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Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

# European Technical Assessment ETA 25/0567 of 07/07/2025

## I General Part

| | |
|---|---|
| **Technical Assessment Body issuing the ETA** | Eurofins Expert Services Oy |
| **Trade name of the construction product** | SSF Angle Brackets |
| **Product family to which the construction product belongs** | Three-dimensional nailing plates |
| **Manufacturer** | **SSF Industrial Co., Limited**<br>Zhenxing Road<br>CN – Liaocheng<br>China<br>www.ssfwashers.com |
| **Manufacturing plant** | SSF Industrial Co., Limited<br>Zhenxing Road<br>CN – Liaocheng<br>China |
| **This European Technical Assessment contains** | 14 pages including 2 Annexes which form an integral part of this assessment |
| **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 |

**II Specific Part**

# 1 Technical description of the product

The angle brackets covered by this ETA are stated in Table A2.1 of Annex 2.

SSF Angle Brackets are one-piece non-welded three-dimensional nailing plates to be used in timber-to-timber connections. The angle brackets are connected to the timber members by anchor nails or screws.

The SSF Angle Brackets are made from pre-galvanized steel DX51D+Z275 or S220GD+275Z according to EN 10346:2015. The yield strength $R_{el}$ or $R_{02}$ of the steel is at least 220 N/mm², the tensile strength $R_m$ at least 300 N/mm² and elongation at failure $A_{80}$ at least 20 %. Amount of the zinc coating is at least 275 g/m$^2$.

The product drawings are in Annex 1 and the sizes of SSF Angle Brackets are listed in tables of Annex 2. The steel material thickness of the connectors is 2,00 $\pm$ 0,15 mm or 2,50 $\pm$ 0,17 mm.

# 2 Specification of the intended uses in accordance with the applicable EAD

## 2.1 Intended uses

Intended use of SSF Angle Brackets are timber constructions, where both flanges of the bracket are fixed to strength graded timber according to EN 14081-1, glulam according to EN 14080, laminated veneer lumber (LVL) according to EN 14374, cross laminated timber (CLT), or corresponding timber material. The characteristic density $\rho_k$ of the timber shall not be greater than 500 kg/m³. This ETA does not cover angle brackets fixed in the end of a timber member or in the edge of a LVL member.

The forces to be transferred by the angle bracket shall act at the centre of the fastener group on the plane defined by flange A. For non-symmetric connections the flange A means the bigger flange, when flange B is smaller flange. Shear capacity represents the force component that is in effect in direction of a flange surface. Tensile and compression force are the force components that are in effect in direction perpendicular to a flange surface.

SSF Angle Brackets shall be fixed to timber by anchor nails or anchor screws (see Figure 1) according to EN 14592. The diameter of the anchor nails shall be $d$ = 4,0 mm and the profiled length at least 24 mm. The anchor screw shall have a conical head, the diameter of the smooth part of the screw shall be $d$ = 4,5…5,0 mm and the inner diameter of the threaded part $d_1 \geq$ 3,0 mm. The length of the threaded part of the screw shall be at least 6$d$.

Connections with SSF Angle Brackets shall fulfil the minimum spacing and edge distance requirement specified in EN 1995-1-1. Timber parts shall not be pre-drilled for the nails or screws. Fasteners shall be perpendicular to the grain of the timber.

For SSF Angle Brackets the intended service classes according to EN 1995-1-1 are classes 1 and 2. In service class 2, the nails or screws shall have an electroplated zinc coating according to EN ISO 2081 at least of type and thickness Fe/Zn 12c, or they shall be hot dip zinc coated according to EN ISO 1461, thickness at least 39 μm.

a)

b)

**Figure 1.** Fasteners: a) anchor nail and b) anchor screw.

### 2.2 Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of the angle brackets of 50 years.[1]

### 2.3 Identification

SSF Angle Brackets are identified by product labels that are marked with SSF -logo.

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

Table 1. Basic requirements for construction works and essential characteristics

| Basic requirement and essential characteristics | Performance |
|---|---|
| BWR 1. Mechanical resistance and stability | |
| Joint strength | Clause 3.1 |
| Joint stiffness | No performance assessed |
| Joint ductility | No performance assessed |
| Resistance to seismic actions | No performance assessed |
| Resistance to corrosion and deterioration | Clause 3.1 |
| BWR 2. Safety in case of fire | |
| Reaction to fire | Clause 3.2 |
| Resistance to fire | No performance assessed |

### 3.1 Mechanical resistance and stability, BWR 1

#### 3.1.1 Joint strength

Characteristic resistance values of SSF Angle Brackets are given in Annex 2.

[1] This means that it is expected that when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements of the works. The indications given as to the working life of a product cannot be interpreted as a guarantee given by the producer or the assessment body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for products in relation to the expected, economically reasonable working life of the works.

3.1.2 Resistance to corrosion and deterioration

SSF Angle Brackets have been assessed as having satisfactory durability and serviceability when used in timber structures when the timber species (including timbers preserved with organic solvent, boron diffusion and related preservatives) described in Eurocode 5 (EN 1995-1-1: 2004) are used and the structures are subject to the dry, internal conditions defined by service classes 1 and 2.

## 3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

SSF Angle Brackets are made of materials classified to have reaction to fire class A1 according to EN 13501-1.

# 4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

According to the Decision 97/638/EC of the European Commission[2], the system of assessment and verification of constancy of performance (see Annex V to the regulation (EU) No 305/2011) is System 2+.

