TSA
TED SINGLETON & ASSOCIATES
CONSULTING ENGINEERS

Project: Concorde Glass Ltd	Contract: 1983-1
Subject: Glassloc Side Mount Channel 21.52mm EVA Glass	Sheet No. 1
Date: 26/06/2024	By: A.N & R.F

Concorde Glass Ltd.,

Linx House,

104 Waterloo Rd,

Mablethorpe,

LN12 1LE,

UK.

Glassloc Side Mount Channel 21.52mm EVA Glass Test Data

Analysis By	Checked By	Checked By
A.N & R.F	C.C	T.S

1	26/06/2024	T.S	Fully New analysis and calculations based on new glass height and medium wind load.
0	15/04/2024	T.S.	Issued
Revision	**Date**	**Issued By**	**Comment**

Contents

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 Medium Wind load = 1.5kN/m²

Assumption:

Concrete Grade = C30/37

Bolts are grade 8.8 Mild Steel.

Timber Grade = C16 (minimum)

Aluminium Shoe grade 6063-T6

Result Summary:

Side Fix Mount U – Channel:

1- **Connection to Concrete**: Use 1No. Ultracut FBS II 10×100 45/35/15 Zinc Plated Steel Fischer Countersunk Concrete screws @200mm C/C with Minimum Embedment depth is 68mm 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 - with No handrail**: 21.52mm Toughened Laminated Glass Panel with EVA Interlayers.

Analysis – 21.52mm Thickness EVA Interlayer	**mm**
Deflection of Glass due to Wind Loading	**6.235**
Deflection of Glass due to Balustrade Loading	4.44
Deflection of Glass due to Point Loading	1.57
Deflection of Shoe due to Shoe Loading	**12.06**
Combined deflection of system	**18.30**

Combined Deflection 18.30mm < 25mm {BS6180:2011 cl. 6.4.1}

Revisions:

Revision 1:

New calculations and analysis have been completed in revision 1, based on a glass height of 1210mm and the revised typical medium wind load of $1.5kN/m^2$.

Glass Strength

Balustrade Loading:

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

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

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

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

Wind Loading:

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

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

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

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

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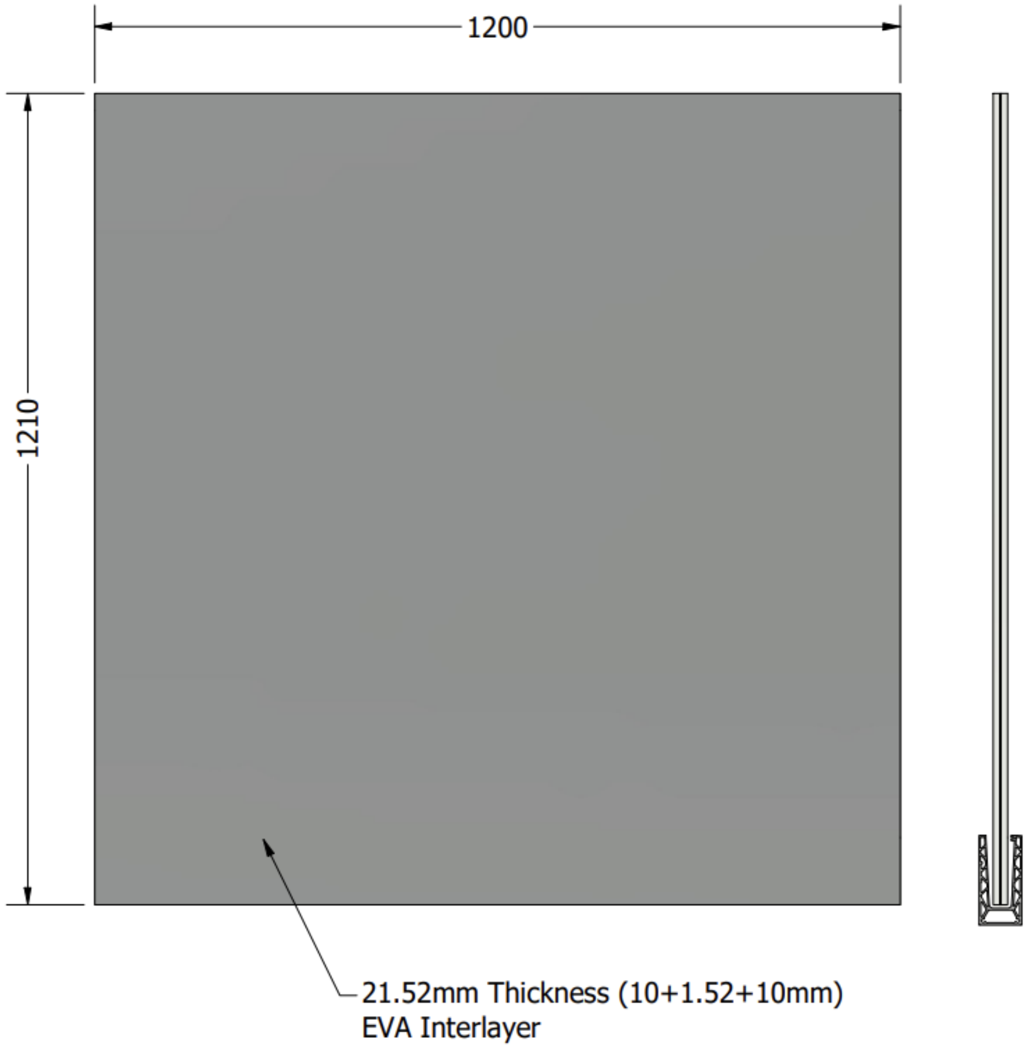
Side Mount Shoe – Side Fix Connections:

Sketch of System:



Note:

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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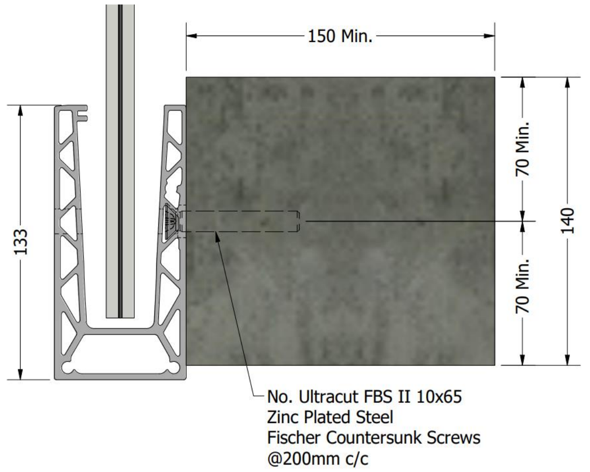
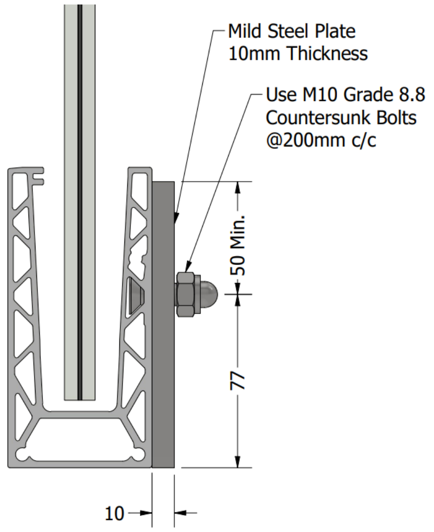
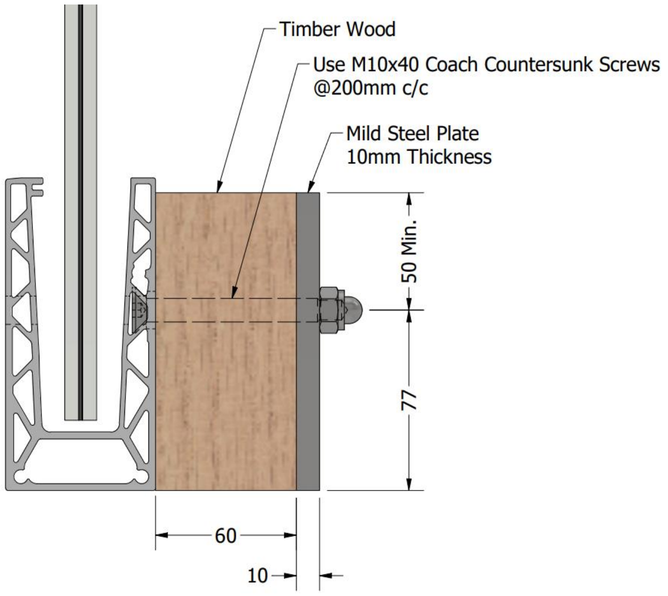






