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MEMBER OF EOTA



European Technical Assessment ETA-20/0143 of 2020/10/05

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:

SPAX Hold-downs SXAH, SXHD, SXHDL, SXHT, SXHT2P

Product family to which the above construction product belongs:

Three-dimensional nailing plate (Angle brackets and hold-downs for timber-to-timber or timber-to-concrete or steel connections)

Manufacturer:

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Manufacturing plant:

SPAX International production facilities

This European Technical Assessment contains:

46 pages including 2 annexes which form an integral part of the document

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:

EAD 130186-00-0603 for Three-dimensional nailing plates

This version replaces:

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

SPAX hold-downs, respectively angle brackets, are one-piece non-welded or welded, face-fixed and side - fixed angle brackets to be used in timber to timber or in timber to concrete or to steel connections. They are connected to construction members made of timber or wood-based products with profiled (ringed shank) nails or screws according to ETA-20/0527 (SPAX connector screws and nails) or to EN 14592, and to concrete or steel members with bolts or metal anchors.

The hold-downs with a steel plate thickness of 2 mm to 4 mm are made from pre-galvanized steel S250 GD / Z 275 or DX 51 D / Z 275 according to EN 10346 with $R_e \geq 250 \text{ N/mm}^2$, $R_m \geq 360 \text{ N/mm}^2$ and $A_{80} \geq 19\%$ or steel grade S355 according to EN 10025-2. The Washers are made from steel grade S235 according to EN 10025-2. Dimensions, hole positions and typical installations are shown in Annex A and B. SPAX angle brackets and hold-downs are made from steel with tolerances according to EN 10143.

2 Specification of the intended use in accordance with the applicable EAD

The hold-downs are intended for use in making connections in load bearing timber structures, as a connection between a column or a purlin and a concrete or steel member, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

The static and kinematical behaviour of the timber members or the supports shall be as described in Annex B.

The wood members may be of solid timber, glued laminated timber and similar glued members, or wood-based structural members with a characteristic density from 290 kg/m^3 to 420 kg/m^3 . This requirement to the material of the wood members can be fulfilled by using the following materials:

- Structural solid timber classified to C14-C40 according to EN 14081,
- Glulam classified to GL24-GL36 according to EN 14080,
- LVL according to EN 14374,

- Parallam PSL,
- Intrallam LSL,
- Glued solid timber according to EN 14080,
- Cross laminated timber,
- Plywood according to EN 636

Annex B states the load-carrying capacities of the bracket connections for a characteristic density of 350 kg/m^3 . For timber or wood-based material with a lower characteristic density than 350 kg/m^3 the load-carrying capacities shall be reduced by the k_{dens} factor:

$$k_{\text{dens}} = \left(\frac{\rho_k}{350} \right)^2$$

Where ρ_k is the characteristic density of the timber in kg/m^3 .

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code. The wood members shall have a thickness which is larger than the penetration depth of the fasteners into the members. If a wood-based panel interlayer is placed between the connector plate and the timber member, the lateral load-carrying capacity of the nail or screw, respectively, has to take into account the effect of the interlayer.

The hold-downs are primarily for use in timber structures subject to the dry, internal conditions defined by service classes 1 and 2 of Eurocode 5 and for connections subject to static or quasi-static loading.

The brackets may also be used in outdoor timber structures, service class 3, when a corrosion protection in accordance with Eurocode 5 is applied, or when stainless steel with similar or better characteristic yield and ultimate strength is employed. If a stainless steel with a lower characteristic yield or ultimate strength is employed, the load-carrying capacities $F_{m,Rk}$, $F_{v,Rk}$ or $F_{t,Rk}$ in Tables 1 and 2 (see annex B) are to be reduced proportionally.

The hold-downs may also be used for connections between two timber members.

The scope of the brackets regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the connectors of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or

Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Characteristic load-carrying capacity	See Annex B
Stiffness	No performance assessed
Ductility in cyclic testing	No performance assessed
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The hold downs are made from steel classified as performance class A1 in accordance with the provisions of Commission Delegated Regulation 2016/364 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC
3.8 General aspects related to the performance of the product	The hold-downs have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2
Identification	See Annex A

*) See additional information in section 3.9 – 3.12.

3.9 Methods of verification

The characteristic load-carrying capacities are based on the characteristic values of the nail or screw connections and the steel plates. To obtain design values the capacities have to be divided by different partial factors for the material properties, the nail or screw connection in addition multiplied with the coefficient k_{mod} .

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity may be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Thus, the characteristic values of the load-carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of nails or screws subjected to shear or the withdrawal capacity of the most loaded nail or screw, respectively) as well as for steel plate failure $F_{Rk,S}$. The design value of the load-carrying capacity is the smaller value of both load-carrying capacities.

$$F_{Rd} = \min \left\{ \frac{k_{mod} \cdot F_{Rk,H}}{\gamma_{M,H}}; \frac{F_{Rk,S}}{\gamma_{M,S}} \right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for steel or timber, respectively, are also correctly taken into account.

3.10 Mechanical resistance and stability

See annex B for the characteristic load-carrying capacity in the different directions F_1 to F_3 .

The characteristic capacities of the hold-downs are determined by calculation assisted by testing as described in the EAD 130186-00-0603 for Three-dimensional nailing plates. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

No performance has been determined in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

No performance has been determined in relation to the joint's stiffness properties to be used for the analysis of the serviceability limit state.

3.11 Aspects related to the performance of the product

3.11.1 Corrosion protection in service class 1 and 2.
In accordance with EAD 130186-00-0603 for Three-dimensional nailing plates the zinc-coated hold downs and angle brackets have a zinc coating weight of min Z275. The steel employed is S250 GD+Z275 to EN 10346:2009 or DX51D with min Z275 according to EN 10346:2009, and steel grade S355 according to EN 10025-2 with FeZn 12C.

3.12 General aspects related to the fitness for use of the product

The performances given in this ETA are based on the following:

- The structural members – the components 1 and 2 shown in the figure on page 12 – to which the brackets are fixed shall be:
 - Restrained against rotation.
 - Strength class C14 or better, see section II.1 of this ETA
 - Free from wane under the bracket.
- The actual end bearing capacity of the timber member to be used in conjunction with the bracket is checked by the designer of the structure to ensure it is not less than the bracket capacity and, if necessary, the bracket capacity reduced accordingly.
- The gap between the timber members does not exceed 3 mm.

There are no specific requirements relating to preparation of the timber members.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/638/EC of the European Commission, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

Issued in Copenhagen on 2020-10-05 by



Thomas Bruun
Managing Director, ETA-Danmark

Annex A - Product details definitions

Table A.1 Materials specification

Bracket type		Thickness (mm)	Steel specification	Coating specification
SXAH155	155x50x40x3,0	3,0	S250 GD or DX51D	Z 275
SXAH200	200x40x40x2,0	2,0	S250 GD or DX51D	Z 275
SXAH20040	200x40x40x4,0	4,0	S250 GD or DX51D	Z 275
SXAH300	300x40x40x2,0	2,0	S250 GD or DX51D	Z 275
SXAH30040	300x40x40x4,0	4,0	S250 GD or DX51D	Z 275
SXAH400	400x40x40x2,0	2,0	S250 GD or DX51D	Z 275
SXAH40040	400x40x40x4,0	4,0	S250 GD or DX51D	Z 275
SXAH500	500x40x40x2,0	2,0	S250 GD or DX51D	Z 275
SXAH50040	500x40x40x4,0	4,0	S250 GD or DX51D	Z 275
SXAH600	600x40x40x2,0	2,0	S250 GD or DX51D	Z 275
SXAH60040	600x40x40x4,0	4,0	S250 GD or DX51D	Z 275
SXHD340	340x182x40x2,0	2,0	S250 GD or DX51D	Z 275
SXHD400	400x123x40x3,0	3,0	S250 GD or DX51D	Z 275
SXHD420222	420x222x60x2,0	2,0	S250 GD or DX51D	Z 275
SXHD420102	420x102x60x2,0	2,0	S250 GD or DX51D	Z 275
SXHD480	480x123x60x2,5	2,5	S250 GD or DX51D	Z 275
SXHD280	280x122x40x2,0	2,0	S250 GD or DX51D	Z 275
SXHD142	142x93x60x2,0	2,0	S250 GD or DX51D	Z 275
SXHD520	520x222x60x2,5	2,5	S250 GD or DX51D	Z 275
hold-down Vario SXHDL240	240x120x55x2,0	2,0	S250 GD or DX51D	Z 275
hold-down Vario SXHDL280	280x120x55x2,0	2,0	S250 GD or DX51D	Z 275
SXHT340		3,0	S355	FeZn 12c
SXHT440		3,0	S355	FeZn 12c
SXHT540		3,0	S355	FeZn 12c
SXHT420		3,0	S355	FeZn 12c
SXHT520		3,0	S355	FeZn 12c
SXHT620		3,0	S355	FeZn 12c
SXHT740		3,0	S355	FeZn 12c
SXHT540R22		3,0	S355	FeZn 12c
SXHT620R26		3,0	S355	FeZn 12c
SXBP Washer 40x43x10		10,0	S 235	FeZn 12c
SXBP Washer 160x50x15		15,0	S 235	FeZn 12c
SXBP Washer 110x60x15		15,0	S 235	FeZn 12c
SXBP Washer 200x60x20		20,0	S 235	FeZn 12c
SXBP Washer 85x60x20		20,0	S 235	FeZn 12c
SXBP Washer 115x70x20		20,0	S 235	FeZn 12c
SXBP Washer 220x60x25		25,0	S 235	FeZn 12c
SXBP Washer 90x50x12		12,0	S 235	FeZn 12c
SXBP Washer 114x55x20		20,0	S 235	FeZn 12c
SXBP Washer 56x50x10		10,0	S 235	FeZn 12c
SXBP Washer 77x70x20		20,0	S 235	FeZn 12c
SXBP Washer 80x130x40		40,0	S 235	FeZn 12c

Table A1.1 Materials specification bracket types SXHT2P

Hold-down type	Thick-ness (mm)	Steel specification	Coating specification	Tension plate	Base bracket
SXHT2P-GF-BPF	3,0	S355	FeZn 12c	SXHT2PGF340 M10 340x60x3,0mm	SXHT2PBPF Base bracket with washer 103x144x60x3,0mm
SXHT2P-GF-BWF	3,0	S355	FeZn 12c	SXHT2PGF340 M10 340x60x3,0mm	SXHT2PBWF Base bracket with web 103x73x60x3,0mm
SXHT2P-G2F-BWF	3,0	S355	FeZn 12c	SXHT2PG2F340 2xM10 340x60x3,0mm	SXHT2PBWF Base bracket with web 103x73x60x3,0mm
SXHT2P-G-BP73	3,0	S355	FeZn 12c	SXHT2PG340 M10 340x60x3,0mm	SXHT2PBP73 Base bracket with washer adjustable height 103x73x60x3,0mm
SXHT2P-G-BP	3,0	S355	FeZn 12c	SXHT2PG340 M10 340x60x3,0mm	SXHT2PBP Base bracket with washer adjustable height 103x144x60x3,0
SXHT2P-G-BW	3,0	S355	FeZn 12c	SXHT2PG340 M10 340x60x3,0mm	SXHT2PBW Base bracket with web adjustable height 103x73x60x3,0
SXHT2P-L-BW	3,0	S355	FeZn 12c	SXHT2PL340 M10 340x60/60x3,0mm	SXHT2PBW Base bracket with web adjustable height 103x73x60x3,0
SXHT2P-L425-BW	3,0	S355	FeZn 12c	SXHT2PL425 M10 425x60/60x3,0mm	SXHT2PBW Base bracket with web adjustable height 103x73x60x3,0
SXHT2P-R-BW	3,0	S355	FeZn 12c	SXHT2PR340 M10 340x60/60x3,0mm	SXHT2PBW Base bracket with web adjustable height 103x73x60x3,0
SXHT2P-R425-BW	3,0	S355	FeZn 12c	SXHT2PR425 M10 425x60/60x3,0mm	SXHT2PBW Base bracket with web adjustable height 103x73x60x3,0
SXBP Washer 140x60x15	15,0	S 235	-	-	-
SXBP Washer 70x60x15	15,0	S 235	-	-	-

Table A.2 Range of sizes

Bracket type		Height (mm) vertical		Height (mm) horizontal		Width (mm)	
SXAH155	155x50x40x3,0	154	156	49	51	39	41
SXAH200	200x40x40x2,0	199	201	39	41	39	41
SXAH20040	200x40x40x4,0	199	201	39	41	39	41
SXAH300	300x40x40x2,0	299	301	39	41	39	41
SXAH30040	300x40x40x4,0	299	301	39	41	39	41
SXAH400	400x40x40x2,0	399	401	39	41	39	41
SXAH40040	400x40x40x4,0	399	401	39	41	39	41
SXAH500	500x40x40x2,0	499	501	39	41	39	41
SXAH50040	500x40x40x4,0	499	501	39	41	39	41
SXAH600	600x40x40x2,0	599	601	39	41	39	41
SXAH60040	600x40x40x4,0	599	601	39	41	39	41
SXHD340	340x182x40x2,0	339	341	181	183	39	41
SXHD400	400x123x40x3,0	399	401	122	124	39	41
SXHD420222	420x222x60x2,0	319	421	221	223	59	61
SXHD420102	420x102x60x2,0	419	421	101	103	59	61
SXHD480	480x123x60x2,5	479	481	122	124	59	61
SXHD280	280x122x40x2,0	279	281	121	123	39	41
SXHD142	142x93x60x2,0	141	143	92	94	59	61
SXHD520	520x222x60x2,5	519	521	221	223	59	61
hold-down Vario SXHDL240	240x120x55x2,0	239	241	119	121	54	56
hold-down Vario SXHDL280	280x120x55x2,0	279	281	119	121	54	56
SXHT340		339	341	62	64	59	61
SXHT440		439	441	62	64	64	61
SXHT540		539	541	62	64	59	61
SXHT420		419	421	62/82	64/84	79	81
SXHT520		519	521	62/82	64/84	79	81
SXHT620		619	621	62/82	64/84	79	81
SXHT740		739	741	82	84	139	141
SXHT540R22		539	541	62	64	59	61
SXHT620R26		619	621	82	84	79	81
SXBP Washer	40x43x10	-	-	39	41	42	44
SXBP Washer	160x50x15	-	-	159	161	49	51
SXBP Washer	110x60x15	-	-	109	111	59	61
SXBP Washer	200x60x20	-	-	199	201	59	61
SXBP Washer	85x60x20	-	-	84	86	59	61
SXBP Washer	115x70x20	-	-	114	116	69	71
SXBP Washer	220x60x25	-	-	219	221	59	61
SXBP Washer	90x50x12	-	-	89	91	49	51
SXBP Washer	114x55x20	-	-	113	115	54	56
SXBP Washer	56x50x10	-	-	55	57	49	51
SXBP Washer	77x70x20	-	-	76	78	69	71
SXBP Washer	80x130x40	-	-	79	81	129	131

Table A.2.1 Range of sizes bracket type SXHT2P

Hold-down type	Height (mm)		Height (mm)		Width (mm)	
	vertical		horizontal			
SXHT2P-GF-BPF	349	351	146	148	59	61
SXHT2P-GF-BWF	387	389	75	77	59	61
SXHT2P-G2F-BWF	347	349	75	77	59	61
SXHT2P-G-BP73	340	373	75	77	59	61
SXHT2P-G-BP	340	373	146	148	59	61
SXHT2P-G-BW	340	373	75	77	59	61
SXHT2P-L-BW	340	373	75	77	59	61
SXHT2P-L425-BW	425	458	75	77	59	61
SXHT2P-R-BW	340	373	75	77	59	61
SXHT2P-R425-BW	425	458	75	77	59	61
SXBP Washer 140x60x15	139	141	14,5	16	59	61
SXBP Washer 70x60x15	69	71	14,5	16	56	61

Table A.3 Fastener specification

FASTENER	Length Min – max	Nail type
Profiled nail 4.0 mm	40 – 100 mm	Ringed shank nail according to EN 14592
SPAX Connector Nail 4.0 mm	40 – 100 mm	Ringed shank nail according to ETA-20/0527
SPAX Connector Screw 5.0 mm	25 – 70 mm	Self-tapping screw according to ETA-20/0527

In the load-carrying-capacities of the nailed or screwed connection in Annex B the capacities calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral fastener load-carrying-capacity. The load-carrying-capacities of the hold downs have been determined based on the use of connector nails $\varnothing 4,0$ mm or connector screws $\varnothing 5,0$ mm in accordance with the European Technical Approval for the nails or the screws. The characteristic withdrawal capacity of the nails according to EN 14592 has to be determined by calculation in accordance with EN 1995-1-1, paragraph 8.3.2 (head pull-through is not relevant):

$$F_{ax,Rk} = f_{1,k} \times d \times t_{pen}$$

Where:

$f_{1,k}$ Characteristic value of the withdrawal parameter in N/mm²

d Nail or screw diameter in mm

t_{pen} Penetration depth of the profiled shank in mm;

(4,0 x 40 mm $t_{pen} \geq 31$ mm; 4,0 x 50 mm $t_{pen} \geq 40$ mm; 4,0 x 60 mm $t_{pen} \geq 50$ mm)

Based on tests by Versuchsanstalt für Stahl, Holz und Steine, University of Karlsruhe, the characteristic value of the withdrawal resistance for the threaded nails according to EN 14592 can be calculated as:

$$f_{1,k} = 50 \times 10^{-6} \times \rho_k^2$$

Where:

ρ_k Characteristic density of the timber in kg/m³

The shape of the nail or screw directly under the head shall be in the form of a truncated cone with a diameter under the head which fits or exceeds the hole diameter.

