



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 1
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

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

Glassloc Side Mount Channel  
 Wind Load Test Data with & without Handrail

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

0	15/04/2024	T.S.	Issued
<b>Revision</b>	<b>Date</b>	<b>Issued By</b>	<b>Comment</b>



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 2
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

**Contents**

**Introduction/Actions/Assumptions/Result Summary: ..... 3**

Introduction:..... 3

Actions: ..... 3

Assumption:..... 3

Result Summary:..... 3

**Glass Strength..... 4**

    Balustrade Loading: ..... 4

Wind Loading:..... 4

**Glass Analysis- 15mm Toughened Glass with handrail ..... 4**

**Glass Analysis – 21.52mm Thickness EVA Interlayer: .....12**

**Shoe Analysis:.....19**

<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 3
<b>Date:</b> 15/04/2024	<b>By:</b> 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 15mm toughened glass with handrail for the side-mounted U Channel system.
- 2- Provide a glass analysis for 21.52mm toughened laminated glass without handrail for the side-mounted U Channel system.

### 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/m<sup>2</sup>

### Assumption:

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

### Result Summary:

#### A. Side Fix Mount U – Channel:

- 1- **Shoe:** 136×66mm Aluminium Shoe.
- 2- **Glass Panel 1 – Handrail:** Glass is 15mm Toughened Panels.

**Please 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.**

<b>Analysis for 15mm Toughened Glass with Handrail:</b>	<b>mm</b>
Deflection of Glass due to Wind Loading	<b>9.682</b>
Deflection of Shoe due to wind loading at Shoe	<b>11.36</b>
<b>Combined deflection of system</b>	<b>21.04</b>

Combined Deflection 21.04mm < 25mm {BS6180:2011 cl. 6.4.1}

- 3- **Glass Panel 2 - with No handrail:** 21.52mm Toughened Laminated Glass Panel with EVA Interlayers.

<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 4
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

<b>Analysis for 21.52mm Glass with EVA Interlayer – without Handrail</b>	<b>mm</b>
Deflection of Glass due to Wind Loading	<b>4.857</b>
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	<b>11.36</b>
<b>Combined deflection of system</b>	<b>16.22</b>

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 =>  $k_{mod} = 0.74$

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

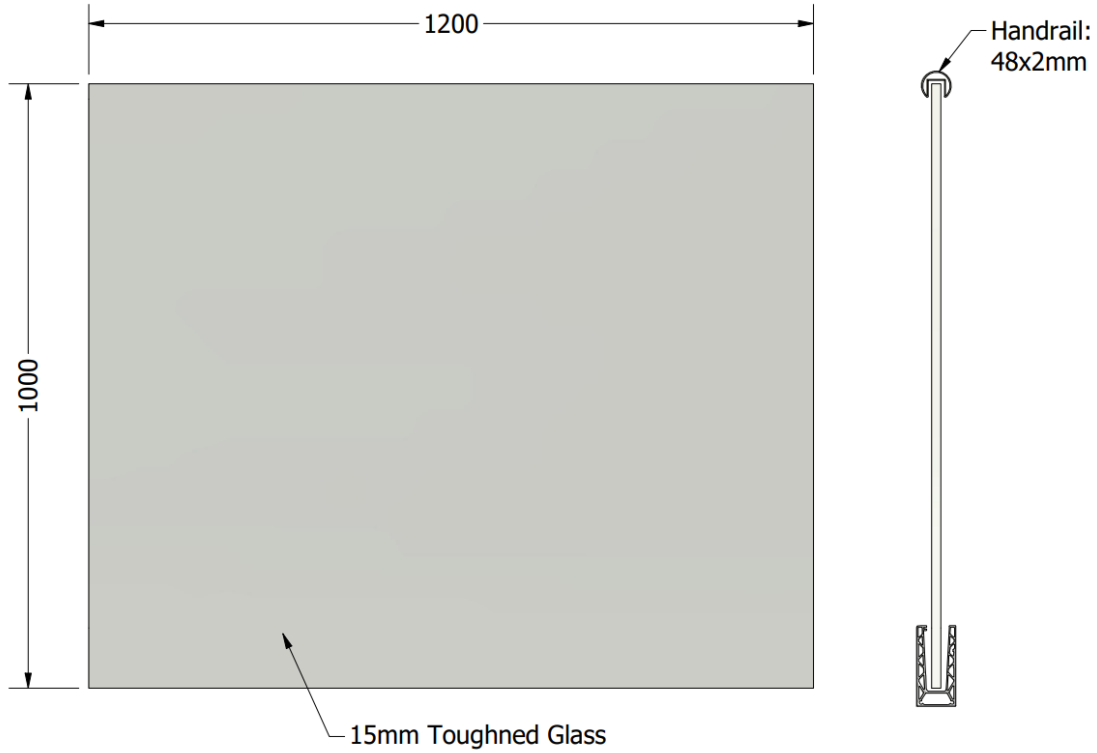
$$f_{gd} = (0.74)(1.0)(45) / 1.6 + 1.0(120 - 45) / 1.2$$

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

### Glass Analysis- 15mm Toughened Glass with handrail

#### System Sketch:

<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 5
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.



**Please 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.

2- The above sketch is for illustration purposes only.

<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 6
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

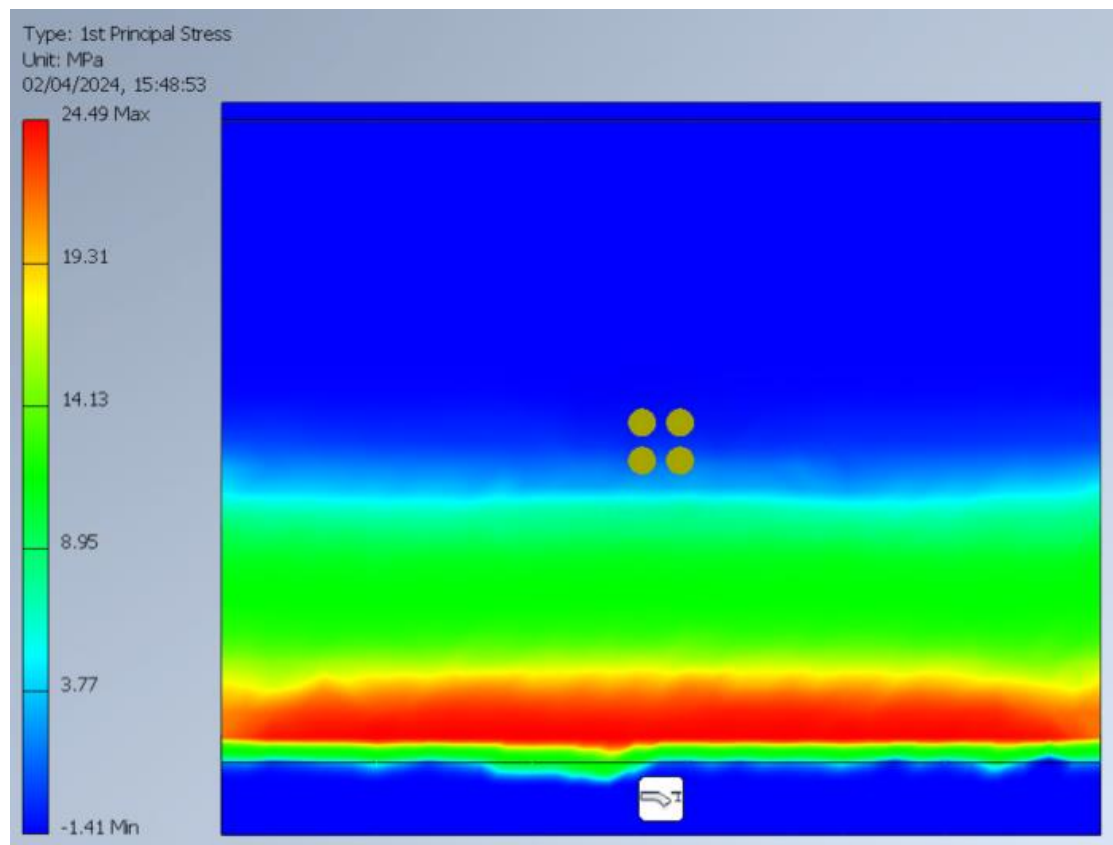
**Glass Analysis - Bending Stress of Glass Panel due to 2.5kN/m<sup>2</sup> Wind Loading:**

