



European Technical Assessment + Evaluation report

ETA 13/0451 of 14/04/2020

I General Part

| | |
|---|---|
| Technical Assessment Body issuing the ETA | Eurofins Expert Services Oy |
| Trade name of the construction product | Taizhou Homer Column Shoes |
| Product family to which the construction product belongs | Three-dimensional nailing plates |
| Manufacturer | Jiangsu Homer Hardware Manufacturing Co., Ltd 516 Keji Road, The Economic Development Zone, Jiangyan District, Taizhou City, Jiangsu Province China 225500 |
| Manufacturing plant | Jiangsu Homer Hardware Manufacturing Co., Ltd 516 Keji Road, The Economic Development Zone, Jiangyan District, Taizhou City, Jiangsu Province China 225500 |
| This European Technical Assessment contains | 42 pages including 3 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 | ETAG 015 used as EAD, 2012, Three-dimensional nailing plates |
| This ETA replaces | ETA 13/0451, issued on May 14, 2019 |

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II Specific Part

1 Technical description of the product

There are nine different types of Taizhou Homer Column Shoes: Adjustable Column Shoe, Multi Adjustable column shoe, Column Anchor Strap, Column Shoe type E, Column Shoe type L, Column Shoe type D, Heavy Supporting Shoe, Adjustable Column Leg and Adjustable Supporting Tube (see Figure 1). Construction and dimensions of all types of Taizhou Homer Column Shoes are given in Annex 1. Tolerance for the main dimensions of the connectors and the position of the holes is within $\pm 1,00$ mm.

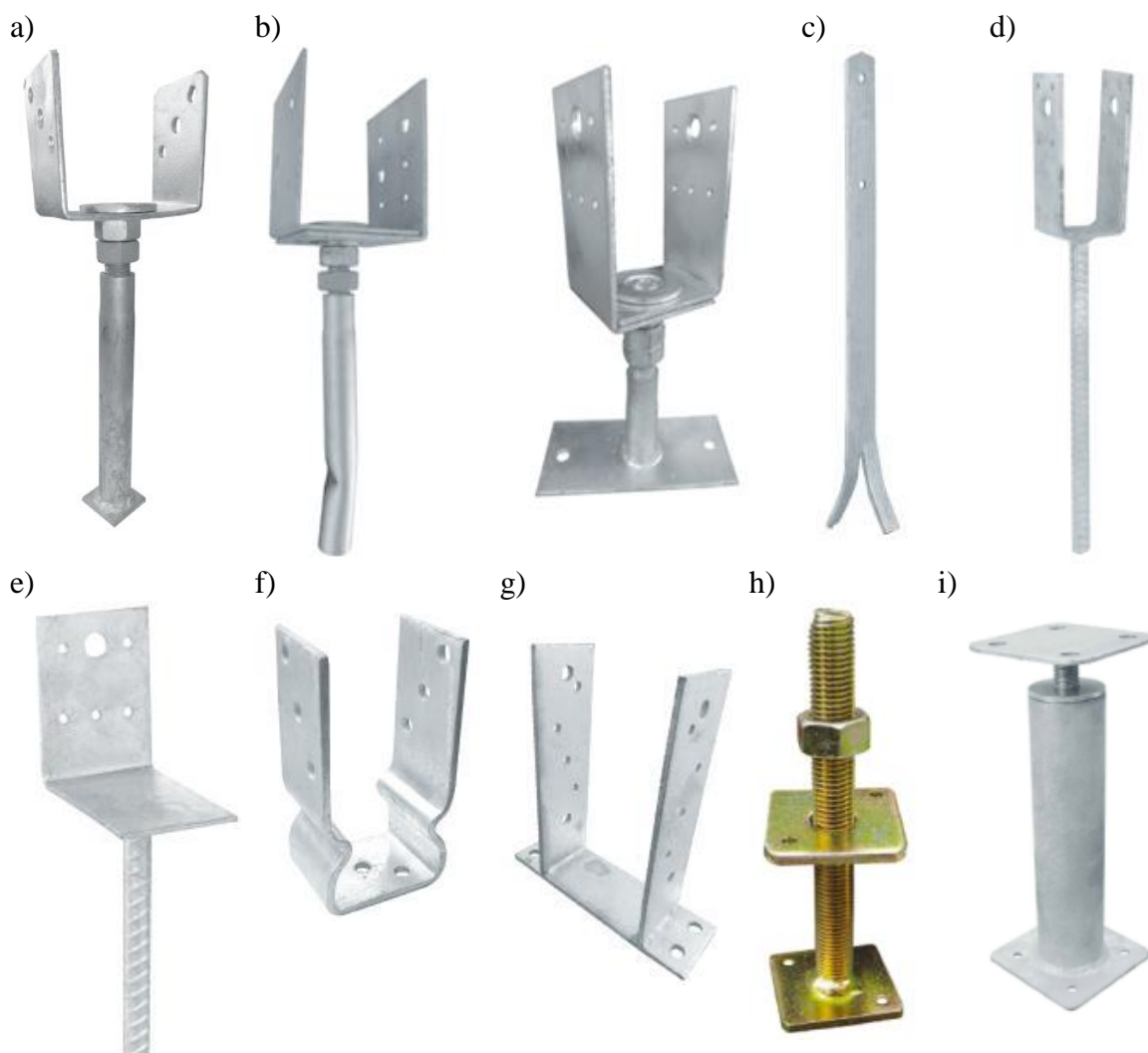


Figure 1. Different types of Taizhou Homer Column Shoes: a) Adjustable Column Shoe, b) Multi Adjustable Column Shoe, c) Column Anchor Strap, d) Column Shoe type E, e) Column Shoe type L, f) Column Shoe type D and g) Heavy Supporting Shoe, h) Adjustable Column Leg and i) Adjustable Supporting Tube.

Column Anchor Straps and Column Shoes of type D are one-piece non-welded three-dimensional nailing plates manufactured by pressing of steel plate. All other Taizhou Homer Column Shoes are welded steel connectors. Heavy Supporting Shoes are welded from steel plates. Adjustable and Multi Adjustable Column Shoes, Adjustable Column Legs and Adjustable Supporting Tubes are assembly from pressed steel plates, thread rods, nuts and steel pipes. Column Shoes of types E and L are welded from pressed steel plates and ribbed reinforcement bars. The Adjustable Column Legs are yellow electroplated zinc coated and one of the Column Shoe type E product is stainless steel

connector. All other Taizhou Homer Column Shoes are hot dipped galvanized after pressing and welding.

The steel plate material used in mild steel Taizhou Homer Column Shoes is hot rolled steel strip of grade S235JR according to the standard EN 10025-2 or Chinese grade Q235B in accordance with the specification GB/T 3274. The yield strength R_{eH} is at least 235 N/mm², the tensile strength R_m at least 360 N/mm² and elongation at failure A_{80} at least 19 %. The thickness of steel plate is $4,0 \pm 0,5$ mm, $5,0 \pm 0,6$ mm or $6,0 \pm 0,6$ mm.

The ribbed bars are hot rolled reinforcement bar of Chinese grade HRB335 according to specification GB 1499. The characteristic yield strength of ribbed bars is 335 N/mm². The grade of threaded rods is 4.8 according to ISO 4018 and the grade of nuts is 5 according to ISO 4034.

The stainless steel Column Shoes are manufactured from cold rolled austenitic stainless steel plate of the grade of 1.4301 according to the standard EN 10088-2 or from grade AISI 304 (SS304) according to the standard ASTM A240/A240M.

The mild steel column shoes are hot dipped galvanized according to EN ISO 1461:1999 with a zinc thickness at least 55 µm or yellow electroplated zinc coated according to ISO 2081 with a zinc thickness of at least 5 µm.

Assessment

The manufacturer delivered technical specification of the product that corresponds to the scope of ETAG 015.

Conclusion

Requirements set in clause 1.1 of ETAG 015 are met.

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

2.1 Intended uses

The intended use of Taizhou Homer Column Shoes is to support end of timber columns to concrete structures as structural connectors (see Figure 2). The timber columns are strength graded timber according to EN 14081-1, glulam according to EN 14080 or laminated veneer lumber according to EN 14374. The characteristic density ρ_k of the timber shall not be greater than 500 kg/m³. This ETA does not cover column shoes fixed as load bearing fasteners to the end grain of a timber member or to the edge face of a LVL member. Strength class of concrete shall be at least C20/25.

The upper part of the column shoe e.g. a U- or L-shaped plate or a steel plate is fastened to the timber member with nails, screws, bolts or dowels. The lower part of the column shoe is fastened to the concrete basement by a threaded rod, a tube or a plate for embedment into the support of concrete or a steel plate to be fasteners by anchor bolts to the support of concrete. The penetration length in concrete shall be at least 150 mm. The used anchor bolts shall have a separate European Technical Assessment, where the lateral load-carrying capacity and withdrawal resistance for bolted steel-to-concrete connection is given.

In holes of 5 mm anchor nails or anchor screws according EN 14592 are used (see Figure 3). The diameter of these anchor nails shall be $d = 4,0$ mm and the profiled length at least 24 mm. The diameter of the smooth part of the anchor screws shall be $d = 4,5 \dots 5,0$ 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 $6d$. In

Column Anchor Straps, anchor nails of diameter $d = 6$ mm or lag screws according to EN 14592 are used. Timber parts are not pre-bored for the nails and screws of diameter $d \leq 6$ mm.

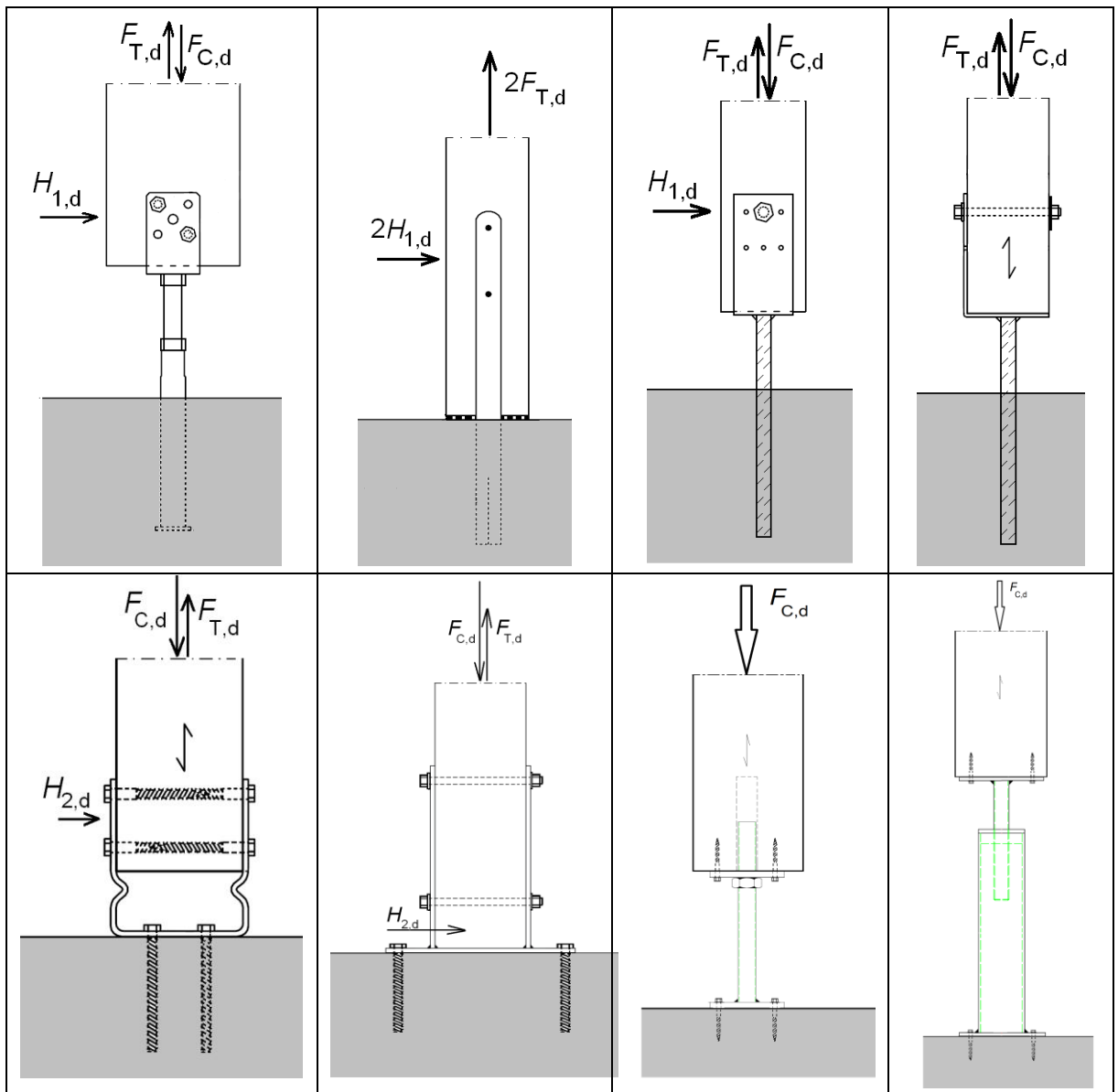


Figure 2. Typical use of Taizhou Column Shoes.



Figure 3. Anchor nail and screw types to be used in holes of 5 mm of the column shoes.

In the holes from 7,0 to 13,5 mm of the upper part of Column Shoes bolts or lag screws according to EN 14592 are used as follows: in holes of 7 mm diameter of the fastener is 6,0 mm, in 9 mm holes 8 mm, in 10,5 and 11 mm holes 10 mm and in holes of 13 and 13,5 mm the nominal diameter of bolt or lag screws should be 12 mm. Lag screw is a shank screw where the outer thread diameter is equal to the shank diameter. Bolts are used with nuts as double or single shear steel to timber fasteners and lag screws as single shear fasteners. For bolts and lag screws pre-drilling of timber is used according to requirements of EN 1995-1-1.

For Taizhou Homer Column Shoes, the intended service classes according to EN 1995-1-1 are classes 1, 2 and 3. However, the yellow zinc plated J-AL-1650 and J-AL-2080 connectors are suitable only for service class 1 applications and the yellow zinc plated J-AL-24100 connectors are not suitable for service class 3 applications.