# 5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD.

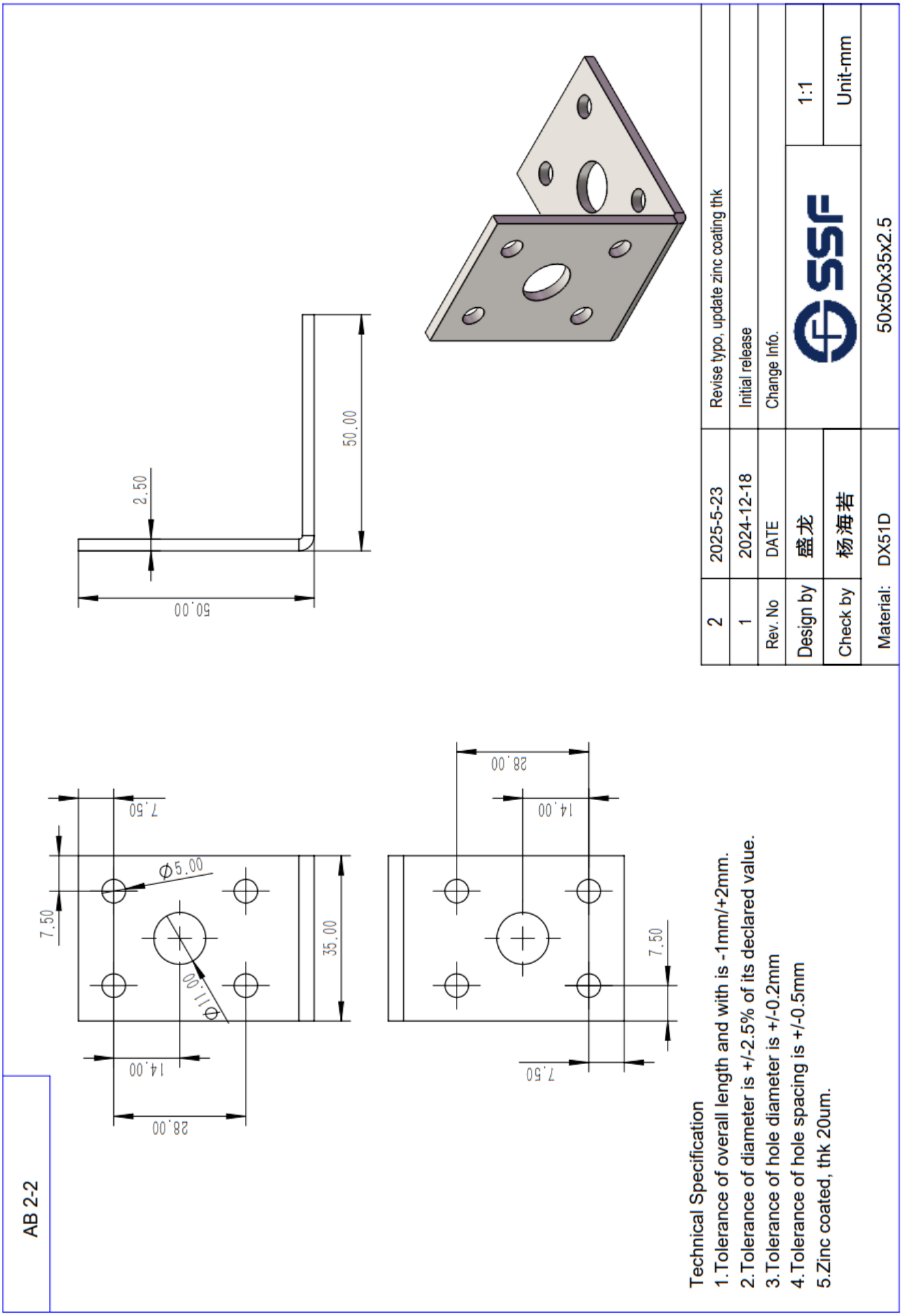
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Eurofins Expert Services Oy prior to CE marking.

