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Construction drawings — Simplified representation of concrete reinforcement

Dessins de construction — Représentation simplifiée des armatures de béton

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 3766 was prepared by Technical Committee ISO/TC 10, *Technical product documentation*, Subcommittee SC 8, *Construction documentation*.

This third edition cancels and replaces the second edition (ISO 3766:1995) and ISO 4066:1994, which have been technically revised.

Construction drawings — Simplified representation of concrete reinforcement

1 Scope

This International Standard specifies the simplified representation and the characterization of reinforcement in reinforced and in prestressed concrete for use in construction drawings. It also establishes a system for the scheduling of reinforced bars, comprising

— a method for specifying dimensions,

— a coding system for bar shapes,

— a schedule of preferred shapes, and

— a shape schedule and bending schedule.

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.

ISO 128-23:1999, *Technical drawings — General principles of presentation — Part 23: Lines on construction drawings*

ISO 10209-4:1999, *Technical product documentation — Vocabulary — Part 4: Terms relating to construction documentation*

3 Requirements to reinforcement construction drawings

The construction parts shall be provided with the main dimensions, the concrete reinforcement shall be drawn and all parts shall be represented unambiguously and clearly in scaled plans, elevations and sections. The representations shall correspond with the indications in the structural calculations and should, where applicable, contain all dimensions required for the construction of the members and the verification of the calculations.

Drawings used for off-site casting and factory production are excepted from this provision.

Reference shall be referred to accessory drawings. For drawings modified later, all concerned drawings shall be modified as well.

The following characterizations (general information and placement information) of the reinforcement bars shall be given on the drawing:

— required concrete strength class, the exposure class and further requirements to the concrete given in reference standards;

— type of reinforcing steel and prestressed steel given in reference standards;

— bar mark, number, diameter, shape and position of the reinforcement bars; distance between the bars and overlap length at joints; arrangement, dimensions and development of welding points by specification of the joining metal, jarring plates, position of the concreting gap;

— type of the prestressing system; number, type and position of the tendons; number, type and position of the tendon anchoring and tendon coupling; bar mark, number, diameter, shape and position of the accessory not prestressed concrete reinforcement; type and diameter of the encasing tubes; specification of the intrusion grout;

— measures for securing the position of the concrete reinforcement and the tendons (e.g. kind and arrangement of the bar chairs, as well as arrangement, dimensions and shape for the support of the upper concrete reinforcement layer and the tendons);

— the layer dimension c_V which derives from the nominal dimension c_{nom} of the concrete cover, as well as the allowance in design for tolerance Δc of the concrete cover;

— the joint development;

— special measures for quality assurance, if required.

The following information on bending the reinforcement bars shall be given on the drawing or on separate documents such as a bar schedule:

— if the shape coding system according to 6.3 is applied, bending shapes of the reinforcement bars shall refer unambiguously to the shape numbers, hence the graphical representation may be unscaled;

— single length, sectional lengths and, if applicable, bending angles of the reinforcement bars shall be indicated (for typifying bending shapes, Table 5 shall be taken into account, and in every case the reference standard mandrel or radii shall be represented on the drawing);

— the mandrel diameters or radii.

Manufacturing tolerances shall be taken into account in dimensioning the reinforcement components, in order to reach the desired concrete cover in the ready-made structure.

4 Placement information and representation

4.1 Reinforcement without prestressing

The representation and drawing conventions of concrete reinforcements without prestressing shall be in accordance with Table 1.

Table 1 — Representation and drawing conventions of concrete reinforcements without prestressing

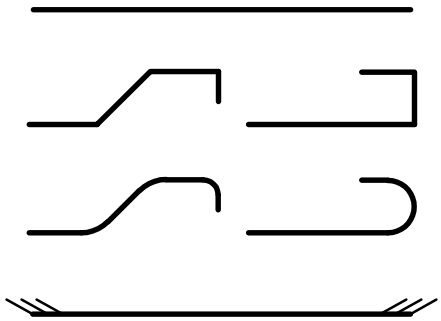
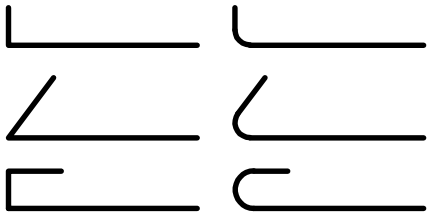
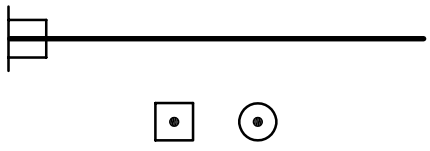
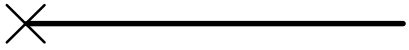
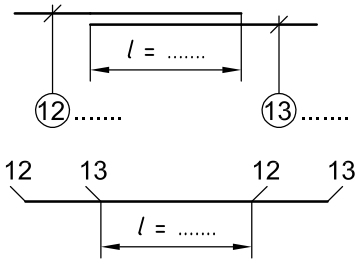
No.	Description	Representation
1	**Views** a) General representation of bar by a continuous extra-wide line b) Bent reinforcement bar 1) representation as a polygonal continuous line or 2) representation as a continuous line made up of straight lines and arcs c) Bundle of bars drawn using a single line, with end markings indicating number of bars in bundle EXAMPLE Bundle of three identical bars.	
2	**Section of bar** a) section of single reinforcement bar b) bundle of two reinforcement bars c) bundle of three reinforcement bars	
3	**Bar with hook anchoring** a) elevation of bar terminating in a 90° bend b) elevation of bar terminating in a bend between 90° and 180° c) elevation of bar terminating in a 180° bend	
4	Straight bars lying in a row or a plane to indicate the ends of the bars, showing corresponding bar marks using narrow line	
5	**End anchorage with plates** a) elevation or plan view b) section or end view	
6	Bar bent at a right angle away from viewer	
7	Bar bent at a right angle towards viewer	
8	**Overlapping stack of reinforcement bars** a) *without* marking bar ends by a slash and bar marks b) *with* marking bar ends by a slash and bar marks	