The above sketches are for Illustration purposes only.

Connection to Concrete Design - Side Fixed:

Moment due to Balustrade Load $= 0.74\text{kN/m} \times 1.5 \times 0.6\text{m} \times 1.2\text{m} = 0.8\text{kNm (ULS)}$

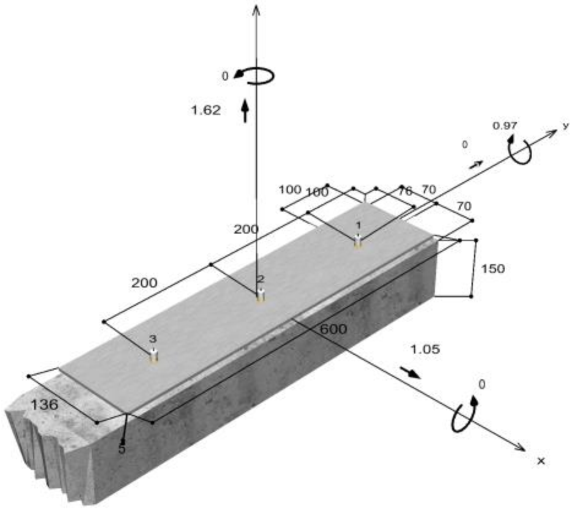
Tension Force due to Balustrade Load $= 0.74\text{kN/m} \times 1.5 \times 0.6\text{m} = 0.666\text{kN (ULS)}$

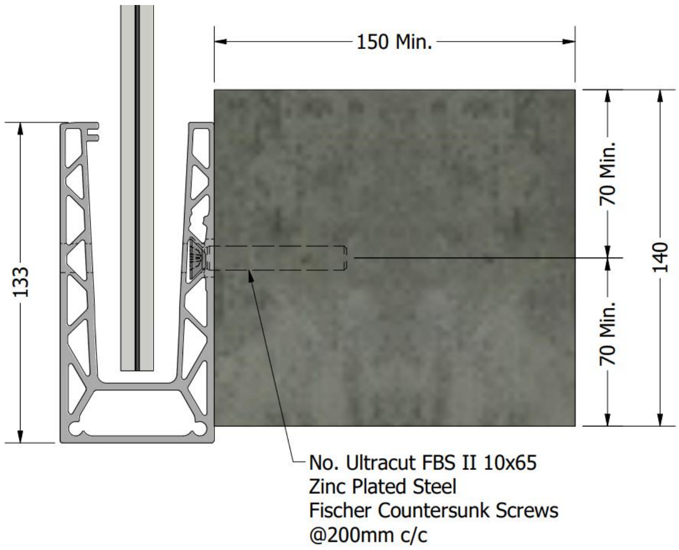
Moment due to Wind Load $= 1.5\text{kN/m}^2 \times 1.5 \times 1.2\text{m} \times 0.6\text{m} \times 0.6\text{m} =$
0.972kNm (ULS) – Worst Case.

Tension Force due to Wind Load $= 1.5\text{kN/m}^2 \times 1.5 \times 1.2\text{m} \times 0.6\text{m} = 1.62\text{kN (ULS)}$

Shear Load due to Self weight of the glass $= 1.2\text{kN} \times 1.21\text{m} \times 0.02152\text{m} \times 25\text{kN/m}^3 \times 1.35 = 1.05\text{kN (ULS)}$

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.





Connection To Mild Steel Baseplate - Side Fixed:

M10 Grade 8.8 Countersunk Bolt:

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

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

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

$K_2 = 0.63$ *(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.*

$\mathrm{F_{t,Ed}} = 6.42\mathrm{kN}$

$$\mathrm{F_{t,Rd}} = \frac{\mathrm{K_2 F_{ub} A}}{\lambda \mathrm{m2}} = \frac{0.63\ x\ 800\ x\ 58}{1.25}\ x\ 10^{-3} = 23.38\mathrm{kN} \rightarrow \mathrm{F_{t,Rd}} = 23.38\mathrm{kN} > 6.42\mathrm{kN} \quad \textbf{Okay}$$

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.*

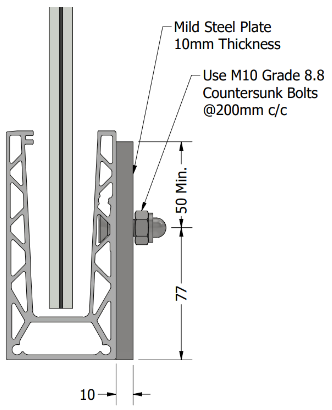
$$\mathrm{F_{V,Ed}} = \frac{1.05\mathrm{kN}}{3} = 0.35\mathrm{kN}$$

$$\mathrm{F_{V,Rd}} = \frac{\alpha \mathrm{F_{ub} A}}{\lambda \mathrm{m2}} = \frac{0.6\ x\ 800\ x\ 58}{1.25}\ x\ 10^{-3} = 22.27\mathrm{kN} \rightarrow \mathrm{F_{V,Rd}} = 22.27\mathrm{kN} > 0.35\mathrm{kN} \quad \textbf{Okay}$$

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

$$\frac{F_{v,Ed}}{F_{v,Rd}} + \frac{F_{t,Ed}}{1.4F_{t,Rd}} \leq 1 \rightarrow \frac{0.35}{22.27} + \frac{6.42}{1.4\ x\ 23.38} = 0.212 \leq 1 \quad \textbf{Okay}$$

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



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Connection To Wood - Side Fixed:

Tensile Resistance Check:

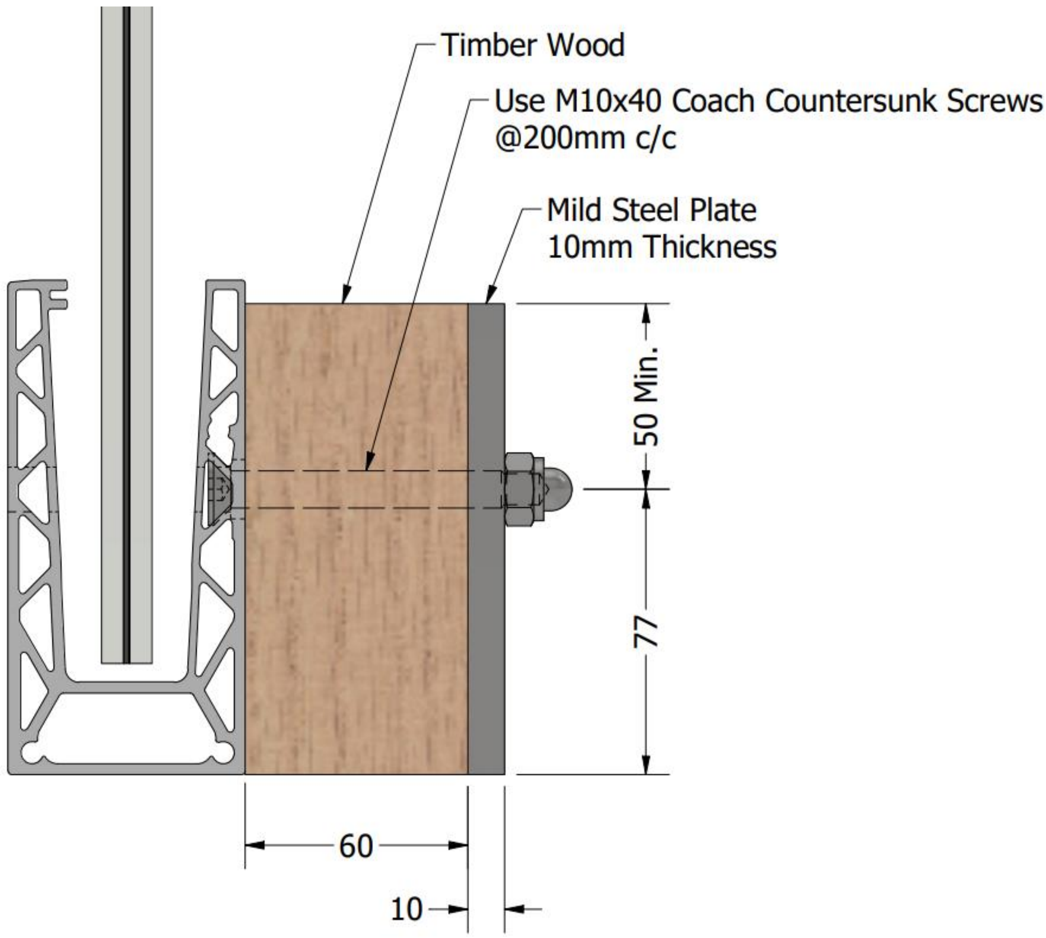
$\text{Tensile Force per screw} = 6.42\text{kN}$

$\text{Tension Capacity of } 10 \times 40\text{mm Coach Screws} = 26.45\text{kN}$ as per specification sheet in appendix A.

$\text{Therefore, } 26.45\text{kN} > 6.42\text{kN}$ **Okay**

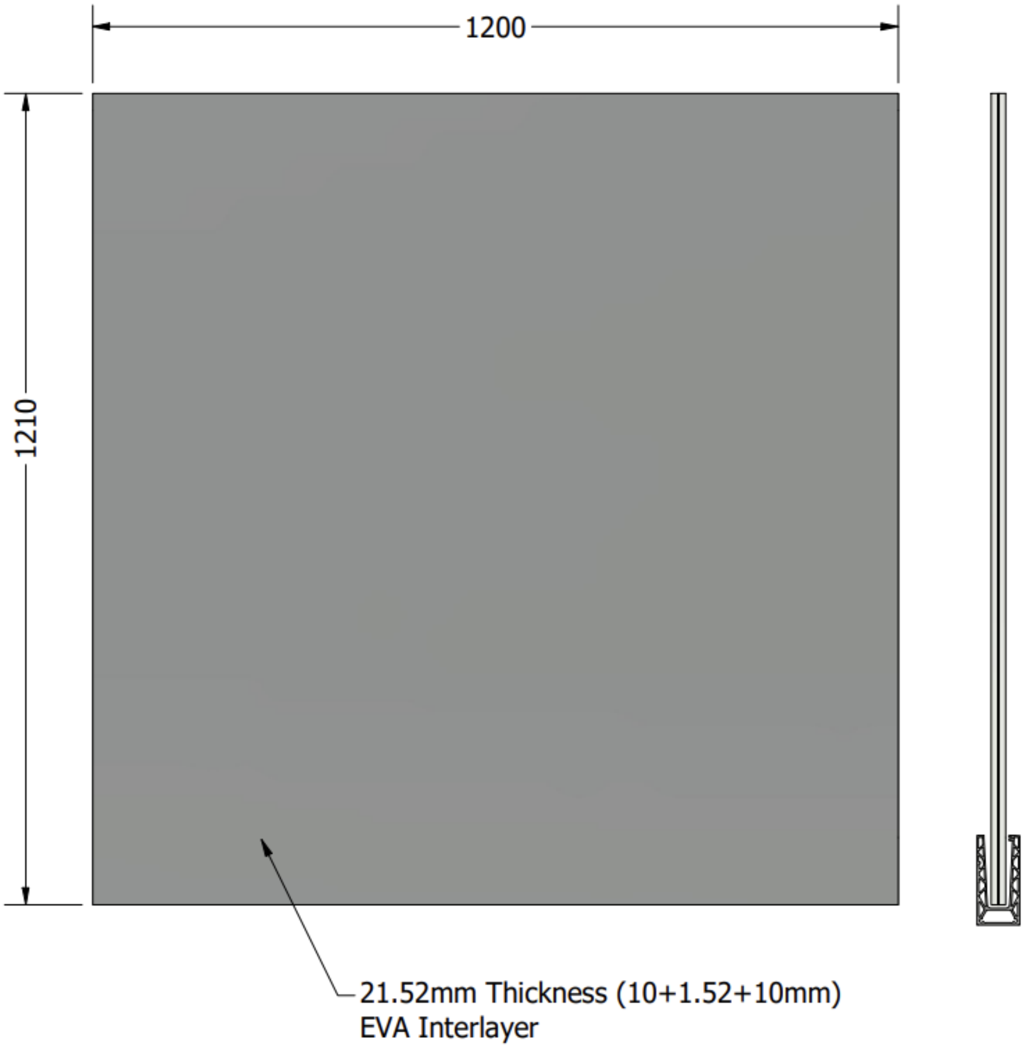
Minimum edge distance required is 5d = 5 x 10 = 50mm.