Issued in Espoo on July 7, 2025
by Eurofins Expert Services Oy

Jouni Hakkarainen
Leading Expert

Ari Kevarinmäki
Leading Expert

[2] Official Journal of the European Communities L 268 of 1/10/1997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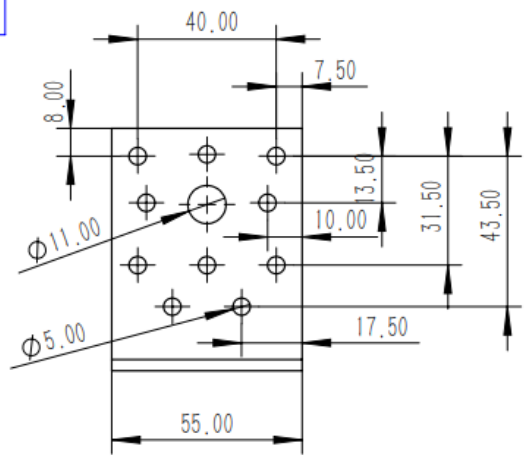
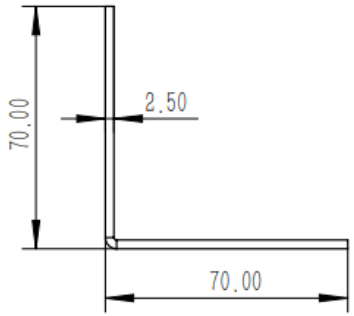
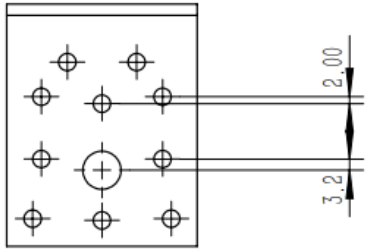
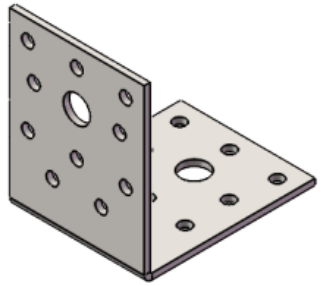
2.Tolerance of diameter is +/-2.5% of its declared value.
3.Tolerance of hole diameter is +/-0.2mm
4.Tolerance of hole spacing is +/-0.5mm
5.Zinc coated, thk 20um.
2 | 2025-5-23 | Revise typo, update zinc coating thk
1 | 2024-12-18 | Initial release
Rev. No | DATE | Change Info.
Design by | 盛龙
Check by | 杨海若
Material: DX51D
SSF
1:1
Unit-mm
50x50x35x2.5
50.00
2.50
28.00
14.00
7.50
35.00
Φ5.00
Φ11.00

AB 2-3



eeTechnical Specification

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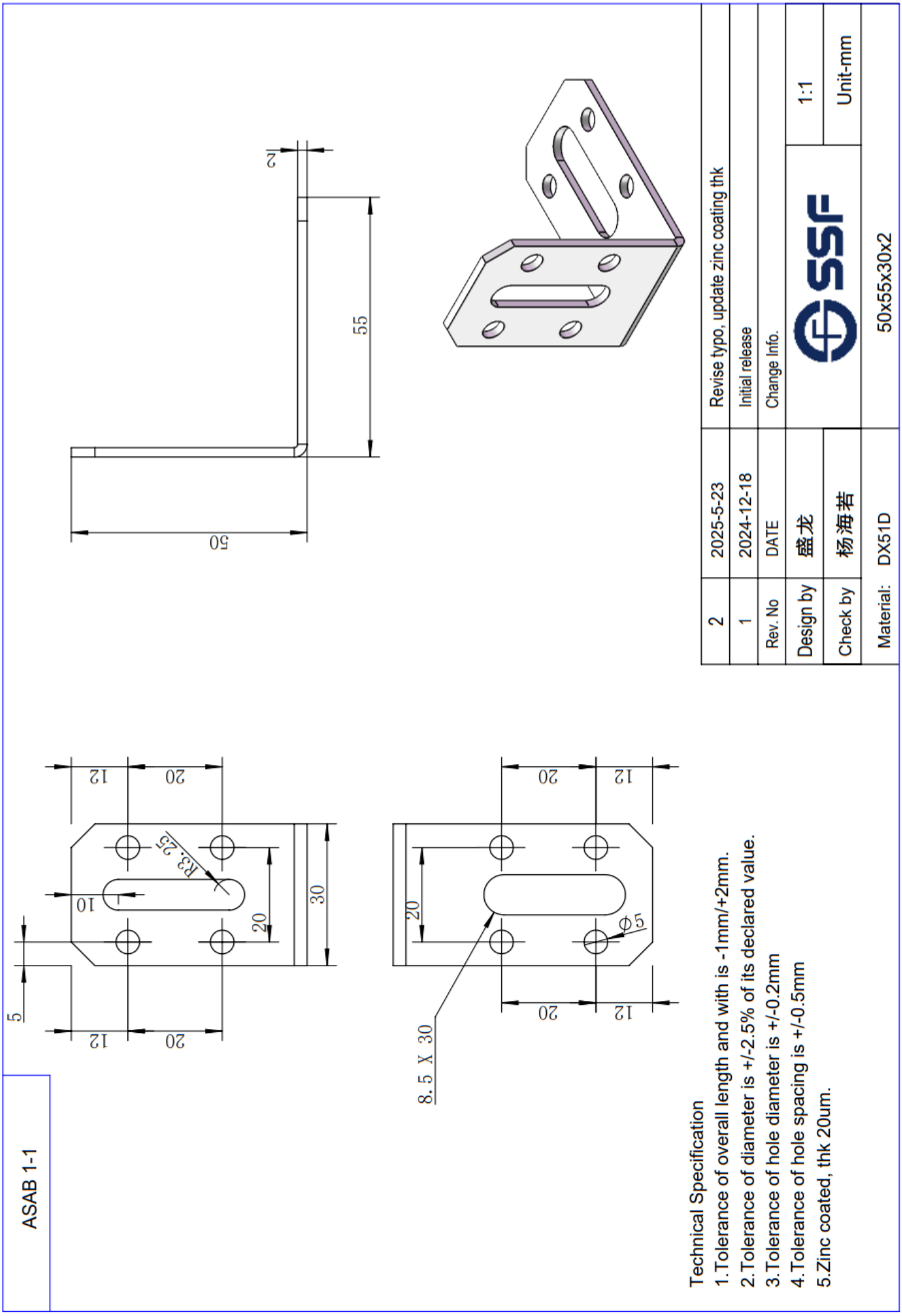
3.Tolerance of hole diameter is +/-0.2mm
4.Tolerance of hole spacing is +/-0.5mm
5.Zinc coated, thk 20um.