Table 1 (*continued*)

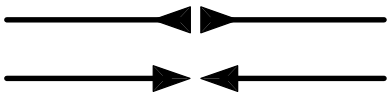
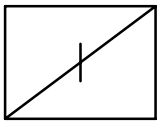
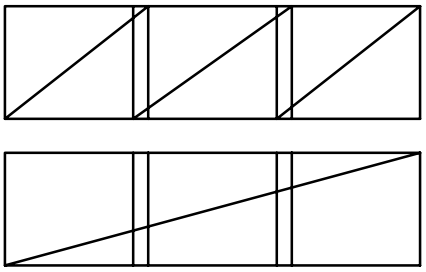
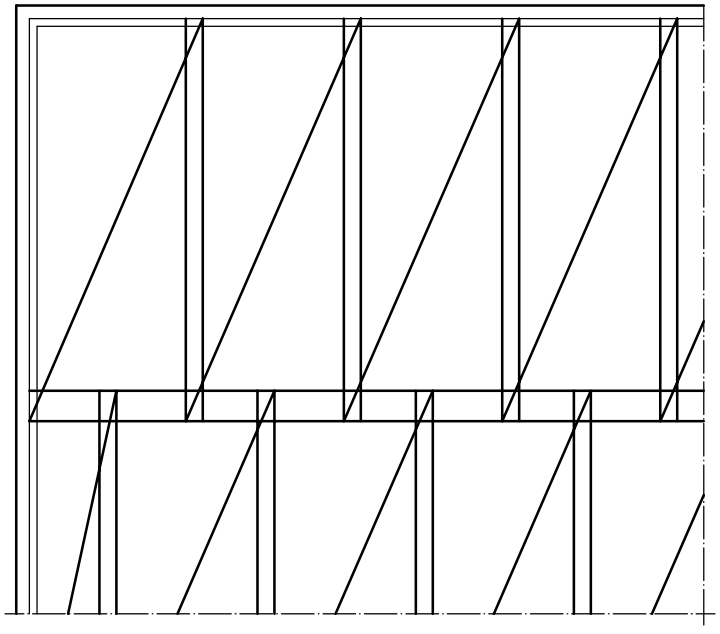
No.	Description	Representation
9	**Bars joined by mechanical couplers — general representation** a) tension coupler b) compression coupler	
10	Welded fabric, top view (If required, an oblique stroke crossing the diagonal line may be used to indicate the direction of the main reinforcement, as shown here.)	
11	**Welded fabric, identical sheets in a row** a) with representation of single sheets b) condensed representation Overlapping length shall be given on the drawing	
12	**Top view of layer containing identical sheets** a) with representation of single sheets	

Table 1 (*continued*)

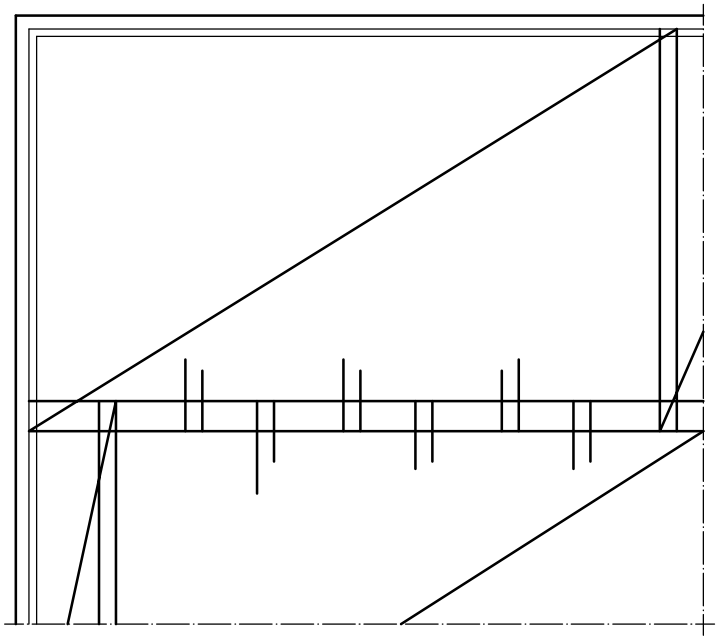
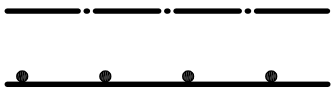
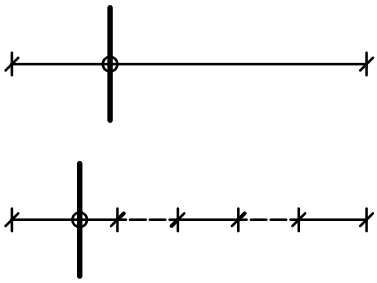
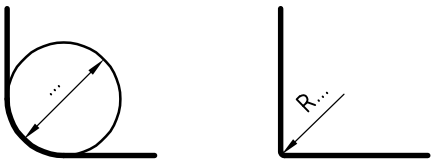
No.	Description	Representation
	b) condensed representation with indication of overlapping Overlapping length shall be given on the drawing	
13	**Welded fabric, section** a) simplified representation by a long dashed dotted extra-wide line b) conventional representation	
14	**Set of identical bars** a) each set of identical bars indicated by one scaled-drawn reinforcement bar and a line terminated by oblique lines to mark extreme bars (circle connects "set line" with correct bar) b) identical bars placed in groups.	
15	Bars with a specification of the diameter or radius of mandrel, if differing from the minimum diameter or radius of the mandrel NOTE A radius is indicated by the additional letter R.	

