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|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 1 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

Concorde Glass Ltd.,
 Linx House,
 104 Waterloo Rd,
 Mablethorpe,
 LN12 1LE,
 UK.

Glassloc Side Mount Channel
 21.52mm EVA Glass Test Data - 0.74kN/m

| | |
|-----------------|------------|
| Analysis By | Checked By |
| A.N & R.F. & CC | C.K |

| | | | |
|-----------------|-------------|------------------|----------------|
| 0 | 15/04/2024 | T.S. | Issued |
| Revision | Date | Issued By | Comment |



| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 2 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

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| Date: 15/04/2024 | By: A.N & R.F. & CC |

Introduction/Actions/Assumptions/Result Summary:

Introduction:

TSA was instructed by Concorde Glass Ltd to provide the below Calculations:

- 1/. Provide a glass analysis for 21.52mm toughened laminated glass without handrail for the side-mounted U Channel system.
- 2/. Provide fixing details to steel/ concrete and timber.

Actions:

Balustrade load = 0.74kN (Table NA.6 IS1991-1-1:2002)
 Point load = 0.5kN (Table NA.5 IS1991-1-1:2002)
 Typical High Wind load = 2.5kN/m²

Assumption:

Concrete Grade = C30/37

Bolts are grade 8.8 Mild Steel.

Timber Grade = C16 (minimum)

Aluminium Shoe grade 6063-T6 – Minimum strength is 195Mpa.

Result Summary:

A. Side Fix Mount U – Channel:

- 1- **Connection to Concrete:** Use 1No. Ultracut FBS II 10×65 Zinc Plated Steel Fischer Countersunk Concrete screws @200mm C/C with Minimum Embedment depth is 43mm and Minimum edge distance is 70mm.
- 2- **Connection to Steel:** Use M10 Grade 8.8 Countersunk bolts @200mm C/C.
- 3- **Connection to Timber:** Use M10 Grade 8.8 Countersunk bolts @200mm C/C.
- 4- **Shoe:** 136×66mm Aluminium Shoe.
- 5- **Glass Panel 1 - with No handrail:** 21.52mm Toughened Laminated Glass Panel with EVA Interlayers.

| Analysis for 21.52mm Glass with EVA Interlayer – without Handrail | mm |
|---|--------------|
| Deflection of Glass due to Wind Loading | 4.857 |
| Deflection of Glass due to Balustrade Loading | 4.441 |
| Deflection of Glass due to Point Loading | 0.9252 |
| Deflection of Shoe due to Shoe Loading | 11.36 |

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| | |
|--------------------------------------|--------------|
| Combined deflection of system | 16.22 |
|--------------------------------------|--------------|

Combined Deflection 16.22mm < 25mm {BS6180:2011 cl. 6.4.1}

Glass Strength

Balustrade Loading:

< 5mins duration => $k_{mod} = 0.77$

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

$$f_{gd} = (0.77)(1.0)(45)/1.6 + 1.0(120-45)/1.2$$

$$f_{gd} = 84.2\text{N/mm}^2$$

Wind Loading:

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

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

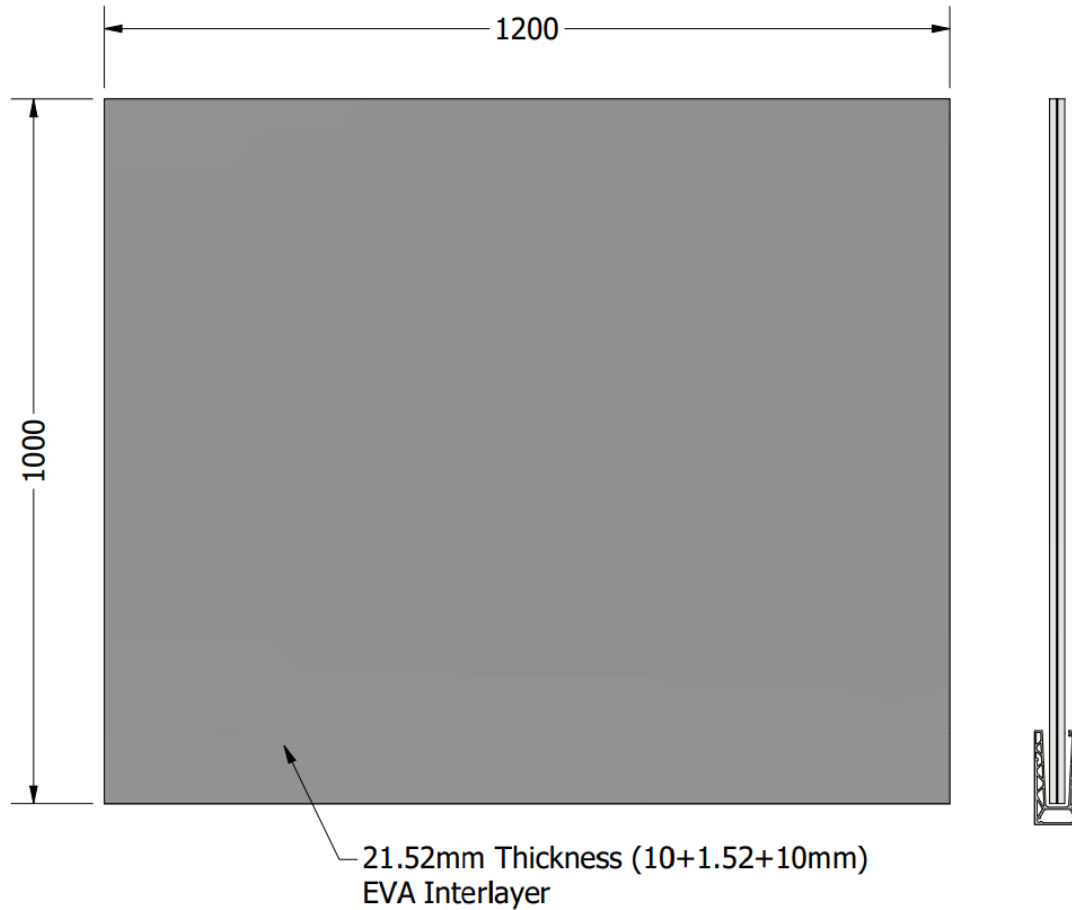
$$f_{gd} = (0.74)(1.0)(45)/1.6 + 1.0(120-45)/1.2$$

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

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Side Mount Shoe – Side Fix Connections:

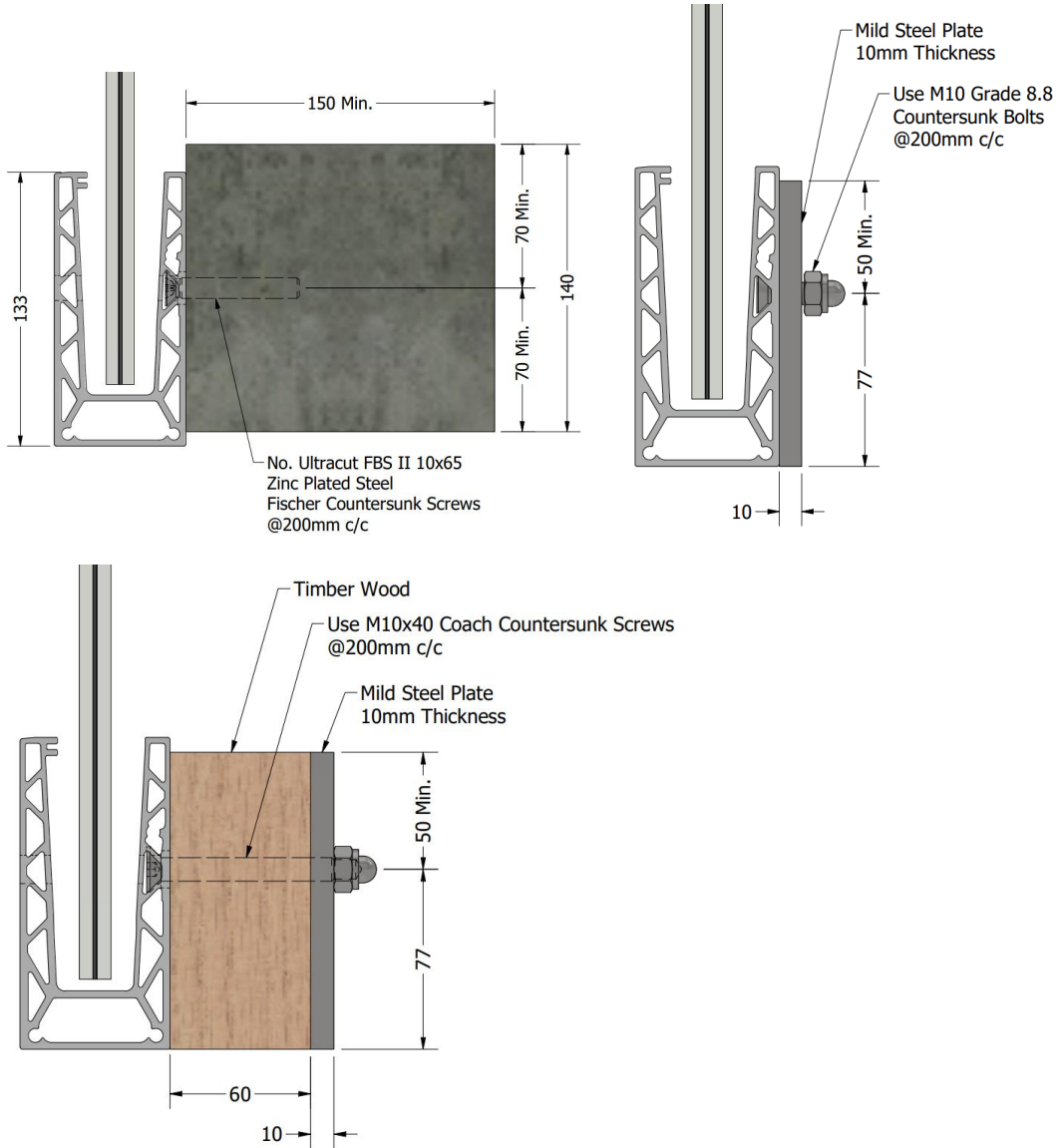
Sketch of System:



Note:

- 1- toughened glass is not permitted to bear horizontal balustrade loading on its own.
As a result, a handrail must be designed specifically to support the horizontal balustrade load.

