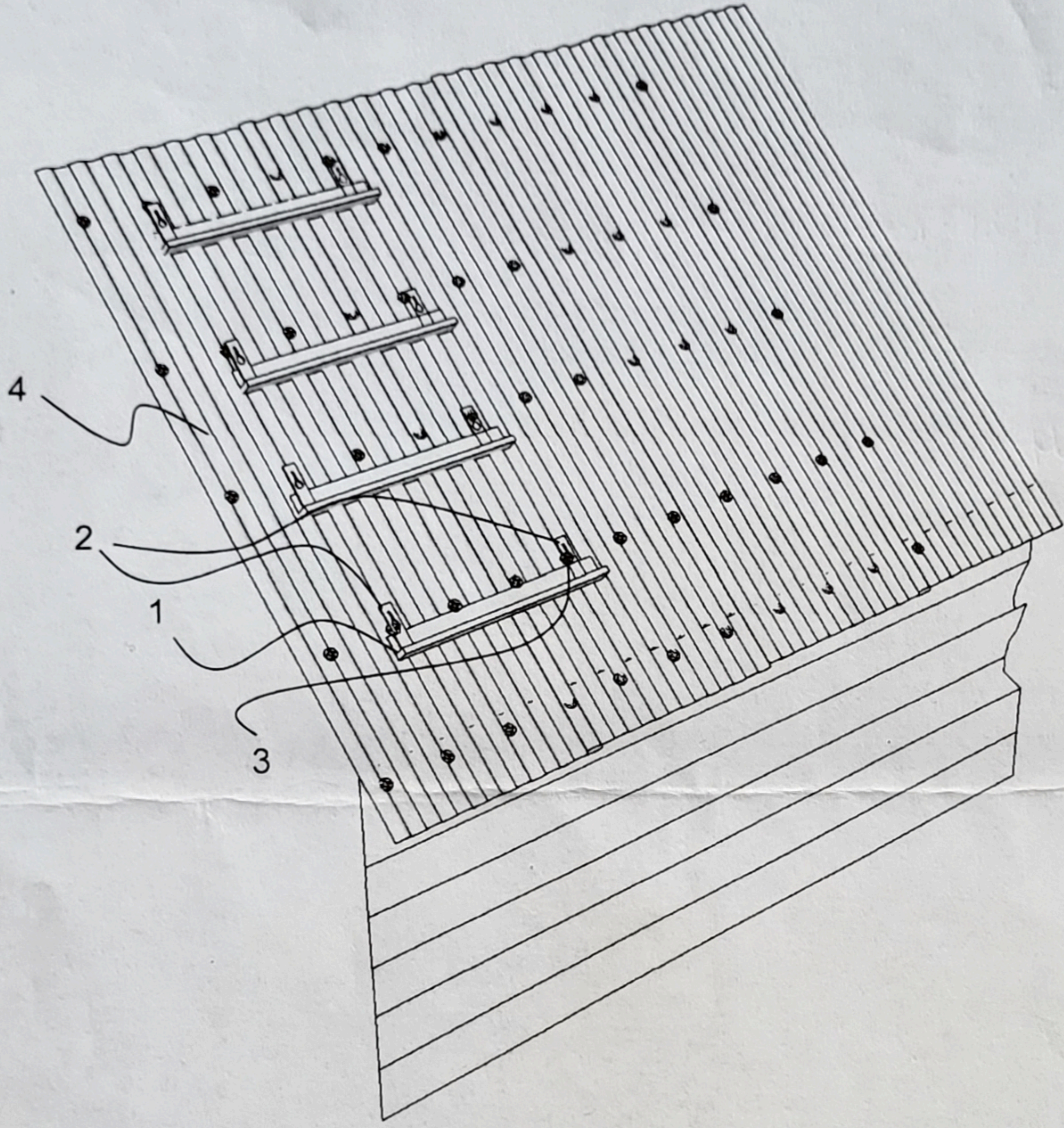


Figure 1



PAT NO. 715105
NZ DES. 421021

12g SCREW 11.8kN
14g SCREW 13.5kN

SHEAR
WEIGHT

ENGINEERS: ELECTROTECH CONSULTANTS



NEW ZEALAND
INTELLECTUAL
PROPERTY OFFICE

CERTIFICATE OF REGISTRATION DESIGN

DESIGN REGISTRATION NUMBER: 421021

In accordance with the Designs Act 1953 this design, of which representation is attached, was entered into the register of designs in respect of the application of the design to:

Roof safety apparatus

Owner(s): TARANAKI STEELFORMERS LIMITED, c/o Pricewaterhousecoopers, 54 Gill Street, New Plymouth 4310, New Zealand

The term of initial registration is 5 years commencing on 11 December 2015.

Mandy McDonald

Mandy McDonald
Commissioner of Designs

Issued on 11 March 2016





**NEW ZEALAND
INTELLECTUAL
PROPERTY OFFICE**

CERTIFICATE OF REGISTRATION TRADE MARK

TRADE MARK REGISTRATION NUMBER: 1031262

In accordance with the Trade Marks Act 2002 this trade mark was entered on the register of trade marks on **27 February 2018** with a deemed registration date of **9 November 2015**. The details of registration are:

Roof Crawler

Owner(s): **TARANAKI STEELFORMERS LIMITED, c/o Pricewaterhousecoopers, 54 Gill Street, New Plymouth 4310, New Zealand**

In respect of the goods and services that follow.

Ross van der Schyff
Commissioner of Trade Marks

Issued on 27 February 2018



MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT
KŌKŪA WHAKATŪTURU

New Zealand Government

COMPLETE SPECIFICATION

TITLE

Apparatus for safety on a roof.

5 FIELD OF INVENTION

This invention relates to apparatus for enhancing safety while working on a roof.

BACKGROUND

10 Working on a roof can be dangerous in that a fall can cause serious injury or even be fatal. It is known to assemble scaffolding around the edge of a roof so as to minimise risk, but this does not really assist one much when it comes to moving across the actual surface of the roof. It is accordingly an object of a preferred form of the invention to go at least some way towards addressing this problem. While this object applies to the preferred embodiment, it should not be seen as a limit on the scope of
15 the claims. The object of the invention in its broadest form is simply to provide the public with a useful choice.

The term "comprising" as used in this document in relation to a combination of features should not be taken to rule out the option of there being other features. The
20 term should therefore not be interpreted in a limiting way.

Reference to a roof should be taken to include a roof already formed, or one that is under construction but has not yet been completed.

25 SUMMARY OF INVENTION

According to one aspect of the invention there is provided apparatus for enhancing safety on a roof, comprising a series of elongate treads laid out generally horizontally across the roof, one above the other in spaced parallel relationship, so as to provide a series of foot plants for a human worker, each tread being isolated from the other
30 said tread(s) and having at least a pair of connector parts, each connector part having an aperture that receives a fastener (eg a screw, nail or the like) driven through and protruding above roof cladding, so that the tread is releasably secured to the roof by way of the connector parts.

35 Optionally each connector part comprises a tab.

Optionally the tabs of each tread are removable from the rest of the tread.

5 Optionally the aperture of each tab comprises a broad region and narrower linear region (eg a key-hole shape).

Optionally each tread has a generally "L" shaped profile.

10 Optionally each tread has an undulating surface adapted to enhance grip between a worker's feet and the tread when the worker is standing on one or more of the treads.

Optionally each tread has one or more recesses which contain cushioning means arranged to protect the roof from being scratched by other parts of the tread.

15 Optionally the cushioning means is/are removable from the recess(es).

Optionally each tread has a series of spaced holes to provide a selection of points for fixing the connector parts/tabs to the rest of the tread.

20 Optionally each connector part (eg tab) is prevented from pulling away from the roof by a head of a respective one of the fasteners.

DRAWINGS

25 Some preferred embodiments of the invention will now be described by way of example and with reference to the accompanying drawings, of which:

Figure 1 is an isometric view of a series of treads fixed to the roof of a building;

Figure 2 is an isometric view of one of the treads;

Figure 3 is a front elevation view of the tread;

Figure 4 is a side view of the tread; and

30 **Figure 5** is an isometric view of a connector tab forming part of the tread.

DETAILED DESCRIPTION

Referring to figure 1, a series of treads 1 are fitted to the roof of a building to provide a safe walking surface for a worker. The treads simulate a ladder except that they

each engage the roof independently. They are not joined to one another. Each tread 1 has a pair of tabs 2 hooked onto the screws 3 used to secure roof-cladding 4. In figure 1 the cladding is in the form of sheets of corrugated iron, although the treads 1 can also be used to good effect on other types of cladding.

5

Referring to figures 2, 3 and 4, each tread 1 is beam-like and is a little longer than the distance between adjacent rafters under the roof cladding. The treads 1 are generally "L" shaped in transverse cross section and each has a pair of end caps 5, 6 and a pair of strip-like pads 7 (see figure 4). The pads 7 fit releasably into recesses 8 at the back 9 of the tread to provide a cushion between the tread and the roof. This protects against scratching or marking the cladding especially if it is painted. The right-angled front or foot 10 of the tread is hollow and provides a stepping surface for the worker. He or she can walk up and down the treads, one after the other, using them like a ladder to get a good foothold and keep from slipping down the roof. As shown, each tread has serrated upward and outward facing anti-slip surfaces 11 to help the worker maintain a good grip.

10

15

20

25

Referring to figure 5, each connector tab 2 has a lower hole 12 to enable it to be releasably bolted to the rest of the tread. The tabs 2 also have an upper keyhole shaped fixing aperture 13 and it is this that hooks onto the roof screws in each case. The broader region of the keyhole makes it easier to position the tab 2 over the screw's head, and then gravity causes the tab to drop a little so that the screw engages the narrower region of the keyhole. When this happens the head of the screw, which is wider, stops the tab 2 from pulling away from the screw. The tabs 2 can engage roof nails in the same way, if for example these are used instead of screws.

30

In some embodiments of the invention each tread may have a series of holes (not shown) spaced along its length to provide a selection of points for fixing the tabs 2. This enables adjustment of the position of the tabs if for example the treads are used with roofs of other than standard spacing between rafters. Tilting the tabs 2 slightly to the left or right before tightening them to the rest of the tread also facilitates a degree of adjustment.

35

Preferably the treads 1 are formed from a suitable metallic material, for example galvanised steel, except of course for the pads 7. In a particularly preferred embodiment the treads are approximately 1m long, the tabs 2 are fixed

approximately 120 mm from each end, the back 9 is approximately 70 mm high and the foot 10 extends forwards approximately 56 mm. However these dimensions are not critical and many alternatives will suffice without detracting from overall functionality.

