BVBS-Guideline
Data exchange of reinforcement data

Interface description - Version 3.1

This guideline „Data exchange of reinforcement data" – definition and description of the interface – was developed with the cooperation of the following construction software companies, rebar machine manufacturers, rebar shops, construction companies and institutions.

ALLPLAN	D 81829	München
AUG.PRIEN	D 21079	Hamburg
Dobler GmbH & Co. KG Bauunternehmung	D 87600	Kaufbeuren
GLASER Programmsysteme GmbH	D 30974	Wennigsen
Institut für Stahlbetonbewehrung e.V.	D 40474	Düsseldorf
LENNERTS & PARTNER GmbH	D 96450	Coburg
mb AEC Software GmbH	D 67657	Kaiserslautern
RIB Engineering GmbH	D 70567	Stuttgart
RIB SAA	A 1100	Wien
SOFiSTiK AG	D 85764	Oberschleißheim
Trimble Germany GmbH	D 65479	Raunheim
Unitechnik	D 51674	Wiehl
Ed. Züblin AG	D 70567	Stuttgart

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Foreword

The Bundesverband Bausoftware e.V. (BVBS) published the first version of this guideline for the data exchange of reinforcement data in 1995. From the beginning, construction software companies, rebar shops and machine manufacturers, institutions and steel suppliers worked closely together in drafting this guidline. The publication of the revised version 2.0 followed in 2002. In 2019 significat extensions were made and version 3.0 was completed. For the present version 3.1, an editorial revision of version 3.0 including additional explanations was carried out.

We would like to thank all those involved in the development of version 3.0 and 3.1 for their constructive and trusting cooperation. We are happy to take suggestions for the further development of the guideline.

BVBS - Bundesverband Bausoftware e.V.

Dr.-Ing. Ines Prokop
Geschäftsführerin

Procedure for the exchange of reinforcement data

Each data provider/-receiver needs to create only <u>one</u> converter (software).
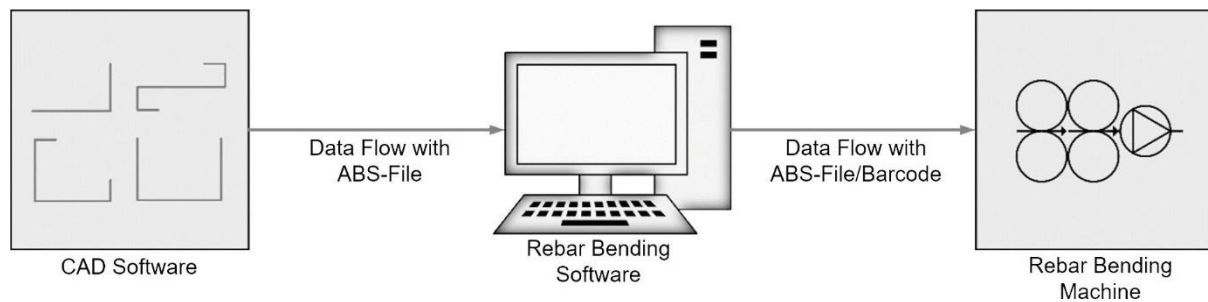
With the CAD software a bending schedule, in .abs format along side the .pdf format, for the exchange of reinforcement data, is being produced. The .abs format can be read during the bending process and it can be transferred to other bending machines.

Example of .abs data with the according bar bending schedule:

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p1@l6000@n15@e23.1@d25@gBSt500S@s175@v@Gl6000@w0@C76@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p2@l3000@n42@e3.63@d14@gBSt500S@s56@v@Gl150@w-135@l640@w90@l590@w90@l700@w60@l313@w165@l-66@w0@C68@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p3@l4600@n51@e7.268@d16@gBSt500S@s64@v@Gl1135@w79.7@l350@w90@l1630@w90@l350@w79.7@l1135@w0@C72@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p4@l6700@n6@e16.549@d20@gBSt500S@s140@v@Gl400@w90@l1350@w56.31@l900@w-37.87@l700@w-36.87@l700@w-37.87@l900@w56.31@l1350@w90@l400@w0@C92@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p5@l3500@n49@e5.53@d16@gBSt500S@s64@v@Gl620@w56.31@l770@w-56.31@l720@w-56.31@l770@w56.31@l620@w0@C82@
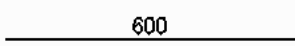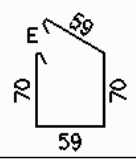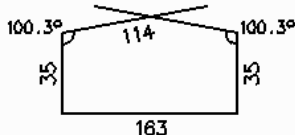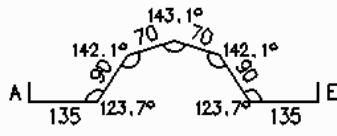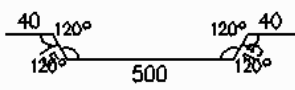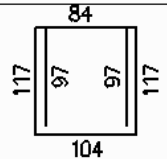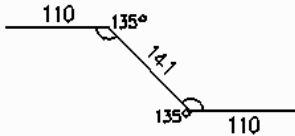
BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p6@l6100@n8@e7.381@d14@gBSt500S@s56@v@Gl400@w-60@l150@w60@l5000@w60@l150@w-60@l400@w0@C90@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p7@l7000@n72@e6.216@d12@gBSt500S@s48@v@Gl970@w90@l840@w90@l1170@w90@l1040@w90@l1170@w90@l840@w90@l970@w0@C77@

BF2D@HjZEICON
Bewehrungslis@rZEICON@i1@p8@l3604@n14@e4.361098@d14@gBSt500S@s56@v@Gl1095@w-45@l1414@w45@l1095@w0@C83@

ZEICON™ Biegeliste *Stabstahl*								RIB running together

Projekt:	*Industriehalle Darwinstraße*			Bearbeiter:	**HG**	Datum: **15.04.2021**	Blatt: **1**
Plan:	*Rohbau*			Nr:	**4711**		