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2- The above sketches are for illustration purposes only.

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Connection to Concrete Design - Side Fixed:

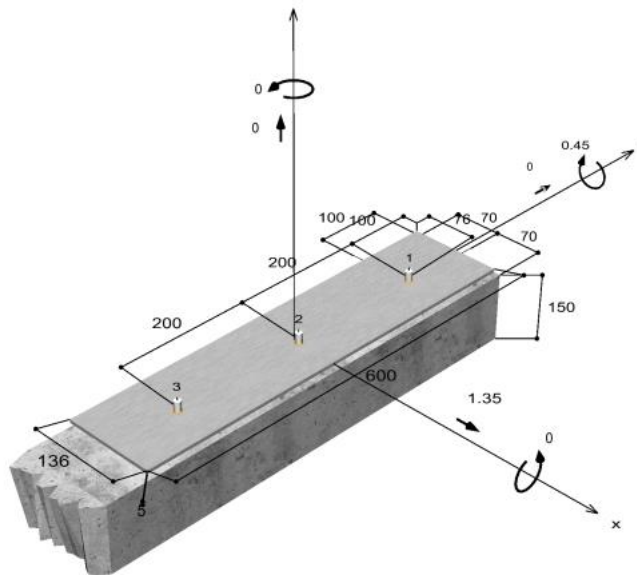
Moment due to Balustrade Load = $0.74\text{kN/m} \times 1.5 \times 0.6\text{m} \times 0.6\text{m} = 0.4\text{kNm}$ (ULS)

Moment due to Wind Load = $2.5\text{kN/m}^2 \times 1.5 \times 0.6\text{m} \times 0.6\text{m} \times 0.33\text{m} = 0.45\text{kNm}$ (ULS) – **Worst Case.**

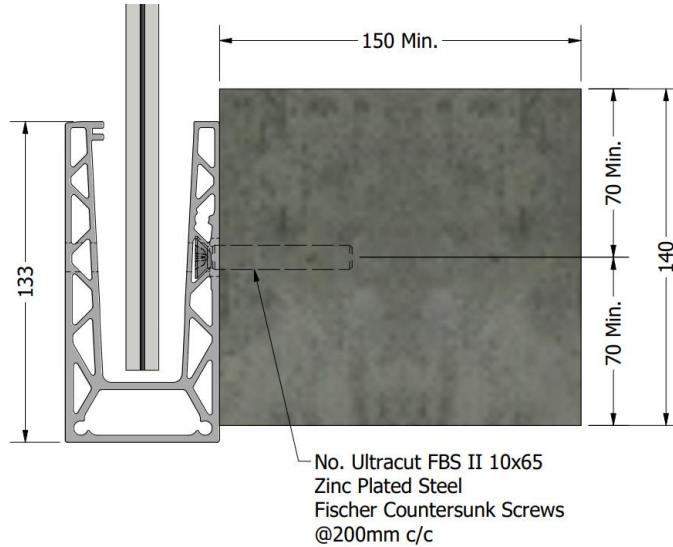
Shear Load due to Balustrade load = $0.74\text{kN/m} \times 1.5 \times 0.6\text{m} = 0.666\text{kN}$ (ULS)

Shear Load due to Wind load = $2.5\text{kN/m}^2 \times 1.5 \times 0.6\text{m} \times 0.6\text{m} = 1.35\text{kN}$ (ULS) – **Worst Case.**

Therefore, use 1No. Ultracut FBS II 10×65 Zinc Plated Steel Fischer Countersunk Concrete screws@200mm C/C with Minimum Embedment depth is 43mm and Minimum edge distance is 70mm as per the screenshot below.



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Connection To Mild Steel Baseplate - Side Fixed:

M10 Grade 8.8 Countersunk Bolt:

$$f_{ub} = 800 \text{ MPa} \quad (\text{Grade 8.8 Mild Steel, Table 3.1 EN 1993-1-8:2005})$$

$$\alpha = 0.6 \quad (\text{Table 3.4 EN 1993-1-8:2005})$$

$$A = 58.00 \text{ mm}^2 \quad (\text{For M10 Bolts})$$

$$K_2 = 0.63 \quad (\text{Table 3.4 EN 1993-1-8:2005})$$

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

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.

$$F_{t,Ed} = 2.7 \text{ kN}$$

$$F_{t,Rd} = \frac{K_2 F_{ub} A}{\lambda_{m2}} = \frac{0.63 \times 800 \times 58}{1.25} \times 10^{-3} = 23.38 \text{ kN} \rightarrow F_{t,Rd} = 23.38 \text{ kN} > 2.7 \text{ kN} \quad \text{Okay}$$

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

$F_{v,Ed}$: is the design shear force per bolt for the ultimate limit state.

$F_{v,Rd}$: is the design shear resistance per bolt.

$$F_{v,Ed} = 0.45 \text{ kN}$$

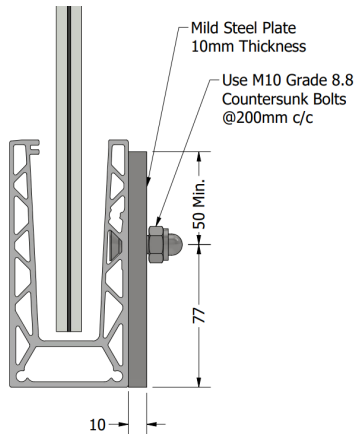
$$F_{v,Rd} = \frac{\alpha F_{ub} A}{\lambda_{m2}} = \frac{0.6 \times 800 \times 58}{1.25} \times 10^{-3} = 22.27 \text{ kN} \rightarrow F_{v,Rd} = 22.27 \text{ kN} > 0.45 \text{ kN} \quad \text{Okay}$$

Combined Shear & Tensile Resistance Check: (Table 3.4 EN 1993-1-8:2005)

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$$\frac{F_{v,Ed}}{F_{v,Rd}} + \frac{F_{t,Ed}}{1.4F_{t,Rd}} \leq 1 \rightarrow \frac{0.45}{22.27} + \frac{2.7}{1.4 \times 23.38} = 0.103 \leq 1 \quad \text{Okay}$$

Therefore, Use M10 Grade 8.8 Countersunk Bolts @200mm C/C.



Connection To Wood - Side Fixed:

Tensile Resistance Check:

Tensile Force per screw = 2.7kN

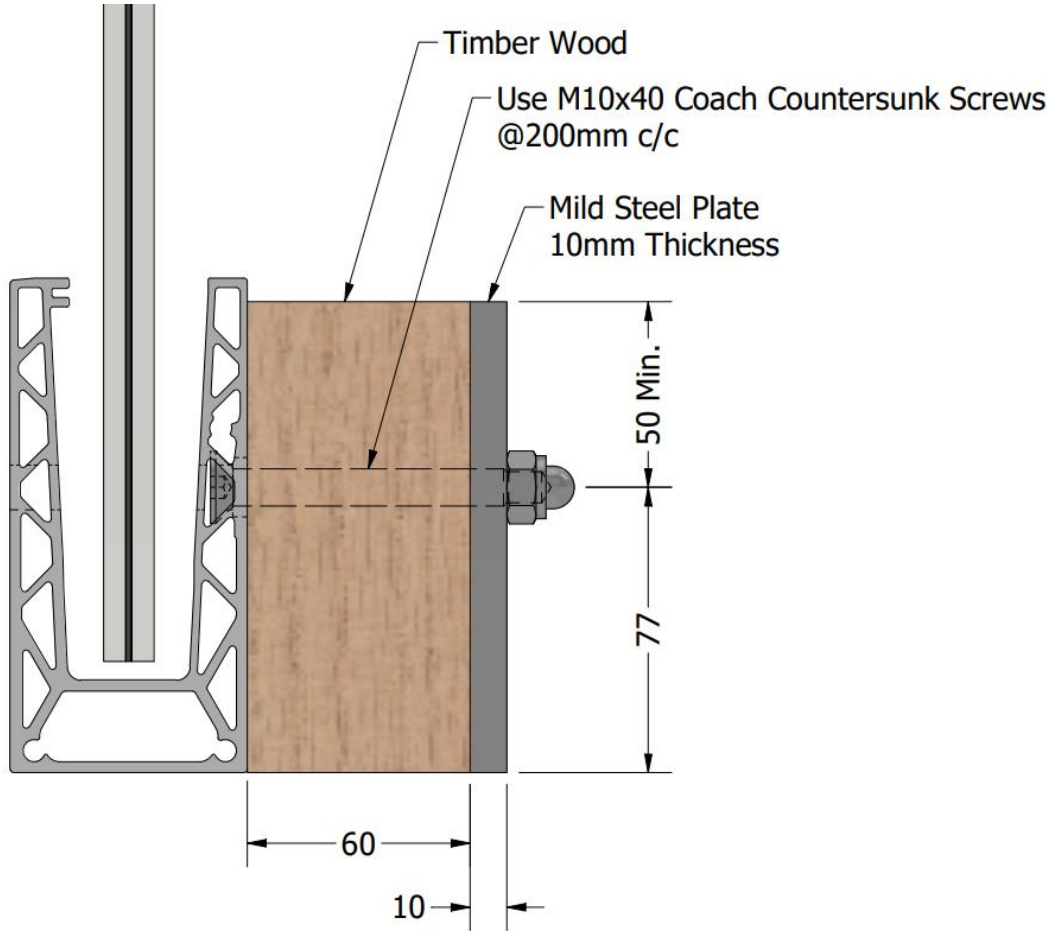
Tension Capacity of 10 × 40mm Coach Screws = 26.45kN as per specification sheet in appendix A.

Therefore, 26.45kN > 2.7kN **Okay**

Minimum edge distance required is 5d = 5 × 10 = 50mm.

Therefore, use M10 countersunk bolts. @200mm C/C.