Table 1 (*continued*)

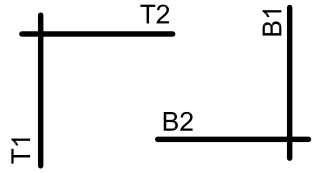
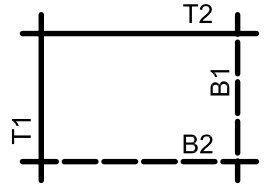
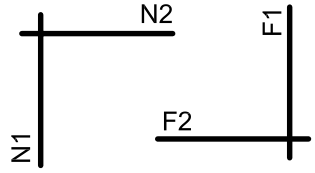
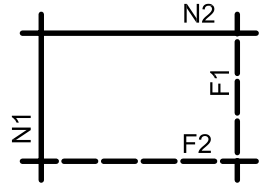
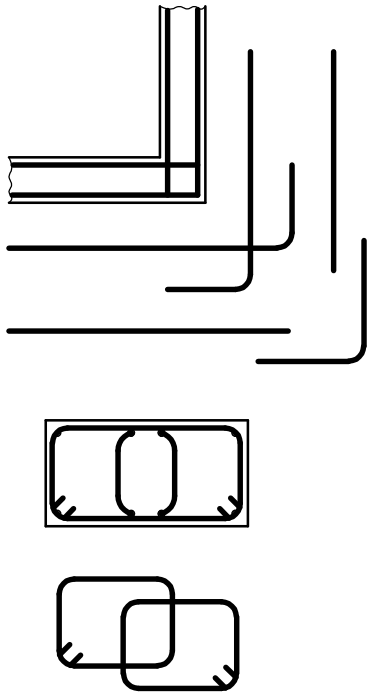
No.	Description	Representation
16	**Location of layers of reinforcement on plan drawings** where B is the bottom layer; T is the top layer; 1 is the layer nearest the concrete face; 2 is the second layer from the concrete face. NOTE B and T are used for the English language; equivalent letters for other languages are possible. a) bottom and top layers shown on separate plans b) bottom and top layers shown on the same plan (The bottom layer shall be indicated by a dashed extra-wide line.)	 
17	**Location of layers of reinforcement on elevation drawings** where N is the near face F is the far face 1 is the layer nearest the concrete face 2 is the second layer from the concrete face NOTE N and F are used for the English language; equivalent letters for other languages are possible. a) near-face and far-face reinforcement shown on separate elevations b) near-face and far-face reinforcement shown on the same elevation (The far face layer shall be indicated by a dashed extra-wide line.)	 

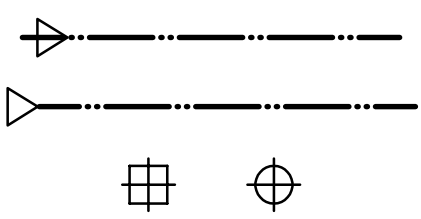
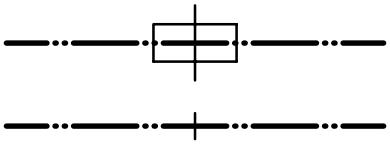
Table 1 (*continued*)

No.	Description	Representation
18	If the arrangement of the reinforcement is not represented unambiguously by the section, an additional detailed representation of the reinforcement may be given outside of the section. NOTE For the representation of the bends, see No. 1.	

4.2 Prestressed reinforcement

The general representation of prestressed concrete reinforcement shall be in accordance with Table 2.

Table 2 — General representation and drawing conventions of prestressed concrete reinforcements

No.	Description	Representation
1	Prestressing bar or cable (tendon) by long dashed double-dotted extra-wide line	
2	Section of post-tensioned reinforcement in pipes or conduits	
3	Section of prestressed reinforcement with immediate bond	
4	**Anchorage** a) anchorage at tensioning end b) fixed anchorage c) end view of anchorage	
5	**Coupling** a) movable splice b) fixed splice	

5 Marking

Items of information concerning reinforcing bars shall be written on the drawing in the longitudinal direction of the bars or along reference lines indicating the bars in question.

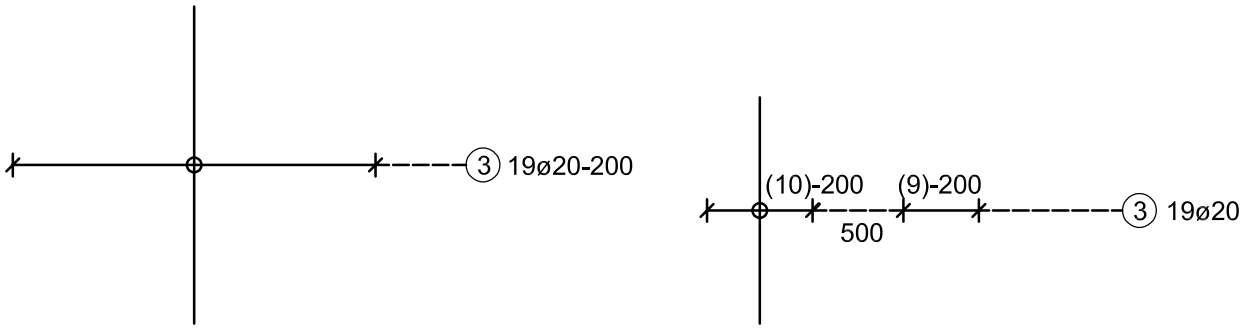
Items of information for welded fabric shall be written along the diagonal line. The sheet mark shall be indicated together with the number of sheets.