In service class 2, the anchor nails and anchor 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. In service class 3, the nails, screws and bolts shall have an electroplated zinc coating according to EN ISO 2081 at least of type and thickness Fe/Zn 25c, or they shall be hot dip zinc coated according to EN ISO 1461, thickness at least 49 µm. In stainless steel connectors, only fasteners manufactured of applicable stainless steel shall be used.

2.2 Working life

The provisions made in this European Technical Assessment are based on an assumed intended working life of Taizhou Homer Column Shoes of 50 years¹.

2.3 Identification

Taizhou Homer Column Shoes are identified having "TAIZHOU HOMER" stamped on each connector.

Assessment

Information was given by the manufacturer regarding intended uses of the product.

Working life corresponds to clause 1.3 of ETAG 015.

Identification of the product is made as provided in ETAG 015, clause 5.

Conclusion

Requirements set in clauses 1.2, 1.3 and 5.1 of ETAG 015 are met.

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 building kit cannot be interpreted as a guarantee given by the producer or the technical assessment body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for building kits 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

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 corrosion and deterioration | Clause 3.1 |
| Dimensional stability | No performance assessed |
| BWR 2. Safety in case of fire | |
| Reaction to fire | Clause 3.2 |
| Resistance to fire | No performance assessed |
| BWR 3. Hygiene, health and the environment | |
| Content, emission and/or release of dangerous substances | Clause 3.3 |
| BWR 7. Sustainable use of natural resources | |
| Sustainable use of natural resources | No performance assessed |

3.1 Mechanical resistance and stability, BWR 1

3.1.1 Joint strength

Characteristic resistance values of Taizhou Homer Column Shoes are given in Annex 2.

Assessment

Behaviour of the joints is ductile as defined in ETAG 015, 5.1.1.1; therefore, mechanical resistances may be determined by calculation. For Heavy Supporting Shoes the mechanical resistances have been determined by calculation. For the other types of Column Shoes the mechanical resistances have been determined using calculation assisted by testing.

The load-carrying tests of Taizhou Homer Column Shoes have been performed by VTT Expert Services Ltd and Eurofins Expert Services Oy and presented in reports VTT-S-03156-13 and EUFI29-19006337-T4. Eurofins Expert Services Oy / Ari Kevärinmäki has developed design instructions for Taizhou Column Shoes as described in reports VTT-S-03376-13 and EUFI29-19006337-T5.

Method 2 has been used so that the ETA gives characteristic values for the connectors together with the equations for the calculation of design values.

No quantified performance is determined for ductility.

Conclusion

Calculations and calculations assisted by testing have been carried out according to the requirements in ETAG 015. Results of the assessment are given in the ETA.

Requirements set in clause 2.4.1 of ETAG 015 are met.

3.1.2 Resistance to corrosion and deterioration

The hot dip galvanised and stainless steel Taizhou Homer Column Shoes 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 conditions defined by service classes 1, 2 and 3. The yellow zinc plated J-AL-1650 and J-AL-2080 connectors are suitable only for service class 1 applications and the yellow zinc plated J-AL-24100 connectors for service classes 1 and 2.

Assessment

The product specification (including associated ancillary components) has been examined and an assessment or appropriate test and evaluation shall be carried out, to determine the thickness of corrosion protection or the material specification.

Conclusion

Assessment is based on the materials' specification.

Requirements set in clause 2.4.7 of ETAG 015 are met.

3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

Taizhou Homer Column Shoes are made of materials classified to have reaction to fire class A1 according to EN 13501-1.

Assessment

The three-dimensional nailing plates are considered to satisfy the requirements for performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of the listing of their materials in that decision.

Conclusion

Requirements set in clause 2.4.2.1 of ETAG 015 are met.

3.3 Hygiene, health and environment, BWR 3

3.3.1 Content, emission and/or release of dangerous substances

The product does not contain harmful or dangerous substances listed in EOTA TR 34 dated May 2014.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Assessment

The EOTA “model clauses on dangerous substances” apply.

The manufacturer has submitted the chemical constitution and composition of the materials and components of the product according to which there are no dangerous substances present in the product.

Conclusion

Requirements set in clause 2.4.3 of ETAG 015 are met.

Overall conclusion

Assessment has been conducted in accordance with ETAG 015 used as an EAD.

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 Commission², 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.

Documentation

Test reports presented by the manufacturer and other material used as basis for the assessment are presented in Annex 3.

Documents available to the notified body responsible for the evaluation of constancy of performance (AVCP) include:

- The ETA
- Basic manufacturing process
- Product and materials specifications
- Control plan

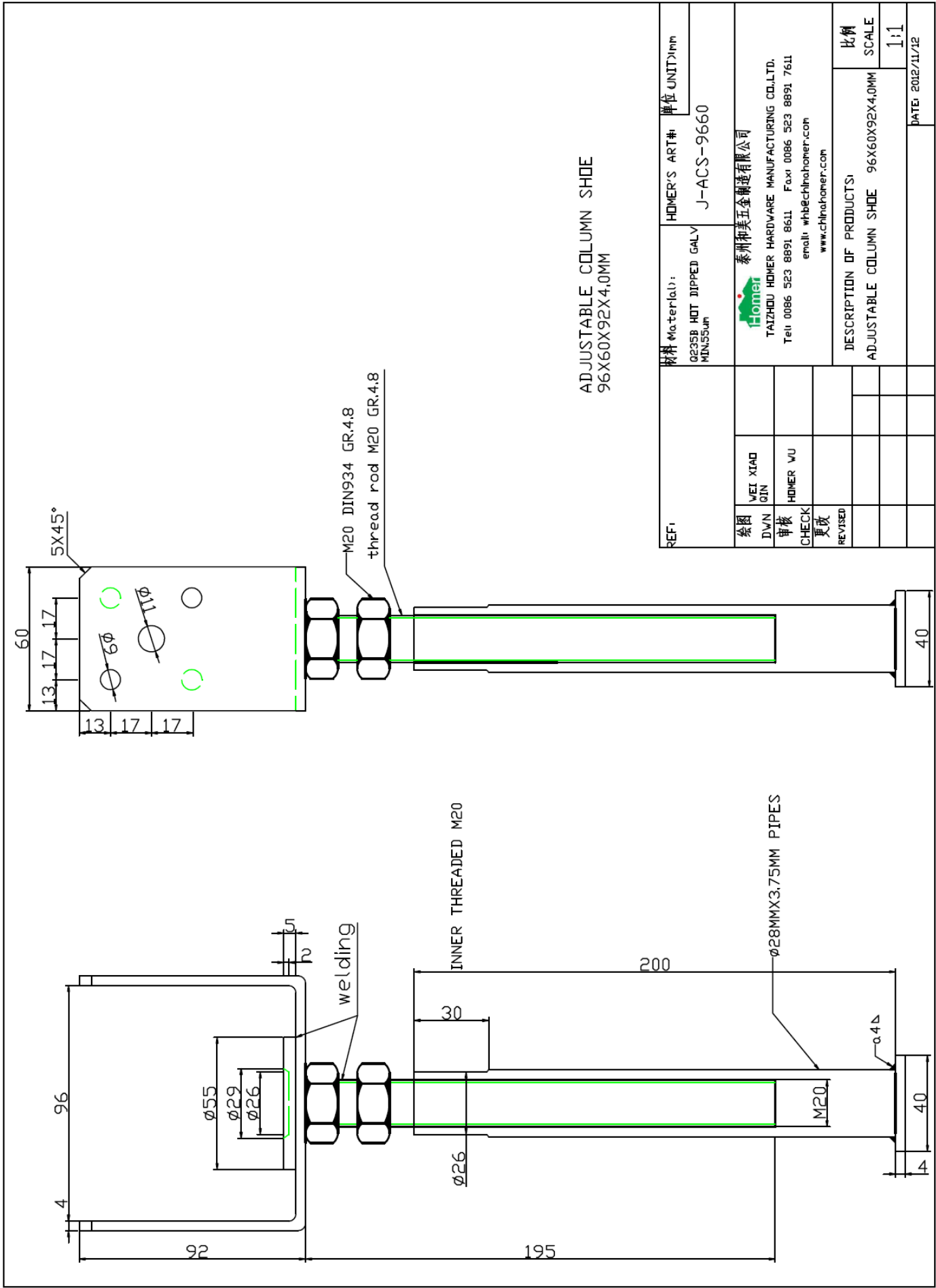
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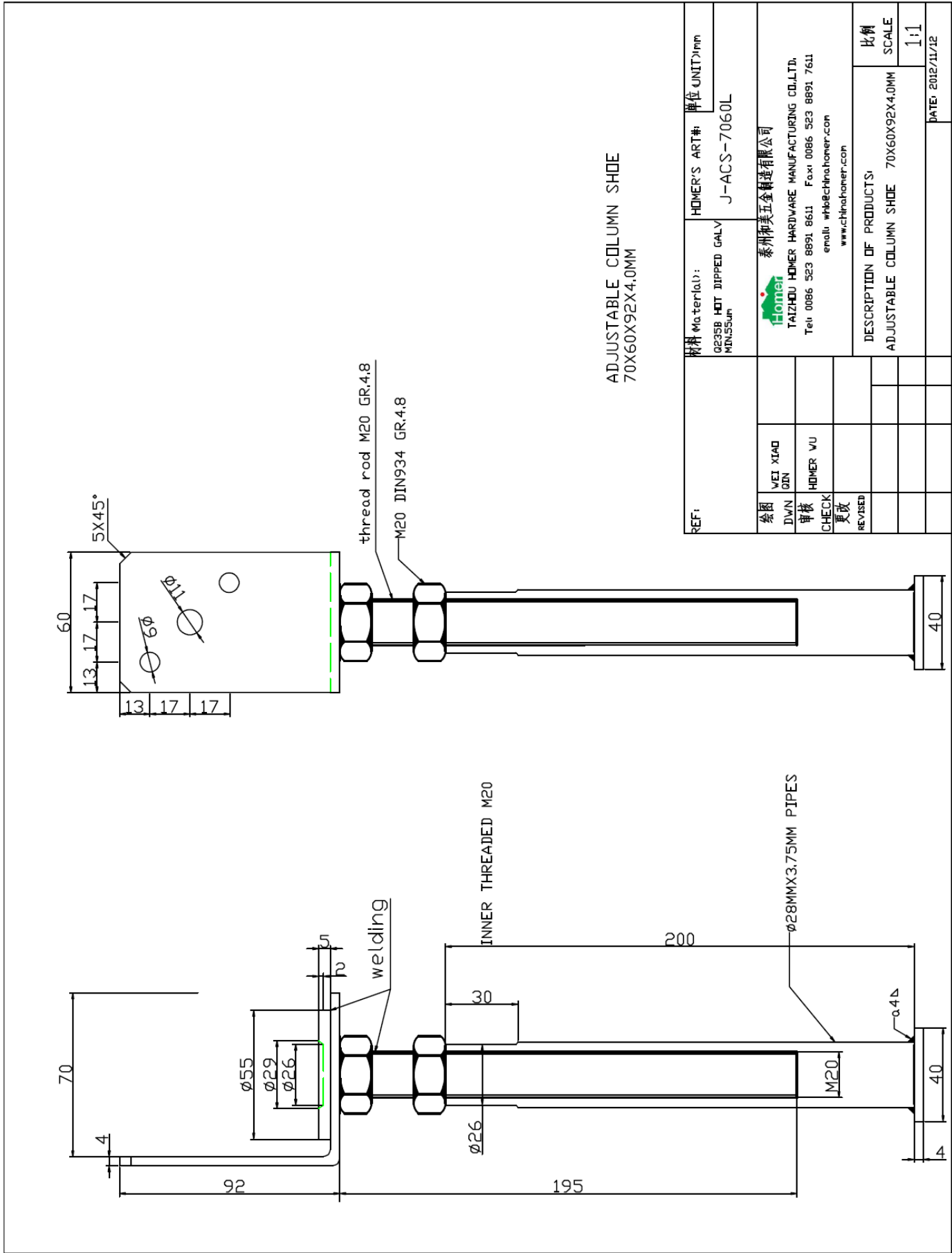
Ari Kevarinmäki
Leading Expert

