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CONSULTING ENGINEERS

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 1
Date: 08/05/2020	**By:** R.F.

Concorde Glass Ltd.,

Linx House,

104 Waterloo Rd,

Mablethorpe,

LN12 1LE,

UK.

General Wind Load

1388-3 Glass Adaptor and Spigot

Analysis By	Checked By
R.F.	T.S.

0	08/05/2020	T.S.	Issued
Revision	**Date**	**Issued By**	**Comment**

Contents

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 4
Date: 08/05/2020	**By:** R.F.

Introduction/Actions/Result Summary:

Introduction:

TSA was instructed by Concorde to provide a matrix of wind load for the glass adaptor and spigot.

Actions – Loading Considerated:

Infill load = 0.42kN (per calculation)
Infill load = 1.0kN (Table NA.5 IS1991-1-1:2002)
Infill load = 1.5kN (Table NA.5 IS1991-1-1:2002)
Infill load = 2.0kN (Table NA.5 IS1991-1-1:2002)

Assumption:

Concrete Grade = C30/37

Result Summary:

Glass Analysis					
Case Study	Glass	Interlayer	Wind Load - Qw	Height glass	Glass Deflection
	(mm)		(kN/m)	(m)	(mm)
1	15		1.00	1.4	13.42
2	17.52	PVB	1.00	1.4	22.68
3	21.52	PVB	1.50	1.4	19.69
4	15		0.42	1.192	8.422
5	15		1.50	1.11	15.46

NOTE: All deflection < 25mm and therefore acceptable.

Connection To Concrete		
Case Study	Fischer	Edge (mm)
5	M10 FAZ II 10/10	100

Connection To Mild Steel		
Case Study	Fischer	Edge (mm)
5	M10x30mm Grade 8.8	70

Connection To Wood		
Case Study	Fischer	Edge (mm)
5	Rampa SKL M10x60mm	-

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Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Glass Strength

Wind Loading:

10min duration, Multiple Gust Storm => $k_{mod} = 0.74$

$f_{gd} = (k_{mod})(k_{sp})(f_{gk})/ \gamma_{ma} + k_v(f_{bk}-f_{gk})/\gamma_{mv}$

$f_{gd} = (0.74)(1.0)(45)/1.6 + 1.0(120-45)/1.2$

$\underline{f_{gd} = 83.3 N/mm^2}$

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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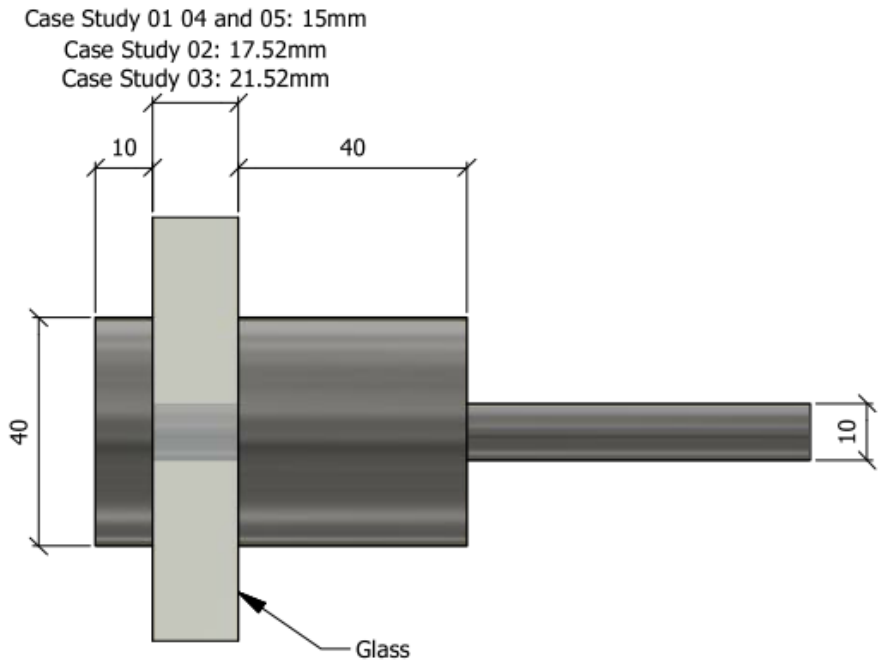
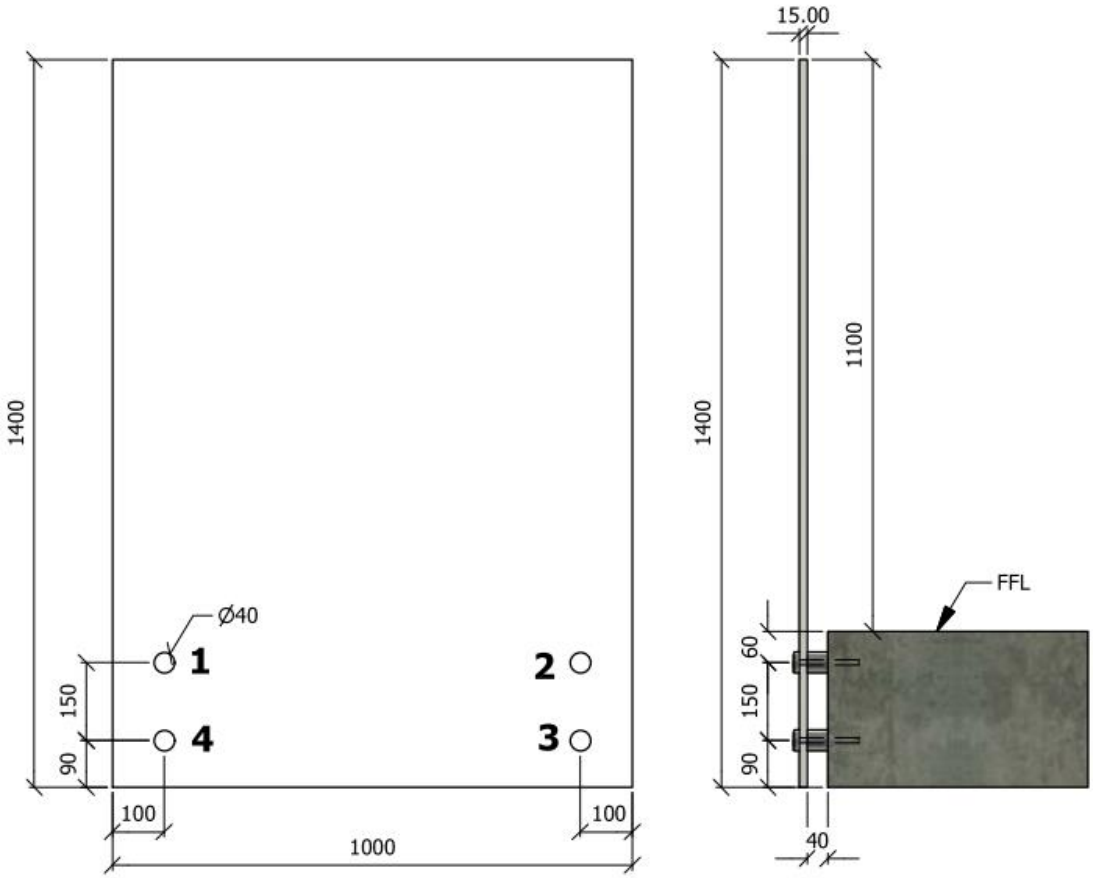
System Sketch:

Glass Adaptor:



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 7
Date: 08/05/2020	**By:** R.F.

Case Study 01: 15mm Tough – 1.0x1.40m – 1.0kN/m^2:

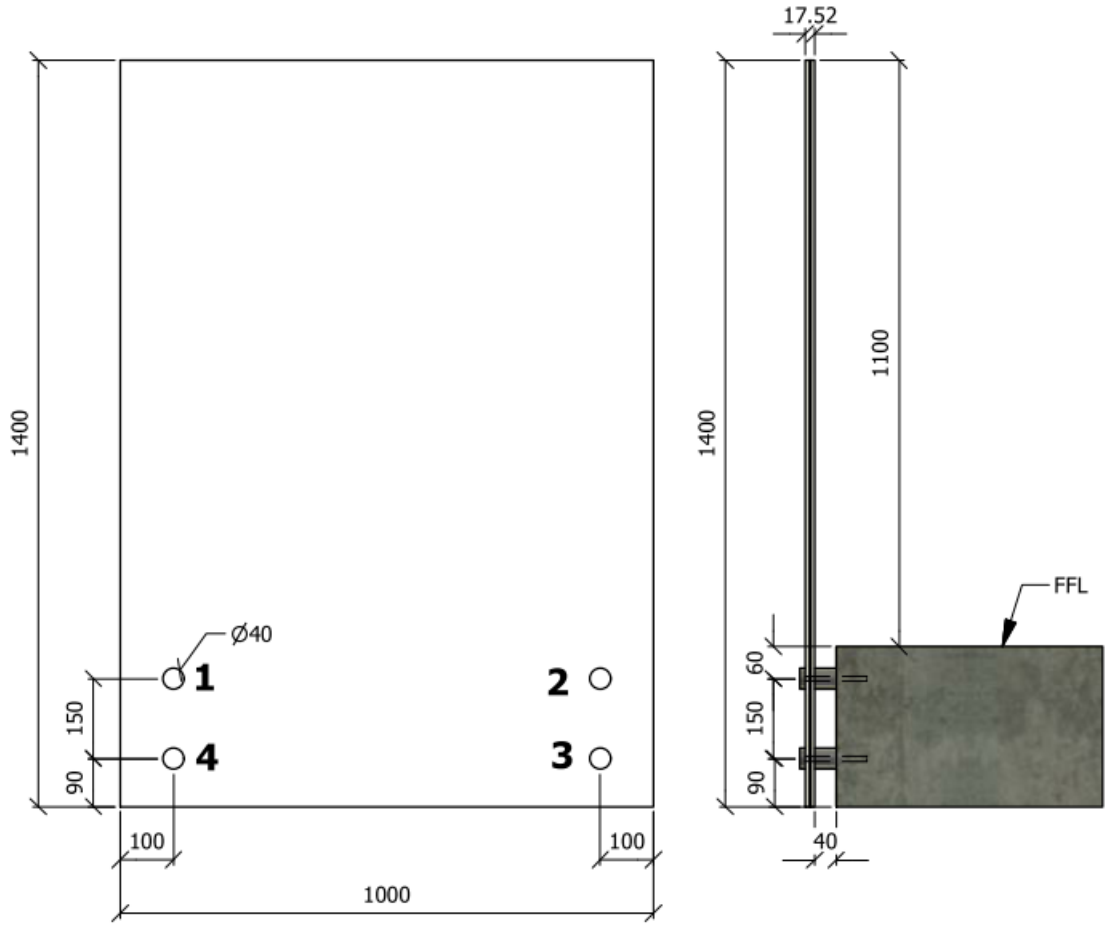


NOTE:

- Deflection on the glass 13.42mm = **OK in deflectionnessa**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 8
Date: 08/05/2020	**By:** R.F.