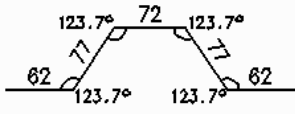| Position	Anzahl	D	Sorte	Länge	Gewicht	Ges.länge [m]	Ges.gew.	Biegeform
①	15	25	BSt500S	600,00	23,100	90,00	346,500	600
②	42	14	BSt500S	300,00	3,630	126,00	152,460	E 59 / 70 / 70 / 59 Haken A: 21.0 Haken E: 21.0
③	51	16	BSt500S	460,00	7,268	234,60	370,668	100.3° 114 100.3° / 35 / 35 / 163
④	6	20	BSt500S	670,00	16,549	40,20	99,294	143,1° 142,1° 70 70 142,1° 90 90 A 123,7° 123,7° E 135 135 Winkelhaken A: 40.0 Winkelhaken E: 40.0
⑤	49	16	BSt500S	350,00	5,530	171,50	270,970	123,7° 72 123,7° 77 77 62 62 123,7° 123,7°
⑥	8	14	BSt500S	610,00	7,381	48,80	59,048	40 120° 120° 40 120° 500 120°
⑦	72	12	BSt500S	700,00	6,216	504,00	447,552	84 117 97 97 117 104
⑧	14	14	BSt500S	360,42	4,356	50,40	60,984	110 135° 141 135° 110

Summe Gesamtgewicht:	**1807,476**

Initial situation

Basically, the following requirements are placed on this interface.

The data format should:

- be as flexible and extensible as possible
- only contain data known to the designer (machine neutral)
- be compact (no more than 1000 characters per bending shape)
- also be evaluable without CAD.

Due to the different geometric possibilities, the reinforcement shapes are divided into groups. Each of these groups is given its own designation. This makes it possible, for example, to decide immediately at a bending machine for 2D bending shapes whether suitable data is provided without having to analyze the entire data set. The following identifiers are used.

Main groups

- **BF2D** two dimensional bending shapes
- **BF3D** three dimensional bending shapes
- **BFWE** helixes and spirals
- **BFMA** reinforcing steel meshes
- **BFGT** lattice girders
- **BFAU** spacers an supporting cages

Each bending shape has geometry-independent data (e.g. schedule number, position, quantity, $\varnothing$, etc.). These data are summarized in a header block (block identifier **H**). The block opening identifier **H** can be followed by various numbers of data fields. Each starts with a lower case letter as field identifier (a…-z) and ends with an "@" as field end character. The end of the header block is reached when a field end identifier @ is followed by a capital letter. The order of the data fields within the block is <u>fixed</u>.

The geometry data (block identifier **G**) follows in another block. This block can also contain various numbers of data fields. Each data field starts with a lower case letter as the field indentifier (a…-z) and ends with @ as field end character. In this block the order of the data is also fixed.

The field identifiers used (a…-z) are only unique in conjunction with the block identifier. In block **H**, for example, r = schedule number, but in block **G** r = radius. The set of data is teminated with **CRLF** (ASCII 13+10).

Basic conditions

General convention for the data are:

- **ASCII** will be used as character code. The character "@" is used as the separating character. Therefore, the character "@" has to be avoided in the free text.

- All length specifications are in **mm** – especially, with regard to the desired compactness of data, the use of decimal places should be avoided for all specifications that already are in milimeters (diameter and total length in the header block, individual leg lengths or radii in the geometry block, as well as vectors for three dimensional curved positions).

- All length specifications of the 2D shapes are referred to the outer dimension, analogous to the printed bending schedule. For the 3D bending shape the length specifications in coordinate notation refer to the axis dimension. Diameters and radii are inner dimensions.

- All weight specification in **kg**

- All angle specification in **degrees** (right angle is 90°). Decimal places may be used.

- Positive values without sign, negative values with preceding "–" (minus), decimal separator "." (dot)

- All field identifiers must be included in the specified order of the block descriptions. The indicator mus always be specified, even if no value is present.

- Each data set ends with a checksum block as the last block before CRLF.

- Solely for BFMA:
  - The basis of all data is a spatial coordinate system. The flat mesh lies in the X-Y plane. Negative values for X and Y coordinates are not permitted.
  - Longitudinal bars are always at the bottom
  - X-bars are transverse bars
  - Y-bars are longitudinal bars

- Certain postitions cannot be described due to the definition of the reinforcement interface (e.g. three dimensional curved postitions with radially curved legs). These should nevertheless be exported. The header block and the cecksum block must be specified here. The geometry block is not to be specified.

- If the data exchange is done with files, the files have the extention .**ABS** (General Reinforcement Interface = German: "**A**llgemeine-**B**ewehrungs-**S**chnittstelle")

Each line consists of:

Header	always 1*
Geometry block	optional 1* or
Spacer block	optional 1*
Coupler block	optional 1*
Rod block	n times
Private block	optional 1*
Checksum block	always 1*

The data of the **header**, **geometry** or **spacer**, **private** blocks are always valid for all following bar blocks.

Definition of segment lengths
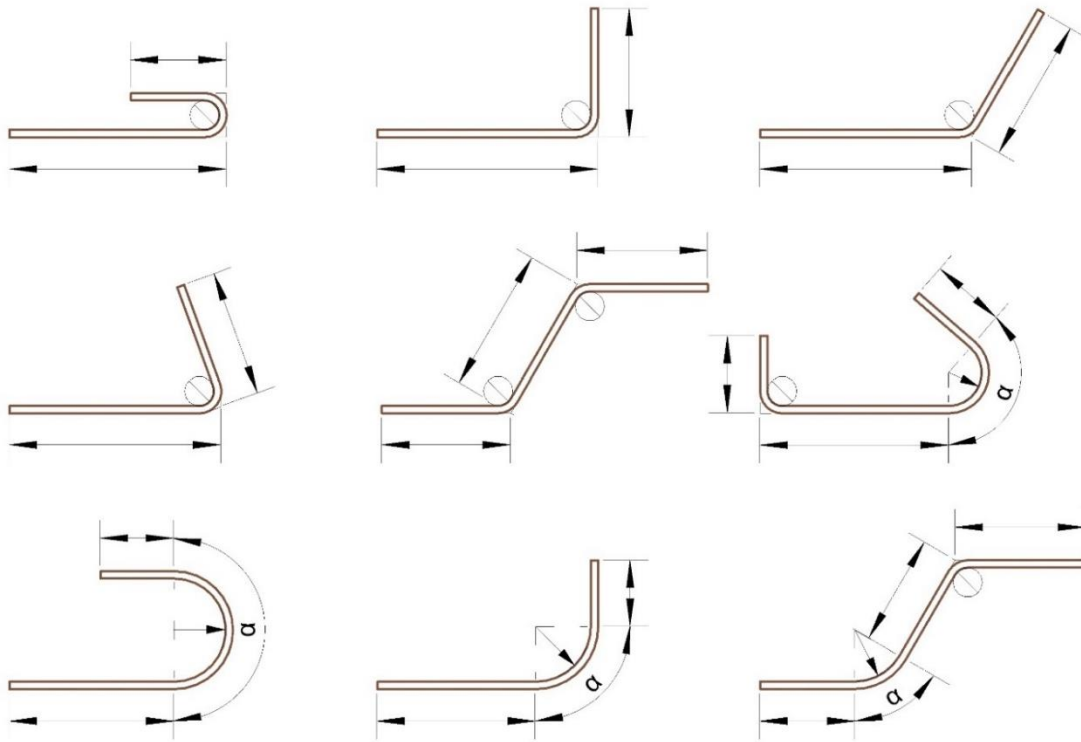
Legend:

A basic distinction is made between bends (with standard diameter of mandrel 4*ds) and arches (with specification of angle and radius). Bends are marked with the bending pin symbol in the picture.

For further explanations of segment lengths see the current version of EN ISO 3766.

Header block

H field identificator	Header block description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
j	Project number (optional)	X	X	X	X	X	X
r	Schedule number of the associated drawing	X	X	X	X	X	X
i	Revision of the associated drawing	X	X	X	X	X	X
p	Bar mark / mesh position/ supply position	X	X	X	X	X	X
l	Bar length [mm] / mesh length [mm] / supporting length	X	X	X	X	X	X
n	Quantity of reinforcing bar / mesh/ supply	X	X	X	X	X	X
e	Bar mark / mesh / accessory weight [kg]	X	X	X	X	X	X
d	Steel diameter [mm]	X	X	X			
g	Steel grade e.g. 500S	X	X	X	X	X	
s	Diameter of mandrel [mm]	X	X	X	X		
m	Mesh type e.g. Q188 / Spacer type / supporting type				X	X	X
b	Mesh width [mm]				X		
h	Lattice girders / spacer or supporting height [mm]					X	X
v	Designer (is not to be currently)	X	X	X	X	X	
a	Layer (optional) Numerica, ascending from bottom to top	X			X		
t	Delta I for staggered rebars (optional)	X					
c	Group of staggered rebars (optional)	X	X	X			

*   All field idenfications permissible for a main group must be completed and in the listed order.

New from version 2.0

- The main group BFGT for the describtion of lattice girders (Gitterträger).
  The length (l), width (b) and type are transfered as information.
- The field @a (layer) is required, in addition to the Z-position contained in the bar block, for the insertion sequence in automatic bar placing machines (automatische Eisenanlagen).
- Staggered rebars:
  The field identifier **t** as indicator for varying lengths and c for the last length.
  "c" as indicator for the length of the last bar in the geometry block (c can also be used with radii)
  Note: This assumes a linear division course ((c - 1)/ t).
  From version 3.1. onwards, it is recommened to specify the varying positions individually. The field identifier **t** will still be used to make for the compatibility with version 2.0.

New from version 3.0

- Since non-linear staggered rebars must be described as single items, an indicator is specified as a group of staggered rebars, by which it is recognizable which single items belong to a group of staggered rebars. For this purpose, the same indicator is specified in the respective line items. It is recommendes to use the fixed component of the bar mark.
- New reinforcement group BFAU for spacers and supporting cages.

Notice:

There is only one diameter of mandrel for a bending shape (parameter "s" [mm] defined in header block). Each bend of the position is carried out with this diameter of mandrel.

If it is necessary to deviate from this value for nominal reasons, the specifics have to be made as a separate curved element in the bending shape using the "r" parameter in the geometry block (the radius is always larger than half diameter of mandrel, according to the header block).

Checksum block

last block before CR/LF

C field identificator	**Checksum block** description	**BF2D**	**BF3D**	**BFWE**	**BFMA**	**BFGT**	**BFAU**
	value checksum	X	X	X	X		X

*   The checksum is calculated with the following algorithm (analogous to the checksum calculation for the calcompplotters)

(IP - 96) +[$\sum_{i=1}^{n} Ci$] MODULO 32 = 0

provided that

IP = checksum
n   = number of ASCII characters from the beginning of the record up to and including the C of the checksum block
Ci = The ASCII characters inside the checksum loop.

<u>In FORTRAN, the routine would like this:</u>

```
    ISUM = 0
    DO 10 I = 1,N
10 ISUM = ISUM + ICHAR(C(I))
    IP = 96-(MOD(ISUM,32)
```

<u>In C, the routine would look like this:</u>

```
int     i, IP, n;          // declare variables
int     iSum = 0;          // declare variables
char* C = "abcde@C";       // example data

n = strlen(C);             // calculate amount of characters
for ( i=0; i<n; i++)
{
        iSum += C[i];      // sum ASCII value  of the characters
}
IP = 96 - iSum % 32;       // calculate checksum
```

example::

The checksum is to be formed for the character string **"abcde@C"**.

IP = 96 - MOD((a+b+c+d+e+@+C), 32) 1 a=ASCII(a)=97; b=ASC ll(b)=98,

IP = 96 - MOD((97+ 98+99+100+101+64+67), 32)

IP = 96 - MOD(626, 32) = 96 -18 = 78

Geometry block

G(x/y)* field identificator	Geometry block description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
l**	Leg length [mm]	X		X	X		
r**, ***	Radius of bend	X		X	X		
w**	Angle of the following bend	X		X	X		
x****	X-coordinate for 3D-reinforcing bars		X				
y****	Y-coordinate for 3D-reinforcing bars		X				
z****	Z-coordinate for 3D-reinforcing bars		X				
n	Number of turns for helixes			X			
g	Helix pitch [mm]			X			
c	Last length staggered rebars (only in conjunction with "t" in the header block)	X					

An empty geometry block **G@** or a non-existent geometry block is a special form that cannot be displayed

Running meter positions (lfm) are specified in the geometry block as a straight bar with total length, see BF2D – example 10.

The total length of the bended reinforcing bar is calculated from the data of the geometry block, the length specifications in the header or in the bar is to be ingored.