BOLTS diameter	Correspondent Hole diameter	Bolt type
10.0 - 30.0 mm	Max. 2 mm. larger than the bolt diameter	Bolt according to EN 14592

METAL ANCHORS diameter	Correspondent Hole diameter	Anchor type
10.0 - 30.0 mm	Max. 2 mm. larger than the anchor diameter	See specification of the manufacturer

Table A.3.1 Fastener specification for brackets type SXHT2P specifically

FASTENER	Length Min – max	Fastener type
Nail 4.0 mm	40 – 100 mm	Ringed shank nails according to EN 14592 or ETA-20/0527
Screw 5.0 mm	25 – 70 mm	Self-tapping screws according to EN 14592 or ETA-20/0527

BOLT diameter	Correspondent Hole diameter	Bolt type
16.0 mm	1 mm. larger than the bolt diameter	Bolt according to EN 14592

METAL ANCHOR diameter	Correspondent Hole diameter	Anchor type
16.0 mm	1 mm. larger than the anchor diameter	See specification of the manufacturer

Table A.4 Installation options for bracket type SXHT2P specifically

SXHT2P tension plate	SXHT2P base bracket			
	with web adjustable height	with washer 140	with washer 70	with web not adjustable
SXHT2P G M10 340x60x3,0mm	x	x	x	x
SXHT2P G 2xM10 340x60x3,0mm	-	-	-	x
SXHT2P left M10 340x60/60x3,0mm	x	x	x	x
SXHT2P right M10 340x60/60x3,0mm	x	x	x	x
SXHT2P left M10 425x60/60x3,0mm	x	x	x	x
SXHT2P right M10 425x60/60x3,0mm	x	x	x	x

Annex B

Characteristic load-carrying capacities

Table 1: Force F_1 , 1 angle bracket / connection timber-timber

type	capacity per nail or screw in the vertical flange ($F_{v,Rk}$) [kN] ²⁾			capacity in the horizontal flange ($F_{ax,Rk}$) [kN] ^{1) 2)}			steel
	4x40/ 5x40	4x50/ 5x40	4x60/ 5x50	4x40/ 5x40	4x50/ 5x40	4x60/ 5x50	bending ($F_{m,Rk}$) [kN]
SXAH155	1,57	1,87	1,93	1,0	1,3	1,7	1,3
SXAH200-600; t=2,0 mm	1,57	1,87	1,93	0,9	1,1	1,4	0,6
SXAH200-600; t=4,0 mm	1,57	1,87	1,93	0,9	1,1	1,4	2,4

¹⁾ Both nail holes in the horizontal flange next to the bending line have to be nailed or screwed

²⁾ Given is the minimum load-carrying capacity of 4,0 mm nails according to EN 14592 and 5,0 mm screws according to ETA-20/0527. If a wood-based panel interlayer is placed between the connector plate and the timber member, the lateral load-carrying capacity of the nail or screw, respectively, has to take into account the effect of the interlayer.

Table 2: Force F_1 , 1 angle bracket / connection timber-concrete

type	capacity per nail or screw in the vertical flange ($F_{v,Rk}$) [kN] ²⁾			concrete	steel ³⁾			bolt
	4x40/ 5x40	4x50/ 5x40	4x60/ 5x50		bending ($F_{m,Rk}$) [kN]	shear ($F_{v,Rk}$) [kN]	tensile ($F_{t,Rk}$) [kN]	$k_{t II}$
SXAH155	1,57	1,87	1,93	see EN 1992	3,5	17,3	25,8	3,08
SXAH200-600, t=2,0 mm	1,57	1,87	1,93		23,3	11,6	17,8	3,16
SXAH200-600, t=4,0 mm	1,57	1,87	1,93		23,9	23,1	35,6	4,00
SXHD340	1,57	1,87	1,93		41,9	11,6	17,8	1,20
SXHD400	1,57	1,87	1,93		60,4	17,3	26,7	1,33
SXHD420222 420x222x60	1,57	1,87	1,93		62,0	17,3	26,7	1,23
SXHD420102 420x102x60	1,57	1,87	1,93		71,3	17,3	26,7	1,88
SXHD480	1,57	1,87	1,93		83,4	21,7	33,4	1,50
SXHD280	1,57	1,87	1,93		24,4	11,5	17,8	1,51
SXHD142	1,57	1,87	1,93		30,0	17,3	29,7	1,51
SXHD520	1,57	1,87	1,93		58,0	21,7	37,1	1,31
SXHDL240	1,57	1,87	1,93		54,4	15,9	23,8	1,49
SXHDL280	1,57	1,87	1,93		54,4	15,9	23,8	1,49
SXHT340, 440, 540 without base plate	1,57	1,87	1,93		42,0	42,0	63,4	1
SXHT340, 440, 540 SXHT540R22	1,57	1,87	1,93		63,4	63,4	63,4	1
SXHT420, 520, 620 without base plate	1,57	1,87	1,93		42,0	42,0	85,2	1
SXHT420, 520, 620 SXHT620R26	1,57	1,87	1,93		85,2	85,2	85,2	1
SXHT740	1,57	1,87	1,93		158	158	158	1

²⁾ Given is the minimum load-carrying capacity of 4,0 mm nails according to EN 14592 and 5,0 mm screws according to ETA-20/0527. Alternative fasteners according to Table A.3 may be used and their load-carrying capacity calculated based on EN 1995-1-1 and ETA-20/0527. If a wood-based panel interlayer is placed between the connector plate and the timber member, the lateral load-carrying capacity of the nail or screw, respectively, has to take into account the effect of the interlayer.

³⁾ Base plates/washers according to the engineering drawings must be used except where otherwise specified.

Table 2 contd.: Force F_1 , 1 hold-down / connection timber-concrete

Type	capacity per nail or screw in the vertical flange (F _{v,Rk}) [kN] ²⁾			concrete	steel ³⁾			bolt
	4x40/ 5x40	4x50/ 5x40	4x60/ 5x50		bending F _{m,Rk} [kN]	shear F _{v,Rk} [kN]	tensile F _{t,Rk} [kN]	k _{III}
SXHT2P-GF-BPF	1,57	1,87	1,93	see EN 1992	19,4*	21,4	36,9	1,40
SXHT2P-GF-BWF	1,57	1,87	1,93		-	21,4	36,9	1,00
SXHT2P-G2F-BWF	1,57	1,87	1,93		-	30,0	36,9	1,00
SXHT2P-G-BP73	1,57	1,87	1,93		16,0*	21,4	36,9	2,66
SXHT2P-G-BP	1,57	1,87	1,93		19,4*	21,4	36,9	1,40
SXHT2P-G-BW	1,57	1,87	1,93		-	21,4	36,9	1,00
SXHT2P-L-BW	1,57	1,87	1,93		-	21,4	36,9	1,00
SXHT2P-L425-BW	1,57	1,87	1,93		-	21,4	36,9	1,00
SXHT2P-R-BW	1,57	1,87	1,93		-	21,4	36,9	1,00
SXHT2P-R425-BW	1,57	1,87	1,93		-	21,4	36,9	1,00
* with SXBP base plate/washer t = 15 mm								

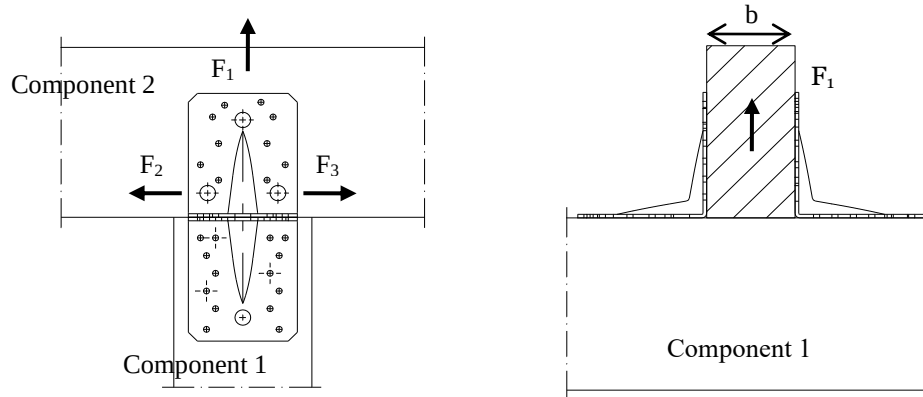
²⁾ 4,0 mm nails or 5,0 mm screws may be used³⁾ base plates/washers according to the engineering drawings are used**Table 3:** Force $F_{2,3}$, 1 angle bracket (nails 4,0 x 50 mm, 4,0 x 60 mm or screws 5,0 x 40 mm, 5,0 x 50 mm)

type	nail-number n_v	nail number n_H	bolt number n_H	$F_{2,3Rk}$ [kN]		bolt $k_{t\perp}$
				timber-timber	timber-concrete	
SXAH155 155x50x40x3,0	1,2,4,5,6,7,8,9,11,12	13,14,16,17	15	3,1	2,9	1,00
SXAH200 200x40x40x2,0	1,2,3,4,5,6,7,8,9,10,11,12, 13,14	16,17,19,20	18	3,1	3,6	1,18 ⁴⁾
SXAH20040 200x40x40x4,0	1,2,3,4,5,6,7,8,9,10,11,12, 13,14	16,17,19,20	18	3,1	3,6	1,18 ⁴⁾

⁴⁾ incl. factor 1/0,85 considering hole tolerance

Definitions of forces, their directions and eccentricity

Forces - Beam to beam connection



Fastener specification

Holes are marked with numbers referring to the nailing pattern in Annex B.

Single angle bracket per connection

Acting forces

- F_1 Lifting force acting in the central axis of the angle bracket. The component 2 shall be prevented from rotation.
- F_2 and F_3 Lateral force acting in the joint between the component 2 and the component 1 in the component 2 direction. The component 2 shall be prevented from rotation.

Double angle brackets per connection

The angle brackets must be placed at each side opposite to each other, symmetrically to the component axis.

Acting forces

- F_1 Lifting force acting along the central axis of the joint. The load-carrying capacity is twice the load-carrying capacity of a connection with one angle bracket.
- F_2 and F_3 Lateral force acting in the joint between the component 2 and component 1 in the component 2 direction. The load-carrying capacity is twice the load-carrying capacity of a connection with one angle bracket.

Wane

Wane is not allowed, the timber has to be sharp-edged in the area of the angle brackets.

Timber splitting

For the lifting force F_1 it must be checked in accordance with Eurocode 5 or a similar national Timber Code that splitting will not occur.

Connection to timber, concrete or steel with a bolt or metal anchor

The load $F_{B,Ed}$ for the design of a bolt or metal anchor is calculated as:

$$F_{B,t,Ed} = k_{t\parallel} \cdot F_{Ed} \text{ for tensile load}$$

$$F_{B,v,Ed} = k_{t\perp} \cdot F_{Ed} \text{ for shear load}$$

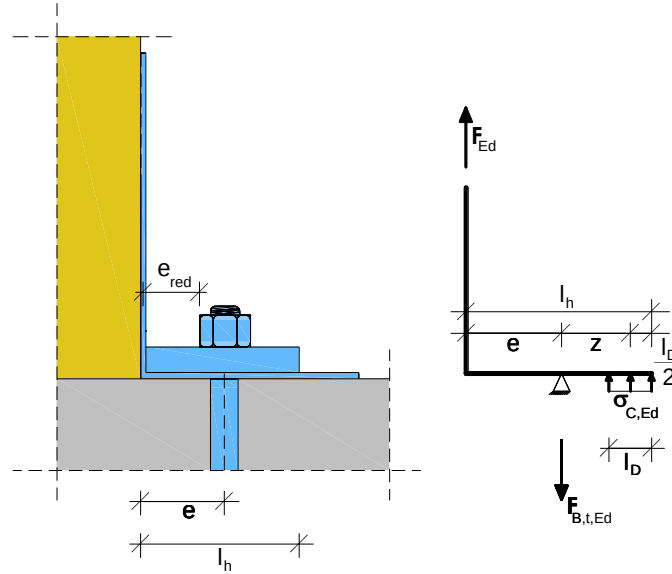
Where:

$F_{B,t,Ed}$ Bolt tensile load in N

$F_{B,v,Ed}$ Bolt shear load in N

k_t Coefficient taking into account the moment arm or hole tolerance, respectively

F_{Ed} Tensile load F_1 on vertical flap of the angle bracket or shear load $F_{2,3}$ in N



Combined forces

If the forces F_1 and F_2/F_3 act at the same time, the following inequality shall be fulfilled:

$$\left(\frac{F_{1,Ed}}{F_{1,Rd}} \right)^2 + \left(\frac{F_{2,Ed}}{F_{2,Rd}} \right)^2 + \left(\frac{F_{3,Ed}}{F_{3,Rd}} \right)^2 \leq 1$$

The forces F_2 and F_3 are forces with opposite direction. Therefore only one force F_2 or F_3 is able to act simultaneously with F_1 , while the other shall be set to zero.