For every bar mark, details concerning reinforcement bars shall be given on the drawing in accordance with Table 3.

Table 3

Indication	Example
Alphanumerical bar mark (surrounded by, for example, a circle or an oval)	③[a]
Number of bars	19
Bar diameter, in millimetres	Ø20
Spacing, in millimetres	200
Position in the component or construction part (optional)	T
Shape code of reinforcement bar (optional)	13

[a] Indication for the example: ③ 19 Ø20—200—T—13 or ③ 19 Ø20—200. See Figure 1.



NOTE The values in parentheses indicate the number of bars in the considered segment.

Figure 1 — Examples of bar markings (without options)

6 Bending information for unprestressed reinforcement bars

6.1 General

This clause specifies a system for the scheduling of reinforcing bars, and comprises

— the method of indicating dimensions,

— a coding system for bar shapes for optional use with a list of preferred bar shapes, and

— information for the bar schedule (see Clause 7).

These specifications apply to all types of steel bars for the reinforcement of concrete. They do not apply to welded fabrics and prestressed steel reinforcement.

6.2 Indication of bar shapes

The bending dimensions shall be indicated as shown in Figures 2 to 8. None of the dimensions stated may be zero. The diameters and radii are inside dimensions, all other dimensions are outside dimensions. The mandrel radius or diameter is usually the smallest permissible diameter or radius according to reference standard regulations for the size of bar scheduled. These diameters or radii shall be stated on the drawing and on the bar schedule, if separate. When, in special cases, other diameters or radii are specified by reference standards, this shall be stated in the relevant documents of the bar schedule.

When the coding system of 6.3 is applied to an arc, the default case is assumed, with the exception of Shape codes 12, 13, 33, 67 and 77. In the case of the specification of bending angles, Shape code 99 shall be applied.

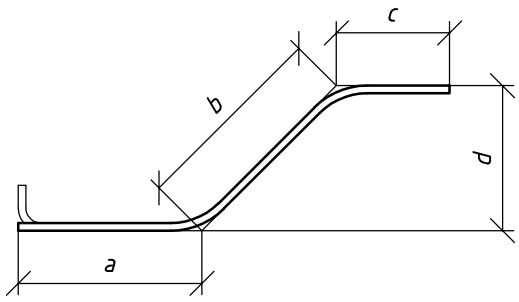


Figure 2 — Bending dimensions — Shape code 26

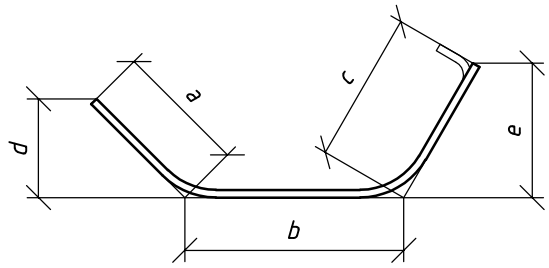


Figure 3 — Bending dimensions — Shape code 25

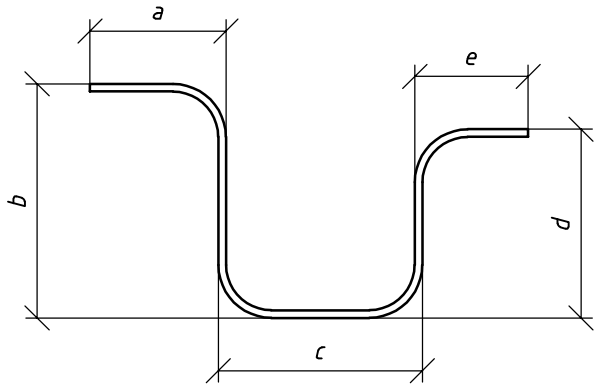


Figure 4 — Bending dimensions — Shape code 44

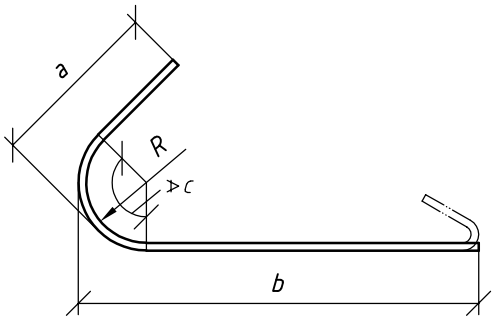


Figure 5 — Bending dimensions — Shape code 99 (non-standard example)

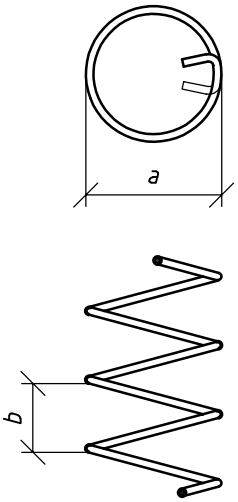
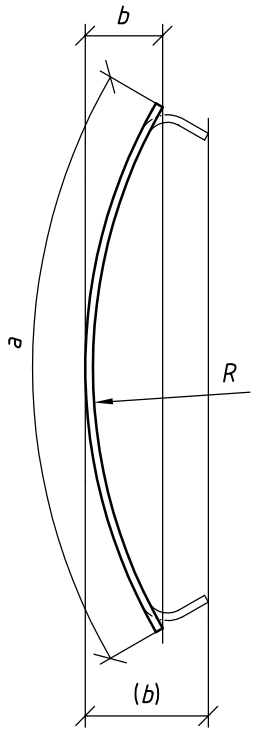


Figure 6 — Bending dimensions — Shape code 77



NOTE Rise of the arc b is optional.