*   Gx / Gy only for bended mesh, can only occure once.
The coordinate system is a tracking coordinate system.

       Gx – the X bars are bent.

       Gy - the Y bars are bent.

**   Always enter the length or the radius first, then the angle. If a reinforcing bar ends without an angle, a w0@ must be appended. After a radially bent leg, where the inner radius as well as the angle of the circular arc is specified, the transition into the following leg does not have to be straight but can also follow with a preceding bending angle. Therefore, to specify the bending angle, another value can be specified with "w…@" following the angle of the circular arc (opening angle).

***   The radius is always larger than half diameter of mandrel defined by the header block

****   The dimensions for the three-dimensional curved positions refer to the axis dimension. The right-handed coordinate system is used for the coordinate system.

Spacer block

A field indenficator	Spacer block description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
t	Spacer type	X			X		
a	First and following distances of the spacer (@a200;500@ values separated by semicolon)	X			X		
p	Absolute position of the spacers	X			X		

The spacer block is used for precast concrete units and defines the positions of the spacers on the reinforcing bar. The spacers can be specified either in the form of

Attype@**a**first; following@ or in the form of

Attype@**p**first@**p**second@ ... @**p**n-ter@.

Spacer block and geometry block cannot be included in the same line.

Bar block

X/Y/E* field identificator	Bar block (can occure several times) description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
d	Bar diameter r [mm] if necessary with decimal „." attached d for double bar				X		
x**	Bar start in X-direction	X			X	X	
y**	Bar start in Y-direction	X			X	X	
l	Bar length in [mm]				X	X	
e***	Bar spacing in [mm]				X	X	
w	Angle of the bars to the X-axis, specification only for E-block (X=0;Y=0;E=Indication w necessary)	X			X	X	
z	Bar position in Z-direction	X			X	X	

The bar block E defines diagonal reinforcing bars.
The angle of the bar block X is always 0°,
the angel of the bar block Y is always 90°,
the angle of the bar block E has to be specified (e.g. @**w**45)

The Z-position of the reinforcing bar is specified in the field @z. (This is of importance for the insertion sequence in automatic production)

*   Equal bars are combined in a X- or Y- bar block. Bars count as equal, if diameter, starting point coordinates of the bar and bar length are equal. The space between the individual bars can differ.

**   The coordination system must be chosen, so that the smallest x-value and the smallest y-value are zero.

***   In order to be able to describe a mesh of identical bars, with varying distances between each other, but as compactly as possible, the e-parameter is to be defined as followed

        In the first part of a X or Y block, the first bar of this block is defined with its location. If this block includes several bars, the e-parameter follows. The field indentifier is followed by sub-blocks separated by semicolon, which describes spacing and number in **mm,n**. **mm** stands for the spacing in mm related to the previous bar. **n** (amount) defines how often the bar is repeated at this spacing. If **n** is not specified, n=1.
        Notice! Since the first bar is already defined only the amount of distances may be specified, not the amount of bars.

        Example: 8 cross bars d=6mm, L=2500mm, x=100mm, y=500mm, 7*e=400mm
                   Xd6@x100@y500@l2500@e400;400;400;400;400;400;400@   or
                   Xd6@x100@y500@l2500@e400,7@

Double bars:

Double bars are bars with the same diameter, placed right next to each other. Their position in the bar direction is not referred to the single bar, but to the common axis between the two bars. In the simplest case, double bars can be of equal length and both bars have the same initial coordinates. However, bars of the same length can also be staggered and thus have unequal initial coordinates. Finally, bars of different lengths with the same or different initial coordinates are possible. In all cases a double bar is formed from two bars which is treated like a single bar.

A double bar therefore has:

- One diameter
- Two x-values
- Two y-values
- Two lengths

For the description, this means that both values are specified separated by semicolons. The first value always refers to the first bar, the second value always to the second bar. If the second value is not specified, the two values are equal.

Examples:

Double bar on full length

　　　Yd6d@x500@y100;100@l4000;4000@e ... @

or　　Yd6d@x500@y100@l4000@e ... @

staggered double bar

　　　Yd6d@x500@y1100;100@l4000;4000@e .. @

Short additional bar in the field

　　　Yd6d@x1500@y100;1100@l4000;2000@e .. @

Coupler block (german: Muffenblock)

M field identificator	Coupler block description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
a	Connection method at the beginning of the bar (in practice usually the manufacturer specifications of the connecting parts)	X	X	X			
b	Type of connection at the beginning of the bar (in practice usually the manufacturer specific type of the connecting parts)	X	X	X			
c	Indicator of the coupler / thread at the beginning of the bar: • 0 or empty – no connection part • 1 – coupler • 2 – thread	X	X	X			
n	Connection method at the end of the bar (in practice usually the manufacturer specifications of the connecting parts)	X	X	X			
o	Type of connection method at the end of the bar (in practice usually the manufacturer specific type of the connecting parts)	X	X	X			
p	Indicator of the coupler / thread at the end of the bar • 0 or empty – no conntection part • 1 – coupler • 2 – thread	X	X	X			

The beginning and the end of the bar are determined by the data in the geometry block. The first leg mentioned is the beginning of the bar.

Couplers are included in the outer dimension of the bending form dimension. The leg length specified in the geometry block may therefore have to be shortened in practice, by a factor depending on the respective coupler.

Also for threads, the type of coupler to be connected to it later should be specified, since different coupler require different threads.

Private block

P field identificator	Private block description	BF2D	BF3D	BFWE	BFMA	BFGT	BFAU
	This block can be used for project or company internal data. The data block must be terminated with „@".	X	X	X	X	X	X

As seperator @ is also used in the private block, where @ + uppercase letter must not occur. End of the private block is @ as for all other blocks.

Examples with barcodes - test data

BF2D Examples - two dimensional bending shapes

As an example the plan **417**, index **a** of the project **TestPFD** , position **1**, quantity **10**, diameter **12**, grade **B500A** and diameter of mandrel 4*ds=48, is used. For a better overview, the data is printed in bold and the block identifiers are printed larger.