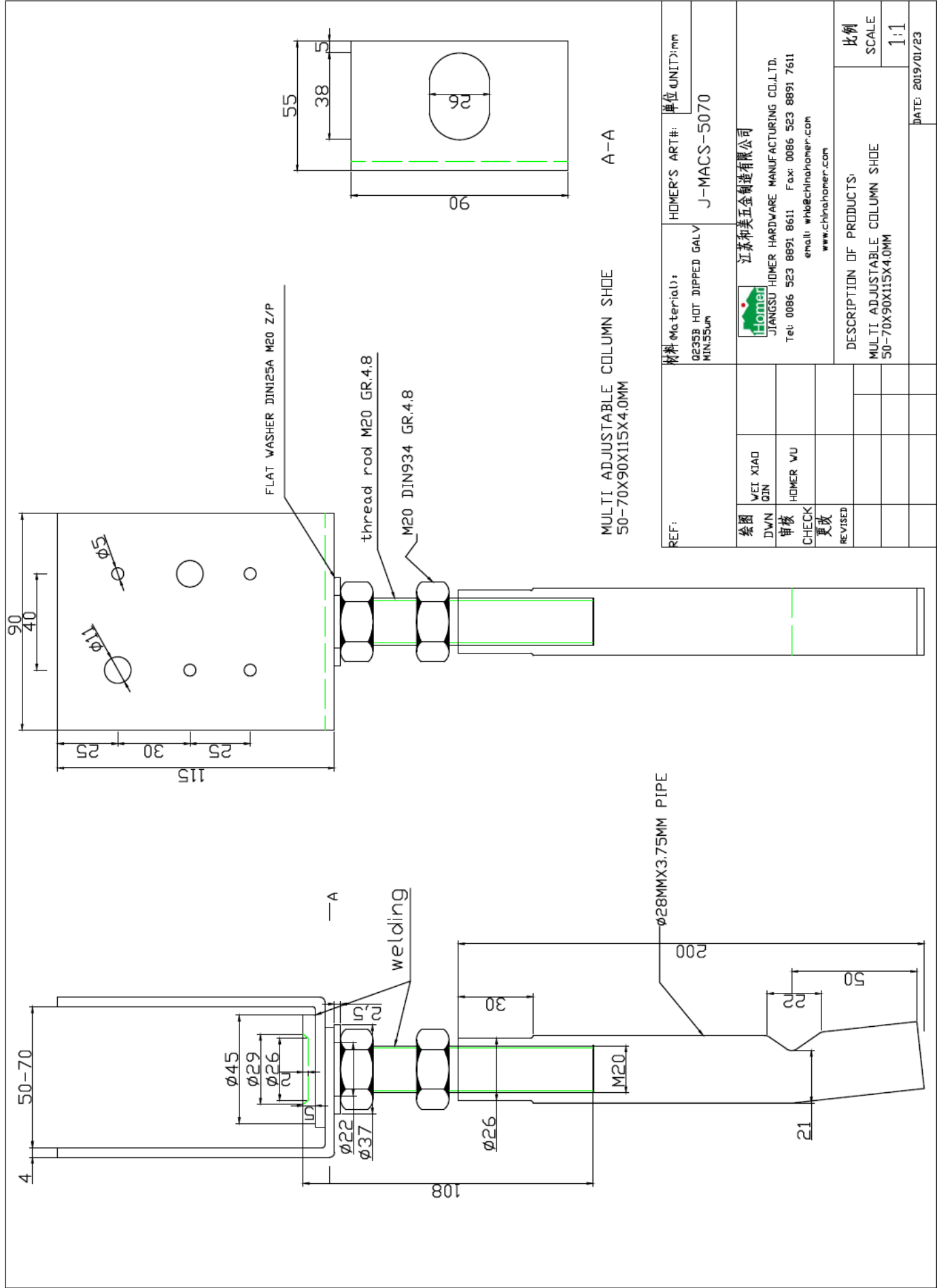
² Official Journal of the European Communities L 268 of 1/10/1997



