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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 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	40 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	ETAG 015 used as EAD, 2012, Three-dimensional nailing plates
This ETA replaces	ETA 13/0451, issued on May 14, 2019

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 ± 1,00 mm.

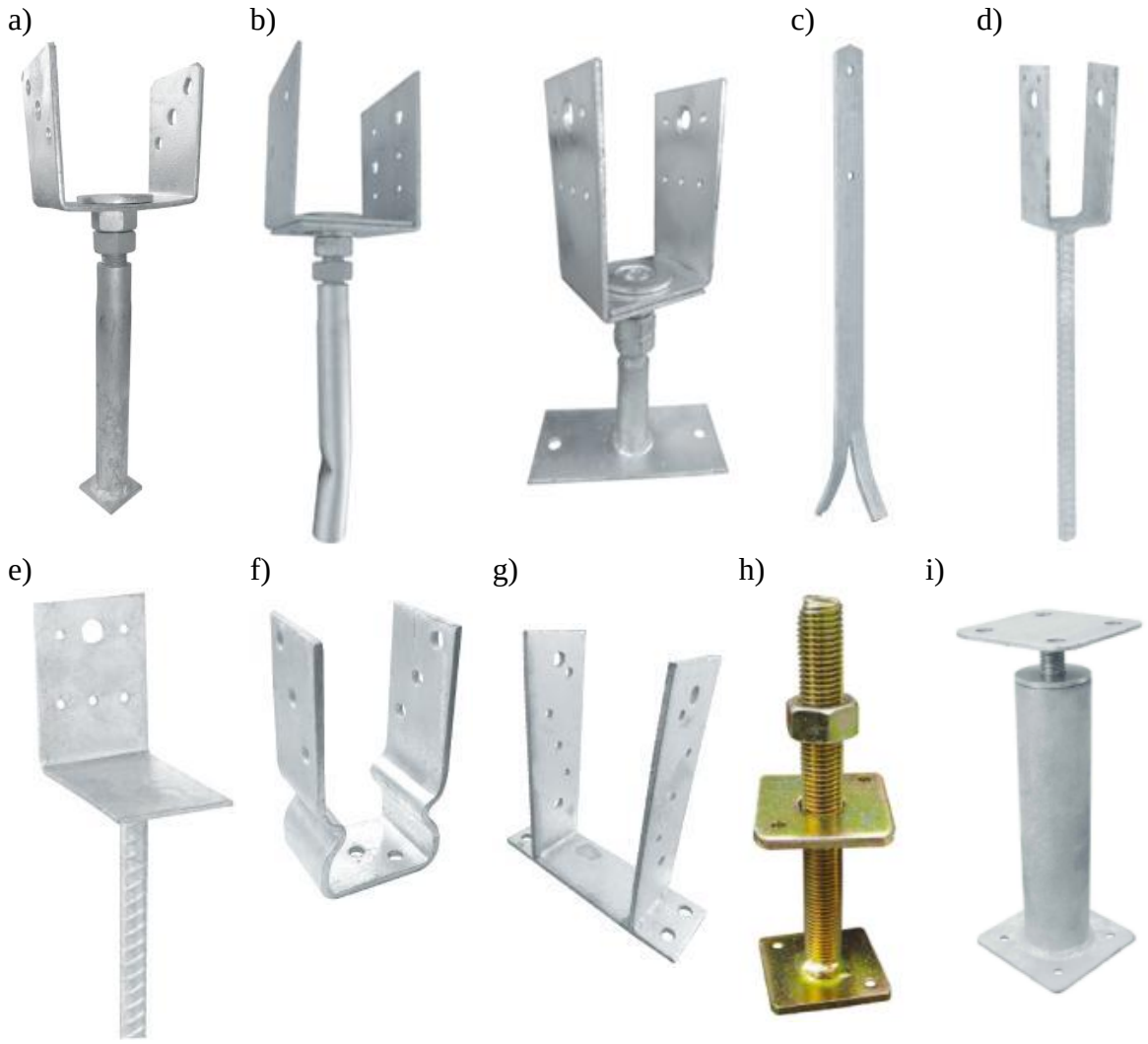


Figure 1. Different types of Taizhou Homer Column Shoes: a) Adjustable Column Shoe, b) Multi Adjustable Column Shoe, c) Column Anchor Strap, d) Column Shoe type E, e) Column Shoe type L, f) Column Shoe type D and g) Heavy Supporting Shoe, h) Adjustable Column Leg and i) Adjustable Supporting Tube.

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.

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…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.

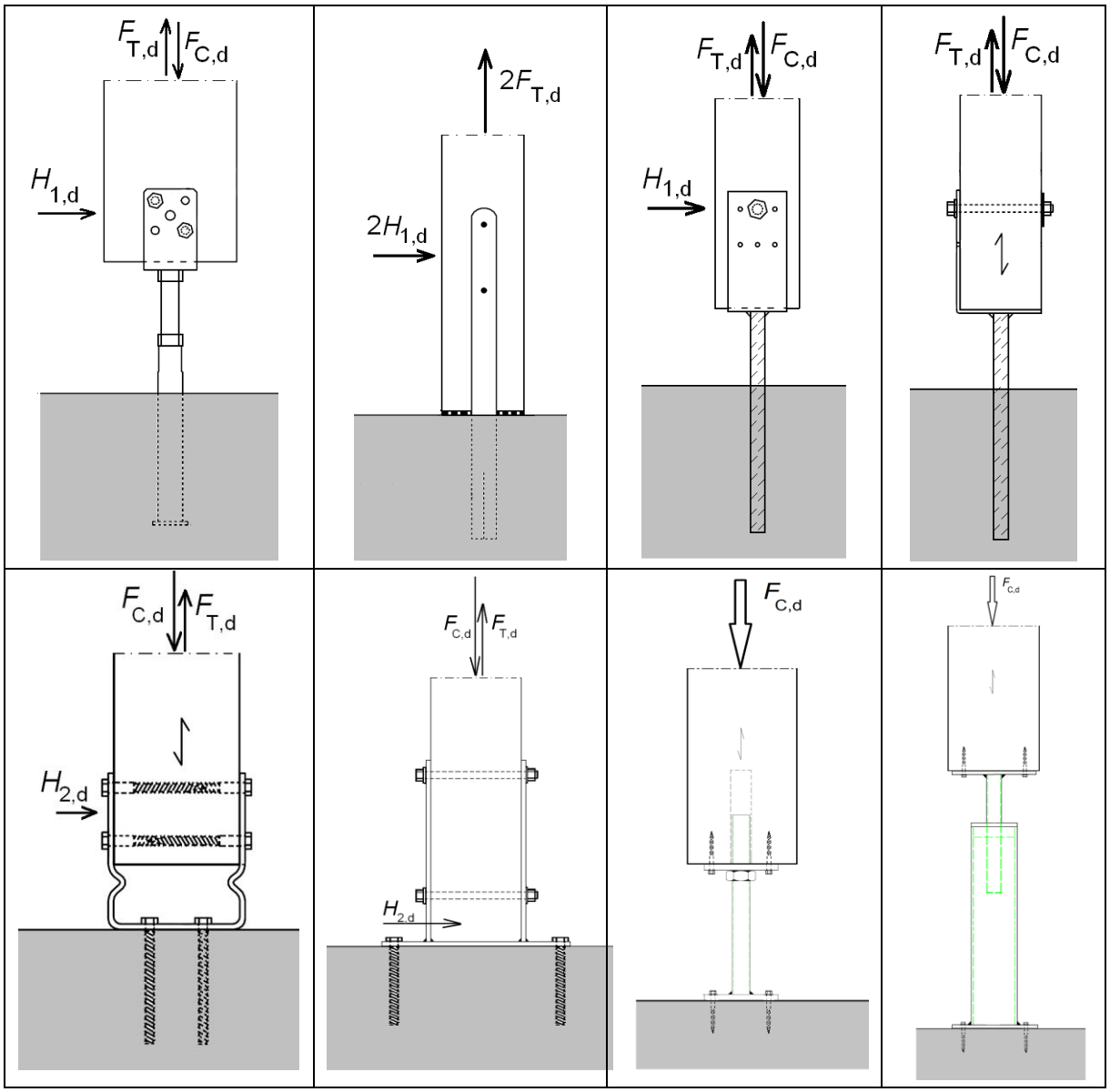


Figure 2. Typical use of Taizhou Column Shoes.

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 years[1].

2.3 Identification

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

[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.

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.

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.

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.

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.

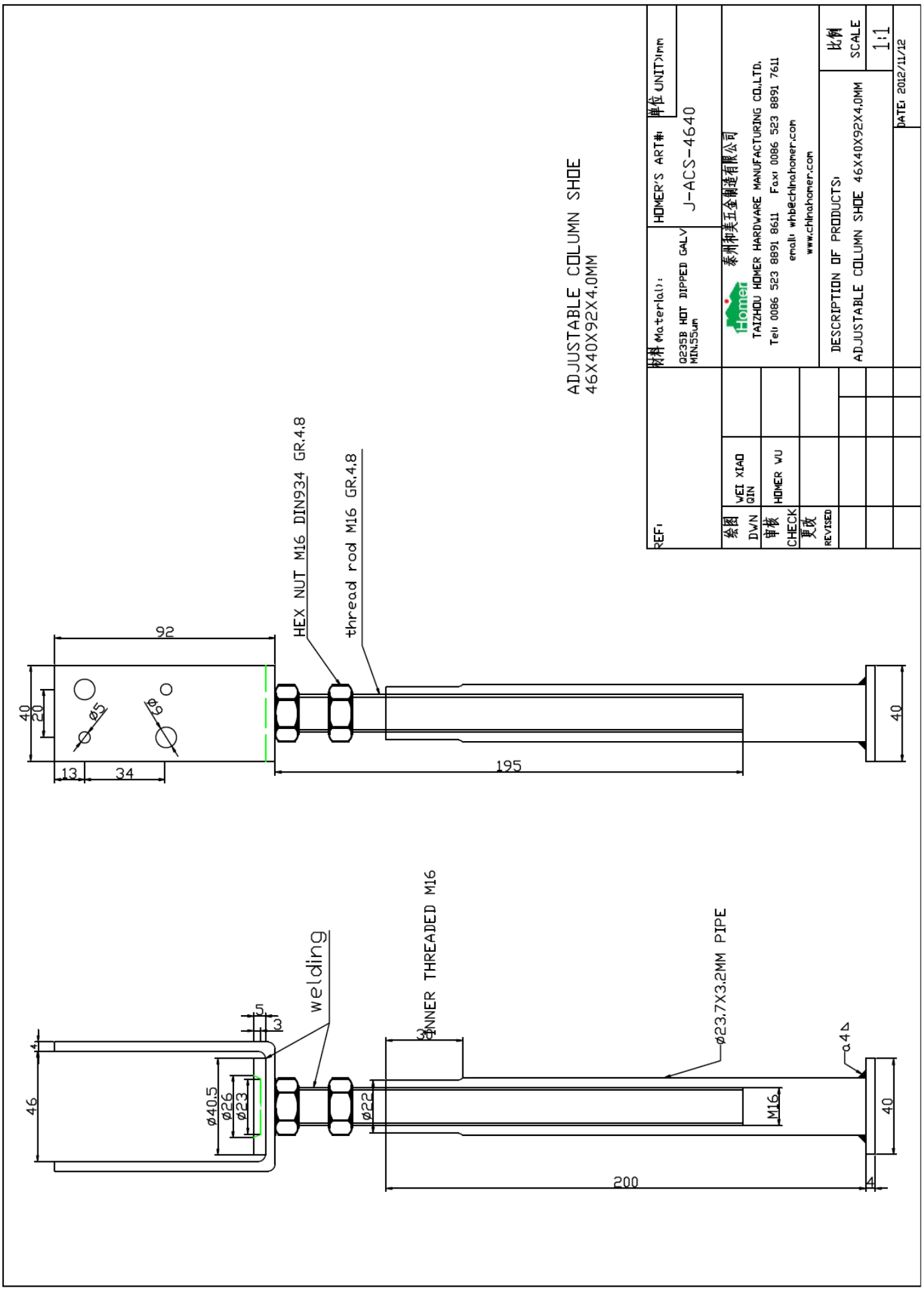
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Eurofins Expert Services Oy.

