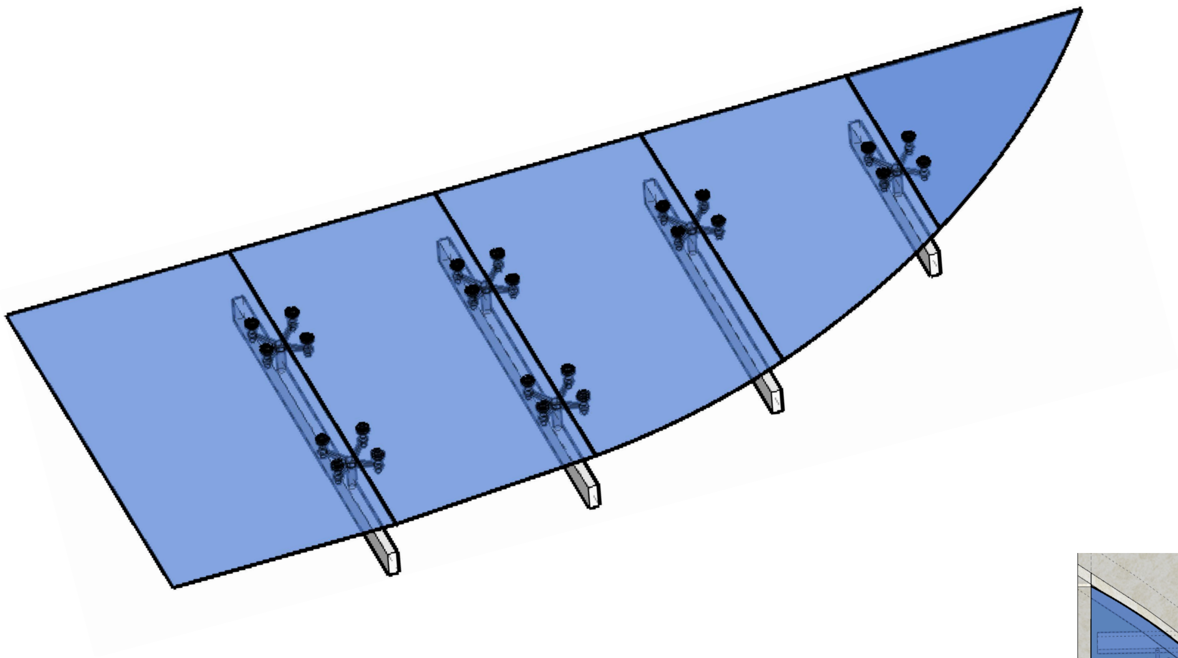
DIMON TECHNOLOGY

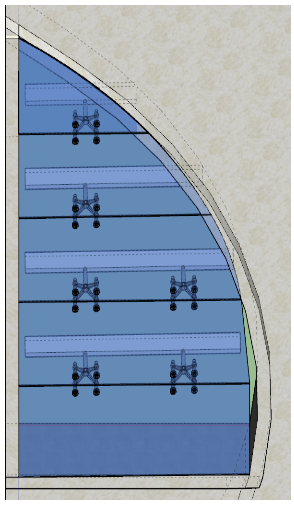
Technical Datasheet

CHLOE @ SKY118

UK DESIGN

Spider fitting frame-less glass Canopy





- Spider system fitting frame-less glass Canopy Design to Comply below Specification
- Building (Construction) Regulations Chapter 123-1990 ;
- Code of Practice on Wind Effects Hong Kong -2004
- Code of Practice for the structural use of Steel -2011
- Code of Practice for the structural use of Concrete-2004 (2nd Edition)
- Code of Practice for the structural use of Aluminium -BS8118: Part 1:1991
- Practice Note for Authorized person, registered structural engineers and registered geotechnical engineers: BD APP-37 (PNAP 106)
- Code of Practice for Dead and Imposed loads-2011

Technical Data

Major Material:	• S.S 316 Spider System • Stainless Steel Grade S316L with ASTM A511 and Plate with ASTM A240 Proof Stress = 220 MPa • 8 mm THK Clear Laminated Tempered Glass comply BS 952 Part 1 and BS 6262 , Allowable Stress 50MPa • Welding comply BS EN 1011-1; BS EN 1011-2; BS EN ISO 15614 • Stainless Steel Fasteners A4-70 comply wiht BS EN ISO 3506-1. Permanent Stain 450Mpa • Sealants -Dow Corning 795/995/983 or Equivalent Material • M16.S.S A4-70 Blot & Nut
Tempered Glass color	• Clear • Dark Grey, • Euro grey; • Ocean blue, • Ford blue, • Dark blue
Tempered Glass Pattern	Custom-made
Design Basic Wing Pressure	2.04KPa
Color Finishes	Hairline Finish
Certificate	ISO 9001:2008 UK DESIGN

Project	Fixture#	Date
		Firm

DIMON TECHNOLOGY

Ordering Information

Choose the option that suits your need and write its corresponding code on the appropriate line to form the product code.

Example product code:

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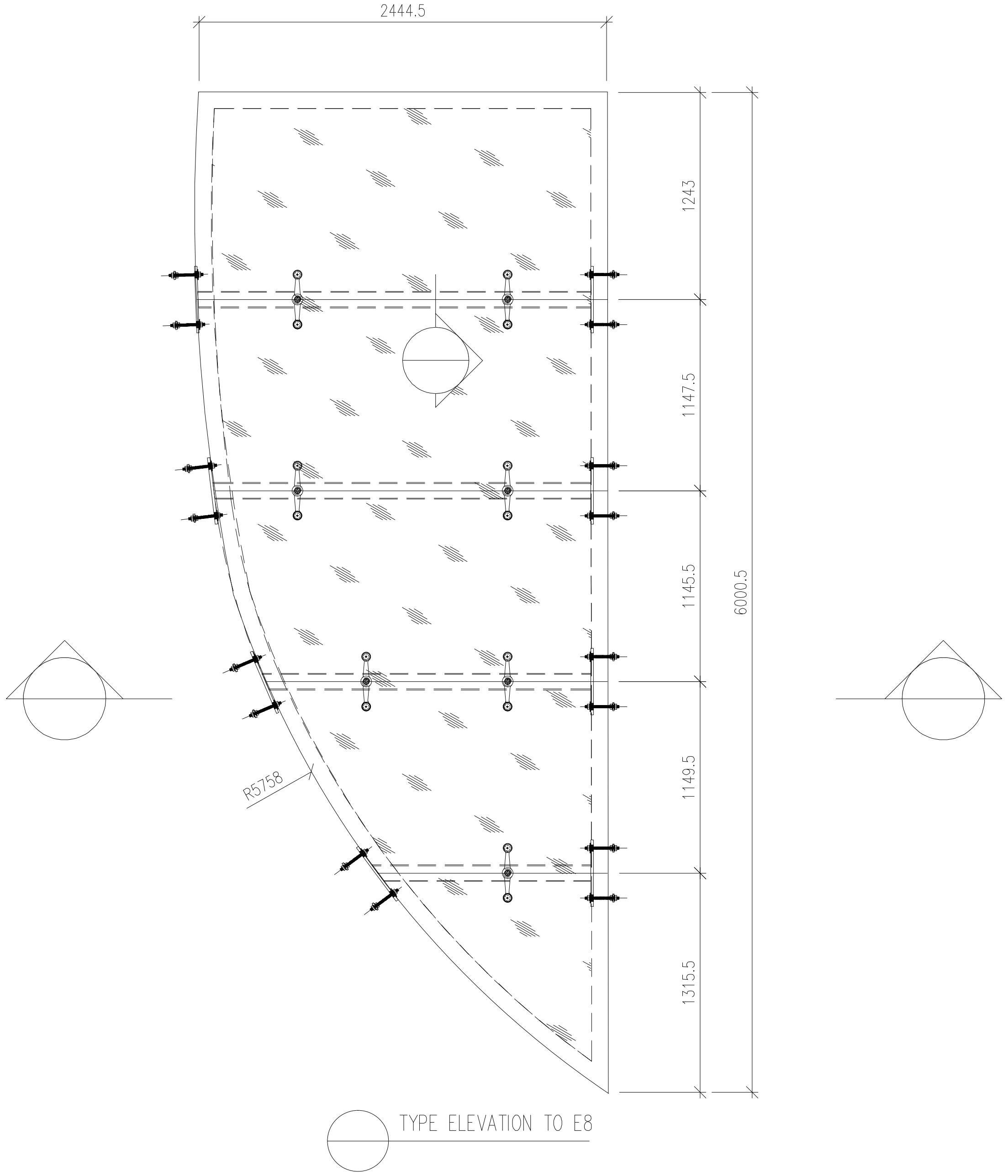

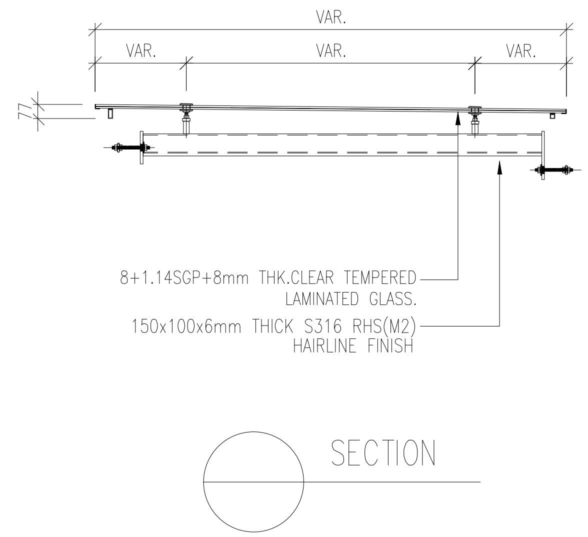

CHLOE@ SKY118

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E-mail:gary@dimontechnology.com

Project:

Job Title:

Drawing Name:

Drawing NO.: QPBE20034-PL06

Drawing Scale: AS SHOW

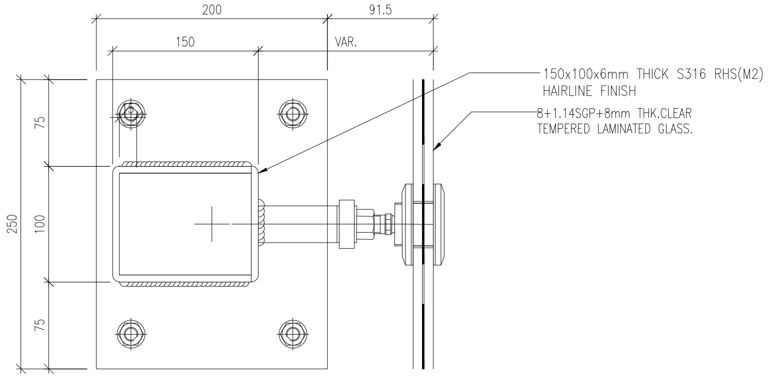
Drawing Date: 2020/06/30

Drawing: KP

Collate: Joyi

Auditing: Gray Hui

Drawing Version: 1



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DE04
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Drawing Status :

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Supplier:

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Fax: 00852-21203398
Http://www.dimontechnology.com
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CHLOE@ SKY118

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Project		Date	16.07.2020
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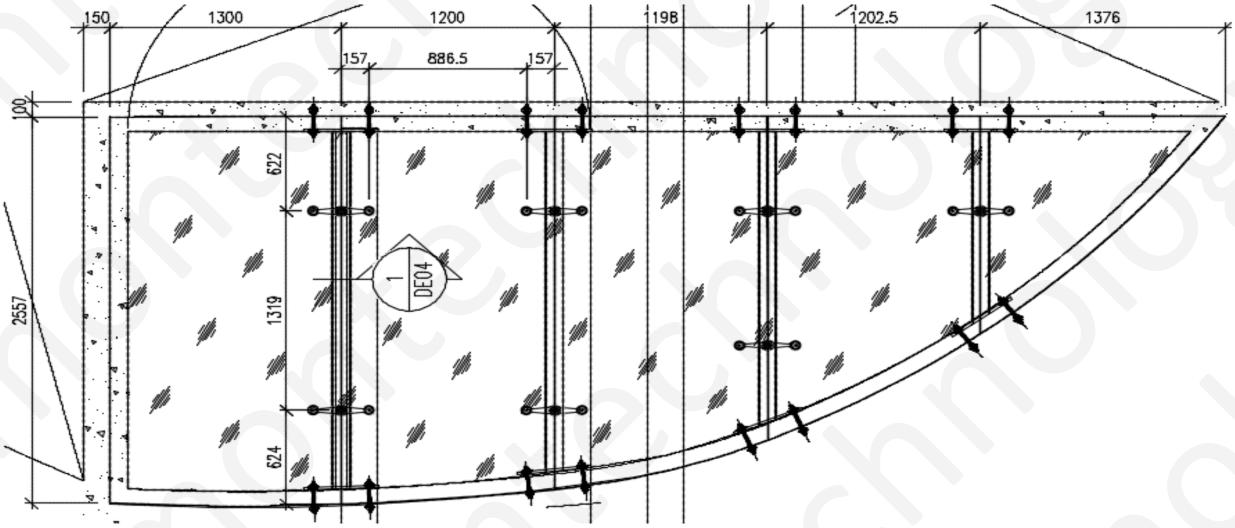
1. Introduction

There are 2 types of glass panel. The overall size of first type is 1300x2557mm with 2 piont & 2 sides supports The overall size of second type is 2565x1200mm with 4 point supports.
The skylights are made of 12+12mm thick laminated tempered glass fixed to s.s. RHS by means of stainless steel spider system. The objective of this calculation is to check the design of skylight to be safe against the dead load, live load and wind load.