Case Study 02: 17.52mm (TLT) – 1.0x1.40m – 1.0kN/m^2:



NOTE:

- Deflection on the glass 22.68mm = **OK in deflection**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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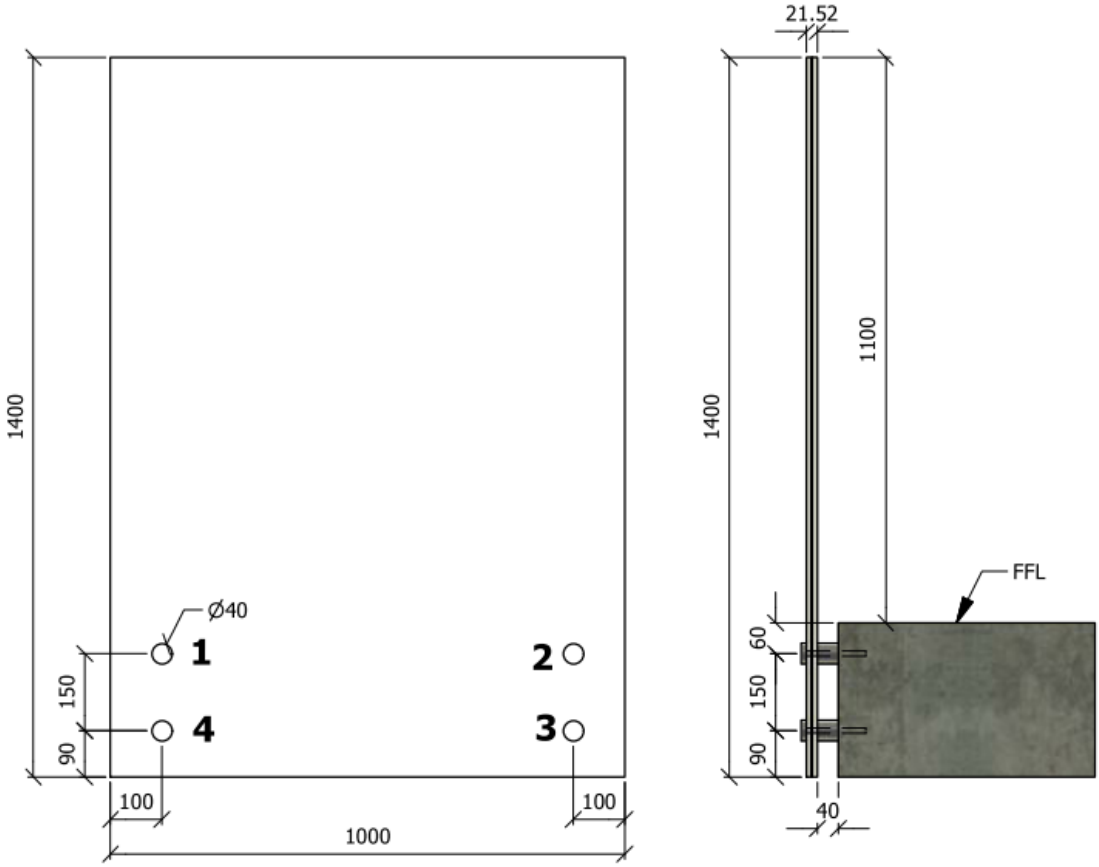
Date: 08/05/2020	**By:** R.F.

Case Study 03: 21.52mm (TLT) – 1.0x1.40m – 1.5kN/m^2:



NOTE:

- Deflection on the glass 19.69mm = **OK in deflection**

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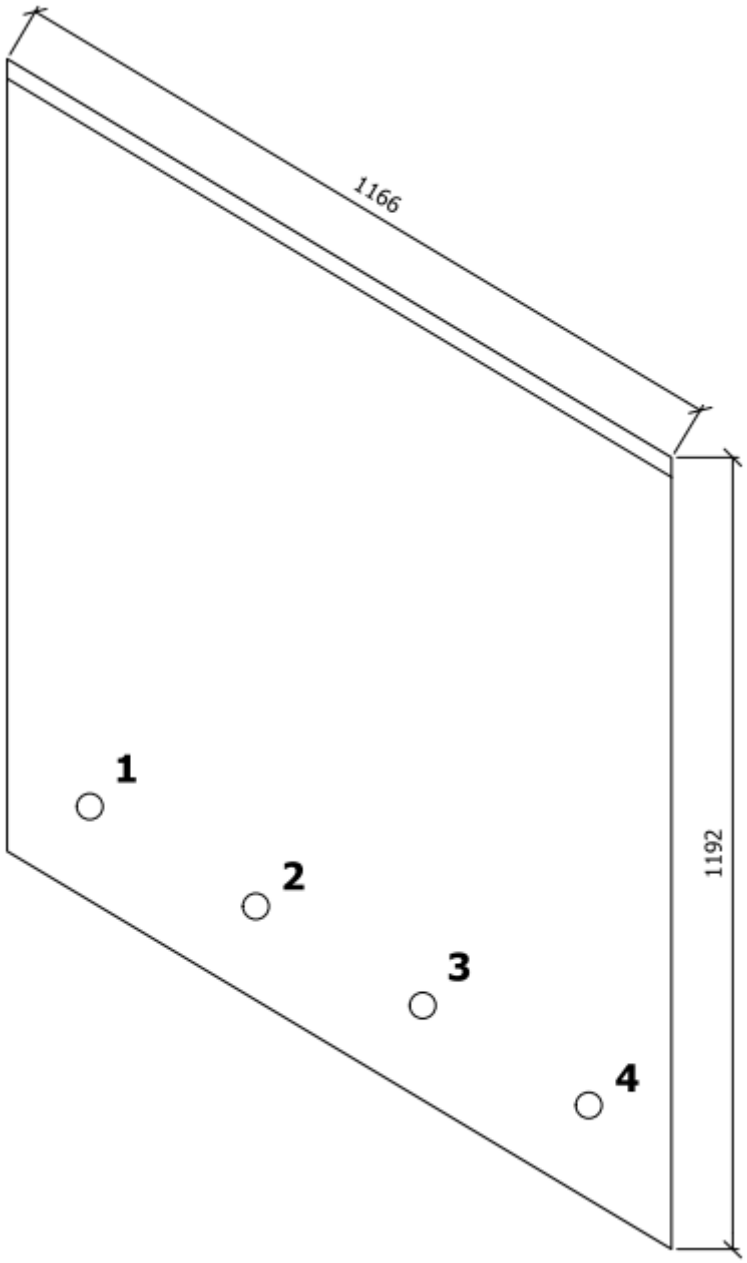
Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 10
Date: 08/05/2020	**By:** R.F.

Case Study 04: 15mm Tough – 1.166x1.192m – 0.42kN:



NOTE:

- Deflection on the glass 8.422mm = **OK in deflection**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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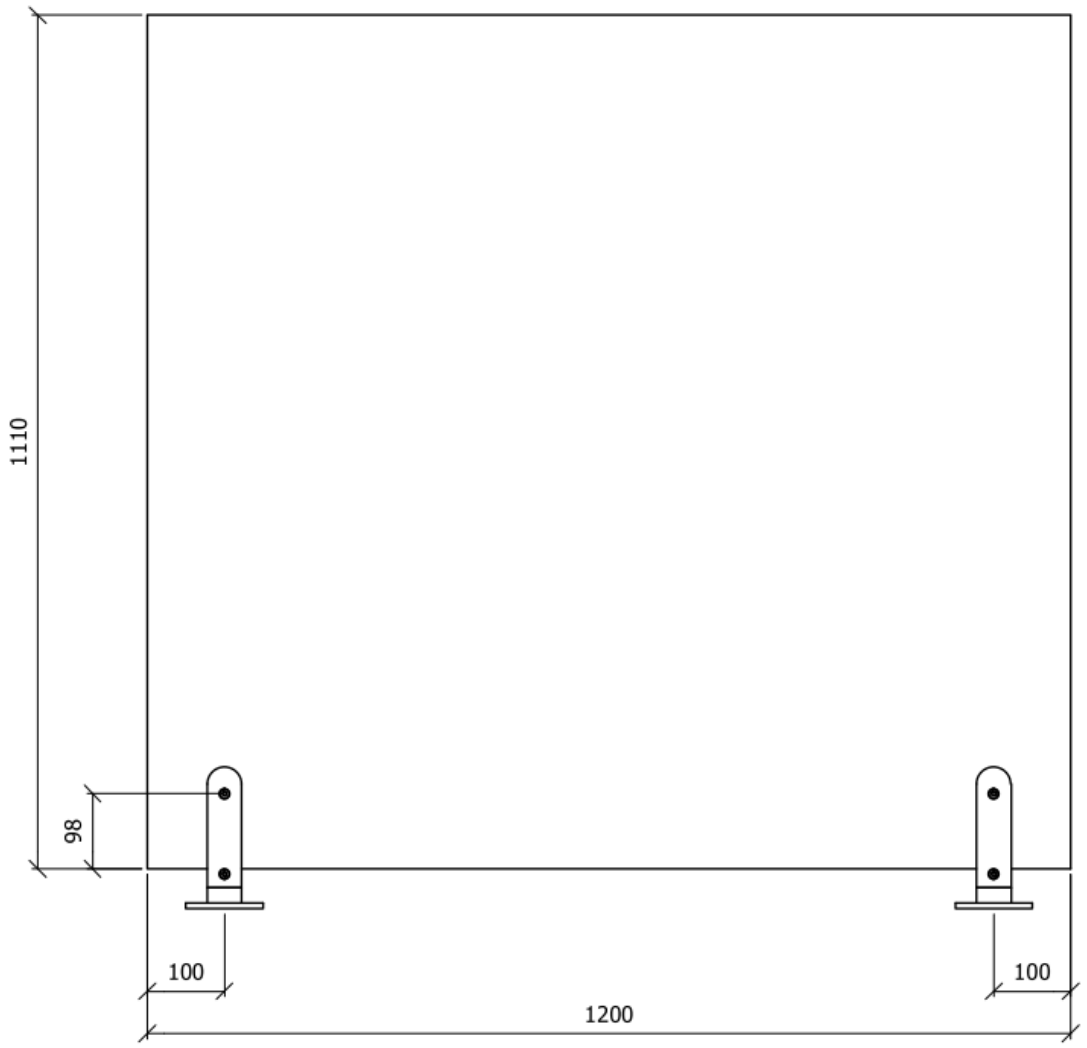
Case Study 05: 15mm Tough – 1.20x1.11m – 1.5kN/m^2:



NOTE:

- Deflection on the glass 15.46mm = **OK in deflection**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Date: 08/05/2020	**By:** R.F.