Figure 7 — Bending dimensions — Shape code 67

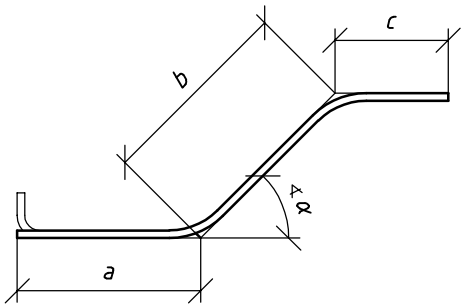


Figure 8 — Bending dimensions — Shape code 99 (non-standard example)

6.3 Coding system (optional)

The shape code of the bar shape comprises two characters. The first indicates the number of arcs or the type of bend or bends, the second character indicates the bending direction of the bend or bends (see Table 4).

Table 4 — Shape code composition

First character			Second character	
0	No bends (optional)		0	Straight bars (optional)
1	1 bend		1	90° bend(s) of standard radius, all bent towards the same direction
2	2 bends		2	90° bend(s) of non-standard radius, all bent towards the same direction
3	3 bends		3	180° bend(s) of non-standard radius, all bent towards the same direction
4	4 bends		4	90° bend(s) of standard radius, not all bent towards the same direction
5	5 bends		5	Bends $< 90°$ of standard radius, all bent towards the same direction
6	Arcs of circles		6	Bends $< 90°$ of standard radius, not all bent towards the same direction
7	Complete helices		7	Arcs or helices
9[a]	Can only be combined with character 9		9[a]	Can only be combined with character 9
NOTE 1 This table explains the logic behind the numbering of the shapes in Table 5.				
NOTE 2 The number of bends does not include bends for hooks as stated below.				
[a] 99 Special non-standard shapes defined by a sketch. Shape code 99 shall be used for all non-standard shapes. Bending radii for shape code 99 shall be assumed to be standard, unless otherwise specified.				

For a specific shape code (and without changing or extending it), parameters for end hooks may be specified. These are defined by two numbers, the first indicating the end hook at stretch a. The sign of these numbers is positive in the case of an identical bending sense of the hook with the nearest bending of the bar. The following numbers are possible:

0 = no end hook;

1 = end hook 90°;

2 = end hook between 90° and 180°, according to reference standards;

3 = end hook 180°.

The lengths h and diameters or radii of the end hooks are given in reference standards and shall be indicated in the bar schedules.

Preferred shapes for bars are given in Table 5. The dimension characters also relate to the corresponding columns of the shape schedule (see 7.2).

NOTE Run-out dimensions are not stated in Table 5.

Table 5 — Bar shapes

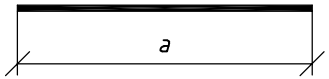
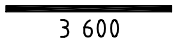
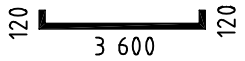
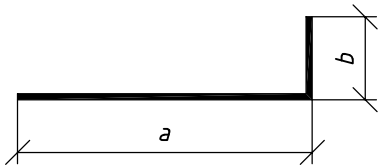
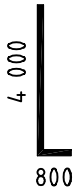
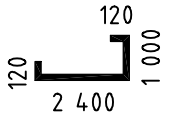
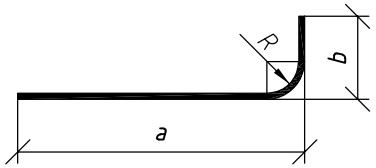
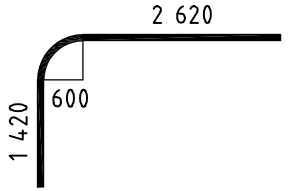
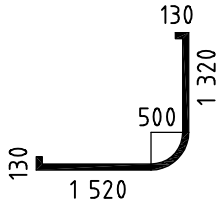
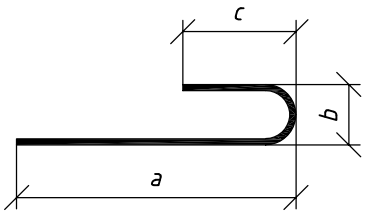
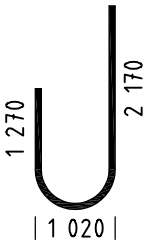
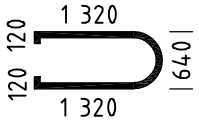
Shape code	Bar shape	Example without end hook	Example with end hook
00			
	00 | 0 | 0 | *a* | *h*	00 | 0 | 0 | 3 600	00 | 1 | 1 | 3 600 | 120
11			
	11 | 0 | 0 | *a* | *b* | *h*	11 | 0 | 0 | 4 000 | 800	11 | 1 | 1 | 2 400 | 1 000 | 120
12			
	12 | 0 | 0 | *a* | *b* | *R* | *h*	12 | 0 | 0 | 2 620 | 1 420 | 600	12 | 1 | 1 | 1 520 | 1 320 | 500 | 130
13			
	13 | 0 | 0 | *a* | *b* | *c* | *h*	13 | 0 | 0 | 2 170 | 1 020 | 1 270	13 | 1 | 1 | 1 320 | 640 | 1 320 | 120

Table 5 (*continued*)