5

In some cases the treads 1 are fastened to the roof screws 3 before they are screwed down hard. This gives a little more elevation to the screws for easier engagement with the treads. When the treads 1 are finally removed the screws can be turned down fully. This mode of use is particularly applicable for roofs still under construction, but even after completion of the screws can be temporarily unscrewed a little to give them more height above the cladding for the tabs to hook onto them. In some embodiments the screws will be sufficient for engaging with the tabs 2 even when they are screwed fully into the roof; it all depends on the size and shape of the screw used.

10

15

While some preferred embodiments of the invention have been described by way of example it should be appreciated that modifications and improvements can occur without departing from the scope of the following claims.

20

25

30

35

CLAIMS

- 5 1. Apparatus for enhancing safety on a roof, comprising a series of elongate treads laid out generally horizontally across the roof, one above the other in spaced parallel relationship, so as to provide a series of foot plants for a human worker, each tread being isolated from the other said tread(s) and having at least a pair of connector parts, each connector part having an aperture that receives a fastener driven through and protruding above roof cladding, so that the tread is releasably secured to the roof by way of the connector parts.
- 10 2. Apparatus according to claim 1, wherein the fasteners comprise screws or nails.
- 15 3. Apparatus according to claim 1 or 2, wherein each connector part comprises a tab.
- 20 4. Apparatus according to claim 1, 2 or 3, wherein the connector parts/tabs of each tread are removable from the rest of the tread.
- 25 5. Apparatus according to any one of the preceding claims, wherein the aperture of each connector part/tab comprises a broad region and a narrower linear region.
- 30 6. Apparatus according to any one of the preceding claims, wherein the aperture of each connector part/tab has a key-hole shape.
- 35 7. Apparatus according to any one of the preceding claims, wherein each tread has a generally "L" shaped profile.
8. Apparatus according to any one of the preceding claims, wherein each tread has an undulating surface adapted to enhance grip between a worker's feet and the tread when the worker is standing on one or more of the treads.
9. Apparatus according to any one of the preceding claims, wherein each tread has one or more recesses which contain cushioning means arranged to protect the roof from being scratched by other parts of the tread.

CLAIMS

- 5
1. Apparatus for enhancing safety on a roof, comprising a series of elongate treads laid out generally horizontally across the roof, one above the other in spaced parallel relationship, so as to provide a series of foot plants for a human worker, each tread being isolated from the other said tread(s) and having at least a pair of connector parts, each connector part having an aperture that receives a fastener driven through and protruding above roof cladding, so that the tread is releasably secured to the roof by way of the connector parts.
- 10
2. Apparatus according to claim 1, wherein the fasteners comprise screws or nails.
3. Apparatus according to claim 1 or 2, wherein each connector part comprises a tab.
- 15
4. Apparatus according to claim 1, 2 or 3, wherein the connector parts/tabs of each tread are removable from the rest of the tread.
5. Apparatus according to any one of the preceding claims, wherein the aperture of each connector part/tab comprises a broad region and a narrower linear region.
- 20
6. Apparatus according to any one of the preceding claims, wherein the aperture of each connector part/tab has a key-hole shape.
- 25
7. Apparatus according to any one of the preceding claims, wherein each tread has a generally "L" shaped profile.
8. Apparatus according to any one of the preceding claims, wherein each tread has an undulating surface adapted to enhance grip between a worker's feet and the tread when the worker is standing on one or more of the treads.
- 30
9. Apparatus according to any one of the preceding claims, wherein each tread has one or more recesses which contain cushioning means arranged to protect the roof from being scratched by other parts of the tread.
- 35

10. Apparatus according to claim 9, wherein the cushioning means is/are removable from the recess(es).

5 11. Apparatus according to any one of the preceding claims, wherein each tread has a series of spaced holes to provide a selection of points for fixing the connector parts/tabs to the rest of the tread.

10 12. Apparatus according to any one of the preceding claims, wherein each connector part is prevented from pulling away from the roof by a head of a respective one of the fasteners.

15 13. Apparatus for enhancing safety on a roof substantially as herein described with reference to the accompanying drawings.

15

20

25

30

35

ABSTRACT

In its preferred embodiment the invention provides apparatus for enhancing safety while working on a roof. It comprises a series of elongate treads laid out generally horizontally across the roof, one above the other in spaced parallel relationship, so as to provide a series of foot plants for a human worker. Each tread has at least a pair of connector tabs 6, each of which has a fixing aperture 13 that receives the head of a fastener (eg a screw 3, nail or the like) driven through but also protruding above roof cladding 4. The arrangement is such that the tread is releasably secured to the roof by way of the tabs 6.

15

APPENDIX I:- Roof Crawler

Electrotech Consultants is a trading name used by Dodge & Associates Ltd

P O Box 851, New Plymouth, N.Z.
Ph 0-6-758 9986 Fax 0-6-757 9812
Email electrotech.consultants@extra.co.nz

5.0 ANALYSIS RESULTS

The analytical results indicate that the maximum stress levels generated in the crawler extruded component under the specified loading are conservative, however the maximum retention tab stresses are relatively high and limit the load rating of the crawler.

The roof fixation under which the crawler retention tab is held will see the following maximum load:

1. Shear force – 0.7kN.
2. Tensile force – 0.27kN

6.0 CONCLUSION

The analysis completed for this report shows that the mechanical design of the Roof Crawler extruded section provides a generous safety margin on component strength under the loading regime specified above. The capacity of the Crawler is limited by the retention tabs.

The Crawler relies on the integrity of the roof fastenings for its retention. It should be verified that these fastenings will safely resist the analysed load for all roofing substrates.

1.0 SYNOPSIS

Analysis indicates that the components of the Taranaki Steelformers Roof Crawler will safely resist the mechanical loads generated by its use when providing a foot hold for a single roofer working on a roof slope of up to 45°.

2.0 INTRODUCTION

Taranaki Steelformers asked Electrotech Consultants to assist their development of a "Roof Crawler" roof access tool by completing an engineering analysis of the strength of the proposed tool and reporting on the findings. This report is the result of that analysis.

3.0 THE ROOF CRAWLER

The concept of the Roof Crawler is a portable and re-usable roof access tool which can be employed to provide a safe foothold for the installation of roofing products secured at 760mm or 1010mm horizontal centres on a roof slope of up to 45°.

The Crawler consists of an extruded aluminum section to which restraint brackets are fastened for retention under the head of the roofing retention screws. (Appendix I) As the roofing material is secured at the lowest section first the Crawler can be used to provide a safe foothold for the progression of the roof installation toward the apex. Once the roof is installed the Crawler sections can be recovered and the roofing retention screws tightened as the roofer descends to the perimeter.

4.0 ANALYSIS METHODS

The most arduous loading condition is when the crawler is utilized on a roof slope of 45°.

An allowance of 100kg was made in the analysis for the roofer and any tools he may have. It is assumed that the crawler will be required to support only one roofer at a time.

The loading model analysed, and the analysis completed appears in Appendix II.

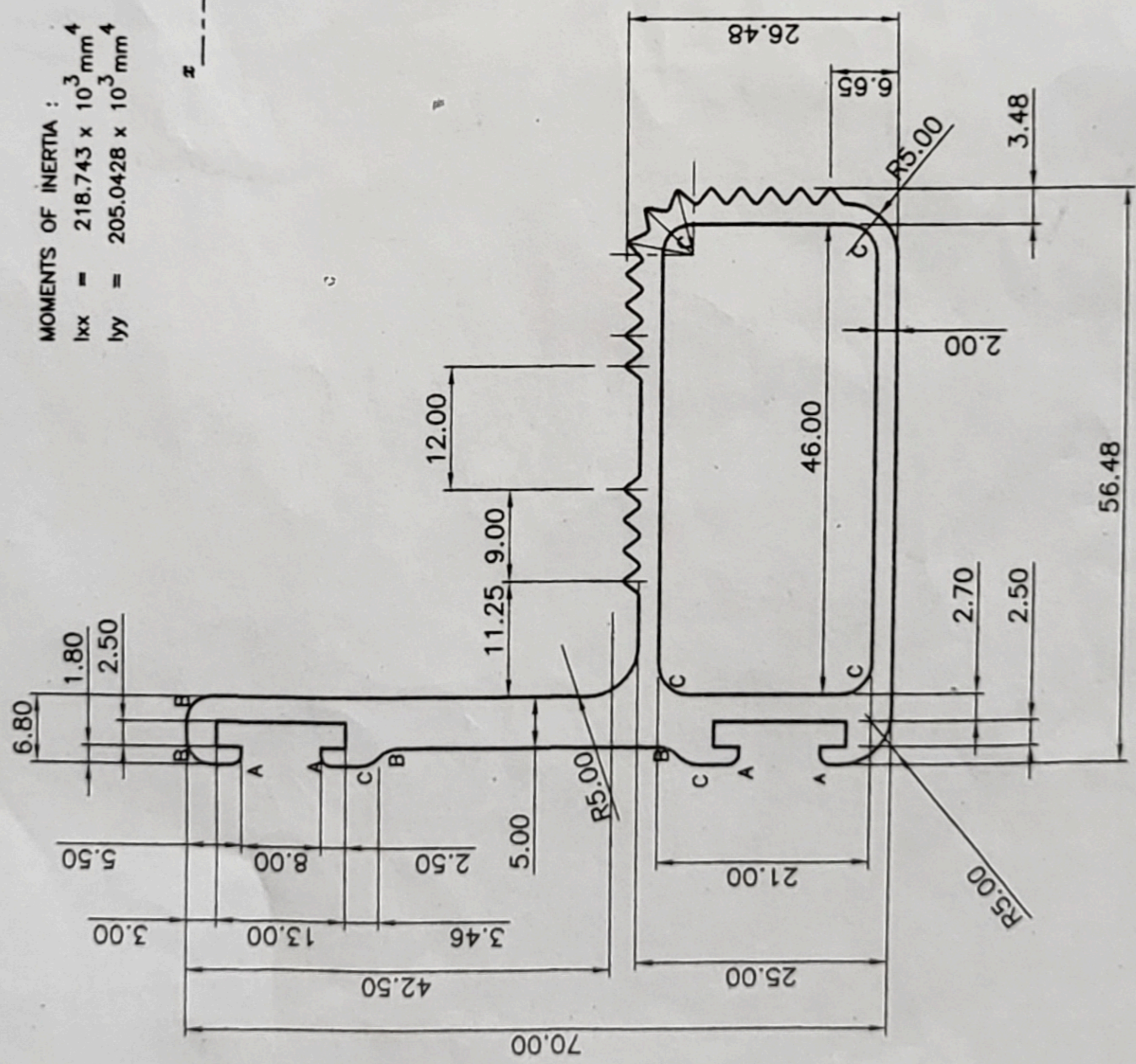
The second moments of area for the aluminum extrusion were taken from the data included on the McKechnie Extrusion drawing. Torsional properties were conservatively determined by modeling the extrusion as an RHS of 2mm wall thickness and outside dimensions of 55x25.

