BS 8666:2000 Incorporating Amendments Nos. 1

and 2

Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete

ICS 77.140.15; 91.080.40



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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee ISE/3, Steel for concrete reinforcement, to Technical Subcommittee ISE/3/9, Bending and scheduling of concrete, upon which the following bodies were represented:

British Precast Concrete Federation Ltd. Institute of Structural Engineers UK Certification Authority for Reinforcing Steels UK Steel Association

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Amendments issued since publication

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Foreword

This British Standard has been prepared under the direction of the Engineering Standards Policy Committee. It supersedes BS 4466:1989 which is withdrawn. The standard has been revised to incorporate the shape codes in BS EN ISO 4066:2000.

Assessed capability. Users of this British Standard are advised to consider the desirability of quality system assessment and registration against the appropriate standard in the BS EN ISO 9000 series by an accredited third-party certification body (see annex B).

A British Standard does not purport to include all necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 18, an inside back cover and a back cover.

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1 Scope

This British Standard specifies requirements for the scheduling, dimensioning, bending, and cutting of steel reinforcement for concrete conforming to BS 4449, BS 4482, BS 4483, and BS 6744.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 4000-1:1990, Sizes of paper and board — Specification for A and B series of trimmed sizes of writing paper and certain classes of printed matters.

BS 4449:1997, Specification for carbon steel bars for the reinforcement of concrete.

BS 4482:1985, Specification for cold reduced steel wire for the reinforcement of concrete.

BS 4483:1998, Specification for steel fabric for the reinforcement of concrete.

BS 6744:1986, Specification for austenitic stainless steel bars for the reinforcement of concrete.

BS 8110-1:1997, Structural use of concrete — Code of practice for design and construction.

3 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

3.1

bar

steel product of any cross-section conforming to BS 4449 or BS 6744 $\,$

3.2

wire

steel product of any cross-section conforming to BS 4482

3.3

nominal size

diameter of a circle, d, with an area equal to the effective cross-sectional area of the bar or wire, sometimes referred to as size

3.4

bar (or fabric) mark

identifying mark which cross-refers individual line entries on the schedule to the detailed drawing NOTE The bar (or fabric) mark also appears on the delivery label.

3.5

shape code

two-digit coded designation of the reinforcement shape

NOTE See Table 1.

3.6

pitch

centre-to-centre spacing of bars or wires in a sheet of fabric

NOTE Pitch and other dimensions used to define fabric are shown in Figure 1.

3.7

mesh

rectangle defined by the pitch of the longitudinal wires and the pitch of the cross wires in a sheet of fabric

3.8

fabric

factory-made product consisting of welded bars or wires conforming to BS 4483

3.9

standard fabric

fabric reinforcement where the wire and mesh arrangement can be defined by an identifiable fabric reference, see Table 2 $\,$

3.10

purpose made fabric

fabric reinforcement not included in Table 2, see Figure C.1

3.11

fabric reference

alpha numeric designation denoting fabric in accordance with Table 2

3.12

bar schedule

a list of reinforcement types, dimensions, quantities, and bar mark numbers cross-referring to the detailed drawing, see Figure 2. The preparation of the list is known as scheduling

3.13

fabric schedule

a list of fabric types, dimensions, quantities, and fabric mark numbers cross-referring to the detailed drawing, see Figure 3



4 Notation

The type and grade of steel reinforcement shall be designated as follows:

- R: grade 250 conforming to BS 4449;

- F: grade 460 deformed type 1 conforming to BS 4482 (for fabric conforming to BS 4483);

— D: grade 460 deformed type 2 conforming to BS 4482 or grade 460A conforming to BS 4449 (for fabric conforming to BS 4483);

— W: grade 460 plain round conforming to BS 4482 (for fabric conforming to BS 4483);

- T: grade 460A or grade 460B deformed

type 2 conforming to BS 4449;

- B: grade 460B deformed type 2 conforming to BS 4449 (for bar or fabric conforming to BS 4483);

— S: a specified grade and type of stainless steel conforming to BS 6744;

— X: reinforcement of a type not included in the above list having material properties that are defined in the design or contract specification.