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



Glass Analysis:

System Sketch – 21.52mm Thickness EVA Interlayer:



Project: Concorde Glass Ltd	Contract: 1983-1
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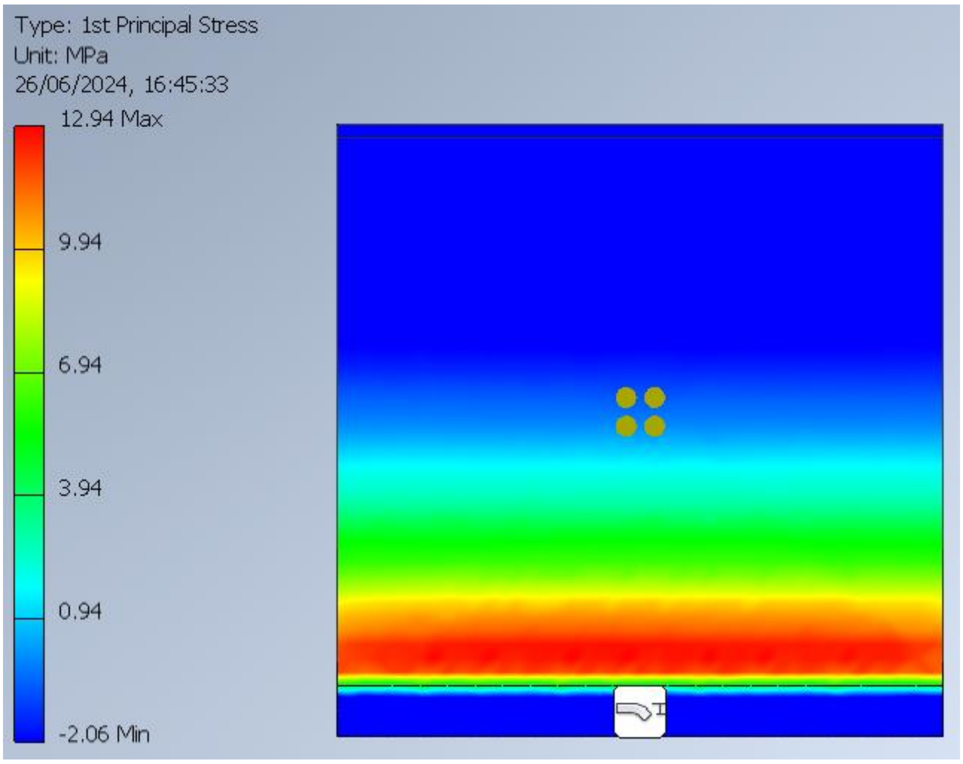
Glass Analysis - Bending Stress of Glass Panel due to 1.5kN/m2 Wind Loading:

- Analysis Software was used to determine maximum bending stress of the glass due to 1.5N/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 1210 (h) mm

Result:

Max. Bending Stress = 12.94N/mm^2 X 1.5 = 19.41N/mm^2 < 83.3N/mm^2

OK in Bending



Project: Concorde Glass Ltd	Contract: 1983-1
Subject: Glassloc Side Mount Channel 21.52mm EVA Glass	Sheet No. 12
Date: 26/06/2024	By: A.N & R.F

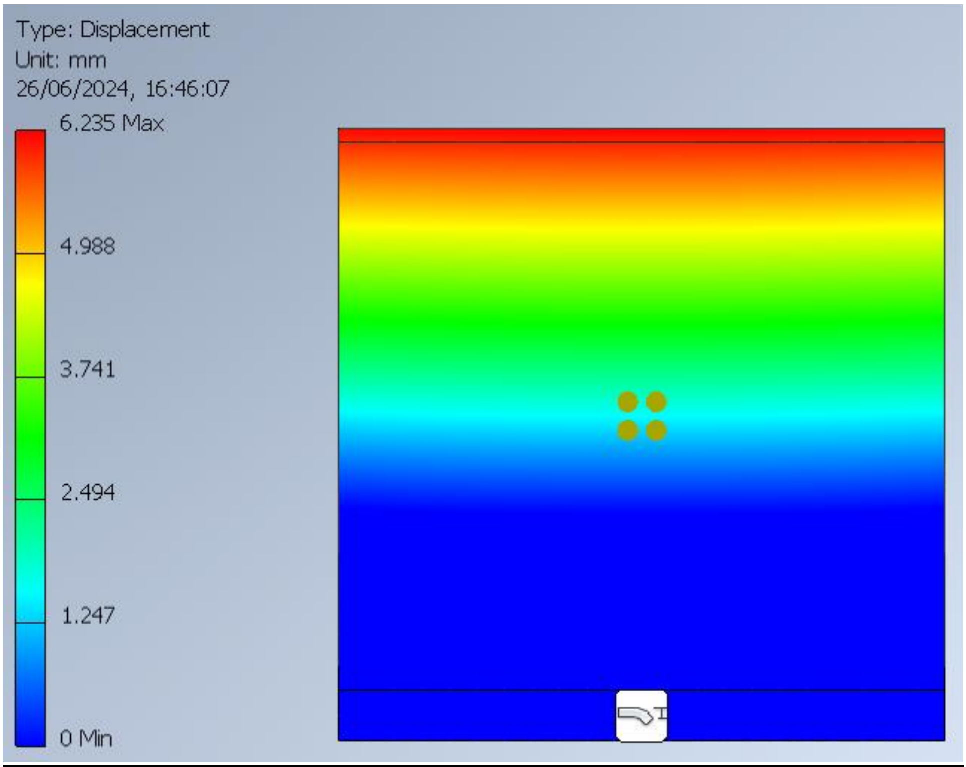
Glass Analysis - Deflection of Glass Panel due to 1.5kN/m2 Wind Loading:

- Analysis Software was used to determine maximum deflection of the glass due to 1.5N/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 1210 (h) mm

Result:

Max. Deflection = 6.235mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Project: Concorde Glass Ltd	Contract: 1983-1
Subject: Glassloc Side Mount Channel 21.52mm EVA Glass	Sheet No. 13
Date: 26/06/2024	By: A.N & R.F

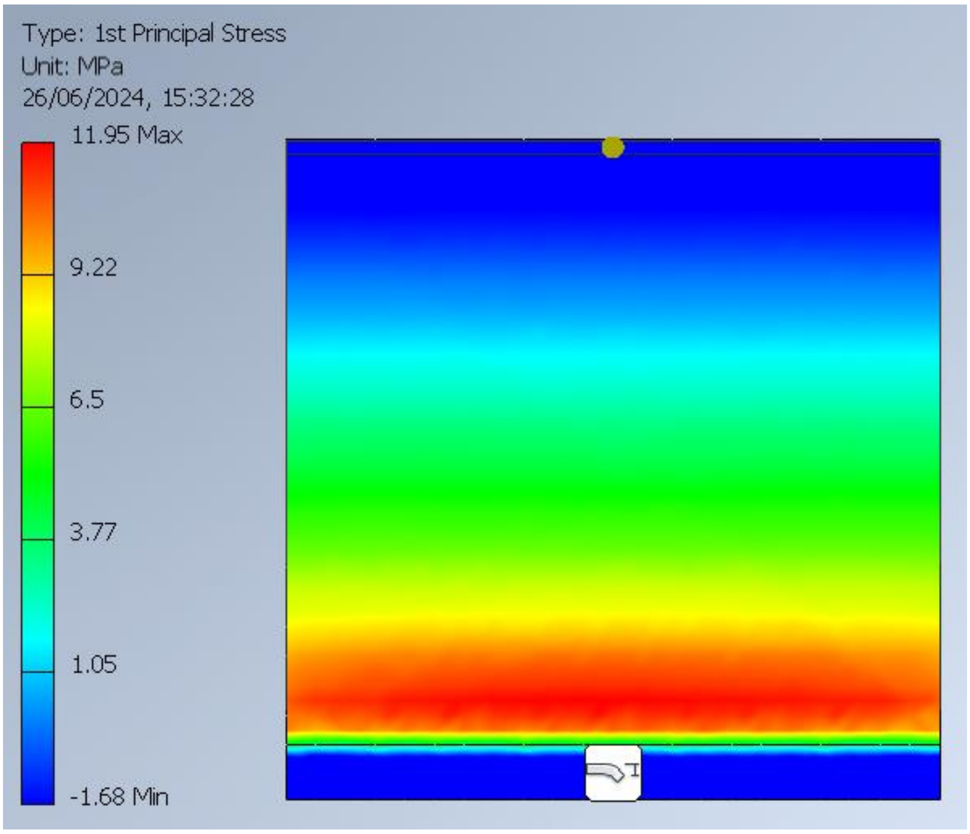
Glass Analysis - Bending Stress of Glass Panel due to 0.74kN/m Balustrade Loading:

- 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 1210 (h) mm

Result:

Max. Bending Stress = 11.95N/mm^2 X 1.5 = 17.93N/mm^2 < 84.2N/mm^2

OK in Bending



Project: Concorde Glass Ltd	Contract: 1983-1
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Date: 26/06/2024	By: A.N & R.F

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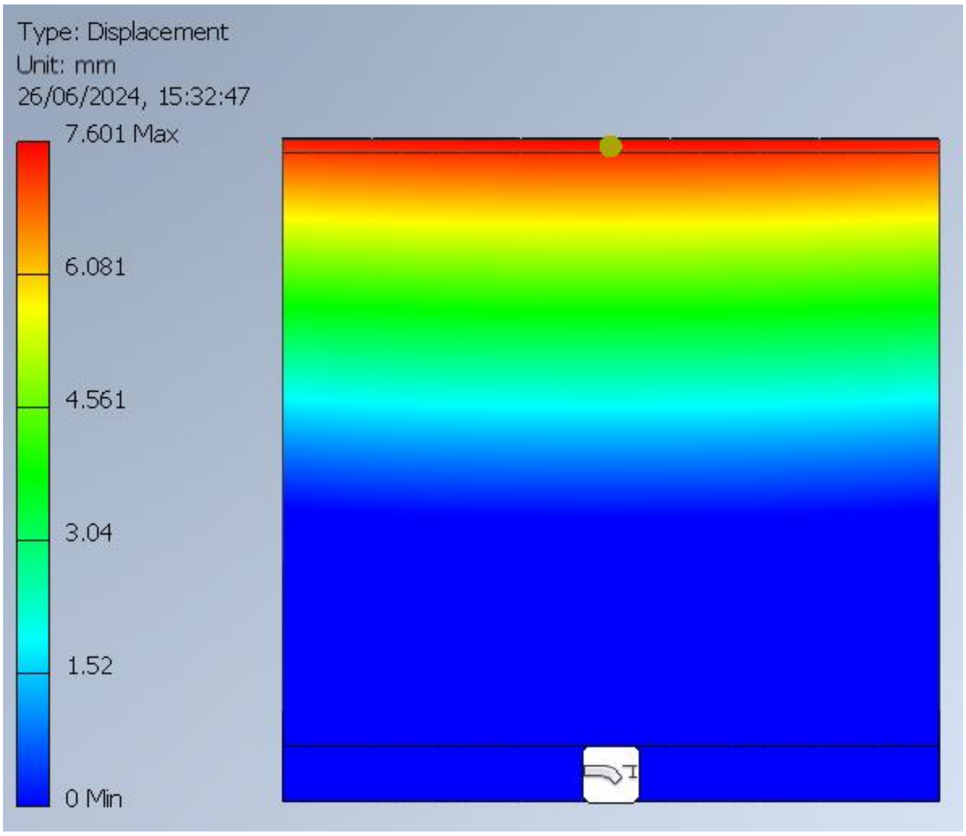
Glass Analysis - Deflection of Glass Panel due to 0.74kN/m Balustrade Loading:

- 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 1210 (h) mm

Result:

Max. Deflection = 7.601mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Project: Concorde Glass Ltd	**Contract:** 1983-1
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Date: 26/06/2024	**By:** A.N & R.F

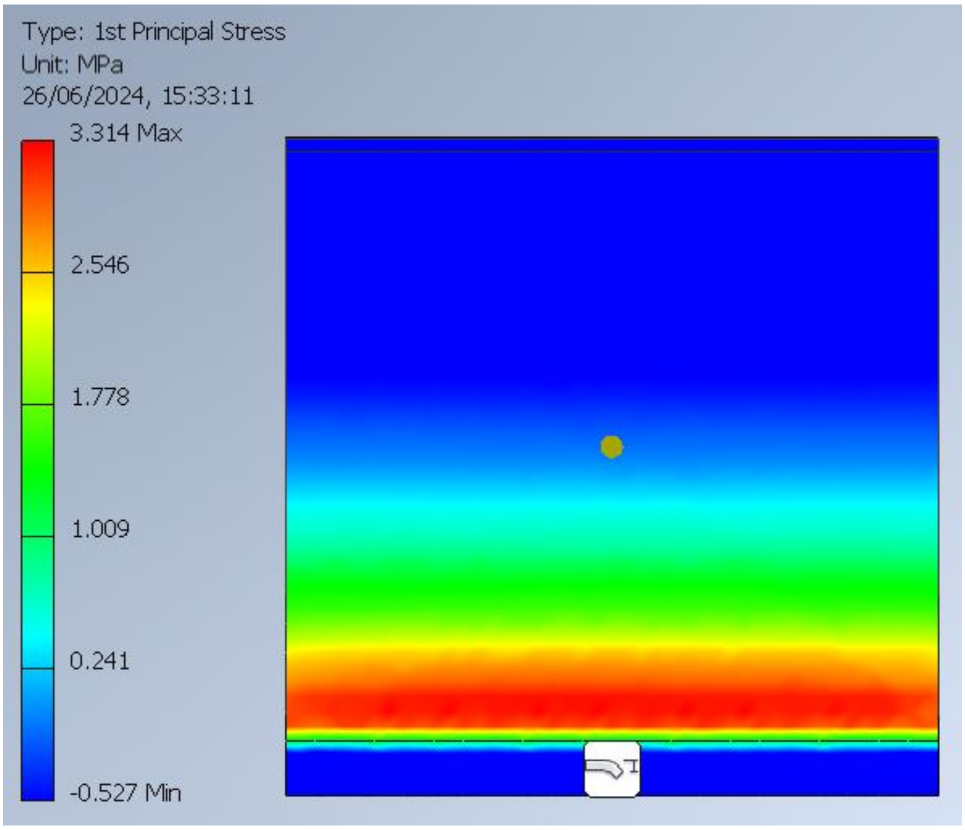
Glass Analysis - Bending Stress of Glass Panel due to 0.5kN Point Load:

- 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 1210 (h) mm

Result:

Max. Bending Stress = 3.314N/mm^2 X 1.5 = 4.97N/mm^2 < 84.2N/mm^2

OK in Bending



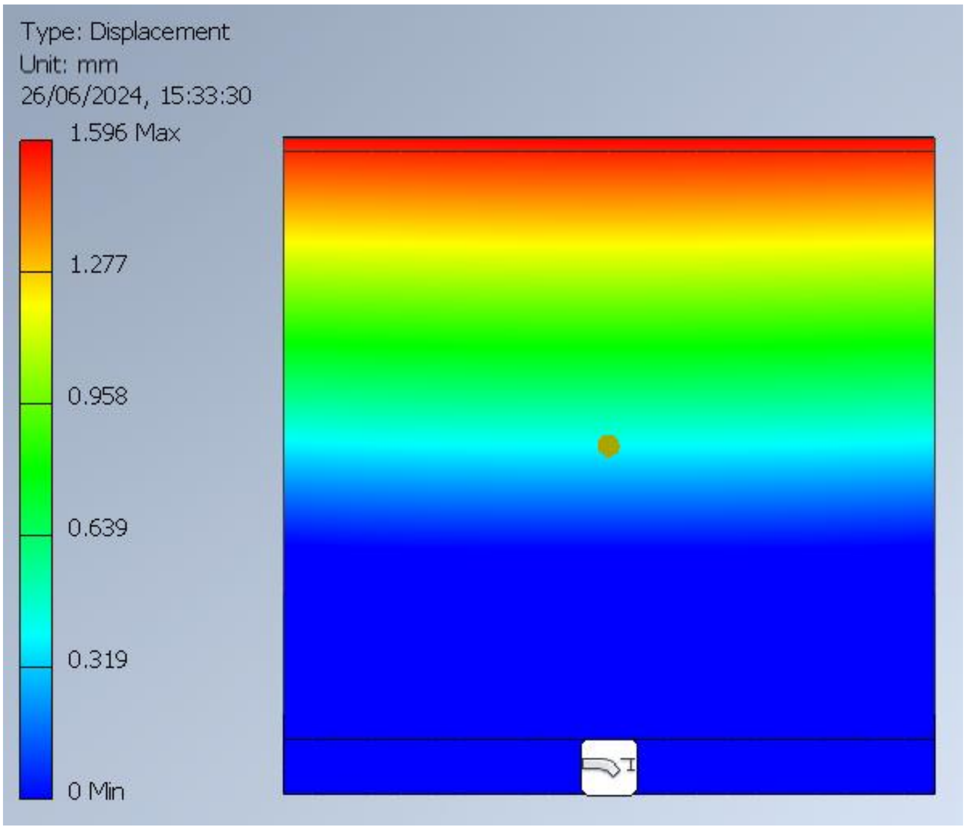
Glass Analysis - Deflection of Glass Panel due to 0.5kN Point Load:

- 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 1210 (h) mm

Result:

Max. Deflection = 1.596mm < 25mm {BS6180:2011 cl. 6.4.1}

OK in Deflection (Glass Only)



Project: Concorde Glass Ltd	Contract: 1983-1
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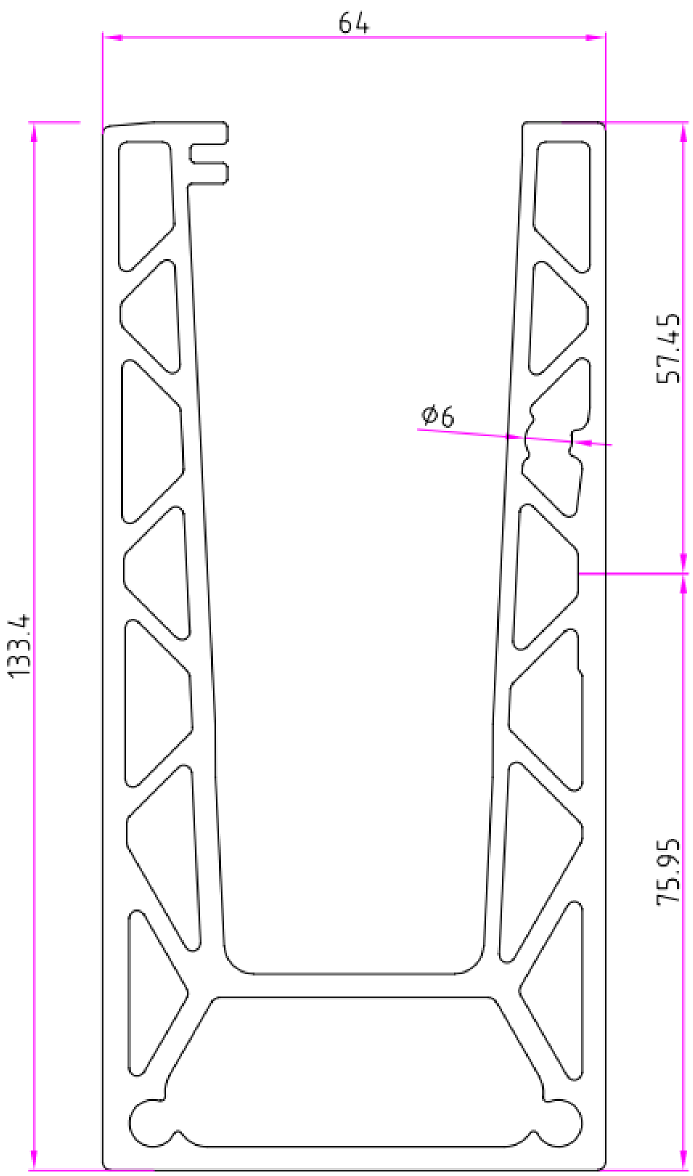
Date: 26/06/2024	By: A.N & R.F

Shoe Analysis:

System Sketch:



Project: Concorde Glass Ltd	Contract: 1983-1
Subject: Glassloc Side Mount Channel 21.52mm EVA Glass	Sheet No. 18
Date: 26/06/2024	By: A.N & R.F

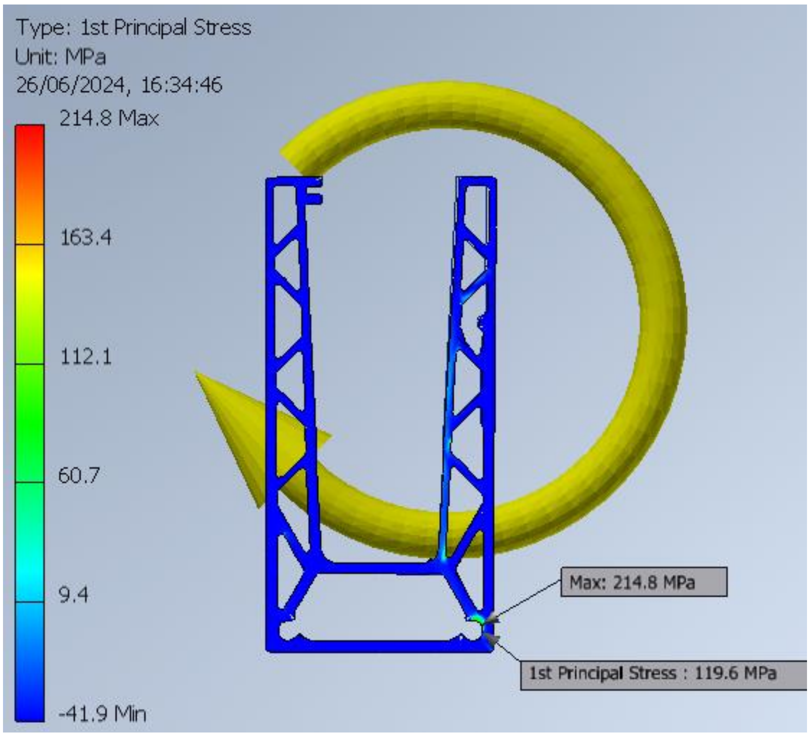
Bending Stress:

- Analysis Software was used to determine maximum bending stress of the shoe due to maximum Moment
- $\text{Moment}_{Wind} = 1.5\text{kN/m2} \times 1.2\text{m} \times 1.21\text{m} \times \frac{1.21\text{m}}{2} = 1.32\text{kN m(SLS)}$ **Worst Case**
- $\text{Moment}_{Balustrade} = 0.74\text{kN/m} \times 1.2\text{m} \times 1.21\text{m} = 1.08\text{kN m(SLS)}$

Result:

Max. Bending Stress = 119.6N/mm^2 x1.5 = 179.4N/mm^2

Okay in Bending



NOTE:

In this case the 214.8 MPa is a localised stress. The most appropriate stress to be considered is 119.6 MPa.