Glass Analysis:

Case Study 01: 15mm Tough – 1.0x1.40m – 1.0kN/m^2:

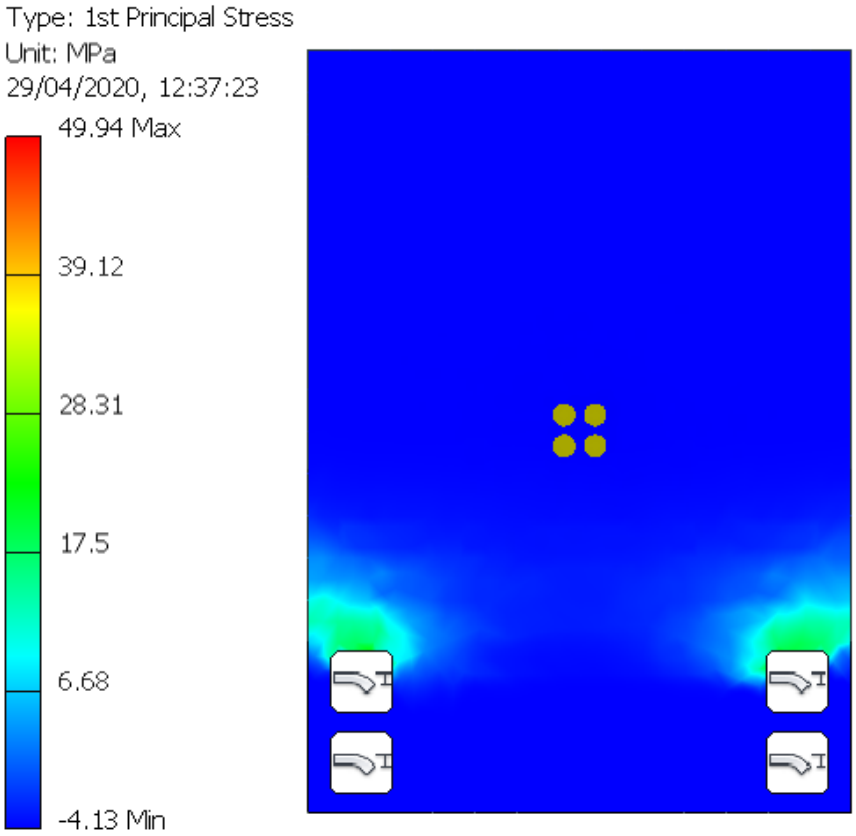
Glass Analysis - Bending Stress of Glass Panel due to 1.0kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.0kN/m2 Infill Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Bending Stress analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Bending Stress = 49.94N/mm² x1.5 = 74.91N/mm² < 83.3N/mm²

OK in Bending



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 13
Date: 08/05/2020	**By:** R.F.

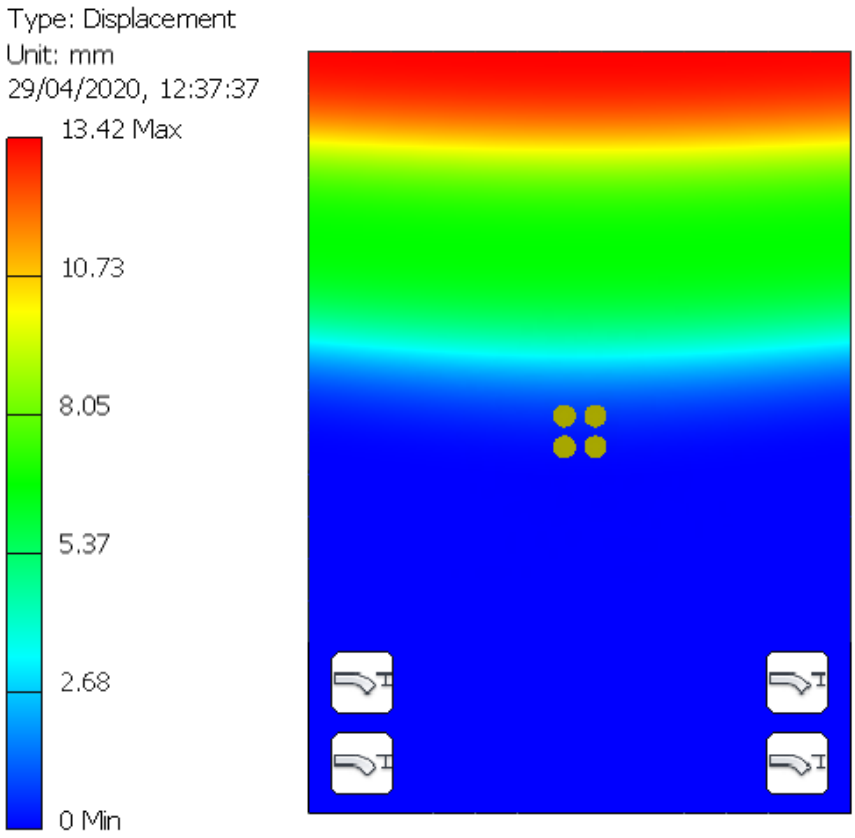
Glass Analysis - Deflection of Glass Panel due to 1.0kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.0kN/m2 Infill Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Deflection analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Deflection = 13.42mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



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Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 14
Date: 08/05/2020	**By:** R.F.

Case Study 02: 17.52mm (TLT) – 1.0x1.40m – 1.0kN/m^2:

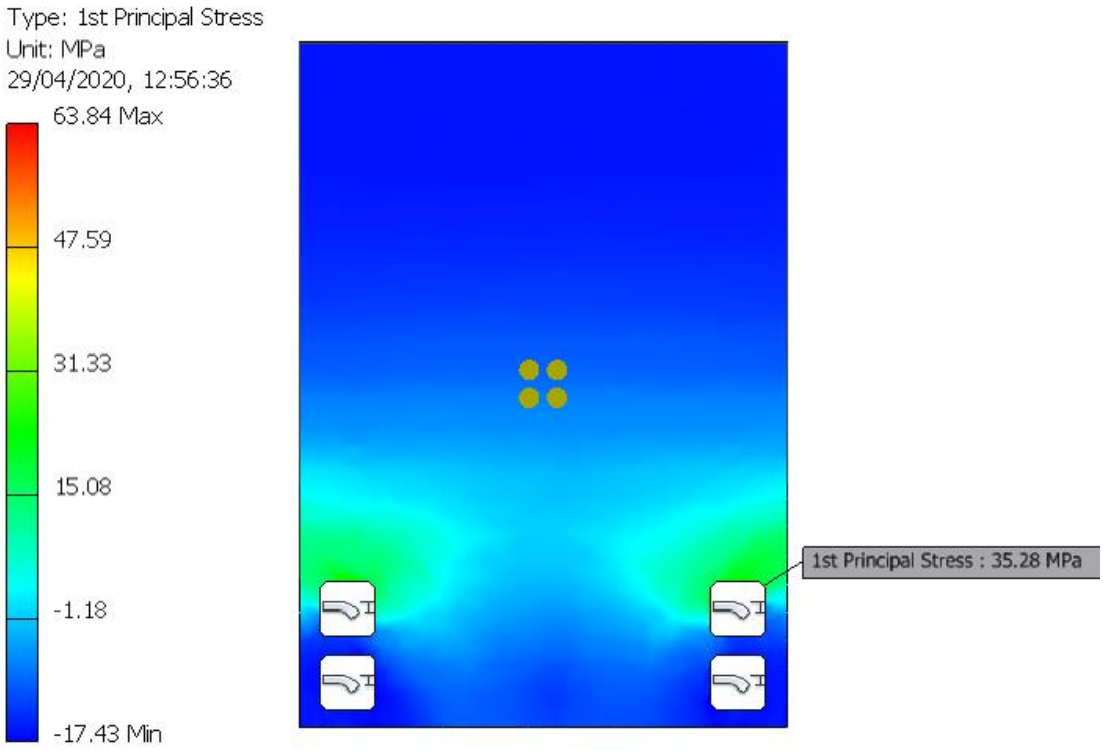
Glass Analysis - Bending Stress of Glass Panel due to 1.0kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.0kN/m2 Infill Loading
- 8/8/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 3MPa, G = 1MPa
- Bending Stress analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Bending Stress = 35.28N/mm^2 x1.5 = 52.92N/mm^2 < 83.3N/mm^2

OK in Bending



Note:

In this case the 63.84 MPa is a localised stress. The most appropriate stress to be considered is 35.28 MPa