Issued in Espoo on April 14, 2020
by Eurofins Expert Services Oy

Tiina Ala-Outinen
Business Manager

Ari Kevarinmäki
Leading Expert

[2] Official Journal of the European Communities L 268 of 1/10/1997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thread rod M16 GR.4.8
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ø5
ø6
13
34
195
40
welding
INNER THREADED M16
ø23.7X3.2MM PIPE
46
ø40.5
ø26
ø23
ø22
M16
200
40
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Q235B HOT DIPPED GALV
MIN.55um
HOMER'S ART#:
J-ACS-4640
单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
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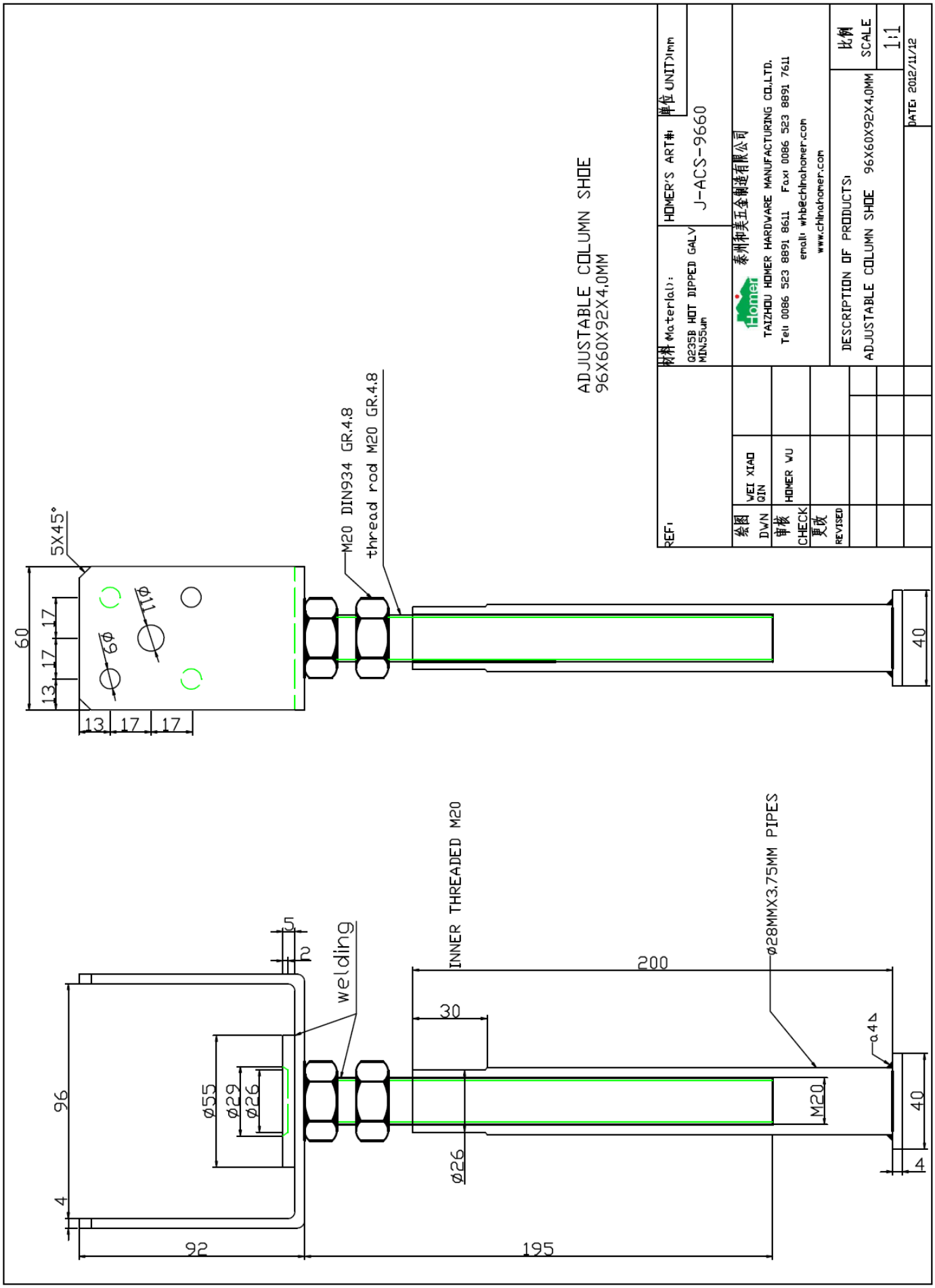
HOMER WU
更改 REVISED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thread rod M20 GR.4.8
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INNER THREADED M20
ø28MMX3.75MM PIPES
welding
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泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
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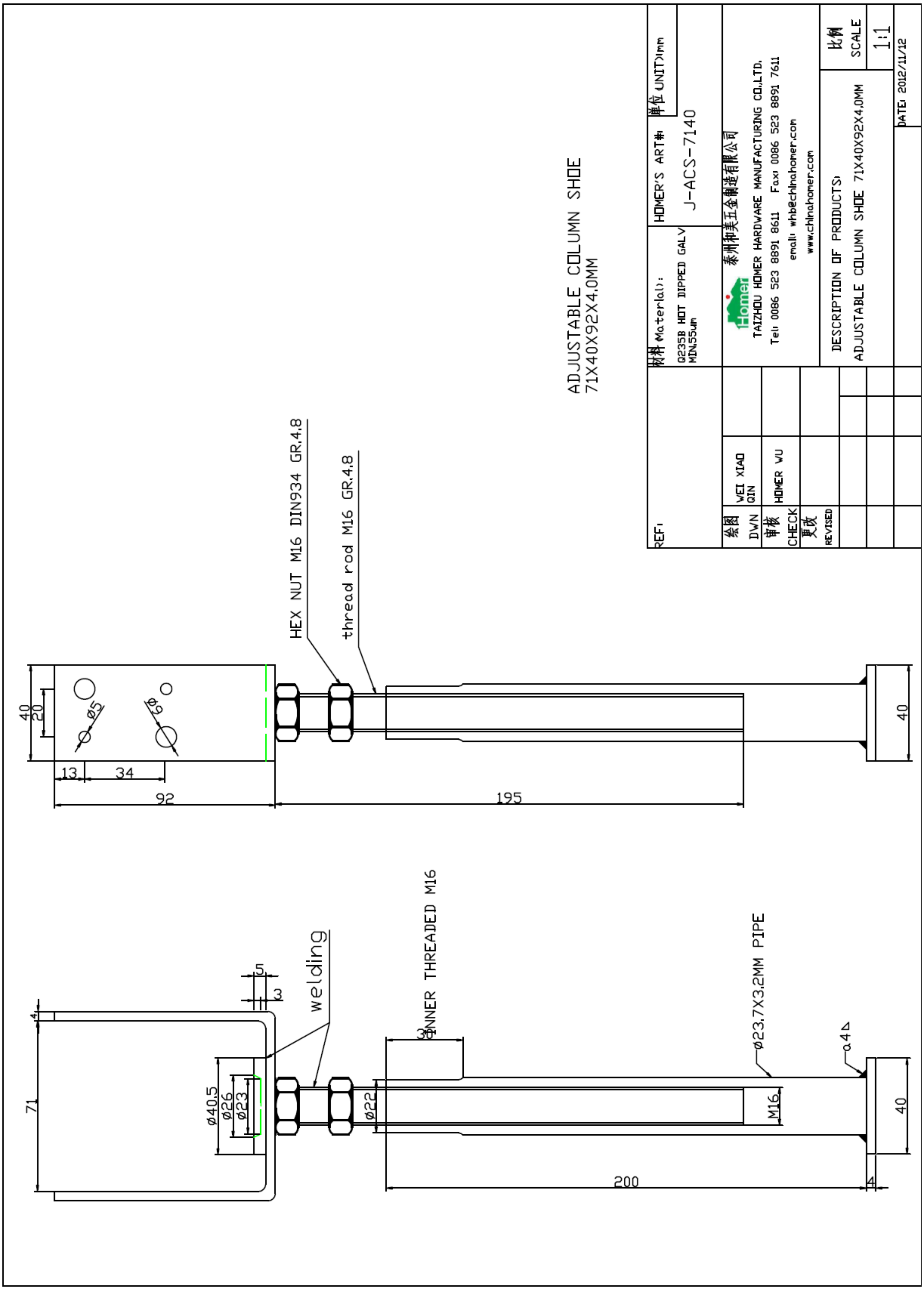
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MIN.55um
HOMER'S ART#:
单位 UNIT: mm