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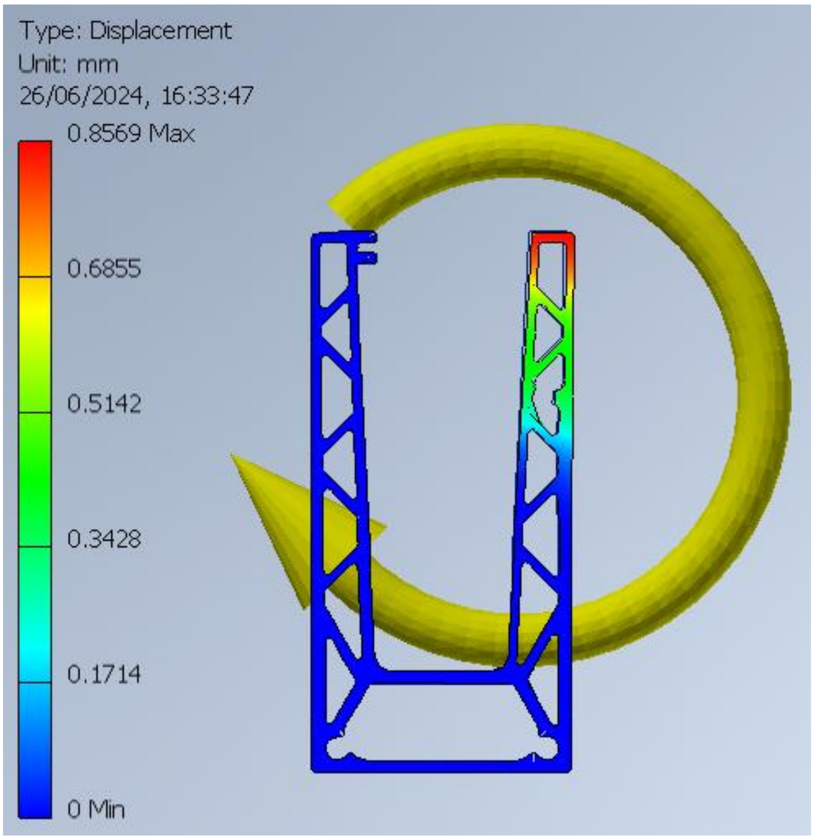
Deflection:



NOTE:

- Deflection 0.8569mm at the top of shoe
- Max. Deflection at the top of the glass = (0.8569 x 1210)/86 = 12.06mm

Appendix A – Timco Timber Screws Specfication Sheet

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

TIMco Coach Screws DIN571

CE

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

TIMco

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

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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										

Appendix B – Fischer Report

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

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

Comment

1983-1_Side Mount_Connection to Concrete_1

Design Specifications

Anchor

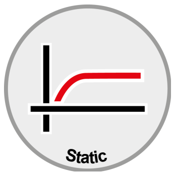
Anchor system	fischer Concrete screw ULTRACUT FBS II
Anchor	Concrete screw with countersunk head FBS II 10x65 10/-/- SK, zinc plated steel
Calculated anchorage depth	43 mm
Design Data	Determined by manufacturer

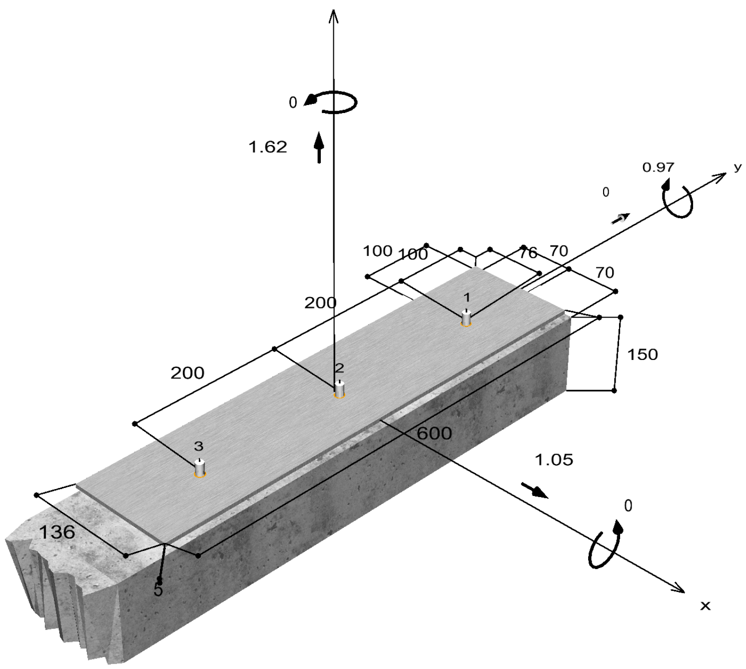
Geometry / Loads / Scale units

mm, kN, kNm

Value of design actions (including

partial safety factor for the load)





Not drawn to scale

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

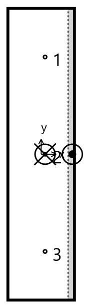
Design actions *)

#	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	1.62	1.05	0.00	0.00	0.97	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	6.42	0.35	0.35	0.00
2	6.42	0.35	0.35	0.00
3	6.42	0.35	0.35	0.00



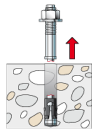
max. concrete compressive strain : 0.14 ‰
max. concrete compressive stress : 4.5 N/mm²
Resulting tensile actions : 19.27 kN , X/Y position (8 / 0)
Resulting compression actions : 17.65 kN , X/Y position (64 / 0)

Resistance to tension loads

Proof	Action kN	Capacity kN	Utilisation β_N %
Steel failure *	6.42	39.29	16.4
Pullout failure *	6.42	7.32	**87.8**
Concrete cone failure	6.42	8.23	78.0

* Most unfavourable anchor

Steel failure

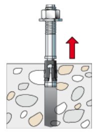


$N_{Sd} \leq \frac{N_{Rk,s}}{\gamma_{Ms}}$ **($N_{Rd,s}$)**

$N_{Rk,s}$ kN	γ_{Ms}	$N_{Rd,s}$ kN	N_{Sd} kN	$\beta_{N,s}$ %
55.00	1.40	39.29	6.42	16.4

Anchor no.	$\beta_{N,s}$ %	Group N°	Decisive Beta
1	16.4	1	$\beta_{N,s;1}$
2	16.4	2	$\beta_{N,s;2}$
3	16.4	3	$\beta_{N,s;3}$

Pullout failure



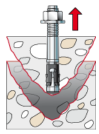
$N_{Sd} \leq \frac{N_{Rk,p}}{\gamma_{Mp}}$ **($N_{Rd,p}$)**

$N_{Rk,p}$ kN	Ψ_c	γ_{Mp}	$N_{Rd,p}$ kN	N_{Sd} kN	$\beta_{N,p}$ %
10.98	1.220	1.50	7.32	6.42	87.8