Thus, the header block results as follows:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**1000**@n**10**@e**0.888**@d**12**@g**B500A**@s**48**@v@

BF2D - Example 1:
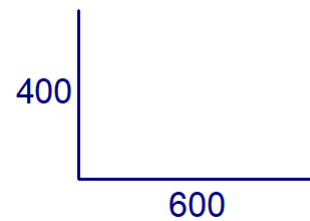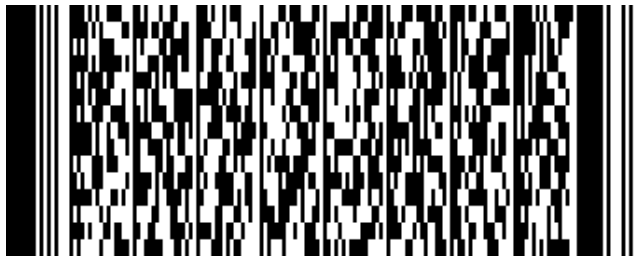
 The geometry block is:

G l**400**@w**90**@l**600**@w**0**@

The complete dataset is:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**1000**@n**10**@e**0.888**@d**12**@g**B500A**@s**48**@v@
G l**400**@w**90**@l**600**@w**0**@
C**72**@CRLF

(86 Characters)

BF2D - Example 2:
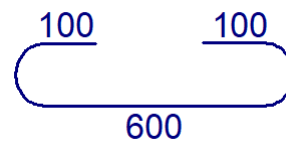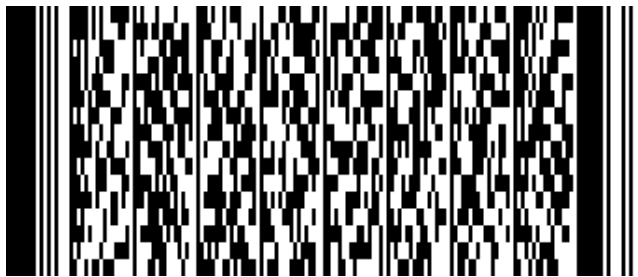
The geometry block is:

G l**100**@w**180**@l**800**@w**180**@l**100**@w**0**@

Notice:
In this bending shape, both ends are bended with 180° hooks with 48 mm diameter of mandrel, the total length is 800 mm.
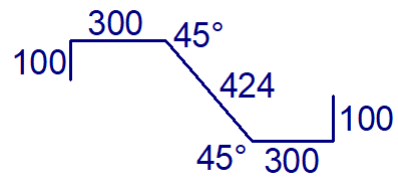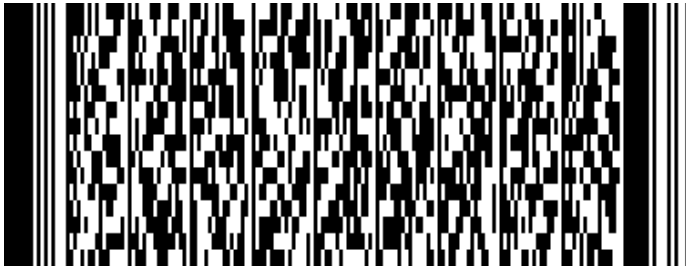
The complete dataset is:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**800**@n**10**@e**0.710**@d**12**@g**B500A**@s**48**@v@
G l**100**@w**180**@l**600**@w**180**@l**100**@w**0**@
C**71**@CRLF

(96 Characters)

BF2D - Example 3:

The geometry block is:

G**l100**@w**90**@l**300**@w**45**@l**424**@w**-45**@l**300**@w**-90**@l**100**@w**0**@

The complete dataset is:

BF2D@H j**TestPDF**@r**417**@i**a**@p**1**@l**1224**@n**10**@e**1.087**@d**12**@g**B500A**@s**48**@v@
G**l100**@w**90**@l**300**@w**45**@l**424**@w**-45**@l**300**@w**-90**@l**100**@w**0**@
C**82**@CRLF

(115 Characters)

BF2D - Example 4:
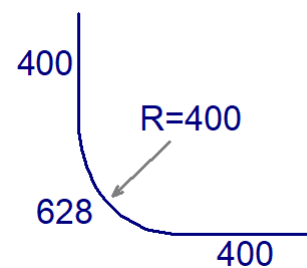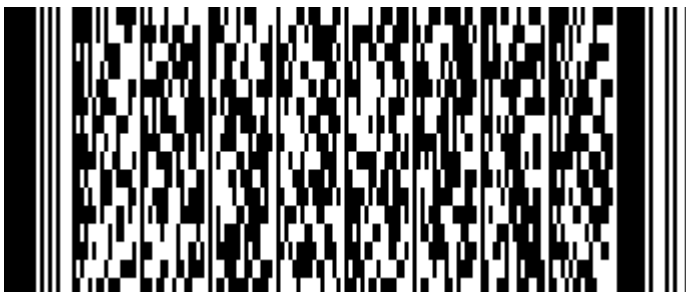
The geometry block is:

G**l400**@w**0**@r**400**@w**90**@w**0**@l**400**@w**0**@

The complete dataset is:

BF2D@H j**TestPDF**@r**417**@i**a**@p**1**@l**1428**@n**10**@e**1.268**@d**12**@g**B500A**@s**48**@v@
G**l400**@w**0**@r**400**@w**90**@w**0**@l**400**@w**0**@
C**79**@CRLF

(95 Characters)

BF2D - Example 5 (opening angle):
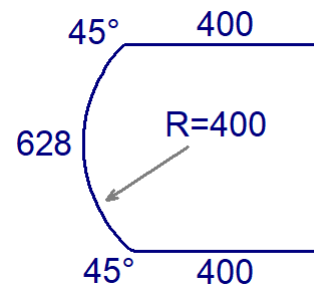
The geometry block is:

G�**400**@w**45**@r**400**@w**90**@w**45**@l**400**@w**0**@

The complete dataset is:

BF2D@Hⱼ**TestPDF**@r**417**@i**a**@p**1**@l**1428**@n**10**@e**1.268**@d**12**@g**B500A**@s**48**@**v**@
G�**400**@w**45**@r**400**@w**90**@w**45**@l**400**@w**0**@
C**93**@CRLF

<div align="right">(97 Characters)</div>

BF2D - Example 6 (coupler):
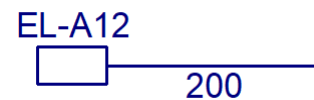
The geometry block is:
G�**200**@w**0**@