J-ACS-7140
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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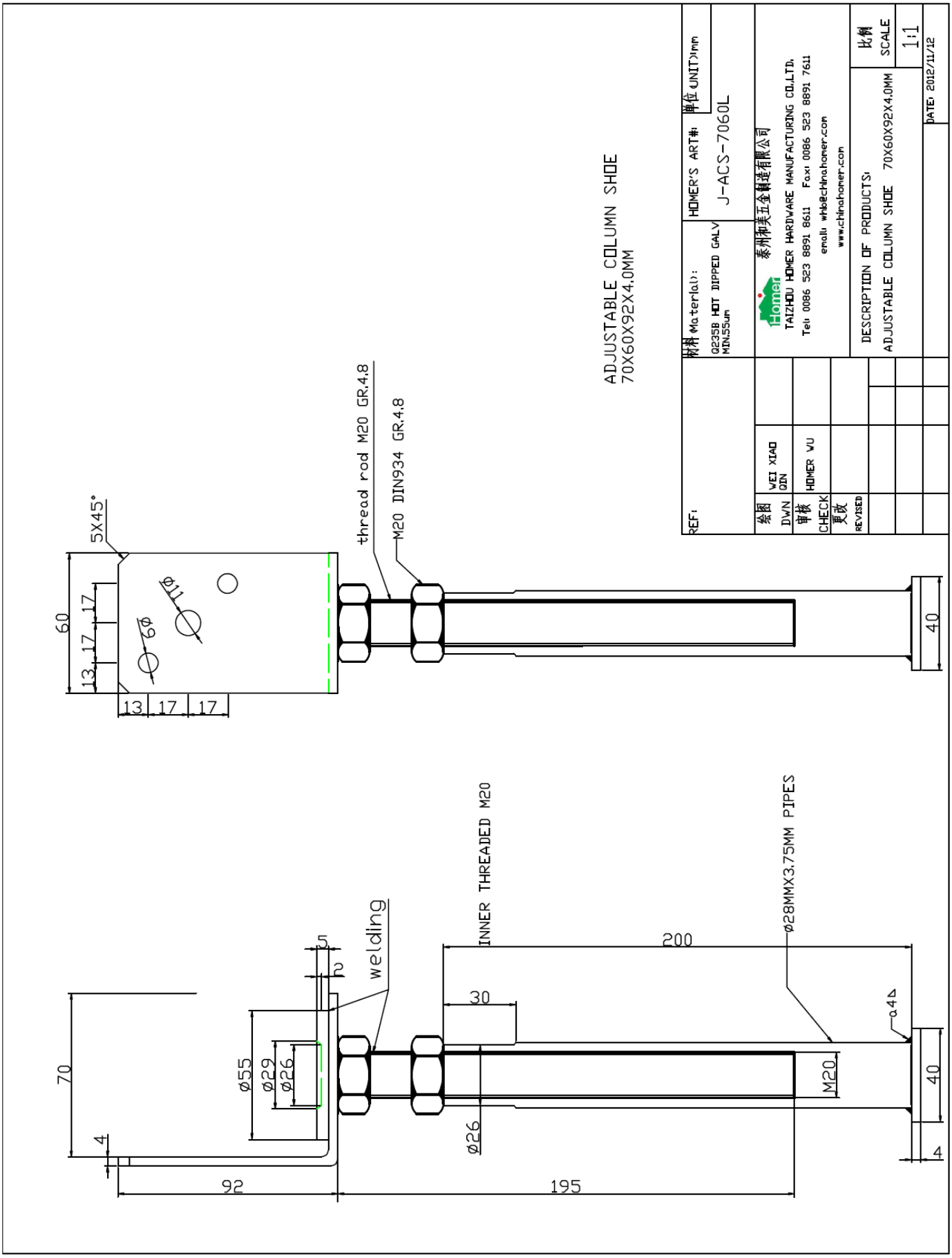
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M20 DIN934 GR.4.8
5X45°
INNER THREADED M20
welding
Ø28MMX3.75MM PIPES
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单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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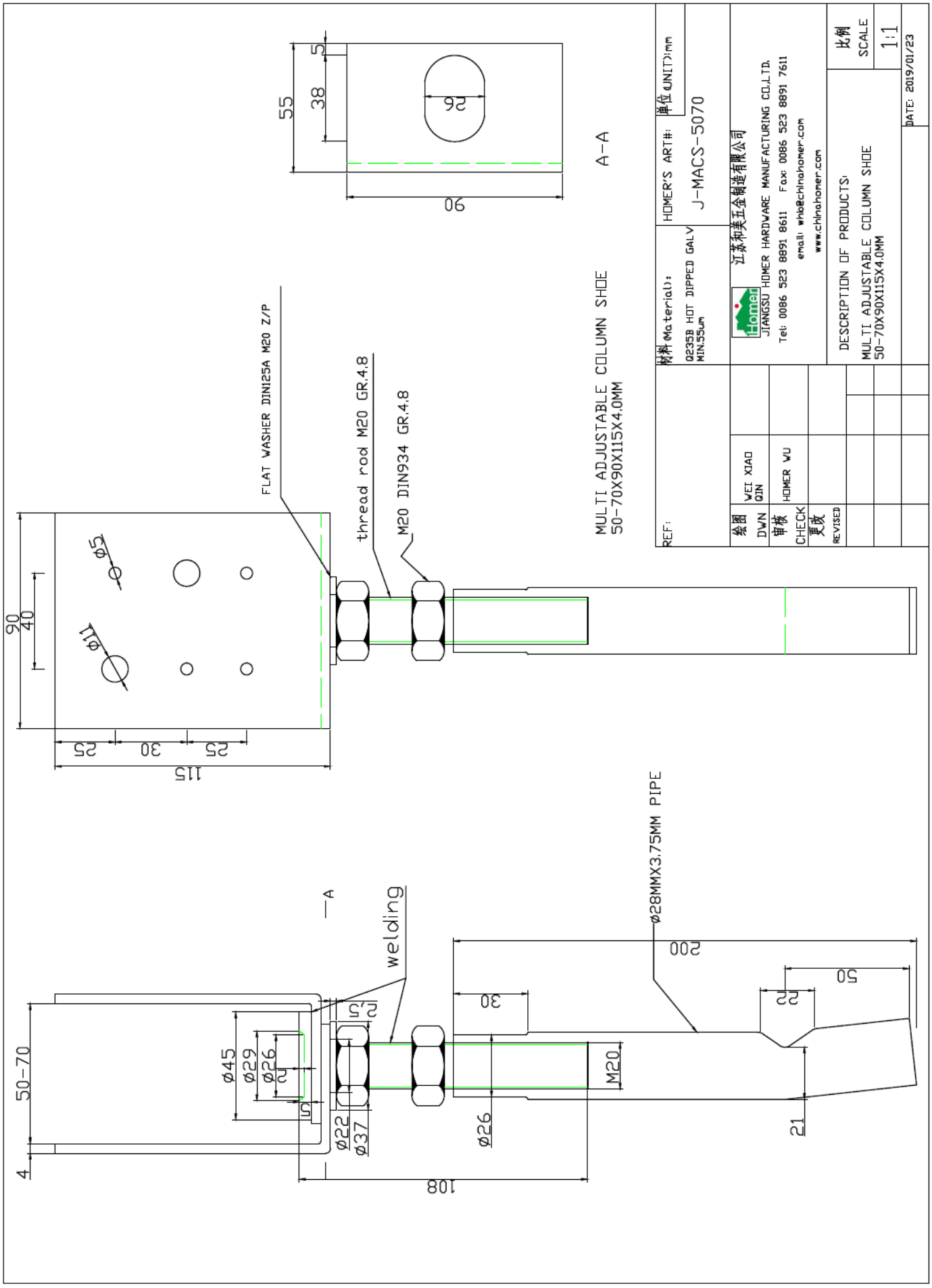
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thread rod M20 GR.4.8
M20 DIN934 GR.4.8
welding
Ø28MMX3.75MM PIPE
J-MACS-5070
HOMER'S ART#:
单位UNIT:mm
材料 Material:
Q235B HOT DIPPED GALV
MIN.55um
江苏和美五金制造有限公司
JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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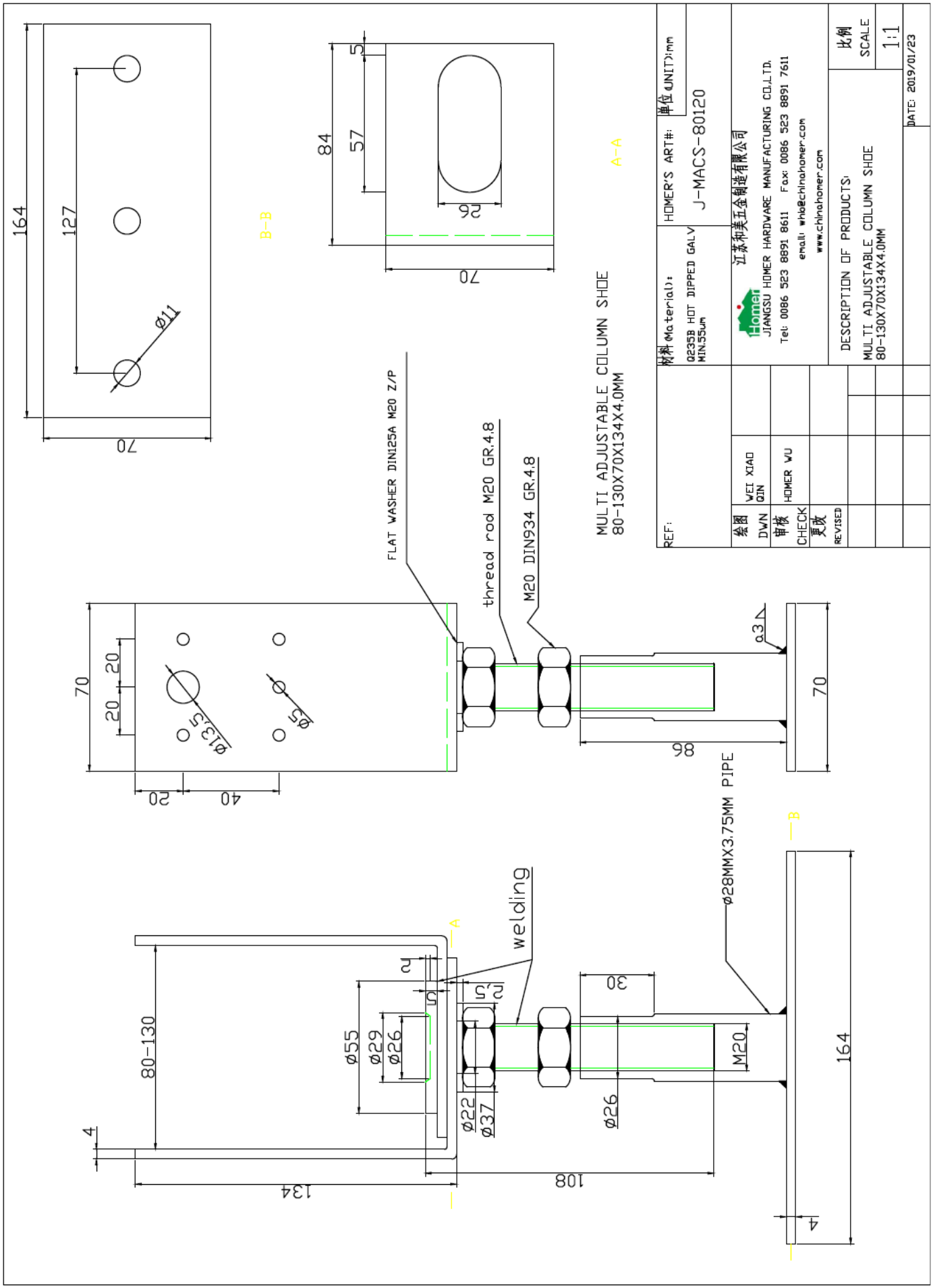
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thread rod M20 GR.4.8
M20 DIN934 GR.4.8
welding
ø28MMX3.75MM PIPE
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JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD.
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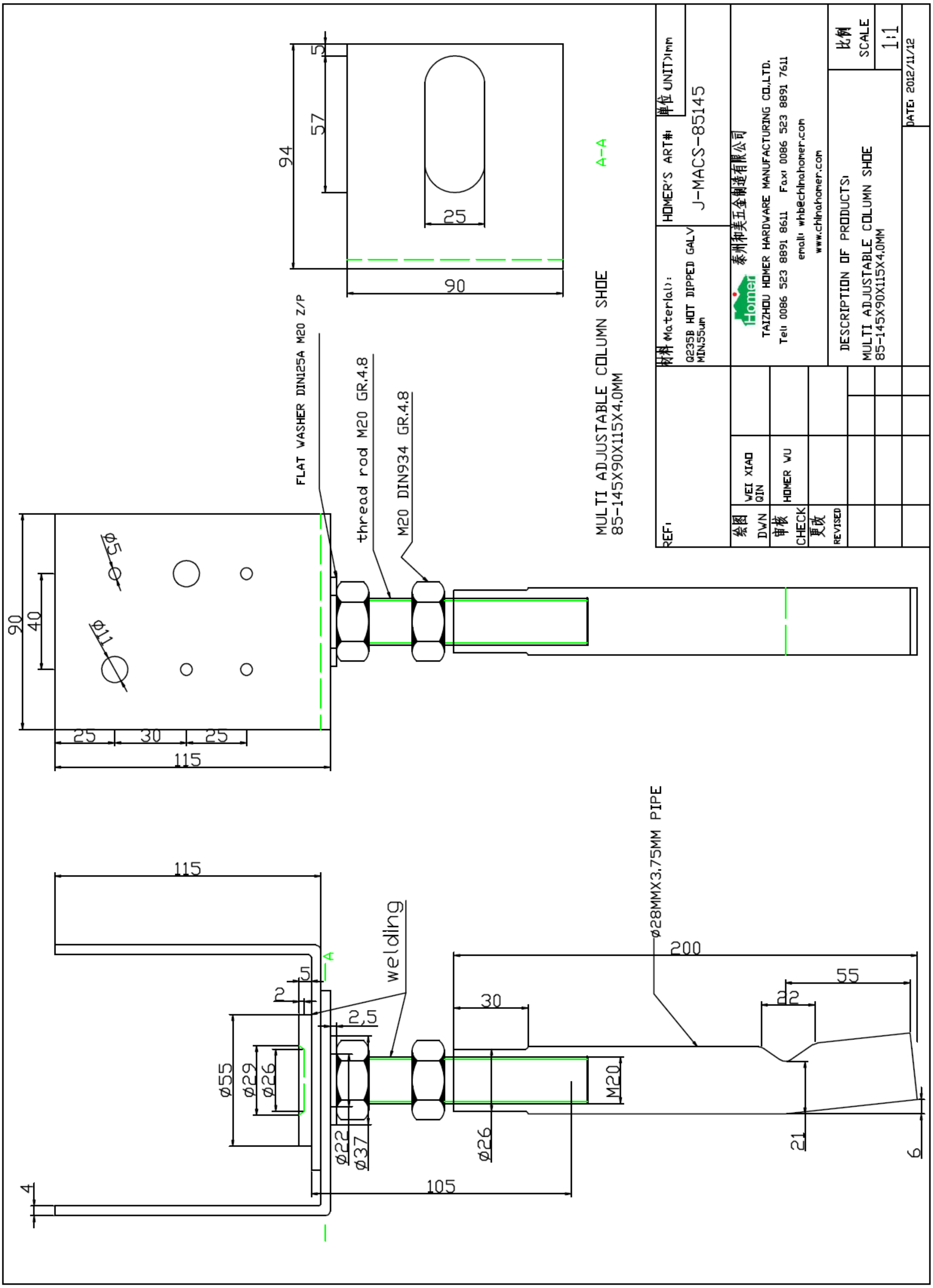