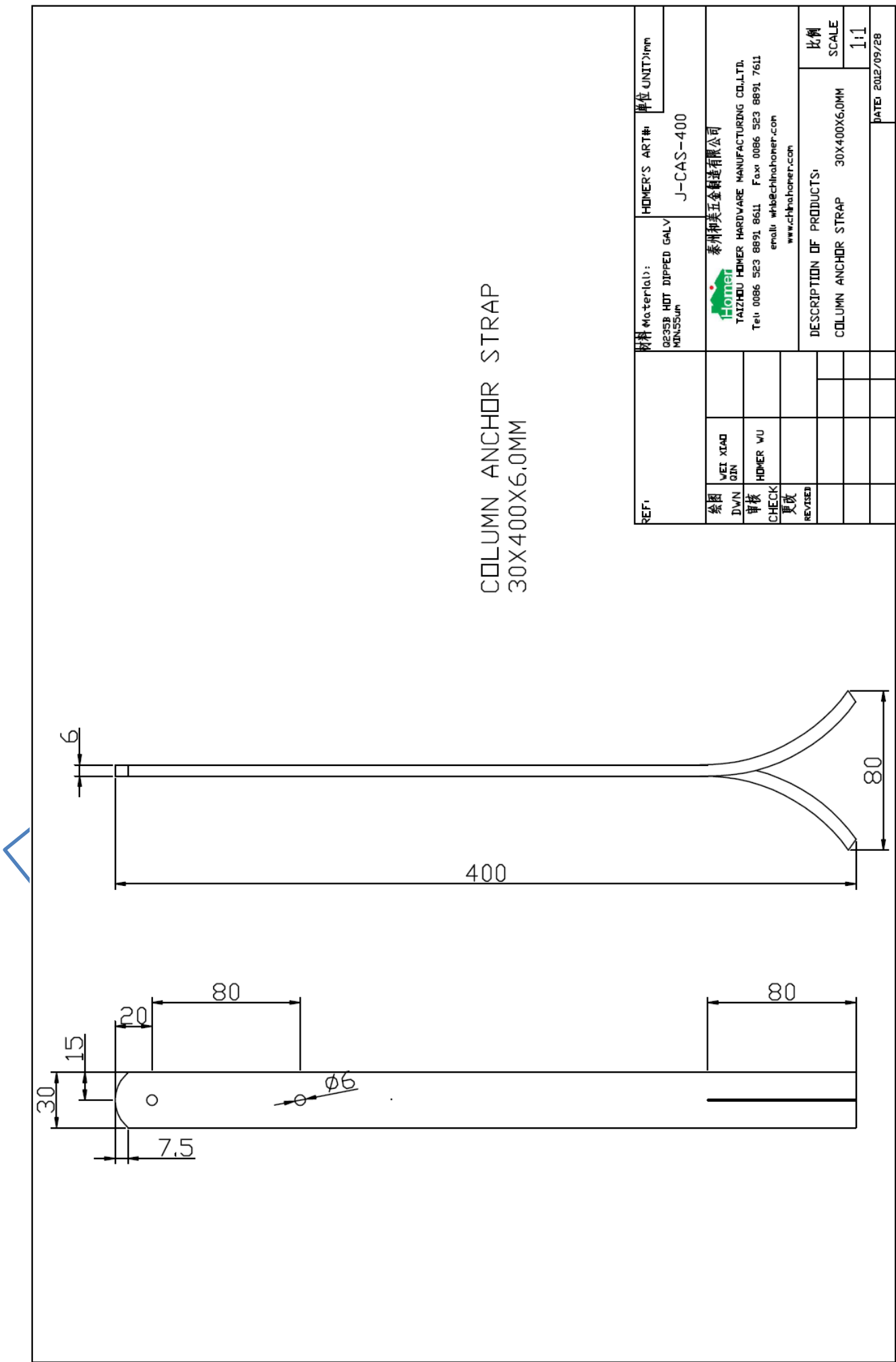


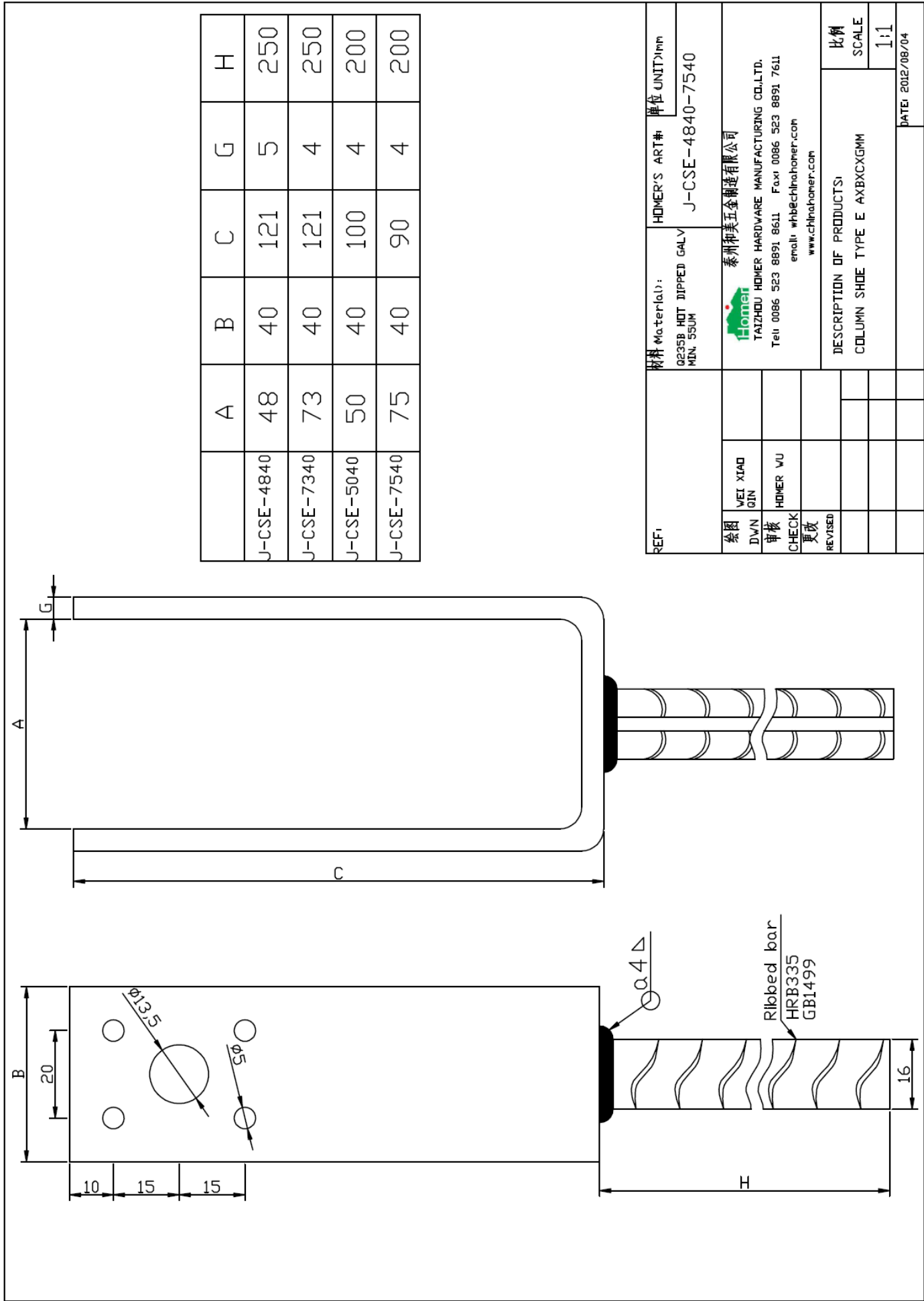


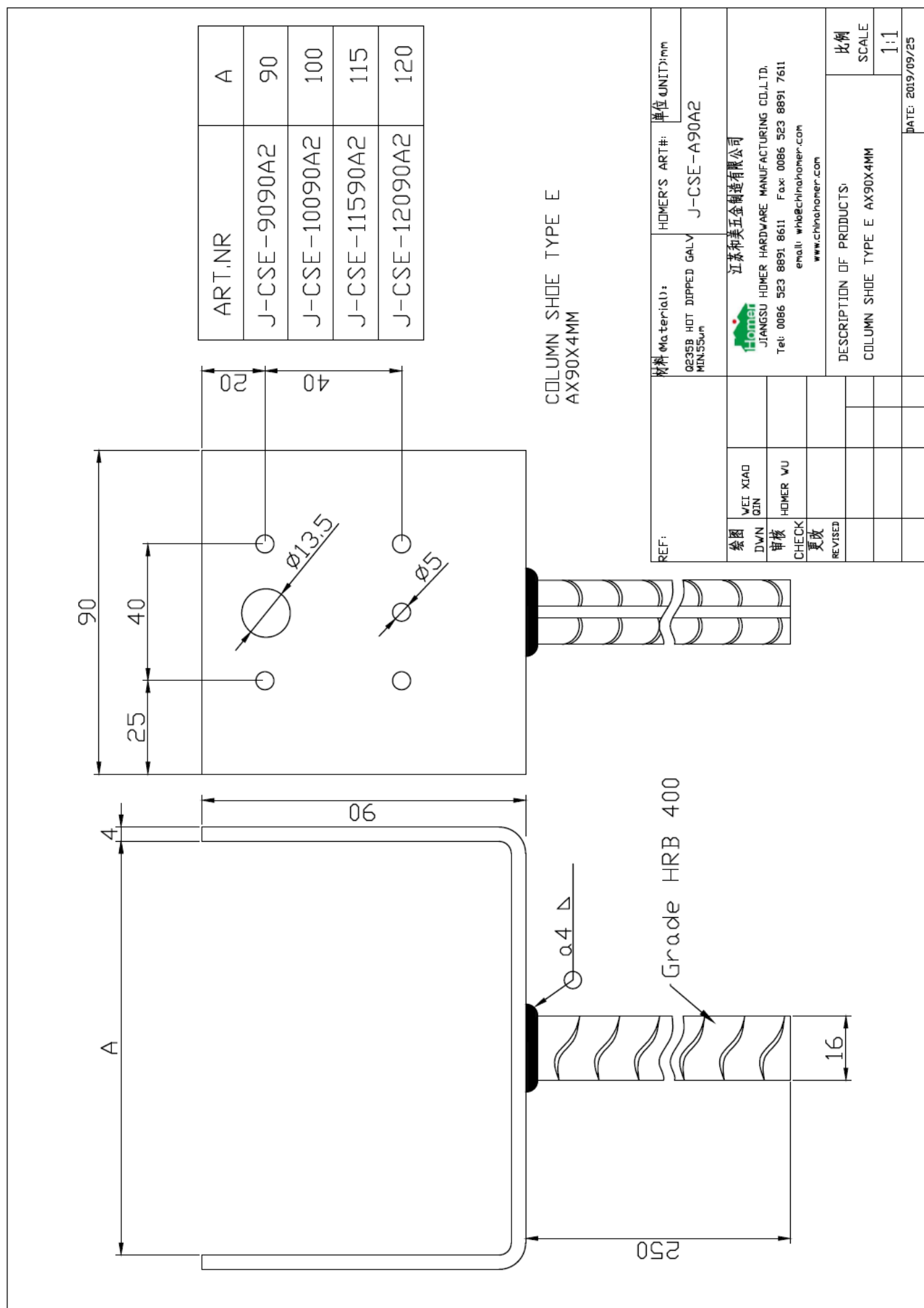









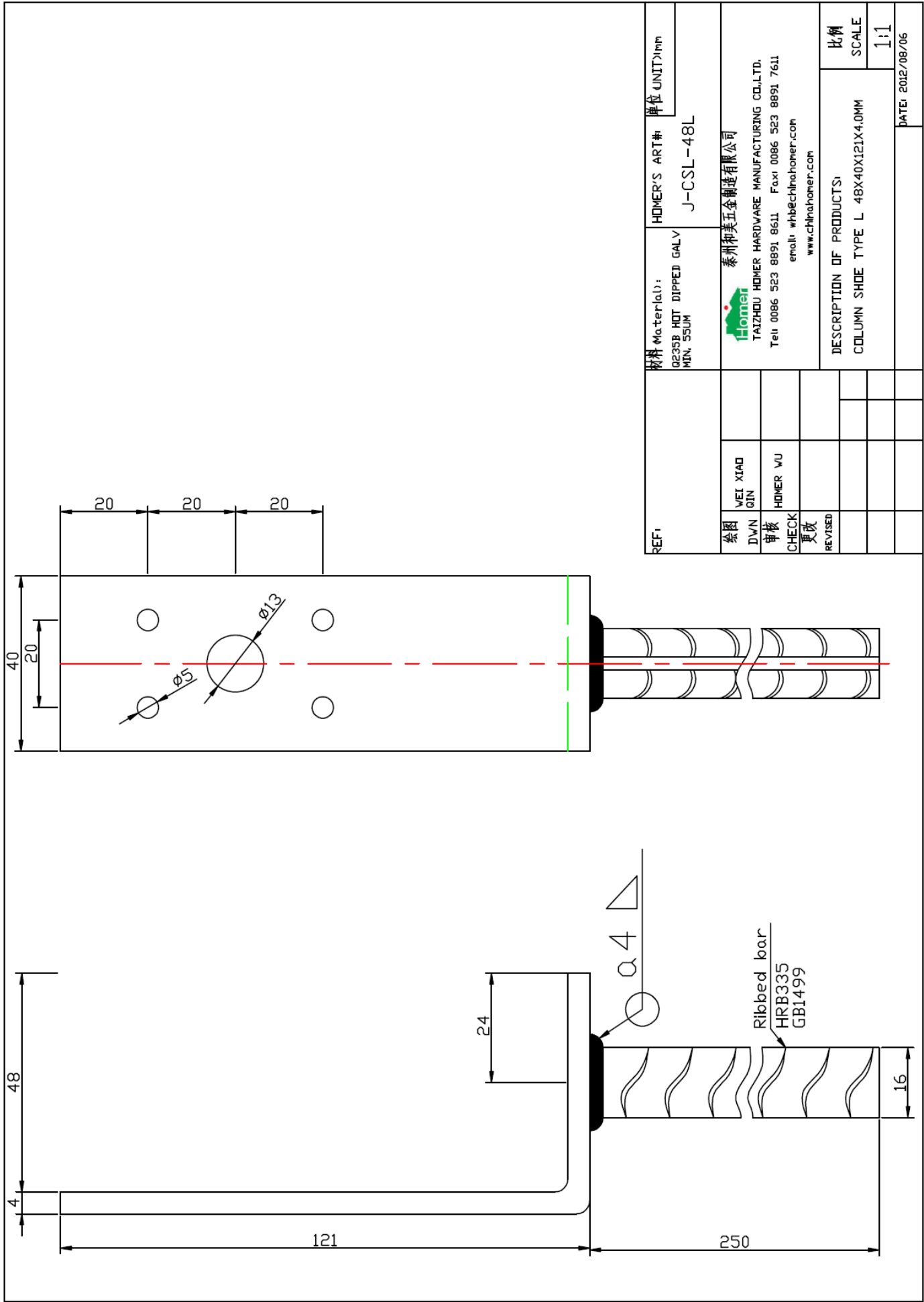


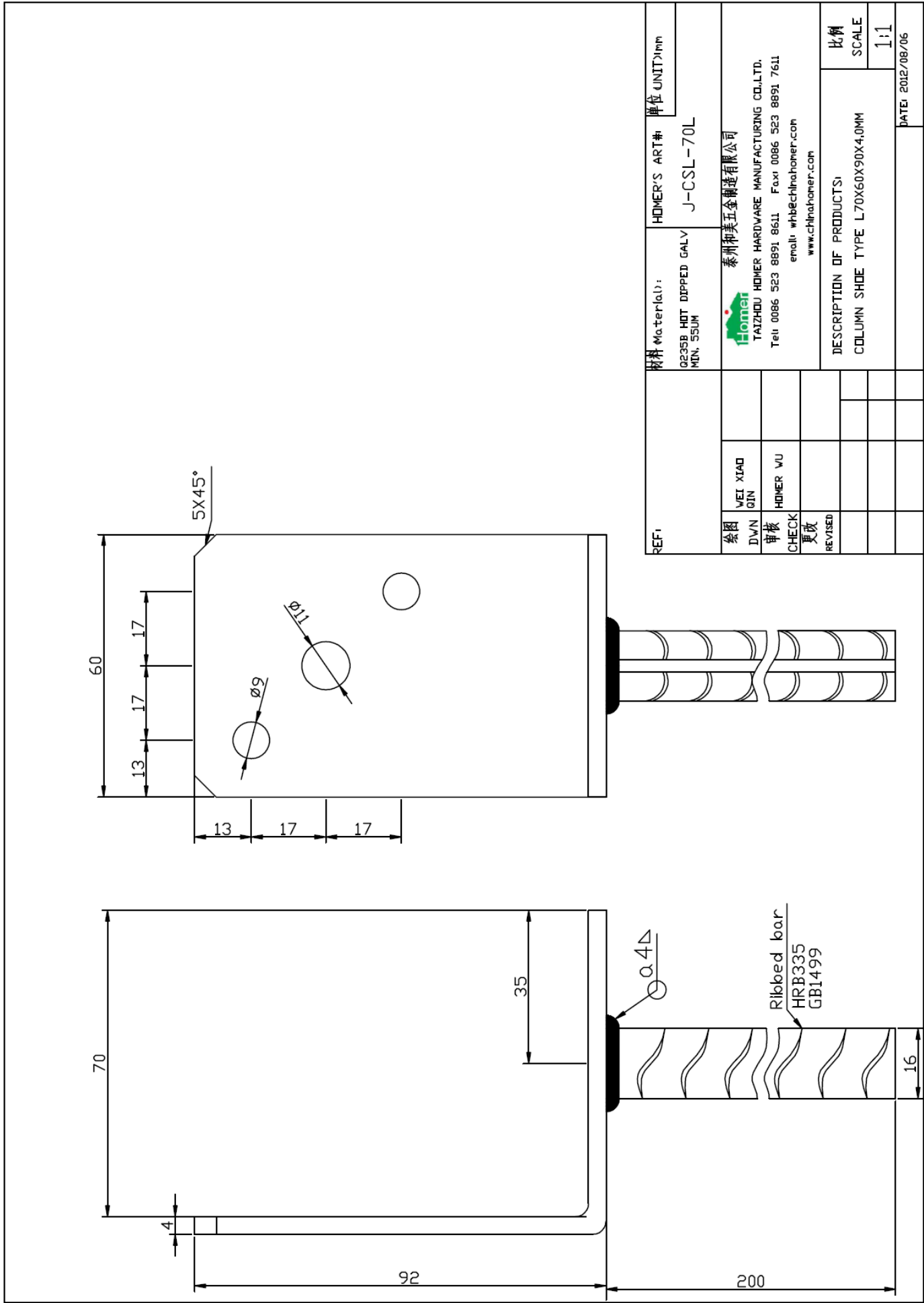




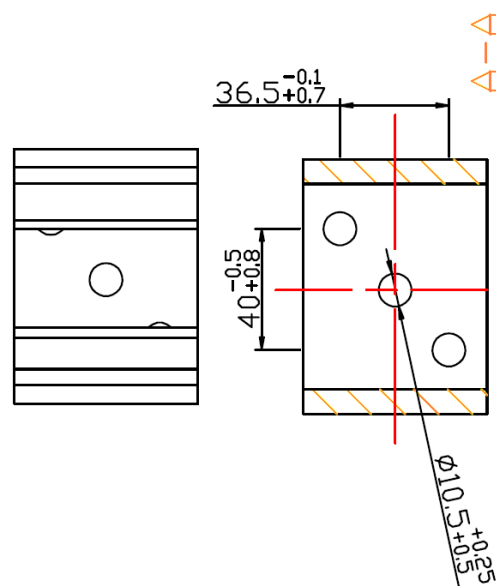
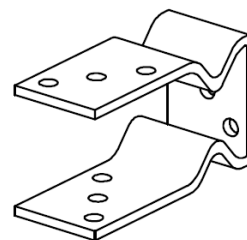
| | | | | |
|---------------|-------------------------------|--|--------------------------|------------------|
| REF: | 材料 Material: | | HOMER'S ART#: 单位 UNIT:mm | |
| | 0235B HOT DIPPED GALV MIN55um | | J-CSE-10070A2 | |
| 绘图 DWG | WEI XIAO QIN |  JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD. Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611 email: whb@chinahomer.com www.chinahomer.com | | |
| 审核 | HOMER WU | | | |
| CHECK | | | | |
| 更改 REVISED | | DESCRIPTION OF PRODUCTS: | | 比例 SCALE |
| | | COLUMN SHOE TYPE E 100X70X4MM | | 1:1 |
| | | | | DATE: 2019/09/25 |

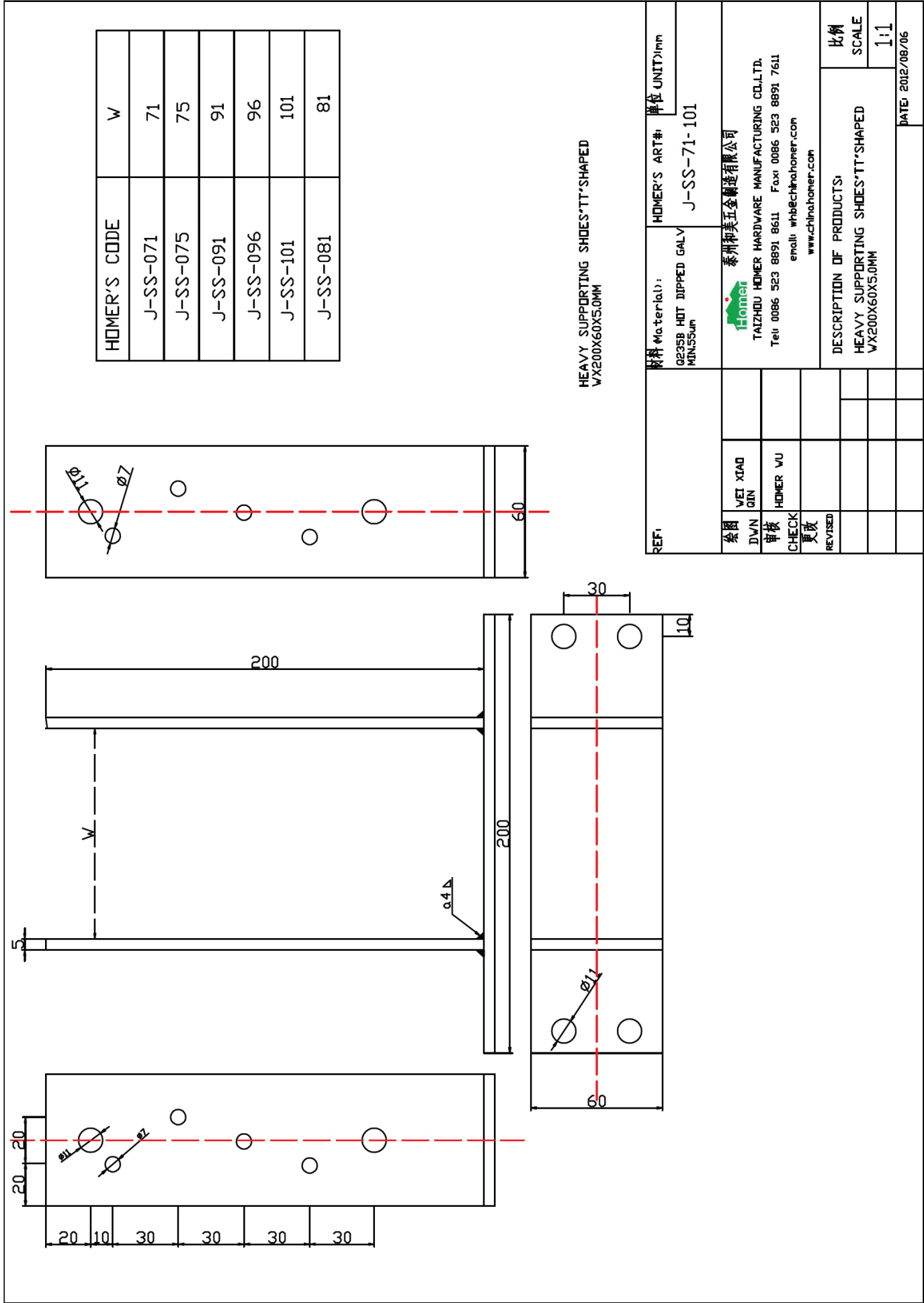
ETA 13/0451 of 14/04/2020 – page 21 of 42