| | | | |
|---|---|---|---|
| 2 | 2025-5-23 | Revise typo, update zinc coating thk | |
| 1 | 2024-12-18 | Initial release | |
| Rev. No | DATE | Change Info. | |
| Design by | 盛龙 | SSF | 1:2 |
| Check by | 杨海若 | | Unit-mm |
| Material: DX51D | | 70x70x55x2.5 | |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8.5 X 30
Φ5
R3.25
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5
10
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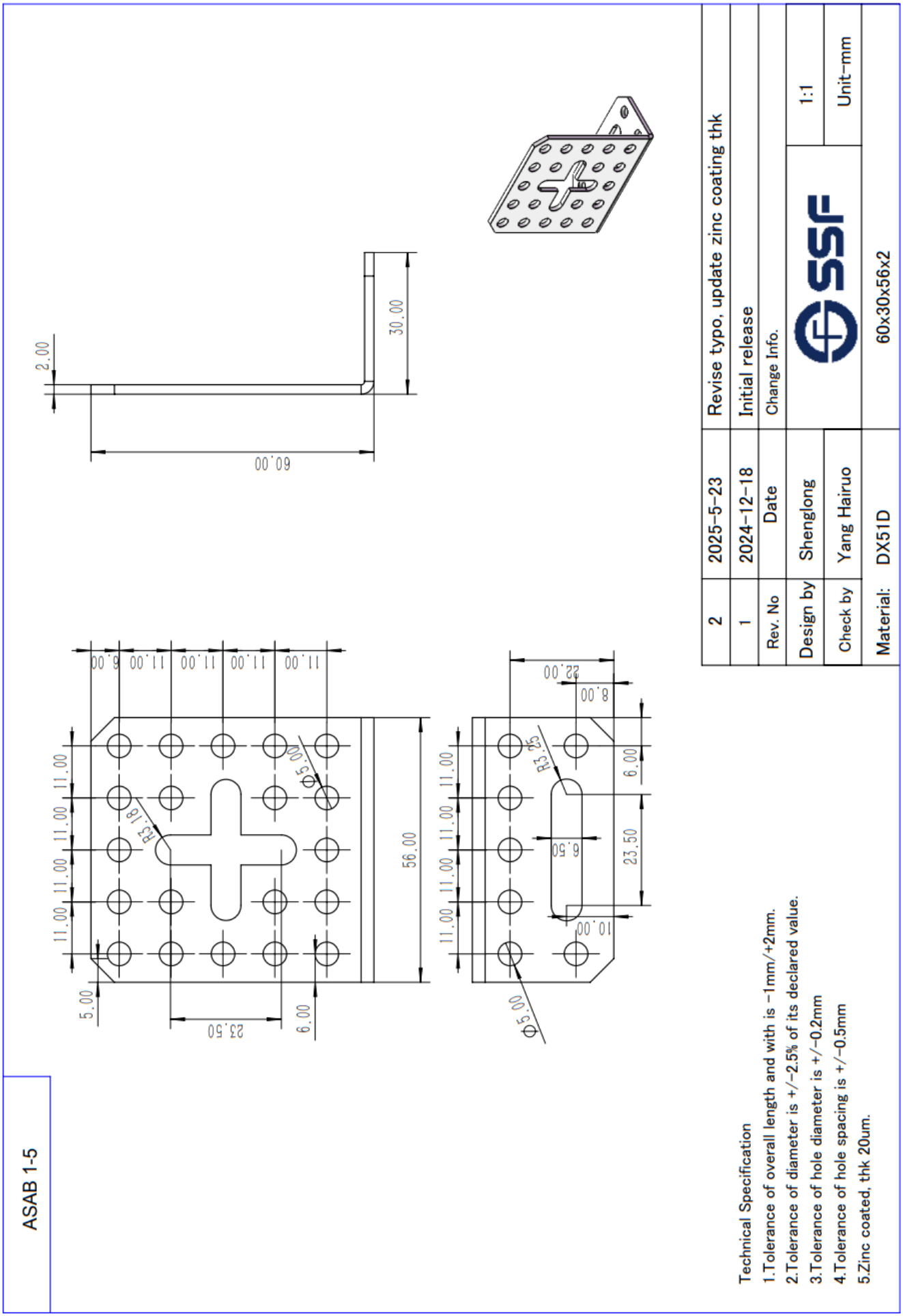
2
2025-5-23
Revise typo, update zinc coating thk
1
2024-12-18
Initial release
Rev. No
DATE
Change Info.
Design by
盛龙
Check by
杨海若
SSF
1:1
Unit-mm
Material: DX51D
50x55x30x2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R2.18
Φ5.00
56.00
5.00
23.50
6.00
22.00
8.00
R3.25
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6.50
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Φ5.00
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3.Tolerance of hole diameter is +/-0.2mm
4.Tolerance of hole spacing is +/-0.5mm
5.Zinc coated, thk 20um.
2 2025-5-23 Revise typo, update zinc coating thk
1 2024-12-18 Initial release
Rev. No Date Change Info.
Design by Shenglong
Check by Yang Hairuo
SSF
1:1
Unit-mm
