



工程指示 / 要求簡箋(E.I.)

工程指示編號：EI / 5447 / 22

修改版次：

工程編號：J - 858

工程名稱：將軍澳日出康城

工程項目：幕牆 單元件地盆用 鋁碼叉腳 (石矢偏入補救方案) 50mm

收件人：生統

發件人：Ant Yeung

日期：08/12/2022

要求提供 / 確認 事項：

- |                                    |                                     |                               |
|------------------------------------|-------------------------------------|-------------------------------|
| <input type="checkbox"/> 初步鋁料 B.M. | <input type="checkbox"/> 加工拆圖，然後生產  | <input type="checkbox"/> 尺寸表  |
| <input type="checkbox"/> 正式鋁料 B.M. | <input type="checkbox"/> 技術上資料 / 指示 | <input type="checkbox"/> 報價   |
| <input type="checkbox"/> 配件 B.M.   | <input type="checkbox"/> 樣辦或貨品說明書   | <input type="checkbox"/> 分判合約 |

內容：

請按加工圖生產鋁碼送地盆。

因石矢偏入補救方案。鋁碼叉脫腳要向牆身方向加 50mm

注意：鋁料已鉻化，全部鋁碼不用 油黑油

X86257 - 01L (40 件) <--- 按此配套打扎

X86257 - 01R (40 件) <--- 按此配套打扎

X86266 - 01L +(20 件) <--- 按此配套打扎

X86266 - 01R +(20 件) <--- 按此配套打扎

請在 2022. 12. 19 前完成上列要求。

附：

以上項目為：

- 原合約工程包                       原合約工程加 / 減賬                       新工程報價

原因：-

分發東莞各部門：

- |                                 |                              |                                |                              |                               |                              |                                |                              |
|---------------------------------|------------------------------|--------------------------------|------------------------------|-------------------------------|------------------------------|--------------------------------|------------------------------|
| <input type="checkbox"/> 生產技術總監 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 技術部   | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 生產部  | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 機械設計部 | <input type="checkbox"/> 連附件 |
| <input type="checkbox"/> 採購部    | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 生產統籌部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 小羅&清 | <input type="checkbox"/> 連附件 |                                |                              |
| <input type="checkbox"/> 質檢部    | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 會計部   | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 報關組  | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 其他    | <input type="checkbox"/> 連附件 |

分發其他分判：

連附件

分發香港各部門：


- |                              |                              |                               |                              |                              |                              |                                  |                              |    |
|------------------------------|------------------------------|-------------------------------|------------------------------|------------------------------|------------------------------|----------------------------------|------------------------------|----|
| <input type="checkbox"/> 行政部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 會計部  | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 統籌部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 工程部地盤科文 | <input type="checkbox"/> 連附件 | 積哥 |
| <input type="checkbox"/> 採購部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> QS 部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 維修部 | <input type="checkbox"/> 連附件 | <input type="checkbox"/> 其他      | <input type="checkbox"/> 連附件 |    |

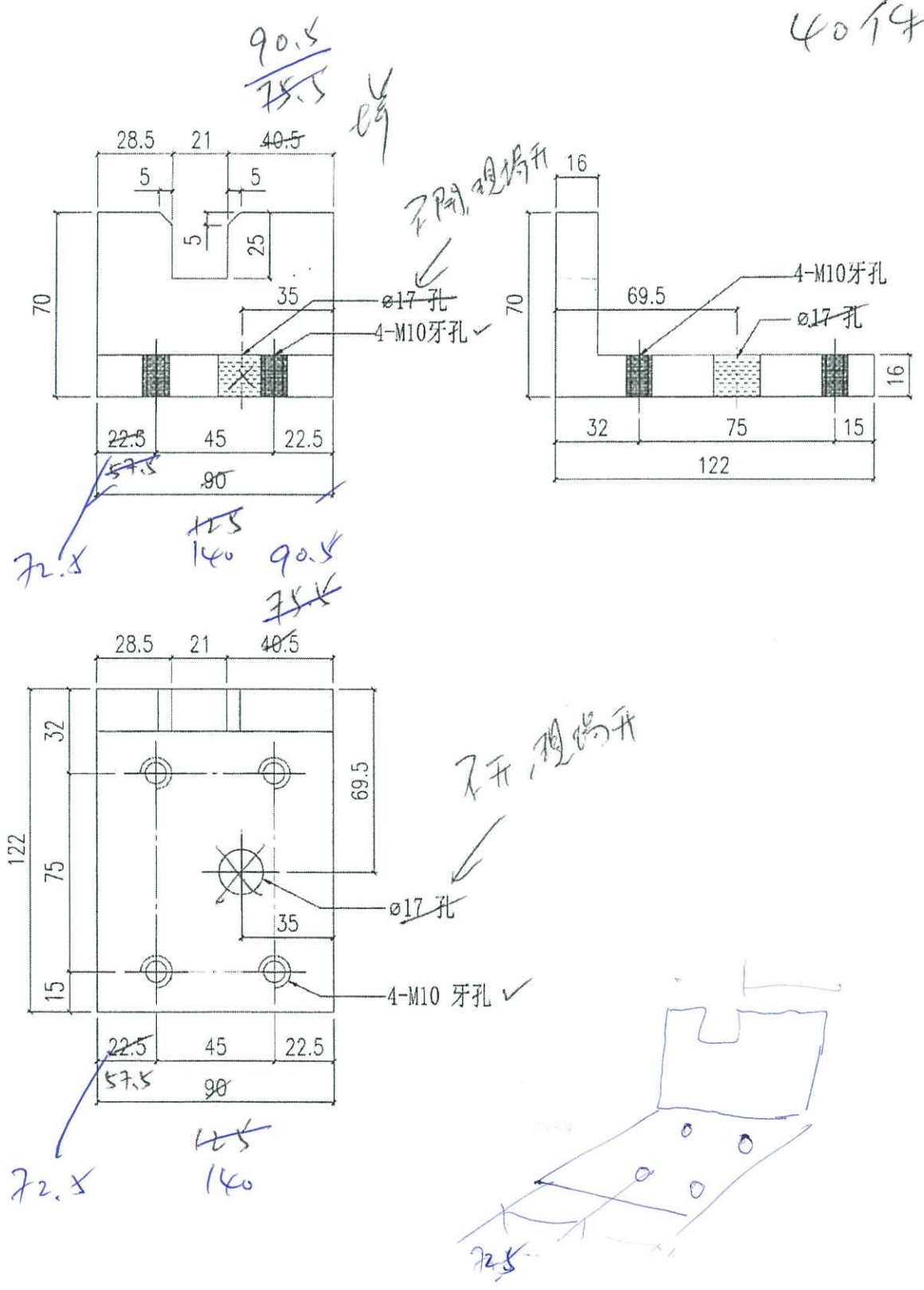
傳遞編號：

HK 2199 / 22

發件人簽署：

項目經理簽署：

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修改	-	-	採用工廠	✓	地盤	-	圖號	X86257-01L
日期	-	-	材料顏色	CHROMATE	圖紙名稱	鋁固定碼加工圖	復核	-
					材料	X86257	批准	-
							數量	4793
							單件重量	- (KG)

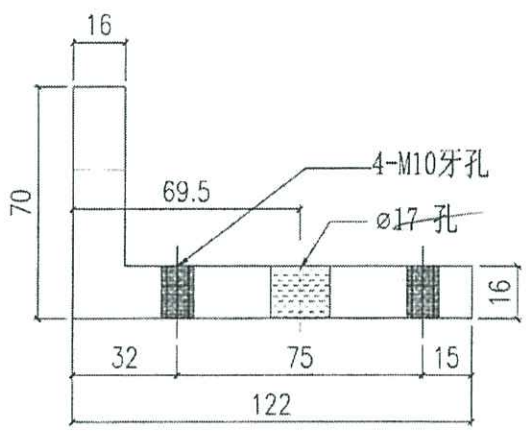
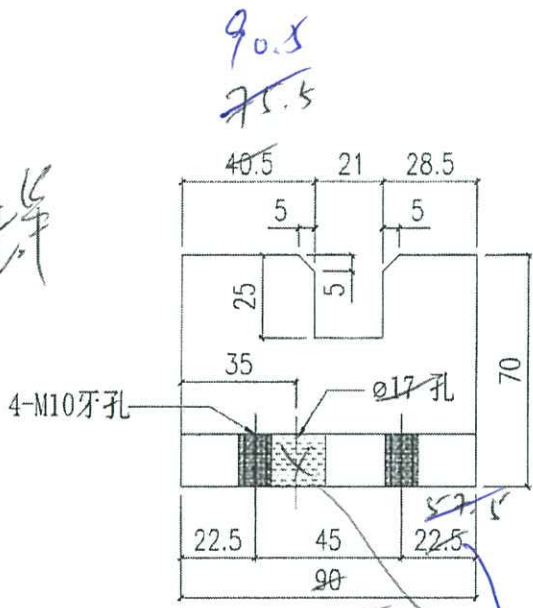


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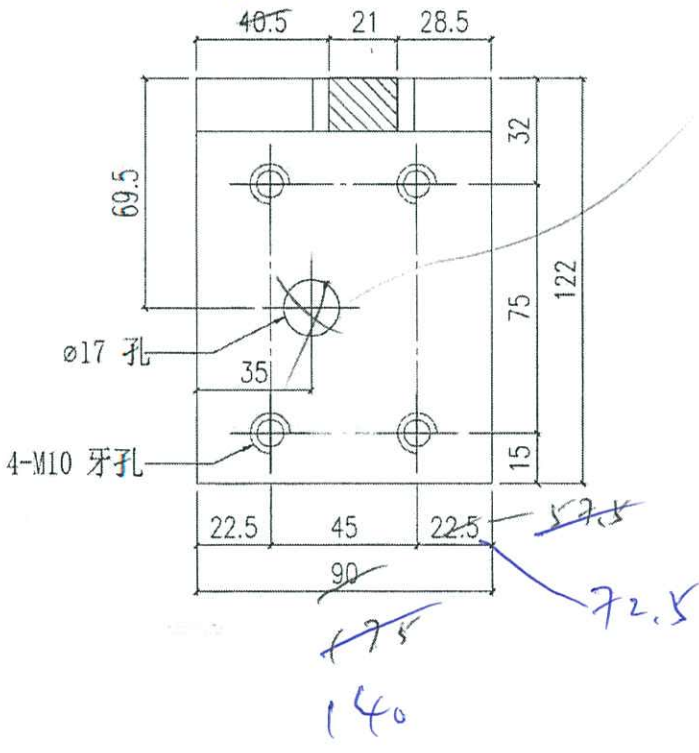
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			地盘	康城11期	制圖	W. E. X	2022-06-14	圖號	X86257-01R			
修改	-	-	採用工廠	✓	地盘	-	圖紙名稱	鋁固定碼加工圖	復核	-	數量	4894
日期	-	-	材料顏色	CHROMATE	材料	X86257	批准	-	單件重量	-	(KG)	