<u>Load path</u>
Wind load to skylight → glass panels → s.s. spiders → steel RHS frame → gms embeds → r.c. structures



2. Design Code, Design Data

2.1 Design Code

a) Hong Kong Building (Construction) Regulation 1990 (Amendment 2011).
b) Code of Practice on Wind Effect 2008, Macau.
c) Code of Practice for the Structural Use of Steel 2011, Hong Kong
d) Code of Practice for the Structural Use of Concrete 2004, Hong Kong
e) Code of Practice for Dead and imposed Loads 2011, Hong Kong
f) Code of Practice for the Structural Use of Steel GB 50017-2003
g) Load Code of the design of buliding structure GB 50009-2012

2.2 Design Data

2.2.1 Stainless steel to be grade X5CrNiMo17-12-2 complied with BS EN 10088

stainless steel grade		1.4401 (316 S31) X5CrNiMo17-12-2
0.2% proof stress	(N/mm^2)	220
ultimate tensile strength, min.	(N/mm^2)	510
Modulus of elasticity	(N/mm^2)	200000
Design strength	(N/mm^2)	220
Design stress of fillet weld	(N/mm^2)	220

2.2.2 All welding to be complied with complied to GB50661-2011

steel grade		E50xx
design strength of filled weld	(N/mm^2)	200

2.2.3 All stainless steel bolts or screws to be grade A4 complied to BS EN ISO 3506

class		70
0.2% proof stress	(N/mm^2)	450
ultimate tensile strength	(N/mm^2)	700
design tensile strength	(N/mm^2)	373
design shear strength	(N/mm^2)	280
design bearing strength	(N/mm^2)	805

stainless steel grade		A4 / 316
design bearing strength on connected part	(N/mm^2)	479

2.2.4 Concrete

concrete strength,	f_{cu}	(N/mm^2)	45	
anchorage bond strength, (= $\beta\ f_{cu}^{0.5}$)	f_{bu}	(N/mm^2)	1.878	β = 0.28 for cast-in threaded rod
design concrete shear stress,	v_c	(N/mm^2)	0.4	
compressive strength, (= 0.6 f_{cu})		(N/mm^2)	27	

2.2.5 The date refer to SAP2000 program.

3. Design Load

3.1 Wind load

Wind pressure,	q_z	=	2.12	kPa	(height above ground level ≤20m)
Pressure coefficient,		=	2		(open frame)
Design wind load		=	2.12 x 2.0		
		=	4.24	kPa	

3.2 Live load

Live load = 0.75 kN/m^2

3.3 Dead Load

Weight of glass	= (12 + 12) x 26.5 / 1000		=	0.636	kPa
Others,	=		=	0.064	kPa
		Total	=	0.7	kPa

4. Check for laminated tempered glass

4.1 Check for 12mm+1.56PVB+12mm clear laminated tempered glass

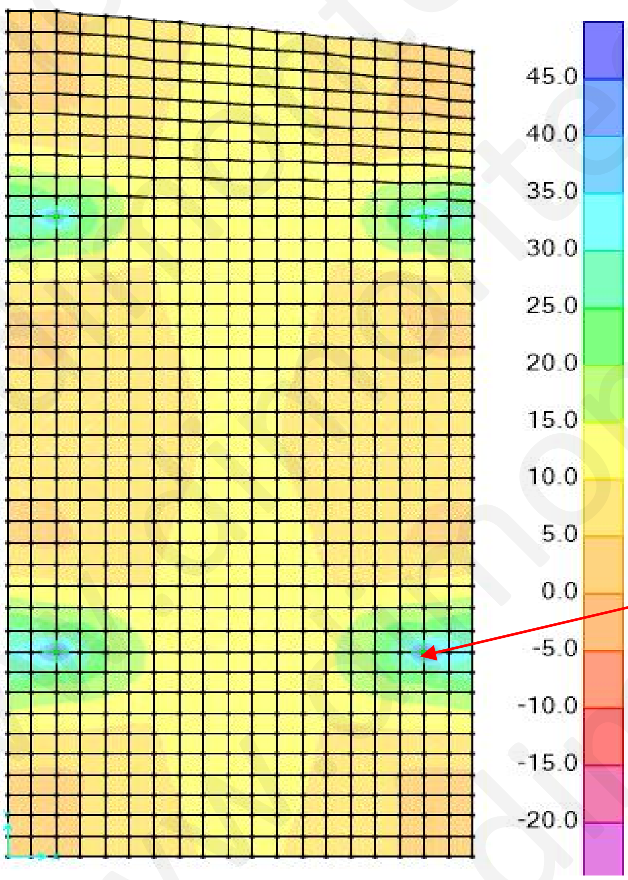
Glass density,	ρ	=	2650	kg/m^3				
Nominal thickness of glass pane 1		=	12	mm	Min. thickness of glass pane 1, t_1	=	11.91	mm
Nominal thickness of glass pane 2		=	12	mm	Min. thickness of glass pane 2, t_2	=	11.91	mm

Glass type for pane 1 & 2	:	tempered	Ultimate design strength, p_y	=	80	N/mm^2
Load duration	:	short term	Reduction factor, γ_d	=	1	
Surface treatment	:	clear	Reduction factor, γ_s	=	1	
			Material factor, γ_m	=	1	

Ultimate resistance strength, $R_{ult} = p_y \gamma_d \gamma_s / \gamma_m$ = 80 N/mm^2

<u>Case 1: 4 point supports</u>

Comb 1: 1.3DL + 1.05LL + 0.9WL;