Material: DX51D
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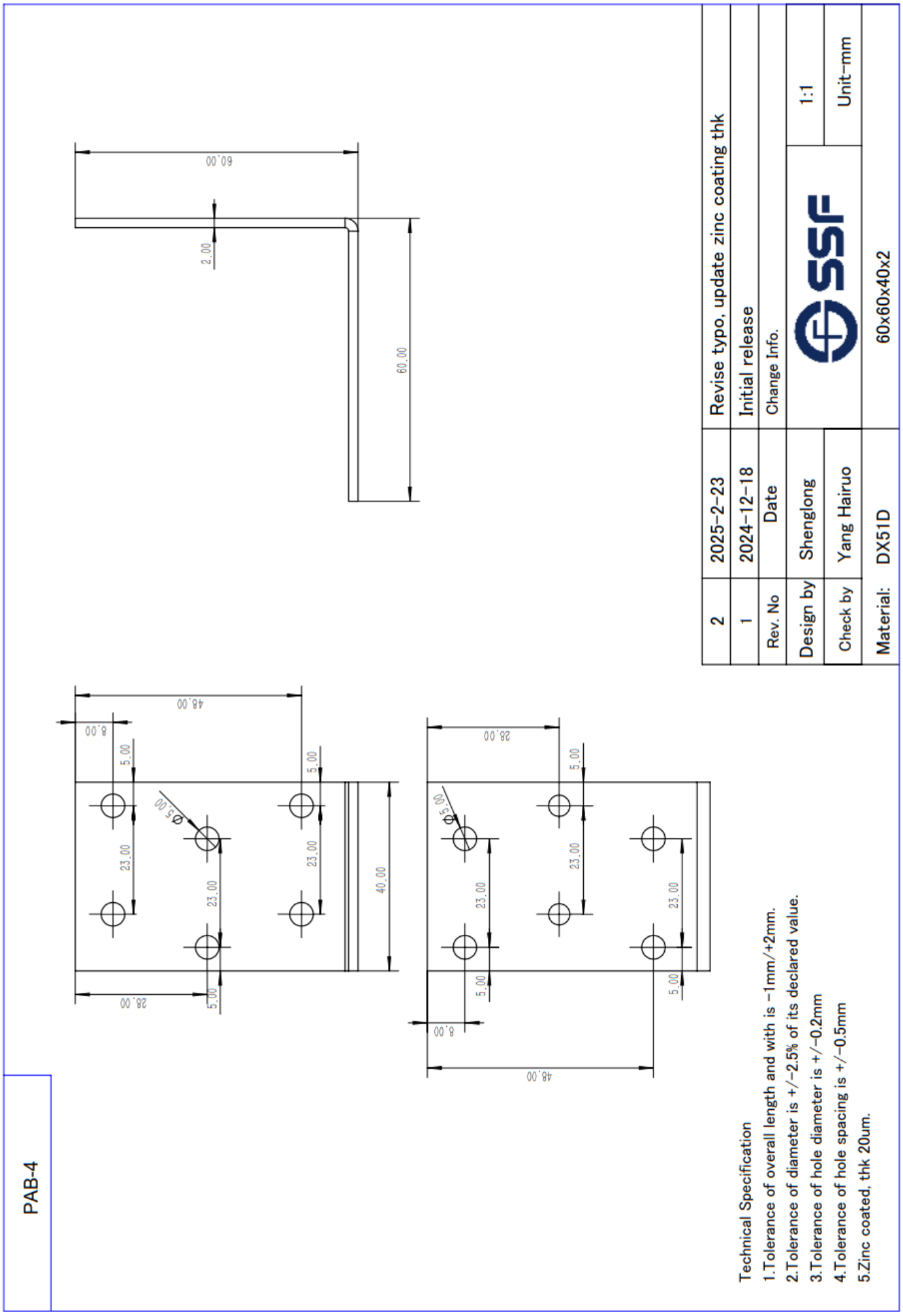
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Technical Specification
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2.Tolerance of diameter is +/-2.5% of its declared value.
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4.Tolerance of hole spacing is +/-0.5mm
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1 2024-12-18 Initial release
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Check by Yang Hairuo
SSF
1:1
Unit-mm
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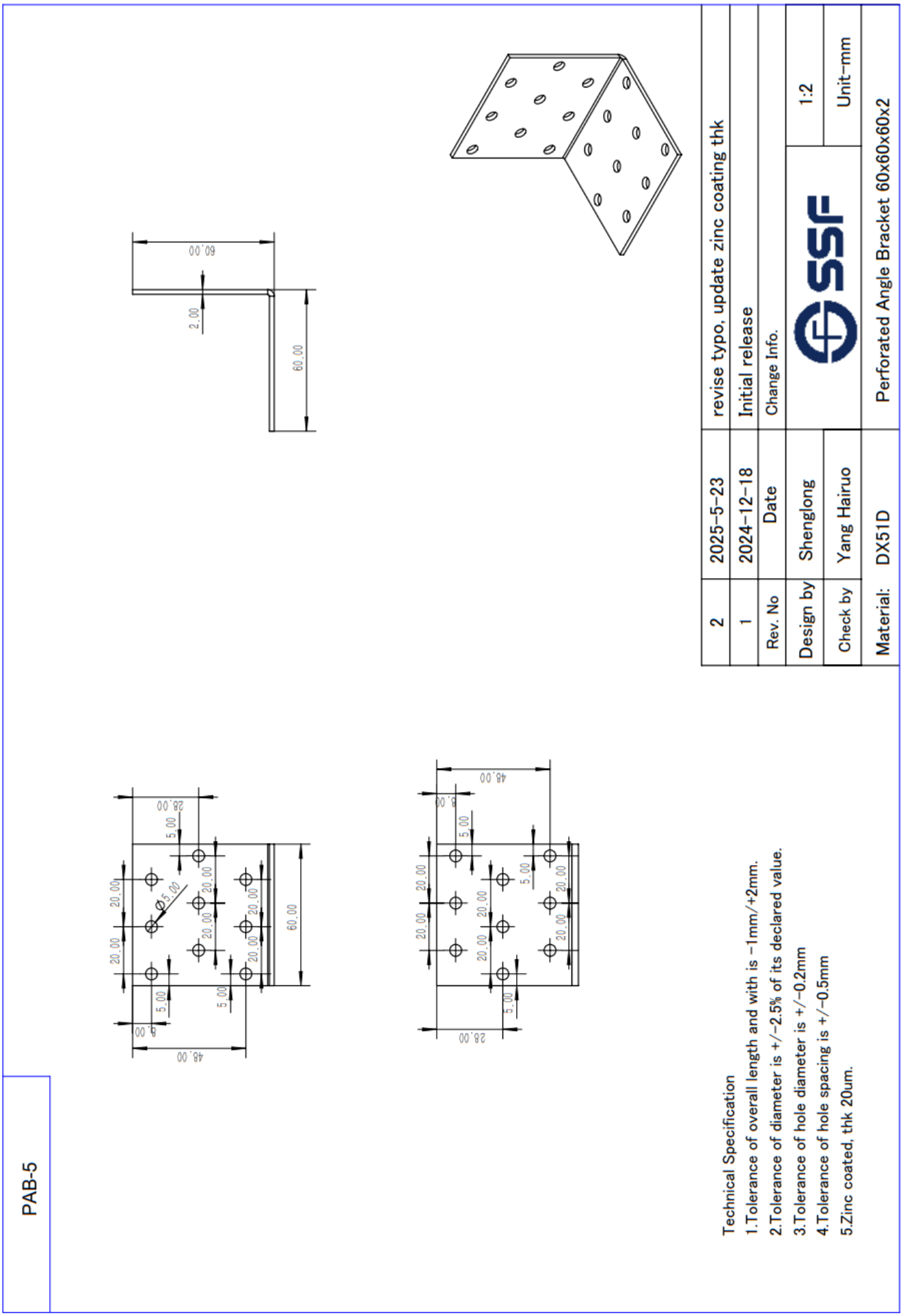
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20.00
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48.00
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2.Tolerance of diameter is +/-2.5% of its declared value.
3.Tolerance of hole diameter is +/-0.2mm
4.Tolerance of hole spacing is +/-0.5mm
5.Zinc coated, thk 20um.
2 2025-5-23 revise typo, update zinc coating thk
1 2024-12-18 Initial release
Rev. No Date Change Info.
Design by Shenglong
Check by Yang Hairuo
SSF
1:2
Unit-mm
Material: DX51D
Perforated Angle Bracket 60x60x60x2