TABLE OF CONTENTS

- 1.0 Synopsis
- 2.0 Introduction
- 3.0 The Roof Crawler
- 4.0 Analysis Methods
- 5.0 Analysis Results
- 6.0 Conclusion

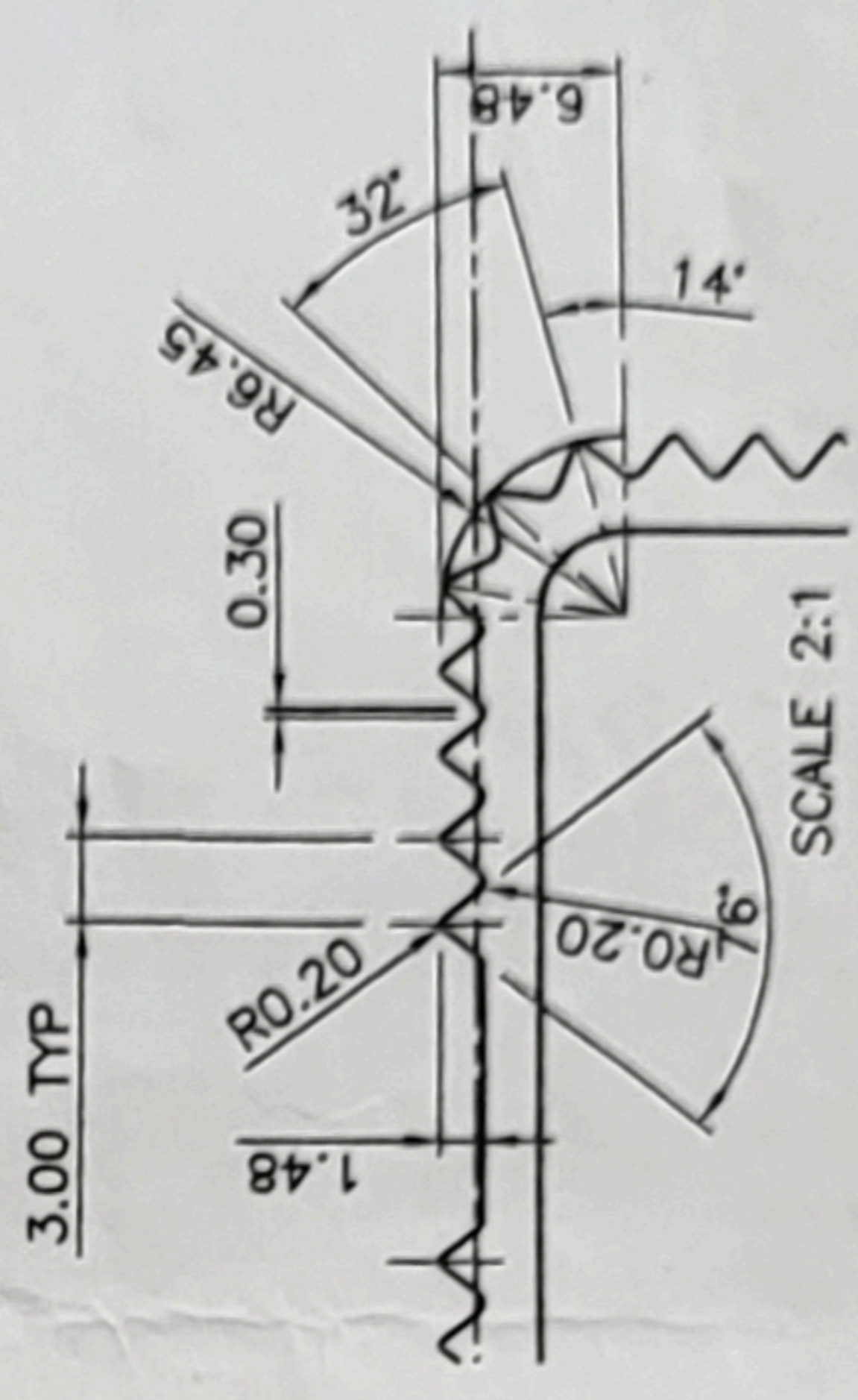
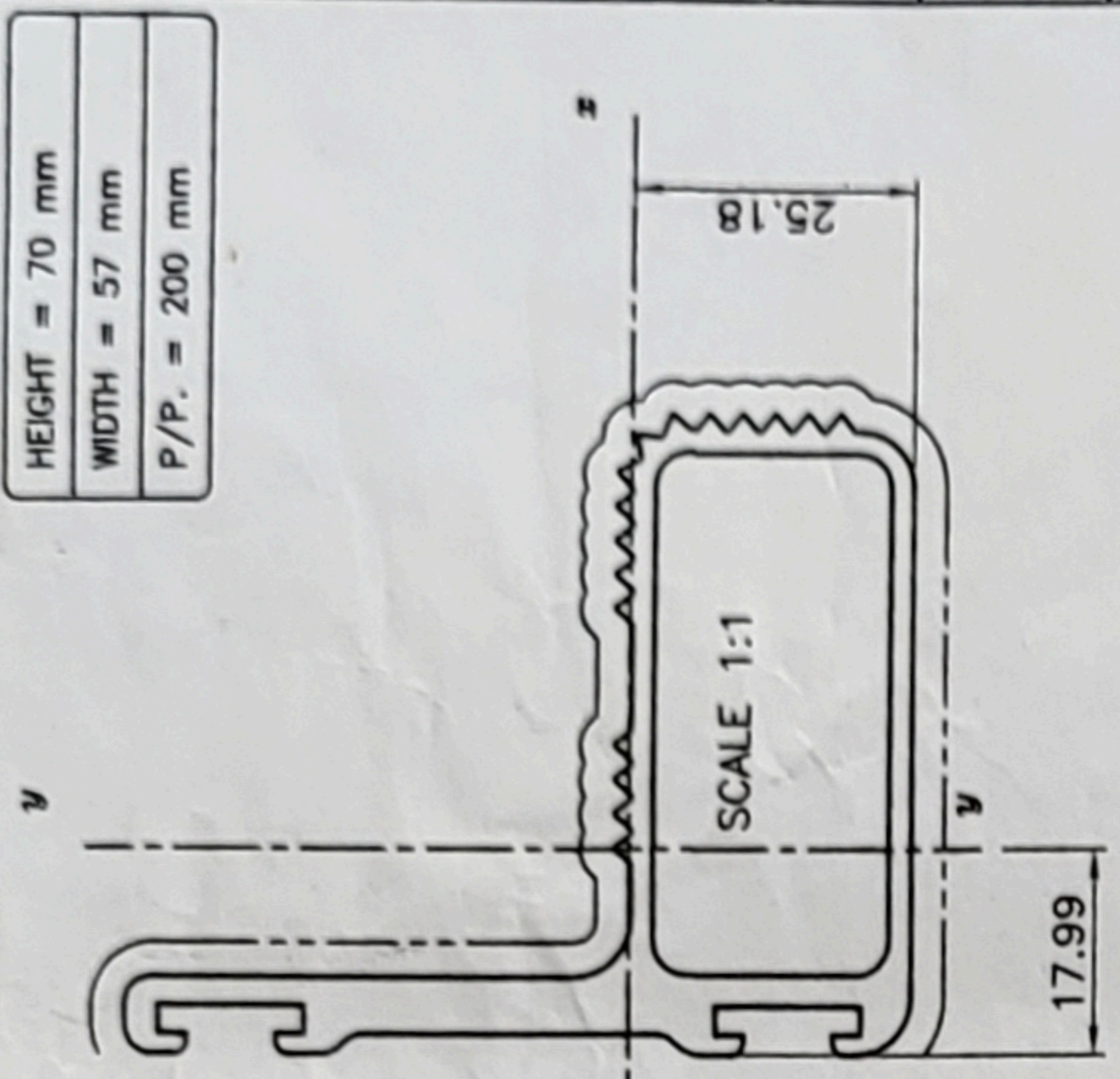
Appendix I:- Roof Crawler

Appendix II:- Engineering Analysis



MOMENTS OF INERTIA :
 $I_{xx} = 218.743 \times 10^3 \text{ mm}^4$
 $I_{yy} = 205.0428 \times 10^3 \text{ mm}^4$

HEIGHT = 70 mm
WIDTH = 57 mm
P/P. = 200 mm



TOLERANCES TO AS/NZS
 1866:1997 UNLESS
 OTHERWISE SHOWN

A = 1.00 mm RADIUS
 B = 2.50 mm RADIUS
 C = 3.00 mm RADIUS
 UNSPECIFIED THICKNESS = 2.00 mm

McKechnie Extrusion	
ALLOY	6063-T6/ 6060-T5
EST. AREA	C.C.D
	592.90 sq mm 88
EST. WT/m	1.607 kg/m
EST. PERIPHERY	298.55 mm Ext 427.40 mm Tot
PRICE GROUP	FACTOR
3	266
SURFACE FINISH SUITABLE FOR ANODISING & P/C	
APPLICATION ROOF FRAME	
DRAWN	DATE
KC/TSD	28/09/15
SCALE (B4)	
1.5:1	
CUSTOMER DRG No.	
SKETCH 1	1
QUOTATION	23/10/15 NP
18017/B	
CUSTOMER	
TARANAKI STEELFORMERS	
PRODUCT No.	ISSUE

McKECHNIE ALUMINIUM SOLUTIONS

DRAWING APPROVAL

We hereby approve this drawing and acknowledge that it is in accordance with our requirements. We accept full responsibility for any infringement of copyright patent trademark or registered design that may arise from the shape drawn. We also acknowledge that your Terms and Conditions of Sale apply.

We accept that Quotation No. dated relates to this drawing and we accept all the Terms and Conditions of that Quotation.

NAME:
 SIGNED:
 DATE:
 QUOTATION No:
 CUSTOMER DRG. No:
 CUSTOMER:

MCKECHNIE ALUMINIUM SOLUTIONS LTD - DRAWING APPROVAL

(The customer) hereby approve this drawing and acknowledge that it is in accordance with our requirements. We accept full responsibility for any infringement of copyright, patent, trademark or registered design that may arise from the shape drawn. We also acknowledge that your Terms & Conditions of Sale apply.

