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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 12/0815 of 06/07/2017

I General Part

Technical Assessment Body issuing the ETA	VTT Expert Services LTD
Trade name of the construction product	MiTek kulmakiinnikkeet MiTek angle brackets
Product family to which the construction product belongs	Naulauslevy rakenteelliseen käyttöön Three-dimensional nailing plates
Manufacturer	MiTek Finland Oy Sepänkatu 7-9 FI-11710 Riihimäki Finland
Manufacturing plant	According to Annex N kept by VTT Expert Services Ltd
This European Technical Assessment contains	92 pages including 3 Annexes that forms an integral part of this assessment
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Three-dimensional nailing plates", ETAG 015, Edition November 2012, used as European Assessment Document (EAD)
This ETA replaces	ETA 12/0185, issued on May 14, 2012

II Specific Part

1 Technical description of the product

MiTek angle brackets are one-piece non-welded three-dimensional nailing plates manufactured from hot-dip zinc coated steel sheet of grade S250 GD Z 275 MA according to EN 10346 or cold formable galvanized steel DX51D-Z275 (EN 10346).

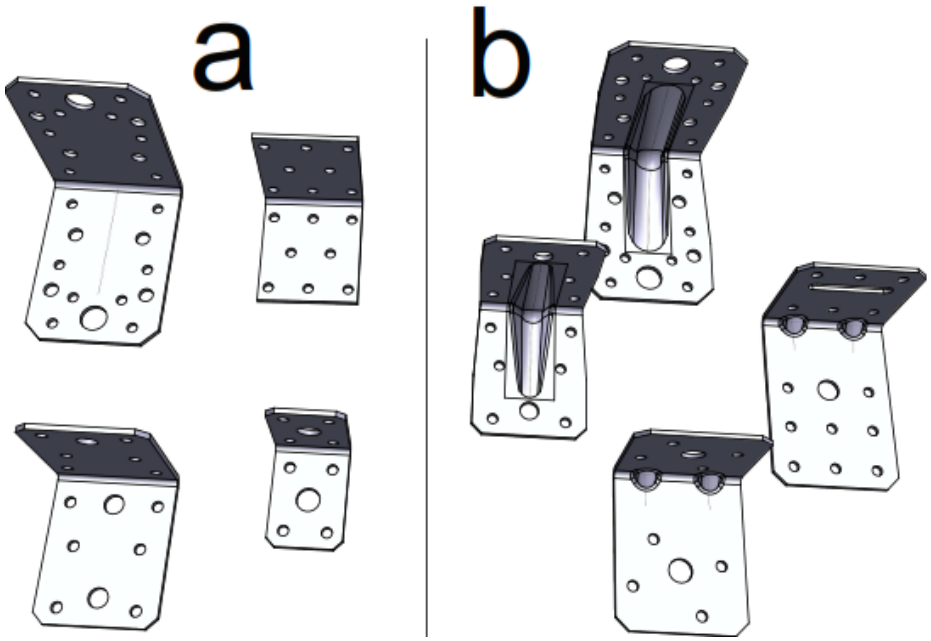


Figure 1. Different types of angle brackets: a) square edged and b) corner rib reinforced (vah).

The yield strength R_{el} tai R_{02} of the steel is at least 250 N/mm², the tensile strength at least 330 N/mm² and elongation at failure A_{80} at least 19 %. The connector may additionally have surface treatment by powder coating.

All angle brackets can alternatively be manufactured of 1.4301, 1.4401 (EN 10088) austenitic stainless steel or 1.4509, 1.4521 (EN 10088) ferritic stainless steel. The yield strength $R_{0,2}$ of the stainless steel 1.4301 is at least 230 N/mm², for 1.4401 at least 220 N/mm². For ferritic grades the yield strength $R_{0,2}$ shall be 250-350 N/mm² for 1.4509 and 275-350 N/mm² for 1.4521.

The steel material thickness is 2,00 $\pm$ 0,14, 2,50 $\pm$ 0,16 mm, 3,00 $\pm$ 0,18 mm or 4,00 $\pm$ 0,21 mm. The product drawings are in Annex. The specified locations and respective distances for holes shall be within $\pm$ 1.00 mm tolerance.

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

2.1 Intended uses

Intended use of MiTek angle brackets are timber constructions, where both flanges of the bracket are fixed to strength graded timber according to EN 14081-1, glulam according to EN 14080, softwood- or laminated logs, laminated veneer lumber (LVL) according to EN 14374, plywood according to EN 13986, cross laminated timber (CLT) with edge glued lamellas, or corresponding timber material. The characteristic density ρ_k of the timber shall not be greater than 500 kg/m³.

The forces to be transferred by the angle bracket shall act at the centre of the fastener group on the plane defined by flanges A or B. This ETA does not cover angle brackets fixed in the end of a timber member or in the edge of a LVL member.

Angle brackets may also be used as reinforcement of the support region of nail plate structures (see Annex 3).

MiTek angle brackets shall be fixed to timber by anchor nails or anchor screws (See figure 2) according to EN 14592.

The diameter of the anchor nails shall be d = 4,0 mm and the profiled length at least 24 mm.

The anchor screw shall have conical head, the diameter of the smooth part of the screw shall be d = 4,5…5,0 mm and the inner diameter of the threaded part $d_1 \geq 3{,}0$ mm. The length of the threaded part of the screw shall be at least 6d. Timber parts shall not be pre-drilled for the nails or screws used in 5mm holes. Fasteners shall be perpendicular to the grain of the timber.

Figure 2. Fasteners: a) anchor nail and b) anchor screw.

The pre-calculated capacity values specified for MiTek Angle bracket *90x90x65x1,5 vah* in Annex 1 have been calculated in conjunction with either MiTek Anchor Nails 40x4,0 (ITT report no. VTT-S-00094-12) or MiTek Anchor Screws 5,0 x 40 (ITT report no: E-30-20144-13) or similar nailing plate screws 5,0x40 which have the length of the threaded part $l_g \geq 30$ mm, inner diameter of the threaded part $d_1 \geq 3{,}0$ mm, tensile capacity $f_{tens,k} \geq 8{,}0$ kN, yield moment $M_{y,k} \geq 6800$ Nmm and withdrawal capacity ($l_g \times f_{ax,k} \times d$) ≥ 1750 N in direction perpendicular to grain, when the characteristic density of timber ρ_k is 350 kg/m^3.

The support side material may also be of other applicable rigid material such as concrete or steel. In this case the angle bracket shall be fixed with CE-marked bolts, threaded bars, anchor bolts or other applicable connector with diameter 10/12 mm through the 11/13 mm holes to the rigid material or with concrete screws with diameter of 6 mm through the 7 mm holes. The concrete screws shall have been ETA assessed in accordance with ETAG 001.

For angle brackets made of hot dip coated steel, the intended service classes according to EN 1995-1-1 are classes 1 and 2. Angle brackets made of stainless steel can also be used in service class 3.

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

When angle brackets are made of stainless steel, the nails or screws shall also be made of stainless steel. Fasteners to concrete 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.

Shear capacity represents the force component that is in effect in direction of a flange surface. Tensile and compression force are the force components that are in effect in direction perpendicular to a flange surface. The flanges are identified as flange A and flange B. With non-symmetric angle brackets the flange A is the flange that has height dimension A and flange B has length dimension respectively (see Figure 3). The sizes of MiTek angle brackets are listed in tables of Annex 2.

Joints with Angle Brackets shall fulfil the minimum spacing and edge distance requirement specified in EN 1995-1-1. In Annex 2 the characteristic load carrying capacities are given for connections with fasteners inserted a) to all ø5 mm holes, b) ø5 mm holes, that are at least 28 mm from the surface of the opposite flange and c) ø5 mm holes, that are at least 42 mm from the opposite flange.

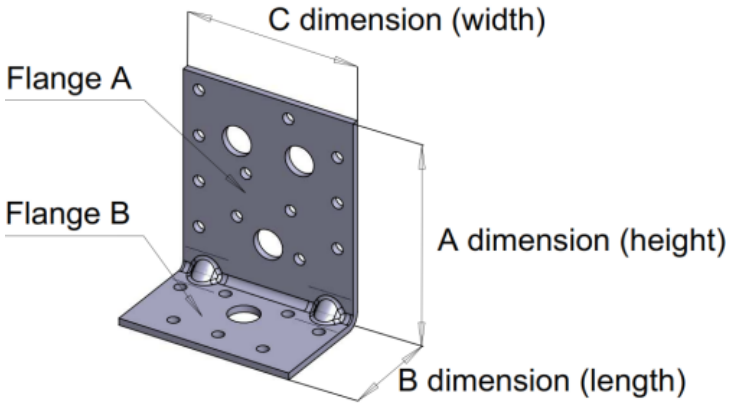


Figure 3. Definitions of MiTek Angle Bracket dimensions and flanges A and B

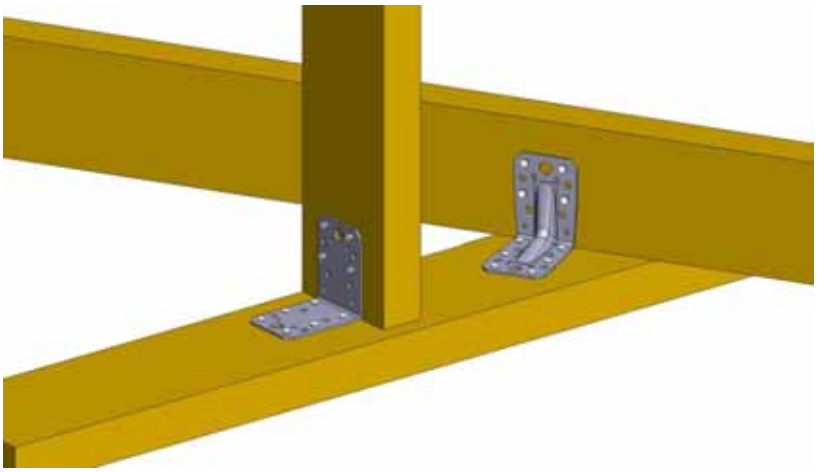


Figure 4. Typical use of MiTek angle brackets

2.2 Working life

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

2.3 Identification

MiTek Angle Brackets are identified having "Mii" 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 product cannot be interpreted as a guarantee given by the producer or the approval body. They should only be regarded as a means for the specifiers to choose the appropriate criteria for products in relation to the expected, economically reasonable working life of the works.

3 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 MiTek Angle Brackets are given in Annex 2.

3.1.2 Resistance to corrosion and deterioration

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

3.2 Safety in case of fire, BWR 2

3.2.1 Reaction to fire

MiTek Angle brackets 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 Approval, 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.

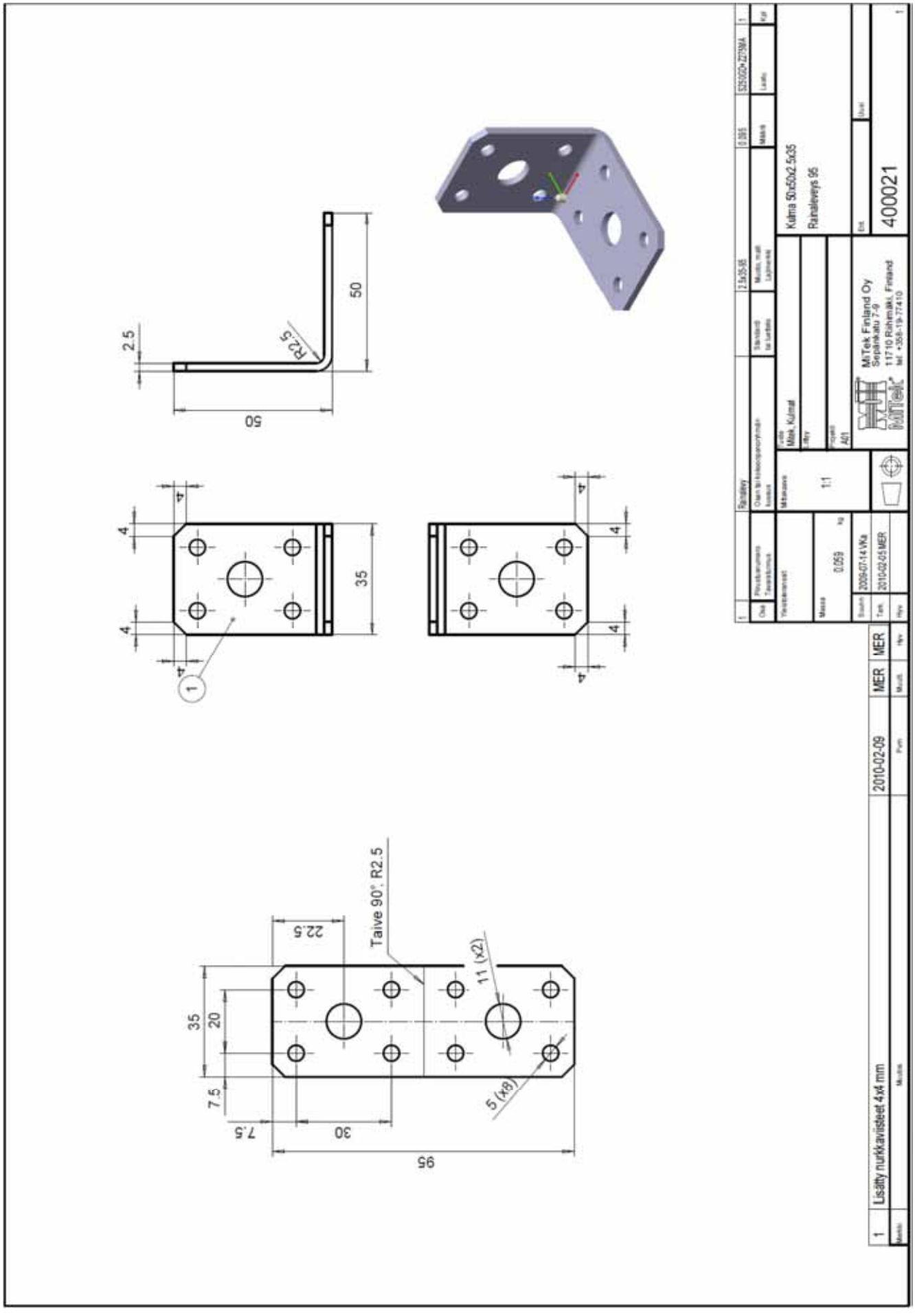
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at VTT Expert Services Ltd.

Issued in Espoo on July 6, 2017
by VTT Expert Services Ltd

Pertti Jokinen
Product Manager

Ari Kevarinmäki
Leading Expert

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


2.5
50
50
R2.5
35
4
4
4
4
4
4
1
Taive 90°, R2.5
22.5
11 (x2)
35
20
7.5
7.5
30
95
5 (x8)
Kulma 50x50x2.5x35
Rainaleveys 95
400021
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
Mitek
Mitek, Kulmat
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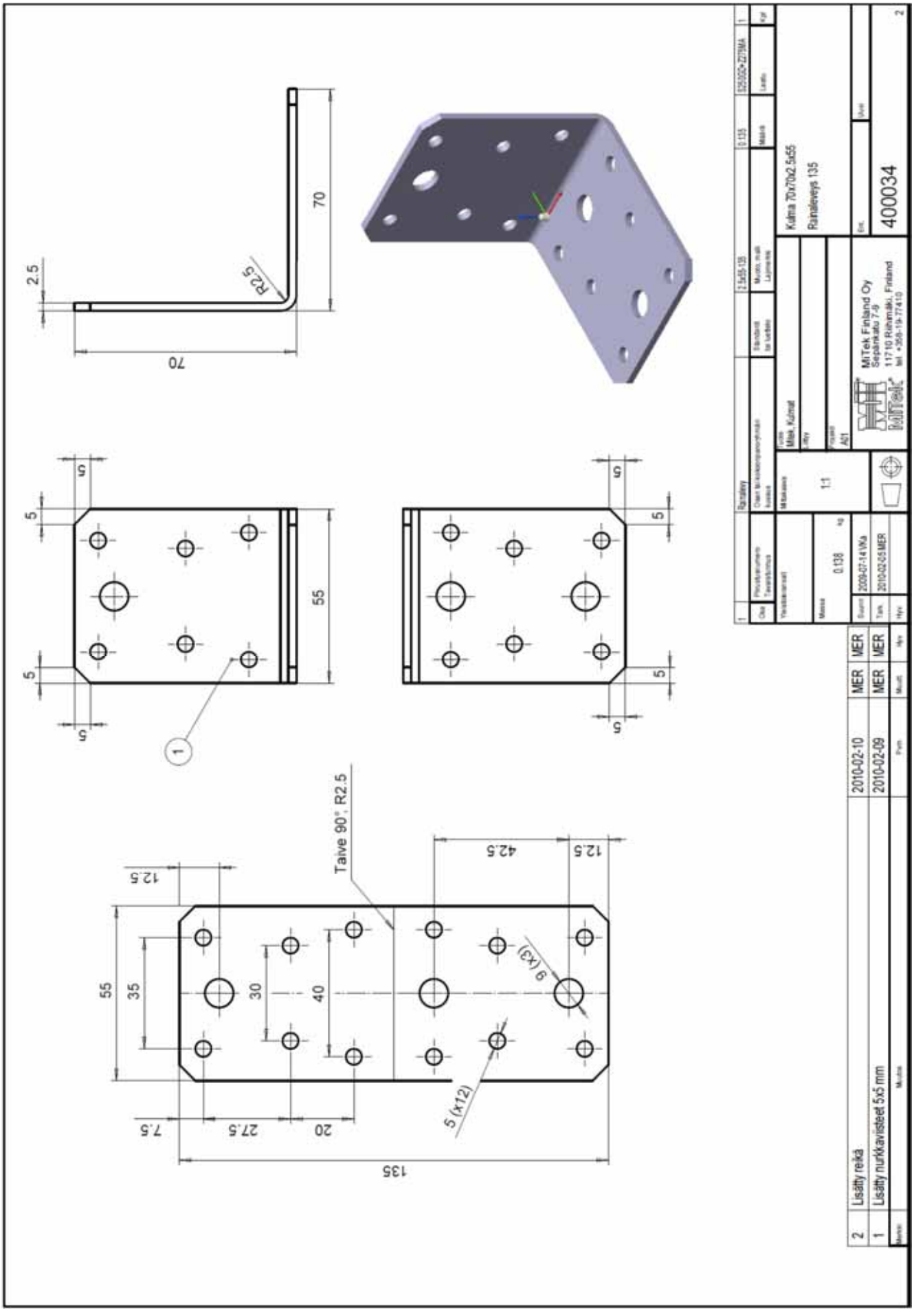
2009-07-14 VKa
2010-02-05 MER
2010-02-09
MER
MER
Lisätty nurkkavälisteet 4x4 mm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Rainaleveys 135
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Sepänkatu 7-9
11710 Riihimäki, Finland
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135
70
55
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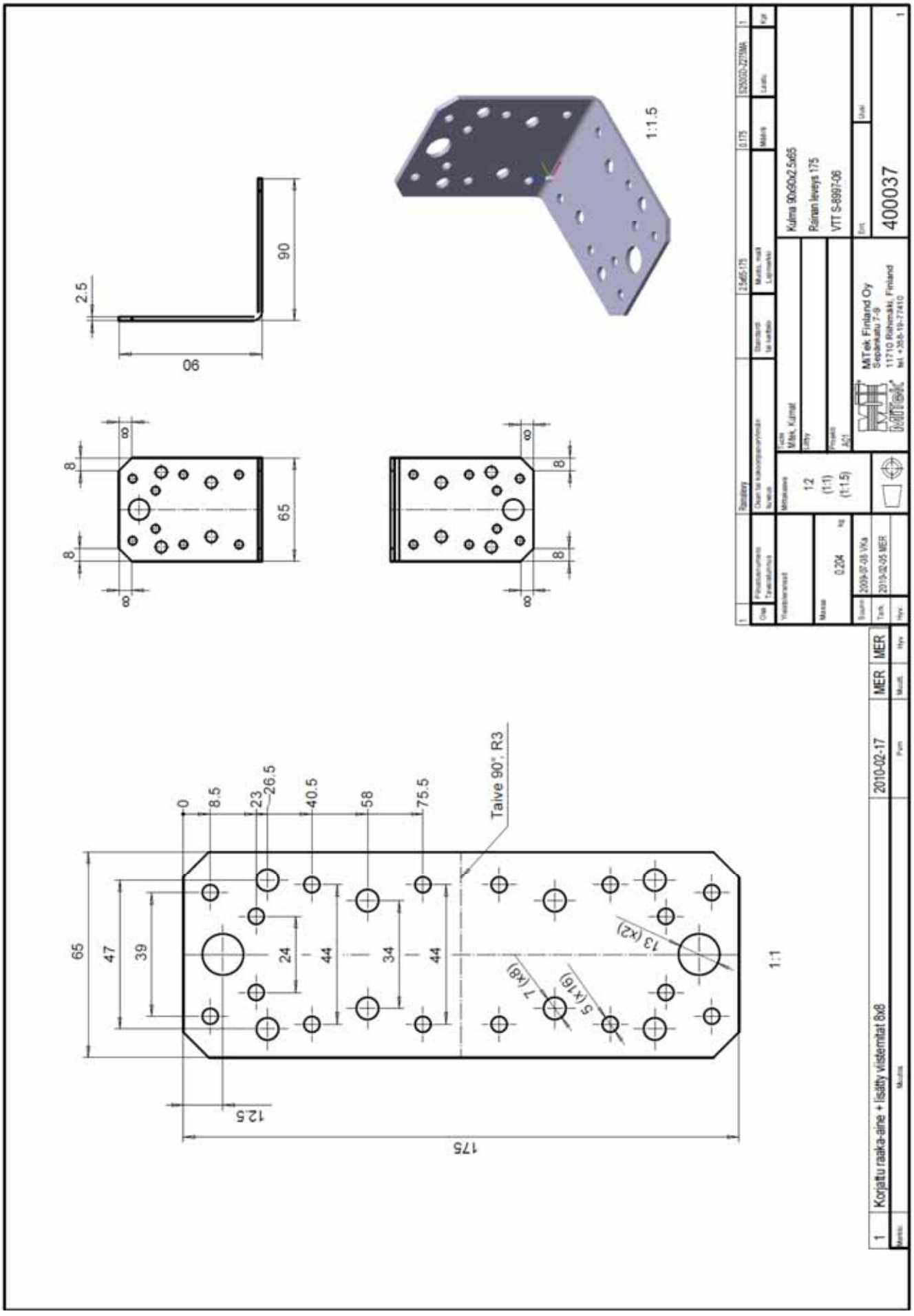
2010-02-09
Lisätty reikä
Lisätty nurkkavisteet 5x5 mm