- Analysis Software was used to determine maximum bending stress of the glass due to 2.5N/m<sup>2</sup> Wind Loading.
- 15mm Toughened Glass.
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm.

**Result:**

Max. Bending Stress = 24.49N/mm<sup>2</sup> X 1.5 = 36.74N/mm<sup>2</sup> < 83.3N/mm<sup>2</sup>

**OK in Bending**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 7
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

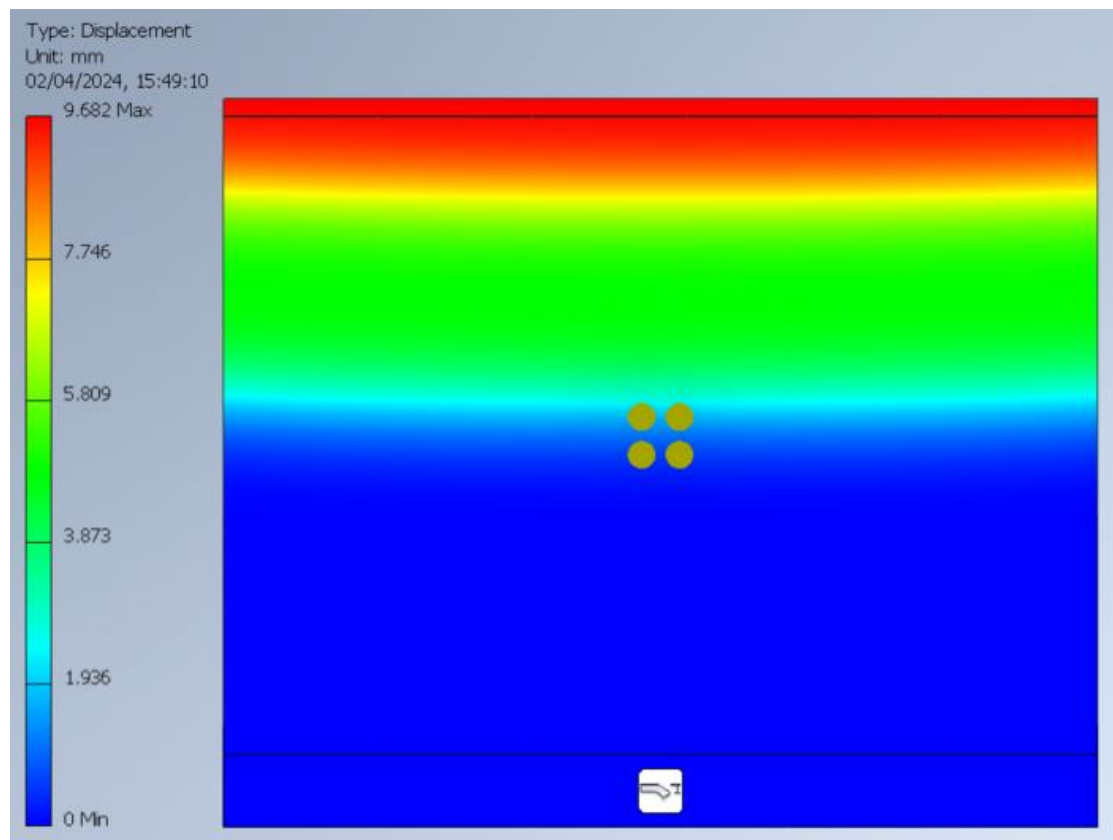
**Glass Analysis - Deflection of Glass Panel due to 2.5kN/m<sup>2</sup> Wind Loading:**

- Analysis Software was used to determine maximum deflection of the glass due to 2.5N/m<sup>2</sup> Wind Loading
- 15mm Toughened Glass
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

**Result:**

Max. Deflection = 9.682mm < 25mm {BS6180:2011 cl. 6.4.1}

**OK in Deflection (Glass Only)**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 8
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

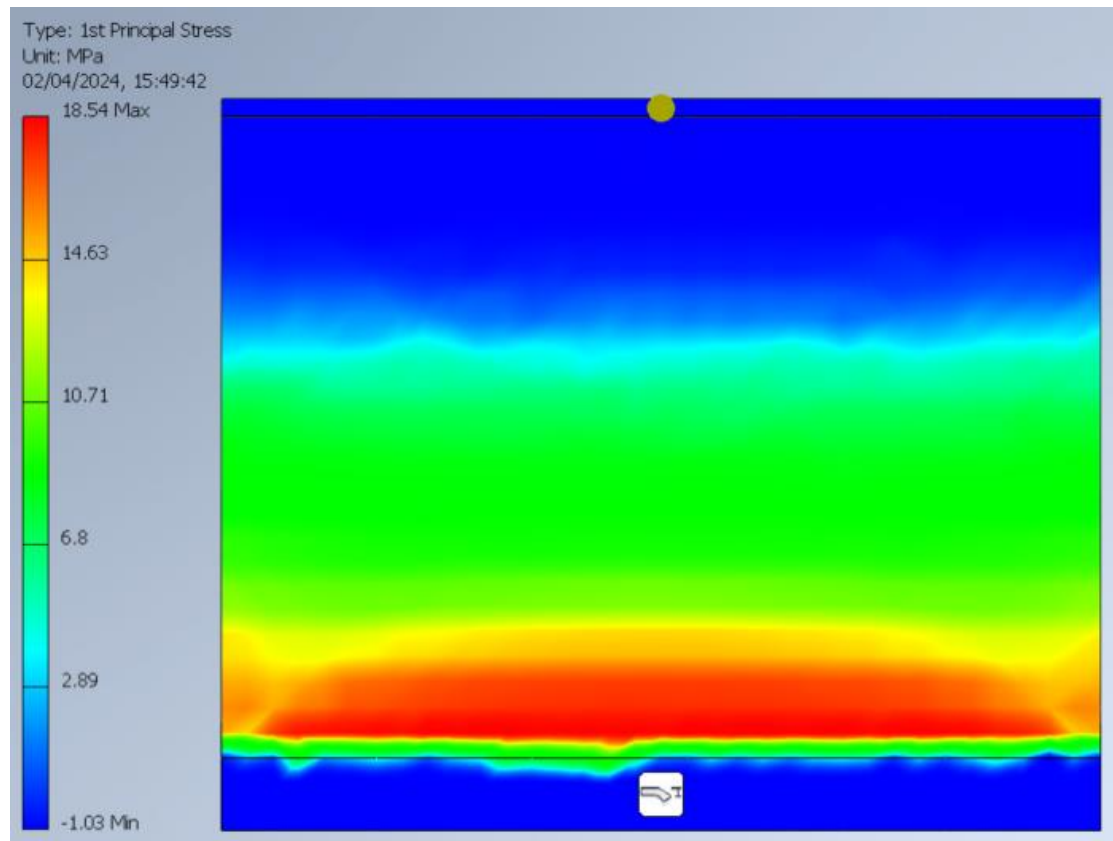
**Glass Analysis - Bending Stress of Glass Panel due to 0.74kN/m Balustrade Loading:**

