MEMO 502 BSF - MAIN DIMENSIONS AND MATERIAL PROPERTIES OF BEAM AND COLUMN UNITS PLANNING	Dato: Siste rev.: Dok. nr.:	17.04.2013 14.02.2020 K4-10/502E	Sign.: Sign.: Kontr.:	sss sss ps

BSF - MAIN DIMENSIONS AND MATERIAL PROPERTIES OF BEAM AND COLUMN UNITS[1]

1.1 QUALITIES

Reinforcement 500C (EN 1992-1-1, Annex C): $f_{yd} = f_{yk}/\gamma_s = 500/1{,}15 = 435$ MPa

Steel Sxxx (EN 10025-2):

S275: Tension/compression: $f_{yd} = f_y/\gamma_{M0} = 275/1{,}1 = 250$ MPa

Shear: $f_{sd} = f_y/(\gamma_{M0}\times\sqrt{3}) = 275/(1{,}1\times\sqrt{3}) = 144$ MPa

Weld: $$f_{w,d} = \frac{f_u}{\gamma_{M2}\sqrt{3}} \times \frac{1}{\beta_w} = \frac{430}{1{,}25\times\sqrt{3}} \times \frac{1}{0{,}85} = 233MPa$$

S355: Tension/compression: $f_{yd} = f_y/\gamma_{M0} = 355/1{,}1 = 322$ MPa

Shear: $f_{sd} = f_y/(\gamma_{M0}\times\sqrt{3}) = 355/(1{,}1\times\sqrt{3}) = 186$ MPa

Weld: $$f_{w,d} = \frac{f_u}{\gamma_{M2}\sqrt{3}} \times \frac{1}{\beta_w} = \frac{510}{1{,}25\times\sqrt{3}} \times \frac{1}{0{,}9} = 262MPa$$

S355: t>40mm: Tension/compression: $f_{yd} = f_y/\gamma_{M0} = 335/1{,}1 = 304$ MPa

Shear: $f_{sd} = f_y/(\gamma_{M0}\times\sqrt{3}) = 335/(1{,}1\times\sqrt{3}) = 175$ MPa

Weld: $$f_{w,d} = \frac{f_u}{\gamma_{M2}\sqrt{3}} \times \frac{1}{\beta_w} = \frac{470}{1{,}25\times\sqrt{3}} \times \frac{1}{0{,}9} = 241MPa$$

Threaded bars/nut: 8.8 quality steel: $f_{yd} = 0{,}9\times f_u/\gamma_{M2} = 0{,}9\times 800/1{,}25 = 576$ MPa

[1] The design of the column unit and horizontal anchoring of the threaded bars in the beam/column is based on the assumption of minimum concrete grade C35/45. BSF1100: Assumed concrete grade C45/55 in column. For NDP's and further information, see Memo 521 "BSF units – Design of reinforcement" and Memo "BSF- Design of steel units"

1.2 DIMENSIONS AND CROSS-SECTION PARAMETERS

UNIT	KNIFE				POSITION	HALF ROUND STEEL			HORIZONTAL ANCHORING
	L [mm]	H [mm]	t [mm]	Steel grade		D [mm]	L [mm]	Steel grade	
BSF225	510	195	20	S355	FRONT (TOP)	Ø76	100	S355	2×M12, 8.8+ nut, L=650mm & st.pl.50×50×8, S355
					BACK (BOTTOM)	Ø76	100	S275	1×M16, 8.8+nut, L=350mm & st.pl.70×70×10,S355
BSF300	510	235	20	S355	FRONT (TOP)	Ø76	100	S355	2×M12, 8.8+nut, L=650mm & st.pl.50×50×8, S355
					BACK (BOTTOM)	Ø76	100	S275	1×M16, 8.8+nut, L=350mm & st.pl.70×70×10,S355
BSF450	645	250	30	S355	FRONT (TOP)	Ø76	140	S355	2×M12, 8.8+nut, L=750mm & st.pl.50×50×8, S355
					BACK (BOTTOM)	Ø76	100	S275	1×M16, 8.8+nut, L=350mm & st.pl.70×70×10,S355
BSF700	645	280	40	S355	FRONT (TOP)	Ø175	140	S355	2×M16, 8.8+nut, L=750mm & st.pl.70×70×10, S355
					BACK (BOTTOM)	Ø76	100	S275	1×M20, 8.8+nut, L=350mm & st.pl.90×90×12,S355
BSF1100	980	360	50	S355[2)]	FRONT (TOP)	Ø175	200	S355	2×M24, 8.8+nut, L=1000mm & st.pl.110×110×15, S355
					BACK (BOTTOM)	Ø100	100	S275	1×M24, 8.8+nut, L=350mm & st.pl.110×110×15, S355