5 Form of schedule

5.1 For bar reinforcement, a bar schedule in accordance with Figure 2 shall be prepared.

For cutting and bending purposes, schedules shall be provided on separate sheets of paper of size not significantly larger than A4 in accordance with BS 4000 and not as part of the detailed reinforcement drawings.

For fabric reinforcement a fabric schedule shall be prepared in accordance with Figure 3.

When used for purpose made fabric, the schedule shall include cross-reference to any relevant dimensional drawings.

5.2 For schedules that are not produced on a computer, the minimum width of the columns in the bar and fabric schedules shall be as shown in Figures 2 and 3.

For computer produced schedules, the column widths and the size of the schedule may vary from those shown in Figures 2 and 3, but the sequence of columns shall be maintained. The schedule shall not be significantly larger than size A4 in accordance with BS 4000.

5.3 The schedule reference shall be included at the top right-hand corner of the schedule form and shall be consecutively numbered. The first three characters of the schedule reference shall be the last three characters of the relevant detailed drawing number, starting at, for example, drawing number 001. The schedule number shall occupy the fourth and fifth spaces, starting at 01 and not exceeding 99 for any one drawing. The sixth space shall be used for schedule revision letters.

Terms such as "sheet number" or "page number" shall not be used on schedules. The styles "1 (of 6)" and "6 (and last)" may be used on manually prepared schedules but the words in parentheses shall not form part of the schedule reference. EXAMPLE

	Dra	wing	ş	Sche	edule	Revision
Bar schedule reference	0	4	6	0	3	Α

Where a schedule revision is necessary, the line or lines affected shall be indicated by a suitable reference on the schedule, e.g. "A" at the right-hand side of the schedule in Figure 2.

NOTE If a job contains more than 999 drawings it can be broken down into groups by the use of a job number, e.g. job number 1234A foundations and job number 1234B ground floor.

5.4 The bar or fabric schedule shall include the statement "this schedule complies with BS 8666:2000".

5.5 The bar (or fabric) mark shall comprise simple and consecutive numbers or letters with a maximum of six characters. Where special end preparation is required (e.g. for couplers), the bar mark shall commence with "E". The bar (or fabric) mark shall be used for labelling purposes in accordance with clause **6**.

5.6 In the "type and size" column of the schedule, the notations specified in clause **4** for the type and grade of reinforcement shall be given and this shall be followed by the nominal size in millimetres.

6 Form of bar or fabric label

The schedule reference and the mark given in the "bar (or fabric) mark" column of the schedule shall be put on the labels attached to the reinforcement. EXAMPLE

Bar schedule refer	ence	C) 4	Ł	6	0	3	A	r
Bar mark				Γ				7	1

The labels shall be durable and securely tied to the reinforcement. Apart from any information required by the supplier for his own identification and internal system, no other information shall appear on the label.





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	_	50		Member	Bar mark	Type and size	No. of mbrs	No.of bars in each	Total no.	Length of each bar † mm	Shape code	A* mm	B* mm	C* mm	D* mm	<i>EIR*</i> mm	Rev letter	
		2	\vdash	Column 18	7	T25	1	5	5	5625	26	4000	600		-80-		A	
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Table 1 — Standard shapes, their method of measurement and calculation of length





Table 1 — Standard shapes, their method of measurement and calculation of length (continued)