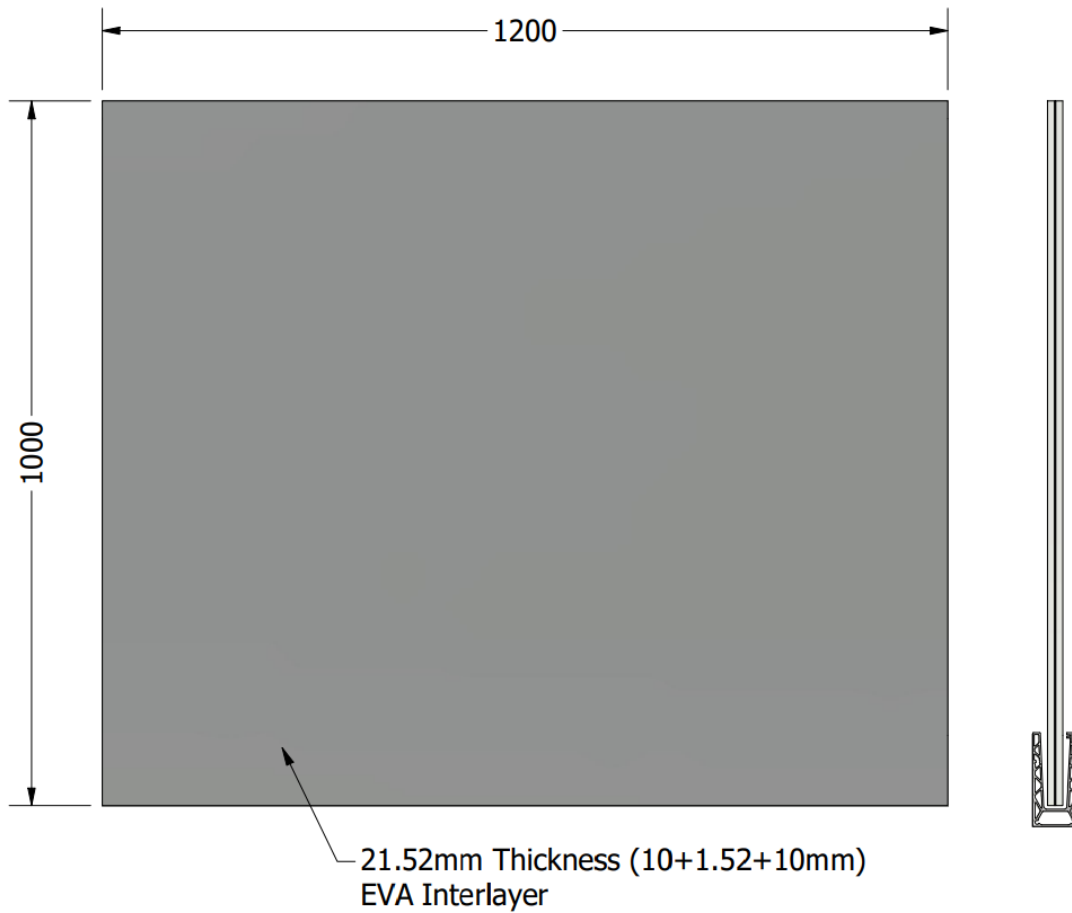
| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 10 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |





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| Date: 15/04/2024 | By: A.N & R.F. & CC |

System Sketch – 21.52mm Thickness EVA Interlayer:



| | |
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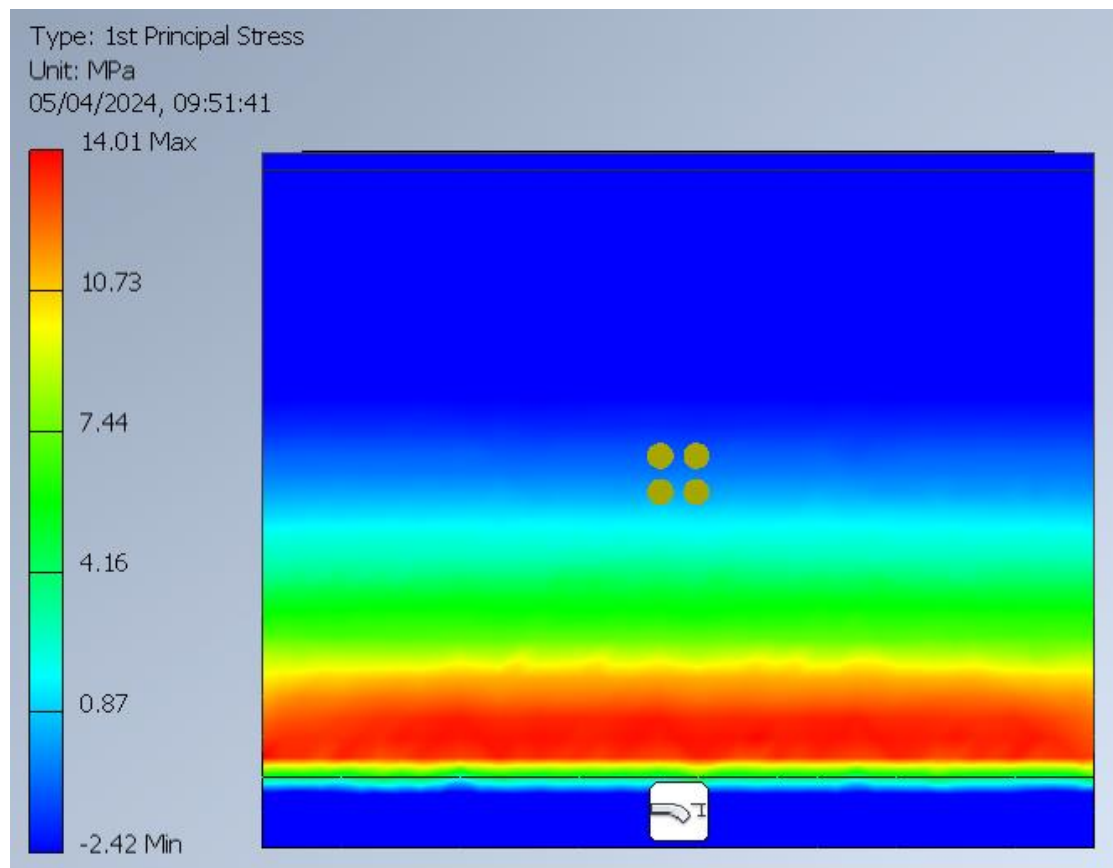
Glass Analysis - Bending Stress of Glass Panel due to 2.5kN/m² Wind Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 2.5N/m² Wind Loading
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Bending Stress = 14.01N/mm² X 1.5 = 21.02N/mm² < 83.3N/mm²

OK in Bending



| | |
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| Project: Concorde Glass Ltd | Contract: 1983-1 |
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| Date: 15/04/2024 | By: A.N & R.F. & CC |

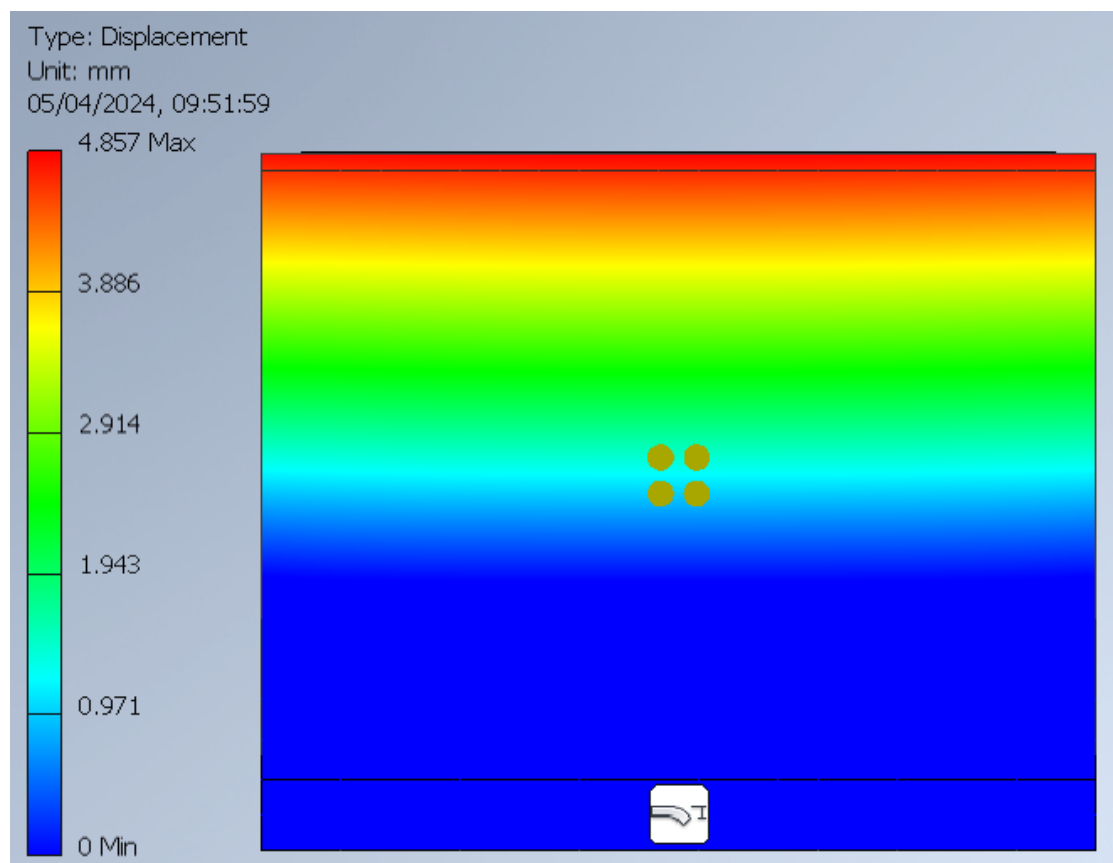
Glass Analysis - Deflection of Glass Panel due to 2.5kN/m² Wind Loading:

- Analysis Software was used to determine maximum deflection of the glass due to 2.5N/m² Wind Loading
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Deflection = 4.857mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



| | |
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| Date: 15/04/2024 | By: A.N & R.F. & CC |