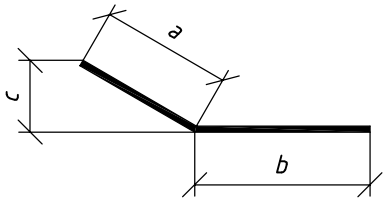
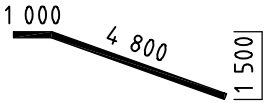
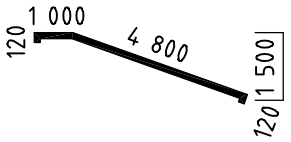
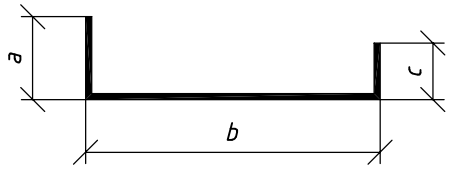
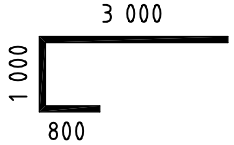
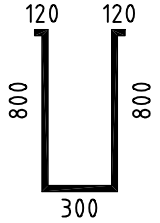
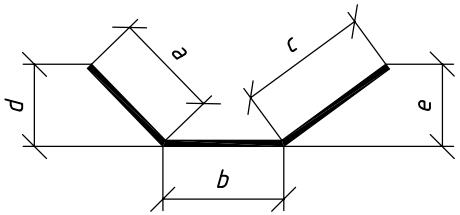
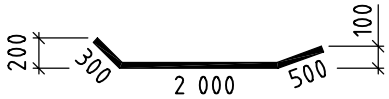
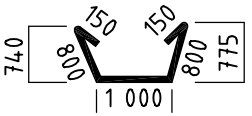
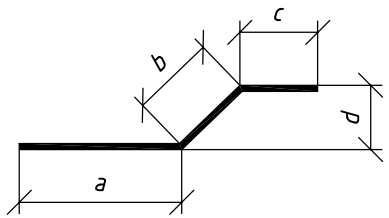
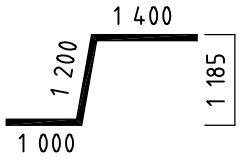
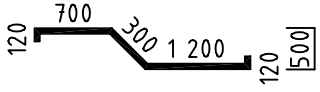
Shape code	Bar shape	Example without end hook	Example with end hook
15			
	15 | 0 | 0 | *a* | *b* | *c* | *h*	15 | 0 | 0 | 1 000 | 4 800 | 1 500	15 | 1 | 1 | 1 000 | 4 800 | 1 500 | 120
21			
	21 | 0 | 0 | *a* | *b* | *c* | *h*	21 | 0 | 0 | 3 000 | 1 000 | 800	21 | –1 | –1 | 800 | 300 | 800 | 120
25			
	25 | 0 | 0 | *a* | *b* | *c* | *d* | *e* | *h*	25 | 0 | 0 | 300 | 2 000 | 500 | 200 | 100	25 | 2 | 2 | 800 | 1 000 | 800 | 740 | 775 | 150
26			
	26 | 0 | 0 | *a* | *b* | *c* | *d* | *h*	26 | 0 | 0 | 1 000 | 1 200 | 1 400 | 1 185	26 | 1 | 1 | 700 | 700 | 1 200 | 500 | 120

Table 5 (*continued*)

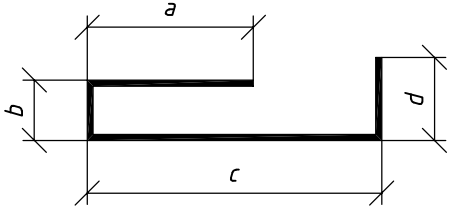
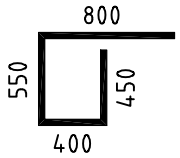
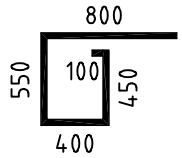
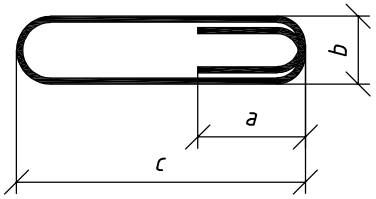
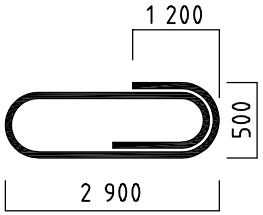
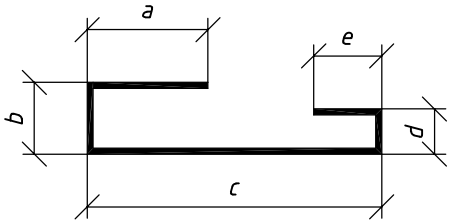
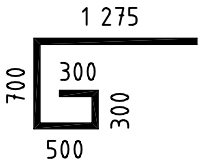
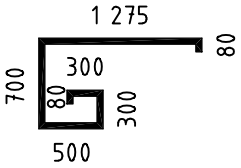
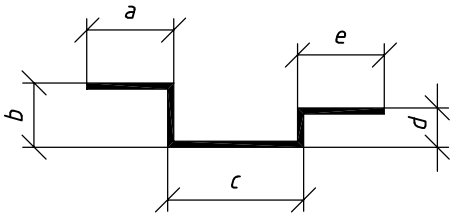
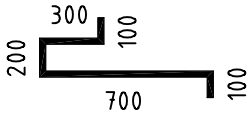
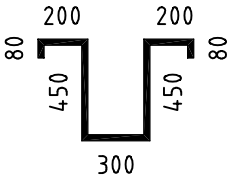
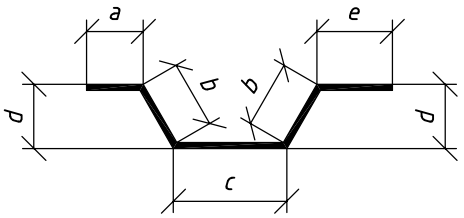
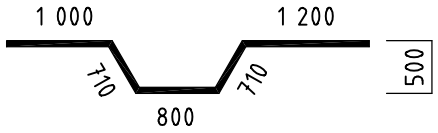
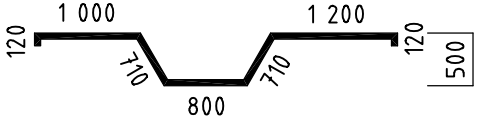
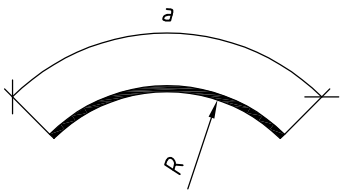
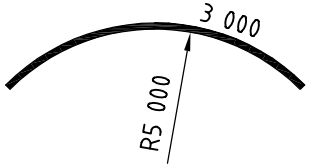
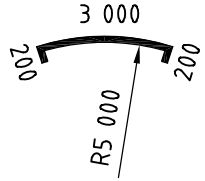
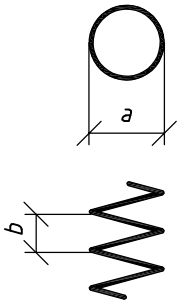
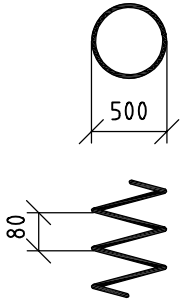
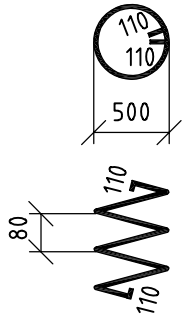
Shape code	Bar shape	Example without end hook	Example with end hook
31			
	31 0 0 *a* *b* *c* *d* *h*	31 0 0 800 550 400 450	31 0 1 800 550 400 450 100
33			(no end hooks)
	33 0 0 *a* *b* *c*	33 0 0 1 200 500 2 900	
41			
	41 0 0 *a* *b* *c* *d* *e* *h*	41 0 0 1 275 700 500 300 300	41 1 1 1 275 700 500 300 300 80
44			
	44 0 0 *a* *b* *c* *d* *e* *h*	44 0 0 100 300 200 700 100	44 1 1 200 450 300 450 200 80