Shape code	Shape	Total length of bar (L) measured along centre line
51		$2(A + B + C) - 2\frac{1}{2}r - 5d$ <i>C</i> and <i>D</i> shall be equal and not more than <i>A</i> or <i>B</i> nor less than <i>A</i> in Table 3
67	A R R	A See clause 10
77	$\mathcal{L} = \text{no. of turns}$	$C\pi(A - d)$ Where <i>B</i> is greater than <i>A</i> /5 this equation no longer applies and <i>L</i> shall be calculated
99	All shapes where standard shapes cannot be used. No other shape code number, form of designation or abbreviation shall be used in scheduling. With the exception of rectangular links, 5 bends or more are undesirable and may be impractical within permitted tolerances but they shall be drawn out in full and coded 99. A dimensioned sketch shall be drawn over the dimension columns A to E. Every dimension shall be specified and the dimension that is to allow for permissible deviations shall be indicated in parenthesis, otherwise the fabricator is free to choose which dimension shall allow for the tolerance	To be calculated
For all in Table The din differen shape c The len	shapes other than 12, 13, 33 and 67 the radius of bend e 3. nensions in parentheses are the free dimensions. If a at dimension is to allow for the possible deviations, t code 99 and the free dimension shall be indicated in p gth of straight between two bends shall be at least 4	I shall be not less than the minimum specified shape given in this table is required but a he shape shall be drawn out and given the parentheses. d, see Figure 6.
NOTE 1 should be measured code 99 w	The length equations for shapes 15, 25, 26, and 46 are approximate e calculated more accurately allowing for the difference between t d along the central axis of the bar or wire. When the bending angle with a fully dimensioned sketch.	e and where the bend angle is greater than 45° the length he specified overall dimensions and the true length es approach 90°, it is preferable to specify shape
NOTE 2 of a conti	For shapes with straight and semicircular lengths (e.g. shape cod inuous curve is 200 mm, and for larger radii the curve may be pro-	es 13 and 33) the largest practical radius for the production duced by a series of straight sections.

Table 1 — Standard shapes, their method of measurement and calculation of length (continued)



Fabric reference	Longitudinal wires		es		Cross wires		
	Nominal wire size	Pitch	Area	Nominal wire size	Pitch	Area	Mass
	mm	mm	mm²/m	mm	mm	mm²/m	kg/m ²
Square mesh:							
A393	10	200	393	10	200	393	6.16
A252	8	200	252	8	200	252	3.95
A193	7	200	193	7	200	193	3.02
A142	6	200	142	6	200	142	2.22
A98	5	200	98	5	200	98	1.54
Structural mesh:							
B1131	12	100	1 131	8	200	252	10.9
B785	10	100	785	8	200	252	8.14
B503	8	100	503	8	200	252	5.93
B385	7	100	385	7	200	193	4.53
B283	6	100	283	7	200	193	3.73
B196	5	100	196	7	200	193	3.05
Long mesh:							
C785	10	100	785	6	400	70.8	6.72
C636	9	100	636	6	400	70.8	5.55
C503	8	100	503	5	400	49	4.34
C385	7	100	385	5	400	49	3.41
C283	6	100	283	5	400	49	2.61
Wrapping mesh:							
D98	5	200	98	5	200	98	1.54
D49	2.5	100	49	2.5	100	49	0.77

Tolerances shall be in accordance with Table 4.

For standard fabric the type of wire shall be designated as a suffix to the fabric reference as illustrated in the example in Figure 3.

Standard lengths and widths shall be 4.8 m and 2.4 m respectively, giving a sheet area of 11.52 m^2 .



7 Dimensions

7.1 The dimensions given on the schedule shall be measured as shown in Table 1. For deformed reinforcement, the outside surface shall be the extremities of the ribs. The total length dimension specified on the schedule for each bar or for wires in each sheet or fabric shall be rounded up to a multiple of 25 mm.

7.2 The bending dimensions of reinforcement shall be in accordance with Table 3.

7.3 The dimensions for the scheduling of reinforcement bounded by two concrete faces shall allow for the permissible deviations.

7.4 The dimensions for the scheduling of reinforcement requiring special end preparation shall take into account the system to be used.

7.5 To facilitate transportation, each bent bar shall be contained within an imaginary rectangle, the shorter side of which shall be not longer than $2\,750$ mm.