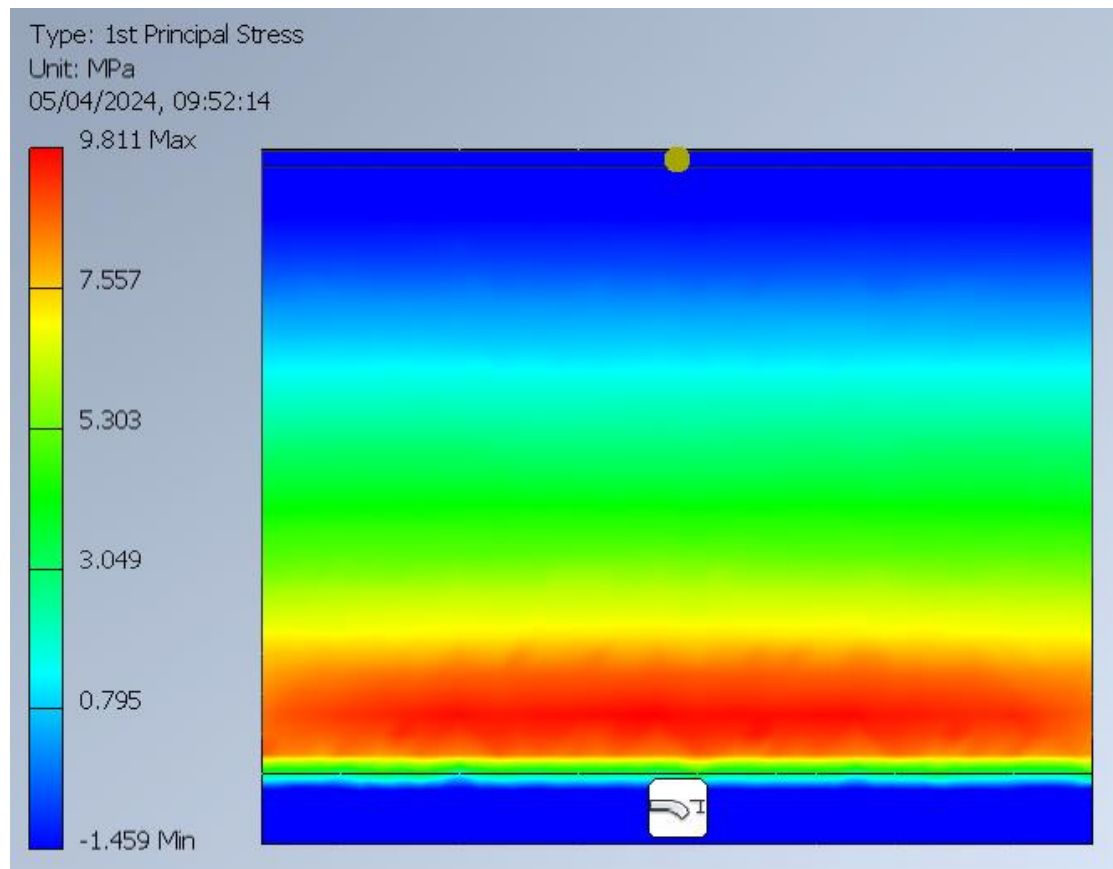
Glass Analysis - Bending Stress of Glass Panel due to 0.74kN/m Balustrade Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 0.74kN/m Balustrade Loading
- Actual Balustrade Load applied to the glass is 0.89kN (0.74kN/m x 1.2m)
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Bending Stress = $9.811\text{N/mm}^2 \times 1.5 = 14.72\text{N/mm}^2 < 84.2\text{N/mm}^2$

OK in Bending



| | |
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| Project: Concorde Glass Ltd | Contract: 1983-1 |
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| Date: 15/04/2024 | By: A.N & R.F. & CC |

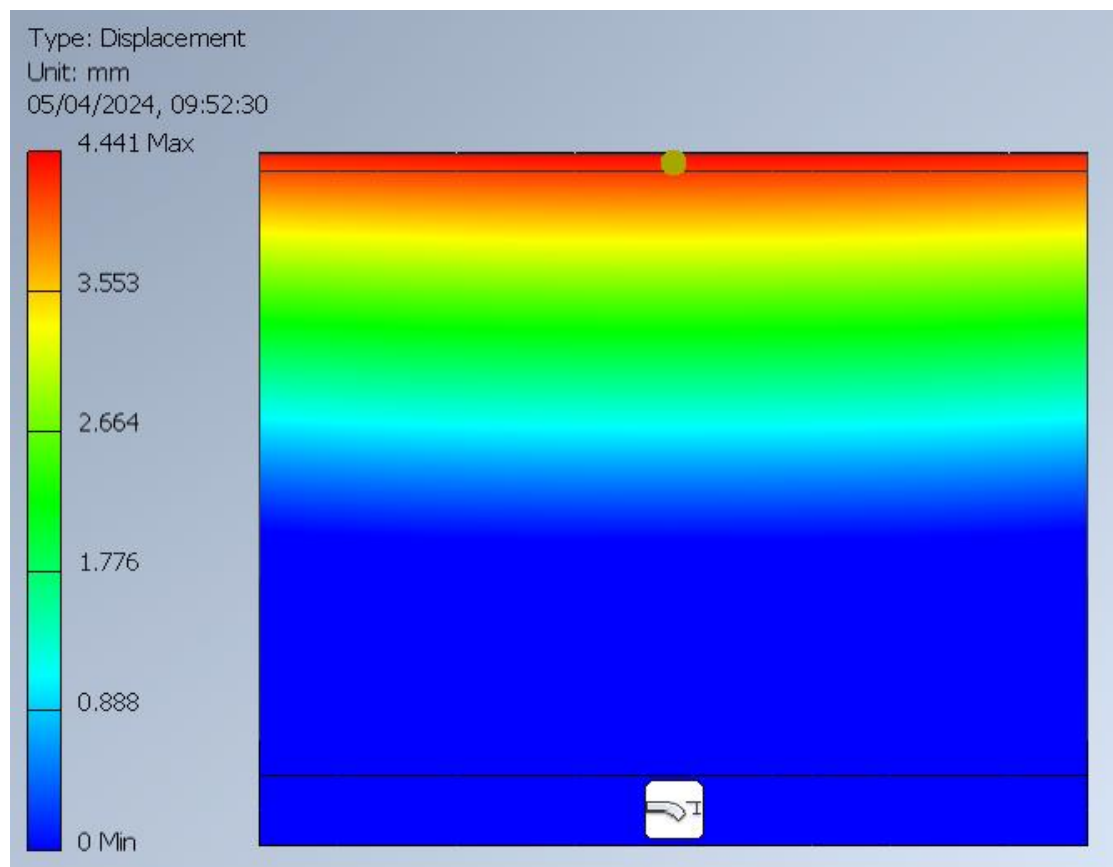
Glass Analysis - Deflection of Glass Panel due to 0.74kN/m Balustrade Loading:

- Analysis Software was used to determine maximum deflection of the glass due to 0.74kN/m Balustrade Loading
- Actual Balustrade Load applied to the glass is 0.89kN (0.74kN/m x 1.2m)
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Deflection = 4.441mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



| | |
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| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 16 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

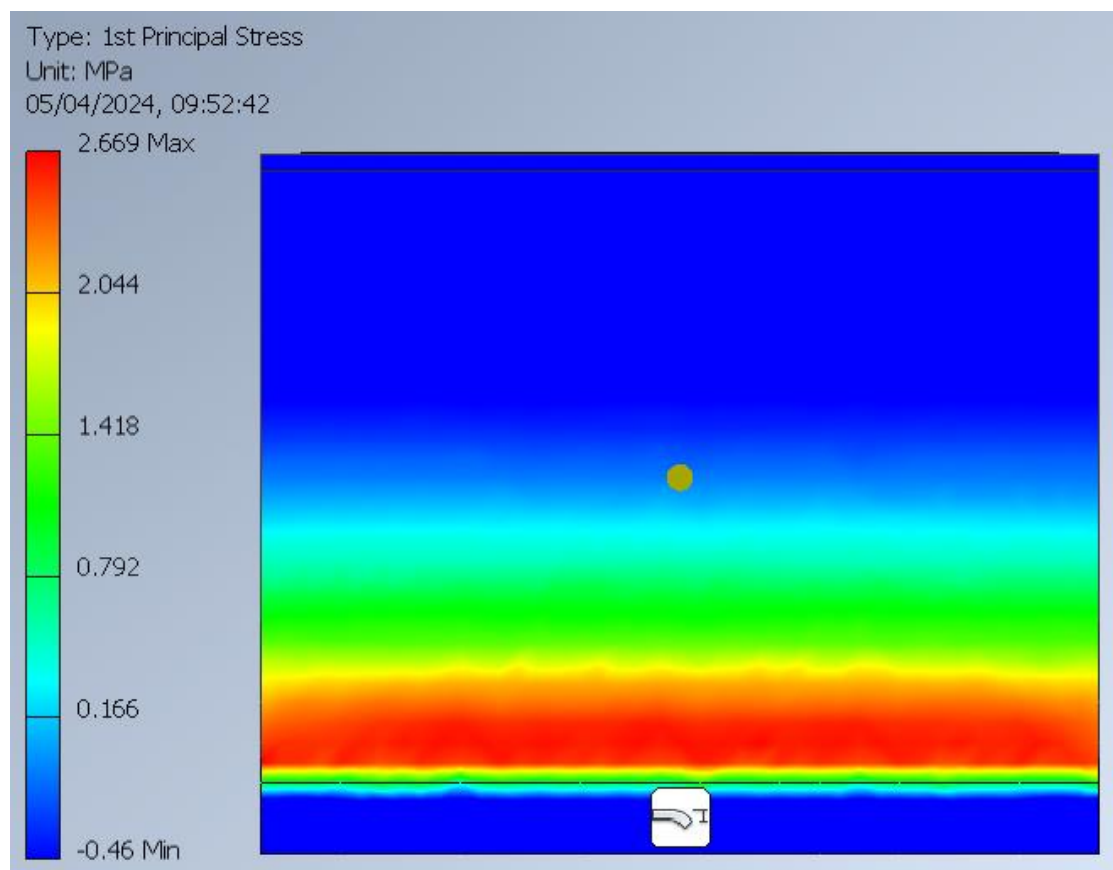
Glass Analysis - Bending Stress of Glass Panel due to 0.5kN Point Load:

- Analysis Software was used to determine maximum bending stress of the glass due to 0.5kN Point Load
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Bending Stress = $2.669\text{N/mm}^2 \times 1.5 = 4.01\text{N/mm}^2 < 84.2\text{N/mm}^2$

OK in Bending



| | |
|---|-------------------------------|
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| Date: 15/04/2024 | By: A.N & R.F. & CC |

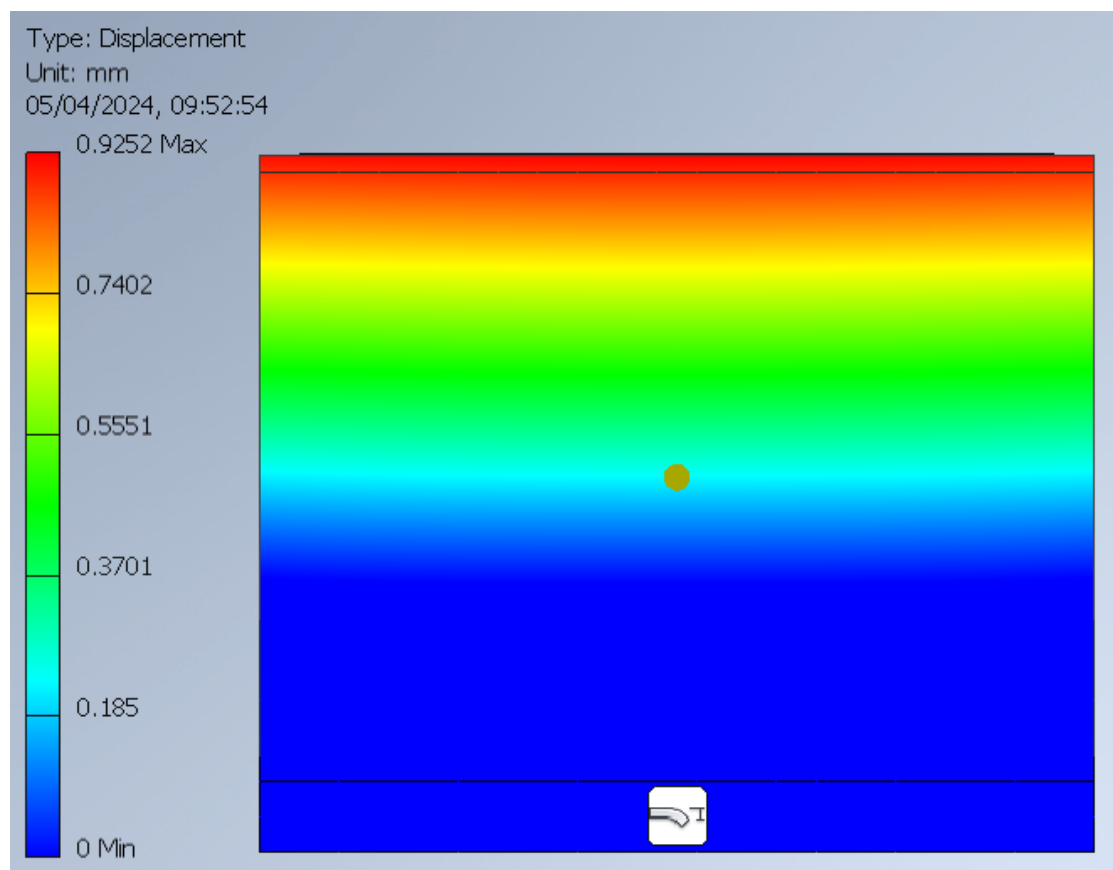
Glass Analysis - Deflection of Glass Panel due to 0.5kN Point Load:

- Analysis Software was used to determine maximum deflection of the glass due to 0.5kN Point Load
- 10/10/1.52mm T/L/T Glass analysed, horizontally toughened Laminated
- Interlayer Properties used for analysis, E= 18MPa, G = 6.82MPa EVA
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

Result:

Max. Deflection = 0.9252mm < 25mm {BS6180:2011 cl. 6.4.1}

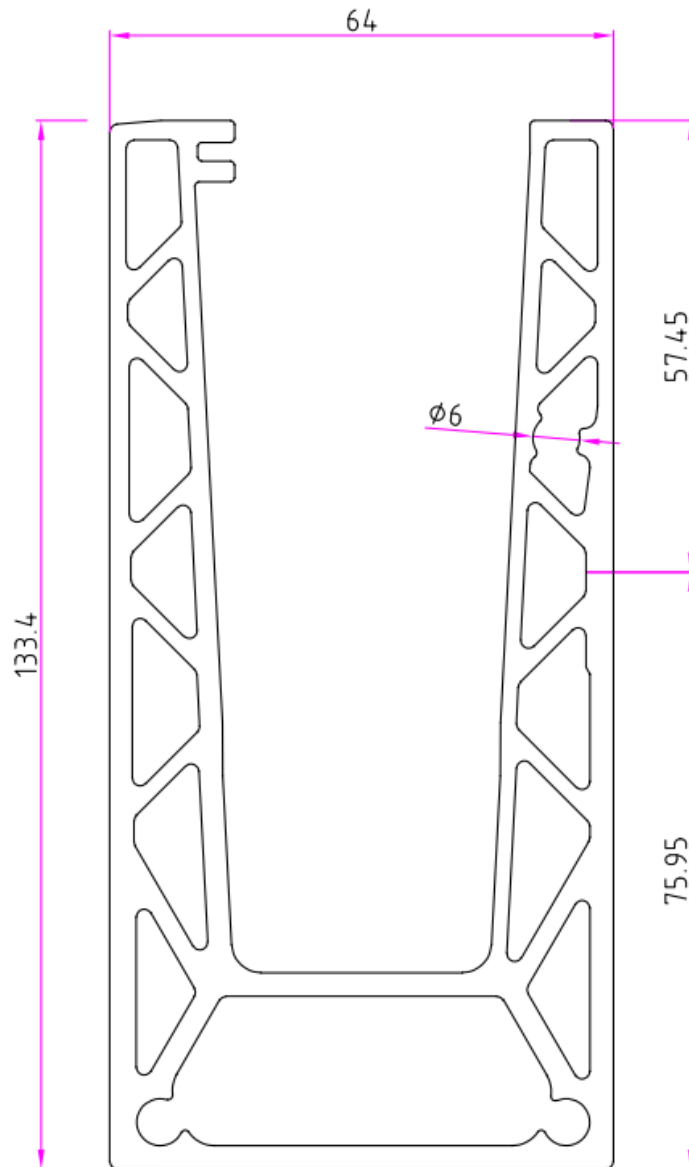
OK in Deflection (Glass Only)





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Shoe Analysis:
System Sketch:



| | |
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| Project: Concorde Glass Ltd | Contract: 1983-1 |
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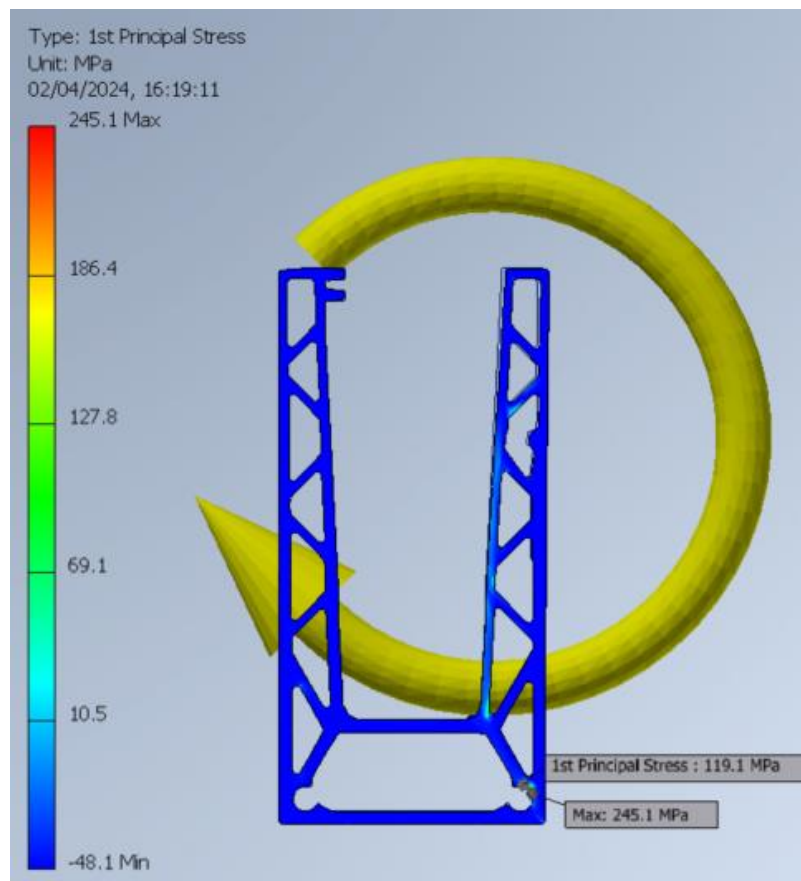
Bending Stress of Shoe:

- Analysis Software was used to determine maximum bending stress of the shoe due to maximum Moment.
- $Moment_{Wind} = 2.5\text{kN/m}^2 \times 1.2\text{m} \times 1.0\text{m} \times \frac{1.0\text{m}}{2} = 1.5\text{kN m(SLS)}$ **Worst Case**
- $Moment_{Balustrade} = 0.74\text{kN/m} \times 1.2\text{m} \times 1.0\text{m} = 0.89\text{kN m(SLS)}$

Result:

Max. Bending Stress = $119.1\text{N/mm}^2 \times 1.5 = 178.65\text{N/mm}^2 < 195\text{N/mm}^2$

