surface of bars with slip-resistant surface
14 Transverse bars
15 Bearing bar pitch
16 Grating length (direction of span)

*NOTE A curved toe plate is not available in pultruded GRP. Where upstand is unavoidable, multisided shaping is acceptable or moulded GRP pipe of a suitable diameter.*

# 4 Information to be supplied

For compliance with the standard both the definitive requirements specified throughout this part of BS 4592 and those specified in BS 4592-0:2006, Clause **4** shall be satisfied.

# 5 Material requirements

**5.1** The material used in glass reinforced plastics (GRP) open bar gratings shall be a composite of thermosetting resin mix reinforced with continuous glass fibre roving which, when fabricated into a panel, meets the appropriate design criteria specified in BS 4592-0 and is fit for the relevant design load, as specified in BS 4592-0:2006, Table 1.

**5.2** Surfaces of the composite shall have a thermoplastic veil.

*NOTE 1 For additional protection, surfaces that are subject to abrasion in service should have a quartz grit applied, bonded on with an epoxy resin adhesive.*

*NOTE 2 The glass fibre might include continuous strand mat reinforcing, and only those additives (stabilizers, fillers, etc.) that are necessary to enable conformance to the requirements of this standard should be used in the resin mix.*

*NOTE 3 A post-manufacture protective surface coat can also be applied, if required, to enhance ultraviolet degradation resistance.*

**5.3** All cut ends shall be sealed with a suitable resin after cutting.

# 6 Size requirements

The sizes of bearing bars, binding bars and transverse bars (subject to the tolerances permitted in the appropriate material standard), shall be such that it can be demonstrated by calculation or test, that they meet the appropriate design criteria specified in BS 4592-0 and are fit for the relevant design load, as specified in BS 4592-0:2006, Table 1.

The transverse bar pitch shall be determined by calculation or test such that it meets the appropriate design criteria specified in BS 4592-0 and is fit for the relevant design load, as specified in BS 4592-0:2006, Table 1.

*NOTE Gratings can be provided with a solid GRP plate bonded to the top surface during manufacture, in order to cover any opening in the top surface that would permit the passage of smaller objects. This would also increase the strength of the floor and provide a more suitable surface for the passage of small solid wheeled trolleys when required.*

# 7 Tolerance requirements

**7.1** The maximum permissible tolerances from finished sizes of glass reinforced plastics (GRP) open bar gratings shall be as shown in Table 1.

Table 1 **Permissible tolerances**

| **Location** | **Tolerance** mm |
|---|---|
| Length of grating panel or individual bearing bar | +0<br>−5 |
| Grating width | +0<br>−5 |
| Depth of bearing bar: | |
| up to and including 25 | +1<br>−0 |
| over 25 up to 50 | +1.5<br>−0 |
| Thickness of bearing bar: | |
| up to 10 | ±0.4 |
| over 10 up to 15 | ±0.5 |
| Binding: | |
| top of binding bar above bearing bar | +4.0<br>−0 |
| Underside of binding bar above bottom of bearing bar | +0 |

**7.2** The maximum permissible manufacturing tolerances for glass reinforced plastics (GRP) open bar gratings shall be as given in Table 2.

Table 2 **Manufacturing tolerances**

| **Location** | **Tolerance** mm |
|---|---|
| Difference between the length of diagonals | 5 (out of squareness of grating panel) |
| Transverse bars in either direction from perpendicular alignment with bearing bars | 1:100 |
| Transverse bar spacing | ±5 per 1 500 length of bearing bars |
| Bearing bar lean | 1:10 |
| Transverse bow of panel before fastening to supports | 1:100 |
| Longitudinal bow of panel before fastening to supports | 1:200 |

# 8 Construction requirements

## 8.1 Bearing bars

Bearing bars shall be provided with lateral restraint by means of transverse bars fixed at each point of intersection or contact with the bearing bars, either mechanically or by means of an epoxy resin adhesive. Binding bars shall be attached by bonding, or bonding and pinning.

## 8.2 Binding bars

Binding bars shall be attached to bearing bars where:

a) panels have less than two transverse bars;

b) the starting edge of a panel is more than 150 mm from the transverse bar.