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泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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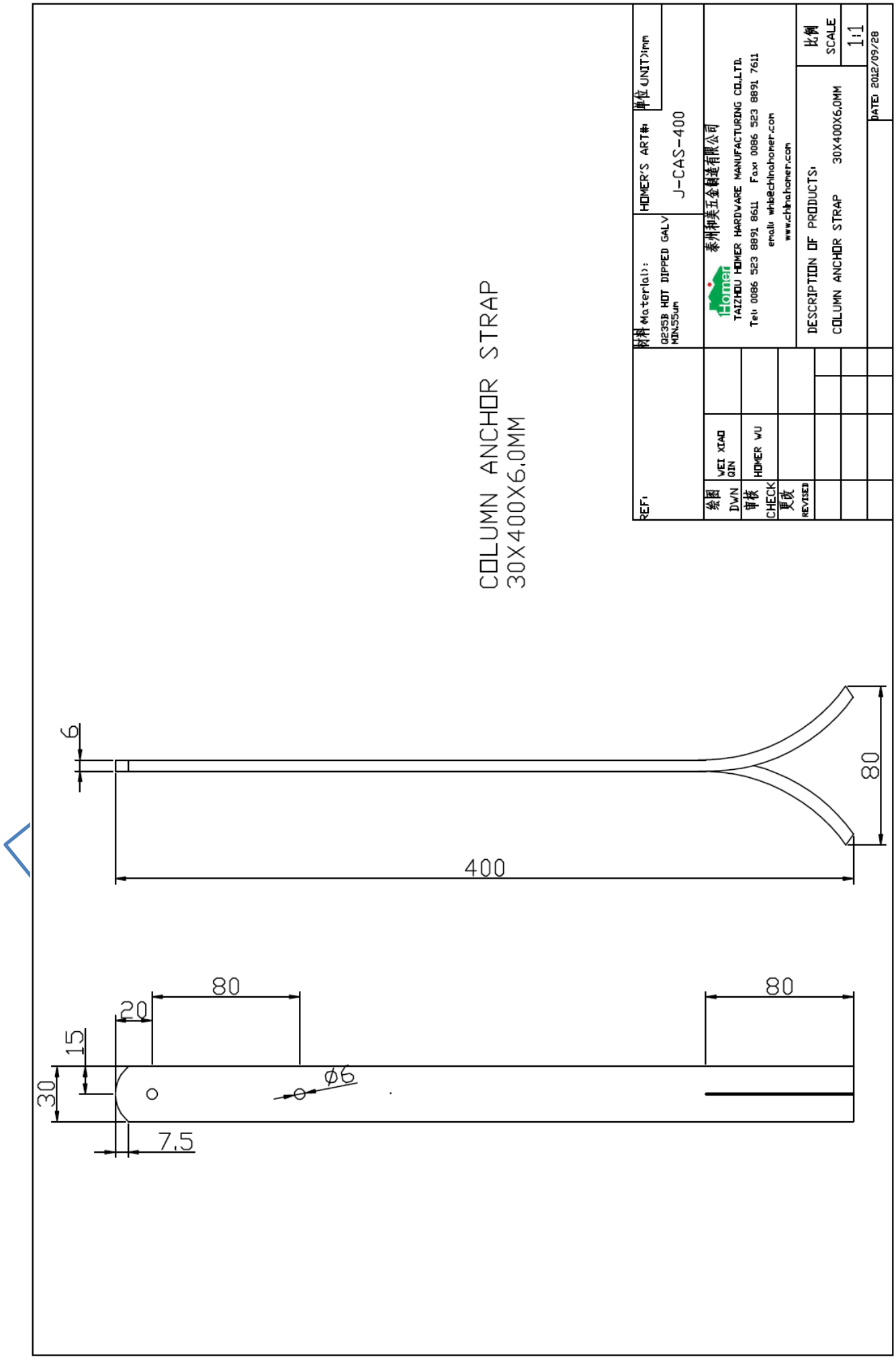
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泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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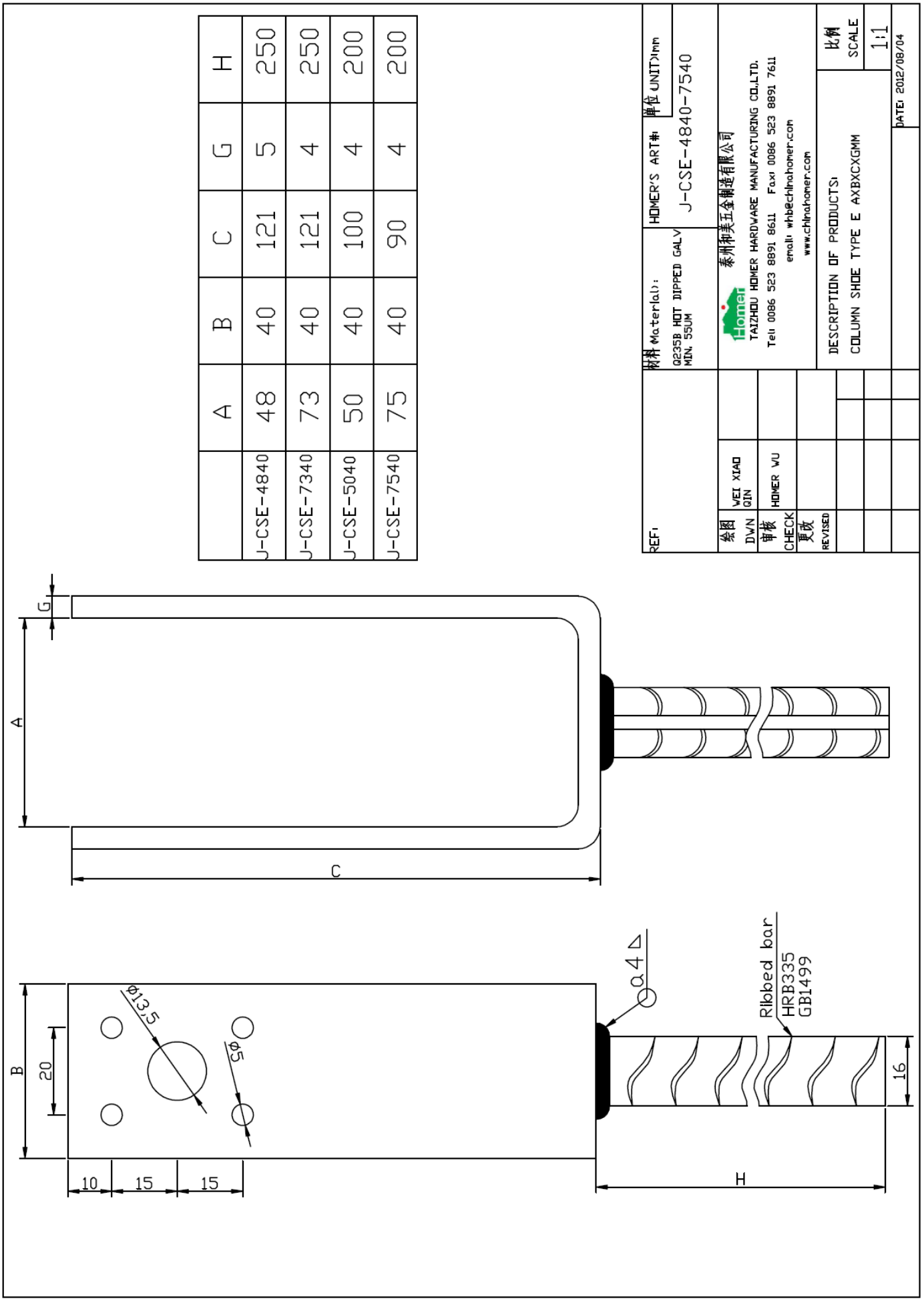
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泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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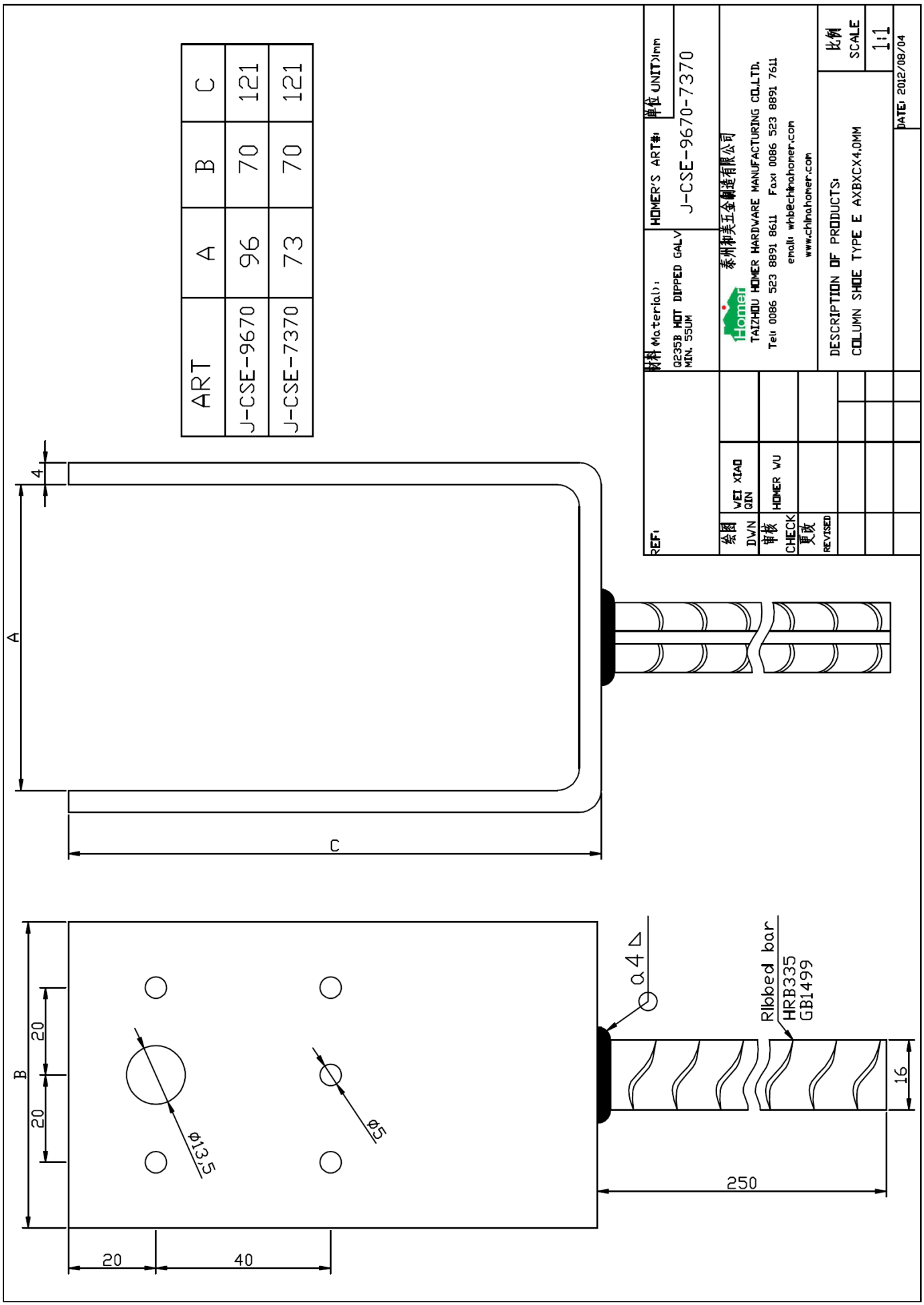
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J-CSE-9670-7370
单位 UNIT):mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
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GB1499
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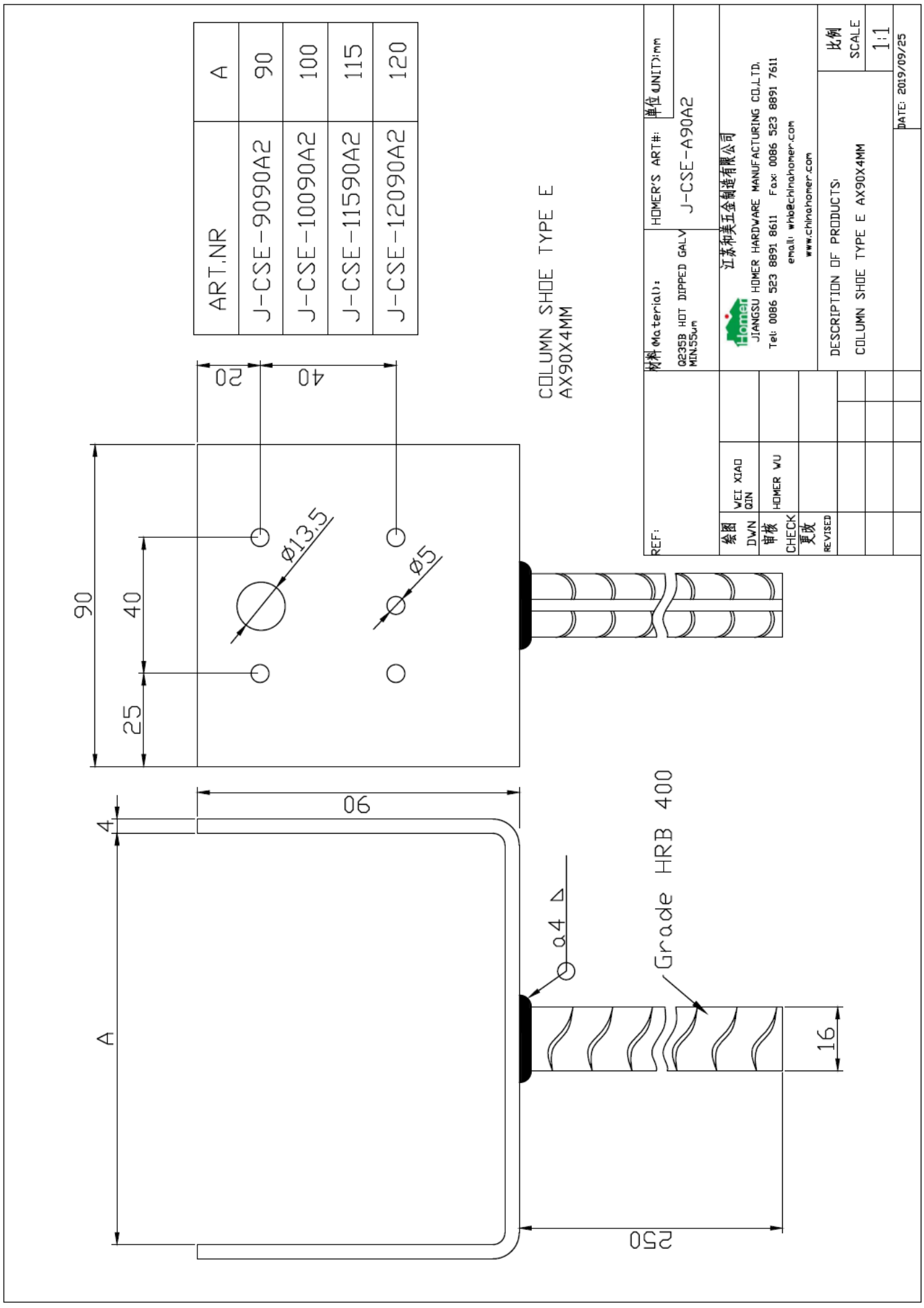
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材料 Material:
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MIN.55um
HOMER'S ART#:
J-CSE-A90A2
单位 UNIT:mm
江苏和美五金制造有限公司
JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
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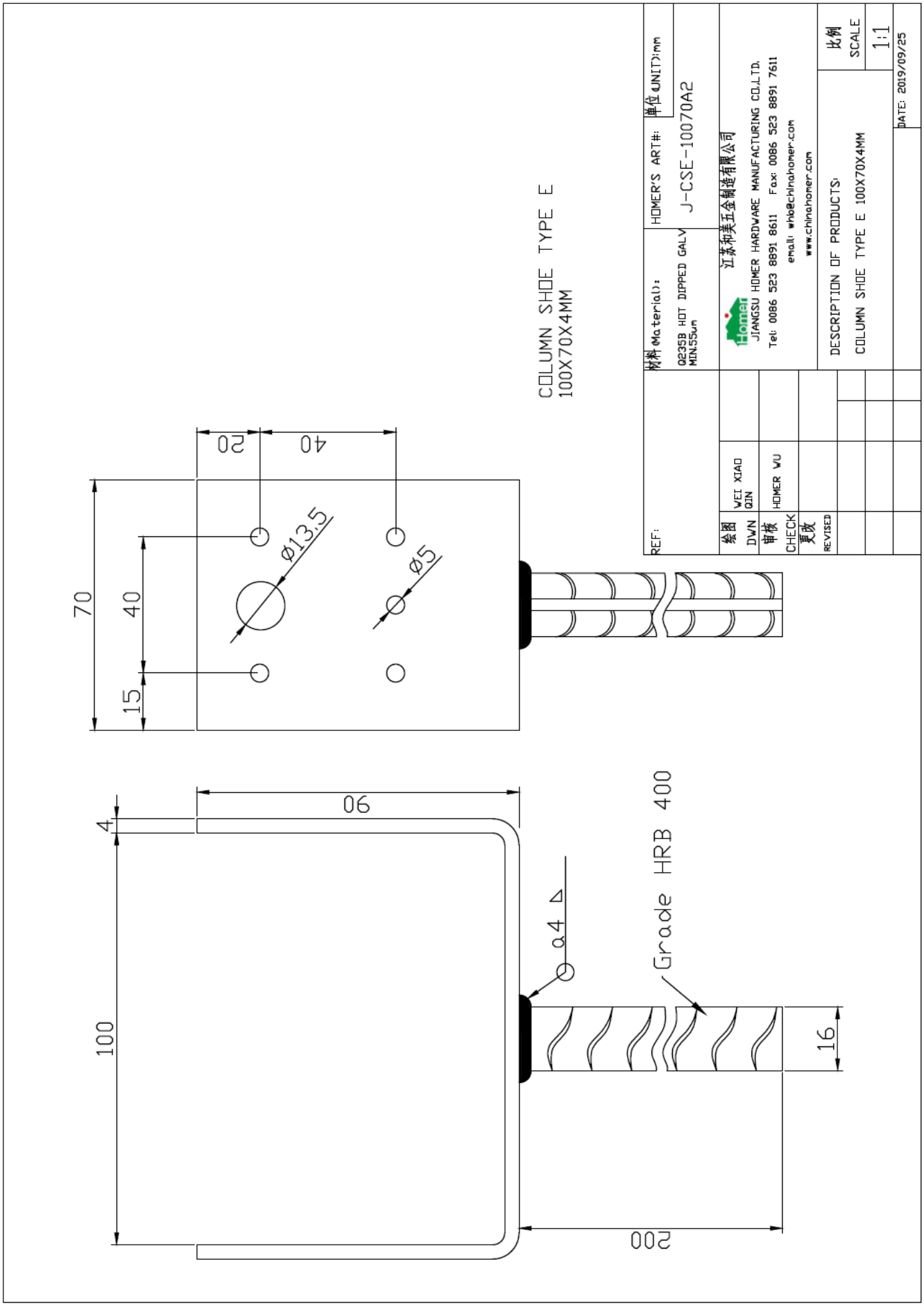
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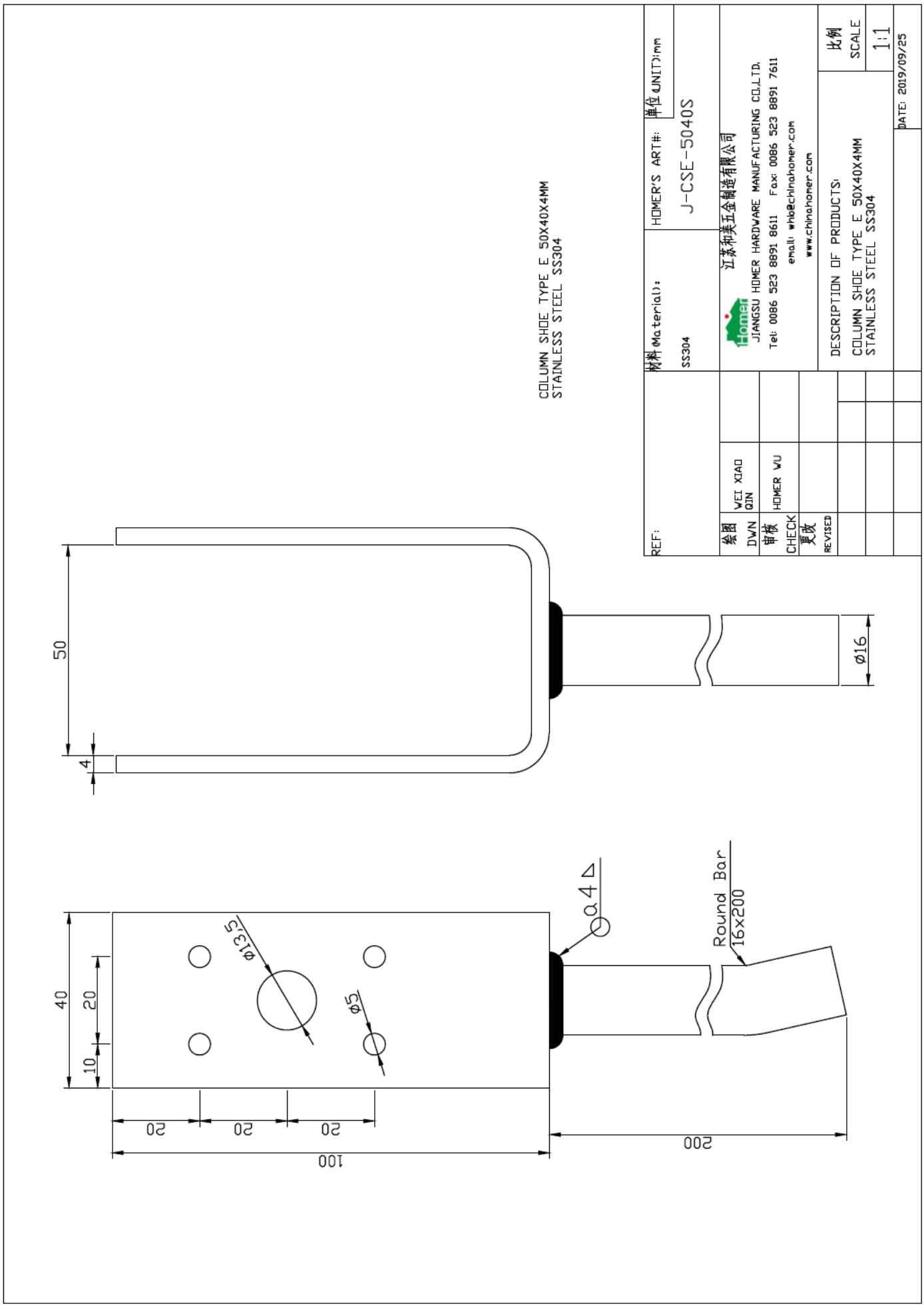
单位 UNIT:mm
江苏和美五金制造有限公司
JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE E 100X70X4MM
比例 SCALE
1:1
DATE: 2019/09/25
绘图 DWN
WEI XIAO QIN
审核 CHECK
HOMER WU