4074

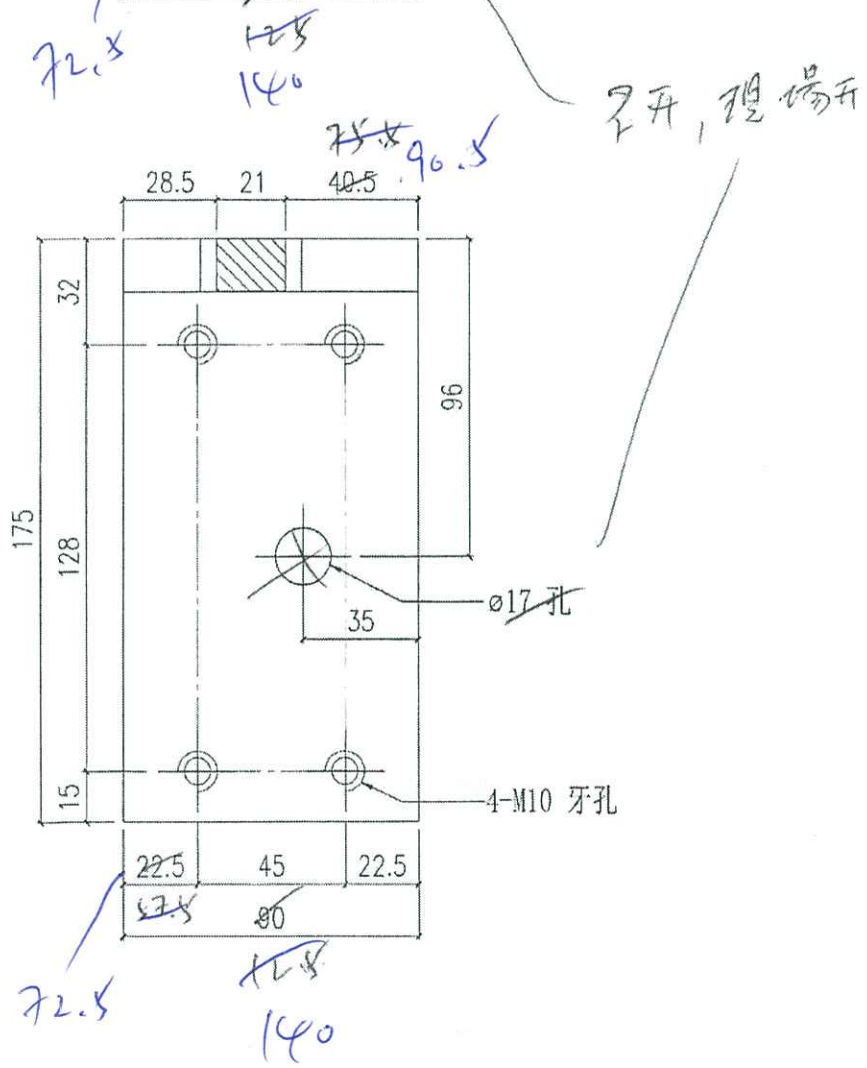
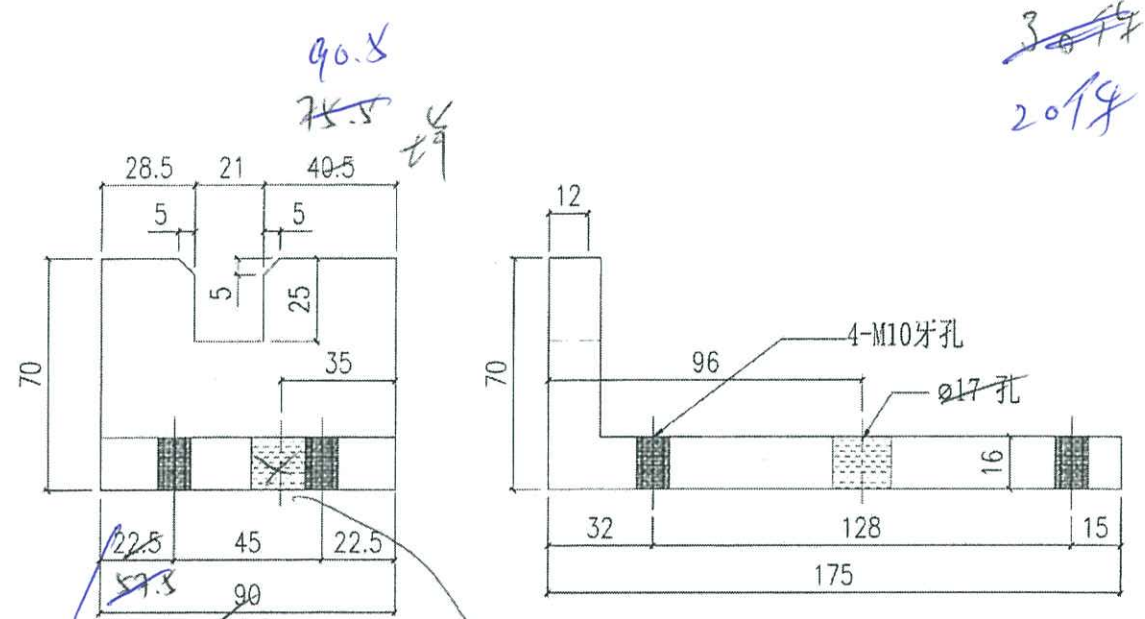
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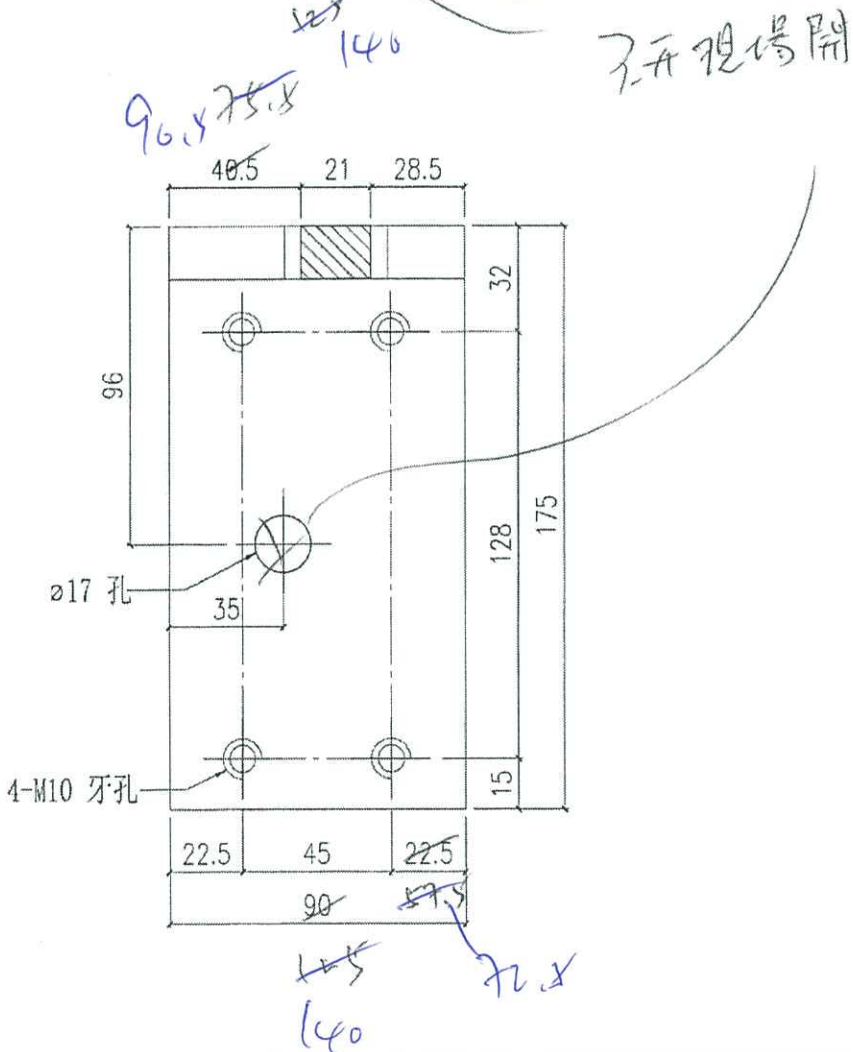
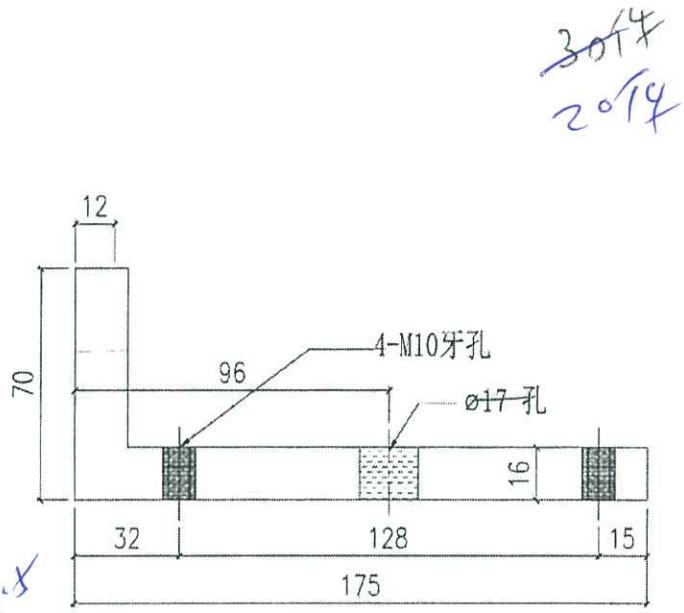
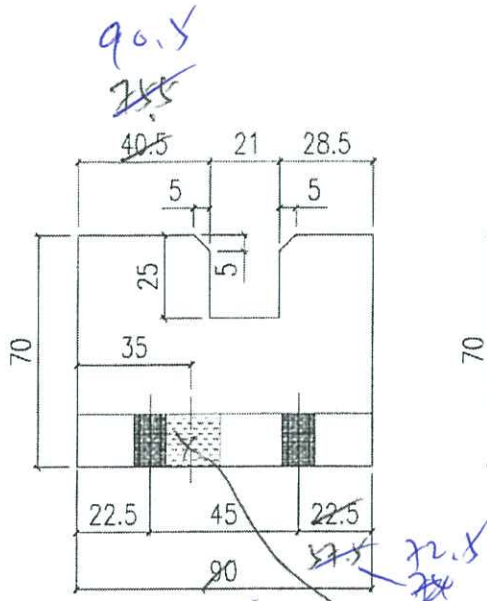
125  
140  
90.5  
75.5  
72.5 不开, 埋地开



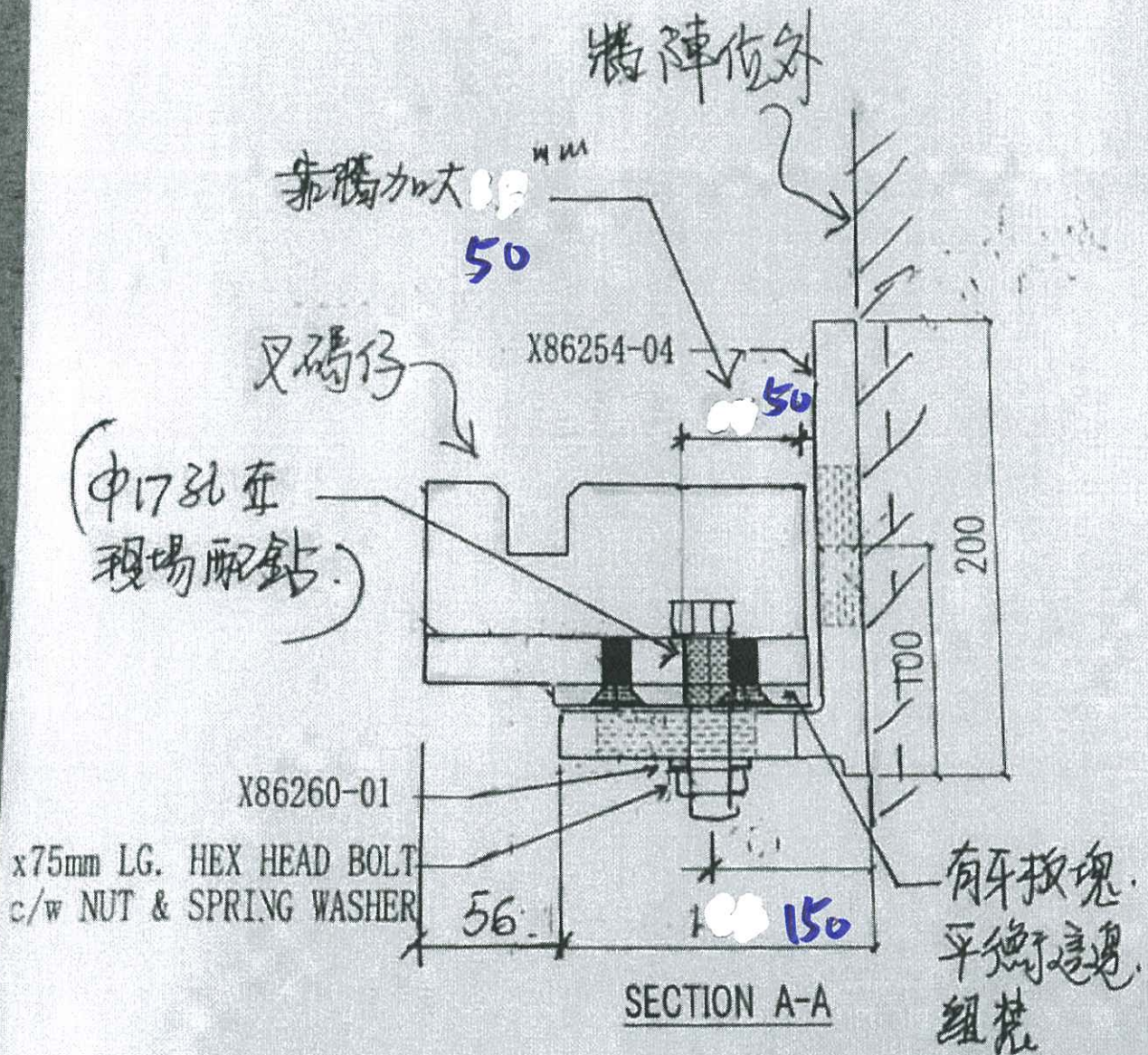
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			地盘	康城11期	制圖	W. E. X	2022-06-14	圖號	X86266-01L	
修改	-	-	採用工廠	✓	地盘	-	-	數量	1900	
日期	-	-	材料颜色	CHROMATE	材料	X86266	批准	-	單件重量	- (KG)



 美特鋁質有限公司 MIDI Aluminium Fabricator Ltd.			工程號 J858 地盘 康城11期	類別 制圖 W. E. X	物料號 - 2022-06-14	圖號 X86266-01R 數量 1799
修改 - 日期 -	採用工廠 <input checked="" type="checkbox"/> 地盘 - 材料颜色 CHROMATE	图纸名称 铝固定码加工图 材料 X86266	復核 - 批准 -	單件重量 - (KG)		