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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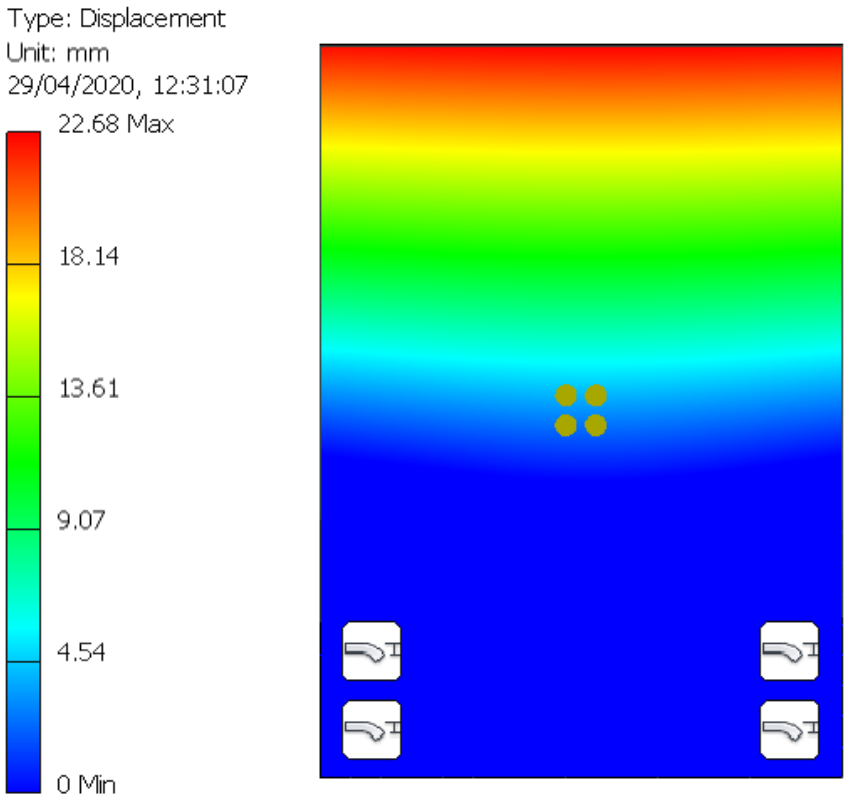
Glass Analysis - Deflection of Glass Panel due to 1.0kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.0kN/m2 Infill Loading
- 8/8/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 3MPa, G = 1MPa
- Deflection analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Deflection = 22.68mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Case Study 03: 21.52mm (TLT) – 1.0x1.40m – $1.5kN/m^2$:

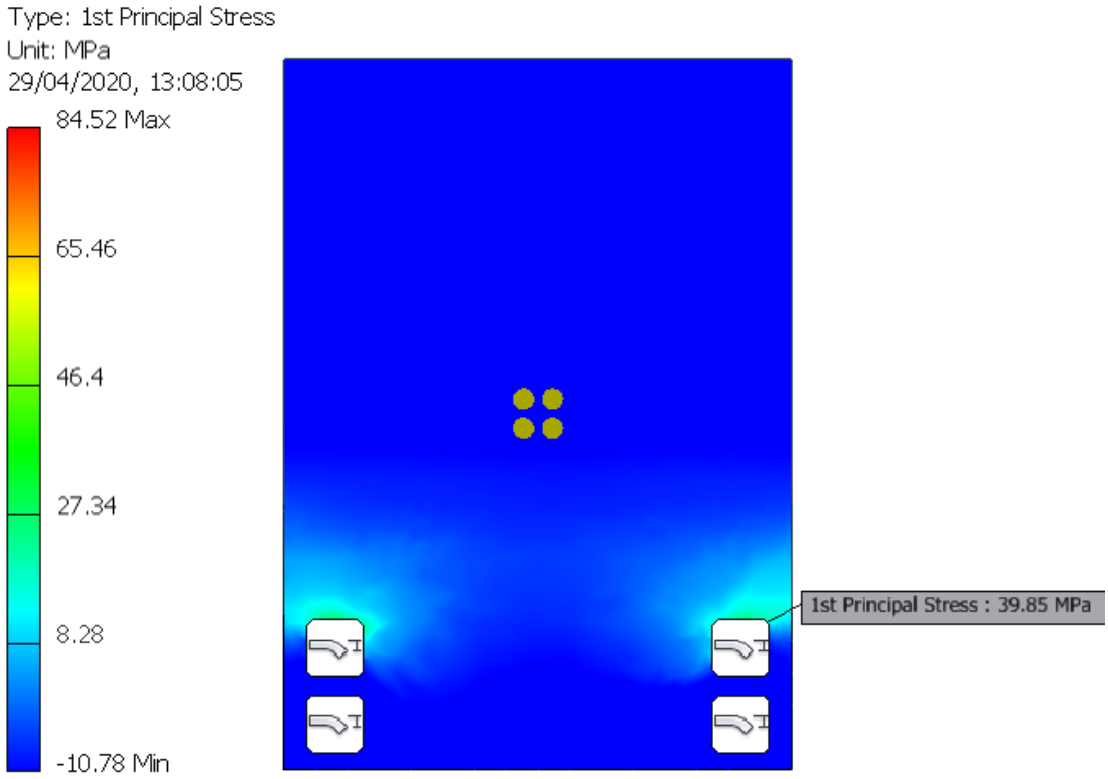
Glass Analysis - Bending Stress of Glass Panel due to 1.5kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.5kN/m2 Infill Loading
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 3MPa, G = 1MPa
- Bending Stress analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Bending Stress = 39.85N/mm^2 x1.5 = 59.78N/mm^2 < 83.3N/mm^2

OK in Bending



Note:

In this case the 84.52 MPa is a localised stress. The most appropriate stress to be considered is 39.85 MPa

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Date: 08/05/2020	**By:** R.F.

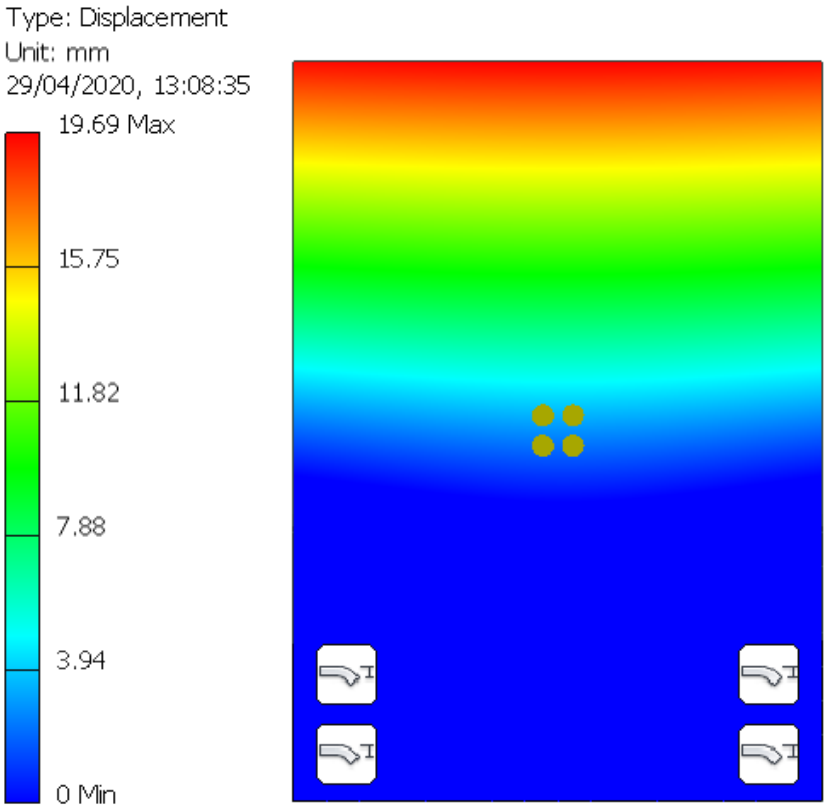
Glass Analysis - Deflection of Glass Panel due to 1.5kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.5kN/m2 Infill Loading
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 3MPa, G = 1MPa
- Deflection analysed based on glass panel of 1.0m x 1.40m

Result:

Max. Deflection = 19.69mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Case Study 04: 15mm Tough – 1.166x1.192m – 0.42kN:

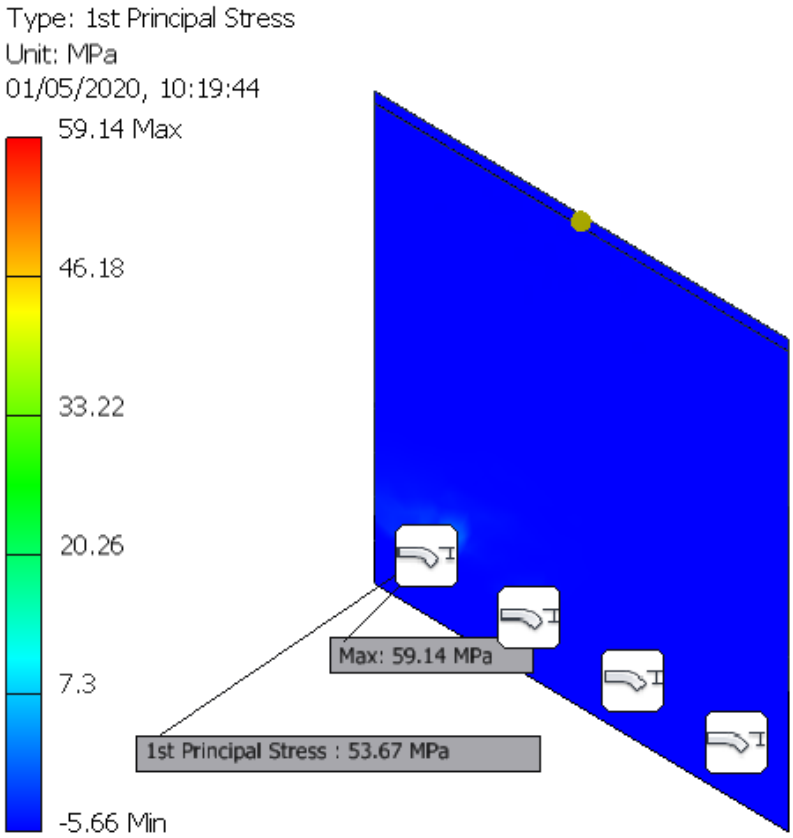
Glass Analysis - Bending Stress of Glass Panel due to 0.42kN/m Balustrade Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 0.42kN/m Balustrade Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Bending Stress analysed based on glass panel of 1.166(l)m x 1.192(h)m

Result:

Max. Bending Stress = 53.67N/mm^2 x1.5 = 80.51N/mm^2 < 83.3N/mm^2

OK in Bending



Note:

In this case the 59.14 MPa is a localised stress. The most appropriate stress to be considered is 53.67 MPa