SPAX Hold-downs and Angle Brackets

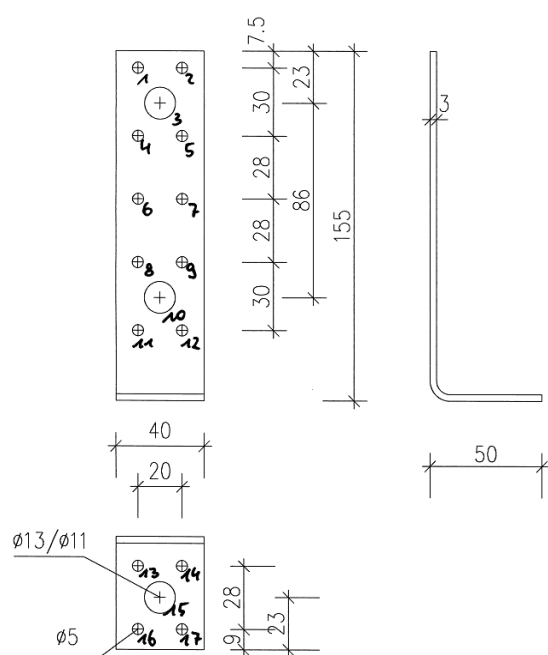


Figure B. 1 Dimensions of SXAH155 155x50x40x3,0

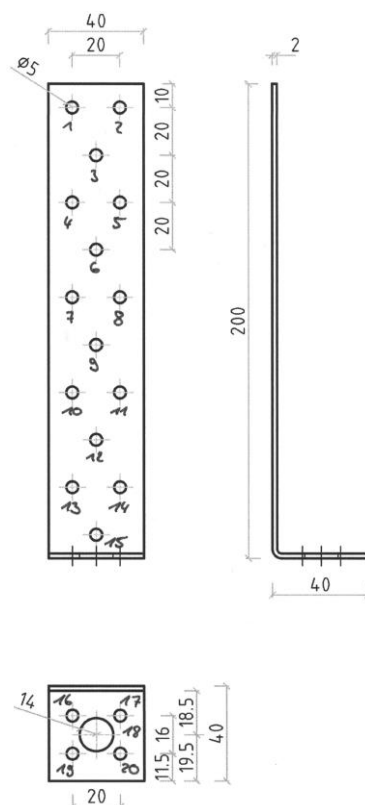


Figure B. 2 Dimensions of SXAH200 200x40x40x2,0

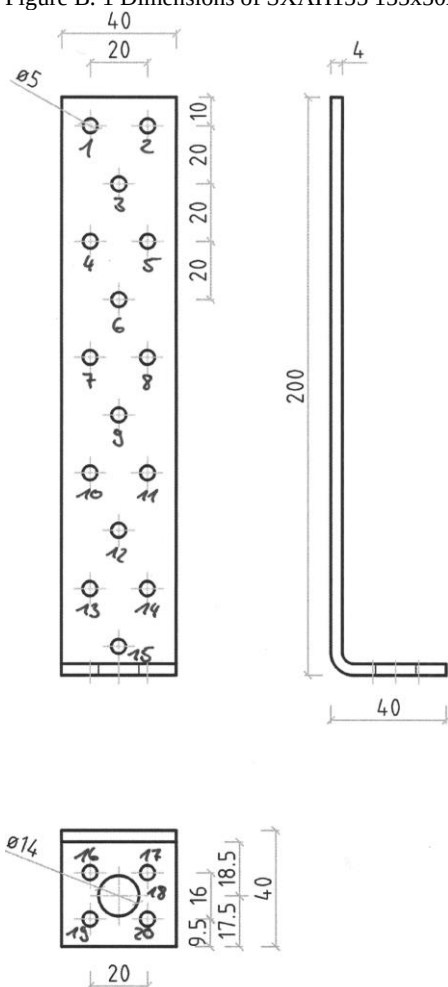


Figure B. 3 Dimensions of SXAH20040 200x40x40x4,0

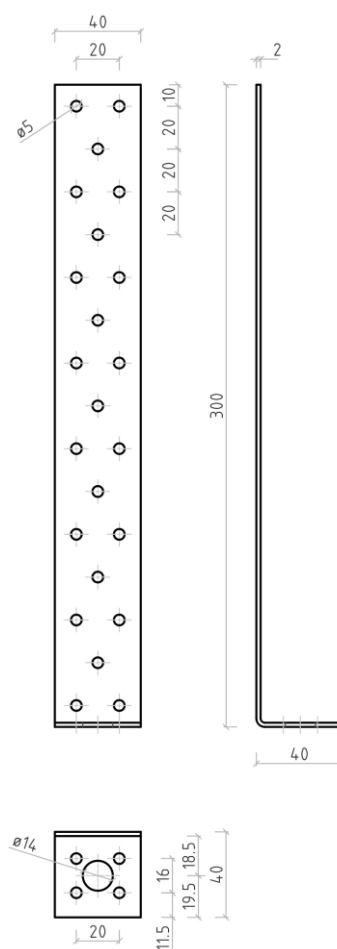


Figure B. 4 Dimensions of SXAH300 300x40x40x2,0

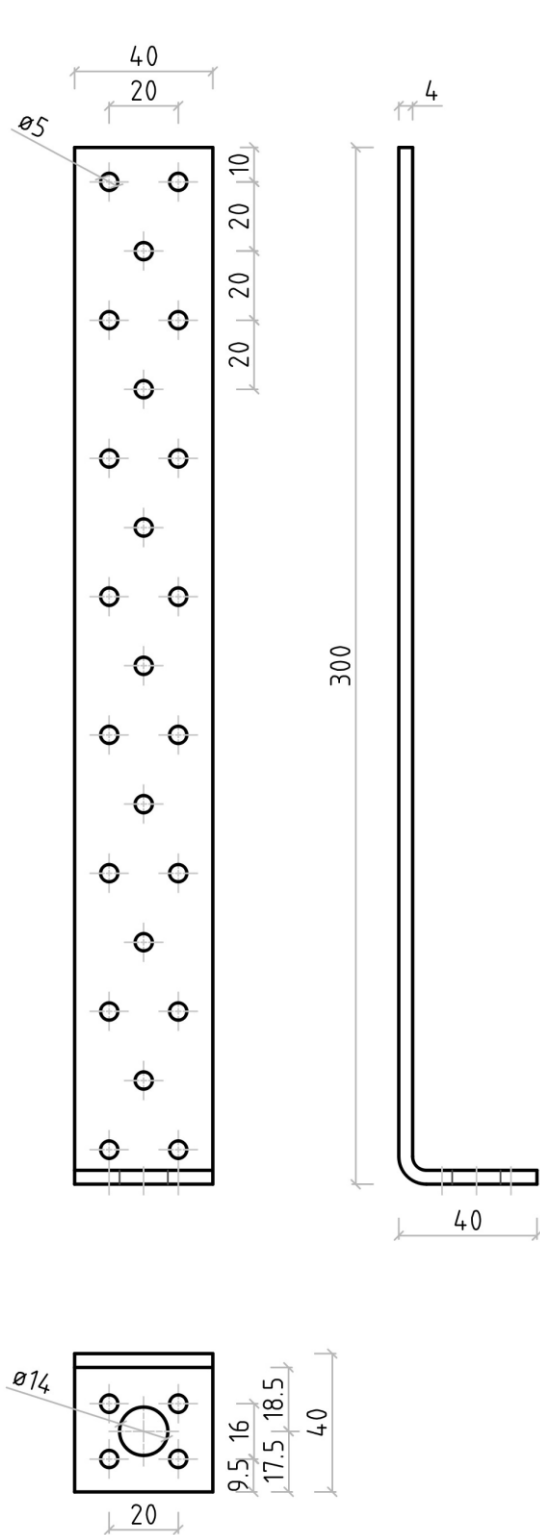


Figure B. 5 Dimensions of SXAH30040 300x40x40x4,0

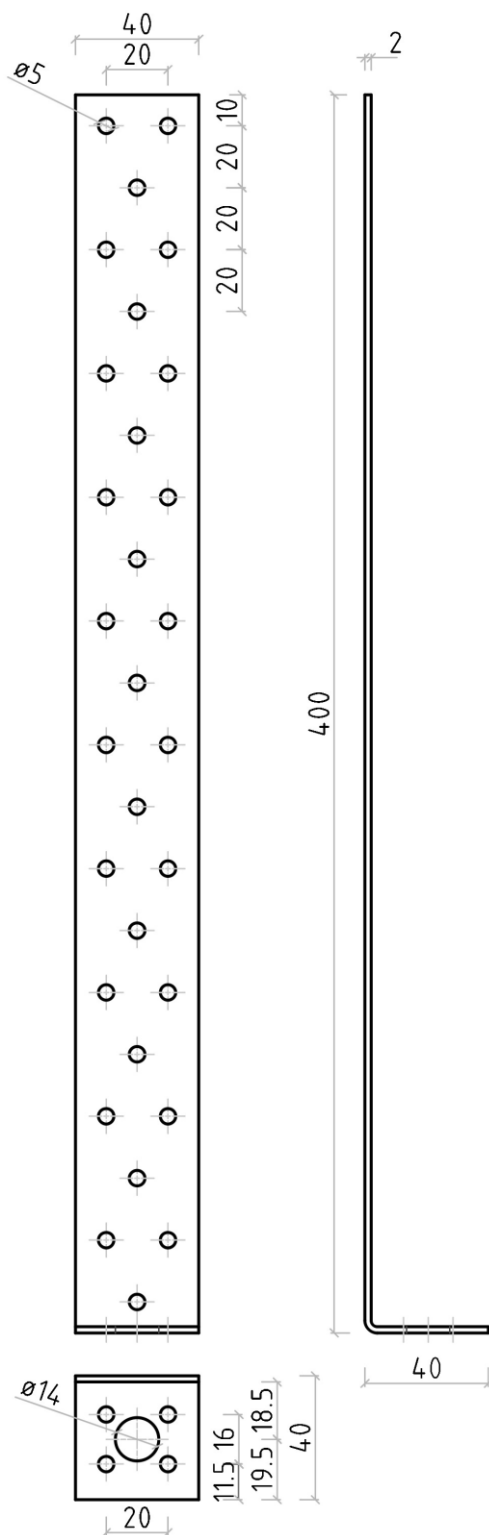


Figure B. 6 Dimensions of SXAH400 400x40x40x2,0

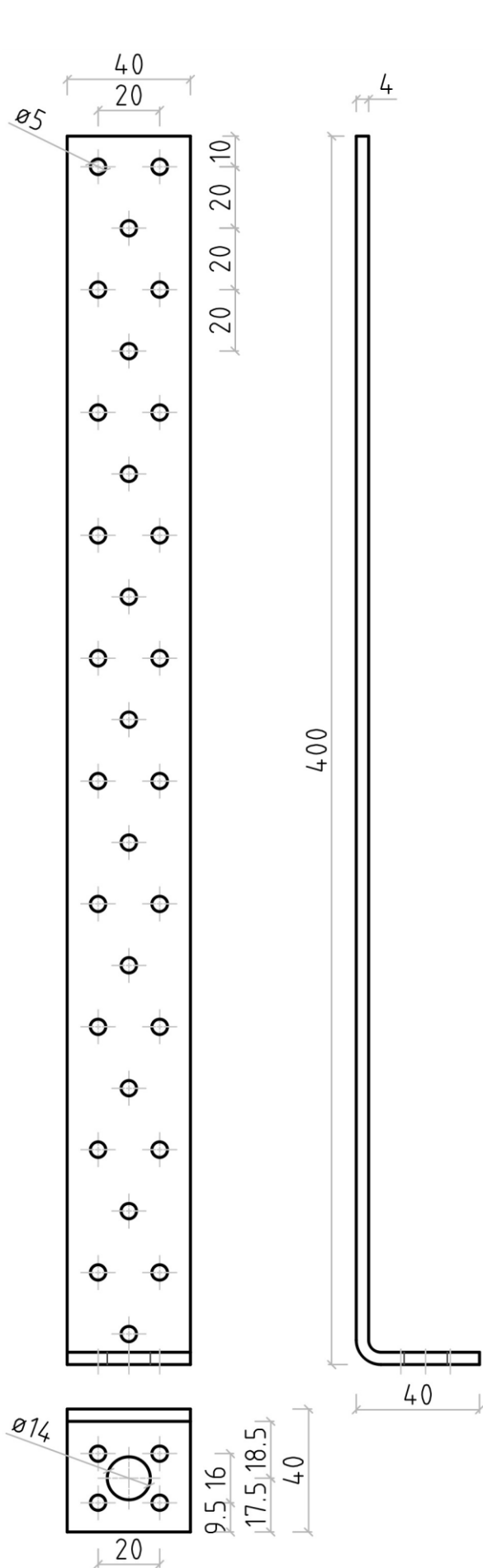


Figure B. 7 Dimensions of SXAH40040 400x40x40x4,0

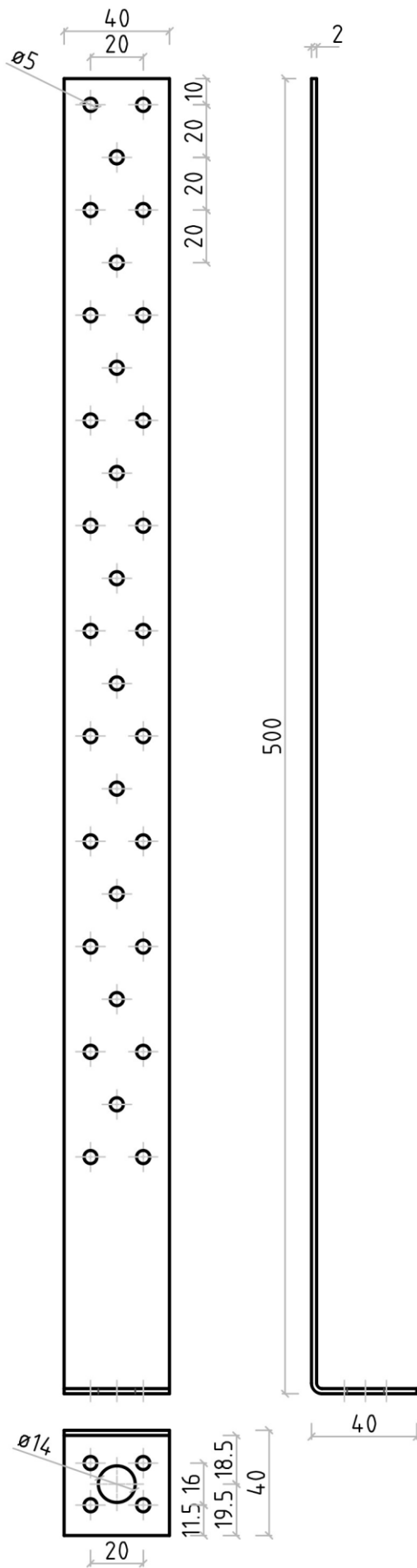


Figure B. 8 Dimensions of SXAH500 500x40x40x2,0

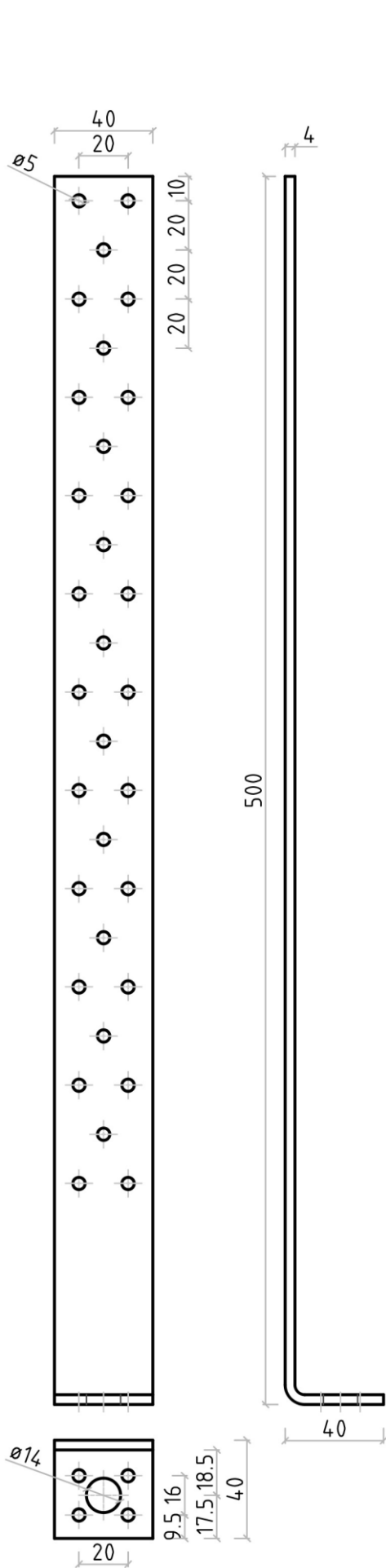


Figure B. 9 Dimensions of SXAH50040 500x40x40x4,0

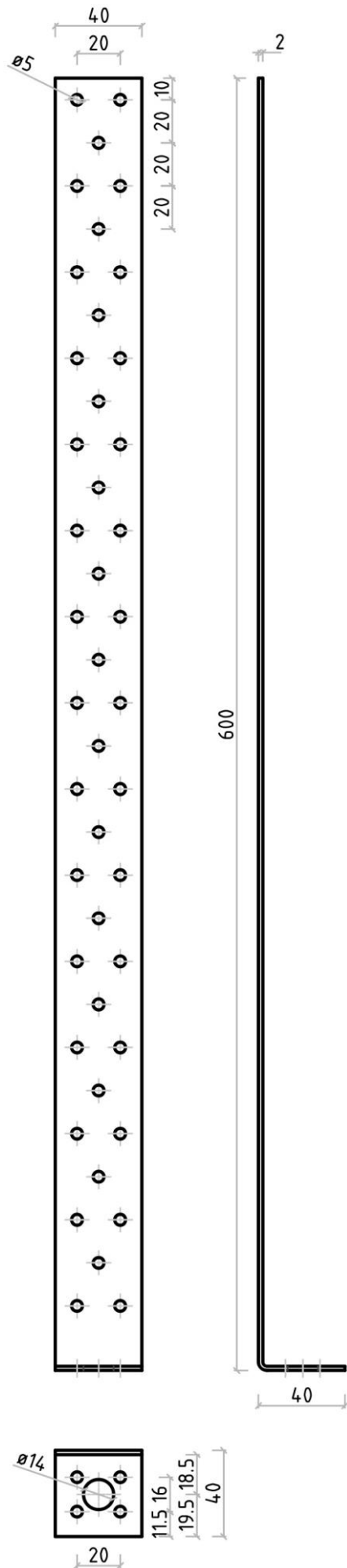


Figure B. 10 Dimensions of SXAH600 600x40x40x2,0

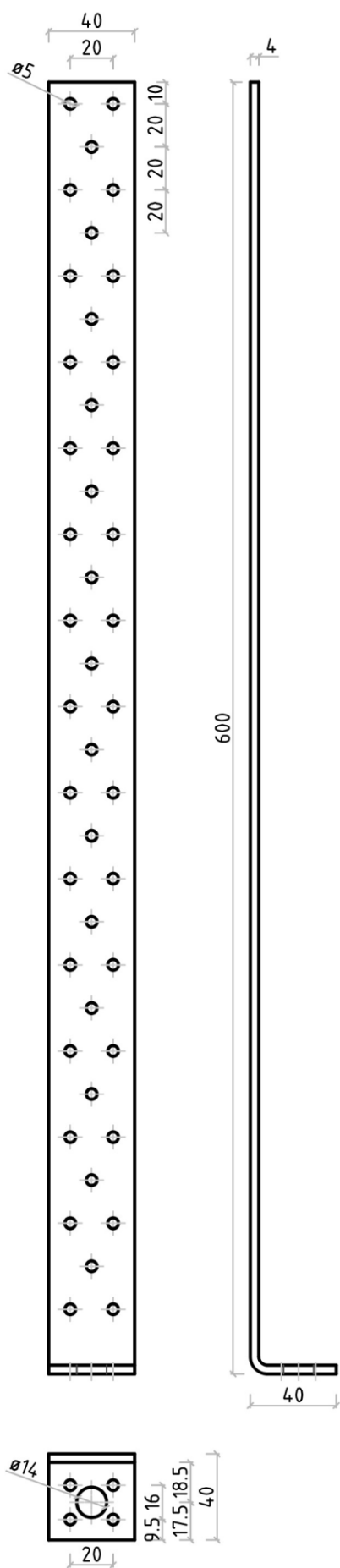


Figure B. 11 Dimensions of SXAH60040 600x40x40x4,0

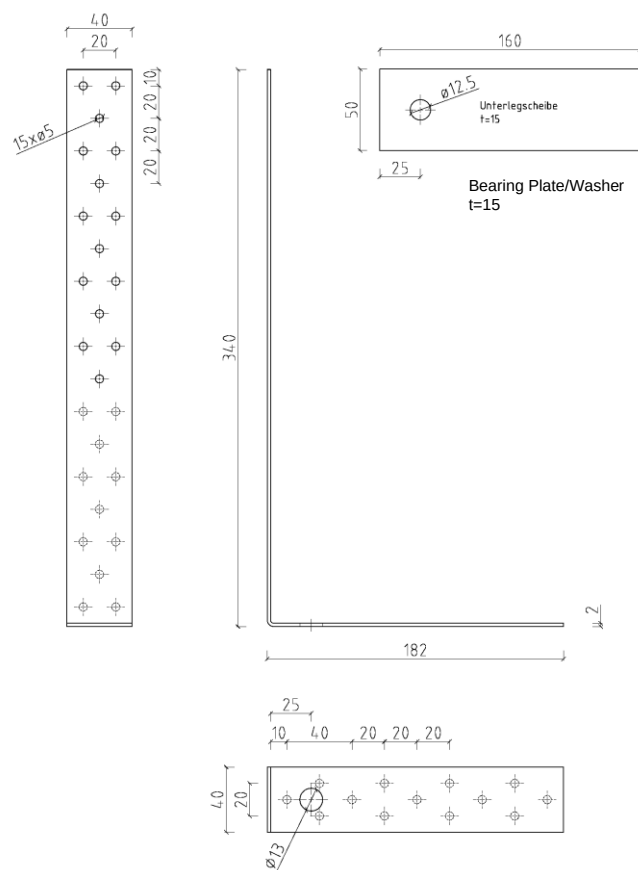


Figure B. 12 Dimensions of SXHD340 340x182x40x2,0