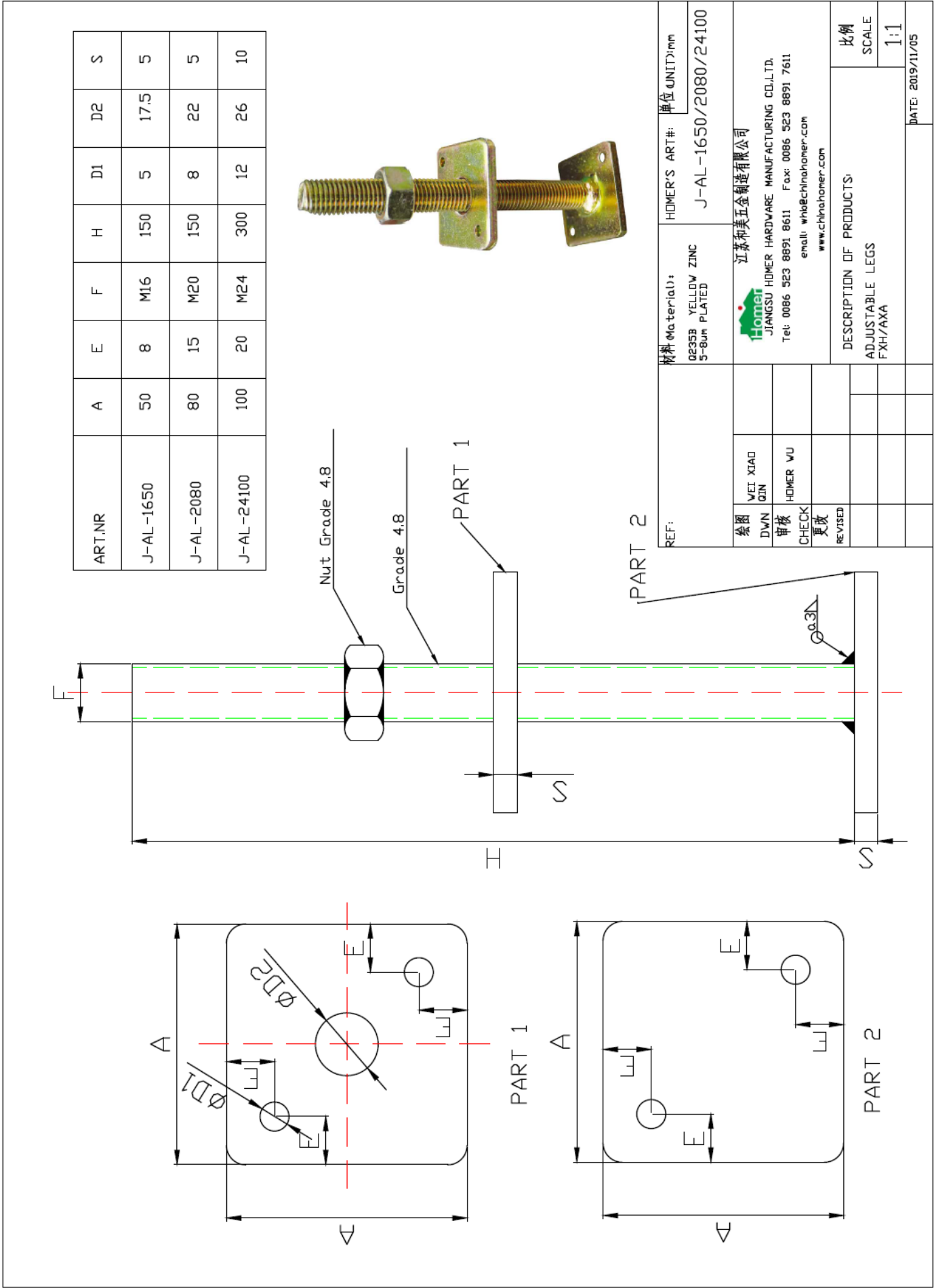


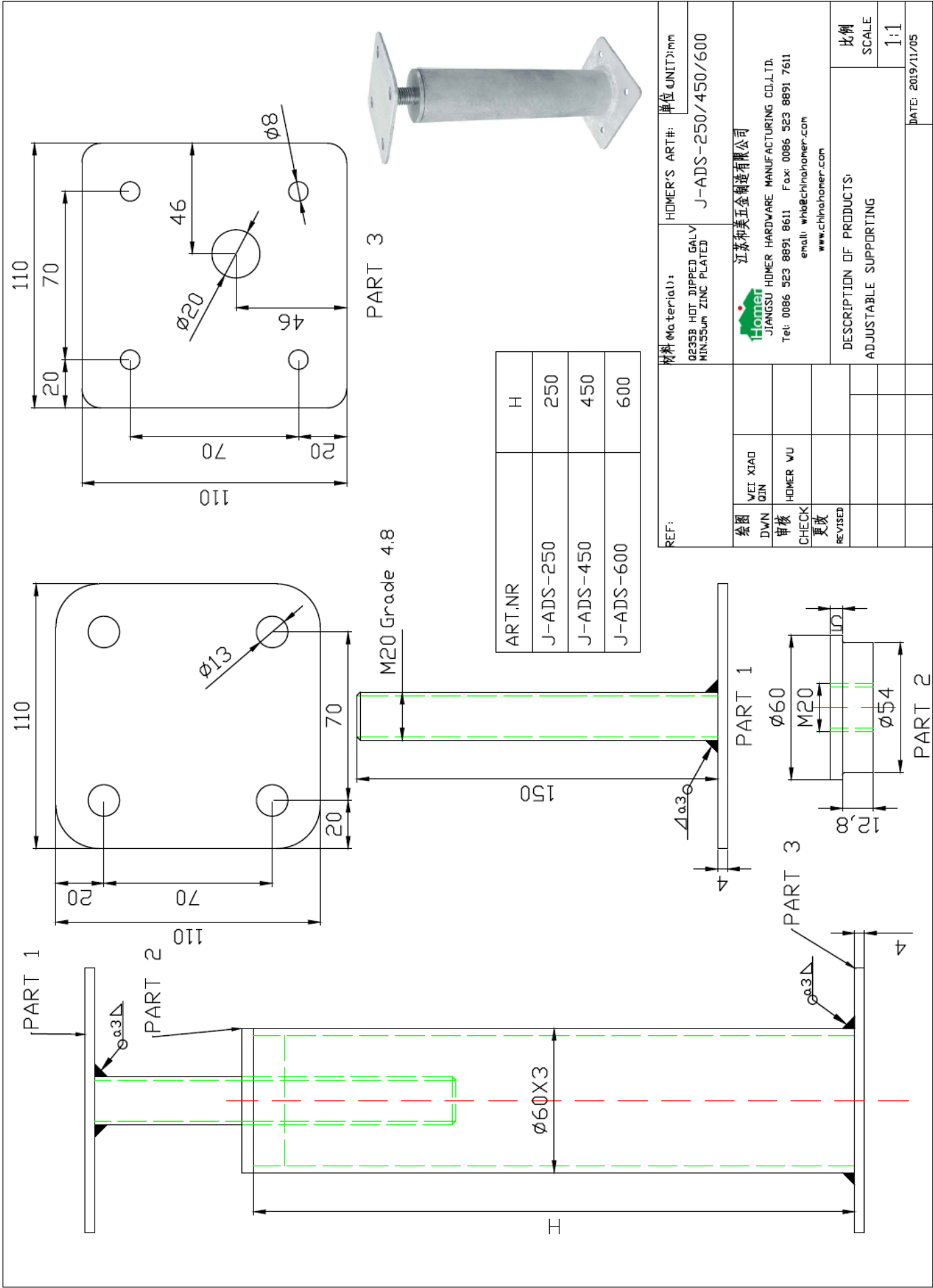


| | | | | | |
|-----------|-----------------------------------|---|--------------|--|------------------|
| REF: | 材料 Material: | | HOMER'S ART: | | 单位 UNIT:mm |
| | Q235B HOT DIPPED GALV MIN.55um | | J-CSD-71-121 | | |
| 绘图 DWG | VEI XIAO QIN | 泰州和美五金制造有限公司 | | | |
| 审核 | HOMER WU | TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD. Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611 email: whb@chhahomer.com www.chhahomer.com | | | |
| 更改 | | DESCRIPTION OF PRODUCTS: COLUMN SHOE TYPE D AXBXCXS,MM | | | |
| REVISD | | | | | |
| | | 比例 SCALE | | | 1:1 |
| | | | | | DATE: 2012/11/11 |









ANNEX 2: CHARACTERISTIC LOAD-CARRYING CAPACITIES

1 General

1.1 Design capacity

The connection capacities are given in this ETA as characteristic values X_{Rk} . The design value X_{Rd} shall be calculated as follows:

$$X_{v,Rd} = \frac{k_{mod} X_{v,Rk}}{\gamma_M} \quad (1)$$

$$X_{w,Rd} = \frac{k_{mod} X_{w,Rk}}{\gamma_M} \quad (2)$$

$$X_{s,Rd} = \frac{X_{s,Rk}}{\gamma_{M0}} \quad (3)$$

$$X_{c,Rd} = \frac{X_{c,Rk}}{\gamma_{Mc}} \quad (4)$$

where

- k_{mod} is the modification factor according to Eurocode 5 taking into account the effect of the duration of the load and moisture content of timber,
- γ_M is the partial factor for the resistance of connections according to the relevant National annex of EN 1995-1-1,
- γ_{M0} is the partial safety factor for the yield strength of steel according to the relevant National annex of EN 1993-1-1 and
- γ_{Mc} is the partial safety factor for the concrete according to the relevant National annex of EN 1992-1-1.

1.2 Lateral load-carrying capacity of fasteners

The characteristic load-carrying capacity for nails and screws of diameter $d \leq 6$ mm should be taken as the minimum value found from the following expression:

$$F_{v,Rk} = \min \left\{ \begin{array}{ll} f_{h,k} t_1 d & (a) \\ f_{h,k} t_1 d \left[\sqrt{2 + \frac{4M_{y,k}}{f_{h,k} d t_1^2}} - 1 \right] + \frac{F_{ax,k}}{4} & (b) \\ 2,3 \sqrt{M_{y,k} f_{h,k} d} + \frac{F_{ax,k}}{4} & (c) \end{array} \right. \quad (5)$$

where the penetration length of fastener in timber $t_1 = L - t$, when L is the length of fastener and t is the thickness of steel plate, d is the nominal diameter of nail or the effective diameter of screw = $1,1 d_i$, when d_i is the inner diameter of threaded part of screw, $M_{y,k}$ is the characteristic yield moment of the fastener determined according to standards EN 14952 and EN 409, $F_{ax,k}$ is the characteristic withdrawal capacity of the fastener with a limitation of term $F_{ax,k}/4$ at maximum to 1/3 with nails and to 1/2 with screws from the load-carrying capacity $F_{v,Rk}$ and the characteristic embedding strength

$$f_{h,k} = 0,082 \rho_k d^{-0,3} \quad \text{N/mm}^2 \quad (6)$$

where ρ_k is the characteristic density of timber.

The characteristic load-carrying capacity for bolts per shear plane per fastener in double shear connections should be taken as the minimum value found from the following expression

$$F_{v,Rk} = \min \begin{cases} 0,5f_{h,k}t_2d & \text{(a)} \\ 1,15\sqrt{2M_{y,k}f_{h,k}}d + \frac{F_{ax,k}}{4} & \text{(b)} \end{cases} \quad (7)$$

where

t_2 is the thickness of timber member,
 d is the diameter of bolt,
 $M_{y,k}$ is the characteristic yield moment of bolt,
 $F_{ax,k}$ is the characteristic axial tension or pull-through capacity of the bolt with a limitation of term $F_{ax,k}/4$ at maximum to 1/5 from the load-carrying capacity $F_{v,Rk}$ and
 $f_{h,\alpha,k}$ is the characteristic embedding strength calculated as follows:

$$f_{h,\alpha,k} = \frac{f_{h,0,k}}{k_{90} \sin^2 \alpha + \cos^2 \alpha} \quad (8)$$

$$f_{h,0,k} = 0,082(1 - 0,01d)\rho_k \quad \text{N/mm}^2 \quad (9)$$

where

$$k_{90} = \begin{cases} 1,35 + 0,15d & \text{for softwoods} \\ 1,30 + 0,15d & \text{for LVL} \\ 0,90 + 0,15d & \text{for hardwoods} \end{cases} \quad (10)$$

and

$f_{h,0,k}$ is the characteristic embedding strength parallel to grain, in N/mm²;
 ρ_k is the characteristic density of timber, in kg/m³;
 α is the angle of the load to the grain;
 d is the diameter of bolt, in mm.

The characteristic load-carrying capacity for the bolts and lag screws per fastener in single shear connections with a thin steel plate ($t \leq d$) should be taken as the minimum value found from the following expression

$$F_{v,Rk} = \min \begin{cases} 0,4f_{h,\alpha,k}t_1d & \text{(a)} \\ 1,15\sqrt{2M_{y,k}f_{h,\alpha,k}}d + \frac{F_{ax,k}}{4} & \text{(b)} \end{cases} \quad (11)$$

where

t_1 is thickness of timber member in case of bolts or the penetration length of screw in timber,
 d is the nominal diameter of the fastener, when the smooth shank penetrates into timber member by not less than $4d$; otherwise $d = 1,1d_i$, when d_i is the inner diameter of threaded part of the screw,
 $M_{y,k}$ is the characteristic yield moment of the fastener according to EN 14952,
 $F_{ax,k}$ is the characteristic withdrawal capacity of the screw with a limitation of term $F_{ax,k}/4$ at maximum to 1/5 with bolts and to 1/2 with lag screws from the load-carrying capacity $F_{v,Rk}$,
 $f_{h,\alpha,k}$ is the characteristic embedding strength calculated by expression (8).

2 Load-carrying capacity of Adjustable and Multi Adjustable column shoe connections

The Adjustable column shoes are used as a timber column connection cast in concrete and subjected to the vertical and horizontal forces presented in Figures A2.1 and A2.2. For the L-shaped connector J-ACS-7060L, any horizontal force in direction $H_{2,d}$ is not allowed.

The end of timber member should be in contact with the bottom plate the connector. The penetration length in concrete shall be at least 150 mm. The distance between the column end and the concrete foundation may be at maximum 150 mm for the Adjustable column shoes and 130 mm for the Multi Adjustable connector as presented in Figures A2.1 and A2.2.

The following design conditions shall be fulfilled for the Adjustable and Multi Adjustable column shoe connections:

$$F_{T,d} \leq F_{T,s,Rd} \quad (12)$$

$$F_{C,d} \leq F_{C,w,Rd} \quad (13)$$

$$\left(\frac{F_{T,d}}{F_{T,v,Rd}} \right)^2 + \left(\frac{H_{1,d}}{H_{1,v,Rd}} \right)^2 \leq 1 \quad (14)$$

$$\frac{F_{C,d}}{F_{C,s,Rd}} + \frac{\sqrt{H_{1,d}^2 + H_{2,d}^2}}{H_{s,Rd}} \leq 1 \quad (15)$$

The characteristic values for the connector capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$ and $H_{s,Rk}$ are presented in Table A2.1.