- 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)
- 15mm Toughened Glass
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm

**Result:**

Max. Bending Stress =  $18.54\text{N/mm}^2 \times 1.5 = 27.81\text{N/mm}^2 < 84.2\text{N/mm}^2$

**OK in Bending**





<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 9
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

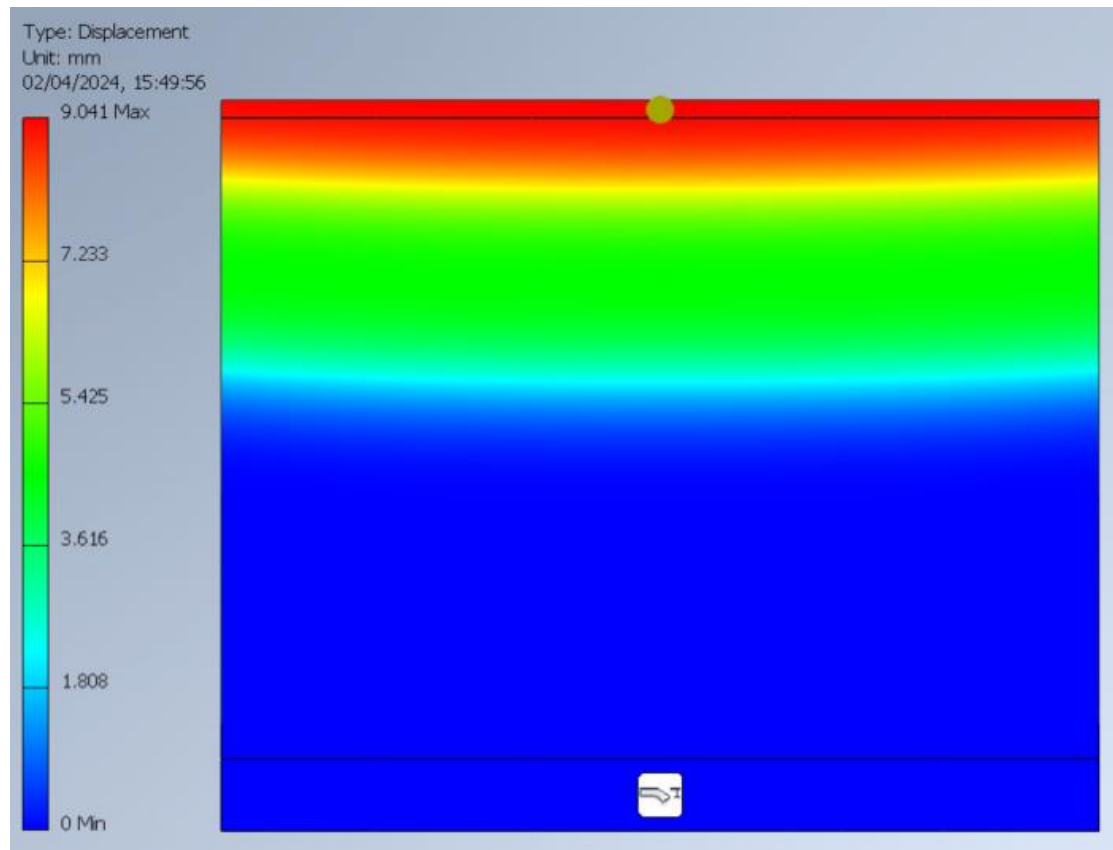
### Glass Analysis - Deflection of Glass Panel due to 0.74kN/m Balustrade Loading:

- 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)
- 15mm Toughened Glass
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

### Result:

Max. Deflection = 9.041mm < 25mm {BS6180:2011 cl. 6.4.1}

**OK in Deflection (Glass Only)**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 10
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

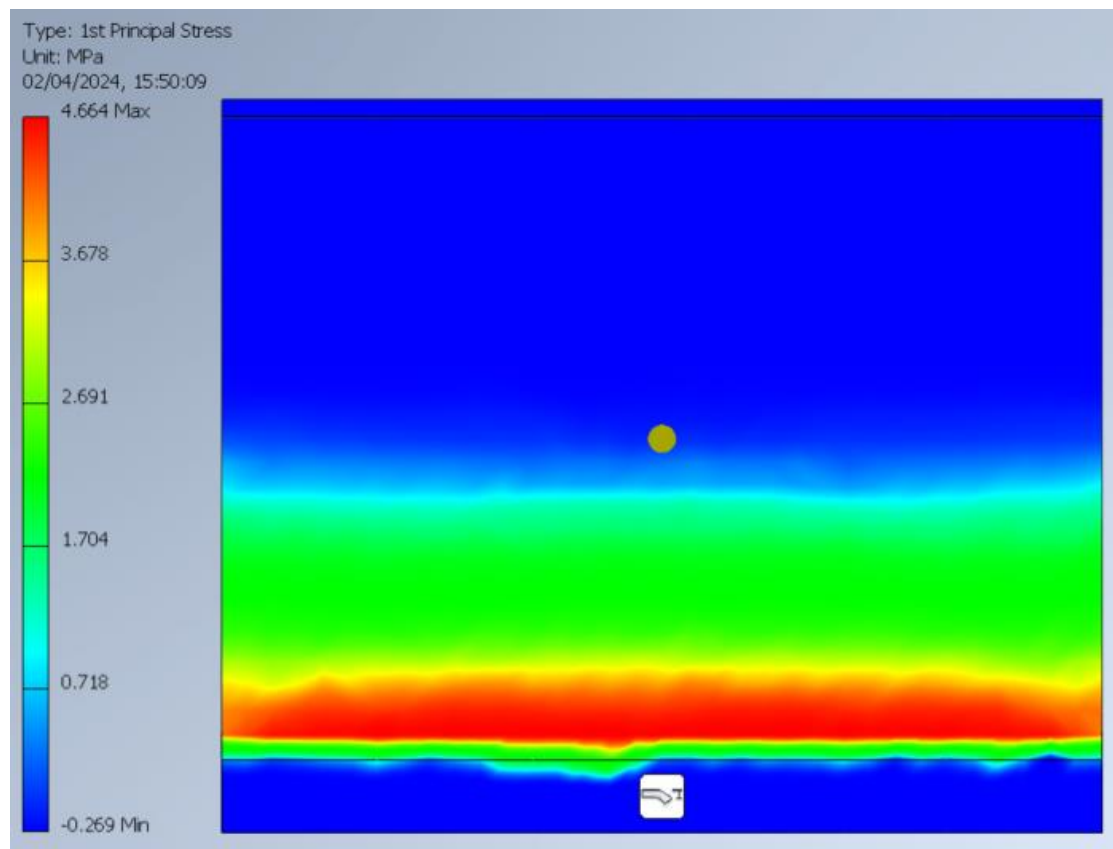
### Glass Analysis - Bending Stress of Glass Panel due to 0.5kN Point Load:

- Analysis Software was used to determine maximum bending stress of the glass due to 0.5kN Point Load
- 15mm Toughened Glass
- Bending Stress analysed based on glass panel of 1200 (l) x 1000 (h) mm

### Result:

Max. Bending Stress =  $4.664\text{N/mm}^2 \times 1.5 = 7.00\text{N/mm}^2 < 84.2\text{N/mm}^2$

**OK in Bending**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 11
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

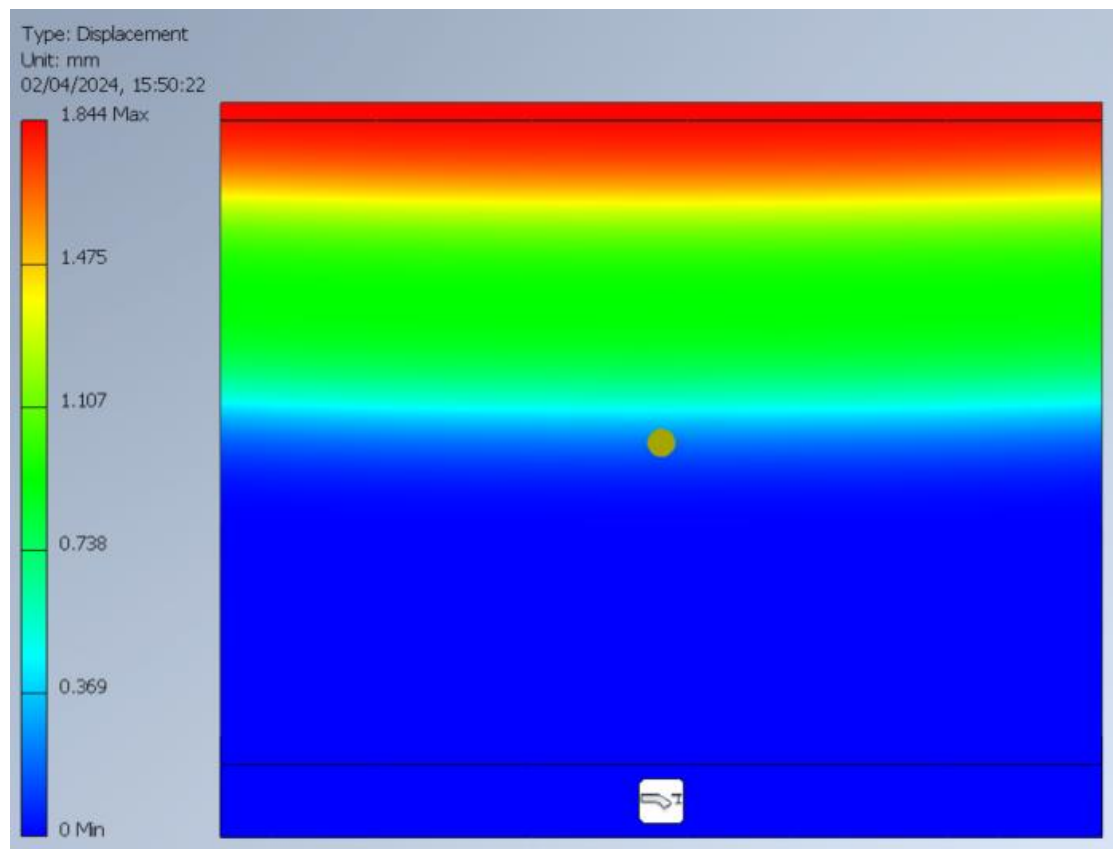
**Glass Analysis - Deflection of Glass Panel due to 0.5kN Point Load:**

- Analysis Software was used to determine maximum deflection of the glass due to 0.5kN Point Load
- 15mm Toughened Glass
- Deflection analysed based on glass panel of 1200 (l) x 1000 (h) mm

**Result:**

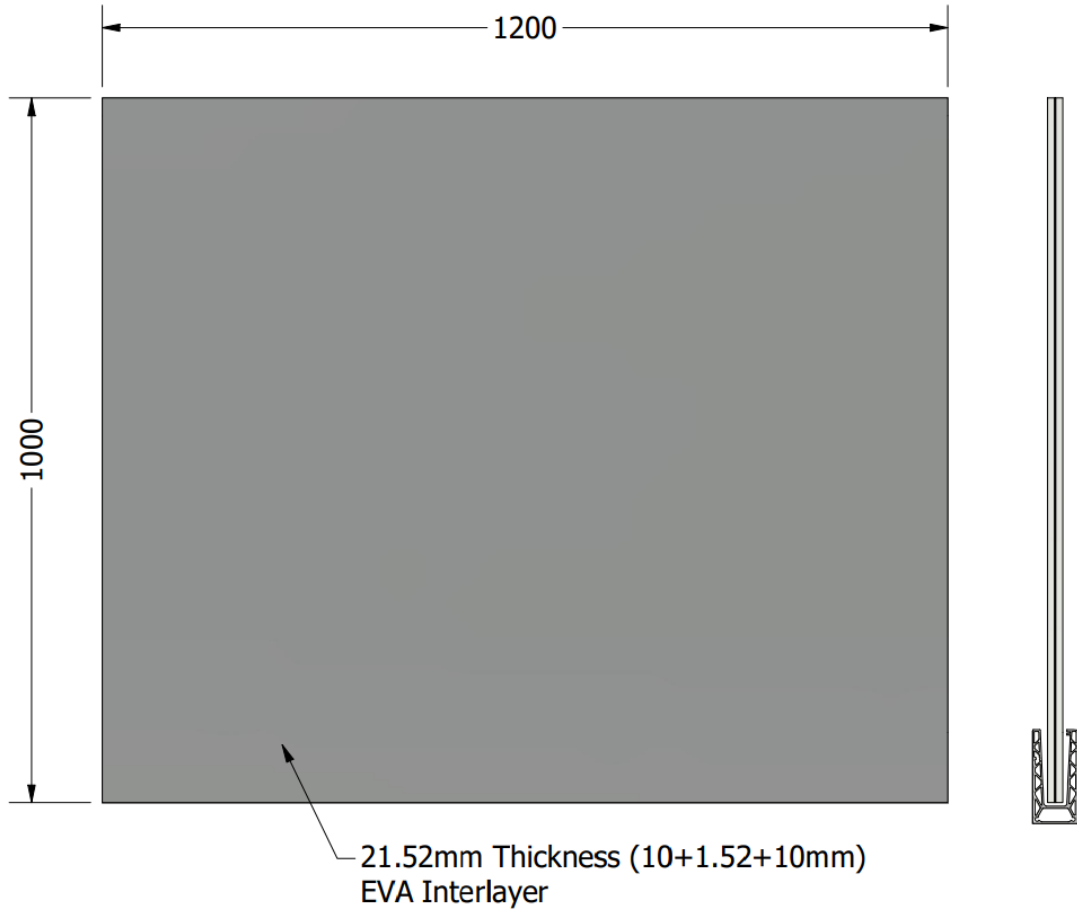
Max. Deflection = 1.844mm < 25mm {BS6180:2011 cl. 6.4.1}