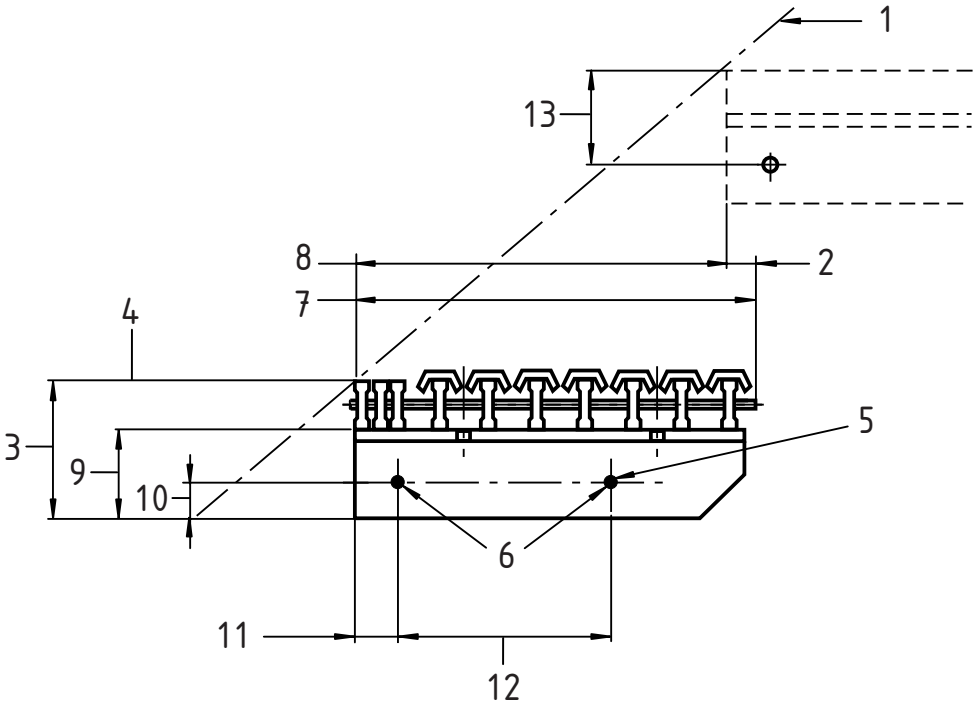
## 8.3 Supports for stair treads

Tread supports, clipped securely to the stair treads, shall be bolted to the stair strings.

*NOTE 1 For typical details of fixing dimensions for tread supports, see Figure 2.*

*NOTE 2 For imposed loads on treads, see BS 4592-0.*

Figure 2 **Fixing dimensions for tread supports**




**Key**

1 Pitch line
2 16 mm min. overlap
3 Depth of tread and support
4 Grating depth of tread
5 Rear hole
6 Fixing holes 13 mm diameter for M12 bolts
7 Width of tread
8 Going
9 Depth of tread support (50 mm)
10 Dimension from bottom of tread support to bolt centre (22 mm)
11 Distance to first bolt centre from end of tread support (30 mm)
12 Bolt centres (see Note 4 and Note 5)
13 Dimension from top of tread to bolt centre

*NOTE 1 Dimension 13 is 53 mm when using 25 mm deep tread.*

*NOTE 2 Dimension 13 is 66 mm when using 38 mm deep tread.*

*NOTE 3 If the width of tread is 250 mm to 290 mm, the dimension 12 is 125 mm.*

*NOTE 4 If the width of tread is 291 mm or more, the dimension 12 is 175 mm.*

*NOTE 5 The minimum section thickness for a tread support angle is 6 mm.*

*NOTE 6 The rear hole (5) in the support angle can be slotted.*

## 8.4 Toe plates

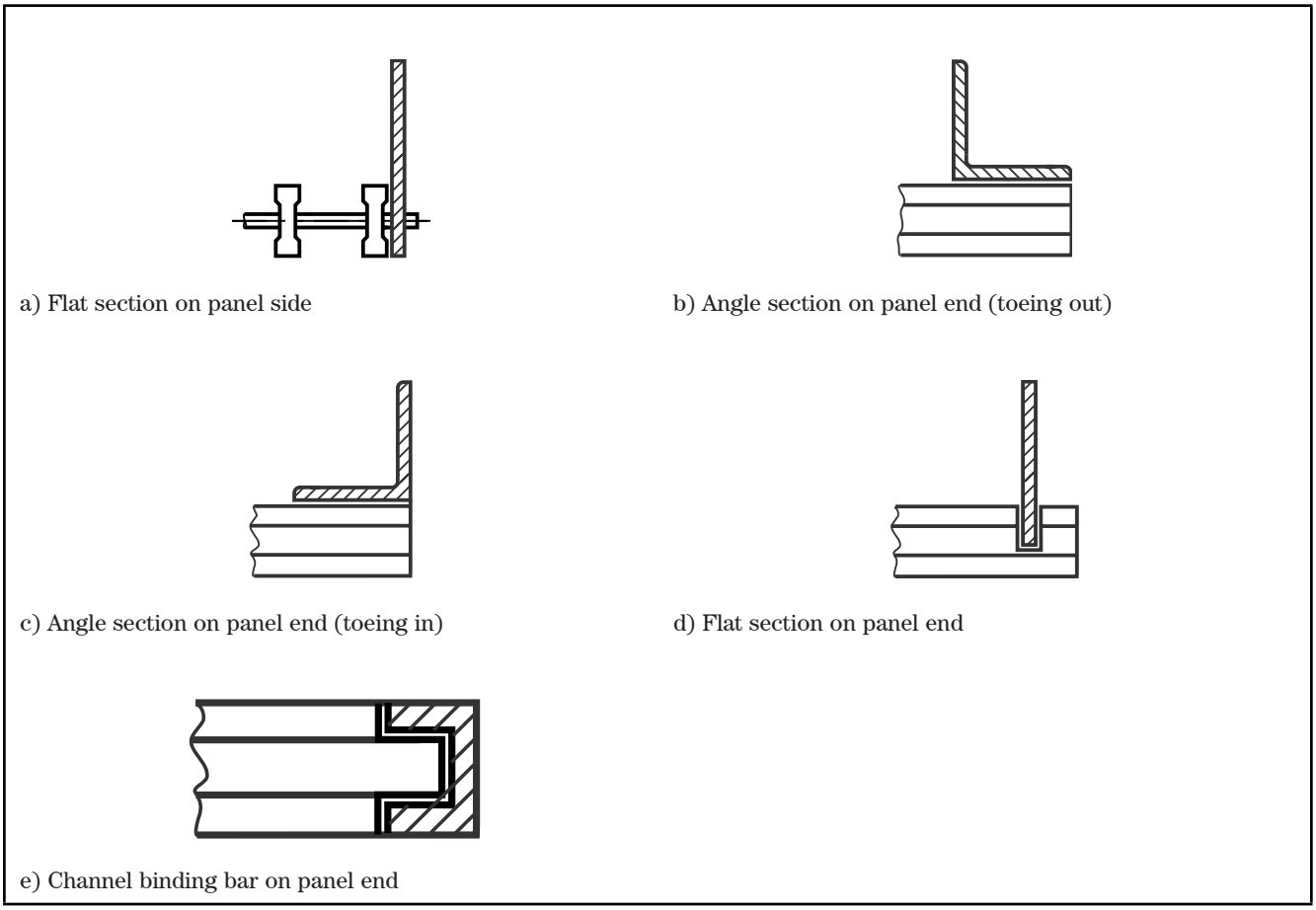
Wherever possible, toe plates shall be fixed to the supporting structure for glass reinforced plastics (GRP) open bar gratings.