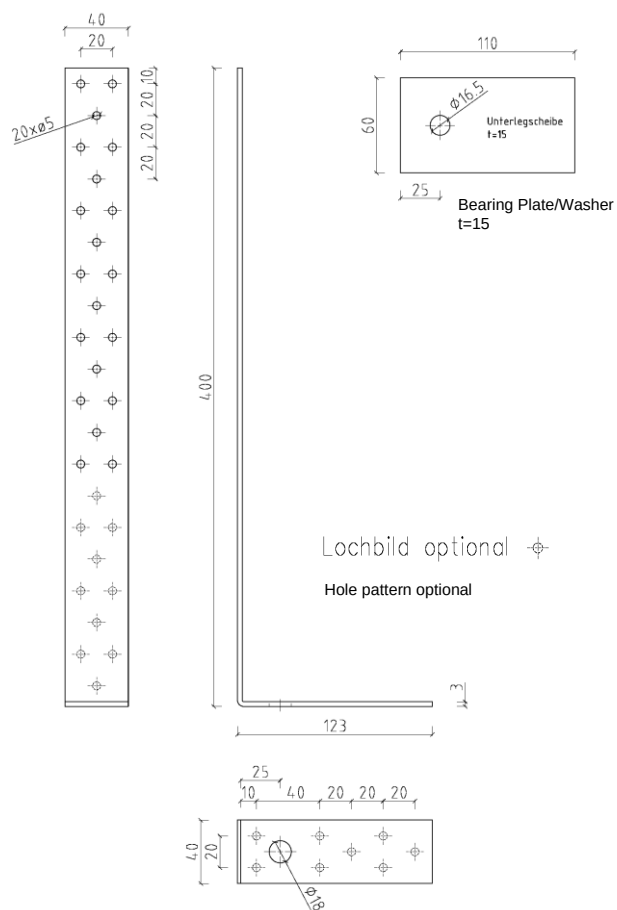


Figure B. 13 Dimensions of SXHD400 400x123x40x3,0

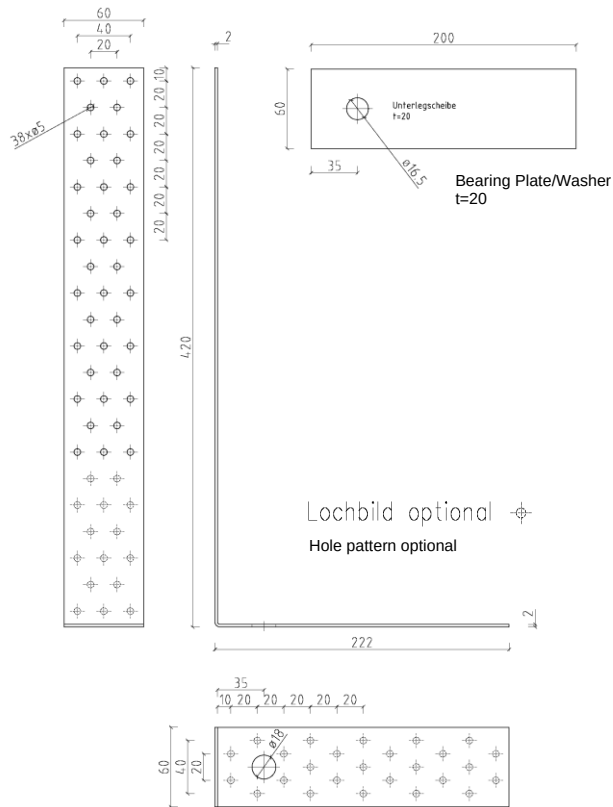


Figure B. 14 Dimensions of SXHD420222 420x222x60x2,0

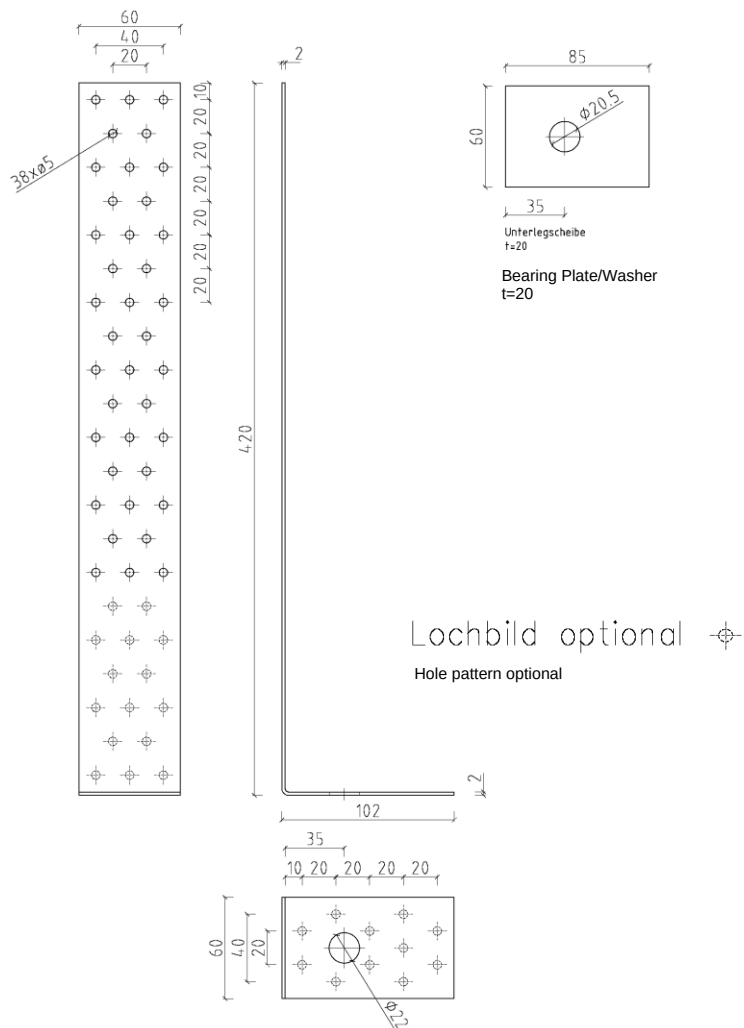


Figure B. 15 Dimensions of SXHD420102 420x102x60x2,0

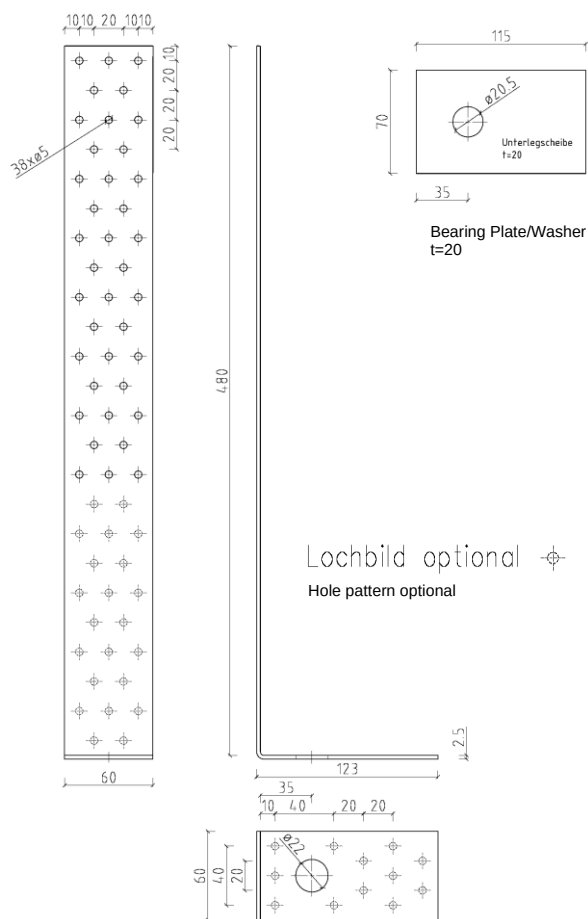


Figure B. 16 Dimensions of SXHD480 480x123x60x2,5

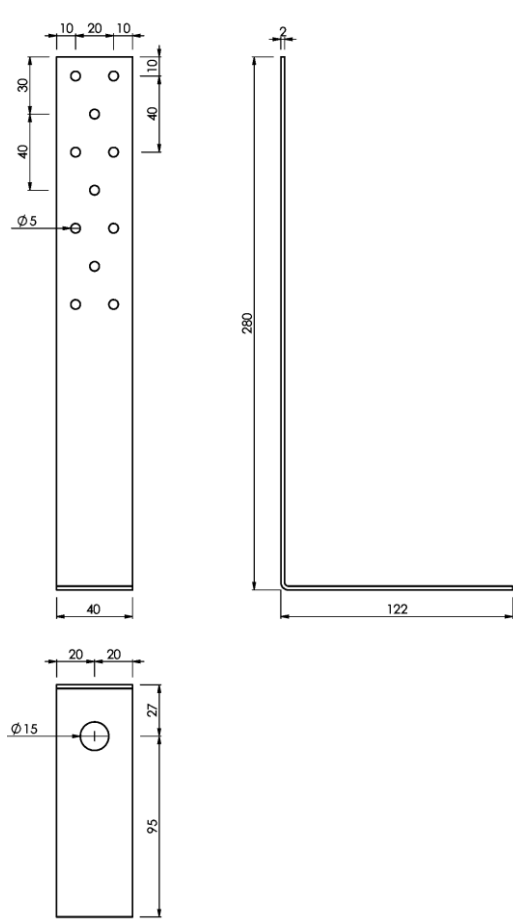


Figure B. 17 Dimensions of SXHD280 280x122x40x2

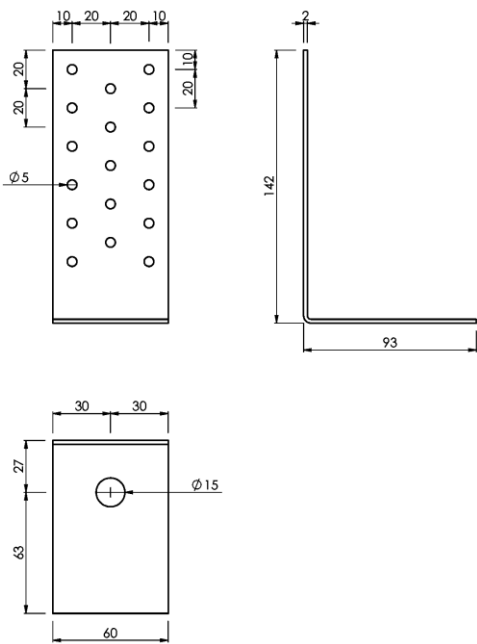


Figure B. 18 Dimensions of SXHD142 142x93x60x2

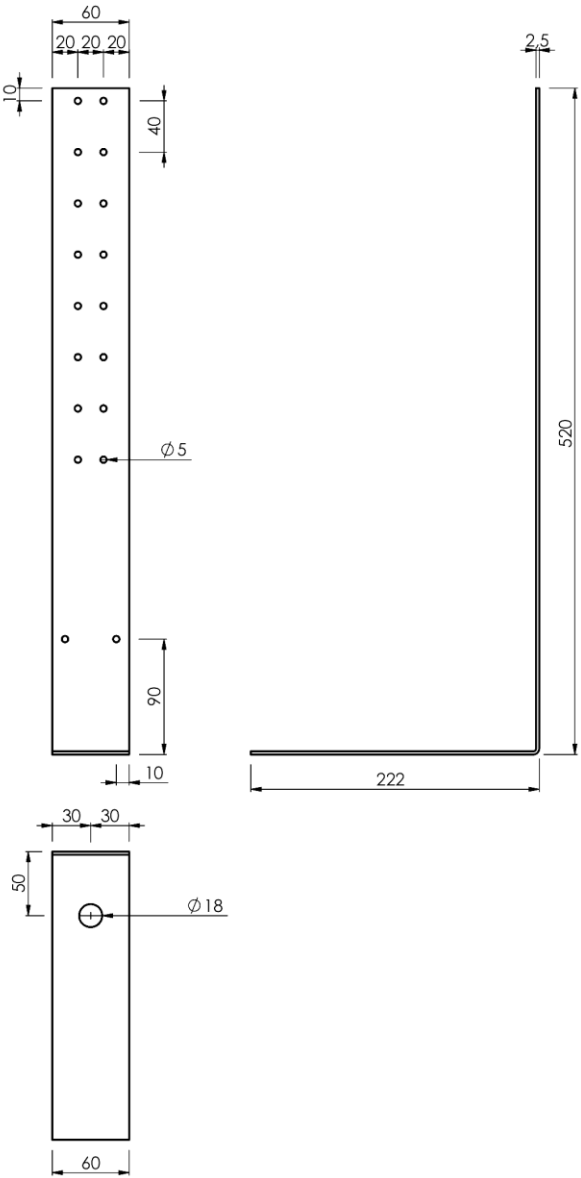


Figure B. 19 Dimensions of SXHD520 520x222x60x2,5

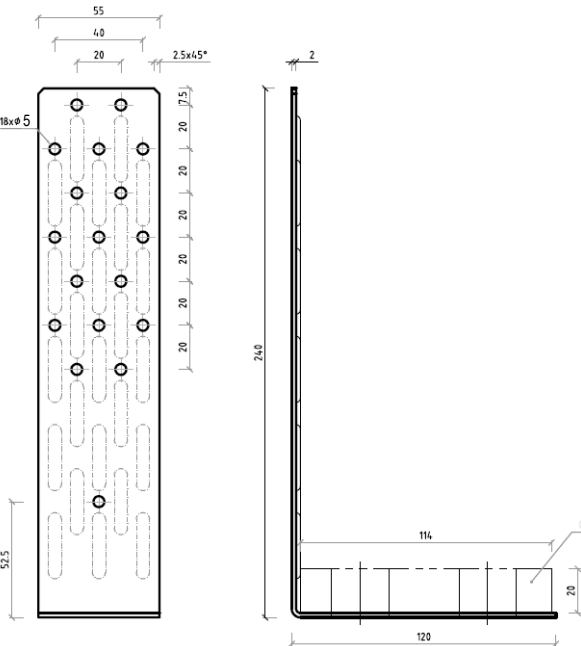


Figure B. 20 Dimensions of SXHDL240 240x120x55x2,0

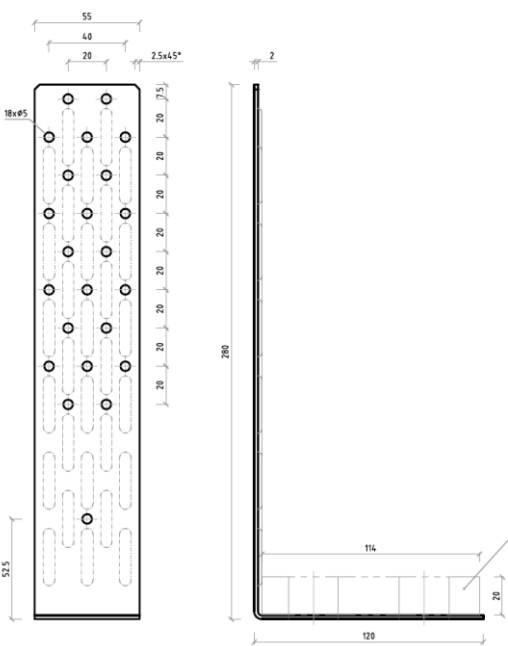


Figure B. 21 Dimensions of SXHDL280 280x120x55x2,0

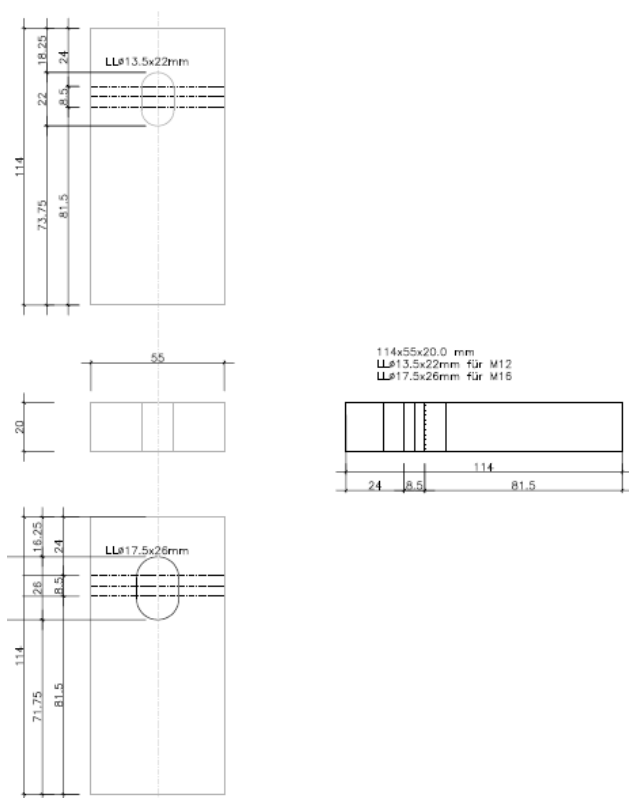


Figure B. 22 Dimensions of washer/bearing plate for SXHDL

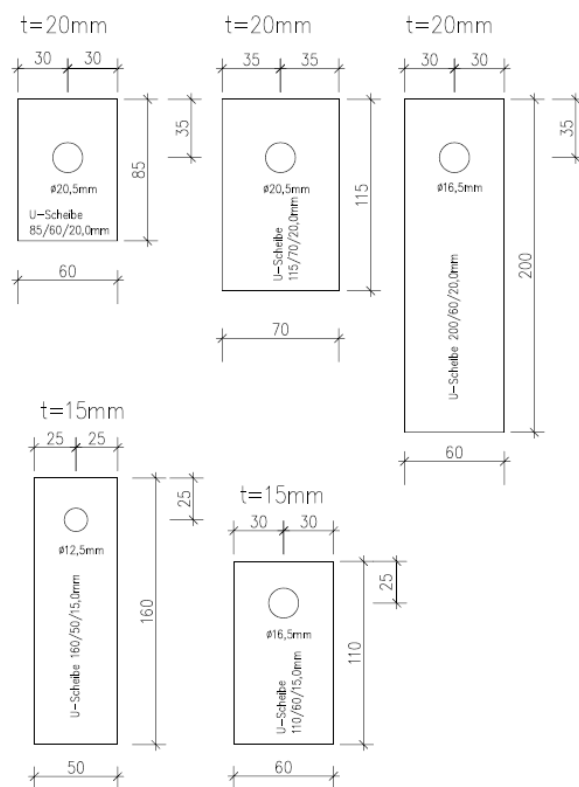


Figure B. 23 Dimensions of washers/bearing plates for hold-downs SXHD

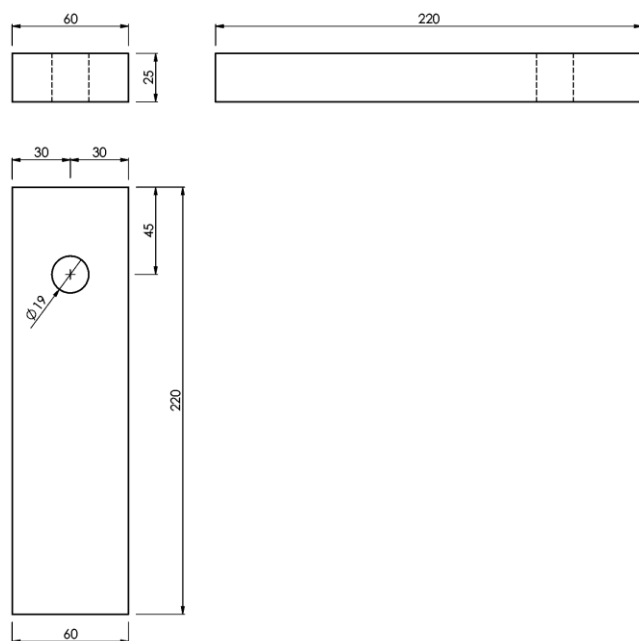


Figure B. 24 Dimensions of washer/bearing plate for hold-down SXHD520 520x222x60x2,5