Okay in Bending

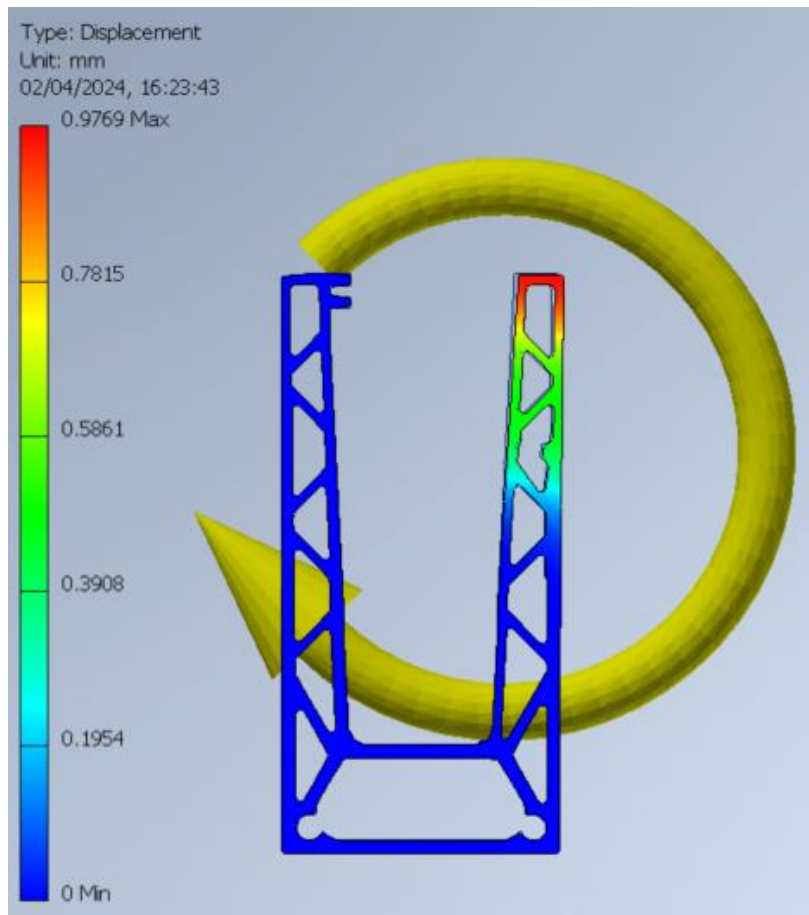


NOTE:

In this case the 245.1 MPa is a localised stress. The most appropriate stress to be considered is 119.1 MPa.

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| Project: Concorde Glass Ltd | Contract: 1983-1 |
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Deflection of Shoe:



NOTE:

- Deflection 0.9769mm at the top of shoe
- Max. Deflection at the top of the glass = $(0.9769 \times 1000)/86 = 11.36\text{mm}$



| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 21 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

Appendix A – Timco Timber Screws Specification Sheet

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

| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 22 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

TIMco Coach Screws DIN571



DECLARATION OF PERFORMANCE

DOP7 v2

We here by declare the following designated products
TIMco Coach Screws DIN571
Diameter 6.0mm, 8.0mm, 10.0mm, 12.0mm

Have been tested by the following independant testing organisation:

- Notified Body 1015

Strojirensky Zkusebni Ustav, s.p., Czech Republic

And that they have performed initial type testing under system 3, Annex V of the regulation (EU) no. 305/2011 (Construction Products Regulation), with the reference to the harmonised European standard (hEN) BS EN 14592:2008+A1:2012 (Timber structures - Dowel type fasteners - Requirements) for nails intended for the use in "load bearing timber structures" and produced the calculation/test reports and certificates as listed below;

Certificate Number: E-30-20414-13, E-30-20405-13, E-30-20406-13, E-30-20407-13.

Test Report Number: No. 30-9915/1 to No. 30-9915/4.

Factory Process Control (FPC) has been established by the factory and independently audited by TUV Rheinland UK in accordance with ISO9001:2008.

This declaration of conformity is valid until there is a significant change in the product and declared characteristics. ie. raw material or change in production process.

Signed by:



Name: *Simon Midwood*

Position: *Managing Director*

Date & Location: *29. 07. 2013*
TIMco House, CW5 6BJ

This declaration is the responsibility of the importer
T.I Midwood & Co. Ltd. Green Lane, Wardle, Nantwich, Cheshire, CW5 6BJ





TSA
TED SINGLETON & ASSOCIATES
CONSULTING ENGINEERS

| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 23 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

Declaration Of Performance

TIMco Coach Screw DIN571 - Zinc

| Size | Nominal diameter d (mm) | Inner thread diameter d1 | Total Length L (mm) | Thread Length lg (mm) | Head diameter dh (mm) | Test Report No. | Certificate No. | Characteristic yield moment $M_{y,k}$ (Nmm) | | Characteristic withdrawal parameter $f_{ax,k}$ (N/mm ²) | | Characteristic head pull-through parameter $f_{head,k}$ (N/mm ²) | Characteristic tensile capacity $f_{tens,k}$ (kN) | Characteristic torsional ratio |
|----------|-------------------------|--------------------------|---------------------|-----------------------|-----------------------|-----------------|-----------------|---|----------------|---|-------------------------|--|---|--------------------------------|
| | | | | | | | | Thread Section | Smooth Section | Loading across the fibre | Loading along the fiber | | | |
| 6 x 25 | 6.0 | 4.2 | 25 | 15 | 10.0 | No. 30-9915/1 | E-30-20414-13 | 11 166 | 18 366 | 16,64 | 10,45 | 24,27 | 9.9 | 1,87* |
| 6 x 30 | | | 30 | 18 | | | | | | | | | | |
| 6 x 40 | | | 40 | 24 | | | | | | | | | | |
| 6 x 50 | | | 50 | 30 | | | | | | | | | | |
| 6 x 60 | | | 60 | 36 | | | | | | | | | | |
| 6 x 65 | | | 65 | 39 | | | | | | | | | | |
| 6 x 70 | | | 70 | 42 | | | | | | | | | | |
| 6 x 75 | | | 75 | 45 | | | | | | | | | | |
| 6 x 80 | | | 80 | 48 | | | | | | | | | | |
| 6 x 100 | | | 100 | 60 | | | | | | | | | | |
| 8 x 30 | 8.0 | 5.6 | 30 | 18 | 13.0 | No. 30-9915/2 | E-30-20405-13 | 22 852 | 41 589 | 13,91 | 8,52 | 22,20 | 16,21 | 1,50* |
| 8 x 40 | | | 40 | 24 | | | | | | | | | | |
| 8 x 50 | | | 50 | 30 | | | | | | | | | | |
| 8 x 60 | | | 60 | 36 | | | | | | | | | | |
| 8 x 65 | | | 65 | 39 | | | | | | | | | | |
| 8 x 70 | | | 70 | 42 | | | | | | | | | | |
| 8 x 75 | | | 75 | 45 | | | | | | | | | | |
| 8 x 80 | | | 80 | 48 | | | | | | | | | | |
| 8 x 90 | | | 90 | 54 | | | | | | | | | | |
| 8 x 100 | | | 100 | 60 | | | | | | | | | | |
| 8 x 150 | 150 | 90 | | | | | | | | | | | | |
| 10 x 40 | 10.0 | 7.0 | 40 | 24 | 17.0 | No. 30-9915/3 | E-30-20406-13 | 42 887 | 89 040 | 12,47 | 10,04 | 22,13 | 26,45 | 2,18* |
| 10 x 50 | | | 50 | 30 | | | | | | | | | | |
| 10 x 60 | | | 60 | 36 | | | | | | | | | | |
| 10 x 70 | | | 70 | 42 | | | | | | | | | | |
| 10 x 75 | | | 75 | 45 | | | | | | | | | | |
| 10 x 80 | | | 80 | 48 | | | | | | | | | | |
| 10 x 100 | | | 100 | 60 | | | | | | | | | | |
| 10 x 120 | | | 120 | 72 | | | | | | | | | | |
| 10 x 130 | | | 130 | 78 | | | | | | | | | | |
| 10 x 150 | | | 150 | 90 | | | | | | | | | | |
| 10 x 200 | 200 | 120 | | | | | | | | | | | | |
| 12 x 50 | 12.0 | 9.0 | 50 | 30 | 19.0 | No. 30-9915/4 | E-30-20407-13 | 82 789 | 147 141 | 12,24 | 9,81 | 21,12 | 40,37 | 2,11* |
| 12 x 75 | | | 75 | 45 | | | | | | | | | | |
| 12 x 80 | | | 80 | 48 | | | | | | | | | | |
| 12 x 100 | | | 100 | 60 | | | | | | | | | | |
| 12 x 150 | | | 150 | 90 | | | | | | | | | | |



| | |
|---|-------------------------------|
| Project: Concorde Glass Ltd | Contract: 1983-1 |
| Subject: Glassloc Side Mount Channel 21.52mm EVA Glass | Sheet No. 24 |
| Date: 15/04/2024 | By: A.N & R.F. & CC |

Appendix B – Fischer Reports

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

| | | |
|---|---|--|
| <p>Design Office TSA Consulting Engineers Ted Singleton 4 BLACKWATER HOUSE MALLOW BUSINESS PARK GOULDS HILL MALLOW CO. CORK P51 KC8C Phone: 0868168300 ted@tsaconsulteng.ie tsaconsulteng.ie</p> | <p>Client Concorde Glass Ltd., Linx House, 104 Waterloo Rd, Mablethorpe, LN12 1LE, UK.</p> | <p>MASONRY FIXINGS Unit 83, Cherry Orchard Industrial Estate Dublin 10 Phone: +353 1 642 6700 Fax: +353 1 626 2197 technical@masonryfixings.ie www.masonryfixings.ie</p> |
|---|---|--|

Comment

1983-1_Side Mount_Connection to Concrete_0

Design Specifications

Anchor

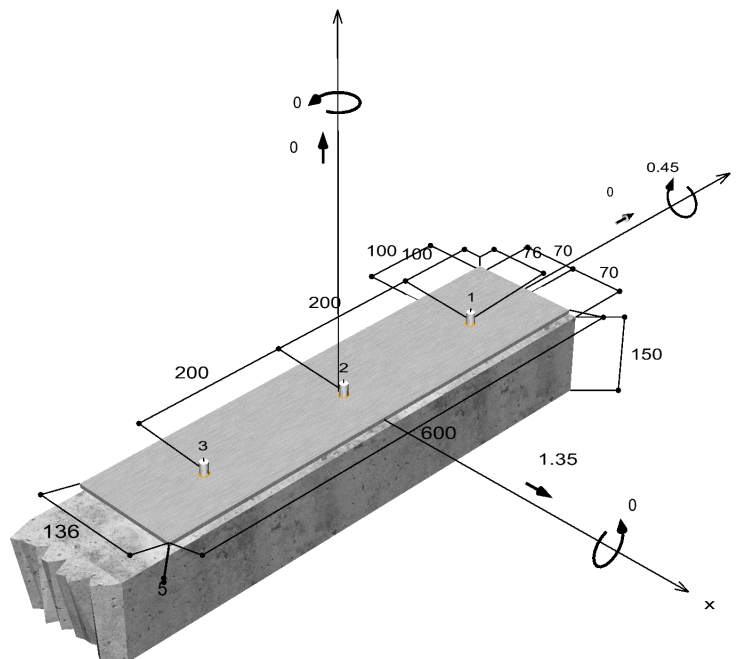
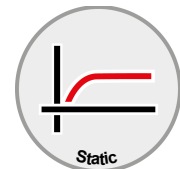
| | |
|----------------------------|--|
| Anchor system | fischer Concrete screw ULTRACUT FBS II |
| Anchor | Concrete screw with countersunk head FBS II 10x65 10/- SK, zinc plated steel |
| Calculated anchorage depth | 43 mm |
| Design Data | Determined by manufacturer |



Geometry / Loads / Scale units

mm, kN, kNm

Value of design actions (including partial safety factor for the load)



Not drawn to scale

The input values and the design results should be checked against local valid standards and approvals. Please respect the disclaimer of warranty in the license agreement of the Software.