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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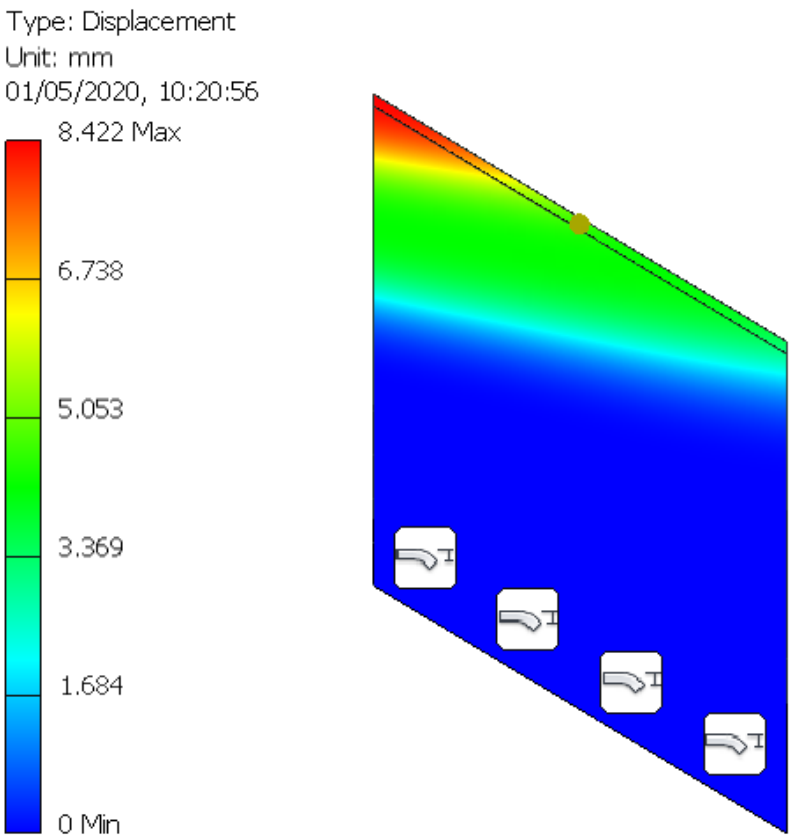
Glass Analysis - Deflection of Glass Panel due to 0.42kN/m Balustrade Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 0.42kN/m Balustrade Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Deflection analysed based on glass panel of 1.166(l)m x 1.192(h)m

Result:

Max. Deflection = 8.422mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Case Study 05: 15mm Tough – 1.20x1.11m – $1.5kN/m^2$:

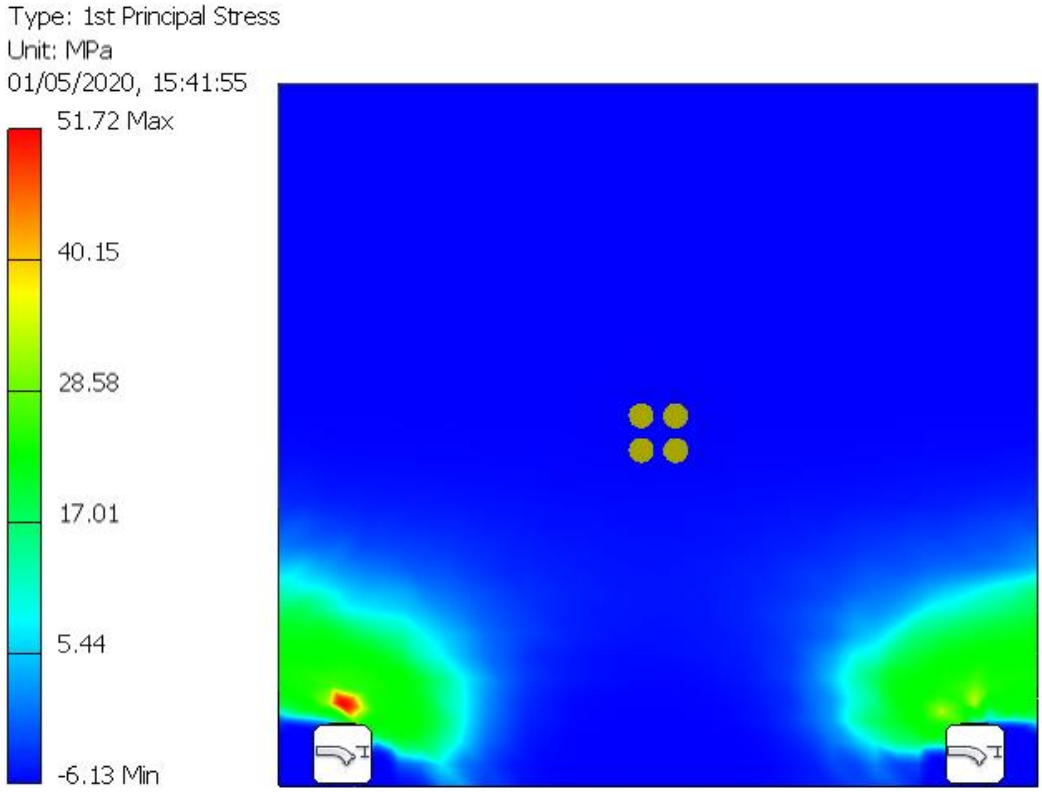
Glass Analysis - Bending Stress of Glass Panel due to 1.5kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.5kN/m2 Infill Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Bending Stress analysed based on glass panel of 1.2m x 1.11m

Result:

Max. Bending Stress = 51.72N/mm² x1.5 = 77.58N/mm² < 83.3N/mm²

OK in Bending



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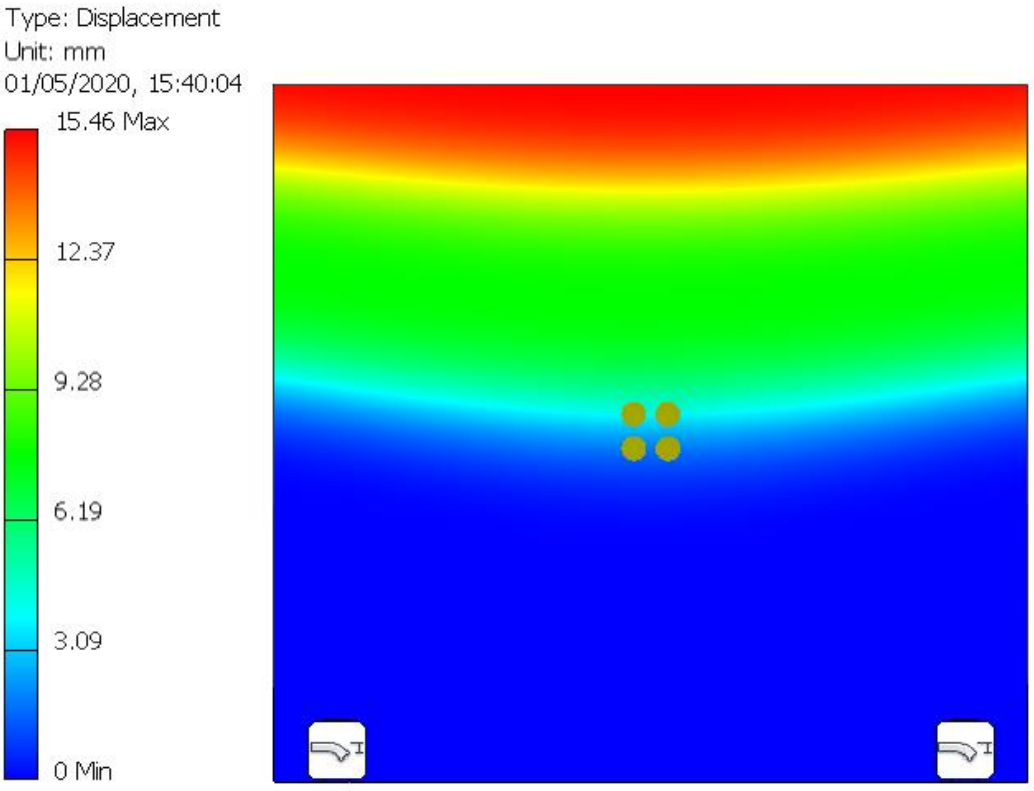
Glass Analysis - Deflection of Glass Panel due to 1.5kN/m2 Infill Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.5kN/m2 Infill Loading
- 15mm Tough Glass analysed, horizontally toughened Laminated
- Deflection analysed based on glass panel of 1.2m x 1.11m

Result:

Max. Deflection = 15.46mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



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Project: Glass Adaptor and Spigot	Contract: 1388-3
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Reactions:

Size of the Glass - 1.00(h) x 1.40(l)m			
Pressure	Reactions (N)		
	Case 01	Case 02	Case 03
1	1001	1433	2319
2	1001	1433	2319
3	-301	-733	-1269
4	-301	-733	-1269

Size of the Glass	
1.166(h) x 1.192(l)m	
Balustrade	Reactions (N)
	Case 04
1	393
2	26
3	69
4	-68

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Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Connection Design:

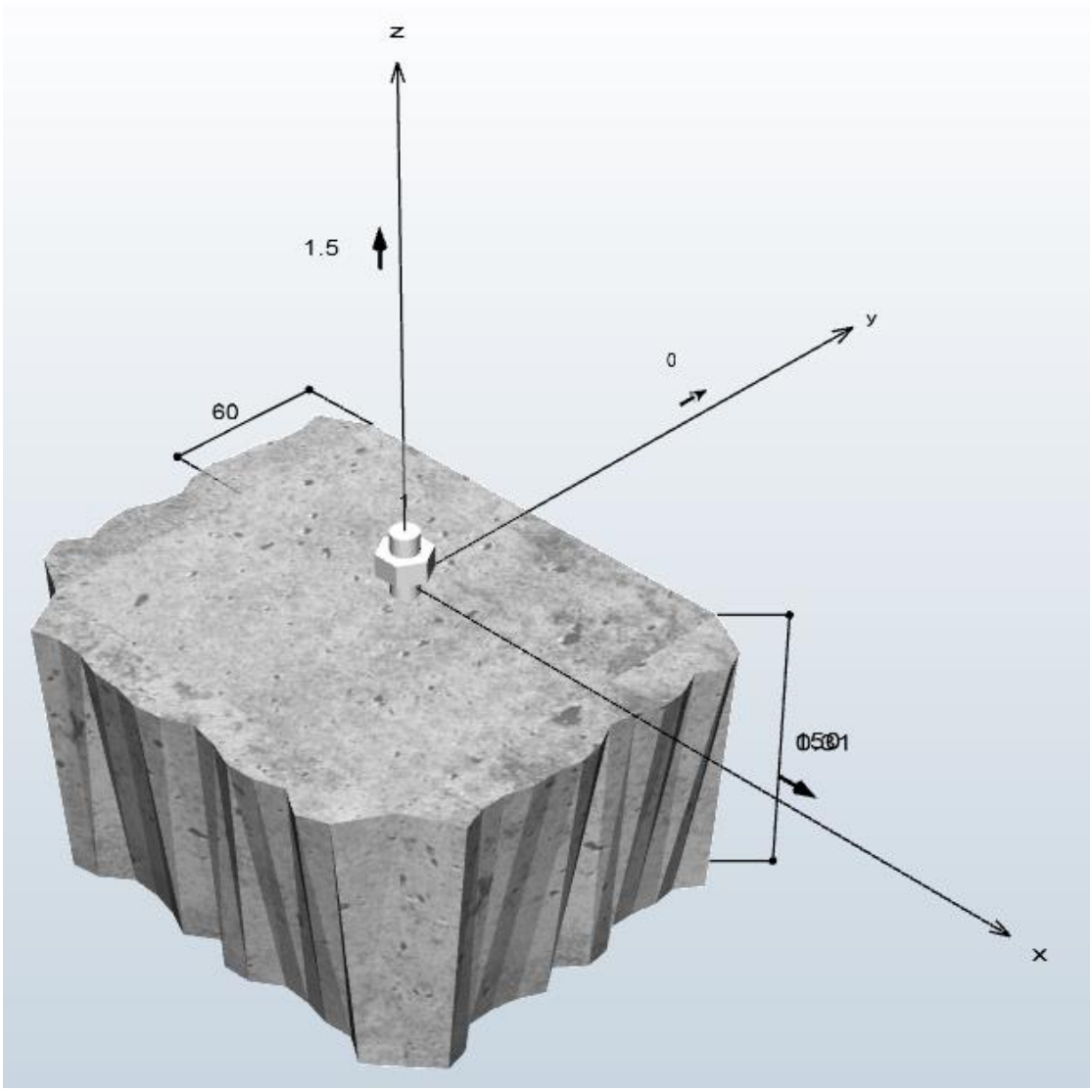
Case Study 01: 15mm Tough – 1.0x1.40m – 1.0kN/m^2:

Connection To Concrete:

Tensile Load $= 1.00\text{kN} \times 1.5 = 1.50\text{kN}$ (ULS)

Shear Load $= 0.23\text{kN} \times 1.35 = 0.31\text{kN}$ (ULS)

Chemical anchor FIS V 360 S M10x150 8.8. See design in Appendix A.



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Connection To Mild Steel:

1Nr M10 Bolt Grade 8.8

$f_y = 210\ MPa$ *(Grade 304 Stainless Steel, Table 2.1 EN 1993-1-4:2006)*

$f_{ub} = 500\ MPa$ *(Grade 304 Stainless Steel, Table 2.2 EN 1993-1-4:2006)*

$\alpha = 0.6$ *(Table 3.4 EN 1993-1-8:2005)*

$A = 58mm^2$ *(For M10 Bolts)*

$K_2 = 0.9$ *(Table 3.4 EN 1993-1-8:2005)*

$\lambda_{m2} = 1.25$ *(Table 5.1 EN 1993-1-4:2006)*

Tensile Resistance Check: *(Table 3.4 EN 1993-1-8:2005)*

$F_{t,Ed}$: *is the design tensile force per bolt for the ultimate limit state.*

$F_{t,Rd}$: *is the design tension resistance per bolt.*

$$\mathrm{F_{t,Ed}} = \frac{1.0\mathrm{kN}}{\mathrm{m^2}} \times 1.5 \times 1.4\mathrm{m} \times 1.0\mathrm{m} \times \frac{1.4\mathrm{m}}{2} = 1.47\mathrm{kNm}$$

$$\mathrm{F_{t,Ed}} = \frac{1.47\mathrm{kN}}{0.15\mathrm{m}} \times \frac{1}{2} = 4.9\mathrm{kN\ per\ bolt}$$

$$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} \rightarrow \mathrm{F_{t,Rd}} = \frac{0.9 \times 500 \times 58 \times 10^{-3}}{1.25} = 20.88\mathrm{kN} > 4.90\mathrm{kN}$$ **Okay**

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Project: Glass Adaptor and Spigot	Contract: 1388-3
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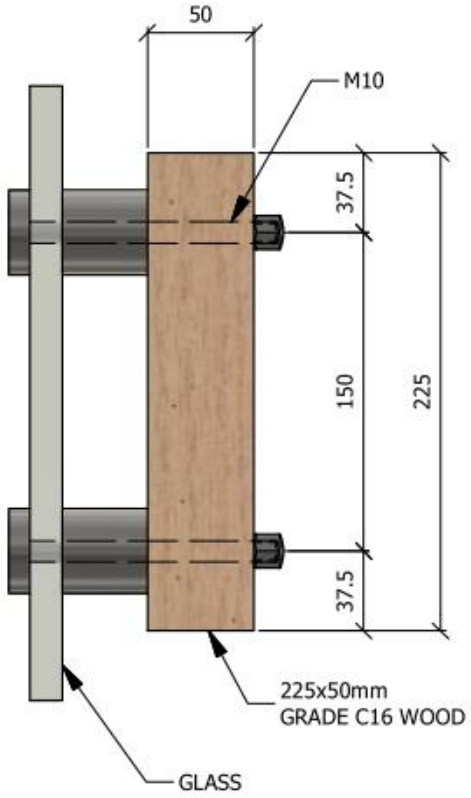
Connection To Wood:



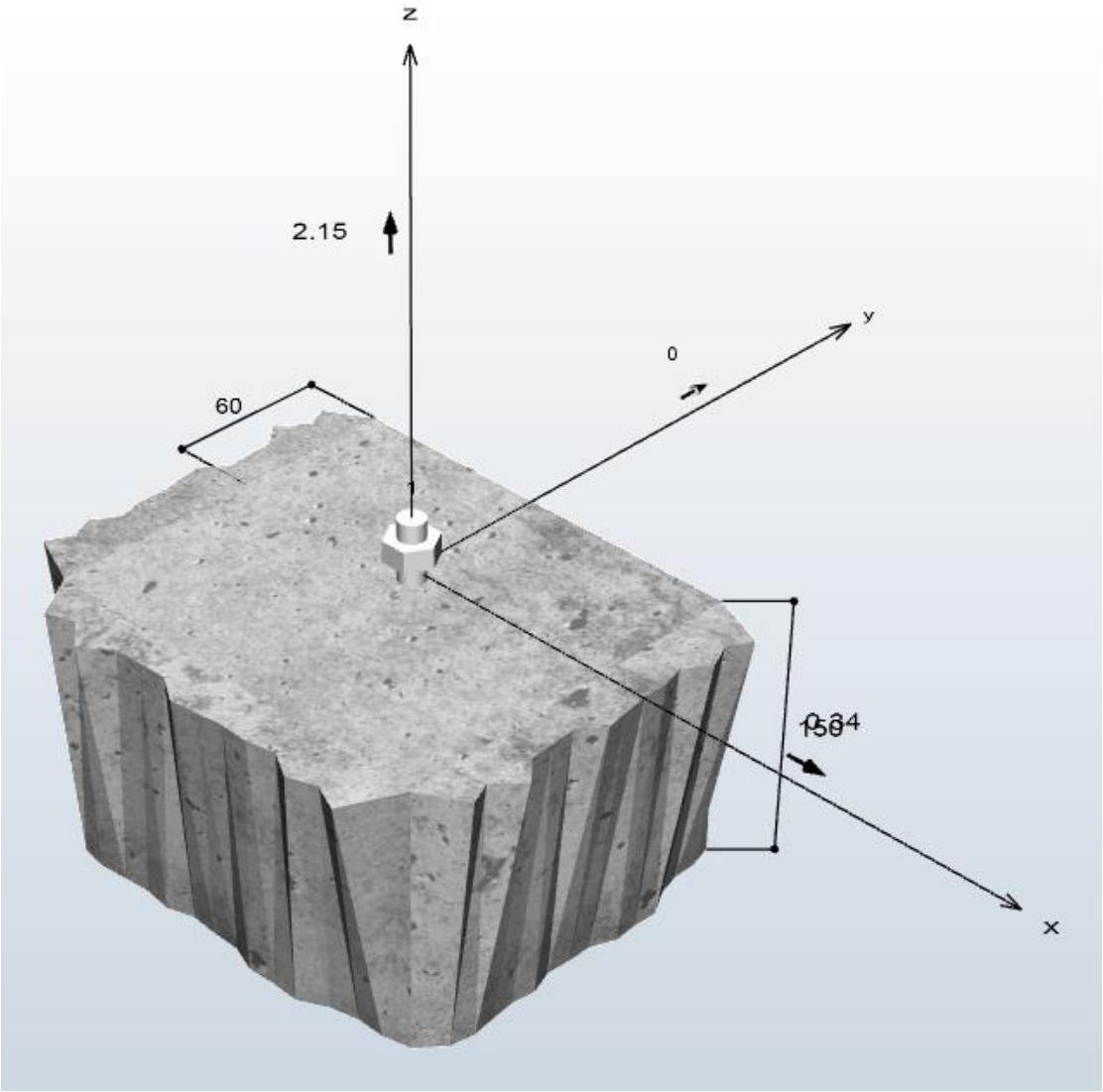
Case Study 02: 17.52mm (TLT) – 1.0x1.40m – 1.0kN/m^2:

Connection To Concrete:

Tensile Load $= 1.43\text{kN} \times 1.5 = 2.15\text{kN}$ (ULS)

Shear Load $= 0.26\text{kN} \times 1.35 = 0.34\text{kN}$ (ULS)

Chemical anchor FIS V 360 S M10x150 8.8. See design in Appendix A.