# 外陣位嚴重偏入補救方案

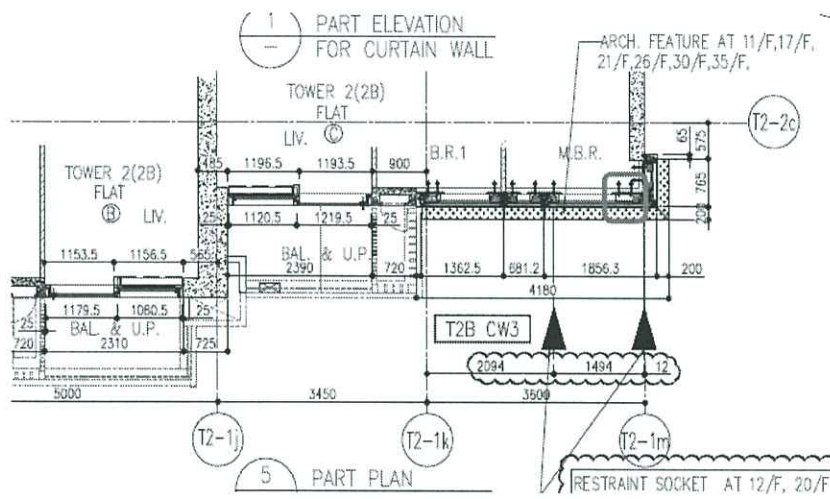
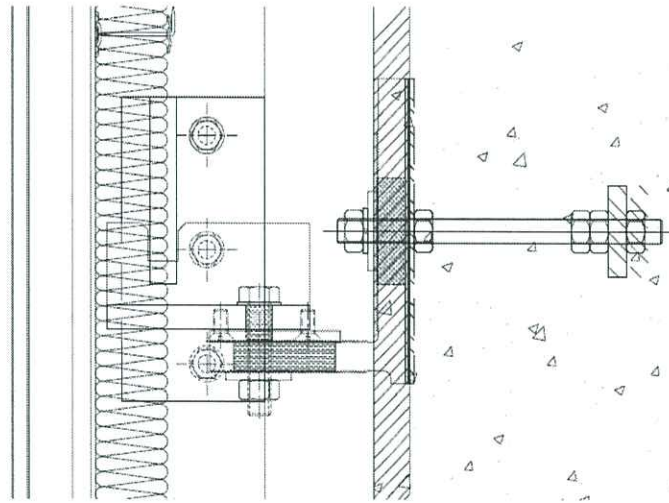


註：有牙板塊，可拆下原本  
隻叉士的(可不需加做)

(叉碼仔搭定  
4個牙孔)

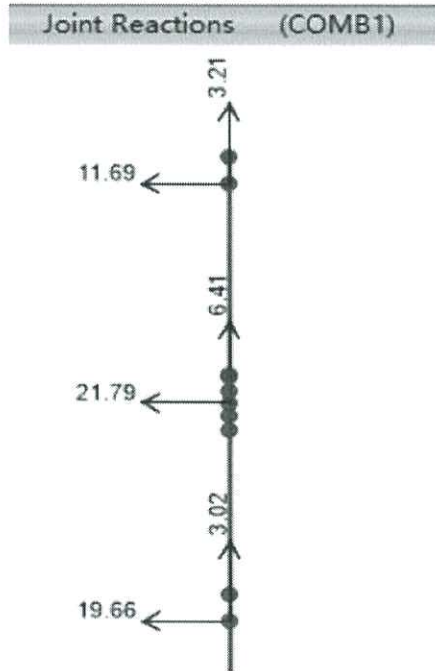
25/10-2022

RM9 RC Set Back 50mm-Corner  
 T2 B Flat C 10F-16F



PE203

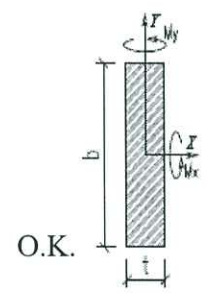
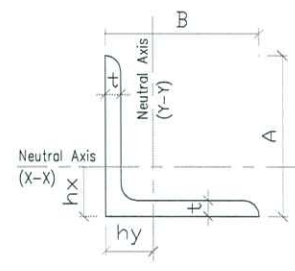
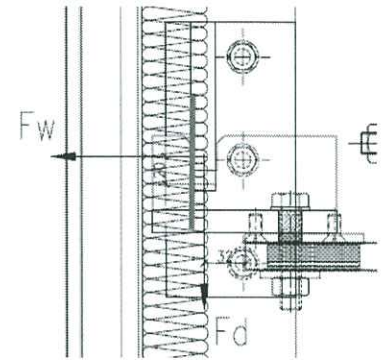
Reactions refer to P4.1-23



Design load	WL = 21.59	KN
	DL = 6.41	KN
Load width in Chapter 4.1	Bo = 1277.5	mm
Max. load width for corner	Bc = 1856.3 / 2	
	= 928.15	mm
Max. reaction load per side	Fw = WL*Bc/Bo	
	= 15.69	KN
	Fd = DL*Bc/Bo	
	= 4.66	KN

Check 16mm thk Alum. Angle

Design force	$F_w = 15.69$	KN
	$F_d = 4.66$	KN
Ecc	$e_1 = 20$	mm
	$e_2 = 32$	mm
Ecc. Moment	$M_e = F_w * e_1 + F_d * e_2$	
	$= 0.46$	KNm
Depth	$A = 70$	mm
Width	$B = 122$	mm
Thickness	$t = 16$	mm
Length of Neutral axis	$h_x = 18.7$	mm
Length of Neutral axis	$h_y = 44.7$	mm
Area	$A_e = 2,816$	mm <sup>2</sup>
Moment Inertia X-X	$I_x = 985,258$	mm <sup>4</sup>
Moment Inertia Y-Y	$I_y = 4,121,898$	mm <sup>4</sup>
Section Modulus X-X	$Z_x = 19,220$	mm <sup>3</sup>
Section Modulus Y-Y	$Z_y = 53,350$	mm <sup>3</sup>
Radius of Gyration X-X	$r_x = 18.7$	mm
Radius of Gyration Y-Y	$r_y = 38.3$	mm
Design strength of 6061-T6	$p_y = 240$	Mpa
Moment capacity	$M_{cx} = p_y * Z_x / 1.2$	
	$= 3.84$	KNm
Tension Capacity	$F_{ct} = p_y * A_e / 1.2$	
	$= 563.20$	KN
Check strength	$k = 1.4 M_e / M_{cx} + 1.4 * F_d / F_{ct}$	
	$= 0.18$	
	$< 1$	
Shear strength of 6061-T6	$p_v = 145$	MPa
Shear capacity	$F_{cs} = p_v * A_e / 1.2$	
	$= 340.3$	KN
Check shear	$k = 1.4 F_w / F_{cs}$	
	$= 0.06$	
	$< 1$	



O.K.

Check M16 Bolt and Nut

Ecc.

$e_1 = 63 \text{ mm}$

$e_2 = 66 \text{ mm}$

Ecc. Moment

$M_e = F_w * e_1 + F_d * e_2$   
 $= 1.30 \text{ KNm}$

Nos of bolt

$n = 1$

Min. Compression edge

$d = 34 \text{ mm}$

Tension force per bolt

$F_t = M_e / (0.8 * d) - F_d$   
 $= 43.0 \text{ KN}$

Shear force per bolt

$F_s = F_w$   
 $= 15.7 \text{ KN}$

Design shear strength (A4-70)

$P_s = 280 \text{ MPa}$

Design tensile strength (A4-70)

$P_t = 450 \text{ MPa}$

Thread area

$A = 157 \text{ mm}^2$

Load factor

$\gamma_f = 1.4$

Shear capacity

$F_{sc} = P_s * A$   
 $= 43.96 \text{ KN}$   
 $> \gamma_f * F_s = 22.0 \text{ KN}$

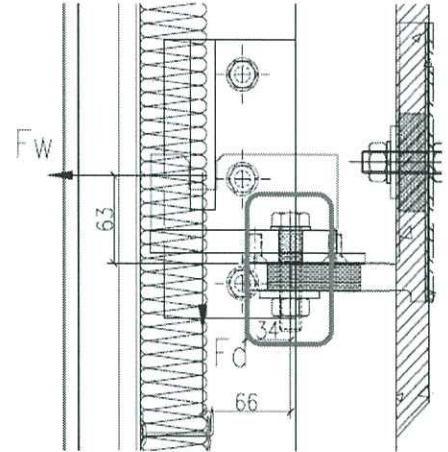
Tensile capacity

$F_{tc} = P_t * A$   
 $= 70.65 \text{ KN}$   
 $> \gamma_f * F_t = 60.2 \text{ KN}$

Combined check

$k = \frac{\gamma_f * F_t}{F_{tc}} + \frac{\gamma_f * F_s}{F_{sc}}$   
 $= 1.35$   
 $< 1.4$

O.K.



Check Bearing

For Connected Plate

Diameter of screw:

$$df = 16 \quad \text{mm}$$

Thickness of thinner part

$$t = 7 \quad \text{mm}$$

Constant

$$co = 2 \quad \text{For } df/t = 2.29 < 10$$

Edge distance

$$eo = 21 \quad \text{mm}$$

Bearing strength of 6061-T6

$$pa = 260 \quad \text{Mpa}$$

Load factor:

$$\gamma_f = 1.4$$

Material factor:

$$\gamma_m = 1.2$$

Bearing Capacity

$$Br1 = \frac{co \cdot df \cdot t \cdot pa}{\gamma_m}$$

$$= 48533.3 \quad \text{N}$$

$$Br2 = \frac{eo \cdot t \cdot pa}{\gamma_m}$$

$$= 38220 \quad \text{N}$$

$$Br = \min(Br1, Br2)$$

$$= 38.22 \quad \text{KN}$$

Strength check:

$$k = \frac{\gamma_f \cdot Fs}{Br}$$

$$= 0.57$$

$$< 1.0$$

O.K.

Check 19mm thk Alum Bracket C-C

Design load

$$F_w = 15.69 \quad \text{KN}$$

$$F_d = 4.66 \quad \text{KN}$$

Ecc.

$$e_1 = 63.0 \quad \text{mm}$$

$$e_2 = 148.0 \quad \text{mm}$$

$$e_3 = 184.5 \quad \text{mm}$$

Ecc. Moment

$$M_y = F_w \cdot e_1 + F_d \cdot e_2$$

$$= 1.68 \quad \text{KNm}$$

$$M_x = F_w \cdot e_3$$

$$= 2.89 \quad \text{KNm}$$

$$T = F_d \cdot e_3$$

$$= 0.86 \quad \text{KNm}$$

Section length

$$b = 385 \quad \text{mm}$$

Angle thickness

$$t = 19 \quad \text{mm}$$

Area

$$A = bt$$

$$= 7315 \quad \text{mm}^2$$

Elastic modulus

$$Z_x = b^2 \cdot t / 4$$

$$= 704068.8 \quad \text{mm}^3$$

$$Z_y = t^2 \cdot b / 4$$

$$= 34746.3 \quad \text{mm}^3$$

Design strength of 6061-T6

$$p_y = 240 \quad \text{Mpa}$$

Moment capacity

$$M_{cx} = p_y \cdot Z_x / 1.2$$

$$= 140.81 \quad \text{KNm}$$

$$M_{cy} = p_y \cdot Z_y / 1.2$$

$$= 6.95 \quad \text{KNm}$$

Tension Capacity

$$F_{ct} = p_y \cdot A / 1.2$$

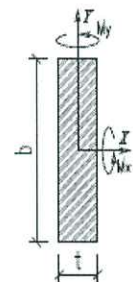
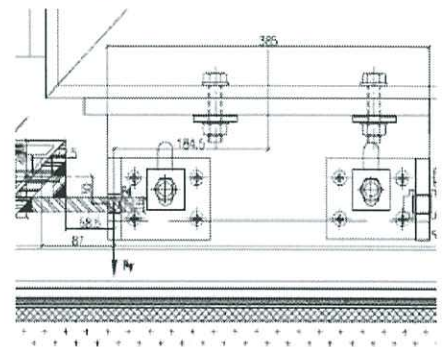
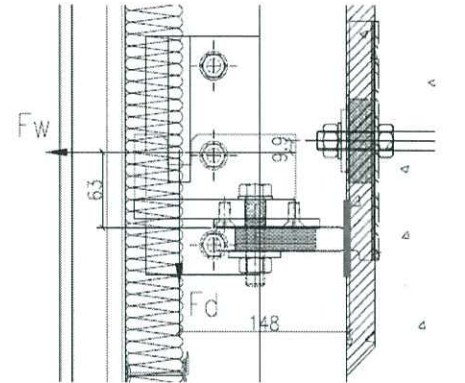
$$= 1463.00 \quad \text{KN}$$

Check strength

$$k = 1.4M_x/M_{cx} + 1.4M_y/M_{cy} + 1.4 \cdot F_w/F_{ct}$$

$$= 0.38$$

$$< 1 \quad \text{O.K.}$$



Check Shear

Torsion modulus

$$\begin{aligned}Cu &= b*t^2/3 \\ &= 46328.3 \text{ mm}^3\end{aligned}$$

Shear strength of 6061-T6

$$pv = 145 \text{ MPa}$$

Shear capacity

$$\begin{aligned}Fcs &= pv*A/1.2 \\ &= 883.9 \text{ KN}\end{aligned}$$

Torsion Capacity

$$\begin{aligned}Tc &= pv*Cu/1.2 \\ &= 5.60 \text{ KNm}\end{aligned}$$

Check shear

$$\begin{aligned}k &= 1.4Fd/Fcs+1.4T/Tc \\ &= 0.22 \\ &< 1\end{aligned}$$

O.K.