Input data

| | |
|---------------------|---|
| Design method | TR055/Design method ENSO Mechanical |
| Base material | C30/37, EN 206 |
| Concrete condition | Cracked, dry hole |
| Reinforcement | No or standard reinforcement. No edge reinforcement. With reinforcement against splitting |
| Drilling method | Hammer drilling |
| Installation type | Push-through installation |
| Annular gap | Annular gap filled |
| Type of loading | Permanent-Transient/Static |
| Base plate location | Base plate flush installed on base material |
| Base plate geometry | 136 mm x 600 mm x 5 mm |
| Profile type | None |

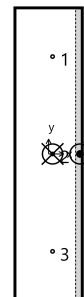
Design actions *)

| # | N _{Sd} kN | V _{Sd,x} kN | V _{Sd,y} kN | M _{Sd,x} kNm | M _{Sd,y} kNm | M _{T,Sd} kNm | Type of loading |
|---|-----------------------|-------------------------|-------------------------|--------------------------|--------------------------|--------------------------|----------------------------|
| 1 | 0.00 | 1.35 | 0.00 | 0.00 | 0.45 | 0.00 | Permanent-Transient/Static |

*) The required partial safety factors for actions are included

Resulting anchor forces

| Anchor no. | Tensile action kN | Shear Action kN | Shear Action x kN | Shear Action y kN |
|------------|----------------------|--------------------|----------------------|----------------------|
| 1 | 2.70 | 0.45 | 0.45 | 0.00 |
| 2 | 2.70 | 0.45 | 0.45 | 0.00 |
| 3 | 2.70 | 0.45 | 0.45 | 0.00 |



| | |
|------------------------------------|-----------------------------------|
| max. concrete compressive strain : | 0.06 ‰ |
| max. concrete compressive stress : | 2.0 N/mm ² |
| Resulting tensile actions : | 8.11 kN , X/Y position (8 / 0) |
| Resulting compression actions : | 8.11 kN , X/Y position (64 / 0) |

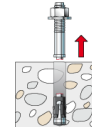
Resistance to tension loads

| Proof | Action kN | Capacity kN | Utilisation β _N % |
|-----------------------|--------------|----------------|---------------------------------|
| Steel failure * | 2.70 | 39.29 | 6.9 |
| Pullout failure * | 2.70 | 7.32 | 36.9 |
| Concrete cone failure | 2.70 | 8.23 | 32.8 |

* Most unfavourable anchor

Steel failure

$$N_{Sd} \leq \frac{N_{Rk,s}}{\gamma_{Ms}} \quad (N_{Rd,s})$$

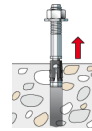


| $N_{Rk,s}$ kN | γ_{Ms} | $N_{Rd,s}$ kN | N_{Sd} kN | $\beta_{N,s}$ % |
|------------------|---------------|------------------|----------------|--------------------|
| 55.00 | 1.40 | 39.29 | 2.70 | 6.9 |

| Anchor no. | $\beta_{N,s}$ % | Group N° | Decisive Beta |
|------------|--------------------|----------|-----------------|
| 1 | 6.9 | 1 | $\beta_{N,s;1}$ |
| 2 | 6.9 | 2 | $\beta_{N,s;2}$ |
| 3 | 6.9 | 3 | $\beta_{N,s;3}$ |

Pullout failure

$$N_{Sd} \leq \frac{N_{Rk,p}}{\gamma_{Mp}} \quad (N_{Rd,p})$$



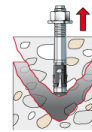
| $N_{Rk,p}$ kN | Ψ_c | γ_{Mp} | $N_{Rd,p}$ kN | N_{Sd} kN | $\beta_{N,p}$ % |
|------------------|----------|---------------|------------------|----------------|--------------------|
| 10.98 | 1.220 | 1.50 | 7.32 | 2.70 | 36.9 |

The given Psi,c-factor may has been determined by interpolation.

| Anchor no. | $\beta_{N,p}$ % | Group N° | Decisive Beta |
|------------|--------------------|----------|-----------------|
| 1, 2, 3 | 36.9 | 1 | $\beta_{N,p;1}$ |

Concrete cone failure

$$N_{Sd} \leq \frac{N_{Rk,c}}{\gamma_{Mc}} \quad (N_{Rd,c})$$



$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \Psi_{s,N} \cdot \Psi_{re,N} \cdot \Psi_{ec,N} \quad \text{Eq. (5.2)}$$

$$N_{Rk,c} = 12.35kN \cdot \frac{16,641mm^2}{16,641mm^2} \cdot 1.000 \cdot 1.000 \cdot 1.000 = 12.35kN$$

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1.5} = 7.2 \cdot \sqrt{37.0N/mm^2} \cdot (43mm)^{1.5} = 12.35kN \quad \text{Eq. (5.2a)}$$

$$\Psi_{s,N} = \min\left(1; 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}}\right) = \min\left(1; 0.7 + 0.3 \cdot \frac{70mm}{65mm}\right) = 1.000 \leq 1 \quad \text{Eq. (5.2c)}$$

$$\Psi_{re,N} = 1.000 \quad \text{Eq. (5.2d)}$$

$$\Psi_{ec,N} = \frac{1}{1 + \frac{2e_n}{s_{cr,N}}} \Rightarrow \Psi_{ec,Nx} \cdot \Psi_{ec,Ny} = 1.000 \cdot 1.000 = 1.000 \leq 1 \quad \text{Eq. (5.2e)}$$

$$\Psi_{ec,Nx} = \frac{1}{1 + \frac{2 \cdot 0mm}{129mm}} = 1.000 \leq 1 \quad \Psi_{ec,Ny} = \frac{1}{1 + \frac{2 \cdot 0mm}{129mm}} = 1.000 \leq 1$$

| N_{Rk,c} kN | Y_{Mc} | N_{Rd,c} kN | N_{Sd} kN | β_{N,c} % |
|-------------------------------|-----------------------|-------------------------------|-----------------------------|-----------------------------|
| 12.35 | 1.50 | 8.23 | 2.70 | 32.8 |

| Anchor no. | β_{N,c} % | Group N° | Decisive Beta |
|-------------------|-----------------------------|-----------------|----------------------|
| 1 | 32.8 | 1 | β _{N,c;1} |
| 2 | 32.8 | 2 | β _{N,c;2} |
| 3 | 32.8 | 3 | β _{N,c;3} |

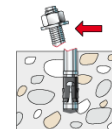
Resistance to shear loads

| Proof | Action kN | Capacity kN | Utilisation β_v % |
|-----------------------------------|---------------------|-----------------------|---------------------------------------|
| Steel failure without lever arm * | 0.45 | 19.60 | 2.3 |
| Concrete pry-out failure | 0.45 | 8.23 | 5.5 |
| Concrete edge failure | 1.35 | 6.10 | 22.1 |

* Most unfavourable anchor

Steel failure without lever arm

$$V_{Sd} \leq \frac{V_{Rk,s}}{\gamma_{Ms}} \quad (V_{Rd,s})$$

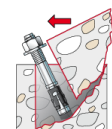


| V_{Rk,s} kN | Y_{Ms} | V_{Rd,s} kN | V_{Sd} kN | β_{Vs} % |
|-------------------------------|-----------------------|-------------------------------|-----------------------------|----------------------------|
| 29.40 | 1.50 | 19.60 | 0.45 | 2.3 |

| Anchor no. | β_{Vs} % | Group N° | Decisive Beta |
|-------------------|----------------------------|-----------------|----------------------|
| 1 | 2.3 | 1 | β _{Vs;1} |
| 2 | 2.3 | 2 | β _{Vs;2} |
| 3 | 2.3 | 3 | β _{Vs;3} |

Concrete pry-out failure

$$V_{Sd} \leq \frac{V_{Rk,cp}}{\gamma_{Mcp}} \quad (V_{Rd,cp})$$



$$V_{Rk,cp} = k \cdot N_{Rk,c} = 1 \cdot 12.35kN = 12.35kN \quad \text{Eq. (5.6)}$$

$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \Psi_{s,N} \cdot \Psi_{re,N} \cdot \Psi_{ec,N} \quad \text{Eq. (5.2)}$$

$$N_{Rk,c} = 12.35kN \cdot \frac{16,641mm^2}{16,641mm^2} \cdot 1.000 \cdot 1.000 \cdot 1.000 = 12.35kN$$