Max stress:
= 46.565 N/mm^2

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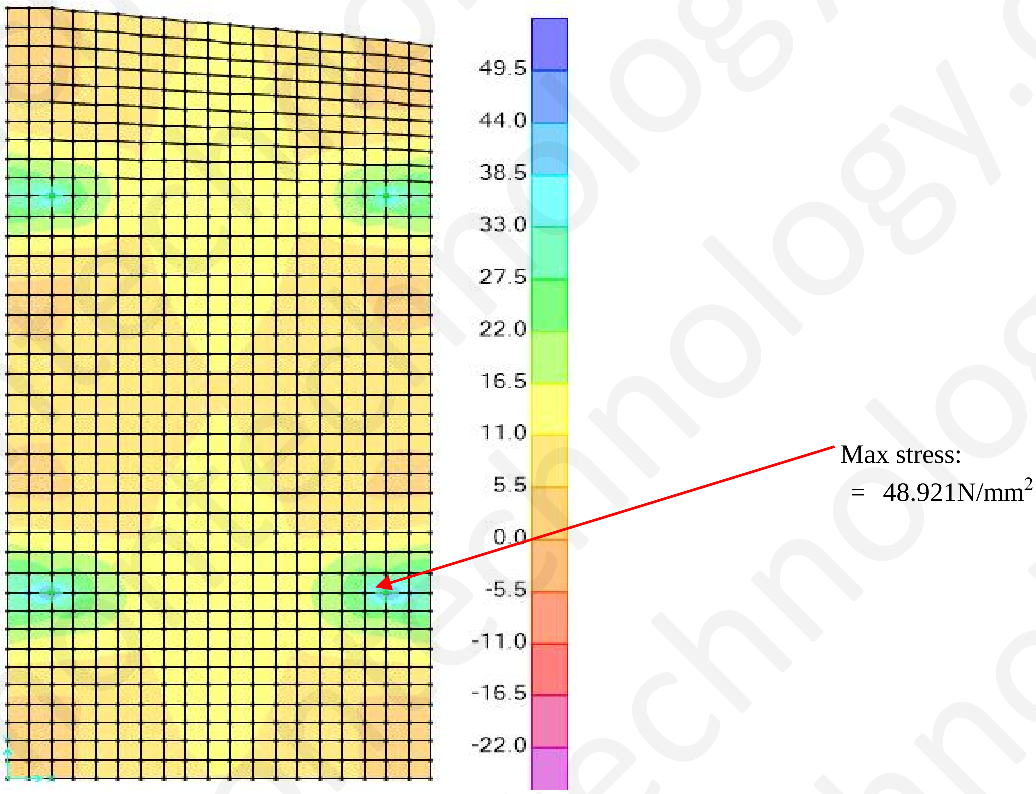
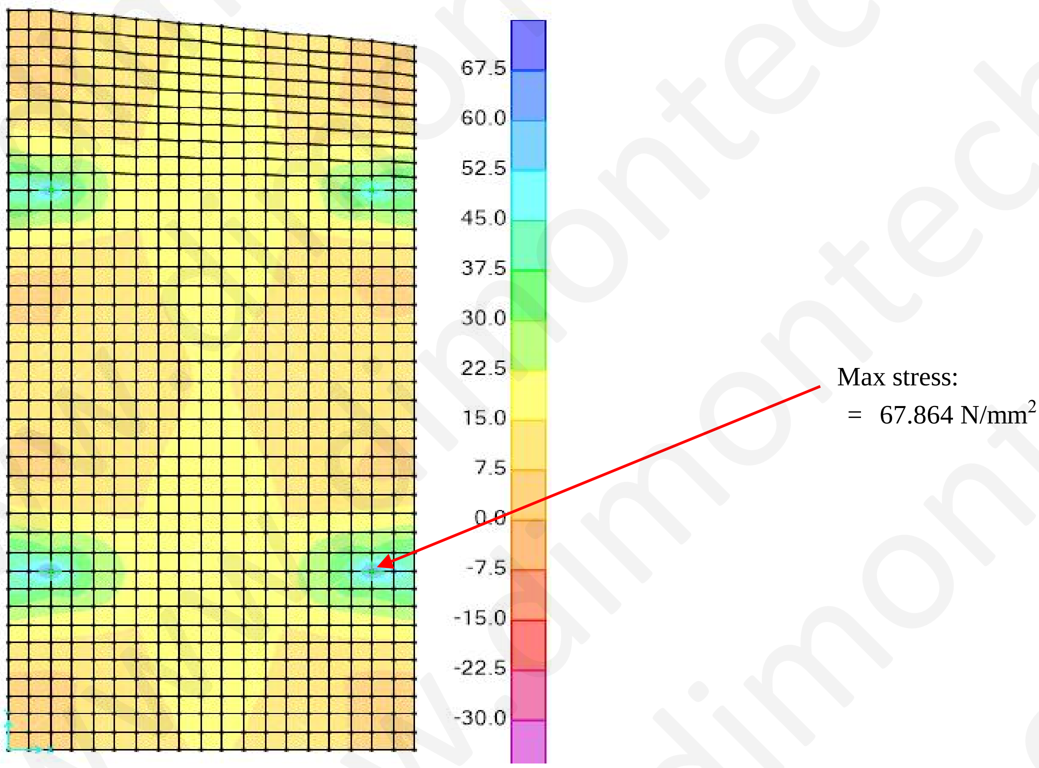
Comb 2: 1.2DL + 1.5LL + 0.9WL;



Comb 3: 1.2DL + 1.05LL + 1.5WL;



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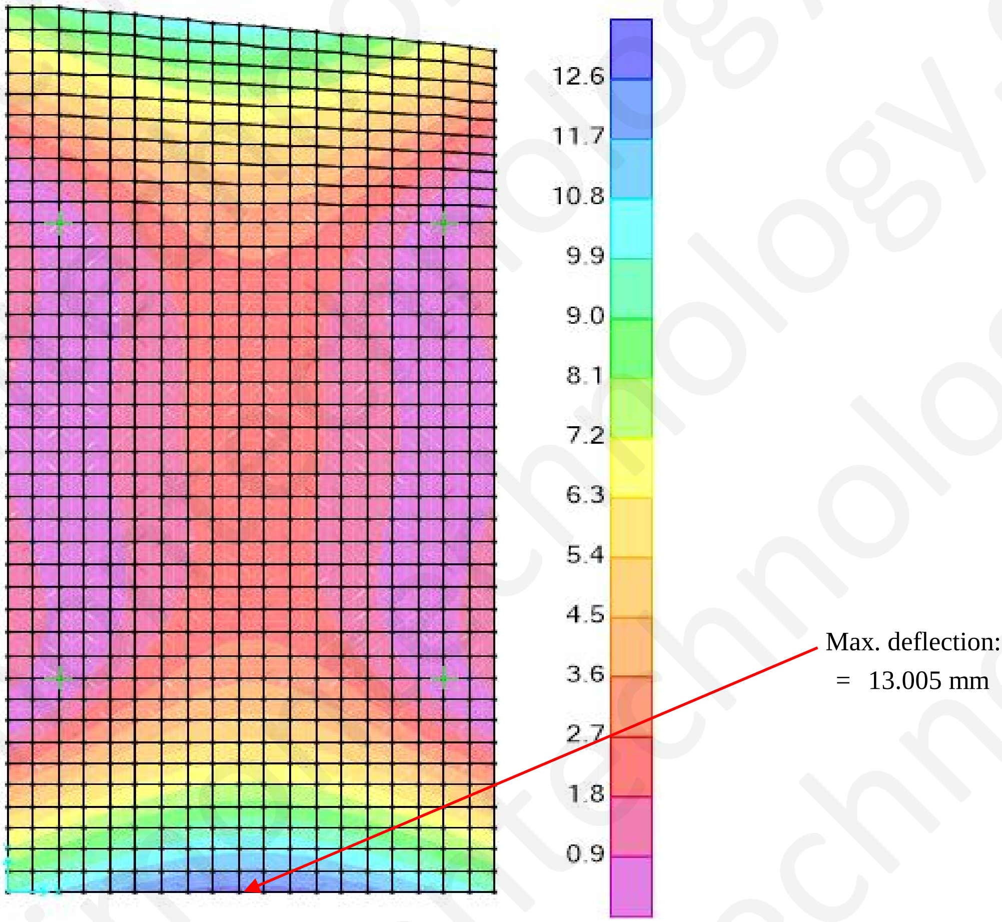
Comb 4: 1.0DL + 1.0WL; (for deflection checking)