**OK in Deflection (Glass Only)**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.:</b> 12
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

Glass Analysis – 21.52mm Thickness EVA Interlayer:



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 13
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

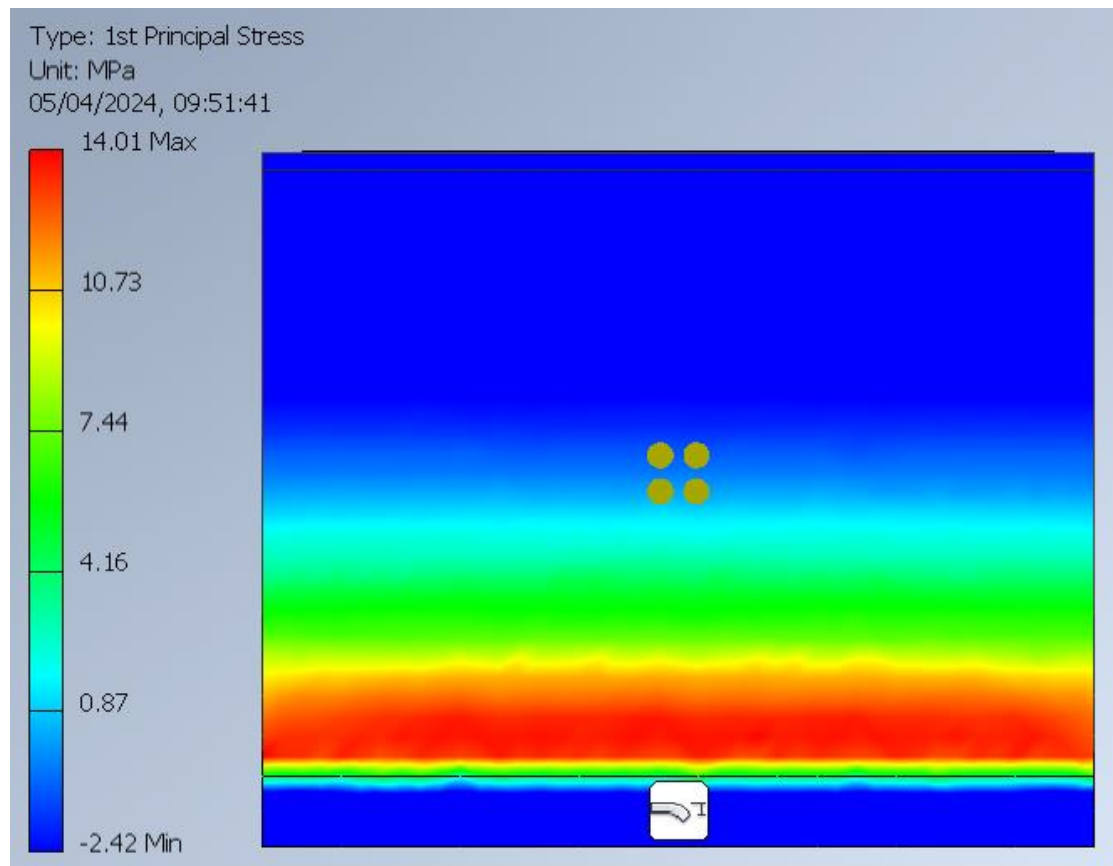
**Glass Analysis - Bending Stress of Glass Panel due to 2.5kN/m2 Wind Loading:**

- 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 =  $14.01\text{N/mm}^2 \times 1.5 = 21.02\text{N/mm}^2 < 83.3\text{N/mm}^2$

**OK in Bending**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 14
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

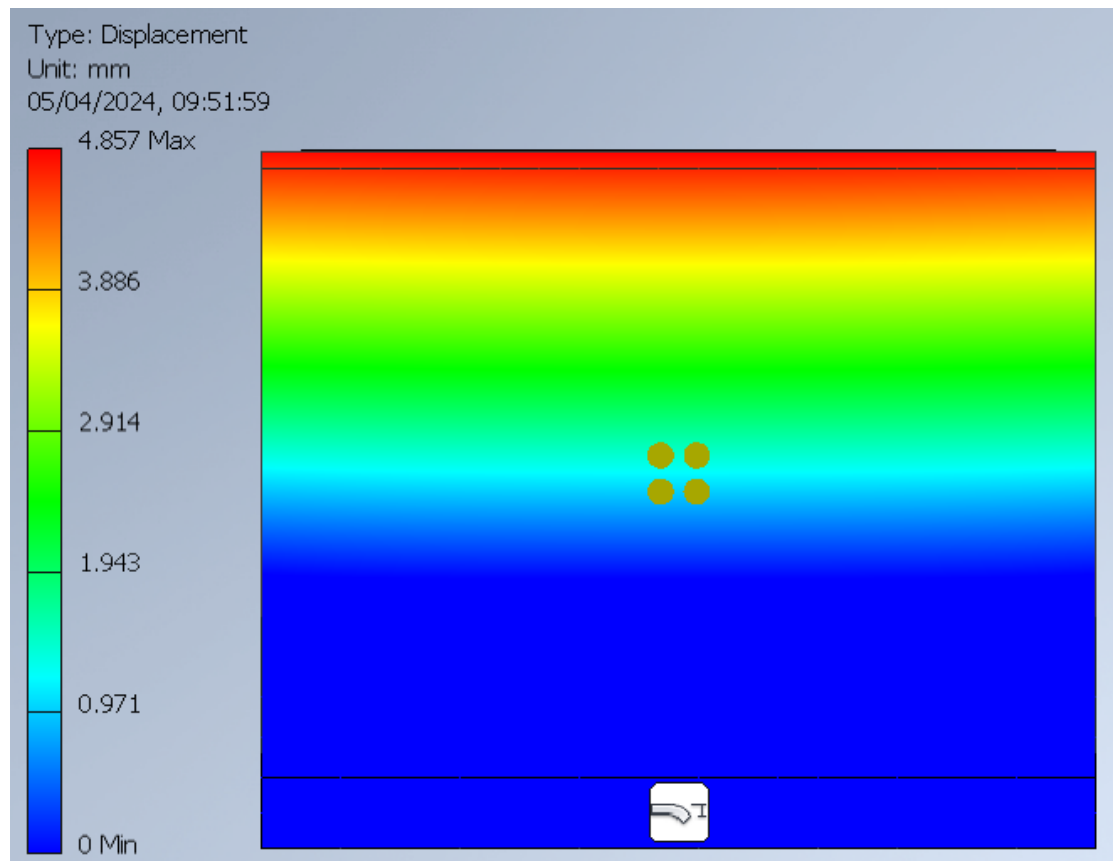
**Glass Analysis - Deflection of Glass Panel due to 2.5kN/m<sup>2</sup> Wind Loading:**