1:1.5
2.5
90
90
65
8
8
8
8
8
8
8
8
Taive 90°, R3
0
8.5
23
26.5
40.5
58
75.5
65
47
39
24
44
34
44
13 (x2)
7 (x8)
5 (x16)
12.5
175
1:1
Kulma 90x60x2.5x65
Rainan leveys 175
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MiTek Finland Oy
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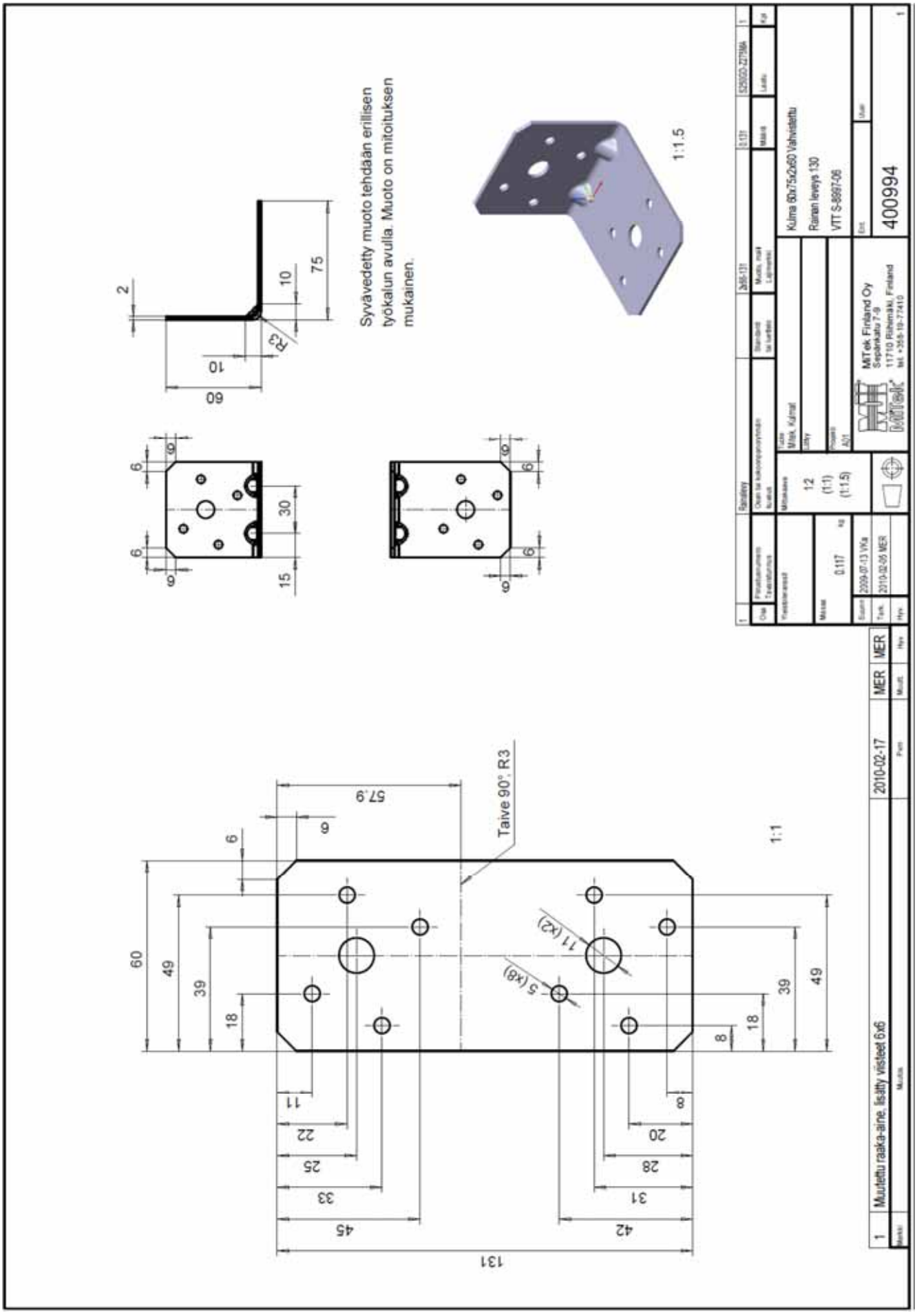
MER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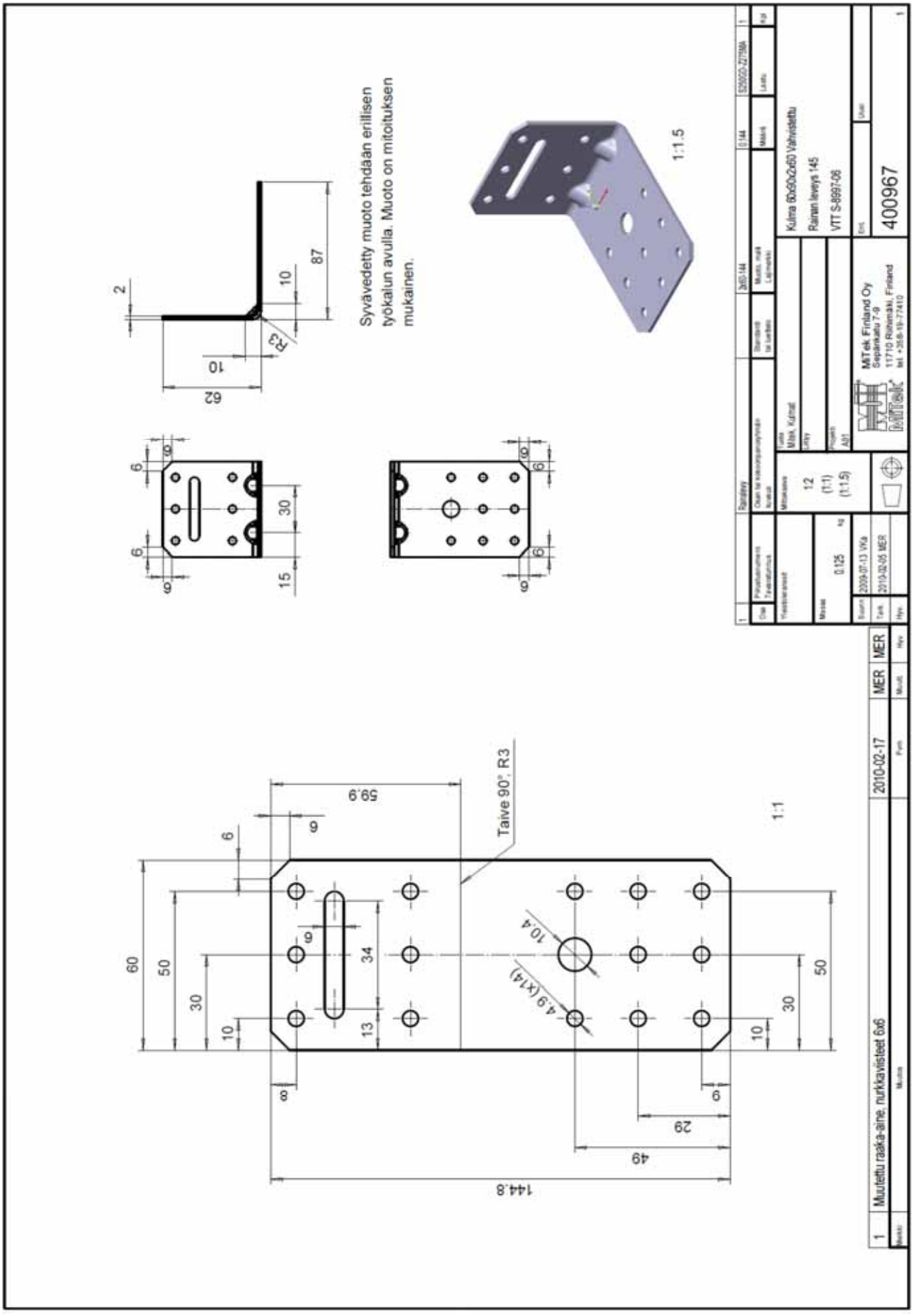
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Taive 90°, R3
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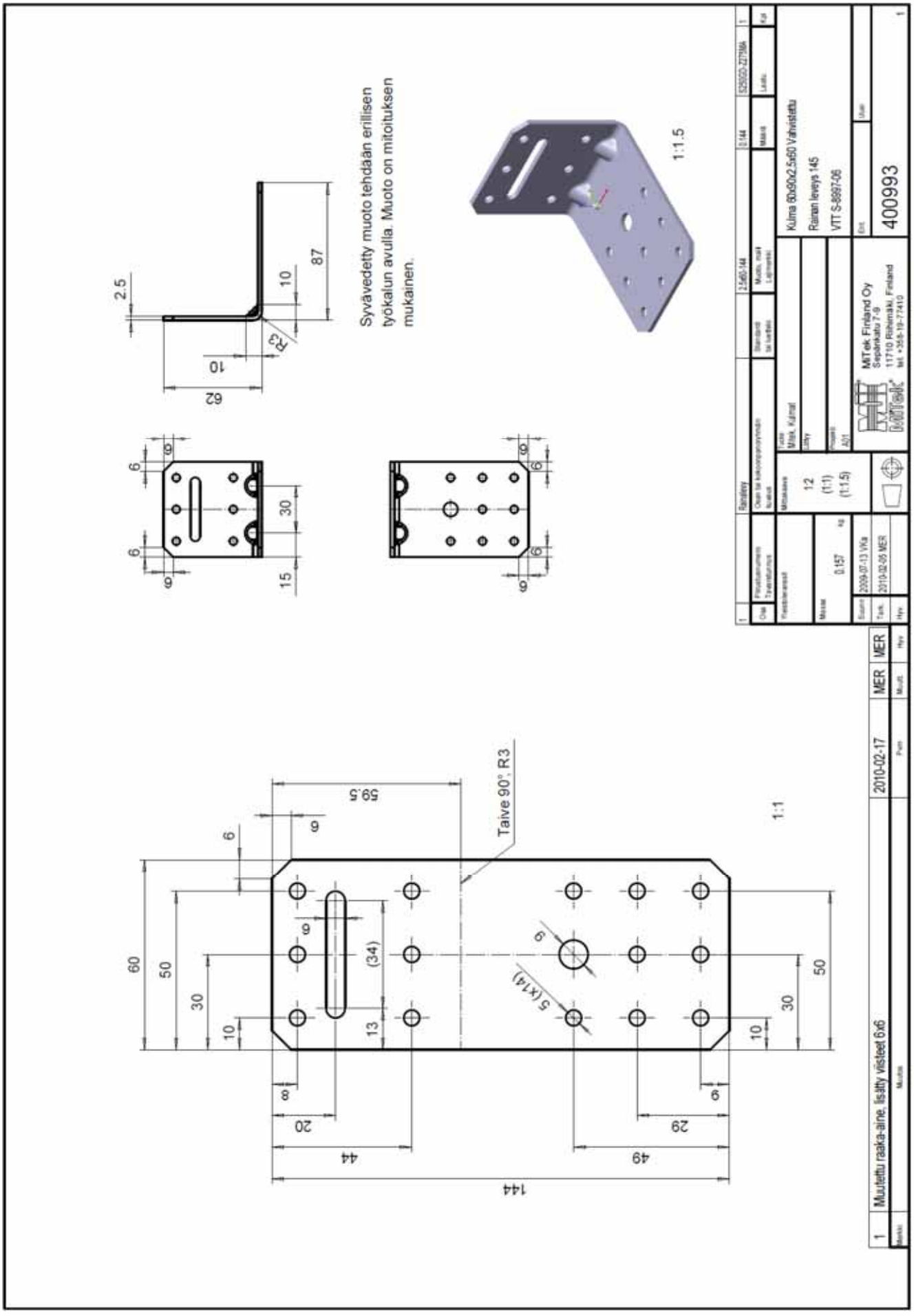
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Taive 90°, R3
1:1
Kulma 60x90x2,5x50 Vahvistettu
Rainan leveys 145
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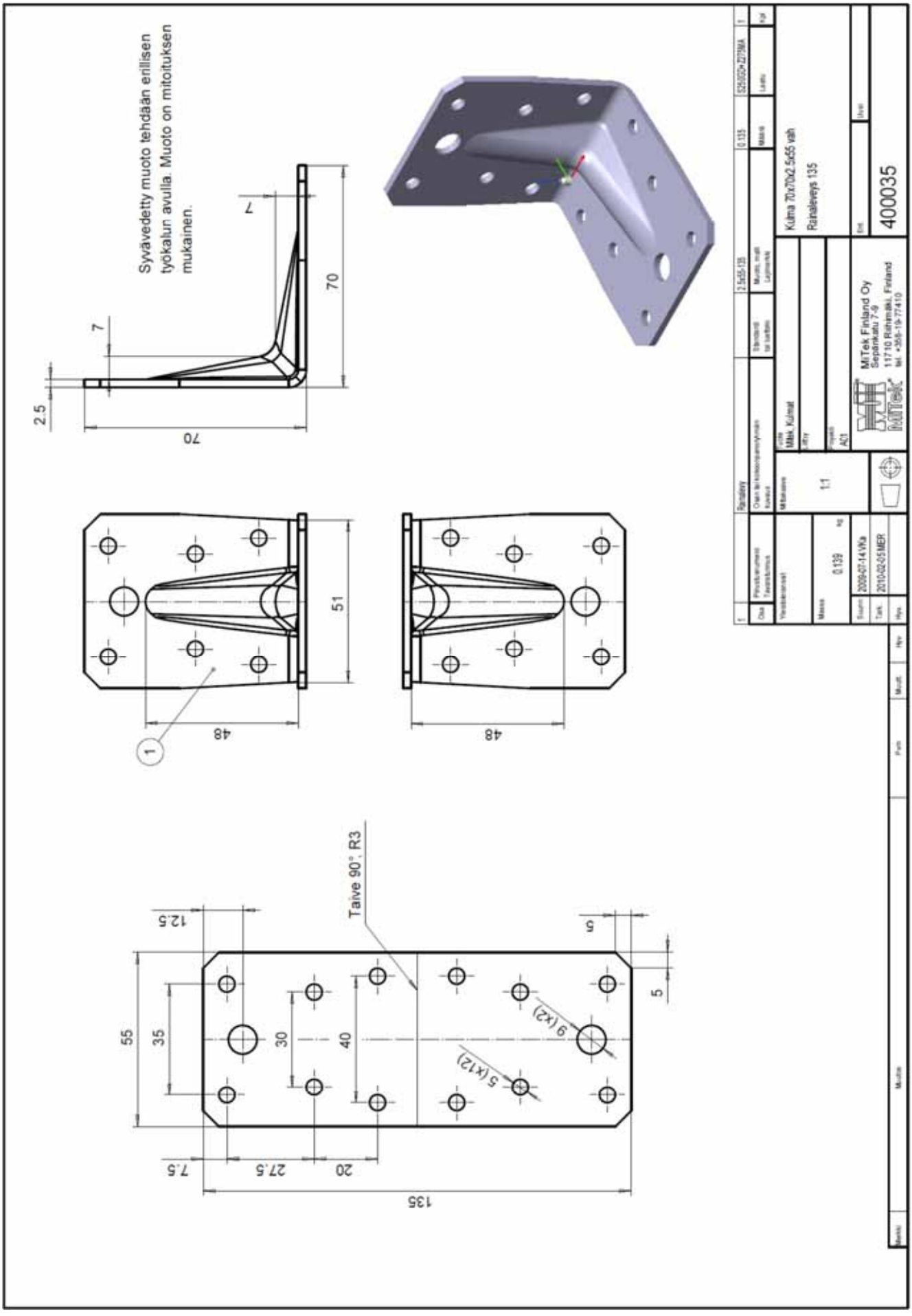
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70
7
2.5
70
51
48
1
48
Taive 90°, R3
12.5
5
5
55
35
30
40
9 (x2)
5 (x12)
7.5
27.5
20
135
Kulma 70x70x2.5x55 vah
Rainaleveys 135
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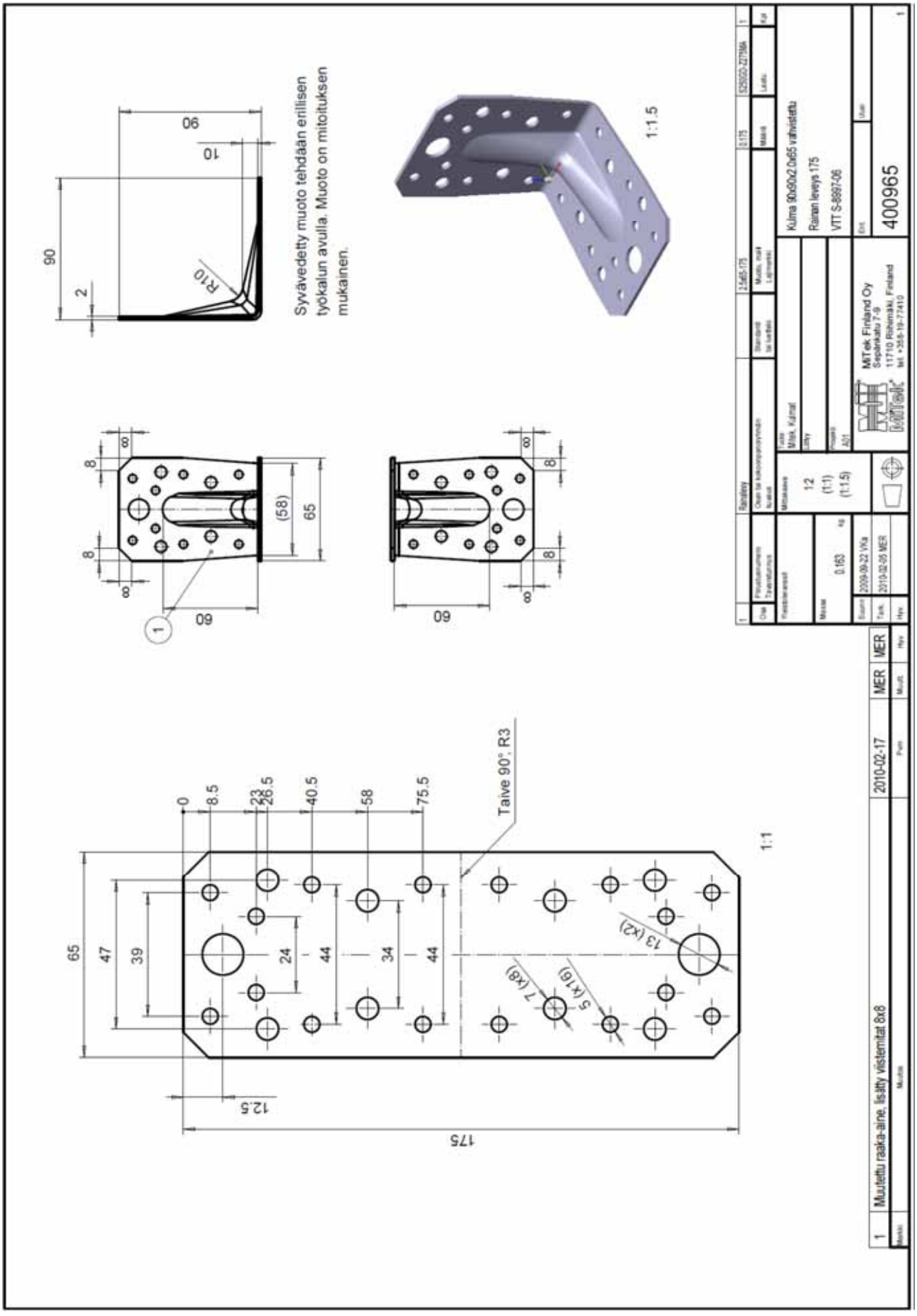
2010-02-05 MER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1:1
Kulma 90x90x2.0x65 vahvistettu
Rainan leveys 175
VTT S-8697-06
MiTek Finland Oy
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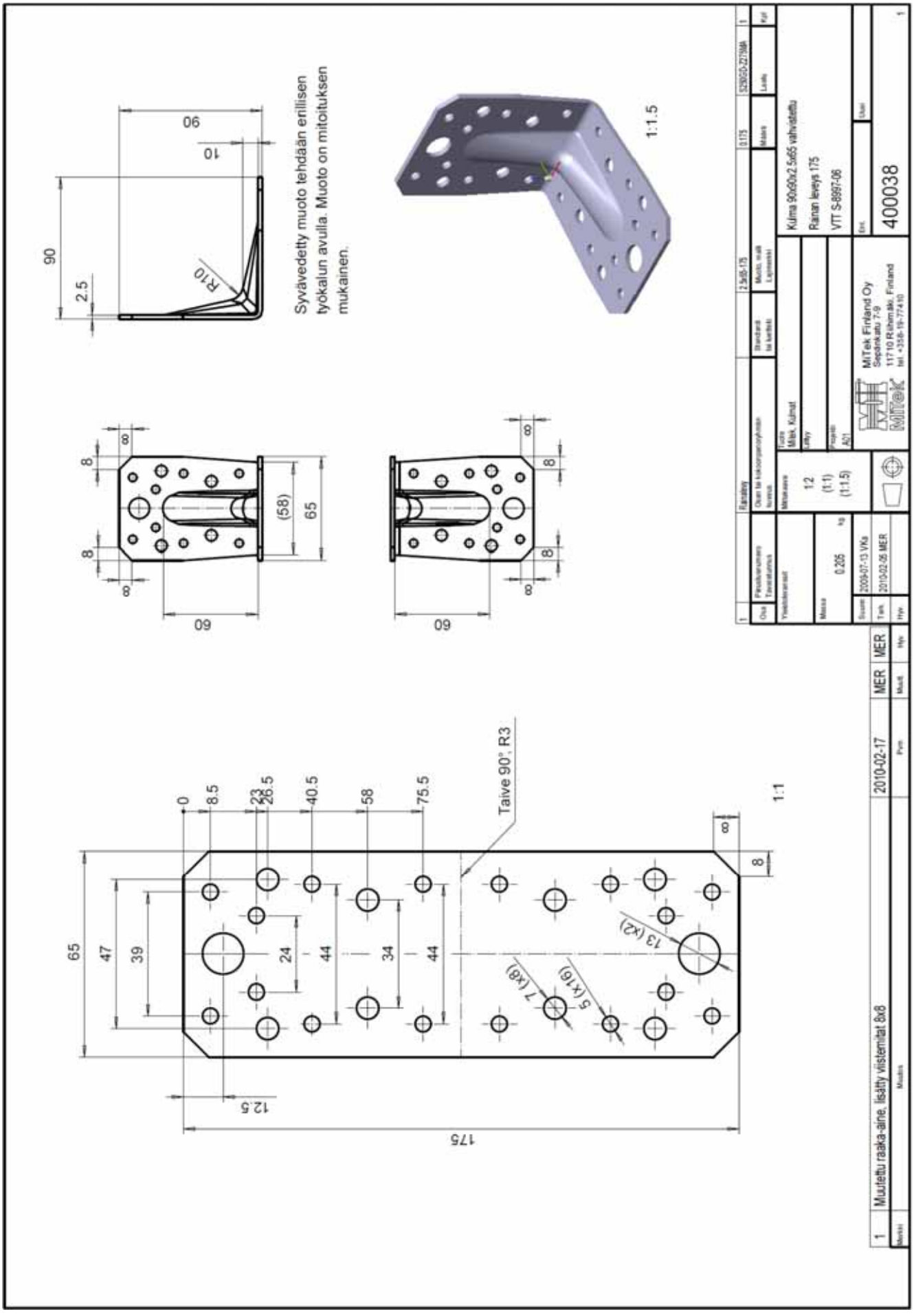
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MiTek Finland Oy
Sepänkatu 7-9
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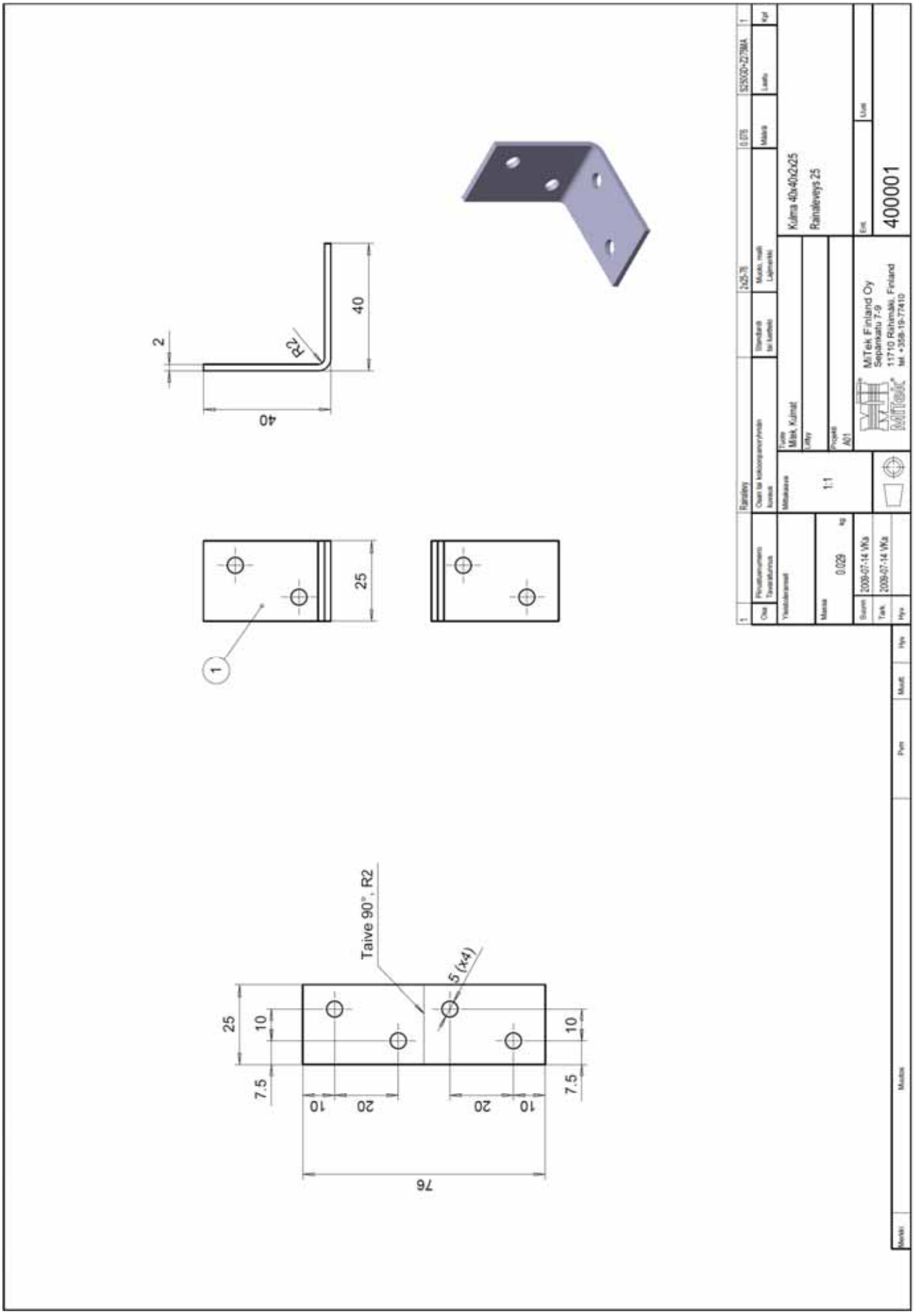
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Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
Taive 90°, R2
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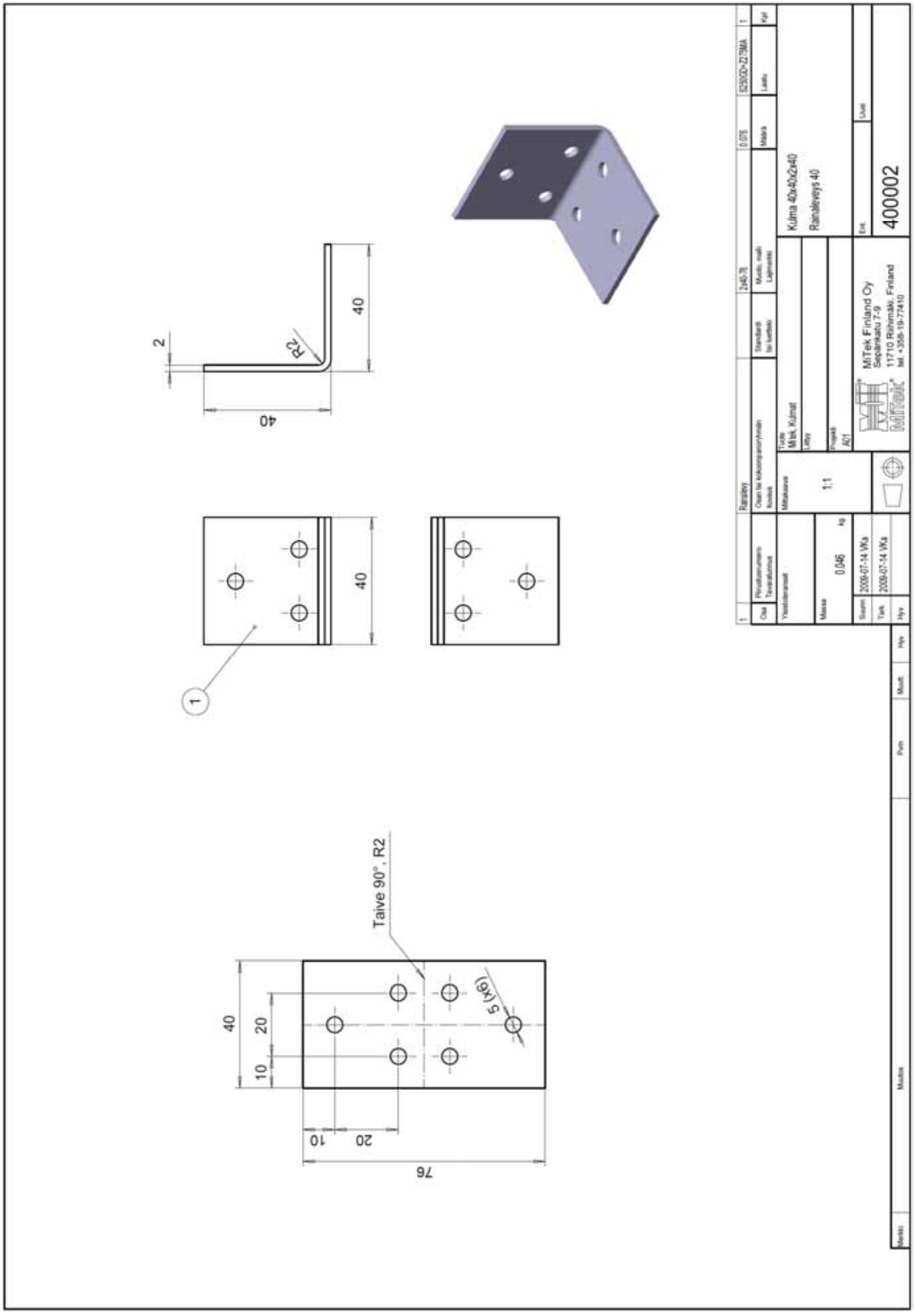
10
7.5
10
20
10
20
10
7.5
76
40
2
R2
40
25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40
20
10
76
10
20
40
R2
2
40
1
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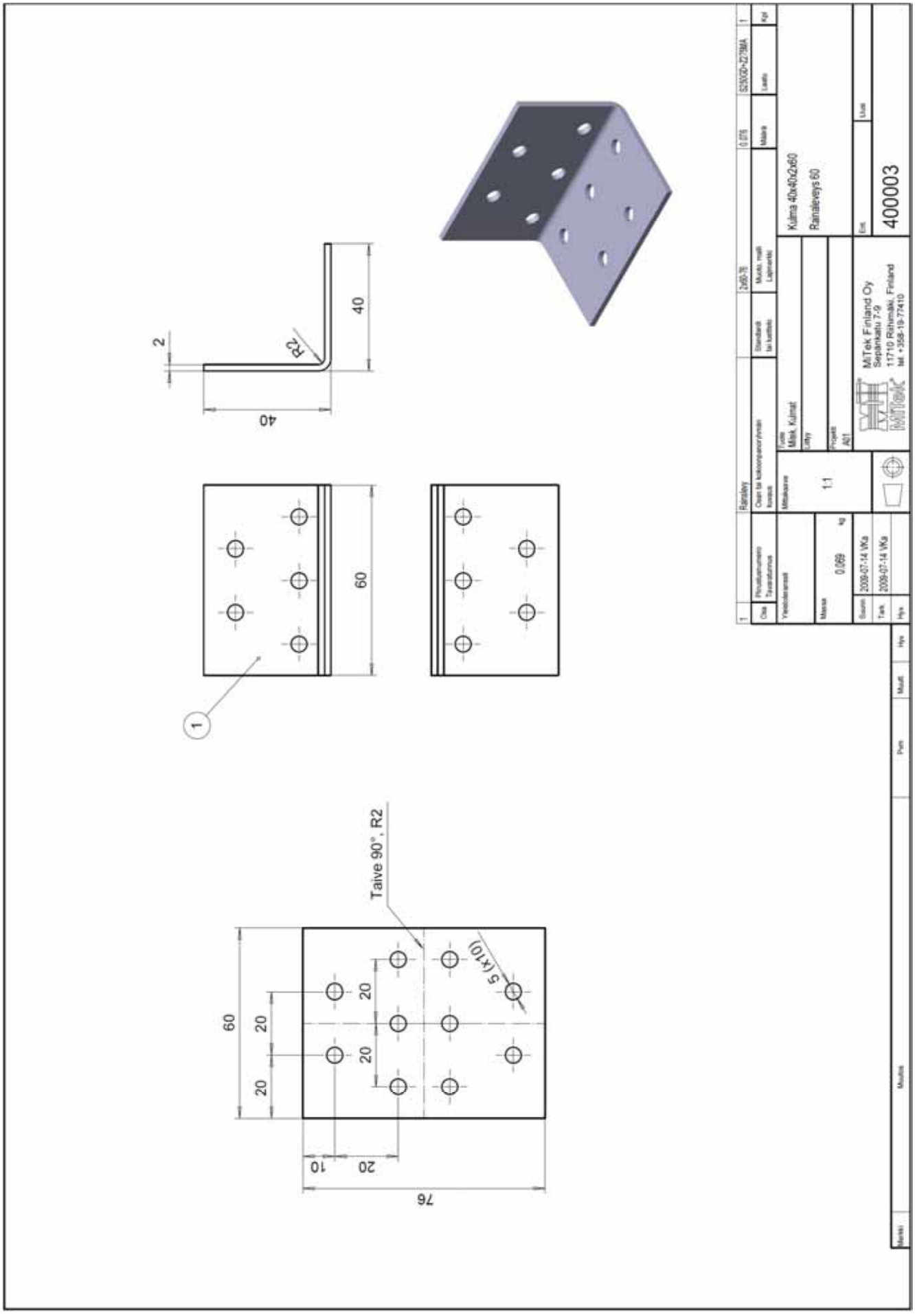
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60
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10
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40
2
R2
40
60
1
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Rainaleveys 60
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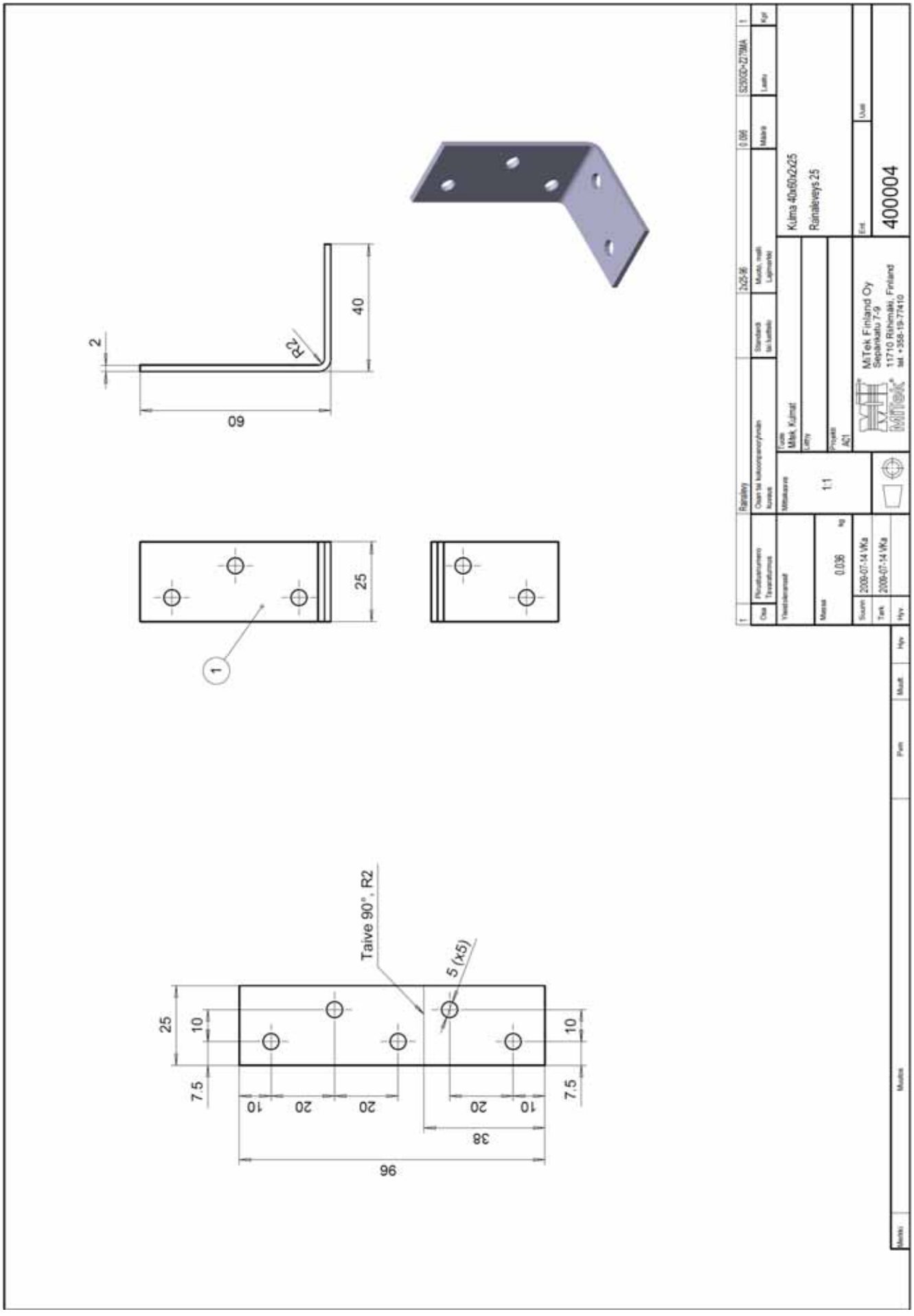
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2009-07-14 Wkä
2009-07-14 Wkä
2
40
60
25
1
Taive 90°, R2
5 (x5)
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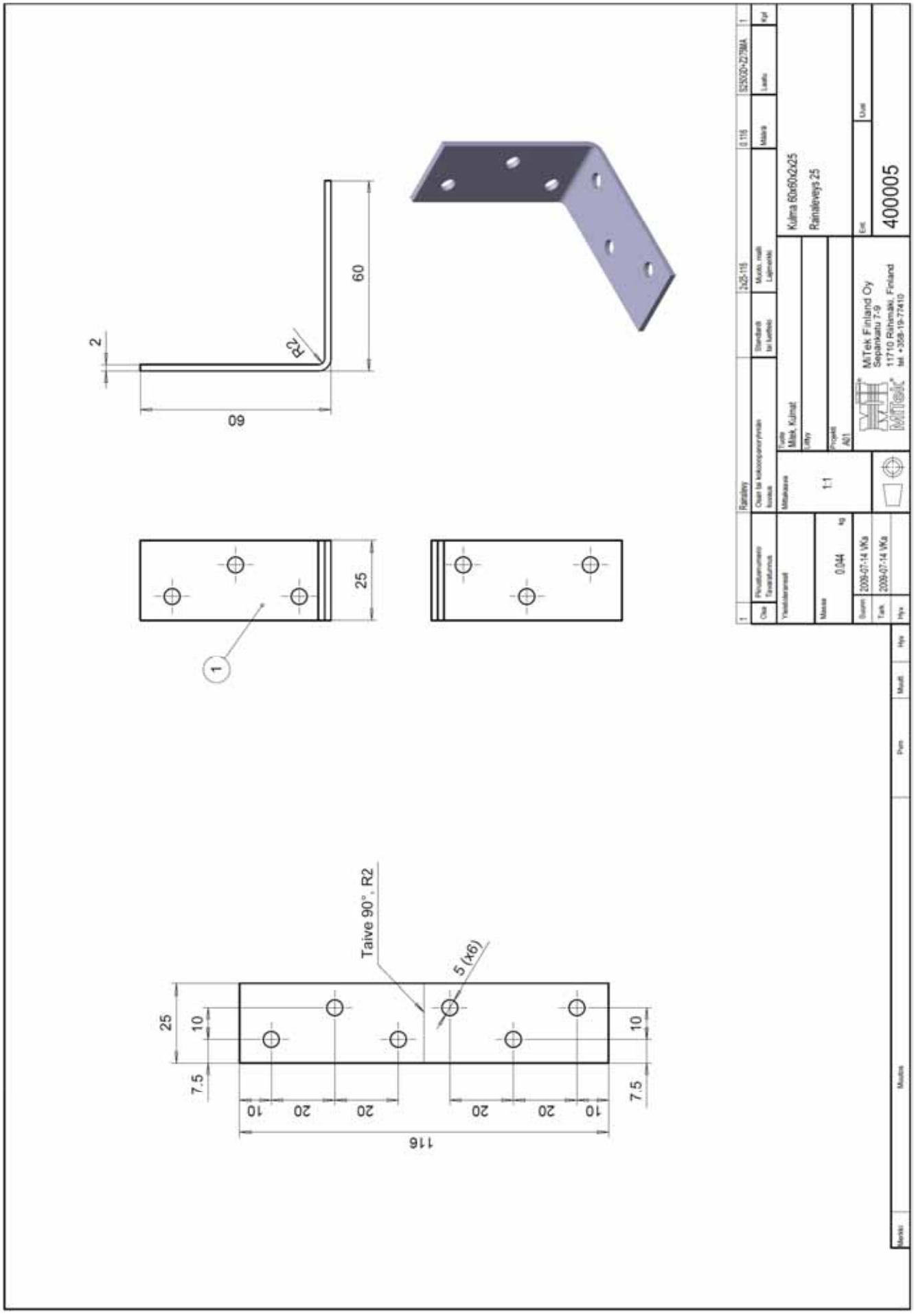
10
7.5
10
20
20
10
38
96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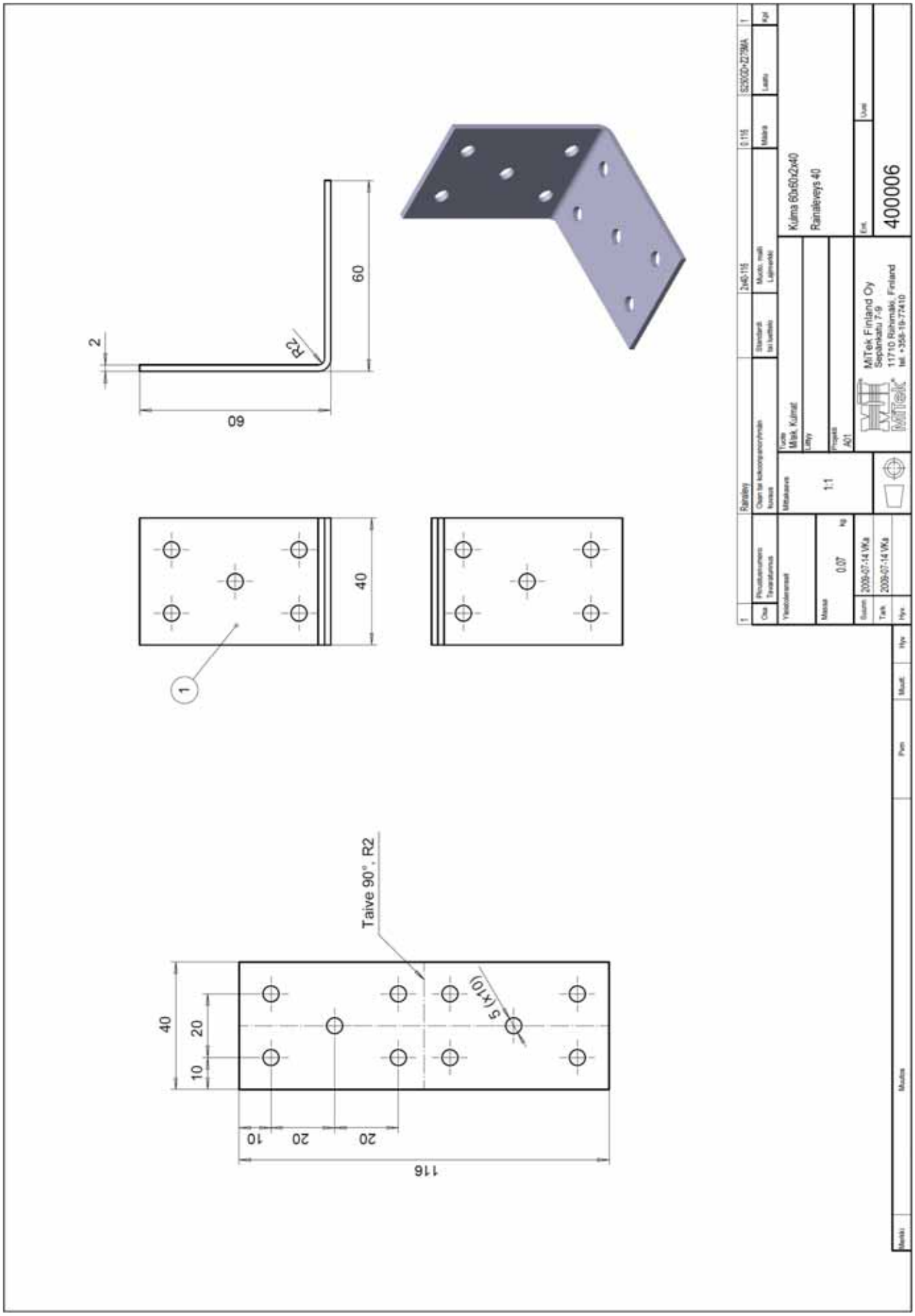
5 (x6)
116


Taive 90°, R2
5 (x10)
116
20
20
10
40
20
10
60
60
2
R2
40
1
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M/Tek Finland Oy
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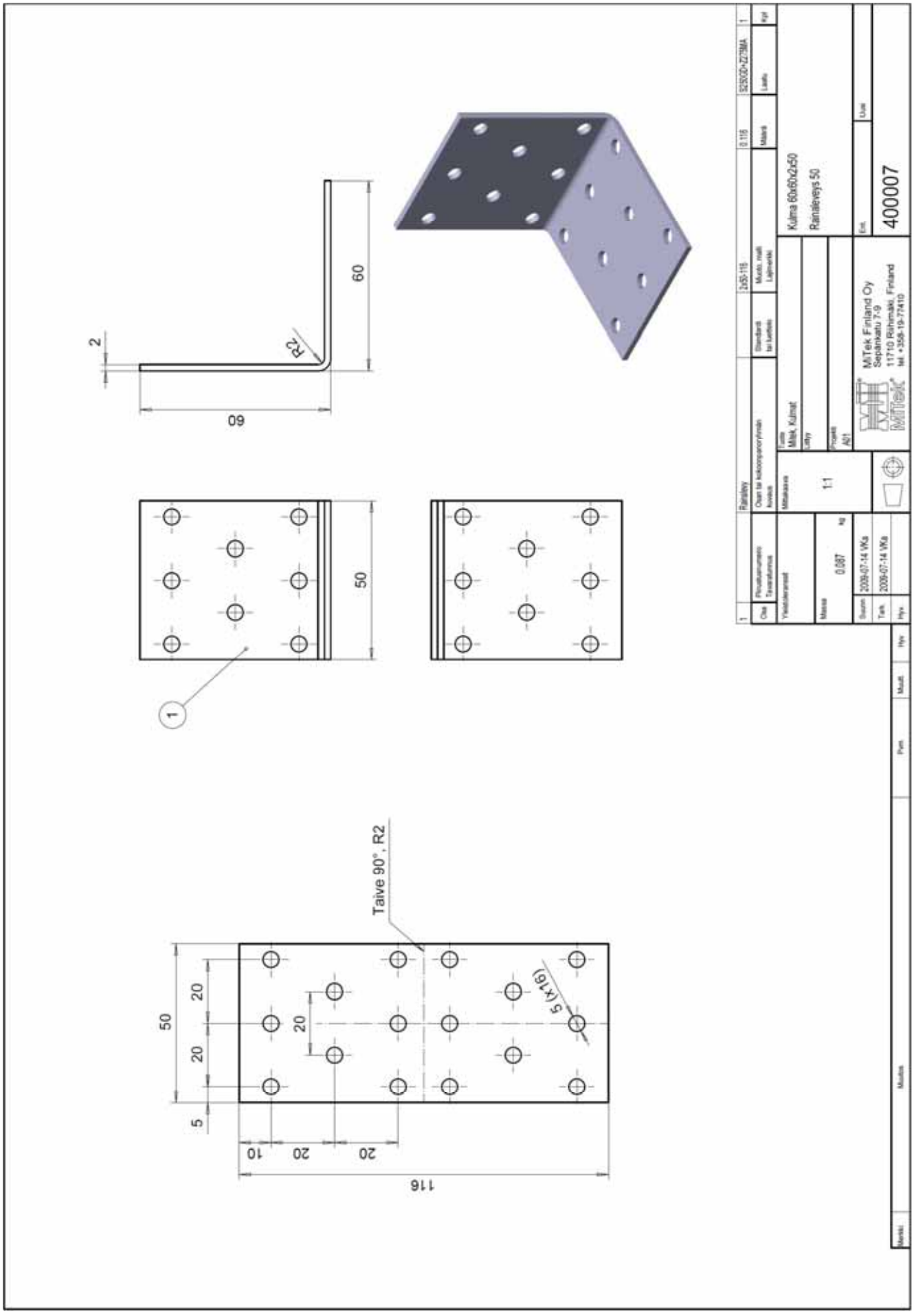
2009-07-14 Wkä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Rainaleveys 50
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11710 Riihimäki, Finland
tel. +358-19-77410
1:1
2009-07-14 VKa
2009-07-14 VKa
0,687
Taive 90°, R2
60
60
2
R2
50
1
50
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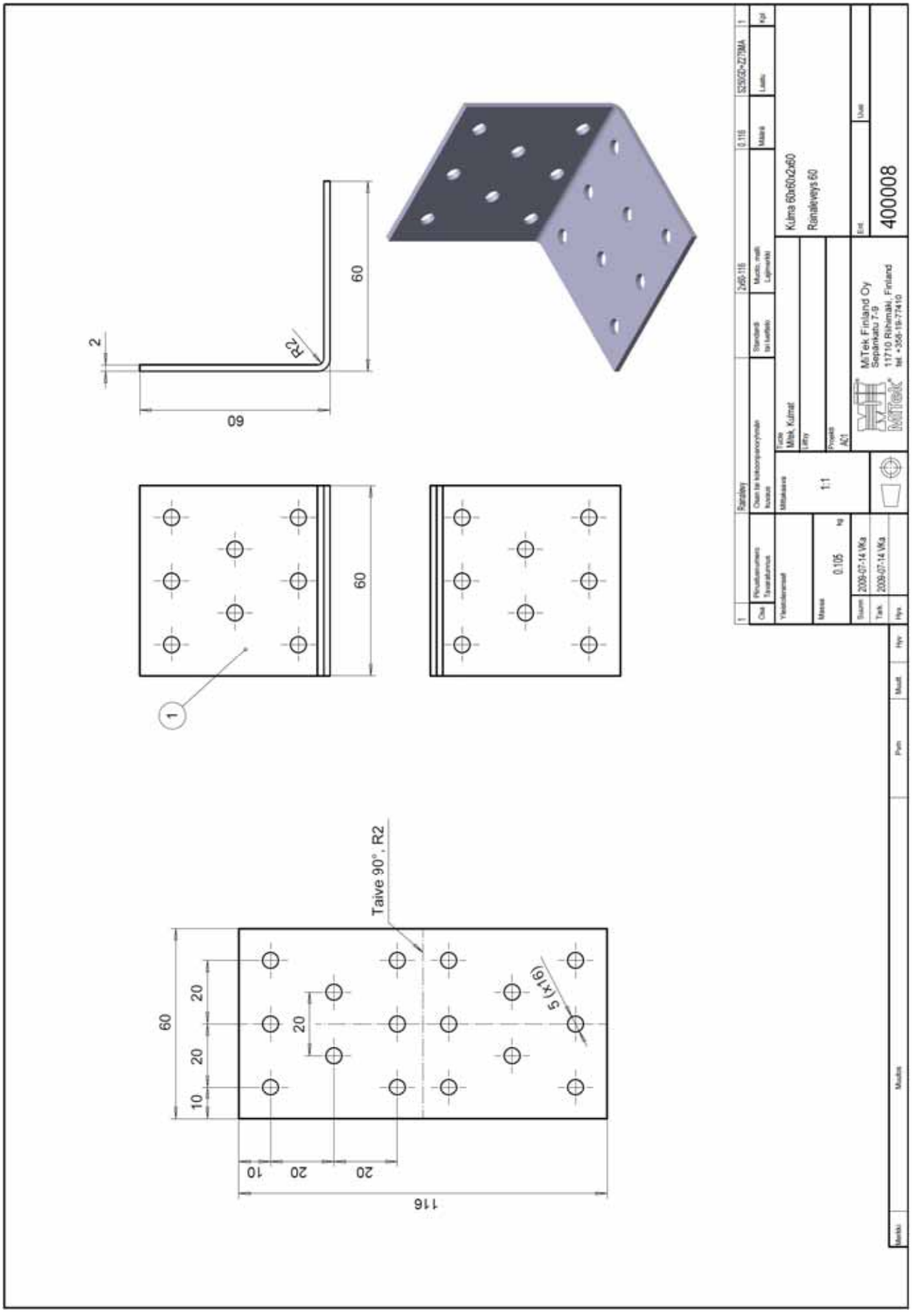
20
20
5
5 (x19)
10
20
20
116