Check 19mm thk Alum Bracket D-D

Max. reaction

$$F_w = 15.7 \quad \text{KN}$$

$$F_d = 4.66 \quad \text{KN}$$

Ecc.

$$e_1 = 10 \quad \text{mm}$$

$$e_2 = 170 \quad \text{mm}$$

Ecc. Moment

$$M_y = F_w * e_1 + F_d * e_2$$

$$= 0.95 \quad \text{KNm}$$

$$M_x = F_w * 206.5 \text{mm}$$

$$= 3.24 \quad \text{KNm}$$

Section length

$$b = 413 \quad \text{mm}$$

Angle thickness

$$t = 19 \quad \text{mm}$$

Area

$$A = bt$$

$$= 7847 \quad \text{mm}^2$$

Elastic modulus

$$Z_y = t^2 b / 6$$

$$= 24848.8 \quad \text{mm}^3$$

$$Z_x = b^2 t / 6$$

$$= 540135.2 \quad \text{mm}^3$$

Design strength of 6061-T6

$$p_y = 240 \quad \text{Mpa}$$

Moment capacity

$$M_{cy} = p_y * Z_y / 1.2$$

$$= 4.97 \quad \text{KNm}$$

$$M_{cx} = p_y * Z_x / 1.2$$

$$= 108.03 \quad \text{KNm}$$

Tension capacity

$$F_{ct} = p_y * A / 1.2$$

$$= 1569.4 \quad \text{KN}$$

Check strength

$$k = 1.4 M_y / M_{cy} + 1.4 * F_d / F_{ct} + 1.4 M_x / M_{cx}$$

$$= 0.31$$

$$< 1$$

O.K.

Shear strength of 6061-T6

$$p_v = 145 \quad \text{Mpa}$$

Shear capacity

$$F_{cs} = p_v * A / 1.2$$

$$= 948.2 \quad \text{KN}$$

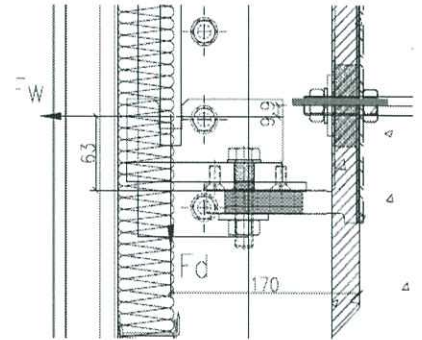
Check shear strength

$$k = 1.4 * F_w / F_{cs}$$

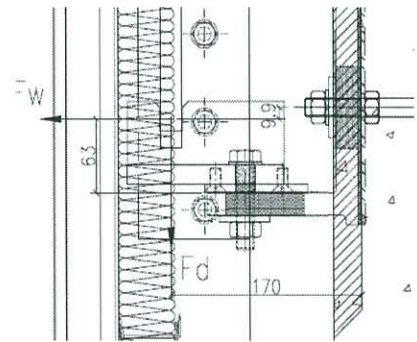
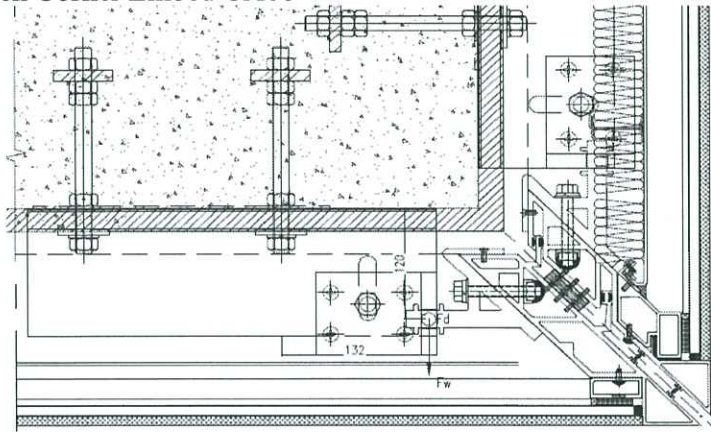
$$= 0.02$$

$$< 1$$

O.K.



Check Corner Embed CA08



Max. Factored reaction load  
per side

$$F_w = 15.69 \quad \text{KN}$$

$$F_d = 4.66 \quad \text{KN}$$

Ecc.

$$e_1 = 10 \quad \text{mm}$$

$$e_2 = 132 \quad \text{mm}$$

$$e_3 = 170 \quad \text{mm}$$

R.c. Tolerance

$$e_t = 25 \quad \text{mm}$$

Max. Ecc. Moment

$$M_x = F_w \cdot (e_t - e_1) + F_d \cdot e_3$$

$$= 1.03 \quad \text{KNm}$$

$$M_y = F_w \cdot (e_2 + e_t)$$

$$= 2.46 \quad \text{KNm}$$

$$T = F_d \cdot (e_2 + e_t)$$

$$= 0.73 \quad \text{KNm}$$

a) Check the RC Compression

Consider bending on X-X axis  
Bearing strength of RC

Modular ratio =  $E_{st}/E_{rc}$

Design strength of Rod

Tension rebar to edge plate

Lever arm to moment

Tension force of per rod

Consider bending on Y-Y axis

Tension rebar to edge plate

Lever arm to moment

Tension force of per rod

Total Factored Compression force

Embed plate size

Compression stress of concrete

$$p_c = 0.4 \cdot 45 \text{ MPa} = 18.0 \text{ MPa}$$

$$m_o = 15$$

$$p_y = 275 \text{ MPa}$$

$$d_1 = 100 \text{ mm}$$

$$d_{n1} = \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_1$$

$$= 49.54 \text{ mm}$$

$$l_{a1} = d_1 - d_{n1} / 3 = 83.49 \text{ mm}$$

$$C_1 = 1.4 \cdot M_x / l_{a1} = 17.2 \text{ KN}$$

$$d_2 = 265 \text{ mm}$$

$$d_{n2} = \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_2$$

$$= 131.3 \text{ mm}$$

$$l_{a2} = d_2 - d_{n2} / 3 = 221.24 \text{ mm}$$

$$C_2 = 1.4 \cdot M_y / l_{a2} = 15.6 \text{ KN}$$

$$C = C_1 + C_2 = 32.8 \text{ KN}$$

$$b = 413 \text{ mm}$$

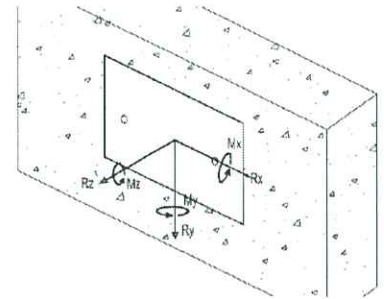
$$d = 200 \text{ mm}$$

$$f_c = 2 \cdot C_1 / d_{n1} \cdot b + 2 \cdot C_2 / d_{n2} \cdot d$$

$$= 2.87 \text{ MPa}$$

$$< f_{cc} = 0.6 \cdot 45 \text{ MPa}$$

$$= 27.0 \text{ MPa} \quad \text{O.K.}$$

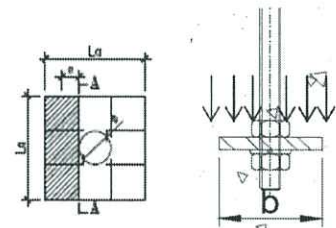


b) Check 2nos  $\psi$ 16mm GMS Bolt (GR8.8)

Factored Tension force per rod	$F_t$	$= 1.4 \cdot F_w / 2 + C_1 / 2 + C_2$	
		$= 35.18$	KN
Rod spacing	$s$	$= 200$	mm
Shear force per rod	$F_s$	$= \frac{1.4 \cdot F_d}{2} + \frac{1.4 \cdot T}{s}$	
		$= 8.38$	KN
Diameter of bolt	$\psi$	$= 16$	mm
Effective Area	$A$	$= 156$	$\text{mm}^2$
Shear strength of GR8.8	$p_v$	$= 375$	Mpa
Shear Capacity:	$P_s$	$= p_v \cdot A$	
		$= 58.5$	KN
		$> F_s$	
		$= 8.4$	KN
	$k$	$= F_s / P_s$	
		$= 0.14$	
		$< 1.00$	O.K.
Tension strength of GR8.8	$p_t$	$= 560$	Mpa
Tension Capacity:	$P_t$	$= p_t \cdot A$	
		$= 87.4$	KN
		$> F_t$	
		$= 35.2$	KN
Check Tension	$k$	$= F_t / P_t$	
		$= 0.40$	
		$< 1.0$	O.K.
Combined Check	$k$	$= \frac{F_s}{F_{cs}} + \frac{F_t}{F_{ct}}$	
		$= 0.55$	
		$< 1.40$	O.K.

c) Check 60\*60\*12mm thk GMS Washer

Shear Force	$F_s = 3 \cdot F_t / 8$	
	$= 13.19$	KN
Length of section	$b = 60$	mm
Ecc	$e = (L_a - \psi) / 4$	
	$= 11.00$	mm
Ecc. Moment	$M_e = F_s \cdot e$	
	$= 0.145$	KNm



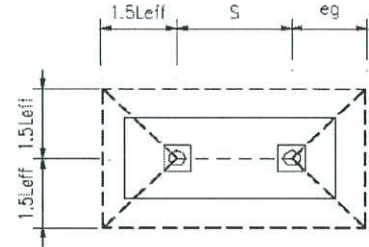
Section Properties

Section width	$b = 60$	mm
Thickness	$t = 12$	mm
Area	$A = b \cdot t$	
	$= 720$	mm <sup>2</sup>
Elastic Modulus	$Z_y = b \cdot t^2 / 6$	
	$= 1440$	mm <sup>3</sup>
Design strength of S275	$p_y = 275$	Mpa
Shear Capacity	$F_{cs} = 0.6 \cdot p_y \cdot A$	
	$= 118.80$	KN
Moment capacity	$M_{cy} = p_y \cdot Z_y$	
	$= 0.40$	KNm
Combined check	$k = \frac{M_e}{M_{cy}} + \frac{F_s}{F_{cs}}$	
	$= 0.48$	
	$< 1.0$	

O.K.

d) Check Concrete against Unching Shear to HKCC 2013

Embedment Depth	Lef	=	175	mm
Width of washer	b	=	60	mm
Bolt spacing	s	=	200	mm
Edge distance	eg	=	195	mm
	1.5*Lef	=	262.5	mm



Perimeter of punching shear  $P1 = 4*(1.5*Lef)+2*s+2*\min(eg, 1.5*Lef)$   
 $= 1840$  mm

Ave. shear stress  $f_v = 2*F_t/P1*Lef$   
 $= 0.22$  Mpa

Conservative take  $\frac{100A_s}{P*L} = 0.15$

Concrete strength  $f_{cu} = 45$  Mpa

Design concrete shear strength  $v_c = \frac{0.79}{1.25} * (\frac{100A_s}{P*L})^{1/3} * (\frac{400}{Lef})^{1/4} * (\frac{f_{cu}}{25})^{1/3}$   
 $= 0.50$  Mpa

Check shear cone  $k = f_v/v_c$   
 $= 0.43$   
 $< 1.0$

O.K.

e) Check the bonding stress

Tension force per rod  $F_t = 35.18$  KN

Diameter of bar:  $\psi = 16$  mm

Effective anchor length  $L_{eff} = 175$  mm

Bond stress  $f_b = \frac{F_t}{\psi*\pi*L_{eff}}$   
 $= 4.00$  Mpa

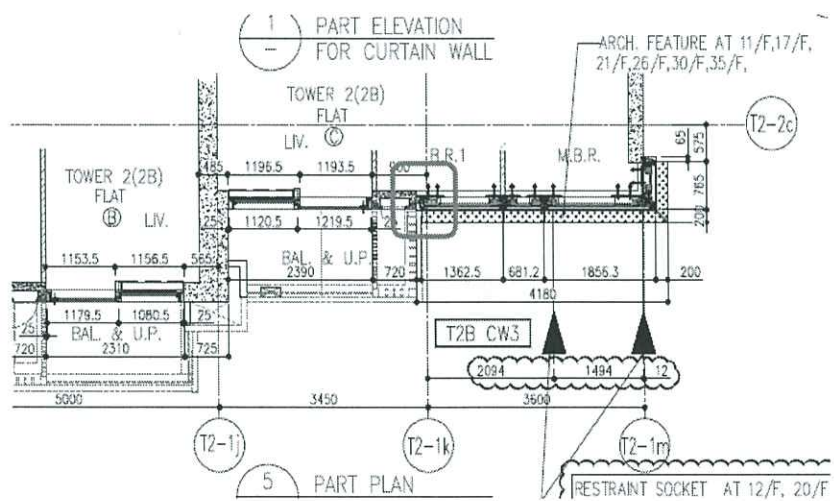
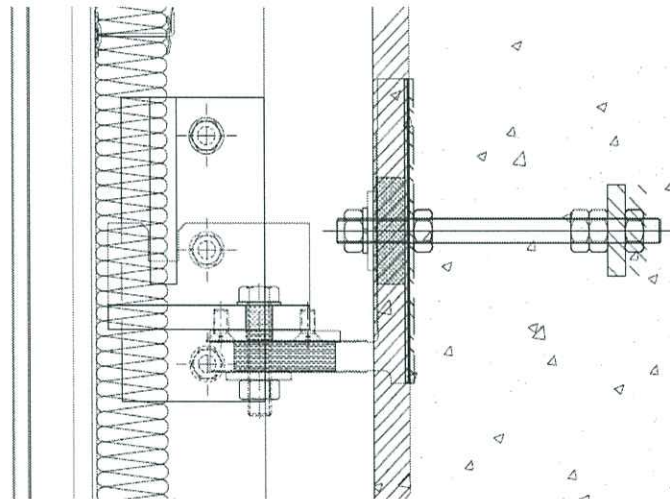
Concrete Grade  $f_{cu} = 45$  Mpa