Table 5 (*continued*)

Shape code	Bar shape	Example without end hook	Example with end hook
46			
	46 0 0 *a* *b* *c* *d* *e* *h*	46 0 0 1 000 710 800 500 1 200	46 1 1 1 000 710 800 500 1 200 120
67			
	67 0 0 *a* *R* *h*	67 0 0 3 000 5 000	67 1 1 3 000 5 000 200
77	 *a* outside diameter *b* pitch of spiral *c* number of complete circles		
	77 0 0 *a* *b* *c* *h*	77 0 0 500 80 57	77 1 1 500 80 57 110
99	Other shapes and angles		
	99	99	99

7 Bar schedule

7.1 General

The bar schedule is the document used to specify and identify reinforcing bars. It is divided up into shape schedules (see 7.2) when applying shape codes, bending schedules (see 7.3) and combined schedules (see 7.4). Special mat schedules or weight schedules are also possible (see Annex A). Every schedule shall contain a title block containing elements in accordance with 7.5.

7.2 Shape schedule

A shape schedule shall contain the following information in the following sequence.

a) Member (identification of the structural member in which the bar is located).

b) Bar mark (unique reference of the bar).

c) Type of steel (designation or abbreviation given in reference standards or other rules). The bar's quality and profile can be designated by a single letter if it is properly defined.

EXAMPLE B is corresponding to FeB 500 (ribbed) given in EN 10080.

d) Bar diameter (nominal diameter), in millimetres.

e) Bar length (cutting length) in millimetres or metres. It shall be specified whether the length is calculated on the basis of outside dimensions (Method A) or the centreline (Method B). When Method A is applied, the outside dimensions of Table 5 shall be used. It should also be specified whether there has been a correction, e.g. for bends or endhooks.

f) Number of members or number of groups of bars.

g) Number of bars in each member or in each group.

h) Total number of bars f) $\times$ g).

i) Total length e) $\times$ h), in millimetres or metres.

j) Bar shape (shape code).

k) Definition of end hooks.

l) Bar-shape parameters (bending dimensions), in millimetres.

m) Modification index of the member. A letter shall be stated, e.g. A, B, C, ..., if one or more lines are modified and a new schedule is distributed. The same letter shall be stated in 7.5 g).

For an example of an ISO shape schedule, see Table 6.

7.3 Bending schedule

A bending schedule shall contain the following information in the sequence given.

a) Member (identification of the structural member in which the bar is located).

b) Bar mark (unique reference of the bar).

c) Type of steel (designation or abbreviation given in reference standards or other rules. The bar's quality and profile can be designated by a single letter if it is properly defined.

d) Bar diameter (nominal diameter), in millimetres.

e) Bar length (cutting length), in millimetres or metres. It shall be specified whether the length is calculated on the basis of outside dimensions (Method A) or the centreline (Method B). When applying Method A, the outside dimension of Table 5 shall be used. It should also be specified whether there has been a correction, e.g. for bends or endhooks.

f) Number of members or number of groups of bars.

g) Number of bars in each member or in each group.

h) Total number of bars f) × g).

i) Total length e) × h) in millimetres or metres.

j) Bar shape (shape code) optional.

k) Dimensioned unscaled sketch of the bending shape.

l) Modification index of the member. A letter shall be stated, e.g. A, B, C, ..., if one or more lines are modified and a new schedule is distributed. The same letter shall be stated in 7.5 g).

For an example of an ISO bending schedule, see Table 7.

7.4 Combined schedules

Combinations of shape schedules and bending schedules are possible. A weight schedule may be drawn up separately or else a column stating the weights may be added to the shape or bending schedule.