NOTE Normally the total length of the bar should not exceed 12 m. Longer lengths may be obtained by agreement with the supplier. In such cases, the upper limit is determined by handling and transportation and should not exceed 18 m.

7.6 The values for minimum radii and end dimension (r and A respectively as specified in Table 3) shall apply to all shape codes. For shape codes 12 and 67, the actual radius used shall not be less than the minimum radius r.

8 Scheduling

8.1 Each bar or sheet of fabric shall be scheduled completely and without reference to earlier schedules. Such descriptions as "see schedule 12" or "as above" shall not be used.

8.2 Shape codes shall be in accordance with Table 1.

8.3 For shape codes 11 to 77, if the free variable dimension (the dimension shown in parentheses in Table 1) does not conform to the requirements specified, then the shape shall be drawn and given the shape code 99.

8.4 No dimension specified in Table 1 shall be given a zero value, as this changes the basic shape.

8.5 Shapes with shape code 99 shall be drawn on the schedule over columns A to E using two parallel lines to indicate the reinforcement thickness. The origin of projected surface intersection lines shall be used for dimensions. The methods of measurement shall be in accordance with those shown in Table 1. The total length shall be given, and one bending dimension shall be indicated in parentheses as the free dimension to allow for the permissible deviations. The tolerances given in Table 4 shall also apply to shape code 99.

8.6 If the angle between two portions of the shape meeting at a bend is not a right angle, it shall be defined by co-ordinates and not by degrees of arc.

8.7 Any shape including an acute angle shall be classified as a 99 shape code and drawn out in full with construction lines.

NOTE $\;$ The shape codes given in Table 1 do not include an acute angle.

When dimensioning an acute angle the tangential lines shown in Figure 4 shall be used.



Figure 4 — Dimensioning of an acute angle

8.8 Bars bent in two planes shall be sketched isometrically or shown in two elevations, using first angle projection. The words "bent in two planes" or "isometric view" shall appear on the schedule.

8.9 The overall offset dimension of a crank shall be not less than twice the size of the bar or wire. The angled length (see Figure 5) shall be not less than:

- 10d for grade 250 and grade 460 in sizes less than 20 mm; or

-13d for grade 460 in sizes of 20 mm or over.

8.10 For all shapes with two or more bends in the same or opposite directions (whether in the same plane or not), the overall dimension given on the schedule shall always include a minimum straight of 4d between the curved portion of the bends, as shown in Figure 6. The value of x in Figure 6 shall be not less than the following:

a) 10d for grade 250 material and grade 460 not

- exceeding nominal size 16 mm diameter;
- b) 13d for grade 460 material in nominal sizes of 20 mm and over.

NOTE The minimum values of x are expressed in terms of the nominal size of the reinforcement. In practice, rolling and bending tolerances, and the fact that the circumscribing diameter of deformed reinforcement may be up to 10 % greater than the nominal size, should be considered.

8.11 The type and grade of wire shall be designated in the type and size column of the schedule as a suffix to the fabric reference using the letter specified in clause **4**.



11

										Dimensions	in millimetres
					(B)		5d min.				
	Type an	d grade R			Type and gra	ide T, B and S	- 1		Type and gra	de F, D and W	τ
Nominal size of bar	Minimum radius for scheduling	Minimum diameter of bending former	Minimum end dimension	Nominal size of bar	Minimum radius for scheduling	Minimum diameter of bending former	Minimum end dimension	Nominal size of wire	Minimum radius for scheduling	Minimum diameter of bending former	Minimum end dimension
D	r	М	A	d	r	М	A	d	r	М	A
—		_		_		_	—	5	10	20	110
6	12	24	110	6	12	24	110	6	12	24	110
-	_	_	—	—	—			7	14	28	115
8	16	32	115	8	16	32	115	8	16	32	115
-	_	_	—	—	_	_		9	18	36	120
10	20	40	120	10	20	40	120	10	20	40	120
12	24	48	125	12	24	48	125	12	24	48	125
16	32	64	130	16	32	64	130	—	—	—	—
20	40	80	160	20	70	140	190	—	—	—	—
25	50	100	200	25	87	175	240			-	-
32	64	128	260	32	112	224	305			-	-
40	80	160	320	40	140	280	380	—	—	—	<u> </u>
NOTE 1 Due	e to "spring back	" the actual radi	ius of bend will	be slightly great	ter than half the	diameter of for	mer.				