We accept that Quotation No. TBA

NAME (Print name) _____


SIGNATURE (Customer) _____

DATE _____

QUOTATION No. TBA

CUSTOMER TARANAKI STEELFORMERS

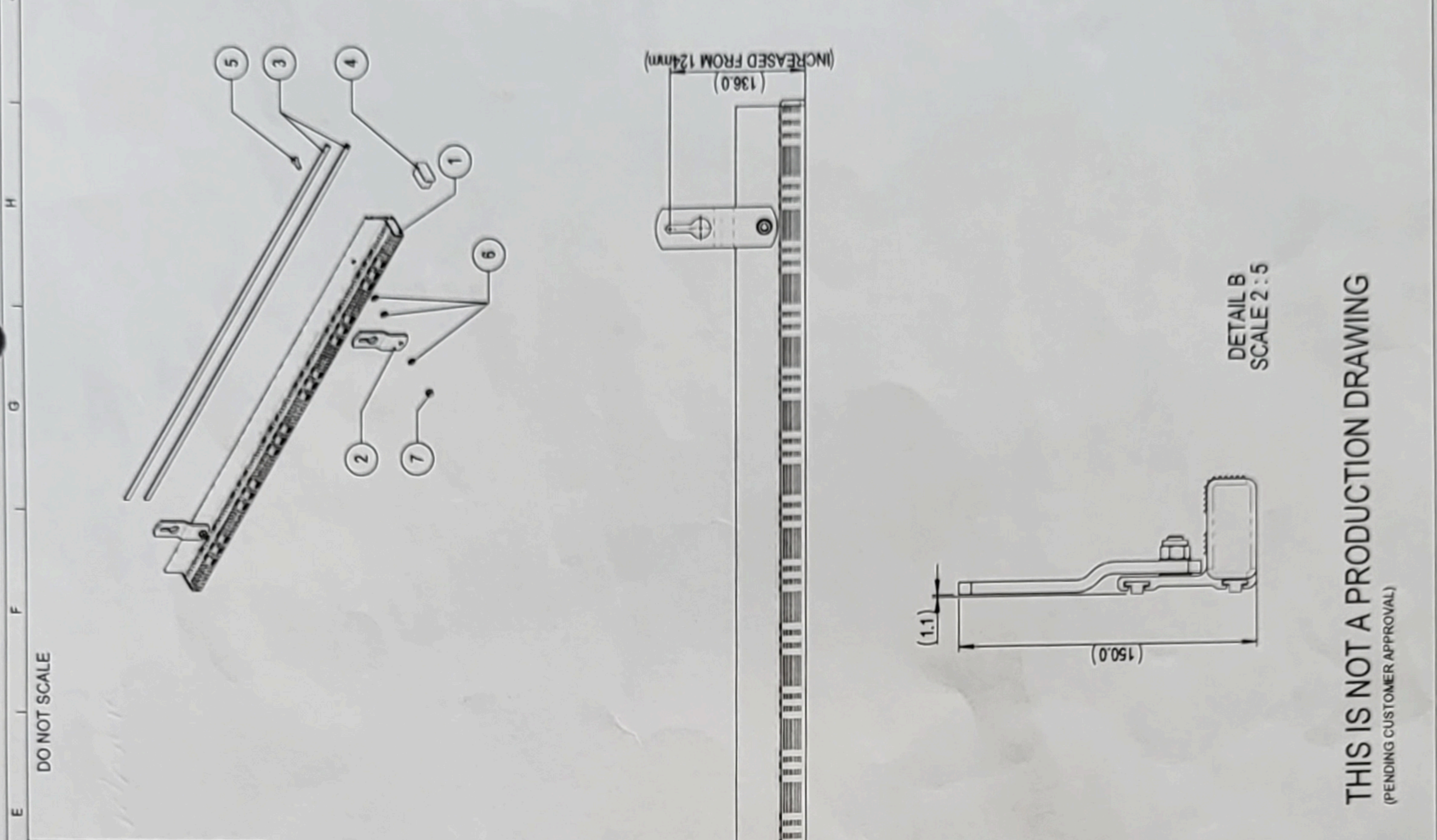
REV.	ZONE	DETAILS	INITIALS	DATE
0	-			



enviro mark
DIAMOND

THE OTHER LEADER TECHNICAL SERVICES CONTRACTORS HERE
SPECIALISES IN THE DESIGN OF ALUMINIUM SOLUTIONS
LTD. IT IS BASED ON THE EXACT CONDITIONS THAT EXIST WITH OUR WEATHER
PROMISED IT MUST NOT BE COVERED, APPROVED, OR OTHERWISE
COMMUNICATED TO ANY THIRD PARTY OR BE USED FOR ANY PURPOSE OTHER
THAN THAT SPECIFIED IN THE PARTICULAR ENQUIRY, TENDER OR CONTRACT WITH
MCKECHNIE. THE OTHER LEADER TECHNICAL SERVICES CONTRACTORS HERE

PART WEIGHT (kg)	2.09
DRAWN	GL
MANUFACTURING APPROVAL BY	21/08/2017
REVISION APPROVAL BY	
CUSTOMER	TARANAKI STEELFORMERS
PROJECT	N/A
QUOTE NO.	TBA
ROOF CRAWLER 1M CONCEPT ONLY	



ITEM	PART NUMBER	DESCRIPTION 1	DESCRIPTION 2	MATERIAL	CUT LENGTH	CUT PERIPHERY	WEIGHT (-kg)	QTY.
1	36766 D	ROOF CRAWLER MAIN BODY	1000	6063-T6	1000	N/A	1.60	1
2	MOTBA 2	EXTRUDED TAB	CONCEPT ONLY	6061-T6	40	N/A	0.07	2
3	609510	PVC INSERT	1000	PVC	1000	N/A	0.06	2
4	695441	RECTANGULAR END CAP 50 X 25 RHS	14-NPRT50Z5	Polyethylene	N/A	N/A	0.02	2
5	695439	M8 X 25 COUNTERSUNK SCREW	CSKSKTMR2SZ	Zinc Plated Steel (CLEAR)	N/A	N/A	0.01	2
6	695440	UV STABILISED M8 NYLON WASHER BLACK	03-PNWB_AB-LV	Nylon	N/A	N/A	0.00	6
7	600332	NYLOC NUT M8	NYLMBZ	Zinc Plated Steel (CLEAR)	N/A	N/A	0.01	2

DETAIL A
SCALE 1:1

INDENT EACH END OF
PVC STRIP GROOVE LIPS
TO STOP BOTH PVC STRIPS
FROM SLIDING LOOSE

DETAIL B
SCALE 2:5

(INCREASED FROM 30°)

(18.0°)

(1.1)

(150.0)

THIS IS NOT A PRODUCTION DRAWING
(PENDING CUSTOMER APPROVAL)

CUT LENGTHS (mm)	HOLE CTRS MATERIAL EDGE	HOLE Ø (mm)	CSK / CBORE (mm)	BEND RADIUS (mm)	OTHER (mm)	TOLERANCES (mm)	ALL DIMENSIONS UNLESS OTHERWISE SPECIFIED IN MILLIMETRES
<150	<300	<5.0mm	DEPTH ±0.5	<150mm ±1.0	BLIND HOLE DP ±0.5	±0.5	
>150	>300	5.0-10.0mm ±0.25	DIAMETER ±0.5	150-500mm ±2.0	CUT ANGLE ±0.25°	±0.25°	
<500	<500	>10.0mm ±0.50	ANGLES ±1.0°	>500mm ±3.0	BEND ANGLE ±1.0°	±1.0°	
±0.25	±0.5	±1.0					

NOTES:

- NO VISIBLE SURFACES
- DE-BURR / REMOVE ALL SHARP EDGES

ELECTROTECH Consultants

CALCULATION SHEET

PROJECT: ROOF CRAWLER REV: 0 SHEET: 2 OF: 6

COMPUTED BY: [Signature] DATE: 2/16 CHKD: _____ DATE: _____

$$F = 267 \text{ N}$$

Maximum BENDING IN TONGUE

$$= 267 \times 0.058$$

$$= 15.5 \text{ Nm}$$

$$\sigma_{\text{max}} = \frac{6 \times 15.5}{0.04 \times 0.005^2}$$

$$= 93 \text{ MPa.} \quad \underline{\text{OK}}$$

Maximum LOAD IN ASSEMBLY SCREW

$$F_{\text{TENSILE}} = \frac{267 \times 58}{25}$$

$$= 619 \text{ N}$$

M8 / 10.9 MACHINE SCREW

$$\sigma = \frac{619}{31.8 \times 10^{-6}}$$

$$= 19.5 \text{ MPa.} \quad \underline{\text{OK}}$$

$$\tau = \frac{700}{31.8 \times 10^{-6}}$$

$$= 22 \text{ MPa.} \quad \underline{\text{OK}}$$

ELECTROTECH Consultants

CALCULATION SHEET

PROJECT: ROOF CRAWLER

REV: 0 SHEET: 1 OF: 6

COMPUTED BY: R. Dey DATE: 2/16 CHKD:

DATE:

MATERIALS

1. EXTRUDED SECTION

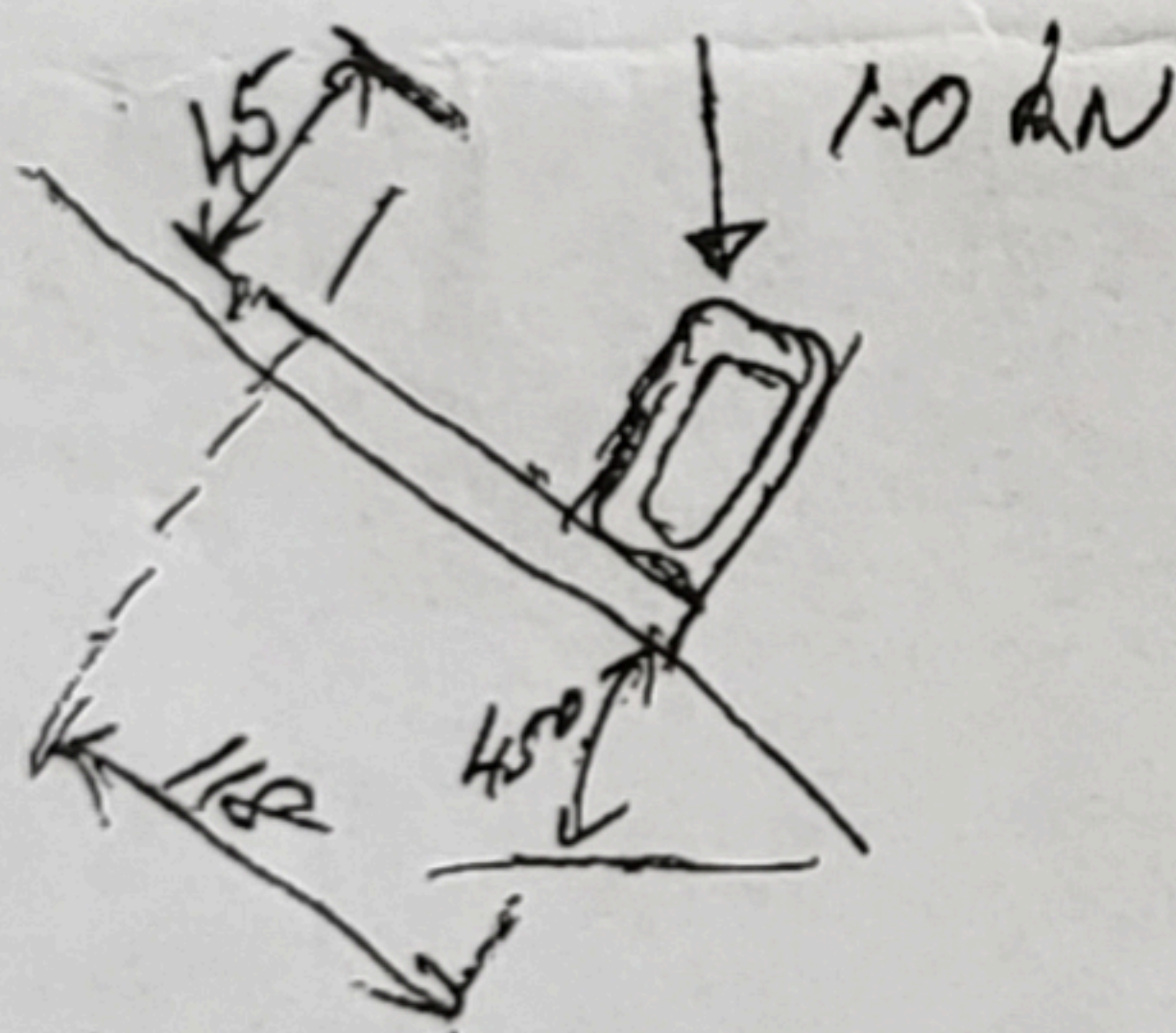
6063-T6, $\sigma_{UTS} = 215 \text{ MPa}$, $\sigma_{0.2\%} = 170 \text{ MPa}$

6060-T5, $\sigma_{UTS} = 160 \text{ MPa}$, $\sigma_{0.2\%} = 120 \text{ MPa}$

2. TAB

5251-H32, $\sigma_{UTS} = 200 \text{ MPa}$, $\sigma_{0.2\%} = 130 \text{ MPa}$

ANALYSIS



IGNORING FRICTION.

DOWN BOLT FORCE

$$= 1.0 \cos 45$$

$$= 0.7 \text{ kN}$$

PERPENDICULAR FORCE

$$= 1.0 \sin 45$$

$$= 0.7 \text{ kN}$$

RETENTION BOLT SHEAR FORCE

$$= 0.7 \text{ kN}$$

RETENTION BOLT TENSILE FORCE

$$0.7 \times 45 = F \times 118$$

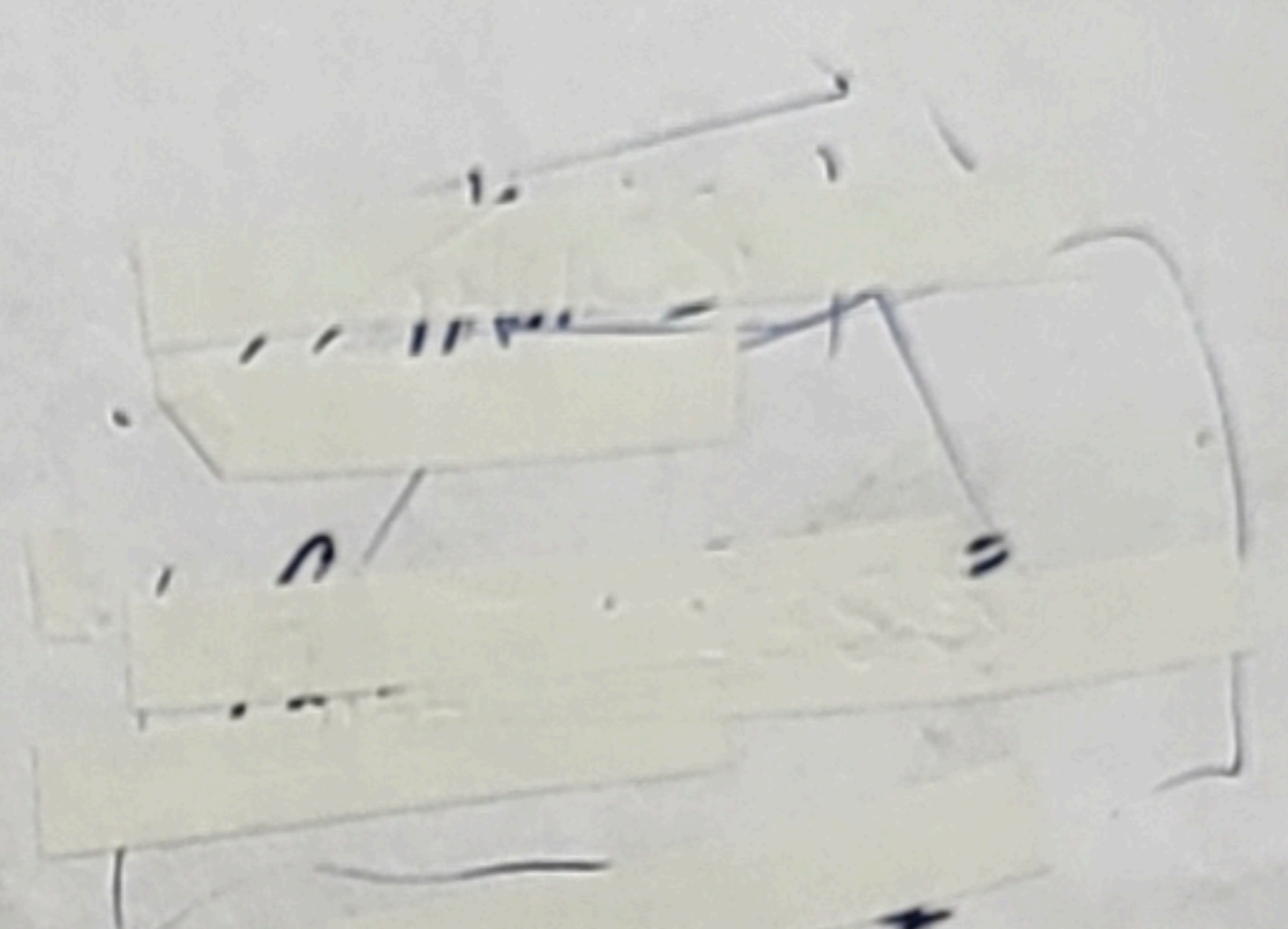
ELECTROTECH Consultants

CALCULATION SHEET

PROJECT: PROOF CRAWLER REV: 0 SHEET: 6 OF: 6

COMPUTED BY: [Signature] DATE: 2/16 CHKD: _____ DATE: _____

$$\begin{aligned}(\sigma_{1,2})_{\max} &= \frac{69}{2} \pm \sqrt{\left(\frac{69}{2}\right)^2 + 4 \cdot 1^2} \\ &= 69.2 \text{ MPa}, 0.2 \text{ MPa. } \underline{ok}\end{aligned}$$



WIEGON STOPS

S

1/10

CALCULATION SHEET

PROJECT: PROF. CAMALDEN REV: 0 SHEET: 5 OF: 6

COMPUTED BY: R. R. R. DATE: 2/16 CHKD: _____ DATE: _____

$$\Rightarrow J = (114 + 32.3) \times 10^9 \\ = 146.3 \times 10^9 \text{ m}^4$$

$$\text{APPLIED TORQUE} \approx 700 \times 0.056 \\ = 39.2 \text{ Nm}$$

$$r \approx \sqrt{\left(\frac{55}{2}\right)^2 + \left(\frac{25}{2}\right)^2} \\ = 30.2 \text{ mm}$$

$$\tau_{\text{max}} = \frac{39.2 \times 0.0302}{2 \times 146.3 \times 10^9} \\ = 4 \text{ MPa}$$

$$(\tau_{\text{max}})_{\text{RESOLVED}} = \sqrt{4^2 + 0.8^2} \\ = 4.1 \text{ MPa}$$