Table 1: Dimensions and steel qualities - beam unit. [2)] Reduced yield stress due to t>40 mm

UNIT	BOTTOM PLATE				VERTICAL REINFORCMENT BAR	HORIZONTAL ANCHORING
	Length [mm]	Width [mm]	Thickness [mm]	Steel grade		
BSF225	110	110	20	S355	1×ø20 L=600mm	2×M12, 8.8 +nut & st.pl. 50×50×8, S355
BSF300	110	150	25	S355	1×ø20 L=600mm	2×M12, 8.8 +nut & st.pl. 50×50×8, S355
BSF450	125	180	30	S355	1×ø25 L=600mm	2×M16, 8.8 +nut & st.pl. 70×70×10, S355
BSF700	150	200	40	S355	2×ø25 L=790mm	2×M20, 8.8 +nut & st.pl. 90×90×12, S355
BSF1100	200	250	60	S355[2)]	2xø32 l=690 mm	2×M24, 8.8 +nut & st.pl. 110×110×15, S355

Table 2: Dimensions and steel qualities - column unit. [2)] Reduced yield stress due to t>40 mm

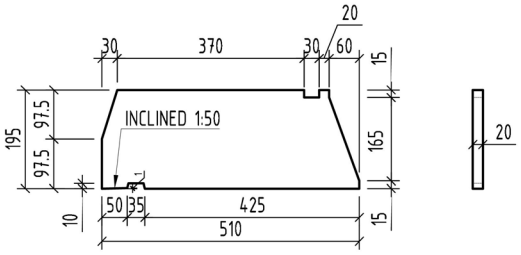
NOMINAL DIAMETER		M12		M16		M20		M24	
Equivalent diameter: $Ø_{eq}$ [mm]		10,4		14,1		17,7		21,2	
Stress area: A_s [mm^2]		84		157		245		353	
Tensile capacity (8.8): $F_{cap}= f_{yd}×A_s$ [kN]		48		90		141		203	
Width across flats: NV [mm]		19		24		30		36	
Required dim. of square steel plate anchoring F_{cap}:[1)] $b_{req}≥[F_{cap}/f_{cd}+π×Ø^2_{nom}/4]^{0.5}$ [mm] Select b×b		≈50,4 Select 50×50		69 Select 70×70		86 Select 90×90		103 Select 110×110	
Net area for compression anchorage: $A_{net}=A_{steel\ plate}-π×Ø^2_{nom}/4$ [mm^2]		2387		4699		7786		11648	
Concrete stress: $σ_c=F_{cap}/A_{net}$ [MPa]		20,1		19,1		18,1		17,4	
Required thickness of steel plate, S355:[1)] $a=(2^{0.5}×b-NV)/2$ $->t_1≥a×(σ_c/f_{yd})^{0,5}$[mm]		a=25,9 c=15,5	t_1=6,5 t_2=6,7	a=37,5 c=23	a=60 c=37	a=60 c=37	t_1=11,5 t_2=12,3	a=60 c=37	t_1=13,9 t_2=14,9
$c=b/2-NV/2$ $->t_2≥3^{0,5}×c×(σ_c/f_{yd})^{0,5}$[mm] $t>[t_1, t_2]$		Select t=8mm		Select t=10mm		Select t=12mm		Select t=15mm	
Standard height of nut: (H) [mm]		10,0		13,0		16,0		21,5	
Required thread length in blind holes:	S275:(f_u=410Mpa): 1,5×D	18mm		24mm		30mm		36mm	
	S355:(f_u=470Mpa): 1,5×D	18mm		24mm		30mm		36mm	
Dimension of corresponding threaded insert [mm]		50×18×18		60×22×22		70×30×30		80×32×32	

Table 3: Dimensions and steel qualities - threaded bars, inserts and anchoring steel plates.