7.5 Title block

The title block should contain at least the following information:

a) title of project;

b) name of client;

c) name of structural designer;

d) preparation date and name of person responsible for preparation;

e) drawing number;

f) schedule number;

g) revision letter and date of last revision;

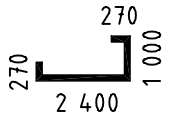
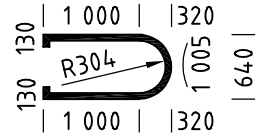
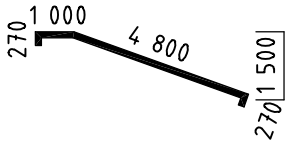
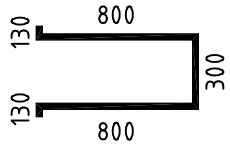
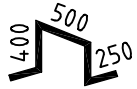
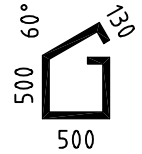
h) number of this International Standard as a basis for the schedule specification.

The drawing number and the schedule number shall coincide.

Table 6 — Example for shape schedule without title block

Member	Bar mark	Type of steel	Bar diameter mm	Length of each bar (Method A) m	Number of members	Number of bars in each member	Total number	Total length m	Shape code	End hook		Bending dimensions mm							Index
												a	*b*	*c*	*d*	*e*	*R*	*h*	
Slab 1	01	BST 500 S	28	3,60	1	10	10	36,00	00	0	0	3 600							
Slab 2	02	BST 500 S	28	3,94	1	20	20	78,80	11	1	1	2 400	1 000					270	
Slab 3	03	BST 500 S	28	3,17	1	2	2	6,34	12	1	1	1 520	1 320				472	270	
Corbel	04	BST 500 S	16	3,27	5	3	15	49,05	13	1	1	1 320	640	1 320				130	
Wall	05	BST 500 S	28	6,34	2	4	8	50,72	15	1	1	1 000	4 800	1 500				270	
Beam 1	06	BST 500 S	16	2,16	4	14	56	120,96	21	–1	–1	800	300	800				130	
Beam 2	07	BST 500 S	20	3,32	3	21	63	209,16	25	2	2	800	1 000	800	740	775		360	
Beam 3	08	BST 500 S	28	3,14	3	6	18	56,52	26	1	1	700	700	1 200	500			270	
Beam 4	09	BST 500 S	12	2,40	1	13	13	31,20	31	1	1	800	550	400	450			100	
Beam 5	10	BST 500 S	10	3,24	1	26	26	84,24	41	1	1	1 280	700	500	300	300		80	
Foundation slab 1	11	BST 500 S	12	1,80	2	300	600	1 080,00	44	1	1	200	450	300	450	200		100	
Foundation slab 1	12	BST 500 S	28	4,96	2	12	24	119,04	46	1	1	1 000	710	800	500	1 200		270	

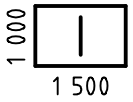
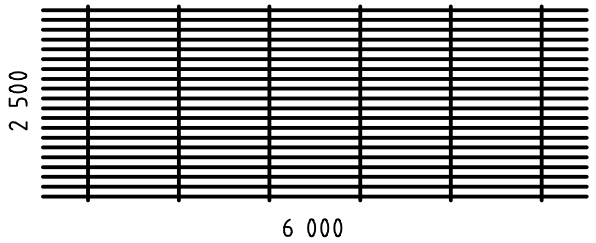
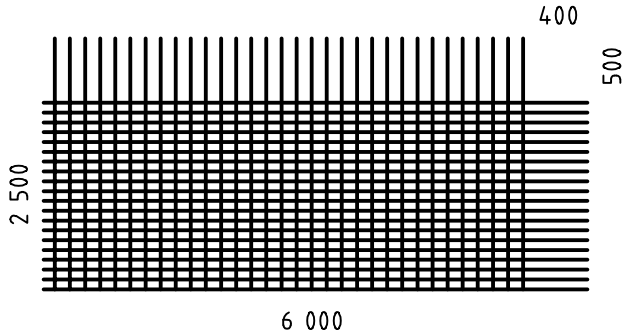
Table 7 — Example for bending schedule without title block

Member	Bar mark	Type of steel	Bar diameter mm	Length of each bar (Method A) m	Number of members	Number of bars in each member	Total number	Total length m	Shape code (Optional)	Bending shape with dimensions	Index
Slab 1	01	BST 500 S	28	3,60	1	10	10	36,00	00		
Slab 2	02	BST 500 S	28	3,94	1	20	20	78,80	11		
Corbel	04	BST 500 S	16	3,27	5	3	15	49,05	13		
Wall	05	BST 500 S	28	6,34	2	4	8	50,72	15		
Beam 1	06	BST 500 S	16	2,16	4	14	56	120,96	21		
Floor slab	14	BST 500 S	20	1,80	1	300	300	540,00		 NOTE 3D representation.	
Support pillar	17	BST 500 S	10	2,26	5	19	95	214,70			

Annex A
(informative)

Mat schedule — Example

Table A.1 — Example of mat schedule without title block

Member	Sheet mark	Type of steel	Mat type (specification optional)	Diameter and spacing longitudinal reinforcement mm	Mat length parallel longitudinal reinforcement mm	Diameter and spacing transversal reinforcement mm	Mat length parallel transversal reinforcement mm	Total number	Dimensional sketch	Index
Slab	1	BSt 500 M	Q513A	7,0/150	1 000	8,0/100	1500	10		
Slab	2	BSt 500 M		12/100	6 000	12/1 000	2 500	20		
Slab	3	BSt 500 M		12/100	6 000	10/150	2 500	10		

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