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1.5} = 7.2 \cdot \sqrt{37.0N/mm^2} \cdot (43mm)^{1.5} = 12.35kN \quad \text{Eq. (5.2a)}$$

$$\Psi_{s,N} = \min\left(1; 0.7 + 0.3 \cdot \frac{c}{c_{cr,N}}\right) = \min\left(1; 0.7 + 0.3 \cdot \frac{70mm}{65mm}\right) = 1.000 \leq 1 \quad \text{Eq. (5.2c)}$$

$$\Psi_{re,N} = 1.000 \quad \text{Eq. (5.2d)}$$

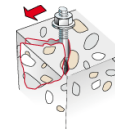
$$\Psi_{ec,N} = \frac{1}{1 + \frac{2e_a}{s_{cr,N}}} \Rightarrow \Psi_{ec,Nx} \cdot \Psi_{ec,Ny} = 1.000 \cdot 1.000 = 1.000 \leq 1 \quad \text{Eq. (5.2e)}$$

| $V_{Rk,cp}$ kN | γ_{Mc} | $V_{Rd,cp}$ kN | V_{Sd} kN | $\beta_{V,cp}$ % |
|-------------------|---------------|-------------------|----------------|---------------------|
| 12.35 | 1.50 | 8.23 | 0.45 | 5.5 |

| Anchor no. | $\beta_{V,cp}$ % | Group N° | Decisive Beta |
|------------|---------------------|----------|------------------|
| 1 | 5.5 | 1 | $\beta_{V,cp;1}$ |
| 2 | 5.5 | 2 | $\beta_{V,cp;2}$ |
| 3 | 5.5 | 3 | $\beta_{V,cp;3}$ |

Concrete edge failure

$$V_{Sd} \leq \frac{V_{Rk,c}}{\gamma_{Mc}} \quad (V_{Rd,c})$$



$$V_{Rk,c} = V_{Rk,c}^0 \cdot \frac{A_{c,V}}{A_{c,V}^0} \cdot \Psi_{s,V} \cdot \Psi_{h,V} \cdot \Psi_{\alpha,V} \cdot \Psi_{ec,V} \cdot \Psi_{re,V} \quad \text{Eq. (5.7)}$$

$$V_{Rk,c} = 15.55kN \cdot \frac{21,000mm^2}{45,000mm^2} \cdot 0.840 \cdot 1.000 \cdot 1.500 \cdot 1.000 \cdot 1.000 = 9.14kN$$

$$V_{Rk,c}^0 = k_1 \cdot d_{nom}^\alpha \cdot h_{ef}^\beta \cdot \sqrt{f_{ck,cube}} \cdot c_1^{1.5} \quad \text{Eq. (5.7a)}$$

$$V_{Rk,c}^0 = 1.7 \cdot (10mm)^{0.074} \cdot (43mm)^{0.063} \cdot \sqrt{37.0N/mm^2} \cdot (100mm)^{1.5} = 15.55kN$$

$$\alpha = 0.1 \cdot \sqrt{\frac{l_f}{c_1}} = 0.1 \cdot \sqrt{\frac{55mm}{100mm}} = 0.074 \quad \beta = 0.1 \cdot \left(\frac{d_{nom}}{c_1}\right)^{0.2} = 0.1 \cdot \left(\frac{10mm}{100mm}\right)^{0.2} = 0.063 \quad \text{Eq. (5.7b/c)}$$

$$\Psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5c_1} = 0.7 + 0.3 \cdot \frac{70mm}{1.5 \cdot 100mm} = 0.840 \leq 1 \quad \text{Eq. (5.7e)}$$

$$\Psi_{h,V} = \max\left(1; \sqrt{\frac{1.5c_1}{h}}\right) = \max\left(1; \sqrt{\frac{1.5 \cdot 100mm}{150mm}}\right) = 1.000 \geq 1 \quad \text{Eq. (5.7f)}$$

$$\Psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{\Psi_{90,V}}\right)^2}} = \sqrt{\frac{1}{(\cos 90.0)^2 + \left(\frac{\sin 90.0}{1.5}\right)^2}} = 1.500 \geq 1 \quad \text{Eq. (10.2-5f)}$$

$$\Psi_{ec,V} = \frac{1}{1 + \frac{2 \cdot e_v}{3 \cdot c'_1}} = \frac{1}{1 + \frac{2 \cdot 0mm}{3 \cdot 100mm}} = 1.000 \leq 1 \quad \text{Eq. (5.7h)}$$

$$\Psi_{re,V} = 1.000$$

$$c'_1 = \max\left(\frac{c_{2,max}}{1.5}; \frac{h}{1.5}\right) = \max\left(\frac{70mm}{1.5}; \frac{150mm}{1.5}\right) = 100mm$$

| $V_{Rk,c}$ kN | Y_{Mc} | $V_{Rd,c}$ kN | V_{Sd} kN | $\beta_{V,c}$ % |
|------------------|----------|------------------|----------------|--------------------|
| 9.14 | 1.50 | 6.10 | 1.35 | 22.1 |

| Anchor no. | $\beta_{V,c}$ % | Group N° | Decisive Beta |
|------------|--------------------|----------|-----------------|
| 1 | 7.4 | 1 | $\beta_{V,c;1}$ |
| 2 | 14.8 | 2 | $\beta_{V,c;2}$ |
| 3 | 22.1 | 3 | $\beta_{V,c;3}$ |

Utilization of tension and shear loads

| Tension loads | Utilisation β_N % | Shear Loads | Utilisation β_V % |
|-----------------------|----------------------------|-----------------------------------|----------------------------|
| Steel failure * | 6.9 | Steel failure without lever arm * | 2.3 |
| Pullout failure * | 36.9 | Concrete pry-out failure | 5.5 |
| Concrete cone failure | 32.8 | Concrete edge failure | 22.1 |

* Most unfavourable anchor

Resistance to combined tensile and shear loads

| Utilisation steel | | |
|---|---|-------------------------|
| $\beta_{N,s} = \beta_{N,s;1} = 0.07 \leq 1$ | | Eq. (5.8a) |
| $\beta_{V,s} = \beta_{V,s;1} = 0.02 \leq 1$ | | Eq. (5.8b) |
| $\beta_N^2 + \beta_V^2 = \beta_{N,s;1}^2 + \beta_{V,s;1}^2 = 0.01 \leq 1$ | | Eq. (5.9) |
| Utilisation concrete |  | Proof successful |
| $\beta_{N,p} = \beta_{N,p;1} = 0.37 \leq 1$ | | Eq. (5.8a) |
| $\beta_{V,c} = \beta_{V,c;3} = 0.22 \leq 1$ | | Eq. (5.8b) |
| $\frac{\beta_N + \beta_V}{1.2} = \frac{\beta_{N,p;1} + \beta_{V,c;1}}{1.2} = 0.35 \leq 1$ | | Eq. (5.8c) |

Information concerning the anchor plate

Base plate details

Plate thickness specified by user without proof

t = 5 mm

Profile type

None

The input values and the design results should be checked against local valid standards and approvals. Please respect the disclaimer of warranty in the license agreement of the Software.



Technical remarks

All data and information in the software is based on fischer products and common engineering knowledge. Please check all the proof results against local valid standards and approvals.

As fischer is not the design office, the attached is no guarantee for incorrect input or assumptions. Any recommendations have to be approved by the building-authority or project engineer. Results are valid only for anchor system calculated in the attached. If any part of the system is changed, it will invalidate this report and new calculations would be required. The calculation was done under the assumption that a sufficient splitting reinforcement is available. In this case the splitting failure can be omitted.

The transmission of the anchor loads to the supports of the concrete member shall be shown for the ultimate limit state and the serviceability limit state; for this purpose, the normal verifications shall be carried out under due consideration of the actions introduced by the anchors. For these verifications the additional provisions given in the current design method shall be taken into account.

As a pre-condition the anchor plate is assumed to be flat when subjected to the actions. Therefore, the plate (if present) must be sufficiently stiff. The C-Fix anchor plate design is based on a proof of stresses and does not allow a statement about the stiffness of the plate. The proof of the necessary stiffness is not carried out by C-Fix.

During the design process, the following hints and warnings were issued:

- Measures must be taken to fill the annular gap on site.

Installation data

Anchor

Anchor system fischer Concrete screw ULTRACUT
FBS II
 Anchor Concrete screw with countersunk
 head FBS II 10x65 10/- SK,
 zinc plated steel

Art.-No. 536884

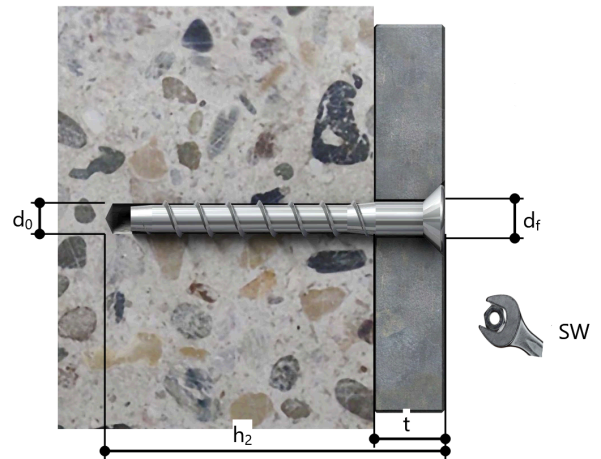


Accessories Blow-out pump ABG big
 Quattric II 10/100/165

Art.-No. 567792
 Art.-No. 549923

Installation details

Thread diameter -
 Drill hole diameter $d_0 = 10 \text{ mm}$
 Drill hole depth $h_2 = 75 \text{ mm}$
 Calculated anchorage
 depth $h_{ef} = 43 \text{ mm}$
 Installation depth $h_{nom} = 55 \text{ mm}$
 Counter-sink size 23 mm x 5 mm
 Drilling method Hammer drilling
 Borehole cleaning Clear the borehole with a hand
 blower.
 Installation type Push-through installation
 Annular gap Annular gap filled
 Maximum torque -
 Socket size T50
 Base plate thickness $t = 5 \text{ mm}$
 Total fixing thickness $t_{fix} = 5 \text{ mm}$
 $t_{fix, max} = 10 \text{ mm}$



Base plate details

Base plate material Not available
 Base plate thickness $t = 5 \text{ mm}$
 Clearance hole in base
 plate $d_f = 14 \text{ mm}$

Attachment

Profile type None

Anchor coordinates

| Anchor no. | x mm | y mm |
|------------|---------|---------|
| 1 | 8 | 200 |
| 2 | 8 | 0 |
| 3 | 8 | -200 |