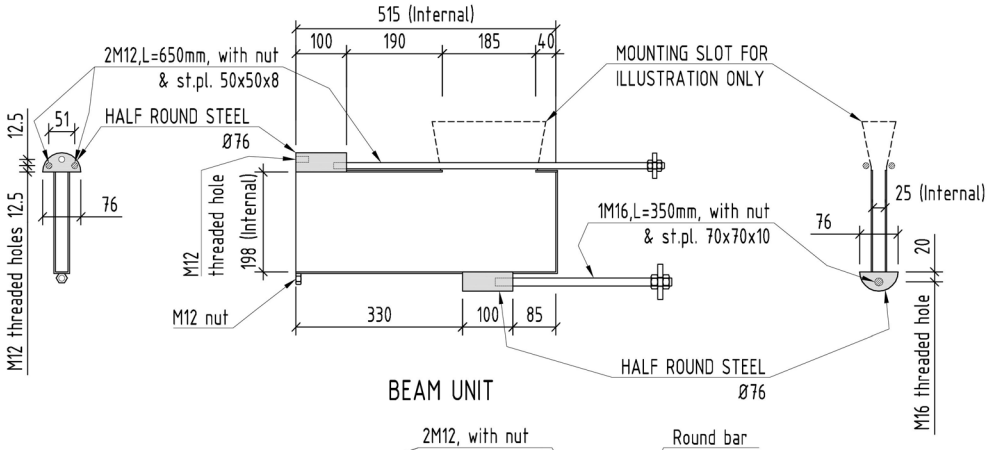
1.3 GENERAL INFORMATION TO THE BELOW ILLUSTATIONS

- Thickness of the box sides: 2mm for both the column and the beam units. (BSF 1100: 3mm)
- Length of the threaded bars in beam unit: The given length are the overall length before screwed into the half round steels.
- Length of the threaded bars in column unit: The length of the threaded bars in the column unit is to be adapted to the column dimension. The user in each case must ensure the bars have a proper length to avoid ripping out a concrete cone.