- Analysis Software was used to determine maximum deflection of the glass due to 2.5N/m<sup>2</sup> 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)**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 15
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

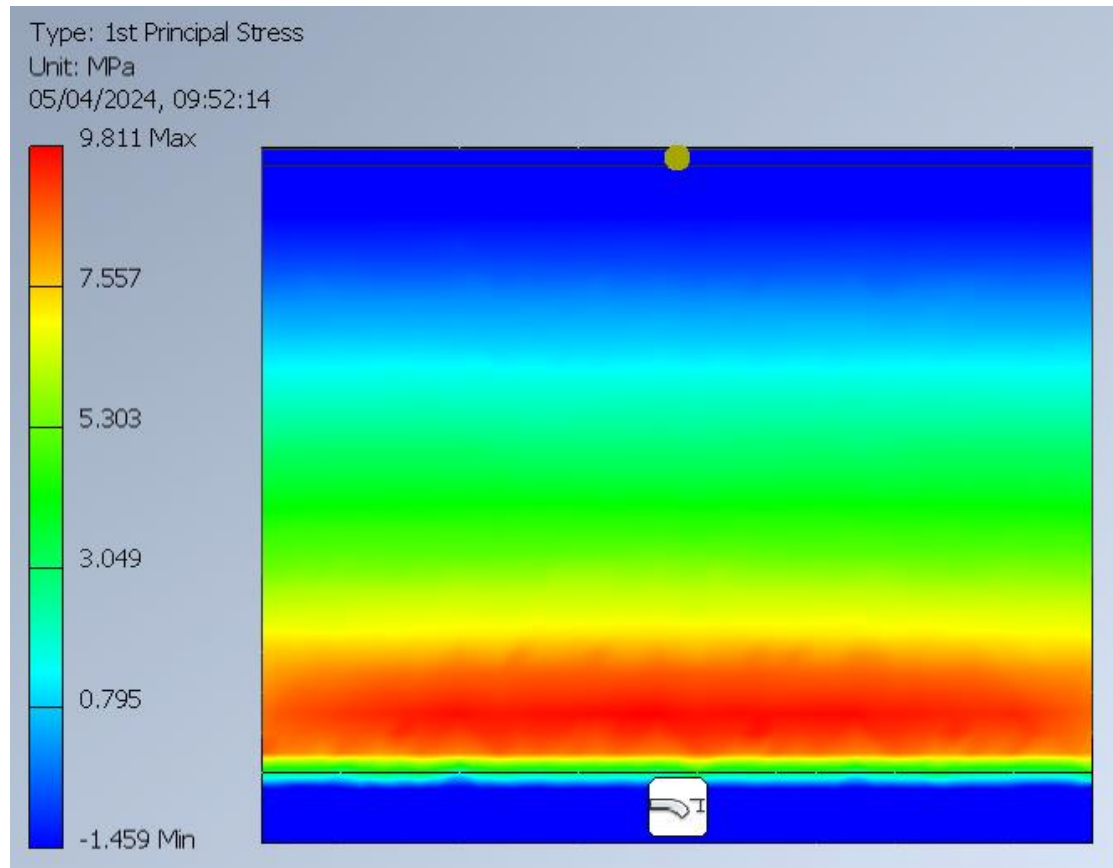
**Glass Analysis - Bending Stress of Glass Panel due to 0.74kN/m Balustrade Loading:**

- 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**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 16
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

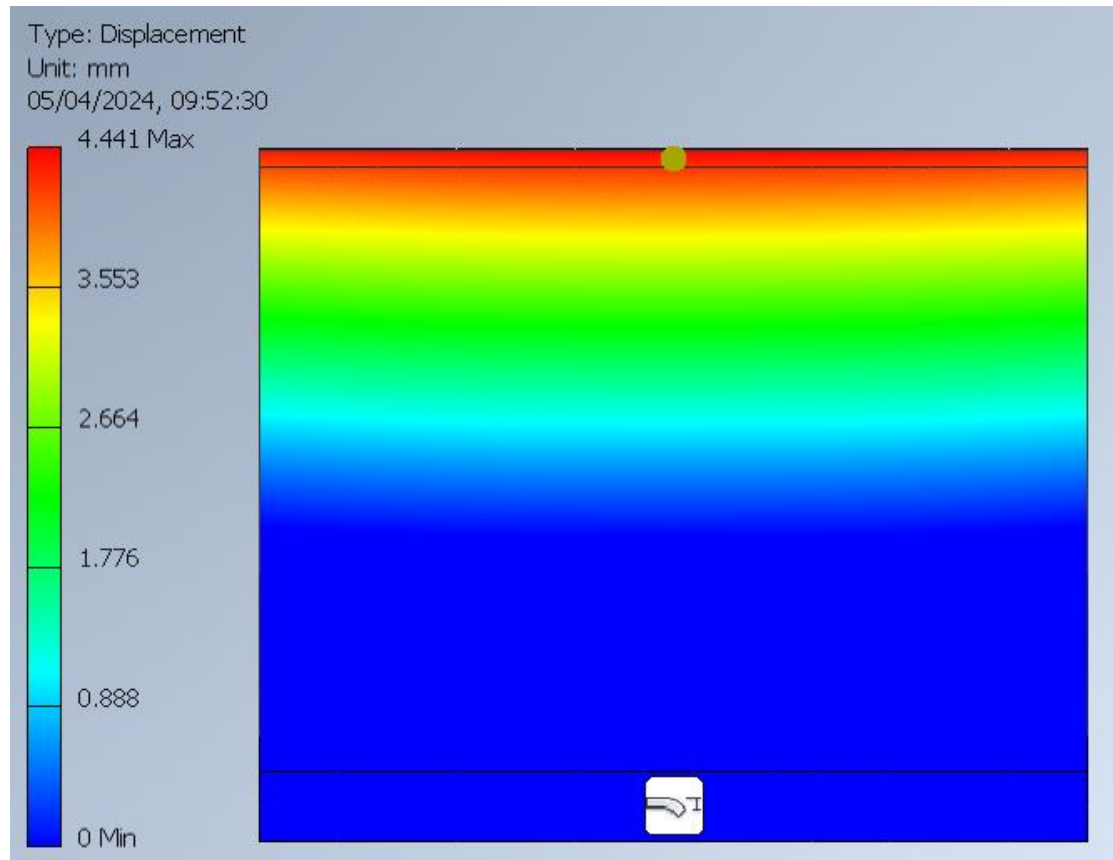
**Glass Analysis - Deflection of Glass Panel due to 0.74kN/m Balustrade Loading:**

- 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)**





<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 17
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