The coupler block is:
Ma**Lenton**@b**A12**@c**1**@n@o@p@

The complete dataset is:

BF2D@Hⱼ**TestPDF**@r**417**@i**a**@p**1**@l**200**@n**1**@e**0.178**@d**12**@g**B500A**@s**48**@**v**@
G⎿**200**@w**0**@
Ma**Lenton**@b**A12**@c**1**@n@o@p@
C**78**@CRLF

<div align="right">(96 Characters)</div>

BF2D - Example 7 (thread):
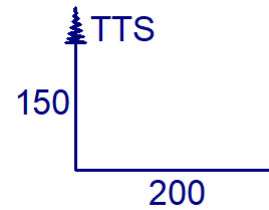
The geometry block is:

G**l150**@w**90**@l**200**@w**0**@

The coupler block is

M**a**Ancon**@b**TTS**@c**2**@n@o@p@

The complete dataset is:

BF2D@H**j**TestPDF**@r**417**@i**a**@p1**@l**350**@n**1**@e**0.311**@d**12**@g**B500A**@s**48**@v**@

G**l150**@w**90**@l**200**@w**0**@

M**a**Ancon**@b**TTS**@c**2**@n@o@p@

C**90**@CRLF

(104 Characters)

BF2D - Example 8 (coupler and thread):
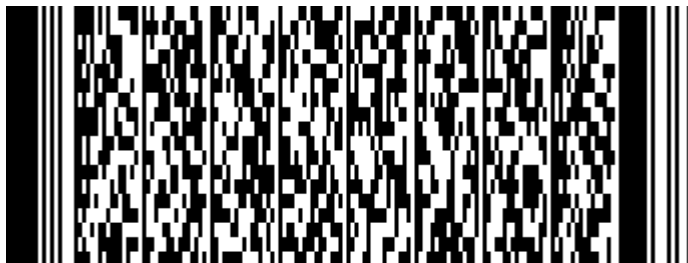
The geometry block is:

G**l200**@w**0**@

The coupler block is:

M**a**Lenton**@b**A12**@c**1**@n**Lenton**@o**P13**@p**2**@

The complete dataset is:

BF2D@H**j**TestPDF**@r**417**@i**a**@p1**@l**200**@n**1**@e**0.178**@d**12**@g**B500A**@s**48**@v**@

G**l200**@w**0**@

M**a**Lenton**@b**A12**@c**1**@n**Lenton**@o**P13**@p**2**@

C**88**@CRLF

(106 Characters)

BF2D - Example 9 (Staggered rebars):

There are three postitions that belong to one group of staggered rebars.
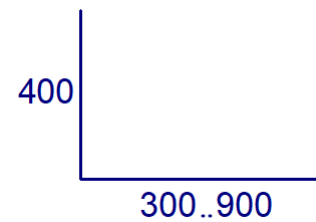
The complete datasets are:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**10.1**@l**700**@n**1**@e**0.522**@d**12**@g**B500A**@s**48**@**v**@c**10**@
G**l400**@w**90**@l**300**@w**0**@
C**65**@CRLF

<div align="right">(89 Characters)</div>

BF2D@Hj**TestPDF**@r**417**@i**a**@p**10.2**@l**1000**@n**1**@e**0.888**@d**12**@g**B500A**@s**48**@**v**@c**10**@
G**l400**@w**90**@l**600**@w**0**@
C**68**@CRLF

<div align="right">(90 Characters)</div>

BF2D@Hj**TestPDF**@r**417**@i**a**@p**10.3**@l**1300**@n**1**@e**1.154**@d**12**@g**B500A**@s**48**@**v**@c**10**@
G**l400**@w**90**@l**900**@w**0**@
C**74**@CRLF

<div align="right">(90 Characters)</div>

BF2D − Example 10 (Running meter positions - lfm):

500000

The geometry block is:

Gl**500000**@w**0**

The complete dataset is:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**500000**@n**1**@e**444.000**@d**12**@g**B500A**@s**48**@v@
Gl**500000**@w**0**@
C**81**@CRLF

(81 Characters)

BF2D − Example 11 (Spacer block):

A straight bar with three type „6" spacer blocks at position 140 mm, 667 mm and 1194 mm measured from the start of the bar.

The geometry block is:

At**6**@p**140**@p**667**@p**1194**

The complete dataset is:

BF2D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**1334**@n**1**@d**10**@g**IV**@s**40**@a**1**@**At6**@p**140**@p**667**@p**1194**@C
**78**@

(74 Characters)

BF3D Example - three dimensional bending shape

As an example the plan **417**, index **a** of the **TestPFD** project, position **1**, quantity **10**, diameter **12**, grade **B500A** and diameter of mandrel 4*ds=48, is used. For a better overview, the data is printed in bold and the block identifiers are printed larger.

The header block is as follows:

BF3D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**1500**@n**10**@e**1.332**@d**12**@g**B500A**@s**48**@v@
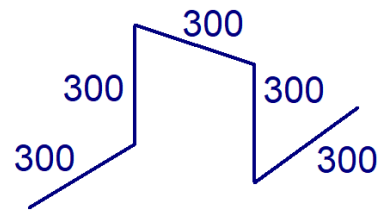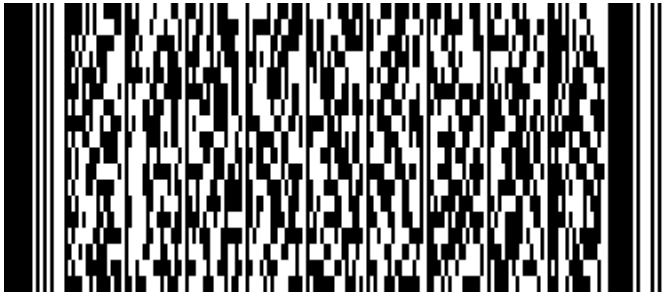
This 3-D reinforcingt bar uses only the coordinate nottation, specifying only the coordinates that actually change.