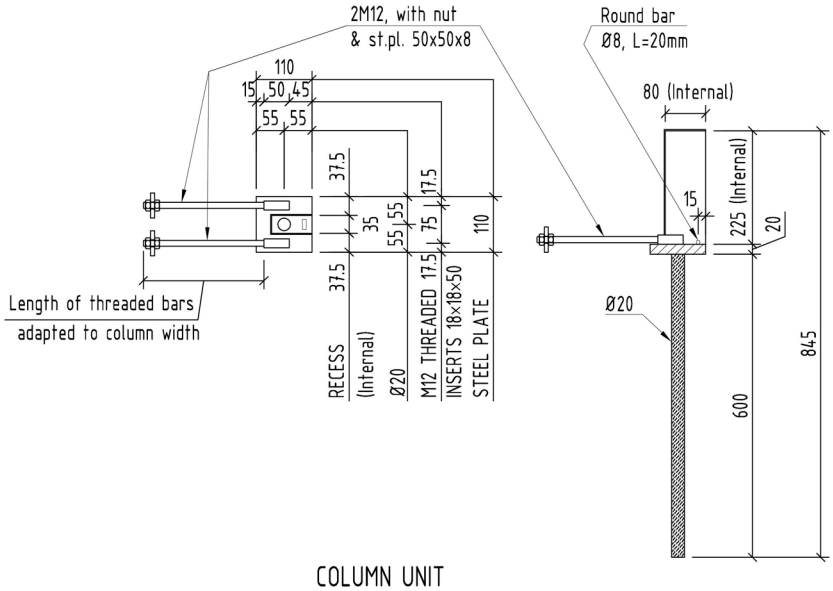
BSF225



KNIFE

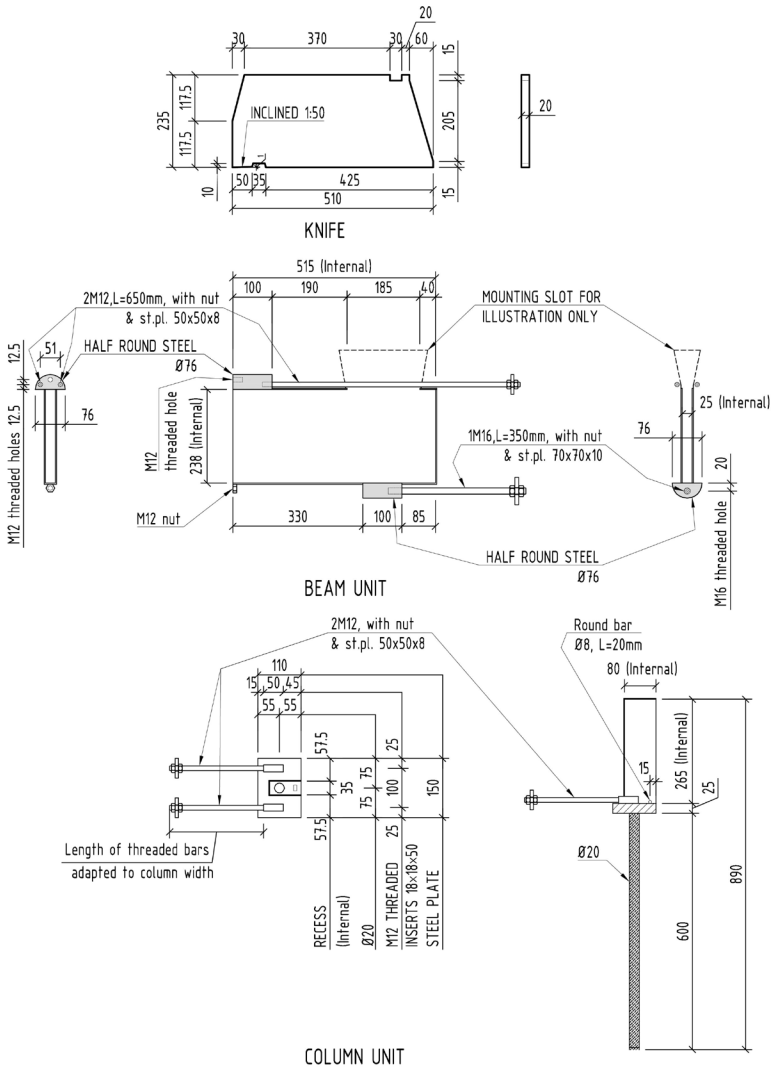


BEAM UNIT

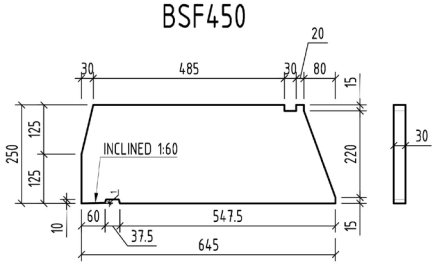


COLUMN UNIT

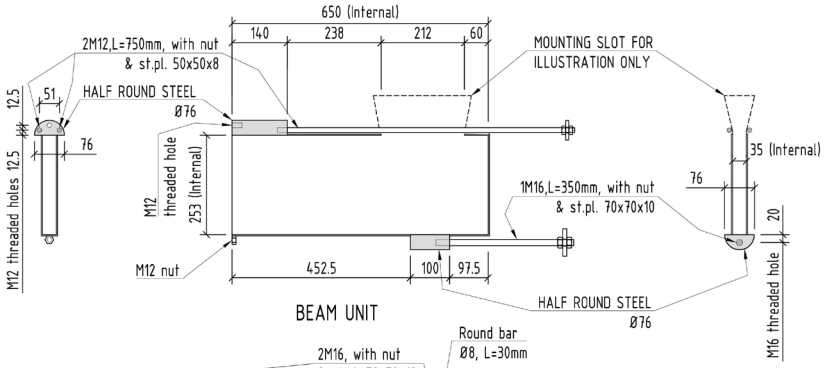
BSF300


KNIFE
INCLINED 1:50
BEAM UNIT
2M12,L=650mm, with nut & st.pl. 50x50x8
HALF ROUND STEEL Ø76
MOUNTING SLOT FOR ILLUSTRATION ONLY
1M16,L=350mm, with nut & st.pl. 70x70x10
M12 threaded holes
M12 threaded hole
M16 threaded hole
M12 nut
COLUMN UNIT
Length of threaded bars adapted to column width
RECESS (Internal) Ø20
M12 THREADED INSERTS 18x18x50 STEEL PLATE
Round bar Ø8, L=20mm
80 (Internal)
265 (Internal)
Ø20
600
890