Taive 90°, R2
5 (1x16)
60
20
20
10
20
20
10
116
2
R2
60
60
60
1
Kulma 60x60x2x60
Ranakeveys 60
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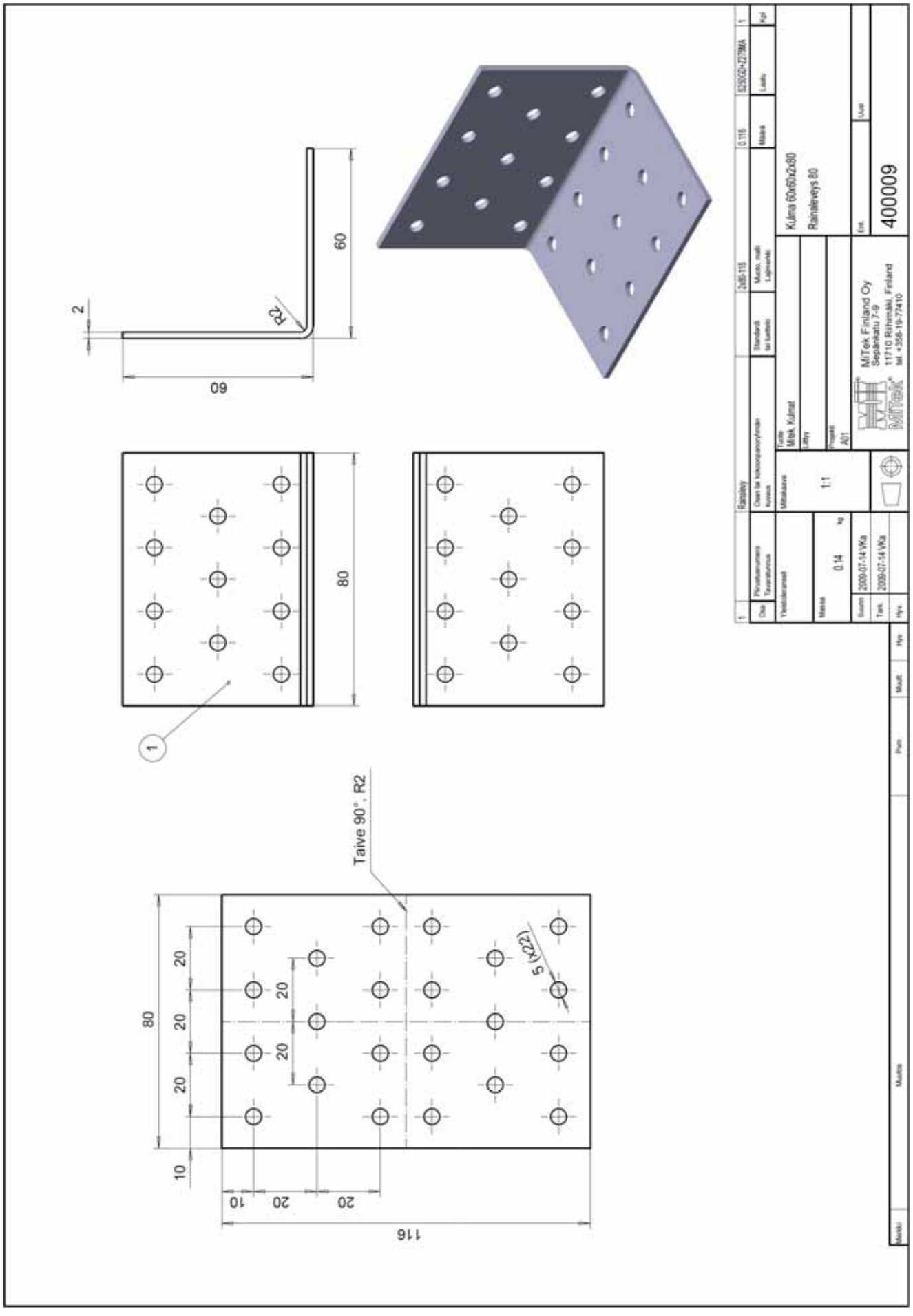
M/Tek Finland Oy
Sepänkatu 7-9
11710 Rihimäki, Finland
tel +358-19-77410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Kulma 60x60x2x80
Rainaleveys 80
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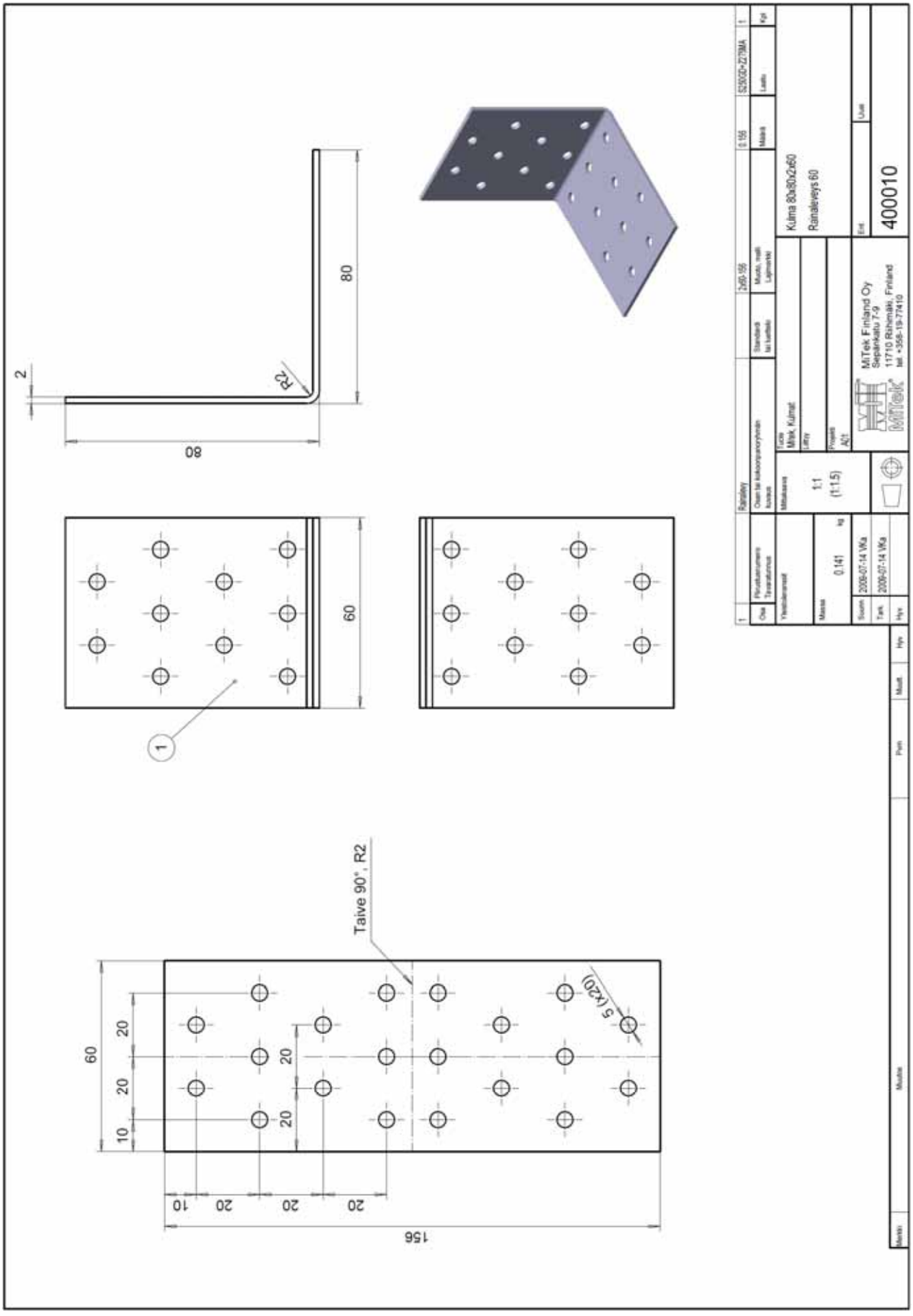
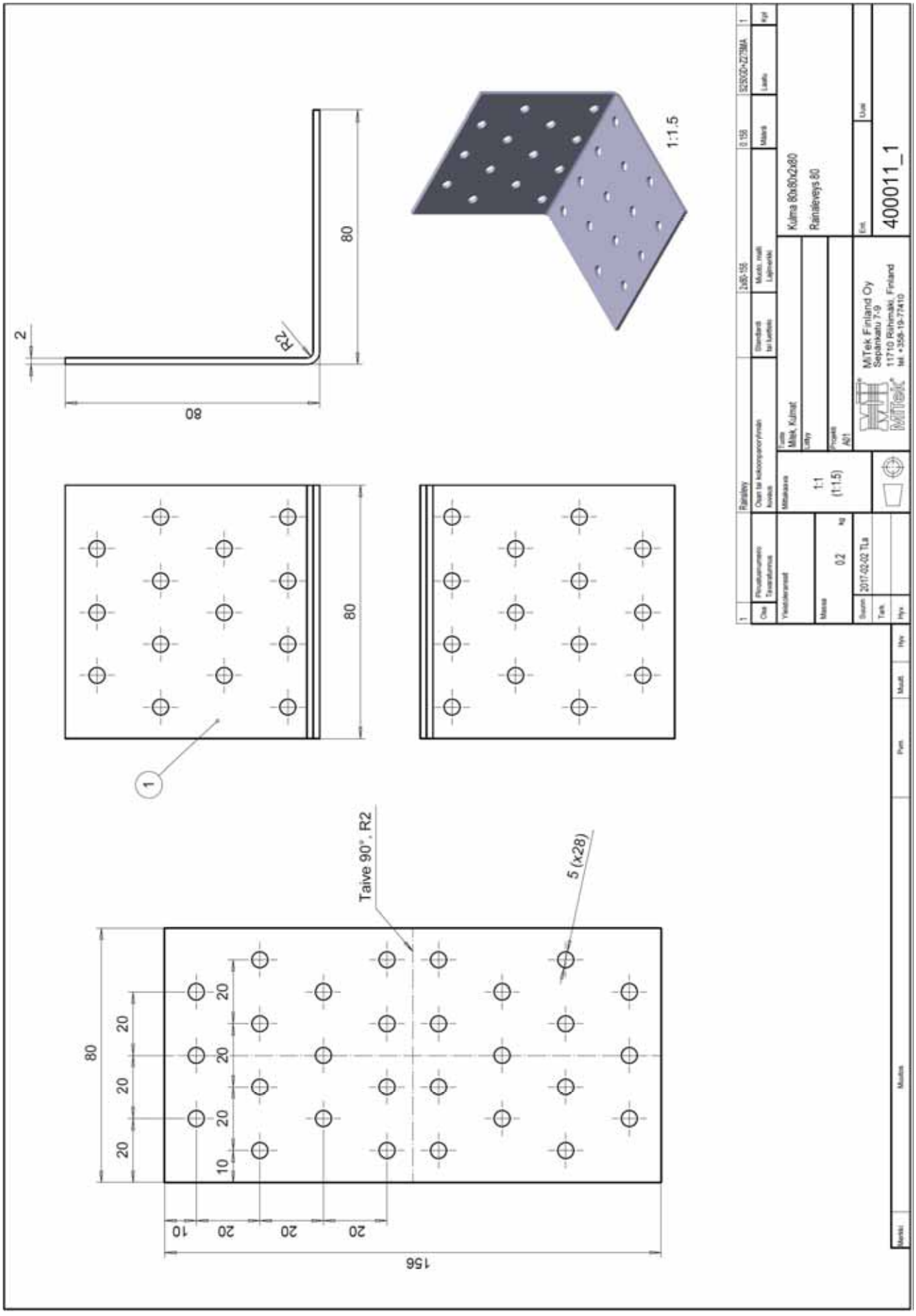
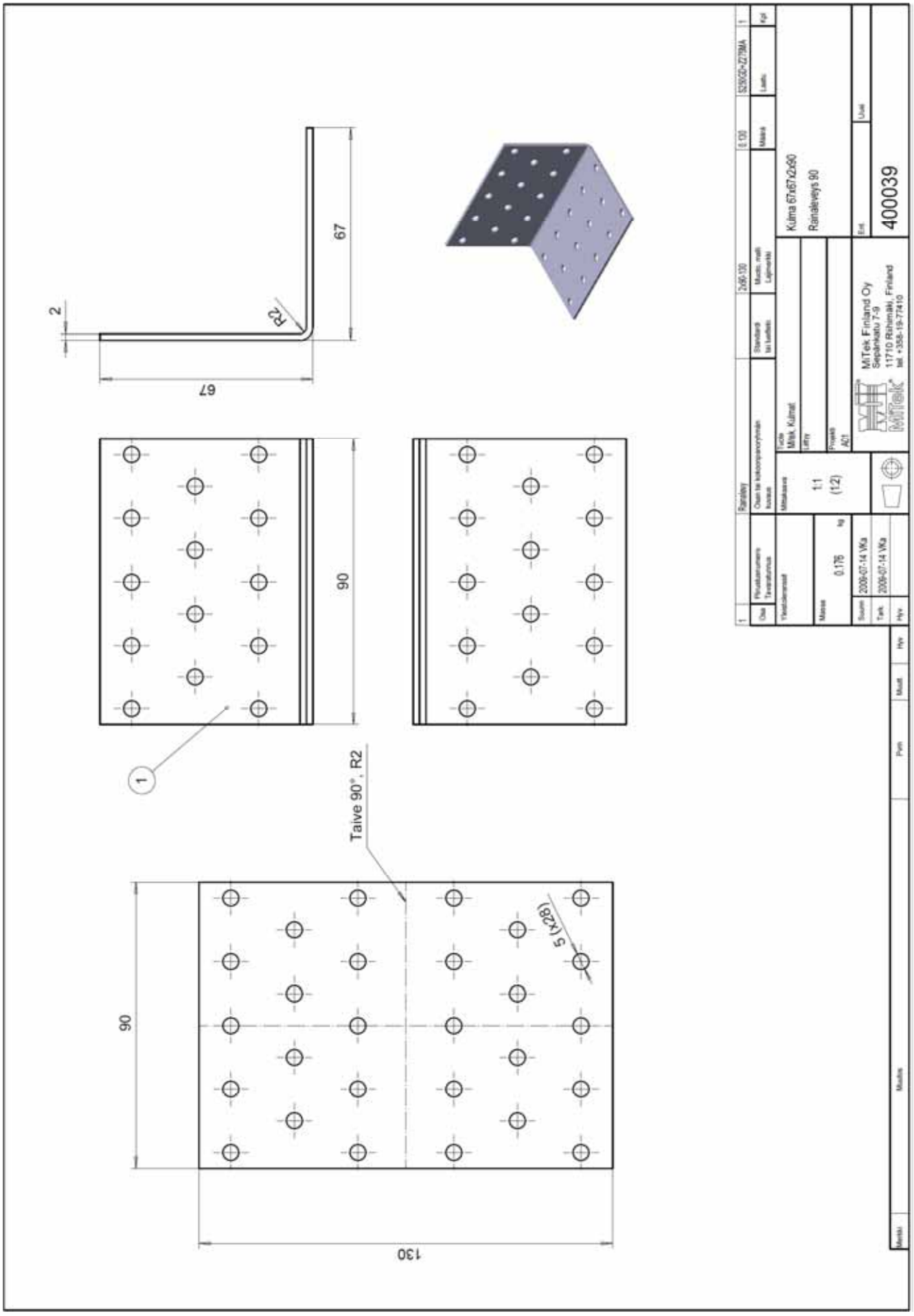
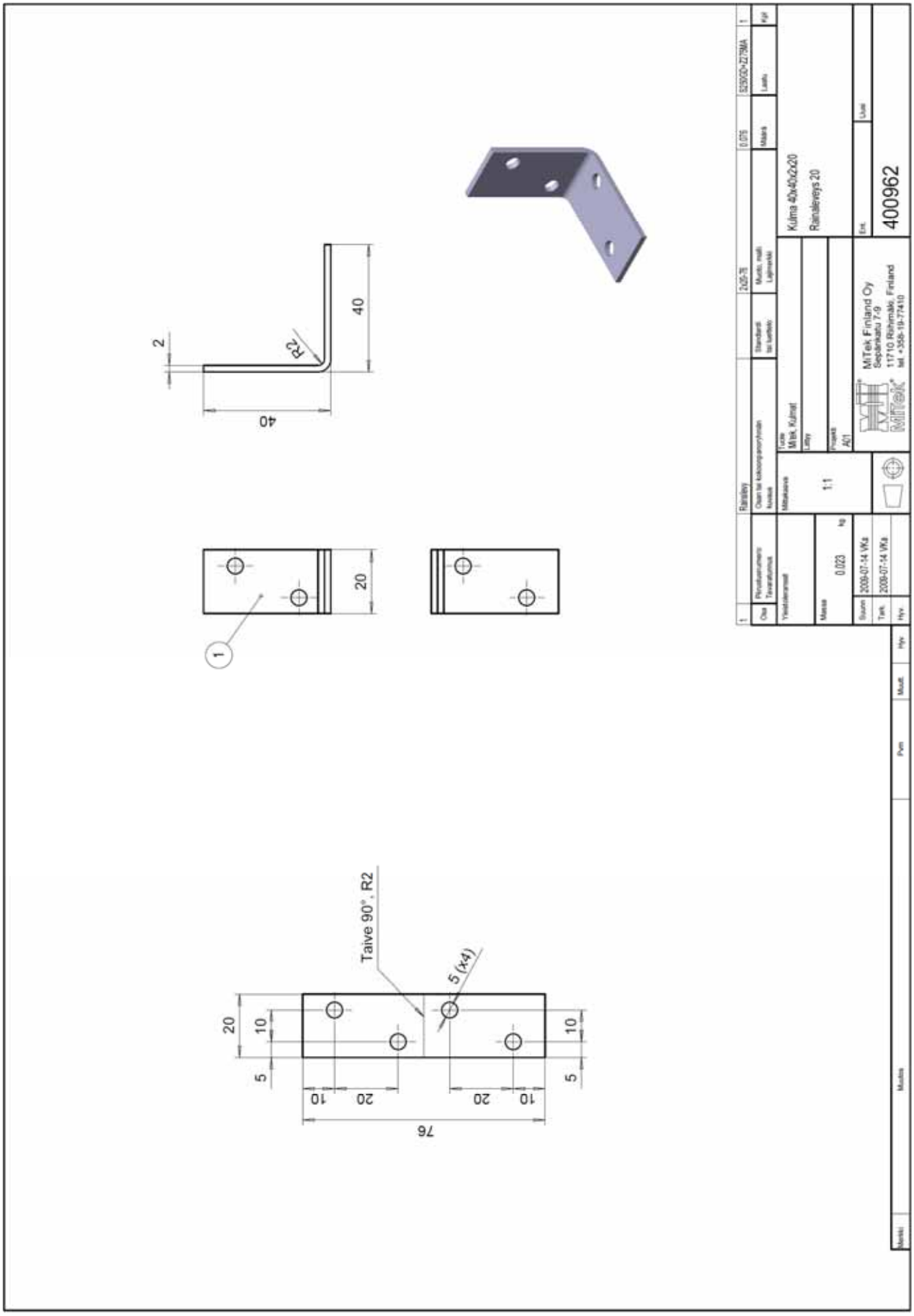
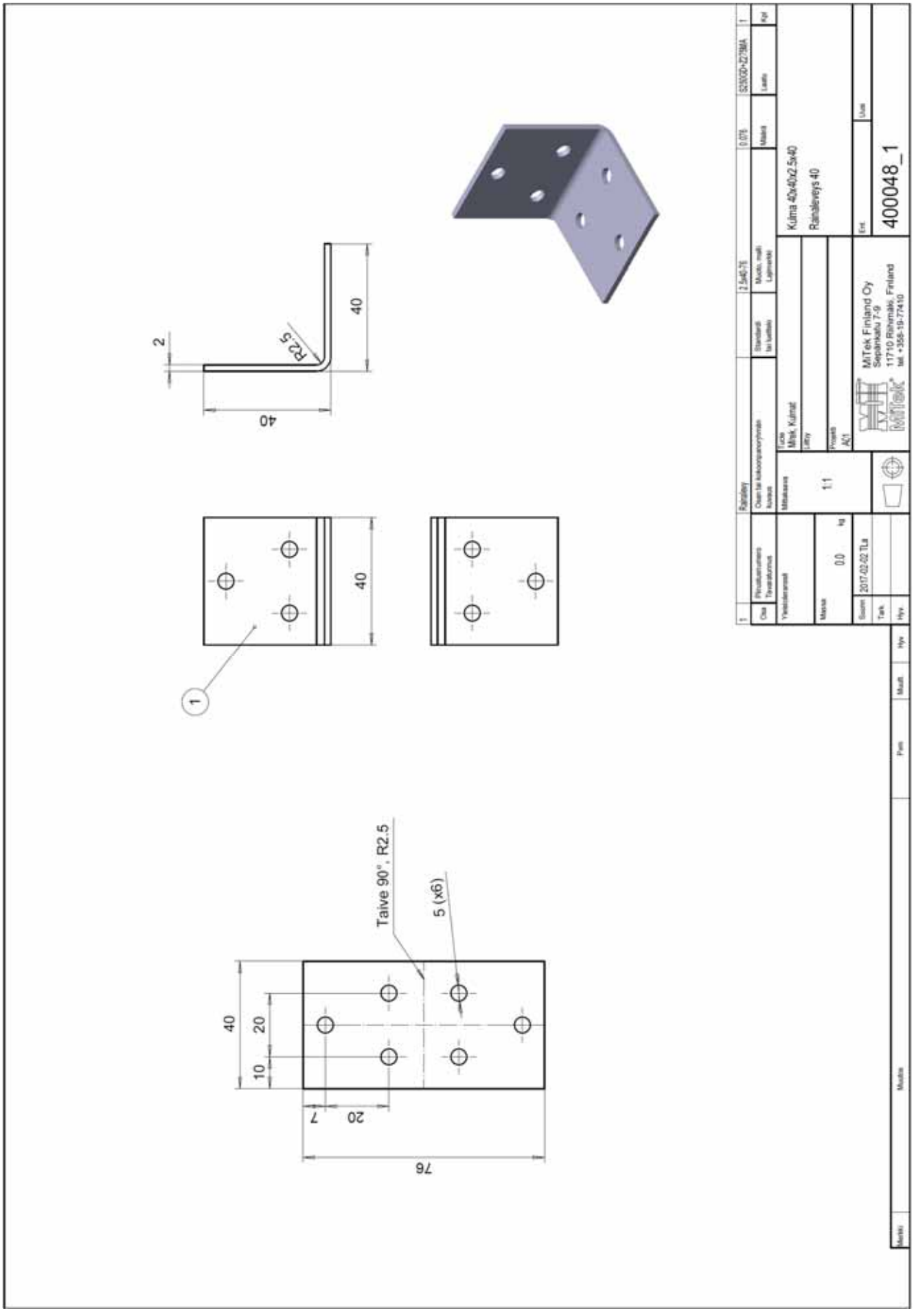
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
Mitek Kulmat
1:1
0,14
2009-07-14 VKa
2009-07-14 VKa

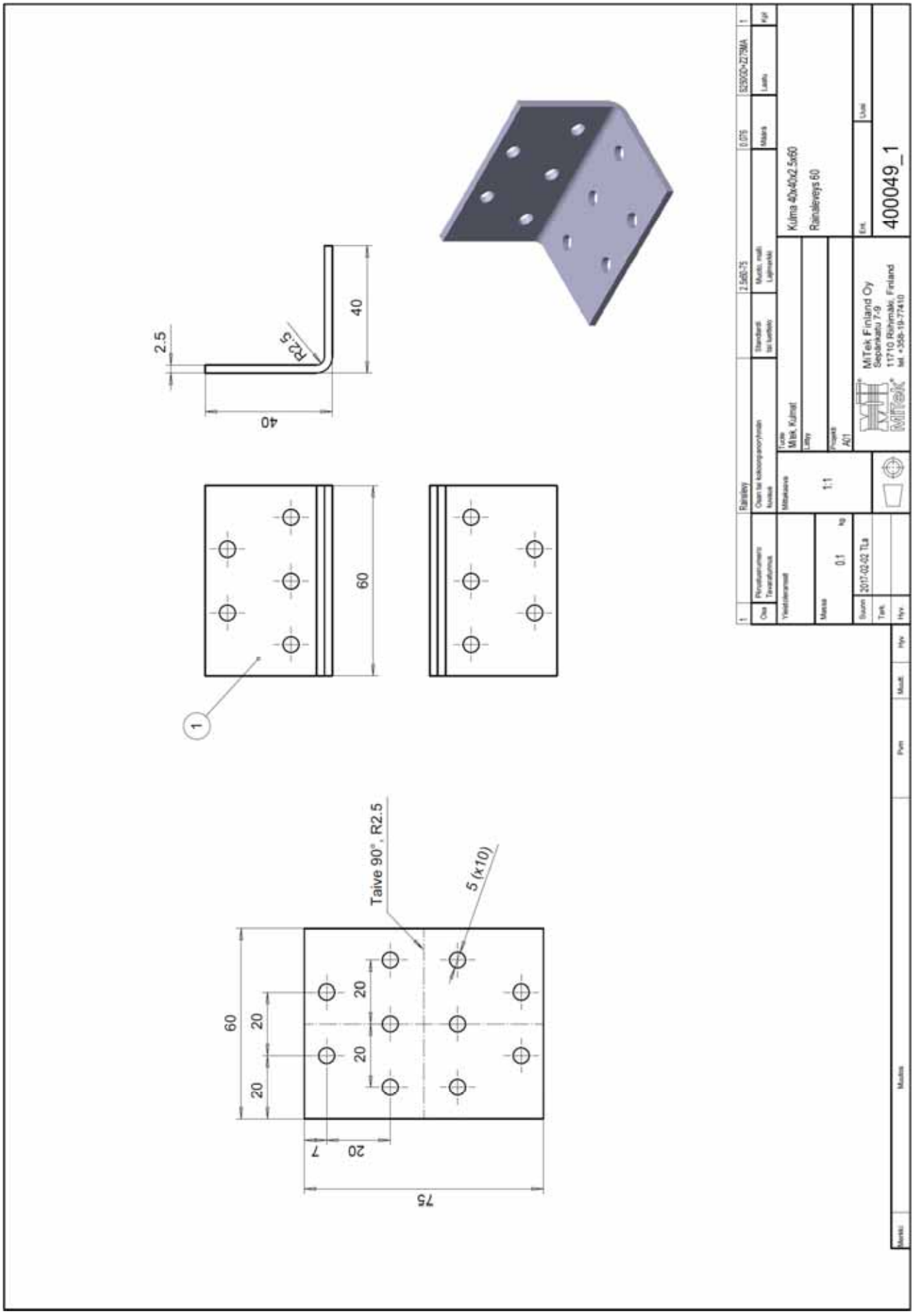

Kulma 80x80x2x60
Rainaleveys 60
400010
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:1
(1:1.5)
0.141
2009-07-14 Wka
2009-07-14 Wka
2
80
80
60
1
Taive 90°, R2
5 (x20)
60
20
20
10
20
20
20
10
20
20
156

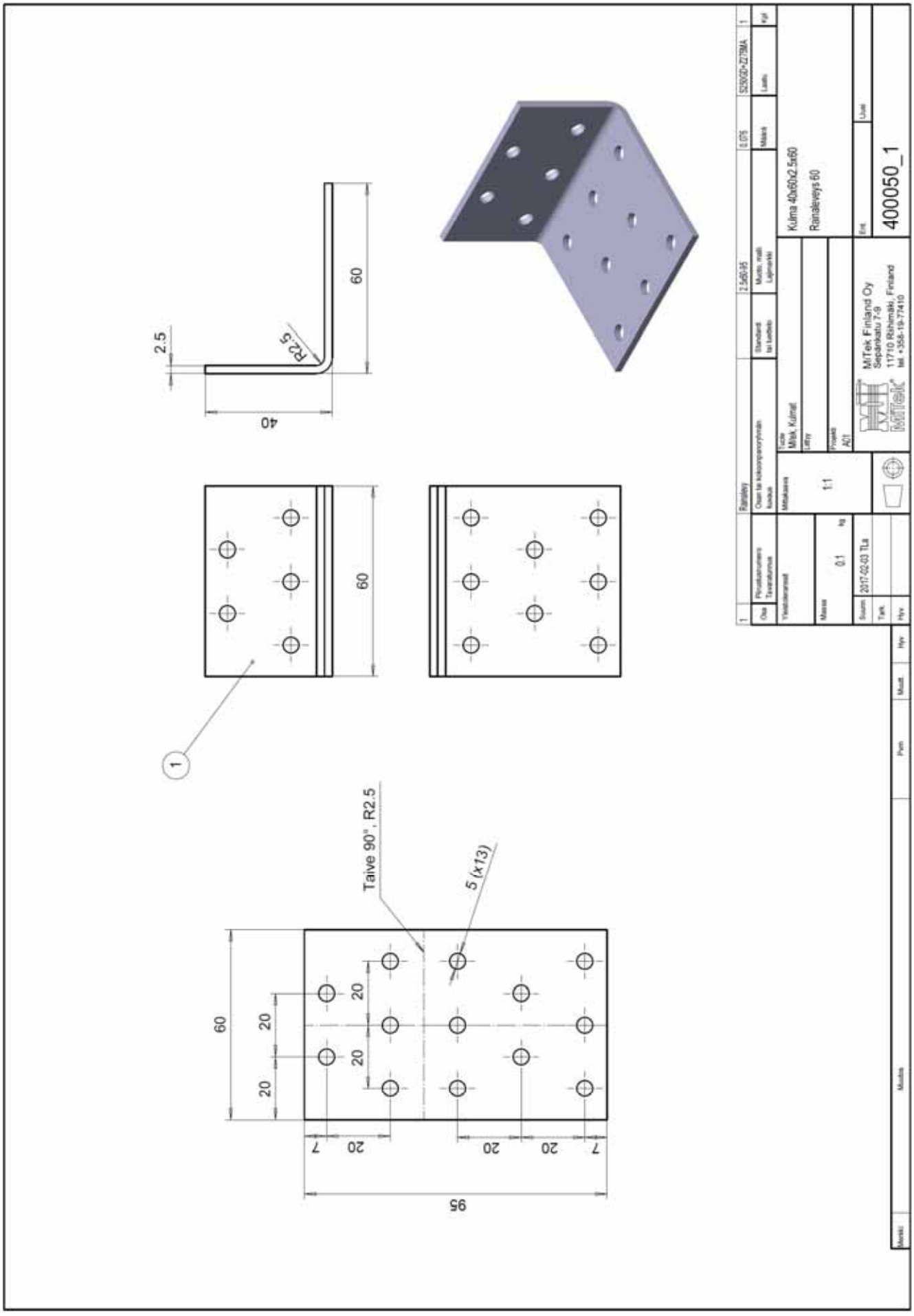

1:1.5
80
2
R2
80
80
1
Taive 90°, R2
5 (x28)
80
20
20
20
20
10
20
20
20
10
156
Kulma 80x80x2x80
Rainaleveys 80
400011_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:1
(1:1.5)
0,2 kg
2017-02-02 TLa

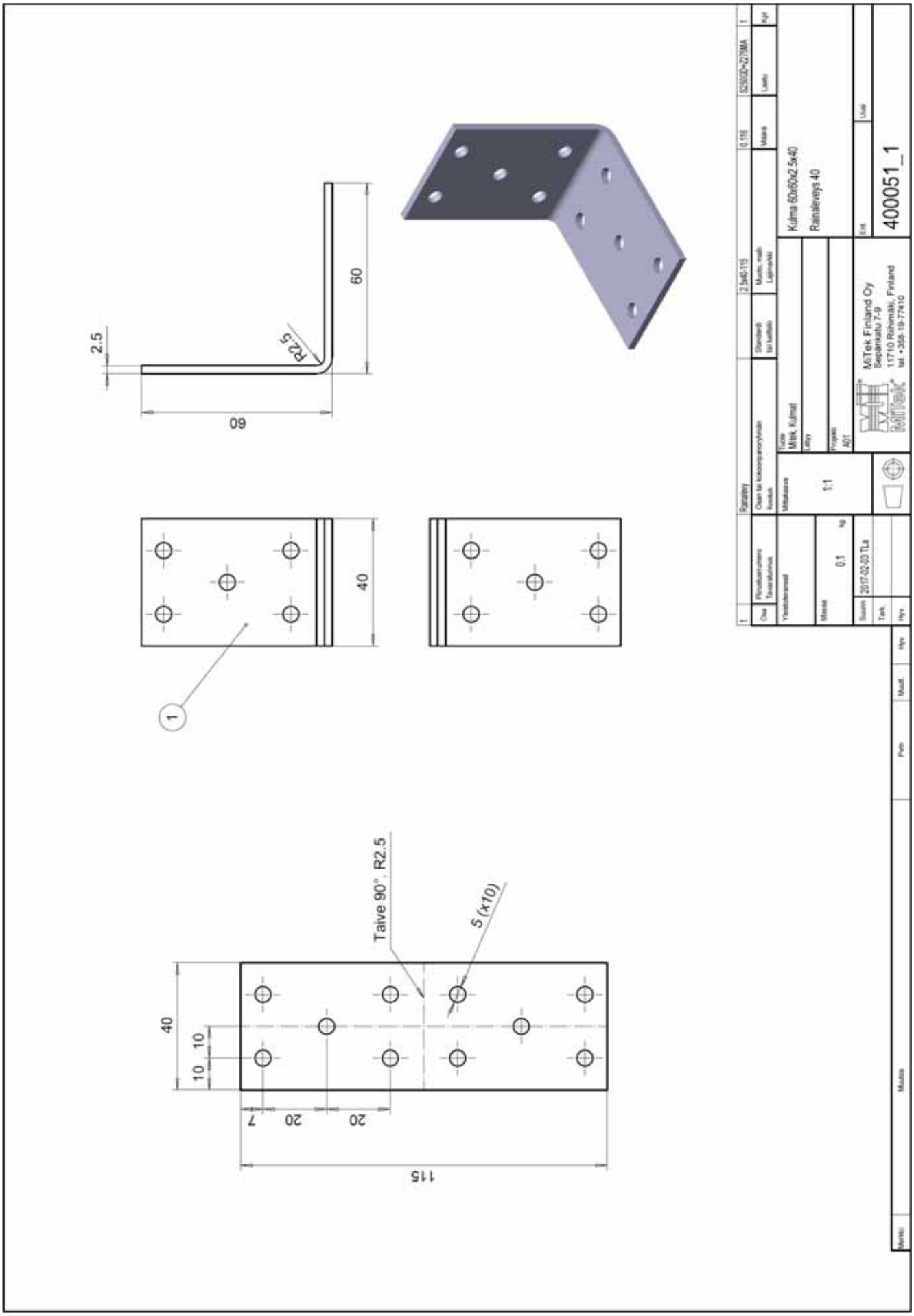

2
R2
67
67
90
1
Taive 90°, R2
90
5 (x28)
130
Kulma 67x67x2x90
Rainaleveys 90
400039
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:1
(1:2)
0,176
2009-07-14 Wlk
2009-07-14 Wlk

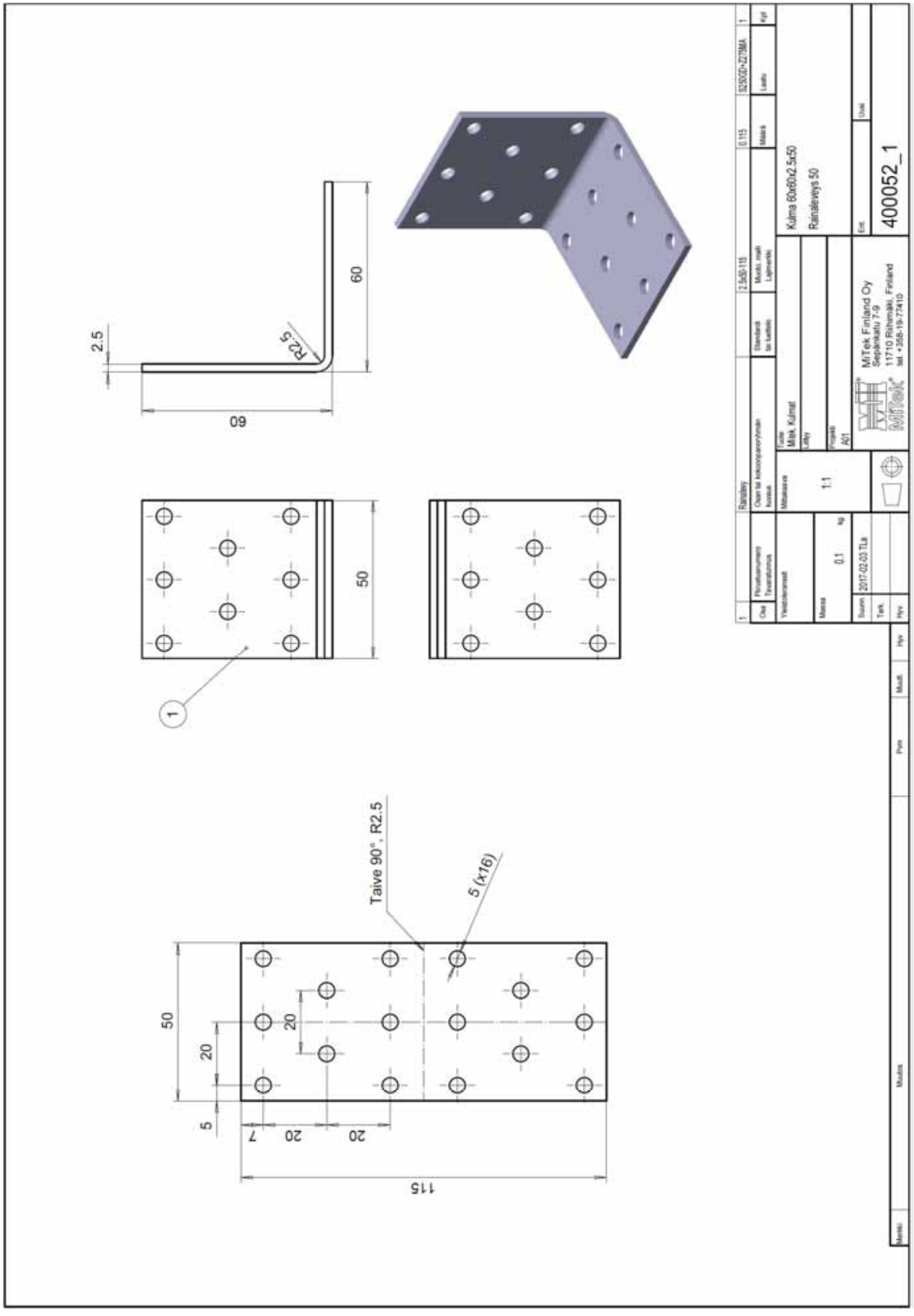

Kulma 40x40x2x20
Rainaleveys 20
400962
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
Taive 90°, R2
5 (x4)
40
20
2
R2
76