The geometry block is:

Gx**294**@y**0**@z**0**@_
x**0**@y**288**@z**0**@_
x**0**@y**0**@z**288**@_
x**0**@y**-288**@z**0**@_
x**294**@y**0**@z**0**@

The complete dataset is:

BF3D@Hj**TestPDF**@r**417**@i**a**@p**1**@l**1500**@n**10**@e**1.332**@d**12**@g**B500A**@s**48**@v@
Gx**294**@y**0**@z**0**@x**0**@y**288**@z**0**@x**0**@y**0**@z**288**@x**0**@y-**288**@z**0**@x**294**@y**0**@z**0**@
C**82**@CRLF

(125 Characters)

BFWE Examples - helixes and spirals

Helixes and spirals can be represented with the existing blocks. In the **G** block, the plane shape is displayed first, this can be a circle or a polygon. The only requirement is that all angles must be greater than 0 and the sum of the bending angles must be 360°. Then **n** and **g** elements follow in pairs (any numbers), **n**=number of turns, **g**=pitch.

As an example the plan **417**, index **a** of the **TestPFD** project, position **1**, quantity **10**, diameter **12**, grade **B500A** and diameter of mandrel 4*ds=48, is used. For a better overview, the data is printed in bold and the block identifiers are printed larger.

BFWE − Example 1:

Square column 40/40, reinforcement 340mm/340mm, with 6 turns at both the base and the top with a pitch of 100 mm and 12 turns in the middle with a pitch of 200 mm.

The complete dataset is:

BFWE@Hj**TestPDF**@r**417**@i**a**@p**1**@l**32856**@n**10**@e**29.176**@d**12**@g**B500A**@s**48**@v@
G l**340**@w**90**@l**340**@w**90**@l**340**@w**90**@l**340**@w**90**@n**6**@g**100**@n**12**@g**200**@n**6**@g**100**@
C**69**@CRLF

(130 Characters)

BFWE − Example 2:

Circular column with a helical diameter of 60 cm, with 6 turns at both the base and the top with a pitch of 100 mm and 12 turns in the middle with a pitch of 200 mm.

The complete dataset is:

BFWE@Hj**TestPDF**@r**417**@i**a**@p**1**@l**45398**@n**10**@e**40.313**@d**12**@g**B500A**@s**48**@v@
G r**300**@w**360**@n**6**@g**100**@n**12**@g**200**@n**6**@g**100**@
C**69**@CRLF

(104 Characters)

BFMA Examples - reinforcing steel meshes

BFMA − Example 1 – stock mesh:

As an example the plan **417**, index **a** of the **TestPFD** project, position **1**, quantity **10**, stock mash **Q257**, length **4000** mm, width **2150** mm, grade **B500A** is used. For a better overview, the data is printed in bold and the block identifiers are printed larger.

The header block is as follows:

BFMA@Hj**TestPDF**@r**417**@i**a**@p**1**@l**4000**@n**10**@e**35.28**@g**B500A**@s**48**@m**Q257**@b**2150**@v@
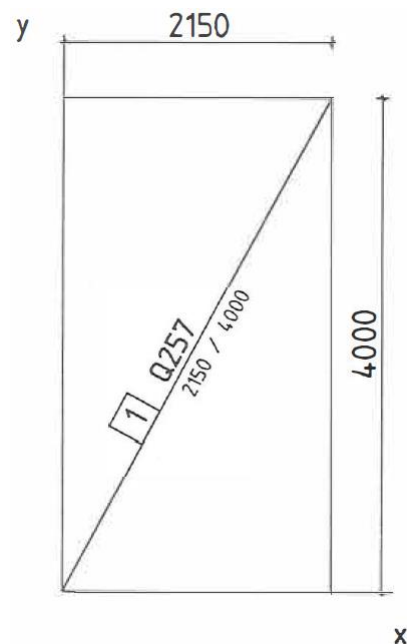
The number is in reference to the respective mesh position

BFMA@Hj**TestPDF**@r**417**@i**a**@p**1**@l**4000**@n**10**@e**35.28**@g**B500A**@s**48**@m**Q257**@b**2150**@v@
C**68**@CRLF

(74 Characters)

BFMA − Example 2 − customized mesh:

(Alle Angaben gerundet!)
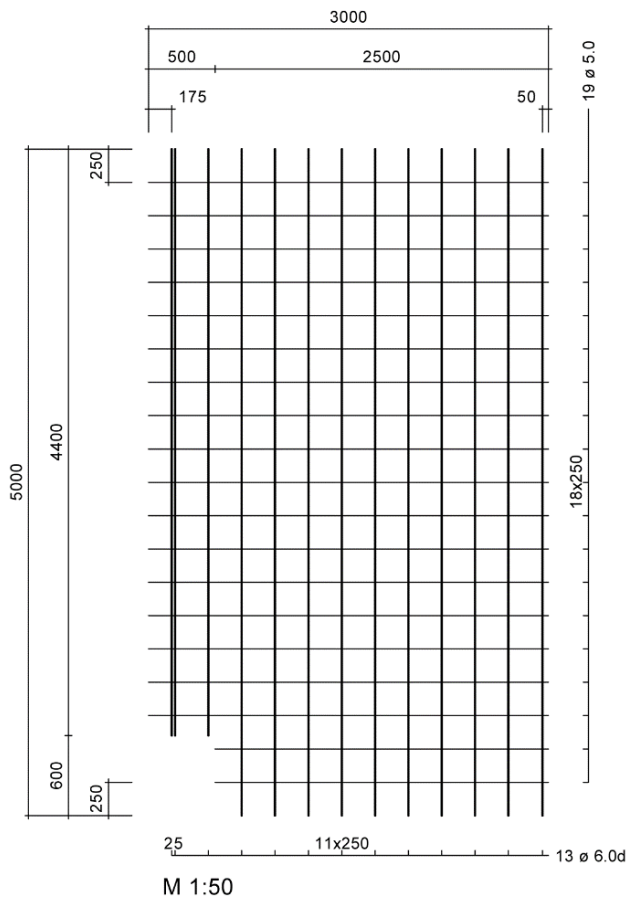
Position : 1
Anzahl : 1

Längsstab		mm	kg
6x	ø6.0	4400	5,861
20x	ø6.0	5000	22,200
Querstab		mm	kg
2x	ø5.0	2500	0,771
17x	ø5.0	3000	7,863
Gewicht je Matte			36,69
Gesamtgewicht			36,69