Table 3 — Minimum scheduling radius, former diameter and bend allowances

ng lightly gi

NOTE 2 For bends (bobs) the minimum straight length beyond the end of the curved portion is 5d, or 10d for links.





9 Tolerances on cutting and bending dimensions

The tolerances for cutting and/or bending dimensions shall be in accordance with Table 4 and shall be taken into account when completing the schedule. The end anchorage or the dimension in parentheses in the shape codes specified in Table 1 shall be used to allow for any permissible deviations resulting from cutting and bending.

10 Radius of bending

Reinforcement to be formed to a radius exceeding that specified in Table 5 shall be supplied straight.

NOTE 1 The required curvature may be obtained during placing. NOTE 2 For shapes with straight and curved lengths (e.g. shape code 13 and 33) the largest practical radius for the production of a continuous curve is 200 mm, and for larger radii the curve may be produced by a series of short straight sections.

Table 4 — Tolerances					
Cutting and bending processes	Tolerance				
	mm				
Cutting of straight lengths (including reinforcement for subsequent bending)	+25, -25				
Bending:					
$\leq 1000 \text{ mm}$	+5, -5				
>1 000 mm to ≤ 2000 mm	+5, -10				
>2 000 mm	+5, -25				
Length of wires in fabric	$\pm 25 \text{ or } 0.5 \%$ of the length				
	(whichever is greater)				

Table 5 — Maximum limit for which a preformed radius is required

Bar size	Wire size	Radius
mm	mm	m
—	5	2.4
6	6	2.5
—	7	2.6
8	8	2.75
—	9	3.0
10	10	3.5
12	11	4.25
16	12	7.5
20	—	14.0
25	—	30.0
32	—	43.0
40		58.0

11 Bending of fabric reinforcement

NOTE The schedule for fabric reinforcement (see Figure 3) includes a column headed "bending instruction" for the additional information that is required when specifying bent fabric. The three-dimensional characteristic of fabric reinforcement can give rise to ambiguities that are best overcome by means of a simple sketch in the "bending instruction" column.

The sketch in the bending instruction column shall indicate the following:



b) The direction of the longitudinal wires of the sheet to ensure bending about the correct axis



Sheet with unequal overhangs

c) The correct orientation of an asymmetric sheet to ensure the correct setting out of bending dimensions

For all bent fabric reinforcement, the bending dimensions shall avoid welded transverse wires occurring within four diameters of the start of a bend, see Figure 7.





12 Fabrication and routine inspection

12.1 Fabrication

12.1.1 Cutting to length shall be carried out using purpose-made shearing equipment. The tolerances specified in Table 4 shall apply to each length.

12.1.2 Bending shall be carried out on power bending machines. Plain smooth surfaces or rolls that do not offer resistance to longitudinal movement to the bars or fabric being bent shall be provided to ensure adequate support. The minimum diameter of the former used in bending for the appropriate type and size of reinforcement shall be in accordance with Table 3. **12.1.3** Bending machine operatives are trained in the skills necessary to produce cut and bent products of consistent quality within the permissible size deviations. A formal operative approval and testing system shall be implemented and operatives shall have been certified competent.

12.2 Routine inspection

Routine inspection shall be carried out in accordance with annex A.



Annex A (normative)

Routine inspection

A.1 The fabricator shall carry out inspections of the following parameters of the schedules and of specimens of cut lengths and bent items at a frequency in accordance with **A.2**. The results of the inspections shall be recorded.

a) Cut lengths

1) The bar (or fabric) mark (see 5.5).