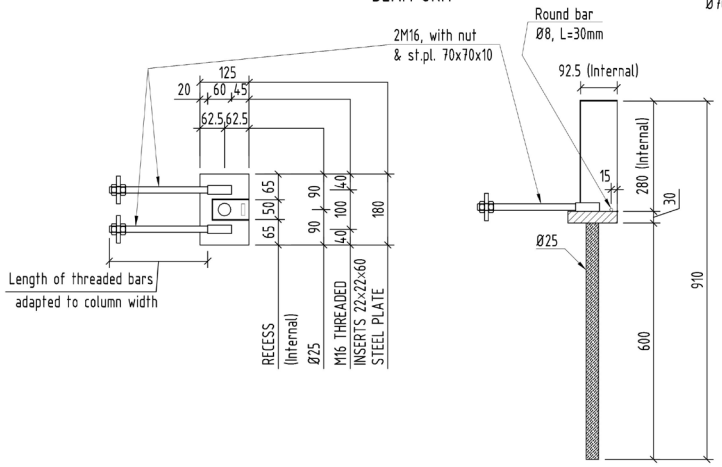
BSF450



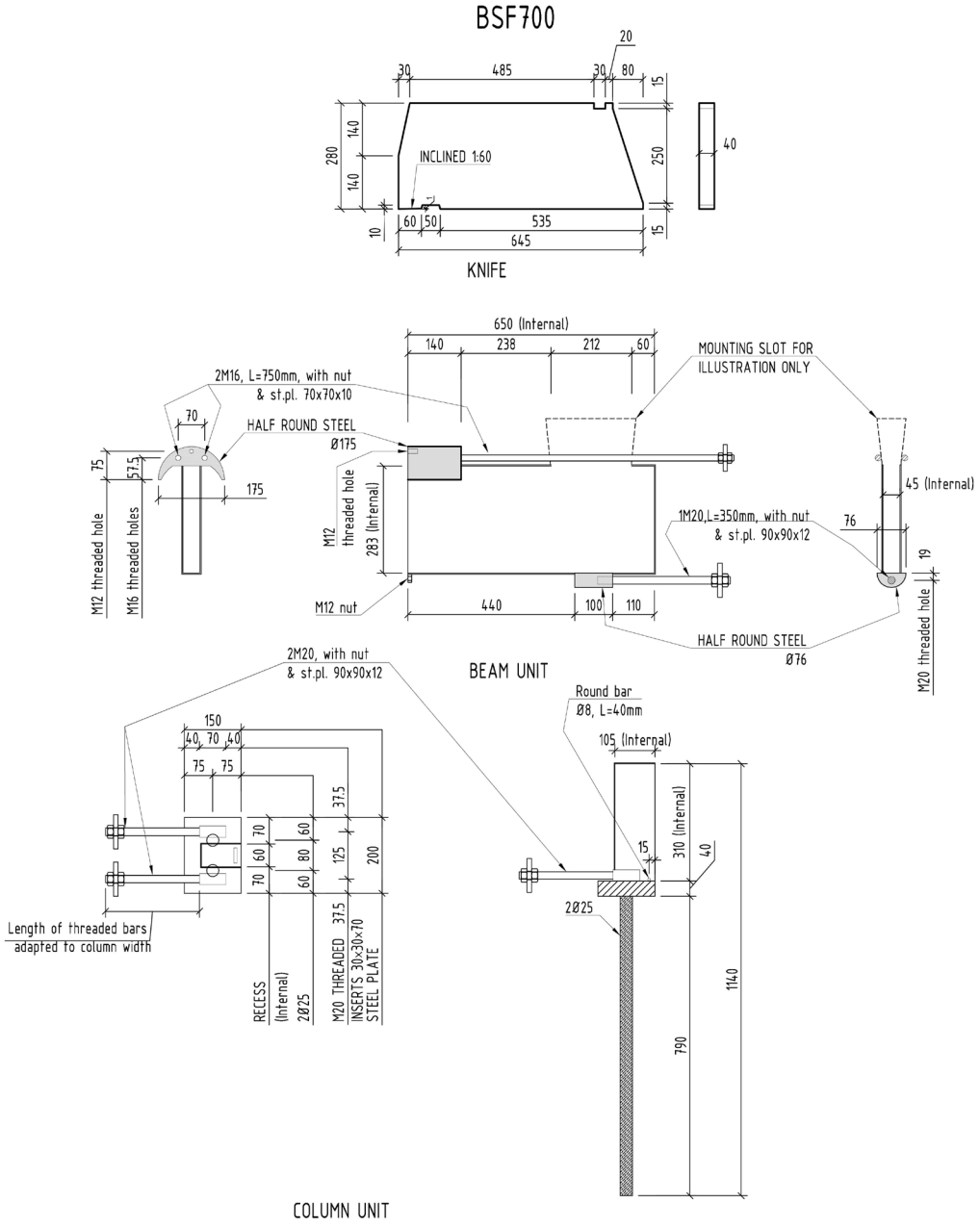
KNIFE

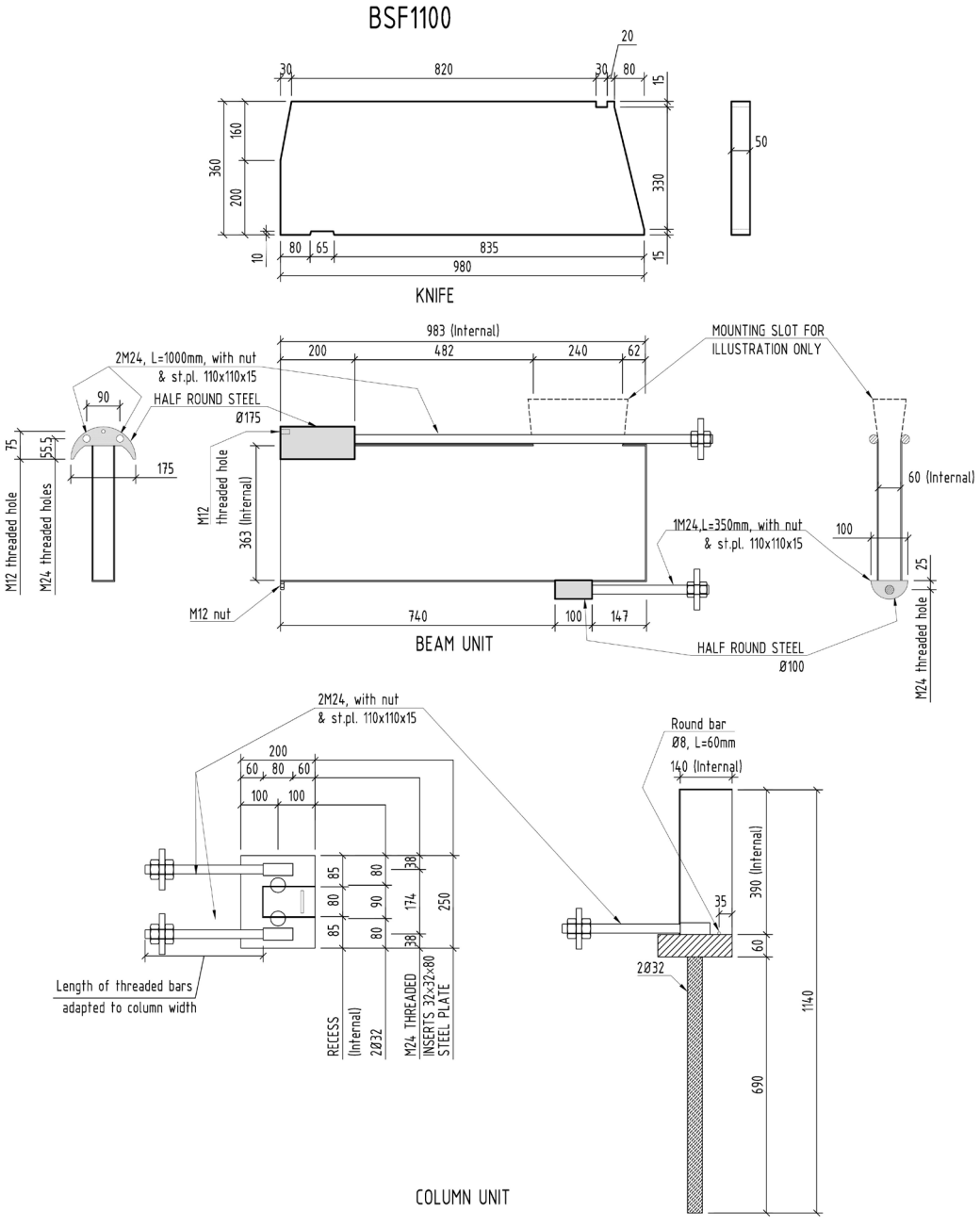


BEAM UNIT



COLUMN UNIT


BSF700
KNIFE
INCLINED 1:60
BEAM UNIT
MOUNTING SLOT FOR ILLUSTRATION ONLY
HALF ROUND STEEL Ø175
HALF ROUND STEEL Ø76
2M16, L=750mm, with nut & st.pl. 70x70x10
1M20,L=350mm, with nut & st.pl. 90x90x12
M12 threaded hole
M16 threaded holes
M12 nut
M20 threaded hole
45 (Internal)
283 (Internal)
650 (Internal)
COLUMN UNIT
2M20, with nut & st.pl. 90x90x12
Round bar Ø8, L=40mm
105 (Internal)
310 (Internal)
Length of threaded bars adapted to column width
RECESS (Internal) 2Ø25
M20 THREADED INSERTS 30x30x70 STEEL PLATE
2Ø25
790
1140


BSF1100
KNIFE
983 (Internal)