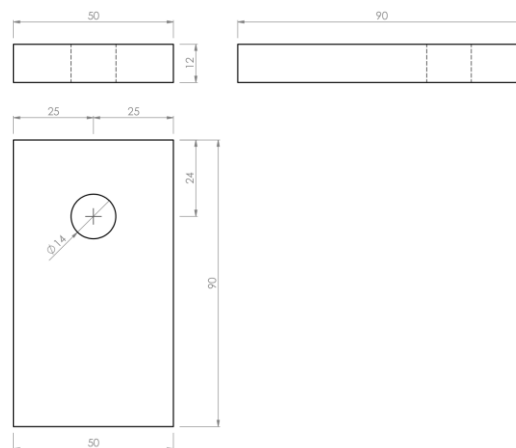


Figure B. 25 Dimensions of washer/bearing plate for hold-down SXHD142 142x93x60x2,0
SXHD280 280x122x40x2,0

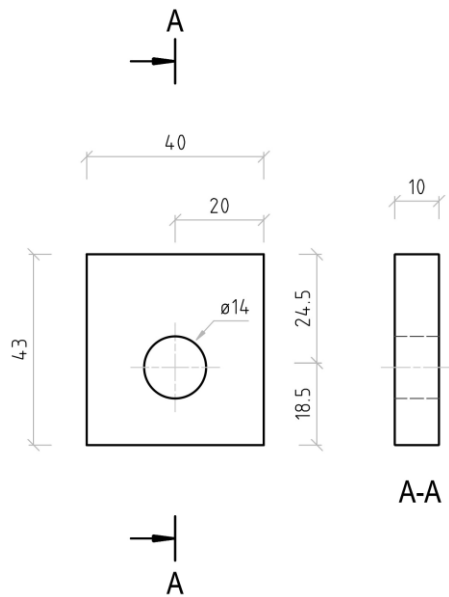


Figure B. 26 Dimensions of washer/bearing plate for SXAH

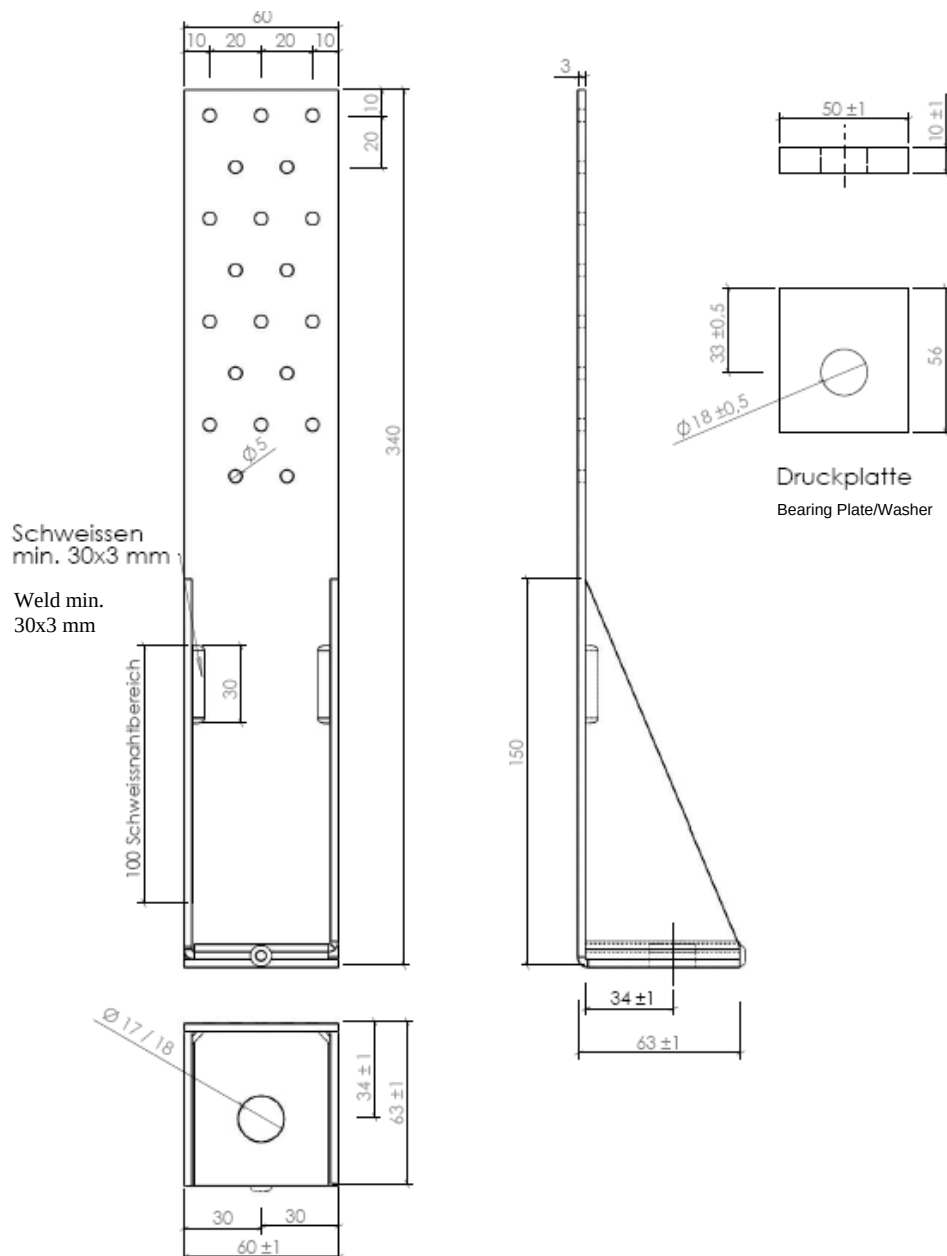


Figure B. 27 Dimensions of SXHT340 (drawing with washer/bearing plate 50x56x10)

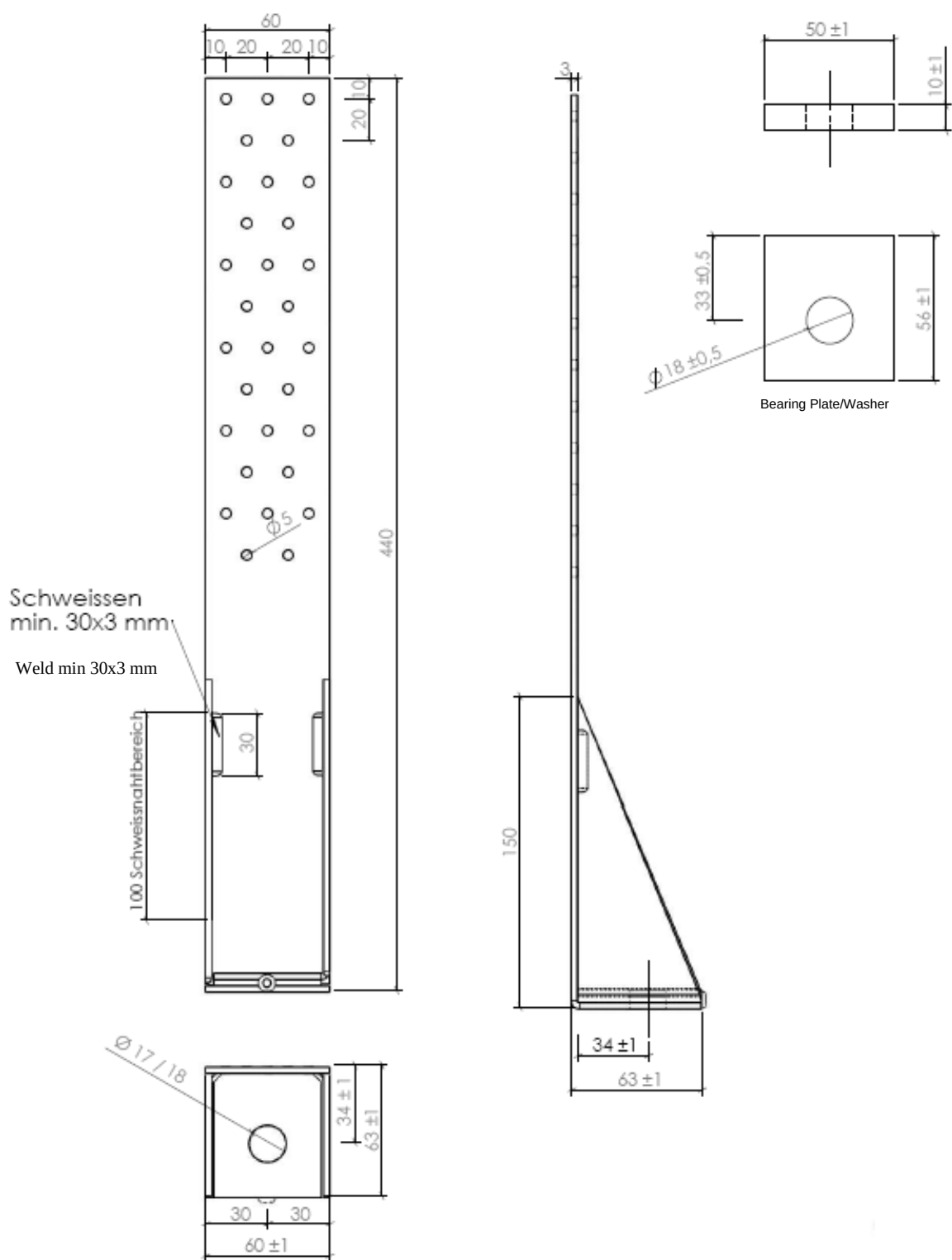


Figure B. 28 Dimensions of SXHT440 (drawing with washer/bearing plate 50x56x10)

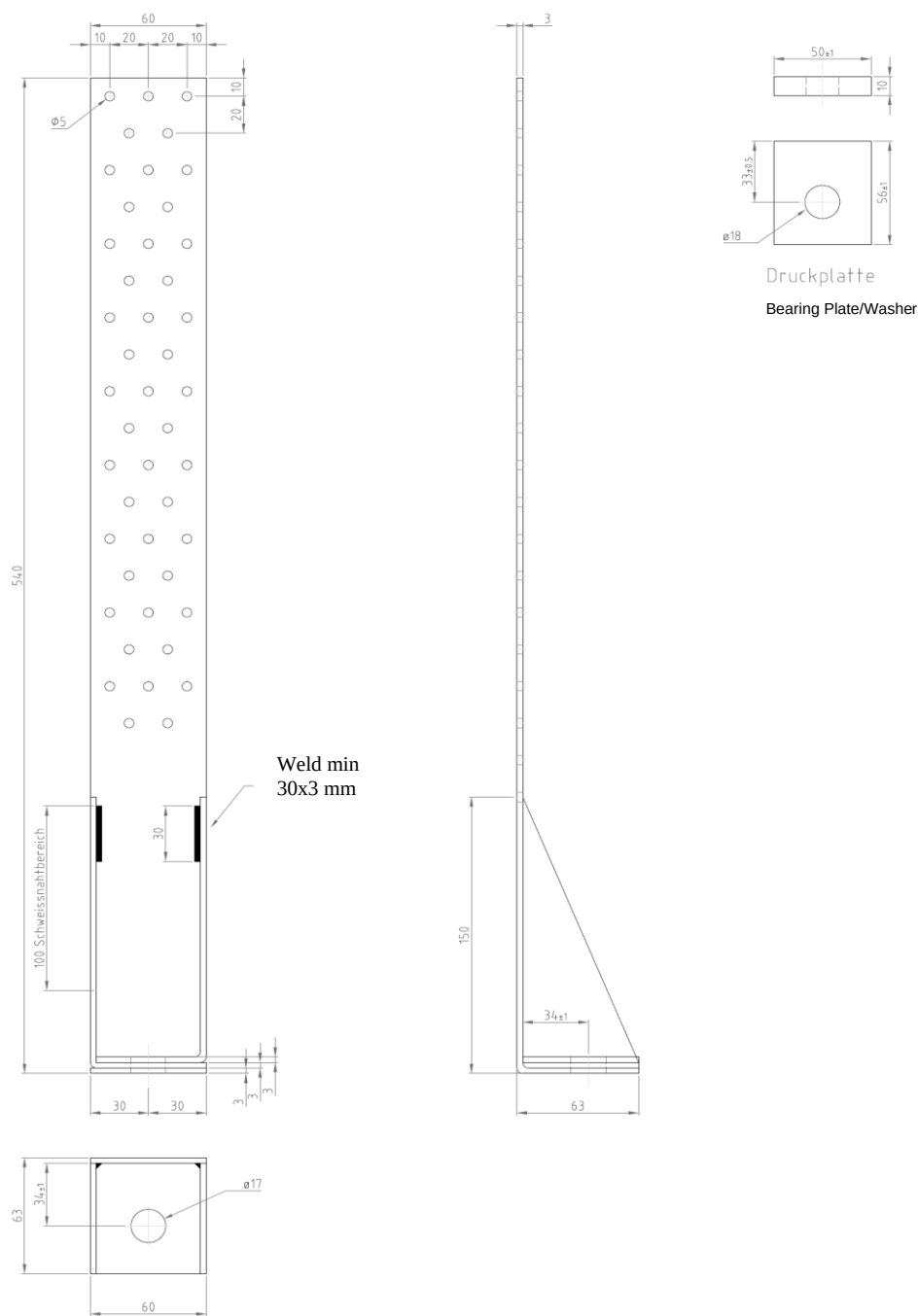


Figure B. 29 Dimensions of SXHT540 (drawing with washer/bearing plate 50x56x10)

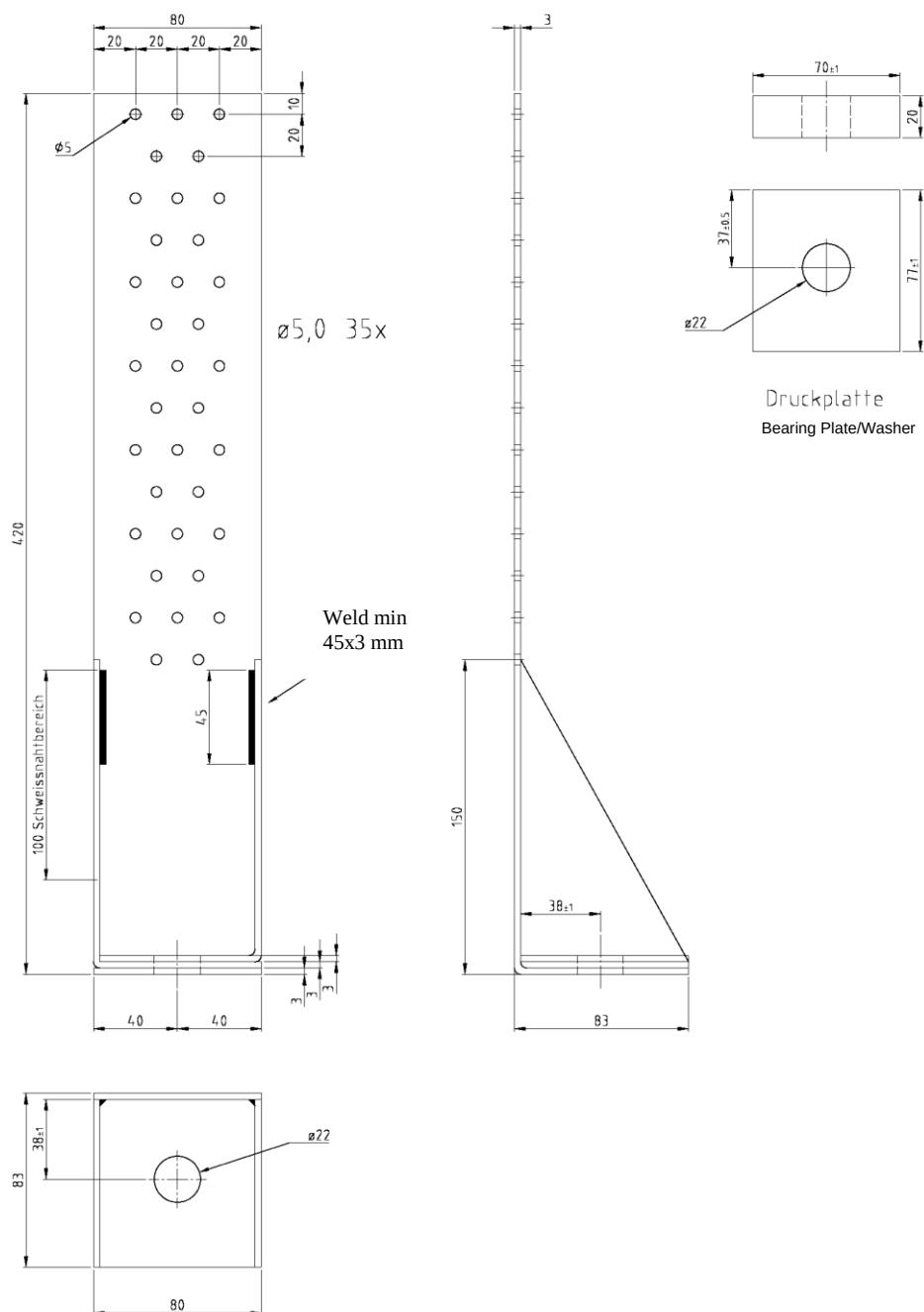


Figure B. 30 Dimensions of SXHT420 width 80 (drawing with washer/bearing plate 77x70x20)