2) The type and size of the specimens and the type and size given on the schedule (see **5.6**).

3) The length of the specimens shall meet the specified requirements as stated on the schedule (see clause 9).

b) Bent items

1) The bar (or fabric) mark (see **5.5**).

2) The type and size of the specimens and the

type and size specified on the schedule (see 5.6).3) The shape of the specimens and the shape code

specified on the schedule (see 8.2 to 8.7).

4) The diameter of former used shall be checked and recorded.

5) The length of the specimens shall meet the specified requirements as stated on the schedule (see clause **9**).

A.2 Daily inspections shall be carried out and inspection records shall be retained for 12 months. Specimens shall be selected at random from a representative range of output items at the frequency specified in Table A.1.

Production records shall be maintained.

If any of the specimens that are inspected are found to have parameters that do not conform to the appropriate requirements all the other bars or fabrics with the same mark shall be inspected and they shall all conform to the appropriate requirements.

Table A	.1 —	Frequen	cv of	inspection
Labre 1	ч. т. —	ricquen		mopection

Average weekly output of the fabrication unit over the preceding twelve week period	Number of specimens to be taken per day
Less than 75	At least 20
75 to 150	At least 30
Greater than 150	At least 40



Annex B (informative) Third party certification and batch testing

B.1 Fabricated material covered by a third party product certification scheme

B.1.1 Consistency of production

For the purposes of determining the consistency of production, the long-term quality level should be assessed at quarterly intervals. No conclusions regarding compliance with this British Standard should be made on the basis of this assessment.

B.1.2 Determination of the long term quality level

The third party certification authority should assess the long-term consistency of production (fabrication) by examining the fabricator's inspection records. No more than 5% of the items inspected should have failed to conform to the specified requirements.

B.2 Batch testing

B.2.1 General

Where material is subjected to batch testing, it is recommended that the following sampling, inspection and testing should be undertaken.

B.2.2 Extent of sampling and inspection/testing

For the purposes of inspection/testing, the delivery should be subdivided into tests units with a maximum mass of 5 t. Specimens should be selected at random from a representative range of output items at the following frequency.

Specimens should be taken from each test unit as follows:

a) 15 specimens (if appropriate 60 specimens) of cut lengths;

b) 15 specimens (if appropriate 60 specimens) of bent items.

B.2.3 Inspection by attributes

The following parameters of the schedule and of the specimens taken in accordance with **B.2.2** should be inspected. The results of the inspections should be recorded.

a) Cut lengths

1) The bar (or fabric) mark (see **5.5**).

2) The type and size of the specimens and the type and size specified on the schedule (see 5.6).3) The length of the specimens should meet the specified requirements as stated on the schedule (see clause 9).

b) Bent items

1) The bar (or fabric) mark (see 5.5).

2) The type and size of the specimens and the size specified on the schedule (see **5.6**).

3) The shape of the specimens and the shape code specified on the schedule (see **8.2** to **8.7**).

4) The diameter of former used should be checked and recorded.

5) The length of the specimens should meet the specified requirements as stated on the schedule (see clause **9**).

B.2.4 Evaluation of results

All the parameters inspected in accordance with **B.2.3** for all the 15 specimens should conform to the appropriate requirements.

If a maximum of two of the 15 results do not conform, a further 45 specimens should be assessed so that a total of 60 specimens is assessed. The test unit should be deemed to conform to this standard if no more than two of the 60 results do not conform to the appropriate requirements.

B.2.5 Inspection report

An inspection report should be produced containing the following data:

a) the name of the fabricator;

b) location of the fabricator's works, yard or site;

c) the cast number(s) of the reinforcing steels used for each bar or fabric mark;

d) the name and address of the manufacturer of the reinforcing steels used;

e) the date of the inspection;

f) the mass of the test unit;

g) the individual results as specified in **B.2.3**.



Annex C (normative)



Figure C.1 — Purpose made fabric example

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