更改 REVISED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STAINLESS STEEL SS304
材料 Material: SS304
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单位 UNIT: mm
江苏和美五金制造有限公司
JIANGSU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: wh@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE E 50X40X4MM
STAINLESS STEEL SS304
比例 SCALE 1:1
DATE: 2019/09/25
REF:
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审核 CHECK HOMER WU
更改 REVISED
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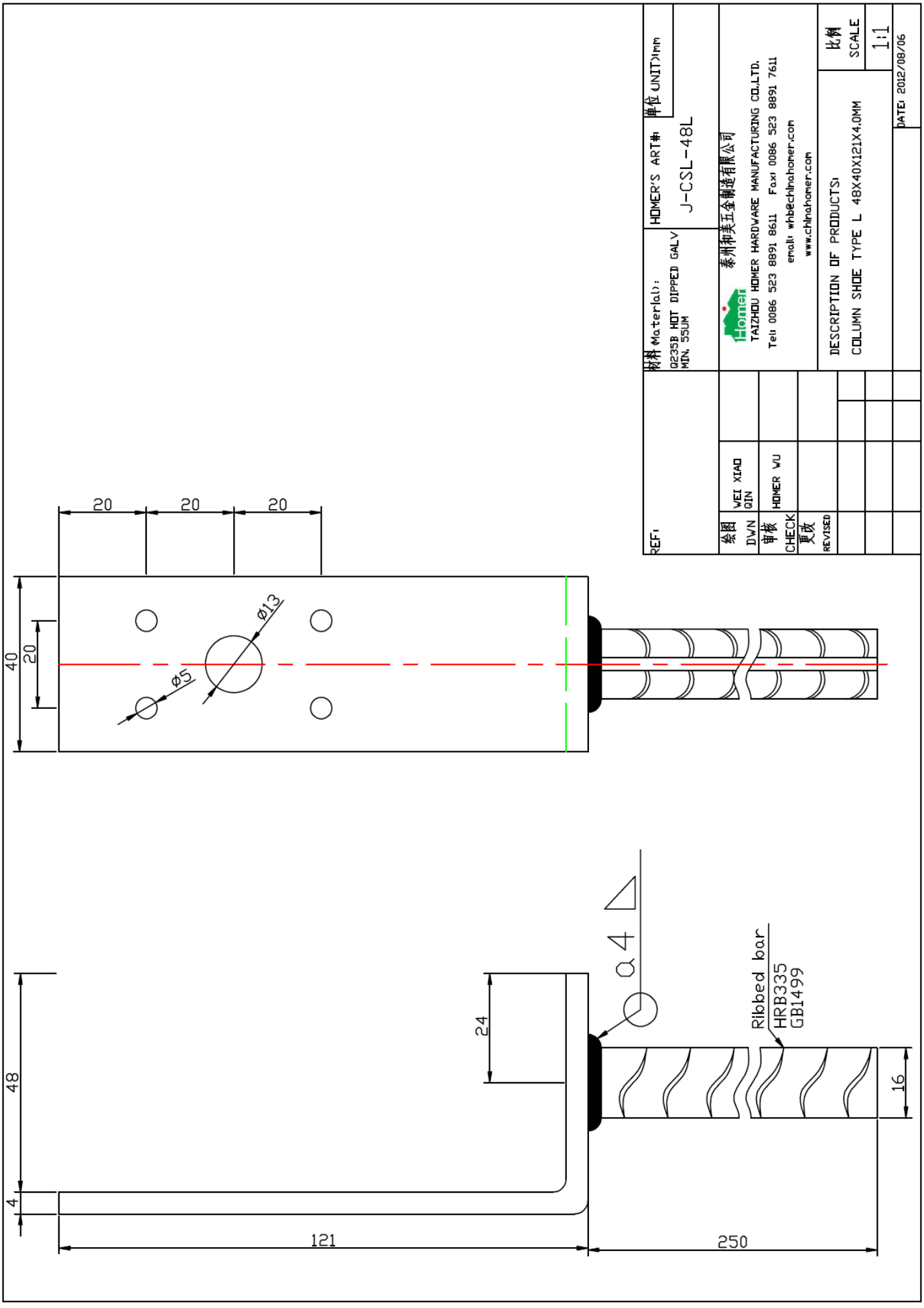
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泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE L 48X40X121X4.0MM
比例 SCALE
1:1
DATE: 2012/08/06
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WEI XIAO QIN
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更改 REVISED
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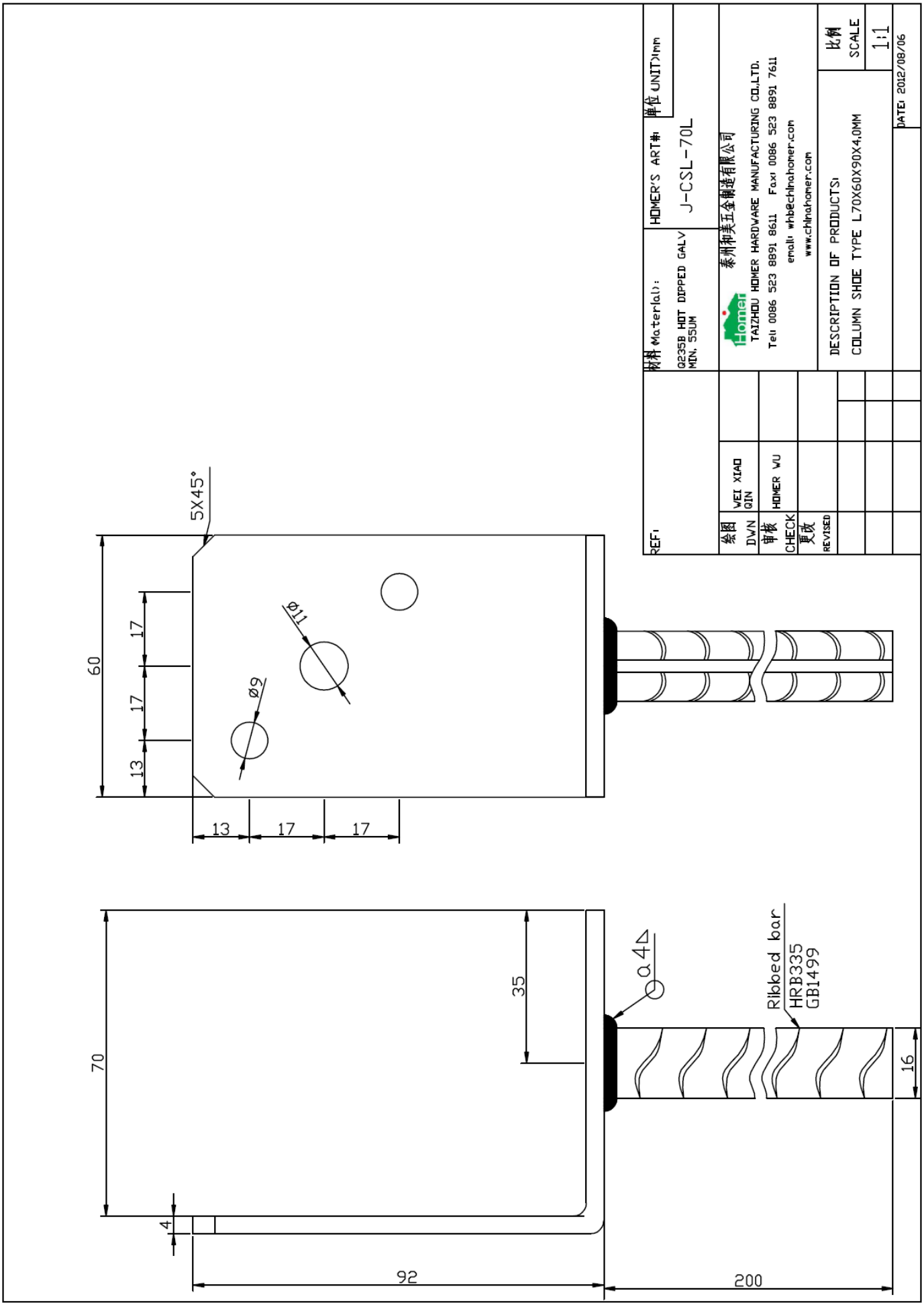
GB1499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REF:
材料 Material:
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MIN. 55UM
HOMER'S ART#
J-CSL-70L
单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE L70X60X90X4.0MM
比例 SCALE
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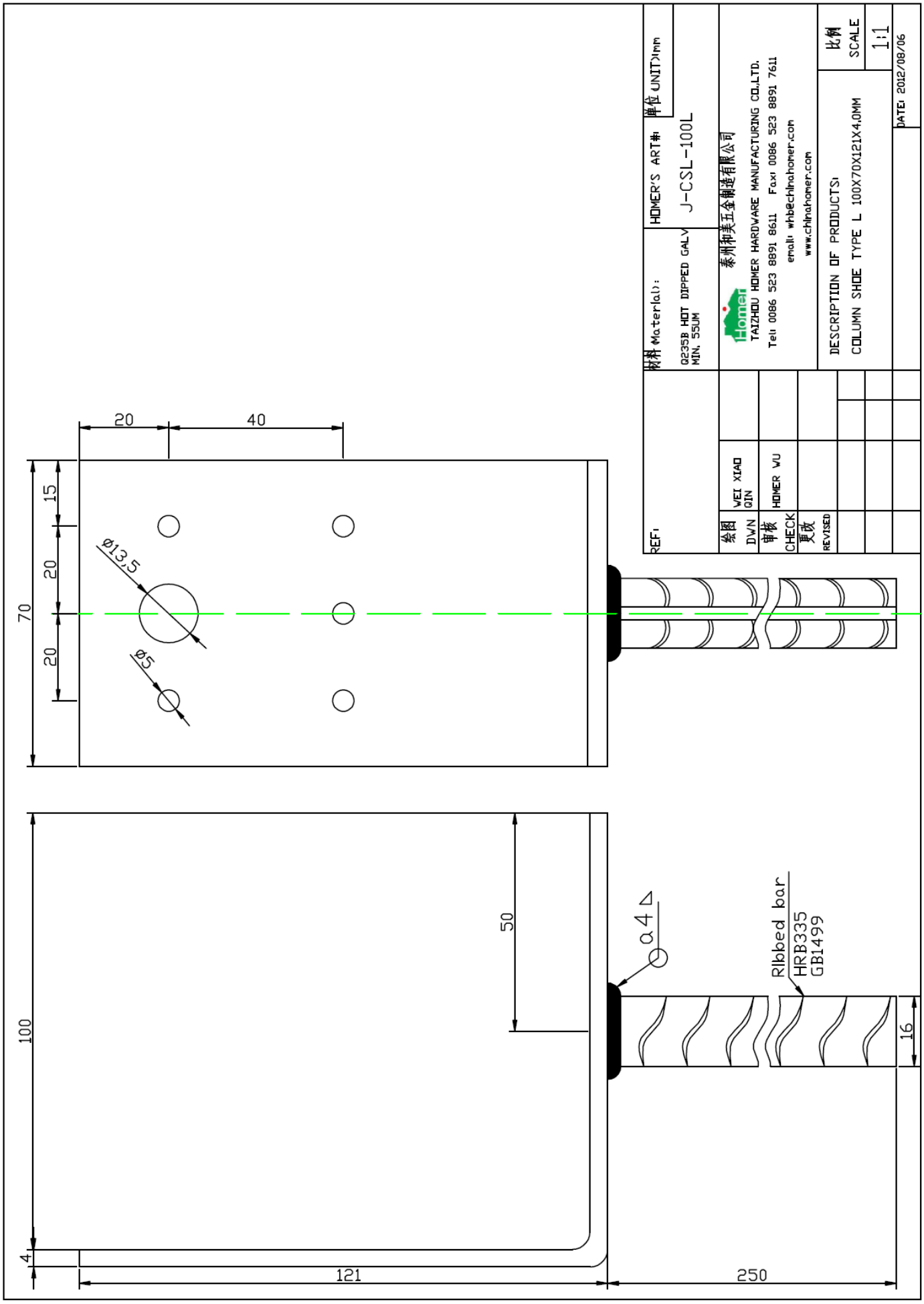
DATE: 2012/08/06
绘图 DWN
WEI XIAO QIN
审核 CHECK
HOMER WU
更改 REVISED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MIN. 55UM
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J-CSL-100L
单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE L 100X70X121X4.0MM