Design Ultimate bond stress  $f_{bu} = 0.65*(f_{cu})^{0.5}$   
 $= 4.36$  Mpa

Check Bonding  $k = f_b/f_{bu}$   
 $= 0.92$   
 $< 1.0$

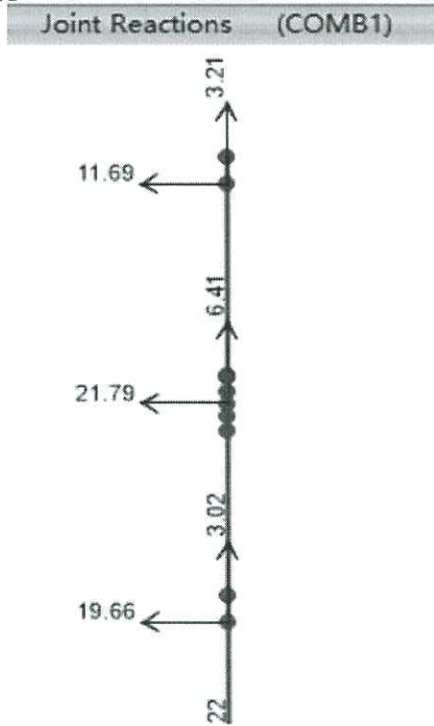
O.K.

RM9 RC Set Back 50mm-Edge  
 T2 B Flat C 10F-16F



PE203

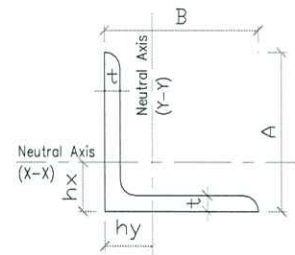
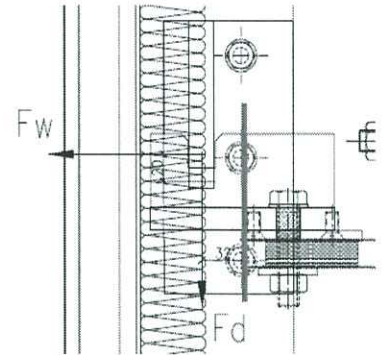
Reactions refer to Chapter 4.1



Design load	WL = 21.79	KN	
	DL = 6.41	KN	
Load width in Chapter 4.1	Bo = 1277.5	mm	
Max. width of Jamb mullion	B = 681.25	mm	(1362.5/2)
Wind load per bracket	Fw = WL*B/Bo		
	= 11.62	KN	
Dead load per bracket	Fd = DL*B/Bo		
	= 3.42	KN	

Check 16mm thk Alum. Angle

Design force	$F_w = 11.62$	KN
	$F_d = 3.42$	KN
Ecc	$e_1 = 20$	mm
	$e_2 = 32$	mm
Ecc. Moment	$M_e = F_w * e_1 + F_d * e_2$	
	$= 0.34$	KNm
Depth	$A = 70$	mm
Width	$B = 122$	mm
Thickness	$t = 16$	mm
Length of Neutral axis	$h_x = 18.7$	mm
Length of Neutral axis	$h_y = 44.7$	mm
Area	$A_e = 2,816$	mm <sup>2</sup>
Moment Inertia X-X	$I_x = 985,258$	mm <sup>4</sup>
Moment Inertia Y-Y	$I_y = 4,121,898$	mm <sup>4</sup>
Section Modulus X-X	$Z_x = 19,220$	mm <sup>3</sup>
Section Modulus Y-Y	$Z_y = 53,350$	mm <sup>3</sup>
Radius of Gyration X-X	$r_x = 18.7$	mm
Radius of Gyration Y-Y	$r_y = 38.3$	mm
Design strength of 6061-T6	$p_y = 240$	Mpa
Moment capacity	$M_{cx} = p_y * Z_x / 1.2$	
	$= 3.84$	KNm
Tension Capacity	$F_{ct} = p_y * A_e / 1.2$	
	$= 563.20$	KN
Check strength	$k = 1.4M_e / M_{cx} + 1.4 * F_d / F_{ct}$	
	$= 0.13$	
	$< 1$	O.K.
Shear strength of 6061-T6	$p_v = 145$	MPa
Shear capacity	$F_{cs} = p_v * A_e / 1.2$	
	$= 340.3$	KN
Check shear	$k = 1.4F_w / F_{cs}$	
	$= 0.05$	
	$< 1$	O.K.



Check M16 Bolt and Nut

Ecc.

$e_1 = 63 \text{ mm}$

$e_2 = 66 \text{ mm}$

Ecc. Moment

$M_e = F_w * e_1 + F_d * e_2$   
 $= 0.96 \text{ KNm}$

Nos of bolt

$n = 1$

Min. Compression edge

$d = 34 \text{ mm}$

Tension force per bolt

$F_t = \frac{M_e}{(0.8 * d)} - F_d$   
 $= 31.8 \text{ KN}$

Shear force per bolt

$F_s = F_w$   
 $= 11.6 \text{ KN}$

Design shear strength (A4-70)

$P_s = 280 \text{ MPa}$

Design tensile strength (A4-70)

$P_t = 450 \text{ MPa}$

Thread area

$A = 157 \text{ mm}^2$

Load factor

$\gamma_f = 1.4$

Shear capacity

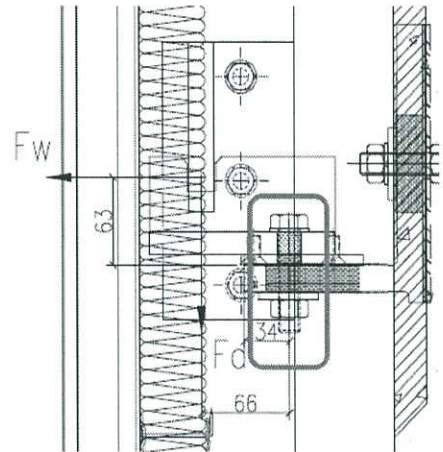
$F_{sc} = P_s * A$   
 $= 43.96 \text{ KN}$   
 $> \gamma_f * F_s = 16.3 \text{ KN}$

Tensile capacity

$F_{tc} = P_t * A$   
 $= 70.65 \text{ KN}$   
 $> \gamma_f * F_t = 44.5 \text{ KN}$

Combined check

$k = \frac{\gamma_f * F_t}{F_{tc}} + \frac{\gamma_f * F_s}{F_{sc}}$   
 $= 1.00$   
 $< 1.4$



O.K.

Check Bearing

For Connected Plate

Diameter of screw:	df	=	16	mm
Thickness of thinner part	t	=	7	mm
Constant	co	=	2	For df/t= 2.29 < 10
Edge distance	eo	=	21	mm
Bearing strength of 6061-T6	pa	=	260	Mpa
Load factor:	$\gamma_f$	=	1.4	
Material factor:	$\gamma_m$	=	1.2	
Bearing Capacity	Br1	=	$\frac{co*df*t*pa}{\gamma_m}$	

$$= 48533.3 \quad \text{N}$$

$$Br2 = \frac{eo*t*pa}{\gamma_m}$$

$$= 38220 \quad \text{N}$$

$$Br = \min(Br1, Br2)$$
$$= 38.22 \quad \text{KN}$$

Strength check:

$$k = \frac{\gamma_f*Fs}{Br}$$

$$= 0.43$$

$$< 1.0$$

O.K.

Check 19mm thk Alum Bracket C-C

Design load

$$F_w = 11.62 \quad \text{KN}$$

$$F_d = 3.42 \quad \text{KN}$$

Ecc.

$$e_1 = 63.0 \quad \text{mm}$$

$$e_2 = 148.0 \quad \text{mm}$$

$$e_3 = 95.0 \quad \text{mm}$$

Ecc. Moment

$$\begin{aligned} M_y &= F_w * e_1 + F_d * e_2 \\ &= 1.24 \quad \text{KNm} \end{aligned}$$

$$\begin{aligned} M_x &= F_w * e_3 \\ &= 1.10 \quad \text{KNm} \end{aligned}$$

$$\begin{aligned} T &= F_d * e_3 \\ &= 0.32 \quad \text{KNm} \end{aligned}$$

Section length

$$b = 202 \quad \text{mm}$$

Angle thickness

$$t = 19 \quad \text{mm}$$

Area

$$\begin{aligned} A &= bt \\ &= 3838 \quad \text{mm}^2 \end{aligned}$$

Elastic modulus

$$\begin{aligned} Z_x &= b^2 * t / 4 \\ &= 193819.0 \quad \text{mm}^3 \end{aligned}$$

$$\begin{aligned} Z_y &= t^2 * b / 4 \\ &= 18230.5 \quad \text{mm}^3 \end{aligned}$$

Design strength of 6061-T6

$$p_y = 240 \quad \text{Mpa}$$

Moment capacity

$$\begin{aligned} M_{cx} &= p_y * Z_x / 1.2 \\ &= 38.76 \quad \text{KNm} \end{aligned}$$

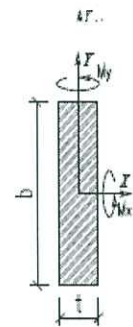
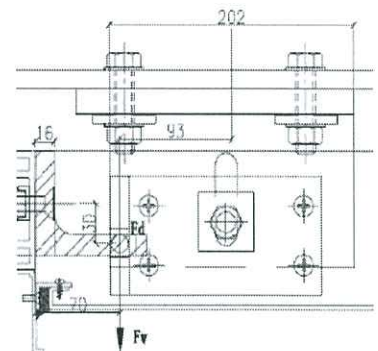
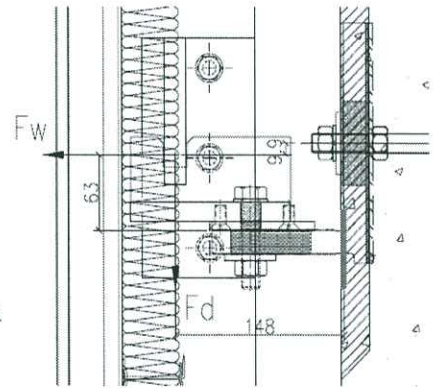
$$\begin{aligned} M_{cy} &= p_y * Z_y / 1.2 \\ &= 3.65 \quad \text{KNm} \end{aligned}$$

Tension Capacity

$$\begin{aligned} F_{ct} &= p_y * A / 1.2 \\ &= 767.60 \quad \text{KN} \end{aligned}$$

Check strength

$$\begin{aligned} k &= 1.4M_x/M_{cx} + 1.4M_y/M_{cy} + 1.4 * F_w / F_{ct} \\ &= 0.54 \\ &< 1 \end{aligned} \quad \text{O.K.}$$



Check Shear

Torsion modulus

$$\begin{aligned} Cu &= b*t^2/3 \\ &= 24307.33 \text{ mm}^3 \end{aligned}$$

Shear strength of 6061-T6

$$pv = 145 \text{ MPa}$$

Shear capacity

$$\begin{aligned} Fcs &= pv*A/1.2 \\ &= 463.8 \text{ KN} \end{aligned}$$

Torsion Capacity

$$\begin{aligned} Tc &= pv*Cu/1.2 \\ &= 2.94 \text{ KNm} \end{aligned}$$

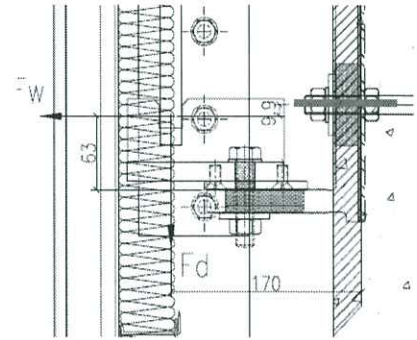
Check shear

$$\begin{aligned} k &= 1.4Fd/Fcs+1.4T/Tc \\ &= 0.17 \\ &< 1 \end{aligned}$$

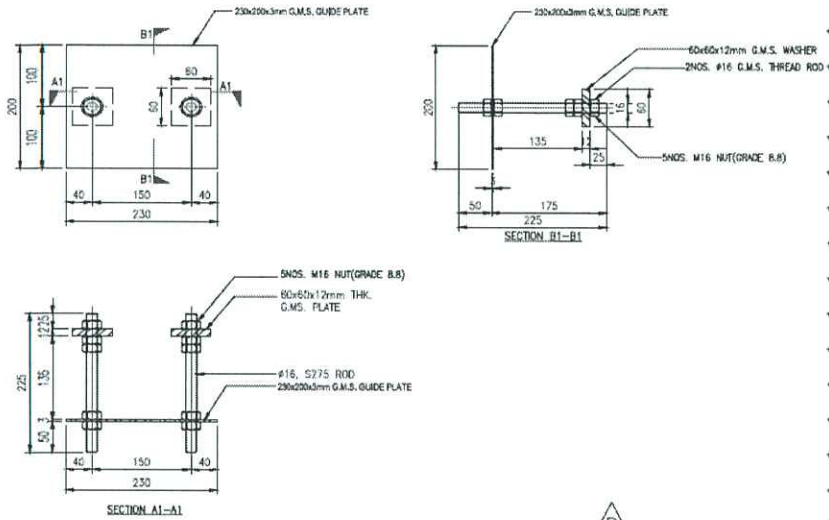
O.K.