When fitted, toe plates shall be formed from channel, angle or flat sections (see Figure 3) or suitable profiles.

*NOTE 1 Channel sections can be used where toe plates are attached to the guard rail posts. Where this is possible, it is the preferred method, as it does not rely on the adhesive bond to a bearing bar.*

*NOTE 2 Angle sections are preferred to flat sections. Flat sections, however, can be used around multi-sided openings (see Figure 1) as curved toe plates of the same material as the bearing bars are generally unavailable.*

Figure 3 **Examples of attachments to bearing bars**




## 8.5 Cut-outs

Where a cut-out is required in a glass reinforced plastics (GRP) open bar grating, it shall be shaped to reduce the necessity for binding bars or toe plates.

*NOTE 1 Additional supports around the cut-out might be required to satisfy the design criteria.*

*NOTE 2 The rigidity of the panel can be maintained by joining to adjacent panels.*

# 9 Performance requirements

## 9.1 General

When tested in accordance with **9.2** or **9.3**, as applicable, glass reinforced plastics (GRP) open bar grating shall withstand the appropriate unfactored loads given in BS 4592-0:2006, Table 1. Where a cut-out is required, the remaining area of the grating shall be able to carry the same load.

The positions of concentrated loads during testing shall be either those that produce the maximum stresses or, where deflection is the design criterion, those that produce maximum deflection.

## 9.2 Flooring and walkways

When tested in accordance with BS 4592-0:2006, Annex A, the flooring or walkway shall conform to the following requirements.

a) shall have a load safety factor, for dead and imposed loads of not less than 4.0 when subjected to the unfactored imposed load given in BS 4592-0:2006, Table 1.

b) It shall deflect elastically by not more than 1/200 times the effective span or 10 mm, whichever is the least amount, when subjected to the unfactored imposed load given in BS 4592-0:2006, Table 1.

*NOTE Standard structural design theory can be used for calculations at the preliminary design stage. In such calculations, it is important that the appropriate mechanical properties for each composite be taken into account (see manufacturer's literature).*

## 9.3 Stair treads

For glass reinforced plastics (GRP) open bar gratings the requirements of BS 4592-0:2006, Clause **6** shall be met.

*NOTE See note to **9.2**.*

# Bibliography

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

## Standards publications

BS 4592-2, *Industrial type flooring and stair treads – Part 2: Expanded metal sections – Specification*

BS 4592-3, *Industrial type flooring and stair treads – Part 3: Cold formed metal planks – Specifications*

BS 4592-4, *Industrial type flooring and stair treads – Part 4: Glass reinforced plastics (GRP) open bar gratings – Specification*

BS 4592-5, *Industrial type flooring and stair treads – Part 5: Solid plates in metal and glass reinforced plastics (GRP) – Specification*

BS 5395-3:1985, *Stairs, ladders and walkways – Part 3: Code of practice for the design of industrial type stairs, permanent ladders and walkways*

BS EN ISO 14122 (all parts), *Safety of machinery*

## Further reading

BS 5395-1, *Stairs, ladders and walkways – Part 1: Code of practice for the design, construction and maintenance of straight stairs and winders*

BS 5502, *Buildings and structures for agriculture*

BS 5950-1:2000, *Structural use of steelwork in building – Code of practice for design – Part 1: Rolled and welded sections*

BS 6100-1, *Glossary of building and civil engineering terms – Part 1: General and miscellaneous*

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