For J-MACS-80120 connector with anchor bolts in concrete, also the following design condition shall be fulfilled:

$$\frac{F_{T,d}}{F_{T,c,Rd}} + \frac{\sqrt{H_{1,d}^2 + H_{2,d}^2}}{H_{c,Rd}} \leq 1 \quad (16)$$

The characteristic withdrawal strength the anchor bolts $F_{T,c,Rk}$ and the lateral-load carrying capacity of the anchor bolts $H_{c,Rk}$ are verified according to the ETA of the actual anchor bolts.

The characteristic tension force capacity of the connection according to the lateral load-carrying capacity of fasteners should be calculated as:

$$F_{T,v,Rk} = n \cdot m \cdot F_{v,Rk} \quad (17)$$

where

$F_{v,Rk}$ is the characteristic load-carrying capacity of the fastener per shear plane parallel to the grain calculated by the actual equation (5), (7) or (11),
 n is number of fasteners and
 m is number of shear planes; $m=2$ for bolts in U-shaped connector, in all other cases $m=1$.

The characteristic compression capacity of the timber member or lateral load-carrying capacity of the connection of fasteners should be calculated as:

$$F_{C,w,Rk} = \max(A_c \cdot f_{c,0,k}; n \cdot m \cdot F_{v,Rk}) \quad (18)$$

where the connection capacity $n \cdot m \cdot F_{v,Rk}$ is calculated as in equation (17) and

$f_{c,0,k}$ is the characteristic compression strength of timber member parallel to the grain and
 A_c is the contact area presented in Table A2.1.

The characteristic horizontal force capacity of the connection according to the lateral load-carrying capacity of fasteners should be calculated as:

$$H_{1,v,Rk} = n \cdot m \cdot F_{v,Rk} \quad (19)$$

where $F_{v,Rk}$ is the characteristic load-carrying capacity of the fastener per shear plane perpendicular to the grain calculated by the actual equation (5), (7) or (11) and symbols n and m are the same as in expression (17).

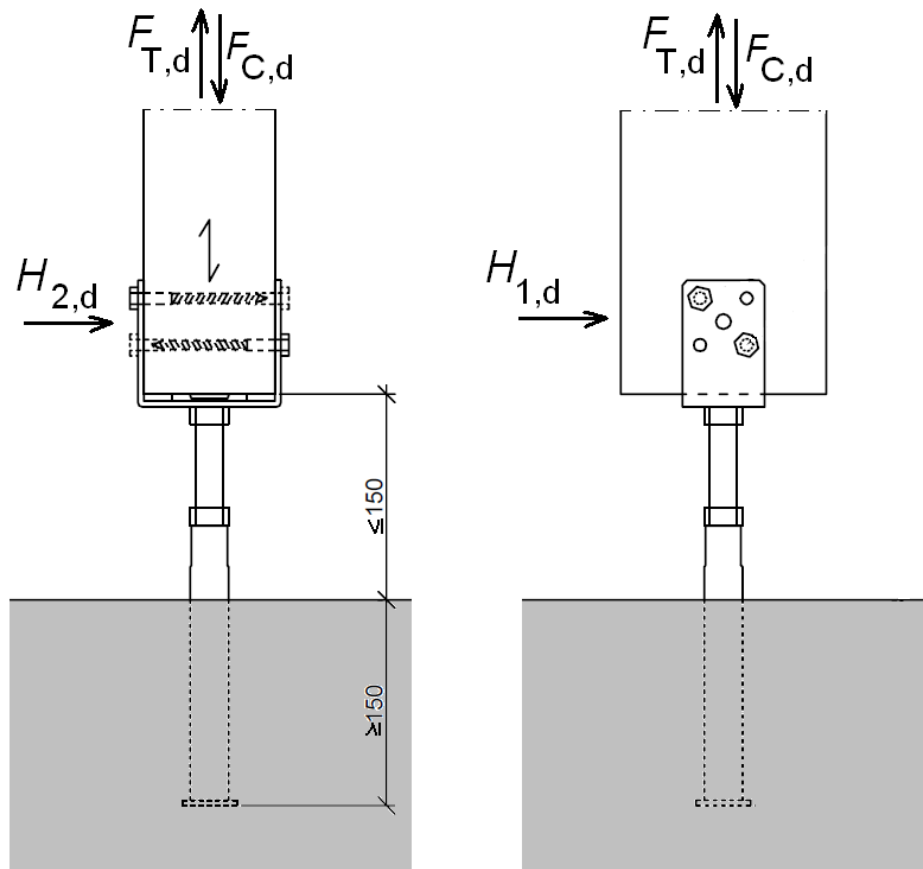


Figure A2.1 Use of Adjustable column shoe and the definition of forces.

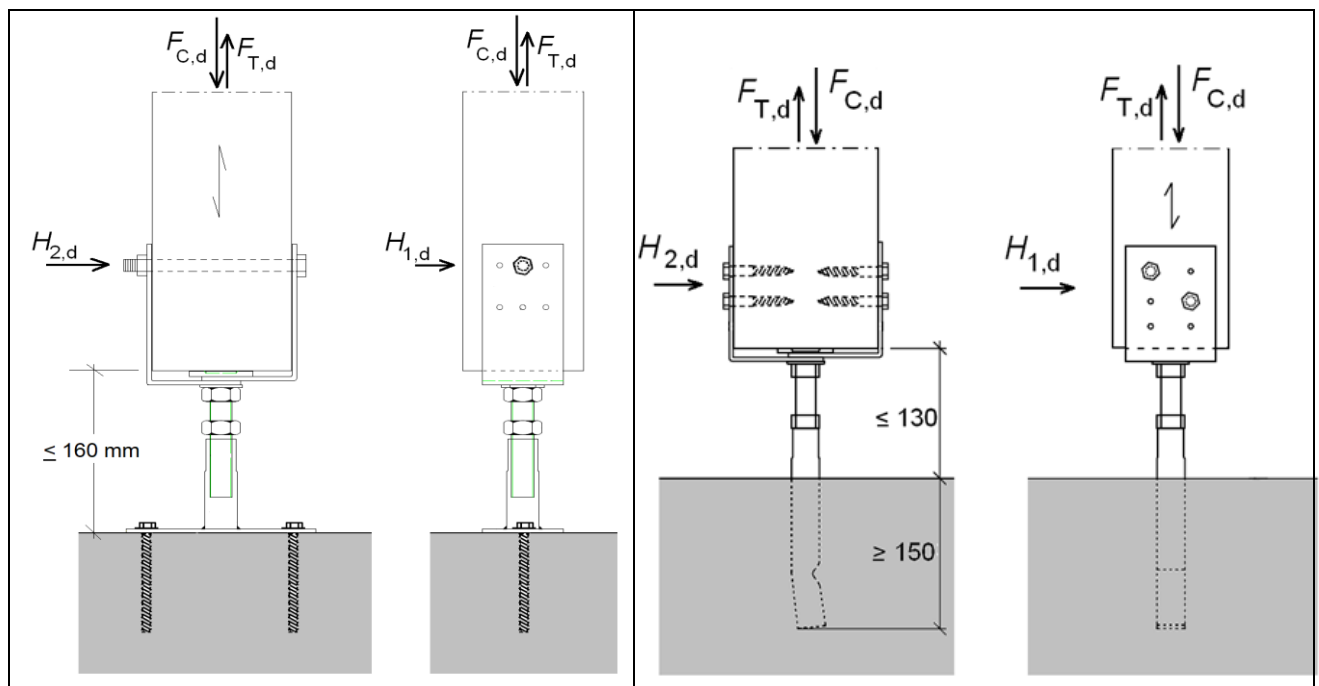


Figure A2.2 Use of Multi Adjustable column shoes and the definition of forces, left J-MACS-80120.

Table A2.1 Adjustable and Multi Adjustable Column Shoes - article numbers, nominal dimensions and characteristic capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$ and $H_{s,Rk}$. A_c is the contact area between timber end and the connector.

| Art. No. | Size (mm) | $F_{T,s,Rk}$ (kN) | $F_{C,s,Rk}$ (kN) | $H_{s,Rk}$ (kN) | A_c (mm ²) |
|--------------|-------------------|----------------------|----------------------|--------------------|-----------------------------|
| J-ACS-4640 | 46x40x92x4,0 | 13,6 | 24,8 | 0,43 | 1288 |
| J-ACS-9660 | 96x60x92x4,0 | 13,9 | 39,6 | 0,83 | 2376 |
| J-ACS-7140 | 71x40x92x4,0 | 13,6 | 24,8 | 0,43 | 1288 |
| J-ACS-7060L | 70x60x92x4,0 | 1,14 | 39,6 | 0,83 | 2376 |
| J-MACS-5070 | 50-70x90x115x4,0 | 5,6 | 41,8 | 0,86 | 1590 |
| J-MACS-80120 | 80-130x70x134x4,0 | 1,59 | 63,9 | 1,18 | 2376 |
| J-MACS-85145 | 85-125x90x115x4,0 | 5,6 | 41,8 | 0,86 | 2376 |

3 Load-carrying capacity of Column Anchor Strap connection

Column Anchor Strap is used in the timber column connection cast in concrete, where the connector is loaded by a vertical tension force $F_{T,d}$ and/or a horizontal force $H_{1,d}$ parallel to the width direction of the connector as presented in Figure A2.3. Normally two straps per column are used on the opposite sides of the column.

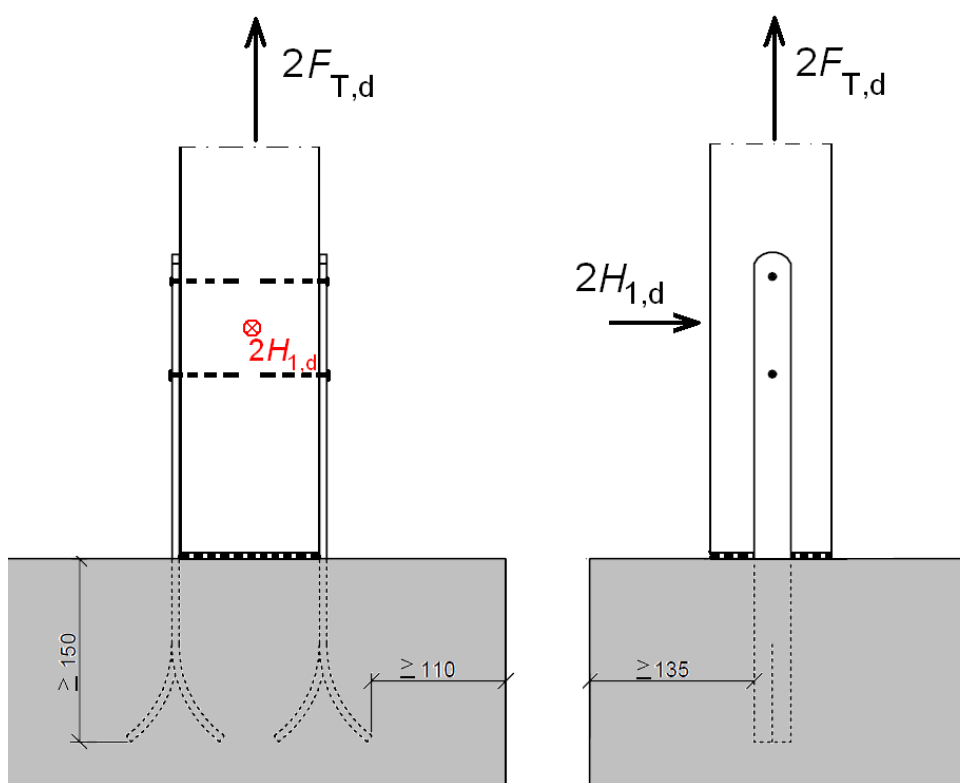


Figure A2.3 Use of Column Anchor Straps and the definition of forces.

The end of timber member should be in contact with the basement for that no compression would appear in the straps. The penetration length in concrete shall be at least 150 mm. For non-reinforced concrete foundation, the minimum edge distances of concrete presented in Figure A2.3 shall be fulfilled. Two anchor nails or lag screws of diameter 6 mm are used in each strap connector.

The following design conditions shall be fulfilled for the Column Anchor Strap connections:

$$F_{T,d} \leq F_{T,c,Rd} \quad (20)$$

$$\sqrt{F_{T,d}^2 + H_{1,d}^2} \leq F_{T,v,Rd} \quad (21)$$

$$H_{1,d} \leq H_{s,Rd} \quad (22)$$

The characteristic values for the connector capacities $F_{T,c,Rk}$ and $H_{s,Rk}$ are presented in Table A2.2. The characteristic connection resistance $F_{T,v,Rk}$ is calculated according to the lateral load-carrying capacity of fasteners

$$F_{T,v,Rk} = 2F_{v,Rk} \quad (23)$$

where $F_{v,Rk}$ is the characteristic load-carrying capacity per the fastener calculated by expression (5).

Table A2.2 Column Anchor Strap - article number, nominal dimensions and characteristic capacities $F_{T,c,Rk}$ and $H_{s,Rk}$.

| Art. No. | Size (mm) | $F_{T,c,Rk}$ (kN) | $H_{s,Rk}$ (kN) |
|-----------|------------|-------------------|-----------------|
| J-CAS-400 | 30x400x6,0 | 26,8 | 1,5 |

4 Load-carrying capacity of Column Shoe type E connections

The Column Shoes of type E are used in the timber column connections cast in concrete and subjected to the vertical and horizontal forces presented in Figure A2.4. The end of timber member shall be in contact with the bottom plate of the connector. The penetration length in concrete shall be at least 150 mm.