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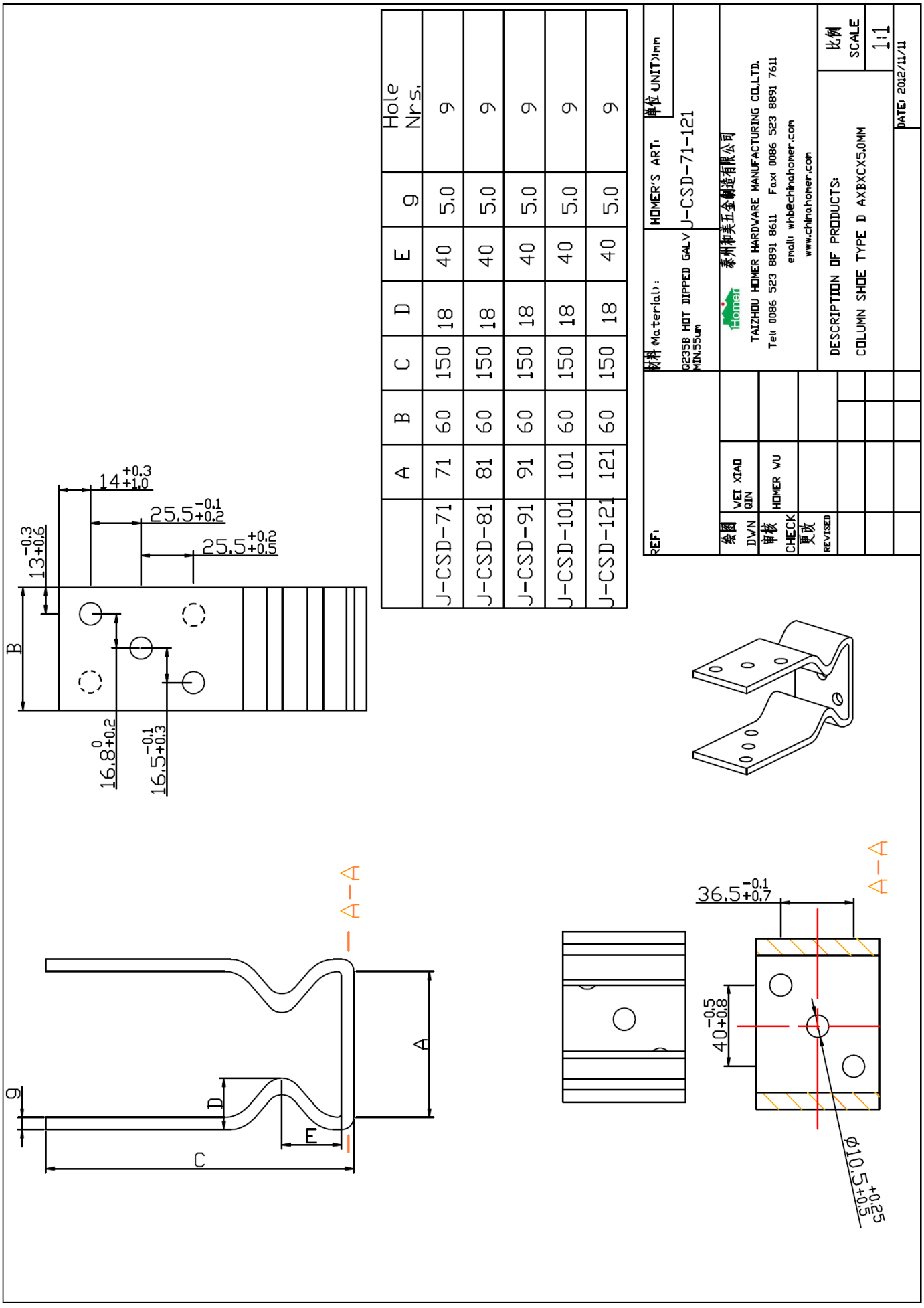
DATE: 2012/08/06
绘图 DWN
WEI XIAO QIN
审核 CHECK
HOMER WU
更改 REVISED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J-CSD-121 121 60 150 18 40 5.0 9
A B C D E G Hole Nrs.
REF:
材料 Material: Q235B HOT DIPPED GALV MIN.55um
HOMER'S ART: J-CSD-71-121
单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
COLUMN SHOE TYPE D AXBXCX5.0MM
比例 SCALE 1:1
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B
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A-A
G
D
F
C
A
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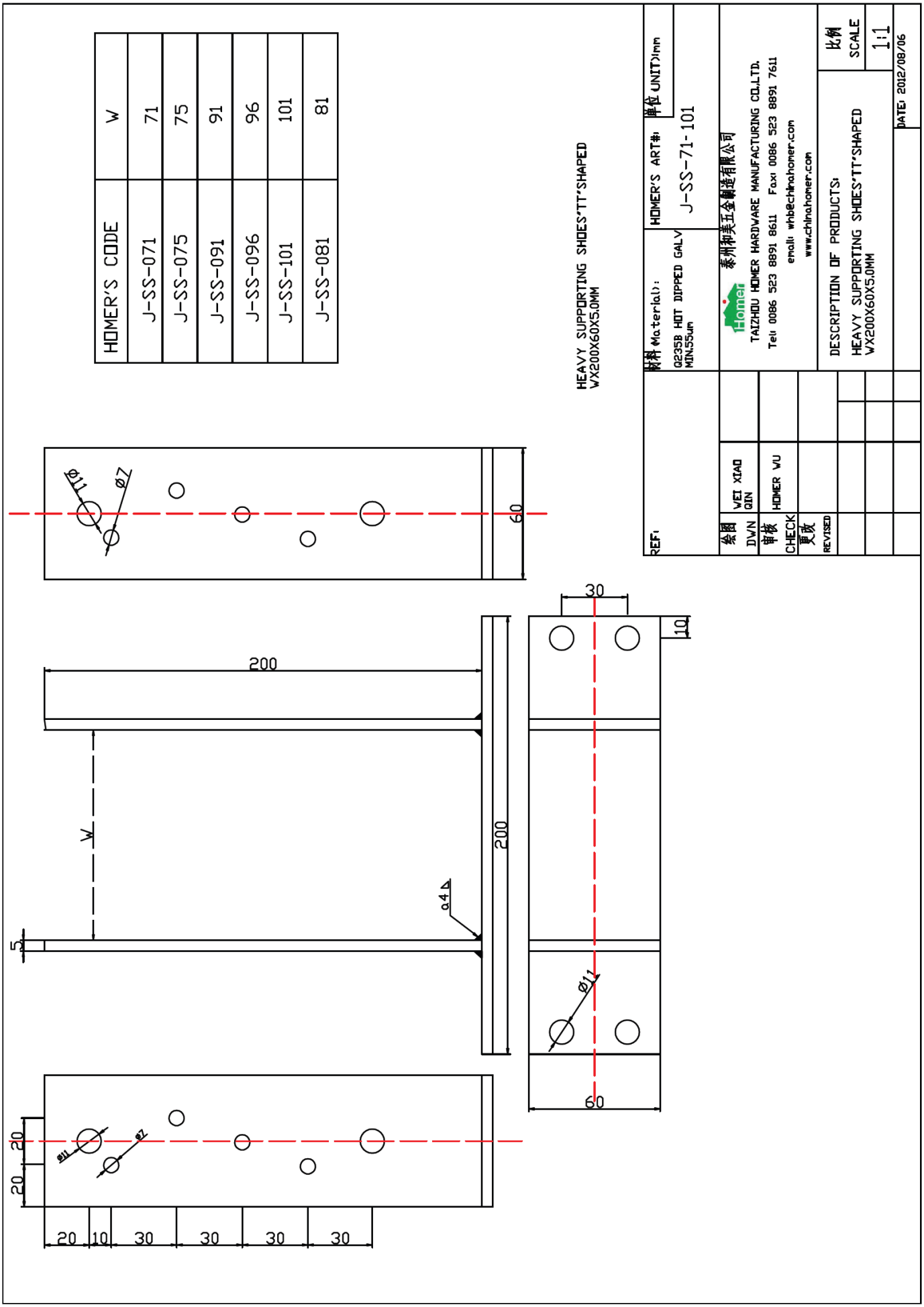
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J-SS-096
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J-SS-101
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J-SS-081
81
HEAVY SUPPORTING SHOES'TT'SHAPED
WX200X60X5.0MM
材料 Material:
Q235B HOT DIPPED GALV
MIN.55um
HOMER'S ART#:
J-SS-71-101
单位 UNIT:mm
泰州和美五金制造有限公司
TAIZHOU HOMER HARDWARE MANUFACTURING CO.,LTD.
Tel: 0086 523 8891 8611 Fax: 0086 523 8891 7611
email: whb@chinahomer.com
www.chinahomer.com
DESCRIPTION OF PRODUCTS:
HEAVY SUPPORTING SHOES'TT'SHAPED
WX200X60X5.0MM
比例 SCALE
1:1
DATE: 2012/08/06
REF:
绘图 DWN
VEI XIAO QIN
审核 CHECK
HOMER WU
更改 REVISED
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ø11
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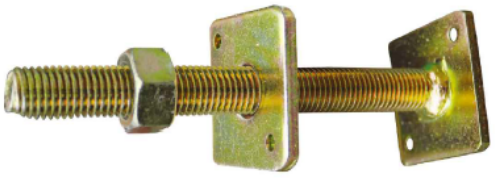
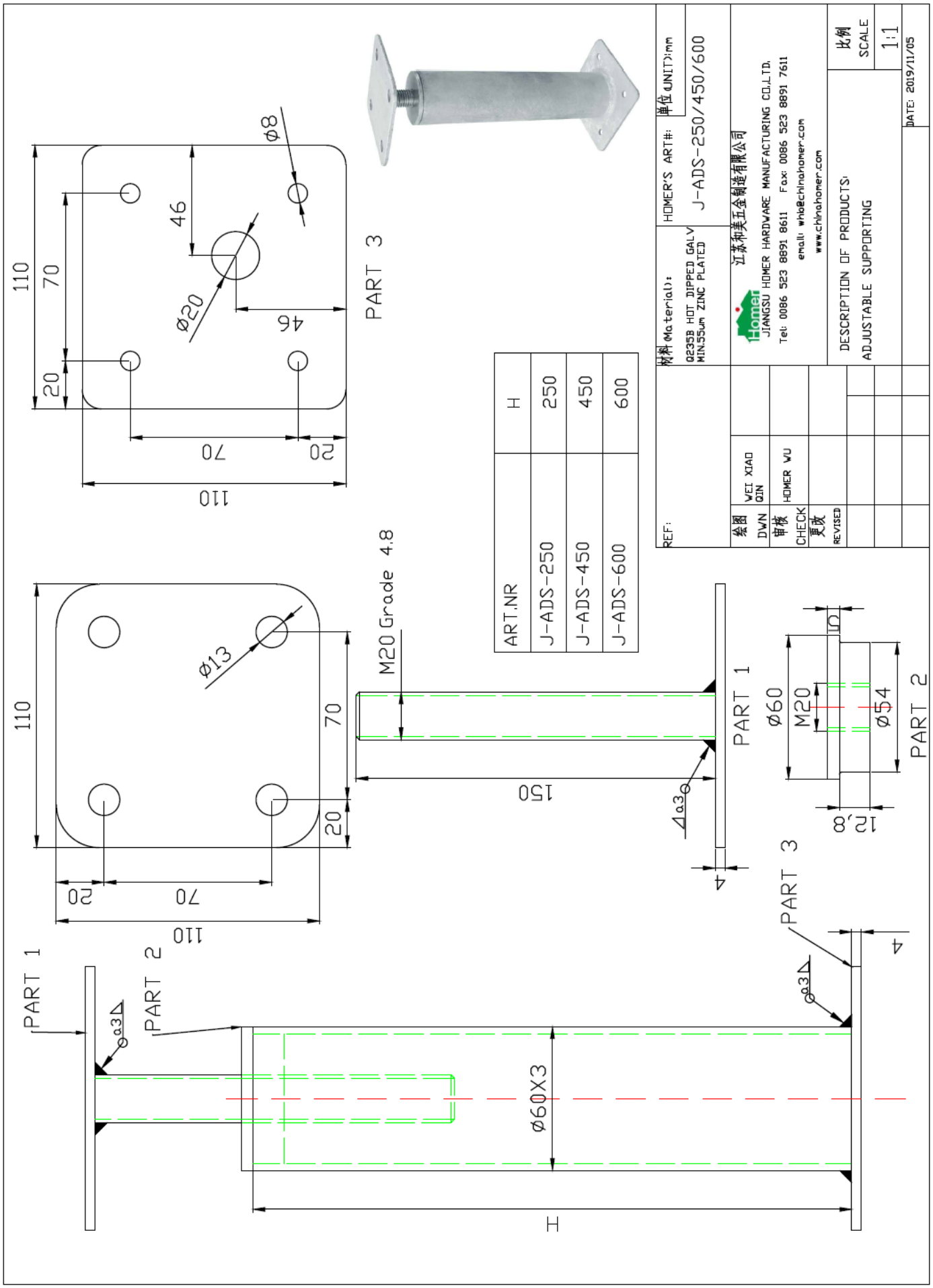
30
30