## ANNEX 2. CHARACTERISTIC LOAD-CARRYING CAPACITIES

### Characteristic resistances for SSF Angle Brackets - calculation method

Load carrying capacity of angle bracket connections

The design resistance $R_d$ of the angle bracket connection is

$$R_d = k_{\text{mod}} \frac{R_k}{\gamma_M} \quad (1)$$

where $k_{mod}$ is the modification factor according to EN 1995-1-1 taking into account the effect of the duration of the load and moisture content for timber, $\gamma_M$ is the partial factor for the resistance of connections according to the relevant National annex of EN 1995-1-1 and $R_k$ is the characteristic resistance of the angle bracket connection.

When the connection made by the angle bracket is loaded by a shear force at the plane of flange A in the middle of the flange, it shall be checked that the conditions according to equations (2) to (4) are fulfilled

$$F_d \leq R_{A,d} \quad (2)$$

$$F_{x,d} \leq R_{B,x,d} \quad (3)$$

$$F_{z,d} \leq \begin{cases} R_{B,z,t,d} & \text{when the connection is in tension} \\ R_{B,z,c,d} & \text{when the connection is in compression} \end{cases} \quad (4)$$

where $F_{x,d}$ is the component in the direction of the bent edge of the angle bracket from the connection force $F_d$ and $F_{z,d}$ is the component perpendicular to $F_{x,d}$ from the connection force $F_d$.

In addition, when the connection is loaded in tension, the following interaction equation shall be fulfilled:

$$\left(\frac{F_{z,d}}{R_{B,z,t,d}}\right)^2 + \left(\frac{F_{x,d}}{R_{B,x,d}}\right)^2 \leq 1 \quad (5)$$

Characteristic resistance

$$R_{A,k} = n_A F_{A,v,Rk} \quad (6)$$

where $n_A$ is number of fasteners at flange A. $F_{A,v,Rk}$ is the characteristic lateral load-carrying capacity of the fastener in the timber part against flange A according to EN 1995-1-1, equation (7) for steel plate thickness $t$ less than or equal to $d/2$ and (8) for thicker steel plates of thickness greater than or equal to $d$:

$$F_{v,Rk} = \min \begin{cases} 0{,}4\, f_{h,k} t_1 d & \text{(a)} \\ 1{,}15\sqrt{2 M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(b)} \end{cases} \quad (7)$$