Check 19mm thk Alum Bracket D-D

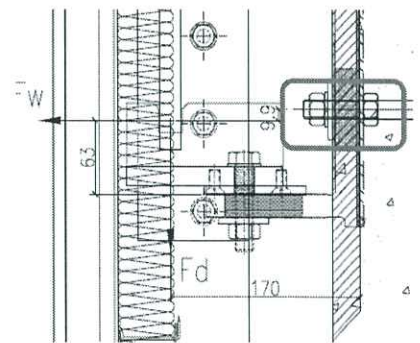
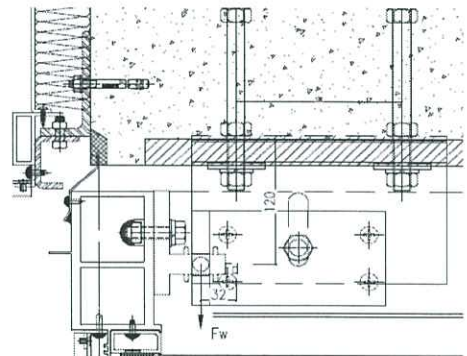
Max. reaction	$F_w = 11.6$	KN	
	$F_d = 3.42$	KN	
Ecc.	$e_1 = 9.5$	mm	
	$e_2 = 170$	mm	
Ecc. Moment	$M_y = F_w * e_1 + F_d * e_2$		
	$= 0.69$	KNm	
	$M_x = F_w * 115$		
	$= 1.34$	KNm	
Section length	$b = 230$	mm	
Angle thickness	$t = 19$	mm	
Area	$A = bt$		
	$= 4370$	mm <sup>2</sup>	
Elastic modulus	$Z_y = t^2 b / 6$		
	$= 13838.3$	mm <sup>3</sup>	
	$Z_x = b^2 t / 6$		
	$= 167516.7$	mm <sup>3</sup>	
Design strength of 6061-T6	$p_y = 240$	Mpa	
Moment capacity	$M_{cy} = p_y * Z_y / 1.2$		
	$= 2.77$	KNm	
	$M_{cx} = p_y * Z_x / 1.2$		
	$= 33.50$	KNm	
Tension capacity	$F_{ct} = p_y * A / 1.2$		
	$= 874.0$	KN	
Check strength	$k = 1.4 M_y / M_{cy} + 1.4 * F_d / F_{ct} + 1.4 M_x / M_{cx}$		
	$= 0.41$		
	$< 1$		O.K.
Shear strength of 6061-T6	$p_v = 145$	Mpa	
Shear capacity	$F_{cs} = p_v * A / 1.2$		
	$= 528.0$	KN	
Check shear strength	$k = 1.4 * F_w / F_{cs}$		
	$= 0.03$		
	$< 1$		O.K.



Check Cast in Embed CA02



Max. reaction	WL = 21.79	KN
(Refer to P4.1-24)	DL = 6.41	KN
Load width in Chapter 4.1	Bo = 1277.5	mm
Max. load width for corner	B = 681.25	mm
Max. Factored reaction load for corner	Fw = 1.4*WL*B/Bo	
	= 16.27	KN
	Fd = 1.4*DL*B/Bo	
	= 4.79	KN
Ecc.	e1 = 10	mm
	e2 = 32	mm
	e3 = 170	mm
R.c. Tolerance	et = 25	mm
Ecc. Moment	Mx = Fw*(et-e1)+Fd*e3	
	= 1.06	KNm
	My = Fw*(e2+et)	
	= 0.93	KNm
	T = Fd*(e2+et)	
	= 0.27	KNm



a) Check the RC Compression

Consider bending on X-X axis

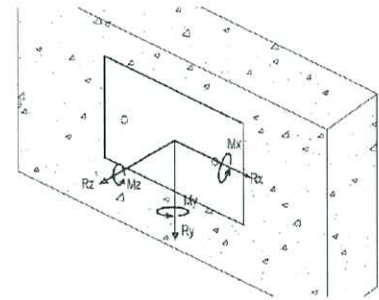
Bearing strength of RC

Modular ratio=Est/Erc

Design strength of Rod

Tension rebar to edge plate

$$\begin{aligned} p_c &= 0.4 \cdot 45 \text{ MPa} \\ &= 18.0 \text{ Mpa} \\ m_o &= 15 \\ p_y &= 275 \text{ Mpa} \\ d_1 &= 100 \text{ mm} \end{aligned}$$



$$\begin{aligned} d_{n1} &= \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_1 \\ &= 49.54 \text{ mm} \end{aligned}$$

Lever arm to moment

$$\begin{aligned} l_{a1} &= d_1 - d_{n1}/3 \\ &= 83.49 \text{ mm} \end{aligned}$$

Tension force of per rod

$$\begin{aligned} C_1 &= M_x / l_{a1} \\ &= 12.7 \text{ KN} \end{aligned}$$

Consider bending on Y-Y axis

Tension rebar to edge plate

$$\begin{aligned} d_2 &= 190 \text{ mm} \\ d_{n2} &= \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_2 \\ &= 94.1 \text{ mm} \end{aligned}$$

Lever arm to moment

$$\begin{aligned} l_{a2} &= d_2 - d_{n2}/3 \\ &= 158.62 \text{ mm} \end{aligned}$$

Tension force of per rod

$$\begin{aligned} C_2 &= M_y / l_{a2} \\ &= 5.8 \text{ KN} \end{aligned}$$

Total Factored Compression force

$$\begin{aligned} C &= C_1 + C_2 \\ &= 18.5 \text{ KN} \end{aligned}$$

$$b = 413 \text{ mm}$$

Embed plate size

$$d = 200 \text{ mm}$$

$$f_c = 2 \cdot C_1 / d_{n1} \cdot b + 2 \cdot C_2 / d_{n2} \cdot d$$

Compression stress of concrete

$$\begin{aligned} &= 1.86 \text{ Mpa} \\ &< f_{cc} = 0.6 \cdot 45 \text{ MPa} \\ &= 27.0 \text{ Mpa} \end{aligned}$$

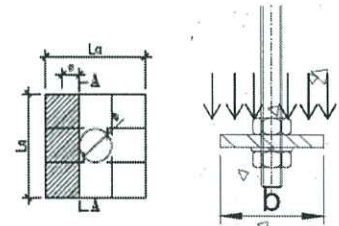
O.K.

b) Check 2nos  $\psi$ 16mm GMS Bolt (GR8.8)

Factored Tension force per rod	$F_t$	$= F_w/2+C1/2+C2$ $= 20.31$	KN	
Rod spacing	$s$	$= 150$	mm	
Shear force per rod	$F_s$	$= \frac{F_d}{2} + \frac{T}{s}$ $= 4.21$	KN	
Diameter of bolt	$\psi$	$= 16$	mm	
Effective Area	$A$	$= 156$	$\text{mm}^2$	
Shear strength of GR8.8	$p_v$	$= 375$	Mpa	
Shear Capacity:	$P_s$	$= p_v * A$ $= 58.5$	KN	
		$> F_s$ $= 4.2$	KN	
	$k$	$= F_s/P_s$ $= 0.07$ $< 1.00$		O.K.
Tension strength of GR8.8	$p_t$	$= 560$	Mpa	
Tension Capacity:	$P_t$	$= p_t * A$ $= 87.4$	KN	
		$> F_t$ $= 20.3$	KN	
Check Tension	$k$	$= F_t/P_t$ $= 0.23$ $< 1.0$		O.K.
Combined Check	$k$	$= \frac{F_s}{F_{cs}} + \frac{F_t}{F_{ct}}$ $= 0.30$ $< 1.40$		O.K.

c) Check 60\*60\*12mm thk GMS Washer

Shear Force	$F_s = 3 \cdot F_t / 8$	
	$= 7.62$	KN
Length of section	$b = 60$	mm
Ecc	$e = (L_a - \psi) / 4$	
	$= 11.00$	mm
Ecc. Moment	$M_e = F_s \cdot e$	
	$= 0.084$	KNm



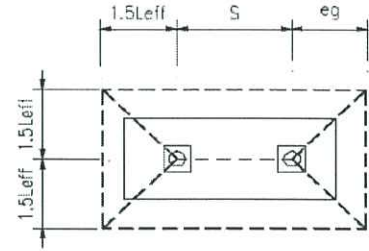
Section Properties

Section width	$b = 60$	mm
Thickness	$t = 12$	mm
Area	$A = b \cdot t$	
	$= 720$	mm <sup>2</sup>
Elastic Modulus	$Z_y = b \cdot t^2 / 6$	
	$= 1440$	mm <sup>3</sup>
Design strength of S275	$p_y = 275$	Mpa
Shear Capacity	$F_{cs} = 0.6 \cdot p_y \cdot A$	
	$= 118.80$	KN
Moment capacity	$M_{cy} = p_y \cdot Z_y$	
	$= 0.40$	KNm
Combined check	$k = \frac{M_e}{M_{cy}} + \frac{F_s}{F_{cs}}$	
	$= 0.28$	
	$< 1.0$	

O.K.

d) Check Concrete against Unching Shear to HKCC 2013

Embedment Depth	Lef	=	175	mm
Width of washer	b	=	60	mm
Bolt spacing	s	=	150	mm
Edge distance	eg	=	131	mm
	1.5*Lef	=	262.5	mm



Perimeter of punching shear  $P1 = 4*(1.5*Lef)+2*s+2*\min(eg, 1.5*Lef)$   
 $= 1612$  mm

Ave. shear stress  $f_v = 2*F_t/P1*Lef$   
 $= 0.14$  Mpa

Conservative take  $\frac{100A_s}{P*L} = 0.15$

Concrete strength  $f_{cu} = 45$  Mpa

Design concrete shear strength  $v_c = \frac{0.79}{1.25} * \left(\frac{100A_s}{P*L}\right)^{1/3} * \left(\frac{400}{Lef}\right)^{1/4} * \left(\frac{f_{cu}}{25}\right)^{1/3}$   
 $= 0.50$  Mpa

Check shear cone  $k = f_v/v_c$   
 $= 0.29$   
 $< 1.0$

O.K.

e) Check the bonding stress

Tension force per rod  $F_t = 20.31$  KN

Diameter of bar:  $\psi = 16$  mm

Effective anchor length  $L_{eff} = 175.0$  mm

Bond stress  $f_b = \frac{F_t}{\psi*\pi*L_{eff}}$   
 $= 2.31$  Mpa

Concrete Grade  $f_{cu} = 45$  Mpa

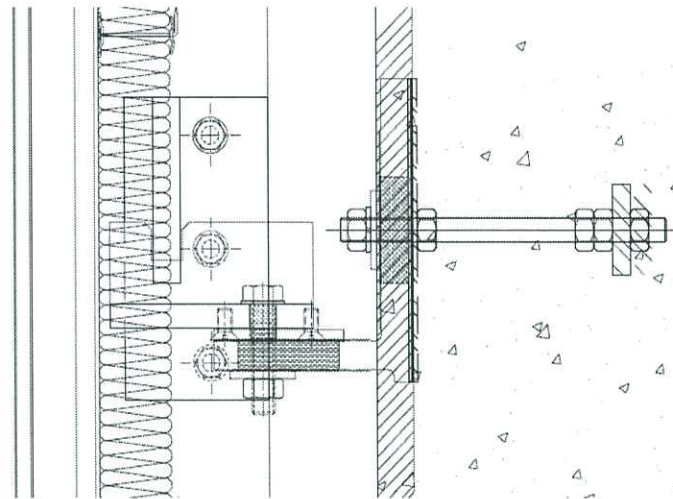
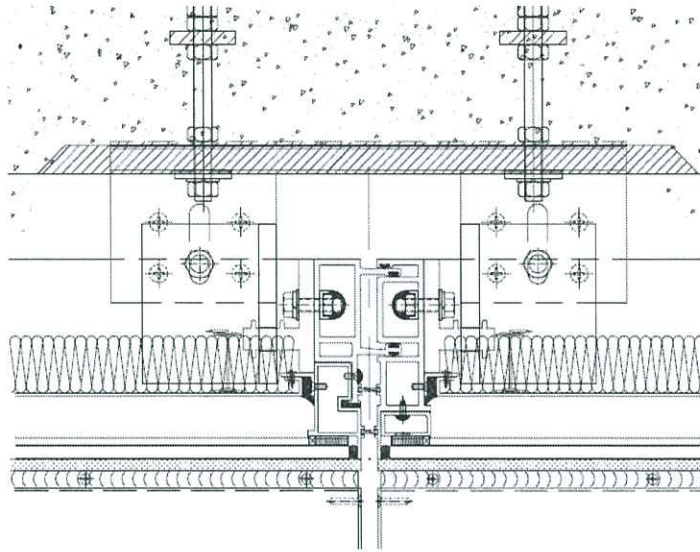
Design Ultimate bond stress  $f_{bu} = 0.65*(f_{cu})^{0.5}$   
 $= 4.36$  Mpa