M 1:50

The customized mesh has the name ZMPDF, with a length of 5000 mm and a width of 3000 mm. In longitudinal direction it consist of 13 double bars, diameter 6, with partly different spacings and lengths. In transverse direction, it consists of 19 single bars, diameter 5, with consistent spacing but partially different lengths.
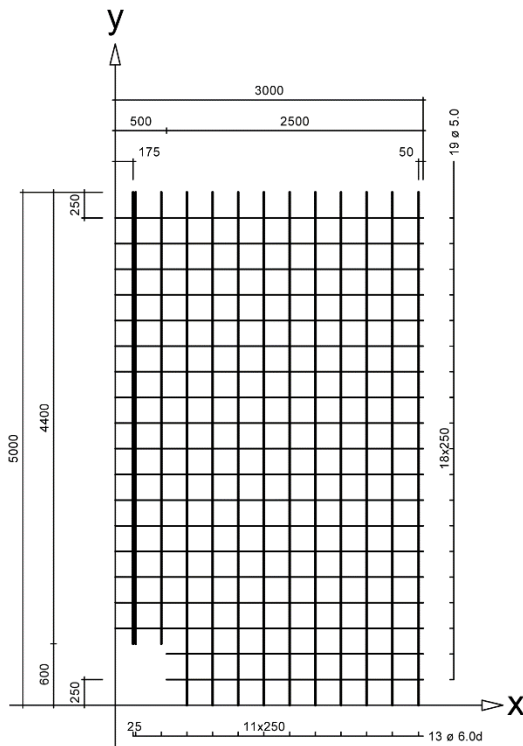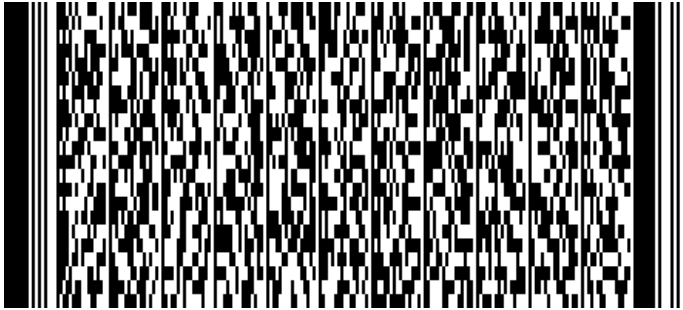
The data record structure with the same header data set, as the example of the stock mesh, would look as follows (the values, underlined italic, can be omitted):

BFMA@
H j**TestPDF**@r**417**@i**a**@p1@l**5000**@n**10**@e**36.695**@g**B500A**@s**48**@m**ZMPDF**@b**3000**@v@
Yd**6d**@x**175**;*175*@y**600**;*600*@l**4400**;*4400*@e**25,1;250,1**@
Yd**6d@x700**;*700*@y**0**;*0*@l**5000**;*5000*@e**250,9**@
Xd**5**@x**500**@y**250**@l**2500**@e**250,1**@
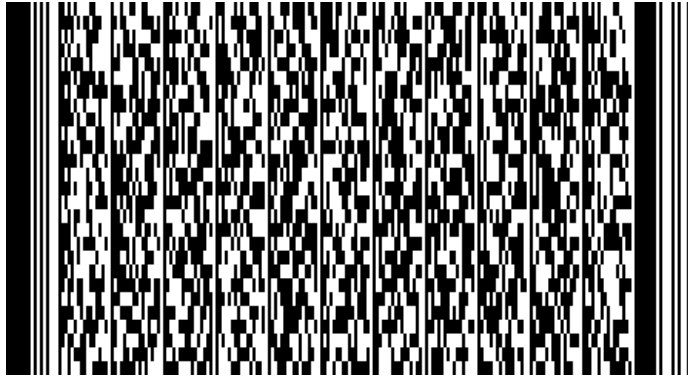Xd**5**@x**0**@y**750**@l**3000**@e**250,16**@
C**68**@CRLF

<div align="right">(209 Characters)</div>

BFMA − Example 3 − bent customized mesh:

If the previous customized mesh should be additionally bent, a geometry block has to be inserted. In the example the logitudinal bars (Y bars) are to be bent. The diameter of mandrel is consistently 4*ds = 24 mm.

Welding pattern see BFMA − example 2

BFMA@
Hj**TestPDF**@r**417**@i**a**@p**1**@l**5000**@n**10**@e**36.695**@g**B500A**@s**48**@m**ZMPDF**@b**3000**@v@
Gyl**200**@w**-90**@l**2000**@w**90**@l**600**@w**90**@l**2000**@w**-90**@l**200**@w**0**@
Yd**6d**@x**175**;*175*@y**600**;*600*@l**4400**;*4400*@e**25,1;250,1**@
Yd**6d**@x**700**;*700*@y**0**;*0*@l**5000**;*5000*@e**250,9**@
Xd**5**@x**500**@y**250**@l**2500**@e**250,1**@
Xd**5**@x**0**@y**750**@l**3000**@e**250,16**@
C**73**@CRLF

(259 Characters)

BFGT Example - lattice girders

The complete dataset is:

BFGT@Hj**TestPDF**@r**417**@i**a**@p**1**@l**2356**@n**1**@e**4.302**@m**KT80910**@h**90**@a**1**@Ex**10**@y300@l2356@w0@z38@C**81**@

(85 Characters)

BFAU Examples - spacers and supporting cages

BFAU − Example 1 − Spacers

As an example the plan **417**, index **a** of the **TestPFD** project, position **1**, quantity **5**, with a spacer of **2000** mm length and **160** mm height is described. The value of the height h is optional. For a better overview, the data is printed in bold and the block identifiers are printed larger.

The complete dataset is:

BFAU@Hj**TestPDF**@r**417**@i@p**1**@l**2000**@n**5**@e**4.5**@m**DS16**@h**160**@
C**68**@CRLF

(56 Characters)

BFAU − Example 2 − Supporting Cages

As an example the plan **417**, index **a** of the **TestPFD** project, position **1**, quantity **150**, with a spacer height of **200** mm is described. The value of the height h is optional. For a better overview, the data is printed in bold and the block identifiers are printed larger.

The complete dataset is:

BFAU@Hj**TestPDF**@r**417**@i@p**1**@l**1**@n**150**@e**1.514**@m**DBV-200-L1/F/T**@h**200**@
C**88**@CRLF

(67 Characters)