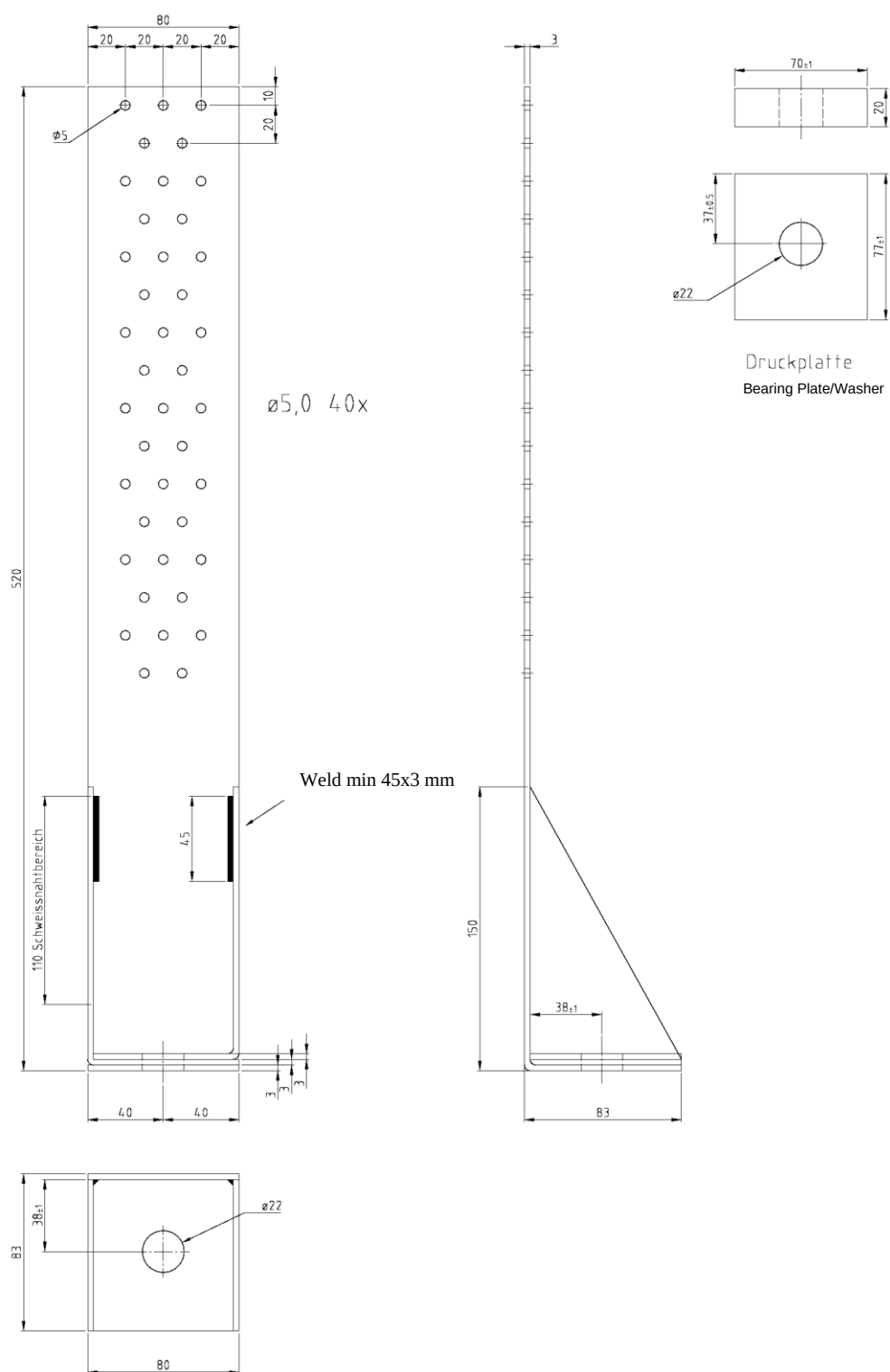


Figure B. 31 Dimensions of SXHT520 width 80 (drawing with washer/bearing plate 77x70x20)

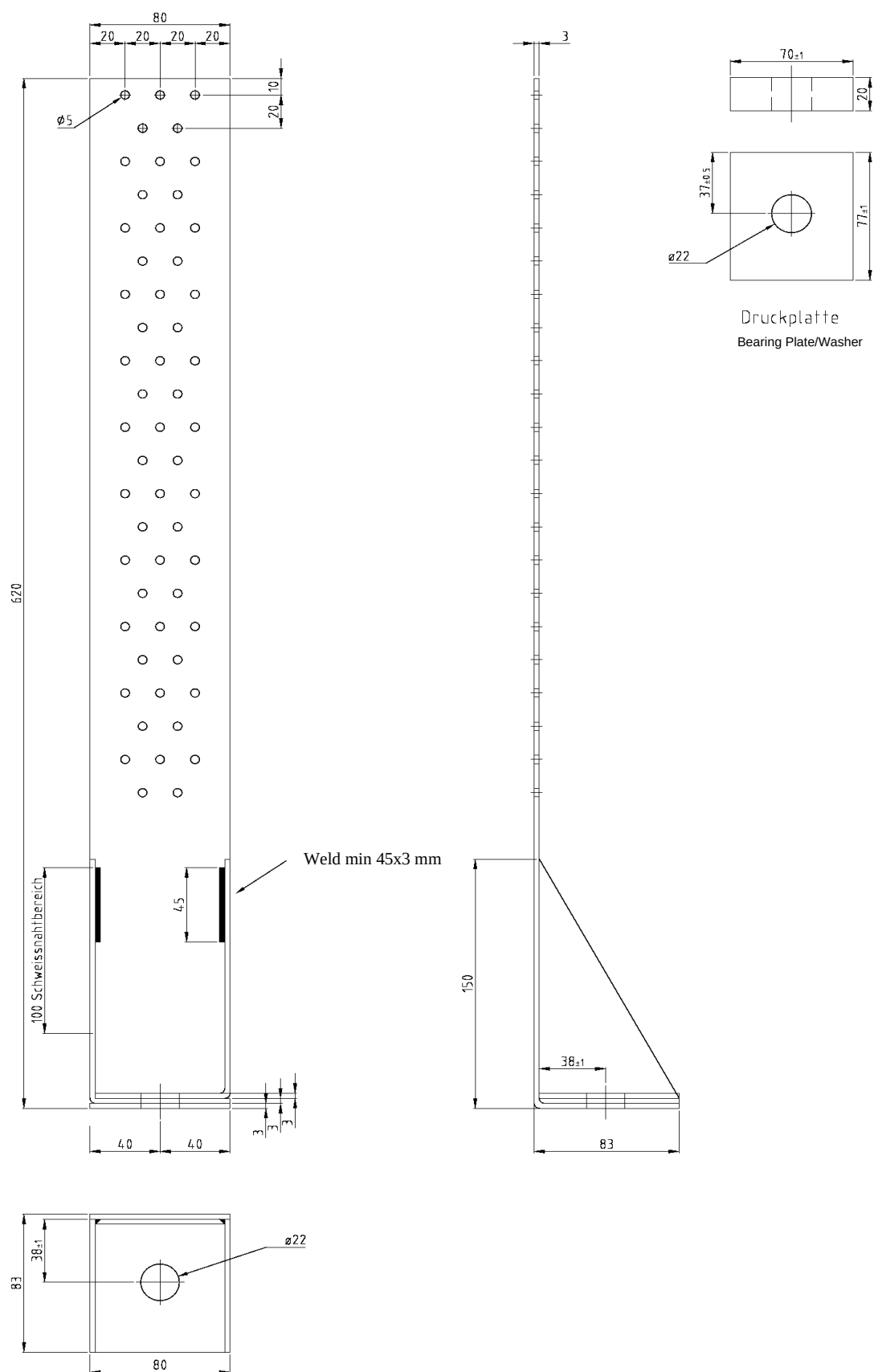


Figure B. 32 Dimensions of SXHT620 width 80 (drawing with washer/bearing plate 77x70x20)

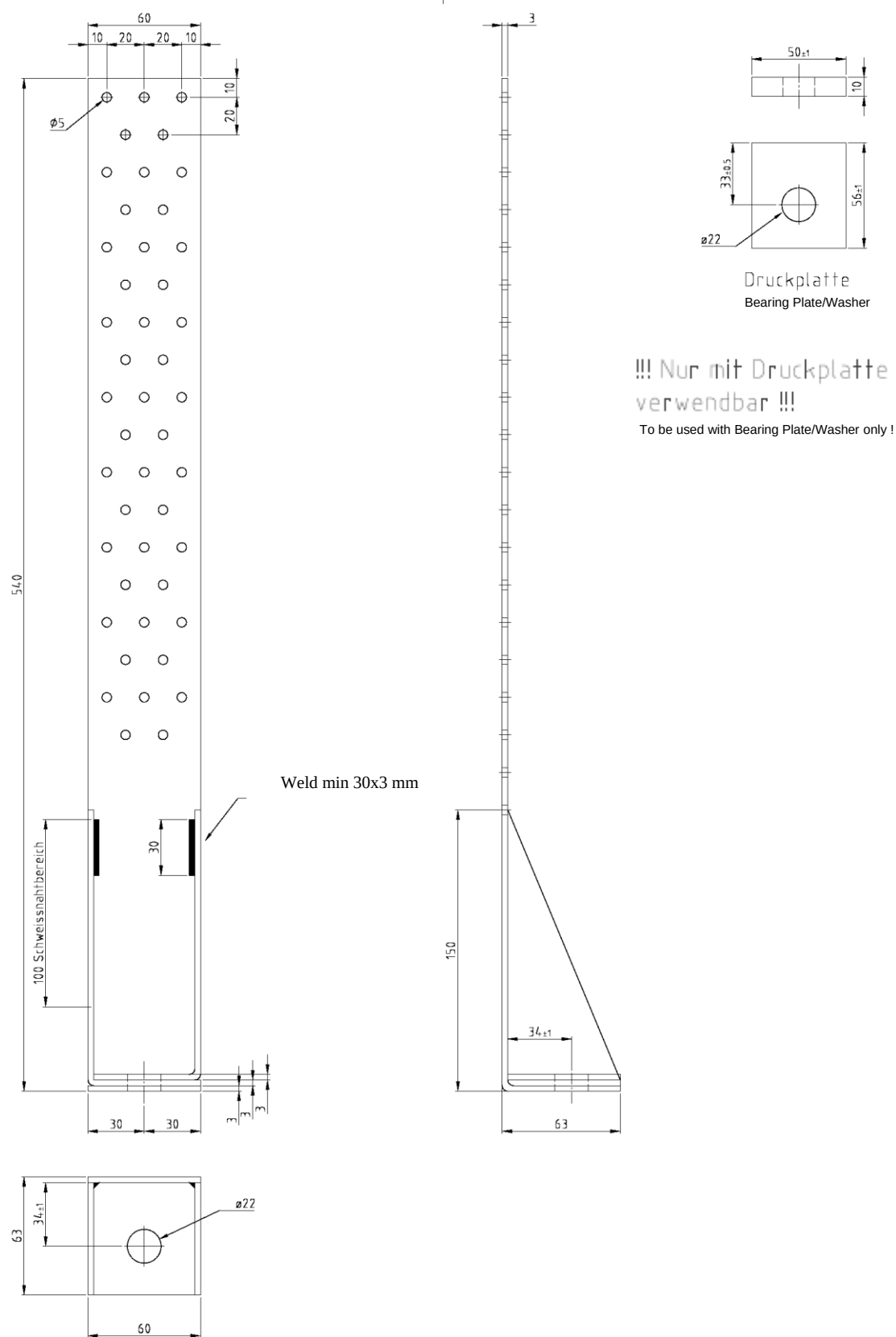


Figure B. 33 Dimensions of SXHT540R22 (with washer/bearing plate 56x50x10)

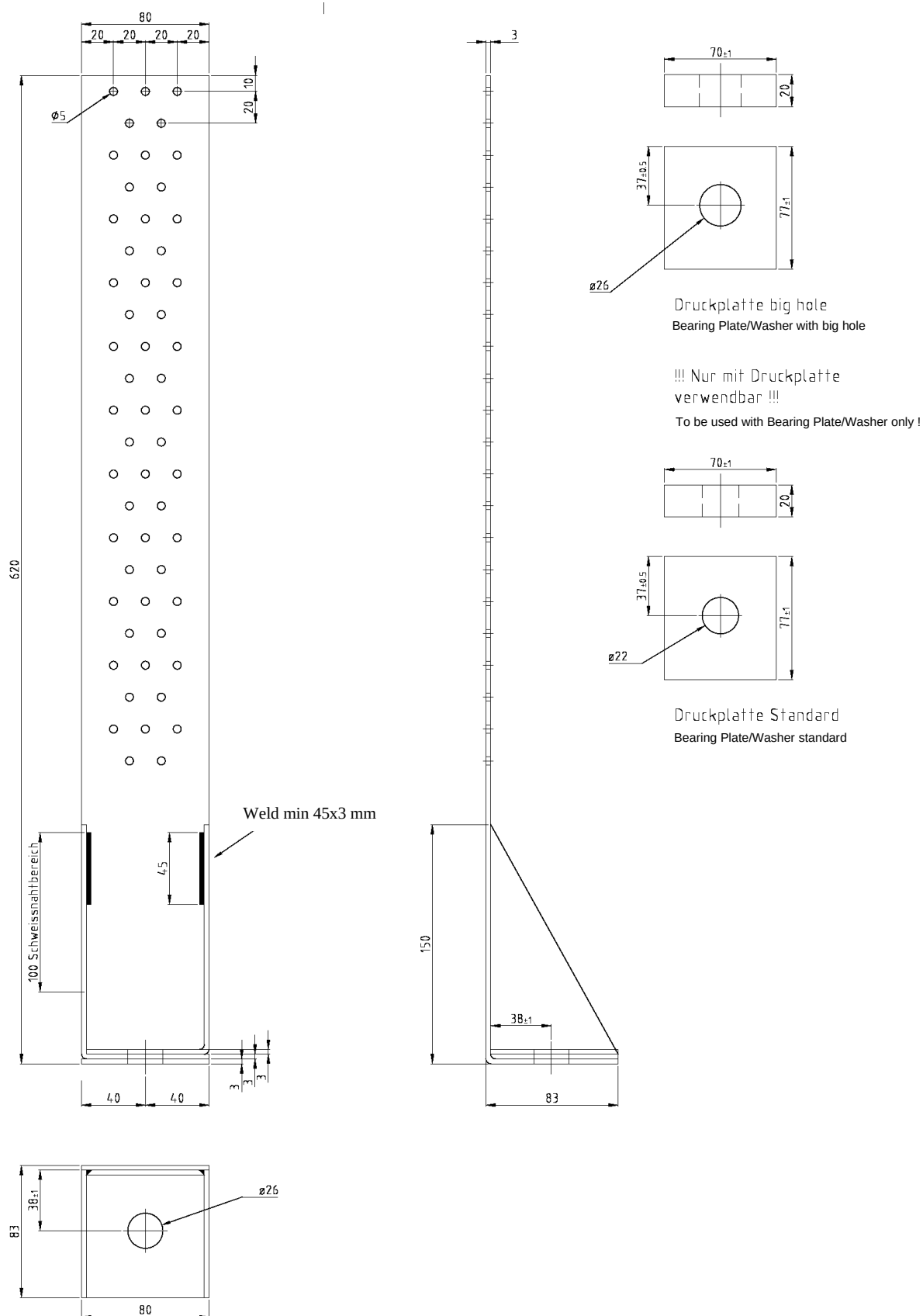


Figure B. 34 Dimensions of SXHT620R26 width 80 (with washer/bearing plate 77x70x20x $\phi 22$ or 77x70x20x $\phi 26$)