Max. bending stress of glass pane,	σ_{c1}	=	67.864	N/mm^2			
		≤	80	N/mm^2			O.K.
Max. deflection,	δ_c	=	13.005	mm			
		≤	950 / 60		= 15.83	mm	O.K.

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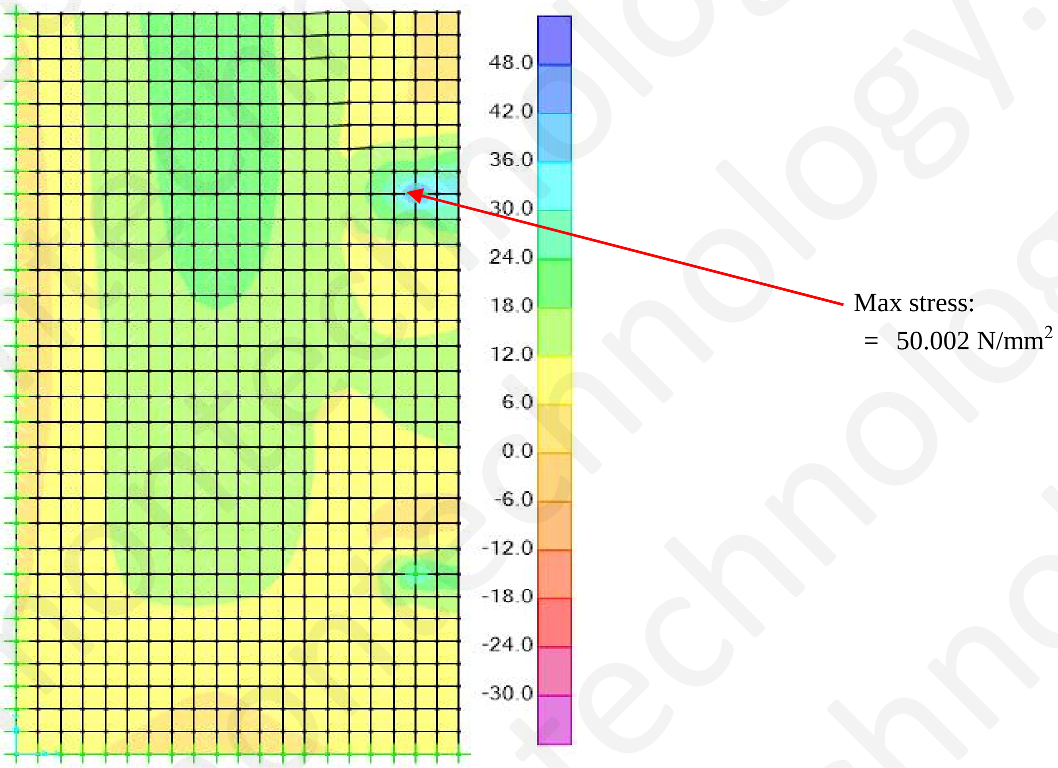
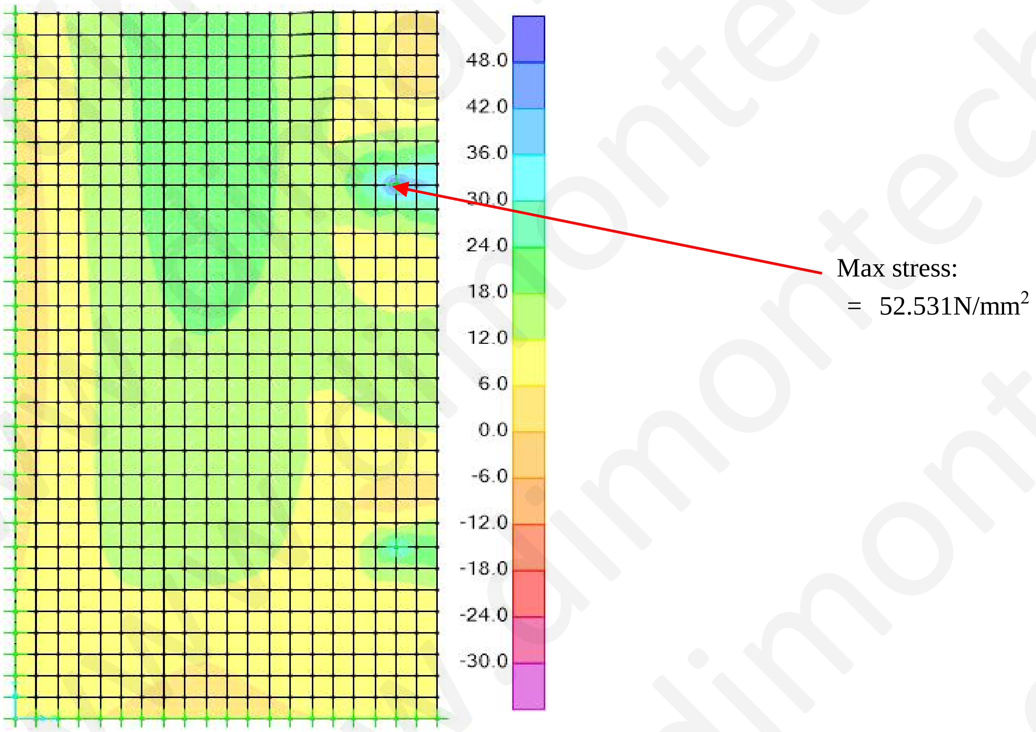
Case 2: 2 point supports + 2 side supports