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

Anchor no.	$\beta_{N,p}$ %	Group N°	Decisive Beta
1, 2, 3	87.8	1	$\beta_{N,p;1}$

Concrete cone failure



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

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

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

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

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

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

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

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

$N_{Rk,c}$ kN	γ_{Mc}	$N_{Rd,c}$ kN	N_{Sd} kN	$\beta_{N,c}$ %
12.35	1.50	8.23	6.42	78.0

Anchor no.	$\beta_{N,c}$ %	Group N°	Decisive Beta
1	78.0	1	$\beta_{N,c;1}$
2	78.0	2	$\beta_{N,c;2}$
3	78.0	3	$\beta_{N,c;3}$

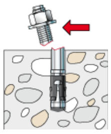
Resistance to shear loads

Proof	Action kN	Capacity kN	Utilisation β_V %
Steel failure without lever arm *	0.35	19.60	1.8
Concrete pry-out failure	0.35	8.23	4.3
Concrete edge failure	1.05	6.10	**17.2**

* Most unfavourable anchor

Steel failure without lever arm

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

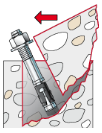


$V_{Rk,s}$ kN	γ_{Ms}	$V_{Rd,s}$ kN	V_{Sd} kN	β_{Vs} %
29.40	1.50	19.60	0.35	1.8

Anchor no.	β_{Vs} %	Group N°	Decisive Beta
1	1.8	1	$\beta_{Vs;1}$
2	1.8	2	$\beta_{Vs;2}$
3	1.8	3	$\beta_{Vs;3}$

Concrete pry-out failure

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



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

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

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

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

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

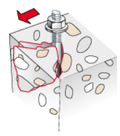
$$\Psi_{re,N} = 1.000$$ Eq. (5.2d)

$$\Psi_{ec,N} = \frac{1}{1 + \frac{2e_n}{s_{cr,N}}} \Rightarrow \Psi_{ec,Nx} \cdot \Psi_{ec,Ny} = 1.000 \cdot 1.000 = 1.000 \leq 1$$ 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	0.35	4.3

Anchor no.	$\beta_{V,cp}$ %	Group N°	Decisive Beta
1	4.3	1	$\beta_{V,cp;1}$
2	4.3	2	$\beta_{V,cp;2}$
3	4.3	3	$\beta_{V,cp;3}$

Concrete edge failure



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

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

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

$$V^0_{Rk,c} = k_1 \cdot d^{\alpha}_{nom} \cdot h^{\beta}_{ef} \cdot \sqrt{f_{ck,cube}} \cdot c'^{1.5}_1$$ Eq. (5.7a)

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

$$\alpha = 0.1 \cdot \sqrt{\frac{l_f}{c'_1}} = 0.1 \cdot \sqrt{\frac{55mm}{100mm}} = 0.074 \qquad \beta = 0.1 \cdot \left(\frac{d_{nom}}{c'_1}\right)^{0.2} = 0.1 \cdot \left(\frac{10mm}{100mm}\right)^{0.2} = 0.063$$ Eq. (5.7b/c)

$$\Psi_{s,V} = 0.7 + 0.3 \cdot \frac{c_2}{1.5c'_1} = 0.7 + 0.3 \cdot \frac{70mm}{1.5 \cdot 100mm} = 0.840 \leq 1$$ Eq. (5.7e)

$$\Psi_{h,V} = max\left(1;\ \sqrt{\frac{1.5c'_1}{h}}\right) = max\left(1;\ \sqrt{\frac{1.5 \cdot 100mm}{150mm}}\right) = 1.000 \geq 1$$ Eq. (5.7f)

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

$$\Psi_{ec,V} = \frac{1}{1 + \frac{2}{3}\frac{e_v}{c'_1}} = \frac{1}{1 + \frac{2 \cdot 0mm}{3 \cdot 100mm}} = 1.000 \leq 1$$ 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	γ_{Mc}	$V_{Rd,c}$ kN	V_{Sd} kN	$\beta_{V,c}$ %
9.14	1.50	6.10	1.05	17.2

Anchor no.	$\beta_{V,c}$ %	Group N°	Decisive Beta
1	5.7	1	$\beta_{V,c;1}$
2	11.5	2	$\beta_{V,c;2}$
3	17.2	3	$\beta_{V,c;3}$

Utilization of tension and shear loads

Tension loads	Utilisation βN %
Steel failure *	16.4
Pullout failure *	**87.8**
Concrete cone failure	78.0

Shear Loads	Utilisation βV %
Steel failure without lever arm *	1.8
Concrete pry-out failure	4.3
Concrete edge failure	**17.2**

* Most unfavourable anchor

Resistance to combined tensile and shear loads

Utilisation steel

$$\beta_{N.s} = \beta_{N,s;3} = 0.16 \leq 1$$ Eq. (5.8a)

$$\beta_{V.s} = \beta_{Vs;1} = 0.02 \leq 1$$ Eq. (5.8b)

$$\beta_N^2 + \beta_V^2 = \beta_{N,s;3}^2 + \beta_{Vs;3}^2 = 0.03 \leq 1$$ Eq. (5.9)

Utilisation concrete

Proof successful

$$\beta_{N.p} = \beta_{N,p;1} = 0.88 \leq 1$$ Eq. (5.8a)

$$\beta_{V.c} = \beta_{V,c;3} = 0.17 \leq 1$$ Eq. (5.8b)

$$\frac{\beta_N + \beta_V}{1.2} = \frac{\beta_{N,p;1} + \beta_{V,c;3}}{1.2} = 0.87 \leq 1$$ Eq. (5.8c)

Information concerning the anchor plate

Base plate details

Plate thickness specified by user without proof t = 5 mm

Profile type None

Technical remarks

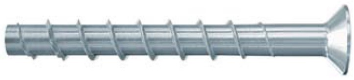
All data and information in the software is based on fischer products and common engineering knowledge. Please check all the proof results against local valid standards and approvals.
As fischer is not the design office, the attached is no guarantee for incorrect input or assumptions. Any recommendations 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 spliiting 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

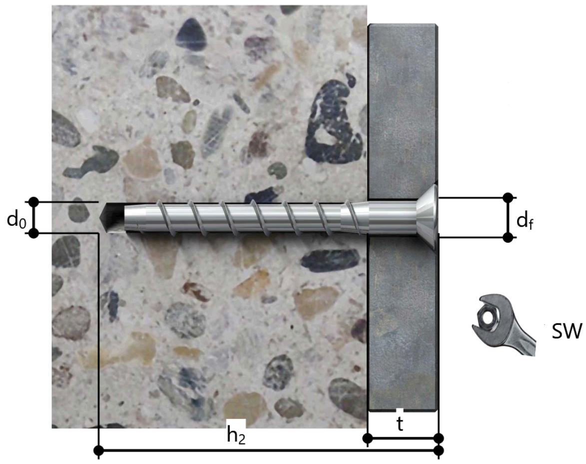
Anchor



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	Art.-No. 567792
	Quattric II 10/100/165	Art.-No. 549923

Installation details

Thread diameter	-
Drill hole diameter	d_0 = 10 mm
Drill hole depth	h_2 = 75 mm
Calculated anchorage depth	h_{ef} = 43 mm
Installation depth	h_{nom} = 55 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 mm
Total fixing thickness	t_{fix} = 5 mm
Tfix,max	$t_{fix,\ max}$ = 10 mm



Base plate details

Base plate material	Not available
Base plate thickness	t = 5 mm
Clearance hole in base plate	d_f=14 mm

Attachment

Profile type	None

Anchor coordinates

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