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & \text{(a)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4 M_{y,Rk}}{f_{h,k} d\, t_1^2}} - 1\right] + \frac{F_{ax,Rk}}{4} & \text{(b)} \\ 2{,}3\sqrt{M_{y,Rk} f_{h,k} d} + \frac{F_{ax,Rk}}{4} & \text{(c)} \end{cases} \quad (8)$$

where $t_1 = L - t$ when $L$ is the length of the fastener, $t$ is the thickness of steel plate, $M_{y,k}$ is according to standards EN 14592 and EN 409 experimentally determined characteristic value of the yield moment of the fastener, $F_{ax,Rk}$ is the withdrawal resistance of the fastener according to Eq. (10) limited at maximum to $^1/_3$ with nails and ½ with screws from the load-carrying capacity $F_{v,Rk}$ and the characteristic value of the embedding strength

$$f_{h,k} = 0{,}082\,\rho_k\, d^{-0,3} \qquad \text{N/mm}^2 \qquad (9)$$

The characteristic withdrawal resistance of the nail

$$F_{ax,Rk} = f_{ax,k}\, d\, t_{pen} \le f_{tens,k} \qquad (10a)$$

and for the screw

$$F_{ax,Rk} = n^{-0,1}\, f_{ax,k}\, d\, l_{ef} \left(\frac{\rho_k}{\rho_a}\right)^{0,8} \le n^{-0,1}\, f_{tens,k} \qquad (10b)$$

where $f_{ax,k}$ is the withdrawal parameter determined by testing according to standards EN 14592 and EN 1382 for the actual timber material with density $\rho_a$, $f_{tens,k}$ is the experimentally determined tensile resistance of the fastener together with a steel plate, $t_{pen}$ is the penetration depth of the profiled part of the nail in timber, $n$ is the number of the screws in the flange of connector, $l_{ef}$ is the length of threaded part of the screw and $\rho_k$ is the characteristic density of timber in the actual connection. If the penetration depth for an anchor nail is less than $t_{pen} \le 8d = 32$ mm, the resistance according to Eq. (10a) is reduced by ($t_{pen}$/8mm - 3).

Eq. (8) may be used for angular ring shank nails, if the nominal thickness of steel plate is at least 2,00 mm, the length of the conical part of nail head is at least 4 mm and the diameter of the cone at the head of the nail is at least 5,2 mm. Otherwise linear interpolation of equations (7) and (8) is used for the steel plate thicknesses between 2 and 4 mm.

Characteristic resistance

$$R_{B,x,k} = k_m F_{B,v,Rk} \qquad (11)$$

where $F_{B,v,Rk}$ is the characteristic lateral load-carrying capacity of the fastener in the timber part against flange B, according to EN 1995-1-1, and the factor $k_m$ depends on the placement of the fasteners. Values of $k_m$ are given in Table A2.1 for cases, where fasteners are used in all 5 mm holes of the angle bracket.

Characteristic tension resistance for angular brackets without reinforcement ribs

$$R_{B,z,t,k} = \min\begin{cases} F_{n,1} + F_{n,2} - 3 \cdot \dfrac{F_{n,1} \cdot d_1 + F_{n,2} \cdot d_2 - \dfrac{B \cdot t_d^{\,2}}{4} \cdot f_y}{2L_B + d_2} & \text{(a)} \\ \dfrac{t_d^{\,2} f_y}{4 d_1} \cdot \left(B + B_{net,1}\right) & \text{(b)} \\ \dfrac{t_d^{\,2} f_y}{4 d_2} \cdot \left(B + B_{net,2}\right) + \dfrac{F_{n,1}\left(d_2 - d_1\right)}{d_2} & \text{(c)} \\ F_{n,1} + F_{n,2} & \text{(d)} \end{cases} \qquad (12)$$

where

$d_1$ distance between the bent edge and the hole row nearest to it in flange B ($i$ = 1),

$d_2$ distance between the bent edge and the hole row second nearest to it in flange B ($i$ = 2),

$B$ the width of the angular bracket,

$t_d$ is the thickness of the Angle Bracket to be used in calculations (= the minimum thickness minus the thickness of the zinc coating),

$f_y$ yield strength of the steel of the Angle Bracket,

$L_B$ the length of flange B from the middle of the bent edge,
$B_{net,i}$ the net width of the Angle Bracket at hole row *i* and

$$F_{n,i} = n_i F_{ax,Rk} \quad (13)$$

when $n_i$ is the number of fasteners at row *i* and $F_{ax,Rk}$ is the characteristic withdrawal resistance of the fastener in the timber member against flange B according to EN 1995-1-1.

If there are fasteners only in one or two rows at flange B, in expression (12) equation (a) is inserted by $F_{n,2} = 0$ and $d_2 = d_1$ and equation (c) needs not to be checked.

Characteristic compression resistance for angle brackets without reinforcement

$$R_{B,z,c,k} = t_d \cdot \sqrt{3 \cdot B \cdot B_{net} \cdot f_y \cdot f_{c,90,k}} \quad (14)$$

where $t_d$, $B$ and $f_y$ are defined as for equation (12) and $B_{net}$ is the smallest net width of the flange B and $f_{c,90,k}$ is the characteristic compression strength perpendicular to the timber member against flange B.

Calculated characteristic compression resistances of SSF Angle Brackets are shown in Table A2.2 for connections of sawn timber of strength class C24.

Structural requirements

Connections with the angle brackets shall fulfil the minimum spacing and edge and end distance requirements specified in EN 1995-1-1. The minimum distances $a_1$ and $a_2$ in table 8.2 of EN 1995-1-1 can be multiplied by a factor of 0,7 (nailed steel-to-timber connections).