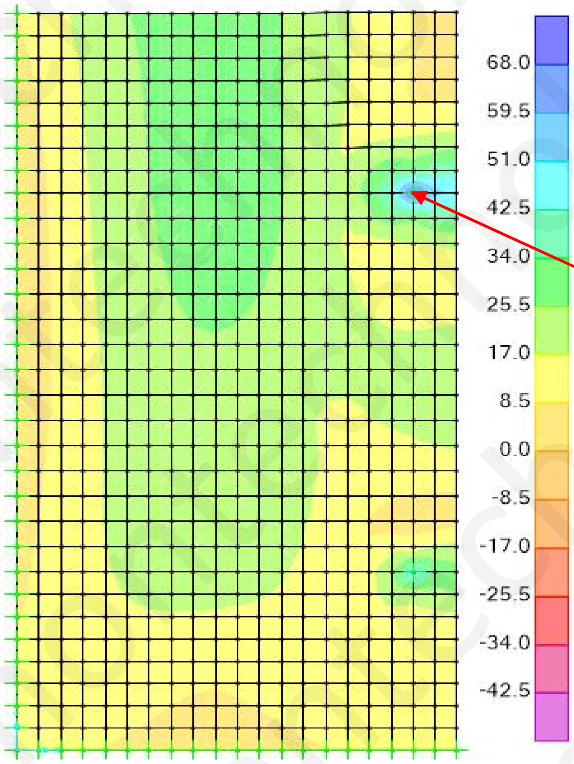
Comb 1: 1.3DL + 1.05LL + 0.9WL;



Comb 2: 1.2DL + 1.5LL + 0.9WL;

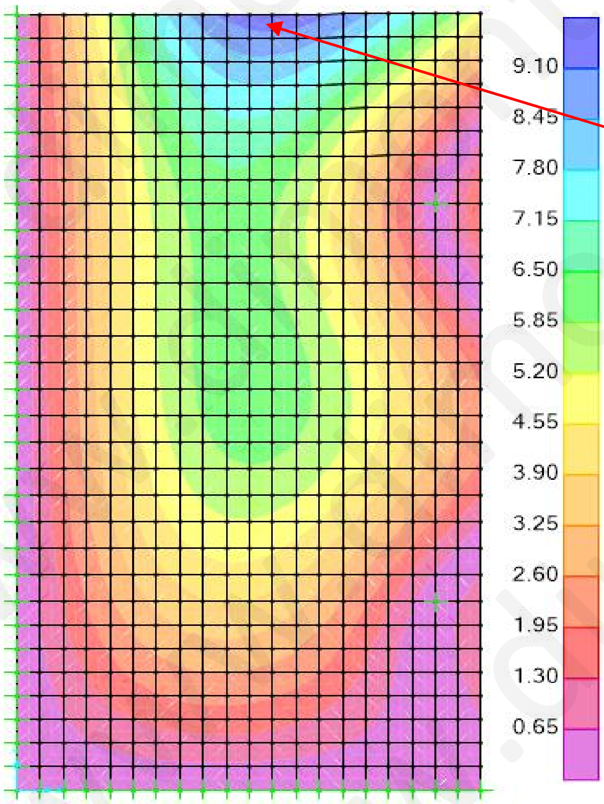


Comb 3: 1.2DL + 1.05LL + 1.5WL;



Max stress:
= 72.872 N/mm^2

Comb 4: 1.0DL + 1.0WL; (for deflection checking)



Max. deflection:
= 9.635 mm

Max. bending stress of glass pane, σ_{c1} = 72.872 N/mm^2
≤ 80 N/mm^2 O.K.

Max. deflection, δ_c = 9.635 mm
≤ 1175 / 60 = 19.58 mm O.K.

Check for structural sealant

Structural sealant bite required = 4.24 x 1.3 / 2 / 0.138
= 19.97 mm
≤ 26 mm O.K.

4.2 Check for flat cap routel (Kin Long TF12)

Case 1: 4 point supports

Table: Joint Reactions

Joint	Output Case	CaseType	F1	F2	F3	M1	M2	M3
			KN	KN	KN	KN-m	KN-m	KN-m
9	COMB1	Combination	0	0	2.112	0	0	0
9	COMB2	Combination	0	0	2.219	0	0	0
9	COMB3	Combination	0	0	3.078	0	0	0
9	COMB4	Combination	0	0	1.897	0	0	0
10	COMB1	Combination	0	0	2.023	0	0	0
10	COMB2	Combination	0	0	2.126	0	0	0
10	COMB3	Combination	0	0	2.949	0	0	0
10	COMB4	Combination	0	0	1.817	0	0	0
15	COMB1	Combination	0	0	2.124	0	0	0
15	COMB2	Combination	0	0	2.231	0	0	0
15	COMB3	Combination	0	0	3.095	0	0	0
15	COMB4	Combination	0	0	1.907	0	0	0
16	COMB1	Combination	0	0	1.914	0	0	0
16	COMB2	Combination	0	0	2.011	0	0	0
16	COMB3	Combination	0	0	2.789	0	0	0
16	COMB4	Combination	0	0	1.719	0	0	0

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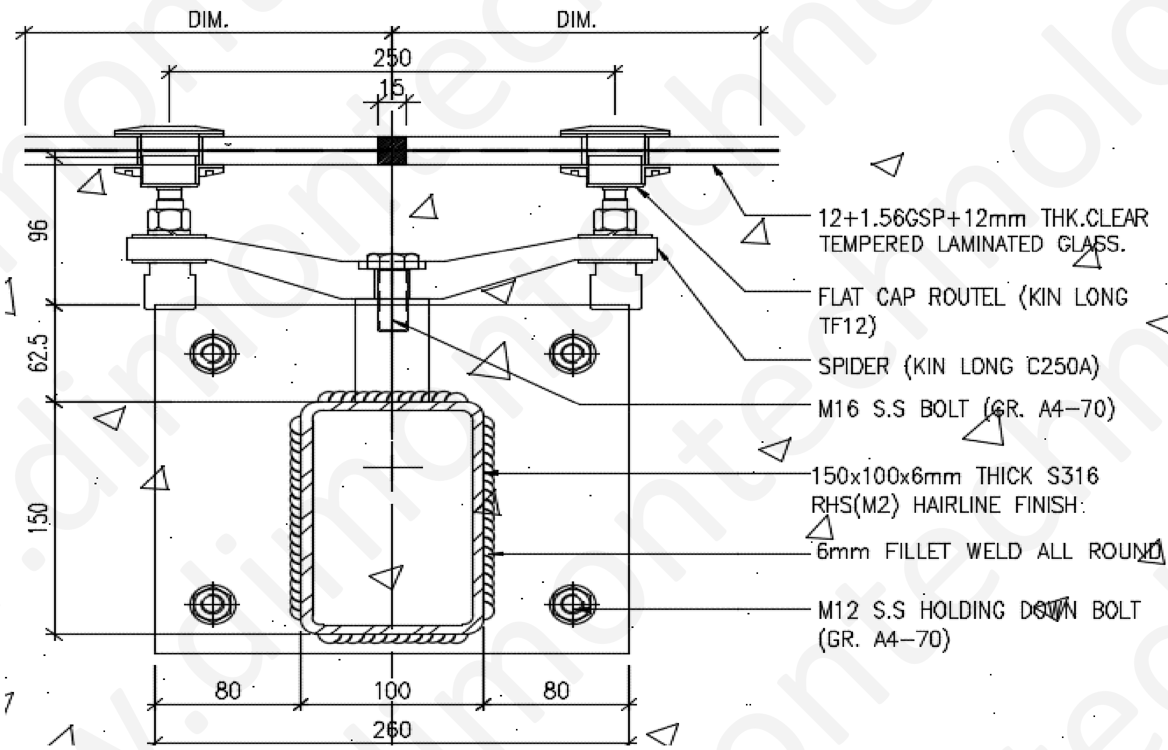
Case 2: 2 point supports + 2 side supports