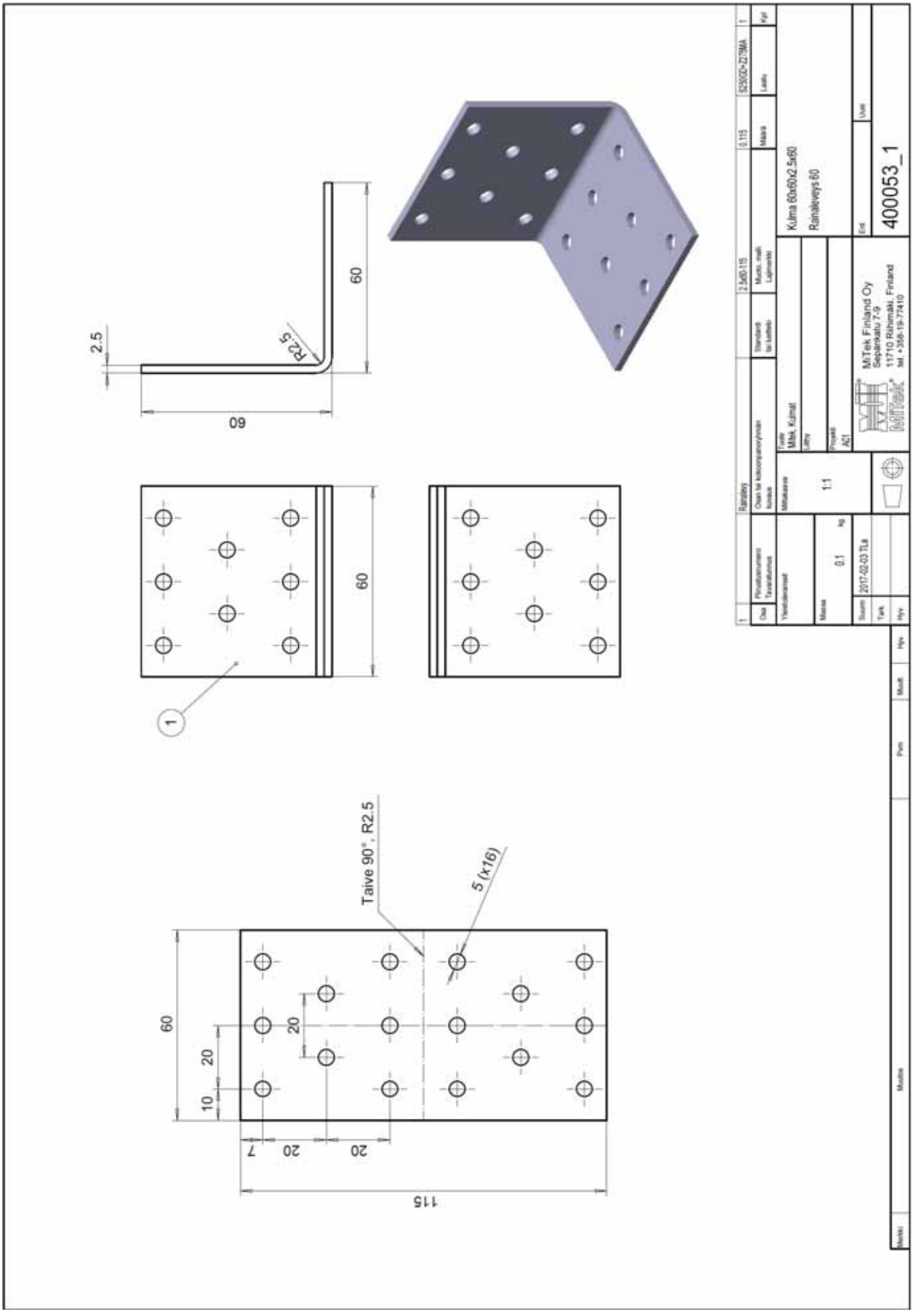

Taive 90°, R2.5
5 (x6)
40
20
10
7
20
76
2
R2.5
40
40
1
Kulma 40x40x2.5x40
Rainaleveys 40
400048_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
1:1
2017-02-02 TLa

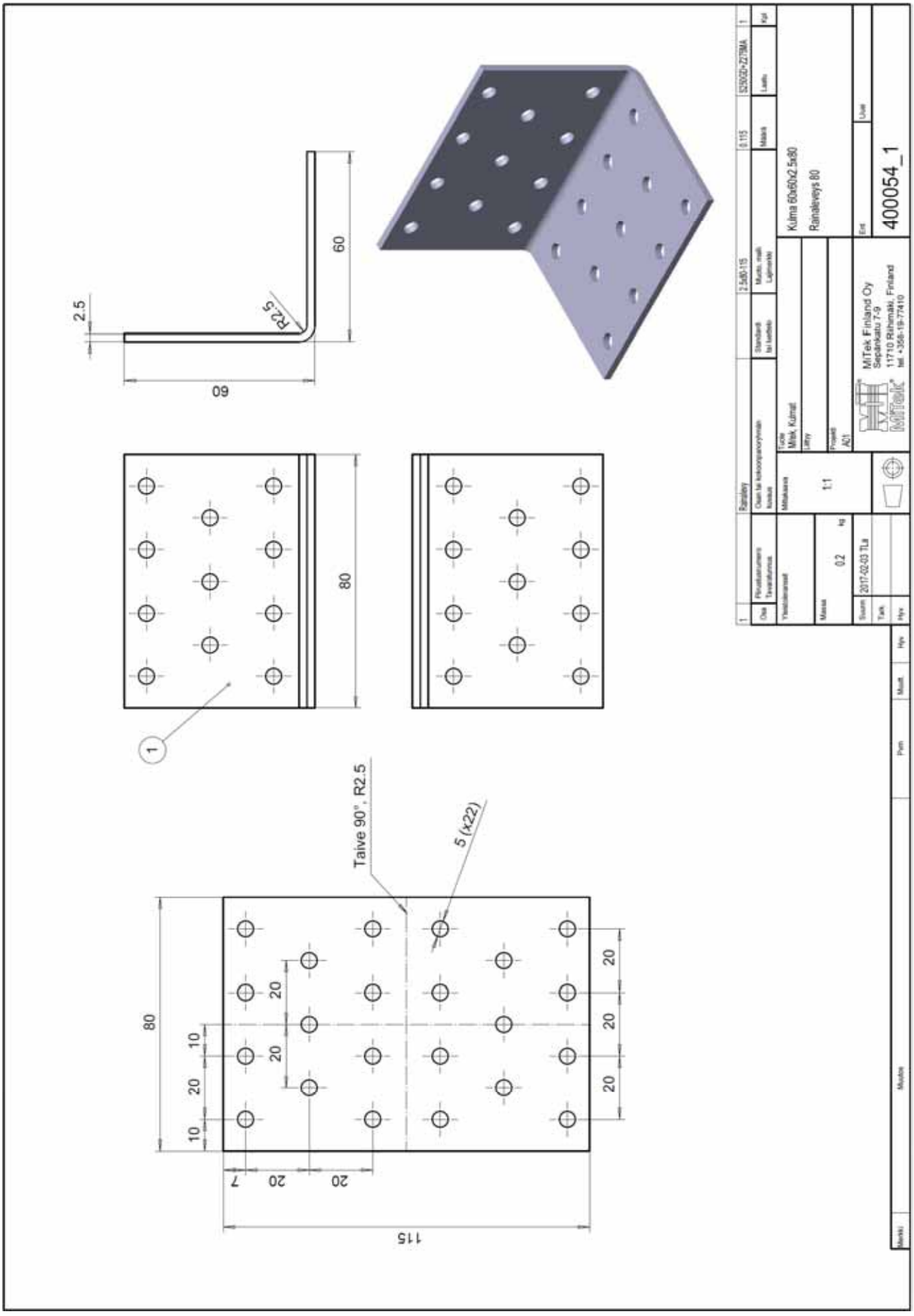

2.5
R2.5
40
40
60
1
Taive 90°, R2.5
5 (x10)
60
20
20
20
20
20
7
75
Kulma 40x40x2.5x60
Rainaleveys 60
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
400049_1

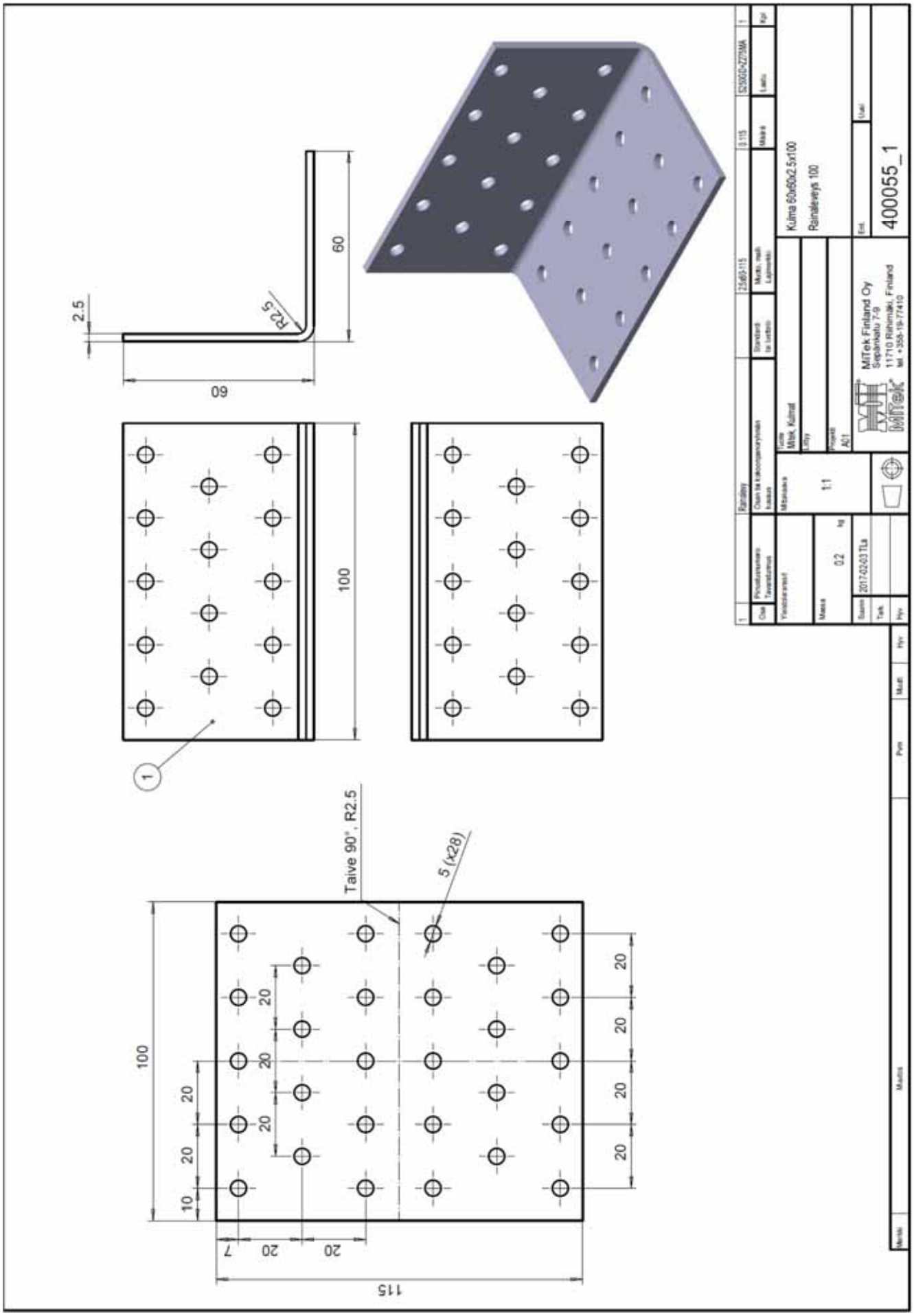

2.5
R2.5
60
40
60
1
Taive 90°, R2.5
5 (x13)
60
20
20
20
20
20
7
20
20
7
95
Kulma 40x60x2.5x60
Rainaleveys 60
M/Tek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
400050_1

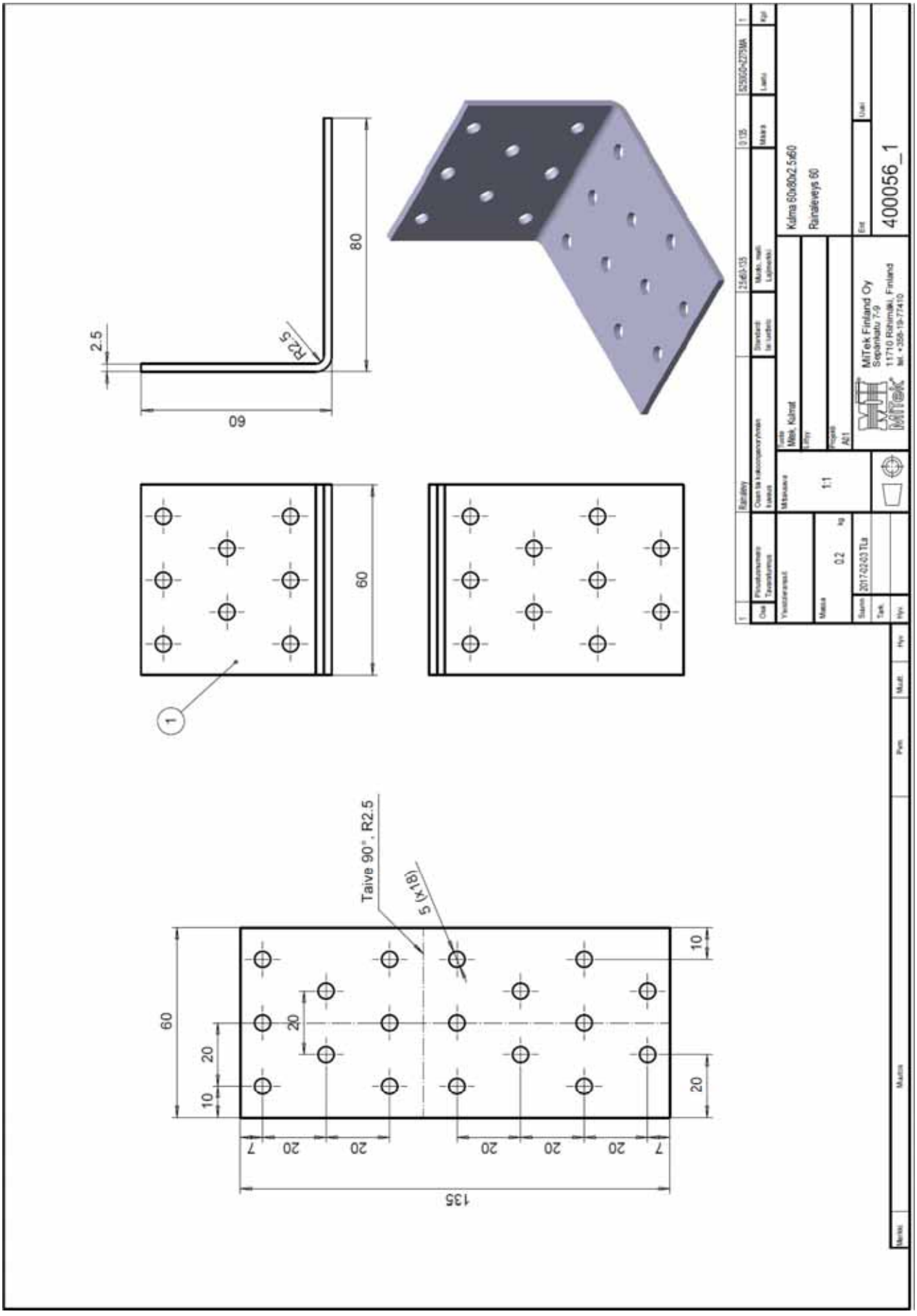

2.5
R2.5
60
60
40
1
Taive 90°, R2.5
5 (x10)
40
10
10
7
20
20
115
Kulma 60x60x2.5x40
Rainaleveys 40
400051_1
M-Tek Finland Oy
Sepänkatu 7-9
11710 Rihimäki, Finland
tel. +358-19-77410
1:1

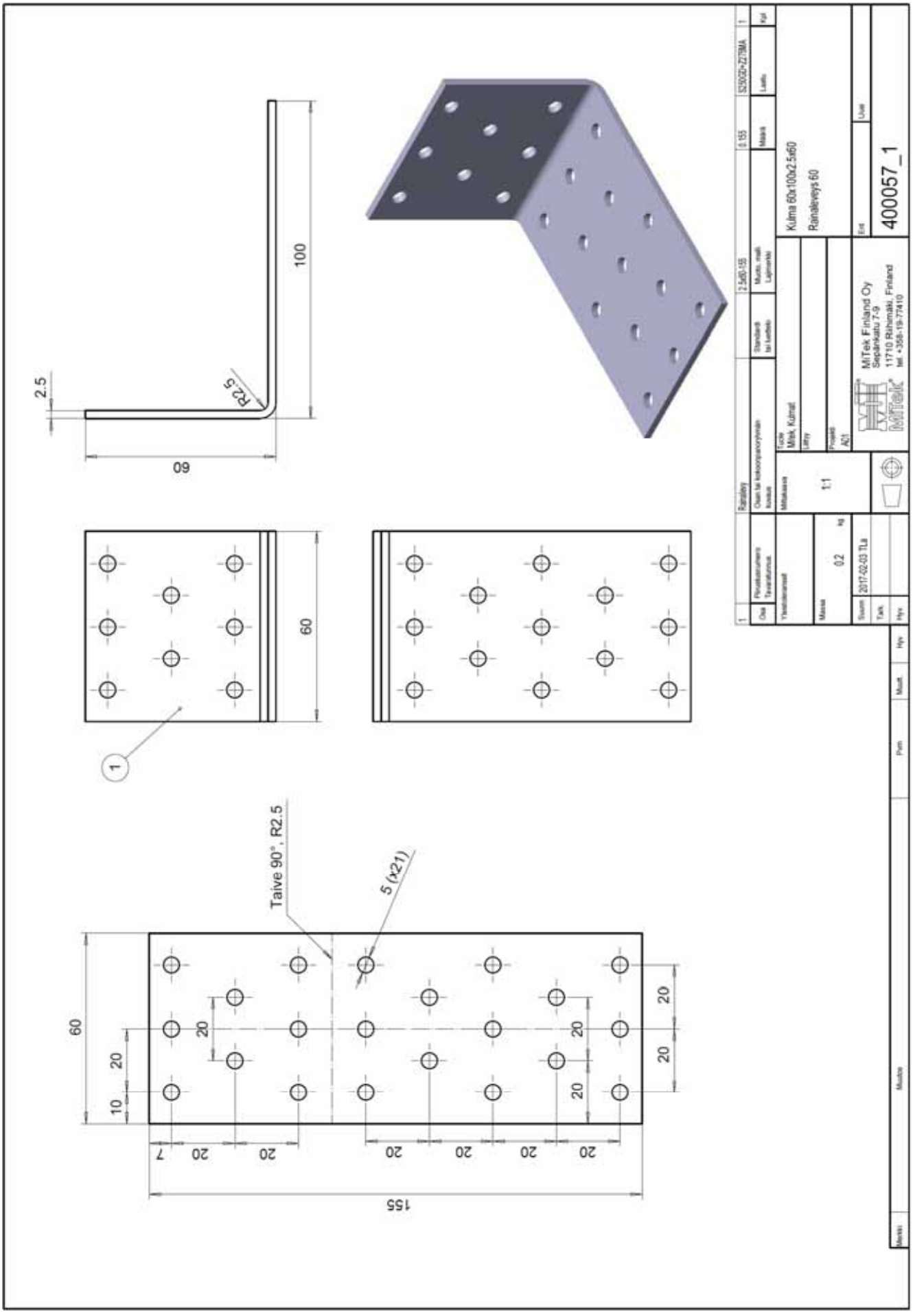

2.5
R2.5
60
60
50
1
Taive 90°, R2.5
5 (x16)
50
20
20
5
7
20
20
115
Kulma 60x60x2,5x50
Rainaleveys 50
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
Tel. +358-19-77410
400052_1
1:1
0,1
2017-02-03 TLa

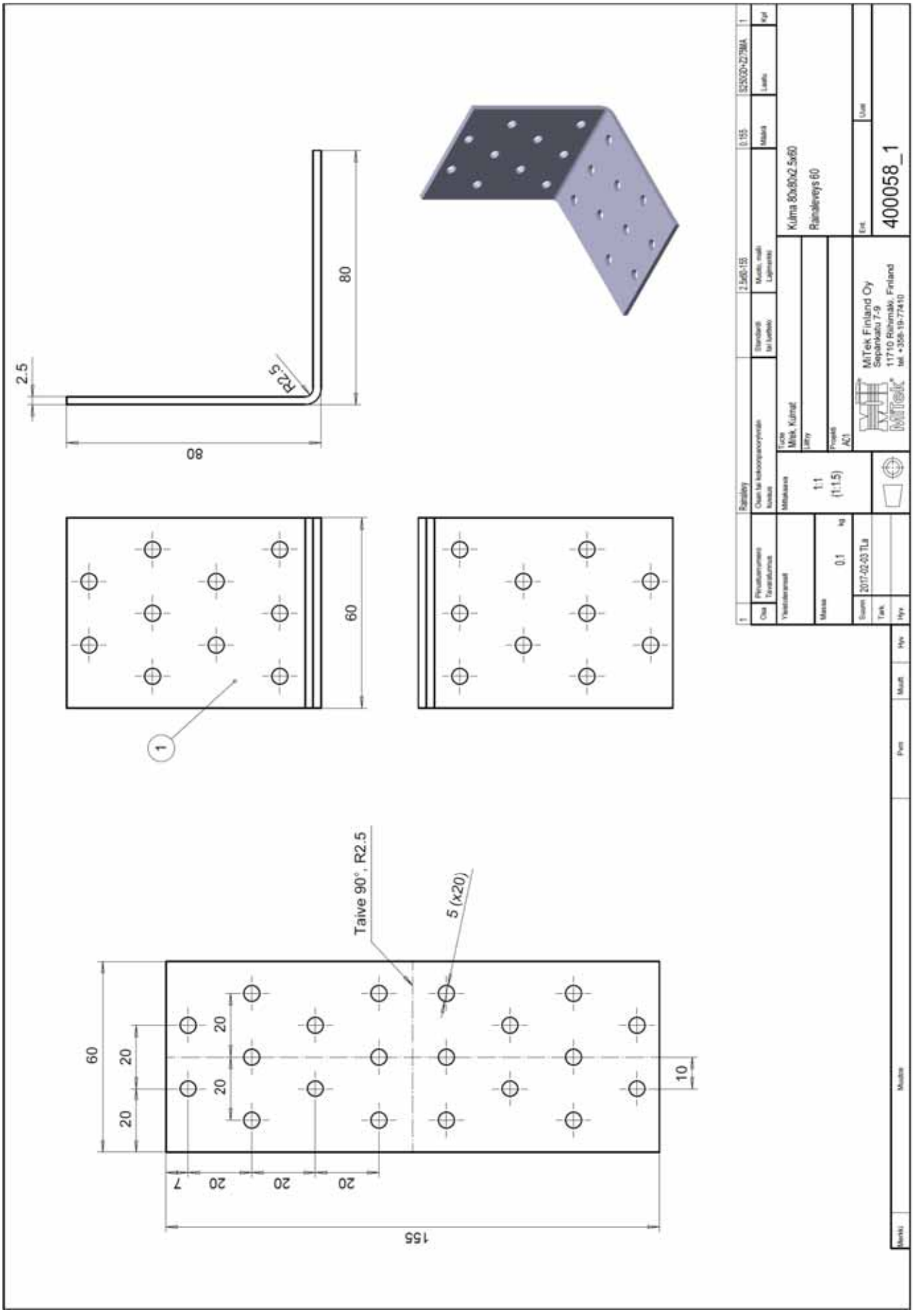

2.5
R2.5
60
60
60
1
Taive 90°, R2.5
5 (x16)
60
20
10
20
7
20
20
115
Kulma 60x60x2.5x60
Rainaleveys 60
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
400053_1

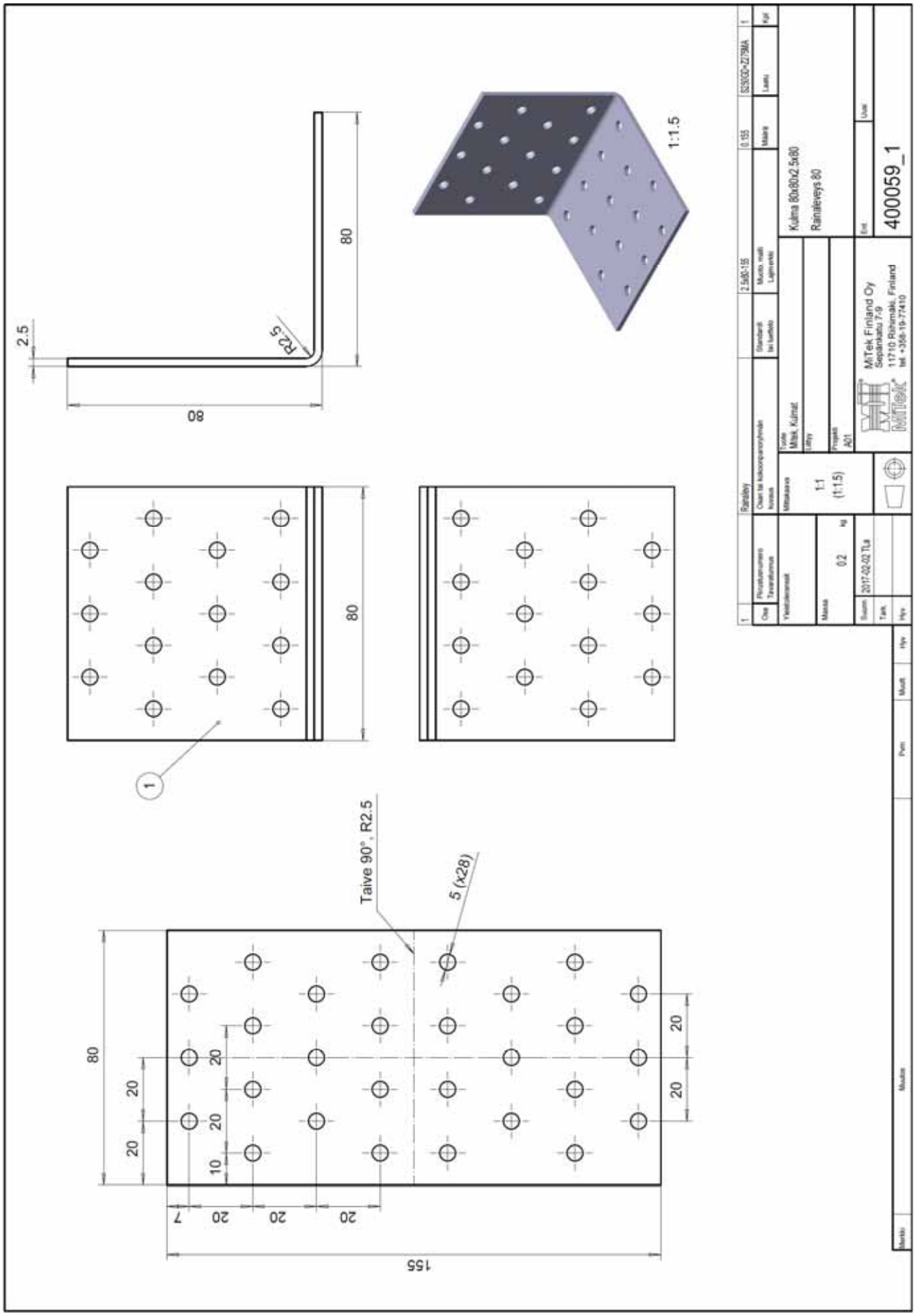

2.5
R2.5
60
60
80
1
Taive 90°, R2.5
5 (x22)
80
10
20
10
20
20
20
20
20
20
20
7
20
20
115
Kulma 60x60x2.5x80
Rainakeveys 80
400054_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:1
0.2
2017-02-03 TLa

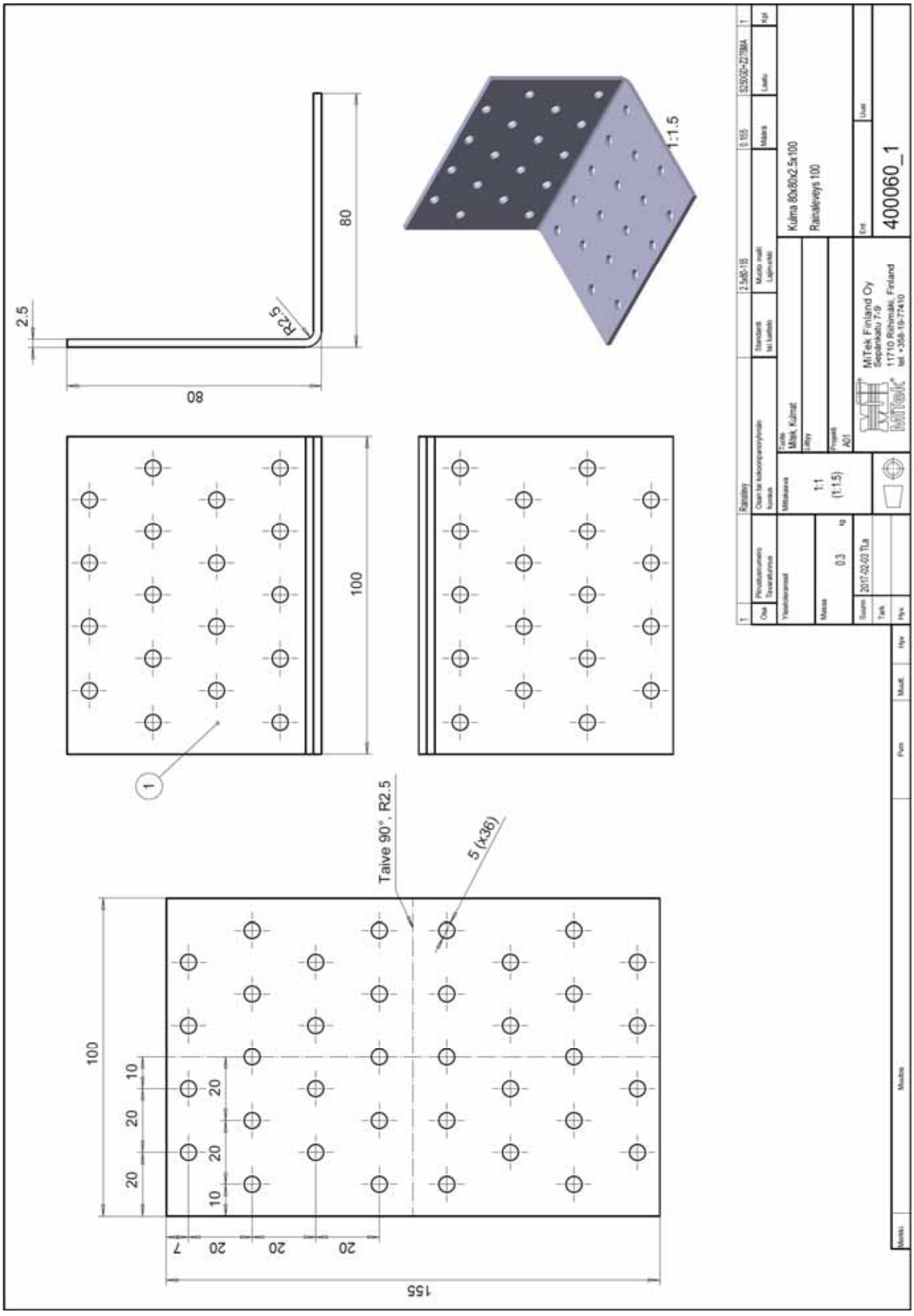

2.5
R2.5
60
09
100
1
Taive 90°, R2.5
5 (x28)
100
20
20
20
20
20
20
20
20
20
20
20
10
7
20
20
115
Kulma 60x60x2.5x100
Rainaleveys 100
400055_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
1:1
02
20170203 TLa

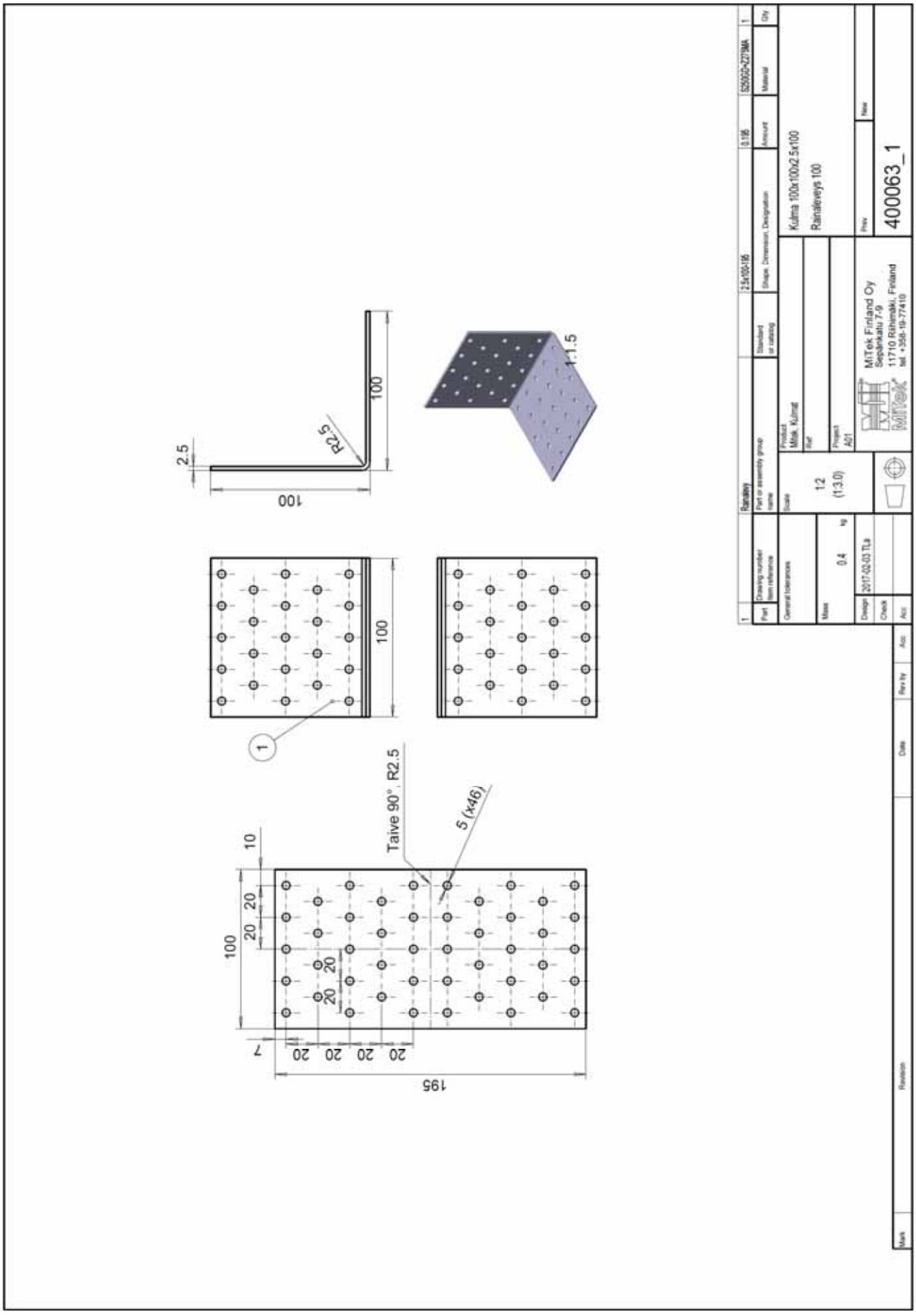

2.5
R2.5
80
60
60
1
Taive 90°, R2.5
5 (x18)
60
20
20
10
10
20
7
20
20
20
20
20
7
135
Kulma 60x80x2.5x60
Rainaleveys 60
MiTek Finland Oy
Sepänkatu 7-9
11710 Rahmäki, Finland
400056_1
1:1
0.2