MOUNTING SLOT FOR ILLUSTRATION ONLY
2M24, L=1000mm, with nut & st.pl. 110x110x15
HALF ROUND STEEL Ø175
M12 threaded hole
M24 threaded holes
M12 threaded hole
363 (Internal)
M12 nut
1M24,L=350mm, with nut & st.pl. 110x110x15
60 (Internal)
HALF ROUND STEEL Ø100
M24 threaded hole
BEAM UNIT
2M24, with nut & st.pl. 110x110x15
Round bar Ø8, L=60mm
140 (Internal)
Length of threaded bars adapted to column width
RECESS (Internal) 2Ø32
M24 THREADED INSERTS 32x32x80 STEEL PLATE
390 (Internal)
2Ø32
690
114.0
COLUMN UNIT

REVISION HISTORY	
Date:	**Description:**
17.04.2013	First Edition (for ETA)
12.06.2013	Updated before ETA. Corrected reinforcement quality from B500C to 500C. Included reference to EN10025-2 for steel quality.
03.10.2013	Replaced “Figure xx” textbox with heading on each unit. Reorganized Table 1.
06.11.2013	Included comments from external review. Included additional dimensions in the drawings. Included chapter 1.3
26.06.2014	Changed half round steel BSF700 unit.
19.08.2014	Changed position of threaded bars in half round steel BSF700 unit
13.01.2015	Updated Table 3. Required thread length in blind holes.
27.02.2015	Included a nut on the front side of the steel plate anchoring the threaded bars. (To ensure correct position of the plate when casting the concrete).
24.11.2015	Corrected misprint on page 6, illustration of BSF700 unit. (Threaded hole at rear: M20)
23.05.2016	New template
08.11.2018	Included BSF1100.Minor text changes.
14.02.2020	Changed column unit