Table: Joint Reactions

Joint	Output Case	CaseType	F1	F2	F3	M1	M2	M3
			KN	KN	KN	KN-m	KN-m	KN-m
1282	COMB1	Combination	0	0	2.058	0	0	0
1282	COMB2	Combination	0	0	2.163	0	0	0
1282	COMB3	Combination	0	0	3	0	0	0
1282	COMB4	Combination	0	0	1.849	0	0	0
1283	COMB1	Combination	0	0	2.682	0	0	0
1283	COMB2	Combination	0	0	2.818	0	0	0
1283	COMB3	Combination	0	0	3.909	0	0	0
1283	COMB4	Combination	0	0	2.409	0	0	0

By comparison, the max. reaction load is 3.909 kN



Vertical load	= 0.7 + 0.75 + 4.24		(DL+LL + WL)
	= 5.69	kN/m^2	(unfactored)
	= 1.2 x 0.7 + 1.05 x 0.75 + 1.5 x 4.24		(1.2DL+1.05LL +1.5 WL)
	= 7.99	kN/m^2	(factored)
Vertical load on routel at centre	= 3.909 x 5.69 / 7.99		
	= 2.78	kN	

Reaction on each routel point				
tension/compresion	=	2.78	kN	(refer to Appendix)
	<	4.5	kN	O.K.

4.3 Check for spider (Kin Long C250A)

Vertical load on spider	=	2.78	kN	(refer to item 4.2)
Reaction on each spider				
tension/compresion	=	2.78	kN	(refer to Appendix)
	<	4	kN	O.K.

4.4 Check for M16 s.s. bolt, A4-70

Vertical load	=	2 x 3.909		
	=	7.818	kN	(refer to item 4.2)
Tensile area of M16 bolt	=	156	mm^2	
Tensile strength of M16 bolt	=	373	N/mm^2	
Shear strength of M16 bolt	=	280	N/mm^2	
Tensile capacity of bolt	=	156 x 373 / 1000		
	=	58.19	kN	
	>	7.818	kN	O.K.
Pull out capacity on connected part,	=	16 x 3.1416 x 10 / 2 x 127 / 1000		
	=	31.919	kN	
	>	7.818	kN	O.K.

<u>Check for 5mm fillet weld connector channel to steel frame</u>

Horizontal load,	=	7.818	kN	
Effective length of fillet weld,	=	2 x 3.14 x 23		
	=	144.44	mm	
Capacity of fillet weld	=	160 x144.44 x 5 x 0.7 / 1000		
	=	80.886	kN	
	>	7.818	kN	O.K.

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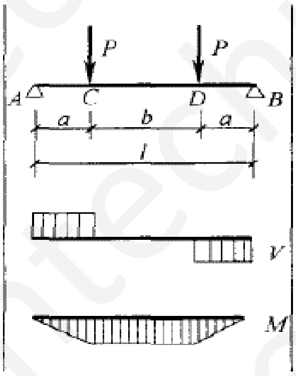
5. Check for steel frame

5.1 Check for 150x100x6mm s.s. RHS



$R_A = R_B = P$

A ~ C 段： $M_x = Px$

C ~ D 段： $M_x = M_{max} = Pa$

A ~ C 段：

$x < a$

$w_x = \frac{Px}{6EI}(3la - 3a^2 - x^2)$

$x = a \quad w_C = \frac{Pa^2}{6EI}(3l - 4a)$

C ~ D 段： $a < x < a + b$：

$w_x = \frac{Pa}{6EI}(3lx - 3x^2 - a^2)$

$w_{max} = \frac{Pa}{24EI}(3l^2 - 4a^2)$

Vertical load,	P	=	2 x 3.909		(refer to item 4.2)
		=	7.818	kN	(factored)
Reaction at support	R€=R_B	=	7.818	kN	
Max bending moment		=	7.818 x 0.521		
		=	4.07	kNm	
Shear stress		=	7.818 x 1000 / (2 x 6 x 150)		
		=	4.34	N/mm^2	
		<	0.6 x 127 = 76.2	N/mm^2	(low shear)
Moment capacity		=	min(1.2 p_y Z_y, p_y S_y)		
		=	(1.2 x 220 x 115/1000 , 220 x 141 / 1000)		
		=	30.36	kNm	(factored)
		>	4.07	kNm	O.K.
Max .deflection		=	2.78 x 2 x 1000 x 521 x (3 x 2362^2 - 4 x 521^2) / (24 x 200000 x 8620000)		
		=	1.096	mm	(unfactored)
		<	2362 / 250 = 9.45	mm	O.K.