Check Bonding  $k = f_b/f_{bu}$   
 $= 0.53$   
 $< 1.0$

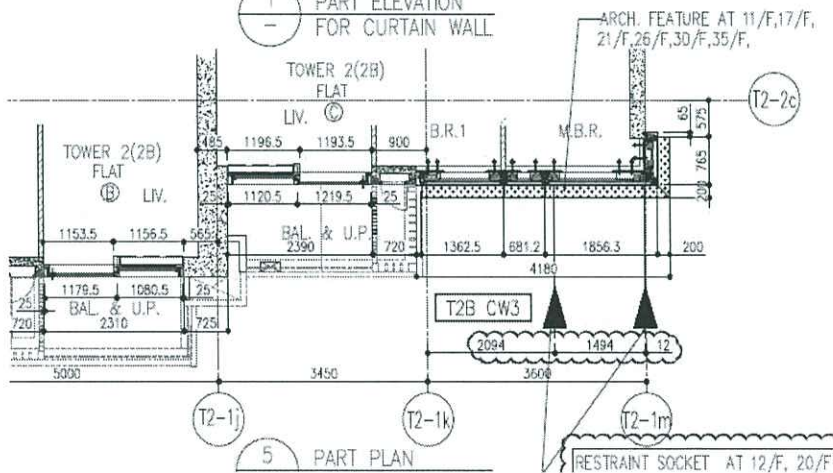
O.K.

RM9 RC Set Back 50mm-Typ

T2 B Flat C 10F-16F

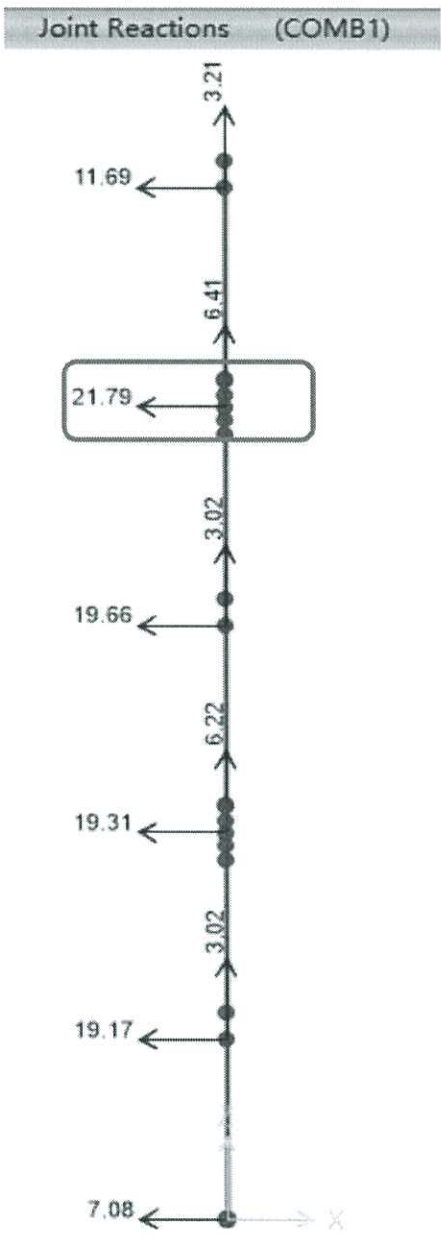


1 PART ELEVATION FOR CURTAIN WALL



PE203

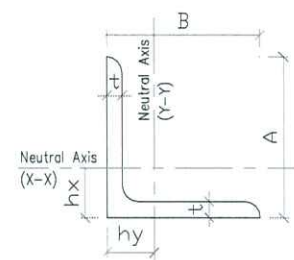
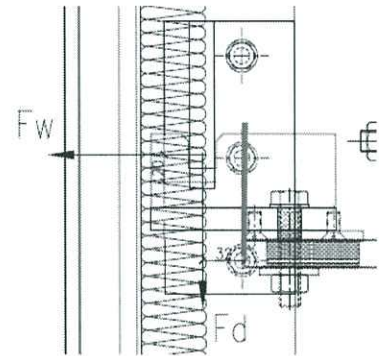
Reactions refer to Chapter 4.1-23



Nos of bracket	n	=	2	
Wind load per bracket	Fw	=	21.79	/ n
		=	10.90	KN
Dead load per bracket	Fd	=	6.41	/ n
		=	3.21	KN

Check 70x122x16mm thk Alum. Angle

Design force	$F_w = 10.90$	KN
	$F_d = 3.21$	KN
Ecc	$e_1 = 20$	mm
	$e_2 = 32$	mm
Ecc. Moment	$M_e = F_w * e_1 + F_d * e_2$	
	$= 0.32$	KNm
Depth	$A = 70$	mm
Width	$B = 122$	mm
Thickness	$t = 16$	mm
Length of Neutral axis	$h_x = 18.7$	mm
Length of Neutral axis	$h_y = 44.7$	mm
Area	$A_e = 2,816$	mm <sup>2</sup>
Moment Inertia X-X	$I_x = 985,258$	mm <sup>4</sup>
Moment Inertia Y-Y	$I_y = 4,121,898$	mm <sup>4</sup>
Section Modulus X-X	$Z_x = 19,220$	mm <sup>3</sup>
Section Modulus Y-Y	$Z_y = 53,350$	mm <sup>3</sup>
Radius of Gyration X-X	$r_x = 18.7$	mm
Radius of Gyration Y-Y	$r_y = 38.3$	mm
Design strength of 6061-T6	$p_y = 240$	Mpa
Moment capacity	$M_{cx} = p_y * Z_x / 1.2$	
	$= 3.84$	KNm
Tension Capacity	$F_{ct} = p_y * A_e / 1.2$	
	$= 563.20$	KN
Check strength	$k = 1.4M_e / M_{cx} + 1.4 * F_d / F_{ct}$	
	$= 0.12$	
	$< 1$	O.K.
Shear strength of 6061-T6	$p_v = 145$	MPa
Shear capacity	$F_{cs} = p_v * A_e / 1.2$	
	$= 340.3$	KN
Check shear	$k = 1.4F_w / F_{cs}$	
	$= 0.04$	
	$< 1$	O.K.



Check M16 Bolt and Nut

Ecc.

$e_1 = 63 \text{ mm}$

$e_2 = 66 \text{ mm}$

Ecc. Moment

$M_e = F_w * e_1 + F_d * e_2$

$= 0.90 \text{ KNm}$

Nos of bolt

$n = 1$

Min. Compression edge

$d = 34 \text{ mm}$

Tension force per bolt

$F_t = \frac{M_e}{(0.8 * d)} - F_d$

$= 29.8 \text{ KN}$

Shear force per bolt

$F_s = F_w$

$= 10.9 \text{ KN}$

Design shear strength (A4-70)

$P_s = 280 \text{ MPa}$

Design tensile strength (A4-70)

$P_t = 450 \text{ MPa}$

Thread area

$A = 157 \text{ mm}^2$

Load factor

$\gamma_f = 1.4$

Shear capacity

$F_{sc} = P_s * A$

$= 43.96 \text{ KN}$

$> \gamma_f * F_s = 15.3 \text{ KN}$

Tensile capacity

$F_{tc} = P_t * A$

$= 70.65 \text{ KN}$

$> \gamma_f * F_t = 41.7 \text{ KN}$

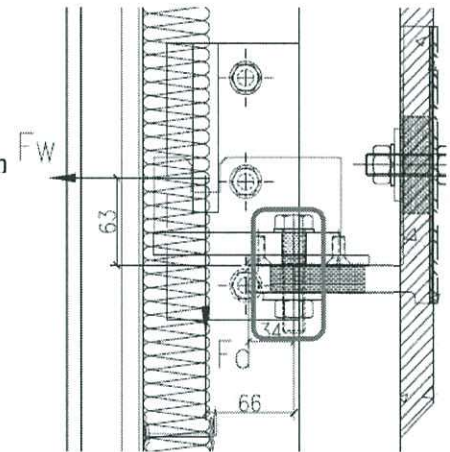
Combined check

$k = \frac{\gamma_f * F_t}{F_{tc}} + \frac{\gamma_f * F_s}{F_{sc}}$

$= 0.94$

$< 1.4$

O.K.



Check Bearing

For Connected Plate

Diameter of screw:

$$df = 16 \quad \text{mm}$$

Thickness of thinner part

$$t = 7 \quad \text{mm}$$

Constant

$$co = 2 \quad \text{For } df/t = 2.29 < 10$$

Edge distance

$$eo = 21 \quad \text{mm}$$

Bearing strength of 6061-T6

$$pa = 260 \quad \text{Mpa}$$

Load factor:

$$\gamma_f = 1.4$$

Material factor:

$$\gamma_m = 1.2$$

Bearing Capacity

$$Br1 = \frac{co \cdot df \cdot t \cdot pa}{\gamma_m}$$

$$= 48533.3 \quad \text{N}$$

$$Br2 = \frac{eo \cdot t \cdot pa}{\gamma_m}$$

$$= 38220 \quad \text{N}$$

$$Br = \min(Br1, Br2)$$

$$= 38.22 \quad \text{KN}$$

Strength check:

$$k = \frac{\gamma_f \cdot Fs}{Br}$$

$$= 0.40$$

$$< 1.0$$

O.K.

Check 19mm thk Alum Bracket C-C

Design load

$$F_w = 10.90 \quad \text{KN}$$

$$F_d = 3.21 \quad \text{KN}$$

Ecc.

$$e_1 = 63.0 \quad \text{mm}$$

$$e_2 = 148.0 \quad \text{mm}$$

$$e_3 = 75.0 \quad \text{mm}$$

Ecc. Moment

$$M_y = F_w \cdot e_1 + F_d \cdot e_2$$

$$= 1.16 \quad \text{KNm}$$

$$M_x = F_w \cdot e_3$$

$$= 0.82 \quad \text{KNm}$$

$$T = F_d \cdot e_3$$

$$= 0.24 \quad \text{KNm}$$

Section length

$$b = 122 \quad \text{mm}$$

Angle thickness

$$t = 19 \quad \text{mm}$$

Area

$$A = bt$$

$$= 2318 \quad \text{mm}^2$$

Elastic modulus

$$Z_x = \frac{b^2 \cdot t}{4}$$

$$= 70699.0 \quad \text{mm}^3$$

$$Z_y = \frac{t^2 \cdot b}{4}$$

$$= 11010.5 \quad \text{mm}^3$$

Design strength of 6061-T6

$$p_y = 240 \quad \text{Mpa}$$

Moment capacity

$$M_{cx} = p_y \cdot Z_x / 1.2$$

$$= 14.14 \quad \text{KNm}$$

$$M_{cy} = p_y \cdot Z_y / 1.2$$

$$= 2.20 \quad \text{KNm}$$

Tension Capacity

$$F_{ct} = p_y \cdot A / 1.2$$

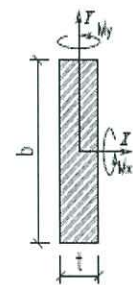
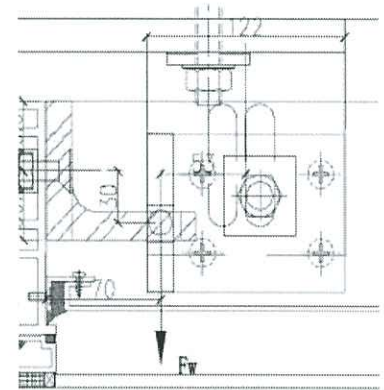
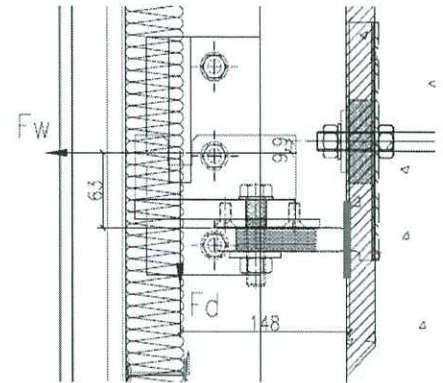
$$= 463.60 \quad \text{KN}$$