If angle brackets are placed on both sides of the timber, the point of the fastener shall be at most 4*d* from the surface of the opposing side, where *d* is the nominal diameter of the fastener.

It is not possible to fill all holes by fasteners in all configurations and loading combinations of the angle brackets. In partial fixing the fasteners shall always be placed in the row nearest to the end of the flange and as near as possible to the bent edge of the angle bracket. Additionally, the fasteners should be positioned symmetrically.

All fasteners in same flange shall be identical. The opposing flanges may have different fasteners.

**Table A2.1.** Article numbers of the SFF Angle Brackets, nominal dimensions, grade of steel plate, number of fasteners in flange B $n_B$, eccentricity of the fastener group *e*, sum of the moment arms for the fastener group $\Sigma r_i$ and values for factor $k_m$ when the fasteners are used in all 5 mm diameter of holes.

| Art. No. | Size (mm) | Grade | $n_B$ | *e* (mm) | $\Sigma r_i$ (mm) | $k_m$ |
|---|---|---|---|---|---|---|
| AB 2-2<br>AB 2-3 | 50x50x35x2,5<br>70x70x55x2,5 | DX51D<br>DX51D | 4<br>10 | 27,3<br>39,9 | 68,8<br>222,1 | 1,621<br>3,576 |
| ASAB 1-1<br>ASAB 1-5 | 50x55x30x2,0<br>60x30x56x2,0 | DX51D<br>DX51D | 4<br>7 | 27,0<br>11,1 | 56,6<br>120,5 | 1,476<br>4,270 |
| PAB-4<br>PAB-5 | 60x60x40x2,0<br>60x60x60x2,0 | DX51D<br>DX51D | 6<br>9 | 31,0<br>31,0 | 115,6<br>200,8 | 2,351<br>3,779 |

**Table A2.2.** Characteristic compression resistance $R_{B,z,c,k}$ for SSF Angle Brackets used with sawn timber in strength class C24. For compression capacities with other strength classes, the characteristic resistance $R_{B,z,c,k}$ should be multiplied by the factor $\sqrt{f_{c,90,k} / 2{,}5}$, where $f_{c,90,k}$ is the characteristic compression strength perpendicular to the grain of the actual timber grade in N/mm$^2$.

| Art. No. | Size (mm) | $f_y$ (N/mm$^2$) | $t_d$ (mm) | $B$ (mm) | $B_{net}$ (mm) | $R_{B,z,c,k}$ (kN) |
|---|---|---|---|---|---|---|
| AB 2-2 | 50x50x35x2,5 | 220 | 2,29 | 35 | 24 | 2,70 |
| AB 2-3 | 70x70x55x2,5 | 220 | 2,29 | 55 | 34 | 4,02 |
| ASAB 1-1 | 50x55x30x2,0 | 220 | 1,81 | 30 | 13,5 | 1,48 |
| ASAB 1-5 | 60x30x56x2,0 | 220 | 1,81 | 56 | 18 | 2,33 |
| PAB-4 | 60x60x40x2,0 | 220 | 1,81 | 40 | 30 | 2,55 |
| PAB-5 | 60x60x60x2,0 | 220 | 1,81 | 60 | 45 | 3,82 |

**Table A2.3.** Characteristic tension resistance $R_{B,z,t,k}$ for SSF Angle Bracket connections when anchor nails 4x50, $f_{ax,k}$ = 6 N/mm$^2$ and $t_{pen}$ = 34 mm, are used in all holes.

| Art. No. | Size (mm) | $L_B$ (mm) | $d_1$ (mm) | $n_1$ | $B_{net,1}$ (mm) | $F_{n,1}$ (N) | $d_2$ (mm) | $n_2$ | $B_{net,2}$ (mm) | $F_{n,2}$ (N) | $F_{z,t,k}$ (a) (N) | $F_{z,t,k}$ (b) (N) | $F_{z,t,k}$ (c) (N) | $F_{z,t,k}$ (d) (N) | $R_{B,z,t,k}$ (kN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AB 2-2 | 50x50x35x2,5 | 48,75 | 13,25 | 2 | 25 | 1632 | 41,25 | 2 | 25 | 1632 | 1320 | 1306 | - | 3264 | 1,31 |
| AB 2-3 | 70x70x55x2,5 | 68,75 | 17,25 | 2 | 45 | 1632 | 29,25 | 3 | 40 | 2448 | 2571 | 1672 | 1606 | 4080 | 1,61 |
| ASAB 1-1 | 50x55x30x2,0 | 49,00 | 17,00 | 2 | 13,5 | 1632 | 37,00 | 2 | 13,5 | 1632 | 1049 | 461 | - | 3264 | 0,46 |
| ASAB 1-5 | 60x30x56x2,0 | 29,00 | 7,00 | 5 | 31 | 4080 | 21,00 | 2 | 18 | 1632 | 3228 | 2239 | - | 5712 | 2,24 |
| PAB-4 | 60x60x40x2,0 | 59,00 | 11,00 | 2 | 30 | 1632 | 31,00 | 2 | 30 | 1632 | 2029 | 1147 | 1460 | 3264 | 1,15 |
| PAB-5 | 60x60x60x2,0 | 59,00 | 11,00 | 3 | 45 | 2448 | 31,00 | 3 | 45 | 2448 | 3044 | 1720 | 2190 | 4896 | 1,72 |