<u>Check for lateral torsional buckling</u>

Design strength, p_y = 220 N/mm^2 Parameter, $\varepsilon = (275 / p_y)^{0.5}$ = 1.118

Modulus of Elasticity, E = 200000 N/mm^2

Overall width,	B	=	100	mm	Overall depth,	D	=	150	mm
Wall thickness,	t	=	6	mm	Area,	A	=	28.2	cm^2
Moment of inertia,	I_x	=	862	cm^4	Moment of inertia,	I_y	=	456	cm^4
Section modulus,	Z_x	=	115	cm^3	Section modulus,	Z_y	=	91.2	cm^3
Plastic modulus,	S_x	=	141	cm^3	Plastic modulus,	S_y	=	106	cm^3

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Torsional constant,	J	= 946	cm^4	Radius of gyration,	r_y	= 4.02	cm
Effective length,	L_E	= 2362	mm				

Slenderness ratio,	λ	$= L_E / r_y$	= 58.8	
	γ_b	$= (1 - I_y / I_x) [1 - J / (2.6 I_x)]$	= 0.2722	
Buckling index,	$ø_b$	$= [S_x^2 \gamma_b / (A J)]^{0.5}$	= 0.4504	
Ratio,	β_w	= 1		for plastic section
Equivalent slenderness,	λ_{LT}	$= 2.25 (ø_b \lambda \beta_w)^{0.5}$	= 11.58	
	P_E	$= \pi^2 E / \lambda_{LT}^2$	= 14720.16	
	α_{LT}	= 7		
	λ_{L0}	$= 0.4 (\pi^2 E / p_y)^{0.5}$	= 37.89	
Perry factor,	η_{LT}	$= \alpha_{LT} (\lambda_{LT} - \lambda_{L0}) / 1000$	= -0.1842	< 0
	$ø_{LT}$	$= [p_y + (\eta_{LT} + 1) P_E] / 2$	= 6114.35	

Bending buckling strength, $p_b = P_E p_y / (ø_{LT} + (ø_{LT}^2 - P_E p_y)^{0.5})$

$= 270.82$ N/mm^2

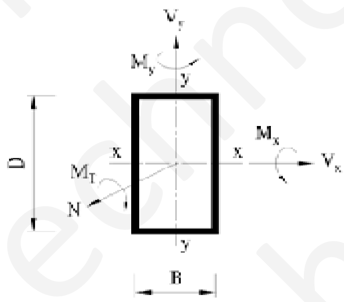
> 220 N/mm^2

5.2 Check for 6mm fillet weld all round connection to base plate

Vertical load = 7.818 kN (refer to item 5.1)

Properties for unit throat thickness of fillet weld (effective length)

Breadth,	B	= 100	mm	
Height,	D	= 150	mm	
Area,	A	$= 2 (B + D)$	= 500	mm^2
Moment of inertia,	I_x	$= B D^2 / 2 + D^3 / 6$	= 1687500	mm^4
Moment of inertia,	I_y	$= B^2 D / 2 + B^3 / 6$	= 916667	mm^4
Polar moment of inertia,	J	$= I_x + I_y$	= 2604167	mm^4



Shear load,	V_x	= 0	kN	Moment,	M_x	= 0	kNm
Shear load,	V_y	= 7.818	kN	Moment,	M_y	= 0	kNm
Tensile load,	N	= 0	kN	Torsional moment,	M_T	= 0	kNm

Leg length of fillet weld, t = 6 mm

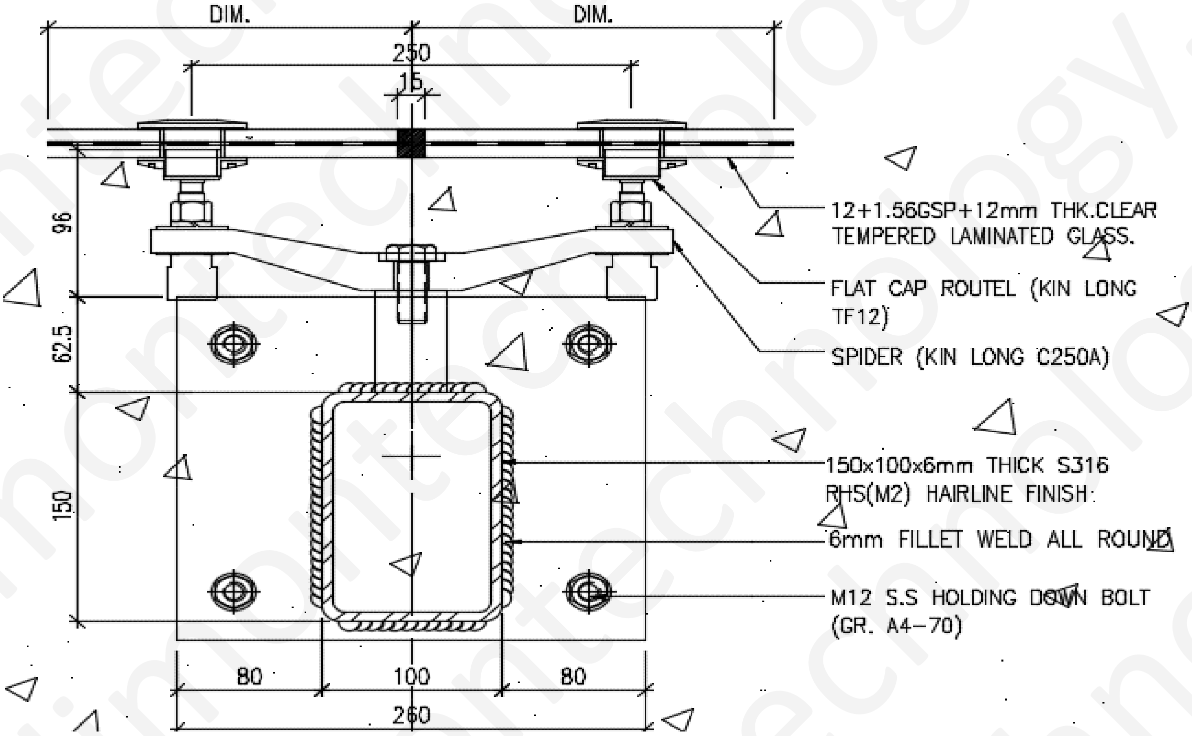
Shear stress,	τ_x	$= V_x / (0.7 t A) + M_T (D / 2) / (0.7 t J)$	= 0	N/mm^2
Shear stress,	τ_y	$= V_y / (0.7 t A) + M_T (B / 2) / (0.7 t J)$	= 3.72	N/mm^2
Tensile stress,	σ	$= N / (0.7 t A)$	= 0	N/mm^2
Tensile stress,	σ_x	$= M_x D / (2 I_x) / (0.7 t)$	= 0	N/mm^2
Tensile stress,	σ_y	$= M_y B / (2 I_y) / (0.7 t)$	= 0	N/mm^2

Resultant , $f_w = [\tau_x^2 + \tau_y^2 + (\sigma + \sigma_x + \sigma_y)^2]^{0.5}$

$= 3.72$ N/mm^2

≤ 200 N/mm^2 O.K.

5.3 Check for M12 holding down bolt, A4-70



Vertical load = 7.818 kN (refer to item 5.1)

Shear load on each bolt = 7.818 / 4

= 1.95 kN

Tensile area of M12 bolt = 84 mm^2

Tensile strength of M12 bolt = 373 N/mm^2

Shear strength of M12 bolt = 280 N/mm^2

Shear capacity of bolt = 84 x 280 / 1000

= 23.52 kN

> 1.95 kN O.K.