Check strength

$$k = 1.4M_x/M_{cx} + 1.4M_y/M_{cy} + 1.4 \cdot F_w/F_{ct}$$

$$= 0.85$$

$$< 1 \quad \text{O.K.}$$



Check Shear

Torsion modulus

$$\begin{aligned} Cu &= b*t^2/3 \\ &= 14680.7 \text{ mm}^3 \end{aligned}$$

Shear strength of 6061-T6

$$pv = 145 \text{ MPa}$$

Shear capacity

$$\begin{aligned} Fcs &= pv*A/1.2 \\ &= 280.1 \text{ KN} \end{aligned}$$

Torsion Capacity

$$\begin{aligned} Tc &= pv*Cu/1.2 \\ &= 1.77 \text{ KNm} \end{aligned}$$

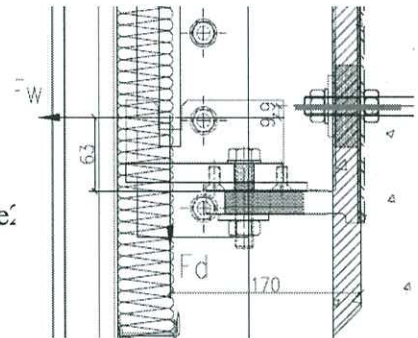
Check shear

$$\begin{aligned} k &= 1.4Fd/Fcs+1.4T/Tc \\ &= 0.21 \\ &< 1 \end{aligned}$$

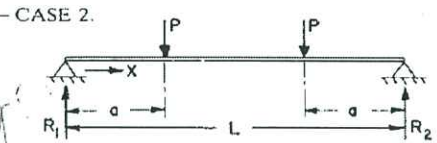
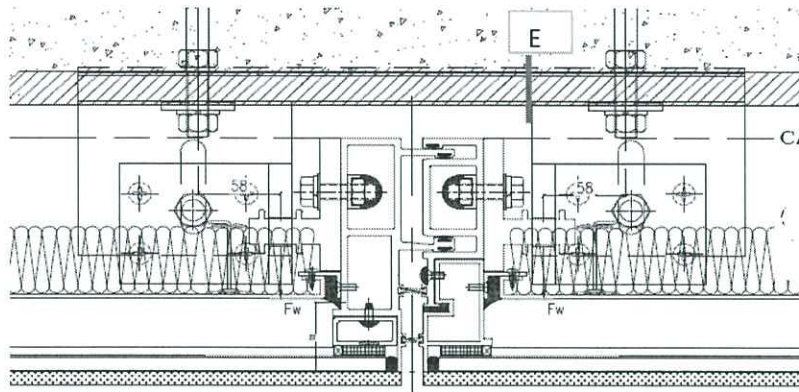
O.K.

Check 19mm thk Alum Bracket D-D

Max. reaction	$F_w = 10.9$	KN	
	$F_d = 3.21$	KN	
Ecc.	$e_1 = 10$	mm	
	$e_2 = 170$	mm	
Ecc. Moment	$M_y = F_w \cdot (e_1 + 25) + F_d \cdot e_2$		
	$= 1.01$	KNm	
	$M_x = F_w \cdot 117$		
	$= 1.27$	KNm	
Section length	$b = 234$	mm	
Angle thickness	$t = 19$	mm	
Area	$A = bt$		
	$= 4446$	mm <sup>2</sup>	
Elastic modulus	$Z_y = t^2 b / 6$		
	$= 14079.0$	mm <sup>3</sup>	
	$Z_x = b^2 t / 6$		
	$= 173394.0$	mm <sup>3</sup>	
Design strength of 6061-T6	$p_y = 240$	Mpa	
Moment capacity	$M_{cy} = p_y \cdot Z_y / 1.2$		
	$= 2.82$	KNm	
	$M_{cx} = p_y \cdot Z_x / 1.2$		
	$= 34.68$	KNm	
Tension capacity	$F_{ct} = p_y \cdot A / 1.2$		
	$= 889.2$	KN	
Check strength	$k = 1.4 M_y / M_{cy} + 1.4 \cdot F_d / F_{ct} + 1.4 M_x / M_{cx}$		
	$= 0.56$		
	$< 1$		O.K.
Shear strength of 6061-T6	$p_v = 145$	Mpa	
Shear capacity	$F_{cs} = p_v \cdot A / 1.2$		
	$= 537.2$	KN	
Check shear strength	$k = 1.4 \cdot F_w / F_{cs}$		
	$= 0.03$		
	$< 1$		O.K.

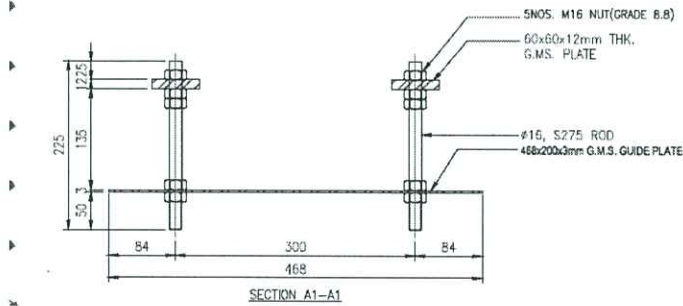
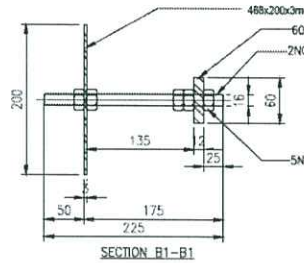
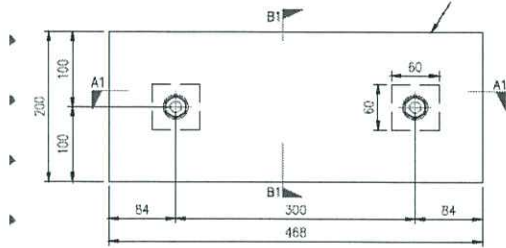


Check 19mm thk Alum Bracket E-E



Ecc.	$e = 58$	mm	
Ecc. Moment on E-E	$M_e = F_w * e$		
	$= 0.63$	KNm	
Section length	$b = 200$	mm	
Angle thickness	$t = 19$	mm	
Area	$A = bt$		
	$= 3800$	mm <sup>2</sup>	
Elastic modulus	$Z_y = t^2 b / 6$		
	$= 12033.3$	mm <sup>3</sup>	
Design strength of 6061-T6	$p_y = 240$	Mpa	
Moment capacity	$M_{cy} = p_y * Z_y / 1.2$		
	$= 2.41$	KNm	
Check strength	$k = 1.4 M_e / M_{cy}$		
	$= 0.37$		
	$< 1$		O.K.
Shear strength of 6061-T6	$p_v = 145$	Mpa	
Shear capacity	$F_{cs} = p_v * A / 1.2$		
	$= 459.2$	KN	
Check shear strength	$k = 1.4 * F_w / F_{cs}$		
	$= 0.03$		
	$< 1$		O.K.

Check 2nos M16 Cast in Bolt (GR8.8)-CA07



Max. reaction  
(Refer to P4.1-24)

Factored load

Ecc.

R.c. Tolerance

Max. Ecc. Moment

WL = 21.79 KN

DL = 6.41 KN

Fw = 1.4\*WL  
= 30.51 KN

Fd = 1.4\*DL  
= 8.97 KN

e1 = 10 mm

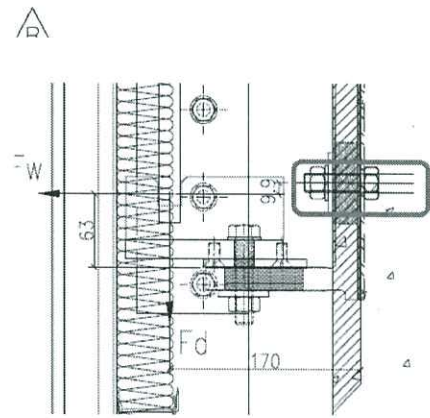
e3 = 170 mm

et = 25 mm

Mx = Fw\*(et+e1)+Fd\*e3  
= 2.59 KNm

My = Fw\*et  
= 0.76 KNm

T = Fd\*et  
= 0.22 KNm



a) Check the RC Compression

Consider bending on X-X axis

Bearing strength of RC

Modular ratio=Est/Erc

Design strength of Rod

Tension rebar to edge plate

Lever arm to moment

Tension force of per rod

Consider bending on Y-Y axis

Tension rebar to edge plate

Lever arm to moment

Tension force of per rod

Total Factpred Compression force

Embed plate size

Comprression stress of concrete

$$p_c = 0.4 \cdot 45 \text{ MPa} = 18.0 \text{ Mpa}$$

$$m_o = 15 \quad p_y = 275 \text{ Mpa}$$

$$d_1 = 100 \text{ mm}$$

$$d_{n1} = \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_1 = 49.54 \text{ mm}$$

$$l_{a1} = d_1 - d_{n1} / 3 = 83.49 \text{ mm}$$

$$C_1 = M_x / l_{a1} = 31.1 \text{ KN}$$

$$d_2 = 350 \text{ mm}$$

$$d_{n2} = \left( \frac{p_c \cdot m_o}{p_c \cdot m_o + p_y} \right) \cdot d_2 = 173.4 \text{ mm}$$

$$l_{a2} = d_2 - d_{n2} / 3 = 292 \text{ mm}$$

$$C_2 = M_y / l_{a2} = 2.6 \text{ KN}$$

$$C = C_1 + C_2 = 33.7 \text{ KN}$$

$$b = 413 \text{ mm}$$

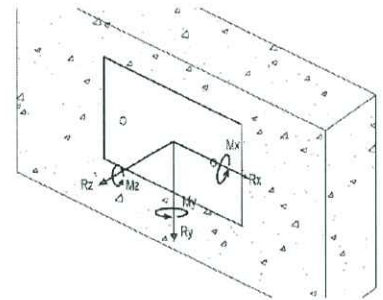
$$d = 200 \text{ mm}$$

$$f_c = 2 \cdot C_1 / d_{n1} \cdot b + 2 \cdot C_2 / d_{n2} \cdot d$$

$$= 3.19 \text{ Mpa}$$

$$< f_{cc} = 0.6 \cdot 45 \text{ MPa}$$

$$= 27.0 \text{ Mpa} \quad \text{O.K.}$$



b) Check 2nos  $\psi$ 16mm GMS Bolt (GR8.8)

Factored Tension force per rod	$F_t$	$= F_w/2+C1/2+C2$ $= 33.39$	KN	
Rod spacing	$s$	$= 300$	mm	
Shear force per rod	$F_s$	$= \frac{F_d}{2} + \frac{T}{s}$ $= 5.23$	KN	
Diameter of bolt	$\psi$	$= 16$	mm	
Effective Area	$A$	$= 156$	$\text{mm}^2$	
Shear strength of GR8.8	$p_v$	$= 375$	Mpa	
Shear Capacity:	$P_s$	$= p_v * A$ $= 58.5$	KN	
		$> F_s$ $= 5.2$	KN	
	$k$	$= F_s/P_s$ $= 0.09$ $< 1.00$		O.K.
Tension strength of GR8.8	$p_t$	$= 560$	Mpa	
Tension Capacity:	$P_t$	$= p_t * A$ $= 87.4$	KN	
		$> F_t$ $= 33.4$	KN	
Check Tension	$k$	$= F_t/P_t$ $= 0.38$ $< 1.0$		O.K.
Combined Check	$k$	$= \frac{F_s}{F_{cs}} + \frac{F_t}{F_{ct}}$ $= 0.47$ $< 1.40$		O.K.

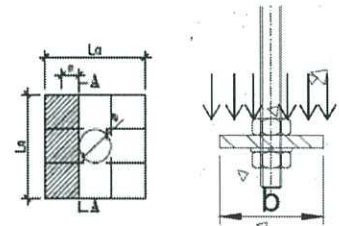
c) Check 60\*60\*12mm thk GMS Washer

Shear Force  $F_s = 3 \cdot F_t / 8$   
 $= 12.52 \text{ KN}$

Length of section  $b = 60 \text{ mm}$

Ecc  $e = (L_a - \psi) / 4$   
 $= 11.00 \text{ mm}$

Ecc. Moment  $M_e = F_s \cdot e$   
 $= 0.138 \text{ KNm}$



Section Properties

Section width  $b = 60 \text{ mm}$

Thickness  $t = 12 \text{ mm}$

Area  $A = b \cdot t$   
 $= 720 \text{ mm}^2$

Elastic Modulus  $Z_y = b \cdot t^2 / 6$   
 $= 1440 \text{ mm}^3$

Design strength of S275  $p_y = 275 \text{ Mpa}$

Shear Capacity  $F_{cs} = 0.6 \cdot p_y \cdot A$   
 $= 118.80 \text{ KN}$

Moment capacity  $M_{cy} = p_y \cdot Z_y$   
 $= 0.40 \text{ KNm}$

Combined check  $k = \frac{M_e}{M_{cy}} + \frac{F_s}{F_{cs}}$   
 $= 0.45$   
 $< 1.0$

O.K.