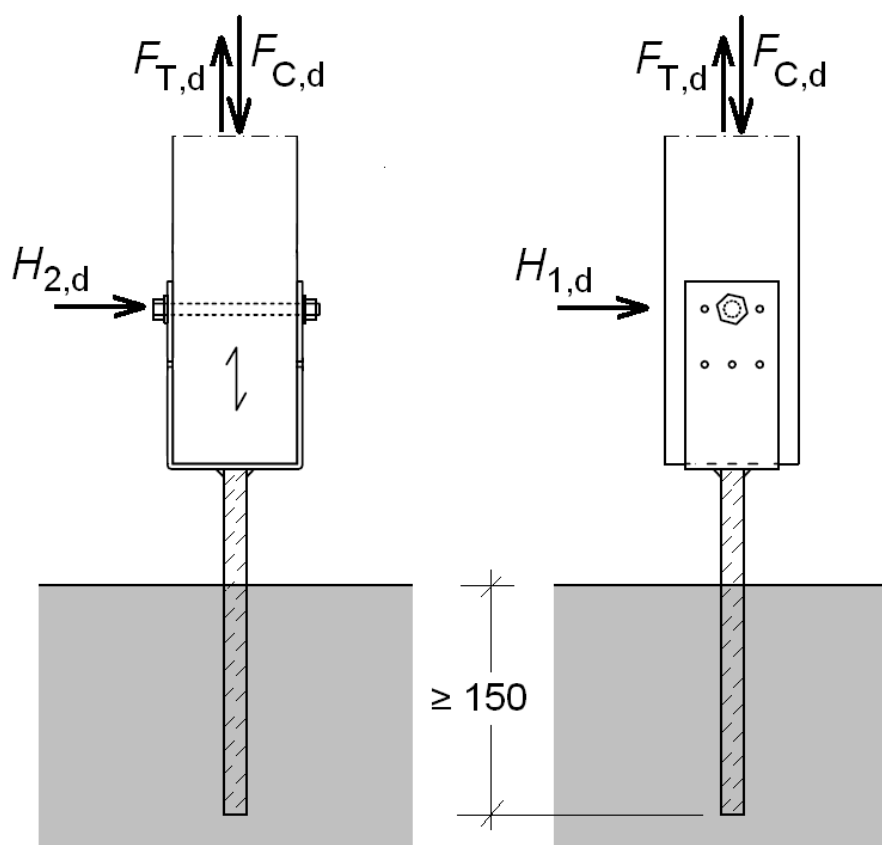


Figure A2.4 Use of Column Shoe type E and the definition of forces.

The design conditions (12) – (15) shall be fulfilled for the Column Shoe type E connections using the values of characteristic capacities and contact areas presented in Table A2.3. The characteristic connection resistances $F_{T,v,Rk}$ and $H_{1,v,Rk}$ are calculated according to the expressions (17) and (19).

Table A2.3 Column Shoes of type E - article numbers, nominal dimensions and characteristic capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$ and $H_{s,Rk}$. A_c is the contact area between timber end and the connector.

| Art. No. | Size (mm) | $F_{T,s,Rk}$ (kN) | $F_{C,s,Rk}$ (kN) | $H_{s,Rk}$ (kN) | A_c (mm ²) |
|---------------|--------------------|----------------------|----------------------|--------------------|-----------------------------|
| J-CSE-4840 | 48x40x121x5/16x250 | 8,7 | 41,0 | 0,69 | 1920 |
| J-CSE-7340 | 73x40x121x4/16x250 | 8,7 | 41,0 | 0,69 | 2920 |
| J-CSE-9670 | 96x70x121x4/16x250 | 8,7 | 41,0 | 0,67 | 6720 |
| J-CSE-7370 | 73x70x121x4/16x250 | 8,7 | 41,0 | 0,67 | 5110 |
| J-CSE-9090A2 | 90x90x90x4/16x250 | 13,8 | 41,0 | 0,79 | 8100 |
| J-CSE-10090A2 | 100x90x90x4/16x250 | 13,8 | 41,0 | 0,79 | 9000 |
| J-CSE-11590A2 | 115x90x90x4/16x250 | 13,8 | 41,0 | 0,79 | 10350 |
| J-CSE-12090A2 | 120x90x90x4/16x250 | 13,8 | 41,0 | 0,79 | 10800 |
| J-CSE-10070A2 | 100x70x90x4/16x200 | 10,7 | 41,0 | 1,12 | 7000 |
| J-CSE-5040 | 50x40x100x4/16x200 | 8,7 | 41,0 | 1,08 | 2000 |
| J-CSE-5040S | 50x40x100x4/16x200 | 8,7 | 41,0 | 0,54 | 2000 |
| J-CSE-7540 | 75x40x90x4/16x200 | 8,7 | 41,0 | 1,17 | 3000 |

5 Load-carrying capacity of Column Shoe type L connection

The Column Shoes of type L are used in the timber column connections cast in concrete and subjected to the vertical and horizontal forces presented in Figure A2.5. The end of timber member shall be in contact with the bottom plate of the connector. The penetration length in concrete shall be at least 150 mm.

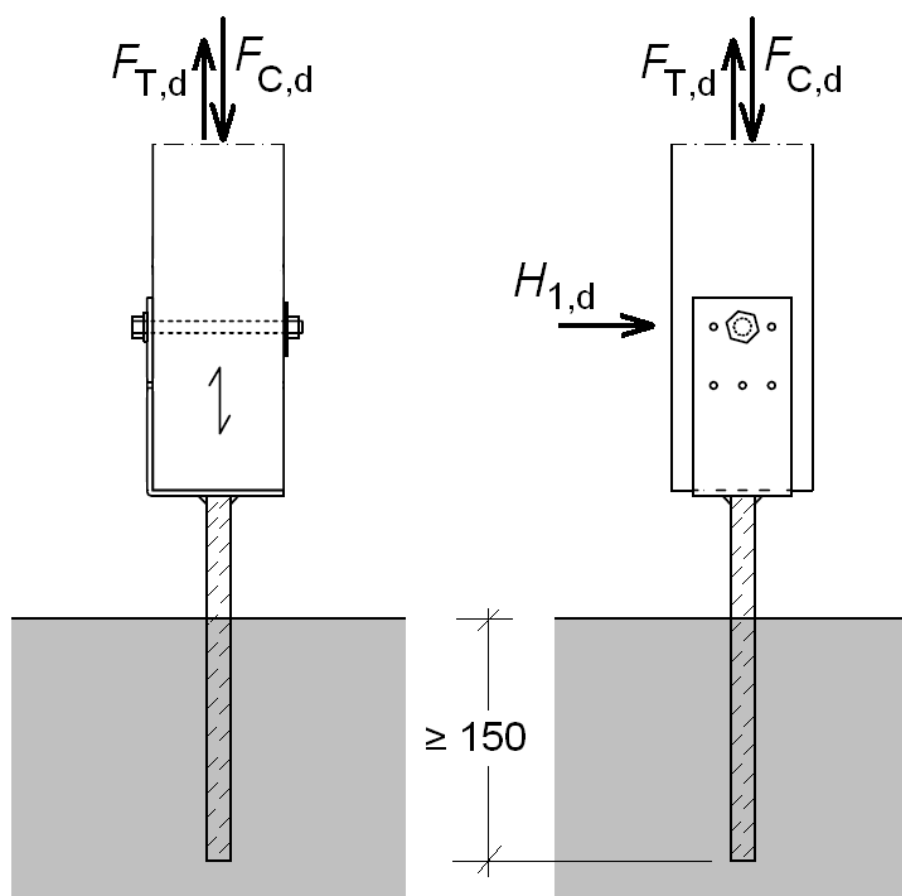


Figure A2.5 Use of Column Shoe type L and the definition of forces.

The following design conditions shall be fulfilled for the Column Shoe type L connections:

$$F_{T,d} \leq F_{T,s,Rd} \quad (24)$$

$$F_{C,d} \leq F_{C,w,Rd} \quad (25)$$

$$\left(\frac{F_{T,d}}{F_{T,v,Rd}} \right)^2 + \left(\frac{H_{1,d}}{H_{1,v,Rd}} \right)^2 \leq 1 \quad (26)$$

$$\frac{F_{C,d}}{F_{C,s,Rd}} + \frac{H_{1,d}}{H_{s,Rd}} \leq 1 \quad (27)$$

The characteristic values for the connector capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$ and $H_{s,Rk}$ are presented in Table A2.4. The characteristic connection resistances $F_{T,v,Rk}$ and $H_{1,v,Rk}$ are calculated according to the expressions (17) and (19). The characteristic compression capacity of timber member $F_{C,w,Rk}$ should be calculated according to expression (18) using the values of contact area presented in Table A2.4.

Table A2.4 Column Shoes of type L - article numbers, nominal dimensions and characteristic capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$ and $H_{s,Rk}$. A_c is the contact area between timber end and the connector.

| Art. No. | Size (mm) | $F_{T,s,Rk}$ (kN) | $F_{C,s,Rk}$ (kN) | $H_{s,Rk}$ (kN) | A_c (mm ²) |
|------------|---------------------|----------------------|----------------------|--------------------|-----------------------------|
| J-CSL-48L | 48x40x121x4/16x250 | 1,07 | 41,0 | 0,74 | 1920 |
| J-CSL-70L | 70x60x90x4/16x200 | 1,14 | 41,0 | 1,20 | 4200 |
| J-CSL-100L | 100x70x121x4/16x250 | 0,95 | 41,0 | 0,67 | 7000 |

6 Load-carrying capacity of Column Shoe type D connection

Column Shoe type D is used as a timber column connector fixed to the timber member by lag screws or a bolt and to the concrete support by anchor bolts and subjected to the vertical and horizontal forces presented in Figure A2.6. At least two anchor bolts should be used symmetrically in the attachment to the concrete. The distance between the end of timber member and concrete support may be at maximum 60 mm.

The following design conditions shall be fulfilled for the Column Shoe type D connections:

$$F_{T,d} \leq \min(F_{T,s,Rd}; F_{T,v,Rd}; F_{T,c,Rd}) \quad (28)$$

$$F_{C,d} \leq \min(F_{C,s,Rd}; F_{T,v,Rd}) \quad (29)$$

$$H_{1,d} \leq \min(H_{1,s,Rd}; H_{1,v,Rd}; H_{c,Rd}) \quad (30)$$

$$H_{2,d} \leq \min(H_{2,s,Rd}; H_{c,Rd}) \quad (31)$$

and for the combination of forces the following conditions shall be satisfied

$$\left(\frac{\max(F_{T,d}; F_{C,d})}{F_{T,v,Rd}} \right)^2 + \left(\frac{H_{1,d}}{H_{1,v,Rd}} \right)^2 \leq 1 \quad (32)$$

$$\frac{F_{T,d}}{F_{T,c,Rd}} + \frac{\sqrt{H_{1,d}^2 + H_{2,d}^2}}{H_{c,Rd}} \leq 1 \quad (33)$$

$$\frac{F_{T,d}}{F_{T,s,Rd}} + \frac{H_{1,d}}{H_{1,s,Rd}} \leq 1 \quad (34)$$

$$\frac{F_{C,d}}{F_{C,s,Rd}} + \frac{H_{2,d}}{H_{2,s,Rd}} \leq 1 \quad (35)$$

The characteristic values for the connector capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$, $H_{1,s,Rk}$ and $H_{2,s,Rk}$ are presented in Table A2.5. The characteristic axial capacity of anchor bolts $F_{T,c,Rk}$ and the lateral load-carrying capacity of anchor bolts $H_{c,Rk}$ are determined according to the ETA of the anchor bolts. The characteristic connection resistances $F_{T,v,Rk}$ and $H_{1,v,Rk}$ are calculated according to the expressions (17) and (19).

Table A2.5 Column Shoes of type D - article numbers, nominal dimensions and characteristic capacities $F_{T,s,Rk}$, $F_{C,s,Rk}$, $H_{1,s,Rk}$ and $H_{2,s,Rk}$.

| Art. No. | Size (mm) | $F_{T,s,Rk}$ (kN) | $F_{C,s,Rk}$ (kN) | $H_{1,s,Rk}$ (kN) | $H_{2,s,Rk}$ (kN) |
|-----------|----------------|----------------------|----------------------|----------------------|----------------------|
| J-CSD-71 | 71x150x60x5,0 | 6,2 | 30,5 | 17,2 | 1,26 |
| J-CSD-81 | 81x150x60x5,0 | 4,9 | 30,5 | 17,2 | 1,26 |
| J-CSD-91 | 91x150x60x5,0 | 4,0 | 30,5 | 17,2 | 1,26 |
| J-CSD-101 | 101x150x60x5,0 | 3,4 | 30,5 | 17,2 | 1,26 |
| J-CSD-121 | 121x150x60x5,0 | 2,6 | 30,5 | 17,2 | 1,26 |

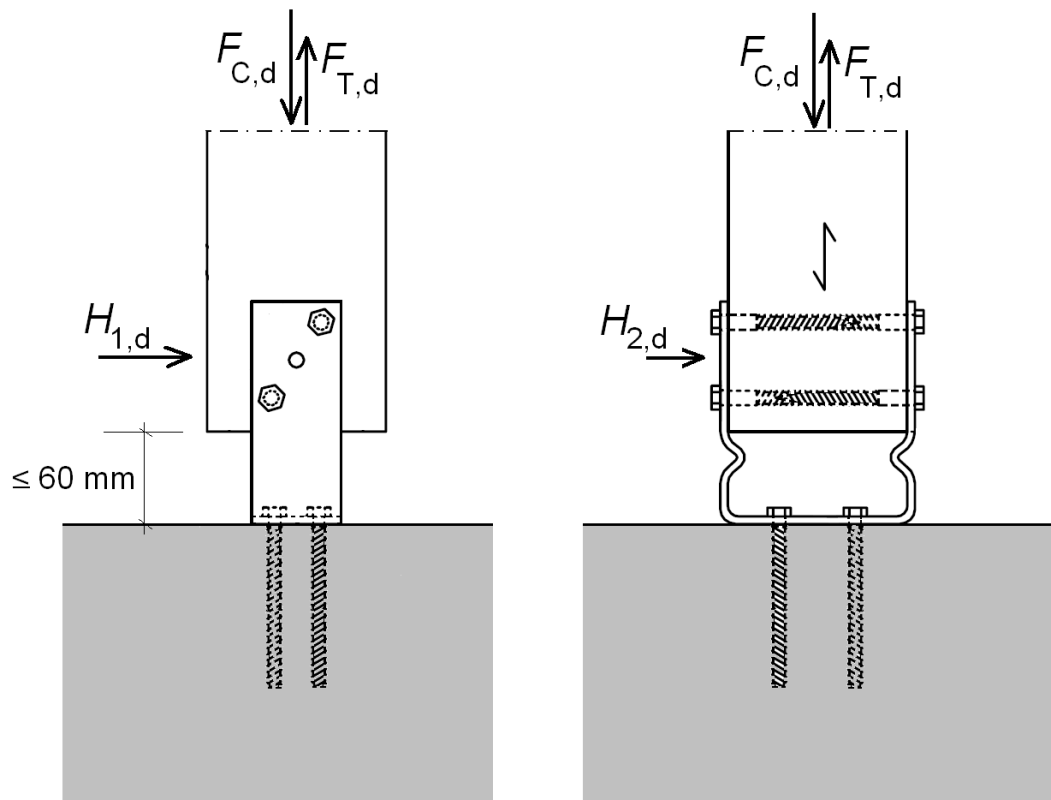


Figure A2.6 Use of Column Shoe type L and the definition of forces.