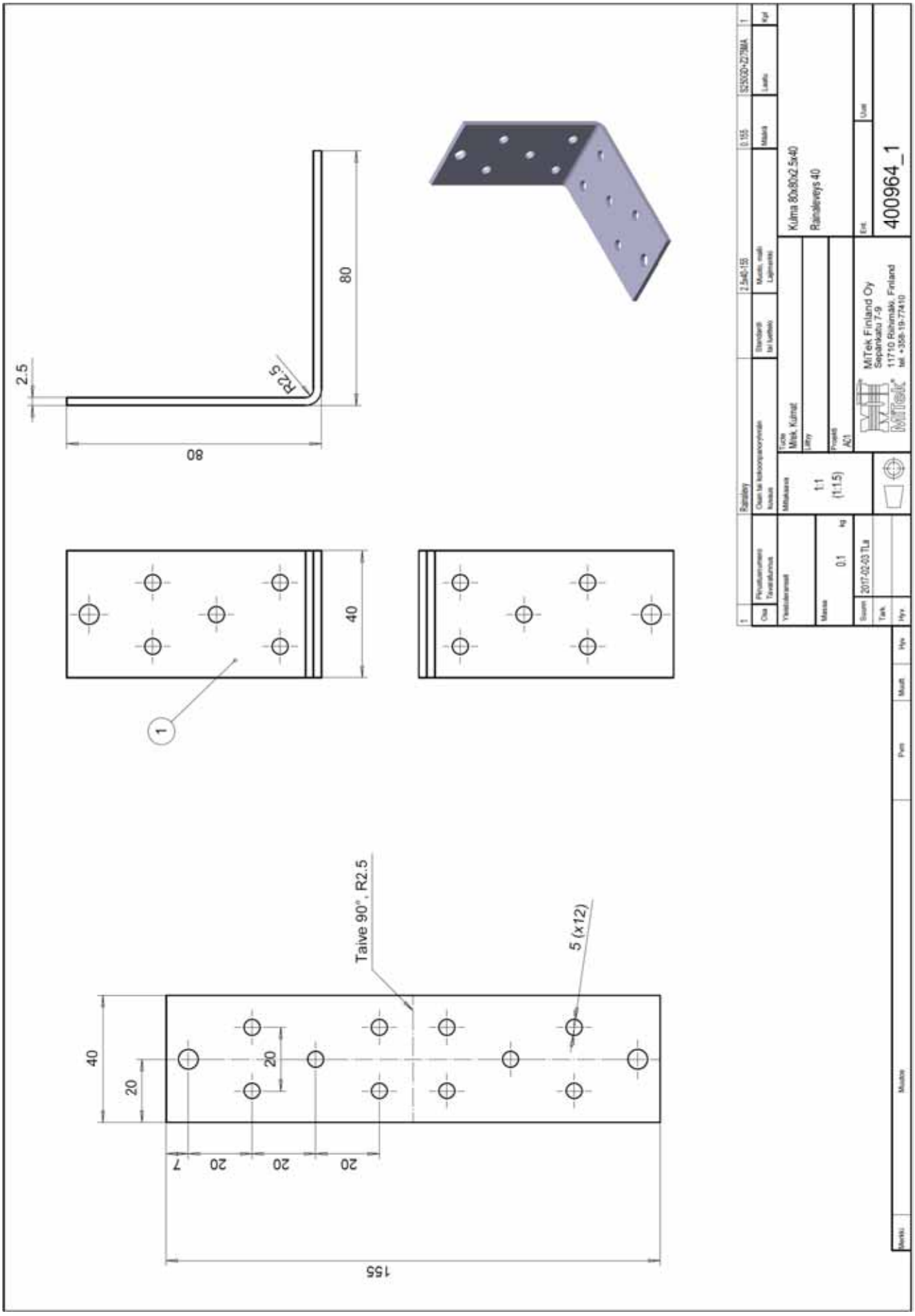

2.5
R2.5
100
60
60
1
Taive 90°, R2.5
5 (x21)
60
20
10
20
20
20
20
20
20
20
20
20
20
7
20
20
20
20
20
155
Kulma 60x100x2.5x60
Rainäleveys 60
400057_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:1
2017-02-03 TLa

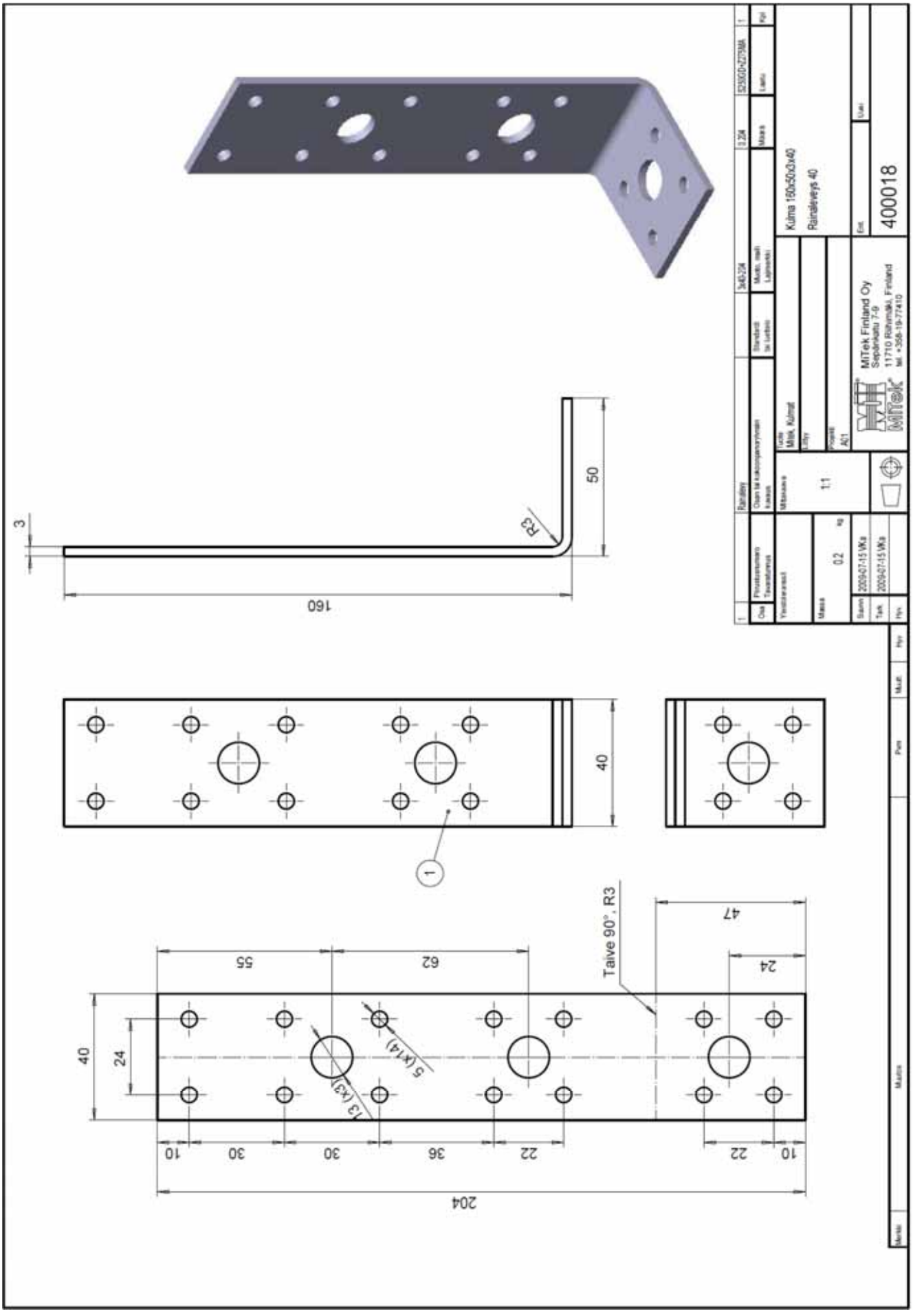

2.5
R2.5
80
80
60
1
Taive 90°, R2.5
5 (x20)
60
20
20
20
20
20
20
7
155
10
Kulma 80x80x2.5x60
Rainsleveys 60
400058_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
1:1
(1:1.5)
0.1
2017-02-03 TLa

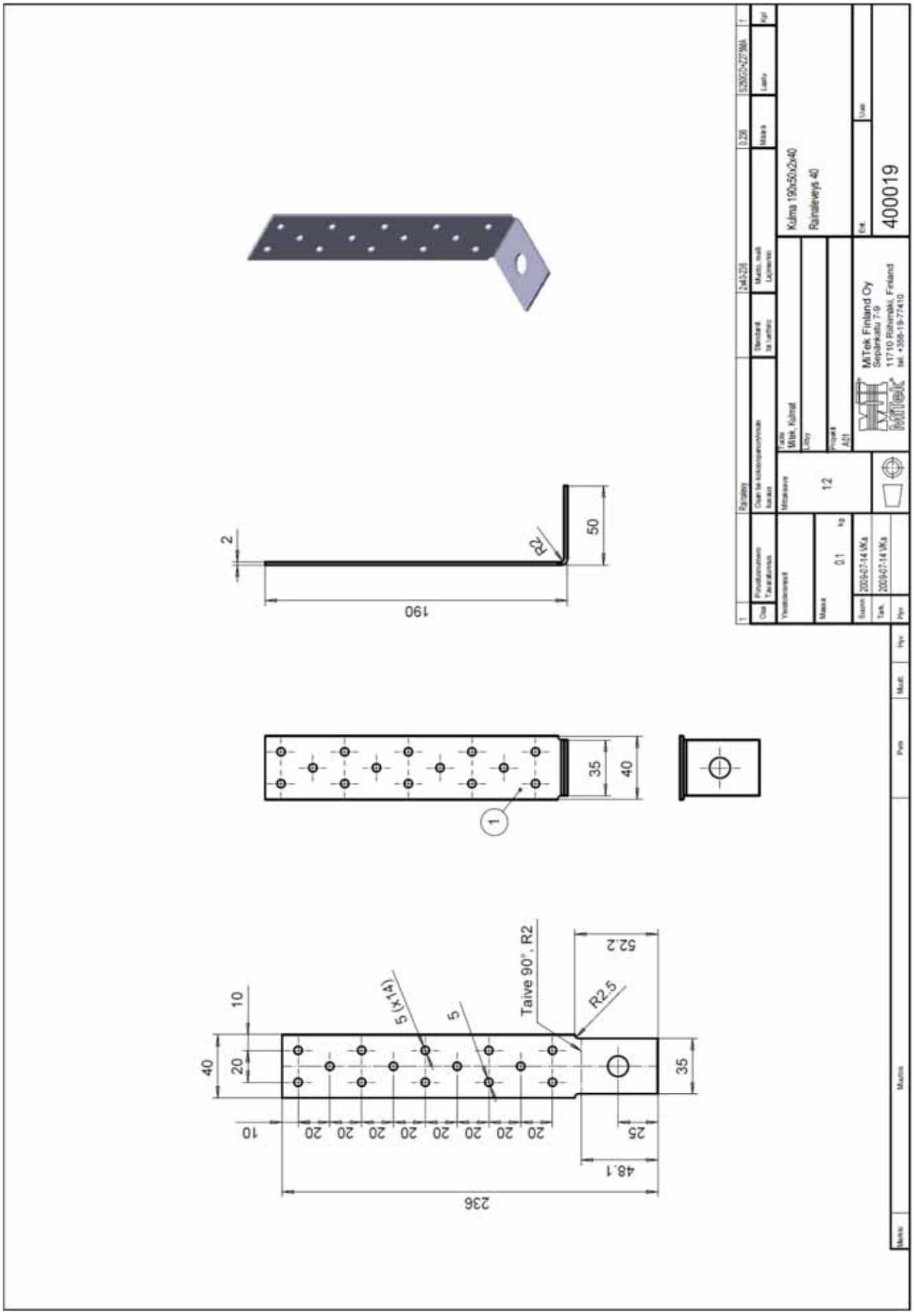

1:1.5
2.5
R2.5
80
80
80
1
Taive 90°, R2.5
5 (x28)
80
20
20
20
20
10
20
20
20
7
20
20
155
Kulma 80x80x2.5x80
Rainteleveys 80
400059_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-7410
1:1
(1:1.5)
2017-02-02 Tlä

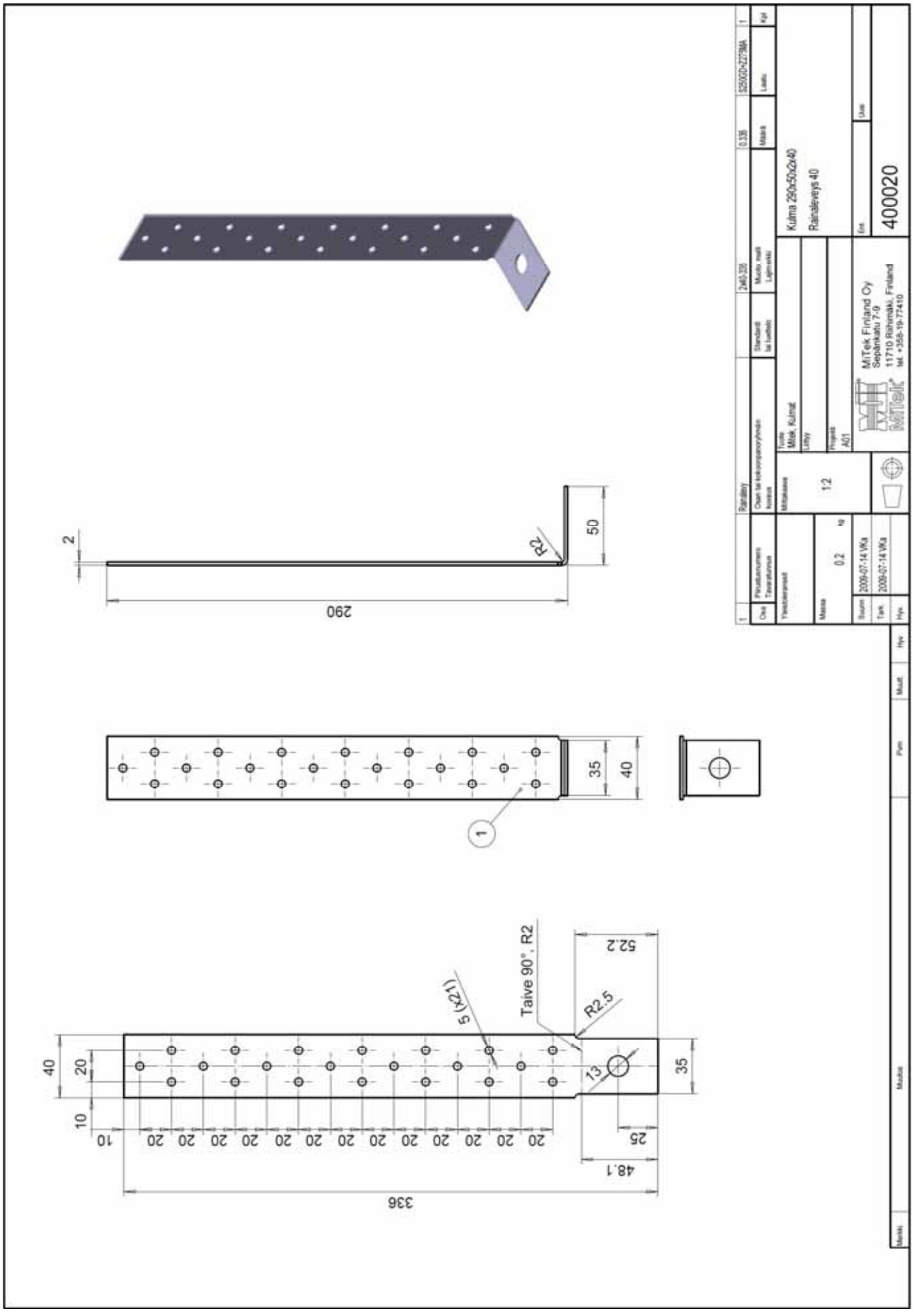

Kulma 80x80x2.5x100
Rainsleveys 100
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
400060_1
1:1.5
2.5
80
100
Taive 90°, R2.5
5 (x36)
155
20
10
7

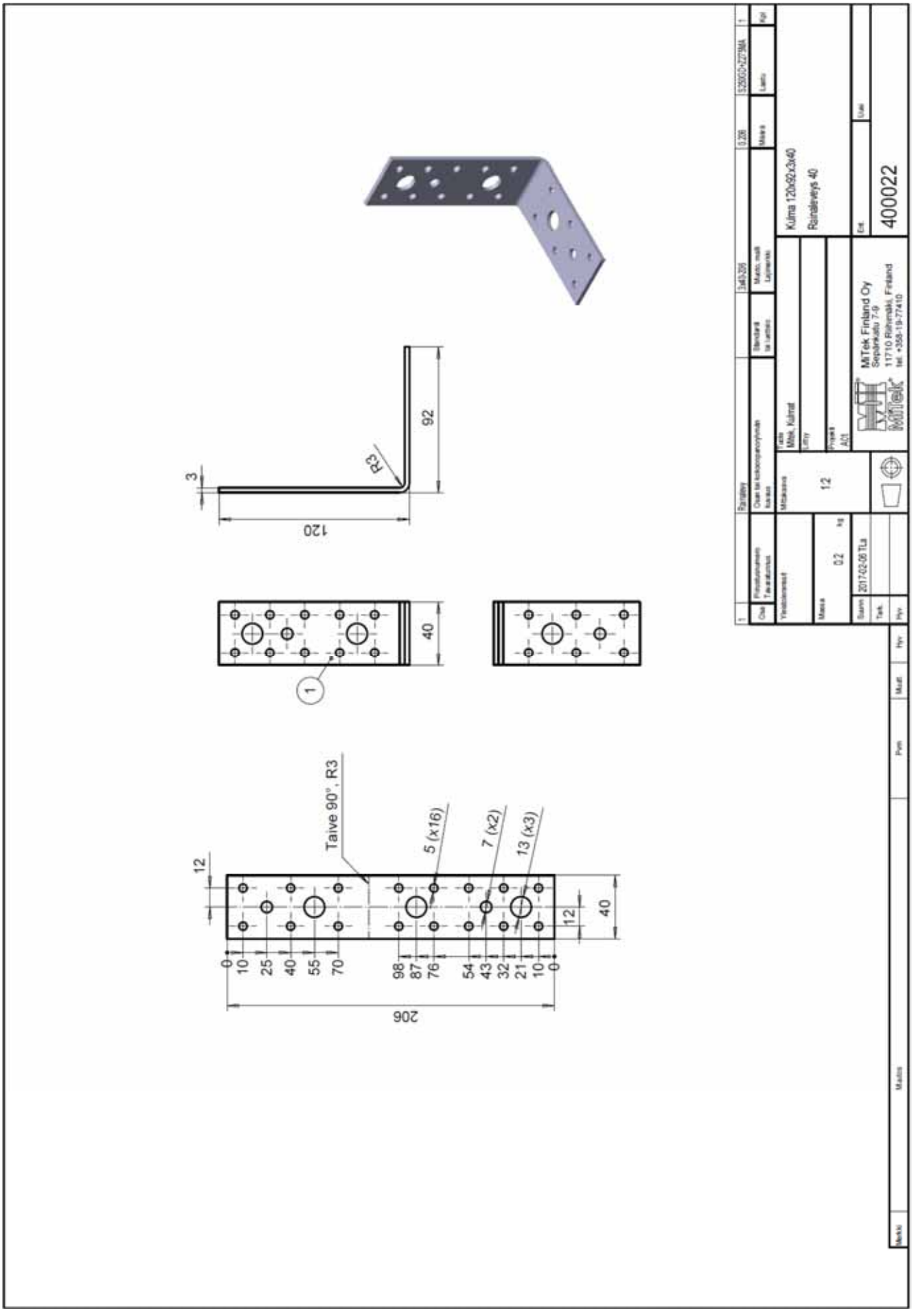

2.5
R2.5
100
100
1:1.5
100
1
Taive 90°, R2.5
5 (x46)
10
100
20
20
20
20
20
20
20
20
7
195
Kulma 100x100x2.5x100
Rainaleveys 100
400063_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Rahemäki, Finland
tel. +358-19-77410
Material
Amount
Shape, Dimension, Designation
Standard or catalog
Part or assembly group name
Drawing number item reference
Part
Scale
1:2
(1:3.0)
Mass
0.4
kg
Design
2017-02-03 TLa
Check
Appr.
Product
Mitek, Kulmat
Ref
Project
A01
Qty
Rev
Mark
Revision
Date
Rev by
Appr.

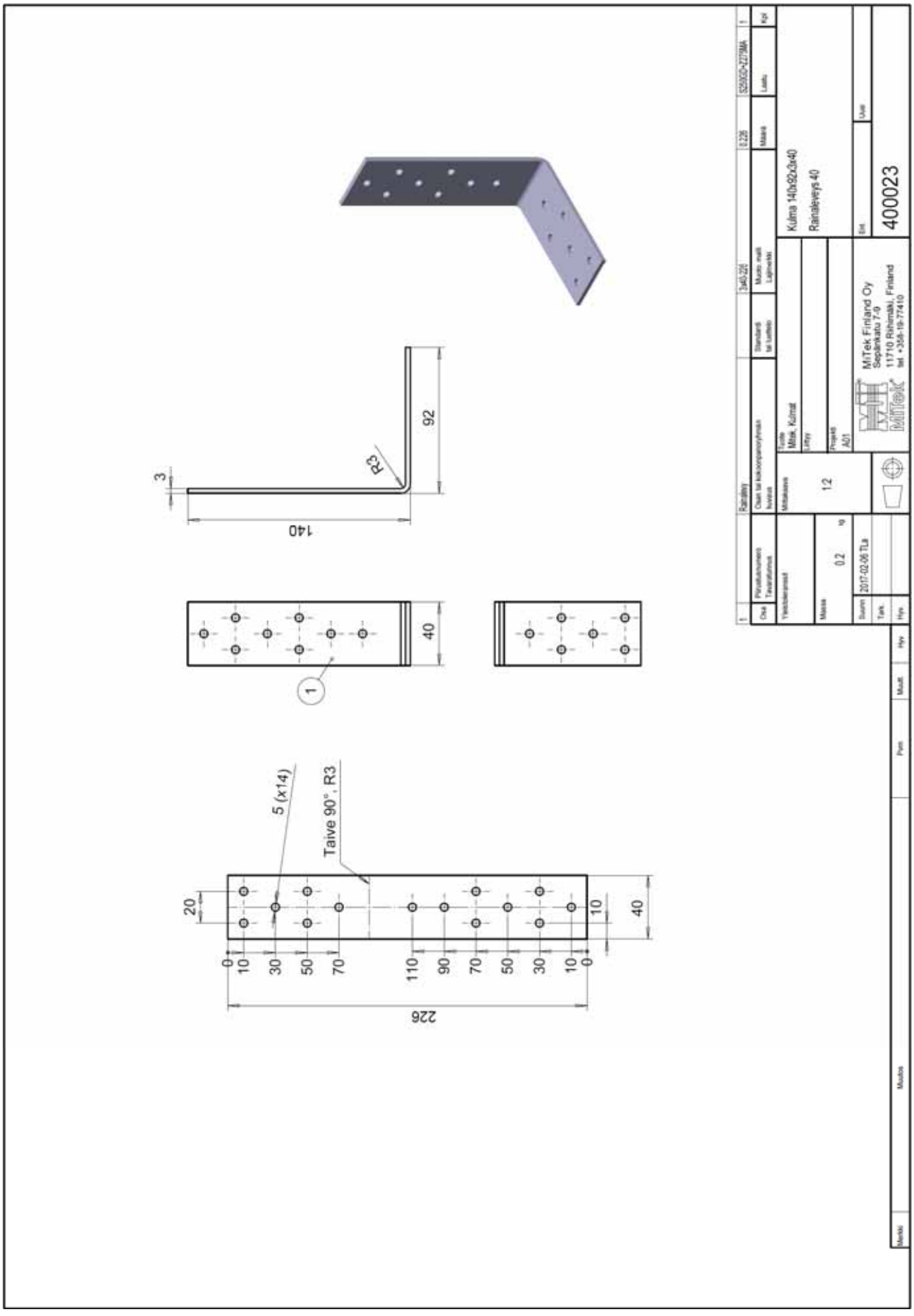

2.5
R2.5
80
80
40
1
Taive 90°, R2.5
5 (x12)
40
20
20
20
20
20
7
155
Kulma 80x80x2.5x40
Rainaleveys 40
400964_1
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
Mitek
Mitek, Kulmat
1:1
(1:1.5)
0.1
2017-02-03 TLa

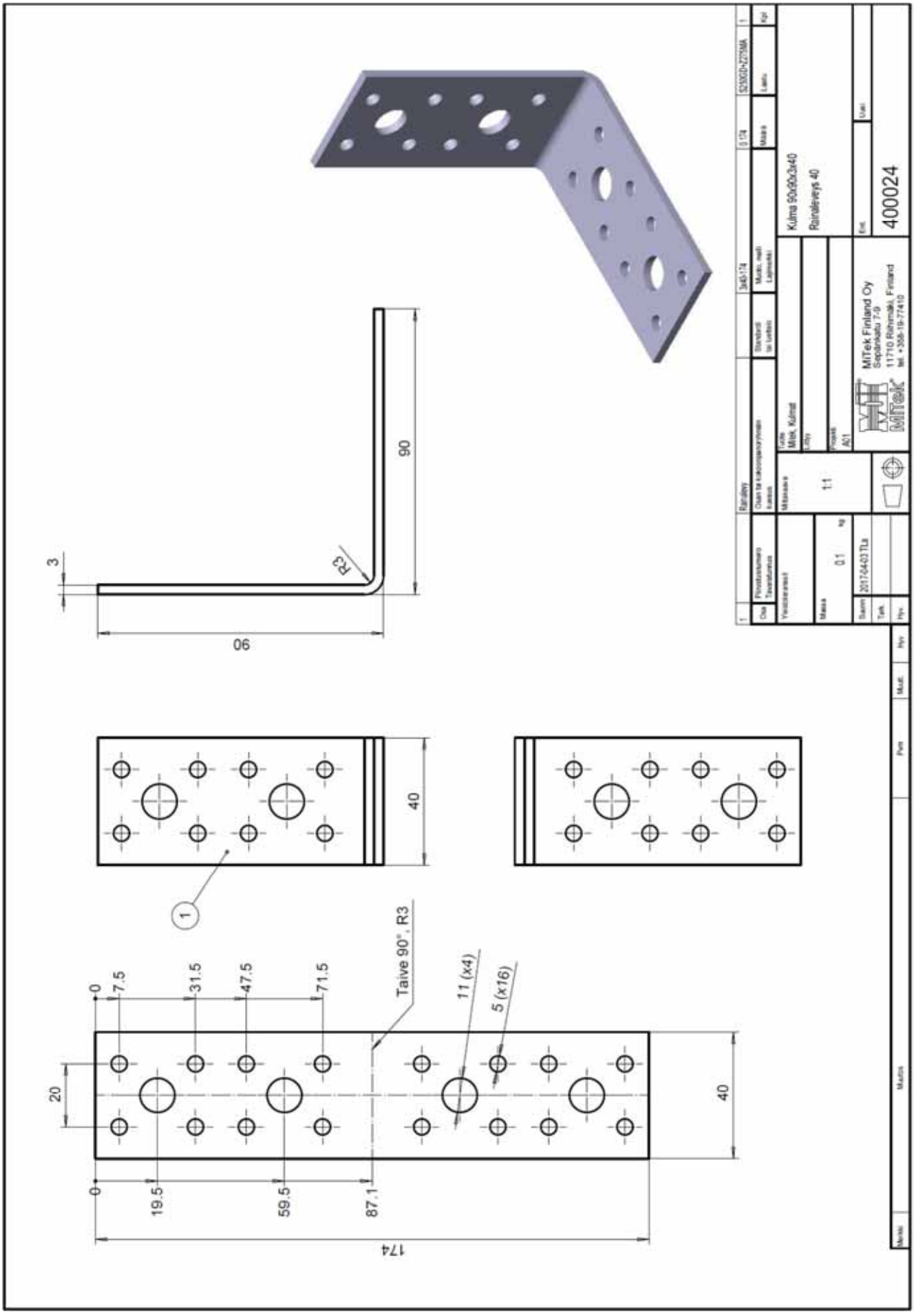

Kulma 150x50x3x40
Rainsleveys 40
400018
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
1:1
02
50
160
3
R3
40
Taive 90°, R3
47
24
55
62
40
24
5 (x14)
13 (x3)
10
30
30
36
22
22
10
204

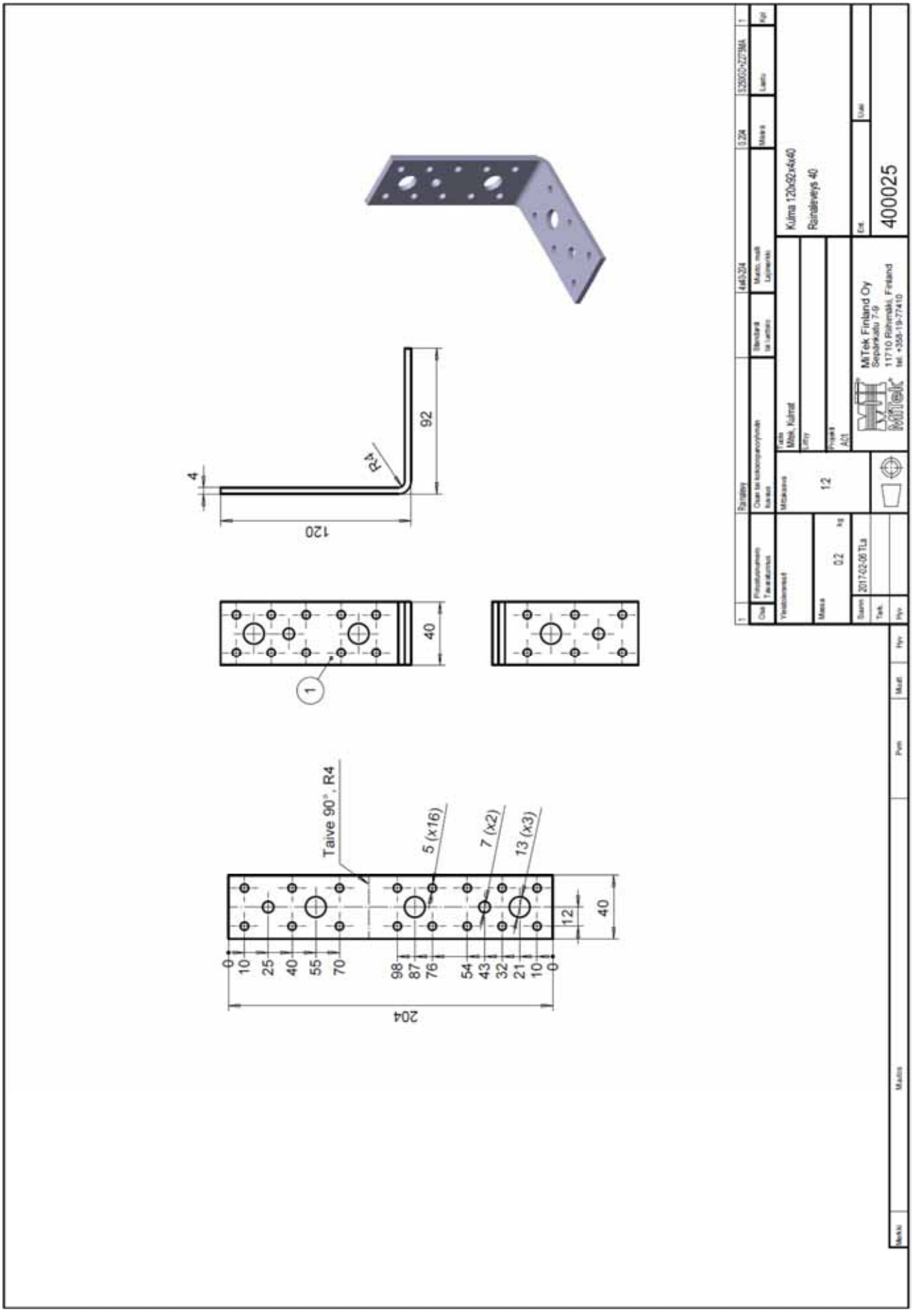

Kulma 190x50x2x40
Rainsleveys 40
400019
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
2
50
R2
190
35
40
1
10
5 (x14)
5
Taive 90°, R2
52.2
R2.5
40
20
10
20
20
20
20
20
20
20
20
25
48.1
236

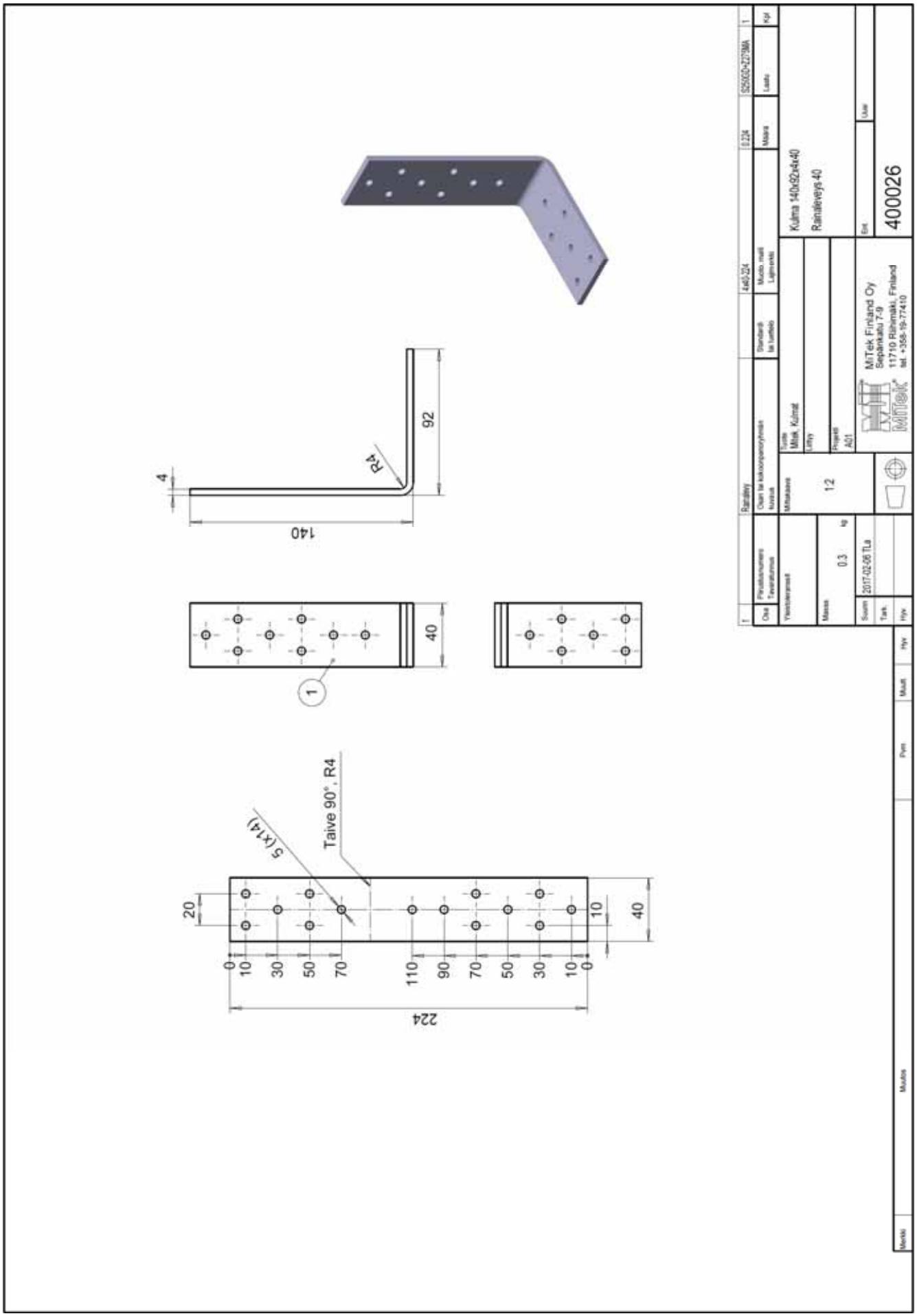

Kulma 290x50x2x40
Rainsleveys 40
400020
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
MiTek
1:2
0,2
2009-07-14 VKa
2009-07-14 VKa
2
50
R2
290
35
40
1
5 (x21)
Taive 90°, R2
52,2
R2,5
13
35
40
20
10
10
20 20 20 20 20 20 20 20 20 20 20 20 20
25
48,1
336

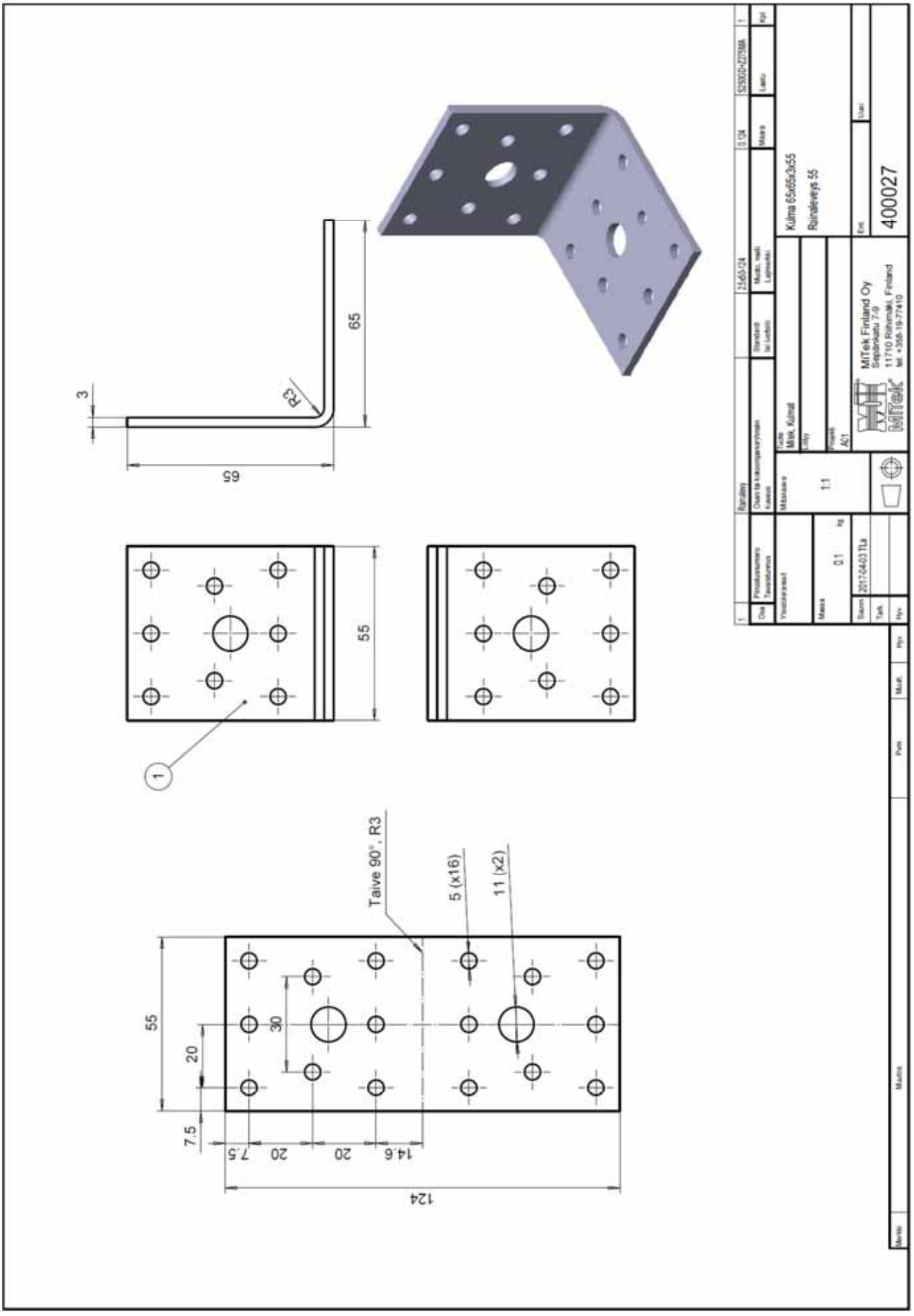

Kulma 120x92x3x40
Rainaleveys 40
400022
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
1:2
Taive 90°, R3
5 (x16)
7 (x2)
13 (x3)
120
92
R3
3
40
12
206