5. Maximum Resolved Stresses

$$\sigma_{\text{comp}} = 33 + 36 \\ = 69 \text{ MPa}$$

$$\sigma_{\text{ten}} = 15.5 + 20 \\ = 35.5 \text{ MPa}$$

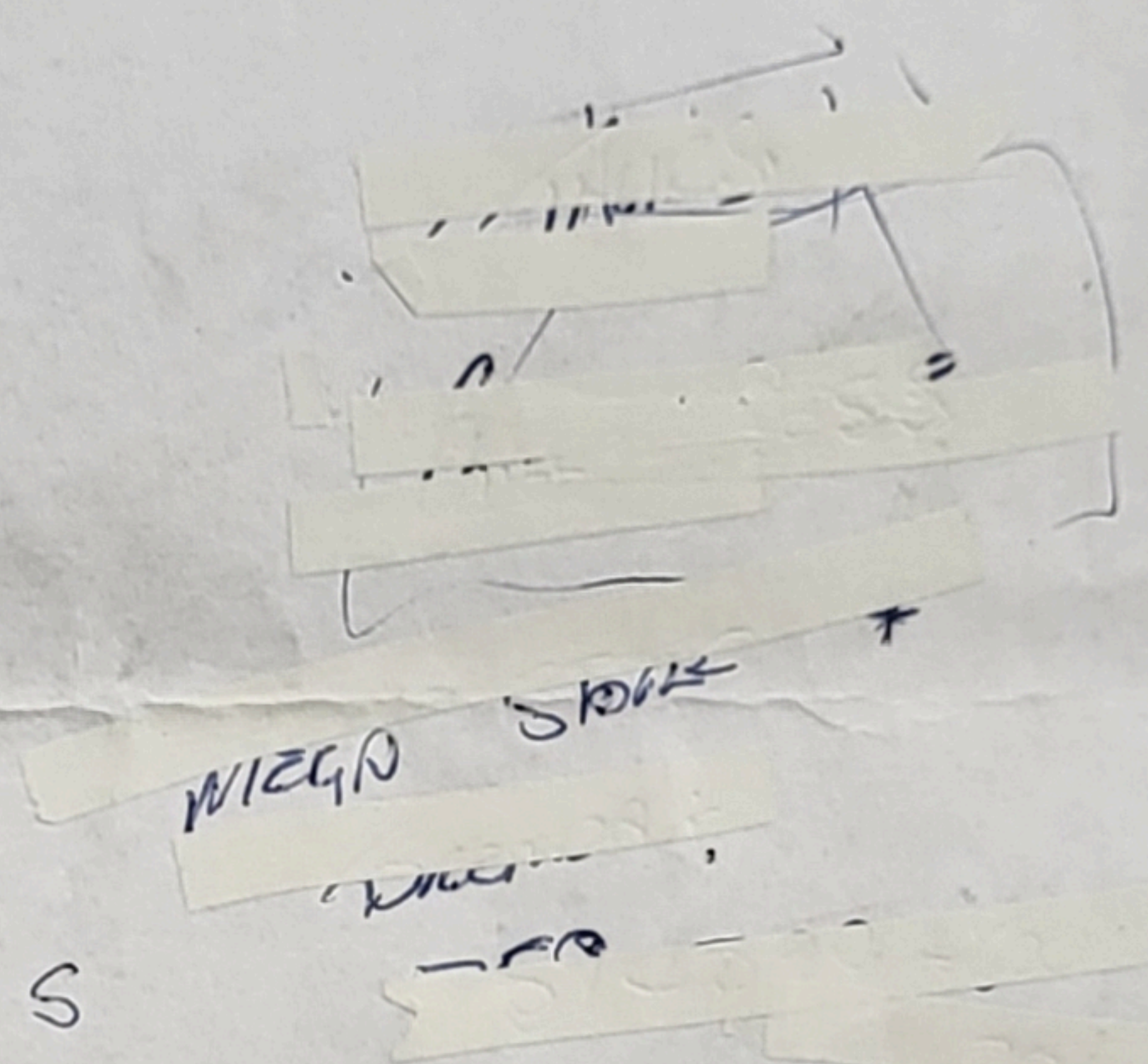
ELECTROTECH Consultants

CALCULATION SHEET

PROJECT: ROOF CRAWLER REV: 0 SHEET: 6 OF: 6

COMPUTED BY: R. Remy DATE: 2/16 CHKD: _____ DATE: _____

$$\begin{aligned} (\sigma_{1,2})_{\max} &= \frac{69}{2} \pm \sqrt{\left(\frac{69}{2}\right)^2 + 4 \cdot 1^2} \\ &= 69.2 \text{ MPa}, 0.2 \text{ MPa. } \underline{\text{ok}} \end{aligned}$$



1/iter

CALCULATION SHEET

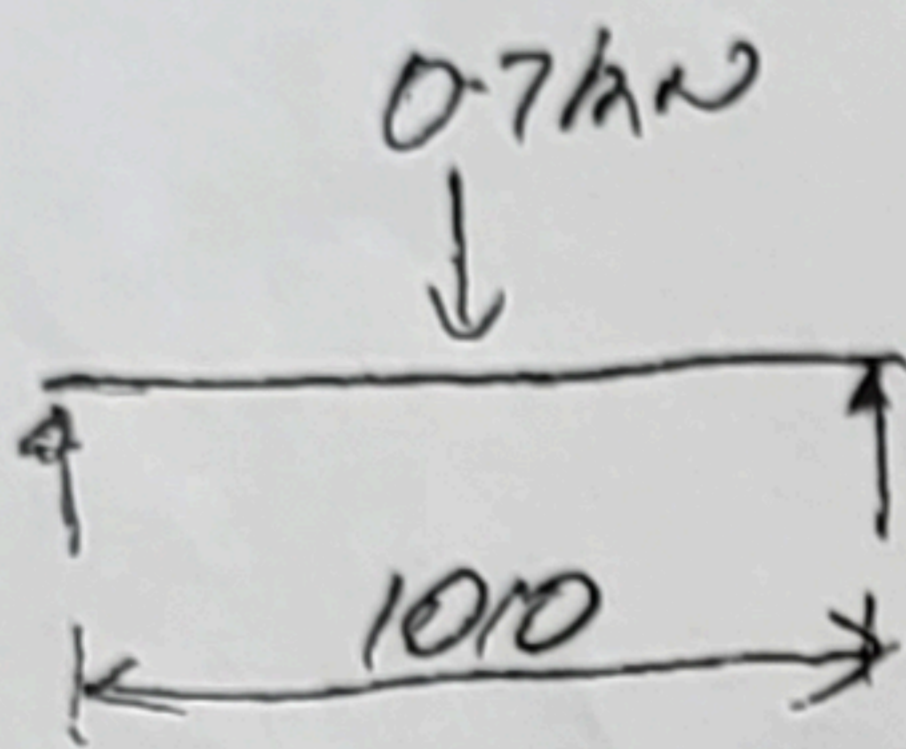
PROJECT: ROOF CRAWLER

REV: 0 SHEET: 4 OF: 6

COMPUTED BY: PKR

DATE: 2/16 CHKD:

DATE:



$$Z_{max} = \frac{219 \times 10^{-9}}{0.0252}$$

$$= 8.7 \times 10^{-6} \text{ m}^3$$

$$(\sigma_{max})_{comp} = \frac{700 \times 1.01}{4 \times 4.9 \times 10^{-6}}$$

$$= 36 \text{ MPa}$$

$$(\sigma_{max})_{ten} = \frac{700 \times 1.01}{4 \times 8.7 \times 10^{-6}}$$

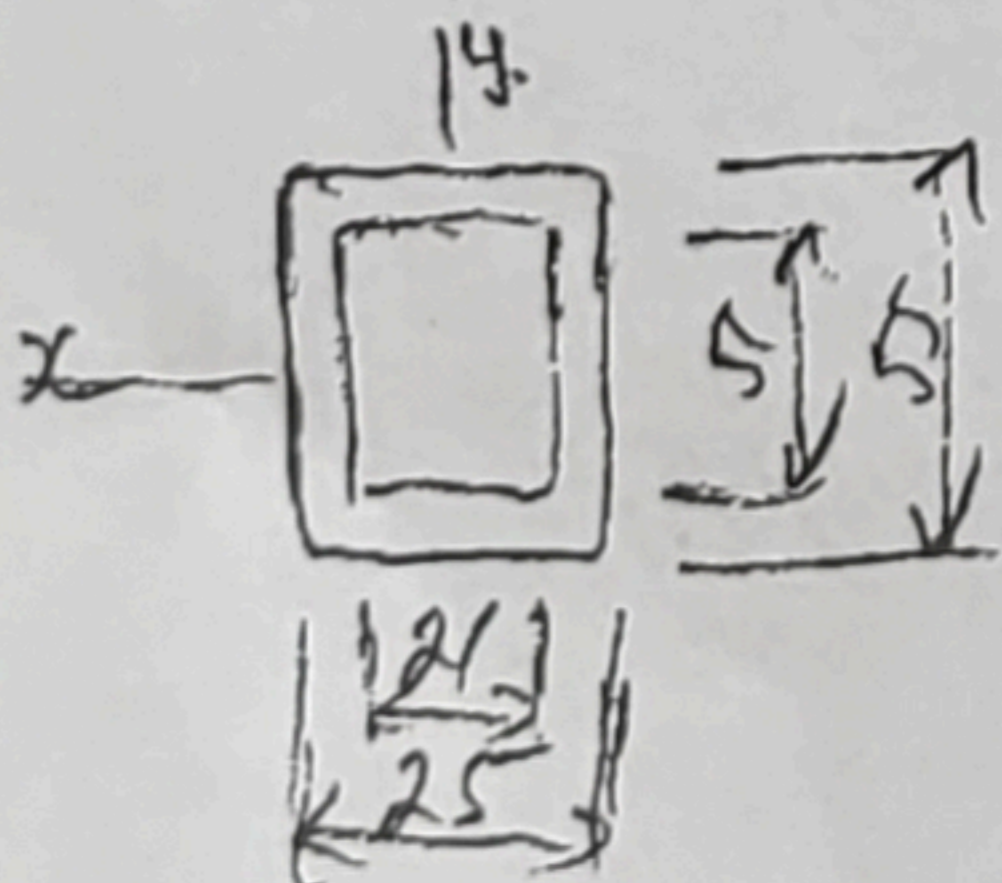
$$= 20 \text{ MPa}$$

3 SHEAR DUE TO DIRECT LOAD

$$= \frac{1 \times 10^3}{2 \times 593 \times 10^{-6}}$$

$$= 0.8 \text{ MPa}$$

4 SHEAR DUE TO TORSION



$$I_{xx} = \frac{1}{12} (0.025 \times 0.055^3 - 0.021 \times 0.051^3)$$

$$= 114 \times 10^{-9} \text{ m}^4$$

$$I_{yy} = \frac{1}{12} (0.055 \times 0.025^3 - 0.051 \times 0.021^3)$$

$$= 32.3 \times 10^{-9} \text{ m}^4$$

ELECTROTECH Consultants

CALCULATION SHEET

PROJECT: ROSE CRAWLER REV: 0 SHEET: 7 OF: 6

COMPUTED BY: PLM DATE: 2/16 CHKD: _____ DATE: _____

SUPPORT BEAM

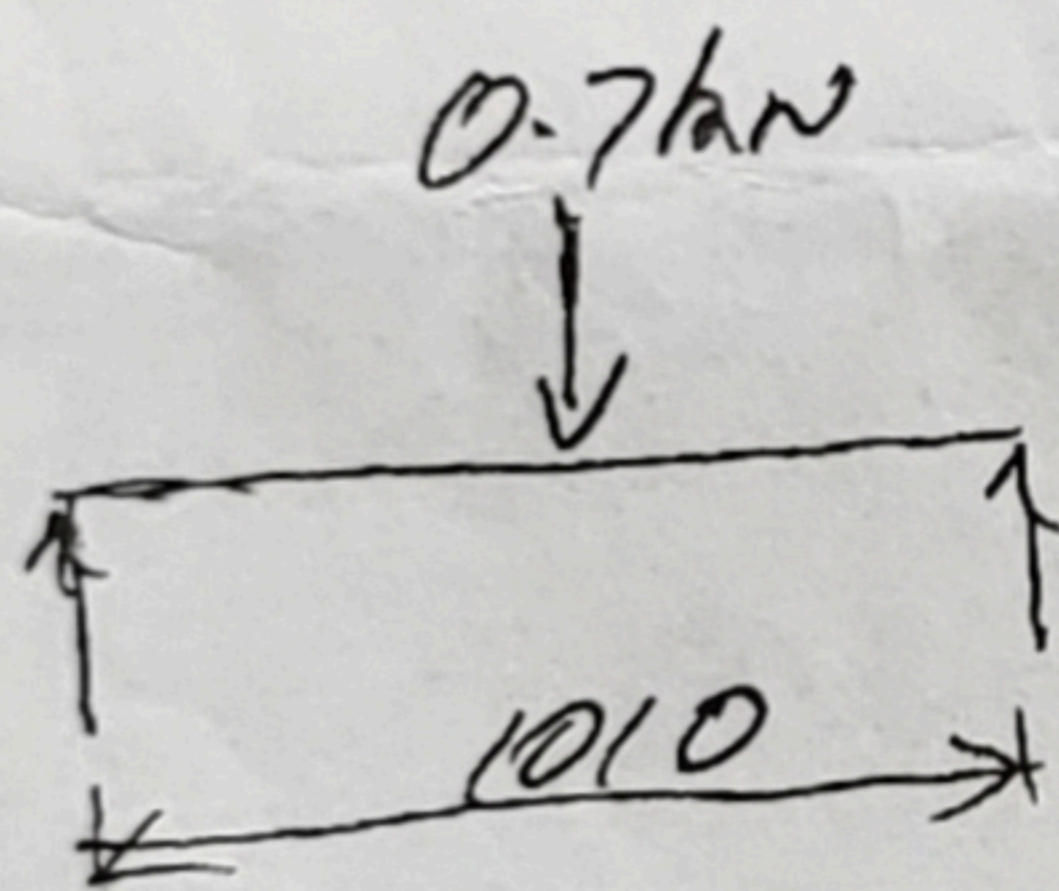
(1) PERPENDICULAR COMPONENT

$$I_{min} = \frac{205 \times 10^{-9}}{(0.0565 - 0.018)}$$

$$= 5.32 \times 10^{-6} \text{ m}^3$$

$$I_{max} = \frac{205 \times 10^{-9}}{0.018}$$

$$= 11.4 \times 10^{-6} \text{ m}^3$$



$$(\sigma_{max})_{comp} = \frac{700 \times 1.01}{4 \times 5.32 \times 10^{-6}}$$

$$= 33 \text{ MPa}$$

$$(\sigma_{max})_{ten} = \frac{700 \times 1.01}{4 \times 11.4 \times 10^{-6}}$$

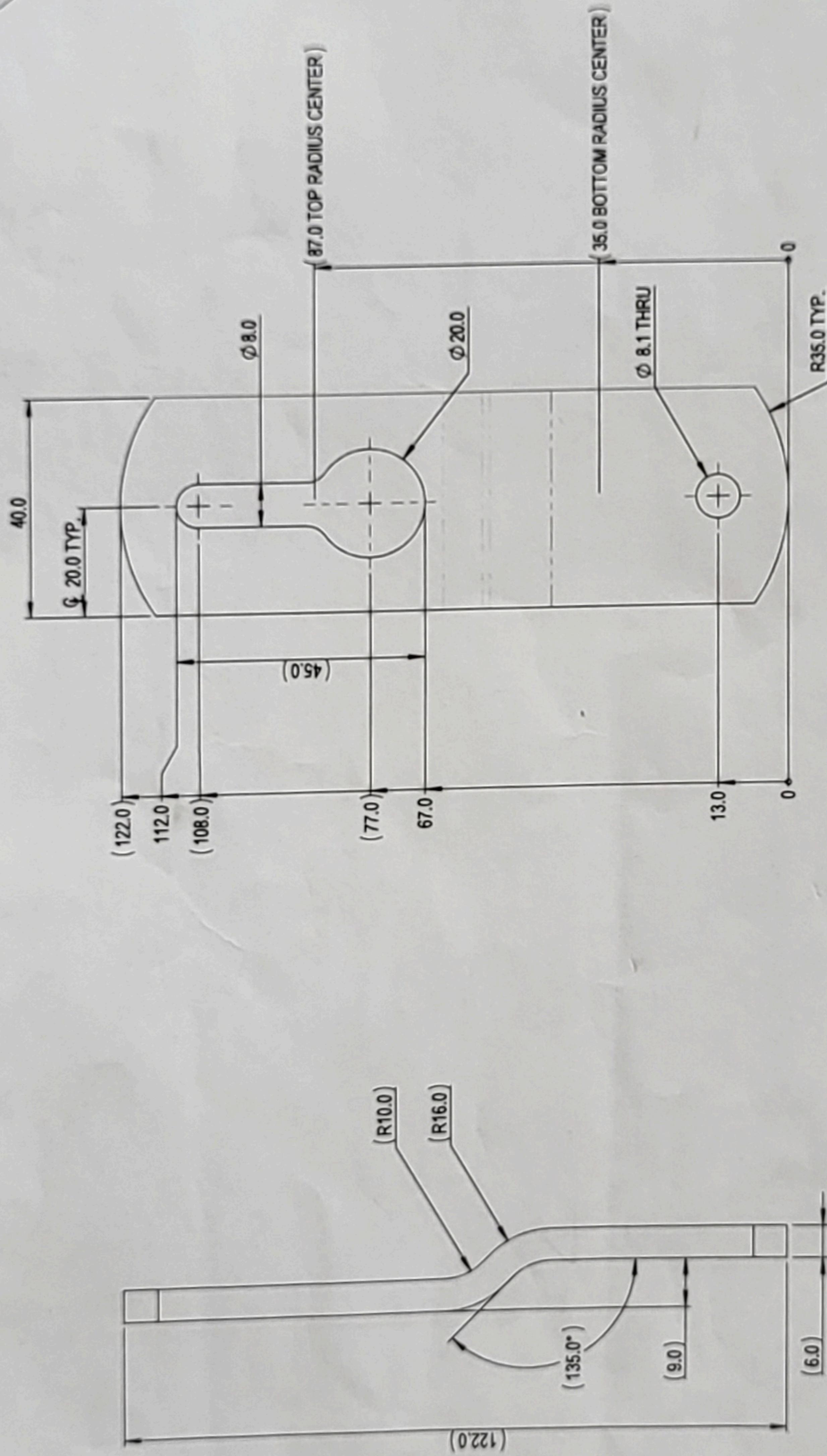
$$= 15.5 \text{ MPa}$$

(2) PARALLEL COMPONENT

$$I_{min} = \frac{219 \times 10^{-9}}{0.07 - 0.0252}$$

$$= 4.9 \times 10^{-6} \text{ m}^3$$

TURK TILK ENGINEERING MARKIL



- NOTES:
1. INVISIBLE SURFACES DE-BURR / REMOVE ALL SHARP EDGES

THIS IS NOT A PRODUCTION DRAWING
(PENDING CUSTOMER APPROVAL)

CUT LENGTHS (mm)		HOLE Ø (mm)		CSK / CBORE (mm)		BEND RADII (mm)		OTHER (mm)		TOLERANCES (mm)		ALL DIMENSIONS IN MILLIMETRES	
<150	>150	<5.0mm	5.0-10.0mm	DEPTH ±0.5	DIAMETER ±0.5	<150mm ±1.0	150-500mm ±2.0	BLIND HOLE DP ±0.5	CUT ANGLE ±0.25°	±0.5	±0.25	BEND ANGLE ±1.0°	
±0.25	±0.5	>10.0mm ±0.50		ANGLES ±1.0°		>500mm ±3.0		BEND ANGLE ±1.0°					

REV.	ZONE	DETAILS	INITIAL RELEASE	DATE
0	-			

MCKECHNIE ALUMINIUM SOLUTIONS LTD.	enviro mark	ISO 9001	ISO 14001
------------------------------------	-------------	----------	-----------

CUT LENGTH (GSAW)	40
CUT PERIPHERY	N/A
MATERIAL	6061-T6
SURFACE FINISH	M
SURFACE COLOUR	N/A
SURFACE FINISH APPLICATION-BEFORE OR AFTER FABRICATION	N/A
PART WEIGHT (-10g)	0.07
DRAWN	GL 21/08/2017
MANUFACTURING APPROVAL (Y)	
DESIGNER APPROVAL (Y)	
CUSTOMER	TARANAKI STEELFORMERS
PROJECT	N/A
QUOTE NO.	TBA