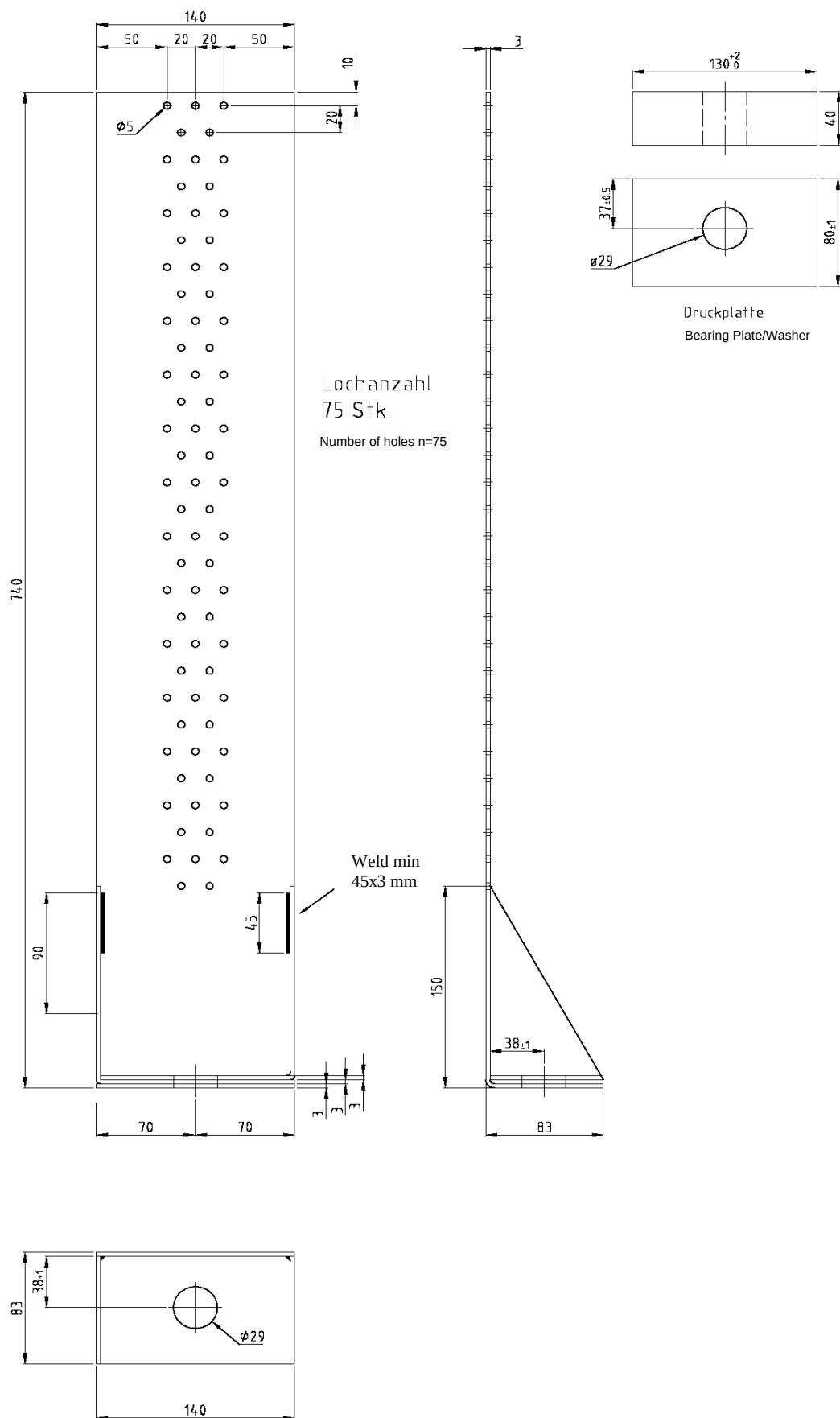


Figure B. 35 Dimensions of SXHT740 width 140 (drawing with washer/bearing plate 80x130x40)

SPAX Hold-downs SXHT2P

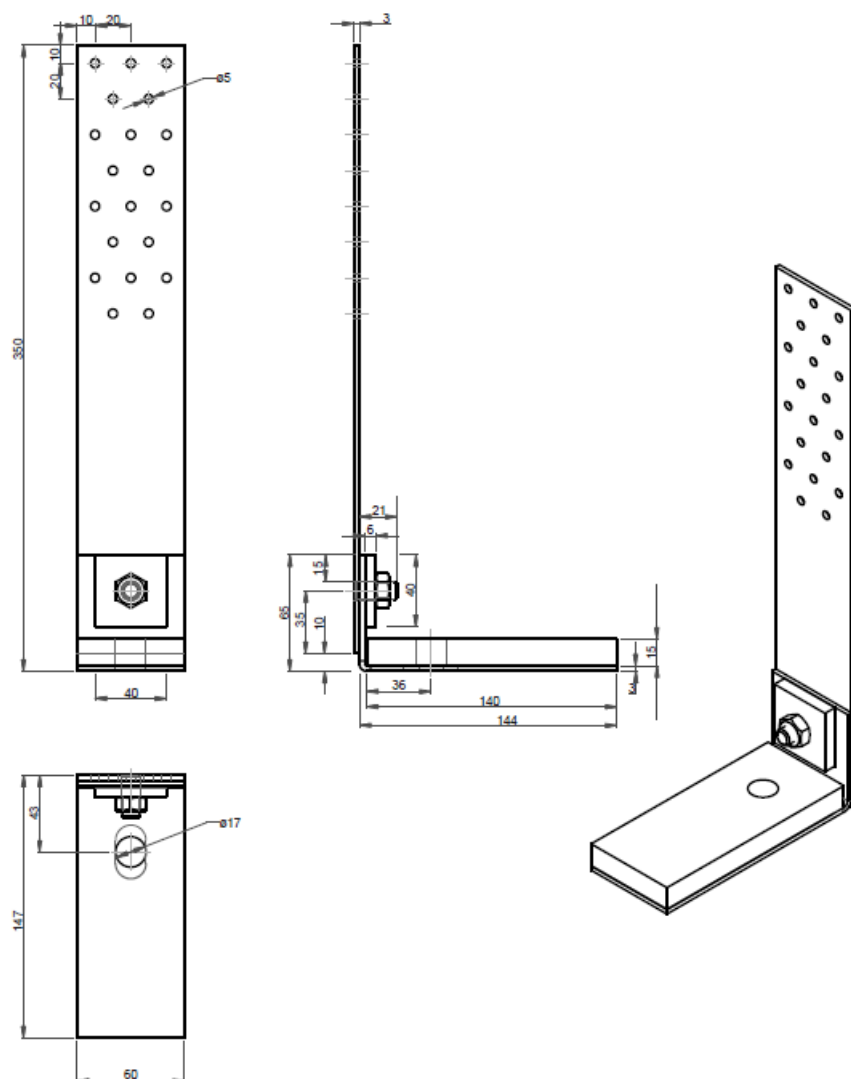


Figure B. 36 SXHT2P-GF-BPF

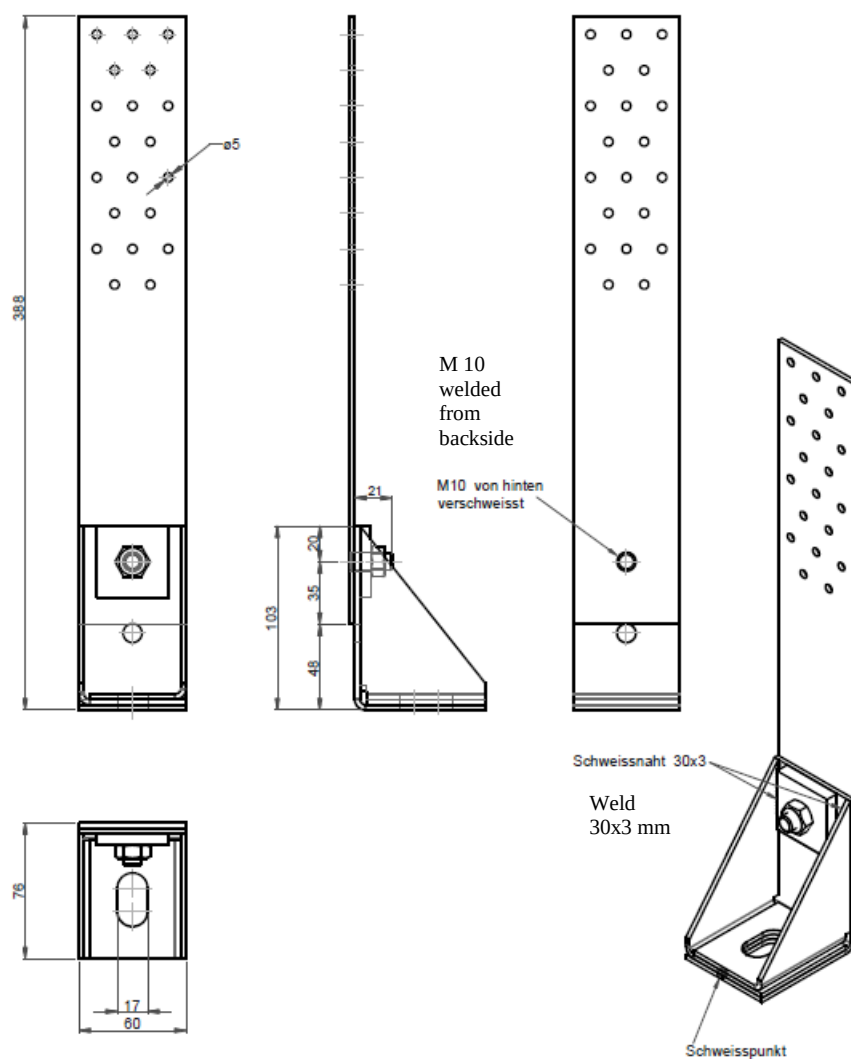


Figure B. 37 SXHT2P-GF-BWF

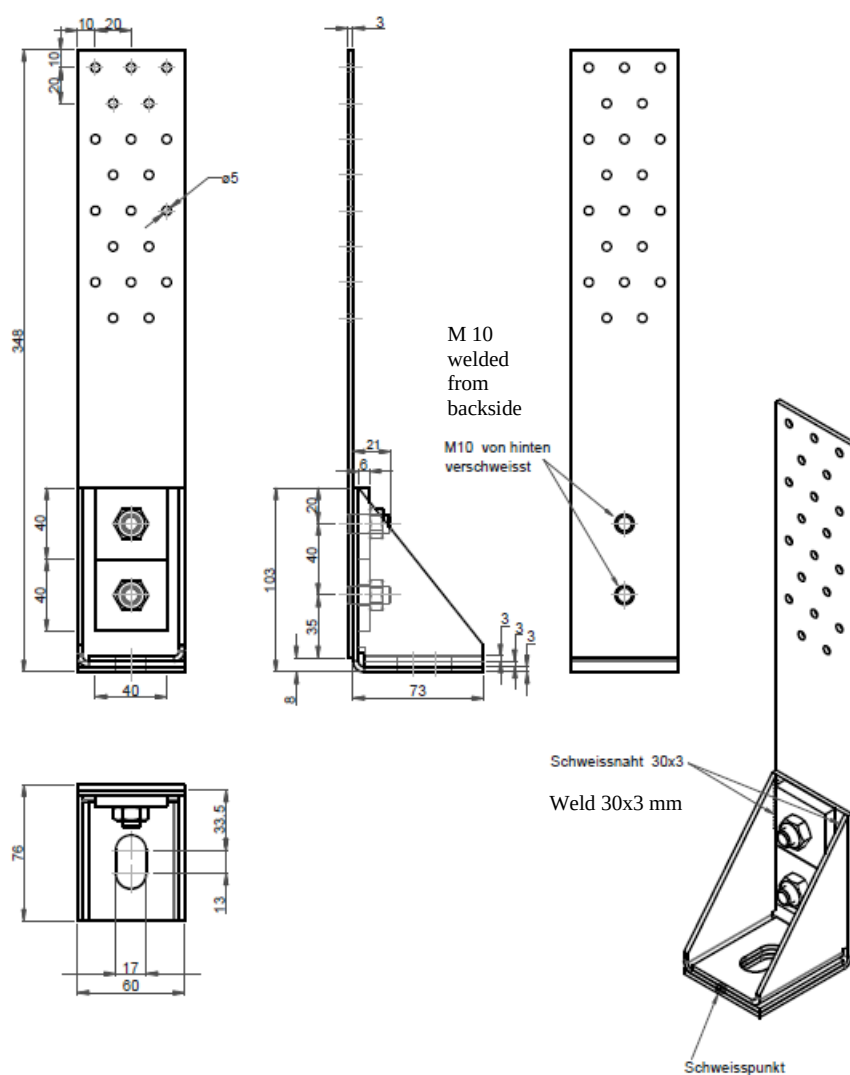


Figure B.38 SXHT2P-G2F-BWF

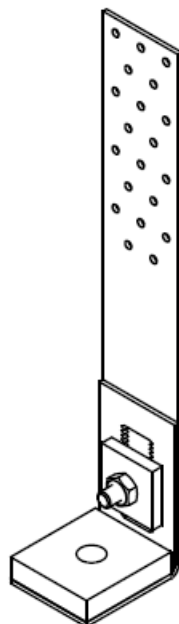
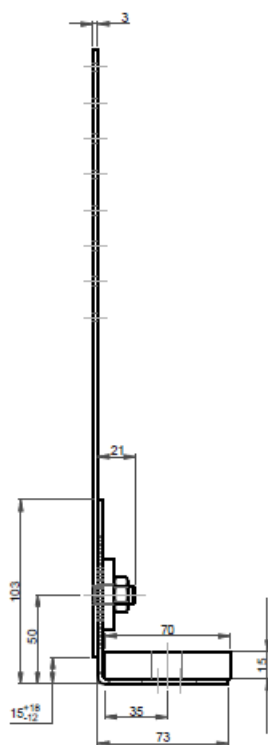