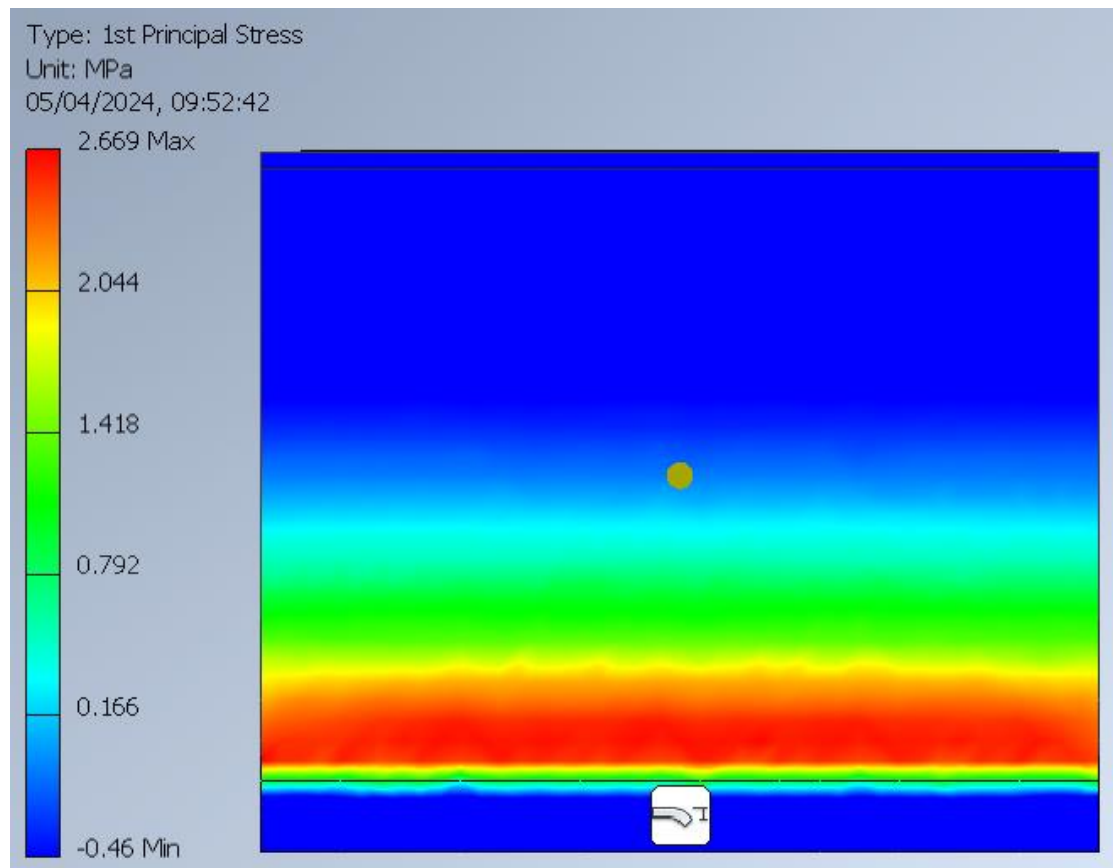
### Glass Analysis - Bending Stress of Glass Panel due to 0.5kN Point Load:

- 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**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 18
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

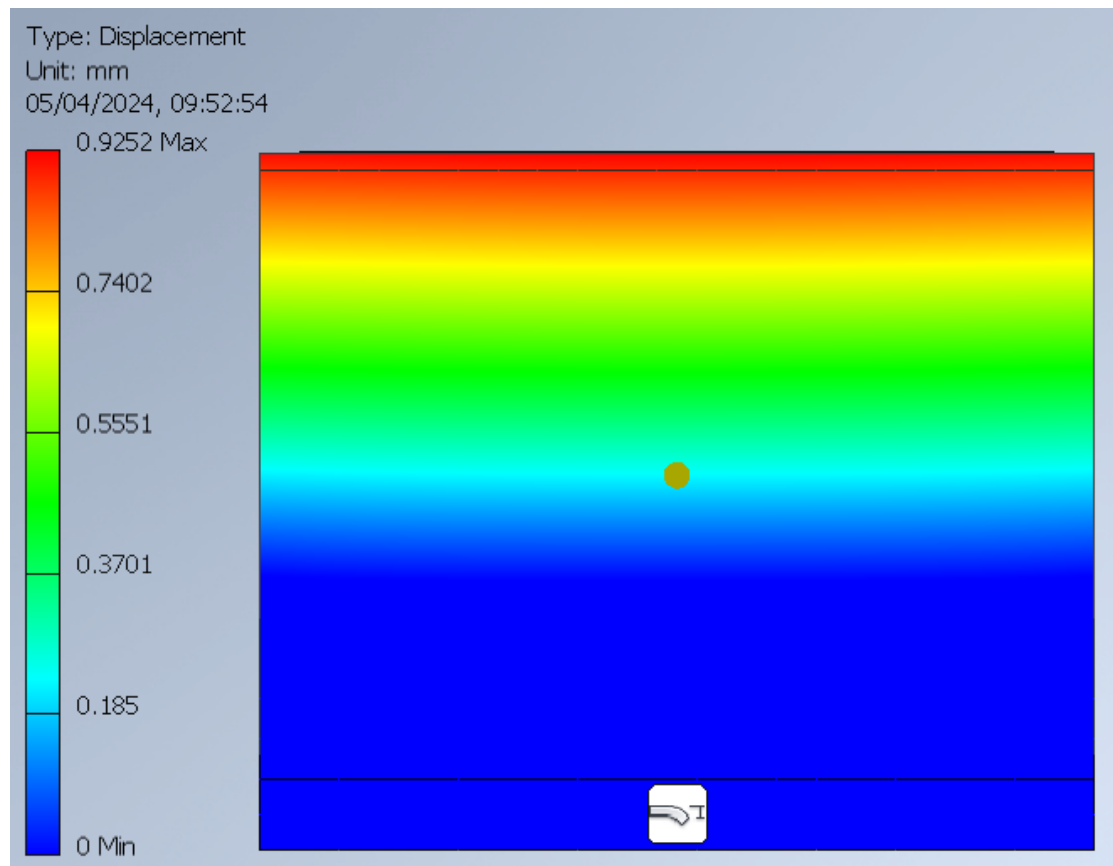
**Glass Analysis - Deflection of Glass Panel due to 0.5kN Point Load:**