ANNEX 1: Product details and definitions

ART.NR	A	E	F	H	D1	D2	S
J-AL-1650	50	8	M16	150	5	17.5	5
J-AL-2080	80	15	M20	150	8	22	5
J-AL-24100	100	20	M24	300	12	26	10



ANNEX 1: Product details and definitions



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:

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

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 = 1,1di, when di 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

$$F_{v,Rk} = \min \begin{cases} 0{,}5 f_{h,k} t_2 d & \text{(a)} \\ 1{,}15\sqrt{2M_{y,k} f_{h,k} d} + \dfrac{F_{ax,k}}{4} & \text{(b)} \end{cases} \qquad (7)$$

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:

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

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

where

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

and

$f_{h,0,k}$ is the characteristic embedding strength parallel to grain, in N/mm^2;
ρ_k is the characteristic density of timber, in kg/m^3;
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

$$F_{v,Rk} = \min \begin{cases} 0{,}4 f_{h,\alpha,k} t_1 d & \text{(a)} \\ 1{,}15\sqrt{2M_{y,k} f_{h,\alpha,k} d} + \dfrac{F_{ax,k}}{4} & \text{(b)} \end{cases} \qquad (11)$$

where

t_1 is thickness of timber member in case of bots 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 bots 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:

$$F_{T,d} \leq F_{T,s,Rd} \tag{12}$$

$$F_{C,d} \leq F_{C,w,Rd} \tag{13}$$

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

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

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:

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

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:

$$F_{T,v,Rk} = n \cdot m \cdot F_{v,Rk} \tag{17}$$

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:

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

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:

$$H_{1,v,Rk} = n \cdot m \cdot F_{v,Rk} \tag{19}$$

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).

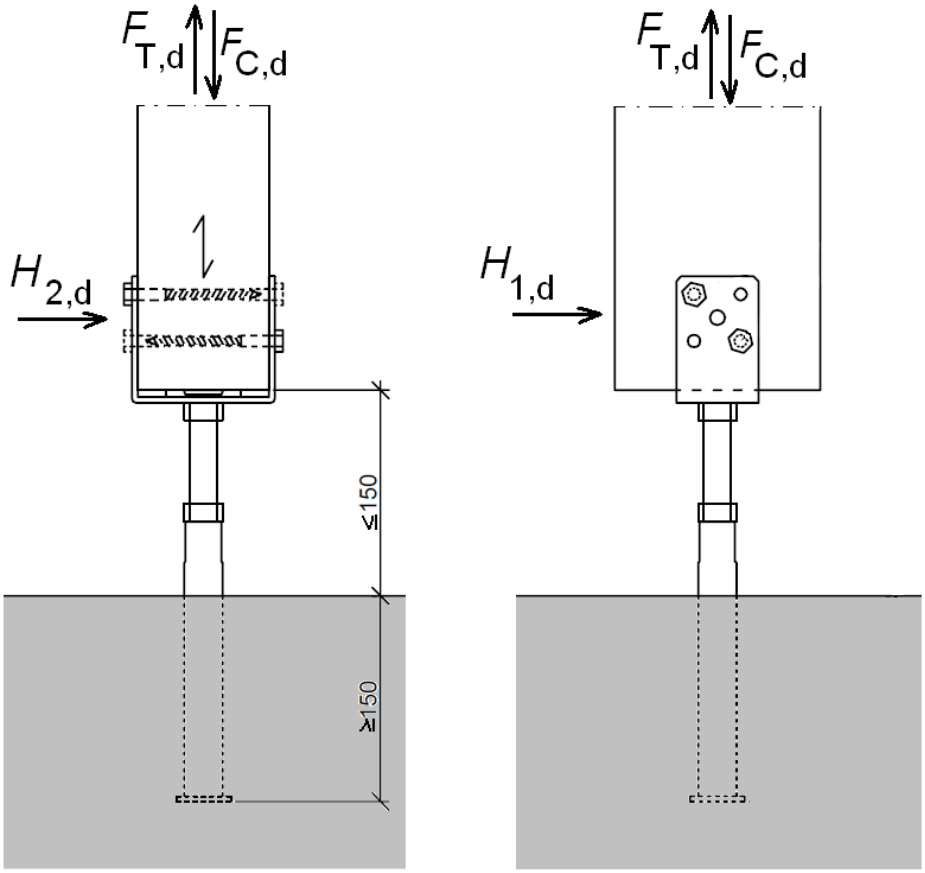


Figure A2.1 Use of Adjustable column shoe and the definition of forces.

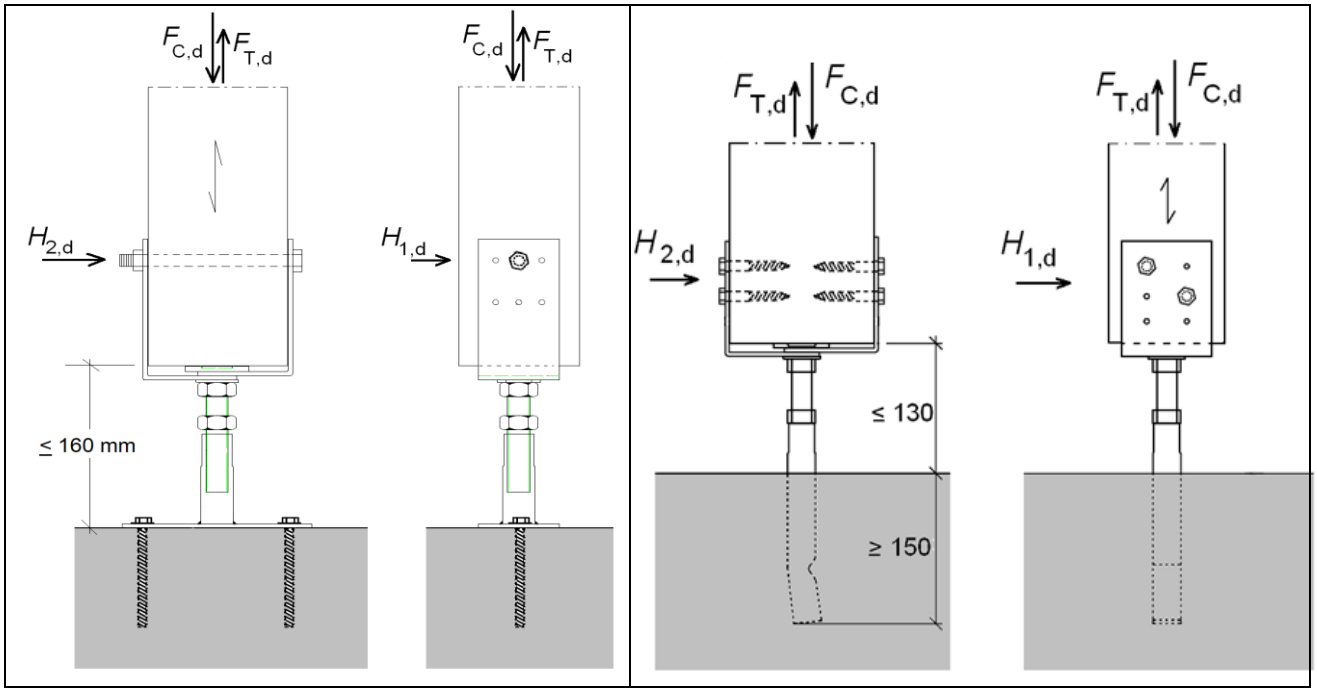


Figure A2.2 Use of Multi Adjustable column shoes and the definition of forces, left J-MACS-80120.

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.

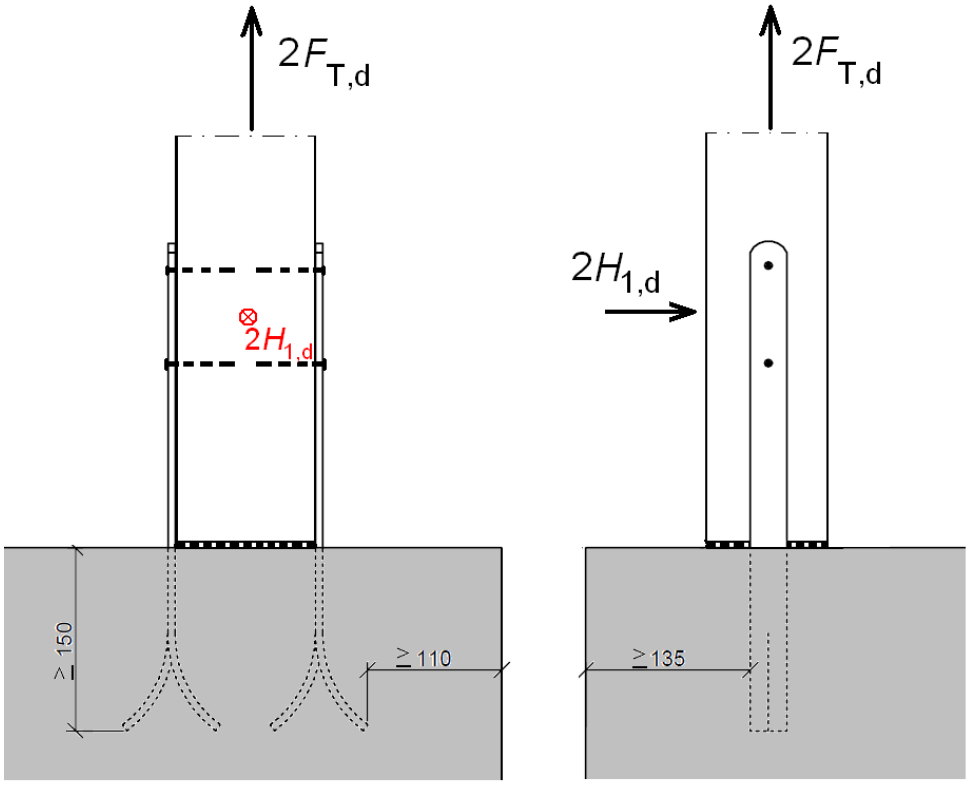


Figure A2.3 Use of Column Anchor Straps and the definition of forces.

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:

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

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

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

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.