Kulma 140x92x3x40
Rainalevey 40
400023
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
1:2
2017-02-06 TLa
92
140
3
R3
40
5 (x14)
Taive 90°, R3
20
10
0
10
30
50
70
110
90
70
50
30
10
0
226

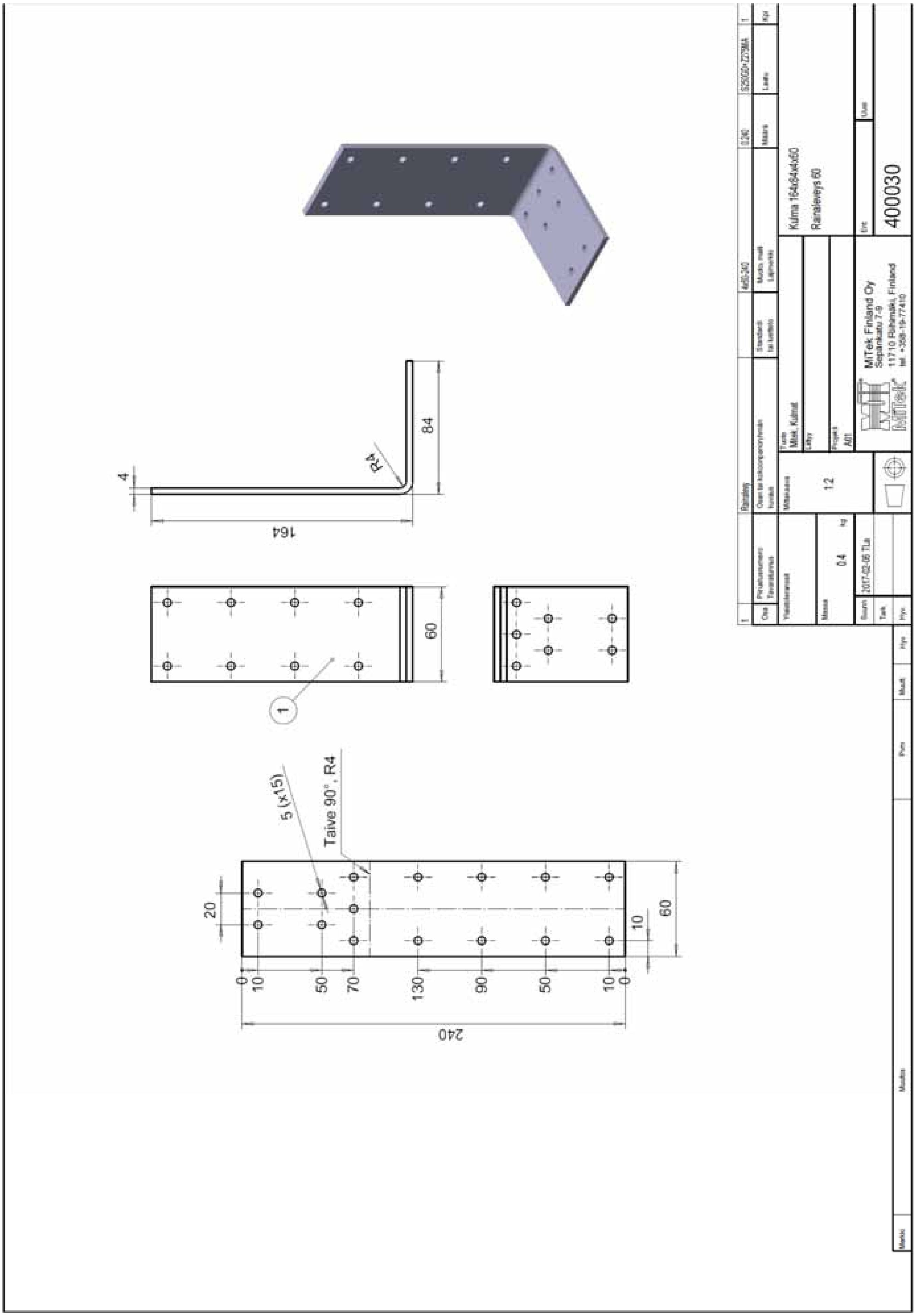

Kulma 90x90x3x40
Rainaleveys 40
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
400024
90
3
R3
90
40
1
Taive 90°, R3
11 (x4)
5 (x16)
0
7.5
31.5
47.5
71.5
20
40
0
19.5
59.5
87.1
174

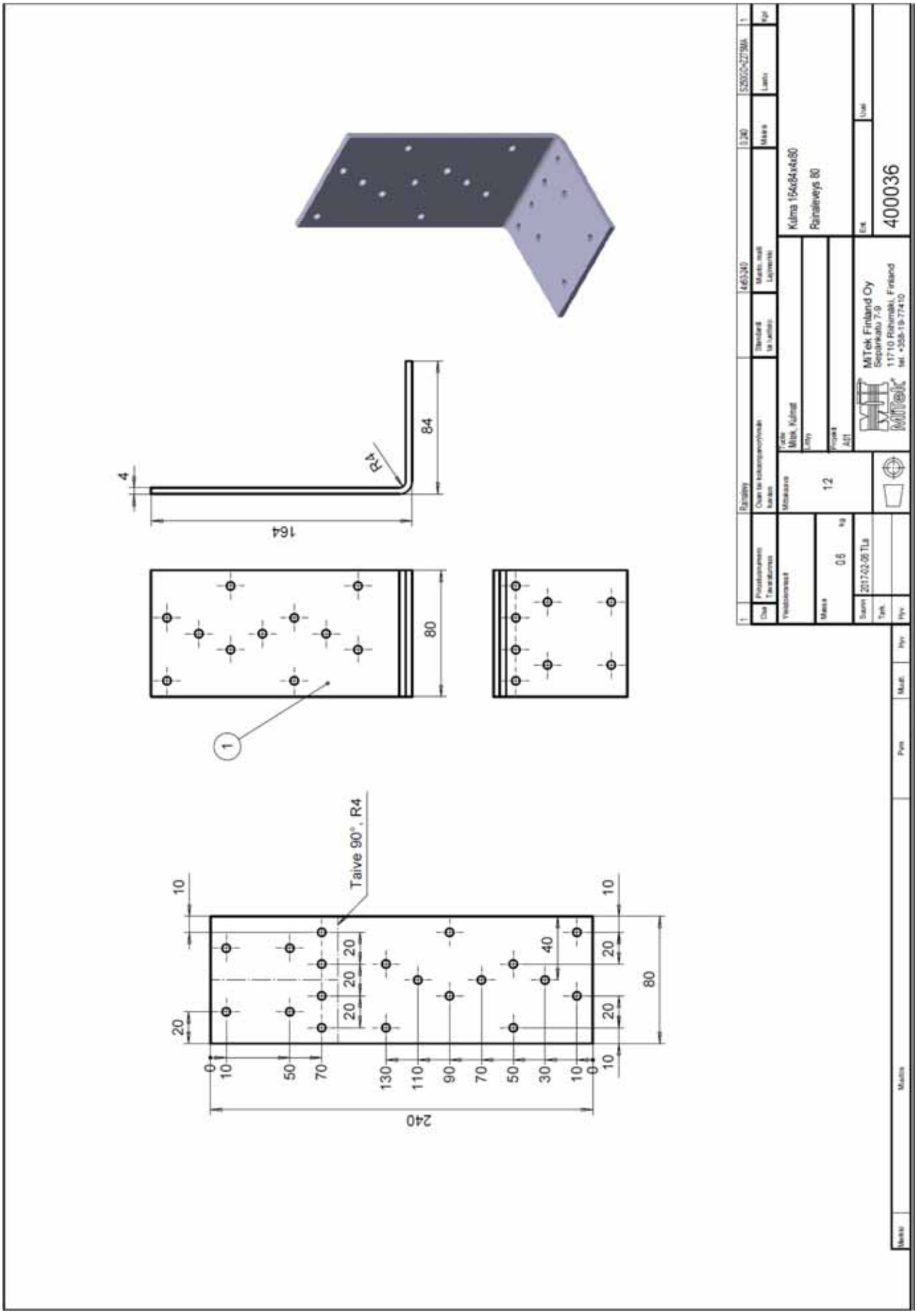

Kulma 120x92x40x40
Rainsleveys 40
400025
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
1:2
92
120
4
40
Taive 90°, R4
5 (x16)
7 (x2)
13 (x3)
12
204
0
10
25
40
55
70
98
87
76
54
43
32
21
10
0

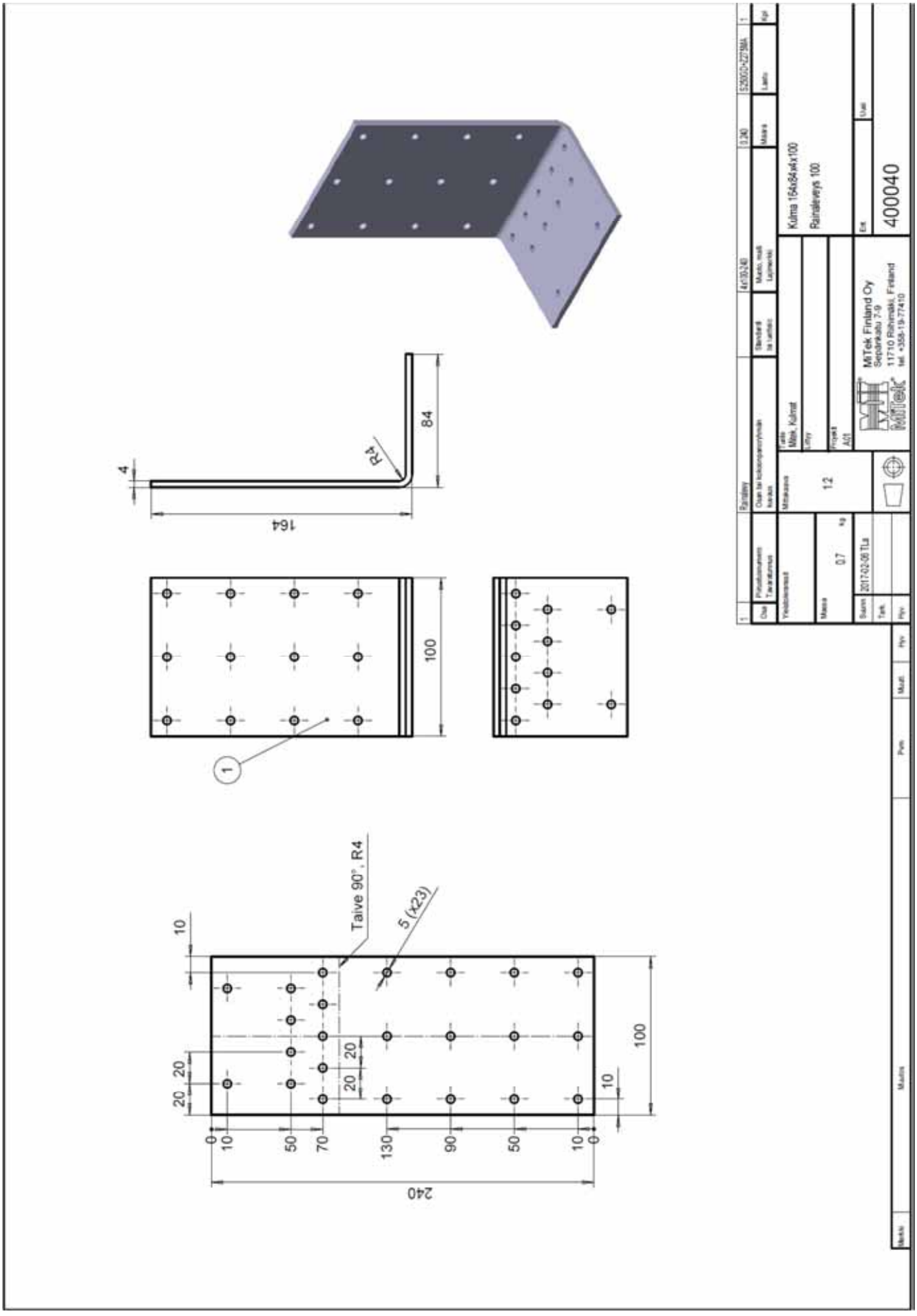

Taive 90°, R4
S (x14)
224
140
92
R4
4
40
20
10
0
10
30
50
70
110
90
70
50
30
10
0
Kulma 140x92x4x40
Rainäleveys 40
400026
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
1:2
0.3
2017-02-06 TLa


65
3
R3
65
55
1
Taive 90°, R3
5 (x16)
11 (x2)
55
30
20
7.5
7.5
20
20
14.6
124
Kulma 65x65x3x55
Rainaleveys 55
MiTek Finland Oy
Sepänkatu 7-9
11710 Rihmälä, Finland
tel. +358-19-77410
400027
1:1
A01
Mitek, Kulmat
2017-04-03 TLa

ANNEX 1: Product details and definitions




Taive 90°, R4
Kulma 154x84x4x80
Rainsieveys 80
400036
MiTek Finland Oy
Sepankatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410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400040
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410
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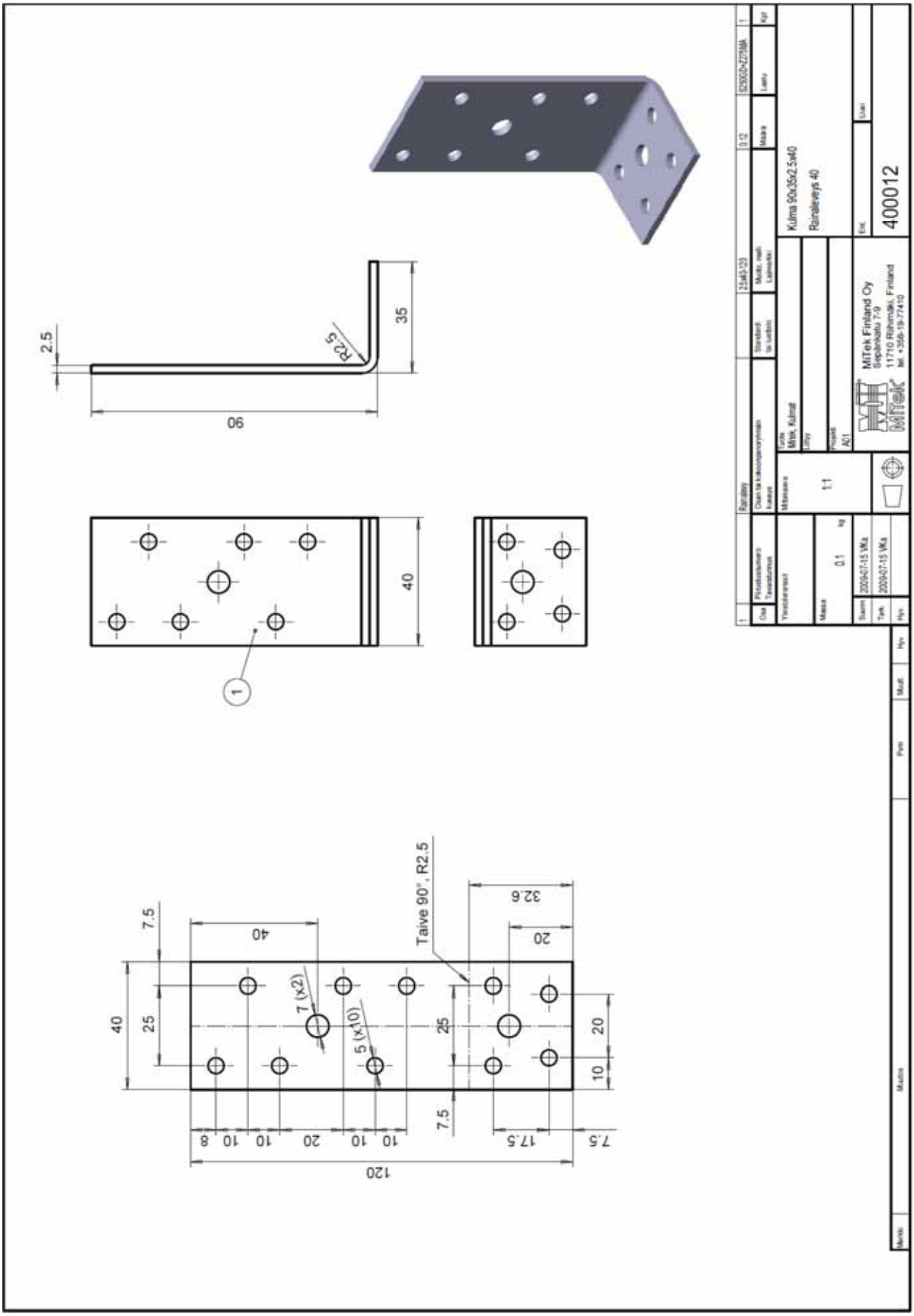
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MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
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R2.5
40
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7.5
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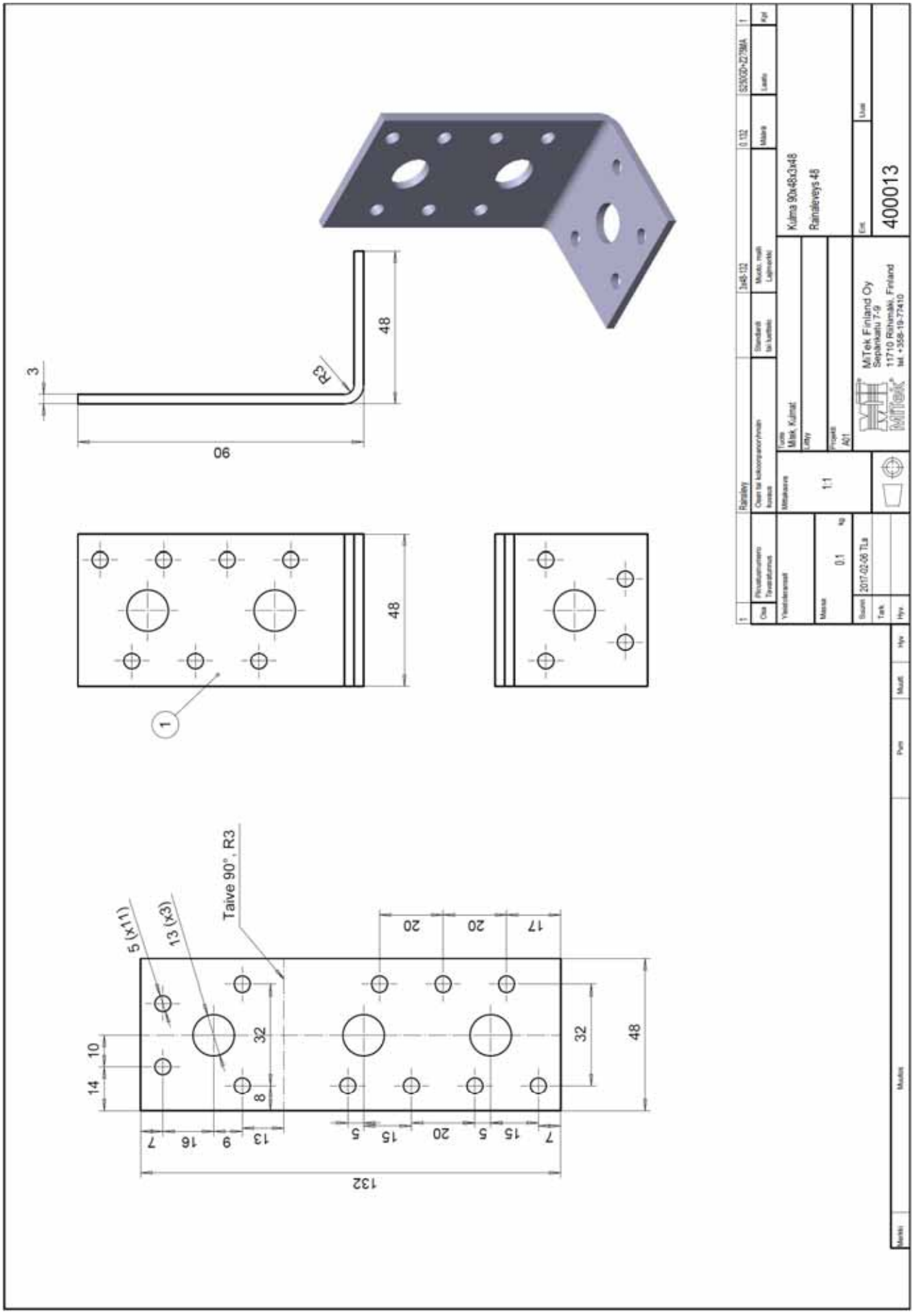
17.5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MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
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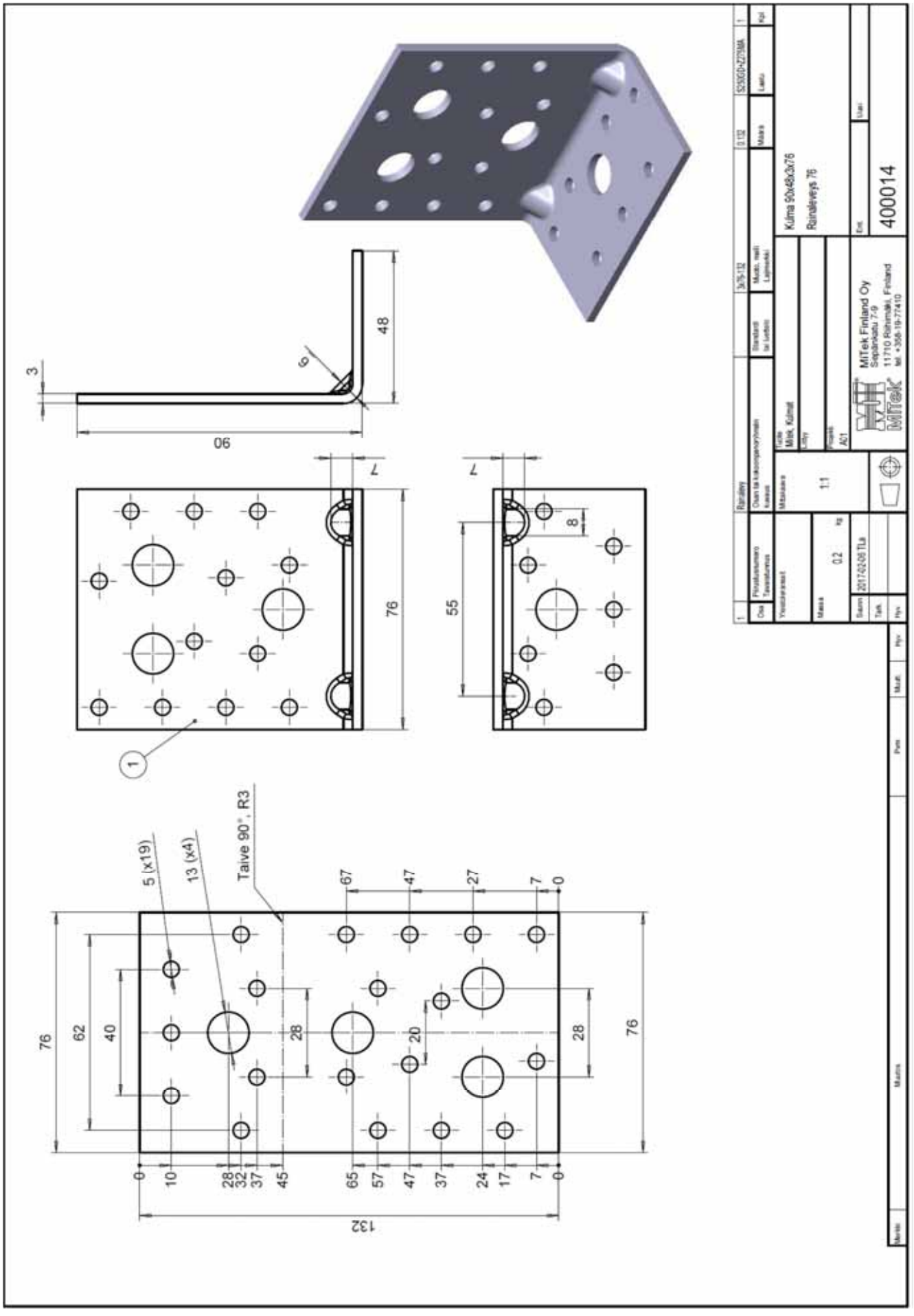
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MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
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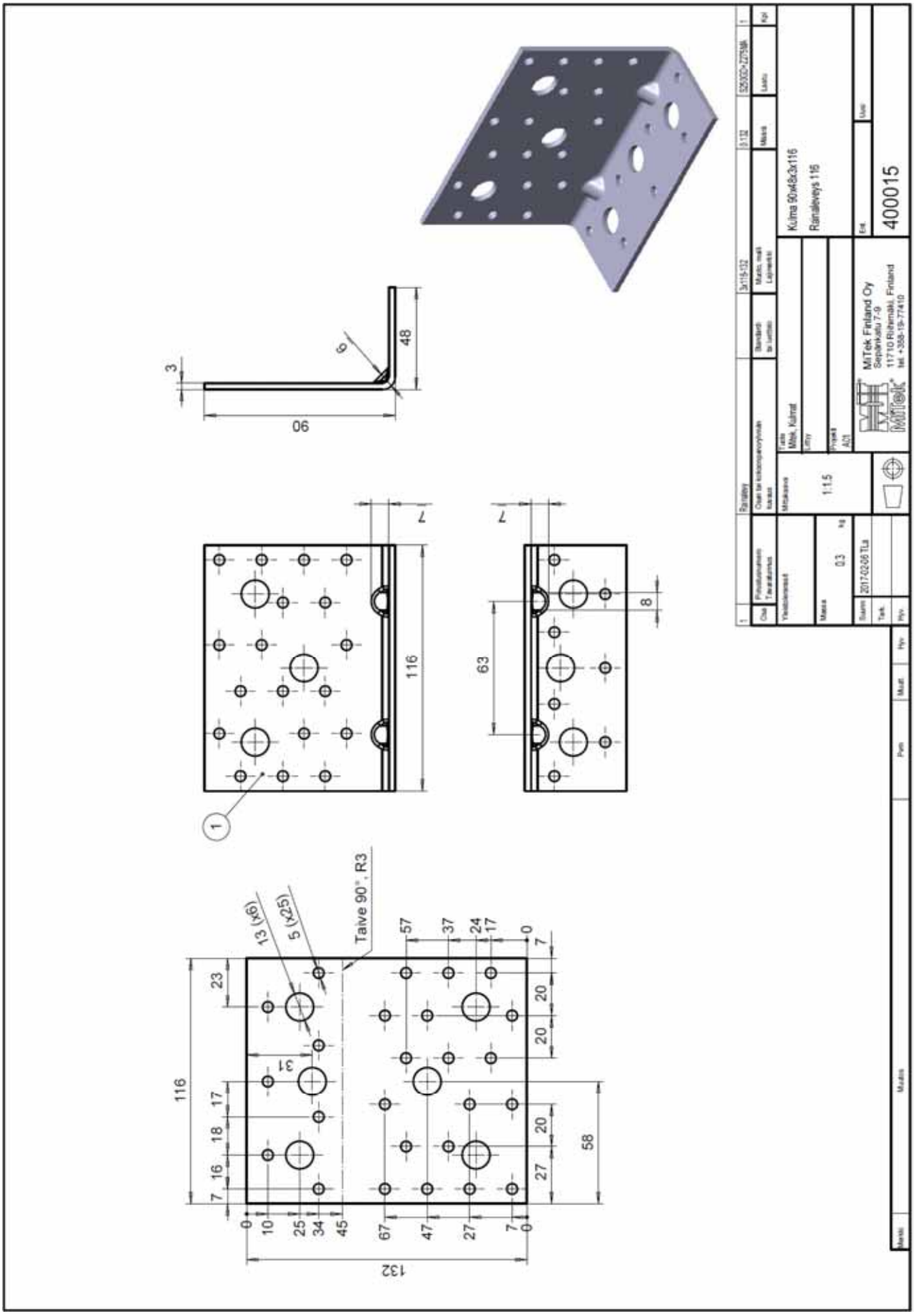
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MiTek Finland Oy
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5 (x25)
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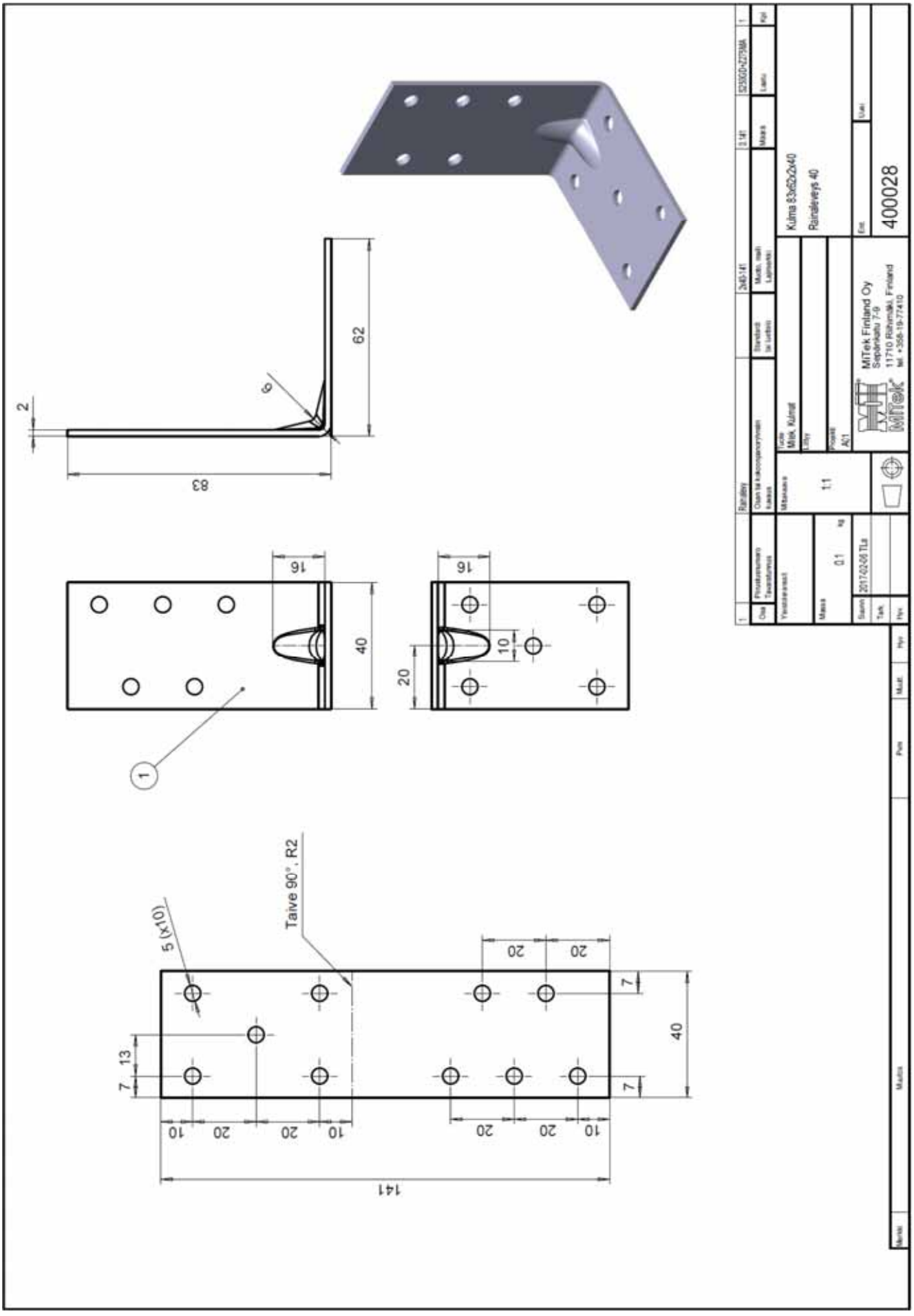
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MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
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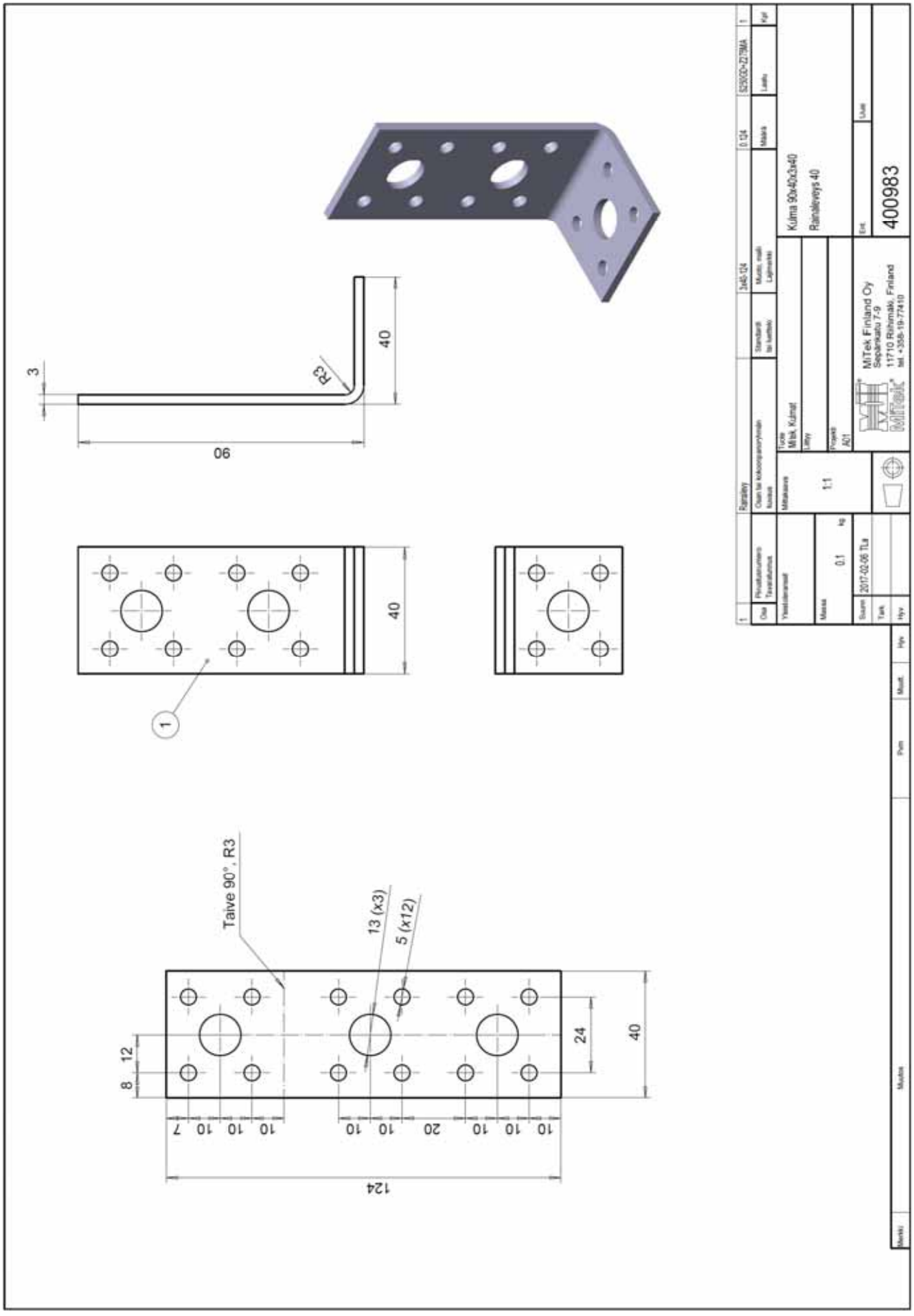
13
7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400983
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel +358-19-77410
3
40
R3
90
40
1
Taive 90°, R3
13 (x3)
5 (x12)
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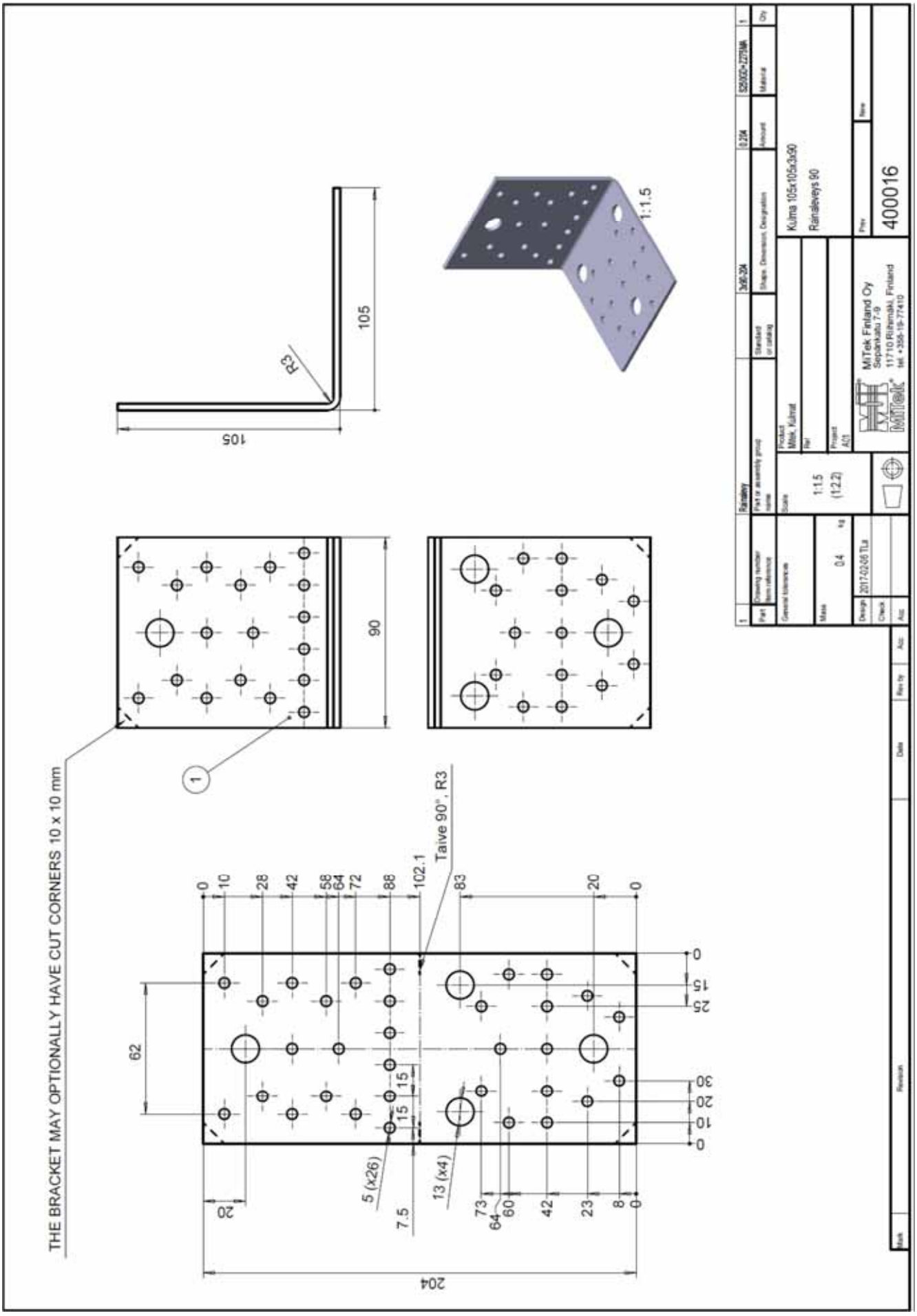
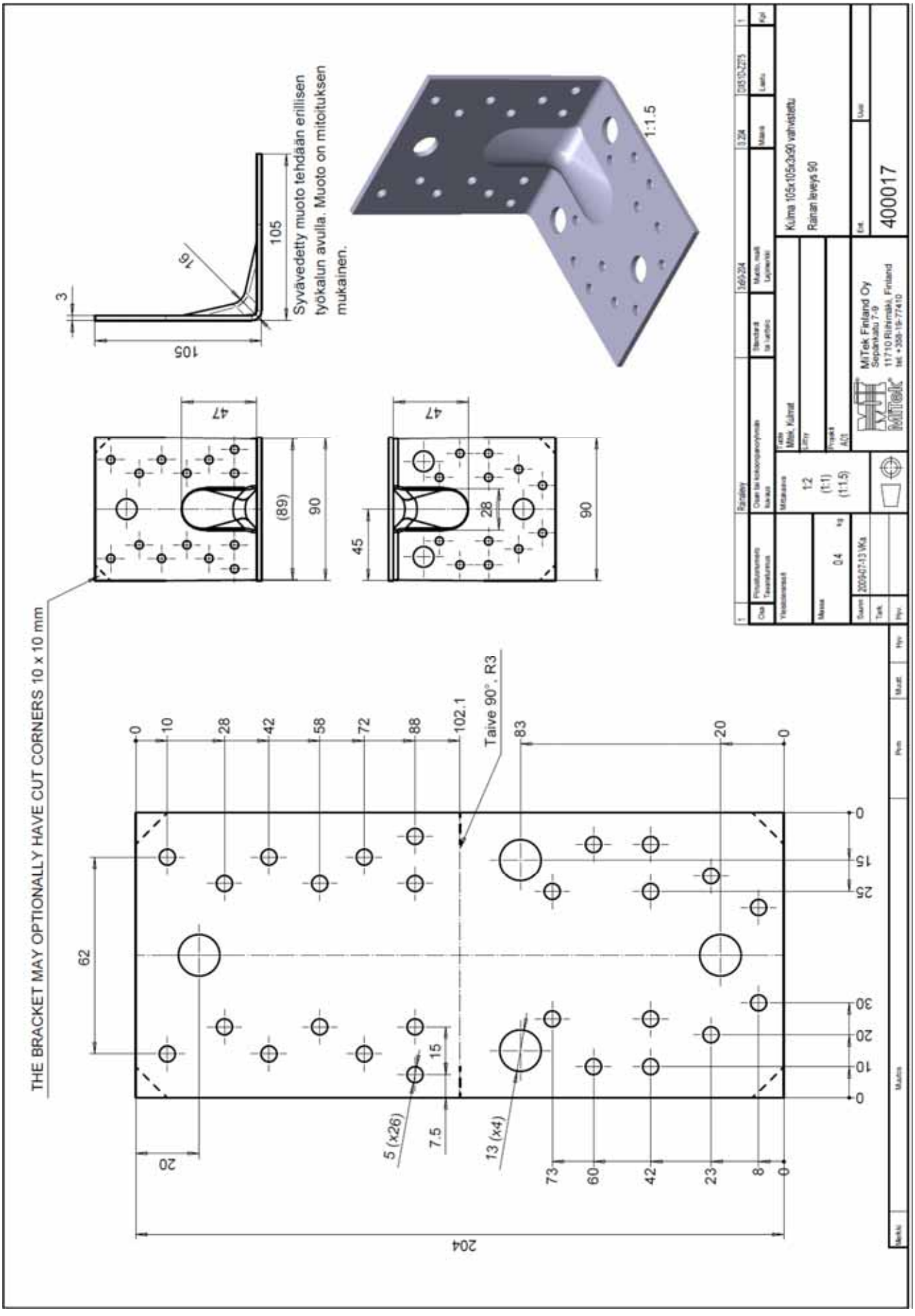
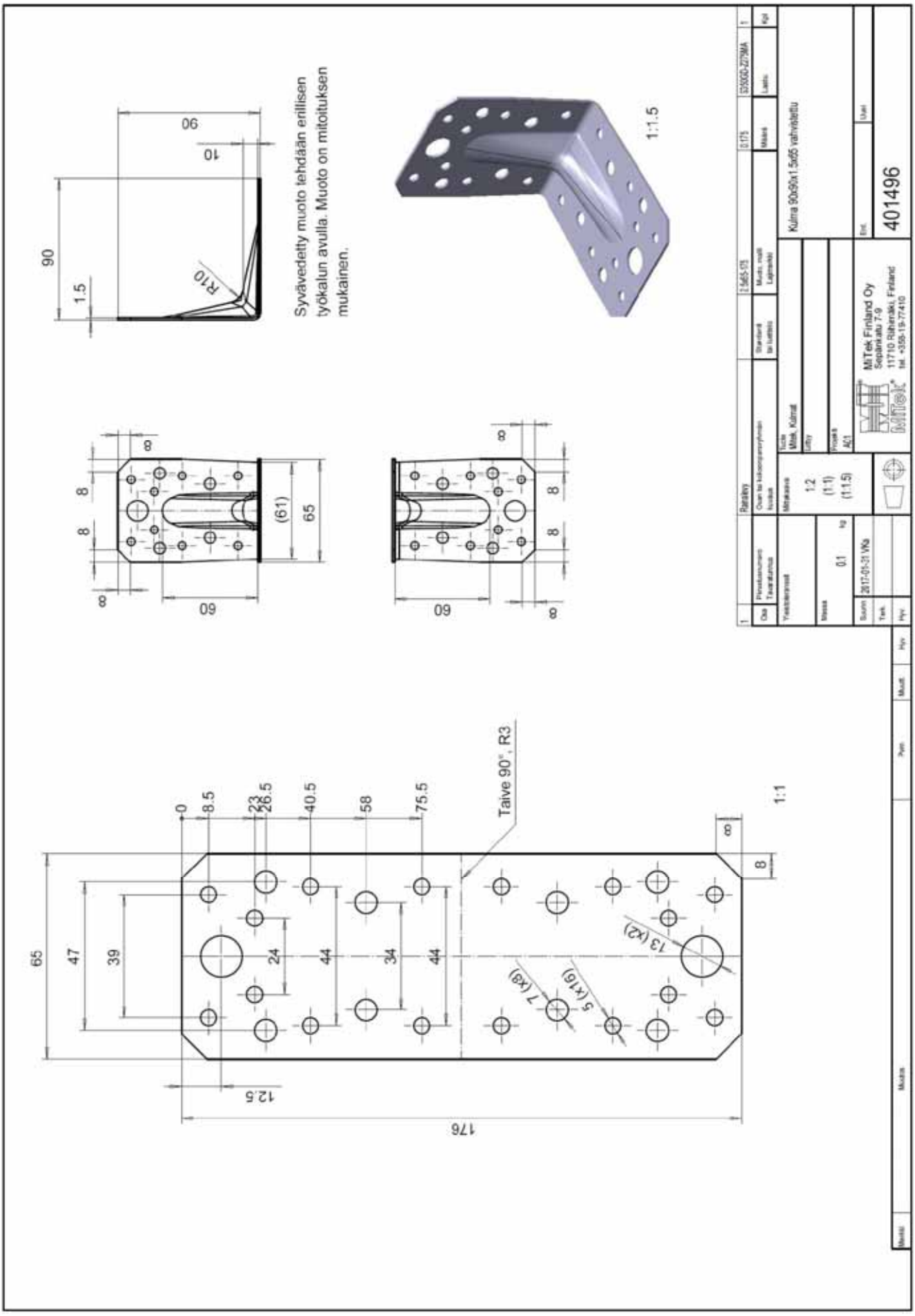
8
24
40
7
10
10
10
10
20
10
10
10
10
124