- 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:**

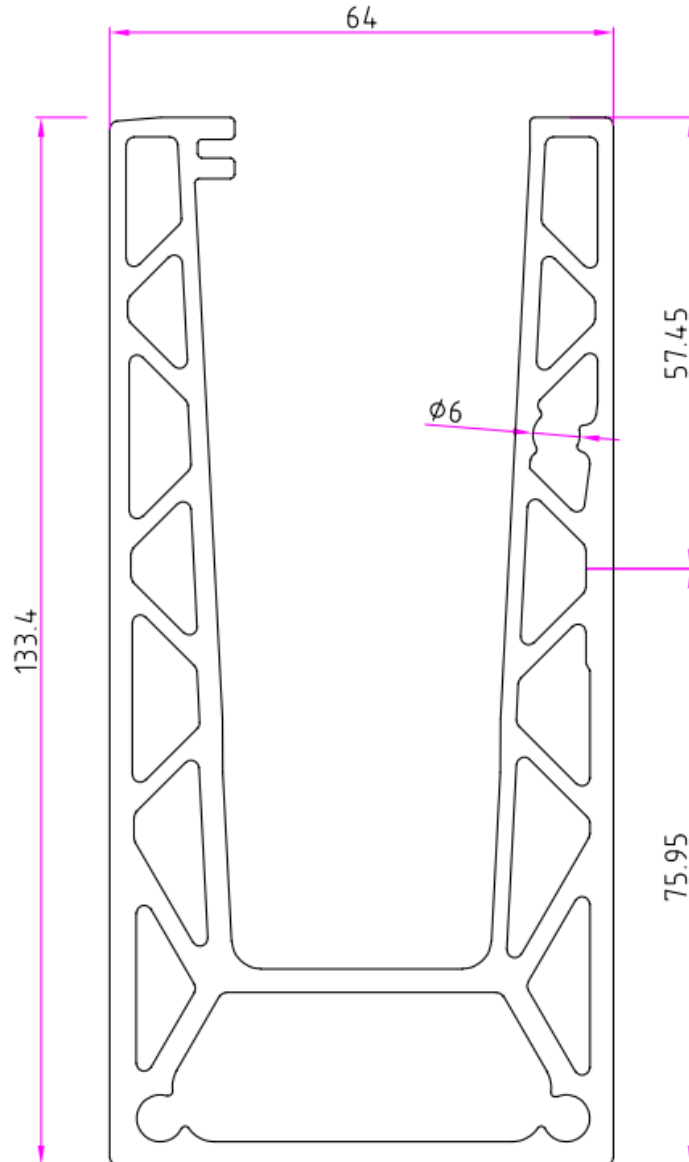
Max. Deflection = 0.9252mm < 25mm {BS6180:2011 cl. 6.4.1}

**OK in Deflection (Glass Only)**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 19
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

**Shoe Analysis:**  
**System Sketch:**



<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 20
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

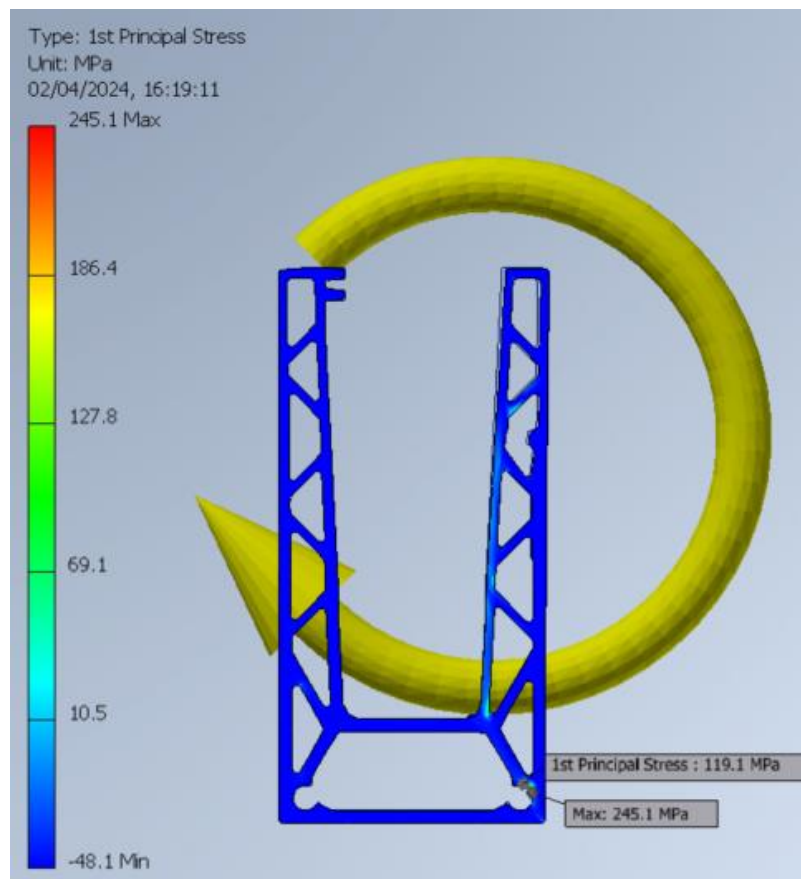
### Bending Stress of Shoe:

- 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

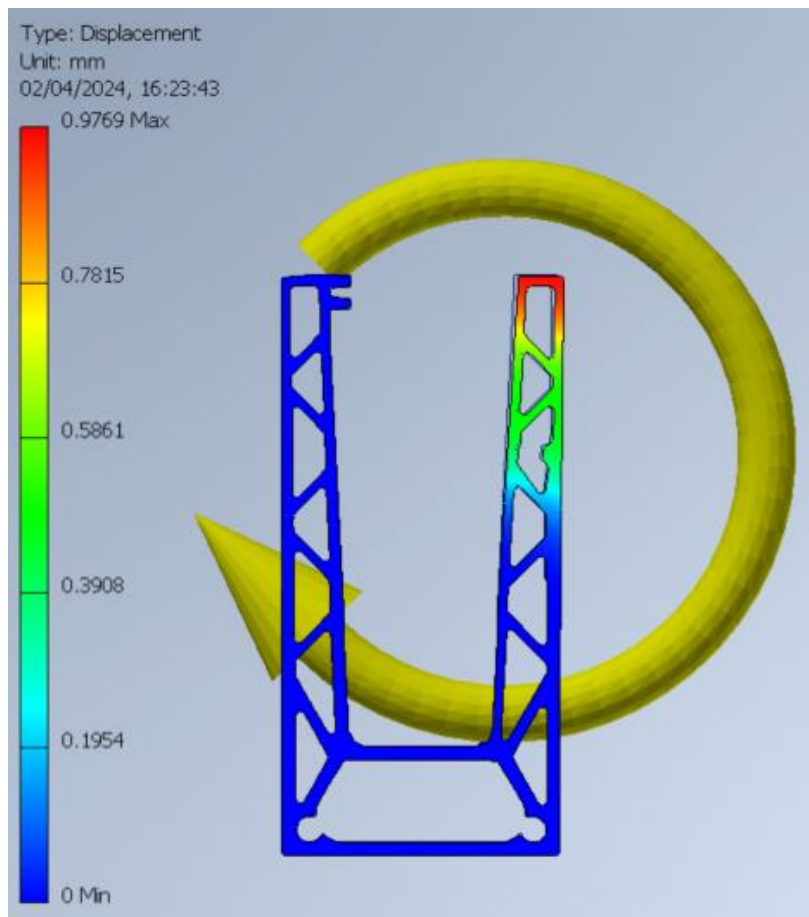


### NOTE:

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

<b>Project:</b> Concorde Glass Ltd	<b>Contract:</b> 1983-1
<b>Subject:</b> Wind Load Test Data	<b>Sheet No.</b> 21
<b>Date:</b> 15/04/2024	<b>By:</b> A.N & R.F & CC.

### Deflection of Shoe:



#### NOTE:

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