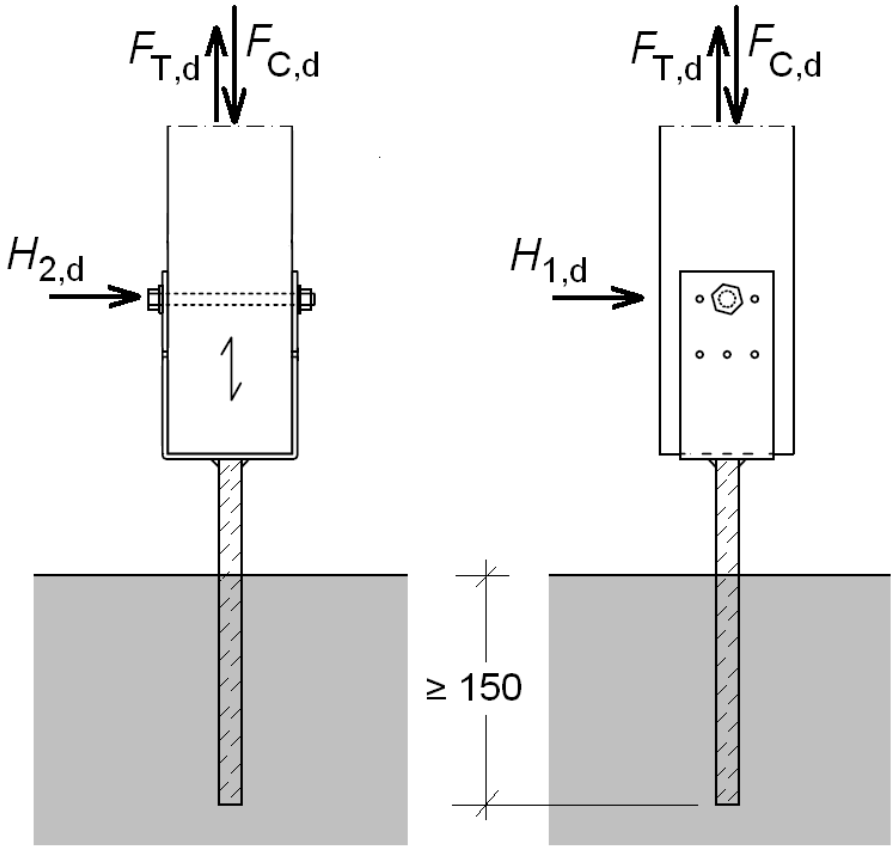


Figure A2.4 Use of Column Shoe type E and the definition of forces.

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 (mm²)
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.

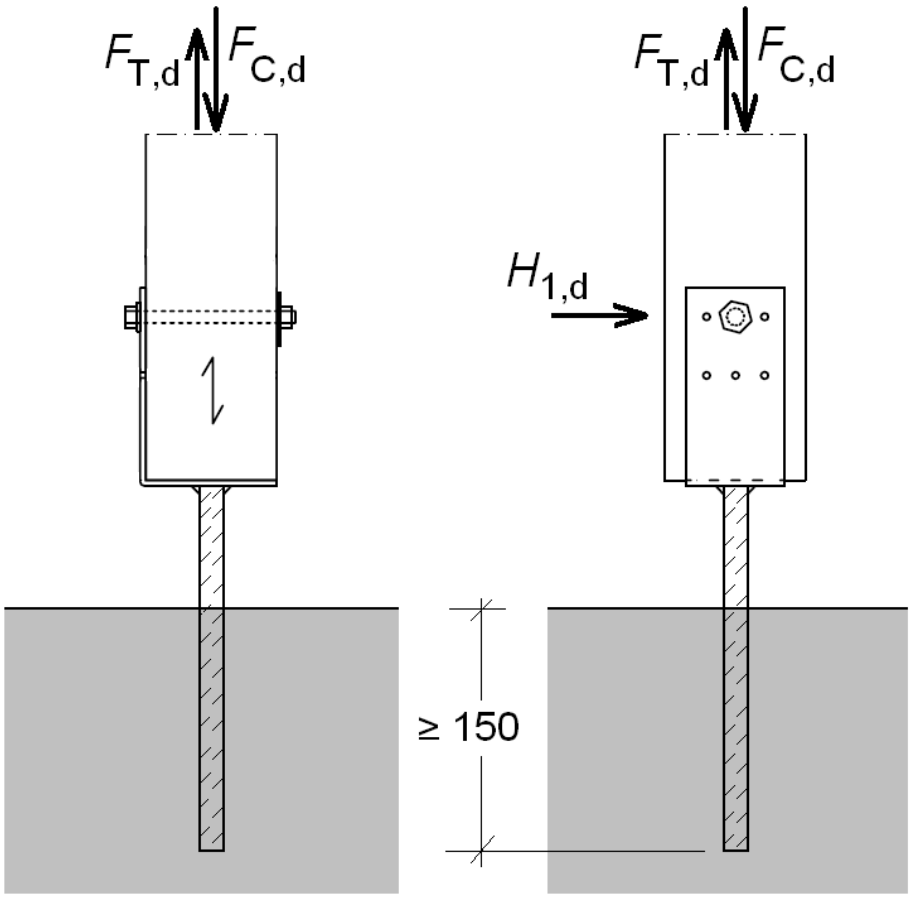


Figure A2.5 Use of Column Shoe type L and the definition of forces.

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

$$F_{T,d} \leq F_{T,s,Rd} \tag{24}$$

$$F_{C,d} \leq F_{C,w,Rd} \tag{25}$$

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

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

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:

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

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

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

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

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

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

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

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

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

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

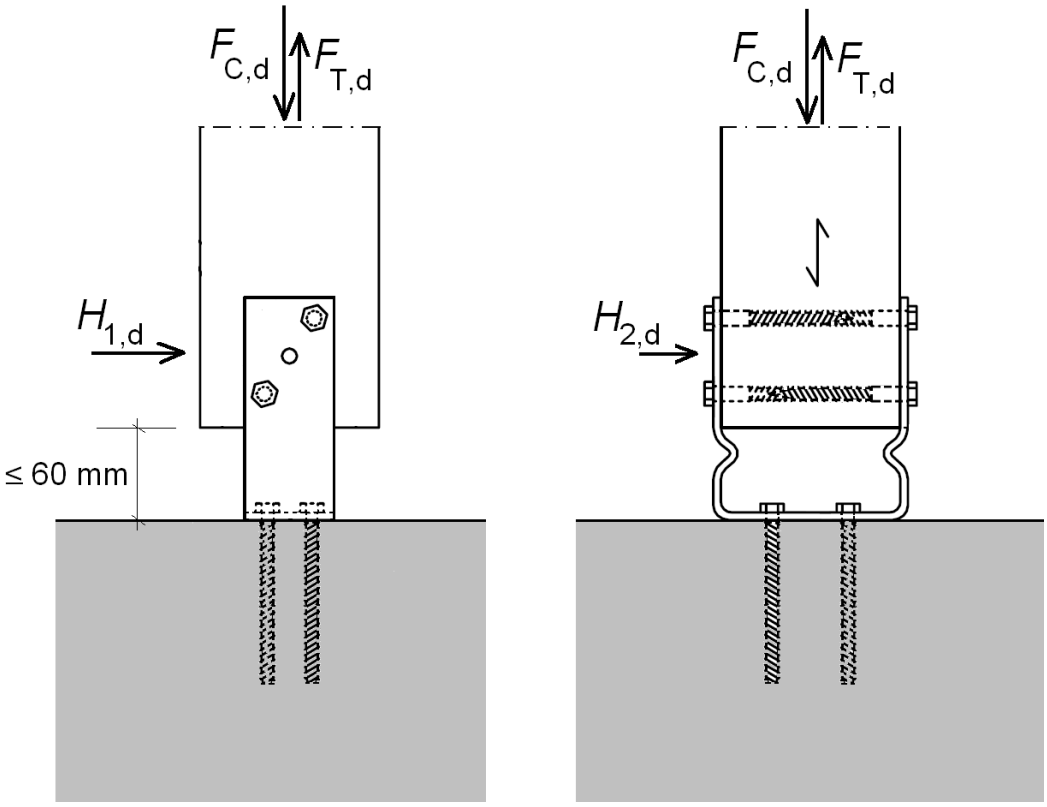


Figure A2.6 Use of Column Shoe type L and the definition of forces.

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.

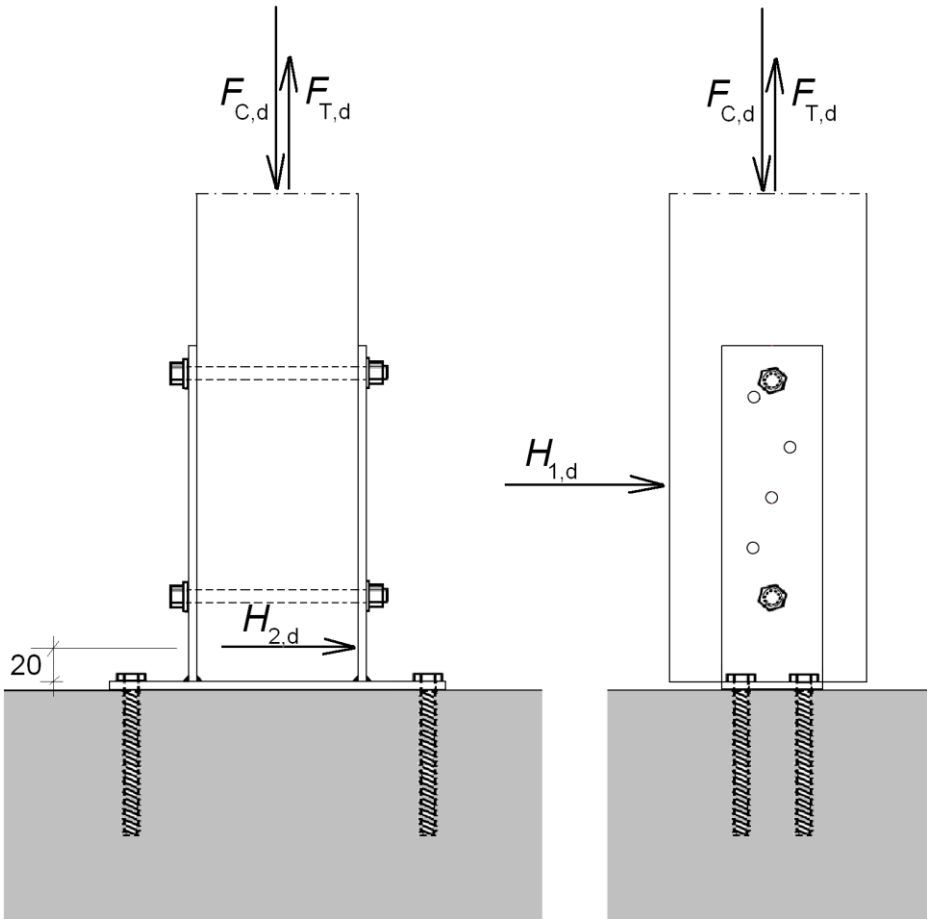


Figure A2.7 Use of Heavy Supporting Shoe and the definition of forces.

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.

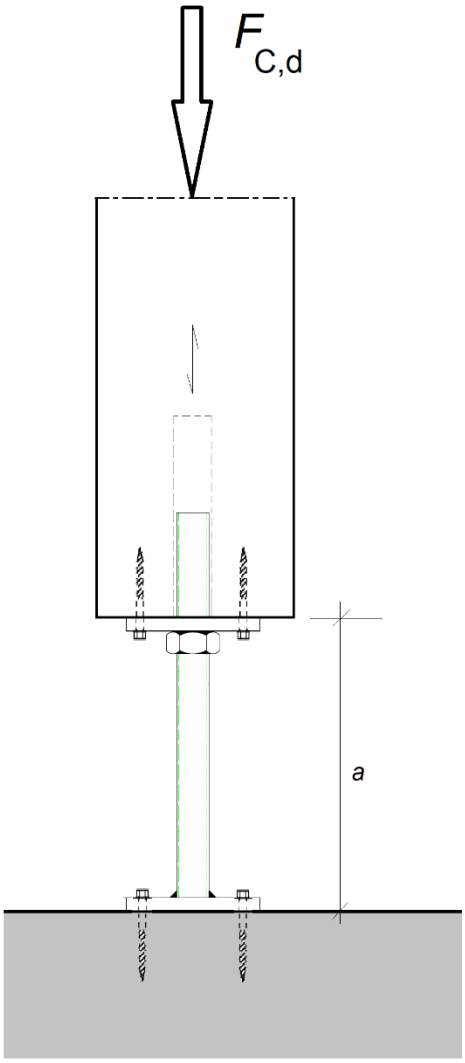


Figure A2.8 Adjustable Column Leg loaded by a centric compression force.

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

$$F_{C,d} \leq k_\rho F_{C,w,Rd} \tag{43}$$

where

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

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

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.

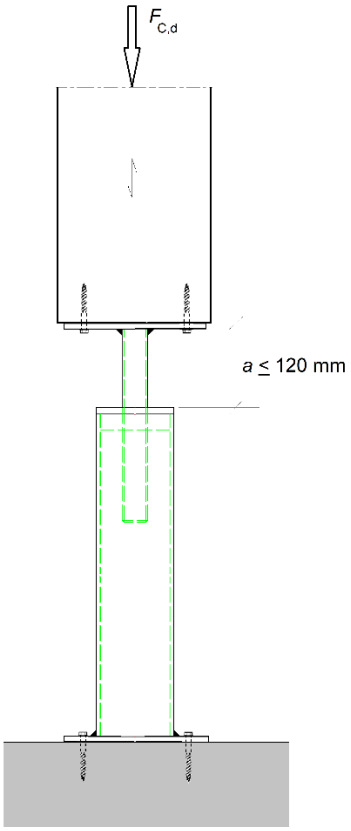


Figure A2.9 Adjustable Supporting Tube loaded by a centric compression force.

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