THE BRACKET MAY OPTIONALLY HAVE CUT CORNERS 10 x 10 mm
Taive 90°, R3
105
R3
105
1:1.5
90
204
62
20
7.5
5 (x26)
13 (x4)
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
Kulma 105x105x3x90
Rainaleveys 90
400016
1:1.5
(1:2.2)
2017/0266 TLa


THE BRACKET MAY OPTIONALLY HAVE CUT CORNERS 10 x 10 mm
Syvävedetty muoto tehdään erillisen työkalun avulla. Muoto on mitoituksen mukainen.
1:1.5
Taive 90°, R3
Kulma 105x105x3x90 vahvistettu
Rainan leveys 90
MiTek Finland Oy
400017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1:1.5
Taive 90°, R3
1:1
Kulma 90x90x1,5x65 vahvistettu
401496
MiTek Finland Oy
Sepänkatu 7-9
11710 Riihimäki, Finland
tel. +358-19-77410

ANNEX 2. CHARACTERISTIC LOAD-CARRYING CAPACITIES

1 Characteristic resistances for MiTek angle brackets - calculation method

The design resistance R_d of the angle bracket connection is

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

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

When the joint made by the angle bracket is loaded by a shear force at the plane of flange 1 (flange A or B) in the middle of the flange, it shall be checked that the conditions according to equations (2) to (4) are fulfilled

$$F_d \le R_{1,d} \quad (2)$$

$$F_{x,d} \le R_{2,x,d} \quad (3)$$

$$F_{z,d} \le \begin{cases} R_{2,z,t,d} & \text{when the joint is in tension} \\ R_{2,z,c,d} & \text{when the joint is in compression} \end{cases} \quad (4)$$

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

In addition, when the joint is stressed in tension, the following interaction equation shall be fulfilled:

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

In conjunction with MiTek Angle bracket *90x90x1,5x65 vah* the equations (2)-(4) for the characteristic design resistances are: $R_{1,k} = R_{2,x,k} = R_{x,k}$, $R_{2,z,c,k} = R_{z,c,k}$ and $R_{2,z,t,k} = R_{z,t,k}$ from equations (6)-(9).

When the characteristic density ρ_k of timber used in connection is at least 350 kg/m³, the characteristic load-carrying capacities for MiTek Angle bracket *90x90x1,5x65 vah* per connector are as follows

- characteristic shear resistance in width direction C

$$R_{x,k} \le \begin{cases} 4{,}47\,\text{kN} & \text{using anchor nails } 8+8\text{n}40\text{x}4{,}0 \\ 6{,}25\,\text{kN} & \text{using anchor screws } 8+8\text{s}5{,}0\text{x}40 \end{cases} \quad (6)$$

- characteristic tensile resistance in lengthwise or height wise direction

$$R_{z,t,k} \le \begin{cases} 3{,}39\,\text{kN} & \text{using anchor nails } 8+8\text{n}40\text{x}4{,}0 \\ 3{,}72\,\text{kN} & \text{using anchor screws } 8+8\text{s}5{,}0\text{x}40 \end{cases} \quad (7)$$

- characteristic compression resistance in lengthwise or height wise direction

$$R_{z,c,k} \le \begin{cases} 7{,}57\,\text{kN} & \text{using anchor nails } 8+8\text{n}40\text{x}4{,}0 \\ 7{,}98\,\text{kN} & \text{using anchor screws } 8+8\text{s}5{,}0\text{x}40 \end{cases} \quad (8)$$

If the characteristic density of the timber is less than 350 kg/m^3 the values in equations (6) – (8) shall be modified with factor

$$k_\rho = \sqrt{\frac{\rho_k}{350}} \quad (9)$$

where ρ_k is the density of timber, glulam, LVL or other applicable timber based material (kg/m^3).

For other angle brackets the characteristic resistance

$$R_{1,k} = n_1 F_{1,v,Rk} \quad (10)$$

where n_1 is number of fasteners at flange 1. $F_{1,v,Rk}$ is the characteristic lateral load-carrying capacity of the fastener in the timber part against flange 1 according to EN 1995-1-1, equation (11) for steel plate thickness t less than or equal to $d/2$ and (12) for thicker steel plates of thickness greater than or equal to d:

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

$$F_{v,Rk} = \min \begin{cases} f_{h,k} t_1 d & \text{(a)} \\ f_{h,k} t_1 d \left[\sqrt{2 + \dfrac{4M_{y,Rk}}{f_{h,k} d\, t_1^2}} - 1 \right] + \dfrac{F_{ax,Rk}}{4} & \text{(b)} \\ 2{,}3\sqrt{M_{y,Rk}\, f_{h,k} d} + \dfrac{F_{ax,Rk}}{4} & \text{(c)} \end{cases} \quad (12)$$

where $t_1 = L - t$ when L is the length of the fastener, t is the thickness of steel plate, $M_{y,k}$ is according to standards EN 14952 and EN 409 experimentally determined characteristic value of the yield moment of the fastener, $F_{ax,k}$ is the withdrawal resistance of the fastener according to Eq. (14) limited so that $F_{ax,k}$ is not more than 4/3 times the lateral load-carrying capacity of the fastener $F_{v,Rk}$ and the characteristic value of the embedding strength is

$$f_{h,k} = 0{,}082\,\rho_k\, d^{-0{,}3} \quad \text{N/mm}^2 \quad (13)$$

where ρ_k is the density of the timber.

Otherwise linear interpolation of equations (11) and (12) is used for steel plate thicknesses between $d/2$ and d mm:

$$F_{v,Rk} = F_{v,Rk}(1) + \frac{t - 2\text{mm}}{2\text{mm}} \left(F_{v,Rk}(2) - F_{v,Rk}(1) \right) \quad (14)$$

where t is the nominal thickness of the connector, $F_{v,Rk}(1)$ is the capacity as per equation (11) and $F_{v,Rk}(2)$ is the capacity as per equation (12).

Characteristic withdrawal capacity of anchorage nail

$$F_{ax,Rk} = f_{ax,k} d\, t_{pen} \leq f_{tens,k} \quad (15)$$

where $f_{ax,k}$ is the withdrawal parameter determined according to standards EN 14592 and EN 1382 for the actual timber material, $f_{tens,k}$ is the experimentally determined tensile resistance of the fastener together with a steel plate and t_{pen} is the penetration depth of the profiled part of the fastener in timber (> 6d). If the penetration depth for an anchor nail is less than $t_{pen} \leq 8d = 32$ mm, the resistance according to Eq. (14) is reduced by (t_{pen}/8mm - 3).

Eq. (12) may be used for angle ring shank nails, if the length of the conical part is at least 4 mm and the diameter of the cone at the head of the nail is at least 5,2 mm. Otherwise linear interpolation of equations (11) and (12) is used for steel plate thicknesses between 2 and 4 mm.

Characteristic shear resistance per connector

$$R_{2,x,k} = k_{m,2} F_{2,v,Rk} \quad (16)$$

where $F_{2,v,Rk}$ is the characteristic lateral load-carrying capacity of the fastener in the timber part against flange 2, according to EN 1995-1-1, and the factor $k_{m,2}$ depends on the placement of the fasteners. Values of $k_{m,2}$ are given in Tables 1 – 3 for cases, where fasteners are used in a) all holes of the angle bracket with diameter 5 mm, b) in all holes where the distance from the outer surface of the flange is at least 28 mm and c) in all holes where the distance from the outer surface of the flange is at least 42 mm.

Characteristic tension resistance for angle brackets without corner rib reinforcement is

$$R_{2,z,t,k} = \min \begin{cases} F_{n,1} + F_{n,2} - 3 \cdot \dfrac{F_{n,1} \cdot d_1 + F_{n,2} \cdot d_2 - \dfrac{C \cdot {t_d}^2}{4} \cdot f_y}{2L_B + d_2} & \text{(a)} \\ \dfrac{{t_d}^2 f_y}{4 d_1} \cdot \left(C + C_{net,1}\right) & \text{(b)} \\ \dfrac{{t_d}^2 f_y}{4 d_2} \cdot \left(C + C_{net,2}\right) + \dfrac{F_{n,1}\left(d_2 - d_1\right)}{d_2} & \text{(c)} \\ F_{n,1} + F_{n,2} & \text{(d)} \end{cases} \quad (17)$$

where

d_1 distance between the bent edge and the hole row nearest to it in flange 2 (i = 1)
d_2 distance between the bent edge and the hole row second nearest to it in flange 2 (i = 2)
C the width of the angle bracket
t_d is the thickness of the angle bracket to be used in calculations (= the minimum thickness minus the thickness of the zinc coating)
f_y yield strength of the steel of the angle bracket
L_B the length of flange 2 from the middle of the bent edge
$C_{net,i}$ the net width of the angle bracket at hole row i and

$$F_{n,i} = n_i F_{ax,Rk} \quad (18)$$

when n_i is the number of fasteners at row i and $F_{ax,Rk}$ is the characteristic resistance against withdrawal in the timber member against flange 2 according to EN 1995-1-1.

If there are fasteners only in one or two rows at flange 2, in equation (17.a) is inserted $F_{n,2} = 0$ and $d_2 = d_1$ and equation (17.c) needs not to be checked.

Characteristic tension resistance for angle brackets with corner rib reinforcement is

$$R_{2,z,t,k} = \min\begin{cases} \Sigma F_{a,j} + F_{n,1} - 3 \cdot \dfrac{F_{n,1} \cdot d_1 - \dfrac{C \cdot {t_d}^2}{4} \cdot f_y}{2L_B - 2a + d_2} & \text{(a)} \\ \dfrac{{t_d}^2 f_y}{4(a+d_1)} \cdot \left(C + C_{net,1}\right) + \dfrac{\Sigma\left(F_{a,j}\left(a + d_1 - a_j\right)\right)}{a + d_1} & \text{(b)} \\ \sum F_{a,j} + F_{n,1} & \text{(c)} \end{cases} \qquad (19)$$

where

d_1 distance between the end of the corner rib reinforcement ridge and the hole row nearest to it in flange 2 (i = 1)
a is the length of the corner rib reinforcement ridge in flange 2
C the width of the angle bracket at the end of the corner rib reinforcement ridge
t_d is the thickness of the angle bracket to be used in calculations (= the minimum thickness minus the thickness of the zinc coating)
f_y yield strength of the steel of the angle bracket
L_B the length of flange 2 from the middle of the bent edge
$C_{net,i}$ the net width of the angle bracket at hole row i
$F_{n,1}$ is calculated from equation (18) where n_1 is the number of fasteners in the row nearest to the end of the corner rib reinforcement ridge (i) and

$$F_{a,j} = n_j F_{ax,Rk} \qquad (20)$$

when n_j is the number of fasteners at row j in the part of flange 2 with the corner rib reinforcement ridge and $F_{ax,Rk}$ is the characteristic resistance against withdrawal in the timber member against flange 2 according to EN 1995-1-1.

If the flange 2 of the angle bracket only has one row of fasteners on the part without corner rib reinforcement ridge, in equation (19) is inserted $F_{n,1} = 0$.

In Tables 4 – 9 calculated characteristic tension force capacities $R_{2,z,t,k}$ are presented for MiTek Angle Brackets, when anchor screws 5,0x40 are used in all holes of 5 mm.

Characteristic compression resistance for angle brackets without corner rib reinforcement is

$$R_{2,z,ck} = t_d \cdot \sqrt{3 \cdot C \cdot C_{net} \cdot f_y \cdot f_{c,90,k}} \qquad (21)$$

where t_d, C and f_y are defined as for equation (17) and C_{net} is the smallest net width of the flange 2 and $f_{c,90,k}$ is the characteristic compression strength perpendicular to the timber member against flange 2.

Characteristic compression resistance for angle brackets with corner rib reinforcement is

$$R_{2,z,c,k} = 3 \cdot a \cdot C_{ef} \cdot f_{c,90} + t_d \cdot \sqrt{3 \cdot C \cdot C_{net} \cdot f_y \cdot f_{c,90,k}} \qquad (22)$$

where a is the length of the corner rib reinforcement ridge from the bent edge of the angle bracket, C_{ef} is the width of the angle bracket minus the width of the corner rib reinforcement ridge and the other symbols as for equation (21).

Structural requirements

Joints with Angle Brackets shall fulfil the minimum spacing and edge distance requirement specified in EN 1995-1-1. The minimum distances a_1 and a_2 in table 8.2 can be multiplied by a factor of 0,7 (nailed steel-to-timber connections).

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

All fasteners in same flange shall be identical. The opposing flanges may have different fasteners. In conjunction with MiTek 90x90x1,5x65 vah bracket however all fasteners used in d = 5 mm holes shall be identical MiTek anchor screws 5x40 or MiTek Anchor nails 4x40.

In service class 2 the anchor nails and –screws shall be corrosion protected with at least Fe/Zn 12c -class (ISO 2081) electroplating or at least 39 µm thick hot dip galvanizing.

Galvanized angle brackets are not suitable for service class 3 applications.

Galvanized angle brackets unprotected are not suitable for structural fire proof applications.

In service class 3 connections anchor nails and –screws manufactured of applicable stainless steel shall be used. In conjunction with concrete bolts, anchors, screw bars or concrete screws with min. FeZn 25c class electroplating or at least 49 µm hot dip galvanized may be used.

Table 1. Symmetric angle brackets - Allowed fastener quantities in Ø5mm holes.

Fastener quantities n and shear capacity modification factors k_m, when fasteners are located in a) all holes, b) with minimum 28 mm edge distance or c) with minimum 42 mm edge distance (with symmetrical brackets $k_{m,A} = k_{m,B} = k_m$)

Angle Bracket	(a) full fixing		(b) edge dist. 28		(c) edge dist. 42	
A x *B* x *t* x *C*	*n*	k_m	*n*	k_m	*n*	k_m
50x50x2,5x35	4	1,70	2	0,47	2	0,47
70x70x2,5x55	6	2,63	4	1,33	2	0,55
90x90x2/2,5x65	8	3,01	6	1,62	6	1,62
70x70x2,5x55 vah	6	2,57	4	1,31	2	0,55
90x90x2/2,5x65 vah	8	2,97	6	1,62	6	1,62
40x40x2x20/25	2	0,76	-	-	-	-
40x40x2/2,5x40	3	1,50	-	-	-	-
40x40x2/2,5x60	5	2,46	2	0,65	-	-
60x60x2x25	3	1,06	2	0,45	-	-
60x60x2/2,5x40	5	1,96	3	0,68	2	0,40
60x60x2/2,5x50/60	8	3,42	5	1,51	3	0,79
60x60x2/2,5x80	11	5,22	7	2,38	4	1,51
80x80x2/2,5x60	10	4,01	7	1,96	5	1,12
67x67x2x90	14	6,30	9	3,35	5	1,97
80x80x2/2,5x80	14	6,01	10	3,22	7	2,01
60x60x2,5x100	14	7,08	9	3,74	5	2,21
80x80x2,5x40	6	2,17	4	0,90	3	0,56
80x80x2,5x100	18	8,29	13	4,77	9	2,75
100x100x2,5x100	23	9,84	18	6,29	14	4,20
90x90x3x40	8	2,59	6	1,44	6	1,44
65x65x3x55	8	3,11	5	1,47	3	0,69

Table 2. Non-symmetric angle brackets - Allowed fastener quantities in Ø5mm holes in Flange A.

Fastener quantities n_A and shear capacity modification factors $k_{m,A}$, when fasteners are located in a) all holes, b) with minimum 28 mm edge distance or c) with minimum 42 mm edge distance.

Angle Bracket *A* x *B* x *t* x *C*	(a) full fixing		(b) edge dist. 28		(c) edge dist. 42	
	n_A	$k_{m,A}$	n_A	$k_{m,A}$	n_A	$k_{m,A}$
60x75x2x60 vah	4	1,65	2	0,65	-	-
60x75x2/2,5x90 vah	6	2,44	3	0,73	3	0,73
40x60x2x25	2	0,76	-	-	-	-
40x60x2,5x60	5	2,25	2	0,60	-	-
60x80x2,5x60	8	3,24	5	1,43	3	0,75
60x100x2,5x60	8	3,24	5	1,43	3	0,75
120x92x3/4x40	10	3,25	8	2,05	8	2,05
140x92x3/4x40	8	2,16	8	2,16	7	1,60
160x50x3x40	10	3,13	10	3,13	8	1,99
164x84x4x60	8	2,69	8	2,69	6	1,50
164x84x4x80	11	3,40	11	3,40	9	2,26
164x84x4x100	12	4,35	12	4,35	9	2,65
190x50x2x40	14	4,55	12	3,22	11	2,64
290x50x2x40	21	6,87	19	5,45	18	4,84
83x62x2x40	5	1,34	5	1,34	4	0,96
90x35x2,5x40	6	1,96	5	1,39	4	0,93
90x40x3x40	8	2,69	6	1,54	4	0,79
90x48x3x48	7	2,31	6	1,78	5	1,30
90x48x3x76	12	4,75	10	3,62	8	3,12
90x48x3x116	18	8,20	15	6,28	12	4,89
105x105x3x90	14	4,68	14	4,68	11	3,68
105x105x3x90 vah	12	4,34	12	4,34	10	3,50

Table 3. Non-symmetric angle brackets - Allowed fastener quantities in Ø5mm holes in Flange B.

Fastener quantities n_B and shear capacity modification factors k_{mB}, when fasteners are located in a) all holes, b) with minimum 28 mm edge distance or c) with minimum 42 mm edge distance.

Angle Bracket	(a) full fixing		(b) edge dist. 28		(c) edge dist. 42 mm	
A x *B* x *t* x *C*	n_B	$k_{m,B}$	n_B	$k_{m,B}$	n_B	$k_{m,B}$
60x75x2x60 vah	4	1,23	4	1,23	3	0,87
60x90x2/2,5x90 vah	8	2,14	8	2,14	6	1,28
40x60x2x25	3	1,03	2	0,45	-	-
40x60x2,5x60	8	3,23	5	1,43	3	0,75
60x80x2,5x60	10	3,83	7	1,88	5	1,08
60x100x2,5x60	13	4,74	10	2,80	8	1,85
120x92x3/4x40	6	2,05	4	0,94	4	0,94
140x92x3/4x40	6	1,72	5	1,16	5	1,16
160x50x3x40	4	1,61	2	0,60	-	-
164x84x4x60	7	2,98	4	1,23	2	0,28
164x84x4x80	8	4,03	4	1,51	2	0,54
164x84x4x100	11	5,59	6	2,51	2	0,77
83x62x2x40	5	1,98	3	0,73	2	0,49
90x35x2,5x40	4	2,02	-	-	-	-
90x40x3x40	4	2,02	2	0,78	-	-
90x48x3x48	4	1,78	2	0,49	-	-
90x48x3x76	7	3,67	3	1,18	-	-
90x48x3x116	7	4,74	3	1,62	-	-
105x105x3x90	18	7,86	12	4,08	9	2,67
105x105x3x90 vah	14	6,52	10	3,88	8	2,69

2 Characteristic resistances for MiTek angle brackets - tabulated values

Timber specification:

Timber characteristic density $\rho_k \geq 350$ kg/m^3.

Fastener specification:

5,0x40 anchor screws EN 14592

Thickness of the core part of the screw threaded part $d_1 \geq 3{,}0$ mm

Threaded length $l_g \geq 30$ mm

Tensile capacity $f_{tens,k} \geq 8{,}0$ kN

Yield moment resistance $M_{y,k} \geq 6800$ Nmm

Withdrawal capacity (l_g x $f_{ax,k}$ x d) ≥ 1750 N at $\rho_k = 350$ kg/m^3

4,0x40 anchor nails EN 14592

Profiled length of the nail $l_g \geq 24$ mm

Yield moment resistance $M_{y,k} \geq 6850$ Nmm

4,0x60 anchor nails EN 14592

Profiled length $l_g \geq 35$ mm

Withdrawal strength $f_{ax,k} \geq 4{,}8$ N/mm^2 with timber density $\rho_k = 350$ kg/m^3

Design resistance: $R_d = \frac{k_{mod}}{\gamma_M} \cdot R_k$

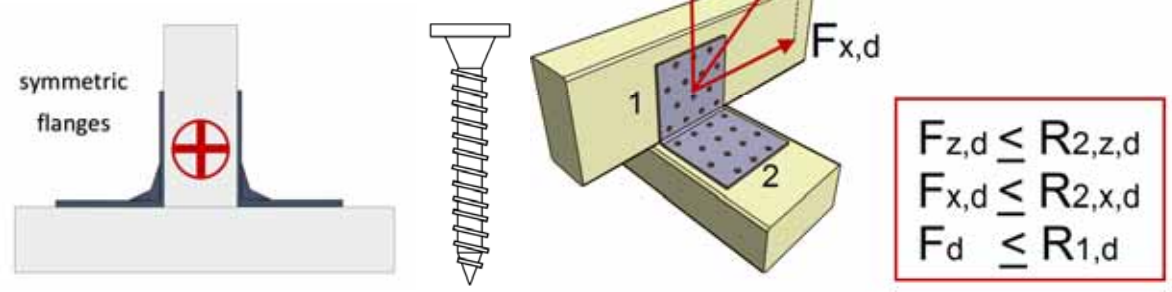
k_{mod} is the modification factor according to EN 1995-1-1 taking into account the effect of the duration of the load and moisture content for timber

γ_M is the partial factor for the resistance of connections according to the relevant National annex of EN 1995-1-1

R_k is the characteristic resistance of the angle bracket connection.

Symmetric MiTek Angle Brackets

Fastener: 5,0x40 anchor screws



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor screws in all 5 mm holes

n_{28mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 5,0x40 anchor screws on the bending flange.

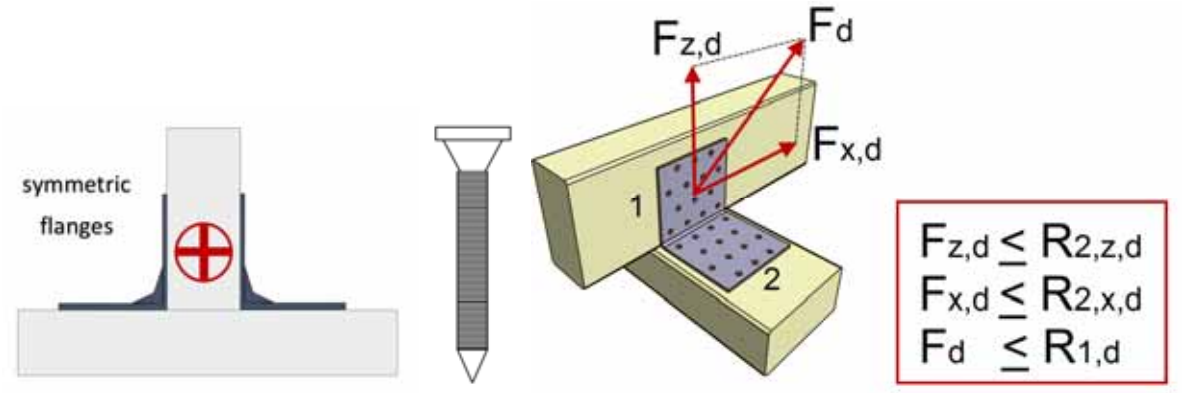
Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{2,z,t,k}$ (kN)	$R_{2,z,c,k}$ (kN)	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{full}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{28mm}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{42mm}
50x50x2,5x35	SZN	1,76	2,95	5,46	2,32	4	2,73	0,64	2	2,73	0,64	2
	SST	1,53	2,75									
70x70x2,5x55	SZN	2,40	4,43	8,18	3,59	6	5,46	1,81	4	2,73	0,75	2
	SST	2,09	4,13									
90x90x2x65	SZN	1,84	4,45	9,27	3,49	8	6,95	1,88	6	6,95	1,88	6
	SST	1,61	4,17									
90x90x2,5x65	SZN	2,88	5,62	10,9	4,11	8	8,18	2,21	6	8,18	2,21	6
	SST	2,60	5,24									
40x40x2x20	SZN	0,81	1,37	2,32	0,88	2						
	SST	0,71	1,28									
40x40x2x25	SZN	1,04	1,53	2,32	0,88	2						
	SST	0,91	1,43									
40x40x2x40	SZN	1,61	2,73	3,48	1,74	3						
	SST	1,41	2,56									
40x40x2,5x40	SZN	1,97	3,45	4,09	2,05	3						
	SST	1,71	3,22									
40x40x2x60	SZN	2,42	4,10	5,79	2,85	5	2,32	0,75	2			
	SST	2,12	3,84									
40x40x2,5x60	SZN	2,95	5,18	6,82	3,36	5	2,73	0,89	2			
	SST	2,57	4,83									
60x60x2x25	SZN	1,04	1,76	3,48	1,23	3	2,32	0,52	2			
	SST	0,91	1,65									
60x60x2x40	SZN	1,61	2,73	5,79	2,27	5	3,48	0,79	3	2,32	0,46	2
	SST	1,41	2,56									
60x60x2,5x40	SZN	1,97	3,45	6,82	2,67	5	4,09	0,93	3	2,73	0,55	2
	SST	1,71	3,22									

Angle Bracket A x B x t x C	Material	$R_{2,z,t,k}$ (kN)	$R_{2,z,c,k}$ (kN)	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{full}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{28mm}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{42mm}
60x60x2x50	SZN SST	1,96 1,72	3,30 3,09	9,27	3,96	8	5,79	1,75	5	3,48	0,92	3
60x60x2,5x50	SZN SST	2,39 2,08	4,17 3,88	10,9	4,67	8	6,82	2,06	5	4,09	1,08	3
60x60x2x60	SZN SST	2,42 2,12	4,10 3,84	9,27	3,96	8	5,79	1,75	5	3,48	0,92	3
60x60x2,5x60	SZN SST	2,95 2,57	5,18 4,83	10,9	4,67	8	6,82	2,06	5	4,09	1,08	3
60x60x2x80	SZN SST	3,22 2,83	5,46 5,11	12,74	6,05	11	8,11	2,76	7	4,63	1,75	4
60x60x2,5x80	SZN SST	3,94 3,43	6,90 6,43	15,0	7,12	11	9,55	3,25	7	5,46	2,06	4
80x80x2x60	SZN SST	2,42 2,12	4,10 3,84	11,6	4,65	10	8,11	2,27	7	5,79	1,30	5
80x80x2,5x60	SZN SST	2,95 2,57	5,18 4,83	13,6	5,47	10	9,55	2,67	7	6,82	1,53	5
67x67x2x90	SZN SST	2,01 1,76	6,03 5,65	16,2	7,30	14	10,4	3,88	9	5,79	2,28	5
80x80x2x80	SZN SST	3,22 2,83	5,46 5,11	16,2	6,96	14	11,6	3,73	10	8,11	2,33	7
80x80x2,5x80	SZN SST	3,94 3,43	6,90 6,43	19,1	8,20	14	13,6	4,39	10	9,55	2,74	7
60x60x2,5x100	SZN SST	4,92 4,28	8,63 8,04	19,1	9,66	14	12,3	5,10	9	6,82	3,01	5
80x80x2,5x40	SZN SST	1,97 1,71	3,45 3,22	8,18	2,96	6	5,46	1,23	4	4,09	0,76	3
80x80x2,5x100	SZN SST	4,92 4,28	8,63 8,04	24,5	11,3	18	17,7	6,51	13	12,3	3,75	9
100x100x2,5x100	SZN SST	4,92 4,28	8,63 8,04	31,4	13,4	23	24,5	8,58	18	19,1	5,73	14
90x90x3x40	SZN SST	1,99 2,05	4,10 4,16	12,6	4,07	8	9,43	2,26	6	9,43	2,26	6
65x65x3x55	SZN SST	3,23 2,79	5,50 5,12	12,6	4,89	8	7,86	2,31	5	4,71	1,08	3
70x70x2,5x55 vah	SZN SST	4,12 4,05	16,9 16,6	8,18	3,51	6	5,46	1,79	4	2,73	0,75	2
90x90x2x65 vah	SZN SST	3,39 3,35	19,7 19,4	9,27	3,44	8	6,95	1,88	6	6,95	1,88	6
90x90x2,5x65 vah	SZN SST	3,63 3,55	20,8 20,5	10,9	4,05	8	8,18	2,21	6	8,18	2,21	6

Symmetric MiTek Angle Brackets

Fastener: 4,0x40 / 4,0x60 anchor nails



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor nails in all 5 mm holes

n_{28mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 4,0x60 mm anchor nails used on the bending flange.