SHT	1 of 1	ITEM NO.	
SIZE	A3	REV.	0
SCALE	1:1	MOTBA 2	

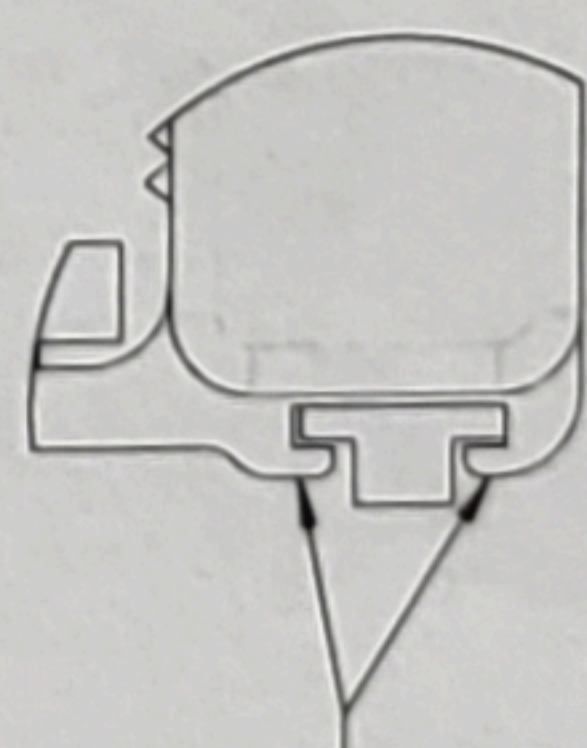
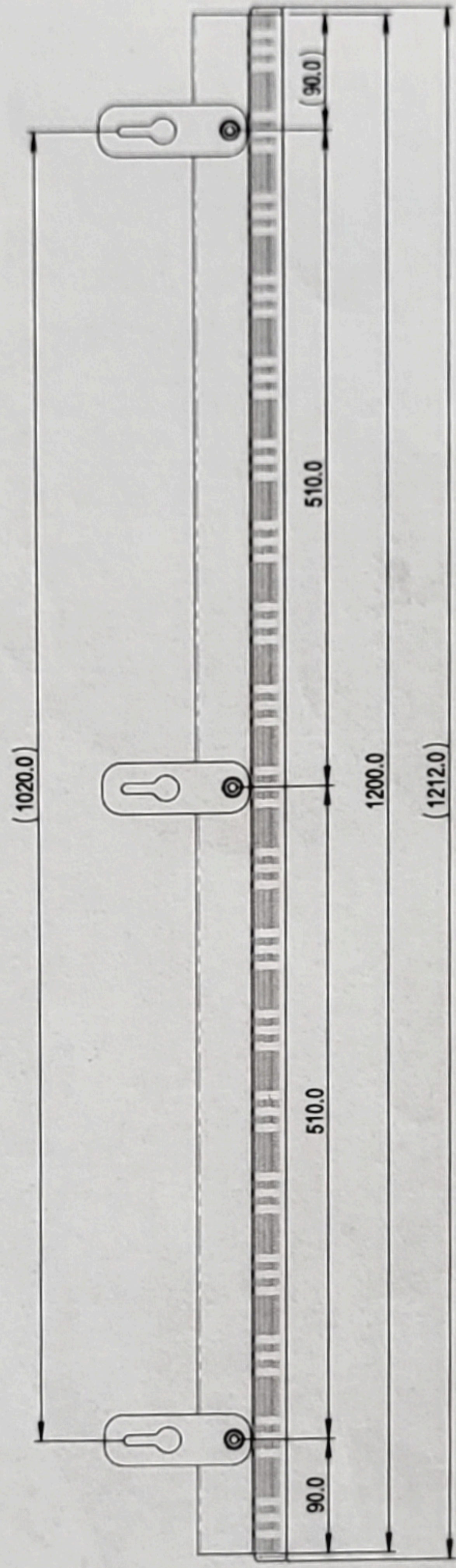
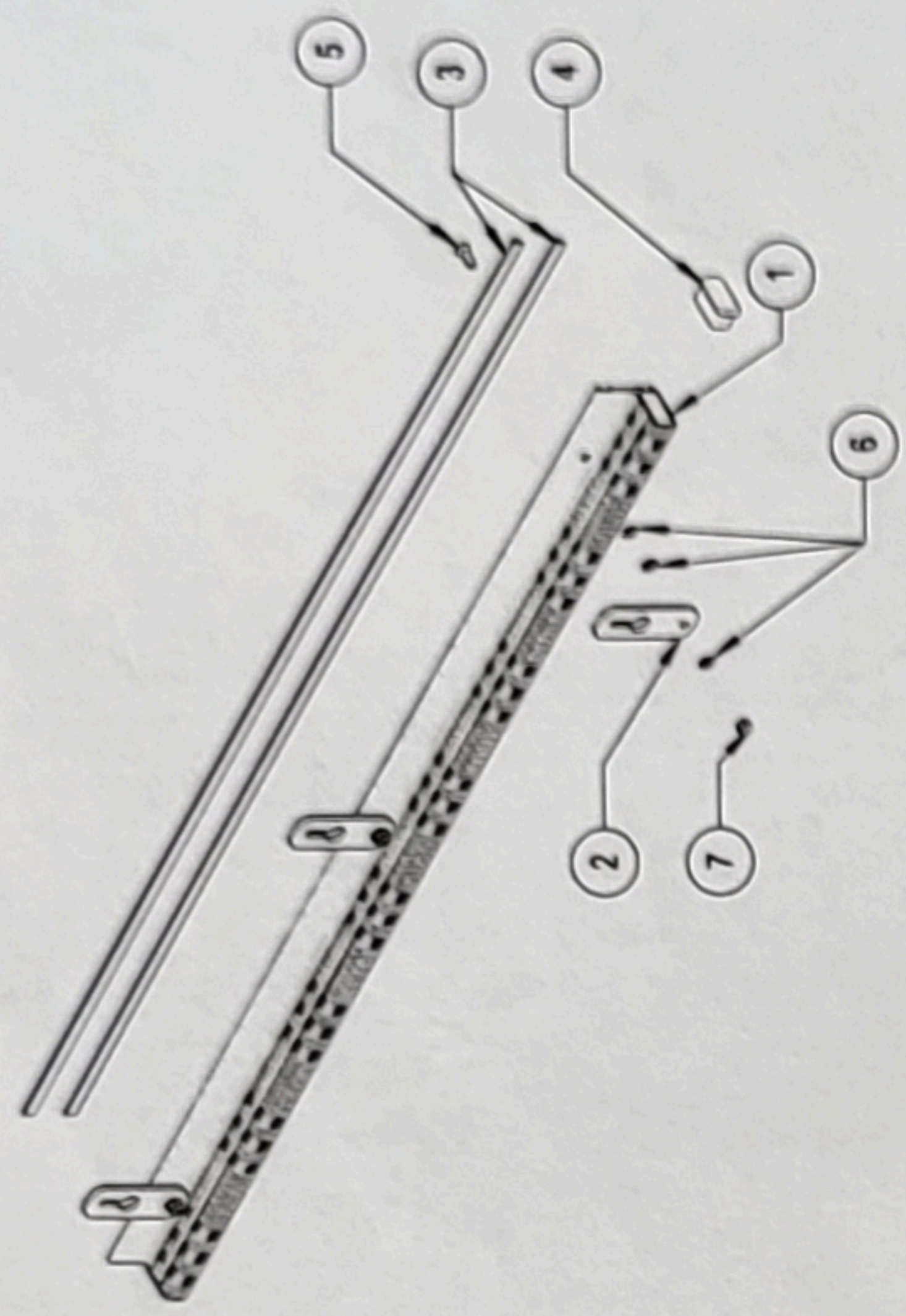
CUSTOMER QUOTATION No. TARANAKI STEELFORMERS
SIGNATURE (Customer)
NAME (Print name)
DATE

MCKECHNIE ALUMINIUM SOLUTIONS LTD - DRAWING APPROVAL
We (the customer) hereby approve this drawing and acknowledge that it is in accordance with our requirements. We accept full responsibility for any infringement of copyright, patent, trademark or registered design that may arise from the shape drawn. We also acknowledge that your Terms & Conditions of Sale apply.
We accept that Quotation No. TBA relates to this drawing and we accept all the Terms and Conditions of that quotation.

A B C D E F G H I J K

ITEM	PART NUMBER	DESCRIPTION 1	DESCRIPTION 2	MATERIAL	CUT LENGTH	CUT PERIPHERY	-WEIGHT (-kg)	QTY.
1	36766 E	ROOF CRAWLER MAIN BODY	1200	6063-T6	1200	N/A	1.92	1
2	M02814	MAIN TAB	115 x 40 x 5	5251-H32	N/A	420	0.06	3
3	609510	PVC INSERT	1200	PVC	1200	N/A	0.08	2
4	695441	RECTANGULAR END CAP 50 X 25 RHS	14-INPRT5025	Polyethylene	N/A	N/A	0.02	2
5	695439	M8 X 25 COUNTERSUNK SCREW	CSKSKTMB25Z	Zinc Plated Steel (CLEAR)	N/A	N/A	0.01	3
6	695440	UV STABILISED M8 NYLON WASHER BLACK	03-PNWB_AB-UV	Nylon	N/A	N/A	0.00	9
7	600332	NYLOC NUT M8	NYLMBZ	Zinc Plated Steel (CLEAR)	N/A	N/A	0.01	3

DO NOT SCALE



DETAIL A
SCALE 1:1

INDENT EACH END OF PVC STRIP GROOVE LIPS TO STOP BOTH PVC STRIPS FROM SLIDING LOOSE

- NOTES:
- NO VISIBLE SURFACES
 - DE-BURR / REMOVE ALL SHARP EDGES

THIS IS NOT A PRODUCTION DRAWING
(PENDING CUSTOMER APPROVAL)

CUT LENGTHS (mm)	HOLE CRS - MATERIAL EDGE	HOLE Ø (mm)	CSK / CBORE (mm)	BEND RADI (mm)	OTHER (mm)
<150	<300	<5.0mm	DEPTH ± 0.5 DIAMETER ± 0.5 ANGLES ± 1.0°	<150mm ± 1.0 150-500mm ± 2.0 >500mm ± 3.0	BLIND HOLE DP ± 0.5 CUT ANGLE ± 0.25° BEND ANGLE ± 1.0°
>150	>300	5.0-10.0mm			
<500		>10.0mm			
±0.25	±1.0	±0.5	±1.0		

REV.	ZONE	DETAILS	DATE
0	-	INITIAL RELEASE	26/03/2016



THE DESIGN AND/OR TECHNICAL INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND IS THE PROPERTY OF MCKECHNIE ALUMINIUM SOLUTIONS LTD. IT IS ISSUED ON THE EXPRESS UNDERSTANDING THAT THE RECIPIENT WILL NOT DISCLOSE OR REPRODUCE THIS INFORMATION IN ANY MANNER WITHOUT THE WRITTEN PERMISSION OF MCKECHNIE ALUMINIUM SOLUTIONS LTD. THE RECIPIENT SHALL INDEMNIFY AND HOLD MCKECHNIE ALUMINIUM SOLUTIONS LTD. HARMLESS FROM AND AGAINST ALL CLAIMS, DAMAGES, LOSSES AND EXPENSES, INCLUDING REASONABLE ATTORNEY'S FEES, THAT MAY BE ASSERTED AGAINST MCKECHNIE ALUMINIUM SOLUTIONS LTD. BY ANY THIRD PARTY AS A RESULT OF THE RECIPIENT'S BREACH OF THIS OBLIGATION.

PART WEIGHT (-kg)	2.36
DRAWN	GL
DATE	9/03/2016
MANUFACTURERS APPROVAL (Y/N)	
REVISION APPROVAL (Y/N)	
CUSTOMER	TARANAKI STEELFORMERS
PROJECT	N/A
QUOTE NO.	JG0013

ROOF CRAWLER 1.2M
General Assembly

SHT	1 of 1	ITEM NO.	
SIZE	A3	REV.	0
SCALE	1:5		M02917

CUSTOMER: TARANAKI STEELFORMERS
QUOTATION No. JG0013
SIGNATURE: _____
DATE: _____

MCKECHNIE ALUMINIUM SOLUTIONS LTD - DRAWING APPROVAL
We (the customer) hereby approve this drawing and acknowledge that it is in accordance with our requirements. We accept full responsibility for any infringement of copyright, patent, trademark or registered design that may arise from the shape of the drawing. We also acknowledge that your Terms & Conditions of Sale apply.
We accept that Quotation No. JG0013 relates to this drawing and we accept all the Terms and Conditions of that quotation.

APPENDIX II:- Engineering Analysis

Electrotech Consultants is a trading name used by Dodge & Associates Ltd

P O Box 851 New Plymouth, N Z.
Ph 0-6-758 9986 Fax 0-6-757 9812
Email electrotech consultants@extra.co.nz