7 Load-carrying capacity of Heavy Supporting Shoe connection

The Heavy Supporting Shoe is used as a timber column connector fixed to the timber member by lag screws or bolts and to the concrete basement by anchor bolts and subjected to the vertical and horizontal forces presented in Figure A.2.7. At least two anchor bolts should be used symmetrically in the attachment to the concrete. The timber end should be contact with the bottom plate of the connector.

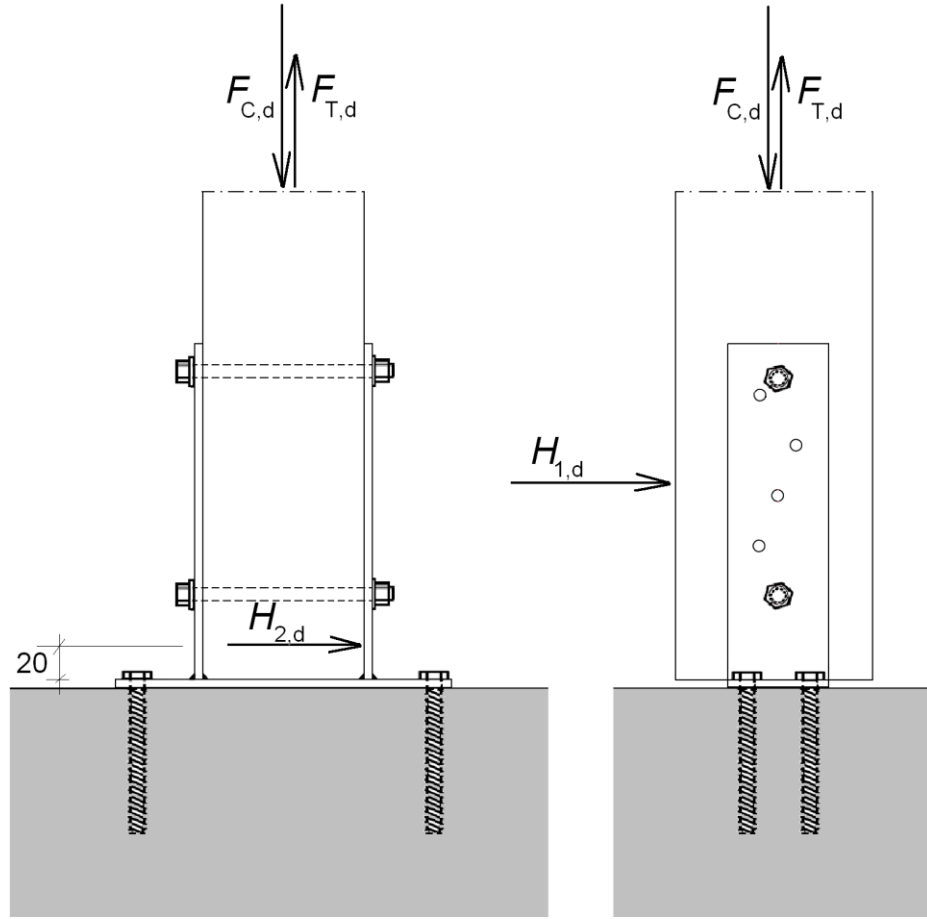


Figure A2.7 Use of Heavy Supporting Shoe and the definition of forces.

The following design conditions shall be fulfilled for the Heavy Supporting Shoe connections:

$$F_{T,d} \leq \min(F_{T,s,Rd}; F_{T,v,Rd}; F_{T,c,Rd}) \quad (36)$$

$$F_{C,d} \leq F_{C,w,Rd} \quad (37)$$

$$H_{1,d} \leq \min(H_{1,s,Rd}; H_{1,v,Rd}; H_{c,Rd}) \quad (38)$$

$$H_{2,d} \leq \min(H_{2,s,Rd}; H_{c,Rd}) \quad (39)$$

and for the combination of forces the following conditions shall be satisfied

$$\left(\frac{F_{T,d}}{F_{T,v,Rd}} \right)^2 + \left(\frac{H_{1,d}}{H_{1,v,Rd}} \right)^2 \leq 1 \quad (40)$$

$$\frac{F_{T,d}}{F_{T,c,Rd}} + \frac{\sqrt{H_{1,d}^2 + H_{2,d}^2}}{H_{c,Rd}} \leq 1 \quad (41)$$

$$\left(\frac{H_{1,d}}{H_{1,s,Rd}} \right)^2 + \left(\frac{H_{2,d}}{H_{2,s,Rd}} \right)^2 \leq 1 \quad (42)$$

The characteristic values for the connector capacities $F_{T,s,Rk}$, $H_{1,s,Rk}$ and $H_{2,s,Rk}$ are presented in Table A2.6. The characteristic axial capacity of anchor bolts $F_{T,c,Rk}$ and for the lateral load-carrying capacity of anchor bolts $H_{c,Rk}$ are determined according to the ETA of the anchor bolts. The characteristic connection resistances $F_{T,v,Rk}$ and $H_{1,v,Rk}$ are calculated according to the expressions (17) and (19). The characteristic compression capacity of timber member $F_{C,w,Rk}$ should be calculated according to expression (18) using the values of contact area presented in Table A2.6.

Table A2.6 Heavy Supporting Shoes - article numbers, nominal dimensions and characteristic capacities $F_{T,s,Rk}$, $H_{1,s,Rk}$ and $H_{2,s,Rk}$. A_c is the contact area between timber end and the connector.

| Art. No. | Size (mm) | $F_{T,s,Rk}$ (kN) | $H_{1,s,Rk}$ (kN) | $H_{2,s,Rk}$ (kN) | A_c (mm ²) |
|----------|----------------|-------------------|-------------------|-------------------|--------------------------|
| J-SS-71 | 71x200x60x5,0 | 2,6 | 16,9 | 3,4 | 4260 |
| J-SS-75 | 75x200x60x5,0 | 2,7 | 16,9 | 3,4 | 4500 |
| J-SS-81 | 81x200x60x5,0 | 2,9 | 16,9 | 3,4 | 4860 |
| J-SS-91 | 91x200x60x5,0 | 3,3 | 16,9 | 3,4 | 5460 |
| J-SS-96 | 96x200x60x5,0 | 3,5 | 16,9 | 3,4 | 5760 |
| J-SS-101 | 101x200x60x5,0 | 3,7 | 16,9 | 3,4 | 6060 |

8 Load-carrying capacity of Adjustable Column Leg connection

The Adjustable Column Leg connectors are used as a timber column connection with concrete basement. The connector may be loaded only by a centric vertical compression force as presented in Figure A2.8. The cross-section dimensions of the timber member shall be larger than the width of the supporting plate. For the threaded rod of the connector, a hole is drilled to the end of timber member. The maximum diameter of the hole is 18 mm for J-AL-1650 connector, 22 mm for JL-AL-2080 connector and 27 mm for J-AL-24100 connector. The maximum distance a between timber end and the concrete basement may be 100 mm for J-AL-1650 and JL-AL-2080 connectors and 250 mm for J-AL-24100 connector.

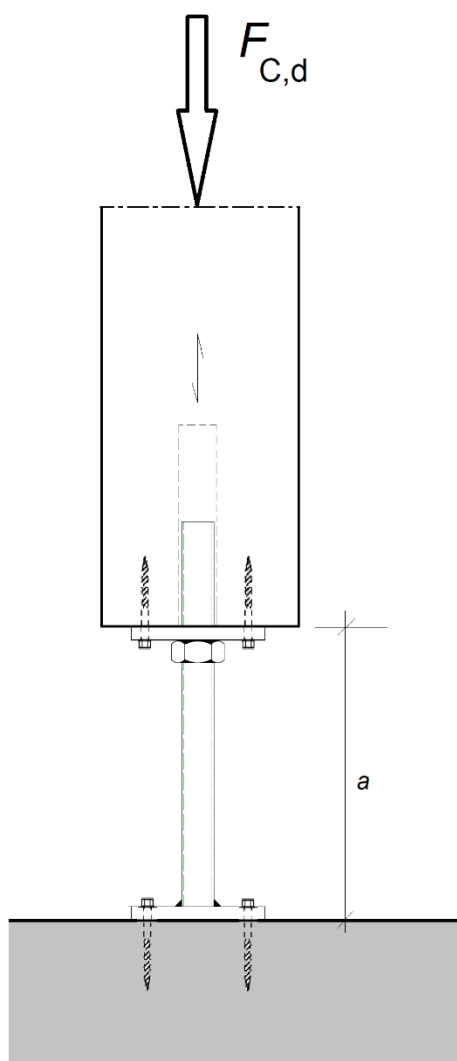


Figure A2.8 Adjustable Column Leg loaded by a centric compression force.

In the design of the Adjustable Column Leg connections, the following criteria shall be satisfied:

$$F_{C,d} \leq k_p F_{C,w,Rk} \quad (43)$$

where

$$k_p = \begin{cases} \min\left(\frac{\rho_k}{350} ; 1\right) & \text{for JL - AL - 1650} \\ \min\left(\frac{\rho_k}{430} ; 1\right) & \text{for JL - AL - 2080 and JL - AL - 24100} \end{cases} \quad (44)$$

when ρ_k is the characteristic density of the timber member in kg/m³.

The characteristic compression capacities of the timber member $F_{C,w,Rk}$ in contact of the connector are shown in Table A2.7.

Table A2.7 Adjustable Column Leg – article numbers, nominal dimensions and the characteristic compression capacities $F_{C,w,Rk}$.

| Art. No. | Size (mm) | $F_{C,w,Rk}$ (kN) |
|------------|--------------------|----------------------|
| J-AL-1650 | M16x150/50x50x5 | 38,1 |
| J-AL-2080 | M20x150/80x80x5 | 68,6 |
| J-AL-24100 | M24x300/100x100x10 | 109,3 |

9 Load-carrying capacity of Adjustable Supporting Tube connection

The Adjustable Column Supporting Tube connectors are used as a timber column connection with concrete basement. The connector may be loaded only by a centric vertical compression force as presented in Figure A2.9. The cross-section of the timber member shall be at least 110 mm x 110 mm. The maximum adjustment distance a shown in Figure A2.9 is 120 mm.

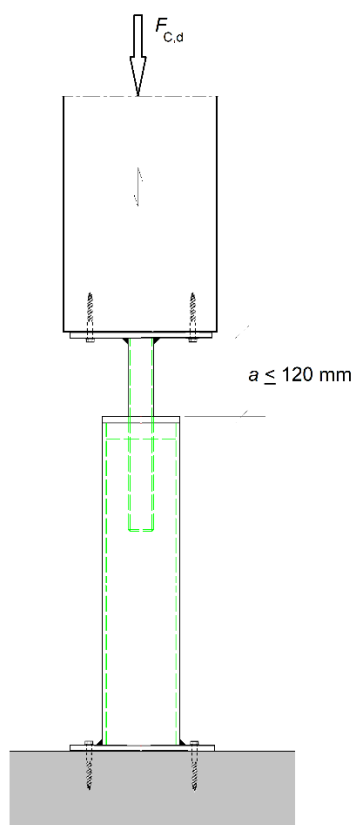


Figure A2.9 Adjustable Supporting Tube loaded by a centric compression force.

In the design of the Adjustable Supporting Tube connections, the compression capacity of the timber member shall be also checked as follows:

$$F_{C,d} \leq \min(F_{C,s,Rd}; F_{C,w,Rd}) \quad (45)$$

The values of characteristic compression capacity $F_{C,s,Rk}$ are presented in Table A2.8 and the characteristic value of local compression capacity of the timber member is calculated as follows:

$$F_{C,w,Rk} = A_c \cdot f_{c,0,k} \quad (46)$$

Where A_c is the effective contact area between the connector plate and end of timber member according to Table A2.8.

Table A2.8 Adjustable Supporting Tube – article numbers, nominal dimensions, the characteristic compression capacity $F_{C,s,Rk}$ and the effective contact area.

| Art. No. | Size (mm) | $F_{C,s,Rk}$ (kN) | A_c (mm ²) |
|-----------|-----------------------------|----------------------|-----------------------------|
| J-ADS-250 | M20x150/φ60x250x3/110x110x4 | 38,1 | 3630 |
| J-ADS-450 | M20x150/φ60x450x3/110x110x4 | 38,1 | 3630 |
| J-ADS-600 | M20x150/φ60x600x3/110x110x4 | 38,1 | 3630 |

ANNEX 3

MATERIAL USED AS BASIS FOR THE ASSESSMENT

| Ref. No. | Author or institution | Report No. | Date | Title / Issue |
|----------|-----------------------------|--------------------|------|--|
| 1 | VTT Expert Services Ltd | VTT-S-03156-13 | 2013 | Testing of column shoes |
| 2 | VTT Expert Services Ltd | VTT-S-03376-13 | 2013 | Initial testing of Column Shoes |
| 3 | VTT Expert Services Ltd | VTT-S-04575-13 | 2013 | Report regarding initial factory inspection at Taizhou Homer Hardware Manufacturing in Taizhou City, China |
| 4 | Eurofins Expert Services Oy | EUFI29-19006337-T4 | 2020 | Mechanical test of Taizhou Homer Column Shoes |
| 5 | Eurofins Expert Services Oy | EUFI29-19006337-T5 | 2020 | Initial testing of Column Shoes |