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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Connection To Mild Steel:

1Nr M10 Bolt Grade 8.8

$f_y = 210\ MPa$ *(Grade 304 Stainless Steel, Table 2.1 EN 1993-1-4:2006)*

$f_{ub} = 500\ MPa$ *(Grade 304 Stainless Steel, Table 2.2 EN 1993-1-4:2006)*

$\alpha = 0.6$ *(Table 3.4 EN 1993-1-8:2005)*

$A = 58mm^2$ *(For M10 Bolts)*

$K_2 = 0.9$ *(Table 3.4 EN 1993-1-8:2005)*

$\lambda_{m2} = 1.25$ *(Table 5.1 EN 1993-1-4:2006)*

Tensile Resistance Check: *(Table 3.4 EN 1993-1-8:2005)*

$F_{t,Ed}$: *is the design tensile force per bolt for the ultimate limit state.*

$F_{t,Rd}$: *is the design tension resistance per bolt.*

$$\mathrm{F_{t,Ed}} = \frac{1.5\mathrm{kN}}{\mathrm{m^2}} \times 1.5 \times 1.4\mathrm{m} \times 1.0\mathrm{m} \times \frac{1.4\mathrm{m}}{2} = 2.21\mathrm{kNm}$$

$$\mathrm{F_{t,Ed}} = \frac{2.21\mathrm{kN}}{0.15\mathrm{m}} \times \frac{1}{2} = 7.37\mathrm{kN\ per\ bolt}$$

$$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} \rightarrow \mathrm{F_{t,Rd}} = \frac{0.9 \times 500 \times 58 \times 10^{-3}}{1.25} = 20.88\mathrm{kN} > 7.37\mathrm{kN}$$ **Okay**

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Project: Glass Adaptor and Spigot	**Contract:** 1388-3
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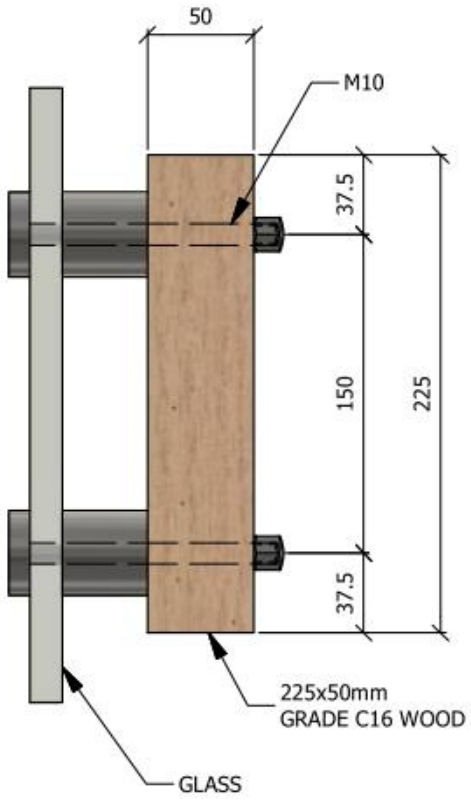
Connection To Wood:



FIS A M 10x150 8.8.

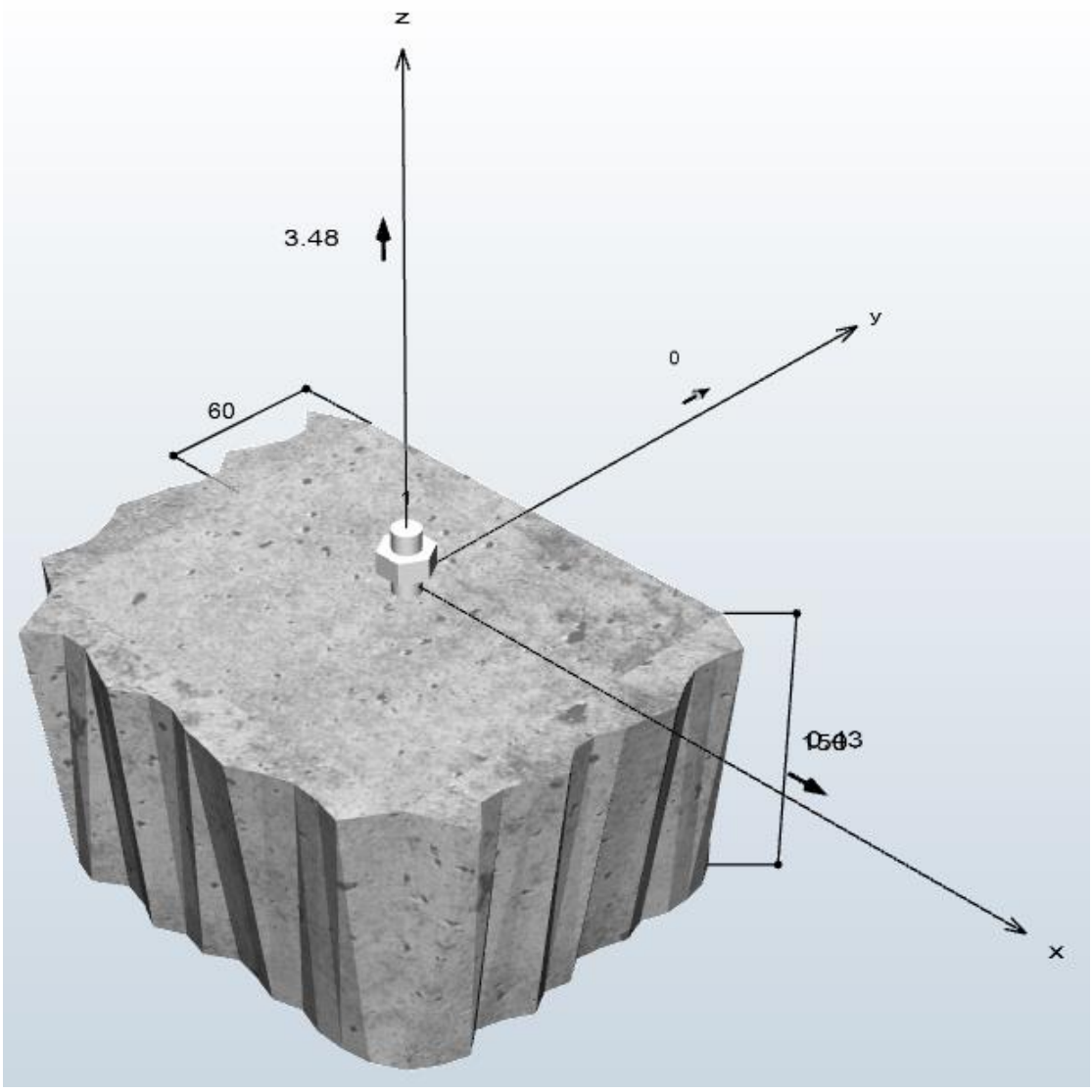
Case Study 03: 21.52mm (TLT) – 1.0x1.40m – 1.5kN/m^2:

Connection To Concrete:

Tensile Load $= 2.32\text{kN} \times 1.5 = 3.48\text{kN}$ (ULS)

Shear Load $= 0.32\text{kN} \times 1.35 = 0.43\text{kN}$ (ULS)

Chemical anchor FIS V 360 S M10x150 8.8. See design in Appendix A.



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 30
Date: 08/05/2020	**By:** R.F.

Connection To Mild Steel:

1Nr M10 Bolt Grade 8.8

$f_y = 210\ MPa$ *(Grade 304 Stainless Steel, Table 2.1 EN 1993-1-4:2006)*

$f_{ub} = 500\ MPa$ *(Grade 304 Stainless Steel, Table 2.2 EN 1993-1-4:2006)*

$\alpha = 0.6$ *(Table 3.4 EN 1993-1-8:2005)*

$A = 58mm^2$ *(For M10 Bolts)*

$K_2 = 0.9$ *(Table 3.4 EN 1993-1-8:2005)*

$\lambda_{m2} = 1.25$ *(Table 5.1 EN 1993-1-4:2006)*

Tensile Resistance Check: *(Table 3.4 EN 1993-1-8:2005)*

$F_{t,Ed}$: *is the design tensile force per bolt for the ultimate limit state.*

$F_{t,Rd}$: *is the design tension resistance per bolt.*

$$\mathrm{F_{t,Ed}} = \frac{2.0\mathrm{kN}}{\mathrm{m^2}} \times 1.5 \times 1.4\mathrm{m} \times 1.0\mathrm{m} \times \frac{1.4\mathrm{m}}{2} = 2.94\mathrm{kNm}$$

$$\mathrm{F_{t,Ed}} = \frac{2.21\mathrm{kN}}{0.15\mathrm{m}} \times \frac{1}{2} = 9.80\mathrm{kN\ per\ bolt}$$

$$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} \rightarrow \mathrm{F_{t,Rd}} = \frac{0.9 \times 500 \times 58 \times 10^{-3}}{1.25} = 20.88\mathrm{kN} > 9.80\mathrm{kN}$$ **Okay**

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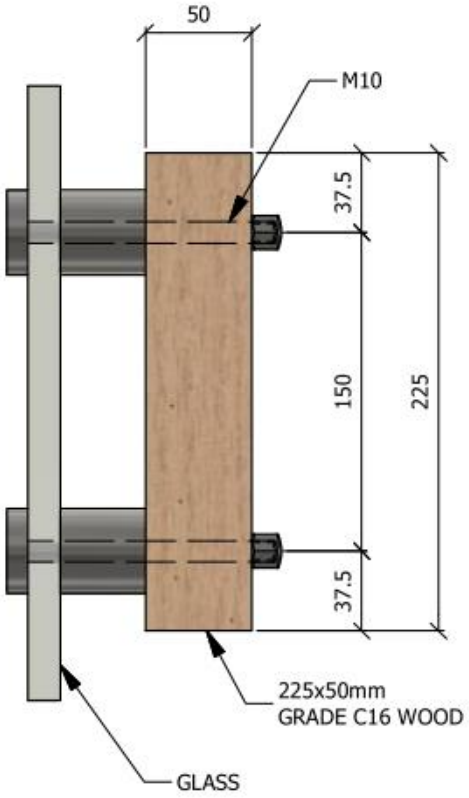
Connection To Wood:

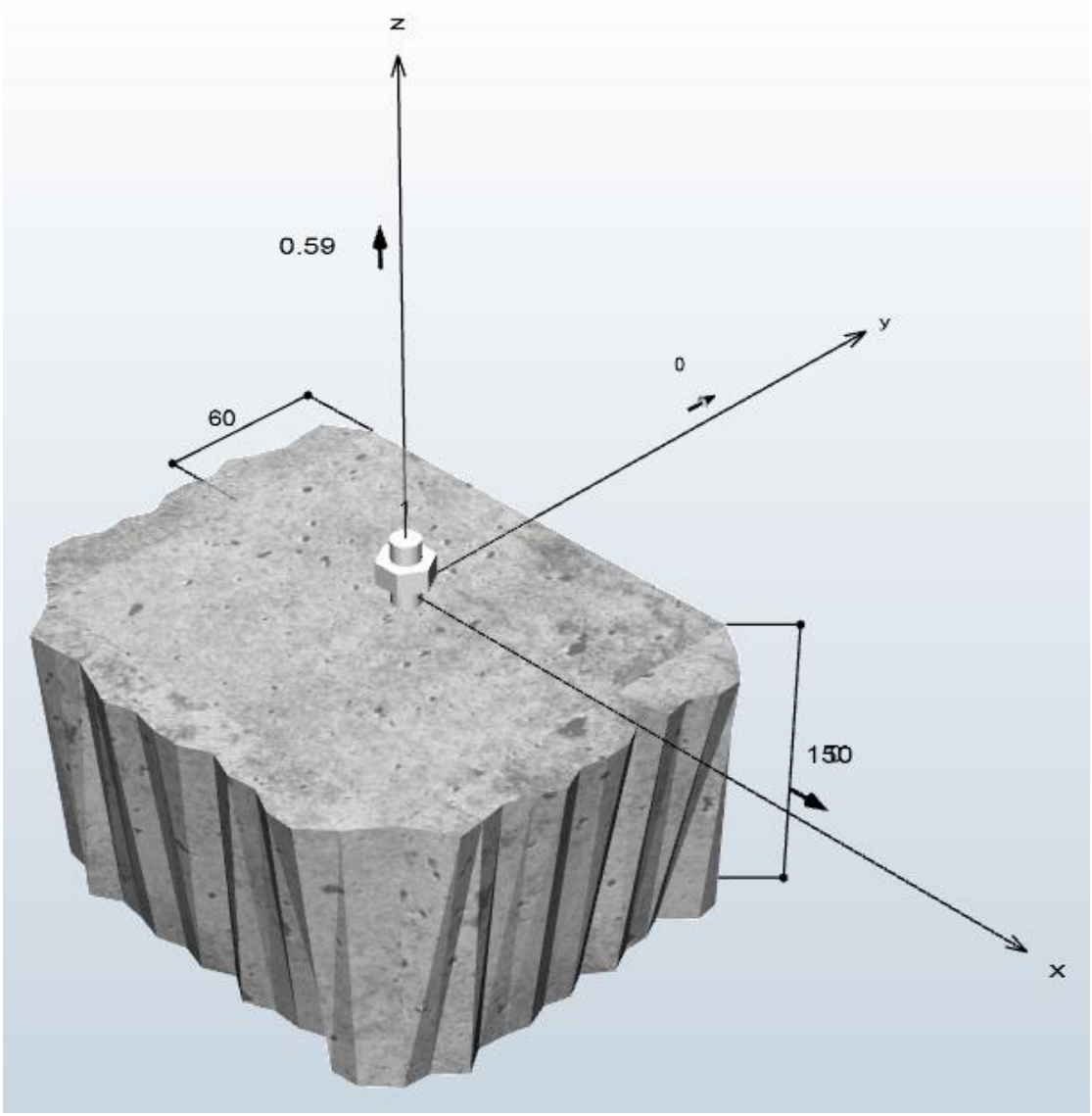


Case Study 04: 15mm Tough – 1.166x1.192m – 0.42kN:

Connection To Concrete:

Tensile Load $= 0.393\text{kN} \times 1.5 = 0.59\text{kN}$ (ULS)

Chemical anchor FIS V 360 S M10x150 8.8. See design in Appendix A.



Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 33
Date: 08/05/2020	**By:** R.F.

Connection To Mild Steel:

1Nr M10 Bolt Grade 8.8

$f_y = 210\ MPa$ *(Grade 304 Stainless Steel, Table 2.1 EN 1993-1-4:2006)*

$f_{ub} = 500\ MPa$ *(Grade 304 Stainless Steel, Table 2.2 EN 1993-1-4:2006)*

$\alpha = 0.6$ *(Table 3.4 EN 1993-1-8:2005)*

$A = 58mm^2$ *(For M10 Bolts)*

$K_2 = 0.9$ *(Table 3.4 EN 1993-1-8:2005)*

$\lambda_{m2} = 1.25$ *(Table 5.1 EN 1993-1-4:2006)*

Tensile Resistance Check: *(Table 3.4 EN 1993-1-8:2005)*

$F_{t,Ed}$: *is the design tensile force per bolt for the ultimate limit state.*

$F_{t,Rd}$: *is the design tension resistance per bolt.*

$\mathrm{F_{t,Ed}} = 0.393\mathrm{kN} \times 1.5 = 0.59\mathrm{kN}\ (\mathrm{ULS})$

$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} \rightarrow \mathrm{F_{t,Rd}} = \frac{0.9 \times 500 \times 58 \times 10^{-3}}{1.25} = 20.88\mathrm{kN} > 0.59\mathrm{kN}$ **Okay**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 34
Date: 08/05/2020	**By:** R.F.

Connection To Wood:

$f_y = 210\ MPa$ *(Grade 304 Stainless Steel, Table 2.1 EN 1993-1-4:2006)*

$f_{ub} = 500\ MPa$ *(Grade 304 Stainless Steel, Table 2.2 EN 1993-1-4:2006)*

$\alpha = 0.6$ *(Table 3.4 EN 1993-1-8:2005)*

$A = 58mm^2$ *(For M10 Bolts)*

$K_2 = 0.9$ *(Table 3.4 EN 1993-1-8:2005)*

$\lambda_{m2} = 1.25$ *(Table 5.1 EN 1993-1-4:2006)*

Tensile Resistance Check: *(Table 3.4 EN 1993-1-8:2005)*

$F_{t,Ed}$: *is the design tensile force per bolt for the ultimate limit state.*

$F_{t,Rd}$: *is the design tension resistance per bolt.*

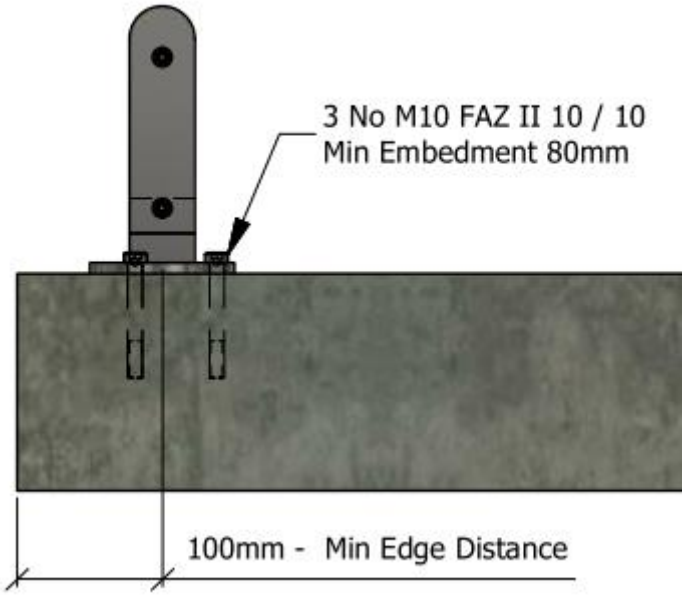
$\mathrm{F_{t,Ed}} = 0.393\mathrm{kN} \times 1.5 = 0.59\mathrm{kN}$ (ULS)

$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} \rightarrow \mathrm{F_{t,Rd}} = \frac{0.9 \times 500 \times 58 \times 10^{-3}}{1.25} = 20.88\mathrm{kN} > 0.59\mathrm{kN}$ **Okay**

Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 35
Date: 08/05/2020	**By:** R.F.

Case Study 05: 15mm Tough – 1.20x1.11m – 1.5kN/m^2:

Connection To Concrete:



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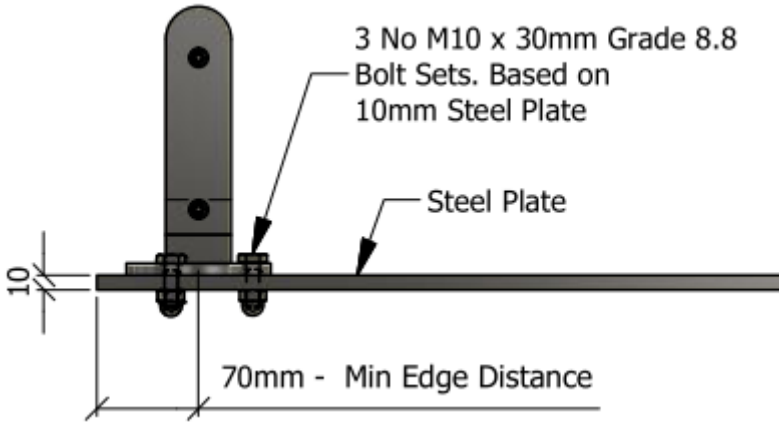
Project: Glass Adaptor and Spigot	**Contract:** 1388-3
Subject: General Wind Load	**Sheet No.** 36
Date: 08/05/2020	**By:** R.F.

Connection To Mild Steel:



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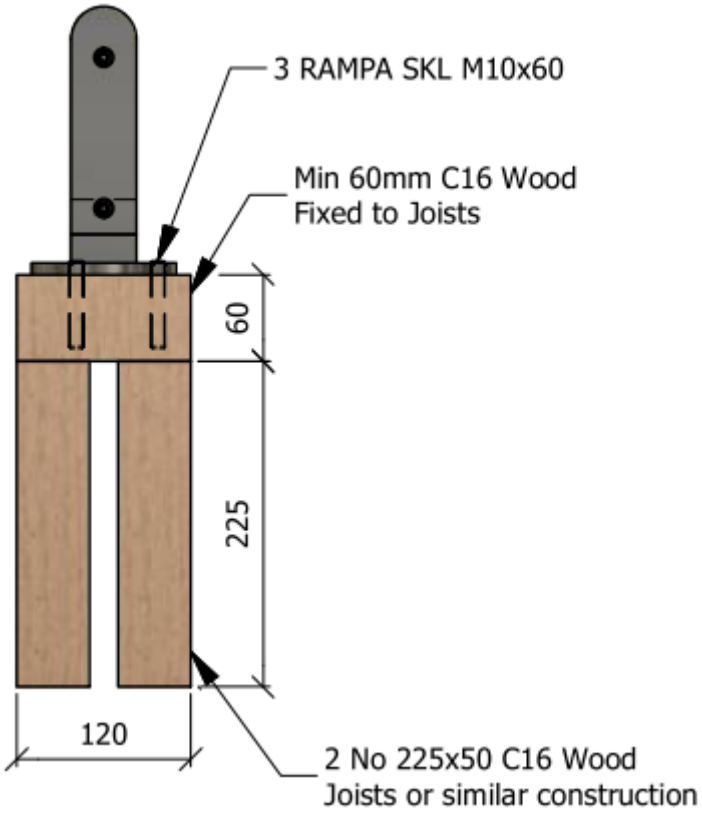
Project: Glass Adaptor and Spigot	Contract: 1388-3
Subject: General Wind Load	Sheet No. 37
Date: 08/05/2020	By: R.F.

Connection To Wood:



Appendix A - Fiscer Reports

TSA is Both the Designer and the Specifier of the Fixings.

Appendix B – Rampa

TSA is Specifier of the Fixings