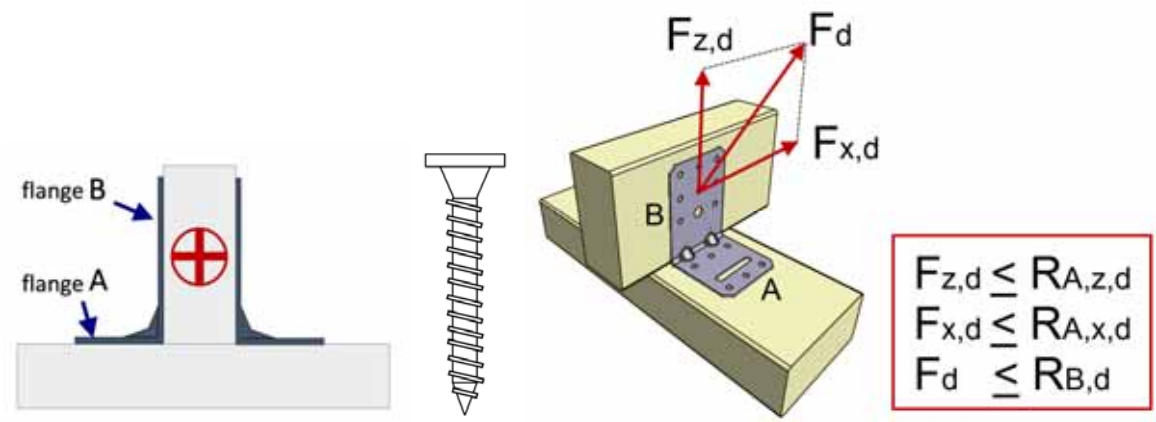
Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{2,z,t,k}$ (kN)	$R_{2,z,c,k}$ (kN)	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{full}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{28mm}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{42mm}
50x50x2,5x35	SZN SST	1,25 1,20	2,95 2,75	5,71	2,43	4	2,85	0,67	2	2,85	0,67	2
70x70x2,5x55	SZN SST	1,78 1,65	4,43 4,13	8,56	3,75	6	5,71	1,90	4	2,85	0,78	2
90x90x2x65	SZN SST	1,48 1,42	4,45 4,17	11,5	4,33	8	8,64	2,33	6	8,64	2,33	6
90x90x2,5x65	SZN SST	1,80 1,69	5,62 5,24	11,4	4,30	8	8,56	2,31	6	8,56	2,31	6
40x40x2x20	SZN SST	0,61 0,59	1,37 1,28	2,88	1,09	2						
40x40x2x25	SZN SST	0,64 0,62	1,53 1,43	2,88	1,09	2						
40x40x2x40	SZN SST	1,21 1,18	2,73 2,56	4,32	2,16	3						
40x40x2,5x40	SZN SST	1,26 1,20	3,45 3,22	4,28	2,14	3						
40x40x2x60	SZN SST	1,82 1,77	4,10 3,84	7,20	3,54	5	2,88	0,94	2			
40x40x2,5x60	SZN SST	2,70 2,57	5,18 4,83	7,13	3,51	5	2,85	0,93	2			
60x60x2x25	SZN SST	0,78 0,75	1,76 1,65	4,32	1,53	3	2,88	0,65	2			
60x60x2x40	SZN SST	1,46 1,40	2,73 2,56	7,20	2,82	5	4,32	0,98	3	2,88	0,58	2
60x60x2,5x40	SZN SST	1,54 1,50	3,45 3,22	7,13	2,80	5	4,28	0,97	3	2,85	0,57	2

Angle Bracket A x B x t x C	Material	$R_{2,z,t,k}$ (kN)	$R_{2,z,c,k}$ (kN)	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{full}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{28mm}	$R_{1,k}$ (kN)	$R_{2,x,k}$ (kN)	n_{42mm}
60x60x2x50	SZN SST	1,96 1,72	3,30 3,09	11,5	4,92	8	7,20	2,17	5	4,32	1,14	3
60x60x2,5x50	SZN SST	2,21 2,08	4,17 3,88	11,4	4,88	8	7,13	2,15	5	4,28	1,13	3
60x60x2x60	SZN SST	2,18 2,08	4,10 3,84	11,5	4,92	8	7,20	2,17	5	4,32	1,14	3
60x60x2,5x60	SZN SST	2,42 2,27	5,18 4,83	11,4	4,88	8	7,13	2,15	5	4,28	1,13	3
60x60x2x80	SZN SST	2,89 2,76	5,46 5,11	15,8	7,51	11	10,1	3,43	7	5,76	2,17	4
60x60x2,5x80	SZN SST	3,20 3,01	6,90 6,43	15,7	7,45	11	9,99	3,40	7	5,71	2,15	4
80x80x2x60	SZN SST	2,18 2,08	4,10 3,84	14,4	5,77	10	10,1	2,82	7	7,20	1,61	5
80x80x2,5x60	SZN SST	2,42 2,27	5,18 4,83	14,8	5,72	10	9,99	2,80	7	7,13	1,60	5
67x67x2x90	SZN SST	2,01 1,76	6,03 5,65	20,1	9,07	14	13,0	4,82	9	7,20	2,84	5
80x80x2x80	SZN SST	2,89 2,76	5,46 5,11	20,1	8,65	14	14,4	4,64	10	10,1	2,89	7
80x80x2,5x80	SZN SST	3,20 3,01	6,90 6,43	20,0	8,58	14	14,3	4,59	10	9,99	2,87	7
60x60x2,5x100	SZN SST	3,99 3,75	8,63 8,04	20,0	10,1	14	12,8	5,34	9	7,13	3,15	5
80x80x2,5x40	SZN SST	1,63 1,53	3,45 3,22	8,56	3,10	6	5,71	1,28	4	4,28	0,80	3
80x80x2,5x100	SZN SST	3,99 3,75	8,63 8,04	25,7	11,8	18	18,5	6,81	13	12,8	3,92	9
100x100x2,5x100	SZN SST	3,99 3,75	8,63 8,04	32,8	14,0	23	25,7	8,98	18	20,0	5,99	14
90x90x3x40	SZN SST	1,61 1,64	4,10 4,16	11,3	3,66	8	8,49	2,04	6	8,49	2,04	6
65x65x3x55	SZN SST	2,36 2,28	5,50 5,12	11,3	4,40	8	7,07	2,08	5	4,24	0,98	3
70x70x2,5x55 vah	SZN SST	2,19 2,12	16,9 16,6	8,56	3,67	6	5,71	1,87	4	2,85	0,78	2
90x90x2x65 vah	SZN SST	1,80 1,76	19,7 19,4	11,5	4,28	8	8,64	2,33	6	8,64	2,33	6
90x90x2,5x65 vah	SZN SST	2,03 1,96	20,8 20,5	11,4	4,24	8	8,56	2,31	6	8,56	2,31	6

Non-symmetric MiTek Angle Brackets, no corner rib reinforcement, flange A load is eccentric

Fastener: 5,0x40 anchor screws



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor screws in all 5 mm holes

n_{28mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 5,0x40 anchor screws on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

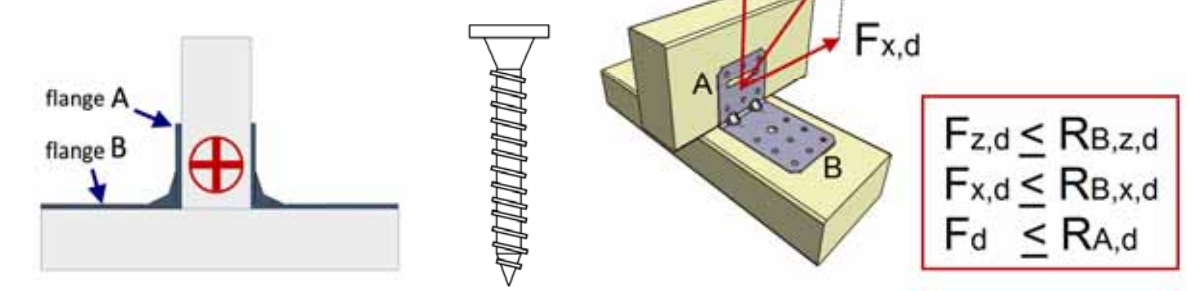
Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{A,z,t,k}$ (kN)	$R_{A,z,c,k}$ (kN)	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,full}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,28mm}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,42mm}$
40x60x2x25	SZN SST	1,04 0,91	1,76 1,65	3,48	0,88	2	2,32	-	-	-	-	-
40x60x2,5x60	SZN SST	3,09 2,68	5,18 4,83	10,9	3,07	5	6,82	0,82	2	4,09	-	-
60x80x2,5x60	SZN SST	3,09 2,68	5,18 4,83	13,6	4,42	8	9,55	1,95	5	6,82	1,02	3
60x100x2,5x60	SZN SST	3,09 2,68	5,18 4,83	17,7	4,42	8	13,6	1,95	5	10,9	1,02	3
120x92x3x40	SZN SST	1,65 1,43	3,96 3,68	9,43	5,11	10	6,29	3,22	8	6,29	3,22	8
120x92x4x40	SZN SST	2,92 2,64	5,34 4,94	10,1	5,47	10	6,73	3,45	8	6,73	3,45	8
140x92x3x40	SZN SST	1,27 1,10	4,17 3,88	9,43	3,39	8	7,86	3,39	8	7,86	2,51	7
140x92x4x40	SZN SST	1,97 1,77	5,63 5,21	10,1	3,63	8	8,41	3,63	8	8,41	2,69	7
160x50x3x40	SZN SST	1,11 0,96	3,96 3,68	6,29	4,92	10	3,14	4,92	10	-	3,13	8
164x84x4x60	SZN SST	2,92 2,59	8,89 8,24	11,8	4,52	8	6,73	4,52	8	3,36	2,52	6
164x84x4x80	SZN SST	3,42 3,31	12,2 11,3	13,5	5,72	11	6,73	5,72	11	3,36	3,80	9
164x84x4x100	SZN	4,70	15,0	18,5	7,32	12	10,1	7,32	12	3,36	4,46	9

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{A,z,t,k}$ (kN)	$R_{A,z,c,k}$ (kN)	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,full}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,28mm}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,42mm}$
	SST	4,26	13,9									
190x50x2x40	SZN SST	0,76 0,67	2,73 2,56	$F_{v,Rk}$ *)	5,27	14	-	3,73	12	-	3,06	11
290x50x2x40	SZN SST	0,76 0,67	2,73 2,56	$F_{v,Rk}$ *)	7,96	21	-	6,31	19	-	5,61	18
90x35x2,5x40	SZN SST	1,20 1,04	3,62 3,37	5,46	2,67	6	-	1,90	5	-	1,27	4
90x48x3x48	SZN SST	1,75 1,57	4,17 3,88	6,29	3,63	7	3,14	2,80	6	-	2,04	5
90x40x3x40	SZN SST	1,83 1,58	4,86 4,52	6,29	4,23	8	3,14	2,42	6	-	1,24	4
105x105x3x90	SZN SST	4,67 4,04	8,85 8,22	28,3	7,35	14	18,9	7,35	14	14,1	5,78	11

*) Flange B fixed with 12 mm bolt or other applicable d = 12 mm fastener.

Non-symmetric MiTek Angle Brackets, no corner rib reinforcement, flange B load is eccentric

Fastener: 5,0x40 anchor screws



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor screws in all 5 mm holes

n_{28mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 5,0x40 anchor screws on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

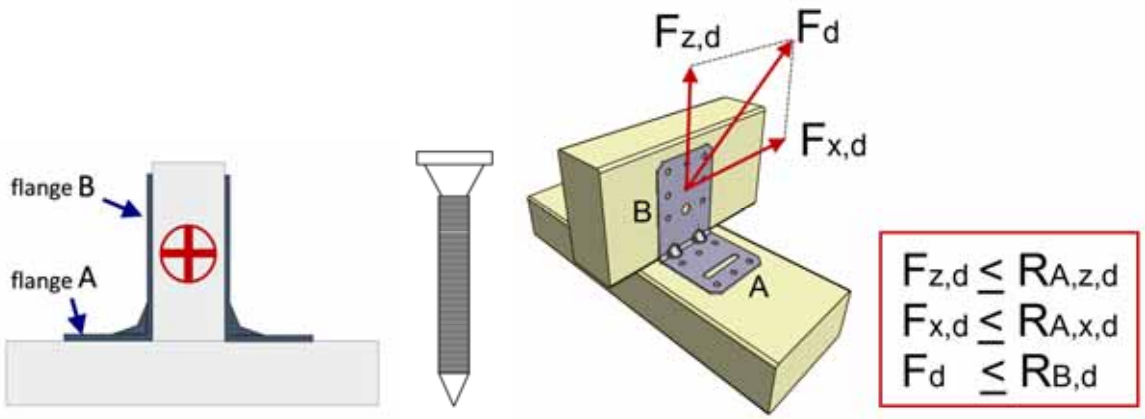
Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{B,z,t,k}$ (kN)	$R_{B,z,c,k}$ (kN)	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,full}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,28mm}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,42mm}$
40x60x2x25	SZN	1,04	1,76	2,32	1,19	3	-	0,52	2	-	-	-
	SST	0,91	1,65									
40x60x2,5x60	SZN	3,09	5,18	6,82	4,41	8	2,73	1,95	5	-	1,02	3
	SST	2,68	4,83									
60x80x2,5x60	SZN	3,09	5,18	10,9	5,22	10	6,82	2,56	7	4,09	1,47	5
	SST	2,68	4,83									
60x100x2,5x60	SZN	3,09	5,18	10,9	6,10	13	6,82	3,82	10	4,09	2,52	8
	SST	2,68	4,83									
120x92x3x40	SZN	1,65	3,96	15,7	3,22	6	12,6	1,48	4	12,6	1,48	4
	SST	1,43	3,68									
120x92x4x40	SZN	2,99	5,34	16,8	3,45	6	13,5	1,58	4	13,5	1,58	4
	SST	2,64	4,94									
140x92x3x40	SZN	1,54	4,17	12,6	2,70	6	12,6	1,82	5	11,0	1,82	5
	SST	1,45	3,88									
140x92x4x40	SZN	2,14	5,63	13,5	2,89	6	13,5	1,95	5	11,8	1,95	5
	SST	1,95	5,21									
160x50x3x40	SZN	2,05	3,96	15,7	2,53	4	15,7	0,94	2	12,6	-	-
	SST	1,77	3,68									
164x84x4x60	SZN	5,72	8,44	13,5	5,01	7	13,5	2,07	4	10,1	0,47	2
	SST	5,29	7,82									
164x84x4x80	SZN	7,17	11,3	18,5	6,78	8	18,5	2,54	4	15,1	0,91	2
	SST	7,02	10,4									
164x84x4x100	SZN	9,25	14,1	20,2	9,40	11	20,2	4,22	6	15,1	1,30	2
	SST	8,54	13,0									

Angle Bracket A x B x t x C	Material	$R_{B,z,t,k}$ (kN)	$R_{B,z,c,k}$ (kN)	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,full}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,28mm}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,42mm}$
190x50x2x40	SZN SST	0,49 0,43	2,19 2,05	16,2	-	1 *)	13,9	-	-	12,7	-	-
290x50x2x40	SZN SST	0,49 0,43	2,19 2,05	24,3	-	1 *)	22,0	-	-	20,9	-	-
90x35x2,5x40	SZN SST	2,65 2,30	3,45 3,22	8,18	2,76	4	6,82	-	-	5,46	-	-
90x48x3x48	SZN SST	2,86 2,48	4,17 3,88	11,0	2,80	4	9,43	0,77	2	7,86	-	-
90x40x3x40	SZN SST	2,94 2,54	4,93 4,59	12,6	3,17	4	9,43	1,23	2	6,29	-	-
105x105x3x90	SZN SST	2,69 2,33	9,14 8,49	22,0	12,4	18	22,0	11,1	12	17,3	4,20	9

*) Flange B fixed with single 12 mm bolt or other applicable d = 12 mm fastener.

Non-symmetric MiTek Angle Brackets, no corner rib reinforcement, flange A load is eccentric

Fastener 4,0x40 / 4,0x60 anchor nails



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor nails in all 5 mm holes

n_{28mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 4,0x60 mm anchor nails used on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

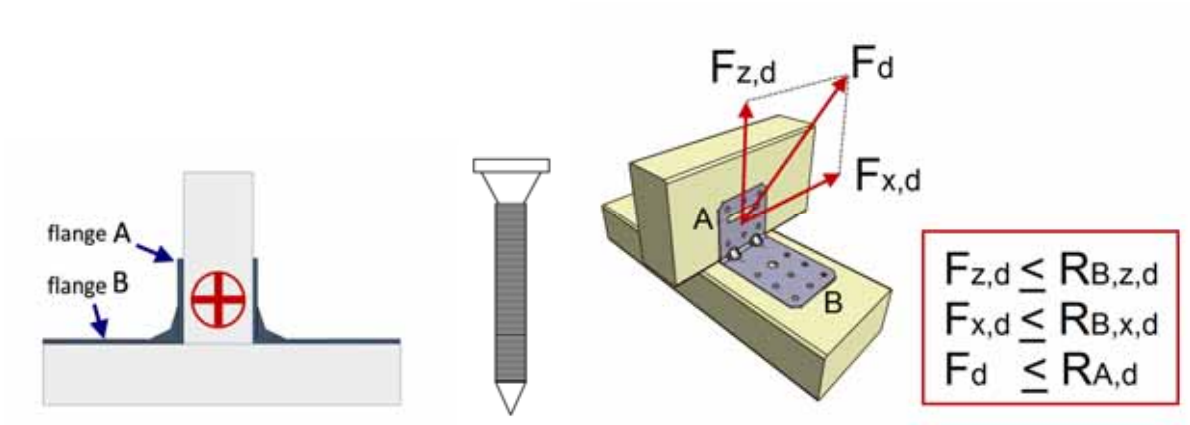
Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{A,z,t,k}$ (kN)	$R_{A,z,c,k}$ (kN)	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,full}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,28mm}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,42mm}$
40x60x2x25	SZN SST	1,04 0,91	1,76 1,65	4,32	1,09	2	2,88	-	-	-	-	-
40x60x2,5x60	SZN SST	2,75 2,67	5,18 4,83	11,4	3,21	5	7,13	0,86	2	4,28	-	-
60x80x2,5x60	SZN SST	2,45 2,30	5,18 4,83	14,3	4,62	8	9,99	2,04	5	7,13	1,07	3
60x100x2,5x60	SZN SST	2,45 2,30	5,18 4,83	18,6	4,62	8	14,3	2,04	5	11,4	1,07	3
120x92x3x40	SZN SST	1,49 1,38	3,96 3,68	8,49	4,60	10	5,66	2,90	8	5,66	2,90	8
120x92x4x40	SZN SST	2,17 1,96	5,34 4,94	8,34	4,52	10	5,56	2,85	8	5,56	2,85	8
140x92x3x40	SZN SST	1,02 0,92	4,17 3,88	8,49	3,06	8	7,07	3,06	8	7,07	2,26	7
140x92x4x40	SZN SST	1,20 1,15	5,63 5,21	8,34	3,00	8	6,95	3,00	8	6,95	2,22	7
160x50x3x40	SZN SST	1,11 0,96	3,96 3,68	5,66	4,43	10	2,83	4,43	10	-	2,81	8
164x84x4x60	SZN SST	2,03 1,90	8,89 8,24	9,73	3,74	8	5,56	3,74	8	2,78	2,08	6
164x84x4x80	SZN SST	1,96 1,88	12,2 11,3	11,1	4,73	11	5,56	4,73	11	2,78	3,14	9
164x84x4x100	SZN SST	3,38 3,28	15,0 13,9	15,3	6,05	12	8,34	6,05	12	2,78	3,68	9

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{A,z,t,k}$ (kN)	$R_{A,z,c,k}$ (kN)	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,full}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,28mm}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,42mm}$
190x50x2x40	SZN SST	0,76 0,67	2,73 2,56	$F_{v,Rk}$ *)	6,55	14	-	4,64	12	-	3,80	11
290x50x2x40	SZN SST	0,76 0,67	2,73 2,56	$F_{v,Rk}$*)	9,89	21	-	7,85	19	-	6,97	18
90x35x2,5x40	SZN SST	1,02 0,92	3,62 3,37	5,71	2,80	6	-	1,98	5	-	1,33	4
90x48x3x48	SZN SST	1,17 1,12	4,17 3,88	5,66	3,27	7	2,83	2,52	6	-	1,84	5
90x40x3x40	SZN SST	1,58 1,46	4,86 4,52	5,66	3,80	8	2,83	2,18	6	-	1,12	4
105x105x3x90	SZN SST	4,60 4,04	8,85 8,22	25,5	6,62	14	17,0	6,62	14	12,7	5,21	11

*) The lateral load-carrying capacity of the 12 mm bolt or other applicable 12 mm fastener used on flange B

Non-symmetric MiTek Angle Brackets, no corner rib reinforcement, flange B load is eccentric

Fastener 4,0x40 / 4,0x60 anchor nails



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor nails in all 5 mm holes

n_{28mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor nails in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 4,0x60 mm anchor nails used on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

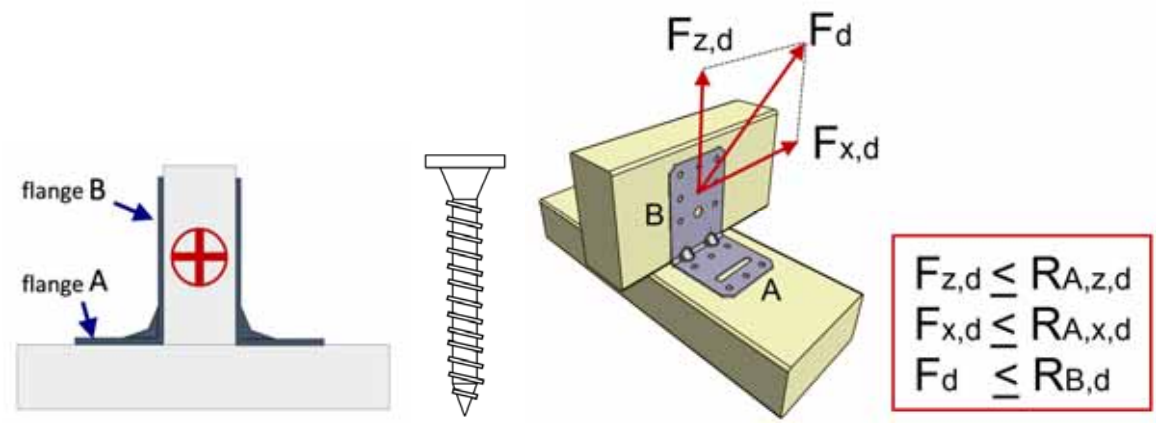
Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{B,z,t,k}$ (kN)	$R_{B,z,c,k}$ (kN)	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,full}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,28mm}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,42mm}$
40x60x2x25	SZN SST	0,78 0,75	1,76 1,65	2,88	1,48	3	-	0,65	2	-	-	-
40x60x2,5x60	SZN SST	2,45 2,30	5,18 4,83	7,13	4,61	8	2,85	2,04	5	-	1,07	3
60x80x2,5x60	SZN SST	2,45 2,30	5,18 4,83	11,4	5,47	10	7,13	2,68	7	4,28	1,54	5
60x100x2,5x60	SZN SST	2,45 2,30	5,18 4,83	11,4	6,38	13	7,13	4,00	10	4,28	2,64	8
120x92x3x40	SZN SST	1,47 1,38	3,96 3,68	14,1	2,90	6	11,3	1,33	4	11,3	1,33	4
120x92x4x40	SZN SST	1,92 1,85	5,34 4,94	13,9	2,85	6	11,1	1,31	4	11,1	1,31	4
140x92x3x40	SZN SST	1,09 0,99	4,17 3,88	11,3	2,43	6	11,3	1,64	5	9,9	1,64	5
140x92x4x40	SZN SST	1,45 1,39	5,63 5,21	11,1	2,39	6	11,1	1,61	5	9,7	1,61	5
160x50x3x40	SZN SST	2,03 1,77	3,96 3,68	14,1	2,28	4	14,1	0,85	2	11,3	-	-
164x84x4x60	SZN SST	3,14 3,02	8,44 7,82	11,1	4,14	7	11,1	1,71	4	8,3	0,39	2
164x84x4x80	SZN SST	3,96 3,80	11,3 10,4	15,3	5,60	8	15,3	2,10	4	12,5	0,75	2
164x84x4x100	SZN SST	5,46 5,27	14,1 13,0	16,7	7,77	11	16,7	3,49	6	12,5	1,07	2

Angle Bracket A x B x t x C	Material	$R_{B,z,t,k}$ (kN)	$R_{B,z,c,k}$ (kN)	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,full}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,28mm}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,42mm}$
190x50x2x40	SZN SST	0,49 0,43	2,19 2,05	20,2	-	1 *)	17,3	-	-	15,8	-	-
290x50x2x40	SZN SST	0,49 0,43	2,19 2,05	30,2	-	1 *)	27,4	-	-	25,9	-	-
90x35x2,5x40	SZN SST	2,28 2,22	3,45 3,22	8,56	2,88	4	7,13	-	-	5,71	-	-
90x48x3x48	SZN SST	2,25 2,16	4,17 3,88	9,9	2,52	4	8,49	0,69	2	7,07	-	-
90x40x3x40	SZN SST	2,30 2,21	4,93 4,59	11,3	2,86	4	8,49	1,10	2	5,66	-	-
105x105x3x90	SZN SST	1,72 1,65	9,14 8,49	19,8	11,1	18	19,8	10,0	12	15,6	3,78	9

*) Flange B fixed with single 12 mm bolt or other applicable d = 12 mm fastener.

Non-symmetric MiTek Angle Brackets, corner rib reinforcement, flange A load is eccentric

Fastener: 5,0x40 anchor screws



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor screws in all 5 mm holes

n_{28mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance $\geq$ 28 mm

n_{42mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance $\geq$ 42 mm

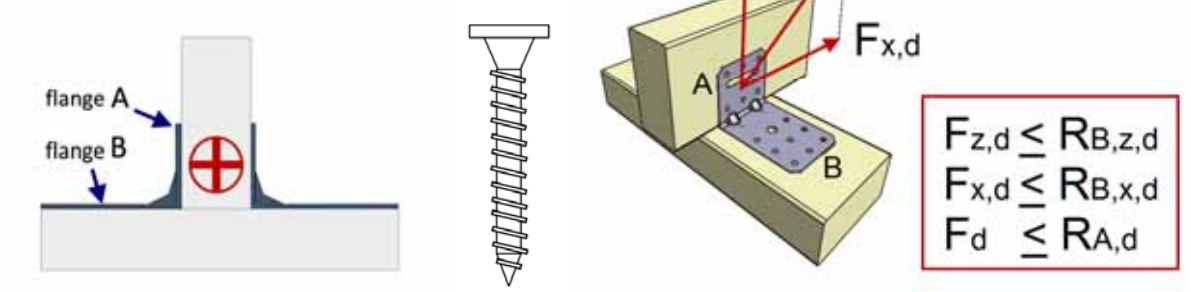
When the joint is under tension all holes shall have 5,0x40 anchor screws on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{A,z,t,k}$ (kN)	$R_{A,z,c,k}$ (kN)	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,full}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,28mm}$	$R_{B,k}$ (kN)	$R_{A,x,k}$ (kN)	$n_{A,42mm}$
60x75x2x60 vah	SZN	1,52	5,43	4,63	1,91	4	4,63	0,75	2	3,48	-	-
	SST	1,49	5,26									
60x90x2x60 vah	SZN	1,28	5,43	10,9	3,33	6	10,9	1,00	3	8,18	1,00	3
	SST	1,12	5,26									
60x90x2,5x60 vah	SZN	2,07	6,08	10,9	3,33	6	10,9	1,00	3	8,18	1,00	3
	SST	1,80	5,84									
83x62x2x40 vah	SZN	0,49	6,77	5,79	1,55	5	3,48	1,55	5	2,32	1,11	4
	SST	0,43	6,59									
90x48x3x76 vah	SZN	2,73	11,0	11,0	7,46	12	4,71	5,69	10	-	4,90	8
	SST	2,52	10,5									
90x48x3x116 vah	SZN	3,93	18,4	11,0	12,9	18	4,71	9,87	15	-	7,68	12
	SST	3,89	17,6									
105x105x3x90 vah	SZN	7,28	32,6	22,0	6,82	12	15,7	6,82	12	12,6	5,50	10
	SST	7,10	31,9									

Non-symmetric MiTek Angle Brackets, corner rib reinforcement, flange B load is eccentric

Fastener: 5,0x40 anchor screws



$F_{z,d}$ is either the compressive force component ($F_{z,c,d}$) or tensile force component ($F_{z,t,d}$).

n_{full} 5,0x40 anchor screws in all 5 mm holes

n_{28mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 28 mm

n_{42mm} 5,0x40 anchor screws in 5 mm holes with end/edge distance ≥ 42 mm

When the joint is under tension all holes shall have 5,0x40 anchor screws on the bending flange.

Bracket raw material: SZN = hot-dip galvanized, SST = stainless steel

Angle Bracket *A* x *B* x *t* x *C*	Material	$R_{B,z,t,k}$ (kN)	$R_{B,z,c,k}$ (kN)	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,full}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{B,28mm}$	$R_{A,k}$ (kN)	$R_{B,x,k}$ (kN)	$n_{A,42mm}$
60x75x2x60 vah	SZN SST	0,82 0,72	6,56 6,32	4,63	1,42	4	2,32	1,42	4	-	1,01	3
60x90x2x60 vah	SZN SST	0,56 0,49	6,56 6,32	8,18	2,92	8	4,09	2,92	8	4,09	1,75	6
60x90x2,5x60 vah	SZN SST	0,91 0,79	7,50 7,17	8,18	2,92	8	4,09	2,92	8	4,09	1,75	6
83x62x2x40 vah	SZN SST	2,42 2,36	6,56 6,38	5,79	2,29	5	5,79	0,85	3	4,63	0,57	2
90x48x3x76 vah	SZN SST	2,88 2,88	11,3 10,7	18,9	5,77	7	15,7	1,85	3	12,6	-	-
90x48x3x116 vah	SZN SST	5,76 5,76	18,0 17,2	28,3	7,45	7	23,6	2,55	3	18,9	-	-
105x105x3x90 vah	SZN SST	3,43 3,26	32,0 31,3	18,9	10,2	14	18,9	6,10	10	15,7	4,23	8

ANNEX 3. REINFORCEMENT OF SUPPORT AREAS OF PUNCHED METAL PLATE STRUCTURES WITH MITEK ANGLE BRACKETS

1 General

This annex relates to the use of MiTek angle brackets types of *60x75x2x60 vah*, 60x90x2x60 vah and *60x90x2,5x60 vah* together with MiTek punched metal plate fastener types of Top-W and M20H (0416-CPD-5909-01 and 0402-CPD-SC0950-09) for the reinforcement of the compression capacity perpendicular to the grain of timber members. The punched metal plate fasteners shall be placed to both sides of the chord member according to Figure A3.1. The timber thickness of the punched metal plate structure b shall be at least 42 mm.

MiTek angle brackets shall be fixed by anchor nails, size 4,0x40, from all the nailing holes of the angle bracket. The angle brackets are placed according to the Figure A3.1 to both sides of the punched metal plate structure. The longer side of the angle bracket shall be fixed to the punched metal plate structure. Pre-drilling of diameter 3,5 mm may be used for the nails fixed through the punched metal plates.

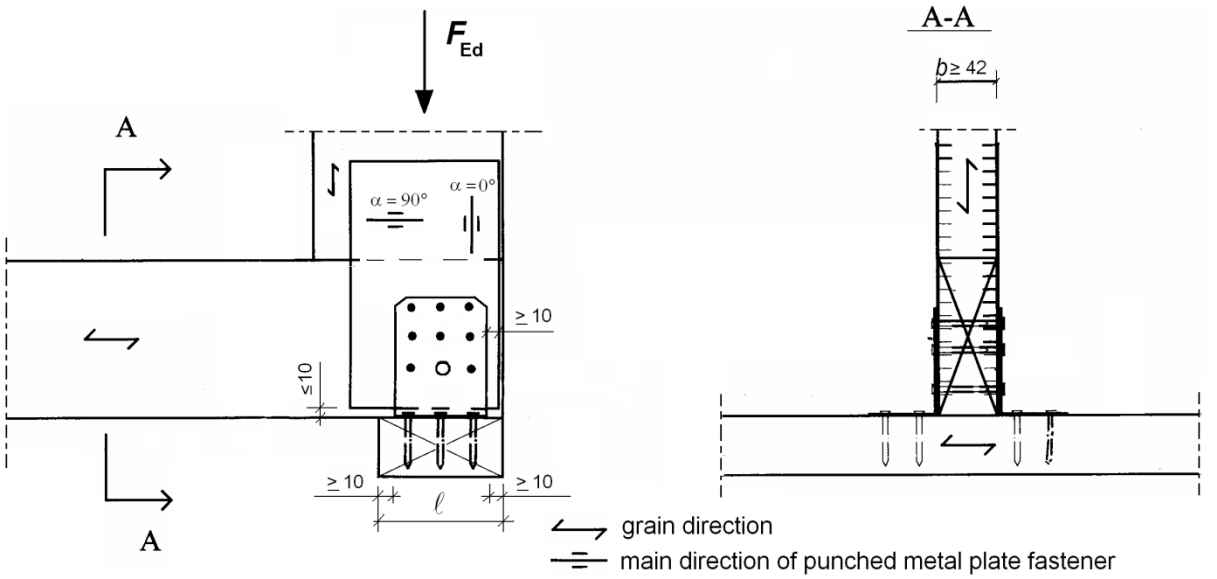


Figure A3.1 Support area reinforced by MiTek angle brackets with punched metal plate fasteners.

2 Compression capacity of sawn timber support

The load bearing capacity perpendicular to the grain of the sawn timber member acting as a support of the punched metal plate structure may be reinforced by the MiTek angle brackets provided that the following conditions are fulfilled:

- the sawn timber support member is softwood of strength class of at least C24
- the width of the sawn timber member is at least 95 mm (support length of punched metal plate structure $\ell \geq 95$ mm)
- the distance from the contact area to the end of the sawn timber member and the distance to the next contact area shall be at least 200 mm
- the loading direction of the punched metal plate fasteners $\alpha = 0°$ (“vertical placement”) or $\alpha = 90°$ (“horizontal placement”) for Top-W plates, while with the M20H plates the main direction of the fastener shall be parallel to the support surface, $\alpha = 90°$ (see Figure A3.1)
- the distance between the lower edge of the punched metal plate fastener and the support surface shall not be greater than 10 mm

- the punched metal plate fastener shall extend at least 20 mm above the angle bracket and in the horizontal directions at least 10 mm over the edges of the angle bracket

The reinforcement effect of the angle brackets may be utilised also with a vertical web member of the punched metal plate structure that is in direct contact to the support provided, that the width of vertical timber member extends at least 10 mm outside the both edges of the angle brackets. Also in this case, the above presented punched metal plate reinforcement shall be used under the angle brackets.

Characteristic compression capacity of the sawn timber support member may be calculated by expression (3.1) provided, that a compression of the support up to 10 mm may be accepted at the ultimate limit states.

$$F_{c,90,Rk} = k_{c,90} f_{c,90,k} b_{ef} \ell + R_{AB,k} \quad (3.1)$$

where

$k_{c,90}$ = 1,25;
$f_{c,90,k}$ is the characteristic compression strength perpendicular to the grain for the sawn timber member;
b_{ef} = b + 60 mm, when b is the timber thickness of the punched metal plate structure;
ℓ is the width of the sawn timber member (support length);
$R_{AB,k}$ is the characteristic reinforcement capacity of the angle brackets, see Table A3.1.

Design capacity $F_{c,90,Rd}$ is calculated according to EN 1995-1-1 using the modification factor k_{mod} and the partial safety factor γ_M given for solid timber.

Table A3.1 Characteristic reinforcement capacity of MiTek angle brackets for sawn timber support member $\boldsymbol{R_{AB,k}}$ (kN), when the support area of the punched metal plate structure is reinforced by Top-W or M20H plates.

Reinforcement	α = 0° (vertical placement)			α = 90°		
Angle brackets	60x75x2x 60 vah	60x90x2x 60 vah	60x90x2,5x 60 vah	60x75x2x 60 vah	60x90x2x 60 vah	60x90x2,5x 60 vah
MiTek TOP-W	5,1	5,7	5,7	12,4	7,6	8,0
MiTek M20H	-	-	-	6,0	5,0	5,6

3 Compression capacity of punched metal plate structure's chord member

The compression capacity of the punched metal plate structure's chord member may be reinforced at the end support by the MiTek angle brackets together with the MiTek punched metal plate fasteners provided, that the following conditions are fulfilled:

- the support starts from the end of the chord and the distance to the next support of the punched metal plate structure is at least 2h measured between the inner edges of the supports, when h is the height of the chord
- the chord member is solid softwood timber where the grain direction is parallel to the support surface
- the main direction of the punched metal plate fasteners is parallel to the grain direction of the chord member ("horizontal placement α = 90°") and the reinforcement plates are also

acting as the normal punched metal plate connection between the chord and web members

- the length of the punched metal plate fasteners shall be equal or greater than the support length ℓ
- the distance between the edge of the punched metal plate fastener and the lower edge of the chord member shall not be greater than 10 mm
- the minimum height of the chord member is at least 12 mm greater than the height of the angle bracket
- in horizontal directions the punched metal plate fastener shall extend at least 10 mm over the edges of the angle bracket
- the lower flange of the angle brackets shall be in full contact to the underneath supporting structure

The design value for the compression capacity for the reinforced support area of the punched metal plate structure may be calculated as follows:

$$R_{c,90,d} = k_{mod}\left(k_{c,90}\frac{f_{c,90,k}}{\gamma_{M,w}}A_{ef} + 2l_{n,ef}\frac{p_{c,90,k}}{\gamma_{M,n}} + \frac{P_{AB,k}}{\gamma_{M,n}}\right) \quad (3.2)$$

where

k_{mod} is the modification factor for service class and duration of load given in Eurocode 5 for solid timber;

$k_{c,90}$ = 1,25;

$f_{c,90,k}$ is the characteristic compression strength perpendicular to the grain for the chord member;

$\gamma_{M,w}$ is the partial safety coefficient for material properties of solid timber according to the actual National Annex of Eurocode 5;

A_{ef} is the effective contact area of wood in compression perpendicular to the grain: $A_{ef} = b\ (\ell + 30\ mm)$, when b is the thickness of the chord member and ℓ is the support length;

$l_{n,ef}$ is the effective length of the reinforcement plates: $l_{n,ef} = \ell - a_n - c$, where ℓ is the support length, a_n is the designed distance between the edge on punched metal plate fastener and the chord end and c is the allowed misplacement tolerance of the punched metal plate fasteners;

$p_{c,90,k}$ is the characteristic reinforcement resistance of the punched metal plate fastener;

$\gamma_{M,n}$ is the partial safety coefficient for anchorage resistance of punched metal plate fasteners according to the actual National Annex of Eurocode 5;

$P_{AB,k}$ is the characteristic reinforcement resistance of the angle brackets for the support area of punched metal plate structure, see Table A3.2.

For the characteristic reinforcement resistance of the punched metal plate fastener, the following values may be used:

MiTek Top-W:	$p_{c,90,k}$ = 81 N/mm
MiTek M20H:	$p_{c,90,k}$ = 49 N/mm

Table A3.2 Characteristic reinforcement resistance of MiTek angle brackets for the support area of punched metal plate structure $\boldsymbol{P_{AB,Rk}}$ (kN).

Reinforcement	α = 90° (horizontally placed punched metal plates)		
Angle brackets	60x75x2x60 vah	60x90x2x60 vah	60x90x2,5x60 vah
MiTek TOP-W	11,5	7,4	9,0
MiTek M20H	12,2	8,7	10,5