Figure B.39 SXHT2P-G-BP73

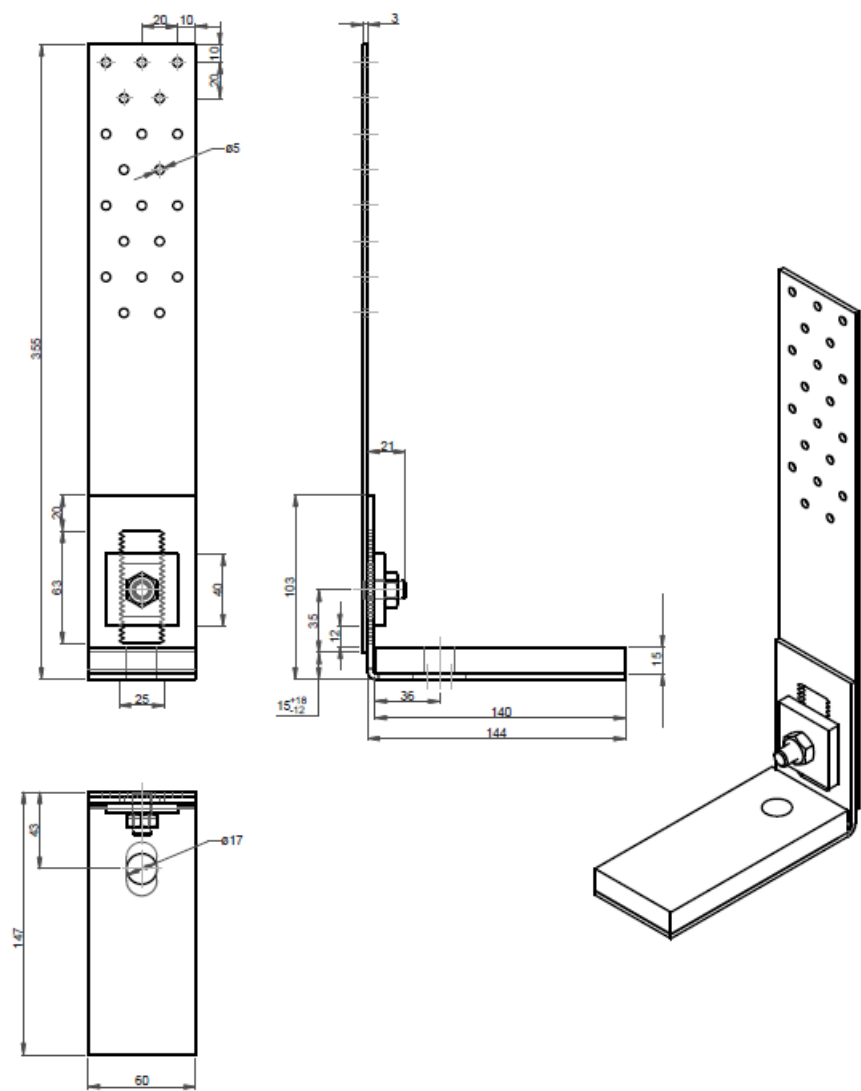


Figure B.40 SXHT2P-G-BP

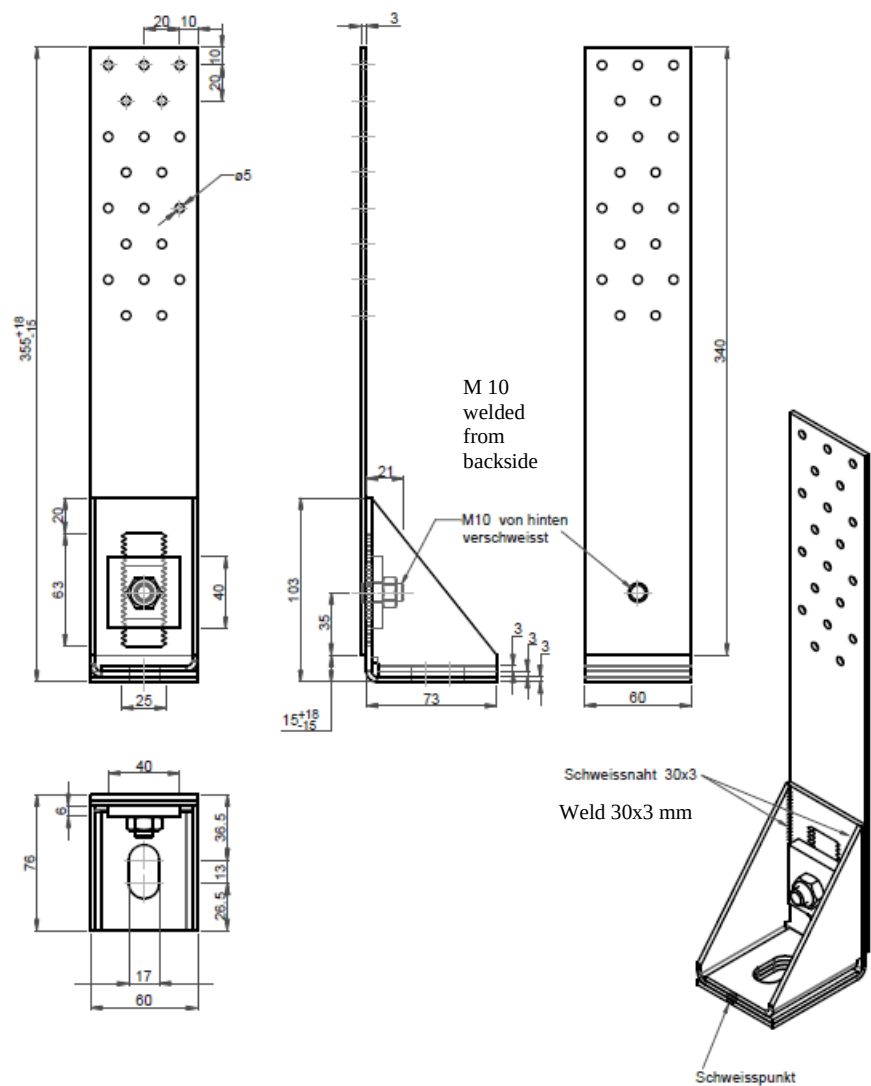


Figure B.41 SXHT2P-G-BW

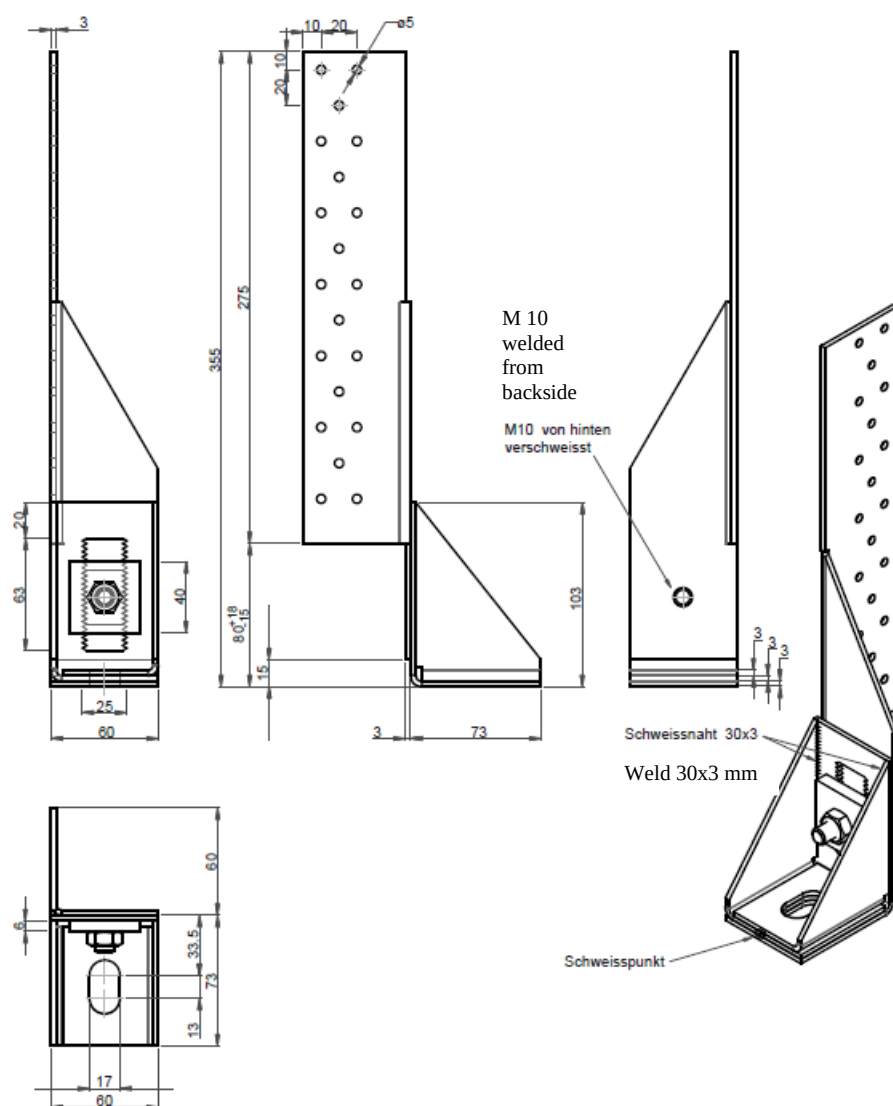


Figure B.42 SXHT2P-L-BW

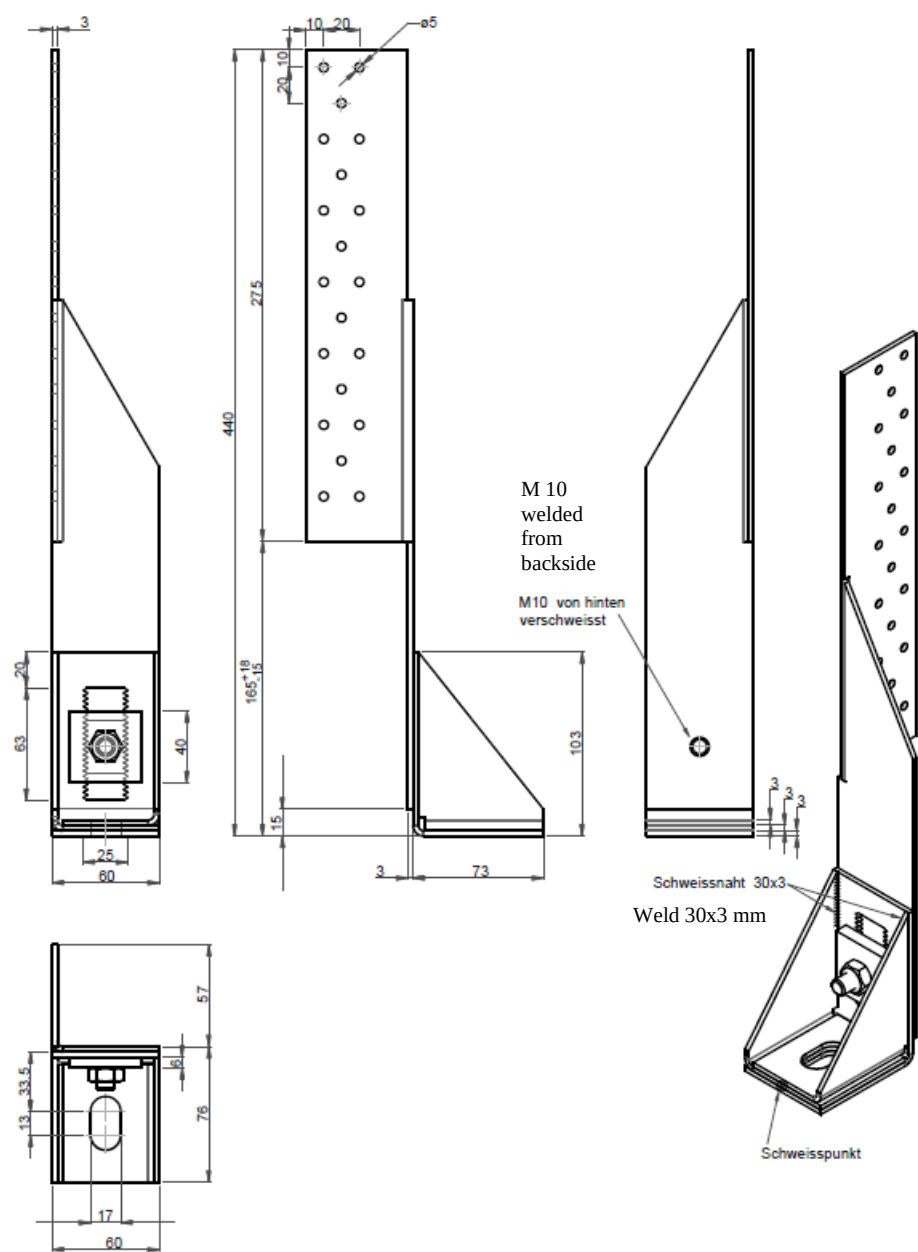


Figure B. 43 SXHT2P-L425-BW

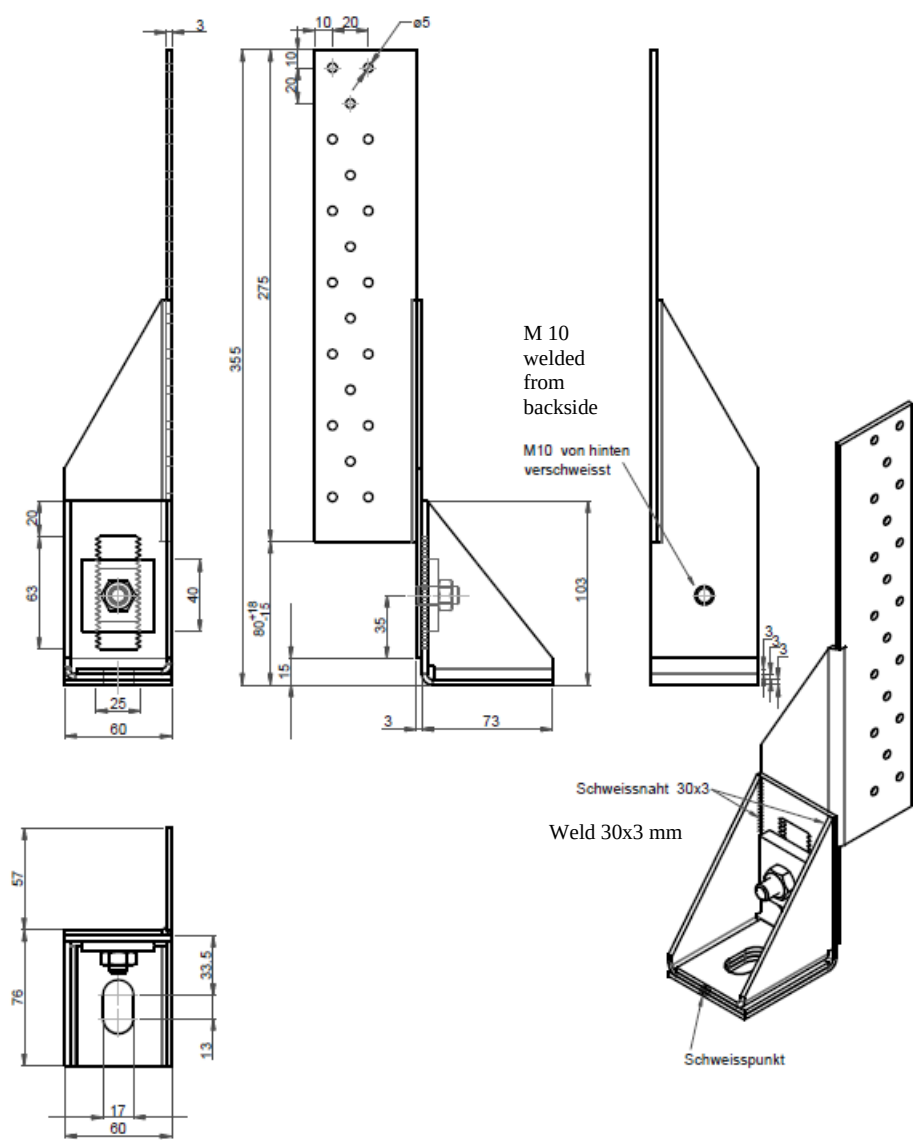


Figure B.44 SXHT2P-R-BW

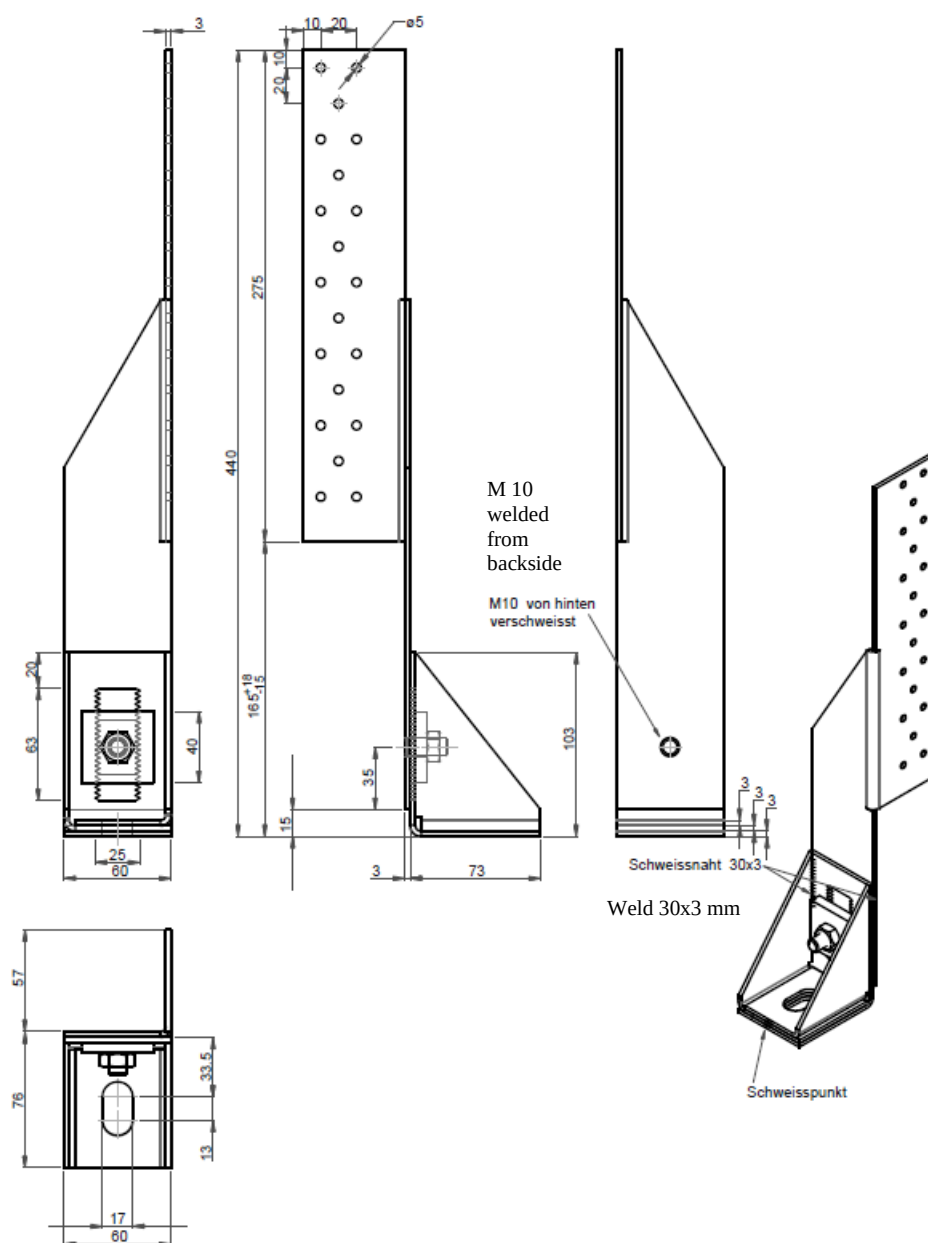


Figure B.45 SXHT2P-R425-BW

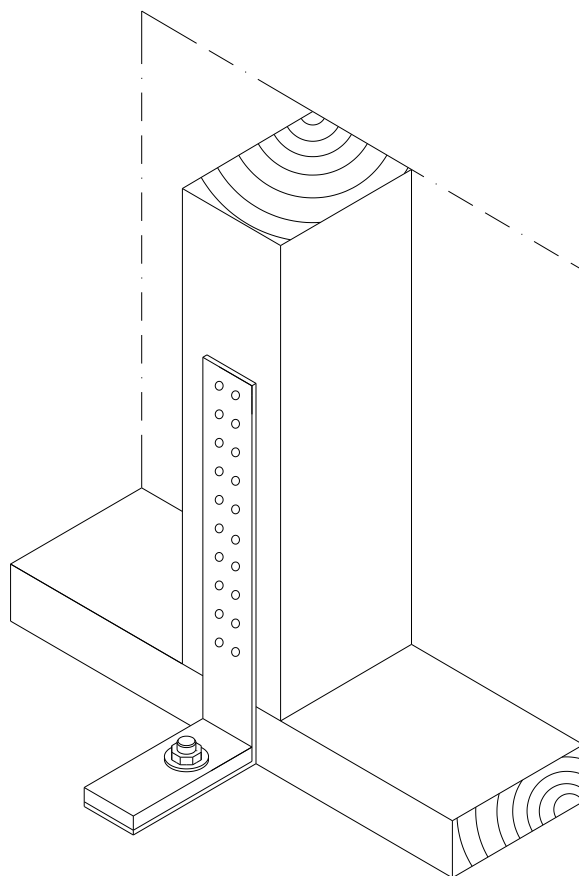


Figure B. 46 Typical installation